REVISED PER AND POLYFLUOROALKYL SUBSTANCES (PFAS) SUPPLEMENTAL INVESTIGATION WORKPLAN, PERDUE AGRIBUSINESS LLC ZION CHURCH ROAD FACILITY

for

Perdue AgriBusiness LLC
6906 Zion Church Road
Salisbury, Maryland

Prepared For:

Perdue AgriBusiness LLC
P.O. Box 1537
Salisbury, MD 21802-1537

Prepared By:

Langan Engineering and Environmental Services, LLC
1818 Market Street, Suite 3300
Philadelphia, Pennsylvania 19103

Adam Hackenberg
Senior Project Manager

Jeffrey A. Smith
Senior Associate

July 17, 2026
220210101

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION AND SETTING 3

2.1 SITE SETTING AND OPERATIONS 3
2.1.1 Site Setting 3
2.1.2 AOI Descriptions 4
2.1.3 Facility Water Supply 9
2.1.4 Current Facility Operations 10
2.2 PHYSICAL SETTING 12
2.2.1 Topography 12
2.2.2 Geology and Hydrogeology 13
2.2.3 Surface Water Hydrology 16

3.0 SCREENING LEVELS 17

3.1 MDE GUIDANCE AND USEPA REGIONAL SCREENING LEVELS (RSLS) 18
3.2 USEPA MCLS FOR PUBLIC DRINKING WATER 19
3.3 SITE-SPECIFIC SOIL-TO-GROUNDWATER SCREENING LEVELS 19
3.4 PFAS BACKGROUND LEVELS 20

4.0 WORKING CONCEPTUAL SITE MODEL 21

4.1 PRIMARY PFAS AREA OF INTEREST – FORMER AFFF FIRE SUPPRESSION SYSTEM (AOI-1) 21
4.2 SECONDARY PFAS AREAS OF INTEREST 22
4.3 PFAS DISTRIBUTION AND POTENTIAL MIGRATION PATHWAYS IN GROUNDWATER 23

5.0 SAMPLING AND ANALYSIS PLAN 28

5.1 DECONTAMINATION 30
5.2 SUBSURFACE UTILITY CLEARANCE 32
5.3 GROUNDWATER GRAB SAMPLE COLLECTION AND ANALYSIS 32
5.3.1 On-Site Supplemental Groundwater Grab Investigation 34
5.3.2 Off-Site Groundwater Grab Investigation 35
5.4 SOIL SAMPLE COLLECTION AND ANALYSIS 36
5.4.1 On-Site Supplemental Soil Investigation 37

5.4.2 Off-Site Soil Investigation 38
5.5 Monitoring Well Installation and Development 39
5.5.1 On-Site Supplemental Monitoring Well Installations 41
5.5.2 Off-Site Monitoring Well Installations 41
5.6 Off-Site Stream Gauge and Piezometer Installations 42
5.7 Location/Elevation Survey 42
5.8 Synoptic Water Level Gauging 43
5.9 Surface Water Sample Collection and Analysis 43
5.10 Sediment Collection and Analysis 44
5.11 Groundwater Sample Collection and Analysis 45
5.12 Pneumatic Slug Testing 46
5.13 Waste Containerization and Disposal 47
5.14 Data Validation and Interpretation 47

6.0 QUALITY ASSURANCE PROJECT PLAN 49

7.0 REPORTING 49

8.0 IMPLEMENTATION SCHEDULE 50

9.0 REFERENCES 51

LIST OF TABLES

Table 1a PFAS Compounds and Generic Screening Levels for Soil and Soil to Groundwater
Table 1b PFAS Compounds and Screening Levels for Potable Water and Groundwater
Table 2 Master Sampling and Analysis Plan
Table 3a Groundwater Sampling and Analytical Plan – On-Site
Table 3b Groundwater Sampling and Analytical Plan – Off-Site
Table 4a Soil Sampling and Analytical Plan – On-Site
Table 4b Soil Sampling and Analytical Plan – Off-Site
Table 5 Surface Water and Sediment Sampling Plan
Table 6 Well Installation Plan
Table 7 Method Bottleware Requirements

LIST OF FIGURES

Figure 1 Site Location Map
Figure 2 Site Plan Overview
Figure 3 PFAS Areas of Interest
Figure 4 Proposed On-and Near-Site Supplemental Groundwater Grab, Surface Water, and Sediment Sample Locations
Figure 5 Proposed On-Site Supplemental Soil Locations
Figure 6 Proposed On-Site Supplemental Monitoring Well Locations
Figure 7a Proposed Off-Site Soil Sample Locations – West of Site
Figure 7b Proposed Off-Site Groundwater Grab Sample and Surface Water Investigation Locations – West of Site
Figure 8a Proposed Off-Site Soil Sample Locations – South of Site
Figure 8b Proposed Off-Site Groundwater Grab Sample and Surface Water Investigation Locations – South of Site
Figure 9 Proposed Off-Site Surface Water Investigation Locations – Far West of Site

LIST OF APPENDICES

Appendix A Quality Assurance Project Plan
Appendix B Health and Safety Plan
Appendix C PFAS Investigation Standard Operating Procedures (SOPs)
Appendix D Langan Unified Soil Classification System

1.0 INTRODUCTION

Langan Engineering and Environmental Services, LLC (Langan) has prepared this Per- and Polyfluoroalkyl Substances (PFAS) Supplemental Investigation Workplan (Workplan) on behalf of Perdue AgriBusiness LLC (PAB) for the next phase of PFAS site investigation activities to be performed for the PAB facility located at 6906 Zion Church Road in Salisbury, Wicomico County, Maryland (the "Site" or "Zion Church Road [ZCR] Facility"). A Site Location Map is included as Figure 1, and Figure 2 is a Site Plan Overview.

The purpose of the activities described in this Workplan is to: 1) fill identified data gaps that remain following the initial phases of investigation at the Site, and 2) address comments made by the Maryland Department of the Environment (MDE) in their February 25, 2026 letter responding to Langan's November 13, 2025 PFAS Site Investigation Technical Memorandum (SITM). Data and findings from previous investigations were summarized in the following four deliverables:

- January 21, 2025 Environmental Assessment of PFAS Report (2025 ESA)
- May 28, 2025 Revised/Final PFAS Investigation Workplan (2025 Revised/Final IWP)
- November 13, 2025 PFAS Site Investigation Technical Memorandum (2025 SITM)
- April 30, 2026 PFAS Groundwater Investigation Technical Memorandum (2026 GWITM)
- June 5, 2026 Process Water Assessment Report (2026 PWAR)

Detailed descriptions of the PFAS Areas of Interest (AOIs) were provided in Langan's *Environmental Assessment of PFAS Report* and are summarized herein in Section 1.1.2. Figure 3 indicates the locations of previously identified PFAS AOIs. Langan's 2025 SITM, 2026 GWITM, and 2026 PWAR summarize groundwater, surface water, soil, sediment, and process water investigations that have been performed. Inclusive of and following the investigation activities summarized in Langan's 2025 SITM, 34 borings were advanced to collect 193 groundwater grab samples, 21 conventional monitoring wells have been installed, 9 stream gauges have been installed, 4 surface water samples were collected, 67 borings were advanced to collect 482 soil samples, 3 sediment samples were collected, and 69 process water samples were collected.

The following technical memoranda have been prepared and submitted to MDE to summarize on-site PFAS mitigation measures that have been implemented to date:

- April 30, 2026 Technical Memorandum RE: Summary of the Interim Wastewater PFAS Treatment System
- May 28, 2026 Technical Memorandum RE: Aqueous Film Forming Foam (AFFF) System Decommissioning

The primary objectives of the investigation activities proposed herein are as follows:

- Continue to assess the three-dimensional distribution of PFAS-impacted groundwater including off-site, within the private well testing area that has been approved by MDE.
- Assess the relationship between groundwater and surface water (i.e., Peggy Branch and Middle Neck Branch) in downgradient/downstream areas; use this information to determine where these streams are being fed by groundwater and where they are recharging (draining into) groundwater.
- Further assess vertical and horizontal groundwater flow patterns at the Site and assess horizontal groundwater flow patterns downgradient from the Site, to support a more detailed assessment of potential migration pathways for PFAS-impacted groundwater.
- Assess current PFAS concentrations and water quality conditions downstream from the Site in surface water of Peggy Branch, Middle Neck Branch, and the Wicomico River, including surface water locations previously sampled by MDE.
- Assess and characterize AOI-4 (Wastewater Treatment Facility Impoundments) as a secondary source of PFAS through soil and groundwater sampling
- Further characterize subsurface geology/stratigraphy both on- and off-site and determine how the hydrostratigraphic framework could be influencing the distribution and migration of PFAS-impacted groundwater.
- Determine if PFAS mass is being retained within low permeability (silt and clay) units within and adjacent to the relevant aquifers, and if mass retention processes (if observed) could be mitigating the migration of PFAS-impacted groundwater.
- Assess current PFAS concentrations in sediment in Peggy Branch downstream of the ZCR Site.
- Create a network of monitoring points (monitoring wells and stream gauges) to enable on-going monitoring and evaluation of temporal changes in groundwater flow patterns and PFAS concentrations. This will include the installation of monitoring wells to support future aquifer testing.
- Obtain more precise estimates of aquifer hydraulic properties, as needed to assess groundwater flow velocities at the Site and to evaluate potential remedial alternatives.

- Obtain data to evaluate potential influence of anthropogenic background sources – unrelated to the ZCR Facility – on the occurrence of PFAS in groundwater within the study area.

This Workplan includes proposed additional soil, groundwater, and surface water sampling related primarily to the on-going investigation of PFAS in groundwater at the ZCR Facility (PFAS Area of Interest [AOI] 5).

This Workplan also includes proposed soil, groundwater, surface water and sediment sampling in off-site areas to the north, south and west of the ZCR facility. The resultant data will be used to assess the nature, occurrence, and distribution of PFAS and migration pathways and receptors potentially affected by Site-related PFAS.

Section 2 of this Workplan describes the Site and physical setting including an expanded summary of the local and regional geology/hydrogeology that incorporates recently acquired site-specific information. Section 3 provides an overview of screening levels, where available, for evaluating the obtained PFAS analytical data. Sections 4, 5, 6, 7, and 8 provide the working conceptual site model, sampling and analysis plan, quality assurance project plan, documentation plan, and schedule, respectively. References are provided in Section 9.

2.0 SITE DESCRIPTION AND SETTING

Provided below are descriptions of the Site setting and operations (Section 2.1) and physical setting (Section 2.2).

2.1 Site Setting and Operations

2.1.1 Site Setting

The ZCR Facility includes approximately 294 acres situated in a predominantly rural area east of Salisbury, Maryland at 6906 Zion Church Road. It is bounded to the west by the Salisbury Bypass (US Route 50) with residential properties beyond; to the north by Morris Leonard Road with residential, farm, and wooded/undeveloped properties beyond; to the east by Zion Church Road with residential, farm, mixed-use, and wooded/undeveloped properties beyond; and to the south by the Delmarva Central Railroad with residential and mixed-used properties beyond. A Site Location Map is presented as Figure 1.

The Site, comprised of five lots on four tax parcels, is identified by the Wicomico County Department of Assessments and Taxation as consisting of the following: Lot 1 (Parcel 0490), Lots 2 and 4 (Parcel 0087), Lot 3 (Parcel 0176), and Lot 5 (Parcel 0327). The eastern portion of the Site is zoned I-2 (heavy industrial), and the western portion of the Site is zoned I-1 (light industrial). The eastern portion of the Site includes a grain elevator and grain storage silos, a feed mill, a boiler house, a soybean crush plant and soybean oil extraction plant, two hatcheries, a truck maintenance garage and associated wash bay, a maintenance shop, wastewater treatment facilities, and various support operations. The south-central portion of the Site includes outdoor grain storage silos, a soybean oil refinery, a tanker wash bay, and various support operations. The northern and western portions of the Site include the following operations and features, among others: a former spray irrigation field (AOI-8) and forest (AOI-9), former crop fields, a forest conservation area, a former poultry research farm, a soil stockpile (AOI-2), and a former borrow pit containing dredge spoils from Peggy Branch (AOI-7). Figure 2 is a Site Plan Overview depicting the Site boundaries and features.

2.1.2 AOI Descriptions

Provided below are detailed descriptions of the identified PFAS AOIs (see Figure 3) at the ZCR Facility, updated to reflect more current information.

AOI-1 Former AFFF Fire Suppression System

There was an aqueous film-forming foam (AFFF) fire suppression system associated with the Soybean Oil Extraction Plant at the ZCR Facility. This system provided fire protection related to the use of hexane as a solvent in the soybean oil extraction process. Hexane is a volatile and flammable aliphatic hydrocarbon. AFFF was stored in two aboveground tanks inside Fire Station #3 (aka, the "Foam House"), a 900-gallon tank constructed in 1986 and a 500-gallon tank constructed in 2012 and commissioned for use at the facility in 2014. Most recently (2021 – May 2025), the AFFF fire suppression system was equipped with Ansulite AFC-3B 3% AFFF, which contains short-chain, C-6 fluorochemicals manufactured using a telomer-based process that does not produce perfluorooctane sulfonate (PFOS) or materials that would breakdown to yield perfluorooctanoic acid (PFOA). The system was previously equipped with a variety of older AFFF products (e.g., 3M FC-783F, BFC-3 Platinum, and Ansulite 3% AFC-3A), at least some of which would have contained "long-chain" materials including PFOS and/or PFOA.

There are no known deployments of the AFFF system to suppress a live fire at the facility. However, based on PAB's investigation to date, there have been accidental triggers of the system in the history of the plant. As described in PAB's June 5, 2026 response to MDE regarding AFFF discharges, some of the known discharges resulted in discharge of foam both inside and outside the Soybean Oil Extraction building.

The former AFFF Fire Suppression System was decommissioned and removed from the Site between May and August 2025. The decommissioned AFFF system was replaced by a Synthetic Fluorine Free Foam (SFFF) system that became operational in January 2026. A summary of the AFFF system decommissioning activities was provided to the MDE on May 28, 2026.

Langan's 2025 Supplemental Investigation Technical Memo (SITM) presented PFAS results for numerous soil and groundwater samples collected in and around this AOI.

AOI-2 Stockpiled Soil – Northwest

There is a soil stockpile in the northwestern corner of the subject property. It has a footprint of approximately 20,000 square feet and is estimated to be at least 10 feet high. Based on historical aerial imagery, the stockpile was originally created between 2015 and 2018. According to PAB, it contains excess soil from various construction projects at the ZCR Facility, including some soil that may have come from the construction of the new Soybean Oil Extraction Plant located to the west of the former Extraction Plant. This construction took place near the exterior areas that may have been affected by past discharges from the former AFFF Fire Suppression System. Accordingly, excess soil removed during construction and placed in the soil stockpile could contain AFFF, and therefore PFAS. Langan's 2025 SITM presented PFAS results for soil samples collected from this AOI.

AOI-3 Stockpiled Soil – East-Central

There is another soil stockpile in the east-central portion of the subject property, to the east of the Litter Building and Former Temporary Grain Ground Pile. This soil stockpile has a footprint of less than 700 square feet and is estimated to be at least 5 feet high. Based on historical aerial imagery, this stockpile appears to have been created since 2018. PAB reported that this stockpile contains excess soil from the aforementioned construction near the exterior areas that may have

been affected by past discharges from the former AFFF Fire Suppression System. Accordingly, excess soil removed during construction and placed in this soil stockpile could contain AFFF, and therefore PFAS. Langan's 2025 SITM presented PFAS results for soil samples collected from this AOI.

AOI-4 Wastewater Treatment Facility Impoundments

The wastewater treatment system at the ZCR Facility includes four clay-lined impoundments: an aeration basin, a wastewater basin, an emergency lagoon, and a sewage sludge holding pond. These impoundments are located to the north of the Wastewater Treatment Plant buildings and to the east of the Former Spray Irrigation Field. The aeration basin is an integral component of the wastewater treatment process. The wastewater basin was previously used to hold treated wastewater slated for discharge via spray irrigation. The sewage sludge holding pond is used for temporary storage of excess return activated sludge and sludge that is periodically removed from the sanitary lift station and disposed off-site. The emergency lagoon provides excess temporary storage in case of emergencies but is not part of the routine process. As part of the clean-up of some accidental triggers of the AFFF fire suppression system, AFFF foam was placed in the sewage sludge holding pond and emergency lagoon. A variety of PFAS have been detected in wastewater and sludge samples collected at various stages in the treatment process including in the influent wastewater, Dissolved Air Floatation (DAF) influent and effluent, DAF sludge, water and sludge in the emergency lagoon, sludge from the holding pond, and return activated sludge. For example, a sample of influent wastewater collected in August 2023 identified PFOS at a concentration of 1,500 ng/L, PFOA at a concentration of 33.2 ng/L, and other PFAS. It is possible that some PFAS could have seeped from these clay-lined impoundments into underlying soil and groundwater.

AOI-5 PFAS in Groundwater at the ZCR Facility

PFAS have been detected in groundwater throughout the ZCR Facility in monitoring wells associated with the former spray irrigation operations (MW-1 through MW-6), in multi-level monitoring wells that were installed and sampled for PFAS in July 2024 on the western end of the property (MW-1W through MW-6W), in several of PAB's water supply wells, and in groundwater samples collected by Langan and reported in Langan's 2025 SITM and 2026 GWITM. The highest PFAS concentrations that have been observed in groundwater at the ZCR facility (e.g., PFOS up to 382,000 ng/L) have been detected near AOI-1 (Former AFFF Fire

Suppression System), at the water table, downgradient (to the west) of the Foam House. The PFAS concentrations detected near AOI-1 are at least an order of magnitude higher than the concentrations detected in other areas of the Site including the other identified PFAS AOIs (see Langan's 2025 SITM and 2026 GWITM).

AOI-6 Outfall 001 to Peggy Branch

A variety of PFAS have been detected in samples of treated effluent discharged to Peggy Branch through Outfall 001. The highest concentrations were detected in a sample collected by MDE in August 2023. Results from MDE's August 2023 sampling identified PFOS at a concentration of 694 ng/L and PFOA at a concentration of 40.5 ng/L. Since that time, lower concentrations of PFAS have been detected in samples collected from Outfall 001. Langan initiated monthly sampling of Outfall 001 and analysis of PFAS in November 2024, on behalf of PAB, as requested by MDE. Since June 20, 2025, PAB has been using an interim system to treat wastewater for PFAS prior to discharge to Peggy Branch. This system was summarized in an April 30, 2026 memo regarding PAB's interim PFAS wastewater treatment system. During the April 2026 monthly sampling of Outfall 001, no PFAS were detected in the treated effluent. Langan's 2025 SITM presented PFAS results for surface water and sediment samples collected within Peggy Branch.

AOI-7 Dredge Spoils Deposits

There is a former soil Borrow Pit on the western portion of the subject property that has been used by PAB to emplace dredge spoils from periodic (permitted) dredging of sediment from the on-site portion of Peggy Branch Creek. According to PAB, dredging typically takes place at intervals of four years or more, to remove accumulations of sediment that form downstream of the discharge of treated wastewater effluent (at Outfall 001) and upstream of stormwater Outfall 002, where Peggy Branch passes through a culvert under the Delmarva Central railroad bed. The Former Borrow Pit appears to have been created between 1989 and 1991. The bottom of the pit is currently at least 5 feet below the surrounding ground surface. Apparent dredge spoil deposits are present primarily in the northwestern half of the Former Borrow Pit, while the southeastern half contains standing water, estimated to be less than approximately 1 foot deep. PFAS that have been detected in treated wastewater effluent discharged to Peggy Branch. Langan's 2025 SITM presented PFAS results for sediment (dredge spoils) and surface water (ponded water) from inside the Former Borrow Pit and for groundwater in the area downgradient of the pit. The

dredge spoil and surface/pond water samples contain PFAS (see Langan's 2025 SITM) that are likely attributed to sorption of PFAS from historically discharged wastewater onto the sediment within Peggy Branch.

AOI-8 Former Spray Irrigation Field

Prior to 2024, treated wastewater from the facility's Wastewater Treatment Plant was used, on a seasonal basis, to spray irrigate the farm fields located in the central portion of the Site. It appears that spray irrigation began in this area between 1989 and 1991 based on a review of historical aerial photographs. As noted above, with respect to Outfall 001 to Peggy Branch, a variety of PFAS have been detected in samples of treated effluent from the facility's Wastewater Treatment Plant. A variety of PFAS were also detected in the monitoring wells surrounding the Former Spray Irrigation Field when those wells were sampled by MDE in December 2023, with the highest concentrations detected in MW-3. Results from MDE's December 2023 sampling identified PFOS in MW-3 at a concentration of 1,370 ng/L and PFOA at a concentration of 159 ng/L. Langan's 2025 SITM and 2026 GWITM presented PFAS results for numerous soil and additional groundwater samples that have been collected in and around this AOI.

AOI-9 Former Spray Irrigation Forest

Prior to 2024, treated wastewater from the facility's Wastewater Treatment Plant was used, on a seasonal basis, to spray irrigate a forested area in the northern portion of the subject property. This irrigation system is comprised of 4 separate sections that were operated alternately, with fixed spray irrigation risers and nozzles spaced at regular intervals. It appears that spray irrigation began in this area between 1991 and 1998 based on a review of historical aerial photographs. As noted above, with respect to Outfall 001 to Peggy Branch, a variety of PFAS have been detected in samples of treated effluent from the facility's Wastewater Treatment Plant. A variety of PFAS were also detected in the monitoring wells surrounding the Former Spray Irrigation Forest when those wells were sampled by MDE in December 2023, with the highest concentrations detected in MW-3. Results from MDE's December 2023 sampling identified PFOS in MW-3 at a concentration of 1,370 ng/L and PFOA at a concentration of 159 ng/L. Langan's 2026 GWITM presented PFAS results for numerous additional groundwater samples that have been collected in and around this AOI.

2.1.3 Facility Water Supply

The water supply system for the ZCR Facility currently consists of four active on-site process water wells (Wells 001, 002, 003, 004) screened in the Lower Surficial Aquifer (with well screens between 55 and 100 feet below ground surface [bgs]) and three drinking water wells (Wells 100, 200, and 300) screened in the confined Manokin Aquifer (with well screens from 230 to 250 feet bgs).

Wells 001 and 004 are currently being used as the active process water supply wells for the Facility. Their usage was roughly equal until late 2023, when PAB began using Well 001 as the primary active process water supply well. Well 004 is now used only intermittently during periods of high demand. Wells 002 and 003 were formerly used as back-up wells and to supply firewater but are now offline. Another process water supply well, Well 005, has not been used since at least 2010 and was abandoned in 2024. PAB's process water supply wells have been sampled for PFAS numerous times since July 2023. PFAS have been detected in all five of the process water supply wells. The highest concentrations of PFAS were detected in Well 004 in July 2023, with PFOS, PFHxS, and PFOA reported at concentrations of 360 ng/L, 84 ng/L, and 19 ng/L, respectively. However, Well 004 did not contain detectable levels of PFAS when it was sampled most recently in October 2024. The PFAS concentrations reported in Well 001 have been relatively consistent averaging 29.8 ng/L, 18.6 ng/L, and 6.15 ng/L for PFOS, PFHxS, and PFOA, respectively. The presence of PFAS in the Facility's process water supply has been attributed to groundwater that has been impacted by historical accidental discharges of AFFF from the Facility's Former AFFF Fire Suppression System (AOI-1).

Process water is supplied to, and used within, various operations at the ZCR Facility including the Feed Mill, the Soybean Crush and Oil Extraction Plant, the Oil Refinery and associated Tanker Wash, the hatcheries, and the Truck Fleet Maintenance Garage. The Oil Refinery and associated Tanker Wash is the largest single user of process water, typically making up over 40% of the Facility's process water usage. In October 2024, PAB began adding systems to remove PFAS from certain process water streams, prior to use. PFAS treatment was initiated in November 2024 for the Oil Refinery Wash Bay; in January 2025 for the Oil Refinery and the main boiler (servicing the Feed Mill and Soybean Oil Extraction process), and in October 2025 for the Soybean Crush Plant.

In January 2024, PAB installed Wells 100, 200, and 300, screened in the confined Manokin Aquifer, as a dedicated source for the Facility's potable water supply. These wells became active in December 2025. Wells 100, 200, and 300 were sampled for PFAS several times between February 2024 and January 2026. PFBA, PFOA, and PFOSA have occasionally been detected in all three wells, at low concentrations below the United States Environmental Protection Agency's (EPA's) Maximum Contaminant Levels (MCLs) for regulated public drinking water. 3.1 ng/L of PFBA, 2.27 ng/L of PFOSA, and 0.933 ng/L of PFOA have been detected at Well 100; 2.44 ng/L of PFOSA and 0.845 ng/L of PFOA have been detected at Well 200; and 0.429 ng/L of PFOA has been detected at Well 300. These detections are likely attributable to the use of PTFE thread sealants used on the well pump and/or piping.

2.1.4 Current Facility Operations

Provided below is a summary of current operations at the ZCR Facility. Figure 2 depicts the locations of the key operational areas and features.

Grain Receiving, Storage, and Transfer

Grain is received at the Facility by truck and railcar, which are unloaded into below grade pits and then transferred into grain storage tanks/bins by grain elevators consisting of conveyors and overhead belts. Truck receiving pits are partially enclosed by a roof cover and side walls. Grain dryers are used to control the grain moisture to specifications needed for further processing.

Feed Mill Operation

The Feed Mill receives grain and feed additives that are processed into animal feed through milling, pelleting, and conditioning. Received commodities are either obtained from other operations at the Site or are received via truck. The Feed Mill consists of tanks and bins, dust control systems, and receiving and loadout operations that have overhead cover, limiting exposure to the environment and incorporation in stormwater. Animal fats and liquids are stored in bulk ingredient tanks. Other additives are stored in bags or drums in on-site warehouses. Animal feed products are stored in bulk storage tanks.

Soybean Crush and Oil Extraction Plant

The Soybean Crush and Soybean Oil Extraction Plant receive soybeans from the on-site grain storage and produces soybean meal and soybean oil. Meal is stored in bulk tanks, and the unfinished (crude) soybean oil is stored in above-ground tanks. Soybean meal can be loaded into

trucks or conveyed to the Feed Mill. The truck loading area is partially enclosed. Crude soybean oil is pumped to the on-site Oil Refinery via above ground piping to be further processed. Steam and hot water used in the soybean oil extraction process are provided by a main boiler that is located adjacent to the Feed Mill (and which provides steam for Feed Mill operations). The Soybean Oil Extraction Plant is equipped with a dedicated cooling tower to support heat management.

Wastewater Treatment Plant (WWTP)

The Wastewater Treatment Plant receives and treats process wastewater from manufacturing activities on-site. Sanitary waste is also added to the wastewater treatment process. Water treatment chemicals such as polymers and acids/bases are received and stored on-site in closed and monitored containers, and most are stored indoors as space allows. WWTP operations include an interim wastewater PFAS treatment system, which became operational on June 20, 2025. Langan provided a summary of this system to MDE in a technical memorandum dated April 30, 2026. The results of monthly system performance monitoring are also being provided to MDE on a regular basis.

Oil Refinery

The Oil Refinery processes crude soybean oil into an edible product. Crude soybean oil is received by pipeline from the Soybean Oil Extraction Plant, or via truck and rail shipments. Other oilseed oils may be received via railcar or truck for processing at the Refinery. Stormwater is protected by containment systems, and stormwater retention areas and containments are monitored regularly for oil. Containment water is initially treated with an oil-water separator in the refinery and then processed via the on-site Wastewater Treatment Plant. Attached to the western side of the Oil Refinery is an enclosed tanker wash bay that is used for cleaning and sanitizing oil tankers. Tanker wash water is conveyed to, and treated by, the on-site Wastewater Treatment Plant. An oil tanker staging area for temporary parking of loaded oil trucks is provided at the Site. The Oil Refinery is equipped with a dedicated boiler room to provide hot water and steam that are used in the refining process, and a dedicated cooling tower to support heat management.

Hatcheries

There are two hatcheries (#2 and #3) on-site that receive fertilized eggs for incubation and hatching. Eggs are received, and hatched chicks are shipped by truck. Chemicals used in the hatchery are stored indoors. Hatchery organic solid and semi-solid wastes are loaded into trucks and shipped to non-PAB facilities that may re-use or otherwise conduct permitted disposal of the

material. Tractor trailer trucks that are customized for transport of chicks are washed and rinsed in the loading bay of each hatchery. The truck wash water and other hatchery-generated wastewater are pumped through underground wastewater lines to the on-site WWTP.

Truck Fleet Maintenance Garage

The Truck Fleet Garage has an enclosed wash bay, a fueling station, and a truck and trailer maintenance shop. Trucks awaiting maintenance park at this facility, and parts are stored indoors and outside. Diesel fuel is stored according to the Spill Prevention, Control, and Countermeasures (SPCC) Plan for the Site, and secondary containment structures are provided. Fuel and other chemicals are received via delivery trucks. For the fueling station and maintenance shop, used fluids are collected and shipped out to a non-PAB facility via truck. For the wash bay, wash water is collected by a garage drain in the wash bay and drip-dry water is collected by another connected drain, outside the wash bay to the west. The drains are directed to a lift station that is located to the west of the Truck Fleet Garage, inside the secondary containment for the above ground fuel tank.

Main Boiler Room

The boiler system supplies steam to multiple downstream process areas, including the soybean extraction unit, feed mill pellet conditioning, Hatchery #2, and the Truck Wash Bay. The area also includes internal water-handling systems such as a deaerator, PFAS treatment unit, and condensate return loop.

2.2 Physical Setting

The following sections summarize the physical setting of the Site including topography, geology and hydrogeology, and surface water hydrology.

2.2.1 Topography

The 2019 United States Geological Survey (USGS) 7.5-minute quadrangle topographic map for Salisbury depicts the Site at elevations varying from approximately 40 to 60 feet above mean sea level (amsl). On-site survey points recorded during Langan's investigations in September 2025, and February 2026 note the highest elevation on-site as 60.2 feet amsl (AOI-2, SB-2-2) and the lowest elevation as 39.84 feet amsl (AOI-7, SB-7-2B). Overall, the regional topography is relatively flat, with ground surface elevation varying from approximately 15 to 60 feet amsl, and topography

sloping downward to the west toward the Wicomico River, which at its nearest point is located approximately 3 miles west of the Site.

2.2.2 Geology and Hydrogeology

The geologic and hydrogeologic interpretations presented herein are based on available site-specific data, regional published information, and professional judgment, and are subject to refinement as additional data are obtained.

Physiographic Setting and Soil Types

Wicomico County lies within the Atlantic Coastal Plain physiographic province, which is characterized by stratified sand, silt, and clay deposits thickening from a few feet to several thousand feet from west to east (USGS, 1997). The shallower sediments near the Site consist of unconsolidated marine, estuarian, and fluvial deposits. According to the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) data for Wicomico County, soils at the Site consist primarily of high to moderately well-drained sands and loams with high infiltration rates. The soil that has been encountered at the Site during the PFAS Site Investigation and Site-Wide Groundwater Investigation has included fine to medium moderately well-drained sands and silty sands with clay lenses also encountered throughout the Site.

Geology and Hydrogeology

The following summary of regional geology and hydrogeology was derived mainly from regional water resource evaluations by the USGS (1997 and 2001). The regional hydrogeological framework near the City of Salisbury consists of the unconfined Surficial Aquifer (combined Beaverdam Sand and Pensauken Formation; also known as the Salisbury Aquifer or Columbia Aquifer) and the confined Manokin Formation (Aquifer) located below it. Both the Surficial and the Manokin Aquifers are underlain and separated by confining units.

The Surficial (Columbia) Aquifer directly underlies the Salisbury area including the Site. The Surficial Aquifer includes the Beaverdam Sand (fine-coarse sand) and the Pensauken Formation (gravelly sand). Below the Surficial Aquifer is a clay confining bed, the Upper Chesapeake Confining Unit, which is on average approximately 25 feet thick. Beneath the Upper Chesapeake

Confining Unit is the Manokin Aquifer, which is comprised of clayey/silty and medium- to coarse-grained sand (USGS, 1997). Beneath the Manokin Aquifer is the St. Marys Formation, consisting of clayey silt, silty clay, and very fine sand. The St. Marys Formation is considered the base of the local hydrogeological system for the purpose of this Workplan.

Data from Langan's Site-Wide Groundwater Investigation indicate that, within the Surficial Aquifer, there are two distinct but hydraulically connected aquifers. These are referred to herein as the 'Upper Surficial Aquifer' and the 'Lower Surficial Aquifer'. The Upper Surficial Aquifer appears to correspond with the Beaverdam Sand. Based on soil cores obtained and logged by Langan, the Upper Surficial Aquifer is approximately 60 feet thick and is primarily comprised of interbedded sand (of various grain sizes) with lenses of coarser- and finer-grained deposits. It includes a shallow, discontinuous clayey layer that has been consistently observed by Langan and others throughout the Site. This unit is comprised of gray and tan clay and clayey sand that has been observed at depths up to at least 16 feet below ground surface (bgs) with a thickness varying from 1 to 10 feet. The Lower Surficial Aquifer appears to correspond with the Pensauken Formation. It is approximately 35 feet thick and consists of fine to coarse sand with some gravel. Local private water supply wells, including some of PAB's groundwater supply wells, are commonly screened at depths corresponding with the Lower Surficial Aquifer. At some locations, primarily on the western side of the Site, a gray clay layer has been observed between the Upper and Lower Surficial Aquifers. This intervening clay layer has been observed by Langan between 50 and 75 feet bgs, with a thickness varying from 1 to 10 feet. It was also observed during the drilling of New Columbia Test Well 7 (a water supply test well as shown in Figure 4) located on the southern edge of the Former Spray Irrigation Field. The clay layer between the Upper and Surficial Aquifer is referred to herein as the 'Dividing Clay'.

The Upper Chesapeake Confining Unit, which divides the entire Surficial Aquifer from the deeper Manokin Aquifer, has been observed, both by Langan and PAB's water well drilling subcontractors, at numerous locations throughout the Site. This confining unit has been described as a stiff gray clay. Langan observed the top of the Upper Chesapeake Confining Unit at depths between 96 and 99 feet bgs while drilling and installing monitoring wells MW-7-LS, MS-15-LS, MW-16-LS, MW-17-LS, and MW-18-LS on the western side of the Site (see locations on Figure 4). The top of the Upper Chesapeake Confining Unit has also been observed during drilling and installation of the Facility's water supply wells including the following wells, from

west to east: New Columbia Well 6[1] (105 feet bgs), Test Well 7 (113 feet bgs), and Wells 100, 200, and 300 (115 feet bgs). Based on well logs from on-site water supply Wells 100, 200, and 300 in the Manokin Aquifer, and borehole geophysical data from Well 100, the Upper Chesapeake Confining Unit is approximately 35 feet thick where it has been encountered at the Site.

Also based on the logs for the on-site Manokin Aquifer water supply wells, the Manokin Aquifer is at least 110 feet thick at the Site (noted from 150 to 260 feet bgs in the well logs) and consists of gray sand with some clay, gravel, and wood. The underlying St. Marys Formation has not been encountered during drilling at the Site.

Groundwater Occurrence and Flow

The Site is located within the Upper Wicomico River drainage basin covering an area of about 70 square miles. Shallow groundwater flow is topographically influenced, with shallow groundwater typically originating in areas of topographic highs and flowing toward topographically lower areas, such as rivers, stream valleys, ponds, and wetlands.

As discussed in Langan's 2026 GWITM, the water table has historically been observed at depths varying from approximately 8 to 17 feet bgs on-site; recent site-wide measurements collected in February 2026 indicate water table depths that varied between approximately 8 to 15 feet bgs. Groundwater elevation data obtained during the February 2026 gauging event indicates flow potentials that are in a westerly direction. The highest observed groundwater head elevation in the Upper Surficial Aquifer (35.27 feet amsl) was observed in monitoring well MW-14-US located along Zion Church Road and in the southeast corner of the Site (see Figure 2). The lowest observed Upper Surficial Aquifer head elevation (31.10 feet amsl) was observed in monitoring well MW-1_W located in the northwest corner of the Site (see Figure 2). Groundwater elevation data for the Lower Surficial Aquifer also indicates flow potentials that are generally in a westerly direction. The highest observed groundwater head elevation in the Lower Surficial Aquifer (35.14 feet amsl) was observed in a former water supply well (Farm 12) located to the northeast of the Site (see Figure 2). The lowest observed groundwater head elevation (31.26 feet amsl) in the Lower Surficial Aquifer was along the western border of the Site in monitoring well MW-18-LS (see Figure 2).

[1] Installed but not yet in service.

Comparisons of groundwater elevations between the Upper and Lower Surficial Aquifer indicate that vertical hydraulic gradients vary across the Site; additional data collection under this Workplan is intended to further evaluate vertical hydraulic gradients.

2.2.3 Surface Water Hydrology

Peggy Branch

Peggy Branch, a tributary of the Wicomico River, has its headwaters on the eastern side. Peggy Branch flows southwesterly across the Site and exits the Site along the southern property boundary. It then flows to the west approximately 2.5 miles where it merges with Middle Neck Branch before emptying into the North Prong of the Wicomico River. The Wicomico River flows to the south and southwest approximately 27 miles where it empties into the Tangier Sound near Deal Island and eventually the Chesapeake Bay. Relative to the on-site portion of Peggy Branch, the creek bed is at least 4 feet higher than nearby observed groundwater elevations (including in monitoring well MW-6-1), indicating that the on-site portion of Peggy Branch is a losing stream that potentially recharges groundwater. Additional data collection under this Workplan is intended to further evaluate the interaction between Peggy Branch and groundwater.

Middle Neck Branch

Middle Neck Branch, another tributary of the Wicomico River, lies approximately 225 feet north of the Site at its nearest point. Flowing west, Middle Neck Branch merges with Peggy Branch approximately 1.75 miles west of the PAB facility before continuing to empty into the North Prong of the Wicomico River. Based on the occurrence and distribution of PFAS in groundwater, Middle Neck Branch is interpreted to be a discharge boundary for groundwater flowing from the Site to the northwest. Additional data collection under this Workplan is intended to further evaluate the interaction between Middle Neck Branch and groundwater.

On-site Stormwater Drainage Areas and Ditches

Stormwater is managed at the ZCR Facility by several retention ponds, underground storm sewers, and drainage swales, with some storm water likely infiltrating on-site, particularly in the undeveloped western portion of the Site (including the Former Spray Irrigation Field) and portions of the Former Spray Irrigation Forest. Otherwise, stormwater leaves the Site through Peggy

Branch (SW Outfall 002), a drainage swale leading to Peggy Branch (SW Outfall 001), a drainage swale leading to Middle Neck Branch (SW Outfall 003), and via overland flow and drainageways on the northcentral and northwestern portion of the Site.

3.0 SCREENING LEVELS

Samples collected under this Workplan will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A[2] and at select locations Total Oxidizable Precursor (TOP) Assay. PFAS analytical data obtained will be evaluated by comparing concentrations to a variety of screening levels including Regional Screening Levels (RSLs) published by the United States Environmental Protection Agency (USEPA), Maximum Contaminant Levels (MCLs) established for six PFAS compounds by the USEPA in public drinking water, site-specific values that were developed using site-specific synthetic precipitation leaching procedure (SPLP) data, and concentrations or concentration ranges that are characteristic of global and regional background PFAS impacts.

The assessment of PFAS risks in sediment is an emerging field of science. No screening levels for PFAS in sediment have been published either by MDE or the United States Environmental Protection Agency (USEPA). As such, at this time, there is no standard or criteria to evaluate PFAS analytical data for sediment. USEPA recognizes that the investigation of sediment (in general, not just for PFAS) is unique and complex, and has issued numerous guidance documents outlining policies and procedures, advocating for an iterative approach, and stressing the importance of considering sediment in the watershed context, including the identification and consideration of other potential contaminant sources.

The screening levels applied herein are not clean-up or remediation goals or standards, nor is a screening level exceedance a determination that there is an established risk to human health or the environment. Rather, the screening levels are used as available preliminary reference values to screen and evaluate the relative concentrations and distribution of PFAS in media sampled as part of the 2025 SI activities and help determine whether further assessment may be warranted.

[2] This is the current version of the analytical method and analyte list used for sampling previously performed by MDE at the ZCR Facility and for monthly sampling of wastewater that is being performed by Perdue at MDE's request.

Tables 1a (soil) and Table 1b (water) summarize USEPA values to be used as screening levels, along with method and laboratory method detection limits (MDLs), limits of quantitation (LOQs), and reporting limits (RLs) for the targeted PFAS analytes. The following sections provide additional details on screening levels and methods that will be used.

3.1 MDE Guidance and USEPA Regional Screening Levels (RSLs)

MDE has published guidance on clean-up standards in a document titled *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater Interim Final Guidance (Update No. 3, October 2018) including Amendment #1 (April 2022)* (hereafter "MDE Standards Guidance"). The standards published in this guidance are based on USEPA's RSLs. MDE's Standards Guidance does not include standards or screening levels for PFAS compounds; however, USEPA has published RSLs for several PFAS compounds[3]. As such, USEPA's most recent PFAS RSLs (November 2024) will be used to screen soil and groundwater analytical data obtained under this Workplan. Additionally, because Federal and Maryland state screening levels for PFAS in surface water have not been established, surface sample analytical results will be assessed without relevant screening values for comparison. The following USEPA RSLs will be used as screening levels under this Workplan, consistent with MDE's Standards Guidance:

- Industrial Soil RSLs corresponding to a cancer risk level of 1E-6 or a hazard quotient (HQ) of 0.1, whichever is lower.
- Resident Soil RSLs corresponding to a cancer risk level of 1E-6 or a HQ of 0.1, whichever is lower.
- Protection of Groundwater RSLs with a dilution attenuation factor (DAF) of 20.
- RSLs for Resident Tap Water, for PFAS compounds that do not have USEPA MCLs (see Section 3.2 below).

Additionally, consistent with MDE's Standards Guidance, analytical reporting limits (RLs) and/or limits of quantitation (LOQ) may be used as the screening levels where they are higher than the published health-based RSLs. As indicated on Table 1a, some of USEPA's soil RSLs are lower than LOQs and/or RLs for the following PFAS compounds: perfluorooctanoic acid (PFOA), perfluorodecanoic acid (PFDA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic

[3] USEPA first published RSLs for one PFAS compound (perfluorobutane sulfonate and its potassium salt) in November 2014, and first published RSLs for other PFAS, including PFOA and PFOS, in May 2022. USEPA has updated its RSLs for PFAS since the initial publications.

acid (PFOS), and hexafluoropropylene oxide dimer acid (HPFO-DA, aka "Gen-X"). As indicated on Table 1b, the Tap Water RSL for PFDA is also lower than the LOQ and RL.

3.2 USEPA MCLs for Public Drinking Water

USEPA's MCLs for PFAS in public drinking water, promulgated in April 2024,[4] will be used as groundwater screening levels for PFAS for which MCLs have been published, as follows:

Compound	MCL
PFOA	4.0 nanograms per liter (ng/L)
PFOS	4.0 ng/L
PFHxS	10 ng/L
PFNA	10 ng/L
HPFO-DA	10 ng/L
Mixtures containing two or more of PFHxS, PFNA, HPFO-DA, and PFBS	1 (unitless) Hazard Index[5]

USEPA's MCLs apply to public drinking water supplies that are regulated under the federal Safe Drinking Water Act (SDWA).[6] They are not applicable or enforceable with respect to private drinking water supplies or to groundwater (in general). Nevertheless, as a conservative measure and in consideration of known potable usage of groundwater, USEPA's PFAS MCLs will be used as groundwater screening levels for data obtained under this Workplan.

3.3 Site-Specific Soil-to-Groundwater Screening Levels

Site-Specific Soil-to-Groundwater Screening Levels for PFAS were developed using paired sample results of bulk soil and leachate analytical results that were obtained during Langan's PFAS Site Investigation (July - September 2025). PFAS analysis of bulk soil samples was performed using the USEPA Method 1633, while leachate analysis was performed by first

[4] USEPA has indicated an intention to amend or rescind certain MCLs in the future. Because of the likely timing of this action, however, it will not affect the proposed Workplan. Moreover, as noted, the MCLs are proposed as a reference to evaluate the data, not as a remediation standard.
[5] Hazard Index calculated using the method described in USEPA's Fact Sheet titled *Understanding the Final National Primary Drinking Water Regulation Hazard Index Maximum Contaminant Level*.
[6] It is noted that EPA has proposed to rescind the MCLs for PFHxS, PFNA, HPFO-DA, and the Hazard Index. This pending change for screening levels will be considered if the proposed change takes effect.

subjecting the soil sample to the Synthetic Precipitation Leaching Procedure (SPLP) using USEPA Method 1312, and then analyzing the resultant leachate for PFAS using USEPA Method 1633. These paired data were used to calculate soil-water partition coefficient (Kd) values for individual PFAS compounds. Those Kd values were then used to calculate a Site-Specific Soil-to-Groundwater Screening Level for each compound that was assessed. These values are summarized in the table below alongside the generic screening levels published by the USEPA, including those based on both drinking water MCLs and tap water RSLs; both adjusted using a DAF of 20 per MDE guidance.

Compound Name	Computed Site-Specific Soil-to-Groundwater Screening Level (DAF = 20) (ug/kg)	USEPA Generic Soil-to-Groundwater RSLs based on USEPA MCLs (DAF=20)[1] (ug/kg)	USEPA Generic Soil-to-Groundwater RSLs based on USEPA Tap Water RSLs (DAF=20)[1] (ug/kg)
PFOS	2.43	0.6	0.0306
PFHxS	2.58	0.084	0.334
PFBS	136	-	6.02
PFDA	0.00450	-	0.0001624
PFNA	5.55	0.84	0.494
PFOA	1.08	1.22	0.000806
PFHxA	222	-	4.78

These Site-Specific Screening Levels will be considered, along with other factors, in evaluating the potential for leaching of PFAS to groundwater, in further delineating the extent of PFAS-impacted soil, and in decision-making regarding soil management and remediation at the Site.

3.4 PFAS Background Levels

The extended period of time during which PFAS have been produced and the many uses and sources of PFAS released to the environment have resulted in low-level concentrations in environmental media worldwide (ITRC 2023). This Workplan will investigate the potential influence of anthropogenic background sources of PFAS in the off-site area through sample lab analyses for potential chemical markers, that may include some of the following: acesulfame (artificial sweetener), sucralose (artificial sweetener), caffeine (stimulant), paraxanthine (caffeine metabolite), carbamazepine (antiepileptic), sulfamethoxazole (human antibiotic), nitrate, and

boron. The analysis of these compounds will be performed by a specialty environmental laboratory (to be determined).

Analytical results for these anthropogenic background markers will be considered alongside PFAS results, hydrogeologic conditions, and other available information to inform the overall interpretation of off-site groundwater data.

4.0 WORKING CONCEPTUAL SITE MODEL

This section provides a working-version of the conceptual site model (CSM) that is guiding Langan's PFAS investigation for the ZCR facility, including the investigation activities that are proposed in this Workplan. This is a dynamic CSM that will be refined and updated as new information is obtained.

4.1 Primary PFAS Area of Interest – Former AFFF Fire Suppression System (AOI-1)

The primary PFAS Area of Interest (AOI) at the ZCR Facility is confirmed to be the former AFFF Fire Suppression System (AOI-1). This system provided fire protection related to the use of hexane as a solvent in the soybean oil extraction process. AFFF was formerly stored in two aboveground tanks inside Fire Station #3 (aka the 'Foam House'), one constructed in 1986 and the other constructed in 2012. PAB has indicated that there have been accidental triggers of the system in the history of the plant. AFFF discharged inside the Former Soybean Oil Extraction Plant would have been contained and directed to the Former Extraction Plant Containment Sump (aka 'Former Skim Pit'), which was connected to the Facility's Wastewater Treatment Plant (WWTP) via underground process sewers. However, AFFF discharged via spray nozzles positioned above the Former Skim Pit and Hexane Tank Enclosure could have fallen on the ground surrounding those structures. The ground surrounding the Foam House, Former Skim Pit, and Hexane Tank Enclosure were historically unpaved. The Former AFFF Fire Suppression System was taken out of service in May 2025 and removed between May and August 2025. It was replaced by a synthetic fluorine free foam (SFFF) fire suppression system, which became operational in January 2026.

Based on the investigation to-date, AFFF from the Former AFFF Fire Suppression System (AOI-1) is believed to be the only original site-related source of regulated PFAS detected in

environmental media (soil, groundwater, surface water, sediment) at the ZCR Facility (2025 PFAS SITM). This conclusion is supported by multiple lines of evidence, as follows:

- PAB has indicated that there have been accidental historical triggers of the former AFFF Fire Suppression System at the Facility (2025 ESA of PFAS Report).
- AFFF contains PFAS (ITRC 2026 Firefighting Foams) including specific PFAS that have been identified in various environmental media sampled at and around the ZCR facility.
- The concentrations of PFAS that have been detected in soil and groundwater within AOI-1 are substantially higher – by several orders of magnitude – than those detected elsewhere at the Facility including in secondary PFAS AOIs that have been identified and investigated (2025 PFAS SITM, 2026 PFAS GWITM).
- PAB has not identified sources unrelated to AFFF that could be materially contributing to the PFAS concentrations observed in environmental media at the ZCR Facility.

4.2 Secondary PFAS Areas of Interest

The secondary PFAS AOIs that have been identified are areas that received residuals from historical discharges of AFFF in AOI-1. AOI-2 and AOI-3 are stockpiles of soil containing material that was excavated from AOI-1 to support the construction of a new Soybean Oil Extraction Plant and Skim Pit. AOI-4 and AOI-6 through AOI-9 are features that are (or were) related to the treatment and/or discharge of wastewater at the Facility. These features were identified as PFAS AOIs because: 1) some of the AFFF that was accidentally discharged in AOI-1 flowed to the Facility's WWTP through underground process sewers, and 2) groundwater that has been used as process water at the Facility (and later discharged) has been impacted by historical AFFF discharges. AOI-4 consists of wastewater impoundments associated with the Facility's WWTP. AOI-6 is Outfall 001 to Peggy Branch, which is the current discharge point for treated wastewater (now with added interim PFAS treatment) from the WWTP. AOI-7 is a Former Borrow Pit that contains dredge spoil deposits from periodic historical maintenance dredging of the on-site portion of Peggy Branch. AOI-8 (Former Spray Irrigation Field) and AOI-9 (Former Spray Irrigation Forest) were previously used (in addition to Outfall 001) to manage treated wastewater from the WWTP. By early 2024, these former spray irrigation areas had been taken out of service. Langan's previous deliverables (2025 ESA of PFAS Report and 2025 PFAS SITM) provided additional details about the history and use of these secondary AOIs and the investigative data that have been obtained for them to date. These areas are considered to be secondary PFAS AOIs because: 1) they contain PFAS that originated from historic discharges of AFFF within AOI-1 (Former AFFF

Fire Suppression System), and 2) they exhibit PFAS concentrations that are lower – by orders of magnitude – than the highest concentrations detected in AOI-1.

4.3 PFAS Distribution and Potential Migration Pathways in Groundwater

Groundwater at the ZCR Facility has been identified as a PFAS AOI on a Facility-wide basis (AOI-5). Langan performed a Site-wide PFAS groundwater investigation from November 2025 through February 2026. The results of that investigation are summarized in Langan's April 30, 2026 PFAS GWITM. Based on investigation findings to date, Langan's understanding of the source(s) of PFAS-impacted groundwater at the Facility and subsurface migration pathways are summarized below.

- **AOI-1 is the Primary Source of Impacted Soil and Groundwater at the ZCR Facility**. Historical accidental discharges from the Former AFFF Fire Suppression System have impacted soil and groundwater within AOI-1.
    - **Soil**: The highest PFAS concentrations in soil (e.g., PFOS up to 39,100 ng/g) were observed above the water table, in the vicinity of the Foam House, from approximately 0 to 4 feet bgs. The highest concentrations in soil are bounded both horizontally and vertically by concentrations that are lower by orders of magnitude. While there are PFAS concentrations in AOI-1 that exceed the soil screening levels, the potential for human contact and further migration to groundwater (i.e., through leaching) has been limited by the installation of concrete and asphalt pavement over the most impacted areas.
    - **Groundwater**: The highest PFAS concentrations in groundwater (e.g., PFOS up to 382,000 ng/L) were observed at and near the water table, downgradient (to the west) of the Foam House. In groundwater, PFAS concentrations decrease with depth. For example, at depths greater than 70 feet bgs, PFOS concentrations in AOI-1 are generally less than 20 ng/L.
- **The Available Data Indicate Westerly Groundwater Flow**. The available groundwater elevation data indicate westerly groundwater flow potentials in the Upper and Lower Surficial Aquifers within the ZCR Facility, although data for the Lower Surficial Aquifer is currently limited to the northwestern portion of the Site. Additional groundwater elevation data are needed to assess groundwater flow potentials downgradient to the west of the ZCR Facility, and to further assess deeper groundwater flow potentials in the Lower Aquifer within the ZCR Facility.

- **There is an area of PFAS-impacted groundwater that extends northwesterly from AOI-1**. This distribution of PFAS in groundwater is consistent with the overall westerly groundwater flow potentials that have been observed. PFAS concentrations decrease to the northwest (downgradient). The depth of the highest concentrations also increases to the northwest (downgradient) but remain within the Surficial Aquifer. These patterns are exemplified by PFOS, which decreases from a maximum of 382,000 ng/L within AOI-1 (GW-1-1 at 14 feet bgs), to a maximum of 27,000 ng/L 650 feet downgradient in AOI-8 (GW-20 at 30 feet bgs), to a maximum of 1,840 ng/L 3,500 feet downgradient (GW-11 at 50 feet bgs) near the western property boundary. While these concentrations cross several AOI, current analysis indicates that AOI-1 is the primary source of concentration. In the noted downgradient samples, substantially lower concentrations have been observed both above and below these observed maximums suggesting minimal influence from AOIs outside of AOI-1. This area of PFAS-impacted groundwater extends beyond PAB's western property boundary as indicated by PFAS analytical data obtained in connection with PAB's testing of private wells in off-site areas. However, off-site groundwater is also susceptible to potential contributions from other anthropogenic background sources because of 1) the dense, mixed regional land use, 2) soils that are well drained, and 3) the prevalent use of relatively shallow, unconfined, private water supply wells. In most cases, precise depths have not been ascertained for private wells that have been tested for PFAS in the area of the Site, so the vertical distribution of PFAS-impacted groundwater off-site warrants further investigation. Additional groundwater investigation and sampling will be performed to further characterize the nature and extent of PFAS in off-site groundwater to the west and south/southwest of the ZCR Facility.
- **There may also be diffuse secondary areas of PFAS impacts in groundwater associated with the Former Spray Irrigation Field and Forest, and the Wastewater Treatment Facility Impoundments**. The available groundwater grab sampling data indicate that, at certain locations within the Former Spray Irrigation Field (AOI-8) and Former Spray Irrigation Forest (AOI-9), there are moderately elevated PFAS concentrations (e.g., PFOS up to 1,030 ng/L) near the water table (e.g., at ~20 feet bgs) that initially decrease with depth. This may indicate that shallow groundwater was impacted by historical permitted discharges of treated wastewater from the Wastewater Treatment Plant in those areas. Any secondarily impacted groundwater is also likely migrating northwesterly. The PFAS concentrations detected in soil within AOI-8 (Former Spray Irrigation Field) were relatively low compared to most of the other AOIs, with only

a small fraction of samples (0.93%) exceeding the Site-Specific Soil-to-Groundwater Screening Levels (see Section 3.0). This indicates that, while shallow groundwater in the Former Spray Irrigation Field may be impacted by historical applications of treated wastewater, it does not appear that soil in the Former Spray Irrigation Field is a significant active source of PFAS-impacted groundwater. Samples will be collected to evaluate soil conditions in AOI-9 (Former Spray Irrigation Forest) under separate Workplan that is being prepared for additional soil investigation sampling.

As the Site's primary means of detaining wastewater prior to treatment and discharge, AOI-4 (Wastewater Treatment Facility Impoundments) warrants further evaluation. Analytical results for groundwater grab samples collected to date within AOI-4 reveal moderate to high concentrations of PFAS compared to results of grab samples taken in areas that surround AOI04. Groundwater sample concentrations to the east of AOI-4 reveal up to 68.9 ug/l at 30 feet bgs (GW-18). Groundwater samples taken to west of AOI-4 reveal higher concentrations up to 27,000 ug/l at 30 feet bgs (GW-20). Current groundwater grab sample data throughout the Site indicates that the higher PFAS concentration detected at GW-20 is likely the result of those highest PFAS concentrations at AOI-1 (former AFFF system area) migrating in a northwesterly direction. Additional groundwater grab and soil sampling will be performed in and around AOI-4.

- **The Other Secondary PFAS AOIs do not Appear to be Major Sources of PFAS to Groundwater**. The PFAS concentrations in shallow groundwater in the other secondary PFAS AOIs are relatively low compared to those observed in AOI-1, AOI-8 and AOI-9. The AOIs where PFAS concentrations are relatively low in nearby shallow groundwater include, but are not necessarily limited to, the following:
    - AOI-2 (Stockpiled Soil – Northwest) (e.g., PFOS not detected at 20 feet bgs in GW-12),
    - AOI-6 (Outfall 001 to Peggy Branch) (e.g., PFOS detected at 70.1 ng/L at approximately 15 feet bgs in MW-6-1), and
    - AOI-7 (Dredge Spoils Deposits) (e.g., PFOS detected at 4.78 ng/L at approximately 15 feet bgs in MW-7-1).
- **Observed PFAS Concentrations Upgradient and Side-gradient of AOI-1 are Relatively Low**. Based on sampling performed to-date, PFAS concentrations are relatively low (i.e., PFOS < 30 ng/L) in groundwater in areas that are upgradient or side-gradient from AOI-1, including the following:

- Grab boring GW-10 (max PFOS = 3.68 ng/L) located in the far northeastern corner of the Facility (side-gradient)
- Grab borings GW-28 (max PFOS = 28.9 ng/L), GW-29 (max PFOS = 6.28 ng/L), GW-30/30A (max PFOS = 3.23 ng/L), GW-31 (max PFOS = 21.2 ng/L) located along the southern Facility Boundary, and
- Water supply Well 001 (max PFOS = 29.8 ng/L), Well 002 (max PFOS = 22.2 ng/L), and Well 003 (max PFOS = 0.89 ng/L) located to the southeast of AO1-1 (upgradient) and screened in the Lower Surficial Aquifer.

- **The Surficial Aquifer appears to be comprised of two distinct formations, based on data from Langan's Site-Wide Groundwater Investigation, which may be influencing groundwater flow and PFAS distribution**. These two distinct formations that have been identified are referred to as the 'Upper Surficial Aquifer' and the 'Lower Surficial Aquifer'. The Upper Surficial Aquifer appears to resemble a regionally mapped formation known as the Beaverdam Sand. The Lower Surficial Aquifer is coarser than the Upper Surficial Aquifer and aligns with the Pensauken Formation.

  A five- to ten-foot-thick clay layer, referred to as the Dividing Clay, has been observed between the Upper and Lower Surficial Aquifers on the western side of the ZCR Facility. The available PFAS groundwater analytical data indicate that the highest PFAS concentrations at the ZCR Facility are in the Upper Surficial Aquifer, above the Dividing Clay (where present). Differences in the hydraulic properties between the Upper and Lower Surficial Aquifers may have influenced the distribution and migration of PFAS in groundwater. Additional data are needed to further characterize the soil stratigraphy both on- and off-site, and to assess the presence/absence and continuity of the clay units that have been observed. Additionally, testing is also needed to characterize and quantify the key hydraulic properties of the Upper and Lower Surficial Aquifers, and to evaluate potential differences between them.

- **There is Little Evidence of PFAS Impacts in the Manokin Aquifer**. The Manokin Aquifer is a deeper aquifer that is occasionally used as a water supply in the Salisbury area. It is separated from the Surficial Aquifer by a regionally mapped confining clay unit known as the 'Upper Chesapeake Confining Unit'. This confining unit is approximately 35 feet thick at the ZCR Facility based on drilling logs prepared during the installation of the Facility's new Manokin supply wells in 2024 (Wells 100, 200, and 300). These wells, which

are screened from 230 to 250 feet bgs, provide potable water to the ZCR Facility. The top of the Upper Chesapeake Confining Unit dips to the east, occurring as shallow as 95 feet bgs on the western side of the Facility (as observed by Langan) and as deep as 115 feet bgs in the southeastern corner of the Facility (as observed by PAB's water supply wells drillers) at the location of the Facility's Manokin water supply wells. To date, testing of the Facility's Manokin wells has not identified PFAS concentrations that are above USEPA's MCLs. Well depths and/or screened intervals are available for approximately half of the private wells that have been sampled by Langan on behalf of PAB. Those depths come from a variety of sources including output from a database of private well data provided by MDE, well identification plaques affixed to the wellhead, and information reported to Langan by property owners on well information questionnaire forms. These sources are not always consistent with respect to well depths and screened intervals and may not be accurate. A small fraction of the wells for which depths are available (40 or ~10%) have reported depths greater than 130 feet bgs, which would potentially place them in the Manokin Aquifer. In a substantial majority of those (36 or 90%), the six PFAS being analyzed as a part of PAB's private well testing program have not been detected or have been detected at concentrations below EPA's MCLs. This Workplan includes additional investigation activities to further assess the depth, character, and continuity of the Upper Chesapeake Confining Unit, which separates the Surficial Aquifer from the Manokin Aquifer, throughout the study area.

- **Middle Neck Branch Appears to be Intercepting the Northwesterly Migration of PFAS-Impacted Groundwater**. As noted, the areas of PFAS-impacted groundwater at the Site appear to have migrated to the west and northwest, toward Middle Neck Branch, based on: 1) the observed northwesterly orientation of the area of PFAS-impacted groundwater at the ZCR Facility, 2) available groundwater elevation data indicating westerly flow potentials, and 3) variance between the occurrence and distribution of PFAS in private wells that were sampled on the north and south sides of Middle Neck Branch (as further explained below).

  To the south of Middle Neck Branch (i.e., between the ZCR Facility and Middle Neck Branch), PFAS have been detected frequently in private water supply wells at concentrations greater than 10 times the groundwater screening levels. In contrast, PFAS have not been detected in most of the private water supply wells that have been sampled to the north of Middle Neck Branch. Furthermore, where detected to the north of Middle Neck Branch, PFAS concentrations are low (compared to those detected to the south),

and are only infrequently above the USEPA's MCLs. These sporadic, low-level detections of PFAS in private water supply wells to the north of Middle Neck Branch do not appear to be related to impacts observed to the south of Middle Neck Branch. Middle Neck Branch is considered to be a gaining stream that is intercepting groundwater and preventing further northwesterly groundwater migration. Additional off-site groundwater and surface water elevation data are warranted to confirm that Middle Neck Branch is a gaining stream and a discharge boundary inhibiting further PFAS migration in groundwater. Additionally, surface water sampling is needed to assess water quality within Middle Neck Branch and to compare to the results of PFAS sampling previously performed by MDE.

- **The On-Site Portion of Peggy Branch is a Losing Stream**. Based on the surface water and groundwater gauging data obtained to-date, the surface water elevation in Peggy Branch is higher than the underlying and adjacent water table elevation. This indicates that the on-site portion of Peggy Branch is a losing stream and therefore is potentially a source of groundwater recharge. Additional off-site groundwater and surface water elevation data are needed to further assess the interaction between Peggy Branch surface water and groundwater downstream from the ZCR Facility, to determine if, and approximately where, Peggy Branch is a gaining stream that does not recharge groundwater. Additionally, surface water sampling is needed to assess water quality within Peggy Branch and to compare to the results of PFAS sampling previously performed by MDE.

5.0 SAMPLING AND ANALYSIS PLAN

Provided below is a summary of the specific scope and objectives of the activities described in this Workplan:

- Collect groundwater grab samples from 11 locations on-site
    - 4 in the northern and western portions of the Site to further assess the vertical and horizontal distribution of PFAS in groundwater
    - 7 in AOI-4 (Wastewater Treatment Facility Impoundments) to evaluate and characterize the PFAS occurrence near the on-site wastewater lagoons

- Collect groundwater grab samples from 29 locations off-site to the west, south and north of the Site to assess the vertical and horizontal distribution of PFAS in off-site groundwater.
- Analyze all groundwater grab samples for PFAS via Method 1633A and select samples for indicators compounds to assess potential influence of anthropogenic background sources – unrelated to the ZCR Facility – on background PFAS concentrations and groundwater water quality.
- Advance up to 8 deep soil borings on-site to evaluate soil/stratigraphic conditions that may influence the distribution and migration of PFAS-impacted groundwater and 7 shallower (e.g. 35-feet bgs) soil borings in AOI-4 (Wastewater Treatment Facility Impoundments) to evaluate and characterize the potential PFAS occurrence and distribution near the on-site wastewater impoundments.
    - Collect and analyze approximately 48 soil samples for PFAS to assess partitioning of PFAS mass between aquifer and aquitard (silt and clay) units. These samples will be used to assess PFAS mass retention processes.
- Advance up to 7 deep soil borings off-site to evaluate soil/stratigraphic conditions that may influence the distribution and migration of PFAS-impacted groundwater.
    - Collect and analyze approximately 12 soil samples for PFAS to assess partitioning of PFAS mass between aquifer and aquitard (silt and clay) units. These samples will be used to assess PFAS mass retention processes.
- Install 25 new permanent monitoring wells on-site, to support future and on-going monitoring of temporal changes in groundwater flow patterns and PFAS concentrations, and to support future aquifer testing.
- Install and sample a to-be-determined number of permanent monitoring wells off-site, to characterize concentrations of PFAS (if and where present) and assess hydrogeologic conditions, including water table depth, potentiometric head distribution, hydraulic gradients and groundwater flow direction in the Upper and Lower Surficial Aquifer off-site.
- Install stream gauges at 10 off-site locations within Peggy Branch and Middle Neck Branch and 2 off-site locations on the Wicomico River; install paired piezometers at 3 of the locations within Peggy Branch.
- Collect sediment samples from 2 locations in Peggy Branch that are downstream of previously collected sediment samples at the ZCR facility.
- Survey the horizontal and vertical positions of newly installed groundwater grab sampling locations, soil boring/sampling locations, monitoring wells, and stream gauges.

- Perform synoptic water level gauging at available gauging points including monitoring wells, water supply wells, and stream gauges to assess hydrogeologic conditions, including water table depth, potentiometric head distribution, hydraulic gradients, groundwater flow direction, and interactions between surface water and groundwater.
- Collect and analyze samples for PFAS from permanently installed on- and off-site monitoring wells, select on-site former on-site water supply wells, and established stream gauge locations to obtain a temporal snapshot of water quality throughout the study area, to compare to previous results (where available), and to support the development of a groundwater monitoring plan.
- Perform hydraulic testing (pneumatic slug tests) at up to 20 monitoring wells to obtain estimates of hydraulic conductivity that will be used to estimate groundwater flow velocity and to assess spatial variation in hydraulic conductivity (including potential differences between the Upper and Lower Surficial Aquifer).

Figures 4, 5, and 6 indicate the locations of the on-site groundwater grab samples, soil borings, and monitoring wells that are proposed in this Workplan. Figures 7a/7b, 8a/8b, and 9 indicate the locations of the off-site soil borings, groundwater grab samples, monitoring wells, and surface water investigation locations that are proposed in this Workplan. Table 2 outlines the sampling and analytical plan for all media. Tables 3a/3b, 4a/4b, and 5 provide details regarding the groundwater, soil, and surface water samples, respectively, that are to be collected and analyzed under this Workplan. Table 7 provides a summary of laboratory analyses that will be performed and associated laboratory methods, bottleware, preservatives, and holding times. Sample collection and analysis will be performed in a manner consistent with this Workplan and the attached Quality Assurance Project Plan (QAPP) (Appendix A). Field sampling activities will be performed in a manner consistent with the attached Health and Safety Plan (HASP) (Appendix B) and Standard Operating Procedures (SOPs) (Appendix C).

The following sections provide additional details regarding the key elements of the Workplan and the scope of sampling and analysis to be performed.

5.1 Decontamination

Drilling and sampling equipment will be decontaminated before the initiation of field sampling activities and between sampling locations in a manner consistent with the SOPs outlined in Appendix C. Water to be used for decontamination and drilling procedures will be obtained from

a source that is not expected to have detectable concentration of PFAS. This may include water that has been treated using one of PAB's on-site process water treatment systems. Prior to the initiation of field sampling activities, each source of decontamination water (directly from the on-site system and from the driller's water tank) will be sampled and analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A. Collection of these QA/QC samples will occur every two weeks during active field operations. Final rinses of sampling devices will be performed using PFAS-free water provided by the analytical laboratory.

Decontamination procedures for sampling are as follows:

- Geoprobe® Screen Point 16 (SP-16) Groundwater Grab Sampling: Upon completion of a sample interval, SP-16 screen samplers will be pressured washed into a 55-gallon drum prior to the three-stage decontamination procedure. The three-step decontamination procedure outlined as follows:
  - In a PFAS-free bucket wash the equipment with a mixture of PFAS-free water and PFAS-free soap (bucket #1).
  - In a second PFAS-free bucket (bucket #2), rinse the equipment with PFAS-free water.
  - A second rinse should be done with PFAS-free water using a third bucket (bucket #3).

  1/8-inch high density polyethylene (HDPE)/silicon tubing used for groundwater sampling and will be discarded between sampling intervals and disposed of in appropriate garbage receptacles on-site.

- Sonic Drilling: Upon reaching determined borehole (or well) depth, the outside of the sonic casing and inside of the tooling will be pressure washed with PFAS-free water. Pressure washing is to be performed in the containment tub at the base of the drill rig.
- Soil Sampling: Soil sampling will be performed using sonic core sample bags; used bags will be discarded and disposed of with soil cuttings in 55-gallon drums. Stainless steel bowls used to homogenize soil samples will be decontaminated using the three-step decontamination procedure outlined above.
- Low-flow Groundwater Sampling: 1/8-inch-high density polyethylene (HDPE)/silicon tubing will be used for groundwater sampling and will be discarded between sampling intervals and disposed of in appropriate garbage receptacles on-site.

- Surface Water Sampling: Where use of a stainless-steel water scoop is needed, the stainless-steel water scoop will be decontaminated using the three-step decontamination procedure outlined above.
- As outlined below in Section 5.12, decontamination wash and rinse water will be contained, collected, and transferred to labeled 55-gallon drums and staged in a central location at the ZCR Facility pending off-Site disposal.

5.2 Subsurface Utility Clearance

Prior to soil boring advancement for both groundwater sampling and/or soil sampling, each boring location will be assessed for potential underground utility conflicts. Langan personnel will adhere to the Langan Underground Utility and Subsurface Clearance Policy regarding subsurface clearing in agricultural and industrial areas. A copy of the Underground Utility and Subsurface Clearance Policy is included in Appendix C. This will include an evaluation of available utility as-built drawings, notification of the local one-call service (Miss Utility 811), and performance of a private subsurface utility survey using geophysical methods. Soil boring locations may be adjusted, based on the utility survey, so that they are more than 3 feet away from identified subsurface utilities.

The first five feet of each soil boring will be advanced using "soft dig" techniques that may include hand-augering, air-knifing, and/or vacuum excavation. The diameter of the soft-dig pilot hole will be at least as large in diameter as the diameter of the largest mechanized drill tooling that will be used.

5.3 Groundwater Grab Sample Collection and Analysis

Groundwater grab sampling will be performed using a Geoprobe® Screen Point 16 (SP-16) Groundwater Sampling System, mounted to a direct push drill rig. A copy of Geoprobe's® SP-16 SOP document is attached in Appendix C. Groundwater grab sample boring locations will be assessed for potential underground utility conflicts and advanced using "soft dig" methods for the first five feet of each boring as described in Sections 5.2.1 and 5.2.2.

Groundwater grab sampling will be performed in a manner consistent with the SOPs outlined in Appendix C. At each sample interval, 1/8-inch-high density polyethylene (HDPE) tubing will be advanced to the SP-16 screen depth and directly connected to a peristaltic pump to initiate well purging and facilitate groundwater sampling. Prior to purging at each target sample interval, an

initial depth to water measurement may be obtained using an electronic water level sounder. The interval will be purged and sampled using a peristaltic pump. New/dedicated pump tubing will be used for each interval. During purging, a calibrated multi-parameter water quality meter will be used to measure field water quality parameters including temperature, pH, specific conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Purging will be performed at a flow rate of 250 mL per minute or less and will continue until at least 3 screen interval volumes have been removed. Reasonable steps should be taken to minimize turbidity prior to sampling, targeting less than 50 nephelometric turbidity units (NTU) and preferably less than 10 NTU. Once purging is complete, samples will be collected directly into the laboratory-provided sample bottles at the same flow rate used for purging. Samples will be labeled and stored on-site between 2-6 °C in a cooler or a secured, dedicated project refrigerator until the laboratory takes possession.

During the collection of groundwater grab samples, one blind duplicate sample will be collected and analyzed for every 20 field samples or fraction thereof. Additionally, equipment blank (EB) samples will be collected and analyzed at a frequency of at least one per 20 field samples per type of sampling device, with a minimum of one per day per type of sampling device. One EB sample will be collected for each type of sampling device at the start of the field program, prior to the initiation of sampling. EB samples will be collected by using a peristaltic pump equipped with new/dedicated tubing to transfer laboratory-provided PFAS free water into laboratory-provided sample bottles.

The groundwater grab samples and associated quality control samples (duplicates and EBs) will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A and, for select locations, TOP Assay. Additional sample volume (at least one additional 250 mL bottle) will be collected for each sample to allow for potential analysis using the TOP Assay. The TOP Assay is intended to assess the presence and type of precursor PFAS in a sample that can be transformed into fully fluorinated perfluoroalkyl acids (PFAAs). When the total concentration of PFAS increases after oxidization, it can be inferred that PFAA precursors were present and were converted by oxidization into detectable PFAAs.

Additionally, select groundwater grab locations and sample intervals will be analyzed for indicator parameters to assist with understanding the potential influence of anthropogenic background sources on background PFAS concentrations and groundwater water quality. The groundwater grab sample locations specified for indicator parameter analysis are identified on Table 2.

Based on field turbidity readings, samples may be centrifuged (to remove suspended sediment in the sample) prior to analysis.

Laboratory analysis will be performed by Pace (formerly Alpha) Analytical in Mansfield, Massachusetts for PFAS (Method 1633A), the TOP Assay, and certain indicator parameters. Other indicator parameters will be analyzed by a specialty analytical laboratory (to be determined).

Wastewater generated during purging and decontamination will be contained, collected and stored in 55-gallon drums. Investigative derived waste (IDW) containerization and disposal are outlined in detail in section 5.12.

Provided below is a more detailed summary of the groundwater grab sampling plan, including sampling objectives and rationale, organized by on- and off-site locations.

5.3.1 On-Site Supplemental Groundwater Grab Investigation

Groundwater grab samples will be collected from 11 on-site boring locations at the ZCR Facility. These samples will be collected to:

- Further characterize the vertical and horizontal distribution of PFAS in groundwater (if and where present).
- Delineate and characterize the PFAS occurrence in groundwater along the northern boundary of the ZCR facility along Morris Leonard Road (if and where present)
- Evaluate and characterize the potential occurrence of PFAS that may be associated with AOI-4 (Wastewater Treatment Facility Impoundments).

The on-site groundwater grab sample locations are depicted on Figure 4. These sample locations were selected to provide evenly distributed horizontal and vertical coverage throughout the off-site study area and to further assess observed variations in PFAS results from the 2026 GWITM. Table 3a summarizes the sampling/analytical plan for each groundwater grab location including boring/sampling method(s), boring depths, sampling depths/intervals, and rationale.

Samples will be collected approximately every 10 feet from the first water-bearing zone (typical samples intervals will be at 20, 30, 40, 50, 70, 80, and 90 feet bgs). Sample collection depths may be adjusted based on observed subsurface conditions (e.g., if the targeted interval intersects

a clay layer and does not yield water). Each boring will be terminated upon tool refusal or upon encountering the Upper Chesapeake Confining Unit, whichever is encountered first.

5.3.2 Off-Site Groundwater Grab Investigation

Groundwater grab samples will be collected from 29 off-site boring locations; 14 to the west of the Site, 12 to the south of the Site, and 3 to the north of the Site. These samples will be collected to:

- Further characterize the horizontal and vertical distribution of PFAS in groundwater (if and where present); and
- Compare observed PFAS distribution patterns to PFAS results from prior testing of nearby private water supply wells.

The off-site groundwater grab sample locations to the west, south and north of the Site are depicted on Figures 7b, 8b and 4, respectively. To date, vertical groundwater PFAS are limited off-site, restricted to the known screen and well depths of private residences as discussed in Section 4.3. As with the on-site SP-16 sampling performed in November 2025 – January 2026, these samples will be used to better understand the vertical and horizontal distribution of PFAS off-site.

These sample locations were selected to provide evenly distributed horizontal and vertical coverage throughout the off-site study area and to further assess observed variations in PFAS results (i.e., from the initial residential sampling) throughout the study area. The selected locations include areas with anomalously higher PFAS drinking water results and areas near or adjacent to commercial properties. Table 3b summarizes the sampling/analytical plan for each groundwater grab sample location including boring/sampling method(s), target boring depths, target sampling depths/intervals, and rationale.

Samples will be collected approximately every 10 feet from the first water-bearing zone (typical samples intervals will be at 20, 30, 40, 50, 70, 80, and 90 feet bgs). Sample collection depths may be adjusted based on observed subsurface conditions (e.g., if the screened interval intersects a clay layer and does not yield water). Each boring will be terminated upon tool refusal or upon encountering the Upper Chesapeake Confining Unit, whichever is encountered first.

Off-site groundwater grab sample locations are anticipated to be installed within: 1) property owned by PAB, 2) Wicomico County-owned Right-of-Ways (ROWs), including roads, streets, cul-de-sacs, and "paper streets", and 3) other County-owned property. Exact locations of

groundwater grab sample locations and the timing of groundwater sample collection are subject to the receipt of necessary permits and approvals from Wicomico County.

5.4 Soil Sample Collection and Analysis

Soil boring/sampling will be performed in a manner consistent with the SOPs outlined in Appendix C. Soil borings will be advanced using a sonic drill rig to the terminal borehole depth, as outlined in Tables 4a/4b. Sonic borings/sampling will be performed using sonic core sample bags. Sonic core barrels will be decontaminated between boring locations using the method described above in Section 5.1. When hand augers are being used to collect samples for laboratory analysis (i.e., shallow samples, within the first five feet of the boring), field sampling personnel will use two hand augers, alternating augers between half-foot intervals to minimize the potential for vertical borehole cross contamination. Hand augers will be decontaminated between each interval using methods described in Section 5.1.

Sonic drilling soil cores will be recovered, and soil conditions will be logged continuously from the ground surface to the terminal depth of each boring. Soil conditions to be observed/recorded will include texture, color, and moisture content. Changes in stratigraphy will be noted, and soil will be classified in accordance with the Unified Soil Classification System (USCS) (Appendix D). A soil boring log will be prepared for each boring noting the date, drilling/sampling method(s), soil descriptions/classifications, depth of first water, field instrument readings, depths of samples collected for laboratory analysis, and other observations as appropriate. Select soil boring locations will be converted to monitoring wells; Table 2 outlines the operations to be completed at each location.

Soil samples will be collected for laboratory analysis at the targeted depth intervals described in Sections 5.4.1 and 5.4.2 below and Table 4a and 4b. Each soil sample will represent an approximate six-inch vertical interval. Sampled soil will be homogenized in the field before being placed in laboratory bottleware, as further described in the applicable SOP (Appendix C). Samples will be analyzed for the method-specific 40 PFAS using USEPA Method 1633A. Sample analysis will be performed by Pace (formerly Alpha) Analytical in Mansfield, Massachusetts.

During the collection of soil samples, one blind duplicate sample will be collected and analyzed for every 20 field samples or fraction thereof. Additionally, equipment blank (EB) samples will be collected and analyzed at a frequency of at least one per 20 field samples per type of sampling

device, with a minimum of one per day per type of sampling device. One EB sample will be collected for each type of sampling device at the start of the field program, prior to the initiation of soil sampling at the Site. EB samples will be collected by pouring laboratory-provided PFAS-free water over/through the decontaminated sampling device and collecting the rinsate in laboratory-provided sample bottles. Duplicate and EB samples will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A.

Soil cuttings generated during drilling will be contained, collected, and stored in 55-gallon drums. IDW containerization and disposal are outlined in detail in Section 5.12.

Provided below is a more detailed summary of the soil sampling plan, including sampling objectives and rationale, organized by on- and off-site locations.

5.4.1 On-Site Supplemental Soil Investigation

Soil samples will be collected from 15 sonic soil boring locations at the ZCR Facility. Samples collected on-site will be used to:

- Characterize site stratigraphy and fill identified geologic/stratigraphic data gaps;
- Assess soil conditions that may influence the distribution and migration of PFAS-impacted groundwater; and
- Evaluate potential PFAS mass retention within low permeability (silt and clay) units located within and adjacent to Surficial Aquifer.
- Evaluate and characterize the potential occurrence of PFAS at AOI-4 (Wastewater Treatment Facility Impoundments)

Although soil sampling has been conducted on-site previously, those efforts primarily focused on characterizing PFAS in shallow soil within the identified PFAS AOIs. In contrast, these sample locations are focused on evaluating the partitioning of PFAS between deeper soil and groundwater and assessing the possibility of PFAS retention in low or impermeable soils. Observations from previous investigations indicate that the Dividing Clay Unit influences both the horizontal and vertical distribution of PFAS within the Surficial Aquifer. Therefore, another objective of the sonic soil borings proposed herein is to further assess the horizontal extent of the Dividing Clay Unit and to characterize its composition, consistency, and continuity. Similarly, because groundwater samples from the Manokin Aquifer indicate minimal PFAS impact, another

objective is to provide data to map out the top of the Chesapeake Confining Unit throughout the study area to better understand its role as a hydraulic barrier.

At each soil boring, discrete soil samples will be collected for laboratory analysis at the approximate depth of the highest recorded groundwater result in both the Upper and Lower Surficial aquifer. Additionally, up to three six-inch soil samples will be collected from the Dividing Clay unit (where encountered) that separates the upper and lower surficial aquifer to evaluate potential retention of PFAS in low permeable media. These samples are anticipated to be collected from the top, middle, and bottom of the Dividing Clay. Finally, a discrete soil sample will be collected from the top of the Upper Chesapeake Confining Unit, if contact with the unit is made. Additional shallow samples (<10 feet bgs) may be collected to support on-going soil delineation of PFAS-impacted AOIs. Soil borings will be terminated upon tool refusal or where the Upper Chesapeake Confining Unit (anticipated to be 80-100 feet bgs) is observed, whichever is encountered first. On-site soil boring locations are depicted on Figure 5. Table 4a summarizes the sampling/analytical plan for each on-site soil boring including associated AOI, boring/sampling method(s), boring depths, and sampling depths/intervals.

Proposed groundwater grab/soil boring locations SB-37 through SB-43 in AOI-4 (Wastewater Treatment Facility Impoundments) will be collected every 2 feet bgs until the water table is encountered (assumed to be about 20 feet bgs); one additional sample will be collected approximately 5 feet below the water table to assess soil below the water table. Collected samples will target depths from 0.0 to 0.5 feet bgs (or first six inches of sampleable soil), 1.5 to 2 feet bgs, and every two feet thereafter (e.g., 3.5 – 4.0 feet bgs, 5.5 – 6.0 feet bgs, etc.). Each soil sample will represent an approximate 6-inch vertical interval. Soil sampled from the targeted interval will be homogenized in the field before being placed in laboratory bottleware, as further described in the applicable SOP (Appendix C). Two sample aliquots will be collected from each specified sampling depth/interval. One aliquot will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A. The other aliquot may be held by the laboratory for potential SPLP extraction and analysis.

5.4.2 Off-Site Soil Investigation

Off-site soil samples will be collected from approximately 2 sonic soil boring locations west of the Site boundary. Samples collected off-site will be used to:

- Characterize site stratigraphy and fill identified geologic/stratigraphic data gaps;
- Assess soil conditions that may influence the distribution and migration of PFAS-impacted groundwater; and
- Evaluate potential PFAS mass retention within low permeability (silt and clay) units located within and adjacent to Surficial Aquifer.

At each soil boring, discrete soil samples will be collected for laboratory analysis at the approximate depth of the highest recorded groundwater result in both the Upper and Lower Surficial aquifer. Additionally, up to three six-inch soil samples will be collected from the Dividing Clay unit (where encountered) that separates the upper and lower surficial aquifer to evaluate potential retention of PFAS in low permeable media. These samples are anticipated to be collected from the top, middle, and bottom of the Dividing Clay. Finally, a discrete soil sample will be collected from the top of the Upper Chesapeake Confining Unit, if contact with the unit is made. The soil borings will be terminated upon tool refusal or where the Upper Chesapeake Confining Unit (anticipated from 70-90 feet bgs) is observed, whichever is encountered first. The off-site soil boring locations to the west and south of the Site are depicted on Figures 7a and 8a, respectively. Table 4b summarizes the sampling/analytical plan for each soil boring including boring/sampling method(s), boring depths, and sampling depths/intervals.

Off-site soil boring locations are anticipated to be installed within 1) property owned by PAB, 2) Wicomico County-owned ROWs, including roads, streets, cul-de-sacs, and "paper streets", and 3) other County-owned property. Exact locations of soil borings and the timing of soil sample collection are subject to the receipt of necessary permits and approvals from Wicomico County.

5.5 Monitoring Well Installation and Development

Monitoring wells will be installed in a manner consistent with the SOPs outlined in Appendix C. Monitoring wells will be installed by an MDE-licensed well driller using a sonic drill rig equipped with an approximate six-inch diameter dual wall core barrel. They will be constructed with 2-inch diameter schedule 40 PVC screens and risers with an annular space of approximately 2-inches between the screen/riser and borehole wall. Each well will be constructed with a 10- to 15-foot length of 0.01-inch slotted PVC well screen, and the annular space opposite the screen will be filled with an appropriately sized filter sand during core barrel removal. The filter sand will be emplaced from the bottom of the borehole to approximately 2 – 3 feet above the top of the well screen. Bentonite grout with no polymer additives will be used to seal the remaining annular

space from the top of the filter sand to the ground surface. The monitoring wells will be completed with either flush-mounted manholes or "stick-up" risers with protective outer steel casings set around the riser that extend 2 – 3 feet above the ground surface. Flush-mounted manholes and steel casings will be secured with a concrete pad at ground surface. Well risers (inner casings) will be equipped with lockable compression-type well-plugs (j-plugs), and outer protective casings will be equipped with steel lids. Steel and concrete bollards will be installed around "stick-up" wells located in high traffic areas to protect them from damage. Additionally, a stainless-steel well identification tag will be affixed to each well, and will be labeled with the well permit number, common name (e.g., MW-1), completion date, and other construction specifications. Table 6 summarizes the planned screen depth and total depth for each well to be installed.

During well installations, soil cores will be recovered, and soil conditions will be logged continuously from the ground surface to the terminal depth of each boring. Soil conditions to be observed/recorded will include texture, color, and moisture content. Changes in stratigraphy will be noted, and soil will be classified in accordance with the Unified Soil Classification System (USCS) (Appendix D). A soil boring log and well construction log will be prepared for each well installation noting the date, drilling/sampling method(s), soil descriptions/classifications, depth of first water, field instrument readings, depths of samples collected for laboratory analysis (if applicable), and other observations as appropriate.

After installation, each well will be developed by the driller using a submersible pump to remove fine sediment and establish water flow into the well. Development will be performed using surge and pump techniques, by moving the pump up and down in the water column during development. Wells will be developed until a clear discharge is achieved, with a minimum of five well volumes of water to be removed.

IDW generated during development will be contained, collected, and stored in 55-gallon drums. IDW containerization and disposal are outlined in detail in section 5.12.

Provided below is a more detailed summary of the monitoring well installation plan, including well location objectives and rationale, organized by on- and off-site locations.

5.5.1 On-Site Supplemental Monitoring Well Installations

Twenty-five permanent Surficial Aquifer monitoring wells will be installed and sampled at the ZCR Facility. These wells will serve the following purpose:

- Further assess vertical and horizontal groundwater flow patterns at the Site to support a more detailed assessment of potential migration pathways for PFAS-impacted groundwater.
- Create a network of monitoring points to enable on-going monitoring and evaluation of temporal changes in groundwater flow patterns and PFAS concentrations. This will include the installation of monitoring wells to support future aquifer testing and to serve as sentinel wells for the vertical migration of PFAS-impacted groundwater in the vicinity of the Facility's deep (Manokin Aquifer) drinking water supply wells.
- Allow for representative site-wide slug testing to obtain more precise estimates of aquifer hydraulic properties, as needed to assess groundwater flow velocities at the Site and to evaluate potential remedial alternatives.
- Establish a network of observations wells that may be used to collect data in connection with potential future aquifer pump tests.

Figure 6 depicts the locations of the proposed on-site wells, while Table 6 outlines proposed well construction details.

5.5.2 Off-Site Monitoring Well Installations

Up to 6 permanent water table monitoring wells will be installed and sampled off-site to:

- Assess horizontal groundwater flow patterns downgradient from the Site, to support a more detailed assessment of potential migration pathways for PFAS-impacted groundwater.
- Create a network of monitoring points (including monitoring wells) to enable on-going monitoring and evaluation of temporal changes in groundwater flow patterns and PFAS concentrations.

Locations and screen depths of the off-site monitoring wells will be determined following review of the proposed groundwater grab sampling results.

5.6 Off-Site Stream Gauge and Piezometer Installations

Surface water stream gauges will be installed at 12 off-site locations to the west of the ZCR Facility. The locations selected include locations sampled previously by MDE (including an upstream background location on the Wicomico River), with a preference for locations that are on, or accessible from, Perdue-owned parcels or public property. Piezometers will also be installed at three off-site locations (GS-PB-1 and GS-PB-2 on PAB-owned property and GS-PB-3 on a Wicomico County-owned ROW) to the south of the ZCR Facility. The off-site surface water investigation locations are depicted on Figure 9.

Stream gauges will be constructed of rebar that will be driven into the stream bed, marked, and surveyed. Piezometers will consist of a small diameter (approximately 1-inch) slotted stainless steel or PVC well installed adjacent to the paired stream gauge on the upland area directly adjacent to the stream channel. At each location, a piezometer consisting of a 5-foot section of screen will be installed to a depth of 2 to 5 feet below the first encountered water. Each piezometer will have an appropriate length of riser pipe. Depth-to-water and elevation data collected from piezometers, compared to adjacent surface water elevation data collected at adjacent stream gauges, will help to determine if the adjacent stream segment is recharging groundwater (i.e., a 'losing' stream) or is being fed by ground (i.e., a 'gaining' stream).

5.7 Location/Elevation Survey

The horizontal and vertical positions of sampling locations, monitoring wells, stream gauges, and piezometers will be surveyed by a licensed surveyor. Horizontal positions will be surveyed with respect to the North American Datum of 1983, and vertical elevations will be surveyed with respect to the North American Datum of 1988. Horizontal positions will be given in longitude and latitude (decimal degrees), and vertical elevations will be given in feet above mean sea level (feet amsl).

For soil borings, the survey will include ground surface elevation. For monitoring wells and piezometers, the survey will include ground surface and the top of the inner well casing/riser (at a point marked or to be marked on the well casing/riser). For stream gauges, the survey will include the elevation of a vertical measurement reference point to be identified and clearly marked.

5.8 Synoptic Water Level Gauging

Following the installation of permanent monitoring wells, stream gauges, and piezometers, a round of synoptic water level gauging will be performed on a site-wide basis, including all known and accessible permanent monitoring wells, water supply wells, stream gauges, and piezometers. Depth to water will be measured to the nearest 0.01 inch from the surveyed reference points using an electronic water level sounder.

The data from this gauging event will be used to further assess the occurrence and movement of groundwater on a site-wide basis (including in off-site areas where possible based on the newly acquired data), and to assess the relationships between groundwater and surface water. This assessment will include the preparation of potentiometric surface maps and the computation of horizontal and vertical hydraulic gradients.

5.9 Surface Water Sample Collection and Analysis

Surface water sample collection will be performed in a manner consistent with the SOPs outlined in Appendix C. Based on field-determined accessibility, the surface water samples will be collected using the direct dip method whereby the technician will allow the bottles to slowly fill, taking care not to create turbulence or stir-up sediment. If conditions are not conducive to direct dip sampling, a telescoping pole sampler, or a disposable bailer will be used to collect surface water samples. Samples will be collected beginning at the most downstream location, and sampling will proceed upstream to avoid disturbing or affecting other locations to be sampled. Following sample collection, a calibrated multi-parameter water quality meter will be used to measure field water quality parameters including temperature, pH, specific conductivity, DO, ORP, and turbidity.

Four surface water samples (WS-6-1 through WS-6-4) will be collected along Peggy Branch on-site. These samples will be collected next to existing stream gauge locations. Proposed on-site surface water sample locations are depicted on Figure 4.

Six surface water samples (WS-PB-1 through WS-PB-6) will be collected along Peggy Branch. Six surface water samples (WS-MNB-1 through WS-MNB-6) will be collected along Middle Neck Branch. Finally, one surface water sample (WS-WR-1) will be collected along the Wicomico River downstream from Peggy Branch and Middle Neck Branch, and one surface water sample (WS-NP-1) will be collected upstream along the Northern Prong of the Wicomico River. These samples

will be collected next to existing or proposed stream gauge locations off-site. Off-site surface water sample locations are depicted in Figure 9. These samples will be collected to assess the concentrations of PFAS (if present) in the waters of Peggy Branch, Middle Neck Branch, and the Wicomico River.

Surface water sampling will be performed during the same mobilization, and at approximately the same time as, the groundwater sampling described in Section 5.11 below.

The surface water samples will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A. Laboratory analysis will be performed by Pace (formerly Alpha) Analytical in Mansfield, Massachusetts. One blind duplicate surface water sample will be collected to evaluate the reproducibility of the analytical results. One equipment blank will be collected from each piece of equipment used to sample surface water, if applicable (i.e., in the event that a bailer or stainless-steel pole sampler is used).

5.10 Sediment Collection and Analysis

Two sediment samples (SE-PB-1 and SE-PB-2) will be collected to assess PFAS concentrations in the sediment of Peggy Branch. The sediment samples will be collected at locations coincident with the surface water gauging stations (GS-PB-1 and GS-PB-2) installed in Peggy Branch. Proposed sediment sample locations are depicted in Figure 4.

Sediment sample collection will be performed in a manner following the SOPs outlined in Appendix C. Based on field-determined accessibility, polycarbonate core tubes will be utilized to collect sediment samples within the first 6-inches of the stream bed. Retained sediment samples will be transferred from the polycarbonate core tube into a decontaminated stainless-steel bowl for homogenization and sample collection. Observations such as creek, sediment color, general lithology, and presence of macroinvertebrates and macrophytes will be recorded for each sample in the sediment and surface water sampling logs. The sediment samples will be collected beginning at the most downstream location, moving upstream to avoid disturbing or affecting other areas to be sampled. The sediment samples will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A. Laboratory analysis will be performed by Pace Analytical in Mansfield, Massachusetts.

During the collection of sediment samples, one blind duplicate sample will be collected and analyzed. Additionally, one EB sample will be collected for each type of sampling device at the start of the field program, prior to the initiation of sediment sampling at the Site. EB samples will be collected by pouring laboratory-provided PFAS-free water over/through the decontaminated sampling device and collecting the rinsate in laboratory-provided sample bottles. Duplicate and EB samples will be analyzed for the method-specific list of 40 PFAS using USEPA Method 1633A.

5.11 Groundwater Sample Collection and Analysis

The newly installed monitoring wells will be sampled for PFAS approximately two weeks after installation to allow time for the wells to equilibrate with the surrounding groundwater, in addition to all accessible established monitoring and out of service potable wells on-site. Groundwater sampling will be performed in a manner consistent with the SOPs outlined in Appendix C, using a modified low-flow purging and sampling method.

Prior to purging, an initial depth to water measurement will be obtained from each well using an electronic water level sounder. The wells will be purged and sampled using a peristaltic pump. New/dedicated HDPE pump tubing will be used for each well. During purging, a multi-parameter water quality meter equipped with a flow-through cell will be used to measure field water quality parameters including temperature, pH, specific conductivity, DO, ORP, and turbidity. Purging will be performed at a flow rate of 250 mL per minute or less and will continue until the purging criteria are met, as indicated in the attached SOP (Appendix C). Reasonable steps should be taken to minimize turbidity, targeting less than 50 nephelometric turbidity units (NTU) and preferably less than 10 NTU.

Once purging is complete, samples will be collected directly into the laboratory-provided sample bottles at the same flow rate used for purging. Samples will be labeled and stored on-site between 2-6°C in a cooler or a secured, dedicated project refrigerator until the laboratory takes possession. Non-dedicated equipment such as water level sounders and water quality meters (and flow-through cells) will be decontaminated as specified in Section 5.1.

During the collection of groundwater samples, one blind duplicate sample will be collected and analyzed for every 20 field samples or fraction thereof. One EB sample will be collected by using a peristaltic pump equipped with new/dedicated tubing to transfer laboratory-provided PFAS free water into laboratory-provided sample bottles. Additionally, EB samples will be collected and

analyzed at a frequency of at least one per 20 field samples per type of sampling device, with a minimum of one per day per type of sampling device. One EB sample will be collected for each type of sampling device at the start of the field program, prior to the initiation of sampling.

Wastewater generated during purging will be contained, collected, and stored in 55-gallon drums. IDW containerization and disposal are outlined in detail in section 5.12.

The groundwater samples and associated quality control samples (EB and duplicate) will be collected for the method-specific list of 40 PFAS using USEPA Method 1633A and for contingent analysis using the TOP Assay. All samples will initially be analyzed for PFAS using Method 1633A. Based on the Method 1633A results, a limited subset of samples (up to approximately 10%) may also be chosen for analysis using the TOP Assay. Additional sample volume (at least one additional 250 mL bottle) will be collected for each sample to allow for potential analysis using the TOP Assay. Additionally, as indicated on Table 2, groundwater samples will be collected at selected wells for the analysis of indicator parameters to assist with understanding the potential influence of anthropogenic background sources on background PFAS concentrations and groundwater water quality. The indicator parameters to be analyzed are described in Section 3.4 and summarized in Table 7. Laboratory analysis will be performed by Pace (formerly Alpha) Analytical in Mansfield, Massachusetts for PFAS (Method 1633A), the TOP Assay, and certain indicator parameters. Other indicator parameters will be analyzed by a specialty analytical laboratory (to be determined).

5.12 Pneumatic Slug Testing

Pneumatic slug testing will be performed in a manner consistent with the SOPs outlined in Appendix C. Table 2 summarizes the anticipated wells to be tested. A pneumatic Hi-K® Slug or similar device will be used in conjunction with a transducer and barometer to record and assess groundwater displacement during testing. Pneumatic slug testing is performed by using air pressure to displace water in a well, as an alternative to pumping or using a solid slug. Pneumatic slug testing is regarded as a preferred method for performing slug tests in high permeability formations, but it cannot be used in wells that are screened across the water table (because such wells would not hold pressure).

Data collected from these tests will be used to obtain estimates of hydraulic conductivity that, in turn, will be used to estimate groundwater flow velocity and to assess spatial variation in

hydraulic conductivity throughout the Site, including potential differences between the Upper and Lower Surficial Aquifer.

Prior to pressurization, the depth-to-water in the well being tested will be manually gauged (with a water level sounder) to the nearest 0.01 inch. A Rugged BaroTROLL Data Logger or similar device will be installed in an undisturbed well to measure and log barometric pressure and temperature to enable computations that will be performed to adjust transducer pressure/level readings for changes in barometric pressure. A pre-calibrated pressure transducer will then be deployed to record groundwater displacement before, during, and after pressurization. This process will be performed two times at each well. The resultant data will be used to calculate an averaged hydraulic conductivity value for each well tested.

5.13 Waste Containerization and Disposal

Investigative derived waste (IDW) generated during drilling and sampling activities including excess soil/cuttings, decontamination water, and well development and purge water, will be contained, collected, and transferred to 55-gallon drums labeled with the drum number, type of IDW, the dates of generation, and the associated sample locations. A daily log of generated IDW will be kept including drum number, type and approximate volume of IDW, date generated, and associated sample locations. Once activities are completed at a boring or sample location, drums will be transported to an on-site staging area to be determined by PAB. Soil cuttings may be transferred from drums to roll-off dumpsters via dumper/telehandler or similar at the staging area. Wastewater will be transferred to a staged frac tank. A log will be kept to record the transfer of IDW from drums roll-off dumpsters and frac tanks, including for each transfer date the identities of the drums transferred the method of transfer, and the types and volumes of waste transferred. Empty drums will be reused for waste containerization if in suitable condition.

Upon completion of activities outlined in this Workplan, waste classification samples will be collected from each IDW container to characterize/profiled the IDW for disposal. IDW will be disposed of at an appropriately licensed off-site facility.

5.14 Data Validation and Interpretation

Data validation will be performed in accordance with the applicable USEPA data quality SOPs for data validation and USEPA's National Functional Guidelines for Organic and Inorganic Data Review. Tier 1 data validation (the equivalent of MDE's Tier III validation and USEPA's Stage 2A

validation) will be performed to evaluate data quality. Langan Tier 2 data validation (the equivalent of USEPA's Stage 3 validation) will be performed as needed on select sample analyses based on laboratory case narrative notes and professional judgment.

Langan Tier 1 data validation is based on completeness and compliance checks of sample-related QC results including:

- Holding times;
- Sample preservation;
- Blank results (method, trip, and field blanks);
- Surrogate recovery compounds and extracted internal standards (as applicable);
- PFAS Isotope Dilution Standards;
- LCS and LCSD recoveries and relative percent difference (RPDs);
- MS and MSD recoveries and RPDs;
- Laboratory duplicate RPDs; and
- Field duplicate RPDs

In addition to the items outlined in Langan Tier 1 data validation, Langan Tier 2 data validation additionally includes:

- Lab QC samples (serial dilution and post-digestion spikes, as applicable);
- Instrument calibration; and
- Interference check standards

A Data Usability Assessment (DUA) will be prepared by the data validator and reviewed by the Quality Assurance Manager (QAM) before issuance. The DUA will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

As described in Section 3, PFAS analytical data obtained under this Workplan will be evaluated by comparing them to a variety of levels and values including Regional Screening Levels (RSLs) published by the United States Environmental Protection Agency (USEPA), Maximum Contaminant Levels (MCLs) established by the USEPA for public drinking water, site-specific values that may be developed using SPLP data, and concentrations or concentration ranges that

are characteristic of global and regional background PFAS impacts. These levels are not being proposed as clean-up or remediation standards, rather they will be used as preliminary reference values to screen and evaluate the data obtained.

6.0 QUALITY ASSURANCE PROJECT PLAN

A Quality Assurance Project Plan (QAPP) is attached to this Workplan as Appendix A.

7.0 REPORTING

Upon receipt, validation, and evaluation of the laboratory analytical data obtained under this Workplan, Langan will prepare a Remedial Investigation (RI) Report to summarize the investigation results and findings, and to synthesize results, findings, and interpretations from the multiple phases of investigation that have been completed at the time the time the Report is issued. RI Report will include the following, at a minimum:

- Laboratory analytical data reports and tabulated laboratory and field analytical data screened against the values indicated in Section 3.0 where applicable;
- Figures depicting the distribution of PFAS in soil, groundwater, and surface water based on the data obtained;
- Groundwater elevation and potentiometric surface maps that will be used to assess and interpret horizontal and vertical groundwater flow on- and off-site;
- Estimates of hydraulic conductivity and groundwater velocity calculated using the obtained slug test data, and
- Hydrostratigraphic cross-sections.

The RI Report will provide a detailed account of Langan's on- and off-Site PFAS field sampling activities. It will include a chronology of PFAS assessment activities at the ZCR Facility since MDE's initial sampling in August 2023, and it will include a summary and compilation of relevant on- and off-Site PFAS investigative data obtained for the Site since that time. It will also include an updated CSM. The RI Report and updated CSM will form the basis of recommendations, as appropriate, to further characterize the nature and extent of PFOA and PFOS at the ZCR Facility to a degree sufficient to 1) assess the need for remedial actions, and 2) identify and evaluate potential short- and long-term remedial actions, if needed. It is expected that remedial action decisions will be based on identifying and mitigating exposure and migration pathways and on

prioritizing areas where PFAS concentrations in soil exceed applicable screening levels by an order of magnitude. It is expected that further characterization of nature and extent of PFOA and PFOS will be performed as an iterative remedial investigation process.

Based on the results of the investigation activities proposed herein and previous sampling data, Langan will also propose an established monitoring well network and integrated, site-wide groundwater monitoring program that will be spatially diverse and represent key locations and depths.

8.0 IMPLEMENTATION SCHEDULE

The anticipated schedule for implementing the activities described in this Workplan is provided below. Following MDE authorization, Langan will initiate off-site access coordination and well permitting activities. Groundwater grab sampling is expected to begin within three to four weeks of MDE authorization and will continue for approximately four to six weeks.

Soil borings and monitoring well installations will commence following completion of groundwater grab sampling and are anticipated to require an additional four to six weeks. A round of groundwater and surface water gauging and sampling will be conducted following completion of the well installations. A survey of groundwater grab points, surface water gauges and piezometers, and newly installed wells will be conducted following the completion of the groundwater grab sampling and well installation phases.

Assuming an expedited review and approval of the Workplan by MDE, and Wicomico County's expedited approval of access, Langan expects to complete field activities between late Summer and early Fall 2026. Data analysis and reporting will follow in Fall 2026, with a comprehensive report anticipated in Winter 2026.

The initiation of field activities is contingent upon the time required to secure necessary access agreements with Wicomico County and obtain MDE approval of this Workplan.

9.0 REFERENCES

American Society for Testing and Materials (ASTM). (2017). Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). Designation D2487-17. West Conshohocken, PA: ASTM International. *Retrieved from https://www.astm.org/d2487-17.html*

Brusseau, Mark L., R. Hunter Anderson, and Bo Guo. (2020). "PFAS concentrations in soils: Background levels versus contaminated sites." Science of the Total Environment 740:140017.

Earth Data Inc. (2017), Groundwater Flow Direction Study, 26 June 2017.

Earth Data Inc. (2021), Results of Spray Irrigation Effluent Analysis, Water Level Contours and Gradient, and Water Quality Analysis of Five Temporary Sampling Wells, January 2021.

Interstate Technology Regulatory Council (ITRC). (2023). Technical/Regulatory Guidance, Per- and Polyfluoroalkyl Substances (PFAS), September 2023.

Interstate Technology Regulatory Council (ITRC). (2026). Firefighting Foams, Per- and Polyfluoroalkyl Substances (PFAS), January 2026.

Johnson, Gwynn R. (2022). "PFAS in soil and groundwater following historical land application of biosolids." Water Research 211:118035.

Langan Engineering and Environmental Services, LLC (Langan). (2025). Environmental Assessment of Per and Polyfluoroalkyl Substances (PFAS) Prepared for Perdue AgriBusiness LLC. January 2025.

Langan Engineering and Environmental Services, LLC (Langan). (2025). December 2024 Groundwater Monitoring Report. Prepared for Perdue AgriBusiness LLC. February 2025.

Langan Engineering and Environmental Services, LLC (Langan). (2025). Per and Polyfluoroalkyl Substances (PFAS) Site Investigation Technical Memorandum. Prepared for Perdue AgriBusiness LLC. November 2025.

Langan Engineering and Environmental Services, LLC (Langan). (2025). Per and Polyfluoroalkyl Substances (PFAS) Groundwater Investigation Technical Memorandum. Prepared for Perdue AgriBusiness LLC. April 2026.

Maryland Department of the Environment (MDE). (2018). State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater, October 2018, Interim Final Guidance (Update No. 3).

Maryland Department of the Environment (MDE). (2020-2022) Summary Report for MDE's PFAS Public Water System Study.

Maryland Department of the Environment (MDE). (2023). Maryland PFAS Action Plan, Prepared for: The Maryland General Assembly, Annapolis, MD, December 2023.

Schaider, Laurel A., Ackerman, Janet M., and Rudel, Ruthann A. (2016). "Septic systems as sources of organic wastewater compounds in domestic drinking water wells in a shallow sand and gravel aquifer." Science of the Total Environment 547:470-481.

United States Environmental Protection Agency (USEPA). (2002). Guidance on Environmental Data Verification and Data Validation, EPA QA/G-8, November 2002.

United States Environmental Protection Agency (USEPA). (1994). Method 1312 Synthetic Precipitation Leaching Procedure, part of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

United States Environmental Protection Agency (USEPA). (2024). Method 1633A: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS. Washington, DC: USEPA Office of Water. EPA 821-R-24-001.

United States Environmental Protection Agency (USEPA). (2017). National Functional Guidelines for Organic and Inorganic Data Review. Superfund Contract Laboratory Program (CLP). Retrieved from *https://www.epa.gov/clp/superfund-clp-national-functional-guidelines-data-review*

United States Environmental Protection Agency (USEPA). National Primary Drinking Water Regulations. Retrieved from *https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations*

United States Environmental Protection Agency (USEPA). Regional Screening Levels (RSLs) - Generic Tables. Retrieved from *https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables*

United States Environmental Protection Agency (USEPA), Region 2. (n.d.). Standard Operating Procedures (SOPs) for Data Validation. USEPA Region 2 Quality Assurance Guidance and SOPs. Retrieved

from *https://www.epa.gov/quality/region-2-quality-assurance-guidance-and-standard-operating-procedures*

United States Environmental Protection Agency (USEPA). (1994). USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994.

United States Environmental Protection Agency (USEPA). (1999). USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999.

United States Geological Survey (USGS) (2019) 7.5-minute quadrangle topographic map for Delmar, MD, DE Quadrangle.

TABLES

Table 1A
PFAS Compounds and Generic Screening Levels for Soil and Soil to Groundwater
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Target Analyte Name	Abbreviation	CAS Number	Family	Carbon Chain Length	USEPA Industrial Soil RSLs (ug/kg)	USEPA Residential Soil RSLs (ug/kg)	USEPA Soil-to-Groundwater RSLs based on USEPA MCLs (DAF=20)[1] (ug/kg)	USEPA Soil-to-Groundwater RSLs based on USEPA Tap Water RSLs (DAF=20)[1] (ug/kg)	EPA Method 1633A Solid MDL (ug/kg)	EPA Method 1633A Solid LOQ Range (ug/kg)	Pace Analytical Soil MDL (ug/kg)	Pace Analytical Soil RL (ug/kg)
Carboxylates												
Perfluorobutanoic acid	PFBA	375-22-4	Carboxylate	4	120000	7800	--	13	0.15	0.64-1.6	0.536	0.8
Perfluoropentanoic acid	PFPeA	2706-90-3	Carboxylate	5	--	--	--	--	0.07	0.32-0.8	0.08	0.4
Perfluorohexanoic acid	PFHxA	307-24-4	Carboxylate	6	41000	3200	--	4.78	0.06	0.16-0.4	0.164	0.2
Perfluoroheptanoic acid	PFHpA	375-85-9	Carboxylate	7	--	--	--	--	0.05	0.16-0.4	0.072	0.2
Perfluorooctanoic acid	PFOA	335-67-1	Carboxylate	8	0.078[ab]	0.019[ab]	1.22	0.000806[ab]	0.07	0.16-0.4	0.044	0.2
Perfluorononanoic acid	PFNA	375-95-1	Carboxylate	9	250	19	0.84	0.494	0.14	0.16-1.3	0.032	0.2
Perfluorodecanoic acid	PFDA	335-76-2	Carboxylate	10	0.16[ab]	0.013[ab]	--	0.0001624[ab]	0.06	0.16-0.4	0.05	0.2
Perfluoroundecanoic acid	PFUnA	2058-94-8	Carboxylate	11	25000	1900	--	89.8	0.12	0.16-0.5	0.088	0.2
Perfluorododecanoic acid	PFDoA	307-55-1	Carboxylate	12	4100	320	--	342	0.06	0.16-0.4	0.1	0.2
Perfluorotridecanoic acid	PFTrDA	72629-94-8	Carboxylate	13	--	--	--	--	0.07	0.16-0.4	0.092	0.2
Perfluorotetradecanoic acid	PFTeDA	376-06-7	Carboxylate	14	82000	6300	--	18780	0.05	0.16-0.4	0.146	0.2
Sulfonates												
Perfluorobutanesulfonic acid	PFBS	375-73-5	Sulfonate	4	25000	1900	--	6.02	0.05	0.16-0.4	0.05	0.2
Perfluoropentansulfonic acid	PFPeS	2706-91-4	Sulfonate	5	--	--	--	--	0.08	0.16-0.4	0.028	0.2
Perfluorohexanesulfonic acid	PFHxS	355-46-4	Sulfonate	6	1600	130	0.084[ab]	0.334	0.08	0.16-0.4	0.05	0.2
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	Sulfonate	7	--	--	--	--	0.07	0.16-0.4	0.034	0.2
Perfluorooctanesulfonic acid	PFOS	1763-23-1	Sulfonate	8	8.2	0.63	0.6	0.0306[ab]	0.07	0.16-0.4	0.104	0.2
Perfluorononanesulfonic acid	PFNS	68259-12-1	Sulfonate	9	--	--	--	--	0.07	0.16-0.4	0.094	0.2
Perfluorodecanesulfonic acid	PFDS	335-77-3	Sulfonate	10	--	--	--	--	0.08	0.16-0.4	0.094	0.2
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	Sulfonate	11	--	--	--	--	0.06	0.16-0.4	0.094	0.2
Fluorotelomer sulfonic acids												
1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	Fluorotelomer sulfonic acids	6	--	--	--	--	0.20	0.64-1.5	0.154	0.8
1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2	Fluorotelomer sulfonic acids	8	--	--	--	--	0.39	0.64-1.5	0.48	0.8
1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4	Fluorotelomer sulfonic acids	10	--	--	--	--	0.31	0.64-1.5	0.236	0.8
Perfluorooctane sulfonamides												
Perfluorooctanesulfonamide	PFOSA	754-91-6	Perfluorooctane sulfonamides	8	--	--	--	--	0.04	0.16-0.4	0.114	0.2
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	Perfluorooctane sulfonamides	8	--	--	--	--	0.07	0.16-0.4	0.06	0.2
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	Perfluorooctane sulfonamides	8	--	--	--	--	0.07	0.16-0.4	0.066	0.2
Perfluorooctane sulfonamidoacetic acids												
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	Perfluorooctane sulfonamidoacetic acids	8	--	--	--	--	0.08	0.16-0.4	0.096	0.2
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	Perfluorooctane sulfonamidoacetic acids	8	--	--	--	--	0.08	0.16-0.4	0.078	0.2
Perfluorooctane sulfonamide ethanols												
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	Perfluorooctane sulfonamide ethanols	8	--	--	--	--	0.36	1.6-4.0	0.25	2
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	Perfluorooctane sulfonamide ethanols	8	--	--	--	--	0.35	1.6-4.0	0.242	2
Per- and Polyfluoroether carboxylic acids												
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	Per- and Polyfluoroether carboxylic acids	3	350	23	0.2[ab]	0.0296[ab]	0.25	0.64-1.6	0.16	0.8
4,8-Dioxa-3*H*-perfluorononanoic acid	ADONA	919005-14-4	Per- and Polyfluoroether carboxylic acids	3	--	--	--	--	0.23	0.64-1.5	0.284	0.8
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	Per- and Polyfluoroether carboxylic acids	4	--	--	--	--	0.07	0.32-0.8	0.036	0.4
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	Per- and Polyfluoroether carboxylic acids	5	--	--	--	--	0.05	0.32-0.8	0.052	0.4
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	Per- and Polyfluoroether carboxylic acids	5	--	--	--	--	0.20	0.32-0.8	0.12	0.4
Ether sulfonic acids												
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic	9Cl-PF3ONS	756426-58-1	Ether sulfonic acids	3	--	--	--	--	0.22	0.64-1.5	0.156	0.8
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic	11Cl-PF3OUdS	763051-92-9	Ether sulfonic acids	3	--	--	--	--	0.18	0.64-1.5	0.396	0.8
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	Ether sulfonic acids	5	--	--	--	--	0.08	0.32-0.7	0.048	0.4
Fluorotelomer carboxylic acids												
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	Fluorotelomer carboxylic acids	3	--	--	--	--	0.23	0.80-5.0	0.346	1
2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid	5:3FTCA	914637-49-3	Fluorotelomer carboxylic acids	3	--	--	--	--	0.86	4-10	1.404	5
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	Fluorotelomer carboxylic acids	3	--	--	--	--	0.87	4-10	1.95	5

Notes
This table includes PFAS tested for by USEPA Method 1633A
-- No Screening Level Listed
USEPA: United States Environmental Protection Agency
RSL: Regional Screening Level
MCL: Maximum Contaminant Level
LOQ: Limit of Quantitation
MDL: Method Detection Limit
RL: Reporting Limit
DAF: Dilution Attenuation Factor
ug/kg: micrograms per kilogram
[1] - Consistent with Maryland Department of the Environment (MDE) Protection of Groundwater Cleanup Standards for Soil, a Dilution/Attenuation Factor of 20 is applied to the USEPA soil-to-groundwater migration RSLs.

a. Value is less than or equal to USEPA Method 1633A Solid LOQ Range
b. Value is less than or equal to Pace Analytical Soil RL

Sources

1 - United States Environmental Protection Agency. (2025). Per- and Polyfluoroalkyl Substances (PFAS); Final PFAS National Primary Drinking Water Regulation.
2 - United States Environmental Protection Agency. (2024). Regional Screening Levels (RSLs), TR=1E-06, THQ=0.1.
3 - United States Environmental Protection Agency. (2024). Method 1633A - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS.
4 - Pace Analytical. (2026).PFAS via USEPA 1633A (SOIL)

Table 1B
PFAS Compounds and Screening Levels for Potable Water and Groundwater
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Target Analyte Name	Abbreviation	CAS Number	Family	Carbon Chain Length	USEPA MCL for Public Drinking Water (ng/l)	USEPA Tap Water Regional Screening Levels (ng/l)	USEPA Method 1633A Aqueous MDL (ng/l)	USEPA Method 1633A Aqueous LOQ Range (ng/l)	Pace Analytical SPLP MDL (ng/l)	Pace Analytical SPLP RL (ng/l)	Preferred Groundwater Screening Levels (ng/l)
Carboxylates											
Perfluorobutanoic acid	PFBA	375-22-4	Carboxylate	4	--	1800	0.79	4-16	4.288	6.4	1800
Perfluoropentanoic acid	PFPeA	2706-90-3	Carboxylate	5	--	--	0.54	2-8	0.64	3.2	--
Perfluorohexanoic acid	PFHxA	307-24-4	Carboxylate	6	--	990	0.46	1-4	1.312	1.6	990
Perfluoroheptanoic acid	PFHpA	375-85-9	Carboxylate	7	--	--	0.37	1-4	0.496	1.6	--
Perfluorooctanoic acid	PFOA	335-67-1	Carboxylate	8	4	0.0027[ab]	0.54	1-4	0.4	1.6	4[c]
Perfluorononanoic acid	PFNA	375-95-1	Carboxylate	9	10	5.9	0.45	1-4	0.256	1.6	10[c]
Perfluorodecanoic acid	PFDA	335-76-2	Carboxylate	10	--	0.004[ab]	0.52	1-4	0.416	1.6	0.004
Perfluoroundecanoic acid	PFUnA	2058-94-8	Carboxylate	11	--	600	0.45	1-4	0.704	1.6	600
Perfluorododecanoic acid	PFDoA	307-55-1	Carboxylate	12	--	100	0.40	1-4	0.8	1.6	100
Perfluorotridecanoic acid	PFTrDA	72629-94-8	Carboxylate	13	--	--	0.46	1-4	0.736	1.6	--
Perfluorotetradecanoic acid	PFTeDA	376-06-7	Carboxylate	14	--	2000	0.49	1-4	1.168	1.6	2000
Sulfonates											
Perfluorobutanesulfonic acid	PFBS	375-73-5	Sulfonate	4	--	600	0.37	1-4	0.512	1.6	600
Perfluoropentansulfonic acid	PFPeS	2706-91-4	Sulfonate	5	--	--	0.50	1-4	0.368	1.6	--
Perfluorohexanesulfonic acid	PFHxS	355-46-4	Sulfonate	6	10	39	0.54	1-4	0.704	1.6	10[c]
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	Sulfonate	7	--	--	0.50	1-4	0.496	1.6	--
Perfluorooctanesulfonic acid	PFOS	1763-23-1	Sulfonate	8	4	0.2[ab]	0.63	1-4	1.232	1.6	4[c]
Perfluorononanesulfonic acid	PFNS	68259-12-1	Sulfonate	9	--	--	0.47	1-4	0.528	1.6	--
Perfluorodecanesulfonic acid	PFDS	335-77-3	Sulfonate	10	--	--	0.60	1-4	0.752	1.6	--
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	Sulfonate	11	--	--	0.60	1-4	0.752	1.6	--
Fluorotelomer sulfonic acids											
1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	Fluorotelomer sulfonic acids	6	--	--	1.69	4-15	1.488	6.4	--
1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4	Fluorotelomer sulfonic acids	10	--	--	2.45	4-15	3.056	6.4	--
1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2	Fluorotelomer sulfonic acids	8	--	--	2.50	4-15	3.84	6.4	--
Perfluorooctane sulfonamides											
Perfluorooctanesulfonamide	PFOSA	754-91-6	Perfluorooctane sulfonamides	8	--	--	0.32	1-4	0.912	1.6	--
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	Perfluorooctane sulfonamides	8	--	--	0.43	1-4	0.464	1.6	--
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	Perfluorooctane sulfonamides	8	--	--	0.45	1-4	0.624	1.6	--
Perfluorooctane sulfonamidoacetic acids											
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	Perfluorooctane sulfonamidoacetic acids	8	--	--	0.68	1-4	0.736	1.6	--
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	Perfluorooctane sulfonamidoacetic acids	8	--	--	0.59	1-4	1.152	1.6	--
Perfluorooctane sulfonamide ethanols											
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	Perfluorooctane sulfonamide ethanols	8	--	--	3.81	10-40	1.696	16	--
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	Perfluorooctane sulfonamide ethanols	8	--	--	4.84	10-40	1.44	16	--
Per- and Polyfluoroether carboxylic acids											
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	Per- and Polyfluoroether carboxylic acids	3	10	1.5[ab]	0.51	2-8	0.944	6.4	10[c]
4,8-Dioxa-3*H*-perfluorononanoic acid	ADONA	919005-14-4	Per- and Polyfluoroether carboxylic acids	3	--	--	0.50	2-8	1.248	6.4	--
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	Per- and Polyfluoroether carboxylic acids	4	--	--	1.46	4-16	0.144	3.2	--
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	Per- and Polyfluoroether carboxylic acids	5	--	--	1.41	4-15	0.832	3.2	--
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	Per- and Polyfluoroether carboxylic acids	5	--	--	0.75	2-7	0.944	3.2	--
Ether sulfonic acids											
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic	9Cl-PF3ONS	756426-58-1	Ether sulfonic acids	3	--	--	1.38	4-15	1.248	6.4	--
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic	11Cl-PF3OUdS	763051-92-9	Ether sulfonic acids	3	--	--	1.67	4-15	3.168	6.4	--
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	Ether sulfonic acids	5	--	--	1.17	2-8	0.4	3.2	--
Fluorotelomer carboxylic acids											
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	Fluorotelomer carboxylic acids	3	--	--	2.47	5-20	2.064	8	--
2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid	5:3FTCA	914637-49-3	Fluorotelomer carboxylic acids	3	--	--	9.59	25-100	11.488	40	--
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	Fluorotelomer carboxylic acids	3	--	--	8.71	25-100	12.08	40	--

Notes
- This table includes PFAS tested for by USEPA Method 1633A
-- No Screening Level Listed
USEPA: United States Environmental Protection Agency
RSL: Regional Screening Level
MCL: Maximum Contaminant Level
LOQ: Limit of Quantitation
RL: Reporting Limit
MDL: Method Detection Limit
DAF: Dilution Attenuation Factor
SPLP: Synthetic Precipitation Leaching Procedure
ng/l: nanograms per liter

a. Value is less than or equal to USEPA Method 1633A Aqueous LOQ Range
b. Value is less than or equal to Pace Analytical SPLP RL
c. USEPA MCL will be used as the preferred screening level

Sources

1 - United States Environmental Protection Agency. (2025). Per- and Polyfluoroalkyl Substances (PFAS); Final PFAS National Primary Drinking Water Regulation.
2 - United States Environmental Protection Agency. (2024). Regional Screening Levels (RSLs) - Resident Tap Water, TR=1E-06, THQ=0.1.
3 - United States Environmental Protection Agency. (2024). Method 1633A - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS.
4 - Pace Analytical. (2026). SPLP PFAS via EPA 1312/EPA 1633A (SOIL)
5 - Pace Analytical. (2026). PFAS via EPA 1633A (WATER)

Table 2
Master Sampling and Analysis Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)/ Cardinal Location	Location ID	Approximate Proposed Location		Investigation Activity								
		Easting Coordinates[1]	Northing Coordinates[1]	Soil Sampling	Lithology Logging	SP-16 Sampling	Surface Water Sampling	Sediment Sampling	Upper Surficial - Well Installation	Lower Surficial - Well Installation	Synoptic Groundwater Sampling	Pneumatic Slug Testing
On-Site Sample Plan												
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	MW-1-1	1733741.17	264631.43								X	
	MW-1-1-IS	1733713.61	264620.69		X				X		X	
	MW-1-1-LS/MW-1-1-SB	1730968.25	263437.01	X	X					X	X	X
	MW-1-2	1733969.10	264526.37								X	
	MW-1-2-LS	1734022.94	264540.87		X					X	X	
	MW-1-3	1733757.74	264319.52								X	
	Well 100	1733838.57	264111.78								X	
	Well 100-US	1733820.88	264134.73		X				X		X	X
	Well 100-IS	1733820.88	264134.73		X				X		X	
	Well 100-LS/Well-100-SB	1733820.88	264134.73	X	X					X	X	X
	Well 200	1734156.94	264346.61								X	
	Well 200-US	1734207.06	264354.21		X				X		X	X
	Well 200-IS	1734207.06	264354.21		X				X		X	
	Well 200-LS	1734207.06	264354.21		X					X	X	
	Well 300	1734453.63	263783.18								X	
AOI 4 - Wastewater Treatment Facility Impoundments	GW-37/SB-37	1733440.64	264968.48	X	X	X						
	GW-38/SB-38	1733691.76	264927.08	X	X	X						
	GW-39/SB-39	1733527.16	264676.10	X	X	X						
	GW-40/SB-40	1733424.60	265452.96	X	X	X						
	GW-41/SB-41	1733139.85	265353.09	X	X	X						
	GW-42/SB-42	1733152.64	265157.03	X	X	X						
	GW-43/SB-43	1733298.09	264788.74	X	X	X						
AOI 5 - PFAS in Groundwater at the ZCR Facility	GW-33	1731355.91	265770.55			X						
	SB-33	1730709.85	265712.34	X	X							
	GW-34/SB-34	1731737.19	266594.68	X	X	X						
	GW-35	1730887.33	266679.40			X						
	GW-36	1730864.70	264763.54			X						
	MW-1_W	1729824.04	266820.54								X	
	MW-2_W	1730238.65	266941.49								X	
	MW-3_W	1730197.92	266324.58								X	
	MW-4_W	1730555.74	265395.06								X	
	MW-5_W	1730753.75	265076.71								X	
	MW-6_W	1731069.50	264804.38								X	
	MW-11-US	1730998.23	263333.56								X	
	MW-11-LS	1730968.25	263437.01		X					X	X	X
	MW-12-US	1733320.46	264136.43								X	

Table 2
Master Sampling and Analysis Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)/ Cardinal Location	Location ID	Approximate Proposed Location		Investigation Activity								
		Easting Coordinates[1]	Northing Coordinates[1]	Soil Sampling	Lithology Logging	SP-16 Sampling	Surface Water Sampling	Sediment Sampling	Upper Surficial - Well Installation	Lower Surficial - Well Installation	Synoptic Groundwater Sampling	Pneumatic Slug Testing
AOI 5 - PFAS in Groundwater at the ZCR Facility	MW-13-US	1734460.96	264941.84								X	
	MW-13-LS	1734432.05	264916.21		X					X	X	
	MW-14-US	1734928.24	263601.45								X	
	MW-14-LS	1734911.06	263633.42		X					X	X	
	MW-15-US	1730727.06	265785.96								X	
	MW-15-LS	1730730.78	265795.12								X	
	MW-16-US	1730695.97	265638.51								X	X
	MW-16-LS	1730688.43	265643.12								X	X
	MW-17-US	1730517.52	265866.63								X	
	MW-17-LS	1730521.39	265874.69								X	
	MW-18-US	1730577.99	265376.62								X	X
	MW-18-LS	1730571.47	265380.04								X	X
	MW-22-US	1730846.03	264140.99		X				X		X	
	MW-22-LS	1730846.03	264140.99		X					X	X	
	Well 1	1733847.77	264027.43								X	
	Well 2	1734106.97	264327.25								X	
	Well 3	1734443.37	264095.29								X	
	Well 4	1733660.50	265248.76								X	
	New Columbia Well 6	1732325.06	263885.04								X	
	New Columbia Well 7	1732461.67	264186.84								X	
	Farm 10	1731691.88	266724.63								X	X
	Farm West	1733432.13	267044.51								X	X
AOI 6 - Outfall 001 to Peggy Branch	GS-UT-1/WS-UT-1	1733221.25	266923.53				X				X	
	GS-6-1_N/WS-6-1/SE-6-1	1732762.81	263857.00				X				X	
	GS-6-1_S	1732760.32	263851.83								X	
	GS-6-2/WS-6-2	1733092.34	264437.52				X				X	
	GS-6-3/WS-6-3	1733593.33	264686.29				X				X	
	GS-6-4/WS-6-4/SE-6-4	1732721.81	263425.47				X	X			X	
	MW-6-1	1732722.50	263839.39								X	
AOI 7 - Dredge Spoils Deposits	MW-7-1	1730783.19	265885.82								X	
	MW-7-LS	1730784.26	265873.13								X	
AOI 8 - Former Spray Irrigation Field	MW-3	1732405.87	265484.40								X	
	MW-3-LS/MW-3-SB	1732453.10	265467.23	X	X					X	X	
	MW-4	1733160.36	264900.39								X	X
	MW-4-IS	1733111.85	264895.48		X				X		X	X
	MW-4-LS/MW-4-SB	1733111.85	264895.48	X	X					X	X	X
	MW-5	1732941.32	264399.08								X	

Table 2
Master Sampling and Analysis Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)/ Cardinal Location	Location ID	Approximate Proposed Location		Investigation Activity								
		Easting Coordinates[1]	Northing Coordinates[1]	Soil Sampling	Lithology Logging	SP-16 Sampling	Surface Water Sampling	Sediment Sampling	Upper Surficial - Well Installation	Lower Surficial - Well Installation	Synoptic Groundwater Sampling	Pneumatic Slug Testing
AOI 8 - Former Spray Irrigation Field	MW-6	1731613.48	264535.74								X	
	MW-6-LS/MW-6-SB	1731636.93	264492.13	X	X					X	X	
	MW-8-1	1731520.63	265336.23								X	
	MW-19-US	1732459.21	264902.44		X				X		X	X
	MW-19-LS/MW-19-SB	1732459.21	264902.44	X	X					X	X	X
	MW-20-US	1732537.61	264240.27		X				X		X	X
	MW-20-LS	1732537.61	264240.27		X					X	X	X
	MW-21-US	1732424.88	264151.52		X				X		X	
	MW-21-LS	1732424.88	264151.52		X					X	X	
AOI 9 - Former Spray Irrigation Forest	MW-1	1732043.29	266560.01								X	
	MW-2	1733613.25	266183.60								X	
	MW-9-US	1731764.45	265893.30								X	
	MW-10-US	1733276.37	266501.81								X	X
	MW-10-LS	1733245.85	266500.80		X					X	X	X
Off-Site Sample Plan												
West	GW-OFF-1	1728672.32	266414.80			X						
	GW-OFF-2	1728342.36	265711.36			X						
	GW-OFF-3	1730017.80	264902.33			X						
	GW-OFF-4	1729969.53	263504.38			X						
	GW-OFF-5	1726642.84	265464.84			X						
	GW-OFF-6	1726374.37	264081.88			X						
	GW-OFF-7	1725511.32	263827.42			X						
	GW-OFF-8/SB-OFF-8	1727739.55	267733.01		X	X						
	GW-OFF-9/SB-OFF-9	1726123.33	266502.61		X	X						
	GW-OFF-10/SB-OFF-10	1729789.85	265898.98	X	X	X						
	GW-OFF-11/SB-OFF-11	1728476.88	265060.26	X	X	X						
	GW-OFF-12/SB-OFF-12	1727885.92	264015.71		X	X						
	GW-OFF-13	1727016.12	264719.32			X						
	GW-OFF-14	1725795.87	264984.48			X						
	WS-MNB-1	1733097.87	268726.88				X				X	
	WS-MNB-2	1729478.53	266990.27				X				X	
	WS-MNB-3	1727896.74	266179.93				X				X	
	WS-MNB-4	1724328.96	265822.09				X				X	
	WS-MNB-5	1718482.79	264410.74				X				X	
	WS-MNB-6	1716822.08	264210.04				X				X	
	WS-PB-4	1726729.13	263688.93				X				X	

Table 2
Master Sampling and Analysis Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)/ Cardinal Location	Location ID	Approximate Proposed Location		Investigation Activity								
		Easting Coordinates[1]	Northing Coordinates[1]	Soil Sampling	Lithology Logging	SP-16 Sampling	Surface Water Sampling	Sediment Sampling	Upper Surficial - Well Installation	Lower Surficial - Well Installation	Synoptic Groundwater Sampling	Pneumatic Slug Testing
West	WS-PB-5	1725449.71	263849.84				X				X	
	WS-PB-6	1724960.28	264172.17				X				X	
	WS-NP-1	1715016.24	273538.70				X				X	
	WS-WR-1	1712546.23	257500.69				X				X	
South	GW-OFF-15	1733627.14	263171.69			X						
	GW-OFF-16	1733693.59	262619.82			X						
	GW-OFF-17	1729021.80	262797.07			X						
	GW-OFF-18	1729392.01	262855.76			X						
	GW-OFF-19	1729798.03	262707.99			X						
	GW-OFF-20	1729380.39	262175.37			X						
	GW-OFF-21	1730133.37	261664.04			X						
	GW-OFF-22	1728247.54	260952.82			X						
	GW-OFF-23	1727678.69	262478.78			X						
	GW-OFF-24	1727173.68	260847.18			X						
	GW-OFF-25/SB-OFF-25	1732676.44	261685.47		X	X						
	GW-OFF-26/SB-OFF-26	1736168.24	261962.92		X	X						
	WS-PB-1/SE-PB-1	1732387.32	263170.56				X	X			X	
	WS-PB-2	1731890.86	263104.40				X				X	
	WS-PB-3	1729769.27	262894.54				X				X	
North	GW-OFF-27	1731107.92	266962.57				X				X	
	GW-OFF-28	1732094.36	266873.66				X				X	
	GW-OFF-29	1732519.95	266818.14				X				X	

Notes:
[1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing
[2]National Oceanic
One blind duplicate surface water sample will be collected to evaluate the reproducibility of the analytical results.
One equipment
TBD: To be determined based on field conditions. Boring will be advanced until refusal is encountered.

Table 3A
Groundwater Sampling and Analysis Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Location ID	Sample ID	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
					Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
Proposed Groundwater Grab Locations											
AOI 4 - Wastewater Treatment Facility Impoundments	GW-37	GW-37_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733440.64	264968.48	7	Data gap from the SITM and GWITM. Few samples have been taken from this AOI	X		
	GW-38	GW-38_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733691.76	264927.08	7	Data gap from the SITM and GWITM. Few samples have been taken from this AOI	X		
	GW-39	GW-39_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733527.16	264676.10	7	Vertical data point to delineate PFAS concentrations from AOI-1 to MW-4	X		
	GW-40	GW-40_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733424.60	265452.96	7	Data gap from the SITM and GWITM. Few samples have been taken from this AOI	X		
	GW-41	GW-41_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733139.85	265353.09	7	Data gap from the SITM and GWITM. Few samples have been taken from this AOI	X		
	GW-42	GW-42_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733152.64	265157.03	7	Data gap from the SITM and GWITM. Few samples have been taken from this AOI	X		
	GW-43	GW-43_YYYYMMDD	Every 10 ft to 50 ft bgs	SP-16 Groundwater Sampler	1733298.09	264788.74	7	Vertical data point to delineate PFAS concentrations from AOI-1 to MW-4	X		
AOI 5 - PFAS in Groundwater at the ZCR Facility	GW-33	GW-33_YYYYMMDD	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1731355.91	265770.55	7	Data gap from the GWITM. Few samples in the proposed PFAS plume were taken from this area	X		
	GW-34	GW-34_YYYYMMDD	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1731737.19	266594.68	7	Grab samples upgradient of this location detected lower PFAS results than downgradient. This location was chosen to assess this condition	X		
	GW-35	GW-35_YYYYMMDD	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1730887.33	266679.40	7	Grab sample GW-7, downgradient of this location, resulted as non-detect, despite surrounding high PFAS results in the surrounding area. This location was chosen to assess this condition	X		
	GW-36	GW-36_YYYYMMDD	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1730864.70	264763.54	7	Vertical data point intercepting PFAS concentrations between MW-6_W and GW-OFF-3	X		
Proposed Monitoring Wells											
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	MW-1-1-IS	MW-1-1-IS_YYYYMMDD	45 - 60	Low-Flow Purge with Peristaltic Pump	1733713.61	264620.69	1	Site-wide synoptic sampling	X	X	
	MW-1-1-LS	MW-1-1-LS_YYYYMMDD	85 - 100	Low-Flow Purge with Peristaltic Pump	1733713.61	264620.69	1	Site-wide synoptic sampling	X	X	
	MW-1-2-LS	MW-1-2-LS_YYYYMMDD	60 - 75	Low-Flow Purge with Peristaltic Pump	1734022.94	264540.87	1	Site-wide synoptic sampling	X	X	
	Well 100-US	Well 100-US_YYYYMMDD	15 - 25	Low-Flow Purge with Peristaltic Pump	1733820.88	264134.73	1	Site-wide synoptic sampling	X	X	
	Well 100-IS	Well 100-IS_YYYYMMDD	45 - 60	Low-Flow Purge with Peristaltic Pump	1733820.88	264134.73	1	Site-wide synoptic sampling	X	X	
	Well 100-LS	Well 100-LS_YYYYMMDD	85 - 100	Low-Flow Purge with Peristaltic Pump	1733820.88	264134.73	1	Site-wide synoptic sampling	X	X	
	Well 200-US	Well 200-US_YYYYMMDD	15 - 25	Low-Flow Purge with Peristaltic Pump	1734207.06	264354.21	1	Site-wide synoptic sampling	X	X	
	Well 200-IS	Well 200-IS_YYYYMMDD	45 - 60	Low-Flow Purge with Peristaltic Pump	1734207.06	264354.21	1	Site-wide synoptic sampling	X	X	

Table 3A
Groundwater Sampling and Analysis Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Location ID	Sample ID	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
					Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	Well 200-LS	Well 200-LS_YYYYMMDD	85 - 100	Low-Flow Purge with Peristaltic Pump	1734207.06	264354.21	1	Site-wide synoptic sampling	X	X	
AOI 5 - PFAS in Groundwater at the ZCR Facility	MW-11-LS	MW-11-LS_YYYYMMDD	85 - 95	Low-Flow Purge with Peristaltic Pump	1730968.25	263437.01	1	Site-wide synoptic sampling	X		
	MW-13-LS	MW-13-LS_YYYYMMDD	60 - 75	Low-Flow Purge with Peristaltic Pump	1734432.05	264916.21	1	Site-wide synoptic sampling and determination of off-site anthropogenic tracers upgradiant of Site	X		X
	MW-14-LS	MW-14-LS_YYYYMMDD	60 - 75	Low-Flow Purge with Peristaltic Pump	1734911.06	263633.42	1	Site-wide synoptic sampling	X	X	
	MW-22-US	MW-22-US_YYYYMMDD	15 - 30	Low-Flow Purge with Peristaltic Pump	1730846.03	264140.99	1	Site-wide synoptic sampling	X		
	MW-22-LS	MW-22-LS_YYYYMMDD	65 - 80	Low-Flow Purge with Peristaltic Pump	1730846.03	264140.99	1	Site-wide synoptic sampling	X		
AOI 8 - Former Spray Irrigation Field	MW-3-LS	MW-3-LS_YYYYMMDD	65 - 80	Low-Flow Purge with Peristaltic Pump	1732453.10	265467.23	1	Site-wide synoptic sampling	X		
	MW-4-IS	MW-4-IS_YYYYMMDD	40-55	Low-Flow Purge with Peristaltic Pump	1733111.85	264895.48	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-4 and its surrounding area are amoungst the highest on-site PFAS well results	X		X
	MW-4-LS	MW-4-LS_YYYYMMDD	85-100	Low-Flow Purge with Peristaltic Pump	1733111.85	264895.48	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-4 and its surrounding area are amoungst the highest on-site PFAS well results	X		X
	MW-6-LS	MW-6-LS_YYYYMMDD	45-60	Low-Flow Purge with Peristaltic Pump	1731636.93	264492.13	1	Site-wide synoptic sampling	X		
	MW-19-US	MW-19-US_YYYYMMDD	15 - 30	Low-Flow Purge with Peristaltic Pump	1732459.21	264902.44	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-19-US and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-19-LS	MW-19-LS_YYYYMMDD	65 - 80	Low-Flow Purge with Peristaltic Pump	1732459.21	264902.44	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-19-LS and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-20-US	MW-20-US_YYYYMMDD	15 - 25	Low-Flow Purge with Peristaltic Pump	1732537.61	264240.27	1	Site-wide synoptic sampling	X		
	MW-20-LS	MW-20-LS_YYYYMMDD	75 - 90	Low-Flow Purge with Peristaltic Pump	1732537.61	264240.27	1	Site-wide synoptic sampling	X		
	MW-21-US	MW-21-US_YYYYMMDD	10 - 25	Low-Flow Purge with Peristaltic Pump	1732424.88	264151.52	1	Site-wide synoptic sampling	X		
	MW-21-LS	MW-21-LS_YYYYMMDD	75 - 90	Low-Flow Purge with Peristaltic Pump	1732424.88	264151.52	1	Site-wide synoptic sampling	X		
AOI-9 - Former Spray Irrigation Forest	MW-10-LS	MW-10-LS_YYYYMMDD	65 - 80	Low-Flow Purge with Peristaltic Pump	1733245.85	266500.80	1	Site-wide synoptic sampling and determination of off-site anthropogenic tracers along the northern portion of the Site	X		X
Existing Monitoring Wells											
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	MW-1-1	MW-1-1_YYYYMMDD	8.5 - 18.5	Low-Flow Purge with Peristaltic Pump	1733741.17	264631.43	1	Site-wide synoptic sampling. TOP Assay is collected in AOI-1 to monitor presence of PFAS precursors	X	X	
	MW-1-2	MW-1-2_YYYYMMDD	8.5 - 18.5	Low-Flow Purge with Peristaltic Pump	1733969.10	264526.37	1	Site-wide synoptic sampling. TOP Assay is collected in AOI-1 to monitor presence of PFAS precursors	X	X	

Table 3A
Groundwater Sampling and Analysis Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Location ID	Sample ID	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
					Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	MW-1-3	MW-1-3_YYYYMMDD	10.5 - 20.5	Low-Flow Purge with Peristaltic Pump	1733757.74	264319.52	1	Site-wide synoptic sampling. TOP Assay is collected in AOI-1 to monitor presence of PFAS precursors	X	X	
AOI 5 - PFAS in Groundwater at the ZCR Facility	MW-11-US	MW-11-US_YYYYMMDD	9 - 24	Low-Flow Purge with Peristaltic Pump	1730998.23	263333.56	1	Site-wide synoptic sampling	X		
	MW-12-US	MW-12-US_YYYYMMDD	5 - 20	Low-Flow Purge with Peristaltic Pump	1733320.46	264136.43	1	Site-wide synoptic sampling	X		
	MW-13-US	MW-13-US_YYYYMMDD	4.4 - 19.4	Low-Flow Purge with Peristaltic Pump	1734460.96	264941.84	1	Site-wide synoptic sampling	X		X
	MW-14-US	MW-14-US_YYYYMMDD	5 - 20	Low-Flow Purge with Peristaltic Pump	1734928.24	263601.45	1	Site-wide synoptic sampling	X		
	MW-15-US	MW-15-US_YYYYMMDD	35 - 45	Low-Flow Purge with Peristaltic Pump	1730727.06	265785.96	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-15-US and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-15-LS	MW-15-LS_YYYYMMDD	80 - 90	Low-Flow Purge with Peristaltic Pump	1730730.78	265795.12	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-15-LS and its surrounding area are within the direct path of the proposed PFAS plume	X		X
	MW-16-US	MW-16-US_YYYYMMDD	34.5 - 44.5	Low-Flow Purge with Peristaltic Pump	1730695.97	265638.51	1	Site-wide synoptic sampling	X		
	MW-16-LS	MW-16-LS_YYYYMMDD	77 - 87	Low-Flow Purge with Peristaltic Pump	1730688.43	265643.12	1	Site-wide synoptic sampling	X		
	MW-17-US	MW-17-US_YYYYMMDD	35 - 45	Low-Flow Purge with Peristaltic Pump	1730517.52	265866.63	1	Site-wide synoptic sampling	X		
	MW-17-LS	MW-17-LS_YYYYMMDD	80 - 90	Low-Flow Purge with Peristaltic Pump	1730521.39	265874.69	1	Site-wide synoptic sampling	X		
	MW-18-US	MW-18-US_YYYYMMDD	34 - 44	Low-Flow Purge with Peristaltic Pump	1730577.99	265376.62	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-18-US and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-18-LS	MW-18-LS_YYYYMMDD	76.5 - 86.5	Low-Flow Purge with Peristaltic Pump	1730571.47	265380.04	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-18-LS and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-1_W	MW-1_W_YYYYMMDD	20-20.5, 30-30.5, 40-40.5, 50-50.5, 60-60.5, 70-70.5, 80-80.5	Low-Flow Purge with Peristaltic Pump	1729824.04	266820.54	7	Site-wide synoptic sampling	X		
	MW-2_W	MW-2_W_YYYYMMDD	20-20.5, 30-30.5, 40-40.5, 50-50.5, 60-60.5, 70-70.5, 80-80.5	Low-Flow Purge with Peristaltic Pump	1730238.65	266941.49	7	Site-wide synoptic sampling	X		
	MW-3_W	MW-1_W_YYYYMMDD	19-19.5, 29-29.5, 39-39.5, 49-49.5, 59-59.5, 69-69.5, 79-79.5	Low-Flow Purge with Peristaltic Pump	1730197.92	266324.58	7	Site-wide synoptic sampling	X		
	MW-4_W	MW-1_W_YYYYMMDD	20-20.5, 30-30.5, 40-40.5, 50-50.5, 60-60.5, 70-70.5, 80-80.5	Low-Flow Purge with Peristaltic Pump	1730555.74	265395.06	7	Site-wide synoptic sampling	X		
	MW-5_W	MW-1_W_YYYYMMDD	20-20.5, 30-30.5, 40-40.5, 50-50.5, 60-60.5, 70-70.5, 80-80.5	Low-Flow Purge with Peristaltic Pump	1730753.75	265076.71	7	Site-wide synoptic sampling	X		

Table 3A
Groundwater Sampling and Analysis Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Location ID	Sample ID	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
					Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
AOI 5 - PFAS in Groundwater at the ZCR Facility	MW-6_W	MW-1_W_YYYYMMDD	19-19.5, 29-29.5, 39-39.5, 49-49.5, 59-59.5, 69-69.5, 79-79.5	Low-Flow Purge with Peristaltic Pump	1731069.50	264804.38	7	Site-wide synoptic sampling	X		
	Farm 10	Farm 10_YYYYMMDD	70 - 75	Low-Flow Purge with Peristaltic Pump	1731691.88	266724.63	1	Site-wide synoptic sampling	X		
	Farm West	Farm West_YYYYMMDD	58 - 63	Low-Flow Purge with Peristaltic Pump	1730337.96	266590.91	1	Site-wide synoptic sampling	X		
AOI 6 - Outfall 001 to Peggy's Branch	MW-6-1	MW-6-1_YYYYMMDD	8 - 18	Low-Flow Purge with Peristaltic Pump	1732722.50	263839.39	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-6-1 and its surrounding area are along the southern edge the proposed path of the PFAS plume	X		X
AOI 7 - Dredge Spoils Deposits	MW-7-1	MW-7-1_YYYYMMDD	10 - 20	Low-Flow Purge with Peristaltic Pump	1730783.19	265885.82	1	Site-wide synoptic sampling	X		
	MW-7-LS	MW-7-LS_YYYYMMDD	85 - 95	Low-Flow Purge with Peristaltic Pump	1730784.26	265873.13	1	Site-wide synoptic sampling	X		
AOI 8 - Former Spray Irrigation Field	MW-3	MW-3_YYYYMMDD	10 - 20	Low-Flow Purge with Peristaltic Pump	1732405.87	265484.40	1	Site-wide synoptic sampling	X		
	MW-4	MW-4_YYYYMMDD	5 - 15	Low-Flow Purge with Peristaltic Pump	1733160.36	264900.39	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-4 and its surrounding area are amoungst the highest on-site PFAS well results	X		X
	MW-5	MW-5_YYYYMMDD	9.2 - 19.2	Low-Flow Purge with Peristaltic Pump	1732941.32	264399.08	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-5 and its surrounding area are within the proposed path of the PFAS plume	X		X
	MW-6	MW-6_YYYYMMDD	10 - 30	Low-Flow Purge with Peristaltic Pump	1731613.48	264535.74	1	Site-wide synoptic sampling	X		
	MW-8-1	MW-8-1_YYYYMMDD	8.5 - 18.5	Low-Flow Purge with Peristaltic Pump	1731520.63	265336.23	1	Site-wide synoptic sampling and determination of off-site anthropogenic influences as MW-8-1 and its surrounding area are within the proposed path of the PFAS plume	X		X
AOI-9 - Former Spray Irrigation Forest	MW-1	MW-1_YYYYMMDD	8.8 - 18.8	Low-Flow Purge with Peristaltic Pump	1732043.29	266560.01	1	Site-wide synoptic sampling	X		
	MW-2	MW-2_YYYYMMDD	9 - 19	Low-Flow Purge with Peristaltic Pump	1733613.25	266183.60	1	Site-wide synoptic sampling	X		
	MW-9-US	MW-9-US_YYYYMMDD	4.8 - 19.8	Low-Flow Purge with Peristaltic Pump	1731764.45	265893.30	1	Site-wide synoptic sampling	X		
	MW-10-US	MW-10-US_YYYYMMDD	4.5 - 19.5	Low-Flow Purge with Peristaltic Pump	1733276.37	266501.81	1	Site-wide synoptic sampling	X		

Notes:
· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing
· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024 at https://coast.noaa.gov/dataviewer
· * TOP Assay bottleware will be collected and held at each sample location. Following analysis of the Method 1663A PFAS results, up to ten percent of TOP Assay samples may be released for analysis.
· ** Athropogenic Indicator bottleware will be collected at up to 3 Upper Surficial aquifer and one Lower Surifical aquifer sample locations.
· One blind duplicate surface water sample will be collected to evaluate the reproducibility of the analytical results.
· One equipment blank (EB) sample will be collected by using a peristaltic pump equipped with new/dedicated tubing to transfer laboratory-provided PFAS free water into laboratory-provided sample bottles.
TBD: To be determined based on field conditions. Boring will be advanced until refusal is encountered.
ft bgs: feet below ground surface

Table 3B
Groundwater Sampling and Analysis Plan - Off-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Location ID	Sample ID	Cardinal Direction From Site	Location Description	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
						Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
Proposed Groundwater Grab Locations												
GW-OFF-1	GW-OFF-1_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1728672.321	266414.7994	7	Define horizonal and vertical western/southwestern extent of plume off-site. Assess PFAS composition in the Sherwood Circle neighborhood and assess the "dipping" PFAS plume to the northwest	X	X	
GW-OFF-2	GW-OFF-2_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1728342.361	265711.3593	7	Define horizonal and vertical western/southwestern extent of plume off-site. Assess PFAS composition in the Sherwood Circle neighborhood and assess the "dipping" PFAS plume to the northwest	X	X	
GW-OFF-3	GW-OFF-3_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1730017.797	264902.332	7	Define horizonal and vertical western/southwestern extent of plume off-site. Assess PFAS composition in the King Williams Court neighborhood and investigate low concentrations between the Site and Sherwood Circle	X	X	X
GW-OFF-4	GW-OFF-4_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729969.534	263504.3755	7	Assess range of PFAS concentrations in southeast corner of residences across King Williams Court and Heather Glen	X	X	
GW-OFF-5	GW-OFF-5_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1726642.837	265464.8374	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	
GW-OFF-6	GW-OFF-6_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1726374.372	264081.8776	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	X
GW-OFF-7	GW-OFF-7_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1725511.317	263827.4211	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	
GW-OFF-8	GW-OFF-8_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1727739.553	267733.0065	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	
GW-OFF-9	GW-OFF-9_YYYYMMDD	West	ROW / Cul-de-sac	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1726123.328	266502.6139	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	
GW-OFF-10	GW-OFF-10_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729789.852	265898.979	7	Define horizonal and vertical western/southwestern extent of plume off-site. Assess PFAS composition in the King Williams Court neighborhood and investigate low concentrations between the Site and Sherwood Circle	X	X	X
GW-OFF-11	GW-OFF-11_YYYYMMDD	West	ROW / Paper street	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1728476.885	265060.2644	7	Define horizonal and vertical western/southwestern extent of plume off-site. Assess PFAS composition in the Sherwood Circle neighborhood and assess the "dipping" plume to the northwest	X	X	X
GW-OFF-12	GW-OFF-12_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1727885.919	264015.7055	7	Define horizonal and vertical western/southwestern extent of plume off-site	X	X	X
GW-OFF-13	GW-OFF-13_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1727016.121	264719.3169	7	Define horizonal and vertical western/southwestern extent of plume off-site. Investigate nearby private wells with signficantly higher concentrations in a deep well (100 ft bgs)	X	X	X
GW-OFF-14	GW-OFF-14_YYYYMMDD	West	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1725795.875	264984.4841	7	Define horizonal and vertical western/southwestern extent of plume off-site. Investigate nearby private wells with wide range on concentrations	X	X	X
GW-OFF-15	GW-OFF-15_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1733627.136	263171.6937	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers	X	X	
GW-OFF-16	GW-OFF-16_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1733693.592	262619.8198	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers. Assess significantly elevated PFAS concentrations in nearby private well	X	X	X
GW-OFF-17	GW-OFF-17_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729021.805	262797.0659	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers	X	X	

Table 3B
Groundwater Sampling and Analysis Plan - Off-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Location ID	Sample ID	Cardinal Direction From Site	Location Description	Proposed Sample Interval(s) (ft bgs)	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Rationale	Analyses		
						Easting Coordinates[1]	Northing Coordinates[1]			Method 1633A - Full 40 PFAS List	TOP Assay*	Anthropogenic Indicators**
Proposed Groundwater Grab Locations												
GW-OFF-18	GW-OFF-18_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729392.008	262855.7567	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers	X	X	
GW-OFF-19	GW-OFF-19_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729798.031	262707.9863	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers	X	X	
GW-OFF-20	GW-OFF-20_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1729380.386	262175.366	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers. Assess significantly elevated PFAS concentrations in nearby private wells	X	X	X
GW-OFF-21	GW-OFF-21_YYYYMMDD	South	ROW / Paper street	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1730133.373	261664.0402	7	Define horizonal and vertical southwestern/southern extent of plume off-site and investigate potenital anthropogenic tracers	X	X	X
GW-OFF-22	GW-OFF-22_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1728247.538	260952.8205	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and investigate potenital anthropogenic tracers. Assess significantly elevated PFAS concentrations in nearby private well	X	X	X
GW-OFF-23	GW-OFF-23_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1727678.689	262478.7814	7	Define horizonal and vertical southwestern/southern extent of plume off-site and investigate potenital anthropogenic tracers. Assess PFAS composition and potential influences on increased PFOA	X	X	X
GW-OFF-24	GW-OFF-24_YYYYMMDD	South	ROW	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1727173.677	260847.177	7	Define horizonal and vertical southwestern/south of the start of Peggy Branch extent of plume off-site and assess potential commercial properties influence	X	X	
GW-OFF-25	GW-OFF-25_YYYYMMDD	South	Off-Site PAB-owned property	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1732676.436	261685.468	7	Define horizonal and vertical southwestern/southern extent of plume off-site	X	X	
GW-OFF-26	GW-OFF-26_YYYYMMDD	South	Wicominco County property	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1736168.243	261962.9212	7	Define horizonal and vertical southwestern/southern extent of plume off-site	X	X	
GW-OFF-27	GW-OFF-27_YYYYMMDD	North	Wicominco County property	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1731107.925	266962.5733	7	Define horizonal and vertical northern extent of plume off-site	X		
GW-OFF-28	GW-OFF-28_YYYYMMDD	North	Wicominco County property	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1732094.36	266873.6552	7	Define horizonal and vertical northern extent of plume off-site	X		
GW-OFF-29	GW-OFF-29_YYYYMMDD	North	Wicominco County property	Every 10 ft to 50 ft bgs, then every 20 ft to refusal	SP-16 Groundwater Sampler	1732519.953	266818.1431	7	Define horizonal and vertical northern extent of plume off-site	X		
Proposed Monitoring Wells												
Location(s) and number(s) of potential off-Site monitoring wells to be determined based on results of proposed off-Site groundwater grab (SP-16) and soil sampling.												

Notes:
· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing
· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024 at https://coast.noaa.gov/dataviewer.
· * TOP Assay bottleware will be collected and held at each sample location. Following analysis of the Method 1663A PFAS results, up to ten percent of TOP Assay samples may be released for analysis.
· ** Athropogenic Indicator bottleware will be collected at up to 3 Upper Surficial aquifer and one Lower Surifical aquifer sample locations.
· One blind duplicate surface water sample will be collected to evaluate the reproducibility of the analytical results.
· One equipment blank (EB) sample will be collected by using a peristaltic pump equipped with new/dedicated tubing to transfer laboratory-provided PFAS free water into laboratory-provided sample bottles.
· One blind duplicate groundwater sample will be collected to evaluate the reproducibility of the analytical results.
TBD: To be determined based on drilling conditions. Boring will be advanced unti refusal is encountered.
ft bgs: feet below ground surface
ROW: Right of Way

Table 4A
Soil Sampling and Analytical Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Boring ID	Sample ID(s)	Approximate Proposed		Target Boring Depth	Sample Depths (ft bgs)	Maximum Number of Samples	Analyses
			Easting Coordinates[1]	Northing Coordinates[1]				
AOI-1 - Former AFFF Fire Supression system	MW-1-1-SB	MW-1-1-SB-depth_YYYYMMDD	1733713.615	264620.6948	Chesapeake Confining Unit or Refusal	14-14.5, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	Method 1633A - Full 40 PFAS List
	MW-100-SB	MW-100-SB-depth_YYYYMMDD	1733815.849	264150.6225		12-12.5, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	
AOI 4 - Wastewater Treatment Facility Impoundments	SB-37	SB-37-depth_YYYYMMDD	1733440.641	264968.4762	25 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	11	
	SB-38	SB-38-depth_YYYYMMDD	1733691.758	264927.0833	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	
	SB-39	SB-39-depth_YYYYMMDD	1733527.157	264676.0959	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	
	SB-40	SB-40-depth_YYYYMMDD	1733424.596	265452.9552	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	
	SB-41	SB-41-depth_YYYYMMDD	1733139.853	265353.085	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	
	SB-42	SB-42-depth_YYYYMMDD	1733152.64	265157.0254	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	
	SB-43	SB-43-depth_YYYYMMDD	1733298.095	264788.7407	15 ft bgs.	Every 2 ft until water table; one sample at 5 ft below water table	6	

Table 4A
Soil Sampling and Analytical Plan - On-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Boring ID	Sample ID(s)	Approximate Proposed		Target Boring Depth	Sample Depths (ft bgs)	Maximum Number of Samples	Analyses
			Easting Coordinates[1]	Northing Coordinates[1]				
AOI-5 - PFAS in Groundwater at the ZCR Facility	SB-33	SB-33-depth_YYYYMMDD	1730709.855	265712.3389	Chesapeake Confining Unit or Refusal	48.5-49, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	Method 1633A - Full 40 PFAS List
	SB-34	SB-34-depth_YYYYMMDD	1731737.19	266594.6754		18.5-19, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	
AOI-8 - Former Spray Irrigation Field	MW-3-SB	MW-3-SB-depth_YYYYMMDD	1732450.513	265467.3499		28.5-29, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	
	MW-19-SB	MW-19-SB-depth_YYYYMMDD	1732369.721	264897.7611		48.5-4, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	
	MW-4-SB	MW-4-SB-depth_YYYYMMDD	1733100.759	264889.7096		28.5-29, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	
	MW-6-SB	MW-6-SB-depth_YYYYMMDD	1731640.793	264491.2813		28.5-29, 80-80.5, and three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the top of the Chesapeake Clay	6	

Notes:
· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing
· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024 at https://coast.noaa.gov/dataviewer.
· One equipment blank (EB) sample will be collected at a frequence of one per 20 field samples per type of sampling device, with a minimum of one per day per type of sampling device. Sample IDs for each EB sample will be named as follows: "EB-#-YYYYMMDD"
· Duplicate samples will be collected at a frequency of one duplicate sample per day or one duplicate sample per 20 regular samples, whichever is more frequent. Sample IDs for each duplicate sample will be named as follows: "DUP=#-YYYYMMDD"
TBD: To be determined based on drilling conditions. Boring will be advanced unti refusal is encountered.
ft bgs: feet below ground surface

Table 4B
Soil Sampling and Analytical Plan - Off-Site
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Boring ID	Sample ID(s)	Cardinal Direction From Site	Location Description	Sampling Method(s)	Approximate Proposed Location		Target Boring Depth	Sample Depths (ft bgs)	Maximum Number of Samples	Analyses
					Easting Coordinates[1]	Northing Coordinates[1]				
GW-OFF-8 / SB-OFF-8	-	West	ROW / Cul-de-sac	Hand Auger & Sonic Drilling	1727739.553	267733.0065	Chesapeake Confining Unit or Refusal	NA	0	NA
GW-OFF-9 / SB-OFF-9	-	West	ROW / Cul-de-sac	Hand Auger & Sonic Drilling	1726123.328	266502.6139		NA	0	NA
GW-OFF-10 / SB-OFF-10	SB-OFF-10-depth_YYYYMMDD	West	ROW	Hand Auger & Sonic Drilling	1729789.852	265898.979		One sample from the Upper Surifical aquifer sand (depth TBD),three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the Lower Surficial Aquifer sand (depth TBD), and one sample from the top of the Chesapeake Clay (depth TBD)	6	Method 1633A - Full 40 PFAS List
GW-OFF-11 / SB-OFF-11	SB-OFF-11-depth_YYYYMMDD	West	ROW / Paper Street	Hand Auger & Sonic Drilling	1728467.853	265040.6427		One sample from the Upper Surifical aquifer sand (depth TBD),three samples (depth TBD) from the clay unit dividing the Upper/Lower Surficial (Columbia) Aquifer, one sample from the Lower Surficial Aquifer sand (depth TBD), and one sample from the top of the Chesapeake Clay (depth TBD)	6	Method 1633A - Full 40 PFAS List
GW-OFF-12 / SB-OFF-12	-	West	ROW	Hand Auger & Sonic Drilling	1727887.579	264019.6924		NA	0	NA
GW-OFF-25 / SB-OFF-25	-	South	Off-Site PAB-owned Property	Hand Auger & Sonic Drilling	1732676.436	261685.468		NA	0	NA
GW-OFF-26 / SB-OFF-26	-	South	Wicominco County Property	Hand Auger & Sonic Drilling	1736166.913	261965.3723		NA	0	NA

Notes:
· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing

· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024 at https://coast.noaa.gov/dataviewer.

· One equipment blank (EB) sample will be collected at a frequence of one per 20 field samples per type of sampling device, with a minimum of one per day per type of sampling device. Sample IDs for each EB sample will be named as follow "EB-#-YYYYMMDD"

· Duplicate samples will be collected at a frequency of one duplicate sample per day or one duplicate sample per 20 regular samples, whichever is more frequent. Sample IDs for each duplicate sample will be named as follows: "DUP=#-YYYYMMDD

· *Boring depth based on feet below bottom of concrete

TBD: To be determined based on field conditions. Boring to be advanced until refusal is encountered
ft bgs: feet below ground surface
NA: Not Applicable
ROW: Right of Way

Table 5
Surface Water and Sediment Sampling Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Sample ID	Cardinal Direction From Site	Sample ID	Sampling Method	Approximate Proposed Location		Proposed Number of Samples	Analyses
				Easting Coordinates[1]	Northing Coordinates[1]		
On-Site Surface Water Sample Locations							
GS-UT-1/WS-UT-1	-	WS-UT-1_YYYYMMDD	Dip Sample/Bailer	1733221.25	266923.53	1	Method 1633A - Full 40 PFAS compound list
GS-6-1_N/WS-6-1	-	WS-6-1_YYYYMMDD	Dip Sample/Bailer	1732762.81	263857.00	1	
GS-6-2/WS-6-2	-	WS-6-2_YYYYMMDD	Dip Sample/Bailer	1733092.34	264437.52	1	
GS-6-3/WS-6-3	-	WS-6-3_YYYYMMDD	Dip Sample/Bailer	1733593.33	264686.29	1	
GS-6-4/WS-6-4	-	WS-6-4_YYYYMMDD	Dip Sample/Bailer	1732721.81	263425.47	1	
Off-Site Surface Water Sample Locations							
GS-PB-1/WS-PB-1	South	WS-PB-1_YYYYMMDD	Dip Sample/Bailer	1732387.32	263170.56	1	Method 1633A - Full 40 PFAS compound list
GS-PB-2/WS-PB-2	South	WS-PB-2_YYYYMMDD	Dip Sample/Bailer	1731890.86	263104.40	1	
GS-PB-3/WS-PB-3	South	WS-PB-3_YYYYMMDD	Dip Sample/Bailer	1729769.27	262894.54	1	
GS-PB-4/WS-PB-4	West	WS-PB-4_YYYYMMDD	Dip Sample/Bailer	1726729.13	263688.93	1	
GS-PB-5/WS-PB-5	West	WS-PB-5_YYYYMMDD	Dip Sample/Bailer	1725449.71	263849.84	1	
GS-PB-5/WS-PB-6	West	WS-PB-6_YYYYMMDD	Dip Sample/Bailer	1724960.28	264172.17	1	
GS-MNB-1/WS-MNB-1	West	WS-MNB-1_YYYYMMDD	Dip Sample/Bailer	1733097.87	268726.88	1	
GS-MNB-2/WS-MNB-2	West	WS-MNB-2_YYYYMMDD	Dip Sample/Bailer	1729478.53	266990.27	1	
GS-MNB-3/WS-MNB-3	West	WS-MNB-3_YYYYMMDD	Dip Sample/Bailer	1727896.73	266179.93	1	
GS-MNB-4/WS-MNB-4	West	WS-MNB-4_YYYYMMDD	Dip Sample/Bailer	1724328.96	265822.09	1	
GS-MNB-5/WS-MNB-5	West	WS-MNB-5_YYYYMMDD	Dip Sample/Bailer	1718482.79	264410.74	1	
GS-MNB-6/WS-MNB-6	West	WS-MNB-6_YYYYMMDD	Dip Sample/Bailer	1716822.08	264210.04	1	
GS-NP-1/WS-NP-1	West	WS-NP-1_YYYYMMDD	Dip Sample/Bailer	1715016.24	273538.70	1	
GS-WR-1/WS-WR-1	West	WS-WR-1_YYYYMMDD	Dip Sample/Bailer	1712546.23	257500.69	1	
Sediment Sample Locations							
SE-6-4	South	SE-6-4_YYYYMMDD	Polycarbonate core tub	1732721.81	263425.47	1	Method 1633A - Full 40 PFAS compound list
SE-PB-1	South	SE-PB-1_YYYYMMDD	Polycarbonate core tub	1732387.32	263170.56	1	

Notes:

· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing

· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024 at https://coast.noaa.gov/dataviewer.

· One equipment blank (EB) sample will be collected at a frequence of one per 20 field samples per type of sampling device, with a minimum of one per day per type of sampling device. Sample IDs for each EB sample will be named as follows: "EB-#-YYYYMMDD"

· Duplicate samples will be collected at a frequency of one duplicate sample per day or one duplicate sample per 20 regular samples, whichever is more frequent. Sample IDs for each duplicate sample will be named as follows: "DUP=#-YYYYMMDD"

Table 6
Well Installation Plan
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

PFAS Area of Interest (AOI)	Monitoring Well/ Gauging Station ID	Aquifer	Approximate Proposed Location		Nominal Well Diameter (inches)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Length (ft)	Total Well Depth (ft bgs)
			Easting Coordinates[1]	Northing Coordinates[1]					
Proposed On-Site Wells									
AOI 1 - Aqueous Film Forming Foam (AFFF) – Fire Suppression System	MW-1-1-IS	Intermediate Surficial	1733713.61	264620.69	2	45	60	15	60
	MW-1-1-LS	Lower Surficial	1730968.25	263437.01	2	85	100	15	100
	MW-1-2-LS	Lower Surficial	1734022.94	264540.87	2	60	75	15	75
	Well 100-US	Upper Surficial	1733820.88	264134.73	2	15	25	10	25
	Well 100-IS	Intermediate Surficial	1733820.88	264134.73	2	45	60	15	60
	Well 100-LS	Lower Surficial	1733820.88	264134.73	2	85	100	15	100
	Well 200-US	Upper Surficial	1734207.06	264354.21	2	15	25	10	25
	Well 200-IS	Intermediate Surficial	1734207.06	264354.21	2	45	60	15	60
	Well 200-LS	Lower Surficial	1734207.06	264354.21	2	85	100	15	100
AOI 5 - PFAS in Groundwater at the ZCR Facility	MW-11-LS	Lower Surficial	1730968.25	263437.01	2	85	100	15	100
	MW-13-LS	Lower Surficial	1734432.05	264916.21	2	65	75	10	75
	MW-14-LS	Lower Surficial	1734911.06	263633.42	2	65	75	10	75
	MW-22-US	Upper Surficial	1730846.03	264140.99	2	15	30	15	30
	MW-22-LS	Lower Surficial	1730846.03	264140.99	2	65	80	15	80
AOI - 8 Former Spray Irrigation Field	MW-3-LS	Lower Surficial	1732453.10	265467.23	2	65	80	15	80
	MW-4-IS	Intermediate Surficial	1733111.85	264895.48	2	45	55	10	55
	MW-4-LS	Lower Surficial	1733111.85	264895.48	2	65	80	15	80
	MW-6-LS	Lower Surficial	1731636.93	264492.13	2	65	80	15	80
	MW-19-US	Upper Surficial	1732459.21	264902.44	2	15	30	15	30
	MW-19-LS	Lower Surficial	1732459.21	264902.44	2	65	80	15	80
	MW-20-US	Upper Surficial	1732537.61	264240.27	2	20	30	10	30
	MW-20-LS	Lower Surficial	1732537.61	264240.27	2	75	90	15	90
	MW-21-US	Upper Surficial	1732424.88	264151.52	2	15	30	15	30
	MW-21-LS	Lower Surficial	1732424.88	264151.52	2	75	90	15	90
AOI 9 - Former Spray Irrigation Forest	MW-10-LS	Lower Surficial	1733245.85	266500.80	2	65	80	15	80
Proposed Off-Site Wells									
Location(s) and number(s) of potential off-Site monitoring wells to be determined based on results of proposed off-Site groundwater grab (SP-16) and soil sampling.									
West of Site	MW-OFF-#	Upper Surficial	TBD	TBD	2	5	20	15	20
South of Site	MW-OFF-#	Upper Surficial	TBD	TBD	2	5	20	15	20

Notes:
· [1]Coordinates were generated using ArcGIS Pro, provided by Langan's Esri Software Licensing
· [2]National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer. Custom processing of "2020 - 2021 USGS Lidar: Southeast MD". Charleston, SC: NOAA Office for Coastal Management. Accessed Oct 08, 2024
ft bgs - feet below ground surface

Table 7
Method Bottleware Requirements
Perdue AgriBusiness
6909 Zion Church Road, Salisbury, Maryland
Langan Project No.: 220210101

Analytical Method	Parameters	Media	Bottleware	# of Bottles	Preservative	Hold Time (before extraction)
Method 1633A	NA	Groundwater/Surface Water	250 mL HDPE	2	Unpreserved	28 days
	NA	Soil/Sediment	90 mL HDPE	1	Unpreserved	90 days
TOP Assay	NA	Groundwater	250 mL HDPE	2	Unpreserved	28 days
Nitrate	NA	Groundwater	250 mL HDPE	1	Unpreserved	48 hours
Boron	NA	Groundwater	250 mL HDPE	1	HNO3	180 days
PPCP (Anthropogenic Indicators)	Carbamazepine	Groundwater	1000 mL Amber Glass	1	Unpreserved	28 days
	Sulfamethoxazole					
	Acesulfame					
	Sucralose					
	Caffeine					
	Paraxanthine					

Notes:
HDPE: High-Density Polyethylene
TOP: Total Oxidizable Precursors
mL: milliliter
VOC: Volatile organic carbon
NA: Not applicable
HNO3: Nitric acid
PPCP: Pharmaceuticals and Personal Care Products (Anthropogenic Indicators)
Bottleware requirements and hold time for select PPCP analyses are dependant on final laboratory selection.

FIGURES



Notes:
1. USGS "The National Map" topographic basemap: Delmar Quadrangle, is provided through Langan's Esri ArcGIS software licensing and ArcGIS online. Data refreshed October 27, 2025.

LANGAN
Langan Engineering and Environmental Services, LLC
1818 Market Street, Suite 3300
Philadelphia, PA 19103
T: 215.845.8900 F: 215.845.8901
www.langan.com

Project	Figure Title	Project No.	Figure
PERDUE AGRIBUSINESS, LLC SALISBURY WICOMICO COUNTY MARYLAND	**SITE LOCATION MAP**	220210101 Date 7/17/2026 Scale 1"=2,000' Drawn By LCC	1

© 2026 Langan



Legend

- Groundwater Monitoring Well Location
- PAB Water Supply Well Location – Manokin Aquifer
- PAB Water Supply Well Location – Shallow Aquifer
- Out of Service PAB Residential Style Water Supply Well Location
- Gauging Station Location
- Site Boundary
- Streams and Waterbody Boundaries

Notes:

1. All site feature locations are approximate.
2. Imagery provided through Langan's subscription to Nearmap.com. Flown 2/23/2025.
3. Feature labels are based on information obtained during Langan site visits on 11/12/2024 and 1/8/2025, and on POWER Engineers, Inc. "Site Plan with Oil Storage Locations," prepared 4/16/2018, and Perdue Agribusiness LLC "Stormwater Pollution Prevention Plan, SP3 Figure 5," prepared 2/16/2024.
4. Sample locations, wells, gauging stations and comingled manhole were surveyed by Langan.
5. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
6. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 300 600
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

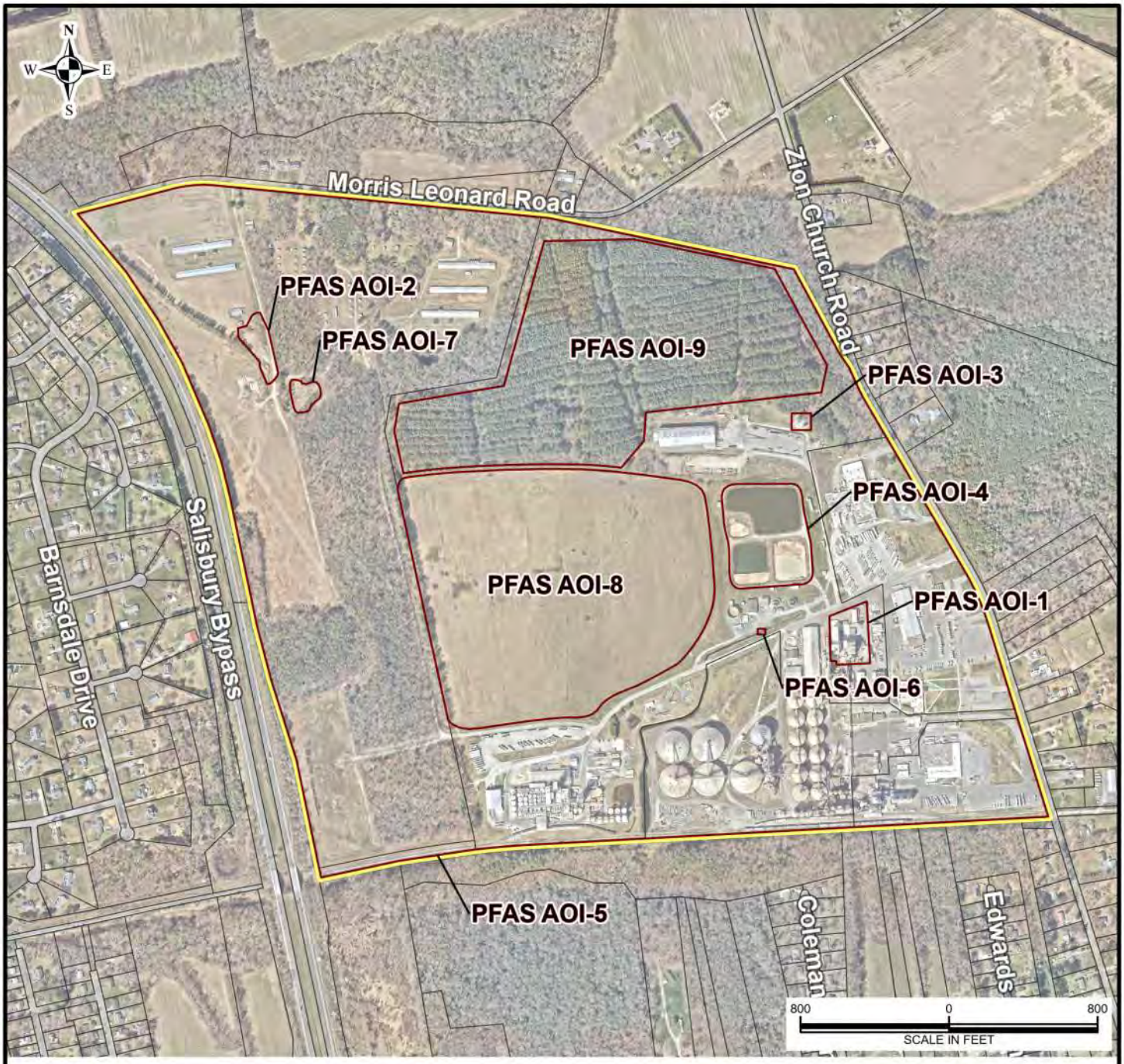
WICOMICO COUNTY MARYLAND

Drawing Title

SITE PLAN OVERVIEW

Project No.	Figure
220210101	2
Date: 7/17/2026	
Scale: 1"=300'	
Drawn By: GT	

© 2026 Langan



Legend

- Site Boundary
- PFAS Areas of Interest
- Wicomico County Parcel Boundary

PFAS AOI Number	PFAS AOI Name
PFAS AOI-1	Former AFFF Fire Suppression System
PFAS AOI-2	Stockpiled Soil - Northwest
PFAS AOI-3	Stockpiled Soil - East-Central
PFAS AOI-4	Wastewater Treatment Facility Impoundments
PFAS AOI-5	PFAS in Groundwater at the ZCR Facility
PFAS AOI-6	Outfall 001 to Peggy Branch
PFAS AOI-7	Dredge Spoils Deposits
PFAS AOI-8	Former Spray Irrigation Field
PFAS AOI-9	Former Spray Irrigation Forest

PFAS –Perfluoroalkyl and Polyfluoroalkyl Substances
AFFF –Aqueous Film Forming Foam
AOI – Area of Interest

Notes:
1. Imagery is provided through Langan's subscription to Nearmap.com. Flown 3/20/2026.
2. Parcel data was provided by Wicomico County GIS on 3/6/2026.
3. The PFAS Area of Interest 1 and 2 boundaries have been updated since the submittal of Langan's Environmental Assessment of PFAS Report dated January 21, 2025.

LANGAN
Langan Engineering and Environmental Services, LLC
1818 Market Street, Suite 3300
Philadelphia, PA 19103
T: 215.845.8900 F: 215.845.8901
www.langan.com

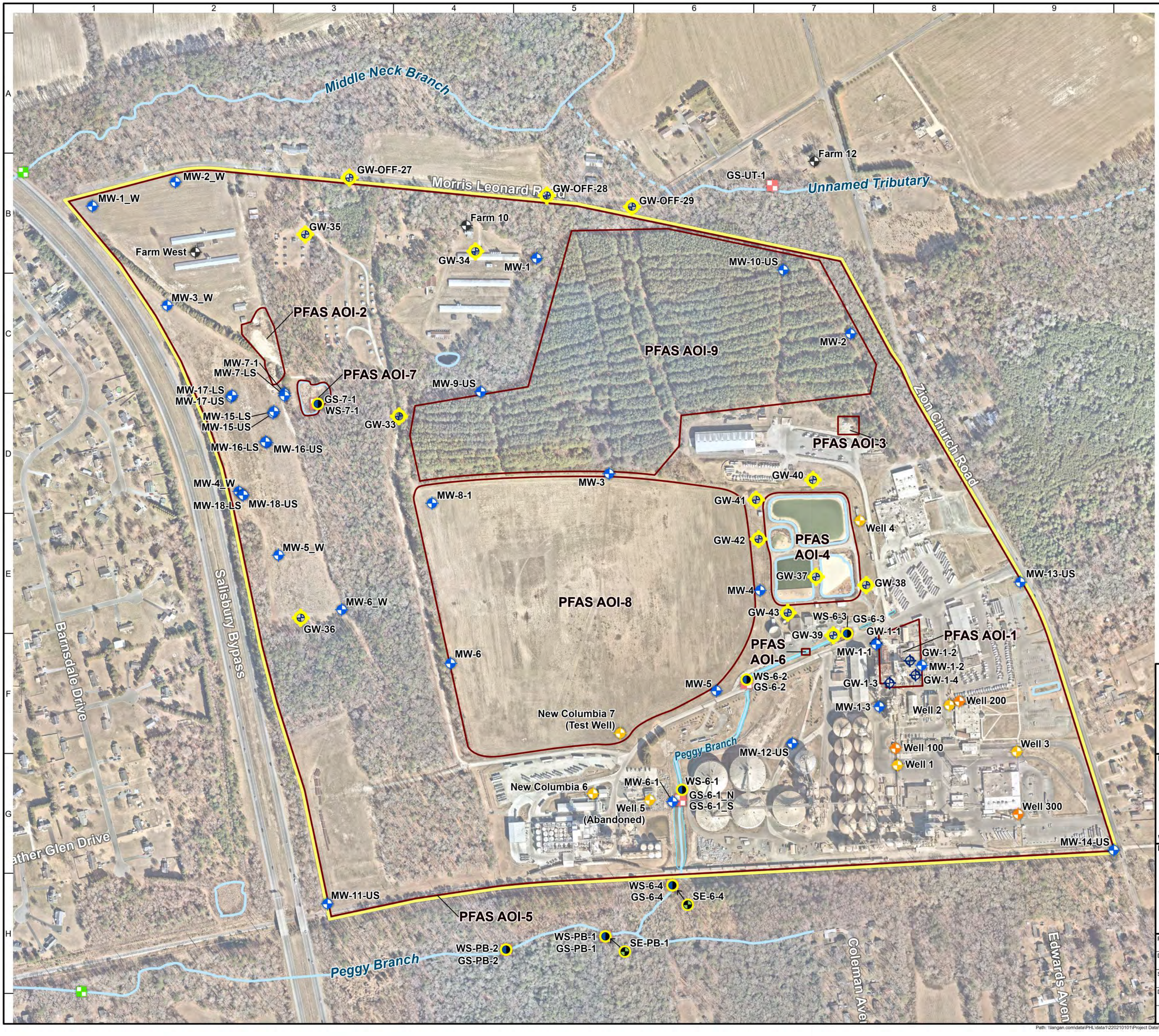
Project
PERDUE AGRIBUSINESS, LLC
SALISBURY
WICOMICO COUNTY MARYLAND

Figure Title
PFAS AREAS OF INTEREST

Project No. 220210101
Date 7/17/2026
Scale 1"=800'
Drawn By SH

Figure 3

© 2026 Langan



Legend

- Proposed Sediment Sample Location
- Proposed Surface Water Sample Location
- Proposed Groundwater Grab Sample Location
- Groundwater Grab Sample Location
- Proposed Gauging Station Location
- Groundwater Monitoring Well Location
- PAB Water Supply Well Location – Manokin Aquifer
- PAB Water Supply Well Location – Shallow Aquifer
- Out of Service PAB Residential Style Water Supply Well Location
- Gauging Station Location
- Streams and Waterbody Boundaries
- Site Boundary
- PFAS Areas of Interest

Notes:

1. All site feature locations are approximate.
2. Imagery provided through Langan's subscription to Nearmap.com. Flown 2/23/2025.
3. Feature labels are based on information obtained during Langan site visits on 11/12/2024 and 1/8/2025, and on POWER Engineers, Inc. "Site Plan with Oil Storage Locations," prepared 4/16/2018, and Perdue Agribusiness LLC "Stormwater Pollution Prevention Plan, SP3 Figure 5," prepared 2/16/2024.
4. Sample locations, wells, gauging stations and comingled manhole were surveyed by Langan.
5. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
6. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 300 600
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

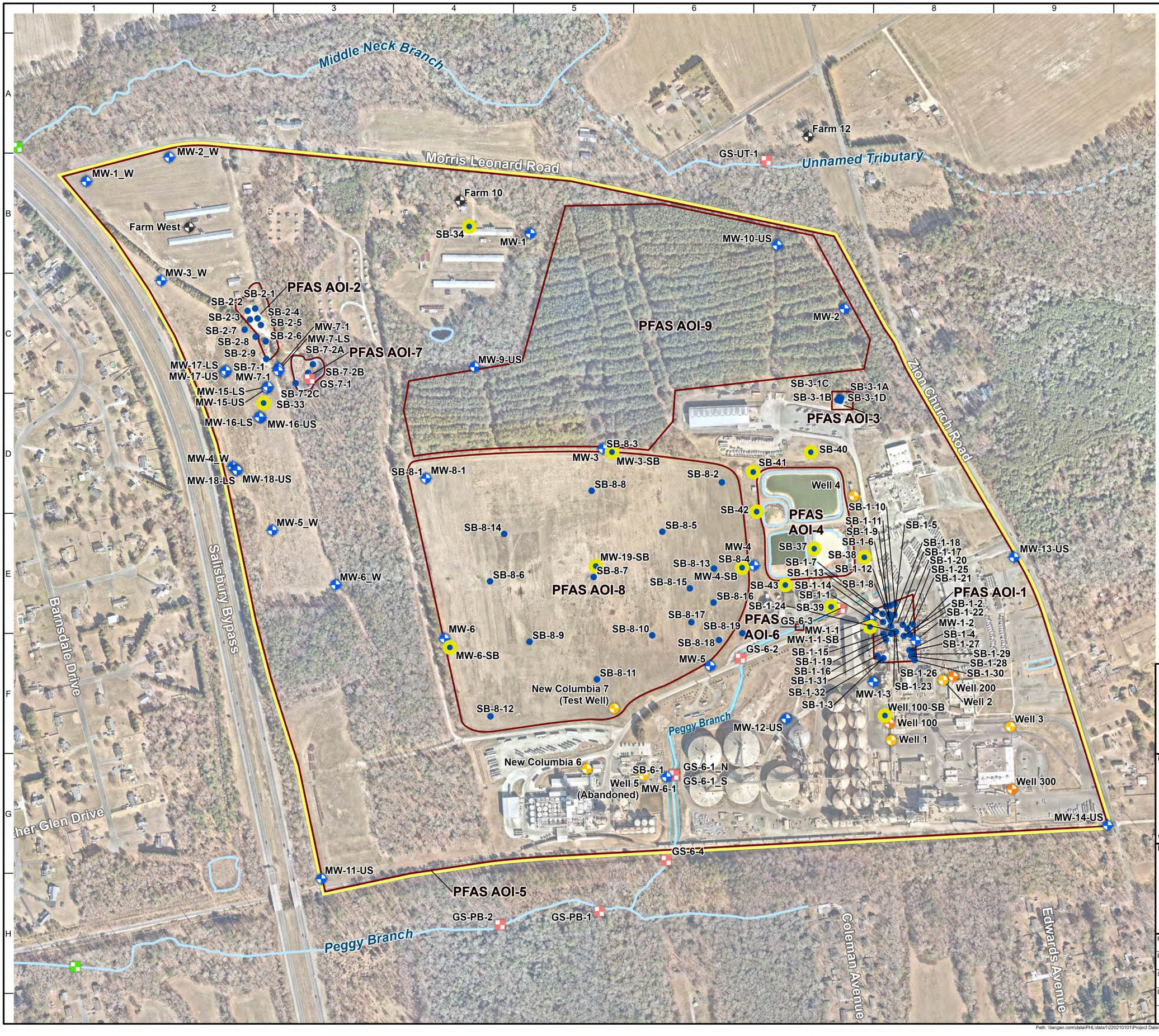
Drawing Title

PROPOSED ON- AND NEAR-SITE SUPPLEMENTAL GROUNDWATER GRAB, SURFACE WATER, AND SEDIMENT SAMPLE LOCATIONS

Project No.	Figure
220210101	4
Date: 7/17/2026	
Scale: 1"=300'	
Drawn By: CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 4:29 PM



N
W E
S

Legend

- Proposed Soil Sample Location
- Sampled Soil Sample Location
- Proposed Gauging Station Location
- Groundwater Monitoring Well Location
- PAB Water Supply Well Location – Manokin Aquifer
- PAB Water Supply Well Location – Shallow Aquifer
- Out of Service PAB Residential Style Water Supply Well Location
- Gauging Station Location
- Streams and Waterbody Boundaries
- Site Boundary
- PFAS Areas of Interest

Notes:

1. All site feature locations are approximate.
2. Imagery provided through Langan's subscription to Nearmap.com. Flown 2/23/2025.
3. Feature labels are based on information obtained during Langan site visits on 11/12/2024 and 1/8/2025, and on POWER Engineers, Inc. "Site Plan with Oil Storage Locations," prepared 4/16/2018, and Perdue Agribusiness LLC "Stormwater Pollution Prevention Plan, SP3 Figure 5," prepared 2/16/2024.
4. Sample locations, wells, gauging stations and comingled manhole were surveyed by Langan.
5. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
6. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 300 600
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

Drawing Title

PROPOSED ON-SITE SUPPLEMENTAL SOIL SAMPLE LOCATIONS

Project No. 220210101	Figure 5
Date 7/17/2026	
Scale 1"=300'	
Drawn By CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 5:19 PM



N

W E

S

Legend

- Proposed Groundwater Monitoring Well Location
- Proposed Gauging Station Location
- Groundwater Monitoring Well Location
- PAB Water Supply Well Location – Manokin Aquifer
- PAB Water Supply Well Location – Shallow Aquifer
- Out of Service PAB Residential Style Water Supply Well Location
- Gauging Station Location
- Streams and Waterbody Boundaries
- Site Boundary
- PFAS Areas of Interest

Notes:

1. All site feature locations are approximate.
2. Imagery provided through Langan's subscription to Nearmap.com. Flown 2/23/2025.
3. Feature labels are based on information obtained during Langan site visits on 11/12/2024 and 1/8/2025, and on POWER Engineers, Inc. "Site Plan with Oil Storage Locations," prepared 4/16/2018, and Perdue Agribusiness LLC "Stormwater Pollution Prevention Plan, SP3 Figure 5," prepared 2/16/2024.
4. Sample locations, wells, gauging stations and comingled manhole were surveyed by Langan.
5. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
6. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 300 600

SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

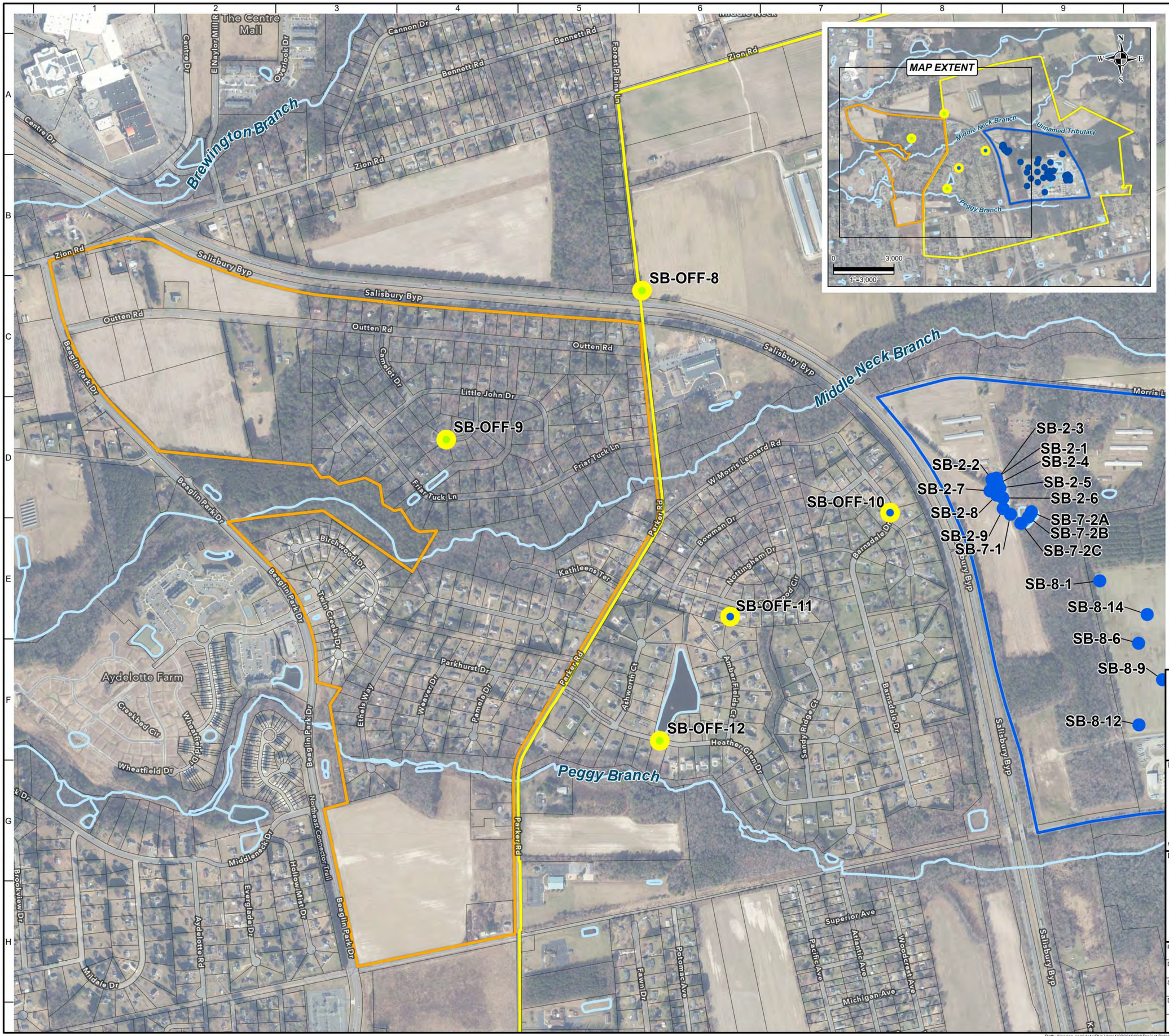
Drawing Title

PROPOSED ON-SITE SUPPLEMENTAL MONITORING WELL LOCATIONS

Project No.	Figure
220210101	6
Date: 7/17/2026	
Scale: 1"=300'	
Drawn By: CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 5:27 PM



LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

Drawing Title

PROPOSED OFF-SITE SOIL SAMPLE LOCATIONS – WEST OF SITE

Project No. 220210101	Figure 7A
Date 7/17/2026	
Scale 1"=500'	
Drawn By CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 5:26 PM



Notes:

1. Only proposed samples West of the site are currently shown, for off-site proposed sample locations South of the site, refer to "Figure 8B - Proposed Off-Site Groundwater Grab Sample and Surface Water Investigation Locations – South of Site."
2. All site feature locations are approximate.
3. Imagery is provided by the State of Maryland, Department of Information Technology, iMAP.
4. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
5. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 500 1,000
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

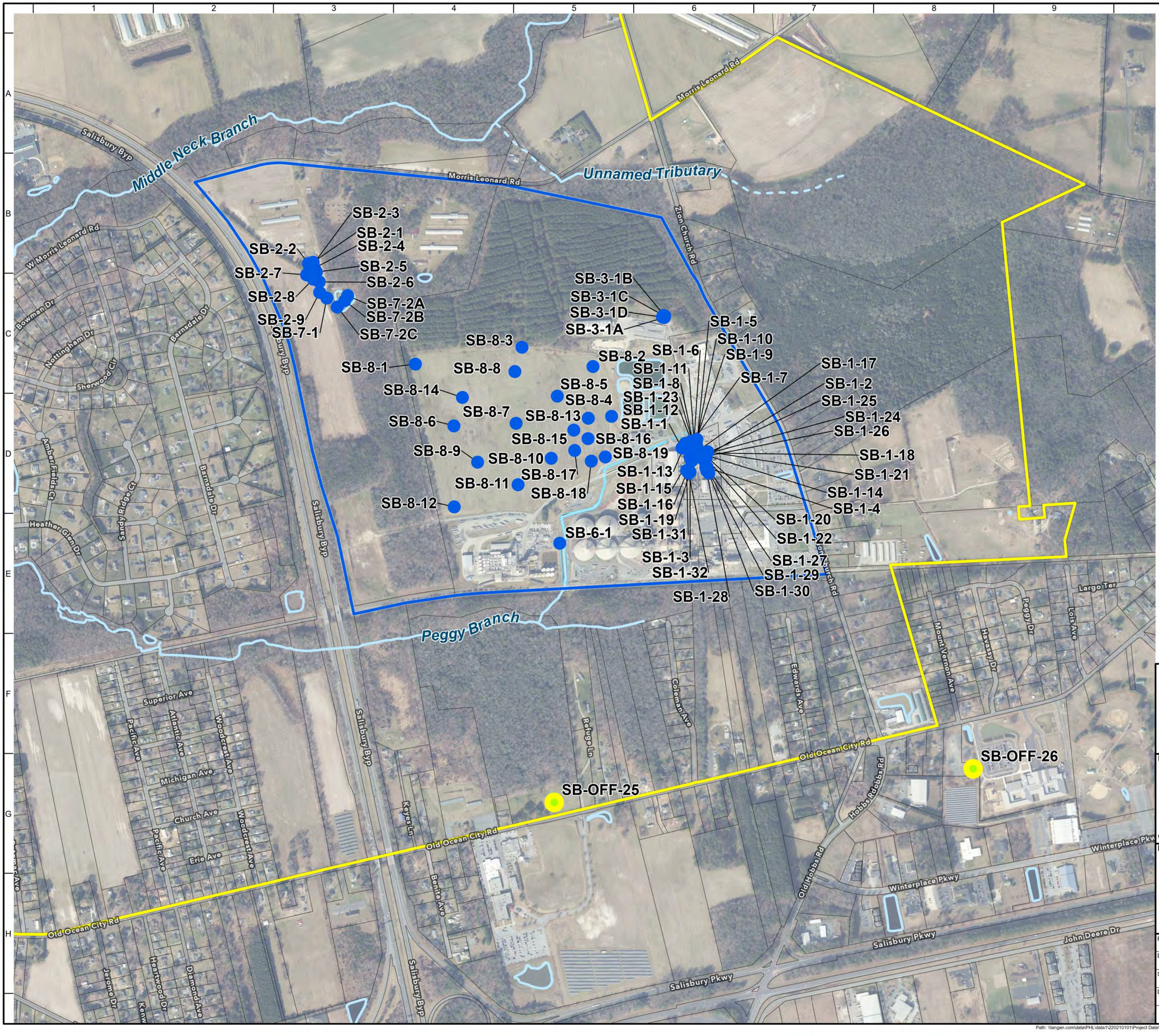
Drawing Title

PROPOSED OFF-SITE GROUNDWATER GRAB SAMPLE AND SURFACE WATER INVESTIGATION LOCATIONS – WEST OF SITE

Project No. 220210101	Figure 7B
Date 7/17/2026	
Scale 1"=500'	
Drawn By CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 4:38 PM



N
W E
S

Legend

- Sampled,Soil Sample Location
- Proposed Lithology Boring Location
- Streams and Waterbody Boundaries
- Site Boundary
- Initial Testing Area
- Expanded Testing Area
- Parcel Boundaries

Notes:

1. Only proposed soil samples south of the site are currently shown, for off-site proposed soil sample locations west of the site, refer to "Figure 7A - Proposed Off-Site Soil Sample Locations – West of Site."
2. All site feature locations are approximate.
3. Imagery is provided by the State of Maryland, Department of Information Technology, iMAP.
4. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
5. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 500 1,000
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

Drawing Title

PROPOSED OFF-SITE SOIL SAMPLE LOCATIONS – SOUTH OF SITE

Project No.	Figure
220210101	8A
Date: 7/17/2026	
Scale: 1"=500'	
Drawn By: CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 4:42 PM



Legend

- Proposed Groundwater Grab Sample Location
- Groundwater Grab Sample Location
- Streams and Waterbody Boundaries
- Site Boundary
- Initial Testing Area
- Expanded Testing Area
- Parcel Boundaries

Notes:

1. Only proposed samples south of the site are currently shown, for off-site proposed sample locations west of the site, refer to "Figure 7B - Proposed Off-Site Groundwater Grab Sample and Surface Water Investigation Locations – West of Site."
2. All site feature locations are approximate.
3. Imagery is provided by the State of Maryland, Department of Information Technology, iMAP.
4. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
5. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 500 1,000
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

Drawing Title

PROPOSED OFF-SITE GROUNDWATER GRAB SAMPLE INVESTIGATION LOCATIONS – SOUTH OF SITE

Project No. 220210101	Figure 8B
Date 7/17/2026	
Scale 1"=500'	
Drawn By CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 5:25 PM



Legend

- Proposed Surface Water Sample Location
- Proposed Gauging Station Location
- Streams and Waterbody Boundaries
- Site Boundary
- Initial Testing Area
- Expanded Testing Area
- Parcel Boundaries

Notes:

1. All site feature locations are approximate.
2. Imagery is provided by the State of Maryland, Department of Information Technology, iMAP.
3. Streams and waterbody boundaries provided by Wicomico County, City of Salisbury, Department of Information Services: GIS Division.
4. Unnamed tributary extent is dashed where inferred and was estimated using field reconnaissance, Google maps, and Verdantas LLC's February 2023 Stormwater Drainage Figure provided by Perdue.

0 1,200 2,400
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, LLC

1818 Market Street, Suite 3300
Philadelphia, PA 19103-3638

T: 215.845.8946 F: 215.845.8901 www.langan.com

Project

PERDUE AGRIBUSINESS, LLC

SALISBURY

WICOMICO COUNTY MARYLAND

Drawing Title

PROPOSED OFF-SITE SURFACE WATER SAMPLE AND GAUGE LOCATIONS

Project No. 220210101	Figure 9
Date 7/17/2026	
Scale 1"=1,200'	
Drawn By CH	

© 2026 Langan

Path: \\langan.com\data\PHL\data1\220210101\Project Data\ArcGIS\APRX\220210101\220210101_2026.aprx Date: 7/17/2026 User: gthorp Time: 5:07 PM

Appendix A
Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN; PER AND POLYFLUOROALKYL SUBSTANCES (PFAS) SUPPLEMENTAL INVESTIGATION WORKPLAN, PERDUE AGRIBUSINESS LLC ZION CHURCH ROAD FACILITY

for

Perdue AgriBusiness LLC
6906 Zion Church Road
Salisbury, Maryland

Prepared for:

Perdue AgriBusiness LLC
P.O. Box 1537
Salisbury, MD 21802-1537

Prepared by:

Langan Engineering and Environmental Services, LLC
1818 Market Street, Suite 3300
Philadelphia, Pennsylvania 19103

June 5, 2026
Langan Project No.: 220210101

LANGAN

TABLE OF CONTENTS

1.0 PROJECT DESCRIPTION 1
1.1 Introduction 1
1.2 Project Purpose and Scope 1
2.0 DATA QUALITY OBJECTIVES AND PROCESS 2
3.0 PROJECT ORGANIZATION 4
4.0 QUALITY ASSURANCE OBJECTIVES FOR COLLECTION OF DATA 5
4.1 Precision 5
4.2 Accuracy 5
4.3 Completeness 6
4.4 Representativeness 6
4.5 Comparability 7
4.6 Sensitivity 7
5.0 SAMPLE COLLECTION AND FIELD DATA ACQUISITION PROCEDURES 9
5.1 Field Documentation Procedures 9
5.1.1 Field Data and Notes 9
5.1.2 Sample Labeling 10
5.2 Equipment Calibration and Preventative Maintenance 11
5.3 Sample Collection 12
5.3.1 Field Samples 12
5.3.2 Duplicates and Equipment Blanks 13
5.4 Sample Containers and Handling 13
5.5 Special Considerations for PFAS Sample Collection 13
5.6 Sample Preservation 14
5.7 Sample Shipment 14
5.7.1 Packaging 14
5.7.2 Shipping 14
5.8 Decontamination Procedures 15
5.9 Residuals Management 15
5.10 Chain of Custody Procedures 15
5.11 Laboratory Sample Storage Procedures 19
6.0 DATA REDUCTION, VALIDATION, AND REPORTING 20

6.1 Introduction 20
6.2 Data Reduction 20
6.3 Data Validation 20
6.4 Reporting 22
7.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS 23
7.1 Introduction 23
7.2 System Audits 23
7.3 Performance Audits 23
7.4 Formal Audits 23
8.0 CORRECTIVE ACTION 25
8.1 Introduction 25
8.2 Procedure Description 25
9.0 REFERENCES 28

FIGURES

Figure 5.1 Sample Custody Process....17

Figure 5.2 Chain-of-Custody Record - Water 18

Figure 8.1 Corrective Action Request....27

Attachments

Attachment A Laboratory Reporting Limits and Method Detection Limits

Attachment B Analytical Methods and Quality Assurance Summary Table

Attachment C Laboratory Quality Manual, Analytical Methods, and Certifications

1.0 PROJECT DESCRIPTION

1.1 Introduction

This Quality Assurance Project Plan (QAPP) was prepared on behalf of Perdue AgriBusiness LLC (Perdue AgriBusiness) to describe the quality assurance/quality control (QA/QC) procedures that will be used during soil, surface water, and groundwater sampling for certain per- and polyfluoroalkyl substances (PFAS), nitrate, boron, and anthropogenic indicators (carbamazepine, sulfamethoxazole, acesulfame, sucralose, caffeine, and paraxanthine) at the Perdue AgriBusiness facility located at 6906 Zion Church Road, Salisbury, Maryland ("ZCR Facility" or "Site"). Perdue AgriBusiness has retained Langan to perform this soil and water (surface, and groundwater) sampling and analysis.

This QAPP specifies analytical methods to obtain groundwater, surface water, and soil sampling data that is precise, accurate, representative, comparable, complete, and sensitive of this project's requirements. As specified in Maryland Department of the Environment (MDE)-approved Tier III data requirements, this QAPP has been prepared in general accordance with:

- United States Environmental Protection Agency (EPA) Guidance for Quality Assurance Project Plans (EPA, 2002); and
- Maryland's Assessment Methodologies (MDE, 2024).
- Maryland's Department of the Environment Cleanup Standards for Soil and Groundwater.

1.2 Project Purpose and Scope

The project purpose and scope are described in Langan's *Per and Polyfluoroalkyl Substances (PFAS) Supplemental Investigation Workplan, Perdue AgriBusiness, LLC Zion Church Road Facility* dated June 5, 2026.

2.0 DATA QUALITY OBJECTIVES AND PROCESS

Data Quality Objectives (DQO) are qualitative and quantitative statements to obtain data of known and appropriate quality. DQOs for sampling activities are determined by evaluating five factors:

- Data needs and uses: The types of data required and how the data will be used after it is obtained.
- Parameters of Interest: The types of chemical or physical parameters required for the intended use.
- Level of Concern: Levels of constituents, which may require remedial actions or further investigations.
- Required Analytical Level: The level of data quality, data precision, and QA/QC documentation required for chemical analysis.
- Required Detection Limits: The detection limits necessary based on the above information.

The quality assurance and quality control objectives for measurement data include:

- **Precision** – an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal quality control (QC) duplicates and/or matrix spike duplicates.
- **Accuracy** – a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. Accuracy will be determined through the assessment of the analytical results of equipment blanks. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), internal standards, laboratory method blanks, instrument calibration, and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.
- **Representativeness** – expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. Compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession aids in obtaining representativeness in the laboratory. This is accomplished by following applicable methods, laboratory-issued standard operating procedures (laboratory-issued

SOPs), the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

- **Completeness** – the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested.
- **Comparability** – expresses the degree of confidence with which one data set can be compared to another. The comparability of data collected for this project will be obtained using several procedures, including standard methods for sampling and analysis as documented in the QAPP, using standard reporting units and reporting formats, and data validation.
- **Sensitivity** – the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and quality assurance (QA) personnel, sampling and analytical procedures that achieve the required levels of detection.

The above objectives are discussed in detail in Section 4.0.

3.0 PROJECT ORGANIZATION

Soil and water sampling will be overseen by Langan on behalf of Perdue AgriBusiness. Langan will also arrange data analysis and reporting tasks. The analytical services will be performed by an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory. Data validation services will be performed by Langan. Sampling will be performed by Langan, and the PFAS, nitrate, and boron analytical services will be performed by Pace Analytical Services, LLC (Pace) (formerly Alpha Analytical) of Mansfield, Massachusetts (ELAP accreditation number 206224). The laboratory that will analyze the anthropogenic indicators (carbamazepine, sulfamethoxazole, acesulfame, sucralose, caffeine, and paraxanthine) has not been determined at this time. Data validation services will be performed by Joseph Conboy and Mariana Wissink of Langan.

Key contacts for this project are summarized below.

Personnel	Investigation Role	Contact Information
Jeffrey Smith, P.G. Langan	Project Director/ Senior Associate	Phone – 215-694-7549 Email – jsmith@langan.com
Adam Hackenberg, P.G. Langan	PFAS Subject Matter Expert / Senior Project Manager	Phone – 267-939-3236 Email – ahackenberg@langan.com
Anna Willett, P.E. Langan	Senior Project Manager; Quality Assurance Officer (QAO) / PFAS Subject Matter Expert	Phone – 571-591-5548 Email – awillett@langan.com
To Be Determined	Field Task Manager	To Be Determined
Joseph Conboy Langan	Data Validator / Program Quality Assurance Manager (QAM)	Phone – 609-282-8055 Email – jconboy@langan.com
Mariana Wissink Langan	Data Validator / Program QAM	Phone – 973-560-4885 Email – mwissink@langan.com
Alycia Mogayzel Pace Analytical Services, LLC	Laboratory Representative	Phone – 508-844-4120 Email – Alycia.mogayzel@pacelabs.com

4.0 QUALITY ASSURANCE OBJECTIVES FOR COLLECTION OF DATA

The overall quality assurance and quality control objectives for measurement data include precision, accuracy, representativeness, completeness, comparability, and sensitivity. These objectives are defined in following subsections. Variances from the quality assurance objectives during the investigation will result in the implementation of appropriate corrective measures and an assessment of the impact of corrective measures on the usability of the data.

4.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Field precision is assessed through the collection and measurement of field duplicates. Laboratory precision and sample heterogeneity also contribute to the uncertainty of field duplicate measurements. This uncertainty is taken into account during the data assessment process. The following field duplicate precision criteria will be applied for aqueous samples:

- Results greater than 5 times the laboratory reporting limit (RL) must have a relative percent difference (RPD) $\leq 30\%$.
- Results less than 5 times the RL must have an absolute difference $\leq \pm$RL.

The following field duplicate precision criteria will be applied for soil samples:

- Results greater than 5 times the laboratory reporting limit (RL) must have a relative percent difference (RPD) $\leq 50\%$.
- Results less than 5 times the RL must have an absolute difference $\leq \pm 2$RL.

RLs and method detection limits (MDL) are provided in Attachment A.

Laboratory precision is assessed through the analysis of matrix spike/matrix spike duplicates (MS/MSD), laboratory control sample/laboratory control sample duplicates (LCS/LCSD) and subsequent calculation of RPD. For outliers, if additional sample volume is present, the MS/MSD should be reanalyzed and the RPD recomputed. If additional volume is not present, an evaluation will be performed to determine the extent of potential matrix interference.

4.2 Accuracy

Accuracy is the measurement of the reproducibility of the sampling and analytical methodology. It should be noted that precise data may not be accurate data. For the purpose of this QAPP, bias is defined as the constant or systematic distortion of a measurement process, which manifests itself as a persistent positive or negative deviation from the known or true value. This may be due to (but not limited to) improper sample collection, sample matrix, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques.

Accuracy in the field is assessed through the use of equipment blanks and through compliance to sample handling, preservation, and holding time requirements. Equipment blanks should be non-detect when analyzed by the laboratory. Contaminant detected in an associated equipment blank will be evaluated against laboratory blanks (preparation or method) and evaluated against field samples collected on the same day to determine potential for bias.

Laboratory accuracy is assessed by evaluating the percent recoveries of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCS), surrogate compound recoveries, and the results of method preparation blanks. MS/MSD, LCS, and surrogate percent recoveries will be compared to either method-specific control limits or laboratory-derived control limits. Sample volume permitting, samples displaying outliers should be reanalyzed. Associated method blanks should be non-detect when analyzed by the laboratory.

4.3 Completeness

Laboratory completeness is the ratio of total number of samples analyzed and verified as acceptable compared to the number of samples submitted to the fixed-base laboratory for analysis, expressed as a percent. Three measures of completeness are defined:

- Sampling completeness, defined as the number of valid samples collected relative to the number of samples planned for collection;
- Analytical completeness, defined as the number of valid sample measurements relative to the number of valid samples collected; and
- Overall completeness, defined as the number of valid sample measurements relative to the number of samples planned for collection.

Data will be subject to a 90% completeness criterion. If the criterion is not met, sample results will be evaluated for trends in rejected and unusable data. The effect of unusable data required for a determination of compliance will also be evaluated. Each individual sample result will be evaluated relative to appropriate screening levels.

4.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. This is performed by following applicable SOPs and this QAPP. Field technicians will be given copies of appropriate documents prior to sampling events and are required to read, understand, and follow each document as it pertains to the tasks at hand.

Representativeness in the laboratory is certified by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is performed by following applicable United States Environmental Protection Agency (USEPA) methods, laboratory-issued SOPs, the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

4.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. The comparability of data collected for this project will be checked by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of analytical standards and/or source materials to the USEPA or National Institute of Standards and Technology (NIST);
- Requiring that calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in cases where appropriate; and
- Requiring that validation qualifiers be used when an analytical result is used.

These steps will enable future users of either the data or the conclusions drawn from them to judge the comparability of these data and conclusions.

4.6 Sensitivity

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The Project Director (or designee) will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection and QC acceptance limits that meet established performance criteria. Concurrently, the Project Manager (or designee) will select the level of data assessment so that only data meeting the project DQOs are used in decision-making.

Field equipment will be used that can achieve the required levels of detection for analytical measurements in the field. In addition, the field sampling staff should collect and submit full volumes of samples as required by the laboratory for analysis, whenever possible. Full volume aliquots will help achieve the required limits of detection and allow for reanalysis if necessary. The concentration of the lowest level check standard in a multi-point calibration curve will represent the reporting limit.

Analytical methods and quality assurance parameters associated with the sampling program are presented in Attachment B. The frequency of associated field blanks and duplicate samples is described in Section 5.3.

Site-specific MS/MSD samples will be prepared and analyzed by the analytical laboratory by spiking an aliquot of submitted sample volume with analytes of interest. Additional sample volume is not required by the laboratory for this purpose, so long as the full volume required for the sample analysis is collected. An MS/MSD analysis will be analyzed at a rate of 1 out of every 20 samples, or one per analytical batch.

5.0 SAMPLE COLLECTION AND FIELD DATA ACQUISITION PROCEDURES

Personnel performing sampling should follow Langan's project-specific SOPs. The following sections describe procedures to be followed for specific tasks.

5.1 Field Documentation Procedures

Field documentation procedures will include summarizing field observations in field books and/or electronic logs, completing forms for sampling, and proper sample labeling. These procedures are described in the following sections.

5.1.1 Field Data and Notes

Field notebooks, electronic logs, and/or field data sheets will be used to record documentary evidence regarding procedures used and tasks performed by field personnel. Hard cover, bound field notebooks will be used because of their compact size, durability, and secure page binding. Field books with waterproofing should not be used because of the possible presence of PFAS compounds. The pages of the notebook will not be removed. An appropriate electronic system will also be used to record certain field notes and sample logs.

Paper entries will be made in blue or black ink. No erasures will be allowed. If an incorrect entry is made, the information should be crossed out with a single strike mark and the change initialed and dated by the team member making the change. Each entry should be dated. Entries should be legible and contain accurate and thorough documentation of the individual or sampling team's activities or observations made. The level of detail should be sufficient to explain and reconstruct the activity conducted. Each entry should be signed by the person(s) making the entry.

The following types of information should be provided for each sampling task, as appropriate:

- Project name and number.
- Reasons for being onsite or taking the sample.
- Date and time of activity.
- Sample identification numbers.
- Geographical location of sampling points with references to the site, other facilities or a map coordinate system. Sketches will be made in the field logbook when appropriate.
- Physical location of sampling locations.
- Description of the method of sampling including procedures followed, equipment used and departure from the specified procedures.
- Description of the sample including physical characteristics, odor, etc.
- Readings obtained from health and safety equipment.

- Weather conditions at the time of sampling and previous meteorological events that may affect the representative nature of a sample.
- Photographic information including a brief description of what was photographed, the date and time, the compass direction of the picture and the number of the picture on the camera.
- Other pertinent observations such as the presence of other persons on the site, actions by others that may affect performance of site tasks, etc.
- Names of sampling personnel and signature of persons making entries.

Field records may also be collected on field data sheets. Field data sheets should include the project number and stored in the field project files when not in use. At the completion of the field activities, the field data sheets will be maintained in the central project file.

5.1.2 Sample Labeling

Each sample collected will be assigned a unique identification number and placed in an appropriate sample container. Each sample container will have a sample label affixed to the outside with the date and time of sample collection and project name. In addition, the label will contain the sample identification number, analysis, and chemical preservatives added, if any. Samplers will avoid the use of Sharpies and other thick markers because they may contain PFAS compounds. Documentation will be completed in waterproof ink.

Sample nomenclature will be as follows:

SB-#-depth_YYYYMMDD for soil samples

MW-#-#_YYYYMMDD or MW-#_YYYYMMDD for groundwater samples from monitoring wells

WS-#-#_YYYYMMDD for surface water samples

Where,

- The first "#" is the Area of Interest (AOI) numbers or, if there is only one "#", this is the soil, monitoring well, or surface water sample number
- The second "#" is the sequential soil, monitoring well, or surface water sample number within each AOI (these are predetermined and identified in the accompanying Workplan),
- YYYYMMDD is the sample date, four digit year followed by two-digit month and day

GW-#-depth_YYYYMMDD for groundwater samples from groundwater grab borings

Where,

- The first "#" is the sequential groundwater grab sample number (predetermined and identified in the accompanying Workplan),

- The depth for groundwater grab samples is represented as a depth interval given in feet (e.g., "10-14"),
- YYYYMMDD is the sample date, four digit year followed by two-digit month and day

GW-OFF-#-depth_YYYYMMDD for off-Site groundwater samples from groundwater grab borings

SB-OFF-#-depth_YYYYMMDD for off-Site soil samples

Where,

- The first "#" is the sequential groundwater grab sample number (predetermined and identified in the accompanying Workplan),
- The depth for groundwater grab samples is represented as a depth interval given in feet (e.g., "10-14"),
- YYYYMMDD is the sample date, four digit year followed by two-digit month and day

QA/QC sample nomenclature will be as follows:

EB-#_YYYYMMDD for Equipment Blank (QA/QC Sampling)

DUP-#_YYYYMMDD for Duplicate (QA/QC Sampling)

Source-Water-#_YYYYMMDD for samples of source water being used for drilling and decontamination purposes

Where,

- The "#" is the numbering sequence for each type QA/QC sample collected on a given day (e.g., the first duplicate on a given day would be "DUP-1," the second would be "DUP-2," etc.)
- YYYYMMDD is the sample date, four-digit year followed by two-digit month and day

Field personnel should record the location, and a detailed description of, QC samples in the field book and/or electronic log including the reason for the QC sample, sampling procedures, and associated parent samples (in the case of duplicates).

5.2 Equipment Calibration and Preventative Maintenance

At a minimum, field calibration and/or field equipment checking should be performed once daily, prior to use. Field calibration will be documented in the field notebook, electronic logs, or on field data sheets. Entries made regarding the status of field equipment should include the following information:

- Date and time of calibration
- Type of equipment serviced and identification number (such as serial number)

- Reference standard used for calibration
- Calibration and/or maintenance procedure used
- Other pertinent information

A water quality meter (Horiba U-52 or or similar) will be used during purging of water to measure field water quality parameters as specified in the applicable SOP. Water-quality meters should be calibrated, and the results documented before use each day using standardized field calibration procedures and calibration checks.

A photoionization detector (PID) will be used during soil logging to measure VOCs and other volatile gases for health and safety monitoring purposes. PIDs should be calibrated, and the results documented before use each day using standardized field calibration procedures and calibration checks.

Equipment that fails calibration or becomes inoperable during use should be removed from service and segregated to prevent inadvertent utilization. The equipment should be properly tagged to indicate that it is out of calibration. Such equipment should be repaired and recalibrated to the manufacturer's specifications by qualified personnel. Equipment that cannot be repaired should be replaced.

Off-site calibration and maintenance of field instruments should be performed as appropriate throughout the duration of project activities. Field instrumentation, sampling equipment and accessories should be maintained in accordance with the manufacturer's recommendations and specifications and established field equipment practice. Off-site calibration and maintenance should be performed by qualified personnel. A logbook, tablet, or field data sheet will be kept to document that established calibration and maintenance procedures have been followed. Documentation should include both scheduled and unscheduled maintenance.

5.3 Sample Collection

5.3.1 Field Samples

Personnel performing sampling should follow Langan's project-specific SOPs.

Samples should be collected directly into pre-cleaned laboratory-supplied bottles. Samples collected for PFAS analysis will be collected into HDPE containers. After collection, sample bottles will be capped and securely tightened, and placed in iced coolers to attempt to maintain a temperature of less than 6°C until they are transferred to the laboratory for analysis, in accordance with the procedures outlined in Section 5.4. Analysis and/or extraction and digestion of collected samples should meet the holding times required as specified in Attachment B. In addition, analysis of collected samples should meet quality assurance criteria set forth by this QAPP.

5.3.2 Duplicates and Equipment Blanks

Field blanks should be collected at a rate of 5% of the total number of samples. Duplicate samples will be collected and analyzed for quality assurance purposes. Duplicate samples should be collected at a frequency of a minimum of 5% of the total number of samples and should be submitted to the laboratory as "blind" duplicate samples. If fewer than 20 samples are collected during a particular sampling event, one duplicate sample will be collected.

Equipment blank and source water samples should be collected at the frequency, and using the methods specified in, Langan's project-specific SOPs. The purpose of the equipment blanks is to evaluate potential interference or cross-contamination from sampling equipment or other potential sources. The purpose of the source water samples is to evaluate the PFAS content of water that is to be used for drilling and decontamination purposes (i.e., water that may come into contact with field samples).

5.4 Sample Containers and Handling

Certified, commercially clean sample containers will be obtained from the analytical laboratory. The laboratory will also prepare and supply the required duplicate, equipment blank, and source water sample containers and reagent preservatives. Sample bottle containers will be placed into plastic coolers by the laboratory. Prior to the commencement of field work, Langan field personnel will fill the plastic coolers with ice in Ziploc® bags (or equivalent) to attempt to maintain a temperature at or below 6°C.

Samples collected in the field for laboratory analysis will be placed directly into the laboratory-supplied sample containers. Samples will then be placed and stored on-ice in laboratory provided coolers until shipment to the laboratory. Samples may also be stored in a secured, access-controlled, refrigerator at the Site while awaiting shipment to the laboratory. Blue ice will not be used to cool PFAS samples.

Possession of samples collected in the field will be traceable from the time of collection until they are analyzed by the analytical laboratory or are properly disposed. Chain-of-custody procedures, described in Section 5.10, will be followed to maintain and document sample possession. Samples should be packaged and shipped as described in Section 5.7.

5.5 Special Considerations for PFAS Sample Collection

Special considerations apply to the collection of samples for PFAS analysis to prevent cross-contamination, which are detailed in the PFAS Investigation SOPs, included as an Appendix to the *PFAS Supplemental Investigation Workplan*.

PFAS will be analyzed using USEPA Method 1633A. The laboratory will report the 40 compounds listed in the method. A subset of aqueous samples will additionally be analyzed for nitrate, boron,

anthropogenic indicators (carbamazepine, sulfamethoxazole, acesulfame, sucralose, caffeine, and paraxanthine) and/or analyzed using Total Oxidizable Precursor (TOP) methodology.

The laboratory reporting limits for PFAS are indicated in Attachment A. The laboratory-issued SOP for PFAS analysis, PFAS compound sampling protocol, and associated laboratory accreditation are provided in Attachment C.

5.6 Sample Preservation

Sample preservation measures will be used in an attempt to prevent sample decomposition by contamination, degradation, biological transformation, chemical interactions and other factors during the time between sample collection and analysis. Preservation will commence at the time of sample collection and will continue until analyses are performed. Should chemical preservation be required, the analytical laboratory will add the preservatives to the appropriate sample containers before shipment to the office or field. Samples will be preserved according to the requirements of the specific analytical method selected, as summarized in Attachment B, and detailed in Attachment C.

5.7 Sample Shipment

5.7.1 Packaging

Sample containers will be placed in plastic coolers. Ice placed in Ziploc® bags (or similar) will be placed around sample containers. Blue ice will not be used to cool PFAS samples. Cushioning material will be added around the sample containers if necessary. Chains-of-custody and other paperwork will be placed in a Ziploc® bag (or similar) and placed inside the cooler. The cooler will be taped closed and custody seals will be affixed to one side of the cooler at a minimum. Samples may also be stored in a secured, access-controlled, refrigerator at the Site while awaiting shipment to the laboratory. If the samples are being shipped by an express delivery company (e.g. FedEx) then laboratory address labels will be placed on top of the cooler.

5.7.2 Shipping

Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below.

Environmental samples will be transported to the laboratory by a laboratory-provided courier or an express delivery company (e.g., FedEx) under the chain-of-custody protocols described in Section 5.10.

Prior notice should be provided to the laboratory regarding when to expect shipped samples. If the number, type or date of shipment changes due to site constraints or program changes, the laboratory should be informed.

5.8 Decontamination Procedures

Special considerations apply for decontamination procedures to prevent cross-contamination when sampling for PFAS, which are detailed in the applicable SOPs that are attached to the *PFAS Supplemental Investigation Workplan*.

5.9 Residuals Management

Debris (e.g., paper, plastic and disposable personal protective equipment [PPE]) should be collected in plastic garbage bags and disposed of as non-hazardous industrial waste using appropriate receptacles at the Facility. Debris is expected to be transported to a local municipal landfill for disposal.

Investigation derived wastes should be properly managed as indicated in the applicable SOPs that are attached to the *PFAS Supplemental Investigation Workplan*.

5.10 Chain of Custody Procedures

A chain-of-custody protocol has been established for collected samples that will be followed during sample handling activities in both field and laboratory operations. The primary purpose of the chain-of-custody procedures is to document the possession of the samples from collection through shipping, storage and analysis to data reporting and disposal. Chain-of-custody refers to actual possession of the samples. Samples are considered to be in custody if they are within sight of the individual responsible for their security or locked in a secure location. Each person who takes possession of the samples, except the shipping courier, is responsible for sample integrity and safe keeping. Chain-of-custody procedures are provided below:

Chain-of-custody will be initiated by the laboratory supplying the pre-cleaned and prepared sample containers. Chain-of-custody forms will accompany the sample containers.

Following sample collection, the chain-of-custody form will be completed for the sample collected. The sample identification number, date and time of sample collection, analysis requested and other pertinent information (e.g., preservatives) will be recorded on the form. Entries will be made in blue or black ink.

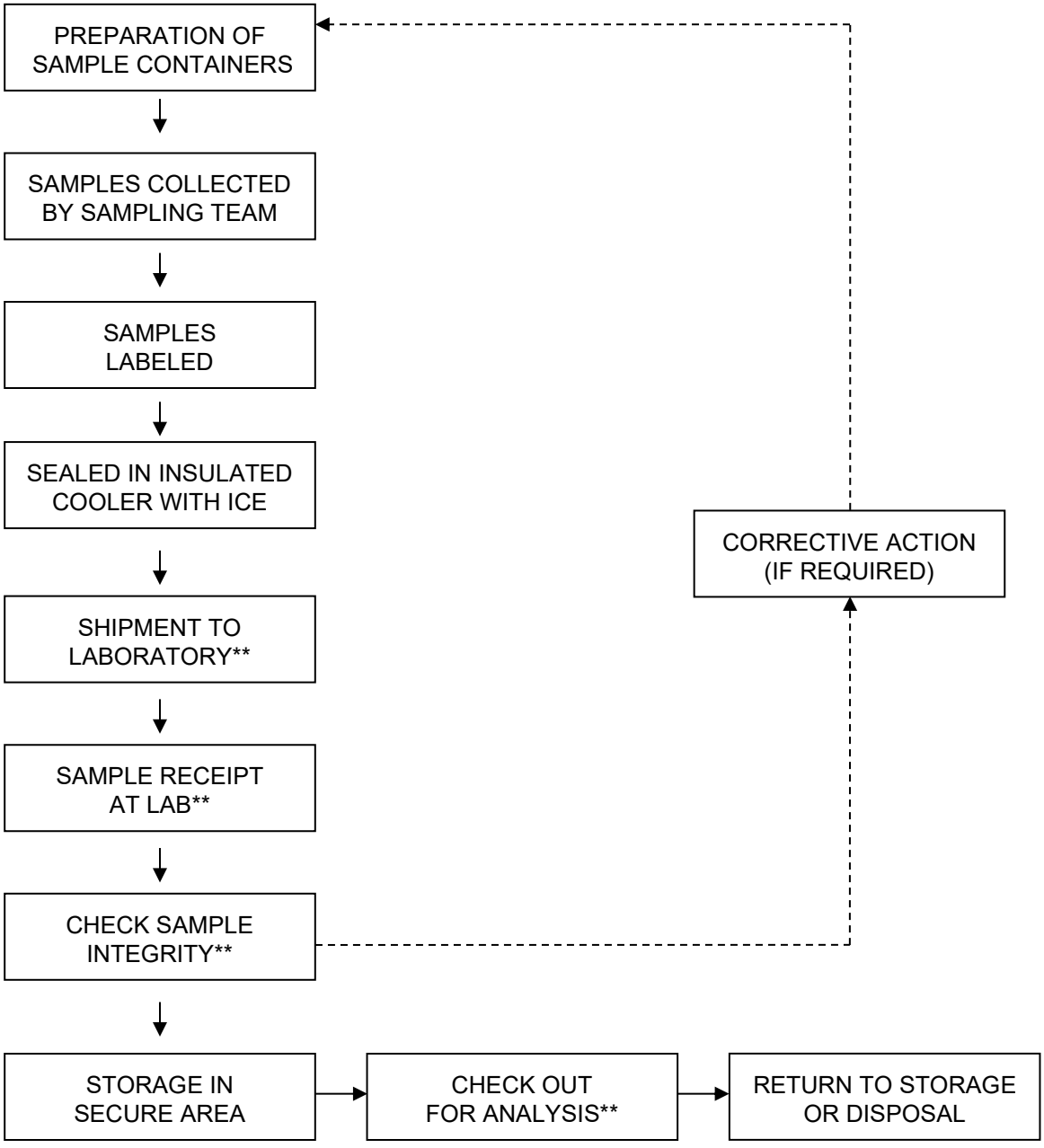
Langan field personnel will be responsible for the care and custody of the samples collected until the samples are transferred to another party, dispatched to the laboratory, or disposed. The sampling team leader will be responsible for enforcing chain-of-custody procedures during field work.

When the form is full or when samples have been collected that will fit in a single cooler, the sampling team leader will check the form for possible errors and sign the chain-of-custody form. Necessary corrections will be made to the record with a single strike mark, dated, and initialed.

Sample coolers will be accompanied by the chain-of-custody form, sealed in a Ziploc®® bag (or similar) and placed on top of the samples or taped to the inside of the cooler lid. If applicable, a shipping bill will be completed for each cooler and the shipping bill number recorded on the chain-of-custody form.

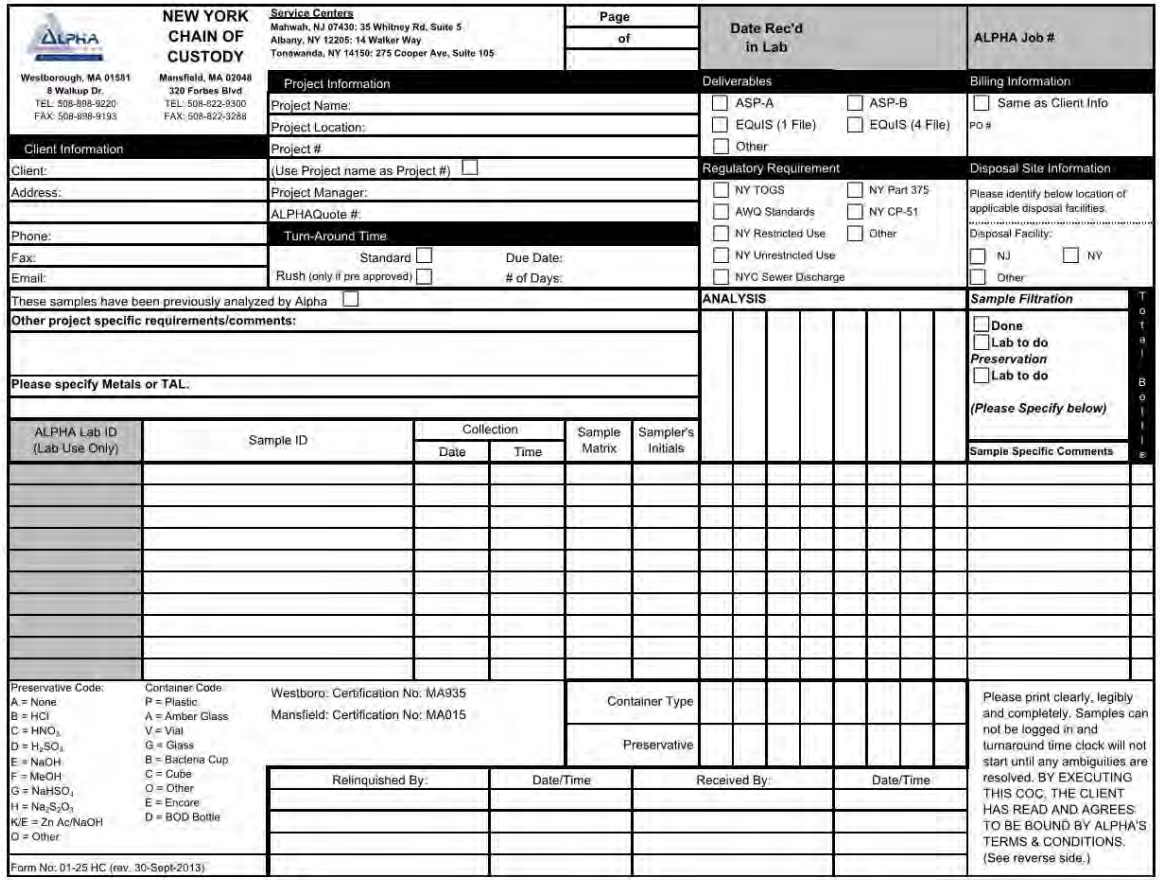
Samples will be packaged for shipment to the laboratory with the appropriate chain-of-custody form. A copy of the form will be retained by the sampling team for the project file and the original will be sent to the laboratory with the samples. Bills of lading will also be retained as part of the documentation for the chain-of-custody records, if applicable. When transferring custody of the samples, the individuals relinquishing and receiving custody of the samples will verify sample numbers and condition and will document the sample acquisition and transfer by signing and dating the chain-of-custody form. This process documents sample custody transfer from the sampler to the analytical laboratory. A flow chart showing a sample custody process is included as Figure 5.1. Blank chain-of-custody forms from Pace are included as Figure 5.2.

Figure 5.1 Sample Custody Process



**REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

Figure 5.2 Sample Chain-of-Custody Form – Water and Soil



NEW YORK CHAIN OF CUSTODY

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

Page of

Date Rec'd in Lab

ALPHA Job #

Project Information
Project Name:
Project Location:
Project #
(Use Project name as Project #)
Project Manager:
ALPHAQuote #:

Deliverables
ASP-A ASP-B
EQuIS (1 File) EQuIS (4 File)
Other

Billing Information
Same as Client Info
PO #

Client Information
Client:
Address:
Phone:
Fax:
Email:

Regulatory Requirement
NY TOGS NY Part 375
AWQ Standards NY CP-51
NY Restricted Use Other
NY Unrestricted Use
NYC Sewer Discharge

Disposal Site Information
Please identify below location of applicable disposal facilities.
Disposal Facility:
NJ NY
Other

Turn-Around Time
Standard Due Date:
Rush (only if pre approved) # of Days:

These samples have been previously analyzed by Alpha

ANALYSIS

Sample Filtration
Done
Lab to do
Preservation
Lab to do
(Please Specify below)

Other project specific requirements/comments:

Please specify Metals or TAL:

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Sample Specific Comments

Total Bottle

Preservative Code:
A = None
B = HCl
C = HNO_3
D = H_2SO_4
E = NaOH
F = MeOH
G = $NaHSO_4$
H = $Na_2S_2O_3$
K/E = Zn Ac/NaOH
O = Other

Container Code
P = Plastic
A = Amber Glass
V = Vial
G = Glass
B = Bacteria Cup
C = Cube
O = Other
E = Encore
D = BOD Bottle

Westboro: Certification No: MA935
Mansfield: Certification No: MA015

Container Type
Preservative

Relinquished By:	Date/Time	Received By:	Date/Time

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. BY EXECUTING THIS COC, THE CLIENT HAS READ AND AGREES TO BE BOUND BY ALPHA'S TERMS & CONDITIONS. (See reverse side.)

Form No: 01-25 HC (rev. 30-Sept-2013)

Laboratory chain-of-custody will be maintained throughout the analytical processes as described in the laboratory's QA Manual. The analytical laboratory will provide a copy of the chain-of-custody in the analytical data deliverable package. The chain-of-custody becomes the permanent record of sample handling and shipment.

5.11 Laboratory Sample Storage Procedures

The subcontracted laboratory will use a laboratory information management system (LIMS) to track and schedule samples upon receipt. Sample anomalies identified during sample log-in should be evaluated on individual merit for the impact on the results and the data quality objectives of the project. When irregularities do exist, the environmental consultant must be notified to discuss recommended courses of action and documentation of the issue must be included in the project file.

For samples requiring thermal preservation, the temperature of each cooler will be recorded immediately upon receipt by the laboratory. Each sample and container will be assigned a unique laboratory identification number and secured within the custody room walk-in coolers designated for new samples. Samples will be, as soon as practical, disbursed in a manner that is functional for the operational team. The temperature of coolers and freezers will be monitored and recorded using a certified temperature sensor. Temperature excursions outside of acceptance criteria (i.e., samples must be below 6°C before samples are received by the laboratory; once received by the lab, samples must be held at or below 6°C until extraction or as otherwise specified by the analytical method) will initiate an investigation to determine whether samples may have been affected. Following analysis, the laboratory's specific procedures for retention and disposal will be followed as specified in the laboratory's SOPs and/or QA manual.

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

6.1 Introduction

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified as per USEPA 1633A. The data package provided by the laboratory will contain items appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis will be attached to the analytical reports.

6.2 Data Reduction

A CLP-Like Level IV lab report and an electronic data deliverable (EDD) will be provided by the laboratory after receipt of a complete sample delivery group. The Project Manager should arrange for archiving the results and preparation of result tables. These tables will be part of the database for assessment of the site contamination condition.

Each EDD deliverable must be formatted using a Microsoft Windows operating system and the Langan specific EQEDD data deliverable format for EQuIS. To avoid transcription errors, data will be loaded directly into the American Standard Code for Information Interchange (ASCII) format from the LIMS. EDDs must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

Data will be compared to appropriate screening levels as indicated in the *PFAS Supplemental Investigation Workplan*.

The Project Manager or Task Manager should maintain close contact with the QA reviewer to communicate non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

6.3 Data Validation

Data validation will be performed in a manner generally consistent with the USEPA Region 2 SOPs for data validation and USEPA's National Functional Guidelines for Organic. Tier 1 data validation (the equivalent of MDE's Tier III validation and USEPA's Stage 2A validation) will be performed to evaluate data quality. Langan Tier 2 data validation (the equivalent of USEPA's Stage 3 validation) will be performed as needed on select sample analyses based on laboratory case narrative notes and professional judgment.

Langan Tier 1 data validation is based on completeness and compliance checks of sample-related QC results including:

- Holding times;
- Sample preservation;
- Blank results (method, trip, and field blanks);
- Surrogate recovery compounds and extracted internal standards (as applicable);
- PFAS Isotope Dilution Standards;
- LCS and LCSD recoveries and RPDs;
- MS and MSD recoveries and RPDs;
- Laboratory duplicate RPDs; and
- Field duplicate RPDs

In addition to the items outlined in Langan Tier 1 data validation, Langan Tier 2 data validation additionally includes:

- Lab QC samples (serial dilution and post-digestion spikes, as applicable)
- Instrument calibration
- Interference check standards

A Data Usability Assessment (DUA) will be prepared by the data validator and reviewed by the QAM before issuance. The DUA will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected. The associated number indicates the approximate sample concentration necessary to be detected significantly greater than the level of the highest associated blank;
- "UJ" - Not detected. Quantitation limit may be inaccurate or imprecise;
- "J" - Analyte is present. Reported value may be associated with a higher level of uncertainty than is normally expected with the analytical method;
- "R" – Unreliable result; data is rejected or unusable. Analyte may or may not be present in the sample; and

- No Flag - Result accepted without qualification.

6.4 Reporting

Upon receipt of validated analytical results, sampling results will be prepared and submitted to MDE.

7.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

7.1 Introduction

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the QAO. These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

7.2 System Audits

System audits may be performed by the QAO or designated auditors and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may be performed.

7.3 Performance Audits

The laboratory may be required to conduct an analysis of Performance Evaluation samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

7.4 Formal Audits

Formal audits refer to system or performance audits that are documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating data. Items, activities, and documents determined by lead auditors to be in non-compliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged, and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the non-compliance in a specified and timely manner.

The Project Manager has overall responsibility to promptly and satisfactorily address corrective actions necessary to resolve audit findings. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. Audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

8.0 CORRECTIVE ACTION

8.1 Introduction

The following procedures have been established so that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

8.2 Procedure Description

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

Project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA Method 1633A.

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 8.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify non-compliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that recommended corrective actions are implemented, documented, and approved.

FIGURE 8.1

CORRECTIVE ACTION REQUEST
Number: _____ Date: _____
TO: _____ You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _____
CONDITION:
REFERENCE DOCUMENTS:
RECOMMENDED CORRECTIVE ACTIONS:
_____ _____ _____ _____ _____ _____ Originator Date Approval Date Approval Date
RESPONSE
CAUSE OF CONDITION
CORRECTIVE ACTION (A) RESOLUTION (B) PREVENTION (C) AFFECTED DOCUMENTS
C.A. FOLLOW UP: CORRECTIVE ACTION VERIFIED BY: _____ DATE:_____

9.0 REFERENCES

1. MDE. Department of the Environment Cleanup Standards for Soil and Groundwater, October 2018.
2. MDE. Information about Submitting Water Quality Data for Maryland's Integrated Report. https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Pages/Data-Solicitation.aspx. Accessed October 9, 2024.
3. Taylor, J. K., 1987. Quality Assurance of Chemical Measurements. Lewis Publishers, Inc., Chelsea, Michigan
4. USEPA, 2002. Guidance for Quality Assurance Project Plans. December 2002.
5. USEPA 2017. National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation, EPA-540-R-2017-002, January 2017.
6. USEPA 2024. Method 1633, Revision A. Analysis of Per- and Polyfluoroalkyl (PFAS) in Aquesous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, December 2024.

Attachment A
Laboratory Reporting Limits and Method Detection Limits

Date Created: 05/13/26
Created By: Alycia Mogayzel
File: PM21619-1
Page: 1

PFAAs via EPA 1633 (SOIL)

Holding Time: 90 days
Container/Sample Preservation: 1 - Plastic 90mL Unpreserved for PFAS

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	0.8	0.536	ng/g	70-140	30	70-140	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	0.4	0.08	ng/g	60-150	30	60-150	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	0.2	0.05	ng/g	65-145	30	65-145	30	30			
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	757124-72-4	0.8	0.154	ng/g	60-150	30	60-150	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	0.2	0.164	ng/g	65-140	30	65-140	30	30			
Perfluoropentanesulfonic Acid (PFPeS)	2706-91-4	0.2	0.028	ng/g	55-160	30	55-160	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	0.2	0.072	ng/g	65-145	30	65-145	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	0.2	0.05	ng/g	60-150	30	60-150	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	0.2	0.044	ng/g	70-150	30	70-150	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	0.8	0.48	ng/g	55-200	30	55-200	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	0.2	0.034	ng/g	65-155	30	65-155	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	0.2	0.032	ng/g	70-155	30	70-155	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	0.2	0.104	ng/g	65-160	30	65-160	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	0.2	0.05	ng/g	70-155	30	70-155	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	0.8	0.236	ng/g	70-150	30	70-150	30	30			
Perfluorononanesulfonic Acid (PFNS)	68259-12-1	0.2	0.094	ng/g	55-140	30	55-140	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2355-31-9	0.2	0.096	ng/g	65-155	30	65-155	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	0.2	0.088	ng/g	70-155	30	70-155	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	0.2	0.094	ng/g	40-155	30	40-155	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	0.2	0.114	ng/g	70-140	30	70-140	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	0.2	0.078	ng/g	65-165	30	65-165	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	0.2	0.1	ng/g	70-150	30	70-150	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	0.2	0.092	ng/g	65-150	30	65-150	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	0.2	0.146	ng/g	65-150	30	65-150	30	30			
2,3,3,3-Tetrafluoro-2-[1,1,2,2,3,3,3-Heptafluoropropoxy]-Propanoic Acid (HFPO-DA)	13252-13-6	0.8	0.16	ng/g	70-145	30	70-145	30	30			
4,8-Dioxa-3h-Perfluorononanoic Acid (ADONA)	919005-14-4	0.8	0.284	ng/g	70-160	30	70-160	30	30			
Perfluorododecane Sulfonic Acid (PFDoDS)	79780-39-5	0.2	0.094	ng/g	25-160	30	25-160	30	30			
9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid (9Cl-PF3ONS)	756426-58-1	0.8	0.156	ng/g	70-150	30	70-150	30	30			
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	763051-92-9	0.8	0.396	ng/g	45-160	30	45-160	30	30			
N-Methyl Perfluorooctane Sulfonamide (NMeFOSA)	31506-32-8	0.2	0.06	ng/g	70-155	30	70-155	30	30			
N-Ethyl Perfluorooctane Sulfonamide (NEtFOSA)	4151-50-2	0.2	0.066	ng/g	70-140	30	70-140	30	30			
N-Methyl Perfluorooctanesulfonamido Ethanol (NMeFOSE)	24448-09-7	2	0.25	ng/g	70-140	30	70-140	30	30			
N-Ethyl Perfluorooctanesulfonamido Ethanol (NEtFOSE)	1691-99-2	2	0.242	ng/g	70-135	30	70-135	30	30			
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	377-73-1	0.4	0.036	ng/g	30-140	30	30-140	30	30			
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	863090-89-5	0.4	0.052	ng/g	60-150	30	60-150	30	30			
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	113507-82-7	0.4	0.048	ng/g	70-140	30	70-140	30	30			
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	151772-58-6	0.4	0.12	ng/g	60-155	30	60-155	30	30			
3-Perfluoropropyl Propanoic Acid (3:3FTCA)	356-02-5	1	0.346	ng/g	45-130	30	45-130	30	30			
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3FTCA)	914637-49-3	5	1.404	ng/g	60-130	30	60-130	30	30			
3-Perfluoroheptyl Propanoic Acid (7:3FTCA)	812-70-4	5	1.95	ng/g	60-150	30	60-150	30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	*NONE*									*8-130*		
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	*NONE*									*35-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. ***(Soil/Solids only)***

Please Note that the information provided in this table is subject to change at anytime at the discretion of Pace Analytical Services.

Date Created: 05/13/26
Created By: Alycia Mogayzel
File: PM21619-1

PFAAs via EPA 1633 (SOIL)

Holding Time: 90 days
Container/Sample Preservation: 1 - Plastic 90mL Unpreserved for PFAS

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	*NONE*									*40-135*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	*NONE*									*40-165*		
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	*NONE*									*40-130*		
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	*NONE*									*40-130*		
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	*NONE*									*40-130*		
Perfluoro[13C8]Octanoic Acid (M8PFOA)	*NONE*									*40-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	*NONE*									*40-215*		
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	*NONE*									*40-130*		
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	*NONE*									*40-130*		
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	*NONE*									*40-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	*NONE*									*40-275*		
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	*NONE*									*40-135*		
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	*NONE*									*40-130*		
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	*NONE*									*40-130*		
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	*NONE*									*40-150*		
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	*NONE*									*40-130*		
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	*NONE*									*20-130*		
2,3,3,3-Tetrafluoro-2-[1,1,2,2,3,3,3-Heptafluoropropoxy]-13C3-Propanoic Acid (M3HFPO-DA)	*NONE*									*40-130*		
N-Methyl-d3-Perfluoro-1-Octanesulfonamide (d3-NMeFOSA)	*NONE*									*10-130*		
N-Ethyl-d5-Perfluoro-1-Octanesulfonamide (d5-NEtFOSA)	*NONE*									*10-130*		
2-(N-Methyl-d3-Perfluoro-1-Octanesulfonamido)ethan-d4-ol (d7-NMeFOSE)	*1265205-95-5*									*20-130*		
2-(N-Ethyl-d5-Perfluoro-1-Octanesulfonamido)ethan-d4-ol (d9-NEtFOSE)	*NONE*									*15-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. ***(Soil/Solids only)***
Please Note that the information provided in this table is subject to change at anytime at the discretion of Pace Analytical Services.

Date Created: 05/13/26
Created By: Alycia Mogayzel
File: PM21618-1
Page: 1

PFAAs via EPA 1633A (WATER)

Holding Time: 28 days
Container/Sample Preservation: 2 - Plastic 250ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	6.4	4.288	ng/l	70-140	30	70-140	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	3.2	0.64	ng/l	65-135	30	65-135	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	1.6	0.512	ng/l	60-145	30	60-145	30	30			
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	757124-72-4	6.4	1.488	ng/l	70-145	30	70-145	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	1.6	1.312	ng/l	70-145	30	70-145	30	30			
Perfluoropentanesulfonic Acid (PFPeS)	2706-91-4	1.6	0.368	ng/l	65-140	30	65-140	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	1.6	0.496	ng/l	70-150	30	70-150	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	1.6	0.704	ng/l	65-145	30	65-145	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	1.6	0.4	ng/l	70-150	30	70-150	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	6.4	3.84	ng/l	65-155	30	65-155	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	1.6	0.496	ng/l	70-150	30	70-150	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	1.6	0.256	ng/l	70-150	30	70-150	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	1.6	1.232	ng/l	55-150	30	55-150	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	1.6	0.416	ng/l	70-140	30	70-140	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	6.4	3.056	ng/l	60-150	30	60-150	30	30			
Perfluorononanesulfonic Acid (PFNS)	68259-12-1	1.6	0.528	ng/l	65-145	30	65-145	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2355-31-9	1.6	1.152	ng/l	50-140	30	50-140	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	1.6	0.704	ng/l	70-145	30	70-145	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	1.6	0.752	ng/l	60-145	30	60-145	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	1.6	0.912	ng/l	70-145	30	70-145	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	1.6	0.736	ng/l	70-145	30	70-145	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	1.6	0.8	ng/l	70-140	30	70-140	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	1.6	0.736	ng/l	65-140	30	65-140	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	1.6	1.168	ng/l	60-140	30	60-140	30	30			
2,3,3,3-Tetrafluoro-2-[1,1,2,2,3,3,3-Heptafluoropropoxy]-Propanoic Acid (HFPO-DA)	13252-13-6	6.4	0.944	ng/l	70-140	30	70-140	30	30			
4,8-Dioxa-3h-Perfluorononanoic Acid (ADONA)	919005-14-4	6.4	1.248	ng/l	65-145	30	65-145	30	30			
Perfluorododecane Sulfonic Acid (PFDoDS)	79780-39-5	1.6	0.752	ng/l	50-145	30	50-145	30	30			
9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid (9Cl-PF3ONS)	756426-58-1	6.4	1.248	ng/l	70-155	30	70-155	30	30			
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	763051-92-9	6.4	3.168	ng/l	55-160	30	55-160	30	30			
N-Methyl Perfluorooctane Sulfonamide (NMeFOSA)	31506-32-8	1.6	0.624	ng/l	60-150	30	60-150	30	30			
N-Ethyl Perfluorooctane Sulfonamide (NEtFOSA)	4151-50-2	1.6	0.464	ng/l	65-145	30	65-145	30	30			
N-Methyl Perfluorooctanesulfonamido Ethanol (NMeFOSE)	24448-09-7	16	1.696	ng/l	70-145	30	70-145	30	30			
N-Ethyl Perfluorooctanesulfonamido Ethanol (NEtFOSE)	1691-99-2	16	1.44	ng/l	70-135	30	70-135	30	30			
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	377-73-1	3.2	0.144	ng/l	55-140	30	55-140	30	30			
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	863090-89-5	3.2	0.832	ng/l	60-150	30	60-150	30	30			
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	113507-82-7	3.2	0.4	ng/l	70-140	30	70-140	30	30			
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	151772-58-6	3.2	0.944	ng/l	50-150	30	50-150	30	30			
3-Perfluoropropyl Propanoic Acid (3:3FTCA)	356-02-5	8	2.064	ng/l	65-130	30	65-130	30	30			
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3FTCA)	914637-49-3	40	11.488	ng/l	70-135	30	70-135	30	30			
3-Perfluoroheptyl Propanoic Acid (7:3FTCA)	812-70-4	40	12.08	ng/l	50-145	30	50-145	30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	*NONE*									*5-130*		
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	*NONE*									*40-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. ***(Soil/Solids only)***

Please Note that the information provided in this table is subject to change at anytime at the discretion of Pace Analytical Services.

Date Created: 05/13/26
Created By: Alycia Mogayzel
File: PM21618-1
Page: 2

PFAAs via EPA 1633A (WATER)

Holding Time: 28 days
Container/Sample Preservation: 2 - Plastic 250ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	*NONE*									*40-135*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	*NONE*									*40-200*		
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	*NONE*									*40-130*		
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	*NONE*									*40-130*		
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	*NONE*									*40-130*		
Perfluoro[13C8]Octanoic Acid (M8PFOA)	*NONE*									*40-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	*NONE*									*40-200*		
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	*NONE*									*40-130*		
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	*NONE*									*40-130*		
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	*NONE*									*40-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	*NONE*									*40-300*		
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	*NONE*									*40-170*		
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	*NONE*									*30-130*		
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	*NONE*									*40-130*		
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	*NONE*									*25-135*		
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	*NONE*									*10-130*		
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	*NONE*									*10-130*		
2,3,3,3-Tetrafluoro-2-[1,1,2,2,3,3,3-Heptafluoropropoxy]-13C3-Propanoic Acid (M3HFPO-DA)	*NONE*									*40-130*		
N-Methyl-d3-Perfluoro-1-Octanesulfonamide (d3-NMeFOSA)	*NONE*									*10-130*		
N-Ethyl-d5-Perfluoro-1-Octanesulfonamide (d5-NEtFOSA)	*NONE*									*10-130*		
2-(N-Methyl-d3-Perfluoro-1-Octanesulfonamido)ethan-d4-ol (d7-NMeFOSE)	*1265205-95-5*									*10-130*		
2-(N-Ethyl-d5-Perfluoro-1-Octanesulfonamido)ethan-d4-ol (d9-NEtFOSE)	*NONE*									*10-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. ***(Soil/Solids only)***
Please Note that the information provided in this table is subject to change at anytime at the discretion of Pace Analytical Services.

Attachment B
Analytical Methods and Quality Assurance Summary Table

ATTACHMENT B

ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE

Matrix Type	Field Parameters	Laboratory Parameters	Analytical Methods	Sample Preservation	Sample Container Volume and Type	Sample Hold Time	Field Duplicate Sample Frequency	Equipment Rinsate Blank Samples	MS/MSD Samples
Soil	NA	Listed in Attachment A	USEPA 1633A	Cool below 6°C No Preservative	One 90 mL HDPE; no perservative	90 days	1 per 20 samples	*As specified in the PFAS Supplemental Investigation Workplan*	Conducted by the laboratory 1 per batch (20 samples)
Groundwater	Temperature, pH, turbidity, conductivity, dissolved oxygen, and oxidation/reduction potential	Listed in Attachment A	USEPA 1633A and Total Oxidizable Precursor (TOP)*	Cool below 6°C No Preservative	Two** 250 mL HDPE ; no perservative	28 days	1 per 20 samples	*As specified in the PFAS Supplemental Investigation Workplan*	Conducted by the laboratory 1 per batch (20 samples)
			Nitrate		One 250 mL HDPE; no preservative	48 hours			
			Boron		One 250 mL HDPE; HNO3 preservative	180 days			
			PPCP (Anthropogenic Indicators)		One 1000 mL Amber Glass	28 days	TBD		TBD
Surface Water	Temperature, pH, turbidity, conductivity, dissolved oxygen, and oxidation/reduction potential	Listed in Attachment A	USEPA 1633A	Cool below 6°C No Preservative	Two 250mL HDPE; no perservative	28 days	1 per 20 samples	As specified in the *PFAS Supplemental Investigation Workplan*	Conducted by the laboratory 1 per batch (20 samples)

Notes:
USEPA - United States Environmental Protection Agency
PFAS - Per-fluoroalkyl substances
HDPE - High-Density Polyethylene
TBD - To Be Determined
PPCP - Pharmaceuticals and Personal Care Products
HNO3 - Nitric Acid
* - A subset of aqueous samples will be additionally analyzed using TOP
** - TOP analysis requires an additonal two 250 mL HDPE bottles

Attachment C
Laboratory Quality Manual, Analytical Methods, and Certifications

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Andy Rezendes Approved on 2/1/2025 7:50:41 AM
Chris Ouellette Approved on 2/23/2025 7:56:19 AM
Elena Dayn Approved on 1/29/2025 11:59:21 AM
John Trimble Approved on 1/27/2025 3:20:37 PM
Marco Soares Approved on 1/28/2025 8:23:25 AM
Pete Henriksen Approved on 1/24/2025 3:49:21 PM
Rusty Vicinie Approved on 2/2/2025 6:40:03 PM
Stephen Witkowski Approved on 2/24/2025 8:27:01 AM
Jason Hebert Approved on 2/24/2025 1:08:15 PM

Management Approval Page
Local Quality Manual
Pace Analytical Services, LLC (PAS)

Signatory Attestation: The employee's electronic signature on this management approval page affirms the approver's obligation, commitment, and responsibility to uphold the requirements of the PAS Quality Management System (QMS) described in this Quality Manual (manual) at each location for which this manual is prepared.

Refer to the page for Quality Manual Signatories to view the job title and physical address for each approver.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Title Page
Local Quality Manual
Pace Analytical Services, LLC (PAS)

This manual has been prepared for the following PAS laboratories and subsidiaries:

PAS-WES2 Pace Analytical Services, LLC - Westborough, MA
Analytical Laboratory
8 Walkup Drive
Westborough, MA 01581
Phone: 508-898-9220

PAS-MANS Pace Analytical Services, LLC - Mansfield, MA (320 Forbes)
Analytical Laboratory
320 Forbes Blvd.
Mansfield, MA 02048
Phone: 508-822-9300

PAS-MANS Pace Analytical Services, LLC - Mansfield, MA (120 Forbes)
Air Center of Excellence
120 Forbes Blvd.
Mansfield, MA 02048
Phone: 508-822-9300

Administrative Offices
145 Flanders Road
Westborough, MA 01581
Phone: 508-898-9220

Albany, NY Service Center
14 Walker Way, Suite 1
Albany, NY 12205
Phone: 518-869-0394

New Hampshire Service Center
222 International Drive, Suite 155
Portsmouth, NH 03801
Phone: 603-436-5111

Buffalo, NY Service Center
275 Cooper Avenue, Suite 105
Tonawanda, NY 14150
Phone: 716-783-9291

New Jersey Service Center
123 Tice Blvd. Suite 102
Woodcliff Lake, NJ 07677
Phone: 201-847-9100

Maine Service Center
72 Center Street, Suite 3
Brewer, ME 04412
Phone: 207-624-0713

Mid-Atlantic PA Service Center
1013 Ashland Ave
Folcroft, PA 19032
Phone: 610-532-5742

Rochester, NY Service Center
Metro Park Business Center, Suite M-105
Rochester, NY
Phone: 518-869-0394

Syracuse, NY Service Center
10 Adler Dr., Suite 104
Syracuse, NY 13057
Phone: 518-860-9724

Cleveland, OH Service Center
7575 Tyler Blvd, Bldg C, Suite C35
Mentor, OH
Phone: 614-357-3321

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Quality Manual Approver Information

The individuals listed below are approvers of this manual and are responsible for implementing the PAS Quality Management System and upholding the requirements of this manual at the location(s) for which this manual was prepared, at the time this version of the manual was made effective.

The manual is not revised and released under an updated version when there is a change to personnel. Personnel information is updated during the manual's normal review and revision cycle.

If an approver changes positions, leaves the company, or is on extended leave of absence, the responsibility to implement and uphold the PAS QMS automatically transfers to the primary or alternate deputy for the position until the approver is replaced and/or the approver returns to work. The individual replacing the approver automatically accepts the responsibilities associated with the original approver's attestation. Refer to Section 4.1.5.1.1 of this manual to view the deputies assigned to key personnel job titles.

PAS-Westborough

Name	Job Title	Location	Email
Albert (Rusty) Vicinie	Vice President of Operations	Corporate	rusty.vicinie@pacelabs.com
Christopher Ouellette	Director of Lab Operations	Corporate	chris.ouellette@pacelabs.com
Peter Henriksen	General Manager	8 Walkup Dr. Westborough, MA 01581	pete.henriksen@pacelabs.com
Stephen Witkowski	Quality Program Manager	Corporate	stephen.witkowski@pacelabs.com
Jason Hebert	Quality Manager	320 Forbes Blvd. Mansfield, MA 02048	jason.hebert@pacelabs.com
Marco Soares	Technical Manager (TNI)	8 Walkup Dr. Westborough, MA 01581	marco.soares@pacelabs.com
Elena Dayn	Technical Manager (TNI)	8 Walkup Dr. Westborough, MA 01581	elena.dayn@pacelabs.com

PAS-Mansfield

Name	Job Title	Location	Email
Albert (Rusty) Vicinie	Vice President of Operations	Corporate	rusty.vicinie@pacelabs.com
Christopher Ouellette	Director of Lab Operations	Corporate	chris.ouellette@pacelabs.com
Peter Henriksen	General Manager	8 Walkup Dr. Westborough, MA 01581	pete.henriksen@pacelabs.com
Stephen Witkowski	Quality Program Manager	Corporate	stephen.witkowski@pacelabs.com
Jason Hebert	Quality Manager	320 Forbes Blvd. Mansfield, MA 02048	jason.hebert@pacelabs.com
John Trimble	Technical Manager (TNI)	320 Forbes Blvd. Mansfield, MA 02048	john.trimble@pacelabs.com

PAS-Mansfield Air Center of Excellence

Name	Job Title	Location	Email
Albert (Rusty) Vicinie	Vice President of Operations	Corporate	rusty.vicinie@pacelabs.com
Christopher Ouellette	Director of Lab Operations	Corporate	chris.ouellette@pacelabs.com
Peter Henriksen	General Manager	8 Walkup Dr. Westborough, MA 01581	pete.henriksen@pacelabs.com
Stephen Witkowski	Quality Program Manager	Corporate	stephen.witkowski@pacelabs.com
Jason Hebert	Quality Manager	320 Forbes Blvd. Mansfield, MA 02048	jason.hebert@pacelabs.com
Andy Rezendes	Technical Manager (TNI)	320 Forbes Blvd. Mansfield, MA 02048	andy.rezendes@pacelabs.com

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Table of Contents

1.0 PURPOSE AND SCOPE 8

1.1 PURPOSE 8
1.2 SCOPE AND APPLICATION 8
1.2.1 QUALITY MANUAL TEMPLATE 9
1.2.2 QUALITY MANUAL 9
1.2.3 REFERENCES TO SUPPORTING DOCUMENTS 10

2.0 REFERENCES 10

3.0 TERMS AND DEFINITIONS 11

4.0 MANAGEMENT REQUIREMENTS 12

4.1 ORGANIZATION 12
4.1.1 LEGAL IDENTITY 12
4.1.2 COMPLIANCE RESPONSIBILITY 12
4.1.3 SCOPE OF THE QUALITY MANAGEMENT SYSTEM 12
4.1.4 ORGANIZATION HISTORY AND INFORMATION 12
4.1.5 MANAGEMENT REQUIREMENTS 13
4.2 QUALITY MANAGEMENT SYSTEM 19
4.2.1 QUALITY MANAGEMENT SYSTEM OBJECTIVES 19
4.2.2 QUALITY POLICY STATEMENT 21
4.2.3 MANAGEMENT COMMITMENT: QUALITY MANAGEMENT SYSTEM 22
4.2.4 MANAGEMENT COMMITMENT: CUSTOMER SERVICE 23
4.2.5 SUPPORTING PROCEDURES 23
4.2.6 ROLES AND RESPONSIBILITIES 24
4.2.7 CHANGE MANAGEMENT 24
4.3 DOCUMENT CONTROL 24
4.3.1 GENERAL 24
4.3.2 DOCUMENT APPROVAL AND ISSUE 25
4.3.3 DOCUMENT REVIEW AND CHANGE 25
4.4 ANALYTICAL SERVICE REQUEST, TENDER, AND CONTRACT REVIEW 25
4.5 SUBCONTRACTING (INTERNAL AND EXTERNAL) 26
4.6 PURCHASING SERVICES AND SUPPLIES 27
4.7 CUSTOMER SERVICE 27
4.7.1 COMMITMENT TO MEET CUSTOMER EXPECTATIONS 27
4.7.2 CUSTOMER FEEDBACK 28
4.8 COMPLAINTS 28
4.9 NONCONFORMING WORK 28

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.9.1 DEFINITION OF NONCONFORMING WORK 28
4.10 CONTINUOUS IMPROVEMENT 30
4.11 CORRECTIVE ACTION 31
4.11.1 CAUSE ANALYSIS (AKA ROOT CAUSE ANALYSIS) 31
4.11.2 EFFECTIVENESS REVIEW 31
4.11.3 ADDITIONAL AUDITS 32
4.12 PREVENTIVE ACTION 32
4.12.1 CHANGE MANAGEMENT 32
4.13 CONTROL OF RECORDS 32
4.13.1 GENERAL REQUIREMENTS 33
4.13.2 TECHNICAL RECORDS 34
4.14 AUDITS 35
4.14.1 INTERNAL AUDIT 35
4.15 MANAGEMENT REVIEW 36
4.16 DATA INTEGRITY 37

5.0 TECHNICAL REQUIREMENTS 37

5.1 GENERAL 37
5.2 PERSONNEL 38
5.2.1 PERSONNEL QUALIFICATIONS 38
5.2.2 REQUIRED TRAINING 38
5.2.3 PERSONNEL SUPERVISION 43
5.2.4 JOB DESCRIPTIONS 44
5.2.5 AUTHORIZATION OF TECHNICAL PERSONNEL 44
5.3 ACCOMMODATIONS AND FACILITIES 44
5.3.1 FACILITIES 44
5.3.2 ENVIRONMENTAL CONDITIONS 44
5.3.3 SEPARATION OF INCOMPATIBLE ACTIVITIES 44
5.3.4 SECURITY 45
5.3.5 GOOD HOUSEKEEPING 45
5.4 TEST METHODS 45
5.4.1 GENERAL REQUIREMENTS 45
5.4.2 METHOD SELECTION 45
5.4.3 LABORATORY DEVELOPED METHODS 45
5.4.4 NON-STANDARD METHODS 46
5.4.5 METHOD VALIDATION 46
5.4.6 MEASUREMENT UNCERTAINTY 50
5.4.7 CONTROL OF DATA 50
5.5 CALIBRATION REQUIREMENTS 52
5.5.1 AVAILABILITY OF EQUIPMENT 52
5.5.2 CALIBRATION 52
5.5.3 EQUIPMENT USE AND OPERATION 52
5.5.4 EQUIPMENT IDENTIFICATION 53

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.5.5 Equipment Lists and Records 53
5.5.6 Out of Service Protocol 54
5.5.7 Calibration Status 54
5.5.8 Returned Equipment Checks 54
5.5.9 Intermediate Equipment Checks 54
5.5.10 Safeguarding Equipment Integrity 54
5.6 Measurement Traceability 55
5.6.1 General 55
5.6.2 Equipment Correction Factors 55
5.6.3 Reference Standards and Reference Materials 55
5.7 Sampling 57
5.7.1 Sampling Plans and SOPs 58
5.7.2 Customer Requested Deviations 58
5.7.3 Recordkeeping 58
5.8 Sample Management & Handling 58
5.8.1 Procedures 58
5.8.2 Unique Identification 60
5.8.3 Sample Receipt Checks and Sample Acceptance Policy 60
5.8.4 Sample Control and Tracking 61
5.8.5 Sample Storage, Handling, and Disposal 62
5.9 Assuring the Quality of Test Results 63
5.9.1 Quality Control (QC) Procedures 63
5.9.2 QC Corrective Action 67
5.9.3 Data Review 67
5.9.4 Calibration Certificates 68
5.9.5 Opinions and Interpretations 69
5.9.6 Subcontractor Reports 69
5.9.7 Electronic Transmission of Results 69
5.9.8 Format of Test Reports 69
5.9.9 Amendments to Test Reports 69
5.10 Reporting 69
5.10.1 General Requirements 69
5.10.2 Test Reports: Required Items 70
5.10.3 Test Reports: Supplemental Items 70

6.0 REVISION HISTORY 72

7.0 APPENDICES 74

7.1 Appendix A: Certification / Accreditation Listing 74
7.1.1 PAS-WES2 8 Walkup Drive, Westborough, MA 74
7.1.2 PAS-MANS 320 Forbes Blvd. Mansfield, MA 74
7.1.3 PAS-MANS 120 Forbes Blvd. Mansfield, MA 75

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.2 APPENDIX B: CAPABILITY LISTING 75
7.3 APPENDIX C: GLOSSARY 75
7.4 APPENDIX D: ORGANIZATION CHART(S) 85
7.4.1 PAS CORPORATE ORGANIZATION CHART(S) 85
7.4.2 PAS QUALITY SYSTEMS MANAGEMENT ORGANIZATION CHART 86
7.4.3 PAS-WES2 8 WALKUP DRIVE, WESTBOROUGH, MA – ORGANIZATION CHART 87
7.4.4 PAS-MANS 320 FORBES BLVD, MANSFIELD, MA – ORGANIZATION CHART 88
7.4.5 PAS-MANS 120 FORBES BLVD. MANSFIELD, MA – ORGANIZATION CHART 89
7.5 APPENDIX E: EQUIPMENT LISTING 90

8.0 ADDENDUM: PROGRAM REQUIREMENTS 91

8.1 DOD 91
8.2 UNREGULATED CONTAMINANT MONITORING RULE 5 (UCMR5) 97

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

1.0 PURPOSE AND SCOPE

1.1 Purpose

This quality manual (manual) outlines the quality management system and management structure of Pace® Analytical Services, LLC. Throughout this manual, Pace® Analytical Services, LLC is also referred to by the acronym PAS. Building Sciences laboratories are a subset of specialized laboratories within PAS and may also be referred to by the acronyms BSCI or BDSG within the quality management system.

The QMS is also called the quality program throughout this manual and other PAS documents. "Quality Management System" and "Quality Program" are synonymous and inferred by the acronym QMS.

The QMS is the collection of policies and processes established by the senior leaders of PAS (top management) to ensure the services and products provided by PAS consistently meet relevant requirements and achieves the goal of Pace® to provide customers with high quality, cost-effective, analytical measurements, and services.

The QMS is planned to establish conformance[1] and compliance with the current published versions of these international and national quality system Standards:

ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*

TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

The QMS is also planned to achieve regulatory compliance with the various federal and state programs for which PAS locations provide compliance testing and/or holds certification or accreditation. Federal or state requirements that do not apply to all PAS locations, are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

A list of accreditation and certifications held by each location associated with this manual is provided in Appendix A.

A list of analytical testing capabilities offered by each location associated with this manual is managed by local Quality and maintained in document ENV-FORM-WES2-0188 Analytical Testing Capabilities List.

1.2 Scope and Application

This manual applies to each location listed on the Title Page of this manual:

For purposes of the PAS QMS the term "location" refers to laboratories and/or service centers.

The term "laboratory" refers to any PAS location, however named by Pace® that provides testing, collects samples (sampling), or conducts field measurement services in a fixed building, mobile unit, or in-situ (field).

The phrase "service center" refers to any PAS location, however named by Pace® that does not perform any testing, sampling, or field measurements.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

PAS locations are defined by their physical address and other information:

Laboratories are defined by physical address and certification/accreditation ID.

Mobile units are defined by the address of the location to which they are assigned, by VIN (vehicle identification number), or by certification/accreditation ID.

The phrase "satellite laboratory" is used by PAS to refer to a limited-service laboratory affiliated with a larger PAS business unit or location. Some PAS business groups refer to satellite laboratories as service centers for accounting purposes. This designation is not consistent with the definitions specified in this manual or throughout the supporting documents associated with the QMS. Regardless of any internal reference or jargon, any PAS location that generates a test result is a "laboratory" and all laboratories must comply with all requirements specified in this manual for analytical testing services.

1.2.1 Quality Manual Template

This manual was prepared from the PAS Quality Manual Template (template) created by the PAS Corporate Quality team.

The template, known as document ID ENV-TMP-CORQ-0007, specifies the minimum requirements that every PAS location must abide by, regardless of scope of services or number of personnel, in order to achieve the objectives of the PAS Quality Policy (Refer to Section 4.2.2).

The template is the mechanism used by top management[1] to communicate their commitment to continuously develop and improve the QMS for effectiveness, to meet customer expectations, and to comply with any statutory and regulatory requirements. Their signature of approval for the template is the mechanism used to document their responsibility.

[1]Top Management is the phrase in the TNI Standard that refers to the leaders of an organization that develop and/or release the PAS Quality Policy Statement and manual under their authority. For PAS, top management includes the PAS President, Vice President of Quality, Risk Management Officer, Senior Vice President of Operations (Sr. VPO), and the Chief Technical Officer (CTO).

The template and instructions for use of the template are released by corporate quality personnel to the local quality managers responsible for each location (Local Quality Manager (QM)). The local QM uses the template to prepare the location's manual by following the instructions provided to them. The local QM may not alter the font, structure, or content of the template, except where specified by instruction to do so.

The template is reviewed by corporate quality personnel annually and updated, if needed. More frequent review and revision may occur to manage change, to maintain conformance and compliance to relevant standards or to improve the QMS.

Refer to standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.2 Quality Manual

The template and the manual include references to other organization documents that support the QMS such as policies and standard operating procedures (SOPs).

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

These references may include the document's document control number (DC#) and the document title. This information is subject to change at the discretion of PAS. The manual and/or template are updated to reflect the editorial change during the manual's next scheduled review/revision cycle or the next time a version of the manual is released, whichever is sooner.

Each location maintains a current list of documents used by the location to support the QMS. This list, known as the controlled document or master list is readily available to personnel for their use and it provides a cross reference to the legacy document ID, where applicable. Parties external to PAS may contact the location of interest to obtain the most current version of controlled document list if desired.

1.2.3 References to Supporting Documents

The template and the manual include references to other organization documents that support the QMS such as policies and standard operating procedures (SOPs).

These references may include the document's document control number (DC#) and the document title. This information is subject to change at the discretion of PAS. The manual and/or template are updated to reflect the editorial change during the manual's next scheduled review/revision cycle or the next time a version of the manual is released, whichever is sooner.

Each location maintains a current list of documents used by the location to support the QMS. This list, known as the controlled document or master list is readily available to personnel for their use and it provides a cross reference to the legacy document ID, where applicable. Parties external to PAS may contact the location of interest to obtain the most current version of controlled document list if desired.

2.0 REFERENCES

Incorporated by reference are the following documents that were used for the preparation of the quality manual, ensuring compliance with accreditation requirements.

"Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.

"Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.

"Methods for Chemical Analysis of Water and Wastes," EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.

U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.

U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.

"Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.

"Annual Book of ASTM Standards," Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.

"Annual Book of ASTM Standards," Section 11: Water and Environmental Technology, American Society of Testing and Materials.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

"NIOSH Manual of Analytical Methods," U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.

"Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).

Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.

Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February 1992.

Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July 1990.

AIHA Laboratory Accreditation Programs, LLC Policy Modules, AIHA, most current version.

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories, 2nd Edition 2005-05-15; 3rd Edition 2017-11

The following are implemented by normative reference to ISO/IEC 17025:

ISO/IEC Guide 99, International vocabulary of metrology –Basic and general concepts and associated terms

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

Department of Defense Quality Systems Manual (QSM), most current version.

TNI (The NELAC Institute) Standard, 2016 version.

UCMR Laboratory Approval Requirements and Information Document, most current version.

US EPA Drinking Water Manual, most current version.

National Voluntary Laboratory Accreditation Program (NVLAP) - Procedures and General Requirements. NIST Handbook 150: 2020

National Voluntary Laboratory Accreditation Program (NVLAP) - Bulk Asbestos Analysis. NIST Handbook 150-3: 2006

National Voluntary Laboratory Accreditation Program (NVLAP) – Airborne Asbestos Analysis. NIST Handbook 150-13: 2006

EPA National Lead Laboratory Accreditation Program: Laboratory Quality System Requirements, Revision 3.0, July 05, 2007

3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by PAS to support the QMS.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.0 MANAGEMENT REQUIREMENTS

4.1 Organization

4.1.1 Legal Identity

Pace® Analytical Services, LLC is the responsible entity authorized by the State of Minnesota to do business as a limited liability company, under the parent company, PAS Parent, Inc.

4.1.1.1 Change of Ownership

If there is a change of ownership, if a PAS location goes out of business, or if the entire organization ceases to exist, PAS management must notify regulatory authorities of the change within the time required by each state agency for which the location is certified or accredited.

Specifications for retention of records and other business information are addressed in the ownership transfer agreement and in accordance with appropriate regulatory requirements. These details are not included in this manual because each situation is specific to the change event.

4.1.2 Compliance Responsibility

PAS management has the responsibility and authority to establish and implement procedures and to maintain resources necessary to ensure its testing activities are carried out in such a way to meet applicable federal and statutory requirements in addition to the requirements specified in this manual and QMS supporting documents

4.1.3 Scope of the Quality Management System

The QMS applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

The permanent and mobile facilities to which this manual applies are listed on the Title Page of this manual.

4.1.4 Organization History and Information

Founded in 1978, Pace® Analytical Services, LLC is a privately held scientific services firm operating one of the largest full-service contract laboratory and service center networks in the United States.

The business purpose of PAS is to deliver the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by transparent data, a highly trained team, and the service and support that comes from over four decades of experience.

4.1.4.1 Organization Structure

Each PAS location is led by a management team referred to as local management[1]. Local management is responsible for making day-to-day decisions regarding the operations of the facility and implementing, and sustaining the requirements, policies, and procedures of the PAS quality program.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

[1] The term "local management" does not mean "on-site" management. Some of the roles included in the local management team, work off site or from a different PAS location.

For purpose of the QMS, the job titles associated with the local management team include Vice President of Operations (VPO), General Manager (GM), Director of Laboratory Operations (DLO), Quality Program Manager (QPM), and Quality Manager.

The local management team is supported by department supervisors and team leaders, and business groups that support the organization such as HR, IT, Sales & Marketing, Finance, and EHS (Environmental Health & Safety).

Technical oversight for each location is provided by local personnel with support and guidance from the PAS Chief Technical Officer. Locations that hold TNI accreditation, also have personnel appointed to serve as the "acting technical manager for TNI, however named" to perform the duties and responsibilities of this designation per the TNI Standard. Refer to Section 4.1.5.2.1 for more information on this TNI requirement.

The reporting relationships and responsibilities of quality personnel are independent of operations in order to safeguard impartiality. Refer to Section 4.1.5.2 for more information.

Refer to the organization charts provided in Appendix D to view the organization structure, reporting relationships, and the interrelationships between positions.

4.1.5 Management Requirements

4.1.5.1 Personnel

Each PAS location is staffed with administrative and/or technical personnel who perform and verify work under the supervision of their direct line supervisor.

All personnel are required to perform their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures and other quality system documents. PAS policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

4.1.5.1.1 Key Personnel

Key personnel are management positions that have the authority and responsibility to plan, direct, and control activities related to the QMS for the entire division (PAS Corporate), or for one or more PAS locations (Local).

PAS Key Personnel Positions & Deputy Assignments by Role

Job Title	Primary / Alternate Deputy
Chief Executive Officer	President

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Chief Compliance Officer	VPQ / As Assigned
President	CEO / Sr. VPO
Vice President of Quality	RMO or CTO
Quality Program Manager	CQD / Peer QPM / As Assigned
Chief Technical Officer	VPQ / As Assigned
Risk Management Officer	VPQ or CTO
Sr. VP of Operations	President / VPO
Vice President of Operations	Sr. VPO / Peer VPO
Director of Lab Operations[1]	VPO / Peer DLO or Sr. VPO
Health and Safety Director	As Assigned
IT Director	CIO
Quality Manager	QPM /Peer QM / QAA
General Manager[1]	VPO / Sr. VPO or Peer GM
Operations Manager[1]	GM / DL or VPO
Technical Manager (TM)[1]	CTO / Peer TM
TNI or NLLAP Approved TM[2]	Another Qualified Employee

[1:]Position is not in place at all locations.

[2:] The TNI TM is not a PAS position. Refer to Section 4.1.5.2.1 for more information.

Some certification and accreditation programs require notification any time there is a change in key personnel. Notification requirements are tracked and upheld by the local QM, when these requirements apply.

4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position at Pace® are detailed in job descriptions maintained by the Pace® Human Resource (HR) personnel.

The following sections provide a general overview of various management and supervisory roles and are presented in no particular order.

Chief Executive Officer: Provides leadership for overall operations; development of growth strategies; and long-range capital and strategic planning for Pace®.

Chief Compliance Officer: Provides leadership for compliance related activities.

President: Provides leadership for overall operations; oversight of regulatory and compliance standards; development of growth strategies; and long-range capital and strategic planning for PAS.

Chief Technical Officer: Provides technical oversight and leadership to all PAS locations. Responsible for innovation and standardization of technical activities.

Vice President of Quality (VPQ): Responsible for developing the PAS quality program and the policies and procedures that support the QMS. The VPQ leads the

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

quality team, establishing functions, responsibilities, duties, and organizational structure for PAS.

Risk Management Officer (RMO): Responsible for the risk management program and initiatives within PAS. Specializes in the identification, assessment, and mitigation of operational and regulatory risk. The RMO leads the risk management team to ensure the development and implementation of risk management strategies.

Corporate Quality Program Manager: Responsible for helping local management implement, monitor, maintain and improve the PAS quality program for one or more locations in the network and for direct supervision of Quality Manager(s).

Director of Information Technology: Oversees and delivers the systems and processes of information technology used by PAS. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity, security of electronic data, and associated policies and procedures.

Sr. Vice President of Operations: Provides leadership, direction, and insight necessary to achieve strategic initiatives. Develops and improves processes, structure, and allocation of resources for operations for all PAS.

Vice-President of Operations: Provides leadership, guidance, and resources, including allocation of personnel, necessary to achieve the strategic goals of the organization and the PAS quality program to one or more PAS locations.

Director of Laboratory Operations: Refer to descriptions for VPO and General Manager. The DLO is an intermediary management position that provides leadership and resources to one or more locations.

General Manager: The GM is responsible for overall administration and operation of one or more PAS locations. Although task duties associated with this responsibility may be delegated, the GM is responsible for ensuring all duties and activities of the locations they oversee comply with the PAS QMS, the PAS EHS program, and with any applicable statutory, regulatory requirements or program requirements. If a GM is not assigned to the location, these responsibilities are transferred to the Operations Manager (OM) or DLO; if no DLO, to the VPO.

Any GM of a TNI Accredited laboratory is also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (Refer to Section 4.1.5.2.1) and for notifying the quality team of any extended absence or reassignment of these designations.

Quality Manager: The QM oversees and monitors the implementation, compliance, and improvement of the QMS and communicates gaps, deviations, and opportunities for improvement to local and corporate laboratory management. The QM is independent of the operation and analytical activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

The QM:

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

serves as the focal point for QA/QC protocol decisions and oversees review of QC data for trend analysis;

evaluates data objectively and performs assessments without outside influence;

has documented training and experience in QA/QC procedures and the PAS quality system;

has a general knowledge of the analytical methods offered by the laboratory;

coordinates and conducts internal systems and technical audits;

notifies laboratory management of deficiencies in the quality system;

monitors corrective actions;

provides support to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

Client Services Manager (CSM): This position is responsible for the training and supervision of project manager(s) and/or shipping, receiving and courier personnel. The primary responsibility of the CSM is to ensure projects are successfully managed to meet the expectations and needs of PAS customers.

Department Managers, or however named: These positions are responsible for administrative and operations management and implementation of the QMS in the work area he/she oversees. These responsibilities include but are not limited to: training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the QMS; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and suitability for the intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work; purchasing of supplies and equipment adequate for use; maintaining instrumentation and equipment in proper working order and calibration; and general maintenance of administrative and technical processes and procedures established by the laboratory.

Operations Manager: The OM is responsible for management of production and/or other duties assigned by the GM..

4.1.5.2.1 Approved Technical Manager (TNI or ELLAP/NLLAP Accreditation Only)

The requirements in this subsection apply only to PAS locations that are NELAC/TNI or ELLAP/NLLAP accredited.

The TNI Standard and National Lead Laboratory Accreditation Program: Laboratory Quality System Requirements (NLLAP LQSR) specify requirements for the qualification and duties of technical personnel. The TNI Standard lists these duties under the reference "technical manager(s), however named."

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

At PAS, these duties closely correlate with the responsibilities and duties outlined in the PAS job descriptions for managers, supervisors, team leads, and/or scientists. However, these duties do not need to be associated with any specific job title and can be assigned to any one or more PAS employees that meets the qualifications specified in the TNI Standard.

Refer to the applicable version of the TNI Standard to view the required qualifications for each discipline. The required qualifications for a laboratory accredited by ELLAP/NLLAP shall be the same as those listed in the TNI Standard.

PAS locations that are TNI accredited must designate one or more employees to perform these duties and submit these qualifications to the TNI accreditation body for approval.

Employees approved by the TNI AB, to perform these duties retain their Pace® assigned job title.

When TNI Accreditation Bodies refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to perform duties of the 'technical manager, however named' as specified in the TNI Standard and not to a PAS job title.

The duties of any approved technical manager for TNI, however named, can be completed in person or remotely. If an employee that is an approved technical manager for TNI is completely absent from work or on a leave of absence for more than 15 calendar days, the duties and responsibilities specified in the TNI Standard are temporarily reassigned to another employee that meets the qualifications for the technology or field of accreditation. If the employee's absence exceeds 35 calendar days, the local QM must formally notify the TNI primary AB of the absence and the details of reassignment of duties in writing.

4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests that may affect impartiality. It is the policy of Pace® to ensure business relationships, decisions and transactions do not place personal interest ahead of the organization, customers, colleagues, job responsibilities or the public we serve. Conflict of interest is avoided by making personnel aware of circumstances that conflict or appear to conflict with impartiality and/or designing process and procedures to include checks and balances to prevent conflict and ensure impartiality.

Refer to the current version of policy COR-POL-0004 *Code of Ethics and Professional Conduct* for more information.

4.1.5.4 Confidentiality

PAS management is committed to preserving the confidentiality of Pace® customers and confidentiality of Pace® business information.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative, except when Pace® is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, Pace® will notify the client of the release of information and the information provided, unless notification is prohibited by law.

When Pace® obtains information about the customer from a source other than the customer, Pace® will keep the source of the information confidential unless disclosure is agreed upon by the source.

The terms of client confidentiality are included in PAS Standard Terms and Conditions (T&C) which can be found on the Hub (**https//info.pacelabs.com/hubfs/pas-standard-term.pdf**). With the acceptance of the T&C and/or the implicit contract for analytical services that occurs when the client sends samples to PAS for testing, the client authorizes Pace® to release confidential information when required. Other procedures used by PAS to maintain confidentiality include:

A Code of Ethics and Professional Conduct policy that covers this topic (COR-POL-0004);

A Confidentiality Agreement which supervisory and sales personnel and other positions are required to sign at the time of employment and abide by the conditions of throughout employment;

Record retention and disposal procedures that ensure confidentiality is maintained; and

Physical access controls and encryption of electronic data.

Refer to policy COR-POL-0004 *Code of Ethics and Professional Conduct* for more information.

4.1.5.5 Communication

Communication is defined as the imparting or exchanging of news and information. Effective (good) communication occurs when the people included in the communication get the point and understand it.

4.1.5.5.1 Workplace Communication

Effective communication in the workplace is necessary to ensure work is performed correctly, efficiently, and in accordance with client specifications.

Instructions for how to conduct testing and other work activities are communicated to personnel via written policies, standard operating procedures, and other work instructions.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Information about PAS performance (positive and negative) and ideas for improvement are communicated to personnel using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

PAS management is responsible for training personnel to communicate in professional and respectful ways to build strong relationships and to avoid misunderstanding.

4.2 Quality Management System

4.2.1 Quality Management System Objectives

The objectives of the PAS QMS are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work products are analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality.'

4.2.1.1 Impartiality

PAS achieves and maintains impartiality by establishing an organizational structure that safeguards impartiality (Refer to Section 4.1.4.1) and implementing and adhering to the policies and processes of the QMS outlined in this manual, which are based on industry accepted standards and methodologies.

PAS procedures for handling nonconforming work (Refer to Section 4.9), corrective and preventive actions (Refer to Section 4.11, 4.12) and management review (Refer to Section 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the QMS uncertain.

An opportunity is something that has potential positive consequences for the organization.

PAS personnel manage risks and opportunities on a daily basis by following policies, procedures and processes that support the QMS. Some ways in which the QMS is designed to identify, minimize, or eliminate risk on a daily basis include but are not limited to:

Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of authority for regulatory compliance;

SOPs and other controlled instructional documents are provided to personnel to eliminate variability in the process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;

Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;

Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;

An established program for ethics, and data integrity;

Tiered data review process;

Culture of continuous improvement;

Monitoring activities to assess daily and long-term performance; and

Annual critical review of the effectiveness of the QMS.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by PAS to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team-based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. The PAS lean program and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by PAS management to communicate the QMS to personnel.

To ensure personnel understand and implement the quality program outlined in the manual:

PAS personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has:

1) been informed of the manual by management;

2) has access to the manual;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

3) has read the manual;

4) understands the content of the manual; and

5) agrees to abide by the requirements, policies, and procedures therein.

Personnel are informed that the manual provides the "what" of the QMS. The "how to" implementation of the QMS is provided in policy, SOPs, standard work instructions, and other instructional documents.

This manual and supporting policies and procedures are made readily accessible to personnel in the area where the work activity is performed.

4.2.2 Quality Policy Statement

The quality policy of PAS is to provide customers with data of known and documented quality fit for their intended purpose. PAS achieves this policy by implementing the QMS defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control activities, by conformance with published and industry accepted testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

PAS will provide customers with reliable, consistent, and professional service. This is accomplished by making sure each PAS location has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.

PAS maintains a quality program that complies with applicable state, federal, and industry standards for analytical testing and competency.

PAS management provides training to personnel so that all personnel are familiar with the QMS outlined in this manual and that they understand that implementation of the QMS is achieved by adherence to the Pace® and PAS policies and procedures.

PAS management continuously evaluates and improves the effectiveness of the QMS by responding to customer feedback, and other measures of performance, such as but not limited to the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews..

4.2.2.1 Ethics Policy / Data Integrity Program

Pace® has established a comprehensive ethics and data integrity program that is communicated to all Pace® employees so that they understand what is expected of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the Pace® Ethics / Data Integrity Program include:

Ethics Policy (COR-POL-0004);

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;

Policy Acknowledgement Statements that all Pace® personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;

SOPs that provide instructions for how to carry out a test method or process to ensure tasks are done correctly and consistently by each employee;

On the Job Training;

Data integrity monitoring activities which include, but are not limited to: primary, secondary and completeness data reviews, internal technical and system audits, data audits, data surveillance, and proficiency testing; and

Confidential reporting process for alleged ethics and data integrity issues.

All PAS managers and supervisors are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

Pace® has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours per day/7 days per week. The alert line may be used by any employee to report potential violations of the company's ethics and data integrity program. Reports are forwarded to Pace® leadership to investigate and resolve the matter. Investigations concerning data integrity are kept confidential.

Refer to COR-POL-0001 *Compliance Alertline* for more information.

Posters and flyers with the compliance alert line information must be prominently posted in each PAS location for personnel reference.

Compliance Alert Line Information:

English Speaking US & Canada	(844) 940-0003
Spanish Speaking North America	(800) 216-1288
Internet	www/lighthouse-services.com/pacelabs
Email	reports@lighthouse-services.com

4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the QMS is provided by the application of their signature of approval to the template and/or manual. Their signature confirms they understand their responsibility to implement the QMS outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the QMS outlined in this manual, implementing the QMS outlined in this manual, and upholding these requirements for all work activities.

4.2.5 Supporting Procedures

References to processes and procedures that support the QMS are included throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015 *Document Management* and summarized in the following subsections.

4.2.5.1 Quality Management System Document Structure

Documents associated with the QMS are classified into document types that identify the purpose of the document and establish how the document is managed and /or controlled.

Examples: Types of PAS Internally Created Documents

Document Type	Purpose
Quality Manual	Outlines the PAS QMS and structure and how it works for a system including policy, goals, objectives and detailed explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems, and other information necessary to meet the objectives of the system described.
Policy	Provide requirements and rules for a process and is used to set course of actions and to guide and influence decisions. Policy describes the "what," not the "how."
Standard Operating Procedure	Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed. Ensures that activities are performed properly in accordance with applicable requirements.
Standard Work Instruction	Provide step by step visual and/or written instruction to perform a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results.
Template	Pre-formatted document that serves as a starting point for a new document.
Guide	Assists users in using a particular product; or a technical interpretation of a method or process by which PAS locations must abide.
Form / Worksheet	Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP.

Examples: Types of External Documents used by PAS

Certificate	Lists parameters, methods, and matrices for which the location is certified/accredited to perform within the authority of the issuing regulatory agency or accreditation body.
Reference Document	Provide information, protocol, instructions, and/or requirements. Issued by the specifier. Examples include ISO/IEC, TNI, DoD/DOE and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Project Document	Provides requirements necessary to meet individual client expectations for intended use of data. Examples include project quality assurance plans (QAPP), client-program technical specifications, contracts, and other agreements.

Project documents are managed as external documents and any requirements for work specified are followed when work for the project is performed. If the project document is less stringent than the PAS QMS, policies, or SOPs, and/or is less stringent than applicable federal or state requirements, PAS locations are still required to meet the minimum requirements of the PAS QMS and any applicable statutory or federal requirements in addition to the requirements specified in the project document. Information and requirements from project documents are not incorporated into PAS policy or SOPs in order to maintain client confidentiality.

Document types are ranked to identify which documents take precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to ensure downline documents agree with documents of higher rank.

PAS Document Hierarchy

Rank	Document Type
1	External Reference Documents (Standards, Test Methods)
2	Quality Manual Template
3	Corporate & Division Policy
4	Corporate & Division SOP
5	Division SWI, Guides, Forms/Worksheets
6	Local Quality Manual
7	Local SOP
8	Local SWI, Guides, Forms/Worksheets

4.2.6 Roles and Responsibilities

The roles and responsibilities for technical management and the quality manager are provided in section 4.1.5.2.

4.2.7 Change Management

When significant changes to the PAS QMS are planned, these changes are managed by corporate quality personnel to assure that the integrity of the QMS is maintained.

4.3 Document Control

4.3.1 General

PAS uses electronic document management software (eDMS) to control documents that support the PAS QMS. eDMS provides centralized distribution and access to all documents used by PAS. All PAS locations must use the PAS eDMS system unless an exemption to this requirement has been granted by the PAS Corporate Quality Director.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

eDMS automates the process for unique document identification, version control, approval, access, and archival and restricts access to archived documents except to authorized users to prevent the use of obsolete documents.

The local QM maintains a master list of controlled documents used at each location. The master list minimally includes the document control number, document title, and current revision status and is made available to personnel for their reference.

Refer to SOP ENV-SOP-CORQ-0015 *Document Management* for more information.

4.3.2 Document Approval and Issue

Documents that support the QMS are reviewed by qualified personnel and approved by management prior to release for use.

Only the approved versions of documents are available to personnel for use unless a draft document is authorized by management.

The managers responsible for authorization of each document are specific to the document type.

Refer to SOP ENV-SOP-CORQ-0015 *Document Management* for more information.

4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program documents are reviewed at least every two years to ensure the documents remain current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they conduct their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

PAS does not allow hand-edits of documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as change in progress form, email, or memorandum.

The document review, revision, and archival process is managed by quality personnel at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management.*

4.4 Analytical Service Request, Tender, and Contract Review

PAS management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the location(s) performing the work has the capability, capacity, and resources necessary to successfully meet the customer's needs. These review procedures are described in SOP ENV-SOP-WES2-0125 Review of Analytical Requests.

The procedures in this SOP(s) are established to ensure:

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The PAS location(s) performing the work understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;

PAS locations and any external subcontractor(s) have the capability, capacity, and resources to meet the project requirements and expectations within the requested time for delivery of work product;

Any concerns that arise from review are discussed and resolved with the client;

Any discrepancies between the PAS QMS, statutory or regulatory requirements and the client request are resolved; and

The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the PAS locations contracted to perform the work and any internal or external subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the location can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network locations and any potential subcontractors are able to manage the sample load and deliver work production within the delivery time requested.

Resource review verifies that the location and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

Customers must be notified when there is a deviation from the contract after acceptance of the contract by both parties. Instructions for this notification process must be included in the laboratory's SOP for this process.

4.5 Subcontracting (Internal and External)

The terms 'subcontract' and "subcontracting" refers to analytical work done by an organization external to Pace® (External Subcontracting) or by a Pace® location with an address different than the address listed on the cover page of the test report (Internal Subcontracting).

The PAS network offers comprehensive analytical capability and capacity to ensure Pace® can meet a diverse range of client needs for any type of project. If a PAS laboratory receives a request for analytical services and it cannot fulfill the project specifications, the location's client services team will collaborate with the client to place the work within the PAS network.

When it is not possible to place the work within network, the location will, with documented client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed on between the location and the client.

Whenever work is subcontracted, the PAS location responsible for management of the project verifies each of these qualifications:

The internal or external subcontractor has the proper accreditation/certifications required for the project and these are current; and

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The use of the internal or external subcontractor is approved by the client and/or regulatory agency when such approval is required by the customer. Record of customer approval is retained in the project record.

External subcontractors selected by Pace® must be pre-qualified by quality personnel to verify their QMS is similar to Pace® and complies with all relevant Standards such as ISO/IEC 17025 and the TNI Standard(s) and/or federal and state regulatory requirements. The list of approved subcontractors for each location is maintained by local quality personnel. Pre-qualification of a subcontractor does not eliminate the requirement for the PAS location placing work to verify the subcontractor has the certifications, capability, capacity, and resources to perform work on behalf of Pace® on a project-specific basis.

For all subcontracted work, the PAS location placing the work internally or externally is responsible to ensure project specifications are always communicated to and understood by the subcontractor.

4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to PAS are qualified to meet the needs of Pace®. These needs include but are not limited to competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. Evidence of this qualification is the availability to purchase services and supplies from the vendor in the corporate purchasing system.

PAS locations may purchase goods and services from any supplier in the purchasing system.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance.

All requisitions for materials and consumables are approved by local management who is responsible for ensuring the services and supplies procured and received are fit for intended use.

4.7 Customer Service

Project details and management are managed by PAS client services personnel.

4.7.1 Commitment to Meet Customer Expectations

PAS personnel collaborate closely with our customers to ensure their needs are met and to establish their confidence in the capability of PAS to meet their needs for analytical services and expectations for service.

The project manager (PM) is the customer's primary point of contact for each analytical service request (work order). The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Supervisors are expected to keep the PM informed of project status and any delays or key issues, so that the PM can keep the client informed.

PAS encourages customers to visit our locations to learn more about the capabilities, observe performance and to meet personnel.

PAS customers expect confidentiality. Personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

purposes. Refer to Section 4.1.5.4 of this manual and policy COR-POL-0004 *Code of Ethics and Professional Conduct* for more information on the policy for client confidentiality.

4.7.2 Customer Feedback

PAS actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with PAS and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is reviewed to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Refer to Sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by PAS and used to enhance the QMS.

4.8 Complaints

Per ISO/IEC 17025:2017, a complaint is a formal expression of dissatisfaction with the performance of a service or product originating from a party external to the organization. PAS believes complaints provide opportunities to improve processes and/or build stronger working relationships with our clients.

The PAS complaint resolution process is specified in corporate SOP ENV-SOP-CORQ-0020 and all PAS locations are required to use this SOP as their process.

Complaints are thoroughly reviewed to determine if they are valid. If the complaint is valid, action is taken to resolve the situation with the customer. In accordance with ISO/IEC 17025 requirements, the response to the customer is independently reviewed before it is given to ensure the response from PAS is thorough and proper for the situation.

Complaint information is captured in a centralized database and the data is used by PAS management personnel to identify trends and opportunities for improvement during Annual Management Review – Refer to Section 4.15 for more information about annual management review.

4.9 Nonconforming Work

4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, policies, and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes from various sources which include, but are not limited to:

results of quality control samples and instrument calibrations;

quality checks on consumables and materials;

general observations of personnel;

data review;

proficiency testing;

internal and external audits;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

complaints and feedback;

management review and reports; and

regulatory and certification and accreditation actions.

The way in which the laboratory or service center manages nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (Refer to Section 4.11) and/or data recall (Refer to Section 4.16). When the location releases data and test results associated with nonconforming QC and acceptance criteria, test results are qualified, or non-conformances are noted in the final analytical report to apprise the data user of the situation. (Refer to Section 5.10)

Nonconforming work also includes unauthorized departure from policies, procedures, and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

4.9.1.1 Authorized Departure from SOPs

Departures from an SOP may sometimes be necessary to correct an error in an SOP or to resolve a complex problem. For example, to mitigate complex matrix interference.

An authorized departure from a test method SOP is one that has been reviewed and approved by the department leader, however named, of the work area in which the test method is performed. The leader, when authorizing a departure from an SOP, accepts full responsibility to ensure the departure does not conflict with Pace® or PAS policy or procedure, does not affect statutory, regulatory or program compliance and does not adversely affect data integrity or usability.

Departure from administrative or process-oriented SOPs must be approved by the local QM.

Documentation of the reason for the SOP departures must be retained with management approval. Approved departures from test method SOPs should be noted in the final test report to advise the data user.

Refer to SOP ENV-SOP-CORQ-0016 *SOP for SOPs and SWI*, for more information.

4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated with a published reference test method, the location's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water, wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must comply with or include these requirements, or the resulting data and test results cannot be used for regulatory compliance purposes.

If the procedures in the SOP are modified from the test method, these modifications must be clearly identified in the SOP. The conditions under which the location may establish an SOP that is modified from these reference methods or regulatory

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

program and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

Client requests to deviate from the test method are managed as client requests to depart from the test method SOP since it is the SOP that the location follows when performing work.

4.9.1.3 Stop Work Authority

Stop Work Authority provides PAS personnel with the capability to temporarily stop work when there is a perceived unsafe condition or situation that may affect data integrity or the safety of personnel.

All personnel have the authority to initiate and request a stop work order when necessary to preserve data integrity or safety of workers.

The need for the stop work order and resolution of the problem must be confirmed by subject matter experts and resumption of work must be approved as follows:

For stop work orders related to environmental health and safety and/or waste management, the decision to stop work may be made in real time to protect the safety of the worker. Actions taken to correct the problem and lift the stop work order are made by the EHS Director, or the deputies assigned to these positions.

Any employee may request a temporary stop work order for concerns related to data integrity. However, the request must be reviewed and the need to stop work affirmed by the Quality Manager to confirm the concern is valid. The decision to uphold the stop work order must be made jointly by the local QM, the QPM, the GM or DLO, and the VPO. The Corporate Quality Director and Chief Technical Officer, and other members of PAS management are consulted as needed. The actions taken to correct the problem and authorization to lift the stop work order are made by the same management team.

4.10 Continuous Improvement

The PAS QMS is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about laboratory and service center activities and performance is gained from sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the corrective action (Refer to Section 4.11) and preventive action (Refer to Section 4.12) processes and during annual review of the management system (Refer to Section 4.15) to establish goals and objectives for improvement.

PAS also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team-based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. All activities of 3P and Lean must conform with the requirements of this quality manual and supporting policies and procedures.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.11 Corrective Action

Corrective action is a process used to eliminate the cause of a detected nonconformity. It is different from a correction. A correction is an action taken to fix an immediate problem but that does not resolve the underlying cause of why the problem occurred. The objective of corrective action is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA, is one of the most effective tools used by PAS to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

PAS has two general processes for corrective action, the application of which process is used depends on the type of nonconformity.

Quality control (QC) exceptions (nonconformance) that occur during routine testing is investigated through troubleshooting and required actions for correction is specified in policies and SOPs. When action is not taken, cannot be taken, or is not successful, test results associated with the nonconforming work are qualified in the final test report. Documentation of the nonconformance and corrective action taken is documented in the analytical record.

A 7-stage corrective action process is used when there is a recurring problem. These problems are identified through various activities such as but not limited to quality control trends, internal and external audits, management review, customer feedback, and general observation.

The 7 Stage CAPA Process for PAS includes:

1) Identification and Containment
2) Evaluation
3) Investigation
4) Cause Analysis
5) Action Plan
6) Implementation
7) Follow Up and Effectiveness Review

PAS procedures for corrective action are specified in corporate SOP ENV-SOP-CORQ-0018, *Procedure for Corrective and Preventive Action*. Some key concepts and activities related to the PAS corrective action process are provided in the next three subsections.

4.11.1 Cause Analysis (AKA Root Cause Analysis)

Cause analysis is the process of investigation used to identify the underlying cause(s) of the problem. After causal factors are identified, ways to mitigate the causal factors are identified and action(s) most likely to eliminate these factors are taken.

PAS uses different methods to conduct cause analysis. The most common approach is 5-Why, 4M, Fishbone Diagrams, or brainstorming may be appropriate depending on the situation. The method used is case specific and is documented in the CAPA record.

4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is an essential part of the corrective action process. Effectiveness means the actions taken were appropriate and sustainable. Appropriate

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

means the action(s) taken prevented recurrence of the problem since the time corrective action was taken and sustainable means the actions taken are still in place.

The data from CAPA records are used by PAS to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. Refer to Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

4.11.3 Additional Audits

When cause analysis and investigation of a problem casts doubt on compliance with PAS policies, procedures, or to regulatory requirements; a special audit of the area of activity may be performed as part of the corrective action process. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a grave issue or risk to the business is identified.

4.12 Preventive Action

Preventive action(s) are actions taken to eliminate the cause of a potential nonconformity before it happens.

Some examples of preventive action include, but are not limited to:

Routine instrument maintenance (Preventive maintenance)

Addition of Staff and Equipment

Professional Development Activities

Implementation of New Technology

PAS looks for opportunities for preventive action from a variety of sources including employee ideas, customer feedback, business partners input, trend analysis, business analytics, management reviews, proficiency testing results, and risk-benefit analysis.

PAS management evaluates the success of preventive actions taken in any given year during annual management review. Refer to Section 4.15 for more information.

4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by PAS locations. PAS management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

4.13 Control of Records

PAS records document activities and provide evidence of conformity to the requirements established in the QMS. These records may be hardcopy or electronic on any form of media.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.13.1 General Requirements

4.13.1.1 Procedure

PAS requirements for control of records are specified in corporate policy ENV-POL-CORQ-0013 *Record Managemen*t.

The policy was established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, PAS records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

Record Type	Includes Records of:
Quality	Audits: Internal and External Certificates and Scopes of Accreditation Corrective & Preventive Action Management Review Data Investigations Method Validation Instrument Verification Training Records
Technical	Raw Data Logbooks Certificates of Traceability Analytical Record Test Reports & Project Information Technical Training Records & Demonstration of Capability
Administrative	Personnel Records Finance/Business

4.13.1.2 Record Legibility and Storage

Records are designed to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify personnel that performed the activity or entered the information. Records are archived and stored in a way that they are retrievable. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy records are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Administrative records are kept for a minimum of 5 years and technical and quality records are kept for 10 years unless otherwise specified by the client or regulatory program. All records for Building Science and Absaraka Air Science (Sheridan, WY) laboratories are kept for 5 years.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the record management policy and the location specific SOP for more information

4.13.1.3 Security

PAS locations are secure facilities and access to records is restricted to authorized personnel.

4.13.1.4 Electronic Records

The data systems used to store electronic records is backed up in accordance with SOP ENV-SOP-WES2-0115, *Computer System Backup Control*. Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

4.13.1.5 Electronic Signature Policy

Work done by PAS locations includes activities that require the application of a signature. Some work products are in electronic format and signatures are applied electronically.

The Electronic Signatures in Global and National Commerce Act (E-Sign Act) clarifies that electronic signatures are legally valid and enforceable under United States law.

Refer to guide ENV-GUI-CORQ-0007 *Electronic Signatures* for more information.

4.13.2 Technical Records

In addition to the requirements specified in subsections 4.13.1.1 through 4.13.1.5, the requirements in the following subsections also apply to technical records.

4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project records. The accumulated record needs to provide adequate detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. PAS managers are responsible for ensuring that data entries, whether made electronically or on hardcopy, are identifiable to the task

4.13.2.3 Error Correction

Errors in records must never be erased, deleted, or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single strike through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person making the correction. If the correction is not self-explanatory, a reason for the correction is recorded. Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3.

For electronic records, equivalent measures of error correction or traceability of changes made are kept. For example, audit trails provide records of change.

4.14 Audits

Quality personnel, or their designee, perform internal systems and technical audits to assess implementation of the QMS and compliance to this manual, policy, and procedures that make up the QMS.

PAS locations are also audited by external parties such as regulatory agencies, customers, consultants, and non-government assessment bodies (NGAB).

Information from internal and external audits is used by local and corporate PAS management to address deficiencies and to identify opportunities to improve customer service and quality of work, including reliability and usability of data and test results.

Deficiencies, observations, and recommendations from audits are managed by the local QM using the CAPA process. Refer to Section 4.11 for more information.

4.14.1 Internal Audit

Internal audits are conducted to ensure laboratory and business practices match what we say we do and what we say we do is compliant with the PAS QMS and relevant standards and requirements.

The internal audit program is managed by the local QM who prepares an audit plan at the beginning of each calendar year. The schedule is prepared to ensure that all work areas are reviewed over the course of the year and test methods are audited every two years, unless a more frequent test method audit is required by program. Conformance to the schedule is monitored on a monthly basis.

PAS management is responsible for ensuring the audit schedule is maintained. PAS supervisors are expected to cooperate with the quality personnel to provide them with complete access to the work area, personnel, and records needed to conduct the audit.

Internal audits may be performed by non-quality personnel when the auditor is approved by the local QM. Non-quality personnel may not audit their own work activities unless it can be

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

demonstrated that an effective and objective audit will be conducted. The person conducting the audit must be trained, qualified, and familiar enough with the objectives and policies of the PAS QMS and knowledgeable with process and test method SOPs related to the activities audited. The auditor should be trained in auditing practices in order to perform a thorough and effective evaluation.

Test method audits include reviews of test reports to verify the product is consistent with customer/project requirements, the work was conducted in accordance with policy and SOPs, the SOP complies with the cited reference method, test results are accurate, and of known and documented quality and properly qualified, when necessary.

Special audits are performed as needed to follow up on a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to the location or work area audited.

When observations and findings from any audit (internal or external) cast doubt on the validity of testing results, the location takes immediate action to investigate the problem and take corrective action. (Also refer to Section 4.11 and 4.16)

4.14.1.1 Corporate Compliance Audit

PAS locations may also be audited by Pace® corporate personnel at discretion. The purpose of the corporate compliance audit is to assess whether the location's practices, processes and procedures conform with the PAS QMS and to identify risk and opportunity.

4.15 Management Review

Local management conducts an annual business review of each location under their purview to assess performance and to establish goals, objectives, and action plans for the upcoming year.

The procedure used to conduct this review is specified in corporate SOP ENV-SOP-CORQ-0005 *Management Review*.

At a minimum, the following topics are reviewed and discussed during annual management review:

Changes in internal and external issues relevant to the location;

Fulfillment of objectives and initiatives;

suitability of policies and procedures, including EHS and waste management;

status of actions from previous performance reviews;

The outcome of recent internal audits;

Corrective and preventive actions;

Assessments by external bodies;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The results of interlaboratory comparisons or proficiency tests;

Changes in the volume and type of the work;

Customer and personnel feedback, including complaints;

Effectiveness of improvements / preventive actions made since last review;

Adequacy of resources;

results of risk identification;

Proficiency testing performance and other measures related to the assurance of validity of test results; other relevant factors, such as QC trends and training status.

The discussion and results of this review are documented in a report prepared by local management. This report includes a determination of the effectiveness of the management system and its processes, goals, and objectives for improvements in the coming year with timelines and responsibilities, and any other need for change.

Goals and action items from annual management systems review are shared with local employees and with corporate management to highlight focus areas for improvement in addition to areas in which the location has excelled.

4.16 Data Integrity

PAS procedures for the investigation and response to events that may affect data integrity are described in the PAS corporate SOP ENV-SOP-CORQ-0017 *Data Impact Assessment*s.

Customers whose data are affected by the problem are notified in a timely manner, usually within 30 days after the impact of the problem is understood. Some accreditation programs also require notification to the accreditation body within a certain timeframe from date of discovery. PAS locations must follow any program or project specific requirements for notification, when applicable.

5.0 TECHNICAL REQUIREMENTS

5.1 General

Multiple factors contribute to the correctness and reliability of the technical work performed by PAS.

These factors fall under these broad categories:

Human Performance

Facility and Environmental Conditions

Test Method Performance and Validation

Measurement Traceability

Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each of these factors, PAS accounts for the contribution from each of these categories

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies used.

5.2 Personnel

5.2.1 Personnel Qualifications

PAS personnel are qualified and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (Refer to Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the location to communicate to personnel the duties, responsibilities, and authorities of their position. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The term "personnel" refers to individuals employed by PAS or a PAS subsidiary directly as full-time, part-time, or temporary, and individuals employed by PAS by contract, such as through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For the purposes of this manual, these terms are equivalent.

5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

PAS requirements for competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources. The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when they have completed the required training specified in Section 5.2.2.

5.2.2 Required Training

Training requirements are outlined in Pace® policies COR-POL-0023 *Mandatory Training Policy, COR*-POL-0004 *Code of Ethics and Professional Conduct* and this Quality Manual.

5.2.2.1 Training Program

The PAS training program includes these elements:

Scheduling
Execution
Documentation
Evaluation of Effectiveness

Training is scheduled by corporate personnel, local quality personnel, and the employee's direct supervisor.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Training is delivered using various methods that incorporate techniques that appeal to the four main learning styles: visual, aural, linguistic, and kinesthetic. Delivery methods include, on-the-job (OJT), instructor-led, self-study, eLearning, and blended.

Training must be documented with a training record to prove training occurred. Required training (Section 5.2.2.1.1-5.2.2.1.5) must be complete before the employee is authorized to work independently on client samples. Complete means the employee has successfully completed training and evidence of training is filed in the employees training record maintained by the corporate training group, the corporate group that assigned training, such as IT, HR, or EHS, and/or and the local quality department.

The employee's direct supervisor is responsible for monitoring completion of the employee's required training program and for providing adequate time to the employee to complete training assignments. The supervisor and employee are jointly responsible to ensure the employee's training status and training records for all required training are current, complete, documented and the training records are accessible.

Until the required training is complete, the employee's direct supervisor is responsible and accountable for all work produced by the employee under their supervision.

Training status is tracked by local quality personnel and made readily available to all employees so they can access and monitor their status in real time.

The following subsections specify the required PAS training for new hires and requirements for on-going training.

5.2.2.1.1 New Hire Required Training

New hire training requirements apply to personnel new to Pace® and to existing employees starting in a new position or different work area.

Required new hire training includes each of the following topics:

Ethics and Data Integrity (5.2.2.1.3)

Quality Management System Policy and Procedure (5.2.2.1.4)

Environmental Health and Safety

Demonstration of Capability (DOC) (5.2.2.1.5): Employees that prepare and test samples may also be required to successfully complete a DOC for the test method they are assigned before working independently on customer samples and to verify capability on a routine basis thereafter. Independent means without direct supervision of the work activity by the supervisor or a qualified trainer.

5.2.2.1.2 On-Going Required Training

All personnel receive on-going training on each of the following topics:

Ethics and Data Integrity

Quality Management System Policy and Procedure

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

EHS

5.2.2.1.3 Ethics and Data Integrity

Ethics and data integrity training is provided to all new personnel upon hire and refresher training is provided to all employees minimally on an annual basis and more frequently as needed.

The training materials emphasize expectations, what to do, what not to do and the potential consequences that result from scientific misconduct and improper practices. Employees are informed that Pace® has a Zero Tolerance Policy for scientific misconduct, improper practices, and fraud. The employment of any employee found to have conducted, sanctioned, or instructed an employee to engage in these infractions will be terminated and the employee may be subject to debarment, and civil/criminal prosecution.

The following topics are covered:

Pace® Policy for honest, transparent, and objective reporting of test results and data;

Practices that are considered scientific misconduct, fraudulent and improper;

How and when to report data integrity concerns or ethical violations;

Record Keeping. The training emphasizes the importance of accurate, complete, and legible documentation of work activities;

Procedures used by Pace® to prevent and monitor for infractions;

Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

Refer to COR-POL-0004 for more information.

5.2.2.1.4 Management System Documents Training

The primary documents that support the PAS QMS include the Quality Manual, policies, and SOPs.

These documents specify what we do, how, and why and are the documents all employees must abide. The employee's commitment to abide by these documents is acknowledged with a Read and Acknowledgement Attestation (R&A). PAS employees must have an R&A on record for the local Quality Manual, and the policies and SOPs relevant to their job responsibilities. The R&A acknowledges the employee has received, read, and understands the content of the management system document, the employee agrees to follow any instructions and requirements specified in the document when carrying out their work tasks; and the employee understands that unauthorized changes or departure

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

from procedures and requirements specified in the documents not allowed unless authorized, documented and disclosed.

Other documents that support the management system include forms and worksheets that record original observations and/or calculate test results, guides, project-specific documents, or other reference materials. Employees are not required to have a R&A for these types of documents – how to use the document is learned on the job.

Employee understanding, application, and adherence to the content specified in management system documents is continuously reinforced by on-the-job training and routine checks and balances, such as secondary data review and internal audits.

5.2.2.1.5 Demonstration of Capability (DOC) Requirements

A DOC is a procedure that establishes the ability of the analyst to perform a test procedure and obtain test results with acceptable accuracy and/or precision.

Newly hired employees that prepare or test samples are required to successfully complete an initial demonstration of capability (IDOC) for the test method before they are permitted to work independently on real world samples.

On-going demonstration of capability (ODOC) must be demonstrated on an annual basis thereafter.

The procedure for IDOC and ODOC can differ based on technology, analyte group and/or the regulatory or accreditation/certification program requirements that apply. In general, the options for ODOC are more flexible than for an IDOC on the premise that the analyst has routinely analyzed samples by the test method during the calendar year.

When more than 365 days (1 Year) have passed since the employee last analyzed real world samples by the test method; the employee must successfully redemonstrate capability with an IDOC to remain authorized to independently test real world samples.

A successfully complete DOC (IDOC or ODOC) is one where:

1) The DOC study data has been compiled, reviewed, and verified to meet acceptance criteria;

2) The DOC record has been approved by the department supervisor;

3) The DOC record has been verified complete by local quality personnel; and

4) The DOC record has been archived in the employee's training file for accessibility and reference.

If any of the above conditions is not met, the DOC is not complete.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Until the required training is complete, the employee's direct supervisor is responsible and accountable for all work produced by the employee under their supervision.

DOC procedures and acceptance criteria vary by program, technology, analyte group - therefore all options are not specified in this manual.

PAS locations must put in place a local DOC program appropriate for the testing services offered and that complies with relevant regulatory and/or accreditation/certification program requirements.

For example – an acceptable DOC program for laboratories accredited to the TNI Standard might look like this:

A DOC for chemistry test methods where spiking is an option is based on the employee's capability to achieve acceptable precision and accuracy for each analyte accredited from a series (usually 4) of replicates that were spiked at a specific concentration, and prepared and analyzed using the laboratory's test method SOPs.

A DOC for a test method where spiking is not an option is based on an employee's capability to achieve comparable results to a peer.

If the above options are not feasible, a DOC may consist of:

Analysis of one or more blind samples. Blind samples may be prepared by the trainer or other personnel and may consist of in-house prepared samples, reference slides, or previous PT studies.

ODOC may be demonstrated through continued analysis of blind samples or successful completion of inter- and intra-analyst QC performed on five (5) percent of samples, or at least one (1) each month samples are received, whichever is greater.

AIHA-LAP, LLC Procedure for Initial D.O.C. of Lead Analysts & Technicians:

For each matrix (wipe, air, paint, soil) prepare five aliquots of a suitable reference material. Prepare and analyze by routine procedures. Repeat this process on four different days for each matrix. Acceptance criteria shall meet the criteria of the method. Any outlier shall be addressed as a non-conforming event.

Specific instructions and acceptance criteria for DOCs for each test method may be specified in the test method SOP or a stand-alone SOP for DOC.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.2.2.2 Effectiveness of Training

Training effectiveness is measured by the employee's demonstrated ability to comprehend the training material and apply knowledge and skills gained to their job task. These evaluations include but are not limited to:

Testing of the employee's knowledge of the QMS, policies, and technical and administrative procedures through various mechanisms, such as quizzes, and interviews.

Demonstrated ability to convey information correctly and factually in written and verbal communication.

Demonstrated ability to follow instructions and adhere to policy and procedure.

Demonstrated ability to make sound decisions based on guidance and information available and to defend decisions made.

Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

5.2.2.3 Supplemental Learning

Supplemental learning objectives may be established for newly hired personnel to aid in their development of administrative and technical skills. These learning objectives and materials, referred to as Learning Plans (LP), are managed by the employee's direct supervisor.

Pace® also offers a wide variety of supplemental learning courses that are made available to all employees for professional development. The learning may be self-initiated based on an employee's interest or may be assigned to the employee at the discretion of management as professional development as part of an employee's annual goals.

Supplemental learning assignments are not prerequisites for competency (Section 5.2.1.1) and are not included in the required training program.

5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision.

General supervisory responsibilities may include but are not limited to:

Hiring Employees

Training Employees

Performance Management

Development, oversight, and execution of personnel training plans

Monitoring personnel work product to ensure the work is conducted in accordance with this quality manual, policies, SOPs, and other documents that support the QMS.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each Pace® position are established by top management and kept by corporate HR. The job descriptions apply to employees who are directly employed by Pace®, part-time, temporary, technical, and administrative and by those that are under contract with Pace® through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

5.2.5 Authorization of Technical Personnel

Technical personnel are authorized to perform the technical aspects of their position after laboratory management has verified that the employee meets the qualifications for the position and has successfully completed the required training (Section 5.2.2.1). After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records used to support authorization which may include but are not limited to, transcripts, resumes, training records, experience, training, and certificates are kept by the PAS location or business function to which the employee is assigned, if the employee is in a role that support more than one location or business unit.

5.3 Accommodations and Facilities

5.3.1 Facilities

PAS facilities are designed to support the activity performed. Access to PAS facilities is controlled by various measures, such as card access, locked doors, and staffed main entry.

5.3.2 Environmental Conditions

Each location is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper and safe performance of calibrations and tests. Local management ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound, and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Operations are stopped if it is discovered that the environmental conditions would jeopardize the integrity of analytical results or other work products.

5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each work area are designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic analysis (SVOA).

Samples known or suspected to contain high concentration of analytes are separated from other samples to avoid the possibility of cross-contamination. If contamination is found, the source of contamination is investigated and resolved

5.3.4 Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access to each area may be controlled depending on the required personnel, the sensitivity of the operations performed, and potential safety concerns.

5.3.5 Good Housekeeping

Local management must maintain good housekeeping practices in their facilities and maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety.

5.4 Test Methods

5.4.1 General Requirements

PAS locations must use test methods and procedures that are appropriate for the scope of analytical test services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples must be specified in SOPs. The instructions in SOPs may be supplemented with other documents including, but not limited to, standard work instructions, manuals, guides, project documents, and other reference materials..

5.4.2 Method Selection

The test methods offered by PAS are primarily industry accepted published reference test methods. Each PAS laboratory bases its test method SOP on the latest version of the reference method unless regulatory requirements specify an earlier version must be used.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples following method validation protocols specified in Section 5.4.5.

The test methods used by the laboratory to test real world samples must meet the needs of the customer, be appropriate for the intended use of the data, and must conform with applicable federal, statutory, or program requirements.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical service requests (Refer to Section 4.4).

5.4.3 Laboratory Developed Methods

A laboratory developed method is a test method developed wholly by PAS or a modification to a published method that is substantially modified from the specifications and procedures of a published test method.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Laboratory developed methods must be validated prior to use (Refer to Section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to PAS developed methods.

5.4.4 Non-standard Methods

A non-standard method is a testing protocol that is not published or approved for use by conventional industry standards.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

5.4.5 Method Validation

The laboratory confirms that it can successfully perform the test method before analyzing samples through a process called method validation. Method validation is partially or fully repeated when there is a change in the published reference method or a change in the way the laboratory performs the test method that may affect selectivity, sensitivity, accuracy, precision, or general performance of the method.

5.4.5.1 Validation Description

Validation is the process of confirmation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works as expected and the data and test results are accurate and precise.

The record of validation is retained and kept in accordance with method validation SOP and PAS corporate policy ENV-CORQ-POL-0013 *Record Management*.

5.4.5.3 Validation of Customer Need

The laboratory's validation process includes measures to assess accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, robustness, and cross-sensitivity of the laboratory's procedure against general customer expectations for data usability.

The following subsections describe some of these concepts in relation to organic and inorganic chemistry (chemical testing). These descriptions and the requirements specified are pertinent to chemical testing and may not apply in the same context to other testing services offered by PAS such as radiochemistry, whole effluent toxicity (WET), asbestos, and microbiology. For more information about validation measures for these testing services, refer to the laboratory's test method SOPs.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard. When the result is within a range from the known value (control limit); the result is considered accurate.

5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) of results from separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

5.4.5.3.3 Sensitivity in Chemical Testing

Sensitivity refers to the smallest amount of substance in a sample that can accurately be measured.

In chemical testing, this threshold is commonly known as the detection limit (DL) or method detection limit (MDL).

The DL is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

The DL is either a statistically derived value obtained by multiplying the standard deviation from a series of spiked replicates by the student-T value that correlates to the number of replicates analyzed or it is set to the concentration greater than found in a population of method blanks.

Detections of target analytes below the DL are not reported – unless specified by regulatory program protocol, because presence of target analytes at this level cannot be differentiated from noise.

Limits of Quantitation represent the threshold of the laboratory's procedure for quantitative sensitivity.

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence.

The LLOQ is simply the concentration of the lowest calibration standard included in the calibration curve.

Although the LOQ and LLOQ may be and often are the same value; the definitions are not the same.

The LOQ is static – it is set when the DL is determined. The LOQ value must be routinely verified to confirm the laboratory can detect the concentration within a range of accuracy.

The LLOQ fluctuates based on the series of standards included in each calibration curve – the LLOQ is always the concentration of the lowest

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

calibration standard included in the curve fit and for which samples are quantitated against. The LLOQ is not the concentration of the lowest standard analyzed, if the lowest concentration standard is not included in the curve, it is not relevant to sample quantitation. Unless otherwise specified by test method, regulatory program or project-specific protocol, accuracy at the LLOQ does not need to be verified independent of the evaluation of relative error or relative standard error.

Target analytes detected at concentrations between the DL and LOQ are known as estimated values – they are within the range of qualitative identification and outside the range of quantitative accuracy. If reported, the results must be qualified to indicate the test result is estimated.

The meaning of Limit of Detection (LOD) varies based on the context by which the term is used. Outside of the DoD program, LOD is another term used to refer to the DL or MDL.

PAS laboratories that are accredited for DoD, must also establish an LOD. The DoD defines the LOD as the smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. This definition is different from the definition of DL - the DL represents the theoretical value at which a detection is distinguishable from a blank.

For DoD, the LOD is a value between the DL and the LOQ. The value of the LOD set by the laboratory must meet all criteria for qualitative identification and quantitative accuracy based on the signal to noise ratio.

For DoD/DOE project work, target analytes that are not detected at the DL are reported as undetected at the LOD and results between the DL and the LOQ are reported as estimated values.

The reporting limit (RL) is the value to which test results are reported as detected or not detected. The RL may be project-defined based on project data quality objectives and it may be above or below the LOQ or LLOQ. In the absence of project specific requirements, the RL is usually the same value as the LLOQ. The RL is also called the practical quantitation limit (PQL) – but this can be misleading if the RL is less than the LLOQ or LOQ.

In general, the RL should always be greater than or equal to the value that establishes the threshold for quantitative sensitivity, but it is common for clients to request laboratories to report undetected target analytes at the DL value. This instruction has evolved as an acceptable reporting practice; however, data users should understand the DL is a statistically derived value that does not represent the limit of quantitation.

Unless otherwise specified by regulatory program or test method, detection, quantitation, and reporting limits are adjusted for the amount of sample used (preparation factor) and the dilution factor and are adjusted for percent moisture when samples are reported on a dry weight basis.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

To ensure detection and quantitation limits are sound and defensible, the procedures that PAS laboratories use to establish detection, quantitation and reporting limits for chemical testing must comply with the current version of each of the following documents:

EPA document EPA-821-R-16-006 Definition and Procedure for the Determination of the Method Detection Limit;

2016 TNI Environmental Laboratory Standard Volume 1 Module 4; and

TNI GUID-3-109-Rev. 0, V1M4 2016 Standard Update Guidance on Detection and Quantitation.

5.4.5.3.4 Sensitivity in Microbiological Testing

In microbiological testing, the detection limit (DL) is the lowest microbial density that can be measured. It is determined by using dilutions of reference cultures and measuring recovery among replicates of each dilution. For most microbiological methods the sensitivity is defined in the method. For example, in most colony counting methods the sensitivity is 1 cfu. In microbial testing, the LOQ and LLOQ are the same as the DL.

5.4.5.3.5 Sensitivity in Asbestos Testing

Analytical sensitivity for Transmission Electron Microscopy (TEM) in waters is defined as the waterborne concentration represented by the finding of one asbestos structure in the total area of filter examined. This value will depend on the fraction of the filter sampled and any dilution factor.

Analytical sensitivity for (TEM) in air is defined as the airborne concentration represented by the finding of one asbestos structure in the total area of filter examined. This value will depend on the effective surface area of the filter, the filter area analyzed, and the volume of air sampled.

The normal quantitative working range for Phase Contrast Microscopy (PCM) is 0.04 to 0.5 fiber/ cm2 for a 1000 L air sample. An ideal counting range on the filter shall be 100 to 1300 fibers/mm2. The limit of detection (LOD) is estimated to be 5.5 fibers per 100 fields or 7 fibers/mm2. The LOD in fiber/cc will depend on sample volume and quantity of interfering dust but shall be <0.01 fiber/cm2 for atmospheres free of interferences.

Refer to the method SOP for analytical sensitivity for Polarized Light Microscopy (PLM).

5.4.5.3.6 Selectivity

Selectivity refers to the ability of a method to correctly determine an analyte or species without interference from the surrounding matrix.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.4.5.3.7 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. In general, if linearity is demonstrated then the slope of the response of standards is sufficiently close to one another. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference. Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. The upper range of linearity establishes the upper limit of quantitation. For most technologies, results outside of this range are considered qualitative values. However, some inorganic test methods allow the linear range to be extended above the upper limit of quantitation when accuracy at this level is verified. Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day-to-day basis confirms the laboratory's method is repeatable, reproducible, and robust.

5.4.6 Measurement Uncertainty

PAS provides an estimate of uncertainty with analytical results on request, or when required. For example, for radiochemistry testing, uncertainty is always reported with the test result.

For chemistry the uncertainty of the test method is embedded in the control limits used to assess performance of quality control samples. Language in ISO/IEC 17025 clarifies that measurement uncertainty is satisfied when a well-recognized test method specifies limits that account for source of bias, the laboratory has satisfied the requirements on analytical uncertainty by following the test method and reporting instructions. Refer to Section 5.9.1.1.9 for more information.

For BDSG microbiology and asbestos refer to ENV-GUI-BDSG-0009 *Measurement of Uncertainty*

5.4.7 Control of Data

PAS has policies and processes in place to ensure that reported data is free from calculation and transcription errors, manual changes to data are thoroughly reviewed for need and correctness, and software systems used to generate or store data is secure.

5.4.7.1 Calculations, Data Transfer, Reduction and Review

Data reduction is performed using commercially available data processing/reduction software, the LIMS and/or programs and worksheets created by PAS.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

PAS does not permit manual calculation of results – that is the calculation of a test result by pen and paper or calculator. When there is no commercial software or LIMS option, PAS laboratories must create a worksheet from a spreadsheet program, such as Excel, to calculate results based on raw inputs and original observations. Spreadsheets for these purposes must be validated and controlled in accordance with policy ENV-POL-CORQ-0015 *Spreadsheet Validation*.

5.4.7.1.1 Manual Integration

The PAS policy and procedures for manual integration are specified in PAS SOP ENV-SOP-CORQ-0006 *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration minimally includes:

complete audit trail to permit reconstruction of before and after results;

identification of the analyst that performed the integration and the reason the integration was performed; and

identification of the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible, PAS uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

In-house developed software is validated by Pace® corporate IT for adequacy before release for routine use. Commercial off-the-shelf software is considered sufficiently validated when the location follows the manufacturer or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology group or by the group that performed the validation.

The PAS process for the protection of data stored in electronic systems includes:

Individual usernames and passwords for Laboratory Information Management Systems and auxiliary systems used to store or process data.

Employee Training in Computer Security Awareness

Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.

Operating system and file access safeguards

Protection from Computer Viruses

Regular system backup; and testing of retrieved data

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.

Change control to ensure requests for changes are reviewed and approved by management before the change is made.

Communication channels to assure all staff are aware of changes made.

Version Control and maintenance of historical records.

5.5 Calibration Requirements

5.5.1 Availability of Equipment

Local management ensures the laboratory is furnished with all equipment and instrumentation necessary to correctly perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

5.5.2 Calibration

Equipment and instrumentation are checked prior to use to verify it performs within tolerance for its intended application.

5.5.2.1 Support Equipment

Support equipment is verified to be in proper working order, and to meet the tolerance specifications for the purpose(s) for which it will be used prior to placement in service. Thereafter, periodic checks are performed to verify on-going performance per a schedule maintained by local quality personnel. Support equipment that does not meet specifications is removed from service and either repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to conduct and record these checks are outlined in SOP SOP ENV-SOP-WES2-0036, *Balance Calibration Verification*, ENV-SOP-WES2-0039 *Thermometer Calibration*, ENV-SOP-WES2-0123 *Autopipet and Wet Chem Titrator Calibration Verification*.

5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*. After the initial service date, the calibration of instruments and verification of calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs must comply with the requirements for acceptable calibration practices outlined in corporate policy ENV-POL-CORQ-0005 *Acceptable Calibration Practices*, the reference methods, and any applicable regulatory or program requirements.

5.5.3 Equipment Use and Operation

Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions or

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

instrument manuals which are made readily accessible in the work area to all laboratory personnel.

5.5.4 Equipment Identification

Each piece of equipment is uniquely identified by serial number or any other unique ID system. The identifier is included in the equipment list maintained by the quality department and may not be reused or used interchangeably. New equipment and replacement equipment are assigned a new unique ID. When transferring equipment between PAS locations, the laboratory receiving the equipment assigns a new unique ID and the lab that sent the equipment retires the ID previously assigned.

5.5.5 Equipment Lists and Records

5.5.5.1 Equipment List

Each PAS location maintains a list of equipment that includes information about the equipment including a description, manufacturer, serial number, date placed in service, condition when received, identity, and the work area where the equipment is used. The equipment list(s) for each location covered by this manual is managed by local Quality and maintained in the QA groups in Teams.

5.5.5.2 Equipment Records

In addition to the equipment list, other equipment records maintained by PAS include:

Verification that equipment conforms with specifications.

Calibration records including dates, results, acceptance criteria, and next calibration dates.

Maintenance plan and records.

Records of damage, malfunction, or repair.

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in the analytical method SOPs.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve a specific problem such as degradation of peak resolution, shift in calibration relationship, loss of sensitivity, or repeat failure of instrument performance checks and quality control samples.

Maintenance is performed by PAS personnel or by outside service providers.

All maintenance activities performed by PAS personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, a description of the activity performed, why

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

(when the maintenance is non-routine), and the return to analytical control. When maintenance is performed by an external vendor, the service record must be maintained and accessible for easy retrieval. The location must provide personnel with unrestricted access to instrument maintenance logs in order to promote good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the location will use safe practices for handling and transport to minimize damage and contamination

5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service and either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service because it no longer meets tolerance specifications, the potential effect the nonconformity may have had on previously reported analytical results is evaluated.

5.5.7 Calibration Status

Support equipment is labeled to identify its calibration status.

The calibration status of analytical instruments is identified in the instrument run log, in the data processing software or other systems the laboratory may use for processing of data. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

5.5.8 Returned Equipment Checks

When equipment or an instrument is sent out for service, the function and calibration status of the equipment must be rechecked and shown to be satisfactory before the equipment is returned to service. This requirement must be included in the laboratory's protocols for servicing equipment.

5.5.9 Intermediate Equipment Checks

PAS performs intermediate checks on equipment to verify the on-going calibration status. For example, most test methods require some form of continuing calibration verification check, and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed; Refer to SOP ENV-SOP-WES2-0036 *Balance Calibration Verification*, ENV-SOP-WES2-0039 *Thermometer Calibration*, ENV-SOP-WES2-0039 Autopipet and *Wet Chem Titrator Calibration Verification* for more information.

5.5.10 Safeguarding Equipment Integrity

Equipment integrity in maintained by:

Following manufacturer's specification for instrument use so that settings do not exceed manufacturer's recommendation or stress the performance of the equipment;

Established maintenance programs;

Transparent maintenance records and unrestricted access to maintenance logs;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Validation and approval of software before use;

Audits to confirm instrument settings are consistent with SOPs; and

On-the-job training for safe and proper use of laboratory equipment.

5.6 Measurement Traceability

5.6.1 General

Measurement traceability is best described as the way to ensure measurements take into consideration all uncertainties and are representative of the most accurate measurement captured. Traceability is accomplished with the recording of the lot numbers of materials and equipment used in the testing process and by purchasing materials traceable to the international standards of units (SI), International Bureau of Weights and Measures (BIPM) and/or National Measures Institute (NMI).

When traceability to SI units, BIPM, or NMI cannot be achieved, traceability is accomplished with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

5.6.2 Equipment Correction Factors

Measurements are adjusted by the correction factor when the equipment used for the measurement has a correction factor.

5.6.2.1 Requirements for Calibration Laboratories

PAS does not offer calibration services, therefore, the ISO/IEC 17025 requirements for calibration laboratories do not apply.

5.6.2.2 Requirements for Testing Laboratories

Requirements to verify equipment is calibrated prior to being put into service and to maintain measurement traceability are described in sections 5.5.2 and 5.6, respectively.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

The laboratory uses measurement reference standards to verify adequacy of working weights and thermometers. The working weights are the weight(s) used for daily balance calibration checks and the working thermometers are used for daily temperature measurements.

Working weights and thermometers are periodically checked to verify on-going adequacy for use between the calibrations performed by an external calibration laboratory using reference standards traceable to SI or a national standard and that are used solely for verification purposes.

For example:

An acceptable reference standard to verify working thermometers is a NIST Certified thermometer or a NIST Traceable thermometer that is not used for any other purpose other than to check the adequacy of the working thermometer.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

An acceptable reference standard for the working weights is a set of Class S weights that is not used for any other purpose than to verify the weights used daily.

The working weights are checked against the reference standard annually and recertified by an ISO accredited calibration body every 5 years. "Annually" means within thirteen (13) months from the date of the last check.

Working thermometers are checked against the reference thermometer prior to placement in service to establish a correction factor (CF) and then re-checked annually (within 13 months from date of last check) or if electronic, every three (3) months (within 100 days from date of last check).

Exceptions to the 3-month recheck for battery operated sensors are allowed when the sensor is embedded in a unit and the manufacturer/vendor has evidence to show that the accuracy of the sensor is not affected by battery life.

Liquid in Glass NIST Certified reference thermometers must be recertified by an ISO/IEC accredited calibration laboratory every 5 years. If the reference thermometer is NIST Traceable or is a digital NIST Certified thermometer, the reference thermometer must be recertified annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

5.6.3.2 Reference Materials

PAS purchases chemical reference materials (also known as stock standards) from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COAs are reviewed for adequacy and retained by the laboratory for future reference.

All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.

The laboratory procedure for traceability and use of these materials is provided in SOP ENV-SOP-WES2-0038 *Reagent Solvent and Standard Control.*

This SOP must minimally include each of the following requirements:

Procedures for receipt and tracking of reference and working standards to ensure the record includes material name, name of the material, lot number, receipt date, and manufacturer's expiration date.

Storage conditions and the requirement that reference standards are stored separately from samples, extracts, and digestates.

Requirements to assure that preparation of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and lot number of the solvent, the formulation, date, new expiration date, and the

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

preparer's initials. The lot number of working standards is recorded in the analytical record to provide traceability to the standard preparation record. The preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.

A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless it is not possible to procure a new standard, and the reliability of the expired material is verified and documented by the location using a procedure approved by corporate quality personnel. Otherwise, the expired material is promptly removed from the work area or clearly labeled as acceptable for qualitative/troubleshooting purposes only.

The second source materials used for verification of instrument calibration are obtained from a different manufacturer or may be a different lot from the same manufacturer, when only one vendor or manufacturer provides the standard.

Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.

Procedures for labeling. At a minimum, the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

5.6.3.3 Intermediate Checks

Checks to confirm the acceptability of reference standards and materials are specified in test method SOPs and are appropriate for the purpose for which the standard is used. For example, a second source standard analyzed after an initial calibration may help the analyst identify if degradation of the standards used for calibration has occurred.

5.6.3.4 Transport and Storage

PAS handles, transports and stores reference standards in a manner that protects the integrity of the materials. The integrity of the reference standard is protected by segregation from incompatible materials and/or minimizing exposure to degrading environments or materials. As previously stated, standards and reference materials are stored separately from samples, extracts, and digestates to prevent contamination. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g., remains in liquid state and does not freeze solid).

Specific requirements are provided in test method SOPs.

5.7 Sampling

Sampling refers to both the field collection of samples and to subsamples taken by the laboratory for analysis.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Subsampling procedures are included in each test method SOP or a stand-alone SOP to assure the aliquot used for testing is representative of the field collected sample.

The requirements in the following subsections apply when sampling is performed by PAS.

5.7.1 Sampling Plans and SOPs

When PAS performs field collection of samples, the sampling is conducted in accordance with a project sampling plan and sampling SOPs to ensure representative samples are collected.

5.7.2 Customer Requested Deviations

When the customer requests deviations, additions, or exclusions from the project sampling plan and/or the SOP, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and includes this information in the final test report..

5.7.3 Recordkeeping

PAS assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

5.8 Sample Management & Handling

5.8.1 Procedures

The procedures for sample management and handling are outlined in SOP ENV-SOP-WES2-0003 *Sample Receipt and Login* and SOP ENV-SOP-WES2-0002 *Sample Custody and Tracking*. The procedures in the local SOP must meet the requirements specified in this quality manual to guarantee the integrity of the sample from receipt to disposal.

5.8.1.1 Chain of Custody

All samples received by PAS must be accompanied by a Chain of Custody (COC). The COC is the legal record that documents the collection of samples and the transfer of samples to the laboratory. The COC provides PAS with information about the samples collected and tests requested.

The COC is completed by the sample collector and must minimally include the following information:

Client name, address, phone number;

Project Reference;

Client Sample Identification (Client ID);

Date, Time, and Location of Sampling;

Sampler's Name or Initials;

Matrix;

Type of container, and total number collected;

Preservative;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Analyses Requested;

Mode of collection;

Any special instructions; and

The date and time and signature of sample transfer from collection to PAS. When samples are shipped to the laboratory by a 3rd party such as UPS or Fed EX, the COC is placed inside the sealed shipping container at time of collection and the container is not opened until it is received by PAS. Thus, the intermediate courier does not sign the COC. The shipping manifest and/or air bill is the record of possession of samples during transport to the laboratory. The shipping manifest and/or air bill is part of the COC record and must be retained and provided in the test report with the COC record, when required. (Refer to Section 5.10.3).

A complete and legible COC is required. When the COC is incomplete, illegible, or cannot be understood, the client is contacted for resolution.

Hand entries on the COC must be made in indelible ink and errors corrected by drawing a single line through the original entry, so the original entry is not obscured and entering the correct information with the date the change was made and the initials of the person making the change.

5.8.1.2 Legal Chain of Custody

Legal chain of custody is an industry defined protocol that is sometimes used for evidentiary or legal purposes that establishes an intact, continuous record of the physical possession, storage, and disposal of samples, including sample aliquots and prepared samples.

The legal COC record accounts for all time periods associated with the samples and identifies all individuals who physically handled them from the point established by legal authority, which is usually at the time the sample containers are provided for sample collection or at the time of sample collection.

A sample is in someone's legal custody if:

It is in one's physical possession;

It is in one's view after being in one's physical possession;

It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or

It is kept in a secure area, restricted to authorized personnel only.

Legal COC is not a common request, but if it is requested and the laboratory agrees to the project specification; the laboratory must maintain a procedure or process to guarantee all aspects of the protocol are met.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.8.2 Unique Identification

Each sample received by PAS is assigned a unique identification number (Lab ID) after the sample has been accepted by PAS in accordance with the PAS sample acceptance policy (Refer to Section 5.8.3). The Lab ID is affixed to the sample container using a durable label.

The lab ID is linked to the field ID (client ID) in the sample receipt and log-in record so that both IDs are traceable to testing activities performed.

5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The condition and integrity of samples is checked on receipt and the samples received are verified to match the COC. Any problem with the samples or discrepancy between the COC is recorded. If the problem impacts the suitability of the sample for analysis or if the COC is incomplete, the client is notified for resolution. Decisions and instructions from the client regarding the samples are maintained in the project record.

5.8.3.1 Sample Receipt Checks

The following checks are performed:

The COC is complete and legible;

Sample container labels include the client sample ID, the date and time of collection, and the preservative used;

The container type and preservative are appropriate for the test requested;

The required volume is received for each test requested;

There is no evidence of damage or tampering;

There is no headspace in VOA vials greater than 5-6 mm (the size of a pea);

Thermal Preservation, when required. When thermal preservation is required, temperature on receipt is typically considered acceptable if the temperature is ≤6°C and the samples are not frozen solid unless otherwise specified by federal, statutory, program or test method. If samples are received on the same day of collection, there must be evidence that the chilling process has begun, such as arrival of the samples on ice.

Chemical Preservation, as required.

Holding Time. When the holding time for the test method is longer than 15 minutes from time of collection and samples are received out of hold, the client is notified of the situation so they can make a decision to proceed or cancel analysis. Tests with a holding time of 15 minutes or less from time of collection are those where the method specifies the holding time as “immediate” are excluded from the notification requirement because the customer is aware that the holding time cannot be met unless the test is performed in the field (in situ).

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.8.3.2 Sample Acceptance Policy

PAS maintains a sample acceptance policy to clearly establish the circumstances in which samples are accepted.

When these conditions are not met, the exception must be documented, and the client notified. Decisions to accept or reject the samples are documented and when required, test results are qualified in the test report. How the notification requirement is achieved must be included in a laboratory SOP.

Criteria for Sample Acceptance:

All samples received must be listed on the COC and the information provided must include the client ID of the sample, date and time of collection, collector's name, preservation type and type of sample;

The sample containers must be properly labeled to uniquely identify the sample; and the label must be both durable and legible;

The sample container must be appropriate for the tests requested;

Samples must be received within holding time. Exceptions are made for samples where the test method specifies a holding time of "immediate or immediately" – which is translated to within 15 minutes from sample collection. For these test methods, samples are always received out of hold and/or there is no expectation that the laboratory perform the test within the 15-minute holding time.

Sufficient sample volume must be provided to perform the test method per the laboratory's SOP. If the test is performed for regulatory compliance and the method requested is mandated; the volume provided must be adequate for the laboratory to perform the test per the test method without modification.

Be received within appropriate temperature ranges unless program requirements or customer contractual obligations mandate otherwise.

Be free of evidence of tampering or signs of contamination; and

Meet applicable requirements for thermal and chemical preservation.

Additional conditions may also apply depending on the services offered. For example, some PAS locations will not accept samples known to be radioactive.

5.8.4 Sample Control and Tracking

Samples received by PAS are tracked using the laboratory's Laboratory Information Management System (LIMS).

After the sample receipt process is complete, samples are logged into the LIMS and a Lab ID is assigned and affixed to each container with a durable label. The Lab ID is used to track the samples through the testing process through test report generation and sample disposal.

Minimally, the following information is included in the log-in for each sample:

Client Name and Contact Information;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The laboratory ID linked to the client ID;

Date and time of sample collection;

Date and time of sample receipt;

Matrix; and

Tests Requested.

After log-in is complete, the log-in record must be independently reviewed by the PAS Project Manager (PM) responsible for the work order to verify the log-in is complete and correct per the testing agreement with the customer and the chain-of-custody so that any log-in errors or questions about the samples received are corrected and resolved before work begins.

5.8.5 Sample Storage, Handling, and Disposal

5.8.5.1 Sample Storage

The samples are stored according to the specification in the test method and any appliable program and regulatory requirements. Samples are stored separately from standards, reagents, or other potential sources of contamination and in a manner that prevents cross contamination. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6 (but not frozen) and freezer storage areas are maintained at ≤-10°C, unless otherwise required per method or regulatory program. The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, corrective actions are taken and documented.

Samples are placed in the storage location immediately after sample receipt and log-in procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

5.8.5.2 Sample Retention and Disposal

The procedures used by the location for sample retention and disposal are detailed in SOP ENV-SOP-WES2-0002 *Sample Custody and Tracking* and ENV-SOP-MANS-0077 *Hazardous Waste Management and Sample Disposal.*

In general, PAS retains unused sample volume and prepared samples such as extracts, digestates, distillates and leachates (samples) per Pace® Terms & Conditions, https://info.pacelabs.com/hubfs/pas-standard-terms.pdf.

After analysis, samples may be stored at ambient temperature until time of sample disposal, unless otherwise specified by regulation or agreed upon contract specifications.

After the retention time has expired non-hazardous samples are properly disposed. Hazardous samples are returned to the customer, unless other arrangements for disposal have been made with the laboratory.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.9 Assuring the Quality of Test Results

5.9.1 Quality Control (QC) Procedures

PAS monitors the validity and reliability of test results using quality control samples that are prepared and analyzed concurrently with and in the same manner as field samples. QC results are always associated with and reported with the field samples they were prepared and analyzed with.

When the results are not within acceptance criteria correction and corrective action(s) are taken. These actions may include retesting or qualification of test results and/or disclosure of the situation in the test report to alert the data user of the situation.

Other control measures to maintain quality of test results include the use of certified reference materials (Refer to Section 5.6.3), participation in interlaboratory proficiency testing (Refer to Section 5.9.1.2), verification that formulae used for reduction of data and calculation of results is accurate (Refer to Section 5.9.3), on-going monitoring of environmental conditions that could impact test results (Refer to Section 5.3.2), and evaluation and verification of method selectivity and sensitivity (Refer to Section 5.4.5).

QC results are also used for trend analysis and to establish acceptance criteria when no method or regulatory criteria exist. (Refer to Section 5.9.1.1.9).

5.9.1.1 Essential QC

QC protocol is technology and test method specific and is specified in test method SOPs. The SOP includes the type of QC required, frequency for analysis, acceptance criteria, recommended corrective actions, and procedures for reporting test results associated with QC exceptions.

PAS ensures the QC requirements in the SOP conform to the reference method and applicable regulations for which results of the test are used and to any program requirements for the process required by the certification/accreditation program required for testing.

When a project requires more stringent QC protocol than specified in PAS policy or the test method SOP, the project specification is followed.

When the project requires less stringent QC protocol than PAS policy or the SOP, the project specification may be followed as an authorized departure if the project specification still meets the requirements in the test method and any applicable regulatory and certification/accreditation requirements.

The following sections describe essential QC for chemistry. These QC types may not apply to other technologies and disciplines such as microbiology, radiochemistry, whole effluent toxicity, and/or asbestos. For essential QC for these test offerings, refer to test method SOPs.

5.9.1.1.1 Calibration Verification (Second Source)

A second source standard is a standard from a different vendor or from a different lot than the standards used for initial calibration. A different lot

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

from the same vendor is permissible, when the standard is only available from a single vendor.

It is a positive control used to verify the accuracy of instrument calibration relative to the purity of the standards used for calibration. This check may be referred to in published test methods and quality system standards as the initial calibration verification (ICV) or a quality control sample (QCS). For most test methods, it is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated. The source of the problem should be investigated and corrected prior to use of the calibration/instrument for sample analysis.

5.9.1.1.2 Calibration Verification (CCV)

The CCV is used to determine if the analytical response has significantly changed since calibration. The CCV is usually made from the same standards used for initial calibration, but a second source standard may be used.

When the response of the CCV is within criteria, the calibration is considered valid. If not, there may be a problem that requires further investigation and correction. The actions taken are technology and method specific.

It is sometimes acceptable to report test results associated with a CCV that does not meet criteria.

For example, when a CCV exceeds criteria above the limit; high bias is suspected in the measurement system. If the analyte is not detected in the sample; then the high bias has no impact on the validity of the test result. If the analyte is detected in sample, then corrective action to bring the CCV within criteria is expected to eliminate the possibility that the detection is biased.

5.9.1.1.3 Blanks

Blanks are negative controls used to assess for contamination.

The method blank (MB) is a clean matrix similar to the associated samples that is known to be free of analytes of interest. The MB, unless otherwise specified by the test method, is processed with, and carried through all preparation and analytical steps as the associated samples.

The criteria used to assess for contamination depends on the intended use of data. In general, detections in the MB above the RL or ½ the RL indicate contamination. When contamination is indicated, the source is investigated, and corrections are taken to reduce or eliminate it. Analytical results associated with MB that do not meet criteria are qualified in the final test report.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Other types of blanks that serve as negative controls in the process may include:

Trip Blanks (VOA)

Storage Blanks

Equipment Blanks

Field Blanks

Calibration Blanks

Cleanup Blanks

Instrument Blanks

5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is a positive control used to measure accuracy. The LCS is a blank matrix spiked with standard solution that includes target analytes or it may be a pre-made certified reference standard. Like the MB, unless otherwise specified in the test method, the LCS is processed with and carried through all preparation and analytical steps as the associated samples.

When the percent recovery (%R) of the LCS is within the established control limit, the test is within control. If not, the cause of the problem is investigated and corrected, and the procedure may be repeated. Analytical results associated with LCS that do not meet criteria are qualified in the final test report.

5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

The MS and MSD are replicates of a client sample that is spiked with known amount of target analyte. When there is not a client-designated matrix spike on any sample in the batch, the MS/MSD may be performed on a randomly selected sample and these MS/MSD are called "batch" MS/MSD.

MS/MSD results provide information about the effects the sample matrix has on recovery and reproducibility of target analytes on site samples. MS/MSD results are not used to control performance of the preparation or analytical batch because the way in which the matrix impacts efficiency and robustness of the test cannot be mitigated or controlled by the laboratory.

The heterogeneity of the sample submatrix influences accuracy and precision. For example, MS/MSD results for a sample that is mostly sand will not be the same for a sediment sample even though both matrices are "soil" and both samples subjected to the same test procedure in the same batch. For this reason, batch MS/MSD results may not be representative of the effect the matrix has on accuracy and precision on test results for all

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

samples in the batch – except when all samples in the batch are from the same collection site and are identical in composition.

5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample taken through the testing process used to measure precision and/or homogeneity of samples collected.

The relative percent difference between replicates is evaluated against the established acceptance criteria and if the RPD is not met, associated test results are reported with qualification.

5.9.1.1.7 Surrogates

Surrogates are compounds not normally found in the environment but that have similar physical and chemical properties of target analytes that are added to environmental samples, QC, and calibration standards prior to preparation and analysis. They are used to evaluate extraction efficiency and matrix interference on a sample specific basis.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The location follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable test method SOP.

5.9.1.1.9 QC Acceptance Criteria and Control Limits

QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published test method or regulatory program. When there are no established acceptance criteria, the location develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to establish control limits for LCS, MS/MSD, and surrogate evaluation using historical data. PAS developed limits are referred to as "in-house" control limits. In-house control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Refer to SOP SOP ENV-SOP-WES2-0119 *Control Limit Generation* for more information about the procedures used to establish in-house control limits.

5.9.1.2 Proficiency Testing (PT)

PAS participates in interlaboratory proficiency testing studies to measure our performance of the test method.

PT participation is based on the certification and accreditation requirements held by the laboratory. The PT samples are obtained from accredited proficiency testing providers (PTP) and treated as field samples which means they are incorporated into our normal analytical processes and do not receive extraordinary attention due to their nature.

PAS locations do not share PT samples with other PAS locations, does not communicate with other PAS locations regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

PT results scored unacceptable are investigated and correction action taken, when necessary.

Refer to corporate policy ENV-POL-CORQ-0002, *PT Policy* for more information.

5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

5.9.3 Data Review

PAS uses a tiered system for data review. The tiered process includes as series of sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified, process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes multi-tier review consisting of a primary review, a secondary review, and where applicable and appropriate, an administrative/completeness review.

Detailed procedures for the review process are described in SOP ENV-SOP-WES2-0124 *Data Review*. General expectations for the tiered data review process are specified in the following sections:

5.9.3.1 Primary Review

Primary review is performed by the individual that performed the task. All PAS personnel are responsible for the review of their own work to ensure it is complete, accurate, documented, and consistent with PAS policy and SOPs.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Checks performed during primary review include but are not limited to:

Verification that data transfer and acquisition is complete;

Manual calculations, if performed, are documented and accurate;

Manual integrations, if performed, are documented, and comply with SOP ENV-SOP-CORQ-006 *Manual Integration;*

Calibration and QC criteria were met, instrument calibration conforms with policy ENV-POL-CORQ-005 *Acceptable Calibration Practices*, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified;

Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project quality assurance plans.

5.9.3.2 Secondary Review

Secondary review is an independent review of the data set performed by qualified personnel. Secondary review includes a repeat of the checks performed during primary review in addition to chromatography review to verify the accuracy of quantitative analyte identification.

5.9.3.3 Completeness Review

Completeness review is an administrative review that is performed prior to release of the test report to the customer to verify the final test report is complete and meets project specifications. This review also ensures that information necessary for the client's interpretation of results is explained in the case narrative or footnoted in the test report.

5.9.3.4 Data Audits

Test reports are randomly audited by local quality personnel to verify compliance with SOPs and to check for data integrity, technical accuracy, and compliance with the PAS QMS and any applicable federal, statutory, and program requirements. These audits are not part of the tertiary data review process that is performed prior to release of the test report. These audits are performed on test reports that have been previously released to the customer to avoid potential risks to impartiality and other factors that may influence thoroughness of review.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also refer to Section 4.14 for internal audits

5.9.4 Calibration Certificates

PAS does not perform calibration activities for its customers and calibration certificates are not offered or issued.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.9.5 Opinions and Interpretations

PAS provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information are based solely on fact and PAS does not attempt to explain the meaning (interpret) or offer a view or judgement (opinion) on usability of data.

PAS personnel are not permitted to provide opinions on how a nonconformance impacts the usability of results or how test results and information should be used, or suggestions or guidance to the customer for improvement.

5.9.6 Subcontractor Reports

When analytical work is subcontracted to an organization external to PAS or its subsidiaries, PAS includes the test report from the subcontractor in its entirety as an amendment to the final test report.

Test results performed by multiple locations within the PAS network (internal subcontracting) may be merged into a single test report so long as the test report issued clearly identifies the location and address of each network location that performed testing, and which tests each PAS location performed. (Refer to Section 5.10.2)

5.9.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, the procedures established in this manual for confidentiality and protection of data apply.

5.9.8 Format of Test Reports

The test formats offered by PAS are designed to accommodate each type of analytical test method performed and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables follows the specifications for the EDD.

5.9.9 Amendments to Test Reports

Test reports that are revised or amended by the location after the date of release of the original final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

The customer is the organization doing business with PAS external to PAS.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions and do not need to be tracked or marked as such, these changes are simply corrections to errors found during data review.

The procedure for report amendments and revision are outlined in SOP ENV-SOP-WES2-0120 *Report Generation and Approval.*

5.10 Reporting

5.10.1 General Requirements

PAS offers a wide variety of test report formats to meet project needs of Pace® customers and federal and state regulatory program requirements

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The type and level of deliverable, including the electronic data deliverable format is established between PAS and the customer during the contracting process. The report specifications include the test report format, protocol for the reporting limit, conventions for the reporting of results less than the limit of quantitation, and specification for the use of project or program specific data qualifiers. Information about review of analytical service requests is provided in Section 4.4.

5.10.2 Test Reports: Required Items

Regardless of deliverable or report requested, every test report issued by PAS and its subsidiaries includes each of the following items:

a) A Title;

b) The name and address of the location issuing the test report and for each location where testing was performed if different than address of the location issuing the report. When testing is done at multiple PAS locations, the report must also clearly identify which PAS location performed each test method;

c) Unique identification of the test report and on each page an identification number to link each page to the test report, and clear identification of the end of the report;

d) The name and address of the customer;

e) Identification of test methods used. When testing is done at multiple PAS locations, the report must also clearly identify which PAS location performed each test method;

f) Cross reference between client sample identification number (Sample ID) and the identification number for the sample (Lab ID) to provide unambiguous identification of samples;

g) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria;

h) Date and times of sample collection, receipt, preparation, and analysis;

i) Dilution and/or preparation factor;

j) Test results and units of measurement, and qualification of results associated with QC criteria exceptions, and identification of reported results outside of the calibration range;

k) All chains of custody including records of internal transfer between locations within PAS;

l) Name, title, signature of the person(s) authorizing release of the test report and date of release;

m) A statement that the results in the test report relate only to the items tested; and

n) Statement that the test report may not be reproduced except in full without written approval from PAS.

5.10.3 Test Reports: Supplemental Items

5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

a) Shipping manifests/bill of ladings as applicable when common couriers are utilized for shipment of samples,

b) Explanation of departure from test method SOPs including what the departure was and why it was necessary.

c) Statistical methods used. (Required for Whole Effluent Toxicity)

d) For solid samples, specification that results are reported on a dry weight or wet weight basis.

e) Signed Affidavit, when required by client or regulatory agency.

f) A statement of compliance/non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

g) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

h) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the location if the accrediting body offers accreditation/certification for the test method/analyte. The fields of accreditation/certification vary between agencies, and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

i) Certification Information, including certificate number and issuing body.

For PAS locations accredited to ISO/IEC 17025:2017:

Data included in the test report provided by a customer should be clearly identified.

A statement that the test results apply only to the samples as received.

PAS does not provide opinion or interpretations about usability of data or test results in order to maintain impartiality with the testing services provided.

5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by PAS or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

e) Details of environmental conditions at the time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

6.0 REVISION HISTORY

This Version (Template Version 4):

SECTION	DESCRIPTION OF CHANGE
Header	Updated Copyright
Approval Page	Changed Address, City, State, Zip to Location. Changed Phone to Email. Added a line for Laboratory Supervisor (State LAP).
1.1	Added information on Building Sciences acronyms. Removed NELAC. Removed reference to Appendix B, testing capabilities and referenced where these could be found.
1.2.1	Changed who created the template to Corporate Quality team. Updated list for top management.
2.0	Updated References
4.1.5.1.1	Updated Key Personnel
4.1.5.2	Added Vice President of Quality and Risk Management Officer. Clarified under General Manager who to notify for extended absences/reassignments.
4.1.5.2.1	Added ELLAP/NLLAP information to this section.
4.1.5.4	Added location of the Terms & Conditions
4.13.1.2	State Building Sciences and Absarka Air Sciences use 5 year record retention.
5.2.2.1.5	Added more options for DOC and DOC requirements for AIHA-LAP, LLC
5.4.5.3.3	Removed 2-4x greater than DL but less than LLOQ or LOQ for DoD LOD.
5.4.5.3.4	New section for Microbiology
5.4.5.3.5	New Section for Asbestos
5.4.5.3.6	Add species for micro methods
5.4.6	Added reference to BDSG Uncertainty SOP
5.5.4	Added requirement for transferring equipment to another location
5.5.5.1	Removed reference to appendix E. Added see local quality and where to find the list.
5.6.3.1	Changed +/- to within
5.8.3.1	Changed 0-6 to <6

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

5.8.4	Removed reference to Sample Acknowledgement Form. Deleted a paragraph due to redundant information.
5.8.5.1	Changed to ≤6 and ≤-10.
5.9.3	Changed to multi-tier review
5.9.3.2	Clarified secondary review is completed by qualified personnel
5.10.2	Added dilution and/or prep factor
Appendix B	Updated to remove the table and add location the information can be found.
Appendix C	Added definition of Analyst. Updated definitions for Analyte, Annual, Batch, Confirmation, Holding time, Incremental Sampling Method, Quantitation Range, Selectivity, Sensitivity, Traceability
Appendix D	Updated Org Charts
Appendix E	Updated to remove the table and add location the information can be found.
8.1	Updated information to be consistent with DoD QSM 6.0
8.2	Added information on changes to personnel
8.3	Added information from AIHA-LAP, LLC manual
8.5	New section on UCMR 5
Throughout Document	Grammatical fixes and removal of redundant acronyms.

This document supersedes the following documents:

Document Number	Title	Version
ENV-TMP-CORQ-0007	Quality Manual Template	03
ENV-TMP-CORQ-0007	Quality Manual Template	02
ENV-TMP-CORQ-0007	Quality Manual Template	01
ENV-MAN-CORQ-0001	Quality Manual	00

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.0 APPENDICES

7.1 Appendix A: Certification / Accreditation Listing

Disclaimer: The certifications / accreditation lists provided in this Appendix are those that were held by the PAS location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. This manual is not updated with each change made. Current certificates are accessible via the eDMS Portal for PAS employees. External parties should contact the location for the most current information.

7.1.1 PAS-WES2 8 Walkup Drive, Westborough, MA

Authority	ID	Authority	ID
Connecticut	PH-0826	North Carolina (DW)	25700
Illinois	200077	North Carolina (NPW/SCM)	666
Indiana	C-MA-03	Ohio - VAP	Based on NH
Kentucky	KY98045	Oregon	MA-1316
Maine	MA00086	Pennsylvania	68-03671
Maryland	348	Rhode Island	LAO00065
Massachusetts	M-MA086	Texas	T104704476-17-14
New Hampshire Primary	2064	Vermont	VT-0935
New Jersey	MA935	Virginia	460195
New York	11148		

7.1.2 PAS-MANS 320 Forbes Blvd. Mansfield, MA

Authority	ID	Authority	ID
Connecticut	PH-0825	New Jersey	MA015
ANAB/DoD	L2474	New York	11627
Illinois	200081	North Carolina	685
Indiana	C-MA-04	Ohio-VAP	Based on NH
Kentucky	KY98046	Oregon	MA-0262
Louisiana	3090	Pennsylvania	68-02089
Maine	MA00030	Rhode Island	LAO00299
Maryland	350	Texas	T104704419
Massachusetts	M-MA030	Vermont	VT-0015
Michigan	9110	Virginia	460194
Minnesota	025-999-495	Washington	C954
New Hampshire Primary	2062		

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.1.3 PAS-MANS 120 Forbes Blvd. Mansfield, MA

Authority	ID	Authority	ID
ANAB/DoD	L2474	New York	12191
Maine	MA01156	Oregon	4203
Minnesota	025-999-498	Texas	T104704583
New Hampshire Primary	2249	Virginia	460311
New Jersey	MA025	Washington	C1104

7.2 Appendix B: Capability Listing

The capabilities for PAS-WES2, PAS-MANS 320 Forbes Blvd., and PAS-MANS 120 Forbes Blvd. are maintained by the Quality Assurance department. For a current listing of laboratory capabilities, consult the Quality Assurance Manager identified in the QAM approval list on page 3 of this document.

7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in environmental testing; it is not intended to be a complete list of all terms and definitions used; some terms are defined in the context of the document or application. The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded.

Term	Definition
Acceptance Criteria	Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.
Accreditation Body	The organization having responsibility and accountability for environmental laboratory accreditation, and which grants accreditation.
Accuracy	The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	A discrete, measured, representative portion of a sample taken for analysis.
Analysis	A combination of sample preparation and instrument determination.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	The designated individual who performs the "hands-on" analytical methods and associated techniques, and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Analyte	A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed. DOD Clarification - The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together.
Analytical Method	A formal process that identifies and quantifies the chemical components of interest in a sample.
Analytical Uncertainty	A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Annual (or annually)	A period not to exceed 13 months
Assessment	The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation).
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Audit	A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.
Batch	Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples. DOD Clarification - An analytical batch/sequence shall use the same instrument calibration and shall be bracketed by calibration verifications within acceptance criteria.
Bias	The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage, or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (Refer to Method Blank).
Blind Sample	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
Calibration	A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Calibration Curve	The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve.
Calibration Standard	A substance or reference material used for calibration.
Certified Reference Material	Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Client /Customer	Any individual or organization external to Pace for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another.
Completeness	The percentage of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. This attribute is always calculated by the end data user, not by the laboratory.
Confirmation	Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. DOD Clarification - Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods are used to evaluate an instrument calibration from the standpoint of the integrity of the system.
Continuing Calibration Verification (CCV) Standard	A standard used to verify the initial calibration of compounds in an analytical method. May be referred to as a CCC in some programs, such as UCMR.
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control.
Correction	Action taken to eliminate a detected non-conformity.
Corrective Action	The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.
Data Integrity	The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements.
Data Quality Objective (DQO)	Strategic planning tool that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Data Reduction	The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Demonstration of Capability (DOC)	A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.
Detection Limit (DL)	The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from the method blank results.
Dry Weight	The percent of sample that is not water, which may be used to adjust the reported results.
Electronic Data Deliverable (EDD)	A summary of environmental data which clients request for ease of data review and comparison to historical results.
Environmental Protection Agency (EPA)	An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Extracted Internal Standard Analyte	Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods.
False Negative	A result that fails to identify (detect) an analyte to be present.
False Positive	A result that erroneously identifies (detects) an analyte to be present.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Testing performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify, and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as applicable.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Incremental Sampling Method (ISM)	Structured composite sampling and processing procedure that is designed to reduce data variability and provide a reasonably unbiased estimate of mean contaminant concentrations in a volume of particulate material (e.g., soil and sediment).
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Initial Calibration Verification (ICV)	A standard obtained or prepared from a source independent of the source of the initial calibration standards to verify the initial calibration.
Instrument Blank	An analyte free matrix processed through the instrumental steps of the measurement process; use to determine instrument contamination.
Interference	The suppression or elevation of result of an analyte of interest due to the presence of other compounds.
Internal Standard	A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
International Organization for Standardization (ISO)	An international standard-setting body composed of representatives from various national standards organizations.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	A facility that performs testing, whether in-house or in the field.
Laboratory Control Sample (LCS)	Also known as laboratory fortified blank (LFB): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, which is taken through all sample preparation and analytical steps of the procedure.
Laboratory Information Management System (LIMS)	The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents.
Legal Chain-of-Custody Protocols	Industry defined protocol that is sometimes used for evidentiary or legal purposes that establishes an intact, continuous record of the physical possession, storage, and disposal of samples, including sample aliquots and prepared samples.
Limit(s) of Detection (LOD)	The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence.
Limit(s) of Quantitation (LOQ)	The minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence.
Lower Limit of Quantitation (LLOQ)	The concentration of the lowest calibration standard included in the calibration curve.
Linear Dynamic Range	Concentration range where the instrument provides a linear response.
Liquid chromatography/ tandem mass spectrometry (LC/MS/MS)	Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry.
Lot	A definite amount of material produced during a single manufacturing cycle and intended to have uniform character and quality.
Matrix	The substrate of a test sample.
Matrix Duplicate	A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS)	A sample prepared, taken through all sample preparation and analytical steps of the procedure, to which a known amount of target analyte is added to a specified amount of sample for which an independent test result of target analyte concentration is available.
Matrix Spike Duplicate (MSD)	A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Measurement System	A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).
Measurement Uncertainty	An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level.
Method	A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification).
Method Blank	A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures.
Method Detection Limit (MDL)	The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects.
Minimum Detectable Activity (MDA)	Estimate of the smallest true activity that ensures a specified high confidence, $1 - \beta$, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05.
Negative Control	A sample included in the method that is treated the same as all others but is expected to have a detection of analytes of interest.
Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also, the state of failing to meet the requirements.
Positive Control	A sample included in the method that is treated the same as all others and is expected to have a detection of the analytes of interest.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit.
Precision	The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.
Preservation	Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis.
Primary Accreditation Body (Primary AB)	The TNI-approved state agency responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.
Procedure	Written instructions detailing the performance of a task, process, or other laboratory activity.
Proficiency Testing (PT)	A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.
Proficiency Testing Reporting Limit (PTRL)	A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables.
Qualitative Analysis	Analysis designed to identify the components of a substance or mixture.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Quality Assurance (QA)	An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.
Quality Control Sample (QCS)	A sample used to assess the performance the measurement system.
Quality Manual	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Management System	A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quantitation Range	The range of values (concentrations) in a calibration curve between the LOQ and the highest successfully analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution, and final volume) lies within the calibration range.
Quantitative Analysis	Analysis designed to determine the amounts or proportions of the components of a substance.
Raw Data	The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Record	Documentation, data, or other records constituting a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Records may be in electronic or hardcopy media. Unless otherwise specified, the term "record" refers to both electronic and hardcopy media.
Reference Material	Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Method	A published method issued by an organization recognized as competent to do so. (When the ISO language refers to a "standard method," that term is equivalent to "reference method").

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Reference Standard	Standard used for the calibration of working measurement standards in a given organization or at a given location.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	The value to which test results are reported as detected or not detected.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed.
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Sample	The item submitted for testing.
Sampling	Activity related to obtaining a representative sample for analysis.
Selected Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit.
Selectivity	The ability to analyze, distinguish, and determine a specific analyte from another component that may be a potential interferent or that may behave similarly to the target analyte within the measurement system.
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Standard Operating Procedure (SOP)	A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps.
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Storage Blank	A sample of analyte-free media prepared by the laboratory and retained in the sample storage area.
Suitability	The quality of being appropriate for a particular purpose.
Surrogate	A substance with properties that mimic the analyte of interest, and unlikely to be found in environmental samples.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	Analytes or chemicals of primary concern identified by the customer on a project-specific basis.
Technology	A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

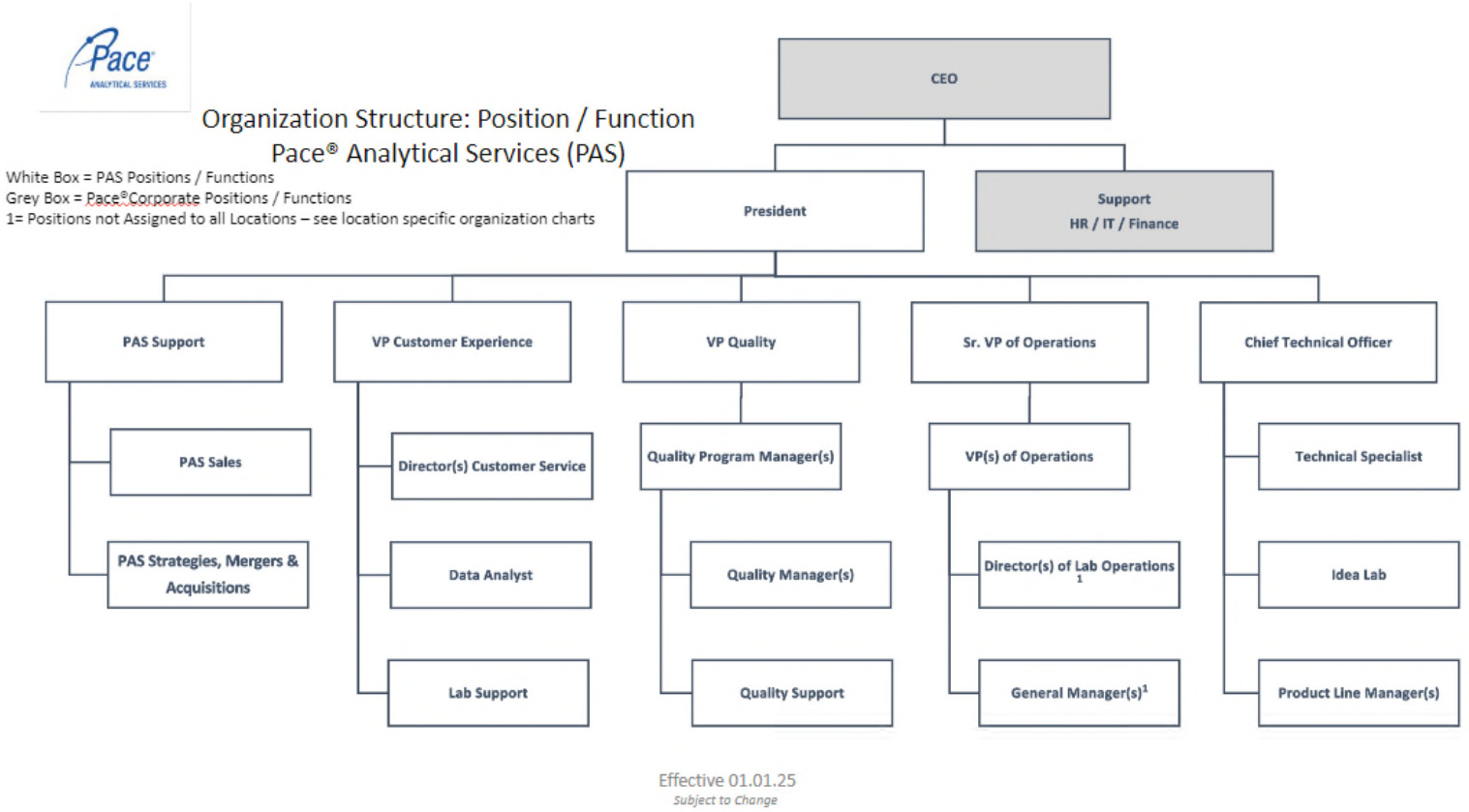
Traceability	The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
Trip Blank	A cleaned sample container filled with laboratory reagent water that is stored, shipped, and analyzed with its associated samples to detect sample contamination during transport and storage of the sample.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Validation	The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation, or specification peculiar to the management of the measuring equipment.
Working Standard	Dilution made of a stock or intermediate standard used in the analytical process.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.4 Appendix D: Organization Chart(s)

7.4.1 PAS Corporate Organization Chart(s)

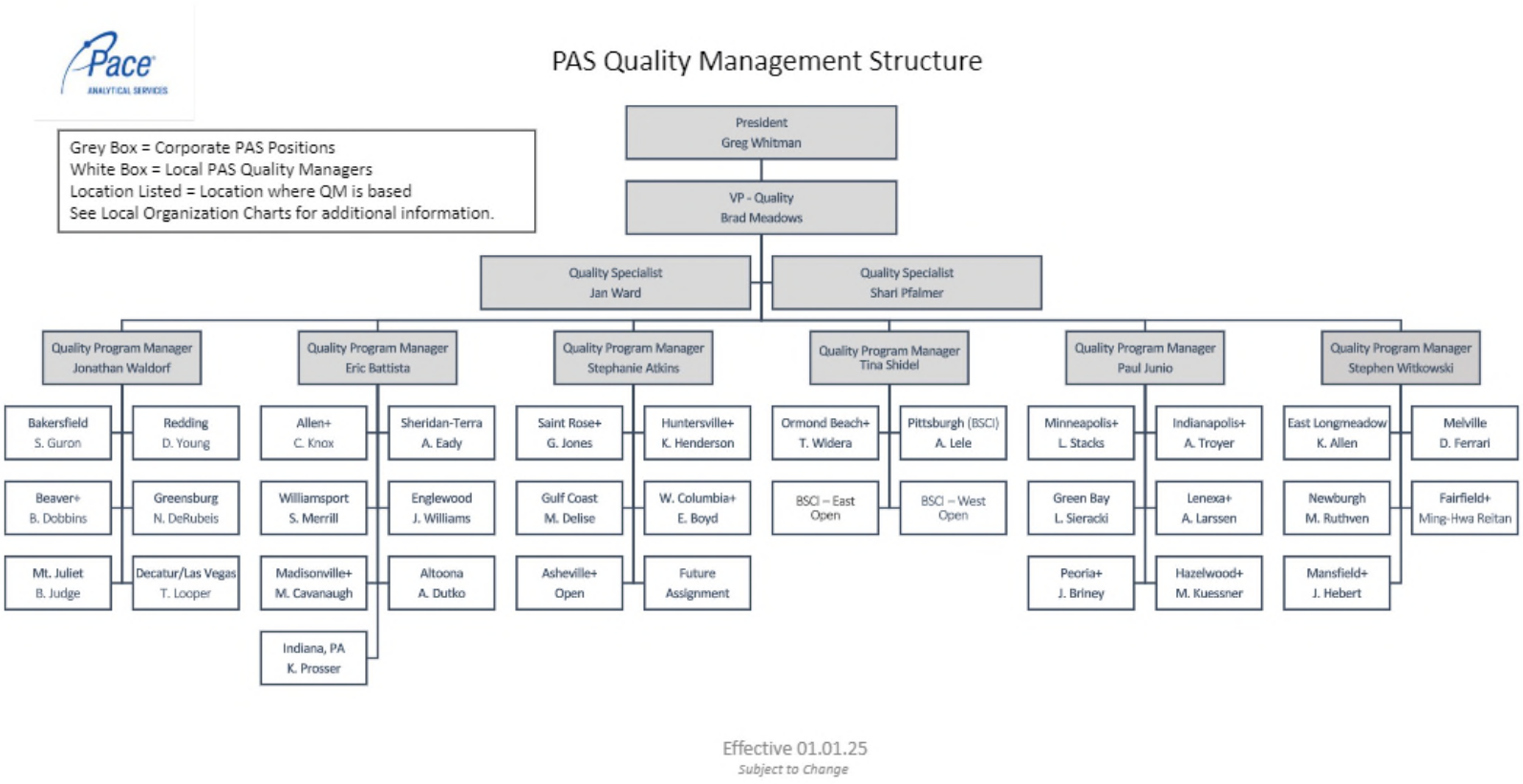
The information in this organization chart is subject to change. Please contact PAS for the most up-to-date version.



COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.4.2 PAS Quality Systems Management Organization Chart

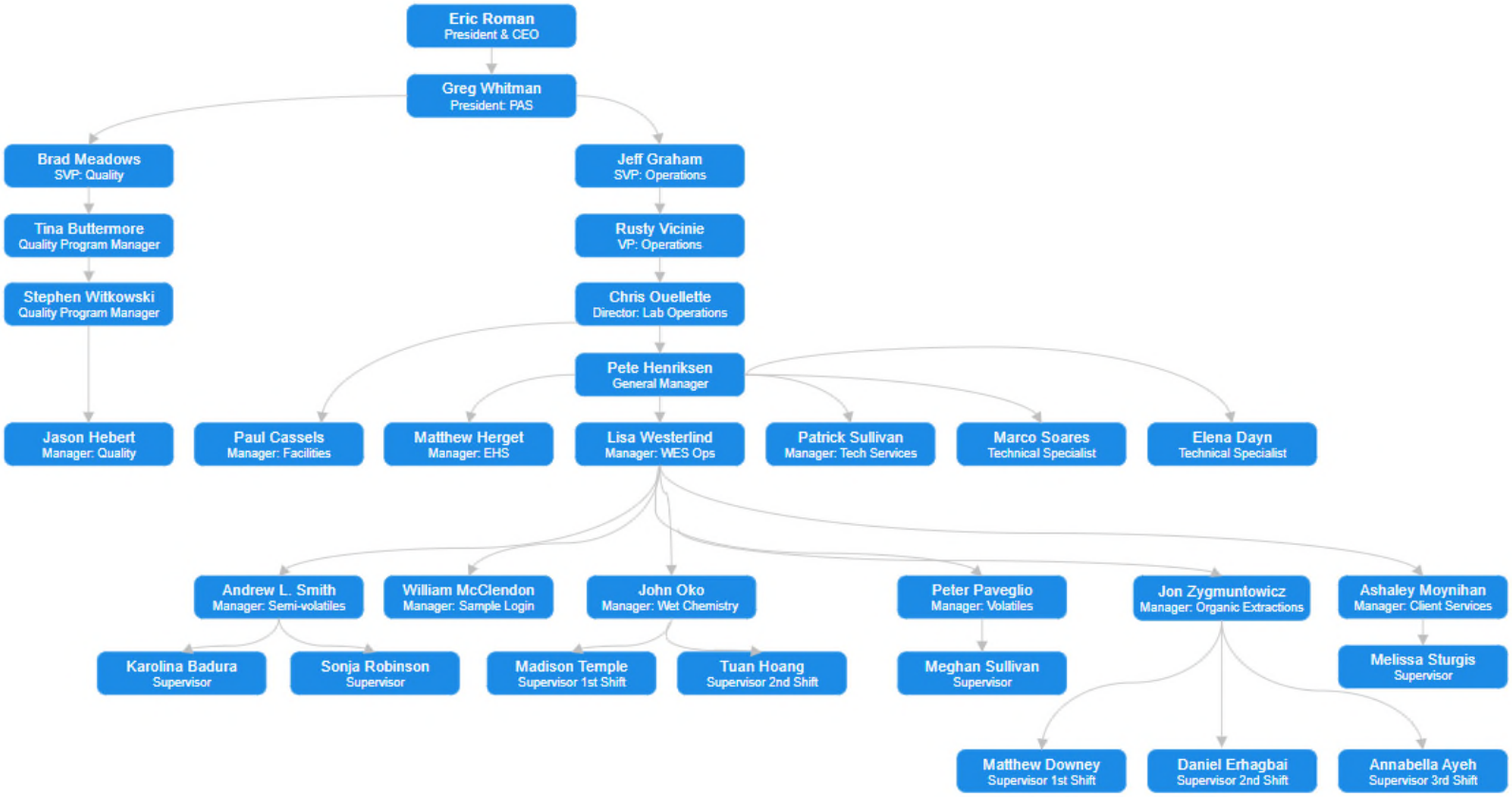
The information in this organization chart is subject to change. Please contact PAS for the most up-to-date version.



COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.4.3 PAS-WES2 8 Walkup Drive, Westborough, MA – Organization Chart

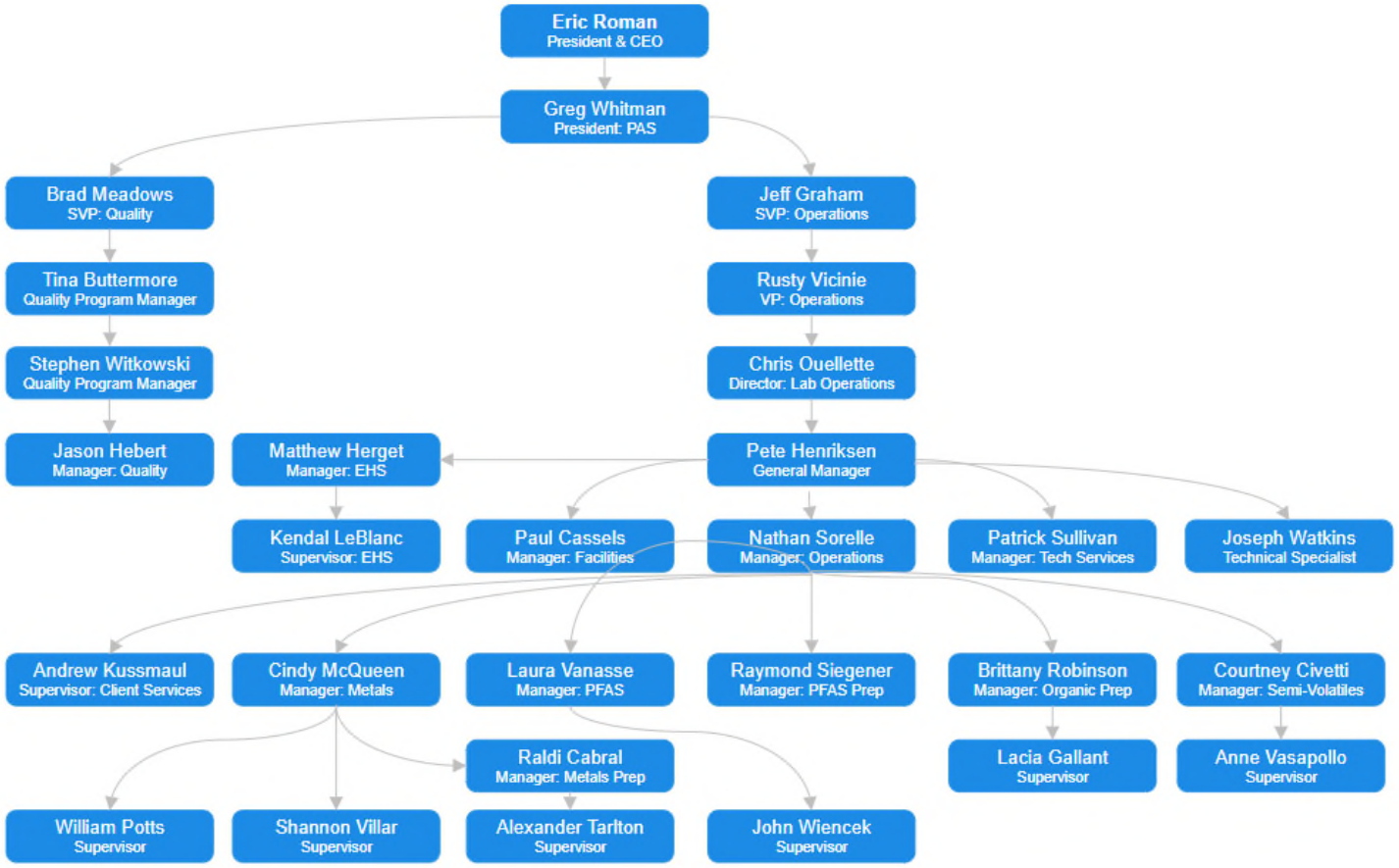
The information in this organization chart is subject to change. Please contact PAS for the most up-to-date version.



COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.4.4 PAS-MANS 320 Forbes Blvd, Mansfield, MA – Organization Chart

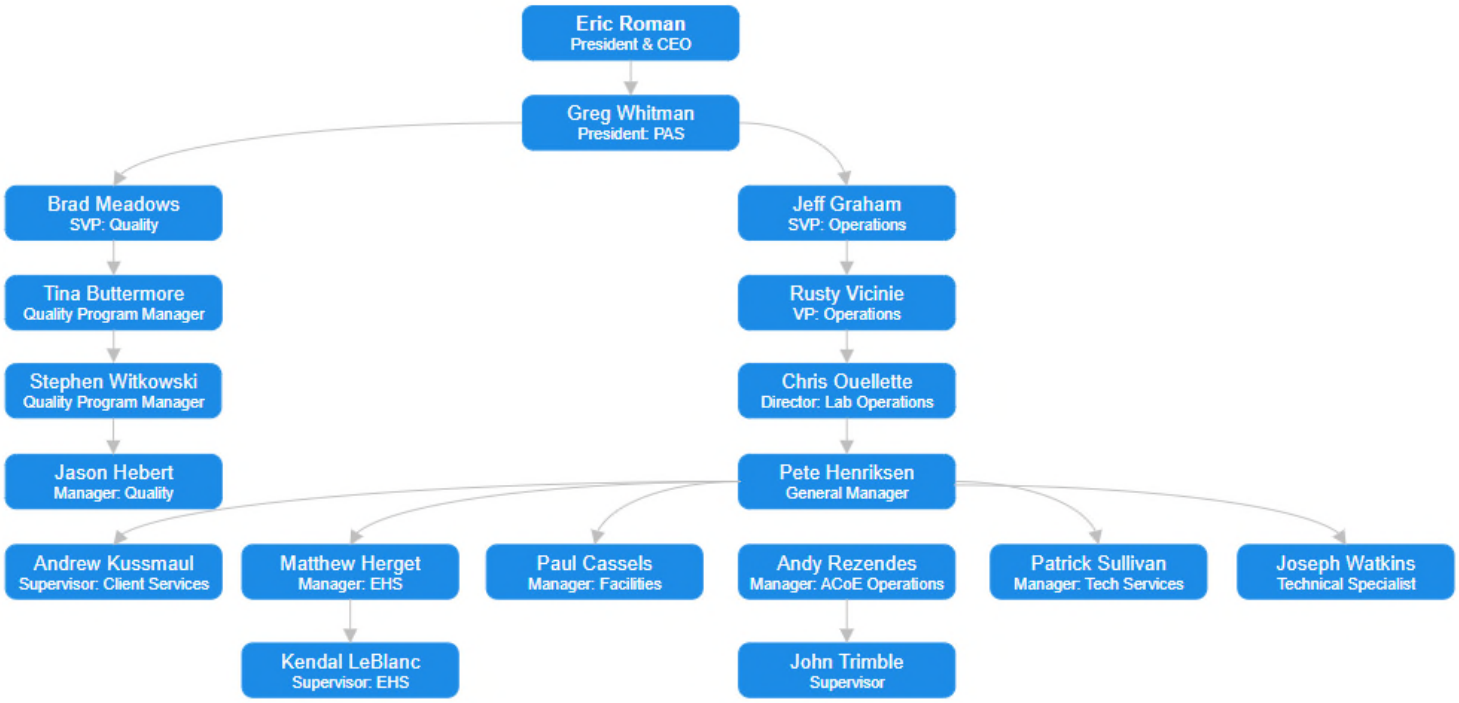
The information in this organization chart is subject to change. Please contact PAS for the most up-to-date version.



COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.4.5 PAS-MANS 120 Forbes Blvd. Mansfield, MA – Organization Chart

The information in this organization chart is subject to change. Please contact PAS for the most up-to-date version.



COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

7.5 Appendix E: Equipment Listing

The equipment list for PAS-WES2, PAS-MANS 320 Forbes Blvd., and PAS-MANS 120 Forbes Blvd. is maintained by the Quality Assurance department. For a current listing of laboratory equipment, consult the Quality Assurance Manager identified in the QAM approval list on page 3 of this document.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

8.0 ADDENDUM: PROGRAM REQUIREMENTS

Section 8.0 provides additional requirements the locations covered by this manual are required to follow when performing work under the program. Only requirements that are not covered by the main body of the manual are listed in addendum.

8.1 DoD

PAS-MANS maintains accreditation for DoD Environmental Laboratory Approval Program (ELAP).

This addendum outlines additional policies and processes established by this laboratory to maintain compliance with DoD program specific requirements as outlined in the DoD Consolidated Quality Systems Manual (QSM) for Environmental Laboratories. The QSM incorporates ISO/IEC 17025 and the TNI Standard and includes additional program-specific requirements for laboratories that perform analytical testing services for DoD, and which must be followed for DoD projects.

Section 4.2.1.2 Risk and Opportunity Assessment

The laboratory identifies and plans mitigation measures for risks and opportunities associated with its activities, as outlined in QSM 6.0, Module 2, clauses 8.5.4.a through 8.5.4.o. The Risk Management Officer (RMO) maintains records of risk identification and mitigation. For further details, refer to the DoD/DOE QSM 6.0 Risk Mitigation Plan.

Section 4.3.3 Document Review and Change

The review frequency for technical SOPs used for DoD testing is annual, instead of every 2 years.

Section 4.4 Review of Analytical Service Requests

Laboratory deviations from the requirements specified in the DoD/DOE QSM are requested on a project basis and include technical justifications for the deviation. These requests are submitted to and approved by the DoD project chemist or contractor, as well as the PAS client. Records of approval are maintained by the laboratory and included in all affected data packages.

For DoD projects, customer clarification or feedback is sought for the following situations:

Methods which require modification to ensure achievement of customer objectives contained in planning documents;

Project planning documents are missing or requirements in the documents require clarification;

The laboratory has encountered problems with sampling that may impact results (e.g. improper sample preservation)

The laboratory maintains records of customer approval for use of an external provider to perform any of the following:

Sampling or subsampling;

Sample preparation;

Sample analysis;

Data reduction;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Data review; or

Reporting

Section 4.5 Subcontracting

The laboratory verifies that subcontractors hold the necessary accreditation or certifications required for the project and maintains records of their accreditation. Approval from the customer is obtained before any subcontracted laboratory analyzes samples.

The requirements for subcontracted laboratories also apply to laboratories within the same corporate group but located at different facilities or locations.

All subcontracted or outsourced management system elements (e.g., data review, data processing, project management, and IT support), as well as outsourced personnel, must comply with accreditation requirements.

Section 4.6 Purchasing and Supplies

The laboratory establishes procedures detailing the selection, purchasing, receipt, and storage of services and supplies impacting laboratory activities.

If the laboratory provides sample containers to customers, it maintains records demonstrating that each lot of containers, along with any included preservatives, is free of likely contaminants exceeding ½ the LOQ for the associated analysis.

Section 4.9.3 Nonconforming Work

The laboratory shall upon discovery of potential data quality issues resulting from nonconforming work, notify all affected customers within 15 business days. Records of corrective actions taken or proposed corrective actions to resolve the nonconformance shall be submitted to the customer within 30 business days of discovery. For data reported to affected customers more than 90 days prior to the discovery of the potential data quality issue, the AB shall also be notified. Notification shall be performed according to the laboratory's procedure for client notification.

Section 4.13 Control of Records

All records shall be maintained for five years from last use. A record is considered in use when it supports current laboratory activities.

Requirements for amendments to technical records also apply to changes to the original output of the automated software algorithms such as manual integrations and eliminating laboratory determined "false positives" (e.g. "Q delete"). These changes to the original output of the automated software algorithms shall be reviewed by a technically qualified supervisor or data review specialist. Records of this review shall be maintained.

For the purpose of preparation batch processing, the start and stop dates and times of the preparation batch preparation shall be recorded. The start time of sample preparation is the time when analytes from the first sample in a batch of samples begin to be removed from the matrix. The stop time of sample preparation is the time when the last sample extract or digestate is ready for additional clean up or analysis.

Section 4.14 Internal Audit

The internal audit schedule shall ensure that all areas of the laboratory are reviewed over the course of one year, with no area exceeding a period of 18 months between audit events.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Section 5.2.1 Personnel Qualifications

Records of communication with personnel regarding their duties, responsibilities, and authorities in their positions shall be maintained.

Section 5.2.2 Required Training

Employees shall receive initial training in computer security awareness upon employment, followed by annual refresher training. Records of the training shall be maintained.

Section 5.3 Accommodations and Facilities

Standards and reference materials shall be stored separately from samples, extracts, and digestates.

Section 5.4.5.3.3 Sensitivity in Chemical Testing

For each combination of analyte-matrix-method listed on the laboratory's scope of accreditation, the laboratory shall determine a DL, LOD, and LOQ, unless it falls within one of the stated exceptions below:

DL, LOD, and LOQ determinations are not required for methods/analytes for which a DL, LOD and LOQ is not applicable such as pH, color, odor, temperature, residues, or leaching procedures.

DL determinations, LOD determinations, and LOD and LOQ verifications are not required for analytes for which no low-level spiking solutions are available.

DL and LOD determinations are not required if results are not reported below the LOQ, unless required by regulation or method.

The laboratory is not required to establish separate DL, LOD, and LOQ for every combination of preparation and cleanup techniques. However, it shall determine these values using the combination of processes most likely to impact sensitivity, including preparation methods and all applicable cleanup steps, such as drying, grinding, and incremental sampling, where relevant.

The DL, LOD and LOQ shall be reported for all analyte-matrix-method combinations unless it is not applicable to the test or specifically excluded by customer requirements.

Records of all supporting data for DL, LOD, and LOQ determinations and verifications shall be maintained. The laboratory shall provide the following when DL, LOD, and LOQ summary information is requested:

an indication of which analyte/matrix/prep method/analytical method and instrument used;

DL;

claimed LOD;

concentration of initial LOD spike and verification spike, if different;

statement of compliance with analyte identification requirements;

signal-to-noise value or statement of compliance with requirements;

claimed LOQ;

concentration of LOQ spike;

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

recovery or result of LOQ spike;

calculated precision and bias at the LOQ that incorporates historic and current data;

accuracy acceptance criteria at the LOQ;

description of precision and bias calculations; and

if specifically requested, raw data to support parameters reported.

Limit of Detection (LOD)

For DoD, the LOD is defined as the lowest concentration empirically determined to consistently provide a response meeting identification and minimum signal requirements for a specific analyte-matrix-method combination. This is an estimate of the smallest concentration of an analyte that shall be present in order to be detected with a result at or above the DL with 99% confidence. The LOD is also the minimum concentration for reliably reporting a non-detect result for an analyte.

After each DL determination, the laboratory establishes the LOD by spiking a quality system matrix at a concentration greater than or equal to the DL. The LOD is equal to the concentration of this spike.

The laboratory verifies the LOD at least quarterly. For methods used infrequently, the laboratory may opt to perform LOD verification on a per-batch basis prior to sample analysis as an alternative to quarterly verification. The chosen verification frequency must be maintained consistently for a minimum of 12 months. If the laboratory chooses per-batch LOD verification, the verification data must be reported to the customer.

LOD verification is performed by repeating the LOD spike process at a concentration between half and double the current/claimed LOD, provided the spike concentration is greater than or equal to the DL (i.e. DL ≤ 1/2x LOD ≤ Ongoing LOD Spike ≤ 2x LOD).

The ongoing LOD verification must meet the same acceptance criteria as the initial LOD verification for signal-to-noise ratio and analyte identification. If the acceptance criteria are met, the initial LOD is verified and may continue to be used. If the verification fails, the laboratory shall redetermine the LOD and, if necessary, the DL, or implement its nonconforming work procedure, until the requirements are met.

If there are multiple instruments that will be assigned the same LOD, then the LOD verification spikes shall be distributed across all the instruments and the results shall meet the acceptance criteria on each instrument.

If the method is altered in a way other than routine maintenance, and the change can be expected to elevate the detection limit, the LOD shall be reverified using the ongoing LOD verification procedure.

Limit of Quantitation (LOQ)

For DoD, the LOQ is defined as the smallest concentration that produces a quantitative result with known and recorded precision and bias.

For methods using multi-level calibration, the laboratory shall select an LOQ for each analyte that is greater than or equal to the LOD and greater than or equal to the lowest non-zero calibration standard. For methods using a single-point calibration, the LOQ shall be greater than or equal to the LOD and greater than or equal to the low-level calibration check standard.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The LOQ is verified by analyzing verification samples. The LOQ verification sample consists of a spiked quality system matrix with a concentration greater than or equal to the LOD or half the LOQ, whichever is lower, and less than or equal to double the LOQ (i.e. LOD or ½ LOQ ≤ LOQ spike ≤ 2x LOQ).

The LOQ verification must meet the same criteria as the initial LOD verification for signal-to-noise ratio and analyte identification and must fall within the laboratory's stated acceptance criteria. These criteria are determined as a maximum of three standard deviations from the mean of historical data but must not exceed the LCS acceptance criteria with an additional allowance of ±20%. Furthermore, the lower limit must be greater than or equal to 10% recovery.

In the event the verification fails, the laboratory shall redetermine the LOQ and, if necessary, the DL and/or LOD; or implement its nonconforming work procedure, until the requirements are met.

If there are multiple instruments that will be assigned the same LOQ, then these LOQ verification spikes shall be distributed across all the instruments and the results shall be included in the precision and bias determination.

The laboratory shall verify the LOQ quarterly, at a minimum. The precision and bias shall be updated annually, at a minimum, using any additional LOQ verification sample results.

In situations where methods are set up and used on an infrequent basis, the laboratory may choose to perform Ongoing LOQ verifications on a one-per-batch basis, before sample analysis, in lieu of quarterly verification. The verification data shall meet requirements and be reported to the customer. Whichever verification frequency is chosen shall be continued for a minimum of 12 months.

The LOQ and associated precision and bias shall be reported in each data package. When reporting precision and bias at the LOQ within a data package, a table for each analyte-matrix-method must present the LOQ concentration and the associated precision and bias at that concentration. The table should also identify how precision and bias were calculated, the spike concentration if different from the LOQ, and how many data points (results) were used in the calculation.

The laboratory's procedure for DL, LOD, and LOQ determination and verification is detailed in SOP ENV-SOP-WES2-0112.

Section 5.4.7 Control of Data

The laboratory shall have a procedure to ensure all LIMS users have unique login authentication credentials. The mechanism employed may be a unique username and password combination, or biometric authentication. Where passwords are used, the passwords shall be changed a minimum of once per year.

Physical access to servers shall be limited by security measures such as locating they system within a secured facility or room and/or utilizing cipher locks or key cards.

Section 5.5.5.2 Equipment Records

Records retained for equipment shall include instrument configuration and settings.

Section 5.7 Sampling

Subsampling procedures shall address recording the presence of extraneous materials present in samples. The procedure shall comply with recognized consensus standards, where applicable.

Section 5.8 Sample Management and Handling

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

The laboratory shall maintain procedures for communicating to all affected laboratory personnel when samples that require non-routine analysis, additional sample preparation steps, or customer-required deviations are received. Records of these communications shall be maintained.

Chemical preservation shall be checked at the time of sample receipt for all samples, unless it is not technically acceptable to check preservation upon receipt (e.g. VOA and Oil and Grease samples).

Samples that are completely consumed during analysis shall be recorded as such for their final disposition.

Section 5.9.1 Quality Control

For DoD, storage blanks are essential QC to monitor the storage of samples for volatile organic analysis (VOA). The SOP for storage of VOA samples must include a contamination monitoring program based on the performance of storage blanks.

A storage blank shall be stored with all volatile organic samples, regardless of suspected concentration levels. Storage blanks shall be used to determine if cross-contamination may have occurred. If cross-contamination greater than ½ LOQ (Methylene chloride, Acetone, 2-Butanone, greater than LOQ) is found in the storage blank, the laboratory shall implement the nonconforming work procedure. The laboratory shall have procedures and acceptance criteria for evaluating storage blanks appropriate to the types of samples being stored. The storage blanks shall be stored in the same manner as the customer samples. The storage blanks shall be analyzed every 14 days at a minimum.

Section 5.9.1.1.9 QC Acceptance Criteria and Control Limits

Control limits are monitored at least quarterly to identify shifts in mean recovery, changes in standard deviation, and emerging trends. The laboratory may use representative compounds for control charts to conduct trend analyses. The basis for selecting representative compounds shall be documented and shall be scientifically valid.

Section 5.10.2 Test Reports: Required Items

Unless specifically waived by the customer, reports shall include:

LOQ and associated precision and bias at the LOQ, where determination of precision and/or bias at the LOQ is required and the LOD and LOQ verification data when the infrequent method option described in module 4 is used.

Records of customer approval and technical justification for any waiver from QSM requirements shall be included in all affected reports

All QC required by the method and specified in the applicable Appendix B Table, including acceptance criteria used by the laboratory.

Case narrative identifying deviations of any calibration standards or QC sample results from acceptance limits and a discussion of the associated actions taken by the laboratory to address the deviation.

Case narrative identifying a list of preparation batches for which no matrix spike and/or matrix spike duplicate were performed due to lack of adequate sample material

Case narrative identifying occurrence of analytes for which manual integration occurred.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

8.2 Unregulated Contaminant Monitoring Rule 5 (UCMR5)

This addendum outlines additional policies and processes established by this laboratory to maintain compliance with UCMR 5 program specific requirements. These requirements are outlined in the UCMR 5 Laboratory Approval Requirements and Information Document. Data may not be uploaded to the Safe Drinking Water Accession and Review System (SDWARS) if it does not comply with these requirements.

Section 5.8.3: Sample Receipt Checks and Sample Acceptance Policy

Samples that are not received in a secure manner, are received in inappropriate containers, are received outside the required temperature range, are received outside the recognized holding time, are received with inadequate identification on sample containers and/or COC or are improperly preserved cannot be reported to SDWARS for UCMR compliance.

Section 5.8.3.1: Sample Receipt Checks - Thermal Preservation

Samples must be received at the laboratory within 48 hours of collection and must be ≤ 10oC. After arrival or within 48 hours of collection, whichever is sooner, the samples must be refrigerated at ≤ 6°C. Samples received more than 48 hours after collection are valid only if they are received at ≤ 6°C and the laboratory can obtain documentation from the client to verify that they were refrigerated between collection and shipment. Temperature requirements apply to all UCMR samples with the exception of metals by EPA 200.8.

Section 5.9.1.1.3: Method Blank

The method blank will be considered contaminated if the concentration of any target analyte in the method blank is greater than 1/3 the MRL for that analyte. If samples cannot be re-processed, then samples must be re-collected. Data with a failing method blank cannot be reported to SDWARS.

Section 5.9.1.1.4: Laboratory Control Sample (LCS)

If the LCS recovery fails, then all data for the problem analyte are considered invalid for all samples in the Extraction or Digestion Batch. Data associated with a failing LCS must not be reported to SDWARS. If the LCS surrogate or internal standard fails QC criteria, all data for the Extraction or Digestion Batch must not be reported to SDWARS.

Section 5.9.1.1.5: Matrix Spikes (MS/MSD)

A UCMR sample must be used as the parent sample for the MS/MSD in batches containing UCMR samples. The spike concentration of the MS/MSD must be alternated between a low- and mid-level concentration.

There are no method analyte recovery acceptance criteria specific for MS/MSD results. Data should not be rejected based on the recovery of the fortified target analytes or on the precision between the MS and MSD, provided internal standard and surrogate standard recoveries and all other QC results are valid. If surrogate or internal standard recovery fails criteria in the MS and MSD, do not report results. If one of the fortified samples fails QC, the results of the fortified sample that passes, should be reported as the MS. The entire analysis batch does not need to be reanalyzed because of a failure of a surrogate or internal standard in MS or MSD. Recollection of the field sample is not required with a surrogate or internal standard fails criteria in the MS/MSD.

COPYRIGHT © 2019-2023 Pace® Analytical Services, LLC.

Section 5.9.1.1.7: Surrogates

A sample that fails QC criteria for surrogate recovery should be rerun in case a mis-injection occurred. If the sample continues to fail surrogate QC criteria, the laboratory should process a new aliquot of the sample. Typically, data for samples with failed surrogate recovery must not be reported to SDWARS.

If the surrogate recovery fails the acceptance criteria in a MB or LCS, the MB or LCS may be reanalyzed later in the Analysis Batch. If surrogate recovery fails again, all field sample results for the associated Extraction Batch are invalid and must not be reported. If the surrogate recovery fails in an MB that is needed to pass an Analysis Batch, all data for that Analysis Batch are invalid and must not be reported. If possible, the laboratory should process new aliquots of the affected samples; if this is not possible, the affected field samples must be recollected. One LCS must pass surrogate recovery within a 24-h period of analysis. If not, the samples in the Analysis Batches that correspond to that required LCS, cannot be reported.

Section 5.9.1.1.8: Internal Standards

If the internal standard recovery in a sample fails the acceptance criteria, then the results for the analytes that are associated with the internal standard in that sample are invalid. Data that fail internal standard criteria must not be reported to SDWARS. If possible, the laboratory should process a new aliquot of the sample; if this is not possible, the field sample must be recollected.

For an Extraction Batch or Digestion Batch, if the internal standard recoveries in an MB or LCS fail the acceptance criteria, all data for the analytes that are associated with that internal standard in that Extraction Batch or Digestion Batch are invalid and must not be reported. If the internal standard recoveries in a MB or LCS fail the acceptance criteria in an Analysis Batch, all data for the analytes that are associated with that internal standard in the Analysis Batch are invalid and must not be reported. If possible, the laboratory should process new aliquots of the affected samples.

© 2024, 2025, 2026, Pace® Analytical Services, LLC (PAS)

1.0 SCOPE & APPLICATION

This standard operating procedure (SOP) describes the laboratory procedure used by PAS-Mansfield for the determination of the per- and polyfluoroalkyl substances (PFAS) by liquid chromatography/mass spectrometry (LC-MS/MS) following EPA 1633A, published December 2024.

1.1 Applicable Matrices

The matrices that can be tested using this SOP include:

Aqueous Matrices	Solid Matrices	Other Matrices
Non-Potable Water	Soil/Sediment	Biphasic (Aqueous/Solid)
Landfill Leachate	Biosolid	Oils
TCLP / SPLP Leachate	Tissue	Non-Standard Matrices
Aqueous Film Forming Foam (AFFF)	Articles of Commerce	
Fluorine-Free Foam (F3)	Wipes	

1.2 Routine Analyte List and Limits of Detection & Quantitation

This SOP uses abbreviations for the analyte name. A cross-reference of analyte name to CAS# and abbreviation is provided in Appendix A, Table 1.

The routine analyte list and limit of quantitation (LOQ) that can be determined by this SOP for each matrix is provided in Appendix A, Table 2.

Detection limits for each analyte are kept on file by the laboratory's Quality Department.

Unless otherwise specified, nominal limits of detection and the LOQ used during testing are adjusted on a per-sample basis to account for actual sample quantities used, percent moisture, and dilution factors.

1.3 Statutory and Program Specific Requirements

When statutory or regulatory program requirements for EPA Method 1633A differ from the procedures outlined in the main body of this SOP, the program specific requirements are called out in the relevant section of the SOP or are provided in appendices to the SOP. These requirements take precedence over the main SOP and must be adhered to when performing work under that jurisdiction, unless otherwise specified on a project-specific basis.

2.0 SUMMARY OF METHOD

Samples are prepared and extracted using solid phase extraction (SPE). Extracts are cleaned using carbon cleanup prior to analysis by LC-MS/MS in the multiple reaction monitoring (MRM) mode.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction.

This test procedure is based on USEPA Method 1633A, December 2024, and includes allowable modifications from the reference method to improve performance.

Refer to Section 14 for a detailed list of modifications and their rationale. Supporting documentation to demonstrate equivalency and comparability, when required, is maintained by the laboratory's Quality Department.

3.0 INTERFERENCES

Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and elevated baselines causing misinterpretation of chromatograms. This SOP includes procedures for equipment cleaning to mitigate these interferences.

Interferences co-extracted from samples will vary considerably from source to source, depending on the diversity of the site being sampled. Interfering compounds may be present at concentrations several orders of magnitude higher than the native PFAS. Because low levels of PFAS are measured by this method, elimination of interferences is essential and these steps are incorporated into the procedural sections of this SOP.

The most frequently encountered interferences are fluoropolymers; however, bile salts (e.g., Taurodeoxycholic Acid [TDCA]) may be present in various matrices, including fish and wastewaters, and can interfere in the chromatography. For this reason, analysis of a standard containing TDCA is required when establishing the initial chromatographic conditions and each analytical sequence.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

- **Articles of Commerce:** Solid consumer and related product materials.
- **Extracted Internal Standard (EIS) quantification:** The response of the target compound is compared to the response of the isotopically labeled analog of another compound with chemical and retention time similarities.
- **Isotope dilution (ID) quantitation:** A means of determining a naturally occurring (native) compound by reference to the same compound in which one or more atoms has been isotopically enriched. The labeled PFAS are spiked into each sample and allow identification and correction of the concentration of the native compounds in the analytical process.
- **Isotopically labeled compound:** An analog of a target analyte in the method which has been synthesized with one or more atoms in the structure replaced by a stable (non-radioactive) isotope of that atom. Common stable isotopes used are 13C (Carbon-13) or Deuterium (D or 2H). These labeled compounds do not occur in nature, so they can be used for isotope dilution quantitation or other method-specific purposes.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

5.0 HEALTH & SAFETY

Contact your supervisor or local safety coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

The following sections provide general health and safety information about chemicals and materials that may be present in the laboratory.

- The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.
- The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (EHS) policies and procedures specified in this SOP and in the Pace® Chemical Hygiene / Safety Manual (COR-MAN-0001).
- Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.
- Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. For procedures that require use of acids, use acids in a fume hood whenever possible with PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. For procedures that that emit large volumes of solvents (evaporation/concentration processes), these activities must be performed in a fume hood or apparatus that reduces exposure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME & STORAGE

6.1 Sample Collection & Bottle Kits

PAS does not offer sample collection services for this test method. PAS advises customers to collect samples in accordance with a sampling plan and collection procedures appropriate to meet regulatory requirements and data quality objectives for the project.

Refer to Appendix A, Table 3 for sample collection, preservation, and holding time requirements for each matrix.

PAS will provide containers for sample collection per customer request. Refer to laboratory SOP (ENV-SOP-WEST-0005) for general instruction on bottle kit preparation and refer to Appendix A, Table 3 for sample collection, preservation, and holding time requirements for each matrix.

PFAS Bottle Kit Specifications:

- If the request includes containers for surface wipes, provide a copy of the Pace® PFAS Wipe Sampling Guide in each sampling kit.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

- Kits for aqueous sample kits should include the instruction to fill the container to the gradation marked on the container, or to the shoulder of the container if no gradations are provided.
- If matrix spikes are requested (or required by program), provide additional containers for the collection of MS/MSD and remind the customer to designate the sample for use on the chain-of-custody (COC).

  For example, if an MS/MSD is requested on an aqueous matrix, the customer must collect and provide seven (7) 250 mL containers, two (2) each for the MS, MSD, and parent sample, plus one (1) 60 mL container for prescreening.
- AFFF Concentrate: Customers should notify PAS at the time of request for quote or sampling containers if the matrix of any sample is an AFFF concentrate. Due to the specific handling requirements needed for this matrix, pre-notification ensures that the laboratory is prepared to handle the sample properly to prevent the sample from contaminating the work area and/or other test samples.

6.2 Sample Receipt, Storage and Disposal

Laboratory sample receiving personnel check thermal preservation and compliance with the PAS Sample Acceptance Policy on receipt following the procedures specified in SOP (ENV-SOP-WEST-0003, Sample Receipt and Login), Refer to the Laboratory Quality Manual for the PAS Sample Acceptance Policy.

Unless otherwise specified by contract, samples and extracts are retained for the timeframe specified in the Pace® standard terms and conditions then disposed of in accordance with Federal, State, and Local regulations.

7.0 EQUIPMENT & SUPPLIES

See Appendix A for a complete list of equipment and supplies needed to perform this procedure.

Substitution of instrumentation, equipment, and supplies is permissible only if the replacement meets the specifications outlined in the SOP. If an alternative item does not meet these specifications, it may impact the procedure's performance, necessitating an update and/or revalidation of the procedure.

Plastic containers must be used for all standard, sample, and extraction preparations due to potential adsorption of analytes onto glass. Do not substitute glass for plastic containers.

7.1 Suitability Checks

- Verify the suitability of SPE cartridges, solvents, cryovials, and autosampler vials on a lot-basis by analysis of a method blank; maintain records of the verification for readily available historical access.

8.0 REAGENTS & STANDARDS

See Appendix B for a complete list of standards and reagents needed to perform this procedure and for formulations of standard solutions prepared by the laboratory.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Substitution of reagents and standards from those listed in Appendix B are permissible only if the replacement meets the specifications outlined in the SOP. If an alternative item does not meet these exact same specifications for purity, composition, or concentration, any formulation in this SOP must be modified to match the material used. If the substitution is permanent, the SOP and formulations in this SOP must be updated.

All purchased standard solutions must be received with a Certification of Analysis (COA). The COA must be maintained on-site in laboratory possession; access to a COA via the vendor's website is generally not acceptable to external regulatory bodies because the COA must be traceable to each lot received. Refer to laboratory SOP (ENV-SOP-MANS-0112, for instructions for receipt and traceability.

9.0 PROCEDURE

9.1 Equipment & Instrument Setup

9.1.1 Support Equipment

9.1.1.1 Top Loading & Analytical Balances

Prior to use on each day of use, verify the calibration verification check on the analytical and/or top loading balance has been performed with working reference weights that bracket the measurements of weights that will be taken.

Verify the balance calibration is within its annual calibration timeframe. If the calibration sticker is missing or the calibration has expired, do not use the balance and notify the quality department of the situation.

If an alternate balance is used: ensure the balance used has been checked for tolerances that bracket the entire range of weight measurements.

9.1.1.2 Drying Oven

Verify the oven is equipped with a calibrated thermometer prior to use.

If the thermometer is missing a calibration label or the calibration has expired, notify the quality department. Do not use the oven until it is equipped with a calibrated thermometer appropriate for the temperature ranges required for the test and the gradients required to record temperatures of use.

If the thermometer used is assigned a correction factor (CF), record the original observation and the temperature corrected for the CF. If the logbook or electronic log does not have a location to record both temperatures, notify the quality department of the gap in traceability.

9.1.1.3 Mechanical Pipettes

Prior to use, check the calibration label of the pipette(s) to verify the accuracy check has not expired. If expired or the calibration label is missing, notify the quality department. Do not use the pipette until its calibration status has been verified.

If a different pipette is used, ensure its calibration has been verified at the volume

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

of use before using the pipette.

9.1.1.4 Refrigerators / Freezers

Ensure samples and extracts, and reagents and standards, if stored refrigerated or frozen, are stored separately and the temperature of the units are monitored daily, including weekends and holidays. Refer to the laboratory's SOP, however named, for monitoring procedures and recording of temperature measurements.

9.1.2 Extraction Equipment

9.1.2.1 Suitability Checks

The suitability of SPE cartridges, solvents and other disposable plasticware may need to be verified by lot prior to use.

Supplies are to be verified by simulating their method usage as both a method blank and an LCS.

These supplies are acceptable for use if no target analytes are detected above the detection limit and all spike recoveries meet the acceptance criteria.

9.1.2.2 Cleaning Procedures

Rinse all glassware prior to use with methanolic ammonium hydroxide (1%) and methanol solvent. Air dry after the solvent rinse.

9.1.2.3 SPE Manifold Setup & Use

Inspect sample manifold ports and transfer tubing (if used) prior to use for signs of wear and/or discoloration. Replace manifold ports and transfer tubing as needed.

Clean all parts of the SPE manifold including the chamber prior to use and between samples with methanolic ammonium hydroxide (1%). Air dry before use.

9.1.3 Analytical Instrumentation

9.1.3.1 Instrument Operating Conditions

Set the instrument operating conditions to the following specifications:

LC Gradient					MS Parameters	
Step	**Total Time (min)**	**Flow Rate (µL/min)**	**A (%)**	**B (%)**	**Parameter**	**Setting/Value**
1	0.00	400	80	20	Sample Loop	50 µL
2	6.00		20	80	Injection Volume	2 µL
3	6.50		20	80	Column Oven Temperature	40° C
4	6.52		80	20	MRM Scan Window	60 sec
5	8.50		80	20	Curtain Gas (CUR)	30.0
					Collision Gas (CAD)	9
					Ion Spray Voltage (IS)	-4500 V

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

					Source Temperature (TEM)	450° C
					Ion Source Gas 1 (GS1)	30.0
					Ion Source Gas 2 (GS2)	50.0

A: 5% Acetonitrile w/ 2mM Ammonium Acetate / B: Acetonitrile

9.1.3.2 Mass Calibration & Mass Calibration Verification

Perform mass calibration and mass calibration verification following the instrument manufacturer instructions prior to first use and at least annually thereafter to check instrument sensitivity and selectivity. Repeat following major instrument maintenance, movement of the instrument, or when other quality control (QC) failures suggest the need.

Ensure the procedures used for mass calibration and mass calibration verification evaluate an ion range that encompasses the ion range (Q1 and Q2 m/z) of the analytes of interest in this method. If the manufacturer's instructions include options for evaluation of mass resolution, the tightest resolution requirements (typically called unit resolution) must be met.

9.2 Calibration Design

Unless otherwise specified, instrument calibration procedures must comply with the PAS Corporate Policy for *Acceptable Calibration Practices for Instrument Testing* (POL ENV-POL-CORQ-0005). Refer to this policy as needed to learn more about policies and requirements for calibration and calibration verification.

9.2.1 Calibration Model

This SOP includes two (2) calibration models. Each option uses isotopically labeled compounds added to the samples prior to extraction. Option 1 is required for any analytes for which there is a stable isotope analogue.

Option 1: Isotope Dilution Quantification (ID): the response of the target compound is compared to the response of its isotopically labeled analog. Twenty-four (24) target compounds are quantified in this way.

Option 2: Extracted Internal Standard quantification (EIS): the response of the target compound is compared to the response of the isotopically labeled analog of another compound with chemical and retention time similarities; sixteen (16) target compounds are quantified in this way.

9.2.2 Calibration Design

The design of the curve specified in this SOP includes analysis of nine (9) calibration standards; however, not all standards must be included in the final curve.

More than the minimum number of calibration points specified in the published reference method are analyzed to extend the calibration range and to permit exclusion of the lowest or highest standards when needed; the calibration set is designed to leave enough standards remaining to meet the minimum number required for the curve fit, and to ensure that eliminating standards at the low or high end of the calibration does not alter the established LOQ.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

- When linear calibration is used, the calibration curve must minimally include 6 calibration levels, with at least 5 within the quantitation range, and the lowest standard at or below the LOQ.
- When non-linear calibration (Quadratic) is used, the calibration curve must minimally include 7 calibration levels, with at least 6 within the quantitation range, and the lowest standard at or below the LOQ.

Weighting is allowed for linear and non-linear regressions, so long as the weighting is inversely proportional to concentration and is not forced through zero.

When considering the range of quantitation, ensure the LOQ routinely achieves a signal to noise ratio of 3:1, and meets the requirements for the confirmation ion and the ion ratio requirements specified in the published reference method. If a confirmation ion is not specified in the published method for the analyte, the signal to noise ratio must be minimally 10:1.

Each calibration sequence must also include the analysis of a second source standard (ICV); however, this standard is never included in the curve – it is used to evaluate accuracy and/or potential bias of calibration standard preparation and curve fit.

Refer to Appendix B for the formulations for each working calibration standard.

Acceptance criteria for the curve are provided later in this SOP.

9.2.3 Calibration Frequency

Calibrate the instrument at initial setup, when calibration verification (ICV, ISC, CCV) results indicate the calibration is no longer valid, when changes made to the operating conditions may affect calibration performance, after major instrument maintenance, or after any other event that may affect instrument performance, such as moving the instrument.

9.2.4 Calibration Sequence

Prepare the calibration standards and the ICV following the instructions in Appendix B.

Prepare an instrument blank (IBLK) by adding 4925 µL of the IBLK Mix and 50 µL of EIS and 25 µl of NIS to a plastic centrifuge tube; vortex to mix.

Analyze calibration standards L1-L9 in order from lowest to highest concentration.

Analyze the instrument blank (IBLK) after the highest concentration calibration standard, followed by the ICV.

9.3 Calibration Evaluation

Evaluate the calibration for linearity, accuracy, sensitivity, and carryover. If any criteria are not met, troubleshoot to identify and correct the problem, then repeat calibration. All criteria must be met before analysis of test samples.

Suggested Actions:

a) Perform instrument maintenance and reanalyze the calibration sequence.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

b) Remake the standards and analyze a new calibration sequence.

c) Reduce the range of calibration by excluding the highest concentration calibration standards or the first calibration standard. Since CAL L1 is not routinely included in the curve and CAL 2 is the LOQ, no other standards at the low end may be removed. Removal of standards in the interior of the curve is not permitted unless an obvious error with the standard is observed.

9.3.1 Linearity Evaluation

Use one of the following options to evaluate the linearity of the calibration curve. When using a weighted regression, assess linearity with option 2 below.

1) Linear Calibration: calculate the relative standard deviation (RSD) of the Relative Response (RR) or Response Factor (RF) values of the initial calibration standards for each target analyte and isotopically labeled compound. The RSD must be ≤ 20%.

2) Non-Linear Quadratic (2nd Order Fit): calculate the relative standard error (RSE) for each native compound and EIS compound for all the initial calibration standards that were analyzed. The RSE for all target and EIS compounds must be ≤ 20%. See Section 10.4.6 for the equation to calculate RSE. Maintain a record of the calculation and evaluation with the curve for historical recordkeeping and reference.

9.3.2 Initial Calibration Verification (ICV)

To verify the accuracy of the calibration, check the recovery of the ICV. The recovery should be within ±30% of the expected value.

When criteria are not met, it is likely there is a problem with the quality or preparation of the calibration standards and/or the ICV; correct the problem prior to sample analysis.

Suggested actions include:

1) Remake and reanalyze the ICV

2) Remake calibration standards and repeat the calibration sequence.

3) If instrument maintenance is performed: in addition to reanalyzing the ICV, the calibration sequence may need to be reanalyzed if the conditions under which the acceptability of the calibration curve was evaluated have changed.

9.3.3 Instrument Sensitivity Check (ISC)

Check instrument sensitivity daily at the lowest calibration standard included in the quantitation range (CAL L2).

The signal-to-noise ratio of the ISC must be ≥ 3:1 for the quantification ions and the confirmation ions, or ≥ 10:1 if the analyte only has a quantification ion. Recovery of the native and EIS compounds for the ISC must be within 70-130%. If the requirements cannot be met, the problem should be corrected before analyses can proceed.

If an individual target compound recovery in an ISC is above the upper control limit and all associated samples are ND for that compound, the data for those samples may be

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

reported. In such cases, a narrative statement must be included in the report indicating the specific compound result that was biased high in the ISC, and that samples were ND for that compound and thus reportable.

See Appendix A, Table 6 for ion associations for each target analyte.

9.3.4 Bile Salts Interference Check

Verify the bile salt peak (TDCA) is detected >1 min outside RT window for PFOS. TDCA is added to multiple calibration standards to facilitate this evaluation.

9.3.5 Initial & Continuing Calibration Blanks (ICB & CCB)

Calibration blanks are used to assess carryover and/or contamination in the instrument system and are included in the initial calibration sequence and each daily analytical sequence thereafter.

In analytical sequences that include calibration, analyze the ICB following the highest concentration ICAL standard before the ICV. In sequences without calibration, analyze a CCB each day prior to sample analysis after the opening CCV.

The concentration of each analyte must be ≤ the MDL.

- If contamination is suspected, troubleshoot to identify and eliminate the source.
- If the failure is due to carryover from a prior standard, either reduce the upper range of the calibration, increase column flush time to reduce potential for carryover.
- If an analyte is present at such levels, analyze one or more additional instrument blanks until the response of the analyte is no longer detectable,

9.3.6 Continuing Calibration Verification (CCV)

Verify the calibration at the beginning of each analytical sequence, after every ten environmental samples, and at the end of the sequence. The ISC may serve as the daily opening CCV. Do not include quality control (MB, LCS), instrument performance check standards (CCV), sample-specific matrix spikes, MS/MSD, field duplicates (FD), or trip blanks in the count of environmental samples.

Use ICAL Level 6 as the CCV and analyze it under the same conditions as the calibration standards.

The recovery of each target analyte and the EIS compounds for the CCVs must be within 70 – 130% to meet CCV criteria.

See Appendix A, Table 6 for ion associations for each target analyte.

If criteria are not met, take corrective action and reanalyze any extracts that were analyzed between the last passing CCV and the one that failed, unless the CCV result is above the upper limit and all associated samples are not detected (ND), in which case, reanalysis is not required.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Alternately, immediately analyze two CCVs for confirmation. If both confirmation CCV analyses meet the recovery criteria, proceed with analysis; however, samples that were analyzed after the failing CCV and before the 2 passing CCVs must be re-analyzed. If either of the 2 confirmation CCV analyses fails to meet the acceptance criteria, recalibrate the instrument.

9.4 Sample Preparation: General Requirements

9.4.1 Contamination Prevention

To reduce potential contamination or bias, do not use any fluoropolymer articles or task wipes during sample preparation or extraction procedures. Use only HDPE or polypropylene containers; reagents and solvents used for cleaning purposes may be stored in glass containers.

9.4.2 Pre-Screening Procedures

Samples may be pre-screened at the discretion of the laboratory prior to sample preparation and/or analysis. Results of the screen may be used to determine if reduced volume extraction is needed or to target dilution of extracts prior to analysis.

Refer to Appendix C for instructions to prepare screening extracts when screening has been scheduled.

9.4.3 Homogenization, Subsampling, and/or Pre-Preparation Requirements

Different matrices require or may require homogenization, subsampling or pre-preparation as specified in the following subsections before sample preparation and extraction.

9.4.3.1 Aqueous: Non-Potable Water and Landfill Leachate

The sample volume used for preparation and extraction may be subsampled from the original container received when it is known that the sample requires a dilution of >10X or when EIS criteria cannot be met due to matrix interference. When subsampling is required to manage high concentrations, no less than 250 µL of aqueous or leachate samples may be subsampled - if greater dilution is required, serial dilution must be employed. When subsampling is required to manage challenging matrices, no less than 1 mL of samples may be subsampled.

Subsampling must be performed with customer knowledge to confirm the protocol used by the laboratory meets their project-specific requirements.

Refer to Appendix D for subsampling instructions.

9.4.3.2 Aqueous: TCLP or SPLP Leachates

The TCLP or SPLP leachates are generated using the laboratory's routine protocol for leachate generation. The leachate solutions provided by the work area performing this step are used as samples for PFAS extraction and analysis. TCLP/SPLP leachates are prepared following the Landfill Leachate protocol, with nominally 50 mL of sample extracted.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

9.4.3.3 Aqueous: AFFF or F3

Samples composed of AFFF, F3, or other matrices KNOWN to require a large dilution prior to extraction will be subsampled consistently, with approximately 0.01 g of material aliquoted for each discrete sample preparation/analysis; each AFFF or F3 concentrate sample must be prepared in duplicate. After creating and documenting the subsample aliquot in a 60 mL HDPE PFAS sample bottle, add approximately 60 mL of reagent water, cap the vessel, and shake vigorously by hand for 20-30 seconds. After adding the reagent water and agitating, allow at least 3 hours for the subsample aliquot to fully dissolve in the water. If dissolution is incomplete after 3 hours, agitate again and wait another 3 hours; consider applying continuous agitation (orbital shaker) if full dissolution of the aliquot into water requires extended time. Following the extended dissolution time, prepared AFFF/F3 samples should be extracted and analyzed following the routine protocols for aqueous sample processing. Aqueous reporting limits will be used, with values adjusted to account for the actual sample aliquot, assuming 1 g/mL; this constitutes a 25,000X nominal adjustment factor for AFFF/F3 reporting limits, relative to nominal aqueous reporting limits.

Pace STRONGLY DISCOURAGES clients from sending AFFF concentrate material for analysis; this protocol is designed for “as-prepared” AFFF materials (i.e. pre-diluted to application concentration) and newer generation ‘Fluorine Free Foam’ (F3) concentrates. If F3 material (concentrate or as-prepared) or AFFF “as-prepared” material is received, follow the normal routines described in the paragraph above. If an AFFF concentrate material (usually of a thick gel-like consistency) is received for analysis, the above protocol may not be enough of a dilution to protect lab systems; in these cases, the lab shall prepare a serial dilution prior to extraction. First, the protocol above is followed (0.01 g of material fully dissolved into 60 mL water). Then a 6 mL aliquot of the initial aqueous solution is diluted into water, with a final volume of 60 mL (i.e., dilute 6 mL of sample solution into 54 mL of water). This serial dilution constitutes a 250,000X nominal adjustment factor for the AFFF concentrate reporting limits, relative to nominal aqueous reporting limits. Handling of AFFF concentrate should ideally be done in an isolated area outside of the PFAS processing area to prevent gross lab contamination.

9.4.3.4 Solid: Soils and Sediments

If a reduced mass extraction is scheduled, use at least 0.2 g (dry weight) for all solid matrices to ensure the amount used for sample preparation is representative of the total mass of sample collected.

9.4.3.5 Solid: Biosolid

If a reduced mass extraction is scheduled, use at least 0.02 g (dry weight) for all biosolid matrices to ensure the amount used for sample preparation is representative of the total mass of sample collected.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

9.4.3.6 Biphasic

If the sample is biphasic and the customer has requested phase separation: centrifuge the sample to separate the phases following the procedure specified in Appendix F, then prepare and extract each phase separately.

9.4.3.7 Articles of Commerce

Articles of commerce typically need to be milled to a fine powder using the protocol specified in Appendix H before sample preparation. This step may not be required when the material is known to be sufficiently homogenous and more than 95% of the material will pass through a 250 µm sieve.

Perform this step as needed and when specified on a project basis.

9.4.3.8 Tissue

Homogenization of tissue matrices is performed on behalf of all PAS locations by either the PAS laboratory located in Green Bay, Wisconsin (PAS-Green Bay) or Mansfield, Massachusetts (PAS-MANS) in accordance with their local SOP's ENV-SOP-GBAY-0129 Sample Homogenization Compositing and Sub-Sampling or ENV-SOP-MANS-0030 Tissue Preparation and Homogenization. PAS personnel may access this SOP via "Qualtrax" (AKA Ideagen Quality Management), the electronic document management system (eDMS) used by PAS for document management, control, and distribution.

If a reduced mass extraction is scheduled, use at least 0.1 g for all tissue matrices to ensure the amount used for sample preparation is representative of the total mass of sample collected.

9.5 Percent Solids Determination

9.5.1 Aqueous Matrices

A percent solids determination is not conducted for aqueous matrices. Instead, the laboratory visually assesses the sample matrix during sample preparation and employs alternative strategies to mitigate the effect of any solids present.

9.5.2 Solid Matrices (excluding tissues and Articles of Commerce)

Percent solids must be determined on all solid and biosolid samples prior to preparation and analysis to determine the sample mass used for extraction in accordance with **ENV-SOP-MANS-0011 Percent Solids Determination 2540G**. Percent solids are logged-in and determined by the same personnel that normally generate this data daily. The percent solids analysis will follow the Method SM2540G protocol.

Percent solids are not determined for tissue, surface wipes or the solid phase of a biphasic sample. These matrices are always reported on a wet weight basis.

9.6 Sample Preparation: Procedure

9.6.1 Aqueous Matrices

Do not filter samples at any point prior to sample preparation.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Unless a reduced volume extraction is necessary, use the following amounts for sample preparation and analysis:

Routine Extraction Volume for Aqueous Matrices[1]

Non-Potable Water	Landfill Leachate	TCLP/SPLP Leachate	AFFF or F3
250 mL	50 mL	50 mL	0.01 g

[1]Nominal amount on which LOQ in Table 2 is derived. When different sample volumes are used, detection limits and the LOQ are adjusted for the actual amount used.

- For NPW: Use the entire volume from one (1) of the 250 mL containers provided.
- Landfill Leachates: Use 50 mL from one (1) of the 60 mL containers provided.
- TCLP/SPLP Leachate: Subsample 50 mL of the filtered leachate generated by pouring the leachate from the container into a 60 mL HDPE PFAS sample bottle. Use the gradations on the bottle as a measuring guide.
- AFFF or F3: Subsample 0.01 g of the material received into a 60 mL HDPE PFAS sample bottle and dilute in 60 mL of reagent water; see Section 9.4.3.3 for the complete pre-extraction preparation protocol.

Create separate preparation batches for aqueous matrices that use different initial volumes because the volume used for the MB and LCS/LLLCS must match the amount used for samples.

Preparation Steps:

1) Remove the sample container from storage. Pull additional containers for each MS/MSD and for the laboratory duplicate, when requested or required, and an additional container has been provided to perform the analysis.

   DoD Accredited Laboratories: If the matrix is AFFF or F3, a duplicate must be performed with each sample. Confirm that there is enough sample available to take the duplicate from the same container.

2) Invert the sample container 3-4 times to homogenize the sample and then allow the sample to settle.

3) Visually inspect each settled sample for settled or suspended solids. Consider any visible indications of particulate matter including settled solids collected on the bottom of the container, cloudiness and/or dark color of the sample, suspended solids within the sample, increased viscosity, etc. If uncertain, seek a second opinion from another analyst, team lead, or supervisor; these matrix characteristics may require reduced-volume extraction.

   a. If potential interferences other than settled solids are observed, take action to mitigate the impacts on data quality. Examples of other sample characteristics that could necessitate precautionary measures with a field sample (i.e., prepare from reduced volume) include presence of standing foam in the sample after shaking, thick/viscous matrix, samples from known highly contaminated

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

sites/projects, client notes indicating potential high concentrations, and knowledge of potential hazards to safety, equipment performance, or process integrity due to sample composition. In such cases, confer with a team lead or supervisor to determine the best approach. Use the largest volume possible (i.e., the smallest reduction possible) when performing a reduced-volume extraction to manage challenging matrix characteristics; use no less than 1 mL of sample.

b. If none of these conditions are observed or if the solids observed are less than ½ cm in depth, proceed to Step 4.

c. If settled solids are observed at a depth greater than ½ cm, skip Section 9.6.1 and follow the preparation and extraction instructions specified in Appendix E.

d. If settled or suspended solids appear to be more than 5% of the total volume of the sample:

- Recap the container and shake to homogenize; uncap the container.
- Using a pipet calibrated to quantitatively measure 1 mL, transfer 1 mL of sample into a pre-labeled 50 mL centrifuge tube.
- Add 50 mL of reagent water to the tube.
- Record 1 mL for the volume used for sample preparation and extraction.
- Proceed with Step 5 after initial weight has been determined for all samples in the batch.

4) Weigh the container+sample on the top-loading balance and record the weight measurement in the preparation record to the nearest 0.1 g. This measurement will be used later to calculate the actual volume of sample extracted.

5) Prepare a method blank (MB), laboratory control sample (LCS), and low-level laboratory control sample (LLLCS) by measuring the volume of blank matrix specified into a 250 mL HPDE container.

- NPW: Use 250 mL of reagent water.
- Landfill Leachate: Use 50 mL of reagent water.
- TCLP / SPLP Leachate: Use 50 mL of TCLP or SPLP blank solution for the LCS, LLCS and Leachate MB.
- AFFF / F3: cannot be batched with NPW; prepare batch QC following AFFF routines.

6) Quantitatively add 64 µL of the STK-10X standard mix to LLLCS and 80 µL of EPA-1633PDS solution mix to the LCS.

7) Add 40 µL of EIS solution to each container (all samples and QC).

8) If the batch includes matrix spikes, add 80 µL of EPA-1633PD mix to each matrix spike.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

9) Cap each container and invert to mix.

10) Check the pH of each container using a pH indicator strip to verify the pH is 6.5 ± 0.5. If necessary, adjust the pH with 50% formic acid or ammonium hydroxide (or with 5% formic acid and 3% aqueous ammonium hydroxide). Do not insert the strip into the sample container: use a disposable pipet to transfer a small amount of sample onto the pH indicator strip instead.

11) Proceed to Section 9.7 for extraction and extract cleanup.

9.6.2 Solid Matrices (Non-Tissue)

Unless a reduced mass extraction is necessary, use the following amounts for sample preparation and analysis:

Routine Target Mass for Solid Matrices[1]

Soil/Sediment	Biosolid	Articles of Commerce	Surface Wipe
2. g dry weight	0.2 g dry weight	.8 g	1 wipe

[1]Nominal amount on which LOQ in Table 2 is derived. When different sample mass is used, detection limits and the LOQ are adjusted for actual amount used.

Do not combine biosolids in the same preparation batch as soils/sediments or articles of commerce due to the difference in amount of material used.

Skip Steps 2-4 if the sample matrix is a surface wipe or article of commerce.

1) Remove the sample from storage.

2) Using a stainless-steel spatula, mix each sample in its original jar by stirring from the bottom of the container to the top and in a circular motion along the sides of the jar, breaking particles up by pressing against the side of the container (to <1 mm). Remove rocks, invertebrates, vegetation and foreign objects that are not representative of the sample from the container. The homogenized sample will be even in color and have no separate layers. Store the homogenized material in its original container. If it is not practical to mix the sample within its container, transfer the sample to a larger container to mix.

3) Check the LIMS to obtain the percent solids result for each sample in the batch.

   - If the test results are not available, check to see if a percent solids analysis is included in the work order; if not, notify the Project Manager (PM) they will need to add the test to the log-in.
   - If test results are not available because the department performing the test has not completed the determination, notify your supervisor or contact the leader of the department performing the test to obtain the status. Preparation may not begin until this information is available.

     If none of these scenarios apply, proceed to Step 4.

4) Determine the target mass for extraction for soils/sediments and biosolids by dividing the target weight for sample preparation by the percent solids in decimal form.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

For example, if a soil sample is 90% percent solids, the mass used for extraction must be within the range of 5.4-5.8 g.

a) Convert 90% percent solids to decimal form by dividing 90 by 100. (90/100 = 0.9)

b) Divide 2 g (target mass) by the percent solids in decimal form (2/0.9=2.22…)

c) Round 2.22 to the same significance of measurement as the top loading balance[1] (2.2).

d) Add ± 0.2 g to the target result of 2.2 g to obtain the target weight range of 2.0to 2.4g.

[1]For biosolids, use an analytical balance and convert the result to the significance of the analytical balance (0.01 g)

5) Place a 50 mL polypropylene centrifuge tube on the balance and tare the balance.

Measure the target weight of sample into the tube so that the weight is within the range determined in the prior step. Record the amount used to the nearest 0.1 g (top loading) or 0.01 g (analytical).

NOTE: *Surface wipes should have been received in a 50 mL centrifuge tube. If the wipe was received in a different container, transfer the wipe to a 50 mL centrifuge tube using clean forceps.*

If matrix spikes or a laboratory duplicate were requested or are required, prepare separate containers for each.

If the sample is extremely dry, wet the sample with 1.0 g of reagent water, which is the same amount always used to wet the clean matrix used for the MB and LCS.

6) Prepare the MB, LCS and LLLCS using Ottawa Sand wetted with reagent water by adding the clean matrix and water to a 50 mL polypropylene centrifuge tube.

- Soil/sediment: Use 2 g Ottawa Sand and 1.0 g of reagent water
- Biosolid: Use 0.2 g of sand and 0.1 g of reagent water
- Surface Wipe: Use a new ghost wipe from a pre-tested lot
- Articles of Commerce: Cannot be batched with soil/sediment. Use 2g of Ottawa Sand and 1g of reagent water.

7) Quantitatively add 64 µL of the STK-10X standard mix to LLLCS and 80 µL of EPA-1633PDS mix to the LCS.

8) If the batch includes matrix spikes, add 80 µL of EPA-1633PDS mix to each matrix spike sample.

9) Add 40 µL of EIS solution to each container (all samples and QC)

10) Using a vortex mixer, vortex the tube to disperse the spike solution and allow to equilibrate for approximately 30 minutes. Alternatively, shake by hand.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

11) First Extraction: Add 15 mL of 0.3% methanolic ammonium hydroxide to each centrifuge tube. Vortex to disperse, then shake for 30 minutes on a variable speed mixing table. Next, centrifuge each tube for 10 minutes at 3000 rpm (~2000 RCF) then transfer the supernatant to a clean, labeled 50 mL polypropylene centrifuge tube.

12) Second Extraction: Add 15 mL of 0.3% methanolic ammonium hydroxide to the remaining solid sample in each centrifuge tube. Vortex to disperse, then shake for 30 minutes on a variable speed mixing table. Centrifuge each tube at 3000 rpm (~2000 RCF) for 10 minutes and decant the supernatant from the second extraction into the same centrifuge tube containing the supernatant from the first extraction.

13) Adjust the extraction solution to 100 mL volume using reagent water. A validated comparison bottle may be used to make this adjustment.

14) Check the pH of each sample solution using a pH indicator strip to verify the pH is 5.0 ± 1.0. If necessary, adjust the pH with acetic acid or ammonium hydroxide (or with 3% aqueous ammonium hydroxide). Do not insert the strip into the sample container: use a disposable pipet to transfer a small amount of sample onto the pH indicator strip instead.

15) Proceed to Section 9.7 for extraction and extract cleanup.

9.6.3 Tissue

Thaw the homogenized tissue before starting the preparation procedure.

1) Place a 50 mL polypropylene centrifuge tube on a top loading balance and tare the balance. Weigh .8 g ± 0.2 g of homogenized sample into the tube. Record the weight measurement to the nearest 0.1 g. After each sample in the batch has been subsampled, reseal the containers and return to frozen storage.

2) If matrix spikes or a laboratory duplicate were requested or are required, prepare separate containers for each.

3) Prepare the MB, LCS and LLLCS using a reference tissue matrix.

4) Quantitatively add 64 µL of the STK-10X standard mix to one LCS (LLLCS) and 80 µL of EPA-1633PDS mix to the other.

5) If the batch includes matrix spikes, add 80 µL of EPA-1633PDS mix to each matrix spike sample.

6) Add 40 µL of EIS solution to each container (all samples and QC).

7) Using a vortex mixer, vortex the tube to disperse the spike solution and allow to equilibrate for approximately 30 minutes. Alternatively, shake by hand.

8) First Extraction: Add 15 mL of 0.05M KOH in methanol to each tube. Vortex to disperse then place tubes on a variable speed mixing table to shake for 1 hour. Centrifuge the tube at 3000 rpm (~2000 RCF) for 10 minutes and collect the supernatant in a 125 mL sample bottle.

9) Second Extraction: Add 10 mL of acetonitrile to remaining tissue in the centrifuge tube, vortex to mix and disperse the tissue. Sonicate for 30 minutes. Centrifuge

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

each tube at 3000 rpm (~2000 RCF) for 10 minutes and collect the supernatant, adding it to the 125 mL bottle containing the initial extract.

10) Adjust the extract solution to 100 mL volume using reagent water. A validated comparison bottle may be used to make this adjustment.

11) Check the pH of each sample solution using a pH indicator strip to verify the pH is 5.0 ± 1.0. If necessary, adjust the pH with acetic acid or ammonium hydroxide (or with3% aqueous ammonium hydroxide). Do not insert the strip into the sample container: use a disposable pipet to transfer a small amount of sample onto the pH indicator strip instead.

12) Proceed to Section 9.7 for extraction and extract cleanup.

9.7 SPE Extraction & Carbon Cleanup

Use the same procedure for all matrices.

1) Prepare an SPE cartridge for each sample and QC by packing clean silanized glass wool into the bottom of a WAX SPE cartridge barrel, to a height of ~1 cm. Ensure the glass wool is not densely packed to allow for proper sample flow.

   a. If using stacked WAX/GCB cartridges, substitute stacked cartridges for WAX SPE cartridges.

2) Set up the vacuum manifold with one prepared WAX SPE cartridge, with a reservoir adaptor and reservoir stacked on each cartridge, ensuring all connections are tight. If using plastic transfer lines instead of reservoirs, ensure the connecting caps are snug in each cartridge and the transfer lines are placed within the appropriate sample. Label each reservoir or cartridge tube with the associated sample ID.

3) Pre-condition the cartridges with 15 mL of 1% methanolic ammonium hydroxide followed by 5 mL of 0.3M formic acid. Perform each rinse separately. Do not allow the WAX SPE to go dry. Discard the wash solvents.

4) Pour the sample into the reservoir taking care to avoid splashing while loading; or, if using transfer lines, begin opening the stopcocks on the vacuum manifold. Do not pipette the sample in this step. Adjust the vacuum/stopcocks to pass each sample through the cartridge at a rate of approximately 5-10 mL/min; discard the eluate. Retain the empty sample bottle for solvent rinsing.

   If the SPE cartridge becomes clogged during sample transfer, refer to Appendix G for troubleshooting steps and mitigation strategies.

5) Rinse the walls of the reservoir twice with 5 mL reagent water, followed by 5 mL of 1:1 0.1M formic acid/methanol. Pass each rinse through the cartridge using vacuum. If using sample transfer lines for loading, add the 3 rinses to the original sample container and load each rinse through the transfer lines to the cartridge, one reagent at a time. Discard the rinse solutions.

6) Dry the cartridges by pulling air through them for ~ 5 minutes.

7) If using separate GCB cartridges, while the WAX cartridges are drying, condition the carbon cartridges (GCB) by rinsing with two aliquots of 5 mL of 1% Methanolic Ammonium

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Hydroxide.. Perform this step on a separate vacuum manifold or on unused ports of the same manifold as the WAX cartridges.

Insert the narrow end of a 5 mL or 10 mL plastic pipette tip into the top of the GCB cartridge and use it like a reservoir for the rinse solvent. Apply a light vacuum to pull the rinse solvent through the cartridge; discard the rinsates. Do not allow the GCB cartridges to go completely dry during/after this step. Remove the pipette tip from the GCB cartridge and discard.

8) When the WAX cartridges are sufficiently dry, remove each WAX cartridge and reservoir out of its manifold port and stack it on a conditioned GCB cartridge by inserting the outlet of the WAX cartridge into the inlet of the GCB cartridge. Place the dual cartridge-reservoir stack back in the same manifold port that the WAX cartridge originally occupied. This cartridge stacking should be done one cartridge at a time to avoid mixing up manifold locations.

   If using transfer lines: follow the same cartridge stacking process but ensure that the transfer line connecting caps are snug in each cartridge and the transfer lines are placed within the appropriate sample bottle after stacking the two cartridges.

9) Place a clean collection tube in the manifold rack for each cartridge so that the extract delivery needles are not touching the walls of the tubes. Resume vacuum and ensure a proper seal is achieved. DO NOT add NIS to these collection tubes.

10) Rinse the inside of each sample container using 5 mL of 1% methanolic ammonium hydroxide. Then pour the rinse from each sample container to transfer the rinse to the associated SPE reservoir to wash the walls of the reservoir. If using sample transfer lines, transfer the container rinse from each sample container to its associated cartridge using vacuum. Whether using reservoirs or transfer lines, allow the elution solvent to soak the SPE sorbent for 2 minutes, then use vacuum to pull the elution solvent through the cartridge and into the collection tubes in a slow, dropwise manner.

11) Aqueous samples: air dry the empty sample container after the rinse is transferred. Weigh the empty container with the cap on and subtract that from the weight of the bottle with sample, determined in Section 9.6.1, step 4.

12) Add 25 µL of concentrated acetic acid and 20 µL of NIS mix to each collection tube and vortex to mix. Transfer a portion of each extract into an autosampler vial for LC-MS/MS analysis. Cap the collection tubes containing the remaining extract and store the extract at 0 - 6°C.

13) Proceed to Section 9.8 for analysis.

9.8 Analysis

Analyze the extracts by LC-MS/MS in multiple reaction monitoring (MRM) mode, with unit mass resolution. Allow the extracts to warm to room temperature prior to aliquoting into autosampler vials and loading on the instrument.

On each day of analysis:

1) Flush the column with 100% Acetonitrile for at least 30 minutes to clear any accumulated impurities and interferences from the sample pathway and to equilibrate the system. Open the purge valve(s) on the pumps for the first ~1 minute of flush time and/or use the “purge”

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

function available as part of the pump functionality and purge the autosampler injector flow path using the “purge” function, if available.

2) Equilibrate the column by flushing the column for ~15 mins with 50:50 Mobile Phase A: Mobile Phase B followed by ~15 minutes of 98:2 Mobile Phase A: Mobile Phase B.

3) Verify system pressure is stable.

4) Bring standards and samples to room temperature, vortex to homogenize, then transfer a portion to an autosampler vial in preparation for analysis.

5) Following any initial priming injections on days when a calibration is not needed, an ISC and an instrument blank (IBLK) will be analyzed to demonstrate system suitability and the absence of system contamination prior to sample analysis.

6) After acceptable ISC and IBLK results are confirmed, load and submit extracted samples for analysis, typically starting with batch QC with field samples following. A CCV and CCB must be analyzed after every 10 (or fewer) field samples.

Arrange standards and samples in an autosampler to run in sequence as follows:

Order of Sequence with ICAL	Order of Sequence w/o ICAL
Cal L1-9 in order of lowest to highest	Opening ISC/CCV
IBLK	IBLK
ICV	MB
Follow same sequence as w/o ICAL, starting at MB	LLLCS
	LCS
	Samples (10 or fewer)
	CCV
	CCB
	Samples (10 or fewer)
	Closing CCV

[1]*The closing CCV analysis may be used as the opening solution for the next analytical sequence when criteria for the opening CCV are also met.*

10.0 DATA ANALYSIS & CALCULATIONS

Data is reduced using the acquisition software provided by the instrument manufacturer.

10.1 Retention Time (RT) Window

Establish RT Windows for all analytes, EIS and NIS with each ICAL event and at the beginning of each analytical sequence thereafter. Analytical conditions must be set to allow a separation of at least 1 minute between TDCA and the retention time window of PFOS. If this is not achieved the problem must be corrected. The RT window used must be of sufficient width to detect earlier-eluting branched isomers.

- In sequences that include an initial calibration curve (ICAL) use the midpoint standard of the curve to set the RT for analytes, EIS and NIS.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

- In sequences that do not include ICAL, use the beginning CCV retention times to set the RT for analytes, EIS and NIS.

10.2 Qualitative Identification

The presence of target analytes, EIS, and NIS compounds are qualitatively confirmed when the criteria in Sections 10.2.1. through 10.2.5. are met.

If identification criteria are not met and, based on analyst discretion, the analyte may be present, the presence of a target analyte may be reported. In such cases, data will be reported with a qualifier alerting the data user that qualitative identification could not be confirmed because the detection did not meet the method-required criteria but based on analyst discretion, the compound may be present and should be considered an estimated value.

If the criteria listed below are not met for the standards, the laboratory must stop analysis of samples and correct the issue.

10.2.1 Integration

The response of all isomers in the quantitative standards should be used to define integration parameters and ion ratios.

In samples, the total integrated response should include the branched isomer peaks that have been identified in the quantitative standard, if present. For compounds with identified branched and linear isomer peaks, the reported concentration is the sum of all isomers. If standards (either quantitative or qualitative) containing a mix of isomers are not available for purchase for a particular compound, only the linear isomer can be identified and quantitated in samples.

10.2.1.1 Manual Integration

Manual integration is sometimes necessary to correct inaccurate automated integrations but must never be used to meet QC criteria or to substitute for proper instrument maintenance and/or method set-up. To assure that all manual integrations are justified and proper, all manual integrations must be performed, documented, reviewed, and approved in accordance with corporate SOP ENV-SOP-CORQ-0006, *Manual Integration*. Refer to this SOP for guidance on manual integration techniques and required procedures.

10.2.2 Retention Time (RT)

The RTs for the target analytes, EIS, and NIS compounds must fall within ±0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial daily CCV, whichever was used to establish the RT window position for the analytical batch. All branched isomer peaks identified in the calibration standards also must fall within 0.4 minutes of the retention times set for the analytical batch.

For all target analytes with exact corresponding isotopically labeled analogs, target analytes must elute within ±0.1 minutes of the associated EIS compound.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

10.2.3 Signal-to-Noise Ratio (S/N)

Peak responses of the quantitation and confirmation ions must be at least three times the background noise level (S/N 3:1); if there is no confirmation ion, S/N must be >10:1.

If the S/N ratio is not met in a standard or QC sample due to high background noise, correct the problem (e.g., perform instrument maintenance).

If the S/N ratio is not met in a blank or sample, then detection of the analyte cannot be confirmed; the analyte is “not detected”.

10.2.4 Ion Ratio Criteria

For any compound that meets S/N and RT criteria, the ratio of the total (branched and linear isomer) quantification ion response to the total (branched and linear isomer) confirmation ion response – referred to as the Ion Ratio – must fall within ± 50% of the ratio observed in the mid-point ICAL standard.

The ion ratio requirement does not apply for PFPrA, PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, or PFMBA because suitable secondary transitions are unavailable (not detectable or inadequate S/N).

10.2.5 Detection Limit

The calculated concentration (see Section 10.4) of the target analyte must be greater than the adjusted detection limit (DL) to be reported. Quantified results below the DL cannot be confirmed and will be reported as “not detected.”

10.3 Quantitative Analysis

Test results are quantified by automated data reduction software using the equations in Section 10.4.

10.4 Calculations

All data is reduced by automated software, no manual calculations are performed for this test.

10.4.1 Target Analyte Concentration

Concentrations of the target analytes are determined with respect to the extracted internal standard (EIS) which is added to the sample prior to extraction (see Appendix A, Table 6). Other equations may be used if the laboratory demonstrates that those equations produce the same numerical result as produced by the equation below.

$$\boldsymbol{Concentration\ (ng/L\ or\ ng/g) = \frac{Area_N M_{EIS}}{Area_{EIS}(\overline{RR}\ or\ \overline{RF})}\ x\ DF\ x\ \frac{Vf}{Vi}}$$

$Area_N$	The measured area of the quantitation ion for the unlabeled PFAS target analyte
$Area_{EIS}$	The measured area of the quantitation ion for the EIS compound
M_{EIS}	The expected concentration of the EIS in the extract (ng/L)
RR	Average response ratio used to quantify target compounds by the isotope dilution method

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

RF	Average response factor used to quantify target compounds by the extracted internal standard method
DF	Extract Dilution Factor; if no extract dilution was performed, DF=1
Vf	Final extract volume (L)
Vi	Initial sample volume (L) or weight (g)

10.4.2 EIS Concentration

The EIS compounds are quantitated with respect to an NIS, as shown in Appendix A Table 6, using the response factors from the most recent initial calibration. Other equations may be used if the laboratory demonstrates that those equations produce the same numerical result as produced by the equation below.

$$\boldsymbol{Concentration\ (ng/L\ or\ ng/g) = \frac{Area_{EIS} M_{NIS}}{Area_{NIS} \overline{RF_S}}\ x\ DF\ x\ \frac{Vf}{Vi}}$$

$Area_{EIS}$	The measured area of the quantitation ion for the EIS compound
$Area_{NIS}$	The measured area of the quantitation ion for the associated NIS compound
M_{NIS}	The expected concentration of the NIS in the extract (ng/L)
$\overline{RF_S}$	Average response factor used to quantify the EIS compound by the non-extracted internal standard method
DF	Dilution Factor; if no extract dilution was performed, DF=1.
Vf	Final extract volume (L)
Vi	Initial sample volume (L) or weight (g)

10.4.3 ICAL Relative Response (RR)

Used to calculate the response ratio (RR) for each target analyte calibrated by isotope dilution quantitation.

$$\boldsymbol{RR = \frac{Area_t M_{EIS}}{Area_{EIS} M_t}}$$

$Area_t$	Measured area of the quantitation ion for the target analyte
$Area_{EIS}$	Measured area of the quantitation ion for the corresponding labeled PFAS used as the EIS in the calibration standards
M_{EIS}	Concentration of the isotopically labeled PFAS used as the EIS in the calibration standards (ng/L)
M_t	Concentration of the target analyte in the calibration standard (ng/L)

10.4.4 ICAL Response Factor (RF): Target Analyte

Used to calculate the response factor (RF) for each target analyte calibrated by extracted internal standard quantitation.

$$\boldsymbol{RF = \frac{Area_t M_{EIS}}{Area_{EIS} M_t}}$$

$Area_t$	Measured area of the quantitation ion for the target analyte

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

$Area_{EIS}$	Measured area of the quantitation ion for the corresponding labeled PFAS used as the EIS in the calibration standards
M_{EIS}	Concentration of the isotopically labeled PFAS used as the EIS in the calibration standards (ng/L)
M_t	Concentration of the target analyte in the calibration standard (ng/L)

10.4.5 ICAL Response Factor (RF): EIS

$$RF_S = \frac{Area_{EIS} M_{NIS}}{Area_{NIS} M_{EIS}}$$

$Area_{EIS}$	Measured area of the quantitation ion for the EIS compound in the calibration standard
$Area_{NIS}$	Measured area of the quantitation ion for the NIS compound in the calibration standard
M_{NIS}	Concentration of the NIS compound in the calibration standard (ng/L)
M_{EIS}	Concentration of the EIS compound in the calibration standard (ng/L)

10.4.6 ICAL Relative Standard Error (RSE)

Used to assess linearity of quadratic curve fits.

$$RSE = 100\,x \sqrt{\sum_{i=1}^{n} \frac{\left[\frac{x_i' - x_i}{x_i}\right]^2}{n - p}}$$

x_i	Nominal concentration (true value) of each calibration standard
x_i'	Measured concentration of each calibration standard
n	Number of standard levels in the curve
p	Type of curve (2 = linear, 3 = quadratic)

10.4.7 Other Calculations

For common calculations such as percent recovery and relative percent difference, refer to laboratory SOP (ENV-SOP-WEST-0124).

10.5 Reporting Specifications

Unless otherwise specified on a project basis, report final test results as follows:

Matrix	Units	Comment
Aqueous: All Matrices	ng/L	If alternate protocols are used to manage matrix characteristics or high concentrations, narrate sample data accordingly.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Soils/Sediments & Biosolids	ng/g dry weight	Test results are adjusted for percent moisture. Include the test information from percent solids determination in the test report.
Biphasic: Solid phase	ng/g wet weight basis	
Tissue	ng/g wet weight basis	
Surface Wipe	ng/wipe	
Article of Commerce	ng/g as received	Indicate if cryomilling was performed before preparation.

Adjust the DL and LOQ for sample volume or mass and any dilution factor before using it as the threshold value for reporting quantitative test results. Unless otherwise specified, test results between the DL and the LOQ, when reported, are qualified as estimated.

The recovery of associated EIS compounds for each target analyte must be included for each sample in the test report, regardless of the type of deliverable provided.

If the sample was diluted, include the DF in the test report to identify the factor by which the final test results were adjusted. Results for any analyte found in a sample or extract that has been diluted will be reported at the least dilute level for which the measured concentration is within the calibration range (e.g., above the LOQ for the analyte and below the highest calibration standard) and in which isotopically labeled compound recoveries are within their respective QC acceptance criteria. This may require reporting results for some analytes in the same sample from different analyses.

For compounds with identified branched and linear isomer peaks, the reported concentration is the sum of all isomers. If standards (either quantitative or qualitative) containing a mix of isomers are not available for purchase for a particular compound, only the linear isomer can be identified and quantitated in samples.

11.0 Quality Control & Method Performance

11.1 Method Performance Validation

The performance of this SOP was verified in accordance with the PAS corporate SOP for Method Validation and Instrument Verification. Records of verification are kept by the Quality Department in accordance with the PAS policy for Record Management (ENV-POL-0013).

Detection limits (DL or MDL, including LOD for DoD) and limits of quantitation (LOQ) were established in accordance with ENV-SOP-CORQ-0023 during initial method setup.

These limits are continuously verified and updated in accordance with USEPA procedures for determining method detection limits, as well as the requirements specified in the TNI Standard and DoD/DOE QSM, as applicable. Customers should be informed that the laboratory is obligated to update these limits when verification checks reveal a change in sensitivity or method performance, regardless of customer approval.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

11.1.1 Initial Precision and Recovery (IPR)

To verify the performance of the laboratory's SOP against the specifications of the test method, a demonstration of capability (DOC) must be conducted for each matrix following the procedure outlined in Section 9.2.1 of EPA Method 1633A. Refer to the method published in January 2024 by the USEPA Office of Water (Document EPA 821-R-24-001) for detailed instructions. In summary, the lab must follow the SOP protocol to extract and analyze four (4) samples prepared as LCS, along with at least one MB, for each matrix to be tested. The average percent recovery and RSD of the target analyte results are tabulated and compared to method acceptance criteria.

The results of the IPR must be within the accuracy and precision limits specified in Appendix A, Table 10. There are no IPR mean or RSD criteria for EIS compounds; %REC of each IPR sample must meet the criteria in Appendix A, Table 9.

11.2 Analyst Demonstration of Capability (DOC)

Before conducting unsupervised (independent) work on any client samples, analytical personnel (including sample preparation) must demonstrate their ability to achieve accurate and precise test results using the procedures specified in this SOP (IDOC) and redemonstrate this capability on an annual basis thereafter (ODOC).

Refer to the laboratory's Quality Manual and to laboratory SOP ENV-SOP-WEST-0122 for more information about the requirements and procedure for IDOC and CDOC.

The average recovery of the target analytes in the DOC samples must be within the accuracy limits for LCS specified in Appendix A, Table 8 and the RSD must be within the precision limits for IPR specified in Appendix A, Table 10. There are no mean or RSD criteria for EIS compounds in the DOC; %REC of each DOC sample must meet the criteria in Appendix A, Table 9.

The IPR study may also suffice as IDOC for the analyst who performed the study.

11.3 Matrix Impact (MS/MSD)

Matrix spikes are used to assess potential impact of matrix interference on the accuracy or precision of the procedure on samples of the same or similar matrix – samples of similar matrix are usually classified as samples of the same matrix type collected from the same sampling site.

According to EPA Method 1633A, matrix spikes (MS/MSD) generally are not required for methods that employ isotopic dilution because the recovery of the EIS compounds spiked into every sample reflects the effect the matrix has on recovery of target compounds.

Therefore, matrix spikes are not required for compliance monitoring. However, the EPA method acknowledges that some projects or programs may be interested in this information.

Customers interested in using information from matrix spikes to understand potential matrix impact on their samples must request MS/MSD, provide additional sample material to the laboratory to perform the test, and identify which sample to use on the chain-of-custody (COC).

If no customer has requested MS/MSD on any sample in the preparation batch, an MS/MSD is not performed.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

11.4 Sampling Impact (Field Duplicate)

A field duplicate (FD) refers to the testing of a replicate container of sample collected with all other samples from a sampling event and used to measure precision of the field sampling technique.

Customers requiring a field duplicate must request this analysis and provide a separate container for analysis. The FD must be logged in as a routine environmental sample; it may not be subsampled from the same container of any other sample.

11.5 Quality Control (QC)

The laboratory prepares and analyzes the following QC at the frequency specified in the table below. Refer to Appendix A, Table 7 for acceptance criteria and requirements for corrective action(s) and/or data qualification.

Item[1]	Acronym	Frequency
Mass Calibration		Annually and as needed
Mass Calibration Verification		After mass calibration
Initial Calibration	ICAL	Initially at instrument setup, then as needed
Initial Calibration Verification	ICV	With each ICAL, prior to sample analysis
Instrument Blank	IBLK/ICB	Daily prior to analysis and after high concentration standards
Instrument Sensitivity Check	ISC	Daily prior to analysis
Continuing Calibration Verification	CCV	At the beginning (ISC) and every 10 samples
Continuing Calibration Blank	CCB	After each bracketing CCV
RT Window	RTW	During ICAL and at the beginning of each analytical sequence
Bile Check	TDCA	With each ICAL and daily with each CCV
Method Blank	MB	1 per batch of 20 or fewer samples
Laboratory Control Samples	LCS & LLLCS	1 pair per batch of 20 or fewer samples
Laboratory Duplicate	DUP	See Section 11.5.1

[1]Extracted (EIS) and Non-extracted Internal Standards (NIS) are included in each QC item.

11.5.1 Laboratory Duplicate (AKA Matrix Duplicate)

A laboratory duplicate is a duplicate preparation and analysis of a sample whose aliquot was taken from the same container as the parent sample and used to measure precision.

EPA Method 1633A does not require laboratory duplicates for NPDES compliance monitoring, but the method acknowledges that a duplicate may be needed on a project-specific basis. Some accreditation programs, such as DoD ELAP, require a duplicate for each sample of certain matrices, such as AFFF or F3.

To support project needs, the laboratory will perform a duplicate when the customer has requested this measure, designated which sample from their sampling event to use as the duplicate on the chain-of-custody (COC), and have provided sufficient additional sample material for the test.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

However, customers should be advised that when the duplicate is taken from a different container, which is necessary for certain matrices, the duplicate effectively becomes a field duplicate and the results for precision are inclusive of potential bias from sampling error.

Instructions for DUP to Laboratory Personnel by Matrix:

- **NPW:** Laboratory duplicates must be prepared from a separate container because the entire sample is consumed during routine preparation and extraction and subsampling is only allowed for primary dilutions of samples expected to have high concentrations of target analytes, or to manage sample matrix characteristics.

  If a duplicate is requested and no sample has been designated for use, confer with the PM to determine which sample to use and verify that more than two (2) 250 mL containers were received. If two or less containers were received; there is insufficient sample volume available to perform the duplicate – notify the PM of the sampling nonconformity. If more than two (2) 250 mL containers were received, use one (1) for the parent sample and one (1) for the duplicate.

  Do not perform reduced volume extraction to provide a DUP.

- **Surface Wipes**: The entire sample is consumed during preparation and extraction. Given the nature of the matrix and collection technique, this sample matrix is not suitable for analysis of a laboratory duplicate.

  If a duplicate is requested, notify the PM that the matrix is not suitable for this determination and cancel the request.

- **AFFF/F3, Soil/Sediment, Biosolid, Articles of Commerce, and Tissue**: A laboratory duplicate is performed when requested by the customer and when there is enough material to take the duplicate aliquot from the same container. Note that DoD QSM 6.0 requires a laboratory duplicate on a sample basis for AFFF and F3 matrices. Thus, for DoD project work, customers must provide sufficient mass for each sample to meet this program requirement.

11.5.2 Extracted Internal Standards (EIS)

To assess method performance on the sample matrix, the laboratory must spike all samples and QC with the EIS solution. Analyze each sample according to the procedures in this SOP. Compute the percent recovery of the EIS compound concentration using the NIS quantitation method; see Appendix A, Table 9 for acceptance criteria.

If the recovery of any EIS compound is outside of the acceptance limits in the original, undiluted analysis, prepare and analyze a limited extract dilution and/or a re-extraction using a reduced sample amount.

Prior to calculating EIS percent recovery, the calculated concentration of the EIS are always adjusted to account for any extract dilutions prepared for analysis.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

11.5.3 Non-extracted Internal Standard (NIS)

To assess method performance, the laboratory must spike all sample extracts with the NIS solution prior to analysis. Percent recovery of the NIS compound is calculated by comparing the measured response in each analysis to the average response of the same compound measured in the ICAL.

Calculate the ratio of the NIS peak areas from the QC and field samples relative to the mean area of the corresponding NIS in the most recent initial calibration to check for possible bad injections of NIS solution or loss of instrument sensitivity. If the NIS areas are low for all the field samples and QC samples in the analytical batch, it suggests a loss of instrument sensitivity, while low areas in only some field or QC samples suggests a possible bad injection. See Appendix A, Table 9 for acceptance criteria.

11.5.4 Sample Dilutions

Samples with quantified target analytes exceeding the upper calibration range must be diluted and reanalyzed to bring the result within the calibration range. However, if it is known that the analytes are not compounds of concern for the project, test results may be reported over the calibration range, if they are qualified to disclose the situation and documented client consent for reporting this way is obtained.

If the extract dilution required is greater than 10X, repeat sample preparation using a reduced sample amount, guided by the magnitude of the original over-range results.

The response of the EIS in the diluted extract must meet the S/N and RT requirements for qualitative identification and must be within the limits specified in Appendix A, Table 9. If EIS criteria are not met, then the compound cannot be measured reliably in the diluted extract, and sample preparation and analysis must be repeated with a smaller subsample.

The amount used for re-extraction should be consistent with the dilution applied to the original extract. For example, if a 10X dilution was needed for an aqueous sample, 25 mL of sample should be subsampled for re-prep and extraction. (Divide the original amount of sample prepared by 10 – this is the sample amount.)

12.0 DATA REVIEW & CORRECTIVE ACTION

12.1 Data Review

The data review process of Pace® Analytical Services includes a series of checks performed at different stages of the process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, QC criteria were met, proper corrective actions were taken for QC failure and other nonconformance(s), and test results are reported with proper qualification, when necessary.

The review and checks that are performed by the employee performing the task is called primary review.

All data and test results are also peer reviewed. This process, known as secondary review, is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

measurement is accurate, all manual integrations are justified, documented, and approved in accordance with the Pace® Analytical Services SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

Lastly, a third-level review, called a completeness check, is performed by reporting or project management staff to verify the test report is complete.

Refer to laboratory SWI ENV-SWI-WEST-0087 SVOA Data Review Work Instructions for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

Corrective action is required when QC or sample results are not within acceptance criteria.

Refer to Appendix B for a complete summary of QC, acceptance criteria, and recommended corrective actions for QC associated with this test method.

If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Corrective action is also required when carryover is suspected and when results are over range. Samples analyzed after a high concentration sample must be checked for carryover and reanalyzed if carryover is suspected. Carryover is usually indicated by low concentration detects of the analyte in successive samples analyzed after the high concentration sample.

Sample results at concentrations above the upper limit of quantitation must be diluted and reanalyzed. The result in the diluted samples should be within the working concentration range of the instrument calibration. If dilution is not performed, any result reported above the upper range is considered a qualitative measurement and must be qualified as an estimated value.

13.0 Pollution Prevention & Waste Management

Refer to laboratory SOP ENV-GUI-WEST-0020, or however named, for waste handling and management practices pertaining to the waste streams created at this facility.

Pace® proactively seeks ways to minimize waste generated during work processes. Some examples of pollution prevention include but are not limited to reduced solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

The EPA requires that laboratory waste management practices comply with all applicable federal and state laws and regulations. Excess reagents, samples, and method process wastes are characterized and disposed of in an acceptable manner in accordance with the Pace® Chemical Hygiene Plan / Safety Manual. Refer to this manual for these procedures.

14.0 Modifications

The procedures in this SOP have been modified from the reference method to improve overall performance. Supporting documentation to demonstrate equivalency and comparability, when required, is maintained by the Quality Department.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Modification	Section of Reference Method Modified	Justification for Modification	Validation of Modification
Changed EIS quantitation association for PFMPA, 7:3FTCA, ADONA, 9Cl-PF3ONS, & 11Cl-PF3OUdS	Section 20, Table 10	Improved performance (allowable modification), more appropriate correlation	MDL, IPR, PT
Updated product ion used for measurement of 13C4-PFOA from m/z 172 to m/z 372	Section 20, Table 10	Match ion transition used for EIS 13C8-PFOA and native PFOA	MDL, IPR, PT
Increased the size of the SPE sorbent bed to 250 mg and tube size to 20 mL	Section 6.7.1	Improved performance (allowable modification); wider cartridge improves sample loading, reduces chances of clogs	MDL, IPR, PT
Added option for WAX/GCB stacked media with same 250 mg bed mass	Section 6.7.1	Improved performance (allowable modification). Improves efficiency or extraction, reduces variability between extraction.	MDL, IPR
Increased flow rate to allow up to 10 mL/min	Section 12.1.4	Comparable and validated performance	MDL, IPR, PT
Omit TSS determination for aqueous samples; utilize centrifugation to minimize clogging of SPE	Section 11.1 & 11.2.4	Allowable modifications per method	Not applicable.
Solid matrix extraction: eliminated 3rd liquid-solid extraction step and omitted concentration step	Section 11.3.4, 11.3.6, and 11.3.9	Improved performance & reduced sample processing time	MDL, IPR, PT
Use pre-packed GCB cartridges; omit syringe filtration	All refences to carbon cleanup	Improved performance, reduced sample processing time, & ease of use	MDL, IPR, PT
Tissue matrix extraction: reduced shake time, eliminated 3rd liquid-solid extraction, and omitted concentration step	Section 11.4.4, 11.4.6, 11.4.8	Comparable and validated performance	MDL, IPR, PT

15.0 RESPONSIBILITIES

PAS employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement (R&A) in their training file for the version(s) of the SOP that were in effect during the time the employee performed the activity.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

PAS supervisors and managers, however named, are responsible for training employees on the procedures in this SOP, implementing the SOP in the work area, and monitoring on-going adherence to the SOP in the work area(s) they oversee.

PAS employees are responsible for following the procedures in this SOP. Unauthorized deviations or departures from this SOP are not allowed except with documented approval from the local QM and only when those deviations do not violate the Pace® Code of Ethics or Professional Conduct (COR-POL-0004) or associated policy and procedure(s). Hand-edits or manual changes to the SOP are not permitted. If a change is desired or necessary, Pace® employees must follow the procedures for document revision specified in corporate SOPs ENV-SOP-CORQ-0015, *Document Management* and ENV-SOP-CORQ-0016, *SOP for Creation of SOP and SWI.*

16.0 ATTACHMENTS

- **Appendix A: Tables**
  - Table 1: Analyte Name / Abbreviation / CAS Number Cross-Reference Table
  - Table 2: Routine Analyte List and LOQ by Matrix
  - Table 3: Sample Collection, Preservation, and Holding Time Requirements
  - Table 4: Required Instruments, Equipment, and Supplies
  - Table 5: Prepared Concentration of Working Calibration Standards
  - Table 6: Identification and Quantitation Ions by Analyte, EIS, and NIS
  - Table 7: QC Acceptance Criteria, Corrective Action and Data Qualification Requirements
  - Table 8: LCS/LLLCS Acceptance Limits
  - Table 9: EIS and NIS Acceptance Limits
  - Table 10: IPR Limits for Method Validation
- **Appendix B: Reference Materials – Reagents, Standards & Formulations**
- **Appendix C: Sample Screening Protocol**
- **Appendix D: Subsampling Procedure for Aqueous Matrices**
- **Appendix E: Aqueous Sample Preparation – Settled Solids Depth > ½ cm**
- **Appendix F: Biphasic Sample Separation Procedure**
- **Appendix G: SPE Clog Mitigation Procedure**
- **Appendix H: Particle Size Reduction by Cryomill for Articles of Commerce**
- **Appendix I: Procedure for Total Oxidizable Precursors (TOP)**
- **Appendix J: Surface Wipe PFAS Analysis by 1633**
- **Appendix K: TCLP/SPLP by 1633**

17.0 REFERENCES

- EPA. Method 1633A, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS. December 2024.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

- DoD-EDQW and DOE-DQW. DoD/DOE Quality Systems Manual (QSM) for Environmental Laboratories, Version 6.0, 2025 – Table B-24)
- Standard Method for the Examination of Water and Wastewater, 23rd Edition, 2017 – Total, Fixed, and Volatile Solids in Solid and Semisolid Samples, Method 2540.
- ENV-POL-CORQ-0005, *Acceptable Calibration Practices*, current version.
- ENV-SOP-CORQ-0006, *Manual Integration*, current version.
- ENV-SOP-CORQ-0011, *Method Validation and Instrument Verification*, current version.
- ENV-SOP-CORQ-0015, *Document Management*, current version.
- ENV-SOP-CORQ-0016, *Standard Operating Procedures and Standard Work Instructions,* current version.
- COR-POL-0004, *Code of Ethics and Professional Conduct*, current version.
- COR-MAN-001, *Pace® Safety Manua*l, current version.
- *ENV-MAN-WEST-0001, Quality Manual*, current version.
- Articles of Commerce: 3M, STANDARD TEST METHOD, Determination of PFOA in articles of commerce: disassembly, disjointment, and mechanical preparation of solid samples, sample preparation of aqueous polymer systems, sample extraction, and LC-MS quantitative analysis, June 2020.

18.0 REVISION HISTORY

Revisions Made from Prior Version

Section	Description of Change
9.4.3.8	Added reference to Mansfield's Tissue Preparation and Homogenization SOP
9.6.2, App F, App M	Reference to wooden spatula replaced with stainless-steel spatula.
9.6.2	Added requirement to remove rocks, invertebrates, foreign objects, and vegetation from the sample container during homogenization.

Document Succession: This version replaces the following document(s):

Document Number	Version	Document Title	Effective Date:
ENV-SOP-MANS-0111	4	Preparation and Analysis of PFAS in Aqueous, Solid, and Tissue by EPA Method 1633A	12/20/2025

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix A: Tables

Table 1: Analyte Name / Abbreviation / CAS Number Cross-Reference Table

Analyte Name	Abbreviation	CAS #
Perfluoropropanoic acid	PFPrA	442-62-0
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	4:2 FTS	757124-72-4
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	6:2 FTS	27619-97-2
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	8:2 FTS	39108-34-4
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2
Bis (trifluoromethylsulfonyl)amine	TFSI	82113-65-3
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2
Hexafluoropropylene oxide dimer acid (GenX)	HFPO-DA	13252-13-6

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Analyte Name	Abbreviation	CAS #
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
3-Perfluoropropyl propanoic acid (FPrPA)	3:3 FTCA	356-02-5
2H,2H,3H,3H-Perfluorooctanoic acid (FPePA)	5:3 FTCA	914637-49-3
3-Perfluoroheptyl propanoic acid (FHpPA)	7:3 FTCA	812-70-4
Extracted Internal Standards (EIS)		
Perfluoro-n-[13C3] propanoic acid	13C3-PFPrA	NA
Perfluoro-n-[13C4] butanoic acid	13C4-PFBA	NA
Perfluoro-n-[13C5] pentanoic acid	13C5-PFPeA	NA
Perfluoro-n-[1,2,3,4,6-13C5] hexanoic acid	13C5-PFHxA	NA
Perfluoro-n-[1,2,3,4-13C4] heptanoic acid	13C4-PFHpA	NA
Perfluoro-n-[13C8] octanoic acid	13C8-PFOA	NA
Perfluoro-n-[13C9] nonanoic acid	13C9-PFNA	NA
Perfluoro-n-[1,2,3,4,5,6-13C6] decanoic acid	13C6-PFDA	NA
Perfluoro-n-[1,2,3,4,5,6,7-13C7] undecanoic acid	13C7-PFUnA	NA
Perfluoro-n-[1,2-13C2] dodecanoic acid	13C2-PFDoA	NA
Perfluoro-n-[1,2-13C2] tetradecanoic acid	13C2-PFTeDA	NA
Perfluoro-1-[2,3,4-13C3] butanesulfonic acid	13C3-PFBS	NA
Perfluoro-1-[1,2,3-13C3] hexanesulfonic acid	13C3-PFHxS	NA
Perfluoro-1-[13C8] octanesulfonic acid	13C8-PFOS	NA
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2] hexanesulfonic acid	13C2-4:2FTS	NA
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2] octanesulfonic acid	13C2-6:2FTS	NA
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2] decanesulfonic acid	13C2-8:2FTS	NA
Perfluoro-1-[13C8] octanesulfonamide	13C8-PFOSA	NA
N-methyl-D3-perfluoro-1-octanesulfonamide	D3-NMeFOSA	NA
N-ethyl-D5-perfluoro-1-octanesulfonamide	D5-NEtFOSA	NA
N-methyl-D3-perfluoro-1-octanesulfonamidoacetic acid	D3-NMeFOSAA	NA

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Analyte Name	Abbreviation	CAS #
N-ethyl-D5-perfluoro-1-octanesulfonamidoacetic acid	D5-NEtFOSAA	NA
N-methyl-D7-perfluorooctanesulfonamidoethanol	D7-NMeFOSE	NA
N-ethyl-D9-perfluorooctanesulfonamidoethanol	D9-NEtFOSE	NA
Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	13C3-HFPO-DA	NA
NIS		
Perfluoro-n-[2,3,4-13C3] butanoic acid	13C3-PFBA	NA
Perfluoro-n-[1,2-13C2]hexanoic acid	13C2-PFHxA	NA
Perfluoro-n-[1,2,3,4-13C4]octanoic acid	13C4-PFOA	NA
Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	13C5-PFNA	NA
Perfluoro-n-[1,2-13C2]decanoic acid	13C2-PFDA	NA
Perfluoro-1-hexane[18O2]sulfonic acid	18O2-PFHxS	NA
Perfluoro-n-[1,2,3,4-13C4] octanesulfonic acid	13C4-PFOS	NA

Table 2: Routine Analyte List and LOQ[1] by Matrix

Abbreviation	CAS #	Aqueous (NPW) (ng/L)	Leachate (Landfill/TCLP/ SPLP) (ng/L)	Solids (Soil/Sediment) (ng/g)	Biosolid (ng/g)	Surface Wipe (ng/wipe)	Tissue (ng/g)
PFPrA	422-64-0	6.4	32	0.8	8	1.6	2.0
PFBA	375-22-4	6.4	32	0.8	8	1.6	2.0
PFPeA	2706-90-3	3.2	16	0.4	4	0.8	1.0
PFHxA	307-24-4	1.6	8	0.2	2	0.4	0.5
PFHpA	375-85-9	1.6	8	0.2	2	0.4	0.5
PFOA	335-67-1	1.6	8	0.2	2	0.4	0.5
PFNA	375-95-1	1.6	8	0.2	2	0.4	0.5
PFDA	335-76-2	1.6	8	0.2	2	0.4	0.5
PFUnA	2058-94-8	1.6	8	0.2	2	0.4	0.5
PFDoA	307-55-1	1.6	8	0.2	2	0.4	0.5
PFTrDA	72629-94-8	1.6	8	0.2	2	0.4	0.5
PFTeDA	376-06-7	1.6	8	0.2	2	0.4	0.5
PFBS	375-73-5	1.6	8	0.2	2	0.4	0.5
PFPeS	2706-91-4	1.6	8	0.2	2	0.4	0.5
PFHxS	355-46-4	1.6	8	0.2	2	0.4	0.5

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Abbreviation	CAS #	Aqueous (NPW) (ng/L)	Leachate (Landfill/TCLP/ SPLP) (ng/L)	Solids (Soil/Sediment) (ng/g)	Biosolid (ng/g)	Surface Wipe (ng/wipe)	Tissue (ng/g)
PFHpS	375-92-8	1.6	8	0.2	2	0.4	0.5
PFOS	1763-23-1	1.6	8	0.2	2	0.4	0.5
PFNS	68259-12-1	1.6	8	0.2	2	0.4	0.5
PFDS	335-77-3	1.6	8	0.2	2	0.4	0.5
PFDoS	79780-39-5	1.6	8	0.2	2	0.4	0.5
4:2 FTS	757124-72-4	6.4	32	0.8	8	1.6	2.0
6:2 FTS	27619-97-2	6.4	32	0.8	8	1.6	2.0
8:2 FTS	39108-34-4	6.4	32	0.8	8	1.6	2.0
PFOSA	754-91-6	1.6	8	0.2	2	0.4	0.5
NMeFOSA	31506-32-8	1.6	8	0.2	2	0.4	0.5
NEtFOSA	4151-50-2	1.6	8	0.2	2	0.4	0.5
TFSI	82113-65-3	3.2	16	.4	4	0.8	1.0
NMeFOSAA	2355-31-9	1.6	8	0.2	2	0.4	0.5
NEtFOSAA	2991-50-6	1.6	8	0.2	2	0.4	0.5
NMeFOSE	24448-09-7	16	80	2.0	20	4	5.0
NEtFOSE	1691-99-2	16	80	2.0	20	4	5.0
HFPO-DA	13252-13-6	6.4	32	0.8	8	1.6	2.0
ADONA	919005-14-4	6.4	32	0.8	8	1.6	2.0
PFMPA	377-73-1	3.2	16	0.4	4	0.8	1.0
PFMBA	863090-89-5	3.2	16	0.4	4	0.8	1.0
NFDHA	151772-58-6	3.2	16	0.4	4	0.8	1.0
9Cl-PF3ONS	756426-58-1	6.4	32	0.8	8	1.6	2.0
11Cl-PF3OUdS	763051-92-9	6.4	32	0.8	8	1.6	2.0
PFEESA	113507-82-7	3.2	16	0.4	4	0.8	1.0
3:3 FTCA	356-02-5	8	40	1.0	10	2	2.5
5:3 FTCA	914637-49-3	40	200	5.0	50	10	12.5
7:3 FTCA	812-70-4	40	200	5.0	50	10	12.5

[1]LOQ effective on SOP effective date; values are subject to change. If you are an external party using this SOP for reference, please contact the laboratory for the most up-to-date information.

Table 3: Sample Collection, Preservation[1] and Holding Time Requirements

Matrix	Container per Sample	Minimum Sample Size[2]	Preservation	Holding Time Collection to Prep	Holding Time

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

					Prep to Analysis
Aqueous: Nonpotable Water (NPW)	Linerless HDPE 2 x 250 mL + 1 x 60 mL[3]	250 mL	Option 1: 0-6°C Option 2: Frozen	Option 1: 28 Days Exception: 7 days, if NMeFOSE, NEtFOSE, NMeFOSAA, and/or NEtFOSAA are analytes of interest Option 2: 90 Days	28 Days
Aqueous: Landfill Leachate	Linerless HDPE 2 x 60 mL	50 mL	Option 1: 0-6°C Option 2: Frozen	Option 1: 28 Days Exception: 7 days, if NMeFOSE, NEtFOSE, NMeFOSAA, and/or NEtFOSAA are analytes of interest Option 2: 90 Days	28 Days
Aqueous: TCLP or SPLP	See TCLP / SPLP SOP(s): Leachates are generated using methods for TCLP and/or SPLP and then processed per this SOP for PFAS				
Solid: Soil / Sediment	Linerless Polypropylene 1 x 3 oz/90 mL wide mouth container	2 g	Option 1: 0-6°C Option 2: Frozen	Option 1: 90 Days Exception: 3 days, if NFDHA is an analyte of interest Option 2: 90 Days Exception: 3 days, if NFDHA is an analyte of interest	28 Days
Solid: Biosolid	Linerless HDPE 1x 125 mL	0..2 g	Option 1: 0-6°C Option 2: Frozen	Option 1: 90 Days Option 2: 90 Days	28 Days
Tissue: Unhomogenized Fish	Sampling team should wrap the fish in aluminum foil or insert into food-grade polyethylene tubing or a resealable zip-top bag for shipment to the lab.	Whole Fish or Fillet (for homogenization)	Frozen	45 Days	N/A
Tissue: Homogenized Fish	Linerless Polypropylene 1 x 3 oz/90 mL wide mouth container	0.8 g	Frozen	90 Days	28 Days

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Solid: Surface Wipe	Polypropylene Centrifuge Tube 1 x 50 mL, shipped with individually packaged pre-soaked ghost wipe	1 Wipe	0-6°C	90 days	28 days
Solid: Articles of Commerce	PFAS Free Container (HDPE bottle, resealable zip-top bag)	0.8 g	0-6°C	365 Days	28 Days
Aqueous: AFFF/F3	Linerless HDPE 1 x 60 mL or 1 x 90 mL	0.01 g	0-6°C	28 Days	28 Days

[1:] *Preservation at time of collection and on receipt at laboratory. Unless otherwise specified, samples are stored after receipt in the laboratory under the same conditions as preservation until time of preparation or analysis.*

[2:] *Nominal amount of sample required for each discrete test. Solid and biosolid sample amounts reflect dry weight.*

[3:] *Used for pre-screening analyses.*

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 4: Required Instruments, Equipment, and Supplies

Item	Specification	Vendor	Model	Catalog #
LC MS/MS	Tandem Quadrapole Mass Spectrometer	Sciex	5500+	5068379
Analytical Column	2.1 x 50 mm (1.7 µm)	Waters	Acquity® BEH C18	186002350
Guard Cartridge/Column	2.1 x 5 mm, 1.8 um	Agilent	Zorbax Eclipse Plus C18	821725-901
Trap / Delay Colum	2.1 X 50mm	Waters	Isolator Column	186004476
Oven	Stable Temperature of 105±5°C	Binder	ED 115	9010-0336
Analytical Balance	Measurement to 0.0001g	Varied	Varied	Varied
Top Loading Balance	Measurement to 0.01g	Varied	Varied	Varied
Ultrasonic Mixer (Sonicator)		Fisherbrand	CPX3800	See catalog
Vortex Mixer	Multi-Tube	Fisher Scientific	Fisherbrand™ Digital Multi-Tube Vortexer	02-215-542
	Alternative Option: Single Tube	VWR	Heavy Duty Vortex	97043-564
Mixing Table	Variable Speed	New Brunswick	Innova 2300	M1191-0020
Centrifuge	3000 RPM (~2000 RCF)	Beckman Coulter	Avanti J-15 IVD	C01994
Centrifuge Bottles	Sterile, Polypropylene, Conical, 500mL	Fisher Scientific	Corning™ Polypropylene Centrifuge Tubes, Sterile	07-200-621
Vacuum Manifold	Designed for SPE Cartridges	Waters	Extraction Manifold, 20-position with rack for 16x100 mm tubes	WAT200609
Manifold Liners	Compatible with SPE manifold	Waters	Long Needle Valve for Sep-Pak Device Vacuum Manifold, 20/pk	WAT200685
Vacuum Pump	Vacuum of ~10-15 inches of mercury	GAST	Modelo 115V, 4.2 A, 60HZ	DOA-P704-AA
Vacuum Tubing	1/4”ID, 5/8” OD, 3/16” Wall	Fisher Scientific	10’ Length	14-176-6B
SPE Cartridges	Designed for PFAS	Phenomenex (locally approved)	Strata-X-AW 33uM Polymeric Weak Anion-PFAS 250mg/20m Tubes	8B-S541-FEG
SPE Cartridges	Designed for PFAS	Phenomenex (locally approved)	Strata-X-AW 33uM Polymeric Weak Anion-PFAS 250mg/100mg GCB; 20m Tubes	CS0–9220
SPE Reservoirs	60mL, polypropylene	Phenomenex	Empty SPE Tubes 60cc	AHO-7189
Adapter Caps	To fit 12, 20, 60mL SPE tubes	MilliporeSigma	Cartridge Adapter	57267
Adapter Tubing	LLDPE – 1/8” OD, 1/16” ID	Freeline-Wade	500’ Reel	1C-109-10
Adjustable-volume Mechanical Pipettes	10uL to 10mL	Various	Various	Various
Disposable Pipette Tips	HDPE or Polypropylene:	Various	Various	Various

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Item	Specification	Vendor	Model	Catalog #
	volume of 10uL to 5mL			
Solvent Evaporator	Nitrogen Evaporation	Oganomation		
Carbon Cartridges	Graphitized Carbon Black Solid Phase Extraction Absorbent	Phenomenex	Strata GCB, 25mg/1mL Pass Through Cartridge	8B-S528-CAJ
Glass Wool	Silanized	VWR	Corning Pyrex 3950	89219-589
Water System	PFAS Free	Thermo	Barnstead	7119
pH Indicator Strips	Range 0-14, Sensitivity 0.5 pH unit 0 to 9, 1 pH unit 9-14	MilliporeSigma	Whatman Panepha™	WHA0360005
Bottles	HDPE or Polypropylene with linerless caps of same material	QEC (Pace Approved)	65 ml	
			90 mL	6214-003PPGBC-P
			125 mL	6213-U004BC-P
			250 mL	6212-Q008BC-P
			500 mL	6212-Q016/BC-150 PACE
Tubes	HDPE or Polypropylene with linerless caps of same material	Fisher Scientific	Falcon™ 15 mL conical	05-527-90
			Falcon™ 50 mL conical	14-432-22
Containers	Narrow Mouth HDPE	Thermo	4 mL	2002-9125
			8 mL	2002-9025
			15 mL	2002-9050
	Polyethylene	Grainger	Cryogenic Vial 2 mL	6EMV1
	Microcentrifuge Tube	Fisher	1.5 mL	05-408-129
Screw Top Vials	Polypropylene vial	Waters	300 µL	186004112
Screw Top Vials	Polypropylene vial	Waters	700 µL	186005219
Screw Top Vials	Polypropylene vial	VWR	2 ml	89524-188A
Screw Top Cap	9mm clear propylene, thin polypropylene-silicone septa	Waters	Screw Style Cap	186004169
Single-step Filter Vials	0.2 µm nylon membrane	Restek	SINGLE StEP® Standard Filter Vials	25891
Surface Wipe	Pre-wetted with methanol	Environmental Express (locally approved)	Ghost Wipes for Methamphetamine testing	SC5000
Ottawa Sand	30-40 mesh size	VWR	500 grams, Poly bottle	BDH9274-500G
Reference Tissue	Cod	Various	Filets	N/A
Cryogenic Mill	30 Hz; -200C	Retsch	CryoMill, 10/240 V, 50/60 Hz	207490001
Grinding Balls	25 mm; Stainless Steel	Retsch	25 mm; Stainless Steel	053680105

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Item	Specification	Vendor	Model	Catalog #
Grinding Jars	Stainless Steel	Retsch	50 mls	014620332
Scissors or Heavy Plate Shears	Various Size			
Cleaning Brushes	Various Size			

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 5: Prepared Concentration of Working Calibration Standards (ng/mL)[1]

Compound	L1	L2[2]	L3	L4	L5	L6[3]	L7	L8	L9
Perfluoroalkyl carboxylic acids									
PFPrA	0.2	0.4	0.8	2	10	20	50	100	200
PFBA	0.2	0.4	0.8	2	10	20	50	100	200
PFPeA	0.1	0.2	0.4	1	5	10	25	50	100
PFHxA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFHpA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFOA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFNA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFDA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFUnA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFDoA	0.06	0.1	0.2	0.5	2.5	5	12.5	25	50
PFTrDA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
PFTeDA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
Perfluoroalkyl sulfonic acids									
PFBS	0.044	0.089	0.178	0.444	2.22	4.44	11.1	22.2	44.4
PFPeS	0.047	0.094	0.188	0.470	2.35	4.70	11.8	23.5	47.0
PFHxS	0.046	0.091	0.182	0.456	2.28	4.56	11.4	22.8	45.6
PFHpS	0.048	0.095	0.190	0.476	2.38	4.76	11.9	23.8	47.6
PFOS	0.046	0.093	0.186	0.464	2.32	4.64	11.6	23.2	46.4
PFNS	0.048	0.096	0.192	0.480	2.40	4.80	12.0	24.0	48.0
PFDS	0.048	0.096	0.193	0.482	2.41	4.82	12.1	24.1	48.2
PFDoS	0.048	0.097	0.194	0.484	2.42	4.84	12.1	24.2	48.4
Fluorotelomer sulfonic acids									
4:2FTS	0.188	0.375	0.750	1.87	9.37	18.7	46.9	93.7	187
6:2FTS	0.190	0.380	0.761	1.90	9.51	19.0	47.6	95.1	190
8:2FTS	0.192	0.384	0.768	1.92	9.6	19.2	48	96	192
Perfluorooctane sulfonamides									
PFOSA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
NMeFOSA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
NEtFOSA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
Perfluoromethane sulfonamide									
TFSI	0.1	0.2	.4	1	5	10	25	50	100
Perfluorooctane sulfonamidoacetic acids									
NMeFOSAA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
NEtFOSAA	0.05	0.1	0.2	0.5	2.5	5	12.5	25	50
Perfluorooctane sulfonamide ethanols									
NMeFOSE	0.5	1	2	5	25	50	125	250	500

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Compound	L1	L2[2]	L3	L4	L5	L6[3]	L7	L8	L9
NEtFOSE	0.5	1	2	5	25	50	125	250	500
Per- and polyfluoroether carboxylic acids									
HFPO-DA	0.2	0.4	0.8	2	10	20	50	100	200
ADONA	0.189	0.378	0.756	1.89	9.45	18.9	47.25	94.5	189
PFMPA	0.1	0.2	0.4	1	5	10	25	50	100
PFMBA	0.1	0.2	0.4	1	5	10	25	50	100
NFDHA	0.1	0.2	0.4	1	5	10	25	50	100
Ether sulfonic acids									
9Cl-PF3ONS	0.187	0.373	0.746	1.87	9.33	18.7	46.7	93.3	187
11Cl-PF3OUdS	0.189	0.377	0.754	1.89	9.43	18.9	47.2	94.3	189
PFEESA	0.089	0.178	0.357	0.892	4.46	8.92	22.3	44.6	89.2
Fluorotelomer Carboxylic Acids									
3:3FTCA	0.25	0.5	1	2.5	12.5	25	62.5	125	250
5:3FTCA	1.25	2.5	5	12.5	62.5	125	313	625	1250
7:3FTCA	1.25	2.5	5	12.5	62.5	125	313	625	1250
TOP Assay Control Surrogates (EIS)									
13C2,D4-4:2FTS	5	5	5	5	5	5	5	5	5
13C2-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Extracted Internal Standards (EIS)									
13C3-PFPrA	10	10	10	10	10	10	10	10	10
13C4-PFBA	10	10	10	10	10	10	10	10	10
13C5-PFPeA	5	5	5	5	5	5	5	5	5
13C5-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C7-PFUnA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C3-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C2-4:2FTS	5	5	5	5	5	5	5	5	5
13C2-6:2FTS	5	5	5	5	5	5	5	5	5
13C2-8:2FTS	5	5	5	5	5	5	5	5	5
13C8-PFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D3-NMeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Compound	L1	L2[2]	L3	L4	L5	L6[3]	L7	L8	L9
D5-NEtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D3-NMeFOSAA	5	5	5	5	5	5	5	5	5
D5-NEtFOSAA	5	5	5	5	5	5	5	5	5
D7-NMeFOSE	25	25	25	25	25	25	25	25	25
D9-NEtFOSE	25	25	25	25	25	25	25	25	25
13C3-HFPODA	10	10	10	10	10	10	10	10	10
Non-Extracted Internal Standards (NIS)									
13C3-PFBA	5	5	5	5	5	5	5	5	5
13C2-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

[1] Concentration of each target analyte, EIS, and NIS in each calibration level when the formulations specified in Appendix B are used to prepare the working standards.

[2] L2 is the set LOQ.

[3] L6 is used as the CCV.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 6: Identification and Quantification Ions by Analyte, EIS, NIS

Abbreviation	CAS #	Ion Mass			Quantification Reference
		Parent	Quantification	Confirmation	
PFPrA	422-64-0	163	119	NA	13C3-PFPrA
PFBA	375-22-4	213	169	NA	13C4-PFBA
PFPeA	2706-90-3	263	219	69	13C5-PFPeA
PFHxA	307-24-4	313	269	119	13C5-PFHxA
PFHpA	375-85-9	363	319	169	13C4-PFHpA
PFOA	335-67-1	413	369	169	13C8-PFOA
PFNA	375-95-1	463	419	219	13C9-PFNA
PFDA	335-76-2	513	469	219	13C6-PFDA
PFUnA	2058-94-8	563	519	269	13C7-PFUnA
PFDoA	307-55-1	613	569	319	13C2-PFDoA
PFTrDA	72629-94-8	663	619	169	13C2-PFDoA
PFTeDA	376-06-7	713	669	169	13C2-PFTeDA
PFBS	375-73-5	299	80	99	13C3-PFBS
PFPeS	2706-91-4	349	80	99	13C3-PFHxS
PFHxS	355-46-4	399	80	99	13C3-PFHxS
PFHpS	375-92-8	449	80	99	13C8-PFOS
PFOS	1763-23-1	499	80	99	13C8-PFOS
PFNS	68259-12-1	549	80	99	13C8-PFOS
PFDS	335-77-3	599	80	99	13C8-PFOS
PFDoS	79780-39-5	699	80	99	13C8-PFOS
4:2 FTS	757124-72-4	327	307	81	13C2-4:2FTS
6:2 FTS	27619-97-2	427	407	81	13C2-6:2FTS
8:2 FTS	39108-34-4	527	507	81	13C2-8:2FTS
PFOSA	754-91-6	498	78	478	13C8-PFOSA
NMeFOSA	31506-32-8	512	219	169	D3-NMeFOSA
NEtFOSA	4151-50-2	526	219	169	D5-NEtFOSA
TFSI	82113-65-3	280	78	147	13C3-HFPO-DA
NMeFOSAA	2355-31-9	570	419	483	D3-NMeFOSAA
NEtFOSAA	2991-50-6	584	419	526	D5-NEtFOSAA
NMeFOSE	24448-09-7	616	59	NA	D7-NMeFOSE
NEtFOSE	1691-99-2	630	59	NA	D9-NEtFOSE
HFPO-DA	13252-13-6	285	169	185	13C3-HFPODA
ADONA	919005-14-4	377	251	85	13C4-PFHpA
PFMPA	377-73-1	229	85	NA	13C4-PFBA
PFMBA	863090-89-5	279	85	NA	13C5-PFPeA
NFDHA	151772-58-6	295	201	85	13C5-PFHxA
9Cl-PF3ONS	756426-58-1	531	351	533→353	13C8-PFOS
11Cl-PF3OUdS	763051-92-9	631	451	633→453	13C8-PFOS
PFEESA	113507-82-7	315	135	83	13C5-PFHxA
3:3FTCA	356-02-5	241	177	117	13C5-PFPeA
5:3FTCA	914637-49-3	341	237	217	13C5-PFHxA
7:3FTCA	812-70-4	441	317	337	13C9-PFNA
Extracted Internal Standards (EIS)					
13C3-PFPrA	NA	166	121	NA	13C4-PFBA

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Abbreviation	CAS #	Ion Mass			Quantification Reference
		Parent	Quantification	Confirmation	
13C4-PFBA	NA	217	172	NA	13C3-PFBA
13C5-PFPeA	NA	268	223	NA	13C2-PFHxA
13C5-PFHxA	NA	318	273	NA	13C2-PFHxA
13C4-PFHpA	NA	367	322	NA	13C2-PFHxA
13C8-PFOA	NA	421	376	NA	13C4-PFOA
13C9-PFNA	NA	472	427	NA	13C5-PFNA
13C6-PFDA	NA	519	474	NA	13C2-PFDA
13C7-PFUnA	NA	570	525	NA	13C2-PFDA
13C2-PFDoA	NA	615	570	NA	13C2-PFDA
13C2-PFTeDA	NA	715	670	NA	13C2-PFDA
13C3-PFBS	NA	302	80	NA	18O2-PFHxS
13C3-PFHxS	NA	402	80	NA	18O2-PFHxS
13C8-PFOS	NA	507	80	NA	13C4-PFOS
13C2-4:2FTS	NA	329	81	NA	18O2-PFHxS
13C2-6:2FTS	NA	429	81	NA	18O2-PFHxS
13C2-8:2FTS	NA	529	81	NA	18O2-PFHxS
13C8-PFOSA	NA	506	78	NA	13C4-PFOS
D3-NMeFOSA	NA	515	219	NA	13C4-PFOS
D5-NEtFOSA	NA	531	219	NA	13C4-PFOS
D3-NMeFOSAA	NA	573	419	NA	13C4-PFOS
D5-NEtFOSAA	NA	589	419	NA	13C4-PFOS
D7-NMeFOSE	NA	623	59	NA	13C4-PFOS
D9-NEtFOSE	NA	639	59	NA	13C4-PFOS
13C3-HFPO-DA	NA	287	169	NA	13C2-PFHxA
Non-Extracted Internal Standards (NIS)					
13C3-PFBA	NA	216	172	NA	NA
13C2-PFHxA	NA	315	270	NA	NA
13C4-PFOA	NA	417	372	NA	NA
13C5-PFNA	NA	468	423	NA	NA
13C2-PFDA	NA	515	470	NA	NA
18O2-PFHxS	NA	403	84	NA	NA
13C4-PFOS	NA	503	80	NA	NA

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 7: QC Acceptance Criteria, Corrective Action and Data Qualification Requirements

QC Item	Acceptance Criteria	Corrective Action	Qualification
Mass Calibration	Must meet manufacturer's acceptance criteria.	Identify and correct source of problem, repeat Mass Calibration.	None. Do not proceed with analysis.
Mass Calibration Verification	Must meet manufacturer's acceptance criteria.	Identify and correct source of problem, repeat Mass Calibration.	None. Do not proceed with analysis.
Initial Calibration (ICAL)	Must meet linearity requirement specified in Section 9.3.1 for type of curve fit used.	Identify and correct source of problem, repeat.	None. Do not proceed with analysis.
Initial Calibration Verification (ICV)	All analytes must be within ± 30% of their true values. (%R)	Identify and correct source of problem, re-analyze. If repeat failure, repeat ICAL.	If corrective action is not taken, qualify or disclose nonconformity for data user to assess impact on project samples.
Calibration Blank (ICB)	No targets detected greater than MDL.	Identify and correct source of contamination or performance issue. Alternately, re-calibrate using a lower concentration standard for the highest point.	None. Do not proceed with analysis.
RT Window Position	Set position using the mid-point of the ICAL on the day ICAL is performed; otherwise, the opening CCV is used. RT Window is ± 60 secs from RT position.	NA	NA
Instrument Sensitivity Check (ISC)	All native and isotopically labelled compounds within ± 30% recovery.	Identify and correct source of problem and reanalyze ISC. If problem persists, repeat ICAL.	None. Do not proceed with analysis.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

QC Item	Acceptance Criteria	Corrective Action	Qualification
Bile Salts Check	Bile Salt peak detected >1 min outside RT window for PFOS.	Identify and correct source of problem, then reevaluate Bile Salts separation from PFOS.	None. Do not proceed with analysis.
Continuing Calibration Verification (CCV)	All native and isotopically labelled compounds within ±30% recovery.	See Section 9.3.6 for required corrective actions based on circumstance.	Qualify test results associated with CCV failure.
Instrument Blank (IBLK) / Continuing Calibration Blanks (CCB)	No targets detected > MDL.	Identify and correct source of contamination or performance issue. Reanalyze IBLK.	No samples shall be analyzed until opening IBLK has met acceptance criteria, unless the samples to be analyzed will not report the compound(s) detected in the IBLK.
Extracted Internal Standards (EIS)	See Table 9.	If batch QC is acceptable, reanalyze to confirm failure. If confirmed, re-extract from reduced sample amount and reanalyze sample, if possible. If failure persists, no further action is needed.	Qualify outages
Non-extracted Internal Standards (NIS)	NIS areas in all samples must be within 50 – 200% of the average area of the corresponding NIS in the ICAL.	Troubleshoot instrument performance. Reanalyze samples.	Qualify outages
Method Blank (MB)	No targets detected greater than the LOQ or 1/10 of the concentration detected in associated sample(s), whichever is greatest.	If IBLK is acceptable, reanalyze MB to confirm. If confirmed, re-extract and reanalyze associated impacted samples if sufficient amount remains and samples are within holding time; otherwise qualify associated test results.	Qualify outages

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

QC Item	Acceptance Criteria	Corrective Action	Qualification
LCS/LLLCS	%R: See Table 8	If the most recent ISC/CCV is acceptable, reanalyze LCS to confirm. If low-failure results are confirmed, re-extract and reanalyze associated samples (if sufficient sample remains). If insufficient sample remains for reprep, narrate and report data associated with low-failure LCS. If high-failure results are confirmed and sample(s) is ND for failing compound, narrate and report sample data.	Qualify outages
MS/MSD	%R: See Table 8 RPD ≤30%		Qualify outages
Laboratory Duplicate	RPD from parent sample ≤30%		Qualify outages.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 8: LCS/LLLCS Acceptance Limits (%R)

Analyte	CAS #	Aqueous/Leachate	Solid: All Matrices	Tissue
PFPrA	422-64-0	70-140	70-140	60-140
PFBA	375-22-4	70-140	70-140	60-140
PFPeA	2706-90-3	65-135	60-150	60-145
PFHxA	307-24-4	70-145	65-140	60-160
PFHpA	375-85-9	70-150	65-145	60-145
PFOA	335-67-1	70-150	70-150	60-150
PFNA	375-95-1	70-150	70-155	60-145
PFDA	335-76-2	70-140	70-155	60-150
PFUnA	2058-94-8	70-145	70-155	60-155
PFDoA	307-55-1	70-140	70-150	60-140
PFTrDA	72629-94-8	65-140	65-150	60-150
PFTeDA	376-06-7	60-140	65-150	60-140
PFBS	375-73-5	60-145	65-145	60-150
PFPeS	2706-91-4	65-140	55-160	60-145
PFHxS	355-46-4	65-145	60-150	60-155
PFHpS	375-92-8	70-150	65-155	60-140
PFOS	1763-23-1	55-150	65-160	60-160
PFNS	68259-12-1	65-145	55-140	45-140
PFDS	335-77-3	60-145	40-155	50-140
PFDoS	79780-39-5	50-145	25-160	25-140
4:2 FTS	757124-72-4	70-145	60-150	55-150
6:2 FTS	27619-97-2	65-155	55-200	60-150
8:2 FTS	39108-34-4	60-150	70-150	60-170
PFOSA	754-91-6	70-145	70-140	60-150
NMeFOSA	31506-32-8	60-150	70-155	60-160
NEtFOSA	4151-50-2	65-145	70-140	60-150
TFSI	82113-65-3	70-140	70-140	60-140
NMeFOSAA	2355-31-9	50-140	65-155	60-145
NEtFOSAA	2991-50-6	70-145	65-165	60-145
NMeFOSE	24448-09-7	70-145	70-140	40-180
NEtFOSE	1691-99-2	70-135	70-135	60-205
HFPO-DA	13252-13-6	70-140	70-145	60-145
ADONA	919005-14-4	65-145	70-160	55-165
PFMPA	377-73-1	55-140	30-140	25-145
PFMBA	863090-89-5	60-150	60-150	60-150
NFDHA	151772-58-6	50-150	60-155	60-180
9Cl-PF3ONS	756426-58-1	70-155	70-150	60-170
11Cl-PF3OUdS	763051-92-9	55-160	45-160	50-170
PFEESA	113507-82-7	70-140	70-140	50-150
3:3 FTCA	356-02-5	65-130	45-130	30-140
5:3 FTCA	914637-49-3	70-135	60-130	60-160
7:3 FTCA	812-70-4	50-145	60-150	60-200

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 9: EIS and NIS Acceptance Limits (%R)

Labeled Compound	Aqueous	Leachate	Solid:	Biosolid	Tissue
13C3-PFPrA	5-130	5-130	8-130	5-130	5-130
13C4-PFBA	5-130	5-130	8-130	5-130	5-130
13C5-PFPeA	40-130	40-130	35-130	35-130	10-185
13C5-PFHxA	40-130	40-130	40-130	40-130	25-170
13C4-PFHpA	40-130	40-130	40-130	40-130	25-150
13C8-PFOA	40-130	40-130	40-130	40-130	25-150
13C9-PFNA	40-130	40-130	40-130	40-145	35-185
13C6-PFDA	40-130	40-130	40-130	40-130	30-150
13C7-PFUnA	30-130	40-130	40-130	40-130	30-180
13C2-PFDoA	10-130	35-130	40-130	40-130	35-180
13C2-PFTeDA	10-130	25-130	20-130	10-160	20-160
13C3-PFBS	40-135	40-130	40-135	40-150	25-190
13C3-PFHxS	40-130	40-130	40-130	40-140	35-175
13C8-PFOS	40-130	40-130	40-130	40-130	40-160
13C2-4:2FTS	40-200	40-220	40-165	40-300	30-300
13C2-6:2FTS	40-200	40-170	40-215	40-300	35-300
13C2-8:2FTS	40-300	40-145	40-275	40-300	40-365
13C8-PFOSA	40-130	40-130	40-130	20-140	25-180
D3-NMeFOSA	10-130	40-130	10-130	20-130	5-130
D5-NEtFOSA	10-130	35-130	10-130	20-130	5-130
D3-NMeFOSAA	40-170	35-130	40-135	30-150	30-250
D5-NEtFOSAA	25-135	30-130	40-150	20-140	30-235
D7-NMeFOSE	10-130	20-130	20-130	25-130	5-160
D9-NEtFOSE	10-130	20-130	15-130	20-130	5-130
13C3-HFPODA	40-130	40-130	40-130	40-130	20-185
13C3-PFBA	50-200	50-200	50-200	50-200	50-200
13C2-PFHxA	50-200	50-200	50-200	50-200	50-200
13C4-PFOA	50-200	50-200	50-200	50-200	50-200
13C5-PFNA	50-200	50-200	50-200	50-200	50-200
13C2-PFDA	50-200	50-200	50-200	50-200	50-200
18O2-PFHxS	50-200	50-200	50-200	50-200	50-200
13C4-PFOS	50-200	50-200	50-200	50-200	50-200

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Table 10: IPR Limits for Method Verification

Analyte	CAS #	Aqueous/Leachate		Solid: All Matrices		Tissue	
		%R	RPD	%R	RPD	%R	RPD
PFPrA	422-64-0	70-140	20	70-140	20	70-140	20
PFBA	375-22-4	70-135	21	70-140	17	70-135	20
PFPeA	2706-90-3	70-135	23	70-140	26	70-130	20
PFHxA	307-24-4	70-135	24	70-135	23	70-140	20
PFHpA	375-85-9	70-135	28	70-140	21	70-140	20
PFOA	335-67-1	65-155	27	70-140	23	70-130	25
PFNA	375-95-1	70-140	28	65-145	24	70-140	20
PFDA	335-76-2	65-140	26	70-145	26	70-135	20
PFUnA	2058-94-8	70-135	29	70-145	26	70-135	20
PFDoA	307-55-1	70-130	21	70-145	25	70-135	20
PFTrDA	72629-94-8	60-145	29	55-160	26	55-160	20
PFTeDA	376-06-7	70-145	27	70-145	24	70-140	25
PFBS	375-73-5	70-140	23	60-145	25	70-145	20
PFPeS	2706-91-4	70-135	25	65-140	29	70-150	20
PFHxS	355-46-4	70-135	27	65-145	28	70-140	25
PFHpS	375-92-8	70-140	30	70-140	27	70-145	20
PFOS	1763-23-1	70-140	29	70-135	27	70-135	30
PFNS	68259-12-1	70-135	29	70-140	27	60-130	20
PFDS	335-77-3	70-135	30	50-150	31	55-135	20
PFDoS	79780-39-5	45-135	35	40-140	40	25-145	45
4:2 FTS	757124-72-4	70-135	27	70-135	27	65-140	30
6:2 FTS	27619-97-2	70-135	32	60-160	50	70-140	25
8:2 FTS	39108-34-4	70-140	33	70-140	27	70-150	25
PFOSA	754-91-6	70-135	22	70-140	19	70-140	20
NMeFOSA	31506-32-8	70-135	30	65-145	26	70-140	30
NEtFOSA	4151-50-2	70-130	26	70-135	19	70-140	40
TFSI	82113-65-3	70-140	20	70-140	20	70-140	20
NMeFOSAA	2355-31-9	65-140	32	65-145	31	70-140	20
NEtFOSAA	2991-50-6	70-135	28	60-150	31	70-140	25
NMeFOSE	24448-09-7	70-135	29	70-140	19	60-150	20
NEtFOSE	1691-99-2	70-130	21	70-135	17	70-145	40
HFPO-DA	13252-13-6	70-135	23	70-140	25	70-140	25
ADONA	919005-14-4	70-135	23	70-155	26	70-145	20
PFMPA	377-73-1	60-140	23	70-140	25	70-145	40
PFMBA	863090-89-5	65-145	27	55-145	33	70-140	20
NFDHA	151772-58-6	65-140	37	45-145	27	70-155	30
9Cl-PF3ONS	756426-58-1	70-145	30	65-135	23	70-140	20
11Cl-PF3OUdS	763051-92-9	50-150	35	50-135	31	65-140	20
PFEESA	113507-82-7	70-135	25	70-140	20	70-145	25
3:3 FTCA	356-02-5	70-130	23	45-155	32	55-130	25
5:3 FTCA	914637-49-3	70-130	24	70-135	28	70-145	20
7:3 FTCA	812-70-4	55-130	34	70-145	39	70-155	20

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix B: Reference Materials – Reagents, Standards & Formulations

Purchased Reagents

Name	Grade	Vendor	Catalog	Storage
Acetic Acid	ACS	VWR	BDH3098-3.8LP	Room Temperature
Acetonitrile[1]	UPLC	Supelco	AX0142-1	Room Temperature
Ammonium Acetate	LC/MS	VWR	BDH9204-500G	2-8°C, replace every 2 years
Aqueous Ammonium Acetate	1M	Waters	186006693-1	Manufacturer Specification
Ammonium Hydroxide	Certified ACS+	Fisher	A470-500	Room Temperature
Formic Acid	>96% purity	Thermo	270480025	Room Temperature
Methanol	HPLC, 99.9% purity	Fisher	A452-4	Room Temperature
Potassium Hydroxide	Certified ACS	VWR	BDH9262-500G	Room Temperature
Liquid Nitrogen	>99.999%	Airgas	NI BLK	Bulk

[1] *Verify Acetonitrile, Methanol, and Laboratory Generated Regent Water by lot/batch before use.*

Purchased Standard Solutions[1]

Name	Vendor	Catalog	Purpose
EPA 1633 Native PFAS Mix	Wellington Laboratories	EPA-1633STK	Primary Source Standard
L-PFPrA Native Stock Solution (50 µg/ml)	Wellington Laboratories	PFPrA	Primary Source Standard
Lithium bis(trifluoromethanesulfonyl)imide (HQ-115) Native Stock Solution (50 µg/ml)	Wellington Laboratories	LiPFMeSI	Primary Source Standard
1633-PFCs Calibration Standard Mix	Absolute Standards	65735	Second Source Standard
PFPrA Native Stock (50 µg/mL)	Cambridge Isotopes	ULM-11323-A-S	Second Source Standard
TFSI Native Stock (100 µg/mL)	Accustandard	PFOS-030S	Second Source Standard
Sodium 1H,1H,2H,2H-perfluorohexanesulfonate (4:2 FTS) ($^{13}C_2$, 99%; D_4, 98%) (50 µg/mL)	Cambridge Isotopes	CDLM-10753-1.2	TOP Assay Control Surrogate
Perfluoro-n-(1,2-13C2)octanoic acid (50 µg/ml)	Wellington Laboratories	M2PFOA	TOP Assay Control Surrogate
Mass-labelled PFAS Extraction Standard Mix	Wellington Laboratories	MPFAC-HIF-ES	EIS
13C3-PFPrA Stock (50 µg/mL)	Cambridge Isotopes	CLM-11324-A-S	EIS
Mass-labelled PFAS Injection Standard Mix	Wellington Laboratories	MPFAC-HIF-IS	NIS
Neat Taurodeoxycholic Acid (TDCA)	Sigma Aldrich	580221-5GM	Bile Salt Interference

[1] *Unless other storage conditions are specified by the manufacturer, store the purchased standard solutions in the dark at 4 °C, in tightly sealed screw-capped vials. Place a mark on the vial at the level of the solution after each use so that solvent loss by evaporation can be detected. Replace the solution if solvent loss has occurred. Properly discard or remove from the work area unused material on the expiration date to prevent inadvertent use of expired material.*

Purchased standard solutions must be received with a Certificate of Analysis (COA), which must be retained on-site in the laboratory and be traceable to each corresponding lot received. Refer to laboratory SOP 1816 Reagent, Solvent and Standard Control for the procedures for standard receipt and traceability.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Substitution of reagents and standards from those listed in these tables is permissible only if the replacement meets the specifications outlined in the SOP. If an alternative item does not meet these exact same specifications for purity, composition, or concentration, any formulation in this SOP must be modified to match the material used. If the substitution is permanent, the SOP and formulations in this SOP must be updated.

Prepared Reagents & Standard Solution Formulations:

Plastic containers must be used for all standard, sample, and extraction preparations due to potential adsorption of analytes onto glass. Do not substitute glass for plastic containers.

18O-mass labeled perfluoroalkyl sulfonates may undergo isotopic exchange with water under certain conditions, which lowers the isotopic purity of the standards over time - monitor standards for degradation and replace as needed.

Modifications to these formulations are not permitted unless the formulation of the parent component changes, in which case the formulation must be adjusted accordingly.

Laboratory Prepared Reagent Formulation Table

Name	Component	Amount	Volume	Expires
Mobile Phase A: 2mM ammonium acetate in 95:5 water/acetonitrile	5 Ammonium Acetate	2.0 mL	1 L	60 Days
	Acetonitrile	50 mL		
	Reagent Water	948 mL		
Instrument Blank Mix (IBLK Mix): Methanol with 4% Water, 1% Ammonium Hydroxide, and 0.625% Acetic Acid	Methanol	94.4 mL	100 mL	30 Days
	Ammonium Hydroxide	3.3 mL		
	Acetic Acid	0.625 mL		
	Reagent Water	1.67 mL		
Acetic Acid (0.1%)	Acetic Acid	1 mL	1 L	90 Days
	Reagent Water	999 mL		
Ammonium Hydroxide (3%): Aqueous	Ammonium Hydroxide	10 mL	100 mL	90 Days
	Reagent Water	90 mL		
Ammonium Hydroxide (0.3%): Methanolic	Ammonium Hydroxide	1 mL	100 mL	30 Days
	Methanol	99 mL		
Ammonium Hydroxide (1%): Methanolic	Ammonium Hydroxide (30%)	10 mL	1 L	30 Days
	Methanol	990 mL		
Ammonium Hydroxide (2%): Methanolic	Ammonium Hydroxide (30%)	20 mL	1 L	30 Days
	Methanol	980 mL		

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Name	Component	Amount	Volume	Expires
Formic Acid (0.1 M): Aqueous	Formic Acid	3.77 mL	1 L	2 Years
	Regent Water	996.33 mL		
Formic Acid (0.3 M): Aqueous	Formic Acid	11.31 mL	1 L	2 Years
	Regent Water	988.69 mL		
Formic Acid (5% v/v): Aqueous	Formic Acid	5 mL	100 mL	2 Years
	Regent Water	95 mL		
Formic Acid (50% v/v): Aqueous	Formic Acid	50 mL	100 mL	2 Years
	Regent Water	50 mL		
Formic Acid (50% v:v): Methanolic	Formic Acid (0.1M)	50 mL	100 mL	2 Years
	Methanol	50 mL		
Potassium Hydroxide (0.05M): Methanolic	Potassium Hydroxide	3.3 g	1 L	90 Days
	Methanol	1 L		
Reagent Water (ASTM 1)	Laboratory Generated			60 Days

Laboratory Prepared Intermediate Standard Solutions

Name	Component	Amount	Volume	Storage	Expires
TDCA Stock (2000 µg/mL)	Neat TDCA	10 mg	5 mL	Frozen <0°C	1 Year
	Methanol	5 mL			
1633 PDS (Concentrations vary)	EPA-1633STK	5000 µL	10 mL	0-6°C	30 Days or with each new lot of parent standard
	PFPrA stock	100 µL			
	TFSI stock	50 µL			
	Methanol	4850 µL			
STK-10X (5X of PDS, concentrations Vary)	EPA-1633 PDS	600 µL	3 mL	0-6°C	30 Days or with each new lot of parent standard
	Methanol	2.7 mL			
ICV Add PDS (1 µg/mL)	PFPrA Native Stock (50 µg/mL)	80 µl	4 mL	0-6°C	30 Days or with each new lot of parent standard
	TFSI Native Stock (100 µg/mL)	40 µl			
	Methanol	3880 µl			
TOP Assay Surr mix (Concentrations vary)	CDLM-10753-1.2	40 µl	4 mL	0-6°C	30 Days
	M2PFOA	20 µl			
	Methanol	3940 µl			

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

EIS-PDS (Concentrations vary)	MPFAC-HIF-ES	5000 µL	10 mL	0-6°C	30 Days
	13C3-PFPrA stock	100 µL			
	Methanol	4900 µL			

Laboratory Prepared Working Standard Solutions

Name	Component	Amount	Volume	Storage	Expires
ICV	1633-PFCs Calibration Standard Mix	20 µL	4 mL	0-6°C	30 Days
	ICV Add PDS	10 µl			
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	IBLK Mix	3890 µL			
CAL L1	EPA1633-PDS	16 µL	4 mL	0-6°C	30 Days
	EIS-PDS	40 µL			
	TOP Assay Surr Mix	20µl			
	MPFAC-HIF-IS	20 µL			
	IBLK Mix	3904 µL			
CAL L2	EPA1633-PDS	32 µL	4 mL	0-6°C	30 Days
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20µL			
	TOP Assay Surr Mix	20 µl			
	TDCA Stock (2000 µg/mL)	20 µL			
	IBLK Mix	3868 µL			
CAL L3	EPA1633-PDS	64 µL	4 mL	0-6°C	30 Days
	TOP Assay Surr Mix	20 µl			
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	IBLK Mix	3856 µL			
CAL L4	EPA1633-PDS_10X	160 µL	4 mL	0-6°C	30 Days
	TOP Assay Surr Mix	20 µl			
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	IBLK Mix	3760 µL			
CAL L5	EPA1633-PDS	80 µL	4 mL	0-6°C	30 Days

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Name	Component	Amount	Volume	Storage	Expires
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	TOP Assay Surr Mix	20µl			
	IBLK Mix	3840 µL			
CAL L6	EPA1633-PDS	160 µL	4 mL	0-6°C	30 Days
	TOP Assay Surr Mix	20 µl			
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	TDCA Stock (2000 µg/mL)	20 µL			
	IBLK Mix	3740 µL			
CAL L7	EPA1633-PDS	400 µL	4 mL	0-6°C	30 Days
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	TOP Assay Surr Mix	20 µl			
	IBLK Mix	3520 µL			
CAL L8	EPA1633-PDS	800 µL	4 mL	0-6°C	30 Days
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	TOP Assay Surr Mix	20 µl			
	IBLK Mix	3120 µL			
CAL L9	EPA1633-PDS	1600 µL	4 mL	0-6°C	30 Days
	EIS-PDS	40 µL			
	MPFAC-HIF-IS	20 µL			
	TOP Assay Surr Mix	20 µl			
	TDCA Stock (2000 µg/mL)	20 µL			
	IBLK Mix	2300 µL			

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix C: Sample Screening Protocol

Samples that are known or suspected to contain high concentrations of target analytes may be pre-screened to determine if a reduced volume or mass should be used for extraction or if an extract dilution should be performed prior to initial analysis. Other pre-screening procedures may be used.

This screen protocol may be used for all matrices included in this SOP, except surface wipes because there is insufficient representative sample to perform the screen procedure.

Aqueous Matrices (Non-Potable Water, Landfill Leachate, TCLP/SPLP Leachate)

Always take the aliquot for screening from the 60 mL container; do not take a subsample from the sample container to be used for sample preparation or analysis (except in the case of TCLP/SPLP).

1) Mix the sample to ensure it is homogenous. Measure 1 mL of sample into a 15 mL centrifuge tube.
2) Add 1 mL of methanol and 40 µL of EIS-PDS and 20 µL of MPFAC-HIF -NIS to the sample and vortex to mix.
3) Filter 1 mL of the sample through 0.2-µm membrane filter into a microvial.
4) Analyze the screen extract and use the test result to determine if a reduced volume should be extracted or if the extract from the routine procedure should be diluted prior to analysis.

Soil/Sediment, Biosolid, Tissue, and Articles of Commerce: (10X Dilution)

1) Measure 0.5 g (±0.1) of sample into a 50 mL polypropylene centrifuge tube.
2) Add 20 mL of 0.3% methanolic ammonium hydroxide to the sample. Vortex to mix for 10 min. Let the sample sit to settle and/or centrifuge to produce a clear extract.
3) Filter using a 0.2 µm filter vial:
    a. Add 40 µL of EIS-PDS to a clean filter vial (chamber).
    b. Add 400 µL of clear extract from step 2 to the vial. Carefully vortex to mix.
    c. Use filter/plunger to filter the extract.
4) Transfer 30 µL of extract to a ~300 µL polypropylene microvial and dilute to 300 µL with 0.3% methanolic ammonium hydroxide. Add 1.5 µL of NIS to the resulting solution.
5) Analyze the screen extract and use the test result to determine if a reduced volume should be extracted or if the extract from the routine procedure should be diluted prior to analysis.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix D: Subsampling Procedure for Aqueous Matrices

Due to the propensity of some target analytes to stratify within the sample matrix or to adhere to walls of the sample container, subsampling of aqueous samples may only be done on a project-specific basis, with client approval.

In this context, subsampling refers to the taking of an aliquot of sample from the container provided to the laboratory for extraction in lieu of using the entire sample volume collected. This is sometimes necessary when high concentrations of target analytes are expected in the sample or for other project-specific reasons.

Subsampling Procedure for Non-Potable Water (NPW), Landfill Leachate, TCLP/SPLP:

1) Determine the volume (mL) for extraction based on screen results or project specifications. The amount subsampled must be at least 125 µL. If additional dilutions are needed, these must be made by serial dilution of the sample.
2) Place an uncapped, HDPE bottle onto the weigh pan of a top loading balance and tare the balance. Select an appropriately sized bottle for the volume of sample to be aliquoted. Regardless of volume subsampled, the sample aliquot should be diluted to at least 50 mL prior to SPE.
3) Gently invert the sample to mix 3-4 times then transfer the sample into the HDPE bottle until the target volume is achieved, assuming sample density of 1 g/mL.
    - If foam forms during inversion and more than 5 mL is required, pour the sample to transfer, but avoid the transfer of foam.
    - If foam forms and less than 5 mL is needed, use a pipette to draw sample from ½ cm below the foam.
    - If no foam forms, the transfer may be done by pouring or by pipette.
4) Fill the bottle with reagent water.
5) Proceed to Section 9.6 and prepare the sample using the same stepwise procedure used for aqueous samples.

Subsampling Procedure for AFFF and F3 and Other Challenging Aqueous Matrices

The following protocol is designed for “as prepared” AFF materials and newer generation F3 concentrates and other challenging matrices, such as viscous or cloudy matrices, or those with standing foam. Consult with technical specialist or supervisor to determine when to use this protocol.

If concentrated AFF (thick gel-like matrix) was received, notify the supervisor to determine where to perform the subsampling procedure. Subsampling of the concentrate must be done in an isolated area to prevent the material from contaminating the work area and other samples.

1) Prepare 2 samples for all matrices designated AFFF or F3.
2) Place an uncapped 60 mL HDPE bottle onto the weigh pan of a top loading balance and tare the balance.
3) Measure 0.01 g of sample into the HDPE bottle. Record the actual mass subsampled.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

4) Add approximately 60 mL of reagent water to the bottle, cap the bottle.

5) Shake by hand vigorously for 20-30 seconds.

6) Set the sample aside for at least 3 hours for complete dissolution.

7) Check the sample after 3 hours to verify dissolution is complete. If full dissolution has not occurred, place the sample bottle on an orbital shaker for 15 minutes, then allow the sample to settle for 3 hours.

8) If the sample is an AFFF concentrate gel, go to step 9; otherwise, proceed to Section 9.6 and prepare the sample using the same stepwise procedure used for aqueous samples.

9) Dilute the AFFF concentrate subsample solution by quantitatively measuring 6 mL of the 60 mL solution into a new 125 mL HDPE container and dilute to 60 mL with reagent water. The serial dilution, when the above protocol is followed without deviation, represents a 250,000X primary dilution. Proceed to Section 9.6 and extract the prepared sample using the same stepwise procedure used for aqueous samples.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix E: Aqueous Sample Preparation – Settled Solids Depth > ½ cm

As allowed by EPA Method 1633A PAS uses alternate strategies in lieu of the total suspended solids (TSS) determination to mitigate solid materials or other interferences present in aqueous matrices.

Use this procedure in lieu of Section 9.6.1 (steps 1-9) when settled solids in the sample appear to be of a depth > ½ cm and less than 5% of the total volume.

1) Label a 500 mL conical centrifuge bottle with the sample ID. Set the labeled tube in a rack and remove the cap.

2) Spike each sample with 40 µL of **EIS-PDS** in its original sample container.

3) If the sample is a MS or MSD, add 80 µL of 1633PDS to each.

   NOTE: The MS/MSD or laboratory duplicate must be processed the same way as the parent sample and vice versa.

4) Cap the container and vigorously shake to mix.

5) Pour the sample into the labeled centrifuge bottle, taking care to transfer all the solids present in the original sample bottle to the centrifuge bottle. Tightly cap the centrifuge bottle when done.

6) Place the tubes in the centrifuge rotor, ensuring that the carousel is symmetrically balanced. Close the top and centrifuge at 3000 RPM (~2000 RCF) for 6 minutes. Record the start and end time in the preparation log.

7) Decant the centrifuged sample back into its original container, taking care to avoid transfer of the settled solids.

8) Weigh the original sample container + decanted sample and record the weight measurement in the preparation log.

9) Extract the decanted sample using the procedure in Section 9.6.1, starting with step 10. If the SPE cartridge begins to clog during sample transfer, refer to Appendix G for troubleshooting steps and mitigation strategies.

10) When the SPE cartridges have been dried and the carbon cartridges added to the SPE stack, rinse the original sample bottle following the protocol in Step 10 of Section 9.7, but do not start elution.

11) Add 5mL of 1% methanolic ammonium hydroxide to each centrifuge bottle and swirl to rinse. If the condensed solids become re-suspended during this step, centrifuge the container to separate.

12) Using a pipet, transfer the rinsates from the original sample container and the centrifuge bottle to the associated sample's cartridge/reservoir stack. Elute the cartridge with both rinsate volumes; allow the elution solvent to soak the SPE sorbent for 2 minutes, then use vacuum to pull the elution solvent through the cartridge and into the collection tubes in a slow, dropwise manner.

    If using sample transfer lines, add the rinsate from the centrifuge bottle to the original sample bottle for transfer to the cartridge and then elute as above.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

13) Repeat steps 11 and 12.

14) Concentrate the extract to ~3.5 mL using nitrogen blowdown at an approximate flow rate of 1.2 L/min. Adjust to final volume to 4 mL with 1% methanolic ammonium hydroxide using a validated comparison vial.

15) Weigh the empty sample bottle with cap and record the weight measurement. Subtract this weight from the initial container+sample weight from Step 8 to determine initial sample volume.

16) Add 25 µL of concentrated acetic acid and 20 µL of NIS mix to each extract and vortex to mix. Transfer a portion of each extract into an autosampler vial for LC-MS/MS analysis. Cap the collection tubes containing the remaining extracts and store at 0 - 6 °C until analysis.

17) Document in the preparation log which samples in the prep batch were centrifuged prior to SPE; these samples must be identified in the test report to alert the customer and data user of the deviation from routine protocol.

18) Record any other observations or anomalies observed during the centrifugation or extraction process, particularly if any issues were encountered during the sample loading step of the SPE process.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix F: Biphasic Sample Separation Procedure

Use this procedure when the customer has requested separation of a biphasic sample into aqueous and solid phases.

1) Verify the log-in has been updated to specify sample preparation for each matrix. Be sure the log-in for the solid fraction does not include percent solids determination: the solid phase of a biphasic sample is reported on a wet weight basis.

2) Label a 500 mL conical centrifuge bottle with the sample ID. Set the labeled bottle in a rack and remove the cap.

3) Vigorously shake the sample in its original container then completely transfer the entire sample to the corresponding centrifuge bottle and cap the centrifuge bottle.

4) Place the centrifuge bottle(s) in the centrifuge rotor, ensuring that the carousel is symmetrically balanced. Close the top and centrifuge at 3000 RPM (~2000 RCF) for 6 minutes. Record the start and end time in the preparation log.

5) Transfer the liquid portion of sample back into the original sample container; avoid transferring solid material as much as possible.

6) Tare a top loading balance then weigh the original container + liquid sample and record this measurement to the nearest 0.1 g on the preparation log as initial weight for the aqueous phase.

7) Proceed to Section 9.6.1 to add the sample to a routine NPW preparation batch and complete the preparation process starting with Step 7.

8) Label a 50 mL centrifuge tube with the sample ID.

9) Place the tube on a top loading balance and tare the balance.

10) Using a stainless-steel spatula, transfer the solid material from the 500 mL centrifuge bottle to the 50 mL container.

11) Record the amount transferred to the nearest 0.1 g on the preparation log as initial weight, targeting the appropriate weight for the matrix.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix G: SPE Clog Mitigation Procedure

This appendix provides instructions on what to do when an SPE cartridge has become clogged.

Indications that an SPE cartridge may be or will become clogged include discoloration of the cartridge frit or absorbent bed, coloration or sedimentation on the bottom of the reservoir, and a slowing of the sample loading rate.

When these conditions are observed do not add any more sample volume to the reservoir of the clogging cartridge. The goal is to stop the process before the cartridge seizes up completely, so that a sample extract can still be collected from the cartridge.

- If there is >10 mL remaining in the reservoir, close the manifold port to stop sample loading. After all other samples have finished loading, carefully remove the cartridge-adaptor-reservoir assembly and transfer the remaining sample volume back into the original sample container.
- If there is <10 mL remaining, allow the sample to continue to load. If the sample has not finished after all other samples have passed through their cartridge, close all other ports except for the sample loading, then apply more vacuum pressure to pull the sample through. Do this step one at a time for each clogged SPE. If it is obvious that the cartridge has seized, do not attempt this step. Instead, remove the cartridge and return the remaining sample volume to its original container.

The extraction process may continue as follows; if QA acceptance criteria are not met for the resulting extract, the sample should be re-extracted with reduced volume.

- Replace the cartridge from the abandoned sample and finish the SPE elution process (Step 5 from Section 9.7) to collect what extract is available from the SPE. If the SPE clogs completely, abandon the elution process; the sample must be diluted and the extraction repeated.
- To obtain the volume of sample used for preparation and extraction, reweigh the empty container and subtract this weight from the original container+sample weight measurement.
- Record in the preparation log that SPE extraction could not be completed with full sample volume.

Alternatively,

- Option 1: Reprepare and re-extract the sample following the centrifuge procedure in Appendix E. This option may be appropriate when centrifugation was not originally performed on the sample that clogged.
- Option 2: Reprepare the sample using a reduced volume. No less than 1 mL of homogenized sample may be used for extraction in these cases.
- Option 3: With client approval, re-log the sample as a biosolid matrix and prepare following the biosolid matrix extraction protocols, targeting 0.2 g of sample. In this case, the sample results will generally not be corrected for dry weight.
- Option 4: With client approval, re-log and reprepare the sample as two separate phases (aqueous and solid). Attempt phase separation of the aqueous and solid phases of the sample following Appendix F and, if successful, prepare as two separate samples.
- Option 5: Test procedure is not applicable. This may be the only option when the matrix interference and/or the modification to the procedure become so extreme that the resulting test result is unreliable.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

In all cases, the protocol followed must be recorded, disclosed to the customer, and test results adjusted for actual amounts used.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix H: Particle Size Reduction by Cryomill for Articles of Commerce

Clients may submit solid samples of various consumer and related product materials for analysis of PFAS. To effectively mobilize any PFAS that may be present within the structure of the material, samples must be milled to a fine powder using a cryogenic mill (Cryomill). Use this procedure to mill articles of commerce to a fine powder prior to sample preparation, when needed.

Examples of common articles requiring milling prior to extraction and analysis are molded articles, coated wire, textiles, paper, leather, food, and LDPE and polypropylene.

Sample Processing Procedure:

1) Remove the sample from storage.

2) If possible, use scissors or heavy plate shears to roughly cut the material into smaller pieces, preferably to a size ~10 X 10 mm. The optimum size depends on the equipment used for milling.

3) Use a Retsch Cryomill (ball mill) with automatic liquid nitrogen feed to mill the material to ~ 100 um in diameter using the specifications in the table below.

Sample Type[1]	Cycles	Preset	Frequency (Hz)	PCT (minutes)	MT (minutes)	ICT (minutes)
Elastomers (FKM, FFKM, FEPM, and agglomerates)	1	1	30	Auto	2	NA
Compacted Cake	5	NA	30	Auto	2	2
Melt Extruded Pellets and Molded Articles	7	2	30	Auto	4	2
Coated Wire	3	3	30	Auto	2	2
Textiles, Paper, Leather	3	4	25	10	2.5	0
Food (meat, cheese)	1	5	25	8	2	NA
LDPE and PP	2	6	25	10	2	2

1: Use Feed Mass of 5g for most applications

PCT = Processing Time / MT: Milling Time / ICT: In-Between Cooling Time

4) Make sure to follow the User Manual for installing and removing the grinding jar. This includes the two lock rings on the left side of the mechanism.

   a. Make sure outer LOCK RINGS are loosened.

   b. Screw in the grinding jar (from the right side of the mechanism). Tighten with black plastic tightening aid.

   c. Tighten two LOCK RINGS: Outside ring tightened first (hand-tighten only); inner ring tightened second (snug), using the tool.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

d. Perform grinding cycle.

e. Loosen those two LOCK RINGS: Inside ring loosened first, outer ring loosened second. To loosen either ring, the tool will be needed because of icing.

f. Unscrew grinding jar.

g. When cryomill is not in use, make sure to replace the cooling jacket seal.

5) When the milling process is complete, allow the grinding jar to return to ambient temperature, then sweep the milled material into a labeled 50 mL centrifuge tube.

6) Immediately proceed to Section 9.6.2 for sample preparation or freeze the sample at a temperature of ≤ -10°C until preparation.

7) Clean the mill between each sample to avoid cross-contamination (see procedure below).

Mill Cleaning Procedure:

1) Remove any residual material with DI water and a brush. If needed, also use a clean polish cloth or cotton ball/swab.
2) Rinse all parts with methanol followed by DI, using an ultrasonic bath as needed with each rinse.
3) Repeat Steps 1-2 until clean.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix I: Procedure for Total Oxidizable Precursors (TOP)

The following modifications to the referenced SOP are as follows:

Equipment: Water Bath – Capable of monitoring recording to .1 C maintaining 85 C.

Reagents: Sodium Hydroxide (NaOH, CAS#: 1310-73-2) – High purity, demonstrated to be free of analytes and interferences.

Potassium Persulfate ($K_2S_2O_8$, CAS#: 7727-21-1) - High purity, demonstrated to be free of analytes and interferences.

Hydrochloric Acid (HCl, CAS#: 7647-01-0) - High purity, demonstrated to be free of analytes and interferences.

Additional table to be added:

Table 1

Isotope Labeled Standard	Conc. Top Surr Stock (ng/mL)	Vol. of Top Surr Stock (µl)	Final Vol. of Top Surr PDS (mL)	Final Conc. of Top Surr PDS (ng/mL)
$^{13}C_2$-PFOA	50,000	40	4.0	500
$^{13}C_2D_4$-4:2FTS	50,000	80	4.0	1000

For Aqueous samples, prior to SPE extraction in section 9.6, add to each 50 ml sample with Potassium Persulfate until 60 mM (about 1 gram). Add Sodium Hydroxide until the sample is 125 mM (about .313 grams).

Sample should have a pH >12.

Fortify each sample with 20 µl of TOP pre-assay surrogate containing 1 negative control surrogates and 1 positive control surrogates from table 1.

Place sample in a water bath at 85 C for 6 hours.

Remove sample from water bath and adjust pH 6-8 with Hydrochloric Acid.

Following pre-treatment, follow the aqueous extraction protocol from section 9.7 unaltered.

An additional calculation is added for the final reporting of the TOP assay results.

TOP Assay = Result of Post TOP assay extraction – Result of analysis from Pre-Top Assay extraction.

For Soil samples, fortify each sample with 20 µl of TOP pre-assay surrogate containing 1 negative control surrogates and 1 positive control surrogates from table 1 in place of EIS to each 0.4 gram sample.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Extract soil sample as dictated in section 9.6.

Following extraction, evaporate extracts in an Oganomation NVAP system at 55 degrees C to approximately 250ul remains.

Re-constitute sample extract to 50 ml DI water.

Add to each sample Potassium Persulfate until 60 mM (about 1 gram) and Sodium Hydroxide until the sample is 125mM (about .313 grams).

Sample should have a pH >12.

Place sample in a water bath at 85 C for 6 hours.

Remove sample from water bath and adjust pH 6-8 with Hydrochloric Acid.

Following pre-treatment, add 20 ul of EIS solution and follow the SPE clean-up protocol from section 9.7 unaltered.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix J: Surface Wipe PFAS Analysis by 1633

Clients may submit wipe samples for PFAS analysis by 1633; wipes can be used as a proxy measurement of surface contamination in production facilities, labs, etc. The lab provides sampling kits for users which consist of a 50 mL centrifuge tube paired with a packaged ghost wipe for each surface to be sampled (ghost wipes: Environmental Express Part# SC5000). The wipe is used to swab a defined area of the surface or item of interest and is placed in the accompanying centrifuge tube, which is then capped, labeled, and shipped back to the lab for preparation and analysis.

Used wipe samples are prepared directly in the container in which they are received, following the protocols for solid matrices described in Section 9.6.2; analysis follows normal 1633 routines. No correction will be made for percent solids, and results are reported as ng/wipe.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix K: TCLP/SPLP by 1633

Clients may submit samples (solid or aqueous) for PFAS following TCLP or SPLP procedures. For solid samples, the TCLP and SPLP procedures are used to simulate the leaching of environmental contaminants over extended periods of time from a solid material into the environment. A subsample of the client's sample is weighed out and combined with a leaching solution and mechanically tumbled for a set period. Each leachate prep method (TCLP: Method 1311 or SPLP: Method 1312) employs a unique leaching solution dictated by the parent methods. After the sample has been tumbled/leached by the Organic prep department, the leachate is filtered by the Organic Prep department and delivered to the PFAS sample holding area. The PFAS department is notified by email when the leachate solutions are ready for PFAS prep. The filtered leachate solutions are prepared by the PFAS prep analysts using the 1633 aqueous prep method, at a 1:5 dilution (50 mL of leachate solution).

1) Samples requested for PFAS by SPLP/TCLP analysis will be batched and leached by the normal SPLP/TCLP procedures used by the Westborough Alpha Organic Prep department. Organic Prep will be the initial responsible party for samples analyzed for PFAS by SPLP/TCLP.

2) When the leaching process is complete, Organic Prep will collect approximately 500mL (at minimum 100mL) of the leachate solutions in clean HDPE containers provided by the Emerging Contaminants department.

3) After collecting the leachate solution, an Organic Prep analyst will filter approximately 500 mL (at minimum 100mL) of each leachate solution using a Flipmate apparatus, using normal protocols for Flipmate filtration.

4) After filtering the leachates, the Organic Prep analyst will deliver the filtrates to the Sample management department for transport to the Emerging Contaminants Department (EC) at the Alpha Mansfield Facility. Leachates will be transferred to the EC department's designated sample storage refrigerator.

5) Samples to be analyzed for PFAS following TCLP/SPLP will appear on a separate PFAS prep worklist, the title of which will contain "SPLP" or "TCLP." From these worklists, PFAS analysts will select the samples to be extracted.

6) Pour ~50 mL of filtrate solution into a pre-labeled HDPE PFAS sample bottle, using the gradations marked on the bottle as a guide. Record the actual amount of filtrate by weighing the sample bottle. LOQs for samples prepared in this way will be ~5X higher than normal Aqueous matrix LOQs.

7) Following the instructions in step 7, use the leachate blank solution (typically has sample ID L0000000-01) to prepare three bottles for use as batch QC. Volume for the leachate blank, LLLCS, and LCS will be recorded as 50 mL.

8) After preparing the diluted filtrate, filtrate batch QC, and 1633 MB bottles, follow the normal extraction steps for aqueous matrices. Each sample will be spiked with EIS as normal. The filtrate LLLCS and LCS will be spiked with target analytes according to the routine aqueous protocol for LLLCS and LCS target spiking.

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

9) Leachate batch QC (MB/LLLCS/LCS) are documented in LIMS as leachate blank (MB), and LLLCS (LCS).

10) Following the SPE process, the instrumental analyst will analyze the extracts by the 1633 method, as normal.

11) After processing, reviewing, generating reports for the data, and importing the data into LIMS, the TCLP/SPLP tumble date must be input into the analytical results from the leachate logs.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix L: Oil samples for PFAS Analysis by 1633

Clients may submit oil samples for PFAS analysis by 1633; oil samples can be extracted up to 0.5 grams and follow the solid extraction procedure in section 9.6.2. An extraction weight of 0.5 grams PFAS free mineral oil are used for laboratory QC samples.

Analysis follows normal 1633 routines. Percent solids are not calculated for this matrix, and a 100% solid is assumed with results being reported as ng/g.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Appendix M: Sample preparation of non-standard matrices for PFAS Analysis by 1633

Clients may submit samples (solid or aqueous) for PFAS following FDA procedures. For all samples, the QuEChERS procedures are used to extract PFAS compounds from various matrices including food, feed and agricultural matrices. Following extraction, extracts are volumized in deionized water and passed undergo the same SPE clean-up procedure as aqueous samples.

Due to the physical nature of the applicable matrices, sample pretreatment such as tissue prep and homogenization and/or cryomill size reduction may need to be employed prior to sample extraction. Where such procedures are applicable, see the pertinent sections of this SOP prior to proceeding.

Unless a reduced mass extraction is necessary, use the following amounts for sample preparation and analysis:

Routine Target Mass for non-standard Matrices[1]

Aqueous matrices including milk	Plant matter	Dairy including cheese and yogurt	Prepared food products
10.0 g	2.0 g	2.0 g	4.0 g

1. Remove the sample from storage.
2. Using a stainless-steel spatula, mix each sample in its original jar by stirring from the bottom of the container to the top and in a circular motion along the sides of the jar, breaking particles up by pressing against the side of the container (to <1 mm). The homogenized sample will be even in color and have no separate layers. Store the homogenized material in its original container. If it is not practical to mix the sample within its container, transfer the sample to a larger container to mix.
3. Check the LIMS to obtain the percent solids result for each sample in the batch where applicable.
    a. If the test results are not available, check to see if a percent solids analysis is included in the work order; if not, notify the Project Manager (PM) they will need to add the test to the log-in.
    b. If test results are not available because the department performing the test has not completed the determination, notify your supervisor or contact the leader of the department performing the test to obtain the status. Preparation may not begin until this information is available.
    c. If none of these scenarios apply, proceed to Step 4.
4. Determine the target mass for extraction for soils/sediments and biosolids by dividing the target weight for sample preparation by the percent solids in decimal form. For example, if a sample is 90% percent solids, the mass used for extraction must be within the range of 2.0 and 2.4 g.

    Convert 90% percent solids to decimal form by dividing 90 by 100. (90/100 = 0.9)

    Divide 2 g (target mass) by the percent solids in decimal form (2/0.9=2.22…)

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

Round 2.22 to the same significance of measurement as the top loading balance[1] (2.2).

Add ± 0.2 g to the target result of 2.2 g to obtain the target weight range of 2.0to 2.4g.

5. Place a 50 mL polypropylene centrifuge tube on the balance and tare the balance. Measure the target weight of sample into the tube so that the weight is within the range determined in the prior step. Record the amount used to the nearest 0.1 g (top loading) or 0.01 g (analytical).

   If matrix spikes or a laboratory duplicate were requested or are required, prepare separate containers for each.

6. Prepare the MB, LCS and LLLCS using Ottawa Sand or reagent water by adding the clean matrix and water to a 50 mL polypropylene centrifuge tube. Solid: Use 4.0 g Ottawa Sand Aqueous: Use 10.0 g of reagent waterPrepared food products: Use 4.0 g Ottawa Sand.

7. Quantitatively add 64 µL of the STK-10X standard mix to LLLCS and 80 µL of EPA-1633PDS mix to the LCS.

   If the batch includes matrix spikes, add 80 µL of EPA-1633PDS mix to each matrix spike sample.

8. Add 40 µL of EIS solution to each container (all samples and QC)

9. Using a vortex mixer, vortex the tube to disperse the spike solution and allow to equilibrate for approximately 30 minutes. Alternatively, shake by hand.

10. Add 10 mL of acetonitrile to each centrifuge tube. Vortex to disperse, then shake for 30 minutes on a variable speed mixing table.

11. Add 10 mL of deionized water to the sample in each centrifuge tube, then vortex to disperse.

    a. If aqueous samples of 10 grams or more were extracted, do not add any deionized water.

    b. If aqueous samples containing less than 10.0 grams were extracted, add additional deionized water till the aqueous content of the extract is 10.0 mls.

       Example: if 5.0 grams of a sample was weighed out, then add 5.0 mls of deionized water to the tube.

5) Add QuEChERS salt packet (6000 mg MgSO4 and 1500 mg NaOAc; Phenomenex P/N# AH0-9043) and shake vigorously for 1 minute to avoid clumping of sorbent.

6) Centrifuge the extract at 2500 rpm for 10 minutes

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

7) Transfer supernatant (top layer) to a 15 mL PP conical centrifuge tube with dSPE sorbent (1200 mg MgSO4, 400 mg PSA, 400 mg C18E and 400 mg graphitized carbon black; Phenomenex P/N# HS0-9518).
8) Shake vigorously for 2 minutes.
9) Centrifuge the extract at 2500 rpm for 10 minutes
10) Filter the extract with a 0.2 µm polypropylene syringe filter and transfer to a 125 mL HDPE bottle, recording the volume of the extract recovered in the ELN clean-up tab under clean-up volume.
11) Bring the extract volume up to 100 ml with deionized water
12) Check the pH of each sample solution using a pH indicator strip to verify the pH is 5.0 ± 1.0. If necessary, adjust the pH with acetic acid or ammonium hydroxide (or with 3% aqueous ammonium hydroxide). Do not insert the strip into the sample container: use a disposable pipet to transfer a small amount of sample onto the pH indicator strip instead.
13) Proceed to Section 9.7 for extraction and extract cleanup.

Note: Extraction protocol defined in this appendix is based on the procedure found in FDA METHOD NUMBER: C-010.03. Target analytes PFPrA, PFOSA, NMeFOSA, NEtFOSA, NMeFOSAA, NEtFOSAA, NMeFOSE, NEtFOSE, 3:3FTCA, 5:3FTCA, 7:3FTCA, PFMBA, PFMPA, NFDHA, PFEESA and the extracted internal standards 13C3-PFPrA, 13C8-PFOSA, d3-NMeFOSA, d5-NEtFOSA, d3-NMeFOSAA, d5-NEtFOSAA, d7-NMeFOSE, d9-NEtFOSEare not included in the reference method C-010.03, and there is no published performance available for these analytes when extracted by C-010.03. EPA-1633A soil recovery criteria is to be reported, however, any recovery greater than 10% will be subsequently reported with associated narration and potential biases for these analytes.

END OF APPENDIX

The distribution of printed or electronic copies of this document outside of the PAS electronic document management system (eDMS) is not controlled or tracked. PAS employees must ensure any copy used for daily work, if not accessed directly from PAS eDMS, is the current version of the document.

DEPARTMENT OF THE ENVIRONMENT
WATER SUPPLY PROGRAM

Certifies That

Pace Analytical Services, LLC-Mansfield-320 Forbes

320 Forbes Boulevard, Mansfield, MA 02048

Having duly met the requirements of the regulations governing Laboratory Certification and Standards of Performance in accordance with The Annotated Code of Maryland, is hereby approved as a

State Certified Water Quality Laboratory

to perform the analyses indicated on the Annual Certified Parameter List, which must accompany this certificate.

MD Lab ID # 350

Date Issued August 20, 2025

Expiration Date December 30, 2026
(Not Transferable)

Administrator, Water Supply Program

This certification is subject to unannounced laboratory inspections

CONSPICUOUSLY DISPLAY IN THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST. MDE02202

SDWA ANNUAL CERTIFIED PARAMETER LIST

Issue Date: August 20, 2025

Expiration Date: December 30, 2026

Pace Analytical Services, LLC- Mansfield-320 Forbes
320 Forbes Boulevard
Mansfield, MA 02048

John Trimble
MD Lab ID: 350
EPA Lab ID: MA00030

ANALYTE	METHOD	STATUS
Antimony	EPA 200.8, Rev. 5.4	Certified
Arsenic	EPA 200.8, Rev. 5.4	Certified
Barium	EPA 200.7, Rev. 4.4	Certified
Barium	EPA 200.8, Rev. 5.4	Certified
Beryllium	EPA 200.8, Rev. 5.4	Certified
Cadmium	EPA 200.7, Rev. 4.4	Certified
Cadmium	EPA 200.8, Rev. 5.4	Certified
Chromium	EPA 200.7, Rev. 4.4	Certified
Chromium	EPA 200.8, Rev. 5.4	Certified
Copper	EPA 200.7, Rev. 4.4	Certified
Copper	EPA 200.8, Rev. 5.4	Certified
HFPO-DA (GenX)	EPA 533, December 2019	Certified
HFPO-DA (GenX)	EPA 537.1, Version 2.0	Certified
Lead	EPA 200.8, Rev. 5.4	Certified
Mercury	EPA 245.1, Rev. 3	Certified
PFBS	EPA 533, December 2019	Certified
PFBS	EPA 537.1, Version 2.0	Certified
PFHxS	EPA 533, December 2019	Certified
PFHxS	EPA 537.1, Version 2.0	Certified
PFNA	EPA 533, December 2019	Certified
PFNA	EPA 537.1, Version 2.0	Certified
PFOA	EPA 533, December 2019	Certified

SDWA ANNUAL CERTIFIED PARAMETER LIST

Issue Date: August 20, 2025

Expiration Date: December 30, 2026

Pace Analytical Services, LLC- Mansfield-320 Forbes
320 Forbes Boulevard
Mansfield, MA 02048

John Trimble
MD Lab ID: 350
EPA Lab ID: MA00030

ANALYTE	METHOD	STATUS
PFOA	EPA 537.1, Version 2.0	Certified
PFOS	EPA 533, December 2019	Certified
PFOS	EPA 537.1, Version 2.0	Certified
Selenium	EPA 200.8, Rev. 5.4	Certified
Thallium	EPA 200.8, Rev. 5.4	Certified

1800 Washington Boulevard | Baltimore, MD 21230 | 1-800-633-6101 | 410-537-3000 | TTY Users 1-800-735-2258
www.mde.maryland.gov

State of New Hampshire

Environmental Laboratory Accreditation Program

Awards

PRIMARY NH ELAP ACCREDITATION

to

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

of

MANSFIELD, MA

For the matrix, method and analytes listed on the latest Analyte List in accordance with the provisions on the 2016 TNI Standards and Env-C 300.

Certificate Number: 206225

Effective Date: 9/6/2025

Expiration Date: 9/5/2026

Laboratory ID: 2062

PACE ANA9/4/2025

Brian Lamarsh
NH ELAP Program Specialist

Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation.

Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation status by calling (603) 271-2998 or by visiting the NH ELAP website (https://www.des.nh.gov/water/drinking-water/new-hampshire-environmental-laboratory-accreditation-program).

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998

PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 206225-C

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 10248405	**Method Ref: EPA TO-13A**		**Revision:**		**Date:**	
5005	NAPHTHALENE	02/21/2017	09/05/2026	AE	VOC	NE
Method Code: 10248449	**Method Ref: EPA TO-13A SIM**		**Revision:**		**Date:**	
5005	NAPHTHALENE	02/21/2017	09/05/2026	AE	VOC	NE
Method Code: 10248405	**Method Ref: EPA TO-13A**		**Revision:**		**Date:**	
5500	ACENAPHTHENE	02/21/2017	09/05/2026	AE	SBN	NE
5505	ACENAPHTHYLENE	02/21/2017	09/05/2026	AE	SBN	NE
5555	ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
5575	BENZO(A)ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
5580	BENZO(A)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
5585	BENZO(B)FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE
5605	BENZO(E)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
5590	BENZO(G,H,I)PERYLENE	02/21/2017	09/05/2026	AE	SBN	NE
5600	BENZO(K)FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE
5855	CHRYSENE	02/21/2017	09/05/2026	AE	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
6265	FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE
6270	FLUORENE	02/21/2017	09/05/2026	AE	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
6608	PERYLENE	02/21/2017	09/05/2026	AE	SBN	NE
6615	PHENANTHRENE	02/21/2017	09/05/2026	AE	SBN	NE
6665	PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
Method Code: 10248449	**Method Ref: EPA TO-13A SIM**		**Revision:**		**Date:**	
6380	1-METHYLNAPHTHALENE	02/21/2017	09/05/2026	AE	SBN	NE
6385	2-METHYLNAPHTHALENE	02/21/2017	09/05/2026	AE	SBN	NE
5500	ACENAPHTHENE	02/21/2017	09/05/2026	AE	SBN	NE
5505	ACENAPHTHYLENE	02/21/2017	09/05/2026	AE	SBN	NE
5555	ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
5575	BENZO(A)ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
5580	BENZO(A)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
5585	BENZO(B)FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE
5605	BENZO(E)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
5590	BENZO(G,H,I)PERYLENE	02/21/2017	09/05/2026	AE	SBN	NE
5600	BENZO(K)FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE

This analyte list supersedes all previously issued analyte lists. Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation status by calling (603) 271-2998 or by visiting the NH ELAP website (https://www.des.nh.gov/water/drinking-water/new-hampshire-environmental-laboratory-accreditation-program).

5855	CHRYSENE	02/21/2017	09/05/2026	AE	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	02/21/2017	09/05/2026	AE	SBN	NE
6265	FLUORANTHENE	02/21/2017	09/05/2026	AE	SBN	NE
6270	FLUORENE	02/21/2017	09/05/2026	AE	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
6608	PERYLENE	02/21/2017	09/05/2026	AE	SBN	NE
6615	PHENANTHRENE	02/21/2017	09/05/2026	AE	SBN	NE
6665	PYRENE	02/21/2017	09/05/2026	AE	SBN	NE
Method Code: 10247504	**Method Ref: EPA TO-10A (GC/ECD)**		**Revision:**		**Date:**	
8880	AROCLOR-1016 (PCB-1016)	02/21/2017	09/05/2026	AE	SPC	NE
8885	AROCLOR-1221 (PCB-1221)	02/21/2017	09/05/2026	AE	SPC	NE
8890	AROCLOR-1232 (PCB-1232)	02/21/2017	09/05/2026	AE	SPC	NE
8895	AROCLOR-1242 (PCB-1242)	02/21/2017	09/05/2026	AE	SPC	NE
8900	AROCLOR-1248 (PCB-1248)	02/21/2017	09/05/2026	AE	SPC	NE
8905	AROCLOR-1254 (PCB-1254)	02/21/2017	09/05/2026	AE	SPC	NE
8910	AROCLOR-1260 (PCB-1260)	02/21/2017	09/05/2026	AE	SPC	NE
8912	AROCLOR-1262 (PCB-1262)	02/21/2017	09/05/2026	AE	SPC	NE
8913	AROCLOR-1268 (PCB-1268)	02/21/2017	09/05/2026	AE	SPC	NE
Method Code: 10249204	**Method Ref: EPA TO-4A**		**Revision: 2**		**Date: 1999**	
8880	AROCLOR-1016 (PCB-1016)	05/13/2019	09/05/2026	AE	SPC	NE
8885	AROCLOR-1221 (PCB-1221)	05/13/2019	09/05/2026	AE	SPC	NE
8890	AROCLOR-1232 (PCB-1232)	05/13/2019	09/05/2026	AE	SPC	NE
8895	AROCLOR-1242 (PCB-1242)	05/13/2019	09/05/2026	AE	SPC	NE
8900	AROCLOR-1248 (PCB-1248)	05/13/2019	09/05/2026	AE	SPC	NE
8905	AROCLOR-1254 (PCB-1254)	05/13/2019	09/05/2026	AE	SPC	NE
8910	AROCLOR-1260 (PCB-1260)	05/13/2019	09/05/2026	AE	SPC	NE
8912	AROCLOR-1262 (PCB-1262)	05/13/2019	09/05/2026	AE	SPC	NE
8913	AROCLOR-1268 (PCB-1268)	05/13/2019	09/05/2026	AE	SPC	NE
Method Code: 10000405	**Method Ref: 40 CFR PART 50 APPENDIX G (LEAD IN SPM)**		**Revision:**		**Date:**	
3907	PARTICULATE LEAD	02/21/2017	09/05/2026	AE	AIR	NE
Method Code: 10156420	**Method Ref: SW-846 6020B**		**Revision: UPDATE V**		**Date: 2014**	
1000	ALUMINUM	06/29/2018	09/05/2026	BT	MET	NE
1005	ANTIMONY	06/29/2018	09/05/2026	BT	MET	NE
1010	ARSENIC	06/29/2018	09/05/2026	BT	MET	NE
1015	BARIUM	06/29/2018	09/05/2026	BT	MET	NE
1020	BERYLLIUM	06/29/2018	09/05/2026	BT	MET	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

320 FORBES BLVD

MANSFIELD MA 02048

508-822-9300

Lab ID: 2062

1030	CADMIUM	06/29/2018	09/05/2026	BT	MET	NE
1035	CALCIUM	06/29/2018	09/05/2026	BT	MET	NE
1040	CHROMIUM	06/29/2018	09/05/2026	BT	MET	NE
1050	COBALT	06/29/2018	09/05/2026	BT	MET	NE
1055	COPPER	06/29/2018	09/05/2026	BT	MET	NE
1070	IRON	06/29/2018	09/05/2026	BT	MET	NE
1075	LEAD	06/29/2018	09/05/2026	BT	MET	NE
1085	MAGNESIUM	06/29/2018	09/05/2026	BT	MET	NE
1090	MANGANESE	06/29/2018	09/05/2026	BT	MET	NE
1100	MOLYBDENUM	06/29/2018	09/05/2026	BT	MET	NE
1105	NICKEL	06/29/2018	09/05/2026	BT	MET	NE
1125	POTASSIUM	06/29/2018	09/05/2026	BT	MET	NE
1140	SELENIUM	06/29/2018	09/05/2026	BT	MET	NE
1150	SILVER	06/29/2018	09/05/2026	BT	MET	NE
1160	STRONTIUM	06/29/2018	09/05/2026	BT	MET	NE
1165	THALLIUM	06/29/2018	09/05/2026	BT	MET	NE
1175	TIN	06/29/2018	09/05/2026	BT	MET	NE
1185	VANADIUM	06/29/2018	09/05/2026	BT	MET	NE
1190	ZINC	06/29/2018	09/05/2026	BT	MET	NE
Method Code: 10166457	**Method Ref: SW-846 7471B**		**Revision: UPDATE IV**		**Date: 2007**	
1095	MERCURY	12/29/2017	09/05/2026	BT	MET	NE
Method Code: 10167007	**Method Ref: SW-846 7474**		**Revision:**		**Date: 2007**	
1095	MERCURY	02/21/2017	09/05/2026	BT	MET	NE
Method Code: 10136002	**Method Ref: SW-846 3051A**		**Revision: UPDATE IV**		**Date: 2007**	
1426	MICROWAVE DIGESTION OF SOLIDS	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10138202	**Method Ref: SW-846 3510C**		**Revision: UPDATE III**		**Date: 1996**	
1444	SEPERATORY FUNNEL LIQUID-LIQUID EXTRACTION	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10142708	**Method Ref: SW-846 3570**		**Revision:**		**Date: 2002**	
1429	MICROSCALE SOLVENT EXTRACTION	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10144602	**Method Ref: SW-846 3610B**		**Revision:**		**Date: 1996**	
1411	ALUMINA CLEANUP	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10146802	**Method Ref: SW-846 3630C**		**Revision: UPDATE III**		**Date: 1996**	
1446	SILICA GEL CLEAN-UP	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10147203	**Method Ref: SW-846 3640A**		**Revision: UPDATE II**		**Date: 1994**	
1418	GEL-PERMEATION CLEAN-UP	02/21/2017	09/05/2026	BT	PRE	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
5005	NAPHTHALENE	07/13/2020	09/05/2026	BT	VOC	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

320 FORBES BLVD

MANSFIELD MA 02048

508-822-9300

Lab ID: 2062

Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
5005	NAPHTHALENE	07/13/2020	09/05/2026	BT	VOC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
6275	HEXACHLOROBENZENE	08/15/2022	09/05/2026	BT	SBN	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
6703	1,1'-BIPHENYL (BZ-0)	07/13/2020	09/05/2026	BT	SBN	NE
6380	1-METHYLNAPHTHALENE	07/13/2020	09/05/2026	BT	SBN	NE
5795	2-CHLORONAPHTHALENE	07/13/2020	09/05/2026	BT	SBN	NE
6385	2-METHYLNAPHTHALENE	07/13/2020	09/05/2026	BT	SBN	NE
5500	ACENAPHTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5505	ACENAPHTHYLENE	07/13/2020	09/05/2026	BT	SBN	NE
5555	ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
5570	BENZALDEHYDE	07/13/2020	09/05/2026	BT	SBN	NE
5575	BENZO(A)ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
5580	BENZO(A)PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/13/2020	09/05/2026	BT	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5670	BUTYL BENZYL PHTHALATE	07/13/2020	09/05/2026	BT	SBN	NE
5855	CHRYSENE	07/13/2020	09/05/2026	BT	SBN	NE
6065	DI(2-ETHYLHEXYL) PHTHALATE (BIS(2-ETHYLHEXYL)PHTHALATE, DEHP)	07/13/2020	09/05/2026	BT	SBN	NE
5925	DI-N-BUTYL PHTHALATE	07/13/2020	09/05/2026	BT	SBN	NE
6200	DI-N-OCTYL PHTHALATE	07/13/2020	09/05/2026	BT	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
5905	DIBENZOFURAN	07/13/2020	09/05/2026	BT	SBN	NE
6070	DIETHYL PHTHALATE	07/13/2020	09/05/2026	BT	SBN	NE
6135	DIMETHYL PHTHALATE	07/13/2020	09/05/2026	BT	SBN	NE
6265	FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
6270	FLUORENE	07/13/2020	09/05/2026	BT	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
6605	PENTACHLOROPHENOL	07/13/2020	09/05/2026	BT	SBN	NE
6615	PHENANTHRENE	07/13/2020	09/05/2026	BT	SBN	NE
6665	PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
6385	2-METHYLNAPHTHALENE	07/13/2020	09/05/2026	BT	SBN	NE

5500	ACENAPHTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5505	ACENAPHTHYLENE	07/13/2020	09/05/2026	BT	SBN	NE
5555	ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
5575	BENZO(A)ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
5580	BENZO(A)PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/13/2020	09/05/2026	BT	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/13/2020	09/05/2026	BT	SBN	NE
6265	FLUORANTHENE	07/13/2020	09/05/2026	BT	SBN	NE
6270	FLUORENE	07/13/2020	09/05/2026	BT	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
6605	PENTACHLOROPHENOL	07/13/2020	09/05/2026	BT	SBN	NE
6615	PHENANTHRENE	07/13/2020	09/05/2026	BT	SBN	NE
6665	PYRENE	07/13/2020	09/05/2026	BT	SBN	NE
Method Code: 10179201	**Method Ref: SW-846 8082A**		**Revision:**		**Date: 2000**	
8880	AROCLOR-1016 (PCB-1016)	02/21/2017	09/05/2026	BT	SPC	NE
8885	AROCLOR-1221 (PCB-1221)	02/21/2017	09/05/2026	BT	SPC	NE
8890	AROCLOR-1232 (PCB-1232)	02/21/2017	09/05/2026	BT	SPC	NE
8895	AROCLOR-1242 (PCB-1242)	02/21/2017	09/05/2026	BT	SPC	NE
8900	AROCLOR-1248 (PCB-1248)	02/21/2017	09/05/2026	BT	SPC	NE
8905	AROCLOR-1254 (PCB-1254)	02/21/2017	09/05/2026	BT	SPC	NE
8910	AROCLOR-1260 (PCB-1260)	02/21/2017	09/05/2026	BT	SPC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
7355	4,4'-DDD	08/15/2022	09/05/2026	BT	SPE	NE
7360	4,4'-DDE	08/15/2022	09/05/2026	BT	SPE	NE
7365	4,4'-DDT	08/15/2022	09/05/2026	BT	SPE	NE
7025	ALDRIN	08/15/2022	09/05/2026	BT	SPE	NE
7110	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	BT	SPE	NE
7115	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	BT	SPE	NE
7250	CHLORDANE (TECH.)	08/15/2022	09/05/2026	BT	SPE	NE
7240	CIS-CHLORDANE (ALPHA-CHLORDANE)	08/15/2022	09/05/2026	BT	SPE	NE
7105	DELTA-BHC	08/15/2022	09/05/2026	BT	SPE	NE
7470	DIELDRIN	08/15/2022	09/05/2026	BT	SPE	NE
7510	ENDOSULFAN I	08/15/2022	09/05/2026	BT	SPE	NE
7515	ENDOSULFAN II	08/15/2022	09/05/2026	BT	SPE	NE

7520	ENDOSULFAN SULFATE	08/15/2022	09/05/2026	BT	SPE	NE
7540	ENDRIN	08/15/2022	09/05/2026	BT	SPE	NE
7530	ENDRIN ALDEHYDE	08/15/2022	09/05/2026	BT	SPE	NE
7535	ENDRIN KETONE	08/15/2022	09/05/2026	BT	SPE	NE
7120	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	BT	SPE	NE
7245	GAMMA-CHLORDANE	08/15/2022	09/05/2026	BT	SPE	NE
7685	HEPTACHLOR	08/15/2022	09/05/2026	BT	SPE	NE
7690	HEPTACHLOR EPOXIDE	08/15/2022	09/05/2026	BT	SPE	NE
7810	METHOXYCHLOR	08/15/2022	09/05/2026	BT	SPE	NE
7870	MIREX	08/15/2022	09/05/2026	BT	SPE	NE
8250	TOXAPHENE (CHLORINATED CAMPHENE)	08/15/2022	09/05/2026	BT	SPE	NE
Method Code: 10123463	**Method Ref: EPA 1633**		**Revision:**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	09/05/2025	09/05/2026	BT	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	09/05/2025	09/05/2026	BT	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	09/05/2025	09/05/2026	BT	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	09/05/2025	09/05/2026	BT	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	09/05/2025	09/05/2026	BT	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	09/05/2025	09/05/2026	BT	PFC	NE
9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	09/05/2025	09/05/2026	BT	PFC	NE
9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	09/05/2025	09/05/2026	BT	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	09/05/2025	09/05/2026	BT	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	09/05/2025	09/05/2026	BT	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	09/05/2025	09/05/2026	BT	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	09/05/2025	09/05/2026	BT	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	09/05/2025	09/05/2026	BT	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	09/05/2025	09/05/2026	BT	PFC	NE

9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	09/05/2025	09/05/2026	BT	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	09/05/2025	09/05/2026	BT	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	09/05/2025	09/05/2026	BT	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	09/05/2025	09/05/2026	BT	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	09/05/2025	09/05/2026	BT	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	09/05/2025	09/05/2026	BT	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	09/05/2025	09/05/2026	BT	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	09/05/2025	09/05/2026	BT	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	09/05/2025	09/05/2026	BT	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	09/05/2025	09/05/2026	BT	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	09/05/2025	09/05/2026	BT	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	09/05/2025	09/05/2026	BT	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	09/05/2025	09/05/2026	BT	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	09/05/2025	09/05/2026	BT	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	09/05/2025	09/05/2026	BT	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	09/05/2025	09/05/2026	BT	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	09/05/2025	09/05/2026	BT	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	09/05/2025	09/05/2026	BT	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	09/05/2025	09/05/2026	BT	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	09/05/2025	09/05/2026	BT	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	09/05/2025	09/05/2026	BT	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	09/05/2025	09/05/2026	BT	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	09/05/2025	09/05/2026	BT	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	09/05/2025	09/05/2026	BT	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	09/05/2025	09/05/2026	BT	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	09/05/2025	09/05/2026	BT	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	09/05/2025	09/05/2026	BT	PFC	NE
Method Code: 10123474	**Method Ref: EPA 1633A**		**Revision: A**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	05/16/2025	09/05/2026	BT	PFC	NE

6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	05/16/2025	09/05/2026	BT	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	05/16/2025	09/05/2026	BT	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	05/16/2025	09/05/2026	BT	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	05/16/2025	09/05/2026	BT	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	05/16/2025	09/05/2026	BT	PFC	NE
9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	05/16/2025	09/05/2026	BT	PFC	NE
9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	05/16/2025	09/05/2026	BT	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	05/16/2025	09/05/2026	BT	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	05/16/2025	09/05/2026	BT	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	05/16/2025	09/05/2026	BT	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	05/16/2025	09/05/2026	BT	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	05/16/2025	09/05/2026	BT	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	05/16/2025	09/05/2026	BT	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	05/16/2025	09/05/2026	BT	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	05/16/2025	09/05/2026	BT	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	05/16/2025	09/05/2026	BT	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	05/16/2025	09/05/2026	BT	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	05/16/2025	09/05/2026	BT	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	05/16/2025	09/05/2026	BT	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	05/16/2025	09/05/2026	BT	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	05/16/2025	09/05/2026	BT	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	05/16/2025	09/05/2026	BT	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	05/16/2025	09/05/2026	BT	PFC	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

320 FORBES BLVD

MANSFIELD MA 02048

508-822-9300

Lab ID: 2062

6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	05/16/2025	09/05/2026	BT	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	05/16/2025	09/05/2026	BT	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	05/16/2025	09/05/2026	BT	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	05/16/2025	09/05/2026	BT	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	05/16/2025	09/05/2026	BT	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	05/16/2025	09/05/2026	BT	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	05/16/2025	09/05/2026	BT	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	05/16/2025	09/05/2026	BT	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	05/16/2025	09/05/2026	BT	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	05/16/2025	09/05/2026	BT	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	05/16/2025	09/05/2026	BT	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	05/16/2025	09/05/2026	BT	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	05/16/2025	09/05/2026	BT	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	05/16/2025	09/05/2026	BT	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	05/16/2025	09/05/2026	BT	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	05/16/2025	09/05/2026	BT	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	05/16/2025	09/05/2026	BT	PFC	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM	02/21/2017	09/05/2026	D	MET	NE
1015	BARIUM	02/21/2017	09/05/2026	D	MET	NE
1025	BORON	02/21/2017	09/05/2026	D	MET	NE
1030	CADMIUM	02/21/2017	09/05/2026	D	MET	NE
1035	CALCIUM	02/21/2017	09/05/2026	D	MET	NE
1040	CHROMIUM	02/21/2017	09/05/2026	D	MET	NE
1050	COBALT	02/21/2017	09/05/2026	D	MET	NE
1055	COPPER	02/21/2017	09/05/2026	D	MET	NE
1070	IRON	02/21/2017	09/05/2026	D	MET	NE
1080	LITHIUM	02/03/2022	09/05/2026	D	MET	NE
1085	MAGNESIUM	02/21/2017	09/05/2026	D	MET	NE
1090	MANGANESE	02/21/2017	09/05/2026	D	MET	NE
1105	NICKEL	02/21/2017	09/05/2026	D	MET	NE
1125	POTASSIUM	02/21/2017	09/05/2026	D	MET	NE
1150	SILVER	02/21/2017	09/05/2026	D	MET	NE
1155	SODIUM	02/21/2017	09/05/2026	D	MET	NE
1160	STRONTIUM	02/21/2017	09/05/2026	D	MET	NE

1175	TIN	02/21/2017	09/05/2026	D	MET	NE
1180	TITANIUM	02/21/2017	09/05/2026	D	MET	NE
1185	VANADIUM	02/21/2017	09/05/2026	D	MET	NE
1190	ZINC	02/21/2017	09/05/2026	D	MET	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1000	ALUMINUM	02/21/2017	09/05/2026	D	MET	NE
1005	ANTIMONY	02/21/2017	09/05/2026	D	MET	NE
1010	ARSENIC	02/21/2017	09/05/2026	D	MET	NE
1015	BARIUM	02/21/2017	09/05/2026	D	MET	NE
1020	BERYLLIUM	02/21/2017	09/05/2026	D	MET	NE
1030	CADMIUM	02/21/2017	09/05/2026	D	MET	NE
1040	CHROMIUM	02/21/2017	09/05/2026	D	MET	NE
1050	COBALT	02/21/2017	09/05/2026	D	MET	NE
1055	COPPER	02/21/2017	09/05/2026	D	MET	NE
1070	IRON	05/10/2018	09/05/2026	D	MET	NE
1075	LEAD	02/21/2017	09/05/2026	D	MET	NE
1090	MANGANESE	02/21/2017	09/05/2026	D	MET	NE
1105	NICKEL	02/21/2017	09/05/2026	D	MET	NE
1125	POTASSIUM	05/10/2018	09/05/2026	D	MET	NE
1140	SELENIUM	02/21/2017	09/05/2026	D	MET	NE
1150	SILVER	02/21/2017	09/05/2026	D	MET	NE
1155	SODIUM	05/10/2018	09/05/2026	D	MET	NE
1165	THALLIUM	02/21/2017	09/05/2026	D	MET	NE
1185	VANADIUM	02/21/2017	09/05/2026	D	MET	NE
1190	ZINC	02/21/2017	09/05/2026	D	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY	02/21/2017	09/05/2026	D	MET	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1550	CALCIUM HARDNESS AS CACO3	02/21/2017	09/05/2026	D	NMI	NE
1755	TOTAL HARDNESS AS CACO3	02/21/2017	09/05/2026	D	NMI	NE
Method Code: 10088570	**Method Ref: EPA 522**		**Revision: 1**		**Date: 2008**	
4735	1,4-DIOXANE (1 4-DIETHYLENEOXIDE)	12/12/2017	09/05/2026	D	VOC	NE
Method Code: 10091595	**Method Ref: EPA 537.1**		**Revision: 2**		**Date: 2020**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	09/12/2024	09/05/2026	D	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	09/12/2024	09/05/2026	D	PFC	NE

6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	09/12/2024	09/05/2026	D	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	09/12/2024	09/05/2026	D	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	09/12/2024	09/05/2026	D	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	09/12/2024	09/05/2026	D	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	09/12/2024	09/05/2026	D	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	09/12/2024	09/05/2026	D	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	09/12/2024	09/05/2026	D	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	09/12/2024	09/05/2026	D	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	09/12/2024	09/05/2026	D	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	09/12/2024	09/05/2026	D	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	09/12/2024	09/05/2026	D	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	09/12/2024	09/05/2026	D	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	09/12/2024	09/05/2026	D	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	09/12/2024	09/05/2026	D	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	09/12/2024	09/05/2026	D	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	09/12/2024	09/05/2026	D	PFC	NE
Method Code: 10091619	**Method Ref: EPA 533**		**Revision:**		**Date: 2019**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	03/20/2020	09/05/2026	D	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	03/20/2020	09/05/2026	D	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	03/20/2020	09/05/2026	D	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	03/20/2020	09/05/2026	D	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	03/20/2020	09/05/2026	D	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	03/20/2020	09/05/2026	D	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	03/20/2020	09/05/2026	D	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	03/20/2020	09/05/2026	D	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	03/20/2020	09/05/2026	D	PFC	NE

6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	03/20/2020	09/05/2026	D	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	03/20/2020	09/05/2026	D	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	03/20/2020	09/05/2026	D	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	03/20/2020	09/05/2026	D	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	03/20/2020	09/05/2026	D	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	03/20/2020	09/05/2026	D	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	03/20/2020	09/05/2026	D	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	03/20/2020	09/05/2026	D	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	03/20/2020	09/05/2026	D	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	03/20/2020	09/05/2026	D	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	03/20/2020	09/05/2026	D	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	03/20/2020	09/05/2026	D	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	03/20/2020	09/05/2026	D	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	03/20/2020	09/05/2026	D	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	03/20/2020	09/05/2026	D	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	03/20/2020	09/05/2026	D	PFC	NE
Method Code: 60001174	**Method Ref: ALPHA SOP 23528**		**Revision: 17**		**Date: 2022**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	10/14/2022	09/05/2026	D	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	10/14/2022	09/05/2026	D	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	10/14/2022	09/05/2026	D	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	10/14/2022	09/05/2026	D	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	10/14/2022	09/05/2026	D	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	10/14/2022	09/05/2026	D	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	10/14/2022	09/05/2026	D	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	10/14/2022	09/05/2026	D	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	10/14/2022	09/05/2026	D	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	10/14/2022	09/05/2026	D	PFC	NE

9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	10/14/2022	09/05/2026	D	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	10/14/2022	09/05/2026	D	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	10/14/2022	09/05/2026	D	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	10/14/2022	09/05/2026	D	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	10/14/2022	09/05/2026	D	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	10/14/2022	09/05/2026	D	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	10/14/2022	09/05/2026	D	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	10/14/2022	09/05/2026	D	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	10/14/2022	09/05/2026	D	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	10/14/2022	09/05/2026	D	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	10/14/2022	09/05/2026	D	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	10/14/2022	09/05/2026	D	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	10/14/2022	09/05/2026	D	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	10/14/2022	09/05/2026	D	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	10/14/2022	09/05/2026	D	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	10/14/2022	09/05/2026	D	PFC	NE
6901	PERFLUOROHEXADECANOIC ACID (PFHXDA) 67905-19-5	10/14/2022	09/05/2026	D	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	10/14/2022	09/05/2026	D	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	10/14/2022	09/05/2026	D	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	10/14/2022	09/05/2026	D	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	10/14/2022	09/05/2026	D	PFC	NE
6916	PERFLUOROOCTADECANOIC ACID (PFODA) 16517-11-6	10/14/2022	09/05/2026	D	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	10/14/2022	09/05/2026	D	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	10/14/2022	09/05/2026	D	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	10/14/2022	09/05/2026	D	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	10/14/2022	09/05/2026	D	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	10/14/2022	09/05/2026	D	PFC	NE
9320	PERFLUOROPROPANESULFONIC ACID (PFPRS) 423-41-6	10/14/2022	09/05/2026	D	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	10/14/2022	09/05/2026	D	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	10/14/2022	09/05/2026	D	PFC	NE

6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	10/14/2022	09/05/2026	D	PFC	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM	02/21/2017	09/05/2026	N	MET	NE
1005	ANTIMONY	02/21/2017	09/05/2026	N	MET	NE
1010	ARSENIC	02/21/2017	09/05/2026	N	MET	NE
1015	BARIUM	02/21/2017	09/05/2026	N	MET	NE
1020	BERYLLIUM	02/21/2017	09/05/2026	N	MET	NE
1025	BORON	02/21/2017	09/05/2026	N	MET	NE
1030	CADMIUM	02/21/2017	09/05/2026	N	MET	NE
1035	CALCIUM	02/21/2017	09/05/2026	N	MET	NE
1040	CHROMIUM	02/21/2017	09/05/2026	N	MET	NE
1050	COBALT	02/21/2017	09/05/2026	N	MET	NE
1055	COPPER	02/21/2017	09/05/2026	N	MET	NE
1070	IRON	02/21/2017	09/05/2026	N	MET	NE
1075	LEAD	02/21/2017	09/05/2026	N	MET	NE
1085	MAGNESIUM	02/21/2017	09/05/2026	N	MET	NE
1090	MANGANESE	02/21/2017	09/05/2026	N	MET	NE
1100	MOLYBDENUM	02/21/2017	09/05/2026	N	MET	NE
1105	NICKEL	02/21/2017	09/05/2026	N	MET	NE
1125	POTASSIUM	02/21/2017	09/05/2026	N	MET	NE
1140	SELENIUM	02/21/2017	09/05/2026	N	MET	NE
1150	SILVER	02/21/2017	09/05/2026	N	MET	NE
1155	SODIUM	02/21/2017	09/05/2026	N	MET	NE
1160	STRONTIUM	02/21/2017	09/05/2026	N	MET	NE
1165	THALLIUM	02/21/2017	09/05/2026	N	MET	NE
1175	TIN	02/21/2017	09/05/2026	N	MET	NE
1180	TITANIUM	02/21/2017	09/05/2026	N	MET	NE
1185	VANADIUM	02/21/2017	09/05/2026	N	MET	NE
1190	ZINC	02/21/2017	09/05/2026	N	MET	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1000	ALUMINUM	02/21/2017	09/05/2026	N	MET	NE
1005	ANTIMONY	02/21/2017	09/05/2026	N	MET	NE
1010	ARSENIC	02/21/2017	09/05/2026	N	MET	NE
1015	BARIUM	02/21/2017	09/05/2026	N	MET	NE
1020	BERYLLIUM	02/21/2017	09/05/2026	N	MET	NE
1030	CADMIUM	02/21/2017	09/05/2026	N	MET	NE

1035	CALCIUM	09/12/2024	09/05/2026	N	MET	NE
1040	CHROMIUM	02/21/2017	09/05/2026	N	MET	NE
1050	COBALT	02/21/2017	09/05/2026	N	MET	NE
1055	COPPER	02/21/2017	09/05/2026	N	MET	NE
1070	IRON	05/10/2018	09/05/2026	N	MET	NE
1075	LEAD	02/21/2017	09/05/2026	N	MET	NE
1085	MAGNESIUM	09/12/2024	09/05/2026	N	MET	NE
1090	MANGANESE	02/21/2017	09/05/2026	N	MET	NE
1100	MOLYBDENUM	02/21/2017	09/05/2026	N	MET	NE
1105	NICKEL	02/21/2017	09/05/2026	N	MET	NE
1125	POTASSIUM	05/10/2018	09/05/2026	N	MET	NE
1140	SELENIUM	02/21/2017	09/05/2026	N	MET	NE
1150	SILVER	02/21/2017	09/05/2026	N	MET	NE
1155	SODIUM	05/10/2018	09/05/2026	N	MET	NE
1165	THALLIUM	02/21/2017	09/05/2026	N	MET	NE
1185	VANADIUM	02/21/2017	09/05/2026	N	MET	NE
1190	ZINC	02/21/2017	09/05/2026	N	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY	02/21/2017	09/05/2026	N	MET	NE
Method Code: 10038105	**Method Ref: EPA 245.7**		**Revision: 2**		**Date: 2005**	
1095	MERCURY	08/09/2024	09/05/2026	N	MET	NE
Method Code: 10155916	**Method Ref: SW-846 6010D**		**Revision: UPDATE V**		**Date: 2014**	
1000	ALUMINUM	06/29/2018	09/05/2026	N	MET	NE
1005	ANTIMONY	06/29/2018	09/05/2026	N	MET	NE
1010	ARSENIC	06/29/2018	09/05/2026	N	MET	NE
1015	BARIUM	06/29/2018	09/05/2026	N	MET	NE
1020	BERYLLIUM	06/29/2018	09/05/2026	N	MET	NE
1025	BORON	06/29/2018	09/05/2026	N	MET	NE
1030	CADMIUM	06/29/2018	09/05/2026	N	MET	NE
1035	CALCIUM	06/29/2018	09/05/2026	N	MET	NE
1040	CHROMIUM	06/29/2018	09/05/2026	N	MET	NE
1050	COBALT	06/29/2018	09/05/2026	N	MET	NE
1055	COPPER	06/29/2018	09/05/2026	N	MET	NE
1070	IRON	06/29/2018	09/05/2026	N	MET	NE
1075	LEAD	06/29/2018	09/05/2026	N	MET	NE
1080	LITHIUM	07/18/2023	09/05/2026	N	MET	NE

1085	MAGNESIUM	06/29/2018	09/05/2026	N	MET	NE
1090	MANGANESE	06/29/2018	09/05/2026	N	MET	NE
1100	MOLYBDENUM	06/29/2018	09/05/2026	N	MET	NE
1105	NICKEL	06/29/2018	09/05/2026	N	MET	NE
1125	POTASSIUM	06/29/2018	09/05/2026	N	MET	NE
1140	SELENIUM	06/29/2018	09/05/2026	N	MET	NE
1150	SILVER	06/29/2018	09/05/2026	N	MET	NE
1155	SODIUM	06/29/2018	09/05/2026	N	MET	NE
1160	STRONTIUM	06/29/2018	09/05/2026	N	MET	NE
1165	THALLIUM	06/29/2018	09/05/2026	N	MET	NE
1175	TIN	06/29/2018	09/05/2026	N	MET	NE
1180	TITANIUM	06/29/2018	09/05/2026	N	MET	NE
1185	VANADIUM	06/29/2018	09/05/2026	N	MET	NE
1190	ZINC	06/29/2018	09/05/2026	N	MET	NE
Method Code: 10156420	**Method Ref: SW-846 6020B**		**Revision: UPDATE V**		**Date: 2014**	
1000	ALUMINUM	06/29/2018	09/05/2026	N	MET	NE
1005	ANTIMONY	06/29/2018	09/05/2026	N	MET	NE
1010	ARSENIC	06/29/2018	09/05/2026	N	MET	NE
1015	BARIUM	06/29/2018	09/05/2026	N	MET	NE
1020	BERYLLIUM	06/29/2018	09/05/2026	N	MET	NE
1025	BORON	06/29/2018	09/05/2026	N	MET	NE
1030	CADMIUM	06/29/2018	09/05/2026	N	MET	NE
1035	CALCIUM	06/29/2018	09/05/2026	N	MET	NE
1040	CHROMIUM	06/29/2018	09/05/2026	N	MET	NE
1050	COBALT	06/29/2018	09/05/2026	N	MET	NE
1055	COPPER	06/29/2018	09/05/2026	N	MET	NE
1070	IRON	06/29/2018	09/05/2026	N	MET	NE
1075	LEAD	06/29/2018	09/05/2026	N	MET	NE
1085	MAGNESIUM	06/29/2018	09/05/2026	N	MET	NE
1090	MANGANESE	06/29/2018	09/05/2026	N	MET	NE
1100	MOLYBDENUM	06/29/2018	09/05/2026	N	MET	NE
1105	NICKEL	06/29/2018	09/05/2026	N	MET	NE
1125	POTASSIUM	06/29/2018	09/05/2026	N	MET	NE
1140	SELENIUM	06/29/2018	09/05/2026	N	MET	NE
1150	SILVER	06/29/2018	09/05/2026	N	MET	NE

1155	SODIUM	06/29/2018	09/05/2026	N	MET	NE
1160	STRONTIUM	06/29/2018	09/05/2026	N	MET	NE
1165	THALLIUM	06/29/2018	09/05/2026	N	MET	NE
1175	TIN	06/29/2018	09/05/2026	N	MET	NE
1185	VANADIUM	06/29/2018	09/05/2026	N	MET	NE
1190	ZINC	06/29/2018	09/05/2026	N	MET	NE
Method Code: 10165807	**Method Ref: SW-846 7470A**		**Revision: UPDATE II**		**Date: 1994**	
1095	MERCURY	02/21/2017	09/05/2026	N	MET	NE
Method Code: 10237204	**Method Ref: EPA 1631E**		**Revision:**		**Date: 2002**	
1095	MERCURY	02/21/2017	09/05/2026	N	MET	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1550	CALCIUM HARDNESS AS CACO3	03/06/2025	09/05/2026	N	NMI	NE
1990	SILICA AS SIO2	02/21/2017	09/05/2026	N	NMI	NE
1755	TOTAL HARDNESS AS CACO3	02/21/2017	09/05/2026	N	NMI	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1755	TOTAL HARDNESS AS CACO3	10/07/2024	09/05/2026	N	NMI	NE
Method Code: 10155916	**Method Ref: SW-846 6010D**		**Revision: UPDATE V**		**Date: 2014**	
1990	SILICA AS SIO2	07/07/2022	09/05/2026	N	NMI	NE
2017	SULFUR	06/29/2018	09/05/2026	N	NMI	NE
1755	TOTAL HARDNESS AS CACO3	07/13/2020	09/05/2026	N	NMI	NE
Method Code: 10156420	**Method Ref: SW-846 6020B**		**Revision: UPDATE V**		**Date: 2014**	
1755	TOTAL HARDNESS AS CACO3	07/13/2020	09/05/2026	N	NMI	NE
Method Code: 20046440	**Method Ref: SM 2340 B-2021**		**Revision:**		**Date: 2021**	
1755	TOTAL HARDNESS AS CACO3	03/06/2025	09/05/2026	N	NMI	NE
Method Code: 20046611	**Method Ref: SM 2340 B-2011**		**Revision:**		**Date: 2011**	
1755	TOTAL HARDNESS AS CACO3	02/21/2017	09/05/2026	N	NMI	NE
Method Code: 10133207	**Method Ref: SW-846 3005A**		**Revision: UPDATE I**		**Date: 1992**	
1438	PRECONCENTRATION UNDER ACID	11/22/2016	09/05/2026	N	PRE	NE
Method Code: 10134006	**Method Ref: SW-846 3015A**		**Revision: UPDATE IV**		**Date: 2007**	
1430	MICROWAVE-ASSISTED ACID DIGESTION OF TCLP EXTRACTS	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10138202	**Method Ref: SW-846 3510C**		**Revision: UPDATE III**		**Date: 1996**	
1444	SEPERATORY FUNNEL LIQUID-LIQUID EXTRACTION	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10143007	**Method Ref: SW-846 3580A**		**Revision: UPDATE I**		**Date: 1992**	
1470	WASTE DILUTION	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10146802	**Method Ref: SW-846 3630C**		**Revision: UPDATE III**		**Date: 1996**	
1446	SILICA GEL CLEAN-UP	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10147203	**Method Ref: SW-846 3640A**		**Revision: UPDATE II**		**Date: 1994**	
1418	GEL-PERMEATION CLEAN-UP	02/21/2017	09/05/2026	N	PRE	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

320 FORBES BLVD

MANSFIELD MA 02048

508-822-9300

Lab ID: 2062

Method Code: 10148400	**Method Ref: SW-846 3660B**		**Revision: UPDATE III**		**Date: 1996**	
1456	SULFUR CLEAN-UP	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10148808	**Method Ref: SW-846 3665A**		**Revision: UPDATE III**		**Date: 1996**	
1458	SULFURIC ACID / PERMANGANATE CLEAN-UP	02/21/2017	09/05/2026	N	PRE	NE
Method Code: 10088570	**Method Ref: EPA 522**		**Revision: 1**		**Date: 2008**	
4735	1,4-DIOXANE (1 4-DIETHYLENEOXIDE)	02/21/2017	09/05/2026	N	VOC	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
5155	1,2,4-TRICHLOROBENZENE	07/13/2020	09/05/2026	N	VOC	NE
4610	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	07/13/2020	09/05/2026	N	VOC	NE
4615	1,3-DICHLOROBENZENE (M-DICHLOROBENZNE)	07/13/2020	09/05/2026	N	VOC	NE
4620	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	07/13/2020	09/05/2026	N	VOC	NE
4835	HEXACHLOROBUTADIENE	07/13/2020	09/05/2026	N	VOC	NE
4840	HEXACHLOROETHANE	07/13/2020	09/05/2026	N	VOC	NE
5005	NAPHTHALENE	07/13/2020	09/05/2026	N	VOC	NE
5015	NITROBENZENE	07/13/2020	09/05/2026	N	VOC	NE
5095	PYRIDINE	07/13/2020	09/05/2026	N	VOC	NE
Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
5005	NAPHTHALENE	07/13/2020	09/05/2026	N	VOC	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
4750	ETHANOL	02/21/2017	09/05/2026	N	VOC	NE
4785	ETHYLENE GLYCOL	02/21/2017	09/05/2026	N	VOC	NE
4875	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	02/21/2017	09/05/2026	N	VOC	NE
4895	ISOPROPYL ALCOHOL (2-PROPANOL, ISOPROPANOL)	02/21/2017	09/05/2026	N	VOC	NE
4930	METHANOL	02/21/2017	09/05/2026	N	VOC	NE
5055	N-PROPANOL	02/21/2017	09/05/2026	N	VOC	NE
4368	TERT-AMYL ALCOHOL (TAA)	02/21/2017	09/05/2026	N	VOC	NE
4420	TERT-BUTYL ALCOHOL (2-METHYL-2-PROPANOL)	02/21/2017	09/05/2026	N	VOC	NE
Method Code: NH0361	**Method Ref: SW-846 8270E SIM ISOTOPE DILUTION**		**Revision: UPDATE VI**		**Date: 2018**	
4735	1,4-DIOXANE (1 4-DIETHYLENEOXIDE)	05/29/2024	09/05/2026	N	VOC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
6275	HEXACHLOROBENZENE	08/15/2022	09/05/2026	N	SBN	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
6703	1,1'-BIPHENYL (BZ-0)	07/13/2020	09/05/2026	N	SBN	NE
6710	1,2,3,5-TETRACHLOROBENZENE	07/13/2020	09/05/2026	N	SBN	NE
6715	1,2,4,5-TETRACHLOROBENZENE	07/13/2020	09/05/2026	N	SBN	NE
6220	1,2-DIPHENYLHYDRAZINE	07/13/2020	09/05/2026	N	SBN	NE

4659	2,2'-OXYBIS(1-CHLOROPROPANE), BIS(2-CHLORO-1-METHYLETHYL)ETHER	07/13/2020	09/05/2026	N	SBN	NE
6735	2,3,4,6-TETRACHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6835	2,4,5-TRICHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6840	2,4,6-TRICHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6000	2,4-DICHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6130	2,4-DIMETHYLPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6175	2,4-DINITROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6185	2,4-DINITROTOLUENE (2,4-DNT)	07/13/2020	09/05/2026	N	SBN	NE
6190	2,6-DINITROTOLUENE (2,6-DNT)	07/13/2020	09/05/2026	N	SBN	NE
5795	2-CHLORONAPHTHALENE	07/13/2020	09/05/2026	N	SBN	NE
5800	2-CHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6360	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	07/13/2020	09/05/2026	N	SBN	NE
6385	2-METHYLNAPHTHALENE	07/13/2020	09/05/2026	N	SBN	NE
6400	2-METHYLPHENOL (O-CRESOL)	07/13/2020	09/05/2026	N	SBN	NE
6460	2-NITROANILINE	07/13/2020	09/05/2026	N	SBN	NE
6490	2-NITROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
5945	3,3'-DICHLOROBENZIDINE	07/13/2020	09/05/2026	N	SBN	NE
6405	3-METHYLPHENOL (M-CRESOL)	07/13/2020	09/05/2026	N	SBN	NE
6465	3-NITROANILINE	07/13/2020	09/05/2026	N	SBN	NE
5660	4-BROMOPHENYL PHENYL ETHER (BDE-3)	07/13/2020	09/05/2026	N	SBN	NE
5700	4-CHLORO-3-METHYLPHENOL	07/13/2020	09/05/2026	N	SBN	NE
5745	4-CHLOROANILINE	07/13/2020	09/05/2026	N	SBN	NE
5825	4-CHLOROPHENYL PHENYLETHER	07/13/2020	09/05/2026	N	SBN	NE
6410	4-METHYLPHENOL (P-CRESOL)	07/13/2020	09/05/2026	N	SBN	NE
6470	4-NITROANILINE	07/13/2020	09/05/2026	N	SBN	NE
6500	4-NITROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
5500	ACENAPHTHENE	07/13/2020	09/05/2026	N	SBN	NE
5505	ACENAPHTHYLENE	07/13/2020	09/05/2026	N	SBN	NE
5510	ACETOPHENONE	07/13/2020	09/05/2026	N	SBN	NE
5545	ANILINE	07/13/2020	09/05/2026	N	SBN	NE
5555	ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE
5570	BENZALDEHYDE	07/13/2020	09/05/2026	N	SBN	NE
5595	BENZIDINE	07/13/2020	09/05/2026	N	SBN	NE
5575	BENZO(A)ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE

5580	BENZO(A)PYRENE	07/13/2020	09/05/2026	N	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/13/2020	09/05/2026	N	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
5610	BENZOIC ACID	07/13/2020	09/05/2026	N	SBN	NE
5630	BENZYL ALCOHOL	07/13/2020	09/05/2026	N	SBN	NE
5760	BIS(2-CHLOROETHOXY)METHANE	07/13/2020	09/05/2026	N	SBN	NE
5765	BIS(2-CHLOROETHYL) ETHER	07/13/2020	09/05/2026	N	SBN	NE
5670	BUTYL BENZYL PHTHALATE	07/13/2020	09/05/2026	N	SBN	NE
5680	CARBAZOLE	07/13/2020	09/05/2026	N	SBN	NE
5855	CHRYSENE	07/13/2020	09/05/2026	N	SBN	NE
6065	DI(2-ETHYLHEXYL) PHTHALATE (BIS(2-ETHYLHEXYL)PHTHALATE, DEHP)	07/13/2020	09/05/2026	N	SBN	NE
5925	DI-N-BUTYL PHTHALATE	07/13/2020	09/05/2026	N	SBN	NE
6200	DI-N-OCTYL PHTHALATE	07/13/2020	09/05/2026	N	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE
5905	DIBENZOFURAN	07/13/2020	09/05/2026	N	SBN	NE
6070	DIETHYL PHTHALATE	07/13/2020	09/05/2026	N	SBN	NE
6135	DIMETHYL PHTHALATE	07/13/2020	09/05/2026	N	SBN	NE
6265	FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
6270	FLUORENE	07/13/2020	09/05/2026	N	SBN	NE
6275	HEXACHLOROBENZENE	07/13/2020	09/05/2026	N	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/13/2020	09/05/2026	N	SBN	NE
6320	ISOPHORONE	07/13/2020	09/05/2026	N	SBN	NE
6545	N-NITROSODI-N-PROPYLAMINE	07/13/2020	09/05/2026	N	SBN	NE
6530	N-NITROSODIMETHYLAMINE	07/13/2020	09/05/2026	N	SBN	NE
6535	N-NITROSODIPHENYLAMINE	07/13/2020	09/05/2026	N	SBN	NE
6600	PENTACHLORONITROBENZENE	07/13/2020	09/05/2026	N	SBN	NE
6605	PENTACHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6615	PHENANTHRENE	07/13/2020	09/05/2026	N	SBN	NE
6625	PHENOL	07/13/2020	09/05/2026	N	SBN	NE
6665	PYRENE	07/13/2020	09/05/2026	N	SBN	NE
Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
6380	1-METHYLNAPHTHALENE	07/13/2020	09/05/2026	N	SBN	NE
6385	2-METHYLNAPHTHALENE	07/13/2020	09/05/2026	N	SBN	NE
5500	ACENAPHTHENE	07/13/2020	09/05/2026	N	SBN	NE

5505	ACENAPHTHYLENE	07/13/2020	09/05/2026	N	SBN	NE
9297	ALKALATED PAHS	07/13/2020	09/05/2026	N	SBN	NE
5555	ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE
5575	BENZO(A)ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE
5580	BENZO(A)PYRENE	07/13/2020	09/05/2026	N	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/13/2020	09/05/2026	N	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
5855	CHRYSENE	07/13/2020	09/05/2026	N	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/13/2020	09/05/2026	N	SBN	NE
6265	FLUORANTHENE	07/13/2020	09/05/2026	N	SBN	NE
6270	FLUORENE	07/13/2020	09/05/2026	N	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/13/2020	09/05/2026	N	SBN	NE
6605	PENTACHLOROPHENOL	07/13/2020	09/05/2026	N	SBN	NE
6615	PHENANTHRENE	07/13/2020	09/05/2026	N	SBN	NE
6665	PYRENE	07/13/2020	09/05/2026	N	SBN	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
6657	PROPYLENE GLYCOL	02/21/2017	09/05/2026	N	SBN	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
9369	DIESEL RANGE ORGANICS (DRO)	02/21/2017	09/05/2026	N	SNO	NE
Method Code: 10179201	**Method Ref: SW-846 8082A**		**Revision:**		**Date: 2000**	
8880	AROCLOR-1016 (PCB-1016)	02/21/2017	09/05/2026	N	SPC	NE
8885	AROCLOR-1221 (PCB-1221)	02/21/2017	09/05/2026	N	SPC	NE
8890	AROCLOR-1232 (PCB-1232)	02/21/2017	09/05/2026	N	SPC	NE
8895	AROCLOR-1242 (PCB-1242)	02/21/2017	09/05/2026	N	SPC	NE
8900	AROCLOR-1248 (PCB-1248)	02/21/2017	09/05/2026	N	SPC	NE
8905	AROCLOR-1254 (PCB-1254)	02/21/2017	09/05/2026	N	SPC	NE
8910	AROCLOR-1260 (PCB-1260)	02/21/2017	09/05/2026	N	SPC	NE
8912	AROCLOR-1262 (PCB-1262)	02/21/2017	09/05/2026	N	SPC	NE
8913	AROCLOR-1268 (PCB-1268)	02/21/2017	09/05/2026	N	SPC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
7355	4,4'-DDD	08/15/2022	09/05/2026	N	SPE	NE
7360	4,4'-DDE	08/15/2022	09/05/2026	N	SPE	NE
7365	4,4'-DDT	08/15/2022	09/05/2026	N	SPE	NE
7025	ALDRIN	08/15/2022	09/05/2026	N	SPE	NE
7110	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	N	SPE	NE

7115	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	N	SPE	NE
7250	CHLORDANE (TECH.)	08/15/2022	09/05/2026	N	SPE	NE
7240	CIS-CHLORDANE (ALPHA-CHLORDANE)	08/15/2022	09/05/2026	N	SPE	NE
7105	DELTA-BHC	08/15/2022	09/05/2026	N	SPE	NE
7470	DIELDRIN	08/15/2022	09/05/2026	N	SPE	NE
7510	ENDOSULFAN I	08/15/2022	09/05/2026	N	SPE	NE
7515	ENDOSULFAN II	08/15/2022	09/05/2026	N	SPE	NE
7520	ENDOSULFAN SULFATE	08/15/2022	09/05/2026	N	SPE	NE
7540	ENDRIN	08/15/2022	09/05/2026	N	SPE	NE
7530	ENDRIN ALDEHYDE	08/15/2022	09/05/2026	N	SPE	NE
7535	ENDRIN KETONE	08/15/2022	09/05/2026	N	SPE	NE
7120	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	N	SPE	NE
7245	GAMMA-CHLORDANE	08/15/2022	09/05/2026	N	SPE	NE
7685	HEPTACHLOR	08/15/2022	09/05/2026	N	SPE	NE
7690	HEPTACHLOR EPOXIDE	08/15/2022	09/05/2026	N	SPE	NE
7725	ISODRIN	08/15/2022	09/05/2026	N	SPE	NE
7810	METHOXYCHLOR	08/15/2022	09/05/2026	N	SPE	NE
7870	MIREX	08/15/2022	09/05/2026	N	SPE	NE
8250	TOXAPHENE (CHLORINATED CAMPHENE)	08/15/2022	09/05/2026	N	SPE	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
7065	ATRAZINE	07/13/2020	09/05/2026	N	SPE	NE
7180	CAPROLACTAM	07/13/2020	09/05/2026	N	SPE	NE
6285	HEXACHLOROCYCLOPENTADIENE	07/13/2020	09/05/2026	N	SPE	NE
Method Code: 10123463	**Method Ref: EPA 1633**		**Revision:**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	09/05/2025	09/05/2026	N	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	09/05/2025	09/05/2026	N	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	09/05/2025	09/05/2026	N	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	09/05/2025	09/05/2026	N	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	09/05/2025	09/05/2026	N	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	09/05/2025	09/05/2026	N	PFC	NE

9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	09/05/2025	09/05/2026	N	PFC	NE
9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	09/05/2025	09/05/2026	N	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	09/05/2025	09/05/2026	N	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	09/05/2025	09/05/2026	N	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	09/05/2025	09/05/2026	N	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	09/05/2025	09/05/2026	N	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	09/05/2025	09/05/2026	N	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	09/05/2025	09/05/2026	N	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	09/05/2025	09/05/2026	N	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	09/05/2025	09/05/2026	N	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	09/05/2025	09/05/2026	N	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	09/05/2025	09/05/2026	N	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	09/05/2025	09/05/2026	N	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	09/05/2025	09/05/2026	N	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	09/05/2025	09/05/2026	N	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	09/05/2025	09/05/2026	N	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	09/05/2025	09/05/2026	N	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	09/05/2025	09/05/2026	N	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	09/05/2025	09/05/2026	N	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	09/05/2025	09/05/2026	N	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	09/05/2025	09/05/2026	N	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	09/05/2025	09/05/2026	N	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	09/05/2025	09/05/2026	N	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	09/05/2025	09/05/2026	N	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	09/05/2025	09/05/2026	N	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	09/05/2025	09/05/2026	N	PFC	NE

6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	09/05/2025	09/05/2026	N	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	09/05/2025	09/05/2026	N	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	09/05/2025	09/05/2026	N	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	09/05/2025	09/05/2026	N	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	09/05/2025	09/05/2026	N	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	09/05/2025	09/05/2026	N	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	09/05/2025	09/05/2026	N	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	09/05/2025	09/05/2026	N	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	09/05/2025	09/05/2026	N	PFC	NE
Method Code: 10123474	**Method Ref: EPA 1633A**		**Revision: A**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	05/16/2025	09/05/2026	N	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	05/16/2025	09/05/2026	N	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	05/16/2025	09/05/2026	N	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	05/16/2025	09/05/2026	N	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	05/16/2025	09/05/2026	N	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	05/16/2025	09/05/2026	N	PFC	NE
9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	05/16/2025	09/05/2026	N	PFC	NE
9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	05/16/2025	09/05/2026	N	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	05/16/2025	09/05/2026	N	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	05/16/2025	09/05/2026	N	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	05/16/2025	09/05/2026	N	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	05/16/2025	09/05/2026	N	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	05/16/2025	09/05/2026	N	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	05/16/2025	09/05/2026	N	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	05/16/2025	09/05/2026	N	PFC	NE

4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	05/16/2025	09/05/2026	N	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	05/16/2025	09/05/2026	N	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	05/16/2025	09/05/2026	N	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	05/16/2025	09/05/2026	N	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	05/16/2025	09/05/2026	N	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	05/16/2025	09/05/2026	N	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	05/16/2025	09/05/2026	N	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	05/16/2025	09/05/2026	N	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	05/16/2025	09/05/2026	N	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	05/16/2025	09/05/2026	N	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	05/16/2025	09/05/2026	N	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	05/16/2025	09/05/2026	N	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	05/16/2025	09/05/2026	N	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	05/16/2025	09/05/2026	N	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	05/16/2025	09/05/2026	N	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	05/16/2025	09/05/2026	N	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	05/16/2025	09/05/2026	N	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	05/16/2025	09/05/2026	N	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	05/16/2025	09/05/2026	N	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	05/16/2025	09/05/2026	N	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	05/16/2025	09/05/2026	N	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	05/16/2025	09/05/2026	N	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	05/16/2025	09/05/2026	N	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	05/16/2025	09/05/2026	N	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	05/16/2025	09/05/2026	N	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	05/16/2025	09/05/2026	N	PFC	NE
Method Code: 60001174	**Method Ref: ALPHA SOP 23528**		**Revision: 17**		**Date: 2022**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	10/14/2022	09/05/2026	N	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	10/14/2022	09/05/2026	N	PFC	NE

9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	10/14/2022	09/05/2026	N	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	10/14/2022	09/05/2026	N	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	10/14/2022	09/05/2026	N	PFC	NE
6951	4,8-DIOXA-3H-PERFLURONONANOIC ACID (DONA) 919005-14-4	10/14/2022	09/05/2026	N	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	10/14/2022	09/05/2026	N	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	10/14/2022	09/05/2026	N	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	10/14/2022	09/05/2026	N	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	10/14/2022	09/05/2026	N	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	10/14/2022	09/05/2026	N	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	10/14/2022	09/05/2026	N	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	10/14/2022	09/05/2026	N	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	10/14/2022	09/05/2026	N	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	10/14/2022	09/05/2026	N	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	10/14/2022	09/05/2026	N	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	10/14/2022	09/05/2026	N	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	10/14/2022	09/05/2026	N	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	10/14/2022	09/05/2026	N	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	10/14/2022	09/05/2026	N	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	10/14/2022	09/05/2026	N	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	10/14/2022	09/05/2026	N	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	10/14/2022	09/05/2026	N	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	10/14/2022	09/05/2026	N	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	10/14/2022	09/05/2026	N	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	10/14/2022	09/05/2026	N	PFC	NE

6901	PERFLUOROHEXADECANOIC ACID (PFHXDA) 67905-19-5	10/14/2022	09/05/2026	N	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	10/14/2022	09/05/2026	N	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	10/14/2022	09/05/2026	N	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	10/14/2022	09/05/2026	N	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	10/14/2022	09/05/2026	N	PFC	NE
6916	PERFLUOROOCTADECANOIC ACID (PFODA) 16517-11-6	10/14/2022	09/05/2026	N	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	10/14/2022	09/05/2026	N	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	10/14/2022	09/05/2026	N	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	10/14/2022	09/05/2026	N	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	10/14/2022	09/05/2026	N	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	10/14/2022	09/05/2026	N	PFC	NE
9320	PERFLUOROPROPANESULFONIC ACID (PFPRS) 423-41-6	10/14/2022	09/05/2026	N	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	10/14/2022	09/05/2026	N	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	10/14/2022	09/05/2026	N	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	10/14/2022	09/05/2026	N	PFC	NE
Method Code: 10155916	**Method Ref: SW-846 6010D**		**Revision: UPDATE V**		**Date: 2014**	
1000	ALUMINUM	06/29/2018	09/05/2026	SC	MET	NE
1005	ANTIMONY	06/29/2018	09/05/2026	SC	MET	NE
1010	ARSENIC	06/29/2018	09/05/2026	SC	MET	NE
1015	BARIUM	06/29/2018	09/05/2026	SC	MET	NE
1020	BERYLLIUM	06/29/2018	09/05/2026	SC	MET	NE
1025	BORON	06/29/2018	09/05/2026	SC	MET	NE
1030	CADMIUM	06/29/2018	09/05/2026	SC	MET	NE
1035	CALCIUM	06/29/2018	09/05/2026	SC	MET	NE
1040	CHROMIUM	06/29/2018	09/05/2026	SC	MET	NE
1050	COBALT	06/29/2018	09/05/2026	SC	MET	NE
1055	COPPER	06/29/2018	09/05/2026	SC	MET	NE
1070	IRON	06/29/2018	09/05/2026	SC	MET	NE
1075	LEAD	06/29/2018	09/05/2026	SC	MET	NE
1080	LITHIUM	10/30/2023	09/05/2026	SC	MET	NE
1085	MAGNESIUM	06/29/2018	09/05/2026	SC	MET	NE
1090	MANGANESE	06/29/2018	09/05/2026	SC	MET	NE
1100	MOLYBDENUM	06/29/2018	09/05/2026	SC	MET	NE
1105	NICKEL	06/29/2018	09/05/2026	SC	MET	NE
1125	POTASSIUM	06/29/2018	09/05/2026	SC	MET	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

1140	SELENIUM	06/29/2018	09/05/2026	SC	MET	NE
1150	SILVER	06/29/2018	09/05/2026	SC	MET	NE
1155	SODIUM	06/29/2018	09/05/2026	SC	MET	NE
1160	STRONTIUM	06/29/2018	09/05/2026	SC	MET	NE
1165	THALLIUM	06/29/2018	09/05/2026	SC	MET	NE
1175	TIN	06/29/2018	09/05/2026	SC	MET	NE
1180	TITANIUM	06/29/2018	09/05/2026	SC	MET	NE
1185	VANADIUM	06/29/2018	09/05/2026	SC	MET	NE
1190	ZINC	06/29/2018	09/05/2026	SC	MET	NE

Method Code: 10156420 **Method Ref: SW-846 6020B** **Revision: UPDATE V** **Date: 2014**

1000	ALUMINUM	06/29/2018	09/05/2026	SC	MET	NE
1005	ANTIMONY	06/29/2018	09/05/2026	SC	MET	NE
1010	ARSENIC	06/29/2018	09/05/2026	SC	MET	NE
1015	BARIUM	06/29/2018	09/05/2026	SC	MET	NE
1020	BERYLLIUM	06/29/2018	09/05/2026	SC	MET	NE
1030	CADMIUM	06/29/2018	09/05/2026	SC	MET	NE
1035	CALCIUM	06/29/2018	09/05/2026	SC	MET	NE
1040	CHROMIUM	06/29/2018	09/05/2026	SC	MET	NE
1050	COBALT	06/29/2018	09/05/2026	SC	MET	NE
1055	COPPER	06/29/2018	09/05/2026	SC	MET	NE
1070	IRON	06/29/2018	09/05/2026	SC	MET	NE
1075	LEAD	06/29/2018	09/05/2026	SC	MET	NE
1085	MAGNESIUM	06/29/2018	09/05/2026	SC	MET	NE
1090	MANGANESE	06/29/2018	09/05/2026	SC	MET	NE
1100	MOLYBDENUM	06/29/2018	09/05/2026	SC	MET	NE
1105	NICKEL	06/29/2018	09/05/2026	SC	MET	NE
1125	POTASSIUM	06/29/2018	09/05/2026	SC	MET	NE
1140	SELENIUM	06/29/2018	09/05/2026	SC	MET	NE
1150	SILVER	06/29/2018	09/05/2026	SC	MET	NE
1155	SODIUM	06/29/2018	09/05/2026	SC	MET	NE
1160	STRONTIUM	06/29/2018	09/05/2026	SC	MET	NE
1165	THALLIUM	06/29/2018	09/05/2026	SC	MET	NE
1175	TIN	06/29/2018	09/05/2026	SC	MET	NE
1185	VANADIUM	06/29/2018	09/05/2026	SC	MET	NE
1190	ZINC	06/29/2018	09/05/2026	SC	MET	NE

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998

PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 206225-C

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

Method Code: 10166457	**Method Ref: SW-846 7471B**		**Revision: UPDATE IV**		**Date: 2007**	
1095	MERCURY	12/29/2017	09/05/2026	SC	MET	NE
Method Code: 10167007	**Method Ref: SW-846 7474**		**Revision:**		**Date: 2007**	
1095	MERCURY	02/21/2017	09/05/2026	SC	MET	NE
Method Code: 10155916	**Method Ref: SW-846 6010D**		**Revision: UPDATE V**		**Date: 2014**	
2017	SULFUR	06/29/2018	09/05/2026	SC	NMI	NE
Method Code: 20005203	**Method Ref: SM 2540 G**		**Revision: 18th ED**		**Date: 1992**	
1950	RESIDUE-TOTAL (TS)	02/21/2017	09/05/2026	SC	NMI	NE
Method Code: 10135601	**Method Ref: SW-846 3050B**		**Revision: UPDATE III**		**Date: 1996**	
1400	ACID DIGESTION OF SOLIDS	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10136002	**Method Ref: SW-846 3051A**		**Revision: UPDATE IV**		**Date: 2007**	
1426	MICROWAVE DIGESTION OF SOLIDS	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10142708	**Method Ref: SW-846 3570**		**Revision:**		**Date: 2002**	
1429	MICROSCALE SOLVENT EXTRACTION	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10143007	**Method Ref: SW-846 3580A**		**Revision: UPDATE I**		**Date: 1992**	
1470	WASTE DILUTION	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10146802	**Method Ref: SW-846 3630C**		**Revision: UPDATE III**		**Date: 1996**	
1446	SILICA GEL CLEAN-UP	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10147203	**Method Ref: SW-846 3640A**		**Revision: UPDATE II**		**Date: 1994**	
1418	GEL-PERMEATION CLEAN-UP	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10148400	**Method Ref: SW-846 3660B**		**Revision: UPDATE III**		**Date: 1996**	
1456	SULFUR CLEAN-UP	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10148808	**Method Ref: SW-846 3665A**		**Revision: UPDATE III**		**Date: 1996**	
1458	SULFURIC ACID / PERMANGANATE CLEAN-UP	02/21/2017	09/05/2026	SC	PRE	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
5155	1,2,4-TRICHLOROBENZENE	07/07/2022	09/05/2026	SC	VOC	NE
4610	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	07/07/2022	09/05/2026	SC	VOC	NE
4615	1,3-DICHLOROBENZENE (M-DICHLOROBENZNE)	07/07/2022	09/05/2026	SC	VOC	NE
4620	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	07/07/2022	09/05/2026	SC	VOC	NE
4835	HEXACHLOROBUTADIENE	07/07/2022	09/05/2026	SC	VOC	NE
4840	HEXACHLOROETHANE	07/07/2022	09/05/2026	SC	VOC	NE
5005	NAPHTHALENE	07/07/2022	09/05/2026	SC	VOC	NE
5015	NITROBENZENE	07/07/2022	09/05/2026	SC	VOC	NE
5095	PYRIDINE	07/07/2022	09/05/2026	SC	VOC	NE
Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
5005	NAPHTHALENE	07/13/2020	09/05/2026	SC	VOC	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
4750	ETHANOL	02/21/2017	09/05/2026	SC	VOC	NE

4785	ETHYLENE GLYCOL	02/21/2017	09/05/2026	SC	VOC	NE
4875	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	02/21/2017	09/05/2026	SC	VOC	NE
4895	ISOPROPYL ALCOHOL (2-PROPANOL, ISOPROPANOL)	02/21/2017	09/05/2026	SC	VOC	NE
4930	METHANOL	02/21/2017	09/05/2026	SC	VOC	NE
5055	N-PROPANOL	02/21/2017	09/05/2026	SC	VOC	NE
4368	TERT-AMYL ALCOHOL (TAA)	02/21/2017	09/05/2026	SC	VOC	NE
4420	TERT-BUTYL ALCOHOL (2-METHYL-2-PROPANOL)	02/21/2017	09/05/2026	SC	VOC	NE
Method Code: NH0361	**Method Ref: SW-846 8270E SIM ISOTOPE DILUTION**		**Revision: UPDATE VI**		**Date: 2018**	
4735	1,4-DIOXANE (1 4-DIETHYLENEOXIDE)	05/29/2024	09/05/2026	SC	VOC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
6275	HEXACHLOROBENZENE	08/15/2022	09/05/2026	SC	SBN	NE
Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
6703	1,1'-BIPHENYL (BZ-0)	07/07/2022	09/05/2026	SC	SBN	NE
6715	1,2,4,5-TETRACHLOROBENZENE	07/07/2022	09/05/2026	SC	SBN	NE
6220	1,2-DIPHENYLHYDRAZINE	07/07/2022	09/05/2026	SC	SBN	NE
4659	2,2'-OXYBIS(1-CHLOROPROPANE), BIS(2-CHLORO-1-METHYLETHYL)ETHER	07/07/2022	09/05/2026	SC	SBN	NE
6735	2,3,4,6-TETRACHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6835	2,4,5-TRICHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6840	2,4,6-TRICHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6000	2,4-DICHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6130	2,4-DIMETHYLPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6175	2,4-DINITROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6185	2,4-DINITROTOLUENE (2,4-DNT)	07/07/2022	09/05/2026	SC	SBN	NE
6190	2,6-DINITROTOLUENE (2,6-DNT)	07/07/2022	09/05/2026	SC	SBN	NE
5795	2-CHLORONAPHTHALENE	07/07/2022	09/05/2026	SC	SBN	NE
5800	2-CHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6360	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	07/07/2022	09/05/2026	SC	SBN	NE
6385	2-METHYLNAPHTHALENE	07/07/2022	09/05/2026	SC	SBN	NE
6400	2-METHYLPHENOL (O-CRESOL)	07/07/2022	09/05/2026	SC	SBN	NE
6460	2-NITROANILINE	07/07/2022	09/05/2026	SC	SBN	NE
6490	2-NITROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
5945	3,3'-DICHLOROBENZIDINE	07/07/2022	09/05/2026	SC	SBN	NE
6405	3-METHYLPHENOL (M-CRESOL)	07/07/2022	09/05/2026	SC	SBN	NE
6465	3-NITROANILINE	07/07/2022	09/05/2026	SC	SBN	NE

5660	4-BROMOPHENYL PHENYL ETHER (BDE-3)	07/07/2022	09/05/2026	SC	SBN	NE
5700	4-CHLORO-3-METHYLPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
5745	4-CHLOROANILINE	07/07/2022	09/05/2026	SC	SBN	NE
5825	4-CHLOROPHENYL PHENYLETHER	07/07/2022	09/05/2026	SC	SBN	NE
6410	4-METHYLPHENOL (P-CRESOL)	07/07/2022	09/05/2026	SC	SBN	NE
6470	4-NITROANILINE	07/07/2022	09/05/2026	SC	SBN	NE
6500	4-NITROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
5500	ACENAPHTHENE	07/07/2022	09/05/2026	SC	SBN	NE
5505	ACENAPHTHYLENE	07/07/2022	09/05/2026	SC	SBN	NE
5510	ACETOPHENONE	07/07/2022	09/05/2026	SC	SBN	NE
5545	ANILINE	07/07/2022	09/05/2026	SC	SBN	NE
5555	ANTHRACENE	07/07/2022	09/05/2026	SC	SBN	NE
5570	BENZALDEHYDE	07/07/2022	09/05/2026	SC	SBN	NE
5595	BENZIDINE	07/07/2022	09/05/2026	SC	SBN	NE
5575	BENZO(A)ANTHRACENE	07/07/2022	09/05/2026	SC	SBN	NE
5580	BENZO(A)PYRENE	07/07/2022	09/05/2026	SC	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/07/2022	09/05/2026	SC	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/07/2022	09/05/2026	SC	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/07/2022	09/05/2026	SC	SBN	NE
5610	BENZOIC ACID	07/07/2022	09/05/2026	SC	SBN	NE
5630	BENZYL ALCOHOL	07/07/2022	09/05/2026	SC	SBN	NE
5760	BIS(2-CHLOROETHOXY)METHANE	07/07/2022	09/05/2026	SC	SBN	NE
5765	BIS(2-CHLOROETHYL) ETHER	07/07/2022	09/05/2026	SC	SBN	NE
5670	BUTYL BENZYL PHTHALATE	07/07/2022	09/05/2026	SC	SBN	NE
5680	CARBAZOLE	07/07/2022	09/05/2026	SC	SBN	NE
5855	CHRYSENE	07/07/2022	09/05/2026	SC	SBN	NE
6065	DI(2-ETHYLHEXYL) PHTHALATE (BIS(2-ETHYLHEXYL)PHTHALATE, DEHP)	07/07/2022	09/05/2026	SC	SBN	NE
5925	DI-N-BUTYL PHTHALATE	07/07/2022	09/05/2026	SC	SBN	NE
6200	DI-N-OCTYL PHTHALATE	07/07/2022	09/05/2026	SC	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/07/2022	09/05/2026	SC	SBN	NE
5905	DIBENZOFURAN	07/07/2022	09/05/2026	SC	SBN	NE
6070	DIETHYL PHTHALATE	07/07/2022	09/05/2026	SC	SBN	NE
6135	DIMETHYL PHTHALATE	07/07/2022	09/05/2026	SC	SBN	NE
6265	FLUORANTHENE	07/07/2022	09/05/2026	SC	SBN	NE

6270	FLUORENE	07/07/2022	09/05/2026	SC	SBN	NE
6275	HEXACHLOROBENZENE	07/07/2022	09/05/2026	SC	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/07/2022	09/05/2026	SC	SBN	NE
6320	ISOPHORONE	07/07/2022	09/05/2026	SC	SBN	NE
6545	N-NITROSODI-N-PROPYLAMINE	07/07/2022	09/05/2026	SC	SBN	NE
6530	N-NITROSODIMETHYLAMINE	07/07/2022	09/05/2026	SC	SBN	NE
6535	N-NITROSODIPHENYLAMINE	07/07/2022	09/05/2026	SC	SBN	NE
6600	PENTACHLORONITROBENZENE	07/07/2022	09/05/2026	SC	SBN	NE
6605	PENTACHLOROPHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6615	PHENANTHRENE	07/07/2022	09/05/2026	SC	SBN	NE
6625	PHENOL	07/07/2022	09/05/2026	SC	SBN	NE
6665	PYRENE	07/07/2022	09/05/2026	SC	SBN	NE
Method Code: 10242565	**Method Ref: SW-846 8270E SIM**		**Revision: UPDATE VI**		**Date: 2018**	
6380	1-METHYLNAPHTHALENE	07/13/2020	09/05/2026	SC	SBN	NE
6385	2-METHYLNAPHTHALENE	07/13/2020	09/05/2026	SC	SBN	NE
5500	ACENAPHTHENE	07/13/2020	09/05/2026	SC	SBN	NE
5505	ACENAPHTHYLENE	07/13/2020	09/05/2026	SC	SBN	NE
9297	ALKALATED PAHS	07/13/2020	09/05/2026	SC	SBN	NE
5555	ANTHRACENE	07/13/2020	09/05/2026	SC	SBN	NE
5575	BENZO(A)ANTHRACENE	07/13/2020	09/05/2026	SC	SBN	NE
5580	BENZO(A)PYRENE	07/13/2020	09/05/2026	SC	SBN	NE
5585	BENZO(B)FLUORANTHENE	07/13/2020	09/05/2026	SC	SBN	NE
5590	BENZO(G,H,I)PERYLENE	07/13/2020	09/05/2026	SC	SBN	NE
5600	BENZO(K)FLUORANTHENE	07/13/2020	09/05/2026	SC	SBN	NE
5855	CHRYSENE	07/13/2020	09/05/2026	SC	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	07/13/2020	09/05/2026	SC	SBN	NE
6265	FLUORANTHENE	07/13/2020	09/05/2026	SC	SBN	NE
6270	FLUORENE	07/13/2020	09/05/2026	SC	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	07/13/2020	09/05/2026	SC	SBN	NE
6605	PENTACHLOROPHENOL	07/13/2020	09/05/2026	SC	SBN	NE
6615	PHENANTHRENE	07/13/2020	09/05/2026	SC	SBN	NE
6665	PYRENE	07/13/2020	09/05/2026	SC	SBN	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
6657	PROPYLENE GLYCOL	02/21/2017	09/05/2026	SC	SBN	NE
Method Code: 10305609	**Method Ref: SW-846 8015D**		**Revision:**		**Date: 2003**	
9369	DIESEL RANGE ORGANICS (DRO)	02/21/2017	09/05/2026	SC	SNO	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)

320 FORBES BLVD

MANSFIELD MA 02048

508-822-9300

Lab ID: 2062

Method Code: 10179201	**Method Ref: SW-846 8082A**		**Revision:**		**Date: 2000**	
8880	AROCLOR-1016 (PCB-1016)	02/21/2017	09/05/2026	SC	SPC	NE
8885	AROCLOR-1221 (PCB-1221)	02/21/2017	09/05/2026	SC	SPC	NE
8890	AROCLOR-1232 (PCB-1232)	02/21/2017	09/05/2026	SC	SPC	NE
8895	AROCLOR-1242 (PCB-1242)	02/21/2017	09/05/2026	SC	SPC	NE
8900	AROCLOR-1248 (PCB-1248)	02/21/2017	09/05/2026	SC	SPC	NE
8905	AROCLOR-1254 (PCB-1254)	02/21/2017	09/05/2026	SC	SPC	NE
8910	AROCLOR-1260 (PCB-1260)	02/21/2017	09/05/2026	SC	SPC	NE
8912	AROCLOR-1262 (PCB-1262)	02/21/2017	09/05/2026	SC	SPC	NE
8913	AROCLOR-1268 (PCB-1268)	02/21/2017	09/05/2026	SC	SPC	NE
Method Code: 10178811	**Method Ref: SW-846 8081B**		**Revision: UPDATE IV**		**Date: 2007**	
7355	4,4'-DDD	08/15/2022	09/05/2026	SC	SPE	NE
7360	4,4'-DDE	08/15/2022	09/05/2026	SC	SPE	NE
7365	4,4'-DDT	08/15/2022	09/05/2026	SC	SPE	NE
7025	ALDRIN	08/15/2022	09/05/2026	SC	SPE	NE
7110	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	SC	SPE	NE
7115	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	SC	SPE	NE
7250	CHLORDANE (TECH.)	08/15/2022	09/05/2026	SC	SPE	NE
7240	CIS-CHLORDANE (ALPHA-CHLORDANE)	08/15/2022	09/05/2026	SC	SPE	NE
7105	DELTA-BHC	08/15/2022	09/05/2026	SC	SPE	NE
7470	DIELDRIN	08/15/2022	09/05/2026	SC	SPE	NE
7510	ENDOSULFAN I	08/15/2022	09/05/2026	SC	SPE	NE
7515	ENDOSULFAN II	08/15/2022	09/05/2026	SC	SPE	NE
7520	ENDOSULFAN SULFATE	08/15/2022	09/05/2026	SC	SPE	NE
7540	ENDRIN	08/15/2022	09/05/2026	SC	SPE	NE
7530	ENDRIN ALDEHYDE	08/15/2022	09/05/2026	SC	SPE	NE
7535	ENDRIN KETONE	08/15/2022	09/05/2026	SC	SPE	NE
7120	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEXANE)	08/15/2022	09/05/2026	SC	SPE	NE
7245	GAMMA-CHLORDANE	08/15/2022	09/05/2026	SC	SPE	NE
7685	HEPTACHLOR	08/15/2022	09/05/2026	SC	SPE	NE
7690	HEPTACHLOR EPOXIDE	08/15/2022	09/05/2026	SC	SPE	NE
7810	METHOXYCHLOR	08/15/2022	09/05/2026	SC	SPE	NE
7870	MIREX	08/15/2022	09/05/2026	SC	SPE	NE
8250	TOXAPHENE (CHLORINATED CAMPHENE)	08/15/2022	09/05/2026	SC	SPE	NE

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998

PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 206225-C

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

Method Code: 10242543	**Method Ref: SW-846 8270E**		**Revision: UPDATE VI**		**Date: 2018**	
7180	CAPROLACTAM	07/07/2022	09/05/2026	SC	SPE	NE
6285	HEXACHLOROCYCLOPENTADIENE	07/07/2022	09/05/2026	SC	SPE	NE
Method Code: 10123463	**Method Ref: EPA 1633**		**Revision:**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	09/05/2025	09/05/2026	SC	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	09/05/2025	09/05/2026	SC	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	09/05/2025	09/05/2026	SC	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	09/05/2025	09/05/2026	SC	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	09/05/2025	09/05/2026	SC	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	09/05/2025	09/05/2026	SC	PFC	NE
9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	09/05/2025	09/05/2026	SC	PFC	NE
9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	09/05/2025	09/05/2026	SC	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	09/05/2025	09/05/2026	SC	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	09/05/2025	09/05/2026	SC	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	09/05/2025	09/05/2026	SC	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	09/05/2025	09/05/2026	SC	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	09/05/2025	09/05/2026	SC	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	09/05/2025	09/05/2026	SC	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	09/05/2025	09/05/2026	SC	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	09/05/2025	09/05/2026	SC	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	09/05/2025	09/05/2026	SC	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	09/05/2025	09/05/2026	SC	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	09/05/2025	09/05/2026	SC	PFC	NE

6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	09/05/2025	09/05/2026	SC	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	09/05/2025	09/05/2026	SC	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	09/05/2025	09/05/2026	SC	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	09/05/2025	09/05/2026	SC	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	09/05/2025	09/05/2026	SC	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	09/05/2025	09/05/2026	SC	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	09/05/2025	09/05/2026	SC	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	09/05/2025	09/05/2026	SC	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	09/05/2025	09/05/2026	SC	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	09/05/2025	09/05/2026	SC	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	09/05/2025	09/05/2026	SC	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	09/05/2025	09/05/2026	SC	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	09/05/2025	09/05/2026	SC	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	09/05/2025	09/05/2026	SC	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	09/05/2025	09/05/2026	SC	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	09/05/2025	09/05/2026	SC	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	09/05/2025	09/05/2026	SC	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	09/05/2025	09/05/2026	SC	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	09/05/2025	09/05/2026	SC	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	09/05/2025	09/05/2026	SC	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	09/05/2025	09/05/2026	SC	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	09/05/2025	09/05/2026	SC	PFC	NE
Method Code: 10123474	**Method Ref: EPA 1633A**		**Revision: A**		**Date: 2024**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	05/16/2025	09/05/2026	SC	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	05/16/2025	09/05/2026	SC	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	05/16/2025	09/05/2026	SC	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	05/16/2025	09/05/2026	SC	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	05/16/2025	09/05/2026	SC	PFC	NE
9340	2H,2H,3H,3H-PERFLUORODECANOIC ACID (7:3 FTCA) 812-70-4	05/16/2025	09/05/2026	SC	PFC	NE
9338	2H,2H,3H,3H-PERFLUOROOCTANOIC ACID (5:3 FTCA) 914637-49-3	05/16/2025	09/05/2026	SC	PFC	NE

9353	4,4,5,5,6,6-HEPAFLUOROHEXANOIC ACID (3:3 FTCA) 356-02-5	05/16/2025	09/05/2026	SC	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	05/16/2025	09/05/2026	SC	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	05/16/2025	09/05/2026	SC	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	05/16/2025	09/05/2026	SC	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	05/16/2025	09/05/2026	SC	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	05/16/2025	09/05/2026	SC	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	05/16/2025	09/05/2026	SC	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	05/16/2025	09/05/2026	SC	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	05/16/2025	09/05/2026	SC	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	05/16/2025	09/05/2026	SC	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	05/16/2025	09/05/2026	SC	PFC	NE
6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	05/16/2025	09/05/2026	SC	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	05/16/2025	09/05/2026	SC	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	05/16/2025	09/05/2026	SC	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	05/16/2025	09/05/2026	SC	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	05/16/2025	09/05/2026	SC	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	05/16/2025	09/05/2026	SC	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	05/16/2025	09/05/2026	SC	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	05/16/2025	09/05/2026	SC	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	05/16/2025	09/05/2026	SC	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	05/16/2025	09/05/2026	SC	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	05/16/2025	09/05/2026	SC	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	05/16/2025	09/05/2026	SC	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	05/16/2025	09/05/2026	SC	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	05/16/2025	09/05/2026	SC	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	05/16/2025	09/05/2026	SC	PFC	NE

6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	05/16/2025	09/05/2026	SC	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	05/16/2025	09/05/2026	SC	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	05/16/2025	09/05/2026	SC	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	05/16/2025	09/05/2026	SC	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	05/16/2025	09/05/2026	SC	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	05/16/2025	09/05/2026	SC	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	05/16/2025	09/05/2026	SC	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	05/16/2025	09/05/2026	SC	PFC	NE
Method Code: 60001174	**Method Ref: ALPHA SOP 23528**		**Revision: 17**		**Date: 2022**	
9490	11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID (11-CL-PF3OUDS)	10/14/2022	09/05/2026	SC	PFC	NE
6948	1H, 1H, 2H, 2H-PERFLUORODECANESULFONIC ACID (8:2 FTS) 39108-34-4	10/14/2022	09/05/2026	SC	PFC	NE
9616	1H, 1H, 2H, 2H-PERFLUORODODECANE SULFONIC ACID (10:2 FTS) 120226-60-0	10/14/2022	09/05/2026	SC	PFC	NE
6946	1H, 1H, 2H, 2H-PERFLUOROHEXANESULFONIC ACID (4:2 FTS) 757124-72-4	10/14/2022	09/05/2026	SC	PFC	NE
6947	1H, 1H, 2H, 2H-PERFLUOROOCTANESULFONIC ACID (6:2 FTS) 27619-97-2	10/14/2022	09/05/2026	SC	PFC	NE
6951	4,8-DIOXA-3H-PERFLUORONONANOIC ACID (DONA) 919005-14-4	10/14/2022	09/05/2026	SC	PFC	NE
6952	9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID (9-CL-PF3ONS)	10/14/2022	09/05/2026	SC	PFC	NE
9460	HEXAFLUOROPROPYLENEOXIDE DIMER ACID (HFPO-DA) (GENX) 13252-13-6	10/14/2022	09/05/2026	SC	PFC	NE
9395	N-ETHYLPERFLUOROOCTANE SULFONAMIDE (ETFOSAM) 4151-50-2	10/14/2022	09/05/2026	SC	PFC	NE
4846	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NETFOSAA) 2991-50-6	10/14/2022	09/05/2026	SC	PFC	NE
9431	N-ETHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (ETFOSE) 1691-99-2	10/14/2022	09/05/2026	SC	PFC	NE
9433	N-METHYLPERFLUOROOCTANE SULFONAMIDE (MEFOSA) 31506-32-8	10/14/2022	09/05/2026	SC	PFC	NE
4847	N-METHYLPERFLUOROOCTANE SULFONAMIDO ACETIC ACID (NMEFOSAA) 2355-31-9	10/14/2022	09/05/2026	SC	PFC	NE
6949	N-METHYLPERFLUOROOCTANE SULFONAMIDO ETHANOL (MEFOSE) 24448-09-7	10/14/2022	09/05/2026	SC	PFC	NE
6956	NONFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA) 151772-58-6	10/14/2022	09/05/2026	SC	PFC	NE

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

6957	PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA) 113507-82-7	10/14/2022	09/05/2026	SC	PFC	NE
6965	PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA) 377-73-1	10/14/2022	09/05/2026	SC	PFC	NE
6966	PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA) 863090-89-5	10/14/2022	09/05/2026	SC	PFC	NE
6918	PERFLUOROBUTANE SULFONIC ACID (PFBS) 375-73-5	10/14/2022	09/05/2026	SC	PFC	NE
6915	PERFLUOROBUTANOIC ACID (PFBA) 375-22-4	10/14/2022	09/05/2026	SC	PFC	NE
6920	PERFLUORODECANE SULFONIC ACID (PFDS) 335-77-3	10/14/2022	09/05/2026	SC	PFC	NE
6905	PERFLUORODECANOIC ACID (PFDA) 335-76-2	10/14/2022	09/05/2026	SC	PFC	NE
6923	PERFLUORODODECANE SULFONIC ACID (PFDOS) 79780-39-5	10/14/2022	09/05/2026	SC	PFC	NE
6903	PERFLUORODODECANOIC ACID (PFDOA) 307-55-1	10/14/2022	09/05/2026	SC	PFC	NE
9470	PERFLUOROHEPTANE SULFONIC ACID (PFHPS) 375-92-8	10/14/2022	09/05/2026	SC	PFC	NE
6908	PERFLUOROHEPTANOIC ACID (PFHPA) 375-85-9	10/14/2022	09/05/2026	SC	PFC	NE
6901	PERFLUOROHEXADECANOIC ACID (PFHXDA) 67905-19-5	10/14/2022	09/05/2026	SC	PFC	NE
6927	PERFLUOROHEXANE SULFONIC ACID (PFHXS) 355-46-4	10/14/2022	09/05/2026	SC	PFC	NE
6913	PERFLUOROHEXANOIC ACID (PFHXA) 307-24-4	10/14/2022	09/05/2026	SC	PFC	NE
6929	PERFLUORONONANE SULFONIC ACID (PFNS) 68259-12-1	10/14/2022	09/05/2026	SC	PFC	NE
6906	PERFLUORONONANOIC ACID (PFNA) 375-95-1	10/14/2022	09/05/2026	SC	PFC	NE
6916	PERFLUOROOCTADECANOIC ACID (PFODA) 16517-11-6	10/14/2022	09/05/2026	SC	PFC	NE
6917	PERFLUOROOCTANE SULFONAMIDE (PFOSAM) 754-91-6	10/14/2022	09/05/2026	SC	PFC	NE
6931	PERFLUOROOCTANE SULFONIC ACID (PFOS) 1763-23-1	10/14/2022	09/05/2026	SC	PFC	NE
6912	PERFLUOROOCTANOIC ACID (PFOA) 335-67-1	10/14/2022	09/05/2026	SC	PFC	NE
6934	PERFLUOROPENTANE SULFONIC ACID (PFPES) 2706-91-4	10/14/2022	09/05/2026	SC	PFC	NE
6914	PERFLUOROPENTANOIC ACID (PFPEA) 2706-90-3	10/14/2022	09/05/2026	SC	PFC	NE
9320	PERFLUOROPROPANESULFONIC ACID (PFPRS) 423-41-6	10/14/2022	09/05/2026	SC	PFC	NE
6902	PERFLUOROTETRADECANOIC ACID (PFTDA) 376-06-7	10/14/2022	09/05/2026	SC	PFC	NE
9563	PERFLUOROTRIDECANOIC ACID (PFTRDA) 72629-94-8	10/14/2022	09/05/2026	SC	PFC	NE
6904	PERFLUOROUNDECANOIC ACID (PFUNDA) 2058-94-8	10/14/2022	09/05/2026	SC	PFC	NE

PACE ANALYTI 12/9/2025

Brian Lamarsh
NH ELAP Program Manager
Issue Date: 12/09/2025

This analyte list supersedes all previously issued analyte lists. Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation status by calling (603) 271-2998 or by visiting the NH ELAP website (https://www.des.nh.gov/water/drinking-water/new-hampshire-environmental-laboratory-accreditation-program).

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998

PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 206225-C

PACE ANALYTICAL SERVICES LLC MANSFIELD MA (320 FORBES)
320 FORBES BLVD
MANSFIELD MA 02048
508-822-9300

Lab ID: 2062

Matrix Legend: AE=Air; BT=Tissue; D=Drinking Water; N=Non-Potable Water; SC=Solid and Chemical Materials

Category Legend: MIC=Microbiology; MET=Metals; NMI=Non-Metal Inorganics; PRE=Preparation; VOC=Volatile Organic Compounds; SBN=SVOC-BNA; SHE=SVOC-Herbicides; SNO=SVOC-NOS; SPC=SVOC-PCB; SPE=SVOC-Pesticides; RAD=Radiochemistry; WET=Wet, PFC=Perfluorinated compound

Accreditation Legend: NE=NELAP; NH=NH State Certification; CE=State Certification; IN=Interim (NELAP); WI=Withdrawn; AP=Applied; RE=Revoked; SU=Suspended

This analyte list supersedes all previously issued analyte lists. Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation status by calling (603) 271-2998 or by visiting the NH ELAP website (https://www.des.nh.gov/water/drinking-water/new-hampshire-environmental-laboratory-accreditation-program).

Appendix B
Health and Safety Plan

HEALTH AND SAFETY PLAN; FOR PER AND POLYFLUOROALKYL SUBSTANCES (PFAS) SITE INVESTIGATION

for

Perdue AgriBusiness LLC
6906 Zion Church Road
Salisbury, Maryland

Prepared for:

Perdue AgriBusiness LLC
P.O. Box 1537
Salisbury, MD 21802-1537

Prepared by:

Langan Engineering and Environmental Services, LLC
1818 Market Street, Suite 3300
Philadelphia, Pennsylvania 19103

March 5, 2025
Langan Project No.: 220210101

LANGAN

TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION 1

2.0 EMERGENCY RESPONSE PLAN 1

2.1 GENERAL 1
2.2 RESPONSIBILITIES 2
2.3 EMERGENCY MEDICAL TREATMENT 2
2.4 NON-EMERGENCY MEDICAL TREATMENT 3
2.5 NEAREST MEDICAL ASSISTANCE 3
2.6 EMERGENCY CONTACTS/NOTIFICATION SYSTEM 4
2.7 EVACUATION 4
2.8 THE BUDDY SYSTEM 5
2.9 FIRE OR EXPLOSION 5
2.10 EXPLOSIVE ATMOSPHERES 5
2.11 OXYGEN DEFICIENT ATMOSPHERES 6
2.12 SPILLS/LEAKS 6
2.13 ADVERSE WEATHER CONDITIONS 7
2.14 UNDERGROUND UTILITIES STRIKE 7
2.15 DOCUMENTATION 7

3.0 SITE LOCATION AND BACKGROUND 8

3.1 LOCATION 8
3.2 BACKGROUND 8
3.3 SUMMARY OF WORK TASKS 9

4.0 IDENTIFICATION OF KEY PERSONNEL/HEALTH AND SAFETY PERSONNEL 9

4.1 LANGAN PROJECT MANAGER (PM) 9
4.2 LANGAN CORPORATE HEALTH AND SAFETY MANAGER (HSM) 9
4.3 LANGAN SITE SAFETY OFFICER (SSO) 10
4.4 SUBCONTRACTOR RESPONSIBILITIES 11

5.0 GENERAL HAZARD MANAGEMENT 11

5.1 CHEMICAL EXPOSURE HAZARDS 12
5.2 PHYSICAL HAZARDS 12
5.3 BIOLOGICAL HAZARDS 12

5.4 TASK-BY-TASK RISK ANALYSIS 12
5.5 JOB SAFETY ANALYSIS 12
5.6 TAILGATE SAFETY BRIEFINGS 12
5.7 SAFE WORK CERTIFICATE 13

6.0 TRAINING & MEDICAL CLEARANCE REQUIREMENTS 13

6.1 PROJECT TRAINING 13
6.2 SITE SPECIFIC TRAINING 13
6.3 MEDICAL SURVEILLANCE/FITNESS FOR DUTY 14

7.0 AIR MONITORING 14

7.1 GENERAL 14
7.2 ACTION LEVELS 14

8.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) 15

8.1 LEVELS OF PROTECTION 15
8.2 RESPIRATOR FIT-TEST 17

9.0 SITE CONTROL 17

9.1 SITE COMMUNICATIONS PLAN 17
9.2 WORK ZONES 18
9.3 STANDING ORDERS/SAFE WORK PRACTICES 18
9.4 SITE SECURITY 18
9.5 UNDERGROUND UTILITY CLEARANCE 19
9.6 SITE SAFETY INSPECTION 19
9.7 HAND AND POWER TOOLS 19
9.8 STOP WORK AUTHORITY 19
9.9 SUBCONTRACTOR SAFETY SCREENING PROGRAM 20

10.0 DECONTAMINATION PLAN 21

10.1 GENERAL 21
10.2 DECONTAMINATION PROCEDURES 21
10.3 DISPOSAL OF WASTES 22

11.0 CONFINED SPACE ENTRY 22

12.0 HASP ACKNOWLEDGEMENT FORM 22

LIST OF TABLES

Table 1 Emergency Notification List*****

Table 2 Task Risk Analysis

Table 3 Summary of Monitoring Equipment

Table 4 Instrument Action Levels

LIST OF FIGURES

Figure 1 Route to Hospital (map with directions)*

LIST OF APPENDICES

Appendix A Standing Orders*

Appendix B Decontamination Procedures

Appendix C Employee Exposure/Injury Incident Report

Appendix D Calibration Log

Appendix E Safety Data Sheets (SDS)*

Appendix F Jobsite Safety Inspection Checklist

Appendix G Job Safety Analysis Forms

* Items to be posted prominently on site or made readily available to personnel

1.0 INTRODUCTION

Langan Engineering and Environmental Services, LLC (Langan) is committed to providing a safe and healthful work environment. Langan's goal is to be SAFE (Stay Accident Free Everyday), meaning that we strive to complete every project without injury, illness, property damage, or environmental damage. Safety must always take precedence over expediency. No phase of the planned operation is more important than accident prevention. As such, high standards have been followed in developing the safety program for this project. Through adherence to the safety program, careful planning, and a positive safety attitude by workers; Langan asserts that the safety of people and property is of the utmost importance.

This Health and Safety Plan (HASP) has been developed by Langan to comply with Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120(b)(4), *Hazardous Waste Operations and Emergency Response*, Langan policies/procedures, and Perdue AgriBusiness (PAB) requirements and considerations as currently understood and as appropriate. In addition, Langan will comply with federal, state, and local regulations as applicable to the project. Compliance with this HASP is required of Langan personnel and subcontractors who are engaged in the tasks covered by this HASP at, and involving, the PAB facility located at 6906 Zion Church Road in Salisbury, Wicomico County, Maryland (the "Site" or "Zion Church Road [ZCR] Facility").

The management of the day-to-day site activities and implementation of this HASP in the field is the responsibility of the Site Safety Officer (SSO). Assistance in the implementation of this HASP can also be obtained from the Langan Health and Safety Manager (HSM). The content of this HASP may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the scope of work.

2.0 EMERGENCY RESPONSE PLAN

2.1 General

This Emergency Response Plan has been developed as part of the HASP to address management of emergency situations such as injury or chemical exposure to personnel; fire or explosion; environmental release; security threat, or serious weather conditions. Reference Table 1 for the emergency notification master contact list.

2.2 Responsibilities

2.2.1 Site Emergency Coordinator - The SSO, or their designated alternate, will serve as the Site Emergency Coordinator and shall implement emergency procedures whenever conditions warrant such action. The Site Emergency Coordinator will be responsible for coordinating with PAB regarding the evacuation, emergency treatment, emergency transport of site personnel, and notification of emergency units and the appropriate management staff. Emergency response instructions will be provided by PAB and the SSO as part of every employee's training prior to the start of work.

2.2.2 Employees - Langan employees at the Site will be familiar with emergency response procedures for this work location.

2.3 Emergency Medical Treatment

Personnel Injury - In case of injury to Langan personnel, the SSO will or their designee will administer emergency first aid as soon as possible. The ambulance/rescue squad will also be contacted as necessary. Some situations may require transport of the injured parties to the closest emergency medical facility. Therefore, maps/directions to the nearest hospital are provided as Figure 1. Figure 1 will either be posted at the site or will be made readily available to personnel.

Personnel Exposure – If there is exposure to a chemical, follow procedures on the corresponding Safety Data Sheet (SDS) attached to Appendix E and seek emergency medical attention/poison control if warranted based on the severity of the exposure. The following provides general emergency first aid procedures for chemical exposure.

Skin Contact: Use ample amounts of soap and water. Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Rinse eyes with water for at least 15 minutes.

Inhalation: Move to fresh air and/or, if necessary, decontaminate and transport to emergency medical facility or request the assistance of emergency medical professionals.

Ingestion: Decontaminate and transport to emergency medical facility or request assistance of medical professionals.

Puncture/Laceration: Decontaminate, if possible, and transport to emergency medical facility or request the assistance of emergency medical professionals.

2.4 Non-Emergency Medical Treatment

In case of injury to personnel, which is not a medical emergency the employee will contact WorkCare at (1-888-449-7787). WorkCare provides access 24 hours / 7 days a week to experienced occupational health nurses and physicians who confer with employees at the onset of a work-related injury or illness. WorkCare will provide over the phone injury treatment or direct employees to medical treatment by third party provider, if appropriate.

2.5 Nearest Medical Assistance

The address and telephone number of the nearest hospital/emergency care facility:

TidalHealth Peninsula Regional
100 E. Carroll Street
Salisbury, Maryland 21801
410-546-6400

A map with directions to the hospital/emergency care facility is provided as Figure 1. Be advised that the specific directions to the hospital listed above will vary depending on the location where injury, exposure, or other health event occurred. From most sampling locations, the individual should head south and turn right onto Old Ocean City Road. From there, the individual can follow the instructions included on Figure 1. This information will either be posted prominently at the Site or be otherwise readily available to Langan personnel. Further, field personnel, including the SSO, will know the directions to the hospital.

2.6 Emergency Contacts/Notification System

Emergency telephone numbers are summarized in Table 1. This list is to be included with the site first aid kit and readily available to Langan personnel. Langan requires that property damage, environmental releases, injuries of personnel (Langan employees, subcontractors, property owner, site visitors, etc.), and near misses associated with the field activities be reported on the Incident Injury Report located in Appendix C and to Langan's Incident/Injury Hotline at (973-560-4699) as soon as possible following the incident.

2.7 Evacuation

In the event of an emergency situation on-Site, Langan personnel should follow procedures prescribed by Perdue AgriBusiness, which will be communicated to Langan Site personnel upon initial arrival at the Site.

Otherwise, in the event of an off-Site emergency situation, an air horn or vehicle horn should be sounded three times indicating the initiation of evacuation procedures. Loud voice command, if appropriate, can be used. Personnel should evacuate and assemble at the Site entrance or pre-designated muster point. No one, except the emergency responders, will be allowed to proceed into the area once the emergency signal has been given. The Site Safety Officer will facilitate access for emergency equipment and direct the shutdown of sources of combustion (e.g., operating machinery, etc.) once the alarm has been sounded. Wind direction should be taken into consideration for evacuation plans. Evacuation plans will be discussed at the initial Site-Specific Training and as needed at the regular safety briefings.

When an on-site emergency results in an evacuation, personnel shall not re-enter until:

- The conditions resulting in the emergency have been corrected,
- The hazards have been reassessed,
- This HASP has been reviewed, and
- Site personnel have been briefed on changes to this HASP.

2.8 The Buddy System

When working in teams of two or more, workers will use the "buddy system" for work activities so that rapid assistance can be provided in the event of an emergency. Work groups will be organized so workers can remain close together and maintain visual contact with one another. Workers using the "buddy system" have the following responsibilities:

- Provide his/her partner with assistance.
- Observe his/her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his/her partner's PPE.
- Notify the SSO or other site personnel if emergency service is needed.

2.9 Fire or Explosion

Appropriate fire extinguishers should be made available at the site for trained personnel to use on fires in their initial stage without endangering the safety and health of those nearby. If the use of fire extinguishers will not extinguish the fire, immediately notify the fire department or call 911, sound the evacuation signal, and then evacuate the area, assembling at the site entrance to be accounted for and to receive further instruction.

2.10 Explosive Atmospheres

Areas deemed to be an explosive atmosphere are to be classified as a confined space/permit required confined space and shall not be entered. Confined space/permit required confined space entry procedures must be followed per Langan's Corporate HASP prior to entering an explosive atmosphere. Langan employees are prohibited from entering or conducting work in a confined space where IDLH conditions are present.

Areas where an explosive atmosphere exist should not be entered until appropriate testing has deemed the area safe for entry and confined space entry procedures have been followed. For explosive atmospheres such as excavation operations, a multi-gas meter equipped for monitoring of VOCs, H_2S, LEL, O_2, and CO with a remote sensing head should be used.

For LEL readings between 0% to <10%; continue to work and continue to monitor atmosphere. For reading $\geq$10% of the LEL; evacuate the area.

2.11 Oxygen Deficient Atmospheres

Areas deemed oxygen deficient are to be considered a confined space/permit required confined space and shall not be entered. Confined space/permit required confined space entry procedures must be followed per Langan's Corporate HASP prior to entering an oxygen deficient atmosphere. Langan employees are prohibited from entering or conducting work in a confined space where IDLH conditions are present.

Areas where oxygen deficient atmospheres exist should not be entered until appropriate testing has deemed the area safe for entry and confined space entry procedures have been followed. Prior to entering spaces where an oxygen deficiency may exist, an oxygen meter will be used to test for adequate oxygen levels. Decisions will be based on oxygen concentrations as follows:

Oxygen Concentration	**Decision**
20.8%	Continue Operations
< 20.8%	Continuous Monitoring
< 19.5%	Stop Work/Do not Enter, withdraw from work area; notify HSM & PM
> 22%	Stop Work/Do not Enter, withdraw from work area; notify HSM & PM

2.12 Spills/Leaks

In the event of accidental spillage, the following spill response protocol will be implemented as follows:

- Immediately stop work and move up-wind of the spill.
- Administer first aid to injured personnel and call 911 if necessary.
- Notify the Langan SSO immediately of the spill. The SSO will notify the Project Manager who will notify the client and appropriate outside agencies.
- If possible and safe to do, gather data regarding material spilled, location, quantity spilled, injuries and environmental impacts.
- An exclusion zone will be set up, informing and warning site personnel of the hazard(s).
- Complete an Incident Injury Report and notify Langan's Incident/Injury Hotline at (973-560-4699) as soon as possible following the incident.

2.13 Adverse Weather Conditions

In the event of severe weather (rain, snow, sleet, heat, etc.), conditions will be assessed on site to determine if the work can proceed safely. If it is determined that the weather poses a significant hazard, site operations will be stopped and rescheduled. Some of the items to be considered prior to determining if work should continue include:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions.
- Limited visibility.

2.14 Underground Utilities Strike

In the event a utility is encountered or disturbed during subsurface work, follow these procedures:

- Immediately stop work;
- Leave the work area and retreat to a safe area;
- Call 911, if necessary;
- Contact the client representative and owner and operator of the property; and
- Immediately notify the Langan PM, SSO and Langan Incident/Injury Hotline.

2.15 Documentation

Employees are required to contact WorkCare at (1-888-449-7787) to document incidents/injuries which are not medical emergencies. Following an incident or near miss, unless emergency medical treatment is required, either the employee, coworker or supervisor must contact the Langan Incident/Injury Hotline at (973-560-4699) and the client representative to report the incident or near miss. For emergencies involving personnel injury and/or exposure, the SSO and affected employee will complete an Incident Injury Report located in Appendix C and submit to Langan's H&S Department as soon as possible following the incident.

3.0 SITE LOCATION AND BACKGROUND

3.1 Location

The ZCR Facility includes approximately 294-acres situated in a predominantly rural area to the east of Salisbury, Maryland at 6906 Zion Church Road. It is bounded to the west by the Salisbury Bypass (US Route 50) with residential properties beyond; to the north by Morris Leonard Road with residential, farm, and wooded/undeveloped properties beyond; to the east by Zion Church Road with residential, farm, mixed-use, and wooded/undeveloped properties beyond; and to the south by the Delmarva Central Railroad with residential and mixed-used properties beyond. The Site currently consists of a soybean processing plant, a feed mill, a boiler house, grain receiving and storage facilities, an edible soybean oil refinery, two hatcheries, a truck fleet garage, and related support facilities and operations. A Site plan depicting the Site boundaries and features is included as Figure 2.

The 2019 United States Geological Survey (USGS) 7.5-minute quadrangle topographic map for Salisbury depicts the Site at elevations varying from approximately 40 to 60 feet above mean sea level (amsl). The regional topography is relatively flat, with ground surface elevation varying from approximately 15 to 60 feet amsl, and topography sloping downward to the west toward the Wicomico River, which is located approximately 3 miles west of the Site at its nearest point.

This HASP includes activities necessary to identify, report, and sample soil, groundwater, and surface water points on the ZCR Facility.

3.2 Background

According to Perdue Agribusiness, in August 2023, the MDE contacted Perdue AgriBusiness as part of a state-wide sampling project to assess PFAS levels in wastewater, drinking water, and groundwater across the state. In these initial tests, MDE detected elevated levels of certain PFAS, specifically, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), in wastewater at the ZCR Facility. As a result, in December 2023, Perdue AgriBusiness, in collaboration with MDE and the Maryland Department of Health, provided additional information and facilitated MDE conducting

additional PFAS sampling and testing. The subsequent testing results showed lower levels of the detected PFAS, complicating determination of a source. Perdue completed additional follow-up sampling and testing on-Site at the request of MDE in February and March 2024. In cooperation with MDE, additional monitoring wells were installed, and another round of testing was conducted in July 2024. Results for this sampling event were submitted to MDE in August 2024. On September 12, 2024, MDE sent Perdue AgriBusiness a letter designating the company as the responsible person for elevated PFAS concentrations in groundwater at the Site.

3.3 Summary of Work Tasks by AOI

The scope of sampling and testing covered by this HASP is described in Langan's *PFAS Site Investigation Workplan* for the ZCR Facility dated March 5, 2025. Film Forming Foam (AFFF) – Fire Suppression System

4.0 IDENTIFICATION OF KEY PERSONNEL/HEALTH AND SAFETY PERSONNEL

The following sections briefly describe the health and safety (H&S) designations and general responsibilities that may be employed for this site. The personnel titles have been established to accommodate the project needs and requirements and promote the safe conduct of Site activities. The H&S personnel requirements for a given work location are based on the proposed site activities.

4.1 Langan Project Manager (PM)

The Langan Project Manager (PM) is **Anna Willett**. Responsibilities include:

- Arranging for an appropriate HASP to be developed and approved prior to on-Site activities.
- Seeing that the project tasks are performed in a manner consistent with Langan's Corporate Health and Safety Program and this HASP.
- Verifying that subcontractors being utilized have been approved for usage in Langan's Subcontractor Safety Screening Program.

4.2 Langan Corporate Health and Safety Manager (HSM)

The Langan Corporate Health and Safety Manager (HSM) is Tony Moffa. Responsibilities include:

- Updating the Health and Safety Program.
- Assisting the Site Safety Officer (SSO) with development and revisions of the HASP.
- Assisting the SSO in the implementation of this HASP and conducting Jobsite Safety Inspections and assisting with communication of results and correction of shortcomings found.
- Maintaining records on personnel including medical evaluation results, training, certifications, and Incident/Injury reports

4.3 Langan Site Safety Officer (SSO)

The Langan Site Safety Officers (SSO) is to be determined; alternate SSOs may be designed throughout the project, and those alternates will be notified of their responsibilities and clearly identified to the Langan project team. The SSO responsibilities include:

- Participating in the development and implementation of this HASP.
- The management of the day-to-day site activities and implementation of this HASP in the field.
- Complete the Safe Work Certificate (in cooperation with the PM) and conducting the daily Tailgate Safety and Close-Out Meetings.
- Conduct Jobsite Safety Inspections and correct shortcomings in a timely manner.
- Making proper PPE available and worn by Langan employees as appropriate and properly stored and maintained.
- Controlling entry into and exit from the site contaminated areas or zones.
- Monitoring employees for signs of stress, such as heat stress, fatigue, and cold exposure.
- Monitoring site hazards and conditions.
- Knowing (and confirming that site personnel also know) emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department.
- Resolving conflicts that may arise concerning safety requirements and working conditions.
- Reporting incidents, injuries and near misses to the Langan Incident/Injury Hotline immediately and the client representative.

4.4 Subcontractor Responsibilities

Each subcontractor shall develop and implement their own HASP, which identifies a lead individual responsible for H&S compliance for each of their employees, lower-tier subcontractors, and consultants. The subcontractor's HASP will be at least as stringent as this Langan HASP. The subcontractor must be familiar with and abide by the requirements outlined in their own HASP. A subcontractor may elect to adopt Langan's HASP as its own provided that it has given written notification to Langan, but where Langan's HASP excludes provisions pertinent to the subcontractor's work (i.e., confined space entry); the subcontractor must provide written addendums to this HASP. Additionally, the subcontractor must:

- Confirm their employees are trained in the use of appropriate PPE for the tasks involved;
- Notify Langan of hazardous material brought onto the job site or site related area, the hazards associated with the material, and must provide a SDS for the material;
- Have knowledge of, understand, and abide by current federal, state, and local health and safety regulations pertinent to the work;
- Confirm their employees have received current training in the appropriate levels of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response* (HAZWOPER) and other training required for site work;
- Confirm their employees have been medically cleared to work and to wear a respirator, if necessary;
- Confirm their employees have been fit-tested within the year on the type of respirator they will wear.

5.0 GENERAL HAZARD MANAGEMENT

This section provides an assessment of the general hazards that may be encountered during field work activities at the site through a task-by-task risk analysis. Potential hazards are addressed below.

5.1 Chemical Exposure Hazards

Known and suspected chemical contaminant hazards that could be encountered during site operations are detailed in Table 2, Part A. An inventory of safety data sheets (SDS) for chemical products that may be encountered can be found in Appendix E.

5.2 Physical Hazards

Physical hazards, which may be encountered during site operations for this project, are detailed in Table 2 Part B.

5.3 Biological Hazards

Biological hazards, which may be encountered during site operations for this project, are detailed in Table 2 Part B.

5.4 Task-By-Task Risk Analysis

Through information gathering, inspection, and monitoring; hazards that are potentially present have been determined for each specific task described in Table 2. This table provides a summary of chemical, physical and biological hazards that could potentially be encountered by personnel during each task effort.

5.5 Job Safety Analysis

A Job Safety Analysis (JSA) is a process to identify existing and potential hazards associated with each job or task so these hazards can be eliminated, controlled or minimized. JSAs should be reviewed at the beginning of each workday, when a Langan employee begins a new task or moves to a new location. JSAs should be developed and reviewed by parties involved. A blank JSA form and documentation of completed JSAs are in Appendix G.

5.6 Tailgate Safety Briefings

Before starting work each day or as needed, the Langan SSO will conduct a brief tailgate safety briefing meeting to assist site personnel in conducting their activities safely. Briefings will include the following:

- Scope of work for the day.

- Review of safety information relevant to planned tasks and environmental conditions.
- New activities/task being conducted.
- Results of Jobsite Safety Inspection Checklist.
- Changes in work practices.
- Safe work practices; and
- Discussion and remedies for noted or observed deficiencies.

5.7 Safe Work Certificate

A Safe Work Certificate (SWC) must be developed, documented and adhered to by Langan employees daily while conducting fieldwork. A SWC and associated Tailgate Safety Meeting must be completed prior to the start of fieldwork each day. The SWC must be submitted during the Close-Out Meeting at the end of each workday or after completion of site fieldwork, whichever occurs first. The Site Safety Officer (SSO) is responsible for completing the Safe Work Certificate Process. Copies of SWC are saved to the project folder.

6.0 TRAINING & MEDICAL CLEARANCE REQUIREMENTS

The general training and medical clearance requirements for Langan personnel are discussed in the following sections.

6.1 Project Training

Completion of an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training program as detailed in OSHA's 29 CFR 1910.120(e) is required for employees who will perform work in areas where the potential for a toxic exposure exists. Annual eight-hour refresher training is also required to maintain competencies. Training records are maintained by Langan's H&S Department.

6.2 Site Specific Training

Training will be provided to specifically address the activities, procedures, monitoring, and equipment for site operations at the beginning of each field mobilization and the beginning of each discrete phase of work. The training will include the site and facility layout,

hazards, and emergency services at the site, and will detail the provisions contained within this HASP.

6.3 Medical Surveillance/Fitness for Duty

Personnel who will be performing field work involving potential exposure to toxic and hazardous substances will be required to have passed an initial baseline medical examination, with follow-up medical exams thereafter, consistent with 29 CFR 1910.120(f). Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine. Personnel who may be required to perform work while wearing a respirator must receive medical clearance as required under CFR 1910.134(e), *Respiratory Protection*. Results of medical evaluations are maintained by Langan's H&S Department.

7.0 AIR MONITORING

7.1 General

In certain instances, it will be necessary to monitor the atmospheric conditions during on-site work activities to identify and quantify airborne contaminants; to assist in defining work zones; and, to determine the level of work protection needed. Air monitoring will be performed on an as needed basis, when and where the possibility of worker exposure to hazardous substances exists. If determined to be needed, air monitoring will be performed at the worker's breathing zone. Upgrades/downgrades to personal protective equipment (PPE) will be made based on air monitoring results in the breathing zone. If needed, the air monitoring device will be calibrated daily, and readings will be recorded in the field log or in Appendix D.

7.2 Action Levels

A PID will be used to evaluate action levels during investigation activities. Table 3 provides a summary explanation of available monitoring equipment.

Breathing zone readings should be taken at the start of work in each areas each day, as well as during the field activities, and frequently whenever strong odors are detected. Before any field activities commence, the background levels of the site will be monitored

and recorded away from the areas of potential contamination to representative conditions. Continuous monitoring is required during intrusive work. Instrumentation Action levels for general monitored gases based on PID readings are provided in Table 4.

Work will be stopped immediately, and crews will remove themselves to fresh air if workers are experiencing potential acute physical symptoms of exposure such as irritation, nausea, drowsiness or headache. Work will not recommence in the area until reasoning for exposure is determined, and appropriate control measures have been taken.

8.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.1 Levels of Protection

Langan will provide PPE to workers to protect them from the specific hazards they are likely to encounter on-site. Selection of the appropriate PPE must take into consideration: (1) identification of the hazards or suspected hazards; (2) potential exposure routes; and (3) the performance of the PPE construction (materials and seams) in providing a barrier to these hazards.

Activities to be performed within certain areas of the Site designated by PAB will be performed using Level D protection as described below.

The upgrading/downgrading of the level of protection will be based on continuous air monitoring results as described in Section 7 or based on the potential exposure to chemicals. The decision to modify standard PPE will be made by the SSO after conferring with the site project manager. The levels of protection are described below.

Level D Protection

Level D is used when no respiratory protection is required, and minimal skin protection is needed (used for nuisance contamination only). The following conditions suggest a need for Level D protection:

The atmosphere contains no known hazard; and Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of chemicals.

The following constitutes Level D equipment; to be used as appropriate:

- Long pants
- Nitrile gloves (during sampling activities)
- Boots/shoes, chemical-resistant steel toe and shank
- Short-or long sleeve t-shirt
- Safety glasses or chemical splash goggles (during sampling activities)
- Safety vest or high-visibility clothing (optional – as applicable)
- Boots, outer, chemical-resistant (disposable) (optional – as applicable).
- Hard hat (required on-Site)
- Escape mask (optional – as applicable)
- Face shield (optional – as applicable).

Level D Modified

Level D Modified is the same as Level D for respiratory protection, but the skin protection is increased to that of level C.

Level C Protection (as needed)

Level C is used when the concentrations and types of airborne substances are known and the criteria for using air purifying respirators are met. The following conditions suggest a need for Level C protection:

- The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through exposed skin;

- The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

The following constitutes Level C equipment; it may be used as appropriate.

- Full-face or half-mask, air purifying respirators (NIOSH approved).
- Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Coveralls (optional – as applicable).
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots (outer), chemical-resistant steel toe and shank (optional – as applicable).
- Boot-covers, outer, chemical-resistant (disposable) (optional – as applicable).
- Hard hat (optional – as applicable).
- Face shield (optional – as applicable).
- Escape mask (optional – as applicable).

8.2 Respirator Fit-Test

Langan employees who may be exposed to hazardous volatile or airborne substances at the work site are in possession of a full or half face-piece air-purifying respirator, appropriate cartridges and have been successfully fit-tested within the past year. Fit-test records are maintained by Langan's H&S Department.

9.0 SITE CONTROL

9.1 Site Communications Plan

Verbal communications will be the primary method of communication used at the work site. Cell phones shall be used to the extent practical if allowed to be used on-Site. In the instances where verbal communication cannot be used, such as when working in respiratory protective equipment, hand signals will be used. Hand signals will be covered prior to the start of jobsite work or during tailgate safety meetings.

Hand Signal	Meaning
Hand gripping throat	Out of air; cannot breathe
Grip partners wrists or place both hands around waist	Leave immediately without debate
Hands on top of head	Need assistance
Thumbs up	OK; I'm alright; I understand
Thumbs down	No; negative
Simulated "stick" break with fists	Take a break; stop work

9.2 Work Zones

The need to formally establish specific work zones (Support, Contamination Reduction, and Exclusion Zones) during site activities will be determined by the SSO. A general description of these work zones is provided in Figure 2. It is important for the safety of concerned that appropriate barriers (cones, wooden horses, plastic fencing etc.) are in place to keep vehicles and pedestrians away from the Work Zone.

9.3 Standing Orders/Safe Work Practices

The standing orders, which consist of a description of safe work practices that must always be followed by Langan employees and subcontractors while on-Site, are shown in Appendix A. The SSO has the responsibility for enforcing these practices. The standing orders will be posted prominently at the site or are made available to personnel. Those who do not abide by these safe work practices will be removed from the site.

9.4 Site Security

No unauthorized personnel shall be permitted access to the work areas.

9.5 Underground Utility Clearance

Langan's Underground Utility Clearance Policy should be adhered to when ground disturbance is being conducted by Langan or its subcontractors. The following procedures must be completed and documented prior to ground disturbance:

- One-Call System Notification (or equivalent)
- Private Utility Mark-Out
- Site Utility Plans Reviewed
- Site Visit Conducted
- Soft Digging Requirements Followed

9.6 Site Safety Inspection

The Langan SSO or designated alternate will conduct daily checks of the work area at the beginning and end of each work shift at a minimum. More frequent checks may be required to confirm safe work conditions. The SSO or designated alternate must complete the Jobsite Safety Inspection Checklist, found in Appendix F, at least weekly or before completion of work, whichever is shorter. Deficiencies shall be discussed during the daily tailgate meeting and shared with the PM and HSM, if needed.

9.7 Hand and Power Tools

Hand and electric-power tools, and similar equipment shall be maintained in a safe operating condition. Electric-power tools must be inspected initially and prior to each use. Damaged tools shall be tagged and removed immediately from service or repaired. Tools shall be used only for the purpose for which they were designed. Users must be properly trained in their safe operation.

9.8 Stop Work Authority

Langan employees have the authority to stop work of Langan employees and subcontractors when they believe an unsafe condition exists. Project staff are encouraged to exercise "stop work authority" as part of Langan's safety culture.

The following steps shall be taken by Langan employees when performing work with Langan co-workers and Langan subcontractors within a work zone at a site and an unsafe condition is observed.

- When an employee observes an unsafe condition, a Stop Work Intervention shall be immediately initiated with the person(s) potentially. at risk.
- The Stop Work Intervention shall be coordinated through the Langan SSO on-site.
- All affected personnel in the work zone shall immediately be notified of the Stop Work Intervention. If necessary, associated work activities should be stopped and persons should be removed from the area.
- All affected personnel shall discuss and gain agreement on the cause of the Stop Work Intervention.
- Every attempt shall be made to resolve the cause of the Stop Work Intervention prior to the resumption of work.
- If the cause of the Stop Work Intervention cannot be resolved immediately, then work shall be suspended until proper resolution is achieved.
- All Stop Work Interventions and associated details shall be documented and reported to the PM and HSM, if needed.

9.9 Subcontractor Safety Screening Program

Subcontractors utilized by Langan are required to be screened through Langan's Subcontractor Safety Screening program. This Program is intended to confirm that subcontractors utilized by Langan have safety programs, training, policies and statistical data of safety performance that are in accordance with Langan and project requirements and policies. A Langan subcontractor is a firm or person who has been contracted by Langan to perform services for Langan and is not a permanent employee of Langan. A list of Langan's subcontractors currently in the Subcontractor Safety Screening Program and their assigned "grades" can be found on Langan’s intranet.

10.0 DECONTAMINATION PLAN

10.1 General

In the event that equipment is contaminated, personnel, equipment, and samples leaving the contaminated area of the site must be decontaminated. Decontamination for this operation is achieved through physical removal and chemical detoxification/ disinfection/sterilization. The first step in decontamination, however, is prevention and standard operating procedures have been established meant to minimize contact with wastes:

- Work habits that minimize contact with wastes are stressed.
- Disposable equipment, where appropriate, will be used.

In addition to the above, precautions shall be taken by the sampler to avoid- the initial introduction of PFAS into the sampling area to avoid cross-contamination. Precautionary actions include the following:

- Avoid wearing or carrying items that may contain PFAS, such as certain water-resistant clothing, cosmetics, sunscreen, and insect repellant.
- Use PFAS-free materials for sampling (e.g. no Teflon tape, no waterproof notebooks). Consult Attachment A of Appendix I for more information.
- Change gloves frequently, especially if they come into contact with surfaces that might be contaminated.

The sampler should consult Langan's *Recommended Environmental PFAS Sampling Procedures* attached Langan's *PFAS Site Investigation Workplan* for the ZCR Facility.

10.2 Decontamination Procedures

The Standard decontamination procedures are described in Appendix B. In accordance with the Langan *PFAS Investigation Standard Operating Procedures (SOPs)* included as Appendix B of the *PFAS Site Investigation Workplan*, standard decontamination procedures have been altered to reflect PFAS sensitivity. The following procedures should be employed for decontamination if warranted:

- Establish a decontamination area aware from sampling activities
- Perform a four-step decontamination of sampling equipment before sample collection and between sampling location (if equipment is being reused).
    - Wash with potable water and a detergent.
        - Alconox and Citrinox are generally acceptable detergents, but it is recommended to verify potential presence/absence of PFAS with manufacturer prior to use.
    - Initial potable water rinse.
    - Secondary potable water rinse
    - Complete final triple-rinse with lab verified PFAS-free water (for components coming into direct contact with the sample).

10.3 Disposal of Wastes

Debris (e.g., paper, plastic and disposable personal protective equipment [PPE]) will be collected in plastic garbage bags and disposed of as non-hazardous industrial waste using appropriate receptacles at the Site. Debris is expected to be transported to a local municipal landfill for disposal.

Investigation derived wastes should be properly managed as indicated in the applicable SOPs that are attached to the *PFAS Site Investigation Workplan*.

11.0 CONFINED SPACE ENTRY

A confined space has limited or restricted means for entry or exit and is not designed for continuous occupancy. Confined spaces include, but are not limited to, tanks, vessels, silos, storage bins, hoppers, vaults, pits, manholes, tunnels, equipment housings, ductwork, pipelines, etc. Confined spaces **will not** be entered by Langan personnel.

12.0 HASP ACKNOWLEDGEMENT FORM

Langan field personnel and subcontractors will sign this HASP Compliance Agreement indicating that they have become familiar with this HASP and that they understand it and agree to abide by it.

LANGAN PERSONNEL

Anna Willett, Senior Project Manager	Date
Site Safety Officer (SSO)	Date

Printed Name	Signature	Company	Date

TABLES

TABLE 1
EMERGENCY NOTIFICATION MASTER CONTACT LIST

ORGANIZATION	CONTACT	TELEPHONE
Local Police Department		911 or 410-548-3165
Local Fire Department		911 or 410-548-3122
Ambulance/Rescue Squad		911 or 860-435-0058
Hospital		911 or 410-546-6400
(Work related Injuries/Illnesses)		
WorkCare		1-888-449-7787
Langan Incident / Injury Hotline		973-560-4699
Langan Senior Project Manager	Anna Willett	571-591-5548 (cell)
Langan Project Leader	Jeff Smith	215-694-7549 (cell)
Langan Health and Safety Manager (HSM)	Tony Moffa	215-491-6545 (office) 215-756-2523 (cell)
Langan Site Health & Safety Officer (SSO)	To be Determined	To be Determined
Perdue	G. Andrew (Drew) Getty	443-397-8023
Perdue	Jaclyn Mays	443-397-0255
National Response Center (NRC)		800-424-8802
Chemical Transportation Emergency Center (Chemtrec)		800-424-9300
Center for Disease Control (CDC)		404-639-3534
EPA (RCRA Superfund Hotline)		800-424-9346
TSCA Hotline		202-554-1404
Poison Control Center		800-222-1222

TABLE 2
TASK RISK ANALYSES

A. CONTAMINANT HAZARDS OF CONCERN

Task	Contaminant	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1	Per- and polyfluoroalkyl substances (PFAS)			Water, Soil	Abs, Con		Eyes and Skin: Wash and irrigate as appropriate using PFAS-free, laboratory supplied water.

EXPLANATION OF ABBREVIATIONS

PID = Photoionization Detector
Inh = Inhalation
Abs = Skin absorption
Ing = Ingestion
Con = Skin and/or eye contact
PEL = Permissible Exposure Limit (8-hour Time Weighted Average
IDLH = Immediately Dangerous to Life and Health
LEL = Lower Explosive Limit
ppm = part per million
TLV = Threshold Limit Value
abdom = abdominal
anor = anorexia
arrhy = arrhythmia
card = cardiac
Ca = Considered by NIOSH to be potential occupational carcinogen
[carc] = potential occupational carcinogen
CNS = central nervous system
depres = depressant/depression
derm= dermititis
dizz = dizziness
drow = drowsiness
tg = fatigue
gidd = giddiness
inco = incoordination
inj = injury
lass = lassitude (weakness, exhaustion)
muc memb = mucous membrane
nau = nausea
pares = paresthesia
som = somnolence (sleepiness, unnatural drowsiness)
verti = vertigo
vis dist = visual disturbance

B. PHYSICAL & BIOLOGICAL HAZARDS OF CONCERN

Task	Hazard	Description	Control Measures	First Aid
1	Skin contact	Sample water or sample preservative spills on skin; splashes in eyes. Contact with contaminated water during sampling.	Wear proper PPE; follow safe practices; TAKE 5	See "A" above
1	Lacerations, abrasions, punctures	Cutting tubing, twine, etc. with knife. Using tools in tight spaces, etc.	Wear proper PPE; follow safe practices; TAKE 5; Cut resistant gloves; No open blade knifes	Utilize first aid kit. Depending on severity of injury, seek medical attention if needed.
1	Lifting	Improper lifting/carrying of equipment and materials causing strains	Follow safe lifting techniques; TAKE 5	Follow the Rest, Ice, Compression, and Elevation (RICE) procedures
1	Slips, trips, and falls	A number of injuries could occur from slips, trips, and falls in carrying out these tasks	Good housekeeping at site, constant awareness and focus on the task; TAKE 5; Plan your route	
1	Traveling To/From Jobsite	Other Vehicles, Wildlife, Weather Conditions, Fatigue	Adjust safety features of vehicle prior to driving; Obey posted signage, do not use cellphones while driving, Situational awareness, Take breaks frequently, do not drive if fatigued, watch for wildlife while driving or other objects that may enter your lane of travel; adjust driving according to the weather and time of day; TAKE 5	

Task	Hazard	Description	Control Measures	First Aid
1	Pinch points	Incidental pinch points created during sampling and movement of equipment and lifting of well lids.	Recognize pinch points prior to starting activity. Use other tools (i.e. crowbar) for leverage.	Assess severity. Seek immediate medical attention if needed.
1	Unknown conditions	Sampling will be conducted in private residences. Conditions within private residences are not known.	Wear proper PPE; Also utilize the Buddy System when entering into an unknown residence. TAKE 5 and perform JSA for unexpected hazardous conditions	
1	Biological hazards	Wild animals, or spiders/insects	One Buddy keep watch while sampling is occurring. Wear gloves when reaching into infrequently-used spaces.	

TABLE 3
Summary of Monitoring Equipment

Instrument	Operation Parameters
Photoionization Detector (PID)	**Hazard Monitored:** Many organic and some inorganic gases and vapors. **Application:** Detects total concentration of many organic and some inorganic gases and vapors. Some identification of compounds is possible if more than one probe is measured. **Detection Method:** Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions. **General Care/Maintenance:** Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories. **Typical Operating Time:** 10 hours. 5 hours with strip chart recorder.
Oxygen Meter	**Hazard Monitored:** Oxygen (O_2). **Application:** Measures the percentage of O_2 in the air. **Detection Method:** Uses an electrochemical sensor to measure the partial pressure of O_2 in the air and converts the reading to O_2 concentration. **General Care/Maintenance:** Replace detector cell according to manufacturer's recommendations. Recharge or replace batteries prior to explanation of the specified interval. If the ambient air is less than 0.5% C O_2, replace the detector cell frequently. **Typical Operating Time:** 8 – 12 hours.
Additional equipment (if needed, based on site conditions)	
Combustible Gas Indicator (CGI)	**Hazard Monitored:** Combustible gases and vapors. **Application:** Measures the concentration of combustible gas or vapor. **Detection Method:** A filament, usually made of platinum, is heated by burning the combustible gas or vapor. The increase in heat is measured. Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present. **General Care/Maintenance:** Recharge or replace battery. Calibrate immediately before use. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.

Instrument	Operation Parameters
Flame Ionization Detector (FID) with Gas Chromatography Option *(i.e., Foxboro Organic Vapor Analyzer (OVA))*	**Hazard Monitored:** Many organic gases and vapors (approved areas only). **Application:** In survey mode, detects the concentration of many organic gases and vapors. In gas chromatography (GC) mode, identifies and measures specific compounds. In survey mode, all the organic compounds are ionized and detected at the same time. In GC mode, volatile species are separated. **General Care/Maintenance:** Recharge or replace battery. Monitor fuel and/or combustion air supply gauges. Perform routine maintenance as described in the manual. Check for leaks. **Typical Operating Time:** 8 hours; 3 hours with strip chart recorder.
Potable Infrared (IR) Spectrophotometer	**Hazard Monitored:** Many gases and vapors. **Application:** Measures concentration of many gases and vapors in air. Designed to quantify one or two component mixtures. **Detection Method:** Passes different frequencies of IR through the sample. The frequencies absorbed are specific for each compound. **General Care/Maintenance:** As specified by the manufacturer.
Direct Reading Colorimetric Indicator Tube	**Hazard Monitored:** Specific gas and vapors. **Application:** Measures concentration of specific gases and vapors. **Detection Method:** The compound reacts with the indicator chemical in the tube, producing a stain whose length or color change is proportional to the compound's concentration. **General Care/Maintenance:** Do not use a previously opened tube even if the indicator chemical is not stained. Check pump for leaks before and after use. Refrigerate before use to maintain a shelf life of about 2 years. Check expiration dates of tubes. Calibrate pump volume at least quarterly. Avoid rough handling which may cause channeling.
Aerosol Monitor	**Hazard Monitored:** Airborne particulate (dust, mist, fume) concentrations. **Application:** Measures total concentration of semi-volatile organic compounds, PCBs, and metals. **Detection Method:** Based on light-scattering properties of particulate matter. Using an internal pump, air sample is drawn into the sensing volume where near infrared light scattering is used to detect particles. **General Care/Maintenance:** As specified by the mfr. Also, the instrument must be calibrated with particulates of a size and refractive index similar to those to be measured in the ambient air.
Monitox	**Hazard Monitored:** Gases and vapors.

Instrument	Operation Parameters
	Application: Measures specific gases and vapors. **Detection Method:** Electrochemical sensor relatively specific for the chemical species in question. **General Care/Maintenance:** Moisten sponge before use; check the function switch; change the battery when needed.
Gamma Radiation Survey Instrument	**Hazard Monitored:** Gamma Radiation. **Application:** Environmental radiation monitor. **Detection Method:** Scintillation detector. **General Care/Maintenance:** Must be calibrated annually at a specialized facility. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.

TABLE 4

INSTRUMENTATION ACTION LEVELS
Below levels are based using Benzene as the COC and use of a Full-Face or Half-Face Air Purifying Respirator.

Photoionization Detector Action Levels	**Action Required**
Background to 1 ppm	No respirator; no further action required.
> 1 ppm but < 5 ppm for < 5 minutes	1. Temporarily discontinue all activities and evaluate potential causes of the excessive readings. If these levels persist and cannot be mitigated (i.e., by slowing drilling or excavation activities), contact SSO to review conditions and determine source and appropriate response action. 2. If PID readings remain above 1 ppm, temporarily discontinue work and upgrade to Level C protection (Half-Face or Full-Face Respirator Required). 3. If sustained PID readings fall below 1 ppm, downgrading to Level D protection may be permitted.
> 5 ppm but < 10 ppm for > 5 minutes	1. Discontinue all work; all workers shall move to an area upwind of the jobsite. 2. Evaluate potential causes of the excessive readings and allow work area to vent until VOC concentrations fall below 5 ppm. 3. Level C protection (Half-face or Full-Face Respirator Required) will continue to be used until PID readings fall below 1 ppm.
>10 ppm but < 50 ppm for > 5 minutes	1. Discontinue all work; all workers shall move to an area upwind of the jobsite. 2. Re-evaluate potential causes of the excessive readings and allow work area to vent until VOC concentrations fall below 10 ppm. Follow Level C Protection ((Half-face or Full-Face Respirator Required) 3. Level C protection (Full-Face Respirator Required – see note #4) will continue to be used until PID readings fall below 10 ppm.
> 50 ppm	Evacuate the work area.

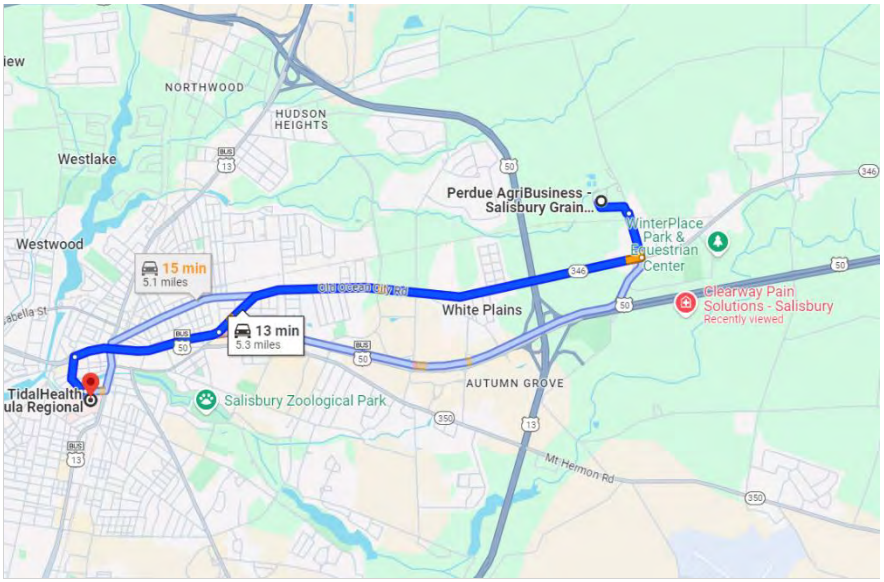
Notes:

1. 1 ppm level based on OSHA Permissible Exposure Limit (PEL) for benzene.
2. 5 ppm level based on OSHA Short Term Exposure Limit (STEL) maximum exposure for benzene for any 15-minute period.
3. 50 ppm level based on the Maximum Use Concertation (MUC) for a full-face respirator or NIOSH Immediately Dangerous to Life and Health (IDLH) for benzene. (The lower value will be used).
4. Full-Face air purifying respirator must have been fit tested using Quantitative fit testing procedures.

FIGURES

FIGURE 1

HOSPITAL MAP & DIRECTIONS



Head south toward Zion Church Rd
Restricted usage road
0.3 mi

Turn right onto Zion Church Rd
0.3 mi

Turn right onto MD-346 W/Ocean City Rd/Old Ocean City Rd
Continue to follow MD-346 W
3.2 mi

Slight right onto Ocean Gateway/E Salisbury Pkwy
1.1 mi

Turn left onto N Division St
0.3 mi

Turn left onto E Carroll St
135 ft

Turn right
279 ft

TidalHealth Peninsula Reg'l
100 E Carroll St, Salisbury, MD 21801

LANGAN

APPENDIX A

STANDING ORDERS

STANDING ORDERS

GENERAL

- Utilize Stop Work Authority when warranted.
- No smoking, eating, or drinking in this work zone.
- Use PFA-s free water.
- Be sensitive as to not wear PFAS containing materials or products such as deodorants, waterproof clothing, perfumes, sunblock and insect repellants, etc.
- Upon leaving the work zone, personnel will thoroughly wash their hands and face.
- Minimize contact with contaminated materials through proper planning of work areas and decontamination areas, and by following proper procedures. Do not place equipment on the ground. Do not sit on contaminated materials.
- No open flames in the work zone.
- Only properly trained and equipped personnel are permitted to work in potentially contaminated areas.
- Use the appropriate level of personal protective equipment (PPE).
- Maintain close contact with your buddy in the work zone.
- Contaminated material will be contained in the Exclusion Zone (EZ) and will need to be transported between properties.
- Report unusual conditions.
- Work areas will be kept clear and uncluttered. Debris and other slip, trip, and fall hazards will be removed as frequently as possible.
- The number of personnel and equipment in the work zone will be kept to an essential minimum.
- Be alert to the symptoms of fatigue and heat/cold stress, and their effects on the normal caution and judgment of personnel.
- Conflicting situations which may arise concerning safety requirements and working conditions must be addressed and resolved quickly by the site SSO.

TOOLS AND HEAVY EQUIPMENT

- Do not enter or ride in or on a backhoe bucket, materials hoist, or other device not specifically designed to carrying passengers.
- Loose-fitting clothing or loose long hair is prohibited around moving machinery.
- See that heavy equipment operators and other personnel in the work zone are using the same hand signals to communicate.
- Drilling/excavating within 10 feet of overhead power lines is prohibited.
- The locations of underground utilities must be identified and marked out prior to initiating subsurface activities.
- Check to verify that the equipment operator has lowered blades and buckets to the ground before shutting off the vehicle.
- If the equipment has an emergency stop device, have the operator show personnel its location and how to activate it.
- Help the operator verify adequate clearances when the equipment must negotiate in tight quarters; serve as a signalman to direct backing as necessary.
- Direct that heavy equipment that is used in the Exclusion Zone is kept in that zone until the job is done, and that such equipment is appropriately decontaminated before moving it into the clean area of the work zone.

- Samplers must not reach into or get near rotating equipment such as the drill rig. If personnel must work near tools that could rotate, the equipment operator must completely shut down the rig prior to initiating such work. It may be necessary to use a remote sampling device.

APPENDIX B

DECONTAMINATION PROCEDURES

PERSONNEL DECONTAMINATION

LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves and Outer Garment Removal	5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	Facepiece Removal	6. Facepiece is removed (avoid touching face with fingers). Facepiece deposited on plastic sheets.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

LEVEL D DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical resistant splash suit with PFAS-free decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Boot, Gloves and Outer Garment Removal	4. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 5:	Field Wash	5. Hands and face are thoroughly washed. Shower as soon as possible.

EQUIPMENT DECONTAMINATION

GENERAL:

Equipment to be decontaminated during the project may include tools, monitoring equipment, respirators, sampling containers, laboratory equipment and drilling equipment.

All decontamination will be done by personnel in protective gear, appropriate for the level of decontamination, as determined by the site SSO. The decontamination work tasks will be split or rotated among support and work crews. Decontamination of equipment shall be conducted in accordance with the Langan *PFAS Investigation Standard Operating Procedures (SOPs)* included with Langan's *PFAS Site Investigation Workplan for the ZCR Facility* using a direct push methods and a hand auger (Appendix I). PFAS-free water, equipment and detergent shall be used during the decontamination process.

Depending on site conditions, pumps may be decontaminated over a portable decontamination pad to contain wash water; or, wash water may be allowed to run off into a storm sewer system. Equipment needed may include a steam generator with high-pressure water, empty drums, screens, screen support structures, and shovels. Drums will be used to hold contaminated wash water pumped from the lined pit. These drums will be labeled as such.

Miscellaneous tools and equipment will be dropped into a plastic pail, tub, or other container. They will be brushed off and rinsed with a PFAS-free detergent solution, and finally rinsed with PFAS-free water.

MONITORING EQUIPMENT:

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed in the appropriate containers. Dirt or obvious contamination will be brushed or wiped with a disposable paper wipe.

RESPIRATORS:

Respirators will be cleaned and disinfected after every use. Taken from the drop area, the masks (with the cartridges removed and disposed of with other used disposable gear) will be immersed in a cleaning solution and scrubbed gently with a soft brush, followed by a rinse in plain warm water, and then allowed to air dry. In the morning, new cartridges will be installed. Personnel will inspect their own masks for serviceability prior to donning them. And, once the mask is on, the wearer will check the respirator for leakage using the negative and positive pressure fit check techniques.

APPENDIX C

INCIDENT/ INJURY REPORT

INCIDENT/ INJURY REPORT
LANGAN ENGINEERING & ENVIRONMENTAL SERVICES

(Complete and return to Tony Moffa in the Doylestown Office)

Affected Employee Name: _____ Date: _____

Incident type: ☐ Injury ☐ Report Only/No Injury
☐ Near Miss ☐ Other: _____

EMPLOYEE INFORMATION (Person completing Form)

Employee Name: _____ Employee No: _____

Title: _____ Office Location: _____

Length of time employed or date of hire: _____

Mailing address: _____

_____

Sex: M ☐ F ☐ Birth date: _____

Business phone & extension: _____ Residence/cell phone: _____

ACCIDENT INFORMATION

Project: _____ Project #: _____

Date & time of incident: _____ Time work started & ended: _____

Site location: _____

Incident Type: Possible Exposure ☐ Exposure ☐ Physical Injury ☐

Names of person(s) who witnessed the incident: _____

_____

Exact location incident occurred: _____

_____

Describe work being done:

Describe what affected employee was doing prior to the incident occurring:

Describe in detail how the incident occurred:

Nature of the incident (List the parts of the body affected):

Person(s) to whom incident was reported (Time and Date):

List the names of other persons affected during this incident:

Possible causes of the incident (equipment, unsafe work practices, lack of PPE, etc):

Weather conditions during incident:

MEDICAL CARE INFORMATION

Did affected employee receive medical care? Yes ☐ No ☐

If Yes, when and where was medical care received:

Provide name of facility (hospital, clinic, etc):

Length of stay at the facility? _____

Did the employee miss work time? Yes ☐ No ☐ Undetermined ☐

Date employee last worked: _____ Date employee returned to work: _____

Has the employee returned to work? Yes ☐ No ☐

Does the employee have work limitations or restrictions from the injury?: Yes ☐ No ☐

If Yes, please describe: _____

_____

Did the exposure/injury result in permanent disability? Yes ☐ No ☐ Unknown ☐

If Yes, please describe: _____

HEALTH & SAFETY INFORMATION

Was the operation being conducted under an established site-specific Health and Safety Plan?
Yes ☐ No ☐ Not Applicable: ☐

Describe protective equipment and clothing used by the employee:

_____

_____

_____

Did limitations in safety equipment or protective clothing contribute to or affect exposure / injury? If so, explain:

_____

_____

_____

_____ _____

Employee Signature Date

_____ _____

Langan Representative Date

APPENDIX D

CALIBRATION LOG

DATE: _____

PROJECT: _____

CALIBRATION LOG

Date & Time	Inst Type	Inst #	Media	Initial Reading	Span #	Calib Reading	Performed By:

LANGAN

APPENDIX E

SAFETY DATA SHEETS (SDSs)

AccuStandard, Inc.
125 Market St., New Haven, CT 06513 USA
Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: PFOA-026S

Description: 3-Perfluoropropyl Propanoic acid (3:3 FTCA) in Methanol

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

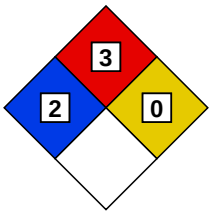
Emergency Phone #: AccuStandard, Inc.
1-203-502-7070 (USA)
+001-203-502-7070 (International)

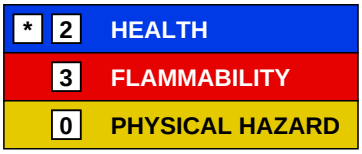
24 hours / 7 days a week

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements







Signal Word: Danger

Hazard Codes:

H225 - Highly Flammable (Flammable liquids, category 2)

H301 - Toxic if swallowed. (Acute toxicity, oral, category 3)

H311 - Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

H315 - Irritating to skin. (Skin corrosion/irritation, category 2)

H320 - Irritating to eyes. (Eye damage/irritation, category 2B)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H336 - Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

H360 - California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

H370 - Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

Precautionary Codes:

SECTION 2 - HAZARDS IDENTIFICATION *- continued*

2.1 - GHS Label Elements *- continued*

P202 - This product should only by used by persons trained in the safe handling of hazardous chemicals.

P233 - Store in a tightly closed container. (P404)

P262 - Do not get in eyes, on skin or clothing.

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P280 - Protective gloves must be worn to prevent skin contact.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P331 - Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

2.2 - Other Hazards

2.2.1 - Symptom of Exposure Health/Environment

Highly Flammable (Flammable liquids, category 2)

Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 or 18 hours.

POISON: May be fatal or cause blindness if swallowed.

Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

2.2.2 - Potential Health Effects

Irritating to eyes. (Eye damage/irritation, category 2B)

Irritating to skin. (Skin corrosion/irritation, category 2)

Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

Irritating to mucous membrane and upper respiratory system.

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Toxic if swallowed. (Acute toxicity, oral, category 3)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: 3-Perfluoropropyl Propanoic acid (3:3 FTCA) in Methanol

SECTION 3 - COMPOSITION / ANALYTES DATA *- continued*

Analyte	CAS #	% Concentration	ACGIH -TLV (mg/m³)			OSHA -PEL (mg/m³)		
			TWA	STEL	Skin	TWA	STEL	Skin
3-Perfluoropropyl propanoic acid	356-02-5	0.010						
PT Methanol	67-56-1	99.990				260		

SECTION 4 - FIRST AID MEASURES

4.1 - First Aid Procedures - General

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. (P331)

SECTION 5 - FIRE FIGHTING MEASURES

5.1 - Flammable Properties

Dangerous fire and explosive hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

6.1 - Spill Response

Wear suitable protective equipment listed under Exposure Controls / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Dispose as hazardous waste. Comply with Federal, State and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool place below 14 °F (-10 °C).

Avoid breathing vapors or mists.

Use with adequate ventilation.

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only by used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS

8.1 - Engineering Controls/PPE

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

8.2 - General Hygene Considerations

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Protective gloves must be worn to prevent skin contact. (P280)

(Chloroprene, natural rubber, nitrile, or equivalent)

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear liquid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: -93.9 °C

Boiling Point: 65 °C

Flash Point: 52 °F (11 °C) (tcc)

Evaporation Rate (Butyl Acetate=1): 5.9

Flammability Class: N/A

Lower Flammability Level: 6.7

Upper Flammability Level: 36.5

Vapor Pressure: 97 mmHg (20 °C)

Vapor Density (Air = 1): 1.1 g/L

Specific Gravity: 0.791 g/cm3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES *- continued*

Solubility in Water: Very soluble

Partition Coefficient: log Pow: -0.77

Autoignition Temperature: 385 °C

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: 99.9+

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Acids
Oxidizers

Hazardous Decomposition: Oxides of carbon; Formaldehyde

Hazardous Polymerization: Will not occur

Condition to Avoid: Heat; Contact with ignition sources

SECTION 11 - TOXICOLOGICAL INFORMATION

Human Health Toxicity

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): Human - 143 mg/kg; Rat - 1500 mg/kg

LD50 (Dermal) : Rabbit - >2000 mg/kg

LC50 (Inhalation): Rat - >20 mg/L

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION

Environmental Toxicity

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): >1000 mg/L 96H

EC50 (Aquatic Invertebrate): >1000 mg/L 48H

BCF: 1.0

Hydrolyzes readily on contact with water. Readily biodegradable.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATION

Transportation Information (DOT/IATA)

SECTION 14 - TRANSPORT INFORMATION *- continued*

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

Not all components are listed on the TSCA Inventory.

This product contains a compound or compounds subject to EU Regulation (EC) No 1907/2006 (REACH) on Annex XIV, Annex XVII, and/or Article 59. Refer to the below table for details.

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

This product is subject to SARA section 313 reporting requirements.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

			REACH (1907/2006)		
Analyte	CAS #	% Concentration	Annex XIV	Annex XVII	Article 59
PT Methanol	67-56-1	99.990		X	

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals and CLP Regulation (EC) No. 1272/2008.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY RESULTING FROM ITS USE.

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

0 - Minimal
1 - Slight
2 - Moderate
3 - Serious
4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

Category 1 - Most Severe
Category 5 - Least Severe

**** End of Document ****

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

1 Identification

· **Product identifier**

· **Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid**
· **Synonym** 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexanesulfonic acid

· **Article number:** 37261
· **CAS Number:**
757124-72-4
· **EC number:**
816-391-3
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

(Contd. on page 2)

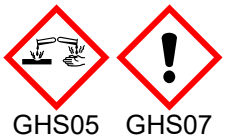
Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 1)

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H302+H312+H332 Harmful if swallowed, in contact with skin or if inhaled.
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**
P260 Do not breathe dusts or mists.
P264 Wash 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/doctor if you feel unwell.
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/doctor.
P321 Specific treatment (see on this label).
P362+P364 Take off contaminated clothing and wash it before reuse.
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 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.
· **vPvB:** Not applicable.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
757124-72-4 1H,1H,2H,2H-Perfluorohexanesulfonic Acid
· **Identification number(s)**
· **EC number:** 816-391-3

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
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:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **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 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 section 13.
Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 3)

See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**
· **PAC-1:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 4)

· **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.
· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C6H5F9O3S
· **Molecular Weight**	328.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 5)

Kinematic:	Not applicable.
· **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:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 6)

· **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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorohexanesulfonic Acid

(Contd. from page 7)

· **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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/18/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

1 Identification

· **Product identifier**

· **Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid**

· **Article number:** 37270
· **CAS Number:**
914637-49-3
· **EC number:**
811-572-3
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B H314 Causes severe skin burns and eye damage.


GHS07

Specific Target Organ Toxicity - Single Exposure 3 H335 May cause respiratory irritation.

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

(Contd. on page 2)

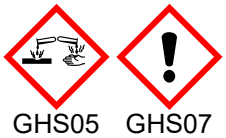
Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor.
P321	Specific treatment (see 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 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.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
914637-49-3 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 2)

· **Identification number(s)**
· **EC number:** 811-572-3

4 First-aid measures

· **Description of first aid measures**
· **General information:** Immediately remove any clothing soiled by the product.
· **After inhalation:** 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:** Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 3)

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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.
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

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.
· **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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 4)

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C8H5F11O2
· **Molecular Weight**	342.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	DMF: 5 mg/ml; DMSO: 2 mg/ml; Ethanol: insol; PBS (pH 7.2): insol
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 5)

· **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:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:** Strong caustic effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 6)

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/31/2023 Revision date 01/31/2023

Trade name: 2H,2H,3H,3H-Perfluorooctanoic Acid

(Contd. from page 7)

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 01/31/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

AccuStandard, Inc.
125 Market St., New Haven, CT 06513 USA
Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: PFOS-028S

Description: 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS) in Methanol

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

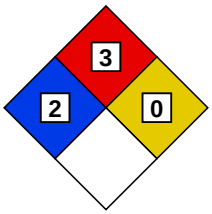
Emergency Phone #: AccuStandard, Inc.
1-203-502-7070 (USA)
+001-203-502-7070 (International)

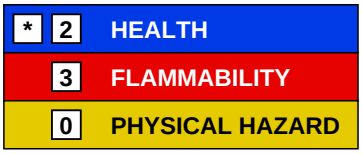
24 hours / 7 days a week

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements







Signal Word: Danger

Hazard Codes:

H225 - Highly Flammable (Flammable liquids, category 2)

H301 - Toxic if swallowed. (Acute toxicity, oral, category 3)

H311 - Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

H315 - Irritating to skin. (Skin corrosion/irritation, category 2)

H320 - Irritating to eyes. (Eye damage/irritation, category 2B)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H336 - Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

H360 - California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

H370 - Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

Precautionary Codes:

SECTION 2 - HAZARDS IDENTIFICATION *- continued*

2.1 - GHS Label Elements *- continued*

P202 - This product should only by used by persons trained in the safe handling of hazardous chemicals.

P233 - Store in a tightly closed container. (P404)

P262 - Do not get in eyes, on skin or clothing.

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P280 - Protective gloves must be worn to prevent skin contact.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P331 - Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

2.2 - Other Hazards

2.2.1 - Symptom of Exposure Health/Environment

Highly Flammable (Flammable liquids, category 2)

Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 or 18 hours.

POISON: May be fatal or cause blindness if swallowed.

Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

2.2.2 - Potential Health Effects

Irritating to eyes. (Eye damage/irritation, category 2B)

Irritating to skin. (Skin corrosion/irritation, category 2)

Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

Irritating to mucous membrane and upper respiratory system.

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Toxic if swallowed. (Acute toxicity, oral, category 3)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS) in Methanol

SECTION 3 - COMPOSITION / ANALYTES DATA *- continued*

Analyte	CAS #	% Concentration	ACGIH -TLV (mg/m^3)			OSHA -PEL (mg/m^3)		
			TWA	STEL	Skin	TWA	STEL	Skin
1H,1H,2H,2H-Perfluorooctane sulfonic acid	27619-97-2	0.010						
Methanol	67-56-1	99.990				260		

SECTION 4 - FIRST AID MEASURES

4.1 - First Aid Procedures - General

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. (P331)

SECTION 5 - FIRE FIGHTING MEASURES

5.1 - Flammable Properties

Dangerous fire and explosive hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

6.1 - Spill Response

Wear suitable protective equipment listed under Exposure Controls / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Dispose as hazardous waste. Comply with Federal, State and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool area away from ignition sources and oxidizers.

Avoid breathing vapors or mists.

Use with adequate ventilation.

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only by used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS

8.1 - Engineering Controls/PPE

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

8.2 - General Hygene Considerations

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Protective gloves must be worn to prevent skin contact. (P280)

(Chloroprene, natural rubber, nitrile, or equivalent)

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear liquid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: -93.9 °C

Boiling Point: 65 °C

Flash Point: 52 °F (11 °C) (tcc)

Evaporation Rate (Butyl Acetate=1): 5.9

Flammability Class: N/A

Lower Flammability Level: 6.7

Upper Flammability Level: 36.5

Vapor Pressure: 97 mmHg (20 °C)

Vapor Density (Air = 1): 1.1 g/L

Specific Gravity: 0.791 g/cm3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES *- continued*

Solubility in Water: Very soluble

Partition Coefficient: log Pow: -0.77

Autoignition Temperature: 385 °C

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: 99.9+

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Acids
Oxidizers

Hazardous Decomposition: Oxides of carbon; Formaldehyde

Hazardous Polymerization: Will not occur

Condition to Avoid: Heat; Contact with ignition sources

SECTION 11 - TOXICOLOGICAL INFORMATION

Human Health Toxicity

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): Human - 143 mg/kg; Rat - 1500 mg/kg

LD50 (Dermal) : Rabbit - >2000 mg/kg

LC50 (Inhalation): Rat - >20 mg/L

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION

Environmental Toxicity

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): >1000 mg/L 96H

EC50 (Aquatic Invertebrate): >1000 mg/L 48H

BCF: 1.0

Hydrolyzes readily on contact with water. Readily biodegradable.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATION

Transportation Information (DOT/IATA)

SECTION 14 - TRANSPORT INFORMATION *- continued*

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

This product contains a compound or compounds subject to EU Regulation (EC) No 1907/2006 (REACH) on Annex XIV, Annex XVII, and/or Article 59. Refer to the below table for details.

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

This product is subject to SARA section 313 reporting requirements.

All components are listed on the TSCA Inventory.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

			REACH (1907/2006)		
Analyte	CAS #	% Concentration	Annex XIV	Annex XVII	Article 59
Methanol	67-56-1	99.990		X	

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals and CLP Regulation (EC) No. 1272/2008.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY RESULTING FROM ITS USE.

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

0 - Minimal
1 - Slight
2 - Moderate
3 - Serious
4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

Category 1 - Most Severe
Category 5 - Least Severe

**** End of Document ****

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

1 Identification

· **Product identifier**

· **Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid**
· **Synonym** 4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-pentadecafluoro-decanoic acid

· **Article number:** 37271
· **CAS Number:**
812-70-4
· **EC number:**
696-430-7
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

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

(Contd. on page 2)

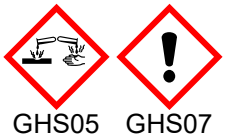
Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor.
P321	Specific treatment (see 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 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.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
812-70-4 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 2)

· **Identification number(s)**
· **EC number:** 696-430-7

4 First-aid measures

· **Description of first aid measures**
· **General information:** Immediately remove any clothing soiled by the product.
· **After inhalation:** 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:** Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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 section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 3)

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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.
· **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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 4)

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C10H5F15O2
· **Molecular Weight**	442.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 5)

· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 6)

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 2H,2H,3H,3H-Perfluorodecanoic Acid

(Contd. from page 7)

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/18/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

1 Identification

· **Product identifier**

· **Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid**
· **Synonym** 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluoro-1-decanesulfonic acid

· **Article number:** 37259
· **CAS Number:**
39108-34-4
· **EC number:**
254-295-8
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**



GHS08 Health hazard

Specific Target Organ Toxicity - Repeated Exposure 2 H373 May cause damage to organs through prolonged or repeated exposure.



GHS05 Corrosion

Skin Corrosion 1A H314 Causes severe skin burns and eye damage.

Eye Damage 1 H318 Causes serious eye damage.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 1)


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS05 GHS07 GHS08

· **Signal word** Danger
· **Hazard statements**
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
H373 May cause damage to organs through prolonged or repeated exposure.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor if you feel unwell.
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/doctor.
P321	Specific treatment (see on this label).
P314	Get medical advice/attention if you feel unwell.
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 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

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 2)

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
39108-34-4 1H,1H,2H,2H-Perfluorodecanesulfonic Acid
· **Identification number(s)**
· **EC number:** 254-295-8

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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 section 13.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 3)

Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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:**
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

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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 4)

· **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.
· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C10H5F17O3S
· **Molecular Weight**	528.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 5)

Kinematic:	Not applicable.
· **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:**
· **Primary irritant effect:**
· **on the skin:** Strong caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 6)

· **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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: 1H,1H,2H,2H-Perfluorodecanesulfonic Acid

(Contd. from page 7)

· **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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/18/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1A: Skin corrosion/irritation – Category 1A
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
Specific Target Organ Toxicity - Repeated Exposure 2: Specific target organ toxicity (repeated exposure) – Category 2

REFERENCE MATERIAL CERTIFICATE

Reference Material

This certificate is designed in accordance with ISO Guide 31. This reference material (RM) was designed, produced and verified in accordance with a registered quality management system ISO 9001. All measurements were performed according to ISO/IEC 17025 by a DAkkS accredited laboratory (D-PL-19883-01-00).

Product Name
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid potassium

Product Code
DRE-CA11407100

CAS No.
83329-89-9

Mol. Weight
670.69

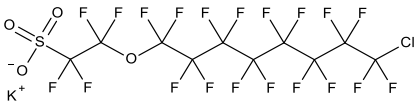
Mol. Formula
$C_{10}ClF_{20}O_4S \cdot K$

Lot Number
1480096

Format
Neat

Expiry Date
05 Sep 2027

Storage Temp
20°C ± 4°C



CERTIFIED	CERTIFIED
Purity 97.7% (g/g)	Expanded Uncertainty (U) 5.0% (g/g)

Uncertainty
The certified value(s) and uncertainty(ies) are determined in accordance with EURACHEM/CITAC Guide for "Quantifying Uncertainty in Analytical Measurement, 3rd edition", with an 95% confidence level (k=2). Uncertainty is based on the Total Combined Uncertainty, including uncertainties of characterisation and stability testing. Stability values are based on real evidence opposed to simulation.

The producer certifies that this reference material meets the specification stated in this certificate until the expiry date, provided it is stored unopened at the recommended temperature herein. Product warranties for this reference material are set out in the terms and conditions of purchase.

CERTIFIED BY	CERTIFIED ON		
N. Müller	05 Sep 2024		RM Release

REFERENCE MATERIAL CERTIFICATE

CHROMATOGRAM

No chromatogram available.

Instrument
HPLC/DAD+MS

Detection
DAD+MS

Column
Synergi Polar-RP 4 µm 250 x 4.6 mm

Method Details
see Batch Information

Inj.-Vol.
10 µL

Flow
0.5 mL/min

Method of Characterisation
Purity was determined by quantitative 19F-NMR

Method of Identification
NMR, RT, IR, MS

Batch Information
Substance is hygroscopic.
Method Details
Eluent A: 100% Acetonitrile
Eluent B: Water + Formic Acid

Time [min]	Eluent A [%]	Eluent B [%]
0	10	90
1	10	90
21	98	2
25	98	2

Intended Use
This RM is intended for use in a laboratory as a calibration and quality control standard or in method development for analytical techniques.

Safety
Proper precautions should be observed while handling. See Safety Data Sheet.

Traceability
The balances used for gravimetric measurements are calibrated with weights traceable to the national standards (DKD). The calibration of the balances is verified daily internally and annually by an external accredited calibration service. Chromatographic methods are traceable to the International System of Units (SI).

Storage
The RM should be stored in the original sealed container at the indicated temperature.

Instructions for use
It is recommended to use 1 mg as the minimum sample size and if less material is used, to increase the certified uncertainty by a factor of two for half sample and four for a quarter of sample. If storage after opening is necessary, the RM should be tightly closed and kept from light and moisture. If the RM was in a sealed ampoule, it should be transferred to a vial with minimum head space. Visit the support section of our website lgcstandards.com for a series of Dr. Ehrenstorfer Tech Tip videos and frequently asked questions.

LGC Labor GmbH
Bgm.-Schlosser-Straße 6A
86199 Augsburg, Germany
T | +49 821 906080
F | +49 821 9060888
E | dr.ehrenstorfer@lgcgroup.com

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/29/2023 *Reviewed on 06/29/2023*

1 Identification

· **Product identifier**

· **Product Name: Stock Organic Standard**

· **Part Name:** PFAS-ADONA
· **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
732-549-7144
USMet-CRMSales@antylia.com

· **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

Flammable Liquids 2 — H225 Highly flammable liquid and vapor.



GHS06 Skull and crossbones

Acute Toxicity - Inhalation 3 — H331 Toxic if inhaled.



GHS08 Health hazard

Specific Target Organ Toxicity - Single Exposure 1 — H370 Causes damage to the central nervous system and the visual 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
· **Hazard statements**
H225 Highly flammable liquid and vapor.
H331 Toxic if inhaled.
H370 Causes damage to the central nervous system and the visual organs.
· **Precautionary statements**

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/fume/gas/mist/vapors/spray.
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/shower.
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P307+P311	IF exposed: Call a POISON CENTER or doctor/physician.
P321	Specific treatment (see on this label).
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P403+P235	Store in a well-ventilated place. Keep cool.

(Contd. on page 2)

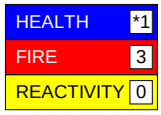
(Contd. of page 1)

P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
· **Classification system:**
· **NFPA ratings (scale 0 - 4)**



Health = 1
Fire = 3
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = *1
Fire = 3
Reactivity = 0

· **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	94.5%

· **Chemical identification of the substance/preparation**		
7732-18-5	water, distilled, conductivity or of similar purity	4.99%
1310-73-2	sodium hydroxide	<0.5%
919005-14-4	4,8-Dioxa-3H-perfluorononanoic Acid	0.01%

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 give anything to eat or drink - Do not induce vomitting
· **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, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **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:**
Dilute with plenty of water.
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.

(Contd. on page 3)
US

(Contd. of page 2)

Ensure adequate ventilation.
· **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:**		
67-56-1	methanol	530 ppm
1310-73-2	sodium hydroxide	0.5 mg/m³

· **PAC-2:**		
67-56-1	methanol	2,100 ppm
1310-73-2	sodium hydroxide	5 mg/m³

· **PAC-3:**		
67-56-1	methanol	7200* ppm
1310-73-2	sodium hydroxide	50 mg/m³

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:**	
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: 250 ppm Long-term value: 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.

(Contd. on page 4)
US

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 3)

· **Respiratory protection:**
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

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:	64.7 °C (148.5 °F)
· **Flash point:**	< 23 °C (< 73.4 °F)
· **Flammability (solid, gaseous):**	Highly flammable.
· **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 Vol %
· **Vapor pressure at 20 °C (68 °F):**	128 hPa (96 mm Hg)
· **Density at 20 °C (68 °F)**	0.80048 g/cm³ (6.68001 lbs/gal)
· **Relative density**	Not applicable.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Fully miscible.
· **Partition coefficient (n-octanol/water):**	Not applicable.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	94.5 %
Water:	5.0 %
VOC content:	94.50 %

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/29/2023 *Reviewed on 06/29/2023*

Product Name: Stock Organic Standard

(Contd. of page 4)

Solids content:	*>0.5 %*
· ***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:***		
67-56-1 methanol		
Oral	*LD50*	*5,628 mg/kg (rat)*
Dermal	*LD50*	*15,800 mg/kg (rabbit)*

· ***Primary 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 2 (Self-assessment): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
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.*
· ***Recommended cleansing agent:*** *Water, if necessary with cleansing agents.*

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 06/29/2023 *Reviewed on 06/29/2023*

Product Name: Stock Organic Standard

(Contd. of page 5)

14 Transport information

· ***UN-Number***
· ***DOT, ADR, IMDG, IATA*** *UN1230*

· ***UN proper shipping name***
· ***DOT*** *Methanol*
· ***ADR*** *1230 METHANOL*
· ***IMDG, IATA*** *METHANOL*

· ***Transport hazard class(es)***

· ***DOT***



· ***Class*** *3 Flammable liquids*
· ***Label*** *3, 6.1*

· ***ADR***



· ***Class*** *3 Flammable liquids*
· ***Label*** *3+6.1*

· ***IMDG***



· ***Class*** *3 Flammable liquids*
· ***Label*** *3/6.1*

· ***IATA***



· ***Class*** *3 Flammable liquids*
· ***Label*** *3 (6.1)*

· ***Packing group***
· ***DOT, ADR, IMDG, IATA*** *II*

· ***Environmental hazards:*** *Not applicable.*

· ***Special precautions for user*** *Warning: Flammable liquids*
· ***Hazard identification number (Kemler code):*** *336*
· ***EMS Number:*** *F-E,S-D*
· ***Stowage Category*** *B*
· ***Stowage Code*** *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)*** *1L*
· ***Excepted quantities (EQ)*** *Code: E2*
Maximum net quantity per inner packaging: 30 ml
Maximum net quantity per outer packaging: 500 ml

(Contd. on page 7)

(Contd. of page 6)

· UN "Model Regulation":	UN 1230 METHANOL, 3 (6.1), II

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture** No further relevant information available.
· **Sara**

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

67-56-1	methanol

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

67-56-1	methanol	ACTIVE
7732-18-5	water, distilled, conductivity or of similar purity	ACTIVE
1310-73-2	sodium hydroxide	ACTIVE

· **Hazardous Air Pollutants**

67-56-1	methanol

· **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)**
None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

· **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
· **Hazard statements**
H225 Highly flammable liquid and vapor.
H331 Toxic if inhaled.
H370 Causes damage to the central nervous system and the visual organs.
· **Precautionary statements**
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ventilating/lighting/equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P260 Do not breathe dust/fume/gas/mist/vapors/spray.
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/shower.
P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P307+P311 IF exposed: Call a POISON CENTER or doctor/physician.
P321 Specific treatment (see on this label).
P403+P233 Store in a well-ventilated place. Keep container tightly closed.
P403+P235 Store in a well-ventilated place. Keep cool.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

(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** 06/29/2023
· **Abbreviations and acronyms:**
ADR: Accord relatif au transport international 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
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
Flammable Liquids 2: Flammable liquids – Category 2
Acute Toxicity - Inhalation 3: Acute toxicity – Category 3
Specific Target Organ Toxicity - Single Exposure 1: Specific target organ toxicity (single exposure) – Category 1

SAFETY DATA SHEET

This safety data sheet was created pursuant to the requirements of:
Regulation (EC) No. 1907/2006 and Regulation (EC) No. 1272/2008

Revision date 06-Apr-2023 **Revision Number** 1

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

1.1. Product identifier

Product Code(s) CIL-ULM-10843-1.2

Product Name 9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid,(9CL-PF3ONS)(F53MBAJ) K Salt Unlabelled, 100 µg/mL In Methanol

Form Not applicable

Pure substance/mixture Mixture

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

Recommended use Laboratory use

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier

LGC Limited
Queens Road
Teddington
Middlesex TW11 0LY
UNITED KINGDOM
:+44 (0) 20 8943 7000
Fax :+44 (0) 20 8943 2767
eMail : gb@lgcstandards.com

Web : www.lgcstandards.com

For further information, please contact

E-mail address sds-request@lgcgroup.com

1.4. Emergency telephone number

Emergency Telephone 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

Emergency Telephone - §45 - (EC)1272/2008	
Europe	**112**

Austria	No information available
Bulgaria	
Croatia	
Cyprus	
Czech Republic	
Denmark	
France	
Hungary	
Ireland	
Italy	
Lithuania	
Luxembourg	
Netherlands	
Norway	
Portugal	
Romania	
Slovakia	
Slovenia	
Spain	
Sweden	
Switzerland	

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008

Acute toxicity - Oral	Category 3 - (H301)
Acute toxicity - Dermal	Category 3 - (H311)
Acute toxicity - Inhalation (Dusts/Mists)	Category 3 - (H331)
Skin corrosion/irritation	Category 2 - (H315)
Serious eye damage/eye irritation	Category 2 - (H319)
Specific target organ toxicity — single exposure	Category 1 - (H370)
Flammable liquids	Category 2 - (H225)

2.2. Label elements

Contains Methanol



Signal word
Danger

Hazard statements
H301 - Toxic if swallowed
H311 - Toxic in contact with skin
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H331 - Toxic if inhaled
H370 - Causes damage to organs
H225 - Highly flammable liquid and vapour

Precautionary Statements - EU (§28, 1272/2008)
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
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor
P403 + P235 - Store in a well-ventilated place. Keep cool

2.3. Other hazards

No information available.

This mixture contains no substance considered to be persistent, bioaccumulating or toxic (PBT). This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

Endocrine Disruptor Information This product does not contain any known or suspected endocrine disruptors.

Chemical name	EU - REACH (1907/2006) - Article 59(1) - Candidate List of Substances of Very High Concern (SVHC) for Authorisation	EU - REACH (1907/2006) - Endocrine Disruptor Assessment List of Substances
Methanol	-	-

SECTION 3: Composition/information on ingredients

3.1 Substances

Not applicable

3.2 Mixtures

Chemical name	Weight-%	REACH registration number	EC No (EU Index No)	Classification according to Regulation (EC) No. 1272/2008 [CLP]	Specific concentration limit (SCL)	M-Factor	M-Factor (long-term)
Methanol 67-56-1	80 - 100	-	200-659-6	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 1 (H370) Flam. Liq. 2 (H225)	STOT SE 1 :: C>=10% STOT SE 2 :: 3%<=C<10%		

Full text of H- and EUH-phrases: see section 16

Acute Toxicity Estimate
If LD50/LC50 data is not available or does not correspond to the classification category, then the appropriate conversion value from CLP Annex I, Table 3.1.2, is used to calculate the acute toxicity estimate (ATEmix) for classifying a mixture based on its components

Chemical name	Oral LD50 mg/kg	Dermal LD50 mg/kg	Inhalation LC50 - 4 hour - dust/mist - mg/L	Inhalation LC50 - 4 hour - vapour - mg/L	Inhalation LC50 - 4 hour - gas - ppm
Methanol 67-56-1	6200	15840	No data available	41.6976	No data available

This product does not contain candidate substances of very high concern at a concentration >=0.1% (Regulation (EC) No. 1907/2006 (REACH), Article 59)

SECTION 4: First aid measures

4.1. Description of first aid measures

General advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Inhalation Remove to fresh air. IF exposed or concerned: Get medical advice/attention. Get medical attention immediately if symptoms occur. If breathing has stopped, give artificial respiration. Get medical attention immediately. Immediate medical attention is required. 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. If breathing is difficult, (trained personnel should) give oxygen.

Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Get immediate medical

	advice/attention. Remove contact lenses, if present and easy to do. Continue rinsing.
Skin contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention.
Ingestion	Do NOT induce vomiting. Rinse mouth. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.
Self-protection of the first aider	Remove all sources of ignition. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Use personal protective equipment as required. See section 8 for more information. Avoid contact with skin, eyes or clothing. 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. Do not breathe vapour or mist.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms	May cause redness and tearing of the eyes. Burning sensation. Coughing and/ or wheezing. Difficulty in breathing.

4.3. Indication of any immediate medical attention and special treatment needed

Note to doctors	Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media	Dry chemical. Carbon dioxide (CO2). Water spray. Alcohol resistant foam.
Large Fire	CAUTION: Use of water spray when fighting fire may be inefficient.
Unsuitable extinguishing media	Do not scatter spilled material with high pressure water streams.

5.2. Special hazards arising from the substance or mixture

Specific hazards arising from the chemical	Risk of ignition. Keep product and empty container away from heat and sources of ignition. In the event of fire, cool tanks with water spray. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

5.3. Advice for firefighters

Special protective equipment and precautions for fire-fighters	Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Evacuate personnel to safe areas. Use personal protective equipment as required. See section 8 for more information. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Pay attention to flashback. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Do not breathe vapour or mist.

Other information Ventilate the area. Refer to protective measures listed in Sections 7 and 8.

For emergency responders Use personal protection recommended in Section 8.

6.2. Environmental precautions

Environmental precautions Refer to protective measures listed in Sections 7 and 8. Prevent further leakage or spillage if safe to do so. Prevent product from entering drains.

6.3. Methods and material for containment and cleaning up

Methods for containment Stop leak if you can do it without risk. Do not touch or walk through spilled material. A vapour suppressing foam may be used to reduce vapours. Dyke far ahead of spill to collect run-off water. Keep out of drains, sewers, ditches and waterways. Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.

Methods for cleaning up Take precautionary measures against static discharges. Dam up. Soak up with inert absorbent material. Pick up and transfer to properly labelled containers.

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

6.4. Reference to other sections

Reference to other sections See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling Use personal protection equipment. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use grounding and bonding connection when transferring this material to prevent static discharge, fire or explosion. Use spark-proof tools and explosion-proof equipment. Keep in an area equipped with sprinklers. Use according to package label instructions. Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Take off contaminated

clothing and wash it before reuse. Do not eat, drink or smoke when using this product. Do not breathe vapour or mist. In case of insufficient ventilation, wear suitable respiratory equipment. Handle product only in closed system or provide appropriate exhaust ventilation.

General hygiene considerations Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Do not breathe vapour or mist. Avoid contact with skin, eyes or clothing. Do not eat, drink or smoke when using this product. Wash hands before breaks and after work. Wear suitable gloves and eye/face protection.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Keep in properly labelled containers. Do not store near combustible materials. Keep in an area equipped with sprinklers. Store in accordance with the particular national regulations. Store in accordance with local regulations. Keep out of the reach of children. Store locked up. 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.

7.3. Specific end use(s)

Risk Management Methods (RMM) The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits

Chemical name	European Union	Austria	Belgium	Bulgaria	Croatia
Methanol 67-56-1	TWA: 200 ppm TWA: 260 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ STEL 800 ppm STEL 1040 mg/m³ H*	TWA: 200 ppm TWA: 266 mg/m³ STEL: 250 ppm STEL: 333 mg/m³ *	TWA: 200 ppm TWA: 260.0 mg/m³ K*	TWA: 200 ppm TWA: 260 mg/m³ *

Chemical name	Cyprus	Czech Republic	Denmark	Estonia	Finland
Methanol 67-56-1	* TWA: 200 ppm TWA: 260 mg/m³	TWA: 250 mg/m³ Ceiling: 1000 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ H*	TWA: 200 ppm TWA: 250 mg/m³ STEL: 250 ppm STEL: 350 mg/m³ A*	TWA: 200 ppm TWA: 270 mg/m³ STEL: 250 ppm STEL: 330 mg/m³ iho*

Chemical name	France	Germany	Germany MAK	Greece	Hungary
Methanol 67-56-1	TWA: 200 ppm TWA: 260 mg/m³ STEL: 1000 ppm STEL: 1300 mg/m³ *	TWA: 100 ppm TWA: 130 mg/m³ H*	TWA: 100 ppm TWA: 130 mg/m³ Peak: 200 ppm Peak: 260 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ STEL: 250 ppm STEL: 325 mg/m³ skin - potential for cutaneous absorption	TWA: 260 mg/m³ *

Chemical name	Ireland	Italy	Italy REL	Latvia	Lithuania
Methanol 67-56-1	TWA: 200 ppm TWA: 260 mg/m³ STEL: 600 ppm STEL: 780 mg/m³ Sk*	TWA: 200 ppm TWA: 260 mg/m³ pelle*	TWA: 200 ppm TWA: 262 mg/m³ STEL: 250 ppm STEL: 328 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ *	* TWA: 200 ppm TWA: 260 mg/m³

Chemical name	Luxembourg	Malta	Netherlands	Norway	Poland
Methanol 67-56-1	* TWA: 200 ppm TWA: 260 mg/m³	* TWA: 200 ppm TWA: 260 mg/m³	TWA: 133 mg/m³ H*	TWA: 100 ppm TWA: 130 mg/m³ STEL: 125 ppm STEL: 162.5 mg/m³ H*	STEL: 300 mg/m³ TWA: 100 mg/m³ Prohibited - substances or mixtures containing Methanol in weight concentration >3%;except fuels used in the model building, powerboating, fuel cells and biofuels *

Chemical name	Portugal	Romania	Slovakia	Slovenia	Spain
Methanol 67-56-1	TWA: 200 ppm TWA: 260 mg/m³ STEL: 250 ppm P*	TWA: 200 ppm TWA: 260 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ STEL: STEL ppm STEL: STEL mg/m³ *	TWA: 200 ppm TWA: 266 mg/m³ vía dérmica*

Chemical name	Sweden	Switzerland	United Kingdom
Methanol 67-56-1	NGV: 200 ppm NGV: 250 mg/m³ Vägledande KGV: 250 ppm Vägledande KGV: 350 mg/m³ *	TWA: 200 ppm TWA: 260 mg/m³ STEL: 800 ppm STEL: 1040 mg/m³ H*	TWA: 200 ppm TWA: 266 mg/m³ STEL: 250 ppm STEL: 333 mg/m³ Sk*

Biological occupational exposure limits

Chemical name	European Union	Austria	Bulgaria	Croatia	Czech Republic

Methanol 67-56-1	-	-	-	7.0 mg/g Creatinine - urine (Methanol) - at the end of the work shift	0.47 mmol/L (urine - Methanol end of shift) 15 mg/L (urine - Methanol end of shift)

Chemical name	Denmark	Finland	France	Germany	Germany
Methanol 67-56-1	-	-	15 mg/L - urine (Methanol) - end of shift	15 mg/L (urine - Methanol end of shift) 15 mg/L (urine - Methanol for long-term exposures: at the end of the shift after several shifts) 15 mg/L - BAT (for long-term exposures: at the end of the shift after several shifts) urine 15 mg/L - BAT (end of exposure or end of shift) urine	15 mg/L (urine - Methanol end of shift) 15 mg/L (urine - Methanol for long-term exposures: at the end of the shift after several shifts)

Chemical name	Hungary	Ireland	Italy	Italy REL
Methanol 67-56-1	30 mg/L (urine - Methanol end of shift) 940 µmol/L (urine - Methanol end of shift)	15 mg/L (urine - Methanol end of shift)	-	15 mg/L - urine (Methanol) - end of shift

Chemical name	Latvia	Luxembourg	Romania	Slovakia
Methanol 67-56-1	-	-	-	30 mg/L (urine - Methanol end of exposure or work shift) 30 mg/L (urine - Methanol after all work shifts)

Chemical name	Slovenia	Spain	Switzerland	United Kingdom
Methanol 67-56-1	30 mg/L - urine (Methanol) - at the end of the work shift; for long-term exposure: at the end of the work shift after several consecutive workdays	15 mg/L (urine - Methanol end of shift)	30 mg/L (urine - Methanol end of shift, and after several shifts (for long-term exposures))	-

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Personal protective equipment

Eye/face protection	Tight sealing safety goggles. Avoid contact with eyes. Wear safety glasses with side shields (or goggles).
Hand protection	Wear suitable gloves. Impervious gloves. The protective gloves to be used must comply with the specifications of EC Directive 89/686/EEC and the related standard EN374.
Skin and body protection	Long sleeved clothing. Chemical resistant apron. Antistatic boots. Wear suitable protective clothing.
Respiratory protection	No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.
General hygiene considerations	Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Do not breathe vapour or mist. Avoid contact with skin, eyes or clothing. Do not eat, drink or smoke when using this product. Wash hands before breaks and after work. Wear suitable gloves and eye/face protection.
Environmental exposure controls	Do not allow into any sewer, on the ground or into any body of water.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	Liquid
Appearance	Liquid
Colour	colourless
Odour	Pungent.
Odour threshold	No information available

Property	**Values**	**Remarks • Method**
Melting point / freezing point	-98 °C	None known
Initial boiling point and boiling range	64.7 °C	None known
Flammability	No data available	None known
Flammability Limit in Air		None known
Upper flammability or explosive limits	36 %(V)	
Lower flammability or explosive	6 %(V)	

limits		
Flash point	9.7 °C	CC (closed cup)
Autoignition temperature	455 °C	None known
Decomposition temperature		None known
pH	No data available	None known
pH (as aqueous solution)	No data available	No information available
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Water solubility	Water: Completely miscible	None known
Solubility(ies)	No data available	None known
Partition coefficient	-0.77	None known
Vapour pressure	130.3 hPa	@ 20°C
Relative density	0.791 g/ml	@ 25 °C
Bulk density	No data available	
Liquid Density	No data available	
Relative vapour density	1.11	None known
Particle characteristics		
Particle Size	No information available	
Particle Size Distribution	No information available	

9.2. Other information

9.2.1. Information with regards to physical hazard classes
Not applicable

9.2.2. Other safety characteristics
No information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity No information available.

10.2. Chemical stability

Stability Stable under normal conditions.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge Yes.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

10.4. Conditions to avoid

Conditions to avoid Heat, flames and sparks. Excessive heat.

10.5. Incompatible materials

Incompatible materials Strong acids. Strong bases. Strong oxidising agents.

Hazardous decomposition products None known based on information supplied.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available. Toxic by inhalation. (based on components).

Eye contact Specific test data for the substance or mixture is not available. Causes serious eye irritation. (based on components). May cause redness, itching, and pain.

Skin contact Specific test data for the substance or mixture is not available. Causes skin irritation. (based on components). Toxic in contact with skin.

Ingestion Specific test data for the substance or mixture is not available. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea. Toxic if swallowed. (based on components).

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms Redness. May cause redness and tearing of the eyes. Coughing and/ or wheezing. Difficulty in breathing.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)	100.00 mg/kg
ATEmix (dermal)	300.00 mg/kg
ATEmix (inhalation-dust/mist)	0.501 mg/l

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Methanol	= 6200 mg/kg (Rat)	= 15840 mg/kg (Rabbit)	= 22500 ppm (Rat) 8 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation Classification based on data available for ingredients. Causes skin irritation.

Serious eye damage/eye irritation Classification based on data available for ingredients. Causes serious eye irritation.

Respiratory or skin sensitisation No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure Based on the classification criteria of the Globally Harmonized System as adopted in the country or region with which this safety data sheet complies, this product has been determined to cause systemic target organ toxicity from acute exposure. (STOT SE). Causes damage to organs if swallowed. Causes damage to organs in contact with skin.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

11.2. Information on other hazards

11.2.1. Endocrine disrupting properties

Endocrine disrupting properties No information available.

11.2.2. Other information

Other adverse effects No information available.

SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicity

Unknown aquatic toxicity Contains 0 % of components with unknown hazards to the aquatic environment.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Methanol	-	LC50: 13500 - 17600mg/L (96h, Lepomis macrochirus) LC50: 18 - 20mL/L (96h, Oncorhynchus mykiss) LC50: 19500 - 20700mg/L (96h, Oncorhynchus mykiss) LC50: =28200mg/L (96h, Pimephales promelas) LC50: >100mg/L (96h, Pimephales promelas)	-	-

12.2. Persistence and degradability

Persistence and degradability No information available.

12.3. Bioaccumulative potential

Bioaccumulation No information available.

Component Information

Chemical name	Partition coefficient
Methanol	-0.77

12.4. Mobility in soil

Mobility in soil No information available.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment

Chemical name	PBT and vPvB assessment
Methanol	The substance is not PBT / vPvB PBT assessment does not apply Further information relevant for the PBT assessment is necessary

12.6. Endocrine disrupting properties

Endocrine disrupting properties No information available.

12.7. Other adverse effects
No information available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from residues/unused products Should not be released into the environment. Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Empty containers pose a potential fire and explosion hazard. Do not cut, puncture or weld containers.

SECTION 14: Transport information

IATA

14.1 UN number or ID number UN1230
14.2 UN proper shipping name Methanol mixture
14.3 Transport hazard class(es) 3
Subsidiary hazard class 6.1
14.4 Packing group II
Description UN1230, Methanol mixture, 3 (6.1), II
14.5 Environmental hazards Not applicable
14.6 Special precautions for user
Special Provisions A113
ERG Code 3L

IMDG

14.1 UN number or ID number UN1230
14.2 UN proper shipping name Methanol mixture
14.3 Transport hazard class(es) 3
Subsidiary hazard class 6.1
14.4 Packing group II

Description	UN1230, Methanol mixture, 3 (6.1), II, (9.7°C c.c.)
14.5 Marine pollutant	NP
14.6 Special precautions for user	
Special Provisions	279
EmS-No	F-E, S-D No information available
14.7 Maritime transport in bulk according to IMO instruments	No information available

RID

14.1 UN number or ID number	UN1230
14.2 UN proper shipping name	Methanol mixture
14.3 Transport hazard class(es)	3
Subsidiary hazard class	6.1
14.4 Packing group	II
Description	UN1230, Methanol mixture, 3 (6.1), II
14.5 Environmental hazards	Not applicable
14.6 Special precautions for user	
Special Provisions	279
Classification code	FT1

ADR

14.1 UN number or ID number	UN1230
14.2 UN proper shipping name	Methanol mixture
14.3 Transport hazard class(es)	3
Subsidiary hazard class	6.1
14.4 Packing group	II
Description	UN1230, Methanol mixture, 3 (6.1), II, (D/E)
14.5 Environmental hazards	Not applicable
14.6 Special precautions for user	
Special Provisions	279
Classification code	FT1
Tunnel restriction code	(D/E)

SECTION 15: Regulatory information

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

National regulations

France
Occupational Illnesses (R-463-3, France)

Chemical name	French RG number	Title
Methanol 67-56-1	RG 84	-

Water hazard class (WGK) obviously hazardous to water (WGK 2)

Poland

SDS created according to the following Polish regulation: Act of February 25, 2011 on chemical substances and their mixtures (Journal of Laws of 2018, item 143, as amended). Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), establishing the European Chemicals Agency (EC) as amended. Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labeling and packaging of substances and mixtures, as amended. Regulation of the Minister of Health of 10 August 2012 on the criteria and method of classifying chemical substances and their mixtures (Journal of Laws of 2012, item 1018). Regulation of the Minister of Health of 20 April 2012 on labeling packaging of hazardous substances and mixtures and some mixtures (Journal of Laws of 2012, item 445). Regulation of the Minister of Family, Labor and Social Policy of 12 June 2018 on the maximum allowable concentrations and intensities of factors harmful to health in the work environment (Journal of Laws of 2018, item 1286). Announcement of the Minister of Economy, Labor and Social Policy of August 28, 2003 on the publication of the unified text of the Ordinance of the Minister of Labor and Social Policy on general health and safety at work regulations (Journal of Laws of 2003, No. 169, item 1650) . Regulation of the Minister of Health of 30 December 2004 on occupational safety and health related to the presence of chemical agents in the workplace (Journal of Laws of 2005, No. 11, item 86). Act of December 14, 2012 on waste (Journal of Laws of 2013, item 21) Regulation of the Minister of Health of December 30, 2004 on occupational health and safety related to the presence of chemical agents in the workplace (Journal U. of 2005, No. 11, item 86). Waste Act of December 14, 2012 (Journal of Laws of 2013, item 21). Act of 13 June 2013 on the management of packaging and packaging waste, Journal of Laws 2013, item 888). Government statement of September 24, 2002 - European Agreement on the International Carriage of Dangerous Goods by Road (ADR) (Journal of Laws No. 194, item 1629 and Journal of Laws of 2003, No. 207, item 2013 and 2014).

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Authorisations and/or restrictions on use:

This product contains one or more substance(s) subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

DIRECTIVE (EU) 2021/1187 on the marketing and use of explosives precursors

Not applicable

Chemical name	Restricted substance per REACH Annex XVII	Substance subject to authorisation per REACH Annex XIV
Methanol - 67-56-1	69.	

Persistent Organic Pollutants

Not applicable

Dangerous substance category per Seveso Directive (2012/18/EU)
H2 - ACUTE TOXIC
H3 - STOT SPECIFIC TARGET ORGAN TOXICITY - SINGLE EXPOSURE
P5a - FLAMMABLE LIQUIDS
P5b - FLAMMABLE LIQUIDS
P5c - FLAMMABLE LIQUIDS

Named dangerous substances per Seveso Directive (2012/18/EU)

Chemical name	Lower-tier requirements (tons)	Upper-tier requirements (tons)
Methanol - 67-56-1	500	5000

Ozone-depleting substances (ODS) regulation (EC) 1005/2009
Not applicable

International Inventories

TSCA	Contact supplier for inventory compliance status
DSL/NDSL	Contact supplier for inventory compliance status
EINECS/ELINCS	Contact supplier for inventory compliance status
ENCS	Contact supplier for inventory compliance status
IECSC	Contact supplier for inventory compliance status
KECL	Contact supplier for inventory compliance status
PICCS	Contact supplier for inventory compliance status
AIIC	Contact supplier for inventory compliance status

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical Safety Report A Chemical Safety Assessment is not required for this substance

SECTION 16: Other information

SAFETY DATA SHEET

This safety data sheet was created pursuant to the requirements of:
Regulation (EC) No. 1907/2006 and Regulation (EC) No. 1272/2008

Revision date 06-Apr-2023 **Revision Number** 1

CIL-ULM-10843-1.2 - 9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid,(9CL-PF3ONS)(F53MBAJ) K Salt Unlabelled, 100 µg/mL In Methanol

Key or legend to abbreviations and acronyms used in the safety data sheet

Full text of H-Statements referred to under section 3
H225 - Highly flammable liquid and vapour
H301 - Toxic if swallowed
H311 - Toxic in contact with skin
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H331 - Toxic if inhaled
H370 - Causes damage to organs

Legend
SVHC: Substances of Very High Concern for Authorisation:

Legend Section 8: Exposure controls/personal protection

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Classification procedure	
Classification according to Regulation (EC) No. 1272/2008 [CLP]	Method Used
Acute oral toxicity	Calculation method
Acute dermal toxicity	Calculation method
Acute inhalation toxicity - gas	Calculation method
Acute inhalation toxicity - Vapour	Calculation method
Acute inhalation toxicity - dust/mist	Calculation method
Skin corrosion/irritation	Calculation method
Serious eye damage/eye irritation	Calculation method
Respiratory sensitisation	Calculation method
Skin sensitisation	Calculation method
Mutagenicity	Calculation method
Carcinogenicity	Calculation method
Reproductive toxicity	Calculation method
STOT - single exposure	Calculation method
STOT - repeated exposure	Calculation method
Acute aquatic toxicity	Calculation method
Chronic aquatic toxicity	Calculation method
Aspiration hazard	Calculation method
Ozone	Calculation method

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))

U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine’s PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organisation for Economic Co-operation and Development Environment, Health, and Safety Publications
Organisation for Economic Co-operation and Development High Production Volume Chemicals Programme
Organisation for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Revision date 06-Apr-2023

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer

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.

End of Safety Data Sheet

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

1 Identification

· **Product identifier**

· **Trade name: Hexafluoropropylene Oxide Dimer Acid**
· **Synonym** 2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid

· **Article number:** 37266
· **CAS Number:**
13252-13-6
· **EC number:**
236-236-8
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1C	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

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

(Contd. on page 2)

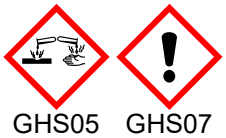
Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor if you feel unwell.
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/doctor.
P321	Specific treatment (see 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 in accordance with local/regional/national/international regulations.

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



Health = 3
Fire = 2
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = *3
Fire = 2
Reactivity = 0

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

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
13252-13-6 Hexafluoropropylene Oxide Dimer Acid
· **Identification number(s)**
· **EC number:** 236-236-8

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; consult doctor in case of complaints.
· **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:**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 3)

· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.
Take precautionary measures against static discharge.re.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 4)

· **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:**
Safety glasses



Tightly sealed goggles

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Liquid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C6HF11O3
· **Molecular Weight**	330.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	60 °C (140 °F)
· **Flash point:**	60 °C (140 °F)
· **Flammability (solid, gaseous):**	Not applicable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not determined.
· **Density at 20 °C (68 °F):**	1.748 g/cm³ (14.58706 lbs/gal)
· **Relative density**	Not determined.
· **Vapor 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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 5)

· **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:**
· **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)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 6)

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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Hexafluoropropylene Oxide Dimer Acid

(Contd. from page 7)

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

16 Other information

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/14/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1C: Skin corrosion/irritation – Category 1C
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

1 Identification

· **Product identifier**

· **Trade name: N-ethyl Perfluorooctanesulfonamide**
· **Synonym**

· **Article number:** 37263
· **CAS Number:**
4151-50-2
· **EC number:**
223-980-3
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS09 Environment

Aquatic Chronic 2	H411 Toxic to aquatic life with long lasting effects.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.
Skin Irritation 2	H315 Causes skin irritation.
Eye Irritation 2A	H319 Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

(Contd. on page 2)

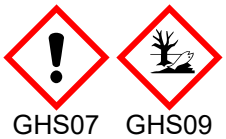
Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 1)

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS07 GHS09

· **Signal word** Warning
· **Hazard statements**

H302+H312+H332	Harmful if swallowed, in contact with skin or if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H411	Toxic to aquatic life with long lasting effects.

· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P301+P312	If swallowed: Call a poison center/doctor if you feel unwell.
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of water.
P321	Specific treatment (see on this label).
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.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P362+P364	Take off contaminated clothing and wash it before reuse.
P337+P313	If eye irritation persists: Get medical advice/attention.
P391	Collect spillage.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	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 = 2
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 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 2)

· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
4151-50-2 N-ethyl Perfluorooctanesulfonamide
· **Identification number(s)**
· **EC number:** 223-980-3

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:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:**
Rinse opened eye for several minutes under running water. If symptoms persist, 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.
A solid water stream may be inefficient.
· **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** Not required.
· **Environmental precautions:**
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:** Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 3)

See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**
· **PAC-1:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
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

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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 4)

· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C10H6F17NO2S
· **Molecular Weight**	527.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 5)

· **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:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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.
· **Ecotoxical effects:**
· **Remark:** Toxic for fish
· **Additional ecological information:**
· **General notes:**
Water hazard class 2 (Self-assessment): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
Toxic for aquatic organisms
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 6)

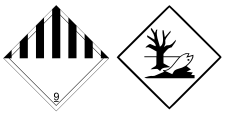
· **Other adverse effects** No further relevant information available.

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**	UN3077
· **UN proper shipping name**	
· **DOT, IATA**	Environmentally hazardous substance, solid, n.o.s. (N-ethyl Perfluorooctanesulfonamide)
· **IMDG**	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (N-ethyl Perfluorooctanesulfonamide)
· **Transport hazard class(es)**	
· **DOT**	
· **Class**	9 Miscellaneous dangerous substances and articles
· **Label**	9
· **IMDG, IATA**	
· **Class**	9 Miscellaneous dangerous substances and articles
· **Label**	9
· **Packing group**	
· **DOT, IMDG, IATA**	III
· **Environmental hazards:**	
· **Marine pollutant:**	Symbol (fish and tree)
· **Special marking (IATA):**	Symbol (fish and tree)
· **Special precautions for user**	Warning: Miscellaneous dangerous substances and articles
· **Hazard identification number (Kemler code):**	90
· **EMS Number:**	F-A,S-F
· **Stowage Category**	A

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 7)

· **Stowage Code**	SW23 When transported in BK3 bulk container, see 7.6.2.12 and 7.7.3.9.
· **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: 400 kg On cargo aircraft only: 400 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
· **IATA**	
· **Remarks:**	When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10. Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.
· **UN "Model Regulation":**	UN 3077 ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (N-ETHYL PERFLUOROOCTANESULFONAMIDE), 9, III

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/13/2023 Revision date 11/13/2023

Trade name: N-ethyl Perfluorooctanesulfonamide

(Contd. from page 8)

no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 11/13/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
Aquatic Chronic 2: Hazardous to the aquatic environment - long-term aquatic hazard – Category 2

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

1 Identification

· **Product identifier**

· **Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid**

· **Article number:** 37363
· **CAS Number:**
2991-50-6
· **EC number:**
221-061-1
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Skin Irritation 2	H315 Causes skin irritation.
Eye Irritation 2A	H319 Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

· **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 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS07

· **Signal word** Warning
· **Hazard statements**
H302 Harmful if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash 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 eye protection / face protection.
P301+P312	If swallowed: Call a poison center/doctor if you feel unwell.
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of water.
P321	Specific treatment (see on this label).
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.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P362+P364	Take off contaminated clothing and wash it before reuse.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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



Health = 2
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 2
Fire = 0
Reactivity = 0

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

US

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
2991-50-6 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid
· **Identification number(s)**
· **EC number:** 221-061-1

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:** 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. If symptoms persist, 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:** Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 3)

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.
Take precautionary measures against static discharge.re.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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.
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

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.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 4)

· **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
· **Structural Formula**	C12H8F17NO4S
· **Molecular Weight**	585.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	DMF: 2 mg/ml; DMSO: 2 mg/ml
· **Other information**	No further relevant information available.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 5)

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:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 6)

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** INACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/20/2023 Revision date 02/20/2023

Trade name: 2-(N-Ethylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 7)

these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 02/20/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

AccuStandard, Inc.
125 Market St., New Haven, CT 06513 USA
Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: PFOS-039S

Description: N-Ethyl-N-(2-hydroxyethyl)perfluorooctylsulphonamide (NEtFOSE) in Methanol

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

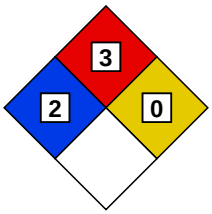
Emergency Phone #: AccuStandard, Inc.
1-203-502-7070 (USA)
+001-203-502-7070 (International)

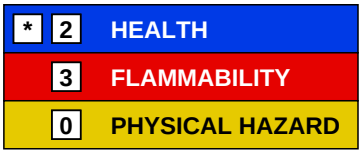
24 hours / 7 days a week

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements







Signal Word: Danger

Hazard Codes:

H225 - Highly Flammable (Flammable liquids, category 2)

H301 - Toxic if swallowed. (Acute toxicity, oral, category 3)

H311 - Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

H315 - Irritating to skin. (Skin corrosion/irritation, category 2)

H320 - Irritating to eyes. (Eye damage/irritation, category 2B)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H336 - Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

H360 - California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

H370 - Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

Precautionary Codes:

SECTION 2 - HAZARDS IDENTIFICATION *- continued*

2.1 - GHS Label Elements *- continued*

P202 - This product should only by used by persons trained in the safe handling of hazardous chemicals.

P233 - Store in a tightly closed container. (P404)

P262 - Do not get in eyes, on skin or clothing.

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P280 - Protective gloves must be worn to prevent skin contact.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P331 - Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

2.2 - Other Hazards

2.2.1 - Symptom of Exposure Health/Environment

Highly Flammable (Flammable liquids, category 2)

Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 or 18 hours.

POISON: May be fatal or cause blindness if swallowed.

Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

2.2.2 - Potential Health Effects

Irritating to eyes. (Eye damage/irritation, category 2B)

Irritating to skin. (Skin corrosion/irritation, category 2)

Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

Irritating to mucous membrane and upper respiratory system.

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Toxic if swallowed. (Acute toxicity, oral, category 3)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: N-Ethyl-N-(2-hydroxyethyl)perfluorooctylsulphonamide (NEtFOSE) in Methanol

SECTION 3 - COMPOSITION / ANALYTES DATA *- continued*

Analyte	CAS #	% Concentration	ACGIH -TLV (mg/m³) TWA	ACGIH -TLV (mg/m³) STEL	ACGIH -TLV (mg/m³) Skin	OSHA -PEL (mg/m³) TWA	OSHA -PEL (mg/m³) STEL	OSHA -PEL (mg/m³) Skin
N-Ethyl-N-(2-hydroxyethyl)perfluorooctylsulphonamide	1691-99-2	0.010						
Methanol	67-56-1	99.990				260		

SECTION 4 - FIRST AID MEASURES

4.1 - First Aid Procedures - General

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. (P331)

SECTION 5 - FIRE FIGHTING MEASURES

5.1 - Flammable Properties

Dangerous fire and explosive hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

6.1 - Spill Response

Wear suitable protective equipment listed under Exposure Controls / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Dispose as hazardous waste. Comply with Federal, State and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool place below 14 °F (-10 °C).

Avoid breathing vapors or mists.

Use with adequate ventilation.

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only by used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS

8.1 - Engineering Controls/PPE

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

8.2 - General Hygene Considerations

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Protective gloves must be worn to prevent skin contact. (P280)

(Chloroprene, natural rubber, nitrile, or equivalent)

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear liquid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: -93.9 °C

Boiling Point: 65 °C

Flash Point: 52 °F (11 °C) (tcc)

Evaporation Rate (Butyl Acetate=1): 5.9

Flammability Class: N/A

Lower Flammability Level: 6.7

Upper Flammability Level: 36.5

Vapor Pressure: 97 mmHg (20 °C)

Vapor Density (Air = 1): 1.1 g/L

Specific Gravity: 0.791 g/cm3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES *- continued*

Solubility in Water: Very soluble

Partition Coefficient: log Pow: -0.77

Autoignition Temperature: 385 °C

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: 99.9+

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Acids
Oxidizers

Hazardous Decomposition: Oxides of carbon; Formaldehyde

Hazardous Polymerization: Will not occur

Condition to Avoid: Heat; Contact with ignition sources

SECTION 11 - TOXICOLOGICAL INFORMATION

Human Health Toxicity

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): Human - 143 mg/kg; Rat - 1500 mg/kg

LD50 (Dermal) : Rabbit - >2000 mg/kg

LC50 (Inhalation): Rat - >20 mg/L

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION

Environmental Toxicity

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): >1000 mg/L 96H

EC50 (Aquatic Invertebrate): >1000 mg/L 48H

BCF: 1.0

Hydrolyzes readily on contact with water. Readily biodegradable.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATION

Transportation Information (DOT/IATA)

SECTION 14 - TRANSPORT INFORMATION *- continued*

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

This product contains a compound or compounds subject to EU Regulation (EC) No 1907/2006 (REACH) on Annex XIV, Annex XVII, and/or Article 59. Refer to the below table for details.

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

This product is subject to SARA section 313 reporting requirements.

All components are listed on the TSCA Inventory.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

			REACH (1907/2006)		
Analyte	CAS #	% Concentration	Annex XIV	Annex XVII	Article 59
Methanol	67-56-1	99.990		X	

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals and CLP Regulation (EC) No. 1272/2008.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY RESULTING FROM ITS USE.

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

0 - Minimal
1 - Slight
2 - Moderate
3 - Serious
4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

Category 1 - Most Severe
Category 5 - Least Severe

**** End of Document ****

SAFETY DATA SHEET

Santa Cruz Biotechnology, Inc.
Revision date 10-Jul-2019
Version 1

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product Name	Nonafluoro-3,6-dioxaheptanoic acid
Product Code	SC-263954

Recommended use of the chemical and restrictions on use

For research use only. Not intended for diagnostic or therapeutic use.

Details of the supplier of the safety data sheet

Santa Cruz Biotechnology, Inc.
10410 Finnell Street
Dallas, TX 75220
831.457.3800
800.457.3801
scbt@scbt.com

Emergency telephone number

Chemtrec
1.800.424.9300 (Within USA)
+1.703.527.3887 (Outside USA)

2. HAZARDS IDENTIFICATION

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification

Skin corrosion/irritation	Category 1 Sub-category B
Serious eye damage/eye irritation	Category 1

Label elements

Signal word	Danger
Hazard statements	Causes severe skin burns and eye damage
Symbols/Pictograms	
Precautionary Statements - Prevention	Do not breathe dust/fume/gas/mist/vapors/spray Wash face, hands and any exposed skin thoroughly after handling Wear protective gloves/protective clothing/eye protection/face protection
Precautionary Statements - Response	Immediately call a POISON CENTER or doctor/physician 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 or doctor/physician IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower Wash contaminated clothing before reuse IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing Immediately call a POISON CENTER or doctor/physician IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Precautionary Statements - Storage	Store locked up
Precautionary Statements - Disposal	Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Hazards not otherwise classified (HNOC)	Not applicable

Other Information

Unknown acute toxicity	100% of the mixture consists of ingredient(s) of unknown toxicity.

NFPA			**HMIS**		
	Health hazards	-		Health hazards	-
	Flammability	-		Flammability	-
	Stability	-		Physical hazards	-
	Physical and chemical properties	-		Personal protection	-

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS No	151772-58-6
Molecular Weight	296.04
Formula	$C_5HF_9O_4$

Chemical name	CAS No.	Weight-%	Oral LD50	Dermal LD50	Inhalation LC50
Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	>98	-	-	-

4. FIRST AID MEASURES

First Aid Measures

General advice	Consult a physician if necessary. Remove to fresh air.
Eye contact	Wash with plenty of water.
Skin Contact	Wash skin with soap and water.
Inhalation	Remove to fresh air If breathing is difficult, give oxygen If not breathing, give artificial respiration
Ingestion	Never give anything by mouth to an unconscious person. Clean mouth with water.

Most important symptoms and effects, both acute and delayed

Symptoms	No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media

Suitable Extinguishing Media	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable Extinguishing Media	No information available.

Specific hazards arising from the chemical

Specific hazards arising from the chemical	No information available.
Hazardous combustion products	Carbon oxides. Hydrogen fluoride.

Explosion data

Sensitivity to Mechanical Impact	No information available.
Sensitivity to Static Discharge	No information available.

Protective equipment and precautions for firefighters

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.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions	See Section 12 for additional Ecological Information.

Methods and material for containment and cleaning up

Methods for containment	Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling	Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Conditions	Keep containers tightly closed in a dry, cool and well-ventilated place. Store at room temperature.
Incompatible materials	None known based on information supplied.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines	This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering Controls	Showers Eyewash stations Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin and Body Protection	Wear protective gloves and protective clothing.
Respiratory protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
General Hygiene Considerations	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	liquid

Appearance	No information available
Odor	No information available

Property	**Values**
pH	No information available
Melting point/freezing point	No information available
Boiling point	145 °C
Flash point	No information available
Liquid Density	No information available
Evaporation rate	No information available
Upper flammability limits	No information available
Lower flammability limit	No information available
Vapor pressure	No information available
Vapor density	No information available
Specific gravity	No information available
Water solubility	No information available
Solubility in other solvents	No information available
Partition coefficient	No information available
Autoignition temperature	No information available
Decomposition temperature	No information available
Kinematic viscosity	No information available
Explosive properties	No information available
Oxidizing properties	No information available

10. STABILITY AND REACTIVITY

Reactivity	Not applicable
Chemical stability	Stable under recommended storage conditions.
Possibility of Hazardous Reactions	None under normal processing.
Hazardous polymerization	No information available.
Conditions to avoid	Extremes of temperature and direct sunlight.
Incompatible materials	Strong oxidizing agents.
Hazardous Decomposition Products	Carbon oxides. Hydrogen fluoride.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	No data available.
Eye contact	No data available.
Skin Contact	No data available.
Ingestion	No data available.

Information on toxicological effects

Symptoms	No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Chronic Toxicity	No information available.

Numerical measures of toxicity - Product Information

Unknown acute toxicity	100% of the mixture consists of ingredient(s) of unknown toxicity

12. ECOLOGICAL INFORMATION

Ecotoxicity	May cause long lasting harmful effects to aquatic life

100% of the mixture consists of components(s) of unknown hazards to the aquatic environment.

Persistence and degradability	No information available.
Bioaccumulation	No information available.
Mobility	No information available.

13. DISPOSAL CONSIDERATIONS

Disposal of wastes	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated packaging	Do not reuse container.
US EPA Waste Number	D002

14. TRANSPORT INFORMATION

DOT

UN/ID no	UN3265
Hazard Class	8
Packing Group	III
Proper shipping name	Corrosive liquid, acidic, organic, n.o.s.
Description	UN3265, Corrosive liquid, acidic, organic, n.o.s., 8, III
Emergency Response Guide Number	153

IMDG

UN/ID no	UN3265
Hazard Class	8
Packing Group	III
Proper shipping name	Corrosive liquid, acidic, organic, n.o.s.
Description	UN3265, Corrosive liquid, acidic, organic, n.o.s., 8, III
Special Provisions	223, 274
EmS-No	F-A, S-B

IATA

UN/ID no	UN3265
Hazard Class	8
Packing Group	III
Proper shipping name	Corrosive liquid, acidic, organic, n.o.s.
Description	UN3265, Corrosive liquid, acidic, organic, n.o.s., 8, III
ERG Code	8L

15. REGULATORY INFORMATION

International Inventories

All of the components in the product are on the following Inventory lists

No information available

X - Listed
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances

ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive hazard	No

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations
This product does not contain any substances regulated by state right-to-know regulations

16. OTHER INFORMATION

Revision note	No information available

Disclaimer
The information provided in this Material 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 Safety Data Sheet

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

1 Identification

· **Product identifier**

· **Trade name: N-methyl Perfluorooctanesulfonamide**
· **Synonym** 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-N-methyl-1-octanesulfonamide

· **Article number:** 37264
· **CAS Number:**
31506-32-8
· **EC number:**
250-665-8
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.
Skin Irritation 2	H315 Causes skin irritation.
Eye Irritation 2A	H319 Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

· **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 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 1)

· **Hazard pictograms**



GHS07

· **Signal word** Warning
· **Hazard statements**

H302+H312+H332	Harmful if swallowed, in contact with skin or if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash 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/doctor if you feel unwell.
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of water.
P321	Specific treatment (see on this label).
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.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P362+P364	Take off contaminated clothing and wash it before reuse.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	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 = 2
Fire = 0
Reactivity = 0

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

US

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
31506-32-8 N-methyl Perfluorooctanesulfonamide
· **Identification number(s)**
· **EC number:** 250-665-8

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:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:**
Rinse opened eye for several minutes under running water. If symptoms persist, 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.
A solid water stream may be inefficient.
· **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** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:** Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 3)

· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
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

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.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 4)

· **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
· **Structural Formula**	C9H4F17NO2S
· **Molecular Weight**	513.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Other information**	No further relevant information available.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 5)

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:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 6)

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: N-methyl Perfluorooctanesulfonamide

(Contd. from page 7)

these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/18/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

1 Identification

· **Product identifier**

· **Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid**

· **Article number:** 37262
· **CAS Number:**
2355-31-9
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS07

Acute Tox. 4 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.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS07

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 1)

· **Signal word** Warning
· **Hazard statements**
H302 Harmful if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash 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 / eye protection / face protection.
P301+P312	If swallowed: Call a poison center/doctor if you feel unwell.
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of water.
P321	Specific treatment (see on this label).
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.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P362+P364	Take off contaminated clothing and wash it before reuse.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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



Health = 2
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 2
Fire = 0
Reactivity = 0

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
2355-31-9 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 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:** 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. If symptoms persist, consult a doctor.
· **After swallowing:** Immediately call a doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
May cause anemia, cough, CNS depression, drowsiness, headache, heart damage, lassitude (weakness, exhaustion), liver damage, narcosis, reproductive effects, teratogenic effects.
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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:** Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.
Take precautionary measures against static discharge.re.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 3)

· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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.
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

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.
· **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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 4)

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C11H6F17NO4S
· **Molecular Weight**	571.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	EtOH
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 5)

· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 6)

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/03/2022 Revision date 08/03/2022

Trade name: 2-(N-Methylperfluorooctanesulfonamido)acetic Acid

(Contd. from page 7)

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/03/2022 / -
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
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
Skin Irrit. 2: Skin corrosion/irritation – Category 2
Eye Irrit. 2A: Serious eye damage/eye irritation – Category 2A
STOT SE 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

1 Identification

· **Product identifier**

· **Trade name: N-methyl Perfluorooctanesulfonamidoethanol**
· **Synonym**
1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-N-(2-hydroxyethyl)-N-methyl-1-octanesulfonamide

· **Article number:** 37265
· **CAS Number:**
24448-09-7
· **EC number:**
246-262-1
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**



GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.
Skin Irritation 2	H315 Causes skin irritation.
Eye Irritation 2A	H319 Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

· **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 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 1)

· **Hazard pictograms**



GHS07

· **Signal word** Warning
· **Hazard statements**

H302+H312+H332	Harmful if swallowed, in contact with skin or if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash 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/doctor if you feel unwell.
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of water.
P321	Specific treatment (see on this label).
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.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P362+P364	Take off contaminated clothing and wash it before reuse.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	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 = 2
Fire = 0
Reactivity = 0

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

US

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
24448-09-7 N-methyl Perfluorooctanesulfonamidoethanol
· **Identification number(s)**
· **EC number:** 246-262-1

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:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:**
Rinse opened eye for several minutes under running water. If symptoms persist, 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.
A solid water stream may be inefficient.
· **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** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:** Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 3)

· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
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

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.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 4)

· **Eye protection:**



Tightly sealed goggles

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	A low melting solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C11H8F17NO3S
· **Molecular Weight**	557.2 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Other information**	No further relevant information available.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 5)

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

· **RTECS Number** RG9701370
· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 6)

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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: N-methyl Perfluorooctanesulfonamidoethanol

(Contd. from page 7)

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

16 Other information

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/14/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
· *** Data compared to the previous version altered.**

WELLINGTON LABORATORIES

SAFETY DATA SHEET

Perfluoro-n-butanoic acid (PFBA)

Scantec Nordic AB

Chemwatch Hazard Alert Code: **4**

Version No: **11.20**
Safety Data Sheet (Conforms to Annex II of REACH (1907/2006) - Regulation 2020/878)

Issue Date: **28/09/2023**
Print Date: **29/02/2024**
S.REACH.SWE.EN

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

1.1. Product Identifier

Product name	Perfluoro-n-butanoic acid (PFBA)
Chemical Name	Not Applicable
Synonyms	Methyl alcohol (methanol),Methyl hydrate (methanol),Methylol (methanol)
Proper shipping name	METHANOL
Chemical formula	Not Applicable
Other means of identification	Not Available

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

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 (CofA) for further product information. Wellington Laboratories Inc. believes the information stated below to be reliable and accurate. This data is solely for reference purposes. Wellington Laboratories Inc. shall not be held liable for damages resulting from handling or contact with the above stated material.
Uses advised against	No specific uses advised against are identified.

1.3. Details of the manufacturer or supplier of the safety data sheet

Registered company name	**Scantec Nordic AB**	**Greyhound Chromatography & Allied Chemicals**	**Wellington Laboratories**
Address	Fabriksstraket 29 Jonsered 433 76 Sweden	6 Kelvin Park, Birkenhead, Merseyside CH41 1LT United Kingdom	345 Southgate Drive Guelph Ontario N1G 3M5 Canada
Telephone	+031 336 90 00	+44-0-151 649 4000	+1 519 822 2436
Fax	Not Available	+44-0-151 649 4001	+1 519 822 2849
Website	www.scantecnordic.se	www.greyhoundchrom.com	http://well-labs.com/
Email	info@scantecnordic.se	info@greyhoundchrom.com	orders@well-labs.com

1.4. Emergency telephone number

Association / Organisation	**CANUTEC**
Emergency telephone numbers	+1 888 226 8832 (North American)
Other emergency telephone numbers	+1 613 996 6666 (International)

SECTION 2 Hazards identification

2.1. Classification of the substance or mixture

Considered a hazardous mixture according to Reg. (EC) No 1272/2008 and their amendments. Classified as Dangerous Goods for transport purposes.

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 according to regulation (EC) No 1272/2008 [CLP] and amendments [1]	H225 - Flammable Liquids Category 2, H301 - Acute Toxicity (Oral) Category 3, H311 - Acute Toxicity (Dermal) Category 3, H331 - Acute Toxicity (Inhalation) Category 3, H370 - Specific Target Organ Toxicity - Single Exposure Category 1
Legend:	*1. Classified by Chemwatch; 2. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI*

2.2. Label elements

Hazard pictogram(s)	
Signal word	**Danger**

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H301	Toxic if swallowed.
H311	Toxic in contact with skin.
H331	Toxic if inhaled.
H370	Causes damage to organs.

Supplementary statement(s)

Not Applicable

CLP classification (additional)

Not Applicable

Precautionary statement(s) Prevention

P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe mist/vapours/spray.
P264	Wash all exposed external body areas 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 and protective clothing.
P240	Ground and bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/intrinsically safe equipment.
P242	Use non-sparking tools.
P243	Take action to prevent static discharges.

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.
P330	Rinse mouth.
P370+P378	In case of fire: Use alcohol resistant foam or normal protein foam to extinguish.
P302+P352	IF ON SKIN: Wash with plenty of water and soap.
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P361+P364	Take off immediately all contaminated clothing and wash it before reuse.
P303+P361+P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].

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 to authorised hazardous or special waste collection point in accordance with any local regulation.

Material contains methanol, sodium hydroxide.

2.3. Other hazards

Cumulative effects may result following exposure*.

May produce discomfort of the eyes and skin*.

Vapours potentially cause drowsiness and dizziness*.

HARMFUL: may cause lung damage if swallowed

methanol	Listed in the Europe Regulation (EC) No 1907/2006 - Annex XVII (Restrictions may apply)

SECTION 3 Composition / information on ingredients

3.1.Substances

See 'Composition on ingredients' in Section 3.2

3.2.Mixtures

1. CAS No 2.EC No 3.Index No 4.REACH No	%[weight]	Name	Classification according to regulation (EC) No 1272/2008 [CLP] and amendments	SCL / M-Factor	Nanoform Particle Characteristics
1. 67-56-1 2.200-659-6 3.603-001-00-X 4.Not Available	98.729	methanol *	Flammable Liquids Category 2, Acute Toxicity (Oral) Category 3, Acute Toxicity (Dermal) Category 3, Acute Toxicity (Inhalation) Category 3, Specific Target Organ Toxicity - Single Exposure Category 1; H225, H301, H311, H331, H370 [2]	* STOT SE 1; H370: C ≥ 10 % | STOT SE 2; H371: 3 % ≤ C < 10 %	Not Available
1. 375-22-4* 2.206-786-3 3.Not Available 4.Not Available	0.006	Perfluoro-n-butanoic acid	Not Classified [1]	Not Available	Not Available
1. 1310-73-2 2.215-185-5 3.011-002-00-6 4.Not Available	0.002	sodium hydroxide	Skin Corrosion/Irritation Category 1A; H314 [2]	Skin Corr. 1A; H314: C ≥ 5 % | Skin Corr. 1B; H314: 2 % ≤ C < 5 % | Skin Irrit. 2; H315: 0,5 % ≤ C < 2 % | Eye Irrit.2; H319: 0,5 % ≤ C < 2 %	Not Available
1. 7732-18-5 2.231-791-2 3.Not Available 4.Not Available	1.262	water	Not Classified [1]	Not Available	Not Available

Legend:	*1. Classified by Chemwatch; 2. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI; 3. Classification drawn from C&L; * EU IOELVs available; [e] Substance identified as having endocrine disrupting properties*

SECTION 4 First aid measures

4.1. 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: ▸ Quickly but gently, wipe material off skin with a dry, clean cloth. ▸ Immediately 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.
Ingestion	▸ 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. ▸ Observe the patient carefully. ▸ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. ▸ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. ▸ Seek medical advice. ▸ Avoid giving milk or oils. ▸ Avoid giving alcohol. ▸ If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11

4.3. 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]

Methanol poisoning can be treated with fomepizole, or if unavailable, ethanol. Both drugs act to reduce the action of alcohol dehydrogenase on methanol by means of competitive inhibition. Ethanol, the active ingredient in alcoholic beverages, acts as a competitive inhibitor by more effectively binding and saturating the alcohol dehydrogenase enzyme in the liver, thus blocking the binding of methanol. Methanol is excreted by the kidneys without being converted into the very toxic metabolites formaldehyde and formic acid. Alcohol dehydrogenase instead enzymatically converts ethanol to acetaldehyde, a much less toxic organic molecule. Additional treatment may include sodium bicarbonate for metabolic acidosis, and hemodialysis or hemodiafiltration to remove methanol and formate from the blood. Folinic acid or folic acid is also administered to enhance the metabolism of formate.

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 Firefighting measures

5.1. 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.
- Water spray or fog - Large fires only.

5.2. 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

5.3. Advice for firefighters

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. ▸ Consider evacuation (or protect in place). ▸ Fight fire from a safe distance, with adequate cover. ▸ If safe, switch off electrical equipment until vapour fire hazard removed. ▸ Use water delivered as a fine spray to control fire and cool adjacent area. ▸ Avoid spraying water onto liquid pools. ▸ **DO NOT** approach containers suspected to be hot. ▸ Cool fire exposed containers with water spray from a protected location. ▸ If safe to do so, remove containers from path of fire.
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. ▸ On combustion, may emit toxic fumes of carbon monoxide (CO). Combustion products include: , carbon dioxide (CO_2) , formaldehyde , other pyrolysis products typical of burning organic material.

SECTION 6 Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

See section 8

6.2. Environmental precautions

See section 12

6.3. 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. ▸ Contain and absorb small quantities with vermiculite or other absorbent material. ▸ Wipe up. ▸ Collect residues in a flammable waste container.
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. ▸ Prevent, by any means available, spillage from entering drains or water course. ▸ Consider evacuation (or protect in place). ▸ No smoking, naked lights or ignition sources. ▸ Increase ventilation. ▸ Stop leak if safe to do so. ▸ Water spray or fog may be used to disperse vapour. ▸ Contain or absorb spill with sand, earth or vermiculite. ▸ Use only spark-free shovels and explosion proof equipment. ▸ Collect recoverable product into labelled containers for recycling. ▸ Collect solid residues and seal in labelled drums for disposal. ▸ Wash area and prevent runoff into drains. ▸ After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using. ▸ If contamination of drains or waterways occurs, advise emergency services.

6.4. Reference to other sections

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

SECTION 7 Handling and storage

7.1. 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** enter confined spaces until atmosphere has been checked. ‣ Avoid smoking, naked lights, heat or ignition sources. ‣ When handling, **DO NOT** eat, drink or smoke. ‣ Vapour may ignite on pumping or pouring due to static electricity. ‣ **DO NOT** use plastic buckets. ‣ Earth and secure metal containers when dispensing or pouring product. ‣ Use spark-free tools when handling. ‣ Avoid contact with incompatible materials. ‣ Keep containers securely sealed. ‣ Avoid physical damage to containers. ‣ Always wash hands with soap and water after handling. ‣ Work clothes should be laundered separately. ‣ Use good occupational work practice. ‣ Observe manufacturer's storage and handling recommendations contained within this SDS. ‣ Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions. ‣ **DO NOT** allow clothing wet with material to stay in contact with skin
Fire and explosion protection	See section 5
Other information	‣ Store in original containers in approved flame-proof area. ‣ No smoking, naked lights, heat or ignition sources. ‣ **DO NOT** store in pits, depression, basement or areas where vapours may be trapped. ‣ Keep containers securely sealed. ‣ Store away from incompatible materials in a cool, dry well ventilated area. ‣ Protect containers against physical damage and check regularly for leaks. ‣ Observe manufacturer's storage and handling recommendations contained within this MSDS. ‣ Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Cleaning, inspection and maintenance of storage tanks is a specialist operation, which requires the implementation of strict procedures and precautions. ‣ Keep in a cool place. Electrostatic charges will be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk. The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable. ‣ For containers, or container linings use mild steel, stainless steel. Examples of suitable materials are: high density polyethylene (HDPE), polypropylene (PP), and Viton (FMK), which have been specifically tested for compatibility with this product. ‣ For container linings, use amine-adduct cured epoxy paint. ‣ For seals and gaskets use: graphite, PTFE, Viton A, Viton B. ‣ Unsuitable material: Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials. ‣ Do not cut, drill, grind, weld or perform similar operations on or near containers. Containers, even those that have been emptied, can contain explosive vapours.

7.2. 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. (23 deg. C) ‣ Manufactured product that requires stirring before use and having a viscosity of at least 20 cSt (25 deg. C): (i) Removable head packaging; (ii) Cans with friction closures and (iii) low pressure tubes and cartridges may be used. ‣ Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages

	▸ In addition, where inner packagings are glass and contain liquids of packing group I there must be sufficient inert absorbent to absorb any spillage, unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.
Storage incompatibility	Methanol: ▸ reacts violently with strong oxidisers, acetyl bromide, alkyl aluminium salts, beryllium dihydride, bromine, chromic acid, 1-chloro-3,3-difluoro-2-methoxycyclopropene, 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-methoxycyclopropene ▸ 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, dialkylzincs, 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.
Hazard categories in accordance with Regulation (EC) No 1272/2008	H2: Acute Toxic, H3: STOT Specific Target Organ Toxicity – Single Exposure, P5a: Flammable Liquids, P5b: Flammable Liquids, P5c: Flammable Liquids
Qualifying quantity (tonnes) of dangerous substances as referred to in Article 3(10) for the application of	H2 Lower- / Upper-tier requirements: 50 / 200 H3 Lower- / Upper-tier requirements: 50 / 200 P5a Lower- / Upper-tier requirements: 10 / 50 P5b Lower- / Upper-tier requirements: 50 / 200 P5c Lower- / Upper-tier requirements: 5 000 / 50 000

7.3. Specific end use(s)

See section 1.2

SECTION 8 Exposure controls / personal protection

8.1. Control parameters

Ingredient	DNELs Exposure Pattern Worker	PNECs Compartment
methanol	Dermal 1 601 mg/kg bw/day (Systemic, Chronic) Inhalation 11.67 mg/m³ (Systemic, Chronic) Inhalation 20 mg/m³ (Local, Chronic) Dermal 20 mg/kg bw/day (Systemic, Acute) Inhalation 130 mg/m³ (Systemic, Acute) Inhalation 40 mg/m³ (Local, Acute) *Dermal 4 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 2.9 mg/m³ (Systemic, Chronic) ** *Oral 1 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 26 mg/m³ (Local, Chronic) ** *Dermal 4 mg/kg bw/day (Systemic, Acute) ** *Inhalation 26 mg/m³ (Systemic, Acute) ** *Oral 4 mg/kg bw/day (Systemic, Acute) ** *Inhalation 26 mg/m³ (Local, Acute) **	Not Available
sodium hydroxide	Inhalation 2.05 mg/m³ (Systemic, Chronic) Inhalation 1 mg/m³ (Local, Chronic) Inhalation 2 mg/m³ (Local, Acute) *Inhalation 0.51 mg/m³ (Systemic, Chronic) ** *Oral 10 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 1 mg/m³ (Local, Chronic) **	Not Available

Ingredient	DNELs Exposure Pattern Worker	PNECs Compartment
water	Dermal 0.02 mg/kg bw/day (Systemic, Chronic) Inhalation 0.12 mg/m³ (Systemic, Chronic) Inhalation 0.11 mg/m³ (Local, Chronic) Dermal 5 mg/kg bw/day (Systemic, Acute) Inhalation 2.5 mg/m³ (Systemic, Acute) Inhalation 0.33 mg/m³ (Local, Acute) *Dermal 0.35 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 0.144 mg/m³ (Systemic, Chronic) ** *Oral 0.08 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 0.03 mg/m³ (Local, Chronic) ** *Dermal 2.5 mg/kg bw/day (Systemic, Acute) ** *Inhalation 1.96 mg/m³ (Systemic, Acute) ** *Oral 2.5 mg/kg bw/day (Systemic, Acute) ** *Inhalation 0.09 mg/m³ (Local, Acute) **	Not Available

* Values for General Population

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)	methanol	Methanol	200 ppm / 260 mg/m3	Not Available	Not Available	Skin

Emergency Limits

Ingredient	TEEL-1	TEEL-2	TEEL-3
methanol	Not Available	Not Available	Not Available
Perfluoro-n-butanoic acid	0.5 mg/m3	5.5 mg/m3	33 mg/m3
sodium hydroxide	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
methanol	6,000 ppm	Not Available
Perfluoro-n-butanoic acid	Not Available	Not Available
sodium hydroxide	10 mg/m3	Not Available
water	Not Available	Not Available

Occupational Exposure Banding

Ingredient	Occupational Exposure Band Rating	Occupational Exposure Band Limit
sodium hydroxide	C	> 0.1 to ≤ milligrams per cubic meter of air (mg/m³)
Notes:	*Occupational exposure banding is a process of assigning chemicals into specific categories or bands based on a chemical's potency and the adverse health outcomes associated with exposure. The output of this process is an occupational exposure band (OEB), which corresponds to a range of exposure concentrations that are expected to protect worker health.*	

8.2. Exposure controls

8.2.1. 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. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use.
Employers may need to use multiple types of controls to prevent employee overexposure.
For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant.
Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:

	solvent, vapours, degreasing etc., evaporating from tank (in still air). — 0.25-0.5 m/s (50-100 f/min.)
	aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation) — 0.5-1 m/s (100-200 f/min.)
	direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion) — 1-2.5 m/s (200-500 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min.) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.
· Adequate ventilation is typically taken to be that which limits the average concentration to no more than 25% of the LEL within the building, room or enclosure containing the dangerous substance.
· Ventilation for plant and machinery is normally considered adequate if it limits the average concentration of any dangerous substance that might potentially be present to no more than 25% of the LEL. However, an increase up to a maximum 50% LEL can be acceptable where additional safeguards are provided to prevent the formation of a hazardous explosive atmosphere. For example, gas detectors linked to emergency shutdown of the process might be used together with maintaining or increasing the exhaust ventilation on solvent evaporating ovens and gas turbine enclosures.
· Temporary exhaust ventilation systems may be provided for non-routine higher-risk activities, such as cleaning, repair or maintenance in tanks or other confined spaces or in an emergency after a release. The work procedures for such activities should be carefully considered.. The atmosphere should be continuously monitored to ensure that ventilation is adequate and the area remains safe. Where workers will enter the space, the ventilation should ensure that the concentration of the dangerous substance does not exceed 10% of the LEL (irrespective of the provision of suitable breathing apparatus)

8.2.2. Individual protection measures, such as personal protective equipment



Eye and face protection

- Safety glasses with side shields.
- Chemical goggles. [AS/NZS 1337.1, EN166 or national equivalent]
- 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. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

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. 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.
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
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. · Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term use. · Contaminated gloves should be replaced. As defined in ASTM F-739-96 in any application, gloves are rated as: · Excellent when breakthrough time > 480 min · Good when breakthrough time > 20 min · Fair when breakthrough time < 20 min · Poor when glove material degrades For general applications, gloves with a thickness typically greater than 0.35 mm, are recommended. It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times. Glove thickness may also vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers technical data should always be taken into account to ensure selection of the most appropriate glove for the task. Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example: · Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are only likely to give short duration protection and would normally be just for single use applications, then disposed of. · Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is abrasion or puncture potential 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.
Body protection	See Other protection below
Other protection	‣ Overalls. ‣ PVC Apron. ‣ PVC protective suit may be required if exposure severe. ‣ Eyewash unit. ‣ Ensure there is ready access to a safety shower. ‣ 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. Electrical resistance must range between 0 to 500,000 ohms. Conductive shoes should be stored in lockers close to the room in which they are worn. Personnel who have been issued conductive footwear should not wear them from their place of work to their homes and return.

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:
Perfluoro-n-butanoic acid (PFBA)

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

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 5 x ES	AX-AUS / Class 1	-	AX-PAPR-AUS / Class 1
up to 25 x ES	Air-line*	AX-2	AX-PAPR-2
up to 50 x ES	-	AX-3	-
50+ x ES	-	Air-line**	-

* - Continuous-flow; ** - Continuous-flow or positive pressure demand
^ - 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,

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.

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

Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Required minimum protection factor	Maximum gas/vapour concentration present in air p.p.m. (by volume)	Half-face Respirator	Full-Face Respirator
up to 10	1000	AX-AUS / Class 1	-
up to 50	1000	-	AX-AUS / Class 1
up to 50	5000	Airline *	-
up to 100	5000	-	AX-2
up to 100	10000	-	AX-3
100+		-	Airline**

** - Continuous-flow or positive pressure demand.
A(All classes) = Organic vapours, B AUS or B1 = Acid gases, 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 deg C)

8.2.3. Environmental exposure controls

See section 12

SECTION 9 Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	Clear/Colourless with Characteristic Odour

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

Nanoform Solubility	Not Available	**Nanoform Particle Characteristics**	Not Available
Particle Size	Not Available		

9.2. Other information

Not Available

SECTION 10 Stability and reactivity

10.1.Reactivity	See section 7.2
10.2. 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.
10.3. Possibility of hazardous reactions	See section 7.2
10.4. Conditions to avoid	See section 7.2
10.5. Incompatible materials	See section 7.2
10.6. Hazardous decomposition products	See section 5.3

SECTION 11 Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Inhaled	Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects. The material is not thought to produce respiratory irritation (as classified by EC Directives using animal models). Nevertheless inhalation of vapours, fumes or aerosols, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress. 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. 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*]
Ingestion	**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. Methanol may produce a burning or painful sensation in the mouth, throat, chest, and stomach. This may be accompanied by nausea, vomiting, headache, dizziness, shortness of breath, weakness, fatigue, leg cramps, restlessness, confusion, drunken behaviour, visual disturbance, drowsiness, coma and death. 60-200 ml of methanol is a fatal dose for most adults with as little as 10 ml producing blindness. In massive overdose, liver, kidney, heart and muscle injury have been described. Even ingestion of small amounts of methanol is enough to seriously damage parts of the central nervous system, leading to permanent brain and/or nerve problems. 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. 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. There is some evidence to suggest that the material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.
Eye	Methanol is a mild to moderate eye irritant. High vapor concentration or liquid contact with eyes causes irritation, tearing, and burning. Direct contact of the eye with ethanol may cause immediate stinging and burning with reflex closure of the lid and tearing, transient injury of the corneal epithelium and hyperaemia of the conjunctiva. 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	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed. This material can cause serious damage if one is exposed to it for long periods. It can be assumed that it contains a substance which can produce severe defects. 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.

Perfluoro-n-butanoic acid (PFBA)	**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: 64000 ppm4h[2]	Eye (rabbit): 40 mg-moderate
	Oral (Rat) LD50: 5628 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]
Perfluoro-n-butanoic acid	**TOXICITY**	**IRRITATION**
	Not Available	Not Available
sodium hydroxide	**TOXICITY**	**IRRITATION**
	Dermal (rabbit) LD50: 1350 mg/kg[2]	Eye (rabbit): 0.05 mg/24h SEVERE
	Oral (Rabbit) LD50; 325 mg/kg[1]	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]
water	**TOXICITY**	**IRRITATION**
	Oral (Rat) LD50: >90000 mg/kg[2]	Not Available

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.
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. 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. On the other hand, industrial bronchitis is a disorder that occurs as a result of exposure due to high concentrations of irritating substance (often particles) and is completely reversible after exposure ceases. The disorder is characterized by difficulty breathing, cough and mucus production. 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.
WATER	No significant acute toxicological data identified in literature search.

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*

11.2 Information on other hazards

11.2.1. Endocrine disrupting properties

No evidence of endocrine disrupting properties were found in the current literature.

11.2.2. Other information

See Section 11.1

SECTION 12 Ecological information

12.1. Toxicity

Perfluoro-n-butanoic acid (PFBA)

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
EC50	48h	Crustacea	>10000mg/l	2
EC50	96h	Algae or other aquatic plants	14.11-20.623mg/l	4
NOEC(ECx)	720h	Fish	0.007mg/L	4
LC50	96h	Fish	290mg/l	2

Perfluoro-n-butanoic acid

Endpoint	Test Duration (hr)	Species	Value	Source
EC50	48h	Crustacea	180.008-183.218mg/L	4
EC10(ECx)	48h	Algae or other aquatic plants	42-92mg/l	4
LC50	96h	Fish	>3000mg/l	4

sodium hydroxide

Endpoint	Test Duration (hr)	Species	Value	Source
EC50	48h	Crustacea	34.59-47.13mg/l	4
EC50(ECx)	48h	Crustacea	34.59-47.13mg/l	4
LC50	96h	Fish	144-267mg/l	4

water

Endpoint	Test Duration (hr)	Species	Value	Source
Not Available	Not Available	Not Available	Not Available	Not Available

Legend: *Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 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*

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. Evaporation of methanol from moist/dry soil surfaces is expected to be an important fate process. Biological breakdown in soil is expected to be an important fate process for methanol based on half-lives of 1 day, in sandy silt loam, and 3.2 days in sandy loam.
Aquatic Fate: Methanol is not expected to adsorb to suspended solids and sediment and the substance mixes in water. The substance is expected to evaporate from water surfaces with half-lives, for a model river, of 3 days, and 35 days, for a model lake. Concentration of the substance in aquatic organisms is expected to be low. Breakdown by water and sunlight are not expected to be an important environmental fate processes. The substance is expected to be broken down by microorganisms in water.
Ecotoxicity: Methanol is non-toxic to fish, including fathead minnow, rainbow trout, bluegill sunfish, and guppy. The substance is also non-toxic to aquatic invertebrates, including Daphnia pulex water fleas, brine and brown shrimp. The substances are non-toxic to shellfish, including mussels, marine bacterium, including Photobacterium phosphoreum, and the protozoan Tetrahymena pyriformis.

DO NOT discharge into sewer or waterways.

12.2. Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air

Ingredient	Persistence: Water/Soil	Persistence: Air
methanol	LOW	LOW
Perfluoro-n-butanoic acid	HIGH	HIGH
sodium hydroxide	LOW	LOW
water	LOW	LOW

12.3. Bioaccumulative potential

Ingredient	Bioaccumulation
methanol	LOW (BCF = 10)
Perfluoro-n-butanoic acid	LOW (LogKOW = 2.4347)
sodium hydroxide	LOW (LogKOW = -3.8796)

12.4. Mobility in soil

Ingredient	Mobility
methanol	HIGH (KOC = 1)
Perfluoro-n-butanoic acid	LOW (KOC = 58.43)
sodium hydroxide	LOW (KOC = 14.3)

12.5. Results of PBT and vPvB assessment

	P	B	T
Relevant available data	Not Available	Not Available	Not Available
PBT	✗	✗	✗
vPvB	✗	✗	✗

PBT Criteria fulfilled?	No
vPvB	No

12.6. Endocrine disrupting properties

No evidence of endocrine disrupting properties were found in the current literature.

12.7. Other adverse effects

No evidence of ozone depleting properties were found in the current literature.

SECTION 13 Disposal considerations

13.1. 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. 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. ▸ 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. Observe all label safeguards until containers are cleaned and destroyed.
Waste treatment options	Not Available
Sewage disposal options	Not Available

SECTION 14 Transport information

Labels Required

	
Marine Pollutant	NO

Land transport (ADR-RID)

14.1. **UN number or ID number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	Class: 3 Subsidiary Hazard: 6.1
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	Hazard identification (Kemler): 336 Classification code: FT1 Hazard Label: 3 +6.1 Special provisions: 279 Limited quantity: 1 L Tunnel Restriction Code: D/E

Air transport (ICAO-IATA / DGR)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	Methanol
14.3. **Transport hazard class(es)**	ICAO/IATA Class: 3 ICAO / IATA Subsidiary Hazard: 6.1 ERG Code: 3L
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **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)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	IMDG Class: 3 IMDG Subsidiary Hazard: 6.1
14.4. **Packing group**	II
14.5 **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	EMS Number: F-E , S-D Special provisions: 279 Limited Quantities: 1 L

Inland waterways transport (ADN)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	3 | 6.1
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	Classification code: FT1 Special provisions: 279; 802 Limited quantity: 1 L Equipment required: PP, EP, EX, TOX, A Fire cones number: 2

14.7. Maritime transport in bulk according to IMO instruments

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

Not Applicable

14.7.2. Transport in bulk in accordance with MARPOL Annex V and the IMSBC Code

Product name	Group
methanol	Not Available
Perfluoro-n-butanoic acid	Not Available
sodium hydroxide	Not Available
water	Not Available

14.7.3. Transport in bulk in accordance with the IGC Code

Product name	Ship Type
methanol	Not Available
Perfluoro-n-butanoic acid	Not Available
sodium hydroxide	Not Available
water	Not Available

SECTION 15 Regulatory information

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

methanol is found on the following regulatory lists

Chemical Footprint Project - Chemicals of High Concern List

EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)
EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances
EU REACH Regulation (EC) No 1907/2006 - Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles
Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)
European Union (EU) Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures - Annex VI
Sweden Swedish Chemicals Agency (KEMI) Restricted Substances Database

Perfluoro-n-butanoic acid is found on the following regulatory lists

Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)

sodium hydroxide is found on the following regulatory lists

Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)
European Union (EU) Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures - Annex VI

water is found on the following regulatory lists

Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)

Additional Regulatory Information

Not Applicable

This safety data sheet is in compliance with the following EU legislation and its adaptations - as far as applicable - : Directives 98/24/EC, - 92/85/EEC, - 94/33/EC, - 2008/98/EC, - 2010/75/EU; Commission Regulation (EU) 2020/878; Regulation (EC) No 1272/2008 as updated through ATPs.

Information according to 2012/18/EU (Seveso III):

Seveso Category	H2, H3, P5a, P5b, P5c

15.2. Chemical safety assessment

No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

National Inventory Status

National Inventory	Status
Australia - AIIC / Australia Non-Industrial Use	Yes
Canada - DSL	No (Perfluoro-n-butanoic acid)
Canada - NDSL	No (methanol; sodium hydroxide; water)
China - IECSC	Yes
Europe - EINEC / ELINCS / NLP	Yes
Japan - ENCS	Yes
Korea - KECI	Yes
New Zealand - NZIoC	Yes
Philippines - PICCS	No (Perfluoro-n-butanoic acid)
USA - TSCA	Yes
Taiwan - TCSI	Yes
Mexico - INSQ	No (Perfluoro-n-butanoic acid)
Vietnam - NCI	Yes
Russia - FBEPH	Yes
Legend:	*Yes = All CAS declared ingredients are on the inventory* *No = One or more of the CAS listed ingredients are not on the inventory. These ingredients may be exempt or will require registration.*

SECTION 16 Other information

Revision Date	28/09/2023

Initial Date	16/09/2017

Full text Risk and Hazard codes

H314	Causes severe skin burns and eye damage.

SDS Version Summary

Version	Date of Update	Sections Updated
10.20	28/09/2023	Toxicological information - Acute Health (skin), Hazards identification - Classification, Composition / information on ingredients - 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.

For detailed advice on Personal Protective Equipment, refer to the following EU CEN Standards:
EN 166 Personal eye-protection
EN 340 Protective clothing
EN 374 Protective gloves against chemicals and micro-organisms
EN 13832 Footwear protecting against chemicals
EN 133 Respiratory protective devices

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
- ES: Exposure Standard
- 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
- DNEL: Derived No-Effect Level
- PNEC: Predicted no-effect concentration

- AIIC: Australian Inventory of Industrial Chemicals
- DSL: Domestic Substances List
- NDSL: Non-Domestic Substances List
- IECSC: Inventory of Existing Chemical Substance in China
- EINECS: European INventory of Existing Commercial chemical Substances
- ELINCS: European List of Notified Chemical Substances
- NLP: No-Longer Polymers
- ENCS: Existing and New Chemical Substances Inventory
- KECI: Korea Existing Chemicals Inventory
- NZIoC: New Zealand Inventory of Chemicals
- PICCS: Philippine Inventory of Chemicals and Chemical Substances
- TSCA: Toxic Substances Control Act
- TCSI: Taiwan Chemical Substance Inventory
- INSQ: Inventario Nacional de Sustancias Químicas
- NCI: National Chemical Inventory
- FBEPH: Russian Register of Potentially Hazardous Chemical and Biological Substances

Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 [CLP]

Classification according to	Classification Procedure

regulation (EC) No 1272/2008 [CLP] and amendments	
Flammable Liquids Category 2, H225	On basis of test data
Acute Toxicity (Oral) Category 3, H301	On basis of test data
Acute Toxicity (Dermal) Category 3, H311	On basis of test data
Acute Toxicity (Inhalation) Category 3, H331	On basis of test data
Specific Target Organ Toxicity - Single Exposure Category 1, H370	Minimum classification

Powered by AuthorITe, from Chemwatch.

Safety Data Sheet

according to Regulation (EC) No 1907/2006

***N*-Ethyl-*N*-methyl-*N*-propylammonium perfluorobutanesulfonate**

Revision Date: 9/22/2022

Date Issued: 9/22/2022 Version: 2

1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

1.1 Product identifier

Product name	*N*-Ethyl-*N*-methyl-*N*-propylammonium perfluorobutanesulfonate
Product code	IL-0338
CAS	1186599-90-5
REACH No.	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

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

Identified uses	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Supplier	IoLiTec Ionic Liquids Technologies GmbH Im Zukunftspark 9 D – 74076 Heilbronn Germany
Telephone	+49 (0)7131-89839-0
Fax	+49 (0)7131-89839-109
Email	msds@iolitec.de

1.4 Emergency telephone number

Emergency telephone	+49 (0)151-41255671

2 HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification (REGULTATION (EC) No 1272/2008)

Caution! Substance not yet fully tested. Risks cannot be excluded if the product is handled inappropriately. For laboratory use only!

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Substance not yet fully tested.

Hazard statements

H-phrases	Substance not yet fully tested.

Precautionary statements

P phrases

P262:	Do not get in eyes, on skin, or on clothing.
P280:	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338:	IF IN EYES: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P313:	Get medical advice/attention.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Safety Data Sheet

according to Regulation (EC) No 1907/2006

***N*-Ethyl-*N*-methyl-*N*-propylammonium perfluorobutanesulfonate**

Revision Date: 9/22/2022

Date Issued: 9/22/2022 Version: 2

3 COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

N-Ethyl-*N*-methyl-*N*-propylammonium perfluorobutanesulfonate

CAS: 1186599-90-5

Ingredient name	Contents	Classification
N-Ethyl-*N*-methyl-*N*-propylammonium perfluorobutanesulfonate	99%	Substance not yet fully tested!

Nonafluorobutane-1-sulfonic acid is included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH).

4 FIRST AID MEASURES

4.1 Description of first aid measures

General

Contaminated clothing should be removed and washed before being reused.

Inhalation

Move the exposed person to fresh air at once. If respiratory problems, provide artificial respiration/oxygen.

Ingestion

Immediately rinse mouth and provide fresh air. Do not induce vomiting. Get medical attention immediately.

Skin

Wash the skin immediately with soap and water.

Eyes

Promptly wash eyes with plenty of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention immediately. Continue to rinse.

4.2 Most important symptoms and effects, both acute and delayed

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

No data available

5 FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use: Water spray, fog or mist. Carbon dioxides (CO_2). Dry chemicals, sand, dolomite etc.

5.2. Special hazards arising from the substance or mixture
Avoid water in straight hose stream, will scatter and spread fire. Keep run-off water out of sewers and water sources. Dike for water control. Fire causes formation of toxic gases.

5.3. Advice for firefighters
Wear self-contained breathing apparatus as combustion may produce hazardous fumes.

6 ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear protective clothing and avoid inhalation of vapor, skin or eye contact.

6.2 Environmental precautions
Avoid washing into water courses. Avoid contaminating public drains or water supply.

6.3 Methods and materials for containment and cleaning up
Avoid contact with skin or inhalation of spillage, dust or vapor. Avoid dust formation. Collect and reclaim or dispose in sealed containers in license waste. Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Ventilate.

6.4 Reference to other sections
For disposal see section 13.

7 HANDLING AND STORAGE

7.1 Precautions for safe handling

Keep away from heat, sparks and open flame. Do not use in confined spaces without adequate ventilation and/or respirator.

7.2 Conditions for safe storage, including any incompatibilities

Store at moderate temperatures in dry, well-ventilated area.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

8.1 Control parameters

Ingredients with workplace control parameters

8.2 Exposure controls

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).

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.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

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.

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).

9 PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	Liquid.
Color	Colorless to orange.
Odor/taste	No characteristic odor.

9.2 Other safety information

No data available

10 STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

No particular stability concerns.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Avoid contact to strong oxidizers and bases.

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

High temperatures generate: Corrosive gases/vapor/fumes of: Carbon dioxide (CO_2). Carbon monoxide (CO). Nitrous gases (NO_x). Hydrogen fluoride (HF).

11 TOXICOLOGICAL INFORMATION

11.1 Information on hazard classes

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

Inhalation - May cause respiratory irritation.

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

11.2 Information on other hazards

Potential health effects

Inhalation May be harmful if inhaled. Causes respiratory tract irritation.

Ingestion May be harmful if swallowed.

Skin May be harmful if absorbed through skin. Causes skin irritation.

Eyes Causes serious 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

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

No data available

13 DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Contact specialist disposal companies. Dispose of in accordance with Local Authority requirements. Recover and reclaim or recycle, if practical.

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

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

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

Authorisations and/or restrictions on use

Contains <1% Nonafluorobutane-1-sulfonic acid - REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59).

15.2 Chemical safety assessment

no data available

Country specific information

Germany WGK: 3 (Self-Classification)

16 OTHER INFORMATION

DISCLAIMER

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPOSED TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. IOLITEC SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. THIS INFORMATION RELATES ONLY TO THE SPECIFIC MATERIAL DESIGNATED AND MAY NOT BE VALID FOR SUCH MATERIAL USED IN COMBINATION WITH ANY OTHER MATERIALS OR ANY PROCESS. IT IS THE USERE'S RESPONISIBILTY TO SATISFY HIMSELF AS TO THE SUITABILITY OF SUCH INFORMATION FOR HIS OWN PARTICULAR USE.

IN NO WAY SHALL IOLITEC BE LIABLE FOR ANY CLAIMS, LOSSES OR DAMAGES OF ANY THIRD PARTY OR FOR THE LOST PROFITS OR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES, HOWSOEVER ARISING, EVEN IF THE COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

1 Identification

· **Product identifier**

· **Trade name: Perfluorodecanoic Acid**

· **Article number:** 37244
· **CAS Number:**
335-76-2
· **EC number:**
206-400-3
· **Index number:**
607-720-00-X
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS06 Skull and crossbones

Acute Toxicity - Oral 3	H301	Toxic if swallowed.


GHS08 Health hazard

Carcinogenicity 2	H351	Suspected of causing cancer.
Toxic to Reproduction 1B	H360-H362	May damage fertility or the unborn child. May cause harm to breast-fed children.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 1)


GHS07

Skin Irritation 2	H315	Causes skin irritation.
Eye Irritation 2A	H319	Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335	May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS06 GHS07 GHS08

· **Signal word** Danger
· **Hazard statements**
H301 Toxic if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H351 Suspected of causing cancer.
H360-H362 May damage fertility or the unborn child. May cause harm to breast-fed children.
H335 May cause respiratory irritation.
· **Precautionary statements**
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe dusts or mists.
P263 Avoid contact during pregnancy/while nursing.
P264 Wash 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+P310 If swallowed: Immediately call a poison center/doctor.
P321 Specific treatment (see on this label).
P330 Rinse mouth.
P302+P352 If on skin: Wash with plenty of 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.
P308+P313 IF exposed or concerned: Get medical advice/attention.
P312 Call a poison center/doctor if you feel unwell.
P362+P364 Take off contaminated clothing and wash it before reuse.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P337+P313 If eye irritation persists: Get medical advice/attention.
P403+P233 Store in a well-ventilated place. Keep container tightly closed.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 2)

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



Health = 2
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = *2
Fire = 0
Reactivity = 0

· **Other hazards**
· **Results of PBT and vPvB assessment**

· **PBT:**	
335-76-2	Perfluorodecanoic Acid

· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
335-76-2 Perfluorodecanoic Acid
· **Identification number(s)**
· **EC number:** 206-400-3
· **Index number:** 607-720-00-X

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
In case of irregular breathing or respiratory arrest provide artificial respiration.
· **After inhalation:** 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. If symptoms persist, 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**
May cause anemia, cough, CNS depression, drowsiness, headache, heart damage, lassitude (weakness, exhaustion), liver damage, narcosis, reproductive effects, teratogenic effects.
No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 3)

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
Use fire fighting measures that suit the environment.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 4)

Wash hands before breaks and at the end of work.
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

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.

· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C10HF19O2
· **Molecular Weight**	514.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 5)

· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	DMF: 1 mg/ml; Ethanol: 2 mg/ml; DMSO: insoluble; PBS (pH 7.2): insoluble
· **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:**

Oral	LD50	111 mg/kg (mouse)
		57 mg/kg (rat)
	TDLO	0.72 mg/kg (mouse)
	Intraperitoneal TDLO	20 mg/kg (rat)
	Intraperitoneal LD50	150 mg/kg (mouse)
		40 mg/kg (rat)

· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 6)

· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 3 (Self-assessment): extremely hazardous for water
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
· **Results of PBT and vPvB assessment**

· **PBT:**	
335-76-2	Perfluorodecanoic Acid

· **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**	UN3288
· **UN proper shipping name**	
· **DOT, IATA**	Toxic solid, inorganic, n.o.s. (Perfluorodecanoic Acid)
· **IMDG**	TOXIC SOLID, INORGANIC, N.O.S. (Perfluorodecanoic Acid)

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 7)

· **Transport hazard class(es)**

· **DOT**



· **Class**	6.1 Toxic substances
· **Label**	6.1

· **IMDG, IATA**



· **Class**	6.1 Toxic substances
· **Label**	6.1
· **Packing group**	
· **DOT, IMDG, IATA**	III
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Warning: Toxic substances
· **Hazard identification number (Kemler code):**	60
· **EMS Number:**	F-A,S-A
· **Stowage Category**	A
· **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: 100 kg On cargo aircraft only: 200 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
· **IATA**	
· **Remarks:**	When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10. Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.
· **UN "Model Regulation":**	UN 3288 TOXIC SOLID, INORGANIC, N.O.S. (PERFLUORODECANOIC ACID), 6.1, III

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorodecanoic Acid

(Contd. from page 8)

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 10/25/2022
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 3: Acute toxicity – Category 3
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Carcinogenicity 2: Carcinogenicity – Category 2
Toxic to Reproduction 1B: Reproductive toxicity – Category 1B
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluorododecanoic Acid**

· **Article number:** 37245
· **CAS Number:**
307-55-1
· **EC number:**
206-203-2
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

*
2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS08 Health hazard

Carcinogenicity 2	H351	Suspected of causing cancer.
Toxic to Reproduction 1B	H360-H362	May damage fertility or the unborn child. May cause harm to breast-fed children.
Specific Target Organ Toxicity - Repeated Exposure 1	H372	Causes damage to organs through prolonged or repeated exposure.


GHS07

Acute Toxicity - Inhalation 4	H332	Harmful if inhaled.
Skin Irritation 2	H315	Causes skin irritation.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 1)

Eye Irritation 2A	H319	Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335	May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS07 GHS08

· **Signal word** Danger
· **Hazard statements**

H332	Harmful if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H351	Suspected of causing cancer.
H360-H362	May damage fertility or the unborn child. May cause harm to breast-fed children.
H335	May cause respiratory irritation.
H372	Causes damage to organs through prolonged or repeated exposure.

· **Precautionary statements**

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dusts or mists.
P263	Avoid contact during pregnancy/while nursing.
P264	Wash 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.
P302+P352	If on skin: Wash with plenty of 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.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P312	Call a poison center/doctor if you feel unwell.
P321	Specific treatment (see on this label).
P314	Get medical advice/attention if you feel unwell.
P362+P364	Take off contaminated clothing and wash it before reuse.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	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

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 2)

· **HMIS-ratings (scale 0 - 4)**

HEALTH *2	Health = *2
FIRE 0	Fire = 0
REACTIVITY 0	Reactivity = 0

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

· **vPvB:**	
307-55-1	Perfluorododecanoic Acid

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
307-55-1 Perfluorododecanoic Acid
· **Identification number(s)**
· **EC number:** 206-203-2

*
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:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:**
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:** If symptoms persist consult 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

(Contd. from page 3)

· **Advice for firefighters**
· **Protective equipment:** Mouth respiratory protective device.

*
6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

*
7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 4)

· **Protection of hands:**



Protective gloves

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.

· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C12HF23O2
· **Molecular Weight**	614.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 5)

· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with Water:**	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **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

· **RTECS Number** JR3740000
· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 6)

· **Additional ecological information:**
· **General notes:**
Water hazard class 3 (Assessment by list): extremely hazardous for water
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.

· **vPvB:**	
307-55-1	Perfluorododecanoic Acid

· **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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 01/09/2023 Revision date 01/09/2023

Trade name: Perfluorododecanoic Acid

(Contd. from page 7)

· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 01/09/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Inhalation 4: Acute toxicity – Category 4
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Carcinogenicity 2: Carcinogenicity – Category 2
Toxic to Reproduction 1B: Reproductive toxicity – Category 1B
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
Specific Target Organ Toxicity - Repeated Exposure 1: Specific target organ toxicity (repeated exposure) – Category 1
· *** Data compared to the previous version altered.**

SAFETY DATA SHEET

PFC and PFAS, Individual Compounds (≤ 100 µg/mL), in Methanol VI

SECTION 1: Identification

1.1. Product identifier

Trade name

PFC and PFAS, Individual Compounds (≤ 100 µg/mL), in Methanol VI

Product no.

C11340.16, C13264.24, C14863.8, C14173.10, C14846.11, C14717.30, C2145.8, C2845.9, C2848.10, C14797.5, C15034.8, C14847.8, C14172.7, C14963.12, C14460.7, C14170.4, C14171.5, C14949.7, C14848.12, C14952.5

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

Relevant identified uses of the substance or mixture

Laboratory use
Restricted to professional users.

Uses advised against

None known.

1.3. Details of the supplier of the safety data sheet

Company and address

Chiron AS
Stiklestadveien 1
N-7041 TRONDHEIM

Contact person

Solveig Bye Hauge

E-mail

quality@chiron.no

SDS date

10/31/2023

SDS Version

1.0

1.4. Emergency telephone number

Contact the poison control at 1-800-222-1222 (24/7) or use the webPOISONCONTROL® (triage.webpoisoncontrol.org) to get specific guidance for your case
See also section 4 “First aid measures”.

SECTION 2: Hazard(s) identification

OSHA/HCS status

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

2.1. Classification of the substance or mixture

Flam. Liq. 2; H225, Highly flammable liquid and vapour.
Acute Tox. 3; H301, Toxic if swallowed.
Acute Tox. 3; H311, Toxic in contact with skin.
Acute Tox. 3; H331, Toxic if inhaled.
STOT SE 1; H370, Causes damage to organs.

2.2. Label elements

Hazard pictogram(s)



Signal word

Danger

Hazard statement(s)

Highly flammable liquid and vapour. (H225)
Toxic if swallowed, in contact with skin or if inhaled. (H301+H311+H331)
Causes damage to organs. (H370)

Precautionary statement(s)

General

-

Prevention

Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. (P210)
Keep container tightly closed. (P233)
Do not breathe vapour/mist. (P260)
Wash hands and exposed skin thoroughly after handling. (P264)
Wear face protection/protective gloves/protective clothing. (P280)

Response

IF SWALLOWED: Immediately call a POISON CENTER/doctor. (P301+P310)
IF INHALED: Remove person to fresh air and keep comfortable for breathing. (P304+P340)
IF exposed or concerned: Call a POISON CENTER/doctor (P308+P311)
Call a doctor/POISON CENTER. (P311)
Rinse mouth. (P330)
Take off immediately all contaminated clothing and wash it before reuse. (P361+P364)
In case of fire: Use water mist/carbon dioxide/alcohol-resistant foam to extinguish. (P370+P378)

Storage

Store in a well-ventilated place. Keep container tightly closed. (P403+P233)
Store in a well-ventilated place. Keep cool. (P403+P235)

Disposal

Dispose of contents/container in accordance with local regulation
(P501)

Additional labelling

Not applicable.

2.3. Other hazards

Additional warnings

This mixture/product does not contain any substances considered to meet the criteria classifying them as PBT and/or vPvB.

SECTION 3: Composition/Information on Ingredients

3.1. Substances

Not applicable. This product is a mixture.

3.2. Mixtures

Product/substance	Identifiers	% w/w	Classification	Note
Methanol	CAS No.: 67-56-1	≥99.98 %	Flam. Liq. 2, H225 Acute Tox. 3, H301 Acute Tox. 3, H311 Acute Tox. 3, H331 STOT SE 1, H370 (SCL: 10.00 %) STOT SE 2, H371 (SCL: 3.00 %)	
6:2 DiPAPS, Sodium salt	CAS No.: 407582-79-0	<0.02%		
10:2 DiPAPS sodium salt	CAS No.: 120433-74-1	<0.02%		
n-Perfluorooctanesulfonic acid	CAS No.: 1763-23-1	<0.02%	Acute Tox. 4, H302 Acute Tox. 4, H332 Carc. 2, H351 Repr. 1B, H360D Lact. H362 STOT RE 1, H372	
2H-Perfluoro-2-decenoic acid	CAS No.: 70887-84-2	<0.02%	Acute Tox. 3, H301 Eye Dam. 1, H318 Acute Tox. 4, H332 Carc. 2, H351	

			Repr. 2, H361 STOT RE 1, H372
N-(2-Hydroxyethyl)-N-methylperfluorooctanesulfonamide-d7	CAS No.: 1265205-95-5	<0.02%	Acute Tox. 4, H302 Acute Tox. 4, H312 Skin Irrit. 2, H315 Eye Irrit. 2, H319 Acute Tox. 4, H332 STOT SE 3, H335
Didecyldimethylammonium perfluorooctane sulfonate	CAS No.: 251099-16-8	<0.02%	
1H,1H-Perfluorooctan-1-ol	CAS No.: 307-30-2	<0.02%	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335
1H,1H-Perfluorononan-1-ol	CAS No.: 423-56-3	<0.02%	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335
1H,1H-Perfluorodecan-1-ol	CAS No.: 307-37-9	<0.02%	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335
Perfluoropentanesulfonic acid, sodium salt	CAS No.: 630402-22-1	<0.02%	Acute Tox. 4, H302 Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335
2H,2H,3H,3H-Perfluorooctanoic acid	CAS No.: 914637-49-3	<0.02%	Skin Corr. 1, H314
N-Methyl-n-perfluorobutanesulfonylglycine	CAS No.: 159381-10-9	<0.02 %	Acute Tox. 4, H302 Acute Tox. 4, H312 Skin Irrit. 2, H315 Eye Irrit. 2, H319 Acute Tox. 4, H332 STOT SE 3, H335
Perfluorododecanesulfonic acid	CAS No.: 79780-39-5	<0.02%	
Dodecafluoro-3H-4,8-dioxanonanoic acid	CAS No.: 919005-14-4	<0.02%	Met. Corr. 1, H290 Skin Corr. 1A, H314 Eye Dam. 1, H318 1, HHNOC071
n-Perfluorobutanesulfonamide	CAS No.: 30334-69-1	<0.02%	Acute Tox. 4, H302 Acute Tox. 4, H312 Skin Irrit. 2, H315 Eye Irrit. 2, H319 Acute Tox. 4, H332 STOT SE 3, H335
N-Methyl-n-perfluorobutanesulfonamide	CAS No.: 68298-12-4	<0.02%	Acute Tox. 4, H302 Eye Irrit. 2, H319 Repr. 2, H361
N-Methyl-n-perfluorobutanesulfonylglycine-d3	CAS No.:	<0.02%	
N-Ethyl-N-(2-hydroxyethyl)perfluorooctane sulphonamide-d9	CAS No.: 1691-99-2	<0.02%	Acute Tox. 3, H301 Acute Tox. 4, H332 Carc. 2, H351 Repr. 1A, H360D Lact. H362

			STOT RE 1, H372
N-Methyl-n-perfluorobutanesulfonamide-d3	CAS No.:	<0.02%	Acute Tox. 4, H302 Eye Irrit. 2, H319 Repr. 2, H361

Where the concentration of an ingredient is expressed as a range the exact concentration has been withheld as a trade secret.

See full text of H-phrases in section 16. Occupational exposure limits are listed in section 8, if these are available.

Other information

-

SECTION 4: First-aid measures

4.1. Description of first aid measures

General information

If breathing is irregular, drowsiness, loss of consciousness or cramps: Call 911 and give immediate treatment (first aid).
Contact a doctor if in doubt about the injured person's condition or if the symptoms persist. Never give an unconscious person water or other drink.

Inhalation

Upon breathing difficulties or irritation of the respiratory tract: Bring the injured person into fresh air. Make sure the injured person is continuously monitored. Prevent shock by keeping the injured person warm and calm. If breathing ceases, give mouth-to-mouth resuscitation. If unconscious, roll the injured person into recovery position. Call an ambulance.

Skin contact

Remove contaminated clothing and shoes immediately. Ensure to wash exposed skin thoroughly with water and soap. Skin cleanser can be used. DO NOT use solvents or thinners.
If skin irritation occurs: Get medical advice/attention.

Eye contact

If in eyes: Flush eyes with water or saline water (20-30 °C) for at least 5 minutes. Remove contact lenses. Seek medical assistance and continue flushing during transport.

Ingestion

In the case of ingestion, contact a doctor immediately. If the person is conscious, give them water. DO NOT try to induce vomiting unless this is recommended by a doctor. Hold head facing down to prevent vomit from returning to the mouth and throat. Prevent shock by keeping the injured person warm and calm. Initiate immediate resuscitation if breathing stops. If unconscious, roll the injured person into recovery position. Call an ambulance.

Burns

Rinse with water until pain stops then continue to rinse for 30 minutes.

4.2. Most important symptoms and effects, both acute and delayed

Neurotoxic effects: This product contains organic solvents, which may cause adverse effects to the nervous system. Symptoms of neurotoxicity include: loss of appetite, headache, dizziness, ringing in ears, tingling sensations of skin, sensitivity to the cold, cramps, difficulty in concentrating, tiredness, etc. Repeated exposure to solvents can result in the breaking down of the skin's natural fat layer and may result in an increased absorption potential of other hazardous substances at the area of exposure.

4.3. Indication of any immediate medical attention and special treatment needed

IF exposed or concerned:
Get immediate medical advice/attention.

Information to medics

Bring this safety data sheet or the label from this product.

SECTION 5: Fire-fighting measures

5.1. Extinguishing media

Suitable extinguishing media: Alcohol-resistant foam, carbon dioxide, powder, water mist.
Unsuitable extinguishing media: Waterjets should not be used, since they can spread the fire.

5.2. Special hazards arising from the substance or mixture

Highly flammable liquid and vapour.
In use may form flammable/explosive vapour-air mixture.
Fire will result in dense smoke. Exposure to combustion products may harm your health. Closed containers, which are exposed to fire, should be cooled with water. Do not allow fire-extinguishing water to enter the sewage system and nearby surface waters.
If the product is exposed to high temperatures, e.g. in the event of fire, dangerous decomposition compounds are produced. These are:
Carbon oxides (CO / CO2)

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective clothing to prevent contact. Upon direct exposure contact the Poison Help Line on 1-800-222-1222 (24/7) in order to obtain further advice.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Storages not yet ignited must be cooled by water mist. Remove flammable materials if conditions allow it. Ensure sufficient ventilation.
Avoid direct contact with spilled substances.
Ensure adequate ventilation, especially in confined areas.
Avoid inhalation of vapours from spilled material.
Contaminated areas may be slippery.

6.2. Environmental precautions

Avoid discharge to lakes, streams, sewers, etc.
Keep unauthorized persons away from the spill

6.3. Methods and material for containment and cleaning up

Limit spillage and collect using granular absorbent or similar materials, and dispose of it in accordance with the regulations on dangerous waste.
Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations.
Wherever possible cleaning should be performed with normal cleaning agents. Avoid use of solvents.

6.4. Reference to other sections

See section 13 “Disposal considerations” on handling of waste.
See section 8 "Exposure controls/personal protection" for protective measures.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Ground and bond container and receiving equipment.
Use explosion-proof [electrical/lighting/ventilating] equipment.
Use non-sparking tools.
Take action to prevent static discharges.
Avoid direct contact with the product.
Avoid contact during pregnancy and while nursing.
Smoking, drinking and consumption of food is not allowed in the work area.
See section 8 "Exposure controls/personal protection" for information on personal protection.

7.2. Conditions for safe storage, including any incompatibilities

Store locked up. A sign warning of toxic materials shall be affixed the room and cupboard containing the product(s).
Containers that have been opened must be carefully resealed and kept upright to prevent leakage.
Take action to prevent static discharges.
Must be stored in a cool and well-ventilated area, away from possible sources of ignition.

Recommended storage material

Glass

Liquid class

Flammable liquid / Class IB (NFPA 30)

Storage temperature

Freezer , -18 to -24°C

Incompatible materials

Strong acids, strong bases, strong oxidizing agents, and strong reducing agents.

7.3. Specific end use(s)

This product should only be used for applications quoted in section 1.2.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Methanol
Short term exposure limit (STEL) (ACGIH TLV) (ppm): 250
Short term exposure limit (STEL) (NIOSH REL) (ppm): 250
Long term exposure limit (OSHA Table Z-1) (mg/m³): 260
Long term exposure limit (OSHA Table Z-1) (ppm): 200
Long term exposure limit (ACGIH TLV) (ppm): 200

Part 1910 - Occupational Safety and Health Standards (29 CFR 1910.1000 TABLE Z-1 - Limits for Air Contaminants)

8.2. Exposure controls

Compliance with the given occupational exposure limits values should be controlled on a regular basis.

General recommendations

Smoking, drinking and consumption of food is not allowed in the work area.

Exposure scenarios

There are no exposure scenarios implemented for this product.

Exposure limits

Professional users are subjected to the legally set maximum concentrations for occupational exposure. See occupational hygiene limit values above.

Appropriate technical measures

The formation of vapours must be kept at a minimum and below current limit values (see above). Installation of a local exhaust system if normal air flow in the work room is not sufficient is recommended. Ensure eyewash and emergency showers are clearly marked.
Apply standard precautions during use of the product. Avoid inhalation of vapours.

Hygiene measures

In between use of the product and at the end of the working day all exposed areas of the body must be washed thoroughly. Always wash hands, forearms and face.

Measures to avoid environmental exposure

Keep damming materials near the workplace. If possible, collect spillage during work.

Individual protection measures, such as personal protective equipment

Generally

Use only protective equipment with a recognized certification mark, e.g. the UL mark.

Respiratory Equipment

Work situation	Type	Class	Colour	Standards	
In case of inadequate ventilation	AX		Brown	EN14387	

Skin protection

Recommended	Type/Category	Standards	
Dedicated work clothing should be worn.	-	-	

Hand protection

Work situation	Material	Glove thickness (mm)	Breakthrough time (min.)	Standards	
In the event of short termed exposure or low concentrations	Nitrile	0,38	> 30	EN374-2, EN374-3, EN388	

Work situation	Material	Glove thickness (mm)	Breakthrough time (min.)	Standards	
In the event of prolonged exposure or high concentrations	Butyl	0,7	> 480	EN374-2, EN374-3, EN388, EN421	
When there is risk of splash- / intermittent exposure	Fluoropolymer elastomer (e.g. Viton®)	0,7	> 120	EN374-2, EN374-3, EN388	
	Gloves	-	-	EN374	

Eye protection

Type	Standards	
Face shield alternatively safety glasses with side shields.	EN166	

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state
Liquid

Colour
Transparent

Odour
Sharp/pungent

Odour threshold (ppm)
No data available

pH
No data available

Density (g/cm³)
Testing not relevant or not possible due to the nature of the product.
-

Relative density
0.7923

Kinematic viscosity
0.54 - 0.59 mm²/s (20 °C)

Dynamic viscosity
> 0.544 - < 0.59 mPa.s (25 °C)

Phase changes

Melting point (°F)
-

Melting point (°C)
-98

Softening point/range (waxes and pastes) (°F)
Does not apply to liquids.

Boiling point (°F)
-

Boiling point (°C)
64.7

Vapour pressure
130.3 hPa (20 °C)

Vapour density
1.11

Decomposition temperature (°F)
Not applicable
Evaporation rate (n-butylacetate = 100)
No data available
Data on fire and explosion hazards
Flash point (°F)
-
Flash point (°C)
9.7
Flammability (°F)
The material is ignitable.
Auto-ignition temperature (°F)
-
Auto-ignition temperature (°C)
455
Explosion limits (% v/v)
6 - 36
Solubility
Solubility in water
Completely soluble
n-octanol/water coefficient
-0.77
Solubility in fat (g/L)
No data available
9.2. Other information
Evaporation rate (n-butylacetate = 100)
No data available
Other physical and chemical parameters
No data available.
Oxidizing properties
Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity
No data available.
10.2. Chemical stability
The product is stable under the conditions, noted in section 7 “Handling and storage”.
10.3. Possibility of hazardous reactions
None known.
10.4. Conditions to avoid
Avoid static electricity.
Do not expose to any forms of heat (e.g. solar radiation). May lead to excess pressure.
10.5. Incompatible materials
Strong acids, strong bases, strong oxidizing agents, and strong reducing agents.
10.6. Hazardous decomposition products
The product is not degraded when used as specified in section 1.

SECTION 11: Toxicological information

11.1. Information on toxicological effects
Acute toxicity

Product/substance	Methanol
Species:	Rat
Route of exposure:	Oral
Test:	LD50
Result:	5628 mg/kg

Product/substance	Methanol
Species:	Rabbit
Route of exposure:	Dermal
Test:	LD50
Result:	15800 mg/kg

Product/substance	Methanol
Species:	Rat
Route of exposure:	Inhalation
Test:	LC50
Result:	64000 mg/kg

Product/substance	Methanol
Species:	Rat
Route of exposure:	Inhalation
Test:	LC50
Result:	85.3 mg/l

Toxic if swallowed.
Toxic in contact with skin.
Toxic if inhaled.

Skin corrosion/irritation
Based on available data, the classification criteria are not met.

Serious eye damage/irritation
Based on available data, the classification criteria are not met.

Respiratory sensitisation
Based on available data, the classification criteria are not met.

Skin sensitisation
Based on available data, the classification criteria are not met.

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
Causes damage to organs.

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.

Long term effects
Neurotoxic effects: This product contains organic solvents, which may cause adverse effects to the nervous system. Symptoms of neurotoxicity include: loss of appetite, headache, dizziness, ringing in ears, tingling sensations of skin, sensitivity to the cold, cramps, difficulty in concentrating, tiredness, etc. Repeated exposure to solvents can result in the breaking down of the skin's natural fat layer and may result in an increased absorption potential of other hazardous substances at the area of exposure.

Other information
None known.

SECTION 12: Ecological information

12.1. Toxicity

Product/substance	Methanol
Species:	Fish, Poecilia reticulata
Test:	LC50
Result:	11.5 mg/l

Product/substance	Methanol
Species:	Algae, Chlorella pyrenoidosa

Test:	EC50
Result:	3.6 mg/l

Product/substance	Methanol
Species:	Crustacean, Daphnia magna
Test:	EC50
Result:	> 10000 mg/l

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
This mixture/product does not contain any substances considered to meet the criteria classifying them as PBT and/or vPvB.

12.6. Other adverse effects
None known.

SECTION 13: Disposal considerations

RCRA Hazardous waste ("P" and "U" list) (40 CFR 261)
Methanol is listed with EPA Hazardous Waste Number: U154

Specific labelling

Contaminated packing
Packaging containing residues of the product must be disposed of similarly to the product.

SECTION 14: Transport information

	14.1 UN / ID	14.2 UN proper shipping name	14.3 Hazard class(es)	14.4 PG*	14.5 Env**	Other information:
DOT	UN1230	METHANOL	Transport hazard class: 3 Label: 3+6.1 Classification code: FT1 	II	No	Limited quantities: 1 L Tunnel restriction code: (D/E) See below for additional information.
IMDG	UN1230	METHANOL	Transport hazard class: 3 Label: 3+6.1 Classification code: FT1 	II	No	Limited quantities: 1 L EmS: F-E S-D See below for additional information.
IATA	UN1230	METHANOL	Transport hazard class: 3 Label: 3+6.1 Classification code: FT1 	II	No	See below for additional information.

* Packing group

** Environmental hazards

Additional information
Although this product is environmentally hazardous, the environmentally hazardous substance mark has been

omitted as the product is supplied in packaging with a maximum quantity of 5 L / 5 kg.
-
DOT / See § 172.101 Hazardous Materials Table for any information on special provisions, requirements, or warnings in connection with transport. See § 172.602, for instructions in writing regarding mitigation of damages in relation to incidents or accidents during transport.
IMDG / See section 3.2.1, for any information on special provisions, requirements, or warnings in connection with transport.
IATA / See Table 4.2 for any information on special provisions, requirements, or warnings in connection with transport.
This product is within scope of the regulations of transport of dangerous goods.

14.6. Special precautions for user
Not applicable.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code
No data available.

SECTION 15: Regulatory information

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

15.2. U.S. Federal regulations

TSCA (the non-confidential portion)
Methanol is listed

Clean Air Act
Methanol is regulated as a hazardous air pollutant (HAPS)

EPCRA Section 302
None of the components are listed

EPCRA Section 304
None of the components are listed

EPCRA section 313
Methanol is listed

CERCLA
Methanol is regulated with a Reportable Quantity (RQ) of: 5000 pounds

State regulations

California / Prop. 65
Methanol is known to cause: Developmental Toxicity
NSRL/MADL (µg/day): 47,000 (inhalation) 23,000 (oral)
—

Massachusetts / Right To Know Act
Methanol is listed

New Jersey / Right To Know Act
Methanol / Substance number: 1222
Methanol is on the Special Health Hazard Substance List
—

New York / Right To Know Act
Methanol is listed
Methanol is regulated with a Reportable Quantity (RQ) of: 5000 pounds
Methanol is regulated with a Treshold Reporting Quantity (TRQ) of: 10 pounds
—

Pennsylvania / Right To Know Act
Methanol is listed
Methanol is hazardous to the environment (E)
—

15.4. Restrictions for application
Restricted to professional users.
Pregnant women and women breastfeeding must not be exposed to this product. The risk, and possible technical precautions or design of the workplace needed to eliminate exposure, must be considered.

15.5. Demands for specific education
No specific requirements.

15.6. Additional information
Not applicable.

15.7. Chemical safety assessment

No

15.8. Sources

OSHA Hazard Communication Standard (29 CFR 1910.1200)

SECTION 16: Other information

Full text of H-phrases as mentioned in section 3

H225, Highly flammable liquid and vapour.
H290, May be corrosive to metals.
H301, Toxic if swallowed.
H302, Harmful if swallowed.
H311, Toxic in contact with skin.
H312, Harmful in contact with skin.
H314, Causes severe skin burns and eye damage.
H315, Causes skin irritation.
H318, Causes serious eye damage.
H319, Causes serious eye irritation.
H331, Toxic if inhaled.
H332, Harmful if inhaled.
H335, May cause respiratory irritation.
H351, Suspected of causing cancer.
H360D, May damage the unborn child.
H361, Suspected of damaging fertility or the unborn child.
H362, May cause harm to breast-fed children.
H370, Causes damage to organs.
H371, May cause damage to organs.
H372, Causes damage to organs through prolonged or repeated exposure.
HHNOC071, Corrosive to the respiratory tract.

The full text of identified uses as mentioned in section 1

None known.

Abbreviations and acronyms

ACGIH = American Conference of Governmental Industrial Hygienists
ADN = European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterway
ADR = The European Agreement concerning the International Carriage of Dangerous Goods by Road
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
CAS = Chemical Abstracts Service
CERCLA = Comprehensive Environmental Response Compensation and Liability Act
DOT = Department of Transportation
EINECS = European Inventory of Existing Commercial chemical Substances
EPCRA = Emergency Planning and Community Right-To-Know Act
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
HCIS = Hazardous Chemical Information System
HNOC = Hazards Not Otherwise Classified
IARC = International Agency for Research on Cancer
IATA = International Air Transport Association
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
NFPA = National Fire Protection Association
NIOSH = National Institute for Occupational Safety and Health
OECD = Organisation for Economic Co-operation and Development
OSHA = Occupational Safety and Health Administration
PBT = Persistent, Bioaccumulative and Toxic
RCRA = Resource Conservation and Recovery Act
RID = The Regulations concerning the International Carriage of Dangerous Goods by Rail
RRN = REACH Registration Number
SARA = Superfund Amendments and Reauthorization Act
SCL = A specific concentration limit.

STEL = Short-term exposure limits
STOT-RE = Specific Target Organ Toxicity - Repeated Exposure
STOT-SE = Specific Target Organ Toxicity - Single Exposure
TSCA = The Toxic Substances Control Act
TWA = Time weighted average
UN = United Nations
UVBC = Unknown or variable composition, complex reaction products or of biological materials
VOC = Volatile Organic Compound
vPvB = Very Persistent and Very Bioaccumulative

Additional information

The classification of the mixture in regard of health hazards is in accordance with the calculation methods given by HCS (29 CFR 1910.1200).
The classification of the mixture in regard to physical hazards has been based on experimental data.

The safety data sheet is validated by

Stine Rapp

Other

A change (in proportion to the last essential change (first cipher in SDS version, see section 1)) is marked with a blue triangle.
The information in this safety data sheet applies only to this specific product (mentioned in section 1) and is not necessarily correct for use with other chemicals/products.
It is recommended to hand over this safety data sheet to the actual user of the product. Information in this safety data sheet cannot be used as a product specification.
Country-language: US-en

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

1 Identification

· **Product identifier**

· **Trade name: Perfluorodecanesulfonic Acid**

· **Article number:** 34990
· **CAS Number:**
335-77-3
· **EC number:**
206-401-9
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS07

Skin Irrit. 2 H315 Causes skin irritation.
Eye Irrit. 2A H319 Causes serious eye irritation.
STOT SE 3 H335 May cause respiratory irritation.

· **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 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS07

· **Signal word** Warning
· **Hazard statements**
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves / eye protection / face protection.
P302+P352	If on skin: Wash with plenty of 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/doctor if you feel unwell.
P321	Specific treatment (see on this label).
P362+P364	Take off contaminated clothing and wash it before reuse.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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



Health = 2
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 2
Fire = 0
Reactivity = 0

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
335-77-3 Perfluorodecanesulfonic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 2)

· **Identification number(s)**
· **EC number:** 206-401-9

4 First-aid measures

· **Description of first aid measures**
· **After inhalation:** 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. If symptoms persist, consult a doctor.
· **After swallowing:** If symptoms persist consult doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
May cause anemia, cough, CNS depression, drowsiness, headache, heart damage, lassitude (weakness, exhaustion), liver damage, narcosis, reproductive effects, teratogenic effects.
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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:** Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 3)

Take precautionary measures against static discharge.re.
· **Information about protection against explosions and fires:** No special measures required.

· **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.
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

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.
· **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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 4)

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C10HF21O3S
· **Molecular Weight**	600.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	DMSO
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 5)

· **Incompatible materials:** Bases, Strong oxidizing agents, Reducing agents
· **Hazardous decomposition products:** Carbon oxides, Hydrogen fluoride

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 6)

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** INACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 02/14/2022 Revision date 02/14/2022

Trade name: Perfluorodecanesulfonic Acid

(Contd. from page 7)

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 02/14/2022 / -
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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
Skin Irrit. 2: Skin corrosion/irritation – Category 2
Eye Irrit. 2A: Serious eye damage/eye irritation – Category 2A
STOT SE 3: Specific target organ toxicity (single exposure) – Category 3

AccuStandard, Inc.
125 Market St., New Haven, CT 06513 USA
Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: PFOA-019S-0.02X

Description: Perfluoro(2-ethoxyethane)sulphonic acid in Methanol

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

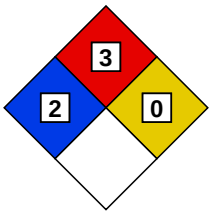
Emergency Phone #: AccuStandard, Inc.
1-203-502-7070 (USA)
+001-203-502-7070 (International)

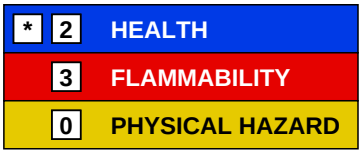
24 hours / 7 days a week

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements







Signal Word: Danger

Hazard Codes:

H225 - Highly Flammable (Flammable liquids, category 2)

H301 - Toxic if swallowed. (Acute toxicity, oral, category 3)

H311 - Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

H315 - Irritating to skin. (Skin corrosion/irritation, category 2)

H320 - Irritating to eyes. (Eye damage/irritation, category 2B)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H336 - Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

H360 - California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

H370 - Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

Precautionary Codes:

SECTION 2 - HAZARDS IDENTIFICATION *- continued*

2.1 - GHS Label Elements *- continued*

P202 - This product should only by used by persons trained in the safe handling of hazardous chemicals.

P233 - Store in a tightly closed container. (P404)

P262 - Do not get in eyes, on skin or clothing.

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P280 - Protective gloves must be worn to prevent skin contact.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P331 - Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

2.2 - Other Hazards

2.2.1 - Symptom of Exposure Health/Environment

Highly Flammable (Flammable liquids, category 2)

Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 or 18 hours.

POISON: May be fatal or cause blindness if swallowed.

Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

2.2.2 - Potential Health Effects

Irritating to eyes. (Eye damage/irritation, category 2B)

Irritating to skin. (Skin corrosion/irritation, category 2)

Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

Irritating to mucous membrane and upper respiratory system.

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Toxic if swallowed. (Acute toxicity, oral, category 3)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: Perfluoro(2-ethoxyethane)sulphonic acid in Methanol

SECTION 3 - COMPOSITION / ANALYTES DATA *- continued*

Analyte	CAS #	% Concentration	ACGIH -TLV (mg/m^3)			OSHA -PEL (mg/m^3)		
			TWA	STEL	Skin	TWA	STEL	Skin
Perfluoro(2-ethoxyethane)sulphonic acid	113507-82-7	<0.001						
Methanol	67-56-1	>99.999				260		

SECTION 4 - FIRST AID MEASURES

4.1 - First Aid Procedures - General

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. (P331)

SECTION 5 - FIRE FIGHTING MEASURES

5.1 - Flammable Properties

Dangerous fire and explosive hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

6.1 - Spill Response

Wear suitable protective equipment listed under Exposure Controls / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Dispose as hazardous waste. Comply with Federal, State and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool place below 14 °F (-10 °C).

Avoid breathing vapors or mists.

Use with adequate ventilation.

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only by used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS

8.1 - Engineering Controls/PPE

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

8.2 - General Hygene Considerations

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Protective gloves must be worn to prevent skin contact. (P280)

(Chloroprene, natural rubber, nitrile, or equivalent)

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear liquid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: -93.9 °C

Boiling Point: 65 °C

Flash Point: 52 °F (11 °C) (tcc)

Evaporation Rate (Butyl Acetate=1): 5.9

Flammability Class: N/A

Lower Flammability Level: 6.7

Upper Flammability Level: 36.5

Vapor Pressure: 97 mmHg (20 °C)

Vapor Density (Air = 1): 1.1 g/L

Specific Gravity: 0.791 g/cm3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES *- continued*

Solubility in Water: Very soluble

Partition Coefficient: log Pow: -0.77

Autoignition Temperature: 385 °C

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: 99.9+

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Acids
Oxidizers

Hazardous Decomposition: Oxides of carbon; Formaldehyde

Hazardous Polymerization: Will not occur

Condition to Avoid: Heat; Contact with ignition sources

SECTION 11 - TOXICOLOGICAL INFORMATION

Human Health Toxicity

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): Human - 143 mg/kg; Rat - 1500 mg/kg

LD50 (Dermal) : Rabbit - >2000 mg/kg

LC50 (Inhalation): Rat - >20 mg/L

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION

Environmental Toxicity

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): >1000 mg/L 96H

EC50 (Aquatic Invertebrate): >1000 mg/L 48H

BCF: 1.0

Hydrolyzes readily on contact with water. Readily biodegradable.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATION

Transportation Information (DOT/IATA)

SECTION 14 - TRANSPORT INFORMATION *- continued*

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

This product contains a compound or compounds subject to EU Regulation (EC) No 1907/2006 (REACH) on Annex XIV, Annex XVII, and/or Article 59. Refer to the below table for details.

Not all components are listed on the TSCA Inventory.

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

This product is subject to SARA section 313 reporting requirements.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

			REACH (1907/2006)		
Analyte	CAS #	% Concentration	Annex XIV	Annex XVII	Article 59
Methanol	67-56-1	>99.999		X	

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals and CLP Regulation (EC) No. 1272/2008.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY RESULTING FROM ITS USE.

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

0 - Minimal
1 - Slight
2 - Moderate
3 - Serious
4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

Category 1 - Most Severe
Category 5 - Least Severe

**** End of Document ****

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

1 Identification

· **Product identifier**

· **Trade name: Perfluoroheptanoic Acid**

· **Article number:** 37247
· **CAS Number:**
375-85-9
· **EC number:**
206-798-9
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS08 Health hazard

Toxic to Reproduction 1B	H360 May damage fertility or the unborn child.
Specific Target Organ Toxicity - Repeated Exposure 1	H372 Causes damage to organs through prolonged or repeated exposure.


GHS05 Corrosion

Skin Corrosion 1A	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 1)


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Aquatic Acute 3	H402 Harmful to aquatic life.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS05 GHS07 GHS08

· **Signal word** Danger
· **Hazard statements**
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H360 May damage fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H402 Harmful to aquatic life.
· **Precautionary statements**

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dusts or mists.
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P301+P312	If swallowed: Call a poison center/doctor if you feel unwell.
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/doctor.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P321	Specific treatment (see on this label).
P314	Get medical advice/attention if you feel unwell.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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



Health = 3
Fire = 1
Reactivity = 0

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 2)

· **HMIS-ratings (scale 0 - 4)**



Health = *3
Fire = 1
Reactivity = 0

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
375-85-9 Perfluoroheptanoic Acid
· **Identification number(s)**
· **EC number:** 206-798-9

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. Immediately call a doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
May cause anemia, cough, CNS depression, drowsiness, headache, heart damage, lassitude (weakness, exhaustion), liver damage, narcosis, reproductive effects, teratogenic effects.
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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 3)

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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:**
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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 4)

· **Protection of hands:**



Protective gloves

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.

· **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:	A low melting solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C7HF13O2
· **Molecular Weight**	364.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	30 °C (86 °F)
Boiling point/Boiling range:	175–177 °C (347–350.6 °F)
· **Flash point:**	>113 °C (>235.4 °F)
· **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:**	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 5)

· **Density at 20 °C (68 °F):**	1.792 g/cm³ (14.95424 lbs/gal)
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with Water:**	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	2 mg/ml PBS
· **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

· **RTECS Number** MJ2415000
· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Strong caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **OSHA-Ca (Occupational Safety & Health Administration)** Substance is not listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 6)

· **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 (Self-assessment): 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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/10/2022 Revision date 10/10/2022

Trade name: Perfluoroheptanoic Acid

(Contd. from page 7)

· **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):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 10/10/2022
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1A: Skin corrosion/irritation – Category 1A
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Toxic to Reproduction 1B: Reproductive toxicity – Category 1B
Specific Target Organ Toxicity - Repeated Exposure 1: Specific target organ toxicity (repeated exposure) – Category 1
Aquatic Acute 3: Hazardous to the aquatic environment - acute aquatic hazard – Category 3
· *** Data compared to the previous version altered.**

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluoroheptanesulfonic Acid**
· **Synonym**

· **Article number:** 37246
· **CAS Number:**
375-92-8
· **EC number:**
206-800-8
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

(Contd. on page 2)

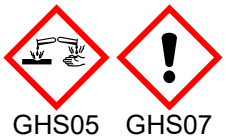
Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 1)

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H302+H312+H332 Harmful if swallowed, in contact with skin or if inhaled.
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**
P260 Do not breathe dusts or mists.
P264 Wash 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/doctor if you feel unwell.
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/doctor.
P321 Specific treatment (see on this label).
P362+P364 Take off contaminated clothing and wash it before reuse.
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 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.
· **vPvB:** Not applicable.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
375-92-8 Perfluoroheptanesulfonic Acid
· **Identification number(s)**
· **EC number:** 206-800-8

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
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:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **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 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 section 13.
Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 3)

See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**
· **PAC-1:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 4)

· **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.
· **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:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C7HF15O3S
· **Molecular Weight**	450.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 5)

Kinematic:	Not applicable.
· **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:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 6)

· **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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** INACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/07/2023 Revision date 11/07/2023

Trade name: Perfluoroheptanesulfonic Acid

(Contd. from page 7)

· **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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 11/07/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

1 Identification

· **Product identifier**

· **Trade name: Perfluorohexanoic Acid**

· **Article number:** 37249
· **CAS Number:**
307-24-4
· **EC number:**
206-196-6
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B H314 Causes severe skin burns and eye damage.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS05

· **Signal word** Danger

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 1)

· **Hazard statements**
H314 Causes severe skin burns and eye damage.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash thoroughly after handling.
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/doctor.
P321	Specific treatment (see on this label).
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	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.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
307-24-4 Perfluorohexanoic Acid
· **Identification number(s)**
· **EC number:** 206-196-6

4 First-aid measures

· **Description of first aid measures**
· **General information:** Immediately remove any clothing soiled by the product.
· **After inhalation:** 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:** Drink copious amounts of water and provide fresh air. Immediately call a doctor.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Trade name: Perfluorohexanoic Acid

(Contd. from page 2)

· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed**
May cause anemia, cough, CNS depression, drowsiness, headache, heart damage, lassitude (weakness, exhaustion), liver damage, narcosis, reproductive effects, teratogenic effects.
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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 3)

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.
Avoid contact with the eyes and skin.
· **Breathing equipment:** Not required.
· **Protection of hands:**



Protective gloves

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.
· **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:	Solid
Color:	According to product specification
· **Odor:**	Characteristic
· **Structural Formula**	C6HF11O2
· **Molecular Weight**	314.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 4)

· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **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:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
SOLUBILITY	2 mg/ml DMSO
· **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

· **RTECS Number** MO8445000
· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:** Strong caustic effect.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 5)

· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **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**	not regulated
· **UN proper shipping name**	
· **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)**	
· **DOT, ADN, IMDG, IATA**	
· **Class**	not regulated

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 6)

· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 10/25/2022
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
PBT: Persistent, Bioaccumulative and Toxic

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/25/2022 Revision date 10/25/2022

Trade name: Perfluorohexanoic Acid

(Contd. from page 7)

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
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

*
1 Identification

· **Product identifier**

· **Trade name: Perfluorohexanesulfonic Acid**
· **Synonym**
1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluoro-1-hexanesulfonic acid
PFHxS

· **Article number:** 37248
· **CAS Number:**
355-46-4
· **EC number:**
206-587-1
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

*
2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Acute Toxicity - Dermal 4	H312 Harmful in contact with skin.
Acute Toxicity - Inhalation 4	H332 Harmful if inhaled.

(Contd. on page 2)

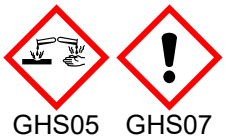
Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 1)

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H302+H312+H332 Harmful if swallowed, in contact with skin or if inhaled.
H314 Causes severe skin burns and eye damage.
· **Precautionary statements**
P260 Do not breathe dusts or mists.
P264 Wash 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/doctor if you feel unwell.
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/doctor.
P321 Specific treatment (see on this label).
P362+P364 Take off contaminated clothing and wash it before reuse.
P363 Wash contaminated clothing before reuse.
P405 Store locked up.
P501 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.
· **vPvB:** Not applicable.

US

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
355-46-4 Perfluorohexanesulfonic Acid
· **Identification number(s)**
· **EC number:** 206-587-1

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
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:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **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 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 section 13.
Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 3)

See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.
· **Protective Action Criteria for Chemicals**
· **PAC-1:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 4)

· **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.
· **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:	A low melting solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C6HF13O3S
· **Molecular Weight**	400.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	238.5 °C (461.3 °F)
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density at 20 °C (68 °F):**	1.841 g/cm³ (15.36315 lbs/gal)
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 5)

Kinematic:	Not applicable.
SOLUBILITY	DMF: 10 mg/ml; DMSO: 10 mg/ml; Ethanol: 10 mg/ml
· **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

· **RTECS Number** MO4247000
· **Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
Oral	TDLO	6.1 mg/kg (mouse)

· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 1 (Self-assessment): slightly hazardous for water

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 6)

Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.

· **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**	UN1759
· **UN proper shipping name**	
· **DOT**	Corrosive solids, n.o.s. (Perfluorohexanesulfonic Acid)
· **IMDG**	CORROSIVE SOLID, N.O.S. (Perfluorohexanesulfonic Acid)
· **IATA**	Corrosive solid, n.o.s. (Perfluorohexanesulfonic Acid)
· **Transport hazard class(es)**	
· **DOT**	
· **Class**	8 Corrosive substances
· **Label**	8
· **IMDG, IATA**	
· **Class**	8 Corrosive substances
· **Label**	8
· **Packing group**	
· **DOT, IMDG, IATA**	II
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Warning: Corrosive substances
· **Hazard identification number (Kemler code):**	80

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 7)

· **EMS Number:**	F-A,S-B
· **Stowage Category**	A
· **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: 15 kg On cargo aircraft only: 50 kg
· **IMDG**	
· **Limited quantities (LQ)**	1 kg
· **Excepted quantities (EQ)**	Code: E2 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 500 g
· **IATA**	
· **Remarks:**	When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10. Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.
· **UN "Model Regulation":**	UN 1759 CORROSIVE SOLID, N.O.S. (PERFLUOROHEXANESULFONIC ACID), 8, II

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/21/2024 Revision date 05/21/2024

Trade name: Perfluorohexanesulfonic Acid

(Contd. from page 8)

these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 05/21/2024 / -
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
· *** Data compared to the previous version altered.**

AccuStandard, Inc.
125 Market St., New Haven, CT 06513 USA
Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: PFOA-021S

Description: Perfluoro(4-methoxybutanoic) acid

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

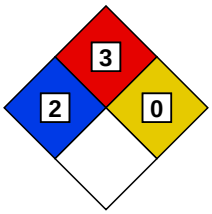
Emergency Phone #: AccuStandard, Inc.
1-203-502-7070 (USA)
+001-203-502-7070 (International)

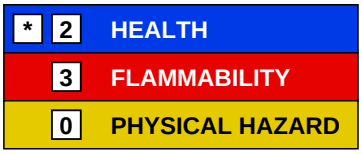
24 hours / 7 days a week

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements







Signal Word: Danger

Hazard Codes:

H225 - Highly Flammable (Flammable liquids, category 2)

H301 - Toxic if swallowed. (Acute toxicity, oral, category 3)

H311 - Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

H315 - Irritating to skin. (Skin corrosion/irritation, category 2)

H320 - Irritating to eyes. (Eye damage/irritation, category 2B)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H336 - Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

H360 - California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

H370 - Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

Precautionary Codes:

SECTION 2 - HAZARDS IDENTIFICATION *- continued*

2.1 - GHS Label Elements *- continued*

P202 - This product should only by used by persons trained in the safe handling of hazardous chemicals.

P233 - Store in a tightly closed container. (P404)

P262 - Do not get in eyes, on skin or clothing.

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P280 - Protective gloves must be worn to prevent skin contact.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P331 - Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

2.2 - Other Hazards

2.2.1 - Symptom of Exposure Health/Environment

Highly Flammable (Flammable liquids, category 2)

Causes damage to organs. (Specific target organ toxicity, single exposure, category 1)

After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 or 18 hours.

POISON: May be fatal or cause blindness if swallowed.

Overexposure may cause dizziness, nausea, muscle weakness, narcosis and respiratory failure.

2.2.2 - Potential Health Effects

Irritating to eyes. (Eye damage/irritation, category 2B)

Irritating to skin. (Skin corrosion/irritation, category 2)

Toxic if absorbed through skin. (Acute toxicity, dermal, category 3)

Irritating to mucous membrane and upper respiratory system.

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Toxic if swallowed. (Acute toxicity, oral, category 3)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 Warning: This product contains a component (or components) that may cause birth defects or other reproductive harm in a quantity greater than or equal to 0.1%.

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: Perfluoro(4-methoxybutanoic) acid

SECTION 3 - COMPOSITION / ANALYTES DATA *- continued*

Analyte	CAS #	% Concentration	ACGIH -TLV (mg/m³)			OSHA -PEL (mg/m³)		
			TWA	STEL	Skin	TWA	STEL	Skin
Perfluoro(4-methoxybutanoic) acid	863090-89-5	0.010						
Methanol	67-56-1	99.990				260		

SECTION 4 - FIRST AID MEASURES

4.1 - First Aid Procedures - General

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. (P331)

SECTION 5 - FIRE FIGHTING MEASURES

5.1 - Flammable Properties

Dangerous fire and explosive hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

6.1 - Spill Response

Wear suitable protective equipment listed under Exposure Controls / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Dispose as hazardous waste. Comply with Federal, State and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool place below 14 °F (-10 °C).

Avoid breathing vapors or mists.

Use with adequate ventilation.

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only by used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS

8.1 - Engineering Controls/PPE

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

8.2 - General Hygene Considerations

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Protective gloves must be worn to prevent skin contact. (P280)

(Chloroprene, natural rubber, nitrile, or equivalent)

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear liquid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: -93.9 °C

Boiling Point: 65 °C

Flash Point: 52 °F (11 °C) (tcc)

Evaporation Rate (Butyl Acetate=1): 5.9

Flammability Class: N/A

Lower Flammability Level: 6.7

Upper Flammability Level: 36.5

Vapor Pressure: 97 mmHg (20 °C)

Vapor Density (Air = 1): 1.1 g/L

Specific Gravity: 0.791 g/cm3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES *- continued*

Solubility in Water: Very soluble

Partition Coefficient: log Pow: -0.77

Autoignition Temperature: 385 °C

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: 99.9+

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Acids
Oxidizers

Hazardous Decomposition: Oxides of carbon; Formaldehyde

Hazardous Polymerization: Will not occur

Condition to Avoid: Heat; Contact with ignition sources

SECTION 11 - TOXICOLOGICAL INFORMATION

Human Health Toxicity

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): Human - 143 mg/kg; Rat - 1500 mg/kg

LD50 (Dermal) : Rabbit - >2000 mg/kg

LC50 (Inhalation): Rat - >20 mg/L

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION

Environmental Toxicity

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): >1000 mg/L 96H

EC50 (Aquatic Invertebrate): >1000 mg/L 48H

BCF: 1.0

Hydrolyzes readily on contact with water. Readily biodegradable.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATION

Transportation Information (DOT/IATA)

SECTION 14 - TRANSPORT INFORMATION *- continued*

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

This product contains a compound or compounds subject to EU Regulation (EC) No 1907/2006 (REACH) on Annex XIV, Annex XVII, and/or Article 59. Refer to the below table for details.

Not all components are listed on the TSCA Inventory.

WARNING: This product contains chemicals known to the state of California to cause birth defects or other reproductive harm.

This product is subject to SARA section 313 reporting requirements.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

			REACH (1907/2006)		
Analyte	CAS #	% Concentration	Annex XIV	Annex XVII	Article 59
Methanol	67-56-1	99.990		X	

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals and CLP Regulation (EC) No. 1272/2008.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY RESULTING FROM ITS USE.

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

0 - Minimal
1 - Slight
2 - Moderate
3 - Serious
4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

Category 1 - Most Severe
Category 5 - Least Severe

**** End of Document ****

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluoro-3-methoxypropanoic Acid**
· **Synonym** 2,2,3,3-tetrafluoro-3-(trifluoromethoxy)-propanoic acid

· **Article number:** 37268
· **CAS Number:**
377-73-1
· **EC number:**
876-098-1
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1B	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

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

(Contd. on page 2)

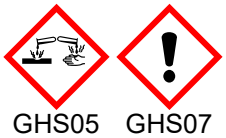
Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor.
P321	Specific treatment (see 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 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.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
377-73-1 Perfluoro-3-methoxypropanoic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 2)

· **Identification number(s)**
· **EC number:** 876-098-1

4 First-aid measures

· **Description of first aid measures**
· **General information:** Immediately remove any clothing soiled by the product.
· **After inhalation:** 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:** Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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 section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 3)

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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.
· **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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 4)

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C4HF7O3
· **Molecular Weight**	230 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 5)

· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **RTECS Number** UF7772000
· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 6)

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number** · **DOT, IMDG, IATA**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/18/2023 Revision date 08/18/2023

Trade name: Perfluoro-3-methoxypropanoic Acid

(Contd. from page 7)

these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/18/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

WELLINGTON LABORATORIES

SAFETY DATA SHEET

Perfluoro-n-nonanoic acid (PFNA)

Scantec Nordic AB

Chemwatch Hazard Alert Code: **4**

Version No: **8.10**
Safety Data Sheet (Conforms to Annex II of REACH (1907/2006) - Regulation 2020/878)

Issue Date: **20/10/2023**
Print Date: **20/02/2024**
S.REACH.SWE.EN

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

1.1. Product Identifier

Product name	Perfluoro-n-nonanoic acid (PFNA)
Chemical Name	Not Applicable
Synonyms	Methyl alcohol (methanol),Methyl hydrate (methanol),Methylol (methanol)
Proper shipping name	METHANOL
Chemical formula	Not Applicable
Other means of identification	Not Available

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

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 (CofA) for further product information. Wellington Laboratories Inc. believes the information stated below to be reliable and accurate. This data is solely for reference purposes. Wellington Laboratories Inc. shall not be held liable for damages resulting from handling or contact with the above stated material.
Uses advised against	No specific uses advised against are identified.

1.3. Details of the manufacturer or supplier of the safety data sheet

Registered company name	**Scantec Nordic AB**	**Greyhound Chromatography & Allied Chemicals**	**Wellington Laboratories**
Address	Fabriksstraket 29 Jonsered 433 76 Sweden	6 Kelvin Park, Birkenhead, Merseyside CH41 1LT United Kingdom	345 Southgate Drive Guelph Ontario N1G 3M5 Canada
Telephone	+031 336 90 00	+44-0-151 649 4000	+1 519 822 2436
Fax	Not Available	+44-0-151 649 4001	+1 519 822 2849
Website	www.scantecnordic.se	www.greyhoundchrom.com	http://well-labs.com/
Email	info@scantecnordic.se	info@greyhoundchrom.com	orders@well-labs.com

1.4. Emergency telephone number

Association / Organisation	**CANUTEC**
Emergency telephone numbers	+1 888 226 8832 (North American)
Other emergency telephone numbers	+1 613 996 6666 (International)

SECTION 2 Hazards identification

2.1. Classification of the substance or mixture

Considered a hazardous mixture according to Reg. (EC) No 1272/2008 and their amendments. Classified as Dangerous Goods for transport purposes.

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 according to regulation (EC) No 1272/2008 [CLP] and amendments [1]	H225 - Flammable Liquids Category 2, H301 - Acute Toxicity (Oral) Category 3, H311 - Acute Toxicity (Dermal) Category 3, H331 - Acute Toxicity (Inhalation) Category 3, H370 - Specific Target Organ Toxicity - Single Exposure Category 1
Legend:	*1. Classified by Chemwatch; 2. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI*

2.2. Label elements

Hazard pictogram(s)	
Signal word	**Danger**

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H301	Toxic if swallowed.
H311	Toxic in contact with skin.
H331	Toxic if inhaled.
H370	Causes damage to organs.

Supplementary statement(s)

Not Applicable

CLP classification (additional)

Not Applicable

Precautionary statement(s) Prevention

P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe mist/vapours/spray.
P264	Wash all exposed external body areas 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 and protective clothing.
P240	Ground and bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/intrinsically safe equipment.
P242	Use non-sparking tools.
P243	Take action to prevent static discharges.

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.
P330	Rinse mouth.
P370+P378	In case of fire: Use alcohol resistant foam or normal protein foam to extinguish.
P302+P352	IF ON SKIN: Wash with plenty of water and soap.
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P361+P364	Take off immediately all contaminated clothing and wash it before reuse.
P303+P361+P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].

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 to authorised hazardous or special waste collection point in accordance with any local regulation.

CLP Article 18 Product Identifiers

Material contains methanol, sodium hydroxide.

2.3. Other hazards

Cumulative effects may result following exposure*.

May produce discomfort of the eyes and skin*.

Vapours potentially cause drowsiness and dizziness*.

HARMFUL: may cause lung damage if swallowed

methanol	Listed in the Europe Regulation (EC) No 1907/2006 - Annex XVII (Restrictions may apply)
Perfluoro-n-nonanoic acid	Listed in the European Chemicals Agency (ECHA) Candidate List of Substances of Very High Concern for Authorisation
Perfluoro-n-nonanoic acid	Listed in the Europe Regulation (EC) No 1907/2006 - Annex XVII (Restrictions may apply)

SECTION 3 Composition / information on ingredients

3.1.Substances

See 'Composition on ingredients' in Section 3.2

3.2.Mixtures

1. CAS No 2.EC No 3.Index No 4.REACH No	%[weight]	Name	Classification according to regulation (EC) No 1272/2008 [CLP] and amendments	SCL / M-Factor	Nanoform Particle Characteristics
1. 67-56-1 2.200-659-6 3.603-001-00-X 4.Not Available	98.729	methanol *	Flammable Liquids Category 2, Acute Toxicity (Oral) Category 3, Acute Toxicity (Dermal) Category 3, Acute Toxicity (Inhalation) Category 3, Specific Target Organ Toxicity - Single Exposure Category 1; H225, H301, H311, H331, H370 [2]	* STOT SE 1; H370: C ≥ 10 % | STOT SE 2; H371: 3 % ≤ C < 10 %	Not Available
1. 375-95-1* 2.206-801-3 3.607-718-00-9 4.Not Available	0.006	Perfluoro-n-nonanoic acid	Not Classified [1]	Not Available	Not Available
1. 7732-18-5 2.231-791-2 3.Not Available 4.Not Available	1.262	water	Not Classified [1]	Not Available	Not Available
1. 1310-73-2 2.215-185-5 3.011-002-00-6 4.Not Available	0.002	sodium hydroxide	Skin Corrosion/Irritation Category 1A; H314 [2]	Skin Corr. 1A; H314: C ≥ 5 % | Skin Corr. 1B; H314: 2 % ≤ C < 5 % | Skin Irrit. 2; H315: 0,5 % ≤ C < 2 % | Eye Irrit.2; H319: 0,5 % ≤ C < 2 %	Not Available

Legend:	*1. Classified by Chemwatch; 2. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI; 3. Classification drawn from C&L; * EU IOELVs available; [e] Substance identified as having endocrine disrupting properties*

SECTION 4 First aid measures

4.1. 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: ‣ Quickly but gently, wipe material off skin with a dry, clean cloth. ‣ Immediately 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.
Ingestion	‣ 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. ‣ Observe the patient carefully. ‣ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. ‣ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. ‣ Seek medical advice. ‣ Avoid giving milk or oils. ‣ Avoid giving alcohol. ‣ If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11

4.3. 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]

Methanol poisoning can be treated with fomepizole, or if unavailable, ethanol. Both drugs act to reduce the action of alcohol dehydrogenase on methanol by means of competitive inhibition. Ethanol, the active ingredient in alcoholic beverages, acts as a competitive inhibitor by more effectively binding and saturating the alcohol dehydrogenase enzyme in the liver, thus blocking the binding of methanol. Methanol is excreted by the kidneys without being converted into the very toxic metabolites formaldehyde and formic acid. Alcohol dehydrogenase instead enzymatically converts ethanol to acetaldehyde, a much less toxic organic molecule. Additional treatment may include sodium bicarbonate for metabolic acidosis, and hemodialysis or hemodiafiltration to remove methanol and formate from the blood. Folinic acid or folic acid is also administered to enhance the metabolism of formate.

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 Firefighting measures

5.1. 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.
- Water spray or fog - Large fires only.

5.2. 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

5.3. Advice for firefighters

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. ‣ Consider evacuation (or protect in place). ‣ Fight fire from a safe distance, with adequate cover. ‣ If safe, switch off electrical equipment until vapour fire hazard removed. ‣ Use water delivered as a fine spray to control fire and cool adjacent area. ‣ Avoid spraying water onto liquid pools. ‣ **DO NOT** approach containers suspected to be hot. ‣ Cool fire exposed containers with water spray from a protected location. ‣ If safe to do so, remove containers from path of fire.
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. ‣ On combustion, may emit toxic fumes of carbon monoxide (CO). Combustion products include: , carbon dioxide (CO_2) , formaldehyde , other pyrolysis products typical of burning organic material.

SECTION 6 Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

See section 8

6.2. Environmental precautions

See section 12

6.3. 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. ‣ Contain and absorb small quantities with vermiculite or other absorbent material. ‣ Wipe up. ‣ Collect residues in a flammable waste container.
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. ‣ Prevent, by any means available, spillage from entering drains or water course. ‣ Consider evacuation (or protect in place). ‣ No smoking, naked lights or ignition sources. ‣ Increase ventilation. ‣ Stop leak if safe to do so. ‣ Water spray or fog may be used to disperse vapour. ‣ Contain or absorb spill with sand, earth or vermiculite. ‣ Use only spark-free shovels and explosion proof equipment. ‣ Collect recoverable product into labelled containers for recycling. ‣ Collect solid residues and seal in labelled drums for disposal.

	‣ Wash area and prevent runoff into drains. ‣ After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using. ‣ If contamination of drains or waterways occurs, advise emergency services.

6.4. Reference to other sections

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

SECTION 7 Handling and storage

7.1. 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** enter confined spaces until atmosphere has been checked. ‣ Avoid smoking, naked lights, heat or ignition sources. ‣ When handling, **DO NOT** eat, drink or smoke. ‣ Vapour may ignite on pumping or pouring due to static electricity. ‣ **DO NOT** use plastic buckets. ‣ Earth and secure metal containers when dispensing or pouring product. ‣ Use spark-free tools when handling. ‣ Avoid contact with incompatible materials. ‣ Keep containers securely sealed. ‣ Avoid physical damage to containers. ‣ Always wash hands with soap and water after handling. ‣ Work clothes should be laundered separately. ‣ Use good occupational work practice. ‣ Observe manufacturer's storage and handling recommendations contained within this SDS. ‣ Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions. ‣ **DO NOT** allow clothing wet with material to stay in contact with skin
Fire and explosion protection	See section 5
Other information	‣ Store in original containers in approved flame-proof area. ‣ No smoking, naked lights, heat or ignition sources. ‣ **DO NOT** store in pits, depression, basement or areas where vapours may be trapped. ‣ Keep containers securely sealed. ‣ Store away from incompatible materials in a cool, dry well ventilated area. ‣ Protect containers against physical damage and check regularly for leaks. ‣ Observe manufacturer's storage and handling recommendations contained within this MSDS. ‣ Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Cleaning, inspection and maintenance of storage tanks is a specialist operation, which requires the implementation of strict procedures and precautions. ‣ Keep in a cool place. Electrostatic charges will be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk. The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable. ‣ For containers, or container linings use mild steel, stainless steel. Examples of suitable materials are: high density polyethylene (HDPE), polypropylene (PP), and Viton (FMK), which have been specifically tested for compatibility with this product. ‣ For container linings, use amine-adduct cured epoxy paint. ‣ For seals and gaskets use: graphite, PTFE, Viton A, Viton B. ‣ Unsuitable material: Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials. ‣ Do not cut, drill, grind, weld or perform similar operations on or near containers. Containers, even those that have been emptied, can contain explosive vapours.

7.2. 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. (23 deg. C)

	‣ Manufactured product that requires stirring before use and having a viscosity of at least 20 cSt (25 deg. C): (i) Removable head packaging; (ii) Cans with friction closures and (iii) low pressure tubes and cartridges may be used. ‣ Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages ‣ In addition, where inner packagings are glass and contain liquids of packing group I there must be sufficient inert absorbent to absorb any spillage, unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.
Storage incompatibility	Methanol: ‣ reacts violently with strong oxidisers, acetyl bromide, alkyl aluminium salts, beryllium dihydride, bromine, chromic acid, 1-chloro-3,3-difluoro-2-methoxycyclopropene, 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-methoxycyclopropene ‣ 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, dialkylzincs, 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.
Hazard categories in accordance with Regulation (EC) No 1272/2008	H2: Acute Toxic, H3: STOT Specific Target Organ Toxicity – Single Exposure, P5a: Flammable Liquids, P5b: Flammable Liquids, P5c: Flammable Liquids
Qualifying quantity (tonnes) of dangerous substances as referred to in Article 3(10) for the application of	H2 Lower- / Upper-tier requirements: 50 / 200 H3 Lower- / Upper-tier requirements: 50 / 200 P5a Lower- / Upper-tier requirements: 10 / 50 P5b Lower- / Upper-tier requirements: 50 / 200 P5c Lower- / Upper-tier requirements: 5 000 / 50 000

7.3. Specific end use(s)

See section 1.2

SECTION 8 Exposure controls / personal protection

8.1. Control parameters

Ingredient	DNELs Exposure Pattern Worker	PNECs Compartment
methanol	Dermal 1 601 mg/kg bw/day (Systemic, Chronic) Inhalation 11.67 mg/m³ (Systemic, Chronic) Inhalation 20 mg/m³ (Local, Chronic) Dermal 20 mg/kg bw/day (Systemic, Acute) Inhalation 130 mg/m³ (Systemic, Acute) Inhalation 40 mg/m³ (Local, Acute) *Dermal 4 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 2.9 mg/m³ (Systemic, Chronic) ** *Oral 1 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 26 mg/m³ (Local, Chronic) ** *Dermal 4 mg/kg bw/day (Systemic, Acute) ** *Inhalation 26 mg/m³ (Systemic, Acute) ** *Oral 4 mg/kg bw/day (Systemic, Acute) ** *Inhalation 26 mg/m³ (Local, Acute) **	Not Available
water	Dermal 0.02 mg/kg bw/day (Systemic, Chronic) Inhalation 0.12 mg/m³ (Systemic, Chronic) Inhalation 0.11 mg/m³ (Local, Chronic)	Not Available

Ingredient	DNELs Exposure Pattern Worker	PNECs Compartment
	Dermal 5 mg/kg bw/day (Systemic, Acute) Inhalation 2.5 mg/m³ (Systemic, Acute) Inhalation 0.33 mg/m³ (Local, Acute) *Dermal 0.35 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 0.144 mg/m³ (Systemic, Chronic) ** *Oral 0.08 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 0.03 mg/m³ (Local, Chronic) ** *Dermal 2.5 mg/kg bw/day (Systemic, Acute) ** *Inhalation 1.96 mg/m³ (Systemic, Acute) ** *Oral 2.5 mg/kg bw/day (Systemic, Acute) ** *Inhalation 0.09 mg/m³ (Local, Acute) **	
sodium hydroxide	Inhalation 2.05 mg/m³ (Systemic, Chronic) Inhalation 1 mg/m³ (Local, Chronic) Inhalation 2 mg/m³ (Local, Acute) *Inhalation 0.51 mg/m³ (Systemic, Chronic) ** *Oral 10 mg/kg bw/day (Systemic, Chronic) ** *Inhalation 1 mg/m³ (Local, Chronic) **	Not Available

* Values for General Population

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)	methanol	Methanol	200 ppm / 260 mg/m3	Not Available	Not Available	Skin

Emergency Limits

Ingredient	TEEL-1	TEEL-2	TEEL-3
methanol	Not Available	Not Available	Not Available
sodium hydroxide	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
methanol	6,000 ppm	Not Available
Perfluoro-n-nonanoic acid	Not Available	Not Available
water	Not Available	Not Available
sodium hydroxide	10 mg/m3	Not Available

Occupational Exposure Banding

Ingredient	Occupational Exposure Band Rating	Occupational Exposure Band Limit
sodium hydroxide	C	> 0.1 to ≤ milligrams per cubic meter of air (mg/m³)
Notes:	*Occupational exposure banding is a process of assigning chemicals into specific categories or bands based on a chemical's potency and the adverse health outcomes associated with exposure. The output of this process is an occupational exposure band (OEB), which corresponds to a range of exposure concentrations that are expected to protect worker health.*	

8.2. Exposure controls

8.2.1. 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. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use. Employers may need to use multiple types of controls to prevent employee overexposure. For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant. Type of Contaminant: | Air Speed:

	solvent, vapours, degreasing etc., evaporating from tank (in still air). — 0.25-0.5 m/s (50-100 f/min.)
	aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation) — 0.5-1 m/s (100-200 f/min.)
	direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion) — 1-2.5 m/s (200-500 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min.) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.
· Adequate ventilation is typically taken to be that which limits the average concentration to no more than 25% of the LEL within the building, room or enclosure containing the dangerous substance.
· Ventilation for plant and machinery is normally considered adequate if it limits the average concentration of any dangerous substance that might potentially be present to no more than 25% of the LEL. However, an increase up to a maximum 50% LEL can be acceptable where additional safeguards are provided to prevent the formation of a hazardous explosive atmosphere. For example, gas detectors linked to emergency shutdown of the process might be used together with maintaining or increasing the exhaust ventilation on solvent evaporating ovens and gas turbine enclosures.
· Temporary exhaust ventilation systems may be provided for non-routine higher-risk activities, such as cleaning, repair or maintenance in tanks or other confined spaces or in an emergency after a release. The work procedures for such activities should be carefully considered.. The atmosphere should be continuously monitored to ensure that ventilation is adequate and the area remains safe. Where workers will enter the space, the ventilation should ensure that the concentration of the dangerous substance does not exceed 10% of the LEL (irrespective of the provision of suitable breathing apparatus)

8.2.2. Individual protection measures, such as personal protective equipment



Eye and face protection

- Safety glasses with side shields.
- Chemical goggles. [AS/NZS 1337.1, EN166 or national equivalent]
- 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. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

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. 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.
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
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. · Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term use. · Contaminated gloves should be replaced. As defined in ASTM F-739-96 in any application, gloves are rated as: · Excellent when breakthrough time > 480 min · Good when breakthrough time > 20 min · Fair when breakthrough time < 20 min · Poor when glove material degrades For general applications, gloves with a thickness typically greater than 0.35 mm, are recommended. It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times. Glove thickness may also vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers technical data should always be taken into account to ensure selection of the most appropriate glove for the task. Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example: · Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are only likely to give short duration protection and would normally be just for single use applications, then disposed of. · Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is abrasion or puncture potential 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.
Body protection	See Other protection below
Other protection	‣ Overalls. ‣ PVC Apron. ‣ PVC protective suit may be required if exposure severe. ‣ Eyewash unit. ‣ Ensure there is ready access to a safety shower. ‣ 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. Electrical resistance must range between 0 to 500,000 ohms. Conductive shoes should be stored in lockers close to the room in which they are worn. Personnel who have been issued conductive footwear should not wear them from their place of work to their homes and return.

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:
Perfluoro-n-nonanoic acid (PFNA)

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

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 5 x ES	AX-AUS / Class 1	-	AX-PAPR-AUS / Class 1
up to 25 x ES	Air-line*	AX-2	AX-PAPR-2
up to 50 x ES	-	AX-3	-
50+ x ES	-	Air-line**	-

* - Continuous-flow; ** - Continuous-flow or positive pressure demand
^ - 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,

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.

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

Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Required minimum protection factor	Maximum gas/vapour concentration present in air p.p.m. (by volume)	Half-face Respirator	Full-Face Respirator
up to 10	1000	AX-AUS / Class 1	-
up to 50	1000	-	AX-AUS / Class 1
up to 50	5000	Airline *	-
up to 100	5000	-	AX-2
up to 100	10000	-	AX-3
100+		-	Airline**

** - Continuous-flow or positive pressure demand.
A(All classes) = Organic vapours, B AUS or B1 = Acid gases, 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 deg C)

8.2.3. Environmental exposure controls

See section 12

SECTION 9 Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	Clear/Colourless with Characteristic Odour

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

Nanoform Solubility	Not Available	**Nanoform Particle Characteristics**	Not Available
Particle Size	Not Available		

9.2. Other information

Not Available

SECTION 10 Stability and reactivity

10.1.Reactivity	See section 7.2
10.2. 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.
10.3. Possibility of hazardous reactions	See section 7.2
10.4. Conditions to avoid	See section 7.2
10.5. Incompatible materials	See section 7.2
10.6. Hazardous decomposition products	See section 5.3

SECTION 11 Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Inhaled	Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects. The material is not thought to produce respiratory irritation (as classified by EC Directives using animal models). Nevertheless inhalation of vapours, fumes or aerosols, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress. 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. 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*]
Ingestion	**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. Methanol may produce a burning or painful sensation in the mouth, throat, chest, and stomach. This may be accompanied by nausea, vomiting, headache, dizziness, shortness of breath, weakness, fatigue, leg cramps, restlessness, confusion, drunken behaviour, visual disturbance, drowsiness, coma and death. 60-200 ml of methanol is a fatal dose for most adults with as little as 10 ml producing blindness. In massive overdose, liver, kidney, heart and muscle injury have been described. Even ingestion of small amounts of methanol is enough to seriously damage parts of the central nervous system, leading to permanent brain and/or nerve problems. 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. 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. There is some evidence to suggest that the material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.
Eye	Methanol is a mild to moderate eye irritant. High vapor concentration or liquid contact with eyes causes irritation, tearing, and burning. Direct contact of the eye with ethanol may cause immediate stinging and burning with reflex closure of the lid and tearing, transient injury of the corneal epithelium and hyperaemia of the conjunctiva. 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	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed. This material can cause serious damage if one is exposed to it for long periods. It can be assumed that it contains a substance which can produce severe defects. 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.

Perfluoro-n-nonanoic acid (PFNA)	**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: 64000 ppm4h[2]	Eye (rabbit): 40 mg-moderate
	Oral (Rat) LD50: 5628 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]
Perfluoro-n-nonanoic acid	**TOXICITY**	**IRRITATION**
	Not Available	Not Available
water	**TOXICITY**	**IRRITATION**
	Oral (Rat) LD50: >90000 mg/kg[2]	Not Available
sodium hydroxide	**TOXICITY**	**IRRITATION**
	Dermal (rabbit) LD50: 1350 mg/kg[2]	Eye (rabbit): 0.05 mg/24h SEVERE
	Oral (Rabbit) LD50; 325 mg/kg[1]	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. 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. On the other hand, industrial bronchitis is a disorder that occurs as a result of exposure due to high concentrations of irritating substance (often particles) and is completely reversible after exposure ceases. The disorder is characterized by difficulty breathing, cough and mucus production. 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*

11.2 Information on other hazards

11.2.1. Endocrine disrupting properties

No evidence of endocrine disrupting properties were found in the current literature.

11.2.2. Other information

See Section 11.1

SECTION 12 Ecological information

12.1. Toxicity

Perfluoro-n-nonanoic acid (PFNA)

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
EC50	48h	Crustacea	>10000mg/l	2
EC50	96h	Algae or other aquatic plants	14.11-20.623mg/l	4
NOEC(ECx)	720h	Fish	0.007mg/L	4
LC50	96h	Fish	290mg/l	2

Perfluoro-n-nonanoic acid

Endpoint	Test Duration (hr)	Species	Value	Source
EC50	48h	Crustacea	21.812-32.486mg/L	4
EC50	72h	Algae or other aquatic plants	129.942mg/L	4
NOEC(ECx)	504h	Crustacea	0.008mg/l	4

water

Endpoint	Test Duration (hr)	Species	Value	Source
Not Available	Not Available	Not Available	Not Available	Not Available

sodium hydroxide

Endpoint	Test Duration (hr)	Species	Value	Source
EC50	48h	Crustacea	34.59-47.13mg/l	4
EC50(ECx)	48h	Crustacea	34.59-47.13mg/l	4
LC50	96h	Fish	144-267mg/l	4

Legend: *Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 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*

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. Evaporation of methanol from moist/dry soil surfaces is expected to be an important fate process. Biological breakdown in soil is expected to be an important fate process for methanol based on half-lives of 1 day, in sandy silt loam, and 3.2 days in sandy loam.
Aquatic Fate: Methanol is not expected to adsorb to suspended solids and sediment and the substance mixes in water. The substance is expected to evaporate from water surfaces with half-lives, for a model river, of 3 days, and 35 days, for a model lake. Concentration of the substance in aquatic organisms is expected to be low. Breakdown by water and sunlight are not expected to be an important environmental fate processes. The substance is expected to be broken down by microorganisms in water.
Ecotoxicity: Methanol is non-toxic to fish, including fathead minnow, rainbow trout, bluegill sunfish, and guppy. The substance is also non-toxic to aquatic invertebrates, including Daphnia pulex water fleas, brine and brown shrimp. The substances are non-toxic to shellfish, including mussels, marine bacterium, including Photobacterium phosphoreum, and the protozoan Tetrahymena pyriformis.

DO NOT discharge into sewer or waterways.

12.2. Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air

Ingredient	Persistence: Water/Soil	Persistence: Air
methanol	LOW	LOW
Perfluoro-n-nonanoic acid	HIGH	HIGH
water	LOW	LOW
sodium hydroxide	LOW	LOW

12.3. Bioaccumulative potential

Ingredient	Bioaccumulation
methanol	LOW (BCF = 10)
Perfluoro-n-nonanoic acid	LOW (LogKOW = 7.2652)
sodium hydroxide	LOW (LogKOW = -3.8796)

12.4. Mobility in soil

Ingredient	Mobility
methanol	HIGH (KOC = 1)
Perfluoro-n-nonanoic acid	LOW (KOC = 123000)
sodium hydroxide	LOW (KOC = 14.3)

12.5. Results of PBT and vPvB assessment

	P	B	T
Relevant available data	Not Available	Not Available	Not Available
PBT	✗	✗	✗
vPvB	✗	✗	✗

PBT Criteria fulfilled?	No
vPvB	No

12.6. Endocrine disrupting properties

No evidence of endocrine disrupting properties were found in the current literature.

12.7. Other adverse effects

No evidence of ozone depleting properties were found in the current literature.

SECTION 13 Disposal considerations

13.1. 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. 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. ▸ 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. Observe all label safeguards until containers are cleaned and destroyed.
Waste treatment options	Not Available
Sewage disposal options	Not Available

SECTION 14 Transport information

Labels Required

	
Marine Pollutant	NO

Land transport (ADR-RID)

14.1. **UN number or ID number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	Class: 3 Subsidiary Hazard: 6.1
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	Hazard identification (Kemler): 336 Classification code: FT1 Hazard Label: 3 +6.1 Special provisions: 279 Limited quantity: 1 L Tunnel Restriction Code: D/E

Air transport (ICAO-IATA / DGR)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	Methanol
14.3. **Transport hazard class(es)**	ICAO/IATA Class: 3 ICAO / IATA Subsidiary Hazard: 6.1 ERG Code: 3L
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **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)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	IMDG Class: 3 IMDG Subsidiary Hazard: 6.1
14.4. **Packing group**	II
14.5 **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	EMS Number: F-E , S-D Special provisions: 279 Limited Quantities: 1 L

Inland waterways transport (ADN)

14.1. **UN number**	1230
14.2. **UN proper shipping name**	METHANOL
14.3. **Transport hazard class(es)**	3 | 6.1
14.4. **Packing group**	II
14.5. **Environmental hazard**	Not Applicable
14.6. **Special precautions for user**	Classification code: FT1 Special provisions: 279; 802 Limited quantity: 1 L Equipment required: PP, EP, EX, TOX, A Fire cones number: 2

14.7. Maritime transport in bulk according to IMO instruments

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

Not Applicable

14.7.2. Transport in bulk in accordance with MARPOL Annex V and the IMSBC Code

Product name	Group
methanol	Not Available
Perfluoro-n-nonanoic acid	Not Available
water	Not Available
sodium hydroxide	Not Available

14.7.3. Transport in bulk in accordance with the IGC Code

Product name	Ship Type
methanol	Not Available
Perfluoro-n-nonanoic acid	Not Available
water	Not Available
sodium hydroxide	Not Available

SECTION 15 Regulatory information

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

methanol is found on the following regulatory lists

Chemical Footprint Project - Chemicals of High Concern List

EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)
EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances
EU REACH Regulation (EC) No 1907/2006 - Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles
Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)
European Union (EU) Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures - Annex VI
Sweden Swedish Chemicals Agency (KEMI) Restricted Substances Database

Perfluoro-n-nonanoic acid is found on the following regulatory lists

Chemical Footprint Project - Chemicals of High Concern List
EU REACH Regula\tion (EC) No 1907/2006 - Annex XVII (Appendix 6) Reproductive toxicants: Category 1 B
EU REACH Regulation (EC) No 1907/2006 - Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles
EU REACH Regulation (EC) No 1907/2006 - Proposals to identify Substances of Very High Concern: Annex XV reports for commenting by Interested Parties previous consultation
Europe EC Inventory
Europe European Chemicals Agency (ECHA) Candidate List of Substances of Very High Concern for Authorisation
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)
European Union (EU) Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures - Annex VI
Sweden Swedish Chemicals Agency (KEMI) Restricted Substances Database

water is found on the following regulatory lists

Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)

sodium hydroxide is found on the following regulatory lists

Europe EC Inventory
European Union - European Inventory of Existing Commercial Chemical Substances (EINECS)
European Union (EU) Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures - Annex VI

Additional Regulatory Information

Not Applicable

This safety data sheet is in compliance with the following EU legislation and its adaptations - as far as applicable - : Directives 98/24/EC, - 92/85/EEC, - 94/33/EC, - 2008/98/EC, - 2010/75/EU; Commission Regulation (EU) 2020/878; Regulation (EC) No 1272/2008 as updated through ATPs.

Information according to 2012/18/EU (Seveso III):

Seveso Category	H2, H3, P5a, P5b, P5c

15.2. Chemical safety assessment

No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

National Inventory Status

National Inventory	Status
Australia - AIIC / Australia Non-Industrial Use	No (Perfluoro-n-nonanoic acid)
Canada - DSL	No (Perfluoro-n-nonanoic acid)
Canada - NDSL	No (methanol; Perfluoro-n-nonanoic acid; water; sodium hydroxide)
China - IECSC	No (Perfluoro-n-nonanoic acid)
Europe - EINEC / ELINCS / NLP	Yes
Japan - ENCS	Yes
Korea - KECI	No (Perfluoro-n-nonanoic acid)
New Zealand - NZIoC	No (Perfluoro-n-nonanoic acid)
Philippines - PICCS	No (Perfluoro-n-nonanoic acid)
USA - TSCA	Yes
Taiwan - TCSI	Yes
Mexico - INSQ	No (Perfluoro-n-nonanoic acid)
Vietnam - NCI	Yes

National Inventory	Status
Russia - FBEPH	Yes
Legend:	*Yes = All CAS declared ingredients are on the inventory* *No = One or more of the CAS listed ingredients are not on the inventory. These ingredients may be exempt or will require registration.*

SECTION 16 Other information

Revision Date	20/10/2023
Initial Date	27/09/2017

Full text Risk and Hazard codes

H314	Causes severe skin burns and eye damage.

SDS Version Summary

Version	Date of Update	Sections Updated
7.10	20/10/2023	Hazards identification - Classification, Composition / information on ingredients - Ingredients, Accidental release measures - Spills (major)

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.

For detailed advice on Personal Protective Equipment, refer to the following EU CEN Standards:
EN 166 Personal eye-protection
EN 340 Protective clothing
EN 374 Protective gloves against chemicals and micro-organisms
EN 13832 Footwear protecting against chemicals
EN 133 Respiratory protective devices

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
- ES: Exposure Standard
- 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
- DNEL: Derived No-Effect Level
- PNEC: Predicted no-effect concentration

- AIIC: Australian Inventory of Industrial Chemicals
- DSL: Domestic Substances List
- NDSL: Non-Domestic Substances List
- IECSC: Inventory of Existing Chemical Substance in China
- EINECS: European INventory of Existing Commercial chemical Substances
- ELINCS: European List of Notified Chemical Substances
- NLP: No-Longer Polymers
- ENCS: Existing and New Chemical Substances Inventory
- KECI: Korea Existing Chemicals Inventory

- NZIoC: New Zealand Inventory of Chemicals
- PICCS: Philippine Inventory of Chemicals and Chemical Substances
- TSCA: Toxic Substances Control Act
- TCSI: Taiwan Chemical Substance Inventory
- INSQ: Inventario Nacional de Sustancias Químicas
- NCI: National Chemical Inventory
- FBEPH: Russian Register of Potentially Hazardous Chemical and Biological Substances

Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 [CLP]

Classification according to regulation (EC) No 1272/2008 [CLP] and amendments	Classification Procedure
Flammable Liquids Category 2, H225	On basis of test data
Acute Toxicity (Oral) Category 3, H301	On basis of test data
Acute Toxicity (Dermal) Category 3, H311	On basis of test data
Acute Toxicity (Inhalation) Category 3, H331	On basis of test data
Specific Target Organ Toxicity - Single Exposure Category 1, H370	Minimum classification

Powered by AuthorITe, from Chemwatch.

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluorononanesulfonic Acid (sodium salt)**

· **Article number:** 38908
· **CAS Number:**
98789-57-2
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS06 Skull and crossbones

Acute Toxicity - Oral 3 H301 Toxic if swallowed.


GHS09 Environment

Aquatic Chronic 2 H411 Toxic to aquatic life with long lasting effects.


GHS07

Acute Toxicity - Inhalation 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)

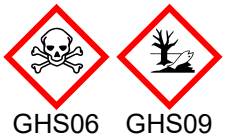
Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 1)

· **Hazard pictograms**



GHS06 GHS09

· **Signal word** Danger
· **Hazard statements**
H301 Toxic if swallowed.
H332 Harmful if inhaled.
H411 Toxic to aquatic life with long lasting effects.
· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P301+P310	If swallowed: Immediately call a poison center/doctor.
P321	Specific treatment (see on this label).
P330	Rinse mouth.
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P312	Call a poison center/doctor if you feel unwell.
P391	Collect spillage.
P405	Store locked up.
P501	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 = 2
Fire = 0
Reactivity = 0

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
98789-57-2 Perfluorononanesulfonic Acid (sodium salt)

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 2)

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
In case of irregular breathing or respiratory arrest provide artificial respiration.
· **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:** 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:**
Use fire fighting measures that suit the environment.
A solid water stream may be inefficient.
· **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** Not required.
· **Environmental precautions:**
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:**
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 3)

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
· **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:**
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.
· **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:** Not required.

9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**
Form: Solid

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 4)

Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C9F19O3S • Na
· **Molecular Weight**	572.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **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.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 5)

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** No irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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.
· **Ecotoxical effects:**
· **Remark:** Toxic for fish
· **Additional ecological information:**
· **General notes:**
Water hazard class 3 (Self-assessment): extremely hazardous for water
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
Toxic for aquatic organisms
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 6)

14 Transport information

· **UN-Number**
· **DOT, IMDG, IATA** UN3288

· **UN proper shipping name**
· **DOT, IATA** Toxic solid, inorganic, n.o.s. (Perfluorononanesulfonic Acid (sodium salt))
· **IMDG** TOXIC SOLID, INORGANIC, N.O.S. (Perfluorononanesulfonic Acid (sodium salt))

· **Transport hazard class(es)**

· **DOT**



· **Class** 6.1 Toxic substances
· **Label** 6.1

· **IMDG, IATA**



· **Class** 6.1 Toxic substances
· **Label** 6.1

· **Packing group**
· **DOT, IMDG, IATA** III

· **Environmental hazards:** Environmentally hazardous substance, solid

· **Special precautions for user** Warning: Toxic substances
· **Hazard identification number (Kemler code):** 60
· **EMS Number:** F-A,S-A
· **Stowage Category** A

· **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: 100 kg
On cargo aircraft only: 200 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

· **IATA**
· **Remarks:** When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 7)

·	Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.
· **UN "Model Regulation":**	UN 3288 TOXIC SOLID, INORGANIC, N.O.S. (PERFLUORONONANESULFONIC ACID (SODIUM SALT)), 6.1, III, ENVIRONMENTALLY HAZARDOUS

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 05/05/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
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

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Printing date 05/05/2023 Revision date 05/05/2023

Trade name: Perfluorononanesulfonic Acid (sodium salt)

(Contd. from page 8)

Acute Toxicity - Oral 3: Acute toxicity – Category 3
Acute Toxicity - Inhalation 4: Acute toxicity – Category 4
Aquatic Chronic 2: Hazardous to the aquatic environment - long-term aquatic hazard – Category 2

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**



GHS05 GHS07 GHS08

· **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

Trade name: Perfluorooctanoic Acid (PFOA)

(Contd. of page 2)

· **vPvB:** Not applicable.

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)

(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)

(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)

(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

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)

Safety Data Sheet
acc. to OSHA HCS

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

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 04/01/2019 Version Number 2 Reviewed on 04/01/2019

*
1 Identification

· **Product identifier**

· **Trade name: PFOA/PFOS Standard (1X1 mL)**

· **Part number:** PFM-100-1
· **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**


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. 1B H360 May damage fertility or the unborn child.
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
perfluorooctanoic acid (PFOA)
perfluorooctane sulfonic acid (PFOS)

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 04/01/2019 Version Number 2 Reviewed on 04/01/2019

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 1)

· **Hazard statements**
Highly flammable liquid and vapor.
Toxic if inhaled.
Suspected of causing cancer.
May damage fertility or the unborn child.
Causes damage to organs.
· **Precautionary statements**
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
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 on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
IF exposed or concerned: Get medical advice/attention.
Specific treatment (see on this label).
In case of fire: Use for extinction: CO2, powder or water spray.
Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.
Dispose of contents/container in accordance with local/regional/national/international regulations.
· **Classification system:**
· **NFPA ratings (scale 0 - 4)**



Health = 1
Fire = 3
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = *1
Fire = 3
Reactivity = 0

· **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.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 2)

· **Dangerous components:**		
67-56-1	methanol	99.747%
335-67-1	perfluorooctanoic acid (PFOA)	0.126%
1763-23-1	perfluorooctane sulfonic acid (PFOS)	0.126%

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:** If symptoms persist consult 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:**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **For safety reasons unsuitable extinguishing agents:** Water with full jet
· **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:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
· **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.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 3)

· **Protective Action Criteria for Chemicals**

· **PAC-1:**		
67-56-1	methanol	530 ppm
335-67-1	perfluorooctanoic acid (PFOA)	1.1 mg/m³

· **PAC-2:**		
67-56-1	methanol	2,100 ppm
335-67-1	perfluorooctanoic acid (PFOA)	12 mg/m³

· **PAC-3:**		
67-56-1	methanol	7200* ppm
335-67-1	perfluorooctanoic acid (PFOA)	75 mg/m³

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:**	
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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 4)

· **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.
· **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.
· **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
· **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:	Fluid
Color:	Colorless
· **Odor:**	Alcohol-like
· **Odor threshold:**	Not determined.
· **pH-value:**	Not determined.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 5)

· **Change in condition**	
Melting point/Melting range:	-98 °C (-144.4 °F)
Boiling point/Boiling range:	64.7 °C (148.5 °F)
· **Flash point:**	9 °C (48.2 °F)
· **Flammability (solid, gaseous):**	Not applicable.
· **Ignition temperature:**	455 °C (851 °F)
· **Decomposition temperature:**	Not determined.
· **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 Vol %
· **Vapor pressure at 20 °C (68 °F):**	100 hPa (75 mm Hg)
· **Density at 20 °C (68 °F):**	0.8007 g/cm³ (6.68184 lbs/gal)
· **Relative density**	Not determined.
· **Vapor density**	Not determined.
· **Evaporation rate**	Not determined.
· **Solubility in / Miscibility with**	
Water:	Not miscible or difficult to mix.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **Solvent content:**	
Organic solvents:	99.7 %
VOC content:	99.75 % 798.7 g/l / 6.67 lb/gal
Solids content:	0.3 %
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 6)

11 Toxicological information

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

· **LD/LC50 values that are relevant for classification:**		
ATE (Acute Toxicity Estimate)		
Inhalative	LC50/4 h	3.01 mg/L

67-56-1 methanol		
Oral	LD50	5,628 mg/kg (rat)
Dermal	LD50	15,800 mg/kg (rabbit)
1763-23-1 perfluorooctane sulfonic acid (PFOS)		
Oral	LD50	154 mg/kg (rat)

· **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)**		
335-67-1	perfluorooctanoic acid (PFOA)	2B

· **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 2 (Self-assessment): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 7)

· **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

· **Not Regulated, De minimus Quantities**	-
· **UN-Number** · **DOT, IMDG, IATA**	UN1230
· **UN proper shipping name** · **DOT** · **IMDG, IATA**	Methanol solution METHANOL solution
· **Transport hazard class(es)**	
· **DOT**	
· **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, IMDG, IATA**	II
· **Environmental hazards:**	Not applicable.

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 8)

· **Special precautions for user**	Warning: Flammable liquids
· **Danger code (Kemler):**	336
· **EMS Number:**	F-E,S-D
· **Stowage Category**	B
· **Stowage Code**	SW2 Clear of living quarters.
· **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: 1 L On cargo aircraft only: 60 L
· **IMDG**	
· **Limited quantities (LQ)**	1L
· **Excepted quantities (EQ)**	Code: E2 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 500 ml
· **UN "Model Regulation":**	UN 1230 METHANOL SOLUTION, 3 (6.1), II

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.

· **TSCA new (21st Century Act): (Substances not listed)**

1763-23-1	perfluorooctane sulfonic acid (PFOS)

· **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:**
All ingredients are listed.

(Contd. on page 10)

Safety Data Sheet
acc. to OSHA HCS

Trade name: PFOA/PFOS Standard (1X1 mL)

(Contd. of page 9)

· **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.

· **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** 04/01/2019 / 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
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. 1B: Reproductive toxicity – Category 1B
STOT SE 1: Specific target organ toxicity (single exposure) – Category 1

· *** Data compared to the previous version altered.**

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluorooctanesulfonamide**
· **Synonym**

· **Article number:** 37258
· **CAS Number:**
754-91-6
· **EC number:**
212-046-0
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS06 Skull and crossbones

Acute Toxicity - Oral 3 — H301 Toxic if swallowed.


GHS09 Environment

Aquatic Acute 1 — H400 Very toxic to aquatic life.
Aquatic Chronic 1 — H410 Very toxic to aquatic life with long lasting effects.


GHS07

Skin Irritation 2 — H315 Causes skin irritation.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 1)

Eye Irritation 2A	H319 Causes serious eye irritation.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS06 GHS07 GHS09

· **Signal word** Danger
· **Hazard statements**
H301 Toxic if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
H410 Very toxic to aquatic life with long lasting effects.
· **Precautionary statements**

P261	Avoid breathing dust/fume/gas/mist/vapors/spray
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear eye protection / face protection.
P301+P310	If swallowed: Immediately call a poison center/doctor.
P321	Specific treatment (see on this label).
P330	Rinse mouth.
P302+P352	If on skin: Wash with plenty of 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/doctor if you feel unwell.
P362+P364	Take off contaminated clothing and wash it before reuse.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P337+P313	If eye irritation persists: Get medical advice/attention.
P391	Collect spillage.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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



Health = 2
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 2
Fire = 0
Reactivity = 0

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 2)

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

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
754-91-6 Perfluorooctanesulfonamide
· **Identification number(s)**
· **EC number:** 212-046-0

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
In case of irregular breathing or respiratory arrest provide artificial respiration.
· **After inhalation:** 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. If symptoms persist, 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:**
Use fire fighting measures that suit the environment.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:**
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:**
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from 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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.
Take precautionary measures against static discharge.re.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
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

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

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 4)

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.

· **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:	Lyophilized powder lyophilized A solution in acetonitrile Solid material
Color:	White Not determined.
· **Odor:**	Characteristic
· **Odor threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not applicable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not determined.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not determined.
· **Evaporation rate**	Not applicable.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 5)

· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **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:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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.
· **Ecotoxical effects:**
· **Remark:** Very toxic for fish
· **Additional ecological information:**
· **General notes:**
Water hazard class 3 (Self-assessment): extremely hazardous for water
Do not allow product to reach ground water, water course or sewage system, even in small quantities.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 6)

Danger to drinking water if even extremely small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
Very toxic for aquatic organisms

· **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**	UN3288
· **UN proper shipping name**	
· **DOT, IATA**	Toxic solid, inorganic, n.o.s. (Perfluorooctanesulfonamide)
· **IMDG**	TOXIC SOLID, INORGANIC, N.O.S. (Perfluorooctanesulfonamide)
· **Transport hazard class(es)**	
· **DOT**	
· **Class**	6.1 Toxic substances
· **Label**	6.1
· **IMDG, IATA**	
· **Class**	6.1 Toxic substances
· **Label**	6.1
· **Packing group**	
· **DOT, IMDG, IATA**	III
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Warning: Toxic substances
· **Hazard identification number (Kemler code):**	60

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 7)

· **EMS Number:**	F-A,S-A
· **Stowage Category**	A
· **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: 100 kg On cargo aircraft only: 200 kg
· **IMDG**	
· **Limited quantities (LQ)**	5 kg
· **Excepted quantities (EQ)**	Code: E1 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 1000 ml
· **IATA**	
· **Remarks:**	When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10. Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.
· **UN "Model Regulation":**	UN 3288 TOXIC SOLID, INORGANIC, N.O.S. (PERFLUOROOCTANESULFONAMIDE), 6.1, III, ENVIRONMENTALLY HAZARDOUS

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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 not listed.
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes

(Contd. on page 9)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/16/2023 Revision date 11/16/2023

Trade name: Perfluorooctanesulfonamide

(Contd. from page 8)

no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 11/16/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 3: Acute toxicity – Category 3
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Irritation 2A: Serious eye damage/eye irritation – Category 2A
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
Aquatic Acute 1: Hazardous to the aquatic environment - acute aquatic hazard – Category 1
Aquatic Chronic 1: Hazardous to the aquatic environment - long-term aquatic hazard – Category 1

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluoropentanoic Acid**
· **Synonym** 2,2,3,3,4,4,5,5,5-nonafluoro-pentanoic acid

· **Article number:** 37254
· **CAS Number:**
2706-90-3
· **EC number:**
220-300-7
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS08 Health hazard

Toxic to Reproduction 2 H361 Suspected of damaging fertility or the unborn child.


GHS05 Corrosion

Skin Corrosion 1B H314 Causes severe skin burns and eye damage.
Eye Damage 1 H318 Causes serious eye damage.

· **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 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS08

· **Signal word** Danger
· **Hazard statements**
H314 Causes severe skin burns and eye damage.
H361 Suspected of damaging fertility or the unborn child.
· **Precautionary statements**

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dusts or mists.
P264	Wash thoroughly after handling.
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/doctor.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P321	Specific treatment (see on this label).
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	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.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
2706-90-3 Perfluoropentanoic Acid

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 2)

· **Identification number(s)**
· **EC number:** 220-300-7

4 First-aid measures

· **Description of first aid measures**
· **General information:** Immediately remove any clothing soiled by the product.
· **After inhalation:** 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:** Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 3)

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
No special precautions are necessary if used correctly.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.
Keep away from sources of ignition.
Take precautionary measures against static discharge.re.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.
· **Breathing equipment:** Not required.
· **Protection of hands:**



Protective gloves

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.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 4)

· **Eye protection:**



Tightly sealed goggles

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Liquid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C5HF9O2
· **Molecular Weight**	264 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not applicable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not determined.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor 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.
· **Other information**	No further relevant information available.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 5)

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:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 6)

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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 08/14/2023 Revision date 08/14/2023

Trade name: Perfluoropentanoic Acid

(Contd. from page 7)

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

16 Other information

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 08/14/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Toxic to Reproduction 2: Reproductive toxicity – Category 2

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluoropentanesulfonic Acid**
· **Synonym**

· **Article number:** 37253
· **CAS Number:**
2706-91-4
· **EC number:**
220-301-2
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS05 Corrosion

Skin Corrosion 1A	H314 Causes severe skin burns and eye damage.
Eye Damage 1	H318 Causes serious eye damage.


GHS07

Acute Toxicity - Oral 4	H302 Harmful if swallowed.
Specific Target Organ Toxicity - Single Exposure 3	H335 May cause respiratory irritation.

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

(Contd. on page 2)

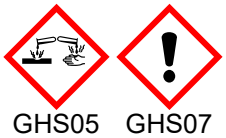
Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 1)

· **Hazard pictograms**



GHS05 GHS07

· **Signal word** Danger
· **Hazard statements**
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.
· **Precautionary statements**

P260	Do not breathe dusts or mists.
P264	Wash 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/doctor if you feel unwell.
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/doctor.
P321	Specific treatment (see 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 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.
· **vPvB:** Not applicable.

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 2)

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
2706-91-4 Perfluoropentanesulfonic Acid
· **Identification number(s)**
· **EC number:** 220-301-2

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:** 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:**
Immediately call a doctor.
Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
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 section 13.
Ensure adequate ventilation.
· **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.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 3)

· **Protective Action Criteria for Chemicals**
· **PAC-1:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** Thorough dedusting.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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.
Avoid contact with the eyes.
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

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.
· **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.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 4)

· **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
· **Structural Formula**	C5HF11O3S
· **Molecular Weight**	350.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	>300 °C (>572 °F)
Boiling point/Boiling range:	225 °C (437 °F)
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density at 20 °C (68 °F):**	1.844 g/cm³ (15.38818 lbs/gal)
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Other information**	No further relevant information available.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 5)

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:**
· **Primary irritant effect:**
· **on the skin:** Strong caustic effect on skin and mucous membranes.
· **on the eye:**
Strong caustic effect.
Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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 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.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 6)

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**	not regulated
· **UN proper shipping name** · **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	not regulated
· **Packing group** · **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.
· **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):** INACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** Substance is not listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)** Substance is not listed.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 11/28/2023 Revision date 11/28/2023

Trade name: Perfluoropentanesulfonic Acid

(Contd. from page 7)

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

16 Other information

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 11/28/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Oral 4: Acute toxicity – Category 4
Skin Corrosion 1A: Skin corrosion/irritation – Category 1A
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

1 Identification

· **Product identifier**

· **Trade name: Perfluorotetradecanoic Acid**
· **Synonym**

· **Article number:** 37255
· **CAS Number:**
376-06-7
· **EC number:**
206-803-4
· **Application of the substance / the mixture**
This product is for research use - Not for human or veterinary diagnostic or therapeutic use.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Cayman Chemical Co.
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108
USA

· **Information department:** Product safety department
· **Emergency telephone number:**
During normal opening times: +1 (734) 971-3335
US/CANADA: 800-424-9300
Outside US/CANADA: 703-741-5970

2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS08 Health hazard

Carcinogenicity 2	H351	Suspected of causing cancer.
Toxic to Reproduction 1B	H360-H362	May damage fertility or the unborn child. May cause harm to breast-fed children.
Specific Target Organ Toxicity - Repeated Exposure 1	H372	Causes damage to organs through prolonged or repeated exposure.


GHS05 Corrosion

Skin Corrosion 1B	H314	Causes severe skin burns and eye damage.

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 1)


GHS07

Acute Toxicity - Inhalation 4 H332 Harmful if inhaled.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS05 GHS07 GHS08

· **Signal word** Danger
· **Hazard statements**
H332 Harmful if inhaled.
H314 Causes severe skin burns and eye damage.
H351 Suspected of causing cancer.
H360-H362 May damage fertility or the unborn child. May cause harm to breast-fed children.
H372 Causes damage to organs through prolonged or repeated exposure.
· **Precautionary statements**
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe dusts or mists.
P263 Avoid contact during pregnancy/while nursing.
P264 Wash 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+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/doctor.
P308+P313 IF exposed or concerned: Get medical advice/attention.
P321 Specific treatment (see on this label).
P314 Get medical advice/attention if you feel unwell.
P363 Wash contaminated clothing before reuse.
P405 Store locked up.
P501 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

(Contd. on page 3)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 2)

· **HMIS-ratings (scale 0 - 4)**



Health = *3
Fire = 0
Reactivity = 0

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

· **vPvB:**	
376-06-7	Perfluorotetradecanoic Acid

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
376-06-7 Perfluorotetradecanoic Acid
· **Identification number(s)**
· **EC number:** 206-803-4

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
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:** 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:** Drink copious amounts of water and provide fresh air. 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.
A solid water stream may be inefficient.
· **Special hazards arising from the substance or mixture** No further relevant information available.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 3)

· **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 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 section 13.
Ensure adequate ventilation.
· **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:** Substance is not listed.
· **PAC-2:** Substance is not listed.
· **PAC-3:** Substance is not listed.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store in accordance with information listed on the product insert.
· **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 section 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 and skin.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 4)

· **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

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.
· **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:	A low melting solid
Color:	Not determined.
· **Odor:**	Characteristic
· **Structural Formula**	C14HF27O2
· **Molecular Weight**	714.1 g/mol
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Decomposition temperature:**	Not determined.
· **Ignition temperature:**	Not determined.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.

(Contd. on page 6)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 5)

Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with Water:**	Not determined.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **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:**
· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:** Strong caustic effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

· **Carcinogenic categories**
· **IARC (International Agency for Research on Cancer)** Substance is not listed.
· **NTP (National Toxicology Program)** Substance is not listed.
· **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.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 6)

· **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 (Self-assessment): 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:**	
376-06-7	Perfluorotetradecanoic Acid

· **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**	not regulated
· **UN proper shipping name**	
· **DOT, IMDG, IATA**	not regulated
· **Transport hazard class(es)**	
· **DOT, ADN, IMDG, IATA**	
· **Class**	not regulated
· **Packing group**	
· **DOT, IMDG, IATA**	not regulated
· **Environmental hazards:**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	not regulated

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
No further relevant information available.

(Contd. on page 8)

Safety Data Sheet
acc. to OSHA HCS

Printing date 09/26/2023 Revision date 09/26/2023

Trade name: Perfluorotetradecanoic Acid

(Contd. from page 7)

· **Sara**
· **Section 355 (extremely hazardous substances):** Substance is not listed.
· **Section 313 (Specific toxic chemical listings):** Substance is listed.
· **TSCA (Toxic Substances Control Act):** ACTIVE
· **Hazardous Air Pollutants** Substance is not listed.
· **Proposition 65**
· **Chemicals known to cause cancer:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for females:** Substance is not listed.
· **Chemicals known to cause reproductive toxicity for males:** Substance is not listed.
· **Chemicals known to cause developmental toxicity:** Substance is not listed.

· **Carcinogenic categories**
· **EPA (Environmental Protection Agency)** Substance is not listed.
· **TLV (Threshold Limit Value)** 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

All chemicals may pose unknown hazards and should be used with caution. This SDS applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. Cayman Chemical Company assumes no responsibility for incidental or consequential damages, including lost profits, arising from the use of these data. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Cayman Chemical Company assumes no responsibility for the completeness or accuracy of the information contained herein.

· **Department issuing SDS:** Environment protection department.
· **Contact:** -
· **Date of preparation / last revision** 09/26/2023
· **Abbreviations and acronyms:**
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
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)
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 Toxicity - Inhalation 4: Acute toxicity – Category 4
Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Carcinogenicity 2: Carcinogenicity – Category 2
Toxic to Reproduction 1B: Reproductive toxicity – Category 1B
Specific Target Organ Toxicity - Repeated Exposure 1: Specific target organ toxicity (repeated exposure) – Category 1

SAFETY DATA SHEET

Version 6.3
Revision Date 10/27/2021
Print Date 10/05/2024

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

1.1 Product identifiers

Product name : Perfluorotridecanoic acid

Product Number : 654973
Brand : Aldrich
CAS-No. : 72629-94-8

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 4), H332
Carcinogenicity (Category 2), H351
Reproductive toxicity (Category 1B), H360
Effects on or via lactation, H362
Specific target organ toxicity - repeated exposure (Category 1), Liver, H372

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Hazard statement(s)

H302 + H332	Harmful if swallowed or if inhaled.
H351	Suspected of causing cancer.
H360	May damage fertility or the unborn child.
H362	May cause harm to breast-fed children.
H372	Causes damage to organs (Liver) through prolonged or repeated exposure.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
P263	Avoid contact during pregnancy/ while nursing.
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 + P330	IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	$C_{13}HF_{25}O_2$
Molecular weight	:	664.11 g/mol
CAS-No.	:	72629-94-8
EC-No.	:	276-745-2

Component	Classification	Concentration
Perfluorotridecanoic acid		
	Acute Tox. 4; Carc. 2; Repr. 1B; Lact. ; STOT RE 1; H302, H332, H351, H360, H362, H372	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Immediately call in physician. If breathing stops: immediately apply artificial respiration, if necessary also oxygen.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
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
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water Foam Carbon dioxide (CO2) Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Nature of decomposition products not known.
Combustible.
Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Avoid generation and inhalation of dusts in all circumstances. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry. Keep in a well-ventilated place. Keep locked up or in an area accessible only to qualified or authorized persons.

Storage class
Storage class (TRGS 510): 6.1C: Combustible, acute toxic Cat.3 / toxic compounds or compounds which causing chronic effects

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

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). Safety glasses

Skin protection
Handle with impervious gloves.

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 112 - 123 °C (234 - 253 °F) - lit.
f)	Initial boiling point and boiling range	No data available
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid,	No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

	gas)	
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Density	No data available
	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Autoignition 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

SECTION 10: Stability and reactivity

10.1 Reactivity
The following applies in general to flammable organic substances and mixtures: in correspondingly fine distribution, when whirled up a dust explosion potential may generally be assumed.

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
no information available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
In the event of fire: see section 5

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
Acute toxicity estimate Oral - 500.1 mg/kg
(Expert judgment)
Acute toxicity estimate Inhalation - 4 h - 11.1 mg/l - vapor

(Expert judgment)
Dermal: No data available
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
No data available
No data available

Carcinogenicity
Suspected of causing cancer.

IARC:	No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
NTP:	No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
May damage the unborn child.
Studies indicating a hazard to babies during the lactation period

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Causes damage to organs through prolonged or repeated exposure. - Liver

Aspiration hazard
No data available

11.2 Additional Information

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

After absorption:

gastric pain
Nausea
Vomiting

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Drowsiness
somnolence

Handle in accordance with good industrial hygiene and safety practice.

SECTION 12: Ecological information

12.1 Toxicity

No data available

Toxicity to daphnia and other aquatic invertebrates	Remarks: No data available (Perfluorotridecanoic acid)
Toxicity to algae	Remarks: No data available (Perfluorotridecanoic acid)

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

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

Discharge into the environment must be avoided.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)

Not dangerous goods

IMDG

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Not dangerous goods

IATA
Not dangerous goods

Further information
Not classified as dangerous in the meaning of transport regulations.

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
No SARA Hazards

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

Perfluorotridecanoic acid	CAS-No. 72629-94-8	Revision Date

New Jersey Right To Know Components

Perfluorotridecanoic acid	CAS-No. 72629-94-8	Revision Date

SECTION 16: Other information

Further 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. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.3 Revision Date: 10/27/2021 Print Date: 10/05/2024

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SAFETY DATA SHEET

Version 6.8
Revision Date 09/07/2024
Print Date 09/08/2024

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

1.1 Product identifiers

Product name : Perfluoroundecanoic acid

Product Number : 446777
Brand : Aldrich
CAS-No. : 2058-94-8

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

Identified uses : Laboratory chemicals, Synthesis of substances

Uses advised against : The product is being supplied under the TSCA R&D Exemption (40 CFR Section 720.36). It is the recipient's responsibility to comply with the requirements of the R&D exemption. The product may not be used for a non-exempt commercial purpose under TSCA unless appropriate consent is granted in writing by MilliporeSigma.

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 4), H332
Serious eye damage (Category 1), H318
Carcinogenicity (Category 2), H351

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Reproductive toxicity (Category 1B), H360
Effects on or via lactation, H362
Specific target organ toxicity - repeated exposure (Category 1), Liver, H372

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal Word Danger

Hazard Statements

H302 + H332	Harmful if swallowed or if inhaled.
H318	Causes serious eye damage.
H351	Suspected of causing cancer.
H360	May damage fertility or the unborn child.
H362	May cause harm to breast-fed children.
H372	Causes damage to organs (Liver) through prolonged or repeated exposure.

Precautionary Statements

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust.
P263	Avoid contact during pregnancy/ while nursing.
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 + P330	IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
P305 + P351 + P338 + P310	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.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	$C_{11}HF_{21}O_2$
Molecular weight	:	564.09 g/mol
CAS-No.	:	2058-94-8

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

EC-No. : 218-165-4

Component	Classification	Concentration
Henicosafluoroundecanoic acid		
	Acute Tox. 4; Eye Dam. 1; Carc. 2; Repr. 1B; Lact. ; STOT RE 1; H302, H332, H318, H351, H360, H362, H372	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Immediately call in physician. If breathing stops: immediately apply artificial respiration, if necessary also oxygen.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Immediately call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
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
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water Foam Carbon dioxide (CO2) Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

5.2 Special hazards arising from the substance or mixture

Carbon oxides
Hydrogen fluoride
Combustible.
Vapors are heavier than air and may spread along floors.
Forms explosive mixtures with air on intense heating.
Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters

Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information

Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Avoid generation and inhalation of dusts in all circumstances. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry. Keep in a well-ventilated place. Keep locked up or in an area accessible only to qualified or authorized persons.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Storage class
Storage class (TRGS 510): 6.1C: Combustible, acute toxic Cat.3 / toxic compounds or compounds which causing chronic effects

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

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). Tightly fitting safety goggles

Skin protection
Handle with impervious gloves.

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN 16523-1 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
Recommended Filter type: Filter type P3

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

The entrepeneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/ range: 96 - 101 °C (205 - 214 °F) - lit.
f)	Initial boiling point and boiling range	160 °C 320 °F at 80 hPa - lit.
g)	Flash point	113 °C (235 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Density	No data available
	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Autoignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

s) Explosive properties No data available

t) Oxidizing properties none

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

Forms explosive mixtures with air on intense heating.
A range from approx. 15 Kelvin below the flash point is to be rated as critical.
The following applies in general to flammable organic substances and mixtures: in correspondingly fine distribution, when whirled up a dust explosion potential may generally be assumed.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Violent reactions possible with:
Oxidizing agents

10.4 Conditions to avoid

Strong heating.

10.5 Incompatible materials

No data available

10.6 Hazardous decomposition products

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute toxicity estimate Oral - 500.1 mg/kg
(Expert judgment)
Acute toxicity estimate Inhalation - 4 h - 11.1 mg/l - vapor

(Expert judgment)
Dermal: No data available

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

Remarks: Causes serious eye damage.

Respiratory or skin sensitization

No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Germ cell mutagenicity
No data available

Carcinogenicity
Suspected of causing cancer.

IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
May damage the unborn child.
Studies indicating a hazard to babies during the lactation period

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Causes damage to organs through prolonged or repeated exposure.
- Liver

Aspiration hazard
No data available

11.2 Additional Information

After absorption:

gastric pain
Nausea
Vomiting
Drowsiness
somnolence

Handle in accordance with good industrial hygiene and safety practice.

SECTION 12: Ecological information

12.1 Toxicity

No data available

Toxicity to daphnia and other aquatic invertebrates	Remarks: No data available (Henicosafluoroundecanoic acid)
Toxicity to algae	Remarks: No data available (Henicosafluoroundecanoic acid)
Toxicity to daphnia and other aquatic	Remarks: No data available (Henicosafluoroundecanoic acid)

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

invertebrates(Chronic toxicity)

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
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties
No data available

12.7 Other adverse effects
Discharge into the environment must be avoided.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

SECTION 14: Transport information

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

Further information
Not classified as dangerous in the meaning of transport regulations.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 15: Regulatory information

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 302 Extremely Hazardous Substances Threshold Planning Quantity

This material does not contain any components with a section 302 EHS TPQ.

SARA 311/312 Hazards : Acute Health Hazard

SARA 313 : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

US State Regulations

Massachusetts Right To Know

No components are subject to the Massachusetts Right to Know Act.

Maine Chemicals of High Concern

Product does not contain any listed chemicals

Vermont Chemicals of High Concern

Product does not contain any listed chemicals

Washington Chemicals of High Concern

Product does not contain any listed chemicals

The ingredients of this product are reported in the following inventories:

TSCA : Product contains substance(s) not listed on TSCA inventory.

TSCA list

No substances are subject to a Significant New Use Rule.

No substances are subject to TSCA 12(b) export notification requirements.

SECTION 16: Other information

Further information

The information is believed to be correct but is not exhaustive and will be used solely as a guideline, which is based on current knowledge of the chemical substance or mixture and is applicable to appropriate safety precautions for the product. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.
Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.
Version: 6.8 Revision Date: 09/07/2024 Print Date: 09/08/2024

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

APPENDIX F

JOBSITE SAFETY INSPECTION CHECKLIST

Job Safety Inspection Checklist
Health & Safety

LANGAN

Document #: HSE-HASP-JSIC-FRM-01	Version #: 01

Date: _____ **Inspected By:** _____

Location: _____ **Project #:** _____

Check one of the following: **A:** Acceptable **NA**: Not Applicable **D**: Deficiency

	A	NA	D	Remarks
1. HASP available on site for inspection?				
2. Health & Safety Compliance agreement (in HASP) appropriately signed by Langan employees and subcontractors?				
3. Hospital route map with directions posted on site?				
4. Emergency Notification List posted on site?				
5. First Aid kit available and properly stocked?				
6. Personnel trained in CPR/First Aid on site?				
7. SDSs readily available, and workers knowledgeable about the specific chemicals and compounds to which they may be exposed?				
8. Appropriate PPE being worn by Langan employees and subcontractors?				
9. Project site safe practices ("Standing Orders") posted?				
10. Project staff have 40-hr./8-hr./Supervisor HAZWOPER training?				
11. Project staff medically cleared to work in hazardous waste sites and fit-tested to wear respirators, if needed?				
12. Respiratory protection readily available?				
13. Health & Safety Incident Report forms available?				
14. Air monitoring instruments calibrated daily and results recorded on the Daily Instrument Calibration check sheet?				
15. Air monitoring readings recorded on the air monitoring data sheet/field logbook?				
16. Subcontract workers have received 40-hr./8-hr./Spvsr. HAZWOPER training, as appropriate?				
17. Subcontract workers medically cleared to work on site, and fit-tested for respirator wear?				
18. Subcontract workers have respirators readily available?				
19. Markouts of underground utilities done prior to initiating subsurface activities?				

20. Decontamination procedures being followed as outlined in HASP?				
21. Are tools in good condition and properly used?				
22. Drilling performed in areas free from underground objects including utilities?				
23. Adequate size/type fire extinguisher supplied?				
24. Equipment at least 20 feet from overhead powerlines?				
25. Evidence that drilling operator is responsible for the safety of his rig.				
26. Trench sides shored, layed back, or boxed?				
27. Underground utilities located, and authorities contacted before digging?				
28. Ladders in trench (25-foot spacing)?				
29. Excavated material placed more than 2 feet away from excavation edge?				
30. Public protected from exposure to open excavation?				
31. People entering the excavation regarding it as a permit-required confined space and following appropriate procedures?				
32. Confined space entry permit is completed and posted?				
33. Persons knowledgable about the conditions and characteristics of the confined space?				
34. Persons engaged in confined space operations have been trained in safe entry and rescue (non-entry)?				
35. Full body harnesses, lifelines, and hoisting apparatus available for rescue needs?				
36. Attendant and/or supervisor certified in basic first aid and CPR?				
37. Confined space atmosphere checked before entry and continuously while the work is going on?				
38. Results of confined space atmosphere testing recorded?				
39. Evidence of coordination with off-site rescue services to perform entry rescue, if needed?				
40. Are extension cords rated for this work being used and are they properly maintained?				
41. Are GFCIs provided and being used?				

Unsafe Acts:

Notes:

APPENDIX G

JOB SAFETY ANALYSIS FORM

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Direct-Push Soil Borings
JSA Number: JSA004-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Half-face respirator, dust cartridges, PID (if applicable)				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Move equipment to work site	1. Back strain when lifting equipment 2. Slips/ Trips/ Falls while moving equipment 3. Traffic (if applicable) 4. Pinched fingers or running over toes during geoprobe set-up 5. Overturn drilling rig while transporting to loading dock on flat-bed tow truck	1. Use proper lifting technique (use legs for bending and lifting and not the back)/ Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle 2. Use proper lifting technique (use legs for bending and lifting and not the back) / Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle / Have unobstructed path to vehicle or collection point / Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility safety vests or clothing / Exercise caution 4. Wear proper PPE (cut-resistant gloves) / Stay alert, be aware of geoprobe rig at all times 5. Drill rig should be parked in center of flat-bed tow truck / Emergency brake shall be used at all times during transport on the flat-bed truck/ All unnecessary personnel should stay away from the flat-bed truck during moving activities
2. Calibration of monitoring equipment	1. Skin or eye contact with calibration chemicals 2. Pinch fingers in monitoring equipment	1. Wear proper PPE (safety glasses/ goggles) 2. Wear proper PPE (leather gloves)
3. Set-up geoprobe rig	1. Geoprobe rig movement	1. All field personnel should stay clear of the geoprobe rig while moving / Use a spotter when backing up the geoprobe
4. Advance geoprobe rods below ground surface to desired depth	1. Underground utilities 2. High noise levels	1. Clean all subsurface soil borings to a minimum of 5 feet below grade 2. Wear proper PPE (hearing protection)
5. Remove and open acetate liner	1. Pinched fingers while removing macrocore 2. Cuts/lacerations when cutting acetate liner open	1. Wear proper PPE (nitrile gloves, cut-resistant or leather gloves 2. Wear proper PPE (cut-resistant or leather gloves)

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	3. Exposure to hazardous vapors	3. Do not place face over acetate liner when opening / Monitor hazardous vapors in air with PID / Upgrade PPE as necessary based on levels contained in the Health and Safety Plan
5. Remove and open acetate liner (cont'd)	4. Skin contact with contaminated soil	4. Wear proper PPE (nitrile gloves)
6. Sample Collections a) Monitor parameters b) Prepare sample containers and labels	1. Contact with potentially contaminated soil 2. Lacerations from broken sample bottles 3. Back strain while transporting full coolers 4. Internal exposure to contaminants and metals through inhalation of dust 5. Slips/ Trips/ Falls	1. Use monitoring devices / Wear proper PPE (safety glasses, nitrile gloves) 2. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage 3. Use proper lifting techniques / Do not lift heavy loads without assistance 4. Avoid creating dust / If necessary, wear a half mask respirator with applicable dust cartridge / Inspect respirator for damage and cleanliness prior to use / Clean respirator after each use and store in a clean, secure location 5. Be alert / Follow good housekeeping procedures
7. Remove excess soil from acetate liner and place in 55-gallon drum (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Cuts/lacerations from acetate liner 2. Pinched fingers/hand while opening/closing drum 3. Skin contact with contaminated soil 4. Soil debris in eyes	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (nitrile gloves) 4. Wear proper PPE (safety glasses)
8. Transport drums to central staging location (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drums 6. Drop drum on feet/toes	1. Use drum cart for moving drums / Use proper lifting techniques / Do not lift heavy loads without assistance 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (cut-resistant or leather gloves) 4. Wear proper PPE (nitrile gloves underneath work gloves) 5. Follow good housekeeping procedures / Ensure route to move drum and storage space is free from obstructions 6. Wear proper PPE (safety shoes) / Work in a safe manner to prevent dropped drum
9. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection

JSA Title: Direct-Push Soil Borings
JSA Number: JSA004-01

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
9. All activities (cont'd)	8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: **Driving (Travel)**
JSA Number: **JSA059**

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):				
☐ Safety Boots	☐ Long Sleeves	☐ Safety Vest (Class 2)	☐ Hard Hat	☐ Hearing Protection
☐ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☐ Nitrile Gloves	☐ PVC Gloves
☐ Task Specific Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	☐ Impact Gloves
☒ Other: Seat belt utilized, Travel Route, Itinerary				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Vehicle inspection prior to departure	1. Slip, Trip, Fall 2. Hitting obstructions, unseen objects 3. Vehicle start: Rotating parts, belts, dashboard light indicators 4. Opening and closing vehicle doors	1. Do not carry anything when entering vehicle. Load equipment/bags/gear into vehicle first 2. Perform a 360º vehicle walk around to identify any hazards/objects in vehicle vicinity. Identify safest way to depart. Inspect vehicle for any damage that occurred on vehicle while not in motion. 3. Listen to engine when starting vehicle, make sure radio is off to listen to engine/belts. Note if any dashboard indicator lights indicate a vehicular issue 4. Check to make sure fingers, other body parts, or equipment are not between door/tailgate and frame before closing doors
2. Driving Vehicle	1. Backing up 2. Driving 3. Road Rage 4. Wildlife 5. Fatigue / Under the influnce 6. Distracted driving 7. Other vehicle 8. Other objects	1. Use a spotter to back up if available. Only back up if first forward motion is not a possibility. If backing up, honk horn prior to backing up 2. Drive defensively and abide by all laws. Know intended travel route (have directions). Obey posted signage. 3. Do not engage aggressive drivers, do not respond to hostile drivers/road rage, pass with caution. 4. Watch for wildlife signs. Reduce speed when wildlife is nearby. Avoid swerving into stationary items or oncoming traffic. 5. Ensure proper rest before travel. Pull over if you become drowsy. No alcohol or drugs prior to or while driving.

JSA Title: Travel
JSA Number:

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
		6. No use of hands free devices or cell phones while driving. Focus on driving and avoid all distractions while driving. 7. Maintain safe distance from vehicles in front. Proper following distance – 3 second rule 8. Scan area in front of vehicle for flying objects. Be alert when approaching oncoming vehicles on curved or winding portions of the road. Proper clearance around objects - turning radius. Ensure windshield is safe – no cracks or other damage.
9. Weather	1. Inclement Weather	1. Check for inclement weather prior to travel. Have appropriate wiper fluid, antifreeze, salt, sand etc. as needed. Take alternate route if necessary
10. Vehicle Fueling	1. Damage to vehicle/fuel pumps 2. Slip/Trips/Falls 3. Fuel Spills 4. Fires/Explosion/Burns	1. Pay attention and use caution when approaching fuel pumps. Ensure fuel nozzle is removed from vehicle prior to leaving. Ensure vehicle is placed in "park" and turned-off before exiting vehicle 2. Do not attempt to step over fuel hose while fueling. 3. Insert fuel nozzle fully to avoid spills. Never leave vehicle unattended while fueling. Know where Emergency Stop Button is located. Notify fuel station employees if fuel spill occurs. Do not overfill vehicles, stop fueling when auto-shutoff works. 4. Touch vehicle and pump prior to fueling to dissipate static electricity. No smoking and no cellphones while fueling.
11. Parking	1. Parking Vehicle	1. Park so when departing on next trip the first motion is forward. Use a spotter if one is available. Park in well-lit secure areas

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: **Environmental Sampling**
JSA Number: **JSA021-01**

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☐ Hard Hat	☐ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☐ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☒ Insect/Animal Repellent	☒ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek Sleeves				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Drive to sample location	1. Unfamiliar terrain	1. Pay attention to road conditions such as road erosion, unprotected embankments, and soft road conditions.
2. Sample Collection (Walking)	1. Slip/Trips/Falls 2. Back strains 3. Wildlife (Insects, Stray animals, rodents) 4. Poisonous vegetation	1. Minimize distance to sample area/ Plan route and check surface prior to carrying heavy equipment/ Locate safest access point/ Follow good housekeeping procedures/ Mark significant below grade hazards (holes, trenches) with spray paint or cones/ Wear foot protection with ankle support and gripping soles. 2. Use proper lifting techniques/ Use wheeled transport/ Obtain assistance where and when needed/ Consider load weight when evaluating what is safe and unsafe to carry. 3. Be aware of surroundings for the presence of wildlife/ Do not approach stray animals/ Carry and use animal repellant when needed/ Use bug spray when needed. 4. Keep skin covered/ Identify and avoid poisonous vegetation/ Clean areas after contact with suspected vegetation.
3. Sample Collection (Water)	1. Drowning Hazards 2. Chemical burns (when adding acid preservative to sample) 3. Back Strains 4. Ergonomic issues 5. Slip/Trips/Falls	1. Use buddy system. 2. Wear proper PPE (Nitrile gloves, Tyvek Sleeves) 3. Use proper lifting techniques/ Use wheeled transport/ Obtain assistance where and when needed/ Consider load weight when evaluating what is safe or unsafe to carry. 4. When possible avoid bending over for long periods of time/ Use a small stool for sitting or knee pad for kneeling. 5. Minimize distance to sample area/ Plan route and check surface prior to

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
		carrying heavy equipment/ Locate safest access point/ Follow good housekeeping procedures/ Mark significant below grade hazards (holes, trenches) with spray paint or cones/ Wear foot protection with ankle support and gripping soles/ Avoid standing water or slippery terrain.
4. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Groundwater Sampling
JSA Number: JSA008-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☐ Hard Hat	☐ Hearing Protection
☒ Safety Glasses	☒ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek sleeves, Dermal Protection, PID				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work area	1. Back Strain 2. Slips/ Trips/ Falls 3. Traffic 4. Cuts/abrasions from equipment 5. Contusions from dropped equipment	1. Use proper lifting techniuqes / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
2. Remove well cover if present	1. Scrape knuckles/hand 2. Strain wrist/bruise plam 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using a hammer, tap the end of the wrench to loosen grip of bolts 3. Wear proper PPE (leather gloves)
3. Remove well cap and lock if present	1. Well can pops from pressure 2. Exposure to hazardous substances through inhalation or dermal exposure 3. Scrape knuckles/hand 4. Strain write/bruise palm	1. Remove cap slowly to relieve pressure / Do not place face over well when opening / Wear proper PPE (safety glasses) 2. Use direct air monitoring/reading instrument (i.e. PID) / Be familiar with and follow actions prescribed in the HASP / Wear proper PPE (nitrile gloves) 3. Wear proper PPE (leather gloves) 4. Using hammer, tap the end of the wrench to loosen grip
4. Measure head-space vapor levels	1. Exposure to hazardous substances through inhalation	1. Do not place face over well when collecting measurement
5. Remove deciated tubing (if necessary)	1. Exposure to hazardous substances through inhalation or dermal exposure 2. Tubing swings around after removal	1. Wear proper PPE (nitrile gloves, Tyvek sleeves) 2. Wear proper PPE (safety glasses)
6. Set-up plastic sheeting for work site around the area	1. Lacerations when cutting plastic sheeting	1. Use scissors to cut plastic sheeting / Cut motions should always be away from body and body parts

JSA Title: Groundwater Sampling
JSA Number: JSA008-01

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
7. Calibrate monitoring equipment	1. Skin or eye contact with calibration chemicals 2. Pinch fingers or hand in monitoring equipment	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (leather gloves) / Avoid pinch points
8. Install sampling pump in well (if necessary)	1. Hand injuries during installation of pump 2. Lacerations when cutting tubing 3. Back strain during installation of pump 4. Physical hazards associated with manual lifting of heavy equipment 5. Back strain from starting generator 6. Burns from hot exhaust from generator 7. Electrical shock from improper use of generator and pump 8. Contaminated water spray from loose connections	1. Wear proper PPE (leather gloves, nitrile gloves) 2. Use safey tubing cutter 3. Use proper lifting techniques 4. Use proper lifting techniques / Use wheeled transport for heavy equipment 5. Use arm when starting generator / Do not over-strain if generator does not start 6. Do not touch generator near exhaust / Use proper handle to carry / Allow generator to cool down before moving 7. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord 8. Check all tubing connections to ensure they are tight and secure
10. Flushed water	1. Contact with potentially contaminated water 2. Tripping potential on sample discharge lines and pump electric line	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Use proper lifting techniques / Use wheeled transport 3. Organize discharge of electric line to keep out of way as much as possible / Mark potential tripping hazards with caution tape or safety cones
11. Sample water collection	1. Contact with potentially contaminated groundwater through dermal exposure 2. Contact with and burns from acid used for sample preservation 3. Tripping potential on sample discharge lines and pump electric line 4. Lacerations from broken sample bottles 5. Back strain when transporting coolers full of collected samples 6. Slips/ Trips/ Falls	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (safety glasses, nitrile gloves) / Ensure sample bottle lids are secure before use and after sample collection 3. Organize line to keep out of the way as much as possible / Mark potential tripping hazards with caution tape or safety cones 4. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage / Wrap glass bottles in bubble wrap, if possible 5. Use proper lifting techniques / Use wheeled transport / Seek assistance if coolers weight exceeds 50lbs. / Minimize distance to vehicle 6. Have unobstructed path to vehicle or collection point / Follow good housekeeping procedures / Do not lift/walk with coolers that are too heavy/difficult to lift
17. Decontaminate equipment	1. Splashing water/soap from decontamination 2. Contact with potentially contaminated groundwater through dermal exposure 3. Electrical shock from broken electric cords	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (safety glasses, dermal protection) 3. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord
18. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	10. Eye Injuries	6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: **Groundwater/Product Purgeing/Sampling with Bailer**
JSA Number: **JSA053**

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☒ Safety Goggles	☒ Face Shield	☒ Nitrile Gloves	☒ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☒ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☒ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek sleeves, Dermal Protection, PID, absorbent pads				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work area	1. Back Strain 2. Slips/ Trips/ Falls 3. Traffic 4. Cuts/abrasions from equipment 5. Contusions from dropped equipment	1. Use proper lifting techniuqes / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
2. Remove well cover	1. Scrape knuckles/hand 2. Strain wrist/bruise plam 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using a hammer, tap the end of the wrench to loosen grip of bolts 3. Wear proper PPE (leather gloves)
3. Remove well cap and lock	1. Well can pops from pressure 2. Exposure to hazardous substances through inhalation or dermal exposure 3. Scrape knuckles/hand 4. Pinch points 5. Strain write/bruise palm	1. Remove cap slowly to relieve pressure / Do not place face over well when opening / Wear proper PPE (safety glasses, face shield, hand protection) 2. Use direct air monitoring/reading instrument (i.e. PID) / Be familiar with and follow actions prescribed in the HASP / Wear proper PPE (nitrile gloves) 3. Wear proper PPE (leather gloves) 4. Using hammer, tap the end of the wrench to loosen grip
4. Measure head-space vapor levels	1. Exposure to hazardous substances through inhalation	1. Do not place face over well when collecting measurement
5. Set-up plastic sheeting/absorbent pads for work site around the well	1. Lacerations when cutting plastic sheeting/absorbent pads	1. Use scissors to cut plastic sheeting/absorbent pads / Cut motions should always be away from body and body parts
6. Lower Bailer sleeve into	1. Repetitive motion injury (pulled arm/back	1. Take breaks while lowering bailer into well/ Use a mechanical device to

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
well	muscles) 2. Dehydration	lower bailer into well/ Rotate employees (take turns conducting the manual labor portion) 2. Take breaks and drink water.
7. Purge/Sample water/product collection	1. Contact with potentially contaminated groundwater or product through dermal exposure 2. Contact with and burns from acid used for sample preservation 3. Tripping potential on sampling lanyard 4. Lacerations from broken sample bottles 5. Back strain when transporting coolers full of collected samples 6. Slips/ Trips/ Falls	1. Wear proper PPE (safety glasses, nitrile gloves, safety shield, Tyvek) 2. Ensure sample bottle lids are secure before use and after sample collection 3. Organize lanyard to keep out of the way as much as possible / Mark potential tripping hazards with caution tape or safety cones 3. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage / Wrap glass bottles in bubble wrap, if possible 4. Use proper lifting techniques / Use wheeled transport / Seek assistance if coolers weight exceeds 50lbs. / Minimize distance to vehicle 5. Have unobstructed path to vehicle or collection point / Follow good housekeeping procedures / Do not lift/walk with coolers that are too heavy/difficult to lift
8. Retieval of bailer	1. Repetitive motion injury (pulled arm/back muscles) 2. Dehydration	1. Take breaks while retrieving bailer out of the well/ Use a mechanical device to raise bailer out of well/ Rotate employees (take turns conducting the manual labor portion) 2. Take breaks and drink water.
9. Pack-up equipment	1. Back strain when removing or lifting heavy equipment	1. Use proper lifting technique / Use wheeled transport for heavy equipment
10. Replace well cap and lock	1. Scrape fingers/hand 2. Strain wrist/bruise palm	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the well cap to tighten grip
11. Replace well cover	1. Scrape knuckles/hand 2. Strain write/bruise palm 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the wrench to tighten the grip of the bolts 3. Wear proper PPE (leather gloves)
12. Place used PPE in designated dispoal drum	1. Pressure build-up inside drum 2. Pinch hazard	1. Remove cap from bung hole in drum to relieve pressure 2. Wear proper PPE (leather gloves) 3. Product drums may require additional spill protecton/electrical grounding, check local regulations
13. Decontaminate equipment	1. Splashing water/soap from decontamination 2. Contact with potentially contaminated groundwater through dermal exposure	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (safety glasses, dermal protection)
14. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
		Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Hand Auger Soil Sampling
JSA Number: JSA003-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – *Stop,* what has changed?
T – *Think* about the task
E – *Evaluate* potential hazards
P – *Plan* safe approach
S - *Start* task / *Stop* & regroup

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☒ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Half-face respirator, dust cartridges, PID (if applicable)				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Unpack equipment	1. Slips/ Trips/ Falls 2. Physical hazards including strains and hand injury	1. Be aware of hazards in area/ Place safety cones in areas of potential slips/trips/falls 2. Use proper lifting techniques / Do not lift heavy loads without assitance / Avoid putting hands near pinch points / Wear proper PPE (leather gloves)
2. Calibration of monitoring equipment	1. Skin or eye contact with calibration chemicals 2. Pinch fingers in monitoring equipment	1. Wear proper PPE (safety glasses/ goggles) 2. Wear proper PPE (leather gloves)
3. Advancing and removing hand auger	1. Physical hazards including back strain and hand injury	1. Twist auger using arms and shoulders/ Do not over exert / Keep back in neutral position, bend at the knees / Request assistance when needed / Remove auger from ground keeping back in neutral position and lift using legs
4. Sample collections a) Monitor parameters b) Prepare sample containers and labels c) Collect soil sample d) Securely cap containers, label and store in sample cooler until shipping e) Deliver cooler to lab or courier to lab	1. Contact with potentially contaminated soil 2. Lacerations from broken sample bottles 3. Back strain with transporting coolers 4. Internal exposure to contaminants through inhalation of dust 5. Slips/ Trips/ Falls	1. Use monitoring devices / Wear proper PPE (safety glasses, nitrile gloves) 2. Do not over-tighten bottles caps / Handle bottles safety to prevent breakage 3. Use proper lifting techniques / Do not lift heavy loads without assistance 4. Avoid creating dust / If necessary, wear a half-face respirator with applicable dust cartridges / Inspect respirator for damage and cleanliness prior to use / Clean respirator after each use and store in a clean, secure location 5. Be alert / Follow good housekeeping procedures
5. Decontamination of equipment	1. Splashing water/soap from decontamination 2. Contact with potentially contaminated soil	1. Wear proper PPE (safety glasses, gloves) 2. Wear proper PPE (safety glasses, gloves)
6. All activities	1. Slips/ Trips/ Falls	1. Be aware of potential trip hazards / Follow good housekeeping

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
6. All activities (cont'd)	2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Surface Water Sampling
JSA Number: JSA009-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☒ Life Vest/Jacket	
☐ Other				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work site	1. Back strain 2. Slips/ Trips/ Falls 3. Traffic 4. Cuts/abrasions from equipment 5. Contusions from dropped equipment	1. Use proper lifting techniques / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
2. Collect water samples	1. Potential drowning hazard working around water 2. Contact with potentially contaminated water through dermal exposure 3. Contact and burns from acid used for sample preservation 4. Lacerations from broken sample bottles 5. Back strain when transporting cooler full of collected samples 6. Slips/ Trips/ Falls	1. Always work with a partner when working around water / Wear proper PPE when working in moving water or water deeper than 2ft. (floatation device- i.e. Life vest/jacket) / Select a working area where the footing is stable / Do not stand in or attempt to cross swift moving water 2. Wear proper PPE (safety glasses, nitrile gloves) 3. Wear proper PPE (safety glasses, nitrile gloves) / Ensure sample bottle lids are secure before use and after sample collection 4. Do not over-tighten bottle caps / Handle bottles safely to avoid breakage / Wrap glass bottles in bubble wrap, if possible 5. Use proper lifting techniques / Use wheeled transport / Seek assistance if cooler's weight exceeds 50lbs. / Minimize distance to vehicle 6. Have unobstructed path to vehicle or collection point / Follow good housekeeping procedures / Do not lift/walk with coolers that are too heavy/difficult to lift
3. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
3. All activities (cont'd)	4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Well Installation
JSA Number: JSA019-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions. Prior to the start of any work "TAKE 5" and conduct a Last Minute Risk Assessment.



S – ***Stop,*** *what has changed?*
T – ***Think*** *about the task*
E – ***Evaluate*** *potential hazards*
P – ***Plan*** *safe approach*
S - ***Start*** *task /* ***Stop*** *& regroup*

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: PID, Tyvek sleeves				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Move equipment to work site	1. Back strain when lifting equipment 2. Slips/ Trips/ Falls while moving equipment 3. Traffic (if applicable) 4. Pinched fingers or running over toes during geoprobe set-up 5. Overturn drilling rig while transporting to loading dock on flat-bed tow truck	1. Use proper lifting technique (use legs for bending and lifting and not the back)/ Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle 2. Use proper lifting technique (use legs for bending and lifting and not the back) / Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle / Have unobstructed path to vehicle or collection point / Do not lift/walk with boxes that are heavy/difficult to lift 3. Wear high visibility safety vests or clothing / Exercise caution 4. Wear proper PPE (cut-resistant gloves) / Stay alert, be aware of geoprobe rig at all times 5. Drill rig should be parked in center of flat-bed tow truck / Emergency brake shall be used at all times during transport on the flat-bed truck/ All unnecessary personnel should stay away from the flat-bed truck during moving activities
2. Calibration of monitoring equipment	1. Skin or eye contact with calibration chemicals 2. Pinch fingers in monitoring equipment	1. Wear proper PPE (safety glasses/ goggles) 2. Wear proper PPE (leather gloves)
3. Set-up geoprobe rig	1. Geoprobe rig movement	1. All field personnel should stay clear of the geoprobe rig while moving / Use a spotter when backing up the geoprobe
4. Advance geoprobe rods below ground surface to desired depth	1. Underground utilities 2. High noise levels	1. Clean all subsurface soil borings to a minimum of 5 feet below grade 2. Wear proper PPE (hearing protection)
5. Remove and open acetate	1. Pinched fingers while removing macrocore	1. Wear proper PPE (nitrile gloves, cut-resistant or leather gloves

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
liner 5. Remove and open acetate liner (cont'd)	2. Cuts/lacerations when cutting acetate liner open 3. Exposure to hazardous vapors 4. Skin contact with contaminated soil	2. Wear proper PPE (cut-resistant or leather gloves) 3. Do not place face over acetate liner when opening / Monitor hazardous vapors in air with PID / Upgrade PPE as necessary based on levels contained in the Health and Safety Plan 4. Wear proper PPE (nitrile gloves)
6. Remove excess soil from acetate liner and place in 55-gallon drum (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Cuts/lacerations from acetate liner 2. Pinched fingers/hand while opening/closing drum 3. Skin contact with contaminated soil 4. Soil debris in eyes	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (nitrile gloves) 4. Wear proper PPE (safety glasses)
7. Attach hollow-stem augers to the geoprobe rig; Advance augers and attach additional augers until desired depth is reached	1. Strain wrist/bruise palm 2. Pinched fingers 3. Back Strain 4. Clothing entanglement 5. Carbon monoxide poisoning 6. Bruise toes/foot 7. High noise levels 8. Skin contact with contaminated soil	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Use proper lifting techniques 4. Wear proper work attire(no loose clothing/strings) 5. Properly ventilate work area 6. Wear proper PPE (safety shoes) 7. Wear proper PPE (hearing protection) 8. Wear proper PPE (Tyvek sleeves, nitrile gloves)
8. Install monitoring well	1. Pinched fingers 2. Lacerations/abrasions 3. Back Strain	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Use proper lifting techniques
9. Tremie-grout annulus space above bentonite seal	1. Back strain 2. Pinched fingers	1. Use proper lifting techniques 2. Wear proper PPE (cut-resistant or leather gloves)
10. Install flush-mount monitoring well pad	1. Splashed concrete 2. Pinched fingers 3. Cuts/lacerations	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (cut-resistant or leather gloves)
11. Decontaminate equipment	1. Splashing water/soap 2. Contact with potentially contaminated groundwater/soil through dermal exposure 3. Electrical shock from broken electric cords	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (safety glasses, dermal protection) 3. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord
12. Transport drums to central staging location (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drums 6. Drop drum on feet/toes	1. Use drum cart for moving drums / Use proper lifting techniques / Do not lift heavy loads without assistance 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (cut-resistant or leather gloves) 4. Wear proper PPE (nitrile gloves underneath work gloves) 5. Follow good housekeeping procedures / Ensure route to move drum and storage space is free from obstructions 6. Wear proper PPE (safety shoes) / Work in a safe manner to prevent dropped drum
13. All activities	1. Slips/ Trips/ Falls	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
13. All activities (cont'd)	2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	**Sign Name**	**Date**
Prepared by:		
Reviewed by:		

Appendix C
PFAS Investigation Standard Operating Procedures (SOPs)

Standard Operating Procedure (SOP) for the Collection of Groundwater Sampling via Low Flow Purging for Per and Polyfluoroalkyl Substances (PFAS) Analysis

1. Purpose

The purpose of this standard operating procedure (SOP) is to describe the low flow purging and sampling technique. The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This SOP for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

2. Limitations

The procedures described herein should be followed to meet project data quality objectives. Note, however, that regulatory, client-specific, health & safety, or field conditions ("overriding conditions") may necessitate deviations from the procedures in this SOP to address such overriding conditions. Deviations should be documented in the final report for the associated phase of the project.

3. Health and Safety

When working on-site, comply with the project Health and Safety Plan (HASP) and Langan's Injury and Illness Prevention Program. Proper personal protection clothing and equipment (PPE) are to be worn as specified in the HASP and Job Safety Analysis (JSA).

4. Scope, Application, and Planning

Site-specific conditions may warrant modifying field practices performed in accordance with this SOP. Therefore, guidance provided in this SOP is presented in terms of general steps and strategies that should be applied when approaching an investigation involving low-flow groundwater sampling.

The project manager (PM) and field sampling team are responsible for providing the depths of the proposed groundwater sample and verifying them in the field. Contact the laboratory to confirm the required sample size necessary to obtain the desired reporting limits and request the properly sized sample containers. Coordinate site access with the client or building/property manager.

5. Methods

Field methodology for field instrument calibration, depth to water measurement, pump installation, well purging, water quality monitoring, sampling procedures, and equipment decontamination is provided below.

Pre-Sampling Preparation:

1. Review the sampling plan, QAPP, and site-specific instructions and documents.
2. Sign the HASP; have the subcontractor review and sign the HASP if hired by Langan.
3. Before the field work begins, complete the Langan Safe Work Certificate (SWC) which provides a summary of the daily work tasks, identification of potential hazards associated with the work tasks and measures employees should follow to mitigate potential hazards.
4. Verify that personnel are aware of and adhere to protocols to minimize PFAS cross-contamination. See Recommended Environmental PFAS Sampling SOP for expanded guidance.
5. When multiple samples from one site are collected determine sampling order of monitoring wells, sample up gradient areas first followed by those down gradient of the suspected source.
6. Turn on and calibrate the water quality meter in accordance with manufacturer requirements, and record calibration on field data sheets.

Low-Flow Groundwater Sampling Protocol:

1. Upon arrival, document site conditions (e.g., nearby activities, presence of standing water, ground surface materials), weather, and any potential sources of cross-contamination (including PFAS-related considerations such as site equipment or materials that may contain fluoropolymers).
2. Unlock and open well. Collect depth to water measurement using electronic water level meter. Point of measurement shall be consistent across monitoring events (typically north). Use depth to water measurement and well completion report to calculate length of water column and the volume of standing water in the well. If possible, obtain well depth from well construction data rather than field measurement to avoid resuspension of settled sediments.
3. Use length of water column and well screen interval information to determine pump intake depth in accordance with project requirements. Slowly lower pump, tubing, electrical lines and safety cable to the target pump intake elevation to avoid mixing of the water column. The pump intake depth should be within the screened interval and no less than two feet above the bottom of the well to minimize disturbance of sediments at the bottom.
4. Re-measure depth to water before starting the pump.
5. Begin pumping at a low flow purge rate. Purge rate shall be consistent across sampling events. Purging will be performed at a flow rate of 250 mL per minute of less. Reduce the flow rate if the water is excessively turbid. Stabilized turbidity at the time of sampling should be less than 50 nephelometric turbidity units (NTU), and preferably less than 10 NTU. Methods that can be utilized to minimize turbidity include reducing flow rate and extending the purge time and volume. Discharge water into a graduated cylinder or other container to track total volume purged and to calculate current flow rate. Measure depth to water periodically to monitor drawdown in the well. Adjust rate so there is little (< 4 inches or < 0.1 m) to no water level drawdown. If drawdown does occur it should be minimized.

6. Monitor and record water quality parameters in the field book, low-flow purge field data sheet, Collector App, etc. Water quality parameters include temperature, specific conductance, dissolved oxygen (DO), pH, and oxidation reduction potential (ORP) every five minutes until readings are stable. Stability may be defined as having three consecutive readings within the following limits:
    - 3% for temperature
    - 3% for specific conductance
    - 10% for DO and turbidity
    - ± 0.1 for pH
    - ± 10 millivolts for ORP
7. Sample once water quality indicator parameters stabilize or three volumes of standing water have been purged, whichever comes first.
8. For sampling, disconnect the flow through cell and direct the flow of water into the sample containers and fill each container to the top (but do not overfill).
9. Use fresh, clean nitrile gloves between individual sample collection.
10. Collect groundwater for PFAS analysis using USEPA Method 1633:
    - All samples will be collected at the low flow purge rate by directing the flow down the inside wall of the container with minimal turbulence.
    - When applicable, confirm that samples are collected in bottles with the appropriate preservative.
11. Use laboratory-provided sample containers specific to required analytical parameters, and label appropriate sample containers according to the site-specific work plan(s), Langan's sample nomenclature SOPs, etc.
12. Collect QA/QC samples in accordance with the site-specific work plan(s). These may include, but are not limited to, duplicates, matrix spike/matrix spike duplicates (MS/MSD), field blanks, temperature blanks, trip blanks, rinsate blanks, etc.
    - Typical QA/QC protocols are 1 duplicate sample per 20 samples, 1 temperature blank per cooler, and 1 equipment blank/rinsate blank per day, per sampling device when sampling tools are decontaminated.
13. Ensure sample container lids are secure and confirm sample label includes:
    - Project name,
    - Sample ID,
    - Sample date,
    - Sample time of collection (each sample receives a unique sample time, there should not be two or more samples with the same sample time),
    - Analysis,
    - Preservative, and
    - Sampler's initials.
14. Document sample information in field book, low-flow purge logs, Collector App, etc., as prescribed in the site-specific work plan(s). The sample collection time, sample ID, sample parameters, and sample container used should be legibly marked in the field book and match the information on the sample container label and Chain of Custody (CoC).
15. Document sample information on CoC.

16. Place sample containers into a clean re-sealable plastic bag, then place the bag in a cooler with double-bagged ice to preserve sample quality and maintain a temperature of less than 6°C. Refer to the site-specific work plan(s) or ask the PM for additional information regarding sample preservation, packing, and shipping.
17. Remove pump and tubing.
18. Take final depth to water measurement and confirm well depth with electronic water level meter.

Start of Day, Between Low-Flow Groundwater Sampling Locations, and End of Day:

1. Decontaminate pump and other instrumentation at the start of each day, between each monitoring well location, and at the end of each day in order to mitigate potential cross-contamination of samples.
2. Dispose of disposable sampling equipment in trash bag and as specified by site-specific work plan(s).
3. Following sample collection close and lock well.

Decontamination:

1. Establish a decontamination area away from sampling activities.
2. Wash equipment with PFAS-free water, which can be requested from the laboratory.
3. Use a three-stage decontamination process to clean field sampling and other downhole equipment between multiple uses.
    - In a PFAS-free bucket wash the equipment with a mixture of PFAS-free water and PFAS-free soap (bucket #1).
    - In a second PFAS-free bucket (bucket #2), rinse the equipment with PFAS-free water.
    - A second rinse should be done with PFAS-free water using a third bucket (bucket #3).
4. Replenish decontamination solutions between sampling locations. Spent decontamination fluids should be properly disposed.

6. Resources

Low-flow groundwater sampling requires materials and services be provided by outside contractors and supplies. An environmental rental company will provide necessary equipment for well purging. Laboratory suppliers will provide the sample containers and perform analytical testing of the samples. The section outlines the requirements from each entity.

From the environmental rental equipment rental company:

- Water quality meter and flow-through cell
- Water pump and controller (typically a peristaltic pump should be used for PFAS sampling and for this project)

- Appropriate High-density polyethylene (HDPE) (preferred) or Low-density polyethylene (LDPE) tubing depending on pump type
- Battery
- Safety Cable
- Electronic water level meter

From the laboratory contractor:

- High-density polyethylene (HDPE) sampling jars – before ordering, check work plan(s) and confirm the scope with the PM. While not required, it is advisable and good practice to order spare sampling jars as a contingency but there may be incremental costs.
- QA/QC Sampling – QA/QC samples include collection of duplicate, rinsate/equipment blank, and field blank samples in accordance with the site-specific work plan(s). Refer to the site-specific work plan(s) and ask your PM which QA/QC samples will be collected and for what analyses.
- CoC Form – follow standard sample nomenclature when completing the CoC and the sample identification of the soil sample jars. Sample nomenclature is defined in the work plan, Quality Assurance Project Plan (QAPP), or Langan's sample nomenclature SOP.
- PFAS-free deionized water – Used for the final rinse of field sampling equipment and downhole equipment during the decontamination process. Water must be laboratory-verified as PFAS-free prior to use. Decontamination solutions should be replenished between sampling locations as needed.

From Langan personnel:

- Planning Documentation
    - Health and Safety Plan – inquire about any site-specific safety requirements/policies,
    - Sampling and Analysis Plan/Work plan(s)/proposal,
    - Quality Assurance Project Plan (if applicable)
    - Well location map
    - Well construction data
    - Field data from last sampling event (if applicable)
    - Printed field sheets/calibration logs/low-flow purge logs, and/or
    - Client contact and site contact for coordinating access.

- Equipment:
    - PPE, as specified in the HASP (at minimum, Level D),
    - Well keys and tools to open wells
    - Mobile field tablet with GIS maps and Collector App,
    - Disposable powderless nitrile gloves,
    - Paper towels,
    - Ball point pens and fine-tipped Sharpie Markers,

- Re-sealable low-density polyethylene (LDPE) bags (e.g., Ziploc®) (to store sample containers)
- Appropriate decontamination supplies:
  - Distilled water,
  - Alconox or equivalent (e.g., Simple Green),
  - Decontamination brush,
  - High-density polyethylene (HDPE) 5-gallon buckets, and
- Trash bags

See Recommended Environmental PFAS Sampling Procedures (SOP) for additional guidance on the selection of sampling equipment and materials.

7. References:

- Interstate Technology and Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance Document, https://pfas-1.itrcweb.org/.
- Maryland Department of Environment (MDE), Water and Science Administration, Per-and Polyfluoroalkyl Substances (PFAS) Sampling Guidance Document for Wastewater Analysis, September 10, 2024.
- USEPA Final Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.

9. Revision History:

- October 10, 2024 - Version 1.0
- February 11, 2025 – Version 2.0
- March 5, 2025 – Version 3.0

Standard Operating Procedure (SOP) for the Collection of Soil Samples Using a Hand Auger for Per and Polyfluoroalkyl Substances (PFAS) Analysis

1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to describe soil-sampling methods using a manual hand auger. Hand augering is effective for application in unconsolidated formations consisting primarily of sand, silt, and clay with some gravel. This procedure gives descriptions of equipment, field procedures, and quality assurance/quality control (QA/QC) procedures necessary to collect soil samples using a hand auger. The soil sampling techniques described in this SOP are generally suitable for samples analyzed for chemical characterization and physical classification tests. However, because of the open bucket of the hand auger, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. This SOP provides protocols and procedures for initial scoping/planning/preparation, pre-sampling procedures, sampling methods using hand augers, post-sample collection procedures and documentation, other resources and considerations, and select reference materials. These are SOPs (i.e., typically applicable), which can be varied or changed as required, depending on site conditions, equipment limitations, or other procedural limitations, as encountered. In all instances, any deviations from the SOPs should be discussed with the field team leader/project manager before proceeding and the ultimate procedures should be documented.

2. Limitations

The procedures described herein should be followed to meet project data quality objectives. Note, however, that regulatory, client-specific, health & safety, or field conditions ("overriding conditions") may necessitate deviations from the procedures in this SOP to address such overriding conditions. Deviations should be documented in the final report for the associated phase of the project.

3. Health & Safety

When working on-site, comply with the project Health and Safety Plan (HASP) and Langan's Injury and Illness Prevention Program. Proper personal protection clothing and equipment (PPE) are to be worn as specified in the HASP and Job Safety Analysis (JSA).

4. Scope, Application, and Planning

Site-specific conditions may warrant modifying field practices performed in accordance with this SOP. Therefore, guidance provided in this SOP is presented in terms of general steps

and strategies that should be applied when approaching an investigation involving soil sampling utilizing hand augering techniques.

The project manager (PM) and field development team are responsible for providing the proposed soil sample locations. Coordinate site access with the client or site manager and ensure you have access to each soil sample location.

5. Methods

Hand augers are used to advance the sampler bucket into the subsurface, and samples are recovered incrementally as the boring is advanced. Samples are tripped out of the boring through the uncased borehole so formation collapse and cross contamination in non-cohesive and saturated formations may be problematic.

Langan personnel will log the lithology of the boring in the field book, boring log form, Collector App, etc., and screen the soil boring with a photoionization detector (PID) for potential environmental impacts, as prescribed in the site-specific work plan(s). Samples will be collected using clean, stainless steel or disposal spoons from the prescribed sample interval.

Pre-Sampling Preparation:

1. Review the sampling plan, QAPP, and site-specific instructions and documents.
2. Sign the HASP; have the subcontractor review and sign the HASP if hired by Langan.
3. Before the field work begins, complete the Langan Safe Work Certificate (SWC) which provides a summary of the daily work tasks, identification of potential hazards associated with the work tasks and measures employees should follow to mitigate potential hazards.
4. Verify that samplers have reviewed the Langan's guidelines for soil sampling.
5. Verify that personnel are aware of and adhere to protocols to minimize PFAS cross-contamination. See Recommended Environmental PFAS Sampling SOP for expanded guidance.
6. Check sampling equipment and bottles for accuracy with orders and project requirements.
7. Sampling Personnel should be familiar with the tiered approach to evaluate unplanned conditions. See Recommended Environmental PFAS Sampling SOP for expanded guidance.

Hand Auger Soil Sampling Protocol:

1. Upon arrival, document site conditions (e.g., nearby activities, presence of standing water, ground surface materials), weather, and any potential sources of cross-contamination (including PFAS-related considerations such as site equipment or materials that may contain fluoropolymers).

2. Identify the soil boring location and at what depth it should be advanced based on site-specific work plans and in review of safety, utility clearances, and consultation with driller. Wear proper head (hard hat), eye, hearing, and hand protection.
3. Advance the hand auger six inches into the soil using a clockwise twisting motion to cut through any organic matter or difficult clay layers and pull the auger straight out of the sediment.
4. Continue augering in six-inch increments, through the same hole, to reach the target sample depths.
    - The sampler will utilize two augers, alternating between half-foot intervals to minimize cross contamination. Augers will be decontaminated between each interval. See below for decontamination procedures.
5. Log soil lithology in half-foot intervals or wherever there is a change in lithology or other observed physical characteristics. Soil should be classified using the system specified in the site-specific work plan(s) (modified Burmister Classification System, USCS, or other) and recorded in the field book, boring logs, Collector App, etc. Samples will be collected using laboratory-provided sample containers. Samplers will label sample bottles with the sample identification, date, time, and analysis to be performed.
6. Use fresh, clean nitrile gloves between individual sample collection.
7. Use laboratory-provided sample containers specific to required analytical parameters, and label appropriate sample containers according to the site-specific work plan(s), Langan's sample nomenclature SOPs, etc.
8. Use dedicated, disposable sampling equipment for each sample location. If this is not possible, thorough decontamination of stainless-steel sampling equipment is required prior to use and in between sampling locations. A rinsate blank(s) may be required each day; refer to site-specific work plans.
9. Prior to placing soil in the laboratory bottleware, empty the soil from the bott (cutting edge) of the hand auger into a decontaminated stainless-steel bowl. Do not include/use soil from the top portion (~1 inch) of the auger because this material may include borehole slough from shallower intervals. Homogenize the soil in the stainless steel bowl before distributing it among the bottleware provided by the laboratory for the targeted analyses. Then place the homogenized soil into the appropriate, labeled sample containers using the alternate shoveling method: place a similar volume of soil into each container in sequence and repeat until all containers are full.
10. Collect QA/QC samples in accordance with the site-specific work plan(s). These may include, but are not limited to, duplicates, matrix spike/matrix spike duplicates (MS/MSD), field blanks, temperature blanks, trip blanks, rinsate blanks, etc.
    - Typical QA/QC protocols are 1 duplicate sample per 20 samples, 1 temperature blank per cooler, and 1 equipment blank/rinsate blank per day, per sampling device when sampling tools are decontaminated.
11. Ensure sample container lids are secure and confirm sample label includes:
    - Project name,
    - Sample ID,

- Sample date,
- Sample time of collection (each sample receives a unique sample time, there should not be two or more samples with the same sample time),
- Analysis,
- Preservative, and
- Sampler's initials.

12. Document sample information in field book, boring logs, Collector App, etc., as prescribed in the site-specific work plan(s). The sample collection time, sample ID, sample parameters, and sample container used should be legibly marked in the field book and match the information on the sample container label and Chain of Custody (CoC).
13. Document sample information on CoC.
14. Place sample containers into a clean re-sealable plastic bag, then place the bag in a cooler with double-bagged ice to preserve sample quality and maintain a temperature of less than 6°C. Refer to the site-specific work plan(s) or ask the PM for additional information regarding sample preservation, packing, and shipping.

Start of Day, Between DP Soil Sampling Locations, and End of Day:

1. Decontaminate any tools used to collect sample at the start of each day, between each sample location, and at the end of each day in order to mitigate potential cross-contamination of samples.
2. Dispose of disposable tools in trash bag and as specified by site-specific work plan(s).
3. Following sample collection and boring completion, backfill boring with drill cuttings, or as specified in the site-specific work plan.

Decontamination:

1. Establish a decontamination area away from sampling activities.
2. Initially scrape or brush equipment caked with drill cuttings, soil, or other material. The scrapings can be sampled, characterized, and appropriately disposed of.
3. Wash equipment with PFAS-free water, which can be requested from the laboratory.
4. Place decontaminated downhole equipment (e.g. augers) on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and allowed to air dry. Minimize airborne contamination by covering or wrapping equipment in PFAS-free plastic sheeting until use.
5. Use a four-stage decontamination process to clean field sampling and other downhole equipment between multiple uses.
    - In a PFAS-free bucket wash the equipment with a mixture of PFAS-free water and PFAS-free soap (bucket #1).
    - In a second PFAS-free bucket (bucket #2), rinse the equipment with PFAS-free water.
    - A second rinse should be done with PFAS-free water using a third bucket (bucket #3).

- Complete a final triple-rinse with PFAS-free water using a spray bottle (for components coming into direct contact with sample).

6. Replenish decontamination solutions between sampling locations. Spent decontamination fluids should be properly disposed.

6. Resources

Hand auger soil sampling requires that materials and services be provided by outside contractors and suppliers. An environmental rental company may provide a PID to screen the soil for volatile vapors. Laboratory suppliers will provide the sample containers and perform analytical testing of the samples. This section outlines the requirements from each entity.

From the environmental equipment rental company:

- PID: Use a PID with a 10.6 eV lamp (or as appropriate for screening volatile vapors) and a measurement range of 1 ppm to 10,000 ppm with a 1 ppm resolution.
    - PID user manual, and
    - PID calibration gas and equipment (regulator).

From the laboratory contractor:

- High-density polyethylene (HDPE) sampling jars – before ordering, check work plan(s) and confirm the scope with the PM. While not required, it is advisable and good practice to order spare sampling jars as a contingency but there may be incremental costs.
- QA/QC Sampling – QA/QC samples include collection of duplicate, rinsate/equipment blank, and field blank samples in accordance with the site-specific work plan(s). Refer to the site-specific work plan(s) and ask your PM which QA/QC samples will be collected and for what analyses.
- CoC Form – follow standard sample nomenclature when completing the CoC and the sample identification of the soil sample jars. Sample nomenclature is defined in the work plan, Quality Assurance Project Plan (QAPP), or Langan's sample nomenclature SOP.
- PFAS-free deionized water – Used for the final rinse of field sampling equipment and downhole equipment during the decontamination process. Water must be laboratory-verified as PFAS-free prior to use. Decontamination solutions should be replenished between sampling locations as needed.

From Langan personnel:

- Planning Documentation:
    - Health and Safety Plan – inquire about any site-specific safety requirements/policies,
    - Sampling and Analysis Plan/Work plan(s)/proposal,
    - QAPP (if applicable),
    - Printed sample location maps and figures,

  - Printed field sheets/boring logs, and /or
  - Client contact and site contact for coordinating access

- Equipment:
  - PPE, as specified in the HASP (at minimum, Level D),
  - GPS or survey equipment,
  - Mobile field tablet with GIS maps and Collector App,
  - Steel pin flags, or wooden stakes and spray paint/high-visibility flashing,
  - Measuring tape or field ruler,
  - Stainless steel pocketknife,
  - Stainless steel mixing bowl,
  - Stainless steel or disposal scops,
  - Disposable powderless nitrile gloves,
  - Hang auger with 3"x6" bucket
  - Paper towels,
  - Ball point pens and fine-tipped Sharpie Markers,
  - Re-sealable low-density polyethylene (LDPE) bags (e.g., Ziploc®) (to store sample containers)
  - Appropriate decontamination supplies:
    - Distilled water,
    - Alconox or equivalent (e.g., Simple Green),
    - Decontamination brush,
    - Plastic Sheeting
    - High-density polyethylene (HDPE) 5-gallon buckets
    - Trash bags or container for waste (drum or bucket, 5-gallon), and
    - Labels for waste container,
  - Camera, and/or
  - Thin-wall tube sampler.

See Recommended Environmental PFAS Sampling Procedures (SOP) for additional guidance on the selection of sampling equipment and materials.

8. References:

- Interstate Technology and Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance Document, Section 11.1.7.5, https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/
- USEPA Final Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.
- USEPA, Region 4 Soil Sampling Operating Procedure, July 2007, Reviewed June 10, 2024.

9. Revision History:

- December 24, 2024 - Version 1.0
- February 11, 2025 – Version 2.0
- March 5, 2025 – Version 3.0

Standard Operating Procedure (SOP) for the Collection of Sediment Samples for Per and Polyfluoroalkyl Substances (PFAS) Analysis

1. Purpose

The purpose of this standard operating procedure (SOP) is to describe the technique for sediment sampling. The goal of this sediment sampling procedure is to collect samples for analysis that are representative of the area(s) requiring classification. This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect sediment samples and obtain representative data.

This SOP provides protocols and procedures for initial scoping/planning/preparation, pre-sampling procedures, sampling methods for sediment, post sample collection procedures and documentation, other resources and considerations, and select reference materials. These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on-site conditions and limitations with equipment. In all instances, the ultimate procedures employed should be documented.

2. Limitations

The procedures described herein should be followed to meet project data quality objectives. Note, however, that regulatory, client-specific, health & safety, or field conditions ("overriding conditions") may necessitate deviations from the procedures in this SOP to address such overriding conditions. Deviations should be documented in the final report for the associated phase of the project.

3. Health & Safety

When working on-site, comply with the project Health and Safety Plan (HASP) and Langan's Injury and Illness Prevention Program. Proper personal protection clothing and equipment (PPE) are to be worn as specified in the HASP and Job Safety Analysis (JSA). Some samples may contain biological and chemical hazards. These samples must be handled with suitable protection to skin, eyes, etc. Weather hazards, such as freezing or near freezing temperatures and heavy rain that could result in flooding, must be taken into consideration when scheduling sampling. Exercise caution when using boats or waders. Waders should not be used when the depth of water is unknown, highly variable, or could present a drowning hazard. Inspect the waders for punctures and tares before donning them. Additionally, floatation devices must always be worn when working over water. Always keep two paddles in the boat in case of battery or motor failure.

4. Scope, Application, and Planning

Site-specific conditions may warrant modifying field practices performed in accordance with this SOP. Therefore, guidance provided in this SOP is presented in terms of general steps and strategies that should be applied when approaching an investigation involving surface sediment sampling.

The project manager (PM) and field sampling team are responsible for providing the locations of the proposed sediment sample points and verifying them in the field. Contact the laboratory to confirm the required sample size necessary to obtain the desired reporting limits and request the properly sized sample containers. Coordinate site access with the client or building/property manager.

5. Methods

Field methodology for spade/trowel and benthic dredging sampling approaches are provided below. In all approaches, sampling must begin at the most downstream location and move upstream to avoid disturbing or affecting the areas to be sampled. At each sample location, measure the depth from the top of the sediment surface to the surface of the water (i.e., water depth), and sediment thickness (feet below sediment surface [bss]), if applicable. Additionally, depositional areas should be targeted as these areas will have the greatest level of contamination in an aquatic system. These areas are typically characterized by slow moving water where fine-grained sediment tend to accumulate. Prior to collection of sediments at a sample location, all other sampling (i.e., surface water or pore water) and analysis (i.e., surface water quality readings) should be completed.

Pre-Sampling Preparation:

1. Review the sampling plan, QAPP, and site-specific instructions and documents.
2. Sign the HASP; have sub-contractor review/sign the HASP if they are hired by Langan.
3. Before the field work begins, complete the Langan Safe Work Certificate (SWC) which provides a summary of the daily work tasks, identification of potential hazards associated with the work tasks and measures employees should follow to mitigate potential hazards.
4. Verify that personnel are aware of and adhere to protocols to minimize PFAS cross-contamination. See Recommended Environmental PFAS Sampling SOP for expanded guidance.
5. Prepare and decontaminate selected sampling device(s)
    - Stainless steel spade / trowel
    - Benthic dredge sampler (e.g., Petite Ponar Grab or Ekman Dredge sampler)

Spade/Trowel

A spade or trowel may be used to sample sediment if the conditions allow (i.e., water column depth is less than two feet and bore hole can be maintained).

1. Upon arrival, document site conditions (e.g., nearby activities, presence of standing water, ground surface materials), weather, and potential sources of cross-contamination (including PFAS-related considerations such as site equipment or materials that may contain fluoropolymers).
2. Identify sampling locations and start sampling at the most downstream location and move upstream to avoid disturbing or affecting the areas to be sampled.

3. Advance the spade or trowel to the desired sediment depth by collecting material in approximately six-inch segments
4. Lay the sediment material out on a surface in the correct order (surface to desired depth) and record sediment boring notes.
5. Place the desired sediment interval in a stainless-steel bowl and homogenize.
6. Gently fill the laboratory-provided sample containers.
7. Repeat the sediment sampling protocol described above for each sampling location, as applicable. Record the sampling information the appropriate field data sheet, field book, etc.

Polycarbonate Coring

If conditions prevent the collection of sediment at any station with a spade/trowel, sediment may be collected with polycarbonate core tube sampler. These samplers can penetrate to a depth of 4-feet, but is dependent on the sampler's ability to remove the core without disturbing material. As such it is recommended that a sample is taken from zero to 6 inches below grade. Therefore, only zero to 6-inch deep samples would be collected at these stations.

1. After identifying the soil location, the sampler should position the polycarbonate core tube at a 40° angle before driving it into the sediment.
2. Once the core has reached the appropriate depth, the tube should be capped with either the sampler's hand or a cap to create a suction and keep the sediment in place
3. Withdraw the core slowly. Once above the water, carefully decant the excess water in the tube before depositing the sediment sample.
4. Homogenize the sediment using a stainless-steel trowel or spatula.
5. Gently fill the laboratory-provided sample containers.
6. Repeat the sediment sampling protocol described above for each sampling location, as applicable. Record the sampling information the appropriate field data sheet, field book,

After Sample Collection:

1. Collect QA/QC samples in accordance with the site-specific work plan(s). These may include, but are not limited to, duplicates, matrix spike/matrix spike duplicates (MS/MSD), field blanks, temperature blanks, trip blanks, rinsate blanks, etc.
    - Typical QA/QC protocols are 1 duplicate sample per 20 samples, 1 temperature blank per cooler, and 1 equipment blank/rinsate blank per day, per sampling device when sampling tools are decontaminated.
2. Ensure sample container lids are secure and confirm sample label includes:
    - Project name,
    - Sample ID,
    - Sample date,
    - Sample time of collection (each sample receives a unique sample time, there should not be two or more samples with the same sample time),
    - Analysis,
    - Preservative, and

- Sampler's initials.

3. Document sample information in field book, boring logs, Collector App, etc., as prescribed in the site-specific work plan(s). The sample collection time, sample ID, sample parameters, and sample container used should be legibly marked in the field book and match the information on the sample container label and Chain of Custody (CoC).
4. Document sample information on CoC.
5. Place sample containers into a clean re-sealable plastic bag, then place the bag in a cooler with double-bagged ice to preserve sample quality and maintain a temperature of less than 6°C. Refer to the site-specific work plan(s) or ask the PM for additional information regarding sample preservation, packing, and shipping.

Start of Day, Between Sediment Sampling Locations, and End of Day:

1. Decontaminate any tools used to collect samples at the start of each day, between each sample location, and at the end of each day in order to mitigate potential cross-contamination of samples.
2. Gloves and assorted disposables should be packaged in a garbage bag and disposed in the nearest sanitary waste receptacle.

Decontamination:

1. Establish a decontamination area away from sampling activities.
2. Use a three-stage decontamination process to clean field sampling and other downhole equipment between multiple uses.
    - In a PFAS-free bucket wash the equipment with a mixture of PFAS-free water and PFAS-free soap (bucket #1).
    - In a second PFAS-free bucket (bucket #2), rinse the equipment with PFAS-free water.
    - A second rinse should be done with PFAS-free water using a third bucket (bucket #3).
3. Replenish decontamination solutions between sampling locations. Spent decontamination fluids should be properly disposed.

6. Resources

From Langan personnel:

- Planning Documentation
    - Health and Safety Plan – inquire about any site-specific safety requirements and/or policies
    - Sampling and Analysis Plan
    - Quality Assurance Project Plan (if applicable)
    - Sample location map
    - Field data from last sampling event (if applicable)

  - Client contact and site contact for coordinating access

- Equipment
  - PPE, as specified in the HASP (at minimum, Level D),
  - Mobile field tablet with GIS maps and Collector App,

- General Equipment
  - Stainless-steel trays/bowls
  - Paper towels
  - Boots and/or waders
  - Flotation device
  - Cooler and ice
  - Appropriate decontamination supplies:
    - Distilled water,
    - Alconox or equivalent (e.g., Simple Green),
    - Decontamination brush,
    - High-density polyethylene (HDPE) 5-gallon buckets
  - Field logbook and field sheets
  - Laboratory-supplied sample jars and labels
  - Disposable powderless nitrile gloves
  - Ball point pens and fine-tipped Sharpie Markers,
  - Re-sealable low-density polyethylene (LDPE) bags (e.g., Ziploc®) (to store sample containers)
  - Several garbage bags
  - Ruler and/or measuring tape
  - Stainless steel spatulas or trowels
  - Box cutter or knife
  - Stainless steel scoop

- Spade/trowel sampling
  - Stainless steel spade

- Benthic Dredging
  - Disposable 5-ft polycarbonate core tube

From the laboratory contractor:

- High-density polyethylene (HDPE) sampling jars – before ordering, check work plan(s) and confirm the scope with the PM. While not required, it is advisable and good practice to order spare sampling jars as a contingency but there may be incremental costs.
- QA/QC Sampling – QA/QC samples include collection of duplicate, rinsate/equipment blank, and field blank samples in accordance with the site-specific work plan(s). Refer to the site-specific work plan(s) and ask your PM which QA/QC samples will be collected and for what analyses.

- CoC Form – follow standard sample nomenclature when completing the CoC and the sample identification of the soil sample jars. Sample nomenclature is defined in the work plan, Quality Assurance Project Plan (QAPP), or Langan's sample nomenclature SOP.
- PFAS-free deionized water – Used for the final rinse of field sampling equipment and downhole equipment during the decontamination process. Water must be laboratory-verified as PFAS-free prior to use. Decontamination solutions should be replenished between sampling locations as needed.

See Recommended Environmental PFAS Sampling Procedures (SOP) for additional guidance on the selection of sampling equipment and materials.

7. References:

- Block et al, 13 December 2018. The unique methodological challenges of winter limnology. 64 pages.
- Interstate Technology and Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance Document, Section 11.1.7.5, https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/
- USEPA Region 4. 23 February 2020. Sediment Sampling Operating Procedure. 17 pages.
- USEPA Region 9. September 1999. Field Sampling Guidance Document #1215 Sediment Sampling. 10 pages.
- USEPA, 17 November 1994. Sediment Sampling SOP#: 2016. 11 pages.
- USEPA Final Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.

8. Revision History:

- May 15, 2025 - Version 1.0
  - Adapted from: *Langan Sediment Sampling Procedure V1.0 10 October 2022*
- October 31, 2025 – Version 2.0

Standard Operating Procedure (SOP) for Monitoring Well Installation and Development for Per and Polyfluoroalkyl Substances (PFAS) Analysis

1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to outline the proper installation and development of monitoring wells to ensure the collection of accurate and representative groundwater samples, water-level measurements, and other field data.

Monitoring wells must be installed using construction materials that do not introduce contaminants or degrade sample quality. Proper well installation involves selecting materials compatible with site conditions and ensuring secure seals and locking well covers to prevent cross-contamination between aquifers and from surface contaminants. Construction methods should minimize disturbance to the surrounding subsurface and maintain the integrity of the monitoring well for long-term data collection.

Following installation, monitoring wells must be developed to remove drilling fluids, fine-grained particles, and any residual materials that could impact sample quality. Development restores aquifer hydraulic conductivity, establishes an effective filter pack around the well screen, and removes any skin that may form around the screen. This process allows for the collection of water-level data and groundwater samples that are reproducible and chemically and physically representative of the aquifer of interest.

This SOP provides detailed guidance on well installation and development procedures, including appropriate techniques such as bailing, overpumping, surging, and jetting. It also includes protocols for planning, pre-development procedures, post-development verification, and documentation. Site-specific factors, such as recharge rates, well depth, and equipment limitations, may necessitate modifications, which should be discussed with the Project Manager. Proper adherence to these procedures ensures the reliability of monitoring wells for long-term environmental assessments and contaminant migration studies.

2. Limitations

The procedures described herein should be followed to meet project data quality objectives. Note, however, that regulatory, client-specific, health & safety, or field conditions ("overriding conditions") may necessitate deviations from the procedures in this SOP to address such overriding conditions. Deviations should be documented in the final report for the associated phase of the project.

3. Health and Safety

When working on-site, comply with the project Health and Safety Plan (HASP) and Langan's Injury and Illness Prevention Program. Proper personal protection clothing and equipment (PPE) are to be worn as specified in the HASP and Job Safety Analysis (JSA).

4. Scope, Application and Planning

This Standard Operating Procedure (SOP) provides guidance on the drilling, installation, and development of groundwater monitoring wells to ensure accurate sampling and reliable field data. Monitoring wells serve as critical access points for groundwater sampling, water-level measurements, and other field data collection. They must be constructed using materials that are compatible with contaminants potentially present in soils or groundwater, so as not to contribute or degrade samples. Additionally, properly installed seals and locking well covers are essential to prevent cross-contamination between aquifers and from surface contaminants.

While this SOP outlines general procedures, site-specific conditions may necessitate modifications. During the planning stage, evaluate all known or potential contaminants and consider factors such as recharge rates, anticipated volumes of development water, and best practices for handling, storage, and disposal of development water. Where necessary, contain well development water in steel drums or other suitable containers with adequate headspace for volatile contaminants.

Coordinate with the Project Manager (PM) and onsite personnel to confirm the locations of monitoring wells, arrange site access, and ensure the availability of necessary keys or tools. Ideally, well development should commence 24 hours to no more than 7 days after well completion, grouting, and well-head or surface casing protection. However, for wells with high recharge rates or specific installation methods, discuss with the PM whether development can begin sooner or should be delayed. During development, monitor water quality parameters—pH, specific conductance, temperature, and turbidity—to optimize well performance.

Adherence to the procedures in this SOP and any approved site-specific modifications will ensure that installed monitoring wells provide representative groundwater samples and maintain the long-term integrity of the subsurface environment.

5. Methods

Monitoring Well Installation

Pre-Installation Preparation:

1. Review the sampling plan, QAPP and site-specific instructions and documents.
2. Review the scope of work with the drilling subcontractor to assure that proper equipment is available, and that the field operations and health and safety requirements are understood.
3. Before the field work begins, complete the Langan Safe Work Certificate (SWC) which provides a summary of the daily work tasks, identification of potential hazards

associated with the work tasks and measures employees should follow to mitigate potential hazards.

4. Before the field work begins, complete the Langan Safe Work Certificate (SWC) which provides a summary of the daily work tasks, identification of potential hazards associated with the work tasks and measures employees should follow to mitigate potential hazards.
5. Verify that personnel are aware of and adhere to protocols to minimize PFAS cross-contamination. See Recommended Environmental PFAS Sampling SOP for expanded guidance.
6. Confirm the drilling subcontractor does not use lubricants or decontamination fluids containing PFAS.
7. Underground cable, power lines, and utilities will be determined before drilling activities begin.

Well Installation:

1. Identify the well installation location and at what depth it should be advanced based on site-specific work plans. Wear proper PPE and stay clear of equipment during operation.
2. Clear the first 5-feet of the borehole with soft-digging techniques (i.e. air-knife or other).
3. Advance the borehole to the required depth utilizing a hollow-stem auger or other drilling tool/methods suited to the subsurface and drilling conditions.
4. Make up the screen for installation. The casing and screen should be sampled with an equipment blank (follow water sampling SOP procedures under separate cover, as applicable).
5. Lower the casing string into the drill casing.
6. Install the filter pack. Six inches or more of filter pack material should be spotted at the bottom of the hole, under the screen. Filter pack will be installed to 2 to 3 feet above the top of the screen.
7. Check the depth to the top of the filter pack with a weighted tape.
8. Feed bentonite (PFAS-free) onto the top of the filter pack.
9. Pure bentonite grout will be used as the annular seal, grout will be mechanically mixed with the appropriate amount of water.
10. If wellhead is completed as flush-mounted construction, finish the concrete pad so that it slopes away from the wellhead. If weather conditions warrant, cover the concrete until cured. Lock the well cover.
11. Record the appropriate construction/completion information in the field logbook and on the appropriate monitoring well installation.
12. The well identification should be marked on the protective casing and PVC cap.

Sample Collection:

1. As prescribed in the sampling plan and QAPP, rinsate blank samples from the drill tools will be collected using laboratory-provided sample containers. Samplers will label

sample bottles with the sample identification, date, time, and analysis to be performed.
2. Equipment blanks should taken for both drill tool(s) and PVC screen/casing of well.
3. Fill the sample bottle taking care not to overfill and flush out (or spill) any preservative, if present.
4. Cap the bottle tightly and place it immediately into a cooler with double-bagged ice to maintain a temperature of less than 10°C.

Decontamination:

If required by the project or if field conditions are such that direct collection is not possible, the sampler should discuss the use of tubing or other sampling equipment to support sample collection with the project manager using the tiered approach and equipment guides in the Recommended Environmental PFAS Sampling SOP. Prior to use of any sampling equipment that will contact the sample, an initial decontamination should be completed and an equipment rinsate blank collected.

1. Establish a decontamination area away from sampling activities.
2. Perform a 4-step decontamination of sampling equipment before sample collection and between sampling locations (if equipment is being re-used).
    - Wash with potable water and a detergent.
        - Alconox, Liquinox, and Citrinox are generally acceptable detergents, but it is recommended to verify potential presence/absence of PFAS with manufacturer prior to their use.
    - Initial potable water rinse.
    - Secondary potable water rinse.
    - Complete a final triple-rinse with lab verified PFAS-free water (for components coming into direct contact with sample).

Documentation:

1. Record all well construction details in the field logbook and well construction log, including:
    - Lithology observed
    - Odors, staining, or other discerning observations in soil
    - Top and bottom depth of casing
    - Screen length
    - Length of time for well development
    - Amount of water purged for well development
    - Deviations from the SOP (including documentation of reasons for the deviation and the alternative procedures used)
    - Other observations
2. Record all sampling details in the field logbook, including:
    - Date and time of sample collection
    - Sample location

- Deviations from the SOP (including documentation of reasons for the deviation and the alternative procedures used)
- Other observations

3. Ensure the COC form is signed by all parties involved in the sample handling and transportation.

Quality Assurance/Quality Control (QA/QC):

Follow QA/QC procedures as outlined in the sampling plan, including the collection of field duplicates, field blanks, field reagent blanks, equipment rinsate blanks, trip blanks, and source water blanks, as applicable. QA/QC samples shall be identified with unique sample IDs on chains of custody for submission to the laboratory.

1. Field Blanks (FB): If required, collect by pouring laboratory-provided deionized water into a sample bottle at the sampling site.
2. Equipment Rinsate Blanks (ERB): If sampling equipment will contact the sample, the sampler should collect an ERB from that piece of equipment. Collect the ERB following decontamination (steps below). Pour laboratory-provided PFAS-free deionized water through the sampling tube/equipment and into a laboratory-supplied sample container. To the extent practicable, sampling equipment should be dedicated to each sampling location and not utilized at multiple sample sites to avoid cross-contamination.
   - When in Doubt Blank it Out: If field personnel identify a potential cross contamination issue or source or cannot avoid use of a restricted Tier 1 or 2 material, an ERB should be collected. Field personnel should discuss the situation with the project manager prior to submittal for analysis.
3. Trip Blanks (TB): If required, sampler shall collect a trip blank with each sample shipment to the lab. Samplers should verify that trip blanks remain unopened and accompany the samples throughout the sampling and transportation process.
4. Verify that samples are properly labeled, documented, and transported under chain-of-custody procedures.
5. Verify that samplers follow the guidelines outlined in this document, including proper sample handling, documentation, and transportation.

Monitoring Well Development

Monitoring wells are developed to settle and remove fines from the surrounding geologic formation and filter pack. Wells should not be developed for 24 hours after completion when a bentonite grout is used to seal the annular space. Wells are purged immediately before groundwater sampling to remove stagnant water and collect a sample that represents groundwater conditions. Wells should be sampled within 3 hours of purging (optimum) to 24 hours after purging (maximum, for low recharge conditions). Means and methods of developing wells can vary and include:

- Bailing: removing volumes of water with a bailer;

- Over-pumping: pumping the well at a rate higher than recharge;
- Surging: forcing water to flow into and out of the screen by operation of a plunger (surge block) up and down within the well casing, similar to a piston in a cylinder or vi air-lift pumping; and
- Jetting: forcing water into the well at high pressure or flow rate

Means methods and procedures are subject to change based on actual field and subsurface conditions encountered and in discussion and consultation with the driller. This SOP describes protocols and procedures for initial scoping/planning/preparation, pre-development procedures, well development methods, post-development procedures and documentation, other resources and considerations, and select reference materials.

1. Confirm with the project manager and project team before mobilizing to the field the manner in which development water will be handled/managed consistent with project plans and as pre-determined before the on-set of the well development program. Prepare and communicate to the driller and field team.
2. Turn on and calibrate water quality meter(s) in accordance with the manufacturer's instructions, record calibration in the field book.
3. Open and check the condition of the wellhead, noting and recording the condition of the well covers, pressure caps and surveyed reference mark (if present). If a surveyed reference mark is not present, inform the PM. Mark the location of collected measurements on the wellhead using a permanent marker or paint pen on the north side of the top of casing.
4. Measure and record the depth of the static water level (DTW) and depth-to-bottom (DTB) in the monitoring well from the reference mark using an electronic water-level meter, oil/water interface probe or weighted measuring tape and record them in a field form, notebook, or tablet. Compare measurements to previous records of total depth and dimensions obtained from the well installation/completion records, if available.
5. Calculate well volume and record.
    - General equation:
        - For a 2-inch monitoring well:
        - r is radius of well casing in feet (i.e., half of the diameter)
        - H is the difference between the DTW and DTB in feet
6. Setup the selected development method and ensure you can control the flow/discharge of the purged groundwater directed to an appropriate pre-determined location and/or container.
7. Monitor water quality indicator parameters (e.g. pH, specific conductance and turbidity) before beginning development procedures and record during and the end of the development period. During development, visually note any changes/improvements in the observed color and turbidity of discharge water and monitor water quality parameters periodically.
8. Develop the well until produced water is visually clear and free of suspended solids.

9. If the well is depleted of all water during development, temporarily discontinue pumping/bailing and allow groundwater to recharge. Record the recharge rate with periodic water level measurements.
10. Remove the pump assembly from the well and decontaminate. Lock the well cover prior to departure.
11. Manage and properly handle development water generated consistent with project plans and as pre-determined before the on-set of the well development program.

Post Sampling:

1. Complete the sample bottle labels with time of collection and COC form, ensuring information is accurate and matches the sample labels.
2. Store the samples in the cooler with ice (double bagged), not ice packs, to maintain a sample temperature of less than 10°C until they are relinquished to the laboratory or laboratory courier.
3. Transport samples to the laboratory within 48-hours, ideally within 24 hours of collection.

6. Resources

Monitoring well installation and development requires that materials and services be provided by outside contractors and suppliers. The drilling subcontractor will provide the appropriate drilling and sampling tools. Laboratory suppliers will provide the sample containers and perform analytical testing of the samples. This section outlines the requirements from each entity.

From the drilling subcontractor:

- Drilling rig capable of installing wells to the depth in the expected formation material and conditions.
- Drilling or auguring equipment appropriate to site conditions, drilling depth, and other project requirements.
- Drill bits appropriate for the expected soil and rock type(s) to be encountered.
- Sufficient threaded flush-joint riser pipe of an approved material [stainless steel, polyvinyl chloride (PVC), Teflon] in convenient lengths.
- Sufficient threaded flush-joint slotted screen of an approved material (stainless steel, PVC, Teflon) to meet design criteria.
- Properly sized and washed filter pack material (quartz sand) in sufficient volume to meet well design criteria.
- Bentonite or other well PFAS-free well seal material.
- Protective casing with locking cap.
- Weighted measuring tape.

From the environmental equipment rental company:

- Electronic water level meter

From the laboratory contractor:

- High-density polyethylene (HDPE) sampling jars – before ordering, check work plan(s) and confirm the scope with the PM. While not required, it is advisable and good practice to order spare sampling jars as a contingency but there may be incremental costs.
- QA/QC Sampling – QA/QC samples include collection of duplicate, rinsate/equipment blank, and field blank samples in accordance with the site-specific work plan(s). Refer to the site-specific work plan(s) and ask your PM which QA/QC samples will be collected and for what analyses.
- CoC Form – follow standard sample nomenclature when completing the CoC and the sample identification of the soil sample jars. Sample nomenclature is defined in the work plan, Quality Assurance Project Plan (QAPP), or Langan's sample nomenclature SOP.
- PFAS-free deionized water – Used for the final rinse of field sampling equipment and downhole equipment during the decontamination process. Water must be laboratory-verified as PFAS-free prior to use. Decontamination solutions should be replenished between sampling locations as needed.

From Langan personnel:

- Planning Documentation:
  - Health and Safety Plan – inquire about any site-specific safety requirements/policies,
  - Sampling and Analysis Plan/Work plan(s)/proposal,
  - QAPP (if applicable),
  - Printed sample location maps and figures,
  - Printed field sheets/boring logs, well construction logs and /or
  - Client contact and site contact for coordinating access

- Equipment
  - PPE, as specified in the HASP (at minimum, Level D),
  - GPS or survey equipment,
  - Disposable powderless nitrile gloves,
  - Paper towels,
  - Re-sealable low-density polyethylene (LDPE) bags (e.g., Ziploc®) (to store sample containers)
  - Weighted tape measure.
  - Mobile field tablet with GIS maps and Collector App,
  - Steel pin flags, or wooden stakes and spray paint/high-visibility flashing,
  - Appropriate decontamination supplies:
    - Distilled water,
    - Alconox or equivalent (e.g., Simple Green),
    - Decontamination brush,

- Plastic Sheeting
- High-density polyethylene (HDPE) 5-gallon buckets
- Trash bags or container for waste (drum or bucket, 5-gallon), and
- Labels for waste container,

See Recommended Environmental PFAS Sampling Procedures (SOP) for additional guidance on the selection of sampling equipment and materials.

8. References:

- ASTM D5521/D5521M-18 Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers
- Driscoll, F.G., "Groundwater and Wells", 2nd Edition, Johnson Division, St. Paul, Minnesota, 1986.
- Interstate Technology and Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance Document, https://pfas-1.itrcweb.org/.
- USEPA Final Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.

9. Revision History:

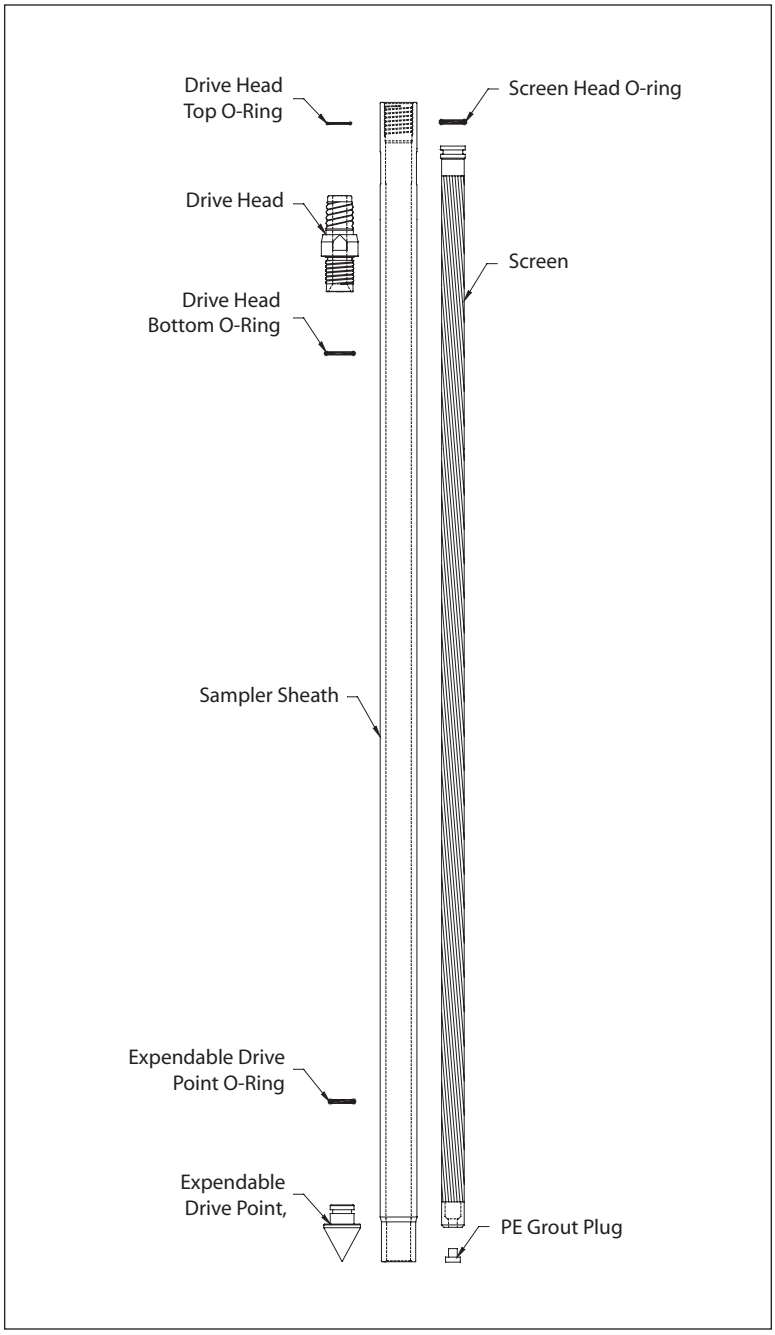
- December 24, 2024 - Version 1.0
- March 6, 2025 – Version 2.0

GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3142

PREPARED: November, 2006



GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER PARTS



Geoprobe® and Geoprobe Systems®, Macro-Core® and Direct Image® are Registered Trademarks of Kejr, Inc., Salina, Kansas

Screen Point 16 Groundwater Sampler is manufactured under U.S. Patent 5,612,498

COPYRIGHT© 2006 by Kejr, Inc.
ALL RIGHTS RESERVED.
No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from Kejr, Inc.

1.0 OBJECTIVE

The objective of this procedure is to drive a sealed stainless steel or PVC screen to depth, deploy the screen, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 16 Groundwater Sampler enables the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 BACKGROUND

2.1 Definitions

Geoprobe®: A brand name of high quality, hydraulically powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and monitoring, soil conductivity and contaminant logging, grouting, and materials injection.

Screen Point 16 (SP16) Groundwater Sampler: A direct push device consisting of a PVC or stainless steel screen that is driven to depth within a sealed, steel sheath and then deployed for the collection of representative groundwater samples. The assembled SP16 Sampler is approximately 51.5 inches (1308 mm) long with an OD of 1.625 inches (41 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. The Screen Point 16 Groundwater Sampler is designed for use with 1.5-inch probe rods and machines equipped with the more powerful GH60 Hydraulic Hammer. Operators with GH40 Series hammers may chose to use this sampler in soils where driving is difficult.

Rod Grip Pull System: An attachment mounted on the hydraulic hammer of a direct push machine which makes it possible to retract the tool string with extension rods or flexible tubing protruding from the top of the probe rods. The Rod Grip Pull System includes a pull block with rod grip jaws that are bolted directly to the machine. A removable handle assembly straddles the tool string while hooking onto the pull block to effectively grip the probe rods as the hammer is raised. A separate handle assembly is required for each probe rod diameter.

2.2 Discussion

In this procedure, the assembled Screen Point 16 Groundwater Sampler (Fig. 2.1A) is threaded onto the leading end of a Geoprobe® probe rod and advanced into the subsurface with a Geoprobe® direct push machine. Additional probe rods are added incrementally and advanced until the desired sampling interval is reached. While the sampler is advanced to depth, O-ring seals at each rod joint, the drive head, and the expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods (Fig. 2.1B). As the tool string is retracted, the expendable point is released from the sampler sheath. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

There are three types of screens that can be used in the Screen Point 16 Groundwater Sampler. Two of the these, a stainless steel screen with a standard slot size of 0.004 inches (0.10 mm) and a PVC screen with a standard slot size of 0.010 inches (0.25 mm), are recovered with the tool string after sampling. The third screen is also manufactured from PVC with a standard slot size of 0.010 inches (0.25 mm), but is designed to be left downhole when sampling is complete. This disposable screen has an exposed screen length of approximately 43 inches (1092 mm). The two screens that are recovered with the sampler both have an exposed screen length of approximately 41 inches (1041 mm).

(continued on following page)

An O-ring on the head of the stainless steel screens maintains a seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen. PVC screens do not require an O-ring because the tolerance between the screen head and sampler sheath is near that of the screen slot size.

The screens are constructed such that flexible tubing, a mini-bailer, or a small-diameter bladder pump can be inserted into the screen cavity. This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screens allows the user to grout as the sampler is extracted for further use.

Groundwater samples can be obtained in a number of ways. A common method utilizes polyethylene (TB25L) or Teflon® (TB25T) tubing and a Check Valve Assembly (GW4210). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down.

An alternative means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). Another technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

The latest option for collecting groundwater from the SP16 sampler is to utilize a Geoprobe® MB470 Series Mechanical Bladder Pump (MBP)*. The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).

**The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

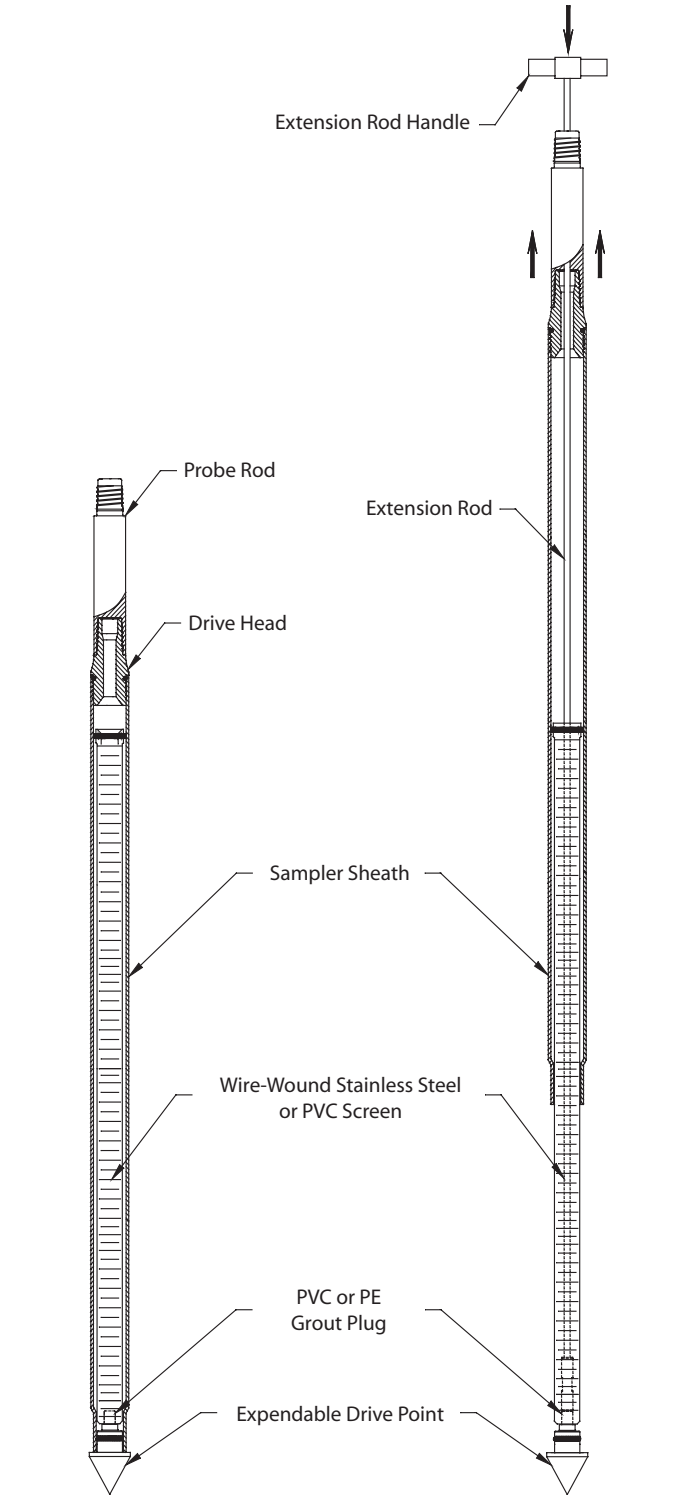


FIGURE 2.1
Screen Point 16 Groundwater Sampler

3.0 TOOLS AND EQUIPMENT

The following tools and equipment can be used to successfully recover representative groundwater samples with the Geoprobe® Screen Point 16 Groundwater Sampler. Refer to Figures 3.1 and 3.2 for identification of the specified parts. Tools are listed below for the most common SP16 / 1.5-inch probe rod configurations. Additional parts for optional rod sizes and accessories are listed in Appendix A.

SP16 Sampler Parts	**Part Number**
SP16 Sampler Sheath	15187
SP16 Drive Head, 0.5-inch bore, 1.5-inch rods*	18307
SP16 O-ring Service Kit, 1.5-inch rods *(includes 4 each of the O-ring packets below)*	15844
O-rings for Top of SP16 Drive Head, 1.5-inch rods only (Pkt. of 25)	*15389*
O-rings for Bottom of SP16 Drive Head (Pkt. of 25)	*13196*
O-rings for GW1520 Screen Head (Pkt. of 25)	*GW1520R*
O-rings for SP16 Expendable Drive Point (Pkt. of 25)	*GW1555R*
Screen, Wire-Wound Stainless Steel, 4-Slot*	GW1520
Grout Plugs, PE (Pkg. of 25)	GW1552K
Expendable Drive Points, steel, 1.625-inch OD (Pkg. of 25)*	GW1555K
Screen Point 16 Groundwater Sampler Kit, 1.5-inch Probe Rods *(includes 1 each of: 15187, 18307, 15844, GW1520, GW1535, GW1540, GW1555K, and GW1552K)*	15770

Probe Rods and Probe Rod Accessories	**Part Number**
Drive Cap, 1.5-inch probe rods, threadless, (for GH60 Hammer)	12787
Pull Cap, 1.5-inch probe rods	15090
Probe Rod, 1.5-inch x 60-inch*	11121

Extension Rods and Extension Rod Accessories	**Part Number**
Screen Push Adapter	GW1535
Grout Plug Push Adapter	GW1540
Extension Rod, 60-inch*	10073
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Jig	AT690
Extension Rod Quick Link Coupler, pin	AT695
Extension Rod Quick Link Coupler, box	AT696

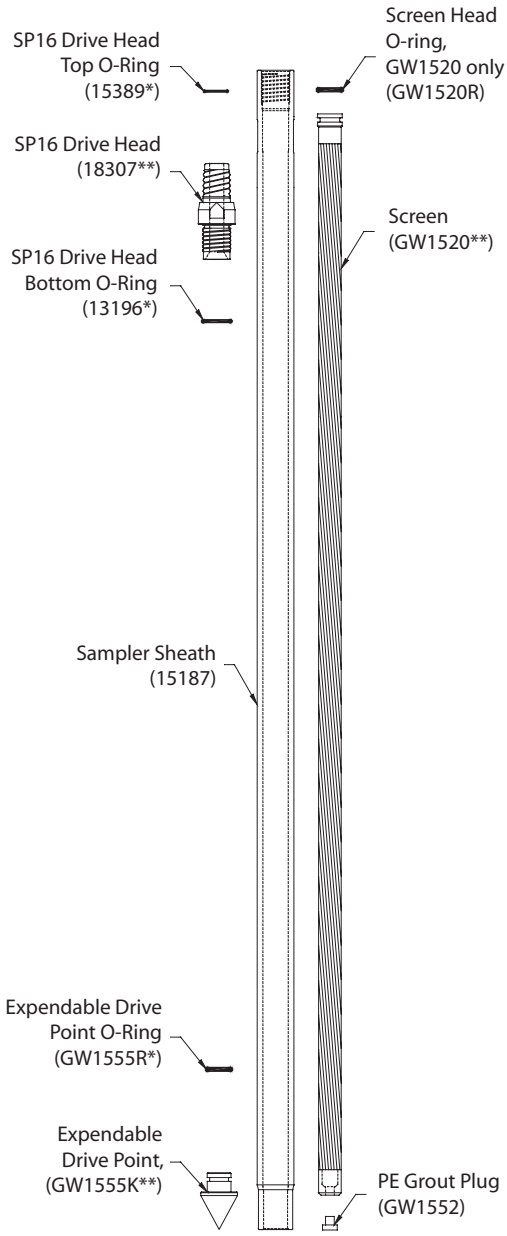
Grout Accessories	**Part Number**
Grout Nozzle, for 0.375-inch OD tubing	GW1545
High-Pressure Nylon Tubing, 0.375-inch OD / 0.25-inch ID, 100-ft. (30 m)	11633
Grout Machine, self-contained*	GS1000
Grout System Accessories Package, 1.5-inch rods	GS1015

Groundwater Purging and Sampling Accessories	**Part Number**
Polyethylene Tubing, 0.375-inch OD, 500 ft.*	TB25L
Check Valve Assembly, 0.375-inch OD Tubing*	GW4210
Water Level Meter, 0.438-inch OD Probe, 100 ft. cable*	GW2000
Mechanical Bladder Pump**	MB470
Mini Bailer Assembly, stainless steel	GW41

Additional Tools	**Part Number**
Adjustable Wrench, 6.0-inch	FA200
Adjustable Wrench, 10.0-inch	FA201
Pipe Wrenches	NA

* See Appendix A for additional tooling options.

** Refer to the Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.



* Included in the SP16 O-ring Service Kit (15844)
** Part numbers show most common tool configuration. See Appendix A for alternative parts.

FIGURE 3.1
SP16 Sampler Parts

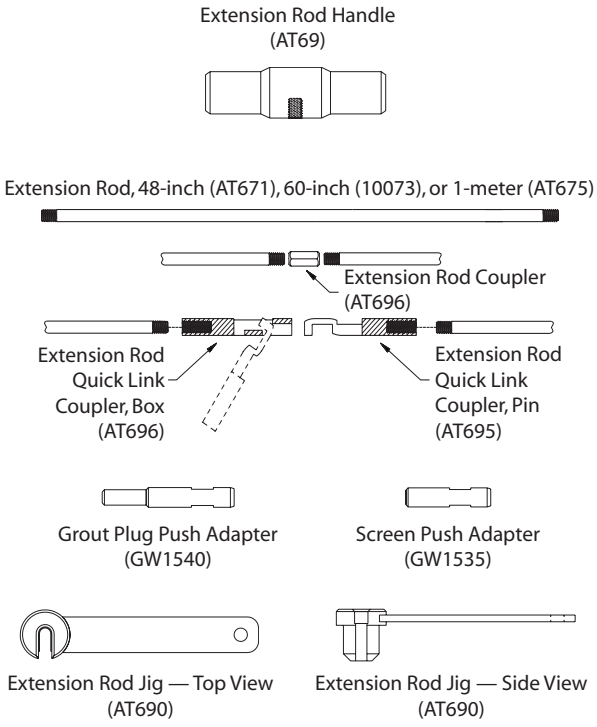


FIGURE 3.2
Geoprobe® Extension Rods and Accessories

4.0 OPERATION

4.1 Basic Operation

The SP16 sampler utilize a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a watertight sheath which keeps contaminants out of the system as the sampler is driven to depth.

Once the sampling interval is reached, extension rods equipped with a screen push adapter are inserted down the ID of the probe rods. The tool string is then retracted up to 44 inches (1118 mm) while the screen is held in place with the extension rods. The system is now ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

4.2 Sampler Options

The Screen Point 15 and Screen Point 16 Groundwater Samplers are nearly identical. Subtle differences in the design of the SP16 sampler make it more durable than the earlier SP15 system. Operators of GH60-equipped machines should always utilize SP16 tooling. Operators of machines equipped with GH40 Series hammers may also choose SP16 tooling when sampling in difficult probing conditions.

A 1.75-inch OD Expendable Drive Point (17066K) and Disposable PVC Screen (16089) provide two useful options for the SP16 sampler. The 1.75-inch drive point may be used when soil conditions make it difficult to remove the sampler after driving to depth. The disposable PVC screen may be left downhole after sampling (when regulations permit) to eliminate the time required for screen decontamination.

4.3 Decontamination

In order to collect representative groundwater samples, all sampler parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

4.4 SP16 Sampler Assembly (Figure 4.1)

Part numbers are listed for a standard SP16 sampler using 1.5-inch probe rods. Refer to Page 6 for screen and drive head alternatives.

1. Place an O-ring on a steel expendable drive point (GW1555K). Firmly seat the expendable point in the necked end of a sampler sheath (15187).

2. Install a PE Grout Plug (GW1552) in the bottom end of a Wire-wound Stainless Steel Screen (GW1520). Place a GW1520R O-ring in the groove on the top end of the screen.

3. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Ensure that the expendable point was not displaced by the screen.

4. Install a bottom O-ring (13196) on a Drive Head (18307 or 15188). Thread the drive head into the sampler sheath using an adjustable wrench if necessary to ensure complete engagement of the threads. Attach a Drive Cap (12787 or 15590) to the top of the drive head.

   NOTE: The 18307 drive head should be used whenever possible as the smaller 0.5-inch ID provides a greater material cross-section for increased durability.

Sampler assembly is complete.

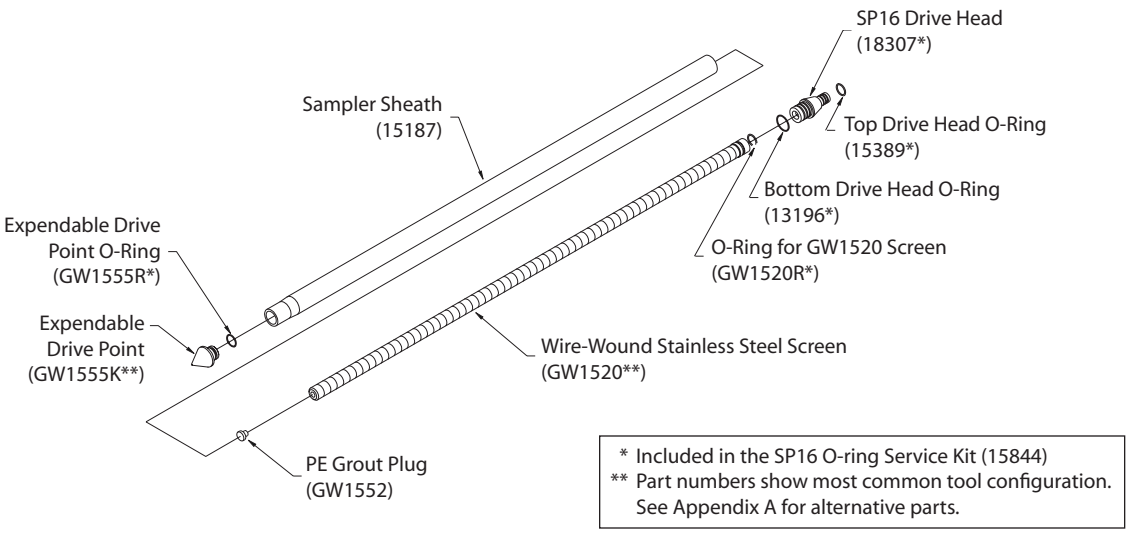


FIGURE 4.1
Screen Point 16 Groundwater Sampler Assembly

4.5 Advancing the SP16 Sampler

To provide adequate room for screen deployment with the Rod Grip Pull System, the probe derrick should be extended a little over halfway out of the carrier vehicle when positioning for operation.

1. Begin by placing the assembled sampler (Fig. 2.1.A) in the driving position beneath the hydraulic hammer of the direct push machine as shown in Figure 4.2.

2. Advance the sampler with the throttle control at slow speed for the first few feet to ensure that the sampler is aligned properly. Switch to fast speed for the remainder of the probe stroke.

3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the drive head. Distilled water may be used to lubricate the O-ring if needed.

Add a probe rod (length to be determined by operator) and reattach the drive cap to the rod string. Drive the sampler the entire length of the new rod with the throttle control at fast speed.

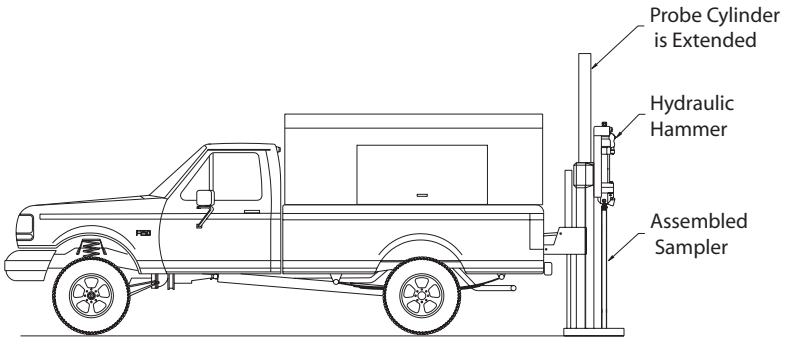


FIGURE 4.2
Screen Point 16 Groundwater Sampler in Driving Position

4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.

5. Remove the drive cap and retract the probe derrick away from the tool string.

4.6 Screen Deployment

1. Thread a screen push adapter (GW1535) on an extension rod of suitable length (AT671, 10073, or AT675). Attach a threaded coupler (AT68) to the other end of the extension rod. Lower the extension rod inside of the probe rod taking care not to drop it down the tool string. An extension rod jig (AT690) may be used to hold the rods.

2. Add extension rods until the adapter contacts the bottom of the screen. To speed up this step, it is recommended that Extension Rod Quick Links (AT695 and AT696) are used at every other rod joint.

3. Ensure that at least 48 inches (1219 mm) of extension rod protrudes from the probe rod. Thread an extension rod handle (AT69) on the top extension rod.

4. Maneuver the probe assembly into position for pulling.

5. Raise (pull) the tool string while physically holding the screen in place with the extension rods (Fig. 4.3.B). A slight knock with the extension rod string will help to dislodge the expendable point and start the screen moving inside the sheath.

   Raise the hammer and tool string about 44 inches (1118 cm) if using a GW1520 or GW1530 screen. At this point the screen head will contact the necked portion of the sampler sheath (Fig. 4.3.C.) and the extension rods will rise with the probe rods. Use care when deploying a PVC screen so as not to break the screen when it contacts the bottom of the sampler sheath.

   The Disposable Screen (16089) will extend completely out of the sheath if the tool string is raised more than 45 inches (1143 mm). Measure and mark this distance on the top extension rod to avoid losing the screen during deployment.

6. Remove the rod grip handle, lower the hammer assembly, and retract the probe derrick. Remove the top extension rod (with handle) and top probe rod. Finally, extract all extension rods.

7. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing bottom check valve assembly, bladder pump, or other acceptable small diameter sampling device.

   When inserting tubing or a bladder pump down the rod string, ensure that it enters the screen interval. The leading end of the tubing or bladder pump will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing or bladder pump past the lip and into the screen.

4.7 Abandonment Grouting for GW1520 and GW1530 Screens

The SP16 Sampler can meet ASTM D 5299 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of GW1520 and GW1530 screens. A GS500 or GS1000 Grout Machine is then used to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling. Attach the rod grip puller to the top probe rod. Raise the tool string approximately 4 to 6 inches (102 to 152 cm) to allow removal of the grout plug.

2. Thread the Grout Plug Push Adapter (GW1540) onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the grout plug at the bottom of the screen. Attach the handle to the top extension rod. When the extension rods are slightly raised and lowered, a relatively soft rebound should be felt as the adapter contacts the grout plug. This is especially true when using a PVC screen.

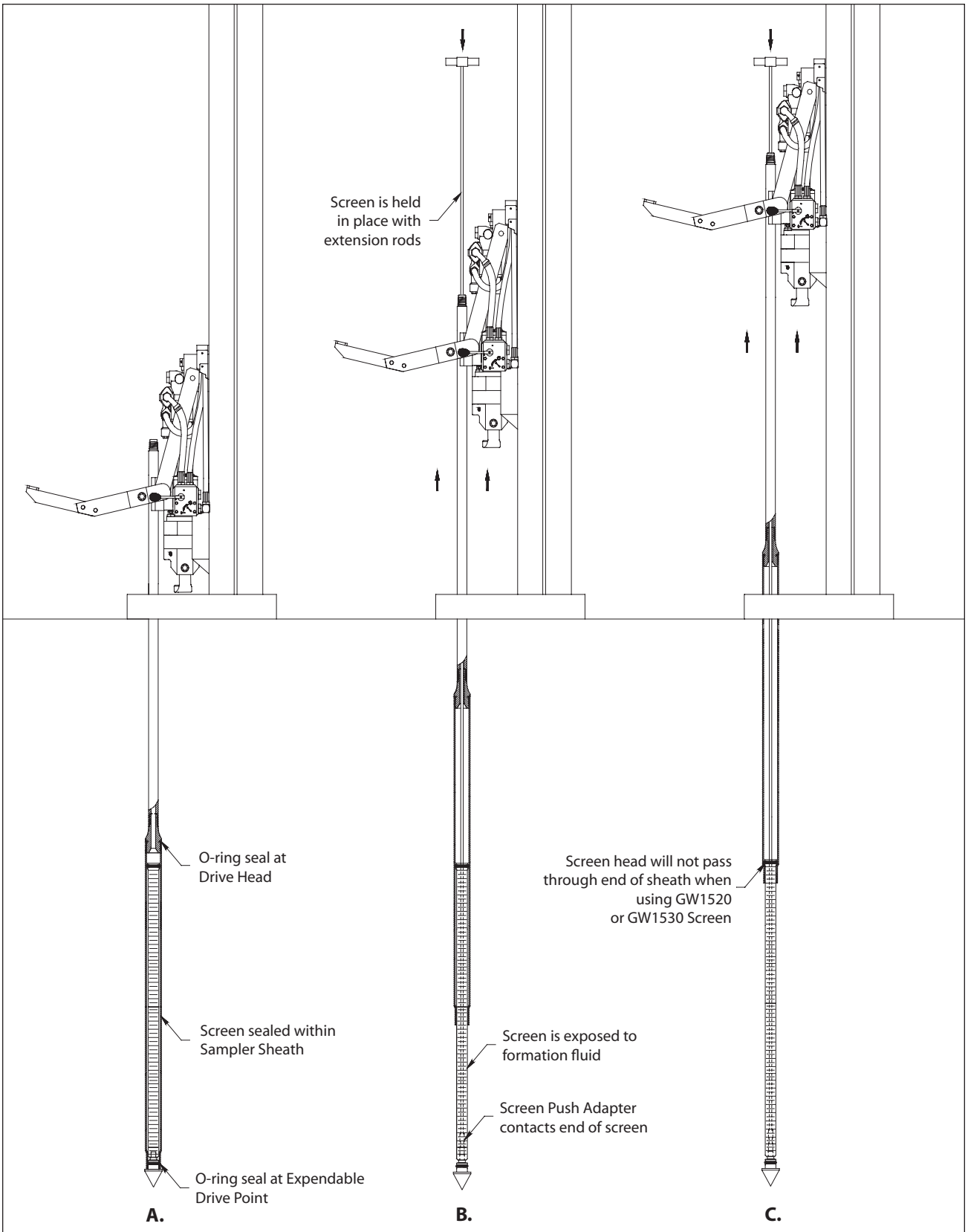


FIGURE 4.3
Screen Deployment for SP16 Sampler

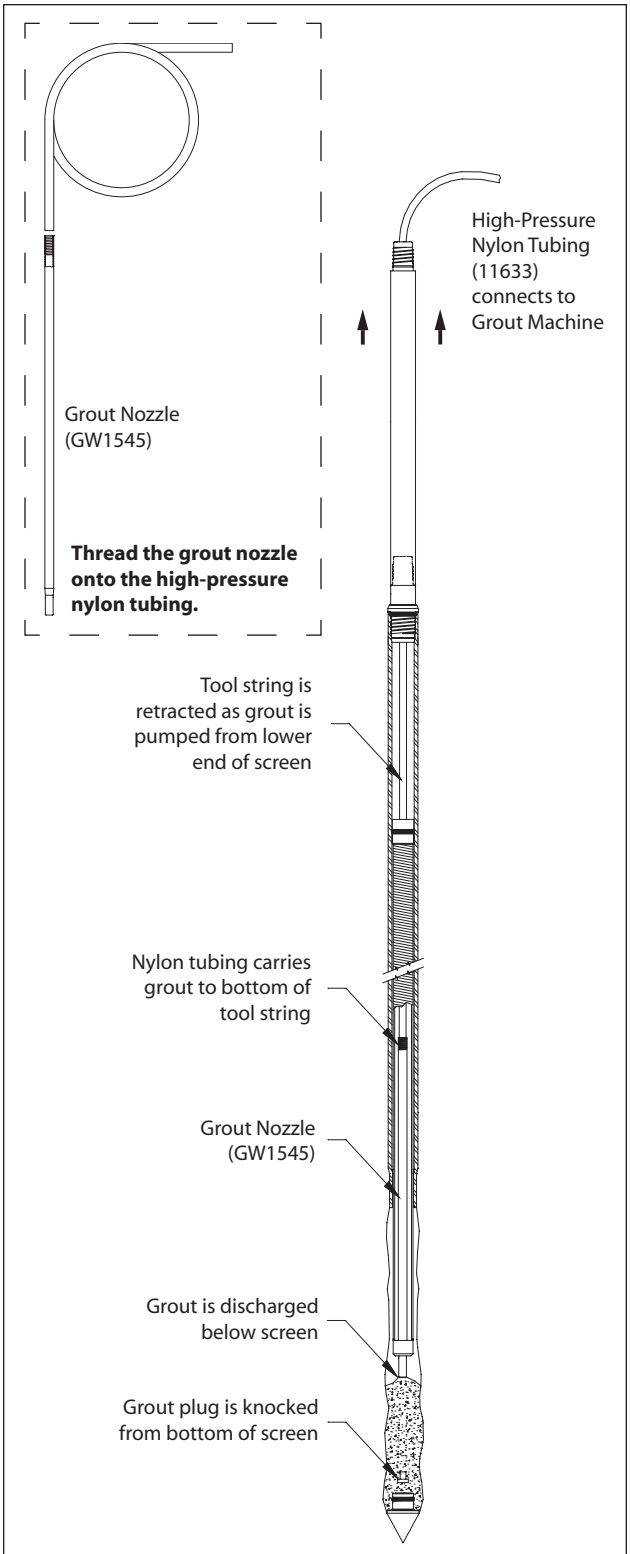


FIGURE 4.4
Grouting the SP16 Sampler With a GW1520 or GW1530 Screen

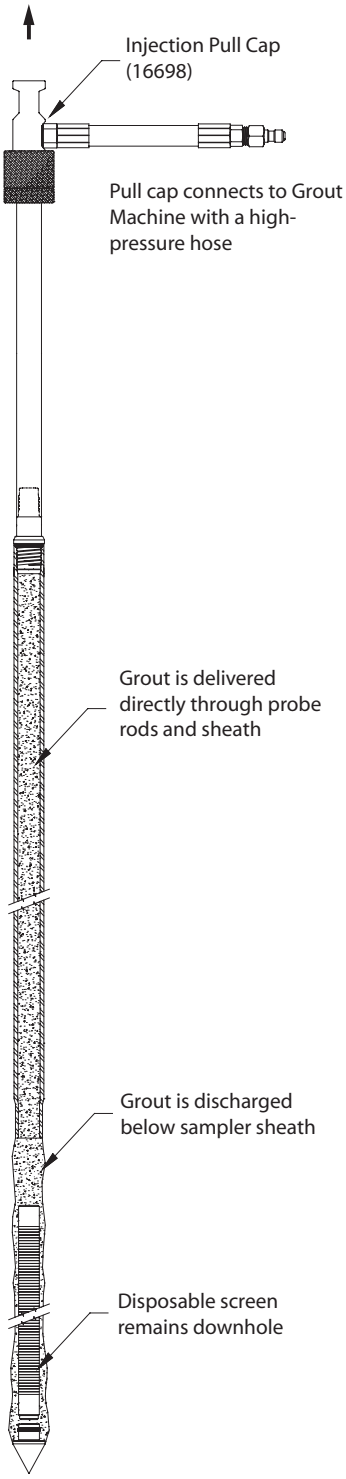


FIGURE 4.5
Grouting the SP16 Sampler With a 16089 Disposable Screen

3. Place a mark on the extension rod even with the top of the probe rod. Apply downward pressure on the extension rods and push the grout plug out of the screen. The mark placed on the extension rod should now be below the top of the probe rod. Remove all extension rods.

   Note: When working with a stainless steel screen, it may be necessary to raise and quickly lower the extension rods to jar the grout plug free. When the plug is successfully removed, a metal-on-metal sensation may be noted as the extension rods are gently "bounced" within the probe rods.

4. A Grout Nozzle (GW1545) is now connected to High-Pressure Nylon Tubing (11633) and inserted down through the probe rods to the bottom of the screen (Fig. 4.4). It may be necessary to pump a small amount of clean water through the tubing during deployment to jet out sediments that settled in the bottom of the screen. Resistance will sometimes be felt as the grout nozzle passes through the drive head. Rotate the tubing while moving it up-and-down to ensure that the nozzle has reached the bottom of the screen and is not hung up on the drive head.

   Note: *All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 20 feet is generally enough.*

5. Operate the grout pump while pulling the first rod with the rod grip pull system. Coordinate pumping and pulling rates so that grout fills the void left by the sampler. After pulling the first rod, release the rod grip handle, fully lower the hammer, and regrip the tool string. Unthread the top probe and slide it over the tubing placing it on the ground near the end of the tubing.

6. Repeat Step 5 until the sampler is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.

7. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

4.8 Abandonment Grouting for the 16089 Disposable Screen

ASTM D 5299 requirements can also be met for the SP16 samplers when using the 16089 disposable screen. Because the screen remains downhole after sampling, the operator may choose either to deliver grout to the bottom of the tool string with nylon tubing or pump grout directly through the probe rods using an Injection Pull Cap (16698). A GS500 or GS1000 Grout Machine is needed to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling with the rod grip puller.

2. Thread the screen push adapter onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the bottom of the screen. Attach the handle to the top extension rod.

3. The disposable screen must be extended at least 46 inches (1168 mm) to clear the bottom of the sampler sheath. Considering the length of screen deployed in Section 4.7, determine the remaining distance required to fully extend the screen from the sheath. Mark this distance on the top extension rod.

4. Pull the tool string up to the mark on the top extension rod while holding the disposable screen in place.

   The screen is now fully deployed and the sampler is ready for abandonment grouting. Apply grout to the bottom of the tool string during retrieval using either flexible tubing (as described in Section 4.7) or an injection pull cap (Fig. 4.5). This section continues with a description of grouting with a pull cap.

5. Remove the rod grip handle and maneuver the probe assembly directly over the tool string. Thread an Injection Pull Cap (16698) onto the top probe rod and close the hammer pull latch over the top of the pull cap.

6. Connect the pull cap to a Geoprobe® grout machine using a high-pressure grout hose.

7. Operate the pump to fill the entire tool string with grout. When a sufficient volume has been pumped to fill the tool string, begin pulling the rods and sampler while continuing to operate the grout pump. Considering the known pump volume and sampler cross-section, time tooling withdrawal to slightly "overpump" grout into the subsurface. This will ensure that all voids are filled during sampler retrieval.

   The grouting process can lubricate the probe hole sufficiently to cause the tool string to slide back downhole when disconnected from the pull cap. Prevent this by withdrawing the tool string with the rod grip puller while maintaining a connection to the grout machine with the pull cap.

4.9 Retrieving the Screen Point 16 Sampler

If grouting is not required, the Screen Point 16 Sampler can be retrieved by pulling the probe rods as with most other Geoprobe® applications. The Rod Grip Pull System should be used for this process as it allows the operator to remove rods without completely releasing the tool string. This avoids having the probe rods fall back downhole when released during the pulling procedure. A standard Pull Cap (15164) may still be used if preferred. Refer to the Owner's Manual for your Geoprobe® direct push machine for specific instructions on pulling the tool string.

5.0 REFERENCES

American Society of Testing and Materials (ASTM), 2003. D6771-02 Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. ASTM, West Conshocken, PA. (www.astm.org)

American Society of Testing and Materials (ASTM), 1993. ASTM 5299 *Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.* ASTM West Conshohocken, PA. (www.astm.org)

Geoprobe Systems®, 2003, *Tools Catalog, V.6.*

Geoprobe Systems®, 2006, *Model MB470 Mechanical Bladder Pump Standard Operating Procedure (SOP), Technical Bulletin No. MK3013.*

Puls, Robert W., and Michael J. Barcelona, 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures. EPA/540/S-95/504. April.

U.S. Environmental Protection Agency (EPA), 2003. Environmental Technology Verification Report: Geoprobe Inc., Mechanical Bladder Pump Model MB470. Office of Research and Development, Washington, D.C. EPA/600R-03/086. August.

Appendix A
ALTERNATIVE PARTS

The following parts are available to meet unique soil conditions. See section 3.0 for a complete listing of the common tool configurations for the Geoprobe® Screen Point 16 Groundwater Sampler.

SP16 Sampler Parts and Accessories	**Part Number**
SP16 Drive Head, 0.625-inch bore, 1.5-inch rods	15188
Expendable Drive Points, aluminum, 1.625-inch OD (Pkg. of 25)	GW1555ALK
Expendable Drive Points, steel, 1.75-inch OD (Pkg. of 25)	17066K
Screen, PVC, 10-Slot	GW1530
Screen, Disposable, PVC, 10-Slot	16089

Groundwater Purging and Sampling Accessories	**Part Number**
Polyethylene Tubing, 0.25-inch OD, 500 ft	TB17L
Polyethylene Tubing, 0.5-inch OD, 500 ft	TB37L
Polyethylene Tubing, 0.625-inch OD, 50 ft	TB50L
Check Valve Assembly, 0.25-inch OD Tubing	GW4240
Check Valve Assembly, 0.5-inch OD Tubing	GW4220
Check Valve Assembly, 0.625-inch OD Tubing	GW4230
Water Level Meter, 0.375-inch OD Probe, 100-ft. cable	GW2001
Water Level Meter, 0.438-inch OD Probe, 200-ft. cable	GW2002
Water Level Meter, 0.375-inch OD Probe, 200-ft. cable	GW2003
Water Level Meter, 0.438-inch OD Probe, 30-m cable	GW2005
Water Level Meter, 0.438-inch OD Probe, 60-m cable	GW2007
Water Level Meter, 0.375-inch OD Probe, 60-m cable	GE2008

Grouting Accessories	**Part Number**
Grout Machine, auxiliary-powered	GS500

Probe Rods, Extension Rods, and Accessories	**Part Number**
Probe Rod, 1.5-inch x 1-meter	17899
Probe Rod, 1.5-inch x 48-inch	13359
Drive Cap, 1.5-inch rods (for GH40 Series Hammer)	15590
Rod Grip Pull Handle, 1.5-inch Probe Rods (for GH40 Series Hammer)	GH1555
Extension Rod, 48-inch	AT671
Extension Rod, 1-meter	AT675

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.



A DIVISION OF KEJR, INC.

Corporate Headquarters
601 N. Broadway • Salina, Kansas 67401
1-800-GEOPROBE (1-800-436-7762) • Fax (785) 825-2097
www.geoprobe.com

1. Purpose

This written protocol describes the methods for collecting field data to calculate in situ hydraulic conductivity by monitoring and recording well water displaced by the use of the "pneumatic slug test" method. During a slug test the water level in a well is changed rapidly, and the rate of water-level response to that change is measured. From these data, an estimate of aquifer parameters (or coefficients) such as hydraulic conductivity can be calculated using appropriate analytical methods. These aquifer parameters are used to determine the rates of groundwater flow and contaminant transport.

Slug tests involve displacing a known volume of water in a well instantaneously while simultaneously measuring changes in the water level as it returns to equilibrium. Displacing the water in the well is accomplished by affixing a sealed hand pump to a 2" or 4" diameter well and applying pressure to displace water.

A pneumatic slug is comprised of a handheld pump, a compression coupler, and a pressure gauge for monitoring. Tests performed by increasing pressure and displacing water in the sealed well and then depressurizing are known as rising-head slug tests. Tests performed by applying a vacuum and drawing water up a sealed well before releasing that vacuum are known as falling-slug tests. Typically, falling-head tests and rising-head tests can be conducted in pairs (when appropriate) as a quality control check to measure consistency of test results.

2. Limitations

The procedures described herein shall be followed to assure compliance with Langan's Quality Management System and Quality Management Plan ("QMS/QMP"). Note, however, that regulatory, client-specific, health & safety, or field conditions ("overriding conditions") may necessitate deviations from the procedures in this SOP to address such overriding conditions. Any proposed deviation shall be consistent with the Langan QMS/QMP and the professional standard of care, and shall be reviewed and approved by the project manager and the principal-in-charge before being implemented. All approved deviations shall be documented in the final report for the associated phase of the project.

3. Health & Safety

When working on-site, comply with the site's health/safety procedures, Langan's Corporate Health and Safety Plan, and Langan's Injury and Illness Prevention Program. All proper personal protection clothing and equipment (PPE) are to be worn. Some groundwater may contain biological and chemical hazards and must be handled with suitable protection to skin, eyes, etc.

When working on-site, comply with the site's health/safety procedures, Langan's Corporate Health and Safety Plan, and Langan's Injury and Illness Prevention Program. All proper personal protection clothing and equipment (PPE) are to be worn. Some groundwater may contain biological and chemical hazards and must be handled with suitable protection to skin, eyes, etc.

4. Methods

Pre-Test Planning

Field Team Leaders and other key project members shall meet with the Project Manager to discuss the following items:

- The extent and type of the pneumatic slug tests (rising or falling head) to be performed.
- Review available project background information
    - Topographic maps,
    - Historical aquifer characterization data,
    - Geologic survey maps and/or cross sections,
    - Well construction and development records,
    - Historical water levels.
- Make sure the field laptop computer has the appropriate software to program and run the pressure transducer/data logger (PTDL). Also see Deploying Pressure Transducer SOP.
- Make sure the PTDL has an adequate pressure range for testing (a 5 to 20 psi unit is appropriate).
- The PTDL recording interval (schedule) will depend on the conductivity of the materials being tested. A shorter time interval should be used for high conductivity formations and a longer time interval for lower conductivity formations.
- Well dimensions (diameter, screen depth) must be considered to ensure adequate displacement during testing. A water level displacement of between 0.5 to 3 feet is usually adequate.
- Slug testing should not be performed in any well containing NAPL.

Field Test Set-up and Operations

The following are general procedures for performing pneumatic slug tests. The procedures required for a particular slug test may vary slightly from those described below, depending on site-specific conditions. Take precautions to minimize the potential for cross-contamination between wells that are being tested; decontaminate all in-well materials before and after conducting each test at each well location. The following are field steps and procedures for performing a pneumatic slug test:

- Remove the well cap and allow the water level to equilibrate with the atmosphere.
- Using an electronic water level meter measure and record the pre-test, static depth to water.
- Determine if the screened section of the well and the filter pack is fully saturated.

- Note in the field book if the screen or the filter pack is not saturated.
- Affix the Pneumatic Slug Assembly to the Valve Assembly, utilizing PFAS-free thread seal tape to avoid air leaks. Thread the Compression Coupling onto the Pneumatic Slug Assembly.
- Attach the compression coupler to the top of the well casing, tightening the pipe clamp to avoid air leaks.
- Measure out a length of PTDL cable sufficient to lower a transducer to a point approximately 10 feet below the water level measured in the well. The PTDL should not be lowered to a depth greater than 1 foot above the measured bottom of the well to avoid being clogged with sediment.
- Remove the Transducer Access Hole Cap and remove the rubber stopper before lowering the transducer into the well. Thread the transducer cable through the access hole in the stopper before replacing both the stopper and the Transducer Access Hole Cap.
- Secure the PTDL cable to the outside of the well's protective casing. The PTDL should not be moved during testing.
- Program the PTDL if it was not programmed in the office. Collect readings depending on the aquifer response expected; shorter intervals or logarithmic for quick-response and longer for slower response. Since most pneumatic slug tests are less than 30 to 60 minutes in duration a one-second interval should be adequate for most situations.
- Attach the handheld air pump to the air valve fitting.
- Begin taking data on the PTDL and begin to apply air pressure into the well to displace and force the water into the formation.
- Read the transducer and the pressure gauge. Once pressure/water levels have stabilized in the well, remove the air pump and release the air pressure. This will begin the rising head test.
- Continue measuring and recording depth-time measurements until the water level returns to a minimum 90 percent of pretest equilibrium conditions, or if a sufficient number of water level measurements have been made to clearly show a trend on a plot of the data showing recovery versus the logarithm of time. Generally, 10 to 30 minutes is adequate. The data collected by the PTDL should be viewable on the laptop in real time with the manufactures software.
- Stop the PTDL operation (if necessary) and remove all equipment from the well.
- Replace and lock the well cap.
- Decontaminate all equipment and move on to the next test well (as needed).

Post-Test Operations

The following procedures cover the activities that will be performed at the test well in the field after slug testing has been completed:

- Review the logbook and data collection forms for completeness.
- Download electronic water level data from the logger(s) to the laptop computer.
- Restore site to pre-test conditions.
- Electronic and manual water levels measurements shall be forwarded to the project

hydrogeologist along with a copy of all field notes and forms to aid in aquifer parameter estimation.

5. Resources

Field resources are provided below:

- Planning Documentation
  - Health and Safety Plan
  - Sampling and Analysis Plan
  - Quality Assurance Project Plan (if applicable)
  - Well location map
  - Well construction data
  - Field data from last sampling event (if applicable)
- Equipment
  - Well keys and tools to open wells
  - Photoionization detector (PID) (if applicable)
  - Electronic water level meter
  - Electronic oil/water interface probe (if applicable)
  - Combination pressure transducer/data logger
  - Field laptop with appropriate PTDL software.
  - Record keeping supplies/Electronic field tablet
  - Decontamination supplies (buckets, non-phosphate detergent, and distilled
  - water)
  - PPE

6. Documentation

Document any non-conformances or variances from standards.

7. Troubleshooting and Considerations

a. Water level responds too slowly
b. Water level responds too quickly
c. Too little displacement

8. Related Documents

Deploying Pressure Transducer SOP

9. Version/Revision History

Version 1.0 – 7 October 2022 T. Stanley, J. Smith
Version 2.0 – 14 April 2026 D. Minnick

10. Reference

- ASTM D4043 Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques
- ASTM D4044 Test Method (Field Procedure) for Instantaneous Change in Head (Slug Tests) for Determining Hydraulic Properties of Aquifers
- ASTM D4104 Test Method (Analytical Procedure) for Determining Transmissivity of Non-Leaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Test)
- British Columbia, Canada. November 24, 2020. BC Field Sampling Manual: Standard Operating Procedure for Monitoring Well Response Testing SOP-E2-08. 6 p.
- Butler, J. 2019. The Design, Performance, and Analysis of Slug Test, 2nd Edition. CRC Press. 266 p.
- Dawson, K.J. and J.D. Istok. 1991. Aquifer Testing: Design and Analysis of Pumping and Slug Tests. Lewis Publishers. 344 p.
- Driscoll, F.G., "Groundwater and Wells", 2nd Edition, Johnson Division, St. Paul, Minnesota, 1986.
- Ferris, J.G., and D.B., Knowles, 1954. "The Slug Test for Estimating Transmissivity", U.S. Geological Survey Ground Water Note 26.
- Freeze, R. Allen and John A. Cherry, 1979. Groundwater, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
- Hvorslev, 1951. "Time Lag and Soil Permeability in Ground Water Observations", Bulletin No. 36, U.S. Army Corps of Engineers p. 50.
- Midwest GeoSciences Group. Field Guide for Slug Testing and Data Analysis. 6 p.
- USGS. 2010. Conducting an Instantaneous Change in Head (Slug) Test with a Mechanical Slug and Submersible Pressure Transducer. GWPD 17. 8 p.

midwest
GEOSCIENCES
www.midwestgeo.com group

1950 Greyhound Pass Suite 18-200 Carmel, IN 46033

Thank you for purchasing the FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS.

The FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS is intended to improve the design, reliability and analysis of slug testing. The Field Guide provides a series of practical guidelines from test configuration, set up and test initiation, test performance, data processing and data analysis. It includes specific steps for testing using both solid slugs, bailers and pneumatic initiation methods. The Field Guide was prepared using same the critical themes presented in "***Improving The Design, Performance and Analysis of Slug Tests*** (Butler, 1998): (1) Importance of Complete Well Development, (2) Importance of Proper Test Design and (3) Importance of Appropriate Analysis Procedures.

A key element of test perforance is documentation. Attached are Data Acquisition Sheets that are also available on line at http://www.midwestgeo.com. We recommend using these sheets to prepare your test design and track test performance.

A list of slug test references are also available on the MidwestGeo website.

A special thank you is extended to Jim Butler, PhD, and Glenn Duffield who directed preparation of the FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS.

Each of the steps and parameters on the Field Guide are based from previously published standards and references including:

Bouwer and Rice, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resour. Res., 12(3), 423, 1976.

Butler, J..J.,1998, **The Design, Performance, and Analysis of Slug Tests**, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, Ground Water, v. 41, no. 5, 620 - 630 pp.

Butler and Zhan, Hydraulic tests in highly permeable aquifers, Water Resour. Res., 40, W12402, doi:10.1029/2003WR002998, 2004 – math and theory underlying new solution for hydraulic tests in high-K media.

Cooper, Bredehoeft, and Papadopulos, Response of a finite-diameter well to an instantaneous charge of water, Water Resour. Res., 3(1), 263, 1967.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? Ground Water, v. 36, no. 1, 37-48 pp.

midwest GEOSCIENCES group
www.midwestgeo.com

Training for Improving Observational, Descriptive, and Interpretive Skills

The Midwest GeoSciences Group conducts short courses, workshops, field trips and webinars on a variety of geoscience topics. Other FIELD GUIDES and FIELD TOOLS are also available from Midwest GeoSciences Group:



The **Hi-K Pneumatic Slug** is the answer for accurate rising head tests when the water level is above the screen interval! The pneumatic slug uses air pressure from a hand-held pump to lower the water level and the easy-to-use valve releases the pressure immediately to dramatically improve test results!

Each pneumatic slug assembly comes with a pressure gauge reading head displacement in inches of water, a hand pump an attachment for a 2" diameter well, and a storage case. It is compatible with most In-Situ and Solinist transducers up to 1" diameter. Optional accessories include attachments for fitting 3/4" diameter wells such as those for direct push well installations and attachments for 4" diameter wells.



THE FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS is a double-sided, plastic-coated guide for making accurate and complete soil and sediment descriptions on field boring logs. It is intended to improve the analysis of various sedimentary depositional environments applied to both environmental and engineering projects.

Common terms from geologic, engineering, and soil science disciplines are used on the Field Guide to help prepare meaningful boring logs that are clear and concise. Awarded Citation as Outstanding Geologic Literature by A.W. Hatheway and others / Engineering Geology 70 (2003).

THE FIELD GUIDE FOR ROCK CORE LOGGING AND FRACTURE-ANALYSIS is a double-sided, plastic-coated guide for improving rock core descriptions and characterizing bedrock fractures on meaningful rock core logs that are clear, consistent, and concise.

The front side presents procedures for labeling natural fractures, marking rock core, and calculating Total, Solid, and Modified Core Recovery and Rock Quality Designation (RQD). It also includes an easy-to-use flow chart for describing and characterizing rock core.





THE USDA SOIL TEXTURING FIELD FLOW CHART is a single-sided, plastic-coated guide for assisting with soil texturing procedures and assigning a Texture Class using the USDA texture triangle. The Flow Chart uses step-wise procedures (adopted from Foth and others, 1992) for estimating sand, silt, and clay content.

The Flow Chart uses the ribbon method to estimate the fine-grained fraction followed by placing the fraction within the texture triangle to determine Texture Class (ex: sandy loam). Awarded Citation as Outstanding Geologic Literature by A.W. Hatheway and others / Engineering Geology 70 (2003).

Go to www.midwestgeo.com to order.

Slug Test - Data Acquisition Sheet

General Information

Well Number_____
Well Location_____
Project_____

Date_____
Tests Performed by:_____
_____
_____

Reported Well Depth from Land Surface_____
Measured Depth from TOC (top of casing)_____
Casing Diameter and Schedule_____
Screen Length and Slot Size_____
Depth to Top of Screen from TOC_____
Filter Pack Details_____

Date of Last Well Development_____
Initial Static Water Level from TOC_____
Final Static Water Level from TOC_____
TOC from land surface_____
Borehole Diameter_____
Annular Seal Details_____

	Type	Serial Number	Purpose and Placement	Reading in Air
Transducer #1				
Transducer #2				

Data Logger Type and Serial Number_____
Logging Program:_____ Acquisition Rate:_____
Pressure or Pressure Head Units: Time Units:
Comments:

Test Information

	Test 01	Test 02	Test 03	Test 04	Test 05
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 01	
Test 02	
Test 03	
Test 04	
Test 05	

	Test 06	Test 07	Test 08	Test 09	Test 10
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 06	
Test 07	
Test 08	
Test 09	
Test 10	

File for Field Data:

Slug Test - Data Processing and Analysis Sheet

Data Processing

Well No./Location: Test Date: Data File:

Pressure or Pressure Head Units: Time Units: Date of Processing: Processed by:

	Test 01	Test 02	Test 03	Test 04	Test 05
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 01			
Test 02			
Test 03			
Test 04			
Test 05			

	Test 06	Test 07	Test 08	Test 09	Test 10
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 06			
Test 07			
Test 08			
Test 09			
Test 10			

File for Processed Data:

Data Analysis

Tests Chosen for Analysis:

Rationale for Choice:

Analysis Software: Date of Analysis: Analyzed by:

	Test number and analysis model	K estimate	Indication of low-K skin?	Other comments
Analysis 1				
Analysis 2				
Analysis 3				
Analysis 4				
Analysis 5				

File for Analysis Results:

1774278260 Evan Jones

Midwest GeoSciences Group - Order Receipt

Order Date: Monday, March 23, 2026 9:04am (MDT)
Order ID: 1774278260 (*Paid for*)
User ID: Did NOT sign-in

Merchandise	Quantity	Price	Amount
PNEUMATIC 'HI-K' SLUG® (2026v.)	1	$425.00	$425.00
[Unit_of_Measure=English]			

Order Total

Items	$425.00
Shipping	$58.00
Tax	$25.50
Total Charges	$508.50

Contact Information

Name:	Evan Jones
EMail:	ejones@langan.com
Phone:	2677749797
Notes:	We are looking to use this on a project in 2 weeks' time, if there is an option for expedited shipping we are interested. Let me know.

Billing Information

Payment Type:	Credit Card
Credit Card:	ending in 7546
Authorize.Net Response-	
Transaction ID:	121537323177
Authorization Code:	02527Z
First Name:	Evan
Last Name:	Jones
Company:	Langan
Address:	2700 KELLY DRIVE SUITE 200
City/State/Zip:	WARRINGTON, PA 18976
Country:	UNITED STATES
Phone:	2677749797
Fax:	

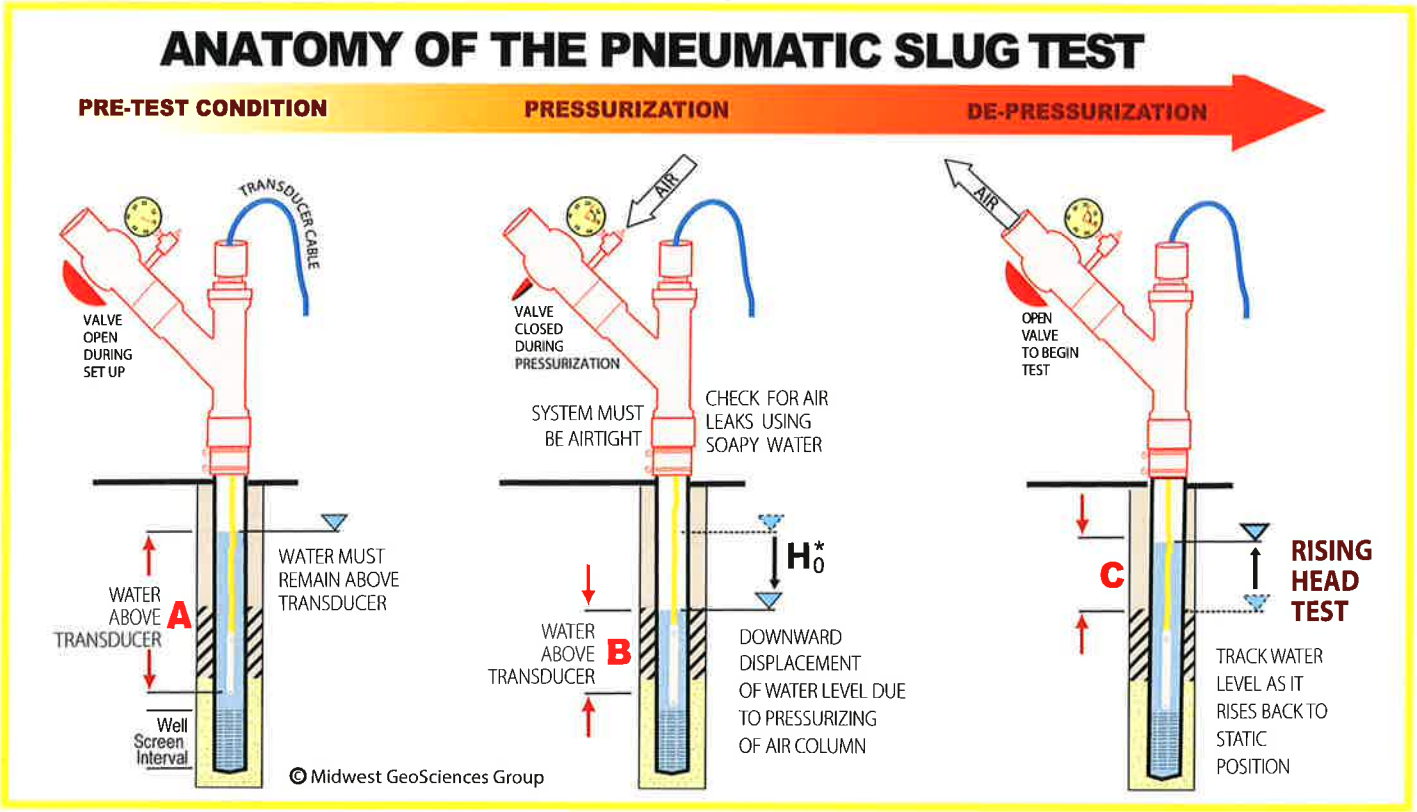
Shipping Information

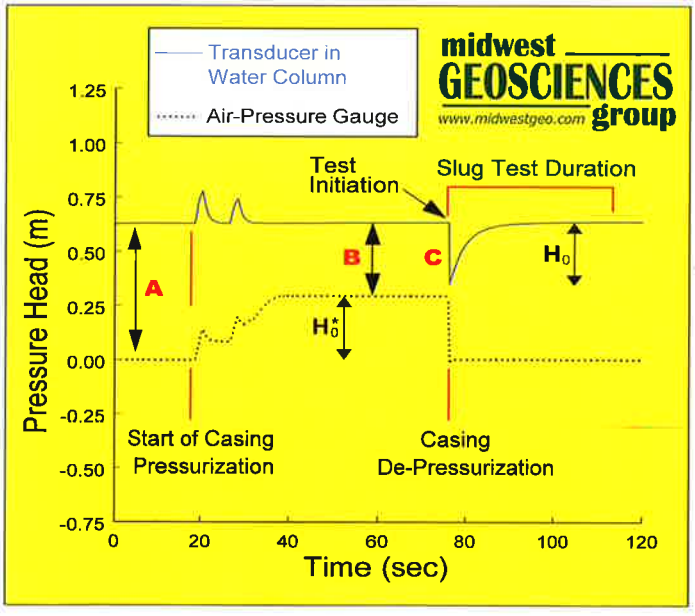
First Name:	Evan
Last Name:	Jones
Company:	Langan
Address:	2700 KELLY DRIVE SUITE 200
City/State/Zip:	WARRINGTON, PA 18976
Country:	UNITED STATES

ADDED:
COMP.
. FG SLUG TEST
. STICKERS

General Instructions for Using the Pneumatic Hi-K(R) Slug Assembly

1. The Pneumatic Hi-K(R) Slug Assembly uses air pressure to displace water in a well to perform a slug test.
2. The Pneumatic Hi-K(R) Slug can only be used if the water level occurs and remains above the top of the screen before the during the test.
3. The Pneumatic Hi-K(R) Slug can only be used to conduct rising head slug tests.
4. The Pneumatic Hi-K(R) Slug works best for slug tests in wells that recover quickly.
5. Pneumatic slug testing requires transducer reading to return to the reference point before a valid test may be initiated.





Users agree to defend, indemnify and hold harmless Midwest GeoSciences Group, its owners, managers, officers, directors, agents, and affiliates from any damages or charges resulting from the use of the equipment. Users liability shall include all losses, costs, damages, or expenses arising from any use, accident, bodily injury, or other occurrences to any persons or properties, including the users and their agents which arise from the equipment, proper use or otherwise.

EQUIPMENT LIST

1. PNEUMATIC SLUG MANIFOLD
2. VALVE ASSEMBLY WITH AIR GAUGE (in. or cm.)
3. COMPRESSION COUPLING ASSEMBLY (includes rubber stoppers with holes)
4. WELL COUPLER
5. OFFSET SCREWDRIVER AND SOCKET WRENCH
6. TEFLON TAPE
7. HAND PUMP
8. CARRYING CASE
9. INSTRUCTION SHEET

ASSEMBLY AND OPERATING INSTUCTIONS

PNEUMATIC
midwest GEOSCIENCES group
www.midwestgeo.com
Hi-K SLUG®

Step 1 - Assembly

1. Apply Teflon tape to the male threads of the parts to be assembled.
2. Thread the Valve Assembly onto the Pneumatic Slug Assembly.
3. Choose the proper size Compression Coupling Assembly to match the well casing diameter. The standard unit comes with 2-inch well coupler.
4. Thread the Compression Coupling Assembly onto the Pneumatic Slug Assembly.

Step 2 - Attach the Pneumatic Slug to the Well

1. Loosen the pipe clamp and slide the Compression Coupling Assembly onto the well.
2. Tighten the pipe clamp until secure and air tight.



Step 3 - Insert the Transducer

1. Unscrew the Transducer Access Hole Cap and remove the Black Rubber Stopper from the Transducer Access Hole.
2. Insert the transducer through the Transducer Access Hole Cap with the treaded end of the Transducer Access Hole Cap facing toward the Pneumatic Slug.
3. Insert the transducer into the Access Hole, and lower the transducer to the desired depth.
4. Insert the transducer cable into the hole in the Black Rubber Stopper so that the smaller end of the Black Rubber Stopper is facing the Pneumatic Slug. The Black Rubber Stopper has a slit in the side to allow the transducer cable to be inserted into the hole.
5. Insert the Black Rubber Stopper into the Transducer Access Hole.
6. Screw the Transducer Access Hole Cap over the Black Rubber Stopper to hold the stopper in place.
7. Read the transducer depth.
8. Start the transducer and data logger, on "Fast Linear" data measurement frequency setting. In normal conditions, you can keep the data logger running -without stopping- for multiple tests. Be sure to take reliable notes about test times and initial displacements.

Step 4 - Displace Water Column in the Well





1. Close the valve.
2. Attach the Air Pump to the Air Valve Fitting.
3. Pump air into the well until the desired displacement is achieved. Note that the Water Displacement Gauge reads in inches (or cm) of water. Do not apply too much pressure as it may damage the pressure gauge or cause hazardous conditions.
4. Read the transducer. Once the pressure/water level has equilibrated, it should read the same water depth as during original reference conditions. If the transducer does not read the same depth, wait until it recovers back to the original reference level.
5. Remove the Air Pump.





Step 5 - Run the Slug Test

1. Watch the data logger readings when you open the valve to release the air pressure.
2. When the water level has returned to equilibrium level, the test is complete.
3. Review the slug test data to ensure a valid test. Repeat the test as desired, usually with different displacements.

Step 6 - Remove the Pneumatic Slug

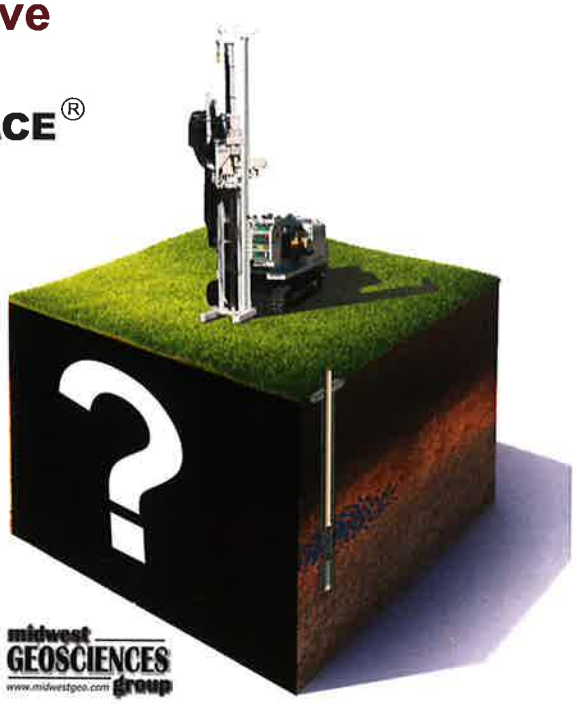
1. Remove the transducer from the well by unscrewing the Transducer Access Hole Cap, removing the Black Rubber Stopper, and removing the transducer.
2. Loosen the pipe clamp and remove the Pneumatic Slug from the well casing.
3. Disassemble the Pneumatic Slug and return the parts to the toolbox.

Do more than just identify soil, start deciphering the subsurface.

midwest GEOSCIENCES group
www.midwestgeo.com

New Training
On-Site and In-Person, at your office!
1-Day Classroom Intensive

What does **TAKING THE MYSTERY OUT OF THE SUBSURFACE®** mean?



It means characterizing the sedimentary succession according to how the sediments were deposited so we can define geologic units and predict their distribution, unit geometries, and physical properties.

This training is designed to improve both basic field descriptive procedures and subsurface analysis skills....because frankly, as geo-professionals that's the job we are hired to do.

It's not always simple to define and correlate sediments according to their depositional environments and stratigraphic context.

It's easier to try and rationalize secondary attributes such as lithology, soil classifications, CPT values, N-values, geophysics, geospatial statistical comparisons, water levels, or contaminant detections - but none of these attributes are the **SOLE INDEPENDENT VARIABLE:** that is, the geology.

One-Day Classroom Intensive at Your Location

Training for
Taking the Mystery Out of the Subsurface®

Learning to Translate the Sedimentary Sequence to Soil Boring Logs

You benefit from our established exercises and teaching experience.

Schedule Your Training Today



Your projects benefit from staff who perform efficiently and consistently with skills to decipher the subsurface for environmental and engineering projects.

midwest GEOSCIENCES group www.midwestgeo.com

STEP FIVE: DATA ANALYSIS

SELECTION OF TEST FOR ANALYSIS

1. If normalized plots from a series of slug tests coincide, choose only one test for analysis. The selected test should have the lowest data noise level of that series.
2. If normalized plots do not coincide, seek explanation for lack of coincidence. Possible explanations include insufficiently developed well and non-laminar flow losses. See Butler (1998) and Butler et al. (2003) for further explanations of lack of coincidence of normalized plots.

SELECTION OF TEST CATEGORY

Select appropriate category for well-formation configuration.

CATEGORY I - Wells in Confined Formations and Wells Screened Below the Water Table in Unconfined Formations.

CATEGORY II - Wells Screened Across the Water Table.

CATEGORY III - Wells in Category I and in Highly Permeable Conditions.

FRACTURED FORMATIONS

If formation is densely fractured and behaves as an equivalent porous media, standard methods are valid. If formation behaves as a double-porosity media, then validity decreases as well screen increases in length. If formation is sparsely fractured and flow is restricted to fractures, the validity of standard methods varies. If flow induced by test is radial, standard methods are valid. If flow is restricted to only a small portion of fracture plane, standard methods are not appropriate. See Butler (1998) and Shapiro and Hsieh (1998) for details.

TEST CATEGORIES

CATEGORY I ANALYSIS

A) Analyze data with Cooper et al. model for tests in fully penetrating wells.
B) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate can be calculated from the transmissivity (T) estimate using $K = T / L_e$
- If not, go to C.

C) Question: Is the well fully or partially penetrating?
- If fully pentrating well, test may be affected by insufficient development or double-porosity flow. See Butler (1998).
- If partially penetrating well, test may be affected by vertical flow above or below the screened interval. Go to D.

D) Analyze data with KGS model for tests in partially penetrating wells.
E) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate should be reasonable.
- If not, the test may be affected by insufficient development. See Butler (1998) for details.

CATEGORY II ANALYSIS

A) Question: Do data display a double straight line on a log normalized head vs. linear time plot (see Category II Figure)?
- If so, go to B.
- If not, go to A of Category I Analysis.

B) Fit a straight line to the formation response portion of the plot (2nd straight line segment).
C) Estimate K with Bouwer and Rice model.
- Use effective casing radius, not nominal casing radius, in analysis. See Butler (1998).

BOUWER & RICE AND HVORSLEV MODELS

These approximate methods involve fitting a straight line to data plotted in a log normalized head vs. linear time format. Although K estimates are obtained rapidly, these methods, unlike the Cooper et al. and KGS models, cannot provide clues that the test has been significantly impacted by insufficient development. If flow is primarily horizontal, data will display a concave-upward curvature in this plotting format. Straight line should be fit to the 0.15 - 0.25 (Hvorslev) and 0.2 - 0.3 (Bouwer & Rice) normalized head range. These ranges should be with respect to H_0^+ when data plot as a double straight line (see Catagory II Analysis Plot).

CATEGORY III ANALYSIS

A) Question: Are data oscillatory in nature or display a concave-downward curvature on a log normalized head vs. linear time plot?
- If so, go to B.
- If not, go to A of Category I Analysis.

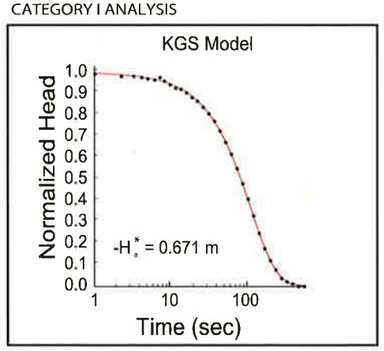
B) Question: Do normalized data plots coincide?
- If so, go to C.
- If not, go to D.

C) Question: Is well fully penetrating or nearly so?
- If so, analyze data with Butler & Zhan model.
- If not, analyze data with either Butler & Zhan model or high-K extensions of Hvorslev and Bouwer-Rice models.

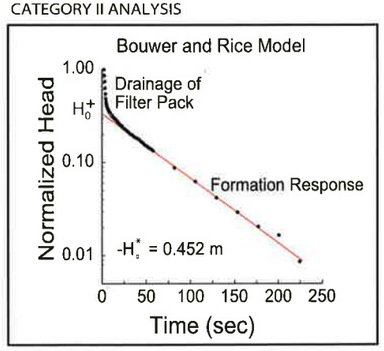
D) Question: Do normalized data plots from tests initiated with similar H_0^+ coincide?
- If so, go to E.
- If not, further development may be needed.

E) Question: Can tests be repeated?
- If so, repeat tests with smaller initial displacements and go to B.
- If not, analyze data with non-linear slug test model of McElwee and Zenner. Note error in K estimate may increase as well approaches full penetration.

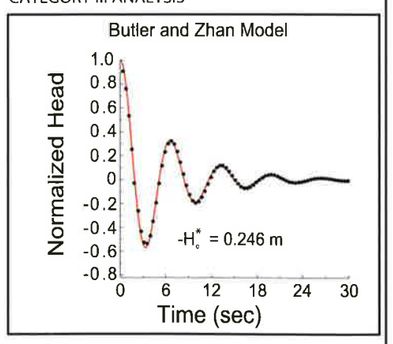
CATEGORY I ANALYSIS



CATEGORY II ANALYSIS



CATEGORY III ANALYSIS



CREATED BY: Butler, J. Jim, G.F. Duffield, and D.L. Kelleher (complete list of references at www.midwestgeo.com)

Butler, 1998, *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, v. 41, no. 5, 620 - 630 pp.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, v. 36, no. 1, 37-48 pp.

Copyright © 2007- 2025 Midwest GeoSciences Group Press

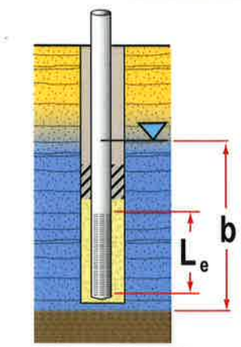
FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS™

midwest GEOSCIENCES group www.midwestgeo.com

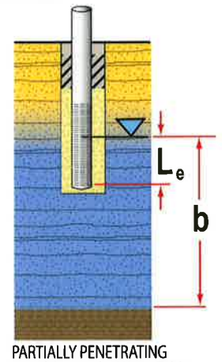
STEP ONE: TEST WELL CONFIGURATION

K = Hydraulic Conductivity
b = Thickness of Tested Unit
L_e = Effective Screen Length (portion through which flow occurs, usually not the length of the filter pack)

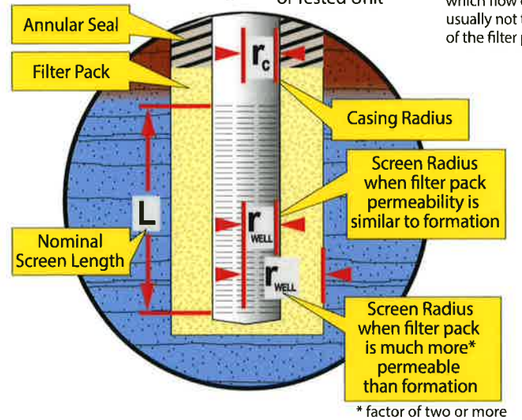
UNCONFINED CONDITIONS



PARTIALLY PENETRATING
Screened Below the Water Table
$L_e = L$

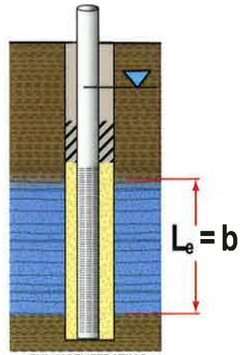


PARTIALLY PENETRATING
Screened Across the Water Table
$L_e < L$

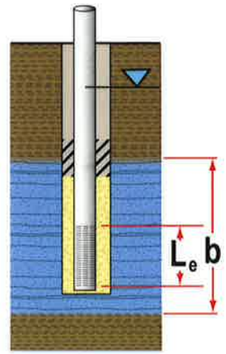


* factor of two or more

CONFINED CONDITIONS

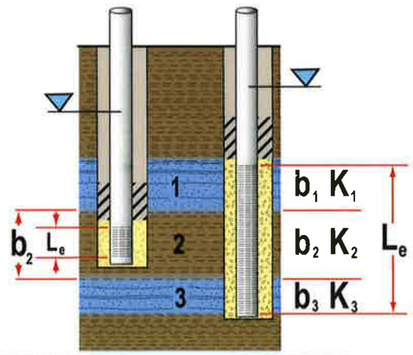


FULLY PENETRATING
Screened Across the Entire Unit
$L_e < L$



PARTIALLY PENETRATING
Screened Across a Portion of the Unit
$L_e = L$

LAYERED SETTINGS



PARTIALLY PENETRATING
Screened Across a Portion of a Layer
$L_e < b_2$
$K \approx K_2$

FULLY PENETRATING
Screened Across Multiple Layers
$K \approx \frac{[(b_1 K_1)+(b_2 K_2)+(b_3 K_3)]}{L_e}$

Slug tests are also an effective means of estimating K in aquitards. See Butler (1998) for specialized test procedures.

WELL DEVELOPMENT IS CRITICAL

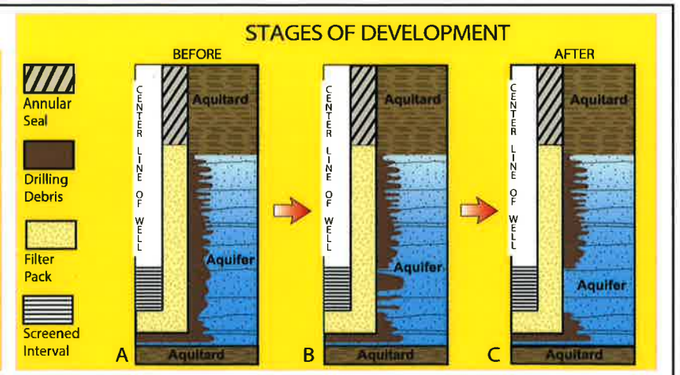
1. MUST develop well thoroughly before slug testing because a near-well zone of disturbance may be created during drilling. Characteristics of zone depend on formation properties and drilling method. Zone often consists of various types of "drilling debris".

Hydraulic conductivity estimates from tests in poorly or undeveloped wells may be much less than formation K due to impact of "drilling debris".

2. Perform slug tests and assess the sufficiency of well development during data processing and analysis (see Steps 4 and 5).

For monitoring wells, development should produce a situation between B and C. Assume $L_e = L$ for analysis.

STAGES OF DEVELOPMENT



midwest GEOSCIENCES group
www.midwestgeo.com

STEP TWO: SET UP AND TEST INITIATION

FOR TESTS USING SOLID SLUGS OR BAILERS

INITIAL ACTIVITIES

1. Measure depth to water.
2. Measure depth to bottom of well.
3. Measure slug volume (solid or bailer)

$$V_{SLUG} = \pi r_{SLUG}^2 L_{SLUG}$$

EXAMPLE: Solid slug, 2.5-cm diameter, 75-cm long

$V_{SLUG} = (3.14)(1.25\text{cm})^2(75\text{cm}) = 368.2\ \text{cm}^3$

4. Calculate expected initial displacement

$$H_0^* = V_{SLUG} / \pi r_{CASING}^2$$

EXAMPLE: Solid slug in 5-cm diameter well

$H_0^* = (368.2\ \text{cm}^3) / (3.14)(2.5\text{cm})^2 = 18.8\ \text{cm}$

5. Calculate length of water column in well.
6. Check depth limit of transducer and determine appropriate transducer position.

Height of water column above transducer should allow sufficient room for slug introduction and rapid removal.

EQUIPMENT

Must be appropriate for expected rate of head change. Always use a transducer and data logger for tests in moderate to high permeability formations (K > 0.001 cm/s). Manual measurement of water levels is a reasonable approach for tests in lower permeability formations.

SET UP

1. Submerge transducer to pre-determined depth and allow 15 to 20 minutes for transducer to thermally equilibrate with water and transducer cable to stretch.

Submerge transducer a sufficient distance to avoid interference during slug movement. If transducer is located within screened interval, place above well bottom to avoid plugging by settled fines.

2. Secure transducer cable to prevent movement during test.
3. Check data logger to ensure connectivity and communication.
4. Track water level through time to ensure near-static conditions have been achieved prior to test.
5. Prepare solid slug or bailer for test. Check bailer for leaks.

FALLING HEAD (Slug In) TEST

Place bottom of slug just above top of water column. Measure drop distance on cord and fasten cord prior to test.

RISING HEAD (Slug Out) TEST

Place top of slug just below top of water column. Measure removal distance on cord and prepare to fasten cord after removal.

TEST INITIATION

1. Double check data logger settings.
2. Verify water level has returned to static.
3. Start logging data 5 to 10 seconds prior to test initiation.
4. Create near-instantaneous water-level change relative to formation response.

For tests in high-permeability formations, water level change produced by a solid slug or bailer may not be fast enough. Use pneumatic method for tests initiation (see Step Three).

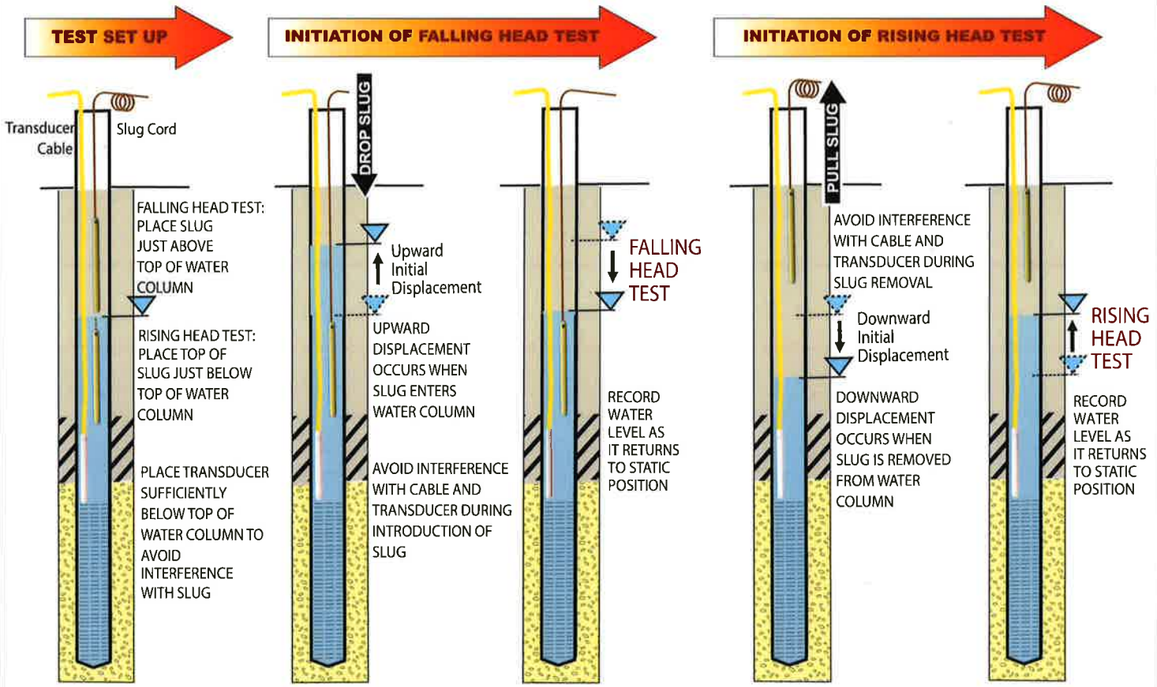
5. Prevent entanglement with transducer or its cable during test initiation.

When moving slug to initiate test, try to minimize distance of movement by positioning slug a short distance above or below top of water column. This will help avoid getting the slug entangled in the tranducer cable or hitting the transducer.

INITIAL DISPLACEMENT

In moderate or lower permeability formations (K < 0.02 cm/s), an initial displacement of 0.3 to 0.9 meters should produce a reasonable signal-to-noise ratio. In higher K formations, use smaller displacements (< 0.3 meters) to reduce non-Darcian flow losses. Slug size does not affect test radius - see Butler (1998).

FALLING & RISING HEAD TESTING

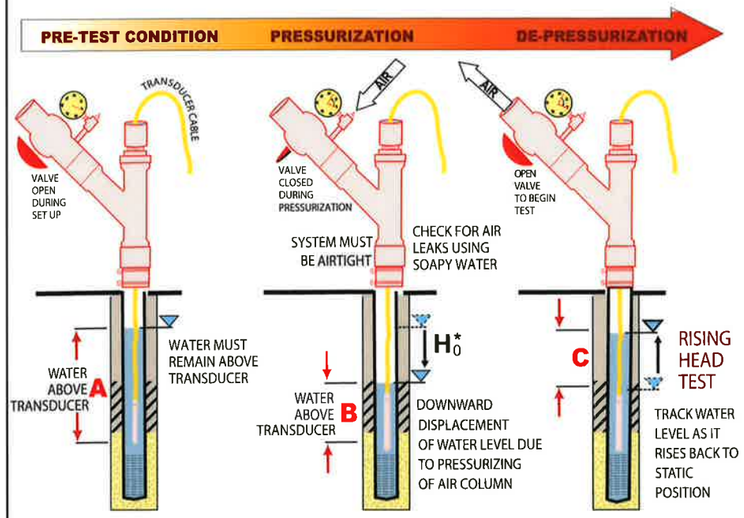


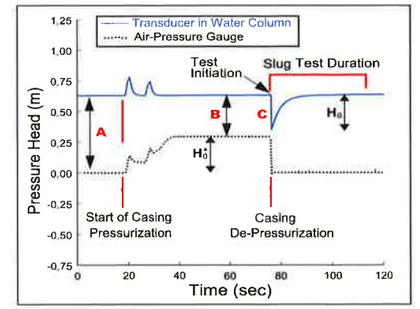
Copyright © 2007 - 2025 Midwest GeoSciences Group Press

FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS

midwest GEOSCIENCES group
www.midwestgeo.com

FOR TESTS USING PNEUMATIC INITIATION SYSTEM





1. Use pneumatic method to initiate tests in highly permeable formations. The pneumatic method uses air pressure, either positive or negative, to displace water. Water level must remain above screen and transducer.
2. Rising head tests are performed by pressurizing air column, allowing pressures to stabilize, and then depressurizing air column.
3. Falling head tests are performed in a similar manner by applying a vacuum to air column.

STEP THREE: TEST PERFORMANCE

GENERAL PERFORMANCE GUIDELINES

1. Perform three or more tests at each well.
2. Use at least two initial displacements varying by a factor of two or more.
3. Conduct both rising and falling head tests if possible. First and last tests should use approximately same initial displacement.

Repeat tests with different H_0^* are used to assess the viability of assumptions underlying slug test analysis methods.

4. Run each test to near completion (i.e. heads within 5% of static).

Running tests to near completion allows data to be analyzed with more sophisicated methods (Cooper et al. and KGS models). These methods can provide insights into impact of anisotropy, double-porosity behavior, and insufficient well development. See Butler (1998) for further details.

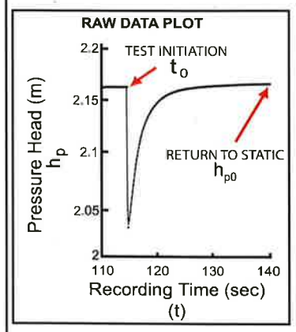
STEP FOUR: DATA PROCESSING

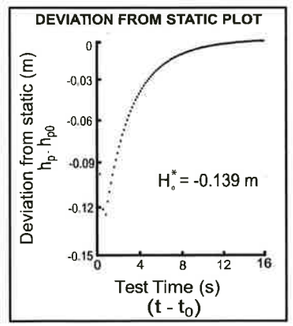
H_0^* = Expected initial displacement estimated from geometrical considerations (solid slug) or air pressure readings (pneumatic initiation).

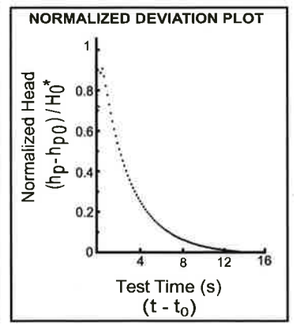
H_0 = Initial water-level displacement measured in well.

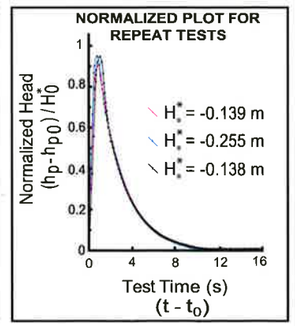
GENERAL PROCESSING GUIDELINES

1. Estimate time test began (t_0) and the pressure head at static conditions (h_{p0}) from the raw data plot.
2. Subtract h_{p0} and t_0 from the head (h_p) and time (t) records, respectively, to compute head deviation from static and time since test began (deviation from static plot).
3. Normalize data by dividing deviation data by the expected displacement (H_0^*).
4. Compare the expected displacement (H_0^*) with the initial water level displacement measured in the well (H_0). Are they different? If so, possible explanations could include: (1) effective casing radius different from nominal casing radius, (2) test initiation too slow, (3) measurement rate too slow, and (4) transducer too deep in water column (high K formation).
5. Compare normalized data plots from repeat tests at the same well. Coincidence of normalized plots suggests that assumptions underlying conventional analysis methods may be valid at that well. If normalized plots do not coincide, then more development may be necessary.









Copyright © 2007 - 2025 Midwest GeoSciences Group Press

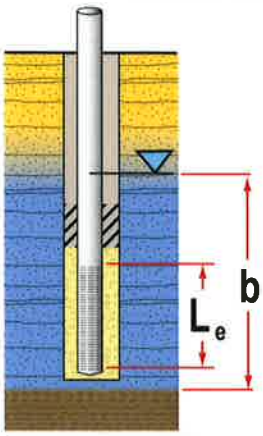
FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS™

midwest GEOSCIENCES group
www.midwestgeo.com

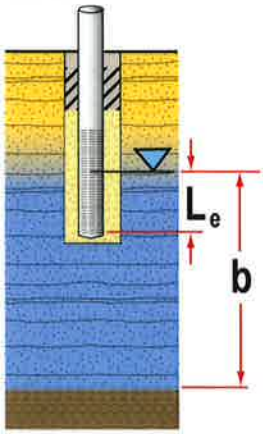
STEP ONE: TEST WELL CONFIGURATION

K = Hydraulic Conductivity
b = Thickness of Tested Unit
L_e = Effective Screen Length (portion through which flow occurs, usually not the length of the filter pack)

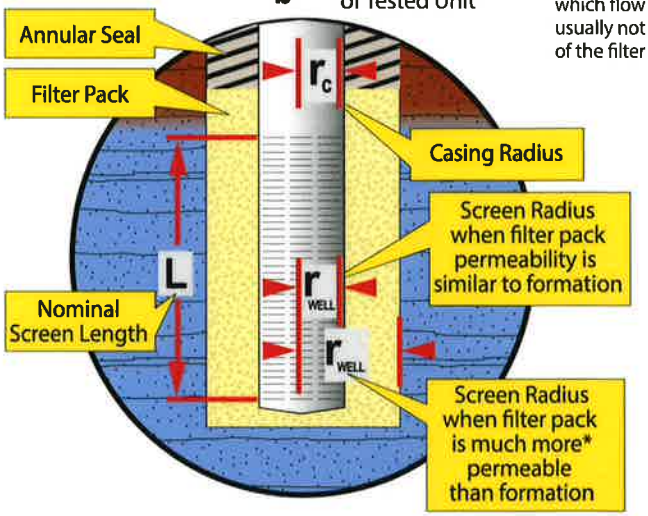
UNCONFINED CONDITIONS



PARTIALLY PENETRATING
Screened Below the Water Table
$L_e = L$

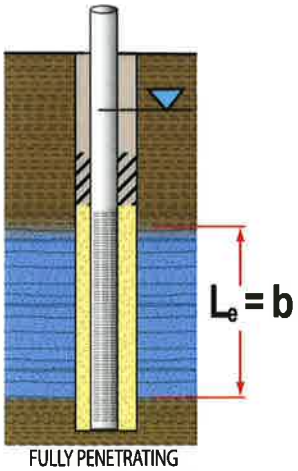


PARTIALLY PENETRATING
Screened Across the Water Table
$L_e < L$

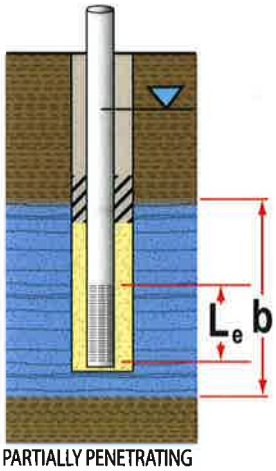


* factor of two or more

CONFINED CONDITIONS

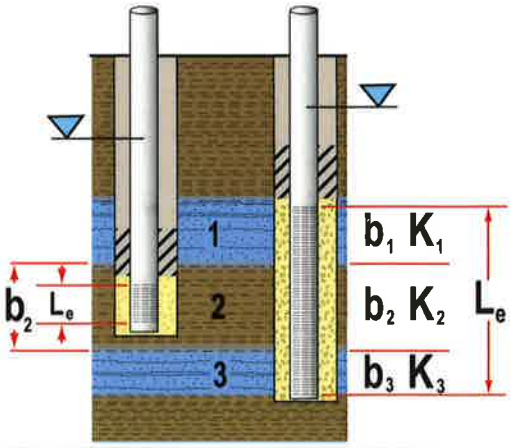


FULLY PENETRATING
Screened Across the Entire Unit
$L_e < L$



PARTIALLY PENETRATING
Screened Across a Portion of the Unit
$L_e = L$

LAYERED SETTINGS



PARTIALLY PENETRATING
Screened Across a Portion of a Layer
$L_e < b_2$
$K \approx K_2$

FULLY PENETRATING
Screened Across Multiple Layers
$$K \approx \frac{[(b_1 K_1)+(b_2 K_2)+(b_3 K_3)]}{L_e}$$

Slug tests are also an effective means of estimating K in aquitards. See Butler (1998) for specialized test procedures.

WELL DEVELOPMENT IS CRITICAL

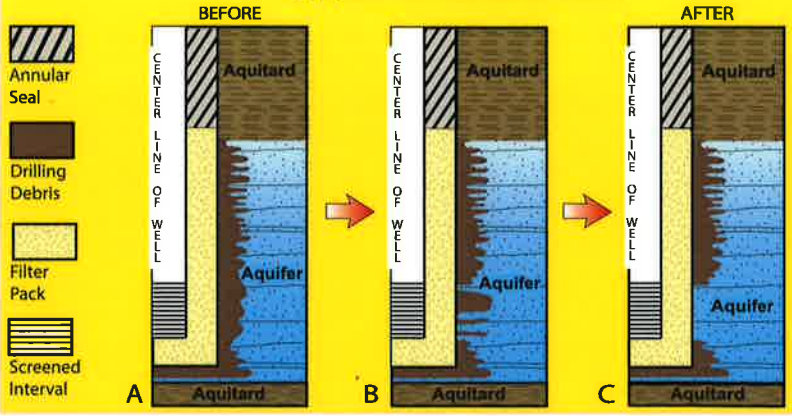
1. MUST develop well thoroughly before slug testing because a near-well zone of disturbance may be created during drilling. Characteristics of zone depend on formation properties and drilling method. Zone often consists of various types of "drilling debris".

   Hydraulic conductivity estimates from tests in poorly or undeveloped wells may be much less than formation K due to impact of "drilling debris".

2. Perform slug tests and assess the sufficiency of well development during data processing and analysis (see Steps 4 and 5).

   For monitoring wells, development should produce a situation between B and C. Assume $L_e = L$ for analysis.

STAGES OF DEVELOPMENT



midwest GEOSCIENCES group
www.midwestgeo.com

STEP TWO: SET UP AND TEST INITIATION

FOR TESTS USING SOLID SLUGS OR BAILERS

INITIAL ACTIVITIES

1. Measure depth to water.
2. Measure depth to bottom of well.
3. Measure slug volume (solid or bailer)

$$V_{SLUG} = \pi r_{SLUG}^2 L_{SLUG}$$

EXAMPLE: Solid slug, 2.5-cm diameter, 75-cm long

$V_{SLUG} = (3.14)\ (1.25\text{cm})^2 (75\text{cm}) = 368.2\ \text{cm}^3$

4. Calculate expected initial displacement

$$H_0^* = V_{SLUG} / \pi r_{CASING}^2$$

EXAMPLE: Solid slug in 5-cm diameter well

$H_0^* = (368.2\ \text{cm}^3) / (3.14)(2.5\text{cm})^2 = 18.8\ \text{cm}$

5. Calculate length of water column in well.
6. Check depth limit of transducer and determine appropriate transducer position.

> Height of water column above transducer should allow sufficient room for slug introduction and rapid removal.

EQUIPMENT

Must be appropriate for expected rate of head change. Always use a transducer and data logger for tests in moderate to high permeability formations ($K > 0.001$ cm/s). Manual measurement of water levels is a reasonable approach for tests in lower permeability formations.

SET UP

1. Submerge transducer to pre-determined depth and allow 15 to 20 minutes for transducer to thermally equilibrate with water and transducer cable to stretch.

> Submerge transducer a sufficient distance to avoid interference during slug movement. If transducer is located within screened interval, place above well bottom to avoid plugging by settled fines.

2. Secure transducer cable to prevent movement during test.
3. Check data logger to ensure connectivity and communication.
4. Track water level through time to ensure near-static conditions have been achieved prior to test.
5. Prepare solid slug or bailer for test. Check bailer for leaks.

FALLING HEAD (Slug In) TEST

Place bottom of slug just above top of water column. Measure drop distance on cord and fasten cord prior to test.

RISING HEAD (Slug Out) TEST

Place top of slug just below top of water column. Measure removal distance on cord and prepare to fasten cord after removal.

TEST INITIATION

1. Double check data logger settings.
2. Verify water level has returned to static.
3. Start logging data 5 to 10 seconds prior to test initiation.
4. Create near-instantaneous water-level change relative to formation response.

> For tests in high-permeability formations, water level change produced by a solid slug or bailer may not be fast enough. Use pneumatic method for tests initiation (see Step Three).

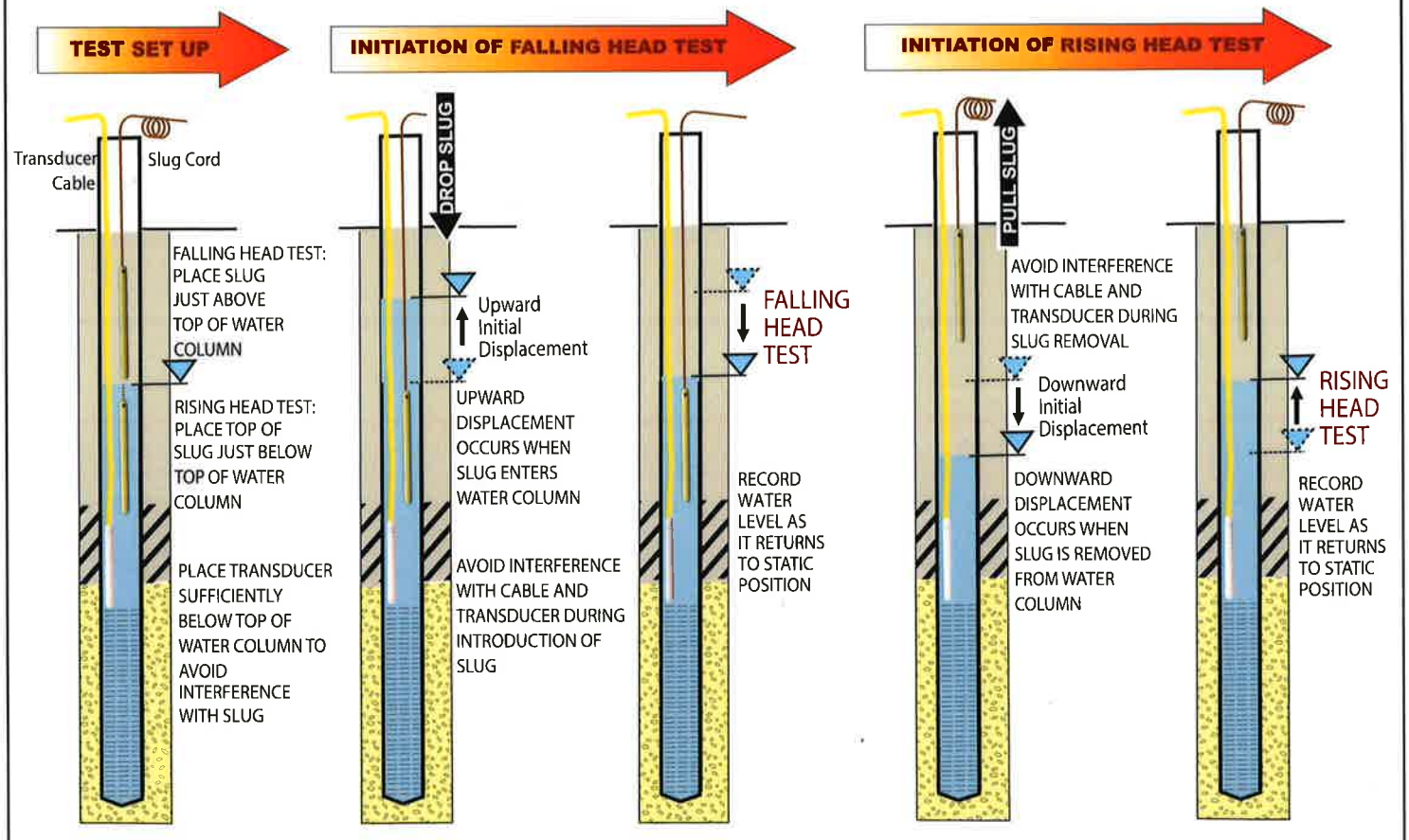
5. Prevent entanglement with transducer or its cable during test initiation.

> When moving slug to initiate test, try to minimize distance of movement by positioning slug a short distance above or below top of water column. This will help avoid getting the slug entangled in the tranducer cable or hitting the transducer.

INITIAL DISPLACEMENT

In moderate or lower permeability formations ($K < 0.02$ cm/s), an initial displacement of 0.3 to 0.9 meters should produce a reasonable signal-to-noise ratio. In higher K formations, use smaller displacements (< 0.3 meters) to reduce non-Darcian flow losses. Slug size does not affect test radius - see Butler (1998).

FALLING & RISING HEAD TESTING

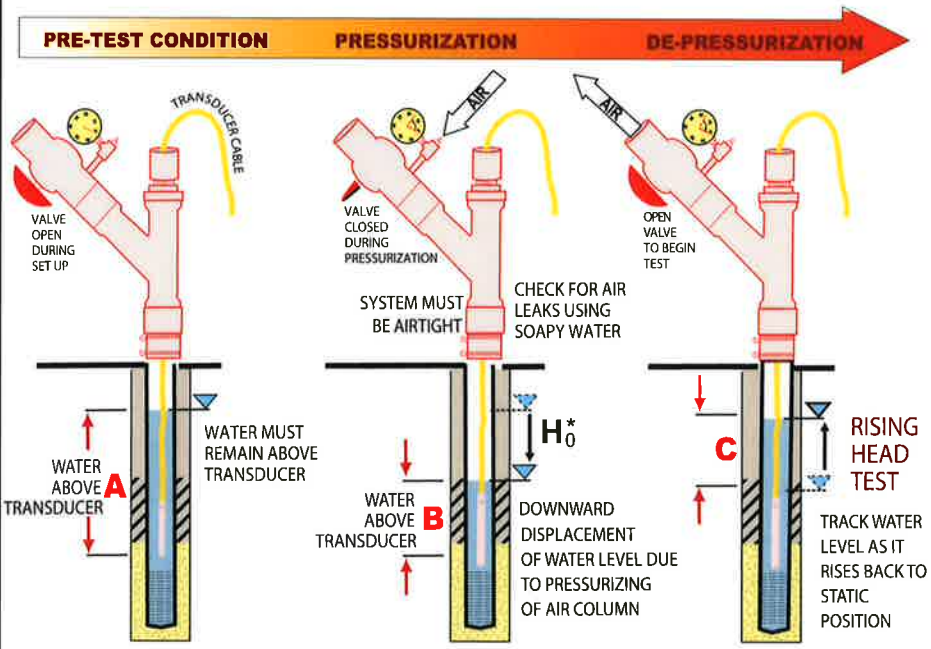


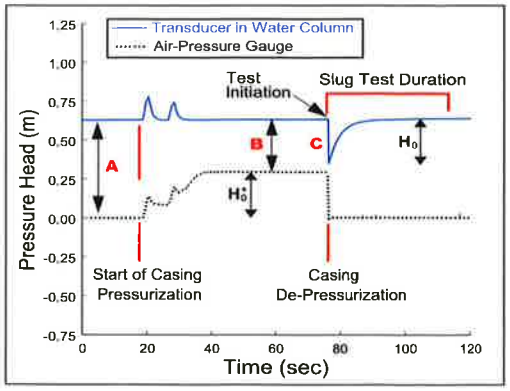
Copyright © 2007 - 2025 Midwest GeoSciences Group Press

FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS

midwest GEOSCIENCES group
www.midwestgeo.com

FOR TESTS USING PNEUMATIC INITIATION SYSTEM





1. Use pneumatic method to initiate tests in highly permeable formations. The pneumatic method uses air pressure, either positive or negative, to displace water. Water level must remain above screen and transducer.
2. Rising head tests are performed by pressurizing air column, allowing pressures to stabilize, and then depressurizing air column.
3. Falling head tests are performed in a similar manner by applying a vacuum to air column.

STEP THREE: TEST PERFORMANCE

GENERAL PERFORMANCE GUIDELINES

1. Perform three or more tests at each well.
2. Use at least two initial displacements varying by a factor of two or more.
3. Conduct both rising and falling head tests if possible. First and last tests should use approximately same initial displacement.

Repeat tests with different H_0^* are used to assess the viability of assumptions underlying slug test analysis methods.

4. Run each test to near completion (i.e. heads within 5% of static).

Running tests to near completion allows data to be analyzed with more sophisicated methods (Cooper et al. and KGS models). These methods can provide insights into impact of anisotropy, double-porosity behavior, and insufficient well development. See Butler (1998) for further details.

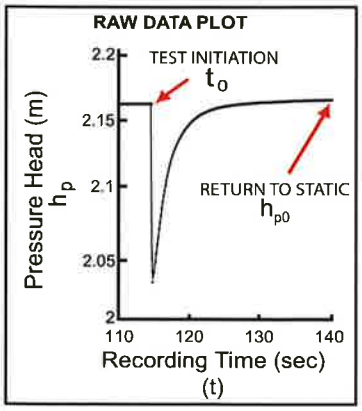
STEP FOUR: DATA PROCESSING

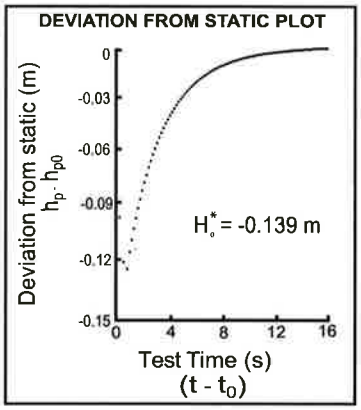
H_0^* = Expected initial displacement estimated from geometrical considerations (solid slug) or air pressure readings (pneumatic initiation).

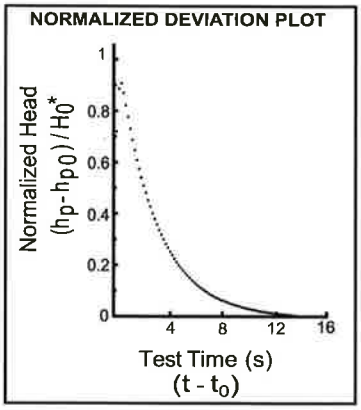
H_0 = Initial water-level displacement measured in well.

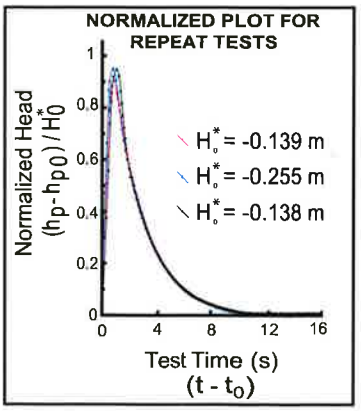
GENERAL PROCESSING GUIDELINES

1. Estimate time test began (t_0) and the pressure head at static conditions (h_{p0}) from the raw data plot.
2. Subtract h_{p0} and t_0 from the head (h_p) and time (t) records, respectively, to compute head deviation from static and time since test began (deviation from static plot).
3. Normalize data by dividing deviation data by the expected displacement (H_0^*).
4. Compare the expected displacement (H_0^*) with the initial water level displacement measured in the well (H_0). Are they different? If so, possible explanations could include: (1) effective casing radius different from nominal casing radius, (2) test initiation too slow, (3) measurement rate too slow, and (4) transducer too deep in water column (high K formation).
5. Compare normalized data plots from repeat tests at the same well. Coincidence of normalized plots suggests that assumptions underlying conventional analysis methods may be valid at that well. If normalized plots do not coincide, then more development may be necessary.









Copyright © 2007 - 2025 Midwest GeoSciences Group Press

midwest GEOSCIENCES group www.midwestgeo.com

STEP FIVE: DATA ANALYSIS

SELECTION OF TEST FOR ANALYSIS

1. If normalized plots from a series of slug tests coincide, choose only one test for analysis. The selected test should have the lowest data noise level of that series.
2. If normalized plots do not coincide, seek explanation for lack of coincidence. Possible explanations include insufficiently developed well and non-laminar flow losses. See Butler (1998) and Butler et al. (2003) for further explanations of lack of coincidence of normalized plots.

SELECTION OF TEST CATEGORY

Select appropriate category for well-formation configuration.

CATEGORY I - Wells in Confined Formations and Wells Screened Below the Water Table in Unconfined Formations.

CATEGORY II - Wells Screened Across the Water Table.

CATEGORY III - Wells in Category I and in Highly Permeable Conditions.

FRACTURED FORMATIONS

If formation is densely fractured and behaves as an equivalent porous media, standard methods are valid. If formation behaves as a double-porosity media, then validity decreases as well screen increases in length. If formation is sparsely fractured and flow is restricted to fractures, the validity of standard methods varies. If flow induced by test is radial, standard methods are valid. If flow is restricted to only a small portion of fracture plane, standard methods are not appropriate. See Butler (1998) and Shapiro and Hsieh (1998) for details.

TEST CATEGORIES

CATEGORY I ANALYSIS

A) Analyze data with Cooper et al. model for tests in fully penetrating wells.
B) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate can be calculated from the transmissivity (T) estimate using $K = T / L_e$
- If not, go to C.

C) Question: Is the well fully or partially penetrating?
- If fully pentrating well, test may be affected by insufficient development or double-porosity flow. See Butler (1998).
- If partially penetrating well, test may be affected by vertical flow above or below the screened interval. Go to D.

D) Analyze data with KGS model for tests in partially penetrating wells.
E) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate should be reasonable.
- If not, the test may be affected by insufficient development. See Butler (1998) for details.

CATEGORY II ANALYSIS

A) Question: Do data display a double straight line on a log normalized head vs. linear time plot (see Category II Figure)?
- If so, go to B.
- If not, go to A of Category I Analysis.

B) Fit a straight line to the formation response portion of the plot (2nd straight line segment).
C) Estimate K with Bouwer and Rice model.
- Use effective casing radius, not nominal casing radius, in analysis. See Butler (1998).

BOUWER & RICE AND HVORSLEV MODELS

These approximate methods involve fitting a straight line to data plotted in a log normalized head vs. linear time format. Although K estimates are obtained rapidly, these methods, unlike the Cooper et al. and KGS models, cannot provide clues that the test has been significantly impacted by insufficient development. If flow is primarily horizontal, data will display a concave-upward curvature in this plotting format. Straight line should be fit to the 0.15 - 0.25 (Hvorslev) and 0.2 - 0.3 (Bouwer & Rice) normalized head range. These ranges should be with respect to H_0^+ when data plot as a double straight line (see Catagory II Analysis Plot).

CATEGORY III ANALYSIS

A) Question: Are data oscillatory in nature or display a concave-downward curvature on a log normalized head vs. linear time plot?
- If so, go to B.
- If not, go to A of Category I Analysis.

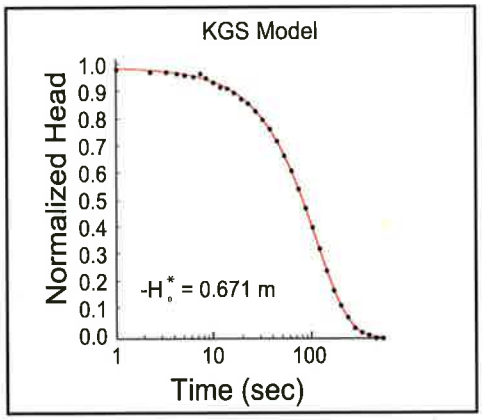
B) Question: Do normalized data plots coincide?
- If so, go to C.
- If not, go to D.

C) Question: Is well fully penetrating or nearly so?
- If so, analyze data with Butler & Zhan model.
- If not, analyze data with either Butler & Zhan model or high-K extensions of Hvorslev and Bouwer-Rice models.

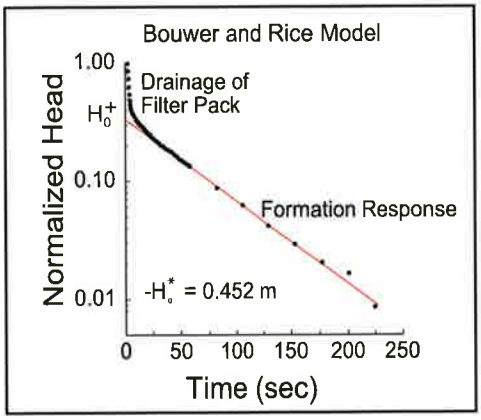
D) Question: Do normalized data plots from tests initiated with similar H_0^* coincide?
- If so, go to E.
- If not, further development may be needed.

E) Question: Can tests be repeated?
- If so, repeat tests with smaller initial displacements and go to B.
- If not, analyze data with non-linear slug test model of McElwee and Zenner. Note error in K estimate may increase as well approaches full penetration.

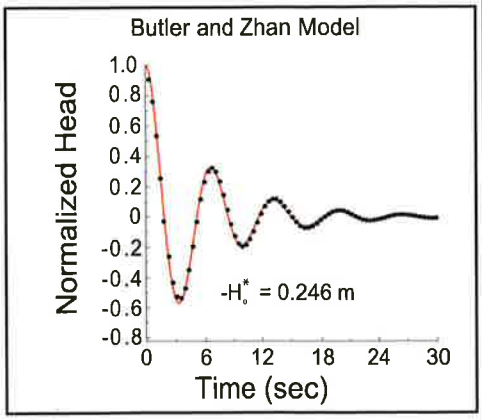
CATEGORY I ANALYSIS



CATEGORY II ANALYSIS



CATEGORY III ANALYSIS



CREATED BY: Butler, J. Jim, G.F. Duffield, and D.L. Kelleher (complete list of references at www.midwestgeo.com)

Butler, 1998, *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, v. 41, no. 5, 620 - 630 pp.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, v. 36, no. 1, 37-48 pp.

Copyright © 2007- 2025 Midwest GeoSciences Group Press

midwest
GEOSCIENCES
www.midwestgeo.com group

1950 Greyhound Pass Suite 18-200 Carmel, IN 46033

Thank you for purchasing the FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS.

The FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS is intended to improve the design, reliability and analysis of slug testing. The Field Guide provides a series of practical guidelines from test configuration, set up and test initiation, test performance, data processing and data analysis. It includes specific steps for testing using both solid slugs, bailers and pneumatic initiation methods. The Field Guide was prepared using same the critical themes presented in "***Improving The Design, Performance and Analysis of Slug Tests*** (Butler, 1998): (1) Importance of Complete Well Development, (2) Importance of Proper Test Design and (3) Importance of Appropriate Analysis Procedures.

A key element of test perforance is documentation. Attached are Data Acquisition Sheets that are also available on line at http://www.midwestgeo.com. We recommend using these sheets to prepare your test design and track test performance.

A list of slug test references are also available on the MidwestGeo website.

A special thank you is extended to Jim Butler, PhD, and Glenn Duffield who directed preparation of the FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS.

Each of the steps and parameters on the Field Guide are based from previously published standards and references including:

Bouwer and Rice, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resour. Res., 12(3), 423, 1976.

Butler, J..J.,1998, **The Design, Performance, and Analysis of Slug Tests**, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, Ground Water, v. 41, no. 5, 620 - 630 pp.

Butler and Zhan, Hydraulic tests in highly permeable aquifers, Water Resour. Res., 40, W12402, doi:10.1029/2003WR002998, 2004 – math and theory underlying new solution for hydraulic tests in high-K media.

Cooper, Bredehoeft, and Papadopulos, Response of a finite-diameter well to an instantaneous charge of water, Water Resour. Res., 3(1), 263, 1967.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? Ground Water, v. 36, no. 1, 37-48 pp.

midwest GEOSCIENCES group
www.midwestgeo.com

Training for Improving Observational, Descriptive, and Interpretive Skills

The Midwest GeoSciences Group conducts short courses, workshops, field trips and webinars on a variety of geoscience topics. Other FIELD GUIDES and FIELD TOOLS are also available from Midwest GeoSciences Group:



The **Hi-K Pneumatic Slug** is the answer for accurate rising head tests when the water level is above the screen interval! The pneumatic slug uses air pressure from a hand-held pump to lower the water level and the easy-to-use valve releases the pressure immediately to dramatically improve test results!

Each pneumatic slug assembly comes with a pressure gauge reading head displacement in inches of water, a hand pump an attachment for a 2" diameter well, and a storage case. It is compatible with most In-Situ and Solinist transducers up to 1" diameter. Optional accessories include attachments for fitting 3/4" diameter wells such as those for direct push well installations and attachments for 4" diameter wells.



THE FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS is a double-sided, plastic-coated guide for making accurate and complete soil and sediment descriptions on field boring logs. It is intended to improve the analysis of various sedimentary depositional environments applied to both environmental and engineering projects.

Common terms from geologic, engineering, and soil science disciplines are used on the Field Guide to help prepare meaningful boring logs that are clear and concise. Awarded Citation as Outstanding Geologic Literature by A.W. Hatheway and others / Engineering Geology 70 (2003).

THE FIELD GUIDE FOR ROCK CORE LOGGING AND FRACTURE-ANALYSIS is a double-sided, plastic-coated guide for improving rock core descriptions and characterizing bedrock fractures on meaningful rock core logs that are clear, consistent, and concise.

The front side presents procedures for labeling natural fractures, marking rock core, and calculating Total, Solid, and Modified Core Recovery and Rock Quality Designation (RQD). It also includes an easy-to-use flow chart for describing and characterizing rock core.





THE USDA SOIL TEXTURING FIELD FLOW CHART is a single-sided, plastic-coated guide for assisting with soil texturing procedures and assigning a Texture Class using the USDA texture triangle. The Flow Chart uses step-wise procedures (adopted from Foth and others, 1992) for estimating sand, silt, and clay content.

The Flow Chart uses the ribbon method to estimate the fine-grained fraction followed by placing the fraction within the texture triangle to determine Texture Class (ex: sandy loam). Awarded Citation as Outstanding Geologic Literature by A.W. Hatheway and others / Engineering Geology 70 (2003).

Go to www.midwestgeo.com to order.

Slug Test - Data Acquisition Sheet

General Information

Well Number_____
Well Location_____
Project_____

Date_____
Tests Performed by:_____
_____
_____

Reported Well Depth from Land Surface_____
Measured Depth from TOC (top of casing)_____
Casing Diameter and Schedule_____
Screen Length and Slot Size_____
Depth to Top of Screen from TOC_____
Filter Pack Details_____

Date of Last Well Development_____
Initial Static Water Level from TOC_____
Final Static Water Level from TOC_____
TOC from land surface_____
Borehole Diameter_____
Annular Seal Details_____

	Type	Serial Number	Purpose and Placement	Reading in Air
Transducer #1				
Transducer #2				

Data Logger Type and Serial Number_____
Logging Program:_____ Acquisition Rate:_____
Pressure or Pressure Head Units: Time Units:
Comments:

Test Information

	Test 01	Test 02	Test 03	Test 04	Test 05
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 01	
Test 02	
Test 03	
Test 04	
Test 05	

	Test 06	Test 07	Test 08	Test 09	Test 10
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 06	
Test 07	
Test 08	
Test 09	
Test 10	

File for Field Data:

Slug Test - Data Processing and Analysis Sheet

Data Processing

Well No./Location: Test Date: Data File:

Pressure or Pressure Head Units: Time Units: Date of Processing: Processed by:

	Test 01	Test 02	Test 03	Test 04	Test 05
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 01			
Test 02			
Test 03			
Test 04			
Test 05			

	Test 06	Test 07	Test 08	Test 09	Test 10
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 06			
Test 07			
Test 08			
Test 09			
Test 10			

File for Processed Data:

Data Analysis

Tests Chosen for Analysis:

Rationale for Choice:

Analysis Software: Date of Analysis: Analyzed by:

	Test number and analysis model	K estimate	Indication of low-K skin?	Other comments
Analysis 1				
Analysis 2				
Analysis 3				
Analysis 4				
Analysis 5				

File for Analysis Results:

1774278260 Evan Jones

Midwest GeoSciences Group - Order Receipt

Order Date: Monday, March 23, 2026 9:04am (MDT)
Order ID: 1774278260 (*Paid for*)
User ID: Did NOT sign-in

Merchandise	Quantity	Price	Amount
PNEUMATIC 'HI-K' SLUG® (2026v.)	1	$425.00	$425.00
[Unit_of_Measure=English]			

Order Total

Items	$425.00
Shipping	$58.00
Tax	$25.50
Total Charges	$508.50

Contact Information

Name:	Evan Jones
EMail:	ejones@langan.com
Phone:	2677749797
Notes:	We are looking to use this on a project in 2 weeks' time, if there is an option for expedited shipping we are interested. Let me know.

Billing Information

Payment Type:	Credit Card
Credit Card:	ending in 7546
Authorize.Net Response-	
Transaction ID:	121537323177
Authorization Code:	02527Z
First Name:	Evan
Last Name:	Jones
Company:	Langan
Address:	2700 KELLY DRIVE SUITE 200
City/State/Zip:	WARRINGTON, PA 18976
Country:	UNITED STATES
Phone:	2677749797
Fax:	

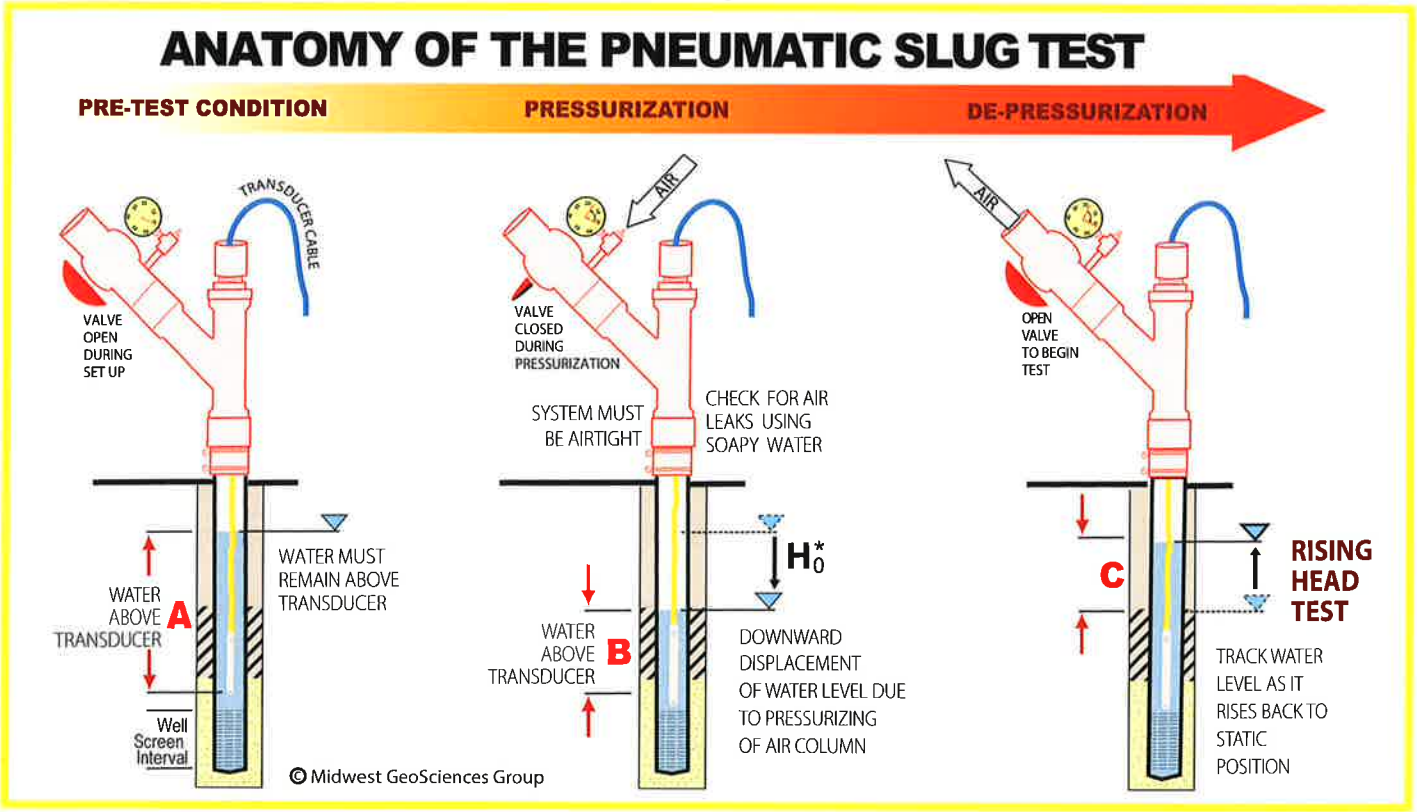
Shipping Information

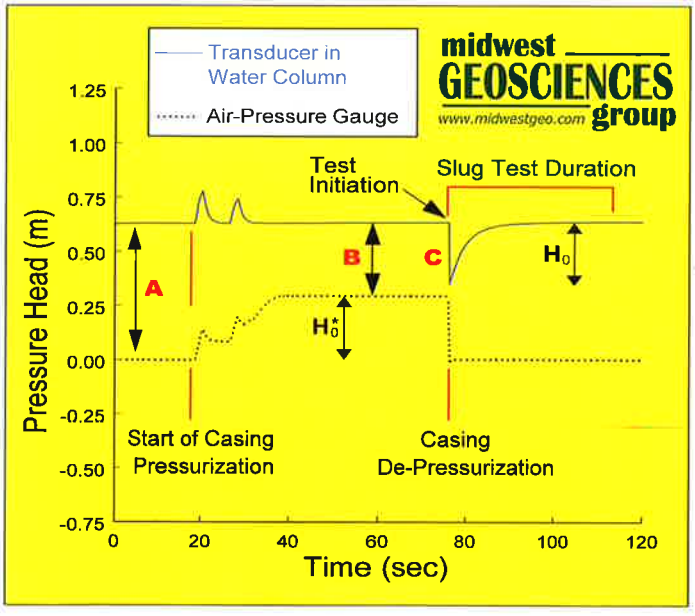
First Name:	Evan
Last Name:	Jones
Company:	Langan
Address:	2700 KELLY DRIVE SUITE 200
City/State/Zip:	WARRINGTON, PA 18976
Country:	UNITED STATES

ADDED:
COMP.
. FG SLUG TEST
. STICKERS

General Instructions for Using the Pneumatic Hi-K(R) Slug Assembly

1. The Pneumatic Hi-K(R) Slug Assembly uses air pressure to displace water in a well to perform a slug test.
2. The Pneumatic Hi-K(R) Slug can only be used if the water level occurs and remains above the top of the screen before the during the test.
3. The Pneumatic Hi-K(R) Slug can only be used to conduct rising head slug tests.
4. The Pneumatic Hi-K(R) Slug works best for slug tests in wells that recover quickly.
5. Pneumatic slug testing requires transducer reading to return to the reference point before a valid test may be initiated.





Users agree to defend, indemnify and hold harmless Midwest GeoSciences Group, its owners, managers, officers, directors, agents, and affiliates from any damages or charges resulting from the use of the equipment. Users liability shall include all losses, costs, damages, or expenses arising from any use, accident, bodily injury, or other occurrences to any persons or properties, including the users and their agents which arise from the equipment, proper use or otherwise.

EQUIPMENT LIST

1. PNEUMATIC SLUG MANIFOLD
2. VALVE ASSEMBLY WITH AIR GAUGE (in. or cm.)
3. COMPRESSION COUPLING ASSEMBLY (includes rubber stoppers with holes)
4. WELL COUPLER
5. OFFSET SCREWDRIVER AND SOCKET WRENCH
6. TEFLON TAPE
7. HAND PUMP
8. CARRYING CASE
9. INSTRUCTION SHEET

ASSEMBLY AND OPERATING INSTUCTIONS

PNEUMATIC
midwest GEOSCIENCES group
www.midwestgeo.com
Hi-K SLUG®

Step 1 - Assembly

1. Apply Teflon tape to the male threads of the parts to be assembled.
2. Thread the Valve Assembly onto the Pneumatic Slug Assembly.
3. Choose the proper size Compression Coupling Assembly to match the well casing diameter. The standard unit comes with 2-inch well coupler.
4. Thread the Compression Coupling Assembly onto the Pneumatic Slug Assembly.

Step 2 - Attach the Pneumatic Slug to the Well

1. Loosen the pipe clamp and slide the Compression Coupling Assembly onto the well.
2. Tighten the pipe clamp until secure and air tight.



Step 3 - Insert the Transducer

1. Unscrew the Transducer Access Hole Cap and remove the Black Rubber Stopper from the Transducer Access Hole.
2. Insert the transducer through the Transducer Access Hole Cap with the treaded end of the Transducer Access Hole Cap facing toward the Pneumatic Slug.
3. Insert the transducer into the Access Hole, and lower the transducer to the desired depth.
4. Insert the transducer cable into the hole in the Black Rubber Stopper so that the smaller end of the Black Rubber Stopper is facing the Pneumatic Slug. The Black Rubber Stopper has a slit in the side to allow the transducer cable to be inserted into the hole.
5. Insert the Black Rubber Stopper into the Transducer Access Hole.
6. Screw the Transducer Access Hole Cap over the Black Rubber Stopper to hold the stopper in place.
7. Read the transducer depth.
8. Start the transducer and data logger, on "Fast Linear" data measurement frequency setting. In normal conditions, you can keep the data logger running -without stopping- for multiple tests. Be sure to take reliable notes about test times and initial displacements.

Step 4 - Displace Water Column in the Well





1. Close the valve.
2. Attach the Air Pump to the Air Valve Fitting.
3. Pump air into the well until the desired displacement is achieved. Note that the Water Displacement Gauge reads in inches (or cm) of water. Do not apply too much pressure as it may damage the pressure gauge or cause hazardous conditions.
4. Read the transducer. Once the pressure/water level has equilibrated, it should read the same water depth as during original reference conditions. If the transducer does not read the same depth, wait until it recovers back to the original reference level.
5. Remove the Air Pump.





Step 5 - Run the Slug Test

1. Watch the data logger readings when you open the valve to release the air pressure.
2. When the water level has returned to equilibrium level, the test is complete.
3. Review the slug test data to ensure a valid test. Repeat the test as desired, usually with different displacements.

Step 6 - Remove the Pneumatic Slug

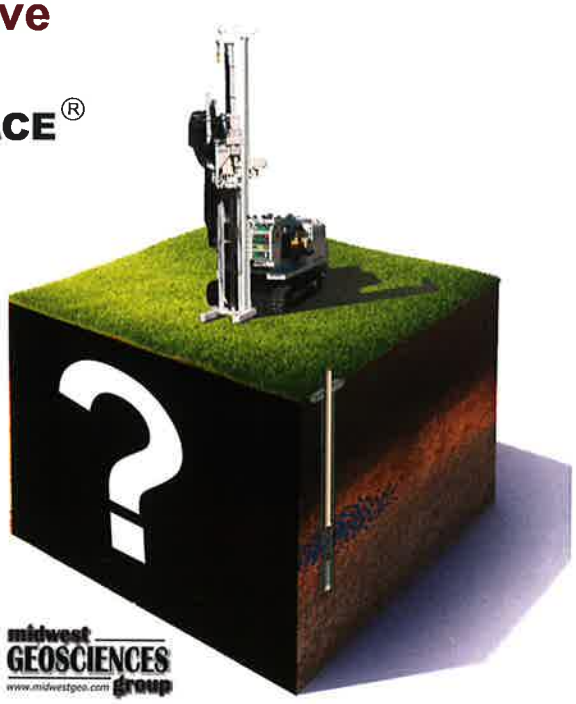
1. Remove the transducer from the well by unscrewing the Transducer Access Hole Cap, removing the Black Rubber Stopper, and removing the transducer.
2. Loosen the pipe clamp and remove the Pneumatic Slug from the well casing.
3. Disassemble the Pneumatic Slug and return the parts to the toolbox.

Do more than just identify soil, start deciphering the subsurface.

midwest GEOSCIENCES group
www.midwestgeo.com

New Training
On-Site and In-Person, at your office!
1-Day Classroom Intensive

What does **TAKING THE MYSTERY OUT OF THE SUBSURFACE®** mean?



It means characterizing the sedimentary succession according to how the sediments were deposited so we can define geologic units and predict their distribution, unit geometries, and physical properties.

This training is designed to improve both basic field descriptive procedures and subsurface analysis skills....because frankly, as geo-professionals that's the job we are hired to do.

It's not always simple to define and correlate sediments according to their depositional environments and stratigraphic context.

It's easier to try and rationalize secondary attributes such as lithology, soil classifications, CPT values, N-values, geophysics, geospatial statistical comparisons, water levels, or contaminant detections - but none of these attributes are the **SOLE INDEPENDENT VARIABLE:** that is, the geology.

One-Day Classroom Intensive at Your Location

Training for
Taking the Mystery Out of the Subsurface®

Learning to Translate the Sedimentary Sequence to Soil Boring Logs

You benefit from our established exercises and teaching experience.

Schedule Your Training Today



Your projects benefit from staff who perform efficiently and consistently with skills to decipher the subsurface for environmental and engineering projects.

midwest GEOSCIENCES group www.midwestgeo.com

STEP FIVE: DATA ANALYSIS

SELECTION OF TEST FOR ANALYSIS

1. If normalized plots from a series of slug tests coincide, choose only one test for analysis. The selected test should have the lowest data noise level of that series.
2. If normalized plots do not coincide, seek explanation for lack of coincidence. Possible explanations include insufficiently developed well and non-laminar flow losses. See Butler (1998) and Butler et al. (2003) for further explanations of lack of coincidence of normalized plots.

SELECTION OF TEST CATEGORY

Select appropriate category for well-formation configuration.

CATEGORY I - Wells in Confined Formations and Wells Screened Below the Water Table in Unconfined Formations.

CATEGORY II - Wells Screened Across the Water Table.

CATEGORY III - Wells in Category I and in Highly Permeable Conditions.

FRACTURED FORMATIONS

If formation is densely fractured and behaves as an equivalent porous media, standard methods are valid. If formation behaves as a double-porosity media, then validity decreases as well screen increases in length. If formation is sparsely fractured and flow is restricted to fractures, the validity of standard methods varies. If flow induced by test is radial, standard methods are valid. If flow is restricted to only a small portion of fracture plane, standard methods are not appropriate. See Butler (1998) and Shapiro and Hsieh (1998) for details.

TEST CATEGORIES

CATEGORY I ANALYSIS

A) Analyze data with Cooper et al. model for tests in fully penetrating wells.
B) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate can be calculated from the transmissivity (T) estimate using $K = T / L_e$
- If not, go to C.

C) Question: Is the well fully or partially penetrating?
- If fully pentrating well, test may be affected by insufficient development or double-porosity flow. See Butler (1998).
- If partially penetrating well, test may be affected by vertical flow above or below the screened interval. Go to D.

D) Analyze data with KGS model for tests in partially penetrating wells.
E) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate should be reasonable.
- If not, the test may be affected by insufficient development. See Butler (1998) for details.

CATEGORY II ANALYSIS

A) Question: Do data display a double straight line on a log normalized head vs. linear time plot (see Category II Figure)?
- If so, go to B.
- If not, go to A of Category I Analysis.

B) Fit a straight line to the formation response portion of the plot (2nd straight line segment).
C) Estimate K with Bouwer and Rice model.
- Use effective casing radius, not nominal casing radius, in analysis. See Butler (1998).

BOUWER & RICE AND HVORSLEV MODELS

These approximate methods involve fitting a straight line to data plotted in a log normalized head vs. linear time format. Although K estimates are obtained rapidly, these methods, unlike the Cooper et al. and KGS models, cannot provide clues that the test has been significantly impacted by insufficient development. If flow is primarily horizontal, data will display a concave-upward curvature in this plotting format. Straight line should be fit to the 0.15 - 0.25 (Hvorslev) and 0.2 - 0.3 (Bouwer & Rice) normalized head range. These ranges should be with respect to H_0^+ when data plot as a double straight line (see Catagory II Analysis Plot).

CATEGORY III ANALYSIS

A) Question: Are data oscillatory in nature or display a concave-downward curvature on a log normalized head vs. linear time plot?
- If so, go to B.
- If not, go to A of Category I Analysis.

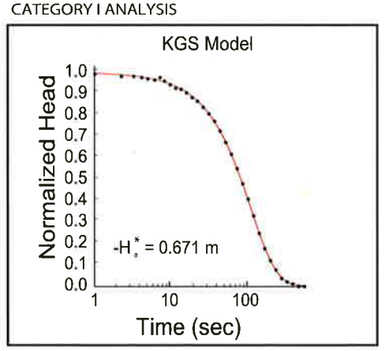
B) Question: Do normalized data plots coincide?
- If so, go to C.
- If not, go to D.

C) Question: Is well fully penetrating or nearly so?
- If so, analyze data with Butler & Zhan model.
- If not, analyze data with either Butler & Zhan model or high-K extensions of Hvorslev and Bouwer-Rice models.

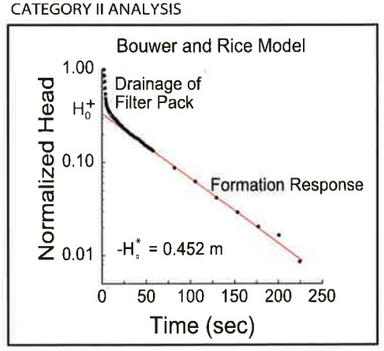
D) Question: Do normalized data plots from tests initiated with similar H_0^+ coincide?
- If so, go to E.
- If not, further development may be needed.

E) Question: Can tests be repeated?
- If so, repeat tests with smaller initial displacements and go to B.
- If not, analyze data with non-linear slug test model of McElwee and Zenner. Note error in K estimate may increase as well approaches full penetration.

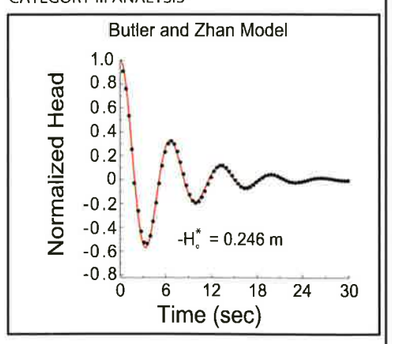
CATEGORY I ANALYSIS



CATEGORY II ANALYSIS



CATEGORY III ANALYSIS



CREATED BY: Butler, J. Jim, G.F. Duffield, and D.L. Kelleher (complete list of references at www.midwestgeo.com)

Butler, 1998, *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, v. 41, no. 5, 620 - 630 pp.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, v. 36, no. 1, 37-48 pp.

Copyright © 2007- 2025 Midwest GeoSciences Group Press

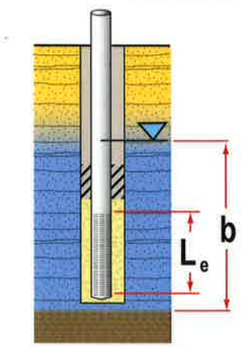
FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS™

midwest GEOSCIENCES group www.midwestgeo.com

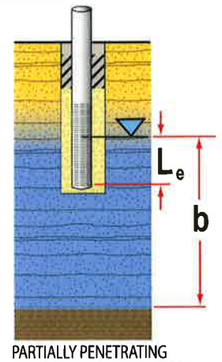
STEP ONE: TEST WELL CONFIGURATION

K = Hydraulic Conductivity
b = Thickness of Tested Unit
L_e = Effective Screen Length (portion through which flow occurs, usually not the length of the filter pack)

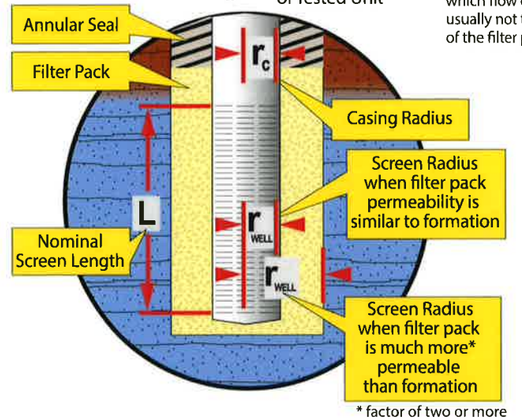
UNCONFINED CONDITIONS



PARTIALLY PENETRATING
Screened Below the Water Table
$L_e = L$

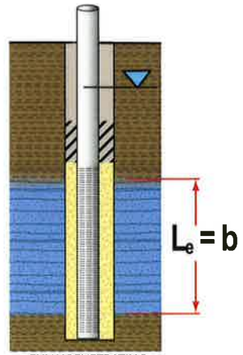


PARTIALLY PENETRATING
Screened Across the Water Table
$L_e < L$

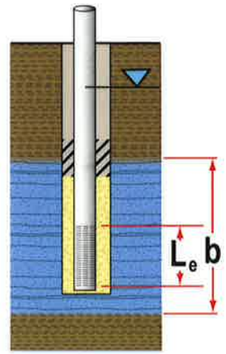


* factor of two or more

CONFINED CONDITIONS

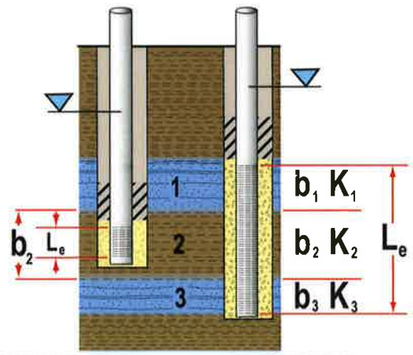


FULLY PENETRATING
Screened Across the Entire Unit
$L_e < L$



PARTIALLY PENETRATING
Screened Across a Portion of the Unit
$L_e = L$

LAYERED SETTINGS



PARTIALLY PENETRATING
Screened Across a Portion of a Layer
$L_e < b_2$
$K \approx K_2$

FULLY PENETRATING
Screened Across Multiple Layers
$K \approx \frac{[(b_1 K_1)+(b_2 K_2)+(b_3 K_3)]}{L_e}$

Slug tests are also an effective means of estimating K in aquitards. See Butler (1998) for specialized test procedures.

WELL DEVELOPMENT IS CRITICAL

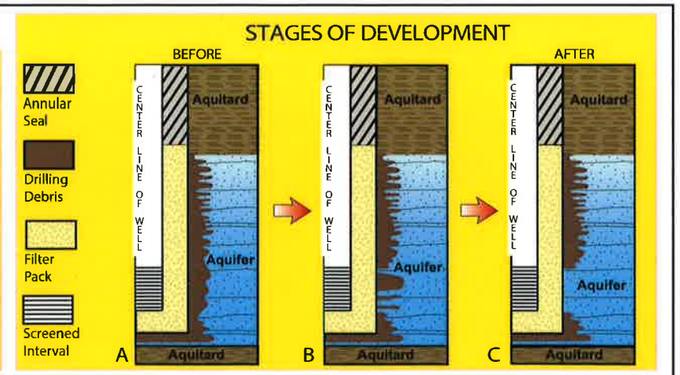
1. MUST develop well thoroughly before slug testing because a near-well zone of disturbance may be created during drilling. Characteristics of zone depend on formation properties and drilling method. Zone often consists of various types of "drilling debris".

Hydraulic conductivity estimates from tests in poorly or undeveloped wells may be much less than formation K due to impact of "drilling debris".

2. Perform slug tests and assess the sufficiency of well development during data processing and analysis (see Steps 4 and 5).

For monitoring wells, development should produce a situation between B and C. Assume $L_e = L$ for analysis.

STAGES OF DEVELOPMENT



midwest GEOSCIENCES group
www.midwestgeo.com

STEP TWO: SET UP AND TEST INITIATION

FOR TESTS USING SOLID SLUGS OR BAILERS

INITIAL ACTIVITIES

1. Measure depth to water.
2. Measure depth to bottom of well.
3. Measure slug volume (solid or bailer)

$$V_{SLUG} = \pi r_{SLUG}^2 L_{SLUG}$$

EXAMPLE: Solid slug, 2.5-cm diameter, 75-cm long

$V_{SLUG} = (3.14)(1.25\text{cm})^2(75\text{cm}) = 368.2\ \text{cm}^3$

4. Calculate expected initial displacement

$$H_0^* = V_{SLUG} / \pi r_{CASING}^2$$

EXAMPLE: Solid slug in 5-cm diameter well

$H_0^* = (368.2\ \text{cm}^3) / (3.14)(2.5\text{cm})^2 = 18.8\ \text{cm}$

5. Calculate length of water column in well.
6. Check depth limit of transducer and determine appropriate transducer position.

Height of water column above transducer should allow sufficient room for slug introduction and rapid removal.

EQUIPMENT

Must be appropriate for expected rate of head change. Always use a transducer and data logger for tests in moderate to high permeability formations (K > 0.001 cm/s). Manual measurement of water levels is a reasonable approach for tests in lower permeability formations.

SET UP

1. Submerge transducer to pre-determined depth and allow 15 to 20 minutes for transducer to thermally equilibrate with water and transducer cable to stretch.

Submerge transducer a sufficient distance to avoid interference during slug movement. If transducer is located within screened interval, place above well bottom to avoid plugging by settled fines.

2. Secure transducer cable to prevent movement during test.
3. Check data logger to ensure connectivity and communication.
4. Track water level through time to ensure near-static conditions have been achieved prior to test.
5. Prepare solid slug or bailer for test. Check bailer for leaks.

FALLING HEAD (Slug In) TEST

Place bottom of slug just above top of water column. Measure drop distance on cord and fasten cord prior to test.

RISING HEAD (Slug Out) TEST

Place top of slug just below top of water column. Measure removal distance on cord and prepare to fasten cord after removal.

TEST INITIATION

1. Double check data logger settings.
2. Verify water level has returned to static.
3. Start logging data 5 to 10 seconds prior to test initiation.
4. Create near-instantaneous water-level change relative to formation response.

For tests in high-permeability formations, water level change produced by a solid slug or bailer may not be fast enough. Use pneumatic method for tests initiation (see Step Three).

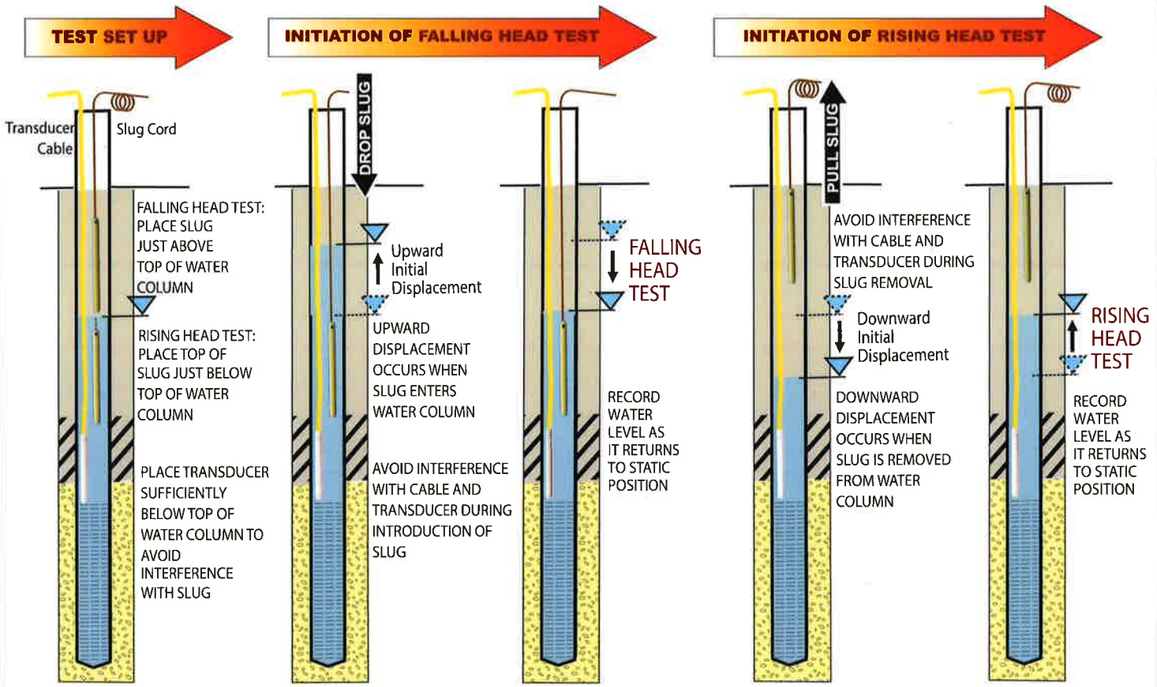
5. Prevent entanglement with transducer or its cable during test initiation.

When moving slug to initiate test, try to minimize distance of movement by positioning slug a short distance above or below top of water column. This will help avoid getting the slug entangled in the tranducer cable or hitting the transducer.

INITIAL DISPLACEMENT

In moderate or lower permeability formations (K < 0.02 cm/s), an initial displacement of 0.3 to 0.9 meters should produce a reasonable signal-to-noise ratio. In higher K formations, use smaller displacements (< 0.3 meters) to reduce non-Darcian flow losses. Slug size does not affect test radius - see Butler (1998).

FALLING & RISING HEAD TESTING

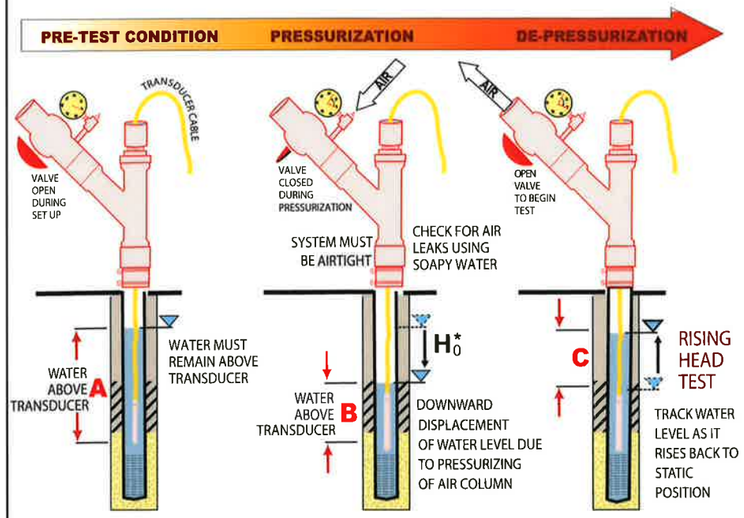


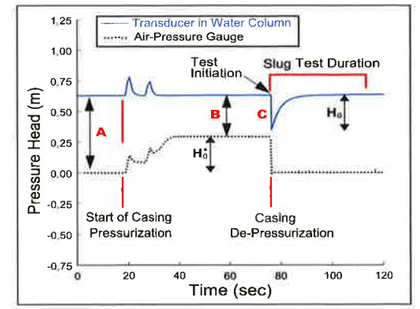
Copyright © 2007 - 2025 Midwest GeoSciences Group Press

FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS

midwest GEOSCIENCES group
www.midwestgeo.com

FOR TESTS USING PNEUMATIC INITIATION SYSTEM





1. Use pneumatic method to initiate tests in highly permeable formations. The pneumatic method uses air pressure, either positive or negative, to displace water. Water level must remain above screen and transducer.
2. Rising head tests are performed by pressurizing air column, allowing pressures to stabilize, and then depressurizing air column.
3. Falling head tests are performed in a similar manner by applying a vacuum to air column.

STEP THREE: TEST PERFORMANCE

GENERAL PERFORMANCE GUIDELINES

1. Perform three or more tests at each well.
2. Use at least two initial displacements varying by a factor of two or more.
3. Conduct both rising and falling head tests if possible. First and last tests should use approximately same initial displacement.

Repeat tests with different H_0^* are used to assess the viability of assumptions underlying slug test analysis methods.

4. Run each test to near completion (i.e. heads within 5% of static).

Running tests to near completion allows data to be analyzed with more sophisicated methods (Cooper et al. and KGS models). These methods can provide insights into impact of anisotropy, double-porosity behavior, and insufficient well development. See Butler (1998) for further details.

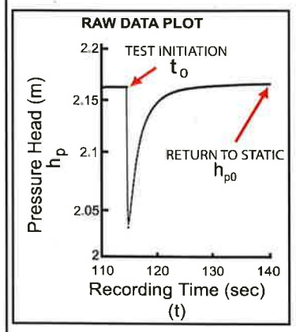
STEP FOUR: DATA PROCESSING

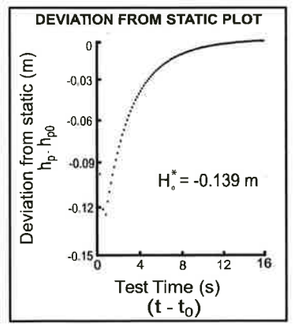
H_0^* = Expected initial displacement estimated from geometrical considerations (solid slug) or air pressure readings (pneumatic initiation).

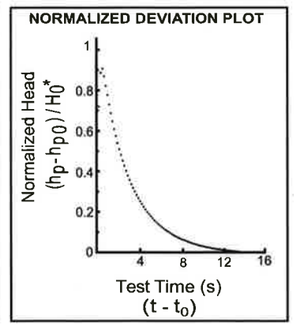
H_0 = Initial water-level displacement measured in well.

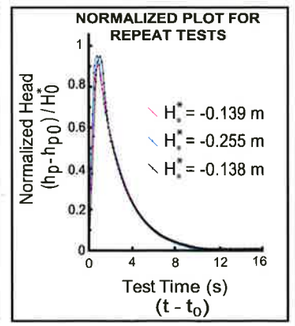
GENERAL PROCESSING GUIDELINES

1. Estimate time test began (t_0) and the pressure head at static conditions (h_{p0}) from the raw data plot.
2. Subtract h_{p0} and t_0 from the head (h_p) and time (t) records, respectively, to compute head deviation from static and time since test began (deviation from static plot).
3. Normalize data by dividing deviation data by the expected displacement (H_0^*).
4. Compare the expected displacement (H_0^*) with the initial water level displacement measured in the well (H_0). Are they different? If so, possible explanations could include: (1) effective casing radius different from nominal casing radius, (2) test initiation too slow, (3) measurement rate too slow, and (4) transducer too deep in water column (high K formation).
5. Compare normalized data plots from repeat tests at the same well. Coincidence of normalized plots suggests that assumptions underlying conventional analysis methods may be valid at that well. If normalized plots do not coincide, then more development may be necessary.









Copyright © 2007 - 2025 Midwest GeoSciences Group Press

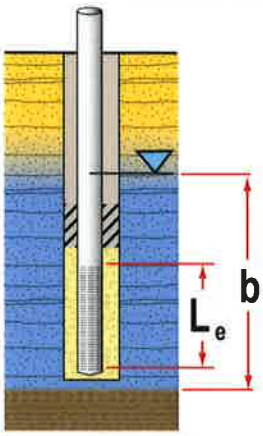
FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS™

midwest GEOSCIENCES group
www.midwestgeo.com

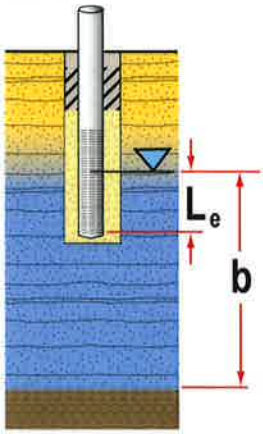
STEP ONE: TEST WELL CONFIGURATION

K = Hydraulic Conductivity
b = Thickness of Tested Unit
L_e = Effective Screen Length (portion through which flow occurs, usually not the length of the filter pack)

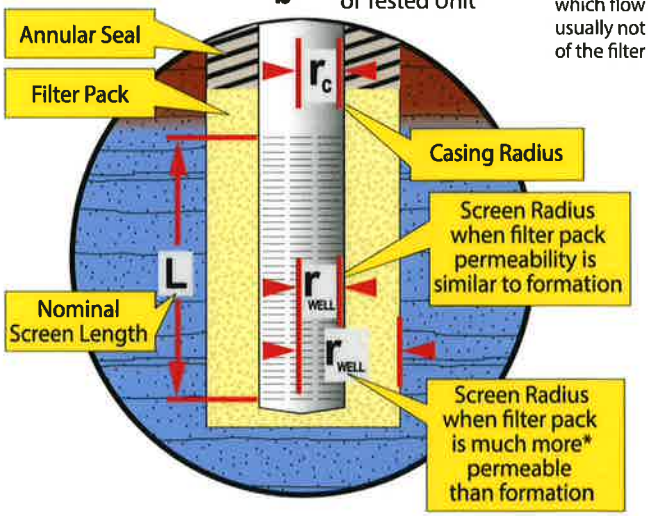
UNCONFINED CONDITIONS



PARTIALLY PENETRATING
Screened Below the Water Table
$L_e = L$

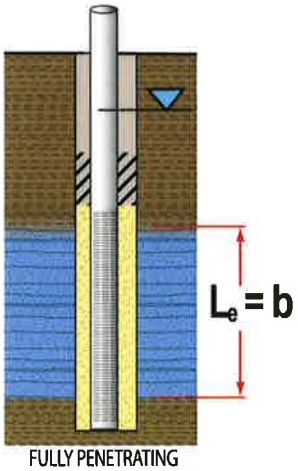


PARTIALLY PENETRATING
Screened Across the Water Table
$L_e < L$

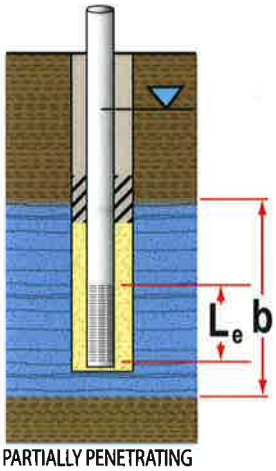


* factor of two or more

CONFINED CONDITIONS

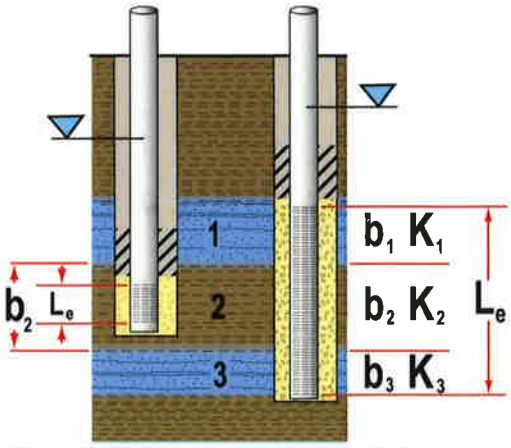


FULLY PENETRATING
Screened Across the Entire Unit
$L_e < L$



PARTIALLY PENETRATING
Screened Across a Portion of the Unit
$L_e = L$

LAYERED SETTINGS



PARTIALLY PENETRATING
Screened Across a Portion of a Layer
$L_e < b_2$
$K \approx K_2$

FULLY PENETRATING
Screened Across Multiple Layers
$$K \approx \frac{[(b_1 K_1)+(b_2 K_2)+(b_3 K_3)]}{L_e}$$

Slug tests are also an effective means of estimating K in aquitards. See Butler (1998) for specialized test procedures.

WELL DEVELOPMENT IS CRITICAL

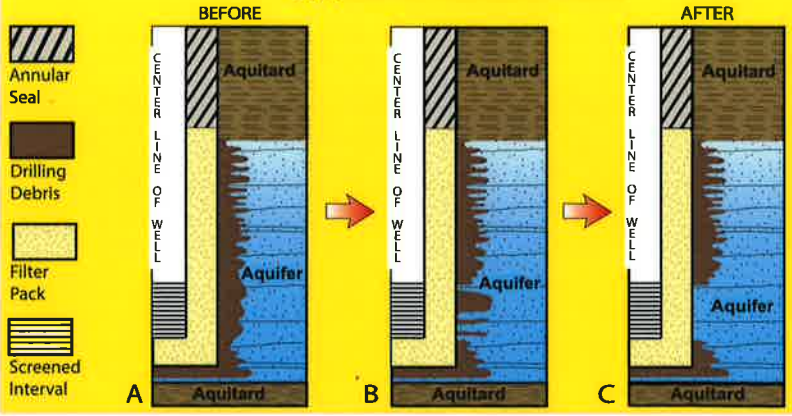
1. MUST develop well thoroughly before slug testing because a near-well zone of disturbance may be created during drilling. Characteristics of zone depend on formation properties and drilling method. Zone often consists of various types of "drilling debris".

   Hydraulic conductivity estimates from tests in poorly or undeveloped wells may be much less than formation K due to impact of "drilling debris".

2. Perform slug tests and assess the sufficiency of well development during data processing and analysis (see Steps 4 and 5).

   For monitoring wells, development should produce a situation between B and C. Assume $L_e = L$ for analysis.

STAGES OF DEVELOPMENT



midwest GEOSCIENCES group
www.midwestgeo.com

STEP TWO: SET UP AND TEST INITIATION

FOR TESTS USING SOLID SLUGS OR BAILERS

INITIAL ACTIVITIES

1. Measure depth to water.
2. Measure depth to bottom of well.
3. Measure slug volume (solid or bailer)

$$V_{SLUG} = \pi r_{SLUG}^2 L_{SLUG}$$

EXAMPLE: Solid slug, 2.5-cm diameter, 75-cm long

$V_{SLUG} = (3.14)\ (1.25\text{cm})^2 (75\text{cm}) = 368.2\ \text{cm}^3$

4. Calculate expected initial displacement

$$H_0^* = V_{SLUG} / \pi r_{CASING}^2$$

EXAMPLE: Solid slug in 5-cm diameter well

$H_0^* = (368.2\ \text{cm}^3) / (3.14)(2.5\text{cm})^2 = 18.8\ \text{cm}$

5. Calculate length of water column in well.
6. Check depth limit of transducer and determine appropriate transducer position.

> Height of water column above transducer should allow sufficient room for slug introduction and rapid removal.

EQUIPMENT

Must be appropriate for expected rate of head change. Always use a transducer and data logger for tests in moderate to high permeability formations ($K > 0.001$ cm/s). Manual measurement of water levels is a reasonable approach for tests in lower permeability formations.

SET UP

1. Submerge transducer to pre-determined depth and allow 15 to 20 minutes for transducer to thermally equilibrate with water and transducer cable to stretch.

> Submerge transducer a sufficient distance to avoid interference during slug movement. If transducer is located within screened interval, place above well bottom to avoid plugging by settled fines.

2. Secure transducer cable to prevent movement during test.
3. Check data logger to ensure connectivity and communication.
4. Track water level through time to ensure near-static conditions have been achieved prior to test.
5. Prepare solid slug or bailer for test. Check bailer for leaks.

FALLING HEAD (Slug In) TEST

Place bottom of slug just above top of water column. Measure drop distance on cord and fasten cord prior to test.

RISING HEAD (Slug Out) TEST

Place top of slug just below top of water column. Measure removal distance on cord and prepare to fasten cord after removal.

TEST INITIATION

1. Double check data logger settings.
2. Verify water level has returned to static.
3. Start logging data 5 to 10 seconds prior to test initiation.
4. Create near-instantaneous water-level change relative to formation response.

> For tests in high-permeability formations, water level change produced by a solid slug or bailer may not be fast enough. Use pneumatic method for tests initiation (see Step Three).

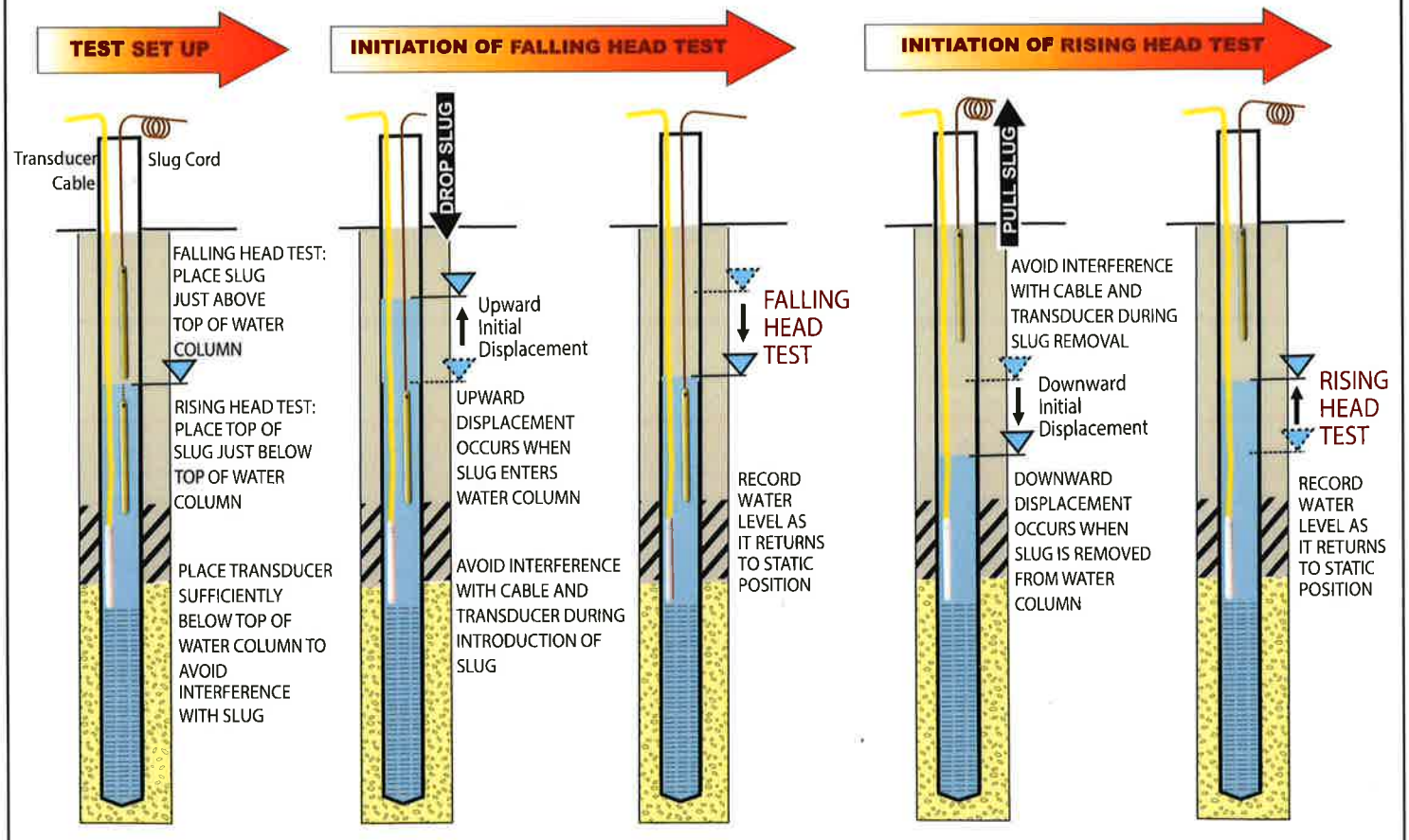
5. Prevent entanglement with transducer or its cable during test initiation.

> When moving slug to initiate test, try to minimize distance of movement by positioning slug a short distance above or below top of water column. This will help avoid getting the slug entangled in the tranducer cable or hitting the transducer.

INITIAL DISPLACEMENT

In moderate or lower permeability formations ($K < 0.02$ cm/s), an initial displacement of 0.3 to 0.9 meters should produce a reasonable signal-to-noise ratio. In higher K formations, use smaller displacements (< 0.3 meters) to reduce non-Darcian flow losses. Slug size does not affect test radius - see Butler (1998).

FALLING & RISING HEAD TESTING

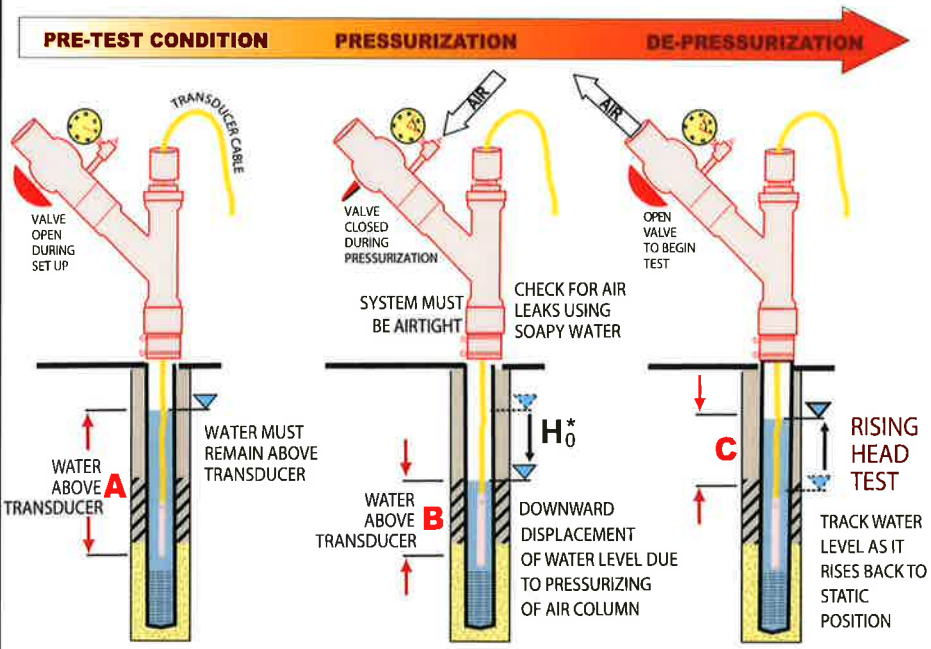


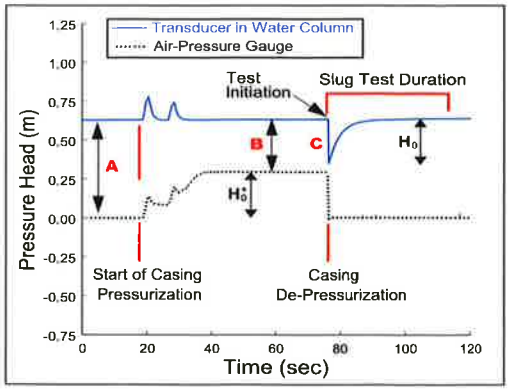
Copyright © 2007 - 2025 Midwest GeoSciences Group Press

FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS

midwest GEOSCIENCES group
www.midwestgeo.com

FOR TESTS USING PNEUMATIC INITIATION SYSTEM





1. Use pneumatic method to initiate tests in highly permeable formations. The pneumatic method uses air pressure, either positive or negative, to displace water. Water level must remain above screen and transducer.
2. Rising head tests are performed by pressurizing air column, allowing pressures to stabilize, and then depressurizing air column.
3. Falling head tests are performed in a similar manner by applying a vacuum to air column.

STEP THREE: TEST PERFORMANCE

GENERAL PERFORMANCE GUIDELINES

1. Perform three or more tests at each well.
2. Use at least two initial displacements varying by a factor of two or more.
3. Conduct both rising and falling head tests if possible. First and last tests should use approximately same initial displacement.

Repeat tests with different H_0^* are used to assess the viability of assumptions underlying slug test analysis methods.

4. Run each test to near completion (i.e. heads within 5% of static).

Running tests to near completion allows data to be analyzed with more sophisicated methods (Cooper et al. and KGS models). These methods can provide insights into impact of anisotropy, double-porosity behavior, and insufficient well development. See Butler (1998) for further details.

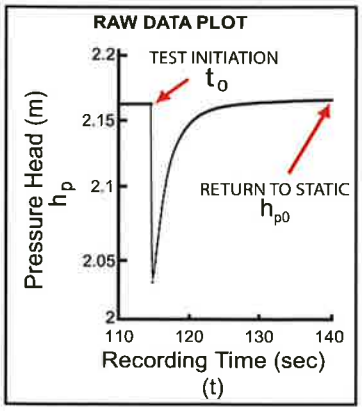
STEP FOUR: DATA PROCESSING

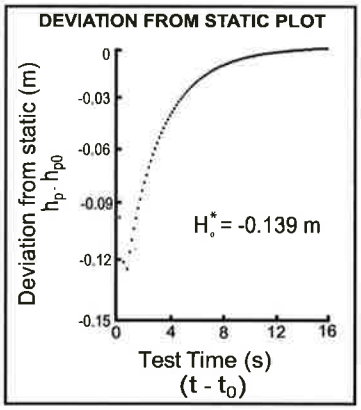
H_0^* = Expected initial displacement estimated from geometrical considerations (solid slug) or air pressure readings (pneumatic initiation).

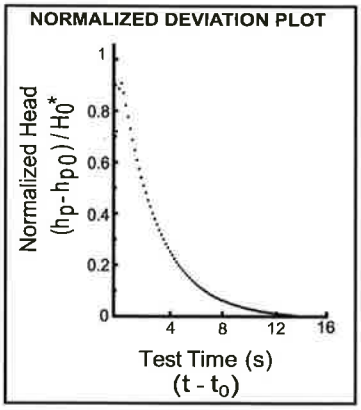
H_0 = Initial water-level displacement measured in well.

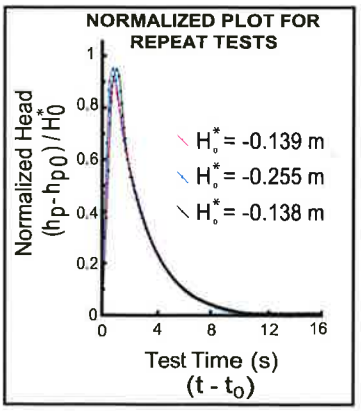
GENERAL PROCESSING GUIDELINES

1. Estimate time test began (t_0) and the pressure head at static conditions (h_{p0}) from the raw data plot.
2. Subtract h_{p0} and t_0 from the head (h_p) and time (t) records, respectively, to compute head deviation from static and time since test began (deviation from static plot).
3. Normalize data by dividing deviation data by the expected displacement (H_0^*).
4. Compare the expected displacement (H_0^*) with the initial water level displacement measured in the well (H_0). Are they different? If so, possible explanations could include: (1) effective casing radius different from nominal casing radius, (2) test initiation too slow, (3) measurement rate too slow, and (4) transducer too deep in water column (high K formation).
5. Compare normalized data plots from repeat tests at the same well. Coincidence of normalized plots suggests that assumptions underlying conventional analysis methods may be valid at that well. If normalized plots do not coincide, then more development may be necessary.









Copyright © 2007 - 2025 Midwest GeoSciences Group Press

midwest GEOSCIENCES group www.midwestgeo.com

STEP FIVE: DATA ANALYSIS

SELECTION OF TEST FOR ANALYSIS

1. If normalized plots from a series of slug tests coincide, choose only one test for analysis. The selected test should have the lowest data noise level of that series.
2. If normalized plots do not coincide, seek explanation for lack of coincidence. Possible explanations include insufficiently developed well and non-laminar flow losses. See Butler (1998) and Butler et al. (2003) for further explanations of lack of coincidence of normalized plots.

SELECTION OF TEST CATEGORY

Select appropriate category for well-formation configuration.

CATEGORY I - Wells in Confined Formations and Wells Screened Below the Water Table in Unconfined Formations.

CATEGORY II - Wells Screened Across the Water Table.

CATEGORY III - Wells in Category I and in Highly Permeable Conditions.

FRACTURED FORMATIONS

If formation is densely fractured and behaves as an equivalent porous media, standard methods are valid. If formation behaves as a double-porosity media, then validity decreases as well screen increases in length. If formation is sparsely fractured and flow is restricted to fractures, the validity of standard methods varies. If flow induced by test is radial, standard methods are valid. If flow is restricted to only a small portion of fracture plane, standard methods are not appropriate. See Butler (1998) and Shapiro and Hsieh (1998) for details.

TEST CATEGORIES

CATEGORY I ANALYSIS

A) Analyze data with Cooper et al. model for tests in fully penetrating wells.
B) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate can be calculated from the transmissivity (T) estimate using $K = T / L_e$
- If not, go to C.

C) Question: Is the well fully or partially penetrating?
- If fully pentrating well, test may be affected by insufficient development or double-porosity flow. See Butler (1998).
- If partially penetrating well, test may be affected by vertical flow above or below the screened interval. Go to D.

D) Analyze data with KGS model for tests in partially penetrating wells.
E) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate should be reasonable.
- If not, the test may be affected by insufficient development. See Butler (1998) for details.

CATEGORY II ANALYSIS

A) Question: Do data display a double straight line on a log normalized head vs. linear time plot (see Category II Figure)?
- If so, go to B.
- If not, go to A of Category I Analysis.

B) Fit a straight line to the formation response portion of the plot (2nd straight line segment).
C) Estimate K with Bouwer and Rice model.
- Use effective casing radius, not nominal casing radius, in analysis. See Butler (1998).

BOUWER & RICE AND HVORSLEV MODELS

These approximate methods involve fitting a straight line to data plotted in a log normalized head vs. linear time format. Although K estimates are obtained rapidly, these methods, unlike the Cooper et al. and KGS models, cannot provide clues that the test has been significantly impacted by insufficient development. If flow is primarily horizontal, data will display a concave-upward curvature in this plotting format. Straight line should be fit to the 0.15 - 0.25 (Hvorslev) and 0.2 - 0.3 (Bouwer & Rice) normalized head range. These ranges should be with respect to H_0^+ when data plot as a double straight line (see Catagory II Analysis Plot).

CATEGORY III ANALYSIS

A) Question: Are data oscillatory in nature or display a concave-downward curvature on a log normalized head vs. linear time plot?
- If so, go to B.
- If not, go to A of Category I Analysis.

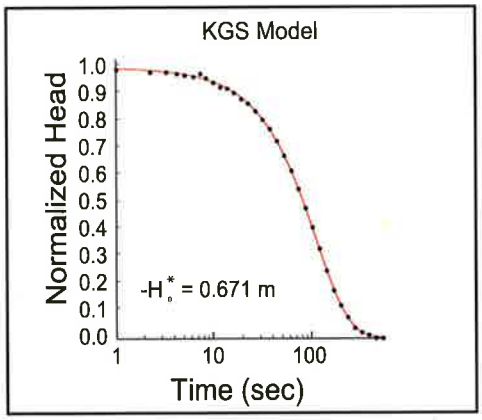
B) Question: Do normalized data plots coincide?
- If so, go to C.
- If not, go to D.

C) Question: Is well fully penetrating or nearly so?
- If so, analyze data with Butler & Zhan model.
- If not, analyze data with either Butler & Zhan model or high-K extensions of Hvorslev and Bouwer-Rice models.

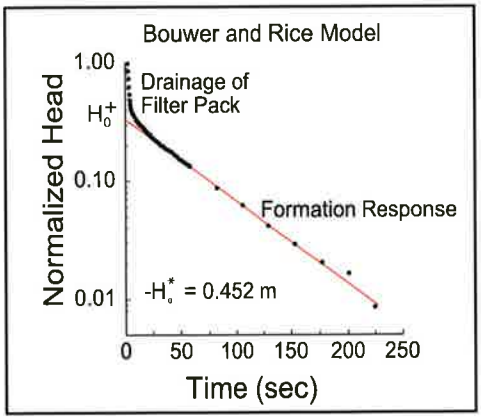
D) Question: Do normalized data plots from tests initiated with similar H_0^* coincide?
- If so, go to E.
- If not, further development may be needed.

E) Question: Can tests be repeated?
- If so, repeat tests with smaller initial displacements and go to B.
- If not, analyze data with non-linear slug test model of McElwee and Zenner. Note error in K estimate may increase as well approaches full penetration.

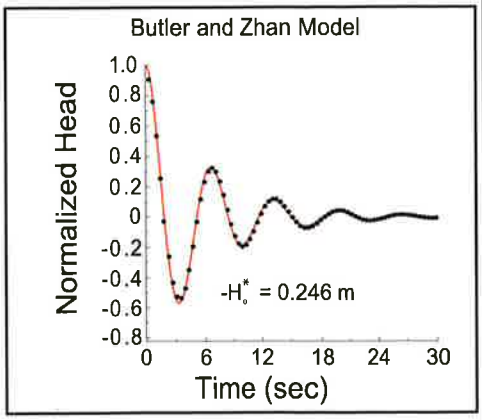
CATEGORY I ANALYSIS



CATEGORY II ANALYSIS



CATEGORY III ANALYSIS



CREATED BY: Butler, J. Jim, G.F. Duffield, and D.L. Kelleher (complete list of references at www.midwestgeo.com)

Butler, 1998, *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, v. 41, no. 5, 620 - 630 pp.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, v. 36, no. 1, 37-48 pp.

Copyright © 2007- 2025 Midwest GeoSciences Group Press

RECOMMENDED ENVIRONMENTAL PFAS SAMPLING PROCEDURES

1. Statement of Issue

This standard operating procedure (SOP) has been prepared to provide guidelines sampling various media for per- and polyfluoroalkyl substances (PFAS) at Perdue AgriBusiness, LLC (PAB) facility located at 6906 Zion Church Road in Salisbury, Wicomico County, Maryland (the "ZCR Facility" and/or the "Site"). This sampling is being performed at the request of the Maryland Department of the Environment (MDE) Water and Science Administration, Wastewater Pollution Prevention and Reclamation Program (the "Department") in response to their *Request for Action to Address PFAS in Wastewater* letter issued to PAB on November 8, 2024.

This SOP outlines proper equipment, materials, and methods for PFAS sampling at the ZCR Facility and includes procedures and guidance that are intended to limit the potential for PFAS cross-contamination and interference from sources unrelated to the targeted media.

2. Background

On September 12, 2024, MDE issued a letter designating PAB as a responsible person (as defined by Section 7-201 of the Environmental Article) for PFAS detected in groundwater at the western edge of the ZCR Facility and in well and surface water samples collected by MDE to the west of the ZCR Facility.

Langan Engineering and Environmental Services, LLC (Langan) has developed a PFAS Site Investigation Workplan on behalf of PAB to describe the scope and methods for the next phase of a PFAS site/remedial investigation that is being performed for the PAB facility. The Workplan includes proposed soil, groundwater, and/or surface water sampling and other investigation activities that require guidance on limiting cross-contamination of samples in and out of the sample location.

This SOP is informed by EPA Method 1633, approved in January 2024 and ITRC's "Sampling and Analysis" section, revised September 2023.

3. Methodology

3.1 Health and Safety

Langan personnel must abide by Langan's health and safety protocols when performing work-related activities. These protocols should be followed even when they are potentially in conflict with this SOP (including protocols that are intended to limit the potential for PFAS cross-contamination). When there is no appropriate protocol that is consistent both with safe work practices and with this SOP, it is acceptable to deviate from this SOP. Deviations should be documented, and equipment rinsate blanks should be collected and analyzed as appropriate to assess and quantify the potential cross-contamination and other data quality issues arising from the deviation. Refer to the site-specific health and safety plan (HASP) for specific field-related activities and safe work practices.

General safety guidelines are included below:

- Wear safety glasses, protective clothing (i.e., long sleeves and pants; closed-toed, steel-toed shoes; hard hat), and disposable polyethylene or nitrile gloves sampling.
- Avoid contact, inhalation, or ingestion of samples.
- Wash hands thoroughly, along with any other areas that may have contacted or been exposed to the sample, after sampling is complete.
- Post signage to communicate hazards to other facility personnel or isolate work areas, where applicable.

The facility is responsible for following and maintaining on-site awareness of relevant regulations under the Occupational Safety and Health Administration (OSHA), regarding safe sampling handling practices. Safety data sheets for materials used on-site must be made available to facility personnel, and facility personnel must be trained in the proper doffing of contaminated gloves and clothing.

3.2 General Considerations

Industry standard sampling methods for environmental sampling are generally acceptable for use in PFAS sampling, provided that the sampling equipment is evaluated for potential PFAS interference.

3.3 Field Decision Guide

Field staff should follow the tiered approach adopted by Langan in assessing unplanned conditions that could increase the risk of sample cross-contamination by site conditions and/or sampling equipment and procedures. The tiered approach considers possible impact to environmental samples when assessing an unplanned condition. The table below identifies the tiered approach to formulate a solution/response that can be discussed with the PM to confirm conformance with objectives of the sampling program.

Definition		Questions to Consider
Tier 1	Unplanned materials or equipment that will come into direct contact or could reasonably come into direct contact with field samples	Discuss issue and proposed solution with PM Does the material or equipment directly contact field samples? Is there an alternative material or piece of equipment that would be considered acceptable and that is readily available? Is the material necessary for proper sample collection? Can steps be taken to avoid direct contact with field samples? Can a rinsate blank be collected to support an evaluation of cross contamination?
Tier 2	Unplanned materials and equipment that are not expected to come into direct contact with	Issue and solution may warrant discussion with PM.

	Definition	Questions to Consider
	field samples, but present the potential for incidental contact and may contain PFAS	Can measures be put in place to further ensure contact with the field samples is avoided? Is additional Quality Assurance/Quality Control (QA/QC) sampling warranted based on project DQO's?
Tier 3	Unplanned materials and equipment that will not come into direct contact with field samples, pose no risk of incidental contact with a sample, and are not known to contain PFAS	Discussion with the PM is not likely necessary and nor is added QA/QC Is this material necessary for the work at hand? Can it be safely and securely removed from the work area?

3.4 Sampling Documentation and Labeling

Follow environmental sampling accepted practices when documenting PFAS sampling. Field books and writing instruments should be evaluated as potential sources of PFAS interference. In addition, evaluate the sampling containers, label paper, adhesive backing and printing ink as potential sources of PFAS interference. As a precaution, labels for PFAS sample containers should be applied after collecting the sample.

3.5 Field Clothing, Personal Protective Equipment and Personal Care Products

Langan field personnel should adhere to standard protective clothing including but not limited to hi-visibility shirts, pants, steel-toed work shoes, and safety glasses. Water resistant, waterproof, stainproof, or stain-treated materials should be avoided when possible, including the standard issued Langan field jacket. Field clothing made of synthetic and natural fibers (preferably cotton) are acceptable. Field clothing should be laundered without the use of fabric softener. Preferably, field gear should be cotton construction and well laundered. New clothing may contain PFAS related treatments.

Additionally, personnel should avoid application of cosmetics, moisturizers, and creams as these may contain PFAS. This includes specific sunscreens and insect repellants. Review **Attachment A - Clothing/ Personal Protective Equipment (PPE) and Personal Care Products** for additional guidance and specific brands of materials and products that are and are not acceptable when PFAS sampling.

3.6 Sampling Equipment

Equipment brought onsite by Langan personnel should be reviewed and confirmed to be PFAS-free prior to sampling event. This includes standard equipment such as:

- Nitrile gloves
- Laboratory provided sample bottles
- Field logbook and writing utensil
- Labels and permanent markers
- Laboratory supplied PFAS-free water

Standard equipment such as Rite in the Rain® field notebooks and fine-tipped Sharpies® have been reviewed by USEPA to not contain PFAS and are acceptable in the field.

Subcontractors and their equipment should be vetted prior to sampling event. Water transported onsite for drilling should be confirmed to be PFAS-free by the subcontractor prior to use. All subcontractors should be made aware of QAPP standards, including Langan

Equipment that comes into contact with samples (i.e. acetate liners, drill bits) should be sampled as an equipment blanks and decontaminated as needed.

3.7 Sampling Procedure

General Procedures

- Wear nitrile gloves and change them frequently. New gloves should be donned prior to sample collection and each time the sampler handles a new tool or contacts a new surface.
- Personal care products should not be applied within the work area. Samplers should thoroughly wash hands and don new gloves after application. Review **Attachment A - Clothing/ Personal Protective Equipment (PPE) and Personal Care Products** for additional guidance.
- Use reputable equipment vendors and laboratories and seek their input on minimizing the potential for introducing PFAS and cross contamination.
- Limit contact with items that are not required for the work at hand; do not eat in the work area.
- Maintain a neat and orderly work area; do not allow sampling equipment to contact the ground (lay out plastic sheeting as necessary).
- Review the project-specific Quality Assurance and Quality Control program with the project team to understand the nuances of PFAS QA/QC as these may be significantly different than standard sampling and have specific procedures and protocols not required for other types of environmental sampling.

Samples should be shipped as soon as practicable, with sufficient ice to maintain a temperature at or below 6°C (approximately 43°F) during transport for a period of at least 48 hours to allow for shipping delays. Upon receipt by the laboratory, samples should be stored at or below -20°C (approximately -4°F, holding time up to 90 days from collection) or between 0 and 6 °C if analyzed within 7 days from time of collection (since analytes of interest include NMeFOSE, NEtFOSE, NMeFOSAA, and NEtFOSAA, and transformation between these PFAS compounds has been observed to occur more quickly than others, which are allotted a 28-day holding time at this storage temperature).

Samples will be analyzed via EPA Method 1633. EPA Method 1633 is titled, "*Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS.*" LC-MS/MS refers to liquid chromatography-tandem mass

spectrometry, an analytical technique with high sensitivity and specificity for identifying and quantifying compounds in a sample. This method supports NPDES permits and contains all the required quality control procedures for use under the CWA. See Attachment C for a copy of this method.

4. References

Interstate Technology and Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance (https://pfas-1.itrcweb.org/), updated June 2022.

United States Environmental Protection Agency (USEPA). (2024). Method 1633: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS. Washington, DC: USEPA Office of Water. Retrieved from https://www.epa.gov/cwa-methods/cwa-analytical-methods-and-polyfluorinated-alkyl-substances-pfas

USEPA Final Method 1633, Revision A, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Soil, Biosolids, and Tissue Samples by LC-MS/MS, December 2024.

LANGAN	Underground Utility Clearance Policy Health & Safety
Effective: March 1, 2024	*Reviewed/Approved: February 29, 2024*

1. Purpose

This document presents Langan's Underground Utility Clearance Policy and details how to identify, manage and avoid subsurface utilities on Langan led projects.

2. Applicability

This policy applies to Langan employees and Subcontractors when Ground Disturbance is part of Langan's scope of services.

3. Definitions

3.1. Ground Disturbance

Any work, operation or activity by a Langan employee or Subcontractor resulting in disturbance or displacement of soil.

3.2. Subcontractor

Any firm or person who has been contracted by Langan to provide services that is not a permanent employee of Langan.

3.3. One-Call System

An entity that administers a system to notify owners/operators of underground utilities in an area of proposed Ground Disturbance. One-Call Systems are typically limited to notifying and subsequently locating underground utilities on public property and right-of-ways.

3.4. Private Utility Mark-Out

Private Utility Mark-Outs estimate and mark the approximate location of underground utilities, objects or obstructions. Typical methods include ground penetrating radar (GPR), scoping, conductivity, and other non-destructive methods.

3.5. Soft Digging

Methods of removing soil which are non-destructive to underground utilities. Soft Digging procedures include, but are not limited to, hand digging, hydro excavation, and air/vacuum excavation.

3.6. Underground Utilities

Any public or private infrastructure located below the earth's surface. Underground utilities include, but are not limited to, water pipes, sewer pipes, natural gas pipes, telecommunication cables, oil/gas pipelines, electrical ducts/cables, manholes, vaults, and tunnels.

4. Langan Employee Roles & Responsibilities

4.1. Employees

Langan employees are responsible for following this policy when Langan's contracted scope of services includes Ground Disturbance. Employees overseeing underground utility clearance procedures must have training as required by this policy.

4.2. Project Managers

Langan Project Managers must confirm that: 1) projects under their supervision are executed in accordance with this policy; 2) employees conducting underground utility clearance have been trained in this policy, and 3) any deviations from this policy are reviewed and approved by the Langan Principal-in-Charge prior to Ground Disturbance.

4.3. Senior Associate and Above

Employees at the level of Senior Associate and above, may be delegated by the Principal-in-Charge of the project, to review and approve deviations, where applicable, from this policy prior to Ground Disturbance.

4.4. Principal-in-Charge

The Principal-in-Charge is responsible for reviewing and approving deviations, where applicable, from this policy prior to Ground Disturbance. The Principal-in-Charge may delegate the responsibility for reviewing and approving deviations, to an employee at the level of Senior Associate or above who is involved with the project.

5. Underground Utility Clearance

5.1. Ground Disturbance Area

Areas of Ground Disturbance must be identified by Langan prior to beginning underground utility clearance procedures. Changes to the locations of Ground Disturbance must be approved by the Project Manager and documented.

5.2. Utility Clearance Procedures

The following procedures must be completed and documented prior to commencing Ground Disturbance.

1. One-Call System mark-out (or equivalent): A One-Call System mark-out is always required to meet regulations and identify public underground utilities in the area of Ground Disturbance.
    a) The party conducting Ground Disturbance, Langan or its Subcontractor, shall be responsible for contacting the One-Call System. If both Langan and the Subcontractor will be conducting Ground Disturbance, both parties are required to contact the One-Call System to obtain separate One-Call System tickets.
    b) When the Subcontractor is responsible for notification of the One-Call System, Langan must verify a One-Call System notification was completed.
    c) Langan must obtain a copy of the Subcontractor's One-Call System ticket number and verify the area requested by the Subcontractor is consistent with the area of proposed Ground Disturbance.
    d) Langan must document the dates for which the One-Call System ticket is valid and manage the Ground Disturbance such that the activities are performed in the valid timeframe.
    e) If the boundaries of Ground Disturbance are extended outside the limits of the previously completed One-Call System mark-out, Ground Disturbance must be terminated until the One-Call System mark-out is conducted for the new area.
    f) Following the site visit (See Section 5.2.4), if the Langan field representative or the Subcontractor has reason to suspect that the One-Call System mark-out is incorrect or incomplete, the party that obtained the One-Call System ticket must notify the One-Call System in accordance with local requirements. For the One-Call System mark-out to be complete, responses must be received from the member agencies listed on the One-Call System ticket. No Ground Disturbance is permitted until Langan and the Subcontractor confirm the One-Call System mark-out has been completed.
2. Private Utility Mark-Out: Private Utility Mark-Out is always required in the area of Ground Disturbance.
    a) If the boundaries of Ground Disturbance are extended outside the limits of the completed Private Utility Mark-Out, Ground Disturbance must be terminated until the Private Utility Mark-Out is conducted for the new area.
    b) **Exemption** – Private Utility Mark-Out may be exempted if prior written approval is provided by the project Principal-in-Charge, or their delegate, and client. Exemption must be based on

historical knowledge of site, previous utility mark-outs, other credible information depicting the existence and location of underground utilities, or nonexistence of underground utilities in the area of Ground Disturbance. Exemption cannot be due to project scheduling or budget constraints.

3. Site Utility Plans: Detailed utility drawings are to be requested in writing from the property owner or site manager and reviewed to identify underground utilities in the area of the proposed Ground Disturbance. Drawings must illustrate the proposed area of Ground Disturbance and be intended to convey information about underground utilities including location depth and utility type. Langan must document the site utility plan request and whether plans were provided for review.

4. Site Visit: A site visit must be conducted by Langan to review the mark-outs provided by the One-Call System and Private Utility Mark-Out (if applicable). The purpose of the site visit is to determine if any further evaluation of potential underground utilities is warranted prior to initiating Ground Disturbance. The site visit can be conducted in conjunction with the above referenced mark-outs and is intended to identify the utilities/structures (gas, electric, water, cable, fiber) coming on and traversing the site.

5. Soft Digging:

    a) Soft Digging is required for the first 5 feet of depth of Ground Disturbance on all Langan projects. Soft digging must clear an area of the same size or larger than the area of proposed Ground Disturbance.

    b) **Exemption** – Soft Digging may be exempted if prior written approval is provided by the project Principal-in-Charge or their delegate. Exemption must be based on required sampling/screening methods, soil conditions or technical limitations. Soft Digging cannot be exempted due to project scheduling or budget constraints.

    c) Soft Digging is required, *without exception*, in any of the following circumstances:
        1) Ground Disturbance will take place within 3 feet of a marked or identified active underground utility, or a geophysical anomaly suggestive of a below ground utility or structure;
        2) A high potential for presence of underground utilities exists; or,
        3) When required by the owner/client.

6. The Project Manager is responsible for determining if additional clearance measures are required prior to start of Ground Disturbance. When an increased potential for contact with underground utilities exits, the project manager and subcontractor, when applicable, should determine if additional protective measures are required. Protective measures include administrative control measures, de-energization of lines, insulated personal protection equipment or grounding of equipment.

The attached Underground Utility Clearance Guideline should be used to document and assist employees in complying with this policy.

5.3. Utility Marking – Color Codes

The following color codes are generally used for marking underground utilities. Employees should verify the color codes used by local utility clearance companies, One-Call System, Private Utility Mark-Out companies and facilities. Note, any paint marking must be assumed to be a subsurface utility until proven otherwise.

- Red - Electric power lines, cables or conduit and lighting cables
- Yellow - Gas, oil, steam, petroleum or gaseous material
- Orange - Communication, alarm or signal lines, cables or conduits and fiber optic
- Blue - Potable water
- Purple - Slurry, irrigation and reclaimed water
- Green - Sewers (sanitary and storm), drainage facilities or other drainage lines.
- Pink - Temporary survey markings
- White - Proposed excavation area

5.4. Underground Utility Contact Incidents

When an underground utility is contacted during Ground Disturbance, the Langan employee must immediately stop work and notify all personnel in the work area. Employees must follow local requirements for evacuation and notification of the One-Call System, utility operator and/or emergency services. Following any required local notifications, the employee must contact the Project Manager, project Associate/Shareholder, and Principal-in-Charge to discuss the next steps. The Project Manager and project Associate/Shareholder are responsible for notification to the owner/client.

The incident must be reported to the Corporate Health & Safety Department immediately. **NOTE:** Underground utilities purposely located utilizing soft digging techniques and are not damaged, do not have to be reported.

6. Training

Employees responsible for coordinating and conducting Ground Disturbance must be trained on this policy prior to commencing the employee's initial field assignment. Documentation of training will be maintained by the Corporate Health & Safety Department.

Appendix D
Langan Unified Soil Classification System

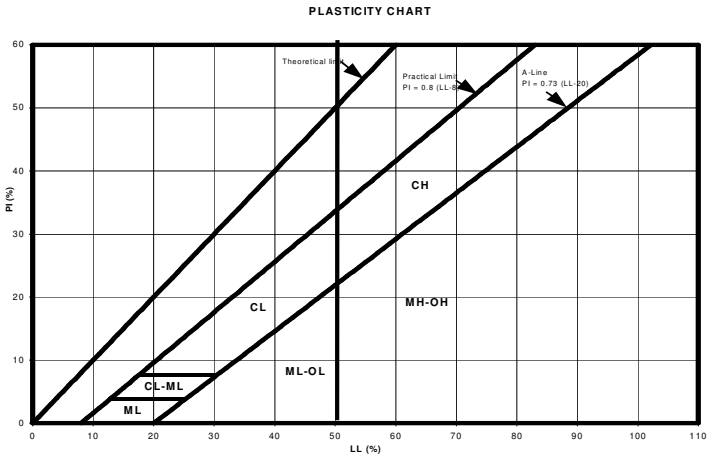
FINE-GRAINED SOIL

More Than Half the Material is Smaller Than the No. 200 Sieve

	GROUP SYMBOLS		GROUP NAMES AND LABORATORY CLASSIFICATION CRITERIA	TYPICAL SOIL IDENTIFICATION FOR INDIVIDUAL GROUPS	FIELD IDENTIFICATION PROCEDURES		
					DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PL)
SILTS and CLAYS with the liquid limit less than 50%	ML		Inorganic, non-plastic and slightly plastic SILTS, and medium plastic clayey SILTS with the limit data plotting below the "A" line and hatched zone on the plasticity chart	v.f. sandy non—plastic SILT medium plastic clayey SILT, trace f. sand	None to slight	Quick to slow	None
	CL		Inorganic, slightly plastic silty CLAYS, and medium plastic to plastic CLAYS with the limit data plotting above the "A" line and hatched zone on the plasticity chart	Slightly plastic to medium plastic silty CLAY Medium plastic silty CLAY, trace f. sand	Medium to high	None to very slow	Medium
	OL		Organic non-plastic to medium plastic SILTS with the limit data plotting below the "A" line and hatched zone on the plasticity chart	f. sandy non-plastic ORGANIC SILT some fibers	Slight to medium	Slow	Slight
SILTS and CLAYS with the liquid limit greater than 50%	MH		Inorganic micaceous or diatomaceous slightly plastic SILTS, and medium plastic to very plastic clayey SILTS with the limit data plotting below the "A" line on the plasticity chart	Medium plastic to plastic clayey SILT Medium plastic clayey SILT, some m.f. sand	Slight to medium	Slow to none	Slight to medium
	CH		Inorganic plastic to very plastic CLAYS with the limit data plotting above the "A" line on the plasticity chart	Plastic to very plastic CLAY f. sandy plastic CLAY	High to very high	None	High
	OH		Organic medium plastic to plastic silty CLAYS, and very plastic CLAYS with the limits data plotting below the "A" line on the plasticity chart	Fibrous plastic ORGANIC silty CLAY	Medium to high	None to very slow	Slight to medium
HIGHLY ORGANIC SOILS	Pt		Organic soils with a distinctive organic texture and containing particles of leaves, grass, branches or other fibrous vegetable matter	Organic silty clayey ROOTMAT Organic silty clayey PEAT, some fibers	Readily identified by color, odor, spongy feel and frequently by fibrous texture		

CONSISTENCY

Descriptive Term	Behavior	Std. Pen. blows/ft	Unconfined Strength, tsf
Very soft	Extruded from between fingers when squeezed	<2	1/4
Soft	Molded by light finger pressure	2 - 4	1/4 - 1/2
Firm	Molded by strong finger pressure	4 - 8	1/2 - 1
Stiff	Indented by thumb	8 - 16	1 - 2
Very stiff	Indented by thumb nail	16 - 32	2 - 4
Hard	Difficult to indent by thumb nail	>32	4



Langan

UNIFIED SOIL CLASSIFICATION CHART PLATE A

COARSE GRAINED SOIL

More Than Half the Material is Larger Than the No. 200 Sieve

GROUP DIVISIONS		GROUP SYMBOLS		GROUP NAMES AND LABORATORY CLASSIFICATION CRITERIA	TYPICAL SOIL IDENTIFICATION FOR INDIVIDUAL GROUPS	FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 IN. AND BASING FRACTIONS ON ESTIMATED WEIGHTS)
GRAVELS More than half of the coarse fraction is retained on the No. 4 sieve	Gravels with trace or no fines	GW		Well graded GRAVELS with less than 5% fines, Cu greater than 4 and Cc between 1 and 3	Well-graded gravels or gravel-sand mixtures, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.
		GP		Poorly graded GRAVELS with less than 5% fines, and not meeting all gradation requirements for GW	Poorly-graded gravels or gravel-sand mixtures, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing.
	Gravels with some or many fines	GM		GRAVELS with greater than 12% ML or MH fines	Silty gravels, gravel-sand-silt mixtures	Nonplastic fines or fines with low plasticity (for identification procedures, see ML other side).
		GC		GRAVELS with greater than 12% CL or CH fines	Clayey gravels, gravel-sand-clay mixtures	Plastic fines (for identification procedures, see CL other side).
		GO		GRAVELS with greater than 12% OL or OH fines		
SANDS More than half of the coarse fraction passes the No. 4 sieve	Sands with trace or no fines	SW		Well-graded SANDS with less than 5% fines, Cu greater than 6 and Cc between 1 and 3	Well-graded sands or gravelly sands, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate particle sizes
		SP		Poorly graded SANDS with less than 5% fines, and not meeting all gradation requirements for SW	Poorly-graded sands or gravelly sands, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing
	Sands with some or many fines	SM		SANDS with greater than 12% ML or MH fines	Silty sands, sand-silt mixtures	Nonplastic fines or fines with low plasticity (for identification procedures, see ML other side).
		SC		SANDS with greater than 12% CL or CH fines	Clayey sands, sand-silt mixtures	Plastic fines (for identification procedures, see CL other side).
		SO		SANDS with greater than 12% OL or OH fines		

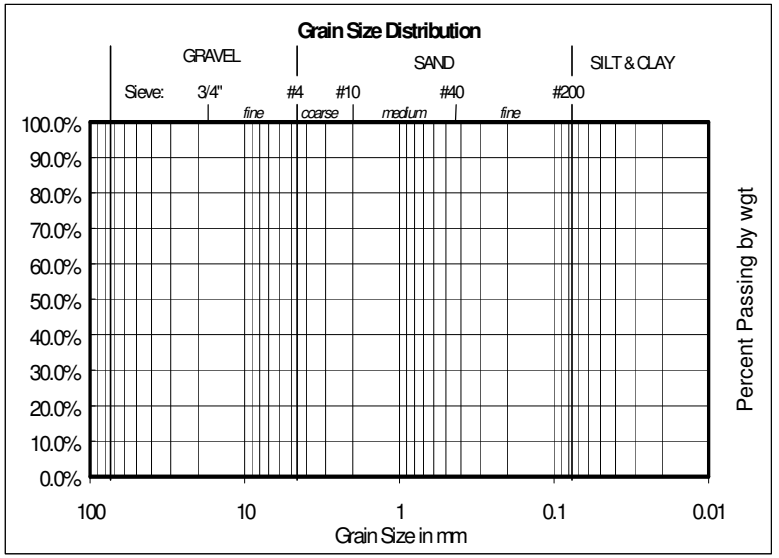
DESCRIPTION OF CONSTITUENT PERCENTAGES AS USED IN SOIL SAMPLE CLASSIFICATIONS				
1%	to	12%	-	"Trace"
13%	to	30%	-	"Some"
31%	to	49%	-	Adjective form of soil group (e.g., sandy)

Equal amount of different soil groups - "and"

DESCRIPTION OF WATER CONTENT	
Dry	Coarse Grained Soils
Moist	Signs of water and soil is not dusty
Wet	Signs of water and there is some free water when soil densified

COMPACTNESS	BEHAVIOR	STD. PEN. BLOWS/ FT[1]	RELATIVE DENSITY, %
Very loose		<4	0 - 15
Loose	Easily penetrated with ½ inch rod pushed by hand	4 - 10	15 - 40
Medium dense	Easily penetrated with ½ inch rod driven with a 5 pound hammer	10 - 30	40 - 70
Dense	Penetrated 1-foot with ½ inch rod driven with a 5 pound hammer	30 - 50	70 - 85
Very dense	Penetrated only a few inches with a ½ inch rod driven with a 5 pound hammer	>50	85 - 100

[1] Should use chart to adjust for overburden



Langan

UNIFIED SOIL CLASSIFICATION CHART **PLATE B**

Rock Types

Rock Name	Characteristics	Symbol
Shale	Clay sized particles, shale has fissility which is a horizontal sheet-like or laminated feature.	
Claystone	Clay sized particles that are consolidated, lacking fissility.	
Siltstone	Composed of silt, normally breaks as irregular chunks	
Sandstone	Primarily sand sized particles modified w/ the descriptor fine, medium, or coarse.	
Conglomerate	Gravel sized grains and larger held together by finer material, called a breccia if clasts are angular.	
Limestone	Effervesses w/ diluted HCl, can be composed of clay up to gravel particles (fossils).	
Coal	Black and shiny, can break into cubes or conchoidally.	

Rock Quality Descriptions

Weathering

Completely Weathered: All rock material is decomposed and/or disintegrated. The original rock structure may still be intact.

Highly Weathered: More than half of the rock material is decomposed. Fresh rock is present only as a discontinuous framework or as corestones.

Moderately Weathered: Less than half of the rock material is decomposed. Fresh rock is present at a discontinuous framework or as corestones.

Slightly Weathered: Discoloration or staining indicates weathering of rock material on discontinuity surfaces. Rock may be discolored and softened.

Fresh: No visible signs of rock material weathering.

RQD

Descriptor	%
Very Poor	<25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	>90

Brokenness

Descriptor	Fracture Spacing (in & ft)
Very Broken	< 1 (<0.08)
Broken	1-3 (0.08-0.25)
Moderately Broken	3-6 (0.25-0.5)
Slightly Broken	>6 (>0.5)

Rock Hardness

Descriptor	Field Criterion	Relative Unconfined Compressive Strength
Very Hard	Difficult to break w/ Hammer	> 30,000 psi
Hard	Hand-held sample breaks w/ Hammer	8,000 to 30,000 psi
Medium Hard	Cannot scrape surface w/ knife	2,000 to 8,000 psi
Soft	Cutting or scraping w/ knife difficult	500 to 2,000 psi
Very Soft	Can be cut w/ knife	< 500 psi