

## 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND THE COMPANY/UNDERTAKING

Identification of the substance/preparation	: Nitrogen Trifluoride
Chemical formula	: NF <sub>3</sub>
Other means of identification	: Nitrogen trifluoride
Use of the Substance/Mixture	: General Industrial
Restrictions on Use	: No data available.
Manufacturer/Importer/Distributor	: Versum Materials Singapore Pte. Ltd. 2 International Business Park #03-24, The Strategy Singapore 609930 Toll Free No: 800 448 1755
Email Address – Technical Information	: <a href="mailto:techinfo@versummaterials.com">techinfo@versummaterials.com</a>
Telephone	: 800 448 1755
Emergency telephone number (24h)	: 800-101-2201 / +(65)-31581349

## 2. HAZARDS IDENTIFICATION

### GHS classification

Oxidizing gases - Category 1  
Acute toxicity - Inhalation Category 4  
Gases under pressure - Compressed gas.  
Specific target organ toxicity - repeated exposure - Inhalation Category 2

### GHS label elements

#### Hazard pictograms/symbols



Signal Word: Danger

#### Hazard Statements:

H270: May cause or intensify fire; oxidiser.  
H280: Contains gas under pressure; may explode if heated.

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

H332:Harmful if inhaled.  
H373:May cause damage to organs through prolonged or repeated exposure.

## Precautionary Statements:

Prevention : P220:Keep away from clothing and other combustible materials.  
P244:Keep valves and fittings free from oil and grease.  
P260:Do not breathe dust/fume/gas/mist/vapours/spray.

Response : P314 :Get medical advice/attention if you feel unwell.

Storage : P403:Store in a well-ventilated place.

Disposal : P501:Disposal of contents/container to be specified in accordance with regulations.

## Other hazards which do not result in classification

Use a back flow preventative device in the piping.  
Use only with equipment of compatible materials of construction, rated for cylinder pressure.  
Use only with equipment cleaned for oxygen service and rated for cylinder pressure.  
Open valve slowly.  
Close valve after each use and when empty.  
High pressure, oxidizing gas.  
Vigorously accelerates combustion.  
Keep oil, grease, and combustibles away.  
May react violently with combustible materials.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Mixture : Substance

Components	Chemical formula	CAS Number	Concentration (Volume)
Nitrogen trifluoride	NF3	7783-54-2	100 %

Concentration is nominal. For the exact product composition, please refer to technical specifications.

## 4. FIRST AID MEASURES

General advice : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Eye contact : IF exposed or concerned: Get medical advice/attention.

Skin contact : Adverse effects not expected from this product. IF exposed or concerned: Get medical advice/attention.

Ingestion : Ingestion is not considered a potential route of exposure.

Inhalation : Move to fresh air. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately.

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

Symptoms : Cyanosis. Weakness, dizziness, and confusion are some of the effects associated with reduction of the oxygen supply in blood.

## Notes to physician

Treatment : If exposed or concerned: Get medical attention/advice.

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## 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : All known extinguishing media can be used.

Specific hazards : Exposure to high temperatures may yield toxic by-products which may be corrosive in the presence of moisture. Exposure to high temperatures may yield toxic by-products which may be corrosive in the presence of moisture. Upon exposure to intense heat or flame, cylinder will vent rapidly and or rupture violently. Oxidant. Strongly supports combustion. May react violently with combustible materials. Some materials which are noncombustible in air may burn in the presence of an oxidizer. Move away from container and cool with water from a protected position. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. If possible, stop flow of product.

Special protective equipment for fire-fighters : Wear self contained breathing apparatus for fire fighting if necessary. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. Standard EN 469 - Protective clothing for firefighters. Standard - EN 659: Protective gloves for firefighters.

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## 6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Evacuate personnel to safe areas. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. Ventilate the area.

Environmental precautions : Do not discharge into any place where its accumulation could be dangerous. Prevent further leakage or spillage if safe to do so.

Methods for cleaning up : Ventilate the area.

Additional advice : If possible, stop flow of product. Increase ventilation to the release area and monitor concentrations. If leak is from cylinder or cylinder valve, call the emergency telephone number. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs.

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## 7. HANDLING AND STORAGE

### Handling

Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperature to exceed 50°C (122°F). Before using the product, determine its identity by reading the label. Know and understand the properties and hazards of the product before use. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Do not remove or deface labels provided by the supplier for the identification of

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

the cylinder contents. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Use an adjustable strap wrench to remove over-tight or rusted caps. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Ensure the complete gas system is compatible for pressure rating and materials of construction. Ensure the complete gas system has been checked for leaks before use. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. Do not use containers as rollers or supports or for any other purpose than to contain the gas as supplied. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Do not smoke while handling product or cylinders. Never re-compress a gas or a gas mixture without first consulting the supplier. Never attempt to transfer gases from one cylinder/container to another. Always use backflow protective device in piping. When returning cylinder install valve outlet cap or plug leak tight. Never permit oil, grease, or other readily combustible substances to come into contact with valves or containers containing oxygen or other oxidants. Do not use rapidly opening valves (e.g. ball valves). Open valve slowly to avoid pressure shock. Never pressurize the entire system at once. Use only with equipment cleaned for oxygen service and rated for cylinder pressure. Never use direct flame or electrical heating devices to raise the pressure of a container. Containers should not be subjected to temperatures above 50°C (122°F).

## Storage

Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Full containers should be stored so that oldest stock is used first. Stored containers should be periodically checked for general condition and leakage. Observe all regulations and local requirements regarding storage of containers. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Containers should be stored in the vertical position and properly secured to prevent toppling. The container valves should be tightly closed and where appropriate valve outlets should be capped or plugged. Container valve guards or caps should be in place. Keep containers tightly closed in a cool, well-ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Full and empty cylinders should be segregated. Do not allow storage temperature to exceed 50°C (122°F). Display "No Smoking or Open Flames" signs in the storage areas. Return empty containers in a timely manner.

## Technical measures/Precautions

Containers should be segregated in the storage area according to the various categories (e.g. flammable, toxic, etc.) and in accordance with local regulations.

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## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### Engineering measures

Ensure adequate ventilation.

### Personal protective equipment

Respiratory protection : Not required under normal use. Self contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmosphere.  
Users of breathing apparatus must be trained.

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

- Hand protection : Wear working gloves when handling gas containers.  
Gloves must be clean and free of oil and grease.  
Standard EN 388 - Protective gloves against mechanical risk.
- Eye protection : Safety glasses recommended when handling cylinders.  
Standard EN 166 - Personal eye-protection.
- Skin and body protection : Safety shoes are recommended when handling cylinders.  
Standard EN ISO 20345 - Personal protective equipment - Safety footwear.
- Special instructions for protection and hygiene : Ensure adequate ventilation, especially in confined areas.

## Exposure limit(s)

Nitrogen trifluoride	Time Weighted Average (TWA): EH40 WEL	-	2.5 mg/m <sup>3</sup>
Nitrogen trifluoride	Time Weighted Average (TWA): EU ELV	-	2.5 mg/m <sup>3</sup>
Nitrogen trifluoride	Time Weighted Average (TWA): EU SCOELS	-	2.5 mg/m <sup>3</sup>

## 9. PHYSICAL AND CHEMICAL PROPERTIES

- Appearance : Compressed gas. Colorless gas
- Odor : No odor warning properties.
- Odor threshold : No data available.
- pH : Not applicable.
- Melting point/range : -341 °F (-207 °C)
- Boiling point/range : -200 °F (-129 °C)
- Flash point : Not applicable.
- Evaporation rate : Not applicable.
- Flammability (solid, gas) : Refer to product classification in Section 2
- Upper/lower explosion/flammability limit : No data available.
- Vapor pressure : Not applicable.
- Water solubility : 0.061 g/l
- Relative vapor density : 2.4 (air = 1) Heavier than air.
- Relative density : 1.5 (water = 1)
- Partition coefficient (n-octanol/water) : Not applicable.

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

Auto-ignition temperature	: No data available.
Decomposition temperature	: No data available.
Viscosity	: Not applicable.
Molecular Weight	: 71 g/mol
Density	: 0.187 lb/ft <sup>3</sup> (0.0030 g/cm <sup>3</sup> ) at 70 °F (21 °C) Note: (as vapor)
Specific Volume	: 5.43 ft <sup>3</sup> /lb (0.3390 m <sup>3</sup> /kg) at 70 °F (21 °C)

## 10. STABILITY AND REACTIVITY

Chemical Stability	: Stable under normal conditions.
Conditions to avoid	: Heat. None under recommended storage and handling conditions (see section 7).
Reactivity/Incompatible Materials	: Flammable materials. Organic materials. Avoid oil, grease and all other combustible materials.
Hazardous decomposition products	: High temperature disassociation can produce very reactive fluorine species that may react with surrounding material to form additional toxic fluoride compounds.
Possibility of hazardous reactions	: Violently oxidises organic material.

## 11. TOXICOLOGICAL INFORMATION

### Likely routes of exposure

Effects on Eye	: May cause eye irritation. In case of direct contact with eyes, seek medical advice.
Effects on Skin	: Adverse effects not expected from this product.
Inhalation Effects	: Acute or repeated exposures can reduce the blood's ability to transport oxygen. Exposure to NF <sub>3</sub> can lead to the destruction of red blood cells.
Ingestion Effects	: Ingestion is not considered a potential route of exposure.
Symptoms	: Cyanosis. Weakness, dizziness, and confusion are some of the effects associated with reduction of the oxygen supply in blood.

### Acute toxicity

Acute Oral Toxicity	: No data is available on the product itself.
Inhalation	: LC <sub>50</sub> (1 h) : 6700 ppm Species : Rat. Rats exposed to 1000 ppm of Nitrogen Trifluoride for 4 hours exhibited methemoglobinemia (cyanosis). These effects were not observed when rats were exposed to 3000 ppm for 10 minutes. Rats

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

exposed to 1000 ppm of Nitrogen Trifluoride for 4 hours exhibited methemoglobinemia (cyanosis). These effects were not observed when rats were exposed to 3000 ppm for 10 minutes.

Acute Dermal Toxicity : No data is available on the product itself.

Serious eye damage/eye irritation : No data available.

Sensitization. : No data available.

## Chronic toxicity or effects from long term exposures

Carcinogenicity : No data available.

Reproductive toxicity : No data is available on the product itself.

Germ cell mutagenicity : Nitrogen Trifluoride (NF3) was tested at various times to determine its mutagenic potential. The current status of knowledge is as follows: NF3 sometimes produces a very weak mutagenic response in bacterial test systems (some of the Ames Salmonella strains and in one strain of E. coli) both with and without metabolic activation. The concentrations which produced the sometimes positive responses vary from 0.5% (5000 ppm) to 5% (50,000 ppm). The test results are often equivocal (e.g. the same sample gives negative or borderline positive responses at different times), which is a characteristic of weak mutagens. NF3 was found to be non-mutagenic in the mammalian cell (mouse lymphoma) test system when the cells were exposed to NF3 concentrations of up to 10% (100,000 ppm) both with and without metabolic activation. NF3 was not mutagenic in the mouse micronucleus test when whole animals were exposed to 2500 ppm of NF3 by inhalation.

Specific target organ systemic toxicity (single exposure) : No data available.

Specific target organ systemic toxicity (repeated exposure) : In a repeated dose study rats were exposed to NF3 concentrations of 0, 5, 20, 50, and 100 ppm, 6 hrs per day, 5 days per week for 13 weeks. Rats in the 100 ppm group (both sexes) and in the 50 ppm group (females) exhibited adverse blood effects indicative of hemolytic anemia. Mild to moderate red blood cell effects and increased methemoglobin were observed in rats exposed to  $\geq 20$  ppm. Organ weight, macroscopic and/or microscopic changes were noted in the liver, kidneys, spleen and bone marrow of the rats exposed to  $\geq 5$  ppm. These pathological effects were considered secondary responses to hemolytic anemia.

Aspiration hazard : No data available.

## 12. ECOLOGICAL INFORMATION

### Ecotoxicity effects

Aquatic toxicity : No data is available on the product itself.

Toxicity to other organisms : No data available.

# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

## Persistence and degradability

- Biodegradability : No data is available on the product itself.
- Mobility : Because of its high volatility, the product is unlikely to cause ground pollution.
- Bioaccumulation : Refer to Section 9 "Partition Coefficient (n-octanol/water)".

## Further information

Contains fluorinated greenhouse gases covered by Kyoto Protocol. For quantities see concentrations or cylinder contents.

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## 13. DISPOSAL CONSIDERATIONS

- Waste from residues / unused products : Return unused product in original cylinder to supplier. Contact supplier if guidance is required. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at <http://www.eiga.org> for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04: Gases in pressure containers (including halons) containing dangerous substances.
- Contaminated packaging : Return cylinder to supplier.

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## 14. TRANSPORT INFORMATION

### ADR

- UN/ID No. : UN2451
- Proper shipping name : NITROGEN TRIFLUORIDE
- Class or Division : 2
- Tunnel Code : (C/E)
- Label(s) : 2.2 (5.1)
- ADR/RID Hazard ID no. : 25
- Marine Pollutant : No

### IATA

- UN/ID No. : UN2451
- Proper shipping name : Nitrogen trifluoride
- Class or Division : 2.2
- Label(s) : 2.2 (5.1)
- Marine Pollutant : No

### IMDG

- UN/ID No. : UN2451
- Proper shipping name : NITROGEN TRIFLUORIDE
- Class or Division : 2.2
- Label(s) : 2.2 (5.1)
- Marine Pollutant : No
- Segregation Group: : None

### RID



# SAFETY DATA SHEET

Version 5.0  
Revision Date 05.12.2016

SDS Number 300000000103  
Print Date 16.12.2017

UN/ID No. : UN2451  
Proper shipping name : NITROGEN TRIFLUORIDE  
Class or Division : 2  
Label(s) : 2.2 (5.1)  
Marine Pollutant : No

## Further Information

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. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

## 15. REGULATORY INFORMATION

Workplace Safety and Health Act & Workplace Safety and Health (General Provisions) Regulations

Workplace Health and Safety Act , SS586 Labeling.

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Not on Inventory.
Japan	ENCS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.

## 16. OTHER INFORMATION

Ensure all national/local regulations are observed.

Prepared by : Versum Materials, Product Regulatory Department

For additional information, please visit Versum Materials' Product Stewardship web site.  
<http://www.versummaterials.com/productstewardship/>