File No: NA/549

May 1998

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Synthetic Polymer NB#1962977

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 the National Occupational Health and Safety Commission 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.

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 following hours:

Monday - Wednesday	8.30 am - 5.00 pm
Thursday	8.30 am - 8.00 pm
Friday	8.30 am - 5.00 pm

Copies of this full public report may also be requested, free of charge, by contacting the Administration Coordinator on the fax number below.

For enquiries please contact the Administration Coordinator at:

Street Address: 92 Parramatta Rd Camperdown, NSW 2050, AUSTRALIA
Postal Address: GPO Box 58, Sydney 2001, AUSTRALIA
Telephone: (61) (02) 9577-9466 FAX (61) (02) 9577-9465

Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

Synthetic Polymer NB#1962977

1. APPLICANT

Exxon Chemical Australia Ltd of 12 Riverside Quay SOUTHBANK 3006 has submitted a standard notification statement in support of their application for an assessment certificate for Synthetic Polymer NB#1962977

2. IDENTITY OF THE CHEMICAL

Synthetic Polymer NB#1962977 is considered not 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, spectral data, details of the polymer composition and details of exact import volume have been exempted from publication in the Full Public Report and the Summary Report.

Trade Name:	NB#19629-77
Number-Average Molecular Weight (NAMW):	3 360
Maximum Percentage of Low Molecular Weight Species	
Molecular Weight < 500:	1.76%
Molecular Weight < 1 000:	18.8%
Method of Detection and Determination:	The notifier provided two gel permeation chromatographic traces for the notified material, together with supporting slice printout data from which the molecular weight information listed above was derived; an infrared spectrum which characterises the main functionalities within the material was also provided.

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	amber viscous liquid
Boiling Point Range:	332-618°C

Specific Gravity:	0.8822 at 15.5ºC
Vapour Pressure:	3.19 x 10^{-4} Pa at 23°C
Water Solubility:	0.46 mg.L^{-1} at 20°C
Partition Co-efficient (n-octanol/water):	log P_{ow} > 6
Hydrolysis as a Function of pH:	no data provided - see comments below
Adsorption/Desorption:	log K_{oc} > 4.64 - see comments below
Dissociation Constant:	no data provided
Fat Solubility	> 1 000 g.kg^{-1} fat
Flammability Limits:	not determined
Autoignition Temperature:	not available
Explosive Properties:	none
Reactivity/Stability:	not considered reactive

Comments on Physico-Chemical Properties

Tests were performed according to EEC/OECD test guidelines at facilities complying with OECD Principles of Good Laboratory Practice.

A test report detailing the conduct of the water solubility test was provided. The indicated solubility of 0.46 mg.L^{-1} appears high for a compound of this nature. However, the material is surface active, and it is possible that much of the “water soluble” material is dispersed as colloidal aggregates like micelles. The flask method of OECD TG 105 which was presumably employed for this determination would not discriminate between truly water soluble material, and material dispersed in such aggregates.

The molecules of notified material contain amide linkages, but these are unlikely to hydrolyse under usual environmental pH conditions (4<pH<9). Hydrolysis is also not favoured by the low water solubility which will preclude contact between the susceptible amide groups and the water medium.

The log P_{ow} value was determined using a method based on comparison of HPLC retention times of the notified substance and a series of standards. Log P_{ow} was found to be greater than 6 which is in accord with the high hydrocarbon content indicating high affinity of the material for the oil phase. This is also reflected in the high fat solubility.

The log K_{oc} estimate was calculated from the log P_{ow} estimates, and again the high value reflects affinity for an organic environment, and indicates the material would adsorb strongly into the organic component of soils and sediments.

No dissociation data was provided, but the notified chemical contains secondary amino groups which could be expected to have a pKa of between 10 and 11. In an aqueous dispersion the material may therefore exhibit basic behaviour.

No surface tension data was provided, but the material is expected to be surface active under usual environmental conditions.

4. PURITY OF THE CHEMICAL

Degree of Purity:	81%
Toxic or Hazardous Impurities:	< 0.02% phenol compound
Non-hazardous Impurities (> 1% by weight):	17% of polymeric monomer and 2% copolymer of the phenolic compound above and the latter polymeric monomer
Additives/Adjuvants:	none

5. USE, VOLUME AND FORMULATION

The notified chemical will not be manufactured in Australia, but will be imported in 200 L steel drums as a component of a lubricant additive package of which it will constitute 5.3% by weight.

Import volumes for the notified chemical are anticipated to be between 120 and 200 tonnes per annum over the next five years.

The lubricant additive package containing the notified material will be sold to petroleum companies where it will be blended with other petrochemicals and additives for production of brand name engine oils. It is expected that typically the new material would constitute less than 2% (w/w) of the final lubricant product which would be packed into containers and drums of between 1 and 200 L for distribution to consumers. The maximum annual import of 200 tonnes of notified material equates to annual production of 12 500 tonnes of lubricant.

6. OCCUPATIONAL EXPOSURE

The new polymer is manufactured in the Europe, and will be imported as a component (less than 6 % (w/w)) of a new engine oil additive package. The notifier estimates that 2 people would be involved in receiving the import at the dock. A

further 1 to 2 people would be involved in the transport of the product to the customer blending facilities. Worker exposure to the notified polymer during this phase of operations is only likely to occur in the event of accidental spillage.

Blending of the additive package into finished crankcase lubricants takes place at the customer facility. Lubricant processors blend the additive package containing the notified polymer with mineral oil and other additives, in batches 250 to 50 000 L, to form a finished lubricant. The finished lubricant will typically contain less than 2 % (w/w) of the notified polymer, and will be repacked into consumer size containers, generally of volumes 1 to 200 L. Typically 1 to 4 workers are involved in this process, for the operation of the valves and pumps of the automated equipment. Worker exposure to the notified polymer during transfer processes may occur through incidental loss of the additive during the connection/disconnection of transfer hoses, but should be controlled by use of appropriate protective clothing and gloves. The notifier estimates that less than 20 mL of the additive would be spilt during the transfer process.

Finally, mechanics (in addition to do-it-yourself enthusiasts) involved in the maintenence of crankcases are likely to be exposed to the notified chemical. No estimate of worker exposure for this category of workers was provided.

7. PUBLIC EXPOSURE

There would be negligible potential for exposure of the public during transport, distribution and reformulation operations. Spillage of oil containing the notified polymer in the reformulation plant would have little consequence for the public as it would be contained and become associated with the treatment plant sludge. If oil containing the notified polymer is spilled outside the workpalce, it would be prevented from entering the sewers, watercourses or low areas and contained with sand or earth, prior to recovery by absorption and disposal to landfill.

The notifier estimates that approximately 20% of oils containing the notified polymer would be used by members of the public, who could become exposed by dermal contact when inspecting and servicing engines. However, the frequency of contact would be low and the duration of contact would usually not be prolonged. The potential for exposure would be further reduced by the low concentration of the notified polymer in finished oils.

Most used oils containing the notified polymer would be recycled or incinerated. Public exposure from these activities is not anticipated. However, survey data cited indicates that significant amounts of waste oils are disposed of by burial, disposal to stormwater drains, or are used for treating fence posts or herbicidal purposes. In these instances, exposure would be limited by the physico-chemical properties of the notified polymer.

8. ENVIRONMENTAL EXPOSURE

Release

Some release of the notified material could occur as a result of spills during the reformulation activities. The notifier anticipates these would be small, and would be contained and treated at dedicated waste treatment facilities operated by the petroleum companies. In these cases the material would become associated with treatment plant sludge and in all probability be placed into landfill or incinerated.

The vapour pressure of the material is very low, so release to the atmosphere would be negligible.

Some release is likely during transfer of the lubricants from containers to engine blocks. If it is assumed that each transfer involves 4 litres of lubricant, then a calculation indicates around 3,500,000 engine oil changes (using the notified product) take place throughout Australia each year. The notifier anticipates that on average 20 mL of lubricant, containing 1.6% of the notified substance, is likely to be either spilt or left as residuals in containers as a result of transfer operations. Consequently around 1 000 kg (0.5% of import quantity) of the notified material would be released annually via this route.

The notifier anticipates that around 80% of oil changes take place in specialised automotive service centres, where old oil drained from crankcases could be expected to be disposed of responsibly, either to oil recycling or incineration. This accounts for around 160 tonne per annum of the notified material. Around 20% of oil transfer operations are expected to be performed by enthusiasts, and in these cases some of the old oil would be either incinerated, left at transfer stations where it is again likely to be recycled or deposited into landfill. However, recent survey data tracing the fate of used lubricating oil in Australia (1) indicates that only around 20% of old oil removed by enthusiasts is collected for recycling, and about 25% is buried or tipped into landfill, 5% is disposed of into stormwater drains and the remaining 40% is used in treating fence posts, killing grass and weeds or disposed of in other ways.

Fate

The notified material is not readily biodegradable in aerobic environments, and the modified Sturm test [OECD Method 301B] indicates only 10% degradation after 28 days.

However, despite the low apparent rate for biodegradation, it is expected that if placed into landfill (if for example adsorbed into sawdust after accidental spills) the material would be slowly degraded through the slow biological and abiotic processes operative in these facilities. Apart from producing some carbon dioxide, these processes could be expected to produce methane, ammonia and water.

Leaching from a landfill would be slow, and the high K_{oc} indicates that the material would not be mobile, but would adsorb into and become associated with the organic component of soils and sediments. Similarly, in the event of accidental release into

the water compartment, it is likely to become associated with suspended organic material, and eventually be incorporated into sediments.

Although the polymer has a high log P_{ow}, the high molecular weight will preclude easy transfer across cell membranes, and hence the material is unlikely to bioaccumulate.

Incineration of waste oil containing the notified material would destroy the substance with evolution of water vapour and oxides of carbon and nitrogen. Sludges from waste treatment plants or oil recycling facilities could also be incinerated. Relatively large quantities of material placed into landfill as a result of irresponsible disposal practices would be adsorbed into and become associated with soil material and eventually be slowly degraded as described above.

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Acute Toxicity

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat	> 2 000 $mg.kg^{-1}$	(2)
acute dermal toxicity	rabbit	> 2 000 $mg.kg^{-1}$	(3)
skin irritation	rabbit	non-irritant	(4)
eye irritation	rabbit	not determined	-
skin sensitisation	guinea pig	non sensitising	(5)

9.1.1 Oral Toxicity (2)

Species/strain:	rat/Crl:CD BR
Number/sex of animals:	5/sex
Observation period:	14 days
Method of administration:	oral intubation via syringe
Clinical observations:	one male found dead on day 2 following a confirmed dosing accident; clinical observations in surviving animals were limited to wet rales in two females on day 0 and a reduced amount of stool in one of these animals on days 1 and 2; all other animals were free of abnormalities
Mortality:	1 animal death due to non-treatment related causes
Morphological findings:	no treatment-related changes

Test method:	similar to OECD guidelines (6)
LD_{50}:	2 000 $mg.kg^{-1}$
Result:	the notified polymer was of low acute oral toxicity in rats

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:	50% concentration of the notified chemical in peanut oil was applied to the the body surface of test animals using semi-occlusive dressing; residual chemical was removed 24 hours after exposure
Clinical observations:	none
Mortality:	none
Morphological findings:	no treatment-related changes
Draize scores:	topical application of the test material elicited very slight erythema in 6 animals and well-defined erythema in 1 animal on day 1; these effects diminished by day 10
Test method:	similar to OECD guidelines (6)
LD_{50}:	> 2 000 $mg.kg^{-1}$
Result:	the notified chemical was of low dermal toxicity in rabbits

9.1.3 Inhalation Toxicity

not determined

9.1.4 Skin Irritation (4)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	3 males
Observation period:	72 hours

Method of administration:	0.5 mL of the notified chemical in peanut oil (50% (w/v)) was applied to the shaved shoulder region using a semi-occlusive dressing for a period of 4 hours
Comments	dermal responses were limited to two animals with very slight erythema (one animal at the 1 hour interval and another at the 48 hour interval); all animals were free of signs of irritation by the 72 hour interval
Test method:	similar to OECD guidelines (6)
Result:	the notified chemical was non irritating to the skin of rabbits

9.1.5 Eye Irritation

not determined

9.1.6 Skin Sensitisation (5)

Species/strain:	guinea pig/Dunkin Hartley Albino
Number of animals:	20 test, 10 control
Induction procedure:	day 1 - 0.4 mL of a 50%(w/v) solution of the notified chemical in peanut oil applied topically to the shaved scapular region of each animal and held using semi-occlusive wrap for 6 hours; one treated animal was found dead on day 7, but this was considered not to be treatment related this process was repeated on days 8 and 15
Challenge procedure:	day 29 - 0.4 mL of the notified chemical (95% (w/v) in peanut oil was applied topically to the clipped area of the right flank and held in place for six hours using a semi-occlusive wrap;

Challenge outcome:

Challenge concentration	Test animals		Control animals	
	24 hours*	48 hours*	24 hours	48 hours
50%	0/19	0/19	0/10	0/10

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

Test method: similar to OECD guidelines (6)

Comments: the report states that 3/19 animals showed an allergic response, however these three scores were ± grades on the Draize scale; this is below the threshold considered for positive scores; animals have to show scores of at least 1 on the Draize scale to be considered sensitised

Result: the notified chemical was not sensitising to the skin of guinea pigs

9.2 Repeated Dose Dermal Toxicity (7)

Species/strain: rat/Crl:CD BR

Number/sex of animals: 5/sex (5 groups including a control and satellite group)

Method of administration: the notified chemical in peanut oil was applied to the unabraded skin and held in place using a semi-occlusive dressing; daily exposure was for at least 6 hours

Dose/Study duration: 100 (low), 300 (mid) 1 000 $mg.kg^{-1}.day^{-1}$(high dose)/28 days

Clinical observations: none

Clinical chemistry/Haematology there were no statistically significant differences in serum chemistry parameters between treated and control animals of either sex at main study termination; haematological parameters between treated and control animals of either sex were similar at termination of the study

Histopathology: minimal to moderate thickening of the skin of treated and control animals; changes were considered to be due to the vehicle

Test method:	similar to OECD guidelines (6)
Result:	the notified chemical elicited no signs of systemic toxicity; transient dermal irritation was observed in several treated females

9.3 Genotoxicity

9.3.1 *Salmonella typhimurium* Reverse Mutation Assay (8)

Strains:	TA 98, TA 100, TA 1535, TA 1537, TA 1538
Concentration range:	50, 100, 500, 1 000 and 5 000 μg per plate
Test method:	similar to OECD guidelines (6)
Result:	the notified polymer was not mutagenic to bacterial cells with or without S9 metabolic activation

9.3.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (9)

Species/strain:	mouse/CD-1
Number and sex of animals:	5/sex (3 test groups, 1 control group, 1 positive group)
Doses:	500 (low), 1 000 (mid) and 2 000 $mg.kg^{-1}$ (high dose)
Method of administration:	oral gavage
Test method:	similar to OECD guidelines (6)
Result:	the notified chemical did not produce an increase in micronuclei formation and did not induce cytotoxicity in the bone marrrow of mice at any dose level evaluated

9.3.3 In Vitro Chromosomal Aberration Assay in Chinese Hamster Ovary (CHO) Cells (10)

Cell Type:	Chinese Hamster Ovary (CHO)
Doses:	31.25 - 1 250 $\mu g.mL^{-1}$ with and without S9 metabolic activation; the notified chemical was solubilised as a 25% mixture in tetrahydrofuran

Test method:	similar to OECD guidelines (6)
Result:	the notified chemical did not produce induce chromosomal aberrations in CHO cells

9.4 Overall Assessment of Toxicological Data

Given the high molecular weight of the notified polymer, it is unlikely to be absorbed across biological membranes. The notified chemical is of low acute oral toxicity in rats (LD_{50} > 2 000 $mg.kg^{-1}$) and low acute dermal toxicity in rabbits (LD_{50} > 2 000 $mg.kg^{-1}$). The most important finding in dermal toxicity studies is a slight and transient erythema which cleared in all animals by day 10. The notified chemical is at most slightly irritating to the skin of rabbits, but it is not a skin sensitiser in the guinea pig. No eye irritation studies were provided by the notifier, however the lack of skin irritation potential and the high molecular weight of the polymer suggests that ocular effects are not likely to occur on exposure.

The notified chemical is not genotoxic in the Ames test, a mouse micronuclei assay, or a chromosomal aberrations assay.

Based on the toxicological information provided by the notifier, the notified chemical would not be classifed as hazardous according to the National Occupational Health and Safety Commission (NOHSC) *Approved Criteria for the Classification of Hazardous Substances*.

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.

Test	Species	Results (Nominal)
Acute Toxicity [OECD 203]	*Oncorhynchus mykiss* (Rainbow trout)	LL_{50}(96h)>1 000 $mg.L^{-1}$
Acute Immobilisation [OECD 202]	*Daphnia magna*	EL_{50}(48h)>1 000 $mg.L^{-1}$
Growth Inhibition [OECD 201]	Algae *Scenedesmus subspicatus*	EL_{50}(72h) >1 000 $mg.L^{-1}$
Respiration Inhibition [OECD 209]	Aerobic Waste Water Bacteria	No inhibition

The tests on rainbow trout were performed using the water accommodation fraction (WAF) of the test material in a semi-static (renewal) system over a 96-hour period. Around 80% of the water was removed daily and replaced with fresh water containing the WAF of the test material produced at a loading equivalent to 1 000 $mg.L^{-1}$. No mortality of the fish occurred over the 96-hour. test period, and accordingly the lethal loading (50% mortality) is greater than 1 000 $mg.L^{-1}$.

The acute immobilisation tests on daphnia were also performed in a static test over a 48 hour test period with water accommodated fractions of the notified substance for nominal loadings of 62.5, 125, 250, 500 and 1 000 $mg.L^{-1}$. No immobilisation was observed, and the 50% Effect Loading was determined at greater than 1 000 $mg.L^{-1}$.

Inhibition of increase in algal biomass was also determined using a static test over a 72-hour test period with water accommodated fractions of the notified substance with nominal loadings of 62.5, 125, 250, 500 and 1 000 $mg.L^{-1}$. The NOEL (72h) based on average specific growth rate was 125 $mg.L^{-1}$, while the EL_{50} was greater than 1000 $mg.L^{-1}$.

Tests on the effect of the new material on the respiration of activated sludge bacteria were also conducted using nominal loadings of 250, 500 and 1 000 $mg.L^{-1}$. No reduction in the rate of oxygen uptake was observed, and it was concluded that the material does not inhibit bacterial respiration.

The ecotoxicity data for the notified chemical indicate that it is non toxic to the aquatic species tested up to the limit of its solubility.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The environmental hazard from the notified chemical is considered to be small provided that the material is used as indicated, and that disposal of old oil takes place via suitable routes as previously indicated.

It is expected that most replaced oil would be either recycled or incinerated. If recycled the notified material would become associated with waste sludges from the recycling plant and then most likely be placed into landfill. Incineration would destroy the material with evolution of carbon and nitrogen oxides.

Some oil and sludges containing the material may be placed into landfill, but would be immobile and tend to become associated with soils and sediments. In this situation the material would degrade slowly through the agency of micro-biological and abiotic processes.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

According to the NOHSC approved criteria for the classification of hazardous substances, the notified polymer would not be classified as hazardous. Given the automated nature of the blending processes and the physico-chemical parameters (ie high viscosity and low vapour pressure) of the notified polymer, it is considered unlikely that exposure would be high. The notified polymer is of low oral toxicity and is not a skin irritant or sensitiser. This combined with the low concentration of the notified polymer in the imported (less than 6 %(w/w)) and products finished (less than 2% (w/w)), indicates that the occupational health and safety risks posed to workers involved in the re-formulation process would be low. The possibility of incidental contact with the new chemical would be further reduced if the workplaces adopt good industrial hygiene practices, including the use of adequate protective

equipment such as gloves, safety goggles and overalls.

As a consequence of the occupational hygiene practices of automotive mechanics, the risk of exposure of this group of workers to the notified polymer is likely to be high. However given the toxicological properties of the notified polymer, exposure is unlikely to have adverse effects on these workers. The possibility of unecessary contact with the notified polymer would be reduced in workplaces adopting good industrial hygiene practice.

13. RECOMMENDATIONS

To minimise occupational exposure to the notified polymer the following guidelines and precautions should be observed:

- Industrial clothing should conform to the specifications detailed in AS 2919 (11);
- Impermeable gloves or mittens should conform to AS 2161 (12);
- All occupational footwear should conform to AS/NZS 2210 (13);
- 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 practised to minimise the potential for ingestion;
- A copy of the Material Safety Data Sheet (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* (14).

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

1. Snow, R. *Used Oil Management*. In *The Used Oil Management Conference*. 1997. Brisbane: Queensland Department of Environment.

2. Frank, E. 1996, *Acute Oral Toxicity Study in the Rat (Synthetic Polymer NB# 19629-77)*, Project no., 156002, Exxon Biomedical Sciences inc, New Jersey.

3. Frank, E. 1996, *Acute Dermal Toxicity Study in the Rat (Synthetic Polymer NB# 19629-77)*, Project no., 156007, Exxon Biomedical Sciences inc, New Jersey.

4. Frank, E. 1996, *Primary Dermal Irritation Study in the Rabbit (Synthetic Polymer NB# 19629-77)*, Project no., 156004, Exxon Biomedical Sciences inc, New Jersey.

5. Frank, E. 1996, *Dermal Sensitisation Study in the Guinea pig (Synthetic Polymer NB# 19629-77)*, Project no., 156022, Exxon Biomedical Sciences inc, New Jersey.

6. Organisation for Economic Co-operation and Development 1995-1996, *OECD Guidelines for the Testing of Chemicals on CD-Rom*, OECD, Paris.

7. Frank, E. 1996, *28-Day Repeated-Dose Dermal Toxicity Study in the Rat with Satellite Recovery Group (Synthetic Polymer NB# 19629-77)*, Project no., 156010, Exxon Biomedical Sciences inc, New Jersey.

8. Przygoda, R. 1996, *Microbial Mutagenesis in Salmonella Mammalian Microsome Plate Incorporation Assay*, Project no., 156025, Exxon Biomedical Sciences Inc, New Jersey.

9. Przygoda, R. 1996, *In Vivo Mammalian Bone Marrow Micronucleus Assay – Oral Gavage*, Project no., 156030, Exxon Biomedical Sciences Inc, New Jersey.

10. Przygoda, R. 1996, *In Vitro Chromosomal Aberration Assay in Chinese Hamster Ovary (CHO) Cells,* Project no., 156032, Exxon Biomedical Sciences Inc, New Jersey.

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

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

13. 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.

14. National Occupational Health and Safety Commission 1994, National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011(1994)], Australian Government Publishing Service, 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