AR 226-0585

Voluntary Use and Exposure Information Profile
N-ethyl perfluorooctanesulfonamido ethyl methacrylate

I. CHEMICAL IDENTIFICATION

Chemical Name: N-ethyl perfluorooctanesulfonamido ethyl methacrylate (EtFOSEMA)
CAS Number: 376-14-7

II. COMPANY IDENTIFICATION

Company Name: 3M

Site Location: 10746 Innovation Road
Cottage Grove, MN 55016

1400 State Docks Road
Decatur, AL 35601

Technical Contact: W.A. Weppner
Phone: 651/733-6374
Address: 3M Center, Building 236-1B-10
St. Paul, MN 55144

III. ON-SITE ACTIVITIES

CAS #	Mfg. (1997)	Imported
376-14-7*	< 100M lbs.	0

Estimate the amount of subject chemical distributed off-site: 0

*Submitted in 1998 TSCA IUR.

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Narrative Description and Process Flow Schematic:

3M Company utilizes a process known as Simons Electro-Chemical Fluorination (ECF) to synthesize organofluorine molecules. In this process, organic feedstocks are dispersed in liquid, anhydrous hydrogen fluoride, and an electric current is passed through the solution, causing the hydrogen atoms on the molecule to be replaced with fluorine. The predominant components of the products created by this process have the same carbon skeletal arrangement as the feedstock used, but with all of the hydrogen atoms replaced by fluorine. However, fragmentation and rearrangement of the carbon skeleton can also occur and significant amounts of cleaved, branched and cyclic structures may be formed. The degree of fluorination of the organic feedstock is also dependent upon the specific carbon chain length of the feedstock and parameters of the ECF process such as electrical current and the length of time the process is run. It is possible to synthesize fully fluorinated or perfluoroorganic molecules where all of the hydrogen atoms of the hydrocarbon feedstock have been replaced by fluorine atoms. Using these perfluoroorganic molecules as basic building blocks, unique chemistries can be created by further reactions with functionalized hydrocarbon molecules.

3M has produced sulfonyl based fluorochemicals commercially for over 40 years using the ECF process. A basic building block of such products and the highest production volume fluorochemical 3M manufactures is perfluorooctanesulfonyl fluoride (POSF). The starting feedstock for this reaction is 1-octanesulfonyl fluoride.
(Reaction 1)

Reaction 1

$$C_8H_{17}S0_2F + 17\,HF \xrightarrow[ECF]{Energy} C_8F_{17}S0_2F + 17\,H_2$$

1-Octanesulfonyl fluoride Perfluorooctanesulfonyl fluoride

The electrochemical fluorination process yields about 35%-40% straight chain (normal) POSF, and a mixture of biproducts and waste of unknown and variable composition comprised of the following:

1) higher and lower straight-chain homologs, i.e., n-$CnF_2n_{+1}SO_2F$, e.g., $C_6F_{13}SO_2F$, $C_7F_{15}SO_2F$, $C_9F_{19}SO_2F$ which comprise about 7% of the process output

2) branched-chain, perfluoroalkylsulfonyl fluorides with various chain lengths, about 18-20% of the output

3) straight-chain, branched, and cyclic (non-functional) perfluoroalkanes and ethers, which comprise about 20-25% of the output

4) "tars" (high molecular weight fluorochemical byproducts) and other byproducts, including molecular hydrogen, which comprise about 10-15% of the output.

Because of slight differences in process conditions, raw materials, and equipment, the mixture produced by the electrochemical fluorination process varies somewhat from lot-to-lot and from plant-to-plant. The product that results from electrochemical fluorination is thus not a pure chemical but rather a mix of isomers and homologues. The commercialized POSF derived products are a mixture of approximately 70% linear POSF derivatives and 30% branched POSF derived impurities.

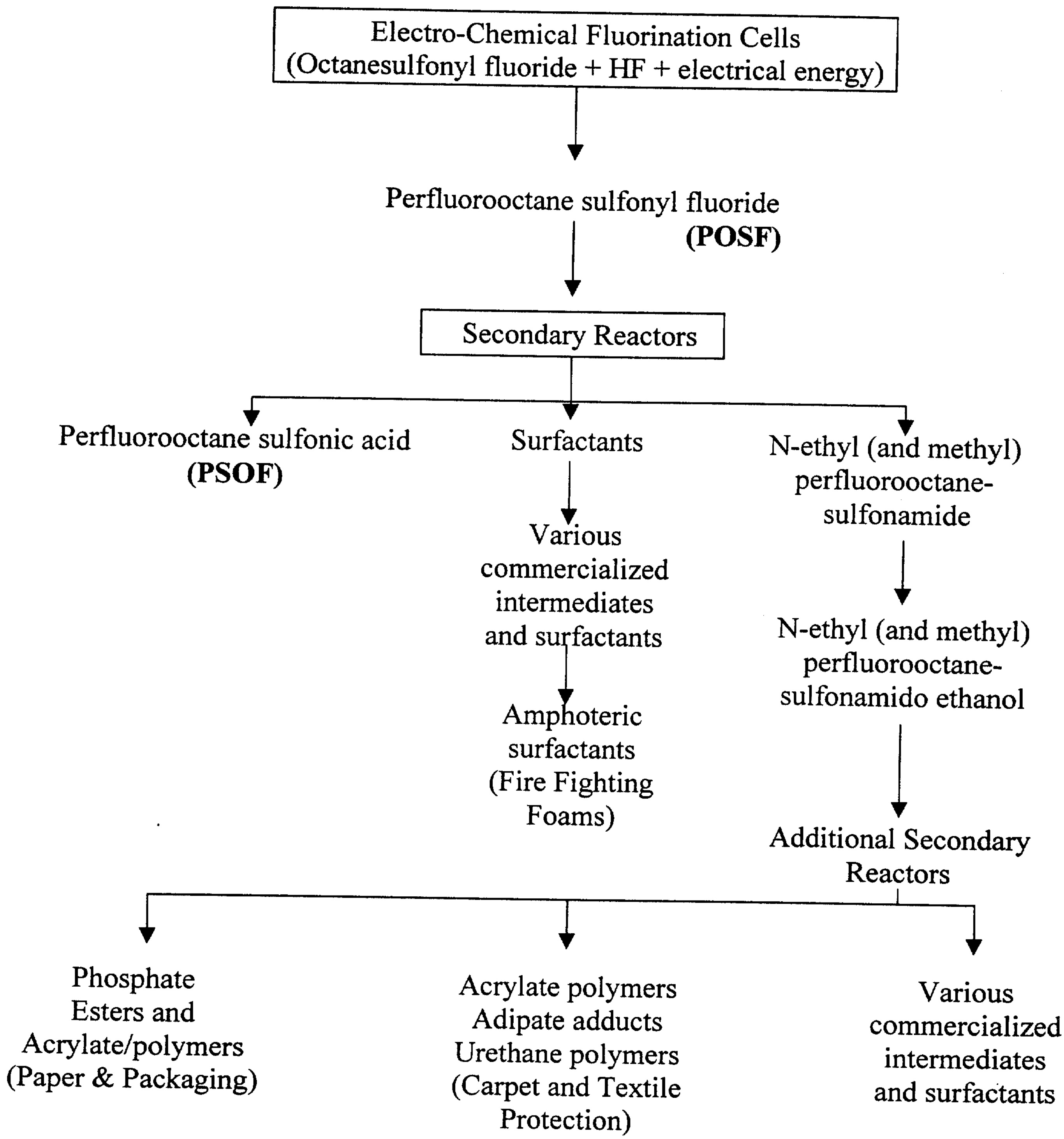
During production, byproducts and waste products are formed. The volatile waste products, such as perfluoromethane, have been vented to the atmosphere in the past, but plans are being implemented to capture and destroy these releases by thermal oxidation over the next few years. The tars have been landfilled in a hazardous waste landfill in the past, but are all currently being incinerated at an in-house or external hazardous waste incinerator. The byproducts, many of which are incompletely fluorinated with hydrogen atoms still present, can be recycled back into the ECF process or are partially degraded in stabilization processes and discharged to controlled, in-house, wastewater treatment systems. The treatment sludge associated with the ECF process has been either landfilled or land-incorporated in the past, but all of this treatment sludge is being landfilled off-site since early 1998.

POSF is itself a commercially viable product, but is primarily an important intermediate in the synthesis of substances used in many other 3M fluorochemical products. The majority is used to produce functionally derivatized fluorochemicals and high molecular weight polymeric products.

Unique chemistries can be created by derivatizing POSF through the sulfonyl fluoride moiety of the molecule using conventional hydrocarbon reactions. POSF is reacted with methyl or ethyl amine to produce either N-methyl or N-ethylperfluorooctanesulfonamide (MeFOSA or EtFOSA). Some of the MeFOSA and EtFOSA is isolated to be used as intermediates to be reacted to form other materials. The majority of the MeFOSA and EtFOSA is not isolated and subsequently reacted with ethylene carbonate to form either N-methyl or N-ethylperfluorooctane sulfonamido ethanol. These are the principal building blocks of the 3M product lines.

The following block flow diagram describes the process discussed above.

BLOCK FLOW DIAGRAM



IV. SITE RELEASE AND TRANSFER INFORMATION FOR TRI CHEMICALS

Not applicable.

V. SITE RELEASE AND TRANSFER INFORMATION FOR NON-TRI CHEMICALS

While analytical methods have improved over time, large variability still exists for certain matrices and compounds, so data available for this report is mostly of a qualitative nature. Although limited monitoring data exists, most emission and waste estimates are based upon process models and engineering calculations. Engineering calculations, however, have limitations with respect to fluorochemicals because fluorochemical losses were not always included in the analysis of each intermediate step.

The accuracy of the emissions data submitted varies due to several factors. Batch process systems are difficult to measure due to quickly changing process conditions, venting pressures and difficulty in isolating processes to take measurements. Additionally, the unique characteristics of these compounds cause them to behave differently from conventional compounds, and physical chemical data properties are not available for all intermediate reaction steps in the past.

A. ON-SITE AIR RELEASES

ALL PLANTS - Fugitive emissions may occur from vacuum charging from drums, sampling from reactors, drumming of product/intermediate, flaking monomer, drying operations. Materials may be handled in a molten or solid state; vapors are produced from molten material. Industrial hygiene monitoring has been conducted for some compounds. Some minor amounts of these compounds have been detected as fugitive emissions during industrial hygiene exposure testing.

Decatur, AL

Emission estimates are based upon existing process models and engineering calculations from the facility. Fugitive emissions may have occurred during some handling steps but have not been quantified.

	Estimated Total Annual Releases (lbs.)	**Estimated % Accuracy of Estimate** (optional)	**# days/years release occurs**
Fugitive – (non-point)	No data available.		
Stack (point)			

	Estimated Total Annual Releases (lbs.) (1997)	**Estimated % Accuracy of Estimate** (optional)	**# days/years release occurs**
	< 1		

Cottage Grove

Emission estimates are based upon existing process models and engineering calculations from the facility. Fugitive emissions may have occurred during some handling steps but have not been quantified.

	Estimated Total Annual Releases (lbs.) (1997)	**Estimated % Accuracy of Estimate** (optional)	**# days/years release occurs**
Fugitive (non-point)	No data available.		
Stack (point)	0		

Comments:

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B. WATER RELEASES FROM SITE

Decatur, AL

This chemical was not on the analyte list for wastewater treatment.

	Estimated Total Annual Releases (lbs.) (1997)	Estimated % Accuracy of Estimate (optional)
Water releases:	No data available.	

Number of days/year release occurs:

Receiving Water Name:

NPDES Number:

Comments:

Cottage Grove, MN

Engineering calculations were used to estimate the amount of material discharged to wastewater. The amount of material discharged to the river was determined through use of existing removal efficiency testing results from another facility.

	Estimated Total Annual Releases (lbs.) (1997)	Estimated % Accuracy of Estimate (optional)
Water releases:	0	

Number of days/year release occurs:

Receiving Water Name:

NPDES Number:

Comments:

C. ON-SITE LAND RELEASES

Decatur, AL

The land treatment of Decatur sludge was discontinued in early 1998. Sludge is now transported to an offsite landfill, after passing through a thickener and a sludge press. An impoundment was used in 1997 as part of the wastewater treatment operation but is now only used for back-up operation.

	Estimated Total Annual Releases (lbs.) (1997)	**Estimated % Accuracy of Estimate (optional)**
Landfill	0	
Land Treatment/Land Amendment	No data available/No longer used	
Surface Impoundments	No data available/No longer used	
Underground Injection	0	
Other (specify):		

Comments:

Cottage Grove, MN

Sludge from the Cottage Grove facility is sent to an off-site industrial landfill

	Estimated Total Annual Releases (lbs.) (1997)	**Estimated % Accuracy of Estimate (optional)**
Landfill	0	
Land Treatment/Land Amendment	0	
Surface Impoundments	0	
Underground Injection	0	
Other (specify):		

Comments:

D. OFF-SITE TRANSFERS

Decatur, AL

Process wastewaters are managed in an on-site wastewater treatment facility and are not sent to the POTW.

D1. Transfer to Publicly Owned Treatment Works (POTW)

Number of days/year the release occurs:

Annual Transfer (lb): 0

Estimated % Accuracy of Transfer Estimate (optional) (%):

POTW Name:
Street Address:
City: **Country:**
State: **Zip Code:**
NPDES Number:

Comments:

Cottage Grove, MN

Process wastewaters are managed in an on-site wastewater treatment facility and are not sent to the POTW.

D1. Transfer to Publicly Owned Treatment Works (POTW)

Number of days/year the release occurs:

Annual Transfer (lb): 0

Estimated % Accuracy of Transfer Estimate (optional) (%):

POTW Name:
Street Address:
City: **Country:**
State: **Zip Code:**
NPDES Number:

Comments:

D2. TRANSFERS TO OTHER OFF-SITE LOCATIONS

General Waste Information: There is limited information by CAS number for compound specific reporting and off-site transfers cannot be readily verified. Rather wastes are classified by halogen content, regulatory waste codes, physical properties and non-specific fluorochemical categories. Where wastes are tracked by CAS number, the amounts have been included.

Decatur, AL

A review of plant records regarding waste disposal locations for Decatur fluoride-containing wastes indicates that over 70% is disposed through incineration at various off-site locations and approximately 30% is landfilled at a hazardous waste landfill. Incineration is now the predominant disposal method for these materials.

	Estimated Total Annual Releases (lbs.)	**Estimated % Accuracy of Estimate** (optional)
Incineration:	No specific CAS numbers available.	
Wastewater Treatment (Excluding POTW)	0	
Underground Injection	0	
Hazardous Waste (RCRA Subtitle C) landfill	No specific CAS numbers available.	
Other Landfill	No specific CAS numbers available.	
Recycle or Recovery	0	
Unknown or Other	-	

Comments:

Cottage Grove, MN

Cottage Grove facility utilizes incineration for all their drummed wastes.

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)
Incineration:	No specific CAS numbers available..	
Wastewater Treatment (Excluding POTW)	0	
Underground Injection	0	
Hazardous Waste (RCRA Subtitle C) landfill	0	
Other Landfill	0	
Recycle or Recovery	0	
Unknown or Other		

Comments:

VI. ON-SITE WORKPLACE EXPOSURE

3M Company, Specialty Materials Manufacturing Division, Cottage Grove, MN

This information will assist EPA in characterizing the number of workers potentially exposed and the magnitude, frequency, and duration of potential exposure. When providing monitoring data, ensure that data is linked with worker activities described in question 2.

1. **Estimate the number of workers potentially exposed routinely to the subject chemical for each of the exposure duration times. If a worker is involved in more than one activity, enter only his/her most typical activity in the table. Don't count a worker more than once. The total number in the table should equal the total number of workers potentially exposed.**

	Days/Year			
Hours/Day	<10	10-100	100-250	>250
<.25	6			
.25-1	8			
1-8	8			
>8				

2. **Describe the routine worker activities to which the workers in question 1 are exposed: sampling, removal of filter cake, and drumming of liquids, manufacture an article, etc. For these activities, describe the physical state of the subject chemical (liquid, gas, particulate, or aerosol, etc.) and, if in a mixture, the chemical's concentration:**

   Vacuum charging from drums, sampling from reactor, drumming of product/intermediate, maintenance (changing flange, hose, pipe, valve, filter, pump or sight glass); materials may be handled in a molten or solid state or dissolved in organic solvents; vapors are produced from molten material; approximate concentration ranges from <1% to 80%.

3. **Provide industrial hygiene monitoring data, if available, with a brief description of the sampling method and exposure scenario monitored, e.g., describe the specific worker activities performed by the individuals monitored. For privacy considerations, please do not include any personal identifiers such as a worker's name or social security number with any data submitted to EPA.**

   There is no chemical-specific personal industrial hygiene monitoring data or area/source monitoring data for this specific material at this facility. For most areas of the facility, recent qualitative assessment of potential exposure to this material under 3M's ongoing industrial hygiene program indicates a low exposure potential to this material.

Each 3M plant that produces sulfonated fluorochemicals has an industrial hygienist on staff and is supported by a corporate industrial hygiene group. 3M's industrial hygiene program focuses on task-based exposure assessment and control. Exposures are identified and assessed qualitatively and/or quantitatively. Qualitative assessments are performed by an industrial hygienist. Quantitative assessments include task-based personal sampling for certain, specific fluorochemicals and/or source or area sampling. The results of the assessments support decisions on exposure control. Engineering controls are preferred, but personal protective equipment may be used on an interim basis or when effective engineering control is not feasible.

4. **Briefly describe the engineering controls used to minimize exposure to this chemical:**

Materials are transferred using closed piping (where possible) from reactor vessels to other containers. Vacuum charging of materials from drums is a standard practice. Positionable local exhaust ventilation hoods are situated at significant point sources such as at drum bungs when drumming. General room air provides for dilution of airborne materials.

5. **Briefly list the personal protective equipment your workers regularly wear to prevent exposure of this chemical:**

Process operating standards list the respirator (e.g., supplied air, organic vapor cartridge with particulate prefilter, or particulate filtering), glove by elastomer (e.g., neoprene or nitrile), chemical protective clothing (e.g., 2-piece PVC rainsuit), eye protection (e.g., chemical splash goggles with or without full faceshield depending on type of respirator used) to be used by the employee when the task involves exposure to a particular fluorochemical material.

Comments: (This section is available to clarify the responses given. Attach additional pages if desired.)

3M Company, Specialty Materials Manufacturing Division, Decatur, AL

This information will assist EPA in characterizing the number of workers potentially exposed and the magnitude, frequency, and duration of potential exposure. When providing monitoring data, ensure that data is linked with worker activities described in question 2.

1. **Estimate the number of workers potentially exposed routinely to the subject chemical for each of the exposure duration times. If a worker is involved in more than one activity, enter only his/her most typical activity in the table. Don't count a worker more than once. The total number in the table should equal the total number of workers potentially exposed.**

	Days/Year			
Hours/Day	<10	10-100	100-250	>250
<0.25				
0.25-1	4	4		
1-8		48	24	
>8				

2. **Describe the routine worker activities to which the workers in question 1 are exposed: sampling, removal of filter cake, and drumming of liquids, manufacture an article, etc. For these activities, describe the physical state of the subject chemical (liquid, gas, particulate, or aerosol, etc.) and, if in a mixture, the chemical's concentration:**

Vacuum charging from drums, sampling from reactor, drumming of product/intermediate, flaking monomer, maintenance (changing flange, hose, pipe, valve, filter, pump or sight glass); materials may be handled in a molten or solid state; vapors are produced from molten material; material concentration ranges up to 85%.

Wastewater treatment operations: collecting and analyzing QC samples, operating filter press, monitoring process, and maintenance activities; material typically present in waste stream at less than 1%.

3. **Provide industrial hygiene monitoring data, if available, with a brief description of the sampling method and exposure scenario monitored, e.g., describe the specific worker activities performed by the individuals monitored. For privacy considerations, please do not include any personal identifiers such as a worker's name or social security number with any data submitted to EPA.**

   There is no chemical-specific personal industrial hygiene monitoring data or area/source monitoring data for this specific material at this facility. For most areas of the facility, recent qualitative assessment of potential exposure to this material under 3M's ongoing industrial hygiene program indicates a low exposure potential to this material.

   Each 3M plant that produces sulfonated fluorochemicals has an industrial hygienist on staff and is supported by a corporate industrial hygiene group. 3M's industrial hygiene program focuses on task-based exposure assessment and control. Exposures are identified and assessed qualitatively and/or quantitatively. Qualitative assessments are performed by an industrial hygienist. Quantitative assessments include task-based personal sampling for certain, specific fluorochemicals and/or source or area sampling. The results of the assessments support decisions on exposure control. Engineering controls are preferred, but personal protective equipment may be used on an interim basis or when effective engineering control is not feasible.

4. **Briefly describe the engineering controls used to minimize exposure to this chemical:**

   Materials are transferred using closed piping (where possible) from reactor vessels to other containers. Vacuum charging of materials from drums is a standard practice. Local exhaust ventilation hoods are situated at significant point sources such as at drum bungs when drumming. Some equipment, such as the flaker, is equipped with local exhaust ventilation. General room air provides for dilution of airborne materials.

5. **Briefly list the personal protective equipment your workers regularly wear to prevent exposure of this chemical:**

Specific personal protective equipment is indicated on written operating procedures used by process operators.

Respiratory protection: Tasks with significant exposure potential (charging, drumming, some maintenance tasks) are performed using positive pressure, pressure demand full face supplied air respirators. Tasks with moderate exposure potential (short term sampling from taps or drums, and some maintenance tasks) are performed using full face air-purifying respirators with organic vapor cartridges and P100 prefilters.

Hand protection: All tasks identified as having potential for hand contact require neoprene (Scorpio) or nitrile industrial gloves.

Body protection: Exposure significant tasks use one or two-piece PVC suits. Aprons may be worn for some low exposure potential tasks such as sampling.

Foot protection: Tasks identified as posing a significant foot exposure potential require chemical resistant boots.

Comments: (This section is available to clarify the responses given. Attach additional pages if desire

VII. CHEMICAL END USES

A. END USE AS AN INTERMEDIATE CONSUMED TO MAKE OTHER CHEMICALS

A1. On-Site Use as a Intermediate:

N-ethyl perfluorooctanesulfonamido ethyl methacrylate is used in four different processes to react or copolymerize yielding the following product chemicals. These chemicals are intermediates for final products listed in the end use section.

	Product chemical class or product chemical (Include CAS number if appropriate)	% of total volume of subject chemical manufactured or imported
1.	Fluoromethacrylate oxide	10%
2.	Fluoroaliphatic polymericesters	17%
3.	Fluorinated alkyl ester	12%
4.	Fluorinated alkyl acrylate	60%

As reported in Part III, p.2

A2. Off-Site Use as an Intermediate

Used as a reactive intermediate in the industrial synthesis of chemicals and fluoropolymers used as textile treating resins, paper sizings and surfactants.

	Product chemical class or product chemical (Include CAS number if appropriate)	% of total volume of subject chemical manufactured or imported
1.	Fluorinated alkyl methacrylate	< 1%

As reported in Part III, p.2

B. END USES OTHER THAN AS A CONSUMED INTERMEDIATE

Use Number 1 of 3

Description of Chemical End Use: Fire fighting professionals use fire fighting foams to aid wetting of water for fire extinguishment and vapor suppression. This chemical is present as a low level residual.

Percent of total manufactured or imported Volume going to this use: < 1

If used in a mixture check appropriate box to indicate weight fraction. Average values are acceptable:

X <1%
___ 1-30%
___ 30-60%
___ 60-90%
___ >90%

Check all physical forms of the chemical during this use:

___ Aerosol
___ Dry Powder
___ Pellets or large crystals
___ Water or solvent – wet solid
___ Gas or vapor
X Liquid solution
___ Other (Explain)

Use Number 2 of 3

Description of Chemical End Use: Film manufacturers use this chemical as a surfactant to improve the wetting of protective coatings.

Percent of total manufactured or imported volume going to this use: < 1

If used in a mixture check appropriate box to indicate weight fraction. Average values are acceptable:

X <1% (0.25%)
___ 1-30%
___ 30-60%
___ 60-90%
___ >90%

Check all physical forms of the chemical during this use:

___ Aerosol
___ Dry Powder
___ Pellets or large crystals
___ Water or solvent – wet solid
___ Gas or vapor
X Liquid solution
___ Other (Explain)

Use Number 3 of 3

Description of Chemical End Use: Film manufacturers use this chemical as a surfactant to improve the wetting of protective coatings.

Percent of total manufactured or imported volume going to this use: < 1

If used in a mixture check appropriate box to indicate weight fraction. Average values are acceptable:

_X_ <1%
___ 1-30%
___ 30-60%
___ 60-90%
___ >90%

Check all physical forms of the chemical during this use:

___ Aerosol
___ Dry Powder
___ Pellets or large crystals
___ Water or solvent – wet solid
___ Gas or vapor
_X_ Liquid solution
___ Other (Explain)