Indirect precusors of perfluoroalkane sulfonic acids (PFSA) (C5-C7): Human health tier II assessment

03 July 2015

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
2-Propenoic acid, 2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl ester	1893-52-3
1-Hexanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-(2-hydroxyethyl)-	34455-03-3
1-Propanaminium, N-(2-hydroxyethyl)-N,N-dimethyl-3-[(3-sulfopropyl)[(tridecafluorohexyl)sulfonyl]amino]-, hydroxide, inner salt	38850-58-7
1-Propanaminium, N,N,N-trimethyl-3-[[(tridecafluorohexyl)sulfonyl]amino]-, chloride	52166-82-2
Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	56372-23-7
2-Propenoic acid, 2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl ester	59071-10-2

Chemical Name in the Inventory	CAS Number
1-Propanaminium, N,N,N-trimethyl-3-[[(undecafluoropentyl)sulfonyl]amino]-, chloride	68957-55-1
1-Propanaminium, N,N,N-trimethyl-3-[[(undecafluoropentyl)sulfonyl]amino]-, iodide	68957-57-3
1-Propanaminium, N,N,N-trimethyl-3-[[(tridecafluorohexyl)sulfonyl]amino]-, iodide	68957-58-4
1-Pentanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-, monohydrochloride	68957-60-8
1-Hexanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-, monohydrochloride	68957-61-9
Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-methoxy-	68958-60-1
Glycine, N-ethyl-N-[(undecafluoropentyl)sulfonyl]-, potassium salt	67584-52-5
Glycine, N-ethyl-N-[(tridecafluorohexyl)sulfonyl]-, potassium salt	67584-53-6
1-Propanaminium, N,N,N-trimethyl-3-[[(pentadecafluoroheptyl)sulfonyl]amino]-, iodide	67584-58-1
Glycine, N-ethyl-N-[(pentadecafluoroheptyl)sulfonyl]-, potassium salt	67584-62-7
1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxy)ethyl]-	67923-61-9
1-Pentanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-[2-(phosphonooxy)ethyl]-	67939-90-6
1-Heptanesulfonamide, N,N',N''-[phosphinylidynetris(oxy-2,1-ethanediyl)]tris[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-	67939-94-0

Chemical Name in the Inventory	CAS Number
1-Heptanesulfonamide, N,N'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-, ammonium salt	67939-97-3
1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxy)ethyl]-, diammonium salt	67939-98-4
1-Heptanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-, monohydrochloride	67940-02-7
1-Hexanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-[2-(phosphonooxy)ethyl]-	67969-65-7
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	68259-38-1
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	68259-39-2
2-Propenoic acid, 2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl ester	68298-06-6
Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	68298-80-6
Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	68298-81-7
Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-	68310-17-8
Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-[[(pentadecafluoroheptyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt	68541-01-5
Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-[[(undecafluoropentyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt	68541-02-6
1-Pentanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-(2-hydroxyethyl)-	68555-72-6

Chemical Name in the Inventory	CAS Number
1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-(2-hydroxyethyl)-	68555-73-7
1-Pentanesulfonamide, 1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-(2-hydroxyethyl)-N-methyl-	68555-74-8
1-Hexanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-(2-hydroxyethyl)-N-methyl-	68555-75-9
1-Heptanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-(2-hydroxyethyl)-N-methyl-	68555-76-0
1-Propanaminium, N,N,N-trimethyl-3-[[(pentadecafluoroheptyl)sulfonyl]amino]-, chloride	68555-81-7
Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-[[(tridecafluorohexyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt	68815-72-5
Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(pentadecafluoroheptyl)sulfonyl]glycinato-O1:O1']]-.mu.-hydroxybis(2-propanol)-	68891-97-4
Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(tridecafluorohexyl)sulfonyl]glycinato-O1:O1']]-.mu.-hydroxybis[2-propanol]di-	68891-98-5
Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(undecafluoropentyl)sulfonyl]glycinato-O1:O1']]-.mu.-hyroxybis[2-propanol]di-	68891-99-6
1-Propanesulfonic acid, 3-[[3-(dimethylamino)propyl][(tridecafluorohexyl)sulfonyl]amino]-2-hydroxy-, monosodium salt	73772-32-4
1-Propanaminium, N-(2-hydroxyethyl)-3-[(2-hydroxy-3-sulfopropyl)[(tridecafluorohexyl)sulfonyl]amino]-N,N-dimethyl-, hydroxide, monosodium salt	81190-38-7

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group are both non-polymeric substances and side-chain fluorinated polymers containing 5–7 perfluorinated carbons linked to a sulfonic ester or sulfonamide group.

NICNAS has developed an action plan to assess and manage chemicals which might degrade to perfluorinated carboxylic acids (PFCAs), perfluoroalkane sulfonic acids (PFSAs) or similar chemicals. The action plan can be found in Appendix G of the *Handbook for notifiers* on the NICNAS website (NICNASa). The primary assumption outlined in this plan is that chemicals with a perfluorinated chain terminated by a sulfonyl group will degrade to PFSAs of the same chain length. On this basis, the chemicals in this group have the potential to degrade into a range of environmentally persistent PFSA anions (namely perfluoropentane sulfonate, perfluorohexane sulfonate or perfluoroheptane sulfonate anions) and, therefore, are considered to be indirect precursors of PFSAs (C5–C7).

The degradation of PFSAs is very slow compared with their rate of formation from precursor degradation, and PFSAs will be the final degradant from all of these precursors. Therefore, the amount of the PFSAs in the environment (general or local) is expected to be higher than that of any of the individual precursors. Whilst fluorinated polymers generally do not present significant risks, direct exposure to the non-polymeric substances in this group could pose health risks. However, the available

information indicates that any use of these non-polymers is in small volume and/or low concentrations in Australia (see **Australian import, manufacture and use**). Consequently, the most important health risk is expected to arise from secondary exposure to PFSAs through the environment. As such, the focus of this assessment is on the long-term effects of the chemicals due to the chemicals degrading to PFSAs (C5–C7). Acute and local effects have not been considered.

Direct precursors of PFSAs (C5–C7) have been assessed earlier in order to compare their toxicity profile with that of perfluorooctane sulfonic acid (PFOS) (NICNASb).

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified. However, general information on the use of PFSAs has been reported. The most recent data collected by NICNAS indicate that PFSAs are predominantly used in Australia in mist suppressants for the metal plating industry and in fire fighting foams. Approximately 60 tonnes of fire fighting foams containing perfluoroalkyl sulfonates at concentrations up to 5 % were held in Australia in 2007. Other uses included carpet treatments, curatives, industrial coatings and printing inks (NICNAS, 2013).

In 2004, it was reported that 1.6 tonnes of PFSAs and related chemicals were imported into Australia. By 2007, the imported quantity of these chemicals had increased to 13.6 tonnes. It was reported that the majority of these imports were of chemicals based on the C4 homologue, perfluorobutanesulfonic acid (PFBS). The chemicals in this group are not manufactured in Australia (NICNAS, 2013).

It is noted that some of the chemicals in this group could be present in the environment due to historic use, due to release from articles or as breakdown products resulting from using other indirect precursor chemicals covered in this assessment.

International

Due to their unique chemical properties perfluorinated chemicals and their precursors have found use in a wide range of industrial applications. However, concerns regarding the persistence and bioaccumulation hazards of long-chain perfluoroalkyl sulfonates resulted in the largest manufacturer of these chemicals ceasing their production in 2002 (Buck, et al., 2011). This is expected to have significantly reduced global supply of C6 and C7 perfluoroalkyl sulfonate derivatives. It should be noted, however, that perfluorohexanesulfonyl fluoride (CAS No. 423-50-7) is a likely precursor for many of the chemicals in this group and this chemical was reportedly produced in the United States in 2008 (OECD, 2011). Current production volumes of C5 perfluoroalkyl sulfonate derivatives are unclear. A number of the chemicals in this group are pre-registered under the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) legislation, but none have been registered under the REACH legislation at the time of assessment.

Nevertheless, many perfluoroalkyl sulfonamides and their derivatives appear to be used in the production of other fluorochemical products, such as surfactant materials (Buck, et al., 2011). The N-alkyl perfluoroalkanesulfonamide acrylates, such as CAS Nos 59071-10-2, 1893-52-3 and 68298-06-6, are reported to be used as co-monomers in the synthesis of acrylic polymers that are used in surface protection applications (Buck, et al., 2011). In addition, use of the three perfluoroalkyl sulphonamide acetate salts in this group (CAS RNs 67584-52-5, 67584-53-6 and 67584-62-7) was reported in 2012 in Denmark (SPIN). Data available for the homologous C8 perfluoroalkyl sulphonamide acetate salt suggest these chemicals may have use in surface treatments, cleaning products and floor waxes (NICNASc).

Less information is available for the remaining chemicals in this group. However, it is noted that data for the homologous C8 chemicals suggest the perfluoroalkyl sulfonamide phosphate esters may be used in fabric paper treatments, paints, lacquers and varnishes, while the polyglycol derivatives may be used in surfactant preparations (NICNASc).

No evidence of the presence of these chemicals in consumer products was found in the available North American databases (Household Products Database and Personal Care Council), indicating that the chemicals are not likely to be widely available for domestic or cosmetic uses.

Restrictions

Australian

No known mandatory restrictions have been identified.

Measures taken to date to reduce the importation and use of PFSA compounds and their salts and precursors has largely been through NICNAS recommendations (published as alerts as part of NICNAS Factsheets) since 2002 and subsequent voluntary action by industry. The latest NICNAS alert Factsheet (published in 2008) recommended that PFOS- and related PFSA-based chemicals be restricted to only essential uses for which no suitable or less hazardous alternatives were available (NICNAS, 2013).

International

In the United States of America (USA), all the chemicals in this group are subject to a Significant New Use Rule (SNUR). These SNURs allow the continuation of a few limited, highly technical uses of these chemicals for which no alternatives are available, and which are characterised by very low volume, low exposure, and low releases. Any other uses of these chemicals required prior notice to, and review by, the US Environmental Protection Agency (EPA) (US EPA, 2002; US EPA, 2007). The EPA is currently proposing to modify this existing SNUR to make inapplicable the exemption for persons who import PFSA chemical substances as a component of carpets (US EPA, 2015).

In Canada, substances having perfluoroheptyl derivatives with the formula C7F15 as a structural element, except those derivatives with the formula C7F15 X, where X = F, Cl, Br are listed under Schedule 1 (the Toxic Substances List) of the Canadian Environmental Protection Act 1999 (Government of Canada, 1999).

In Europe, a proposal to ban the manufacture, use and placing on the market as substances on their own, as constituents of other substances, in a mixture or in articles is being considered for substances having linear or branched perfluoroheptyl derivatives with the formula C7F15 as a structural element, including its salts except those derivatives with the formula C7F15 X, where X= F, Cl, Br (ECHA, 2015).

Whilst perfluorooctane sulfonate (PFOS) is restricted in several countries, the chemicals in this group are not covered by these restrictions.

Existing Worker Health and Safety Controls

Hazard Classification

The chemicals are not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standards are available for the chemicals in this group.

International

No specific exposure standards are available for the chemicals in this group.

Health Hazard Information

Toxicological data for this group of chemicals are not available. Whilst direct exposure to fluorinated polymers generally does not present significant risks, direct exposure to the non-polymeric substances in this group could pose health risks. However, the available information indicates that any use of these non-polymers is in small volume and/or low concentrations in Australia. Therefore, the primary health risk for the chemicals in this group is expected to arise from secondary exposure to PFSAs (C5–C7) (see **Grouping rationale**). Both PFOS and perfluorohexanesulfonate (PFHxS) are well absorbed by the digestive tract and are mainly accumulated in the liver, followed by plasma, kidneys and lungs. Once absorbed, these perfluorinated chemicals (PFCs) are eliminated from the human body very slowly. Mean elimination half-lives of PFOS of up to 8.7 years have been reported in retired workers, with a lower values (5.4 years (arithmetic mean) and 4.8 years (geometric mean) reported in more recent sampling. The mean elimination half-life of PFHxS was 7–8 years (Sundstrom et al., 2012; NICNASb).

Biomonitoring studies have shown that exposure in the general population is widespread and that PFHxS and PFOS are the PFSAs commonly present in human serum (Calafat et al., 2006; Fromme et al., 2007; Kato et al., 2011). In pooled human sera from the Australian population, PFOS was the highest PFSA detected, with concentrations of 4.4–17.4 ng/mL. PFHxS levels ranged from 1.2–5.7 ng/mL (08/09) and 1.4–5.4 ng/mL (10/11). Median levels of PFHxS have not significantly changed from 2002 (Toms et al., 2014).

Perfluoroalkyl compounds have been found in human breast milk, but there are no studies that looked at whether a baby's health was affected by drinking this milk. Levels of perfluoroalkyls in breast milk are much lower than in the mother’s blood, indicating that these substances are not concentrated during milk production (ATSDR, 2009).

Where available, hazard data for PFHxS can be used to estimate hazards for this group's chemical degradation products that contain five or six perfluorinated carbons. In the absence of toxicological data, PFOS hazard information is used to estimate systemic hazards.

Risk Characterisation

Critical Health Effects

The critical health effects for the chemicals in this group are considered to be long-term due to the degradation to PFSAs (C5–C7). Acute and local effects have not been considered.

Data available for the direct precursors of PFSA (C5–C7) (NICNASb) indicate that there is the potential for systemic long-term effects (hepatotoxicity) at low doses and possible carcinogenicity. The chemicals in this group with ≤6 perfluorinated carbon chains were not considered to be reproductive/developmental toxins at low dose levels. However, in the absence of information for the chemicals with >6 perfluorinated carbons, developmental effects similar to those observed for PFOS cannot be ruled out (NICNASb).

Public Risk Characterisation

Use in consumer products

Significant direct exposure of the public to the chemicals is not expected. Whilst the public can be exposed to articles treated with the polymers in this group, these are not expected to present significant risks while in polymeric form. Hence, the public risk from these chemicals is not considered to be unreasonable.

Secondary exposure to PFSA via the environment

The primary health risk is expected to arise from secondary, long-term exposure to the degradation products (PFSAs (C5–C7)) from the chemicals in this group.

It is noted that these chemicals could be present in the environment due to historic use, or due to release from articles or the use of other indirect precursor chemicals covered by this assessment. Median levels of PFHxS in Australian blood sera have not significantly changed from 2002. In addition, PFHxS was not detected in a survey of 65 foods and beverages packaged in glass, paper, plastic or cans conducted by Food Standards Australia New Zealand (NICNASb).

The PFSA degradants of the chemicals in this group have been identified as persistent and are known to be, or may be, highly bioaccumulative (NICNASd). Chemicals which are persistent and bioaccumulative remain in the environment and accumulate in biota over an extended period of time, even if new emissions of the chemicals cease. These characteristics can result in very high internal concentrations in exposed organisms, which may cause long-term toxic effects that are not readily identified through standard testing protocols. Chemicals with these hazard characteristics are, therefore, considered to be of concern for the environment (NICNASd).

Occupational Risk Characterisation

Based on the available use information, the chemicals or their products are not manufactured in Australia. Therefore, the non-polymer chemicals are not likely to be used by workers in significant quantities in Australia. Perfluorinated polymers generally do not present significant risks from direct exposure.

Further assessment of the chemicals in this group could be necessary to assess the risk to workers if information becomes available indicating that the non-polymer chemicals in this group are introduced into Australia in significant quantities.

Long-term occupational exposure to low concentrations of PFSA could occur while using these precursors or formulated products containing PFSA as a contaminant.

NICNAS Recommendation

Currently it is recommended that industry seek alternatives to PFSAs related to PFOS and chemicals that can degrade to PFSA, and ultimately aim to phase out their use.

The chemicals in this group have been assessed as having the potential to cause adverse outcomes for the environment (NICNASd). These chemicals are currently listed on the Australian Inventory of Chemical Substances (AICS), and are available to be introduced into Australia without any further assessment by NICNAS. Other chemicals with a reduced potential for adverse outcomes are becoming available but, given the properties of these chemicals, their assessment as new chemicals under the *Industrial Chemicals (Notification and Assessment) Act 1989* (the ICNA Act) is still required to fully characterise the human health and environmental risks associated with their use.

It is recommended that NICNAS consult with industry and other stakeholders to consider strategies, including regulatory mechanisms available under the ICNA Act, to encourage the use of safer chemistry.

Regulatory Control

Advice for industry

Control measures

Control measures to minimise the risk from exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemicals are used. Examples of control measures which could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- health monitoring for any worker who is at risk of exposure to the chemical[s], if valid techniques are available to monitor the effect on the worker's health;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and

- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemicals are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of these chemicals has not been undertaken as part of this assessment.

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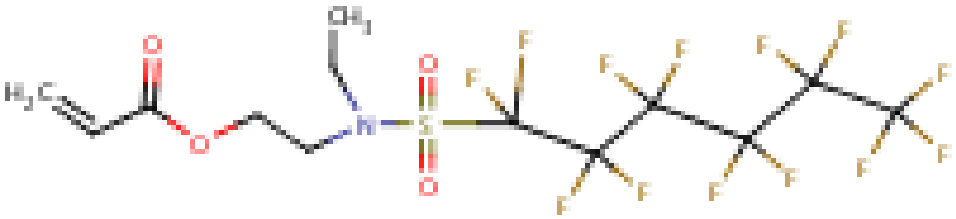
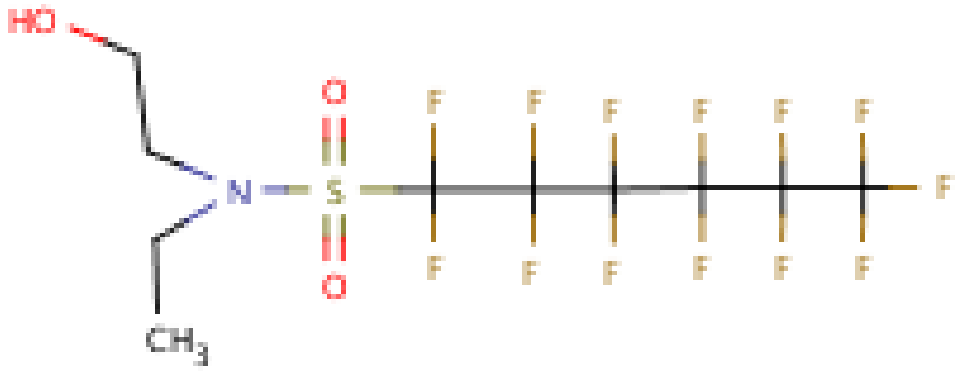
Last Update 03 July 2015

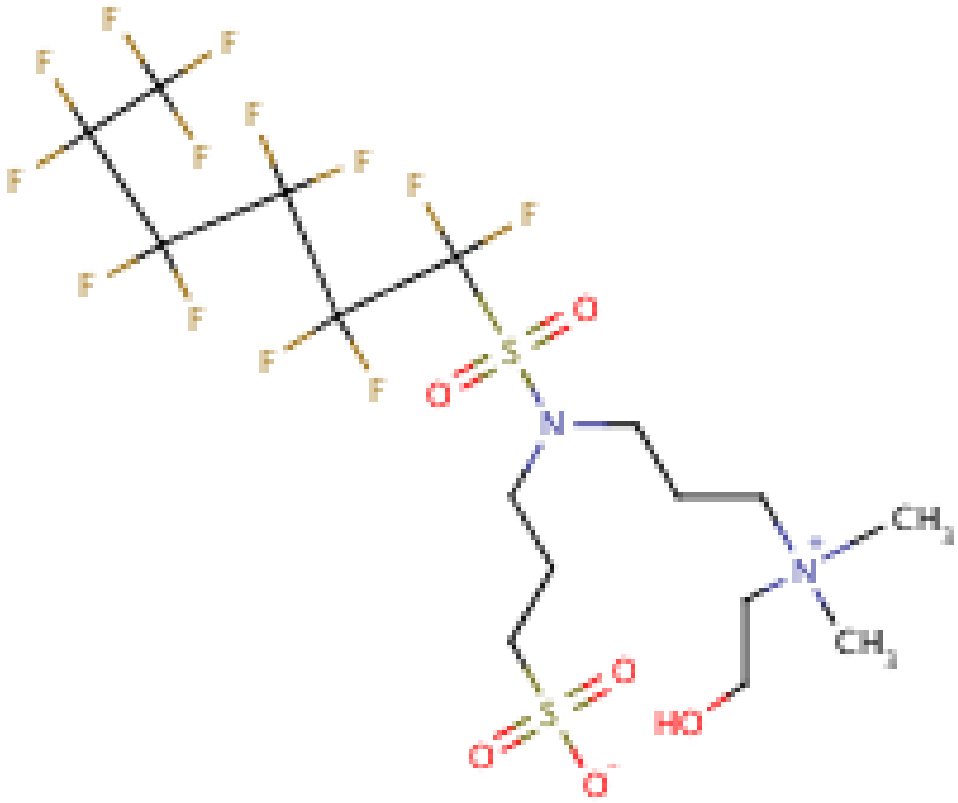
Chemical Identities

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl ester** 2-propenoic acid, 2-(ethyl((1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluorohexyl)sulfonyl)amino)ethyl ester 2-(ethyl((tridecafluorohexyl)sulfonyl)amino)ethyl acrylate N-ethylperfluorohexanesulfonamindoethyl acrylate
CAS Number	1893-52-3
Structural Formula	
Molecular Formula	C13H12F13NO4S
Molecular Weight	525.3

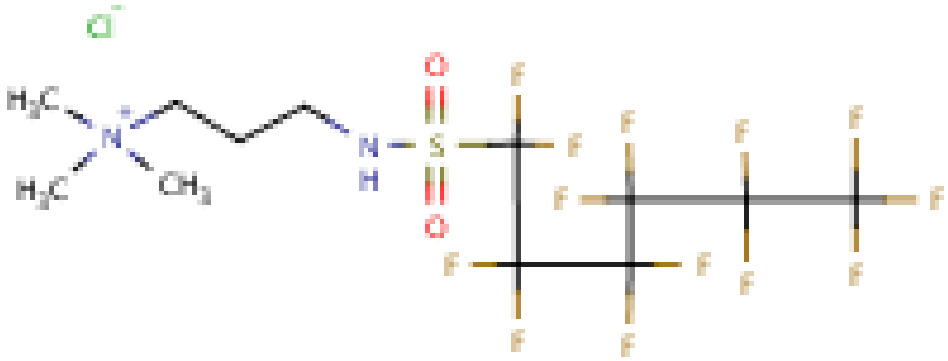
Chemical Name in the Inventory and Synonyms	**1-Hexanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-(2-hydroxyethyl)-** N-ethyltridecafluoro-N-(2-hydroxyethyl)-1-hexanesulfonamide N-ethylperfluorohexanesulfonamidoethanol

CAS Number	34455-03-3
Structural Formula	
Molecular Formula	C10H10F13NO3S
Molecular Weight	471.2

Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N-(2-hydroxyethyl)-N,N-dimethyl-3-[(3-sulfopropyl)[(tridecafluorohexyl)sulfonyl]amino]-, hydroxide, inner salt** N-(3-(dimethyl)(hydroxyethyl)aminopropyl)perfluorohexanesulfonamide propylsulfate, inner salt
CAS Number	38850-58-7
Structural Formula	

	
Molecular Formula	C16H23F13N2O6S2
Molecular Weight	650.5

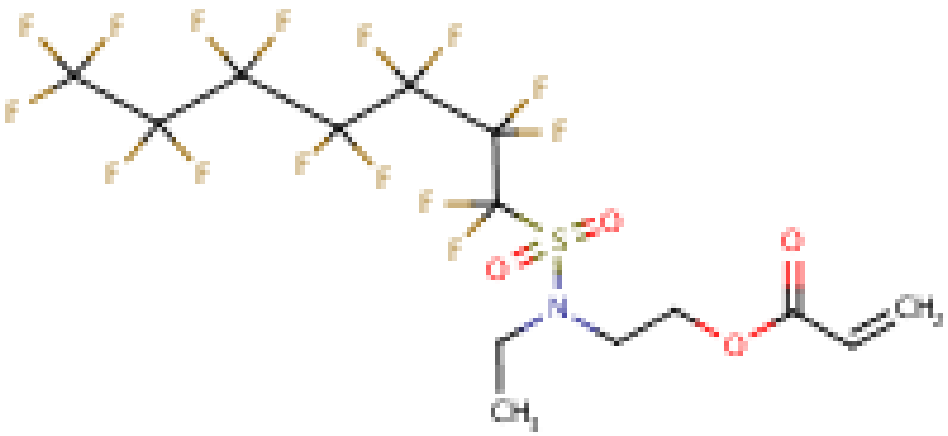
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(tridecafluorohexyl)sulfonyl]amino]-, chloride** 3-[[(tridecafluorohexyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium chloride N-(3-(trimethyl)aminopropyl)perfluorohexanesulfonamide chloride
CAS Number	52166-82-2
Structural Formula	



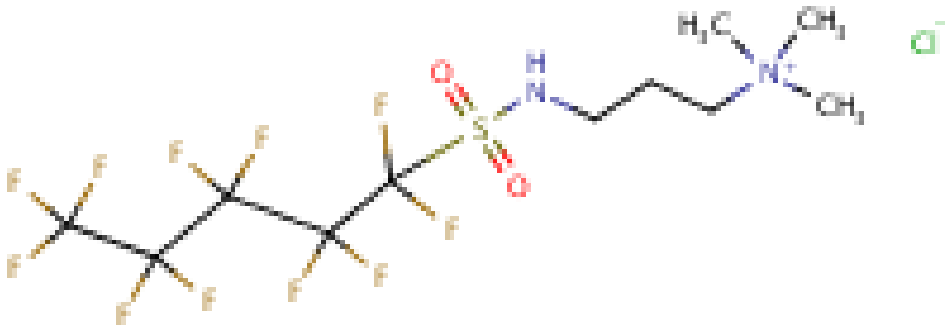
Molecular Formula	C12H16F13N2O2S.Cl
Molecular Weight	534.8

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-** N-ethylperfluorohexanesulfonamide poly(ethylene glycol)
CAS Number	56372-23-7
Structural Formula	**No Structural Diagram Available**

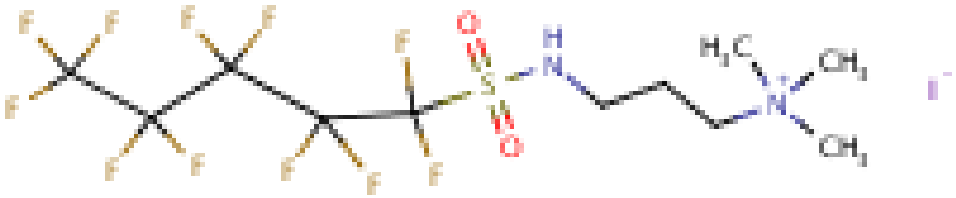
Molecular Formula	(C2H4O)nC10H10F13NO3S
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl ester** N-ethylperfluoroheptanesulfonamindoethyl acrylate
CAS Number	59071-10-2
Structural Formula	
Molecular Formula	C14H12F15NO4S
Molecular Weight	575.3

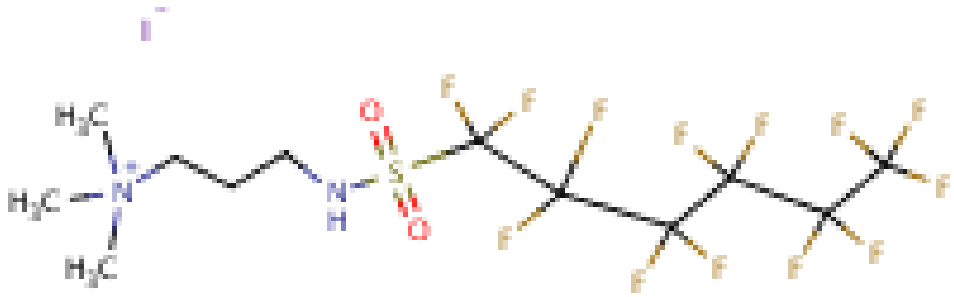
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(undecafluoropentyl)sulfonyl]amino]-, chloride** 3-[[(undecafluoropentyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium

	chloride N-(3-(trimethyl)aminopropyl)perfluoropentanesulfonamide chloride
CAS Number	68957-55-1
Structural Formula	
Molecular Formula	C11H16F11N2O2S.Cl
Molecular Weight	484.8

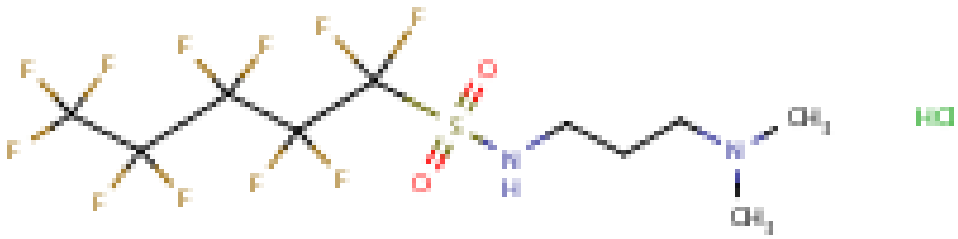
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(undecafluoropentyl)sulfonyl]amino]-, iodide** 3-[[(undecafluoropentyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium iodide N-(3-(trimethyl)aminopropyl)perfluoropentanesulfonamide iodide
CAS Number	68957-57-3
Structural Formula	

	
Molecular Formula	C11H16F11N2O2S.I
Molecular Weight	576.2

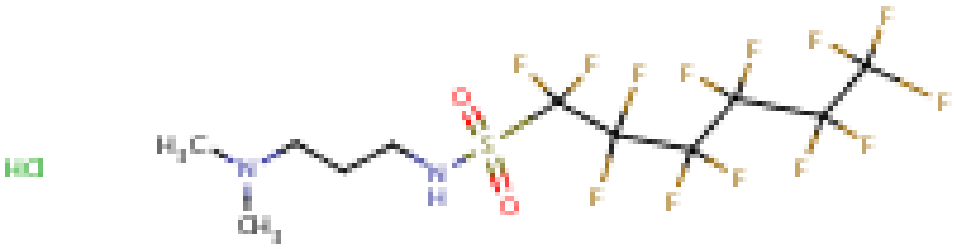
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(tridecafluorohexyl)sulfonyl]amino]-, iodide** 3-[[(tridecafluorohexyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium iodide N-(3-(trimethyl)aminopropyl)perfluorohexanesulfonamide iodide
CAS Number	68957-58-4
Structural Formula	

	
Molecular Formula	C12H16F13N2O2S.I
Molecular Weight	626.2

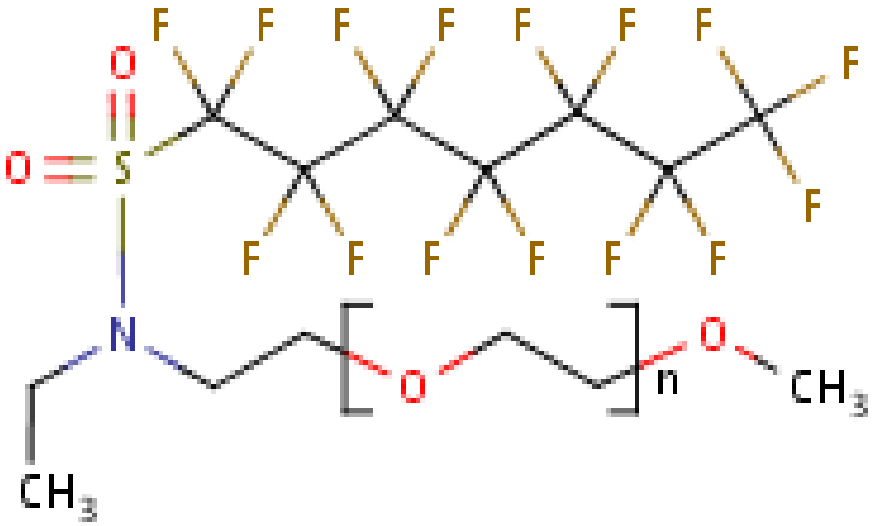
Chemical Name in the Inventory and Synonyms	**1-Pentanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-, monohydrochloride** N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-1-pentanesulfonamide, hydrochloride
CAS Number	68957-60-8
Structural Formula	

	
Molecular Formula	C10H13F11N2O2S.ClH
Molecular Weight	470.7

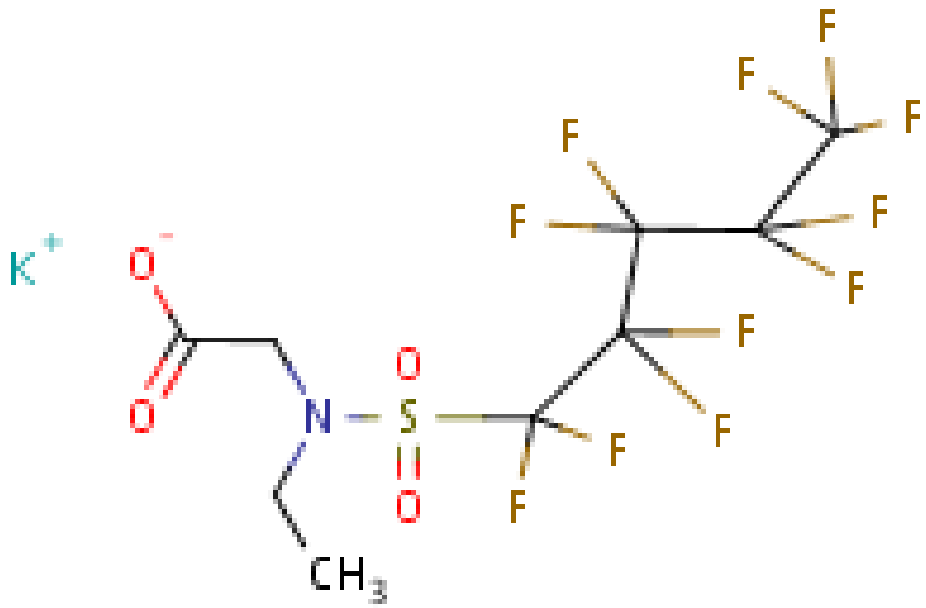
Chemical Name in the Inventory and Synonyms	**1-Hexanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-, monohydrochloride** N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-1-hexanesulfonamide, hydrochloride
CAS Number	68957-61-9
Structural Formula	

	
Molecular Formula	C11H13F13N2O2S.ClH
Molecular Weight	520.7

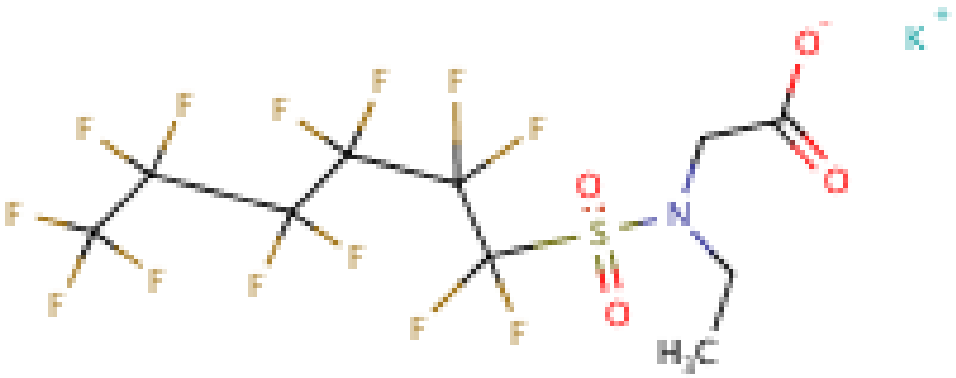
Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-methoxy-**
CAS Number	68958-60-1
Structural Formula	

	
Molecular Formula	(C2H4O)nC12H12F15NO3S
Molecular Weight	

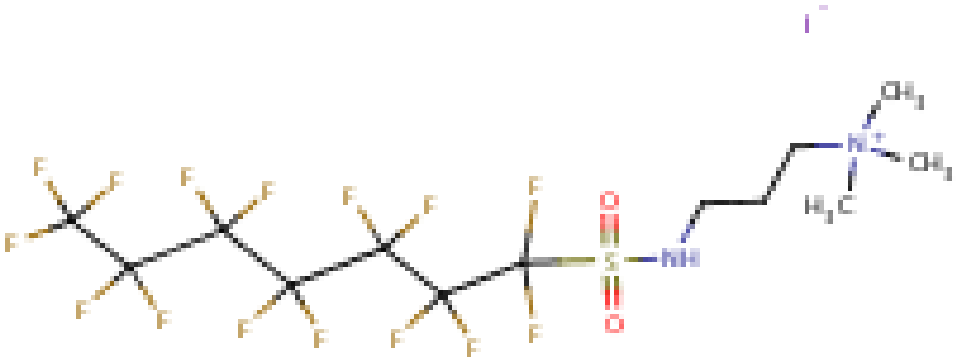
Chemical Name in the Inventory and Synonyms	**Glycine, N-ethyl-N-[(undecafluoropentyl)sulfonyl]-, potassium salt** N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-1-hexanesulfonamide, hydrochloride potassium N-ethylperfluoropentanesulfonamido acetate
CAS Number	67584-52-5
Structural Formula	

	
Molecular Formula	C9H8F11NO4S.K
Molecular Weight	473.3

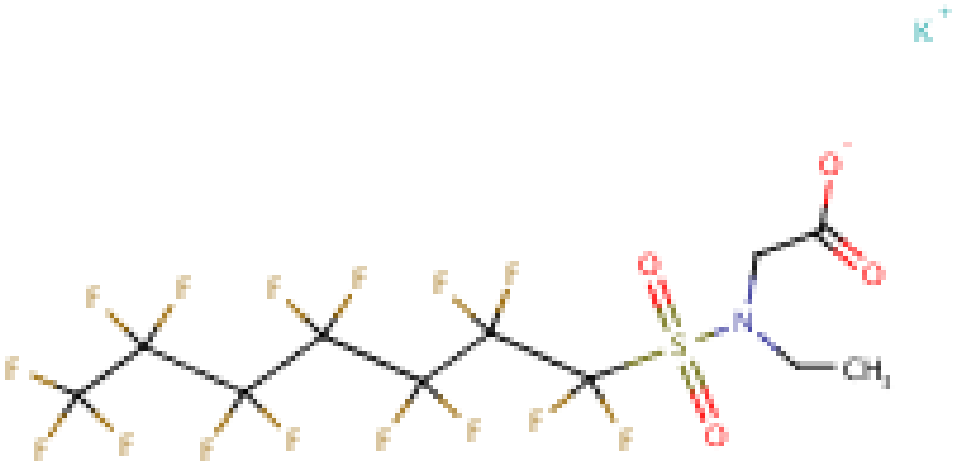
Chemical Name in the Inventory and Synonyms	**Glycine, N-ethyl-N-[(tridecafluorohexyl)sulfonyl]-, potassium salt** N-ethyl-N-[(tridecafluorohexyl)sulfonyl]glycine, potassium salt potassium N-ethylperfluorohexanesulfonamido acetate
CAS Number	67584-53-6
Structural Formula	

	
Molecular Formula	C10H8F13NO4S.K
Molecular Weight	523.3

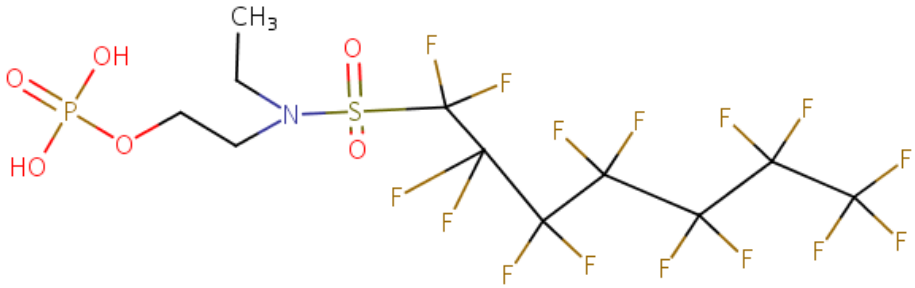
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(pentadecafluoroheptyl)sulfonyl]amino]-, iodide** 3-[[(pentadecafluoroheptyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium iodide N-(3-(trimethyl)aminopropyl)perfluoroheptanesulfonamide iodide
CAS Number	67584-58-1
Structural Formula	

	
Molecular Formula	C13H16F15N2O2S.I
Molecular Weight	676.2

Chemical Name in the Inventory and Synonyms	**Glycine, N-ethyl-N-[(pentadecafluoroheptyl)sulfonyl]-, potassium salt** N-ethyl-N-[(pentadecafluoroheptyl)sulfonyl]glycine, potassium salt potassium N-ethylperfluoroheptanesulfonamido acetate
CAS Number	67584-62-7
Structural Formula	

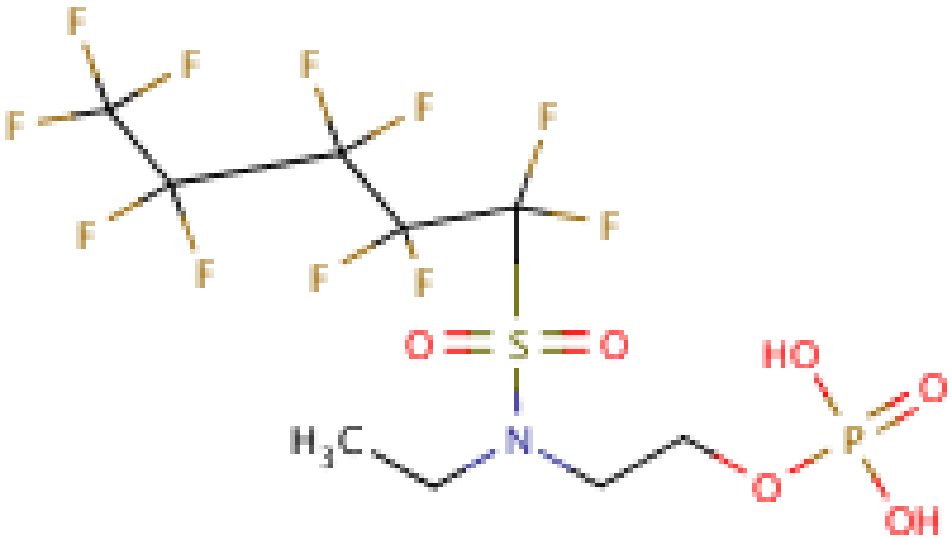
	
Molecular Formula	C11H8F15NO4S.K
Molecular Weight	573.2

Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxy)ethyl]-** N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxy)ethyl N-ethylperfluoroheptanesulfonamidoethyl dihydrogen phosphate
CAS Number	67923-61-9
Structural Formula	



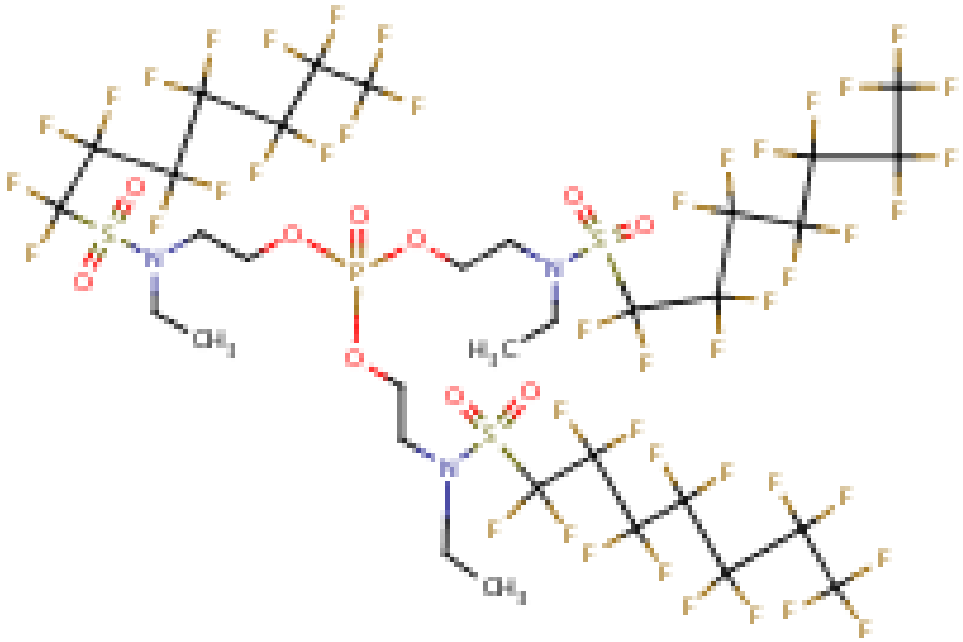
Molecular Formula	C11H11F15NO6PS
Molecular Weight	601.2

Chemical Name in the Inventory and Synonyms	**1-Pentanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-[2-(phosphonooxy)ethyl]-** N-ethyl perfluoropentanesulfonamidoethyl dihydrogen phosphate
CAS Number	67939-90-6
Structural Formula	



Molecular Formula	C9H11F11NO6PS
Molecular Weight	501.2

Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N,N',N''-[phosphinylidynetris(oxy-2,1-ethanediyl)]tris[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-** tris(N-ethylperfluoroheptanesulfonaminoethyl)phosphate
CAS Number	67939-94-0
Structural Formula	



Molecular Formula	C33H27F45N3O10PS3
Molecular Weight	1607.7

Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N,N'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-, ammonium salt** ammonium bis(N-ethylperfluoroheptanesulfonaminoethyl)phosphate
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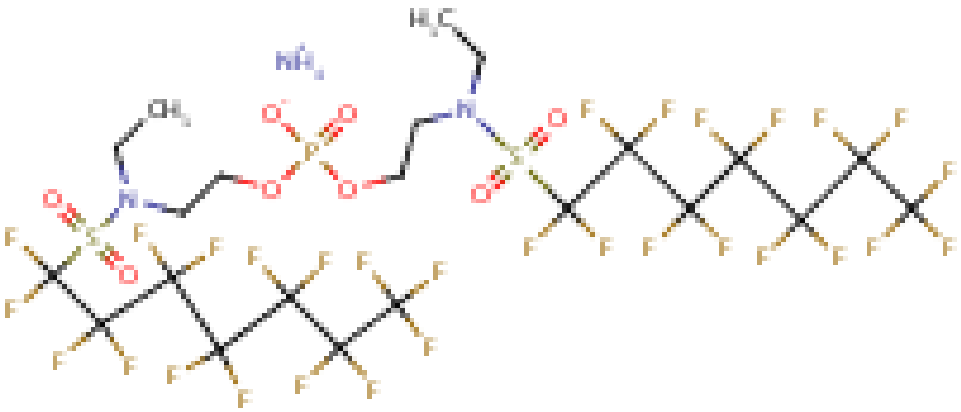
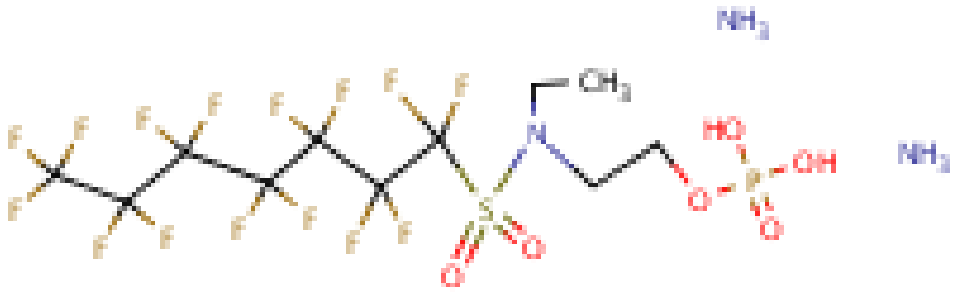
Structural Formula	

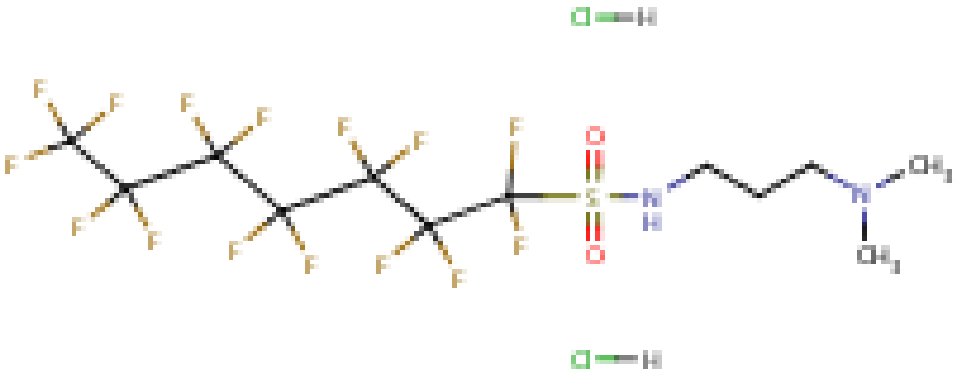


Molecular Formula	C22H19F30N2O8PS2.H3N
Molecular Weight	1121.5

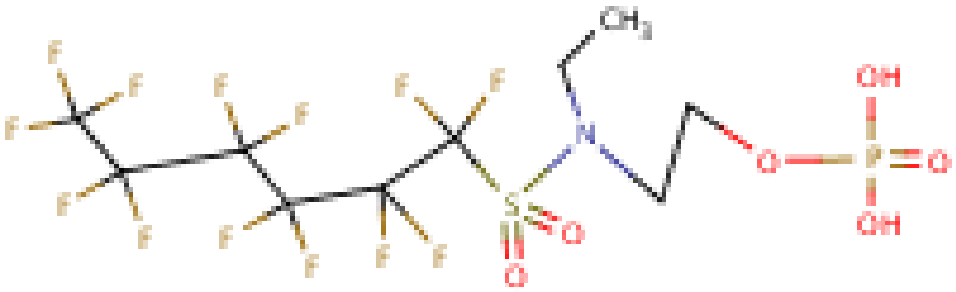
Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxy)ethyl]-, diammonium salt** N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-[2-(phosphonooxyl)ethyl]-1-heptanesulfonamide, ammonium salt diammonium N-ethylperfluoroheptanesulfonamidoethyl phosphate
CAS Number	67939-98-4
Structural Formula	

	
Molecular Formula	C11H11F15NO6PS.2H3N
Molecular Weight	635.3

Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-, monohydrochloride** N-[3-(dimethylamino)propyl]-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-1-heptanesulfonamide, hydrochloride
CAS Number	67940-02-7
Structural Formula	

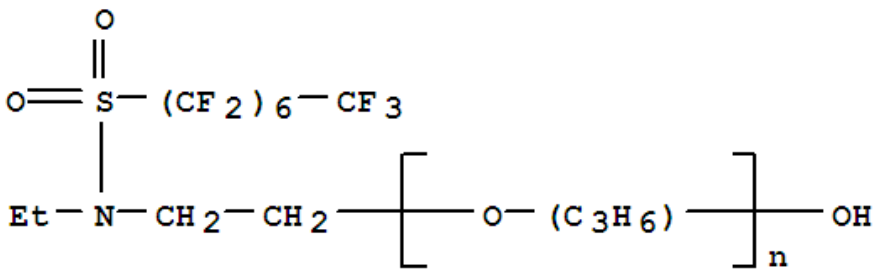
	
Molecular Formula	C12H13F15N2O2S.ClH
Molecular Weight	570.75

Chemical Name in the Inventory and Synonyms	**1-Hexanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-[2-(phosphonooxy)ethyl]-** N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-[2-(phosphonooxy)ethyl N-ethylperfluorohexanesulfonamidoethyl dihydrogen phosphate
CAS Number	67969-65-7
Structural Formula	

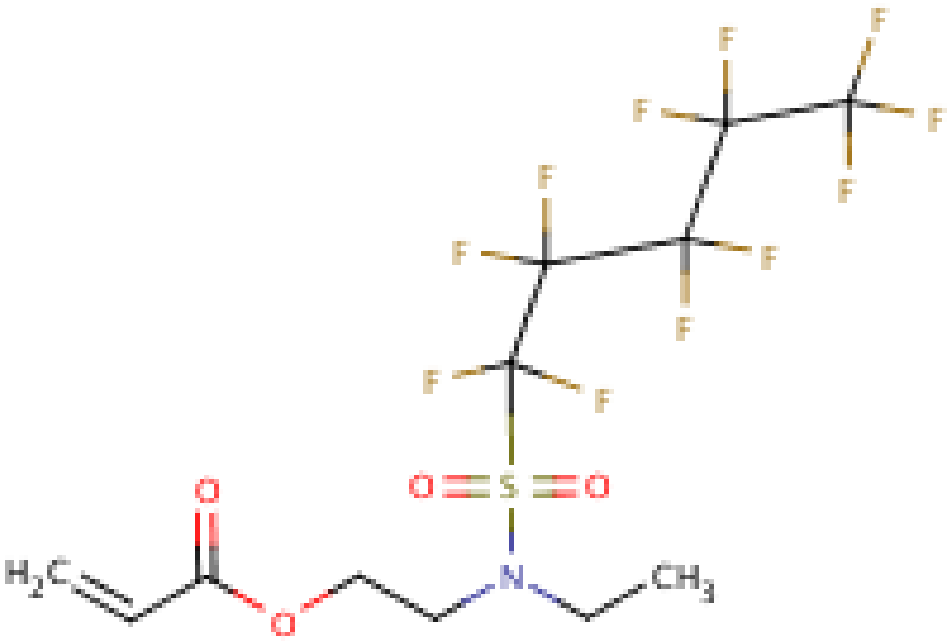
	
Molecular Formula	C10H11F13NO6PS
Molecular Weight	551.2

Chemical Name in the Inventory and Synonyms	**Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(tridecafluorohexyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-** Poly(oxy(methyl-1,2-ethanediyl)), alpha-(2-(ethyl((1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluorohexyl)sulfonyl)amino)ethyl)-omega-hydroxy- poly(oxy(methyl-1,2-ethanediyl)), alpha-(2-(ethyl((tridecafluorohexyl)sulfonyl)amino)ethyl)-
CAS Number	68259-38-1
Structural Formula	

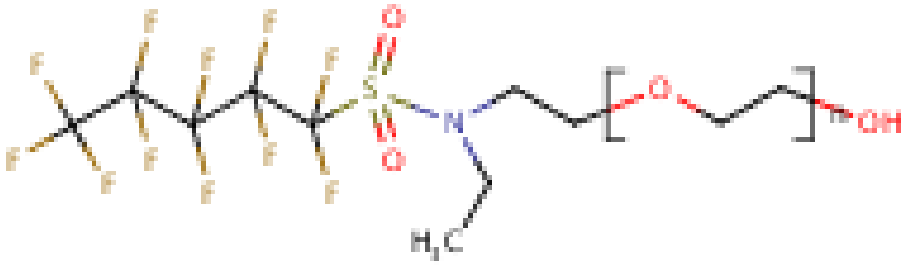
	No Structural Diagram Available
Molecular Formula	(C3H6O)nC10H10F13NO3S
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-**
CAS Number	68259-39-2
Structural Formula	
Molecular Formula	(C3H6O)nC11H10F15NO3S
Molecular Weight	

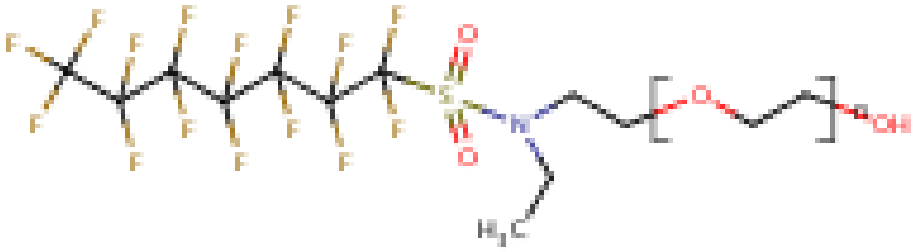
Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl ester** N-ethylperfluoropentanesulfonamindoethyl acrylate

CAS Number	68298-06-6
Structural Formula	
Molecular Formula	C12H12F11NO4S
Molecular Weight	475.2

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-** alpha-[2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl]-w-hydroxy poly(oxy-1,2-ethanediyl)
CAS Number	68298-80-6
Structural Formula	

	
Molecular Formula	(C2H4O)nC9H10F11NO3S
Molecular Weight	

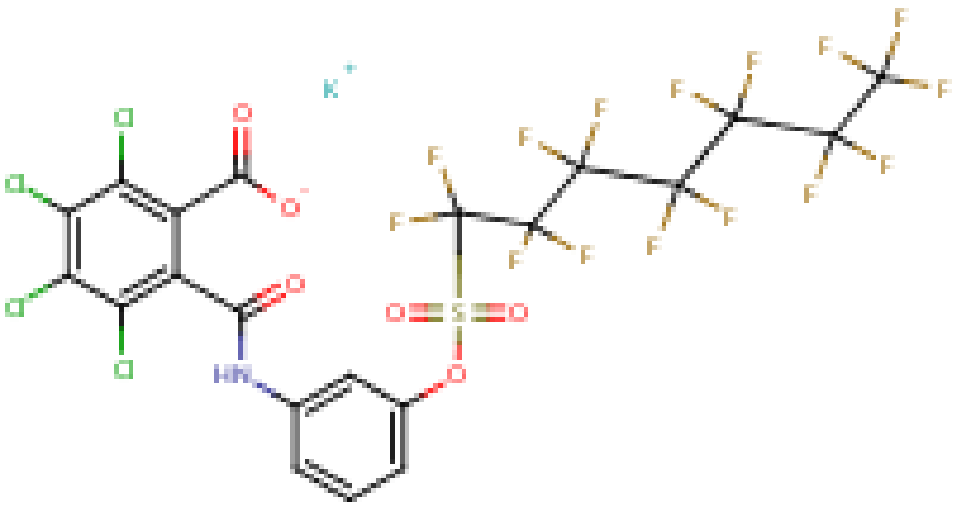
Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-[2-[ethyl[(pentadecafluoroheptyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-** N-ethylperfluoroheptanesulfonamide poly(ethylene glycol)
CAS Number	68298-81-7
Structural Formula	



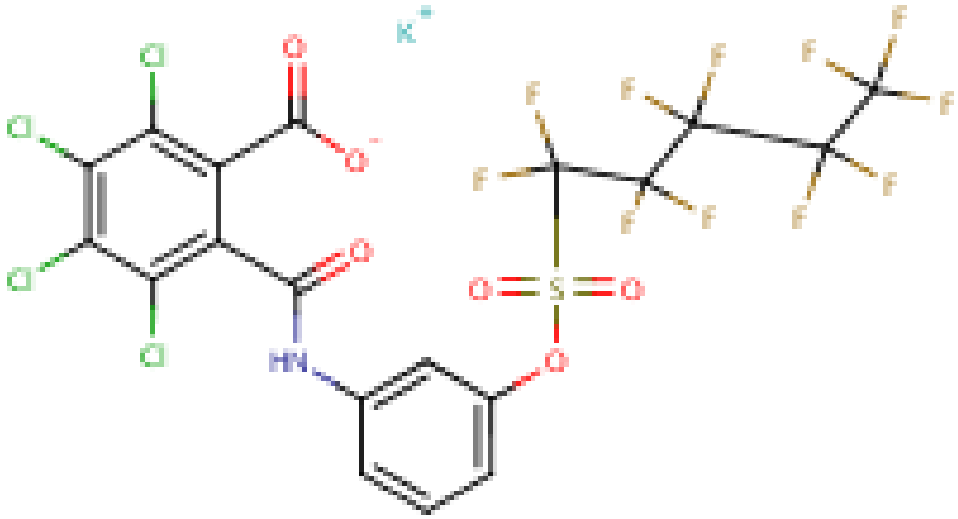
Molecular Formula	(C2H4O)nC11H10F15NO3S
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-[2-[ethyl[(undecafluoropentyl)sulfonyl]amino]ethyl]-.omega.-hydroxy-**
CAS Number	68310-17-8
Structural Formula	**No Structural Diagram Available**

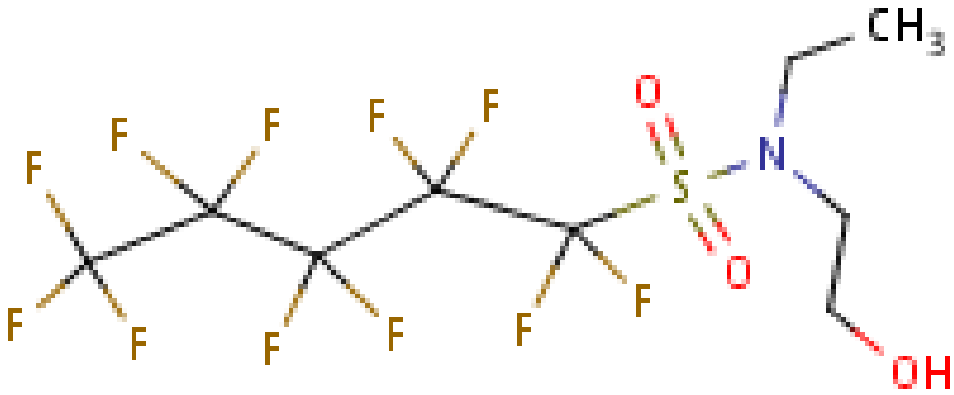
Molecular Formula	(C3H6O)nC9H10F11NO3S
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-[[(pentadecafluoroheptyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt** potassium 2,3,4,5-tetrachloro-6-[[[3-[[perfluoroheptane sulfonyl]oxy]phenyl]amino]carbony]benzoate
CAS Number	68541-01-5
Structural Formula	
Molecular Formula	C21H6Cl4F15NO6S.K
Molecular Weight	865.2

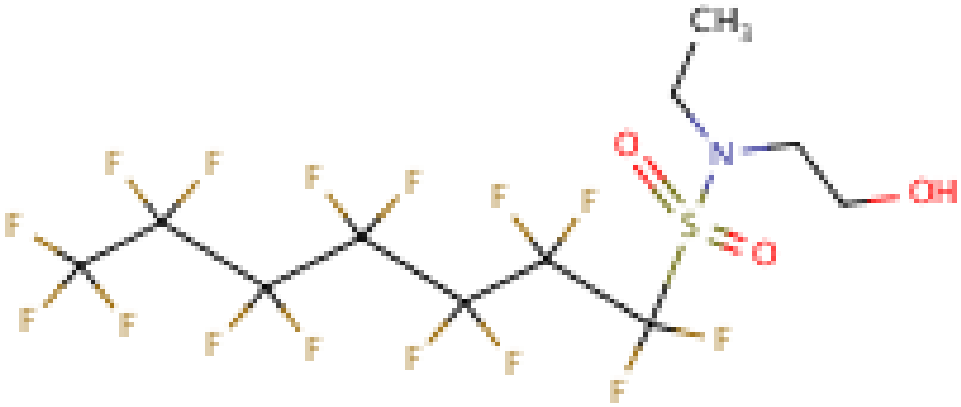
Chemical Name in the	**Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-**

Inventory and Synonyms	**[[(undecafluoropentyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt** 2,3,4,5-tetrachloro-6-((3-(undecafluoropentyl)sulfonyloxy)phenylaminocarbonyl)benzoic acid, potassium salt potassium 2,3,4,5-tetrachloro-6-[[[3-[[perfluoropentane sulfonyl]oxy]phenyl]amino]carbonyl]benzoate
CAS Number	68541-02-6
Structural Formula	
Molecular Formula	C19H6Cl4F11NO6S.K
Molecular Weight	765.2

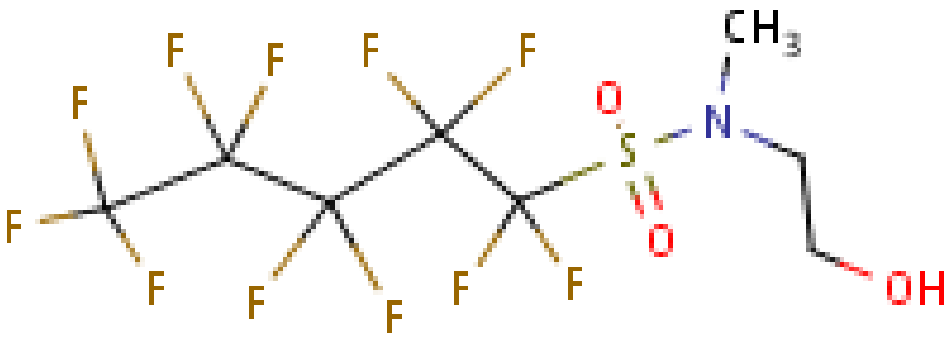
Chemical Name in the Inventory and Synonyms	**1-Pentanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-(2-hydroxyethyl)-** N-ethylundecafluoro-N-(2-hydroxyethyl)-1-pentanesulfonamide
CAS Number	68555-72-6
Structural Formula	

	
Molecular Formula	C9H10F11NO3S
Molecular Weight	421.2

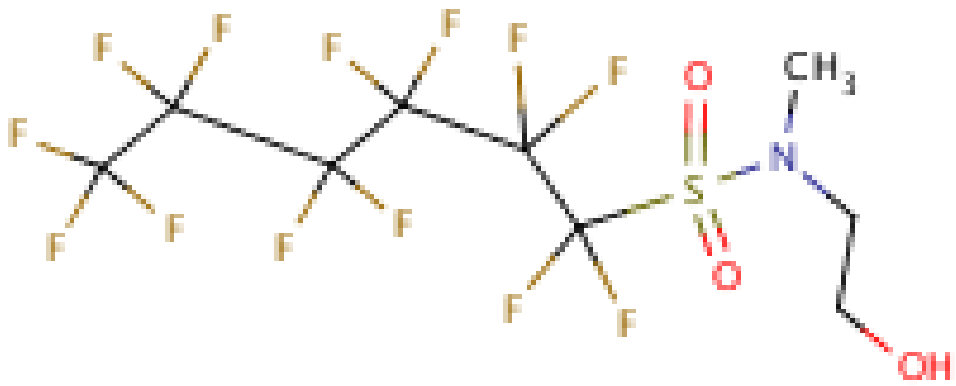
Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-(2-hydroxyethyl)-** N-ethyl-pentadecafluoro-N-(2-hydroxyethyl)-1-heptanesulfonamide
CAS Number	68555-73-7
Structural Formula	

	
Molecular Formula	C11H10F15NO3S
Molecular Weight	521.2

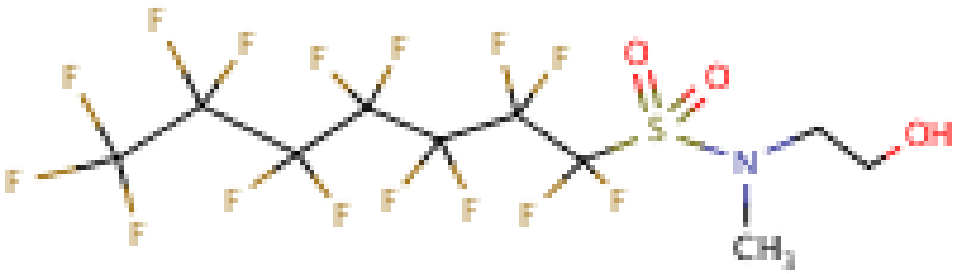
Chemical Name in the Inventory and Synonyms	**1-Pentanesulfonamide, 1,1,2,2,3,3,4,4,5,5,5-undecafluoro-N-(2-hydroxyethyl)-N-methyl-** undecafluoro-N-(2-hydroxyethyl)-N-methyl-1-pentanesulfonamide N-methylperfluoropentanesulfonamidoethanol
CAS Number	68555-74-8
Structural Formula	

	
Molecular Formula	C8H8F11NO3S
Molecular Weight	407.2

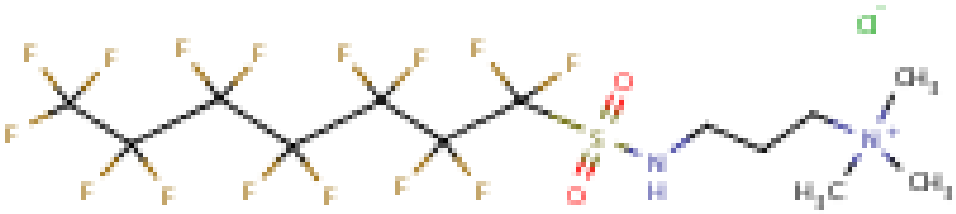
Chemical Name in the Inventory and Synonyms	**1-Hexanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-N-(2-hydroxyethyl)-N-methyl-** tridecafluoro-N-(2-hydroxyethyl)-N-methyl-1-hexanesulfonamide N-methylperfluorohexanesulfonamidoethanol
CAS Number	68555-75-9
Structural Formula	

	
Molecular Formula	C9H8F13NO3S
Molecular Weight	457.2

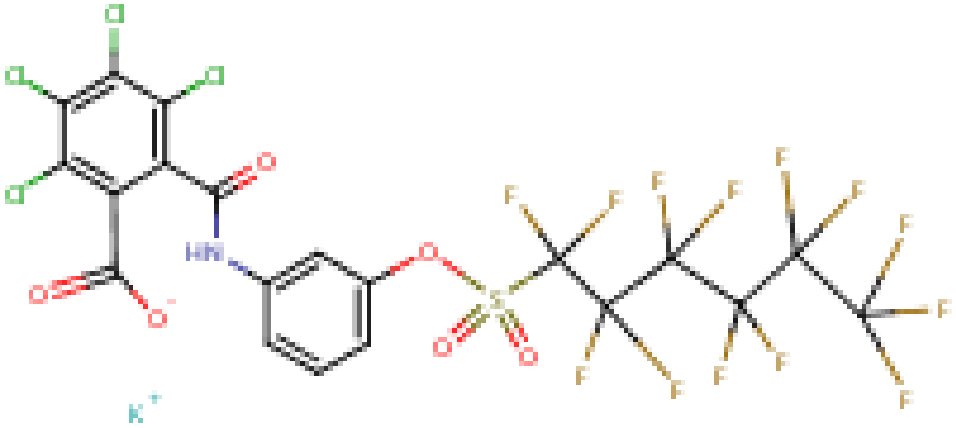
Chemical Name in the Inventory and Synonyms	**1-Heptanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-N-(2-hydroxyethyl)-N-methyl-** pentadecafluoro-N-(2-hydroxyethyl)-N-methyl-1-heptanesulfonamide N-methylperfluoroheptanesulfonamidoethanol
CAS Number	68555-76-0
Structural Formula	

	
Molecular Formula	C10H8F15NO3S
Molecular Weight	507.2

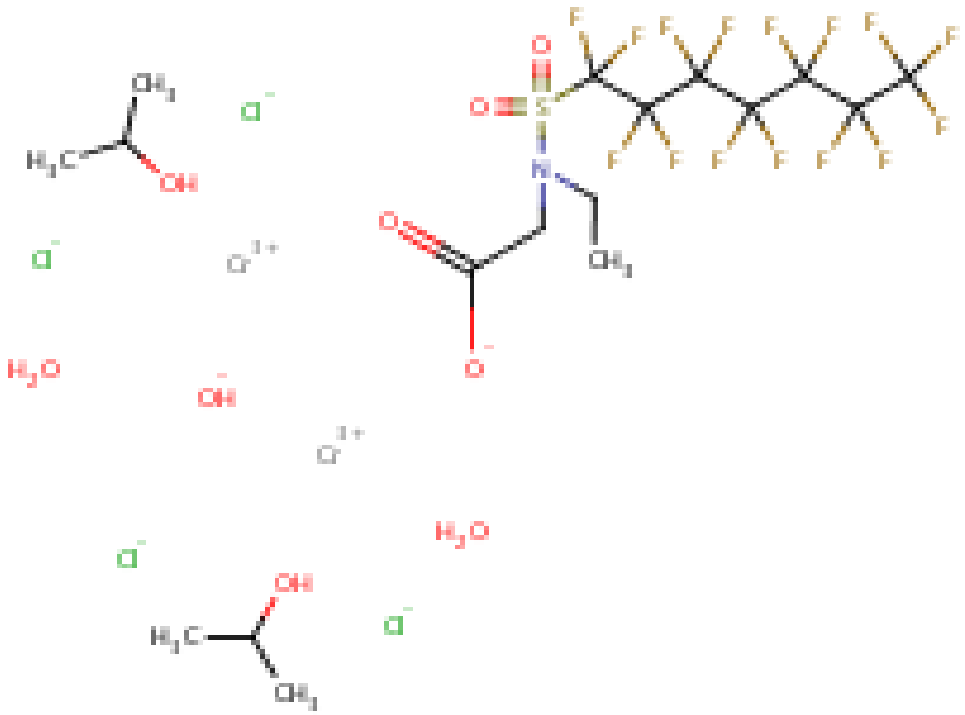
Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N,N,N-trimethyl-3-[[(pentadecafluoroheptyl)sulfonyl]amino]-, chloride** 3-[[(pentadecafluoroheptyl)sulfonyl]amino]-N,N,N-trimethyl-1-propanaminium chloride
CAS Number	68555-81-7
Structural Formula	

	
Molecular Formula	C13H16F15N2O2S.Cl
Molecular Weight	584.8

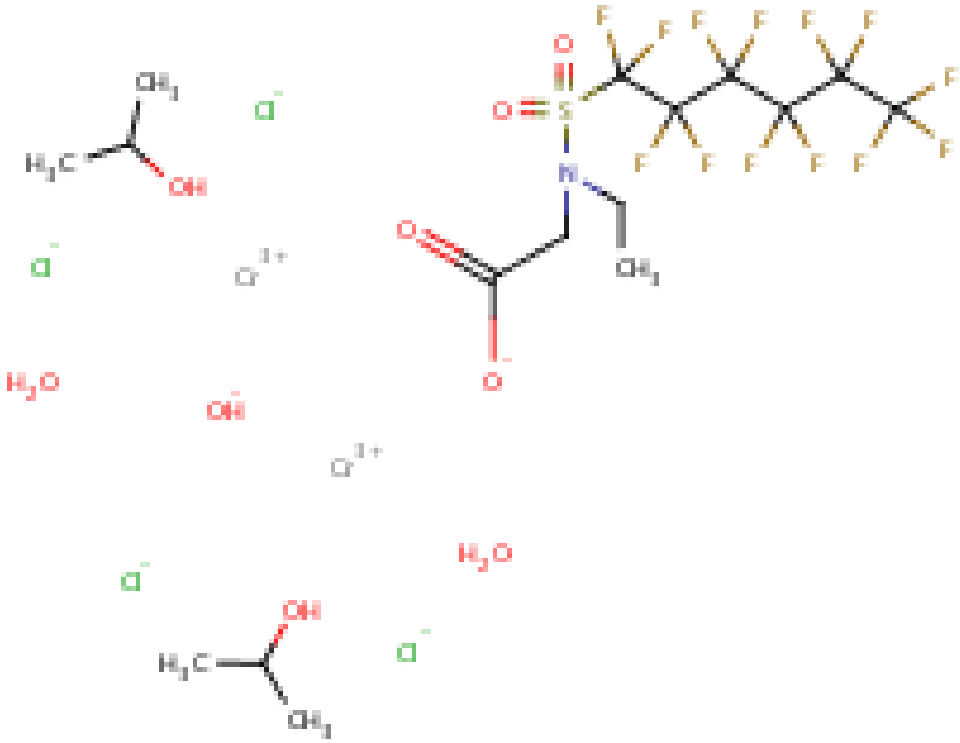
Chemical Name in the Inventory and Synonyms	**Benzoic acid, 2,3,4,5-tetrachloro-6-[[[3-[[(tridecafluorohexyl)sulfonyl]oxy]phenyl]amino]carbonyl]-, monopotassium salt** 2,3,4,5-tetrachloro-6-((3-(tridecafluorohexyl)sulfonyloxy)phenylaminocarbonyl)benzoic acid, potassium salt potassium 2,3,4,5-tetrachloro-6-[[[3-[[perfluorohexane sulfonyl]oxy]phenyl]amino]carbonyl]benzoate
CAS Number	68815-72-5
Structural Formula	

	
Molecular Formula	C20H6Cl4F13NO6S.K
Molecular Weight	815.2

Chemical Name in the Inventory and Synonyms	**Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(pentadecafluoroheptyl)sulfonyl]glycinato-O1:O1']]-.mu.-hydroxybis(2-propanol)-** diaquatetrachloro(mu-(N-ethyl-N-((pentadecafluoroheptyl)sulphonyl)glycinato-O1:O1'))-mu-hydroxybis(propan-2-ol)chromium N-ethylperfluoroheptanesulfonylamido acetate chromium complex
CAS Number	68891-97-4
Structural Formula	

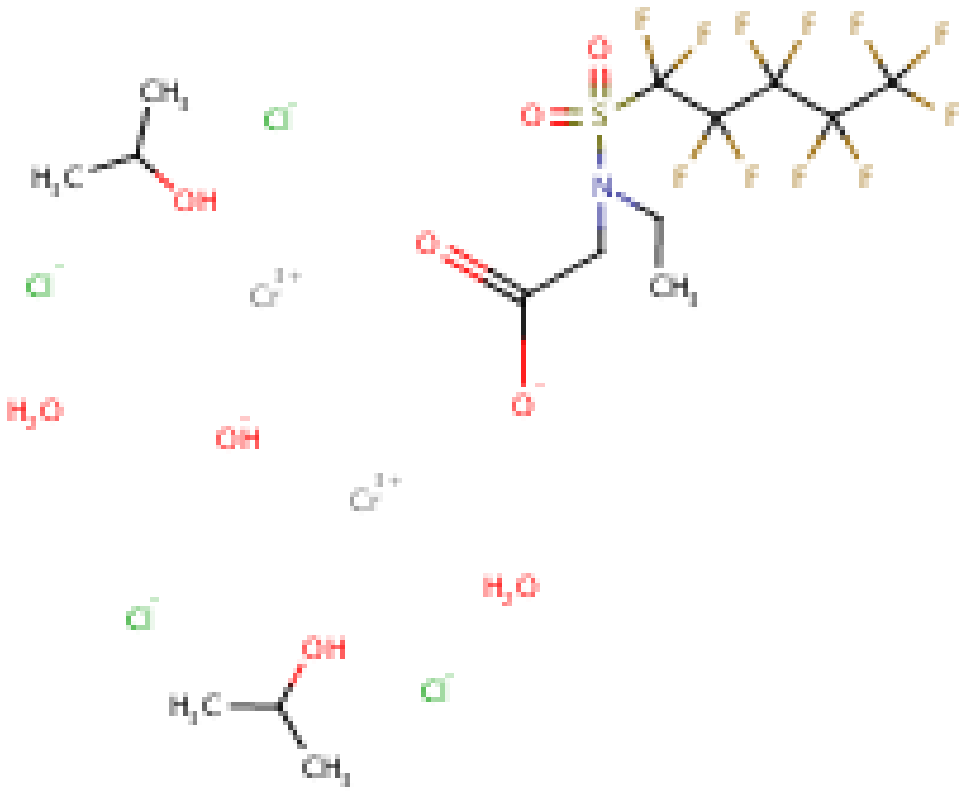
	
Molecular Formula	C17H28Cl4Cr2F15NO9S
Molecular Weight	953.2

Chemical Name in the Inventory and Synonyms	**Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(tridecafluorohexyl)sulfonyl]glycinato-O1:O1']]-.mu.-hydroxybis[2-propanol]di-** diaquatetrachloro(mu-(N-ethyl-N-((tridecafluorohexyl)sulphonyl)glycinato-O1:O1'))-mu-hydroxybis(propan-2-ol)dichromium N-ethylperfluorohexanesulfonamido acetate chromium complex
CAS Number	68891-98-5
Structural Formula	

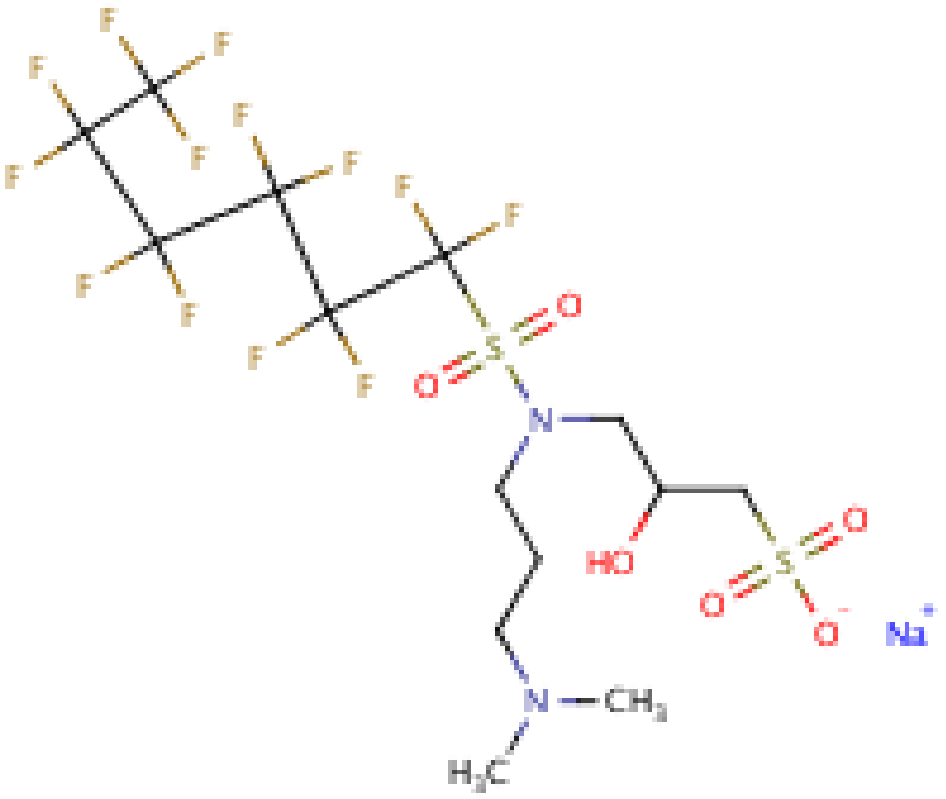


Molecular Formula	C16H28Cl4Cr2F13NO9S
Molecular Weight	903.2

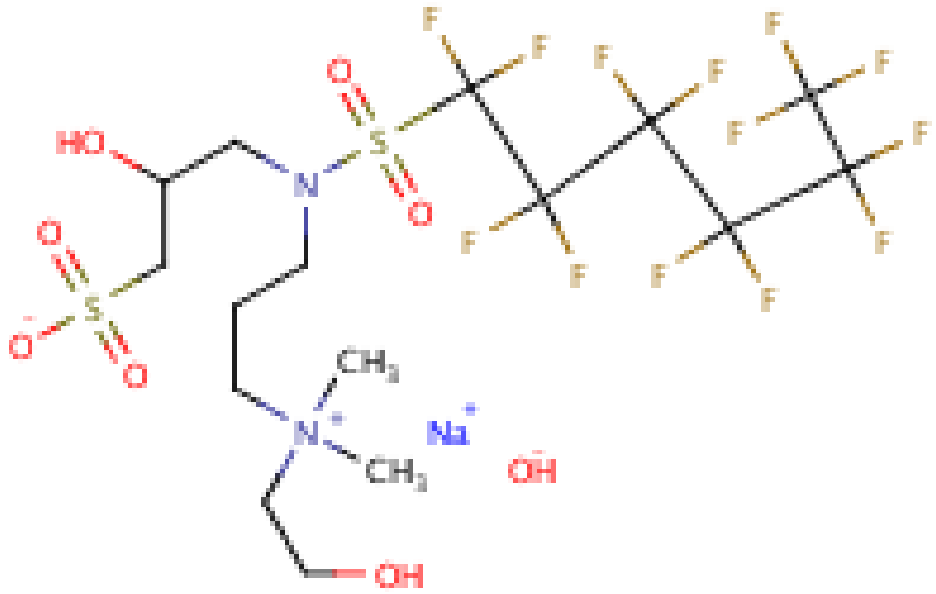
Chemical Name in the Inventory and Synonyms	**Chromium, diaquatetrachloro[.mu.-[N-ethyl-N-[(undecafluoropentyl)sulfonyl]glycinato-O1:O1']]-.mu.-hyroxybis[2-propanol]di-** diaquatetrachloro(mu-(N-ethyl-N-((undecafluoropentyl)sulphonyl)glycinato-O1:O1'))-mu-hydroxybis(propan-2-ol)dichromium N-ethylperfluoropentanesulfonylamido acetate chromium complex
CAS Number	68891-99-6
Structural Formula	

	
Molecular Formula	C15H28Cl4Cr2F11NO9S
Molecular Weight	853.2

Chemical Name in the Inventory and Synonyms	**1-Propanesulfonic acid, 3-[[3-(dimethylamino)propyl] [(tridecafluorohexyl)sulfonyl]amino]-2-hydroxy-, monosodium salt** sodium 3-((3-(dimethylamino)propyl)((tridecafluorohexyl)sulphonyl)amino)-2-hydroxypropanesulphonate
CAS Number	73772-32-4
Structural Formula	

	
Molecular Formula	C14H19F13N2O6S2.Na
Molecular Weight	644.4

Chemical Name in the Inventory and Synonyms	**1-Propanaminium, N-(2-hydroxyethyl)-3-[(2-hydroxy-3-sulfopropyl)[(tridecafluorohexyl)sulfonyl]amino]-N,N-dimethyl-, hydroxide, monosodium salt** sodium N-(2-hydroxyethyl)-N,N-dimethyl-3-[(2-hydroxy-3-sulfopropyl)perfluorohexane sulfonamino]propylammonium hydroxide
CAS Number	81190-38-7
Structural Formula	

	
Molecular Formula	C16H24F13N2O7S2.HO.Na
Molecular Weight	706.5

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