

SUFFOLK COUNTY FIREMATICS SITE
676 MAPLE STREET, YAPHANK, NEW YORK
SCTM ID: 0200-779.00-01.00-002.000
NYSDEC SITE: 152246

INTERIM REMEDIAL MEASURE WORK PLAN

DISPOSAL OF PFAS CONTAMINATED SOIL

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, New York 12233-7016

PREPARED FOR:



Suffolk County Department of Health Services
Office of Pollution Control
15 Horseblock Place
Farmingville, New York 11738

PREPARED BY:



P.W. Grosser Consulting
630 Johnson Ave., Suite 7
Bohemia, NY 11716
Phone: 631-589-6353

PWGC Project Number: SHD2502

JULY 2025

**INTERIM REMEDIAL MEASURE WORK PLAN – DISPOSAL OF PFAS CONTAMINATED SOIL
SUFFOLK COUNTY FIREMATICS SITE, 676 MAPLE STREET, YAPHANK, NEW YORK**

TABLE OF CONTENTS	PAGE
1.0 INTRODUCTION.....	1
1.1. Site Description and History	1
1.2. Previous Investigations	1
2.0 DESCRIPTION OF INTERIM REMEDIAL ACTION.....	2
2.1. Soil Screening Methods.....	2
2.2. Stockpile Methods	2
2.3. Sample Analysis	2
2.4. Quality Assurance/Quality Control.....	3
3.0 ENGINEERING SPECIFICATIONS AND CONTROLS.....	4
3.1. Engineering Specifications	4
3.1.1. <i>Mobilization and Site Preparation</i>	4
3.1.2. <i>Soil Stockpile Removal</i>	4
3.1.3. <i>Soil Excavation</i>	4
3.1.4. <i>Soil Disposal</i>	4
3.1.5. <i>Demobilization</i>	4
3.2. Engineering Controls.....	5
3.2.1. <i>Dust Suppression</i>	5
3.2.2. <i>Odor Control</i>	5
4.0 MONITORING AND MAINTENANCE	6
4.1. Construction Phase Monitoring.....	6
4.2. Waste Characterization.....	6
5.0 HEALTH AND SAFETY PLAN.....	7
6.0 COMMUNITY AIR MONITORING PLAN.....	8
7.0 SCHEDULE	9
8.0 REFERENCES.....	10

FIGURES

Figure 1	Site Location
Figure 2	Site Plan
Figure 3	Truck Route Map

APPENDICES

Appendix A	Soil Stockpile Results
Appendix B	Health and Safety Plan
Appendix C	Community Air Monitoring Plan

ACRONYMS

Acronym	Definition
ASP	Analytical Services Protocol
CAMP	Community air monitoring plan
CHASP	Construction health and safety plan
CY	Cubic yard
EDD	Electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
FS	Feasibility Study
HSM	Health and safety manager
IRM	Interim Remedial Measure
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
OU	Operable units
PCB	Polychlorinated biphenyl
PFAS	Per- and polyfluoroalkyl substances
PID	Photo Ionization Detector
PM	Project manager
POGSGV	Protection of Groundwater Soil Guidance Values
PWGC	P.W. Grosser Consulting Inc.
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
RIR	Remedial Investigation Report
SCDHS	Suffolk County Department of Health Services
SDIR	Soil Delineation Investigation Report
SMMP	Soil/Materials Management Plan
SVOCs	Semi-Volatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This Interim Remedial Measure (IRM) Work Plan has been prepared by P.W. Grosser Consulting Inc. (PWGC), on behalf of the Suffolk County Department of Health Services (SCDHS), to document the proposed non-emergency IRM activities planned at the Suffolk County Firematics Site (Site) located at 676 Maple Street, Yaphank, New York. A Site Location Map is included as **Figure 1**.

The proposed scope of work includes disposal of soil impacted with per- and polyfluoroalkyl substances (PFAS) above the New York State Department of Environmental Conservation (NYSDEC) Protection of Groundwater Soil Guidance Values (POGSGVs) specifically associated with approximately 100 cubic yards (CY) soil excavated in support of the Residential Class A Training Area, Oil Water Separator Installation in October 2017 and the Northern Prop Construction Activities excavation into known PFAS-contaminated soil areas on the Site, as detailed in the Soils/Materials Management Plan (SMMP) prepared by PWGC in February 2025, and the requirements of the SCDHS and NYSDEC for the subject property. The approximate proposed non-emergency IRM areas of work are included on **Figure 2**.

1.1. Site Description and History

The subject property is located at 676 Maple Street in the hamlet of Yaphank, New York. The Site is in the Town of Brookhaven, Suffolk County (**Figure 1**). The property is identified in the Suffolk County Tax Map as: 0200-779.00-01.00-002.000.

The Site is included in the State Superfund Program (Site Code: 152246). The site is owned by Suffolk County and has been used as a firefighting training facility since 1959. The Firematics site measures approximately 28 acres in size and is divided into two operable units (OUs) for purposes of planning and implementing remedial actions. OU1 includes onsite soil and groundwater impacted with PFAS, and OU2 includes the offsite groundwater PFAS plume.

PWGC prepared a Remedial Investigation Report (RIR) in January 2021, a Soil Delineation Investigation Report (SDIR) in May 2023, and a draft Feasibility Study (FS) in December 2024. PFAS were identified in soil and groundwater across the site. The adjacent property to the east and west are undeveloped, wooded plots of land. Yaphank Avenue and single-family residential properties are present farther to the east and Sill Industrial Park is present farther to the west. The Suffolk County Sheriff's office is present to the north. **Figure 2** shows the Site and historical use.

1.2. Previous Investigations

This section lists previous investigations performed onsite and offsite. Details of these investigations can be found in the SMMP and FS.

- Preliminary Site Assessment – SCDHS Investigation, April 2016
- IRM Stormwater System, April 2020
- Remedial Investigation, January 2021
- Soil Delineation Investigation, May 2023
- Feasibility Study, December 2024

2.0 DESCRIPTION OF INTERIM REMEDIAL ACTION

Based on the findings of the RI and SDI, PWGC recommended that an IRM be implemented at the Site to properly handle and dispose of soils impacted with PFAS that have been previously generated as part of the oil water separator installation in 2017 (approximately 100 cubic yards) and PFAS impacted soil that will potentially be generated to support the proposed new Props located adjacent to and north of the Site. The IRM recommendations for the Site consists of:

- Equipment and personnel mobilization,
- Offsite disposal of PFAS contaminated soil from the 2017 soil stockpile,
- Excavation for driveways and utility connections for the proposed fire training prop construction under the SMMP,
- Waste characterization sampling,
- Offsite disposal of PFAS contaminated soil generated from the proposed fire training prop construction under the SMMP, and
- Preparation of an IRM Completion Report.

2.1. Soil Screening Methods

Visual, olfactory and photo ionization detector (PID) soil screening and assessment will be conducted during invasive work related to construction activities under the supervision of a Qualified Environmental Professional (QEP) and will be reported to SCDHS and NYSDEC at the end of construction activities.

2.2. Stockpile Methods

If stockpiles are generated, excavated soil will be stockpiled directly on poly sheeting and removed as soon as practicable. Excavated soils will be stockpiled on, at minimum, a single layer of 10-mil poly sheeting, will be kept covered at all times with appropriately anchored plastic tarps, and will be routinely inspected. Damaged tarps will be promptly replaced.

2.3. Sample Analysis

Soil/fill or other excavated media onsite will be sampled and evaluated for reuse onsite or offsite transport for disposal in a manner required by the receiving facility, and in compliance with applicable laws and regulations. Soil proposed for reuse onsite will be managed as defined in the SMMP.

Waste characterization samples will be submitted to a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) certified laboratory (specific laboratory to be determined) to support waste characterization. Soil samples will be analyzed for:

- PFAS by United States Environmental Protection Agency (USEPA) Method 1633
- Volatile organic compounds (VOCs) by USEPA Method 8260C
- Semi-VOCs (SVOCs) by USEPA Method 8270D
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082A
- Pesticides by USEPA Method 8081
- Metals by USEPA Method 6010C/6020A
- Toxicity Characteristic Leaching Procedure (TCLP) – VOCs, SVOCs, PCBs, Pesticides, and Metals

- Hazardous Waste Characterization (includes: pH-Hydrogen ion concentration by USEPA Method 9045, Reactive Cyanide by USEPA Method 7.3, Reactive Sulfide by USEPA Method 7.3, and Ignitability by USEPA Method 1030)

2.4. Quality Assurance/Quality Control

Field and laboratory quality assurance/quality control (QA/QC) procedures will be consistent with the requirements outlined in NYSDEC Department of Materials Management (DMM) Part 375. Field QA/QC samples will be collected at the frequency detailed in the table below:

Table 1 – QC Sample Frequency

Sample Type	Purpose	Collection
Duplicate	Check laboratory and field procedures	1 sample/20 normal field samples
Equipment Blank	Check field decontamination procedures	1 sample per day from decontaminated dedicated sampling equipment
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	Required by laboratory protocols	1 sample/20 normal field samples

All analytical data will be analyzed by a NYSDOH ELAP certified laboratory. Data will be generated using NYSDEC Analytical Services Protocol (ASP) Category B data deliverables. Electronic Data Deliverables (EDD) will be submitted at the completion of the IRM.

3.0 ENGINEERING SPECIFICATIONS AND CONTROLS

3.1. Engineering Specifications

The following engineering specifications are included under this IRM.

3.1.1. Mobilization and Site Preparation

Mobilization will include the delivery of equipment and materials to the site. Site workers will receive site orientation and training in accordance with the SMMP and established policies and procedures to be followed during the implementation of the IRM. The contractor and associated subcontractors will each receive a copy of the IRM Work Plan and SMMP and will be briefed on their contents.

3.1.2. Soil Stockpile Removal

Soil associated with the existing stockpile was previously sampled in 2017, and again in 2024 and 2025. Analytical results for waste characterization met acceptance criteria and were approved for disposal at Clean Earth (the detection of total PCBs at a concentration of 0.0679 milligrams per kilogram (mg/kg) in the 2024 sample did not affect the disposal requirements for the stockpile). Soil will be disposed of in accordance with the procedures described under *Section 3.1.4*

Analytical results for samples collected from the soil stockpile are included in **Appendix A**.

3.1.3. Soil Excavation

Excavation will occur onsite in accordance with the SMMP. All excavation will be performed in a manner that minimizes to the extent practicable,

- The amount/degree of soil disturbance.
- Ensures soil excavation associated with the new prop construction activities that occur onsite remain onsite and are not moved offsite or commingled with soil excavated from offsite construction activities,
- Soils excavated onsite will be stockpiled onsite, if necessary, sampled, and transported for offsite disposal.

3.1.4. Soil Disposal

Excavated soil will be sampled in accordance with the procedures described under *Section 2.3* to meet the waste acceptance criteria of the disposal facility. Impacted soil to be removed from the site will be transported in tri-axel dump trucks, or equivalent. Loading will be performed with a back-ho, excavator, or equivalent. Loaded trucks will be covered with a tarp. Soil will be disposed of in accordance with local, state, and federal requirements.

Truck transport routes are included in **Figure 3**.

3.1.5. Demobilization

Following the completion of IRM activities at the Site, equipment will be dismantled and removed from the site. Solid wastes generated during IRM activities (i.e., polyethylene sheeting) will be properly disposed of in accordance with local, state, and federal regulations. NYSDEC will be provided disposal facilities/options for approval before the offsite disposal of materials. At a minimum the NYSDEC will be provided analytical results and acceptance letter(s) from Clean Earth. Waste manifests will be included in the IRM Completion Report.

3.2. Engineering Controls

The following engineering controls are anticipated under this IRM.

3.2.1. Dust Suppression

Dust generation from IRM activities will be monitored as described in the Community Air Monitoring Program (CAMP) (**Appendix C**).

If dust generation approaches action levels, suppression will be accomplished by:

- Use of a dedicated water spray methodology for roads, excavation areas and stockpiles.
- Use of properly anchored tarps to cover stockpiles.
- Exercise extra care during dry and high-wind periods.
- Use of gravel or recycled concrete aggregate on egress and other roadways to provide a clean and dust-free road surface.
- Hauling materials in properly covered containers.
- Restricting vehicle speeds to 10 mph.

Atomizing sprays will be used to prevent overly wet conditions, conserve water, and offer an effective means of suppressing fugitive dust. If used, sprays will be applied in a manner that prevents runoff and the potential for the migration of contaminants. Whenever possible, impacted soils will be loaded directly into trucks for immediate offsite disposal.

3.2.2. Odor Control

Because the contaminants of concern at the site are primarily PFAS, it is not expected that generation of odors will be a concern during IRM activities. In the event that odor suppression becomes necessary, techniques to be implemented for control of odors from stockpiled soil or from the open excavations will include one or more of the following:

- Cover removed soil with plastic
- Limit working hours to favorable wind and temperature conditions

4.0 MONITORING AND MAINTENANCE

4.1. Construction Phase Monitoring

Monitoring during soil removal will be performed to protect the health of site workers and the surrounding community. A health and safety plan (HASP) and air monitoring requirements have been developed for this project (**Appendix B**). These plans specify the monitoring procedures, action levels, and contingency measures that are required to protect public health and site workers. Generally, air monitoring would include real-time measurement of volatile emissions and dust levels.

4.2. Waste Characterization

Waste characterization will be performed by collecting composite samples of soil removed during the IRM as part of the Northern Prop Construction Activities. Sample analysis will be as specified by the requirements of the disposal facility's (Clean Earth) waste acceptance criteria. At a minimum, samples will be analyzed for the analysis detailed in *Section 2.3*.

After the results of the analysis are complete, PWGC will prepare the necessary forms for submittal to the waste disposal/treatment facility. Forms will then be submitted to the waste disposal facility for evaluation and final approval. NYSDEC/NYSDOH will be provided the analytical results and disposal facility acceptance forms for approval prior to the offsite transportation of waste.

5.0 HEALTH AND SAFETY PLAN

The HASP takes into account the specific hazards inherent to the site and presents the minimum requirements which are to be met by PWGC, its subcontractors, and other onsite personnel in order to avoid and, if necessary, protect against health and/or safety hazards. The HASP is included in **Appendix B**.

PWGC sub-contractors will have the option of adopting this HASP or developing their own site-specific document. If a subcontractor chooses to prepare their own HASP, it must meet the minimum requirements as detailed in the site HASP prepared by PWGC and must be made available to PWGC, SCDHS, and NYSDEC.

Activities performed under the HASP will comply with applicable parts of Occupational Safety and Health Administration (OSHA) Regulations, primarily 29 CFR Parts 1910 and 1926, and the PWGC Corporate Environmental Health and Safety policy. Modifications to the HASP may be made with the approval of the PWGC Health and Safety Manager (HSM) and/or Project Manager (PM).

6.0 COMMUNITY AIR MONITORING PLAN

The CAMP provides measures for protection of the downwind community (i.e., off-site receptors including residences, businesses, and onsite workers not directly involved in the IRM work) from potential airborne contaminant releases resulting from IRM activities at the site.

The primary concerns for this site are dust particulates. Air monitoring requirements are included in **Appendix C**.



7.0 SCHEDULE

The estimated duration of the IRM activities are approximately fifteen (15) weeks. The project includes equipment and personnel mobilization, existing soil stockpile disposal, excavation for construction of driveways and utility connections for fire training prop structures, soil stockpiling, waste characterization sampling and analysis, and waste loading and transport. See Figure 2 for the onsite proposed extents of excavation for IRMWP activities.



8.0 REFERENCES

6 NYCRR Part 375, Environmental Remediation Programs, December 2006.

NYSDEC, Division of Environmental Restoration, May 2004, Draft Brownfield Program Cleanup Guide.

NYSDEC, Division of Environmental Restoration, December 2002, Draft DER-10, Technical Guidance for Site Investigation and Remediation.

NYSDEC, Division of Technical and Administrative Guidance, October 27, 1989, Memorandum #4031 – Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites.

NYSDOH, Guidance for Evaluating Soil Vapor Intrusion in the State of New York, 2006.

PWGC, Feasibility Study, December 2024.

PWGC, Remedial Investigation Report, January 2021.

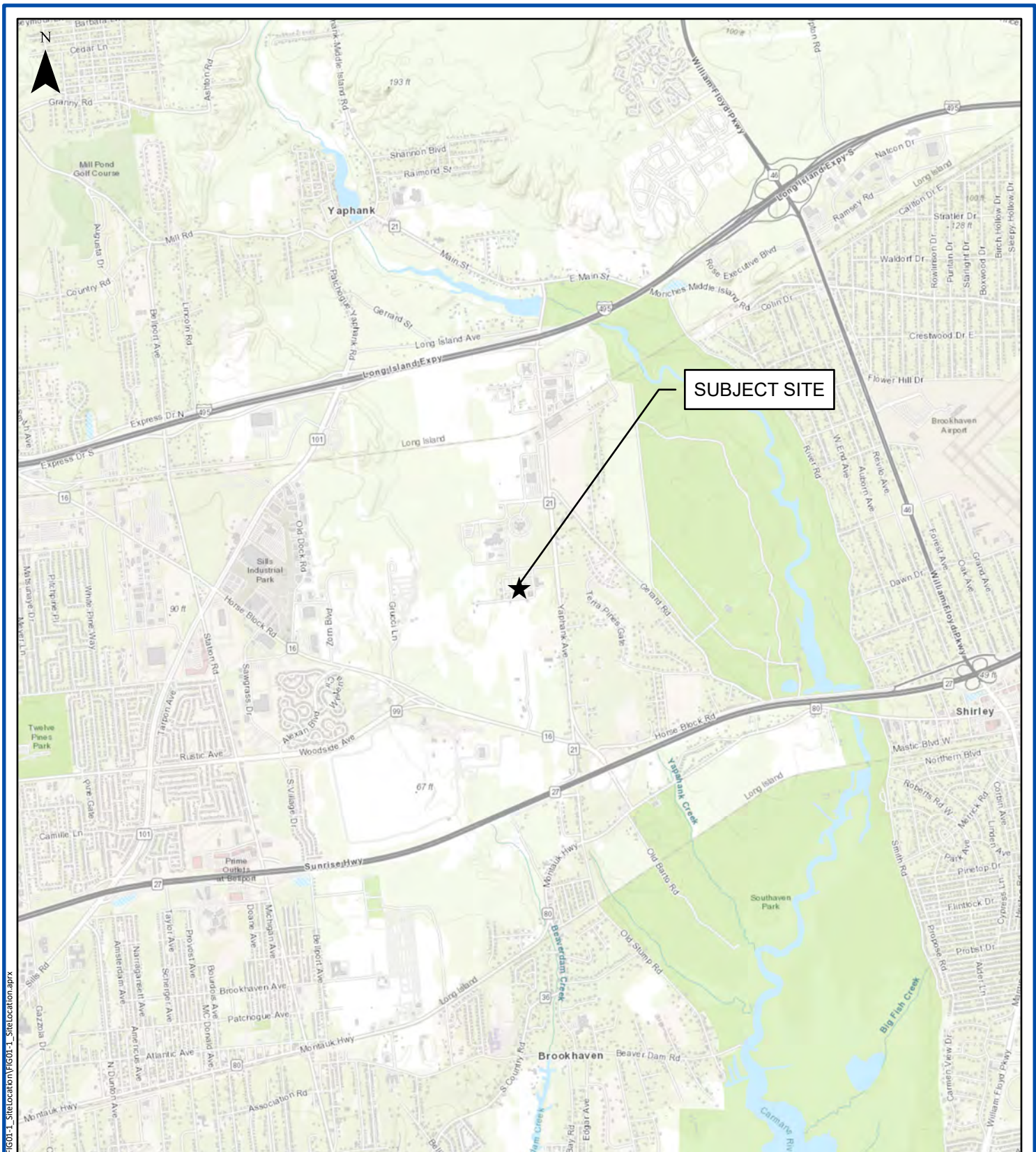
PWGC, Soil Delineation Investigation Report, May 2023.

PWGC, Soil/Materials Management Plan, February 2025.

PWGC, Suffolk County Firematics, Site Specific Uniform Federal Policy Quality Assurance Project Plan, November 2017.

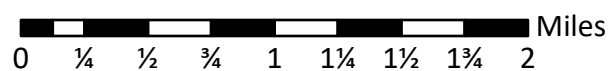
FIGURES





SITE LOCATION

676 MAPLE ST
YAPHANK, NY



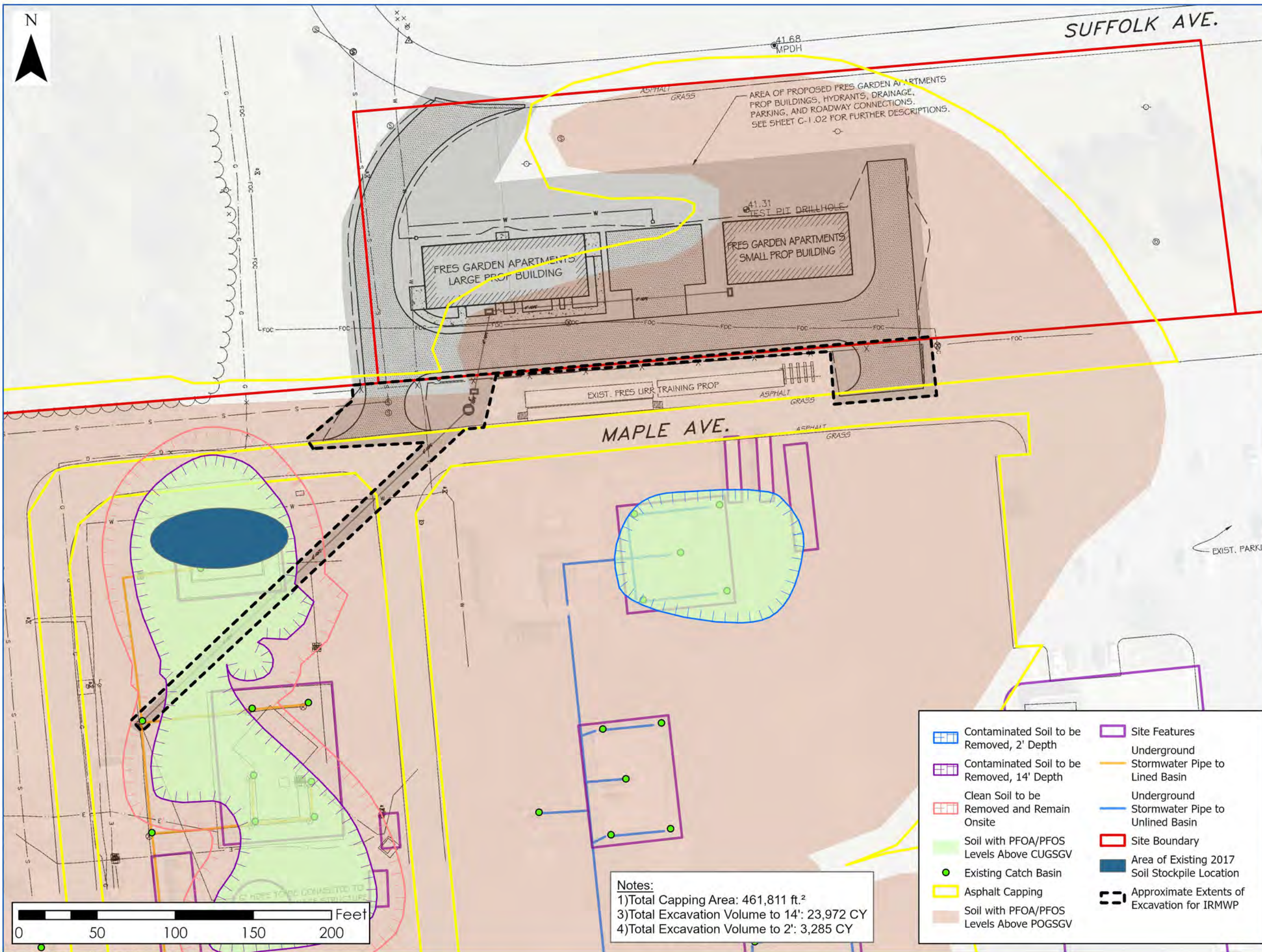
Project:	SHD2205
Date:	7/12/2022
Designed by:	JP
Drawn by:	FT
Approved by:	JP
Figure No:	1



PWGC
CLIENT DRIVEN SOLUTIONS

P.W. Grosser Consulting, Inc.

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgrosser.com



P.W. Grosser Consulting Engineer & Hydrogeologist, PC

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgros.com

UNAUTHORIZED ALTERATION OR ADDITION TO THIS
DRAWING AND RELATED DOCUMENTS IS A VIOLATION
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION:

Project:	SHD2502	Designed by:	AL
Date:	7/22/2025	Drawn by:	HS
Scale:	AS SHOWN	Approved by:	AL

Site Plan

Suffolk County Firematics
676 Maple St
Yaphank, NY

FIGURE NO:

2

Notes:

- 1) Total Capping Area: 461,811 ft.²
- 2) Total Excavation Volume to 14': 23,972 CY
- 3) Total Excavation Volume to 2': 3,285 CY

Contaminated Soil to be Removed, 2' Depth	Site Features
Contaminated Soil to be Removed, 14' Depth	Underground Stormwater Pipe to Lined Basin
Clean Soil to be Removed and Remain Onsite	Underground Stormwater Pipe to Unlined Basin
Soil with PFOA/PFOS Levels Above CUGSGV	Site Boundary
Existing Catch Basin	Area of Existing 2017 Soil Stockpile Location
Asphalt Capping	Approximate Extents of Excavation for IRMWPs
Soil with PFOA/PFOS Levels Above POGSGV	



P.W. Grosser Consulting, Inc.

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgros.com

UNAUTHORIZED ALTERATION OR ADDITION TO THIS
DRAWING AND RELATED DOCUMENTS IS A VIOLATION
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION:

Project:	SHD2302	Designed by:	MP
Date:	4/2/2024	Drawn by:	AM
Scale:	AS SHOWN	Approved by:	MP

Truck Route Map

Suffolk County Firematics
676 Maple St
Yaphank, NY

FIGURE NO:

- ★ Subject Site
- Truck Route to Nearest Main Highway

APPENDIX A



Table 1
Soil Analytical for Volatile Organics
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SB001-A		SP001-B		SB002-A
Sample Type:	NY-COMM	NY-UNRES	Soil		Soil		Soil
Laboratory ID:	(mg/kg)	(mg/kg)	460-140861-1		460-140861-2		460-140861-3
Sampling Date:			9/12/2017		9/12/2017		9/12/2017
Volatile Organics by 8260C							
1,1,1-Trichloroethane	500	0.68	0.00033 U		0.00031 U		0.00042 U
1,1,2,2-Tetrachloroethane	NA	NA	0.00030 U		0.00029 U		0.00039 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	0.00043 U		0.00040 U		0.00054 U
1,1,2-Trichloroethane	NA	NA	0.00025 U		0.00024 U		0.00032 U
1,1-Dichloroethane	240	0.27	0.00029 U		0.00027 U		0.00037 U
1,1-Dichloroethene	500	0.33	0.00032 U		0.00030 U		0.00041 U
1,2,3-Trichlorobenzene	NA	NA	0.00026 U		0.00024 U		0.00033 U
1,2,4-Trichlorobenzene	NA	NA	0.00013 U		0.00012 U		0.00017 U
1,2-Dibromo-3-Chloropropane	NA	NA	0.00065 U		0.00061 U		0.00083 U
1,2-Dichlorobenzene	500	1.1	0.00020 U		0.00019 U		0.00026 U
1,2-Dichloroethane	30	0.02	0.00042 U		0.00040 U		0.00053 U
1,2-Dichloropropane	NA	NA	0.00060 U		0.00056 U		0.00076 U
1,3-Dichlorobenzene	280	2.4	0.00023 U		0.00021 U		0.00029 U
1,4-Dichlorobenzene	130	1.8	0.00014 U		0.00013 U		0.00018 U
1,4-Dioxane	130	0.1	0.013 U		0.012 U		0.017 U
2-Butanone (MEK)	NA	0.12	0.0016 U		0.0015 U		0.0020 U
2-Hexanone	NA	NA	0.0011 U		0.0010 U		0.0014 U
4-Methyl-2-pentanone (MIBK)	NA	NA	0.00094 U		0.00089 U		0.0012 U
Acetone	500	0.05	0.0054 U		0.0051 U		0.0068 U
Acrolein	NA	NA	0.040 U		0.037 U		0.051 U
Acrylonitrile	NA	NA	0.0023 U		0.0022 U		0.0030 U
Benzene	44	0.06	0.00037 U		0.00034 U		0.00047 U
Bromoform	NA	NA	0.00060 U		0.00057 U		0.00077 U
Bromomethane	NA	NA	0.00067 U		0.00063 U		0.00086 U
Carbon disulfide	NA	NA	0.00038 U		0.00036 U		0.00048 U
Carbon tetrachloride	22	0.76	0.00026 U		0.00024 U		0.00033 U
Chlorobenzene	500	1.1	0.00025 U		0.00024 U		0.00032 U
Chlorobromomethane	NA	NA	0.00040 U		0.00038 U		0.00051 U
Chlorodibromomethane	NA	NA	0.00028 U		0.00026 U		0.00035 U
Chloroethane	NA	NA	0.00074 U		0.00070 U		0.00094 U
Chloroform	350	0.37	0.00045 U		0.00043 U		0.00058 U
Chloromethane	NA	NA	0.00062 U		0.00058 U		0.00079 U
cis-1,2-Dichloroethene	500	0.25	0.00022 U		0.00020 U		0.00027 U
cis-1,3-Dichloropropene	NA	NA	0.00039 U		0.00036 U		0.00049 U
Cyclohexane	NA	NA	0.00031 U		0.00029 U		0.00040 U
Dichlorobromomethane	NA	NA	0.00036 U		0.00034 U		0.00046 U
Dichlorodifluoromethane	NA	NA	0.00048 U		0.00045 U		0.00061 U
Ethylbenzene	390	1	0.00028 U		0.00027 U		0.00036 U
Ethylene Dibromide	NA	NA	0.00026 U		0.00024 U		0.00033 U
Isopropylbenzene	NA	NA	0.00018 U		0.00017 U		0.00023 U
Methyl acetate	NA	NA	0.0061 U		0.0057 U		0.0078 U
Methyl tert-butyl ether	500	0.93	0.00018 U		0.00017 U		0.00023 U
Methylcyclohexane	NA	NA	0.00023 U		0.00021 U		0.00029 U
Methylene Chloride	500	0.05	0.00023 U		0.00022 U		0.00029 U
m-Xylene & p-Xylene	NA	NA	0.00026 J		0.00023 U		0.00034 J
o-Xylene	NA	NA	0.00013 U		0.00013 U		0.00017 U
Styrene	NA	NA	0.00017 U		0.00016 U		0.00022 U
Tetrachloroethene	150	1.3	0.00020 U		0.00019 U		0.00026 U
Toluene	500	0.7	0.00089 U		0.00083 U		0.0011 U
trans-1,2-Dichloroethene	500	0.19	0.00035 U		0.00033 U		0.00044 U
trans-1,3-Dichloropropene	NA	NA	0.00038 U		0.00036 U		0.00048 U
Trichloroethene	200	0.47	0.00020 U		0.00019 U		0.00026 U
Trichlorofluoromethane	NA	NA	0.00058 U		0.00054 U		0.00073 U
Vinyl chloride	13	0.02	0.00078 U		0.00073 U		0.00099 U

Notes:

All units are mg/kg

Yellow highlighted text denotes concentrations exceeding NY-UNRES Cleanup Objective

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 2
Soil Analytical for Semivolatile Organics
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SP001		SP002
Sample Type:	NY-COMM	NY-UNRES	Soil		Soil
Laboratory ID:	(mg/kg)	(mg/kg)	460-140861-4		460-140861-5
Sampling Date:			9/12/2017		9/12/2017
Semivolatile Organics by 8270D					
1,1'-Biphenyl	NA	NA	0.030 U		0.030 U
1,2,4,5-Tetrachlorobenzene	NA	NA	0.026 U		0.026 U
2,2'-oxybis[1-chloropropane]	NA	NA	0.015 U		0.014 U
2,3,4,6-Tetrachlorophenol	NA	NA	0.033 U		0.033 U
2,4,5-Trichlorophenol	NA	NA	0.035 U		0.035 U
2,4,6-Trichlorophenol	NA	NA	0.010 U		0.010 U
2,4-Dichlorophenol	NA	NA	0.0083 U		0.0083 U
2,4-Dimethylphenol	NA	NA	0.078 U		0.077 U
2,4-Dinitrophenol	NA	NA	0.27 U		0.27 U
2,4-Dinitrotoluene	NA	NA	0.014 U		0.014 U
2,6-Dinitrotoluene	NA	NA	0.019 U		0.019 U
2-Chloronaphthalene	NA	NA	0.0080 U		0.0080 U
2-Chlorophenol	NA	NA	0.0090 U		0.0089 U
2-Methylnaphthalene	NA	NA	0.0078 U		0.0078 U
2-Methylphenol	500	0.33	0.015 U		0.015 U
2-Nitroaniline	NA	NA	0.012 U		0.012 U
2-Nitrophenol	NA	NA	0.012 U		0.012 U
3,3'-Dichlorobenzidine	NA	NA	0.039 U		0.039 U
3-Nitroaniline	NA	NA	0.010 U		0.010 U
4,6-Dinitro-2-methylphenol	NA	NA	0.094 U		0.094 U
4-Bromophenyl phenyl ether	NA	NA	0.011 U		0.011 U
4-Chloro-3-methylphenol	NA	NA	0.015 U		0.015 U
4-Chloroaniline	NA	NA	0.0091 U		0.0090 U
4-Chlorophenyl phenyl ether	NA	NA	0.011 U		0.011 U
4-Methylphenol	500	0.33	0.0096 U		0.0096 U
4-Nitroaniline	NA	NA	0.013 U		0.013 U
4-Nitrophenol	NA	NA	0.17 U		0.17 U
Acenaphthene	500	20	0.0086 U		0.0085 U
Acenaphthylene	500	100	0.0091 U		0.013 J
Acetophenone	NA	NA	0.0077 U		0.0077 U
Anthracene	500	100	0.034 U		0.033 U
Atrazine	NA	NA	0.016 U		0.016 U
Benzaldehyde	NA	NA	0.027 U		0.027 U
Benzo[a]anthracene	5.6	1	0.030 U		0.10
Benzo[a]pyrene	1	1	0.011 U		0.14
Benzo[b]fluoranthene	5.6	1	0.014 U		0.24
Benzo[g,h,i]perylene	500	100	0.020 U		0.061 J
Benzo[k]fluoranthene	56	0.8	0.015 U		0.073
Bis(2-chloroethoxy)methane	NA	NA	0.011 U		0.011 U
Bis(2-chloroethyl)ether	NA	NA	0.0083 U		0.0083 U
Bis(2-ethylhexyl) phthalate	NA	NA	0.014 U		0.026 J
Butyl benzyl phthalate	NA	NA	0.011 U		0.011 U
Caprolactam	NA	NA	0.025 U		0.025 U
Carbazole	NA	NA	0.0088 U		0.0087 U
Chrysene	56	1	0.0096 U		0.11 J
Dibenz(a,h)anthracene	0.56	0.33	0.018 U		0.018 U
Dibenzofuran	350	7	0.011 U		0.011 U
Diethyl phthalate	NA	NA	0.010 U		0.010 U
Dimethyl phthalate	NA	NA	0.010 U		0.010 U
Di-n-butyl phthalate	NA	NA	0.011 U		0.011 U
Di-n-octyl phthalate	NA	NA	0.018 U		0.018 U
Fluoranthene	500	100	0.010 U		0.17 J
Fluorene	500	30	0.0077 U		0.0077 U
Hexachlorobenzene	6	0.33	0.014 U		0.014 U
Hexachlorobutadiene	NA	NA	0.010 U		0.0099 U
Hexachlorocyclopentadiene	NA	NA	0.022 U *		0.022 U
Hexachloroethane	NA	NA	0.013 U		0.013 U
Indeno[1,2,3-cd]pyrene	5.6	0.5	0.024 U		0.068
Isophorone	NA	NA	0.0076 U		0.0075 U
Naphthalene	500	12	0.0090 U		0.0089 U
Nitrobenzene	69	NA	0.011 U		0.011 U
N-Nitrosodi-n-propylamine	NA	NA	0.012 U		0.012 U
N-Nitrosodiphenylamine	NA	NA	0.032 U		0.032 U
Pentachlorophenol	6.7	0.8	0.043 U		0.043 U
Phenanthrene	500	100	0.0094 U		0.060 J
Phenol	500	0.33	0.012 U		0.011 U
Pyrene	500	100	0.016 U		0.13 J

Notes:

All units are mg/kg

Yellow highlighted text denotes concentrations exceeding NY-UNRES Cleanup Objective

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 3
Soil Analytical for Total Metals
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SP001	SP002
Sample Type:	NY-COMM	NY-UNRES	Soil	Soil
Laboratory ID:	(mg/kg)	(mg/kg)	460-140861-4	460-140861-5
Sampling Date:			9/12/2017	9/12/2017
Metals				
Arsenic	16	13	2.5 J	5.1
Barium	400	350	16.6 J	35.9 J
Cadmium	9.3	2.5	0.13 U	0.13 U
Chromium	NA	NA	7.3	12.5
Lead	1,000	63	6.1	27.7
Mercury	2.8	0.18	0.012 U	0.027
Selenium	1,500	3.9	1.3 J	1.3 U
Silver	1,500	2	0.33 U	0.32 U
Hexavalent Chromium	400	1	0.43 U	0.42 U

Notes:

All units are mg/kg

Yellow highlighted text denotes concentrations exceeding NY-UNRES Cleanup Objective

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 4

Soil Analytical for Polychlorinated Biphenyls
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SP001	SP002
Sample Type:	NY-COMM	NY-UNRES	Soil	Soil
Laboratory ID:	(mg/kg)	(mg/kg)	460-140861-4	460-140861-5
Sampling Date:			9/12/2017	9/12/2017
Polychlorinated Biphenyls by GC				
Aroclor 1016	1	0.1	0.0095 U	0.0095 U
Aroclor 1221	1	0.1	0.0095 U	0.0095 U
Aroclor 1232	1	0.1	0.0095 U	0.0095 U
Aroclor 1242	1	0.1	0.0095 U	0.0095 U
Aroclor 1248	1	0.1	0.0095 U	0.0095 U
Aroclor 1254	1	0.1	0.0099 U	0.0098 U
Aroclor 1260	1	0.1	0.0099 U	0.0098 U
Aroclor 1262	1	0.1	0.0099 U	0.0098 U
Aroclor 1268	1	0.1	0.0099 U	0.0098 U
PCBs, Total	NS	NS	0.0099 U	0.0098 U

Notes:

All units are mg/kg

Yellow highlighted text denotes concentrations exceeding NY-UNRES Cleanup Objective

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 5
Soil Analytical for Organochlorine Pesticides
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SP001	SP002
Sample Type:	NY-COMM	NY-UNRES	Soil	Soil
Laboratory ID:	(mg/kg)	(mg/kg)	460-140861-4	460-140861-5
Sampling Date:			9/12/2017	9/12/2017
Organochlorine Pesticides by 8081B (Silvex by 8151A)				
4,4'-DDD	92	0.0033	0.0037 J	0.0012 U
4,4'-DDE	62	0.0033	0.014	0.013
4,4'-DDT	47	0.0033	0.021	0.022
Aldrin	0.68	0.005	0.0011 U	0.0011 U
alpha-BHC	3.4	0.02	0.00073 U	0.00072 U
beta-BHC	3	0.036	0.00080 U	0.00080 U
Chlordane (technical)	NA	NA	0.017 U	0.12
delta-BHC	500	0.04	0.00044 U	0.00044 U
Dieldrin	1.4	0.005	0.00093 U	0.00093 U
Endosulfan I	200	2.4	0.0011 U	0.0011 U
Endosulfan II	200	2.4	0.0018 U	0.0018 U
Endosulfan sulfate	200	2.4	0.00090 U	0.00089 U
Endrin	89	0.014	0.0010 U	0.0010 U
Endrin aldehyde	NA	NA	0.0017 U	0.0017 U
Endrin ketone	NA	NA	0.0014 U	0.0014 U
gamma-BHC (Lindane)	9.2	0.1	0.00067 U	0.00066 U
Heptachlor	15	0.042	0.00085 U	0.00084 U
Heptachlor epoxide	NA	NA	0.0011 U	0.0011 U
Methoxychlor	NA	NA	0.0016 U	0.0016 U
Silvex	500	3.8	0.012 U	0.012 U
Toxaphene	NA	NA	0.026 U	0.026 U

Notes:

All units are mg/kg

Yellow highlighted text denotes concentrations exceeding NY-UNRES Cleanup Objective

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 6
Per- and Polyfluoroalkyl Substances
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:			SP001	SP002
Sample Type:	NY-COMM	NY-UNRES	Soil	Soil
Laboratory ID:	(mg/kg)	(mg/kg)	320-31604-1	320-31604-2
Sampling Date:			9/12/2017	9/12/2017
Per- and Polyfluoroalkyl Substances by 537				
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	NA	0.0004 U	0.00043 U
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	NA	0.0013 U	0.0014 U
Perfluorobutanesulfonic acid (PFBS)	NA	NA	0.00011 U	0.00011 U
Perfluorodecanoic acid (PFDA)	NA	NA	0.000063 J	0.00013 J
Perfluorododecanoic acid (PFDoA)	NA	NA	0.00012 U	0.00013 U
Perfluoroheptanoic acid (PFHpA)	NA	NA	0.00009 U	0.000096 U
Perfluorohexanesulfonic acid (PFHxS)	NA	NA	0.00034	0.00044
Perfluorohexanoic acid (PFHxA)	NA	NA	0.000073 U	0.000078 U
Perfluorononanoic acid (PFNA)	NA	NA	0.00044	0.00011 J
Perfluorooctanesulfonic acid (PFOS)	NA	NA	0.0039	0.0023
Perfluorooctanoic acid (PFOA)	NA	NA	0.00016 J	0.00013 J
Perfluorotetradecanoic acid (PFTeA)	NA	NA	0.00006 U	0.000064 U
Perfluorotridecanoic Acid (PFTriA)	NA	NA	0.000094 U	0.00022
Perfluoroundecanoic acid (PFUnA)	NA	NA	0.00022	0.00035

Notes:

All units are mg/kg

****NYSDEC has not established standards for PFAS in soil****

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 7
Quality Assurance / Quality Control Samples
Suffolk County Firematics Site, Yaphank, New York

Client Sample ID:	AWQS	Trip Blank Soil 460-140861-6 9/12/2017
Sample Type:		
Laboratory ID:		
Sampling Date:		
Volatile Organics by 8260C		
1,1,1-Trichloroethane	5	0.28 U
1,1,2,2-Tetrachloroethane	5	0.19 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	0.34 U
1,1,2-Trichloroethane	NA	0.080 U
1,1-Dichloroethane	5	0.24 U
1,1-Dichloroethene	5	0.34 U
1,2,3-Trichlorobenzene	NA	0.35 U
1,2,4-Trichlorobenzene	5	0.27 U
1,2-Dibromo-3-Chloropropane	NA	0.23 U
1,2-Dichlorobenzene	4.7	0.22 U
1,2-Dichloroethane	5	0.25 U
1,2-Dichloropropane	NA	0.18 U
1,3-Dichlorobenzene	5	0.33 U
1,4-Dichlorobenzene	5	0.33 U
1,4-Dioxane	NA	8.7 U
2-Butanone (MEK)	50	2.2 U
2-Hexanone	NA	0.72 U
4-Methyl-2-pentanone (MIBK)	50	0.63 U
Acetone	50	1.1 U
Acrolein	NA	0.88 U
Acrylonitrile	NA	1.0 U
Benzene	0.7	0.090 U
Bromoform	NA	0.18 U
Bromomethane	NA	0.18 U
Carbon disulfide	50	0.22 U
Carbon tetrachloride	5	0.33 U
Chlorobenzene	5	0.24 U
Chlorobromomethane	NA	0.30 U
Chlorodibromomethane	50	0.22 U
Chloroethane	50	0.37 U
Chloroform	7	0.22 U
Chloromethane	NA	0.22 U
cis-1,2-Dichloroethene	NA	0.26 U
cis-1,3-Dichloropropene	NA	0.16 U
Cyclohexane	NA	0.26 U
Dichlorobromomethane	NA	0.15 U
Dichlorodifluoromethane	NA	0.14 U
Ethylbenzene	5	0.30 U
Ethylene Dibromide	NA	0.19 U
Isopropylbenzene	NA	0.32 U
Methyl acetate	NA	0.58 U
Methyl tert-butyl ether	NA	0.13 U
Methylcyclohexane	NA	0.22 U
Methylene Chloride	5	0.21 U
m-Xylene & p-Xylene	NA	0.28 U
o-Xylene	NA	0.32 U
Styrene	NA	0.17 U
Tetrachloroethene	5	0.12 U
Toluene	5	0.25 U
trans-1,2-Dichloroethene	5	0.18 U
trans-1,3-Dichloropropene	NA	0.19 U
Trichloroethene	5	0.22 U
Trichlorofluoromethane	NA	0.15 U
Vinyl chloride	2	0.060 U
Client Sample ID:	AWQS	FB001 DI Water 320-31604-3 9/12/2017
Sample Type:		
Laboratory ID:		
Sampling Date:		
Perfluorinated Compounds by 537		
N-ethyl perfluorooctane sulfonamidoacetic acid (NETFOSAA)	NA	0.00494 U
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	0.00555 U
Perfluorobutanesulfonic acid (PFBS)	NA	0.0009 U
Perfluorodecanoic acid (PFDA)	NA	0.00043 U
Perfluorododecanoic acid (PFDoA)	NA	0.00057 U
Perfluoroheptanoic acid (PFHpA)	NA	0.00079 U
Perfluorohexanesulfonic acid (PFHxS)	NA	0.00216 U
Perfluorohexanoic acid (PFHxA)	NA	0.00077 U
Perfluorononanoic acid (PFNA)	NA	0.00064 U
Perfluorooctanesulfonic acid (PFOS)	NA	0.00222 U
Perfluorooctanoic acid (PFOA)	NA	0.00074 U
Perfluorotetradecanoic acid (PFTeA)	NA	0.0002 J
Perfluorotridecanoic Acid (PFTriA)	NA	0.00054 U
Perfluoroundecanoic acid (PFUnA)	NA	0.00074 U

Notes:

units are ug/l

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NA - No Analytical Standard

Table 1
Per- and Polyfluoroalkyl Substances
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID:	CAS Number	NYSDEC UUSGVs*	NYSDEC RUSGV	NYSDEC RRUSGV	NYSDEC CUSGV	NYSDEC IUSGVs	NYSDEC POGSGVs	SP001 JD99769-1 11/6/2024
Laboratory ID:								
Sampling Date:								
PFAS by EPA 1633 (mg/kg)								
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	NS	NS	NS	NS	NS	NS	0.00020 U
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	NS	NS	NS	NS	NS	NS	0.00010 U
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	757124-72-4	NS	NS	NS	NS	NS	NS	0.00029 U
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	NS	NS	NS	NS	NS	NS	0.00012 U
3:3 Fluorotelomer carboxylate (3:3FTCA)	356-02-5	NS	NS	NS	NS	NS	NS	0.00025 U
5:3 Fluorotelomer carboxylic acid (5:3FTCA)	914637-49-3	NS	NS	NS	NS	NS	NS	0.00064 U
7:3 Fluorotelomer carboxylate (7:3FTCA)	812-70-4	NS	NS	NS	NS	NS	NS	0.00065 U
Potassium 9-chlorohexadecafluoro-3-oxanonane-1-sulfonate (9CI-PF3ONS) (F-53B Major)	756426-58-1	NS	NS	NS	NS	NS	NS	0.00027 U
Potassium 11-chloroeicosafluoro-3-oxaundecane-1-sulfonate (11CI-PF3OUdS) (F-53B Minor)	763051-92-9	NS	NS	NS	NS	NS	NS	0.00019 U
Hexafluoropropylene oxide dimer acid (HFPO-DA) (Gen-X)	13252-13-6	NS	NS	NS	NS	NS	NS	0.00019 U
N-ethylperfluorooctanesulfonamide (NETFOSA)	4151-50-2	NS	NS	NS	NS	NS	NS	0.000051 U
N-ethylperfluorooctanesulfonamidoacetic acid (NETFOSAA)	2991-50-6	NS	NS	NS	NS	NS	NS	0.00013 U
N-ethylperfluorooctanesulfonamidoethanol (NETFOSE)	1691-99-2	NS	NS	NS	NS	NS	NS	0.00075 U
Perfluoro-3,6-dioxahexanoic acid (NFDHA)	151772-58-6	NS	NS	NS	NS	NS	NS	0.00013 U
N-Methylperfluorooctanesulfonamide (NMeFOSA)	31506-32-8	NS	NS	NS	NS	NS	NS	0.000062 U
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	NS	NS	NS	NS	NS	NS	0.000082 U
N-methylperfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	NS	NS	NS	NS	NS	NS	0.00029 U
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	NS	NS	NS	NS	NS	NS	0.000072 U
Perfluorobutanoic Acid (PFBA)	375-22-4	NS	NS	NS	NS	NS	NS	0.00011 U
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	NS	NS	NS	NS	NS	NS	0.00011 U
Perfluorodecanoic Acid (PFDA)	335-76-2	NS	NS	NS	NS	NS	NS	0.00010 J
Perfluorododecanoic Acid (PFDoA)	307-55-1	NS	NS	NS	NS	NS	NS	0.000082 J
Perfluorododecanesulfonic acid (PFDoDS)	79780-39-5	NS	NS	NS	NS	NS	NS	0.000051 U
Perfluoro(2-ethoxyethane)sulfonic acid (PFEEA)	113507-82-7	NS	NS	NS	NS	NS	NS	0.000031 U
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	NS	NS	NS	NS	NS	NS	0.00010 U
Perfluoroheptanoic Acid (PFHpA)	375-85-9	NS	NS	NS	NS	NS	NS	0.000051 U
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	NS	NS	NS	NS	NS	NS	0.00027 U
Perfluorohexanoic Acid (PFHxA)	307-24-4	NS	NS	NS	NS	NS	NS	0.000031 U
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	NS	NS	NS	NS	NS	NS	0.000062 U
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	NS	NS	NS	NS	NS	NS	0.000031 U
Perfluorononanoic Acid (PFNA)	375-95-1	NS	NS	NS	NS	NS	NS	0.000051 U
Perfluorononanesulfonic acid (PFNS)	68259-12-1	NS	NS	NS	NS	NS	NS	0.00014 U
Perfluorooctanesulfonamide (FOSA)	754-91-6	NS	NS	NS	NS	NS	NS	0.000072 U
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	0.00088	0.0088	0.044	0.44	0.44	0.0010	0.0013
Perfluorooctanoic Acid (PFOA)	335-67-1	0.00066	0.0066	0.033	0.50	0.60	0.0008	0.000082 U
Perfluoropentanoic Acid (PFPeA)	2706-90-3	NS	NS	NS	NS	NS	NS	0.000072 U
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	NS	NS	NS	NS	NS	NS	0.00010 U
Perfluorotetradecanoic Acid (PFTA)	376-06-7	NS	NS	NS	NS	NS	NS	0.00010 U
Perfluorotridecanoic Acid (PFTTrDA)	72629-94-8	NS	NS	NS	NS	NS	NS	0.000093 U
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	NS	NS	NS	NS	NS	NS	0.00010 J
PFOA/PFOS, Total	-	NS	NS	NS	NS	NS	NS	0.0013

Notes:

All units are milligram/kilogram (mg/kg)

* NYSDEC proposed Unrestricted, Residential, Restricted Residential, and Commercial, Industrial, and Protection of Groundwater Soil Guidance Values (SGVs), Guidance for Sampling, Analysis, and Assessment of PFAS Under NYSDEC's Part 375 Remedial Programs, April 2023.

U - Indicates that the analyte was not detected above the laboratory MDL

J - Indicates an estimated value

NS - No Standard

Highlighted value exceeds the lower of UUSGVs or POGSGVs.

Table 2
Soil Analytical for Volatile Organics
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	NYSDEC RRUSCOs *	SP001 JD99787-1 11/6/2024	
Volatile Organics by 8260C				
1,1,1-Trichloroethane	71-55-6	100	0.00059	U
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.00073	U
1,1,2-Trichloroethane	79-00-5	NS	0.00067	U
1,1-Dichloroethane	75-34-3	NS	0.00060	U
1,1-Dichloroethene	75-35-4	26	0.00079	U
1,2,3-Trichlorobenzene	87-61-6	100	0.0030	U
1,2,4-Trichlorobenzene	120-82-1	NS	0.0030	U
1,2-Dibromo-3-chloropropane	71932	NS	0.00084	U
1,2-Dibromoethane	106-93-4	NS	0.00051	U
1,2-Dichlorobenzene	95-50-1	100	0.00066	U
1,2-Dichloroethane	107-06-2	3.1	0.00057	U
1,2-Dichloropropane	78-87-5	NS	0.00057	U
1,3-Dichlorobenzene	541-73-1	49	0.00060	U
1,4-Dichlorobenzene	106-46-7	13	0.00060	U
2-Butanone (MEK)	78-93-3	13	0.0029	U
2-Hexanone	591-78-6	100	0.0026	U
4-Methyl-2-pentanone(MIBK)	108-10-1	NS	0.0028	U
Acetone	67-64-1	NS	0.0050	U
Benzene	71-43-2	100	0.00055	U
Bromochloromethane	74-97-5	4.8	0.00068	U
Bromodichloromethane	75-27-4	NS	0.00052	U
Bromoform	75-25-2	NS	0.0017	U
Bromomethane	74-83-9	NS	0.00093	U
Carbon disulfide	75-15-0	2.4	0.00065	U
Carbon tetrachloride	56-23-5	100	0.00075	U
Chlorobenzene	108-90-7	NS	0.00056	U
Chloroethane	75-00-3	49	0.00072	U
Chloroform	67-66-3	NS	0.0012	U
Chloromethane	74-87-3	100	0.0024	U
cis-1,2-Dichloroethene	156-59-2	NS	0.0010	U
cis-1,3-Dichloropropene	10061-01-5	NS	0.00058	U
Cyclohexane	110-82-7	NS	0.00080	U
Dibromochloromethane	124-48-1	41	0.00068	U
Dichlorodifluoromethane	75-71-8	NS	0.00088	U
Ethylbenzene	100-41-4	NS	0.00055	U
Freon 113	76-13-1	100	0.0032	U
Isopropylbenzene	98-82-8	NS	0.0017	U
m,p-Xylene		NS	0.0011	U
Methyl Acetate	79-20-9	100	0.0017	U
Methyl Tert Butyl Ether	1634-04-4	NS	0.00057	U
Methylcyclohexane	108-87-2	NS	0.0011	U
Methylene chloride	64164	NS	0.0033	J
o-Xylene	95-47-6	19	0.00056	U
Styrene	100-42-5	100	0.00049	U
Tetrachloroethene	127-18-4	NS	0.00070	U
Toluene	108-88-3	NS	0.00064	U
trans-1,2-Dichloroethene	156-60-5	NS	0.00074	U
trans-1,3-Dichloropropene	10061-02-6	100	0.00055	U
Trichloroethene	65386	NS	0.00092	U
Trichlorofluoromethane	75-69-4	21	0.00083	U
Vinyl chloride	63923	NS	0.00058	U
Xylene (total)	1330-20-7	0.9	0.00056	U

Notes:

All units are milligram/kilogram (mg/kg)

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil Cleanup

Objective (RRUSCO) Table 375-6.8b

ND - Not detected above the laboratory MDL

NS - No Standard

J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

U : Indicates the analyte was analyzed for but not detected above the laboratory MDL

Table 3
Soil Analytical for Semi-Volatile Organics
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	NYSDEC RRUSCOs *	SP001 JD99787 11/6/2024
Semi-Volatile Organics by 8270D			
1,1'-Biphenyl	92-52-4	NS	0.0055 U
1,2,4,5-Tetrachlorobenzene	95-94-3	NS	0.010 U
1,4-Dioxane b	123-91-1	NS	0.027 U
2,2'-Oxybis(1-chloropropane)	108-60-1	NS	0.014 U
2,3,4,6-Tetrachlorophenol	58-90-2	NS	0.027 U
2,4,5-Trichlorophenol	95-95-4	NS	0.030 U
2,4,6-Trichlorophenol	68821	NS	0.024 U
2,4-Dichlorophenol	120-83-2	NS	0.034 U
2,4-Dimethylphenol	105-67-9	NS	0.072 U
2,4-Dinitrophenol	51-28-5	NS	0.15 U
2,4-Dinitrotoluene	121-14-2	NS	0.012 U
2,6-Dinitrotoluene	606-20-2	NS	0.020 U
2-Chloronaphthalene	91-58-7	NS	0.0096 U
2-Chlorophenol	95-57-8	NS	0.020 U
2-Methylnaphthalene	91-57-6	100	0.0091 U
2-Methylphenol	95-48-7	NS	0.026 U
2-Nitroaniline a	88-74-4	NS	0.0095 U
2-Nitrophenol	88-75-5	NS	0.027 U
3&4-Methylphenol a		NS	0.033 U
3,3'-Dichlorobenzidine	91-94-1	NS	0.034 U
3-Nitroaniline	72930	NS	0.010 U
4,6-Dinitro-o-cresol	534-52-1	NS	0.043 U
4-Bromophenyl phenyl ether a	101-55-3	NS	0.016 U
4-Chloro-3-methyl phenol	59-50-7	NS	0.025 U
4-Chloroaniline	106-47-8	100	0.015 U
4-Chlorophenyl phenyl ether	7005-72-3	NS	0.013 U
4-Nitroaniline	100-01-6	NS	0.010 U
4-Nitrophenol a	100-02-7	100	0.110 U
Acenaphthene	83-32-9	100	0.014 U
Acenaphthylene	208-96-8	NS	0.0333 J
Acetophenone a	98-86-2	100	0.0087 U
Anthracene	120-12-7	NS	0.025 U
Atrazine a	1912-24-9	NS	0.017 U
Benzaldehyde	100-52-7	1.0	0.010 U
Benzo(a)anthracene	56-55-3	1.0	0.0233 J
Benzo(a)pyrene	50-32-8	1.0	0.0248 J
Benzo(b)fluoranthene	205-99-2	100	0.034 J
Benzo(g,h,i)perylene	191-24-2	3.9	0.020 U
Benzo(k)fluoranthene	207-08-9	NS	0.019 U
bis(2-Chloroethoxy)methane	111-91-1	NS	0.0086 U
bis(2-Chloroethyl)ether	111-44-4	NS	0.017 U
bis(2-Ethylhexyl)phthalate	117-81-7	NS	0.102
Butyl benzyl phthalate	85-68-7	NS	0.0098 U
Caprolactam a	105-60-2	NS	0.016 U
Carbazole	86-74-8	3.9	0.0153 J
Chrysene	218-01-9	0.33	0.0236 J
Dibenzo(a,h)anthracene	53-70-3	59	0.018 U
Dibenzofuran	132-64-9	NS	0.016 U
Diethyl phthalate	84-66-2	NS	0.0086 U
Dimethyl phthalate	131-11-3	NS	0.0072 U
Di-n-butyl phthalate	84-74-2	NS	0.0079 J
Di-n-octyl phthalate	117-84-0	100	0.010 U
Fluoranthene	206-44-0	100	0.0514
Fluorene	86-73-7	1.2	0.019 U
Hexachlorobenzene a	118-74-1	NS	0.010 U
Hexachlorobutadiene	87-68-3	NS	0.016 U
Hexachlorocyclopentadiene a	77-47-4	NS	0.016 U
Hexachloroethane	67-72-1	0.5	0.020 U
Indeno(1,2,3-cd)pyrene	193-39-5	NS	0.019 U
Isophorone	78-59-1	100	0.0086 U
Naphthalene	91-20-3	NS	0.011 U
Nitrobenzene a	98-95-3	NS	0.016 U
N-Nitroso-di-n-propylamine a	621-64-7	NS	0.012 U
N-Nitrosodiphenylamine	86-30-6	6.7	0.015 U
Pentachlorophenol	87-86-5	100	0.038 U
Phenanthrene	67580	100	0.0305 J
Phenol	108-95-2	NS	0.021 U
Pyrene	129-00-0	100	0.0447

Notes:

All units are mg/kg

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil Cleanup

Objective (RRUSCO) Table 375-6.8b

NS - No Standard

J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

U : Indicates the analyte was analyzed for but not detected above the laboratory MDL

Highlighted value exceeds RRUSCOs.

Table 4
Soil Analytical for Pesticides
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	NYSDEC RRUSCOs *	SP001 JD99787 11/6/2024
Pesticides by 8081B			
4,4'-DDD	72-54-8	13	0.0019
4,4'-DDE	72-55-9	8.9	0.0024
4,4'-DDT	50-29-3	7.9	0.0074
Aldrin	309-00-2	0.097	0.000089 U
alpha-BHC	319-84-6	0.48	0.000053 U
alpha-Chlordane	5103-71-9	NS	0.00097
beta-BHC	319-85-7	0.36	0.000066 U
delta-BHC	319-86-8	100	0.000069 U
Dieldrin	60-57-1	0.2	0.0014
Endosulfan I	1031-07-8	24	0.000055 U
Endosulfan II	959-98-8	24	0.000062 U
Endosulfan sulfate	33213-65-9	24	0.00051
Endrin	72-20-8	11	0.000066 U
Endrin aldehyde	7421-93-4	NS	0.00013 U
Endrin ketone	53494-70-5	NS	0.000073 U
gamma-BHC (Lindane)	58-89-9	1.3	0.00008 U
gamma-Chlordane	5103-74-2	NS	0.000069 U
Heptachlor	76-44-8	2.1	0.000060 U
Heptachlor epoxide	1024-57-3	NS	0.000082 U
Methoxychlor	72-43-5	NS	0.00018 U
Toxaphene	8001-35-2	NS	0.0038 U

Notes:

All units are mg/kg

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil

Cleanup Objective (RRUSCO) Table 375-6.8b

NS - No Standard

U : Indicates the analyte was analyzed for but not detected above the laboratory MDL

Highlighted value exceeds RRUSCOs.

Table 5
Soil Analytical for Polychlorinated Biphenyls
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	NYSDEC RRUSCOs *	SP001 JD99787 11/6/2024
Polychlorinated biphenyls by 8082A			
Aroclor 1016	12674-11-2	NS	0.0097 U
Aroclor 1221	11104-28-2	NS	0.0077 U
Aroclor 1232	11141-16-5	NS	0.019 U
Aroclor 1242	53469-21-9	NS	0.014 U
Aroclor 1248	12672-29-6	NS	0.0049 U
Aroclor 1254	11097-69-1	NS	0.0679
Aroclor 1260	11096-82-5	NS	0.0079 U
Aroclor 1268	11100-14-4	NS	0.0023 U
Aroclor-1262	37324-23-5	NS	0.0019 U
Polychlorinated biphenyls, Total	1336-36-3	1.0	0.0679

Notes:

All units are mg/kg

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil

NS - No Standard

U : Indicates the analyte was analyzed for but not detected above the laboratory MDL

Highlighted value exceeds RRUSCOs.

Table 6
Soil Analytical for Metals
Suffolk County Firematics Site, Yaphank, New York
November 2024

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	NYSDEC RRUSCOs *	SP001 JD99787 11/6/2024
Metals by 6010D			
Arsenic	7440-38-2	16	3.6
Barium	7440-39-3	400	16 U
Cadmium	7440-43-9	4.3	0.40 U
Chromium	7440-47-3	NS	6.4
Lead	7439-92-1	400	8.9
Selenium	7782-49-2	180	1.6 U
Silver	7440-22-4	180	0.40 U
Metals by 7471B			
Mercury	7439-97-6	0.81	0.037 U

Notes:

All units are mg/kg

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil

Cleanup Objective (RRUSCO) Table 375-6.8b

NS - No Standard

U : Indicates the analyte was analyzed for but not detected above the laboratory RL

Table 1
Soil Analytical - Additional Parameters for Disposal
Suffolk County Firematics Site, Yaphank, New York
July 2025

Client Sample ID: Laboratory ID: Sampling Date:	CAS Number	Unit	NYSDEC RRUSCOs *	WC02 JE14445 7/2/2025
Analyte				
Beryllium	7440-41-7	mg/kg	72	0.27 U
Nickel	7440-02-0	mg/kg	310	3.90
Ethylene Glycol	107-21-1	mg/kg	NS	2.2 U
Isopropylbenzene	98-82-8	ug/kg	100,000	1.400 U
Methanol	67-56-1	ug/kg	NS	110.000 U

Notes:

*NYSDEC 6 NYCRR Environmental Remediation Programs Part 375 Restrictd Residential Use of Soil Cleanup Objective

(RRUSCO) Table 375-6.8b

NS - No Standard

U : Indicates the analyte was analyzed for but not detected above the laboratory MDL

Highlighted value exceeds RRUSCOs.

APPENDIX B



SUFFOLK COUNTY FIREMATICS SITE
676 MAPLE STREET, YAPHANK, NEW YORK
SCTM ID: 0200-779.00-01.00-002.000
NYSDEC SITE: 152246

HEALTH AND SAFETY PLAN

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, New York 12233-7016

PREPARED FOR:



Suffolk County Department of Health Services
Office of Pollution Control
15 Horseblock Place
Farmingville, New York 11738

PREPARED BY:



P.W. Grosser Consulting
630 Johnson Ave., Suite 7
Bohemia, NY 11716
Phone: 631-589-6353

PWGC Project Number: SHD2502

MARCH 2025

HEALTH AND SAFETY PLAN
SUFFOLK COUNTY FIREMATICS SITE, 676 MAPLE STREET, YAPHANK, NEW YORK

TABLE OF CONTENTS	PAGE
STATEMENT OF COMMITMENT.....	1
1.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS.....	2
1.1. Site Safety Plan Acceptance, Acknowledgement and Amendments.....	2
1.2. Daily Safety Meetings.....	2
1.3. Key Personnel – Roles and Responsibilities	2
2.0 SITE BACKGROUND AND SCOPE OF WORK	4
3.0 POTENTIAL HAZARDS OF THE SITE.....	5
3.1. Chemical Hazards	5
3.1.1. <i>Additional Chemical Hazards</i>	8
3.2. Biological Hazards	8
3.2.1. <i>Animals</i>	8
3.2.2. <i>Insects</i>	8
3.2.3. <i>Plants</i>	8
3.3. Physical Hazards.....	9
3.3.1. <i>Temperature Extremes</i>	9
3.3.1.1. <i>Heat Stress</i>	9
3.3.1.2. <i>Cold Stress</i>	9
3.3.2. <i>Noise</i>	9
3.3.3. <i>Fire and Explosion</i>	9
3.3.4. <i>Manual Lifting/Material Handling</i>	9
3.3.5. <i>Slips, Trips and Falls</i>	9
3.3.6. <i>Heavy Equipment Operation</i>	9
3.3.7. <i>Electrocution</i>	10
4.0 PERSONAL PROTECTIVE EQUIPMENT	11
4.1. Level D.....	11
4.2. Level C	11
4.3. Level B	12
5.0 AIR MONITORING.....	13
6.0 TRAINING AND MEDICAL SURVEILLANCE	14
6.1. Annual Eight-Hour Refresher Training	14
6.2. Medical Surveillance	14
7.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN	15
7.1. Emergency Equipment On-site.....	15
7.2. Emergency Telephone Number	15
7.3. Personnel Responsibilities during an Emergency	15



7.4.	Medical Emergencies.....	16
7.5.	Fire or Explosion.....	16
7.6.	Evacuation Routes.....	16

FIGURES

Figure 1 Hospital Route Map

APPENDICES

Appendix A	Site Safety Plan Acceptance and Acknowledgement Form
Appendix B	Site Safety Amendment Form
Appendix C	Chemical Safety Data Sheets
Appendix D	Summary of Prohibited and Acceptable Materials
Appendix E	Heat and Cold Stress Safety
Appendix F	Field Accident Report



STATEMENT OF COMMITMENT

This Health and Safety Plan (HASP) has been prepared to ensure that workers are not exposed to chemical, biological and physical hazards during the planned Interim Remedial Measure (IRM) to be performed at the site known as Suffolk County Firematics Site located at 676 Maple Street, Yaphank, New York. P.W. Grosser Consulting Inc.'s (PWGC's) policy is to minimize the possibility of work-related exposure through awareness and qualified supervision, health and safety training, medical monitoring, use of appropriate personal protective equipment, and the following activity specific safety protocols contained in this HASP. PWGC has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP, which applies to persons present at the Site actually or potentially exposed to safety or health hazards, describes emergency response procedures for actual and potential physical, biological and chemical hazards. This HASP is also intended to inform and guide personnel entering the work area. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy by signing off on receipt of their individual copy of the document. Contractors and suppliers are retained as independent contractors and are responsible for ensuring the health and safety of their own employees as it relates to general construction practices.



1.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS

This document describes the health and safety guidelines developed by P.W. Grosser Consulting, Inc. (PWGC) at the request of Suffolk County for the proposed IRM activities to be performed at the Site to protect onsite personnel, visitors, and the public from exposure to hazardous materials or wastes. In accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.120 Hazardous Waste Operations and Emergency Response Final rule, this HASP, including the attachments, addresses safety and health hazards relating to this phase of site operations as detailed in the IRM Work Plan. The HASP may be revised by PWGC at the request of Suffolk County upon receipt of new information regarding site conditions. Changes will be documented by written amendments.

1.1. Site Safety Plan Acceptance, Acknowledgement and Amendments

The project manager (PM) and the site safety officer (SSO) are responsible for informing personnel entering the work area of the contents of this plan and ensuring that each person signs the safety plan acknowledging the onsite hazards and procedures required to minimize exposure to adverse effects of these hazards. A copy of the Acknowledgement Form is included in **Appendix A**.

Site conditions may warrant an amendment to the HASP. Amendments to the HASP are acknowledged by completing forms included in **Appendix B**.

1.2. Daily Safety Meetings

Each day before work begins; the SSO will hold safety (tailgate or tool box) meetings to ensure that onsite personnel understand the site conditions and operating procedures and to address safety questions and concerns. Meeting minutes and attendance will be recorded. Project staff will discuss and remedy health and safety issues at these meetings.

1.3. Key Personnel – Roles and Responsibilities

The following key personnel are planned for this project:

- Project Manager (PM)
- Site Safety Officer (SSO)

The PM is responsible for overall project administration and, with guidance from the SSO, for supervising the implementation of this HASP. The SSO will conduct daily (tail gate or tool box) safety meetings at the project site and oversee daily safety issues. Each subcontractor and supplier (defined as an OSHA employer) is also responsible for the health and safety of its employees. If there is any dispute about health and safety or project activities, onsite personnel will attempt to resolve the issue. If the issue cannot be resolved at the site, then the PM will be consulted.

The SSO is responsible for the following:

1. Educating personnel about information in this HASP and other safety requirements to be observed during site operations, including, but not limited to, designation of work zones and levels of protection and emergency procedures dealing with fire and first aid.
2. Coordinating site safety decisions with the PM.
3. Monitoring the condition and status of known onsite hazards specified in this HASP.
4. Maintaining the work zone entry/exit log and site entry/exit log.

5. Maintaining records of safety problems, corrective measures and documentation of chemical exposures or physical injuries (the SSO will document these conditions in a bound notebook and maintain a copy of the notebook onsite).

The person who observes safety concerns and potential hazards that have not been addressed in the daily safety meetings should immediately report their observations/concerns to the SSO or appropriate key personnel.

2.0 SITE BACKGROUND AND SCOPE OF WORK

The Site is located in Yaphank, New York and is identified as Suffolk County Section 742, Block 1, p/o Lot 0200-779.00-01.00-002.000. Currently, the Site consist of 22 buildings/training areas located within a 28-acre site. The training areas are used for variety of training scenarios, some involve live fire training (fire generated using liquefied petroleum gas) and others do not. The current buildings were constructed between 1959 and 2005.

Per and poly fluoroalkyl substances (PFAS) have been identified above the New York State Department of Environmental Conservation (NYSDEC) protection of groundwater soil guidance values (POGSGVs) in soil samples collected from the stockpile (approximately 100 cubic yards (CY)) previously generated as part of the oil waster separator installation in 2017. PFAS have also been identified in soil and ground water beneath the Site during previous investigations. The primary PFAS of interest are Perfluorooctane sulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA). Suffolk County is constructing additional firefighting props adjacent to and north of the Site. This construction will entail soil disturbance on the Site; to perform required site grading and connections to the Site stormwater collection system.

This HASP covers on Site soil disturbance activities, excavated soil handling/stockpiling, material sampling, and loading for offsite transport to approved disposal facilities.

3.0 POTENTIAL HAZARDS OF THE SITE

This section presents an assessment of the chemical, biological, and physical hazards that may be encountered. Additional information can be found in **Appendix C**.

3.1. Chemical Hazards

Review of historical information from the site indicates that PFOA and PFOS were detected above NYSDEC POGSGVs of 0.8 micrograms per kilogram (ug/kg) and 1.0 ug/kg, respectively, in soil borings previously installed at the Site and above the NYSDEC proposed ambient water quality standards and guidance values (AWQS/GVs) of 6.7 nanograms per liter (ng/l) and 2.7 ng/l, respectively, and the USEPA HAL of 4.0 ng/l for both compounds, in groundwater monitoring wells at the Site. Additionally, in the USEPA's Final National Primary Drinking Water Regulation (NPDWR) of April 2024, a maximum contaminant level (MCL) of 10 ng/L was also set for Perfluorohexanesulfonic acid (PFHxS), Perfluorononanoic acid (PFNA) and hexafluoropropylene oxide dimer acid (HFPO-DA (commonly known as Gen-X)). Mixtures containing two or more of PFHxS, PFNA, Gen-X and Perfluorobutane sulfonic acid (PFBS) were assigned a unitless Hazard Index (HI) of 1. These compounds may present an occupational exposure hazard during site operations.

The chemicals identified above may have fetal effects and effects on breastfed children (low birth weight, accelerated puberty, skeletal variations), liver effects, immune effects, thyroid effects and cholesterol changes. These chemicals may also be linked to testicular and kidney cancers. Acute exposure symptoms may include cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Specific information on the chemicals identified at the Site can be found in **Table 3-1** as well as on the Safety Data Sheets found in **Appendix C**.

Table 3-1 – Chemical Hazards

COMPOUND	CAS#	TVL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Gen-X (HFPO-DA)	13252-13-6	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	Colorless gas
PFBS	375-73-5	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	Colorless liquid or corrosive solid
PFHxS	355-46-4	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	Beige crystals
PFNA	375-95-1	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	White Powder

COMPOUND	CAS#	TVL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
PFOA	355-67-1	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	White Powder
PFOS	1763-23-1	Not yet established	Inhalation Ingestion Skin/Eye	Short Term: Cough, sore throat, redness and pain on skin, redness, blurred vision, abdominal pain, nausea and vomiting. Long Term: Can affect a subject's liver, cardiovascular system, development, reproductive system, immune system and thyroid.	Respiratory tract, eyes and skin	White Powder

Abbreviations

C = Ceiling limit, not to be exceeded

CNS = Central Nervous System

TVL=Threshold limit values

ppm = parts per million

TWA = Time-weighted average (8 hours)

3.1.1. Additional Chemical Hazards

Although no specific compounds have been identified there is the potential to come in contact with petroleum related VOC's and semi-VOC's given the past and existing storage of petroleum products and the nature of the activities at the site. Additionally, metals are commonly found in subsurface soils. For these reasons, specific information regarding the compounds most anticipated to be encountered can be found in the Safety Data Sheets in **Appendix C. Additional compounds will be added should sampling activities planned at the site document their presence.**

3.2. Biological Hazards

Work will be performed in a fire training facility containing several building and various props used in fire training exercises in Yaphank, New York. In general, the facility is only occupied while an active training session is taking place. During the project, there is potential for workers to come into contact with biological hazards such as animals, insects and plants.

3.2.1. Animals

The Site is located in a predominantly developed area. It is possible that dogs, cats, rats and mice may be present. Workers shall use discretion and avoid all contact with animals.

3.2.2. Insects

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear appropriate repellents and personnel protective equipment (PPE), if deemed necessary, when working in areas where insects are expected to be present.

During the months of April through October, caution must be exercised to minimize exposure to deer ticks and the potential for contracting Lyme disease. Given the nature of the compounds of concern, certain sampling equipment, field clothing and PPE should be avoided, if possible. A summary of prohibited and Acceptable Materials is included in **Appendix D.** Specific precautionary work practices that are recommended include the following:

- Cover your body as much as possible. Wear long pants and long-sleeved shirts. Light color clothing makes spotting of ticks easier.
- Try to eliminate possible paths by which the Deer Tick may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves. (Duct tape may be utilized to help seal cuffs and ankles). If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek coveralls may be utilized for added protection when the potential for heat stress is not a concern.
- Conduct periodic and frequent, (e.g., hourly), surveys of your clothing for the presence of ticks. Remove any tick, save it and report to the clinic with the tick.
- Certain types of Insect repellents may be used and are listed below.
 - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics.

3.2.3. Plants

Poison ivy, sumac and oak may be present on site. The PM/SSO should identify susceptible individuals. Worker shall avoid all contact with these plants.

3.3. Physical Hazards

During the project, there is potential for workers to come into contact with physical hazards such as heat stress, cold stress, noise, fire and explosions.

3.3.1. Temperature Extremes

3.3.1.1. Heat Stress

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE in hot environments. The potential hazards of working in hot environments include dehydration, cramps, heat rash, heat exhaustion, and heat stroke.

3.3.1.2. Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, and poor judgment.

PWGC's Heat/Cold Stress Protocols are specified in **Appendix E**.

3.3.2. Noise

Noise is a potential hazard associated with the operation of heavy equipment, pumps and engines. Workers will wear hearing protection while in the work zone when these types of machinery are operating.

3.3.3. Fire and Explosion

When conducting excavation or loading activities, the opportunity of encountering fire and explosion hazards may exist from encountering underground utilities, from the use of diesel engine equipment, propane, liquefied petroleum gas and other potential ignition sources. During dry periods there is an increased chance of forest and brush fires starting at the job site. If these conditions occur no smoking will be permitted at the site and all operations involving potential ignition sources will be monitored continuously (fire watch).

3.3.4. Manual Lifting/Material Handling

Manual lifting of heavy objects may be required. Failure to follow proper lifting technique can result in back injuries and strains. Back injuries are a serious concern as they are the most common work place injury, often resulting in lost or restricted work time, and long treatment and recovery periods.

3.3.5. Slips, Trips and Falls

Working in and around the site will pose slip, trip and fall hazards due to slippery surfaces that may be oil covered, or from rough terrain, surfaces that are steep inclines, surfaced debris, or surfaces which are wet from rain or ice. Falls may result in twisted ankles, broken bones, head trauma or back injuries.

3.3.6. Heavy Equipment Operation

Heavy equipment including excavators and payloaders, or equivalent, will be utilized for Site grading and excavation for connections to the Site stormwater collection system. An excavator, payloaders, tri-axel trucks, or equivalent may be used to excavate and transport soil where required. Working

with or near heavy equipment poses many potential hazards, including electrocution, fire/explosion, being struck by or against, or pinched/caught/crushed by, and can result in serious physical harm.

3.3.7. *Electrocution*

Encountering underground utilities may pose electrical hazards to workers. Additionally, overhead electrical lines can be a concern during grading, excavation and loading operations. Potential adverse effects of electrical hazards include burns and electrocution, which could result in death.

4.0 PERSONAL PROTECTIVE EQUIPMENT

PPE shall be selected in accordance with OSHA 29 CFR 1910.120(c), (g), and 1910.132. Protective equipment shall be National Institute for Occupational Safety and Health (NIOSH) approved and respiratory protection shall conform to OSHA 29 CFR Part 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136. The only true difference among the levels of protection from D through B is the addition of the type of respiratory protection. **It is anticipated that work will be performed in Level D PPE.**

4.1. Level D

Level D PPE shall be donned when the atmosphere contains no known hazards and work functions preclude splashes, immersion, or the potential for inhalation of, or contact with, hazardous concentrations of harmful chemicals. Given the nature of the compounds of concern, certain sampling equipment, field clothing and PPE should be avoided, if possible. A summary of prohibited and Acceptable Materials is included in **Appendix D**. Level D PPE consists of:

- standard work uniform, coveralls, or tyvek, as needed;
- steel toe work that do not contain Gore-Tex. boots;
- hard hat;
- gloves, as needed;
- safety glasses;
- hearing protection;
- equipment replacements are available as needed.

4.2. Level C

Level C PPE shall be donned when the concentrations of measured total organic vapors in the breathing zone exceed background concentrations (using a portable photoionization detector (PID), or equivalent), but are less than 5 ppm. The specifications on the APR filters used must be appropriate for contaminants identified or expected to be encountered. Level C PPE shall be donned when the identified contaminants have adequate warning properties and criteria for using APR have been met. Given the nature of the compounds of concern, certain sampling equipment, field clothing and PPE should be avoided, if possible. A summary of prohibited and Acceptable Materials is included in **Appendix D**. Level C PPE consists of:

- chemical resistant or coated tyvek coveralls;
- steel-toe work boots that do not contain Gore-Tex;
- chemical resistant over boots or disposable boot covers;
- disposable inner gloves (surgical gloves);
- disposable outer gloves;
- full face APR fitted with organic vapor/dust and mist filters or filters appropriate for the identified or expected contaminants;
- hard hat;
- splash shield, as needed; and,
- ankles/wrists taped with duct tape.

The SSO will verify if Level C is appropriate by checking organic vapor concentrations using compound and/or class-specific detector tubes.

4.3. Level B

Level B PPE shall be donned when the contaminants have not been identified and/or the concentrations of unknown measured total organic vapors in the breathing zone exceed 5 ppm (using a portable PID, or equivalent). Level B PPE shall be donned if the immediately dangerous to life or health (IDLH) of a known contaminant is exceeded. If a contaminant is identified or is expected to be encountered for which NIOSH and/or OSHA recommend the use of a positive pressure self-contained breathing apparatus (SCBA) when that contaminant is present, Level B PPE shall be donned even though the total organic vapors in the breathing zone may not exceed 5 ppm. Level B shall be donned for confined space entry, and when the atmosphere is oxygen deficient (oxygen less than 19.5%) or potentially oxygen deficient. If Level B PPE is required for a task, at least three people shall be donned in Level B at any one time during that task. PPE shall only be donned at the direction of the site safety officer. Given the nature of the compounds of concern, certain sampling equipment, field clothing and PPE should be avoided, if possible. A summary of prohibited and Acceptable Materials is included in **Appendix D**. Level B PPE consists of:

- supplied air SCBA or airline system with five-minute egress system;
- chemical resistant coveralls;
- steel-toe work boots that do not contain Gore-Tex;
- chemical resistant over boots or disposable boot covers;
- disposable inner gloves;
- disposable outer gloves;
- hard hat; and,
- ankles/wrists taped.

The exact PPE ensemble is decided on a site-by-site basis by the PWGC SSO with the intent to provide the most protective and efficient worker PPE.

5.0 AIR MONITORING

Air monitoring will be performed for protection for onsite workers and the downwind community (i.e., offsite receptors including residences, businesses, and on-site workers not directly involved in the remedial investigation work) from potential airborne contaminant releases resulting from remedial activities at the site. Air monitoring will be used to help to confirm that the remedial investigation work will not spread contamination off-site through the air. The primary concerns for this site are dust particulates. Although and VOCs are not anticipated to be a concern, based on the historic use of the site, monitoring will be performed as a precautionary measure. Site monitoring with a PID and particulate dust/aerosol meter will be performed during any invasive activities.

Real-time monitoring for dust and VOCs will be conducted both within the work area, and along the site perimeter, during intrusive activities such as excavation and drilling activities.

Detailed information on the types, frequency and location of real-time monitoring and community air monitoring requirements are provided in the Community Air Monitoring Plan (CAMP) prepared for this project.

6.0 TRAINING AND MEDICAL SURVEILLANCE

Site workers that have the potential of coming in contact with site contaminants will have the following training and medical surveillance.

6.1. Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of site field personnel directly involved with site activities whom may come in contact with site contaminants. The training will cover a review of 1910.120 requirements and related company programs and procedures.

6.2. Medical Surveillance

Site field personnel directly involved with site activities whom may come in contact with site contaminants are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f).

7.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN

Site personnel must be prepared in the event of an emergency. Emergencies can take many forms: illnesses, injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather.

Emergency telephone numbers and a map to the hospital (**Figure 1**) will be posted onsite. Site personnel should be familiar with the emergency procedures, and the locations of site safety, first aid, and communication equipment. These will be outlined in the site-specific HASP.

7.1. Emergency Equipment On-site

Private telephones:	Site personnel.
Two-way radios:	Site personnel where necessary.
Emergency Alarms:	On-site vehicle horns*.
First aid kits:	On-site, in vehicles or office.
Fire extinguisher:	On-site, in office or on equipment.

7.2. Emergency Telephone Number

General Emergencies	911
New York City Police	911
Brookhaven Memorial Hospital	1-631-654-7100
NYSDEC Spills Division	1-800-457-7362
NYSDEC Hazardous Waste Division	1-718-482-4994
Suffolk County Department of Health	1-631-854-0000
Brookhaven Fire Department	911
National Response Center	1-800-424-8802
Poison Control	1-212-340-4494
Project Manager	1-631-589-6353
Site Safety Officer	1-631-589-6353
Alternate Site Safety Officer	1-631-589-6353

7.3. Personnel Responsibilities during an Emergency

The PM is primarily responsible for responding to and correcting any emergency situations. However, in the absence of the project manager, the site safety officer shall act as the project manager's onsite designee and perform the following tasks:

- Take appropriate measures to protect personnel;
- Ensure that appropriate federal, state, and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. If toxic materials are released to the air, the local authorities should be informed in order to assess the need for evacuation;
- Ensure appropriate decontamination, treatment, or testing for exposed or injured personnel;
- Determine the cause of incidents and make recommendations to prevent recurrence; and,
- Ensure that all required reports have been prepared.

7.4. Medical Emergencies

A person who becomes ill or injured, first aid will be administered while waiting for an ambulance or paramedics. A Field Accident Report (**Appendix F**) must be filled out for any injury.

A person transporting an injured/exposed person to a clinic or hospital for treatment will take the directions to the hospital and information on the chemical(s) to which they may have been exposed.

7.5. Fire or Explosion

In the event of a fire or explosion, the local fire department will be summoned immediately. The site safety officer or his designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials onsite. If it is safe to do so, site personnel may:

- use firefighting equipment available on site; or,
- remove or isolate flammable or other hazardous materials that may contribute to the fire.

7.6. Evacuation Routes

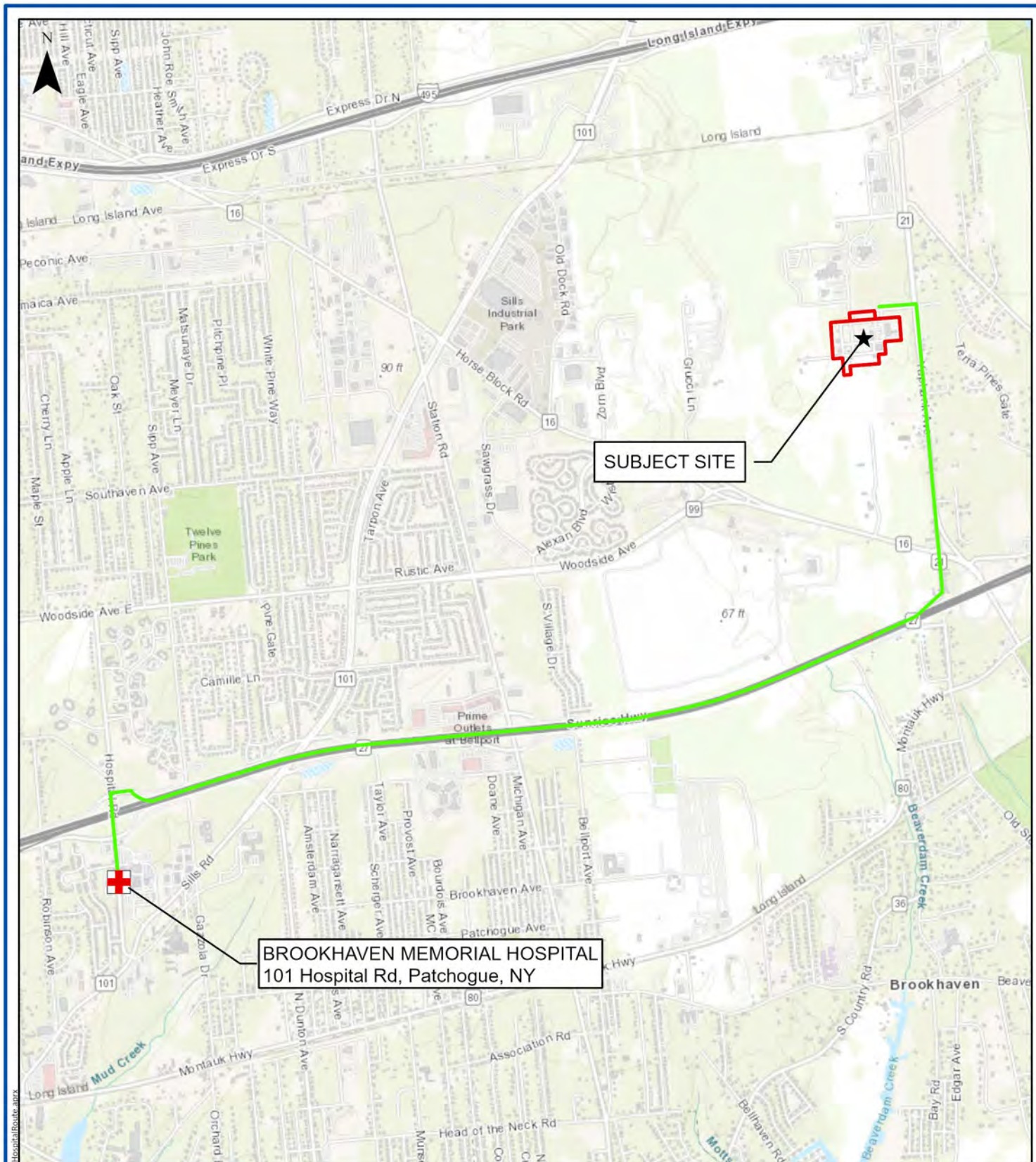
Evacuation routes established by work area locations for each site will be reviewed prior to commencing site operations. As the work areas change, the evacuation routes will be altered accordingly, and the new route will be reviewed.

Under extreme emergency conditions, evacuation is to be immediate without regard for equipment. The evacuation signal will be a continuous blast of a vehicle horn, if possible, and/or by verbal/radio communication. When evacuating the site, personnel will follow these instructions:

- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation through the decontamination corridor is not possible, personnel should remove contaminated clothing once they are in a safe location and leave it near the exclusion zone or in a safe place.
- The site safety officer will conduct a head count to ensure that all personnel have been evacuated safely. The head count will be correlated to the site and/or exclusion zone entry/exit log.
- If emergency site evacuation is necessary, all personnel are to escape the emergency situation and decontaminate to the maximum extent practical.

FIGURE





Document Path: W:\Projects\SHD2502\map files\HospitalRoute.aprx



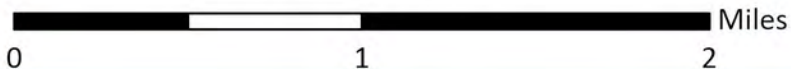
PWGC
CLIENT DRIVEN SOLUTIONS

P.W. Grosser Consulting, Inc.

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgrosser.com

HOSPITAL ROUTE MAP

676 MAPLE AVE
YAPHANK, NY



Project:	SHD2502
Date:	3/19/2025
Designed by:	AL
Drawn by:	AM
Approved by:	AL
Figure No:	1

APPENDIX A





**Health and Safety Plan
Acceptance and Acknowledgement Form**

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP. It is maintained on site by the SSO as a project record. Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the HASP and understand the information presented. I will comply with the provisions contained therein.

<i>Name (Print and Sign)</i>	<i>Date</i>



APPENDIX B





SITE SAFETY PLAN AMENDMENT FORM

SITE SAFETY PLAN AMENDMENT # _____:

SITE NAME: _____

REASON FOR AMENDMENT: _____

ALTERNATIVE PROCEDURES: _____

REQUIRED CHANGES IN PPE: _____

PROJECT MANAGER

DATE

SITE SAFETY OFFICER

DATE



APPENDIX C



Safety Data Sheet
acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

1 Identification

- **Product identifier**
- **Trade name:** Perfluorooctanoic Acid (PFOA)
- **Part number:** N-1588
- **CAS Number:**
335-67-1
- **EC number:**
206-397-9
- **Index number:**
607-704-00-2
- **Application of the substance / the mixture** Reagents and Standards for Analytical Chemical Laboratory Use
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
Agilent Technologies, Inc.
5301 Stevens Creek Blvd.
Santa Clara, CA 95051 USA
- **Information department:**
Telephone: 800-227-9770
e-mail: pdl-msds_author@agilent.com
- **Emergency telephone number:** CHEMTREC®: 1-800-424-9300

2 Hazard(s) identification

- **Classification of the substance or mixture**



GHS08 Health hazard

Carc. 2 H351 Suspected of causing cancer.
Repr. 1B H360 May damage fertility or the unborn child.
STOT RE 1 H372 Causes damage to the liver through prolonged or repeated exposure.



GHS05 Corrosion

Eye Dam. 1 H318 Causes serious eye damage.



GHS07

Acute Tox. 4 H302 Harmful if swallowed.
Acute Tox. 4 H332 Harmful if inhaled.

- **Label elements**
- **GHS label elements** The substance is classified and labeled according to the Globally Harmonized System (GHS).
(Contd. on page 2)

Safety Data Sheet acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 1)

· Hazard pictograms



· Signal word Danger

· Hazard-determining components of labeling:

perfluorooctanoic acid (PFOA)

· Hazard statements

Harmful if swallowed or if inhaled.

Causes serious eye damage.

Suspected of causing cancer.

May damage fertility or the unborn child.

Causes damage to the liver through prolonged or repeated exposure.

· Precautionary statements

Obtain special instructions before use.

Do not handle until all safety precautions have been read and understood.

Do not breathe dust/fume/gas/mist/vapors/spray.

Wash thoroughly after handling.

Do not eat, drink or smoke when using this product.

Use only outdoors or in a well-ventilated area.

Wear protective gloves/protective clothing/eye protection/face protection.

If swallowed: Call a poison center/doctor if you feel unwell.

Rinse mouth.

IF INHALED: Remove person to fresh air and keep comfortable for breathing.

If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.

Continue rinsing.

Immediately call a poison center/doctor.

IF exposed or concerned: Get medical advice/attention.

Get medical advice/attention if you feel unwell.

Store locked up.

Dispose of contents/container in accordance with local/regional/national/international regulations.

· Classification system:

· NFPA ratings (scale 0 - 4)



Health = 3

Fire = 0

Reactivity = 0

· HMIS-ratings (scale 0 - 4)



Health = *3

Fire = 0

Reactivity = 0

· Other hazards

· Results of PBT and vPvB assessment

· PBT: Not applicable.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)· **vPvB:** Not applicable.

(Contd. of page 2)

3 Composition/information on ingredients

- **Chemical characterization: Substances**
- **CAS No. Description**
335-67-1 perfluorooctanoic acid (PFOA)
- **Identification number(s)**
- **EC number:** 206-397-9
- **Index number:** 607-704-00-2

4 First-aid measures

- **Description of first aid measures**
- **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
- **After inhalation:**
Supply fresh air. If required, provide artificial respiration. Keep patient warm. Consult doctor if symptoms persist. In case of unconsciousness place patient stably in side position for transportation.
- **After skin contact:** Generally the product does not irritate the skin.
- **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing:** Immediately call a doctor.
- **Information for doctor:**
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:** Use fire fighting measures that suit the environment.
- **Special hazards arising from the substance or mixture**
During heating or in case of fire poisonous gases are produced.
- **Advice for firefighters**
- **Protective equipment:** Mouth respiratory protective device.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures**
Mount respiratory protective device.
Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 3)

- **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
- **Protective Action Criteria for Chemicals**

· **PAC-1:**1.1 mg/m³· **PAC-2:**12 mg/m³· **PAC-3:**75 mg/m³**7 Handling and storage**

- **Handling:**
- **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
- **Information about protection against explosions and fires:** Keep respiratory protective device available.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see item 7.
- **Control parameters**
- **Components with limit values that require monitoring at the workplace:** Not required.
- **Additional information:** The lists that were valid during the creation were used as basis.
- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.
- **Breathing equipment:**
When used as intended with Agilent instruments, the use of the product under normal laboratory conditions and with standard practices does not result in significant airborne exposures and therefore respiratory protection is not needed.
Under an emergency condition where a respirator is deemed necessary, use a NIOSH or equivalent approved device/equipment with appropriate organic or acid gas cartridge.

(Contd. on page 5)

Safety Data Sheet

acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 4)

· Protection of hands:

Although not recommended for constant contact with the chemicals or for clean-up, nitrile gloves 11-13 mil thickness are recommended for normal use. The breakthrough time is 1 hr. For cleaning a spill where there is direct contact of the chemical, butyl rubber gloves are recommended 12-15 mil thickness with breakthrough times exceeding 4 hrs. Supplier recommendations should be followed.

· Material of gloves

For normal use: nitrile rubber, 11-13 mil thickness

For direct contact with the chemical: butyl rubber, 12-15 mil thickness

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· Penetration time of glove material

For normal use: nitrile rubber: 1 hour

For direct contact with the chemical: butyl rubber: >4 hours

· Eye protection:


Tightly sealed goggles

9 Physical and chemical properties

· Information on basic physical and chemical properties
· General Information
· Appearance:

Form:	Solid
Color:	Not determined.
Odor:	Characteristic
Odor threshold:	Not determined.

· pH-value: Not applicable.

· Change in condition

Melting point/Melting range:	55-56 °C (131-132.8 °F)
Boiling point/Boiling range:	190 °C (374 °F)

· Flash point: Not applicable.

· Flammability (solid, gaseous): Product is not flammable.

· Decomposition temperature: Not determined.

· Auto igniting: Not determined.

· Danger of explosion: Product does not present an explosion hazard.

· Explosion limits:

Lower:	Not determined.
Upper:	Not determined.

· Vapor pressure at 20 °C (68 °F): 0.69 hPa (0.5 mm Hg)

· Density at 20 °C (68 °F): 0.9 g/cm³ (7.5105 lbs/gal)

· Relative density Not determined.

· Vapor density Not applicable.

(Contd. on page 6)

Safety Data Sheet acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 5)

· Evaporation rate	Not applicable.
· Solubility in / Miscibility with Water at 20 °C (68 °F):	3.4 g/l
· Partition coefficient (n-octanol/water):	Not determined.
· Viscosity:	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
VOC content:	0.00 % 0.0 g/l / 0.00 lb/gal
Solids content:	100.0 %
· Other information	No further relevant information available.

10 Stability and reactivity

- **Reactivity** No further relevant information available.
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· Information on toxicological effects

· Acute toxicity:

· LD/LC50 values that are relevant for classification:

ATE (Acute Toxicity Estimate)

Oral	LD50	500 mg/kg
Inhalative	LC50/4 h	1.5 mg/L

· Primary irritant effect:

- **on the skin:** No irritant effect.
- **on the eye:** Strong irritant with the danger of severe eye injury.
- **Sensitization:** No sensitizing effects known.

· Additional toxicological information:

· Carcinogenic categories

· IARC (International Agency for Research on Cancer)

2B

· NTP (National Toxicology Program)

Substance is not listed.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 6)

· OSHA-Ca (Occupational Safety & Health Administration)

Substance is not listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 2 (Assessment by list): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
Danger to drinking water if even small quantities leak into the ground.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· UN-Number	
· DOT, IMDG, IATA	UN3261
· UN proper shipping name	
· DOT	Corrosive solid, acidic, organic, n.o.s. (perfluorooctanoic acid (PFOA))
· IMDG, IATA	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (perfluorooctanoic acid (PFOA))

(Contd. on page 8)

US

Safety Data Sheet acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 7)

· **Transport hazard class(es)**

· **IATA**

· **Class**

8 Corrosive substances

· **Label**

8

· **Environmental hazards:**

Not applicable.

· **Special precautions for user**

Warning: Corrosive substances

· **Danger code (Kemler):**

80

· **EMS Number:**

F-A,S-B

· **Segregation groups**

Acids

· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**

Not applicable.

· **Transport/Additional information:**

· **DOT**

· **Quantity limitations**

On passenger aircraft/rail: 25 kg

On cargo aircraft only: 100 kg

· **IMDG**

· **Limited quantities (LQ)**

5 kg

· **Excepted quantities (EQ)**

Code: E1

Maximum net quantity per inner packaging: 30 g

Maximum net quantity per outer packaging: 1000 g

· **UN "Model Regulation":**

UN 3261 CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S.
(PERFLUOROOCTANOIC ACID (PFOA)), 8, III

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**

· **Sara**

· **Section 355 (extremely hazardous substances):**

Substance is not listed.

· **Section 313 (Specific toxic chemical listings):**

Substance is not listed.

· **TSCA (Toxic Substances Control Act):**

Substance is listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

(Contd. on page 9)

Safety Data Sheet

acc. to OSHA HCS

Printing date 03/23/2019

Version Number 2

Reviewed on 03/23/2019

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 8)

· Chemicals known to cause reproductive toxicity for males:

Substance is not listed.

· Chemicals known to cause developmental toxicity:

Substance is listed.

· Carcinogenic categories
· EPA (Environmental Protection Agency)

Substance is not listed.

· TLV (Threshold Limit Value established by ACGIH)

Substance is not listed.

· NIOSH-Ca (National Institute for Occupational Safety and Health)

Substance is not listed.

· Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other information

The information contained in this document is based on Agilent's state of knowledge at the time of preparation. No warranty as to its accurateness, completeness or suitability for a particular purpose is expressed or implied.

· Date of preparation / last revision 03/23/2019 / 1

· Abbreviations and acronyms:

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

VOC: Volatile Organic Compounds (USA, EU)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

PBT: Persistent, Bioaccumulative and Toxic

vPvB: very Persistent and very Bioaccumulative

NIOSH: National Institute for Occupational Safety

OSHA: Occupational Safety & Health

TLV: Threshold Limit Value

PEL: Permissible Exposure Limit

REL: Recommended Exposure Limit

Acute Tox. 4: Acute toxicity – Category 4

Eye Dam. 1: Serious eye damage/eye irritation – Category 1

Carc. 2: Carcinogenicity – Category 2

Repr. 1B: Reproductive toxicity – Category 1B

STOT RE 1: Specific target organ toxicity (repeated exposure) – Category 1

· * Data compared to the previous version altered.

Safety Data Sheet

acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

1 Identification

- **Product identifier**
- **Product Name:** Perfluoro-n-octane Sulfonate (PFOS)
- **Part Number:** LCS-4951
- **Application of the substance / the mixture** Certified Reference Material
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
SPEX CertiPrep, LLC.
203 Norcross Ave, Metuchen,
NJ 08840 USA
- **Information department:** product safety department
- **Emergency telephone number:**
Emergency Phone Number (24 hours)
CHEMTREC (800-424-9300)
Outside US: 703-527-3887

2 Hazard(s) identification

- **Classification of the substance or mixture**



GHS02 Flame

Flam. Liq. 2 H225 Highly flammable liquid and vapor.



GHS06 Skull and crossbones

Acute Tox. 3 H331 Toxic if inhaled.



GHS08 Health hazard

Carc. 2 H351 Suspected of causing cancer.

Repr. 1 H360-H362 May damage fertility or the unborn child. May cause harm to breast-fed children.

STOT SE 1 H370 Causes damage to organs.

- **Label elements**

· **GHS label elements** The product is classified and labeled according to the Globally Harmonized System (GHS).

- **Hazard pictograms**



GHS02



GHS06



GHS08

- **Signal word** Danger

- **Hazard-determining components of labeling:**

methanol

perfluorooctane sulfonic acid

- **Hazard statements**

H225 Highly flammable liquid and vapor.

H331 Toxic if inhaled.

H351 Suspected of causing cancer.

H360-H362 May damage fertility or the unborn child. May cause harm to breast-fed children.

H370 Causes damage to organs.

- **Precautionary statements**

Avoid contact during pregnancy/while nursing.

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

Use explosion-proof electrical/ventilating/lighting/equipment.

If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.

Store locked up.

Dispose of contents/container in accordance with local/regional/national/international regulations.

(Contd. on page 2)

US

Safety Data Sheet

acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 1)

- **Classification system:**
- **NFPA ratings (scale 0 - 4)**



- **HMIS-ratings (scale 0 - 4)**



- **Other hazards**
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

3 Composition/information on ingredients

- **Chemical characterization: Mixtures**
- **Description:** Mixture of the substances listed below with nonhazardous additions.

- **Dangerous components:**

67-56-1	methanol	99.9%
1763-23-1	perfluorooctane sulfonic acid	0.1%

4 First-aid measures

- **Description of first aid measures**
- **General information:**
Immediately remove any clothing soiled by the product.
Remove breathing apparatus only after contaminated clothing have been completely removed.
In case of irregular breathing or respiratory arrest provide artificial respiration.
- **After inhalation:**
Supply fresh air or oxygen; call for doctor.
In case of unconsciousness place patient stably in side position for transportation.
- **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
- **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing:** Do not induce vomiting; immediately call for medical help.
- **Information for Doctor:**
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed** No further relevant information available.

5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:** CO₂, sand, extinguishing powder. Do not use water.
- **For safety reasons unsuitable extinguishing agents:** Water with full jet
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** Mouth respiratory protective device.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures** Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:**
Do not allow product to reach sewage system or any water course.
Inform respective authorities in case of seepage into water course or sewage system.
Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
Do not flush with water or aqueous cleansing agents

(Contd. on page 3)

Safety Data Sheet acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 2)

Reference to other sections

See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

Handling:
Precautions for safe handling

Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
Prevent formation of aerosols.

Information about protection against explosions and fires:

Keep ignition sources away - Do not smoke.
Protect against electrostatic charges.
Keep respiratory protective device available.

Conditions for safe storage, including any incompatibilities
Storage:
Requirements to be met by storerooms and receptacles: Store in a cool location.

Information about storage in one common storage facility: Not required.

Further information about storage conditions:

Keep receptacle tightly sealed.
Store in cool, dry conditions in well sealed receptacles.

Specific end use(s) No further relevant information available.

8 Exposure controls/personal protection

Additional information about design of technical systems: No further data; see item 7.

Control parameters
Components with limit values that require monitoring at the workplace:

The following constituent is the only constituent of the product which has a PEL, TLV or other recommended exposure limit.
At this time, the remaining constituent has no known exposure limits.

67-56-1 methanol

PEL Long-term value: 260 mg/m³, 200 ppm

REL Short-term value: 325 mg/m³, 250 ppm

Long-term value: 260 mg/m³, 200 ppm

Skin

TLV Short-term value: 328 mg/m³, 250 ppm

Long-term value: 262 mg/m³, 200 ppm

Skin; BEI

Ingredients with biological limit values:
67-56-1 methanol

BEI 15 mg/L

Medium: urine

Time: end of shift

Parameter: Methanol (background, nonspecific)

Additional information: The lists that were valid during the creation were used as basis.

Exposure controls
Personal protective equipment:
General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.

Breathing equipment:

In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use respiratory protective device that is independent of circulating air.

Protection of hands:


Protective gloves

(Contd. on page 4)

US

Safety Data Sheet

acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 3)

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.

Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:**



Tightly sealed goggles

9 Physical and chemical properties

· **Information on basic physical and chemical properties**

· **General Information**

· **Appearance:**

Form:	Liquid
Color:	According to product specification
Odor:	Characteristic
Odour Threshold:	Not applicable.

· **pH-value:** Not applicable.

· **Change in condition**

Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	64 °C (147 °F)

· **Flash point:** 11 °C (52 °F)

· **Flammability (solid, gaseous):** Not applicable.

· **Ignition temperature:** 455 °C (851 °F)

· **Decomposition temperature:** Not applicable.

· **Auto igniting:** Product is not selfigniting.

· **Danger of explosion:** Product is not explosive. However, formation of explosive air/vapor mixtures are possible.

· **Explosion limits:**

Lower:	5.5 Vol %
Upper:	44.0 Vol %

· **Vapor pressure at 20 °C (68 °F):** 128 hPa (96 mm Hg)

· **Density at 20 °C (68 °F)** 0.79 g/cm³ (6.593 lbs/gal)

· **Relative density** Not applicable.

· **Vapor density** Not applicable.

· **Evaporation rate** Not applicable.

· **Solubility in / Miscibility with**

Water: Not miscible or difficult to mix.

· **Partition coefficient (n-octanol/water):** Not applicable.

· **Viscosity:**

Dynamic:	Not applicable.
Kinematic:	Not applicable.

· **Solvent content:**

Organic solvents:	99.9 %
VOC content:	99.9 %

· **Solids content:** 0.1 %

· **Other information** No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.

(Contd. on page 5)

Safety Data Sheet

acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 4)

- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**

LD/LC50 values that are relevant for classification:
67-56-1 methanol

Oral	LD50	5628 mg/kg (rat)
Dermal	LD50	15800 mg/kg (rabbit)

- **Primary irritant effect:**
- **on the skin:** No irritant effect.
- **on the eye:** No irritating effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Toxic

- **Carcinogenic categories**

IARC (International Agency for Research on Cancer)

None of the ingredients is listed.

NTP (National Toxicology Program)

None of the ingredients is listed.

OSHA-Ca (Occupational Safety & Health Administration)

None of the ingredients is listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 1 (Self-assessment): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:** Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

- **UN-Number**
- **DOT, ADR, IMDG, IATA** UN1230
- **UN proper shipping name**
- **DOT** Methanol

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 5)

· ADR · IMDG, IATA	1230 Methanol METHANOL
· Transport hazard class(es) · DOT	
 	
· Class · Label	3 Flammable liquids 3, 6.1
· ADR	
 	
· Class · Label	3 Flammable liquids 3+6.1
· IMDG	
 	
· Class · Label	3 Flammable liquids 3/6.1
· IATA	
 	
· Class · Label	3 Flammable liquids 3 (6.1)
· Packing group · DOT, ADR, IMDG, IATA	II
· Environmental hazards:	Not applicable.
· Special precautions for user · Danger code (Kemler): · EMS Number: · Stowage Category · Stowage Code	Warning: Flammable liquids 336 F-E,S-D B SW2 Clear of living quarters.
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· Transport/Additional information:	
· ADR · Excepted quantities (EQ)	Code: E2 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 500 ml
· IMDG · Limited quantities (LQ) · Excepted quantities (EQ)	1L Code: E2 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 500 ml
· UN "Model Regulation":	UN 1230 METHANOL, 3 (6.1), II

US

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 6)

15 Regulatory information

- Safety, health and environmental regulations/legislation specific for the substance or mixture
- Sara

· Section 355 (extremely hazardous substances):

None of the ingredients is listed.

· Section 313 (Specific toxic chemical listings):

67-56-1 methanol

· TSCA (Toxic Substances Control Act):

All ingredients are listed.

· Proposition 65

· Chemicals known to cause cancer:

None of the ingredients is listed.

· Chemicals known to cause reproductive toxicity for females:

None of the ingredients is listed.

· Chemicals known to cause reproductive toxicity for males:

None of the ingredients is listed.

· Chemicals known to cause developmental toxicity:

67-56-1 methanol

· Carcinogenic categories

· EPA (Environmental Protection Agency)

None of the ingredients is listed.

· TLV (Threshold Limit Value established by ACGIH)

None of the ingredients is listed.

· NIOSH-Ca (National Institute for Occupational Safety and Health)

None of the ingredients is listed.

· Protective Action Criteria for Chemicals

· PAC-1:

67-56-1 methanol

530 ppm

· PAC-2:

67-56-1 methanol

2,100 ppm

· PAC-3:

67-56-1 methanol

7200* ppm

- GHS label elements The product is classified and labeled according to the Globally Harmonized System (GHS).

· Hazard pictograms



GHS02



GHS06



GHS08

- Signal word Danger

· Hazard-determining components of labeling:

methanol

perfluorooctane sulfonic acid

· Hazard statements

H225 Highly flammable liquid and vapor.

H331 Toxic if inhaled.

H351 Suspected of causing cancer.

H360-H362 May damage fertility or the unborn child. May cause harm to breast-fed children.

H370 Causes damage to organs.

· Precautionary statements

Avoid contact during pregnancy/while nursing.

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

Use explosion-proof electrical/ventilating/lighting/equipment.

If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.

Store locked up.

Dispose of contents/container in accordance with local/regional/national/international regulations.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 12/13/2016

Reviewed on 12/13/2016

Product Name: Perfluoro-n-octane Sulfonate (PFOS)

(Contd. of page 7)

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing SDS:** product safety department

· **Contact:**

SPEX CertiPrep, LLC.

1-732-549-7144

· **Date of preparation / last revision** 12/13/2016 / -

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

EINECS: European Inventory of Existing Commercial Chemical Substances

ELINCS: European List of Notified Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

VOC: Volatile Organic Compounds (USA, EU)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

PBT: Persistent, Bioaccumulative and Toxic

vPvB: very Persistent and very Bioaccumulative

NIOSH: National Institute for Occupational Safety

OSHA: Occupational Safety & Health

TLV: Threshold Limit Value

PEL: Permissible Exposure Limit

REL: Recommended Exposure Limit

BEI: Biological Exposure Limit

Flam. Liq. 2: Flammable liquids – Category 2

Acute Tox. 3: Acute toxicity – Category 3

Carc. 2: Carcinogenicity – Category 2

Repr. 1: Reproductive toxicity – Category 1

STOT SE 1: Specific target organ toxicity (single exposure) – Category 1

US

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Wellington Laboratories Inc.

Version No: 6.7

Safety Data Sheet according to WHMIS 2015 requirements

Chemwatch Hazard Alert Code: 4

Issue Date: 13/09/2019

Print Date: 13/09/2019

S.GHS CAN EN

SECTION 1 IDENTIFICATION

Product Identifier

Product name	N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)
Synonyms	Methyl alcohol (methanol), Methyl hydrate (methanol), Methylol (methanol)
Proper shipping name	METHANOL
Other means of identification	Not Available

Recommended use of the chemical and restrictions on use

Relevant identified uses	This product is a solution of organic compound(s) in methanol for laboratory use only (see section 3). This material should only be used by those persons trained in the safe handling of hazardous chemicals. Please refer to the Certificate of Analysis (CoA) for further product information. Wellington Laboratories Inc.

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Registered company name	Wellington Laboratories Inc.
Address	345 Southgate Drive Guelph Ontario N1G 3M5 Canada
Telephone	+1 519 822 2436
Fax	+1 519 822 2849
Website	www.well-labs.com
Email	MSDS@well-labs.com

Emergency phone number

Association / Organisation	Wellington Laboratories Inc.
Emergency telephone numbers	1-888-CANUTEC (226-8832) (North American)
Other emergency telephone numbers	1-613-996-6666 (International)

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

NFPA 704 diamond



Note: The hazard category numbers found in GHS classification in section 2 of this SDSs are NOT to be used to fill in the NFPA 704 diamond. Blue = Health Red = Fire Yellow = Reactivity White = Special (Oxidizer or water reactive substances)

Classification	Eye Irritation Category 2A, Acute Toxicity (Dermal) Category 3, Specific target organ toxicity - single exposure Category 1, Flammable Liquid Category 2, Acute Toxicity (Inhalation) Category 3, Reproductive Toxicity Category 1B, Acute Toxicity (Oral) Category 3

Label elements

Hazard pictogram(s)	

SIGNAL WORD **DANGER**

Hazard statement(s)

H319	Causes serious eye irritation.
H311	Toxic in contact with skin.

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

H370	Causes damage to organs.
H225	Highly flammable liquid and vapour.
H331	Toxic if inhaled.
H360	May damage fertility or the unborn child.
H301	Toxic if swallowed.

Physical and Health hazard(s) not otherwise classified

Not Applicable

Supplementary statement(s)

Not Applicable

CLP classification (additional)

Not Applicable

Precautionary statement(s) Prevention

P201	Obtain special instructions before use.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P270	Do not eat, drink or smoke when using this product.

Precautionary statement(s) Response

P301+P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor/physician/first aider.
P308+P311	IF exposed or concerned: Call a POISON CENTER/doctor/physician/first aider.
P321	Specific treatment (see advice on this label).
P330	Rinse mouth.

Precautionary statement(s) Storage

P403+P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.

Precautionary statement(s) Disposal

P501	Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
67-56-1	98.994	<u>methanol</u>
2991-50-6*	0.006	<u>N-ethylperfluoro-1-octanesulfonamidoacetic acid</u>
7732-18-5	0.99	<u>water</u>
1310-73-2	<0.01	<u>sodium hydroxide</u>

SECTION 4 FIRST-AID MEASURES

Description of first aid measures

Eye Contact	If this product comes in contact with the eyes: - Immediately hold eyelids apart and flush the eye continuously with running water. - Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. - Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes. - Transport to hospital or doctor without delay. - Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	If skin or hair contact occurs: - Immediately flush body and clothes with large amounts of water, using safety shower if available. - Quickly remove all contaminated clothing, including footwear. - Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre. - Transport to hospital, or doctor.
Inhalation	- If fumes or combustion products are inhaled remove from contaminated area. - Lay patient down. Keep warm and rested. - Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. - Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary. - Transport to hospital, or doctor, without delay.

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Ingestion

- ▶ Immediately give a glass of water.
- ▶ First aid is not generally required. If in doubt, contact a Poisons Information Centre or a doctor.
- ▶ If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

Indication of any immediate medical attention and special treatment needed

Any material aspirated during vomiting may produce lung injury. Therefore emesis should not be induced mechanically or pharmacologically. Mechanical means should be used if it is considered necessary to evacuate the stomach contents; these include gastric lavage after endotracheal intubation. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

For acute and short term repeated exposures to methanol:

- ▶ Toxicity results from accumulation of formaldehyde/formic acid.
- ▶ Clinical signs are usually limited to CNS, eyes and GI tract. Severe metabolic acidosis may produce dyspnea and profound systemic effects which may become intractable. All symptomatic patients should have arterial pH measured. Evaluate airway, breathing and circulation.
- ▶ Stabilise obtunded patients by giving naloxone, glucose and thiamine.
- ▶ Decontaminate with Ipecac or lavage for patients presenting 2 hours post-ingestion. Charcoal does not absorb well; the usefulness of cathartics is not established.
- ▶ Forced diuresis is not effective; haemodialysis is recommended where peak methanol levels exceed 50 mg/dL (this correlates with serum bicarbonate levels below 18 meq/L).
- ▶ Ethanol, maintained at levels between 100 and 150 mg/dL, inhibits formation of toxic metabolites and may be indicated when peak methanol levels exceed 20 mg/dL. An intravenous solution of ethanol in D5W is optimal.
- ▶ Folate, as leucovorin, may increase the oxidative removal of formic acid. 4-methylpyrazole may be an effective adjunct in the treatment. 8-Phenytoin may be preferable to diazepam for controlling seizure.

[Ellenhorn Barceloux: Medical Toxicology]

BIOLOGICAL EXPOSURE INDEX - BEI

Determinant	Index	Sampling Time	Comment
1. Methanol in urine	15 mg/l	End of shift	B, NS
2. Formic acid in urine	80 mg/gm creatinine	Before the shift at end of workweek	B, NS

B: Background levels occur in specimens collected from subjects **NOT** exposed.

NS: Non-specific determinant - observed following exposure to other materials.

SECTION 5 FIRE-FIGHTING MEASURES

Extinguishing media

Water may be an ineffective extinguishing media for methanol fires; static explosions are reported for aqueous solutions as dilute as 30%. Water may be used to cool containers.

- ▶ Alcohol stable foam.
- ▶ Dry chemical powder.
- ▶ BCF (where regulations permit).
- ▶ Carbon dioxide.

Special hazards arising from the substrate or mixture

Fire Incompatibility

- ▶ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Special protective equipment and precautions for fire-fighters

Fire Fighting

- ▶ Alert Fire Brigade and tell them location and nature of hazard.
- ▶ May be violently or explosively reactive.
- ▶ Wear full body protective clothing with breathing apparatus.
- ▶ Prevent, by any means available, spillage from entering drains or water course.

Fire/Explosion Hazard

- ▶ Liquid and vapour are highly flammable.
 - ▶ Severe fire hazard when exposed to heat, flame and/or oxidisers.
 - ▶ Vapour may travel a considerable distance to source of ignition.
 - ▶ Heating may cause expansion or decomposition leading to violent rupture of containers.
- Combustion products include:
carbon dioxide (CO₂)
formaldehyde
other pyrolysis products typical of burning organic material.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills

- ▶ Remove all ignition sources.
- ▶ Clean up all spills immediately.
- ▶ Avoid breathing vapours and contact with skin and eyes.
- ▶ Control personal contact with the substance, by using protective equipment.

Major Spills

- ▶ Clear area of personnel and move upwind.
- ▶ Alert Fire Brigade and tell them location and nature of hazard.
- ▶ May be violently or explosively reactive.
- ▶ Wear full body protective clothing with breathing apparatus.

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling	- Containers, even those that have been emptied, may contain explosive vapours. - Do NOT cut, drill, grind, weld or perform similar operations on or near containers. - Avoid all personal contact, including inhalation. - Wear protective clothing when risk of exposure occurs. - Use in a well-ventilated area. - Prevent concentration in hollows and sumps. DO NOT allow clothing wet with material to stay in contact with skin
Other information	- Store in original containers in approved flame-proof area. - No smoking, naked lights, heat or ignition sources. DO NOT store in pits, depressions, basements or areas where vapours may be trapped - Keep containers securely sealed.

Conditions for safe storage, including any incompatibilities

Suitable container	- Glass container is suitable for laboratory quantities - Packing as supplied by manufacturer. - Plastic containers may only be used if approved for flammable liquid. - Check that containers are clearly labelled and free from leaks. - For low viscosity materials (i) : Drums and jerry cans must be of the non-removable head type. (ii) : Where a can is to be used as an inner package, the can must have a screwed enclosure. - For materials with a viscosity of at least 2680 cSt. (23 deg. C) - For manufactured product having a viscosity of at least 250 cSt.
Storage incompatibility	Methanol: - reacts violently with strong oxidisers, acetyl bromide, alkyl aluminium salts, beryllium dihydride, bromine, chromic acid, 1-chloro-3,3-difluoro-2-methoxycyclopropane, cyanuric chloride, diethylzinc, isophthaloyl chloride, nitric acid, perchloric acid, potassium-tert-butoxide, potassium sulfur diimide, Raney nickel catalysts, 2,4,6-trichlorotriazine, triethylaluminium, 1,3,3-trifluoro-2-methoxycyclopropane - is incompatible with strong acids, strong caustics, alkaline earth and alkali metals, aliphatic amines, acetaldehyde, benzoyl peroxide, 1,3-bis(di-n-cyclopentadienyl iron)-2-propen-1-one, calcium carbide, chloroform, chromic anhydride, chromium trioxide, dialkylzinc, dichlorine oxide, dichloromethane, ethylene oxide, hypochlorous acid, isocyanates, isopropyl chlorocarbonate, lithium tetrahydroaluminate, magnesium, methyl azide, nitrogen dioxide, palladium, pentafluoroguanidine, perchloryl fluoride, phosphorus pentasulfide, phosphorus trioxide, potassium, tangerine oil, triisobutylaluminium - mixtures with lead perchlorate, sodium hypochlorite are explosive - may react with metallic aluminium at high temperatures - slowly corrodes lead and aluminium - may generate electrostatic charges, due to low conductivity, on flow or agitation - attacks some plastics, rubber and coatings. Static induced flash fires have happened when filling plastic containers with methanol / water solutions with as low as 30% methanol content Alcohols - are incompatible with strong acids, acid chlorides, acid anhydrides, oxidising and reducing agents. - reacts, possibly violently, with alkaline metals and alkaline earth metals to produce hydrogen - react with strong acids, strong caustics, aliphatic amines, isocyanates, acetaldehyde, benzoyl peroxide, chromic acid, chromium oxide, dialkylzinc, dichlorine oxide, ethylene oxide, hypochlorous acid, isopropyl chlorocarbonate, lithium tetrahydroaluminate, nitrogen dioxide, pentafluoroguanidine, phosphorus halides, phosphorus pentasulfide, tangerine oil, triethylaluminium, triisobutylaluminium - should not be heated above 49 deg. C. when in contact with aluminium equipment - Avoid storage with reducing agents.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	methanol	Methyl alcohol (methanol) - Skin	200 ppm / 260 mg/m3	310 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Nova Scotia Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	TLV Basis: headache; eye damage. BEI
Canada - Alberta Occupational Exposure Limits	methanol	Methanol (Methyl alcohol)	200 ppm / 262 mg/m3	328 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	methanol	Methyl alcohol (methanol)	200 ppm	250 ppm	Not Available	Skin
Canada - Manitoba Occupational Exposure Limits	methanol	Not Available	200 ppm	250 ppm	Not Available	TLV® Basis: Headache; eye dam; dizziness; nausea; BEI
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	methanol	Methyl alcohol	200 ppm / 262 mg/m3	328 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Northwest Territories Occupational Exposure Limits (English)	methanol	Methyl alcohol (methanol)	200 ppm	250 ppm	Not Available	Skin

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Canada - British Columbia Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	Not Available
Canada - Prince Edward Island Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	TLV® Basis: Headache, eye dam, dizziness, nausea, BEI
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	sodium hydroxide	Sodium hydroxide	2 mg/m3	Not Available	Not Available	Not Available
Canada - Nova Scotia Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	TLV Basis: upper respiratory tract, eye & skin irritation
Canada - Alberta Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Manitoba Occupational Exposure Limits	sodium hydroxide	Not Available	Not Available	Not Available	2 mg/m3	TLV® Basis: URT, eye, & skin irr
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Northwest Territories Occupational Exposure Limits (English)	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - British Columbia Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Prince Edward Island Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	TLV® Basis: URT, eye, & skin irr

EMERGENCY LIMITS

Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
methanol	Methyl alcohol; (Methanol)	Not Available	Not Available	Not Available
sodium hydroxide	Sodium hydroxide	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
methanol	6,000 ppm	Not Available
N-ethylperfluoro-1-octanesulfonamidoacetic acid	Not Available	Not Available
water	Not Available	Not Available
sodium hydroxide	10 mg/m3	Not Available

Exposure controls

Appropriate engineering controls	Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are: Process controls which involve changing the way a job activity or process is done to reduce the risk. Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.
Personal protection	
Eye and face protection	▶ Safety glasses with side shields. ▶ Chemical goggles. ▶ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task.
Skin protection	See Hand protection below
Hands/feet protection	▶ Wear chemical protective gloves, e.g. PVC. ▶ Wear safety footwear or safety gumboots, e.g. Rubber The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application. The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice. Personal hygiene is a key element of effective hand care.
Body protection	See Other protection below
Other protection	▶ Overalls. ▶ PVC Apron. ▶ PVC protective suit may be required if exposure severe. ▶ Eyewash unit.

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets).
- Non sparking safety or conductive footwear should be considered. Conductive footwear describes a boot or shoe with a sole made from a conductive compound chemically bound to the bottom components, for permanent control to electrically ground the foot an shall dissipate static electricity from the body to reduce the possibility of ignition of volatile compounds.

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the:

"Forsberg Clothing Performance Index".

The effect(s) of the following substance(s) are taken into account in the **computer-generated** selection:

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Material	CPI
BUTYL	A
NEOPRENE	B
BUTYL/NEOPRENE	C
NAT+NEOPR+NITRILE	C
NATURAL RUBBER	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE	C
NITRILE+PVC	C
PE	C
PE/EVAL/PE	C
PVA	C
PVC	C
PVDC/PE/PVDC	C
SARANEX-23	C
SARANEX-23 2-PLY	C
TEFLON	C
VITON	C
VITON/CHLOROBUTYL	C
VITON/NEOPRENE	C

* CPI - Chemwatch Performance Index

A: Best Selection

B: Satisfactory; may degrade after 4 hours continuous immersion

C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

Respiratory protection

Type AX Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.

Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

Required Minimum Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
up to 10 x ES	AX-AUS	-	AX-PAPR-AUS / Class 1
up to 50 x ES	-	AX-AUS / Class 1	-
up to 100 x ES	-	AX-2	AX-PAPR-2 ^

^ - Full-face

A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

- Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content.
- The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- Cartridge performance is affected by humidity. Cartridges should be changed after 2 hr of continuous use unless it is determined that the humidity is less than 75%, in which case, cartridges can be used for 4 hr. Used cartridges should be discarded daily, regardless of the length of time used

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Not Available		
Physical state	Liquid	Relative density (Water = 1)	0.791
Odour	Not Available	Partition coefficient n-octanol / water	Not Available
Odour threshold	Not Available	Auto-ignition temperature (°C)	455
pH (as supplied)	Not Applicable	Decomposition temperature	Not Available
Melting point / freezing point (°C)	-98	Viscosity (cSt)	Not Available
Initial boiling point and boiling range (°C)	64.7	Molecular weight (g/mol)	32.04
Flash point (°C)	12	Taste	Not Available
Evaporation rate	4.1 BuAC = 1	Explosive properties	Not Available
Flammability	HIGHLY FLAMMABLE	Oxidising properties	Not Available
Upper Explosive Limit (%)	31	Surface Tension (dyn/cm or mN/m)	Not Available
Lower Explosive Limit (%)	6	Volatile Component (%vol)	Not Available
Vapour pressure (kPa)	13	Gas group	Not Available

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Solubility in water	Immiscible	pH as a solution (1%)	Not Applicable
Vapour density (Air = 1)	1.11	VOC g/L	Not Available

SECTION 10 STABILITY AND REACTIVITY

Reactivity	See section 7
Chemical stability	- Static induced flash fires have happened when filling plastic containers with methanol / water solutions with as low as 30% methanol content. - Unstable in the presence of incompatible materials. - Product is considered stable. - Hazardous polymerisation will not occur.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

Inhaled	There is strong evidence to suggest that this material can cause, if inhaled once, very serious, irreversible damage of organs. The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting. Minor but regular methanol exposures may effect the central nervous system, optic nerves and retinae. Symptoms may be delayed, with headache, fatigue, nausea, blurring of vision and double vision. Continued or severe exposures may cause damage to optic nerves, which may become severe with permanent visual impairment even blindness resulting. WARNING Methanol is only slowly eliminated from the body and should be regarded as a cumulative poison which cannot be made non-harmful [CCINFO] Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects.	
Ingestion	There is strong evidence to suggest that this material can cause, if swallowed once, very serious, irreversible damage of organs. The material is not thought to produce adverse health effects following ingestion (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum. Toxic effects may result from the accidental ingestion of the material; animal experiments indicate that ingestion of less than 40 gram may be fatal or may produce serious damage to the health of the individual. Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733)	
Skin Contact	Skin contact with the material may produce toxic effects; systemic effects may result following absorption. There is strong evidence to suggest that this material, on a single contact with skin, can cause very serious, irreversible damage of organs. Open cuts, abraded or irritated skin should not be exposed to this material. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected. There is strong evidence to suggest that this material, on a single contact with skin, can cause serious, irreversible damage of organs.	
Eye	510meth There is some evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Moderate inflammation may be expected with redness; conjunctivitis may occur with prolonged exposure.	
Chronic	Ample evidence exists, from results in experimentation, that developmental disorders are directly caused by human exposure to the material. Long-term exposure to methanol vapour, at concentrations exceeding 3000 ppm, may produce cumulative effects characterised by gastrointestinal disturbances (nausea, vomiting), headache, ringing in the ears, insomnia, trembling, unsteady gait, vertigo, conjunctivitis and clouded or double vision. Liver and/or kidney injury may also result.	
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	TOXICITY	IRRITATION
	Not Available	Not Available
methanol	TOXICITY	IRRITATION
	Dermal (rabbit) LD50: 15800 mg/kg ^[2]	Eye (rabbit): 100 mg/24h-moderate
	Inhalation (rat) LC50: 36208.63875 mg/l/1H ^[2]	Eye (rabbit): 40 mg-moderate
	Oral (rat) LD50: =5300 mg/kg ^[2]	Eye: no adverse effect observed (not irritating) ^[1]
		Skin (rabbit): 20 mg/24 h-moderate
N-ethylperfluoro-1-octanesulfonamidoacetic acid	TOXICITY	IRRITATION
	Not Available	Not Available
water	TOXICITY	IRRITATION
	Oral (rat) LD50: >90000 mg/kg ^[2]	Not Available

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

sodium hydroxide	TOXICITY	IRRITATION
	Dermal (rabbit) LD50: 1350 mg/kg ^[2]	Eye (rabbit): 0.05 mg/24h SEVERE
		Eye (rabbit): 1 mg/24h SEVERE
		Eye (rabbit): 1 mg/30s rinsed-SEVERE
		Eye: adverse effect observed (irritating) ^[1]
		Skin (rabbit): 500 mg/24h SEVERE
		Skin: adverse effect observed (corrosive) ^[1]
Legend: 1 Value obtained from Europe ECHA Registered Substances - Acute toxicity 2 * Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances		

METHANOL	The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.	
WATER	No significant acute toxicological data identified in literature search.	
SODIUM HYDROXIDE	Asthma-like symptoms may continue for months or even years after exposure to the material ends. This may be due to a non-allergic condition known as reactive airways dysfunction syndrome (RADS) which can occur after exposure to high levels of highly irritating compound. Main criteria for diagnosing RADS include the absence of previous airways disease in a non-atopic individual, with sudden onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. Other criteria for diagnosis of RADS include a reversible airflow pattern on lung function tests, moderate to severe bronchial hyperactivity on methacholine challenge testing, and the lack of minimal lymphocytic inflammation, without eosinophilia. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis. The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.	
Acute Toxicity	✓	Carcinogenicity ✗
Skin Irritation/Corrosion	✗	Reproductivity ✓
Serious Eye Damage/Irritation	✓	STOT - Single Exposure ✓
Respiratory or Skin sensitisation	✗	STOT - Repeated Exposure ✗
Mutagenicity	✗	Aspiration Hazard ✗

Legend: ✗ – Data either not available or does not fill the criteria for classification
 ✓ – Data available to make classification

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	Not Available	Not Available	Not Available	Not Available	Not Available
methanol	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	11-850mg/L	2
	EC50	48	Crustacea	>10-mg/L	2
	EC50	96	Algae or other aquatic plants	16.912mg/L	4
	BCF	24	Algae or other aquatic plants	0.05mg/L	4
	EC0	48	Crustacea	>10-mg/L	2
N-ethylperfluoro-1-octanesulfonamidoacetic acid	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	Not Available	Not Available	Not Available	Not Available	Not Available
water	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	897.520mg/L	3
	EC50	96	Algae or other aquatic plants	8768.874mg/L	3
sodium hydroxide	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	125mg/L	4
	EC50	48	Crustacea	40.4mg/L	2
	EC50	96	Algae or other aquatic plants	3180000mg/L	3
	NOEC	96	Fish	56mg/L	4
Legend: Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA. Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data					

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

For Methanol: Log Kow: -0.82 to -0.66; Koc: 1; Henry's Law Constant: 4.55x10⁻⁶ atm-cu m/mole; Vapor Pressure: 127 mm Hg; BCF: < 10.

Atmospheric Fate: Methanol is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase methanol is broken down in the atmosphere by reactions with hydroxyl radicals; the half-life for this reaction in air is estimated to be 17 days.

Terrestrial Fate: Methanol is expected to have very high mobility in soil.

DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
methanol	LOW	LOW
water	LOW	LOW
sodium hydroxide	LOW	LOW

Bioaccumulative potential

Ingredient	Bioaccumulation
methanol	LOW (BCF = 10)
water	LOW (LogKOW = -1.38)
sodium hydroxide	LOW (LogKOW = -3.8796)

Mobility in soil

Ingredient	Mobility
methanol	HIGH (KOC = 1)
water	LOW (KOC = 14.3)
sodium hydroxide	LOW (KOC = 14.3)

SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

Product / Packaging disposal	- Containers may still present a chemical hazard/ danger when empty. - Return to supplier for reuse/ recycling if possible.
	Otherwise: - If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill. - Where possible retain label warnings and SDS and observe all notices pertaining to the product. Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked. A Hierarchy of Controls seems to be common - the user should investigate: - Reduction - Reuse - Recycling - Disposal (if all else fails) This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. DO NOT allow wash water from cleaning or process equipment to enter drains. - It may be necessary to collect all wash water for treatment before disposal. - In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first. - Where in doubt contact the responsible authority. - Recycle wherever possible. - Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified. - Dispose of by: burial in a land-fill specifically licensed to accept chemical and / or pharmaceutical wastes or Incineration in a licensed apparatus (after admixture with suitable combustible material). - Decontaminate empty containers.

SECTION 14 TRANSPORT INFORMATION

Labels Required

	 
Marine Pollutant	NO

Land transport (TDG)

UN number	1230
UN proper shipping name	METHANOL
Transport hazard class(es)	Class : 3
	Subrisk : 6.1
Packing group	II

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Environmental hazard	Not Applicable	
Special precautions for user	Special provisions	43
	Explosive Limit and Limited Quantity Index	1 L
	ERAP Index	Not Applicable

Air transport (ICAO-IATA / DGR)

UN number	1230	
UN proper shipping name	Methanol	
Transport hazard class(es)	ICAO/IATA Class	3
	ICAO / IATA Subrisk	6.1
	ERG Code	3L
Packing group	II	
Environmental hazard	Not Applicable	
Special precautions for user	Special provisions	A113
	Cargo Only Packing Instructions	364
	Cargo Only Maximum Qty / Pack	60 L
	Passenger and Cargo Packing Instructions	352
	Passenger and Cargo Maximum Qty / Pack	1 L
	Passenger and Cargo Limited Quantity Packing Instructions	Y341
	Passenger and Cargo Limited Maximum Qty / Pack	1 L

Sea transport (IMDG-Code / GGVSee)

UN number	1230	
UN proper shipping name	METHANOL	
Transport hazard class(es)	IMDG Class	3
	IMDG Subrisk	6.1
Packing group	II	
Environmental hazard	Not Applicable	
Special precautions for user	EMS Number	F-E , S-D
	Special provisions	279
	Limited Quantities	1 L

Transport in bulk according to Annex II of MARPOL and the IBC code

SOURCE	PRODUCT NAME	POLLUTION CATEGORY	SHIP TYPE
	Methyl alcohol	Y	3

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

METHANOL IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada - Alberta Occupational Exposure Limits
Canada - British Columbia Occupational Exposure Limits
Canada - Manitoba Occupational Exposure Limits
Canada - Northwest Territories Occupational Exposure Limits
Canada - Nova Scotia Occupational Exposure Limits
Canada - Prince Edward Island Occupational Exposure Limits
Canada - Quebec Permissible Exposure Values for Airborne Contaminants
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances
Canada Categorization decisions for all DSL substances
Canada Domestic Substances List (DSL)
Canada Forensic Identification Services Chemical Carcinogenicity Evaluation - Table 1 - Chemicals Considered for Assessment

Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
Canada Transport Dangerous Goods - Schedule 1
Canada Transport Dangerous Goods - Schedule 3
GESAMP/EHS Composite List - GESAMP Hazard Profiles
IMDG Code - Medical First Aid Guide for use in accidents involving Dangerous Goods (MFAG) - Appendix 15 List Of Substances
IMO IBC Code Chapter 17: Summary of minimum requirements
IMO MARPOL (Annex II) - List of Noxious Liquid Substances Carried in Bulk
IMO MARPOL 73/78 (Annex II) - List of Other Liquid Substances
IMO Provisional Categorization of Liquid Substances - List 2: Pollutant only mixtures containing at least 99% by weight of components already assessed by IMO
International Air Transport Association (IATA) Dangerous Goods Regulations
International Maritime Dangerous Goods Requirements (IMDG Code)
United Nations Recommendations on the Transport of Dangerous Goods Model Regulations

N-ETHYLPERFLUORO-1-OCTANESULFONAMIDOACETIC ACID IS FOUND ON THE FOLLOWING REGULATORY LISTS

Not Applicable

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

WATER IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada Categorization decisions for all DSL substances
Canada Domestic Substances List (DSL)

Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
IMO IBC Code Chapter 18: List of products to which the Code does not apply

SODIUM HYDROXIDE IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada - Alberta Occupational Exposure Limits
Canada - British Columbia Occupational Exposure Limits
Canada - Manitoba Occupational Exposure Limits
Canada - Northwest Territories Occupational Exposure Limits
Canada - Nova Scotia Occupational Exposure Limits
Canada - Prince Edward Island Occupational Exposure Limits
Canada - Quebec Permissible Exposure Values for Airborne Contaminants
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances
Canada Categorization decisions for all DSL substances
Canada Domestic Substances List (DSL)

Canada Forensic Identification Services Chemical Carcinogenicity Evaluation - Table 1 - Chemicals Considered for Assessment
Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
Canada Transport Dangerous Goods - Schedule 1
Canada Transport Dangerous Goods - Schedule 3
GESAMP/EHS Composite List - GESAMP Hazard Profiles
IMO IBC Code Chapter 17: Summary of minimum requirements
IMO Provisional Categorization of Liquid Substances - List 3: (Trade-named) mixtures containing at least 99% by weight of components already assessed by IMO, presenting safety hazards
International Air Transport Association (IATA) Dangerous Goods Regulations
International Maritime Dangerous Goods Requirements (IMDG Code)
United Nations Recommendations on the Transport of Dangerous Goods Model Regulations

National Inventory Status

National Inventory	Status
Australia - AICS	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Canada - DSL	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Canada - NDSL	No (methanol; water; sodium hydroxide; N-ethylperfluoro-1-octanesulfonamidoacetic acid)
China - IECSC	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Europe - EINEC / ELINCS / NLP	Yes
Japan - ENCS	Yes
Korea - KECI	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
New Zealand - NZIoC	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Philippines - PICCS	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
USA - TSCA	Yes
Taiwan - TCSI	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Mexico - INSQ	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Vietnam - NCI	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Russia - ARIPS	No (N-ethylperfluoro-1-octanesulfonamidoacetic acid)
Legend:	Yes = All CAS declared ingredients are on the inventory No = One or more of the CAS listed ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

SECTION 16 OTHER INFORMATION

Revision Date	13/09/2019
Initial Date	05/10/2016

SDS Version Summary

Version	Issue Date	Sections Updated
5.7.1.1.1	13/09/2019	Chronic Health, Classification, Exposure Standard, Ingredients

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC — TWA: Permissible Concentration-Time Weighted Average
PC — STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL: No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

Continued...

N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)

Powered by AuthoriTe, from Chemwatch.

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Wellington Laboratories Inc.

Version No: 6.7

Safety Data Sheet according to WHMIS 2015 requirements

Chemwatch Hazard Alert Code: 4

Issue Date: 13/09/2019

Print Date: 13/09/2019

S GHS CAN EN

SECTION 1 IDENTIFICATION

Product Identifier

Product name	N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)
Synonyms	Methyl alcohol (methanol), Methyl hydrate (methanol), Methylol (methanol)
Proper shipping name	METHANOL
Other means of identification	Not Available

Recommended use of the chemical and restrictions on use

Relevant identified uses	This product is a solution of organic compound(s) in methanol for laboratory use only (see section 3). This material should only be used by those persons trained in the safe handling of hazardous chemicals. Please refer to the Certificate of Analysis (CoA) for further product information. Wellington Laboratories Inc.

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Registered company name	Wellington Laboratories Inc.
Address	345 Southgate Drive Guelph Ontario N1G 3M5 Canada
Telephone	+1 519 822 2436
Fax	+1 519 822 2849
Website	www.well-labs.com
Email	MSDS@well-labs.com

Emergency phone number

Association / Organisation	Wellington Laboratories Inc.
Emergency telephone numbers	1-888-CANUTEC (226-8832) (North American)
Other emergency telephone numbers	1-613-996-6666 (International)

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

NFPA 704 diamond



Note: The hazard category numbers found in GHS classification in section 2 of this SDSs are NOT to be used to fill in the NFPA 704 diamond. Blue = Health Red = Fire Yellow = Reactivity White = Special (Oxidizer or water reactive substances)

Classification	Eye Irritation Category 2A, Acute Toxicity (Dermal) Category 3, Specific target organ toxicity - single exposure Category 1, Flammable Liquid Category 2, Acute Toxicity (Inhalation) Category 3, Reproductive Toxicity Category 1B, Acute Toxicity (Oral) Category 3

Label elements

Hazard pictogram(s)	

SIGNAL WORD **DANGER**

Hazard statement(s)

H319	Causes serious eye irritation.
H311	Toxic in contact with skin.

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

H370	Causes damage to organs.
H225	Highly flammable liquid and vapour.
H331	Toxic if inhaled.
H360	May damage fertility or the unborn child.
H301	Toxic if swallowed.

Physical and Health hazard(s) not otherwise classified

Not Applicable

Supplementary statement(s)

Not Applicable

CLP classification (additional)

Not Applicable

Precautionary statement(s) Prevention

P201	Obtain special instructions before use.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P270	Do not eat, drink or smoke when using this product.

Precautionary statement(s) Response

P301+P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor/physician/first aider.
P308+P311	IF exposed or concerned: Call a POISON CENTER/doctor/physician/first aider.
P321	Specific treatment (see advice on this label).
P330	Rinse mouth.

Precautionary statement(s) Storage

P403+P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.

Precautionary statement(s) Disposal

P501	Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
67-56-1	98.994	<u>methanol</u>
2355-31-9*	0.006	<u>N-methylperfluoro-1-octanesulfonamidoacetic acid</u>
7732-18-5	0.99	<u>water</u>
1310-73-2	<0.01	<u>sodium hydroxide</u>

SECTION 4 FIRST-AID MEASURES

Description of first aid measures

Eye Contact	If this product comes in contact with the eyes: ▶ Immediately hold eyelids apart and flush the eye continuously with running water. ▶ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. ▶ Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes. ▶ Transport to hospital or doctor without delay. ▶ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	If skin or hair contact occurs: ▶ Immediately flush body and clothes with large amounts of water, using safety shower if available. ▶ Quickly remove all contaminated clothing, including footwear. ▶ Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre. ▶ Transport to hospital, or doctor.
Inhalation	▶ If fumes or combustion products are inhaled remove from contaminated area. ▶ Lay patient down. Keep warm and rested. ▶ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. ▶ Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary. ▶ Transport to hospital, or doctor, without delay.

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Ingestion

- ▶ Immediately give a glass of water.
- ▶ First aid is not generally required. If in doubt, contact a Poisons Information Centre or a doctor.
- ▶ If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

Indication of any immediate medical attention and special treatment needed

Any material aspirated during vomiting may produce lung injury. Therefore emesis should not be induced mechanically or pharmacologically. Mechanical means should be used if it is considered necessary to evacuate the stomach contents; these include gastric lavage after endotracheal intubation. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

For acute and short term repeated exposures to methanol:

- ▶ Toxicity results from accumulation of formaldehyde/formic acid.
- ▶ Clinical signs are usually limited to CNS, eyes and GI tract. Severe metabolic acidosis may produce dyspnea and profound systemic effects which may become intractable. All symptomatic patients should have arterial pH measured. Evaluate airway, breathing and circulation.
- ▶ Stabilise obtunded patients by giving naloxone, glucose and thiamine.
- ▶ Decontaminate with Ipecac or lavage for patients presenting 2 hours post-ingestion. Charcoal does not absorb well; the usefulness of cathartic is not established.
- ▶ Forced diuresis is not effective; haemodialysis is recommended where peak methanol levels exceed 50 mg/dL (this correlates with serum bicarbonate levels below 18 meq/L).
- ▶ Ethanol, maintained at levels between 100 and 150 mg/dL, inhibits formation of toxic metabolites and may be indicated when peak methanol levels exceed 20 mg/dL. An intravenous solution of ethanol in D5W is optimal.
- ▶ Folate, as leucovorin, may increase the oxidative removal of formic acid. 4-methylpyrazole may be an effective adjunct in the treatment. 8-Phenytoin may be preferable to diazepam for controlling seizure.

[Ellenhorn Barceloux: Medical Toxicology]

BIOLOGICAL EXPOSURE INDEX - BEI

Determinant	Index	Sampling Time	Comment
1. Methanol in urine	15 mg/l	End of shift	B, NS
2. Formic acid in urine	80 mg/gm creatinine	Before the shift at end of workweek	B, NS

B: Background levels occur in specimens collected from subjects **NOT** exposed.

NS: Non-specific determinant - observed following exposure to other materials.

SECTION 5 FIRE-FIGHTING MEASURES

Extinguishing media

Water may be an ineffective extinguishing media for methanol fires; static explosions are reported for aqueous solutions as dilute as 30%. Water may be used to cool containers.

- ▶ Alcohol stable foam.
- ▶ Dry chemical powder.
- ▶ BCF (where regulations permit).
- ▶ Carbon dioxide.

Special hazards arising from the substrate or mixture

Fire Incompatibility

- ▶ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Special protective equipment and precautions for fire-fighters

Fire Fighting

- ▶ Alert Fire Brigade and tell them location and nature of hazard.
- ▶ May be violently or explosively reactive.
- ▶ Wear full body protective clothing with breathing apparatus.
- ▶ Prevent, by any means available, spillage from entering drains or water course.

Fire/Explosion Hazard

- ▶ Liquid and vapour are highly flammable.
 - ▶ Severe fire hazard when exposed to heat, flame and/or oxidisers.
 - ▶ Vapour may travel a considerable distance to source of ignition.
 - ▶ Heating may cause expansion or decomposition leading to violent rupture of containers.
- Combustion products include:
carbon dioxide (CO₂)
formaldehyde
other pyrolysis products typical of burning organic material.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills

- ▶ Remove all ignition sources.
- ▶ Clean up all spills immediately.
- ▶ Avoid breathing vapours and contact with skin and eyes.
- ▶ Control personal contact with the substance, by using protective equipment.

Major Spills

- ▶ Clear area of personnel and move upwind.
- ▶ Alert Fire Brigade and tell them location and nature of hazard.
- ▶ May be violently or explosively reactive.
- ▶ Wear full body protective clothing with breathing apparatus.

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling	- Containers, even those that have been emptied, may contain explosive vapours. - Do NOT cut, drill, grind, weld or perform similar operations on or near containers. - Avoid all personal contact, including inhalation. - Wear protective clothing when risk of exposure occurs. - Use in a well-ventilated area. - Prevent concentration in hollows and sumps. DO NOT allow clothing wet with material to stay in contact with skin
Other information	- Store in original containers in approved flame-proof area. - No smoking, naked lights, heat or ignition sources. DO NOT store in pits, depressions, basements or areas where vapours may be trapped. - Keep containers securely sealed.

Conditions for safe storage, including any incompatibilities

Suitable container	- Glass container is suitable for laboratory quantities - Packing as supplied by manufacturer. - Plastic containers may only be used if approved for flammable liquid. - Check that containers are clearly labelled and free from leaks. - For low viscosity materials (i) : Drums and jerry cans must be of the non-removable head type. (ii) : Where a can is to be used as an inner package, the can must have a screwed enclosure. - For materials with a viscosity of at least 2680 cSt. (23 deg. C) - For manufactured product having a viscosity of at least 250 cSt.
Storage incompatibility	Methanol: - reacts violently with strong oxidisers, acetyl bromide, alkyl aluminium salts, beryllium dihydride, bromine, chromic acid, 1-chloro-3,3-difluoro-2-methoxycyclopropane, cyanuric chloride, diethylzinc, isophthaloyl chloride, nitric acid, perchloric acid, potassium-tert-butoxide, potassium sulfur diimide, Raney nickel catalysts, 2,4,6-trichlorotriazine, triethylaluminium, 1,3,3-trifluoro-2-methoxycyclopropane - is incompatible with strong acids, strong caustics, alkaline earth and alkali metals, aliphatic amines, acetaldehyde, benzoyl peroxide, 1,3-bis(di-n-cyclopentadienyl iron)-2-propen-1-one, calcium carbide, chloroform, chromic anhydride, chromium trioxide, dialkylzinc, dichlorine oxide, dichloromethane, ethylene oxide, hypochlorous acid, isocyanates, isopropyl chlorocarbonate, lithium tetrahydroaluminate, magnesium, methyl azide, nitrogen dioxide, palladium, pentafluoroguanidine, perchloryl fluoride, phosphorus pentasulfide, phosphorus trioxide, potassium, tangerine oil, triisobutylaluminium - mixtures with lead perchlorate, sodium hypochlorite are explosive - may react with metallic aluminium at high temperatures - slowly corrodes lead and aluminium - may generate electrostatic charges, due to low conductivity, on flow or agitation - attacks some plastics, rubber and coatings. Static induced flash fires have happened when filling plastic containers with methanol / water solutions with as low as 30% methanol content Alcohols - are incompatible with strong acids, acid chlorides, acid anhydrides, oxidising and reducing agents. - reacts, possibly violently, with alkaline metals and alkaline earth metals to produce hydrogen - react with strong acids, strong caustics, aliphatic amines, isocyanates, acetaldehyde, benzoyl peroxide, chromic acid, chromium oxide, dialkylzinc, dichlorine oxide, ethylene oxide, hypochlorous acid, isopropyl chlorocarbonate, lithium tetrahydroaluminate, nitrogen dioxide, pentafluoroguanidine, phosphorus halides, phosphorus pentasulfide, tangerine oil, triethylaluminium, triisobutylaluminium - should not be heated above 49 deg. C, when in contact with aluminium equipment - Avoid storage with reducing agents.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	methanol	Methyl alcohol (methanol) - Skin	200 ppm / 260 mg/m3	310 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Nova Scotia Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	TLV Basis: headache; eye damage. BEI
Canada - Alberta Occupational Exposure Limits	methanol	Methanol (Methyl alcohol)	200 ppm / 262 mg/m3	328 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	methanol	Methyl alcohol (methanol)	200 ppm	250 ppm	Not Available	Skin
Canada - Manitoba Occupational Exposure Limits	methanol	Not Available	200 ppm	250 ppm	Not Available	TLV® Basis: Headache; eye dam; dizziness; nausea; BEI
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	methanol	Methyl alcohol	200 ppm / 262 mg/m3	328 mg/m3 / 250 ppm	Not Available	Not Available
Canada - Northwest Territories Occupational Exposure Limits (English)	methanol	Methyl alcohol (methanol)	200 ppm	250 ppm	Not Available	Skin

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Canada - British Columbia Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	Not Available
Canada - Prince Edward Island Occupational Exposure Limits	methanol	Methanol	200 ppm	250 ppm	Not Available	TLV® Basis: Headache; eye dam; dizziness; nausea; BEI
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	sodium hydroxide	Sodium hydroxide	2 mg/m3	Not Available	Not Available	Not Available
Canada - Nova Scotia Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	TLV Basis: upper respiratory tract, eye & skin irritation
Canada - Alberta Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Manitoba Occupational Exposure Limits	sodium hydroxide	Not Available	Not Available	Not Available	2 mg/m3	TLV® Basis: URT, eye, & skin irr
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Northwest Territories Occupational Exposure Limits (English)	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - British Columbia Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	Not Available
Canada - Prince Edward Island Occupational Exposure Limits	sodium hydroxide	Sodium hydroxide	Not Available	Not Available	2 mg/m3	TLV® Basis: URT, eye, & skin irr

EMERGENCY LIMITS

Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
methanol	Methyl alcohol; (Methanol)	Not Available	Not Available	Not Available
sodium hydroxide	Sodium hydroxide	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
methanol	6,000 ppm	Not Available
N-methylperfluoro-1-octanesulfonamidoacetic acid	Not Available	Not Available
water	Not Available	Not Available
sodium hydroxide	10 mg/m3	Not Available

Exposure controls

Appropriate engineering controls	Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are: Process controls which involve changing the way a job activity or process is done to reduce the risk. Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.
Personal protection	
Eye and face protection	▶ Safety glasses with side shields. ▶ Chemical goggles. ▶ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task.
Skin protection	See Hand protection below
Hands/feet protection	▶ Wear chemical protective gloves, e.g. PVC. ▶ Wear safety footwear or safety gumboots, e.g. Rubber The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application. The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice. Personal hygiene is a key element of effective hand care.
Body protection	See Other protection below
Other protection	▶ Overalls. ▶ PVC Apron. ▶ PVC protective suit may be required if exposure severe. ▶ Eyewash unit.

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

- ▶ Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- ▶ For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets).
- ▶ Non sparking safety or conductive footwear should be considered. Conductive footwear describes a boot or shoe with a sole made from a conductive compound chemically bound to the bottom components, for permanent control to electrically ground the foot and shall dissipate static electricity from the body to reduce the possibility of ignition of volatile compounds.

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the:

"Forsberg Clothing Performance Index".

The effect(s) of the following substance(s) are taken into account in the **computer-generated** selection:

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Material	CPI
BUTYL	A
NEOPRENE	B
BUTYL/NEOPRENE	C
NAT+NEOPR+NITRILE	C
NATURAL RUBBER	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE	C
NITRILE+PVC	C
PE	C
PE/EVAL/PE	C
PVA	C
PVC	C
PVDC/PE/PVDC	C
SARANEX-23	C
SARANEX-23 2-PLY	C
TEFLON	C
VITON	C
VITON/CHLOROBUTYL	C
VITON/NEOPRENE	C

* CPI - Chemwatch Performance Index

A: Best Selection

B: Satisfactory; may degrade after 4 hours continuous immersion

C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

Respiratory protection

Type AX Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.

Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

Required Minimum Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
up to 10 x ES	AX-AUS	-	AX-PAPR-AUS / Class 1
up to 50 x ES	-	AX-AUS / Class 1	-
up to 100 x ES	-	AX-2	AX-PAPR-2 ^

^ - Full-face

A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO₂), G = Agricultural chemicals, K = Ammonia(NH₃), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

- ▶ Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content.
- ▶ The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- ▶ Cartridge performance is affected by humidity. Cartridges should be changed after 2 hr of continuous use unless it is determined that the humidity is less than 75%, in which case, cartridges can be used for 4 hr. Used cartridges should be discarded daily, regardless of the length of time used

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Not Available		
Physical state	Liquid	Relative density (Water = 1)	0.791
Odour	Not Available	Partition coefficient n-octanol / water	Not Available
Odour threshold	Not Available	Auto-ignition temperature (°C)	455
pH (as supplied)	Not Applicable	Decomposition temperature	Not Available
Melting point / freezing point (°C)	-98	Viscosity (cSt)	Not Available
Initial boiling point and boiling range (°C)	64.7	Molecular weight (g/mol)	32.04
Flash point (°C)	12	Taste	Not Available
Evaporation rate	4.1 BuAC = 1	Explosive properties	Not Available
Flammability	HIGHLY FLAMMABLE.	Oxidising properties	Not Available
Upper Explosive Limit (%)	31	Surface Tension (dyn/cm or mN/m)	Not Available
Lower Explosive Limit (%)	6	Volatile Component (%vol)	Not Available
Vapour pressure (kPa)	13	Gas group	Not Available

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Solubility in water	Immiscible	pH as a solution (1%)	Not Applicable
Vapour density (Air = 1)	1.11	VOC g/L	Not Available

SECTION 10 STABILITY AND REACTIVITY

Reactivity	See section 7
Chemical stability	▶ Static induced flash fires have happened when filling plastic containers with methanol / water solutions with as low as 30% methanol content. ▶ Unstable in the presence of incompatible materials. ▶ Product is considered stable. ▶ Hazardous polymerisation will not occur.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

Inhaled	There is strong evidence to suggest that this material can cause, if inhaled once, very serious, irreversible damage of organs. The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting. Minor but regular methanol exposures may effect the central nervous system, optic nerves and retinae. Symptoms may be delayed, with headache, fatigue, nausea, blurring of vision and double vision. Continued or severe exposures may cause damage to optic nerves, which may become severe with permanent visual impairment even blindness resulting. WARNING Methanol is only slowly eliminated from the body and should be regarded as a cumulative poison which cannot be made non-harmful [CC/INFO] Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects.
Ingestion	There is strong evidence to suggest that this material can cause, if swallowed once, very serious, irreversible damage of organs. The material is not thought to produce adverse health effects following ingestion (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum. Toxic effects may result from the accidental ingestion of the material; animal experiments indicate that ingestion of less than 40 gram may be fatal or may produce serious damage to the health of the individual. Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733)
Skin Contact	Skin contact with the material may produce toxic effects; systemic effects may result following absorption. There is strong evidence to suggest that this material, on a single contact with skin, can cause very serious, irreversible damage of organs. Open cuts, abraded or irritated skin should not be exposed to this material. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected. There is strong evidence to suggest that this material, on a single contact with skin, can cause serious, irreversible damage of organs.
Eye	510meth There is some evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Moderate inflammation may be expected with redness; conjunctivitis may occur with prolonged exposure.
Chronic	Ample evidence exists, from results in experimentation, that developmental disorders are directly caused by human exposure to the material. Long-term exposure to methanol vapour, at concentrations exceeding 3000 ppm, may produce cumulative effects characterised by gastrointestinal disturbances (nausea, vomiting), headache, ringing in the ears, insomnia, trembling, unsteady gait, vertigo, conjunctivitis and clouded or double vision. Liver and/or kidney injury may also result.

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	TOXICITY	IRRITATION
	Not Available	Not Available
methanol	TOXICITY	IRRITATION
	Dermal (rabbit) LD50: 15800 mg/kg ^[2]	Eye (rabbit): 100 mg/24h-moderate
	Inhalation (rat) LC50: 36208.63875 mg/l/1H ^[2]	Eye (rabbit): 40 mg-moderate
	Oral (rat) LD50: =5300 mg/kg ^[2]	Eye: no adverse effect observed (not irritating) ^[1]
		Skin (rabbit): 20 mg/24 h-moderate
		Skin: no adverse effect observed (not irritating) ^[1]
N-methylperfluoro-1-octanesulfonamidoacetic acid	TOXICITY	IRRITATION
	Not Available	Not Available
water	TOXICITY	IRRITATION
	Oral (rat) LD50: >90000 mg/kg ^[2]	Not Available

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

	TOXICITY	IRRITATION
sodium hydroxide	Dermal (rabbit) LD50: 1350 mg/kg ^[2]	Eye (rabbit): 0.05 mg/24h SEVERE
		Eye (rabbit): 1 mg/24h SEVERE
		Eye (rabbit): 1 mg/30s rinsed-SEVERE
		Eye: adverse effect observed (irritating) ^[1]
		Skin (rabbit): 500 mg/24h SEVERE
		Skin: adverse effect observed (corrosive) ^[1]
Legend:	1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. * Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances	

METHANOL	The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.	
WATER	No significant acute toxicological data identified in literature search.	
SODIUM HYDROXIDE	Asthma-like symptoms may continue for months or even years after exposure to the material ends. This may be due to a non-allergic condition known as reactive airways dysfunction syndrome (RADS) which can occur after exposure to high levels of highly irritating compound. Main criteria for diagnosing RADS include the absence of previous airways disease in a non-atopic individual, with sudden onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. Other criteria for diagnosis of RADS include a reversible airflow pattern on lung function tests, moderate to severe bronchial hyperreactivity on methacholine challenge testing, and the lack of minimal lymphocytic inflammation, without eosinophilia. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis. The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.	
Acute Toxicity	✓	Carcinogenicity ✗
Skin Irritation/Corrosion	✗	Reproductivity ✓
Serious Eye Damage/Irritation	✓	STOT - Single Exposure ✓
Respiratory or Skin sensitisation	✗	STOT - Repeated Exposure ✗
Mutagenicity	✗	Aspiration Hazard ✗

Legend: ✗ – Data either not available or does not fill the criteria for classification
 ✓ – Data available to make classification

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	Not Available	Not Available	Not Available	Not Available	Not Available
methanol	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	11-850mg/L	2
	EC50	48	Crustacea	>10-mg/L	2
	EC50	96	Algae or other aquatic plants	16.912mg/L	4
	BCF	24	Algae or other aquatic plants	0.05mg/L	4
	EC0	48	Crustacea	>10-mg/L	2
	NOEC	72	Crustacea	0.1mg/L	4
N-methylperfluoro-1-octanesulfonamidoacetic acid	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	Not Available	Not Available	Not Available	Not Available	Not Available
water	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	897.520mg/L	3
	EC50	96	Algae or other aquatic plants	8768.874mg/L	3
sodium hydroxide	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	125mg/L	4
	EC50	48	Crustacea	40.4mg/L	2
	EC50	96	Algae or other aquatic plants	3180000mg/L	3
	NOEC	96	Fish	56mg/L	4
Legend:	Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data				

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

For Methanol: Log Kow: -0.82 to -0.66; Koc: 1; Henry's Law Constant: 4.55×10^{-6} atm-cu m/mole; Vapor Pressure: 127 mm Hg; BCF: < 10.

Atmospheric Fate: Methanol is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase methanol is broken down in the atmosphere by reactions with hydroxyl radicals; the half-life for this reaction in air is estimated to be 17 days.

Terrestrial Fate: Methanol is expected to have very high mobility in soil.

DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
methanol	LOW	LOW
water	LOW	LOW
sodium hydroxide	LOW	LOW

Bioaccumulative potential

Ingredient	Bioaccumulation
methanol	LOW (BCF = 10)
water	LOW (LogKOW = -1.38)
sodium hydroxide	LOW (LogKOW = -3.8796)

Mobility in soil

Ingredient	Mobility
methanol	HIGH (KOC = 1)
water	LOW (KOC = 14.3)
sodium hydroxide	LOW (KOC = 14.3)

SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

Product / Packaging disposal	- Containers may still present a chemical hazard/ danger when empty. - Return to supplier for reuse/ recycling if possible. Otherwise: - If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill. - Where possible retain label warnings and SDS and observe all notices pertaining to the product. Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked. A Hierarchy of Controls seems to be common - the user should investigate: - Reduction - Reuse - Recycling - Disposal (if all else fails) This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. DO NOT allow wash water from cleaning or process equipment to enter drains. - It may be necessary to collect all wash water for treatment before disposal. - In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first. - Where in doubt contact the responsible authority. - Recycle wherever possible. - Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified. - Dispose of by: burial in a land-fill specifically licensed to accept chemical and / or pharmaceutical wastes or Incineration in a licensed apparatus (after admixture with suitable combustible material). - Decontaminate empty containers.

SECTION 14 TRANSPORT INFORMATION

Labels Required

	 
Marine Pollutant	NO

Land transport (TDG)

UN number	1230
UN proper shipping name	METHANOL
Transport hazard class(es)	Class 3 Subrisk 6.1
Packing group	II

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Environmental hazard	Not Applicable		
Special precautions for user	Special provisions		43
	Explosive Limit and Limited Quantity Index		1 L
	ERAP Index		Not Applicable

Air transport (ICAO-IATA / DGR)

UN number	1230		
UN proper shipping name	Methanol		
Transport hazard class(es)	ICAO/IATA Class		3
	ICAO / IATA Subrisk		6.1
	ERG Code		3L
Packing group	II		
Environmental hazard	Not Applicable		
Special precautions for user	Special provisions		A113
	Cargo Only Packing Instructions		364
	Cargo Only Maximum Qty / Pack		60 L
	Passenger and Cargo Packing Instructions		352
	Passenger and Cargo Maximum Qty / Pack		1 L
	Passenger and Cargo Limited Quantity Packing Instructions		Y341
	Passenger and Cargo Limited Maximum Qty / Pack		1 L

Sea transport (IMDG-Code / GGVSee)

UN number	1230		
UN proper shipping name	METHANOL		
Transport hazard class(es)	IMDG Class		3
	IMDG Subrisk		6.1
Packing group	II		
Environmental hazard	Not Applicable		
Special precautions for user	EMS Number	F-E , S-D	
	Special provisions		279
	Limited Quantities		1 L

Transport in bulk according to Annex II of MARPOL and the IBC code

SOURCE	PRODUCT NAME	POLLUTION CATEGORY	SHIP TYPE
	Methyl alcohol	Y	3

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

METHANOL IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada - Alberta Occupational Exposure Limits
 Canada - British Columbia Occupational Exposure Limits
 Canada - Manitoba Occupational Exposure Limits
 Canada - Northwest Territories Occupational Exposure Limits
 Canada - Nova Scotia Occupational Exposure Limits
 Canada - Prince Edward Island Occupational Exposure Limits
 Canada - Quebec Permissible Exposure Values for Airborne Contaminants
 Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits
 Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances
 Canada Categorization decisions for all DSL substances
 Canada Domestic Substances List (DSL)
 Canada Forensic Identification Services Chemical Carcinogenicity Evaluation - Table 1 - Chemicals Considered for Assessment

Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
 Canada Transport Dangerous Goods - Schedule 1
 Canada Transport Dangerous Goods - Schedule 3
 GESAMP/EHS Composite List - GESAMP Hazard Profiles
 IMDG Code - Medical First Aid Guide for use in accidents involving Dangerous Goods (MFAG) - Appendix 15 List Of Substances
 IMO IBC Code Chapter 17: Summary of minimum requirements
 IMO MARPOL (Annex II) - List of Noxious Liquid Substances Carried in Bulk
 IMO MARPOL 73/78 (Annex II) - List of Other Liquid Substances
 IMO Provisional Categorization of Liquid Substances - List 2: Pollutant only mixtures containing at least 99% by weight of components already assessed by IMO
 International Air Transport Association (IATA) Dangerous Goods Regulations
 International Maritime Dangerous Goods Requirements (IMDG Code)
 United Nations Recommendations on the Transport of Dangerous Goods Model Regulations

N-METHYLPERFLUORO-1-OCTANESULFONAMIDOACETIC ACID IS FOUND ON THE FOLLOWING REGULATORY LISTS

Not Applicable

Continued...

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

WATER IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada Categorization decisions for all DSL substances
Canada Domestic Substances List (DSL)

Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
IMO IBC Code Chapter 18: List of products to which the Code does not apply

SODIUM HYDROXIDE IS FOUND ON THE FOLLOWING REGULATORY LISTS

Canada - Alberta Occupational Exposure Limits
Canada - British Columbia Occupational Exposure Limits
Canada - Manitoba Occupational Exposure Limits
Canada - Northwest Territories Occupational Exposure Limits
Canada - Nova Scotia Occupational Exposure Limits
Canada - Prince Edward Island Occupational Exposure Limits
Canada - Quebec Permissible Exposure Values for Airborne Contaminants
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances
Canada Categorization decisions for all DSL substances
Canada Domestic Substances List (DSL)

Canada Forensic Identification Services Chemical Carcinogenicity Evaluation - Table 1 - Chemicals Considered for Assessment
Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS GHS (English)
Canada Transport Dangerous Goods - Schedule 1
Canada Transport Dangerous Goods - Schedule 3
GESAMP/EHS Composite List - GESAMP Hazard Profiles
IMO IBC Code Chapter 17: Summary of minimum requirements
IMO Provisional Categorization of Liquid Substances - List 3: (Trade-named) mixtures containing at least 99% by weight of components already assessed by IMO, presenting safety hazards
International Air Transport Association (IATA) Dangerous Goods Regulations
International Maritime Dangerous Goods Requirements (IMDG Code)
United Nations Recommendations on the Transport of Dangerous Goods Model Regulations

National Inventory Status

National Inventory	Status
Australia - AICS	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Canada - DSL	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Canada - NDSL	No (methanol; water; N-methylperfluoro-1-octanesulfonamidoacetic acid; sodium hydroxide)
China - IECSC	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Europe - EINEC / ELINCS / NLP	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Japan - ENCS	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Korea - KECI	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
New Zealand - NZIoC	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Philippines - PICCS	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
USA - TSCA	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Taiwan - TCSI	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Mexico - INSQ	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Vietnam - NCI	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Russia - ARIPS	No (N-methylperfluoro-1-octanesulfonamidoacetic acid)
Legend:	Yes = All CAS declared ingredients are on the inventory No = One or more of the CAS listed ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

SECTION 16 OTHER INFORMATION

Revision Date	13/09/2019
Initial Date	05/10/2016

SDS Version Summary

Version	Issue Date	Sections Updated
5.7.1.1.1	13/09/2019	Chronic Health, Classification, Exposure Standard, Ingredients

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC – TWA: Permissible Concentration-Time Weighted Average
PC – STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL: No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)

Powered by AuthorTe, from Chemwatch.

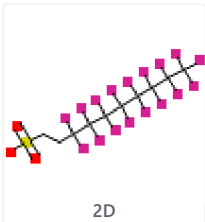
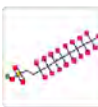
COMPOUND SUMMARY

3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecane-1-sulfonate

Cite



Download

PubChem CID	20734545
Structure	 2D Find Similar Structures
Molecular Formula	C ₁₀ H ₄ F ₁₇ O ₃ S ⁻
Synonyms	8:2 Fluorotelomer sulfonate DTXSID80873416 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecane-1-sulfonate 481071-78-7
Molecular Weight	527.18
Parent Compound	 CID 3016044 (3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecanesulphonic acid)
Dates	Modify 2021-05-22 Create 2007-12-05

Contents

1 Structures

2 Names and Identifiers

3 Chemical and Physical Properties

4 Related Records

5 Patents

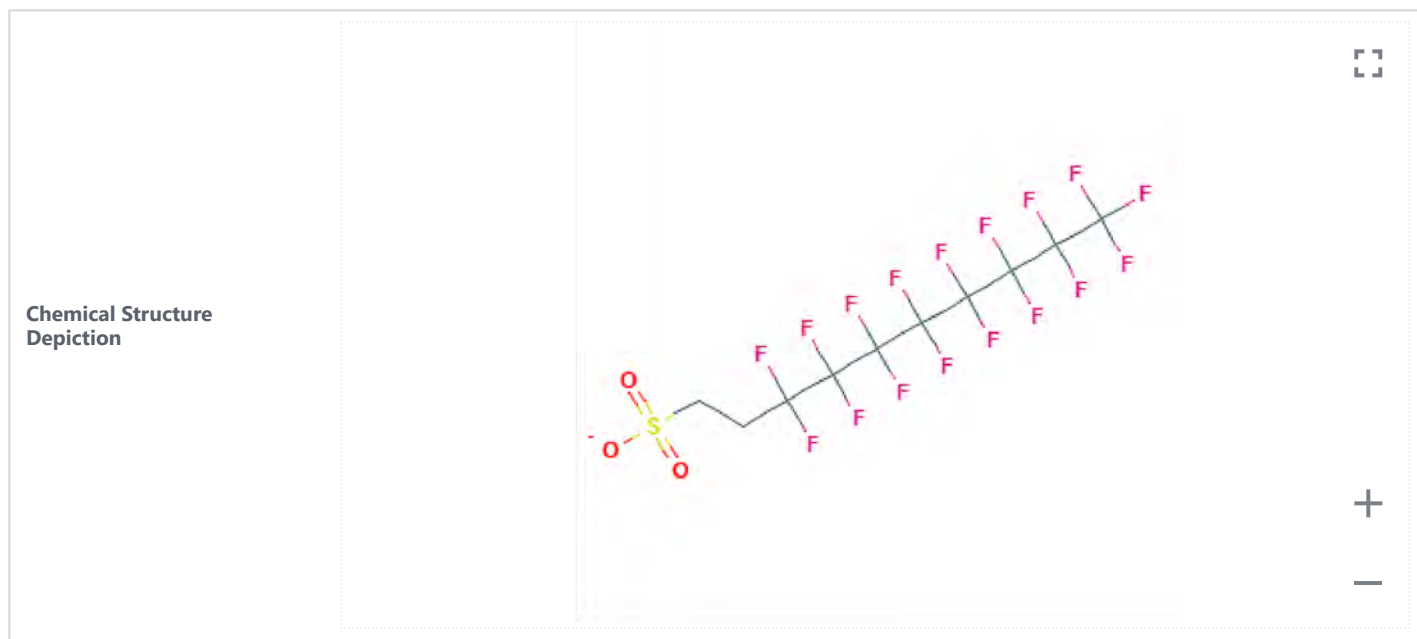
6 Classification

7 Information Sources

1 Structures



1.1 2D Structure



► PubChem

1.2 3D Status



Conformer generation failed at clustering step

► PubChem

2 Names and Identifiers



2.1 Computed Descriptors



2.1.1 IUPAC Name



3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecane-1-sulfonate

Computed by LexiChem 2.6.6 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.2 InChI



InChI=1S/C10H5F17O3S/c11-3(12,1-2-31(28,29)30)4(13,14)5(15,16)6(17,18)7(19,20)8(21,22)9(23,24)10(25,26)27/h1-2H2,(H,28,29,30)/p-1

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.3 InChI Key



ALVYVCQIFHTIRD-UHFFFAOYSA-M

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.4 Canonical SMILES



C(CS(=O)(=O)[O-])C(C(C(C(C(C(C(F)(F)F)(F)F)(F)F)(F)F)(F)F)(F)F)(F)F)(F)F

Computed by OEChem 2.1.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.2 Molecular Formula



C10H4F17O3S-

Computed by PubChem 2.1 (PubChem release 2019.06.18)

► [PubChem](#)

2.3 Other Identifiers



2.3.1 Wikipedia



[8:2 Fluorotelomer sulfonate](#)

► [Wikipedia](#)

2.4 Synonyms





2.4.1 Depositor-Supplied Synonyms

8:2 Fluorotelomer sulfonate

DTXSID80873416

3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecane-1-sulfonate

481071-78-7

► [PubChem](#)

3 Chemical and Physical Properties



3.1 Computed Properties



Property Name	Property Value	Reference
Molecular Weight	527.18	Computed by PubChem 2.1 (PubChem release 2021.05.07)
XLogP3-AA	5.2	Computed by XLogP3 3.0 (PubChem release 2019.06.18)
Hydrogen Bond Donor Count	0	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Hydrogen Bond Acceptor Count	20	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Rotatable Bond Count	8	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Exact Mass	526.9609689	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Monoisotopic Mass	526.9609689	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Topological Polar Surface Area	65.6 Å ²	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Heavy Atom Count	31	Computed by PubChem
Formal Charge	-1	Computed by PubChem
Complexity	747	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2010.01.29)

► PubChem

4 Related Records



4.1 Related Compounds with Annotation



► PubChem

4.2 Parent Compound



CID 3016044 (3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecanesulphonic acid)

► PubChem

4.3 Related Compounds



Same Parent, Exact	11 Records
Mixtures, Components, and Neutralized Forms	1 Record
Similar Compounds	545 Records

► PubChem

4.4 Substances



4.4.1 Related Substances



Same	5 Records

► PubChem

4.4.2 Substances by Category



► PubChem

5 Patents



5.1 Depositor-Supplied Patent Identifiers



► PubChem

[Link to all deposited patent identifiers](#)

► PubChem

5.2 WIPO PATENTSCOPE



Patents are available for this chemical structure:

<https://patentscope.wipo.int/search/en/result.jsf?inchikey=ALVYVCQIFHTIRD-UHFFFAOYSA-M>

► PATENTSCOPE (WIPO)

6 Classification



6.1 Ontologies



6.1.1 EPA DSSTox Classification



► EPA DSSTox

7 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. **Wikipedia**

8:2 Fluorotelomer sulfonate

<https://www.wikidata.org/wiki/Q81978900>

2. **PubChem**

<https://pubchem.ncbi.nlm.nih.gov>

3. **EPA DSSTox**

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical_lists/

4. **PATENTSCOPE (WIPO)**

SID 390138071

<https://pubchem.ncbi.nlm.nih.gov/substance/390138071>

6:2 Fluorotelomer Sulfonate (6:2 FTS)

TOXICOLOGY AT A GLANCE



6:2 FTS

- In 2012-2015, the U.S. metal plating industry transitioned from PFOS to short-chain fluorotelomers (e.g., 6:2) FTS in their chromium electroplating processes.
- The standard suite of tests conducted for regulatory approval of industry manufacture and use is available for 6:2 FTS.
- Based on currently available data, 6:2 FTS is less toxic and less persistent in the environment compared to PFOS and does not bioaccumulate.

Mammalian Toxicology

- ✓ Several short duration studies show that 6:2 FTS can cause kidney and liver damage in rodent models.
- ✓ 6:2 FTS does not cause DNA damage.
- ✓ 6:2 FTS does not cause damage to the reproductive system or to the developing fetus in available rodent models.
- ✓ No chronic studies are currently available.
- ✓ No studies have been conducted to assess cancer, immune system toxicity, or endocrine disruption following 6:2 FTS exposure.

Ecological Toxicology

- ✓ 6:2 FTS is less toxic than PFOS in studies with fish, algae, water fleas (*Daphnia*), and earthworms.
- ✓ 6:2 FTS does not bioaccumulate in fish.
- ✓ A peer-reviewed aquatic hazard assessment concluded that 6:2 FTS presents little risk to aquatic organisms.

Human Exposure

- ✓ Human exposure is assessed by analyzing blood for the presence of 6:2 FTS; so far, only 4 studies have looked for 6:2 FTS in human blood.
- ✓ Available data indicate that the general population's exposure to 6:2 FTS is low and infrequent.
- ✓ 6:2 FTS has been detected at low levels in some consumer products, drinking water, air, and fish; human exposure may occur through any of these sources.

Environmental Occurrence

- ✓ 6:2 FTS has been found in air, snow, soil, groundwater, and surface water.
- ✓ 6:2 FTS has been detected at sites associated with fluorochemical manufacture or use of certain fire-fighting foams.
- ✓ 6:2 FTS is less persistent than PFOS.
- ✓ 6:2 FTS can degrade to short-chain perfluorinated compounds, but does not degrade to PFOS.
- ✓ Perfluorohexanoic and perfluoropentanoic acids are the primary degradation products, however, not all degradation products have been identified or well-studied.

Historically, the metal plating industry has used, and continues to use, per- and polyfluoroalkyl substances (PFAS) in some metal plating applications. Most notably, beginning in the 1980s, perfluorooctanesulfonic acid (PFOS) was used as a mist suppressant in hard and decorative chromium plating, chromic acid anodizing, and chromium etch for plating on plastic processes. Due to concerns relating to toxicity and environmental persistence, the chrome plating industry transitioned from using PFOS to using a newer formulation, primarily using 6:2 fluorotelomer sulfonate (6:2 FTS), between 2012-2015. Compared to PFOS, 6:2 FTS has an improved toxicity profile in both rodent and ecological models, and is less persistent than PFOS in the environment and is not bioaccumulative. Further, available studies indicate that human exposure to 6:2 FTS is low and infrequent; comparatively, PFOS is detected in the blood of >99% of Americans. Collectively, available toxicology studies indicate that 6:2 FTS is a safer alternative to PFOS. However, significant data gaps do exist.

1. Mammalian Toxicology of 6:2 FTS

Hundreds of studies have been conducted on PFAS, such as PFOS, in laboratory animals including mice, rats, and primates. Furthermore, over 100 human epidemiology studies have been published on PFOS. Comparatively, the toxicology database for 6:2 FTS can be considered “limited”, however, standard testing for regulatory approval of industry manufacture and use have been completed. Toxicology studies that have been completed for 6:2 FTS include (1) six DNA damage studies; (2) three skin irritation and/or sensitization studies; (3) two acute toxicity studies (i.e., single exposure studies); (4) two systemic toxicity studies (i.e., studies investigating multi-organ toxicity following repeated exposure); (5) one liver toxicity study; and (6) one reproductive and developmental toxicity study. Toxicity data following chronic exposure is currently not available. No human epidemiology studies investigating the relationship between exposure to 6:2 FTS and associated health effects have been conducted. 6:2 FTS has not been assessed for its ability to cause cancer, immune system effects, or endocrine (i.e., hormone) disruption, which are all health effects that have been associated with exposure to some PFAS.

6:2 FTS Toxicology Database

- DNA damage studies x 6
- Skin irritation/sensitization studies x 3
- Acute toxicity studies x 2
- Systemic toxicity studies x 2
- Liver toxicity study x 1
- Reproductive/developmental toxicity study x 1

Collectively, results from toxicology studies indicate that 6:2 FTS does not (1) cause damage to DNA; (2) does not act as a skin sensitizer (i.e., cause allergic skin reactions); and (3) does not cause toxicity to reproductive organs or to the developing fetus. In contrast, several studies have shown that PFOS can cause developmental toxicity. Furthermore, several acute toxicity studies (i.e., single dose studies testing for lethality) have demonstrated that 6:2 FTS is less acutely toxic than PFOS in laboratory animals. 6:2 FTS has been shown to cause skin irritation; however, this effect is unlikely to be relevant for the general population as it requires dermal contact with high concentrations of 6:2 FTS that is likely to only occur in settings with concentrated and specific use. Finally, rodent studies have demonstrated that exposure to 6:2 FTS can cause kidney and liver toxicity; comparatively, PFOS is not typically associated with kidney toxicity, but has been shown to

6:2 FTS does not cause:

- Skin sensitization
- DNA damage
- Reproductive or developmental toxicity

6:2 FTS does cause:

- Skin irritation
- Kidney and liver toxicity

cause adverse liver effects in numerous studies. Although results from these studies indicate that 6:2 FTS can cause kidney and liver toxicity, these results occur at higher exposure levels than typically seen in environmental settings. Laboratory studies of longer duration, multiple exposure levels, and with additional endpoints are still needed.

2. Human Exposure to 6:2 FTS

Human exposure to 6:2 FTS (and other PFAS) can be assessed by collecting and analyzing human blood samples for the presence of 6:2 FTS. Exposure of the general U.S. population to PFAS, such as PFOS, has been closely tracked via several large-scale studies, including the Center for Disease Control's National Health and Nutrition Examination Survey (NHANES); however, 6:2 FTS has not been included in NHANES. Four studies have measured human exposure to 6:2 FTS in populations from Australia, China, Hong Kong, and the United States. All four studies consistently demonstrate that human exposure to 6:2 FTS is low and infrequent, and that the average human blood level of 6:2 FTS is approximately 1000 times lower than that of PFOS. However, results from these studies are nearly a decade old, and it is unknown if trends in human exposure to 6:2 FTS have changed over time. Furthermore, no exposure data is available for workers exposed in occupational settings. More human exposure studies are needed.

Many PFAS, including PFOS, have been measured in both maternal and umbilical cord blood, which indicates that PFAS can cross the placenta, resulting in exposure to the developing fetus.

One study has demonstrated that 6:2 FTS can also cross the placenta, although available toxicity data indicate that 6:2 FTS does not cause toxicity to the developing fetus in animal models.

Detection of 6:2 FTS in human blood demonstrates that human exposure occurs; however, the routes by which the general population may be exposed to 6:2 FTS are poorly understood. Exposure may occur through consumption of contaminated drinking water or food products, through inhalation of contaminated air, or through contact with certain consumer products. It is likely that human exposure to 6:2 FTS occurs through a combination of all of these routes, as 6:2 FTS has been detected in consumer products (i.e., polishes, carpets, circuit boards), drinking water, air, and in certain species of edible fish. Finally, there is evidence that certain PFAS used in food packaging products may breakdown to 6:2 FTS, and thus exposure to these "precursor" compounds may also indirectly contribute to human exposure.

Human Exposure to 6:2 FTS

- Human exposure to 6:2 FTS appears to be low and infrequent
- Humans may be exposed to 6:2 FTS through contaminated air, water, food products, or consumer products

3. Ecological Toxicology of 6:2 FTS

Several laboratory studies have been conducted to investigate the toxicity of 6:2 FTS to aquatic organisms such as rainbow trout, *Daphnia magna* (aquatic invertebrates), and green algae following both short-term (i.e., acute) and long-term (i.e., chronic) exposure. For both acute and chronic studies, 6:2 FTS was less toxic than PFOS to aquatic organisms. Further, a peer-reviewed aquatic hazard assessment concluded that 6:2 FTS "*presents little risk to aquatic organisms*¹."

¹ Hoke et al. 2015. Aquatic hazard, bioaccumulation and screening risk assessment for 6: 2 fluorotelomer sulfonate. *Chemosphere*, 128, pp.258-265.

The toxicity of 6:2 FTS to terrestrial organisms has been assessed in one species, the earthworm. In short-term acute studies, 6:2 FTS and PFOS caused toxicity at similar exposure levels. Alternatively, in long-term chronic studies, 6:2 FTS was less toxic than PFOS to earthworms. There is uncertainty surrounding the effects that 6:2 FTS may have on terrestrial organisms – more studies are needed.

Bioaccumulation is the accumulation of a chemical in an organism, and occurs when exposure exceeds the rate at which an organism can metabolize and/or excrete a chemical from the body. Bioaccumulation can be problematic, as it can result in the accumulation of a chemical in an organism to a level that may lead to adverse effect on organismal health. Both laboratory and field-based studies indicate that 6:2 FTS is unlikely to be bioaccumulative.

6:2 FTS is not bioaccumulative

- Available laboratory and field-based studies indicate that 6:2 FTS is unlikely to be bioaccumulative.

4. Environmental Occurrence and Fate of 6:2 FTS

PFAS can enter the environment through a variety of routes, including through waste streams (i.e., landfill leachate, wastewater treatment plant effluent), through production and manufacturing processes, or through consumer use. Environmental monitoring studies have reported detection of 6:2 FTS in a variety of environmental media, including air, snow, rain, groundwater, surface water (i.e., rivers, lakes, estuaries, oceans), sediment, and in biota such as amphipods, birds, bird eggs, earthworms, and fish. Environmental monitoring studies indicate that 6:2 FTS occurs at low-levels in the environment at most sites; however, higher levels of 6:2 FTS have been detected in environmental media at sites associated with point-sources of contamination such as fluorochemical manufacturing facilities or fire fighter training sites where PFAS-containing aqueous film forming foam (AFFF) has been used. For example, the highest level of 6:2 FTS reported in surface water not associated with point-sources of contamination is 36 ng/L (parts per trillion, ppt), whereas detection levels of up to 28,700 ng/L (ppt) 6:2 FTS have been detected in surface water in close proximity to sites where AFFF has been used.

Once in the environment, some PFAS such as PFOS are highly persistent and do not degrade. Alternatively, studies have demonstrated that 6:2 FTS can be degraded by bacteria in the environment under certain conditions. Studies have consistently demonstrated that degradation of 6:2 FTS leads to the formation of the short-chain perfluorocarboxylic acids (PFCAs) perfluorohexanoic acid (PFHxA) and perfluoropentanoic acid (PFPeA); however, over a dozen additional intermediate PFAS may also be formed during the degradation process. Although PFHxA has been shown to pose minimal risk to human health², very little information on the toxicity of the other PFAS formed during 6:2 FTS degradation is available, and the effects of these PFAS on ecological and human health need to be better understood.

Additional Detailed Information on 6:2 FTS Toxicology – See Appendix 1

² Luz et al. 2019. Perfluorohexanoic acid toxicity, part I: Development of a chronic human health toxicity value for use in risk assessment. *Regulatory Toxicology and Pharmacology*, 103, pp.41-55.

² Anderson et al. 2019. Perfluorohexanoic acid toxicity, part II: Application of human health toxicity value for risk characterization. *Regulatory Toxicology and Pharmacology*, 103, pp.10-20.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



1. Overview of 6:2 FTS Toxicology

Compared to per- and polyfluoroalkyl substances (PFAS) such as perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), the toxicology database for 6:2 fluorotelomer sulfonate (6:2 FTS) may be considered “limited” even though the standard testing for regulatory approval for industry manufacture and use have been done. These data are available on the European Union (EU)’s REACH dossier and consists of industry-conducted guideline studies that do not appear to have undergone independent expert peer-review (ECHA 2018).

Between the EU dossier and available peer-reviewed publications, the toxicology database for 6:2 FTS consists of:

- (1) six genotoxicity studies;
- (2) three studies designed to test for skin sensitization and/or irritation;
- (3) two acute toxicity studies;
- (4) one reproductive/developmental toxicity study;
- (5) two sub-chronic systemic toxicity studies; and
- (6) one liver toxicity study.

Chronic (2-year) systemic toxicity or carcinogenicity studies, two-generational reproductive toxicity studies, or studies specifically designed to test for immunotoxicity, developmental neurotoxicity, or endocrine disruption have not yet been conducted for 6:2 FTS.

Additionally, several studies have been conducted to assess the ecological toxicity of 6:2 FTS, and include acute toxicity tests conducted with fish, invertebrates (*Daphnia magna*), algae, and earthworms; and chronic toxicity studies conducted with fish and earthworms.

A summary of toxicity studies and the main conclusions, as presented by the study authors, are provided in Table 1.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Table 1. Summary of 6:2 FTS Toxicology Studies.

Study	Main conclusion	Reference
Genotoxicity Studies		
OECD 471 - Bacterial reverse mutation assay	• 6:2 FTS is not mutagenic	ECHA
OECD 473 - In vitro mammalian chromosome aberration test in CHO cells	• 6:2 FTS-related chromosomal aberrations were not observed	ECHA
OECD 474 - Mammalian erythrocyte micronucleus test	• 6:2 FTS did not induce micronucleus formation	ECHA
OECD 475 - Mammalian bone marrow chromosome aberration test	• 6:2 FTS did not induce chromosomal aberrations	ECHA
OECD 486 - Unscheduled DNA synthesis (UDS) test with mammalian liver cells in vivo	• 6:2 FTS did not induce unscheduled DNA synthesis	ECHA
OECD 489 - In vivo mammalian alkaline comet assay	• 6:2 FTS did not induce DNA damage in vivo	ECHA
Mammalian Toxicology Studies¹		
OECD 429 - Skin sensitization (local lymph node assay) - conducted with mice	• 6:2 FTS is not a dermal sensitizer	ECHA
OECD 435 - In vitro membrane barrier test method for skin corrosion	• 6:2 FTS is irritating to skin • 6:2 FTS is classified as skin corrosive Category 1A with the accompanying hazard statement (H314) "Causes severe skin burns and eye damage."	ECHA
In vivo (rabbit) skin irritation test	• 6:2 FTS is not irritating to the skin	Buck, 2015
OECD 402 - Acute (single dose) dermal toxicity - conducted with Sprague Dawley rats	• 6:2 FTS is not acutely toxic via the dermal exposure route	ECHA
OECD 420 - Acute (single dose) oral toxicity - fixed dose procedure - conducted with Wistar rats	• The oral LD50 is >300, but less than 2,000 mg/kg 6:2 FTS • 6:2 FTS is classified as GHS Category 4, with the hazard statement (H302) "Harmful if swallowed."	ECHA
14-Day oral dose range finding study with Wistar rats	• Kidney toxicity observed (i.e., increased kidney weight, altered creatinine and urea levels)	ECHA
OECD 422 - Combined repeated dose (90-day) toxicity study with the reproduction/developmental toxicity screening test - conducted with Wistar rats	• 6:2 FTS is not a reproductive or developmental toxicant • Kidney toxicity observed (i.e., elevated urea levels, increased incidence of multi-focal tubular dilation in male and female kidneys)	ECHA
28-Day subchronic study with CD1 mice (only 1 dose used; 5 mg/kg-day)	• Exposure to 6:2 FTS (ammonium salt) was associated with liver toxicity (i.e., increased liver weight, increased incidence of necrosis, hepatocellular hypertrophy)	Sheng et al. (2017)
Aquatic Toxicology Studies		
OECD 201 - Freshwater alga and cyanobacteria, growth inhibition test with green alga (<i>P. subcapitata</i>)	• The 72-hour EC50 ranges from >96 mg/L (potassium salt of 6:2 FTS) to >125 mg/L (6:2 FTS)	ECHA; Hoke et al., 2015
OECD 202 - Daphnia sp. acute immobilization test	• The 48-hour EC50 ranges from >109 mg/L (potassium salt of 6:2 FTS) to >112 mg/L (6:2 FTS)	ECHA; Hoke et al., 2015
OECD 203 - Acute toxicity test - conducted with rainbow trout	• The 96-hour LC50 ranges from >107 mg/L (potassium salt of 6:2 FTS) to >108 mg/L (6:2 FTS)	ECHA; Hoke et al., 2015
OECD 210 - Fish early-life stage toxicity test (90-day) - conducted with rainbow trout	• The 90-day NOEC is 2.62 mg/L 6:2 FTS (potassium salt)	ECHA; Hoke et al., 2015
Conclusions by Hoke et al. (2015)	• 6:2 FTS is not expected to pose a risk to aquatic organisms	Hoke et al., 2015
¹ Results from several unpublished toxicology and bioaccumulation studies for 6:2 FTS were presented at the Society of Environmental Toxicology and Chemistry Meeting (SETAC; Buck, 2018). Unpublished toxicology studies included 28-day oral and 4-hour inhalation studies, both conducted with rats. Further, a bioaccumulation study was conducted in rats in which 6:2 FTS was not found to be bioaccumulative.		
Abbreviations: EC50 = effective concentration that elicits 50% of the response; LC50 = lethal concentration that elicits 50% of the response; LD50 = lethal dose that elicits 50% of the response; NOEC = No observable effect concentration		

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



2. Mammalian Toxicology

6:2 FTS is less acutely toxic than PFOS. Results from two acute toxicity studies are listed in the REACH registration dossier for 6:2 FTS (ECHA, 2018), and include oral and dermal exposure studies. 6:2 FTS was not found to be acutely toxic via the dermal route of exposure at doses of up to 2000 mg/kg in an Organization for Economic Cooperation and Development (OECD) Guideline 402 study (OECD 2017; Acute Dermal Toxicity). Alternatively, 6:2 FTS was found to have moderate acute toxicity via the oral exposure route in an OECD Guideline 420 study (OECD, 2002; Acute Oral Toxicity), with an LD₅₀¹ value of between 300 to 2,000 mg/kg. Based on this result, 6:2 FTS was GHS (Globally Harmonized System) classified category 4 for acute oral toxicity, which has the accompanying hazard statement “H302: Harmful if swallowed.” Additionally, Field & Seow (2017) report the acute oral LD₅₀ for rats to be 1,871 mg/kg; however, the study authors did not provide a complete reference and this LD₅₀ could not be verified. Comparatively, the acute oral LD₅₀ value for PFOS has been reported to be 251 mg/kg in rats (Dean et al., 1978). These results demonstrate that 6:2 FTS is less acutely toxic than PFOS via the oral exposure route.

6:2 FTS is not genotoxic. No chronic toxicity studies investigating the carcinogenicity of 6:2 FTS have been conducted. However, a variety of *in vitro* and *in vivo* studies investigating the genotoxic and/or mutagenic potential of 6:2 FTS have been conducted and are reported in the REACH registration dossier for 6:2 FTS (ECHA, 2018). Results from these studies indicate that 6:2 FTS is:

- not mutagenic in the bacterial reverse mutation assay (Guideline 471; OECD, 1997a);
- does not cause DNA damage in an *in vivo* mammalian comet assay (Guideline 489; OECD, 2016a);
- does not induce micronuclei formation (indication of chromosomal damage) in a *in vivo* bone marrow assay (Guideline 474; OECD, 2016b);
- does not induce chromosomal aberrations *in vivo* (Guideline 475; OECD, 1997b) or *in vitro* (Guideline 473; OECD, 1997c) test systems;
- does not causes unscheduled DNA synthesis (Guideline 486; OECD, 1997d).

Collectively, these results indicate that 6:2 FTS is not genotoxic or mutagenic. Similarly, numerous studies have demonstrated that PFOS is not genotoxic [reviewed in USEPA, 2016].

6:2 FTS can cause kidney and liver toxicity. Three studies have been conducted that evaluate the toxicity of 6:2 FTS following repeat exposure. These studies include a 14-day dose-range finding study in rats (ECHA, 2018), a 28-day subchronic study in mice (Sheng et al., 2017), and a 90-day subchronic toxicity study in rats (ECHA, 2018). In the 14-day study, male and female

¹ The LD₅₀ is the lethal dose that causes 50% mortality.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



rats were orally exposed to 10, 50, or 100 mg/kg-day 6:2 FTS. No mortality or clinical signs of toxicity were reported in either sex at any dose. Signs of toxicity included reduced body weight gains and reduced food consumption in male (50 and 100 mg/kg-day treatment groups) and female (100 mg/kg-day group only) rats. Signs of kidney toxicity were observed, and included alterations in serum levels of creatinine and urea, and increased kidney weight in male (50 and 100 mg/kg-day treatment groups) and female (100 mg/kg-day group only) rats (ECHA, 2018).

In the 90-day OECD Guideline 422 study (OECD 1996; combined repeated dose toxicity study with the reproduction/developmental toxicity screening test) male and female rats were orally exposed to 5, 15, or 45 mg/kg-day 6:2 FTS. 6:2 FTS treatment had no effect on mortality, food consumption, or animal behavior, and no gross pathological or neoplastic histopathological findings were reported for either sex at any dose. Treatment-related reduced body weight gains were detected in both sexes in the highest treatment group (45 mg/kg-day). Several clinical signs of toxicity were observed, and included effects related to the skin (sparse hair, encrustations), eye (blepharospasm in one low-dose male rat), and respiratory system (sniffing respiration in two high-dose male rats); however, due to low-incidence and distribution, these effects were not considered treatment-related by the study authors. Hematological findings were reported, including reduced monocytes in male rats (5 mg/kg-day only); however, these effects were not considered treatment-related, as they did not occur in a dose-dependent manner. Mean total protein and albumin serum levels were slightly reduced in male rats (5 and 45 mg/kg-day, but not 15 mg/kg-day group); these effects did not occur in a dose-dependent manner and were not considered treatment-related. Alternatively, a dose-dependent increase in urea levels was reported for high-dose male rats, and was considered treatment related. Additional signs of kidney toxicity were also reported, and these effects were more pronounced in male rats. These effects included increased kidney weight in low- and high-dose male rats, and mild to moderate multifocal tubular dilation in the kidneys of high-dose male (5/12) and female (1/12) rats (ECHA, 2018).

In the 28-day study conducted by Sheng et al. (2017), male CD1 mice were orally exposed to 5.0 mg/kg-day 6:2 FTS, and liver toxicity was investigated. Exposure to 6:2 FTS resulted in increased liver weight, increased serum levels of aspartate transaminase and albumin, and signs of hepatocellular hypertrophy and necrosis. Collectively, these results indicate that 6:2 FTS is hepatotoxic. However, this study has limitations, including the small number of endpoints measured (kidney toxicity not investigated), and only a single exposure group was included in the study, which prevents any dose-response analysis.

Collectively, results from Sheng et al. (2017) and ECHA (2018) indicate that 6:2 FTS can cause kidney and liver toxicity in highly exposed rodent models. Comparatively, the majority of rodent toxicology studies conducted with PFOS do not report kidney toxicity [reviewed in USEPA, 2016], while subchronic and chronic toxicology studies have consistently demonstrated PFOS-induced liver toxicity [reviewed in USEPA, 2016].

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



6:2 FTS is not a reproductive or developmental toxicant. One study investigating the reproductive and developmental effects of 6:2 FTS has been conducted (ECHA, 2018). The study adhered to OECD Guideline 422 (OECD, 1996; Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test) in which male and female rats were orally exposed to 6:2 FTS (5, 15, or 45 mg/kg-day) prior to mating, during mating, and throughout gestation and lactation for a total of approximately 90-days. For parental rats, no treatment-related changes were reported for any reproductive parameter, such as reproductive organ weight, estrous cyclicity, serum T4 hormone levels, or reproductive performance. Similarly, no clinical signs of toxicity, or treatment-related effects on survival, body weight, sexual maturation, organ weight, gross pathology or hormone levels were reported for pups. Collectively, these results indicate that 6:2 FTS is not a reproductive or developmental toxicant at doses of up to 45 mg/kg-day.

Alternatively, numerous studies have reported developmental effects associated with PFOS exposure in rats, mice, and rabbits [for a comprehensive review of PFOS-related developmental and reproductive effects see USEPA, 2016], and these effects have been reported as exposure levels as low as 1.6 – 10 mg/kg-day (Luebker et al., 2005a,b; Thibodeaux et al., 2003).

6:2 FTS can cause skin irritation, but not sensitization. One study has been conducted with mice to investigate the ability of 6:2 FTS to act as a skin sensitizer (i.e., cause allergic skin reactions). Results from the OECD Guideline 429 study (OECD 2010; Local Lymph Node Assay) indicate that 6:2 FTS is not a skin sensitizer (ECHA, 2018). Alternatively, 6:2 FTS is GHS classified category 1 for skin corrosivity, which has the following hazard statement “H314: Causes severe skin burns and eye damage.” The GHS classification is based on results from an *in vitro* OECD Guideline 435 study (OECD, 2006; In Vitro Membrane Barrier Test Method for Skin Corrosion) that indicated 6:2 FTS is corrosive to skin (ECHA, 2018). 6:2 FTS was reported to be not irritating to the skin of rabbits in a non-peer-reviewed book chapter (Buck, 2015); however, no additional study details were provided. The reason for the discrepancies are unclear, but may related to the chemical form of 6:2 FTS administered. 6:2 FTS acid, which was used in the *in vitro* study, is expected to be more irritating/corrosive than non-acidic 6:2 FTS salts, which may have been used in the *in vivo* rabbit study; however, the form of 6:2 FTS used was not reported in Buck (2015).

6:2 FTS is classified as an eye irritant. No formal studies have been conducted to test if 6:2 FTS is an eye irritant. However, based on Regulation No. 1272/2008 skin corrosive chemicals are to be classified as serious eye damage category 1, which has the accompanying hazard statement H318: Causes serious eye damage” (ECHA, 2018). Comparatively, *in vivo* studies have demonstrated that PFOS can also cause severe eye irritation (Riker Laboratories, Inc., 1981).

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



3. Ecological Toxicology

The acute and chronic toxicity of 6:2 FTS has been investigated in several aquatic (fish, *Daphnia*, algae) and terrestrial (earthworms) species. In general, and as discussed in more detail below, 6:2 FTS is less toxic to aquatic and terrestrial organisms than PFOS (Table 2).

Table 2. Comparison of 6:2 FTS and PFOS ecotoxicity.

	6:2 FTS	PFOS
96-Hour Rainbow Trout LC ₅₀ (mg/L)	>107 ^a	7.8 – 22 ^b
48-Hour <i>Daphnia magna</i> Immobilization EC ₅₀ (mg/L)	>109 ^a	67.2 ^b
72-Hour <i>Pseudokirchneriella subcapitata</i> Growth Rate (ErC ₅₀ ; mg/L)	>96 ^a	48.2 ^b
72-Hour <i>Pseudokirchneriella subcapitata</i> NOEC _r (mg/L)	47.6 ^a	42 ^b
90-Day Rainbow Trout NOEC (mg/L)	2.62 ^a	0.29 ^{b,c}
14-Day Earthworm LC ₅₀ (mg/kg)	373 ^d	365 ^e
56-Day Earthworm EC ₅₀ (mg/kg) - # of cocoons	566 ^f	103 ^f
56-Day Earthworm EC ₅₀ (mg/kg) - juvenile weight	253 ^f	29 ^f
^a Hoke et al., 2015 ^b Beach et al., 2006 ^c NOEC is for a 47-d test with fathead minnows, not rainbow trout ^d 3M, 2003 ^e Juong et al. (2010) ^f Stubberud (2006) Acronyms: EC ₅₀ = effective concentration that gives half-maximal response; ErC ₅₀ = EC ₅₀ in terms of reduced growth rate; LC ₅₀ = lethal concentration that causes 50% mortality; NOEC = no observable effect concentration; NOEC _r = NOEC for growth rate		

3.1 Aquatic Toxicology

6:2 FTS is less acutely toxic to aquatic organisms than PFOS. The acute toxicity of 6:2 FTS has been investigated in several species, including *Oncorhynchus mykiss* (rainbow trout), *Daphnia magna* (aquatic invertebrate), and *Pseudokirchneriella subcapitata* (green algae). Compared to PFOS, 6:2 FTS is less acutely toxic to rainbow trout, with a 96-hour LC₅₀ value of >107 mg/L (Hoke et al., 2015), while the 96-hour LC₅₀ value for PFOS ranges from 7.8 to 22 mg/L (Beach et al., 2006). Similarly, *Daphnia* are less sensitive to 6:2 FTS than to PFOS, with EC₅₀ values of >109 mg/L 6:2 FTS (Hoke et al., 2015) and 67.2 mg/L PFOS (Beach et al., 2006). Alternatively, 6:2 FTS and PFOS inhibit green algae growth at similar concentrations, with no observable effect concentrations (NOECs) of 47.6 mg/L for 6:2 FTS (Hoke et al., 2015) and 42 mg/L for PFOS (Beach et al., 2006). However, the concentration at which 6:2 FTS inhibited green algae growth by 50% (EC₅₀) is >96 mg/L (Hoke et al., 2015), while the EC₅₀ for PFOS is 48.2 mg/L (Beach et al., 2006). These results indicate that the slope of the PFOS dose-response curve is steeper than that of 6:2 FTS, which indicates that 6:2 FTS is less toxic to green algae than PFOS.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



6:2 FTS is less chronically toxic to fish than PFOS. One study investigating the chronic, 90-day, toxicity of 6:2 FTS in early-life stage rainbow trout has been conducted (Hoke et al., 2015). In this study, the most sensitive toxicological endpoint was embryo hatching, with a NOEC of 2.62 mg/L. No 90-day early-life stage studies with rainbow trout were identified for PFOS. However, results from a 47-day PFOS chronic toxicity study conducted with Fathead minnows is available (Beach et al., 2006). The lowest NOEC identified in this study was 0.29 mg/L. Although the studies were conducted in different species of fish, both were early-life stage chronic toxicity studies. Further, the PFOS NOEC is nearly 10-fold lower than the 6:2 FTS NOEC. This result indicates that fish are more sensitive to chronic PFOS exposure than to chronic 6:2 FTS exposure.

3.2 Terrestrial Toxicology

6:2 FTS and PFOS display similar acute toxicity to earthworms. One study investigating the acute toxicity of 6:2 FTS to terrestrial organisms has been conducted. In a study conducted by 3M (2003), the 14-day LC50 of 6:2 FTS for earthworms was determined to be 373 mg/kg soil (3M, 2003). Similarly, Juong et al. (2010) determined the 14-day LC50 value of PFOS to be 365 mg/kg soil. Both studies were conducted under similar experimental conditions. Thus, these results indicate 6:2 FTS and PFOS are similarly acutely toxic to earthworms.

6:2 FTS is less chronically toxic than PFOS to earthworms. A study by Stubberud (2006) reports results from an earthworm reproduction test in which the number of cocoons laid, hatching success, and juvenile worm weight was reported. The EC50 values for number of cocoons laid and juvenile weight were calculated to be 566 and 253 mg/kg soil, respectively, for 6:2 FTS. Alternatively, EC50 values for PFOS were 103 (cocoons laid) and 29 mg/kg soil (juvenile weight). These results indicate that 6:2 FTS is less chronically toxic to earthworms than PFOS.

More research on the potential terrestrial and mammalian toxicity of 6:2 FTS is needed.

4. Toxicokinetics and Bioaccumulation

6:2 FTS is eliminated more rapidly than PFOS. Toxicokinetics is the study of how the body handles a chemical, and includes analysis of a chemical's rate of adsorption, tissue distribution, metabolism, and excretion. Limited information is available on the toxicokinetics of 6:2 FTS. One *in vivo* toxicokinetics study and one *in vitro* metabolism study are reported in the REACH registration dossier for 6:2 FTS; however, minimal study details are provided (ECHA, 2018). For the toxicokinetic study, two single doses (dosing levels not provided) of 6:2 FTS were administered (species tested was not reported) and then fat, liver, plasma, and urine samples were collected to investigate the distribution and excretion of 6:2 FTS. Fat-to-plasma ratios could not be calculated for females, while ratios were <0.1 (low dose) to 0.1 (high dose) for

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



males indicating 6:2 FTS does not accumulate in fat. Similarly, liver-to-plasma ratios could not be determined for females, while ratios were 3.0 (low dose) to 3.1 (high dose) for males, indicating partitioning of 6:2 FTS to the liver. 65-68% of the administered dose of 6:2 FTS was recovered in urine 96-hours after dosing, and elimination half-lives ranged from 20.9 to 23.8 hours. Comparatively, the elimination half-life of PFOS following oral administration has been reported to range from 30.5 to 42.8 days for mice and 39.8 to 66.7 days for rats (Chang et al. 2012). These results indicate that 6:2 FTS will be eliminated more rapidly than PFOS.

In vitro studies indicate 6:2 FTS may not be readily metabolized. Two *in vitro* studies investigating the metabolism of 6:2 FTS have been conducted. In the first, 6:2 FTS was incubated with male rat liver S9 microsomes for 2-hours, which is a common *in vitro* method employed to estimate *in vivo* metabolism. No metabolism of 6:2 FTS was detected (ECHA, 2018). In a second study, 6:2 FTS was incubated with rainbow trout hepatocytes for 2-hours; no metabolism of 6:2 FTS was detected (Hoke et al., 2015). However, *in vitro* test systems do not completely replicate *in vivo* metabolism, thus, *in vivo* studies should be conducted to confirm *in vitro* results. Numerous studies have demonstrated that PFOS is recalcitrant to metabolism *in vitro* and *in vivo* [reviewed in USEPA, 2016].

6:2 FTS is not bioaccumulative. Bioaccumulation is the accumulation of a chemical in an organism, and occurs when exposure and adsorption of a chemical occurs at a faster rate than metabolism and/or excretion. Bioaccumulation factors (BAFs) and bioconcentration factors (BCFs) are the ratio of a chemical in an organism to the concentration in the surrounding environment. According to the U.S. EPA, chemicals with BCFs >1000 are considered bioaccumulative, while other regulatory agencies in Canada, the European Union, and the United Nations consider chemicals with BAFs/BCFs of 2,000 to 5,000 to be bioaccumulative (Arnot and Gobas, 2006).

Laboratory- and field-based BCFs/BAFs for 6:2 FTS have been calculated for fish (rainbow trout, white sucker), earthworms, midge, and biofilm. As can be seen in Table 3, all estimated BCFs are below 1000 indicating that 6:2 FTS is not classifiable as bioaccumulative by the most conservative regulatory standard.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Table 3. Summary of 6:2 FTS BCFs and BAFs

Species	Exposure Details	BCF/BAF	Reference
<i>Oncorhynchus mykiss</i> (rainbow trout)	Aqueous exposure to 6:2 FTS	3 - 36	Hoke et al., 2015
	Dietary exposure to 6:2 FTS. ¹	0.3	
<i>Oncorhynchus mykiss</i> (rainbow trout)	Aqueous exposure to 6:2 FTS containing AFFF	ND	Yeung & Mabury, 2013
<i>Chironomus riparius</i> (midge)	Exposure to 6:2 FTS contaminated environmental sediments.	0.018	Bertin et al., 2014
<i>Gammarus</i> spp. (Crustacea)	Exposure to 6:2 FTS contaminated environmental sediments.	0.88	Bertin et al., 2016
<i>Catostomus commersonii</i> (white sucker)	Field-based estimates	0.23 - 0.95	Munoz et al., 2017
Biofilm ²	Field-based estimates	148	Munoz et al., 2018
<i>Eisenia fetida</i> (earthworms)	Exposure to 6:2 FTS contaminated soil from fire training facilities.	2.4	NPCA, 2008

¹ Dietary biomagnification factors are estimated for dietary exposures.

² Log BCF values were estimated to be 1.4, 1.5, and 3.6 from three different locations for a mean value of 2.17, which is equivalent to a BCF of 148.

ND = Not determined; accumulation was not sufficient for BCFs to be estimated.

Compared to PFOS, 6:2 FTS has reduced binding affinity to some proteins. In contrast to most bioaccumulative chemicals, which are lipophilic and accumulate in fat, PFOS bioaccumulation is associated with binding to proteins such as serum albumin, fatty acid binding protein in the liver, and organic anion transporters in the kidney. One study investigating 6:2 FTS protein binding has been published (Sheng et al. 2018). In this study, a fluorescent displacement assay was used to investigate PFOS and 6:2 FTS binding to human liver FABP (hL-FABP). The concentrations required to cause a 50% fluorescent displacement (IC₅₀) were 1.34 and 78.97 µM for PFOS and 6:2 FTS, respectively, indicating that 6:2 FTS has reduced binding affinity to hL-FABP. Furthermore, Sheng et al. (2018) used molecular docking software to investigate the molecular interactions of PFAS with the hL-FABP binding pocket. Using this approach, no binding of 6:2 FTS to the hL-FABP was observed, whereas PFOS binding could be modelled.

5. Human Exposure to 6:2 FTS

Human exposure to 6:2 FTS appears to be low and infrequent. 6:2 FTS has been detected in human serum, thus demonstrating that exposure to 6:2 FTS can occur (Table 4). However, compared to PFOS, 6:2 FTS human biomonitoring data is limited, and only four studies reporting human serum levels of 6:2 FTS are available. In contrast, 100s of studies investigating

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



human exposure to PFOS have been conducted. Additionally, results from all 6:2 FTS biomonitoring studies are based on small sample sizes, and were conducted nearly a decade ago. Thus, it is unclear how human exposure to 6:2 FTS has changed over the past decade, or how occupational exposure levels compares to that of the general population. Additional research on the potential sources of 6:2 FTS and extent of human exposure are needed.

Table 4. Summary of 6:2 FTS Biomonitoring Data

Location	Sampling Year	Sample/ gender/ age	N	FOD	LOD (ng/L)	Min (ng/L)	Median (ng/L)	Arithmetic Mean (ng/L)	Max (ng/L)	Reference
U.S.	2009	Serum, M	20	42%	5	<LOD	--	5.91	18.39	Lee & Mabury (2011) ¹
		Serum, F	20	65%	5	<LOD	--	9.28	29.54	
China	2009	Maternal serum	50	64%	3	<LOD	11.55	13.39	48.24	Yang et al. (2016) ²
		Cord serum	50	68%	3	<LOD	13.53	20.99	90.21	
Hong Kong	--	Blood, M + F	20	100%	--	0.34	1.17	2.19	7.89	Loi et al. (2013) ⁴
Australia	2011	Serum, Age: 0-4	4	50%	--	<LOD	--	10	20	Eriksson et al. (2017) ^{1,3}
		Serum, Age: 5-15	4	0%	--	--	--	--	--	
		Serum, Age: 16-30	4	25%	--	<LOD	--	10	50	
		Serum, Age: 31-45	4	25%	--	<LOD	--	10	30	
		Serum, Age: 46-60	4	0%	--	--	--	--	--	
		Serum, Age: >60	4	0%	--	--	--	--	--	

¹ For purposes for calculating the mean, samples with 6:2 FTS levels below the LOD were substituted with a value of zero.

² For puposes of calculating the mean, samples with 6:2 FTS levels below the LOD were substituted with a value of the LOD divided by the square root of two.

³ N = 4 pooled serum samples; each sample consisted of 100 individual pooled serum samples.

⁴ Serum data is reported in units of pg/g, which is equivalent to parts per trillion (ppt); ng/L is also equivalent to ppt

"--" = Value not provided; "FOD" = frequency of detection; "LOD" = limit of detection

One biomonitoring study was conducted in the United States in 2009 (Lee & Mabury, 2011). In this study, 6:2 FTS was detected in the serum of 42% of male participants and 65% of female participants with arithmetic mean serum levels ranging from 5.9 ng/L (males) to 9.3 ng/L (females). These serum levels are significantly lower than the arithmetic mean serum levels of PFOS reported in the general U.S. population. During the 2009-2010 NHANES survey period, PFOS was detected in the serum of >99% of participants with median levels ranging from 7,800 ng/L (females) to 11,800 ng/L (males) (CDC, 2018). These findings indicate that human exposure to 6:2 FTS is lower than that of PFOS.

6:2 FTS can cross the placenta resulting in fetal exposure. One study has demonstrated that 6:2 FTS can cross the placental resulting in exposure to the developing fetus (Yang et al., 2016). In this study, 6:2 FTS was measured in paired maternal and cord serum from 50 Chinese mothers. The frequency of detection and mean serum levels of 6:2 FTS were similar for maternal and cord serum, and the median placental transfer ratio was 1.2:1 indicating that 6:2 FTS can freely cross the placenta. This finding is similar to PFOS, which has also been shown to cross the placenta.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



6. Exposure Routes

Human exposure to 6:2 FTS may occur via a variety of routes, including consumption of contaminated drinking water or food products, through inhaling 6:2 FTS in the air, or through contact with consumer products that may contain 6:2 FTS. Field and Seow (2017) recently reviewed available monitoring data, and demonstrated that exposure to 6:2 FTS through these routes is possible, as 6:2 FTS has been detected in (1) consumer products including circuit boards, carpets, and polishes; (2) in drinking water in Spain, Germany, and France; (3) in air; and (4) in certain species of fish (see Field and Seow (2017) for a complete review).

Although, it is apparent that human exposure to 6:2 FTS occurs, it remains unknown whether humans are exposed directly to 6:2 FTS or to PFAS precursors that can degrade to 6:2 FTS. Lee & Mabury (2011) suggest that indirect exposure to 6:2 FTS may occur first through exposure to disubstituted thioether phosphates (S-diPAPS; also known as fluorotelomer mercaptoalkyl phosphate esters or FTMAPs), which are used in food packaging products (Trier et al., 2011), and can be metabolized to 6:2 FTS. A wide variety of additional 6:2 FTS precursors have been proposed based on chemical structures (See Table 12 of Field & Seow, 2017), many of which are constituents of firefighting foams (i.e., AFFF); however, little empirical data exists to directly link degradation of these compounds to 6:2 FTS. It is likely that direct exposure to 6:2 FTS and precursors both contribute to human exposure.

7. Environmental Occurrence & Persistence

7.1 Environmental Occurrence

6:2 FTS is detected at low levels and frequencies at sites associated with non-point-sources of contamination. Several studies have monitored the environmental occurrence of 6:2 FTS at both sites associated with non-point sources and with point sources (i.e., firefighting training facilities or fluoropolymer facilities) of contamination [reviewed in Field and Seow, 2017]. 6:2 FTS has been detected in (1) landfill leachate and sediment in Sweden, Norway, Germany, and the U.S.; (2) in wastewater treatment plant influent, effluent, and sludge; (3) in rain and snow; (4) in surface waters including rivers, lakes, estuaries, and oceans; and (5) in organisms including amphipods, birds, bird eggs, worms, and fish. In general, 6:2 FTS is detected at low levels and frequencies in environmental samples collected from sites with non-point sources of contamination, while higher detection frequencies and levels are often reported at sites with known point sources of contamination (Field and Seow, 2017). For example, the highest level of 6:2 FTS reported in surface waters not associated with point sources of contamination is 36 ng/L (Nguyen et al, 2011), while the highest level of 6:2 FTS reported in surface water with known point sources of contaminate (fire-fighting foam) is 28,700 ng/L (Boiteux et al., 2016).

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



7.2 Environmental Persistence

Biodegradation of 6:2 FTS occurs under aerobic, sulfur-limiting, conditions.

Several studies have been conducted to investigate biodegradation of 6:2 FTS under varying conditions. An OECD Guideline 301B (CO₂ Evolution Test; OECD 1992) study was conducted to test whether 6:2 FTS could be utilized as a carbon source by bacteria. Over 28-days a maximum loss of 42% was observed; based on test guidelines this result indicates that 6:2 FTS is not readily biodegradable (ECHA, 2018). Similarly, several studies have demonstrated that 6:2 FTS is not readily biodegradable under anaerobic conditions (Zhang et al. 2016), or in activated sludge from WWTPs under anaerobic or aerobic conditions (Ochoa-Herrera et al., 2016; Wang et al., 2011). Alternatively, several studies have demonstrated that 6:2 FTS can be utilized as a sulfur source by bacteria under aerobic, sulfur-limiting conditions (Key et al., 1998; Shaw et al., 2019; Van Hamme et al., 2013; Zhang et al., 2016). Zhang et al. (2016) report that 6:2 FTS undergoes rapid biodegradation in aerobic sediment, with a biodegradation half-life of less than five days. Biodegradation pathways of 6:2 FTS have also been proposed in several publications, and PFHxA (PFCA with 5 fluorinated carbons), PFPeA (PFCA with 4 fluorinated carbons) and the 5:3 fluorotelomer acid are consistently

reported to be the primary terminal degradation products (Shaw et al., 2019; Van Hamme et al., 2013; Wang et al., 2011; Zhang et al., 2016). However, numerous intermediary PFAS are formed throughout the biodegradation process. Shaw et al. (2019) identified 16 intermediary metabolites, many of which are shown in the proposed major degradation pathway for 6:2 FTS (Figure 1). Major metabolites identified by Shaw et al. (2019) include: 6:2 fluorotelomer (6:2 FT) alcohol (6:2

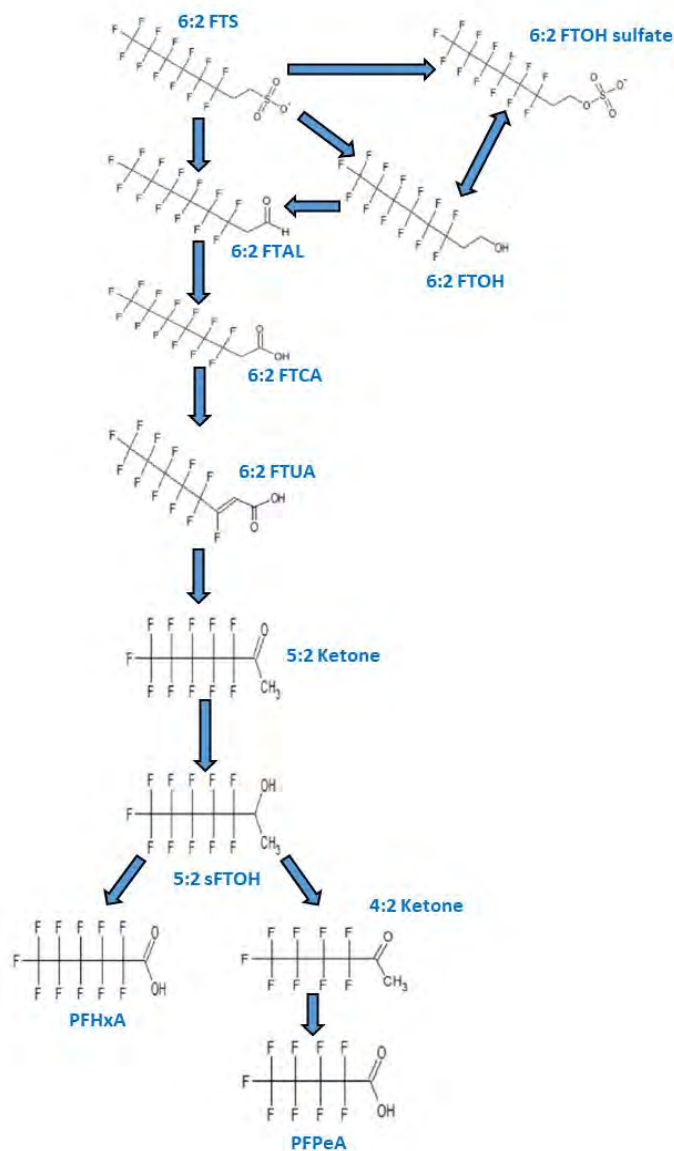


Figure 1. Proposed major degradation pathway for 6:2 FTS. Adapted from Shaw et al. (2019).

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



FTOH), 6:2 FT alcohol sulfate (6:2 FTOH sulfate), 6:2 FT aldehyde (6:2 FTAL), 6:2 FT acid (6:2 FTAC), 6:2 FT unsaturated acid (6:2 FTUA), 5:2 FT ketone, 5:2 FT secondary alcohol (5:2 sFTOH), 4:2 FT ketone, and the short-chain PFCAs PFHxA and PFPeA. Although, the terminal degradation product PFHxA has been shown to pose minimal risk to human health (Anderson et al., 2019), very little toxicological information is available for the other metabolites formed during 6:2 FTS biodegradation, or the proposed terminal degradation products formed through proposed minor degradation pathways, such as PFBA and 4:2 FTUA (Shaw et al., 2019).

Significant and important data gaps related to the environmental and *in vivo* degradation of 6:2 FTS remain.

8. References

- 3M 2003. Environmental and health assessment of perfluorooctanesulphonic acid and its salts. 3M Company, US. [As reported in NPCA, 2008]
- Anderson, J.K., Luz, A.L., Goodrum, P. and Durda, J., 2019. Perfluorohexanoic acid toxicity, part II: Application of human health toxicity value for risk characterization. *Regulatory Toxicology and Pharmacology*.
- Arnot, J.A. and Gobas, F.A., 2006. A review of bioconcentration factor (BCF) and bioaccumulation factor (BAF) assessments for organic chemicals in aquatic organisms. *Environmental Reviews*, 14(4), pp.257-297.
- Beach, S.A., Newsted, J.L., Coady, K. and Giesy, J.P., 2006. Ecotoxicological evaluation of perfluorooctanesulfonate (PFOS). In *Reviews of environmental contamination and toxicology* (pp. 133-174). Springer, New York, NY.
- Beesoon, S. and Martin, J.W., 2015. Isomer-specific binding affinity of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) to serum proteins. *Environmental science & technology*, 49(9), pp.5722-5731.
- Bertin, D., Ferrari, B.J., Labadie, P., Sapin, A., Garric, J., Budzinski, H., Houde, M. and Babut, M., 2014. Bioaccumulation of perfluoroalkyl compounds in midge (*Chironomus riparius*) larvae exposed to sediment. *Environmental pollution*, 189, pp.27-34.
- Bertin, D., Labadie, P., Ferrari, B.J., Sapin, A., Garric, J., Geffard, O., Budzinski, H. and Babut, M., 2016. Potential exposure routes and accumulation kinetics for poly- and perfluorinated alkyl compounds for a freshwater amphipod: *Gammarus* spp. (Crustacea). *Chemosphere*, 155, pp.380-387.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Biesemeier, J.A. and Harris, D.L. 1975. Eye and Skin Irritation Report on Sample T-1166. a) Combined Skin and Eye Irritation Studies Report, b) Eye Irritation Study (with washout procedure) Report. Project No. 501 1023, WARF Institute Inc.

Boiteux, V., Bach, C., Sagres, V., Hemard, J., Colin, A., Rosin, C., Munoz, J.F. and Dauchy, X., 2016. Analysis of 29 per-and polyfluorinated compounds in water, sediment, soil and sludge by liquid chromatography–tandem mass spectrometry. *International journal of environmental analytical chemistry*, 96(8), pp.705-728 [as cited in Field and Seow, 2017].

Buck, R.C., Franklin, J., Berger, U., Conder, J.M., Cousins, I.T., De Voogt, P., Jensen, A.A., Kannan, K., Mabury, S.A. and van Leeuwen, S.P., 2011. Perfluoroalkyl and polyfluoroalkyl substances in the environment: terminology, classification, and origins. *Integrated environmental assessment and management*, 7(4), pp.513-541.

Buck, R.C., 2015. Toxicology data for alternative “short-chain” fluorinated substances. In *Toxicological Effects of Perfluoroalkyl and Polyfluoroalkyl Substances* (pp. 451-477). Humana Press, Cham.

Centers for Disease Control and Prevention. Fourth Report on Human Exposure to Environmental Chemicals, Updated Tables, (March 2018). Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Available at: <https://www.cdc.gov/exposurereport/>

Chang, S.C., Noker, P.E., Gorman, G.S., Gibson, S.J., Hart, J.A., Ehresman, D.J. and Butenhoff, J.L., 2012. Comparative pharmacokinetics of perfluorooctanesulfonate (PFOS) in rats, mice, and monkeys. *Reproductive Toxicology*, 33(4), pp.428-440.

Dean, W.P., Jessup, D.C., Thompson G., Romig, G., and Powell, D. 1978. Fluorad Fluorochemical Surfactant FC-95 Acute Oral Toxicity (LD5₀,) Study in Rats. Study No. 137-083, International Research and Development Corporation. (Includes Acute Oral Toxicity Study in Rats with T-2297 CoC . Project No. 78-1433A7 Biosearch, Inc.)

ECHA (European Chemicals Agency) – REACH Registration Dossier for CAS number 27619-97-2. Available at: <https://echa.europa.eu/fr/registration-dossier/-/registered-dossier/24637/6/2/1>. Accessed December 2018.

Eriksson, U., Mueller, J.F., Toms, L.M.L., Hobson, P. and Kärrman, A., 2017. Temporal trends of PFSA, PFCAs and selected precursors in Australian serum from 2002 to 2013. *Environmental Pollution*, 220, pp.168-177.

Field, J.A. and Seow, J., 2017. Properties, occurrence, and fate of fluorotelomer sulfonates. *Critical Reviews in Environmental Science and Technology*, 47(8), pp.643-691.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Henry, B.J., Carlin, J.P., Hammerschmidt, J.A., Buck, R.C., Buxton, L.W., Fiedler, H., Seed, J. and Hernandez, O., 2018. A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers. *Integrated environmental assessment and management*, 14(3), pp.316-334.

Hoke, R.A., Ferrell, B.D., Ryan, T., Sloman, T.L., Green, J.W., Nabb, D.L., Mingoia, R., Buck, R.C. and Korzeniowski, S.H., 2015. Aquatic hazard, bioaccumulation and screening risk assessment for 6: 2 fluorotelomer sulfonate. *Chemosphere*, 128, pp.258-265.

ITRC. 2018. Interstate Technology and Regulatory Council. Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS). Available at: <https://pfas-1.itrcweb.org/fact-sheets/>

Joung, K.E., Jo, E.H., Kim, H.M., Choi, K. and Yoon, J., 2010. Toxicological Effects of PFOS and PFOA on Earthworm, *Eisenia fetida*. *Environmental Health and Toxicology*, 25(3), pp.181-186.

Key, B.D., Howell, R.D. and Criddle, C.S., 1998. Defluorination of organofluorine sulfur compounds by *Pseudomonas* sp. strain D2. *Environmental science & technology*, 32(15), pp.2283-2287.

Lee, H. and Mabury, S.A., 2011. A pilot survey of legacy and current commercial fluorinated chemicals in human sera from United States donors in 2009. *Environmental science & technology*, 45(19), pp.8067-8074.

Loi, E.I., Yeung, L.W., Mabury, S.A. and Lam, P.K., 2013. Detections of commercial fluorosurfactants in Hong Kong marine environment and human blood: a pilot study. *Environmental science & technology*, 47(9), pp.4677-4685.

Luebker, D.J., Case, M.T., York, R.G., Moore, J.A., Hansen, K.J. and Butenhoff, J.L., 2005a. Two-generation reproduction and cross-foster studies of perfluorooctanesulfonate (PFOS) in rats. *Toxicology*, 215(1-2), pp.126-148.

Luebker, D.J., York, R.G., Hansen, K.J., Moore, J.A. and Butenhoff, J.L., 2005b. Neonatal mortality from in utero exposure to perfluorooctanesulfonate (PFOS) in Sprague–Dawley rats: dose–response, and biochemical and pharmacokinetic parameters. *Toxicology*, 215(1-2), pp.149-169.

Munoz, G., Fechner, L.C., Geneste, E., Pardon, P., Budzinski, H. and Labadie, P., 2018. Spatio-temporal dynamics of per and polyfluoroalkyl substances (PFASs) and transfer to periphytic biofilm in an urban river: case-study on the River Seine. *Environmental Science and Pollution Research*, 25(24), pp.23574-23582.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Munoz, G., Desrosiers, M., Duy, S.V., Labadie, P., Budzinski, H., Liu, J. and Sauvé, S., 2017. Environmental occurrence of perfluoroalkyl acids and novel fluorotelomer surfactants in the freshwater fish *Catostomus commersonii* and sediments following firefighting foam deployment at the Lac-Mégantic railway accident. *Environmental science & technology*, 51(3), pp.1231-1240.

Nguyen, V.T., Reinhard, M. and Karina, G.Y.H., 2011. Occurrence and source characterization of perfluorochemicals in an urban watershed. *Chemosphere*, 82(9), pp.1277-1285 [as cited in Field & Seow, 2017].

NPCA (Norwegian Pollution Control Authority). 2008. Screening of Polyfluorinated organic compounds at four fire training facilities in Norway. TA-2444/2008. Available from: www.miljodirektoratet.no/old/klif/publikasjoner/2444/ta2444.pdf

Ochoa-Herrera, V., Field, J.A., Luna-Velasco, A. and Sierra-Alvarez, R., 2016. Microbial toxicity and biodegradability of perfluorooctane sulfonate (PFOS) and shorter chain perfluoroalkyl and polyfluoroalkyl substances (PFASs). *Environmental Science: Processes & Impacts*, 18(9), pp.1236-1246.

OECD (1992), *Test No. 301: Ready Biodegradability*, OECD Guidelines for the Testing of Chemicals, Section 3, OECD Publishing, Paris, <https://doi.org/10.1787/9789264070349-en>.

OECD (1996), *Test No. 422: Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264070981-en>.

OECD (1997a), *Test No. 471: Bacterial Reverse Mutation Test*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264071247-en>.

OECD (1997b), *Test No. 475: Mammalian Bone Marrow Chromosome Aberration Test*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264071308-en>.

OECD (1997c), *Test No. 473: In vitro Mammalian Chromosome Aberration Test*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264071261-en>.

OECD (1997d), *Test No. 486: Unscheduled DNA Synthesis (UDS) Test with Mammalian Liver Cells in vivo*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264071520-en>.

OECD (2002), *Test No. 420: Acute Oral Toxicity - Fixed Dose Procedure*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264070943-en>.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



OECD (2006), *Test No. 435: In Vitro Membrane Barrier Test Method for Skin Corrosion*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264067318-en>.

OECD (2010), *Test No. 429: Skin Sensitisation: Local Lymph Node Assay*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264071100-en>.

OECD (2016a), *Test No. 489: In Vivo Mammalian Alkaline Comet Assay*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264264885-en>.

OECD (2016b), *Test No. 474: Mammalian Erythrocyte Micronucleus Test*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264264762-en>.

OECD (2017), *Test No. 402: Acute Dermal Toxicity*, OECD Guidelines for the Testing of Chemicals, Section 4, OECD Publishing, Paris, <https://doi.org/10.1787/9789264070585-en>.

Riker Laboratories, Inc. 1981a. Acute ocular irritation test with T-2997CoC in albino rabbits. # 0882EB0009.

Shaw, D.M., Munoz, G., Bottos, E.M., Duy, S.V., Sauv  , S., Liu, J. and Van Hamme, J.D., 2019. Degradation and defluorination of 6: 2 fluorotelomer sulfonamidoalkyl betaine and 6: 2 fluorotelomer sulfonate by *Gordonia* sp. strain NB4-1Y under sulfur-limiting conditions. *Science of The Total Environment*, 647, pp.690-698.

Sheng, N., Zhou, X., Zheng, F., Pan, Y., Guo, X., Guo, Y., Sun, Y. and Dai, J., 2017. Comparative hepatotoxicity of 6: 2 fluorotelomer carboxylic acid and 6: 2 fluorotelomer sulfonic acid, two fluorinated alternatives to long-chain perfluoroalkyl acids, on adult male mice. *Archives of toxicology*, 91(8), pp.2909-2919.

Sheng, N., Cui, R., Wang, J., Guo, Y., Wang, J. and Dai, J., 2018. Cytotoxicity of novel fluorinated alternatives to long-chain perfluoroalkyl substances to human liver cell line and their binding capacity to human liver fatty acid binding protein. *Archives of toxicology*, 92(1), pp.359-369.

Stubberud, H. 2006.   kotoksikologiske effekter av PFOS, PFOA og 6:2 FTS p   meitemark (*Eisenia fetida*). (in Norwegian, English summary). Report TA 2212/2006. Norwegian State Pollution Control Authority, PB 8100 Dep, 0032 Oslo. [As reported in NPCA, 2008].

Thibodeaux, J.R., Hanson, R.G., Rogers, J.M., Grey, B.E., Barbee, B.D., Richards, J.H., Butenhoff, J.L., Stevenson, L.A. and Lau, C., 2003. Exposure to perfluorooctane sulfonate during pregnancy in rat and mouse. I: maternal and prenatal evaluations. *Toxicological Sciences*, 74(2), pp.369-381.

Appendix 1. Technical Support Document: 6:2 Fluorotelomer Sulfonate (6:2 FTS)



Trier, X., Granby, K. and Christensen, J.H., 2011. Polyfluorinated surfactants (PFS) in paper and board coatings for food packaging. *Environmental Science and Pollution Research*, 18(7), pp.1108-1120.

USEPA (U.S. Environmental Protection Agency). 2002. A review of the reference dose and reference concentration processes. December 2002. EPA/630/P-02/002F. Available from: <https://www.epa.gov/osa/review-reference-dose-and-reference-concentration-processes>

USEPA (U.S. Environmental Protection Agency). 2016. Health Effects Support Document for Perfluorooctane Sulfonate (PFOS). May 2016. EPA 822-R-16-002. Available from: https://www.epa.gov/sites/production/files/2016.../documents/pfos_hesd_final_508.pdf

Van Hamme, J.D., Bottos, E.M., Bilbey, N.J. and Brewer, S.E., 2013. Genomic and proteomic characterization of *Gordonia* sp. NB4-1Y in relation to 6: 2 fluorotelomer sulfonate biodegradation. *Microbiology*, 159(8), pp.1618-1628.

Wang, N., Liu, J., Buck, R.C., Korzeniowski, S.H., Wolstenholme, B.W., Folsom, P.W. and Sulecki, L.M., 2011. 6: 2 Fluorotelomer sulfonate aerobic biotransformation in activated sludge of waste water treatment plants. *Chemosphere*, 82(6), pp.853-858.

Yang, L., Wang, Z., Shi, Y., Li, J., Wang, Y., Zhao, Y., Wu, Y. and Cai, Z., 2016. Human placental transfer of perfluoroalkyl acid precursors: Levels and profiles in paired maternal and cord serum. *Chemosphere*, 144, pp.1631-1638.

Yeung, L.W. and Mabury, S.A., 2013. Bioconcentration of aqueous film-forming foam (AFFF) in juvenile rainbow trout (*Oncorhynchus mykiss*). *Environmental science & technology*, 47(21), pp.12505-12513.

Zhang, S., Lu, X., Wang, N. and Buck, R.C., 2016. Biotransformation potential of 6: 2 fluorotelomer sulfonate (6: 2 FTSA) in aerobic and anaerobic sediment. *Chemosphere*, 154, pp.224-230.

Nonafluorobutane-1-sulfonic acid

sc-236187

Material Safety Data Sheet



Hazard Alert Code Key: **EXTREME** **HIGH** **MODERATE** **LOW**

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Nonafluorobutane-1-sulfonic acid

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800

EMERGENCY:

ChemWatch

Within the US & Canada: 877-715-9305

Outside the US & Canada: +800 2436 2255

(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS

C4F9O3HS, "perfluorobutanesulfonic acid (PFBS)", "nonafluorobutane-1-sulfonic acid", "1-butanefluoronic acid, nonafluoro-", "nonafluorobutanesulfonic acid", "pentyl perfluorononabutanoate sulfonate", "1-perfluorobutanesulfonic acid", "1-butanefluoronic acid, 1, 1, 2, 2, 3, 3, 4, 4, 4-nonafluoro-", "C4 sulfonate"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	1		
Toxicity:	2		
Body Contact:	3		
Reactivity:	2		
Chronic:	2		

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4



CANADIAN WHMIS SYMBOLS



EMERGENCY OVERVIEW

RISK

Reacts violently with water.

Harmful if swallowed.

Causes burns.

Risk of serious damage to eyes.

Toxic to bees.

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

! Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.

! The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.

! Ingestion of acidic corrosives may produce burns around and in the mouth.
the throat and esophagus.

EYE

! The material can produce chemical burns to the eye following direct contact.

Vapors or mists may be extremely irritating.

! If applied to the eyes, this material causes severe eye damage.

! Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns.

Mild burns of the epithelia generally recover rapidly and completely.

SKIN

! The material can produce chemical burns following direct contact with the skin.

! Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.

! Skin contact is not thought to produce harmful health effects (as classified using animal models).

Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions.

! Open cuts, abraded or irritated skin should not be exposed to this material.

! Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects.

Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

! The material can cause respiratory irritation in some persons.

The body's response to such irritation can cause further lung damage.

! Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage.

There may be dizziness, headache, nausea and weakness.

CHRONIC HEALTH EFFECTS

! Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs.

Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.

There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.

Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

Perfluoroalkylsulfonate fluoride-based products have included surfactants, paper and packaging treatments, surface protectants (e.g., for carpet, upholstery, textile) and are found in specialised fire-fighting foams (AFFF for example). Depending on the specific functional derivatisation or degree of polymerisation, such products may degrade or metabolize, to an undetermined degree, to perfluoroalkylsulfonates (such as perfluorooctanesulfonate - PFOS), which are stable and persistent end products that have the potential to bioaccumulate. Salts of PFOS are known to cause significant toxic effects, including mortality, in Cynomolgus monkeys (oral doses of 0.75 mg/ kg/ day), 12 rabbits (oral doses of 3.75 mg kg/ day), rats (oral doses of 1.6 mg/ kg/day) and zooplankton (10 mg/l)

PFOS is persistent, bioaccumulative and toxic to mammalian species. There are species differences in the elimination half-life of PFOS; the half-life is 100 days in rats, 200 days in monkeys, and years in humans. The toxicity profile of PFOS is similar among rats and monkeys. Repeated exposure results in hepatotoxicity and mortality; the dose-response curve is very steep for mortality. This occurs in animals of all ages, although the neonate may be more sensitive. In addition, a 2-year bioassay in rats has shown that exposure to PFOS results in hepatocellular adenomas and thyroid follicular cell adenomas; the hepatocellular adenomas do not appear to be related to peroxisome proliferation.

In one study which followed exposed workers for 37 years there was a statistically significant risk of death from bladder cancer. Neoplasms of the male reproductive system, of the gastrointestinal tract also appeared to be elevated. Risk ratios were highest in

workers with highest and longest exposure to fluorochemicals. PFOS has not been shown to be genotoxic in a variety of assay systems. Lower molecular weight homologues such as perfluorobutanesulfonate (PFBS) do not exhibit the levels of toxicity or bioaccumulation of the higher homologues. Studies show PFBS is highly bound to human albumin with indications of a saturated binding to albumin in serum and negligible binding to the other liver-manufactured proteins gamma globulin, alpha globulin, fibrinogen, alpha-2-macroglobulin, transferrin and beta lipoproteins. The results of two in vitro studies and a chromosomal aberration test show no evidence of mutagenicity due to potassium PFBS. Animal data to date does not indicate potassium PFBS is a developmental toxin nor a substance toxic to reproduction, fertility or lactation. In humans PFBS has a much shorter half-life than PFOS (just over one month vs 5.5 years).

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
perfluorobutanesulfonic acid	375-73-5	>98

Section 4 - FIRST AID MEASURES

SWALLOWED

" For advice, contact a Poisons Information Center or a doctor at once. " Urgent hospital treatment is likely to be needed.

EYE

! If this product comes in contact with the eyes: " Immediately hold eyelids apart and flush the eye continuously with running water. " Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.

SKIN

! If skin or hair contact occurs: " Immediately flush body and clothes with large amounts of water, using safety shower if available. " Quickly remove all contaminated clothing, including footwear.

INHALED

" If fumes or combustion products are inhaled remove from contaminated area. " Lay patient down. Keep warm and rested. Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g.

NOTES TO PHYSICIAN

! For acute or short term repeated exposures to strong acids:

" Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.

" Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Not Available
Upper Explosive Limit (%):	Not Available
Specific Gravity (water=1):	Not Available
Lower Explosive Limit (%):	Not Available

EXTINGUISHING MEDIA

" Foam.

" Dry chemical powder.

FIRE FIGHTING

" Alert Emergency Responders and tell them location and nature of hazard.

" Wear full body protective clothing with breathing apparatus.

When any large container (including road and rail tankers) is involved in a fire, consider evacuation by 800 metres in all directions.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

" Combustible.

" Slight fire hazard when exposed to heat or flame.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO₂), hydrogen fluoride, sulfur oxides (SO_x), other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

! Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

PERSONAL PROTECTION

Glasses:

Full face- shield.

Gloves:

Respirator:

Type AB-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

! Environmental hazard - contain spillage.

" Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.

" Check regularly for spills and leaks.

" Clean up all spills immediately.

" Avoid breathing vapors and contact with skin and eyes.

MAJOR SPILLS

! Environmental hazard - contain spillage.

" Clear area of personnel and move upwind.

" Alert Emergency Responders and tell them location and nature of hazard.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

" DO NOT allow clothing wet with material to stay in contact with skin.

" Avoid all personal contact, including inhalation.

" Wear protective clothing when risk of exposure occurs.

RECOMMENDED STORAGE METHODS

! DO NOT use aluminum or galvanized containers.

Check regularly for spills and leaks.

" Lined metal can, Lined metal pail/drum

" Plastic pail.

For low viscosity materials

" Drums and jerricans must be of the non-removable head type.

" Where a can is to be used as an inner package, the can must have a screwed enclosure.

STORAGE REQUIREMENTS

" Store in original containers.

" Keep containers securely sealed.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

The following materials had no OELs on our records

• perfluorobutanesulfonic acid: CAS:375-73-5

PERSONAL PROTECTION



RESPIRATOR

• Type AB-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

EYE

" Chemical goggles.

" Full face shield.

HANDS/FEET

! Elbow length PVC gloves.

" When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

" frequency and duration of contact,

" chemical resistance of glove material,

" glove thickness and

" dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent).

" When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.

" When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.

" Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

OTHER

" Overalls.

" PVC Apron.

ENGINEERING CONTROLS

! Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Corrosive.

Acid.

Reacts violently with water.

State	LIQUID	Molecular Weight	300.1
Melting Range (°F)	Not Available	Viscosity	Not Available
Boiling Range (°F)	234- 237 (14 mm Hg)	Solubility in water (g/L)	Reacts violently
Flash Point (°F)	Not Available	pH (1% solution)	Not Available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not Available
Autoignition Temp (°F)	Not Available	Vapour Pressure (mmHG)	Not Available
Upper Explosive Limit (%)	Not Available	Specific Gravity (water=1)	Not Available
Lower Explosive Limit (%)	Not Available	Relative Vapor Density (air=1)	Not Available
Volatile Component (%vol)	Not Available	Evaporation Rate	Not Available

APPEARANCE

Liquid; reacts violently with water.

PFOS has a solubility of approximately 550 mg/l in pure water - the solubility decreases with increased salt content. For example the potassium salt of PFOS has a solubility of 370 mg/l in pure water. Due to surface active properties of PFOS, the log Kow cannot be measured. The potassium salt of PFOS has a low vapour pressure, 3.31×10^{-4} Pa at 20 C.

Material	Value

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

" Contact with alkaline material liberates heat.

" Presence of incompatible materials.

" Product is considered stable.

STORAGE INCOMPATIBILITY

! Reacts with mild steel, galvanized steel / zinc producing hydrogen gas which may form an explosive mixture with air.

Segregate from alcohol, water.

Segregate from alkalis, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

" Avoid strong bases.

" NOTE: May develop pressure in containers; open carefully. Vent periodically.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

perfluorobutanesulfonic acid

TOXICITY AND IRRITATION

PERFLUOROBUTANESULFONIC ACID:

! unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION

Oral (Rat) LD50: 430 mg/kg

! Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

for perfluorinated sulfonates:

Toxicology studies of the C4 fluoroalkyl sulfonate (PFBS), the C8 fluoroalkyl sulfonate (PFOS) and the C8 fluorocarboxylic acid (PFOA) indicate that chain length is an important factor in toxicity, perhaps partially due to pharmacokinetic factors; toxicity and persistence appears to increase with increasing chain length. Human biomonitoring studies have shown that the C6 perfluorosulfonate, PFOS and PFOA are present in the serum of the general US population, and that the levels of the C6 perfluorosulfonate are quite high in children. Other chain lengths have not yet been monitored in the general population. Environmental monitoring studies have demonstrated the presence of the entire series of perfluorinated compounds, as well as some higher homologs. Current hazard and risk assessments have addressed individual chemicals. If there is a common mode of action for these chemicals the latter efforts are likely to underestimate potential hazard and risk to exposed populations.

Extensive pharmacokinetic information is available for PFOS (perfluorooctanesulfonate) and PFOA (perfluorooctanoic acid) and more limited information is available for PFBS (perfluorobutanesulfonate)
The existing information for PFOS and PFOA suggest the following issues may be critical determinants of pharmacokinetics and blood dosimetry for other members of the class:

" These compounds are well absorbed.

" The carboxylic acids and sulfonates are cleared by urinary and biliary elimination in rodents with no evidence of metabolism, while the telomer alcohols are metabolised apparently to carboxylic acid derivatives. Extensive enterohepatic recirculation has been demonstrated for both PFOA and PFOS.

" Species and sex differences in clearance are most dramatic for PFOA (female rat (hrs)>>male rat (days)>mouse>monkey (weeks)>human (years)). PFOS demonstrates higher blood levels in female rats than males following repeated exposures and the clearance during week 105 was faster than older intravenous and oral studies would predict. PFBS is rapidly eliminated in several hours in rats. The mechanism(s) for species and sex variation in clearance is ill-defined but may in part be related to differential expression of renal transport proteins.

" Serum protein binding (generally albumin) is extensive resulting in high concentrations in serum. Liver has very high concentrations as well, followed by kidney. Other tissues have generally low concentrations (and the fluorination make this a non-lipophilic compound), but account for a significant fraction of the mass in the body.

There is extensive toxicology information available on PFBS, PFOS and PFOA. Studies of PFOS and PFOA have shown that the developing organism is a primary target. A two generation reproductive toxicity study of PFOS in rats, and several subsequent studies in rats and mice, have shown a very high incidence of mortality in the F1 offspring in the first few days following birth. A two-generation reproductive toxicity study of PFOA in rats has demonstrated mortality in the F1 offspring in the first few days following weaning, as well as a delay in sexual maturation. Preliminary studies of PFOA in mice have shown a mortality pattern very similar to that observed following exposure to PFOS in that mortality occurs in the first few days after birth.

In contrast, these effects were not noted in a two-generation reproductive toxicity study of PFBS in rats or a limited one-generation toxicity study of C6 perfluorosulfonate in rats. To date, there is no information on developmental effects following exposure to chain lengths greater than C8.

In addition, several of the compounds in the perfluorinated series are peroxisome proliferators, and PFOS and PFOA have been shown to be carcinogenic in rats. Chronic studies of PFOA in rats have shown the presence of hepatocellular, Leydig cell and pancreatic acinar cell tumors. PFOA is a demonstrated PPAR-alpha (peroxisome proliferator-activated receptor) agonist and this has been hypothesised to be the mode of action for the hepatocellular adenomas. Chronic exposure of PFOS in rats is also associated with hepatocellular adenomas. PFOS is also a peroxisome proliferator, but studies have not been conducted to firmly establish the role of PPAR-alpha agonism in the induction of the liver adenomas. Chronic exposure studies of PFBS have not yet been conducted. Although preliminary studies indicate that PFBS is a weak peroxisome proliferator at comparatively high doses, only very limited liver toxicity has been noted in a two-generation reproductive toxicity study, and no liver toxicity was noted in 28-day and 90-day studies at comparable doses.

Limited studies of the C9 and C10 perfluorocarboxylic acids indicate that both compounds are peroxisome proliferators. Thus, it is likely that liver adenomas may be expected following chronic exposures to many of the compounds in the proposed series. However, several scientific groups have concluded that PPAR-a agonist induced liver tumors in adult rodents are of questionable relevance to humans. Others have questioned whether chronic exposure to peroxisome proliferators would result in a different outcome if exposures were initiated prenatally rather than in adulthood.

Section 12 - ECOLOGICAL INFORMATION

Toxic to bees.

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

This material and its container must be disposed of as hazardous waste.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
perfluorobutanesulfonic acid	HIGH	No Data Available	LOW	MED

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.

#Puncture containers to prevent re-use and bury at an authorized landfill.

Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:

" Reduction

" Reuse

" Recycling

" Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

" Recycle wherever possible.

" Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols: None Hazard class or Division: 8

Identification Numbers: UN3265 PG: II

Label Codes: 8 Special provisions: B2, IB2,

T11, TP2,

TP27

Packaging: Exceptions: 154 Packaging: Non- bulk: 202

Packaging: Exceptions: 154 Quantity limitations: 1 L

Passenger aircraft/rail:

Quantity Limitations: Cargo 30 L Vessel stowage: Location: B

aircraft only:

Vessel stowage: Other: 40

Hazardous materials descriptions and proper shipping names:

Corrosive liquid, acidic, organic, n.o.s.

Air Transport IATA:

UN/ID Number: 3265 Packing Group: II

Special provisions: A3

Cargo Only

Packing Instructions: 855 Maximum Qty/Pack: 30 L

Passenger and Cargo Passenger and Cargo

Packing Instructions: Y840 Maximum Qty/Pack: 1 L

Passenger and Cargo Limited Quantity Passenger and Cargo Limited Quantity

Packing Instructions: 851 Maximum Qty/Pack: 0.5 L

Shipping Name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.

*(CONTAINS PERFLUOROBUTANESULFONIC ACID)

Maritime Transport IMDG:

IMDG Class: 8 IMDG Subrisk: None

UN Number: 3265 Packing Group: II

EMS Number: F-A,S-B Special provisions: 274

Limited Quantities: 1 L

Shipping Name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.(contains perfluorobutanesulfonic acid)

Section 15 - REGULATORY INFORMATION

perfluorobutanesulfonic acid (CAS: 375-73-5) is found on the following regulatory lists;

"Canada Non-Domestic Substances List (NDSL)", "US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

! Cumulative effects may result following exposure*.

! Limited evidence of a carcinogenic effect*.

* (limited evidence).

Denmark Advisory list for selfclassification of dangerous substances

Substance CAS Suggested codes perfluorobutanesulfonic acid 375- 73- 5 Xn; R22

Reasonable care has been taken in the preparation of this information, but the author makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The author makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. For additional technical information please call our toxicology department on +800 CHEMCALL.

! Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

A list of reference resources used to assist the committee may be found at:

www.chemwatch.net/references.

! The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

This document is copyright. Apart from any fair dealing for the purposes of private study, research, review or criticism, as permitted under the Copyright Act, no part may be reproduced by any process without written permission from CHEMWATCH. TEL (+61 3) 9572 4700.

Issue Date: May-24-2009

Print Date: Jul-15-2011



Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Product name:** Perfluorobutanoic acid

· **Part number:** DRE-C15986520

· **CAS Number:**

375-22-4

· **EC number:**

206-786-3

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**

No further relevant information available.

· **Application of the substance / the mixture** Reference material for laboratory use only

· **1.3 Details of the supplier of the safety data sheet**

· **Manufacturer/Supplier:**

LGC Limited

Queens Road

Teddington

Middlesex TW11 0LY

UNITED KINGDOM

Tel : +44 (0) 20 8943 7000

Fax : +44 (0) 20 8943 2767

eMail : gb@lgcstandards.com

Web : www.lgcstandards.com

· **Further information obtainable from:**

Product safety department

eMail : sds-request@lgcgroup.com

· **1.4 Emergency telephone number:**

For Hazardous Materials or Dangerous Goods Incident

Spill, Leak, Fire Exposure, or Accident

Call CHEMTREC:

USA & Canada 1-800-424-9300

Rest of the world +1 703-741-5970

SECTION 2: Hazards identification

· **2.1 Classification of the substance or mixture**

· **Classification according to Regulation (EC) No 1272/2008**



GHS05 corrosion

Skin Corr. 1A H314 Causes severe skin burns and eye damage.

Eye Dam. 1 H318 Causes serious eye damage.

· **2.2 Label elements**

· **Labelling according to Regulation (EC) No 1272/2008**

The substance is classified and labelled according to the CLP regulation.

(Contd. on page 2)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 1)

· Hazard pictograms

GHS05

· Signal word *Danger***· Hazard statements***H314 Causes severe skin burns and eye damage.***· Precautionary statements***P280 Wear protective gloves/protective clothing/eye protection/face protection.**P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].**P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.**P310 Immediately call a POISON CENTER/doctor.**P405 Store locked up.**P501 Dispose of contents/container in accordance with local/regional/national/international regulations.***· 2.3 Other hazards****· Results of PBT and vPvB assessment****· PBT:** Not applicable.**· vPvB:** Not applicable.

SECTION 3: Composition/information on ingredients

· 3.1 Chemical characterisation: Substances**· CAS No. Description***375-22-4 Heptafluorobutyric acid***· Identification number(s)** *None***· EC number:** 206-786-3**· RTECS:** ET4025000**· Additional information:** *For the wording of the listed hazard phrases refer to section 16.*

SECTION 4: First aid measures

· 4.1 Description of first aid measures**· General information:** *Immediately remove any clothing soiled by the product.***· After inhalation:** *Supply fresh air; consult doctor in case of complaints.***· After skin contact:***Immediately wash with water and soap and rinse thoroughly.**Seek immediate medical advice.***· After eye contact:** *Rinse opened eye for several minutes under running water. Then consult a doctor.***· After swallowing:** *Rinse mouth. Do not induce vomiting.***· 4.2 Most important symptoms and effects, both acute and delayed** *No further relevant information available.*

(Contd. on page 3)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 2)

- **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

SECTION 5: Firefighting measures

- **5.1 Extinguishing media**
- **Suitable extinguishing agents:** Use fire extinguishing methods suitable for surrounding conditions.
- **5.2 Special hazards arising from the substance or mixture**
Formation of toxic gases is possible during heating or in case of fire.
- **5.3 Advice for firefighters**
- **Protective equipment:** Wear self-contained respiratory protective device.

SECTION 6: Accidental release measures

- **6.1 Personal precautions, protective equipment and emergency procedures**
Wear protective equipment. Keep unprotected persons away.
- **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **6.3 Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralising agent.
Dispose of contaminated material as waste according to item 13.
Ensure adequate ventilation.
- **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

- **7.1 Precautions for safe handling** Store in cool, dry place in tightly closed receptacles.
- **Information about fire - and explosion protection:** No special measures required.
- **7.2 Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:**
Please refer to the manufacturer's certificate for specific storage and transport temperature conditions.
Store only in the original receptacle unless other advice is given on the CoA.
Keep container in a well-ventilated place. Keep away from sources of ignition and heat.
- **Information about storage in one common storage facility:** Store away from foodstuffs.
- **Further information about storage conditions:** Keep container tightly sealed.
- **7.3 Specific end use(s)** No further relevant information available.

GB

(Contd. on page 4)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 3)

SECTION 8: Exposure controls/personal protection

- **Additional information about design of technical facilities:** No further data; see item 7.
- **8.1 Control parameters**
- **Ingredients with limit values that require monitoring at the workplace:** Not required.
- **Additional information:** Lists used were valid at the time of SDS preparation.
- **8.2 Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
 - Keep away from foodstuffs, beverages and feed.
 - Immediately remove all soiled and contaminated clothing
 - Wash hands before breaks and at the end of work.
 - Avoid contact with the eyes.
 - Avoid contact with the eyes and skin.
- **Respiratory protection:**
 - Not required.
 - Use suitable respiratory protective device in case of insufficient ventilation.
- **Protection of hands:**
 - The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
 - Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
 - The protective gloves to be used must comply with the specifications of EC Directive 89/686/EEC and the related standard EN374



Protective gloves

- **Material of gloves** Fluorocarbon rubber (Viton)
- **Penetration time of glove material**
 - The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
- **Eye protection:**



Tightly sealed goggles

SECTION 9: Physical and chemical properties

- **9.1 Information on basic physical and chemical properties**
- **General Information**
- **Appearance:**

Form:	Liquid
Colour:	Colourless

(Contd. on page 5)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 4)

· Odour:	Odourless
· Odour threshold:	Not determined.
· pH-value:	Not determined.
· Change in condition	
Melting point/freezing point:	Not determined.
Initial boiling point and boiling range:	Not determined. 121 °C
· Flash point:	Not applicable.
· Flammability (solid, gas):	Not determined.
· Ignition temperature:	Not determined
· Decomposition temperature:	Not determined.
· Auto-ignition temperature:	Not determined.
· Explosive properties:	Not determined.
· Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
· Vapour pressure at 25 °C:	13 hPa
· Density at 20 °C:	1.645 g/cm ³
· Relative density	Not determined.
· Vapour density	Not determined.
· Evaporation rate	Not determined.
· Solubility in / Miscibility with water:	Not determined.
· Partition coefficient: n-octanol/water:	Not determined.
· Viscosity:	
Dynamic:	Not determined.
Kinematic:	Not determined.
· 9.2 Other information	No further relevant information available.

SECTION 10: Stability and reactivity

- **10.1 Reactivity**
Stable under normal conditions.
No further relevant information available.
- **10.2 Chemical stability** Stable under normal conditions.
- **Thermal decomposition / conditions to be avoided:**
Formation of toxic gases is possible during heating or in case of fire.
- **10.3 Possibility of hazardous reactions** No dangerous reactions known.
- **10.4 Conditions to avoid Heat.**

(Contd. on page 6)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 5)

- **10.5 Incompatible materials:** Strong oxidizing agents.
- **10.6 Hazardous decomposition products:**
Formation of toxic gases is possible during heating or in case of fire.

SECTION 11: Toxicological information

- **11.1 Information on toxicological effects**
- **Acute toxicity** Based on available data, the classification criteria are not met.
- **Primary irritant effect:**
- **Skin corrosion/irritation**
Causes severe skin burns and eye damage.
- **Serious eye damage/irritation**
Causes serious eye damage.
- **Respiratory or skin sensitisation** Based on available data, the classification criteria are not met.
- **CMR effects (carcinogenicity, mutagenicity and toxicity for reproduction)**
- **Germ cell mutagenicity** Based on available data, the classification criteria are not met.
- **Carcinogenicity** Based on available data, the classification criteria are not met.
- **Reproductive toxicity** Based on available data, the classification criteria are not met.
- **STOT-single exposure** Based on available data, the classification criteria are not met.
- **STOT-repeated exposure** Based on available data, the classification criteria are not met.
- **Aspiration hazard** Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

- **12.1 Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **12.2 Persistence and degradability** No further relevant information available.
- **12.3 Bioaccumulative potential** No further relevant information available.
- **12.4 Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water
Do not allow undiluted product to reach ground water, water course or sewage system.
Must not reach sewage water or drainage ditch undiluted or unneutralised.
- **12.5 Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

- **13.1 Waste treatment methods**
- **Recommendation**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

(Contd. on page 7)



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 6)

- **European waste catalogue**
Waste disposal key numbers from EWC have to be assigned depending on origin and processing.
- **Uncleaned packaging:**
- **Recommendation:** Dispose of in accordance with national regulations.

SECTION 14: Transport information

· 14.1 UN-Number	UN3265
· ADR, IMDG, IATA	3265 CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (Heptafluorobutyric acid)
· ADR	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (Heptafluorobutyric acid)
· IMDG, IATA	
-
· 14.3 Transport hazard class(es)	
· ADR, IMDG, IATA	
	
· Class	8 Corrosive substances.
· Label	8
-
· 14.4 Packing group	
· ADR, IMDG, IATA	I
-
· 14.5 Environmental hazards:	Not applicable.
-
· 14.6 Special precautions for user	Warning: Corrosive substances.
· Danger code (Kemler):	88
· EMS Number:	F-A,S-B
· Segregation groups	Acids
· Stowage Category	B
· Stowage Code	SW2 Clear of living quarters.
-
· 14.7 Transport in bulk according to Annex II of Marpol and the IBC Code	Not applicable.
-
· Transport/Additional information:	

· ADR	
· Limited quantities (LQ)	0
· Excepted quantities (EQ)	Code: E0 Not permitted as Excepted Quantity
· Transport category	1
· Tunnel restriction code	E

(Contd. on page 8)

GB



Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 11.09.2020

Version number 2

Revision: 11.09.2020

Product name: Perfluorobutanoic acid

(Contd. from page 7)

· **UN "Model Regulation":** UN 3265 CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (HEPTAFLUOROBUTYRIC ACID), 8, I

SECTION 15: Regulatory information

- **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Directive 2012/18/EU**
- **Named dangerous substances - ANNEX I** Substance is not listed.
- **REGULATION (EC) No 1907/2006 ANNEX XVII** Conditions of restriction: 3
- **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

The information in this safety data sheet (SDS) has been prepared with due care and is true and accurate to the best of our knowledge. The user must determine the suitability of the information for its particular purpose, ensure compliance with existing laws and regulations, and be aware that other or additional safety or performance considerations may arise when using, handling and/ or storing the material. The information in this SDS does not purport to be all inclusive or a guarantee as to the properties of the material supplied, and should be used only as a guide. LGC makes no warranties or representations as to the accuracy and completeness of the information contained herein, shall not be held responsible for the suitability of this information for the user's intended purposes or the consequences of such use, and shall not be liable for any damage or loss, howsoever arising, direct or otherwise.

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

IATA: International Air Transport Association

GHS: Globally Harmonised System of Classification and Labelling of Chemicals

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

PBT: Persistent, Bioaccumulative and Toxic

vPvB: very Persistent and very Bioaccumulative

Skin Corr. 1A: Skin corrosion/irritation – Category 1A

Eye Dam. 1: Serious eye damage/eye irritation – Category 1

· **Sources**

Tables 3.1 and 3.2 from Annex 6 of EC 1272/2008, EC 1907/2006, EH40/2005 as amended 2011, Registry of Toxic Effects of Chemical Substances (RTECS), The Dictionary of Substances and their Effects, 1st Edition, IUCLID.

- **Data compared to the previous version altered.** All sections have been updated.

SAFETY DATA SHEET

Revision Date 14-Feb-2020

Revision Number 3

1. Identification

Product Name Perfluorodecanoic acid

Cat No. : B22292

CAS-No 335-76-2

Synonyms Decanoic acid, nonadecafluoro-; Ndfda; Nonadecafluoro-n-decanoic acid

Recommended Use Laboratory chemicals.

Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Alfa Aesar
Thermo Fisher Scientific Chemicals, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Tel: 800-343-0660
Fax: 800-322-4757
Email: tech@alfa.com
www.alfa.com

Emergency Telephone Number

During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660.
After normal business hours, call Carechem 24 at (866) 928-0789.

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Carcinogenicity	Category 2
Reproductive Toxicity	Category 1A
Effects on or via lactation	

Label Elements

Signal Word

Danger

Hazard Statements

Suspected of causing cancer
May damage the unborn child. Suspected of damaging fertility
May cause harm to breast-fed children

**Precautionary Statements****Prevention**

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Do not breathe dust/fume/gas/mist/vapors/spray
Avoid contact during pregnancy/while nursing
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product

Response

IF exposed or concerned: Get medical attention/advice

Storage

Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Decanoic acid, nonadecafluoro-	335-76-2	96

4. First-aid measures

General Advice	Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do NOT induce vomiting. Call a physician or poison control center immediately.
Most important symptoms and effects	None reasonably foreseeable.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO ₂). Dry chemical. Alcohol resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	Not applicable
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂). Gaseous hydrogen fluoride (HF).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health
3

Flammability
0

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Avoid dust formation.

7. Handling and storage

Handling	Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Avoid dust formation. Use only under a chemical fume hood. Do not breathe (dust, vapor, mist, gas). Do not ingest. If swallowed then seek immediate medical assistance.
Storage	Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.
Engineering Measures	Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.
Personal Protective Equipment	
Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard

EN166.

Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	White
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	77 - 83 °C / 170.6 - 181.4 °F
Boiling Point/Range	218 °C / 424.4 °F @ 740 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C10 H F19 O2
Molecular Weight	514.08

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Bases, Reducing Agent
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂), Gaseous hydrogen fluoride (HF)
Hazardous Polymerization	No information available.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Decanoic acid, nonadecafluoro-	LD50 = 57 mg/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic No information available

Products**Delayed and immediate effects as well as chronic effects from short and long-term exposure**

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Decanoic acid, nonadecafluoro-	335-76-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains.

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN2811
 Proper Shipping Name TOXIC SOLIDS, ORGANIC, N.O.S.
 Technical Name Decanoic acid, nonadecafluoro-
 Hazard Class 6.1
 Packing Group II

TDG

UN-No UN2811
 Proper Shipping Name Toxic solid, organic, n.o.s.
 Hazard Class 6.1
 Packing Group II

IATA

UN-No UN2811
 Proper Shipping Name Toxic solid, organic, n.o.s.
 Hazard Class 6.1
 Packing Group II

IMDG/IMO

UN-No UN2811
 Proper Shipping Name Toxic solid, organic, n.o.s.
 Hazard Class 6.1
 Packing Group II

15. Regulatory information**United States of America Inventory**

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Decanoic acid, nonadecafluoro-	335-76-2	X	ACTIVE	S

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

' ' - Not Listed

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule.

TSCA 12(b) - Notices of Export

Component	CAS-No	TSCA 12(b) - Notices of Export
Decanoic acid, nonadecafluoro-	335-76-2	Section 5

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Decanoic acid, nonadecafluoro-	335-76-2	-	-	206-400-3	-	X	-	-	-

U.S. Federal Regulations

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ): N

DOT Marine Pollutant N

DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations**Mexico - Grade**

No information available

16. Other information**Prepared By**Health, Safety and Environmental Department
Email: tech@alfa.com
www.alfa.com**Revision Date**

14-Feb-2020

Print Date

14-Feb-2020

Revision Summary

SDS authoring systems update, replaces ChemGes SDS No. 335-76-2.

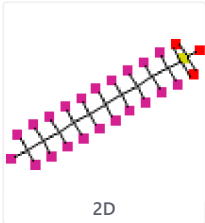
Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

COMPOUND SUMMARY

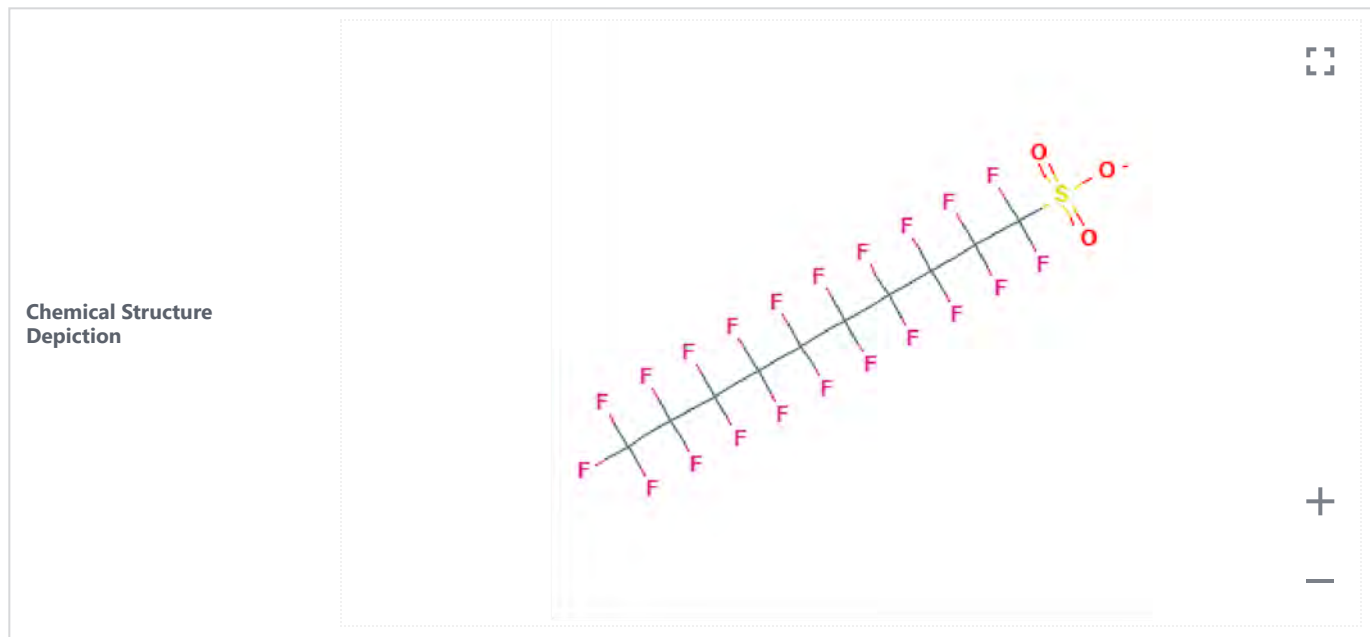
1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Henicosafuorodecane-1-sulfonate

PubChem CID	3446488
Structure	 Find Similar Structures
Molecular Formula	C ₁₀ F ₂₁ O ₃ S ⁻
Synonyms	perfluorodecanesulfonate 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-henicosafuorodecane-1-sulfonate DTXSID00873014 Henicosafuoro-1-decanesulfonic acid anion 126105-34-8
Molecular Weight	599.14
Parent Compound	 CID 67636 (Perfluorodecane sulfonic acid)
Dates	Modify 2021-05-22 Create 2005-09-08

1 Structures



1.1 2D Structure



► [PubChem](#)

1.2 3D Status



Conformer generation failed at clustering step

► [PubChem](#)

Computed by LexiChem 2.6.6 (PubChem release 2019.06.18)

► PubChem

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► PubChem

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

▶ PubChem

Computed by OEChem 2.1.5 (PubChem release 2019.06.18)

▶ PubChem

Computed by PubChem 2.1 (PubChem release 2019.06.18)

▶ PubChem

► EPA DSSTox

DTXSID00873014

► EPA DSSTox

2.3.3 Wikipedia



Perfluorodecanesulfonate

► Wikipedia

2.4 Synonyms



2.4.1 Depositor-Supplied Synonyms



perfluorodecanesulfonate

1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-henicosafuorodecane-1-sulfonate

DTXSID00873014

Henicosafuoro-1-decanesulfonic acid anion

126105-34-8

► PubChem

3 Chemical and Physical Properties

3.1 Computed Properties

Property Name	Property Value	Reference
Molecular Weight	599.14	Computed by PubChem 2.1 (PubChem release 2021.05.07)
XLogP3-AA	6.3	Computed by XLogP3 3.0 (PubChem release 2019.06.18)
Hydrogen Bond Donor Count	0	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Hydrogen Bond Acceptor Count	24	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Rotatable Bond Count	8	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Exact Mass	598.9232814	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Monoisotopic Mass	598.9232814	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Topological Polar Surface Area	65.6 Å²	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Heavy Atom Count	35	Computed by PubChem
Formal Charge	-1	Computed by PubChem
Complexity	893	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2011.04.04)

► PubChem

4 Related Records



4.1 Related Compounds with Annotation



► PubChem

4.2 Parent Compound



CID 67636 (Perfluorodecane sulfonic acid)

► PubChem

4.3 Related Compounds



Same Parent, Exact	20 Records
Mixtures, Components, and Neutralized Forms	1 Record
Similar Compounds	84 Records

► PubChem

4.4 Substances



4.4.1 Related Substances



Same	9 Records

► PubChem

4.4.2 Substances by Category



► PubChem

5 Literature



5.1 Chemical Co-Occurrences in Literature



► PubChem

5.2 Chemical-Gene Co-Occurrences in Literature



► PubChem

5.3 Chemical-Disease Co-Occurrences in Literature



► PubChem

6 Patents



6.1 Depositor-Supplied Patent Identifiers



► PubChem

[Link to all deposited patent identifiers](#)

► PubChem

7 Classification



7.1 Ontologies



7.1.1 NORMAN Suspect List Exchange Classification



► [NORMAN Suspect List Exchange](#)

7.1.2 EPA DSSTox Classification



► [EPA DSSTox](#)

8 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. EPA DSSTox

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

Perfluorodecanesulfonate

<https://comptox.epa.gov/dashboard/DTXSID00873014>

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical_lists/

2. Wikipedia

Perfluorodecanesulfonate

<https://www.wikidata.org/wiki/Q81978598>

3. PubChem

<https://pubchem.ncbi.nlm.nih.gov>

4. NORMAN Suspect List Exchange

NORMAN Suspect List Exchange Classification

<https://www.norman-network.com/nds/SLE/>

**COVID-19 Information**[Public health information \(CDC\)](#) [Research information \(NIH\)](#) [SARS-CoV-2 data \(NCBI\)](#)[Prevention and treatment information \(HHS\)](#) [Español](#)

COMPOUND SUMMARY

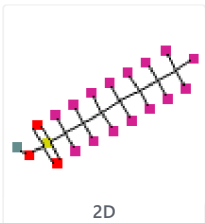
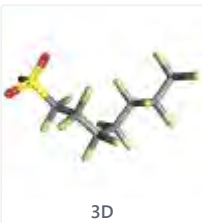
Perfluoroheptanesulfonic acid



Cite



Download

PubChem CID	67820
Structure	  2D 3D Find Similar Structures
Chemical Safety	  Corrosive Irritant Laboratory Chemical Safety Summary (LCSS) Datasheet
Molecular Formula	C ₇ HF ₁₅ O ₃ S
Synonyms	perfluoroheptanesulfonic acid 375-92-8 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoroheptane-1-sulfonic acid perfluoroheptane sulfonic acid 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-Pentadecafluoroheptane-1-sulphonic acid More...
Molecular Weight	450.12
Dates	Modify Create 2021-05-22 2005-08-08

Contents

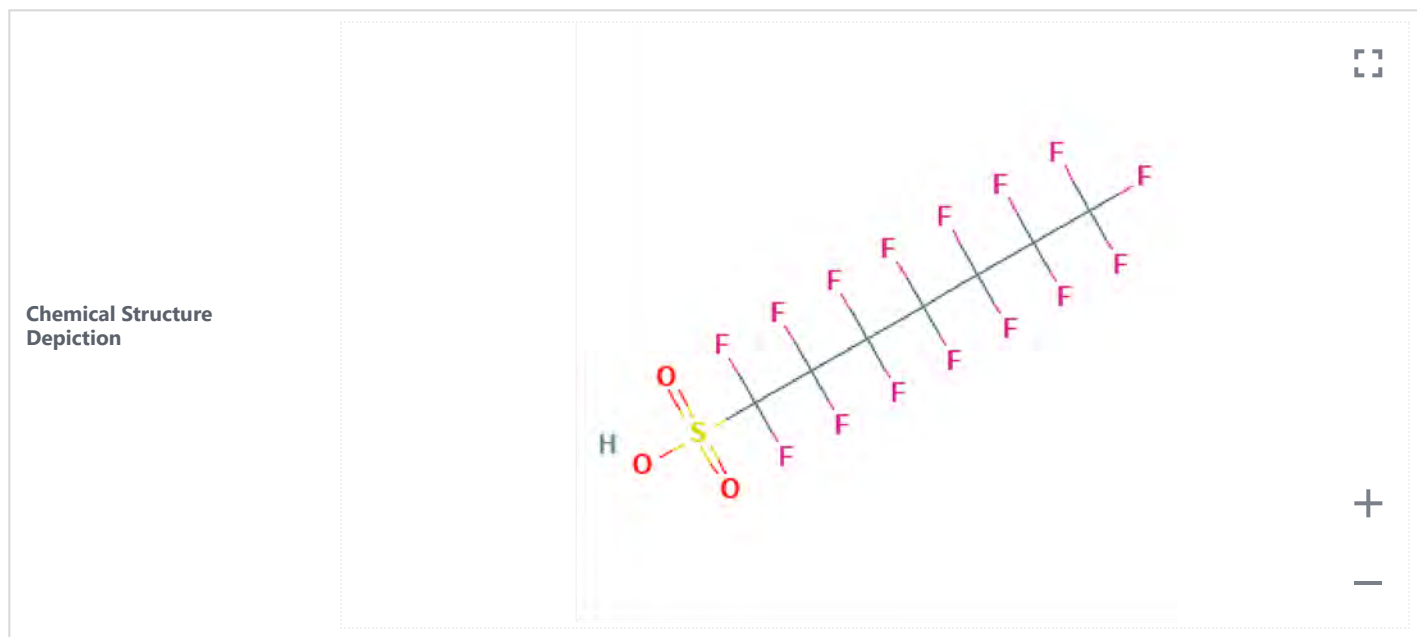
[1 Structures](#)[2 Names and Identifiers](#)[3 Chemical and Physical Properties](#)[4 Spectral Information](#)[5 Related Records](#)

6 Chemical Vendors	
7 Use and Manufacturing	▼
8 Safety and Hazards	▼
9 Literature	▼
10 Patents	▼
11 Classification	▼
12 Information Sources	

1 Structures



1.1 2D Structure



► PubChem

1.2 3D Conformer



► PubChem

2 Names and Identifiers



2.1 Computed Descriptors



2.1.1 IUPAC Name



1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoroheptane-1-sulfonic acid

Computed by LexiChem 2.6.6 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.2 InChI



InChI=1S/C7HF15O3S/c8-1(9,2(10,11)4(14,15)6(18,19)20)3(12,13)5(16,17)7(21,22)26(23,24)25/h(H,23,24,25)

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.3 InChI Key



OYGQVDSRYXATEL-UHFFFAOYSA-N

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.4 Canonical SMILES



C(C(C(C(F)(F)(F)F)(F)F)(C(C(C(F)(F)S(=O)(=O)O)(F)F)(F)F)(F)F

Computed by OEChem 2.1.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.2 Molecular Formula



C7HF15O3S

Computed by PubChem 2.1 (PubChem release 2019.06.18)

► [PubChem](#)

2.3 Other Identifiers



2.3.1 CAS



375-92-8

► [CAS Common Chemistry](#); [ChemIDplus](#); [EPA Chemicals under the TSCA](#); [EPA DSSTox](#); [European Chemicals Agency \(ECHA\)](#)

2.3.2 European Community (EC) Number



206-800-8

► [European Chemicals Agency \(ECHA\)](#)

2.3.3 DSSTox Substance ID



DTXSID8059920

► [EPA DSSTox](#)

2.4 Synonyms



2.4.1 Depositor-Supplied Synonyms



perfluoroheptanesulfonic acid	AKOS030255152
375-92-8	ZINC100424529
1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoroheptane-1-sulfonic acid	Perfluoroheptane sulfonic acid (PFHpS)
perfluoroheptane sulfonic acid	Perfluoroheptanesulfonic acid 100 microg/mL in Acetonitrile
1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-Pentadecafluoroheptane-1-sulphonic acid	
1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-	
Pentadecafluoro-1-heptanesulfonic acid	
EINECS 206-800-8	
SCHEMBL466749	
DTXSID8059920	
CS-B0913	
MFCD28015666	
1-Heptanesulfonic acid,1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-	

► [PubChem](#)

3 Chemical and Physical Properties



3.1 Computed Properties



Property Name	Property Value	Reference
Molecular Weight	450.12	Computed by PubChem 2.1 (PubChem release 2021.05.07)
XLogP3-AA	4.3	Computed by XLogP3 3.0 (PubChem release 2019.06.18)
Hydrogen Bond Donor Count	1	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Hydrogen Bond Acceptor Count	18	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Rotatable Bond Count	6	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Exact Mass	449.9406875	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Monoisotopic Mass	449.9406875	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Topological Polar Surface Area	62.8 Å ²	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Heavy Atom Count	26	Computed by PubChem
Formal Charge	0	Computed by PubChem
Complexity	639	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2019.01.04)

► PubChem

4 Spectral Information

4.1 Mass Spectrometry

4.1.1 LC-MS

Showing 2 of 3 [View More](#) 

MoNA ID	AU595851
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	448.9334
Instrument	Bruker maXis Impact
Instrument Type	LC-ESI-QTOF
Ionization	ESI
Ionization Mode	negative
Collision Energy	20 eV
Retention Time	9.686 min
Splash	splash10-0002-0000900000-b1b456309cf71a49e08b
Thumbnail	
Submitter	Nikolaos Thomaidis, University of Athens

 [MassBank of North America \(MoNA\)](#)

MoNA ID	AU595852
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	448.9334

Instrument	Bruker maXis Impact
Instrument Type	LC-ESI-QTOF
Ionization	ESI
Ionization Mode	negative
Collision Energy	30 eV
Retention Time	9.688 min
Splash	splash10-0002-0000900000-6d7d70ed96726bc23786
Thumbnail	
Submitter	Nikolaos Thomaidis, University of Athens

► [MassBank of North America \(MoNA\)](#)

4.1.2 Other MS

MoNA ID	MoNA024593
MS Category	Experimental
Precursor Type	[M-H]-
precursor m/z	448.9334129
Ionization Mode	negative
Splash	splash10-018b-9400200000-d38b5d1b7a909adacd7d
Thumbnail	

Submitter	Arpana Vaniya, UC DAVIS

► [MassBank of North America \(MoNA\)](#)

5 Related Records



5.1 Related Compounds with Annotation



► PubChem

5.2 Related Compounds



Same Parent, Exact	20 Records
Mixtures, Components, and Neutralized Forms	25 Records
Similar Compounds	38 Records
Similar Conformers	344 Records

► PubChem

5.3 Substances



5.3.1 Related Substances



All	147 Records
Same	47 Records
Mixture	100 Records

► PubChem

5.3.2 Substances by Category



► PubChem

5.4 Entrez Crosslinks



PubMed	4 Records

► PubChem

6 Chemical Vendors



► PubChem

7 Use and Manufacturing



7.1 Use Classification



PFAS (per- and polyfluoroalkyl substances) -> OECD Category

S25 | OECD PFAS | List of PFAS from the OECD | [DOI:10.5281/zenodo.2648775](https://doi.org/10.5281/zenodo.2648775)

► [NORMAN Suspect List Exchange](#)

7.2 General Manufacturing Information



EPA TSCA Commercial Activity Status

1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-: INACTIVE

<https://www.epa.gov/tsca-inventory>

► [EPA Chemicals under the TSCA](#)

EPA TSCA Regulatory Flag

S - indicates a substance that is identified in a final Significant New Use Rule.

<https://www.epa.gov/tsca-inventory>

► [EPA Chemicals under the TSCA](#)

8 Safety and Hazards



8.1 Hazards Identification



8.1.1 GHS Classification



Pictogram(s)	  Corrosive Irritant
Signal	<u>Danger</u>
GHS Hazard Statements	H302 (100%): Harmful if swallowed [Warning Acute toxicity, oral] H312 (100%): Harmful in contact with skin [Warning Acute toxicity, dermal] H314 (100%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation] H332 (100%): Harmful if inhaled [Warning Acute toxicity, inhalation]
Precautionary Statement Codes	P260, P261, P264, P270, P271, P280, P301+P312, P301+P330+P331, P302+P352, P303+P361+P353, P304+P312, P304+P340, P305+P351+P338, P310, P312, P321, P322, P330, P363, P405, and P501 (The corresponding statement to each P-code can be found at the GHS Classification page.)
ECHA C&L Notifications Summary	<i>The GHS information provided by 1 company from 1 notification to the ECHA C&L Inventory.</i>

► [European Chemicals Agency \(ECHA\)](#)

8.1.2 Hazard Classes and Categories



Acute Tox. 4 (100%)

Acute Tox. 4 (100%)

Skin Corr. 1B (100%)

Acute Tox. 4 (100%)

► [European Chemicals Agency \(ECHA\)](#)

9 Literature



9.1 Springer Nature References



► Springer Nature

9.2 Depositor Provided PubMed Citations



► PubChem

9.3 Chemical Co-Occurrences in Literature



► PubChem

9.4 Chemical-Gene Co-Occurrences in Literature



► PubChem

9.5 Chemical-Disease Co-Occurrences in Literature



► [PubChem](#)

10 Patents



10.1 Depositor-Supplied Patent Identifiers



► PubChem

[Link to all deposited patent identifiers](#)

► PubChem

10.2 WIPO PATENTSCOPE



Patents are available for this chemical structure:

<https://patentscope.wipo.int/search/en/result.jsf?inchikey=OYGQVDSRYXATEL-UHFFFAOYSA-N>

► PATENTSCOPE (WIPO)

11 Classification



11.1 Ontologies



11.1.1 ChemIDplus



► [ChemIDplus](#)

11.1.2 UN GHS Classification



► [UN Globally Harmonized System of Classification and Labelling of Chemicals \(GHS\)](#)

11.1.3 NORMAN Suspect List Exchange Classification



► NORMAN Suspect List Exchange

11.1.4 EPA DSSTox Classification



► EPA DSSTox

12 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. CAS Common Chemistry

LICENSE

The data from CAS Common Chemistry is provided under a CC-BY-NC 4.0 license, unless otherwise stated.

<https://creativecommons.org/licenses/by-nc/4.0/>

Perfluoroheptanesulfonic acid

https://commonchemistry.cas.org/detail?cas_rn=375-92-8

2. ChemIDplus

LICENSE

<https://www.nlm.nih.gov/copyright.html>

1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-

<https://chem.nlm.nih.gov/chemidplus/sid/0000375928>

ChemIDplus Chemical Information Classification

<https://chem.nlm.nih.gov/chemidplus/>

3. EPA Chemicals under the TSCA

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-

<https://www.epa.gov/chemicals-under-tsca>

4. EPA DSSTox

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-

<https://comptox.epa.gov/dashboard/DTXSID8059920>

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical_lists/

5. European Chemicals Agency (ECHA)

LICENSE

Use of the information, documents and data from the ECHA website is subject to the terms and conditions of this Legal Notice, and subject to other binding limitations provided for under applicable law, the information, documents and data made available on the ECHA website may be reproduced, distributed and/or used, totally or in part, for non-commercial purposes provided that ECHA is acknowledged as the source: "Source: European Chemicals Agency, <http://echa.europa.eu/>". Such acknowledgement must be included in each copy of the material. ECHA permits and encourages organisations and individuals to create links to the ECHA website under the following cumulative conditions: Links can only be made to webpages that provide a link to the Legal Notice page.

<https://echa.europa.eu/web/guest/legal-notice>

1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoroheptane-1-sulphonic acid

<https://echa.europa.eu/substance-information/-/substanceinfo/100.006.183>

1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoroheptane-1-sulphonic acid

<https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/31812>

6. MassBank of North America (MoNA)

LICENSE

The content of the MoNA database is licensed under CC BY 4.0.

<https://mona.fiehnlab.ucdavis.edu/documentation/license>

Perfluoroheptane sulfonic acid (PFHpS)

<http://mona.fiehnlab.ucdavis.edu/spectra/browse?inchikey=OYGVDSRYXATEL-UHFFFAOYSA-N>

7. NORMAN Suspect List Exchange

LICENSE

Data: CC-BY 4.0; Code (hosted by ECI, LCSB): Artistic-2.0

<https://creativecommons.org/licenses/by/4.0/>

1-Heptanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-pentadecafluoro-

NORMAN Suspect List Exchange Classification

<https://www.norman-network.com/nds/SLE/>

8. **Springer Nature**

<https://pubchem.ncbi.nlm.nih.gov/substance/341183449>

9. **PubChem**

<https://pubchem.ncbi.nlm.nih.gov>

10. **UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)**

GHS Classification Tree

http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

11. **PATENTSCOPE (WIPO)**

SID 388347599

<https://pubchem.ncbi.nlm.nih.gov/substance/388347599>

SAFETY DATA SHEET

Creation Date 06-Mar-2007

Revision Date 19-Jan-2018

Revision Number 4

1. Identification

Product Name Perfluoroheptanoic acid

Cat No. : AC277270000; AC277270050; AC277270100

CAS-No 375-85-9
Synonyms 2,2,3,3,4,4,5,5,6,6,7,7,7-Tridecafluoroheptanoic acid

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.
Details of the supplier of the safety data sheet

Company

Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11

Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99

CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**:001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4
Skin Corrosion/Irritation	Category 1 B
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word

Danger

Hazard Statements

Harmful if swallowed

Causes severe skin burns and eye damage

May cause respiratory irritation

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area

Response

Immediately call a POISON CENTER or doctor/physician

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

Ingestion

Rinse mouth
Do NOT induce vomiting

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Heptanoic acid, tridecafluoro-	375-85-9	96

4. First-aid measures

Eye Contact	Immediate medical attention is required. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Immediate medical attention is required.
Inhalation	Remove from exposure, lie down. Remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Immediate medical attention is required.
Ingestion	Do NOT induce vomiting. Call a physician immediately.
Most important symptoms and effects	Causes burns by all exposure routes. . Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue

Notes to Physician and danger of perforation
Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Carbon dioxide (CO₂). Dry chemical. Chemical foam.

Unsuitable Extinguishing Media No information available

Flash Point > 110 °C / > 230 °F

Method - No information available

Autoignition Temperature No information available

Explosion Limits

Upper No data available

Lower No data available

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂). Gaseous hydrogen fluoride (HF).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
3

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment as required.

Environmental Precautions See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Do not let this chemical enter the environment.

7. Handling and storage

Handling Do not breathe dust. Do not get in eyes, on skin, or on clothing. Do not ingest. If swallowed then seek immediate medical assistance. Handle product only in closed system or provide appropriate exhaust ventilation.

Storage Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed.
Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limit established by the region specific regulatory bodies.

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Light yellow
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	30 °C / 86 °F
Boiling Point/Range	175 °C / 347 °F @ 760 mmHg
Flash Point	> 110 °C / > 230 °F
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	1.790
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C7 H F13 O2
Molecular Weight	364.05

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Strong oxidizing agents, Acids
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂), Gaseous hydrogen fluoride (HF)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information**Acute Toxicity**

Product Information**Component Information****Toxicologically Synergistic** No information available**Products****Delayed and immediate effects as well as chronic effects from short and long-term exposure****Irritation** Causes burns by all exposure routes**Sensitization** No information available**Carcinogenicity** The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Heptanoic acid, tridecafluoro-	375-85-9	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available**Reproductive Effects** No information available.**Developmental Effects** No information available.**Teratogenicity** No information available.**STOT - single exposure** Respiratory system**STOT - repeated exposure** None known**Aspiration hazard** No information available

Symptoms / effects, both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available**Other Adverse Effects** The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains.

Persistence and Degradability No information available**Bioaccumulation/ Accumulation** No information available.**Mobility** No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN3261
 Proper Shipping Name Corrosive solid, acidic, organic, n.o.s.
 Technical Name Heptanoic acid, tridecafluoro-
 Hazard Class 8
 Packing Group II

TDG

UN-No UN3261
Proper Shipping Name Corrosive solid, acidic, organic, n.o.s.
Hazard Class 8
Packing Group II

IATA

UN-No UN3261
Proper Shipping Name Corrosive solid, acidic, organic, n.o.s.
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN3261
Proper Shipping Name Corrosive solid, acidic, organic, n.o.s.
Hazard Class 8
Packing Group II

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Heptanoic acid, tridecafluoro-	375-85-9	X	ACTIVE	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Heptanoic acid, tridecafluoro-	375-85-9	-	X	206-798-9	-	X	X	-	KE-28149

U.S. Federal Regulations

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ): N
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations**Mexico - Grade**

No information available

16. Other information**Prepared By**Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com**Creation Date**

06-Mar-2007

Revision Date

19-Jan-2018

Print Date

19-Jan-2018

Revision Summary

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

**COVID-19 Information**

[Public health information \(CDC\)](#) [Research information \(NIH\)](#) [SARS-CoV-2 data \(NCBI\)](#) [Prevention and treatment information \(HHS\)](#)
[Español](#)



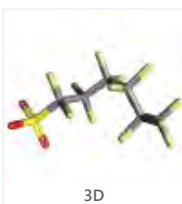
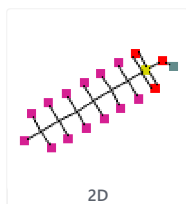
COMPOUND SUMMARY

Perfluorohexanesulfonic acid

PubChem CID

67734

Structure

[Find Similar Structures](#)

Chemical Safety



Corrosive



Irritant

[Laboratory Chemical Safety Summary \(LCSS\) Datasheet](#)

Molecular Formula

C₆HF₁₃O₃S

Synonyms

Perfluorohexanesulfonic acid
355-46-4
1,1,2,2,3,3,4,4,5,5,6,6,6-Tridecafluorohexane-1-sulfonic acid
Perfluorohexane-1-sulphonic acid
perfluorohexane sulfonic acid

[More...](#)

Molecular Weight

400.12

Dates

Modify	Create
2021-05-22	2005-08-08

Perfluorohexanesulfonic acid is a perfluoroalkanesulfonic acid that is [hexane-1-sulfonic acid](#) in which all thirteen of the hydrogens that are attached to carbons have been replaced by fluorines.

[ChEBI](#)

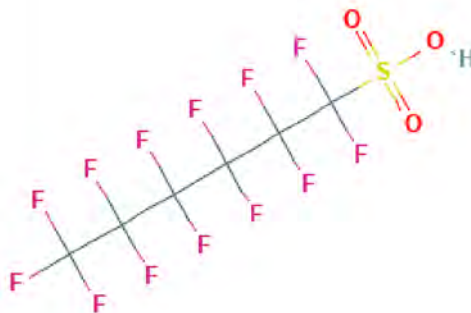
1 Structures



1.1 2D Structure



Chemical Structure
Depiction



+

-

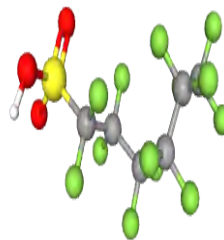
► PubChem

1.2 3D Conformer



Interactive Chemical
Structure Model

- ☒ Ball and Stick
- ☐ Sticks
- ☐ Wire-Frame
- ☐ Space-Filling
- ☒ Show Hydrogens
- ☐ Animate



+

-

► PubChem

2 Names and Identifiers



2.1 Computed Descriptors



2.1.1 IUPAC Name



1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluorohexane-1-sulfonic acid

Computed by LexiChem 2.6.6 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.2 InChI



InChI=1S/C6HF13O3S/c7-1(8,3(11,12)5(15,16)17)2(9,10)4(13,14)6(18,19)23(20,21)22/h(H,20,21,22)

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.3 InChI Key



QZHDEAJFRJCDMF-UHFFFAOYSA-N

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.4 Canonical SMILES



C(C(C(C(F)(F)S(=O)(=O)O)(F)F)(F)F)(C(C(F)(F)F)(F)F)(F)F

Computed by OEChem 2.1.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.2 Molecular Formula



C6HF13O3S

Computed by PubChem 2.1 (PubChem release 2019.06.18)

► [PubChem](#)

2.3 Other Identifiers



2.3.1 CAS



355-46-4

► [CAS Common Chemistry](#); [ChemIDplus](#); [EPA Chemicals under the TSCA](#); [EPA DSSTox](#); [European Chemicals Agency \(ECHA\)](#); [Hazardous Substances Data Bank \(HSDB\)](#)

2.3.2 European Community (EC) Number



206-587-1

► [European Chemicals Agency \(ECHA\)](#)

2.3.3 UNII



ZU6Y1E592S

▶ FDA/SPL Indexing Data

2.3.4 DSSTox Substance ID

?

↗

DTXSID7040150

▶ EPA DSSTox

2.3.5 Wikipedia

?

↗

Perfluorohexanesulphonic acid

▶ Wikipedia

Perfluorohexanesulfonate

▶ Wikipedia

2.4 Synonyms

?

↗

2.4.1 MeSH Entry Terms

?

↗

perfluorohexanesulfonate

perfluorohexanesulfonic acid

PFHS cpd

▶ Medical Subject Headings (MeSH)

2.4.2 Depositor-Supplied Synonyms

?

↗

Perfluorohexanesulfonic acid	C6HF13O3S	AKOS016005064
355-46-4	EINECS 206-587-1	Perfluorohexane sulfonic acid (PFHxS)
1,1,2,2,3,3,4,4,5,5,6,6,6-Tridecafluorohexane-1-sulfonic acid	SCHEMBL332726	LS41238
Perfluorohexane-1-sulphonic acid	CHEMBL1906987	Z-1469
perfluorohexane sulfonic acid	DTXSID7040150	Q26833878
perfluorohexanesulphonic acid	HSDB 8274	Perfluorohexanesulfonic acid 100 microg/mL in Acetonitrile
UNII-ZU6Y1E592S	AMY7161	Perfluorohexanesulfonic acid 50 microg/mL in Methanol:Water
1-Hexanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-	CHEBI:132448	
perfluorohexanesulfonate	CS-B0907	
ZU6Y1E592S	4434AB	
Perfluorohexane-1-sulfonic acid	ANW-65167	
tridecafluorohexane-1-sulfonic acid	MFCD00042453	
PFHxS	ZINC38141431	

▶ PubChem

3 Chemical and Physical Properties



3.1 Computed Properties



Property Name	Property Value	Reference
Molecular Weight	400.12	Computed by PubChem 2.1 (PubChem release 2021.05.07)
XLogP3-AA	3.7	Computed by XLogP3 3.0 (PubChem release 2019.06.18)
Hydrogen Bond Donor Count	1	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Hydrogen Bond Acceptor Count	16	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Rotatable Bond Count	5	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Exact Mass	399.9438812	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Monoisotopic Mass	399.9438812	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Topological Polar Surface Area	62.8 Å ²	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Heavy Atom Count	23	Computed by PubChem
Formal Charge	0	Computed by PubChem
Complexity	553	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2019.01.04)

► PubChem

3.2 Experimental Properties



3.2.1 Boiling Point



238.5 °C

► EPA DSSTox

238-239 °C

Kosswig K; Sulfonic Acids, Aliphatic. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2015). New York, NY: John Wiley & Sons. Online Posting Date: Jun 15, 2000.

► Hazardous Substances Data Bank (HSDB)

3.2.2 Solubility



In water, 6.2 mg/L at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuitd.htm>

► Hazardous Substances Data Bank (HSDB)

3.2.3 Density



1.841 g/cu cm

ChemIndex; Perfluorohexane-1-sulphonic Acid. Available from, as of Oct 6, 2015: <http://www.chemindex.com/355-46-4-cas.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.4 Vapor Pressure



0.0046 mm Hg at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.5 LogP



log Kow = 3.16 (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.6 Stability/Shelf Life



Chemical stability: Stable under recommended storage conditions. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.7 Refractive Index



Index of refraction: 1.309

ChemIndex; Perfluorohexane-1-sulphonic Acid. Available from, as of Oct 6, 2015: <http://www.chemindex.com/355-46-4-cas.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.8 Dissociation Constants



pKa = 0.14 (est)

ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.9 Collision Cross Section



150.81 Å² [M-H]⁻

228.66 Å² [2M-H]⁻

S79 | UACCSCEC | Collision Cross Section (CCS) Library from UAntwerp | [DOI:10.5281/zenodo.4704648](https://doi.org/10.5281/zenodo.4704648)

► [NORMAN Suspect List Exchange](#)

3.2.10 Other Experimental Properties



Beige crystals /[Perfluorohexanesulfonic acid potassium salt](#)/

Sigma-Aldrich; Product Search. Tridecafluorohexane-1-sulfonic acid potassium salt. (3871-99-6). Available from, as of Oct 9, 2015: <http://www.sigmaaldrich.com/united-states.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Henry's Law constant: 4.0X10⁻⁴ atm cu m/mol at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Hydroxyl radical reaction rate constant: 1.4×10^{-13} cu cm/molecule-sec at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

4 Spectral Information

?

4.1 Mass Spectrometry

?

4.1.1 LC-MS

?

Showing 2 of 4 [View More](#)

MoNA ID	AU595750
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	398.9366
Instrument	Bruker maXis Impact
Instrument Type	LC-ESI-QTOF
Ionization	ESI
Ionization Mode	negative
Collision Energy	10 eV
Retention Time	8.837 min
Splash	splash10-0002-0009000000-032b155c5aad417d734a
Thumbnail	
Submitter	Nikolaos Thomaidis, University of Athens

[▶ MassBank of North America \(MoNA\)](#)

MoNA ID	AU595751
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	398.9366
Instrument	Bruker maXis Impact
Instrument Type	LC-ESI-QTOF
Ionization	ESI
Ionization Mode	negative

Collision Energy	20 eV
Retention Time	8.846 min
Splash	splash10-0002-0009000000-10401c65f3ead0881273
Thumbnail	
Submitter	Nikolaos Thomaidis, University of Athens

► [MassBank of North America \(MoNA\)](#)

4.1.2 Other MS

MoNA ID	MoNA024592
MS Category	Experimental
Precursor Type	[M-H]-
precursor m/z	398.9366065
Ionization Mode	negative
Splash	splash10-018b-9402000000-9465cdba153ac41e8185
Thumbnail	
Submitter	Arpana Vaniya, UC DAVIS

► [MassBank of North America \(MoNA\)](#)

5 Related Records



5.1 Related Compounds with Annotation



► PubChem

5.2 Related Compounds



Same Parent, Exact	50 Records
Mixtures, Components, and Neutralized Forms	97 Records
Similar Compounds	31 Records
Similar Conformers	743 Records

► PubChem

5.3 Substances



5.3.1 Related Substances



All	309 Records
Same	72 Records
Mixture	237 Records

► PubChem

5.3.2 Substances by Category



► PubChem

5.4 Entrez Crosslinks



PubMed	196 Records
Taxonomy	5 Records
OMIM	14 Records
Gene	207 Records

► PubChem

5.5 Associated Chemicals



Tridecafluorohexane-1-sulfonic acid potassium salt; 3871-99-6

► Hazardous Substances Data Bank (HSDB)

Perfluorohexanesulfonate; 355-46-4

► Hazardous Substances Data Bank (HSDB)

6 Chemical Vendors



► PubChem

7 Pharmacology and Biochemistry



7.1 Absorption, Distribution and Excretion



/MILK/ The widespread presence of **perfluorooctanesulfonate** (PFOS), **perfluorooctanoate** (PFOA), and **perfluorohexanesulfonate** (PFHxS) in human general populations and their slow elimination profiles have led to renewed interest in understanding the potential human neonatal exposures of perfluoroalkyls (PFAs) from consumption of human milk. The objective of this study was to evaluate the concentrations of **PFOS**, **PFHxS**, and **PFOA** in pooled human milk samples obtained in Sweden between 1972 and 2008 (a period representing the most significant period of PFA production) and to see whether the time trend of these analytes parallels that indicated in human serum. Chemical analysis of **PFOS**, **PFHxS**, and **PFOA** was performed on pooled Swedish human milk samples from 1972 to 2008 after methodological refinements. The 20 samples which formed the 2007 pool were also analyzed individually to evaluate sample variations. Analyses were performed by HPLC-MS/MS. Due to the complexities of the human milk matrix and the requirement to accurately quantitate low pg/mL concentrations, meticulous attention must be paid to background contamination if accurate results are to be obtained. **PFOS** was the predominant analyte present in the pools and all three analytes showed statistically significant increasing trends from 1972 to 2000, with concentrations reaching a plateau in the 1990s. **PFOA** and **PFOS** showed statistically significant decreasing trends during 2001-2008. At the end of the study, in 2008, the measured concentrations of **PFOS**, **PFHxS**, and **PFOA** in pooled human milk were 75 pg/mL, 14 pg/mL, and 74 pg/mL, respectively. The temporal concentration trends of **PFOS**, **PFHxS**, and **PFOA** observed in human milk are parallel to those reported in the general population serum concentrations.

PMID:20880590

Sundstrom M et al; *Environ Int* 37(1):178-83 (2011).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/MILK/ The presence of perfluoroalkyl acids (PFAAs) in breast milk has been documented, but their lactational transfer has been rarely studied. Determination of the elimination rates of these chemicals during breastfeeding is important and critical for assessing exposure in mothers and infants. We aimed to investigate the association between breastfeeding and maternal serum concentrations of **perfluorooctanoic acid** (PFOA), **perfluorooctane sulfonate** (PFOS), **perfluorononanoic acid** (PFNA), and **perfluorohexane sulfonate** (PFHxS). For a subset of the population, for whom we also have their infants' measurements, we investigated associations of breastfeeding with infant serum PFAA concentrations. The present analysis included 633 women from the C8 Science Panel Study who had a child < 3.5 years of age and who provided blood samples and reported detailed information on breastfeeding at the time of survey. PFAA serum concentrations were available for all mothers and 8% (n = 49) of the infants. Maternal and infant serum concentrations were regressed on duration of breastfeeding. Each month of breastfeeding was associated with lower maternal serum concentrations of PFOA (-3%; 95% CI: -5, -2%), PFOS (-3%; 95% CI: -3, -2%), PFNA (-2%; 95% CI: -2, -1%), and PFHxS (-1%; 95% CI: -2, 0%). The infant PFOA and PFOS serum concentrations were 6% (95% CI: 1, 10%) and 4% (95% CI: 1, 7%) higher per month of breastfeeding. Breast milk is the optimal food for infants, but is also a PFAA excretion route for lactating mothers and exposure route for nursing infants.

PMID:24280536

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3915259>

Mondal D et al; *Environ Health Perspect* 122(2):187-92 (2014).

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorooctane sulfonate (PFOS) and **perfluorooctanoate** (PFOA) are normally the dominant perfluoroalkyl substances (PFASs) in human serum, but here a Canadian family of seven was identified with particularly high exposure to **perfluorohexanesulfonate** (PFHxS). Disproportionately high serum PFHxS concentrations (range 27.5-423 ng/mL) and moderately high **PFOS** (range 15.2-108 ng/mL) and **PFOA** (range 2.40-9.23 ng/mL) concentrations were detected in the family members, with all three chemicals being highest in the youngest children. We therefore sought to identify the source(s) and pathway(s) of this unusual exposure, and to study the excretion of PFASs for this family. Serum, urine, and stool were sampled from family members, carpet, dust, and air were sampled in the home, and a questionnaire was administered. Over 15 years, the family's household carpets were treated 8 times with Scotchgard formulations. Elevated concentrations of PFHxS were detected in household dust (2780 ng/g dust) and in family room carpet (2880 ng/g carpet), and the primary mode of excretion for the major PFASs was through urine. The high PFHxS and moderately high **PFOS** concentrations in serum and household samples are consistent with the known PFAS content of certain Scotchgard formulations, and exposure was likely through dust ingestion and/or inhalation.

PMID:23102093

Beesoon S et al; *Environ Sci Technol* 46(23): 12960-7 (2012).

► [Hazardous Substances Data Bank \(HSDB\)](#)

A total of 100 serum samples from 50 new couples (none of the females in this study has ever been pregnant) in Tianjin, North China, were analyzed for eleven perfluoroalkyl acids (PFAAs) with isomer-specific method. Among all samples, total **perfluorooctanesulfonate** (PFOS, mean 11.3 ng/mL) was predominant followed by total **perfluorooctanoate** (PFOA, 2.95 ng/mL), **perfluorodecanoate** (PFDA, 1.17 ng/mL), **perfluorononanoate** (PFNA, 0.93 ng/mL) and **perfluorohexanesulfonate** (PFHxS, 0.67 ng/mL). The mean concentrations of **PFOS** and **PFHxS** in males (14.2 and 0.89 ng/mL) were significantly higher (p=0.001) than in females (8.36 and 0.45 ng/mL). No statistical difference between

genders was observed for the other PFAAs. This suggests that menstruation is one important elimination pathway for PFOS and PFHxS in females. Linear PFOA was the dominant isomer with mean proportion of 99.7%, suggesting that telomeric PFOA (and its precursors), which contains almost pure linear isomer, might be the dominant exposure source of PFOA in Tianjin. On average, the proportion of linear PFOS (n-PFOS) was 59.2% of PFOS, which was lower than that in technical PFOS products (ca. 70% linear). Except perfluoroisopropyl PFOS, all the other monomethyl branched PFOS isomers were enriched in human serum compared to the commercial products, suggesting the monomethyl branched PFOS precursors were preferentially biotransformed in humans /SRP: or a differential clearance occurred/.

PMID:24747327

Zhang Y et al; Environ Int 68:185-91 (2014).

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Absorption, Distribution and Excretion (Complete) data for Perfluorohexanesulfonic acid (6 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

7.2 Biological Half-Life



Perfluorohexanesulfonate (PFHxS) has been found in biological samples from wildlife and humans. The human geometric mean serum PFHxS elimination half-life has been estimated to be 2665 days. A series of studies was undertaken to establish pharmacokinetic parameters for PFHxS in rats, mice, and monkeys after single administration with pharmacokinetic parameters determined by WinNonlin software. Rats and mice appeared to be more effective at eliminating PFHxS than monkeys. With the exception of female rats, which had serum PFHxS elimination half-life of approximately 2 days, the serum elimination half-lives in the rodent species and monkeys approximated 1 month and 4 months, respectively, when followed over extended time periods (10-24 weeks). Collectively, these studies provide valuable insight for human health risk assessment regarding the potential for accumulation of PFHxS in humans.

PMID:21856411

Sundstrom M et al; Reprod Toxicol 33(4): 441-51 (2012).

► [Hazardous Substances Data Bank \(HSDB\)](#)

7.3 Mechanism of Action



Perfluorohexanesulfonate (PFHxS) is one of the most widely distributed perfluoroalkyl compounds (PFCs) and its possible neurotoxicity has been suggested. However, the effects of PFHxS on neuronal function remain to be elucidated. In this study, the effects of PFHxS on neuronal cell death and the underlying mechanisms were examined. Cerebellar granule cells (CGCs) were isolated from 7-day old rat pups and maintained in culture for additional 7d. The apoptotic effects of PFHxS were determined by caspase-3 activity and TUNEL staining. PFHxS increased the apoptotic death of CGC in concentration-dependent manner. It also increased the activation of ERK1/2, JNK and p38 MAPK with different temporal activation. PD98059, an inhibitor of ERK1/2 pathway, completely blocked PFHxS-induced apoptosis whereas SP600125, a JNK inhibitor, significantly increased the apoptosis, showing their opposite roles in the apoptosis of CGCs. Treatment of antioxidants, Trolox or N-acetylcysteine (NAC), completely blocked ROS generation by PFHxS but neither of these antioxidants prevented PFHxS-induced apoptosis, suggesting that ROS may not play a key role in the process of apoptosis. PD98059 prevented ROS accumulation by PFHxS but the ERK1/2 activation was not affected by Trolox or NAC. These results indicate that ROS is one of downstream targets of ERK1/2, not vice versa. Taken together, PFHxS increased apoptosis of CGC in ERK1/2-dependent manner, where downstream pathway other than ROS may play a major role.

...

PMID:24125707

Lee YJ et al; Chemosphere 94:121-7 (2014).

► [Hazardous Substances Data Bank \(HSDB\)](#)

8 Use and Manufacturing



8.1 Overview



IDENTIFICATION: The **potassium** salt of perfluorohexanesulfonic acid is a beige crystal. Perfluorohexanesulfonic acid is moderately soluble in **water**. **USE:** Perfluorohexanesulfonic acid is used to make other organic chemicals containing **fluorine**. It was previously used in firefighting foam and to make **water** and stain coatings for carpets, paper and cloth. **EXPOSURE:** Perfluoroalkyls, which include perfluorohexanesulfonic acid, occur everywhere including the Arctic and open oceans. Workers that use perfluorohexanesulfonic acid may breathe in mists or have direct skin contact. The general population may be exposed from various consumer products, by breathing in air, breathing in indoor dust, eating food and drinking **water**. Perfluorinated compounds, including **perfluorohexanesulfonate**, have been found in human blood, serum and breast milk. If perfluorohexanesulfonic acid is released to the environment it can travel long distances. It will also be in or on particles that eventually fall to the ground. It is not expected to be broken down by light. It will not move into air from moist soil and **water** surfaces. It is expected to move easily through soil and not be degraded by microorganisms. It is expected to build up in aquatic organisms. **RISK:** Increased risk of asthma and behavioral and learning problems (including attention deficit hyperactive deficit disorder) have been observed in some children with high blood levels of perfluorinated compounds, including perfluorohexanesulfonic acid. Mild liver damage, altered human **cholesterol** and triglyceride levels, and immune system impairments may occur with exposure to perfluorinated compounds (including perfluorohexanesulfonic acid); however, human study results vary widely making it difficult to identify potential health effects. Adverse effects on male and female reproductive health and fetal growth have been associated with exposure to some perfluorinated compounds in several human studies, but very little evidence links perfluorohexanesulfonic acid exposure to adverse reproductive effects or impaired fetal growth. Infertility, abortion, and birth defects were not observed in laboratory animals orally exposed to perfluorohexanesulfonic acid. Altered behavior (decreased activity) was observed in offspring of laboratory animals exposed to perfluorohexanesulfonic acid during pregnancy. Perfluorohexanesulfonic acid levels in the blood have not been associated with incidence of prostate cancer in humans. No other data on the potential for perfluorohexanesulfonic acid to cause cancer in humans or laboratory animals were available. The potential for perfluorohexanesulfonic acid to cause cancer in humans has not been assessed by the U.S. EPA IRIS program, the International Agency for Research on Cancer, or the U.S. National Toxicology Program 13th Report on Carcinogens. (SRC)

FOR MORE INFORMATION: (1) National Library of Medicine Hazardous Substances Data Bank. Available from, as of Oct 9, 2015: <http://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm> (2) ATSDR Toxicological Profile for Perfluoroalkyls. Draft for Public Comment. 2015. Available from, as of Oct 9, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp> (3) IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Available from, as of Oct 9, 2015: <http://monographs.iarc.fr/ENG/Classification/index.php> (4) National Toxicology Program. Testing Status of Agents at NTP. RTP No. PFHXS N040005-NTP. Available from, as of Oct 9, 2015: <http://ntp.niehs.nih.gov/> (5) National Toxicology Program. Thirteenth Report on Carcinogens. Available from, as of Oct 9, 2015: <http://ntp.niehs.nih.gov/pubhealth/roc/index.html> (6) USEPA/IRIS Integrated Risk Information System. Available from, as of Oct 9, 2015: <http://www.epa.gov/iris/>

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.2 Use Classification



PFAS (per- and polyfluoroalkyl substances) -> OECD Category

S25 | [OECDPFAS](#) | [List of PFAS from the OECD](#) | [DOI:10.5281/zenodo.2648775](https://doi.org/10.5281/zenodo.2648775)

► [NORMAN Suspect List Exchange](#)

8.3 Uses



EPA CPDat Chemical and Product Categories

► [EPA Chemical and Products Database \(CPDat\)](#)

Used mainly as a raw material or precursor for production of PFAS /perfluoroalkyl sulfonate/ based products.

OECD; PFCS: Outcome of the 2009 survey. Survey on the production, use and release of PFOS, PFAS, PFOA PFCA, their related substances and products/mixtures containing these substances. Series on risk management No.24 (Jan 7, 2011). Available from, as of Oct 6, 2015: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2011\)1&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2011)1&doclanguage=en)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Laboratory applications, manufacture of substances. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorohexane sulfonate (PFHxS) is a six-carbon compound in the perfluoroalkyl family of chemicals. **Perfluorohexane sulfonate** was once used in firefighting foam and carpet treatment solutions. It was once widely used by 3M as a stain and water repellent but was phased out due to U.S. Environmental Protection Agency regulations.

Garcia J. S. et al; Perfluoroalkyl Compounds, Hamilton & Hardy's Industrial Toxicology 69 (2015). <http://onlinelibrary.wiley.com/advanced/search>

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.4 Methods of Manufacturing



Perfluoroalkanesulfonyl fluorides are usually made by the Simons electrochemical fluorination process ... in which a hydrocarbon **sulfonyl fluoride** is electrolyzed in anhydrous **hydrogen fluoride** at **nickel** electrodes. The electrochemical yield is excellent for the first member of the series and decreases progressively with the increasing length of the **carbon** chain; the yield for **octanesulfonyl fluoride** is ca. 40%. Alkaline hydrolysis of perfluoroalkanesulfonyl fluorides gives the corresponding salts, which when acidified and distilled from concentrated **sulfuric acid** yield the anhydrous sulfonic acids.

Siegemund G et al; Fluorine Compounds, Organic. Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2015). NY, NY: John Wiley & Sons. Online Posting Date: June 15, 2000

► [Hazardous Substances Data Bank \(HSDB\)](#)

... The commercially important methods of preparations of perfluorinated sulfonic acid derivatives are electrochemical fluorination and **sulfur trioxide** addition to **tetrafluoroethylene** with subsequent ring opening.

Savu P; Fluorine-Containing Polymers, Perfluoroalkanesulfonic Acids. Kirk-Othmer Encyclopedia of Chemical Technology (1999-2015). John Wiley & Sons, Inc. Online Posting Date: December 4, 2000

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.5 General Manufacturing Information



EPA TSCA Commercial Activity Status

1-Hexanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-: ACTIVE

<https://www.epa.gov/tsca-inventory>

► [EPA Chemicals under the TSCA](#)

EPA TSCA Regulatory Flag

S - indicates a substance that is identified in a final Significant New Use Rule.

<https://www.epa.gov/tsca-inventory>

► [EPA Chemicals under the TSCA](#)

9 Identification



9.1 Analytic Laboratory Methods



Method: EPA-ORD/EPA-OST 537; Procedure: liquid chromatography/tandem mass spectrometry; Analyte: perfluorohexanesulfonic acid; Matrix: drinking water; Detection Limit: 1.6 nanogram/L.

National Environmental Methods Index; Analytical, Test and Sampling Methods. Perfluorohexanesulfonic Acid (355-46-4). Available from, as of September 16, 2015: <http://www.nemi.gov>

► [Hazardous Substances Data Bank \(HSDB\)](#)

9.2 Clinical Laboratory Methods



Perfluorooctane sulfonic acid (PFOS) and **perfluorooctanoic acid**, two of the most widely studied polyfluoroalkyl chemicals (PFCs), can cross the placenta. Therefore, data on the exposure to PFCs of the very young are needed to evaluate the potential health effects associated with such exposure. Human serum, especially serum collected from pregnant women and cord serum, may contain endogenous components that can interfere in the separation by high performance liquid chromatography (HPLC) of **PFOS** and another PFC of interest, perfluorohexane sulfonic acid (PFHxS), from other serum biomolecules. The presence of such interferences may prevent the adequate quantification of **PFOS** and PFHxS in cord serum or serum collected from pregnant women, and potentially hinder the assessment of gestational exposure to these important PFCs using biomonitoring. We have modified our on-line solid phase extraction-HPLC-isotope dilution-tandem mass spectrometry analytical method for measuring PFCs in serum and developed an approach that allows for the elimination of these potential interferences without compromising analytical sensitivity and throughput. The combination of **acetonitrile** as the HPLC mobile phase organic solvent and a Betasil C8 HPLC column provided the best separation of **PFOS** and PFHxS from interferent peaks. In addition to eliminating these interferences, the **acetonitrile** method has a shorter runtime and is more sensitive for most PFCs (limits of detection were 0.1 ng/mL except for **PFOS** (0.2 ng/mL)) than our previous method that used **methanol** for the HPLC separation. The present method should improve the precise and selective analysis of maternal and cord serum for PFCs.

PMID:21084089

Kato K et al; J Chromatogr A. 1218(15): 2133-7 (2011).

► [Hazardous Substances Data Bank \(HSDB\)](#)

The aim of this study is to evaluate the presence of perfluoroalkyl substances (PFASs) in the blood of 46 residents from Barcelona and to study the factors that affect exposure. Compounds analysed included **perfluorooctane sulfonate (PFOS)**, **perfluorohexane sulfonate (PFHxS)**, **perfluorobutane sulfonate (PFBS)**, **perfluorooctanoate acid (PFOA)** and perfluorononanoate acid (**PFNA**). Blood was liquid-liquid extracted and PFASs were determined by liquid chromatography coupled to tandem mass spectrometry. Good recoveries (between 97 +/- 14 and 105 +/- 13 %) were obtained and method detection limits were from 0.03 to 0.07 ng mL⁻¹. Sum of PFASs ranged from 0.11 to 4.37 ng mL⁻¹. **PFOS** was the main compound detected at 0.09-3.35 ng mL⁻¹, followed by **PFOA** and PFHxS. **PFBS** and **PFNA** were seldom detected. Working conditions, smoking and gender did not cause any significant differences among sums of PFASs levels in the blood while age and parity produced decreased concentrations. On the other hand, laboratory working conditions produced significant higher **PFOA** levels compared to the general population. Compared to other studies, the PFASs levels in blood from Barcelona residents is low (mean sum of PFASs of 1.67 +/- 0.88 ng mL⁻¹) and with little variation among the studied population.

PMID:25163560

Gomez-Canela C et al; Environ Sci Pollut Res Int 22(2): 1480-6 (2015).

► [Hazardous Substances Data Bank \(HSDB\)](#)

Fluorinated surfactant-based aqueous film-forming foams (AFFFs) are made up of per- and polyfluorinated alkyl substances (PFAS) and are used to extinguish fires involving highly flammable liquids. The use of **perfluorooctanesulfonic acid (PFOS)** and other perfluoroalkyl acids (PFAAs) in some AFFF formulations has been linked to substantial environmental contamination. Recent studies have identified a large number of novel and infrequently reported fluorinated surfactants in different AFFF formulations. In this study, a strategy based on a case-control approach using quadrupole time-of-flight tandem mass spectrometry (QTOF-MS/MS) and advanced statistical methods has been used to extract and identify known and unknown PFAS in human serum associated with AFFF-exposed firefighters. Two target sulfonic acids [**PFOS** and perfluorohexanesulfonic acid (PFHxS)], three non-target acids [**perfluoropentanesulfonic acid (PFPeS)**, **perfluoroheptanesulfonic acid (PFHpS)**, and **perfluorononanesulfonic acid (PFNS)**], and four unknown sulfonic acids (CI-**PFOS**, ketone-**PFOS**, ether-PFHxS, and CI-PFHxS) were exclusively or significantly more frequently detected at higher levels in firefighters compared to controls. The application of this strategy has allowed for identification of previously unreported fluorinated chemicals in a timely and cost-efficient way.

PMID:25611076

Rotander A et al; Environ Sci Technol 49(4): 2434-42.

► [Hazardous Substances Data Bank \(HSDB\)](#)

10 Safety and Hazards



10.1 Hazards Identification



10.1.1 GHS Classification



Showing 1 of 2 [View More](#)

Pictogram(s)	  Corrosive Irritant
Signal	<u>Danger</u>
GHS Hazard Statements	H302 (100%): Harmful if swallowed [<u>Warning</u> Acute toxicity, oral] H312 (100%): Harmful in contact with skin [<u>Warning</u> Acute toxicity, dermal] H314 (100%): Causes severe skin burns and eye damage [<u>Danger</u> Skin corrosion/irritation] H332 (100%): Harmful if inhaled [<u>Warning</u> Acute toxicity, inhalation]
Precautionary Statement Codes	P260, P261, P264, P270, P271, P280, P301+P312, P301+P330+P331, P302+P352, P303+P361+P353, P304+P312, P304+P340, P305+P351+P338, P310, P312, P321, P322, P330, P363, P405, and P501 (The corresponding statement to each P-code can be found at the GHS Classification page.)
ECHA C&L Notifications Summary	<i>The GHS information provided by 1 company from 1 notification to the ECHA C&L Inventory.</i>

► [European Chemicals Agency \(ECHA\)](#)

10.1.2 Hazard Classes and Categories



Acute Tox. 4 (100%)

Acute Tox. 4 (100%)

Skin Corr. 1B (100%)

Acute Tox. 4 (100%)

► [European Chemicals Agency \(ECHA\)](#)

10.2 Fire Fighting



10.2.1 Fire Fighting Procedures



Advice for firefighters: Wear self-contained breathing apparatus for firefighting if necessary. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Suitable extinguishing media: Use **water** spray, alcohol-resistant foam, dry chemical or **carbon dioxide**. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.3 Accidental Release Measures



10.3.1 Cleanup Methods



Methods and materials for containment and cleaning up: Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.3.2 Disposal Methods



SRP: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or [water](#); effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

► [Hazardous Substances Data Bank \(HSDB\)](#)

Product: Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Contaminated packaging: Dispose of as unused product. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.3.3 Preventive Measures



Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Personal precautions, protective equipment and emergency procedures: Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.4 Handling and Storage



10.4.1 Storage Conditions



Conditions for safe storage, including any incompatibilities: Keep container tightly closed in a dry and well-ventilated place.

/[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Precautions for safe handling: Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.5 Exposure Control and Personal Protection



10.5.1 Personal Protective Equipment (PPE)



Respiratory protection: For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Body Protection: Impervious clothing, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Skin protection: Handle with gloves. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Eye/face protection: Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.6 Stability and Reactivity



10.6.1 Hazardous Reactivities and Incompatibilities



Incompatible materials: Strong oxidizing agents. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.7 Other Safety Information



10.7.1 Toxic Combustion Products



Special hazards arising from the substance or mixture: Carbon oxides, Sulphur oxides, [Hydrogen fluoride](#), Potassium oxides. /[Tridecafluorohexane-1-sulfonic acid potassium salt](#)/

Sigma-Aldrich; Material Safety Data Sheet for Tridecafluorohexane-1-sulfonic acid potassium salt, Product Number: 50929, Version 3.6 (Revision Date 12/22/2014). Available from, as of August 18, 2015: <http://www.sigmaaldrich.com/safety-center.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.7.2 History and Incidents



In summer 2008, an accidental release of aqueous film forming foam (AFFF) took place at Schiphol Amsterdam Airport (The Netherlands). After the release, [water](#), fish, and sediment samples were collected and analyzed for perfluoroalkyl sulfonates (PFASs). In situ [perfluorooctane sulfonate](#) (PFOS) sediment-[water](#) distribution factor (KD) values, bioaccumulation factor (BAF) values, and biota-sediment accumulation factor (BSAF) values showed a remarkable agreement among reference and impacted sites, 10 weeks after the incident as well as after 3 years.

[PMID:24729487](#)

Kwadijk CJ et al; Environ Toxicol Chem 33(8): 1761-5 (2014).

► [Hazardous Substances Data Bank \(HSDB\)](#)

11 Toxicity



11.1 Toxicological Information



11.1.1 Toxicity Summary



IDENTIFICATION AND USE: [Perfluorohexane sulfonate](#) (PFHxS) is a six-carbon compound in the perfluoroalkyl family of chemicals. [Perfluorohexane sulfonate](#) was once used in firefighting foam and carpet treatment solutions. It was once widely used as a stain and [water](#) repellent but was phased out due to U.S. Environmental Protection Agency regulations. HUMAN EXPOSURE AND TOXICITY: An epidemiological study evaluated the associations between serum levels of PFHxS and diagnosis of attention deficit/hyperactivity disorder (ADHD). In another study, the associations of prenatal serum concentrations (PFHxS) with fetal and postnatal growth in girls was examined. Serum samples were obtained from mothers during pregnancy. PFHxS (median, 1.6 ng/mL) was detected in 100% of samples. On average, girls born to mothers with prenatal concentrations of PFHxS in the upper tertile weighed 108 g less at birth than girls born to mothers with concentrations in the lower tertile in adjusted models. In another study, the association between levels of PFHxS and semen volume, sperm concentration, total sperm count, motility and morphology were assessed. The proportion of morphologically normal cells was 35% lower for the third tertile of PFHxS exposure as compared with the first. In a surveillance study, the serum concentrations of perfluoroalkyl acids (PFAAs) in firefighters was evaluated, and serum concentration of PFHxS was statistically higher in firefighters. Another study reported evidence of a significant association between PFHxS and total [cholesterol](#) (TC), low-density lipoprotein [cholesterol](#) (LDL), total [cholesterol](#)/high density lipoprotein [cholesterol](#) ratio (TC/HDL) and non-HDL [cholesterol](#) as well as an elevated odds of high [cholesterol](#). In another study, which evaluated the relationship between serum PFCs and thyroid function, increase in natural log-PFHxS was associated with an increase of total T4 by 0.26 ug/mL and total T3 by 4.074 ng/dL in women and a decrease of natural log-free T4 by 0.016 (ng/dL) in men. ANIMAL STUDIES: A subchronic study investigated the mechanism underlying the effect of PFAS surfactants on lipoprotein metabolism. Mice were fed a Western-type diet with PFHxS, (6 mg/kg/day) for 4-6 weeks. PFHxS markedly reduced TG, non-HDL-C, and HDL-C. The decrease in very low-density lipoprotein (VLDL) was caused by enhanced lipoprotein lipase-mediated VLDL-TG clearance and by decreased production of VLDL-TG and VLDL-apolipoprotein B. Reduced HDL production, related to decreased apolipoprotein AI synthesis, resulted in decreased HDL. PFHxS increased liver weight and hepatic TG content. Hepatic gene expression profiling data indicated that these effects were the combined result of peroxisome proliferator-activated receptor alpha and [pregnane](#) X receptor activation. Another study showed that neonatal exposure to PFHxS can alter neuroprotein levels, e.g. CaMKII, GAP-43, synaptophysin and tau, which are essential for normal brain development in mice. This was measured for both males and females, in hippocampus and cerebral cortex. The results suggest that PFHxS may act as a developmental neurotoxicant and the effects are similar to that of [PFOS](#) and [PFOA](#), but also to other substances such as PCBs, PBDEs and [bisphenol A](#). In another study, in ovo effects of PFHxS exposure (maximum dose = 38,000 ng/g egg) on embryonic death, developmental endpoints, tissue accumulation, mRNA expression in liver and cerebral cortex, and plasma TH levels were evaluated. Pipping success was reduced to 63% at the highest dose of PFHxS; additional effects included decreased tarsus length and embryo mass. Plasma TH levels were reduced in a concentration-dependent manner following PFHxS exposure. A subsequent study evaluated the relationship between PFHxS exposure and TH-dependent neurodevelopmental pathways. PFHxS significantly altered the expression of 11 transcripts at the low dose (890 ng/g) and 101 transcripts at the high dose (38,000 ng/g). Functional enrichment analysis showed that PFHxS affected the genes involved in tissue development and morphology, cellular assembly and organization, and cell-to-cell signaling. In another study, the effects of PFHxS on the neuronal cell death and the underlying mechanisms were examined using PC12 cells as a model of dopaminergic neuron. The treatment with PFHxS reduced cell viability in a dose-dependent manner. PFHxS increased cell apoptosis, increased the activations of ERK1/2, JNK and p38 MAPK with different temporal activations. PFHxS exposure also increased ROS formation.

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.1.2 Antidote and Emergency Treatment



/SRP:/ Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing [water](#). Do not induce vomiting. If vomiting occurs, lean patient forward or place on the left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Poisons A and B/

Currence, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 160

► [Hazardous Substances Data Bank \(HSDB\)](#)

/SRP:/ Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if needed. Administer [oxygen](#) by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary Monitor for shock and treat if necessary Anticipate seizures and treat if necessary For eye contamination, flush eyes immediately with [water](#). Irrigate each eye continuously with 0.9% saline (NS) during transport Do not use emetics. For ingestion,

rinse mouth and administer 5 mL/kg up to 200 mL of [water](#) for dilution if the patient can swallow, has a strong gag reflex, and does not drool ...
 . Cover skin burns with dry sterile dressings after decontamination /Poisons A and B/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 160

► [Hazardous Substances Data Bank \(HSDB\)](#)

/SRP:/ Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Positive-pressure ventilation techniques with a bag valve mask device may be beneficial. Consider drug therapy for pulmonary edema Consider administering a beta agonist such as [albuterol](#) for severe bronchospasm Monitor cardiac rhythm and treat arrhythmias as necessary Start IV administration of D5W TKO /SRP: "To keep open", minimal flow rate/. Use 0.9% saline (NS) or lactated Ringer's (LR) if signs of hypovolemia are present. For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload Treat seizures with [diazepam](#) or [lorazepam](#) Use [proparacaine hydrochloride](#) to assist eye irrigation /Poisons A and B/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 160-1

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.1.3 Human Toxicity Excerpts



/EPIDEMIOLOGY STUDIES/ Our limited understanding of how polyfluoroalkyl chemicals (PFCs) may impact on human health suggests the potential for a protective impact on brain health. This study was designed to explore the association between PFCs and cognitive ability in older adults. We assessed the association between four PFCs, [perfluorooctanoic acid \(PFOA\)](#), [perfluorooctane sulfonic acid \(PFOS\)](#), [perfluorononanoic acid \(PFNA\)](#) and perfluorohexane sulfonic acid (PFHxS), and self-reported limitation due to difficulty remembering or periods of confusion using data from participants aged 60-85 years from the 1999-2000 and 2003-2008 National Health and Nutrition Examination Surveys. We also considered whether diabetic status or diabetic medication use modifies this association in light of in vitro evidence that PFCs may act on the same receptors as some diabetic medications. In multivariable adjusted models, point estimates suggest a protective association between PFCs and self-reported cognitive limitation (odds ratio, OR; 95% confidence interval, CI) for a doubling in PFC concentration: [PFOS](#) (OR, 0.90; 95% CI, 0.78, 1.03), [PFOA](#) (OR, 0.92; 95% CI, 0.78, 1.09), [PFNA](#) (OR, 0.91; 95% CI, 0.79, 1.04) and PFHxS (OR, 0.93; 95% CI, 0.82, 1.06). The protective association was concentrated in diabetics, with strong, significant protective associations in non-medicated diabetics. This cross-sectional study suggests that there may be a protective association between exposure to PFCs and cognition in older adults, particularly diabetics.

PMID:23095808

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3658136>

Power MC et al; *Neuroepidemiology* 40(2): 125-32 (2013).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/EPIDEMIOLOGY STUDIES/ Associations between perfluoroalkyl acids (PFASs) and human thyroid hormone levels remain unclear, especially during early pregnancy when small changes in maternal thyroid hormones can affect fetal brain development. The objective of this study was to examine associations between maternal serum PFAS levels and maternal thyroid hormone levels in the early 2nd trimester of pregnancy. Participants were euthyroid pregnant women (n=152) enrolled in the Chemicals, Health and Pregnancy (CHiP) study based in Vancouver, Canada. Associations between maternal serum PFASs, including [perfluorohexanesulfonate](#) (PFHxS), [perfluorononanoate \(PFNA\)](#), [perfluorooctanoate \(PFOA\)](#) and [perfluorooctanesulfonate \(PFOS\)](#) and repeated measures of maternal thyroid hormones, including free [thyroxine](#) (fT4), total [thyroxine](#) (TT4) and thyroid stimulating hormone (TSH) were examined using mixed effects linear models. Associations were considered in all women, then separately in women with high (greater than or equal to 9 IU/mL) vs normal (<9 IU/mL) levels of thyroid peroxidase antibody (TPOAb), a marker of autoimmune hypothyroidism (Hashimoto's disease). Median PFAS concentrations (ng/mL) in maternal sera were 1.0 (PFHxS), 0.6 (PFNA), 1.7 (PFOA) and 4.8 (PFOS). PFASs were not associated with fT4, TT4 or TSH among women with normal TPOAb. However, among the 9% of women with high TPOAb (n=14), interquartile range (IQR) increases of PFASs were associated with a 46-69% increase in maternal TSH (95% CIs ranging from 8% to 123%) (PFNA, PFOA and PFOS only), and with a 3% to 7% decrease in maternal fT4 (95% CIs ranging from -18% to 5%) (all 4 PFASs). PFNA was also associated with higher maternal TSH in the whole sample. PFASs were positively associated with TSH, and weakly negatively associated with fT4 in the subset of pregnant women with high TPOAb, which occurs in 6-10% of pregnancies. PFASs may exacerbate the already high TSH and low fT4 levels in these women during early pregnancy, which is a critical time of thyroid hormone-mediated fetal brain development. The clinical significance of these findings is not clear. We propose a "multiple hit hypothesis" to explain these findings; this hypothesis deserves evaluation in larger, more representative study samples. /perfluoroalkyl acids/

PMID:25019470

Webster GM et al; *Environ Res* 133: 338-47 (2014).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/EPIDEMIOLOGY STUDIES/ Polyfluoroalkyl chemicals (PFCs) have been widely used in consumer products. Exposures in the United States and in world populations are widespread. PFC exposures have been linked to various health impacts, and data in animals suggest that PFCs may be

potential developmental neurotoxicants. We evaluated the associations between exposures to four PFCs and parental report of diagnosis of attention deficit/hyperactivity disorder (ADHD). Data were obtained from the National Health and Nutrition Examination Survey (NHANES) 1999-2000 and 2003-2004 for children 12-15 years of age. Parental report of a previous diagnosis by a doctor or health care professional of ADHD in the child was the primary outcome measure. **Perfluorooctane sulfonic acid (PFOS)**, **perfluorooctanoic acid (PFOA)**, **perfluorononanoic acid (PFNA)**, and perfluorohexane sulfonic acid (PFHxS) levels were measured in serum samples from each child. Parents reported that 48 of 571 children included in the analysis had been diagnosed with ADHD. The adjusted odds ratio (OR) for parentally reported ADHD in association with a 1-ug/L increase in serum **PFOS** (modeled as a continuous predictor) was 1.03 [95% confidence interval (CI), 1.01-1.05]. Adjusted ORs for 1-ug/L increases in **PFOA** and PFHxS were also statistically significant (**PFOA**: OR = 1.12; 95% CI, 1.01-1.23; PFHxS: OR = 1.06; 95% CI, 1.02-1.11), and we observed a nonsignificant positive association with **PFNA** (OR = 1.32; 95% CI, 0.86-2.02). Our results, using cross-sectional data, are consistent with increased odds of ADHD in children with higher serum PFC levels. Given the extremely prevalent exposure to PFCs, follow-up of these data with cohort studies is needed.

PMID:20551004

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3002197>

Hoffman K et al; *Environ Health Perspect* 118(12): 1762-7 (2010).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/EPIDEMIOLOGY STUDIES/ Prenatal exposures to polyfluoroalkyl compounds (PFCs) may be associated with adverse changes in fetal and postnatal growth. We explored associations of prenatal serum concentrations of **perfluorooctane sulfonate (PFOS)**, **perfluorooctanoate (PFOA)**, and **perfluorohexane sulfonate (PFHxS)** with fetal and postnatal growth in girls. We studied a sample of 447 singleton girls and their mothers participating in the Avon Longitudinal Study of Parents and Children (ALSPAC). Data on weight and length were obtained at birth and at 2, 9, and 20 months. Serum samples were obtained in 1991-1992, from mothers during pregnancy. We explored associations between prenatal PFC concentrations and weight at birth as well as longitudinal changes in weight-for-age SD scores between birth and 20 months. **PFOS** (median, 19.6 ng/mL), **PFOA** (median, 3.7 ng/mL), and PFHxS (median, 1.6 ng/mL) were detected in 100% of samples. On average, girls born to mothers with prenatal concentrations of **PFOS** in the upper tertile weighed 140 g less [95% confidence interval (CI): -238, -42] at birth than girls born to mothers with concentrations in the lower tertile in adjusted models. Similar patterns were seen for **PFOA** (-133 g; 95% CI: -237, -30) and PFHxS (-108 g; 95% CI: -206, -10). At 20 months, however, girls born to mothers with prenatal concentrations of **PFOS** in the upper tertile weighed 580 g more (95% CI: 301, 858) when compared with those in the lower tertile. No differences in weight were found for **PFOA** and PFHxS. Girls with higher prenatal exposure to each of the PFCs examined were smaller at birth than those with lower exposure. In addition, those with higher exposure to **PFOS** were larger at 20 months.

PMID:22935244

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491920>

Maisonet M et al; *Environ Health Perspect* 120(10): 1432-7 (2012).

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Human Toxicity Excerpts (Complete) data for Perfluorohexanesulfonic acid (17 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.1.4 Non-Human Toxicity Excerpts



/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ **Perfluorobutane sulfonate (PFBS)**, **perfluorohexane sulfonate (PFHxS)**, and **perfluorooctane sulfonate (PFOS)** are stable perfluoroalkyl sulfonate (PFAS) surfactants, and PFHxS and **PFOS** are frequently detected in human biomonitoring studies. Some epidemiological studies have shown modest positive correlations of serum **PFOS** with non-high-density lipoprotein (HDL)-**cholesterol (C)**. This study investigated the mechanism underlying the effect of PFAS surfactants on lipoprotein metabolism. CETP mice were fed a Western-type diet with **PFBS**, PFHxS, or **PFOS** (30, 6, and 3 mg/kg/day, respectively) for 4-6 weeks. Whereas **PFBS** modestly reduced only plasma triglycerides (TG), PFHxS and **PFOS** markedly reduced TG, non-HDL-C, and HDL-C. The decrease in very low-density lipoprotein (VLDL) was caused by enhanced lipoprotein lipase-mediated VLDL-TG clearance and by decreased production of VLDL-TG and VLDL-apolipoprotein B. Reduced HDL production, related to decreased apolipoprotein AI synthesis, resulted in decreased HDL. PFHxS and **PFOS** increased liver weight and hepatic TG content. Hepatic gene expression profiling data indicated that these effects were the combined result of peroxisome proliferator-activated receptor alpha and **pregnane X** receptor activation. In conclusion, the potency of PFAS to affect lipoprotein metabolism increased with increasing alkyl chain length. PFHxS and **PFOS** reduce plasma TG and total **cholesterol** mainly by impairing lipoprotein production, implying that the reported positive correlations of serum **PFOS** and non-HDL-C are associative rather than causal.

PMID:21705711

Bijland S et al; *Toxicol Sci* 123(1):290-303 (2011).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ In a recent egg injection study, we showed that in ovo exposure to [perfluorohexane sulfonate](#) (PFHxS) affects the pipping success of developing chicken (*Gallus gallus domesticus*) embryos. We also found evidence of thyroid hormone (TH) pathway interference at multiple levels of biological organization (i.e., somatic growth, messenger RNA expression, and circulating free [thyroxine](#) levels). Based on these findings, we hypothesize that PFHxS exposure interferes with TH-dependent neurodevelopmental pathways. This study investigates global transcriptional profiles in cerebral hemispheres of chicken embryos following exposure to a solvent control, 890 or 38,000 ng PFHxS/g egg (n = 4-5 per group); doses that lead to the adverse effects indicated above. PFHxS significantly alters the expression (greater than or equal to 1.5-fold, p less than or equal to 0.001) of 11 transcripts at the low dose (890 ng/g) and 101 transcripts at the high dose (38,000 ng/g). Functional enrichment analysis shows that PFHxS affects genes involved in tissue development and morphology, cellular assembly and organization, and cell-to-cell signaling. Pathway and interactome analyses suggest that genes may be affected through several potential regulatory molecules, including integrin receptors, myelocytomatosis viral oncogene, and CCAAT/enhancer-binding protein. This study identifies key functional and regulatory modes of PFHxS action involving TH-dependent and -independent neurodevelopmental pathways. Some of these TH-dependent mechanisms that occur during embryonic development include tight junction formation, signal transduction, and integrin signaling, whereas TH-independent mechanisms include gap junction intercellular communication.

PMID:22790973

Cassone CG et al; *Toxicol Sci* 129(2):380-91 (2012).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/DEVELOPMENTAL NEUROTOXICITY/ [Perfluorohexane sulfonate](#) (PFHxS) is an industrial chemical and belongs to the group of perfluorinated compounds (PFCs). It has recently been shown to cause developmental neurobehavioral defects in mammals. These compounds are commonly used in products such as surfactant and protective coating due to their ability to repel [water](#)- and oil stains. PFCs are globally found in the environment as well as in human umbilical cord blood, serum and breast milk. In a previous study on other well-known PFCs, i.e. [PFOS](#) and [PFOA](#), it was shown that neonatal exposure caused altered neuroprotein levels in the hippocampus and cerebral cortex in neonatal male mice. The present study show that neonatal exposure to PFHxS, during the peak of the brain growth spurt, can alter neuroprotein levels, e.g. CaMKII, GAP-43, synaptophysin and tau, which are essential for normal brain development in mice. This was measured for both males and females, in hippocampus and cerebral cortex. The results suggest that PFHxS may act as a developmental neurotoxicant and the effects are similar to that of [PFOS](#) and [PFOA](#), but also to other substances such as PCBs, PBDEs and [bisphenol A](#).

PMID:23701969

Lee I et al; *Neurotoxicology* 37:190-6 (2013).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/ENDOCRINE MODULATION/ Perfluoroalkyl acids (PFAAs), specifically perfluorinated sulfonates and carboxylates, are synthetic substances known for their chemical stability, resistance to degradation, and potential to biomagnify in food chains. The toxicological and biological effects of PFAAs in avian species are not well characterized, although there is some evidence to suggest that they can impact neurodevelopment and hatching success. Our laboratory recently reported significant effects of [perfluorohexane sulfonate](#) (PFHxS) and [perfluorohexanoate](#) (PFHxA) on messenger RNA (mRNA) levels of thyroid hormone (TH)-responsive genes in chicken embryonic neuronal cells. In this study, we determined in ovo effects of PFHxS and PFHxA exposure (maximum dose = 38,000 and 9700 ng/g egg, respectively) on embryonic death, developmental endpoints, tissue accumulation, mRNA expression in liver and cerebral cortex, and plasma TH levels. Pipping success was reduced to 63% at the highest dose of PFHxS; no effects were observed for PFHxA. PFHxS exposure (38,000 ng/g) decreased tarsus length and embryo mass. PFHxS and PFHxA accumulated in the three tissue compartments analyzed as follows: yolk sac > liver > cerebral cortex. Type II and type III 5'-deiodinases (D2 and D3) and cytochrome P450 3A37 mRNA levels were induced in liver tissue of chicken embryos exposed to PFHxS, whereas D2, neurogranin (RC3), and octamer motif binding factor 1 mRNA levels were upregulated in cerebral cortex. Plasma TH levels were reduced in a concentration-dependent manner following PFHxS exposure; PFHxA had no effect. This in ovo study successfully validated previous in vitro results concerning the modulation of TH-responsive genes and identified adverse effects associated with TH homeostasis in response to PFHxS treatment.

PMID:22302310

Cassone CG et al; *Toxicol Sci* 127(1): 216-24 (2012).

► [Hazardous Substances Data Bank \(HSDB\)](#)

/ALTERNATIVE and IN VITRO TESTS/ [Perfluorohexanesulfonate](#) (PFHxS) is one of the major perfluoroalkyl compounds (PFCs) found in human blood and its possible neurotoxicity has been suggested. However, the neuronal responses to PFHxS are not much known. Many studies have demonstrated that the early exposure to environmental chemicals increases the risk of neurodegenerative diseases such as Parkinson's disease in later life. In this study, the effects of PFHxS on the neuronal cell death and the underlying mechanisms were examined using PC12 cells as a model of dopaminergic neuron. The treatment with PFHxS reduced cell viability in a dose-dependent manner. PFHxS increased cell apoptosis which was measured by caspase-3 activity and TUNEL staining. [MK801](#), a [NMDA](#) receptor antagonist reduced PFHxS-induced apoptosis. PFHxS increased the activations of ERK1/2, JNK and p38 MAPK with different temporal activations. The treatment with [PD98059](#), an ERK inhibitor, significantly reduced apoptosis, whereas [SB203580](#), a p38 MAPK inhibitor, had no effect. JNK inhibition by [SP600125](#) significantly increased apoptosis. PFHxS exposure also increased ROS formation, which was completely blocked by antioxidants, [Trolox](#) or [N-acetylcysteine](#) (NAC).

However, neither Trolox nor NAC reduced PFHxS-increased apoptosis, suggesting that ROS may not be a critical mediator for PFHxS-induced apoptosis of cells. Moreover, ERK activation induced by PFHxS was blocked by MK801 but not antioxidants. Taken together, these results have demonstrated that PFHxS induces the apoptosis of dopaminergic neuronal cells, where NMDA receptor-mediated ERK pathway plays a pro-apoptotic role and JNK plays an anti-apoptotic role. Our results may contribute to understanding cellular mechanisms for PFHxS-induced neurotoxicity.

PMID:24534200

Lee YJ et al; Sci Total Environ 491-492: 227-34 (2014).

► Hazardous Substances Data Bank (HSDB)

11.1.5 Ecotoxicity Excerpts



/BIRDS and MAMMALS/ This study is aimed to evaluate the presence and distribution of Perfluorinated Compounds (PFCs) in Yellow-legged gull eggs (*Larus michahellis*) collected from 8 National or Natural Parks from the Iberian Peninsula. In each colony, 12 eggs were randomly collected and pooled from 3 areas of the colony and analyzed using liquid-solid extraction and liquid chromatography coupled to tandem mass spectrometry. Perfluorooctanate sulfonate (PFOS) was the only compound detected in the eggs and its presence was higher in the colonies situated in NE Iberian Peninsula due to the more industrial and mass urbanization in this area compared to the SW Mediterranean or Atlantic colonies. Accordingly, the Medes site, followed by the Ebro Delta and Columbretes, all situated in the NW Mediterranean coast, contained the highest PFOS levels (40.5-54.0ng/g-ww). In all other colonies, PFOS was detected at levels of 10.1-18.6ng/g-ww. Egg shell biometry was studied and it was found that the presence of PFOS did not affect the development of the egg. /perfluorinated Compounds (PFCs)/

PMID:22209369

Vicente J et al; Sci Total Environ 416: 468-75 (2012).

► Hazardous Substances Data Bank (HSDB)

11.2 Ecological Information



11.2.1 Environmental Fate/Exposure Summary



Perfluorohexanesulfonic acid's production and use as a raw material or precursor for production of PFAS (perfluoroalkyl sulfonate) based products and use as surfactants may result in its release to the environment through various waste streams. Its former use in firefighting foam and carpet treatment solutions resulted in its release to the environment through various waste streams. Degradation of commercial N-alkyl perfluoroalkyl sulfonamides to yield perfluorosulfonic acids (such as perfluorohexanesulfonic acid) may occur in the atmosphere via reaction with OH radicals. Perfluoroalkyl sulfonamides are degraded to perfluoroalkyl sulfonic acids in water and can be considered a source of the latter in the environment. If released to air, an estimated vapor pressure of 0.0046 mm Hg at 25 °C indicates perfluorohexanesulfonic acid will exist solely as a vapor in the atmosphere. However, monitoring data indicate the compound exists in both vapor and particulate phases in the atmosphere. Vapor-phase perfluorohexanesulfonic acid will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 115 days. Particulate-phase perfluorohexanesulfonic acid will be removed from the atmosphere by wet and dry deposition. Perfluorohexanesulfonic acid is not expected to be susceptible to direct photolysis by sunlight. Detection of perfluorohexanesulfonic acid in remote Arctic and marine air samples indicates the compound can be transported over long global distances. If released to soil, perfluorohexanesulfonic acid is expected to have very high mobility based upon a Koc of 9.3. The estimated pKa of perfluorohexanesulfonic is 0.14, indicating that this compound will exist almost entirely in the anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process based upon analogy to the PFOS (perfluorooctane sulfonic acid) and because the compound exists as an anion and anions do not volatilize. Perfluorohexanesulfonic acid is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Biodegradation data in soil or water were not available. If released into water, perfluorohexanesulfonic acid is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. A pKa of 0.14 indicates perfluorohexanesulfonic acid will exist almost entirely in the anion form at pH values of 5 to 9 and, therefore, volatilization from water surfaces is not expected to be an important fate process. However, due to the surfactant nature of the perfluoroalkyl compounds (such as perfluorohexanesulfonic acid), some of the amount released to water may form micelles and exist in the associated form despite the low pKa values of these substances. Perfluoroalkyl compounds that associate on water surfaces may volatilize into the atmosphere. A BCF value of 10 and a BAF of 70 suggests bioconcentration in aquatic organisms is low to moderate. Hydrolysis is not expected to be an important environmental fate process based on hydrolysis results for the analogous PFOS. Occupational exposure to perfluorohexanesulfonic acid may occur through inhalation and dermal contact with this compound at workplaces where perfluorohexanesulfonic acid is produced or used. Monitoring data indicate that the general population may be exposed to perfluorohexanesulfonic acid via inhalation of ambient air, dust, ingestion of food and drinking water, and dermal contact with consumer products containing perfluorohexanesulfonic acid. (SRC)

► Hazardous Substances Data Bank (HSDB)

11.2.2 Artificial Pollution Sources



Perfluorohexanesulfonic acid's production and use as a raw material or precursor for production of PFAS (perfluoroalkyl sulfonate) based products(1,2) and use as surfactants(2) may result in its release to the environment through various waste streams(SRC). Its former use in firefighting foam and carpet treatment solutions (once widely used by 3M as a stain and [water](#) repellent)(3) resulted in its release to the environment through various waste streams(SRC). A 2009 survey of manufacturers reported that more than 80% of the releases of PFAS chemicals were to local waterways and very little to air(1); [perfluorohexane sulfonate](#) (PFHS) contributed the most to PFAS release(1); lesser amounts of the chemicals were transferred off-site, mostly for incineration(1).

(1) OECD; PFCS: Outcome of the 2009 survey. Survey on the production, use and release of PFOS, PFAS, PFOA PFCA, their related substances and products/mixtures containing these substances. Series on risk management No.24 (Jan 7, 2011). Available from, as of Oct 6, 2015: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2011\)1&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2011)1&doclanguage=en) (2) NTP; Perfluorohexane sulfonate, PFHXS - M040005 (CAS 355-46-4), National Institute of Environmental Health Sciences. Available from, as of Oct 6, 2015: <http://ntp.niehs.nih.gov/testing/status/agents/ts-m040005.html> (3) Garcia J. S. et al; Perfluoroalkyl Compounds, Hamilton & Hardy's Industrial Toxicology 69 (2015). <http://onlinelibrary.wiley.com/advanced/search>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.3 Environmental Fate



TERRESTRIAL FATE: Based on a classification scheme(1), a Koc value of 9.3(2), determined from field-based monitoring data(2), indicates that perfluorohexanesulfonic acid is expected to have very high mobility in soil(SRC). The estimated pKa of perfluorohexanesulfonic acid is 0.14(3), indicating that this compound will exist almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic [carbon](#) and clay than their neutral counterparts(4). The analogous compound [PFOS \(perfluorooctanesulfonic acid\)](#) is reported to be essentially nonvolatile from moist soil surfaces(5), and the same is expected for perfluorohexanesulfonic acid(SRC). Perfluorohexanesulfonic acid is not expected to volatilize from dry soil surfaces(SRC) based upon an estimated vapor pressure of 0.0046 mm Hg at 25 °C(SRC), determined from a fragment constant method(6). Biodegradation data in soil were not available(SRC, 2015). However, available screening test results indicate that perfluoroalkyl compounds are resistant to biodegradation(3).

(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Awad E et al; Environ Sci Technol 45: 8081-89 (2011) (3) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp> (4) Doucette WJ; pp. 141-188 in Handbook of Property Estimation Methods for Chemicals. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000) (5) Giesy JP, Kannan K; Environ Sci Technol 36: 147A-152A (2002) (6) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

AQUATIC FATE: Based on a classification scheme(1), a Koc value of 9.3(SRC), determined from field-based monitoring data(2), indicates that perfluorohexanesulfonic acid is not expected to adsorb to suspended solids and sediment(SRC). An estimated pKa of 0.14(2) indicates perfluorohexanesulfonic acid will exist almost entirely in the anion form at pH values of 5 to 9 and, therefore, volatilization from [water](#) surfaces is not expected to be an important fate process(SRC). However, due to the surfactant nature of the perfluoroalkyl compounds (such as perfluorohexanesulfonic acid), some of the amount released to [water](#) may form micelles and exist in the associated form despite the low pKa values of these substances(3). Perfluoroalkyl compounds that associate on [water](#) surfaces may volatilize into the atmosphere(3). According to a classification scheme(4), a BCF of 10(5) and a field-based BAF of 70(2) suggest the potential for bioconcentration in aquatic organisms is low to moderate(SRC). Biodegradation data in soil were not available(SRC, 2015). However, available screening test results indicate that perfluoroalkyl compounds are resistant to biodegradation(3). Hydrolysis is not expected to be an important environmental fate process based on hydrolysis results for the analogous [PFOS](#)(3).

(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Awad E et al; Environ Sci Technol 45: 8081-8089 (2011) (3) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp> (4) Franke C et al; Chemosphere 29: 1501-14 (1994) (5) Conder JM et al; Environ Sci Technol 42: 995-1003 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), perfluorohexanesulfonic acid, which has an estimated vapor pressure of 0.0046 mm Hg at 25 °C(SRC), determined from a fragment constant method(2), is expected to exist solely as a vapor in the ambient atmosphere. However, monitoring data indicate the compound exists in both vapor and particulate phases in the atmosphere(3,4). Vapor-phase perfluorohexanesulfonic acid is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals(SRC); the half-life for this reaction in air is estimated to be 115 days(SRC), calculated from its rate constant of 1.4X10⁻¹³ cu cm/molecule-sec at 25 °C(SRC) that was derived using a structure estimation method(2). Particulate-phase perfluorohexanesulfonic acid may be removed from the air by wet and dry deposition(SRC). Perfluoroalkyl sulfonic acids are not expected to undergo direct photolysis(5). Detection of perfluorohexanesulfonic acid in remote Arctic and marine air samples(4,5) indicates the compound can be transported over long global distances(SRC).

(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html> (3) Kim SK, Kannan K; Environ Sci Technol 41: 8328-34 (2007) (4) Dreyer A et al; Environ Sci Technol 43: 6507-14 (2009) (5) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.4 Environmental Biodegradation



Biodegradation data specific to perfluorohexanesulfonic acid were not available(SRC, 2015). However, available screening test results indicate that perfluoroalkyl compounds are resistant to biodegradation(1).

(1) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.5 Environmental Abiotic Degradation



The rate constant for the vapor-phase reaction of perfluorohexanesulfonic acid with photochemically-produced hydroxyl radicals has been estimated as 1.4×10^{-13} cu cm/molecule-sec at 25 °C(SRC) using a structure estimation method(1). This corresponds to an atmospheric half-life of about 115 days at an atmospheric concentration of 5×10^{-5} hydroxyl radicals per cu cm(1). As a class, perfluorinated organic compounds are resistant to hydrolysis and photolysis(2,3). Based on test results for **PFOS (perfluorooctanesulfonic acid)**, perfluoroalkyl sulfonic acids are not expected to undergo direct photolysis(4). The analogous **PFOS** is also stable to environmental hydrolysis with a half-life of 41 years calculated from measured hydrolysis tests at pHs of 5, 7 and 9(4).

(1) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html> (2) Giesy JP, Kannan K; Environ Sci Technol 36: 147A-152A (2002) (3) Beach SA et al; Rev Environ Contam Toxicol 186: 133-74 (2005) (4) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.6 Environmental Bioconcentration



A BCF of 10 has been reported for perfluorohexanesulfonic acid(1). Using monitoring data from creek and pond locations in Toronto, Ontario, Canada, a field-based BAF (bioaccumulation factor) of 70 was determined for perfluorohexanesulfonic acid in fish(2). According to a classification scheme(3), these BCF and BAF values suggests the potential for bioconcentration in aquatic organisms is low to moderate(SRC). In living organisms, perfluoroalkyls bind to protein albumin in blood, liver, and eggs and do not accumulate in fat tissue, which may explain why bioconcentration factors (BCFs) are lower than expected in aquatic organisms(4).

(1) Conder JM et al; Environ Sci Technol 42: 995-1003 (2008) (2) Awad E et al; Environ Sci Technol 45: 8081-89 (2011) (3) Franke C et al; Chemosphere 29: 1501-14 (1994) (4) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.7 Soil Adsorption/Mobility



Using monitoring data from creek and pond locations in Toronto, Ontario, Canada, a field-based Koc of 9.3 was determined for perfluorohexanesulfonic acid(1). According to a classification scheme(2), this estimated Koc value suggests that perfluorohexanesulfonic acid is expected to have very high mobility in soil. The estimated pKa of perfluorohexanesulfonic acid is 0.14(3), indicating that this compound will exist almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic **carbon** and clay than their neutral counterparts(4). However, it has been suggested that compounds like the analogous **PFOS (perfluorooctanesulfonic acid)** may form strong bonds via a chemisorption mechanism(5).

(1) Awad E et al; Environ Sci Technol 45: 8081-89 (2011) (2) Swann RL et al; Res Rev 85: 17-28 (1983) (3) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp> (4) Doucette WJ; pp. 141-188 in Handbook of Property Estimation Methods for Chemicals. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000) (5) Beach SA et al; Rev Environ Contam Toxicol 186: 133-74 (2005)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.8 Volatilization from Water/Soil



The estimated pKa of perfluorohexanesulfonic acid is 0.14(1), indicating that this compound will exist almost entirely in the anion form in the environment(SRC). Therefore, volatilization from **water** surfaces is not expected to be an important fate process(SRC). The analogous compound **PFOS (perfluorooctanesulfonic acid)** is essentially nonvolatile from **water** and moist soil surfaces(2), and the same is expected for perfluorohexanesulfonic acid(SRC). Perfluorohexanesulfonic acid is not expected to volatilize from dry soil surfaces(SRC) based upon an

estimated vapor pressure of 0.0046 mm Hg(SRC), determined from a fragment constant method(3). However, due to the surfactant nature of the perfluoroalkyl compounds (such as perfluorohexanesulfonic acid), some of the amount released to **water** may form micelles and exist in the associated form despite the low pKa values of these substances(1). Perfluoroalkyl compounds that associate on **water** and soil surfaces may volatilize into the atmosphere(1).

(1) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp> (2) Giesy JP, Kannan K; Environ Sci Technol 36: 147A-152A (2002) (3) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of Oct 6, 2015: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.9 Environmental Water Concentrations



GROUNDWATER: Well **water** sampled from a 3M facility in Minnesota contained perfluorohexanesulfonic acid concentrations of 6.47-40.0 ug/L(1).

(1) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

DRINKING **WATER**: Finished drinking **water** and tap **water** samples collected from Amsterdam, Netherlands in January and September 2010 contained mean perfluorohexanesulfonic acid concentrations of 0.6 and 1.3 ng/L, respectively(1). Tap **water** samples collected from Amsterdam, Netherlands between February and April 2011 contained an average perfluorohexanesulfonic acid concentration of 0.55 ng/L(2). Perfluorohexanesulfonic acid concentrations of 0.045-0.15 ng/L were detected in drinking **water** samples collected from Oslo, Norway between October 2008 and January 2009(3). Perfluorohexanesulfonic acid was detected at 21 of 34 drinking **water** sampling sites in Australia between August and November 2010 at levels ranging from <0.92 to 9.98 ng/L(4).

(1) Eschauzier C et al; Environ Sci Technol 46(3): 1708-15 (2011) (2) Eschauzier C et al; Chemosphere 90: 36-41 (2013) (3) Haug LS et al; Chemosphere 80: 1137-43 (2010) (4) Thompson J et al; Chemosphere 83: 1320-25 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE **WATER**: **Water** samples collected from 23 sites along 3 rivers in Tianjin, China in Dec 2008 contained perfluorohexanesulfonic acid concentrations of 0.14-1.28 ng/L(1). **Water** samples collected from Resolute Lake and Meretta Lake in the Canadian Arctic in 2003 and 2004 contained perfluorohexanesulfonic acid concentrations of 1.5-24 ng/L(2). Perfluorohexanesulfonic acid concentrations of <0.25 (detection limit) to 4.05 ng/L were detected in lake water samples collected near Albany, NY in 2006(3). Water samples collected from New York State in July 2004 detected perfluorohexanesulfonic acid in Onondaga Lake (4.2-8.5 ng/L), the Erie Canal (2.5-5.6 ng/L) and other lakes and rivers (0.9-2.8)(4).

(1) Pan Y et al; Bull Environ Contam Toxicol 87(2): 152-57 (2011) (2) Stock NL et al; Environ Sci Technol 41: 3529-36 (2007) (3) Kim SK, Kannan K; Environ Sci Technol 41: 8328-34 (2007) (4) Sinclair E et al; Arch Environ Contam Toxicol 50: 398-410 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SEAWATER: International research cruises undertaken during 2002-2004 detected perfluorohexanesulfonic acid in open seawater at the following concentrations (in pg/L)(1): North Atlantic Ocean (4.1-6.1), Middle Atlantic Ocean (2.6-12), West Pacific Ocean (2.1-2.8), Central to East Pacific Ocean (0.1-1.6). Perfluorohexanesulfonic acid concentrations ranging from <0.2 to 5,600 pg/L have been detected in coastal and ocean waters from Toyko Bay, Hong Kong, Korea and the South China Sea(2).

(1) Yamashita N et al; Mar Poll Bull 51: 658-68 (2005) (2) ATSDR; Draft Toxicological Profile for Perfluoroalkyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

RAIN/SNOW: Perfluorohexanesulfonic acid concentrations of <0.25 (detection limit) to 0.36 ng/L were detected in rain and snow samples collected in Albany, NY during 2006-2007(1).

(1) Kim SK, Kannan K; Environ Sci Technol 41: 8328-34 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.10 Effluent Concentrations



In 2010, effluents from 90 European wastewater treatment plants were analyzed for 156 organic contaminants(1); perfluorohexanesulfonic acid was detected in 71% of the effluents at average and maximum concentrations of 48.6 and 922 ng/L, respectively(1). Analysis of influent and effluent waters from 10 WWTPs nationwide in US detected perfluorohexanesulfonic acid concentrations ranging from 2.3-12 ng/L in the influents and 2.4-17 ng/L in the effluents(2). Effluent waters from 6 WWTPs in New York State contained perfluorohexanesulfonic acid concentrations ranging from <2.5 to 39 ng/L(3).

(1) Loos R et al; *Water Research* 47: 6475-87 (2013) (2) Schultz MM et al; *Environ Sci Technol* 40: 289-95 (2006) (3) Sinclair E, Kannan K; *Environ Sci Technol* 40(5): 1408-14 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.11 Sediment/Soil Concentrations



SEDIMENT: Sediment core samples collected from three Canadian Arctic lakes in 2003 and 2005 contained perfluorohexanesulfonic acid concentrations ranging from about 1 to 10 ng/g dry weight(1). Perfluorohexanesulfonic acid was detected in 28% of 84-92 sediment samples collected from the Mississippi shoreline at a maximum concentration of 11.5 ng/g(2).

(1) Stock NL et al; *Environ Sci Technol* 41: 3529-36 (2007) (2) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

SOIL: Soil samples collected from 4 suburban sites in Tianjin, China in Dec 2008 contained mean perfluorohexanesulfonic acid concentrations of 0.12-0.36 ng/g dry wt (maximum of 5.86 ng/g(1)). Soil samples from a 3M facility in Minnesota contained a maximum perfluorohexanesulfonic acid concentration of 3,470 ng/g(2).

(1) Pan Y et al; *Bull Environ Contam Toxicol* 87: 152-57 (2011) (2) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.12 Atmospheric Concentrations



URBAN/SUBURBAN: Perfluorohexanesulfonic acid concentrations of 0.13-0.44 pg/cu m (mean of 0.31 pg/cu m) were detected in gas-phase air samples collected in Albany, NY during May-July 2006(1); particle-phase air contained concentration of <0.12 pg/cu m(1). Mean perfluorohexanesulfonic acid concentrations of 0.1 and 1.0 pg/cu m were found in air samples from Manchester UK during two sampling sessions(2).

(1) Kim SK, Kannan K; *Environ Sci Technol* 41: 8328-34 (2007) (2) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

INDOOR: Indoor air samples (67 samples) collected in Ottawa, Canada contained a mean perfluorohexanesulfonic acid concentration of 391.96 pg/cu m. 112 Indoor air samples collected from North Carolina and Ohio contained a mean perfluorohexanesulfonic acid concentration of 874 pg/cu m(1).

(1) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

RURAL/REMOTE: Perfluorohexanesulfonic acid was detected in particle-phase air samples collected from research ships in the Atlantic Ocean, Southern Ocean and Baltic Sea in 2007 and 2008 (concentration not reported)(1). Air samples collected on Cornwallis Island in the Canadian Arctic in the summer of 2004 contained a perfluorohexanesulfonic acid concentration of about 2 pg/cu m(2). Mean perfluorohexanesulfonic acid concentrations of 0.05, 0.07 and 0.04 pg/cu m were detected in air samples from Kjeller Norway, Mace Head Ireland and Hazelrigg UK, respectively(3). Marine air samples collected near the east coast of Africa contained a mean level of 0.013 pg/cu m(3).

(1) Dreyer A et al; *Environ Sci Technol* 43: 6507-14 (2009) (2) Stock NL et al; *Environ Sci Technol* 41: 3529-36 (2007) (3) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.13 Food Survey Values



Food items collected from grocery stores in Oslo, Norway between October 2008 and January 2009 contained the following concentrations of perfluorohexanesulfonic acid in pg/g fresh weight: margarine (1.3), bread (1.7), pork meat (1.2) and egg (3.5)(1).

(1) Haug LS et al; *Chemosphere* 80: 1137-43 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.14 Fish/Seafood Concentrations



Fish liver from various Japanese fish contained perfluorohexanesulfonic acid concentrations of <8.5 to 11 ng/g wet wt(1). Fish collected from grocery stores in Oslo, Norway between October 2008 and January 2009 contained the following concentrations of perfluorohexanesulfonic acid in pg/g fresh weight: fish sticks (1.6), salmon (5.5), and cod (2.8)(2).

(1) Senthikumar K et al; *Bull Environ Contam Toxicol* 79: 427-431 (2007) (2) Haug LS et al; *Chemosphere* 80: 1137-1143 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.15 Animal Concentrations



Wildlife samples collected from Japan contained the following concentrations of perfluorohexanesulfonic acid in ng/g wet weight: cormorants (<0.06-0.27), racoon dog (0.14-0.16), eagle (0.01-0.40) and large-bill crow (<0.03-0.10)(1).

(1) Senthikumar K et al; *Bull Environ Contam Toxicol* 79: 427-31 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.16 Milk Concentrations



ENVIRONMENTAL: Perfluorohexanesulfonic acid was detected in 100% of 48 breast milk samples collected from women in France at mean, median, minimum and maximum concentrations of 0.049, 0.050, 0.04 and 0.066 ug/L, respectively(1). Pooled human milk samples from 2009/2010 in Canada were reported to have an average perfluorohexane sulfonic acid concentration of 0.015 ng/mL(2).

(1) Antignac JP et al; *Chemosphere* 91: 802-8 (2013) (2) Kubwabo C et al; *Chemosphere* 91: 771-7 (2013)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.17 Other Environmental Concentrations



Indoor dust samples collected from a rural site near Toronto, Canada in 2007 contained a perfluorohexanesulfonic acid level of nearly 1 pg/cm(1).

(1) Gerwurtz SB et al; *Environ Sci Technol* 43: 7317-23 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoroalkyl chemicals (PFCs) have been used as surfactants and stain repellants in a variety of consumer products for more than 50 years and there is growing concern regarding their persistence and toxicity. Human exposure to these chemicals is essentially universal in North America and researchers have linked them to a variety of health problems ranging from higher rates of cancer, to developmental and reproductive problems, and higher [cholesterol](#) levels. Major exposure pathways are food and [water](#) ingestion, dust ingestion via hand to mouth transfer. In an effort to assess residential exposure, the Wisconsin Department of Health Services tested vacuum cleaner contents from thirty-nine homes for 16 perfluoroalkyl chemicals. [PFOS](#), [PFOA](#), PFHxS, PFHpA and [PFNA](#) were found in all of the vacuum dust samples and dust from eight homes contained all 16 PFCs included in our analysis. The most commonly detected compounds were [perfluorooctanesulfonate \(PFOS\)](#), [perfluorohexanesulfonate \(PFHxS\)](#) and [perfluorooctanoic acid \(PFOA\)](#) which together made up 70% of the total PFC residues in dust from these homes. Summed PFC concentrations in these dust samples ranged from 70 to 2513 ng/g (median 280 ng/g). Our investigation suggests that these chemicals may be ubiquitous contaminants in US homes.

[PMID:22542201](#)

Knobeloch L et al; *Chemosphere* 88(7): 779-83 (2012)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.18 Probable Routes of Human Exposure



Occupational exposure to perfluorohexanesulfonic acid may occur through inhalation and dermal contact with this compound at workplaces where perfluorohexanesulfonic acid is produced or used. Monitoring data indicate that the general population may be exposed to perfluorohexanesulfonic acid via inhalation of ambient air, dust, ingestion of food and drinking [water](#), and dermal contact with consumer products containing perfluorohexanesulfonic acid(1).

(1) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.19 Body Burden



In the Fourth National Report on Human Exposure to Environmental Chemicals (Fourth Report), CDC scientists measured 12 PFCs (perfluorochemicals) in the blood serum (the clear portion of blood) of 2,094 participants aged 12 years and older who took part in the National Health and Nutrition Examination Survey (NHANES) during 2003-2004(1). By measuring PFCs in serum, scientists can estimate the amount of PFCs that have entered people's bodies. CDC scientists found four PFCs (PFOS, PFOA, PFHxS or perfluorohexanesulfonic acid, and PFNA or perfluorononanoic acid) in the serum of nearly all of the people tested, indicating widespread exposure to these PFCs in the U.S. population(1). Mean concentration of perfluorohexane sulfonic acid declined by 10-30% in the 2003-2004 survey compared to a 1999-2000 survey(2).

(1) CDC; *Perfluorochemicals (PFCs) Fact Sheet*, November 2009. Available from, as of Oct 6, 2015: http://www.cdc.gov/biomonitoring/pdf/PFCs_FactSheet.pdf (2) ATSDR; *Draft Toxicological Profile for Perfluoroalkyls*. Atlanta, GA: Agency for Toxic Substances and Disease Registry, US Public Health Service (2015). Available from, as of Oct 5, 2015: <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorohexanesulfonic acid was detected in 100% of 48 breast milk samples collected from women in France at mean, median, minimum and maximum concentrations of 0.049, 0.050, 0.04 and 0.066 ug/L, respectively(1). Pooled human milk samples from 2009/2010 in Canada were reported to have an average perfluorohexanesulfonic acid concentration of 0.015 ng/mL(2).

(1) Antignac JP et al; *Chemosphere* 91: 802-8 (2013) (2) Kubwabo C et al; *Chemosphere* 91: 771-7 (2013)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorohexanesulfonic acid concentration in the blood plasma of 105 fisherman from the Lake Mohne area of Germany (2006-2008) ranged from 0.4-17 ug/L(1). Analysis of blood serum collected from 20 adults in Atlanta, GA in July 2003 detected perfluorohexanesulfonic acid concentrations ranging from 0.4-11.2 ug/L(2).

(1) Holzer J et al; *Environ Sci Technol* 45(19): 8046-52 (2011) (2) Kuklenyik A et al; *Environ Sci Technol* 38: 3698-704 (2004)

► [Hazardous Substances Data Bank \(HSDB\)](#)

12 Associated Disorders and Diseases



► [Comparative Toxicogenomics Database \(CTD\)](#)

13 Literature



13.1 NLM Curated PubMed Citations



► PubChem

13.2 Springer Nature References



► Springer Nature

13.3 Depositor Provided PubMed Citations



► PubChem

13.4 Metabolite References



► Human Metabolome Database (HMDB)

13.5 Chemical Co-Occurrences in Literature



► PubChem

13.6 Chemical-Gene Co-Occurrences in Literature



► PubChem

13.7 Chemical-Disease Co-Occurrences in Literature



► PubChem

14 Patents



14.1 Depositor-Supplied Patent Identifiers



► PubChem

[Link to all deposited patent identifiers](#)

► PubChem

14.2 WIPO PATENTSCOPE



Patents are available for this chemical structure:

<https://patentscope.wipo.int/search/en/result.jsf?inchikey=QZHDEAJFRJCDMF-UHFFFAOYSA-N>

► PATENTSCOPE (WIPO)

15 Biomolecular Interactions and Pathways



15.1 Chemical-Gene Interactions



15.1.1 CTD Chemical-Gene Interactions



► [Comparative Toxicogenomics Database \(CTD\)](#)

16 Classification



16.1 Ontologies



16.1.1 MeSH Tree



► Medical Subject Headings (MeSH)

16.1.2 ChEBI Ontology



► ChEBI

16.1.3 ChemIDplus



► ChemIDplus

16.1.4 UN GHS Classification



► UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

16.1.5 EPA CPDat Classification



► EPA Chemical and Products Database (CPDat)

16.1.6 NORMAN Suspect List Exchange Classification



► [NORMAN Suspect List Exchange](#)

16.1.7 EPA DSSTox Classification



► [EPA DSSTox](#)

17 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. CAS Common Chemistry

LICENSE

The data from CAS Common Chemistry is provided under a CC-BY-NC 4.0 license, unless otherwise stated.

<https://creativecommons.org/licenses/by-nc/4.0/>

Perfluorohexanesulfonic acid

https://commonchemistry.cas.org/detail?cas_rn=355-46-4

2. ChemIDplus

LICENSE

<https://www.nlm.nih.gov/copyright.html>

Perfluorohexanesulfonic acid

<https://chem.nlm.nih.gov/chemidplus/sid/0000355464>

ChemIDplus Chemical Information Classification

<https://chem.nlm.nih.gov/chemidplus/>

3. EPA Chemicals under the TSCA

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

1-Hexanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-

<https://www.epa.gov/chemicals-under-tsca>

4. EPA DSSTox

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

PFHxS

<https://comptox.epa.gov/dashboard/DTXSID7040150>

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical_lists/

5. European Chemicals Agency (ECHA)

LICENSE

Use of the information, documents and data from the ECHA website is subject to the terms and conditions of this Legal Notice, and subject to other binding limitations provided for under applicable law, the information, documents and data made available on the ECHA website may be reproduced, distributed and/or used, totally or in part, for non-commercial purposes provided that ECHA is acknowledged as the source: "Source: European Chemicals Agency, <http://echa.europa.eu/>". Such acknowledgement must be included in each copy of the material. ECHA permits and encourages organisations and individuals to create links to the ECHA website under the following cumulative conditions: Links can only be made to webpages that provide a link to the Legal Notice page.

<https://echa.europa.eu/web/guest/legal-notice>

Perfluorohexane-1-sulphonic acid

<https://echa.europa.eu/substance-information/-/substanceinfo/100.005.989>

Perfluorohexane-1-sulphonic acid

<https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/10265>

6. Hazardous Substances Data Bank (HSDB)

Perfluorohexanesulfonic acid

<https://pubchem.ncbi.nlm.nih.gov/source/hsdb/8274>

7. ChEBI

Perfluorohexanesulfonic acid

<http://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:132448>

ChEBI Ontology

<http://www.ebi.ac.uk/chebi/userManualForward.do#ChEBI%20Ontology>

8. Comparative Toxicogenomics Database (CTD)

LICENSE

It is to be used only for research and educational purposes. Any reproduction or use for commercial purpose is prohibited without the prior express written permission of the MDI Biological Laboratory and NC State University.

<http://ctdbase.org/about/legal.jsp>

<http://ctdbase.org/detail.go?type=chem&acc=C471071>

9. EPA Chemical and Products Database (CPDat)

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

perfluorohexane-1-sulphonic acid

<https://comptox.epa.gov/dashboard/DTXSID7040150#exposure>

EPA CPDat Classification

<https://www.epa.gov/chemical-research/chemical-and-products-database-cpdatt>

10. FDA/SPL Indexing Data

LICENSE

Unless otherwise noted, the contents of the FDA website (www.fda.gov), both text and graphics, are not copyrighted. They are in the public domain and may be republished, reprinted and otherwise used freely by anyone without the need to obtain permission from FDA. Credit to the U.S. Food and Drug Administration as the source is appreciated but not required.

<https://www.fda.gov/about-fda/about-website/website-policies#linking>

ZU6Y1E592S

<https://www.fda.gov/ForIndustry/DataStandards/SubstanceRegistrationSystem-UniqueIngredientIdentifierUNII/>

11. Human Metabolome Database (HMDB)

LICENSE

HMDB is offered to the public as a freely available resource. Use and re-distribution of the data, in whole or in part, for commercial purposes requires explicit permission of the authors and explicit acknowledgment of the source material (HMDB) and the original publication (see the HMDB citing page). We ask that users who download significant portions of the database cite the HMDB paper in any resulting publications.

<http://www.hmdb.ca/citing>

Perfluorohexane sulfonic acid

<http://www.hmdb.ca/metabolites/HMDB0094700>

12. MassBank of North America (MoNA)

LICENSE

The content of the MoNA database is licensed under CC BY 4.0.

<https://mona.fiehnlab.ucdavis.edu/documentation/license>

Perfluorohexane sulfonic acid (PFHxS)

<http://mona.fiehnlab.ucdavis.edu/spectra/browse?inchikey=QZHDEAJFRJCDMF-UHFFFAOYSA-N>

13. NORMAN Suspect List Exchange

LICENSE

Data: CC-BY 4.0; Code (hosted by ECI, LCSB): Artistic-2.0

<https://creativecommons.org/licenses/by/4.0/>

1-Hexanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6-tridecafluoro-

NORMAN Suspect List Exchange Classification

<https://www.norman-network.com/nds/SLE/>

14. Springer Nature

<https://pubchem.ncbi.nlm.nih.gov/substance/341186423>

15. Wikipedia

perfluorohexanesulphonic acid

https://commons.wikimedia.org/wiki/Category:Perfluorohexanesulfonic_acid

Perfluorohexanesulfonate

<https://www.wikidata.org/wiki/Q81978596>

16. PubChem

<https://pubchem.ncbi.nlm.nih.gov>

17. Medical Subject Headings (MeSH)

perfluorohexanesulfonic acid

<https://www.ncbi.nlm.nih.gov/mesh/67471071>

MeSH Tree

<http://www.nlm.nih.gov/mesh/meshhome.html>

18. UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

GHS Classification Tree

http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

19. PATENTSCOPE (WIPO)

SID 403404669

<https://pubchem.ncbi.nlm.nih.gov/substance/403404669>

Perfluorohexanoic acid

Safety Data Sheet 2121339

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 11/18/2015

Revision date: 12/06/2018

Version: 1.1

SECTION 1: Identification

1.1. Identification

Product form : Substance
 Substance name : Perfluorohexanoic acid
 CAS No : 307-24-4
 Product code : 2121-3-39
 Formula : C₆HF₁₁O₂
 Synonyms : Undecafluorohexanoic acid
 Other means of identification : 2121-3-39

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Laboratory chemicals
 Manufacture of substances
 Scientific research and development

1.3. Details of the supplier of the safety data sheet

SynQuest Laboratories, Inc.
 P.O. Box 309
 Alachua, FL 32615 - United States of America
 T (386) 462-0788 - F (386) 462-7097
info@synquestlabs.com - www.synquestlabs.com

1.4. Emergency telephone number

Emergency number : (844) 523-4086 (3E Company - Account 10069)

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Skin Corr. 1B H314 - Causes severe skin burns and eye damage

Eye Dam. 1 H318 - Causes serious eye damage

STOT SE 3 H335 - May cause respiratory irritation

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS05

GHS07

Signal word (GHS-US) :

Danger

Hazard statements (GHS-US) :

H314 - Causes severe skin burns and eye damage

H335 - May cause respiratory irritation

Precautionary statements (GHS-US) :

P260 - Do not breathe fumes, mist, spray, vapors
 P264 - Wash skin thoroughly after handling
 P271 - Use only outdoors or in a well-ventilated area
 P280 - Wear protective gloves/protective clothing/eye protection/face protection
 P301+P330+P331 - If swallowed: rinse mouth. Do NOT induce vomiting
 P303+P361+P353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
 P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
 P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
 P310 - Immediately call a POISON CENTER or doctor/ physician
 P321 - Specific treatment (see supplemental first aid instructions on this label)
 P363 - Wash contaminated clothing before reuse
 P403+P233 - Store in a well-ventilated place. Keep container tightly closed
 P405 - Store locked up
 P501 - Dispose of contents/container to an approved waste disposal plant

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Mono-constituent

Name	Product identifier	%	Classification (GHS-US)
Perfluorohexanoic acid (Main constituent)	(CAS No) 307-24-4	<= 100	Skin Corr. 1B, H314 Eye Dam. 1, H318 STOT SE 3, H335

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

- First-aid measures general : In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Move the affected personnel away from the contaminated area.
- First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing. If not breathing, give artificial respiration. Get immediate medical advice/attention.
- First-aid measures after skin contact : Wash with plenty of soap and water. Remove contaminated clothing and shoes. Get immediate medical advice/attention.
- First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.
- First-aid measures after ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth out with water. Get immediate medical advice/attention.

4.2. Most important symptoms and effects, both acute and delayed

- Symptoms/injuries : The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.
- Symptoms/injuries after inhalation : Material is destructive to tissue of the mucuous membranes and upper respiratory tract. Cough, shortness of breath, headache, nausea.

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

- Suitable extinguishing media : Alcohol resistant foam. Carbon dioxide. Dry powder. Water spray. Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

- Fire hazard : Thermal decomposition generates: Carbon oxides. Hydrogen fluoride.
- Explosion hazard : Risk of explosion if heated under confinement. Use water spray or fog for cooling exposed containers.

5.3. Advice for firefighters

- Firefighting instructions : In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.
- Protection during firefighting : Wear gas tight chemically protective clothing in combination with self contained breathing apparatus. For further information refer to section 8: "Exposure controls/personal protection".

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

No additional information available

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Do not handle until all safety precautions have been read and understood. Ensure good ventilation of the work station. Do not breathe fumes, mist, spray, vapors. Wear personal protective equipment. Avoid contact with skin and eyes.
Hygiene measures	: Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures	: Comply with applicable regulations.
Storage conditions	: Keep container closed when not in use.
Incompatible materials	: Refer to Section 10 on Incompatible Materials.
Storage area	: Store in dry, cool, well-ventilated area.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Appropriate engineering controls	: Ensure good ventilation of the work station. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Hand protection	: Protective gloves. 29 CFR 1910.138: Hand Protection.
Eye protection	: Chemical goggles or safety glasses. Face shield. 29 CFR 1910.133: Eye and Face Protection.
Skin and body protection	: Wear suitable protective clothing.
Respiratory protection	: In case of inadequate ventilation wear respiratory protection. 29 CFR 1910.134: Respiratory Protection.
Other information	: Safety shoes. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance	: Low melting solid.
Color	: No data available
Odor	: No data available
Odor threshold	: No data available
pH	: No data available
Melting point	: 12 - 14 °C
Freezing point	: No data available
Boiling point	: 157 °C
Flash point	: No data available
Relative evaporation rate (butyl acetate=1)	: No data available
Flammability (solid, gas)	: No data available
Explosion limits	: No data available
Explosive properties	: No data available
Oxidizing properties	: No data available
Vapor pressure	: No data available
Relative density	: No data available
Relative vapor density at 20 °C	: No data available
Specific gravity / density	: 1.762 g/ml (@ 20 °C)
Molecular mass	: 314.05 g/mol

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Solubility	: No data available
Log Pow	: No data available
Auto-ignition temperature	: No data available
Decomposition temperature	: No data available
Viscosity	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available

9.2. Other information

Refractive index	: 1.298 (@ 20 °C)

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

The product is stable at normal handling and storage conditions.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

No additional information available

10.5. Incompatible materials

Bases. Oxidizing agents. Reducing agents.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. Hazardous decomposition products in case of fire, see Section 5.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	: Not classified
Skin corrosion/irritation	: Causes severe skin burns and eye damage.
Serious eye damage/irritation	: Causes serious eye damage.
Respiratory or skin sensitization	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: May cause respiratory irritation.
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified
Symptoms/injuries after inhalation	: Material is destructive to tissue of the mucuous membranes and upper respiratory tract. Cough, shortness of breath, headache, nausea.

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

No additional information available

12.4. Mobility in soil

No additional information available

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

- Waste treatment methods : Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber.
- Waste disposal recommendations : Dispose of contents/container in accordance with licensed collector's sorting instructions.
- Additional information : Recycle the material as far as possible.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN3265 Corrosive liquid, acidic, organic, n.o.s., 8, II

UN-No.(DOT) : UN3265

Proper Shipping Name (DOT) : Corrosive liquid, acidic, organic, n.o.s.

Transport hazard class(es) (DOT) : 8 - Class 8 - Corrosive material 49 CFR 173.136

Hazard labels (DOT) : 8 - Corrosive



Packing group (DOT) : II - Medium Danger

DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

DOT Symbols : G - Identifies PSN requiring a technical name

DOT Special Provisions (49 CFR 172.102) : B2 - MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks are not authorized.

IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.

T11 - 6 178.274(d)(2) Normal..... 178.275(d)(3)

TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: t_r is the maximum mean bulk temperature during transport, t_f is the temperature in degrees celsius of the liquid during filling, and a is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transportation (t_r) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d_{15} and d_{50} are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively.

TP27 - A portable tank having a minimum test pressure of 4 bar (400 kPa) may be used provided the calculated test pressure is 4 bar or less based on the MAWP of the hazardous material, as defined in 178.275 of this subchapter, where the test pressure is 1.5 times the MAWP.

DOT Packaging Exceptions (49 CFR 173.xxx) : 154

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 1 L

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 30 L

DOT Vessel Stowage Location : B - (i) The material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) "On deck only" on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

DOT Vessel Stowage Other : 40 - Stow "clear of living quarters"

Other information : No supplementary information available.

TDG

No additional information available

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Transport by sea

UN-No. (IMDG) : 3265
Proper Shipping Name (IMDG) : CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Class (IMDG) : 8 - Corrosive substances
Packing group (IMDG) : II - substances presenting medium danger

Air transport

UN-No. (IATA) : 3265
Proper Shipping Name (IATA) : Corrosive liquid, acidic, organic, n.o.s.
Class (IATA) : 8 - Corrosives
Packing group (IATA) : II - Medium Danger

SECTION 15: Regulatory information

15.1. US Federal regulations

Perfluorohexanoic acid (307-24-4)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA

Perfluorohexanoic acid (307-24-4)

Listed on the Canadian NDSL (Non-Domestic Substances List)

EU-Regulations

No additional information available

National regulations

Perfluorohexanoic acid (307-24-4)

Listed on the AICS (Australian Inventory of Chemical Substances)
Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory
Listed on the Korean ECL (Existing Chemicals List)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

Revision date : 12/06/2018

Full text of H-phrases:

Eye Dam. 1	Serious eye damage/eye irritation Category 1
Skin Corr. 1B	Skin corrosion/irritation Category 1B
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H335	May cause respiratory irritation

Perfluorohexanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

NFPA health hazard

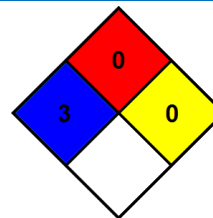
: 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard

: 0 - Materials that will not burn.

NFPA reactivity

: 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health

: 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability

: 0 Minimal Hazard - Materials that will not burn

Physical

: 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

SDS US (GHS HazCom 2012)

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is offered solely for your consideration, investigation, and verification. It does not represent any guarantee of the properties of the product nor that the hazard precautions or procedures described are the only ones which exist. SynQuest shall not be held liable for any damage resulting from handling or from contact with the above product.

**COVID-19 Information**

[Public health information \(CDC\)](#) [Research information \(NIH\)](#) [SARS-CoV-2 data \(NCBI\)](#) [Prevention and treatment information \(HHS\)](#)
[Español](#)



COMPOUND SUMMARY

Perfluorononanoic acid



Cite

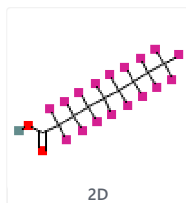


Download

PubChem CID

67821

Structure

[Find Similar Structures](#)

Chemical Safety



Corrosive



Irritant

[Laboratory Chemical Safety Summary \(LCSS\) Datasheet](#)

Molecular Formula

C₉HF₁₇O₂

Synonyms

Perfluorononanoic acid
 375-95-1
 heptadecafluorononanoic acid
 Perfluoro-n-nonanoic acid
 PFNA

[More...](#)

Molecular Weight

464.08

Dates

Modify	Create
2021-05-22	2005-03-26

Perfluorononanoic acid is a fluoroalkanoic acid that is **nonanoic acid** in which all of the hydrogens in the alkyl chain are replaced by fluorines. It has a role as a persistent organic pollutant, a xenobiotic and a surfactant. It derives from a **nonanoic acid**.

[ChEBI](#)

Contents

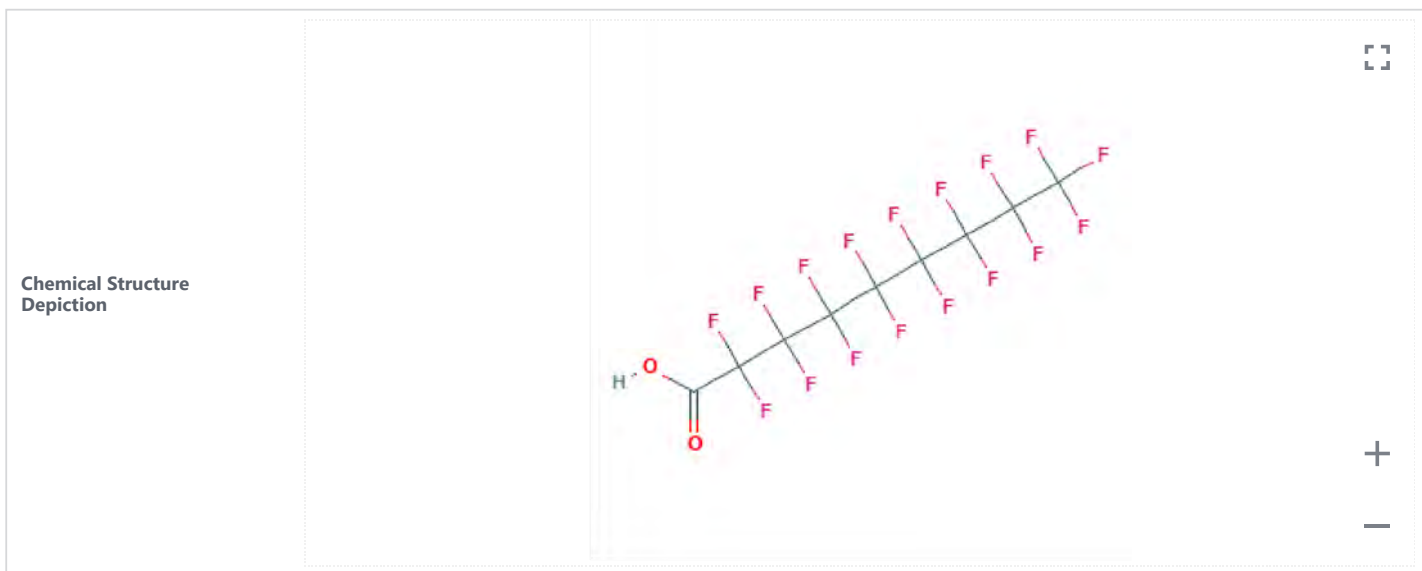
[1 Structures](#)[2 Names and Identifiers](#)[3 Chemical and Physical Properties](#)[4 Spectral Information](#)[5 Related Records](#)

6 Chemical Vendors	
7 Pharmacology and Biochemistry	▼
8 Use and Manufacturing	▼
9 Safety and Hazards	▼
10 Toxicity	▼
11 Associated Disorders and Diseases	
12 Literature	▼
13 Patents	▼
14 Biomolecular Interactions and Pathways	▼
15 Biological Test Results	▼
16 Classification	▼
17 Information Sources	

1 Structures



1.1 2D Structure



► [PubChem](#)

1.2 3D Conformer



► [PubChem](#)

2 Names and Identifiers



2.1 Computed Descriptors



2.1.1 IUPAC Name



2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluorononanoic acid

Computed by LexiChem 2.6.6 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.2 InChI



InChI=1S/C9HF17O2/c10-2(11,1(27)28)3(12,13)4(14,15)5(16,17)6(18,19)7(20,21)8(22,23)9(24,25)26/h(H,27,28)

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.3 InChI Key



UZUFPBIDKMEQEQ-UHFFFAOYSA-N

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.1.4 Canonical SMILES



C(=O)(C(C(C(C(C(C(C(F)(F)F)(F)F)(F)F)(F)F)(F)F)(F)F)(F)F)O

Computed by OEChem 2.1.5 (PubChem release 2019.06.18)

► [PubChem](#)

2.2 Molecular Formula



C9HF17O2

Computed by PubChem 2.1 (PubChem release 2019.06.18)

► [PubChem](#)

2.3 Other Identifiers



2.3.1 CAS



375-95-1

► [CAS Common Chemistry](#); [ChemIDplus](#); [EPA Chemicals under the TSCA](#); [EPA DSSTox](#); [European Chemicals Agency \(ECHA\)](#); [Hazardous Substances Data Bank \(HSDB\)](#)

2.3.2 Related CAS



4149-60-4 (ammonium salt)

► [ChemIDplus](#)

2.3.3 European Community (EC) Number



206-801-3

▶ [European Chemicals Agency \(ECHA\)](#)

2.3.4 UNII



5830Z6S63M

▶ [FDA/SPL Indexing Data](#)

2.3.5 DSSTox Substance ID



DTXSID8031863

▶ [EPA DSSTox](#)

2.3.6 Wikipedia



[Perfluorononanoic acid](#)

▶ [Wikipedia](#)

2.4 Synonyms



2.4.1 MeSH Entry Terms



C9-PFA
perfluoro-n-nonanoic acid
perfluoro-n-nonanoic acid, ammonium salt
perfluoro-n-nonanoic acid, lithium salt
perfluoro-n-nonanoic acid, potassium salt
perfluoro-n-nonanoic acid, sodium salt

▶ [Medical Subject Headings \(MeSH\)](#)

2.4.2 Depositor-Supplied Synonyms



Perfluorononanoic acid	Heptadecafluoronansaeure	ACMC-209iu9
375-95-1	Heptadekafluoronansaeure	C8F17COOH
heptadecafluoronanoic acid	CHEBI:38397	DSSTox_CID_11863
Perfluoro-n-nonanoic acid	MFCD00039605	DSSTox_RID_78893
PFNA	5830Z6S63M	DSSTox_GSID_31863
Perfluorononan-1-oic acid	Nonanoic acid, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptadecafluoro-	SCHEMBL23557
Nonanoic acid, heptadecafluoro-	NSC676910	Perfluorononanoic acid, 97%
2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-Heptadecafluoronanoic acid	EINECS 206-801-3	CHEMBL426404
Heptadecafluoropelargonic Acid	PERFLUORONANOICACID	DTXSID8031863
Perfluoronansaeure	Perfluorononanoic acid (PFNA)	Tox21_300380
n-Heptadecafluoronanoic acid	HSDB 8040	ANW-28687
UNII-5830Z6S63M	Perfluoropelargonic Acid	ZINC38141429

▶ [PubChem](#)

3 Chemical and Physical Properties



3.1 Computed Properties



Property Name	Property Value	Reference
Molecular Weight	464.08	Computed by PubChem 2.1 (PubChem release 2021.05.07)
XLogP3-AA	5.6	Computed by XLogP3 3.0 (PubChem release 2019.06.18)
Hydrogen Bond Donor Count	1	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Hydrogen Bond Acceptor Count	19	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Rotatable Bond Count	7	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Exact Mass	463.9705080	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Monoisotopic Mass	463.9705080	Computed by PubChem 2.1 (PubChem release 2021.05.07)
Topological Polar Surface Area	37.3 Å ²	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Heavy Atom Count	28	Computed by PubChem
Formal Charge	0	Computed by PubChem
Complexity	615	Computed by Cactvs 3.4.6.11 (PubChem release 2019.06.18)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2019.01.04)

► PubChem

3.2 Experimental Properties



3.2.1 Solubility



In **water**, 6.25X10⁻² mg/L at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of Jul 26, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► Hazardous Substances Data Bank (HSDB)

3.2.2 Vapor Pressure



8.3X10⁻² mm Hg at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of Jul 26, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► Hazardous Substances Data Bank (HSDB)

3.2.3 LogP



log Kow = 5.48 (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of Jul 26, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► Hazardous Substances Data Bank (HSDB)

3.2.4 Dissociation Constants



pKa = -0.21

SPARC; pKa/property server. Ver 3. Jan, 2006. Available from, as of July 9, 2012: <http://archemcalc.com/sparc/>

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.5 Collision Cross Section



165.06 Å² [M-H]⁻

240.71 Å² [2M-H]⁻

147.05 Å² [M-H-CO2]⁻

579 | UACCSCEC | Collision Cross Section (CCS) Library from UAntwerp | [DOI:10.5281/zenodo.4704648](https://doi.org/10.5281/zenodo.4704648)

► [NORMAN Suspect List Exchange](#)

3.2.6 Kovats Retention Index



Semi-standard non-polar	1091

► [NIST Mass Spectrometry Data Center](#)

3.2.7 Other Experimental Properties



Hydroxyl radical reaction rate constant = 5.2X10⁻¹¹ cu cm/molec-sec at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of Jul 26, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

4 Spectral Information



4.1 Mass Spectrometry



Showing 2 of 4 [View More](#)

Source of Spectrum	NP-19-337-0
Copyright	Copyright © 2020 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

[▶ SpectraBase](#)

Source of Spectrum	NP-15-4322-0
Copyright	Copyright © 2020 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

[▶ SpectraBase](#)

4.1.1 GC-MS



Showing 2 of 3 [View More](#)

NIST Number	375808
Library	Main library
Total Peaks	110

5/28/2021	Perfluorononanoic acid C9HF17O2 - PubChem
m/z Top Peak	131
m/z 2nd Highest	69
m/z 3rd Highest	45
Thumbnail	

► NIST Mass Spectrometry Data Center

NIST Number	237633
Library	Replicate library
Total Peaks	111
m/z Top Peak	131
m/z 2nd Highest	69
m/z 3rd Highest	45
Thumbnail	

► NIST Mass Spectrometry Data Center

4.1.2 MS-MS	
MS-MS	MS-MS Spectrum 435959 - Perfluorononanoic acid (HMDB0061739) MS-MS Spectrum 435960 - Perfluorononanoic acid (HMDB0061739) MS-MS Spectrum 435961 - Perfluorononanoic acid (HMDB0061739) MS-MS Spectrum 435962 - Perfluorononanoic acid (HMDB0061739) MS-MS Spectrum 435963 - Perfluorononanoic acid (HMDB0061739) MS-MS Spectrum 435964 - Perfluorononanoic acid (HMDB0061739)

► [Human Metabolome Database \(HMDB\)](#)

4.1.3 LC-MS

Showing 2 of 5 [View More](#) 

MoNA ID	EA271851
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	462.9632
Instrument	LTQ Orbitrap XL Thermo Scientific
Instrument Type	LC-ESI-ITFT
Ionization	ESI
Ionization Mode	negative
Collision Energy	35 % (nominal)
Retention Time	13.9 min
Splash	splash10-014i-0000900000-7a30a5904591700ff4a1
Thumbnail	
Submitter	Eawag Team, Eawag - Swiss Federal Institute of Aquatic Science and Technology

► [MassBank of North America \(MoNA\)](#)

MoNA ID	EA271852
MS Category	Experimental
MS Type	LC-MS
MS Level	MS2
Precursor Type	[M-H]-
precursor m/z	462.9632
Instrument	LTQ Orbitrap XL Thermo Scientific
Instrument Type	LC-ESI-ITFT
Ionization	ESI
Ionization Mode	negative

5/28/2021Perfluorononanoic acid | C9HF17O2 - PubChem

Collision Energy	15 % (nominal)
Retention Time	13.9 min
Splash	splash10-014i-0020900000-3a30d00e24e965e23f97
Thumbnail	
SubmitterEawag Team, Eawag - Swiss Federal Institute of Aquatic Science and Technology	

► [MassBank of North America \(MoNA\)](#)

4.1.4 Other MS



MoNA ID	MoNA024628
MS Category	Experimental
Precursor Type	[M-H]-
precursor m/z	462.963234
Ionization Mode	negative
Splash	splash10-014i-0994900000-944aefc1a791dd7e806f
Thumbnail	
SubmitterArpana Vaniya, UC DAVIS	

► [MassBank of North America \(MoNA\)](#)

4.2 IR Spectra



4.2.1 ATR-IR Spectra



Source of Sample	Aldrich
Catalog Number	394459
Copyright	Copyright © 2018-2020 Sigma-Aldrich Co. LLC. - Database Compilation Copyright © 2018-2020 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

► [SpectraBase](#)

4.3 Other Spectra



In [water](#), 6.25X10⁻² mg/L at 25 °C (est)

US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of Jul 26, 2012: <http://www.epa.gov/oppt/exposure/pubs/episutedl.htm>

► [Hazardous Substances Data Bank \(HSDB\)](#)

5 Related Records



5.1 Related Compounds with Annotation



► PubChem

5.2 Related Compounds



Same Connectivity	4 Records
Same Parent, Connectivity	40 Records
Same Parent, Exact	37 Records
Mixtures, Components, and Neutralized Forms	50 Records
Similar Compounds	175 Records
Similar Conformers	155 Records

► PubChem

5.3 Substances



5.3.1 Related Substances



All	247 Records
Same	99 Records
Mixture	148 Records

► PubChem

5.3.2 Substances by Category



► PubChem

5.4 Entrez Crosslinks



PubMed	217 Records
Taxonomy	7 Records
OMIM	8 Records
Gene	1,248 Records

► PubChem

6 Chemical Vendors



► [PubChem](#)

7 Pharmacology and Biochemistry



7.1 Absorption, Distribution and Excretion



Using nuclear magnetic resonance (NMR) spectroscopy, we investigated the importance of **carbon** chain length with regard to the hepatic effects associated with perfluoro-n-carboxylic acids. Male F-344 rats were administered a single intraperitoneal dose of either **perfluoro-n-heptanoic acid** (C7-PFA), perfluoro-n-nonanoic acid (C9-PFA), or **perfluoro-n-undecanoic acid** (C11-PFA). Data from previous studies involving **perfluoro-n-octanoic acid** (C8-PFA) and **perfluoro-n-decanoic acid** (C10-PFA) are included for comparison. Food consumption/body weight was monitored daily for all groups. C9- and C11-PFA treatment yields a prolonged hypophagic response while C7-PFA shows a more acute response. Fluorine-19 NMR spectra of urine and bile samples show no evidence of fluorometabolites and suggest that the distribution of perfluorocarbons into urine or bile is dependent upon **carbon** chain length. The aqueous solubility of C7-PFA appears to facilitate rapid urinary excretion, similar to that observed for C8-PFA. The relative hydrophobicity of C9- and C11-PFA appears to favor biliary enterohepatic recirculation, yielding a more protracted toxicity, similar to C10-PFA. **Phosphorus-31** NMR studies of liver in vivo and liver extracts show that perfluorocarbons of > or = C9 carbons produce a significant increase in liver **phosphocholine** concentration. These data are discussed with regard to the impact of these chemicals on hepatic phospholipid metabolism. Hepatic peroxisomal fatty acyl **CoA**-oxidase activity (FAO) was measured to determine if C7-, C9-, and C11-PFA are peroxisome proliferators. Data indicate that the induction of peroxisomal enzyme activity by perfluorocarbons requires a chain length greater than seven carbons. In general, these results demonstrate the significance of **carbon** chain length in the hepatotoxic response and provide clues toward understanding the processes involved in the biological activities associated with exposure to these compounds.

PMID:8831811

Goecke-Flora CM, Reo NV; *Chem Res Toxicol.* 9 (4): 689-95 (1996)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorononanoic acid (PFNA) is a fluorinated organic chemical found at low levels in the environment, but is detectable in humans and wildlife. The present study compared the pharmacokinetic properties of PFNA in two laboratory rodent species. ... CD-1 mice were given a single oral dose of PFNA of 1 or 10mg/kg, and 4 males and 4 females were killed at /1, 2, 3, 4, 7, 16, 21, 28, 35, 42 and 50 days after treatment/; trunk blood, liver and kidney were collected. Serum and tissue concentrations of PFNA were determined by LC-MS/MS. ... In the mouse, the rates of PFNA serum elimination are non-linear with exposure dose and are slightly faster in females than males, with terminal estimated serum half-life of 25.8-68.4 days and 34.3-68.9 days, respectively. PFNA is also stored preferentially in the mouse liver but not in the kidneys. Hepatic uptake appears to be more efficient and storage capacity greater in male mice than in females. These data suggest that (1) PFNA is more persistent in the mouse than in the rat; (2) there is a major sex difference in the serum elimination of PFNA in the rat, but much less so in the mouse; and (3) there is a significantly higher hepatic accumulation of PFNA in male mice than in females.

PMID:21237237

Tatum-Gibbs K et al; *Toxicology.* 281 (1-3): 48-55 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorononanoic acid (PFNA) is a fluorinated organic chemical found at low levels in the environment, but is detectable in humans and wildlife. The present study compared the pharmacokinetic properties of PFNA in two laboratory rodent species. Male and female Sprague-Dawley rats were given a single dose of PFNA by oral gavage at 1, 3, or 10mg/kg, and blood was collected from the tail vein at 1, 2, 3, 4, 7, 16, 21, 28, 35, 42 and 50 days after treatment. In addition, livers and kidneys were collected for PFNA analysis at the terminal time point. ... Serum and tissue concentrations of PFNA were determined by LC-MS/MS. Serum elimination of PFNA is by and large linear with exposure doses in the rat; however, like **PFOA**, a major sex difference in the rate of elimination is observed, with an estimated half-life of 30.6 days for males and 1.4 days for females. PFNA is stored preferentially in the liver but not in the kidneys. ... These data suggest that (1) PFNA is more persistent in the mouse than in the rat; (2) there is a major sex difference in the serum elimination of PFNA in the rat, but much less so in the mouse; and (3) there is a significantly higher hepatic accumulation of PFNA in male mice than in females.

PMID:21237237

Tatum-Gibbs K et al; *Toxicology.* 281 (1-3): 48-55 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

7.2 Biological Half-Life



CD-1 mice were given a single oral dose of perfluorononanoic acid (PFNA) of 1 or 10mg/kg, and 4 males and 4 females were killed at /1, 2, 3, 4, 7, 16, 21, 28, 35, 42 and 50 days after treatment./ ... In the mouse, the rates of PFNA serum elimination are non-linear with exposure dose and are slightly faster in females than males, with terminal estimated serum half-life of 25.8-68.4 days and 34.3-68.9 days,

PMID:21237237

Tatum-Gibbs K et al; *Toxicology.* 281 (1-3): 48-55 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Male and female Sprague-Dawley rats were given a single dose of perfluorononanoic acid (PFNA) by oral gavage at 1, 3, or 10mg/kg, and blood was collected from the tail vein at 1, 2, 3, 4, 7, 16, 21, 28, 35, 42 and 50 days after treatment. ... Serum elimination of PFNA is by and large linear with exposure doses in the rat ... with an estimated half-life of 30.6 days for males and 1.4 days for females.

[PMID:21237237](#)

Tatum-Gibbs K et al; *Toxicology*. 281 (1-3): 48-55 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

7.3 Mechanism of Action



The potency of the induction of peroxisomal beta-oxidation was compared between perfluorinated fatty acids (PFCAs) with different **carbon** chain lengths in the liver of male and female rats. In male rats, **perfluoroheptanoic acid** (PFHA) has little effect, although **perfluorooctanoic acid** (PFOA), perfluorononanoic acid (PFNA) and **perfluorodecanoic acid** (PFDA) potentially induced the activity. By contrast, PFHA and PFOA did not induce the activity of peroxisomal beta-oxidation in the liver of female rats while PFNA and PFDA effectively induced the activity. The induction of the activity by these PFCAs was in a dose-dependent manner, and there is a highly significant correlation between the induction and hepatic concentrations of PFCAs in the liver regardless of their **carbon** chain lengths. These results strongly suggest that the difference in their chemical structure is not the cause of the difference in the potency of the induction. Hepatic concentrations of PFOA and PFNA was markedly higher in male compared with female rats. Castration of male rats reduced the concentration of PFNA in the liver and treatment with **testosterone** entirely restored the reduction. In contrast to the results obtained from the in vivo experiments, the activity of peroxisomal beta-oxidation was induced by PFDA and PFOA to the same extent in cultured hepatocytes prepared from both male and female rats. These results, taken together, indicate that difference in accumulation between PFCAs in the liver was responsible for the different potency of the induction of peroxisomal beta-oxidation between PFCAs with different **carbon** chain lengths and between sexes.

[PMID:10670823](#)

Kudo N et al; *Chem Biol Interact*. 124 (2): 119-32 (2000)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluorononanoate (PFNA), a perfluorinated alkyl acid containing nine **carbon** chains, has been detected in abiotic and biotic matrices worldwide. Although a few studies have reported toxic effects of PFNA, little information of the mechanism has been offered. In this study, the effects of PFNA exposure on thymus and the related mechanisms were investigated. Male rats were orally dosed with 0, 1, 3, or 5 mg PFNA/kg/day for 14 days. A significant decrease of body weight and thymus weight were observed in the rats receiving 3 or 5 mg PFNA/kg/day. Histopathological examination revealed dose-dependent increases in thymocyte apoptosis. Rats receiving 3 or 5 mg PFNA/kg/day exhibited increased interleukin (IL)-1 and decreased IL-2 concentrations in sera, whereas elevated IL-4 and **cortisol** levels only occurred in the highest dose group. Quantitative real-time PCR indicated that expression of peroxisome proliferator-activated receptor alpha (PPAR-alpha) was increased in the thymi of all dosed rats, and a similar trend occurred for PPAR-gamma in the two highest dose groups. The mRNA levels of c-Jun NH(2)-terminal kinase (JNK), nuclear factor-kappa B, p65 subunit, and inhibitory protein I kappa B alpha were unchanged; however, increased and decreased mRNA levels of p38 kinase were found in rats exposed to 3 or 5 mg PFNA/kg/day, respectively. Decreased Bcl-2 mRNA levels were observed in rats receiving 5 mg PFNA/kg/day. A significant increase in protein levels of phospho-JNK was found in all PFNA-treated rats. Phospho-p38 was significantly enhanced in 1 and 3 mg PFNA/kg/day groups, whereas phospho-I kappa B alpha remained consistent in all rats studied. Together, these data suggested that apart from the activation of PPARs, PFNA exposure in rats lead to the alteration of serum cytokines, which subsequently activated mitogen-activated protein kinase signaling pathways and potentially modulated the immune system. Additionally, increased serum **cortisol** and decreased expression of Bcl-2 in thymus likely contributed to the PFNA-induced thymocyte apoptosis.

[PMID:19196829](#)

Fang X et al; *Toxicol Sci*. 108 (2): 367-76 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

... This study explored the possible involvement of apoptotic signaling pathways in a nine-**carbon**-chain length PFAA-perfluorononanoic acid (PFNA)-induced splenocyte apoptosis. After a 14-day exposure to PFNA, rat spleens showed dose-dependent levels of apoptosis. The production of pro-inflammatory and anti-inflammatory cytokines was significantly increased and decreased, respectively. However, protein levels of tumor necrosis factor receptor 1 (TNFR1), fas-associated protein with death domain (FADD), caspase 8 and caspase 3, which are involved in inflammation-related and caspase-dependent apoptosis, were discordant. Peroxisome proliferator-activated receptors alpha (PPARalpha) and PPARgamma genes expression was up-regulated in rats treated with 3 or 5 mg/kg/day of PFNA, and the level of **hydrogen peroxide** (H2O2) increased concurrently in rats treated with the highest dose. Moreover, superoxide dismutase (SOD) activity and Bcl-2 protein levels were dramatically decreased in spleens after treatment with 3 and 5 mg/kg/day of PFNA. However, protein levels of Bax were unchanged. Apoptosis-inducing factor (AIF), an initiator of caspase-independent apoptosis, was significantly increased in all PFNA-dosed rats. Thus, oxidative stress and the activation of a caspase-independent apoptotic signaling pathway contributed to PFNA-induced apoptosis in rat splenocytes.

[PMID:19878704](#)

Fang X et al; *Toxicology*. 267 (1-3): 54-9 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

8 Use and Manufacturing



8.1 Use Classification



PFAS (per- and polyfluoroalkyl substances) -> OECD Category

S25 | OECD PFAS | List of PFAS from the OECD | DOI:10.5281/zenodo.2648775

► NORMAN Suspect List Exchange

8.2 Uses



EPA CPDat Chemical and Product Categories

► EPA Chemical and Products Database (CPDat)

Long-chain perfluoroalkancarboxylic acids and their salts are surface-active chemicals (surfactants), which greatly reduce the surface tension (surface energy) of [water](#), aqueous solutions, and organic liquids even at low concentrations. These acids (C6- C12) and derivatives are used as wetting, dispersing, emulsifying, and foaming agents. /Long-chain perfluoroalkancarboxylic acids/

Siegemund G et al; Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2012). NY, NY: John Wiley & Sons; Fluorine Compounds, Organic. Online Posting Date: June 15, 2000

► Hazardous Substances Data Bank (HSDB)

8.3 Methods of Manufacturing



Long-chain perfluorocarboxylic acids are prepared by the Simons electrochemical fluorination of the corresponding acyl halide ... The acids are obtained by hydrolysis of the perfluoroacyl fluoride, followed by distillation. Some [carbon-carbon](#) bond scission occurs to form lower homologous acids along with inert fluorocarbons and cyclic ethers. The acid yield decreases with increasing chain length. /Long-chain perfluorocarboxylic acids/

Siegemund G et al; Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2012). NY, NY: John Wiley & Sons; Fluorine Compounds, Organic. Online Posting Date: June 15, 2000

► Hazardous Substances Data Bank (HSDB)

8.4 General Manufacturing Information



EPA TSCA Commercial Activity Status

Nonanoic acid, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptafluoro-: ACTIVE

<https://www.epa.gov/tsc-inventory>

► EPA Chemicals under the TSCA

EPA TSCA Regulatory Flag

S - indicates a substance that is identified in a final Significant New Use Rule.

<https://www.epa.gov/tsca-inventory>

► [EPA Chemicals under the TSCA](#)

9 Safety and Hazards



9.1 Hazards Identification



9.1.1 GHS Classification



Showing 1 of 3 [View More](#)

Pictogram(s)	  Corrosive Irritant
Signal	<u>Danger</u>
GHS Hazard Statements	H314 (12.5%): Causes severe skin burns and eye damage [<u>Danger</u> Skin corrosion/irritation] H315 (87.5%): Causes skin irritation [<u>Warning</u> Skin corrosion/irritation] H319 (87.5%): Causes serious eye irritation [<u>Warning</u> Serious eye damage/eye irritation] H335 (87.5%): May cause respiratory irritation [<u>Warning</u> Specific target organ toxicity, single exposure; Respiratory tract irritation]
Precautionary Statement Codes	P260, P261, P264, P271, P280, P301+P330+P331, P302+P352, P303+P361+P353, P304+P340, P305+P351+P338, P310, P312, P321, P332+P313, P337+P313, P362, P363, P403+P233, P405, and P501 (The corresponding statement to each P-code can be found at the GHS Classification page.)
ECHA C&L Notifications Summary	Aggregated GHS information provided by 48 companies from 6 notifications to the ECHA C&L Inventory. Each notification may be associated with multiple companies. Information may vary between notifications depending on impurities, additives, and other factors. The percentage value in parenthesis indicates the notified classification ratio from companies that provide hazard codes. Only hazard codes with percentage values above 10% are shown.

► [European Chemicals Agency \(ECHA\)](#)

9.1.2 Hazard Classes and Categories



Showing 2 of 3 [View More](#)

Skin Corr. 1C (12.5%)

Skin Irrit. 2 (87.5%)

Eye Irrit. 2 (87.5%)

STOT SE 3 (87.5%)

► [European Chemicals Agency \(ECHA\)](#)

Carcinogenicity - category 2

Reproductive toxicity - category 1B

Reproductive toxicity - effects on or via lactation

Acute toxicity - category 4

Acute toxicity - category 4

Specific target organ toxicity (repeated exposure) - category 1

Eye damage - category 1

► [Hazardous Chemical Information System \(HCIS\), Safe Work Australia](#)

9.1.3 Substance of Very High Concern (SVHC)



REACH SVHC Substance

Substance: Perfluorononan-1-oic-acid

Reason: Toxic for reproduction (Article 57c), PBT (Article 57d)

Decision Document: [PDF Link](#)

► [European Chemicals Agency \(ECHA\)](#)

9.2 Accidental Release Measures



9.2.1 Disposal Methods



SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier.

Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or [water](#); effects on animal and plant life; and conformance with environmental and public health regulations.

► [Hazardous Substances Data Bank \(HSDB\)](#)

9.3 Regulatory Information



9.3.1 Clean Water Act Requirements



Monitoring requirements for unregulated contaminants. This section specifies the monitoring and quality control requirements that must be followed if you own or operate a public [water](#) system (PWS) that is subject to the Unregulated Contaminant Monitoring Regulation (UCMR), as specified in paragraphs (a)(1) and (2) of this section. Perfluorononanoic acid (PFNA) is included on this list.

40 CFR 141.40 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of June 8, 2012: <http://www.ecfr.gov>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10 Toxicity



10.1 Toxicological Information



10.1.1 Antidote and Emergency Treatment



/SRP:/ Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing [water](#). Do not induce vomiting. If vomiting occurs, lean patient forward or place on the left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Poisons A and B/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 160

► [Hazardous Substances Data Bank \(HSDB\)](#)

/SRP:/ Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if needed. Administer [oxygen](#) by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary Monitor for shock and treat if necessary Anticipate seizures and treat if necessary For eye contamination, flush eyes immediately with [water](#). Irrigate each eye continuously with 0.9% saline (NS) during transport Do not use emetics. For ingestion, rinse mouth and administer 5 mL/kg up to 200 mL of [water](#) for dilution if the patient can swallow, has a strong gag reflex, and does not drool Cover skin burns with dry sterile dressings after decontamination /Poisons A and B/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 160

► [Hazardous Substances Data Bank \(HSDB\)](#)

/SRP:/ Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Positive-pressure ventilation techniques with a bag valve mask device may be beneficial. Consider drug therapy for pulmonary edema Consider administering a beta agonist such as [albuterol](#) for severe bronchospasm Monitor cardiac rhythm and treat arrhythmias as necessary Start IV administration of D5W /SRP: "To keep open", minimal flow rate/. Use 0.9% saline (NS) or lactated Ringer's if signs of hypovolemia are present. For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload Treat seizures with [diazepam](#) or [lorazepam](#) Use [proparacaine hydrochloride](#) to assist eye irrigation /Poisons A and B/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); *Emergency Care For Hazardous Materials Exposure*. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 160-1

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.1.2 Human Toxicity Excerpts



/EPIDEMIOLOGY STUDIES/ /The investigators/ analyzed 458 plasma samples of New York State (NYS) employees and National Guard personnel assigned to work in the vicinity of the WTC between September 11 and December 23, 2001, to assess exposure to perfluorochemicals released in dust and smoke. The plasma samples collected from NYS WTC responders were grouped based on estimated levels of exposure to dust and smoke, as follows: more dust exposure (MDE), less dust exposure (LDE), more smoke exposure (MSE), and less smoke exposure (LSE). Furthermore, samples were grouped, based on self-reported symptoms at the time of sampling, as symptomatic and asymptomatic. Eight perfluorochemicals were measured in 458 plasma samples. [PFOS](#), [PFOA](#), [perfluorohexanesulfonate](#) (PFHxS), and perfluorononanoic acid (PFNA), were consistently detected in almost all samples. ... Concentrations of PFNA were significantly higher in the MSE group than in the LSE group. ... A significant negative correlation existed between plasma lipid content and concentrations of certain perfluorochemicals. ...

[PMID:18522136](#)

Tao L et al; *Environ Sci Technol*. 42 (9): 3472-8 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

/BIOMONITORING/ /Reaserchers/ studied occurrence and levels of PFCs in human milk in relation to maternal serum together with the temporal trend in milk levels between 1996 and 2004 in Sweden. Matched, individual human milk and serum samples from 12 primiparous women in Sweden were analyzed together with composite milk samples (25-90 women/year) from 1996 to 2004. Eight PFCs were detected in the serum samples, and five of them were also above the detection limits in the milk samples. [Perfluorooctanesulfonate](#) (PFOS) and [perfluorohexanesulfonate](#) (PFHxS) were detected in all milk samples at mean concentrations of 0.201 ng/mL and 0.085 ng/mL, respectively. [Perfluorooctanesulfonamide](#) (PFOSA), [perfluorooctanoic acid](#) (PFOA), and perfluorononanoic acid (PFNA) were detected less frequently. The total PFC concentration in maternal serum was 32 ng/mL, and the corresponding milk concentration was 0.34 ng/mL. The [PFOS](#) milk level was on average 1% of the corresponding serum level. There was a strong association between increasing serum concentration and increasing milk concentration for [PFOS](#) ($r(2) = 0.7$) and [PFHxS](#) ($r(2) = 0.8$). [PFOS](#) and [PFHxS](#) levels in composite milk samples were relatively unchanged between 1996 and 2004, with a total variation of 20 and 32%

coefficient of variation, respectively. The calculated total amount of PFCs transferred by lactation to a breast-fed infant in this study was approximately 200 ng/day. Lactation is a considerable source of exposure for infants, and reference concentrations for hazard assessments are needed.

PMID:17384769

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1831521>

Karrman A et al; *Environ Health Perspect.* 115 (2): 226-30 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.1.3 Non-Human Toxicity Excerpts



/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Male rats were orally dosed for 1, 3 and 5 mg/kg/day PFNA or with vehicle for 14 days. In the present study, serum [testosterone](#) levels were decreased, while [estradiol](#) levels were increased dramatically in rats receiving 5 mg PFNA/kg/day. Spermatogenic cells from rats that received 5 mg PFNA/kg/day exhibited apoptotic features including crescent chromatin condensation and chromatin margination. Flow cytometric analysis and TUNEL assays revealed a dose-dependent increase of apoptotic cell numbers. In addition, expression of Fas and Bax mRNA levels were upregulated significantly, and Bcl-2 mRNA levels were downregulated markedly in the 3 and 5 mg/kg/day groups. A dose-dependent increase in levels of active caspase-8 and no significant changes of active caspase-9 were observed. ...PFNA exposure can lead to cell apoptosis in rat testis, and this apoptosis was probably associated with the Fas death receptor-dependent apoptotic pathway.

PMID:19646514

Feng Y et al; *Toxicol Lett* 190 (2): 224-30 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

/ENDOCRINE MODULATION/ In this study, male rats were exposed to 0, 0.2, 1 or 5 mg/kg/day PFNA for 14 days to explore the specific effect of PFNA on hepatic glycometabolism and its underlying mechanisms. The results showed that administration of 5 mg/kg/day PFNA significantly increased serum [glucose](#) and hepatic [glycogen](#) in rats. Quantitative real-time PCR analysis showed that PFNA exposure changed the expression levels of several genes related to hepatic [glucose](#) metabolism, such as the [glucose](#)-6-phosphatase (G6PC) gene and the [glucose](#) transporter 2 (GLUT2) gene, which were upregulated, and the glucokinase (GCK) gene and the phosphoinositide-3-kinase, catalytic, alpha polypeptide (PI3Kc) gene, which were decreased. The protein expression levels of phospho-insulin receptor 1 (IRS1), phospho-PI3K, phospho-AKT and phospho-phosphoinositide-dependent kinase 1 (PDK1) were decreased in the livers of rats that received 5 mg/kg/day PFNA. The expression of phospho-[glycogen](#) synthase kinase-3 beta (GSK3beta, Ser 9) was increased, which explains the augment of hepatic [glycogen](#). Significant increases in [hydrogen peroxide](#) (H₂O₂) and [malondialdehyde](#) (MDA) were found in the livers of 5 mg/kg/day PFNA-treated rats. Thus, exposure to PFNA disordered [glucose](#) metabolism via inhibiting hepatic insulin signal pathway, accelerating the output of [glucose](#) and increasing [glycogen](#) synthesis in the rat liver. Furthermore, the oxidative stress induced by PFNA may be involved in this process.

PMID:22387981

Fang X et al; *Toxicology* 294 (2-3): 109-15 (2012)

► [Hazardous Substances Data Bank \(HSDB\)](#)

/ALTERNATIVE and IN VITRO TESTS/ The aim of this study was to investigate the effects of PFNA exposure on cell junction molecules and factors specifically secreted by Sertoli cells. Primary Sertoli cells from 20- to 21-day-old rats were exposed to increasing PFNA concentrations (0, 1, 10, 25, 50, or 75 uM) for 24 hr. No significant changes in the expression of cytoskeleton-associated molecules were noted, although the mRNA levels of vimentin were upregulated dramatically in cells exposed to 50 and 75 uM PFNA. Meanwhile, the mRNA levels of Sertoli cell-specific secretions, such as Mullerian inhibiting substance (MIS), androgen binding protein (ABP), inhibin B, transferrin, and follicle-stimulating hormone receptor (FSH-R) changed significantly in experimental groups. Wilms' tumor gene (WT1), a transcription factor, was upregulated significantly in cells exposed to 1-75 uM PFNA. In additional studies, male rats were exposed to 0, 1, 3, or 5 mg/kg/day PFNA for 14 days. Vacuoles in the cytoplasm of Sertoli cells were observed in the ultrastructure of testis. Furthermore, the changes in the concentrations of MIS and inhibin B in serum and the protein levels of WT1 and transferrin in testis were similar to the mRNA expression levels of those observed after in vitro treatment. In conclusion, these findings demonstrated that PFNA treatment led to the damage of specific secretory functions of Sertoli cells and that these effects might be an underlying cause of the male-specific reproductive toxicity of PFNA.

PMID:20580666

Feng Y et al; *Reprod Toxicol* 30 (3): 429-37 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.1.4 Ecotoxicity Excerpts



/AQUATIC SPECIES/ Perfluorinated surfactants (PFSs) in Asian freshwater fish species were analyzed to investigate tissue distribution, temporal trends, extent of pollution, and level of PFS exposure through food intake. Freshwater fish species, namely carp, snakehead, and catfish, were

collected in Japan, Vietnam, India, Malaysia, and Thailand, and 10 PFSS, including [perfluorooctanesulfonate \(PFOS\)](#) and [perfluorooctanoate](#), were analyzed by liquid chromatography-tandem mass spectrometry. PFSSs in carp in Tokyo were more concentrated in kidneys (sum of 10 PFSSs = 257 +/- 95 ng/g wet weight [ww]) and livers (119 +/- 36 ng/g ww) than in ovaries (43 +/- 2 ng/g ww) and muscles (24 +/- 17 ng/g ww). Concentrations of [PFOS](#) and its precursor, [perfluorooctane sulfonamide](#), in livers of carp and in waters in Tokyo showed a dramatic decrease during the last decade, probably because of 3 M's phasing-out of the manufacture of perfluorooctanesulfonyl-fluoride-based products in 2000. In contrast, continuing contamination by long-chain perfluorocarboxylates (PFCAs) with > or =9 fluorinated carbons was seen in multiple media, suggesting that these compounds continue to be emitted. PFS concentrations in freshwater fish species in tropical Asian countries were generally lower than those in developed countries, such as Japan, e.g., for [PFOS](#) in muscle, Vietnam < 0.05-0.3 ng/g ww; India < 0.05-0.2 ng/g ww; Malaysia < 0.05-0.2 ng/g ww; Thailand < 0.05 ng/g ww; and Japan (Tokyo) = 5.1-22 ng/g ww. Daily intake of short-chain PFCAs with < or =8 fluorinated carbons from freshwater fish species in Japan was approximately one order of magnitude lower than that from drinking water, whereas daily intake of PFOS and long-chain PFCAs with > or =9 fluorinated carbons from freshwater fish species was comparable with or greater than that from drinking [water](#). Because the risk posed by exposure to these compounds through intake of fish species is a matter of concern, we recommend the continued monitoring of PFS levels in Asian developing countries. /Perfluorinated surfactants/

PMID:21424221

Murakami M et al; Arch Environ Contam Toxicol 61 (4): 631-41 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.1.5 Ongoing Test Status



The following link will take the user to the National Toxicology Program (NTP) Test Agent Search Results page, which tabulates all of the "Standard Toxicology & Carcinogenesis Studies", "Developmental Studies", and "Genetic Toxicity Studies" performed with this chemical. Clicking on the "Testing Status" link will take the user to the status (i.e., in review, in progress, in preparation, on test, completed, etc.) and results of all the studies that the NTP has done on this chemical.[Available from, as of June 21, 2012: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchresults&searchterm=375-95-1]

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2 Ecological Information



10.2.1 Environmental Fate/Exposure Summary



Perfluorochemicals like perfluoro-n-nonanoic acid have been widely used since the 1950s in many industrial and consumer products, including protective coatings for fabrics and carpet, paper coatings, insecticide formulations, and surfactants. Perfluoro-n-nonanoic acid's production and use may result in its release to the environment through various waste streams. If released to air, an estimated vapor pressure of 8.3X10⁻² mm Hg at 25 °C indicates perfluoro-n-nonanoic acid will exist solely as a vapor in the atmosphere. Vapor-phase perfluoro-n-nonanoic acid will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 31 days. Perfluoro-n-nonanoic acid does not contain chromophores that absorb at wavelengths >290 nm and, therefore, is not expected to be susceptible to direct photolysis by sunlight. If released to soil, perfluoro-n-nonanoic acid is expected to have no mobility based upon an estimated K_{oc} of 1.2X10⁺⁵. The pK_a of perfluoro-n-nonanoic acid is -0.21, indicating that this compound will exist entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic [carbon](#) and clay than their neutral counterparts. Volatilization from moist soil is not expected because the acid exists as an anion and anions do not volatilize. Perfluoro-n-nonanoic acid is not expected to volatilize from dry soil surfaces based upon its estimated vapor pressure. Organic fluorochemical compounds, such as perfluoro-n-nonanoic acid, are expected to be resistant to biodegradation in soil and [water](#). If released into [water](#), perfluoro-n-nonanoic acid is expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. Volatilization from [water](#) surfaces is not expected to be an important fate process based upon this compound's estimated pK_a. An estimated BCF of 9100 suggests the potential for bioconcentration in aquatic organisms is very high, provided the compound is not metabolized by the organism. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. Occupational exposure to perfluoro-n-nonanoic acid may occur through inhalation and dermal contact with this compound at workplaces where perfluoro-n-nonanoic acid is produced or used. Monitoring data indicate that the general population may be exposed to perfluoro-n-nonanoic acid via inhalation of ambient air, ingestion of food and drinking [water](#), and dermal contact with products containing perfluoro-n-nonanoic acid. (SRC)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.2 Artificial Pollution Sources



Perfluorochemicals like perfluoro-n-nonanoic acid have been widely used since the 1950s in many industrial and consumer products, including protective coatings for fabrics and carpet, paper coatings, insecticide formulations, and surfactants(1). Perfluoro-n-nonanoic acid's production and use may result in its release to the environment through various waste streams(SRC).

(1) Calafat AM et al; *Environ Sci Technol* 40: 2128-34 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.3 Environmental Fate



TERRESTRIAL FATE: Based on a classification scheme(1), an estimated Koc value of 1.2×10^5 (SRC), determined from a structure estimation method(2), indicates that perfluoro-n-nonanoic acid is expected to be immobile in soil(SRC). The pKa of perfluoro-n-nonanoic acid is -0.21(3), indicating that this compound will exist entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts(4). Volatilization of perfluoro-n-nonanoic acid from moist soil surfaces is not expected to be an important fate process(SRC) based on the pKa(3). Perfluoro-n-nonanoic acid is not expected to volatilize from dry soil surfaces(SRC) based upon an estimated vapor pressure of 8.3×10^{-2} mm Hg at 25 °C(SRC), determined from a fragment constant method(5). Organic fluorochemical compounds, such as perfluoro-n-nonanoic acid, are expected to be resistant to biodegradation(6).

(1) Swann RL et al; *Res Rev* 85: 17-28 (1983) (2) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Jan, 2011. Available from, as of July 9, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html> (3) SPARC; pKa/property server. Ver 3. Jan, 2006. Available from, as of July 9, 2012: <http://archemcalc.com/sparc/> (4) Doucette WJ; pp. 141-188 in *Handbook of Property Estimation Methods for Chemicals*. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000) (5) Lyman WJ; p. 31 in *Environmental Exposure From Chemicals Vol I*, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985) (6) Hanson KJ et al; *Environ Sci Technol* 35: 766-70 (2001)

► [Hazardous Substances Data Bank \(HSDB\)](#)

AQUATIC FATE: Based on a classification scheme(1), an estimated Koc value of 1.2×10^5 (SRC), determined from a structure estimation method(2), indicates that perfluoro-n-nonanoic acid is expected to adsorb to suspended solids and sediment(SRC). A pKa of -0.21(3) indicates perfluoro-n-nonanoic acid will exist entirely in the anion form at pH values of 5 to 9 and therefore volatilization from water surfaces is not expected to be an important fate process(SRC). According to a classification scheme(4), an estimated BCF of 9100(SRC), from an estimated log Kow of 5.48(5) and a regression-derived equation(6), suggests the potential for bioconcentration in aquatic organisms is very high(SRC). Perfluoro-n-nonanoic acid is not expected to undergo hydrolysis in the environment due to the lack of functional groups that hydrolyze under environmental conditions(7). Organic fluorochemical compounds, such as perfluoro-n-nonanoic acid, are expected to be resistant to biodegradation(8).

(1) Swann RL et al; *Res Rev* 85: 17-28 (1983) (2) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Jan, 2011. Available from, as of July 9, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html> (3) SPARC; pKa/property server. Ver 3. Jan, 2006. Available from, as of July 9, 2012: <http://archemcalc.com/sparc/> (4) Franke C et al; *Chemosphere* 29: 1501-14 (1994) (5) Meylan WM, Howard PH; *J Pharm Sci* 84: 83-92 (1995) (6) Meylan WM et al; *Environ Toxicol Chem* 18: 664-72 (1999) (7) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 7-4, 7-5 (1990) (8) Hanson KJ et al; *Environ Sci Technol* 35: 766-70 (2001)

► [Hazardous Substances Data Bank \(HSDB\)](#)

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), perfluoro-n-nonanoic acid, which has an estimated vapor pressure of 8.3×10^{-2} mm Hg at 25 °C(SRC), determined from a fragment constant method(2), is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase perfluoro-n-nonanoic acid is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals(SRC); the half-life for this reaction in air is estimated to be 31 days(SRC), calculated from its rate constant of 5.2×10^{-11} cu cm/molecule-sec at 25 °C(SRC) that was derived using a structure estimation method(3). Perfluoro-n-nonanoic acid does not contain chromophores that absorb at wavelengths >290 nm(4) and, therefore, is not expected to be susceptible to direct photolysis by sunlight(SRC).

(1) Bidleman TF; *Environ Sci Technol* 22: 361-367 (1988) (2) Lyman WJ; p. 31 in *Environmental Exposure From Chemicals Vol I*, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985) (3) Meylan WM, Howard PH; *Chemosphere* 26: 2293-99 (1993) (4) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 8-12 (1990)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.4 Environmental Biodegradation



AEROBIC: Organic fluorochemical compounds, such as perfluoro-n-nonanoic acid, are expected to be resistant to biodegradation(1). A related compound, perfluorooctanoic acid, present at 100 mg/L, reached 5% of its theoretical BOD in 4 weeks using an activated sludge inoculum at 30 mg/L in the Japanese MITI test(2), indicating perfluoro-n-nonanoic acid will also not biodegrade(SRC).

(1) Hanson KJ et al; *Environ Sci Technol* 35: 766-70 (2001) (2) NITE; *Chemical Risk Information Platform (CHRIP)*. Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available from, as of July 9, 2012: <http://www.safe.nite.go.jp/english/db.html>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.5 Environmental Abiotic Degradation



The rate constant for the vapor-phase reaction of perfluoro-n-nonanoic acid with photochemically-produced hydroxyl radicals has been estimated as 5.2×10^{-11} cu cm/molecule-sec at 25 °C(SRC) using a structure estimation method(1). This corresponds to an atmospheric half-life of about 31

days at an atmospheric concentration of 5×10^5 hydroxyl radicals per cm^3 (1). Perfluoro-n-nonanoic acid is not expected to undergo hydrolysis in the environment due to the lack of functional groups that hydrolyze under environmental conditions(2). Perfluoro-n-nonanoic acid does not contain chromophores that absorb at wavelengths $>290 \text{ nm}$ (2) and, therefore, is not expected to be susceptible to direct photolysis by sunlight(SRC).

(1) Meylan WM, Howard PH; *Chemosphere* 26: 2293-99 (1993) (2) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 8-12 (1990)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.6 Environmental Bioconcentration



An estimated BCF of 9100 was calculated in fish for perfluoro-n-nonanoic acid(SRC), using an estimated log Kow of 5.48(1) and a regression-derived equation(2). According to a classification scheme(3), this BCF suggests the potential for bioconcentration in aquatic organisms is very high(SRC). The log bioaccumulation factors (BAF) for perfluoro-n-nonanoic acid in lake trout from Lake Superior, Lake Huron, Lake Erie and Lake Ontario were 3.7, 3.6, 3.8 and 3.1, respectively, the average log BAF was 3.6(4). The average Log BAF in eel (*A. anguilla*) from 23 locations in The Netherlands was 2.52 with a range of 2.02 to 3.14(5). The steady state biota sediment accumulation factor for perfluoro-n-nonanoic acid in *Lumbriculus variegatus* was found to be 55(6). Bioaccumulation factors of lake trout in Lake Ontario samples were 5.3, 0.62 and 0.13 based on prey of alewife, smelt and sculpin, respectively, the diet weighted BAF was 2.3 based on all prey(7). Trophic level biomagnification factors were reported as: ringed seal:cod 1.2, beluga:cod 12.9, beluga:herring 5.8, beluga:Arctic cisco 2.9, cod:Calanus hyperboreus 0.7, cod:Themisto libellula 0.3(8).

(1) Meylan WM, Howard PH; *J Pharm Sci* 84: 83-92 (1995) (2) Meylan WM et al; *Environ Toxicol Chem* 18: 664-72 (1999) (3) Franke C et al; *Chemosphere* 29: 1501-14 (1994) (4) Furdul VI; *Environ Sci Technol* 42: 4739-44 (2008) (5) Kwadijk CJAF et al; *Environ Sci Technol* 44: 3746-51 (2010) (6) Higgins CP et al; *Environ Sci Technol* 41: 4600-6 (2007) (7) Martin JW et al; *Environ Sci Technol* 38: 5379-85 (2004) (8) Tomy GT et al; *Environ Sci Technol* 43: 4076-81 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.7 Soil Adsorption/Mobility



Using a structure estimation method based on molecular connectivity indices(1), the Koc of perfluoro-n-nonanoic acid can be estimated to be 1.2×10^5 (SRC). According to a classification scheme(2), this estimated Koc value suggests that perfluoro-n-nonanoic acid is expected to be immobile in soil. The pKa of perfluoro-n-nonanoic acid is -0.21(3), indicating that this compound will exist in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts(4). The log Koc for perfluoro-n-nonanoic acid in three sediments was reported as 2.4(5) and 3.69 in 23 sediments(6).

(1) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of July 9, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite.html> (2) Swann RL et al; *Res Rev* 85: 17-28 (1983) (3) SPARC; pKa/property server. Ver 3. Jan, 2006. Available from, as of July 9, 2012: <http://archemcalc.com/sparc/> (4) Doucette WJ; pp. 141-188 in *Handbook of Property Estimation Methods for Chemicals*. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000) (5) Higgins CP, Luthy RG; *Environ Sci Technol* 40: 7251-6 (2006) (6) Kwadijk CJAF et al; *Environ Sci Technol* 44:3746-51 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.8 Volatilization from Water/Soil



A pKa of -0.21(1) indicates perfluoro-n-nonanoic acid will exist entirely in the anion form at pH values of 5 to 9 and therefore volatilization from water and moist soil surfaces is not expected to be an important fate process(SRC). Perfluoro-n-nonanoic acid is not expected to volatilize from dry soil surfaces(SRC) based upon an estimated vapor pressure of $8.3 \times 10^{-2} \text{ mm Hg}$ (SRC), determined from a fragment constant method(2).

(1) SPARC; pKa/property server. Ver 3. Jan, 2006. Available from, as of July 9, 2012: <http://archemcalc.com/sparc/> (2) Lyman WJ; p. 31 in *Environmental Exposure From Chemicals Vol I*, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.9 Environmental Water Concentrations



GROUND WATER: Perfluoro-n-nonanoic acid was detected in one of 19 well water samples at 25.7 ng/L, samples were taken around Decatur, AL, from area farms that have a history of being treated with fluorochemical industry impacted biosolids(1). Perfluoro-n-nonanoic acid was detected in groundwater samples from the Highland Creek watershed, Canada, taken Feb to March 2010 at 0.071 to 0.54 ng/L(2). Perfluoro-n-nonanoic acid was detected in 15 ground water samples taken in the city of Tokyo, Japan, Sept to Nov 2006; concentrations were 0.1 to 94 ng/L(3).

(1) Lindstrom AM et al; *Environ Sci Technol* 45: 8015-21 (2011) (2) Meyer T et al; *Environ Sci Technol* 45: 8113-9 (2011) (3) Murakami M et al; *Environ Sci Technol* 43: 3480-6 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

DRINKING WATER: Drinking water samples from seven waste water treatment plants throughout the US tested positive in four for perfluoro-n-nonanoic acid at 1.0-9.7 ng/L(1). Perfluoro-n-nonanoic acid was not detected (detection limit 10 ng/L) in the finish water from four wastewater

treatment plants in New York State, but was detected in two others at 4 to 376 ng/L(2). Perfluoro-n-nonanoic acid was not detected (detection limit 0.22 ng/L) in drinking [water](#) samples collected in three homes that receive [water](#) from different [water](#) works in Oslo, Norway, samples were collected between Oct 2008 and Jan 2009(3). Perfluoro-n-nonanoic acid was detected in 79% of 43 tap [water](#) samples taken from homes, schools, offices, restaurants, commercial centers, hotels and an airport in 2006 and 2008 from 10 cities in China(4).

(1) Quinones O, Snyder SA; *Environ Sci Technol* 43: 9089-95 (2009) (2) Sinclair E, Kannan K; *Environ Sci Technol* 40: 1408-14 (2006) (3) Haug LS et al; *Chemosphere* 80: 1137-43 (2010) (4) Mak YL et al; *Environ Sci Technol* 43: 4824-9 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE WATER: Surface [water](#) samples taken from US streams in the Great Lakes basin tested positive for perfluoro-n-nonanoic acid in 38% of 8 samples taken 1994 to 2000 at concentrations of 0.00003 to 0.0004 ug/L(1). Perfluoro-n-nonanoic acid was detected in creek and river samples collected throughout Canada at concentrations of <125 to 3000 pg/L(2). Perfluoro-n-nonanoic acid was detected in nine of 32 surface water samples at 12.4 to 286 ng/L, samples were taken around Decatur, AL, from area ponds and streams near farms that have a history of being treated with fluorochemical industry impacted biosolids(3). Perfluoro-n-nonanoic acid was detected in surface water samples from the Highland Creek watershed, Canada, collected Feb to March 2010 at 0.80 to 2.4 ng/L(4). Out of 100 samples taken from 80 sites in the Cape Fear River Basin, North Carolina, the 11 samples with the highest total perfluorinated organic compound concentrations had perfluoro-n-nonanoic acid concentrations of 2.24-194 ng/L, samples were collected in the spring of 2006(5).

(1) Klecka G et al; *Rev Environ Contam Toxicol* 207: 1-93 (2010) (2) D'eon JC et al; *Environ Toxicol Chem* 28: 2101-7 (2009) (3) Lindstrom AB et al; *Environ Sci Technol* 45: 8015-21 (2011) (4) Meyer T et al; *Environ Sci Technol* 45: 8113-9 (2011) (5) Nakayama S et al; *Environ Sci Technol* 41: 5271-6 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE WATER: Lake [water](#) samples from four lakes on Cornwallis Island, Nunavut, Canada were tested for perfluoro-n-nonanoic acid(1).

Location	Sample Date	Mean (ng/L)	Range (ng/L)
Amituk Lake	Aug 2003	0.3	0.2-0.4
Char Lake	Aug 2003	0.5	not detected-1.4
	July 2005	1.5	0.3-2.5
Resolute Lake	Aug 2003	2.0	not detected-6.1
	July 2005	1.7	1.2-2.3
	Aug 1, 2005	2.8	2.5-3.0
	Aug 8, 2005	1.7	0.9-2.9
Meretta Lake	July 2005	4.1	3.8-4.4
Outflow from Meretta	July 2005	3.5	3.0-4.2

(1) Stock NL et al; *Environ Sci Technol* 41: 3529-36 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE WATER: Perfluoro-n-nonanoic acid was detected in open ocean [water](#) at <5.1-107, <5.1-35 and <5.1 pg/L in 40 samples from the North Atlantic, 10 samples from the Middle Atlantic and 10 samples from the South Atlantic Ocean, respectively, samples were collected April, Oct and Nov of 2007(1). Perfluoro-n-nonanoic acid was detected in seawater samples taken from Finland, Denmark and Iceland, and in lake water from Norway, concentrations were not reported(2). Perfluoro-n-nonanoic acid was not detected (detection limit 1.6 ng/L) in river water samples collected from the Glatt River at Schwerzenbach, Oberrglatt and Rheinsfelden, Switzerland(3). Perfluoro-n-nonanoic acid was detected in all 20 rivers studied throughout Japan from Nov 8 to Dec 12, 2005 at concentrations of 0.25 to 53 ng/L(4). Five streams flowing into Lake Shihwa, Korea had perfluoro-n-nonanoic acid concentrations of 0.83 to 6.95 ng/L, concentrations in Lake Shihwa were 0.63 to 10.86 ng/L and in Gyeonggi Bay were 0.94 to 3.29 ng/L, all samples were collected in Dec of 2004(5). Water samples taken from tributaries of the Pearl River in Guangzhou and along the Yangtze River had perfluoro-n-nonanoic acid concentrations of <0.13-3.1 and <0.005-10 ng/L, respectively(6). Perfluoro-n-nonanoic acid was detected in sea water samples from six locations around Hong Kong, eight locations from the Pearl River Delta and South China Sea at <0.02-0.69 pg/mL, samples were collected July and Sept 2003 and Jan 2004(7). Water samples collected from 11 locations along the west and south coasts of South Korea contained perfluoro-n-nonanoic acid at 0.24-320 pg/mL(7).

(1) Ahrens L et al; *Environ Sci Technol* 43: 3122-7 (2009) (2) Berger U et al; *Organohalogen Compounds* 66: 4046-52 (2004) (3) Huset CA et al; *Environ Sci Technol* 42: 6369-77 (2008) (4) Murakami M et al; *Environ Sci Technol* 42: 6566-72 (2008) (5) Rostkowski P et al; *Environ Toxicol Chem* 25: 2374-80 (2006) (6) So MK et al; *Chemosphere* 68: 2085-95 (2007) (7) So MK et al; *Environ Sci Technol* 38: 4056-63 (2004)

► [Hazardous Substances Data Bank \(HSDB\)](#)

RAIN/SNOW/FOG: Perfluoro-n-nonanoic acid was detected in 81.8% of 11 urban rain [water](#) samples and 71.4% of 21 snow samples at <0.25-3.48 and <0.25-4.94 ng/L, samples were taken Aug 2006 to March 2007 and Feb 2006, Jan to March 2007, respectively(1). Perfluoro-n-nonanoic acid was detected in bulk snow samples from the Highland Creek watershed, Canada, taken Feb to March 2010 at 0.079 to 0.99 ng/L(2).

(1) Kim S, Kannan K; *Environ Sci Technol* 41: 8328-34 (2007) (2) Meyer T et al; *Environ Sci Technol* 45: 8113-9 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

RAIN/SNOW/FOG: Summary range of perfluoro-n-nonanoic acid from precipitation samples(1).

Location	Site	Date Sampled	No. Samples	Concentration (ng/L)
Japan	Tsukuba	June 2006-April 2008	15	0.91-17.5
	Kawaguchi	June 2006-June 2008	16	0.16-6.77
USA	Slingerlands (NY)	June 2006-June 2007	6	0.21-4.81
	Albany	June 2006-June 2007	6	0.24-5.39
China	Hong Kong	May 2007	5	0.13-0.44
India	Patna	Sept 2008	2	<0.06-0.16
France	Toulouse	Oct 2008	2	0.18-0.24

(1) Kwok KY et al; *Environ Sci Technol* 44: 7043-9 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

RAIN/SNOW/FOG: Precipitation samples from nine North American locations were tested for perfluoro-n-nonanoic acid(1).

Location	Category	Year	Concentration (ng/L)
Smith Island, MD	near urban	1998	0.1-20
		1999	<0.1-2.6
Lewes, DE	near urban	1998	0.1-77
		1999	<0.1-4.9
Ithaca, NY	rural	1998	0.1-3.2
		1999	<0.1-2.6
Underhill, VT	rural	1999	<0.1-1.9
Kejimikujik, Nova Scotia	remote	2002	<0.1-3.3
Algoma, Ontario	remote	2002	<0.1-7.6
Saturna Island, British Columbia	rural	2002	<0.1-2.8
Egbertt, Ontario	near urban	2003-4	0.4-4.1
North Toronto, Ontario	urban	2003-4	0.5-9.7

(1) Scott BF et al; *Environ Sci Technol* 40: 7167-74 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.10 Effluent Concentrations



Perfluoro-n-nonanoic acid was detected in sewage effluent samples from Norway and the Faeroe Islands and in landfill effluent samples taken from Finland and Norway, concentrations were not reported(1). Perfluoro-n-nonanoic acid was detected in waste [water](#) treatment sludge from six plants located across Ontario, Canada, collected in 2002, at <0.0625-0.61 ng/g(2). Perfluoro-n-nonanoic acid concentration was reported in influent, effluent and digested sludge from a waste water treatment plant as 1.1 ng/L, 3.4 ng/L and 9.9 ug/kg, respectively(3). Perfluoro-n-nonanoic acid was not detected (detection limit 1.6 ng/L) in the influent or effluent of the waste water treatment plants along the Glatt Valley Watershed, Switzerland, in Faelianden, Bassersdorf, Niederglatt, Buelach or Glattfelden(4). However, perfluoro-n-nonanoic acid was detected in the influent of Duebendorf at 2.6 to 26 ng/L and in the effluent of Duebendorf and Kloten-Opfikon at <1.6-2.6 and <1.6-5.6 ng/L, respectively, all samples were collected Feb to March 2006(4). Two municipal waste water treatment plants in Taipei had perfluoro-n-nonanoic acid concentrations of 10.6 and 0.4 ng/L in their influent samples and <0.1 and 0.3 ng/L in their effluent samples(5). Perfluoro-n-nonanoic acid was also measured at 10.4 ng/L in the effluent of an industrial waste water treatment plant located in Hsinchu Science Park, Taiwan(5).

(1) Berger U et al; *Organohalogen Compounds* 66: 4046-52 (2004) (2) D'eon JC et al; *Environ Sci Technol* 43: 4589-94 (2009) (3) Heidler J, Halden RU; *Environ Sci Technol* 42: 6324-32 (2008) (4) Huset CA et al; *Environ Sci Technol* 42: 6369-77 (2008) (5) Lin AC et al; *Chemosphere* 80: 1167-74 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.11 Sediment/Soil Concentrations



SEDIMENT: Perfluoro-n-nonanoic acid was not detected (detection limit 0.10 ng/g) in sediment samples from 11 sites in the Daliao River system of northeast China, samples were collected in April 2008(1). Perfluoro-n-nonanoic acid was not detected in 13 sediment samples from the Zhujiang River in Guangzhou and nine sediment samples from the Huangpu River in Shanghai, China, samples were collected March 2009(2). Sediment samples, collected from the Hudson Bay region of northeastern Canada May to Sept 1999 to 2003, had perfluoro-n-nonanoic acid concentrations in 33% of <0.06-0.14 ng/g dry weight(3). Perfluoro-n-nonanoic acid was detected at 0.33-0.55 ng/g dry weight in five sediment samples taken from the Ariake Sea in Jan 2004(4).

(1) Bao J et al; *Chemosphere* 77: 652-7 (2009) (2) Bao J et al; *Chemosphere* 80: 123-30 (2010) (3) Kelly BC et al; *Environ Sci Technol* 43: 4037-43 (2009) (4) Nakata H et al; *Environ Sci Technol* 40: 4916-21 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SEDIMENT: Perfluoro-n-nonanoic acid was analyzed at different depths in sediment samples from four lakes on Cornwallis Island, Nunavut, Canada(1).

Depth	Location	Concentration (ng/g dry weight)
0-1 cm	Resolute Lake	3.2
1-2 cm		<3.1
2-3 cm		<2.55
0-1 cm	Char Lake	<0.55
1-2 cm		not detected
2-3 cm		<0.55
0-1.5 cm	Amituk Lake	0.35
1.5-2.5 cm		0.23
2.5-3.5 cm		<0.059

(1) Stock NL et al; *Environ Sci Technol* 41: 3529-36 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SEDIMENT: Perfluoro-n-nonanoic acid was detected in a sediment core sample from Tokyo Bay, Japan, sample was taken May 2008(1).

Depth (cm)	Time Interval	Concn (pg/g dry weight)	Est Flux (pg/sq m/yr)
0-3	2006-2008	14	3.4
3-6	2004-2006	9.3	2.7
6-9	2002-2004	4.6	1.6
9-11	2001-2002	3.4	1.3
13-15	1998-1999	3.7	1.4
17-19	1995-1997	<1	<0.6
21-23	1993-1994	1.1	0.6
25-27	1990-1991	0.7	0.3
29-35	1985-1989	<1	<0.5
37-47	1978-1983	<1	<0.6
49-59	1969-1975	<1	<0.7
61-75	1959-1967	<1	<0.8
77-79	1956-1958	<1	<0.7

(1) Ahrens L et al; *Environ Sci Technol* 43: 6959-75 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.12 Atmospheric Concentrations



URBAN/SUBURBAN: Perfluoro-n-nonanoic acid was detected in 3% of atmospheric samples from Barsbüttel, Germany at a maximum concentration of 0.1 pg/cu m, the study was run April 2007 to June 2008(1). Perfluoro-n-nonanoic acid was detected in atmospheric samples from a location in Albany, NY at 0.16-0.31 pg/cu m, samples were taken May to July 2006(2). Perfluoro-n-nonanoic acid was not detected (detection limit 0.02 pg/cu m) in outdoor air samples from six homes in Vancouver, Canada, samples were collected 2007 to 2008(3).

(1) Dreyer A et al; Environ Sci Technol 43: 6507-14 (2009) (2) Kim S, Kannan K; Environ Sci Technol 41: 8328-34 (2007) (3) Shoeib M et al; Environ Sci Technol 45: 7999-8005 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

RURAL/REMOTE: Perfluoro-n-nonanoic acid had an average concentration of 0.3 pg/cu m in 8% of 141 atmospheric samples from the Atlantic and Southern Oceans and coastal areas of the Baltic sea, the study was run April 2007 to Jan 2009(1).

(1) Dreyer A et al; Environ Sci Technol 43: 6507-14 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

INDOOR: Perfluoro-n-nonanoic acid was not detected in 40 indoor air samples from Oslo, Norway households(1). Perfluoro-n-nonanoic acid was detected at <0.02 to 2.166 pg/cu m in indoor air samples from 59 homes in Vancouver, Canada, samples were collected 2007 to 2008(2).

(1) Haug LS et al; Environ Sci Technol 45: 7991-8 (2011) (2) Shoeib M et al; Environ Sci Technol 45: 7999-8005 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.13 Food Survey Values

Seven types of seafood were purchased from local markets in Zhoushan and Guangzhou, China in 2004, perfluoro-n-nonanoic acid was only detected in sand swimming crab and swimming crab at 0.28 and 0.61 ng/g wet weight, respectively(1). Perfluoro-n-nonanoic acid was sampled in food, tea and milk purchased in grocery stores in Oslo, Norway between Oct 2008 and Jan 2009, concentrations were (pg/g fresh weight): cheese (16), bread (9.5), strawberry jam (3.7), pork meat (5.5), beef (15), chicken meat (6.8), salmon (10), cod (5.9) and cod liver (14)(2). All other products (lettuce, carrot, potato, margarine, milk, egg, fish sticks, canned mackerel) were listed at less than detection limit (detection limits varied)(2). In Nov 2009, food products of 15 food categories were randomly purchased in several Dutch retail stores, perfluoro-n-nonanoic acid was detected as follows (pg/g product); fatty fish (5), lean fish (77), crustaceans (58), butter (2), cheese (7), milk (<1), eggs (6), pork (2), beef (4), chicken/poultry (1), bakery products (1), vegetables/fruit (1), flour (15), vegetable oil (<0.1), industrial oil (<0.3)(3). Concentrations of perfluoro-n-nonanoic acid in food products sampled for the 2004 Canadian Total Diet Study were 3.75 and 1.72 ng/g wet weight in cold cuts and cookies, <0.75, <0.79, <1.43, <0.74, <0.74 and <0.78 ng/g wet weight in processed cheese, peppers, canned lunch meats, pizza, cheese and beef frozen dinner, respectively(4). Perfluoro-n-nonanoic acid was detected in one of three popcorn packaging paper before and after cooking at 2.1 and 2.5 ng/sq cm, respectively(5).

(1) Gulkowska A et al; Environ Sci Technol 40: 3736-41 (2006) (2) Haug LS et al; Chemosphere 80:1137-43 (2010) (3) Noorlandr Cwet al; J Agric Food Chem 59: 7496-505 (2011) (4) Ostertag SK et al; J Agric Food Chem 57: 8534-44 (2009) (5) Sinclair E et al; Environ Sci Technol 41: 1180-5 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Concentration of perfluoro-n-nonanoic acid in aquatic traditional Inuit foods collected between 1997 and 1999 in Nunavut, Canada(1).

Food	Part	Preparation	Concn (ng/g)
Ringed Seal	liver	raw	1.9-2.1
		blood	1.2
	meat	boiled	0.5
		raw	0.9
	blubber	raw	<=0.2
Polar Bear	meat	frozen	0.8
Beluga	blubber	raw	0.4
	meat	dried	0.6-0.9
		muktuk	<0.4
Narwhal	blubber	raw	<0.1
	muktuk	raw	0.5
		frozen	<0.4
Bearded Seal	intestine	boiled	0.3-1.2
	meat	boiled	<0.3
Walrus	blubber	aged	0.4
	kauk	raw	0.6
	meat	raw	0.6-0.8
		aged	<0.3

Food	Part	Preparation	Concn (ng/g)
Eider duck	whole	boiled	<0.1
Black duck	meat	boiled	<0.3
Arctic char	whole	raw	0.2
Lake trout	whole	raw	<0.3
Seaweed	whole	raw	<0.3
Clams	whole	raw	0.5

(1) Ostertag SK et al; Chemosphere 75: 1165-72 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Concentration of perfluoro-n-nonanoic acid in terrestrial traditional Inuit foods collected between 1997 and 1999 in Nunavut, Canada(1).

Food	Part	Preparation	Concn (ng/g)
Caribou	liver	baked	1.6
		raw	2.0
	meat	boiled	<0.1-0.8
		dried	<0.9-1.0
		raw	0.3
		roasted	1.0
	bone marrow	boiled	0.6
	heart blood	raw	0.8
	fat	raw	<0.3
	kidneys	raw	0.2
		boiled	<0.3
	stomach	raw	0.1
	tongue	raw	0.6
Ptarmigan	whole	raw	<0.6
Arctic hare	meat	raw	<0.3
Snow goose	meat	raw	1.2
Berries	whole	raw	<0.3

(1) Ostertag SK et al; Chemosphere 75: 1165-72 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.14 Fish/Seafood Concentrations



Perfluoro-n-nonanoic acid was detected in whole body homogenates of lake trout from Lake Superior, Lake Michigan, Lake Huron, Lake Erie and Lake Ontario at mean concentrations of 1.0, 0.57, 2.8, 2.9 and 1.1 ng/g wet weight, respectively, samples were collected in 2001(1). Fish samples, collected from the Hudson Bay region of northeastern Canada May to Sept 1999 to 2003, had the following perfluoro-n-nonanoic acid concentrations: 71% of capelin (whole body) at 0.01-0.73 ng/g, 100% of cod (muscle) at <0.09-1.3 ng/g and 67% of salmon (muscle) at 0.05-8.0 ng/g(2).

(1) Furdul VI et al Environ Sci Technol 41: 1554-9 (2007) (2) Kelly BC et al; Environ Sci Technol 43: 4037-43 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was detected in freshwater fish (pike, perch, trout) samples taken from Finland, Sweden and Norway, but not in burbot samples taken from Norway(1). Perfluoro-n-nonanoic acid was also detected in all marine [water](#) fish (cod, flounder, eelpout, herring, long rough dab) samples from Sweden, Denmark and Iceland, but not in sculpin, dab, and Arctic char samples from Iceland and the Faeroe Islands(1). Blood samples from 18 cod (*Gadus morhua*), collected from the Gulf of Gdansk in Feb 2003, contained perfluoro-n-nonanoic acid at 100-2100 pg/mL(2). Seven types of seafood were purchased from local markets in Zhoushan and Guangzhou, China in 2004, perfluoro-n-nonanoic acid was only detected in sand swimming crab and swimming crab at 0.28 and 0.61 ng/g wet weight, respectively(3). Ten herring, about the size a common guillemot would eat, sampled from Landsort, Baltic Sea in 2005 contained perfluoro-n-nonanoic acid at concentrations of 0.34 to 0.74 ng/g wet

weight(4). Perfluoro-n-nonanoic acid was detected at one of five sites at <1.06-24.6 ng/g wet weight(detection limit 1.06 ng/g wet weight) in brown mussels from Guanabara Bay, Brazil(5). Perfluoro-n-nonanoic acid was not detected in liver (detection limit 0.49 ng/g wet weight) or muscle (detection limit 1.41 ng/g wet weight) samples of scabbardfish, croaker and mullet from Paraiba do Sul River and Guanavara Bay, Brazil(5).

(1) Berger U et al; *Organohalogen Compounds* 66:4046-52 (2004) (2) Falandysz J et al; *Environ Sci Technol* 40: 748-51 (2006) (3) Gulkowska A et al; *Environ Sci Technol* 40: 3736-41 (2006) (4) Holmstrom KE, Berger U; *Environ Sci Technol* 42: 5879-84 (2008) (5) Quinete N et al; *Chemosphere* 77: 863-9 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

The concentration of perfluoro-n-nonanoic acid was reported in fish sampled from Lake Vattern, Sweden and the Baltic Sea in 2001 with the following results in ng/g fresh weight(1).

Fish	Lake Vattern	Baltic Sea
Perch	0.22-0.51	0.14-0.22
Burbot	0.33-1.0	0.14-0.47
Whitefish	<0.08-0.71	0.18-0.38
Salmon	0.12-0.20	0.10-0.19
Brown trout	0.08-0.26	<0.08-0.18

(1) Berger U et al; *Chemosphere* 76: 799-804 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid in aquatic organisms from the Ariake Sea, Japan, 2000-2003(1).

Location	Species/speciman	No. Sampled	Concn (ng/g wet weight)
Shallow water	filefish	5	<1.5
	sea bream	5	<1.5
	red sea bream	5	<1.5
	right eye flounder	5	<1.5
	hammerhead shark	1	<1.5
Tidal Flat	oyster	5	<1.5
	mussel	5	<1.5
	clam	6	<1.5
	lugworm	5	<1.5
	crab	2	<1.5
	mudskipper	10	<1.5

(1) Nakata H et al; *Environ Sci Technol* 40: 4916-21 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.15 Animal Concentrations



The mean concentration of perfluoro-n-nonanoic acid in herring gull eggs collected in 2007 from 15 colonies in the Laurentian Great Lakes (Granite, Big Sister, Gull, Channel-Shelter, Double, Chantry, Fighting, Middle, Snake and Strachan Islands, Agawa Rocks, Port Colborne, Niagara River, Hamilton and Toronto Harbor) was 0.64-9.6 ng/g wet weight(1). Archived liver samples for northern sea otters (*Enhydra lutris kenyoni*) from south-central Alaska had perfluoro-n-nonanoic acid concentrations of 1.3, <0.9, 8.0, 3.4, 2.8, 2.1, 1.9, 2.3, 6.0, 5.6, 5.9, <2.0, 3.9, 4.3 and 9.4 ng/g wet weight in 1992, 1993, 1994, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2007, respectively(2). An average concentration of 2.1 ng/g wet weight (range <1-16 ng/g wet weight) of perfluoro-n-nonanoic acid was found in 80 female sea otters from the California coast samples from 1992 to 2002(3). Perfluoro-n-nonanoic acid was detected at 0.07-3.0 ng/g wet weight in little brown bats (*Myotis lucifugus*) that had signs of white nose syndrome, collected from caves in eastern New York State from Feb to March 2008(4). Perfluoro-n-nonanoic acid was detected in serum samples from 58 of 73 loggerhead turtles at <100-4420 pg/mL and in all six Kemp's ridley sea turtles at 258-6500 pg/mL, turtles were caught off the US southeastern coast(5). Eider duck and white winged scoter liver samples, collected from the Hudson Bay region of northeastern Canada, May to Sept 1999 to 2003, contain perfluoro-n-nonanoic acid at <0.02-1.1 and 0.24-27.3 ng/g wet weight, respectively(6). Perfluoro-n-nonanoic acid was detected in 26 of 27 beluga whale liver samples at <0.502-5.67 ng/g, collected from Cook Inlet, AK from 1992 to 2006 and in 38 of 41 beluga whale liver samples at <0.180-5.46 ng/g, collected from Chukchi Sea, AK from 1989 to 2000(7).

(1) Gebbink WA et al; *Environ Sci Technol* 43: 7443-9 (2009) (2) Hart K et al; *Arch Environ Contam Toxicol* 56: 607-14 (2009) (3) Kennan K et al; *Environ Sci Technol* 40: 4943-8 (2006) (4) Kannan K et al; *Chemosphere* 80: 613-8 (2010) (5) Keller JM et al; *Environ Sci Technol* 39: 9101-8 (2005) (6) Kelly BC et al; *Environ Sci Technol* 43: 4037-43 (2009) (7) Reiner JL et al; *Environ Sci Technol* 45: 8129-36 (2011)

[► Hazardous Substances Data Bank \(HSDB\)](#)

Reported perfluoro-n-nonanoic acid concentrations in beluga whales collected from the Hudson Bay region of northeastern Canada, May to Sept 1999 to 2003(1).

	Tissue	No. collected	% Positive	Concn (ng/g wet weight)
Female	blood	9	89	0.29-2.4
	muscle	9	0	<0.02
	liver	9	100	0.69-6.58
	milk	6	50	0.26-5.16
	fetus	2	50	<0.04-0.58
Male	blood	9	100	0.27-5.81
	muscle	9	0	<0.02
	liver	13	100	0.81-5.20
	blubber	6	0	<0.9

(1) Kelly BC et al; *Environ Sci Technol* 43: 4037-43 (2009)

[► Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid concentrations in plasma of free-range bottlenose dolphins from the Gulf of Mexico and the Atlantic Ocean were studied June to Sept 2003(1).

Location	Number Samples	Concentration (ng/g wet weight)	Arithmetic Mean (ng/g wet weight)	Geometric Mean (ng/g wet weight)
Sarasota Bay	13	5.3-74	25	19
Bermuda	2	12-21	17	16
Indian River Lagoon	42	3-51	13	11
Charleston	47	11-214	63	51
Delaware Bay	5	211-547	326	305

(1) Houde M et al; *Environ Sci Technol* 45: 7962-73 (2011)

[► Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was detected in all the marine mammal (grey seal, minke whale, pilot whale) samples taken from Sweden, Denmark, Iceland and the Faeroe Islands(1). Perfluoro-n-nonanoic acid was detected in thick-billed murre collected 1975 (5 samples), 1993 (10 samples) and 2004 (10 samples) at 0.02-0.16, 0.01-0.24 and 0.07-0.60 ng/g wet weight, respectively, and in northern fulmars collected 1975 (9 samples), 1987 (8 samples), 1993 (10 samples) and 2003 (9 samples) at concentrations of <0.19, 0.02-0.97, 0.03-0.44 and 0.01-0.09 ng/g wet weight, respectively, all waterfowl were from Prince Leopold Island, Nunavut, Canada(2). Perfluoro-n-nonanoic acid was not detected (detection limit 7.6 ng/g dry weight) in liver samples of Tucuxi dolphins (*Sotalia guianensis*), samples were taken from 23 dolphins from Guanabara Bay and six were collected off the coast of Rio de Janeiro state, Brazil at other locations(3). Blood samples from 16 eider duck (*Somateria mollissima*), collected from the Gulf of Gdansk in Feb 2003, contained perfluoro-n-nonanoic acid at 300-900 pg/mL(4). The concentration of perfluoro-n-nonanoic acid in melon headed whales stranded along the Japanese coast was <1.1 ng/g wet weight in 1982, 5.2-15.5 ng/g wet weight in 2001/2002 and 9.5-20.5 ng/g wet weight in 2006(5). Perfluoro-n-nonanoic acid was not detected in 10 guillemot egg samples collected from Vestmannaeyjar, Iceland, Sandoy Faroe, Islands, Sklinna and Hjelmsøy, Norway but was detected in five of 10 egg samples collected from Stora Karlso, Sweden at <32 to 120 ng/g wet weight, samples were collected in 2005(6). Dolphin samples from Paraíba do Sul River, Brazil had perfluoro-n-nonanoic acid concentrations of <0.49-1.70, <1.46-1.60 and <1.76 ng/g wet weight in liver, muscle and kidney tissue, respectively(7). Liver samples from 29 polar bear captured in eastern Greenland contained a mean concentration of 236 ng/g wet weight of perfluoro-n-nonanoic acid(8). The mean concentration of perfluoro-n-nonanoic acid was 12.2 to 540 ng/g wet weight in liver tissue from polar bears collected at seven locations in the North American and European Arctic(9). Harbor porpoises from the Black Sea coast, collected 1997 and 1998, contained perfluoro-n-nonanoic acid at 1.4-7.2 ng/g wet weight(10). Perfluoro-n-nonanoic acid was detected in the egg yolks of 17 little ringed plover at 6.4-106.7 ng/g wet weight, seven parrot bill at 5.7-97.3 and 20 little egret at 3.9-68.6 ng/g wet weight, samples were collected around Lake Shihwa, Korea in May 2006(11).

(1) Berger U et al; *Organohalogen Compounds* 66: 4046-52 (2004) (2) Butt CM et al; *Environ Sci Technol* 41: 3521-8 (2007) (3) Dorneles PR et al; *Environ Sci Technol* 42: 5368-73 (2008) (4) Falandysz J et al; *Environ Sci Technol* 40: 748-51 (2006) (5) Hart K et al; *Environ Sci Technol* 42:7132-7 (2008) (6) Lofstrand K et al; *Chemosphere* 72: 1475-80 (2008) (7) Quinete N et al; *Chemosphere* 77: 863-9 (2009) (8) Smithwick M et al; *Environ Toxicol Chem* 24: 981-6 (2005) (9) Smithwick M et al; *Environ Sci Technol* 39: 5517-23 (2005) (10) van de Vijver KI et al; *Environ Sci Technol* 41: 315-320 (2007) (11) Yoo H et al; *Environ Sci Technol* 42: 5821-7 (2008)

[► Hazardous Substances Data Bank \(HSDB\)](#)

Average concentration and ranges of perfluoro-n-nonanoic acid in liver tissue of harbor seals (*Phoca vitulina*) collected from the German Bight(1).

Year	No. Collected	Concn (ng/g wet weight)
1988	2	4.1-5.2
1996	2	4.8-12
1999	5	1.0-23
2000	6	2.5-27
2001	7	1.0-27
2002	6	3.2-17
2003	5	1.6-19
2004	1	9.3
2005	5	2.6-18
2006	8	0.3-19
2007	13	5.1-21
2008	3	6.2-9.7

(1) Ahrens L et al; *Chemosphere* 76: 151-8 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was studied in ringed seal (*Phoca hispida*) liver tissue from the east and west sides of Greenland(1).

Location	Year	% Detected	Concn (ng/g wet weight)
Ittoqqortoormilt	1986	0	<1.4
	1994	40	3.1-4
	1999	90	1.9-7.5
	2003	100	2.8-6.4
Qeqertarsuaq	1982	20	2.1-2.4
	1994	10	2.1-2.1
	1999	40	1.4-2.3
	2003	60	1.5-3.0

(1) Bossi R et al; *Environ Sci Technol* 39: 7416-22 (2005)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was studied in ringed seal (*Phoca hispida*) liver tissue from the Canadian Arctic(1).

Location	Year	No. Sampled	Concn (ng/g wet weight)
Arvait	1992	6	1.2-2.5
	1998	10	2.0-8.1
	2003	10	3.0-12.0
	2005	10	1.4-9.1
Resolute Bay	1972	2	0.15-0.51
	1993	9	0.8-3.2
	2000	9	1.6-8.7
	2004	9	2.0-9.3
	2005	9	2.4-10.9

(1) Butt CM et al; *Environ Sci Technol* 41: 42-9 (2007)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was detected in common guillemot (*Uria aalge*) samples from Stora Karlsö Island in the Baltic Sea collected in 1989(1).

Tissue	No. Sampled	Concn (ng/g wet weight)

Tissue	No. Sampled	Concn (ng/g wet weight)
Muscle	8	0.17-0.42
Kidney	10	1.2-5.7
Adult Liver	13	1.3-5.8
Chick Liver	10	0.96-4.7
Egg	8	0.76-1.8

(1) Holmstrom KE, Berger U; *Environ Sci Technol* 42: 5879-84 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Harbor seals collected in 2002 from the Dutch coasts and analyzed for perfluoro-n-nonanoic acid; LOD (limit of detection) not specified(1).

Tissue	No. Analyzed	Concn (ng/g wet weight)
kidney	18	<LOD-60.41
liver	24	<LOD-14
blubber	17	<LOD
muscle	17	<LOD-11.99
tracheo-branchial muscle	1	69.82
spleen	4	<LOD-22.77

(1) Van de Vijver et al; *Environ Sci Technol* 39: 6978-84 (2005)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid in organisms from the Ariake Sea area, Japan(1).

Species/speciman	Sample Date	No. Sampled	Concn (ng/g wet weight)
finless porpoise	1999-2002	5	8.3-44
mallard	2000-2001	11	<1.5
blackheaded gull	2001	2	<1.5

(1) Nakata H et al; *Environ Sci Technol* 40: 4916-21 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid concentrations in waterbird eggs from South China, Quanzhou and Xiamen samples were collected March to May 2004 and Hong Kong samples were collected March to May 2006(1).

Species	Location	Concn (ng/g wet weight)	Mean (ng/g wet weight)
little egret	Quanzhou	2.03-4.13	3.08
	Xiamen	1.16-1.50	1.33
night heron	Quanzhou	0.552-0.643	0.597
	Xiamen	0.956-1.66	1.37
	Hong Kong	0.0720-1.31	0.447
great egret	Hong Kong	0.225-0.427	0.313

(1) Wang Y et al; *Environ Sci Technol* 42: 8146-51 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.16 Milk Concentrations



Perfluoro-n-nonanoic acid was not detected (detection limit 2.1 pg/g) in milk samples purchased at grocery stores in Oslo, Norway between Oct 2008 and Jan 2009(1). In Nov 2009, milk samples randomly purchased in several Dutch retail stores did not contain perfluoro-n-nonanoic acid (detection limit <1 pg/g)(2). Perfluoro-n-nonanoic acid was not detected (detection limit 2.20 pg/mL) in 21 infant formula samples purchased from retail stores in Washington, DC and Boston, MA in 2007, or in 12 dairy milk samples purchased from retail stores and local farms in Albany, NY in 2008(3).

(1) Haug LS et al; *Chemosphere* 80: 1137-43 (2010) (2) Noorlander CW et al; *J Agric Food Chem* 59: 7496-505 (2011) (3) Tao L et al; *Environ Sci Technol* 42: 8597-602 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

In 12 sets of maternal serum, cord serum and milk samples from mothers that gave birth at the National Hospital in Torshavn, Faroe Islands, perfluoro-n-nonanoic acid was not detected in transitional milk samples taken 3-5 days after delivery(1).

(1) Needham LL et al; *Environ Sci Technol* 45: 1121-6 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid concentrations in breast milk samples from seven Asian Countries, samples, collected 1999 to 2005, primarily from women living in major cities(1).

County	No. Samples	% Positive	Concn pg/mL
Japan	24	13	<8.82-23.9
Malaysia	13	8	<8.82-14.9
Philippines	24	17	<8.82-25.0
Indonesia	20	5	<8.62-135
Vietnam	40	5	<8.82-10.9
Cambodia	24	13	<8.82-12.3
India	39	0	<8.82

(1) Tao L et al; *Environ Sci Technol* 42: 8597-602 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.17 Other Environmental Concentrations



Perfluoro-n-nonanoic acid was detected in paper fiber from three paper mills in Ontario, Canada at 2.0-3.0 ng/g, samples were collected 2002, 2003 and 2008(1). Perfluoro-n-nonanoic acid concentrations on window film in a suburban area was greatest on a sheltered window in the summer followed by a sheltered window in the winter, a lower concentration was found on an unsheltered window in the winter (13 mm precipitation), and the lowest concentration was found on an unsheltered window in the summer (47 mm precipitation)(2). Perfluoro-n-nonanoic acid was detected at <0.06 to 680 ng/g in dust samples from 140 homes in Vancouver, Canada, samples were collected 2007 to 2008(3). Perfluoro-n-nonanoic acid was detected in 41 dust samples from Norwegian households at 3.9 to 92 ng/g(4). Dust samples were collected in 2000 to 2001 from vacuum cleaner bags during the US Environmental Protection Agency's Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants study, 102 homes and 10 daycare centers in North Carolina and Ohio were sampled, perfluoro-n-nonanoic acid was detected in 42.9% of the samples at a mean concentration of 22.1 ng/g and a maximum of 263 ng/g(5). Perfluoro-n-nonanoic acid was found in indoor dust samples with a mean value of 3.43 ng/g dry weight and a range of 0.66 to 7.32 ng/g dry weight, samples were collected from homes in Nanchang, Shanghai, Beijing and Tianjin, China(6).

(1) D'eon JC et al; *Environ Sci Technol* 43: 4589-94 (2009) (2) Gewurtz SB et al; *Environ Sci Technol* 43: 7317-23 (2009) (3) Shoeib M et al; *Environ Sci Technol* 45: 7999-8005 (2011) (4) Haug LS et al; *Environ Sci Technol* 45: 7991-8 (2011) (5) Strynar MJ, Lindstrom AB; *Environ Sci Technol* 42: 3751-6 (2008) (6) Zhang T et al; *Environ Sci Technol* 44: 3572-9 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.18 Probable Routes of Human Exposure



Occupational exposure to perfluoro-n-nonanoic acid may occur through inhalation and dermal contact with this compound at workplaces where perfluoro-n-nonanoic acid is produced or used. Monitoring data indicate that the general population may be exposed to perfluoro-n-nonanoic acid via inhalation of ambient air, ingestion of food and drinking [water](#), and dermal contact with products containing perfluoro-n-nonanoic acid. (SRC)

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.19 Average Daily Intake



The average daily intake of perfluoro-n-nonanoic acid in Canadians in the late 1990s ranged from 0.5 to 1.2 ng/kg of body weight/day, in 2004 the estimated value was 1.1 ng/kg of body weight/day(1).

(1) Ostertag SK et al; *J Agric Food Chem* 57: 8534-44 (2009)

► [Hazardous Substances Data Bank \(HSDB\)](#)



10.2.20 Body Burden

Perfluoro-n-nonanoic acid was detected in all serum samples from the US population (1562 participants) as studied in the National Health and Nutrition Examination Survey (NHANES) conducted 1999 thru 2000, with a mean concentration of 0.5 ng/mL and concentration range of 0.5-0.7 ng/mL(1). In the NHANES survey conducted 2003 thru 2004 perfluoro-n-nonanoic acid was detected at a mean concentration of 1.0 ng/mL and concentration range of 0.8-1.1 ng/mL in 100% of the 2094 serum samples analyzed(2). Perfluoro-n-nonanoic acid was detected in 20 pooled blood samples (at least 10 individual donors per sample) at concentrations of 0.34 to 1.8 ug/L, samples were obtained from donors across the Midwestern US in 2004, 2005 and 2008(3). Pooled serum samples from participants of NHANES 2001 to 2002, based on age and demographics had perfluoro-n-nonanoic acid concentrations of 0.7-15.2 and 0.6-1.4 ng/mL in 3-5 and 6-11 year olds, respectively(4). The concentration of perfluoro-n-nonanoic acid in the serum of 20 Atlanta, GA residents was 1.3 to 4.4 ng/mL, samples were collected July 2003(6). Perfluoro-n-nonanoic acid was not detected (detection limit 1.0 ng/mL) in two human milk samples, collection information was not provided(6).

(1) Calafat AM et al; *Environ Sci technol* 41: 2237-42 (2007) (2) Calafat AM et al; *Environ Health Perspect* 115: 1596-1602 (2007) (3) D'eon JC et al; *Environ Sci Technol* 43: 4589-94 (2009) (4) Kato K et al; *Environ Sci Technol* 45: 8037-45 (2011) (6) Kuklenyik Z et al; *Environ Sci Technol* 38: 3698-704 (2004)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid levels in New York State infants using Newborn Screening Programs dried blood spots analysis(1).

Sample date	Mean concn (ng/mL)	Range (ng/mL)
01/02/97	0.31	0.1-0.58
06/28/97	0.37	0.16-0.56
12/30/97	0.37	0.17-0.64
12/29/99	0.35	0.13-0.77
06/29/01	0.43	0.29-0.63
12/29/01	0.43	0.23-0.93
12/30/02	0.51	0.15-0.73
12/29/04	0.33	0.25-0.42
06/27/05	0.27	0.14-0.41
06/26/06	0.39	0.26-0.62
01/08/07	0.39	0.13-0.93

(1) Spliethoff HM et al; *Environ Sci Technol* 42: 5361-7 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid concentration was <0.050 ng/mL (1977), increased to 1.7 ng/mL (1986), and then stabilized at 0.55 to 1.2 ng/mL (1988-2006) in 24 pooled serum samples from men, age 40 to 50 years, representing 1977 to 2006(1). Perfluoro-n-nonanoic acid was found in 40 pooled serum samples collected from 3802 Australian residents collected Nov 2002 to April 2003 at 0.4 to 2.0 ng/mL(2). Perfluoro-n-nonanoic acid was detected in 61 of 66 human blood samples collected from 11 counties in Sweden during the period of 1997 to 2000, concentrations were <0.1-1.9 ng/mL(3). From March to Sept 2008, 138 human blood samples were taken from donors from seven cities in Liaoning province, China, perfluoro-n-nonanoic acid was detected as follows - city (ng/mL): Fuxin (0.24-2.2), Jinzhou (<0.013-1.8), Shenyang (<0.013-1.75), Anshan (0.16-1.02), Yingkou (0.17-2.88), Dalian (0.16-1.44) and Huludao (0.16-1.58)(4). In 12 sets of maternal serum, cord serum and milk samples from mothers that gave birth at the National Hospital in Torshavn, Faroe Islands, the average concentrations of perfluoro-n-nonanoic acid were 0.76 and 0.37 ng/mL in maternal and cord serum, it was not detected in transitional milk samples taken 3-5 days after delivery(5). From 2006 to 2008, 233 human blood samples were taken from donors from the capital cities of 12 provinces or districts of China, perfluoro-n-nonanoic acid was detected as follows - city (ng/mL): Harbin (0.522), Hohhot (0.429), Lanzhou (0.545), Taiyuan (0.221), Shijiazhuang (0.852), Qingdao (0.657), Ningbo (0.984), Changsha (0.295), Chengdu (0.430), Chongqing (0.564), Kuming (3.39) and Guizhou (2.29)(6). Perfluoro-n-nonanoic acid was detected in 100% of 84 pools of human blood serum taken from 2420 Queensland, Australia donors in 2006 to 2007, concentrations reported were 0.1-1.4 ng/mL(7). Human blood samples from volunteer donors from five Chinese cities (Shenyang, Beijing, Gulyang, Jintan, Nanjing) collected in 2004 had perfluoro-n-nonanoic acid concentrations of 0.0630 to 1.34 ng/mL(8).

(1) Haug LS et al; *Environ Sci Technol* 43: 2131-6 (2009) (2) Karrman A et al; *Environ Sci Technol* 40: 3742-8 (2006) (3) Karrman A et al; *Chemosphere* 64: 1582-91 (2006) (4) Liu H et al; *Environ Sci Technol* 43: 4044-8 (2009) (5) Needham LL et al; *Environ Sci Technol* 45: 1121-6 (2011) (6) Pan Y et al; *Environ Toxicol Chem* 29: 2695-701 (2010) (7) Toms LL et al; *Environ Sci Technol* 43: 4194-9 (2009) (8) Yeung LWY et al; *Environ Sci Technol* 42: 8140-5 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Concentration of perfluoro-n-nonanoic acid in adult (age 19-62) human blood, 15 samples from each category, taken from citizens of Gdansk, Poland and nearby villages. Blood donations were all collected July 2003(1).

Parameter	Dockers	Farmers	Fish-dish fanciers	Reference Group
mean (pg/mL)	400	560	1700	610
median (pg/mL)	360	590	1600	490
range (pg/mL)	160-820	300-810	410-3800	300-1500

(1) Falandysz J et al; *Environ Sci Technol* 40: 748-51 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Fifty-three pregnant women participated in a serum study for perfluoro-n-nonanoic acid in Munich, Germany, the study was run Dec 2007 to Oct 2009(1).

Table: Mother

Parameter	Pregnancy (34-37 weeks)	At delivery	6 mo after delivery
N (%> limit of quantitation)	44 (86)	38 (83)	47 (83)
Mean (ug/L)	0.8	0.8	0.7
Median (ug/L)	0.6	0.6	0.5
95th percentile	2.8	3.0	2.0

(1) Fromme H et al; *Environ Sci Technol* 44: 7123-9 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Fifty-three pregnant women participated in a serum study for perfluoro-n-nonanoic acid in Munich, Germany, the study was run Dec 2007 to Oct 2009. Fetus data was reported(1).

Table: Fetus/Infant

Parameter	cord blood	6 mo after birth	19 mo after birth
N (%> limit of quantitation)	33 (30)	40 (90)	24 (83)
Mean (ug/L)	0.4	1.1	0.7
Median (ug/L)	<0.4	1.0	0.6
95th percentile	1.5	2.3	1.4

(1) Fromme H et al; *Environ Sci Technol* 44: 7123-9 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Perfluoro-n-nonanoic acid was studied in wax technicians employed by the Swedish and US national cross-country ski teams. Whole blood samples were taken pre-season (pre) Sept 2007, during the World Cup season (during) Dec 2007 to Mar 2008 and post-season (post) April to Aug 2008. Number of years (years) working as a wax technician and occupations for the off season (April to Nov) are given, one technician is a full-time employee at Swedish Ski Association; NP- sample not provided(1).

Occupation	Years	pre (ng/mL)	during (ng/mL)	post (ng/mL)
student	3	0.86	0.76-2.2	1.7-2.8
carpenter	6	3.8	3.5-5.7	6.1-7.1
full-time w/ Ski Assoc	6	14	15-18	15-20
gardener	10	21	18-21	17-19
fire fighter	5	1.7	2.0-3.7	NP
carpenter	15	NP	56-65	45-57
carpenter	7	NP	10-12	NP
engineer	12	145	133-163	104-128

(1) Nilsson H et al; 44: 2150-5 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Concentration of perfluoro-n-nonanoic acid in serum of Farese children(1).

Age	Sample Date	% Detections	Mean (ng/mL)	Range (ng/mL)
7 years	1993-1994	99	0.9	<0.1-4.8
14 years	2000-2001	100	0.9	0.4-4.8

(1) Weihe P et al; Environ Sci Technol 42: 6291-5 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Concentration of perfluoro-n-nonanoic acid in serum of 12 Faroese mothers and their five year old children(1).

	Sample date	% Detections	Mean (ng/mL)	Range (ng/mL)
mothers	2000	100	0.6	0.1-1.2
children	2005	100	1.4	0.6-3.0

(1) Weihe P et al; Environ Sci Technol 42: 6291-5 (2008)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11 Associated Disorders and Diseases



► [Comparative Toxicogenomics Database \(CTD\)](#)

12 Literature



12.1 NLM Curated PubMed Citations



► PubChem

12.2 Springer Nature References



► Springer Nature

12.3 Wiley References



► Wiley

12.4 Depositor Provided PubMed Citations



► PubChem

12.5 Chemical Co-Occurrences in Literature



► PubChem

12.6 Chemical-Gene Co-Occurrences in Literature



► PubChem

12.7 Chemical-Disease Co-Occurrences in Literature



► PubChem

13 Patents



13.1 Depositor-Supplied Patent Identifiers



► PubChem

[Link to all deposited patent identifiers](#)

► PubChem

13.2 WIPO PATENTSCOPE



Patents are available for this chemical structure:

<https://patentscope.wipo.int/search/en/result.jsf?inchikey=UZUFPBIDKMEQEQ-UHFFFAOYSA-N>

► PATENTSCOPE (WIPO)

14 Biomolecular Interactions and Pathways



14.1 Drug-Gene Interactions



► [Drug Gene Interaction database \(DGIdb\)](#)

14.2 Chemical-Gene Interactions



14.2.1 CTD Chemical-Gene Interactions



► [Comparative Toxicogenomics Database \(CTD\)](#)

15 Biological Test Results



15.1 BioAssay Results



► PubChem

16 Classification



16.1 Ontologies



16.1.1 MeSH Tree



► Medical Subject Headings (MeSH)

16.1.2 ChEBI Ontology



► ChEBI

16.1.3 ChemIDplus



► ChemIDplus

16.1.4 UN GHS Classification



► UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

16.1.5 EPA CPDat Classification



► EPA Chemical and Products Database (CPDat)

16.1.6 NORMAN Suspect List Exchange Classification



► [NORMAN Suspect List Exchange](#)

16.1.7 EPA DSSTox Classification



► [EPA DSSTox](#)

17 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. CAS Common Chemistry

LICENSE

The data from CAS Common Chemistry is provided under a CC-BY-NC 4.0 license, unless otherwise stated.

<https://creativecommons.org/licenses/by-nc/4.0/>

Perfluorononanoic acid

https://commonchemistry.cas.org/detail?cas_rn=375-95-1

2. ChemIDplus

LICENSE

<https://www.nlm.nih.gov/copyright.html>

Perfluoro-n-nonanoic acid

<https://chem.nlm.nih.gov/chemidplus/sid/0000375951>

ChemIDplus Chemical Information Classification

<https://chem.nlm.nih.gov/chemidplus/>

3. EPA Chemicals under the TSCA

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

Nonanoic acid, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-heptadecafluoro-

<https://www.epa.gov/chemicals-under-tsca>

4. EPA DSSTox

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

PFNA

<https://comptox.epa.gov/dashboard/DTXSID8031863>

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical_lists/

5. European Chemicals Agency (ECHA)

LICENSE

Use of the information, documents and data from the ECHA website is subject to the terms and conditions of this Legal Notice, and subject to other binding limitations provided for under applicable law, the information, documents and data made available on the ECHA website may be reproduced, distributed and/or used, totally or in part, for non-commercial purposes provided that ECHA is acknowledged as the source: "Source: European Chemicals Agency, <http://echa.europa.eu/>". Such acknowledgement must be included in each copy of the material. ECHA permits and encourages organisations and individuals to create links to the ECHA website under the following cumulative conditions: Links can only be made to webpages that provide a link to the Legal Notice page.

<https://echa.europa.eu/web/guest/legal-notice>

Perfluorononan-1-oic acid

<https://echa.europa.eu/substance-information/-/substanceinfo/100.006.184>

Perfluorononan-1-oic acid

<https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/31321>

Perfluorononan-1-oic-acid

<https://www.echa.europa.eu/candidate-list-table>

6. Hazardous Substances Data Bank (HSDB)

Perfluoro-n-nonanoic acid

<https://pubchem.ncbi.nlm.nih.gov/source/hsdb/8040>

7. ChEBI

Perfluorononanoic acid

<http://www.ebi.ac.uk/chebi/searchId.do?chebiId=ChEBI:38397>

ChEBI Ontology

<http://www.ebi.ac.uk/chebi/userManualForward.do#ChEBI%20Ontology>

8. Comparative Toxicogenomics Database (CTD)

LICENSE

It is to be used only for research and educational purposes. Any reproduction or use for commercial purpose is prohibited without the prior express written permission of the MDI Biological Laboratory and NC State University.

<http://ctdbase.org/about/legal.jsp>

<http://ctdbase.org/detail.go?type=chem&acc=C101816>
<http://ctdbase.org/detail.go?type=chem&acc=C584865>

9. Drug Gene Interaction database (DGIdb)

LICENSE

The data used in DGIdb is all open access and where possible made available as raw data dumps in the downloads section.

<http://www.dgldb.org/downloads>

<https://www.dgldb.org/drugs/CHEMBL426404>

10. EPA Chemical and Products Database (CPDat)

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

perfluorononanoic acid

<https://comptox.epa.gov/dashboard/DTXSID8031863#exposure>

EPA CPDat Classification

<https://www.epa.gov/chemical-research/chemical-and-products-database-cpdats>

11. Hazardous Chemical Information System (HCIS), Safe Work Australia

perfluorononanoic acid

<http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=5697>

12. NITE-CMC

Perfluorononanoic acid - FY2016

<https://www.nite.go.jp/chem/english/ghs/16-mhlw-0011e.html>

13. FDA/SPL Indexing Data

LICENSE

Unless otherwise noted, the contents of the FDA website (www.fda.gov), both text and graphics, are not copyrighted. They are in the public domain and may be republished, reprinted and otherwise used freely by anyone without the need to obtain permission from FDA. Credit to the U.S. Food and Drug Administration as the source is appreciated but not required.

<https://www.fda.gov/about-fda/about-website/website-policies#linking>

5830Z6S63M

<https://www.fda.gov/ForIndustry/DataStandards/SubstanceRegistrationSystem-UniqueIngredientIdentifierUNII/>

14. Human Metabolome Database (HMDB)

LICENSE

HMDB is offered to the public as a freely available resource. Use and re-distribution of the data, in whole or in part, for commercial purposes requires explicit permission of the authors and explicit acknowledgment of the source material (HMDB) and the original publication (see the HMDB citing page). We ask that users who download significant portions of the database cite the HMDB paper in any resulting publications.

<http://www.hmdb.ca/citing>

Perfluorononanoic acid

<http://www.hmdb.ca/metabolites/HMDB0061739>

15. MassBank of North America (MoNA)

LICENSE

The content of the MoNA database is licensed under CC BY 4.0.

<https://mona.fiehnlab.ucdavis.edu/documentation/license>

Perfluorononanoic acid

<http://mona.fiehnlab.ucdavis.edu/spectra/browse?inchikey=UZUFPBIDKMEQEQ-UHFFFAOYSA-N>

16. NIST Mass Spectrometry Data Center

Perfluorononanoic acid

<http://www.nist.gov/srd/nist1a.cfm>

17. NORMAN Suspect List Exchange

LICENSE

Data: CC-BY 4.0; Code (hosted by ECI, LCSB): Artistic-2.0

<https://creativecommons.org/licenses/by/4.0/>

Nonanoic acid, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-heptafluoro-

NORMAN Suspect List Exchange Classification

<https://www.norman-network.com/nds/SLE/>

18. SpectraBase

Perfluoronanoic acid

<https://spectrabase.com/spectrum/4ErOuFkbHl2>

Perfluoronanoic acid

<https://spectrabase.com/spectrum/8yUkleIkZeD>

Perfluorononanoic acid

<https://spectrabase.com/spectrum/KCO52uduRF2>

Perfluorononanoic acid

<https://spectrabase.com/spectrum/9aMiDt3spM>

Perfluorononanoic acid

<https://spectrabase.com/spectrum/ImfyIufB4VD>

19. **Springer Nature**

20. **Wikipedia**

perfluorononanoic acid

https://en.wikipedia.org/wiki/Perfluorononanoic_acid

21. **Wiley**

<https://pubchem.ncbi.nlm.nih.gov/substance/?source=wiley&sourceid=114372>

22. **PubChem**

<https://pubchem.ncbi.nlm.nih.gov>

23. **Medical Subject Headings (MeSH)**

perfluoro-*n*-nonanoic acid

<https://www.ncbi.nlm.nih.gov/mesh/67101816>

MeSH Tree

<http://www.nlm.nih.gov/mesh/meshhome.html>

24. **UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)**

GHS Classification Tree

http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

25. **PATENTSCOPE (WIPO)**

SID 403400333

<https://pubchem.ncbi.nlm.nih.gov/substance/403400333>

SAFETY DATA SHEET

Creation Date 02-Jul-2015

Revision Date 18-Aug-2020

Revision Number 4

1. Identification

Product Name Perfluorooctanesulfonamide

Cat No. : AC459640000; AC459640010; AC459640050

CAS-No 754-91-6

Synonyms No information available

Recommended Use Laboratory chemicals.

Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99
CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**:001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word

Warning

Hazard Statements

Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell

Skin

IF ON SKIN: Wash with plenty of soap and water
If skin irritation occurs: Get medical advice/attention
Take off contaminated clothing and wash before reuse

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention

Storage

Store in a well-ventilated place. Keep container tightly closed
Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Heptadecafluorooctanesulphonamide	754-91-6	<100

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray, carbon dioxide (CO₂), dry chemical, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature No information available

Explosion Limits

Upper No data available

Lower No data available

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products

None known.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
3

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Avoid dust formation. Ensure adequate ventilation. Avoid ingestion and inhalation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	No information available
Odor	No information available
Odor Threshold	No information available
pH	No information available
Melting Point/Range	154 - 155 °C / 309.2 - 311 °F
Boiling Point/Range	No information available
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C ₈ H ₂ F ₁₇ N O ₂ S
Molecular Weight	499.15

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	None under normal use conditions
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Heptadecafluorooctanesulphonamide	LD50 > 172 mg/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic	No information available

Products**Delayed and immediate effects as well as chronic effects from short and long-term exposure**

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Heptadecafluorooctanesulphonamide	754-91-6	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains.

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated

TDG Not regulated

IATA Not regulated

IMDG/IMO Not regulated

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags

Heptadecafluorooctanesulphonamide	754-91-6	-	-	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export

Component	CAS-No	TSCA 12(b) - Notices of Export
Heptadecafluorooctanesulphonamide	754-91-6	Section 5

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Heptadecafluorooctanesulphonamide	754-91-6	-	-	212-046-0	X	-	-	X	-

U.S. Federal Regulations**SARA 313** Not applicable**SARA 311/312 Hazard Categories** See section 2 for more information**CWA (Clean Water Act)** Not applicable**Clean Air Act** Not applicable**OSHA - Occupational Safety and Health Administration** Not applicable**CERCLA** Not applicable**California Proposition 65** This product does not contain any Proposition 65 chemicals.**U.S. State Right-to-Know Regulations** Not applicable**U.S. Department of Transportation**

Reportable Quantity (RQ): N

DOT Marine Pollutant N

DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.**Other International Regulations****Mexico - Grade** No information available**16. Other information**

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 02-Jul-2015

Revision Date 18-Aug-2020**Print Date** 18-Aug-2020**Revision Summary** This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).**Disclaimer**

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Perfluoropentanoic acid

sc-250679



Material Safety Data Sheet

Hazard Alert Code
Key:

EXTREME

HIGH

MODERATE

LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Perfluoropentanoic acid

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800

EMERGENCY

ChemWatch

Within the US & Canada: 877-715-9305

Outside the US & Canada: +800 2436 2255

(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS

C5HF9O2, CF3(CF2)3CO2H

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max	
Flammability:	1			
Toxicity:	0			
Body Contact:	4			Min/Nil=0 Low=1 Moderate=2 High=3 Extreme=4
Reactivity:	1			
Chronic:	2			

CANADIAN WHMIS SYMBOLS



EMERGENCY OVERVIEW

RISK

Causes severe burns.
Risk of serious damage to eyes.
Harmful to aquatic organisms.
Vapours potentially cause drowsiness and dizziness*.
Cumulative effects may result following exposure*.
Limited evidence of a carcinogenic effect*.
* (limited evidence).

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

! Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and oesophagus.
Immediate pain and difficulties in swallowing and speaking may also be evident.
! The material has NOT been classified by EC Directives or other classification systems as "harmful by ingestion".
This is because of the lack of corroborating animal or human evidence.

EYE

! The material can produce severe chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
! If applied to the eyes, this material causes severe eye damage.
! Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns.
Mild burns of the epithelia generally recover rapidly and completely.

SKIN

! The material can produce severe chemical burns following direct contact with the skin.
! Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.
! Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions.
! Open cuts, abraded or irritated skin should not be exposed to this material.
! Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects.
Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

! The material can cause respiratory irritation in some persons.
The body's response to such irritation can cause further lung damage.
! Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage.
There may be dizziness, headache, nausea and weakness.
! Inhalation of vapours may cause drowsiness and dizziness.
This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo.
! Inhalation hazard is increased at higher temperatures.
! The material has NOT been classified by EC Directives or other classification systems as "harmful by inhalation".
This is because of the lack of corroborating animal or human evidence.
! Inhalation of high concentrations of gas/vapour causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination.

CHRONIC HEALTH EFFECTS

! Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and/or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs. Chronic exposure may inflame the skin or conjunctiva.
Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.
There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.
Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
Long chain PCFAs are present in the environment of most developed countries, and have the potential to adversely affect animal and human health. In tests on laboratory animals, one PFCA (perfluorooctanoic acid, PFOA) has been shown to cause tumours and damage the immune system, and cause moderate to high toxicity in the medium term if given by mouth. Because they are cleared more slowly and have more potential to accumulate in the body, longer chain PFCAs are expected to be of greater concern than PFOA.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
nonafluoropentanoic acid	2706-90-3	>98

Section 4 - FIRST AID MEASURES

SWALLOWED

- For advice, contact a Poisons Information Centre or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.

EYE

If this product comes in contact with the eyes:

- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.

SKIN

If skin or hair contact occurs:

- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital, or doctor.

INHALED

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.
- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).
- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.
- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.

NOTES TO PHYSICIAN

! Treat symptomatically.

For acute or short term repeated exposures to strong acids:

- Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
- Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling
- Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
- Strong acids produce a coagulation necrosis characterised by formation of a coagulum (eschar) as a result of the dessicating action of the acid on proteins in specific tissues.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Not Available
Upper Explosive Limit (%):	Not available.
Specific Gravity (water=1):	1.713
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.

When any large container (including road and rail tankers) is involved in a fire, consider evacuation by 800 metres in all directions.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

- Combustible.
- Slight fire hazard when exposed to heat or flame.
- Acids may react with metals to produce hydrogen, a highly flammable and explosive gas.
- Heating may cause expansion or decomposition leading to violent rupture of containers.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO₂), hydrogen fluoride, other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

- Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.
- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb spill with sand, earth, inert material or vermiculite.

MAJOR SPILLS

- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT allow clothing wet with material to stay in contact with skin
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.

RECOMMENDED STORAGE METHODS

- DO NOT use aluminium or galvanised containers
- Check regularly for spills and leaks
- Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.

For low viscosity materials

- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

<.

STORAGE REQUIREMENTS

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m ³	STEL ppm	STEL mg/m ³	Peak ppm	Peak mg/m ³	TWA F/CC	Notes
US ACGIH Threshold Limit Values (TLV)	nonafluoropentanoic acid (Fluorides, as F)		2.5						TLV® Basis: Bone dam; fluorosis ; BEI

PERSONAL PROTECTION



RESPIRATOR

- Type A-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

EYE

- Safety glasses with unperforated side shields may be used where continuous eye protection is desirable, as in laboratories; spectacles are not sufficient where complete eye protection is needed such as when handling bulk-quantities, where there is a danger of splashing, or if the material may be under pressure
- Chemical goggles whenever there is a danger of the material coming in contact with the eyes; goggles must be properly fitted
- Full face shield (20 cm, 8 in minimum) may be required for supplementary but never for primary protection of eyes; these afford face protection.
- Alternatively a gas mask may replace splash goggles and face shields.

HANDS/FEET

- Elbow length PVC gloves
 - When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.
- Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity
- Neoprene gloves

OTHER

- Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.

ENGINEERING CONTROLS

! Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.

The basic types of engineering controls are:

Process controls which involve changing the way a job activity or process is done to reduce the risk.

Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Does not mix with water.

Sinks in water.

Corrosive.

Acid.

State	LIQUID	Molecular Weight	264.05
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	284	Solubility in water (g/L)	Partly miscible
Flash Point (°F)	None	pH (1% solution)	Not applicable
Decomposition Temp (°F)	Not available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Not Available
Upper Explosive Limit (%)	Not available.	Specific Gravity (water=1)	1.713
Lower Explosive Limit (%)	Not available	Relative Vapour Density (air=1)	>1
Volatile Component (%vol)	Not Available	Evaporation Rate	Not applicable

APPEARANCE

Liquid; does not mix well with water.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

- Contact with alkaline material liberates heat
- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

STORAGE INCOMPATIBILITY

- Avoid strong bases.
- Segregate from alkalies, oxidising agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.
- Reacts with mild steel, galvanised steel / zinc producing hydrogen gas which may form an explosive mixture with air.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

nonafluoropentanoic acid

TOXICITY AND IRRITATION

! Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound.

No significant acute toxicological data identified in literature search.

CARCINOGEN

Fluorides, as F	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4

Section 12 - ECOLOGICAL INFORMATION

Harmful to aquatic organisms.

This material and its container must be disposed of as hazardous waste.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
nonafluoropentanoic acid	HIGH	No Data Available	LOW	MED

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.

Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

- DO NOT allow wash water from cleaning or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.
- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralise at an approved treatment plant. Treatment should involve: Neutralisation with soda-ash or soda-lime followed by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus
- Decontaminate empty containers with 5% aqueous sodium hydroxide or soda ash, followed by water. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	8
Identification Numbers:	UN3265	PG:	II
Label Codes:	8	Special provisions:	B2, IB2, T11, TP2, TP27
Packaging: Exceptions:	154	Packaging: Non-bulk:	202
Packaging: Exceptions:	154	Quantity limitations: Passenger aircraft/rail:	1 L
Quantity Limitations: Cargo aircraft only:	30 L	Vessel stowage: Location:	B
Vessel stowage: Other:	40		

Hazardous materials descriptions and proper shipping names:

Corrosive liquid, acidic, organic, n.o.s.

Air Transport IATA:

ICAO/IATA Class:	8	ICAO/IATA Subrisk:	None
UN/ID Number:	3265	Packing Group:	II
Special provisions:	A3		
Cargo Only			
Packing Instructions:	855	Maximum Qty/Pack:	30 L
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	851	Maximum Qty/Pack:	1 L
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	
Packing Instructions:	Y840	Maximum Qty/Pack:	0.5 L

Shipping name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (contains nonafluoropentanoic acid)

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	None
UN Number:	3265	Packing Group:	II
EMS Number:	F-A,S-B	Special provisions:	274
Limited Quantities:	1 L		

Shipping name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (contains nonafluoropentanoic acid)

Section 15 - REGULATORY INFORMATION



nonafluoropentanoic acid (CAS: 2706-90-3) is found on the following regulatory lists;

"Canada - Alberta Ambient Air Quality Guidelines", "Canada - Alberta Ambient Air Quality Objectives", "Canada - Prince Edward Island Occupational Exposure Limits", "Canada List of Prohibited and Restricted Cosmetic Ingredients (The Cosmetic Ingredient 'Hotlist')", "Canada Non-Domestic Substances List (NDSL)", "International Maritime Dangerous Goods Requirements (IMDG Code) - Substance Index", "US - California Air Toxics 'Hot Spots' List (Assembly Bill 2588) Substances for Which Emissions Must Be Quantified", "US - Georgia Primary Maximum Contaminant Levels for Drinking Water - Inorganics", "US - Hawaii Air Contaminant Limits", "US - Massachusetts Drinking Water - Inorganic Maximum Contaminant Levels (MCLs)", "US - Massachusetts Drinking Water - Secondary Contaminants Maximum Contaminant Levels (MCLs)", "US - North Dakota Air Pollutants - Guideline Concentrations", "US - South Dakota Drinking Water Standards - Inorganic Chemicals", "US - Utah Primary Drinking Water Standards - Inorganic Contaminants", "US - Utah Secondary Drinking Water Standards - Inorganic Contaminants", "US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values", "US ACGIH Threshold Limit Values (TLV)", "US ACGIH Threshold Limit Values (TLV) - Carcinogens", "US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory", "WHO Guidelines for Drinking-water Quality - Guideline values for chemicals that are of health significance in drinking-water"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

! Cumulative effects may result following exposure*.

! Limited evidence of a carcinogenic effect*.

! Vapours potentially cause drowsiness and dizziness*.

* (limited evidence).

Denmark Advisory list for selfclassification of dangerous substances

Substance	CAS	Suggested codes
nonafluoropentanoic acid	2706- 90- 3	Xn; R22

! Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

A list of reference resources used to assist the committee may be found at:

www.chemwatch.net/references.

! The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings.

! For detailed advice on Personal Protective Equipment, refer to the following U.S. Regulations and Standards:

OSHA Standards - 29 CFR:

1910.132 - Personal Protective Equipment - General requirements

1910.133 - Eye and face protection

1910.134 - Respiratory Protection

1910.136 - Occupational foot protection

1910.138 - Hand Protection

Eye and face protection - ANSI Z87.1

Foot protection - ANSI Z41

Respirators must be NIOSH approved.

This document is copyright. Apart from any fair dealing for the purposes of private study, research, review or criticism, as permitted under the Copyright Act, no part may be reproduced by any process without written permission from CHEMWATCH. TEL (+61 3) 9572 4700.

www.Chemwatch.net

Issue Date: Jan-28-2009

Print Date:Mar-20-2012

Perfluorotetradecanoic acid

Safety Data Sheet 2121331

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 01/16/2017

Version: 1.0

SECTION 1: Identification

1.1. Identification

Product form : Substance
 Substance name : Perfluorotetradecanoic acid
 CAS No : 376-06-7
 Product code : 2121-3-31
 Formula : C₁₄HF₂₇O₂
 Synonyms : Perfluoromyristic acid
 Other means of identification : MFCD00153263

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Laboratory chemicals
 Manufacture of substances
 Scientific research and development

1.3. Details of the supplier of the safety data sheet

SynQuest Laboratories, Inc.
 P.O. Box 309
 Alachua, FL 32615 - United States of America
 T (386) 462-0788 - F (386) 462-7097
info@synquestlabs.com - www.synquestlabs.com

1.4. Emergency telephone number

Emergency number : (844) 523-4086 (3E Company - Account 10069)

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Acute Tox. 4 (Oral) H302 - Harmful if swallowed
 Skin Irrit. 2 H315 - Causes skin irritation
 Eye Irrit. 2A H319 - Causes serious eye irritation
 STOT SE 3 H335 - May cause respiratory irritation

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS07

Signal word (GHS-US) : Warning

Hazard statements (GHS-US) : H302 - Harmful if swallowed
 H315 - Causes skin irritation
 H319 - Causes serious eye irritation
 H335 - May cause respiratory irritation

Precautionary statements (GHS-US) : P261 - Avoid breathing dust, mist, spray
 P264 - Wash skin thoroughly after handling
 P270 - Do not eat, drink or smoke when using this product
 P271 - Use only outdoors or in a well-ventilated area
 P280 - Wear protective gloves/protective clothing/eye protection/face protection
 P301+P312 - If swallowed: Call a POISON CENTER or doctor/ physician if you feel unwell
 P302+P352 - If on skin: Wash with plenty of soap and water
 P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
 P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
 P312 - Call a POISON CENTER or doctor/physician if you feel unwell
 P321 - Specific treatment (see supplemental first aid instructions on this label)
 P330 - Rinse mouth
 P332+P313 - If skin irritation occurs: Get medical advice/attention

Perfluorotetradecanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

P337+P313 - If eye irritation persists: Get medical advice/attention
P362+P364 - Take off contaminated clothing and wash it before reuse
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to an approved waste disposal plant

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Mono-constituent

Name	Product identifier	%	Classification (GHS-US)
Perfluorotetradecanoic acid (Main constituent)	(CAS No) 376-06-7	<= 100	Acute Tox. 4 (Oral), H302 Skin Irrit. 2, H315 Eye Irrit. 2A, H319 STOT SE 3, H335

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Move the affected personnel away from the contaminated area.

First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing. If not breathing, give artificial respiration. Get immediate medical advice/attention.

First-aid measures after skin contact : Wash with plenty of soap and water. Get immediate medical advice/attention.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

First-aid measures after ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth out with water. Get immediate medical advice/attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Alcohol resistant foam. Carbon dioxide. Dry powder. Water spray. Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

Fire hazard : Thermal decomposition generates: Carbon oxides. Hydrogen fluoride.

5.3. Advice for firefighters

Firefighting instructions : In case of fire: Evacuate area.

Protection during firefighting : Wear gas tight chemically protective clothing in combination with self contained breathing apparatus. For further information refer to section 8: "Exposure controls/personal protection".

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate unnecessary personnel. Ensure adequate air ventilation. Do not breathe dust.

6.1.1. For non-emergency personnel

Emergency procedures : Only qualified personnel equipped with suitable protective equipment may intervene.

Perfluorotetradecanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

6.1.2. For emergency responders

Protective equipment : Do not attempt to take action without suitable protective equipment. For further information refer to section 8: "Exposure controls/personal protection".

6.2. Environmental precautions

Avoid release to the environment. Notify authorities if product enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

For containment : Stop leak if safe to do so.
Methods for cleaning up : Sweep or shovel spills into appropriate container for disposal. Minimize generation of dust.
Other information : For disposal of solid materials or residues refer to section 13 : "Disposal considerations".

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Do not handle until all safety precautions have been read and understood. Ensure good ventilation of the work station. Do not breathe dust, mist, spray. Wear personal protective equipment. Avoid contact with skin and eyes.
Hygiene measures : Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations.
Storage conditions : Keep container closed when not in use.
Incompatible materials : Refer to Section 10 on Incompatible Materials.
Storage area : Store in dry, cool, well-ventilated area.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Appropriate engineering controls : Ensure good ventilation of the work station. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Hand protection : Protective gloves. 29 CFR 1910.138: Hand Protection.
Eye protection : Chemical goggles or safety glasses. Face shield. 29 CFR 1910.133: Eye and Face Protection.
Skin and body protection : Wear suitable protective clothing.
Respiratory protection : In case of inadequate ventilation wear respiratory protection. 29 CFR 1910.134: Respiratory Protection.
Other information : Safety shoes. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Solid
Color : No data available
Odor : No data available
Odor threshold : No data available
pH : No data available
Melting point : 130 - 131 °C
Freezing point : No data available
Boiling point : 192 °C (@ 60 mm Hg)
Flash point : No data available
Relative evaporation rate (butyl acetate=1) : No data available
Flammability (solid, gas) : No data available
Explosion limits : No data available
Explosive properties : No data available

Perfluorotetradecanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Oxidizing properties	: No data available
Vapor pressure	: 0 mm Hg (@ 20 °C)
Relative density	: No data available
Relative vapor density at 20 °C	: No data available
Molecular mass	: 714.11 g/mol
Solubility	: No data available
Log Pow	: No data available
Auto-ignition temperature	: No data available
Decomposition temperature	: No data available
Viscosity	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

The product is stable at normal handling and storage conditions.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Keep away from heat, sparks and flame.

10.5. Incompatible materials

Strong bases. Strong oxidizing agents.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. Hazardous decomposition products in case of fire, see Section 5.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	: Oral: Harmful if swallowed.
Skin corrosion/irritation	: Causes skin irritation.
Serious eye damage/irritation	: Causes serious eye irritation.
Respiratory or skin sensitization	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: May cause respiratory irritation.
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

No additional information available

Perfluorotetradecanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

- Waste treatment methods : Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber.
- Waste disposal recommendations : Dispose of contents/container in accordance with licensed collector's sorting instructions.
- Additional information : Recycle the material as far as possible.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT
Not regulated for transport

TDG

No additional information available

Transport by sea

No additional information available

Air transport

No additional information available

SECTION 15: Regulatory information

15.1. US Federal regulations

Perfluorotetradecanoic acid (376-06-7)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

EPA TSCA Regulatory Flag

S - S - indicates a substance that is identified in a proposed or final Significant New Uses Rule.

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA

Perfluorotetradecanoic acid (376-06-7)

Listed on the Canadian NDSL (Non-Domestic Substances List)

EU-Regulations

No additional information available

National regulations

Perfluorotetradecanoic acid (376-06-7)

Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

Perfluorotetradecanoic acid

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Full text of H-phrases:

Acute Tox. 4 (Oral)	Acute toxicity (oral) Category 4
Eye Irrit. 2A	Serious eye damage/eye irritation Category 2A
Skin Irrit. 2	Skin corrosion/irritation Category 2
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H302	Harmful if swallowed
H315	Causes skin irritation
H319	Causes serious eye irritation
H335	May cause respiratory irritation

NFPA health hazard

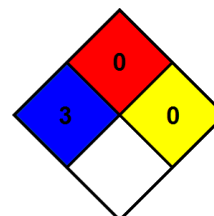
: 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard

: 0 - Materials that will not burn.

NFPA reactivity

: 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health

: 2 Moderate Hazard - Temporary or minor injury may occur

Flammability

: 0 Minimal Hazard - Materials that will not burn

Physical

: 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

SDS US (GHS HazCom 2012)

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is offered solely for your consideration, investigation, and verification. It does not represent any guarantee of the properties of the product nor that the hazard precautions or procedures described are the only ones which exist. SynQuest shall not be held liable for any damage resulting from handling or from contact with the above product.

Safety Data Sheet

according to Regulation (EC) No 1907/2006 (REACH)
Classifications according to Regulation (EC) No 1272/2008.
Printdate May 28, 2021

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product name:

Perfluorotridecanoic acid

1.1. Catalog No.:

676954

1.2. Relevant identified uses of the substance or mixture

Identified: Laboratory chemical
uses: R&D

1.3. Uses advised against:

HPC Standards GmbH
Am Wieseneck 7

04451 Cunnersdorf
Deutschland

Tel. +49 34291 3372-36
Fax. +49 34291 3372-39
contact@hpc-standards.com

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture
Not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008.
This substance is not classified as dangerous according to Directive 67/548/EEC.

2.2. Label elements

2.2.1. Pictogram

2.2.2.

2.2 Label elements
The product does not need to be labelled in accordance with EC directives or respective national laws.
2.3 Other hazards - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances
Formula : C13HF25O2
Molecular Weight : 664,11 g/mol

3.1.1. Formula

C13HF25O2

3.1.2. Molecular Weight (g/mol)

664.11

3.1.3. CAS-No.

72629-94-8

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact

Wash off with soap and plenty of water.

In case of eye contact

Flush eyes with water as a precaution. If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

4.3 Indication of any immediate medical attention and special treatment needed

no data available

5. FIRE-FIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen fluoride

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information

no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapors, mist or gas.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

7.3 Specific end use(s)

no data available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls

General industrial hygiene practice.

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.

Wash and dry hands. Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

- a) Appearance Form: solid
 - b) Odour no data available
 - c) Odour Threshold no data available
 - d) pH no data available
 - e) Melting point/freezing point
Melting point/range: 112 - 123 °C - lit.
 - f) Initial boiling point and boiling range
no data available
 - g) Flash point no data available
 - h) Evaporation rate no data available
 - i) Flammability (solid, gas) no data available
 - j) Upper/lower flammability or explosive limits
no data available
 - k) Vapour pressure no data available
 - l) Vapour density no data available
 - m) Relative density no data available
 - n) Water solubility no data available
 - o) Partition coefficient: noctanol/water
no data available
 - p) Auto-ignition temperature
no data available
 - q) Decomposition temperature
no data available
 - r) Viscosity no data available
 - s) Explosive properties no data available
 - t) Oxidizing properties no data available
- 9.2 Other safety information
no data available

10. STABILITY AND REACTIVITY

- 10.1 Reactivity
no data available
- 10.2 Chemical stability
no data available
- 10.3 Possibility of hazardous reactions
no data available
- 10.4 Conditions to avoid
no data available
- 10.5 Incompatible materials
Strong oxidizing agents
- 10.6 Hazardous decomposition products
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

- 11.1 Information on toxicological effects
 - Acute toxicity
no data available
 - Skin corrosion/irritation
no data available
 - Serious eye damage/eye irritation
no data available
 - Respiratory or skin sensitization
no data available
 - Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

no data available

Specific target organ toxicity - single exposure

no data available

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Potential health effects

Inhalation May be harmful if inhaled. May cause respiratory tract irritation.

Ingestion May be harmful if swallowed.

Skin May be harmful if absorbed through skin. May cause skin irritation.

Eyes May cause eye irritation.

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

12.1 Toxicity

no data available

12.2 Persistence and degradability

no data available

12.3 Bioaccumulative potential

no data available

12.4 Mobility in soil

no data available

12.5 Results of PBT and vPvB assessment

no data available

12.6 Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: - IMDG: - IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods

IMDG: Not dangerous goods

IATA: Not dangerous goods

14.3 Transport hazard class(es)

ADR/RID: - IMDG: - IATA: -

14.4 Packaging group

ADR/RID: - IMDG: - IATA: -

14.5 Environmental hazards

ADR/RID: no IMDG Marine Pollutant: no IATA: no

14.6 Special precautions for user

no data available

15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment

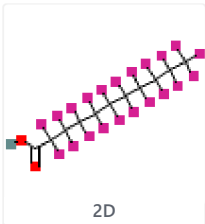
no data available

16. OTHER INFORMATION

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. For lab use only!

**COVID-19 Information**[Public health information \(CDC\)](#) [Research information \(NIH\)](#) [SARS-CoV-2 data \(NCBI\)](#)[Prevention and treatment information \(HHS\)](#) [Español](#)[COMPOUND SUMMARY](#) > [LABORATORY CHEMICAL SAFETY SUMMARY \(LCSS\)](#)

Perfluoroundecanoic acid

PubChem CID	77222
Structure	 2D Find Similar Structures
Synonyms	Perfluoroundecanoic acid 2058-94-8 Henicosafuoroundecanoic acid Perfluoro-n-undecanoic acid 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-henicosafuoroundecanoic acid More...
Molecular Formula	C ₁₁ HF ₂₁ O ₂
Molecular Weight	564.09

[Learn More About LCSS Project](#) >

1 GHS Classification



Pictogram(s)	 Irritant
Signal	Warning
GHS Hazard Statements	H302 (95.12%): Harmful if swallowed [Warning] Acute toxicity, oral] H312 (95.12%): Harmful in contact with skin [Warning] Acute toxicity, dermal] H315 (100%): Causes skin irritation [Warning] Skin corrosion/irritation] H319 (100%): Causes serious eye irritation [Warning] Serious eye damage/eye irritation] H332 (95.12%): Harmful if inhaled [Warning] Acute toxicity, inhalation]
Precautionary Statement Codes	P261, P264, P270, P271, P280, P301+P312, P302+P352, P304+P312, P304+P340, P305+P351+P338, P312, P321, P322, P330, P332+P313, P337+P313, P362, P363, and P501 (The corresponding statement to each P-code can be found at the GHS Classification page.)
ECHA C&L Notifications Summary	<i>Aggregated GHS information provided by 44 companies from 4 notifications to the ECHA C&L Inventory. Each notification may be associated with multiple companies.</i> <i>Reported as not meeting GHS hazard criteria by 3 of 44 companies. For more detailed information, please visit ECHA C&L website.</i> <i>Of the 3 notification(s) provided by 41 of 44 companies with hazard statement code(s).</i> <i>Information may vary between notifications depending on impurities, additives, and other factors. The percentage value in parenthesis indicates the notified classification ratio from companies that provide hazard codes. Only hazard codes with percentage values above 10% are shown.</i>

► [European Chemicals Agency \(ECHA\)](#)

2 Identifiers

2.1 CAS

2058-94-8

► CAS Common Chemistry; ChemIDplus; EPA DSSTox; European Chemicals Agency (ECHA)

2.2 InChI

InChI=1S/C11HF21O2/c12-2(13,1(33)34)3(14,15)4(16,17)5(18,19)6(20,21)7(22,23)8(24,25)9(26,27)10(28,29)11(30,31)32/h(H,33,34)

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► PubChem

2.3 InChI Key

SIDINRCMMRKXGQ-UHFFFAOYSA-N

Computed by InChI 1.0.5 (PubChem release 2019.06.18)

► PubChem

3 Additional Considerations



3.1 Substance of Very High Concern (SVHC)



REACH SVHC Substance

Substance: Henicosafuoroundecanoic acid

Reason: vPvB (Article 57e)

Decision Document: [PDF Link](#)

► [European Chemicals Agency \(ECHA\)](#)

4 Information Sources



FILTER BY SOURCE

ALL SOURCES



1. CAS Common Chemistry

LICENSE

The data from CAS Common Chemistry is provided under a CC-BY-NC 4.0 license, unless otherwise stated.

<https://creativecommons.org/licenses/by-nc/4.0/>

Perfluoroundecanoic acid

https://commonchemistry.cas.org/detail?cas_rn=2058-94-8

2. ChemIDplus

LICENSE

<https://www.nlm.nih.gov/copyright.html>

Perfluoro-n-undecanoic acid

<https://chem.nlm.nih.gov/chemidplus/sid/0002058948>

3. EPA DSSTox

LICENSE

<https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources>

Perfluoroundecanoic acid

<https://comptox.epa.gov/dashboard/DTXSID8047553>

4. European Chemicals Agency (ECHA)

LICENSE

Use of the information, documents and data from the ECHA website is subject to the terms and conditions of this Legal Notice, and subject to other binding limitations provided for under applicable law, the information, documents and data made available on the ECHA website may be reproduced, distributed and/or used, totally or in part, for non-commercial purposes provided that ECHA is acknowledged as the source: "Source: European Chemicals Agency, <http://echa.europa.eu/>". Such acknowledgement must be included in each copy of the material. ECHA permits and encourages organisations and individuals to create links to the ECHA website under the following cumulative conditions: Links can only be made to webpages that provide a link to the Legal Notice page.

<https://echa.europa.eu/web/guest/legal-notice>

Henicosafluoroundecanoic acid

<https://echa.europa.eu/substance-information/-/substanceinfo/100.016.515>

Henicosafluoroundecanoic acid

<https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/86728>

Henicosafluoroundecanoic acid

<https://www.echa.europa.eu/candidate-list-table>

5. PubChem

<https://pubchem.ncbi.nlm.nih.gov>

APPENDIX D



SAMPLING CONSIDERATIONS WHEN ANALYZING FOR PFAS	
Summary of Prohibited and Acceptable Materials	
Prohibited Materials	Acceptable Materials
Field Equipment	
Fluoropolymer tubing, valves and other parts in pumps (Teflon®), low density polyethylene (LDPE), polytetrafluoroethylene (PTFE)	High density polyethylene (HDPE), polyvinyl chloride (PVC), polypropylene, silicone materials, and stainless steel
Fluoropolymer bailers or pump bladders	Disposable Equipment / Dedicated Equipment (no PTFE parts)
Aluminum foil	Thin HDPE sheeting
Blue (chemical) ice*	Ice contained in plastic (polyethylene) bags (double bagged), secured to avoid meltwater from contacting sample containers, overnight shipping
Post-it notes, sharpies, waterproof fieldbook	Ball point pens, Loose paper on aluminum clipboard, non weatherproof fieldbook, pre-printed labels
Glass containers (due to potential loss of analyte through adsorption)	Polypropylene or HDPE sample bottles fitted with an unlined (no PTFE), polypropylene or HDPE screw cap
Decon 90	Alconox and Liquinox soap for decontamination, if needed
Decontamination water from the site	Water used for the decontamination of sampling equipment will be laboratory certified "PFAS-free" water
Field Clothing and Personal Protective Equipment (PPE)	
New clothing or water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex	Well-laundered clothing, defined as clothing that has been washed 6 times or more after purchase, made of synthetic or natural fibers.
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex	Boots made with polyurethane and polyvinyl chloride
No cosmetics, moisturizers, hand cream or other related products as part of personal cleaning/showering routine on the morning of sampling	Sunscreens - Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural"
	Inspect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Inspect repellent, Herbal Armor, BabyGanics
Handling or prepackaged food products	Do not have at sampling location, wash hands well after handling wear powderless nitrile gloves

APPENDIX E



HEAT STRESS

Heat Stress (Hyperthermia)

Heat stress is the body's inability to regulate the core temperature. A worker's susceptibility to heat stress can vary according to his/her physical fitness, degree of acclimation to heat, humidity, age and diet.

1. Prior to site activity, the field team leader may make arrangements for heat stress monitoring (i.e., monitoring heart rate, body temperature, and body water loss) during actual site work if conditions warrant. In addition, the FTL is to ensure that each team member has been acclimatized to the prevailing environmental conditions, that personnel are aware of the signs and symptoms of heat sickness, that they have been adequately trained in first aid procedures, and that there are enough personnel on-site to rotate work assignments and schedule work during hours of reduced temperatures. Personnel should not consume alcoholic or caffeinated beverages but rather drink moderate levels of an electrolyte solution and eat well prior to commencing site work.
2. Although there is no specific test given during a baseline physical that would identify a person's intolerance to heat, some indicators are tobacco or medication use, dietary habits, body weight, and chronic conditions such as high blood pressure or diabetes.
3. *Heat cramps*, caused by profuse perspiration with inadequate fluid intake and salt replacement, most often afflict people in good physical condition who work in high temperature and humidity. Heat cramps usually come on suddenly during vigorous activity. Untreated, heat cramps may progress rapidly to heat exhaustion or heat stroke. First aid treatment: remove victim to a cool place and replace lost fluids with water.
4. Thirst is not an adequate indicator of heat exposure. Drinking fluid by itself does not indicate sufficient water replacement during heat exposure. A general rule, the amount of water administered should replace the amount of water lost, and it should be administered at regular intervals throughout the day. For every half pound of water lost, 8 ounces of water should be ingested. Water should be replaced by drinking 2 – 4 ounce servings during every rest period. A recommended alternative to water is an electrolyte drink split 50/50 with water.

5. *Heat exhaustion* results from salt and water loss along with peripheral pooling of blood. Like heat cramps, heat exhaustion tends to occur in persons in good physical health who are working in high temperatures and humidity. Heat exhaustion may come on suddenly as dizziness and collapse. Untreated, heat exhaustion may progress to heat stroke.
6. *Treatment for heat exhaustion:* Move the victim to a cool environment (e.g. air-conditioned room/car), lay victim down and fan him/her. If the air-conditioning is not available, remove the victim to a shaded area, remove shirt, and fan. If symptoms do not subside within an hour, notify 911 to transport to hospital.
7. *Heat stroke* results from the body's inability to dissipate excess heat. A true medical emergency that requires immediate care, it usually occurs when one ignores the signs of heat exhaustion and continues strenuous activities. Working when the relative humidity exceeds 60% is a particular problem. Workers in the early phase of heat stress may not be coherent of they will be confused, delirious or comatose. Changes in behavior, irritability and combativeness are useful early signs of heat stroke.
8. *Treatment of heat stroke:* Move the victim to a cool, air-conditioned environment. Place victim in a semi-reclined position with head elevated and strip to underclothing. Cool victim as rapidly as possible, applying ice packs to the arms and legs and massaging the neck and torso. Spray victim with tepid water and constantly fan to promote evaporation. Notify 911 to transport to hospital as soon as possible.

TABLE 1

SYMPTOMS OF HEAT STRESS

Heat cramps are caused by heavy sweating with inadequate fluid intake. Symptoms include;

- Muscle cramps
- Cramps in the hands, legs, feet and abdomen

Heat exhaustion occurs when body organs attempt to keep the body cool. Symptoms include;

• Pale, cool moist skin	• Rapid heart rate
• Core temperature elevated 1-2°	• Heavy sweating
• Thirst	• Dizziness
• Anxiety	• Nausea

Heat stroke is the most serious form of heat stress. Immediate action must be taken to cool the body before serious injury and death occur. Symptoms are;

- Red, hot, dry skin
- Lack of perspiration
- Seizures
- Dizziness and confusion
- Strong, rapid pulse
- Core temperature of 104° or above
- Coma

TABLE 2**HEAT STRESS INDICATORS**

Heat stress indicator	When to measure	If Exceeds...	Action
Heart rate (pulse)	Beginning of rest period	110 beats per minute	Shorten next work period by 33%
Oral temperature	Beginning of rest period	99°F (after thermometer is under tongue for 3 minutes)	Shorten next work period by 33%
		100.6°F	Prohibit work in impermeable clothing
Body weight	1. Before workday begins (a.m.) 2. After workday ends (p.m.)		Increase fluid intake

COLD STRESS

Cold stress (Hypothermia)

In hypothermia the core body temperature drops below 95°F. Hypothermia can be attributed to a decrease in heat production, increased heat loss or both.

Prevention

Institute the following steps to prevent overexposure of workers to cold:

1. Maintain body core temperature at 98.6°F or above by encouraging workers to drink warm liquids during breaks (preferably not coffee) and wear several layers of clothing that can keep the body warm even when the clothing is wet.
2. Avoid frostbite by adequately covering hands, feet and other extremities. Clothing such as insulated gloves or mittens, earmuffs and hat liners should be worn. To prevent contact frostbite (from touching metal and cold surfaces below 20°F), workers should wear gloves. Tool handles should be covered with insulating material.
3. Adjust work schedules to provide adequate rest periods. When feasible, rotate personnel and perform work during the warmer hours of the day.
4. Provide heated shelter. Workers should remove their outer layer(s) of clothing while in the shelter to allow sweat to evaporate.
5. In the event that wind barriers are constructed around an intrusive operation (such as drilling), the enclosure must be properly vented to prevent the buildup of toxic or explosive gases or vapors. Care must be taken to keep a heat source away from flammable substances.
6. Using a wind chill chart such as the one in Table 3, obtain the equivalent chill temperature (ECT) based on actual wind speed and temperature. Refer to the ECT when setting up work warm-up schedules, planning appropriate clothing, etc. Workers should use warming shelters at regular intervals at or below an ECT of 20°F. For exposed skin, continuous exposure should not be permitted at or below an ECT of -25°F.

Frostbite

Personnel should be aware of symptoms of frostbite/hypothermia. If the following symptoms are noticed in any worker, he/she should immediately go to a warm shelter.

Condition	Skin Surface	Tissue Under Skin	Skin Color
Frostnip	Soft	Soft	Initially red, then white
Frostbite	Hard	Soft	White and waxy
Freezing	Hard	Hard	Blotchy, white to yellow-gray to gray

1. *Frostnip* is the incipient stage of frostbite, brought about by direct contact with a cold object or exposure of a body part to cool/cold air. Wind chill or cold water also can be major factors. This condition is not serious. Tissue damage is minor and the response to care is good. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostnip.
2. *Treatment of frostnip*: Care for frostnip by warming affected areas. Usually the worker can apply warmth from his/her bare hands, blow warm air on the site, or, if the fingers are involved, hold them in the armpits. During recovery, the worker may complain of tingling or burning sensation, which is normal. If the condition does not respond to this simple care, begin treatment for frostbite.
3. *Frostbite*: The skin and subcutaneous layers become involved. If frostnip goes untreated, it becomes superficial frostbite. This condition is serious. Tissue damage may be serious. The worker must be transported to a medical facility for evaluation. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostbite. The affected area will feel frozen, but only on the surface. The tissue below the surface must still be soft and have normal response to touch. **DO NOT** squeeze or poke the tissue. The condition of the deeper tissues can be determined by gently palpating the affected area. The skin will turn mottled or blotchy. It may also be white and then turn grayish-yellow.
4. *Treatment of frostbite*: When practical, transport victim as soon as possible. Get the worker inside and keep him/her warm. Do not allow any smoking or alcohol consumption. Thaw frozen parts by immersion, re-warming in a 100°F to 106°F water bath. Water temperature will drop rapidly, requiring additional warm water throughout the process. Cover the thawed part with a dry sterile dressing. Do not puncture or drain any blisters.

NOTE: Never listen to myths and folk tales about the care of frostbite. *Never* rub a frostbitten or frozen area. *Never* rub snow on a frostbitten or frozen area. Rubbing the area may cause

serious damage to already injured tissues. Do not attempt to thaw a frozen area if there is any chance it will be re-frozen.

5. *General cooling/Hypothermia:* General cooling of the body is known as systemic hypothermia. This condition is not a common problem unless workers are exposed to cold for prolonged periods of time without any shelter.

Body Temperature	°C	Symptoms
99-96	37-35.5	Intense, uncontrollable shivering
95-91	35.5-32.7	Violent shivering persists. If victim is conscious, he has difficulty speaking.
90-86	32-30	Shivering decreases and is replaced by strong muscular rigidity. Muscle coordination is affected. Erratic or jerkey movements are produced. Thinking is less clear. General comprehension is dulled. There may be total amnesia. The worker is generally still able to maintain the appearance of psychological contact with his surroundings.
85-81	29.4-27.2	Victim becomes irrational, loses contact with his environment, and drifts into a stuporous state. Muscular rigidity continues. Pulse and respirations are slow and the worker may develop cardiac arrhythmias.
80-78	26.6-18.5	Victim becomes unconscious. He does not respond to the spoken word. Most reflexes cease to function. Heartbeat becomes erratic
Below 78	25.5	Cardiac and respiratory centers of the brain fail. Ventricular fibrillation occurs; probably edema and hemorrhage in the lungs; death.

6. *Treatment of hypothermia:* Keep worker dry. Remove any wet clothing and replace with dry clothes, or wrap person in dry blankets. Keep person at rest. Do not allow him/her to move around. Transport the victim to a medical facility as soon as possible.

TABLE 3⁽¹⁾
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED
AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

Estimated wind Speed (in mph)	Actual Temperature Reading (°F)P												
	50	40	30	20	10	0	10	20	30	40	50	60	
	Equivalent Chill Temperature (°F)												
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60	
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68	
10	40	28	15	4	-9	-24	-33	-46	-58	-70	-83	-95	
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112	
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121	
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133	
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140	
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145	
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-146	
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER in < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute				GREAT DANGER may freeze within 30 seconds.				Flesh
	Trench foot and imersion foot may occur at any point on this chart												

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

(1) Reproduced from American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1985-1986, p.01.

APPENDIX F





FIELD ACCIDENT REPORT

This report is to be filled out by the designated Site Safety Officer after EVERY accident.

PROJECT NAME: _____ PROJECT. NO.: _____

Date of Accident: _____ Time: _____ Report By: _____

Type of Accident (Check One):

() Vehicular () Personal () Property

Name of Injured: _____ DOB or Age _____

How Long Employed: _____

Names of Witnesses: _____

Description of Accident: _____

Action Taken: _____

Did the Injured Lose Any Time? _____ How Much (Days/Hrs.)? _____

Was Safety Equipment in Use at the Time of the Accident (Hard Hat, Safety Glasses, Gloves, Safety Shoes, etc.)? _____

(If not, it is the EMPLOYEE'S sole responsibility to process his/her claims through his/her Health and Welfare Fund.)

INDICATE STREET NAMES, DESCRIPTION OF VEHICLES, AND NORTH ARROW



APPENDIX C



SUFFOLK COUNTY FIREMATICS SITE
676 MAPLE STREET, YAPHANK, NEW YORK
SCTM ID: 0200-779.00-01.00-002.000
NYSDEC SITE: 152246

COMMUNITY AIR MONITORING PLAN

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, New York 12233-7016

PREPARED FOR:



Suffolk County Department of Health Services
Office of Pollution Control
15 Horseblock Place
Farmingville, New York 11738

PREPARED BY:



P.W. Grosser Consulting
630 Johnson Ave., Suite 7
Bohemia, NY 11716
Phone: 631-589-6353

PWGC Project Number: SHD2502

JULY 2025

COMMUNITY AIR MONITORING PLAN
SUFFOLK COUNTY FIREMATICS SITE, 676 MAPLE STREET, YAPHANK, NEW YORK

TABLE OF CONTENTS	PAGE
1.0 INTRODUCTION.....	2
1.1. Regulatory Requirements.....	2
2.0 AIR MONITORING.....	3
2.1. Real-Time Monitoring.....	3
2.1.1. Work Area.....	3
2.1.2. Community Air Monitoring Requirements.....	3
3.0 VAPOR EMISSION RESPONSE PLAN	5
4.0 MAJOR VAPOR EMISSION RESPONSE PLAN	6
5.0 VAPOR SUPPRESSION TECHNIQUES	7
6.0 DUST SUPPRESSION TECHNIQUES	8
7.0 DATA QUALITY ASSURANCE.....	9
7.1. Calibration	9
7.2. Operations	9
7.3. Data Review.....	9
8.0 RECORDS AND REPORTING	10

TABLES

Table 1-1	Frequency and Location of Air Monitoring
Table 1-2	Real-Time Air Monitoring Action Levels

APPENDICES

Appendix 1A	NYSDOH Generic CAMP
Appendix 1B	Fugitive Dust and Particulate Monitoring from DER-10 Technical Guidance for Site Investigations and Remediation

1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) provides measures for protection for onsite workers, and the downwind community (i.e., offsite receptors including residences, businesses, and onsite workers not directly involved in the Interim Remedial Measure (IRM) from potential airborne contaminant releases resulting from the non-emergency IRM activities at 676 Maple Street Yaphank, New York.

The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that the work did not spread contamination offsite through the air.

The primary chemicals of potential concern (COPC) to be encountered at the Site are per and poly fluoroalkyl substances (PFAS) related to the historical use of firefighting foam.

1.1. Regulatory Requirements

This CAMP was established in accordance with the following requirements:

- 29 CFR 1910.120(h): This regulation specifies that air shall be monitored to identify and quantify levels of airborne hazardous substances and health hazards, and to determine the appropriate level of protection for workers.
- New York State Department of Health's (NYSDOH) Generic Community Air Monitoring Plan (Appendix 1A): This guidance specifies that a community air-monitoring program shall be implemented to protect the surrounding community and to confirm that the work does not spread contamination off-site through the air.
- New York State Department of Environmental Conservation's (NYSDEC's) Fugitive Dust and Particulate Monitoring from DER-10 Technical Guidance for Site Investigation and Remediation (Appendix 1B) - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites: This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

2.0 AIR MONITORING

The following sections contain information describing the types, frequency and location of real-time monitoring.

2.1. Real-Time Monitoring

This section addresses the real-time monitoring that will be conducted within the work area, and along the site's downwind perimeter, during all ground intrusive activities, such as drilling and test pit excavation.

2.1.1. Work Area

The following instruments will be used for work area monitoring:

- Photoionization Detector (PID)
- Dust Monitor

Table 1-1 presents a breakdown of each main activity and provides the instrumentation, frequency and location of the real-time monitoring for the site. Table 1-2 lists the Real-Time Air Monitoring Action Levels to be used in all work areas.

2.1.2. Community Air Monitoring Requirements

To establish ambient air background concentrations, air will be monitored at several locations around the site perimeter before investigation activities begin. These points will be monitored periodically in series during the site work.

Fugitive respirable dust will be monitored using a MiniRam Model PDM-3 aerosol monitor or equivalent, which is capable of measuring particulate matter less than 10 micrometers in size (PM-10). Air will be monitored for VOCs with a portable Photovac MicroTip PID or equivalent. All air monitoring data is documented in a site log book by the designated site safety officer (SSO). PWGC's SSO or delegate must ensure that air monitoring instruments are calibrated and maintained in accordance with manufacturer's specifications. All instruments will be zeroed daily and checked for accuracy. A daily log will be kept. If additional monitoring is required, the protocols will be developed and appended to this plan.

Table 1-1 – Frequency and Location of Air Monitoring

ACTIVITY	AIR MONITORING INSTRUMENT	FREQUENCY AND LOCATION
Grading, excavation and soil loading	PID	Continuous in Work Zone (WZ) during intrusive activities or if odors become apparent, screening in the BZ every 30 minutes during non-intrusive activities Every 15 minutes at the perimeter during intrusive activities

ACTIVITY	AIR MONITORING INSTRUMENT	FREQUENCY AND LOCATION
Grading, excavation and soil loading	Particulate (Dust, Mist or Aerosol) Meter	Continuous in Work Zone (WX) during intrusive activities or if odors become apparent, screening in the BZ every 30 minutes during non-intrusive activities Every 15 minutes at the perimeter during intrusive activities

Table 1-2 – Real-Time Air Monitoring Action Levels

AIR MONITORING INSTRUMENT	MONITORING LOCATION	ACTION LEVEL	SITE ACTION	REASON FOR SITE ACTION
PID	Breathing Zone	0-25 ppm, non-transient	None	Exposure below established exposure limits
PID	Breathing Zone	25-100 ppm, non-transient	Don APR	Based on potential exposure to VOCs
PID	Breathing Zone	>100 ppm, non-transient	Don ASR or SCBA, Institute vapor/odor suppression measures, Notify SSO.	Increased exposure to site contaminants, potential for vapor release to public areas
PID	Work Area Perimeter (20-foot radius)	< 5 ppm	None	Exposure below established exposure limits.
PID	Work Area Perimeter (20-foot radius)	> 5 ppm	Stop work and implement vapor release response plan until readings return to acceptable levels, Notify SSO	Increased exposure to site contaminants, potential for vapor release to public areas
Particulate (Dust, Mist or Aerosol) Meter	Work Area Perimeter (20-foot radius)	>100 but < 150 µg/m ³	Institute dust suppression measures, Notify SSO. Work may continue if particulate concentrations remain below 150 µg/m ³	Increased exposure to site contaminants, potential for vapor release to public areas
Particulate (Dust, Mist or Aerosol) Meter	Work Area Perimeter (20-foot radius)	>150 µg/m ³	Don ASR or SCBA, Institute dust suppression measures. Stop work and implement dust suppression techniques until readings return to acceptable levels, Notify SSO.	Increased exposure to site contaminants, potential for vapor release to public areas

3.0 VAPOR EMISSION RESPONSE PLAN

This section is excerpted from the NYSDOH guidance for Community Air Monitoring Plan - Ground Intrusive Activities.

If the ambient air concentration of organic vapors exceeds 5 parts per million (ppm) above background at the perimeter of the work area, activities will be halted and monitoring continued. Vapor suppression measures can also be taken at this time. If the organic vapor level decreases below 5 ppm above background, work activities can resume. If the organic vapor levels are greater than 5 ppm over background but less than 25 ppm over background at the perimeter of the work area, activities can resume provided:

- The organic vapor level 200 feet downwind of the work area or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background.

If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down. When work shutdown occurs, downwind air monitoring as directed by the SSO will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission Response Plan Section (Section 4.0).

4.0 MAJOR VAPOR EMISSION RESPONSE PLAN

If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work area or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted. The area 200 feet downwind will be monitored if WZ organic vapor levels are recorded at the levels and durations explained below.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone).

If efforts to abate the emission source (see Section 5.0) are unsuccessful and if organic vapor levels are approaching 5 ppm above background for more than 30 minutes in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect.

However, the Major Vapor Emission Response Plan shall be immediately placed in effect if organic vapor levels are greater than 10 ppm above background for more than 30 minutes in the 20 Foot Zone.

Upon activation, the following activities will be undertaken:

1. All emergency Response Contacts as listed in the Health and Safety Plan (HASP) will go into effect.
2. The local police authorities will immediately be contacted by the SSO and advised of the situation.
3. Frequent air monitoring will be conducted at 30-minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the SSO.

5.0 VAPOR SUPPRESSION TECHNIQUES

Vapor suppression techniques must be employed when action levels warrant the use of these techniques.

The techniques to be implemented for control of VOCs from stockpiled soil or from the open excavation will include one or more of the following:

- Cover with plastic
- Cover with “clean soil”
- Application of hydro-mulch material or encapsulating foam
- Limit working hours to favorable wind and temperature conditions

6.0 DUST SUPPRESSION TECHNIQUES

Reasonable dust-suppression techniques must be employed during all work that may generate dust, such as drilling, excavation, and placement of clean fill. The following techniques were shown to be effective for controlling the generation and migration of dust during remedial activities:

- Wetting equipment and excavation faces;
- Spraying water on buckets during excavation and dumping;
- Hauling materials in properly covered containers; and,
- Restricting vehicle speeds to 10 mph.

It is imperative that utilizing water for suppressing dust does not create surface runoff.

7.0 DATA QUALITY ASSURANCE

7.1. Calibration

Instrument calibration shall be documented in the designated field logbook. All instruments shall be calibrated in accordance with manufacturer's instructions and specifications before each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

7.2. Operations

All instruments shall be operated in accordance with the manufacturer's specifications. Manufacturers' literature, including an operation manual for each piece of monitoring equipment will be maintained onsite by the SSO for reference.

7.3. Data Review

The Project Manager will interpret all monitoring data based on Table 1-2 and his/her professional judgment. The Project Manager shall review the data with the SSO to evaluate the potential for worker and community exposure, upgrades/downgrades in level of protection, comparison to direct reading instrumentation and changes in the integrated monitoring strategy.

Monitoring and sampling data, along with all sample documentation will be periodically reviewed by the SSO.

8.0 RECORDS AND REPORTING

All readings must be recorded and available for review by personnel from NYSDEC and NYSDOH. Should any of the action levels be exceeded for the duration of 30 minutes in the work zone, the NYSDEC Division of Environmental Remediation (DER) and NYSDOH must be notified immediately (within one business day).

The notification shall include a description of the control measures implemented to prevent further exceedances.

All CAMP data recorded during site activities will be provided weekly during implementation of the IRM.

APPENDIX 1A



Appendix 1A

New York State Department of Health

Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed $150 \text{ mcg}/\text{m}^3$ above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than $150 \text{ mcg}/\text{m}^3$ above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within $150 \text{ mcg}/\text{m}^3$ of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

APPENDIX 1B



Appendix 1B

Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.
2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.
3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM₁₀) with the following minimum performance standards:
 - (a) Objects to be measured: Dust, mists or aerosols;
 - (b) Measurement Ranges: 0.001 to 400 mg/m³ (1 to 400,000 :ug/m³);
 - (c) Precision (2-sigma) at constant temperature: +/- 10 :g/m³ for one second averaging; and +/- 1.5 g/m³ for sixty second averaging;
 - (d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
 - (e) Resolution: 0.1% of reading or 1g/m³, whichever is larger;
 - (f) Particle Size Range of Maximum Response: 0.1-10;
 - (g) Total Number of Data Points in Memory: 10,000;
 - (h) Logged Data: Each data point with average concentration, time/date and data point number
 - (i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
 - (j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
 - (k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
 - (l) Operating Temperature: -10 to 50° C (14 to 122° F);
 - (m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.
4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.
5. The action level will be established at 150 ug/m³ (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m³, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m³ above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m³ continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM₁₀ at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

- (a) Applying water on haul roads;
- (b) Wetting equipment and excavation faces;
- (c) Spraying water on buckets during excavation and dumping;
- (d) Hauling materials in properly tarped or watertight containers;
- (e) Restricting vehicle speeds to 10 mph;
- (f) Covering excavated areas and material after excavation activity ceases; and
- (g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m³ action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.