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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

UVASIL 299

This Assessment has been compiled in accordance with the provisions of *the Industrial Chemicals (Notification and Assessment) Act 1989* (the Act), and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by Worksafe Australia which also conducts the occupational health & safety assessment. The assessment of environmental hazard is conducted by the Department of the Environment, Sport, and Territories and the assessment of public health is conducted by the Department of Human Services and Health.

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

UVASIL 299

1. APPLICANT

International Sales and Marketing Pty Ltd of 262 Highett Road HIGHETT VIC 3190 has submitted a limited notification statement in support of their application for an assessment certificate for UVASIL 299.

2. IDENTITY OF THE CHEMICAL

UVASIL 299 is considered to be hazardous based on the nature of the chemical and the data provided. The chemical name, CAS number, molecular and structural formulae, molecular weight and spectral data have been exempted from publication in the Full Public Report and the Summary Report on the following basis:

- The relevant employee unions shall be informed of the conditions of use of UVASIL 299,
- The full chemical name shall be provided to any health professionals in the case of a legitimate need where exposure to the chemical may involve a health risk,
- The full chemical name shall be provided to those on site who are using the chemical and to those who are involved in planning for safe use, etc. in the case of a legitimate need,
- The Director of NICNAS will release the full chemical name etc. in the case of a request from a medical practitioner,
- Confidentiality will expire after a 3 year period,
- The chemical be identified as UVASIL 299 in the Health Effects Section of the MSDS, and that reference to its assessment by NICNAS be made on the MSDS,

These conditions shall be published in the Chemical Gazette.

Trade Name:	UVASIL 299 (commercially available in two grades: UVASIL 299 LM and UVASIL 299 HM)

Comments on Chemical Identity

There are two grades of the notified product. The average molecular weight of both grades combined was obtained using an osmometric pressure test, and was determined to be 1620.

GPC analysis on both grades indicated no low molecular weight (MW) species below 500 and 1000. Limit of detection was about 0.5%, implying for both grades, the maximum of MW species below 1000 and 500 of 1% and 0.5% respectively.

Number-Average Molecular Weight (NAMW):	1 000 to 1 300 (UVASIL 299 LM) 1 800 to 3 000 (UVASIL 299 HM)
Maximum Percentage of Low Molecular Weight Species	
Molecular Weight < 1000:	< 1.0%
Molecular Weight < 500:	< 0.5%
Method of Detection and Determination:	the notified chemical is separated by gelpermeation chromatography and identified by carbon-13 and proton nuclear magnetic resonance (NMR) and infrared (IR) spectroscopy

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	viscous light yellow coloured liquid
Melting Point:	-28.2°C
Density:	1 003 kg/m^3 at 20°C
Vapour Pressure:	9.8 X 10^{-5} kPa at 25°C
Water Solubility:	635 mg/L
Partition Co-efficient (n-octanol/water):	log P_{ow} = 1.395
Hydrolysis as a Function of pH:	$t_{1/2}$ (25°C, pH 4): 46.7 h $t_{1/2}$ (25°C; pH 7): 648.2 h $t_{1/2}$ (50°C; pH 9): < 2.4 h
Adsorption/Desorption:	not determined
Surface Tension:	54 mN/m (containing 461.9 mg/L of UVASIL 299)
Viscosity:	10-35 Pa.s at 25°C

	0.7-3.0 Pa.s at 50°C
Dissociation Constant:	9.22 ± 1 at 23°C
Flash Point:	not determined
Flammability Limits:	not determined
Decomposition Temperature*:*	not determined
Autoignition Temperature:	not determined
Explosive Properties:	not determined
Particle Size:	not applicable
Reactivity/Stability:	not reactive under ambient conditions

Comments on Physico-Chemical Properties

Hydrolysis testing was conducted at 50°C and showed the chemical to be relatively stable at a pH of 7. Results at pH 4 and 7 have been extrapolated to 25°C using the Arrhenius relationship in which the logarithm of rate constants at tested temperatures is plotted against the reciprocal of the absolute temperature. Monomer, dimer and trimer units of propyl-3-oxy(4-(2,2,6,6-tetramethyl)-piperidinyl) methylsiloxane were isolated during testing, and hydrolysis can be expected to occur within the environmental pH range.

An adsorption/desorption test was not conducted, the notifier claiming low solubility meant a suitable analytical method could not be found. The solubility of the notified chemical is 635 mg/L, which is environmentally significant. Polydimethylsiloxanes in intimate contact with many soils undergo siloxane bond redistribution and hydrolysis (1). Therefore, it is highly likely that substituted polymethylsiloxanes will undergo similar reactions, and this reactivity may prevent suitable adsorption data being obtained (see further comments under Fate Section 8.0).

The chemical has a surface tension of less than 60 mN/m, and can be considered surface active.

4. PURITY OF THE CHEMICAL

Degree of Purity:	97.5 ± 2%
Toxic or Hazardous Impurities:	2,2,6,6 - tetramethylpiperidinol, 2,2,6,6 - tetramethyl - 4-oxy (2'-propenyl)-piperidine and 2,2,6,6 - tetramethyl - 4-oxy (1' - propenyl) piperidine (cis,trans) with similar toxicity to the notified chemical (as per section 9.2), estimated to be present at less than 0.05%

Non-Hazardous Impurities
(> 1% by weight): none

Maximum Content
of Residual Monomers: none

Additives/Adjuvants: none

5. USE, VOLUME AND FORMULATION

UVASIL 299 will be imported as a viscous yellow liquid to be used as a new oligomeric ultraviolet (UV) stabiliser of the hindered amine type (HALS). It has been developed as an additive to protect plastics such as polyethylene and polypropylene against degradation caused by exposure to UV radiation.

UVASIL 299 will be commercially available in two grades. Uvasil 299 LM with NAMW of 1 000 to 1 300, used in thicker plastic products such as outdoor furniture and car bumper bars. UVASIL 299 HM with NAMW of 1 800 to 3 000, used in thin plastic products such as bags, ropes, and artificial grass. UVASIL 299 will also be commercially available as a masterbatch in polypropylene as UVASIL 2000 LM (70% active UVASIL 299) and UVASIL 2000 HM (40% active UVASIL 299).

The amount of the notified chemical to be imported will be from 5 to 20 tonnes in the first year, rising to 50 to100 tonnes per year by the fifth year.

6. OCCUPATIONAL EXPOSURE

The notified polymer as UVASIL 299 will be imported in 25 kg polyethylene steel drums on pallets. It will be transported to sites for batching operations. There is potential for exposure during transport or handling but this is unlikely given the secure packaging in steel drums. The notified polymer in UVASIL 2000 will also be imported as a masterbatch in polypropylene in 25 kg polyethylene bags, packed in carton boxes.

There will be approximately four sites involved in the batching of the notified polymer into polyethylene and polypropylene. Processing is carried out in a closed system which involves adding the polymer and additives to an extruder, pelletising and packaging. During addition of UVASIL 299, a worker removes a bung from the drum and places a dip tube in the container. This is followed by pumping of the chemical to the extruder by means of a metering pump. There will be approximately five employees at each site consisting of three plant operators and two technicians. Workers will be potentially exposed to the notified chemical during adding operations.

Occupational exposure to the notified polymer would be greatest during adding operations. In this situation inhalational, dermal and ocular exposure may occur.

When adding the notified polymer as the masterbatch product, it is charged into a feed hopper at the extruder, either by dumping bags directly into the hopper, or by pneumatically conveying from a bulk storage silo to the feed hopper. There will be four to six workers potentially exposed to the notified polymer especially at the dumping stage at each site.

Incorporation of the polymer is carried out at a temperature range of 200 to 300°C and release of fumes containing the notified polymer can be expected. The notified polymer will be incorporated into plastic at a final concentration of between 0.1 and 1%. There are an estimated eight to ten customers where the end polymer product is moulded into an end use product. The exposure through these processes is expected to be minimal considering the low level of the notified polymer in the final product.

7. PUBLIC EXPOSURE

Under normal circumstances the public will not be exposed to the notified chemical other than as a component of a plastic products in which it is immobilised and not bioavailable.

In the event of a transport accident the notified chemical may be dispersed over a limited area. As UVASIL 299 will be transported in steel drums the potential for dispersal will be limited. UVASIL 299 is a viscous liquid with a low vapour pressure and is insoluble in water but is miscible in organic solvents. Under normal conditions spilt product is unlikely to ignite spontaneously as a result of accident. In the event of a fire, combustion of UVASIL 299 may give off fumes of unknown toxicity.

8. ENVIRONMENTAL EXPOSURE

Release

No significant release of this chemical to the environment is likely to occur. The notified substance will be incorporated into plastic at a final concentration of between 0.1 and 1%.
It is anticipated that incorporation of the notified chemical into polyethylene and polypropylene will be carried out at four sites, two in Sydney and two in Melbourne. The notifier has estimated that residues in used containers would be less than 50 g. With a maximum import volume of 100 tonnes per annum, this equates to 200 kg lost through residues, or an average of 50 kg per annum per site. This residue is collected through washing with organic solvents, and the washing solution is disposed of by incineration, or as part of plants liquid waste disposal. It is unlikely to enter the aquatic system.
There is potential for release when "off-specification" material is disposed of to landfill. However, this material is usually recompounded, so release through this route should be minimal. When landfilled, the notified polymer would be expected to remain associated with the compounded plastics, and not leach. The Uniform System for the Evaluation of Substances (USES) model (2) provides an estimated release fraction for the polymer industry at reformulation of 0.001 to soil, which, based on the maximum import volume of 100 tonnes, is 100 kg per annum, or 25 kg per annum per site.
An estimation of release through cleaning of processing equipment has not been provided. At reformulation, the USES model (2) provides an estimated release fraction for the polymer industry of 0.0025 to waste water, which, based on the maximum import volume of 100 tonnes, is 250 kg per annum, or 62.5 kg per annum per site.
A further source of release during processing can be expected through fumes as the notified product is incorporated at 200 to 300°C. The notifier has estimated up to 60 mg/kg of used product is released in this manner, which equates to 6 kg per annum (1.5 kg per site) lost to the atmosphere.
There are an estimated eight to ten customers in Australia where the end polymer is moulded into end use products. Car bumpers, fibres and garden furniture will consume about 80% of the imported product. Environmental releases through moulding processes are expected to be low.
Once moulded, possible routes via which UVASIL 299 may enter the environment are:
∑ gradual weathering of plastics containing the notified substance; and
∑ discard of end use articles to landfill.
Neither of these routes is likely to give rise to significant environmental exposure to the free stabiliser, which would be expected to remain trapped in the plastic matrix.

Fate

Polydimethylsiloxane fluids in intimate contact with many soils undergo siloxane bond redistribution and hydrolysis, resulting in the formation of low molecular weight cyclic and linear oligomers (1). Because this is siloxane bond redistribution, it is highly likely that substituted polymethylsiloxanes will undergo similar reactions. Hydrolysis testing conducted on the notified substance indicate that monomer, dimer and trimer units of propyl-3-oxy(4-(2,2,6,6-tetramethyl)-piperidinyl) methylsiloxane may be formed within the environmental pH range. It is likely that siloxane bond redistribution would release the propyl-3-oxy(4-(2,2,6,6-tetramethyl)-piperidinyl).
Residues that might occur in the moulding of granules into articles are generally cleaned from equipment by passage of natural grade polyethylene or polyester, or another production batch grade of these materials that will not be affected by the residues. The natural grade material is retained for recycling.
Trimmings from moulding of articles are likely to be regranulated or reground and used with virgin polymer. Any remaining granulated material is re-used on other projects or sold for re-working.
Disposal of any granules not recycled should be through a licensed waste disposal contractor to a regulated land fill or by incineration in an approved incinerator. It is expected that landfill, incineration or recycling will be the ultimate fate at the end of the life of the finished moulded articles and other products. Uvasil 299 is expected to remain trapped in the plastics when finished articles are in landfills.
Biodegradation tests on the notified polymer show it to be not readily biodegradable, with 0% of the test substance degraded after 28 days (OECD TG 301 D, closed bottle test). However, due to the expected low exposure of the polymer, biodegradation and bioaccumulation are not relevant. Combustion would expect to yield oxides of carbon, silicon, hydrogen and nitrogen.

9. EVALUATION OF TOXICOLOGICAL DATA

Toxicological data are not required for polymers of NAMW of greater than 1 000 according to the Act. Nevertheless, some tests have been conducted on UVASIL 299 and were submitted as part of the notification statement.

9.1 Acute Toxicity

Table 1 Summary of the acute toxicity of UVASIL 299

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat (males)	LD_{50} 691 mg/kg	3
	rat (females)	LD_{50} 706 mg/kg	3
acute dermal toxicity	rat	LD_{50} 1 961.1 mg/kg	4
skin irritation	rabbit	moderate irritant	5
skin sensitisation	guinea pig	non-sensitiser	6

9.1.1 Oral Toxicity (3)

Species/strain:	rat/(HanIbm); WIST (SPF)
Number/sex of animals:	5/sex
Observation period:	14 days
Method of administration (vehicle):	gavage (distilled water)
Dose levels:	200, 350, 600 and 1 000 mg/kg
Clinical observations:	no clinical signs noted
Mortality: (females)	2 deaths at 600 mg/kg 4 deaths at 1 000 mg/kg
(males)	1 death at 600 mg/kg 5 deaths at 1 000 mg/kg
Test Method:	OECD guidelines for testing of chemicals (7)
LD_{50}: *(the median lethal dose at* 95% confidence intervals)	males 691 (463-1 352) mg/kg females 706 (430-1 295) mg/kg
Result	moderate oral toxicity in rats

9.1.2 Dermal Toxicity (4)

Species/strain:	Sprague Dawley Crl:CD
Number/sex of animals:	5 /sex
Observation period:	14 days
Method of administration (vehicle):	distilled water
Dose levels:	200, 400, 600 and 2 000 mg/kg
Clinical observations:	piloerection, reddish nasal discharge observed at all dose levels; chromodacryorrhea and erythema observed at two higher dose levels
Mortality:	1 death at 600 mg/kg 5 deaths at 2 000 mg/kg
Morphological findings:	congestion of lung, thymus and adrenal glands found at necropsy

Test Method: OECD guidelines for testing of chemicals (7)

LD_{50}: (the median oral lethal dose at 95% confidence intervals) 1 961.1 (1 059.5 - 3 630.2) mg/kg

Result moderate dermal toxicity in rats

9.1.4 Skin Irritation (5)

Species/strain rabbit New Zealand White

Number/sex of animals: 6/sex

Method of administration: a gauze patch bearing 0.5 g of the test article was applied to the right shaved flank of each animal for four hours. A control gauze patch was applied to the contralateral flank.

Draize (8) Scores[i]

Animal	Time after decontamination			
	60 min	1 day	2 days	3 days
ERYTHEMA				
1	2	1	0	0
2	2	1	0	0
3	2	1	0	0
4	2	0	*	-
5	2	*	-	-
6	2	1	0	1
OEDEMA				
1	1	2	2	2
2	1	2	2	2
3	2	2	2	2
4	0	0	*	-
5	0	*	-	-
6	1	2	2	2

Test Method: OECD guidelines for testing of chemicals (7)

Result: moderate irritant to rabbit skin

9.1.6 Skin Sensitisation (6)

Species/strain: Dunkin Hartley albino guinea pigs

Number of animals: 10/sex/group

Induction at day 1: 0.5 ml (5% w/w) of the notified chemical in corn oil applied on the left flank by means of an occlusive patch for 6 hrs; control group only corn oil

Challenge at day 28: test and control group 1, 5% notified chemical in corn oil was applied to the right flank and vehicle only to the left flank

The Challenge Outcome:

Challenge	***24 hrs***		***48hrs***	
Concentration	***test***	***control***	***test***	***control***
5%	0/10	0/10	0/10	0/10

Test Method: OECD guidelines for testing of chemicals (7)

Result: not a skin sensitiser in guinea pigs

9.2 Repeated Dose Toxicity (9)

Species/strain: rats/Sprague-Dawley

Number/sex: 40/sex

Method of administration (vehicle): distilled water

Dose/ Duration of administration: 0, 10, 50, 100 mg/kg/day for 28 days to a total of 80 rats followed by a 14 day recovery period for 4 groups (10 per group)

Toxicologically Significant Observations:

1. *Clinical* dose related salivation was observed within 30 minutes of dosing in animals of both sexes at the two highest doses but no clinical changes were observed during the recovery period

2. *Clinical Chemistry/Haematology* slight decrease in prothrombin time in both males and females was noted at the highest dose, this was also evident for

	females dosed with 50 mg/kg/day but not observed in the recovery groups
3. Necropsy Findings/ Histopathology	no significant changes observed
Test Method:	OECD guidelines for testing of chemicals (7)
Result:	reversible treatment related salivation at doses 50 and 100 mg/kg/day

9.3 Genotoxicity

9.3.1 Salmonella typhimurium and Escherichia coli Reverse Mutation Assays (10)

Strains:	*Salmonella typhimurium* TA 1535, TA 1537, TA 1538, TA 98 and TA100 *Escherichia coli* WP2 and WP2 *uvrA*
Concentration range:	0.01 - 33 μg/plate, with and without the addition of rat liver post mitochondrial supernatant (S9 fraction) as an extrinsic metabolic activation system.
Test Method:	OECD guidelines for testing of chemicals (7)
Result:	not mutagenic

9.3.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (11)

Species/strain:	rat/Sprague Dawley Charles River Crl:CD (SD) BR
Number and sex:	5/sex
Dose levels:	350 mg/kg
Method of administration:	gavage (4 ml/kg)
Test Method:	based on OECD Guidelines for Testing Chemicals (7)
Result:	negative (sampling times 18,42 and 66 hours post-dosing)

9.2 Overall Assessment of Toxicological Data

UVASIL 299 showed moderate oral toxicity (LD_{50} = 691 mg/kg for males and LD_{50} = 706 mg/kg for females) and dermal toxicity (LD_{50} = 1 961.1 mg/kg). When tested in rabbits it was a skin irritant. The chemical was not a skin sensitiser in guinea pigs. When rats were treated orally with up to 100 mg/kg/day for 28-days only small changes to any of the measured parameters were observed. Effects noted at a dose rate of 100 mg/kg/day were reversible. In the presence or absence of metabolic activation, the chemical was neither mutagenic in bacteria nor did it cause chromosomal damage in mouse bone marrow cells.

On the basis of submitted data, the notified polymer would be classified as hazardous in accordance with the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(1994)] (Approved Criteria) in relation to acute oral, dermal toxicity and skin irritant effects (12).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

Although no ecotoxicological data are required for polymers of NAMW greater than 1000 according to the Act, the notifier has conducted tests on rainbow trout and water flea. The results are summarised in the table below.

Ecotoxicity test results for Uvasil 299 (nominal concentrations).

Species	Test	Result
Rainbow trout (*Salmo gairdneri*)	96 h static	LC_{50} = 1.17 mg/L
Daphnia magna	48 h static	EC_{50} = 1.04 mg/L
Earthworm (*Eisenia foetida andrei*)	14 day	LC_{50} > 1 000 mg/kg

Testing followed OECD protocols, which were included with the reports. During the testing for toxicity to rainbow trout, swimming behaviour of the fish was observed. Unusual characteristics observed during the first 6 hours exposure at 5, 2.5 and 1.25 ppm (nominal concentrations) included loss of equilibrium, periods lying on the tank bottom, lethargy, secretion of mucus from the gills and rapid respiration rates. Test fish at 5, 2.5, 1.25, 0.625, and 0.3125 ppm became darker than control fish during the test.

Testing conducted to determine toxicity of the notified substance to earthworms indicate an LC_{50} less than 1 000 ppm nominal concentration. The observed mortality at 1 000 ppm was 17.5%, suggesting the notified polymer is only very slightly toxic to earthworms.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The polymer is being imported for use in plastic mouldings and will act to stop the deterioration of these mouldings. The main release to the Australian environment will be through disposal of finished moulded products. While this amounts to a significant total, the polymer is an additive in cured plastic products and is expected not to leach from the finished product. If the finished product is burnt, no significant quantities of any hazardous combustion products are expected. Further, any monomers or low molecular weight species are expected to share the same fate as the polymer.
Using the USES model release estimates to wastewater, 250 kg per annum is expected to be released to sewer. As a worst case scenario, it will be assumed that this is all from one site, and processing takes place on 100 days per year. This gives a daily release of 2.5 kg, per day, and a concentration in the sewage treatment plant (250 ML) of 10 µg/L (ppb). This is two orders of magnitude below the worst observed environmental concentration, EC_{50} of 1.04 mg/L for water flea, and is prior to any removal from the STP or further dilution in receiving waters.
Therefore, it is considered that the polymer does not pose a significant hazard to the environment.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The toxicological studies presented suggest that the notified polymer would be likely to be toxic by acute oral and dermal exposure in humans. There is potential for dermal and eye irritation to occur in the event of exposure. The notified chemical is not a sensitiser, nor was there any evidence of the notified chemical being mutagenic or clastogenic.

The notified chemical will not pose any exposure risk during transportation due to its packaging in steel drums. However, should a spill occur clean-up procedures and personal protection should be as stated in the recommendation section of this report and the Material Safety Data Sheet (MSDS).

There exists a risk of dermal and ocular exposure to the notified polymer during the batching stage by splashing or aerosol generation from the adding process.
However the use of local exhaust ventilation which is used normally during batching will reduce exposure to aerosols of the notified chemical. Exposure through splashing will also be reduced through the use of closed systems and the employment of protective eye goggles, gloves and protective clothing and respirators should the ventilation prove to be insufficient protection.

The production of thermoplastics during the masterbatch presents a risk of exposure to the notified chemical. The mixing of the notified chemical in formulation to the polymers may generate splashing or aerosols which may result in dermal and/or ocular exposure. Closed mixing systems should be employed to reduce this risk. There is little potential for exposure to the notified chemical after mixing process as it will be dissolved and encapsulated in the polymer. The use of local exhaust ventilation and protective goggles, gloves and clothing are standard for the handling of heated thermoplastics, and will serve to reduce exposure to the notified chemical

further. If exhaust ventilation is inadequate, respiratory protection should be employed.

Under normal circumstances exposure of the public to UVASIL 299 in a form other than bound and immobilised into plastic products at low concentrations, is unlikely. The notified chemical in this form is not bioavailable and represents a low risk to public health when used in the proposed manner.

13. RECOMMENDATIONS

To minimise occupational exposure to UVASIL 299 the following guidelines and precautions should be observed:

- Local exhaust ventilation should be employed where there is likelihood of aerosol generation or poor ventilation.

- the appropriate respiratory devices should be selected and used in accordance with Australian Standard/New Zealand Standard (AS/NZS) 1715 (13) and should comply with AS/NZS 1716 (14).

- eye protection should be selected and fitted in accordance with AS 1336 (15) and used in accordance with AS/NZS (16).

- industrial gloves should conform to the standards detailed in AS 2161 (17).

- industrial clothing must conform to the specifications detailed in AS 2919 (18)

- Should a spill occur, the additional following procedures should be followed:

    - prevent contamination of soil, drains and surface waters.

    - take up mechanically/manually and collect in a suitable container for disposal by incineration.

- Storage should be away from sources of ignition, high temperatures, strong acids, bases or oxidising agents.

- Good personal hygiene should be practised to minimise the potential for ingestion.

- A copy of the MSDS should be easily accessible to employees.

14. MATERIAL SAFETY DATA SHEET

The MSDS for the product containing the notified chemical was provided in accordance with the *National Code of Practice for Preparation of Material Safety Data Sheets* (19).

This MSDS was provided by the applicant as part of the notification statement. It is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the Act, secondary notification of the notified chemical shall be required if any of the circumstances stipulated under subsection 64(2) of the Act arise. No other specific conditions are prescribed.

16. REFERENCES

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12. National Occupational Health and Safety Commission 1995, 'Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment, [NOHSC:1003(1995)]', in Exposure Standards for Atmospheric Contaminants in the Occupational Environment: Guidance Note and National Exposure Standards, Australian Government Publishing Service, Canberra.

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14. Standards Australia, 1991, *Australian Standard 1716-1991 Respiratory Protective Devices,* Standards Association of Australia Publ., Sydney, Australia.

15. Standards Australia, 1994, *Australian Standard 1336-1994, Recommended Practices for Eye Protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney, Australia.

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18. Standards Australia, 1987, *Australian Standard 2919 - 1987 Industrial Clothing,* Standards Association of Australia Publ., Sydney, Australia.

19. National Occupational Health and Safety Commission [NOHSC:2011(1994)] 1994. *National code of practice for the preparation of Material Safety Data Sheets,* AGPS, Canberra.

Attachment 1

The Draize Scale for evaluation of skin reactions is as follows:

Erythema Formation	*Rating*	*Oedema Formation*	*Rating*
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1 mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

The Draize scale for evaluation of eye reactions is as follows:

CORNEA

Opacity	*Rating*	*Area of Cornea involved*	*Rating*
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE

Redness	*Rating*	*Chemosis*	*Rating*	*Discharge*	*Rating*
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS

Values	*Rating*
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe

[1] The Draize Scale for evaluation of skin reactions is as follows:

Erythema Formation	rating	Oedema Formation	rating
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

[2] The Draize scale for evaluation of eye reactions is as follows:

CORNEA			
Opacity	**rating**	**Area of Cornea involved**	**rating**
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE					
Redness	**rating**	**Chemosis**	**rating**	**Discharge**	**rating**
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS	
Values	**rating**
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe