

**Novec™**

Brand

3M™ Novec™ 5110 Insulating Gas Health & Safety Bulletin

Introduction

3M™ Novec™ 5110 Insulating Gas is non-flammable and has a wide safety margin for workers when used as designed for intended applications in the gas insulated electrical equipment industry. It is a versatile insulating gas for medium and high voltage applications including gas insulated lines, gas insulated switchgear, load break switches, disconnectors, instrument transformers and high voltage circuit breakers. Novec 5110 gas is mixed with inert gases for applications in the gas insulated electrical equipment industry.

Novec 5110 gas combines excellent electrical insulation performance with desirable environmental properties. With a GWP of less than 1 and strong dielectric properties, Novec 5110 gas is a more sustainable alternative to SF₆ (Sulfur hexafluoride) for arc quenching and insulation applications leading to dramatic environmental impact reductions in gas insulated equipment. Novec 5110 gas in unmixed form has a relative dielectric strength 1.4 times greater than SF₆ at a given pressure.

Composition of 3M™ Novec™ 5110 Insulating Gas

Novec 5110 gas is a fluoroketone with the chemical formula CF₃C(O)CF(CF₃)₂ and the chemical name 1,1,1,3,4,4,4-heptafluoro-3-(trifluoromethyl)-2-butanone.

Regulatory status

Novec 5110 gas is in compliance with the chemical notification/registration requirements of the United States, Europe, Canada, Korea, China, and Japan. Additional notification/registration activities are in progress in these and other countries (or regions). Certain restrictions may apply. Contact your local 3M sales representative for additional information.

Classification of 3M™ Novec™ 5110 Insulating Gas

Test results demonstrate that unmixed Novec 5110 gas is relatively low in acute toxicity and as a result is not classified as hazardous by inhalation under the Global Harmonized System of Classification and Labeling of Chemicals (GHS).¹ 3M uses independent third-party labs to conduct testing, and has extensive data supporting these test results. For more information contact your 3M technical service representative.

Intended applications in the gas insulated electrical equipment industry typically mix Novec 5110 gas with other gases (such as air). The mixed Novec 5110 gas thereby further decreases exposure risk. The Safety Data Sheet (SDS) for Novec 5110 gas can be found at 3M.com/sds.

¹ The hazards of a materials are routinely characterized by conducting single and repeat exposure studies. Hazards are categorized by using the GHS (Globally Harmonized System of Classification and Labeling of Chemicals) classification scheme, which can be found at unece.org.

Additional testing on 3M™ Novec™ 5110 Insulating Gas

New chemicals brought to market are subject to regulation schemes such as REACH in Europe, TSCA in the U.S., IECSC in China or K-REACH in South Korea. Specific test requirements, including carcinogenicity, mutagenicity and reproductive toxicity (CMR), are either pre-defined or need to be agreed and approved with the regulatory bodies as part of the registration process.

The test requirements are often volume dependent. Taking the example of REACH, the EU registration defines four volume bands:

- ▶ **Annex VII:** 1 to <10 metric tons per year
- ▶ **Annex IX:** 100 to <1000 metric tons per year
- ▶ **Annex VIII:** 10 to <100 metric tons per year
- ▶ **Annex X:** ≥1000 metric tons per year

Testing protocols are determined by the volume band, with increasing requirements as higher volumes are reached. It is also important to understand that testing for higher volume bands is based on the collective body of knowledge generated from the testing at the lower volume bands, including short-term toxicity tests. In some cases, it is deemed not necessary by ECHA (the European Chemicals Agency who administers REACH) to do more specific testing based on the cumulative results from the toxicity tests completed at the lower volume levels. For example, SF₆ was not required to be tested for carcinogenicity at the Annex X volume band based upon the results of the shorter-term toxicity studies completed at the lower volume bands.

3M™ Novec™ 5110 Insulating Gas is currently registered at the Annex VII volume band in REACH. In alignment with this band, 3M has test data on mutagenicity (Ames assay) which demonstrates no evidence for mutagenicity. While carcinogenicity and reproductive toxicity testing are not required at the Annex VII volume band, 3M has used read-across techniques to anticipate the carcinogenicity and reproductive toxicity potential of Novec 5110 gas.

Application of read-across techniques

Read-across techniques leverage existing data on a closely related substance as a surrogate for data on the substance of interest. This type of approach is accepted and encouraged by various regulatory agencies. Under EU REACH for example, it is generally expected that read-across is evaluated prior to initiating any animal studies.

A significant amount of CMR data exists on a product known as 3M™ Novec™ 1230 Fire Protection Fluid. Novec 1230 fluid is chemically similar to Novec 5110 gas. Novec 1230 fluid has a chemical formula of (CF₃)₂CFC(O)CF₂CF₃ and Novec 5110 gas has the chemical formula of (CF₃)₂CFC(O)CF₃.

The data for Novec 1230 fluid indicates that it is not a reproductive or developmental toxicant, is not mutagenic, and presents no carcinogenicity hazard. Using Novec 1230 fluid as a surrogate for CMR data, it is similarly expected that Novec 5110 gas would be not classified for CMR.

The table below compares the CMR classification of Novec 1230 fluid to the current classification of Novec 5110 gas.

Product Name	Chemical Formula	Carcinogenicity	Mutagenicity	Reproductive Toxicity	REACH Status
Novec 1230 Fluid	(CF ₃) ₂ CFC(O)CF ₂ CF ₃	Not classified	Not classified	Not classified	Annex X
Novec 5110 Gas	(CF ₃) ₂ CFC(O)CF ₃	Not required	Not classified	Not required	Annex VII

Handling and use of 3M™ Novec™ 5110 Insulating Gas

The handling procedures for 3M™ Novec™ 5110 Insulating Gas will be similar to the handling procedure associated with SF₆ when used as designed for intended applications in the gas insulated electrical equipment industry. 3M understands that a wide safety margin is necessary for handling and using gases in this industry.

Based on test results, 3M has established an Occupational Exposure Limit (OEL) of 225 ppmv (parts per million by volume) for unmixed Novec 5110 gas. OELs are airborne concentrations of a chemical to which an employee can be exposed in an occupational lifetime without experiencing adverse health effects. The 225 ppmv OEL of Novec 5110 gas is intended to be protective of human health based on exposure to the material for eight hours a day, five days a week, 52 weeks a year, for an occupational lifetime (typically assumed to be 30 years or more). The OEL for Novec 5110 gas is an 8-hour, time-weighted average (TWA) value. For more information contact your 3M technical service representative.

A gas transfer operation may not be necessary in the field. In the event that such an operation is conducted, 3M has assessed the exposure of unmixed 3M™ Novec™ 5110 Insulating Gas gas during a gas transfer operation and found those concentrations to typically be less than 10 ppmv. While 3M expects others to find similar results with unmixed Novec 5110 gas, each site/operation should make a determination based on an industrial hygiene assessment. On this basis, there is a wide safety margin between the OEL of Novec 5110 gas and the anticipated workplace environment exposures.

In normal operation, Novec 5110 gas is mixed with inert gases thereby further decreasing its exposure risk.

Familiar materials with a similar Occupational Exposure Limit as 3M™ Novec™ 5110 Insulating Gas

The table below compares the OEL of Novec 5110 gas to other commonly used materials.

Material	Common Use	OEL (8-hour TWA)
<i>n</i> -propanol	Active ingredient in common hand sanitizers	100 ppmv
2-propanol	Active ingredient in rubbing alcohol	200 ppmv
Novec 5110 Gas	Dielectric insulation gas	225 ppmv
Acetone	Active ingredient in common nail polish removers	250 ppmv
Octane	Primary component of gasoline or petrol	300 ppmv

n-propanol, the active ingredient in hand sanitizer, and octane, the active ingredient in gasoline or petrol, are two chemicals that have widespread use and exposure to the general public. As shown in the above table, both have similar OELs when compared to Novec 5110 gas. On this basis *n*-propanol, octane and Novec 5110 gas present similar risk when used as designed in their respective intended applications.

Additional considerations for arced 3M™ Novec™ 5110 Insulating Gas

In the case of electrical arcing events in equipment containing SF₆, high toxicity decomposition byproducts such as HF, S₂F₁₀, SO₂ can be generated. These byproducts are highly hazardous and pose a potential toxicity risk to those exposed. Depending on the nature of the arcing event, Novec 5110 gas may also undergo some degree of decomposition. Even though testing demonstrated that arced Novec 5110 gas mixtures are less hazardous than arced SF₆ mixtures, similar precautions should be taken when handling such gas mixtures. Additional information can be found in the reference publication.² A copy of this publication can be obtained from your 3M technical service representative.

Employees performing maintenance procedures on electrical switches containing arced SF₆ are required to use proper handling procedures and wear personal protective equipment. Similar precautions should be taken with arced Novec 5110 gas or mixtures of Novec 5110 gas with other gases.

² Maik Hyrenbach, Thomas A. Paul, John Owens, 2017, "Environmental and safety aspects of AirPlus insulated GIS," 24th International Conference on Electricity Distribution, Paper 0230.

Smart. Safe. Sustainable.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of proprietary 3M products. Although each has its own unique formula and performance properties, all Novec products are designed in common to address the need for smart, safe and sustainable solutions in industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, protective coatings, immersion cooling, advanced insulation media replacement solutions and several specialty chemical applications.

3M™ Novec™ Engineered Fluids • 3M™ Novec™ Aerosol Cleaners • 3M™ Novec™ 1230 Fire Protection Fluid • 3M™ Novec™ Electronic Grade Coatings • 3M™ Novec™ Insulating Gases

Safety Data Sheet: Consult Safety Data Sheet before use.

Regulatory: For regulatory information about this product, contact your 3M representative.

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