Indirect precursors of long-chain perfluorocarboxylic acids (PFCAs): Human health tier II assessment

12 December 2019

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
1-Dodecanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluoro-	865-86-1
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester	2144-54-9
Methacrylic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl ester	4980-53-4
Methacrylic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl ester	6014-75-1
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,17,17,18,18,18-tritriacontafluorooctadecyl ester	59778-97-1
1-Tetradecanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluoro-	39239-77-5

Chemical Name in the Inventory	CAS Number
1-propanaminium, 3-[[4-[(heptadecafluorononenyl)oxy]benzoyl]amino]-N,N,N-trimethyl-, iodide	59493-72-0
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,17,17,18,18,19,19,20,20,20-heptatriacontafluoroeicosyl ester	65104-66-7
Poly(difluoromethylene), .alpha.-fluoro-.omega.-[2-[[2-(trimethylammonio)ethyl]thio]ethyl]-, methyl sulfate	65530-57-6
Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, ester with 2,15-bis(carboxymethyl)-4,13-dioxo-3,14-dioxa-5,12-diazahexadecane-1,2,15,16-tetracarboxylic acid (6:1)	65530-58-7
Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, 2-hydroxy-1,2,3-propanetricarboxylate (3:1)	65530-59-8
Ethanol, 2,2'-iminobis-, compd. with alpha-fluoro-omega-[2-(phosphonooxy)ethyl]poly(difluoromethylene) (2:1)	65530-63-4
Ethanol, 2,2'-iminobis-, compd. with alpha,alpha'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[omega-fluoropoly(difluoromethylene)] (1:1)	65530-64-5
Poly(difluoromethylene), .alpha.-[2-[(2-carboxyethyl)thio]ethyl]-.omega.-fluoro-, lithium salt	65530-69-0
Ethanol, 2,2'-iminobis-, compd. with alpha-fluoro-omega-[2-(phosphonooxy)ethyl]poly(difluoromethylene) (1:1)	65530-74-7
Poly(difluoromethylene), .alpha.-[2-[(2-carboxyethyl)thio]ethyl]-.omega.-fluoro-	65530-83-8
Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy-, ether with .alpha.-fluoro-.omega.-(2-hydroxyethyl)poly(difluoromethylene) (1:1)	65545-80-4

Chemical Name in the Inventory	CAS Number
Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, dihydrogen 2-hydroxy-1,2,3-propanetricarboxylate	65605-56-3
Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, hydrogen 2-hydroxy-1,2,3-propanetricarboxylate	65605-57-4
2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)	65605-58-5
2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene) and N-(hydroxymethyl)-2-propenamide	65605-59-6
2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide	65605-60-9
Ethanaminium, N,N-diethyl-N-methyl-2-[(2-methyl-1-oxo-2-propenyl)oxy]-, methyl sulfate, polymer with 2-ethylhexyl 2-methyl-2-propenoate, .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide	65636-35-3
Thiols, C10-20, .gamma.-.omega.-perfluoro	68140-21-6
Butanoic acid, 4-[[3-(dimethylamino)propyl]amino]-4-oxo-, 2(or 3)-[(.gamma.-.omega.-perfluoro-C6-20-alkyl)thio] derivatives	68187-25-7
1-Propanesulfonic acid, 2-methyl-, 2-[[1-oxo-3-[(.gamma.,.omega.-perfluoro-C4-16-alkyl)thio]propyl]amino] derivatives, sodium salts	68187-47-3
2-Propenoic acid, 2-methyl-, 2-ethylhexyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide	68239-43-0

Chemical Name in the Inventory	CAS Number
Alcohols, C8-14, .gamma.-.omega.-perfluoro	68391-08-2
Sulfuric acid, mono(.gamma.-.omega.-perfluoro-C6-12-alkyl) esters, ammonium salts	68516-17-6
Betaines, N-(hydroxyethyl)-N-methyl-N-(2-sulfoethyl)-N-(1,1,2-trihydroperfluoro-C8-14-2-alkenyl)	98219-29-5
Ethene, tetrafluoro-, homopolymer, .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, citrate, reaction products with 1,6-diisocyanatohexane	68891-05-4
Fatty acids, C18-unsaturated, dimers, diisocyanates, polymers with 2,3-bis(.gamma.-.omega.-perfluoro-C4-18-alkyl)-1,4-butanediol, 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane and 2,2'-(methylimino)bis[ethanol]	68990-40-9
Thiols, C8-20, .gamma.-.omega.-perfluoro, telomers with acrylamide	70969-47-0
Poly(oxy-1,2-ethanediyl), .alpha.-methyl-.omega.-hydroxy-, 2-hydroxy-3-[(.gamma.-.omega.-perfluoro-C6-20-alkyl)thio]propyl ethers	70983-59-4
Poly(difluoromethylene), .alpha.-[2-(acetyloxy)-2-[(carboxymethyl)dimethylammonio]ethyl]-.omega.-fluoro-, hydroxide, inner salt	71002-41-0
Piperazinium, 1-(carboxymethyl)-1-(2-hydroxyethyl)-4-(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-nonadecafluoro-1-oxodecyl)-, hydroxide, inner salt	71356-38-2
Pentanoic acid, 4,4-bis[(.gamma.-.omega.-perfluoro-C8-20-alkyl)thio] derivatives, compounds with diethanolamine	71608-61-2
Phosphoric acid, gamma-omega-perfluoro-C8-16-alkyl esters, compds. with diethanolamine	74499-44-8
Sulfuric acid, mono(.gamma.-.omega.-perfluoro-C8-12-alkyl) esters, ammonium salts	84238-62-0

Chemical Name in the Inventory	CAS Number
Imidodicarbonic diamide, N,N',2-tris(6-isocyanatohexyl)-, reaction products with ethylene glycol, alpha-fluoro-omega-[2-[(1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), glycidol and 2,4-TDI	329201-80-1
2-Propenoic acid, .gamma.-.omega.-perfluoro-C8-14-alkyl esters	85631-54-5
Quaternary ammonium compounds, (hydroxyethyl)dimethyl(.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), methyl sulfates	92129-34-5
Pentanoic acid, 4,4-bis[(.gamma.-.omega.-perfluoro-C6-12-alkyl)thio] derivatives, compounds with diethanolamine	94095-37-1
2-Propenoic acid, 2-methyl-, 2-ethylhexyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)	97136-02-2
2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)	101896-32-6
Thiols, C4-20, .gamma.-.omega.-perfluoro, reaction products with methylated formaldehyde-1,3,5-triazine-2,4,6-triamine polymer	113089-67-1
Betaines, (hydroxyethyl)methyl(.gamma.,.omega.-perfluoro-C8-14-.beta.-alkenyl)(2-sulfopropyl)	115340-82-4
Quaternary ammonium compounds, trimethyl(.delta.-.omega.-perfluoro-C8-14-.beta.-alkenyl), chlorides	115535-36-9
2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, hexadecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, octadecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-propenoate	115592-83-1

Chemical Name in the Inventory	CAS Number
Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin, polyethylene glycol monomethyl ether and N,N',2-tris(6-isocyanatohexyl)imidodicarbonic diamide	118102-37-7
Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin, tetrahydrofuran homopolymer and N,N',2-tris(6-isocyanatohexyl)imidodicarbonic diamide	118102-38-8
2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, alpha-(2-methyl-1-oxo-2-propenyl)-omega-[(2-methyl-1-oxo-2-propenyl)oxy]poly(oxy-1,2-ethanediyl), 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate	119973-84-1
2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate	119973-85-2
9-Octadecenoic acid (Z-), reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,1112,12,12-heneicosafluoro-1-dodecanol	125768-41-4
Quaternary ammonium compounds, diethylmethyl(.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), methyl sulfates	127133-57-7
Hexane, 1,6-diisocyanato-, homopolymer, gamma-omega-perfluoro-C6-20-alc.-blocked	135228-60-3

Chemical Name in the Inventory	CAS Number
1,3-Propanediol, 2,2-bis(bromomethyl)-, reaction products with ethanethiol-tetrafluoroethylene telomer, polymers with 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane, 2-heptyl-3,4-bis(9-isocyanatononyl)-1-pentylcyclohexane and 2,2'-(methylimino)bis[ethanol]	144468-32-6
Quaternary ammonium compounds, diethyl methyl (.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), tetraphenyl borates	145477-02-7
Quaternary ammonium compounds, diethyl methyl (.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), tetrafluoroborates	153325-45-2
Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin and propylene oxide, trimethylamine-quaternized	185630-70-0
2-Propenenitrile, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), .alpha.-(2-methyl-1-oxo-2-propenyl)-.omega.-methoxypoly(oxy-1,2-ethanediyl) and .alpha.-(2-methyl-1-oxo-2-propenyl)-.omega.-[(2-methyl-1-oxo-2-propenyl)oxy]poly(oxy-1,2-ethanediyl)	374928-93-5
Alcohols, C8-14, gamma-omega-perfluoro, polymers with alpha-fluoro-omega-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), methanol, stearyl acrylate, stearyl methacrylate, 2,4-TDI and vinyl chloride	376364-33-9
9-Octadecenoic acid (Z-)-, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluoro-1-tetradecanol	220237-52-5
2-Methylpropenoate, ethyleneimine-, copolymer with benzyl-2-methylpropenoate and poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-((1-oxo-2-propenyl)oxy)ethyl)	220713-37-1
Poly(difluoromethylene), .alpha.-fluoro-omega.-(2-((2-methyl-1-oxo-2-propenyl)oxy)ethyl), copolymer with octadecanyl-2-methylpropenoate and ethyleneiminyl-2-methylpropenoate	220713-74-6

Chemical Name in the Inventory	CAS Number
Poly(difluoromethylene), .alpha.-fluoro-omega.-(2-((2-methyl-1-oxo-2-propenyl)oxy)ethyl), copolymer with t-butyl-2-methylpropenoate and ethyleneiminyl-2-methylpropenoate	220713-85-9
2,5-Furandione, dihydro-, monopolyisobutylene derivatives, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluoro-1-tetradecanol	253682-97-2
2,5-Furandione, dihydro-, monopolyisobutylene derivatives, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluoro-1-dodecanol	253682-98-3
Hexane, 1,6-diisocyanato homopolymer, copolymer with .gamma.,.omega.-perfluoroalcohols C8-14, oxiranemethanol, 1,2-ethanediol and 2,4-diisocyanato-1-methylbenzene	253873-70-0
1,2-Propanediol, 3-chloro-, reaction products with imidodicarbonic diamide, N,N',2-tris(6-isocyanatohexyl)-, ethene, tetrafluoro-, ethene and ethane, iodo-	254889-72-0
Oxirane, reaction products with hexamethylene diisocyanate, methanol, tetrafluoroethylene, ethyl iodide and ethylene	254889-79-7
2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine, polyethylene-polypropylene glycol and TDI homopolymer	332076-28-5
2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine and TDI homopolymer	332076-33-2
2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine, polyethylene glycol and TDI homopolymer	332076-34-3
Butenedioic acid, (Z)-, dioctyl-, copolymer with poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-((1-oxo-2-propenyl)oxy)ethyl)chloroethylene	374928-92-4

Chemical Name in the Inventory	CAS Number
1-Propanaminium, 2-hydroxy-N,N,N-trimethyl-, 3-[(gamma-omega-perfluoro-C6-20-alkyl)thio] derivs., chlorides	70983-60-7
Hexane, 1,6-diisocyanato-, homopolymer, alpha-fluoro-omega-(hydroxyethyl)poly(difluoromethylene)- and Me Et ketone oxime- and polyethylene glycol mono-Me ether-blocked	428842-38-0
2-Propenoic acid, 2-methyl-, 2-(diethylamino)ethyl ester, polymer with alpha-fluoro-omega-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), acetate (salt)	500701-62-2
2-Propenoic acid, 2-methyl-, 2-(dimethylamino)ethyl ester, polymers with .gamma.-.omega.-perfluoro-C10-16-alkyl acrylate and vinyl acetate, acetates	196316-34-4
2-Propenoic acid, 2-methyl-, hexadecyl ester, polymers with 2-hydroxyethyl methacrylate, .gamma.-.omega.-perfluoro-C10-16-alkyl acrylate and stearyl methacrylate	203743-03-7
2-Propenoic acid, 2-methyl-, 2-(dimethylamino)ethyl ester, polymers with Bu acrylate, gamma-omega-perfluoro-C8-14-alkyl acrylate and polyethylene glycol monomethacrylate, 2,2'-azobis[2,4-dimethylpentanenitrile]-initiated	150135-57-2
2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-propenoate	1094598-90-9
2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymers with N-(1,1-dimethyl-3-oxobutyl)-2-propenamide, 2-ethylhexyl acrylate, gamma-omega-perfluoro-C8-16-alkyl acrylate, octadecyl 2-propenoate and vinyl chloride, 2,2'-azobis[2-methylpropanimidamide] dihydrochloride-initiated	325966-78-7

Chemical Name in the Inventory	CAS Number
2-Propenoic acid, polymer with butyl 2-propenoate and 2,5-furandione, gamma-omega-perfluoro-C8-14-alkyl esters, potassium salts, tert-Bu benzenecarboperoxoate-initiated	524729-93-9
2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with butyl 2-propenoate and 2,5-furandione, .gamma.-.omega.-perfluoro-C8-14-alkyl esters, tert-Bu benzenecarboperoxoate-initiated	459415-06-6
2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-methyl-2-propenoate, methyl 2-methyl-2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14- pentacosafluorotetradecyl 2-methyl-2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-methyl-2-propenoate	65104-45-2

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

NICNAS has made every effort to assure the quality of information available in this report. However, before relying on it for a specific purpose, users should obtain advice relevant to their particular circumstances. This report has been prepared by NICNAS using a range of sources, including information from databases maintained by third parties, which include data supplied by industry. NICNAS has not verified and cannot guarantee the correctness of all information obtained from those databases. Reproduction or further distribution of this information may be subject to copyright protection. Use of this information without obtaining the permission from the owner(s) of the respective information might violate the rights of the owner. NICNAS does not take any responsibility whatsoever for any copyright or other infringements that may be caused by using this information.

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group include neutral and ionic organic substances of moderate to high molecular weight, and polymers with fluorinated side-chains. All but one of the substances in this group contain a chain of perfluorinated carbons that are linked to another structural unit by at least one non-fluorinated carbon atom. Although some substances in this group are mixtures of discrete chemicals with a range of perfluorinated chain lengths, all potentially have at least one component chemical which has a chain of nine or more perfluorinated carbon atoms. Based on the ingredients in two chemicals (CAS Nos. 254889-79-7 and 254889-72-0), the reactions are expected to create fluorotelomers of an unknown chain length. As a worst case scenario, the fluorotelomers are presumed to belong to a long-chain perfluorinated compounds. The substance represented by CAS Nos. 59493-72-0 has a perfluorinated nonenyl moiety and as such is not a precursor to perfluorononanoic acid (PFNA). This substance is a potential precursor to isomers of perfluorononenoic acid which are considered to be analogous to PFNA.

NICNAS has developed an action plan to assess and manage chemicals which may degrade to perfluorocarboxylic acids (PFCAs), perfluoroalkane sulfonates (PFSAs) or similar chemicals. The primary assumption outlined in the action plan is that chemicals with a perfluorinated chain terminated with an alkyl or aryl group will degrade to form a mix of PFCAs with both the original chain length and one less perfluorinated carbon atom (for more information, see 'Data requirements for notification of new chemicals containing a perfluorinated carbon chain' on the NICNAS website (NICNASa)). In this assessment, environmental degradation of the chemicals in this group is expected to primarily result in release of perfluorocarboxylic acids with one less perfluorinated carbon atom than the parent chemical.

On this basis, the chemicals in this group have the potential to degrade into a range of environmentally persistent long-chain PFCA anions including those containing eight or more perfluorinated carbon atoms. Whilst some members of this group can also degrade to shorter chain PFCAs, the toxicity profile will be dominated by the long-chain PFCAs. Therefore, the chemicals are considered to be indirect precursors of long-chain PFCAs. Indirect precursors for perfluorooctanoic acid (PFOA) with seven perfluorinated carbon atoms and short chain PFCAs which do not include long-chain components have been assessed separately (NICNASb; NICNASc).

These potential long-chain perfluorocarboxylic acid degradants are of concern because the immediate shorter chained homologue, PFOA, has been identified as a persistent, bioaccumulative and toxic (PBT) chemical according to domestic environmental hazard criteria. Chemicals with these hazard characteristics are of high concern to the environment and PFOA (and substances which may degrade to PFOA) are subject to increasingly stringent regulatory controls in other developed countries. Longer chain perfluorocarboxylic acids have received attention internationally for similar reasons. (see **International restrictions**).

The degradation of perfluorinated carboxylic acids is very slow compared with their rate of formation from degradation of the precursors and perfluorinated carboxylic acids will be the final degradants from multiple precursors. Therefore, the amount of perfluorinated carboxylic acids in the environment (general or local) is expected to be higher than that of any of the precursors. It will therefore be assumed for the purposes of this assessment that the primary risk posed by the chemicals in this group results from release of perfluorinated carboxylic acids to the environment. Therefore, this assessment will focus on long-term effects due to the chemicals degrading to long-chain PFCAs.

Import, Manufacture and Use

Australian

In July 2006, NICNAS collected information on manufacture, importation and uses of perfluorinated chemicals including PFCA-related substances and products/mixtures containing these substances for the calendar years 2004 and 2005.

Information obtained by NICNAS indicated that:

- Two PFCA precursors were imported into Australia in 2005. One was a perfluorinated furan compound (0.25 kg) used as an analytical reagent. The other substance was a polymer containing a perfluoroalkylethyl ester moiety imported at 150 kg in 2005, which was used to formulate coatings for wood boards of internal wall cladding.

- Eight products containing PFCA precursors were imported into Australia during 2004 and 2005. Five of these were water/oil repellent products used for textiles, carpets, and masonry/cement surfaces. The remaining three products were used for automotive painting, glass treatment and ink cartridges. These eight PFCA precursors included five perfluoroalkylethyl chemicals/polymers and three fluorinated acrylate polymers. The total volume of the eight products was up to 33,300 kgs per annum, with the majority of this being polymeric substances. The concentration of PFCA precursors in the products ranged from <0.1 % to 50 % (NICNAS, 2013).

The information collected for PFCA-related substances in July 2006 could be incomplete because the call for information did not specifically include the PFCAs group.

Fluorinated surfactants are reported to be imported into Australia. These surfactants can contain some of the fluorinated chemicals evaluated in this assessment and can be used as detergents, emulsifiers or dispersants in the above applications.

Three of the chemicals in this group (CAS Nos. 500701-62-2, 428842-38-0, and 59493-72-0) have previously been assessed as new chemicals for domestic and commercial use under NICNAS, and they were subsequently added to the Inventory. The first two of these chemicals are discontinued products, and are no longer expected to be in active use.

The following uses were identified for products containing indirect precursors of PFCAs, sold in Australia:

- in sealants; and

- in cleaning products.

In addition, it is noted that the chemicals in this group may be present in the environment due to historic use, release from pre-treated articles imported into Australia, or as breakdown products resulting from using other indirect precursor chemicals covered in this assessment.

International

The following international uses for the chemicals in this group were identified through Galleria Chemica (Galleria), Organisation for Economic Development and Cooperation (OECD) Surveys (OECD 2005; OECD 2006; OECD, 2011), Danish EPA Surveys (Jensen et al, 2008; Danish EPA, 2013), European Chemicals Agency (ECHA) reports (ECHA, 2014), European Commission Health and Consumers website (CosIng), The Nordic Chemicals Group report (Posner et al, 2013) and the Substances in Preparations in Nordic Countries (SPIN).

The neutral organic fluorotelomer derivatives in this group are used as industrial intermediates. Five of these chemicals (including 10:2 FTOH, 12:2 FTOH and 12:2 FTMAC) have recently been reported as in use in various Nordic countries. The two neutral organic UVCB substances (CAS Nos 68391-08-2 and 85631-54-5) are currently registered for use in the European Union. In the United States of America (USA), the UVCB fluorotelomer alcohol (CAS No. 68391-08-2) is also reported to have current or recent use (US EPA, 2015).

An additional 20 chemicals in this group have also recently been reported to be in use in various Nordic countries. A number of polymers have use in a range of applications, including use in coating products, fabric protectors, textile impregnation agents, fire-fighting foam and carpet protectors. Similarly, the alkyl ammonium and amine derivatives (CAS Nos. 68187-47-3 and 70983-60-7) appear to have use in fire-fighting foam, while the thio ethyl carboxylic acid and its lithium salt (CAS Nos. 65530-83-8 and 65530-69-0) are reported to be used in cleaning products, polishing agents and products for motor vehicle repair. Three of the four phosphate esters in this group (CAS Nos. 65530-64-5, 65530-74-7 and 65530-63-4), and one of the polyethylene glycol compounds (CAS No. 65545-80-4), are reported to be used in paints, lacquers and varnishes.

Conversely, a number of chemicals in this group appear to have limited use internationally. Twenty five chemicals in this group (including 22 polymers) were not identified as being listed on the chemical inventories of any other country.

Data for one neutral organic derivative (CAS No. 85631-54-5) indicate that it is being used at between 100 and 1000 tonnes per annum in the European Union. No further volume data were identified for the chemicals in this group. Nevertheless, it is noted that it has previously been estimated that approximately 1000 tonnes of PFOA-related substances for textile and leather treatment are introduced per annum in the European Union, with a further 1000 to 10 000 tonnes imported in textile articles (ECHA, 2014).

Restrictions

Australian

In 2007, a factsheet published by NICNAS recommended that industry seek alternatives to PFOA and chemicals that may degrade to PFOA, and ultimately aim to phase out use of these substances (NICNAS, 2013).

Some state governments in Australia have introduced regulations regarding the management of PFAS containing firefighting foams, which could impact the use, release, and disposal of chemicals in this group in these states. In South Australia, the Environmental Protection Agency prohibited potentially hazardous fluorinated firefighting foams on 30 January 2018 (EPA South Australia, 2018). This prohibition covers any firefighting foam containing a fluorinated organic compound or compounds, which would include the chemicals in this group.

The former Queensland Government Department of Environment and Heritage Protection (now the Department of the Environment and Science) has introduced a policy for the environmental management of firefighting foams (Queensland Government, 2016). Firefighting foams that contain PFOA, PFOA precursor compounds or their higher homologues, where the total organic fluorine content equivalent to PFOA and higher homologues exceeds 50 mg/kg bw in foam concentrate must be withdrawn from service as soon as practicable.

Under the terms of the Inventory listings for CAS Nos. 500701-62-2, 428842-38-0, and 59493-72-0, secondary notification conditions apply for introducers of these chemicals.

International

Substances with a perfluorinated moiety of seven to twenty perfluorinated carbons directly bonded to any chemical moiety other than a fluorine, chlorine or bromine atom are listed under Schedule 1 (the Toxic Substances List) of the Canadian Environmental Protection Act 1999 (CEPA) (Government of Canada, 2018c), which prohibits their manufacture, import, use or sale. Exemptions for certain uses of these chemicals where developments are underway or where there are currently no known alternatives are currently in force, but a proposal to further restrict the manufacture, import, use or sale of these chemicals has been released and is expected to be finalised by winter 2020 (Government of Canada, 2018a; Government of Canada, 2018b).

The US EPA published an action plan on long-chain perfluorinated chemicals, covering the chemicals in this group, in 2009 (US EPA, 2009).

US EPA proposed a Significant New Use Rule (SNUR) for long-chain PFCA chemicals, including CAS Nos. 865-86-1, 39239-77-5, 68187-47-3, 68391-08-2, and 70969-47-0, in January 2015. Under the Rule, approval must be sought for new uses of these chemicals after December 2015. The existing uses of these chemicals are expected to be phased out by December 2015 under a voluntary stewardship programme (US EPA, 2015). For this SNUR, EPA is also proposing to make inapplicable the exemption for persons who import long-chain PFCA chemical substances as part of articles.

In 2013, PFOA, its ammonium salt, and C11–C14-PFCAs were included in the Candidate List of Substances of Very High Concern for Authorisation under the European Chemicals Regulation, REACH (ECHA, 2013). In October 2014, a proposal to restrict the manufacture, use and sale of PFOA, its salts, and substances that may degrade to PFOA, under the REACH legislation, was published (ECHA, 2014).

Some of the discrete chemical constituents of a number of the substances in this group can degrade into PFOA according to the recent listing of PFOA, its salts and PFOA-related compounds on Annex A (Elimination) of the Stockholm Convention on

Persistent Organic Pollutants (UNEP, 2001; UNEP, 2019). The listing prohibits production and use of these chemicals for purposes other than specific time-limited exemptions for specialised uses in the manufacture of semiconductors, photographic films, and certain textiles for use in the protection of workers from exposure to dangerous liquids. Australia has not yet ratified this amendment.

Existing Worker Health and Safety Controls

Hazard Classification

The chemical CAS No. 59493-72-0 is classified as hazardous, with the following hazard categories and hazard statements for human health in the Hazardous Chemical Information System (HCIS) (Safe Work Australia): Eye irritation–category 1; H318 (Causes serious eye damage).

The other chemicals in this group are not listed on the Hazardous Chemical Information System (HCIS) (Safe Work Australia).

Exposure Standards

Australian

No exposure standards exist for the chemicals in this group.

International

No exposure standards exist for the chemicals in this group.

Health Hazard Information

Very limited toxicity data were identified for the chemicals in this group. Based on the available Australian use data, non-polymeric substances are only introduced in small quantities. Polymers are generally of low bioavailability and have low toxicity. This is supported by the limited available data that suggest low acute and chronic toxicity as well as low reproductive/developmental toxicity (NICNAS, 1998; NICNAS, 1999; REACH; DuPont, 2001; DuPont, 2004). Some of the chemicals (especially the fluorosurfactants) can cause irritation to the eyes and skin (NICNAS, 1998; NICNAS, 1999; REACH) as well as irritation of the respiratory tract leading to acute lung injury if inhaled (Fischer, 2012). However, the primary health risk is expected to arise from secondary, long-term exposure to the degradation products, the long-chain PFCAs (see **Grouping rationale**). Therefore, the focus of this assessment is on the health effects of the degradation products and potential long-term effects following chronic low level exposure.

Toxicokinetics

The long-chain PFCAs accumulate mainly in the liver (NICNASb; Vanden Heuvel et al 1991a; Vanden Heuvel et al 1991b) and this bioaccumulation is positively associated with carbon chain-length of the chemical (OECD, 2013). The estimated half-lives in men and older women were 4.3 years for perfluorononanoic acid (PFNA; CAS No. 375-95-1), and 12 years for perfluorodecanoic acid (PFDA; CAS No. 355-76-2) and perfluoroundecanoic acid (PFUA; CAS No. 2058-94-8) (Zhang et al., 2013). The half-lives in young women were shorter for all PFCAs but followed the same pattern of being longer for longer carbon chain length.

In humans, urinary clearance decreased with increasing carbon chain length of the PFCAs, while biliary clearance increased. The chemicals PFNA and PFDA had the smallest total clearance among PFCAs with 6 to 14 carbon atoms. The urinary clearances of PFCAs in humans were more than 200 times smaller than those in mice (Fujii et al., 2015).

Long-chain PFCAs were detected in maternal and umbilical cord blood (Monroy et al., 2008; Kim et al., 2011a; Kim et al., 2011b; Lien et al., 2011; Chen et al., 2012) and in maternal milk (Karrman et al., 2007; Tao et al., 2008; Fujii et al., 2012). They were also found to cross the placental barrier and accumulate in the developing foetus (Hinderliter et al., 2005; Das et al., 2014).

Repeated Dose Toxicity

Oral

The liver is the primary target organ of the long-chain PFCAs.

In 4 separate 14-day oral repeat dose studies in rats, PFNA caused increased liver and thymus weights and elevated triglycerides. Decreased spleen weights and increased lymphoid cell apoptosis noted in one of these studies indicated possible effects on the immune system. Alterations in pro- and anti-inflammatory cytokines were also observed in one study (Zhang et al., 2008; Feng et al., 2009; Fang et al., 2010; Fang et al., 2012).

Repeated dose (42–47 days) studies have been conducted with PFUA, perfluorododecanoic acid (PFDoA; CAS No 307-55-1), and perfluorooctadecanoic acid (PFOdA; CAS No 16517-11-6) in Sprague Dawley (SD) rats (Hirata-Koizumi et al., 2011; Kato et al., 2014; Takahashi et al., 2014). All studies were conducted according to OECD Test Guidelines.

In rats fed 0.1, 0.3 or 1.0 mg/kg PFUA, increased liver weights and hepatocellular hypertrophy were observed at 0.3 mg/kg bw/day in male and at 1.0 mg/kg bw/day in female rats. Body weight gain was inhibited at 1 mg/kg bw/day in both sexes. The no observed adverse effect level (NOAEL) for PFUA was concluded to be 0.1 mg/kg bw/day.

For PFDoA, male and female SD rats received daily doses of 0.1, 0.5 or 2.5 mg/kg bw/day of the substance. Doses at 0.5 mg/kg bw/day and higher caused liver hypertrophy, necrosis and inflammatory cholestasis in male and female rats. Significant decrease in body weight as well as reduced bone marrow haematopoiesis and atrophic changes in the spleen, thymus and adrenal glands were observed at 2.5 mg/kg bw/day. A NOAEL of 0.1 mg/kg bw/day was established for this study.

For the PFOdA study, male and female rats received daily doses of 40, 200 or 1000 mg/kg bw/day of the substance. Increased liver weights and hepatocellular hypertrophy were observed at 200 mg/kg bw/day in males and at 1000 mg/kg bw/day in female rats (Hirata-Koizumi et al., 2014). Body weight gain was inhibited at 1000 mg/kg bw/day in both sexes. The NOAEL for PFOdA was concluded to be 40 mg/kg bw/day.

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Limited information on PFOA, PFNA, PFDA and PFDoA indicates that the chemicals in this group are not genotoxic (Eriksen et al., 2010; Butenhoff et al., 2014; NTP, 2015a; NTP, 2015b; NICNASb).

Carcinogenicity

No data are available for long-chain PFCAs.

The seven fluorinated carbon PFCA (PFOA) has been classified as a Category 3 carcinogen (Carc. Cat 3 - Limited evidence of a carcinogenic effect) under the approved criteria for classifying hazardous substances; or Category 2 carcinogen (Carc. Cat. 2 - Suspected of causing cancer) under the globally harmonised system of classification (GHS). Two experimental carcinogenicity studies reported PFOA-induced liver adenomas, Leydig cell adenomas and pancreatic acinar cell tumours in rats. However, several epidemiological and medical surveillance studies of the workers at 3M plants (APFO manufacturing) in various cities of the US could not establish a link between PFOA exposure and cancer incidence.

Reproductive and Developmental Toxicity

Fertility parameters including survival and number of germ cells (male rats) as well as number of corpora lutea and implantations (female rats) were affected by some, but not all, long-chain PFCAs. Developmental effects, such as increased postnatal pup mortality, decreased pup body weight and delayed onset of puberty, were observed in mice and rats following exposure to most of the long-chain PFCAs evaluated. Developmental effects were also detected in the absence of marked maternal toxicity.

Reproductive toxicity

In 3 separate reproductive toxicity studies, conducted according to OECD guidelines, SD rats were exposed to PFUA (0.1, 0.3 or 1 mg/kg/day), PFDoA (0.1, 0.5 or 2.5 mg/kg bw/day), and PFOdA (40, 200 or 1000 mg/kg bw/day) for 14 days before mating, and during the pregnancy and lactation (Hirata-Koizumi et al., 2011; Kato et al., 2014; Takahashi et al., 2014).

PFUA had no effect on the reproductive parameters. PFDoA caused continuous dioestrus in all females only at the highest dose (2.5 mg/kg bw/day), at which histopathological changes including decreased spermatid and spermatozoa counts in males were also observed. Seven out of twelve females in the 2.5 mg/kg bw/day group died during pregnancy and four others did not deliver live pups. Daily exposure to 1000 mg PFOdA/kg bw/day (highest dose) decreased the number of corpora lutea, implantation and total number of pups born and this was associated with significantly reduced body weight. The NOAELs for reproductive effects for PFDoA and PFOdA were established as 0.5 and 200 mg/kg bw/day, respectively.

Rats exposed to PFNA (3 or 5 mg/kg bw/day) for 14 days showed increased cell death of spermatocytes and spermatogonia (Feng et al., 2009). However, S-111-S-WB, a product containing 74 % of PFNA, when administered daily via oral gavage (0.025, 0.125 and 0.6 mg/kg bw/day) to SD rats over two generations (70 days before mating, during pregnancy and lactation), did not affect reproductive performance, mean litter size, pup survival and pup weights (Stump et al., 2008).

Developmental toxicity

In the studies described above, PFUA (0.1, 0.3 or 1 mg/kg/day), PFDoA (0.1, 0.5 or 2.5 mg/kg bw/day), and PFOdA did not have any effects on the development of pups.

In a developmental toxicity study, SD rats were exposed daily to 1, 3 or 5 mg/kg bw/day PFNA between gestation days 1 to 21 (GD1–21) by oral gavage. Maternal weight gain, number of implantations, foetal viability or foetal weight were not affected at any doses. The offspring exposed to 5 mg/kg bw/day PFNA in utero, had significantly lower birth weight than controls (by 16 %), and body weight remained lower than controls through early postnatal development (Das et al., 2012).

In another developmental toxicity study, not performed according to OECD guidelines, timed pregnant female CD-1 mice exposed were exposed to 1, 3, 5 or 10 mg/kg bw/day PFNA between gestation days 1 to 17. At 10 mg/kg bw/day, dams could not carry their pregnancy successfully. Daily exposure to 5 mg/kg bw/day significantly increased neonatal lethality, with 80 % of neonates dying in the first 10 days of life (Das et al., 2014). At weaning, the body weight of the surviving offspring, when compared to controls, was reduced by 73 % and 55 % at doses of 3 and 5 mg/kg bw/day, respectively. The surviving neonates showed dose-dependent delays in eye opening and onset of puberty as well as increased liver weights that lasted to adulthood. Liver weight was increased in pregnant dams at 5 mg/kg bw/day, but no effects on the maternal body weight gain or number of implantations, foetal viability of foetal weights were reported. The NOAEL for developmental toxicity could not be determined, while the LOAEL was considered as 1 mg/kg bw/day based on the effects on developmental landmarks like eye opening and sexual maturation.

These findings are supported by another study in 129S1/SvlmJ mice, where exposure to 0.83, 1.1, 1.5 or 2 mg/kg bw/day PFNA on gestational days 1 to 18 had no effect on maternal body weight or fertility parameters such as number of implantations and total litter size (live and dead pups) (Wolf et al., 2010). However, the number of live pups at birth as well as survival of pups from birth to weaning was significantly reduced at 1.1 and 2.0 mg/kg bw/day. Eye opening was delayed and the offspring weight gain was reduced at 2 mg/kg bw/day. The developmental toxicity of PFNA appear to be mediated via peroxisome proliferator-

activated receptor (PPAR)-alpha mediated mechanisms, as no developmental toxicity was detected in PPAR-alpha knockout mice (Wolf et al., 2012).

The developmental toxicity of PFDA was determined in C57BL/6N mice. The chemical PFDA was administered to pregnant mice between GD 10–13 or GD 6–15 with doses of 0, 0.25, 0.5, 1, 2, 4, 8, 16 or 32 mg/kg bw/day or 0, 0.03, 0.3, 1, 3, 6.4 or 12.8 mg/kg bw/day, respectively. Dams were euthanised on GD18 for maternal and foetal toxicity assessment (Harris and Birnbaum, 1989). Maternal body weight gain was significantly reduced at two highest doses of 6.4 and 12.8 mg/kg bw/day (GD 6–15) and 16 and of 32 mg/kg bw/day (GD10–13). Foetal viability was reduced only in litters of dams showing extensive maternal body weight loss (at 12.8 mg/kg bw/day for GD 6–15). However, foetal body weights were significantly reduced at 0.1 mg/kg bw/day (GD 6–15) and 0.5 mg/kg bw/day (GD 10–13). No malformation was observed in the offspring. The NOAEL for developmental effects of PFDA was 0.03 mg/kg bw/day (GD6–15) based on reduced foetal body weights.

Other Health Effects

Endocrine Disruption

Epidemiological findings in humans as well as experimental findings *in vivo* and *in vitro* indicate that long-chain PFCAs can affect the endocrine system (ECHA, 2014). There are several experimental studies that suggest that PFOA, PFNA, PFDA and PFDoA can alter production of hormones (Bookstaff et al., 1990; Biegel et al., 1995; Boujrad et al., 2000; Shi et al., 2007; 2009a, 2009b; Feng et al., 2009, 2010; Kraugerud et al., 2011; Zhao et al., 2012) or act indirectly, via testicular or ovarian effects (Feng et al., 2009; Dixon et al., 2012). The direct effect on testicular cells was further supported by the observation of reduced cell viability of isolated and cultured rat Sertoli cells treated with 100 µM PFNA for 14 days (Feng et al., 2010).

Risk Characterisation

Critical Health Effects

The chemicals in this group with surfactant properties could induce slight to moderate irritation in eyes and skin as well as acute lung injury if inhaled (NICNAS, 1998; NICNAS, 1999; REACH). However, the main health risk for the chemicals in this group is expected to arise from secondary exposure to the long-chain PFCA degradation products.

The bioaccumulation potential of long-chain PFCAs varies with chain length, and the data indicate that the longer chain lengths are associated with increased bioaccumulation and increased toxicity. Long-term toxicity is reported for long-chain PFCAs that is similar to that of PFOA (see detailed information and relevant references in Human Health Tier II Assessment for Perfluorooctanoic Acid (PFOA) and its Direct Precursors (NICNASb)).

Liver is a target organ for long-chain PFCAs. Hepatocellular hypertrophy and degeneration as well as focal to multifocal necrosis were reported with increasing severity between oral doses of 0.3–15 mg/kg bw/day in rats and mice for C8–C12 PFCAs. Similar effects were observed for PFOdA at 200 mg/kg bw/day.

The immune system is also proposed to be a target for PFCA toxicity with PFNA affecting lymphoid organs including alterations in T-cells and immune cell homeostasis and in pro- and anti-inflammatory cytokines in mice and rats at 1-5 mg/kg bw/day for 14 days.

Fertility parameters such as the number of corpora lutea and implantations in female as well as spermatid and spermatozoa counts in male rats were reduced following exposure to PFNA, PFDoA or PFOdA. However, no major effects on number of pups born were detected for long-chain PFCAs. In several rat and mouse studies, increased postnatal pup mortality, decreased pup body weight and delayed sexual maturation were observed in the absence of marked maternal toxicity following daily exposure to C8–C18-PFCAs.

No carcinogenicity data are available for long-chain PFCAs. The evidence of PFOA carcinogenicity is regarded as limited. Two experimental carcinogenicity studies reported PFOA-induced liver adenomas, Leydig cell adenomas and pancreatic acinar cell tumours in rats. However, several epidemiological and medical surveillance studies of the workers at 3M plants (APFO manufacturing) in various cities of the US could not establish a link between PFOA exposure and cancer incidence.

Public Risk Characterisation

Use in consumer products

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. Significant direct exposure to the non-polymer substances is not expected. Therefore, public risk from these chemicals is not considered to be unreasonable.

Secondary exposure to long-chain PFCAs via the environment

The primary health risk for the public is expected to arise from secondary, long-term exposure to the long-chain PFCA degradation products from the chemicals in this group. While long-term studies in animals show adverse effects from exposure to long-chain PFCAs, epidemiological studies in the general public or in workers exposed to these chemicals do not provide clear evidence of effects in humans. Importantly, exposure of the general public is expected to be low. Blood monitoring data (international and national) suggested widespread exposure of the general population to low levels of PFOA (US EPA, 2005; Toms et al., 2014) and increasing trends for long-chain PFCAs (Karrman et al., 2007; Harada et al., 2011; Okada et al., 2013). In pooled human sera from the Australian population, PFNA and PFDA were detected in concentrations ranging from 0.1–1.6 ng/mL and <0.2–0.8 ng/mL, respectively compared with PFOA ranging from 0.8–9.1 ng/mL (Toms et al., 2014).

Nevertheless, long-chain PFCAs are persistent and bioaccumulative in the environment and, therefore, have the potential to become widely dispersed environmental contaminants (Environment Canada, 2012). Once in the environment, persistent chemicals that are also highly bioaccumulative pose an increased risk of accumulating in exposed organisms and chemical causing adverse effects. They can also biomagnify through the food chain, resulting in very high internal concentrations, especially in top predators.

Occupational Risk Characterisation

Based on the available use information, the non-polymeric substances are not likely to be used by workers in significant quantities in Australia. Polymers with low bioavailability generally do not present significant risks. Therefore the chemicals are not considered to pose an unreasonable risk to the health of workers. The irritant and acute effects of the chemicals with surfactant properties should be considered by a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) in determining the appropriate controls.

Long term occupational exposure to low concentrations of long-chain PFCAs could occur while using these polymers or formulated products containing PFCAs as a contaminant.

NICNAS Recommendation

Currently it is recommended that PFOA- and related PFCA-based chemicals be restricted to only essential uses for which no suitable or less hazardous alternatives were available.

The chemicals in this group have been assessed as having the potential to cause adverse outcomes for the environment and public health. 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 consumers

Products containing the chemicals should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from any 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:

• health monitoring for any worker who is at risk of exposure to the chemicals, 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 12 December 2019

Chemical Identities

Chemical Name in the Inventory and Synonyms	**1-Dodecanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluoro-** 1,1,2,2-tetrahydroperfluorododecanol 2-perfluorodecylethanol 10:2 fluorotelomer alcohol 10:2-FTOH
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	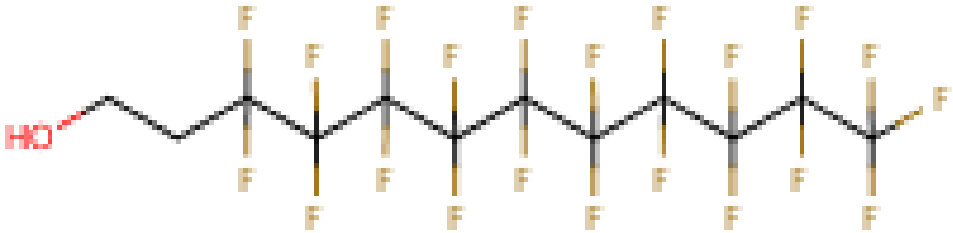
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	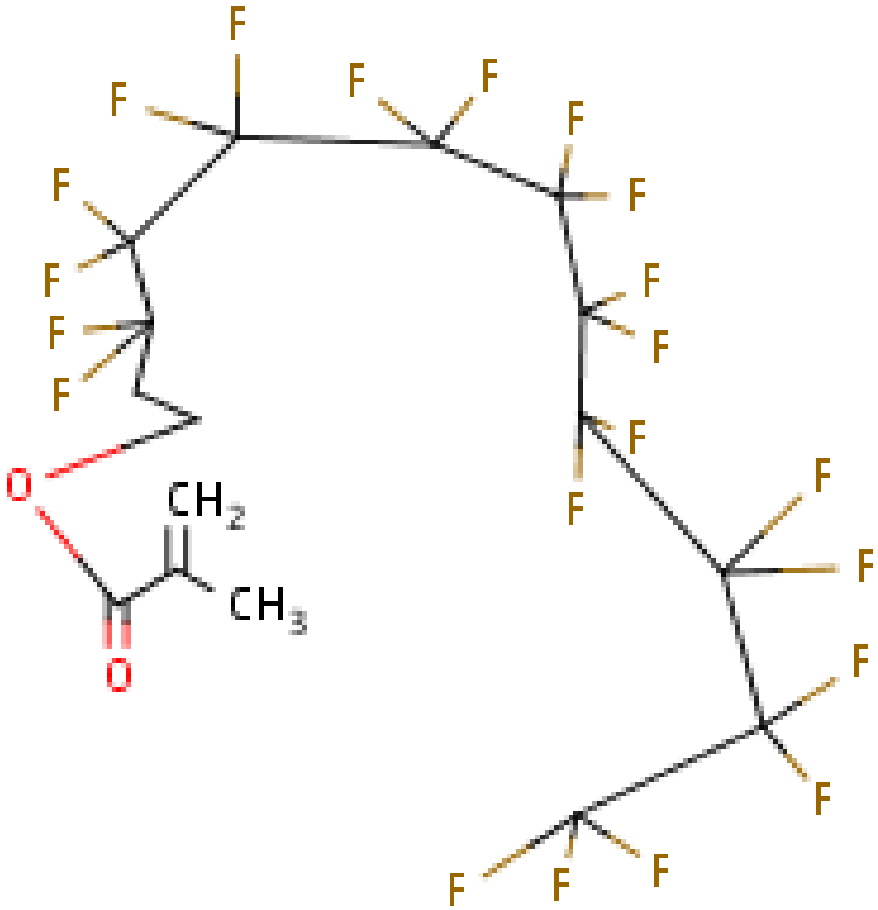
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	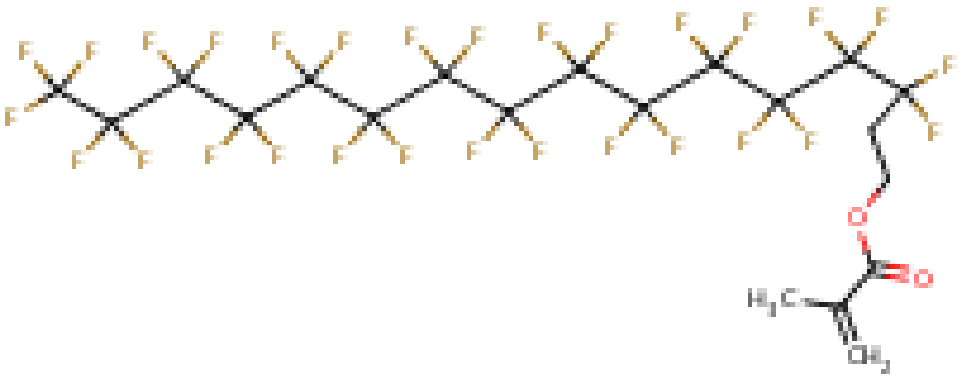
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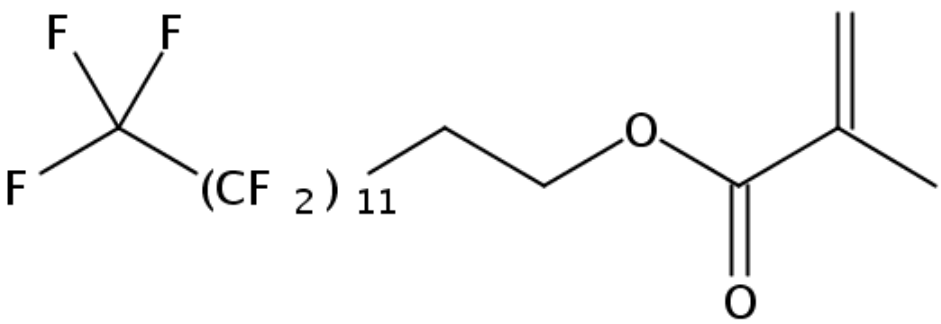
Structural Formula	

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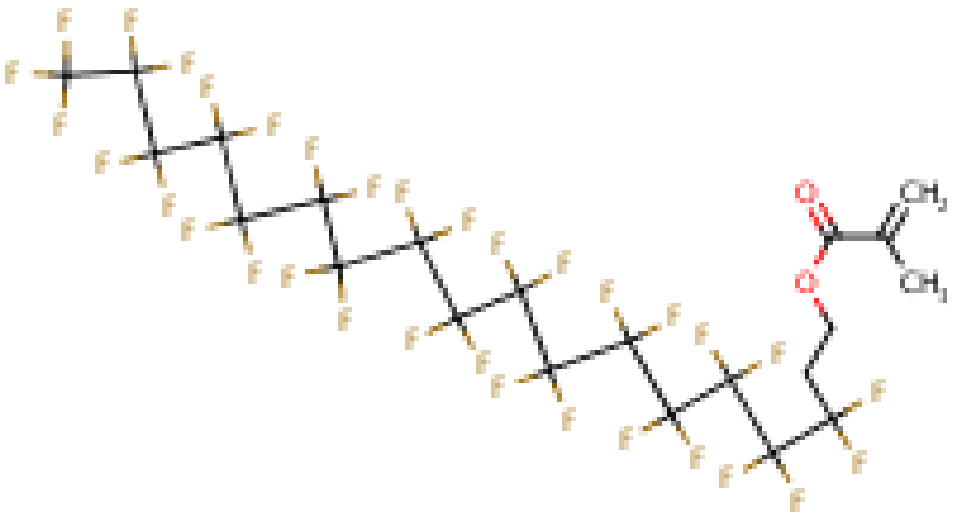
Structural Formula	
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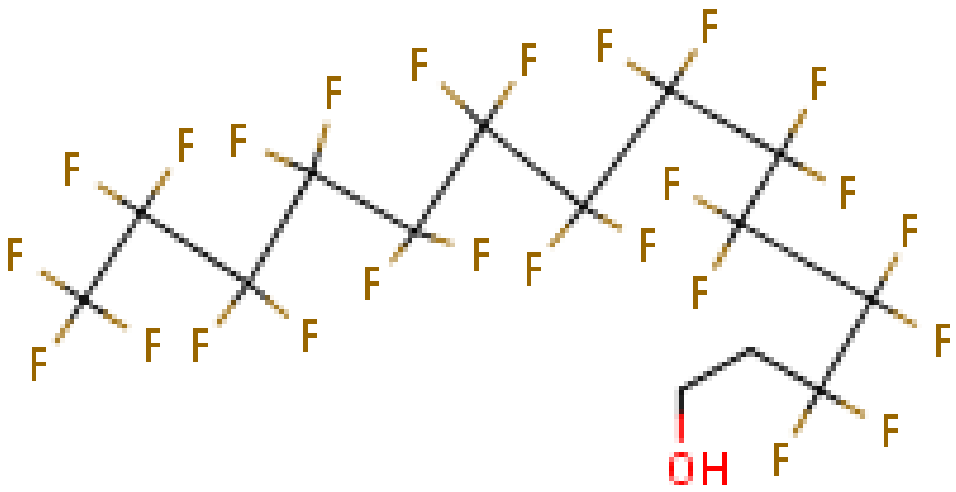
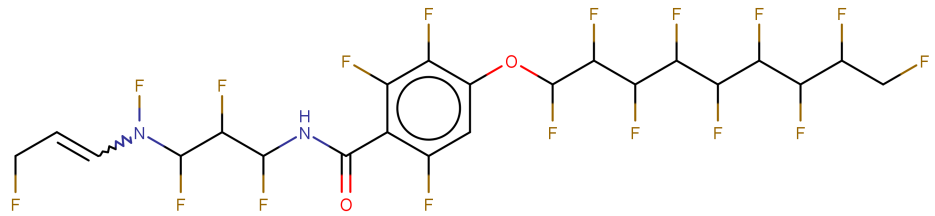
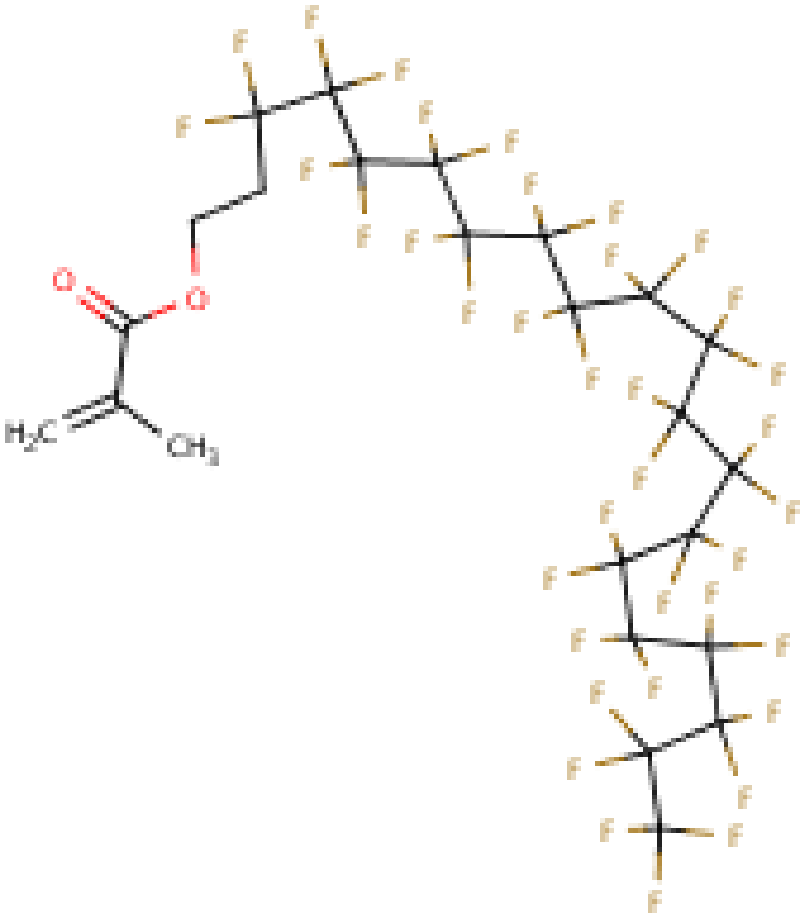
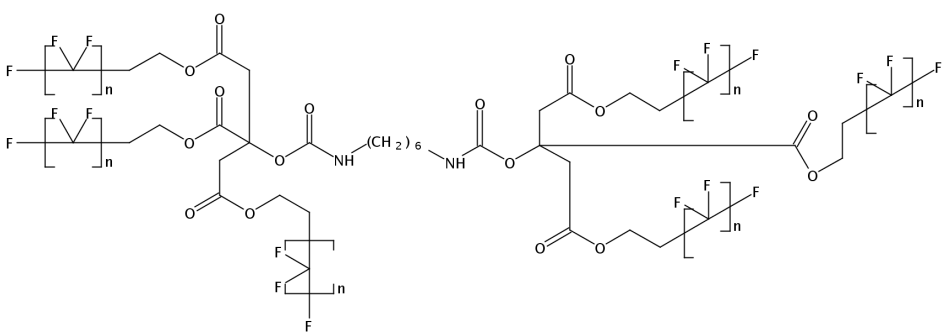
Structural Formula	
Molecular Formula	C14H5F25O
Molecular Weight	664.14

Chemical Name in the Inventory and Synonyms	**1-propanaminium, 3-[[4-[(heptadecafluorononenyl)oxy]benzoyl]amino]-N,N,N-trimethyl-, iodide**
CAS Number	59493-72-0
Structural Formula	

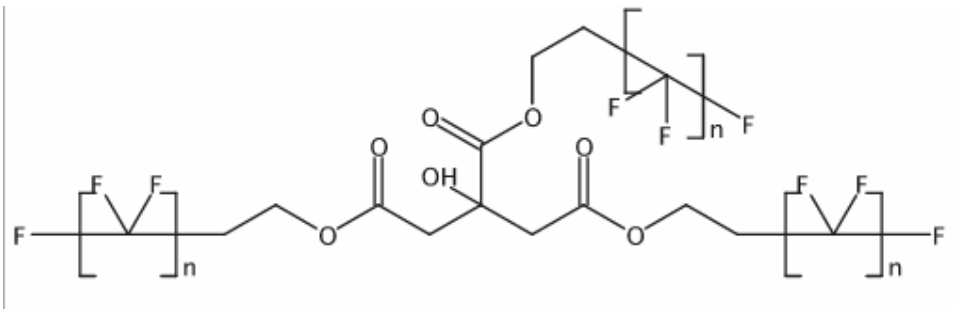
	
Molecular Formula	C22H20F17N2O2I
Molecular Weight	794.28

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,17,17,18,18,19,19,20,20,20-heptatriacontafluoroeicosyl ester** 1,1,2,2-tetrahydroperfluoroeicosyl methacrylate 18:2 fluorotelomer methacrylate 18:2 FTMAC
CAS Number	65104-66-7
Structural Formula	
Molecular Formula	C24H9F37O2
Molecular Weight	1032.26

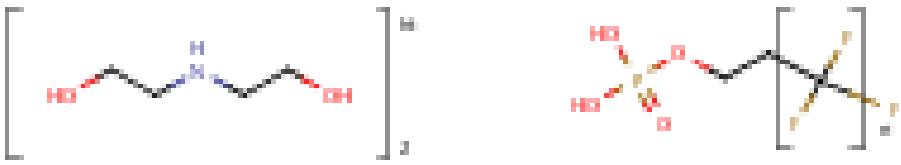
Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-.omega.-[2-[[2-(trimethylammonio)ethyl]thio]ethyl]-, methyl sulfate** perfluoroalkylamine methosulfate
CAS Number	65530-57-6
Structural Formula	**No Structural Diagram Available**
Molecular Formula	CH3O4S.(CF2)nC7H17FNS
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, ester with 2,15-bis(carboxymethyl)-4,13-dioxo-3,14-dioxa-5,12-diazahexadecane-1,2,15,16-tetracarboxylic acid (6:1)** tetraflouromethylene, pentaflouroethyl iodide, citric acid, hexamethylene isocyanate polymer
CAS Number	65530-58-7
Structural Formula	

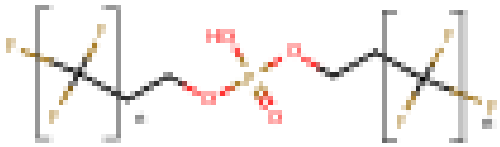
Molecular Formula	(CF2)n(CF2)n(CF2)n(CF2)n(CF2)n(CF2)nC32H46F6N2O16
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, 2-hydroxy-1,2,3-propanetricarboxylate (3:1)**
CAS Number	65530-59-8
Structural Formula	
Molecular Formula	(CF2)n(CF2)n(CF2)nC12H17F3O7
Molecular Weight	

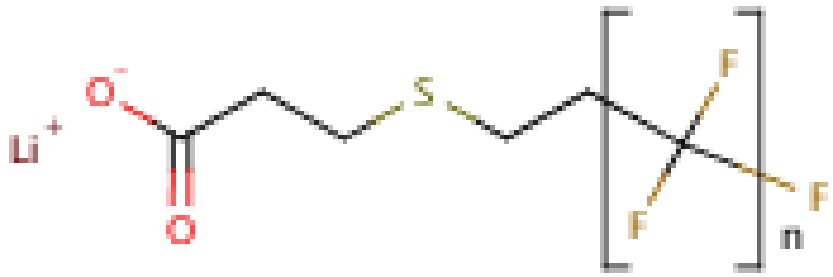
Chemical Name in the Inventory and Synonyms	**Ethanol, 2,2'-iminobis-, compd. with alpha-fluoro-omega-[2-(phosphonooxy)ethyl]poly(difluoromethylene) (2:1)**
CAS Number	65530-63-4
Structural Formula	

	
Molecular Formula	C4H11NO2.1/2(CF2)nC2H6FO4P
Molecular Weight	404.32

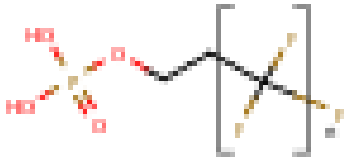
Chemical Name in the Inventory and Synonyms	**Ethanol, 2,2'-iminobis-, compd. with alpha,alpha'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[omega-fluoropoly(difluoromethylene)] (1:1)** diethanolamine bis(C8-C18 perfluoroalkylethyl)phosphate
CAS Number	65530-64-5
Structural Formula	

	 
Molecular Formula	C4H11NO2.(CF2)n(CF2)nC4H9F2O4P
Molecular Weight	395.23

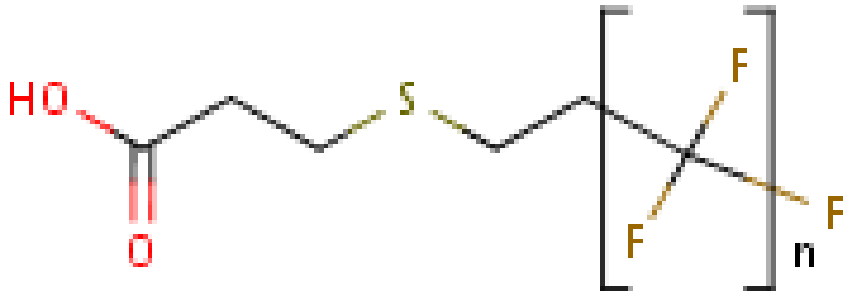
Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-[2-[(2-carboxyethyl)thio]ethyl]-.omega.-fluoro-, lithium salt** lithium 3-(1,1,2,2-fluoroalkylthio)propionate
CAS Number	65530-69-0
Structural Formula	

	
Molecular Formula	(CF2)nC5H9FO2S.Li
Molecular Weight	208.13

Chemical Name in the Inventory and Synonyms	**Ethanol, 2,2'-iminobis-, compd. with alpha-fluoro-omega-[2-(phosphonooxy)ethyl]poly(difluoromethylene) (1:1)**
CAS Number	65530-74-7
Structural Formula	

	 
Molecular Formula	C4H11NO2.(CF2)nC2H6FO4P
Molecular Weight	299.18

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-[2-[(2-carboxyethyl)thio]ethyl]-.omega.-fluoro-** poly(tetrafluoroethylene), .alpha.-[2-[(2-carboxyethyl)thio 3-(1,1,2,2-fluoroalkylthio)propionic acid polymer
CAS Number	65530-83-8
Structural Formula	



Molecular Formula	(CF2)nC5H9FO2S
Molecular Weight	202.20

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy-, ether with .alpha.-fluoro-.omega.-(2-hydroxyethyl)poly(difluoromethylene) (1:1)** plyethylene glycol fluoroalkyl alcohol ether
CAS Number	65545-80-4
Structural Formula	**No Structural Diagram Available**

Molecular Formula	(C2H4O)n(CF2)nC2H5FO
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, dihydrogen 2-hydroxy-1,2,3-propanetricarboxylate**
CAS Number	65605-56-3
Structural Formula	
Molecular Formula	(CF2)nC8H11FO7
Molecular Weight	306.19

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, hydrogen 2-hydroxy-1,2,3-propanetricarboxylate**

CAS Number	65605-57-4
Structural Formula	
Molecular Formula	(CF2)n(CF2)nC10H14F2O7
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)** dodecyl methacrylate, polymer with perfluoroalkylethyl methacrylate
CAS Number	65605-58-5
Structural Formula	

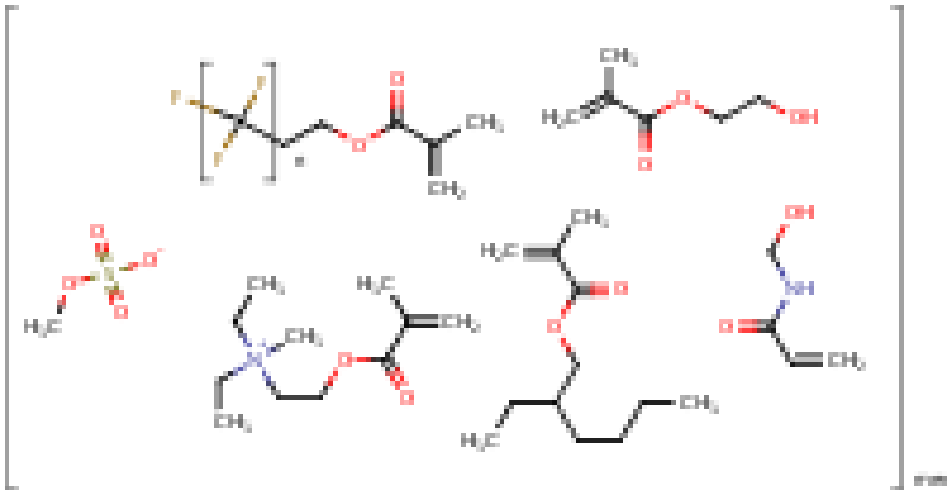
	
Molecular Formula	(C16H30O2.(CF2)nC6H9FO2)x
Molecular Weight	436.55

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene) and N-(hydroxymethyl)-2-propenamide** dodecyl methacrylate, polymer with perfluoroalkylethyl methacrylate and N-hydroxymethylacrylamide
CAS Number	65605-59-6
Structural Formula	

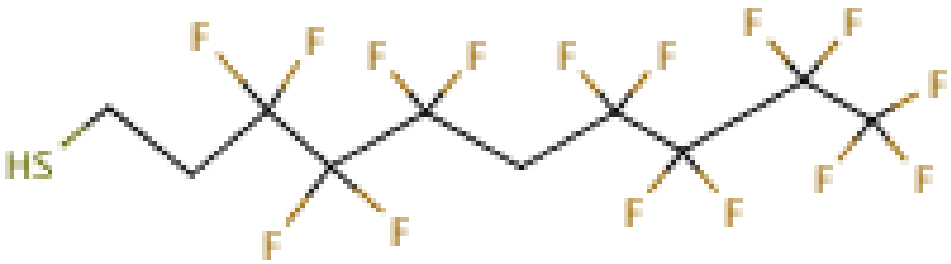
	No Structural Diagram Available
Molecular Formula	(C16H30O2.C4H7NO2.(CF2)nC6H9FO2)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, dodecyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide** dodecyl methacrylate, polymer with perfluoroalkylethyl methacrylate, 2-hydroxyethyl methacrylate and N-hydroxymethylacrylamide
CAS Number	65605-60-9
Structural Formula	No Structural Diagram Available
Molecular Formula	(C16H30O2.C6H10O3.C4H7NO2.(CF2)nC6H9FO2)x
Molecular Weight	

Chemical Name in the	**Ethanaminium, N,N-diethyl-N-methyl-2-[(2-methyl-1-oxo-2-**

Inventory and Synonyms	**propenyl)oxy]-, methyl sulfate, polymer with 2-ethylhexyl 2-methyl-2-propenoate, .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide** diethylaminoethyl methacrylate dimethyl sulphate, polymer with 2-ethylhexyl acrylate, perfluoroalkylethyl methacrylate, 2-hydroxyethyl methacrylate and N-hydroxymethylacrylamide
CAS Number	65636-35-3
Structural Formula	
Molecular Formula	(C12H22O2.C11H22NO2.C6H10O3.C4H7NO2.CH3O4S.(CF2)nC6H9FO2)x
Molecular Weight	923.09

Chemical Name in the Inventory and Synonyms	**Thiols, C10-20, .gamma.-.omega.-perfluoro** perfluoro-C8-18-alkylethyl mercaptan
CAS Number	68140-21-6
Structural Formula	

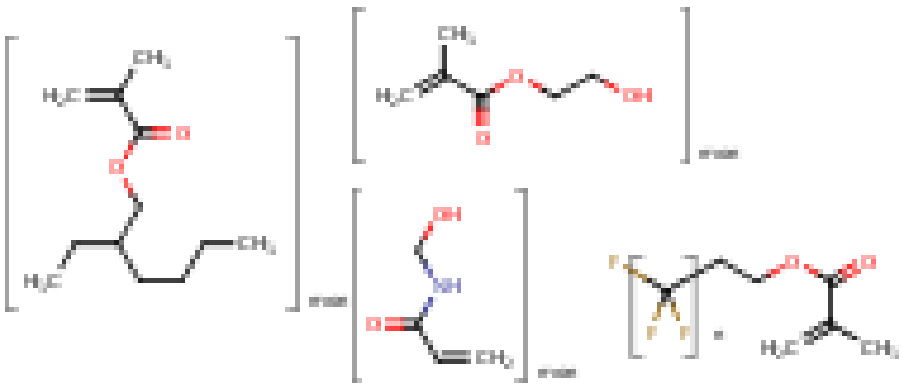
	
Molecular Formula	Unspecified
Molecular Weight	444.20

Chemical Name in the Inventory and Synonyms	**Butanoic acid, 4-[[3-(dimethylamino)propyl]amino]-4-oxo-, 2(or 3)-[(.gamma.-.omega.-perfluoro-C6-20-alkyl)thio] derivatives** N-(N,N-dimethylaminopropyl)-2(or 3)-(1,1,2,2-tetrahydroperfluoro-C6-20-alkylthio)succinamic acid
CAS Number	68187-25-7
Structural Formula	

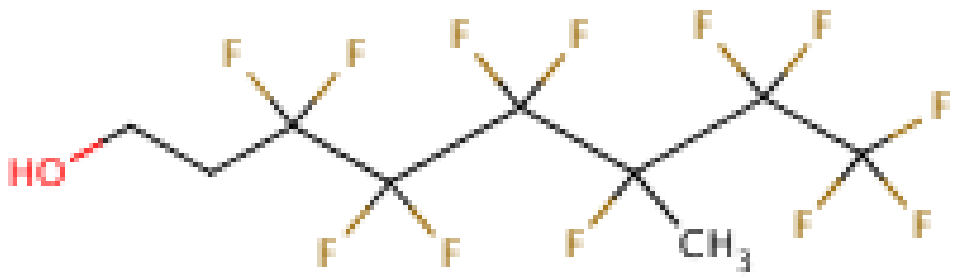
	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1-Propanesulfonic acid, 2-methyl-, 2-[[1-oxo-3-[(.gamma.,.omega.-perfluoro-C4-16-alkyl)thio]propyl]amino] derivatives, sodium salts** 2-methyl-2-[[1-oxo-3-(1,1,2,2-tetrahydroperfluoroalkyl-C4-16-thio)propyl
CAS Number	68187-47-3
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	160.17

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-ethylhexyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), 2-hydroxyethyl 2-methyl-2-propenoate and N-(hydroxymethyl)-2-propenamide**

	tetrafluoroethylene, pentafluoroethyliodide,ethylene, 2-hydroxyethyl methacrylate, 2-ethylhexyl methacrylate, N-hydroxymethyl acrylamide polymer 2-ethylhexyl 2-methylprop-2-enoate N-(hydroxymethyl)prop-2-enamide
CAS Number	68239-43-0
Structural Formula	
Molecular Formula	(C12H22O2.C6H10O3.C4H7NO2.2(CF2)nC6H9FO2)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-14, .gamma.-.omega.-perfluoro** 1,1,2,2-tetrahydroperfluoro-C8-14-alkyl alcohol 2-perfluoro-C6-12-alkyl ethanol
CAS Number	68391-08-2
Structural Formula	



Molecular Formula	Unspecified
Molecular Weight	360.14

Chemical Name in the Inventory and Synonyms	**Sulfuric acid, mono(.gamma.-.omega.-perfluoro-C6-12-alkyl) esters, ammonium salts** 1,1,2,2-tetrahydroperfluoro(C6-C12)alkyl sulfate ammonium salt
CAS Number	68516-17-6
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Betaines, N-(hydroxyethyl)-N-methyl-N-(2-sulfoethyl)-N-(1,1,2-trihydroperfluoro-C8-14-2-alkenyl)**
CAS Number	98219-29-5
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Ethene, tetrafluoro-, homopolymer, .alpha.-fluoro-.omega.-(2-hydroxyethyl)-, citrate, reaction products with 1,6-diisocyanatohexane** telomer B citrate urethane
CAS Number	68891-05-4
Structural Formula	

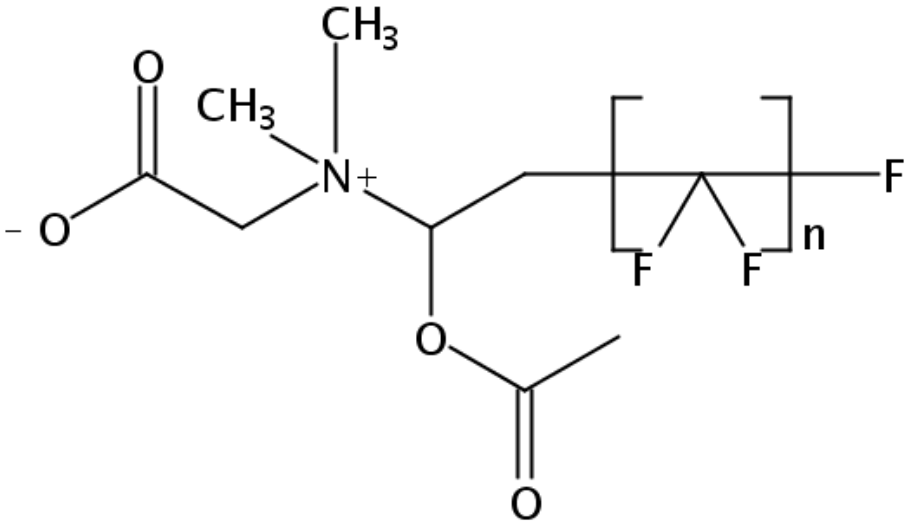
	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Fatty acids, C18-unsaturated, dimers, diisocyanates, polymers with 2,3-bis(.gamma.-.omega.-perfluoro-C4-18-alkyl)-1,4-butanediol, 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane and 2,2'-(methylimino)bis[ethanol]** fatty acids, C18-unsaturated, dimers, diisocyanates, polymers with 2,3-bis(.gamma.-.omega.-25-perfluoro-C4-18-alkyl)-1,4-butanediol, 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane and 2,2-(methylimino)bis[ethanol
CAS Number	68990-40-9
Structural Formula	No Structural Diagram Available
Molecular Formula	(C11H18N2O2.C5H13NO2.C4H10O2.)x
Molecular Weight	

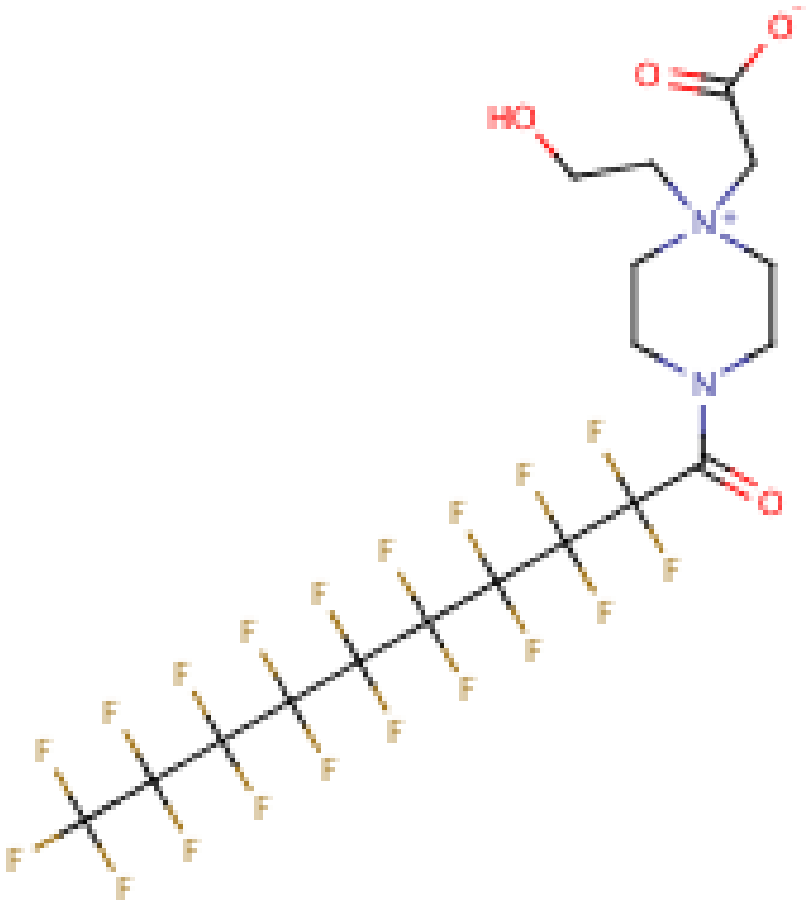
Chemical Name in the Inventory and Synonyms	**Thiols, C8-20, .gamma.-.omega.-perfluoro, telomers with acrylamide**
CAS Number	70969-47-0
Structural Formula	**No Structural Diagram Available**
Molecular Formula	(C3H5NO.)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-methyl-.omega.-hydroxy-, 2-hydroxy-3-[(.gamma.-.omega.-perfluoro-C6-20-alkyl)thio]propyl ethers** 3-(1,1,2,2-tetrahydroperfluoro-C6-20-alkylthio)-2-hydroxy-1-(methoxypolyethyleneoxy)propane
CAS Number	70983-59-4
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified

Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-[2-(acetyloxy)-2-[(carboxymethyl)dimethylammonio]ethyl]-.omega.-fluoro-, hydroxide, inner salt**
CAS Number	71002-41-0
Structural Formula	
Molecular Formula	(CF2)nC8H14FNO4
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Piperazinium, 1-(carboxymethyl)-1-(2-hydroxyethyl)-4-(2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-nonadecafluoro-1-oxodecyl)-, hydroxide, inner salt**
CAS Number	71356-38-2
Structural Formula	

	
Molecular Formula	C18H15F19N2O4
Molecular Weight	684.29

Chemical Name in the Inventory and Synonyms	**Pentanoic acid, 4,4-bis[(.gamma.-.omega.-perfluoro-C8-20-alkyl)thio] derivatives, compounds with diethanolamine** 4,4-bis[(1,1,2,2-tetrahydroperfluoro C8-20-alkyl)thio
CAS Number	71608-61-2
Structural Formula	**No Structural Diagram Available**

Molecular Formula	C5H10O2.C4H11NO2
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Phosphoric acid, gamma-omega-perfluoro-C8-16-alkyl esters, compds. with diethanolamine** phosphoric acid, mono- and bis(.gamma.-omega.-perfluoro-C8-16-alkyl) esters, compounds with diethanolamine
CAS Number	74499-44-8
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Sulfuric acid, mono(.gamma.-.omega.-perfluoro-C8-12-alkyl) esters, ammonium salts**
CAS Number	84238-62-0
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Imidodicarbonic diamide, N,N',2-tris(6-isocyanatohexyl)-, reaction products with ethylene glycol, alpha-fluoro-omega-[2-[(1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), glycidol and 2,4-TDI**
CAS Number	329201-80-1
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, .gamma.-.omega.-perfluoro-C8-14-alkyl esters**

CAS Number	85631-54-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

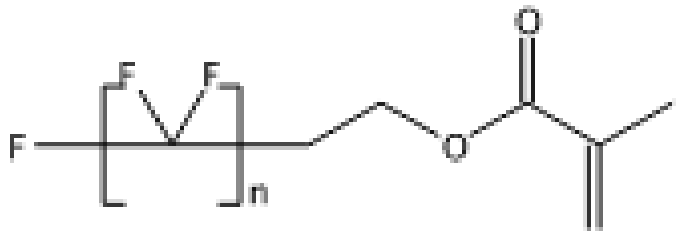
Chemical Name in the Inventory and Synonyms	**Quaternary ammonium compounds, (hydroxyethyl)dimethyl(.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), methyl sulfates**
CAS Number	92129-34-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Pentanoic acid, 4,4-bis[(.gamma.-.omega.-perfluoro-C6-12-alkyl)thio] derivatives, compounds with diethanolamine**
CAS Number	94095-37-1
Structural Formula	**No Structural Diagram Available**
Molecular Formula	C5H10O2.C4H11NO2
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-ethylhexyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)** poly(difluoromethylene), .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy
CAS Number	97136-02-2
Structural Formula	

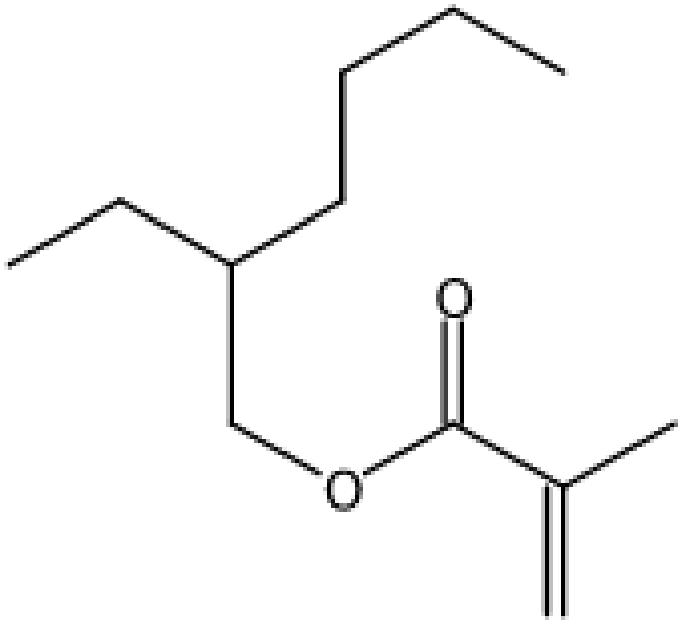
65530-66-7

$(C F_2)_n C_6 H_9 F O_2$



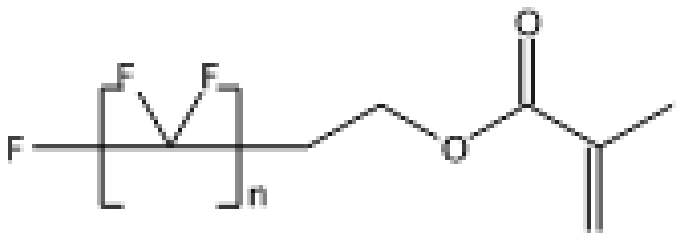
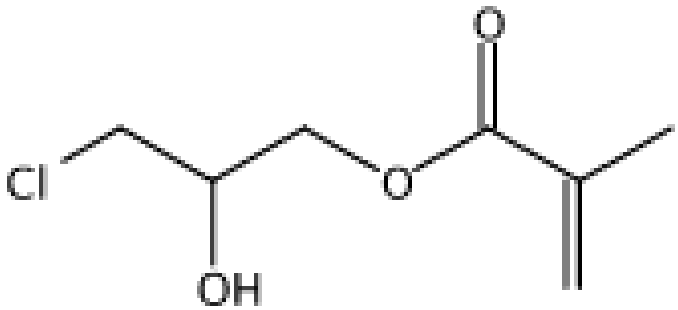
688-84-6

$C_{12} H_{22} O_2$

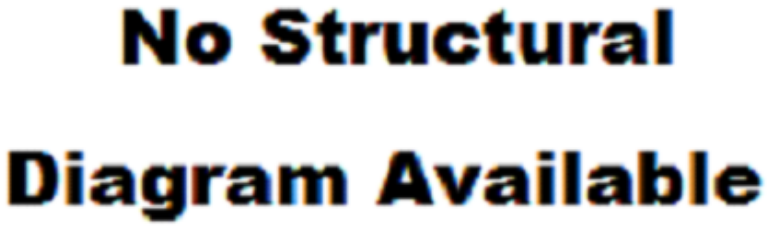


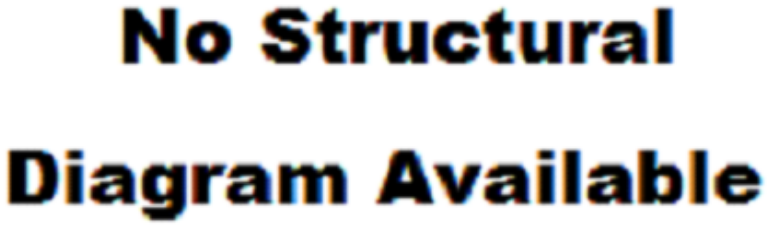
Molecular Formula	(C12H22O2.(CF2)nC6H9FO2)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene)**
CAS Number	101896-32-6

Structural Formula	65530-66-7 $(C F_2)_n C_6 H_9 F O_2$  13159-52-9 $C_7 H_{11} Cl O_3$ 
Molecular Formula	(C7H11ClO3.(CF2)nC6H9FO2)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Thiols, C4-20, .gamma.-.omega.-perfluoro, reaction products with methylated formaldehyde-1,3,5-triazine-2,4,6-triamine polymer**
CAS Number	113089-67-1
Structural Formula	

	
Molecular Formula	(C3H6N6.CH2O.)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Betaines, (hydroxyethyl)methyl(.gamma.,.omega.-perfluoro-C8-14-.beta.-alkenyl)(2-sulfopropyl)**
CAS Number	115340-82-4
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Quaternary ammonium compounds, trimethyl(.delta.-.omega.-perfluoro-C8-14-.beta.-alkenyl), chlorides**

CAS Number	115535-36-9
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, hexadecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, octadecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-propenoate** 2-propenamide, N-(hydroxymethyl)-, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, hexadecyl 2-propenoate, octadecyl 2-propenoate, 3
CAS Number	115592-83-1
Structural Formula	

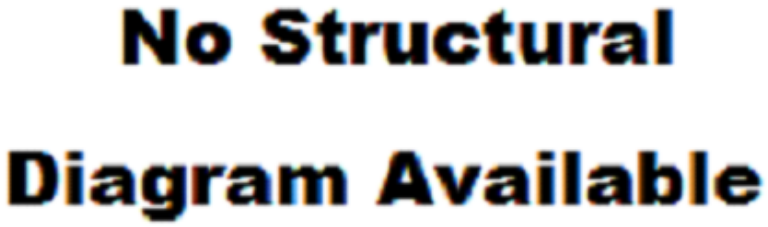
Molecular Formula	(C21H40O2.C19H36O2.C17H7F25O2.C15H7F21O2.C13H7F17O2.C11H7F13O2.C4H7NO2)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin, polyethylene glycol monomethyl ether and N,N',2-tris(6-isocyanatohexyl)imidodicarbonic diamide**
CAS Number	118102-37-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin, tetrahydrofuran homopolymer and N,N',2-tris(6-isocyanatohexyl)imidodicarbonic diamide**
CAS Number	118102-38-8
Structural Formula	

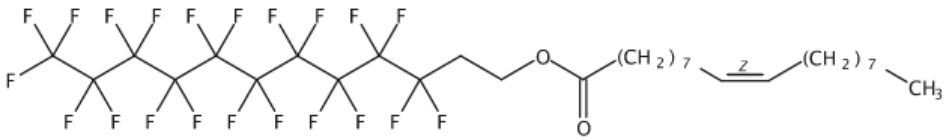
	No Structural Diagram Available
Molecular Formula	(C23H38N6O5.C4H8O.C3H5ClO.)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, alpha-(2-methyl-1-oxo-2-propenyl)-omega-[(2-methyl-1-oxo-2-propenyl)oxy]poly(oxy-1,2-ethanediyl), 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate** 2-propenoic acid, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptade 2-propenoic acid, octadecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, alpha.-(2-methyl-1-oxo-2-propenyl)-omega.-[(2-met poly(oxy-1,2-ethanediyl), alpha-(2-methyl-1-oxo-2-propenyl)-omega-[(2-methyl-1-oxo-2-propenyl)oxy]-, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodec
CAS Number	119973-84-1
Structural Formula	

	
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate** 2-propenamide, N-(hydroxymethyl)-, polymer with 3-chloro-2-hydroxypropyl 2-methyl-2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, 3 2-propenoic acid, octadecyl ester, polymer with 3-chloro-2-hydroxypropyl 2-methyl-2-propenoate, 3,3,3,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, N
CAS Number	119973-85-2
Structural Formula	
Molecular Formula	(C21H40O2.C19H7F29O2.C17H7F25O2.C15H7F21O2.C13H7F17O2.C7H1

	1ClO3.C4H7NO2) x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid (Z-), reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,1112,12,12-heneicosafluoro-1-dodecanol** 10:2 fluorotelomer oleate
CAS Number	125768-41-4
Structural Formula	 Double bond geometry as shown.
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Quaternary ammonium compounds, diethylmethyl(.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), methyl sulfates**
CAS Number	127133-57-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified

Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Hexane, 1,6-diisocyanato-, homopolymer, gamma-omega-perfluoro-C6-20-alc.-blocked** polymeric reaction product of hexamethylene diisocyanate homopolymer, alpha-fluoro-omega-2hydroxyethyl-poly(difluoromethylene) and water
CAS Number	135228-60-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

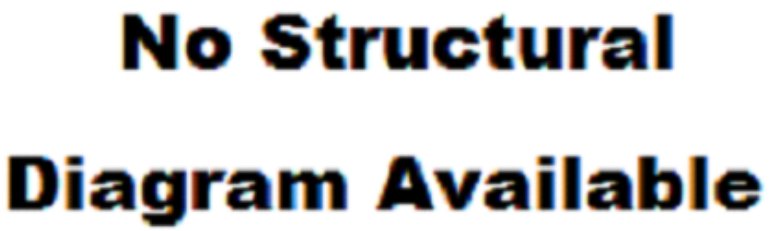
Chemical Name in the Inventory and Synonyms	**1,3-Propanediol, 2,2-bis(bromomethyl)-, reaction products with ethanethiol-tetrafluoroethylene telomer, polymers with 1,6-diisocyanato-2,2,4(or 2,4,4)-trimethylhexane, 2-heptyl-3,4-bis(9-isocyanatononyl)-1-pentylcyclohexane and 2,2'-(methylimino)bis[ethanol]** polymer of 1,3-propanediol,2,2-bis(bromomethyl) reaction product with perfluoroalkylmercaptane, with hexane,1,6-diisocyanato -2,2,4/2,4,4 trimethyl,cyclohexane,2-heptyl-3,4-bis(9-isocyanatononyl)-1-pentyl and ethanol,2,2-(methylimino)bis-
CAS Number	144468-32-6
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Quaternary ammonium compounds, diethyl methyl (.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), tetraphenyl borates**
CAS Number	145477-02-7
Structural Formula	
Molecular Formula	C37H37F11BN-C43H37F23BN
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Quaternary ammonium compounds, diethyl methyl (.gamma.-.omega.-perfluoro-C8-14-.beta.-alkenyl), tetrafluoroborates**

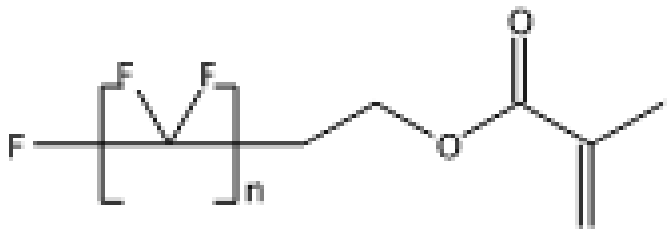
CAS Number	153325-45-2
Structural Formula	
Molecular Formula	C13H16F16BN-C19H16F28BN
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-14, .gamma.-.omega.-perfluoro, reaction products with epichlorohydrin and propylene oxide, trimethylamine-quaternized**
CAS Number	185630-70-0
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenenitrile, polymer with .alpha.-fluoro-.omega.-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), .alpha.-(2-methyl-1-oxo-2-propenyl)-.omega.-methoxypoly(oxy-1,2-ethanediyl) and .alpha.-(2-methyl-1-oxo-2-propenyl)-.omega.-[(2-methyl-1-oxo-2-propenyl)oxy]poly(oxy-1,2-ethanediyl)**
CAS Number	374928-93-5
Structural Formula	

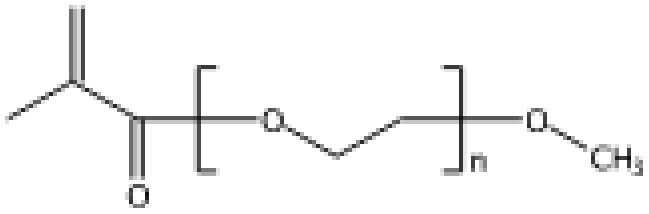
65530-66-7

$(C F_2)_n C_6 H_9 F O_2$



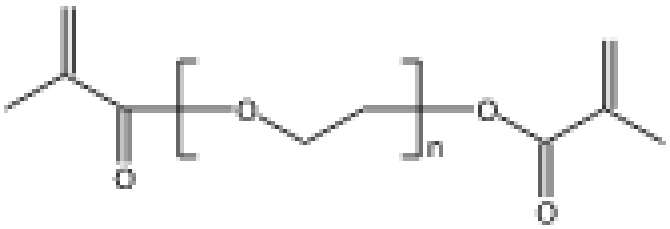
26915-72-0

$(C_2 H_4 O)_n C_5 H_8 O_2$



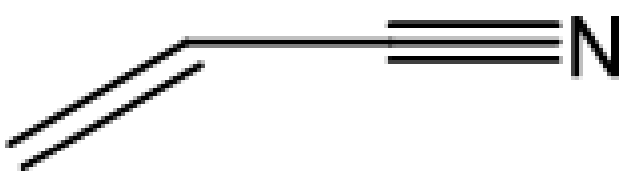
25852-47-5

$(C_2 H_4 O)_n C_8 H_{10} O_3$



107-13-1

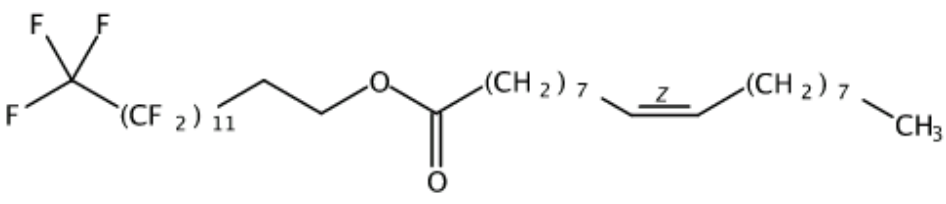
$C_3 H_3 N$



Molecular Formula	

Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-14, gamma-omega-perfluoro, polymers with alpha-fluoro-omega-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), methanol, stearyl acrylate, stearyl methacrylate, 2,4-TDI and vinyl chloride**
CAS Number	376364-33-9
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

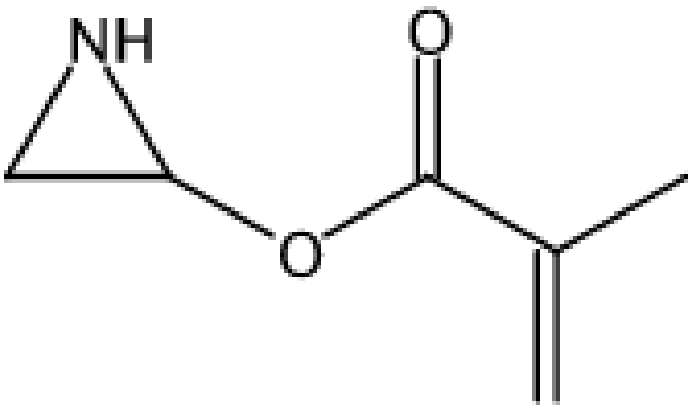
Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid (Z-)-, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluoro-1-tetradecanol** 12:2 fluorotelomer oleate
CAS Number	220237-52-5
Structural Formula	 Double bond geometry as shown.

Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Methylpropenoate, ethyleneimine-, copolymer with benzyl-2-methylpropenoate and poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-((1-oxo-2-propenyl)oxy)ethyl)** 305-55-5A perfluoroalkylethyl acrylate, copolymer with benzyl methacrylate and aziridinyl methacrylate
CAS Number	220713-37-1
Structural Formula	

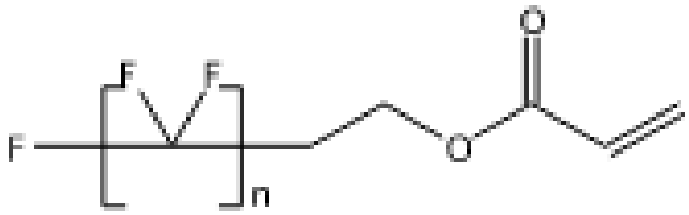
92641-24-2

$C_6 H_9 N O_2$



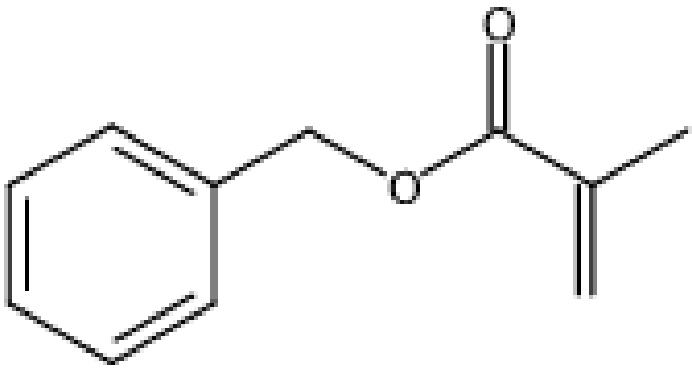
65605-70-1

$(C F_2)_n C_5 H_7 F O_2$



2495-37-6

$C_{11} H_{12} O_2$

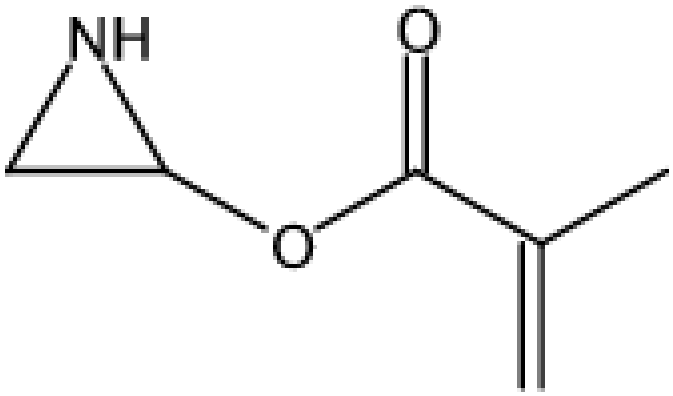


Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-omega.-(2-((2-methyl-1-oxo-2-propenyl)oxy)ethyl), copolymer with octadecanyl-2-methylpropenoate and ethyleneiminyl-2-methylpropenoate** 305-59-9A aziridinyl methacrylate, copolymer with stearyl methacrylate and perfluoroalkylethyl methacrylate
CAS Number	220713-74-6
Structural Formula	

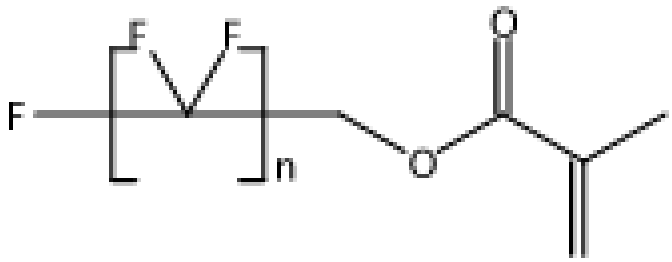
92641-24-2

$C_6 H_9 N O_2$



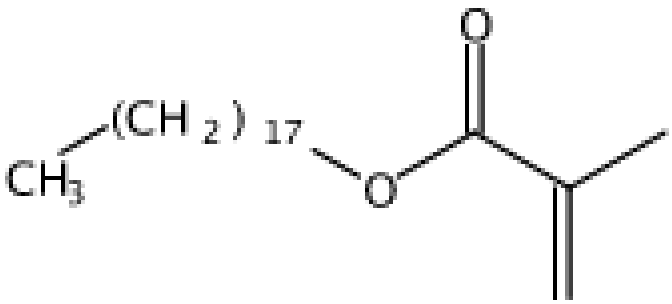
59942-31-3

$(C F_2)_n C_5 H_7 F O_2$



32360-05-7

$C_{22} H_{42} O_2$

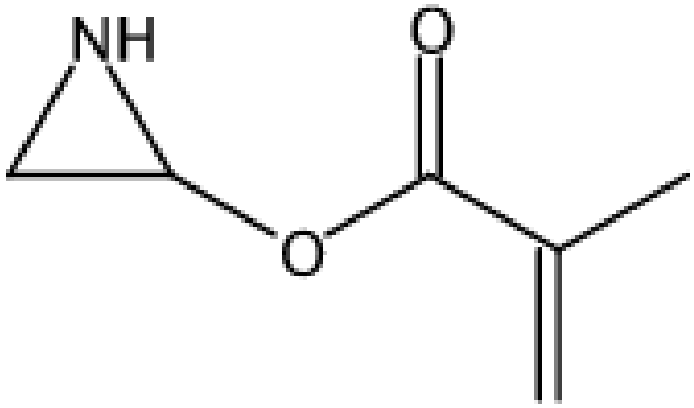


Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Poly(difluoromethylene), .alpha.-fluoro-omega.-(2-((2-methyl-1-oxo-2-propenyl)oxy)ethyl), copolymer with t-butyl-2-methylpropenoate and ethyleneiminyl-2-methylpropenoate** 305-60-2A aziridinyl methacrylate, copolymer with t-butyl methacrylate and perfluoroalkylethyl methacrylate
CAS Number	220713-85-9
Structural Formula	

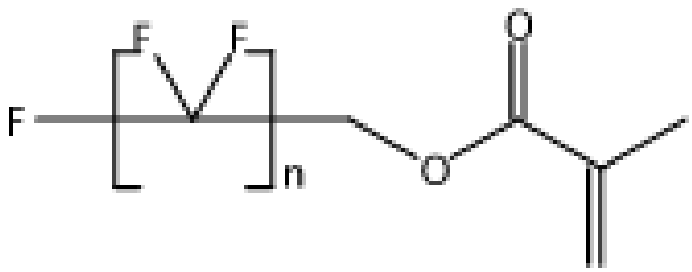
92641-24-2

$C_6 H_9 N O_2$



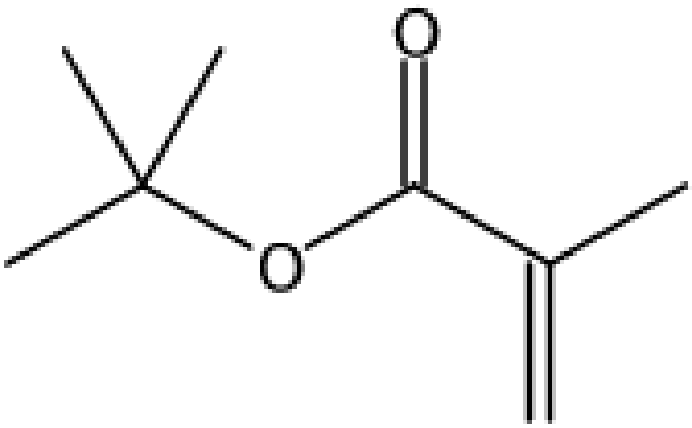
59942-31-3

$(C F_2)_n C_5 H_7 F O_2$



585-07-9

$C_8 H_{14} O_2$



Molecular Formula

Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2,5-Furandione, dihydro-, monopolyisobutylene derivatives, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluoro-1-tetradecanol**
CAS Number	253682-97-2
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2,5-Furandione, dihydro-, monopolyisobutylene derivatives, reaction products with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluoro-1-dodecanol**
CAS Number	253682-98-3
Structural Formula	

	No Structural Diagram Available
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Hexane, 1,6-diisocyanato homopolymer, copolymer with .gamma.,.omega.-perfluoroalcohols C8-14, oxiranemethanol, 1,2-ethanediol and 2,4-diisocyanato-1-methylbenzene**
CAS Number	253873-70-0
Structural Formula	No Structural Diagram Available
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1,2-Propanediol, 3-chloro-, reaction products with imidodicarbonic diamide, N,N',2-tris(6-isocyanatohexyl)-, ethene, tetrafluoro-, ethene and ethane, iodo-**

	310-15-6A
CAS Number	254889-72-0
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Oxirane, reaction products with hexamethylene diisocyanate, methanol, tetrafluoroethylene, ethyl iodide and ethylene** 205-17-4A
CAS Number	254889-79-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine, polyethylene-polypropylene glycol and TDI homopolymer**
CAS Number	332076-28-5
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine and TDI homopolymer**
CAS Number	332076-33-2
Structural Formula	**No Structural Diagram Available**

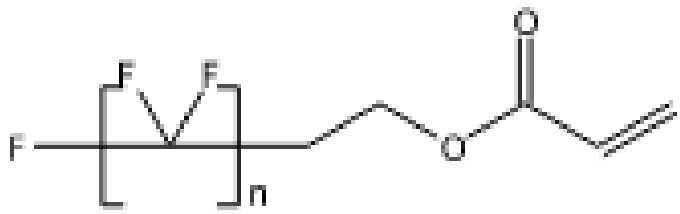
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Oxepanone, homopolymer, decyl perfluoro-C8-14-alkyl esters, reaction products with 1H-imidazole-1-propanamine, polyethylene glycol and TDI homopolymer**
CAS Number	332076-34-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Butenedioic acid, (Z)-, dioctyl-, copolymer with poly(difluoromethylene), .alpha.-fluoro-.omega.-(2-((1-oxo-2-propenyl)oxy)ethyl)chloroethylene**
CAS Number	374928-92-4
Structural Formula	

65605-70-1

$(C F_2)_n C_5 H_7 F O_2$



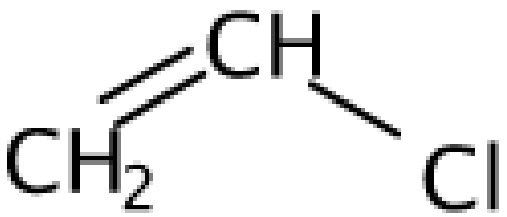
2915-53-9

$C_{20} H_{36} O_4$

Double bond geometry as shown.

75-01-4

$C_2 H_3 Cl$



Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**1-Propanaminium, 2-hydroxy-N,N,N-trimethyl-, 3-[(gamma-omega-perfluoro-C6-20-alkyl)thio] derivs., chlorides**
CAS Number	70983-60-7

Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Hexane, 1,6-diisocyanato-, homopolymer, alpha-fluoro-omega-(hydroxyethyl)poly(difluoromethylene)- and Me Et ketone oxime- and polyethylene glycol mono-Me ether-blocked** Hexane, 1,6-isocyanato-, homopolymer, .alpha.-fluoro-.omega.-(hydroxyethyl)poly(difluoromethylene)-, and Me Et ketone oxime- and polyethylene glycol mono-Me ether-blocked Reaction product of Hexamethylene diisocyanate homopolymer, alpha-fluoro-omega-2-hydroxyethyl-poly (difluoromethylene), polyethylene glycol monoethylether, 2-butanone oxime & water
CAS Number	428842-38-0
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-(diethylamino)ethyl ester, polymer with alpha-fluoro-omega-[2-[(2-methyl-1-oxo-2-propenyl)oxy]ethyl]poly(difluoromethylene), acetate (salt)**
CAS Number	500701-62-2
Structural Formula	**No Structural Diagram Available**
Molecular Formula	
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-(dimethylamino)ethyl ester, polymers with .gamma.-.omega.-perfluoro-C10-16-alkyl acrylate and vinyl acetate, acetates**
CAS Number	196316-34-4
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, hexadecyl ester, polymers with 2-hydroxyethyl methacrylate, .gamma.-.omega.-perfluoro-C10-16-alkyl acrylate and stearyl methacrylate** 2-propenoic acid, 2-methyl-, octadecyl ester, polymer with 2-hydroxyethyl 2-methyl-2-propenoate and gamma-omega-perfluoro-C10-16 alkyl acrylate, and 2-propenoic acid, 2-methyl-, hexadecyl ester
CAS Number	203743-03-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-(dimethylamino)ethyl ester, polymers with Bu acrylate, gamma-omega-perfluoro-C8-14-alkyl acrylate and polyethylene glycol monomethacrylate, 2,2'-azobis[2,4-dimethylpentanenitrile]-initiated**
CAS Number	150135-57-2
Structural Formula	

	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-propenoate, N-(hydroxymethyl)-2-propenamide, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,16,16,16-nonacosafluorohexadecyl 2-propenoate, octadecyl 2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-propenoate**
CAS Number	1094598-90-9
Structural Formula	No Structural Diagram Available
Molecular Formula	(C21H40O2.C19H7F29O2.C17H7F25O2.C15H7F21O2.C13H7F17O2.C11H7F13O2.C7H11ClO3.C4H7N O2)x
Molecular Weight	

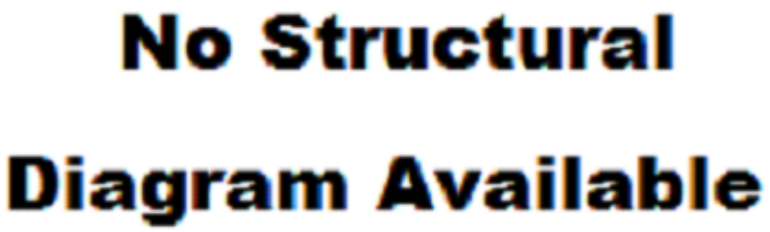
Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3-chloro-2-hydroxypropyl ester, polymers with N-(1,1-dimethyl-3-oxobutyl)-2-propenamide, 2-ethylhexyl acrylate, gamma-omega-perfluoro-C8-16-alkyl acrylate, octadecyl 2-propenoate and vinyl chloride, 2,2'-azobis[2-methylpropanimidamide] dihydrochloride-initiated**
CAS Number	325966-78-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, polymer with butyl 2-propenoate and 2,5-furandione, gamma-omega-perfluoro-C8-14-alkyl esters, potassium salts, tert-Bu benzenecarboperoxoate-initiated**
CAS Number	524729-93-9
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with butyl 2-propenoate and 2,5-furandione, .gamma.-.omega.-perfluoro-C8-14-alkyl esters, tert-Bu benzenecarboperoxoate-initiated**
CAS Number	459415-06-6
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**2-Propenoic acid, 2-methyl-, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heneicosafluorododecyl ester, polymer with 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl 2-methyl-2-propenoate, methyl 2-methyl-2-propenoate, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,13,13,14,14,14-pentacosafluorotetradecyl 2-methyl-2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-methyl-2-propenoate**
CAS Number	65104-45-2
Structural Formula	

	
Molecular Formula	(C12H9F13O2)l . (C14H9F17O2)m . (C16H9F21O2)n . (C18H9F25O2)o . (C15H8O2)p.
Molecular Weight	

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