

3M™ Novec™ Products
For Aircraft Cleaning



Cleaning

for High Flying
Performance



Cleaning is an essential process in aircraft production, maintenance and repair to ensure safe operation. Effective cleaning agents must remove a wide range of contaminants, yet be compatible with a wide range of metals, plastics and elastomers.

Compatibility and cleaning effectiveness are a function of the solvent used. CFC-113, HCFC-141b, and 1,1,1-trichloroethane were commonly used in the many cleaning applications where a noncorrosive, nonflammable solvent with low toxicity was required. However, because of the ozone depletion potential of these compounds, their production and/or use was banned, requiring users to find a new alternative. Other solvents, such as perchloroethylene, trichloroethylene, and methylene chloride, have barriers to use due to environmental or worker safety reasons.

3M™ Novec™ Engineered Fluid Advantages

3M™ Novec™ Engineered Fluids have proven to be highly-effective and versatile aircraft cleaning solvents:

- Effective on a wide range of soils. Excellent materials compatibility
- Can be successfully and economically used in vapor degreasing, tube flushing, spray cleaning and hand wipe operations
- Excellent for the removal of particulate contamination
- Outstanding penetration of tight clearances in complex parts
- Fast drying
- Not hazardous air pollutants (HAPs), low in acute and chronic toxicity*
- Nonflammable throughout the cleaning and drying process*

* See Material Safety Data Sheets for precautions and handling recommendations.

Typical Performance Properties - Table 1

All values determined at 77°F (25°C) unless otherwise specified.

Properties	CFC-113	HCFC-141b	1,1,1-TCA	Novec 7100	Novec 71DE	Novec 7200	Novec 72DE
Formula	CCl ₂ FCClF ₂	C ₂ Cl ₂ H ₃ F	CH ₃ CCl ₃	C ₄ F ₉ OCH ₃	Azeotrope ¹	C ₄ F ₉ OC ₂ H ₅	Azeotrope ²
Average Molecular Weight	187	117	132	250	172	264	146
Boiling Point (°C)	48	32	74	61	41	76	43
Liquid Density (g/ml)	1.56	1.23	1.32	1.52	1.37	1.43	1.28
Surface Tension (dynes/cm)	17.3	19.3	25.1	13.6	16.6	13.6	19.0
Vapor Pressure (mmHG)	334	569	130	202	383	109	350 ³
Heat of Vaporization (Cal/g @ BP)	35	53	58	30	48	30	52
Freezing Point (°C)	-31	-103	-39	-135	NA ⁴	-138	NA ⁴
Solubility for Water (ppm)	110	420	170	95	324	92	360
Viscosity (cps)	0.68	0.43	0.83	0.61	0.45	0.61	0.45
Kauri-Butanol Value	32	56	124	10	27	10	52

¹ Novec 71DE fluid is an azeotropic blend of 50% Novec 7100 fluid and 50% trans-1,2-dichloroethylene

² Novec 72DE fluid is an azeotropic blend of 10% Novec 7100 fluid, 20% Novec 7200 fluid, and 70% trans-1,2-dichloroethylene

Materials Compatibility

When selecting an aircraft cleaning solvent, materials compatibility is as important as the solvent's cleaning ability. Novec fluids are compatible with a wide range of substrates found on an aircraft. Independent laboratory compatibility test results of Novec 7100, 7200, 71DE and 72DE engineered fluids are listed in table 2.

Regulatory Status

Novec fluids have been approved for use as replacements for ozone depleting substances by the U.S. Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) Program. SNAP lists 3M™ Novec™ 7100 and 7200 Engineered Fluids, and components of their azeotropes, as "acceptable without restrictions" for use in precision cleaning, electronics cleaning, metal cleaning and aerosol solvent applications. In addition, Novec 7100 fluid and Novec 7200 fluid have been excluded by the U.S. EPA from the definition of a VOC because they have negligible contribution to tropospheric ozone formation.

3M Novec Engineered Fluid Resources

Novec fluids are supported by global sales, technical and customer service resources, with fully-staffed technical service laboratories in the U.S., Europe, Japan and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues. For additional technical information in the United States, call 3M Electronics Markets Materials Division, 800-810-8513.

For other 3M global offices, and information on additional 3M products, visit our web site at: www.3M.com/electronics.

³ Estimated value

⁴ Separation of DCE and Novec 7100 fluid will occur at -24°C

⁵ Separation of DCE and Novec 7100 and 7200 fluids will occur at -35°C



3M™ Novec™ Engineered Fluid Compatibility Test Results – Table 2

Test Description	ASTM#	Novec 7100	Novec 71DE	Novec 7200	Novec 72DE
Sandwich Corrosion Test	F1110	Conforms	Conforms	Conforms	Conforms
Acrylic Stress Cracking	F484	Conforms	Doesn't conform*	Conforms	Doesn't conform*
Paint Softening Test	F502	Conforms	Conforms	Conforms	Conforms
Hydrogen Embrittlement	F519-77	Conforms	Conforms	Conforms	Conforms
Hydrogen Embrittlement	F519,1C	Conforms	Conforms	Conforms	Conforms
Residue Test	F485	Conforms	Conforms	Conforms	Conforms
Immersion Corrosion Test	F483	Conforms	Conforms	Conforms	Conforms
Cadmium Removal Test	F483	Conforms	Conforms	Conforms	Conforms
Low Embrittling Cadmium Plate	F111	Conforms	Conforms	Conforms	Conforms
Flash Point	D56	Conforms	Conforms	Conforms	Conforms

* Novec 71DE and 72DE fluids caused visible stress crazing of the acrylic plastics. Testing performed by Scientific Materials, Inc.

3M™ Novec™ Engineered Fluids have been approved in a number of high-value applications within the government and military markets. Please contact your 3M representative for more information.

Environmental and Safety Properties – Table 3

Properties	CFC-113	HCFC-141b	1,1,1-TCA	Novec 7100	Novec 71DE	Novec 7200	Novec 72DE
Exposure Limit, ppm (8 hr. time weighted avg.)	1,000	500	350	750	750/200	200	750/200/200
Acute LC ₅₀ , ppm	55,000	10,000	16,000	>100,000	>100,000/ 24,100 ¹	>92,000	>100,000/ >92,000/24,100
Flash Point (open or closed cup)	None	None	None	None	None	None	None
Ozone Depletion Potential (ODP)	0.8	0.1	0.1	0.0	0.0	0.0	0.0
Atmospheric Lifetime, yrs.	85	9.2	4.8	4.1	4.1 ²	0.8	4.1 ¹
Global Warming Potential (GWP) ²	6,130	725	146	297	149	59	42
Hazardous Air Pollutant	No	No	Yes	No	No	No	No
VOC (U.S. EPA definition)	No	No	No	No	50%	No	70%
Solubility in Water (ppmw)	170	210	700	12	600	<20	630

¹ 4.1 Novec 7100 fluid, 0.8 Novec 7200 fluid, 0.01 trans-1,2-dichloroethylene

² CO₂=1, 100 yr. integrated time horizon



Versatile,
Sustainable
Solvent
Chemistries

Hand Wipe and Flush Cleaning with 3M™ Novec™ Aerosol Cleaners



3M™ Novec™ Aerosol Cleaners are designed to meet the need for safe, sustainable and effective solvents in a convenient aerosol form. These fast-drying, non-flammable materials offer a wide margin of worker safety in their intended applications. And, because they are non ozone-depleting and contain no nPB, HFCs or HAPs,

they represent a sustainable technology alternative to ozone depleting solvent cleaners such as HCFC-141b and HCFC-225.

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. Although there are additional compliance rules governing the use of compliant solvents, the few additional steps required must be weighed against their added cleaning performance and superior compatibility.

For full details, please see our brochure “Using 3M™ Novec™ Aerosol Cleaners for Hand-Wipe and Flush Cleaning in Compliance with the U.S. EPA’s Aerospace NESHAP.”

3M™ Novec™ Aerosol Cleaners vs. Aqueous Cleaners

	3M™ Novec™ Aerosol Cleaners	Aqueous Cleaners
Soils		
Hydraulic Fluid Flux	<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.
Silicones		
Nondestructive Test Indicator		
Oil-Laden Dust and Debris		
Systems		
Electronics	<ul style="list-style-type: none"> • Novec Aerosols contain the same solvents that are used in many vapor degreasers in the aerospace industry for new and cleaning. • The cleaning and flux removal of electronic components and assemblies (prior to their permanent installation in the aerospace vehicle) are exempt from 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.
Avionics		
Airframe		
Engine		
Hydraulics		

Specifications

Aerospace/Military Specifications 1526B	Aircraft Exterior Surfaces	Novec 7100, Novec 7200, Novec 71DE, Novec 72DE, Novec 72DA
Boeing, D6 17487	Exterior and General Cleaners	Novec 7100, Novec 7200, 71DE*, 72DE*, 72DA*
BAC 5750	Solvent Cleaning	Novec 71DE, Novec 7100
BAC 5402	Oxygen Tool Cleaning	Novec 71DE, Novec 7100
ADS 61 PRS	AAMCOM	Novec 7100, Novec 71DE, Novec 72DE
Mil Std. 1330 D	Oxygen System Gauge Cleaning	Novec 7100
SES 0073	NASA Orbiter Specification., Oxygen System	Novec 7100

*Stating exception of acrylic stress crazing.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of patented 3M products. Although each has its own unique formula and performance properties, all Novec products are designed in common to address the need for safe, effective, sustainable solutions in industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, lubricant deposition and several specialty chemical applications.

3M™ Novec™ Engineered Fluids • 3M™ Novec™ Aerosol Cleaners • 3M™ Novec™ 1230 Fire Protection Fluid • 3M™ Novec™ Electronic Coatings • 3M™ Novec™ Electronic Surfactants

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Building 224-3N-01
St. Paul, MN 55114
www.3M.com/electronics

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