3M™ Novec™ 5110 Insulating Gas

Introduction
3M™ Novec™ 5110 Insulating Gas is a sustainable alternative to sulfur hexafluoride (SF₆) for electrical equipment insulation and arc quenching applications. It offers excellent dielectric properties, a wide range of operating temperatures and significant reductions in environmental impact compared to SF₆. Novec 5110 gas is non-flammable and has a wide safety margin for workers when used as designed in intended applications. The intended applications are as a dielectric medium for medium voltage and high voltage power generation and distribution equipment which includes gas-insulated switchgear, lines, and circuit breakers. Novec 5110 gas is mixed with inert gases for use in the intended applications.

As shown in the Environmental Properties table, gas mixtures containing Novec 5110 gas enable a significant and meaningful reduction in greenhouse gas (GHG) emissions from gas-insulated equipment compared to using SF₆. Novec 5110 gas has the following advantages:

- Ultra-low global warming potential (GWP) alternative to SF₆ virtually eliminating GHG emissions from gas-insulated equipment
- Potential to reduce GHG emissions by up to 99.99% in gas mixtures
- Dielectric breakdown voltage approximately 1.4 times that of SF₆ at a given pressure (in pure form)
- Wide margin of safety for workers when used as designed for intended applications
- Non-flammable
- Compatibility with a wide range of equipment components

Product Description
Not for specification purposes. All values @ 25°C/77°F unless otherwise specified.

Novec 5110 gas consists of CF₃C(O)CF(CF₃)₂ (CAS No. 756-12-7).
3M™ Novec™ 5110 Insulating Gas

**Typical Physical Properties**
Not for specification purposes. All values @ 25°C/77°F unless otherwise specified. Final product specifications and testing methods will be outlined in the product's Certificate of Analysis (COA) that is shipped with the product.

<table>
<thead>
<tr>
<th>Property</th>
<th>SI Units</th>
<th>Imperial Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>266 g/mol</td>
<td>266 lb/lb mol</td>
</tr>
<tr>
<td>Flammability in air</td>
<td>non-flammable</td>
<td>non-flammable</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>26.9°C</td>
<td>80.4°F</td>
</tr>
<tr>
<td>Freezing Point</td>
<td>-74°C</td>
<td>-166°F</td>
</tr>
<tr>
<td>Critical Temperature</td>
<td>146°C</td>
<td>295°F</td>
</tr>
<tr>
<td>Critical Pressure</td>
<td>2.14 MPa</td>
<td>311 psia</td>
</tr>
<tr>
<td>Ideal Gas Density</td>
<td>10.7 kg/m³ (at 1 bar)</td>
<td>0.67 lb/ft³ (at 14.5 psia)</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>93.8 kPa</td>
<td>13.6 psia</td>
</tr>
<tr>
<td>Dielectric Breakdown Voltage</td>
<td>18.4 at 1 bar over 2.5 mm gap</td>
<td>18.4 at 14.5 psia over 0.1 inch gap</td>
</tr>
</tbody>
</table>

**Environmental Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>3M™ Novec™ 5110 Insulating Gas</th>
<th>SF₆</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Lifetime (years)</td>
<td>0.04</td>
<td>3,200</td>
</tr>
<tr>
<td>Global Warming Potential (100-yr ITH, IPCC 2013 method)</td>
<td>&lt;1</td>
<td>23,500</td>
</tr>
<tr>
<td>Ozone Depletion Potential (CFC-11 = 1)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

As the Novec Insulating Gases are mixed with an inert gas (or gases) the reduction in GHG emissions is significant compared to installations using SF₆.

<table>
<thead>
<tr>
<th>Gas formulation</th>
<th>Novec 5110 Gas (5.0 mole %) in Air</th>
<th>100% SF₆</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas pressure (bar)</td>
<td>6.5</td>
<td>4</td>
</tr>
<tr>
<td>Gas density at 25°C (kg/m³)</td>
<td>10.7</td>
<td>23.6</td>
</tr>
<tr>
<td>Composite GWP of gas mixture</td>
<td>&lt;1*</td>
<td>23,500</td>
</tr>
<tr>
<td>GWP reduction compared to SF₆</td>
<td>99.99%</td>
<td>-</td>
</tr>
<tr>
<td>GHG emissions (MT CO₂e/m³)</td>
<td>0.003**</td>
<td>554</td>
</tr>
<tr>
<td>GHG emissions reduction (i.e. CO₂e reduction)</td>
<td>99.99%</td>
<td>-</td>
</tr>
</tbody>
</table>

* GHG emission reduction takes into account the GWP and reduced density of the gas mixtures
** GWP_mixture = Σxi GWP_i
3M™ Novec™ 5110 Insulating Gas

Dielectric Breakdown Voltage of 3M™ Novec™ 5110 Insulating Gas compared to SF₆
(Uniform field using parallel disk electrodes with 2.5 mm/0.1 inch gap)
Not for specification purposes. All values @ 25°C/77°F unless otherwise specified

Vapor Pressure of Novec 5110 gas compared to SF₆
Not for specification purposes. All values @ 25°C/77°F unless otherwise specified
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Dielectric Breakdown Voltage: Mixtures of 3M™ Novec™ 5110 Insulating Gas in Air compared to SF₆ and pure air
(Uniform field using parallel disk electrodes with 2.5 mm/0.1 inch gap)
Not for specification purposes. All values @ 25°C/77°F unless otherwise specified

Materials Compatibility
In practice, 3M™ Novec™ 5110 Insulating Gas differs somewhat in materials compatibility compared to SF₆. While the product is compatible with most common metals, it can be affected by some of the components found in lubricating greases and the elastomers used in gaskets and O-rings.

Many materials have been found to be compatible with the product. However, material compatibility is best evaluated using the specific materials of construction being considered for contact with the Novec 5110 gas, and the end user will need to determine whether this gas is suitable for their intended application.

3M research scientists are available to provide guidance for running materials compatibility evaluations. Contact your local 3M sales representative for additional information.

Regulatory Status
The component(s) of Novec 5110 gas are in compliance with the chemical notification/registration requirements of the United States, Europe, Canada, Korea, China, Taiwan, New Zealand (in the form of compressed gas mixtures), and Japan. Additional notification/registration activities are in progress in these and other countries or regions. Certain restrictions may apply, including required import of this product through a local 3M subsidiary, import volume limitations, and/or use limitations. Contact your local 3M sales representative for additional information. A current safety data sheet (SDS) and regulatory data sheet for this product is available at 3m.com/sds.
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Storage and Shelf Life
The shelf life of 3M™ Novec™ 5110 Insulating Gas is 60-months (5-years) from the date of manufacture when stored in the original packaging materials at 21°C (70°F) and 50% relative humidity. Please read and follow the precautions and directions for use contained in the product label and Safety Data Sheet before using this product.

Certificate of Analysis (COA)
The 3M Certificate of Analysis (COA) for this product is established when the product is manufactured and is deemed commercially available from 3M. The COA contains the 3M specifications, test methods and test results for the product’s performance attributes that the product will be supplied against. Contact your local 3M representative for this product’s COA.
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Safety Data Sheet: Consult Safety Data Sheet before use. https://www.3m.com/3M/en_US/company-us/SDS-search/

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

Technical Information: The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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3M
Electronics Materials Solutions Division
3M Center, Building 224-3N-11
St. Paul, MN 55144-1000
1-800-810-8513 phone
651-778-4244 fax
www.3M.com/novec

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