



Nitrogen Trifluoride

Product Stewardship Summary

Nitrogen trifluoride is a gas that is made of nitrogen and fluorine atoms. The global electronics industry uses nitrogen trifluoride in its cleaning processes, because the gas outperforms other alternatives, is easier and safer to handle, and helps reduce greenhouse gas emissions.

Chemical Identity

- *Chemical Formula:* NF_3
- *Other names:* nitrogen fluoride

Uses and Benefits

Manufacturers of semiconductors, thin film solar cells and flat-panel displays use nitrogen trifluoride to clean process chambers. Inside the chambers, thin layers of semiconductive and insulating films are applied to wafers and panels. Nitrogen trifluoride removes the residue that these films leave on the chamber walls so the chambers can operate efficiently and produce a quality device.

Nitrogen trifluoride offers many benefits over alternative cleaning agents. It is stable at room temperature, so it is relatively easy and safe to handle. It is also easy to use nitrogen trifluoride to form an energetic, or reactive, gas or a plasma—a gas with free electrons. The relatively long life of fluorine radicals made in the plasma makes nitrogen trifluoride an efficient cleaner.

Before the development of nitrogen trifluoride, electronics manufacturers used a variety of perfluorinated compounds to clean process chamber walls. These compounds generate greenhouse gas emissions, which are believed to contribute to global warming. Since the late 1990s, nitrogen trifluoride has helped the semiconductor industry significantly reduce overall greenhouse gas emissions. Air emission computer models comparing nitrogen trifluoride with perfluorinated compounds in cleaning processes reveal that using nitrogen trifluoride may reduce equivalent global warming emissions by six or seven times due to its lower emission rate—and so it helps protect the earth's climate.

Physical and Chemical Properties

Nitrogen trifluoride has no color or smell. It is 2.5 times heavier than air and will tend to settle in low-lying areas.

At room temperature, nitrogen trifluoride is about as reactive as oxygen. It does not burn, but it makes other materials burn more readily. Heat, a spark, and oil, grease or other materials could start a fire.

Nitrogen trifluoride is a stable chemical. It is safe to transport and store. At high temperatures, nitrogen trifluoride becomes less stable. It will split into fluorine radicals that react with most materials.

Health Effects

Inhaling nitrogen trifluoride can reduce the capacity of red blood cells to carry oxygen. This causes cyanosis, or a bluish discoloration of the skin. Breathing nitrogen trifluoride can also lead to headache, dizziness, weakness and confusion. After prolonged exposure to high concentrations, breakdown of red blood cells and changes in the liver, kidneys, spleen and heart muscle may occur as secondary effects. In fresh air, the initial red blood cell changes will clear over several hours, but the person should still be monitored for secondary effects.

Environmental Effects

We can manufacture, transport, use and dispose of nitrogen trifluoride safely. Nitrogen trifluoride was developed as an environmentally friendly alternative to other gases, which have higher greenhouse gas emissions. Today suppliers, end users and regulators are cooperating to further reduce nitrogen trifluoride emissions and protect the environment.

Exposure Potential and Risk Management Measures

Industrial Use

We ship nitrogen trifluoride as a gas. Depending on how much nitrogen trifluoride our customer uses, we can provide the gas in high-pressure cylinders or bulk containers. Industry guidelines cover the storage and handling of compressed gas cylinders. Workers should use sturdy work gloves, safety glasses with side shields and safety shoes when handling compressed gas cylinders. Gloves should be clean and free of oil or grease.

Store nitrogen trifluoride containers in a well-ventilated area. Protect them from excessive heat and keep them away from materials that could burn. Equipment used to handle nitrogen trifluoride must meet regulatory requirements

and must be cleaned according to strict industry guidelines to prevent contamination.

It is important to have good ventilation when working with nitrogen trifluoride. The gas has no odor, so air monitoring and forced air exhaust ventilation are recommended. The U.S. Occupational Safety and Health Administration (OSHA) requires that nitrogen trifluoride in workplace air remain below 10 parts per million averaged over an eight-hour work shift.

Consumer Use

We do not sell nitrogen trifluoride directly to consumers.

Regulatory Information

Several regulations govern the manufacture, sale, transportation and use of nitrogen trifluoride. These laws vary by country and geographic region. You can find general regulatory information in the [Material Safety Data Sheet](#).

Sources for Additional Information

- [Air Products—MSDS](#)
 - [Air Products—Safetygram 28: Nitrogen Trifluoride](#)
 - [Air Products—Nitrogen Trifluoride \(NF3\) in Chamber Cleaning](#)
 - [Compressed Gas Association](#)
 - [National Fire Protection Association](#)
 - [Air Products Safetygrams](#)
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Conclusion

Manufacturers of semiconductors, flat-panel displays and photovoltaic cells use nitrogen trifluoride as a safe, cost-effective, high-performance chemical for cleaning process chambers. They can handle it safely with minimal environmental effects when they follow industry and company guidelines.



Contact Information

Emergency Response System

- Tel 1-800-523-9374
(Continental U.S. and Puerto Rico)
- Tel 1-610-481-7711 (other locations)
- 24 hours a day, 7 days a week
- For assistance involving Air Products and Chemicals, Inc. gases and equipment

Technical Information Center

- Tel 1-800-752-1597 (U.S.)
- Tel 1-610-481-8565 (other locations)
- Fax 1-610-481-8690
- E-mail gasinfo@airproducts.com
- Monday–Friday, 8:00 a.m.–5:00 p.m. EST

We developed this Product Stewardship Summary to give you a general overview of the chemical. This Summary is not meant to provide emergency response or medical treatment information. You can find in-depth safety and health information on the [Material Safety Data Sheet](#) for the product

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