How 3M™ Novec™ 1230 Fire Protection Fluid is stored as a liquid and discharged as a gas.

3M™ Novec™ 1230 Fire Protection Fluid has been developed for use as a gaseous, total-flooding extinguishing agent. To understand the ability of Novec 1230 fluid to transform from a liquid into a gas upon discharge, some important physical properties need to be understood. For illustration, let's compare Novec 1230 fluid to the best known liquid: water.

<table>
<thead>
<tr>
<th>Intermolecular Forces (or Attraction between Molecules)</th>
<th>Water</th>
<th>Novec 1230 Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each molecule within the liquid water is strongly attracted to its nearest neighboring molecules, forming what's called a hydrogen bond. These strong attractive forces have a profound effect on the physical properties of water.</td>
<td></td>
<td>Novec 1230 fluid does not contain any hydrogen atoms, and therefore has no hydrogen bonds. The bonds between the molecules in Novec 1230 fluid are much weaker than the hydrogen bonds formed between water molecules. This weak attraction between molecules gives Novec 1230 fluid its unique physical properties.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat of Vaporization</th>
<th>Water</th>
<th>Novec 1230 Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because of its strong hydrogen bonds, water has a relatively high heat of vaporization. This means that a significant amount of energy (heat) is required to separate the molecules and convert it from a liquid to a gaseous state (steam or water vapor). When discharged through a nozzle, water tends to stay as liquid droplets since sufficient energy to convert it to vapor cannot be transferred into it in such a short period of time.</td>
<td></td>
<td>Novec 1230 fluid, on the other hand, has a low heat of vaporization. Because of its much weaker attraction between molecules, significantly less energy is needed to evaporate the fluid (25 times less than for water). The energy needed to convert the agent into a gaseous state is readily absorbed from the air when the fluid is discharged from the nozzle. In fact, if you pour Novec 1230 fluid onto a surface, it will evaporate in a matter of seconds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vapor Pressure</th>
<th>Water</th>
<th>Novec 1230 Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor pressure is also a measure of ease of evaporation. Water has a low vapor pressure, meaning that the air has a limited capacity to hold water in its vapor form. At 25°C, water vapor will saturate the air at about 3 percent by volume before it begins to recondense into liquid form.</td>
<td></td>
<td>Novec 1230 fluid has a vapor pressure that is about 12 times that of water, indicating the ease with which it can transform from a liquid to a gas. At 25°C, the air can hold 40% by volume of the agent without it recondensing to liquid form.</td>
</tr>
</tbody>
</table>
These physical properties allow 3M™ Novec™ 1230 Fire Protection Fluid to transition from a liquid to a gaseous state, even at cold discharge. In a properly designed extinguishing system, Novec 1230 fluid will be discharged through a nozzle that evenly distributes the agent throughout the enclosure. The low heat of vaporization and relatively high vapor pressure will allow rapid transformation from a liquid into a gas, extinguishing the fire, protecting valuable equipment, and leaving no residue.

### Comparison of Key Physical Properties of Water and 3M™ Novec™ 1230 Fire Protection Fluid

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Water</th>
<th>Novec 1230 fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling Point</td>
<td>°C</td>
<td>100</td>
<td>49</td>
</tr>
<tr>
<td>Freezing Point</td>
<td>°C</td>
<td>0</td>
<td>-108</td>
</tr>
<tr>
<td>Vapor Pressure @ 25°C</td>
<td>kPa</td>
<td>3.2</td>
<td>40.4</td>
</tr>
<tr>
<td>Heat of Vaporization @ 25°C</td>
<td>kJ/kg</td>
<td>2442</td>
<td>95</td>
</tr>
</tbody>
</table>

**Important Notice to Purchaser:** The information in this publication is based on tests that we believe are reliable. Your results may vary due to differences in test types and conditions. You must evaluate and determine whether the product is suitable for your intended application. Since conditions of product use are outside of our control and vary widely, the following is made in lieu of all express and implied warranties (including the implied warranties of merchantability and fitness for a particular purpose): Except where prohibited by law, 3M’s only obligation and your only remedy, is replacement or, at 3M’s option, refund of the original purchase price of product that is shown to have been defective when you received it. In no case will 3M be liable for any direct, indirect, special, incidental, or consequential damages (including, without limitation, lost profits, goodwill, and business opportunity) based on breach of warranty, condition or contract, negligence, strict tort, or any other legal or equitable theory.

---

**3M Specialty Materials**

3M Center, Building 223-6S-04
St. Paul, MN 55144-1000
800 810 8513
800 810 8514 (Fax)

---

**Europe**

3M Specialty Materials
3M Belgium N. V.
Haven 1005, Canadastraat 11
B-2070 Zaventem
23 3 250 7874

---

**Canada**

3M Canada Company
Specialty Materials
P.O. Box 5757
London, Ontario
N6A 4T1
800 364 3577

---

**Japan**

Sumitomo 3M Limited
33-1, Tamagawadai 2-chome
Setagaya-ku, Tokyo
158-8583 Japan
813 3709 8250

---

**Asia Pacific and Latin America**

Call (U.S.) 651 736 7123