

File No: NA/433

Date: August 1996

**NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION  
AND ASSESSMENT SCHEME**

**FULL PUBLIC REPORT**

**Polymer in E5722**

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 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 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.

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****Polymer in E5722****1. APPLICANT**

Ethyl Asia Pacific Company Pty Ltd of 20 Berry Street Level 12 North Sydney NSW 2060 has submitted a limited notification statement for an assessment certificate for Polymer in E5722.

**2. IDENTITY OF THE CHEMICAL**

Polymer in E5722 is not considered 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, spectral data and details of the polymer composition have been exempted from publication in the Full Public Report and the Summary Report.

**Trade name:** E5722

**Number-average molecular weight:** > 1000

**Maximum percentage of low molecular weight species < 1000 and 500:** none

**Method of detection and determination:** no specific analytical methods are available for this polymer, an infrared (IR) spectrum for Polymer in E5722 (in oil) was provided

**Comments on Identity**

No CAS number has been assigned to this chemical. It is referenced on the US EPA TSCA confidential inventory via Accession Number 110544.

The number average molecular weight is an estimate based on the known molecular weight of a monomer used to manufacture the modified polymer.

The product does not contain any known toxic or hazardous impurities. The only known impurities are residual amounts of the reactive monomers and polymer used to manufacture the intermediates and final dispersant.

The notifier states the polymer should not have any low molecular weight polymeric species below 1,000 molecular weight present.

### 3. PHYSICAL AND CHEMICAL PROPERTIES

The notified polymer is synthesised overseas in the presence of diluent oil and is not isolated during the manufacturing process. Consequently, all analytical data are for E5722, the polymer in diluent oil.

<b>Appearance at 20°C and 101.3 kPa:</b>	viscous red liquid with a slight petroleum oil odour
<b>Boiling point:</b>	not provided
<b>Specific gravity:</b>	0.91 g/cm <sup>3</sup>
<b>Vapour pressure:</b>	< 0.1 mm Hg (0.013 kPa at 25°C)
<b>Water solubility:</b>	< 0.1 weight % in water
<b>Partition co-efficient (n-octanol/water):</b>	not provided but expected to partition to the hydrophobic compartment due to base oil
<b>Hydrolysis as a function of pH:</b>	not provided
<b>Adsorption/desorption:</b>	not provided
<b>Dissociation constant:</b>	not provided
<b>Flash point:</b>	214°C (Cleveland Open Cup )
<b>Flammability limits:</b>	not available
<b>Autoignition temperature:</b>	not provided
<b>Explosive properties:</b>	does not exhibit explosive properties when exposed to heat, friction or flame
<b>Reactivity/stability:</b>	the polymer will react with strong oxidisers, but is stable under normal use conditions

## Comments on Physico-Chemical Properties

It should be noted, the company states there are no intermediate streams which contain the final polymer in a concentrated form. Consequently the notifier is not able to provide analytical or toxicity data on the pure polymer.

The following comments on physico-chemical properties has been provided by the company:

Water solubility has not been determined but will be very low based on the molecular weight and structure of the polymer and diluent oil. The maximum water solubility for the product is estimated to be less than 0.1% in water.

Hydrolysis has not been determined. The polymer should not readily hydrolyse under environmental conditions.

Partition coefficient is only provided for pure, water soluble chemicals. Oily substances such as E5722 would be expected to partition into the hydrophobic compartment.

Adsorption/desorption has not been determined, but should be similar to other oily substances.

Dissociation constant has not been determined. This polymer should have a very low dissociation constant based on the chemical functionality. Also, dissociation would be hard to measure in view of the low water solubility.

On combustion the formulation E5722 produces carbon monoxide, carbon dioxide aldehydes and ketones.

## 4. PURITY OF THE CHEMICAL

**Degree of purity:** high

**Toxic or hazardous impurities:** refer to residual monomers

**Maximum content of residual monomers:** < 15%

**Non-hazardous impurities (> 1% by weight):** refer to residual monomers

**Additives/adjuvants:**

**Chemical name:** mineral oil, petroleum distillates, solvent-dewaxed heavy paraffinic

**Synonyms:** distillates (petroleum), solvent-dewaxed heavy paraffinic (9CI) distillate; SNO-100 oil

<b>CAS No.:</b>	64742-65-0
<b>Weight percentage:</b>	approximately 50, range 40 - 75%
<b>Toxic properties:</b>	mineral oils (untreated and mildly treated oils) are listed as a carcinogen group 1 by IARC (3); i.e sufficient evidence of carcinogenic potential in humans; however, unspecific nature of IARC category indicates that applicability to this chemical is open to review; a specific exposure standard is not listed by NOHSC (4) but for refined mineral oil mist (CAS # 8012-95-1) there is an exposure standard of 5 mg/m <sup>3</sup> .

All the hazardous impurities are at levels below which a hazardous classification is required according to Worksafe Australia's *List of Designated hazardous Substances* (5).

## **5. USE, VOLUME AND FORMULATION**

The notified polymer is to be used as a lubricant additive in gasoline motor vehicles and light duty diesel engines. It is a dispersant, which solubilises sludge and inhibits the formation of sludge precursors. It is estimated that the formulated breakdown distribution will be 98% use for gasoline engines and 2% diesel engines. The notified polymer will be imported into Australia as a blend in a diluent base lubricant oil containing approximately 50% weight of the polymer and as a component in lubricating oil additive packages containing 25-60 wt% of the polymer. The lube oil additive packages may be supplied to approximately 25 locations at most for storage and warehousing prior to distribution and for blending motor oils which will then be widely distributed to the general public. Distribution of the additive packages containing the polymer will be by road and rail.

The product will be imported for sale to lubricant oil formulators for the manufacture and blending of automotive lubricants.

The estimated quantity of the notified polymer to be imported to Australia is 50-1000 tonnes in the first year and 50-1500 tonnes per annum over the next four years.

The final lubricant product will contain < 5% of the notified polymer. The lubricant additive formulations are presently being marketed in the US, Japan, major European countries, South Africa and Central and South America.

## **6. OCCUPATIONAL EXPOSURE**

During the first year, 60% of the product containing the notified polymer will be imported in 205 litre metal drums and 40% in liquid tank containers consisting of approximately 20 metric tons parcels. In the next four years, depending on the demand of the product, the bulk product may be transported in chemical parcel tanks in approximately 150 to 400 metric ton lots.

The metal drums, bulk tank containers or chemical parcel tanks will be shipped to approximately 25 separate locations in Australia for storage and reformulation into the final motor oil product. The number of workers involved in the storage/reformulation of the polymer, at each site, is likely to be in the order of 2-5 people. Handling of the product containing the notified polymer will be for no more than 4 hours a day. The blended lubricating oil containing the notified polymer will then be sold to automotive outlets or the general public.

The major route of exposure to the notified polymer will be dermal. Significant risk of exposure during transport and storage is considered unlikely, except in the event of an accidental spillage or leakage as the polymer will be in secure containers.

Workers may come into direct contact with the notified polymer during the reformulation process, and dermal contact may be high if personal protective equipment is not used. Mechanics may also come into direct contact with the polymer through the handling of lubricating oils containing < 5% of the notified polymer.

## **7. PUBLIC EXPOSURE**

E5722 will be distributed to three locations for storage prior to distribution by road or rail to manufacturers of motor oil. Public exposure to the notified polymer during distribution is not expected to occur. In the event of accidental release, the Material Safety Data Sheet (MSDS) specifies that spills should be contained and wiped up or absorbed onto suitable material prior to collection. Entry into sewers or waterways is to be prevented.

Limited information has been provided on the batch blending processes involved in the manufacture of motor oil, however, it is indicated that “contained liquid handling systems’ will be used which should limit the amount of waste notified polymer (estimated to be approximately 3kg from a 20 tonne batch). The notified polymer is expected to be of low volatility and no public exposure is expected during blending processes.

Disposal of any waste notified polymer is expected to be by incineration and no public exposure is expected to occur. Combustion of the notified polymer during its use as an additive to engine oil or in fuel oil blends (which has been estimated to account for 96% of collected used oils in Australia) will destroy the polymer and no public exposure is anticipated.

Public exposure to the notified polymer may result from the addition and replacement of motor oil.

## **8. ENVIRONMENTAL EXPOSURE**

### **Release**

The imported drums and parcels of the notified polymer in the additive packages are stored at warehouses and storage locations operated by transport companies and chemical storage companies largely in the major capital city environs.

Waste streams containing the notified polymer are confined to slops, washings and spills and contained within bunded areas for adequate treatment or disposal to prevent entry into sewers and waterways.

The notifier stated the spilled material is washed into a separator, a fully enclosed system comprising a series of baffle units and a skimmer to separate oil or immiscible material from the carrier water stream, followed by a unit consisting of adsorbent polypropylene (oleophilic) mats to remove the oil sheen. The water stream is further treated to ensure pH, BOD, sulphides etc comply with the parameters contained within the governmental regulatory discharge license before discharge to the outfall.

The residues from the skimmer unit pass to tanks for settling and dewatering. The oil based layer is incinerated typically as bunker fuel oil. Sludge residues are mixed with activated clay and taken by licensed industrial waste groups for ultimate disposal by land fill or incineration. Oil or product spills containing the notified polymer may also be treated with solid adsorbent and disposed of in the same manner by the licensed industrial waste groups.

In the lube oil blending process it is estimated that typically a 0.2% product loss may be experienced or 40 kg blended oil in a 20 t blend batch containing 3-7 wt% of the notified polymer. For example, 3 kg of polymer may be released as slops or washings during transfers to storage tanks and filling lines, unloading additive from drums or bulk road tankers and sampling for testing purposes. These liquid releases are contained and controlled in appropriate compounds or pits for treatment or disposal. Over one year the amount of polymer released would be ~3 t (worst case situation - assuming importation of 1500 tonnes of the notified polymer per year).

The polymer may also be released to the environment through exhaust emissions, leakage and disposal of used oil.

The notifier has stated that during engine use the chemical is oxidised to combustion products. The amount lost, which is not burned, is probably not measurable, and to the notifier's knowledge has never been determined. The notifier expects this quantity to be no different than with other engine lubricants.

It should be noted that oil emissions with the exhaust are very low (6) and the level of unoxidised polymer is likely to be higher from oil leakage from crankcase lubricated engines and the disposal of used oil.

Oil leaks have a tendency to accumulate in the environment, resulting in a significant environmental load (6). One-third of the lubricating oil sold is lost during use; some is lost on the pavement surface, in the streets, roads and in car parks. The oil

remains on these surfaces until stormwater or the municipal services wash the oil off, when it is transported by stormwater drains to waterways or the ocean of urban zones, or to adjacent soils from roads in non-urban areas (7).

The notifier has stated that losses of the polymer during motor oil changes would not be expected to be any different than losses experienced with other motor oils. Used lubricant handling guidelines stress minimising personal contact and disposal in an environmentally acceptable manner. However, it should be noted a report on used lubricating oil in Australia (8) indicates that lubricating oil not collected for recycling or reuse on site as a fuel or lubricant amounts to 22% of total sales. The methods of disposal of used oil includes dust and vegetation control, and dumping in sewers and landfill.

### **Fate**

The notifier has stated that waste polymer from the blending process is prevented from entry into sewers and waterways.

The notified polymer will enter the environment when waste polymer from the blending process is disposed of by land fill or incineration. When the polymer is land filled it is likely to remain at the site of deposition. Leaching of the polymer is unlikely due to its large molecular weight, expected low water solubility and likely adsorption to soil. Incineration of the polymer is unlikely to produce toxic compounds.

The amount of polymer released to the environment through the exhaust emissions is likely to be low as the chemical is oxidised during combustion and any emissions can be expected to become associated with the soil compartment (including sediment).

Any unoxidised polymer which enters the environment from engine oil leakage and is lost on the pavement surface, in the streets, roads and in car parks is washed off (by rain or the municipal services) and is transported by storm water drains in the case of urban zones to waterbodies and become associated with the sediment. When the polymer is washed off roads to adjacent soils, it is likely to accumulate at the site of deposition unless erosion events transport it to water bodies where it is likely to become associated with the sediment.

The amount of unoxidised polymer in used oil is unclear. However, the potential exists for a significant portion of oil containing the polymer to be disposed of in an environmentally unacceptable manner (eg dust and vegetation control, and dumping in sewers and landfill). Any unoxidised polymer in used oil that is used for dust and vegetation control are likely to remain at the site of application until erosion events transport the polymer to waterbodies, where the polymer is likely to become associated with the sediment. The polymer is unlikely to leach when it is dumped at landfills. The dumping of the polymer in sewers is likely to result in the polymer becoming associated with sludge during treatment.

### Hydrolysis

The notifier has stated the polymer should not readily hydrolyse at ambient



temperature based on the structure of the polymer functionality. The polymer does contain a number of succinimide, amide and hydroxyl groups which may be susceptible to hydrolysis. However, it is unlikely that the polymer would be readily degraded by hydrolysis under environmental conditions because of limited solubility.

#### Biodegradation

No information has been provided by the company. The presence of succinimide, amide and hydroxyl linkages in the polymer indicate it would be vulnerable to cleavage *in vivo* with subsequent elimination. However, the polymer is unlikely to be readily biodegraded under environmental conditions.

#### Bioaccumulation

The high molecular weight of the polymer (~9,000) indicates it is unlikely to bioaccumulate.

## 9. EVALUATION OF TOXICOLOGICAL DATA

### 9.1 Acute Toxicity

The Act does not require the provision of toxicology data for polymers where the number-average molecular weight (NAMW) exceeds 1,000. However, the following tests have been conducted and were submitted as part of the notification statement.

#### **Summary of the acute toxicity of Copolymer E5722 (in oil)**

<b>Test</b>	<b>Species</b>	<b>Outcome</b>	<b>Reference</b>
skin irritation	rabbit	slight irritant	9
eye irritation	rabbit	not an irritant	13

#### 9.1.1 Skin Irritation (9)

*Species/strain:* New Zealand white rabbits

*Number/sex:* 3/3

*Observation period:* 5 days

*Method of administration:* 0.5 ml of Polymer E5722 in oil

*Draize scores (10):*

<b>Time after treatment (days)</b>	<b>Animal #</b>					
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Erythema</b>						

1	<sup>a</sup> 2	2	2	2	2	2
3	1	1	1	2	2	2
<b>Oedema</b>						
1	1	1	1	1	1	1
3	1	0	0	1	1	1

<sup>a</sup> see Attachment 1 for Draize scales

*Test method:* similar to OECD Guidelines for Testing Chemicals (11)

*Result:* slight irritant, however not classified as hazardous according to Worksafe Australia *Approved Criteria for Classifying hazardous Substances* (12)

### 9.1.2 Eye Irritation (13)

*Species/strain:* New Zealand white rabbit

*Number/sex of animals:* 3/3

*Observation period:* 3 days

*Method of administration:* 0.1 ml in conjunctival sac of one eye of each animal

*Draize scores (10) of unirrigated eyes:*

	Time after instillation								
Animal	1 day		2 days		3 days				
Cornea	o <sup>a</sup>	a <sup>b</sup>	o <sup>a</sup>	a <sup>b</sup>	o <sup>a</sup>	a <sup>b</sup>			
1	10	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 <sup>c</sup>	c <sup>d</sup>	d <sup>e</sup>	r <sup>c</sup>	c <sup>d</sup>	d <sup>e</sup>	r <sup>c</sup>	c <sup>d</sup>	d <sup>e</sup>
1	1	0	0	1	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0
3	1	0	0	1	0	0	0	0	
4	1	0	1	1	0	0	0	0	0
5	1	0	1	1	0	1	0	0	0
6	1	0	0	0	0	0	0	0	0

<sup>1</sup> see Attachment 1 for Draize scales

<sup>a</sup> opacity <sup>b</sup> area <sup>c</sup> redness <sup>d</sup> chemosis <sup>e</sup> discharge

*Test method:* similar to OECD Guidelines for Testing Chemicals (11)

*Result:* not an irritant

## 9.2 Overall Assessment of Toxicological Data

The toxicity data presented for E5722 indicate that the substance is a slight skin and irritant but not an eye irritant in rabbits. However, this effect is likely to be due to the diluent oil present in E5722, which is a known irritant, rather than to the notified polymer.

## **10. ASSESSMENT OF ENVIRONMENTAL EFFECTS**

Since the chemical being notified is a polymer of greater than 1000 molecular weight, environmental effects information is not required.

## **11. ASSESSMENT OF ENVIRONMENTAL HAZARD**

Although up to ~3 t (worst-case situation) of polymer per annum may be lost from the blending process, the hazard presented to the environment is likely to be low, due to the release being spread over a number of sites across Australia, and the notifier states that waste is prevented from entering sewers and waterways. The disposal of the waste polymer from the blending process by land fill or incineration is unlikely to present a hazard to the environment.

Emissions during engine use are unlikely to present a hazard to the environment as the amount of intact polymer being lost is likely to be very low due to the oxidation of the polymer during combustion.

The hazard to the environment from the leaking of oil from engines and the disposal of used oil containing the polymer in an environmentally unacceptable manner (eg dust and vegetation control, and dumping in sewers and landfills) is likely to be low because:

The release will be dispersed across Australia (predominantly in the urban regions) and the environmental concentration of the polymer should be very low (below 1 ppb);

The bulk of this release is likely to become associated with soil/sediment;

The toxicity of such modified polymers is low because of low bioavailability; and

Where the polymer is contained in urban and rural runoff and enters aquatic environments, the expected very low concentration of the polymer and its high molecular weight (~9,000) indicates it is unlikely to present a hazard to organisms inhabiting these environments.

## **12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS**

No toxicity data were provided for the notified polymer. However, its NAMW is > 1000 and it is therefore unlikely to cross biological membranes such as the skin and gastrointestinal tract. The notified polymer does not contain any low molecular weight (<1000) species, and apart from one monomer. The levels of residual monomers are low (<0.1%) and not considered to represent toxicological hazards. While this monomer may be present at up to 10%, its high molecular weight (2060) suggests that if exposure did occur, absorption is unlikely.

As the polymer will be present in diluent oil which is more hazardous than the

polymer, the methods proposed by the notifier to reduce exposure to the diluent oil will also be sufficient to reduce exposure to the polymer. It is not possible to classify the additive/adjuvant mineral oil and hence the imported formulation E 5723 on the basis of literature data. On the basis of actual toxicological tests as described above it would not be classified as hazardous according to the criteria of Worksafe Australia (12). The following information is however of relevance.

Mineral oils (untreated and mildly treated oils) are listed as a carcinogen group 1 by IARC (3); i.e there is sufficient evidence of carcinogenic potential in humans. However, the unspecific nature of the IARC category indicates that the applicability to the mineral oil in the formulation E5723 is open to review; a specific exposure standard is not listed by NOHSC (4) but for refined mineral oil mist (CAS # 8012-95-1) there is an exposure standard of 5 mg/m<sup>3</sup>.

Polymer in E5722 is stable in ambient conditions, has negligible vapour pressure, low water solubility and is not explosive, and therefore should not present a significant hazard to workers.

The major route of exposure to the notified polymer will be dermal. Exposure during transport and storage is considered unlikely except in the event of spillage or leaks, as the polymer will be contained in secure containers. Workers may come into direct contact with the notified chemical during the reformulation process and dermal contact may be high if personal protection is not implemented. Mechanics may also come into direct contact with the polymer through handling of motor oils. However, the concentration of the notified polymer in the motor oils is low at < 5% w/w.

There is negligible potential for public exposure to Polymer in E5722 during transport or formulation operations. Some public exposure to the notified polymer may occur by dermal contact during the addition and replacement of engine oil.

Based on the above information, it is considered that Polymer in E5722 will not pose a significant risk to public or occupational health when used in the prescribed manner.

### **13. RECOMMENDATIONS**

To minimise occupational exposure to Polymer in E5722 the following guidelines and precautions should be observed; it should be noted that these recommendations take into account the form in which the notified polymer is imported (E5722, the notified polymer in diluent oil), and the fact that the polymer is never isolated:

- If engineering controls and work practices are insufficient to significantly reduce exposure to a safe level, then personal protective devices which conform to and are used in accordance with Australian Standards (AS) for chemical-type goggles with face shield (AS 1336; AS 1337) (14, 15), impermeable gloves (AS 2161) (16) and protective clothing (AS 3765.1 AS 3765.2) (17, 18) should be worn.
- Good work practices should be implemented to avoid splashing or spillages.

- Good personal hygiene should be adopted.
- A copy of the MSDS for products containing the notified polymer in diluent oil, should be easily accessible to employees working with products containing the chemical.

#### **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* (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**

1. Canadian Centre for Occupational Health and Safety, 1991, Chem Info Data Base.
2. Register of Toxic Effects of Chemical Substances (RTEC), 1992, U.S. Department of Health and Human Services (NIOSH), August 1992.
3. IARC, 1987 *IARC Monograph on the Evaluation of Carcinogenic Risks to Humans*, Supplement 7. World Health Organisation, France
4. 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 Publ., Canberra.
5. National Occupational Health and Safety Commission 1994, *List of Designated Hazardous Substances* [NOHSC:10005(1994)], Australian Government Publishing Service Publ., Canberra.
6. Van Donkelaar P, 1990, "Environmental Effects of Crankcase- and Mixed Lubrication", *The Science of the Total Environment*, 92, p165-179.

7. Vazquez-Duhalt R, 1989, "Environmental Impact of Used Motor Oil", *The Science of the Total Environment*, 79, p1-23
8. Australian and New Zealand Environment Council, 1991, "Used Lubricating Oil: Generation, Recovery and Reuse in Australia", p11.
9. *Primary Dermal Irritation Study in Rabbits*, 1988, Study number PH-420TX-006-88, compound 87-3474, Pharmakon Research International Inc., Pennsylvania, USA, July 1988.
10. Draize J H, *The Appraisal of Chemicals in Foods, Drugs and Cosmetics*, pp. 36-45. Association of Food and Drug Officials of the United States, Austin, Texas 1959.
11. Organisation for Economic Co-operation and Development, *OECD Guidelines for Testing of Chemicals*, OECD, Paris, France.
12. National Occupational Health and Safety Commission 1994, *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(1994)], Australian Government Publishing Service, Canberra.
13. *Primary Eye Irritation*. 1989, Study number PH-421-TX-002-89 compound 87-3474, Pharmakon Research International Inc., Pennsylvania, USA, February 1989.
14. Standards Australia 1994, *Australian Standard 1336-1994, Eye protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney.
15. Standards Australia/Standards New Zealand 1992, *Australian/New Zealand Standard 1337-1992, Eye Protectors for Industrial Applications*, Standards Association of Australia Publ., Sydney, Standards Association of New Zealand Publ, Wellington.
16. Australian Standard 2161-1978, *Industrial Safety Gloves and Mittens (excluding Electrical and Medical Gloves)*, Standard Association of Australia Publ., Sydney, 1978.
17. Australian Standard 3765.1-1990, *Clothing for Protection against Hazardous Chemicals*, Standard Association of Australia Publ., Sydney 1990.
18. Australian Standard 3765.2-1990, *Clothing for Protection against Hazardous Chemicals Part 2 Limited Protection Against Specific Chemicals*, Standard Association of Australia Publ., Sydney 1990.
19. 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:

<b>Erythema Formation</b>	<b>Rating</b>	<b>Oedema Formation</b>	<b>Rating</b>
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**

<b>Opacity</b>	<b>Rating</b>	<b>Area of Cornea involved</b>	<b>Rating</b>
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**

<b>Redness</b>	<b>Rating</b>	<b>Chemosis</b>	<b>Rating</b>	<b>Discharge</b>	<b>Rating</b>
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**

<b>Values</b>	<b>Rating</b>
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