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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

DRIMARENE YELLOW K4G CDG

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

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

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

DRIMARENE YELLOW K4G CDG

1. APPLICANT(S)

Sandoz Australia Pty Ltd of 675 Warrigal Road, Chadstone, Victoria 3148 has submitted a limited notification for assessment of Drimarene Yellow K4G CDG.

2. IDENTITY OF THE CHEMICAL

Drimarene Yellow K4G CDG has been classified as hazardous by Worksafe Australia due to its skin sensitisation properties. However, for commercial reasons, the chemical identity, methods of detection and determination, and spectral data have been granted exemption from publication in the Full Public Report and Summary Report. The conditions of this being permitted are:

- A descriptive generic name be used to identify the substance in public reports and the MSDS,
- The relevant employee unions shall be informed of the conditions of use of Drimarene Yellow K4G CDG,
- The full chemical name shall be provided to any health professionals in the case of a legitimate need where exposure to the chemical may involve a health risk,
- The full chemical name shall be provided to those on site who are using the chemical and to those who are involved in planning for safe use, etc. in the case of a legitimate need,
- The Director of NICNAS will release the full chemical name etc in the case of a request from a medical practitioner,
- Confidentiality will expire after a 3 year period,
- The chemical be identified as a sensitiser in the Health Effects Section of the MSDS, and that reference to its assessment by NICNAS be made on the MSDS,
- These conditions shall be published in the Chemical Gazette.

Other name(s):	Drimarene Yellow K4G CDG
Molecular weight:	757

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	yellow granules
Melting Point:	> 250°C
Density:	1680 kg/m^3
Vapour Pressure:	not provided, expected to be negligible based on the ionic nature, high melting point and high molecular weight
Water Solubility:	80-130 g/L at 20°C
Surface Tension (of aqueous solution):	71.0 mN/m at 20°C
Fat Solubility:	$\leq 5 \times 10^{-2}$ mg/100 g of standard fat at 37°C
Partition Co-efficient (n-octanol/water) log P_{OW}:	- 3.8 at 20°C
Hydrolysis as a function of pH:	half-life estimated >1 year at pH 4, and 7 at 25°C half-life = 108 hours at pH 9 at 25°C
Adsorption/Desorption:	not determined, expected to have low affinity for soil
Dissociation Constant pKa**:**	not determined
Flash Point:	not applicable
Flammability Limits:	not flammable
Autoignition Temperature:	> 360°C
Explosive Properties:	not explosive
Decomposition Temperature:	230°C
Reactivity/Stability:	based on the structure, in the absence of reactive groups which could support oxidation, the notified chemical is not likely to react exothermically with flammable material

· **Comments of physico-chemical properties**

The notified chemical's low partition coefficient and high water solubility indicates it is unlikely to partition to soil or organic matter.

The hydrolysis study was conducted according to EEC Directive C.10. The results indicate the notified chemical is stable under acidic to neutral conditions, but is readily hydrolysed under alkaline conditions.

The dye is a sulphonic acid salt and contains basic nitrogens, therefore, dissociation under environmental conditions is likely.

4. PURITY OF THE CHEMICAL

Degree of purity: 64% (range 59-69%)

Toxic impurities:

. **Chemical name:** Lithium chloride
CAS number: 7447-41-8
Weight percentage: 1.0%
Toxic properties: oral LD_{50} rat= 526 mg/kg; an experimental neoplastigen and teratogen; mutagenic to humans; an eye and severe skin irritant (1)

Chemical name: Sodium 2-(5-chloro-2, 6-difluoropyrimidin-4-ylamino)-4-[4-{5-chloro-2,6-difluorpyrimidin-4ylamino}benzamido] benzene sulfonate
CAS number: Not available
Weight percentage: 4.0%
Toxic properties: expected to be similar to the notified chemical

. **Chemical name:** Sodium 2-(5-chloro-x-fluoro-y-hydroxypyrimidin-4-ylamino)-4-[4-{5-chloro-w-fluoro-z-hydroxypyrimidin-4-ylamino} benzamido] benzene-1-sulfonate
CAS number: Not available
Weight percentage: 1.0%
Toxic properties: expected to be similar to the notfied chemical

Non-toxic impurities (> 1% by weight): sodium chloride (12%), water (6%) and hydrolysed dyestuff (1%)

Impurities of unknown toxicity: five (5%)

Additives/Adjuvants: none

5. INDUSTRIAL USE, FORMULATION AND IMPORT VOLUME

Approximately 10 dyehouses in metropolitan and country areas will be using the notified chemical as a dye to stain cotton in the textile industry. The quantity of Drimarene Yellow K4G CDG imported into Australia per annum over the next five years will be < 1000 kg - this relates to < 700 kg of the notified chemical. No reformulation of the chemical will take place in Australia.

6. OCCUPATIONAL EXPOSURE

The notified chemical is imported in plastic bags (25 kg nett weight) sealed inside steel drums or cardboard boxes.

Normally customers will be expected to order 25 kg drums or boxes of the dye. However, if a customer orders a quantity smaller than 25 kg, 1 storeman at the notifier's site will weigh the required amount into a rigid plastic container. This is done under local exhaust ventilation.

The dye is manufactured in a non-dusting form, that is, fine granules. According to the notifier, the dye kitchens in the dyehouses will, most likely, not be equipped with local exhaust ventilation.

It is estimated that 10 dyehouses will use the notified chemical. At each dyehouse 1 storeman and 1 operator will be exposed to the dye. Exposure is expected to be limited to 1 hour per day.

The dye is weighed out, dissolved in water and added to the dye bath. The dye is instantaneously soluble in cold water which reduces the time for preparation of padliquors and consequently, the potential for exposure. Following dissolution in a premix tank, the dye solution is added to the dyebath by pump or gravity feed. The dye bath is usually, but not always enclosed.

7. PUBLIC EXPOSURE

Very small quantities of the dye may be released during handling, wear or laundering of the fabric. Therefore, public exposure may result from dermal contact with the dye contained in the fabric. Eye contact may result during fabric laundering. However, the notifier states that the dye will be chemically bound to the fabric, and its "reactivity" will be lost after the dyeing process.

Minor public exposure may result from accidental spillage during transport and storage of the fabric dye.

8. ENVIRONMENTAL EXPOSURE

. Release

The dye will be released to the environment in waste water from the dye works. The fixation rate of the product (contains 64% of the notified chemical) is 74%. As 2 kg of the product is used per 100 kg fabric, 0.33 kg of the notified chemical will be lost to wastewater from the bath (volume of 10500 L). Therefore, the concentration of the notified chemical in waste water from the bath will be 32 ppm.

Further dilution will occur in the waste water treatment plant of the dyehouse with an expected dilution factor of 1 in 10. Therefore, dye lost to the sewerage system is estimated to be 3 ppm.

. Fate

The main exposure to the environment will come from the discharge of spent dye from the dyehouse into the sewers. The dye is expected to remain in solution due to its high water solubility and low partition coefficient. Adsorption to sludge at sewage treatment works is unlikely as reactive dyes in general have been found not to adsorb to sludge in model systems (1).

The chemical is an azo dye and aerobic degradation is not expected as oxygen is often an inhibitor of azo reduction. Biodegradation of these dyes by aerobic sludge is reported to be insignificant as greater than 50% of the dye remained unchanged or was only slightly modified. Reduction of azo dyes occurs primarily under anaerobic conditions through cleavage of the azo linkage (2). While azo dyes are generally stable under aerobic conditions, they are susceptible to reductive degradation under the anaerobic conditions characteristic of sediment (3). A possible pathway of azo dye degradation is azo-reductase under anaerobic conditions followed by mineralisation under aerobic conditions, with the resultant end products being NH_3, CO_2 and H_2O (2). However, as the notified chemical is likely to remain in solution and not adsorb to sediment or sludge, the above anaerobic pathway is unlikely to occur.

Biodegradation studies provided indicate the lack of degradation of the dye under aerobic conditions. The dye was tested for its ready biodegradability in the closed bottle test (OECD TG 301D) at nominal concentrations of 2 and 5 mg\L. After 28 days incubation no biodegradation was observed at either concentrations. Therefore, the dye was not readily biodegradable under the test conditions performed.

The dye was also tested for its inherent biodegradability in the 28 days Modified Zahn-Wellens test (OECD TG 302B) at a concentration of ~303 mg\L. The substance was unchanged during the test period. Therefore, the dye was not inherently biodegradable under the test conditions.

Although the dye is not readily or inherently biodegradable, bioaccumulation or adsorption to sediment are not expected due to its low partition coefficient (log P_{ow} = -3.8) and high water solubility (80 - 130 g\L).

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Acute Toxicity

Under the *Industrial Chemicals (Notification and Assessment) Act, 1989*, toxicity data are not required for new chemicals intended to be manufactured or imported at a rate of less than 1 tonne per year. However, the studies evaluated below were available and were submitted as part of the notification statement.

Table 1 Summary of the acute toxicity of Drimarene Yellow K4G CDG

Test	Species	Outcome	Reference
Acute oral toxicity	Rat	LD_{50} > 5000 mg/kg	(4)
Acute dermal toxicity	Rat	LD_{50} > 2000 mg/kg	(6)
Skin Irritation	Rabbit	non-irritant	(7)
Eye irritation	Rabbit	slight irritant	(8)
Skin sensitisation	Guinea-pig	strong sensitiser	(10)

9.1.1 Oral Toxicity (4)

LD_{50}: > 5000 mg/kg *Species/strain*: Wistar-derived albino rats (Alp K:APF SD)

Number and sex of animals: 5/sex

Method of administration (vehicle): gavage (de-ionised water)

Clinical observations: no significant signs of toxicity

Mortality: no deaths *Morphological findings:* no macroscopic abnormalities detected at necropsy

Test Method: directive 84/449/EEC (5) Test B1

9.1.2 Dermal Toxicity (6)

LD_{50}: > 2000 mg/kg *Species/strain:* Wistar-derived albino rats (Alp K:APF SD)

Number and sex of animals: 5/sex

Method of administration (vehicle): as a paste with de-ionised water

Clinical observations: no significant signs of toxicity; slight skin irritation overall

Mortality: no deaths *Morphological findings:* no macroscopic abnormalities detected at necropsy

Test Method: directive 84/449/EEC (5) Test B3

9.1.3 Skin Irritation (7)

Result: non-irritant to rabbit skin

Species/strain: Male New Zealand White rabbits *Number of animals:* 3

Method of administration: sample moistened with de-ionised water applied under occlusive gauze dressing for four hours.

Test Method: directive 84/449/EEC (5) Test B4

Draize (8) Scores[i]:

Animal	Time after decontamination				
	30-60 min	1 day	2 days	3 days	7 days
ERYTHEMA					
1	1	0	0	0	0
2	1	0	0	0	0
3	1	0	0	0	0
OEDEMA					
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0

9.1.4 Eye Irritation (9)

Result: slightly irritant to the rabbit eye

Species/strain: Male New Zealand White rabbits *Number of animals:* 3

Method of administration: test substance (88 mg) instilled in conjunctival sac of one eye

Test Method: directive 84/449/EEC (5) Test B5

Draize (8) Scores[ii]

Animal	Time after instillation														
	1 Hour			1 day			2 days			3 days			7 days		
CORNEA:	opacity	area		opacity	area		opacity	area		opacity	area		opacity	area	
1	0	1*		0	2*		0	0		0	0		0	0	
2	0	1*		0	0		0	0		0	0		0	0	
3	0	1*		0	1*		0	1*		0	0		0	0	
IRIS															
1	1			0			0			0			0		
2	0			0			0			0			0		
3	0			0			0			0			0		
CONJUNCTIVA	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]
1	1	2	0	2	1	1	2	1	1	1	1	1	1	1	0
2	1	2	0	2	1	1	1	1	1	1	1	0	1	0	1
3	1	2	0	2	1	1	1	1	1	1	0	0	1	0	0

*stained area
[a] redness [b] chemosis [c] discharge

9.1.5 Skin Sensitisation (10)

Result: Strong sensitiser

Species/strain: Albino female guinea-pigs/ AlpK:Dunkin Hartley *Number of animals:* 20 in test group, 10 in control group

Induction: Injections of 5% (w/w) notified chemical in saline; FCA, 1:1 with distilled water; and 10% (w/w) notified chemical in saline with 1:1 FCA in distilled water. Topical induction at day 8: 25% (w/v) notified chemical in vaseline.

Results:

Challenge Concentration	24 hrs		48 hrs	
	test	control	test	control
0%	0/20	0/10	0/20	0/10
5%	14/20	0/10	8/20	0/10
10%	10/20	0/10	18/20	0/10
25%	15/20	3/10	16/20	3/10

Positive responses varied from scattered mild redness to intense reddening and swelling.

18 animals showed a positive reaction in response to the 10% concentration. This results indicate a sensitisation rate of 90%

Test Method: directive 84/449/EEC (5) Test B6

9.2 Repeated Dose Toxicity (11)

Species/strain: Rat/ AlpK: APfSD (Wistar derived) *Number/sex:* 5/sex

Method of administration (vehicle): orally by gavage (de-ionised water)

Dose/ Duration of administration: 0, 50, 200 or 1000 mg/kg/day for 28 days
plus 14 day recovery (at 0 and 1000 mg/kg/day)

Toxicologically Significant Observations:

1. Clinical

No clinical signs of toxicity observed in any of the animals.

2. Clinical Chemistry/Haematology

The following findings were observed in the blood profile of animals receiving 200 mg/kg/day and 1000 mg/kg/day: increase in triglyceride (females); decreased glucose (males); increased inorganic phosphate (males and females); and increased cholesterol (males).

3. Necropsy Findings/ Histopathology

All animals receiving 200 mg/kg/day and 1000 mg/kg/day exibited hyperkeratosis in the forestomach and increased eosinophilic infiltration in the submucosa of stomach and caecum.

All the above changes were reversible after the14 day recovery period.

*Test Method***:** directive 84/449/EEC (5) Test

9.3 Genotoxicity

9.3.1 Salmonella typhimurium Reverse Mutation Assay (12)

Result: No significant dose-related induction of mutations above background in the presence or absence of metabolic activation provided by rat liver S9.

*Strains***:** *Salmonella typhimurium* TA 1537, TA 1535, TA 98 and TA 100

Concentration range: 10 to 5000 μg/ plate

Metabolic activation: rat liver S9 *Solvent:* dimethylsulfoxide

Test Method: directive 84/449/EEC (5) Test B1

9.3.2 *In Vivo* micronucleus assay in bone marrow cells of the mouse. (13)

Result: non-clastogenic

Dose levels: 24 hour preparation interval: 200, 700 and 2000 mg/kg body weight
48 hour preperation interval: 2000 mg/kg body weight

Comments: No significant enhancement in the frequency of micronuclei in polychromatic cells were observed at any preparation interval after application or with any dose level used.

*Test Method***:** directive 84/449/EEC (5) Test B12

9.3.3 *In Vitro* Cytogenetic Assay in Chinese Hamster V79 cells (14)

Result: Clastogenic (with metabolic activation)

Dose levels: 18 h: 30, 100 and 150 μg/ml
28 h: 150 μg/ml (without metabolic activation)

18 h: 100, 500 and 1000 μg/ml
28 h: 1000 μg/ml (with metabolic activation)

Experiment repeated with identical doses except 28 h dose level at 500 μg/ml

Metabolic activation: rat liver S9

Comments: With metabolic activation a reduction in the mitotic index was observed in the 28 hour fixation intervals in both experiments.

*Test Method***:** directive 84/449/EEC (5) Test B10

9.4 Overall Assessment of Toxicological Data

Drimarene Yellow K4G CDG is of low toxicity via the oral (LD_{50} > 5000 mg/kg) and dermal (LD_{50} > 2000 mg/kg) routes in the rat. It is not a skin irritant but was a slight irritant to the eye of the rabbit. It is a strong sensitiser to the skin of the guinea-pig. When rats were treated orally with up to 1000 mg/kg/day for 28 days, no results of toxicological significance were observed. Drimarene Yellow K4G CDG was found to be non-mutagenic in *vitro* to *Salmonella typhimurium* strains TA 1537, TA 1535, TA 98 and TA 100. The notified chemical was clastogenic *in vitro* in Chinese Hamster V79 cells but non-clastogenic in the bone marrow cells *in vivo,* from the mouse.

On the basis of submitted data, the notified chemical will be classified as hazardous in accordance with Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1994)] only in relation to sensitising effects (skin).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

Ecotoxicity studies are not required for limited notifications according to the *Industrial Chemicals (Notification and Assessment) Act, 1989*. However, the following studies have been provided by the notifier.

Test	Species	Results
Acute toxicity	Zebra fish	96h LC_{50} > 1000 mg/L
Acute toxicity	*Daphnia magna*	48h EC_{50} > 1000 mg/L
Growth inhibition	Aerobic waste-water bacteria	3h EC_{50} > 100 mg/L
Growth inhibition	Algae *Scenedesmus subspicatus*	72h EC_{50} > 100 mg/L

The above studies were conducted according to OECD test guidelines and the results indicate the dye is practically non-toxic to the species tested.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The main environmental exposure of the notified chemical will come when spent dye from the dyehouse is discharged into the sewer at a concentration of approximately 3 ppm. Further dilution of the chemical would be achieved on entering the waste stream of the main sewer (5-500 ML/day) resulting in an expected concentration in the sub-ppb range. Therefore, based on the chemical's low ecotoxicity and exposure, it is expected to present negligible hazard to the environment.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

In common with a number of other reactive dyes, the notified chemical is likely to be a skin sensitiser in humans. It is a slight eye irritant. A discussion of the health effects of reactive dyes is provided in Information Notice of the Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry supplied by the notifier.

The notified chemical is imported as fine granules which are stated by the manufacturer to be non-dusting. This suggests that inhalational exposure is unlikely to occur.

When the dye is in aqueous solution, skin contact is possible. Transfer from the premix tank where the dye is dissolved to the dyebath is by pump or gravity feed. Thus the potential for spillage or splashing appears to be controlled. Dissolution of the dye in cold water is said to be instantaneous and mists are not formed during mixing.

Most dyebaths using the notified chemical are closed systems although there are open dyebaths in some dyehouses which may lead to exposure due to splashing.

Because the amount of the notified chemical to be imported is a maximum of 700 kg per year, a high level of exposure of workers is not expected.

Although the notified chemical should be regarded as a potential respiratory sensitiser, the risk of respiratory sensitisation would appear to be low given that the dye is in a non-dusting form and is used in relatively small amounts. There is clearly a risk of skin

sensitisation and slight eye irritation from contact with the dye in solution and personal protective equipment as outlined below should be used.

Dermal contact may result during handling, wearing or during laundring of the cotton fabric if the dye is not 100% chemically bound to the fibre. If repeated dermal contact does occur, sensitisation may result. The notifier does state however, that the dye Drimarene Yellow K4G CDG, which contains the notified chemical, will be chemically bound to the fabric, and its reactivity will be lost after the dyeing process

13. RECOMMENDATIONS

To minimise occupational exposure to Drimarene Yellow K4G CDG the following guidelines and precautions should be observed:

. good general and local exhaust ventilation should be provided in weighing areas;

. particular care should be taken to avoid spillage or splashing of the dye solution;

. production of mists in the workplace during mixing operations should be avoided;

. good personal hygiene should be practiced to minimise the potential for ingestion; and

. when handling the dye personal protective equipment which conforms to and is used in accordance with Australian Standards (AS) for eye protection (AS 1336, AS 1337) (15,16), impermeable gloves (AS 2161) (17) protective clothing (AS 3765.1, 3765.2) (18,19) and, if there is any possibility of dust generation, respiratory protection (AS 1715) (20), should be worn.

14. MATERIAL SAFETY DATA SHEET

The Material Safety Data Sheet (MSDS) for Drimarene Yellow K4G CDG was provided in a suitable format.

This MSDS was provided by Clariant (Australia) Pty Ltd as part of their notification statement. The accuracy of this information remains the responsibility of Clariant (Australia) Pty Ltd.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the *Industrial Chemicals (Notification and Assessment) Act 1989*, secondary notification of Drimarene Yellow K4G CDG 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. Reference 25 in S Hobbs, *Industry Category Document: UK Dye Production and Use in the Textile Industry*, UK Department of the Environment (CR36/38), July 1988.

2. Chung K-T and Stevens S, *Degradation of Azo dyes by Environmental Microorganims and Helminths*, Environmental Toxicology and Chemistry, **12**, 1993, pp. 2121-2132.

3. C-P Yen, T A Perenich and G L Baughman, *Environmental Toxicology and Chemistry*, 1991, **10**, pp. 1009-1017.

4. *Assessment of Acute Oral Toxicity Study with Drimarene Yellow K4G CDG in Rats*. *Rat*, RCC Notox Project No. 326340, data on file, Sandoz Chemikalien AG, Basel, Switzerland, Sept. 1992.

5. EEC Council Directive 84/449 on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous preparations, *Official Journal of the European Communities,* No. L251 (19 September 1984).

6. *Assessment of Acute Dermal Toxicity Study with Drimarene Yellow K4G CDG in Rats.* RCC Notox Project No. 334258, data on file, Sandoz Chemikalien AG, Basel, Switzerland, 3 Dec. 1992.

7. Primary Skin Irritation Study with *Drimarene Yellow K4G CDG* in Rabbits, RCC Notox Project No. 334260, data on file, Sandoz Chemikalien AG, Basel, Switzerland, Sept. 1992.

8. Draize J H, 1959, 'Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics', *Association of Food and Drug Officials of the US,* **49**.

9. Acute *Eye Irritation Study with Drimarene Yellow K4G CDG in Rabbits* RCC Notox Project No. 334271, data on file, Sandoz Chemikalien AG, Basel, Switzerland, Oct. 1992.

10. Assessment of *Contact Hypersensitivity to Drimarene Yellow K4G CDG in Albino Guinea Pigs, Maximisation Test*, RCC Notox Project No. 326351, data on file, Sandoz Chemikalien AG, Basel, Switzerland, June. 1992.

11. *Sub-acute 28-Day Oral Toxicity Gavage Study with Drimarene Yellow K4G CDG in Rats,* RCC Notox Project No. 326362, data on file, Sandoz Chemikalien AG, Basel, Switzerland, March. 1993.

12. *Salmonella typhimurium Reverse Mutation Assay for Azo dyes* w*ith Drimarene Yellow K4G CDG,* CCR Project No. 299103, data on file, Sandoz Chemikalien AG, Basel, Switzerland, July. 1992.

13. *Micronucleus Assay in Bone Marrow Cells of the Mouse with Brilliant Green K-RWa 6083,* CCR Project 426701, data on file, Sandoz Chemikalien AG, Basel, Switzerland, Aug.1993.

14. Evaluation in the *in Vitro Cytogenetic Assay in Chinese Hamster V79 Cells,*. CCR Project 316001, data on file, Sandoz Chemikalien AG, Basel, Switzerland, March.1993.

15. Australian Standard 1336-1982, *Recommended Practices for Eye Protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney, 1982.

16. Australian Standard 1337-1984, *Eye Protectors for Industrial Applications*, Standards Association of Australia Publ., Sydney, 1984.

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

18. Australian Standard 3765.1-1990, *Clothing for Protection Against Hazardous Chemicals, Part 1: Protection Against General or Specific Chemicals*, Standards Association of Australia Publ., Sydney, 1990.

19. Australian Standard 3765.2-1990, *Clothing for Protection Against Hazardous Chemicals, Part 2: Limited Protection Against Specific Chemicals*, Standards Association of Australia Publ., Sydney, 1990.

20. Australian Standard 1715-1991, *Selection, use and maintenance of Respiratory Protective Devices*, Standards Association of Australia Publ, Sydney 1991.

[i]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	2
		by definite raising)	
Moderate to severe erythema	3	Moderate oedema (raised approx. 1mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and	4
		extending beyond area of exposure)	

[ii]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 translu cent areas, details		
of iris slightly obscure	2 mild	50% to 75%
3		
Opalescent areas, no details of iris visible,	3 moderate	Greater than 75%
4		
size of pupil barely discernible		
Opaque, iris invisible	4 severe	

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

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	