

## 3M™ Novec™ Brand The Umbrella Over Innovative And Sustainable Technologies

3M's inherent culture of combining the company's unparalleled core technologies is at the heart of 3M innovation. Scientists' breakthrough work developing segregated hydrofluoroether (HFE) technology is a classic example of this innovative culture. The umbrella 3M™ Novec™ brand is the hallmark of segregated HFE technology and fluoroketone technology, both defined by their safe, sustainable patented compounds. Drawing on these sustainable technologies, 3M know-how has spurred the invention of an entire family of products for customers across a host of industries.

The American Chemical Society lauded the team of 3M scientists in 1997 for their revolutionary research in HFEs by naming them Heroes of Chemistry.

Since that time, there has been great expansion in the Novec product portfolio, migrating into seemingly uncommon applications. Novec products address the need for safe, sustainable, effective solutions in industry-specific applications, such as aerosol, movie film, precision and semiconductor cleaning, heat transfer, protective coating, lubricant deposition, specimen preservation; and fire suppression. The diversity of the products and industry solutions include:

### *Products*

**3M™ Novec™ Engineered Fluids** are designed to balance performance with favorable environmental and worker safety properties. They are available for a wide variety of applications, including heat transfer, cleaning, testing, and lubricant deposition. Novec fluids offer excellent dielectric properties; wide range of boiling points; good materials compatibility; low toxicity and non-flammability; low global warming potential; and zero ozone depletion potential.

**3M™ Novec™ 1230 Fire Protection Fluid** is a next-generation halon alternative designed to balance industry concerns for performance, human safety and the environment, which makes Novec 1230 fluid the best option to replace non-sustainable technologies. Novec 1230 fluid has zero ozone depletion potential, a five-day atmospheric lifetime, and a global warming potential of one, enabling a 99.9 percent reduction in a system's carbon footprint as compared to hydrofluorocarbon (HFC) clean agents.

**3M™ Novec™ Aerosol Cleaners** are a revolutionary line of non-flammable, high-performance cleaners based on proprietary 3M formulations. Novec Aerosol Cleaners are non-ozone depleting and have low global warming potential. These high-performing products have a wide margin of safety for use in intended applications and are based on a sustainable technological alternative to HCFC-141b.

**3M™ Novec™ Electronics Grade Coatings** provide excellent anti-wetting, anti-stiction, anti-migration and anti-corrosion properties. Each coating formulation is a clear, low viscosity hydrofluoroether solvent that carries a fluoropolymer coating. The solvent is nonflammable, has low toxicity and provides acceptable environmental properties for today's demanding electronic applications.

**3M™ Novec™ Electronic Surfactants** are intended to improve wet-out, leveling and flow-control characteristics for a variety of applications. Formulated using a sustainable chemistry, they offer excellent solubility for easy mixing and low metals content. They are also shown to withstand continuous filtration.

### *Industry Solutions*

#### **Aerospace, Aviation and Military**

3M™ Novec™ products are designed to meet the critical requirements of your toughest maintenance and operational challenges. From precision cleaning of avionics circuitry, to thermal management of missile guidance

systems, to fire protection of control towers and radar rooms, the Novec brand stands for chemistries that provide safe, effective and sustainable technologies in a wide range of applications.

### **Archives & Museums**

The low surface tension, inertness, non-flammability and other unique characteristics of 3M™ Novec™ Fluids have found application in a variety of applications used to protect and preserve valuable documents and artifacts in museums, archives, libraries, universities and research facilities. Novec 1230 Fire Protection Fluid is ideal for these materials, which are vulnerable to conventional water, foam and dry chemical extinguishing agents. It is used to protect artifacts in the Library of Congress, the Smithsonian the Alamo and the Pennsylvania State Library.

### **Automotive & Transportation**

The 3M™ Novec™ brand is comprised of chemistries designed to address the need for safe, effective, sustainable technology in a wide range of automotive and transportation manufacturing applications, from cleaning precision components and electronics to drilling and machining. Additionally, 3M offers two high-performance working fluids, Novec 649 fluid and Novec 7000 fluid, that are particularly suited to the requirements of organic rankine cycle heat transfer systems – combining excellent thermal stability, compatibility with typical materials of construction and outstanding safety and environmental properties.

### **Data Center and Telecommunications**

3M™ Novec™ 1230 Fire Protection Fluid protects against catastrophic loss in facilities such as data processing centers, telecommunications switch rooms, computer and electronic control rooms, airport control towers, clean rooms, laboratories and computer-controlled manufacturing operations. This highly efficient extinguishing fluid does not damage electronics and delicate mechanical devices and can be safely used on energized equipment, helping to ensure continuity of operations during a fire emergency.

3M has developed a revolutionary, two-phase immersion cooling technology that reduces water consumption and energy use, while increasing supercomputer efficiency. The technique directly immerses servers into 3M™ Novec™ Engineered Fluid. The 3M Novec fluid is an efficient dielectric that keeps the hardware cooled with minimum additional energy, maximum performance and better reliability. 3M's two-phase immersion cooling technology can reduce cooling energy costs by 95 percent and reduces water consumption by eliminating municipal water usage for evaporative cooling. Heat can also be harvested from the system and reused for heating and other process technologies such as desalination of sea water. Additionally, this technique has been shown to require 10 times less space than conventional air cooling and eliminates costly air cooling infrastructure and equipment associated with conventional liquid cooling, making it cost effective for large-scale data center hubs. It enables much tighter component packaging – allowing for greater computing power in less space – and easy access to hardware with no residue.

### **Electronics**

Meeting the requirements of electronics manufacturing demands high-performance, cost-effective chemicals that possess sustainable environmental properties. 3M brings innovation and leadership to fulfilling those needs through the power of our 3M™ Novec™ Engineered Fluids, Electronic Surfactants, Electronic Coatings and Aerosol Cleaners.

### **Film Cleaning**

3M™ Novec™ 8200 Engineered Fluid is an effective, sustainable alternative to chlorinated solvents for high-speed cleaning of motion picture film. When used in specially designed ultrasonic cleaning equipment, Novec 8200 fluid demonstrates cleaning performance equal to or better than perchloroethylene.

### **Hard Disk Drive**

3M™ Novec™ Engineered Fluids meet the cleaning requirements of the hard disk drive industry. These fluids are used for cleaning light oils and particulate from many parts of the drive. The low surface tension of Novec fluids allows greater penetration than conventional solvents. Their low heat of vaporization ensures rapid drying after the

cleaning process. Novec fluids are also used to deposit lubricant onto the hard disks, ensuring a thin, uniform deposition of the lubricant.

### **Marine**

In marine applications, 3M™ Novec™ 1230 Fire Protection Fluid offers a number of important advantages over other clean agents and CO2. Its low toxicity, combined with high extinguishing efficiency, give Novec 1230 fluid a significant margin of safety.

### **Medical Devices**

3M offers a portfolio of products designed to meet critical market requirements and improve productivity. Cleanliness is critical. 3M™ Novec™ Engineered Fluids offer advanced cleaning solvency of greases and other contaminants that can remain after machining and assembly. Compatible with a wide range of substrates, these fluids are excellent replacements for chlorinated, brominated, HCFC and HFC solvents in many applications.

### **Oil & Gas**

3M™ Novec™ 1230 Fire Protection Fluid is an advanced, clean agent halon replacement suitable for use in a wide range of offshore and land-based oil and gas operations to protect occupied spaces and critical equipment.

### **Semiconductor**

3M™ Novec™ product line includes a broad range of heat transfer fluids, cleaning solvents and surfactants. These next-generation compounds are designed to increase throughput, performance and reliability, while helping you keep costs under control. Novec fluids are used in a number of front-end wafer manufacturing applications, including semiconductor wafer cleaning and drying, semiconductor heat transfer solutions, wetting agents for semiconductor process fluids, and semiconductor equipment and tool cleaning. These versatile products are useful in processes ranging from buffered oxide etch (BOE) mixtures to non-damaging photoresist strip; Bosch etch residue removal; wafer cleaning and drying; and heat transfer for wafer platen temperature control.

The American Chemical Society lauded 3M's scientists for the invention of 3M Novec Fluids recognizing the sustainable chemistry as a replacement for HFCs.

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