

Toxicity to Algae (*Selenastrum capricornutum*) for FM-3820 (28% PFOS)

TOXICITY TO AQUATIC PLANTS (E.G., ALGAE)

TEST SUBSTANCE

Identity: Perfluorooctanesulfonate; may also be referred to as PFOS or FC-95 or as part of the mixed product FM-3820 (see Remarks). (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, potassium salt, CAS # 2795-39-3)

Remarks: The test sample is FM-3820, a mixture of the test substance in diethylene glycol butyl ether and water (approximately 24-28% test substance in diethylene glycol butyl ether and water). Calculations were made to adjust test values using the upper limit concentration of the test substance (28%) in the test sample and no adjustment was made for the presence of the diethylene glycol butyl ether or water when noted below. These calculations assumed that all toxicity was due to the presence of the Perfluorooctanesulfonate substance.

METHOD

Method: OECD 201

Test: Static acute

GLP: No

Year completed: 1991

Species: *Selenastrum capricornutum*

Source: Originally from the Culture Collection of Algae at the University of Texas at Austin, maintained in culture medium at EnviroSystems Division, Resource Analysts, Inc., Hampton, NH.

Analytical monitoring: Temperature and pH

Element basis: Growth rate

Exposure period: 96-hours

Start date: 4/29/91

End date: 5/3/91

Test organisms laboratory culture: Algae cultures had been actively growing in sterile enriched media identical to media used for the test and maintained at test conditions.

Test Conditions:

Test temperature range: 23.0 – 23.1°C

Dilution water: Synthetic media prepared with sterile deionized water according to U.S. EPA standard, 1978.

Dilution water source: Not noted.

Stock and test solution preparation: A primary stock solution was prepared in algal medium at a concentration of 1000 mg/L. The primary stock solution was proportionally diluted with algal medium to prepare the five additional test concentrations directly in the test vessels.

Exposure vessels: 250 mL glass Erlenmeyer flasks capped with inverted glass beakers and containing 100 mL of test solution.

Agitation: Shaken continuously

Number of replicates: three

Initial algal cell loading: 1.0×10^4 cells/mL

Number of concentrations: Five plus a negative control

Water chemistry:

pH range (0 – 96 hours)

8.0 – 10.3 (control exposure)

7.2 – 8.1 (1000 mg/L exposure)

Test temperature range (0 – 96 hours)

23.0 – 23.1°C

Light levels: (0 – 96 hours)

40 uEin/sec/m² from continuous cool-white fluorescent lighting

RESULTS

Nominal concentrations: Bk control, 62.5, 125, 250, 500, and 1000 mg/L.

Test Sample Element value:

24-hour EC₅₀ (growth rate) = <62.5 mg/L (CI not calculable)

48-hour EC₅₀ (growth rate) = 707 (500-1000) mg/L

72-hour EC₅₀ (growth rate) = 284 (249-325) mg/L

96-hour EC₅₀ (growth rate) = 255 (222-293) mg/L

96-hour NOEC (growth rate) = 125 mg/L

Perfluorooctanesulfonate concentration adjusted Element value:

24-hour EC₅₀ (growth rate) = <17.5 mg/L

48-hour EC₅₀ (growth rate) = 198 mg/L

72-hour EC₅₀ (growth rate) = 80 mg/L

96-hour EC₅₀ (growth rate) = 71 mg/L

96-hour NOEC (growth rate) = 35 mg/L

All element values based on nominal concentrations

Statistical methods: EC₅₀ values were calculated using the binomial or moving average method. The NOEC was calculated using Dunnett's test. The average specific growth rate was calculated as the natural log of the number of cells per ml at 96 hours minus the natural log of the number of cells per ml at 0 hours divided by the exposure period. The percent change from control is calculated by subtracting the sample average specific growth rate from the control average specific growth rate, dividing that value by the average specific growth rate in the control and multiplying that value by 100. The percent change from control was used to compute EC₅₀ and NOEC values.

Control response: Not noted.

Mean Growth data:

Nominal Concentration, mg/L	Number of Cells per mL	Average Specific Growth Rate (μ)	Percent Inhibition via Growth Rate
Negative Control	448,000	0.040	--
62.5	198,000	0.031	22
125	281,000	0.035	12
250	221,000	0.032	20
500	12,000	0.002	95
1000	11,000	0.001	98

Observations: The number of algal cells/ml in each test vessel was determined by means of direct microscopic counts with a hemacytometer.

Reversibility of Growth Inhibition: Not noted.

CONCLUSIONS

The test substance 96-hour EC₅₀ and 95% confidence interval for *Selenastrum capricornutum* was determined by growth rate to be 255 (222-293) mg/L. The 96-hour NOEC was determined by Dunnett's procedure to be 125 mg/L.

If you attribute all toxicity to the Perfluorooctanesulfonate component of the test substance (FM-3820) using the 28% upper concentration limit, the 96-hour EC₅₀ (growth rate) = 71 mg/L and the 96-hour NOEC (growth rate) = 35 mg/L

Submitter: 3M Company, Environmental Laboratory, P.O. Box 33331, St. Paul, Minnesota, 55133

DATA QUALITY

Reliability: Klimisch ranking = 3. The study lacks analytical measurement of test substance concentrations in the test solutions, determination of the mode of toxicity, insufficient characterization of sample purity, and insufficient explanation of observed anomalies in toxicity readings. Additionally, the write-up did not indicate the test vessels were sterile, and data is for a mixture and toxicity cannot be positively attributed to Perfluorooctanesulfonate as the diethylene glycol butyl ether could also contribute to the toxicity.

REFERENCES

This study was conducted at EnviroSystems Division , Resource Analysts, Incorporated at the request of the 3M Company.

OTHER

Last changed: 5/3/00

Study Title

Static Acute Toxicity of FM 3820
to the Alga, *Selenastrum capricornutum*

Authors

Robert L. Boeri
Timothy J. Ward

Study Completed

June, 1991

Performing Laboratory

EnviroSystems Division
Resource Analysts, Incorporated
P.O. Box 2110
One Lafayette Road
Hampton, New Hampshire 03842

I. SUMMARY

The acute toxicity of FM 3820 to the alga, *Selenastrum capricornutum*, is described in this final report. The test was conducted for 3M Company for 96 hours during April 29 to May 3, 1991, at the EnviroSystems Division of Resource Analysts, Inc. in Hampton, New Hampshire. It was conducted by Jeanne Magazu, Peter Kowalski, Ellen Stanford, Robert Boeri, and Timothy Ward.

The test was performed under static conditions with five concentrations of test substance and a dilution water control at a mean temperature of 23.0°C. The dilution water was synthetic media prepared with sterile deionized water. Flasks were incubated on a rotary shaker. Light was adjusted to 40 uEin/sec/m² with a photoperiod of 24 hours light and 0 hours dark. Nominal concentrations of FM 3820 were: 0 mg/L (control), 62.5 mg/L, 125 mg/L, 250 mg/L, 500 mg/L, and 1,000 mg/L. Nominal concentrations were used for all calculations.

Algae used in the test was from an in-house culture that was maintained under test conditions. Exposure of algae to the test substance resulted in a 72 hour EC50 284 mg/L FM 3820 and a no observed effect concentration (NOEC) less than 62.5 mg/L. The 96 hour EC50 and NOEC are 255 mg/L and 125 mg/L, respectively.

II. TABLE OF CONTENTS

SECTION:	PAGE
I. Summary	2
II. Table of Contents	3
III. Index of Tables	4
IV. Introduction	5
V. Methods and Materials	5
VI. Results	8
VII. References	12
Appendix A. Water Quality Data from Toxicity Test	13

III. INDEX OF TABLES

	PAGE
Table 1. Chemical characterization of a representative sample of deionized water used to prepare test media for toxicity test	6
Table 2. Growth data from toxicity test	9
Table 3. Percent change from control and average specific growth rate from toxicity test	10
Table 4. Median effective concentrations (EC50s) from toxicity test	11
Table A.1. Temperature measured during toxicity test	14
Table A.2. pH measured during toxicity test	15

IV. INTRODUCTION

This study was sponsored by 3M Company, St. Paul, Minnesota. The objective of the study was to determine the acute toxicity of FM 3820 to a freshwater alga. The report contains sections that describe the methods and materials employed in the study, and the results of the investigation. The report also contains an appendix that presents the water quality data collected during the test.

V. METHODS AND MATERIALS

TEST SUBSTANCE:

FM 3820 (EnviroSystems Sample Number 2696E) was delivered to EnviroSystems on November 15, 1990. It was contained in a 250 mL glass bottle that was labelled with the following information: "H 2864-6, FM 3820". FM 3820 (a pale yellow liquid) was supplied by 3M Company, 935 Bush Avenue, St. Paul, Minnesota. Prior to use the test material was stored in the dark at room temperature. A reserve sample (approximately 1.0 grams) will be archived at EnviroSystems for a minimum of 10 years.

DILUTION WATER:

Water used for acclimation of test organisms and for all toxicity testing was sterile enriched media (U.S. EPA, 1978) with a pH of approximately 8.0. Results of chemical analysis of a representative sample of deionized water used to prepare the media are presented in Table 1.

TEST ORGANISM:

Algae used for the test was from a culture originally procured from the Culture Collection of Algae at the University of Texas at Austin and delivered to EnviroSystems on April 12, 1990. The identity of the culture was verified using an appropriate taxonomic key. The culture was transferred to sterile enriched media identical to media used for this test and maintained at test conditions.

TOXICITY TESTING:

The definitive toxicity test was performed during April 29 to May 3, 1991. It is based on procedures of the OECD (1984). The test was conducted at a target temperature of $22 \pm 2^\circ\text{C}$ with five concentrations of test substance and a dilution water control. A 1,000 mg/L stock solution was prepared in dilution water. The stock solution was added directly to dilution water contained in the test vessels without the use of a solvent. Nominal concentrations of the test material were: 0 mg/L (control), 62.5 mg/L, 125 mg/L, 250 mg/L, 500 mg/L, and 1,000 mg/L.

Table 1. Chemical characterization of a representative sample of deionized water used to prepare test media for toxicity test

Parameter	Unit of Measurement	Reporting Limit	Measured Value
Organochlorine pesticides	ug/L	2	ND
Organophosphorus pesticides	ug/L	0.5	ND
Polychlorinated biphenyls	ug/L	0.5	ND

Note: ND = not detected at or above the reporting limit.

Algae was randomly and equally distributed among three replicates of each treatment at the rate of 10,000 cells/ml. The test was performed in 250 ml glass Erlenmeyer flasks that contained 100 ml of test solution. The flasks were capped with inverted glass beakers. Test vessels were randomly arranged on a rotary shaker in an incubator during the 96 hour test (a random numbers table was used to select the location of each vessel). A 24 hour light and 0 hour dark photoperiod was maintained with cool-white fluorescent lights that provided a light intensity of $40 \mu\text{Es}^{-1}\text{m}^{-2}$.

The number of algal cells/ml in each test vessel was determined visually every 24 hours by means of direct microscopic counts with a hemacytometer. The pH (Beckman model pH 12 meter) was determined in each test flask at the beginning and end of the test, and temperature (ASTM mercury thermometer) was measured and recorded daily in the incubator.

STATISTICAL METHODS:

Results of the toxicity test were interpreted by standard statistical techniques (Stephan, 1983). The binomial or moving average method was used by the author to calculate EC50 values using nominal concentrations of test substance. The NOEC was calculated using Dunnett's test, which includes a parametric one-way analysis of variance (ANOVA). The average specific growth rate was calculated as the natural log of the number of cells per ml at 96 hours minus the natural log of the number of cells per ml at 0 hours divided by the exposure period. The percent change from control is calculated by subtracting the sample average specific growth rate from the control average specific growth rate, dividing that value by the average specific growth rate in the control and multiplying that value by 100. The percent change from control was used to compute EC50 and NOEC values.

VI. RESULTS

Biological and water quality data generated by the acute toxicity test are presented in Table 2 and Appendix A, respectively, and the percent of control and average specific growth rate information is presented in Table 3.

The 24, 48, 72, and 96 hour EC50s for algae exposed to FM 3820 are presented in Table 4. The 72 hour EC50 is 284 mg/L, and the 72 hour NOEC is less than 62.5 mg/L FM 3820. The 96 hour EC50 is 255 mg/L and the 96 hour NOEC is 125 mg/L.

Table 2. Growth data from toxicity test

Nominal Concentration ($\mu\text{g/L}$)	rep.	Number of Cells per Milliliter $\times 10^3$ (hour)				
		0	24	48	72	96
0.0 (control)	1	10	26	45	224	486
	2	10	20	54	222	426
	3	10	22	56	320	432
	mean	10	23	52	255	448
62.5	1	10	10	76	88	222
	2	10	12	58	104	168
	3	10	6	62	120	204
	mean	10	9	65	104	198
125	1	10	10	66	92	312
	2	10	12	70	106	296
	3	10	10	54	86	234
	mean	10	11	63	95	281
250	1	10	18	54	127	214
	2	10	14	62	130	256
	3	10	22	62	122	194
	mean	10	18	59	126	221
500	1	10	16	36	26	10
	2	10	12	34	44	22
	3	10	10	32	52	4
	mean	10	13	34	41	12
1,000	1	10	8	16	8	10
	2	10	10	14	12	14
	3	10	8	14	8	10
	mean	10	9	15	9	11

Table 3. Percent change from control and average specific growth rate from toxicity test

Nominal Concentration of Test Substance (mg/L)	Average specific growth rate				Percent change from control			
	24hr	48hr	72hr	96hr	24hr	48hr	72hr	96hr
0.0 (control)	0.034	0.034	0.045	0.040	0	0	0	0
62.5	0.000	0.039	0.033	0.031	100	15	27	22
125	0.003	0.039	0.031	0.035	91	15	31	12
250	0.025	0.037	0.035	0.032	26	9	22	20
500	0.010	0.026	0.020	0.002	71	24	56	95
1,000	0.000	0.008	0.000	0.001	100	76	100	98

Table 4. Median effective concentrations (EC50s) from toxicity test

Exposure period	EC50	95 percent confidence limits	Calculation method
24 hours	<62.5 mg/L	---	---
48 hours	707 mg/L	500 - 1,000 mg/L	binomial
72 hours	284 mg/L	249 - 325 mg/L	moving average
96 hours	255 mg/L	222 - 293 mg/L	moving average

VII. REFERENCES

OECD. 1984. Guidelines for Testing of Chemicals. Section 2: Effects on Biotic Systems. Method 201, Alga, Growth Inhibition Test. Adopted June 4, 1984.

Stephan, C.E. 1983. Computer program for calculation of LC50 values. Personal communication.

U.S. EPA. 1978. The *Selenastrum capricornutum* Printz Algal Assay Bottle Test. EPA-600/9-78-018. July, 1978.

Appendix A. WATER QUALITY DATA FROM TOXICITY TEST

Table A.1. Temperature measured during toxicity test

Day of Exposure	Temperature of Incubator, °C
0	23.0
1	23.0
2	23.0
3	23.0
4	23.1

Table A.2. pH measured during toxicity test

Nominal concentration (mg/L)	Replicate	pH	
		initial	final
0 (control)	1	8.0	10.3
	2	8.1	10.3
	3	8.2	10.3
62.5	1	8.0	7.2
	2	8.1	7.3
	3	8.1	7.2
125	1	8.3	7.2
	2	8.3	7.3
	3	8.3	7.3
250	1	8.1	7.2
	2	8.2	7.3
	3	8.2	7.3
500	1	8.2	7.2
	2	8.2	7.2
	3	8.0	7.2
1,000	1	8.1	7.2
	2	8.1	7.2
	3	8.1	7.2

*

Environmental Lab. Data Report Form

Form 10620-1.1-B-PWO

Parameter ~~95~~ IC50-Algae

Contract Laboratory	<u>ESI</u>
No. Tests	<u>8</u>
No. Hours (Env. Lab Only)	<u>1</u>
Analyst	<u>SAB</u>
QA Check	

LR #	Result	Unit	Date	Comments
J1608-7	IC50 350	mg/L	6/91	
	95% CI (320-390)			
J1608-8	IC50 360	mg/L	6/91	
	95% CI (310-410)			
J1608-3	IC50 87	mg/L	6/91	
	95% CI (73-99)			
J1608- 5 5	IC50 260	"	"	
	95% CI (220-290)			
J1608-4	IC50 14	"	"	
	95% CI (13-16)	"	"	
J1608-6	IC50 170	"	"	
	95% CI (150-180)	"	"	
J1608-1	IC50 > 1000	"	"	
	95% CI (-)			
J1608-2	IC50 91	"	"	
	95% CI (80-100)	"	"	

Form 10420-13-B-PWD

Parameter

Contract Laboratory

ESI

No. Tests

2

No. Hours (Env. Lab Only)

1

Analysis

SAR

QA Check

[illegible]

MATERIAL SAFETY 3M
DATA SHEET 3M Center
(Intermediate) St. Paul, Minnesota
55144-1000
1-800-364-3577 or (651) 737-6501 (24 hours)

Copyright, 2000, Minnesota Mining and Manufacturing Company.
All rights reserved. Copying and/or downloading of this
information for the purpose of properly utilizing 3M products
is allowed provided that:

- 1) the information is copied in full with no changes unless
prior agreement is obtained from 3M, and
- 2) neither the copy nor the original is resold or otherwise
distributed with the intention of earning a profit thereon.

DIVISION: SPECIALTY MATERIALS MANUFACTURING DIV.

MATERIAL:

FLUOROCHEMICAL SALT FM-3820 F-8656 FM-4547 FM-4581 F-9459

ID NUMBER: 41-2600-8656-0 41-2600-9459-8 41-2700-3820-5 41-2700-4547-3
41-2700-4581-2

ISSUED: February 29, 2000

SUPERSEDES: February 15, 2000

DOCUMENT: 04-1601-6

1. INGREDIENT	C.A.S. NO.	PERCENT
DIETHYLENE GLYCOL BUTYL ETHER.....	112-34-5	35 - 40
WATER.....	7732-18-5	35 - 40
PERFLUOROALKYL SULFONATE SALTS.....	TradeSecret	24 - 28
RESIDUAL ORGANIC FLUOROCHEMICALS.....	Mixture	Unknown

The components of this product are in compliance with the chemical
notification requirements of TSCA. All applicable chemical
ingredients in this material are listed on the European Inventory of
Existing Chemical Substances (EINECS), or are exempt polymers whose
monomers are listed on EINECS.

This product contains the following toxic chemical or chemicals subject to
the reporting requirements of Section 313 of Title III of the Emergency
Planning and Community Right-To-Know Act of 1986 and 40 CFR Part 372:

DIETHYLENE GLYCOL BUTYL ETHER

2. PHYSICAL DATA

BOILING POINT:..... > 212 F
VAPOR PRESSURE:..... < 18 mmHg
@68F
VAPOR DENSITY:..... N/D
EVAPORATION RATE:..... N/D
SOLUBILITY IN WATER:..... apprec.
SPECIFIC GRAVITY:..... 1.08 Water=1

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

MSDS: FLUOROCHEMICAL SALT FM-3820 F-8656 FM-4547 FM-4581 F-9459

2. PHYSICAL DATA (continued)

PERCENT VOLATILE:..... 72 %
pH:..... 10 - 10.5
VISCOSITY:..... < 100 centipoise
MELTING POINT:..... N/A

APPEARANCE AND ODOR:
Slightly tinted liquid with butyl carbitol odor.

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:..... > 212 F CC
estimated
FLAMMABLE LIMITS - LEL:..... N/D
FLAMMABLE LIMITS - UEL:..... N/D
AUTOIGNITION TEMPERATURE:..... N/D

EXTINGUISHING MEDIA:
Water spray, Carbon dioxide, Dry chemical, Foam

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
See Hazardous Decomposition section for products of combustion.

4. REACTIVITY DATA

STABILITY: Stable

INCOMPATIBILITY - MATERIALS/CONDITIONS TO AVOID:
None known.

HAZARDOUS POLYMERIZATION: Hazardous polymerization will not occur.

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon Monoxide and Carbon Dioxide, Oxides of Sulfur, Hydrogen Fluoride, Toxic Vapors, Gases or Particulates.

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:

Observe precautions from other sections. Ventilate area. Contain spill. Cover with absorbent material. Collect spilled material. Clean up residue with water. Place in a closed container.

RECOMMENDED DISPOSAL:

Incinerate in an industrial or commercial facility. Combustion products will include HF.

ENVIRONMENTAL DATA:

BIODEGRADATION:

Chemical Oxygen Demand (COD): 1.00 g/g
5-Day Biochemical Oxygen Demand (BOD5): 0.170 g/g
10-Day Biochemical Oxygen Demand (BOD10): 0.355 g/g
20-Day Biochemical Oxygen Demand (BOD20): 0.531 g/g
28-Day Biochemical Oxygen Demand (BOD28): 0.428 g/g

AQUATIC TOXICITY:

Fathead minnow (*Pimephales promelas*) 96-hr LC50: 9.3 mg/L
Water flea (*Daphnia magna*) 48-hr EC50: 115 mg/L
Algae (*Selenastrum capricornutum*) 72-hr IC50: 380 mg/L
Microtox (*Photobacterium phosphoreum*) 30-min EC50: > 1000 mg/L
Activated Sludge Respiration Inhibition 3-hr EC50: > 1000 mg/L

REGULATORY INFORMATION:

Volatile Organic Compounds: N/D.
VOC Less H2O & Exempt Solvents: N/D.

Since regulations vary, consult applicable regulations or authorities before disposal. In the event of an uncontrolled release of this material, the user should determine if the release qualifies as a reportable quantity. U.S. EPA Hazardous Waste Number = None (Not U.S. EPA Hazardous).

The components of this product are in compliance with the chemical registration requirements of: TSCA, EINECS, CDSL, AICS, MITI.

OTHER ENVIRONMENTAL INFORMATION:

This product contains one or more organic fluorochemicals that have the potential to resist degradation and persist in the environment.

EPCRA HAZARD CLASS:

FIRE HAZARD: No PRESSURE: No REACTIVITY: No ACUTE: Yes CHRONIC: No

6. SUGGESTED FIRST AID

EYE CONTACT:

Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

SKIN CONTACT:

Flush skin with large amounts of water. If irritation persists, get medical attention.

INHALATION:

Remove person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, get immediate medical attention.

IF SWALLOWED:

If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

7. PRECAUTIONARY INFORMATION

EYE PROTECTION:

Avoid eye contact with vapor, spray, or mist. Wear vented goggles.

SKIN PROTECTION:

Avoid skin contact. Wear appropriate gloves when handling this material. A pair of gloves made from the following material(s) are recommended: butyl rubber, neoprene. Use one or more of the following personal protection items as necessary to prevent skin contact: apron, coveralls. Protective garments (other than gloves) should be made of either of the following materials: polyethylene/polyvinylidene chloride (Saranex).

RECOMMENDED VENTILATION:

If exhaust ventilation is not adequate, use appropriate respiratory protection. Provide ventilation adequate to control vapor concentrations below recommended exposure limits and/or control spray or mist.

RESPIRATORY PROTECTION:

Avoid breathing of airborne material. Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half-mask organic vapor respirator with dust/mist prefilter, full-face organic vapor respirator with dust/mist prefilter.

7. PRECAUTIONARY INFORMATION (continued)

PREVENTION OF ACCIDENTAL INGESTION:

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

RECOMMENDED STORAGE:

Store away from areas where product may come into contact with food or pharmaceuticals. Store at temperatures below 120 degrees F (49 degrees C). Store at temperatures above 32 degrees F (0 degrees C). Keep container closed when not in use. Keep container in well-ventilated area.

FIRE AND EXPLOSION AVOIDANCE:

Keep container tightly closed. Keep away from heat, sparks, open flame, and other sources of ignition. Combustible liquid and vapor.

OTHER PRECAUTIONARY INFORMATION:

No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS.

HMS HAZARD RATINGS: HEALTH: 2 FLAMMABILITY: 0 REACTIVITY: 0
PERSONAL PROTECTION: X (See precautions, section 7.)

EXPOSURE LIMITS

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
DIETHYLENE GLYCOL BUTYL ETHER.....	35	PPM	TWA	CMRG	
WATER.....	NONE	NONE	NONE	NONE	
PERFLUOROALKYL SULFONATE SALTS.....	0.1	MG/M3	TWA	3M	Y
RESIDUAL ORGANIC FLUORO-CHEMICALS.....	0.1	MG/M3	TWA	3M	Y

* SKIN NOTATION: Listed substances indicated with 'Y' under SKIN refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:

- 3M: 3M Recommended Exposure Guidelines
- CMRG: Chemical Manufacturer Recommended Exposure Guidelines
- NONE: None Established

8. HEALTH HAZARD DATA

EYE CONTACT:

Severe Eye Irritation: signs/symptoms can include redness, swelling, pain, tearing, cloudy appearance of the cornea, impaired vision and possible permanently impaired vision.

SKIN CONTACT:

Mild Skin Irritation: signs/symptoms can include redness, swelling, and itching.

May be absorbed through the skin and produce effects similar to those caused by inhalation and/or ingestion.

INHALATION:

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Single overexposure, above recommended guidelines, may cause:

Irritation (upper respiratory): signs/symptoms can include soreness of the nose and throat, coughing and sneezing.

IF SWALLOWED:

Animal studies conducted on organic fluorochemicals which are present in this product indicate effects including liver disturbances, weight loss, loss of appetite, lethargy, and neurological, pancreatic, adrenal and hematologic effects. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

Ingestion may cause:

Aspiration Pneumonitis: signs/symptoms can include coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE INCLUDED ON THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD, THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT.

Ingestion may cause:

Irritation of Gastrointestinal Tissues: signs/symptoms can include pain, vomiting, abdominal tenderness, nausea, blood in vomitus, and blood in feces.

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue, blurred vision,

Abbreviations: N/A, Not Determined

8. HEALTH HAZARD DATA (continued)

slurred speech, giddiness, tremors and convulsions.

OTHER HEALTH HAZARD INFORMATION:

This product contains one or more organic fluorochemicals that have the potential to be absorbed and remain in the body for long periods of time, either as the parent molecule or as metabolites, and may accumulate with repeated exposures. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

The presence of organic fluorochemicals in the blood of the general population and subpopulations, such as workers, has been published dating back to the 1970's. 3M's epidemiological study of its own workers indicates no adverse effects.

SECTION CHANGE DATES

PHYSICAL DATA SECTION CHANGED SINCE February 15, 2000 ISSUE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information, 3M makes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the MSDS available directly from 3M.