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Construction Air Permit Application
Silfab Solar
Fort Mill, South Carolina

PREPARED FOR:
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Fort Mill, South Carolina 29715

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1.0 Introduction

Silfab Solar (Silfab) proposes to install and operate a new solar cell and panel production facility located at 7149 Logistics Lane in Fort Mill, South Carolina (Site). Silfab is a world-leading manufacturer of residential solar panels throughout Canada and the US. The facility will be installed in an existing industrial building whose location is depicted in Figure 1 and a general site layout of the facility is provided in Figure 2. The facility will consist of three solar panel or module assembly lines, two solar cell manufacturing production lines, and storage tanks.

Since the Silfab facility does not fall within one of the specific 28 categories or has ancillary operations within the specified categories subject to the Prevention of Significant Deterioration threshold in 40 CFR 51.166, the applicable major source threshold for the facility is 250 tons per year (TPY). The total uncontrolled emissions of NO_x, CO, VOC, SO₂, PM₁₀, and PM_{2.5} will not exceed 250; however, the total uncontrolled hazardous air pollutants (HAPs) will be greater than 25 TPY. Therefore, Silfab is requesting that the facility be permitted as a synthetic minor source.

The remainder of this application is organized as follows:

- ◆ Section 2 - Process Description
- ◆ Section 3 - Emission Sources and Controls
- ◆ Section 4 - Emissions Determination
- ◆ Section 5 - Regulatory Review
- ◆ Appendix A - SCDHEC-BAQ Air Permit Application Forms
- ◆ Appendix B - Emission Calculations
- ◆ Appendix C – Air Dispersion Modeling Results and Modeling Output Files

2.0 Process Description

2.1 Cell Manufacturing

Silfab Solar is planning to produce photovoltaic (PV) cells, commonly called solar cells, in their South Carolina facility. This is a process by which silicon wafer substrates are taken and coated with wet chemicals and gases, in precise amounts and sequences, to form specific layers to produce cells that convert sunlight directly into electricity. The exact recipes to make the products are considered proprietary and therefore, are not included in this description. However, the solar cells will be used to produce high-quality solar panels that will be sold for residential and commercial use.

2.2 Module Manufacturing

Glass Station

The glass gets Picked and Placed from Skid to conveyor.

EVA Station

The equipment places EVA sheet on the glass (EVA is ethylene vinyl acetate used as an encapsulating agent).

Stringers

Making stringers from cell by interconnecting the cell with ribbon by soldering.



Layup Station

Place strings coming from stringer on to the glass with EVA in a certain matrix orientation to complete the circuit.

Bussing

Solder Matrix from Layup with busbar at the end of the strings to complete the circuit interconnection.

Auto Tapping

Equipment takes the panel coming from bussing and tapes the strings to maintain String to string distance to avoid overlap for defects and circuit failure. During conveyance and lamination, we have high chances of string overlap and it's used for that purpose.

EVA 2 Station

The equipment places EVA sheet on the matrix coming from tapping which is punched to expose busbar out before laminator and EL station for inspection (EVA is ethylene vinyl acetate used as an encapsulating agent).

Backsheet Station

The equipment places backsheet on EVA 2 sheet which is punched to expose busbar out before laminator and EL station for inspection. This sheet is the on the back side of the panel.

Electro Luminescence (EL)Station

The equipment places probes to the circuit and passes current to expose the cells and test the panel and check for any defects by taking pictures.

Pre-Lamination conveyance

To transfer panels from on the front half of the line. Front End line is all the process prior to lamination process.

Laminator

To laminate the panels coming from the line to bind the panel by heating up the matrix coming from EL, which melts the EVA and bid the whole system and protects from weather or any exposure.

WIP Station

The equipment places offload laminated panels as WIP if the line is blocked and to store on skid, send the panels from Skid if the line is starving.

Auto Trimming Station

The equipment trims excess EVA (EVA is ethylene vinyl acetate used as an encapsulating agent) and BS (backsheet) from laminated panels for framing process.

QC3

To do inspection from the operations for any defects and rectification, to be done manually by visual observation.

Framing Station

The equipment places frames containing silicone on all four sides on the panel and presses together to create a solar panel frame which is used for mounting the panel. Prior to this station or after the station we also apply junction box on the panel which is used in the field to connect to power.

Auto Soldering Station

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The equipment solders JB with the panel busbar which were coming out of punches backsheet to complete the circuit for field use.

Auto Potting Station

The equipment fills Junction box with potting solution which cures in the curing chamber and solidifies to make it weather resistant.

Post lamination Conveyance

To transfer panels from on the back half of the line. Back End line is all the process post lamination process.

Curing Line

The equipment is temperature and Humidity controlled to get the potting material solidified within reasonable time frame for the panel to be ready for next steps.

Auto Corner Miller Station

The equipment files the sharp edges of the solar panel frames.

Flasher

The equipment probes touch the JB and provides it power to identify the wattage of the panel which further gets declared in the system and labeled with right power label for selling of solar panel and, we identify and keep record for future references.

Hipot Station

The equipment probes touch the JB and the frames to very current leakage and continuity for the panel safety while installing on the field. High voltage is run across the panel to verify grounding and leakage.

Electro Luminescence (EL)Station

The equipment places probes to the circuit and passes current to expose the cells and test the panel and check for any defects by taking pictures. This identify any risk associated with the panel and to repair or rework if possible and to verify if any action needs to be taken in certain areas to correct the rest of the process by reducing defects coming from upstream processes.

Auto Sorting Station

The equipment places solar panels onto a skid under right lot and class, as specified by the EL and Flashing process.



3.0 Emission Sources and Controls

The generation of both regulated air pollutants and hazardous air pollutants (HAPs) result from the assembly and production of solar panels. The emissions generally consist of process emissions from panel module assembly, cell manufacturing (includes printing lines), emissions from raw material storage tanks, and emissions from the combustion of diesel fuel in an emergency generator.

Following is a description of the processes that result in those emissions and the table below describes the emission control devices to be installed to reduce emissions.

Emission Unit ID	Area	Type of Control Device	Filtration Capture Efficiency (% of Exhaust Captured)	Control Efficiency %	Exhaust Location
P1ACID	Cell Manufacturing	Phase 1 Acid Scrubber (AEX) – Acid Exhaust	100%	96%	P1ACID
P2ACID	Cell Manufacturing	Phase 2 Acid Scrubber (AEX) – Acid Exhaust	100%	96%	P2ACID
LPCVD/PECVD	Cell Manufacturing	DFTO/Local Scrubber	100%	DFTO 90%/ Scrubber 90%	P1ACID/ P2ACID

3.1 Module Manufacturing

Module manufacturing will include 3 module assembly lines, laboratory, and gel content testing. The 3 module assembly lines will use isopropyl alcohol (IPA), flux(es), and EVA film. VOC and HAP/TAP emissions will be generated from the use of these materials in the module assembly production lines. VOC and HAP/TAP emissions will also be generated in the labs and gel content testing as part of QA/QC testing and general lab usage.

The VOC and HAP/TAP emissions from this area will be vented outside through the general area exhaust system. The detailed emission calculations from this area are provided in Table 2 of Appendix B. Safety Data Sheets (SDS) are also provided in Appendix D for the materials used in this process.

3.2 Solar Cell Manufacturing

Cell manufacturing involves the use of multiple enclosed machines and clean rooms to make solar wafer cells. Most of this process involves inspection, texturing, oxidation, etching, cleaning, and screen printing the wafer cells. Most of these processes are performed inside enclosed machines or clean rooms that are vented to a wet acid scrubber (AEX) that is designed to be 96% efficient. Information from the vendor for this scrubber is forthcoming and will be submitted to SCDHEC upon receipt.

This process will generate VOC and HAP/TAP emissions from the texturing, etching and printing production machines. Specifically, the two HAP/TAP compounds that will be emitted are HF and HCl which will be vented to the Acid Gas Scrubbers (P1ACID/AEX and P2ACID/AEX) which will be 96% efficient. VOC emissions will be generated from the paste and four printing lines, and they will be vented outside in the general area exhaust.

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Silane will be used as a raw material in the cell manufacturing PECVD and LPCVD processing steps during solar cell production. Residual gases will remain in the exhaust stream because the gases are not fully consumed in the individual tools; therefore, a direct fired thermal oxidizer (DFTO) followed by a quench venturi scrubber will be installed to destroy the remaining gases. Once the gas leaves the venturi scrubber, it will be routed to the facility's acid gas scrubber where the remaining gases will be neutralized prior to being vented to the atmosphere.

The detailed emission calculations from this area are provided in Tables 3, 4, 8, and 9 of Appendix B. Safety Data Sheets (SDS) are also provided in Appendix D for the materials used in this process.

3.3 Storage Tanks

There will be two 5,280-gallon storage tanks that will store HCl and two 7,925-gallon storage tanks that will store HF onsite. These tanks will be equipped with nitrogen blankets to reduce HCl and HF emissions. These tanks will vent through one of the two scrubbers (P1ACID or P2ACID). The working and breathing losses from these tanks will result in HAP/TAP emissions.

There will be two tube trailers, each holding 13,228 pounds of silane onsite that will be used to store silane in a specially designed area. EPA and SCHDEC have not designated silane as a VOC, HAP, or TAP; therefore, silane emissions have not been included in the VOC and HAP/TAP calculations and dispersion modeling. However, these tube trailers will be designed to meet all applicable Occupational Safety and Health Administration (OSHA) regulatory standards to prevent potential releases.

Also, there will be two liquid potassium hydroxide (KOH) storage tanks (45%) that will be used in the cell manufacturing process, tools, cleaning and possibly wastewater treatment. There is the potential that one liquid sodium hydroxide (NaOH) storage tank (50%) may be installed to be used as an acid neutralizer in the wastewater treatment process; however, the need for this tank will be dependent on market availability and cost.

3.4 Combustion Sources

One 300 HP diesel-fired emergency generator will provide backup electrical power during power outages. PM, SO₂, NO_x, CO, VOCs, and HAP emissions will result as a by-product of diesel fuel combustion.

The 5.0 MMBTU/hour DFTO will be natural gas fired and will generate PM, SO₂, NO_x, CO, VOCs, and HAP emissions.



4.0 Emissions Determination

Facility wide emissions are provided in Table 1. The detailed emission calculations and supporting tables are presented in Appendix B and below is a summary of the controlled and uncontrolled emissions from the Silfab facility.

Total Uncontrolled Emissions						
Pollutant	Module Manufacturing	Solar Cell Manufacturing	Storage Tanks	Generator	DFTO	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.147	2.152
SO2				0.0003	0.013	0.013
CO				0.0010	1.804	1.805
PM-10		161.46		0.0003	0.163	161.63
PM-2.5		161.46		0.0003	0.163	161.63
VOC	49.3	26.3		0.0004	0.118	75.71
HAPs	0.0	203.6	0.0273	0.0005	0.041	203.90
HF		9.225	0.0051			9.28
HCL		194.4	0.222			194.58

Total Controlled Emissions						
Pollutant	Module Manufacturing	Solar Cell Manufacturing	Storage Tanks	Generator	DFTO	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.147	2.152
SO2				0.0003	0.013	0.013
CO				0.0010	1.804	1.805
PM-10		0.32		0.0003	0.163	0.486
PM-2.5		0.32		0.0003	0.163	0.486
VOC	49.3	26.3		0.0004	0.118	75.715
HAPs	0.0	7.985	0.0109	0.0005	0.041	8.078
HF		0.377	0.00204			0.379
HCl		7.609	0.00888			7.618

4.1 Module Manufacturing Emissions

The module manufacturing process emissions were calculated using material balance calculations, safety data sheet (SDS) data with the maximum anticipated material usage based on another Silfab's Washington facility. The calculated emissions for module manufacturing is provided in Table 2 in Appendix B.



4.2 Solar Cell Manufacturing Emissions

The solar cell manufacturing process emissions were calculated using material balance calculations, SDS data, maximum anticipated material usage, and vendor-supplied usage and emission data. The total emissions from the various steps that comprise the solar cell manufacturing process are summarized in Tables 3 and 4. The solar cell manufacturing paste usage and printing line calculations are provided in Tables 8 and 9, respectively, in Appendix B. The vendor supplied material usage and emission data is provided in Table 9 in Appendix B.

4.3 Storage Tank Emissions

Emissions for the HCl and HF storage tanks were calculated using EPA's TANKS 4.09d program and adjusted for their actual concentration. HCl will be purchased and stored at 37% and HF will be purchased and stored at 49%. The SDS for each material is attached.

The net throughput for the storage tanks was estimated based on continuous operation. The emissions from the KOH and possible NaOH emissions were not calculated since they are not regulated as VOC sources. NaOH is listed as a TAP in Standard No. 8; however, per the SCDHEC Modeling Guidelines, Section 2.3.3, the emissions are considered exempt from modeling when they are in a storage tank due to the low vapor pressure.

The tank characteristics and emissions are summarized in Table 5 in Appendix B, and the TANKS 4.09d program outputs are provided in Appendix B.

4.4 Combustion Emissions

The emissions for the diesel fired emergency generator were calculated using AP-42, Chapter 3, Table 3.3.1 emission factors for industrial engines. The calculated emissions from the combustion of diesel fuel in this engine is provided in Tables 6 and 7 in Appendix B.

The emissions factors for the natural gas fired DFTO were calculated using AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 emission factors for natural gas combustion. The calculated emissions from the combustion of natural gas are provided in Tables 6 and 7 in Appendix B.

5.0 Regulatory Review

5.1 Federal Regulations

5.1.1 *New Source Performance Standards (40 CFR 60)*

5.1.1.1 Subpart Dc – Small Industrial Steam Generating Unit

Subpart Dc will not apply to the Silfab facility since there will not be any fossil fuel fired steam generating units onsite greater than 10 MMBTU/hour.

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5.1.1.2 Subpart Kb - Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced after July 23, 1984

This subpart does not apply to the HCl, HF or silane storage tanks since they are considered volatile organic liquid storage vessels.

5.1.1.3 Subpart IIII – Stationary Compression Ignition Internal Combustion Engines

Portions of this rule will apply to the one emergency generator since its greater than 100 HP. The requirements that pertain to emergency operation are the only requirements that will apply to this engine. Silfab will comply with these requirements by installing EPA-certified diesel fired engines, and the facility will maintain the required operating information specified in 40 CFR 60.4214.

5.1.1.4 Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines

This standard will not apply since Silfab will not have any stationary spark ignition internal combustion engines onsite.

5.1.2 *National Emission Standards for Hazardous Air Pollutants (40 CFR 63)*

40 CFR Part 63 establishes technology-based regulations for specific source categories emitting any of the 187 compounds designated by the EPA as HAPs. The EPA regulates emissions of HAPs from major and area sources as promulgated under a NESHAP. Facilities that are required to demonstrate compliance with a particular NESHAP must employ Maximum Achievable Control Technology (MACT) as specified in the regulation.

Under 40 CFR Part 63, a major source is defined as any stationary source emitting 10 TPY or more of any individual HAP, or 25 TPY or more of any combination of HAPs. An area source of HAPs is a facility that is not a major source of HAPs, is not located at a major source, and is not part of a major source of HAP emissions.

5.1.2.1 Subpart FFFF – Miscellaneous Organic Chemical Manufacturing

This standard will not apply since Silfab will not manufacture an organic chemical as defined in 40 CFR 63.2435(1).

5.1.2.2 Subpart MMMM – Surface Coating of Miscellaneous Metal Parts and Products

This standard will not apply since Silfab will not manufacture or apply spray coating to miscellaneous metal parts as defined in 40 CFR 63.3881(a).

5.1.2.3 Subpart PPPP – Surface Coating of Plastic Parts and Products

This standard will not apply since Silfab will not be coating plastic parts as defined in 40 CFR 63.4481(a).

5.1.2.4 Subpart ZZZZ - Reciprocating Internal Combustion Engines (RICE)

The requirements that pertain to emergency operation are the only requirements that will apply to the emergency generator. To comply with the requirements in Subpart ZZZZ, Silfab will meet the standards in NSPS Subpart III (see Section 5.1.1.3 above). Silfab will comply with these requirements by purchasing new diesel-fired engines so

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they will be certified to meet the EPA Tier 3 emission standards, and the facility will maintain the required operating information specified in 40 CFR 60.4214.

5.1.2.5 Subpart HHHHH – Miscellaneous Coating Manufacturing

This standard will not apply since Silfab will not be manufacturing coatings.

5.1.2.6 Subpart PPPPPP – Lead Acid Manufacturing Area Sources

This standard will not apply since the Fort Mill facility will not be a lead acid manufacturing plant as defined in 40 CFR 11421(a).

5.1.2.7 Subpart PPPPPP – Secondary Nonferrous Metals Processing Area Sources

This standard will not apply since Silfab will not operate a secondary nonferrous metals processing facility as defined in 40.CFR 63.11462.

5.1.3 *Compliance Assurance Monitoring (40 CFR 64)*

This regulation will not apply since the Silfab Fort Mill facility will not be a major source of HAP emissions.

5.2 State Regulations

5.2.1 *SC Regulation 61-62.1*

The facility's uncontrolled PTE for HAP emissions has been determined to be greater than 10 TPY for HCl and 25 TPY for total HAPs; therefore, Silfab will install emission controls throughout the process operations to reduce HAP/TAP emissions to less than 25 TPY. The total uncontrolled criteria pollutants from the facility are less than 250 TPY. Therefore, Silfab is requesting to be permitted as a synthetic minor source.

The detailed emission calculations are provided in Tables 1-8 in Appendix B.

5.2.2 *SC Regulation 61-62.5 Standard No. 1 – Emissions from Fuel Burning Operations*

This standard will not apply to the Silfab facility since there will not be any fossil fuel fired units onsite greater than 10 MMBTU/hour.

5.2.3 *SC Regulation 61-62.5 Standard No. 2 – Ambient Air Quality Standards*

According to this Standard, facility-wide emissions of criteria pollutants must not cause or contribute to an exceedance of the National Ambient Air Quality Standards (NAAQS). The criteria air pollutants will not be emitted in such quantities as to require air dispersion modeling. Section 6.0 provides the air dispersion modeling analysis for these pollutants and de minimis threshold comparisons.

5.2.4 *SC Regulation 61-62.5 Standard No. 3 – Waste Combustion and Reduction*

Silane will be used as a raw material in the cell manufacturing PECVD and LPCVD processing steps during solar cell production. Residual gases will remain in the exhaust stream because the gases are not fully consumed in the

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tools, therefore, it is necessary to use additional means to destroy the remaining gases, prior to emitting them to the atmosphere. Those tools utilizing specialty gases will exhaust through a proposed (DFTO). The proposed DFTO will include a horizontally fired burner which will feed into a horizontal oxidation chamber. The burner will use natural gas as a fuel source to preheat the oxidizer and adequate flue gas residence time is incorporated into the thermal oxidizer design, to ensure high levels of contaminant destruction. The burner will maintain the required thermal oxidizer temperature of approximately 1450 deg. F and the unit will be equipped with automatic temperature control and a high temperature switch, which will ensure the DFTO does not operate above 1600 deg. F. When silane is introduced to oxygen, either as a process gas or in the atmosphere, it is converted to SiO₂ therefore, the silane will be maintained in an oxygen-starved process exhaust until it is introduced to the RTO as indicated on the attached PFD.

The hot flue gases will exit the DFTO chamber and flow through a wet quencher which will lower the temperature from 1400 deg. F to approximately 170 deg. F. The gas will then proceed through a venturi scrubber. The venturi scrubber will atomize the makeup water, which will be treated with 45% KOH, and saturate the gases, further cooling them with evaporative water. This process will help to remove SiO₂ particulates identified as PM₁₀ and PM_{2.5} emissions and neutralize the acids entrained in the stream. The venturi scrubber liquid will be monitored for conductivity and will blowdown (pump) to the WWT system, as necessary, for pretreatment before being discharged to the sanitary sewer. Once the gas leaves the venturi scrubber it will be directed to the facility acid scrubber where the remaining gases will be neutralized prior to being discharged to the atmosphere.

5.2.5 SC Regulation 61-62.5 Standard No. 4 – Emissions from Process Industries

Most of these processes at the Fort Mill facility are solid assembly steps or liquid blending/mixing processes. Allowable PM emissions were calculated using the process weight rate equation provided in Standard No. 4. The results are provided below.

$$E = (F)(4.10p^{0.67}), \text{ where}$$

- E = allowable particulate emission rate in pounds per hour (calculated to be 2.58 lbs/hr)
- F = effect factor (1)
- P = process weight rate in tons per hour (0.5 tons per hour)

In addition, Silfab will comply with an opacity limitation of 20% as stated in the Standard.

5.2.6 SC Regulation 61-62.5 Standard No. 5 – Control of VOCs

The potential VOC emissions from the Fort Mill facility will exceed 100 tons/year (550 lbs/day); however, it is not considered one of the specific source categories listed in Section II of this standard. However, Silfab will provide the emission control device information as part of this application process and will perform stack testing as requested by the SCDHEC to demonstrate compliance with this standard.

5.2.7 SC Regulation 61-62.5 Standard No. 5.2 – Control of Oxides of Nitrogen

There will be one 300 HP diesel-fired emergency generator and one 5.0 MMBTU/hr DFTO at the Silfab facility. Per Section I(B)(1), the diesel engines are exempt from the requirements in this Standard since they are only used for emergency operation. Per Section I.B(5), the DFTO is exempt since it will function solely as a combustion control device to control the silane emissions from two of the cell manufacturing process steps.

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5.2.8 SC Regulation 61-62.5 Standard No. 7 – Prevention of Significant Deterioration

Silfab has implemented HAP/TAP emission controls to ensure the site-wide controlled emissions are below 25 TPY; therefore, the facility will be classified as a synthetic minor source and not subject to this standard.

5.2.9 SC Regulation 61-62.5 Standard No. 8 – Toxic Air Pollutants

Standard No. 8 states that the concentration of HAP/TAP at the facility boundary cannot exceed the maximum allowable ambient concentrations as specified in the Standard. The two compounds that triggered air dispersion modeling for this standard are HCl and HF. Compliance with this standard is discussed and demonstrated in Section 6.0.

5.2.10 SC Regulation 61-62.6 – Control of Fugitive Particulate Matter

Fugitive PM emissions shall be handled in a manner that will minimize fugitive dust. All process operations will be performed in enclosed buildings as well as being liquid-based blending/mixing process which generate minimal (if any) PM/PM10, or PM2.5 emissions.

6.0 Air Dispersion Modeling

As noted in Tables 9 and 10 (Appendix C), the potential NO_x, CO, PM₁₀, PM_{2.5}, and SO₂ emissions from the facility did not exceed 5 tons/year; therefore, Silfab is not required to demonstrate compliance with the ambient air standards outlined in Regulation 61-62.5 Standard No. 2. However, the potential HCl and HF emissions from the facility exceeded their respective de minimis modeling thresholds specified in the SCDHEC Modeling Guidelines for Air Quality Permits, October 2018. Therefore, Silfab is required to demonstrate compliance with the ambient air quality standards outlined in Regulation 61-62.5 Standard No. 8.

All HCl and HF dispersion modeling was performed using their maximum PTE emission rates and conducted in accordance with the SCDHEC Modeling Guidelines for Air Quality Permits, October 2018.

6.1 Model Selection

Air dispersion modeling was conducted using the AERMOD model, which is an EPA-approved regulatory model for performing refined analyses. The AERMOD model was run using the regulatory default options, rural land use setting, and the full 5-year preprocessed concatenated meteorological data set provided by the SCDHEC using York County Regional Airport Surface Data (Station 53871) and Greensboro Upper Air Data (Station 13723). Additional meteorological information is provided in Section 6.4.

6.2 Source Type

The HCl and HF emissions vent through wet scrubber control devices and were modelled as point sources using their design release parameters. Each scrubber was assigned their own individual emission point and no merged stack M calculations were needed.

The HCl and HF storage tanks are vented through the wet scrubber devices and will not vent directly to the atmosphere; therefore, the emissions were modelled as part of the scrubber point sources. Each tank's emissions



were added to their respective wet scrubber emission totals (P1ACID or P2ACID) since they are vented through the same exhaust point. No merged stack M calculations were needed.

NaOH is listed as a TAP in Standard No. 8; however, per the SCDHEC Modeling Guidelines, Section 2.3.3, the emissions are considered exempt from modeling when they are in a storage tank due to the low vapor pressure.

Per SCDHEC modeling guidance, the two emergency generators were not included in the modeling analysis since they will only be used for emergency backup power. The release parameters for the emission sources are summarized in Table 11 in Appendix C.

NaOH is listed as a TAP in Standard No. 8; however, per the SCDHEC Modeling Guidelines, Section 2.3.3, the emissions are considered exempt from modeling when they are in a storage tank due to the low vapor pressure.

Per SCDHEC modeling guidance, the emergency generator was not included in the modeling analysis since they will only be used for emergency backup power. The release parameters for the emission sources are summarized in Table 11 in Appendix C.

6.3 Good Engineering Practice (GEP) Analysis

The only Silfab building onsite is Building 02. The building dimensions were incorporated into the AERMOD model using the BPIP-Prime tool to account for the potential impact of building wake effects. The building parameters are provided in Table 12 in Appendix C.

6.4 Meteorological Data

The modeling was performed using the full 5-year preprocessed AERMET meteorological data provided by the SCDHEC from York County Regional Airport Station 53871 surface data and Greensboro Upper Air Station 13723. Below is a description of the meteorological data used for this analysis.

Pollutant	AERMOD Rank	Met Data Period	AERMOD Met File	Met Data Type
HCl (24-hour)	1st high	2015 - 2019	5-year concatenated	USTAR
HF (24-hour)	1st high	2015 - 2019	5-year concatenated	USTAR

6.5 Receptors

Receptors were located at the nearest property line from each emission source at 50-meter intervals and spaced at 100-meter intervals out to 1500 meters. The receptor grid utilized in this modeling analysis is provided in Figure 4.

Figure 2 illustrates the property boundary and plant layout.



6.6 Terrain Elevations

Emission source, building, and receptor terrain elevations were extracted from the National Elevation Dataset (NED) provided by the SCDHEC website <https://gis.dhec.sc.gov/aermod/>. The AERMOD Terrain Pre-processor AERMAP was then used to extract NED elevations for all emission sources, buildings, and receptor locations. The receptor grid utilized in this modeling analysis is provided in Figure 4.

6.7 Results

Compliance with the HCl and HF ambient air quality standards in Standard No. 8 was demonstrated by calculating the maximum 24-hour 1st high concentration and comparing to the Maximum Allowable Ambient Concentration (MAAC) specified in Standard No. 8. The HCl and HF concentrations are provided in Table 13 (Appendix C) and compliance with the requirements under SCDHEC Standard No. 8 is summarized in Table 14 (in Appendix C).

The AERMOD summary results pages and AERMOD electronic modeling files are provided in Appendix C (electronically).

6.8 Conclusion

The modeling results demonstrate that the predicted worst-case HCl and HF emissions for the Silfab facility will not exceed the ambient air standards under South Carolina Regulation 61-62.5, Standard No. 8. The facility has demonstrated that it will operate in compliance with these standards.

Appendices



Drawing Path: C:\arcgis\silfab\figure 1 site location map.mxd

REFERENCE:
 THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

© OpenStreetMap (and) contributors. CC-BY-SA

	SITE LOCATION MAP	SCALE: AS NOTED	FIGURE NO. 1
	SILFAB SOLAR LOGISTICS LANE FORT MILL, SOUTH CAROLINA	DATE: MAY 2023 PROJECT NUMBER 23350091	

SCALE:

AS SHOWN

DATE:

MAY 2023

PROJECT NUMBER:

23350091

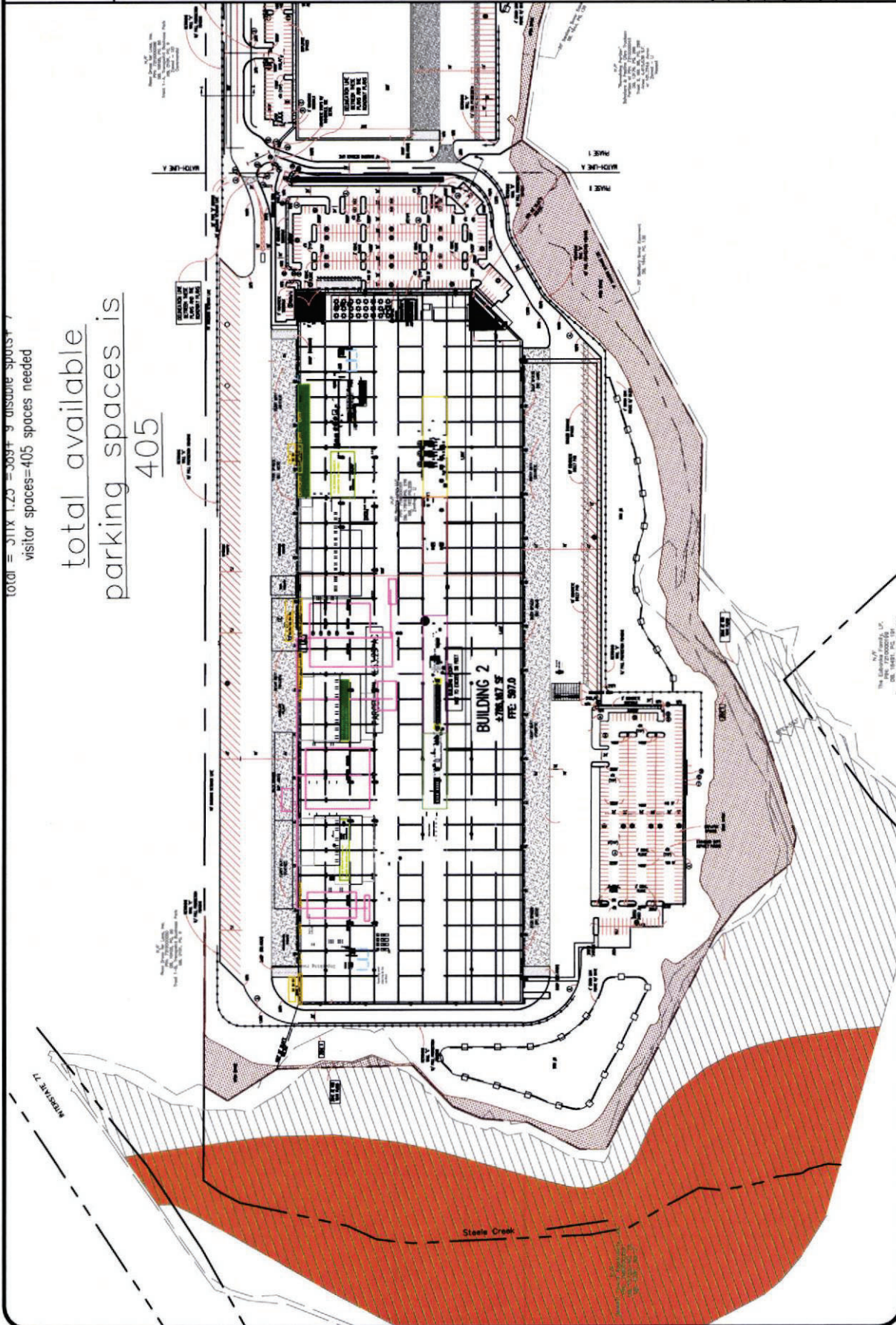
FIGURE NO.:

2

total = 311X 1.25 = 389 + 9 disable spots = 7

visitor spaces = 405 spaces needed

total available
parking spaces is
405

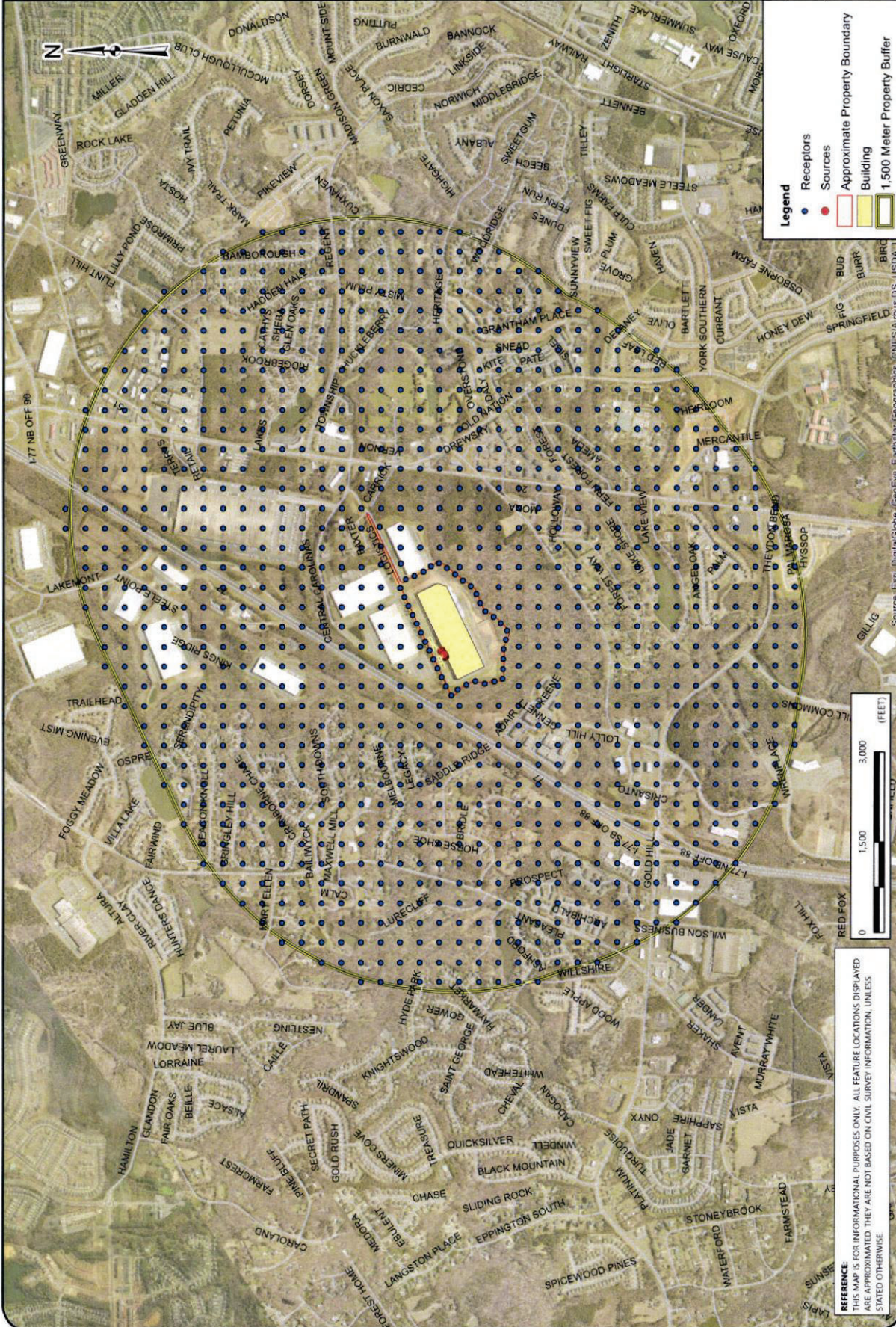




DISPERSION MODELING GRID

SILFAB SOLAR
LOGISTICS LANE
FORT MILL, SOUTH CAROLINA

SCALE:	1" = 1,499'
DATE:	MAY 2023
PROJECT NUMBER:	23350091
FIGURE NO.:	5



Legend

- Receptors
- Sources
- Approximate Property Boundary
- Building
- 1,500 Meter Property Buffer



REFERENCE:
THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,...

Appendix A – SCDHEC-BAQ Air Permit Application Forms



SECTION 1 - FACILITY IDENTIFICATION

SC Air Permit Number (8-digits only) <i>(Leave blank if one has never been assigned)</i> -	Application Date 06/01/23 (revised 02/12/24)
Facility Name/Legal Identity <i>(This should be the official legal name under which the facility is owned/operated and should be consistent with the name registered with the S.C. Secretary of State's office, as applicable.)</i> Silfab Solar	
Facility Site Name (Optional) <i>(Please provide any alternative or additional identifier of the facility, such as a specific plant identifier (e.g., Columbia plant) or any applicable "doing business as" (DBA) identity. This name will be listed on the permit and used to identify the facility at the physical address listed below.)</i>	
Facility Federal Tax Identification Number <i>(Established by the U.S. Internal Revenue Service to identify a business entity)</i> 30-1127398	

REQUEST TYPE (Check all that apply)	
Exemption Request: <input type="checkbox"/> Complete Section 1 and attach documentation to support exemption request.	
Construction Application: <input type="checkbox"/> Minor New Source Review Project <input checked="" type="checkbox"/> Synthetic Minor Project <input type="checkbox"/> Prevention of Significant Deterioration Project <input type="checkbox"/> 112(g) Project	
Expedited Review Request: <input checked="" type="checkbox"/> If checked, include Expedited Form D-2212 in the construction application package.	
Construction Permit Modification: <input type="checkbox"/> Provide the construction permit ID (e.g. CA, CB, etc.) for which modification is requested:	
Application Revision: <input type="checkbox"/>	

CONSTRUCTION PERMIT APPLICATION FORMS BEING REVISED		
<i>(Amended construction permit forms must be filled out completely and attached to this modification request.)</i>		
Form #	Date of Original Submittal	Brief Description of Revision
D2566	06-01-23	Update for control equipment changes
D2573	06-01-23	Update for control equipment changes

FACILITY PHYSICAL ADDRESS		
Physical Address: 7149 Logistics Lane		County: York
City: Fort Mill	State: SC	Zip Code: 29715
Facility Coordinates <i>(Facility coordinates should be based at the front door or main entrance of the facility)</i>		
Latitude: 35 4' 13.289" North		Longitude: 80 56' 48.25" West



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FACILITY'S PRODUCTS / SERVICES	
Primary Products / Services <i>(List the primary product and/or service)</i> Manufacture residential solar panels	
Primary SIC Code <i>(Standard Industrial Classification Codes)</i> 3674	Primary NAICS Code <i>(North American Industry Classification System)</i> 334413
Other Products / Services <i>(List other products and/or services)</i>	
Other SIC Code(s):	Other NAICS Code(s):

PROJECT DESCRIPTION
Project Description (What, why, how, etc.): Silfab Solar will construct a solar panel manufacturing facility.

AIR PERMIT FACILITY CONTACT			
<i>(Person listed will be in our files as the point of contact for all air permitting related questions and will receive all air permitting notifications.)</i>			
Title/Position: Plant Facilities Director	Salutation:	First Name: Matthew	Last Name: Korzelius
Mailing Address: 7149 Logistics Lane			
City: Fort Mill	State: SC	Zip Code: 29715	
E-mail Address: m.korzelius@silfabsolar.com	Primary Phone No.: (716)-949-0241	Alternate Phone No.: (716)-225-6822	

The signed permit will be e-mailed to the designated Air Permit Contact. If additional individuals need copies of the permit, please provide their names and e-mail addresses.	
Name	E-mail Address
Matt Korzelius	m.korzelius@silfabsolar.com
Treff MacDonald	t.macdonald@silfabsolar.com

CONFIDENTIAL INFORMATION / DATA
Is confidential information or data being submitted under separate cover? <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes*

If yes, submit **ONLY ONE COMPLETE CONFIDENTIAL APPLICATION, with original signature, along with the public version of the application.*

CO-LOCATION DETERMINATION
Are there other facilities in close proximity that could be considered collocated? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes*
If yes, list potential collocated facilities, including air permit numbers if applicable:

**If yes, please submit [collocation applicability determination](#) details in an attachment to this application.*



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OWNER OR OPERATOR			
Title/Position: Chief Operating Officer	Salutation: Mr.	First Name: Treff	Last Name: McDonald
Mailing Address: 7149 Logistics Lane			
City: Fort Mill		State: SC	Zip Code: 29715
E-mail Address: t.macdonald@silfabsolar.com		Primary Phone No.: 839-4004338	Alternate Phone No.: 416-788-8200

OWNER OR OPERATOR SIGNATURE
I certify, to the best of my knowledge and belief, that no applicable standards and/or regulations will be contravened or violated. I certify that any application form, supporting documentation, report, or compliance certification submitted in this permit application is true, accurate, and complete based on information and belief formed after reasonable inquiry. I understand that any statements and/or descriptions, which are found to be incorrect, may result in the immediate revocation of any permit issued for this application.

02/12/2024

Signature of Owner or Operator

Date

APPLICATION PREPARER (if other than Professional Engineer below)			
Title/Position: Sr. Environmental Scientist	Salutation: Mr.	First Name: Marty	Last Name: Jones
Mailing Address: 48 Brookfield Drive, Suite F			
City: Greenville		State: SC	Zip Code: 29607
E-mail Address: mjones@smeinc.com		Phone No.: 864-297-9944	Cell No.: 864-630-2956

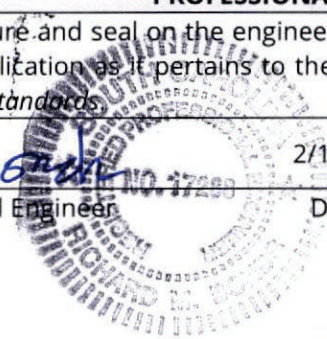
PROFESSIONAL ENGINEER INFORMATION			
Consulting Firm Name: S&ME, Inc.		SC Certificate of Authority License No.: C00473	
Title/Position: Environmental Engineer	Salutation: Mr.	First Name: Richard	Last Name: Bonds
Mailing Address: 301 Zima Park Road			
City: Spartanburg		State: SC	Zip Code: 29301
E-mail Address: rbonds@smeinc.com		Phone No.: 864-208-9354	Cell No.: 864-316-2320
SC License/Registration No.: 17288			

PROFESSIONAL ENGINEER SIGNATURE
I have placed my signature and seal on the engineering documents submitted, signifying that I have reviewed this construction permit application as it pertains to the requirements of <i>South Carolina Regulation 61-62, Air Pollution Control Regulations and Standards</i> .

2/12/24

Signature of Professional Engineer

Date





EQUIPMENT / PROCESS INFORMATION

Be as detailed as possible when filling out "Equipment/Process Description." The following includes examples of source types and relevant information associated with that source:

External Combustion Sources: Equipment type and usage (e.g. steam generation, process heat, drying, curing, etc.), maximum heat capacity (MMBTU/hr), primary and backup fuel type (e.g. natural gas, fuel oil, coal, etc.), fuel sulfur content, Low NO_x burners, direct or indirect heating

Stationary Internal Combustion Sources: Equipment type and usage (e.g. emergency generator, fire pump, etc.), output brake/electrical power (hp/kW), fuel type

Liquid Storage Tanks: Tank type (e.g. fixed roof, floating roof, variable vapor pressure, etc.), materials stored, material density, vapor pressure, maximum average storage temperature, loading source (e.g. pipeline, rail car, process, etc.)

Incinerators: Incinerator type (e.g. rotary kiln, air curtain, single chamber, etc.), primary and secondary waste types (e.g. municipal waste, yard waste, clean wood, etc.), waste charge rate (tons/day or lb/hr), burner capacity (BTU/hr), minimum chamber temperature

Surface Coating Sources: Coating operation type (e.g. large appliances, auto and light duty trucks, paper and other webs, publication printing inks, etc.), transfer efficiency, coating density, percent Volatile Organic Compound (VOC)/Hazardous Air Pollutants (HAPs)/Toxic Air Pollutants (TAPs), Safety Data Sheets (SDS)

Please review applicable regulations to determine additional information that may be required for permitting.



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EQUIPMENT / PROCESS INFORMATION					
Equipment ID/ Process ID	Action	Equipment / Process Description	Maximum Design Capacity (Units)	Control Device ID(s)	Emission Point ID(s)
MAL1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Module Assembly Lines 1-3	CONFIDENTIAL	None	General Area Exhaust
MALGCT	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Module Assembly Lab and Gel Content Testing	CONFIDENTIAL	None	General Area Exhaust
CellP1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Phase 1 Cell Manufacturing	CONFIDENTIAL	SCR1	P1ACID
CellP2	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Phase 2 Cell Manufacturing	CONFIDENTIAL	SCR2	P2ACID
HF-BST-01	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Hydrofluoric Acid Storage Tank 1	CONFIDENTIAL	SCR1	P1ACID
HF-BST-02	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Hydrofluoric Acid Storage Tank 2	CONFIDENTIAL	SCR2	P2ACID
HCL-BST-01	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Hydrochloric Acid Storage Tank 1	CONFIDENTIAL	SCR1	P1ACID
HCL-BST-02	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Hydrochloric Acid Storage Tank 2	CONFIDENTIAL	SCR2	P2ACID
EG1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Emergency Generator 1	300 HP	None	EG1



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DFTO1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Direct Fired Thermal Oxidizer	5 MMBTU/hr	Localized Scrubber	P1ACID P2ACID
-------	--	-------------------------------	------------	--------------------	------------------

CONTROL DEVICE INFORMATION

Inherent, required and voluntary control devices, as used in the table below, are defined as:

Inherent: Consult EPA Guidance "[Criteria for Determining Whether Equipment is Air Pollution Control Equipment or Process Equipment](#)." When a control device is deemed "Inherent", a detailed explanation of the determination must be included as an attachment.

Required: Control device is relied-upon or required by regulation, and controlled emissions are used to show compliance with applicable standards and regulations.

Voluntary: Control device is not relied-upon and uncontrolled emissions are used to show compliance with applicable standards and regulations.



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CONTROL DEVICE INFORMATION								
Control Device ID	Action	Control Device Description	Maximum Design Capacity (Units)	Inherent/Required/Voluntary	Pollutants Controlled (Include CAS #)	Capture Efficiency	Destruction/Removal Efficiency	Emission Point ID(s)
SCR1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Wet Scrubber/Phase 1 Acid Scrubber (AEX)	9706 ACFM	Required	Hydrofluoric Acid (7664-39-3)	100%	96%	P1ACID
SCR1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Wet Scrubber/Phase 1 Acid Scrubber (AEX)	9706 ACFM	Required	Hydrochloric Acid (7647-01-0)	100%	96%	P1ACID
SCR2	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Wet Scrubber/Phase 2 Acid Scrubber (AEX)	9706 ACFM	Required	Hydrofluoric Acid (7664-39-3)	100%	96%	P2ACID
SCR2	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Wet Scrubber/Phase 2 Acid Scrubber (AEX)	9706 ACFM	Required	Hydrochloric Acid (7647-01-0)	100%	96%	P2ACID
DFTO1	<input checked="" type="checkbox"/> Add <input type="checkbox"/> Remove <input type="checkbox"/> Modify <input type="checkbox"/> Existing	Direct Fired Thermal Oxidizer/Local Scrubber	5.0 MMBTU/hr	Required	Silane/SiO2 (7803-62-5)	100%	90%	P1ACID/P2 ACID



SECTION 3 – SOURCE IDENTIFICATION AND EMISSIONS CHECKLIST INSTRUCTIONS

Definitions for completing the information in the tables below:

Uncontrolled emissions: Maximum emission rate at full design capacity without consideration of control devices or emission limitations.

Controlled emissions: Maximum emission rate at full design capacity taking into consideration control devices. Controlled emissions only apply if there are associated control equipment and should be based on uncontrolled emissions and capture/control efficiencies. Controlled emissions do not take into consideration emission limitations.

Potential to Emit (PTE): The maximum capacity of a source to emit a regulated pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a regulated pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design only if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions as defined in S.C. Regulation 61-62.1, Section I(81), do not count in determining the potential to emit of a source.

Check Box for information addressed	Required Information
Source identification and emissions:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Name of each source, process, and control device.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Assign an Emission Point ID for each source.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Assign a Control Device ID for each control device.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • List each pollutant the source will emit.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • List the Uncontrolled, Controlled, and PTE emissions for each source or equipment in lb/hr and tons/year.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Provide the CAS# for each Hazardous Air Pollutant (HAP) and/or Toxic Air Pollutant (TAP).
Information to support emission rates:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Sample calculations.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Explanation of assumptions, bottlenecks, etc.
<input type="checkbox"/>	<ul style="list-style-type: none"> • Source test information: A copy of the source test results may be requested. If the test results are not included in the application, the application should cite whether this was a DHEC approved test, and if not, explain where the test was conducted and other identifying information.



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Check Box for information addressed	Required Information
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> Manufacturer's data.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> Vendor guarantees that support control device efficiencies.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> New Source Review (NSR) analysis.
<input type="checkbox"/>	<ul style="list-style-type: none"> Other (e.g. example particle size analysis)

Existing (Permitted) Facilities		
Check Box	Required Information	Location in Application
<input type="checkbox"/>	Facility-wide emissions prior to construction/modification: <ul style="list-style-type: none"> Include an explanation if these emissions do not match the facility-wide emissions submitted in the last application. 	
<input type="checkbox"/>	Facility-wide emissions after construction/modification: <ul style="list-style-type: none"> Include net change, if applicable. 	
As applicable for the construction/ modification:		
<input type="checkbox"/>	<ul style="list-style-type: none"> Name of each source. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application or on your current construction / operating permit. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Assign a Control Device ID for each control device. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Assign an Emission Point ID for each source. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> List each pollutant the source will emit. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> List the Uncontrolled, Controlled, and PTE (if applicable) emissions for each source or equipment. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Provide the CAS# for each HAP and/or TAP. 	
Information to support facility-wide emission rates:		
<input type="checkbox"/>	<ul style="list-style-type: none"> Sample calculations. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Explanation of assumptions, bottlenecks, etc. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Source test information: A copy of source the test results may be requested. If the results are not included in the application, the application should cite whether this was a DHEC approved test and if not, explain where the test was conducted and other identifying information. 	
<input type="checkbox"/>	<ul style="list-style-type: none"> Manufacturer's data. 	



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Existing (Permitted) Facilities		
Check Box	Required Information	Location in Application
<input type="checkbox"/>	<ul style="list-style-type: none">• Vendor guarantees that support control device efficiencies.	
<input type="checkbox"/>	<ul style="list-style-type: none">• NSR analysis.	
<input type="checkbox"/>	<ul style="list-style-type: none">• Other (please explain)	



Section 4 Completeness Checklist for Regulatory Review

State and Federal Air Pollution Control Regulations and Standards

Perform a review of all State and Federal Air Pollution Control Regulations and Standards for applicability and attach a detailed narrative from the regulatory review to the permit application. If the standard or regulation is not applicable, state the reason. Check all regulations and standards that have been reviewed and addressed in the narrative.

Check Box	State and Federal Air Pollution Control Regulations and Standards
<input checked="" type="checkbox"/>	S.C. Regulation 61-62.1 Section II.E Synthetic Minor Construction Permits
<input type="checkbox"/>	S.C. Regulation 61-62.5 Air Pollution Control Standards
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 1 Emissions from Fuel Combustion
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 2 Ambient Air Quality
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 3 Waste Combustion and Reduction (state only)
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 4 Emissions from Process Industries <i>(Note: If Section VIII of this Standard applies, include the process weight rate (PWR) in ton per hour for each applicable source or process.)</i>
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 5 Volatile Organic Compounds
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 5.2 Nitrogen Oxides Lowest Achievable Emission Rate
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 7 Prevention of Significant Deterioration (PSD)
<input type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 7.1 Nonattainment New Source Review (NSR)
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Standard No. 8 Toxic Air Pollutants (TAPs) (state only)
<input checked="" type="checkbox"/>	S.C. Regulation 61-62.6 Control of Fugitive Particulate Matter
<input checked="" type="checkbox"/>	S.C. Regulation 61-62.60 and 40 CFR Part 60 New Source Performance Standards (NSPS)
<input checked="" type="checkbox"/>	S.C. Regulation 61-62.61 and 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP)
<input checked="" type="checkbox"/>	S.C. Regulation 61-62.63 and 40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories
<input checked="" type="checkbox"/>	40 CFR Part 64 Compliance Assurance Monitoring (CAM)
<input type="checkbox"/>	S.C. Regulation 61-62.68 and 40 CFR Part 68 Chemical Accident Prevention Provisions
<input type="checkbox"/>	S.C. Regulation 61-62.70 and 40 CFR Part 70 Title V Operating Program
<input checked="" type="checkbox"/>	Other S.C. Air Pollution Control Regulations, as applicable.
<input type="checkbox"/>	Other Federal Air Pollution Control Regulations, as applicable.
<input type="checkbox"/>	40 CFR 98 Green House Gas (GHG) emissions <i>(Note: Quantify GHG emissions, if S.C. Regulation 61-62.5, Standard No. 7 or S.C. Regulation 61-62.5, Standard No. 7.1 is triggered.)</i>



Completeness Checklist:

For applicable federal and state regulations, the narrative should address the specific limitations, monitoring, recordkeeping, and reporting requirements associated with the new or altered source(s). Include the specific regulatory citations. Check all that have been reviewed and addressed in the narrative.

Check Box	Completeness Checklist:
Applicability Determination:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is this regulation <i>applicable, reasonably applicable, potentially applicable, or not applicable?</i>
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is the basis for the applicability determination explained?
Affected Sources:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is the name and identification of each emission source or process included?
Compliance Demonstration:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • How will compliance be demonstrated?
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Are specific methods or activities to be utilized by the facility to demonstrate compliance with each specific limitation and/or requirement provided?
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Are control devices and control device requirements included?
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Are monitoring, recordkeeping, and reporting requirements necessary to demonstrate compliance included?
Regulatory Citations:	
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Are the regulatory citations identified?



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Emission Point Information
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A. APPLICATION IDENTIFICATION	
1. Facility Name: Silfab Solar	
2. SC Air Permit Number (if known; 8-digits only): -	3. Application Date: 06/01/2023 (revised 02/12/24)
4. Project Description: Solar panel manufacturing facility	
5. Are other facilities collocated for air compliance? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	6. If Yes, provide permit numbers of collocated facilities:

B. AIR CONTACT			
Consulting Firm Name (if applicable): S&ME, Inc.			
Title/Position: Sr. Environmental Scientist	Salutation: Mr.	First Name: Marty	Last Name: Jones
Mailing Address: 48 Brookfield Oaks Drive, Suite F			
City: Greenville	State: SC	Zip Code: 29607	
E-mail Address: mjones@smeinc.com	Phone No.: 864-297-9944	Cell No.: 864-630-2956	

C. EMISSION POINT DISPERSION PARAMETERS		
<ul style="list-style-type: none">• Source data requirements are based on the appropriate source classification.• Each emission point is classified as a point, flare, area, area circular, area polygon, volume, open pit, line, or buoyant line source.• Contact the Bureau of Air Quality for clarification of data requirements.• Include sources on a scaled site map. Also, a picture of area or volume sources would be helpful but is not required.• A user generated document or spreadsheet may be substituted in lieu of this form provided all of the required emission point parameters are submitted in the same order, units, etc. as presented in these tables.		
Abbreviations / Units of Measure:		
<ul style="list-style-type: none">• AGL = Above Ground Level• BTU/hr = British Thermal Unit per hour• ° = Degrees	<ul style="list-style-type: none">• °F = Degrees Fahrenheit• ft = feet• ft/s = feet per second	<ul style="list-style-type: none">• K = Kelvin• m = meters• UTM = Universal Transverse Mercator



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Reminder: For all Emission Points, list the unique Emission Point ID for that source. Use the same emission point ID as shown in the current permit and provided in the last modeling submittal (as applicable). If the emission point ID has been changed from what was previously submitted, please list the current emission point ID with the old emission point ID in parenthesis

D. POINT SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height (ft)	Exit Temp. (°F)	Exit Velocity (ft/s)	Inside Diameter (ft)	Discharge Orientation	Rain Cap? (Y/N)	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)								Height (ft)	Length (ft)	Width (ft)
P1ACID	Phase 1 Acid Scrubber (AEX)	504946	3880896	19.7	76.7	90.5	1.5	Vertical	No	175	50	850	260
P2ACID	Phase 2 Acid Scrubber (AEX)	504955	3880901	19.7	76.7	90.5	1.5	Vertical	No	175	50	850	260
HF-BST-01	30,000 Liter Hydrofluoric Acid Tank	504925	3880882	Vents through Phase 1 Acid Scrubber (P1ACID)									
HF-BST-02	30,000 Liter Hydrofluoric Acid Tank	504928	3880884	Vents through Phase 2 Acid Scrubber (P2ACID)									
HCL-BST-01	20,000 Liter Hydrochloric Acid Tank	504932	3880885	Vents through Phase 1 Acid Scrubber (P1ACID)									
HCL-BST-02	20,000 Liter Hydrochloric Acid Tank	504935	3880887	Vents through Phase 2 Acid Scrubber (P2ACID)									

E. FLARE SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height (ft)	Heat Release Rate (BTU/hr)	Exit Velocity (ft/s)	Exit Temp. (°F)	Heat Loss Fraction	Distance To Nearest Property Boundary (ft)	Building			
		Easting (m)	Northing (m)							Height (ft)	Length (ft)	Width (ft)	

F. AREA SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						



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F. AREA SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

G. AREA CIRCULAR SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Radius of Area (ft)	Number of Vertices	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)					

H. AREA POLYGON SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Initial Vertical Dimension (ft)	Number of Vertices	Area (ft ²)	Distance To Nearest Property Boundary (ft)
		Easting-1 (m)	Northing-1 (m)					

I. VOLUME SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Physical Horizontal Dimension (ft)	Initial Horizontal Dimension σ_y (ft)	Physical Vertical Dimension (ft)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						



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J. OPEN PIT SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Pit Volume (ft ³)	Angle From North (°)
		Easting (m)	Northing (m)					

K. LINE SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)				Release Height AGL (ft)	Line Length (ft)	Line Width (ft)	Initial Vertical Dimension σ_z (ft)
		Start Easting (m)	Start Northing (m)	End Easting (m)	End Northing (m)				

L. BUOYANT LINE SOURCE (must complete Line Source and Buoyant Line Source tables)							
Emission Point ID	Description/Name	Average Building Length (ft)	Average Building Height (ft)	Average Building Width (ft)	Average Line Source Width (ft)	Average Building Separation (ft)	Average Buoyancy Parameter (m ⁴ /s ³)

M. EMISSION RATES							
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? ⁽¹⁾	Controlled or Uncontrolled	Averaging Period	
P1ACID	HF Acid	7664-39-3	0.0432	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr	
P1ACID	HCl Acid	7647-01-0	0.869	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr	
P2ACID	HF Acid	7664-39-3	0.0432	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr	
P2ACID	HCl Acid	7647-01-0	0.869	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr	
P1ACID	PM-10		0.023	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr	



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M. EMISSION RATES						
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? ⁽¹⁾	Controlled or Uncontrolled	Averaging Period
P1ACID	PM-2.5		0.023	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	PM-10		0.023	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	PM-2.5		0.023	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
				<input type="checkbox"/> Yes <input type="checkbox"/> No		

(1) Any difference between the rates used for permitting and the air compliance demonstration must be explained in the application report.

Appendix B – Emission Calculations (some tables contain proprietary information and have been submitted under separate cover)

Table 1
Silfab Solar
Fort Mill, SC
Emissions Summary

Total Uncontrolled Emissions						
Pollutant	Module Manufacturing	Cell Manufacturing ⁽¹⁾	Storage Tanks	Generator	DFTO Combustion	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.147	2.152
SO2				0.0003	0.013	0.013
CO				0.0010	1.804	1.805
PM-10		161.46		0.0003	0.163	161.63
PM-2.5		161.46		0.0003	0.163	161.63
VOC	49.3	26.3		0.0004	0.118	75.71
HAPs	0.0	203.6	0.2730	0.0005	0.041	203.90
HF		9.225	0.0510			9.28
HCl		194.4	0.2220			194.58

Total Controlled Emissions						
Pollutant	Module Manufacturing	Cell Manufacturing	Storage Tanks	Generator	DFTO Combustion	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.147	2.152
SO2				0.0003	0.013	0.013
CO				0.0010	1.804	1.805
PM-10		0.32		0.0003	0.163	0.486
PM-2.5		0.32		0.0003	0.163	0.486
VOC	49.3	26.3		0.0004	0.118	75.715
HAPs	0.0	7.985	0.0109	0.0410	0.041	8.078
HF		0.377	0.00204			0.379
HCl		7.609	0.00888			7.618

⁽¹⁾ Cell Manufacturing emissions include the process and silane/SiO₂ emissions generated from this process. We have assumed all silane converts to SiO₂ when exposed to oxygen is emitted as PM₁₀ and PM_{2.5}.

Table 6
Silfab Solar
Fort Mill, SC
Combustion Sources Emissions

300 HP Emergency Generator										
Source	Rated Capacity (HP)	Time of Operation ⁽²⁾		Fuel	Air Contaminant	AP-42 Emission Factor ⁽¹⁾		Number of Generators	Total Emissions (lbs/yr)	Total Emissions (tons/yr)
		Amount	Units			Amount	Units			
Emergency Generator ⁽¹⁾⁽²⁾	300	100	Hours	Diesel Fuel	NOX	0.031	lb/HP-Hr	1	9.3	0.0047
	300	100	Hours	Diesel Fuel	SOX ²	2.05E-03	lb/HP-Hr	1	0.6	0.0003
	300	100	Hours	Diesel Fuel	CO	6.68E-03	lb/HP-Hr	1	2.0	0.0010
	300	100	Hours	Diesel Fuel	PM-10	2.20E-03	lb/HP-Hr	1	0.7	0.0003
	300	100	Hours	Diesel Fuel	PM-2.5	2.20E-03	lb/HP-Hr	1	0.7	0.0003
	300	100	Hours	Diesel Fuel	VOC	2.47E-03	lb/HP-Hr	1	0.7	0.0004

Maximum Diesel Fired		
Emergency Generator	18 gal/hr	1800 gal/year
Total	18 gal/hr	1800 gal/year

Source	Rated Max Capacity (MM Btu/hr)	Hours of Operation	Air Contaminant	AP-42 Emission Factor (lb/10 ⁶ SCF) ⁽³⁾	Total Emissions (lbs/hr) ⁽⁴⁾	Total Emissions (tons/yr)
DFTO Natural Gas Usage	5.0	8760	NOX	100	0.4902	2.1471
	5.0	8760	SOX	0.6	0.0029	0.0129
	5.0	8760	CO	84	0.4118	1.8035
	5.0	8760	PM-10	7.6	0.0373	0.1632
	5.0	8760	PM-2.5	7.6	0.0373	0.1632
	5.0	8760	VOC	5.5	0.0270	0.1181
	5.0	8760	Lead	0.0005	0.000002	0.000011

Total Nat. Gas Fired		
DFTO	42.94	MMBtu/yr
Total	42.94	MMBtu/yr

⁽¹⁾ Emergency generator emissions based on emissions factor in AP-42, Chapter 3, Table 3.3.1.
⁽²⁾ Emergency generator operation limited to 100 hours /year for routine testing and maintenance.
⁽³⁾ Emission factors were obtained from AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 for Natural Gas Combustion.
⁽⁴⁾ Heat content of natural gas assumed to be 1020 BTU/scf.

Table 7
Silfab Solar
Fort Mill, SC
HAP Emissions from Combustion Sources

Natural Gas Fired RTO

Natural Gas Burned-Maximum (MMF3):

42.9 MM ft3/year

Generator

Maximum Hours Operated per Generator:

100 hrs/year

Max Gallons of Diesel Fuel Burned:

1,800 gals/year

Number of Generators:

1

Total Heat Input:

250 MMBTU/yr

Hazardous Air Pollutant	Emission Factor (lb/MMF3)	Potential Annual Emissions (Tons/yr)
2-methylnaphthalene	2.40E-05	5.15E-07
3-methylcholanthrene	2.00E-06	4.29E-08
7,12-dimethylbenzanthra	1.60E-05	3.44E-07
acenepaphthene	2.00E-06	4.29E-08
acenepaphthylene	2.00E-06	4.29E-08
anthracene	2.00E-06	4.29E-08
benz(a)anthracene	2.00E-06	4.29E-08
benzene	1.30E-03	2.79E-05
benzo(a)pyrene	2.00E-06	4.29E-08
benzo(b)flouranthene	2.00E-06	4.29E-08
benzo(g,h,i)perylene	1.00E-06	2.15E-08
benzo(k)flouranthene	2.00E-06	4.29E-08
chrysene	2.00E-06	4.29E-08
dibenzo(a)anthracene	1.00E-06	2.15E-08
dichlorobenzene	1.20E-03	2.58E-05
flouranthene	3.00E-06	6.44E-08
fluorene	3.00E-06	6.44E-08
formaldahyde	7.50E-02	1.61E-03
hexane	1.80E+00	3.86E-02
indo(1,2,3-cd)pyrene	2.00E-06	4.29E-08
naphthalene	6.10E-04	1.31E-05
phenanthrene	1.70E-05	3.65E-07
pyrene	5.00E-06	1.07E-07
toluene	3.40E-03	7.30E-05
arsenic	2.00E-04	4.29E-06
beryllium	1.20E-05	2.58E-07
cadmium	1.10E-03	2.36E-05
chromium	1.40E-03	3.01E-05
cobalt	8.40E-05	1.80E-06
manganese	3.80E-04	8.16E-06
mercury	2.60E-04	5.58E-06
selenium	2.30E-05	4.94E-07
nickel	2.10E-03	4.51E-05
Total HAPS (tons/year)		0.0405

Hazardous Air Pollutant	Emission Factor (lb/MMBtu)	Potential Annual Emissions (Tons/yr)
benzene	9.33E-04	1.17E-04
toluene	4.09E-04	5.12E-05
xylenes	2.85E-04	3.57E-05
1,3-butadiene	3.90E-05	4.88E-06
formaldahyde	1.18E-03	1.48E-04
acetaaldehyde	7.67E-04	9.60E-05
acrolein	9.20E-05	1.15E-05
naphthalene	8.50E-05	1.06E-05
acenaphthylene	5.00E-06	6.26E-07
acenaphthene	1.00E-06	1.25E-07
flourene	2.90E-05	3.63E-06
phenanthrene	2.90E-05	3.63E-06
chrysene	0.00E+00	0.00E+00
benzo(a)anthracene	2.00E-06	2.50E-07
benzo(a)flouranthene	0.00E+00	0.00E+00
benzo(k) flouranthene	0.00E+00	0.00E+00
pyrene	5.00E-06	6.26E-07
flouranthene	8.00E-06	1.00E-06
benzo(a)pyrene	0.00E+00	0.00E+00
indo(1,2,3-cd)pyrene	0.00E+00	0.00E+00
benzo(a,h)anthracene	1.00E-06	1.25E-07
benzo(g,h,i)perylene	0.00E+00	0.00E+00
Total HAPS (tons/year)		0.0005

Total HAP Emissions (Boilers and Generators) 0.0410 tons/year

Notes:

1. Emission Factors for natural gas fired equipment from Table 1.4-3 and 1.4-4 of AP-42 Section 1.4 - *Natural Gas Combustion from External Sources*.
2. Emission factors for diesel engines from Table 3.3-2 of AP-42-Chapter 3 Section 3.3 - *Stationary Internal Combustion Sources*.
3. Diesel fuel usage for the generator was calculated based on 139,000 Btu/gal for diesel fuel.

Table 8
Silfab Solar
Fort Mill, SC
Printing VOC Emissions

Helios Nr 20MW monitoring data on M1 Multy cells						VOC calculated	Note: calculation based on BOM difference and
VOC measured						Tons / year	
	kg / year	MW / year	kg/MW	MW	Tons / year	Tons / year	
1	1655	20	82.75	2000	165.5	21.2	

BOM				M1 Poly	M10
MATERIA L			UM	Quantità/pz	
PASTE AL - 2° REAR			Gr	1.400	0.100
PASTE AG/AL - 1° REAR			Gr	0.050	0.000
PASTE AG			Gr	0.115	0.100
			TOTAL	1.565	0.200
			% difference	12.78%	

Table 9
Silfab Solar
Fort Mill, SC
Cell Production Emissions

Process Step	Acidic exhaust EXA Exhaust Acid Flow Rate average (m ³ /h)	Uncontrolled Acidic Exhaust HF Concentration (mg/m ³)	Uncontrolled Acidic Exhaust HCL Concentration (mg/m ³)	Uncontrolled Acidic Exhaust HF Emissions (lbs/hr)	Uncontrolled Acidic Exhaust HCL Emissions (lbs/hr)	Controlled Acidic Exhaust HF Emissions (lbs/hr)	Controlled Acidic Exhaust HCL Emissions (lbs/hr)
BatchTex3 N600	3400	6	9	0.04	0.07	0.0018	0.0027
InEtchSide 3+ (BSG removal)	804	513		0.91	0.00	0.0363	
Power machine + External O3-Generator	1400	6	9	0.02	0.03	0.0007	
InPolySide3+	335	598.5		0.44	0.00	0.0177	
Exhaust	600	532	32810.4	0.70	43.36	0.0281	1.7345
BatchClean3 N600	1800	6	9	0.02	0.04	0.0010	

Appendix C – Air Dispersion Modeling Results and Modeling Files

Table 9
Emission Sources for Modeling Analysis
Silfab Solar
Fort Mill, SC

Source ID	Description	Criteria						HAPs/TAPs			
		NO2	CO	PM10	PM2.5	SO2	VOC	HF	HCl	Toluene	From Generator
		lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Module Manufacturing											
Line 1	Module Assembly Line						7.50				
Line 2	Module Assembly Line						7.50				
Line 3	Module Assembly Line						1.77				
Labs/Testing	Labs and Gel Content Testing						0.109			0.109	
Cell Manufacturing											
Phase 1 Scrubber	Phase 1 Scrubber			0.023	0.023			0.0430	0.868		
Phase 2 Scrubber	Phase 2 Scrubber			0.023	0.023			0.0430	0.868		
Printing	Printing Lines VOC Emissions						4.84				
Paste	Building Exhaust						1.16				
Storage Tanks											
HF-BST-01	HF Storage Tank							2.327E-04			
HF-BST-02	HF Storage Tank							2.327E-04			
HCl-BST-01	HCl Storage Tank								1.014E-03		
HCl-BST-02	HCl Storage Tank								1.014E-03		
Emergency Generator											
1	Emergency Generator	0.0093	0.0020	0.0007	0.0007	0.0006	0.0007				0.002
Total Estimated Emissions		0.0093	0.0020	0.0468	0.0468	0.0006	22.89	0.0865	1.738	0.109	0.002

**Table 10
Modeling Analysis
Silfab Solar
Fort Mill, SC**

Source	Description	Criteria						HAP/TAP			
		NO2	CO	PM10 ⁽¹⁾	PM2.5 ⁽¹⁾	SO2	VOC	HF	HCl	Toluene	Total from Generator
		tons/year	tons/year	tons/year	tons/year	tons/year	tons/year	lbs/day	lbs/day	lbs/day	tons/year
Module Manufacturing											
Line 1	Module Assembly Line	0	0	0	0	0	32.867	0	0	0	0
Line 2	Module Assembly Line	0	0	0	0	0	32.867	0	0	0	0
Line 3	Module Assembly Line	0	0	0	0	0	7.752	0	0	0	0
Labs/Testing	Labs and Gel Content Testing	0	0	0	0	0	0.109	0	0	0.109	0
Cell Manufacturing											
Phase 1 Scrubber	Phase 1 Scrubber	0	0	0.101	0.101	0	0	1.032	20.832	0	0
Phase 2 Scrubber	Phase 2 Scrubber	0	0	0.101	0.101	0	0	1.032	20.832	0	0
Printing	Printing Lines VOC Emissions	0	0	0	0	0	21.2	0	0	0	0
Paste	Building Exhaust	0	0	0	0	0	5.1	0	0	0	0
Storage Tanks											
HF-BST-01	HF Storage Tank	0	0	0	0	0	0	0.00558	0	0	0
HF-BST-02	HF Storage Tank	0	0	0	0	0	0	0.00558	0	0	0
HCl-BST-01	HCl Storage Tank	0	0	0	0	0	0	0	0.02433	0	0
HCl-BST-02	HCl Storage Tank	0	0	0	0	0	0	0	0.02433	0	0
Emergency Generator	1 Emergency Generator	0.0093	0.0020	0.0007	0.0007	0.0006	0.0007	0.0	0.0	0.0	0.002
Total		0.0093	0.0020	0.2025	0.2025	0.0006	99.90	2.075	41.713	0.109	0.002
Standard No. 8 de minimis Threshold (lbs/day)								0.025	2.100	24.000	Exempt
Standard No. 2 de minimis Threshold (tons/year)		5.0	5.0	5.0	5.0	5.0	N/A				Exempt
Modeling Required (Yes/No)		No	No	No	No	No	No	Yes	Yes	No	No

⁽¹⁾ Assume PM10 and PM2.5 are equivalent as worst case.

Table 11
Emission Source Release Parameters
Siffab Solar
Fort Mill, SC

Point Sources Source	Description	Source Type	HF Emission Rate (g/sec)	HCl Emission Rate (g/sec)	UTM Coordinates			Elevation ⁽²⁾ (m)	Stack Height (m)	Diameter (m)	Velocity (m/s)	Temp (Deg. K)	Imperial Units			
					X	Y	Z						Elevation ⁽¹⁾ (ft)	Stack Height (ft)	Diameter (ft)	Velocity (ft/sec)
P1ACID	Phase 1 Acid Scrubber (AEX)	Point	0.00545	0.1096	504946	3880896	178	6	0.46	27.4	298.7	585	19.7	1.5	90	78
P2ACID	Phase 2 Acid Scrubber (AEX)	Point	0.00545	0.1096	504955	3880901	178	6	0.46	27.4	298.7	585	19.7	1.5	90	78
HFBS01	HF Storage Tank	Point	(1)		504925	3880882	178	(1)	(1)	(1)	(1)	585	(1)	(1)	(1)	(1)
HFBS02	HF Storage Tank	Point	(1)		504928	3880884	178	(1)	(1)	(1)	(1)	585	(1)	(1)	(1)	(1)
HClBS01	HCl Storage Tank	Point		(1)	504932	3880885	178	(1)	(1)	(1)	(1)	585	(1)	(1)	(1)	(1)
HClBS02	HCl Storage Tank	Point		(1)	504935	3880887	178	(1)	(1)	(1)	(1)	585	(1)	(1)	(1)	(1)

⁽¹⁾ HF and HCl storage tank emissions are now vented to the acid scrubbers (96% efficient) and not directly to the atmosphere.

⁽²⁾ Source, building and receptor elevations were obtained from York County NED data (provided by SCDHEC) using AERMAP.

Table 12
Building Parameters
Silfab Solar
Fort Mill, SC

Building Parameters ⁽¹⁾		
Main Manufacturing Building	Feet	Meters
Building Height	50	15
Minimum Building Dimension	260	79
Maximum Building Dimension	850	259

⁽¹⁾ Source, building and receptor elevations were obtained from York County NED data (provided by SCDHEC) using AERMAP.

Table 13
Maximum Modelled Concentrations for HAPs and TAPs
Silfab Solar
Fort Mill, SC

Pollutant/Year	Unit	All Sources			
		1 hr	8-hr	24-hr	Annual
HF Concentration 1st High - 2015 to 2019 (5-year concatenated)	(ug/m3)			1.744	
HCl Concentration 1st High - 2015 to 2019 (5-year concatenated)	(ug/m3)			35.080	

Table 14
Compliance with SCDHEC Standard No. 8
Silfab Solar
Fort Mill, SC

Standard No. 8						
Pollutant	Averaging Time	Modelled Concentration (ug/m ³) ⁽¹⁾	Background Concentration (ug/m ³)	Total Concentration (ug/m ³)	Standard No. 8 MAAC (24-hr) ⁽²⁾	Compliance with Standard No. 8 Demonstrated?
HF	24-hr	1.744	N/A	1.744	2.05	Yes
HCl	24-hr	35.08	N/A	35.08	175.00	Yes

⁽¹⁾ Based on 5 years of concatenated meteorological data (2015 -2019) for HAP/TAPs.

⁽²⁾ Standard No. 8 maximum allowable ambient concentrations (MAAC).

Appendix D – Safety Data Sheets

SAFETY DATA SHEET

Ammonia

Section 1. Identification

GHS product identifier : Ammonia
Chemical name : ammonia
Other means of identification : ammonia; anhydrous ammonia
Product type : Gas.
Product use : Synthetic/Analytical chemistry.
Synonym : ammonia; anhydrous ammonia
SDS # : 001003
Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture : FLAMMABLE GASES - Category 2
GASES UNDER PRESSURE - Liquefied gas
ACUTE TOXICITY (inhalation) - Category 4
SKIN CORROSION - Category 1
SERIOUS EYE DAMAGE - Category 1
AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements

Hazard pictograms :



Signal word :

Danger

Hazard statements :

Flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.
Harmful if inhaled.
Causes severe skin burns and eye damage.
Very toxic to aquatic life.

Precautionary statements

General :

Read and follow all Safety Data Sheets (SDS'S) before use. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention :

Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Avoid breathing gas. Wash hands thoroughly after handling.

Section 2. Hazards identification

- Response** : Collect spillage. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or 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 physician. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
- Storage** : Store locked up. Protect from sunlight. Store in a well-ventilated place.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Hazards not otherwise classified** : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : ammonia
- Other means of identification** : ammonia; anhydrous ammonia
- Product code** : 001003

CAS number/other identifiers

- CAS number** : 7664-41-7

Ingredient name	%	CAS number
ammonia	100	7664-41-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention immediately. Call medical doctor or poison control center immediately. Chemical burns must be treated promptly by a physician.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately. Call medical doctor or poison control center immediately. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Continue to rinse for at least 10 minutes. Get medical attention immediately. Call medical doctor or poison control center immediately. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Section 4. First aid measures

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Causes serious eye damage.
- Inhalation** : Harmful if inhaled.
- Skin contact** : Causes severe burns.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following: pain, watering, redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following: pain or irritation, redness, blistering may occur
- Ingestion** : Adverse symptoms may include the following: stomach pains

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : Contains gas under pressure. Flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. This material is very toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.
- Hazardous thermal decomposition products** : Decomposition products may include the following materials: nitrogen oxides

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.
- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Do not breathe gas. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Store locked up. Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Refer to ANSI/CGA G-2.1, Section 5.13 for electrical classification of anhydrous ammonia storage and handling areas. Where anhydrous ammonia is stored indoors, use electrical (ventilating, lighting and material handling) equipment with the appropriate electrical classification rating and use only non-sparking tools.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
ammonia	<p>California PEL for Chemical Contaminants (Table AC-1) (United States). PEL: 25 ppm 8 hours. STEL: 35 ppm 15 minutes.</p> <p>ACGIH TLV (United States, 3/2017). TWA: 25 ppm 8 hours. TWA: 17 mg/m³ 8 hours. STEL: 35 ppm 15 minutes. STEL: 24 mg/m³ 15 minutes.</p> <p>OSHA PEL 1989 (United States, 3/1989). STEL: 35 ppm 15 minutes. STEL: 27 mg/m³ 15 minutes.</p> <p>NIOSH REL (United States, 10/2016). TWA: 25 ppm 10 hours. TWA: 18 mg/m³ 10 hours. STEL: 35 ppm 15 minutes. STEL: 27 mg/m³ 15 minutes.</p> <p>OSHA PEL (United States, 6/2016). TWA: 50 ppm 8 hours. TWA: 35 mg/m³ 8 hours.</p>

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/ or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Section 8. Exposure controls/personal protection

- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Gas. [Compressed gas.]
- Color** : Colorless.
- Odor** : Pungent.
- Odor threshold** : Not available.
- pH** : Approx. 11.6
- Melting point** : -77.7°C (-107.9°F)
- Boiling point** : -33°C (-27.4°F)
- Critical temperature** : 132.85°C (271.1°F)
- Flash point** : Not available.
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Extremely flammable in the presence of the following materials or conditions: oxidizing materials.
- Lower and upper explosive (flammable) limits** : Lower: 16%
Upper: 25%
- Vapor pressure** : 114.1 (psig)
- Vapor density** : 0.59 (Air = 1)
- Specific Volume (ft³/lb)** : 20.79
- Gas Density (lb/ft³)** : 0.0481 (32°C / 89.6 to °F)
- Relative density** : SPECIFIC GRAVITY (AIR=1): @ 70°F (21.1°C) = 0.59
- Solubility** : Soluble in water. Soluble in alcohol and ether.
- Solubility in water** : 540 g/l
- Partition coefficient: n-octanol/water** : Not available.
- Auto-ignition temperature** : 651°C (1203.8°F)
- Decomposition temperature** : Not available.
- Viscosity** : Not applicable.
- Flow time (ISO 2431)** : Not available.
- Molecular weight** : 17.03 g/mole
- Aerosol product**
- Heat of combustion** : -18589392 J/kg

Section 10. Stability and reactivity

- Reactivity** : No specific test data related to reactivity available for this product or its ingredients.
- Chemical stability** : The product is stable.
- Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.
- Conditions to avoid** : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Section 10. Stability and reactivity

Incompatible materials : Oxidizers and Yellow Metals (brass & copper)

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
ammonia	LC50 Inhalation Gas.	Rat	7338 ppm	1 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

- Eye contact** : Causes serious eye damage.
Inhalation : Harmful if inhaled.
Skin contact : Causes severe burns.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following: pain, watering, redness
Inhalation : No specific data.
Skin contact : Adverse symptoms may include the following: pain or irritation, redness, blistering may occur

Section 11. Toxicological information

Ingestion : Adverse symptoms may include the following:, stomach pains

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Other information : IDLH : 300 ppm

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
ammonia	Acute EC50 29.2 mg/l Marine water	Algae - Ulva fasciata - Zoea	96 hours
	Acute LC50 2080 µg/l Fresh water	Crustaceans - Gammarus pulex	48 hours
	Acute LC50 0.53 ppm Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 300 µg/l Fresh water	Fish - Hypophthalmichthys nobilis	96 hours
	Chronic NOEC 0.204 mg/l Marine water	Fish - Dicentrarchus labrax	62 days

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil






Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1005	UN1005	UN1005	UN1005	UN1005
UN proper shipping name	AMMONIA, ANHYDROUS	AMMONIA, ANHYDROUS; OR ANHYDROUS AMMONIA	AMMONIA, ANHYDROUS	AMMONIA, ANHYDROUS	AMMONIA, ANHYDROUS
Transport hazard class(es)	2.2 	2.3 (8) 	2.3 (8) 	2.3 (8) 	2.3 (8) 
Packing group	-	-	-	-	-
Environmental hazards	Yes.	Yes.	Yes. The environmentally hazardous substance mark is not required.	Yes.	Yes. The environmentally hazardous substance mark is not required.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification

: Inhalation hazard
This product is not regulated as a marine pollutant when transported on inland waterways in sizes of ≤5 L or ≤5 kg or by road, rail, or inland air in non-bulk sizes, provided the packagings meet the general provisions of §§ 173.24 and 173.24a.
Reportable quantity 100 lbs / 45.4 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: Forbidden.
Special provisions 13,T50

TDG Classification

: Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2), 2.40-2.42 (Class 8), 2.7 (Marine pollutant mark).
The marine pollutant mark is not required when transported by road or rail.
Explosive Limit and Limited Quantity Index 0
ERAP Index 3000
Passenger Carrying Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden

Section 14. Transport information

Special provisions

- Mexico Classification** : Toxic Inhalation Hazard Zone D
- IMDG** : The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.
- IATA** : The environmentally hazardous substance mark may appear if required by other transportation regulations.
Quantity limitation Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: Forbidden. Limited Quantities - Passenger Aircraft: Forbidden.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
Clean Water Act (CWA) 311: ammonia

Clean Air Act (CAA) 112 regulated toxic substances: ammonia

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
ammonia	100	Yes.	500	-	100	-

SARA 304 RQ : 100 lbs / 45.4 kg

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	ammonia	7664-41-7	100
Supplier notification	ammonia	7664-41-7	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

Section 15. Regulatory information

- New York** : This material is listed.
New Jersey : This material is listed.
Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

- Australia** : This material is listed or exempted.
Canada : This material is listed or exempted.
China : This material is listed or exempted.
Europe : This material is listed or exempted.
Japan : **Japan inventory (ENCs)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.
Malaysia : This material is listed or exempted.
New Zealand : This material is listed or exempted.
Philippines : This material is listed or exempted.
Republic of Korea : This material is listed or exempted.
Taiwan : This material is listed or exempted.
Thailand : Not determined.
Turkey : This material is listed or exempted.
United States : This material is listed or exempted.
Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	3
Flammability		1
Physical hazards		2

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Section 16. Other information



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 2	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
ACUTE TOXICITY (inhalation) - Category 4	Expert judgment
SKIN CORROSION - Category 1	Expert judgment
SERIOUS EYE DAMAGE - Category 1	Expert judgment
AQUATIC HAZARD (ACUTE) - Category 1	Expert judgment

History

Date of printing : 1/10/2019

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Version : 1.09

Key to abbreviations : ATE = Acute Toxicity Estimate
 BCF = Bioconcentration Factor
 GHS = Globally Harmonized System of Classification and Labelling of Chemicals
 IATA = International Air Transport Association
 IBC = Intermediate Bulk Container
 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)
 UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 01/01/1979 Revision date: 01/21/2021 Supersedes: 10/13/2016 Version: 1.0

SECTION 1: Product and company identification

1.1. Product identifier

Product form : Substance
Substance name : Boron trichloride
CAS-No. : 10294-34-5
Formula : BCl₃

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

Use of the substance/mixture : Industrial use; Use as directed.

1.3. Details of the supplier of the safety data sheet

Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268 - USA
www.lindeus.com

Linde Inc. 1-844-44LINDE (1-844-445-4633)
Linde Electronics 1-800-932-0624 or 1-908-329-9700

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS US classification

Press. Gas (Liq.) H280
Acute Tox. 3 (Inhalation:gas) H331
Skin Corr. 1B H314
Eye Dam. 1 H318
STOT SE 3 H335

2.2. Label elements

GHS US labeling

Hazard pictograms (GHS US) :



GHS04

GHS05

GHS06

Signal word (GHS US) :

Danger

Hazard statements (GHS US) :

H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
H314 - CAUSES SEVERE SKIN BURNS AND EYE DAMAGE
H331 - TOXIC IF INHALED
CGA-HG22 - CORROSIVE TO THE RESPIRATORY TRACT
CGA-HG01 - MAY CAUSE FROSTBITE.

Precautionary statements (GHS US) :

P202 - Do not handle until all safety precautions have been read and understood.
P260 - Do not breathe gas/vapors
P262 - Do not get in eyes, on skin, or on clothing.
P264 - Wash exposed skin thoroughly after handling
P271+P403 - Use and store only outdoors or in a well-ventilated place.



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P280+P284 - Wear protective gloves, protective clothing, eye protection, respiratory protection, and/or face protection.
 P321 - Specific treatment (see First aid measures)
 P405 - Store locked up.
 P501 - Dispose of contents/container in accordance with container Supplier/owner instructions
 CGA-PG05 - Use a back flow preventive device in the piping.
 CGA-PG20+CGA-PG10 - Use only with equipment of compatible materials of construction and rated for cylinder pressure.
 CGA-PG12 - Do not open valve until connected to equipment prepared for use.
 CGA-PG18 - When returning cylinder, install leak tight valve outlet cap or plug.
 CGA-PG06 - Close valve after each use and when empty.
 CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).
 P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
 P311 - Call a poison center or doctor.
 P303+P361+P353 - IF ON SKIN OR (HAIR): Take off immediately all contaminated clothing. Rinse skin with water/shower.
 P336 - Thaw frosted parts with lukewarm water. Do not rub affected area.
 P363 - Wash contaminated clothing before reuse.
 P310 - Immediately call a poison center or doctor/physician.
 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.

2.3. Other hazards

Other hazards which do not result in classification : None.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name	Product identifier	%
Boron trichloride (Main constituent)	(CAS-No.) 10294-34-5	100

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician. . WARNING: To avoid possible chemical burns, the rescuer should avoid breathing any exhaled air from the victim.

First-aid measures after skin contact : In case of contact, immediately flush affected areas with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. Discard contaminated shoes.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects after inhalation : Overexposure to vapor concentrations moderately above 5 ppm irritates the upper respiratory tract. Intolerable concentrations range from 50-100 ppm. High concentrations (greater than 50 ppm) severely irritate the upper respiratory tract, causing the throat to burn and producing choking and coughing. Pulmonary edema; general lung injury; ulceration to the nose, throat, and larynx; and laryngeal spasm may also occur. Exposure to concentrations of 1500-2000 ppm for a few minutes is life-threatening. Liver and kidney injury have been reported after exposure to vapors. At higher concentrations, victim may suffocate from lack of oxygen.



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4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

Unsuitable extinguishing media : Reacts with water.

5.2. Special hazards arising from the substance or mixture

Reactivity : No reactivity hazard other than the effects described in sub-sections below.

5.3. Advice for firefighters

Firefighting instructions : **DANGER! Toxic, corrosive, liquefied gas.**

Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.

If leaking do not spray water (reacts violently).

Other information : Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.)

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **Danger: Toxic. Corrosive.** Wear a self-contained breathing apparatus and appropriate personal protective equipment (PPE). (gas tight, chemical-protective) Evacuate personnel to a safe area. Approach suspected leak area with caution. Remove all sources of ignition. Toxic, corrosive vapor can spread from spill. Ventilate area or move container to a well-ventilated area. Before entering the area, especially a confined area, check the atmosphere with an appropriate device. Prevent from entering sewers, basements and workpits, or any place where its accumulation can be dangerous.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.



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SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Do not breathe gas/vapor. Avoid all contact with skin, eyes, or clothing. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g. wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Boron trichloride (10294-34-5)		
ACGIH	ACGIH OEL Ceiling [ppm]	0.7 ppm
ACGIH	Not established	
USA OSHA	Not established	

8.2. Exposure controls

Appropriate engineering controls : Use corrosion-proof equipment. USE ONLY IN A CLOSED SYSTEM. An explosion-proof, corrosion-resistant, forced-draft fume hood is preferred.

Eye protection : Wear safety glasses with side shields. Wear goggles and a face shield when transfilling or breaking transfer connections. Provide readily accessible eye wash stations and safety showers. Wear safety glasses with side shields or goggles when transfilling or breaking transfer connections.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.



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Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas
Molecular mass : 117 g/mol
Color : Gives off white fumes in moist air.
Odor : Pungent.
Odor threshold : No data available
pH : Not applicable.
Relative evaporation rate (butyl acetate=1) : No data available
Relative evaporation rate (ether=1) : Not applicable.
Melting point : -107 °C
Freezing point : No data available
Boiling point : 12.4 °C
Flash point : Not applicable.
Critical temperature : 178.8 °C
Auto-ignition temperature : Not applicable.
Decomposition temperature : No data available
Flammability (solid, gas) : No data available
Vapor pressure : 1.317 bar , 19.1 psia (70°F/21.1°C)
Critical pressure : 3870 kPa
Relative vapor density at 20 °C : No data available
Relative density : 1.3
Relative gas density : 4
Solubility : Water: No data available
Partition coefficient n-octanol/water (Log Pow) : Not applicable.
Partition coefficient n-octanol/water (Log Kow) : Not applicable.
Viscosity, kinematic : Not applicable.
Viscosity, dynamic : Not applicable.
Explosive properties : Not applicable.
Oxidizing properties : None.
Explosion limits : Non flammable.

9.2. Other information

Gas group : Press. Gas (Liq.)
Additional information : Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.



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10.3. Possibility of hazardous reactions

May occur. REACTS VIOLENTLY WITH WATER.

10.4. Conditions to avoid

Avoid moisture in installation systems.

10.5. Incompatible materials

Water. Avoid all organic materials. Hydrogen. Ammonia. Oxygen. Alcohols. Nitrogen peroxide.

10.6. Hazardous decomposition products

Thermal decomposition may produce : Toxic fumes. Chlorides. Hydrochloric acid. Boric acid. Grease. Reacts with water to form toxic and corrosive vapors.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Boron trichloride (f)10294-34-5	
LC50 Inhalation - Rat [ppm]	2541 ppm/1h
ATE US (gases)	1270.5 ppmV/4h

Skin corrosion/irritation : Causes severe skin burns.

pH: Not applicable.

Serious eye damage/irritation : CAUSES SERIOUS EYE DAMAGE.

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

STOT-single exposure : MAY CAUSE RESPIRATORY IRRITATION.

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified

Symptoms/effects after inhalation : Overexposure to vapor concentrations moderately above 5 ppm irritates the upper respiratory tract. Intolerable concentrations range from 50-100 ppm. High concentrations (greater than 50 ppm) severely irritate the upper respiratory tract, causing the throat to burn and producing choking and coughing. Pulmonary edema; general lung injury; ulceration to the nose, throat, and larynx; and laryngeal spasm may also occur. Exposure to concentrations of 1500-2000 ppm for a few minutes is life-threatening. Liver and kidney injury have been reported after exposure to vapors. At higher concentrations, victim may suffocate from lack of oxygen.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

12.2. Persistence and degradability

Boron trichloride (10294-34-5)	
Persistence and degradability	Not applicable for inorganic gases.

12.3. Bioaccumulative potential

Boron trichloride (10294-34-5)	
Partition coefficient n-octanol/water (Log Pow)	Not applicable.
Partition coefficient n-octanol/water (Log Kow)	Not applicable.
Bioaccumulative potential	No data available.



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12.4. Mobility in soil

Boron trichloride (10294-34-5)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

- Other adverse effects : May cause pH changes in aqueous ecological systems.
- Effect on ozone layer : None.
- Effect on the global warming : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

- Product/Packaging disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

SECTION 14: Transport information

In accordance with DOT

- Transport document description (DOT) : UN1741 Boron trichloride, 2.3
- UN-No.(DOT) : UN1741
- Proper Shipping Name (DOT) : Boron trichloride
- Class (DOT) : 2.3 - Class 2.3 - Poisonous gas 49 CFR 173.115
- Hazard labels (DOT) : Poison Gas
2.3 - Poison gas



- DOT Special Provisions (49 CFR 172.102) : 3 - This material is poisonous by inhalation (see 171.8 of this subchapter) in Hazard Zone C (see 173.116(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.
B9 - Bottom outlets are not authorized.
B14 - Each bulk packaging, except a tank car or a multi-unit-tank car tank, must be insulated with an insulating material so that the overall thermal conductance at 15.5 C (60 F) is no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour per square foot per degree Fahrenheit) temperature differential. Insulating materials must not promote corrosion to steel when wet.

Additional information

- Emergency Response Guide (ERG) Number : 125
- Other information : No supplementary information available.
- Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers:
 - Ensure there is adequate ventilation.
 - Ensure that containers are firmly secured.
 - Ensure cylinder valve is closed and not leaking.
 - Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
 - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

- UN-No. (IMDG) : 1741
- Class (IMDG) : 2 - Gases
- MFAG-No : 125



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Air transport

UN-No. (IATA) : 1741
 Class (IATA) : 2
 Civil Aeronautics Law : Gases under pressure/Gases toxic under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Boron trichloride (10294-34-5)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

Listed on the United States SARA Section 302

Subject to reporting requirements of United States SARA Section 313

CERCLA RQ	500 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	500 lb
SARA Section 313 - Emission Reporting	1 %

All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

15.2. International regulations

CANADA

Boron trichloride (10294-34-5)

Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Boron trichloride (10294-34-5)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Boron trichloride (10294-34-5)

Listed on the AICS (Australian Inventory of Chemical Substances)
 Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)
 Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory
 Listed on the Japanese ISHL (Industrial Safety and Health Law)
 Listed on KECL/KECI (Korean Existing Chemicals Inventory)
 Listed on NZIoC (New Zealand Inventory of Chemicals)
 Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)
 Japanese Poisonous and Deleterious Substances Control Law
 Japanese Pollutant Release and Transfer Register Law (PRTR Law)
 Listed on the Canadian IDL (Ingredient Disclosure List)
 Listed on INSQ (Mexican National Inventory of Chemical Substances)
 Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Boron trichloride(10294-34-5)

U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No



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Boron trichloride(10294-34-5)	
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List



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SECTION 16: Other information

Other information

: When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Linde asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Linde Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Linde Inc, it is the user's obligation to determine the conditions of safe use of the product.

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: 01/21/2021

NFPA health hazard

: 3 - Materials that, under emergency conditions, can cause serious or permanent injury.

NFPA fire hazard

: 0 - Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.

NFPA instability

: 1 - Materials that in themselves are normally stable but can become unstable at elevated temperatures and pressures.



SDS US GHS DUAL BRANDED LINDE->PRAXAIR

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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

1.1. Product identifier

Product form : Substance
 Substance name : Hydrochloric Acid, 37% w/w
 CAS No : 7647-01-0
 Product code : LC14950
 Formula : HCl
 Synonyms : Hydrochloric acid / hydrochloric acid, conc=37%, aqueous solution
 BIG no : 29443

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

Use of the substance/mixture : Laboratory chemical

1.3. Details of the supplier of the safety data sheet

LabChem Inc
 Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
 16063 Zelienople, PA - USA
 T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Acute Tox. 4 (Oral) H302
 Skin Corr. 1B H314
 Eye Dam. 1 H318
 STOT SE 3 H335

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US)



GHS05

GHS07

Signal word (GHS-US)

: Danger

Hazard statements (GHS-US)

: H302 - Harmful if swallowed
 H314 - Causes severe skin burns and eye damage
 H318 - Causes serious eye damage
 H335 - May cause respiratory irritation

Precautionary statements (GHS-US)

: P260 - Do not breathe mist, spray, vapours
 P264 - Wash exposed 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 eye protection, face protection, protective clothing, protective gloves
 P301+P330+P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting
 P303+P361+P353 - IF ON SKIN (or hair): Remove/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/...
 P363 - Wash contaminated clothing before reuse
 P403+P233 - Store in a well-ventilated place. Keep container tightly closed
 P405 - Store locked up
 P501 - Dispose of contents/container to Comply with applicable regulations

2.3. Other hazards

Other hazards not contributing to the classification

: None.

Hydrochloric Acid, 37% w/w

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2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substances

Substance type : Multi-constituent
Name : Hydrochloric Acid, 37% w/w
CAS No : 7647-01-0
EC no : 231-595-7
EC index no : 017-002-01-X

Name	Product identifier	%	GHS-US classification
Water	(CAS No) 7732-18-5	63	Not classified
Hydrogen chloride	(CAS No) 7647-01-0	37	Compressed gas, H280 Acute Tox. 3 (Inhalation), H331 Skin Corr. 1A, H314

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

First-aid measures after inhalation : Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Wash immediately with PE-glycol 400. Wash immediately with lots of water (15 minutes)/shower. Remove clothing while washing. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.

First-aid measures after eye contact : Rinse immediately with plenty of water for 15 minutes. Do not apply neutralizing agents. Take victim to an ophthalmologist.

First-aid measures after ingestion : Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Immediately consult a doctor/medical service. Call Poison Information Centre (www.big.be/antigif.htm). Take the container/vomit to the doctor/hospital. Do not give chemical antidote. Ingestion of large quantities: immediately to hospital.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. EXPOSURE TO HIGH CONCENTRATIONS: Respiratory difficulties. Possible laryngeal spasm/oedema. Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Risk of pneumonia. Risk of lung oedema.

Symptoms/injuries after skin contact : Caustic burns/corrosion of the skin.

Symptoms/injuries after eye contact : Corrosion of the eye tissue. Permanent eye damage.

Symptoms/injuries after ingestion : Burns to the gastric/intestinal mucosa. Blood in vomit. Possible esophageal perforation. Shock.

4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : EXTINGUISHING MEDIA FOR SURROUNDING FIRES: All extinguishing media allowed.

Unsuitable extinguishing media : No unsuitable extinguishing media known.

5.2. Special hazards arising from the substance or mixture

Fire hazard : DIRECT FIRE HAZARD. Non combustible. INDIRECT FIRE HAZARD. Reactions involving a fire hazard: see "Reactivity Hazard".

Explosion hazard : INDIRECT EXPLOSION HAZARD. Reactions with explosion hazards: see "Reactivity Hazard".

Reactivity : Decomposes on exposure to temperature rise: release of (highly) toxic gases/vapours (chlorine). On exposure to air: release of corrosive mist. Reacts violently with (some) bases. Reacts exothermically with many compounds. Reacts with (strong) oxidizers: release of (highly) toxic gases/vapours (chlorine). Reacts with (some) metals: release of highly flammable gases/vapours (hydrogen).

Hydrochloric Acid, 37% w/w

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5.3. Advice for firefighters

- Precautionary measures fire : Exposure to fire/heat: keep upwind. Exposure to fire/heat: consider evacuation. Exposure to fire/heat: seal off low-lying areas. Exposure to fire/heat: have neighbourhood close doors and windows.
- Firefighting instructions : Dilute toxic gases with water spray. Take account of toxic fire-fighting water. Use water moderately and if possible collect or contain it.
- Protection during firefighting : Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

- Protective equipment : Gloves. Face-shield. Corrosion-proof suit. Large spills/in enclosed spaces: compressed air apparatus. Large spills/in enclosed spaces: gas-tight suit. Reactivity hazard: compressed air/oxygen apparatus. Reactivity hazard: gas-tight suit.
- Emergency procedures : Mark the danger area. No naked flames. In case of hazardous reactions: keep upwind. In case of reactivity hazard: consider evacuation. Large spills/in confined spaces: consider evacuation. Wash contaminated clothes.

6.1.2. For emergency responders

- Protective equipment : Equip cleanup crew with proper protection.
- Emergency procedures : Stop leak if safe to do so. Ventilate area.

6.2. Environmental precautions

Prevent soil and water pollution. Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

- For containment : Contain released substance, pump into suitable containers. Consult "Material-handling" to select material of containers. Plug the leak, cut off the supply. Dam up the liquid spill. Hazardous reaction: measure explosive gas-air mixture. If reacting: dilute combustible/toxic gases/vapours. Take account of toxic/corrosive precipitation water. Heat exposure: dilute toxic gas/vapour with water spray.
- Methods for cleaning up : Liquid spill: neutralize with soda (sodium carbonate). Neutralized substance: take up in absorbent material. Scoop absorbed substance into closing containers. Damaged/cooled tanks must be emptied. Carefully collect the spill/leftovers. Take collected spill to manufacturer/competent authority. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

- Precautions for safe handling : Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Keep away from naked flames/heat. Observe strict hygiene. Keep container tightly closed. Measure the concentration in the air regularly. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.
- Hygiene measures : Do not eat, drink or smoke when using this product. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

- Incompatible products : Strong bases. metals. cyanides.
- Storage temperature : 2 - 25 °C
- Heat and ignition sources : KEEP SUBSTANCE AWAY FROM: heat sources.
- Prohibitions on mixed storage : KEEP SUBSTANCE AWAY FROM: oxidizing agents. (strong) bases. metals. amines.
- Storage area : Ventilation at floor level. Keep locked up. Provide for a tub to collect spills. Meet the legal requirements.
- Special rules on packaging : SPECIAL REQUIREMENTS: closing. corrosion-proof. clean. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.
- Packaging materials : MATERIAL TO AVOID: steel. metal.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hydrochloric Acid, 37% w/w

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Hydrogen chloride (7647-01-0)		
USA ACGIH	ACGIH Ceiling (mg/m ³)	2.98 mg/m ³
USA ACGIH	ACGIH Ceiling (ppm)	2 ppm
USA OSHA	OSHA PEL (Ceiling) (mg/m ³)	7 mg/m ³
USA OSHA	OSHA PEL (Ceiling) (ppm)	5 ppm

8.2. Exposure controls

Appropriate engineering controls	: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Materials for protective clothing	: GIVE GOOD RESISTANCE: natural rubber, nitrile rubber.
Hand protection	: Gloves.
Eye protection	: Face shield.
Skin and body protection	: Corrosion-proof clothing.
Respiratory protection	: Gas mask with filter type B. Gas mask with filter type E. High vapour/gas concentration: self-contained respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance	: Liquid.
Molecular mass	: 36.46 g/mol
Colour	: Colourless.
Odour	: Irritating/pungent odour.
Odour threshold	: No data available
pH	: < 1
Relative evaporation rate (butylacetate=1)	: No data available
Melting point	: No data available
Freezing point	: -30 °C
Boiling point	: No data available
Flash point	: Not applicable
Self ignition temperature	: Not applicable
Decomposition temperature	: No data available
Flammability (solid, gas)	: No data available
Vapour pressure	: No data available
Relative vapour density at 20 °C	: No data available
Relative density	: 1.2
Density	: 1190 kg/m ³
Solubility	: Soluble in water. Water: Complete
Log Pow	: 0.25 (QSAR)
Log Kow	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: 0.0023 Pa.s (15 °C)
Explosive properties	: Not applicable.
Oxidising properties	: None.
Explosive limits	: No data available

9.2. Other information

Minimum ignition energy	: Not applicable
VOC content	: Not applicable
Other properties	: Gas/vapour heavier than air at 20°C. Producing fumes/mist. Substance has acid reaction.

SECTION 10: Stability and reactivity

10.1. Reactivity

Decomposes on exposure to temperature rise: release of (highly) toxic gases/vapours (chlorine). On exposure to air: release of corrosive mist. Reacts violently with (some) bases. Reacts exothermically with many compounds. Reacts with (strong) oxidizers: release of (highly) toxic gases/vapours (chlorine). Reacts with (some) metals: release of highly flammable gases/vapours (hydrogen).

10.2. Chemical stability

No data available.

Hydrochloric Acid, 37% w/w

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10.3. Possibility of hazardous reactions

Reacts violently with (some) bases: release of heat.

10.4. Conditions to avoid

Incompatible materials.

10.5. Incompatible materials

Strong bases. metals. cyanides. silver nitrate.

10.6. Hazardous decomposition products

Hydrogen chloride.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Harmful if swallowed.

Hydrochloric Acid, 37% w/w (l f)7647-01-0	
LD50 oral rat	700 mg/kg
LD50 dermal rabbit	5010 mg/kg

Hydrogen chloride (7647-01-0)	
ATE (gases)	700.000 ppm/4h

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg

Skin corrosion/irritation : Causes severe skin burns and eye damage.

pH: < 1

Serious eye damage/irritation : Causes serious eye damage.

pH: < 1

Respiratory or skin sensitisation : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Hydrochloric Acid, 37% w/w (7647-01-0)	
IARC group	3

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : May cause respiratory irritation.

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

Symptoms/injuries after inhalation : Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. EXPOSURE TO HIGH CONCENTRATIONS: Respiratory difficulties. Possible laryngeal spasm/oedema. Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Risk of pneumonia. Risk of lung oedema.

Symptoms/injuries after skin contact : Caustic burns/corrosion of the skin.

Symptoms/injuries after eye contact : Corrosion of the eye tissue. Permanent eye damage.

Symptoms/injuries after ingestion : Burns to the gastric/intestinal mucosa. Blood in vomit. Possible esophageal perforation. Shock.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water : Mild water pollutant (surface water). Ground water pollutant. Maximum concentration in drinking water: 250 mg/l (chloride) (Directive 98/83/EC). Slightly harmful to fishes. Toxic to plankton. pH shift. Insufficient data available on ecotoxicity.

Hydrochloric Acid, 37% w/w (7647-01-0)	
LC50 fishes 1	282 mg/l (96 h; Gambusia affinis; PURE SUBSTANCE)
EC50 Daphnia 1	< 56 mg/l (72 h; Daphnia magna; PURE SUBSTANCE)
LC50 fish 2	862 mg/l (Leuciscus idus; PURE SUBSTANCE)
TLM fish 1	282 ppm (96 h; Gambusia affinis; PURE SUBSTANCE)

12.2. Persistence and degradability

Hydrochloric Acid, 37% w/w (7647-01-0)	
Persistence and degradability	Biodegradability: not applicable. No (test)data on mobility of the components of the mixture available.
Biochemical oxygen demand (BOD)	Not applicable

Hydrochloric Acid, 37% w/w

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Hydrochloric Acid, 37% w/w (7647-01-0)	
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Hydrochloric Acid, 37% w/w (7647-01-0)	
Log Pow	0.25 (QSAR)
Bioaccumulative potential	Low potential for bioaccumulation (Log Kow < 4).

12.4. Mobility in soil

Hydrochloric Acid, 37% w/w (7647-01-0)	
Ecology - soil	May be harmful to plant growth, blooming and fruit formation.

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Recycle by distillation. Dehydrate/make insoluble. Immobilize the toxic or harmful components. Remove to an authorized dump (Class I). Treat using the best available techniques before discharge into drains or the aquatic environment.

Additional information : LWCA (the Netherlands): KGA category 01. Hazardous waste according to Directive 2008/98/EC.

SECTION 14: Transport information

In accordance with ADR / RID / ADNR / IMDG / ICAO / IATA

14.1. UN number

UN-No.(DOT) : 1789
DOT NA no. : UN1789

14.2. UN proper shipping name

DOT Proper Shipping Name : Hydrochloric acid
Department of Transportation (DOT) Hazard Classes : 8 - Class 8 - Corrosive material 49 CFR 173.136
Hazard labels (DOT) : 8 - Corrosive substances



Packing group (DOT) : II - Medium Danger
DOT Special Provisions (49 CFR 172.102) : A3 - For combination packagings, if glass inner packagings (including ampoules) are used, they must be packed with absorbent material in tightly closed metal receptacles before packing in outer packagings.
A6 - For combination packagings, if plastic inner packagings are used, they must be packed in tightly closed metal receptacles before packing in outer packagings.
B3 - MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks and DOT 57 portable tanks are not authorized.
B15 - Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance.
IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
N41 - Metal construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material.
T8 - 4 178.274(d)(2) Normal..... Prohibited
TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively.
TP12 - This material is considered highly corrosive to steel.
DOT Packaging Exceptions (49 CFR 173.xxx) : 154
DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

Hydrochloric Acid, 37% w/w

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DOT Packaging Bulk (49 CFR 173.xxx) : 242

14.3. Additional information

Other information : No supplementary information available.

State during transport (ADR-RID) : as liquid.

Overland transport

Packing group (ADR) : II
Class (ADR) : 8 - Corrosive substances
Hazard identification number (Kemler No.) : 80
Classification code (ADR) : C1
Danger labels (ADR) : 8 - Corrosive substances



Orange plates : An orange rectangular label with a black border, divided into two horizontal sections. The top section contains the number '80' and the bottom section contains the number '1789'.

Tunnel restriction code : E

Transport by sea

DOT Vessel Stowage Location : C - The material must be stowed "on deck only" on a cargo vessel and on a passenger vessel.
EmS-No. (1) : F-A
EmS-No. (2) : S-B

Air transport

DOT Quantity Limitations Passenger aircraft/rail : 1 L
(49 CFR 173.27)
DOT Quantity Limitations Cargo aircraft only (49 : 30 L
CFR 175.75)

SECTION 15: Regulatory information

15.1. US Federal regulations

Hydrochloric Acid, 37% w/w (7647-01-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
RQ (Reportable quantity, section 304 of EPA's List of Lists) :	5000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

15.2. International regulations

CANADA

Hydrochloric Acid, 37% w/w (7647-01-0)	
Listed on the Canadian DSL (Domestic Substances List) inventory.	
WHMIS Classification	Class E - Corrosive Material

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Skin Corr. 1B H314
STOT SE 3 H335

Full text of H-phrases: see section 16

Classification according to Directive 67/548/EEC or 1999/45/EC

C; R34
Xi; R37

Full text of R-phrases: see section 16

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15.2.2. National regulations

Hydrochloric Acid, 37% w/w (7647-01-0)

Listed on the Canadian Ingredient Disclosure List

15.3. US State regulations

Hydrochloric Acid, 37% w/w(7647-01-0)

State or local regulations

U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Massachusetts - Right To Know List

SECTION 16: Other information

Full text of H-phrases: see section 16:

Acute Tox. 3 (Inhalation)	Acute toxicity (inhal.), Category 3
Acute Tox. 4 (Oral)	Acute toxicity (oral), Category 4
Compressed gas	Gases under pressure Compressed gas
Eye Dam. 1	Serious eye damage/eye irritation, Category 1
Skin Corr. 1A	Skin corrosion/irritation, Category 1A
Skin Corr. 1B	Skin corrosion/irritation, Category 1B
STOT SE 3	Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation
H280	Contains gas under pressure; may explode if heated
H302	Harmful if swallowed
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H331	Toxic if inhaled
H335	May cause respiratory irritation

NFPA health hazard

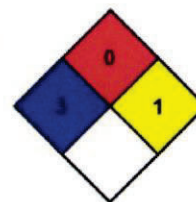
: 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard

: 0 - Materials that will not burn.

NFPA reactivity

: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.



HMIS III Rating

Health

: 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability

: 0 Minimal Hazard

Physical

: 1 Slight Hazard

Personal Protection

: H

SDS US (GHS HazCom 2012)

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Hydrofluoric acid 49 %**000000001555**

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SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Hydrofluoric acid 49 %

MSDS Number : 000000001555

Product Use Description : Metal Pickling, Glass Etching, Chemical derivatives,
Semiconductor etching

Company : Honeywell International, Inc.
101 Columbia Road
Morristown, NJ 07962-1057

For more information call : 1-800-279-9998
1-480-293-9800
www.HFacid.com
(Monday-Friday, 9:00am-5:00pm)

In case of emergency call : **Medical (PROSAR): 1-800-498-5701 or +1-651-523-0309**
: **Transportation (CHEMTREC): 1-800-424-9300 or +1-703-**
: **527-3887**
:
: (24 hours/day, 7 days/week)

SECTION 2. HAZARDS IDENTIFICATION**Emergency Overview**

Form : liquid

Color : colourless

Odor : stinging

Hazard Summary : The effects of contact with dilute solutions of hydrofluoric acid or its vapours may be delayed. Causes burns. Irritating to respiratory system.

Potential Health Effects

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- Skin** : Causes severe burns which may not be immediately painful or visible.
Hydrofluoric Acid will penetrate skin and attack underlying tissues.
- Eyes** : Corrosive to eyes
Causes itching, burning, redness and tearing.
May cause corneal injury.
- Ingestion** : May cause nausea, vomiting, diarrhea, and abdominal discomfort.
Ingestion causes burns of the upper digestive and respiratory tracts.
- Inhalation** : May cause nose, throat, and lung irritation.
May cause:
Shortness of breath
Inhalation causes narcotic effect/intoxication.
Symptoms of overexposure are dizziness, headache, tiredness, nausea, unconsciousness, cessation of breathing.
- Chronic Exposure** : May cause:
fluorosis
- Primary Routes of Entry** : Inhalation

Carcinogenicity

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No.	Concentration
Water	7732-18-5	51.00 %
Hydrofluoric acid	7664-39-3	49.00 %

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SECTION 4. FIRST AID MEASURES

- General advice** : First aider needs to protect himself. Medical assistance essential. Remove all contaminated clothing while washing continuously. After thorough washing the burned area should be immersed in a solution of 0.1% iced aqueous Benzalkonium Chloride. As an alternate first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area. Further treatment by physician.
- Inhalation** : Remove to fresh air. Keep patient warm and at rest. Get competent medical attention immediately. If breathing has stopped, start artificial respiration at once. An authorized person should administer oxygen to a victim who is having difficulty breathing, until the victim is able to breathe easily by himself. Calcium gluconate, 2.5% in normal saline may be given by nebulizer with oxygen. Do not give stimulants unless instructed to do so by a physician. Victim should be examined by a physician and held under observation for at least 24 hours.
- Skin contact** : Limit washing to 15 minutes if treatment specific for HF exposure is available. Remove all contaminated clothing while washing continuously. After thorough washing for at least 5 minutes, the burned area should be immersed in a solution of 0.13% iced aqueous Benzalkonium chloride until pain is relieved. As an alternate first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area until the pain is relieved. For larger burns or burns treated with calcium gluconate gel (in which pain is present longer than 30 minutes), a physician should inject 5% aqueous calcium gluconate beneath, around and in the burned area. Use of local anesthetics is not recommended, as reduction in pain is an indicator of effectiveness of treatment.
- Eye contact** : Protect unharmed eye. Irrigate eyes for at least 15 minutes with copious quantities of water, keeping eyelids apart and away from eyeballs during irrigation. Get competent medical attention immediately, preferably an eye specialist. If a physician is not immediately available, apply one or two drops of 0.5% tetracaine hydrochloride solution, or other aqueous, topical ophthalmic anesthetic and continue irrigation. Do not

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use the solution described for skin treatment (Benzalkonium chloride). Use no other medications unless instructed to do so by a physician. Rubbing of the eyes is to be avoided. Irrigate with 1% calcium gluconate in normal saline for 1 to 2 hours to prevent or lessen corneal damage.

Ingestion : Call a physician immediately. Drink plenty of water. Do NOT induce vomiting. Magnesium hydroxide (milk of Magnesia) as an antacid may be given.

Notes to physician

Treatment : For large skin area burns (totaling greater than 25 square inches), for ingestion and for significant inhalation exposure, severe systemic effects may occur. Monitor and correct for hypocalcemia, cardiac arrhythmias, hypomagnesemia and hyperkalemia. In some cases hemodialysis may be indicated. For certain burns, especially of the digits, use of intra-arterial calcium gluconate may be indicated. For inhalation exposures, treat as chemical pneumonia. Monitor for hypocalcemia. 2.5% calcium gluconate in normal saline by nebulizer or by intermittent positive pressure breathing with 100% oxygen may decrease pulmonary damage. Bronchodilators may also be administered.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Water spray
Foam
Carbon dioxide (CO₂)
Dry powder
The product is not flammable.

Specific hazards during firefighting : Fire may cause evolution of:
Hydrogen fluoride
Do not allow run-off from fire fighting to enter drains or water courses.

Special protective equipment for firefighters : Wear self-contained breathing apparatus and protective suit.
No unprotected exposed skin areas.

Further information : Use extinguishing measures that are appropriate to local

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circumstances and the surrounding environment.
Use water spray to cool unopened containers.

SECTION 6. ACCIDENTAL RELEASE MEASURES

- Personal precautions** : Evacuate personnel to safe areas.
Use personal protective equipment.
Keep people away from and upwind of spill/leak.
Wear full protective clothing and self-contained breathing apparatus.
- Environmental precautions** : Do not flush into surface water or sanitary sewer system.
Prevent further leakage or spillage if safe to do so.
If the product contaminates rivers and lakes or drains inform respective authorities.
Clean contaminated floors and objects thoroughly while observing environmental regulations.
- Methods for cleaning up** : Clean-up methods - large spillage
Suppress (knock down) gases/vapours/mists with a water spray jet.
Dilute with plenty of water.
Use chemical neutralising agents
Neutralise with the following product(s):
lime
Flush with water.
Suitable material for picking up
Universal binder
Never neutralise with the following products:
soda ash
- Additional advice** : Possible need to alert the neighbourhood.

SECTION 7. HANDLING AND STORAGE**Handling**

- Handling** : Exhaust ventilation at the object is necessary.
Use only acid resistant equipment.
Perform filling operations only at stations with exhaust ventilation facilities.

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Plan first aid action before beginning work with this product.
Always have on hand a first-aid kit, together with proper instructions.

Advice on protection against fire and explosion : No special precautions required.
The product is not flammable.

Storage

Further information on storage conditions : Keep containers tightly closed in a dry, cool and well-ventilated place.
Do not leave vessels/containers open
Containers should be protected against falling down.
Avoid product residues in/on containers
Store in a place accessible by authorized persons only.

Other data : The pressure in sealed containers can increase under the influence of heat.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective measures : Avoid exposure - obtain special instructions before use.
Recommended preventive skin protection
Keep working clothes separately.
Take off all contaminated clothing immediately.

Engineering measures : acid resisting floor
Emergency sprinkling nozzle
Local exhaust

Eye protection : see respiratory protection

Hand protection : Protective gloves
Gloves must be inspected prior to use.
Replace when worn.

Skin and body protection : Complete suit protecting against chemicals

Respiratory protection : Full mask, filter B2

Hygiene measures : Separate rooms are required for washing, showering and

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changing clothes.
 Regular cleaning of equipment, work area and clothing.
 Contaminated work clothing should not be allowed out of the workplace.

Exposure Guidelines

Components	CAS-No.	Value	Control parameters	Update	Basis
Hydrofluoric acid	7664-39-3	TWA : time weighted average	(0.5 ppm)	2008	ACGIH:US. ACGIH Threshold Limit Values
Further information	:	Expressed as : as F			
Hydrofluoric acid	7664-39-3	Ceiling : Ceiling Limit Value:	(2 ppm)	2008	ACGIH:US. ACGIH Threshold Limit Values
Further information	:	Expressed as : as F			
Hydrofluoric acid	7664-39-3	SKIN_DE S : Skin designati on:	Can be absorbed through the skin.	2008	ACGIH:US. ACGIH Threshold Limit Values
Further information	:	Expressed as : as F			
Hydrofluoric acid	7664-39-3	Ceil_Tim e : Ceiling Limit Value and Time Period (if specified) :	5 mg/m3 (6 ppm)	2005	NIOSH/GUIDE:US. NIOSH: Pocket Guide to Chemical Hazards

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Honeywell**Hydrofluoric acid 49 %****000000001555**

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Hydrofluoric acid	7664-39-3	REL : Recomm ended exposure limit (REL):	2.5 mg/m ³ (3 ppm)	2005	NIOSH/GUIDE:US. NIOSH: Pocket Guide to Chemical Hazards
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Hydrofluoric acid	7664-39-3	PEL : Permissi ble exposure limit	2.5 mg/m ³	02 2006	OSHA_TRANS:US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)
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Further information	:	Expressed as : as F			
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Hydrofluoric acid	7664-39-3	STEL : Short term exposure limit	(6 ppm)	1989	Z1A:US. OSHA Table Z-1-A (29 CFR 1910.1000)
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Further information	:	Expressed as : as F			
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Hydrofluoric acid	7664-39-3	TWA : time weighted average	(3 ppm)	1989	Z1A:US. OSHA Table Z-1-A (29 CFR 1910.1000)
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Further information	:	Expressed as : as F			
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Hydrofluoric acid	7664-39-3	TWA : time weighted average	(3 ppm)	02 2006	OSHA/Z2:US. OSHA Table Z-2 (29 CFR 1910.1000)
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SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state : liquid

Color : colourless

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Odor	: stinging
pH	: Note: acidic
Melting point/freezing point	: ca. -35 °C
Boiling point/boiling range	: ca. 105 °C at 1,013 hPa
Flash point	: Note: not applicable
Lower explosion limit	: Note: not applicable
Upper explosion limit	: Note: not applicable
Vapor pressure	: 101 hPa at 50 °C(122 °F)
Density	: ca. 1.170 g/cm ³ at 20 °C
Water solubility	: Note: completely miscible
Ignition temperature	: Note: not applicable
Decomposition temperature	: Note: No decomposition if used as directed., Fire or intense heat may cause violent rupture of packages.
Corrosivity	: Note: Corrosive to metals

Hydrofluoric acid 49 %**000000001555**

Version 2.2

Revision Date 09/16/2012

Print Date 06/10/2014

SECTION 10. STABILITY AND REACTIVITY

Possibility of hazardous reactions	: Corrosive in contact with metals
Conditions to avoid	: Heating will cause pressure rise with risk of bursting
Incompatible materials to avoid	: Glass and silicate-containing materials are attacked. Gives off hydrogen by reaction with metals. Incompatible with bases.
Hazardous decomposition products	: No decomposition if stored normally. Stable under normal conditions.

SECTION 11. TOXICOLOGICAL INFORMATION

Acute inhalation toxicity	: LC50: 1276 ppm Exposure time: 1 h Species: rat Note: anhydrous substance
Skin irritation	: Species: rabbit Classification: Corrosive Method: OECD
Further information	: Note: Can cause bone and joint changes in humans (fluorosis).

SECTION 12. ECOLOGICAL INFORMATION**Ecotoxicity effects**

Toxicity to fish	: LC50: 107.5 mg/l Exposure time: 96 h
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Hydrofluoric acid 49 %**000000001555**

Version 2.2

Revision Date 09/16/2012

Print Date 06/10/2014

Species: Oncorhynchus mykiss

: LC50: 925 mg/l
 Exposure time: 96 h
 Species: mosquito fish

Toxicity to daphnia and other aquatic invertebrates : EC50: 270 mg/l
 Exposure time: 48 h
 Species: Daphnia

Further information on ecology**SECTION 13. DISPOSAL CONSIDERATIONS**

Disposal methods : Observe all Federal, State, and Local Environmental regulations.

SECTION 14. TRANSPORT INFORMATION

DOT UN/ID No. : UN 1790
 Proper shipping name : Hydrofluoric acid
 Class : 8
 Packing group : II
 Hazard Labels : 8 (6.1)

IATA UN/ID No. : UN 1790
 Description of the goods : Hydrofluoric acid
 Class : 8
 Packaging group : II
 Hazard Labels : 8 (6.1)
 Packing instruction (cargo aircraft) : 855
 Packing instruction (passenger aircraft) : 851
 Packing instruction (passenger aircraft) : Y840

IMDG UN/ID No. : UN 1790
 Description of the goods : Hydrofluoric acid

Hydrofluoric acid 49 %**000000001555**

Version 2.2

Revision Date 09/16/2012

Print Date 06/10/2014

Class	: 8
Packaging group	: II
Hazard Labels	: 8 (6.1)
EmS Number	: F-A, S-B
Marine pollutant	: no

SECTION 15. REGULATORY INFORMATION**Inventories**

US. Toxic Substances Control Act	: On TSCA Inventory
Australia. Industrial Chemical (Notification and Assessment) Act	: On the inventory, or in compliance with the inventory
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL)	: All components of this product are on the Canadian DSL list.
Japan. Kashin-Hou Law List	: On the inventory, or in compliance with the inventory
Korea. Existing Chemicals Inventory (KECI)	: On the inventory, or in compliance with the inventory
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	: On the inventory, or in compliance with the inventory
China. Inventory of Existing Chemical Substances	: On the inventory, or in compliance with the inventory
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	: On the inventory, or in compliance with the inventory

National regulatory information

Hydrofluoric acid 49 %**000000001555**

Version 2.2

Revision Date 09/16/2012

Print Date 06/10/2014

US. EPA CERCLA Hazardous Substances (40 CFR 302) : The following component(s) of this product is/are subject to release reporting under 40 CFR 302 when release exceeds the Reportable Quantity (RQ):

Reportable quantity: 100 lbs

: Hydrofluoric acid 7664-39-3

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 302 Extremely Hazardous Substance (40 CFR 355, Appendix A) : The following component(s) of this product is/are subject to the emergency planning provisions of 40 CFR 355 when there are amounts equal to or greater than the Threshold Planning Quantity (TPQ):

Threshold Planning Quantity: 100 lbs

: Reportable quantity: 100 lbs

: Hydrofluoric acid 7664-39-3

SARA 302 Components : The following components are subject to reporting levels established by SARA Title III, Section 302:

: Hydrofluoric acid 7664-39-3

SARA 313 Components : The following components are subject to reporting levels established by SARA Title III, Section 313:

: Hydrofluoric acid 7664-39-3

SARA 311/312 Hazards : Acute Health Hazard
Chronic Health Hazard

CERCLA Reportable Quantity : 204 lbs

California Prop. 65 : This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

Massachusetts RTK : Hydrofluoric acid 7664-39-3

New Jersey RTK : Hydrofluoric acid 7664-39-3

Hydrofluoric acid 49 %**000000001555**

Version 2.2

Revision Date 09/16/2012

Print Date 06/10/2014

Pennsylvania RTK : Hydrofluoric acid 7664-39-3

WHMIS Classification : D1A: Very Toxic Material Causing Immediate and Serious Toxic Effects
D2A: Very Toxic Material Causing Other Toxic Effects
E: Corrosive Material
This product has been classified according to the hazard criteria of the CPR and the MSDS contains all of the information required by the CPR.

SECTION 16. OTHER INFORMATION

	HMIS III	NFPA
Health hazard	: 4*	4
Flammability	: 0	0
Physical Hazard	: 1	
Instability	:	1

* - Chronic health hazard

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.

Previous Issue Date: 09/05/2008

Prepared by: Honeywell Performance Materials and Technologies Product Stewardship Group

SAFETY DATA SHEET
Hydrogen Peroxide 50% Oxypure®

SDS # : 7722-84-1-50-34
Revision date: 2015-05-08
Format: NA
Version 1



1. PRODUCT AND COMPANY IDENTIFICATION

Product Identifier

Product Name Hydrogen Peroxide 50% Oxypure®

Other means of identification

CAS-No 7722-84-1

Recommended use of the chemical and restrictions on use

Recommended Use: Potable water treatment: Certified to conform to the requirements of the "NSF / ANSI Standard 60 - Drinking Water Treatment Chemicals - Health Effects" by NSF International

Restrictions on Use: Use as recommended by the label.

Manufacturer/Supplier

PeroxyChem LLC
2005 Market Street
Suite 3200
Philadelphia, PA 19103
Phone: +1 267/ 422-2400 (General Information)
E-Mail: sdsinfo@peroxychem.com
PeroxyChem Canada
PG Pulp Mill Road
Prince George, BC V2N2S6
1+ 250/ 561-4200 (General Information)

Emergency telephone number

For leak, fire, spill or accident emergencies, call:
1 800 / 424 9300 (CHEMTREC - U.S.A.)
1 703 / 527 3887 (CHEMTREC - Collect - All Other Countries)
1 613/ 996-6666 (CANUTEC - Canada)
1 303/ 389-1409 (Medical - U.S. - Call Collect)

1 281 / 474-8750 (Bayport, Texas Plant)
1 250 / 561-4221 (Prince George, BC, Canada Plant)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Acute toxicity - Oral	Category 4
Acute toxicity - Inhalation (Vapors)	Category 4
Skin corrosion/irritation	Category 1 Sub-category B
Serious eye damage/eye irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3

Oxidizing Liquids

Category 2

GHS Label elements, including precautionary statements

EMERGENCY OVERVIEW

Danger

Hazard Statements

- H314 - Causes severe skin burns and eye damage
- H302 - Harmful if swallowed
- H332 - Harmful if inhaled
- H335 - May cause respiratory irritation
- H272 - May intensify fire; oxidizer



Precautionary Statements - Prevention

- P271 - Use only outdoors or in a well-ventilated area
- P260 - Do not breathe mist, vapours or spray.
- P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection
- P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking
- P220 - Keep/Store away from clothing/flammable materials/combustibles
- P221 - Take any precaution to avoid mixing with combustibles/flammables

Precautionary Statements - Response

- P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
- P310 - Immediately call a POISON CENTER or doctor
- P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower
- P363 - Wash contaminated clothing before reuse
- P304 + P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
- P312 - Call a POISON CENTER or doctor if you feel unwell
- P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
- P310 - Immediately call a POISON CENTER or doctor
- P370 + P378 - In case of fire: Use water for extinction

Hazards not otherwise classified (HNOC)

No hazards not otherwise classified were identified.

Other Information

Keep container in a cool place out of direct sunlight. Store only in vented containers. Do not store on wooden pallets. Do not return unused material to its original container. Avoid contamination - Contamination could cause decomposition and generation of oxygen which may result in high pressure and possible container rupture. Empty drums should be triple rinsed with water before discarding.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula HO - OH

Chemical name	CAS-No	Weight %
Hydrogen peroxide	7722-84-1	50
Water	7732-18-5	50

Occupational exposure limits, if available, are listed in section 8

4. FIRST AID MEASURES

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. Seek immediate medical attention/advice.
Skin Contact	Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for further treatment advice.
Inhalation	Move to fresh air. If person is not breathing, contact emergency medical services, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.
Ingestion	Rinse mouth. Do not induce vomiting. If conscious, give 2 glasses of water. Get immediate medical attention. Never give anything by mouth to an unconscious person.
Most important symptoms and effects, both acute and delayed	Hydrogen Peroxide irritates respiratory system and, if inhaled, may cause inflammation and pulmonary edema. The effects may not be immediate. Overexposure symptoms are coughing, giddiness and sore throat. In case of accidental ingestion, necrosis may result from mucous membrane burns (mouth, esophagus and stomach). Oxygen rapid release may cause stomach swelling and hemorrhaging, which may product major, or even fatal, injury to organs if a large amount has been ingested. In case of skin contact, may cause burns, erythema, blisters or even necrosis.
Indication of immediate medical attention and special treatment needed, if necessary	Hydrogen peroxide at these concentrations is a strong oxidant. Direct contact with the eye is likely to cause corneal damage especially if not washed immediately. Careful ophthalmologic evaluation is recommended and the possibility of local corticosteroid therapy should be considered. Because of the likelihood of corrosive effects on the gastrointestinal tract after ingestion, and the unlikelihood of systemic effects, attempts at evacuating the stomach via emesis induction or gastric lavage should be avoided. There is a remote possibility, however, that a nasogastric or orogastric tube may be required for the reduction of severe distension due to gas formation.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media	Water. Do not use any other substance.
Specific Hazards Arising from the Chemical	In closed unventilated containers, risk of rupture due to the increased pressure from decomposition. Contact with combustible material may cause fire
Hazardous Combustion Products	On decomposition product releases oxygen which may intensify fire.
Explosion data	
Sensitivity to Mechanical Impact	Not sensitive.
Sensitivity to Static Discharge	Not sensitive.
Protective equipment and precautions for firefighters	Use water spray to cool fire exposed surfaces and protect personnel. Move containers from fire area if you can do it without risk. As in any fire, wear self-contained breathing apparatus and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Avoid contact with skin, eyes and clothing. Wear personal protective equipment. Isolate and post spill area. Keep people away from and upwind of spill/leak. Eliminate all sources of ignition and remove combustible materials.

Other Combustible materials exposed to hydrogen peroxide should be immediately submerged in or rinsed with large amounts of water to ensure that all hydrogen peroxide is removed. Residual hydrogen peroxide that is allowed to dry (upon evaporation hydrogen peroxide can concentrate) on organic materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in fire.

Environmental Precautions See Section 12 for additional Ecological Information.

Methods for Containment Dike to collect large liquid spills. Stop leak and contain spill if this can be done safely. Small spillage: Dilute with large quantities of water.

Methods for cleaning up Flush area with flooding quantities of water. Hydrogen peroxide may be decomposed by adding sodium metabisulfite or sodium sulfite after diluting to about 5%.

7. HANDLING AND STORAGE

Handling Use only in well-ventilated areas. Keep/Store away from clothing/ combustible materials. Wear personal protective equipment. Never return unused hydrogen peroxide to original container. Contamination may cause decomposition and generation of oxygen gas which could result in high pressures and possible container rupture. Empty drums should be triple rinsed with water before discarding. Utensils used for handling hydrogen peroxide should only be made of glass, stainless steel, aluminum or plastic. Pipes and equipment should be passivated before first use. Hydrogen peroxide should be stored only in vented containers and transferred only in a prescribed manner.

Storage Keep containers in cool areas out of direct sunlight and away from combustibles. Provide mechanical general and/or local exhaust ventilation to prevent release of vapor or mist into work environment. Containers must be vented. Keep/store only in original container. Store rooms or warehouses should be made of non-combustible materials with impermeable floors. In case of release, spillage should flow to safe area. Containers should be visually inspected on a regular basis to detect any abnormalities (swollen drums, increases in temperature, etc.).

Incompatible products Combustible materials. Copper alloys, galvanized iron. Strong reducing agents. Heavy metals. Iron. Copper alloys. Contact with metals, metallic ions, alkalis, reducing agents and organic matter (such as alcohols or terpenes) may produce self-accelerated thermal decomposition.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines Ingredients with workplace control parameters.

Chemical name	ACGIH TLV	OSHA PEL	NIOSH	Mexico
Hydrogen peroxide 7722-84-1	TWA: 1 ppm	TWA: 1 ppm TWA: 1.4 mg/m ³	IDLH: 75 ppm TWA: 1 ppm TWA: 1.4 mg/m ³	Mexico: TWA 1 ppm Mexico: TWA 1.5 mg/m ³ Mexico: STEL 2 ppm Mexico: STEL 3 mg/m ³
Chemical name	British Columbia	Quebec	Ontario TWA EV	Alberta
Hydrogen peroxide 7722-84-1	TWA: 1 ppm	TWA: 1 ppm TWA: 1.4 mg/m ³	TWA: 1 ppm	TWA: 1 ppm TWA: 1.4 mg/m ³

Appropriate engineering controls

Engineering measures Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation.

Individual protection measures, such as personal protective equipment

Eye/Face Protection	Use chemical splash-type monogoggles and a full-face shield made of polycarbonate, acetate, polycarbonate/acetate, PETG or thermoplastic.
Skin and Body Protection	For body protection wear impervious clothing such as an approved splash protective suit made of SBR rubber, PVC (PVC Outershell w/Polyester Substrate), Gore-Tex (Polyester trilaminate w/Gore-Tex), or a specialized HAZMAT Splash or Protective Suite (Level A, B, or C). For foot protection, wear approved boots made of NBR, PVC, Polyurethane, or neoprene. Overboots made of Latex or PVC, as well as firefighter boots or specialized HAZMAT boots are also permitted. DO NOT wear any form of boot or overboot made of nylon or nylon blends. DO NOT USE cotton, wool or leather as these materials react rapidly with higher concentrations of hydrogen peroxide. Completely submerge hydrogen peroxide contaminated clothing or other materials in water prior to drying. Residual hydrogen peroxide, if allowed to dry on materials such as paper, fabrics, cotton, leather, wood or other combustibles, can cause the material to ignite and result in a fire.
Hand Protection	For hand protection, wear approved gloves made of nitrile, PVC, or neoprene. DO NOT use cotton, wool or leather for these materials react RAPIDLY with higher concentrations of hydrogen peroxide. Thoroughly rinse the outside of gloves with water prior to removal. Inspect regularly for leaks.
Respiratory Protection	If concentrations in excess of 10 ppm are expected, use NIOSH/DHHS approved self-contained breathing apparatus (SCBA) or other approved air-supplied respirator (ASR) equipment (e.g., a full-face airline respirator (ALR)). DO NOT use any form of air-purifying respirator (APR) or filtering facepiece (dust mask), especially those containing oxidizable sorbants such as activated carbon.
Hygiene measures	Avoid breathing vapors, mist or gas. Clean water should be available for washing in case of eye or skin contamination.
General information	Protective engineering solutions should be implemented and in use before personal protective equipment is considered.

9. PHYSICAL AND CHEMICAL PROPERTIES
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Information on basic physical and chemical properties

Appearance	Clear, colorless liquid
Physical State	Liquid
Color	Colorless
Odor	odorless
Odor threshold	Not applicable
pH	<= 3.0
Melting point/freezing point	-52 °C
Boiling Point/Range	114 °C
Flash point	Not flammable
Evaporation Rate	> 1 (n-butyl acetate=1)
Flammability (solid, gas)	Not flammable
Flammability Limit in Air	Not applicable
Upper flammability limit:	
Lower flammability limit:	
Vapor pressure	18 mm Hg @ 30 °C
Vapor density	No information available
Density	1.2 @ 20 °C
Specific gravity	1.2
Water solubility	completely soluble
Solubility in other solvents	No information available
Partition coefficient	log Kow = -1.5 @ 20 °C
Autoignition temperature	Not combustible
Decomposition temperature	100 °C (adiabatic)
Viscosity, kinematic	1.17 cP @ 20 °C
Viscosity, dynamic	No information available

Explosive properties	No information available
Oxidizing properties	Strong oxidizer
Molecular weight	34
Bulk density	Not applicable

10. STABILITY AND REACTIVITY

Reactivity	Reactive and oxidizing agent.
Chemical Stability	Stable under normal conditions. Decomposes on heating. Stable under recommended storage conditions.
Possibility of Hazardous Reactions	Contact with organic substances may cause fire or explosion. Contact with metals, metallic ions, alkalis, reducing agents and organic matter (such as alcohols or terpenes) may produce self-accelerated thermal decomposition.
Hazardous polymerization	Hazardous polymerization does not occur.
Conditions to avoid	Excessive heat; Contamination; Exposure to UV-rays; pH variations.
Incompatible materials	Combustible materials. Copper alloys, galvanized iron. Strong reducing agents. Heavy metals. Iron. Copper alloys. Contact with metals, metallic ions, alkalis, reducing agents and organic matter (such as alcohols or terpenes) may produce self-accelerated thermal decomposition.
Hazardous Decomposition Products	Oxygen which supports combustion. Liable to produce overpressure in container.

11. TOXICOLOGICAL INFORMATION

Product Information

LD50 Oral	50% solution: LD50 > 225 mg/kg bw (rat) 35 % solution: LD50 1193 mg/kg bw (rat) 70 % solution: LD50 1026 mg/kg bw (rat)
LD50 Dermal	35% solution: LD50 > 2000 mg/kg bw (rabbit) 70 % solution: LD50 9200 mg/kg bw (rabbit)
LC50 Inhalation	50% solution: LC50 > 170 mg/m ³ (rat) (4-hr) Hydrogen Peroxide vapors: LC0 9400 mg/m ³ (mouse) (5 - 15 minutes) Hydrogen Peroxide vapors: LC50 > 2160 mg/m ³ (mouse)
Serious eye damage/eye irritation	Corrosive. Risk of serious damage to eyes.
Skin corrosion/irritation	Corrosive to skin. Causes severe burns.
Sensitization	Did not cause sensitization on laboratory animals.

Information on toxicological effects

Symptoms	Vapors, mists, or aerosols of hydrogen peroxide can cause upper airway irritation, inflammation of the nose, hoarseness, shortness of breath, and a sensation of burning or tightness in the chest. Prolonged exposure to concentrated vapor or to dilute solutions can cause irritation and temporary bleaching of skin and hair. Exposure to vapor, mist, or aerosol can cause stinging pain and tearing of eyes.
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Delayed and immediate effects as well as chronic effects from short and long-term exposure

Carcinogenicity	This product contains hydrogen peroxide. The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence for carcinogenicity of hydrogen peroxide in humans, but limited evidence in experimental animals (Group 3 - not classifiable as to its carcinogenicity to humans). The American Conference of Governmental Industrial Hygienists (ACGIH) has concluded that hydrogen peroxide is a 'Confirmed Animal Carcinogen with Unknown Relevance to Humans' (A3).
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Chemical name	ACGIH	IARC	NTP	OSHA
Hydrogen peroxide 7722-84-1	A3	3		

Mutagenicity	This product is not recognized as mutagenic by Research Agencies In vivo tests did not show mutagenic effects
Reproductive toxicity	This product is not recognized as reprotox by Research Agencies. No toxicity to reproduction in animal studies.
STOT - single exposure STOT - repeated exposure	May cause respiratory irritation. Not classified.
Target organ effects	Eyes, Respiratory System, Skin.
Aspiration hazard	Aspiration risk: may cause lung damage if swallowed.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity effects	Hydrogen peroxide is naturally produced by sunlight (between 0.1 and 4 ppb in air and 0.001 to 0.1 mg/L in water). Not expected to have significant environmental effects.
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Hydrogen peroxide (7722-84-1)				
Active Ingredient(s)	Duration	Species	Value	Units
Hydrogen peroxide	96 h LC50	Fish Pimephales promelas	16.4	mg/L
Hydrogen peroxide	72 h LC50	Fish Leuciscus idus	35	mg/L
Hydrogen peroxide	48 h EC50	Daphnia pulex	2.4	mg/L
Hydrogen peroxide	24 h EC50	Daphnia magna	7.7	mg/L
Hydrogen peroxide	72 h EC50	Algae Skeletonema costatum	1.38	mg/L
Hydrogen peroxide	21 d NOEC	Daphnia magna	0.63	mg/L

Persistence and degradability	Hydrogen peroxide in the aquatic environment is subject to various reduction or oxidation processes and decomposes into water and oxygen. Hydrogen peroxide half-life in freshwater ranged from 8 hours to 20 days, in air from 10 - 20 hours, and in soils from minutes to hours depending upon microbiological activity and metal contamination.
Bioaccumulation	Material may have some potential to bioaccumulate but will likely degrade in most environments before accumulation can occur.
Mobility	Will likely be mobile in the environment due to its water solubility but will likely degrade over time.
Other Adverse Effects	Decomposes into oxygen and water. No adverse effects.

13. DISPOSAL CONSIDERATIONS

Waste disposal methods	Dispose of in accordance with local regulations. Can be disposed as waste water, when in compliance with local regulations.
US EPA Waste Number	D001 D003
Contaminated Packaging	Dispose of in accordance with local regulations. Drums - Empty as thoroughly as possible. Triple rinse drums before disposal. Avoid contamination; impurities accelerate decomposition. Never return product to original container.

14. TRANSPORT INFORMATION

DOT

UN/ID no UN 2014
 Proper Shipping Name HYDROGEN PEROXIDE, AQUEOUS SOLUTION
 Hazard class 5.1
 Subsidiary class 8
 Packing Group II

TDG

UN/ID no UN 2014
 Proper Shipping Name HYDROGEN PEROXIDE, AQUEOUS SOLUTION
 Hazard class 5.1
 Subsidiary class 8
 Packing Group II

ICAO/IATA

Hydrogen peroxide (>40%) is forbidden on Passenger and Cargo Aircraft. Air regulation permit shipment of Hydrogen Peroxide (<=40%) in non-vented containers for Air Cargo Only aircraft, as well as for Passenger and Cargo aircraft. HOWEVER, all Hydrogen Peroxide containers are vented and therefore, air shipments of H2O2 are not permitted. IATA air regulations state that venting of packages containing oxidizing substances is not permitted for air transport.

IMDG/IMO

UN/ID no UN 2014
 Proper Shipping Name HYDROGEN PEROXIDE, AQUEOUS SOLUTION
 Hazard class 5.1
 Subsidiary Hazard Class 8
 Packing Group II

OTHER INFORMATION

Protect from physical damage. Keep drums in upright position. Drums should not be stacked in transit. Do not store drums on wooden pallets.

15. REGULATORY INFORMATION

U.S. 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 Yes
 Sudden release of pressure hazard No
 Reactive Hazard No

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)

CERCLA

Chemical name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	SARA RQ
Hydrogen peroxide 7722-84-1		1000 lb	

SECTION 1: Identification

1.1. Identification

Product form	: Substance
Substance name	: Isopropyl Alcohol (2-Propanol)
CAS-No.	: 67-63-0
Product code	: LC15750
Formula	: C ₃ H ₈ O
Synonyms	: 1-methylethanol / 1-methylethyl alcohol / 2-hydroxypropane / dimethyl carbinol / ethyl carbinol / hydroxypropane / IPA / i-propanol / isoethylcarbinol / propan-2-ol / sec-propanol

1.2. Recommended use and restrictions on use

Use of the substance/mixture	: Disinfectant Solvent
Recommended use	: Laboratory chemicals
Restrictions on use	: Not for food, drug or household use

1.3. Supplier

LabChem, Inc.
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or +1-703-741-5970

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS US classification

Flammable liquids Category 2	H225 Highly flammable liquid and vapour
Serious eye damage/eye irritation Category 2A	H319 Causes serious eye irritation
Specific target organ toxicity (single exposure) Category 3	H335 May cause respiratory irritation

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS US labeling

Hazard pictograms (GHS US) :



Signal word (GHS US) :

Danger

Hazard statements (GHS US) :

H225 - Highly flammable liquid and vapour
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation

Precautionary statements (GHS US) :

P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking.
P233 - Keep container tightly closed.
P240 - Ground/bond container and receiving equipment.
P241 - Use explosion-proof electrical, lighting, ventilating equipment.
P242 - Use only non-sparking tools.
P243 - Take precautionary measures against static discharge.
P261 - Avoid breathing mist, vapors, spray.
P264 - Wash exposed skin thoroughly after handling.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective clothing, protective gloves.
P303+P361+P353 - IF ON SKIN (or hair): Remove/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.

Isopropyl Alcohol (2-Propanol)

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

P312 - Call a POISON CENTER or doctor/physician if you feel unwell.
P337+P313 - If eye irritation persists: Get medical advice/attention.
P370+P378 - In case of fire: Use dry chemical powder, alcohol-resistant foam, carbon dioxide (CO₂) to extinguish
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 to comply with local, state and federal regulations.

2.3. Other hazards which do not result in classification

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Substance type : Mono-constituent

Name	Product identifier	%	GHS US classification
Isopropyl Alcohol (2-Propanol) (Main constituent)	(CAS-No.) 67-63-0	100	Flam. Liq. 2, H225 Eye Irrit. 2A, H319 STOT SE 3, H335

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with labored breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital. Never give alcohol to drink.

First-aid measures after inhalation : Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Rinse with water. Do not apply (chemical) neutralizing agents without medical advice. Soap may be used. Take victim to a doctor if irritation persists.

First-aid measures after eye contact : Rinse immediately with plenty of water. Remove contact lenses, if present and easy to do. Continue rinsing. Do not apply (chemical) neutralizing agents without medical advice. Take victim to an ophthalmologist if irritation persists.

First-aid measures after ingestion : Rinse mouth with water. Do not apply (chemical) neutralizing agents without medical advice. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Call Poison Information Centre (www.big.be/antigif.htm). Consult a doctor/medical service if you feel unwell. Ingestion of large quantities: immediately to hospital. Take the container/vomit to the doctor/hospital.

4.2. Most important symptoms and effects (acute and delayed)

Potential Adverse human health effects and symptoms : Non-toxic if swallowed (LD50 oral, rat > 5000 mg/kg). Not irritant to skin. Non-toxic in contact with skin (LD50 skin > 5000 mg/kg). May cause drowsiness or dizziness. Causes serious eye irritation.

Symptoms/effects after inhalation : EXPOSURE TO HIGH CONCENTRATIONS: Coughing. Dry/sore throat. Central nervous system depression. Dizziness. Headache. Narcosis.

Symptoms/effects after skin contact : Dry skin.

Symptoms/effects after eye contact : Irritation of the eye tissue. Redness of the eye tissue.

Symptoms/effects after ingestion : AFTER ABSORPTION OF LARGE QUANTITIES: Central nervous system depression. Headache. Dilatation of the blood vessels. Low arterial pressure. Nausea. Vomiting. Abdominal pain. Disturbed motor response. Disturbances of consciousness. FOLLOWING SYMPTOMS MAY APPEAR LATER: Body temperature fall. Slowing respiration.

Chronic symptoms : Red skin. Dry skin. Itching. Cracking of the skin. Skin rash/inflammation. Impaired memory.

4.3. Immediate medical attention and special treatment, if necessary

No additional information available

Isopropyl Alcohol (2-Propanol)

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

- Suitable extinguishing media : Quick-acting ABC powder extinguisher. Quick-acting BC powder extinguisher. Quick-acting class B foam extinguisher. Quick-acting CO2 extinguisher. Class B foam (alcohol-resistant). Water spray if puddle cannot expand.
- Unsuitable extinguishing media : Water (quick-acting extinguisher, reel); risk of puddle expansion. Water; risk of puddle expansion.

5.2. Specific hazards arising from the chemical

- Fire hazard : DIRECT FIRE HAZARD. Highly flammable liquid and vapour. Gas/vapor flammable with air within explosion limits. INDIRECT FIRE HAZARD. May be ignited by sparks. Gas/vapor spreads at floor level: ignition hazard.
- Explosion hazard : DIRECT EXPLOSION HAZARD. Gas/vapour explosive with air within explosion limits. INDIRECT EXPLOSION HAZARD. may be ignited by sparks. Reactions with explosion hazards: see "Reactivity Hazard".

5.3. Special protective equipment and precautions for fire-fighters

- Firefighting instructions : Cool tanks/drums with water spray/remove them into safety. Do not move the load if exposed to heat.
- Protection during firefighting : Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

- General measures : Clean up any spills as soon as possible, using an absorbent material to collect it.

6.1.1. For non-emergency personnel

- Protective equipment : Gloves. Protective goggles. Protective clothing. Large spills/in enclosed spaces: compressed air apparatus.
- Emergency procedures : Keep upwind. Mark the danger area. Consider evacuation. Seal off low-lying areas. Close doors and windows of adjacent premises. Stop engines and no smoking. No naked flames or sparks. Spark- and explosion-proof appliances and lighting equipment. Keep containers closed. Wash contaminated clothes.

6.1.2. For emergency responders

- Protective equipment : Equip cleanup crew with proper protection. Do not breathe gas, fumes, vapor or spray.
- Emergency procedures : Stop leak if safe to do so. Ventilate area. If a major spill occurs, all personnel should be immediately evacuated and the area ventilated.

6.2. Environmental precautions

- Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

- For containment : Contain released substance, pump into suitable containers. Plug the leak, cut off the supply. Dam up the liquid spill. Try to reduce evaporation. Measure the concentration of the explosive gas-air mixture. Dilute/disperse combustible gas/vapour with water curtain. Provide equipment/receptacles with earthing. Do not use compressed air for pumping over spills.
- Methods for cleaning up : Take up liquid spill into absorbent material, e.g.: dry sand/earth/vermiculite or powdered limestone. Scoop absorbed substance into closing containers. Damaged/cooled tanks must be emptied. Do not use compressed air for pumping over spills. Carefully collect the spill/leftovers. Clean contaminated surfaces with an excess of water. Take collected spill to manufacturer/competent authority. Wash clothing and equipment after handling.

6.4. Reference to other sections

- For further information refer to section 8: "Exposure controls/personal protection".

SECTION 7: Handling and storage

7.1. Precautions for safe handling

- Additional hazards when processed : May form explosive peroxides.
- Precautions for safe handling : Use spark-/explosionproof appliances and lighting system. Take precautions against electrostatic charges. Keep away from naked flames/heat. Keep away from ignition sources/sparks. Measure the concentration in the air regularly. Work under local exhaust/ventilation. Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Handle uncleaned empty containers as full ones. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Do not use compressed air for pumping over. Keep container tightly closed.

Isopropyl Alcohol (2-Propanol)

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Hygiene measures : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Incompatible products : Ammonia. Strong acids. Strong oxidizers.
Incompatible materials : Direct sunlight. Heat sources. Sources of ignition.
Heat-ignition : KEEP SUBSTANCE AWAY FROM: heat sources. ignition sources.
Prohibitions on mixed storage : KEEP SUBSTANCE AWAY FROM: oxidizing agents. strong acids. (strong) bases. amines. halogens.
Storage area : Store in a cool area. Store in a dry area. Ventilation at floor level. Fireproof storeroom. Provide for an automatic sprinkler system. Provide for a tub to collect spills. Provide the tank with earthing. May be stored under nitrogen. Meet the legal requirements.
Special rules on packaging : SPECIAL REQUIREMENTS: closing. with pressure relief valve. dry. clean. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.
Packaging materials : SUITABLE MATERIAL: stainless steel. monel steel. carbon steel. copper. nickel. bronze. glass. Teflon. polyethylene. polypropylene. zinc. MATERIAL TO AVOID: steel with rubber inner lining. aluminium.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Isopropyl Alcohol (2-Propanol) (67-63-0)		
ACGIH	ACGIH TWA (ppm)	200 ppm
ACGIH	ACGIH STEL (ppm)	400 ppm
NIOSH	NIOSH REL (TWA) (mg/m ³)	980 mg/m ³
NIOSH	NIOSH REL (TWA) (ppm)	400 ppm
NIOSH	NIOSH REL (STEL) (mg/m ³)	1225 mg/m ³
NIOSH	NIOSH REL (STEL) (ppm)	500 ppm

8.2. Appropriate engineering controls

Appropriate engineering controls : Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Provide adequate general and local exhaust ventilation.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment:

Safety glasses. Gloves. Protective clothing. Face shield. High gas/vapor concentration: gas mask with filter type A.

Materials for protective clothing:

GIVE EXCELLENT RESISTANCE: butyl rubber. nitrile rubber. viton. polyethylene/ethylenevinylalcohol. GIVE GOOD RESISTANCE: neoprene. chloroprene rubber. GIVE LESS RESISTANCE: PVC. neoprene/natural rubber. GIVE POOR RESISTANCE: natural rubber. polyethylene. PVA

Hand protection:

Protective gloves against chemicals (EN 374)

Eye protection:

Safety glasses

Skin and body protection:

Protective clothing

Respiratory protection:

Full face mask with filter type A at conc. in air > exposure limit

Personal protective equipment symbol(s):



Isopropyl Alcohol (2-Propanol)

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SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance	: Liquid.
Color	: Colourless
Odor	: Alcohol odour Stuffy odour Mild odour
Odor threshold	: No data available
pH	: Not applicable
Melting point	: -89 °C
Freezing point	: No data available
Boiling point	: 82 °C (1013 hPa)
Critical temperature	: 235 °C
Critical pressure	: 47600 hPa
Flash point	: 12 °C
Relative evaporation rate (butyl acetate=1)	: 2.3
Relative evaporation rate (ether=1)	: 21
Flammability (solid, gas)	: No data available
Vapor pressure	: 44 hPa (20 °C)
Vapor pressure at 50 °C	: 229 hPa
Relative vapor density at 20 °C	: 2.1
Relative density	: 0.8 (20 °C)
Relative density of saturated gas/air mixture	: 1.05
Specific gravity / density	: 785 kg/m ³
Molecular mass	: 60.1 g/mol
Solubility	: Miscible with water. Soluble in ethanol. Soluble in ether. Soluble in acetone. Soluble in oils/fats. Soluble in chloroform. Water: miscible Ethanol: complete Ether: complete Acetone: soluble
Log Pow	: 0.05 (Weight of evidence approach, 25 °C)
Auto-ignition temperature	: 399 °C
Decomposition temperature	: No data available
Viscosity, kinematic	: 2.532 mm ² /s (25 °C)
Viscosity, dynamic	: 2.1 mPa·s (25 °C)
Explosion limits	: 2 – 13 vol % Lower explosive limit (LEL): 2 vol % Upper explosive limit (UEL): 13 vol %
Explosive properties	: No data available
Oxidizing properties	: No data available

9.2. Other information

Minimum ignition energy	: 0.65 mJ
Specific conductivity	: 350000000 pS/m (25 °C)
Saturation concentration	: 106 g/m ³
VOC content	: 100 %
Other properties	: Gas/vapour heavier than air at 20°C. Clear. Volatile.

SECTION 10: Stability and reactivity

10.1. Reactivity

Violent to explosive reaction with (strong) oxidizers. Prolonged storage/in large quantities: may form peroxides.

10.2. Chemical stability

Stable under normal conditions.

Isopropyl Alcohol (2-Propanol)

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10.3. Possibility of hazardous reactions

May react violently with oxidants.

10.4. Conditions to avoid

Direct sunlight. High temperature. Incompatible materials. Open flame. Sparks.

10.5. Incompatible materials

Ammonia. Strong acids. Strong oxidizers.

10.6. Hazardous decomposition products

Carbon dioxide. Carbon monoxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral) : Not classified

Acute toxicity (dermal) : Not classified

Acute toxicity (inhalation) : Not classified

Isopropyl Alcohol (2-Propanol) (67-63-0)

LD50 oral rat	5840 mg/kg body weight (Equivalent or similar to OECD 401, Rat, Experimental value, Oral, 14 day(s))
LD50 dermal rabbit	16400 mg/kg body weight (Equivalent or similar to OECD 402, 24 h, Rabbit, Experimental value, Dermal, 14 day(s))
LC50 inhalation rat (ppm)	> 10000 ppm (Equivalent or similar to OECD 403, 6 h, Rat, Male / female, Experimental value, Inhalation (vapours), 14 day(s))
ATE US (oral)	5840 mg/kg body weight
ATE US (dermal)	16400 mg/kg body weight

Skin corrosion/irritation : Not classified

pH: Not applicable

Serious eye damage/irritation : Causes serious eye irritation.

pH: Not applicable

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

STOT-single exposure : May cause respiratory irritation.

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified

Viscosity, kinematic : 2.532 mm²/s (25 °C)

Likely routes of exposure : Inhalation. Skin and eye contact.

Potential Adverse human health effects and symptoms : Non-toxic if swallowed (LD50 oral, rat > 5000 mg/kg). Not irritant to skin. Non-toxic in contact with skin (LD50 skin > 5000 mg/kg). May cause drowsiness or dizziness. Causes serious eye irritation.

Symptoms/effects after inhalation : EXPOSURE TO HIGH CONCENTRATIONS: Coughing. Dry/sore throat. Central nervous system depression. Dizziness. Headache. Narcosis.

Symptoms/effects after skin contact : Dry skin.

Symptoms/effects after eye contact : Irritation of the eye tissue. Redness of the eye tissue.

Symptoms/effects after ingestion : AFTER ABSORPTION OF LARGE QUANTITIES: Central nervous system depression. Headache. Dilatation of the blood vessels. Low arterial pressure. Nausea. Vomiting. Abdominal pain. Disturbed motor response. Disturbances of consciousness. FOLLOWING SYMPTOMS MAY APPEAR LATER: Body temperature fall. Slowing respiration.

Chronic symptoms : Red skin. Dry skin. Itching. Cracking of the skin. Skin rash/inflammation. Impaired memory.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : Not classified as dangerous for the environment according to the criteria of Regulation (EC) No 1272/2008.

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- Ecology - air : Not included in the list of substances which may contribute to the greenhouse effect (IPCC). Not included in the list of fluorinated greenhouse gases (Regulation (EU) No 517/2014). Photooxidation in the air. Not classified as dangerous for the ozone layer (Regulation (EC) No 1005/2009).
- Ecology - water : Not harmful to crustacea. Not harmful to fishes. Groundwater pollutant. Inhibition of activated sludge. Not harmful to algae. Not harmful to bacteria.

Isopropyl Alcohol (2-Propanol) (67-63-0)	
LC50 fish 1	9640 – 10000 mg/l (Equivalent or similar to OECD 203, 96 h, Pimephales promelas, Flow-through system, Fresh water, Experimental value, Lethal)

12.2. Persistence and degradability

Isopropyl Alcohol (2-Propanol) (67-63-0)	
Persistence and degradability	Biodegradable in the soil. Biodegradable in the soil under anaerobic conditions. Readily biodegradable in water.
Biochemical oxygen demand (BOD)	1.19 g O ₂ /g substance
Chemical oxygen demand (COD)	2.23 g O ₂ /g substance
ThOD	2.4 g O ₂ /g substance

12.3. Bioaccumulative potential

Isopropyl Alcohol (2-Propanol) (67-63-0)	
Log Pow	0.05 (Weight of evidence approach, 25 °C)
Bioaccumulative potential	Low potential for bioaccumulation (Log Kow < 4).

12.4. Mobility in soil

Isopropyl Alcohol (2-Propanol) (67-63-0)	
Surface tension	0.021 N/m (25 °C)
Log Koc	0.185 – 0.541 (log Koc, SRC PCKOCWIN v2.0, Calculated value)
Ecology - soil	Highly mobile in soil.

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Disposal methods

- Waste disposal recommendations : Do not discharge into drains or the environment. Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Recycle by distillation. Incinerate under surveillance with energy recovery. Obtain the consent of pollution control authorities before discharging to wastewater treatment plants.
- Additional information : Hazardous waste according to Directive 2008/98/EC, as amended by Regulation (EU) No 1357/2014 and Regulation (EU) No 2017/997.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

- Transport document description : UN1219 Isopropyl alcohol, 3, II
- UN-No. (DOT) : UN1219
- Proper Shipping Name (DOT) : Isopropyl alcohol
- Transport hazard class(es) (DOT) : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120
- Packing group (DOT) : II - Medium Danger

Isopropyl Alcohol (2-Propanol)

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Hazard labels (DOT) : 3 - Flammable liquid



DOT Packaging Non Bulk (49 CFR 173.xxx) : 202
DOT Packaging Bulk (49 CFR 173.xxx) : 242
DOT Special Provisions (49 CFR 172.102) : IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
T4 - 2.65 178.274(d)(2) Normal..... 178.275(d)(3)
TP1 - The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = $97 / 1 + a (tr - tf)$ Where: tr is the maximum mean bulk temperature during transport, and tf is the temperature in degrees celsius of the liquid during filling.

DOT Packaging Exceptions (49 CFR 173.xxx) : 4b;150
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 5 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 60 L
DOT Vessel Stowage Location : B - (i) The material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) "On deck only" on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

Other information : No supplementary information available.

Transportation of Dangerous Goods

Transport document description : UN1219 ISOPROPANOL, 3, II
UN-No. (TDG) : UN1219
Proper Shipping Name (Transportation of Dangerous Goods) : ISOPROPANOL
TDG Primary Hazard Classes : 3 - Class 3 - Flammable Liquids
Packing group : II - Medium Danger
Explosive Limit and Limited Quantity Index : 1 L
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index : 5 L

Transport by sea

Transport document description (IMDG) : UN 1219 Isopropyl alcohol, 3, II
UN-No. (IMDG) : 1219
Proper Shipping Name (IMDG) : Isopropyl alcohol
Class (IMDG) : 3 - Flammable liquids
Packing group (IMDG) : II - substances presenting medium danger
EmS-No. (1) : F-E
EmS-No. (2) : S-D

Air transport

Transport document description (IATA) : UN 1219 Isopropyl alcohol, 3, II
UN-No. (IATA) : 1219
Proper Shipping Name (IATA) : Isopropyl alcohol
Class (IATA) : 3 - Flammable Liquids
Packing group (IATA) : II - Medium Danger

Isopropyl Alcohol (2-Propanol)

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SECTION 15: Regulatory information

15.1. US Federal regulations

Isopropyl Alcohol (2-Propanol) (67-63-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Subject to reporting requirements of United States SARA Section 313	
SARA Section 311/312 Hazard Classes	Physical hazard - Flammable (gases, aerosols, liquids, or solids) Health hazard - Serious eye damage or eye irritation Health hazard - Specific target organ toxicity (single or repeated exposure)

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

Chemical(s) subject to the reporting requirements of Section 313 or Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and 40 CFR Part 372.

Isopropyl Alcohol (2-Propanol)	CAS-No. 67-63-0	100%
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15.2. International regulations

CANADA

No additional information available

EU-Regulations

No additional information available

National regulations

No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Revision date : 01/23/2020

Full text of H-phrases: see section 16:

H225	Highly flammable liquid and vapour
H319	Causes serious eye irritation
H335	May cause respiratory irritation

NFPA health hazard : 2 - Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.

NFPA fire hazard : 3 - Liquids and solids (including finely divided suspended solids) that can be ignited under almost all ambient temperature conditions.

NFPA reactivity : 0 - Material that in themselves are normally stable, even under fire conditions.



Isopropyl Alcohol (2-Propanol)

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Hazard Rating	
Health	: 1 Slight Hazard - Irritation or minor reversible injury possible
Flammability	: 3 Serious Hazard - Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73 F and boiling points above 100 F, as well as liquids with flash points between 73 F and 100 F. (Classes IB & IC)
Physical	: 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.
Personal protection	: H H - Splash goggles, Gloves, Synthetic apron, Vapor respirator

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.3
Revision Date 27.09.2019
Print Date 11.10.2021

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : Potassium hydroxide solution

Product Number : 417661
Brand : SIGALD
REACH No. : 01-2119487136-33-XXXX**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 sheetCompany : Merck Life Science S.r.l.
Via Monte Rosa 93
I-20149 MILANO
Telephone : +39 02 3341 7340
Fax : +39 02 3801 0737
E-mail address : serviziotecnico@merckgroup.com**1.4 Emergency telephone number**Emergency Phone # : 800-789-767 (CHEMTREC Italia)
+39-02-4555-7031 (CHEMTREC chiamate internazionali)
+39 02-6610-1029 (Centro Antiveneni Niguarda Ca' Granda - Milano)**SECTION 2: Hazards identification****2.1 Classification of the substance or mixture****Classification according to Regulation (EC) No 1272/2008**Corrosive to metals (Category 1), H290
Acute toxicity, Oral (Category 4), H302
Skin corrosion (Sub-category 1A), H314
Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements**Labelling according Regulation (EC) No 1272/2008**

Pictogram



Signal word	Danger
Hazard statement(s)	
H290	May be corrosive to metals.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage.
Precautionary statement(s)	
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.
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.
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.
Supplemental Hazard Statements	none

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.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Formula : HKO
Molecular weight : 56,11 g/mol

Component	Classification	Concentration
caustic potash		
CAS-No.	1310-58-3	Met. Corr. 1; Acute Tox. 4; Skin Corr. 1A; Eye Dam. 1; H290, H302, H314, H318 Concentration limits: >= 5 %: Skin Corr. 1A, H314; 2 - < 5 %: Skin Corr. 1B, H314; 0,5 - < 2 %: Skin Irrit. 2, H315; 0,5 - < 2 %: Eye Irrit. 2, H319; >= 1 %: Met. Corr. 1, H290;
EC-No.	215-181-3	
Index-No.	019-002-00-8	
Registration number	01-2119487136-33-XXXX	
		>= 30 - < 50 %

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

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. 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

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Potassium oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.



6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Store in cool place.

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

Components with workplace control parameters

Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Inhalation	Long-term local effects	1 mg/m ³
Consumers	Inhalation	Long-term local effects	1 mg/m ³

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). 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 Regulation (EU) 2016/425 and the standard EN 374 derived from it.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber



Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- | | |
|---|------------------------------------|
| a) Appearance | Form: liquid
Colour: colourless |
| b) Odour | No data available |
| c) Odour Threshold | No data available |
| d) pH | No data available |
| e) Melting point/freezing point | No data available |
| f) Initial boiling point and boiling range | No data available |
| g) Flash point | No data available |
| h) Evaporation rate | No data available |
| i) Flammability (solid, gas) | No data available |
| j) Upper/lower flammability or explosive limits | No data available |
| k) Vapour pressure | No data available |



- | | |
|--|---------------------|
| l) Vapour density | No data available |
| m) Relative density | 1,456 g/mL at 25 °C |
| n) Water solubility | No data available |
| o) Partition coefficient:
n-octanol/water | No data available |
| p) Auto-ignition
temperature | No data available |
| q) Decomposition
temperature | No data available |
| r) Viscosity | No data available |
| s) Explosive properties | No data available |
| t) Oxidizing properties | No data available |

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Water, Light metals, Alkali metals, Metals, Organic materials, Copper, reacts violently with:, vigorous reaction with:, Halogens, Nitro compounds, Magnesium, Azides, Contact with aluminum, tin and zinc liberates hydrogen gas. Contact with n formation of shock-sensitive salts.

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Potassium oxides
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

No data available

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

No data available



Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: Not available

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea

SECTION 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

Harmful to aquatic life.



H314 Causes severe skin burns and eye damage.
H315 Causes skin irritation.
H318 Causes serious eye damage.
H319 Causes serious eye irritation.

Further information

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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.

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SAFETY DATA SHEET

Silane

Section 1. Identification

GHS product identifier	: Silane
Chemical name	: silane
Other means of identification	: Silicon tetrahydride; Silicane; Monosilane; silicon hydride; Tetrahydru de silicium; Silicomethane
Product type	: Gas.
Product use	: Synthetic/Analytical chemistry.
Synonym	: Silicon tetrahydride; Silicane; Monosilane; silicon hydride; Tetrahydru de silicium; Silicomethane
SDS #	: 001073
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Compressed gas PYROPHORIC GASES - Category 1 ACUTE TOXICITY (inhalation) - Category 4

GHS label elements

Hazard pictograms



Signal word

: Danger

Hazard statements

: Extremely flammable gas.
Catches fire spontaneously if exposed to air.
Contains gas under pressure; may explode if heated.
Harmful if inhaled.
May displace oxygen and cause rapid suffocation.
May form explosive mixtures with air.

Precautionary statements

General

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Approach suspected leak area with caution.

Prevention

: Wear protective gloves. Wear protective clothing. Wear eye or face protection. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only outdoors or in a well-ventilated area. Avoid breathing gas.

Response

: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. In case of leakage, eliminate all ignition sources. IF INHALED: Call a POISON CENTER or doctor if you feel unwell. IF ON SKIN: Immerse in cool water or wrap in wet bandages.

Storage

: Protect from sunlight. Store in a well-ventilated place.

Section 2. Hazards identification

- Disposal** : Not applicable.
- Hazards not otherwise classified** : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : silane
- Other means of identification** : Silicon tetrahydride; Silicane; Monosilane; silicon hydride; Tetrahydrure de silicium; Silicomethane
- Product code** : 001073

CAS number/other identifiers

- CAS number** : 7803-62-5

Ingredient name	%	CAS number
silane	100	7803-62-5

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Inhalation** : Harmful if inhaled.
- Skin contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.

Section 4. First aid measures

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use dry chemical powder.
- Unsuitable extinguishing media** : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. Runoff to sewer may create fire or explosion hazard. Catches fire spontaneously if exposed to air. May re-ignite itself after fire is extinguished. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
metal oxide/oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Section 6. Accidental release measures

- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
- Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. This product should be handled using appropriate techniques that avoid exposure to atmospheric oxygen and moisture.
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep under an inert atmosphere. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
silane	ACGIH TLV (United States, 3/2019). TWA: 6.6 mg/m ³ 8 hours. TWA: 5 ppm 8 hours. NIOSH REL (United States, 10/2016). TWA: 7 mg/m ³ 10 hours. TWA: 5 ppm 10 hours. OSHA PEL 1989 (United States, 3/1989). TWA: 7 mg/m ³ 8 hours. TWA: 5 ppm 8 hours.

- Appropriate engineering controls** : Use only with adequate ventilation. Engineering controls may be required to control the primary or secondary risks associated with this product. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Section 8. Exposure controls/personal protection

Individual protection measures

- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
- Eye/face protection** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.
- Skin protection**
- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Gas. [COLORLESS GAS WITH A REPULSIVE ODOR]
- Color** : Colorless.
- Odor** : Characteristic.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -185°C (-301°F)
- Boiling point** : -112°C (-169.6°F)
- Critical temperature** : -3.4°C (25.9°F)
- Flash point** : Not available.
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Lower: 1%
Upper: 96%
- Vapor pressure** : Not available.
- Vapor density** : 1.3 (Air = 1)
- Specific Volume (ft³/lb)** : 11.1235
- Gas Density (lb/ft³)** : 0.0899
- Relative density** : Not applicable.
- Solubility** : Not available.
- Solubility in water** : Not available.

Section 9. Physical and chemical properties

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 32.12 g/mole

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow contact with air.

Incompatible materials : Reactive or incompatible with the following materials:
air
Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
silane	LC50 Inhalation Gas.	Rat	19000 ppm	1 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Section 11. Toxicological information

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation : Harmful if inhaled.
Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Inhalation (gases)	9500 ppm

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN2203	UN2203	UN2203	UN2203	UN2203
UN proper shipping name	SILANE	SILANE, COMPRESSED	SILANE	SILANE	SILANE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

Additional information

Section 14. Transport information

- TDG Classification** : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 25
Passenger Carrying Vessel Index Forbidden
Passenger Carrying Road or Rail Index Forbidden
Special provisions 38
- IATA** : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: Forbidden.
- Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

- U.S. Federal regulations** : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
Clean Air Act (CAA) 112 regulated flammable substances: silane
- Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)** : Not listed
- Clean Air Act Section 602 Class I Substances** : Not listed
- Clean Air Act Section 602 Class II Substances** : Not listed
- DEA List I Chemicals (Precursor Chemicals)** : Not listed
- DEA List II Chemicals (Essential Chemicals)** : Not listed
- SARA 302/304**
Composition/information on ingredients
 No products were found.
- SARA 304 RQ** : Not applicable.
- SARA 311/312**
Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

- Massachusetts** : This material is listed.
- New York** : This material is not listed.
- New Jersey** : This material is listed.
- Pennsylvania** : This material is listed.
- California Prop. 65**

This product does not require a Safe Harbor warning under California Prop. 65.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Section 15. Regulatory information

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia	: This material is listed or exempted.
Canada	: This material is listed or exempted.
China	: This material is listed or exempted.
Europe	: This material is listed or exempted.
Japan	: Japan inventory (ENCS) : This material is listed or exempted. Japan inventory (ISHL) : Not determined.
New Zealand	: This material is listed or exempted.
Philippines	: This material is listed or exempted.
Republic of Korea	: This material is listed or exempted.
Taiwan	: This material is listed or exempted.
Thailand	: Not determined.
Turkey	: Not determined.
United States	: This material is active or exempted.
Viet Nam	: This material is listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		4
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Section 16. Other information

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Compressed gas	Expert judgment
PYROPHORIC LIQUIDS - Category 1	Expert judgment
ACUTE TOXICITY (inhalation) - Category 4	On basis of test data

History

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Version : 1.01

Key to abbreviations : ATE = Acute Toxicity Estimate
 BCF = Bioconcentration Factor
 GHS = Globally Harmonized System of Classification and Labelling of Chemicals
 IATA = International Air Transport Association
 IBC = Intermediate Bulk Container
 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)
 UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.



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SAFETY DATA SHEET

Phone 360.733.7478 www.cescosolutions.com
Toll Free 800.241.9110 2227 Midway Lane
Fax 360.733.7479 Bellingham WA 98226

CESCO ISOPROPYL ALCOHOL 70%

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

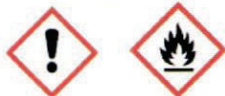
PRODUCT NAME : CESCO ISOPROPYL ALCOHOL 70%
PRODUCT USE : Heavy-duty cleaner
PRODUCT DESCRIPTION : Thin liquid with alcohol odor.
WHMIS CLASSIFICATION: Class B, Division 2

MANUFACTURER : CESCO SOLUTIONS, INC.
ADDRESS : 2227 Midway Lane, Bellingham, WA 98226

EMERGENCY PHONE : 1-800-424-9300
INFORMATION PHONE : (360) 733-7478

2. HAZARDS IDENTIFICATION

SIGNAL WORD: DANGER



HAZARD STATEMENTS: H225 - Highly flammable liquid and vapor
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation

POTENTIAL HEALTH EFFECTS

EYES:

Moderate to severe eye irritant.

SKIN:

Mild to moderate skin irritant. May cause some dryness of skin with repeated contact. Defatting of skin will occur with prolonged or repeated contact.

INGESTION:

Ingestion may cause irritation, nausea and diarrhea. Harmful if swallowed.

INHALATION:

Inhalation can cause nose, throat and respiratory tract irritation and coughing.

MEDICAL CONDITIONS AGGRAVATED:

N/AV

CHRONIC (CANCER) INFORMATION:

N/AV

TERATOLOGY (BIRTH DEFECT) INFORMATION:

N/AV

REPRODUCTION INFORMATION:

N/AV

3. COMPOSITION / INFORMATION ON INGREDIENTS

Component/Exposure Limits	CAS#	WT%
Isopropanol	67-63-0	68 - 72%

4. FIRST AID MEASURES

EYES:

Wash eyes immediately with plenty of running water for 15-20 minutes, or until no evidence of chemical remains, including under eyelids. Remove any contact lenses at once. Speed in beginning the eye wash is essential if permanent injury is to be avoided. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN:

Flush contaminated skin with water for 15 minutes, or until no evidence of chemical remains. Remove contaminated clothing under the shower immediately. Prolong washing in serious cases until doctor arrives. GET MEDICAL CARE FOR EVIDENCE OF BURNING.

INGESTION:

Do not induce vomiting. Drink a large glass of water. Treat symptomatically and supportively. GET MEDICAL ATTENTION IMMEDIATELY. CAUTION: IF UNCONSCIOUS OR HAVING TROUBLE BREATHING OR IN CONVULSIONS, DO NOT INDUCE VOMITING OR GIVE WATER.

INHALATION:

Remove from exposure to mist. If breathing has stopped, provide artificial respiration. Keep the person warm and at rest. OBTAIN IMMEDIATE MEDICAL ATTENTION.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT: 54 F Method: PMCC
FLAMMABLE LIMITS: Lower: 0.7% Upper: 6.1%
AUTOIGNITION TEMPERATURE: 399 C

HAZARDOUS COMBUSTION PRODUCTS:

N/AV

EXTINGUISHING MEDIA:

Dry chemical, carbon dioxide or foam.

FIREFIGHTING INSTRUCTIONS:

DO NOT USE WATER. SCBA recommended: smother to exclude air. Do not use water: handle as an oil fire class B fire procedures. Firefighters should wear self-contained breathing apparatus.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Flammable liquid. Keep away from heat, sparks and open flame. Guard against spontaneous combustion of improperly discarded oily rags. Drums heated by fire can explode.

SENSITIVE TO STATIC DISCHARGE:

N/AV

SENSITIVE TO IMPACT

N/AV

6. ACCIDENTAL RELEASE MEASURES

Shut-off ignition sources. Do not touch spilled material. Stop leak if you can without risk. Use water spray to reduce vapors.

For SMALL SPILLS cover with sand or other absorbent material. With a clean shovel place all spilled material, contaminated soil and other contaminated material into a clean, dry container and cover for later disposal. Move containers from spill area. For LARGER SPILLS, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. Soak up with sand or other non-combustible absorbent. Application of vapor suppression foams may be appropriate. Under some conditions of use, application of clay or cellulose based absorbent on spills may result in generation of flammable vapors since there is a heat of absorption and high surface area. If temperature is above flash point, cover with vapor suppression foam unit until it can be cleaned up.

7. HANDLING AND STORAGE

Usual precautions for flammable or combustible materials. Avoid contact with incompatible chemicals listed in Section 10.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:

Provide natural or mechanical ventilation to minimize exposure, especially where possibility of mist formation exists. If practical, use local mechanical exhaust ventilation at sources of air contamination such as open process equipment. Consult NFPA Standard 91 for design exhaust systems. Ventilation equipment must be explosion proof.

RESPIRATORY PROTECTION:

None needed for normal operating conditions. If vapor concentration becomes high, use self-contained air mask (NIOSH approved).

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SKIN PROTECTION:

Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated contact with this substance.

EYE PROTECTION:

Employee must wear splash proof and dust-resistant safety goggles or face-shield to prevent eye contact with this substance. DO NOT WEAR CONTACT LENSES.

PROTECTIVE GLOVES:

Employee must wear appropriate neoprene, PVC or butyl protective gloves to prevent contact with this substance.

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: 180 F
APPEARANCE & ODOR: Thin liquid with alcohol odor.
VAPOR DENSITY: N/AV
VAPOR PRESSURE: N/AV
SPECIFIC GRAVITY: 0.88
pH: N/A
SOLUBILITY IN WATER: Limited.
VOC: N/AV

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY (CONDITIONS TO AVOID):

May be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back.
Container may explode in heat or fire. Vapor explosion hazard indoors, outdoors or in sewers. Run-off to sewer may create a fire or explosion hazard.

INCOMPATIBILITY:

Strong oxidizers, acids and alkalies.

HAZARDOUS DECOMPOSITION PRODUCTS:

Thermal decomposition products expected to produce carbon monoxide, carbon dioxide and smoke.

HAZARDOUS POLYMERIZATION:

Has not been reported to occur.

11. TOXICOLOGICAL INFORMATION

CHRONIC/CARCINOGENICITY:

N/AV

TERATOLOGY:

N/AV

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REPRODUCTION:

N/AV

MUTAGENICITY:

N/AV

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Product is toxic to aquatic life with lasting effects.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD:

Spilled material should be solidified with sand, soil or other absorbent material so that no free liquid remains before disposal. Incineration and/or disposal in chemical land-fill. Disposal must comply with all federal, state and local disposal and discharge laws.

RCRA (RESOURCE CONSERVATION & RECOVERY ACT) REQUIREMENTS:

Not a hazardous waste.

CLEAN WATER ACT REQUIREMENTS:

No information.

14. TRANSPORT INFORMATION

DOT CLASSIFICATION (USA):

UN 1219, Isopropanol, Class 3, PG II

TDG REGULATIONS (CANADA):

UN 1219, Isopropanol, Class 3, PG II

15. REGULATORY INFORMATION:

U.S. FEDERAL REGULATIONS:

SARA TITLE III (SUPERFUND AMENDMENTS & REAUTHORIZATION ACT):

302/304 EXTREMELY HAZARDOUS SUBSTANCES:

The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III, Section 302 requires notification of the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) of the presence of Extremely Hazardous Substances (EHS), 40 CFR 355 Appendix A, in amounts in excess of the threshold planning quantity (TPQ). Section 304 requires notification of SERC and LEPC of releases involving a RQ of an EHS or CERCLA Hazardous Substance. Extremely Hazardous Substances contained in this product are:

*****NONE*****

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311/312 HAZARD CATEGORIES:

This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories: A Fire Hazard.

313 REPORTABLE INGREDIENTS:

The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III, requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all SDS's that are copied or distributed for this material. Refer to Section 3, HAZARDOUS INGREDIENTS/SARA III INFORMATION, the components that are subject to reporting are designated by an asterisk (*).

TSCA (TOXIC SUBSTANCE CONTROL ACT) STATUS:

N/AV

RCRA (RESOURCE CONSERVATION & RECOVERY ACT) REQUIREMENTS:

N/AV

INTERNATIONAL REGULATIONS:

CANADIAN WHMIS:

N/AV

STATE REGULATIONS:

16. OTHER INFORMATION

NFPA RATINGS:

HEALTH (H): 2 FIRE (2): 3 REACTIVITY (R): 0

HMIS CODES:

HEALTH (H): 2 FIRE (F): 3 PHYSICAL HAZARD (P): 0

SDS REVISION DATE: March 31, 2020

NAME OF PREPARER: Environmental, Health & Safety Department.

CONTACT PHONE NUMBER: (360) 733-7478

MANUFACTURER DISCLAIMER:

IMPORTANT: The information and data herein is based on available data. Buyer assumes all risk of use, storage and handling of this product in compliance with applicable laws and regulations. CESCO SOLUTIONS, INC., MAKES NO WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED, AND WILL NOT BE LIABLE FOR CLAIMS, RELATING TO THE ACCURACY OF THIS DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

Shanghai Huitian New Material Co.,Ltd

Material Safety Data Sheet

No.251 wenji Rd,Songjiang District of Shanghai
Telephone:86-21-57743399 Fax: 86-21-37740088

Part B

Two-component Silicone Potting 5299W-S(PART B information is below)

1. IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

- 1.1 Product Name: Two-component Silicone Potting 5299W-S (PART B information is below)
- 1.2 Chemical Classification: Silicone
- 1.3 Dangerous Goods Classification: Not applicable.
- 1.4 Company Details:
 Manufacturer/Supplier: Shanghai Huitian New Material Co.,Ltd
 Address: No.251 wenji Rd,Songjiang District of Shanghai
 Telephone Number: (86 21) 57743399
 Fax Number: (86 21) 37740088
 Emergency Telephone Number: (86 21) 57743399
 Contact Person: Technical Services Engineer

2. COMPOSITION / INFORMATION ON INGREDIENTS

- 2.1 Chemical characterization: Mixture
- 2.2 Physical Form: Liquid
- 2.3 Color: Colorless or light yellow transparent liquid
- 2.4 Use: Electrical applications
- | 2.5 Chemical Name | CAS No. | % (w/w) |
|--|-----------|---------|
| Tetraethyl orthosilicate | 78-10-4 | 30-55 |
| γ-Aminopropyltriethoxysilane | 919-30-2 | 20-40 |
| [3-(2,3-Epoxypropoxy)propyl]trimethoxysilane | 2530-83-8 | <10 |
| Dibutyl tin diacetate | 1067-33-0 | 0.1-1 |

3. HAZARDS IDENTIFICATION

3.1 Hazard Information:

Flammable, Irritating to eyes and skin.
Harmful: danger of serious damage to health by prolonged exposure if swallowed. Take precautionary measures against static discharges. Wear suitable protective clothing, gloves and eye/face protection. Use only in well-ventilated areas.

3.2 Route of Exposure:

Skin Contact and Accidental Ingestion.

3.3 Possible Health Effects:

Eyes:

Direct contact may cause temporary redness and discomfort.

Skin:

No significant irritation expected from a single short-term exposure.

Ingestion:

Low ingestion hazard in normal use

4. FIRST AID MEASURES

4.1 Eyes:

Immediately flush with water.

4.2 Skin:

No first aid should be needed.

4.3 Inhalation:

No first aid should be needed.

4.4 Ingestion:

Get medical attention.

4.5 Comments:

Treat symptomatically.

4.6 Note to

physicians:

Treat symptomatically. For further information, the medical practitioners should contact Hui Tian (Shanghai) Co. Ltd.

5. FIRE FIGHTING MEASURES

Flammability:

Combustible.

Flash Point:

>200 °C (Pensky-Martens Closed Cup)

Autoignition temperature:

Not determined.

Lower Flammability Limit:

Not determined.

Upper Flammability Limit:

Not determined.

Hazardous Properties:

None.

Extinguishing Media:

On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO₂), dry chemical or water spray. Water can be used to cool fire exposed containers.

Special Fire Fighting

Self-contained breathing apparatus and protective clothing should be worn in

Procedures and Equipment:

Fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool

Hazardous Combustion Products: Silicon oxides. Carbon oxides and traces of incompletely burned carbon compounds. Silicon dioxide. Formaldehyde.

Unsuitable Extinguishing Media: None established

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Avoid eye contact. Do not take internally.

Environmental Precautions: Do not empty into drains. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth etc.

Methods for Cleaning up: Clean up remaining materials from spill with suitable absorbent. Final cleaning may require use of steam, solvents or detergents. You will need to determine which laws and regulations are applicable.

7. HANDLING AND STORAGE

Handling Precautions: Product evolves ethyl alcohol on exposure to water or humid air. Keep container closed. Wash after handling.

Storage Conditions: Keep container closed and away from heat, sparks, flame, water or moisture.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Eyes: Use chemical worker's goggles.

8.2 Hand: Use chemical protective gloves.

8.3 Hygiene Measures: Wash after handling.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form	Liquid
Odor	Slight odor
PH	Not determined
Flash Point	50°C (Closed Cup)
Melting Point	Not determined
Molecular Weight	Not determined
Oxidizing properties	No
Density	0.96

10. STABILITY AND REACTIVITY



- 10.1 Stability: Stable.
- 10.2 Reactivity: Can react with strong oxidizing agents.
Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

- 11.1 Carcinogenic Effects: None known.
- 11.2 Possible Health Effects: Refer to section 3.3.

12. ECOLOGICAL INFORMATION

This product hydrolyses in water or wet soil, releasing alcohols. Harmful to aquatic organisms and may cause long-term adverse effects in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Dispose of in accordance with local regulations.

14. TRANSPORT INFORMATION

UN No.: 1993
Class: 3

15. REGULATORY INFORMATION

Provisions of the Regulations for the Safe Handling of Chemicals in the Workplace, particularly those relating to the safe use, production, storage and transportation of dangerous chemicals.

The Regulations for Safe Management of Dangerous Chemicals (promulgated by the PRC Government on 1-2-2002).

Code of Practice for Safe Management of Dangerous chemicals (Ministry of Labor, No .667-1992)

16. OTHER INFORMATION

This information is not a product specification. Each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

F·RST® EVA Film For Encapsulating Solar Cells**Material Safety Data Sheet**Revision Date: 20-Jun-17
Supersedes Form Dated: 4/July/07

PRODUCT NAMES: F806S, F406P, F806P, F406PS, F806PS, SU406, SU806

Section 1 – Chemical Product and Manufacturer Identification**CHEMICAL PRODUCT**

CHEMICAL NAME: Ethylene/Vinyl Acetate Copolymer
CHEMICAL FAMILY: Functionalized Polyolefin
FORMULA: Copolymer resin (mixture)
MOLECULAR WEIGHT: N/A
SYNONYMS: EVA, F·RST® EVA Film
CAS#: N/A
CAS NAME: N/A

MANUFACTURER'S NAME & ADDRESS:

HANGZHOU FIRST APPLIED MATERIAL CO., LTD
 8# Fusite Street Lin'an Hangzhou R.P.China

EMERGENCY NUMBERS:

Phones: 0086-571-63812086

Fax: 0086-571-63710907

<http://www.firstpvm.com>E-mail: sales@firstpvm.com**Section 2 – Composition/Information on Ingredients**

HAZARDOUS COMPONENTS	(%)	OSHA PEL	ACGIH TLV
Ethylene/Vinyl Acetate Copolymer (CAS# 24937-78-8)	>96	N/A	N/A
coagent	<1.5	N/A	N/A
Peroxide	<1.0	N/A	N/A
Ultraviolet absorbent(octabenzene)	<0.5	N/A	N/A
silane coupling agent	<1.0	N/A	N/A

Section 3 – Hazards Summarizing**Hazard classification according to GHS**

Is not a dangerous mixture

OSHA Hazard Communication Standard: This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 4 – First-Aid Measures

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Not determined, though none are expected

EMERGENCY & FIRST AID: If molten polymer contacts bare skin, cool rapidly and secure medical treatment of the thermal burn

SECTION 5 – Fire Fighting Measures**EXTINGUISHING MEDIA:**

Suitable extinguishing media: Water, foam, ABC dry chemicals, CO₂

Unsuitable extinguishing media: NO.

SPECIAL FIRE FIGHTING PROCEDURES: Protect against inhalation of combustion products. Self Contained Breathing Apparatus (SCBA) and protective clothing should be worn in fighting fires involving chemicals.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Acid, heat or various contaminants particularly oxidizing, reducing agents and metal salts can cause decomposition.

SECTION 6 – Accidental Release Measures

EMERGENCY TREATMENT: N/A

SECTION 7 – Precautions for Safe Handling and Storage

Precautions for handling: Handling is performed in a well ventilated place.

Wash your hands after using, ban on eating in the workplace

Precautions for STORAGE: Store in 0~30°C, less than 60% humidity. Keep containers closed to prevent contamination.

SECTION 8 – Exposure Controls/Personal Protection

RESPIRATORY EQUIPMENT: Not normally required

VENTILATION: Local ventilation must be used over processing equipment to remove dust/fumes away from workers

PROTECTIVE GLOVES: Gloves and long sleeve shirts are recommended particularly when handling hot polymer

EYE PROTECTION: Eye protection is recommended as good industrial hygiene practice

SECTION 9 – Physical & Chemical Characteristics

BOILING POINT:	not distillable	SPECIFIC GRAVITY: (H ₂ O = 1)	0.92 – 0.97
VAPOR PRESSURE: (mm Hg)	N/A	MELTING POINT:	40-80
SOLUBILITY IN WATER	insoluble	EVAPORATION RATE: (BUTYL ACETATE = 1)	N/A
VAPOR DENSITY: (Air = 1)	N/A	APPEARANCE & ODOR:	Clear film or sheet with mild ester odor.

SECTION 10 – Stability and Reactivity**STABILITY:** Stable**HAZARDOUS POLYMERIZATION:** Will not occur**CONDITIONS TO AVOID:** Open flames, ignition sources**INCOMPATIBILITY:** Avoid strong acids, strong oxidizing agents and alkalis.**HAZARDOUS DECOMPOSITION OF PRODUCTS:** Fumes evolved include carbon monoxide and carbon dioxide, methane, ethane, ethylene, acetone and t-butyl alcohol.**SECTION 11 – Toxicological Information****INGESTION:** No data.**SKIN:** No data.**INHALATION:** N/A**CARCINOGENICITY:** Not applicable**SIGNS & SYMPTOMS OF EXPOSURE:** Not determined, though none are expected**SECTION 12 – Ecological Information****ECO-TOXICOLOGICAL TOXICITY:** Not applicable**BIODEGRADABILITY:** Degradable**NON-BIODEGRADABLE:** Burning**BIOCONCENTRATION OR BIOACCUMULATION:** Not accumulation**OTHER HARMFUL EFFECTS:** Not applicable**SECTION 13 – Disposal****NATURE OF WASTE:** Organic compound**WASTE DISPOSAL METHOD:** Landfill or incinerate in compliance with country and Local regulations**WASTE NOTE:** N/A**SECTION 14 – Transport Information****DANGEROUS GOODS CODE:** Not available**UN NUMBER:** Not available**PACKAGING LOGO:** F • RST EVA FILM**PACKAGING CATEGORY:** Not available**PACKING METHOD:** Not available.**TRANSPORT NOTES:** The temperature must be kept below 30°C at transportation. Transportation should prevent bask in, prevent the rain, and avoid strong oxidizer, alkali, acid chemicals.

SECTION 15– Regulatory Information**DOMESTIC REGULATIONS ON CHEMICAL SAFETY:**

"Chemical Safety Management of Dangerous Goods Ordinance" (February 16, 2011 issued by the State Council);

INTERNATIONAL REGULATIONS: "Globally Harmonized System of Classification and Labelling of Chemicals"; "Occupational Safety and Health Act"; "management of the Federal Hazardous Substances Act"; "Toxic Substances Control Act"; "Transport of Dangerous Goods Act".

SECTION 16 – Other Information

REFERENCES: Not available

THE TIME TO FILL IN A FORM: 20/Nov/2017

DEPARTMENT OF FILL IN THE FORM: R&D department

MODIFY NOTE: Not available

FOR ADDITIONAL INFORMATION: Not available



Material Safety Data Sheet Toluene, ACS

Section 1 - Chemical Product and Company Identification

MSDS Name:

Toluene, ACS

Catalog Numbers:

LC26170

Synonyms:

Toluol, methylbenzene, phenylmethane

Company Identification:

LabChem Inc
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
108-88-3	Toluene	100

Section 3 - Hazards Identification

Emergency Overview

Appearance: *Clear, colorless solution*

Warning! Flammable liquid and vapor. May cause central nervous system depression. Aspiration hazard if swallowed; can enter lungs and cause damage. May be absorbed through intact skin. May cause liver and kidney damage. Possible risk of harm to the unborn child. Causes eye, skin, and respiratory tract irritation. Breathing vapors may cause drowsiness and dizziness.

Target Organs: *Kidneys, central nervous system, liver, respiratory system, eyes, skin.*

Potential Health Effects

Eye:

Contact or exposure to vapors causes eye irritation.

Skin:

Skin contact causes irritation. Repeated or prolonged exposure may cause drying and cracking of the skin, defatting, and dermatitis. May be absorbed through the skin.

Ingestion:

Ingestion may cause central nervous system depression, nausea, vomiting, diarrhea, headache, dizziness, weakness, impaired coordination, transient memory loss, and impaired reaction time. If material is aspirated into the lungs, chemical pneumonitis may result, which can be fatal.



Material Safety Data Sheet Toluene, ACS

Inhalation:

Causes respiratory tract irritation. Inhalation of concentrations greater than 200ppm causes CNS encephalopathy, fatigue, depression, weakness, confusion, headache, nausea, transient memory loss and impaired coordination. 800ppm causes rapid irritation of nasal and mucous membranes, metallic taste, impaired balance. Extreme inhalation may cause death by paralysis of the respiratory center.

Chronic:

Repeated exposure in combination with constant, loud noise may cause hearing loss and dizziness. Chronic hydrocarbon abuse has been linked to irregular heart rhythms and potential cardiac arrest. Toluene abuse has been linked to kidney disease, blood, protein, and pus in the urine, elevated serum creatine, decreased urinary output, and metabolic and tubular acidosis. Repeated inhalation may cause irreversible encephalopathy with cerebellar ataxia, unsteadiness, hallucinations, coma, blood disorders. Toluene does not cause the severe injury to bone marrow that is characteristic of benzene poisoning.

Section 4 - First Aid Measures

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids until no evidence of chemical remains. Get medical aid at once.

Skin:

Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid. Wash contaminated clothing before reuse.

Ingestion:

Extreme care must be taken to prevent aspiration. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs naturally, keep head below hips. Get medical aid at once.

Inhalation:

Move victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid at once.

Notes to Physician:

Causes cardiac sensitization to endogenous catecholamines, which may lead to cardiac arrhythmias. Do NOT use adrenergic agents such as epinephrine or pseudoepinephrine.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Flammable liquid and vapor. Cool containers with water spray until well after fire is out. Toluene is lighter than water, and solid streams of water may spread fire. May accumulate static electricity. Vapors are heavier than air and may accumulate in low-lying areas or travel to a source of ignition and flash back. Water runoff can cause environmental damage. If possible, dike and collect water used to fight fire.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, appropriate foam, or water spray. Solid streams of water may be ineffective and spread material.

Autoignition Temperature:

480°C (896°F)

Flash Point:

4°C (39°F)



Material Safety Data Sheet Toluene, ACS

NFPA Rating:

CAS# 108-88-3: Health-2; Flammability-3; Instability-0

Explosion Limits:

Lower: 1.1 Upper: 7.1

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb liquid with inert material (vermiculite, sand, earth), and place in a suitable container labeled as flammables for disposal. Reduce vapor and fire hazard with appropriate foam or water spray. Provide ventilation. Use only non-sparking tools and equipment. Control runoff and isolate discharged material.

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor, mist, or gas. Empty containers retain product residue and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage:

Keep away from sources of ignition. Store tightly closed in a cool, dry, well-ventilated area away from incompatible materials. Separate from oxidizing materials. Bonding and grounding should be in accordance with NFPA 77, Recommended practice on static electricity.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities storing or using this material should be equipped with an eyewash facility and a safety shower. Provide local exhaust or general dilution ventilation to keep airborne concentrations below the permissible exposure limits. Ventilation fans and other electrical service must be non-sparking and have an explosion-proof design.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Toluene	20 ppm TWA	100 ppm TWA 375 mg/m ³ TWA 500 ppm IDLH	200 ppm TWA 300 ppm Ceiling

OSHA Vacated PELs:

Toluene: 100 ppm TWA; 375 mg/m³ TWA



Material Safety Data Sheet Toluene, ACS

Personal Protective Equipment

Eyes:

Do not wear contact lenses when working with chemicals. An eye wash fountain should be available in the immediate work area. Wear splash-proof safety goggles.

Skin:

Wear nitrile or other toluene gloves to prevent skin exposure. Do not wear latex gloves.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State:	Clear liquid
Color:	Colorless
Odor:	Aromatic odor
pH:	Not available
Vapor Pressure:	28.4 mm Hg @ 25°C
Vapor Density:	3.1 (Air = 1)
Evaporation Rate:	2.4 (Butyl acetate = 1)
Viscosity:	0.59 cPs @ 20°C
Boiling Point:	111°C (232°F)
Freezing/Melting Point:	-95°C (-139°F)
Decomposition Temperature:	Not available
Solubility in water:	Insoluble.
Specific Gravity/Density:	0.867
Molecular Formula:	C ₆ H ₅ CH ₃
Molecular Weight:	92.14

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Ignition sources, excess heat, confined spaces.

Incompatibilities with Other Materials:

Nitric acid, sulfuric acid, strong oxidizing agents.

Hazardous Decomposition Products:

Carbon monoxide, carbon dioxide.

Hazardous Polymerization:

Has not been reported

Section 11 - Toxicological Information

RTECS:

CAS# 108-88-3: XS5250000.



Material Safety Data Sheet Toluene, ACS

LD50/LC50:

CAS# 108-88-3:

Inhalation, mouse: LC50 = 400 ppm/24H

Inhalation, rat: LC50 = 49 g/m³/4H

Oral, rat: LD50 = 636 mg/kg

Skin, rabbit: LD50 = 14100 uL/kg.

Carcinogenicity:

CAS# 108-88-3: IARC: Group 3 (Not classifiable)

Epidemiology:

Moderately toxic by inhalation, ingestion, slightly toxic by dermal absorption. Target effects: central nervous system depressant, neurotoxin. Poisoning may affect heart, liver, kidneys, blood.

Teratogenicity:

Children with microcephaly, minor craniofacial and limb anomalies, central nervous system defects, attention disorders, developmental delay, learning disorders, and language deficits were born to mothers who abuse toluene by inhalation during pregnancy.

Reproductive:

No information found.

Mutagenicity:

No information found.

Neurotoxicity:

Neurological changes and memory loss have been reported among people who experienced toluene intoxication.

Section 12 - Ecological Information

No information found.

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Toluene

Hazard Class: 3

UN Number: UN1294

Packing Group: PG II

Section 15 - Regulatory Information

US Federal

TSCA:

CAS# 108-88-3 is listed on the TSCA Inventory.

SARA Reportable Quantities (RQ):

CAS# 108-88-3: final RQ = 1000 pounds (454 kg)



Material Safety Data Sheet Toluene, ACS

CERCLA/SARA Section 313:

This material contains Toluene (CAS# 108-88-3, 100%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

OSHA - Highly Hazardous:

None of the components are on this list.

US State

State Right to Know:

Toluene can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California Regulations:

WARNING: This product contains Toluene, a chemical known to the state of California to cause developmental reproductive toxicity.

European/International Regulations

Canadian DSL/NDSL:

CAS# 108-88-3 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 108-88-3 is listed on Canada's Ingredient Disclosure List.

Section 16 - Other Information

MSDS Creation Date: November 30, 1998

Revision Date: September 8, 2009

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.

TONSAN™1521 White Potting Materials
 for PV Junction Box (Part A)
 839158PM

Print Date: 12-15-2015

SAFETY DATA SHEET

REVISION DATE: 12-15-2015

SUPERSEDES: 12-07-2015

SECTION 1: IDENTIFICATION OF THE PRODUCT AND SUPPLIER

PRODUCT INFORMATION

PRODUCT: TONSAN™1521 White Potting Materials for PV Junction Box (Part A)
PRODUCT DESCRIPTION: Adhesive
INTENDED USE: Adhesive
PRODUCT IDENTIFIER: 839158PM

COMPANY INFORMATION

H.B. Fuller Company
 1200 Willow Lake Boulevard
 Vadnais Heights, MN 55110
 Telephone: 1-888-423-8553

Medical Emergency Phone Number (24 Hours): 1-888-853-1758
 Transport Emergency Phone Number (CHEMTREC): 1-800-424-9300

SECTION 2: HAZARDS IDENTIFICATION

GHS Hazard Symbols:



GHS Signal Word: Warning
GHS Classification: Reproductive Toxicity Category 2
GHS Hazard Phrases: Suspected of damaging fertility or the unborn child.
GHS Precautions:
Safety Precautions: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required.
First Aid Measures: IF exposed or concerned: Get medical advice/attention.
Storage: Store locked up.
Disposal: Dispose of contents/container in accordance with local/regional/national/international regulation for hazardous wastes.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS #	PERCENT	Classification	Note
Siloxanes & silicones	Proprietary	50 - 70		
Aluminum oxide	1344-28-1	10 - 30		* (see below)
Calcium carbonate	471-34-1	10 - 30		* (see below)



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Titanium dioxide	13463-67-7	1 - 5	Carc. 2; H351	*(see below)
Ethylhexoic acid, 2	149-57-5	0.1 - 1	Acute Tox. 4; H312 Repr. 2; H361	

*This product contains one or more materials that may be hazardous when present as an airborne dust. During normal handling of the product, the material is encapsulated within the product and will not present an exposure risk. Once the product has reached its final state and is abraded or disturbed, dusting and exposure may occur.

Unlisted ingredients are not 'hazardous' per the Occupational Safety and Health Administration Hazard Communication Standard (29 CFR 1910.1200) and/or are not found on the Canadian Workplace Hazardous Materials Information System ingredient disclosure list. See Section 8 for exposure limit guidelines.

SECTION 4: FIRST AID MEASURES

IF IN EYES: Use an eye wash to remove a chemical from your eye regardless of the level of hazard. Flush the affected eye for at least twenty minutes. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Seek medical advice after flushing.

IF ON SKIN: Wash with soap and water. Get medical attention if irritation develops or persists.

IF INHALED: Remove to fresh air. Call a physician if symptoms persist.

IF SWALLOWED: Do not induce vomiting. Seek medical attention if symptoms develop. Provide medical care provider with this MSDS. Induced vomiting may lead to aspiration of the material into the lungs potentially causing chemical pneumonitis that may be fatal.

SECTION 5: FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA:	Use water spray, foam, dry chemical or carbon dioxide.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	Vapors are heavier than air and can travel to a source of ignition and flash back.
SPECIAL FIRE FIGHTING INSTRUCTIONS:	Persons exposed to products of combustion should wear self-contained breathing apparatus and full protective equipment.
HAZARDOUS COMBUSTION PRODUCTS:	Carbon dioxide, Carbon monoxide Aluminum oxide

SECTION 6: ACCIDENTAL RELEASE MEASURES

SPECIAL PROTECTION:	No adverse health effects expected from the clean-up of spilled material. Follow personal protective equipment recommendations found in Section 8 of this SDS. Evaporation of volatile substances can lead to the displacement of air creating an environment that can cause asphyxiation.
METHODS FOR CLEAN-UP:	Dike if necessary, contain spill with inert absorbent and transfer to containers for disposal. Keep spilled product out of sewers, watersheds, or water systems. Shut off ignition sources; including electrical equipment and flames. Do not allow smoking in the area.

Transport Emergency Phone Number (CHEMTREC): 1-800-424-9300

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SECTION 7: HANDLING AND STORAGE

Handling: No special handling instructions due to toxicity. This product contains an ingredient that may release formaldehyde at heated cure temperatures.

Storage: Store in a cool, dry, ventilated location. Keep away from heat, sparks, flame and other sources of ignition. Keep container closed.

Consult the Technical Data Sheet for specific storage instructions.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:

Chemical Name	Note	ACGIH EXPOSURE LIMITS	OSHA PEL
Aluminum oxide	* (see below)	No data available.	15 mg/m ³ TWA (total dust); 5 mg/m ³ TWA (respirable fraction)
Calcium carbonate	* (see below)	No data available.	15 mg/m ³ TWA (total dust); 5 mg/m ³ TWA (respirable fraction)
Titanium dioxide	* (see below)	10 mg/m ³ TWA	15 mg/m ³ TWA (total dust)
Ethylhexoic acid, 2		5 mg/m ³ TWA (inhalable fraction and vapor)	Not established

*This product contains one or more materials that may be hazardous when present as an airborne dust. During normal handling of the product, the material is encapsulated within the product and will not present an exposure risk. Once the product has reached its final state and is abraded or disturbed, dusting and exposure may occur.

ENGINEERING CONTROL METHODS:

VENTILATION: Use local exhaust ventilation or other engineering controls to minimize exposures.

EYE PROTECTION: Wear safety glasses when handling this product.

SKIN PROTECTION: Not normally required. Wear chemically resistant gloves to prevent prolonged or repeated contact.

GLOVES: Not normally required. Use nitrile gloves if conditions warrant.

RESPIRATORY PROTECTION: Respiratory protection may be required to avoid overexposure when handling this product. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms. Respirators should be selected by and used following requirements found in OSHA's respirator standard (29 CFR 1910.134).

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: Liquid

COLOR: White

ODOR: Neutral

ODOR THRESHOLD: Not established

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pH:	Not established
FREEZING/MELTING POINT (deg. C):	Not established
BOILING POINT (deg. C):	Not established
FLASH POINT:	-3°C; 27°F
EVAPORATION RATE:	Not established
FLAMMABILITY:	Not a flammable solid or gas
UPPER EXPLOSIVE LIMIT (% in air):	Not established
LOWER EXPLOSIVE LIMIT (% in air):	Not established
VAPOR PRESSURE (mm Hg):	Not established
VAPOR DENSITY:	Not established
WEIGHT PER GALLON (lbs.):	12.27
SPECIFIC GRAVITY:	1.470
SOLUBILITY:	Not established
OCTANOL/WATER COEFFICIENT:	Not established
AUTOIGNITION TEMPERATURE:	Not established
DECOMPOSITION TEMPERATURE:	Not established
VISCOSITY:	No data available.
SOLIDS (% by weight):	100.0
VOC, weight percent	Not determined

SECTION 10: STABILITY AND REACTIVITY

STABILITY:	Stable under normal conditions.
CHEMICAL INCOMPATIBILITY:	Not established
HAZARDOUS POLYMERIZATION:	Will not occur.
HAZARDOUS DECOMPOSITION PRODUCTS:	Aluminum oxide Carbon monoxide, carbon dioxide

SECTION 11: TOXICOLOGICAL INFORMATION

Component Toxicity / Toxicology Data:

COMPONENT NAME	LD50/LC50
Siloxanes & silicones dimethyl, hydroxy-terminated	INHALATION LC50-7H Rat > 8,750.00 MG/M3

This product is a mixture. Unless noted, the information below is based on components.

Skin corrosion / irritation: Can cause minor skin irritation, defatting, and dermatitis.

Serious eye damage / irritation :Can cause minor irritation, tearing and reddening.

Respiratory / skin sensitization: No data available.

Germ cell mutagenicity: No data available.

Carcinogenicity: Contains a material that is suspected of causing cancer.

Reproductive toxicity: Contains a substance that is a possible reproductive hazard based on animal studies.

Specific target organ toxicity-single exposure: No data available.

Respiratory irritation / Narcotic effects: No data available.

Specific target organ toxicity-repeated exposure: No data available.

Target organs potentially affected by exposure: Lungs

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Aspiration hazard: Not an aspiration hazard.

Medical Conditions Aggravated by Exposure: Lung disease

SECTION 12: ECOLOGICAL INFORMATION

OVERVIEW: No ecological information available for this product.
 MOBILITY: No data available.
 PERSISTENCE: No data available.
 BIOACCUMULATION: No data available.

This product has not been tested for ecological effects. Relevant information for components is listed below:

Component:	Ecotoxicity values:
No data available.	Acute Toxicity (Fish): Acute Toxicity (Daphnia): Acute Toxicity (Algae):

SECTION 13: DISPOSAL CONSIDERATIONS

To the best of our knowledge, this product does not meet the definition of hazardous waste under the U.S. EPA Hazardous Waste Regulations 40 CFR 261. Dispose of in an approved landfill. Consult your state, local or provincial authorities and your local waste vendor for more restrictive requirements.

SECTION 14: TRANSPORT INFORMATION

Consult Bill of Lading for transportation information.

US DOT: NOT REGULATED
 IATA: NOT REGULATED

SECTION 15: REGULATORY INFORMATION

INVENTORY STATUS

U.S. EPA TSCA: This product is in compliance with the Toxic Substances Control Act's Inventory requirements.
 CANADIAN CEPA DSL: The components of this product are included on the DSL or are exempt from DSL requirements.
 EUROPEAN REACH: As a result of the introduction of REACH into Europe, this product cannot be imported into Europe unless the REACH requirements are met.
 AUSTRALIA AICS: This product contains a component that is not on the Australian Inventory (AICS).
 CHINA IECSC INVENTORY: This product is in compliance with the Inventory of Existing Chemical Substances in China (IECSC) requirements.

If you need more information about the inventory status of this product call 651-236-5858.

This product may contain chemical substances that are regulated for export by various government agencies (such as the Environmental Protection Agency, the Bureau of Industry and Security, or the Drug Enforcement



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Administration, among others). Before exporting this product from the USA or Canada, we recommend you contact us at reg.request@hbfuller.com to request an export review.

FEDERAL REPORTING

EPA SARA Title III Section 313

Unless listed below, this product does not contain toxic chemical(s) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40 CFR part 372. EPA has advised that when a percentage range is listed the midpoint may be used to fulfill reporting obligations.

Chemical Name	CAS#	%
	1344-28-1	10 - 30

STATE REPORTING

Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986:

Unless listed below, this product does not contain known levels of any chemical known to the State of California to cause cancer or reproductive harm.

Chemical Name/List	CAS	Percent
Titanium dioxide (Carcinogen)	13463-67-7	1 - 5
2-Ethylhexanoic acid (Developmental toxin)	149-57-5	0.1 - 1

Substances of Very High Concern (SVHC) Content:

Unless listed below, this product does not contain SVHC's at 0.1% or greater, as of the version date of this SDS.

SECTION 16: OTHER INFORMATION

SDS VERSION DATE: 12-15-2015

This Safety Data Sheet is prepared to comply with the United States Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200) and the Canadian Workplace Hazardous Materials Information System (WHMIS).

HMIS RATING: HEALTH -- 0 FLAMMABILITY -- 3 REACTIVITY -- 0

See SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for personal protective equipment recommendations.

Prepared by: The Global Regulatory Department

Phone: 651-236-5842

The information and recommendations set forth herein are believed to be accurate. Because some of the information is derived from information provided to the H.B. Fuller Company from its suppliers, and because the H.B. Fuller Company has no control over the conditions of handling and use, the H.B. Fuller Company makes no warranty, expressed or implied, regarding the accuracy of the data or the results to be obtained from the use thereof. The information is supplied solely for your information and consideration, and the H.B. Fuller Company assumes no responsibility for use or reliance thereon. It is the responsibility of the user of H.B. Fuller Company products to comply with all applicable federal, state and local laws and regulations.

Print Date: 12-07-2015

SAFETY DATA SHEET

REVISION DATE: 12-07-2015

SUPERSEDES: 08-27-2015

SECTION 1: IDENTIFICATION OF THE PRODUCT AND SUPPLIER**PRODUCT INFORMATION**

PRODUCT: TONSAN™1521 Potting Materials for PV Junction Box (Part B)
PRODUCT DESCRIPTION: Adhesive
INTENDED USE: Adhesive
PRODUCT IDENTIFIER: 839159PM

COMPANY INFORMATION

H.B. Fuller Company
1200 Willow Lake Boulevard
Vadnais Heights, MN 55110
Telephone: 888-423-8553

Medical Emergency Phone Number (24 Hours): 1-888-853-1758
Transport Emergency Phone Number (CHEMTREC): 1-800-424-9300

SECTION 2: HAZARDS IDENTIFICATION

**GHS Hazard
Symbols:**



**GHS Signal Word:
GHS Classification:**

Danger
Skin Corrosion/Irritation Category 1B; Serious Eye Damage/Eye Irritation Category 1;
Skin Sensitisation Category 1; Reproductive Toxicity Category 1B; Germ Cell
Mutagenicity Category 2; Hazardous to the aquatic environment - Chronic Category 3;
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

**GHS Hazard
Phrases:**

Causes severe skin burns and eye damage.; May cause an allergic skin reaction.; Causes serious eye damage.; May cause respiratory irritation.; Suspected of causing genetic defects.; May damage fertility or the unborn child.; Harmful to aquatic life with long lasting effects.

**GHS Precautions:
Safety Precautions:**

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapours/spray. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area. Contaminated work clothing should not be allowed out of the workplace. Avoid release to the environment. Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:

IF SWALLOWED: rinse mouth. Do NOT induce vomiting. IF ON SKIN: Wash with plenty of soap and water. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF exposed or concerned: Get medical advice/attention. Immediately call a POISON CENTER or doctor/physician. Call a POISON CENTER or doctor/physician if you feel unwell. If skin irritation or rash occurs: Get medical

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advice/attention. Wash contaminated clothing before reuse.

Storage: Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal: Dispose of contents/container in accordance with local/regional/national/international regulation for hazardous wastes.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS #	PERCENT	Classification	Note
Ethyl silicate	78-10-4	10 - 30	Acute Tox. 4; H332 Eye Irrit. 2; H319 Flam. Liq. 3; H226 STOT SE 3; H335	
Silane	Proprietary	10 - 30	Acute Tox. 4; H302 Skin Corr. 1B; H314	
Silane	Proprietary	1 - 5	Aquatic Chronic 3; H412 Acute Tox. 4; H332 Eye Dam. 1; H318 Skin Sens. 1; H317	
Silane	Proprietary	1 - 5	Eye Dam. 1; H318 Muta. 2; H341	
Tin catalyst	Proprietary	0.1 - 1	Aquatic Acute 1; H400 Aquatic Chronic 1; H410 Acute Tox. 3; H311 Acute Tox. 3; H301 Eye Irrit. 2; H319 Muta. 2; H341 Repr. 1B; H360 Skin Irrit. 2; H315 STOT RE 1; H372	

Unlisted ingredients are not 'hazardous' per the Occupational Safety and Health Administration Hazard Communication Standard (29 CFR 1910.1200) and/or are not found on the Canadian Workplace Hazardous Materials Information System ingredient disclosure list. See Section 8 for exposure limit guidelines.

SECTION 4: FIRST AID MEASURES

IF IN EYES: Immediately flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention and monitor the eye daily as advised by your physician.

IF ON SKIN: Wash with soap and water. Remove contaminated clothing, launder immediately, and discard contaminated leather goods. Get medical attention immediately.

IF INHALED: Remove to fresh air. Call a physician if symptoms persist.

IF SWALLOWED: Severely irritating. Do not induce vomiting. Seek medical attention immediately. Drink 2 glasses of water or milk to dilute. Do not give anything by mouth to an unconscious person. Induced vomiting may lead to aspiration of the material into the lungs potentially causing chemical pneumonitis that may be fatal.

SECTION 5: FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA:

Use water spray, foam, dry chemical or carbon dioxide.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Material will burn in a fire.

SPECIAL FIRE FIGHTING INSTRUCTIONS:

Persons exposed to products of combustion should wear self-contained breathing apparatus and full protective equipment.

HAZARDOUS COMBUSTION PRODUCTS:

Carbon dioxide, Carbon monoxide Nitrogen containing gases

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SAFETY DATA SHEET**SECTION 6: ACCIDENTAL RELEASE MEASURES**

SPECIAL PROTECTION: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this MSDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including: the material spilled, the quantity of the spill, and the area in which the spill occurred. Never exceed any occupational exposure limits.

METHODS FOR CLEAN-UP: Dike if necessary, contain spill with inert absorbent and transfer to containers for disposal. Keep spilled product out of sewers, watersheds, or water systems.

Transport Emergency Phone Number (CHEMTREC): 1-800-424-9300

SECTION 7: HANDLING AND STORAGE

Handling: Avoid contacting and avoid breathing the material. Use only in a well ventilated area.
Keep away from heat, sparks and flame.
Wash thoroughly after handling.
Keep container closed.
Emptied container retains vapor and product residue.
Observe all labeled precautions until container is cleaned.
Drums of this material should be grounded when pouring.
DO NOT CUT OR WELD ON OR NEAR THIS CONTAINER.
This product contains an ingredient that may release formaldehyde at heated cure temperatures.
This product contains an ingredient that may react with water or humidity to release ethanol (64-17-5). The TWA for ethanol is 1000 ppm.
This product contains an ingredient that may react with water or humidity to release methanol (67-56-1). The TWA for methanol is 200 ppm.

Storage: Store in a cool, dry place. This product is a Class 3 flammable liquid and must be stored according to the provisions of AS/NZ 1940.

Consult the Technical Data Sheet for specific storage instructions.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION**EXPOSURE LIMITS:**

Chemical Name	Note	ACGIH EXPOSURE LIMITS	OSHA PEL
Ethyl silicate		10 ppm TWA	100 ppm TWA; 850 mg/m ³ TWA

ENGINEERING CONTROL METHODS:

VENTILATION: Use local exhaust ventilation or other engineering controls to minimize exposures.

EYE PROTECTION: Wear safety glasses with side shields when handling this product.
Wear additional eye protection such as chemical splash goggles

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	and/or face shield when the possibility exists for eye contact with splashing or spraying liquid, or airborne material. Have an eye wash station available.
SKIN PROTECTION:	Prevent contact with this product. Wear chemically resistant gloves, long sleeved shirt, an apron, and other protective equipment depending on conditions of use. Skin absorption may potentially contribute to the overall exposure to this material. Appropriate measures should be taken to prevent absorption so that the TLV is not invalidated.
GLOVES:	Butyl rubber
RESPIRATORY PROTECTION:	Respiratory protection may be required to avoid overexposure when handling this product. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms. NIOSH approved air purifying respirator with organic vapor cartridge and dust/mist filter. Respirators should be selected by and used following requirements found in OSHA's respirator standard (29 CFR 1910.134).

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:	Liquid
COLOR:	Yellow
ODOR:	Ammonia
ODOR THRESHOLD:	Not established
pH:	Not established
FREEZING/MELTING POINT (deg. C):	Not established
BOILING POINT (deg. C):	Not established
FLASH POINT:	Not applicable
EVAPORATION RATE:	Not established
FLAMMABILITY:	Not a flammable solid or gas
UPPER EXPLOSIVE LIMIT (% in air):	Not established
LOWER EXPLOSIVE LIMIT (% in air):	Not established
VAPOR PRESSURE (mm Hg):	Not established
VAPOR DENSITY:	Not established
WEIGHT PER GALLON (lbs.):	8.18
SPECIFIC GRAVITY:	0.980
SOLUBILITY:	Not established
OCTANOL/WATER COEFFICIENT:	Not established
AUTOIGNITION TEMPERATURE:	Not established
DECOMPOSITION TEMPERATURE:	Not established
VISCOSITY:	No data available.
SOLIDS (% by weight):	100.0
VOC, weight percent	Not determined

SECTION 10: STABILITY AND REACTIVITY

STABILITY:	Stable under normal conditions.
CHEMICAL INCOMPATIBILITY:	Water
HAZARDOUS POLYMERIZATION:	Will not occur.
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon monoxide, carbon dioxide Nitrogen containing gases

Print Date: 12-07-2015

SAFETY DATA SHEET**SECTION 11: TOXICOLOGICAL INFORMATION****Component Toxicity / Toxicology Data:**

COMPONENT NAME	LD50/LC50
No data available.	

This product is a mixture. Unless noted, the information below is based on components.

Skin corrosion / irritation: Can cause severe irritation, defatting, and dermatitis. Irritation effects may last for hours or days but are not likely to result in permanent damage.

Serious eye damage / irritation :Can cause severe irritation. Eye contact may result in corneal injury. Symptoms may include discomfort or pain, excessive blinking and tear production, with marked redness and swelling of the conjunctiva. Temporary vision impairment (cloudy or blurred vision) is possible.

Respiratory / skin sensitization: May cause an allergic skin reaction.

Germ cell mutagenicity: Suspected of causing genetic defects.

Carcinogenicity: No data available.

Reproductive toxicity: No data available.

Specific target organ toxicity-single exposure: No data available.

Respiratory irritation / Narcotic effects: May cause respiratory irritation.

Specific target organ toxicity-repeated exposure: No data available.

Target organs potentially affected by exposure: Kidneys Central nervous system Immune system

Aspiration hazard: Not an aspiration hazard.

Medical Conditions Aggravated by Exposure: Kidney disease

SECTION 12: ECOLOGICAL INFORMATION

OVERVIEW:	No ecological information available for this product.
MOBILITY:	No data available.
PERSISTENCE:	No data available.
BIOACCUMULATION:	No data available.

This product has not been tested for ecological effects. Relevant information for components is listed below:

Component:	Ecotoxicity values:
No data available.	Acute Toxicity (Fish): Acute Toxicity (Daphnia): Acute Toxicity (Algae):

SECTION 13: DISPOSAL CONSIDERATIONS

To the best of our knowledge, this product does not meet the definition of hazardous waste under the U.S. EPA Hazardous Waste Regulations 40 CFR 261. Disposal via incineration at an approved facility is recommended as industry best practice. Consult state, local or provincial authorities for more restrictive requirements.

SECTION 14: TRANSPORT INFORMATION

Consult Bill of Lading for transportation information.

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US DOT: UN1292, TETRAETHYL SILICATE SOLUTION, 3, III
IATA: UN1292, TETRAETHYL SILICATE SOLUTION, 3, III

SECTION 15: REGULATORY INFORMATION**INVENTORY STATUS**

U.S. EPA TSCA: This product is in compliance with the Toxic Substances Control Act's Inventory requirements.

CANADIAN CEPA DSL: The components of this product are included on the DSL or are exempt from DSL requirements.

EUROPEAN REACH: As a result of the introduction of REACH into Europe, this product cannot be imported into Europe unless the REACH requirements are met.

AUSTRALIA AICS: This product contains a component that is not on the Australian Inventory (AICS).

CHINA IECSC INVENTORY: This product is in compliance with the Inventory of Existing Chemical Substances in China (IECSC) requirements.

If you need more information about the inventory status of this product call 651-236-5858.

This product may contain chemical substances that are regulated for export by various government agencies (such as the Environmental Protection Agency, the Bureau of Industry and Security, or the Drug Enforcement Administration, among others). Before exporting this product from the USA or Canada, we recommend you contact us at reg.request@hbfuller.com to request an export review.

FEDERAL REPORTING**EPA SARA Title III Section 313**

Unless listed below, this product does not contain toxic chemical(s) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40 CFR part 372. EPA has advised that when a percentage range is listed the midpoint may be used to fulfill reporting obligations.

Chemical Name	CAS#	%
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STATE REPORTING**Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986:**

Unless listed below, this product does not contain known levels of any chemical known to the State of California to cause cancer or reproductive harm.

Chemical Name/List	CAS	Percent
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Substances of Very High Concern (SVHC) Content:

Unless listed below, this product does not contain SVHC's at 0.1% or greater, as of the version date of this SDS.

SECTION 16: OTHER INFORMATION

SDS VERSION DATE: 12-07-2015

This Safety Data Sheet is prepared to comply with the United States Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200) and the Canadian Workplace Hazardous Materials Information System (WHMIS).

HMIS RATING: HEALTH -- 3 FLAMMABILITY -- 1 REACTIVITY -- 0

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SAFETY DATA SHEET

See SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for personal protective equipment recommendations.

Prepared by: The Global Regulatory Department

Phone: 651-236-5842

The information and recommendations set forth herein are believed to be accurate. Because some of the information is derived from information provided to the H.B. Fuller Company from its suppliers, and because the H.B. Fuller Company has no control over the conditions of handling and use, the H.B. Fuller Company makes no warranty, expressed or implied, regarding the accuracy of the data or the results to be obtained from the use thereof. The information is supplied solely for your information and consideration, and the H.B. Fuller Company assumes no responsibility for use or reliance thereon. It is the responsibility of the user of H.B. Fuller Company products to comply with all applicable federal, state and local laws and regulations.

Appendix E – DFTO and Scrubber Preliminary Drawings

(DFTO and Preliminary Scrubber Drawings are considered confidential and are submitted under separate cover)

Nasol, David D.

From: Richard M Bonds <RBonds@smeinc.com>
Sent: Thursday, February 22, 2024 10:47 AM
To: Nasol, David D.
Cc: Marty Jones; Matt Korzelius
Subject: Silfab Revised Emissions Calculations and D-2573
Attachments: Emission Calculations_02-21-24_Confidential.pdf; Emission Calculations_02-21-24_Public.pdf; Form D-2573_2-21-2024.pdf

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

David, attached are confidential and public versions of the revised emissions calculations as well as the revised D-2573 form. Please let us know if you need anything else.

Thanks



Richard Bonds, PE

Environmental Engineer



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**Bureau of Air Quality
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A. APPLICATION IDENTIFICATION	
1. Facility Name: Silfab Solar	
2. SC Air Permit Number (if known; 8-digits only): -	3. Application Date: 06/01/2023 (revised 02/21/24)
4. Project Description: Solar panel manufacturing facility	
5. Are other facilities collocated for air compliance? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	6. If Yes, provide permit numbers of collocated facilities:

B. AIR CONTACT			
Consulting Firm Name (if applicable): S&ME, Inc.			
Title/Position: Sr. Environmental Scientist	Salutation: Mr.	First Name: Marty	Last Name: Jones
Mailing Address: 48 Brookfield Oaks Drive, Suite F			
City: Greenville	State: SC	Zip Code: 29607	
E-mail Address: mjones@smeinc.com	Phone No.: 864-297-9944	Cell No.: 864-630-2956	

C. EMISSION POINT DISPERSION PARAMETERS		
<ul style="list-style-type: none">• Source data requirements are based on the appropriate source classification.• Each emission point is classified as a point, flare, area, area circular, area polygon, volume, open pit, line, or buoyant line source.• Contact the Bureau of Air Quality for clarification of data requirements.• Include sources on a scaled site map. Also, a picture of area or volume sources would be helpful but is not required.• A user generated document or spreadsheet may be substituted in lieu of this form provided all of the required emission point parameters are submitted in the same order, units, etc. as presented in these tables.		
Abbreviations / Units of Measure:		
<ul style="list-style-type: none">• AGL = Above Ground Level• BTU/hr = British Thermal Unit per hour• ° = Degrees	<ul style="list-style-type: none">• °F = Degrees Fahrenheit• ft = feet• ft/s = feet per second	<ul style="list-style-type: none">• K = Kelvin• m = meters• UTM = Universal Transverse Mercator



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Reminder: For all Emission Points, list the unique Emission Point ID for that source. Use the same emission point ID as shown in the current permit and provided in the last modeling submittal (as applicable). If the emission point ID has been changed from what was previously submitted, please list the current emission point ID with the old emission point ID in parenthesis

D. POINT SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height (ft)	Exit Temp. (°F)	Exit Velocity (ft/s)	Inside Diameter (ft)	Discharge Orientation	Rain Cap? (Y/N)	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)								Height (ft)	Length (ft)	Width (ft)
P1ACID	Phase 1 Acid Scrubber (AEX)	504946	3880896	19.7	76.7	90.5	1.5	Vertical	No	175	50	850	260
P2ACID	Phase 2 Acid Scrubber (AEX)	504955	3880901	19.7	76.7	90.5	1.5	Vertical	No	175	50	850	260
HF-BST-01	30,000 Liter Hydrofluoric Acid Tank	504925	3880882	Vents through Phase 1 Acid Scrubber (P1ACID)									
HF-BST-02	30,000 Liter Hydrofluoric Acid Tank	504928	3880884	Vents through Phase 2 Acid Scrubber (P2ACID)									
HCL-BST-01	20,000 Liter Hydrochloric Acid Tank	504932	3880885	Vents through Phase 1 Acid Scrubber (P1ACID)									
HCL-BST-02	20,000 Liter Hydrochloric Acid Tank	504935	3880887	Vents through Phase 2 Acid Scrubber (P2ACID)									

E. FLARE SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height (ft)	Heat Release Rate (BTU/hr)	Exit Velocity (ft/s)	Exit Temp. (°F)	Heat Loss Fraction	Distance To Nearest Property Boundary (ft)	Building			
		Easting (m)	Northing (m)							Height (ft)	Length (ft)	Width (ft)	

F. AREA SOURCE										
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)	
		Easting (m)	Northing (m)							



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F. AREA SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

G. AREA CIRCULAR SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Radius of Area (ft)	Number of Vertices	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)					

H. AREA POLYGON SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Initial Vertical Dimension (ft)	Number of Vertices	Area (ft ²)	Distance To Nearest Property Boundary (ft)
		Easting-1 (m)	Northing-1 (m)					

I. VOLUME SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Physical Horizontal Dimension (ft)	Initial Horizontal Dimension σ_y (ft)	Physical Vertical Dimension (ft)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						



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J. OPEN PIT SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Pit Volume (ft ³)	Angle From North (°)
		Easting (m)	Northing (m)					

K. LINE SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)				Release Height AGL (ft)	Line Length (ft)	Line Width (ft)	Initial Vertical Dimension σ_z (ft)
		Start Easting (m)	Start Northing (m)	End Easting (m)	End Northing (m)				

L. BUOYANT LINE SOURCE (must complete Line Source and Buoyant Line Source tables)

Emission Point ID	Description/Name	Average Building Length (ft)	Average Building Height (ft)	Average Building Width (ft)	Average Line Source Width (ft)	Average Building Separation (ft)	Average Buoyancy Parameter (m ⁴ /s ³)

M. EMISSION RATES

Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? ⁽¹⁾	Controlled or Uncontrolled	Averaging Period
P1ACID	HF Acid	7664-39-3	0.0432	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P1ACID	HCl Acid	7647-01-0	0.869	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	HF Acid	7664-39-3	0.0432	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	HCl Acid	7647-01-0	0.869	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P1ACID	PM-10		0.28	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr



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M. EMISSION RATES						
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? ⁽¹⁾	Controlled or Uncontrolled	Averaging Period
P1ACID	PM-2.5		0.28	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	PM-10		0.46	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
P2ACID	PM-2.5		0.46	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Controlled	1-hr
				<input type="checkbox"/> Yes <input type="checkbox"/> No		

(1) Any difference between the rates used for permitting and the air compliance demonstration must be explained in the application report.

Table 1
Silfab Solar
Fort Mill, SC
Emissions Summary

Total Uncontrolled Emissions						
Pollutant	Module Manufacturing	Cell Manufacturing ⁽¹⁾	Storage Tanks	Generator	DFTO Combustion	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.576	2.581
SO2				0.0003	0.015	0.016
CO				0.0010	2.164	2.165
PM-10		12.11		0.0003	0.196	12.31
PM-2.5		12.11		0.0003	0.196	12.31
VOC	49.3	26.3		0.0004	0.142	75.74
HAPs	0.0	203.6	0.2730	0.0005	0.041	203.90
HF		9.225	0.0510			9.28
HCl		194.4	0.2220			194.58

Total Controlled Emissions						
Pollutant	Module Manufacturing	Cell Manufacturing	Storage Tanks	Generator	DFTO Combustion	Total
	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year	Tons/Year
NOX				0.0047	2.576	2.581
SO2				0.0003	0.015	0.016
CO				0.0010	2.164	2.165
PM-10		2.02		0.0003	0.196	2.214
PM-2.5		2.02		0.0003	0.196	2.214
VOC	49.3	26.3		0.0004	0.142	75.738
HAPs	0.0	7.985	0.0109	0.0410	0.041	8.078
HF		0.377	0.00204			0.379
HCl		7.609	0.00888			7.618

⁽¹⁾ Cell Manufacturing emissions include the process and silane/SiO2 emissions generated from this process. We have assumed all silane converts to SiO2 when exposed to oxygen is emitted as PM10 and PM2.5.

**Table 6
Silfab Solar
Fort Mill, SC
Combustion Sources Emissions**

300 HP Emergency Generator										
Source	Rated Capacity (HP)	Time of Operation ⁽²⁾		Fuel	Air Contaminant	AP-42 Emission Factor ⁽¹⁾		Number of Generators	Total Emissions (lbs/yr)	Total Emissions (tons/yr)
		Amount	Units			Amount	Units			
Emergency Generator ⁽¹⁾⁽²⁾	300	100	Hours	Diesel Fuel	NOX	0.031	lb/HP-Hr	1	9.3	0.0047
	300	100	Hours	Diesel Fuel	SOX ²	2.05E-03	lb/HP-Hr	1	0.6	0.0003
	300	100	Hours	Diesel Fuel	CO	6.68E-03	lb/HP-Hr	1	2.0	0.0010
	300	100	Hours	Diesel Fuel	PM-10	2.20E-03	lb/HP-Hr	1	0.7	0.0003
	300	100	Hours	Diesel Fuel	PM-2.5	2.20E-03	lb/HP-Hr	1	0.7	0.0003
	300	100	Hours	Diesel Fuel	VOC	2.47E-03	lb/HP-Hr	1	0.7	0.0004

Maximum Diesel Fired		
Emergency Generator	18 gal/hr	1800 gal/year
Total	18 gal/hr	1800 gal/year

Source	Rated Max Capacity (MM Btu/hr)	Hours of Operation	Air Contaminant	AP-42 Emission Factor (lb/10 ⁶ SCF) ⁽³⁾	Total Emissions (lbs/hr) ⁽⁴⁾	Total Emissions (tons/yr)
DFTO Natural Gas Usage	6.0	8760	NOX	100	0.5882	2.5765
	6.0	8760	SOX	0.6	0.0035	0.0155
	6.0	8760	CO	84	0.4941	2.1642
	6.0	8760	PM-10	7.6	0.0447	0.1958
	6.0	8760	PM-2.5	7.6	0.0447	0.1958
	6.0	8760	VOC	5.5	0.0324	0.1417
	6.0	8760	Lead	0.0005	0.000003	0.000013

Total Nat. Gas Fired		
DFTO	51.53	MMft3/yr
Total	51.53	MMft3/yr

⁽¹⁾ Emergency generator emissions based on emissions factor in AP-42, Chapter 3, Table 3.3.1.

⁽²⁾ Emergency generator operation limited to 100 hours /year for routine testing and maintenance.

⁽³⁾ Emission factors were obtained from AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 for Natural Gas Combustion.

⁽⁴⁾ Heat content of natural gas assumed to be 1020 BTU/scf.

Table 7
Silfab Solar
Fort Mill, SC
HAP Emissions from Combustion Sources

Natural Gas Fired DFTO

Natural Gas Burned-Maximum (MMft³): 42.9 MM ft³/year

Generator

Maximum Hours Operated per Generator: 100 hrs/year
 Max Gallons of Diesel Fuel Burned: 1,800 gals/year
 Number of Generators: 1
 Total Heat Input: 250 MMBTU/yr

Hazardous Air Pollutant	Emission Factor (lb/MMft ³)	Potential Annual Emissions (Tons/yr)
2-methylnaphthalene	2.40E-05	5.15E-07
3-methylcholanthrene	2.00E-06	4.29E-08
7,12-dimethylbenzanthra	1.60E-05	3.44E-07
acenepaphthene	2.00E-06	4.29E-08
acenepaphthylene	2.00E-06	4.29E-08
anthracene	2.00E-06	4.29E-08
benz(a)anthracene	2.00E-06	4.29E-08
benzene	1.30E-03	2.79E-05
benzo(a)pyrene	2.00E-06	4.29E-08
benzo(b)flouranthene	2.00E-06	4.29E-08
benzo(g,h,i)perylene	1.00E-06	2.15E-08
benzo(k)flouranthene	2.00E-06	4.29E-08
chrysene	2.00E-06	4.29E-08
dibenzo(a)anthracene	1.00E-06	2.15E-08
dichlorobenzene	1.20E-03	2.58E-05
flouranthene	3.00E-06	6.44E-08
fluorene	3.00E-06	6.44E-08
formaldehyde	7.50E-02	1.61E-03
hexane	1.80E+00	3.86E-02
indo(1,2,3-cd)pyrene	2.00E-06	4.29E-08
naphthalene	6.10E-04	1.31E-05
phenanthrene	1.70E-05	3.65E-07
pyrene	5.00E-06	1.07E-07
toluene	3.40E-03	7.30E-05
arsenic	2.00E-04	4.29E-06
beryllium	1.20E-05	2.58E-07
cadmium	1.10E-03	2.36E-05
chromium	1.40E-03	3.01E-05
cobalt	8.40E-05	1.80E-06
manganese	3.80E-04	8.16E-06
mercury	2.60E-04	5.58E-06
selenium	2.30E-05	4.94E-07
nickel	2.10E-03	4.51E-05
Total HAPS (tons/year)		0.0405

Hazardous Air Pollutant	Emission Factor (lb/MMBtu)	Potential Annual Emissions (Tons/yr)
benzene	9.33E-04	1.17E-04
toluene	4.09E-04	5.12E-05
xylene	2.85E-04	3.57E-05
1,3-butadiene	3.90E-05	4.88E-06
formaldehyde	1.18E-03	1.48E-04
acetaaldehyde	7.67E-04	9.60E-05
acrolein	9.20E-05	1.15E-05
naphthalene	8.50E-05	1.06E-05
acenaphthylene	5.00E-06	6.26E-07
acenaphthene	1.00E-06	1.25E-07
flourene	2.90E-05	3.63E-06
phenanthrene	2.90E-05	3.63E-06
chrysene	0.00E+00	0.00E+00
benzo(a)anthracene	2.00E-06	2.50E-07
benzo(a)flouranthene	0.00E+00	0.00E+00
benzo(k) fluoranthene	0.00E+00	0.00E+00
pyrene	5.00E-06	6.26E-07
flouranthene	8.00E-06	1.00E-06
benzo(a)pyrene	0.00E+00	0.00E+00
indo(1,2,3-cd)pyrene	0.00E+00	0.00E+00
benzo(a,h)anthracene	1.00E-06	1.25E-07
benzo(g,h,i)perylene	0.00E+00	0.00E+00
Total HAPS (tons/year)		0.0005

Total HAP Emissions (DFTO and Generator) 0.0410 tons/year

Notes:

1. Emission Factors for natural gas fired equipment from Table 1.4-3 and 1.4-4 of AP-42 Section 1.4 - *Natural Gas Combustion from External Sources*.
2. Emission factors for diesel engines from Table 3.3-2 of AP-42-Chapter 3 Section 3.3 - Stationary Internal Combustion Sources.
3. Diesel fuel usage for the generator was calculated based on 139,000 Btu/gal for diesel fuel.

Table 8
Silfab Solar
Fort Mill, SC
Printing VOC Emissions

Helios Nr 20MW monitoring data on M1 Multy cells						VOC calculated	Note: calculation based on BOM difference and
VOC measured						Tons / year	
	kg / year	MW / year	kg/MW	MW	Tons / year	Tons / year	
1	1655	20	82.75	2000	165.5	21.2	

BOM				M1 Poly	M10
MATERIA L			UM	Quantità/pz	
PASTE AL - 2° REAR			Gr	1.400	0.100
PASTE AG/AL - 1° REAR			Gr	0.050	0.000
PASTE AG			Gr	0.115	0.100
			TOTAL	1.565	0.200
			% difference	12.78%	

Table 9
Silfab Solar
Fort Mill, SC
Cell Production Emissions

Process Step	Acidic exhaust EXA Exhaust Acid Flow Rate average (m ³ /h)	Uncontrolled Acidic Exhaust HF Concentration (mg/m ³)	Uncontrolled Acidic Exhaust HCL Concentration (mg/m ³)	Uncontrolled Acidic Exhaust HF Emissions (lbs/hr)	Uncontrolled Acidic Exhaust HCL Emissions (lbs/hr)	Controlled Acidic Exhaust HF Emissions (lbs/hr)	Controlled Acidic Exhaust HCL Emissions (lbs/hr)
BatchTex3 N600	3400	6	9	0.04	0.07	0.0018	0.0027
InEtchSide 3+ (BSG removal)	804	513		0.91	0.00	0.0363	
Power machine + External O3-Generator	1400	6	9	0.02	0.03	0.0007	
InPolySide3+	335	598.5		0.44	0.00	0.0177	
Exhaust	600	532	32810.4	0.70	43.36	0.0281	1.7345
BatchClean3 N600	1800	6	9	0.02	0.04	0.0010	