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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Fluorochemical Ester (5928P)

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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) 565-9466 **FAX (61) (02) 565-9465**

Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

Fluorochemical Ester (5928P)

1. APPLICANT

3M Australia Pty Ltd of 2-74 Dunheved Circuit ST MARYS NSW 2760 has submitted a limited notification statement in support of their application for an assessment certificate for Fluorochemical ester (5928P).

2. IDENTITY OF THE CHEMICAL

Fluorochemical ester (5928P) 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 and appearance have been exempted from publication in the Full Public Report and the Summary Report.

Other names:	fluorochemical ester (5928P)
Trade names:	not applicable - sold as a mixture

3. PHYSICAL AND CHEMICAL PROPERTIES

The notified chemical is not produced outside the leather tanning formulation, however it has been isolated to obtain the following physico-chemical properties

Odour:	not specified
Melting Point:	76.5°C
Density:	not specified
Vapour Pressure:	not applicable
Water Solubility:	insoluble
Partition Co-efficient (n-octanol/water) log P_{ow}:	not applicable
Hydrolysis as a function of pH:	not applicable
Adsorption/Desorption:	not applicable
Dissociation Constant pK_a**:**	not applicable

Flammability Limits:	not flammable
Combustion Products:	not applicable
Decomposition Temperature:	not specified
Decomposition Products:	not specified
Autoignition Temperature:	not autoflammable
Explosive Properties:	not expected to present an explosive hazard
Reactivity/Stability:	not reactive

Comments on Physico-chemical data

The company states that the density for similar compounds (unspecified) is 1290-1360 kg/m^3, while density of the preparation is 1250 kg/m^3. No data for hydrolysis, adsorption/desorption, dissociation constant, and partition coefficient was provided because the substance is insoluble in water.

No hydrolysis of fluorochemical ester (5928P) should occur within the expected environmental pH range. Due to its very low water solubility, fluorochemical ester (5928P) is expected to partition highly to octanol, although this would be difficult to measure. Fluorochemical ester (5928P) is also expected to be associated with soil/sediments. No ionisable hydrogen is present; therefore there will be no dissociation.

4. PURITY OF THE CHEMICAL

Degree of purity: >90%

Additives/Adjuvants: none

5. INDUSTRIAL USE

The notified chemical will be imported into Australia in 20 litre metal containers as a component of FX-3573 Scotchgard Leather Protector at an approximate concentration of 30%. The estimated import quantity of the notified chemical over 5 years is greater than a tonne.

6. OCCUPATIONAL EXPOSURE

The product FX-3573 containing the notified chemical will be imported, stored and shipped to the end user as requested. There is little chance of exposure to the notified chemical occurring unless a spill should occur, where eight to ten transport and warehouse workers may be exposed to a the notified chemical as 30% of the tanning formulation.

At the customer site the notified chemical in the FX-3573 formulation will be utilised for leather treatment. This will be by either spray treatment or exhaust method. The application will involve the transfer by gravity feed or pumping the formulation containing the notified chemical to weighing vessels which will involve the dilution of the FX-3573 formulation to between 1.5-8%. This is transferred to the treatment drum (part of a rotating mill) where leather will be added to the diluted formulation. The drum is then sealed and rotated for 2 hours at 40°C . The wet skins will then be removed manually for drying. This may generate splashing which may constitute an exposure risk. A similar risk of exposure will occur if the formulation containing fluorochemical ester (5928P) is applied to the leather by spray treatment. These procedures are likely to involve up to two people per site of application. Any exposure to the notified chemical from splashing will be between 0.5 to 2.5% of the diluted formulation.

After the leather has dried it will be sold to manufacturers of leather products where it will be fashioned into apparel, upholstery and other leather products. There may be dermal exposure to the notified chemical of manufacturing workers who are involved in the cutting of the leather, however any exposure to the notified chemical should be at a concentration of 0.5 to 2.5% in the formulation bound to the leather.

7. PUBLIC EXPOSURE

The maximum concentration of the product used in leather treatment processes is 8% based on wet weight of leather or 4% based on dry weight, which is equivalent to less than 2.5% of the notified chemical. The treated leather will ultimately be used in the manufacture of products such as shoes, clothing or furniture. The general public will have contact the treated leather products. It is anticipated that a small percentage of the notified chemical will be released from the leather surface and therefore, dermal contact will be the major route of public exposure. However, the notifier states that large quantities of the product are not expected to be removed from the surface unless the leather is abraded or damaged. Minor public exposure may result from accidental spillage of the notified chemical during transport or storage, but any such events are expected to be rare.

8. ENVIRONMENTAL EXPOSURE

Release

There is no reformulation or further treatment of the chemical within Australia, and 3M will sell the leather treatment product, FX-3573, to a sole distributor who will then supply end-users. There are 5 potential use sites, all at industrial metropolitan sites. Any release during distribution would be through accidental spillage.

FX-3573 will contain about 30% solids, of which 95% will be fluorochemical ester (5928P) active. In the application of FX-3573 as a 1.5% aqueous suspension, the concentration of fluorochemical ester (5928P) will be 0.5%. The notifier has provided evidence that in treating leather by drum application, the process will exhaust 99-99.5% of the chemical. If the leather is treated by spray, the notifier claims that all overspray will be collected and re-used. Apart from residues generated in spent process water (estimated to be 0.1-0.3%), solid waste may be generated when hides are shaved, trimmed and buffed.

Fate

According to the Material Safety Data Sheet (MSDS) for FX-3573, any material spilt should be covered with absorbent material and then collected and disposed of by incineration in the presence of a combustible material. The notifier notes in additional information supplied, that disposal of aqueous wastes might also be to sewer, while solids could be disposed of to landfills certified for industrial chemical wastes.

The tanning process for a hide would typically consist of the following steps: fleshing[1]; soaking; dehairing or dewooling with sulphide or lime; deliming with ammonium slats or CO_2; bating[2]; pickling[3]; tanning; sammying; retanning[4], dyeing and fatliquoring[5]; drying[6]; and finishing. FX-3573 can be added to the dye or fatliquor bath, or used after the conventional process of retanning, dyeing and liquoring. The application method will most likely be by spray. The company indicates that a variety of leathers can be treated with FX-3573, including leathers to be used as shoe uppers, sheepskin gloves, clothes (suede and double-faced) and upholstery.

In the tanning process it is expected that unfixed fluorochemical ester (5928P) will be eliminated by adsorption with particulate matter in the process water due to the low solubility of fluorochemical ester (5928P). Any residues from the treatment process, including aqueous wastes, could be incinerated as described above. The notifier, however, does note the potential of some fluorochemical ester (5928P) to be released to sewer. All Australian tanneries have primary treatment, with some also having secondary, and even tertiary, effluent treatment.

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1 removal of fat, muscle and subcutaneous tissue
2 removal of certain proteins by enzyme treatment to improve quality
3 preparation of hide for tanning by treatment with acid and salts
4 removal of water by wringing
5 modifying secondary tanning
6 an oil emulsion that lubricates the freshly tanned leather

- *biodegradation*

A biodegradation test was performed by was exposing the test substance to activated sludge in a closed system oxygen consumption measuring apparatus (OECD Test Guideline 301C). Dissolved organic carbon (DOC) and the residual test substance in the test bottles were measured after 28 d. These ranged from 0.1 to 0.9 mg/L, with a theoretical value of 32.9 mg/L calculated. Though the results were thought to be somewhat equivocal by the notifier, it was concluded that the substance could not be classed as readily biodegradable.

- *bioaccumulation*

The potential for fluorochemical ester (5928P) to bioaccumulate was determined using OECD Test Guideline 305C, with carp (*Cyprinus carpio*) exposed to the fluorochemical ester (5928P). The test concentrations were 0.255 µg/mL and 0.0265 µg/mL, with THF and HCO-20 used to disperse the fluorochemical ester (5928P), were set after first determining the acute toxicity of the fluorochemical ester (5928P) to Orange killifish (*Oryzias latipes*) (see Ecotoxicity below). The concentration of the test substance in fish (20-37 g, 9-12 cm, 3.7% fat) was calculated to be 2.36-5.03 µg/g at the high exposure level and 0.600-1.286 µg/g at the low exposure level. The bioconcentration factors (BCFs) were determined to be 9-20 at the high exposure level and 22-47 at the low exposure level.

On the basis of these results, it is concluded that the test substance will not bioaccumulate in carp under the prescribed test conditions. The EPA notes that the study involved no depuration period and a slight elevation of the BCF at the last time point in the high exposure level (from 11-12 at 6 weeks to 16-20 at 8 weeks). This increase in BCF was not reflected in fish exposed to the low concentration. Also, the lower MW fractions of fluorochemical ester (5928P) still have a MW > 1000, and these would also not be expected to cross biological membranes, and it is agreed bioaccumulation is unlikely.

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Acute Toxicity

Table 1. Summary of the acute toxicity of fluorochemical ester (5928P)

Test	Species	Outcome	Reference
Acute oral toxicity	Rat	LD_{50} > 5000 mg/kg	(1)
Skin irritation	Rabbit	not an irritant	(2)
Eye irritation	Rabbit	slight irritant	(4)
Skin sensitisation	Guinea pig	not a sensitiser	(5)

9.1.1 Oral Toxicity (1)

Albino Cr1:CDBR strain rats (5 per sex; approximately 8 weeks old) were administered a single gavage dose of 5000 mg/kg of the notified chemical (fluorochemical ester (5928P)) in acetone and corn oil. The animals were observed for 14 days. Mortality and clinical signs of toxicity were assessed several times on the day of test compound administration, and twice daily (for mortalities) and daily (for clinical signs of toxicity) thereafter. Body weight was determined pre-treatment and on days 7 and 14. An autopsy was performed on all animals at the completion of the study.

No deaths were seen during the 14 day study. Staggering gait and hypoactivity were noted in the majority of animals up to and including 4 hours after compound administration.

The acute oral LD_{50} of the notified chemical was greater than 5000 mg/kg in male and female rats.

9.1.2 Skin Irritation (2)

The fur was removed from the back of 2 male and 1 female New Zealand White rabbits, 500 mg of the notified chemical (fluorochemical ester (5928P)) in saline was applied to the intact skin, and an occlusive dressing applied, for 4 hours. Residual chemical was then removed. Skin reactions were assessed approximately 30 minutes, 24, 48 and 72 hours after chemical removal. The severity of the reactions were determined by the degree of erythema and oedema, as described by Draize (3).

Very slight erythema (grade 1; mean score 0.3) was noted in 1 of 3 animals 30 minutes after chemical application which resolved within 24 hours.

The notified chemical was not considered to be a dermal irritant in rabbits.

9.1.3 Eye Irritation (4)

A dose of approximately 100 mg of the notified chemical (fluorochemical ester (5928P)) was instilled into the right conjunctival sac of 1 male and 2 female New Zealand White rabbits. The eyes were not flushed. The study was terminated after 72 hours. The eyes were examined 1, 24, 48 and 72 hours after chemical installation, and the degree of irritation assessed using the Draize (3) method. To assess the presence, and severity, of corneal damage, a 2% fluorescein solution was instilled into the eyes 72 hours after chemical installation.

One hour after chemical installation, mild conjunctival hyperaemia was noted in 2 of 3 rabbits (mean score 1.3). The hyperaemia remained in 1 of 3 rabbits for 24 hours. The fluoroscein did not reveal any additional injury.

The notified chemical was a slight ocular irritant in rabbits.

9.1.4 Skin Sensitisation (5)

Twenty four male Haz:(DH)fBR albino guinea pigs were divided into a positive control (n = 4), a naive control group (n = 10) and a treatment group (n = 10). The hair was removed from the backs of each animal. An induction dose of 200 mg of the notified chemical (fluorochemical ester (5928P)), or 400 mL of 2,4-dinitrochlorobenzene (DNCB) (positive control material), was applied to the exposed skin of the left flank of the treatment or positive control groups once a week for 3 weeks. Each chemical application remained *in situ* for 6 hours, after which it was removed. Two weeks after application of the final induction dose, 200 mg of the test material was applied to the right flank of the treatment and naive control groups, and 0.1% w/v of DNCB in acetone was applied to the right flank of the positive control group. The application sites were assessed for erythema, according to the Buehler scoring scale, 24 and 48 hours after application of the induction and challenge doses. In addition, animals were examined for clinical signs of toxicity on a daily basis, and body weights were determined at the beginning and at weekly intervals during the study.

No adverse skin reactions, clinical signs of toxicity, or weight loss was noted during the study.

The notified chemical (fluorochemical ester (5928P)) did not cause skin sensitisation in the guinea pig.

9.2 Repeated Dose Toxicity (6)

Groups of 12 (6 per sex) SD (Crj:CD) rats (approximately 5 weeks old) were administered 0, 20 mg (Low Dose), 140 mg (Medium Dose) or 1,000 mg (High Dose) of the notified chemical (fluorochemical ester (5928P) in 0.5% CMC-Na solution with 0.1% Tween 80)/kg/day, by gavage, for 28 days. A 14 day recovery period was allowed for a control group (n = 6 per sex), and a High Dose group (n = 6 per sex) of animals. Clinical signs of toxicity were assessed daily, a detailed examination was carried out, and body weight was recorded at weekly intervals. Blood to determine haematological and clinical biochemical parameters was collected at the completion of the study. Urinalysis was carried out on day 25 of the study. Autopsies, which included selected organ histopathology, and organ weight determinations, were carried out at study termination.

Body weight and food consumption were decreased in High Dose males and females after 2-3 weeks. A slight reduction in RBC numbers was noted in High Dose males and females, as well as a reduction in haematocrit and haemoglobin concentration in High Dose females at the end of the recovery period. Total cholesterol was reduced in High Dose males, and triglycerides were reduced in Low Dose, Medium Dose and High Dose males and High Dose females. At the end of the recovery period, triglycerides remained low in High Dose males and females.

At the conclusion of the treatment phase, relative adrenal weight was decreased in High Dose males. In addition, relative liver and brain weight were increased in High Dose males, and relative liver weight was increased in High Dose females and relative kidney

weight was increased in Medium Dose and High Dose females. Macroscopic liver abnormalities, and centrilobular hepatocyte hypertrophy were noted in High Dose males and females at the conclusion of the treatment phase. At the end of the recovery phase, relative liver, kidney and brain weights were increased in High Dose females, and relative liver weight was increased and relative adrenal weight was decreased in High Dose males. Additional findings at the end of the recovery phase were hepatocyte hypertrophy in High Dose males and females, and hepatocyte fatty changes in High Dose males.

9.3 Genotoxicity (7,8)

Summary of genotoxicity studies using fluorochemical ester (5928P).

Study Type	Test Object	Concentration	Result	Ref.
Reverse mutation	*S. typhimurium* strain TA98, TA100, TA 1535 and TA1537, and *E. coli*, strain WP2 *uvrA*	156-5,000 mg/plate (with and without metabolic activation)	-ve	7
Clastoge-nicity	Chinese Hamster CHL/IU cell line	1,000-2,000 mg/mL (with and without metabolic activation)	-ve	8

9.4 Overall Assessment of Toxicological Data

The studies demonstrated that the notified chemical (fluorochemical ester (5928P)) has low acute oral toxicity, is a slight eye irritant, and does not cause dermal irritation or sensitisation. A 28 day oral repeat dose study in rats indicated that the main target organ is the liver, and in females, the kidney. Alterations in liver structure were detected when doses of 1,000 mg/kg/day of the notified chemical were given, and the changes were not reversible. The compound, when assessed in *in vitro* assays, was not mutagenic or clastogenic.

The notified chemical is not classed as hazardous according to Worksafe Australia's *Approved Criteria for Classifying Hazardous Substances* (9) in relation to the toxicity data provided.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The ecotoxicity studies with juvenile fathead minnow (*Pimephales promelas*) and *Daphnia magna* were conducted using OECD Test Guidelines 203 and 202, respectively, with FX-3573 added directly to test waters (containing about 30% fluorochemical ester (5928P)). Those with Orange killifish (*Oryzias latipes*) were conducted using the fluorochemical ester (5928P), as part of the bioaccumulation study. No study was provided for algae although test results for Microtox® using FX-3573 were submitted.

Table 2 Ecotoxicity test results

Species	Test	Result
Fathead minnow (*Pimephales promelas*)	Acute, static, 96 h	LC_{50} >312 mg/L (>1000 mg/L)[a,b]
Orange killifish (*Oryzias latipes*)	Acute, static, 48 h	LC_{50} > 100 mg/L[c] (nominal concentration)
Water flea (*Daphnia magna*)	Acute, static, 48 h	EC_{50} =44 mg/L (139 mg/L)[a]
Microtox (*Photobacterium sp*)	5 and 15 min, static	EC_{50} (5 min) = 1084 mg/L[a] EC_{50} (15 min) = 1585 mg/L[a]

a Test performed using FX-3573 containing about 30% fluorochemical ester (5928P); result given as fluorochemical ester (5928P) concentration with FX-3573 concentration given in brackets
b Throughout the test, the highest test concentration of 1000 mg/L was foamy, and had a precipitate by 72 h
c Test performed using the fluorochemical ester (5928P)

Results of the various tests are given in Table 2. As indicated above, the tests were performed at concentrations well above the solubility of fluorochemical ester (5928P), and although its formulation in FX-3573 enables its use as an emulsion, a precipitate still formed in the highest concentration tested by 72 h of fathead minnow test. No mortalities were recorded in any concentration in the test performed with the fathead minnow. In the *Daphnia* test, organisms had a clump of material around the body in the 125 mg/L and all higher concentrations at the 24 hour reading. Daphnia were immobile at 500 mg/L and 1000 mg/L. At the 48 hour reading, organisms in the 125 mg/L concentration had sloughed off the clump and appeared to be swimming and exhibiting normal behaviour. Organisms that were immobile at 48 hours were considered alive[7]. These results, indicate that FX-3573, containing about 30% fluorochemical ester (5928P), is not toxic to aquatic organisms up to the limit of solubility of fluorochemical ester (5928P).
Due to its high NAMW the notified chemical is not expected to cross biological membranes.

[7] Presumably the water fleas mobility was still hampered by the clump of material around the body, although this is unclear from the test reports; it is also unclear how it was determined that the animals were still alive. Any effects however, seem attributable to physical interference from the test compound precipitating from solution.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

Most of the residue is expected to be associated with tannery sludge after primary effluent treatment. The sludge could be incinerated, landfilled or used as a soil conditioner. Its use as a soil conditioner would be restricted by the presence of contaminants, such as chromium and pesticides, as well as its salinity and nutrient content. Any residues disposed of in this manner are expected to be immobile and remain associated with the soil compartment.

The potential for the greatest environmental hazard is in the discharge of unfixed residues to sewer. However, as noted above, nearly complete exhaust is expected of fluorochemical ester (5928P) (99-99.5%) when FX 3573 is used as a 1.5% aqueous suspension containing 0.5% fluorochemical ester (5928P) in drum treatment. This would represent the worst case in terms of potential release. Residues are expected to be further reduced by an order of magnitude with most applications expected to be by spray.

Assuming 1% free residue and use at 5 g/L (0.5% aqueous solution), then a maximum of 50 mg/L free residue could enter the sewer (ie below the lowest EC_{50} observed for *Daphnia magna*). With further dilution from other process water and on entering the sewer and any treatment works, as well as its expected adsorption to particulate matter, the free residue is expected to be significantly reduced by several orders of magnitude (eg it can be expected that there will be dilution with at least 500 mL of sewage effluent if discharged to a large metropolitan sewage treatment works). On entering receiving waters, even greater dilution would be achieved, as well as further adsorption to particulate matter, giving an expected environmental concentration in the ppb range at least.

The predicted environmental hazard is therefore low, as the substance does not appear to have significant bioaccumulation potential and was non-toxic up to the limit of solubility in standard aquatic toxicity tests.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The notified chemical (fluorochemical ester (5928P)) is predicted to exhibit in humans low acute oral toxicity, slight eye irritancy, and not to cause dermal irritation or sensitisation. The compound, is not believed to be mutagenic or clastogenic. A 28 day repeat dose study in rats showed alterations in liver structure when doses of 1,000 mg of the notified chemical/kg/day were given, the changes not being reversible. This may indicates that high levels exposure may be potentially hepatotoxic in some individuals. However, notified chemical is not classed as hazardous according to Worksafe *Australia's Approved Criteria for Classifying Hazardous Substances* (9) in relation to the toxicity data provided.

There is not expected to be any significant exposure to the notified chemical during importation or transport unless a major spill should occur.

There is the potential for dermal exposure to the notified chemical by splashing during the tanning process when leather is treated by the exhaust method or by spraying the formulation. While the notified chemical poses little occupational health risk, some ingredients in the formulation may have the potential for significant health effects requiring the use of protective clothing, eye goggles, protective gloves and respirator. Mechanical ventilation will be used to reduce the risk from vapours from the FX-3573.

The treated leather used by manufacturers has the potential for exposing workers dermally to the notified chemical. Exposure is not expected to be greater than 2.5% of the FX-3573 chemically bound to the leather and is not expected to present any significant risk.

The notified chemical, fluorochemical ester (5928P), constitutes 30% of the leather protector FX-3573. The chemical will be present on the surface of leather used in the manufacture of products such as shoes, clothing or furniture. The general public will therefore be exposed to the notified chemical via dermal contact. However, the notifier states that large quantities of the product are not expected to be removed from the surface unless the leather is abraded or damaged. The notified chemical did not cause dermal irritation or sensitisation, and therefore its use is not expected to result in significant adverse health effects.

13. RECOMMENDATIONS

The combustion products of fluorochemical ester (5928P) occurring by incineration disposal will include HF and therefore the MSDS should state that scrubbers are required to remove this combustion product.

To minimise occupational exposure to fluorochemical ester (5928P) the following guidelines and precautions should be observed:

• *Chemical Spill (of formulation FX-3573 containing fluorochemical ester (5928P))*

The spill should be contained with an absorbent material and the area ventilated if possible. Personnel involved in the cleanup are recommended to wear:

- the appropriate respiratory device utilising an appropriate filter for organic vapours should be selected and used in accordance with Australian Standard/New Zealand Standard (AS/ NZS) 1715 (10) and should comply with AS/NZS 1716 (11)

- eye protection should be selected and fitted in accordance with AS 1336 (12) and used in accordance with AS/NZS 1337 (13)

- industrial clothing must conform with the specifications detailed in AS 2919 (14) and AS 3765.1 (15)

- butyl rubber gloves conforming with the standards detailed in AS 2161 (16)

• *Usage in Leather Treatment*

local exhaust ventilation should be implemented where there is the likelihood of exposure to fumes or aerosols

If engineering controls and work practices are insufficient to reduce exposure to fluorochemical ester (5928P) to a safe level, then:

- the appropriate respiratory device should be selected and used in accordance with Australian Standard/ New Zealand Standard (AS/ NZS) 1715 (10) and should comply with AS/NZS 1716 (11)

- eye protection should be selected and fitted in accordance with AS 1336 (12) and used in accordance with AS/NZS 1337 (13)

- industrial clothing must conform with the specifications detailed in AS 2919 (14)

- butyl rubber gloves conforming with the standards detailed in AS 2161 (16)

- particular care should be taken to avoid spillage or splashing of the notified chemical; should a spill occur the notified should be contained with absorbent material

- good personal hygiene should be practised 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 FX-3573 containing the notified chemical fluorochemical ester (5928P) was provided in an acceptable format in accordance with Worksafe Australia's *National Code of Practice for the Preparation of Material Safety Data Sheets* (17).

This MSDS was provided by 3M Australia Pty Ltd as part of their notification statement. The accuracy of this information remains the responsibility of 3M Australia Pty Ltd.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the *Industrial Chemicals (Notification and Assessment) Act 1989*, secondary notification of fluorochemical ester (5928P) 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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4. Glaza, SM, 1992*, Primary eye irritation/corrosion study of fluorochemical ester (5928P) in rabbits.* Hazleton Wisconsin, USA. HWI no.: 20606219.

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10. Standards Australia, Standards New Zealand, 1994, *Australian/New Zealand Standard 1715-1994 Selection, Use and Maintenance of Respiratory Protective Devices.* Standards Association of Australia Publ., Sydney, Australia, Standards Association of New Zealand Publ. Wellington, New Zealand.

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12. Standards Australia , 1994, *Australian Standard 1336-1994, Recommended Practices for Eye Protection in the Industrial Environment.*, Standards Association of Australia Publ. Sydney, Australia.

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15. Standards Australia, 1990, *Australian Standard 3765-1990 Clothing for Protection Against Chemical Hazards, Part 1 Protection Against General or Specific Chemicals, Part 2 Limited Protection Against Specific Chemicals,* Standards Association of Australia Publ., Sydney, Australia.

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

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

Attachment 1

The Draize Scale for evaluation of skin reactions is as follows:

Erythema Formation	rating	Oedema Formation	rating
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1mm)	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 translu cent 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.	Disharge 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