File No: NA/418

Date: 5 November 1996

NATIONAL INDUSTRIAL C HEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Z-28

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.

For the purposes of subsection 78(1) of the Act, copies of this full public report may be inspected by the public at the Library, Worksafe Australia, 92-94 Parramatta Road, Camperdown NSW 2050, between the hours of 10.00 a.m. and 12.00 noon and 2.00 p.m. and 4.00 p.m. each week day except on public holidays.

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Acting Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

Z-28

1. APPLICANT

Lubrizol Australia of 28 River Street SILVERWATER NSW 2141 has submitted a standard notification for assessment in support of their application for an assessment certificate for Z-28.

2. IDENTITY OF THE CHEMICAL

Z-18 has been classified as hazardous by Worksafe Australia due to its skin irritation properties based on analog data. However, for commercial reasons, the chemical identity, chemical composition, specific use and import volume have been granted exemption from publication in the Full Public Report and Summary Report. The conditions of this being permitted are:

- A descriptive generic name be used to identify the substance in public reports and the Material Safety Data Sheet (MSDS).
- The relevant employee unions shall be informed of the conditions of use of , Reactive Red 7520 FAT 40508/A.
- 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 a sensitiser 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.

Other Name:	Z-28
Method of Detection and Determination:	the notified chemical is identified by nuclear magnetic resonance (NMR) and infrared (IR) spectroscopy and quantitatively determined by ultraviolet/visual (UV/Vis)spectral analysis

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	dark red/brown glass
Melting Point:	27.5°C
Boiling Point:	113°C (at 760 mm Hg)
Relative Density:	1.09 at 20°C
Vapour Pressure:	4.1 x 10^{-13} kPa at 25°C
Water Solubility:	3.23 mg/L at 20°C
Partition Co-efficient (n-octanol/water):	log P_{ow} 1.06 at 21°C
Hydrolysis as a Function of pH:	not determined
Adsorption/Desorption:	not determined
Surface Tension:	71.6 mN/m at 20.5°C
Dissociation Constant:	not determined
Flash Point:	205°C
Flammability Limits:	not flammable
Autoignition Temperature:	not determined
Explosive Properties:	not explosive
Reactivity/Stability:	not reactive

Comments on Physico-Chemical Properties

There seems to be a discrepancy in the low water solubility. It is noted a preliminary test determined the Log P_{OW} as > 3.3.

The notifier has stated that a hydrolysis test was not performed because the material does not contain functionalities expected to undergo hydrolysis in water. This is acceptable.

The surface tension of the notified chemicals is very close to that of water, therefore it is not a surfactant.

Adsorption/desorption was not tested. The notifier has stated that through the intended use of the notified substance, there will be no release to soils. Due to its low water solubility but relatively low partition coefficient, is it expected that the chemical would have a moderate to weak soil adsorption. However, the chemical is likely to react with cations in the soil through exchange.

Dissociation constant was not determined as the compound is a carboxylate acid salt expected to ionise in water.

4. PURITY OF THE CHEMICAL

Degree of Purity: < 100%

5. USE, VOLUME AND FORMULATION

The notified chemical is intended to be used as an antiscuffing agent in trunk piston engine oils. It has a specialised used in ships and might be used in large power generating plants. Z-28 will be imported at a rate of up to 4 tonnes in the first year rising to 7 tonnes per year in the fifth year.

Z-28 will be added at the rate of 5 - 7% to the diesel lubricating oil, blended to achieve homogeneity and fed into storage tanks or oil sump of a ship. It is expected that a maximum of four ships a year would be serviced (topped up), with a typical ship needing 11 340 to 18 900 L of oil.

6. OCCUPATIONAL EXPOSURE

The notified chemical will be imported as a component (30%) of an oil additive package in 205 L steel drums. Typically, a performance additive package which contains the notified chemical, contains dispersants, detergents, anti-foam agents, rust and oxidation inhibitors and demulsifiers.

Following transport by road or rail to the blend facilities of the oil industry, the drums are stored prior to lubricant manufacture. Typically, lubricant manufacture involves first charging the blending vessel with an oil blend. Then two blend plant operators transfer the oil additive package to the blend vessel either by decanting it into a drum dump trough or inserting a spear into the drum. In either case the additive package is pumped directly into the blend vessel through enclosed lines. Additional diluent oil is pumped into the blend vessel. The blending process at each customer site is undertaken in well ventilated ares, overseen by two to three operators (approximate exposure 6 hours) and is typically automated. The lubricating oil would then be transferred to a storage tank or directly into the sump of a ship. It is expected that a maximum of four ships per annum would be serviced requiring one large blend or four smaller blends per annum.

The concentration of the notified chemical in the final product will vary between 5 and 7%

It is stated that the above processes are carried out in closed systems.

Typically the blending process may continue for several days depending on the amount to be blended. The blend size could be expected to range from 15 000 to 20 000 kg.

7. PUBLIC EXPOSURE

The public is unlikely to be exposed to Z-28 during importation and commercial blending operations. Public exposure to environmental contamination would appear to be minimal, especially in view of its low volatility and water solubility. The notified chemical is unlikely to enter the public domain except through accidental release, as it will not be sold to the public and has only limited industrial application.

8. ENVIRONMENTAL EXPOSURE

Release

Release to the environment during transport and handling would only occur in the unlikely event of an accident.

Losses through the blending/transferring process is not expected. Residual material remaining in blend tank or transfer lines will remain for the next blend. If the equipment is cleaned, a mineral oil would be used, which would be allowed to remain until the next blend.

Release of the notified chemical could occur through accidental spillage. The notifier has stated that catchment pans and personal safety equipment will be employed in such a case.

The release of the notified chemical will occur through the partial combustion of the oil of which it is a component. The notifier has estimated that a typical ship's engine will consume about 37 800 L of oil in one year. This equates to approximately 2 650 L (at a concentration of 7%) of the notified substance. This oil is burnt in the piston combustion area.

It is not expected that used oil generated after regular oil changes will be disposed of in Australia. The notifier has stated that the ships using the notified substance are not expected to be based in Australia, and therefore will not have their regular maintenance conducted at Australian dry dock facilities. In the event that a ship does need to be dry docked for maintenance, any oil removed from the vessel will be recycled, incinerated or disposed of according to local laws.

A similar environmental exposure profile could be expected in the event that the chemical is used as an additive in oil used in large power generating plant.

Fate

The major release of the notified chemical into the environment will be through combustion in the engine. Combustion of the notified chemical will produce oxides of carbon, calcium salts and water.

Disposal of used engine oil will be through re-use as a fuel or incineration. The products of combustion of the notified chemical will be the same as those stated above.

A biodegradation test was submitted by the notifier which showed that Z-28 is not readily biodegradable. The modified Sturm test (OECD test guideline 301B) did show some degradation (3.5% over 28 days) which is so low that it is unclear whether the compound is inherently biodegradable.

Bioaccumulation was not determined as the notifier believes the notified chemical will undergo very limited environmental exposure, because of its particular use. On account of the chemicals low Log P_{ow} and large molecular weight, it is unlikely Z-28 will bioaccumulate (1).

9. EVALUATION OF TOXICOLOGICAL DATA

The Act does require the provision of toxicological data for chemicals with import volume > 1 tonne per annum. In the absence of toxicology data for the notified chemical, studies carried out with the sodium analog were provided by the notifier and are reported here.

9.1 Acute Toxicity

Summary of the acute toxicity of the sodium analog of the notified chemical

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat	LD_{50} > 5 000 mg/kg	(2)
acute dermal toxicity	rat	LD_{50} > 2 000 mg/kg	(4)
skin irritation	rabbit	moderate irritant	(5)
eye irritation	rabbit	slight irritant	(7)
skin sensitisation	guinea pig	non-sensitiser	(8)

9.1.1 Oral Toxicity (2)

Species/strain: Rat/Sprague-Dawley

Number/sex of animals: 5/sex

Observation period: 14 days

Method of administration:	gavage; vehicle, 0.5% (w/v) carboxymethylcellulose in 0.1% (w/v) aqueous polysorbate 80
Clinical observations:	mucoid faeces
Mortality:	none
Morphological findings:	urogenital staining
Test method:	OECD Guidelines for Testing of Chemicals (3)
LD_{50}:	> 5 000 mg/kg
Result:	low oral toxicity in a limit test - single dose of 5 000 mg/kg

9.1.2 Dermal Toxicity (4)

Species/strain:	Rabbit/New Zealand White
Number/sex of animals:	5/sex
Observation period:	6 days
Method of administration:	semiocclusive gauze dressing; 24 hour treatment; vehicle, 0.5% (w/v) carboxymethylcellulose in 0.1% (w/v) aqueous polysorbate 80
Clinical observations:	slight to moderate erythema and very slight to moderate oedema in all rabbits; all sites had desquamation by day 6; subcutaneous haemorrhaging and fissuring;
Mortality:	none
Morphological findings:	multiple red pinpoint foci on the lungs; white foamy contents in the lungs and trachea of one male and bright red lungs in one female
Test method:	OECD Guidelines for Testing of Chemicals (3)
LD_{50}:	> 2 000 mg/kg
Result:	low dermal toxicity in a limit test - single dose of 2 000 mg/kg administered

9.1.3 Inhalation Toxicity not determined

9.1.4 Skin Irritation (5)

Species/strain: Rabbit/New Zealand White

Number/sex of animals: 2 males/4 females

Observation period: 72 hours

Method of administration: 0.5 g moistened with physiological saline

Draize scores (6):

Animal number	***Time after treatment***					
	60 min	***1 day***	***2 day***	***3 day***	***4 day***	*5 day*
Erythema						
1	1	3	2	2	-	-
2	1	2	2	2	-	-
3	1	2	2	2	-	-
4	1	2	2	2	-	-
5	1	2	2	2	-	-
6	1	2	2	2	-	-
Oedema						
1	1	2	2	2	-	-
2	1	2	1	1	-	-
3	1	1	1	1	-	-
4	1	1	1	1	-	-
5	1	1	0	0	-	-
6	0	1	1	1	-	-

[a] see Attachment 1 for Draize scales

Test method: OECE Guidelines for Testing of Chemicals (3)

Result: moderate irritant to rabbit skin

9.1.5 Eye Irritation (7)

Species/strain: Rabbit/New Zealand White

Number/sex of animals: 3/males and 3/females

Observation period: 72 hours

Method of administration: 0.1 mL (highest attainable concentration of the notified chemical in 45% w/v white mineral oil) into the conjunctival sac of the left eye

Draize scores (6) of unirrigated eyes:

	Time after instillation														
Animal	***1 day***			***2 days***			***3 days***			***4 days***			***7 days***		
Cornea	***o[a]***	***a[b]***		***o[a]***	***a[b]***		***o[a]***	***a[b]***		***o[a]***	***a[b]***		***o[a]***	***a[b]***	
1	0[1]	0		0	0		0	0		-	-		-	-	
2	0	0		0	0		0	0		-	-		-	-	
3	0	0		0	0		0	0		-	-		-	-	
4	0	0		0	0		0	0		-	-		-	-	
5	0	0		0	0		0	0		-	-		-	-	
6	0	0		0	0		0	0		-	-		-	-	
Iris															
1		0			0			0			-			-	
2		0			0			0			-			-	
3		0			0			0			-			-	
4		0			0			0			-			-	
5		0			0			0			-			-	
6		0			0			0			-			-	
Conjunctiva	***r[c]***	***c[d]***	***d[e]***	***r[c]***	***c[d]***	***d[e]***	***r[c]***	***c[d]***	***d[e]***	***r[c]***	***c[d]***	***d[e]***	***r[c]***	***c[d]***	***d[e]***
1	1	0	0	1	0	0	0	0	0	-	-	-	-	-	-
2	1	1	0	1	0	0	1	0	0	-	-	-	-	-	-
3	1	1	0	1	0	0	0	0	0	-	-	-	-	-	-
4	1	0	0	0	1	0	0	0	0	-	-	-	-	-	-
5	1	1	0	0	1	0	1	0	0	-	-	-	-	-	-
6	1	1	0	1	0	0	0	0	0	-	-	-	-	-	-

[1] see Attachment 1 for Draize scales

[a] opacity [b] area [c] redness [d] chemosis [e] discharge

Test method: OECD Guidelines for Testing of Chemicals (3)

Result: slight eye irritant in rabbits (based on unspecified diluted concentration of the notified chemical)

9.1.6 Skin Sensitisation (8)

Species/strain: Guinea pig/Hartley strain

Number of animals: 10 test, 10 control

Induction procedure: the notified chemical 25% w/v in light, white mineral oil, applied at 0.4 mL/site to the same site on the left flank of all test animals followed by two similar doses spaced one week apart; control animals remained untreated during induction phase

Challenge procedure: after two weeks occluded administration of 5% (w/v) notified chemical in mineral oil applied to right flank of test and control animals

Rechallenge procedure: after one week occluded administration of 2.5% (w/v) notified chemical in mineral oil applied to a new site on the right flank of test and control animals

Challenge outcome:

	Test animals		***Control animals***	
Challenge concentration	***24 hrs****	***48 hrs****	***24 hrs***	***48 hrs***
5%	**9/10	**10/10	**5/10	**10/10
2.5%	10/10	10/10	10/10	10/10

* time after patch removal
** number of animals exhibiting response

Test method: OECD Guidelines for Testing of Chemicals (3)

Result: not a skin sensitiser in guinea pigs

9.2 Repeated Dose Toxicity (9)

Species/strain: Rat/Crl:CD®(SPF)

Number/sex of animals: 5/sex in control and dose groups

Method of administration:	orally (gavage)
Dose/Study duration::	control, low, mid and high dose (two)groups (respectively) calculates as: 0, 50, 200 or 800 mg/kg/day; gavage of the notified chemical continued for 28-days with a 14-day recovery period for the control and high dose groups
Clinical observations:	a slight increase in the soft stools and increase in salivation in the high dose group
Clinical chemistry/Haematology	an increase in alanine aminotransferase and gamma glutamyl transferase in high dose group; and alkaline phosphatase in mid and high dose groups; decrease in mean cholesterol level in high dose group
Histopathology:	one microscopic hepatic tissue change, an increased incidence of cytoplasmic vacuolation (minimal to moderate), in the high dose group but this change was not observed in the recovery group
Test method:	OECD Guidelines for Testing of Chemicals (3)
Result:	reversible hepatocellular and hepatobiliary impairments at a dose level of 800 mg/kg/day

9.3 Genotoxicity

9.3.1 *Salmonella typhimurium* Reverse Mutation Assay (10)

Strains:	TA 1535, TA 1537, TA 1538, TA 100 and TA 98 and *E. coli WP2 uvrA*
Concentration range:	312.5 - 5000 μg/plate
Test method:	OECD Guidelines for Testing of Chemicals (3)
Result:	not mutagenic in the bacterial strains tested in the presence or absence or metabolic activation provided by rat liver S9 fraction

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

Species/strain:	Mice/CD-1
Number and sex of animals:	5/sex
Doses:	0, 20, 40 and 80 mg/kg
Method of administration:	once intraperitoneally and sacrificed at 24, 48 and 72 hours later
Test method:	OECD Guidelines for Testing of Chemicals (3)
Result:	not clastogenic in bone marrow cells *in vivo*

9.3.3 Dominant Lethal Test (12)

Species/strain:	Rats/Sprague-Dawley
Number and sex of animals:	15 males/group
Doses:	0, 50, 200 and 800 mg/kg/day for 70 days
Method of administration:	orally (gavage)
Test method:	on day 70 each male rat was co-housed with 2 virgin young adult Sprague-Dawley female rats per week for 2 consecutive weeks following which the male rats were sacrificed and their testes and final body weight recorded Anderson and Green *et al* (13,14)
Result:	no statistically significant reduction in fertility or increase in post-implantation loss was detected in females treated with the notified chemical at any of the doses evaluated. However, a statistically significant increase in pre-implantation loss in the 200 and 800 mg/kg/day was observed. It was concluded that the notified chemical did not induce dominant lethal mutations in the germ cells of the male rats under the conditions of the study

9.4 Overall Assessment of Toxicological Data

Based on studies carried out on the sodium analog, the notified chemical may exhibit low acute oral toxicity in rats, low acute dermal toxicity in rabbits, moderate skin and slight eye irritation in rabbits and is unlikely to cause skin sensitisation in guinea pigs. A 28-day oral repeated dose toxicity study suggested that there may be some reversible liver toxicity in rats, primarily at

the highest dose (800 mg/kg) used.

The notified chemical will be classified as hazardous according to Worksafe Australia's *Approved Criteria for Classifying Hazardous Substances* (15) in relation to irritant effects (skin) based on submitted analog data.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The results of ecotoxicity tests (table 1) were provided by the notifier. These tests were performed in accordance with OECD test guidelines as indicated. All facilities used complied with OECD principles of GLP.

Table 1

Species	***Test***	***Result***
Fathead minnow, Pimephales promelas	*96 hour acute, OECD Test Guidelines 203 (actual concentration)*	NOEC = 0.76 mg/L LC_{50} = 1.0 mg/L
Daphnia magna	48 hour immobilisation OECD TG 202 (actual concentration)	NOEC = 0.17 mg/L, EC_{50}= 0.37 mg/L
Daphnia magna	21 day Life-Cycle Toxicity, OECD TG 202 (actual concentration)	NOEC = 0.014 mg/L LOEC = 0.031 mg/L EC_{50} =0.08 mg/L
Algae, *Selenastrum capricornutum*	96 hours, cell growth OECD TG 201 (nominal concentrations)	NOEC =250 mg/L EC_{50} = >247 mg/L

The above results indicate that Z-28 is highly toxic to fish and daphnia following acute exposure, very highly toxic to daphnia reproduction and non-toxic to algae up to the limit of its water solubility, based on the species tested.

No precipitates or other irregularities were noted in these tests. Excepting the algae 96 hour toxicity test, each of the toxicity test reports were based on actual values. There was a large variation between the nominal and actual values (fish - 104% to 121%, daphnia 48 hour - 54% to 84% and daphnia life-cycle - 44% to 77%). Algae 96 hour toxicity test used nominal values.

The cumulative mortality and treatment related data indicated that the 48 hour acute toxicity test had a non-monotonic dose-response curve, ie. there was a non-graded increase in effects to *Daphnia* with increased dosage.

The concentrations tested in the algae toxicity test, used water-accommodated fractions. This means sufficient chemical was added to the test solution to achieve the desired concentration eg. 500 mg/L. However, the amount that actually dissolves into solution will be limited to the chemicals water solubility ie.(< 3.23 mg/L). Therefore, test results will only be representative at test concentration less than or equal to that of the chemicals water solubility.

The effect of the notified chemical on algae appeared to be algistatic, since the growth rates in the 9 day recovery period were comparable to that of the control.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

There is expected to be 7 tonnes (maximum) of Z-28 imported as part of a formulation, which is then diluted with petroleum based oil to give a final concentration, in the ready to use oil, of between 5 and 7 %. This corresponds to between 90,000 L and 126,000 L of oil (assumed density of 900 g/L) containing the additive Z-28. Most of the additive is either burned with the oil during use or collected and incinerated with the waste oil of ships and power generation. Incineration or burning of Z-28 will only release water, calcium salts and oxides of carbon.

Apart from a catastrophic event occurring, such as a ship sinking, the expected environmental releases through blending and transferring are expected to be minimal, and should be cleaned up according to the procedures outlined in the MSDS. The overall environmental hazard is rated as low.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The toxicity profile of the notified chemical suggests the acute toxicological effects associated with the chemical to be skin and eye irritation. Cumulative reversible effects are likely with the target organ being the liver. The notified chemical is a dark reddish brown glassy substance produced in diluent oil. The physico-chemical properties of the chemical do not present any concerns to workers. It is not flammable and not explosive.

Exposure to the notified chemical in the additive package may cause skin and eye irritation. Manufacture of the oil blend containing the notified chemical involves the use of closed systems for blending in additives. Exposure during these processes is expected to be negligible. However, there is a small possibility of exposure to the notified chemical during decanting of drums prior to blending.

Occupational exposure to the notified chemical in the lubricating oil is expected to be minimal given its low concentration (5 - 7% w/v) and the fact that it is expected to be pumped through enclosed lines.

It can be concluded that there is a low risk of adverse health effects arising from occupational exposure during lubricant manufacture and use. There is also a low risk of adverse health effects arising from public exposure during environmental contamination.

13. RECOMMENDATIONS

To minimise occupational exposure to Z-28 the following guidelines and precautions should be observed:

- If engineering controls and work practices are insufficient to reduce exposure to the notified chemical to a safe level, then the following personal protective equipment which conforms to Australian Standards (AS) or Australian/New Zealand Standards (AS/NZS) should be worn;

  Safety goggles should be selected and fitted in accordance with AS 1336 (16) to comply with AS/NZS 1337 (17),

  Industrial clothing should conform to the specifications detailed in AS 2919 (18),

  Impermeable gloves should conform to AS 2161 (19),

  All occupational footwear should conform to AS/NZS 2210 (20);

- Spillage of the notified chemical should be avoided, spillages should be cleaned up promptly and then be put into containers for disposal;

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

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

14. MATERIAL SAFETY DATA SHEET

The MSDS for the notified chemical was provided in accordance with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (21).

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; and uses are proposed which will increase exposure to the aquatic environment.

16. REFERENCES

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3. Organisation for Economic Co-operation and Development, OECD *Guidelines for Testing of chemicals*, OECD, Paris, France

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5. *Primary Dermal Irritation Study in Albino Rabbits with OS #89887*, Project No.: WIL-168057, data on file, WIL Research Laboratories Inc, Ashland, OH, USA, 1992.

6. Draize J H, 1959. Appraisal of the safety of chemicals in food, drugs and cosmetics. *Association of Food and Drug Officials of the US*, **49**

7. *Primary Eye Irritation Study in Albino Rabbits with OS #89887*, Project No.: WIL-168058, data on file, WIL Research Laboratories Inc, Ashland, OH, USA, 1992.

8. *Skin Sensitisation Study of OS #89887 in Albino Guinea Pigs*, Project No.: WIL-168088, data on file, WIL Research Laboratories Inc, Ashland, OH, USA, 1993.

9. *A 28-Day Oral Toxicity Study of OS-89887 in Rats,* Project No.: WIL-168052, data on file, WIL Research Laboratories Inc, Ashland, OH, USA, 1992.

10. *Ames/Salmonella-E. coli Plate Incorporation Assay on OS #89887*, Project No.: PH 301-LU-001-92, data on file, Pharmakon USA, Waverley, PA, USA, 1992.

11. *In Vivo Micronucleus Test with OS #89887 in Mouse Bone Marrow Erythropoietic Cells*, Project No.: PH 309-LU-001-92, data on file, Pharmakon USA, Waverley, PA, USA, 1992.

12. *Dominant Lethal Test in Male Rats Treated with OS #89887,* Project No.: PH 327-LU-001-93, data on file, Pharmakon USA, Waverley, PA, USA, 1994.

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15. National Occupational Health and Safety Commission 1994, *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(1994)], Australian Government Publishing Service, Canberra.

16. 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, 1978, *Australian Standard 2161-1978, Industrial Safety Gloves and Mittens (excluding Electrical and Medical Gloves*), Standards Association of Australia Publ., Sydney, Australia.

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

20. Standards Australia, Standards New Zealand 1994, *Australian/ New Zealand Standard 2210 - 1994 Occupational Protective Footwear, Part 1: Guide to Selection, Care and Use. Part 2: Specifications,* Standards Association of Australia Publ., Sydney, Australia, Standards Association of New Zealand Publ. Wellington, New Zealand.

21. National Occupational Health and Safety Commission (1994). *National Code of Practice for the Completion of Material Safety Data Sheets*, [NOHSC:2011(1994)], 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