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April 1998

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

E-2927-A ISO 32 Synthetic Lubricant Basestock

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 and the assessment of public health is conducted by the Department of Health and Family Services.

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

E-2927-A ISO 32 Synthetic Lubricant Basestock

1. APPLICANT

Henkel Australia Pty Ltd of 83 Maffra Street BROADMEADOWS VICTORIA 3047 has submitted a standard notification statement in support of their application for an assessment certificate for 'E-2927-A ISO 32 Synthetic Lubricant Basestock'.

2. IDENTITY OF THE CHEMICAL

E-2927-A ISO 32 Synthetic Lubricant Basestock is considered not to be hazardous based on the nature of the chemical and the data provided. Therefore the chemical name, CAS number, molecular and structural formulae, molecular weight and spectral details have been exempted from publication in the Full Public Report and the Summary Report.

Other Names:	none
Trade Names:	E-2927-A ISO 32 Synthetic Lubricant Basestock' Emery-2927-A ISO 32 Synthetic Lubricant Basestock Suniso SL-32 Proeco 2927-A ISO 32 Synthetic Lubricant Basestock

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 25°C and 101.3 kPa:	colourless odourless non-volatile liquid
Boiling Point:	> 300°C
Pour Point:	-50°C
Specific Gravity:	0.9950
Vapour Pressure:	0.0173 kPa at 107°C

Water Solubility:	4 000 ppm maximum (see comments below)
Partition Co-efficient (n-octanol/water) Log K_{ow}:	> 5 at 20°C (see comments below)
Hydrolysis as a Function of pH:	< 10^{-6} $g.L^{-1}$ at 25°C (see comments below)
Adsorption/Desorption:	not determined (see comments below)
Dissociation Constant:	does not dissociate (see comments below)
Flash Point:	258°C
Flammability Limits:	not flammable
Autoignition Temperature:	not determined
Explosive Properties:	not explosive
Reactivity/Stability:	very stable polyol ester not subject to hydrolysis or oxidation

Comments on Physico-Chemical Properties

The water solubility in the notification is stated as a maximum of 4 000 ppm. However, analytical results accompanying the ecotoxicity studies on aquatic organisms would indicate that the water solubility is considerably lower (< 1ppm). In these tests total organic carbon levels of 1-2 $mg.L^{-1}$ were determined for the water accommodated fractions of the chemical at nominal levels of 130 and 1 000 $mg.L^{-1}$ of the notified chemical. This is also consistent with the value of the partition coefficient (log K_{OW} > 5) determined gravimetrically after equilibration for two weeks and solvent extraction.

The adsorption/desorption behavior of the chemical has not been determined. Based on the low water solubility and high partition coefficient the notified chemical is expected to adsorb strongly to soils and sediments.

An attempt was made to determine the dissociation constant for the notified chemical. It was mixed with dilute base for one week and the base was then back titrated. As the notified chemical contains no dissociable hydrogens this result is consistent with no hydrolysis of the ester funtionalities occurring under weakly basic conditions.

4. PURITY OF THE CHEMICAL

Degree of Purity: nearly 100 %

Toxic or Hazardous Impurities: none

Additives/Adjuvants: none

5. USE, VOLUME AND FORMULATION

The notified chemical is a lubricant which will be imported for use in refrigeration compressors and system components which utilise non-ozone depleting HFC refrigerants. The excellent performance of the notified chemical, with the new chlorine free alternative refrigerants, is well documented by major compressor manufacturers in the US. The notified chemical is said to exhibit the required miscibility at critical temperature, minimum viscosity loss, desired lubricity and stability for extended life. The notified chemical will be used specifically in hermetically sealed compressors for appliances, as well as hermetically sealed and semi-hermetically sealed compressors for commercial refrigeration systems. The notified chemical is used as a lubricant in compressors servicing the following types of equipment:

- home appliances (refrigerator/freezers)
- beverage coolers
- water fountains
- walk-in coolers
- commercial refrigeration units such as frozen food cabinets, ice cream machines, cold boxes and storage units.

The notified chemical (lubricant) will be sold directly to compressor manufacturers who will hermetically seal the lubricant and refrigerant in compressors. The compressors will then be sold to cabinet makers who assemble the refrigeration units. The lubricant will also be sold to service centers to replenish the lubricant in semi-hermetically sealed compressor units.

The import volume of the notified chemical is estimated to be approximately 100 to 1 000 tons per year over the next five years.

It is not anticipated that the notified chemical will be manufactured in Australia.

6. OCCUPATIONAL EXPOSURE

The notified chemical will be shipped into Australia as a liquid in 20 000 L isotanks and in 208 L steel drums. These containers will be taken to warehouses from the dockside for storage. Since the notified chemical is dried to less than 50 ppm moisture level, it remains in the sealed containers until it is put to use. The notified

chemical could be used with or without additives depending on the application.

Two to 5 dockside workers and two to three transport personnel will be exposed to the notified chemical , if it is released accidentally. At the lubricant supplier's site, the notified chemical will be blended with additives. The transferal is undertaken using an automatic closed pipe system. After blending, packaging the product into 3.8 L and 19 L pails is also automated and closed. Three workers will be involved in this operation as well as one worker who will carry out quality control inspections. The closed system used in blending and packaging to prevent absorption of moisture by the lubricant and the product will reduce any possibility of dermal exposure to the notified chemical other than in the event of an accident spill.

At the compressor manufacturer's site three workers will be involved in analysing and introducing the product containing the notified chemical via a closed injection system into the compressor. A worker will pump the product by an automatic device from the transport vessel to a storage tank and then to a vacuum drying system which will automatically inject the product into the compressor. Due to the closed nature of the system no exposure is expected at the compressor manufacturer's site other than in the event of an accident spill.

Service personnel may be exposed to the product containing the notified chemical during routine maintenance of the refrigeration units. Exposure to the notified chemical may occur through minor leaks from seals and gaskets in the system. Most accidental exposure will be to the liquid form of the notified chemical.

7. PUBLIC EXPOSURE

No public exposure to the notified chemical is expected to occur from storage, transport and industrial processes except in the event of an accidental spillage. It will not be sold to the public. The notified chemical is not volatile, and air contamination from industrial processes is not expected to occur.

Compressors filled with the lubricant will be installed on home appliances (refrigerators/freezers). The general public may be exposed to the notified chemical in the rare cases of minor leaks or accidental puncture of compressors in the home appliances. However, compressors in home appliances are hermetically sealed and the amount of lubricant used in these compressors is small (225 to 280 g). Public exposure would be minimal.

Public exposure from disposal is also expected to be negligible. Drums or big containers will be recycled and small containers (3.5 L) will be crushed and disposed of to landfill. The packaging equipment will be cleaned with a solvent, which will be disposed of by incineration. Used lubricant in semi-hermetically sealed commercial compressors will be disposed of by incineration. Used compressors will be recycled or crushed and placed in a landfill. Accidental spills during transport will be collected or contained with absorbents and reclaimed or disposed of according to regulations.

8. ENVIRONMENTAL EXPOSURE

Release

– *General*

The substance will be imported into Australia in sealed containers. No release to the environment is expected during transport and storage except in cases of spills. The chemical will be used as a lubricant either directly or after blending with additives. As a low moisture content in the lubricants is important most operations occur in closed contained systems. All equipment, including automated packaging systems, are completely dry. Any spills which occur are contained and will be adsorbed to sand prior to disposal in appropriate waste containers (used open drum) which will be disposed of by a waste contractor.

Off specification product will be returned to Henkel Pty Ltd in the United States for reprocessing.

– Lubricant Blending

At lubricant manufacturers the notified chemical will be blended with additives in a closed system. The blending process will be mainly automated. However small quantities may be blended by hand. The notifier estimates that approximately 200 kg of waste chemical will be generated per year as a result of lubricant blending. This will arise from the cleaning of compounding and filling equipment at the end of a batch. The notified chemical will be dissolved in a cleaning solvent and the solvent chemical mixture will be incinerated.

– *Compressor Manufacture*

The notified chemical is automatically pumped from its transport container into a storage tank. The chemical is then automatically injected into compressors via a closed system, which includes a vacuum drying system.

– *Use*

There is little likelihood of release of the lubricant from the hermetically sealed compressors. At the end of their useful life compressors will be drained and the used lubricant will be reprocessed or incinerated. The compressor will be crushed and recycled or placed in landfill. The lubricant in semi-hermetically sealed compressors may be changed during their lifetime. The contents of the compressor will be drained and the contents of either a 3.8 or 19 L pail will be added depending on the size of the compressor.

– *Disposal*

– Used lubricants will normally be collected by a contractor for recycling or incineration. The 19 L plastic pails are expected to be emptied, recapped and

returned for reuse. Drained 3.5 L tin pails and 208 L drums are expected to be crushed and consigned to an approved landfill. Empty isocontainers will be returned to the United States for reuse.

Fate

The notifier does not expect release of the notified chemical to the environment will occur under normal operating conditions. However, losses may occur during transport of the drums and any further handling, as well as from the draining and charging of the compressor systems. Any notified chemical that enters sewers/waterways is likely to become associated with sludge/sediment due to the chemical's high octanol-water partition coefficient and low water solubility. Similarly, any chemical that is disposed of to landfill would be expected to bind to soils, where it is anticipated that it will slowly biodegrade.

Incineration of the notified chemical will result in its destruction and produce water and oxides of carbon.

The biodegradability of the notified chemical was assessed according to the Coordinating European Council guideline CEC L-33-T-82 'Biodegradability of two-stroke Cycle Outboard Engine Oils in Water' (superseded by CEC L-33-A-94) with an inoculum obtained from the second (biological) stage of a water treatment plant. At the end of the test [time period unspecified, probably 21 days (1)] 72.5% of the notified chemical had biodegraded. This test is a measure of the 'primary' biodegradation (disappearance of the chemical) of the chemical which correlates with the 'ultimate' biodegradation (mineralisation of the chemical) in the modified Sturm test (1).

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Acute Toxicity

Summary of the acute toxicity of E-2927-A ISO 32 Synthetic Lubricant Basestock

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat	LD_{50} >5 000 mg.kg^{-1}	(2)
acute dermal toxicity	rabbit	LD_{50} >5 000 mg.kg^{-1}	(3)
skin irritation	rabbit	non-irritant	(4)
eye irritation	rabbit	slight irritant	(5)
skin sensitisation	guinea pig	weak sensitiser	(6)

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
Clinical observations:	none related to treatment
Mortality:	none
Morphological findings:	none related to treatment
Test method:	similar to OECD guidelines (7)
LD_{50}:	> 5 000 $mg.kg^{-1}$
Result:	the notified chemical was of low acute oral toxicity in rats in a limit test - single dose of 5 000 $mg.kg^{-1}$

9.1.2 Dermal Toxicity (3)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	5/sex
Observation period:	14 days
Method of administration:	semiocclusive dressing; 24 hour treatment
Clinical observations:	moderate to marked erythema were noted on 8 rabbits for 48 hours and on 7 rabbits for 72 hours; moderate to marked oedema were noted on 5 rabbits for 48 hours and on one rabbit for 72 hours; scaling was observed on the backs of all rabbits up to day 7; all observations resolved by day 14
Mortality:	none

Draize scores (4):

Time after treatment (days)	***Animal #***									
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Erythema [i]										
1	2	2	1	1	1	1	1	1	-	-
2	2	1	1	1	1	1	1	1	-	-
3	3	2	2	2	1	1	-	-	-	-
4	2	2	2	1	1	1	1	1	-	-
5	2	1	1	1	1	1	1	-	-	-
6	2	2	2	1	1	1	1	1	-	-
7	2	2	2	1	1	1	1	-	-	-
8	2	2	2	1	1	1	1	-	-	-
9	2	2	2	1	1	1	1	-	-	-
10	2	2	2	1	1	1	1	-	-	-
Oedema										
1	1	1	1	1	1	1	-	-	-	-
2	1	1	-	-	-	-	-	-	-	-
3	3	2	2	1	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-
5	1	1	-	-	-	-	-	-	-	-
6	2	2	-	-	-	-	-	-	-	-
7	2	2	-	-	-	-	-	-	-	-
8	2	2	-	-	-	-	-	-	-	-
9	2	2	-	-	-	-	-	-	-	-
10	1	1	1	-	-	-	-	-	-	-

[i] see Attachment 1 for Draize scales

Test method: similar to OECD guidelines (7)

LD_{50}: > 5 000 $mg.kg^{-1}$

Result: the notified chemical was of low dermal toxicity in rabbits in a limit test - single dose of 5 000 $mg.kg^{-1}$

9.1.3 Inhalation Toxicity not determined

9.1.4 Skin Irritation (5)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	3/sex
Observation period:	72 hours
Method of administration:	0.5 ml pure notified chemical applied to an intact site on the back of each rabbit for 4 hours
Clinical Observations:	slight erythema was noted on 2 rabbits one hour after application and on another on day 1; all observations resolved by day 2
Test method:	similar to OECD guidelines (7)
Result:	the notified chemical was a slight irritant to the skin of rabbits

9.1.5 Eye Irritation (6)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	3/sex
Observation period:	72 hours
Method of administration:	0.1 mL of the notified chemical into the conjunctival sac of the left eye
UnIrrigated eyes:	conjunctival erythema was noted in all rabbits one hour after application and in one rabbit up to 48 hours; oedema was noted in 5 rabbits one hour after application and in one rabbit up to 48 hours
Test method:	similar to OECD guidelines (7)
Result:	the notified chemical was a slight irritant to the eyes of rabbits

9.1.6 Skin Sensitisation (8)

Species/strain: guinea pig/albino

Number of animals: 20 test; 10 control

Induction procedure: Day 1: three pairs of intradermal injections:

- 0.1 mL Freund's complete adjuvant (FCA)/corne oil (1:1 (v/v))
- 0.1 mL of 5% concentration of notified chemical with corn oil
- 0.1 mL of 5% concentration of notified chemical in FCA and corne oil

Day 7: test area treated with 10% sodium-lauryl-sulfate (SLS) in petroleum jelly

Day 8: occluded application of the notified chemical (100%) in ethanol for 48 hours

Challenge outcome:

	Test animals		***Control animals***	
Challenge concentration	***24 hours****	***48 hours****	***24 hours***	***48 hours***
100%	**20/20	2/20	9/10	0/10

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

Clinical observations after the challenge dose: erythema and edema were noted on all rabbits on day 1 except in one control animal; slight erythema and/or edema were noted in 2 treated rabbits; the observed irritation dissipated after 3 days in one rabbit and 4 days in the other; this increased hyperirritation did not persist or increase in severity after the above time points when observed on day 4 and 5 could be considered to be a weak hypersensitivity reaction

Test method: similar to OECD guidelines (7)

Result: the notified chemical was a weak skin sensitiser in albino guinea pigs

9.2 Repeated Dose Toxicity since there is very little or no human contact with the notified chemical the repeated dose toxicity study has not been carried out

9.3 Genotoxicity

9.3.1 *Salmonella typhimurium* Reverse Mutation Assay (9)

Strains: TA 1537, TA 1535, TA 100 and TA 98

Concentration range: 100 - 5 000 μg/plate

Test method: similar to OECD guidelines (ref)

Result: not mutagenic in the bacterial strains tested in the presence or absence of metabolic activation provided by rat liver S9 fraction

9.3.2 Chromosomal Aberration Assay in Chinese hamster ovary cells (10)

Dosing schedule: with S9 mix:
625-5 000 μg/mL - cells were treated with the test material for 12 hours

without S9 mix:
625-5 000 μg/mL - cells were treated with the test material for 4 hours

chromosomes were prepared 12 hours after the start of treatment with the test material

Test method: similar to OECD guidelines (7)

Result: no increases in cells with structural chromosomal aberrations were seen after treatment with the test article at the dose level tested, in the presence or absence of metabolic activation

the test material was not considered to be clastogenic under the conditions of this chromosomal aberration test

9.4 Overall Assessment of Toxicological Data

The notified chemical exhibited low acute oral (LD_{50} > 5 000 mg.kg^{-1}) and dermal (LD_{50} > 5 000 mg.kg^{-1}) toxicities in rats and rabbits respectively. No inhalation or repeated dose toxicity data were provided by the notifier. The notified chemical was not a skin irritant in rabbits, but caused slight eye irritation in the same species. The notified chemical was a weak sensitiser when tested in guinea pigs.

The notified chemical was not mutagenic in bacteria, and no mutagenicity and clastogenicity were observed in Chinese hamster ovary cells *in vitro*.

On the basis of the toxicity studies summarised above, the notified chemical would not be classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* (11).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The following ecotoxicity studies have been supplied by the notifier. The tests were carried out according to OECD Test Methods (7).

Species	***Test***	***Concentrations[a] (mg.L^{-1})***	***Result (mg.L^{-1})***	***Reference***
Rainbow trout *(Oncorhynchus mykiss)*	96 h acute	0, 130, 220, 360, 600, 1 000	LC_{50} > 1 000 NOEC=1 000	(12)
Water Flea *(Daphnia magna)*	48 h acute	0, 130, 220, 360, 600, 1 000	EC_{50} > 1 000 NOEC = 130	(13)
Algae *(Selanastrum capricornutum)*	96 h growth	0, 130, 220, 360, 600, 1 000	ERC50 > 1 000 EBC50 > 1 000 NOEC = 1 000	(14)

[a]Nominal concentrations. Test media were prepared by agitating the appropriate nominal concentration of the notified chemical in water, allowing to settle and siphoning off the water phase leaving behind undissolved material. TOC measurements of the 0, 130, 1 000 mg.L^{-1} test media only found TOC levels of only 1 to2 mg.L^{-1} above the blank.

In the fish test insoluble material was observed on the water surface at least once at all test concentrations and the 1 000 mg.L^{-1} test solution was observed to be slightly turbid.

Insoluble material was also observed in all test concentrations in the Daphnia

study. Between 2 and 5 immobilised *Daphnia* were observed at nominal concentrations of 220, 360, 600, 1 000 $mg.L^{-1}$.

No effects (size differences, unusual cell shapes, colours, flocculations, adherence of cells to test containers, or aggregation of cells) were noted in the Algal study.

The ecotoxicity data for the notified chemical indicate that the chemical is non-toxic to fish, daphnia and algae up to the level of its solubility in water.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The notified chemical is to be used as a lubricant in the sealed systems of refrigeration units and as such release to the environment from its use is expected to occur only when the lubricants are replaced. Used lubricants will be incinerated. Some will be consigned to landfill with crushed compressors.

Blending of lubricants occurs in a closed system to avoid wetting of the lubricants. Waste generated from the cleaning of blending and packing equipment will also be low and disposed of by incineration.

Releases of the notified chemical to sewers are not expected under normal operating conditions. In the unlikely event that any chemical finds it way to the aquatic environment it is unlikely to be at levels that result in adverse effects. Therefore, the notified chemical is unlikely to present a significant hazard to the environment from its proposed use due to the expected low environmental exposure and its low aquatic toxicity.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Based on the toxicological data, the notified chemical is not expected to exhibit acute toxicity, is not likely to be a skin irritant nor genotoxic. However, it is likely to be a slight eye irritant and a weak sensitiser.

Exposure of transport and storehouse workers to the notified chemical is likely to occur in the rare event of an accident.

Exposure of workers involved in blending of the notified chemical with other additives is expected to be low. Blending will involve fully automated equipment within a closed system so that exposure is only likely in the event of an accidental spill.

At compressor manufacturer's sites introduction of the product containing the notified chemical is via a closed injection process. As such, no exposure could be envisaged at the filling site other than in the event of an accidental spill.

Service personnel may be exposed to the product containing the notified chemical

which may occur through minor leaks and seals and gaskets in the system. However, such releases are minimised by good work practices according to the Australian Refrigeration and Air Conditioning Code of Good Practice (15).

The notified chemical will not be sold to the public and no public exposure is expected to occur during reformulation, packaging or injection into compressors. The general public may be exposed to the notified chemical from minor leaks or accidental puncture of compressors in home appliances. Given that the compressor leaks are uncommon and the amount of notified chemical used in home appliances is small, such exposure should not present a significant hazard to public health. In the event of an accidental spillage during transport or storage, clean-up and disposal procedures described in the Material Safety Data Sheet (MSDS) should minimise any public exposure.

13. RECOMMENDATIONS

To minimise occupational exposure to E-2927-A ISO 32 Synthetic Lubricant Basestock the following guidelines and precautions should be observed:

- if engineering controls and work practices are insufficient to significantly reduce exposure to safe level, then personal protective devices which conform to and are used in accordance with Australian Standard (AS) for eye protection (AS 1336; AS 1337) (16,17).
- When used in confined spaces positive ventilation is necessary to disperse escaped aerosols.
- Leak testing of refrigeration equipment should be conducted on a regular basis.
- Industrial clothing should conform to the specifications detailed in AS 2919 (18).
- Impermeable gloves or mittens 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 with absorbents which should then be put into containers for disposal.
- Good personal hygiene should be practiced 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 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. No other specific conditions are prescribed.

16. REFERENCES

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3. Teresa, D.B 1994, *Acute Dermal Toxicity Study with E-2927-A ISO 32 Synthetic Lubricant Basestock in rats*, Project no., 94-8242-21 (B), Hill Top Biolabs, Inc Miamiville, Ohio, USA.

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12. Ward TJ, Magazu JP and Boeri RL (1994a) Acute Toxicity of the water accommodated fraction (WAF) of Emery 2927 to the rainbow Trout, *Oncorhynchus mykiss*. Study Number 484-HE, T.R. Wilbury Laboratories, Inc. 40 Doaks Lane, Marblehead, Massachusetts, USA. Unpublished

13. Ward TJ, Magazu JP and Boeri RL (1994b) Acute Toxicity of the water accommodated fraction (WAF) of Emery 2927 to the Daphnid, *Daphnia magna*. Study Number 487-HE, T.R. Wilbury Laboratories, Inc. 40 Doaks Lane, Marblehead, Massachusetts, USA. Unpublished.

14. Ward TJ, Magazu JP and Boeri RL (1994c) Acute Toxicity of the water accommodated fraction (WAF) of Emery 2927 to the Freshwater Alga, *Selenastrum capricornutum*. Study Number 488-HE, T.R. Wilbury Laboratories, Inc. 40 Doaks Lane, Marblehead, Massachusetts, USA. Unpublished.

15. Australian Refrigeration and Air Conditioning Code of Good Practice {14)Association of Fluorocarbon Consumers and Manufacturers, 1992 # 191}.

16. Standards Australia 1994, *Australian Standard 1336-1994*, *Eye protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney.

17. Standards Australia/Standards New Zealand 1992, *Australian/New Zealand Standard 1337-1992, Eye Protectors for Industrial Applications*, Standards

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

19. Standards Australia 1978, *Australian Standard 2161-1978, Industrial Safety Gloves and Mittens (excluding electrical and medical gloves),* Standards Association of Australia Publ., Sydney.

20. Standards Australia/Standards New Zealand 1994, *Australian/New Zealand Standard 2210-1994, Occupational Protective Footwear*, Standards Association of Australia/Standards Association of New Zealand, Sydney/Wellington.

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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