

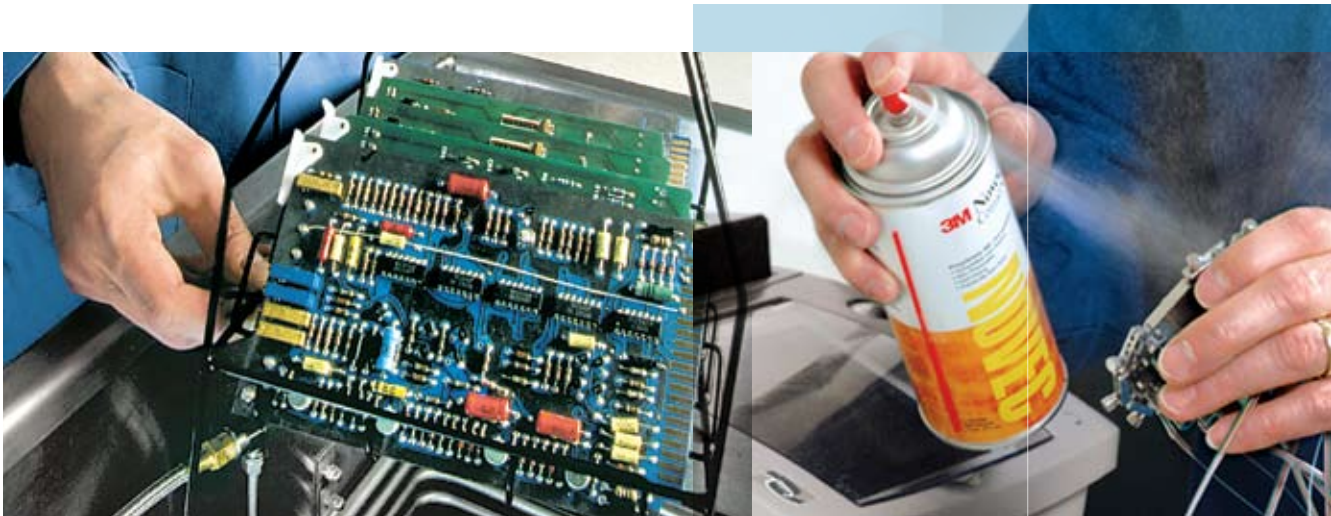
3M™ Novec™ Engineered Fluids



The
Science
of Precision
& Electronics
Cleaning

3M

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Soils: Light oils, release agents, halogenated compounds, light flux residue, particulates	
Typical Applications: hard disk drive components, wafer carriers, fiber optic connectors	
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Soils: Medium- to heavy-weight oils, buffing compounds, lubricants, RMA flux, low melting point waxes, no-clean flux, polishing fluids	
Typical Applications: Relays, flip chip assemblies, precision metal parts	
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Typical Applications: Precision bearings, avionics, printed circuit board assemblies	
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Soils: Heavy-weight oils, waxes, greases, no-clean flux	
Typical Applications: Precision bearings, avionics, precision optics, printed circuit board assemblies	
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A Balanced Solution

Today's fast-changing regulatory and competitive landscapes have made choosing a cleaning solvent more difficult than ever. Users of these materials must reconcile demands for improved performance, lower cost, lower environmental impact, fewer regulatory hassles and a safer, healthier workplace.

3M™ Novec™ Engineered Fluids strike an outstanding balance between all these needs. They're characterized by excellent cleaning performance, zero ozone depletion potential, low global warming potential and low toxicity. Low emissive losses and low drag-out losses contribute to cost savings. And because Novec fluids are nonflammable, they can be used safely in a wide variety of applications.

Technology for today's world

This favorable balance of properties is largely due to the unique structure of the base molecules. The base molecules in Novec cleaning fluids are segregated, nonflammable hydrofluoroethers (HFEs). The presence of the ether oxygen in these compounds, combined with the segregation of the hydrogen atoms from the fluorine atoms around that oxygen, results in an ideal combination of environmental and safety properties. And the right balance of vapor pressure, low surface tension, low heat of vaporization and solvency makes them excellent cleaning solvents.

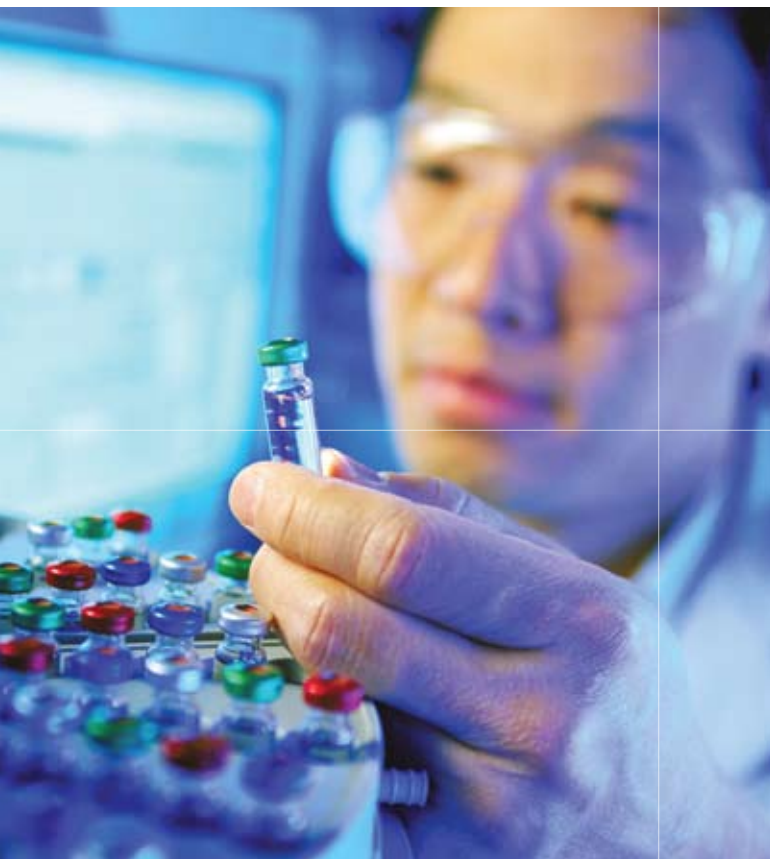
Novec fluids can be used in traditional vapor degreasing and immersion systems. Or they can be used in aerosol or hand-wipe cleaning. Which is why they're finding widespread use in the electronics, aerospace, automotive and even in the motion picture industry.

The following pages contain product suggestions for cleaning specific soils, suggestions for certain cleaning processes and successful cost saving measures. Each precision cleaning application is unique, however. Please contact a 3M representative for an evaluation, samples of Novec engineered fluids or for assistance in helping you determine which products and processes are right for your application.

The 3M™ Novec™ Brand Family

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

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 to address customer needs for safe, effective, sustainable solutions in a number of industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, lubricant deposition and several specialty chemical applications.



Light-Duty Cleaning

Types of Soils Cleaned

- Light oils
- Halogenated compounds
- Particulates
- Release agents

Suggested Products

- 3M™ Novec™ 7100 Engineered Fluid
- 3M™ Novec™ 7200 Engineered Fluid
- 3M™ Novec™ 71IPA Engineered Fluid



3M™ Novec™ Engineered Fluids can be used “neat” to remove light hydrocarbon and silicone oils. As highly-fluorinated compounds, Novec fluids are ideal for cleaning halogenated oils and greases. These solvents function effectively in the removal of particulate from components and final assemblies. And, when needed, Novec 71IPA fluid (an azeotropic blend of HFE and isopropyl alcohol) offers increased solvency while maintaining excellent materials compatibility.

Novec fluids are most often used in vapor degreasing machines or in specialized cleaning machines with ultrasonic agitation. Their ability to penetrate tight spaces on complex parts allows for thorough cleaning of precision components.

A combination of factors, including density, surface tension and viscosity, is responsible for this penetration, and contributes to the cleaning ability of Novec 7100 and 7200 fluids. The low heat of vaporization of these fluids ensures rapid drying after the cleaning process.

Wet Cleaning of Dry Etcher Parts

In recent years, Novec fluids have proven to be highly effective for wet cleaning of semiconductor dry etcher parts. Because of their cleaning speed and favorable safety and

environmental profiles, they are frequently used to replace conventional solvents, such as IPA and acetone, for cleaning fluoropolymer deposits formed during dry etching of dielectric films. These advanced, nonflammable materials are useful for wipe cleaning of chambers and for parts cleaning baths.

Cleaning of Hard Drive Components and Assemblies

Novec fluids are excellent in meeting the demanding cleaning requirements of the hard disk drive industry. These fluids are used for cleaning light oils and particulates from many parts of the drive, including MR heads, HGAs, suspensions and media.

Particulate Removal from Plastics

Because they are compatible with many common plastics, including polycarbonate, ABS, acrylic, PET and others, Novec fluids are ideally suited for removing particulates from injection components for medical devices and other applications, using hand-wipe, dip or spray-cleaning processes.

Typical Physical Properties (All values at 25°C unless noted)

	Boiling Pt. (°C)	Freeze Pt. (°C)	Liquid Density (g/ml)	Surface Tension (dynes/cm)	Vapor Pressure (mm Hg)	Viscosity (cps)	Heat of Vaporization ²
Novec 7100	61	-135	1.52	13.6	202	0.61	30
Novec 7200	76	-138	1.43	13.6	109	0.61	30
Novec 71IPA	54.8	-42 ¹	1.48	14.5	207	0.75	39.5

¹ Critical solution temperature

² cal/g @ boiling point

Tailored Performance for Cost-Efficient Cleaning

Hand Wipe and Aerosol Cleaning

Novec fluids are excellent for removing fine particulates during hand wiping of critical components found throughout electronics manufacturing facilities. The solvent evaporates quickly and completely, leaving behind no residue. Because they are non-reactive, highly stable and nonflammable, they can also be incorporated into aerosol spray cleaners, where they act as both carrier solvents and cleaning agents. 3M™ Novex™ 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 maintenance, rework and repair operations. And, because they are non ozone-depleting and contain no nPB, HFCs or HAPs, they are a sustainable alternative to ozone depleting solvent cleaners such as HCFC-141b.

Types of Soils Cleaned	Suggested Products			
	Novex Contact Cleaner	Novex Contact Cleaner Plus	Novex Electronic Degreaser	Novex Flux Remover
Particulate	•••	•••	•••	•••
Krytox®	•••	•••	••	••
Silicone Oil	•	••	•••	•••
Mineral Oil	•	••	•••	•••
Motor Oil	•	••	•••	•••
Lithium Grease	•	•	••	••
Wheel Bearing Grease	•	•	••	••
Hydraulic Fluid	•	••	•••	•••
Noncorrosive Coating	•	•	•••	•••
RA Flux	•	•	••	•••
RMA Flux	•	•	••	•••
R Flux	•	•	•••	•••

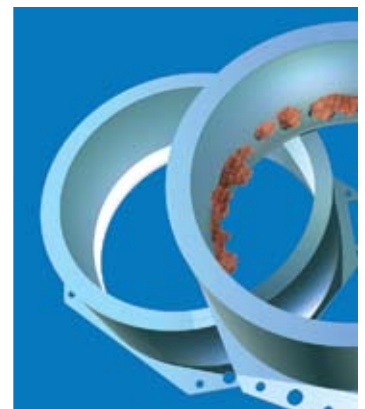
Compatibility

Plastic Compatibility (use on Energized Components)	•••	•	•	•
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Rating Cleaning Performance

••• Excellent •• Very Good • Moderate • Not Recommended

* Test on plastics before using. This product may damage ABS, Ps, polycarbonate or acrylics.



Medium to Heavy-Duty Cleaning

Types of Soils Cleaned

- Medium- to heavy-duty oils
- Lubricants
- Low MP waxes
- Polishing fluids
- Buffing compounds
- RMA flux
- No Clean Flux

Suggested Products

- 3M™ Novec™ 71DA Engineered Fluid
- 3M™ Novec™ 71DE Engineered Fluid
- 3M™ Novec™ 72DA Engineered Fluid
- 3M™ Novec™ 72DE Engineered Fluid

3M has developed a number of non-flammable products that effectively clean medium- to heavy-duty soils. These products – azeotropes or blends of azeotropes – have much higher solvency than pure 3M™ Novec™ Engineered Fluids 7100 or 7200, and are useful on soils ranging from hydrocarbon and silicone oils to greases. Their higher solvency means they can clean solder flux residues and low melting point waxes.

These products are mixtures of Novec fluids and one or more other solvents. Once combined, these azeotropes exhibit desirable physical properties for precision and electronics cleaning applications, with fairly high density, low viscosity, low surface tension and favorable environmental properties.

Their excellent chemical and thermal stability coupled with constant composition during boiling makes them ideal for immersion defluxing and degreasing applications.



Novec 71DA fluid

- Cleaning of oils, greases, waxes, handling oils, solder flux residue, ionic contaminants

Novec 71DE fluid

- Cleaning of oils, greases, waxes

Novec 72DA fluid

- Cleaning of medium- to heavy-duty solder flux residue, oils, greases, waxes, ionic components

Novec 72DE fluid

- Cleaning of medium- to heavy-duty oils, greases, waxes

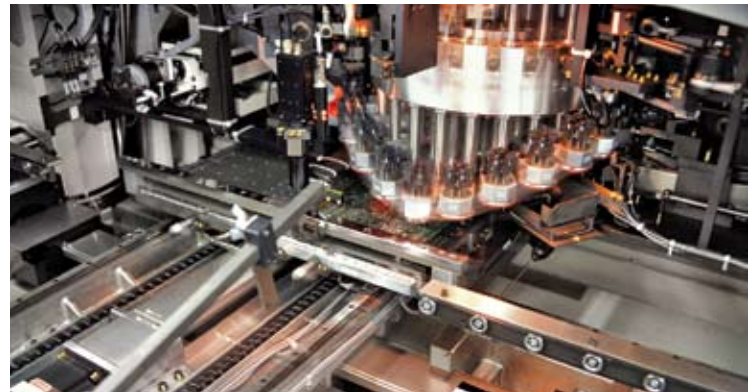
Typical Physical Properties (All values at 25°C unless noted)

	Boiling Pt (°C)	Freeze Pt (°C)	Liquid Density (g/ml)	Surface Tension (dynes/cm)	Vapor Pressure (mm Hg)	Viscosity (cps)	Heat of Vaporization ¹
Novec 71DA	40	-29	1.33	16.4	381	0.45	50
Novec 71DE	41	-24	1.37	16.6	383	0.45	48
Novec 72DA	44	-38	1.27	18	360	0.40	60
Novec 72DE	43	N/A	1.28	19	350	0.45	52

¹ cal/g @ boiling point

Vapor Cleaning Optimization

3M™ Novec™ Engineered Fluids can be used as a drop-in replacement for nearly any cleaning solvent. To improve cleaning performance in some applications, however, it may be beneficial to make slight modifications to the vapor degreaser. In addition, 3M urges customers to implement procedures that will minimize vapor emissions. 3M technical service engineers can help you optimize your process to minimize fluid consumption. See Reducing Fluid Usage on page 12 for more information.



Removing Flux Residue

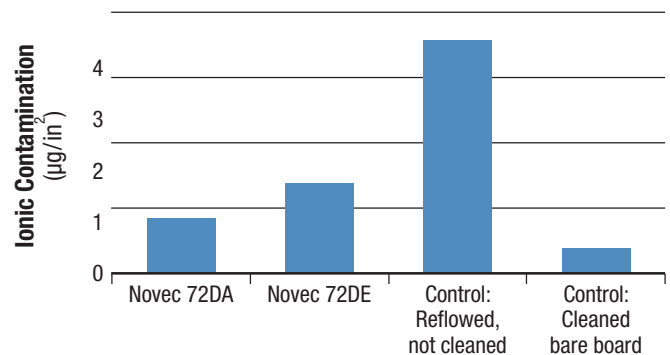
Liquid fluxes, paste fluxes, Type RMA, RA or R, No Clean Fluxes... with such a wide variety, recommending a single cleaning solvent is very difficult. 3M™ Novec™ 72DA Engineered Fluid does an excellent job cleaning most of these flux residues (see graph at right), but numerous process variables can affect cleaning performance:

- solder reflow profile
- time between soldering and cleaning
- orientation of the board

Taking these variables into account, 3M technical service engineers can help you optimize your process slightly to improve cleaning performance, whether you choose to use Novec 72DA fluid or an alternate Novec fluid.

Novec 72DA Ionic Removal Evaluation

Kester 256 Paste, 3 min VPS
1 min vapor, 1 min rinse immersion



Co-Solvent Cleaning

Types of Soils Cleaned

- Heavy-weight oils
- Greases
- Waxes

Suggested Products

- 3M™ Novec™ 7100 Engineered Fluid
- 3M™ Novec™ 7200 Engineered Fluid
- 3M™ Novec™ 71PA Engineered Fluid

Note: Please read and follow the manufacturer's precautions and directions for use before using any solvating agent. User is responsible for evaluating and determining which solvating agents are compatible, suitable, and appropriate for user's particular use and intended application.

Removal of the most challenging soils, such as heavy oils, greases and waxes, can be accomplished with 3M™ Novec™ Engineered Fluids in a co-solvent process. This process uses two fluids: a low-volatility organic solvent that dissolves soils from part surfaces, and Novec 7100, 7200, or 71PA fluid, which functions as an effective rinsing agent to flush solvating agents and soils from part surfaces.

Co-solvent cleaning is inherently flexible and easy to operate, and a variety of low volatility, high solvency organic solvents are available for use in a co-solvent process. These processes allow you to vary the boiling point of the vapor degreaser (see chart below) as the situation requires, and the environmental and safety profile of the process is similar to the neat or azeotropic cleaning process.

Advanced Solvent Technology

Solvating Agents for Use with Novec Fluids

Solvating agents which are miscible at room temperature

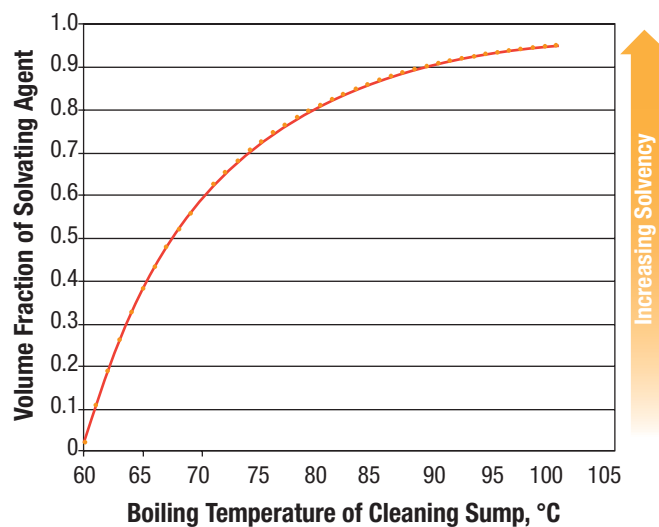
Petroferm™ SA-19	Toshiba™ FRW-1	Purasolv® EHL
Petroferm™ SA-24	Toshiba™ FRW-13	Topklean™ EL-20A
Petroferm™ SA-70	Dowanol™ PnB	Topklean™ EL-20C
Aromatic 150	Purasolv® AL	

Solvating agents which are miscible at boiling temperature

Actrel® 1140L	P&F Limonene	LPA® -142
Actrel® 1178L	NS Clean® 200	

Solvating agents which have limited solubility

Actrel® 1111L	Axarel® 9100	BioDiesel
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Bi-Solvent Cleaning

Types of Soils Cleaned

- Heavy-weight oils
- Greases
- Waxes, pitches

Suggested Products

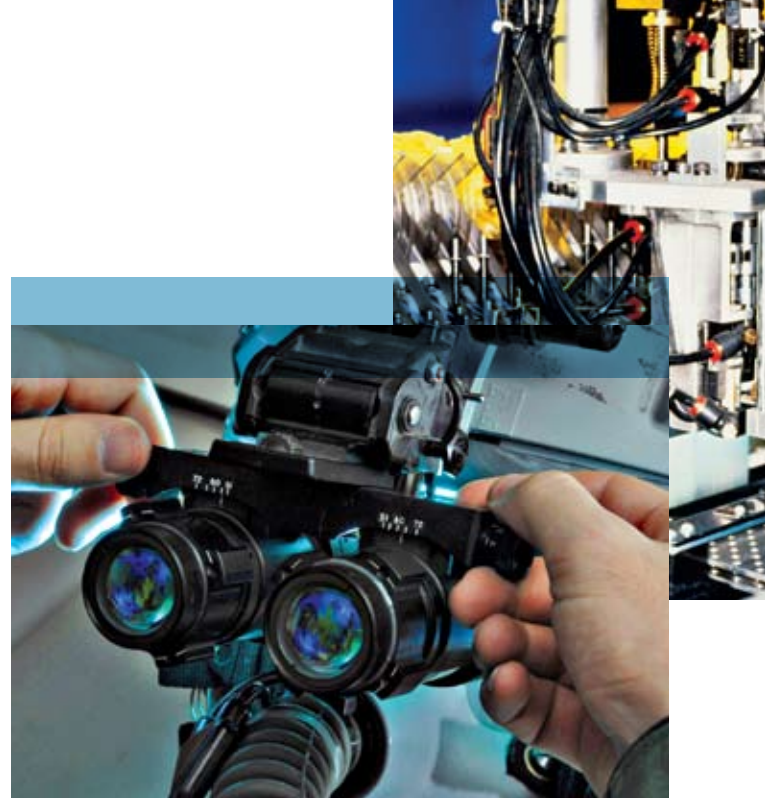
- 3M™ Novec™ 7100 Engineered Fluid
- 3M™ Novec™ 7200 Engineered Fluid
- 3M™ Novec™ 71PA Engineered Fluid

Note: Please read and follow the manufacturer's precautions and directions for use before using any solvating agent. User is responsible for evaluating and determining which solvating agents are compatible, suitable, and appropriate for user's particular use and intended application.

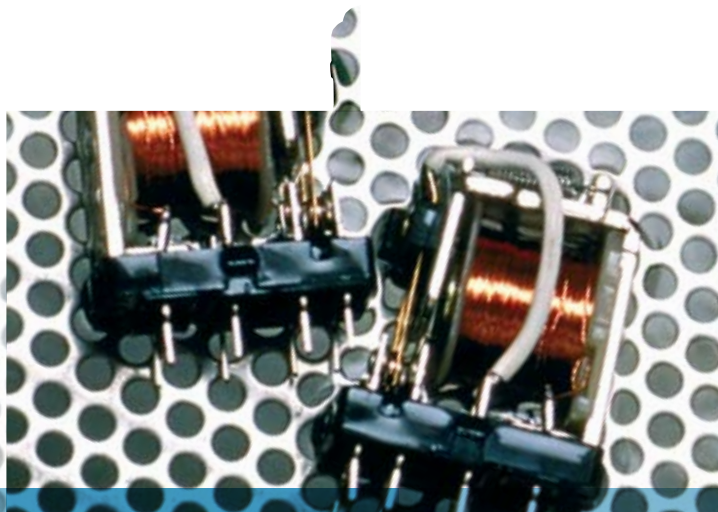
Another means of removing challenging soils is to use a bi-solvent cleaning process. This is similar to co-solvent cleaning, but uses the solvating and rinse agents in separate steps rather than in combination.

First, a part is immersed in a solvent to remove the soil from the surface of the part. Then a second step uses a solvent rinse of 3M™ Novec™ Engineered Fluid, usually in a vapor degreaser, to remove the first solvent and the soil it accumulated. The part emerges free of both soil and residual solvent. This process is being successfully used to remove wax residue during the manufacture of precision optic lenses.

The safety and environmental profiles of Novec 7100, 7200, and 71IPA fluids make them excellent choices for use in bi-solvent cleaning. 3M has partnered with Forward Technology to develop the F500 Bi-Solvent Cleaning Process. This process provides more flexibility for compliance with cleaning rules in California's South Coast Air Quality Management District, which has some of the strictest air quality rules in existence. For more information, please contact your 3M representative.



Meets Toughest Environmental Standards



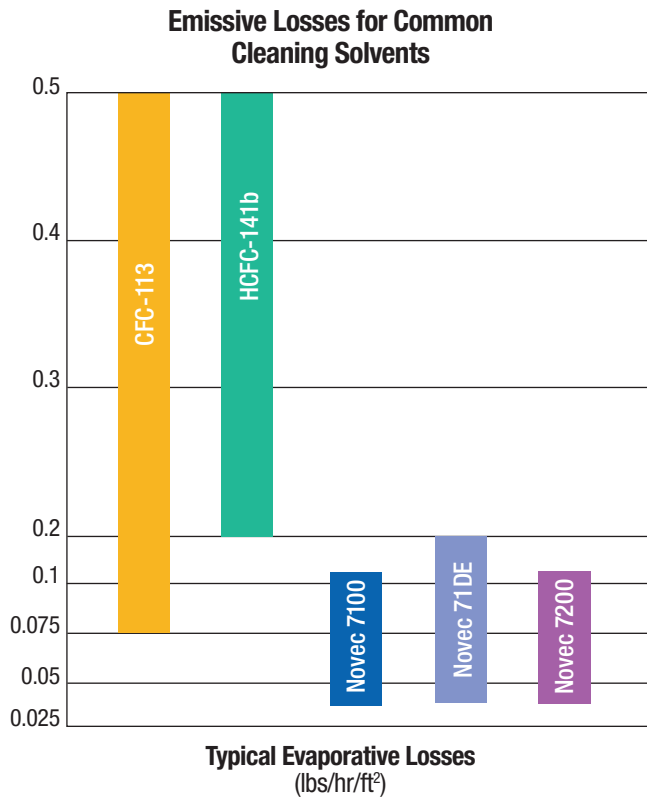
Cost Savings

3M™ Novec™ Engineered Fluids can provide cost savings in a number of areas. Due to their low heat of vaporization, these fluids reduce the electrical costs associated with boiling the liquid and drying parts. Because of their favorable environmental properties and low environmental impact, there is likely no need for costly abatement systems (consult your local regulations). 3M's nationwide Used Fluid Return Program can help reduce disposal costs (see page 16). Novec fluids may also reduce costs associated with regulatory record keeping and reporting requirements when compared to other cleaning solvents.

But the greatest cost savings occur due to reduced emissive and drag-out losses when using Novec fluids.

Emissive Losses

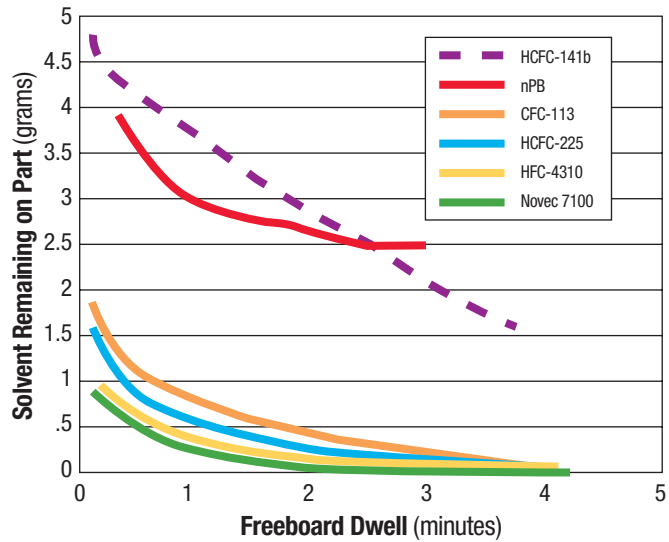
The evaporative loss of Novec fluids when used in vapor degreasing or a similar, recirculating system, is lower than most other solvents for two important reasons: higher molecular weight, and a relatively low vapor pressure. As a consequence, diffusive losses are substantially reduced compared to other cleaning solvents.



Drag-Out Losses

The low surface tension, low viscosity, high density and low heat of vaporization of Novec fluids result in reduced drag-out losses compared to other solvents. Alternate solvents tend to cling to complex surfaces after cleaning and rinsing due to surface tension forces, and are drawn out of the cleaning system before they can drip off or evaporate. In contrast, Novec fluids drip away quickly, without becoming trapped in small spaces when a part is raised through the vapor zone. Further, the lower heat of vaporization means that less energy is required to evaporate the solvent from the part in the freeboard region. This helps to reduce solvent and energy consumption.

Drag-out Characteristics of Various Solvents Simulation for Highly Complex Parts





Solvent Cleaning vs. Aqueous Cleaning: Comparing “Cost-of-Ownership”

Although water is inherently less expensive than fluorinated solvents, it also has a number of serious drawbacks as a cleaning medium for precision and electronic parts. That is why it is so important to compare the total “cost of ownership” of various types of cleaning systems, rather than simply comparing the cost of the fluids used in those systems.

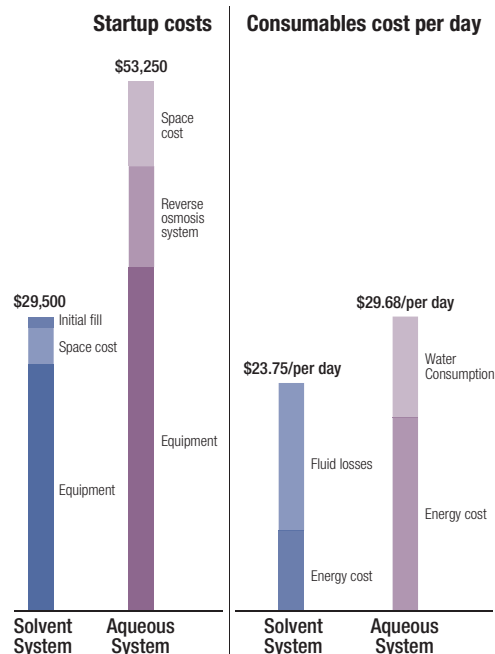
In general, solvent systems offer a number of important cost and performance advantages over aqueous systems. For example, fluorinated solvents have lower surface tensions than water. This can result in improved cleaning of parts with complex geometries, less hold-up of the cleaning medium and less effect on the next step of your process.

Solvent cleaning eliminates the need for costly drying equipment, while helping prevent parts corrosion and contamination associated with water systems. And because parts cleaned in fluorinated solvents such as 3M™ Novec™ Engineered Fluids emerge from the vapor degreaser clean and dry (and with no surfactant residue), they can move quickly to the next process step.

Of course, every application is unique, and a solvent cleaning system will benefit some users more than others. Calculating your own potential savings involves a variety of factors that influence the cost per part cleaned, including variable operating costs (fluid loss, electricity, maintenance, recycling); fixed costs (equipment depreciation, initial fluid fill); and other costs (downtime, yield effects).

3M can help you compare the cost of cleaning with Novec fluids versus other solvents or even aqueous processes. Contact your local 3M representative for more information.

Compare the Total Cost of Ownership of Solvent and Aqueous Cleaning



Reducing
Waste
Reducing
Costs

3M™ Novec™ Engineered Fluids can save you time and money over aqueous cleaning

- Less floor space
- Lower energy usage
- No waste disposal costs
- Quick drying
- Improved cleaning of parts with complex geometries
- Conserves water

Reducing Fluid Usage

Cutting vapor loss helps reduce costs and the environmental impact of any solvent cleaning process. Implementing containment and recovery procedures can greatly improve fluid usage.

To help improve fluid conservation when using 3M™ Novec™ Engineered Fluids, the following equipment designs and features should be considered:

- 1 100% to 125% freeboard
- 2 Chiller coil(s) above the condensing coils
- 3 EPDM or fluoroelastomer (depending on the Novec fluid being used) gaskets and non-threaded pipe fittings
- 4 Programmable hoist system
- 5 Halogen leak detection

For recommendations on equipment and materials for evaluation in your application, consult your 3M representative.

Freeboard (100% to 125%)

Extending the freeboard reduces fluid vapor losses. In most cases, the freeboard addition is fabricated of stainless steel sheet metal and bolted onto the existing freeboard. A bead of silicone caulking is placed between the existing freeboard and the added freeboard to ensure a tight seal. And, if not already present, a sliding cover should be added to the machine. Hinged covers and lift-off covers create a suction action when removed, which can increase the fluid and vapor loss.

Chiller coils

Chiller coils above the primary condenser coils will also reduce vapor losses. The refrigeration system must be capable of maintaining the chiller coils at a temperature of -20°F (-29°C). For optimum condensation, the chiller coils must be placed directly above the condensing coils. Depending upon ambient humidity, the chiller coils may require a defrost cycle to prevent formation of ice and a reduction in cooling efficiency.

EPDM seals and gaskets (for use with Novec 7100, 7200 and 71IPA fluids)

Fluoroelastomer seals and gaskets (for use with Novec 71DA, 71DE, 72DA and 72DE fluids)

Leakage is a source of potential fluid losses. The same properties that allow Novec fluids to penetrate tight spaces for optimum cleaning performance also allow them to escape vapor degreasers through poor or non-ideal seals. Operators can reduce the potential for leaks by using EPDM or fluoroelastomer gaskets and seals.

Vapor degreasers, and other cleaning equipment utilizing Novec fluids, should also avoid threaded pipe fittings to conserve fluid.

Programmable hoist system

High throughput rates can cause disturbances at the vapor/air interface that result in high vapor losses of Novec fluids. To counteract this, machine manufacturers recommend slower, controlled speeds for work entering and leaving the cleaner—typically less than 3 meters/min (10 ft/min).

Because of the difficulty of controlling these speeds manually, programmed hoists are the best option. These hoists can often be integrated with a motorized, sliding lid. The combination of these two components can help to reduce losses due to the “piston effect” or to sprayers disturbing the vapor blanket.

Halogen leak detection

Even when all these suggestions are employed, leakage can still occur. Halogen detectors effectively locate very small leaks in piping and pumps, and are recommended as part of your vapor degreaser maintenance equipment.

Ask 3M

3M technical service engineers are available to help you optimize your cleaning process. Please contact us if you have any fluid conservation questions or experience difficulties when modifying your machine.



Materials Compatibility

If a cleaning solvent is expected to perform at the highest level, it must be compatible with the parts being cleaned as well as with vapor degreasing machinery. To ensure that compatibility, 3M™ Novec™ Engineered Fluids have been tested with a wide variety of metals, plastics and elastomers.

3M™ Novec™ 7100 and 7200 Engineered Fluids were tested on the following substrates by exposing them for one hour at their boiling point, and are compatible.

Materials compatible with Novec Engineered Fluids in a “neat” cleaning process

Metal	Plastics	Elastomers
Aluminum	Acrylic	Butyl Rubber
Copper	Polyethylene	Natural Rubber
Carbon Steel	Polypropylene	Nitrile Rubber
302 Stainless Steel	Polycarbonate	EPDM
Brass	Polyester	
Zinc	Nylon	
Molybdenum	Epoxy	
Tantalum	PMMA	
Titanium	PVC	
Tungsten	PET	
Cu/Be Alloy C172	ABS	
Magnesium Alloy AZ31B		

The azeotropes, 3M™ Novec™ 71DA, 71DE, 71IPA, 72DA and 72DE Engineered Fluids, need more scrutiny, especially when cleaning plastic or elastomeric parts, because their organic solvent components may not be compatible – depending on the material in question and the temperature and duration of exposure.

Materials compatible with Novec Engineered Fluids in an azeotropic cleaning process

Metal	Plastics	Elastomers
Aluminum	Acrylic	Parts containing elastomeric materials should be evaluated for compatibility prior to cleaning with any Novec fluid azeotropes
Copper	Nylon	
Carbon Steel	PTFE	
302 Stainless Steel	Epoxies	
Brass	Parts containing plastic materials should be evaluated for compatibility prior to cleaning with any Novec fluid azeotropes	
Zinc		
Molybdenum		
Tantalum		
Titanium		
Tungsten		
Cu/Be Alloy C172		
Magnesium Alloy AZ31B		



3M™ Novec™ Engineered Fluid Compatibility Test Results

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

* Novec fluids 71DE, 72DE, and 72DA 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.

Compatible
with a
Wide Range
of Materials

Worker Safety

Under normal conditions, workers are exposed to a small amount of cleaning solvent during their shift. Studies have shown that typical solvent concentrations in the operator breathing zone around properly functioning vapor degreasers are in the range of 5 to 50 ppm. The advantage of using 3M™ Novec™ Engineered Fluids is that they provide a wider margin of safety than alternative solvents. Based on extensive toxicity testing, the 8-hour (TWA) worker exposure guidelines for Novec 7100 and 7200 fluids are 750 ppm and 200 ppm, respectively. Other solvents, with low exposure limits, do not offer as wide a margin of safety.



Technology for the Human Environment

Safety/Toxicity

	Exposure Guidelines, 8-hr. time-weighted avg. (ppm)	Exposure Ceiling
Novec 7100 fluid	750	None
Novec 7200 fluid	200	None
Novec 71DA fluid	750/200 ¹ /1000 ²	None
Novec 71DE fluid	750/200 ¹	None
Novec 71IPA fluid	750/400 ³	None
Novec 72DA fluid	750/200/200 ¹ /1000 ²	None
Novec 72DE fluid	750/200/200 ¹	None
CFC-113	1000	None
HCFC-141b	500	None
HFC-4310mee	200	400 ppm
HCFC-225ca/cb	50	None
nPB	10 ⁴	Not Deter.
Trichloroethylene	10 ⁴	25 ppm
Perchloroethylene	25 ⁴	100 ppm

¹ trans-1,2-chloroethylene has an 8-hr. TWA exposure guideline of 200 ppm

² Ethanol has an 8-hr. TWA exposure guideline of 1000 ppm

³ Isopropyl alcohol has an 8-hr. TWA exposure guideline of 400 ppm

⁴ ACGIH

Extensive, peer-reviewed toxicity testing has been conducted on Novec fluids. They are not irritating to the eyes or skin, and have tested negative in all mutagenicity screens. In addition, 3M offers technical assistance to help you determine worker exposure levels related to your cleaning process. And Novec fluids and their azeotropes are nonflammable, even when subjected to direct flame or electrical arcs.

Environmental Profile

Environmental and Regulatory

In today's highly-regulated world, good performance simply isn't enough. The need – driven by product stewardship, government regulations, worker concerns and consumer advocacy – is for safe, environmentally responsible chemistry. Good performance without responsible solutions is not an option.

3M™ Novec™ Engineered Fluids strike an ideal balance between performance and environmental issues. Zero ozone depletion potential and low global warming potential make Novec fluids a long-term, sustainable technology. When compared with other precision cleaning fluids, the environmental advantages are easy to see.

	Ozone Depletion Potential ¹ –ODP	Global Warming Potential ² –GWP	Atmospheric Lifetime–ALT (yrs)
Novec 7100 fluid	0.00	297	4.1
Novec 7200 fluid	0.00	59	0.8
Novec 71DA fluid	0.00	170	4.1
Novec 71DE fluid	0.00	149	4.1
Novec 71IPA fluid	0.00	300	4.1
Novec 72DA fluid	0.00	43	4.1
Novec 72DE fluid	0.00	42	4.1
CFC-113	0.80	6,130	85.0
HCFC-141b	0.10	725	9.2
HFC-4310mee	0.00	1700	17.1
HCFC-225ca/cb	0.03	170/530	2.5/6.6
nPB	0.026	0.31	0.03

¹CFC-11 = 1.0

²GWP—100 year Integration Time Horizon (ITH)

Regulatory agencies around the world have recognized the good environmental properties of Novec fluids and approved their use in a wide variety of applications, including precision cleaning:

- Novec fluids have been accepted for commercial use by regulatory agencies in the United States, Canada, Japan, Korea, Australia, Europe (under the European List of Notified New Chemical Substances), the Philippines and China
- Novec 7100 and 7200 fluids have been approved without restrictions under the Significant New Alternatives Policy (SNAP) program of the U.S. EPA
- Novec 7100 and 7200 fluids have been excluded by the U.S. EPA from the definition of a volatile organic compound (VOC) on the basis that these compounds have a negligible contribution to tropospheric ozone formation
- Novec 7200 fluid has received the Clean Air Solvent Certificate from the South Coast Air Quality Management District (SCAQMD)

Designed
with
the Future
in Mind

Businesses that have converted or will convert from PFCs or HFCs to Novec fluid-based solutions should carefully track the resultant greenhouse gas emissions reductions. These reductions may offer flexibility and, perhaps, “credits” under a future regulatory scheme addressing the issue of global climate change.

Assistance from product to process

At 3M, we provide our customers with extensive product and process support that begins even before you become a customer.

That support can take many forms, including help with equipment and process design, providing resources for safe product handling, used fluid return/disposal* and a host of other considerations.

3M products are supported by global technical and customer service resources. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

We make these cleaning fluids as easy to work with as possible. You can take advantage of our free Parts Cleaning Evaluation Service, or try 3M™ Novec™ Engineered Fluids yourself with our 30-Day Risk-Free Trial and Acceptance Program.

3M can help support your regulatory specialists with documentation required for regulatory compliance, and with reclamation or disposal – helping you accelerate process development and implementation, and deal with any product or process issues throughout the entire life cycle of the fluid. Although 3M does not provide reclamation/reprocessing of waste fluids from our customers, we can put you in contact with our approved service provider, Safety-Kleen, who can handle these arrangements for you.*

As manufacturers face increasingly stringent regulations in the future, this high level of support will become even more

critical to your success. That's just one of the many ways Novec fluids can give you a competitive edge. And another reason why we say 3M™ Novec™ Engineered Fluids are designed for the human environment.

For additional technical information on 3M™ Novec™ Engineered Fluids in the United States, call 3M Customer Service, 800 810 8513.

For information on additional 3M™ Novec™ products and other products for the electronics industry visit our web site at: www.3M.com/novec.

*U.S. and Puerto Rico only. Contact your local 3M office for information about used fluid return programs in your region.



The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of patented 3M compounds. Although each has its own unique formula and performance properties, all Novec products are designed 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

United States	Canada	China	Europe	Japan	Korea	Singapore	Taiwan
3M Electronics Markets Materials Division 800 810 8513	3M Canada Company Specialty Materials 800 364 3577	3M China Ltd. 86 21 6275 3535	3M Belgium N.V. 32 3 250 7521	Sumitomo 3M Limited 813 3709 8250	3M Korea Limited 82 2 3771 4114	3M Singapore Pte. Ltd. 65 454 8611	3M Taiwan Limited 886 2 2704 9011

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