



# 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 Novec1230 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.

## Intermolecular Forces (or Attraction between Molecules)

### Water

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.

### Novec 1230 Fluid

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.

## Heat of Vaporization

### Water

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.

### Novec 1230 Fluid

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.

## Vapor Pressure

### Water

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.

### Novec 1230 Fluid

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.

## Liquid to Gas Upon Discharge

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

Property	Unit	Water	Novec 1230 fluid
Boiling Point	°C	100	49
Freezing Point	°C	0	-108
Vapor Pressure @ 25°C	kPa	3.2	40.4
Heat of Vaporization @ 25°C	kJ/kg	2442	95

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