



Novec™ Aerosol Cleaners

Using 3M™ Novec™ Aerosol Cleaners for Hand-Wipe and Flush Cleaning in Compliance with the U.S. EPA's Aerospace NESHAP

Introduction

3M™ Novec™ Aerosol Cleaners are a family of non-flammable, high performance cleaners based on 3M's proprietary segregated hydrofluoroether (HFE) technology.

3M™ Novec™ Engineered Fluids were developed in the mid 1990s as replacements for CFCs (chlorofluorocarbons) HCFCs (hydrochlorofluorocarbons) and other ozone-depleting materials. Their unique balance of performance, safety and environmental properties has made Novec fluids useful as cleaning solvents and heat transfer fluids in a wide range of industrial and electronics applications. These properties include low toxicity; low odor; non-flammability; zero ozone depletion potential; low global warming potential and short atmospheric lifetimes. Novec fluids are also non-corrosive and dry quickly, leaving virtually no residue. They are compatible with most aerospace materials. Novec fluids are not classified as hazardous air pollutants (HAPs) and in their pure (neat) formulations, they are exempt as volatile organic compounds (VOCs).



Novec fluids for aerospace cleaning applications

Novec fluids are an excellent choice for many aerospace cleaning applications, in both their liquid and aerosol forms. Most pure (neat) Novec engineered fluids are exempt from the U.S. EPA's Aerospace NESHAP (National Emissions Standards for Hazardous Air Pollutants). This includes 3M™ Novec™ Contact Cleaner, designed to remove light oils, greases, silicones, dust and particulates from electronic equipment and fiber optic connectors, including energized components.

The Novec engineered fluid product line includes several azeotropes with improved cleaning strength. These products provide an excellent balance of safety, performance and environmental properties, and as such are valuable and allowable options for both hand wipe and flush cleaning in aerospace facilities. However, because they are formulated with HFE solvents and solvents that are VOCs, two Novec aerosol cleaners, Novec Flux Remover and Novec Electronic Degreaser, are classified as "Option 2" solvents under the Aerospace NESHAP. Option 2 solvents are allowable, but must be used in conformance with specific housekeeping and recordkeeping procedures. The summary on the next page is intended as a guide for proper use of Novec Aerosol Cleaners using the requirements listed.

Exempt Operations

The following cleaning operations are not covered by the Aerospace NESHAP:

- 1) Activities associated with space vehicles, and the re-work of antique aerospace vehicles or components.
- 2) Parts not critical to structural integrity or flight performance.
(i.e. seats, toilets, paneling, interior lights, etc.)
- 3) Electronic parts and assemblies (except cleaning of completed assemblies).
- 4) Research and development, quality control, laboratory testing, and aircraft transparencies manufacturing.

Why use Option 2 solvents?

Many wipe and flush cleaning operations cannot tolerate water-based cleaning systems or are sensitive to residues left by the low volatility of compliant solvents. Often the platforms are simply handled more effectively with volatile solvents, such as Novec aerosol cleaners. The few additional steps required for Option 2-compliant solvents must be weighed against the added cleaning performance and superior compatibility of the Novec Aerosols.

Table I: Option 2 Solvent Performance Advantages

| Aerospace NESHAP Compliance Requirement | Option 2 Solvents | Option 1 Solvents | | |
|---|-------------------|--|--------------------------|-----------------------|
| | | Novec™ Flux Remover and Electronic Degreaser | Novec™ Contact Cleaner | Aqueous/ Semi-Aqueous |
| Performance Features | | | | |
| Fast Drying | Yes | Yes | No | No |
| Residual Solvent | Virtually None | Virtually None | Very Likely ¹ | Likely ² |
| Cleaning Cycle Time | Fast | Fast | Slow | Slow |
| Potential for Corrosion | None | None | High | Low |
| Flashpoint | No | No | No | Yes |
| Solvency for Oil, Grease and Wax | High | Low | Varies | Varies |
| Solvency for Fluorinated Oils and Greases | Medium | High | Low | Low |
| Removal of Particulate, Dust and Debris | Excellent | Excellent | Varies | Varies |

1) Additional water rinse is typically needed to remove residual detergents or additives.

2) The low vapor pressure required for Option 1 compliant solvents will likely cause a slower evaporation, leading to residual solvent being left on the parts.

Table II: Aerospace NESHAP Cleaning Applications

| | Novec Aerosol Cleaners | Option 1 Cleaning Solvents |
|--|---|--|
| Soils - Hydraulic Fluid - Flux - Silicones - Nondestructive Test Indicator - Oil Laden Dust and Debris | <ul style="list-style-type: none"> • Novec Cleaners leave essentially no residue, are fast drying, compatible with most aerospace substrates and have excellent toxicological and environmental properties. • The three Novec formulations can clean a wide variety of soils from the majority of systems found on aerospace vehicles. | <ul style="list-style-type: none"> • Variable cleaning, strength • Residue likely • Slow drying, with possible corrosion and residual solvent trapped in tight spaces. |
| Systems - Electronics - Avionics - Airframe - Engine - Hydraulics | <ul style="list-style-type: none"> • Novec Aerosols are the same solvents that are used in many vapor degreasers in the Aerospace industry for new and MRO cleaning. • The cleaning and flux removal of electronic components and assemblies (prior to their permanent instillation in the aerospace vehicle) is exempt from Aerospace NESHAP compliance. | <ul style="list-style-type: none"> • Components of aqueous and semi-aqueous cleaners may cause corrosion. • Many hydrocarbon and aqueous solvents have been known to contribute to hydrogen embrittlement. |

General Hand Wipe and Flush Cleaning Housekeeping Requirements

Under the Aerospace NESHAP, the use of any Option 2 solvent, including Novec Electronic Degreaser and Novec Flux Remover, will require conformance to the following general requirements:

- Solvents must be stored in closed containers
- Solvent-laden materials must be stored in closed containers
- Standard practices must be instituted to minimize solvent spills

Specific Flush Cleaning Compliance Requirements

The most common use of 3M™ Novec™ Aerosol Cleaners in aerospace applications is for flush cleaning. This is defined as the removal of contaminants by passing solvent over, into or through the item being cleaned. Here, the Novec fluid would be sprayed directly onto the part or assembly to dislodge the contaminants. Operations where wiping, scrubbing, mopping or other hand action is used are not included.

Spent solvent must be captured into a vessel designed for solvent recovery. Alternatively, absorbent material can be used to collect the excess solvent. This material is then placed in a compliant vessel, such as a sealable bag or closed container.

Specific Hand Wipe Cleaning Compliance Requirements

Hand-wipe cleaning is defined as the removal of contaminants such as dirt, grease, oil and coatings by physically rubbing it with a material such as a rag, paper or cotton swab that has been moistened with a cleaning solvent.

3M™ Novec™ Electronic Degreaser and 3M™ Novec™ Flux Remover can be used for hand-wipe cleaning under the Aerospace NESHAP if the facility can demonstrate that the volume of hand-wipe solvents used for cleaning operations has been reduced by at least 60% from a 1996 baseline adjusted for production.

There are a number of operations that are exempt from the hand-wipe section of the Aerospace NESHAP rules. These include:

- Oxygen systems and systems exposed to strong oxidizers or reducers (e.g. gauges, regulators or valves, converters, OBOGs, lines, tubes or other oxygen-related components)
- Cleaning and surface activation prior to adhesive bonding
- Cleaning and cleaning solvent usage associated with research and development, quality control and laboratory testing

What is NESHAP?

The National Emissions Standards for Hazardous Air Pollutants (NESHAP) are a series of industry-specific regulations, set by the United States EPA to protect against airborne contaminants known to be hazardous to human health. For each source category of hazardous air pollutant (HAP) identified, the EPA develops NESHAPs, using standards modeled on the best practices and most effective emission reduction methodologies in use at the affected facilities.

The final NESHAP for Aerospace Manufacturing and Rework Facilities (Aerospace NESHAP) was published in 1995, and has been amended several times. The Aerospace NESHAP was written to reduce emissions of HAPs, but also regulates VOC emissions from solvent and other materials used in four types of aerospace operations:

- Cleaning
- Primer and topcoat application
- Paint removal (depainting)
- Application of chemical milling maskants

Use of Novec Aerosol Cleaners in Compliance with NESHAP

1. Novec Contact Cleaner is exempt from restrictions under the Aerospace NESHAP.
2. Novec Electronic Degreaser and Flux Remover may have significant performance advantages over "Option 1" solvents. See tables on page 2 for details. They are not considered HAPs but are classified as Option 2 Solvents under the Aerospace NESHAP due to their VOC content.
3. Novec Electronic Degreaser and Flux Remover are allowable provided there is compliance with specific housekeeping and record keeping procedures.
4. Exempt cleaning operations include cleaning (including flux removal) of electronic parts and assemblies prior to their permanent installation in the aircraft. Printed circuit boards are not considered completed assemblies, and thus their cleaning is exempt.

Detailed information on the specific types of facilities, cleaning operations and solvents affected by the Aerospace NESHAP is available at: www.epa.gov/ttnatw01/aerosp/aeropp.html

Specific Hand Wipe Cleaning Compliance Requirements

(continued)

- Cleaning operations, using nonflammable liquids, conducted within five feet of an energized electrical system (e.g. where power tools or unshielded electric motors are actively being operated)
- Cleaning of electronic parts or assemblies containing electronic parts (e.g. guidance systems, communications devices, controllers, switches, gauges)
- Cleaning of Aircraft and ground support equipment fluid systems that are exposed to fluid (e.g. hydraulic systems used for flight control and landing gear)
- Cleaning of fuel cells, tanks and confined spaces (e.g. wing interiors, fuel line connections, engine compartments)

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