Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HFE-72DE 3M (TM) Novec (TM) Engineered Fluid
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

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Product Use:

Intended Use:	FOR INDUSTRIAL USE ONLY. NOT INTENDED FOR USE AS A MEDICAL DEVICE OR DRUG.
Specific Use:	Cleaning and Coating Solvent.

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
1,2-TRANS-DICHLOROETHYLENE	156-60-5	68 - 72
ETHYL NONAFLUOROISOBUTYL ETHER	163702-06-5	4 - 16
ETHYL NONAFLUOROBUTYL ETHER	163702-05-4	4 - 16
METHYL NONAFLUOROISOBUTYL ETHER	163702-08-7	2 - 8
METHYL NONAFLUOROBUTYL ETHER	163702-07-6	2 - 8

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: Liquid
Odor, Color, Grade: clear, colorless with slight odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards: May cause target organ effects.

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Skin Contact:
Moderate Skin Irritation: Signs/symptoms may include localized redness, swelling, itching, and dryness.

Inhalation:
If thermal decomposition occurs:

Upper Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Prolonged or repeated exposure, above recommended guidelines, may cause:

Cardiac Sensitization: Signs/symptoms may include irregular heartbeat (arrhythmia), faintness, chest pain, and may be fatal.

NOTE: For a mixture of ethyl nonafluorobutyl ether and its isomer, a single positive response for cardiac sensitization was observed at an exposure level of 49,000 ppm. No adverse health effects are anticipated from normal handling and use.

Ingestion:
May be absorbed following ingestion and cause target organ effects.

Target Organ Effects:
Prolonged or repeated exposure, above recommended guidelines, may cause:

Central Nervous System (CNS) Depression: Signs/symptoms may include headache, dizziness, drowsiness, incoordination, nausea, slowed reaction time, slurred speech, giddiness, and unconsciousness.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

AQUATIC TOXICITY:

Testing results indicate that ethyl nonafluoroisobutyl ether, ethyl nonafluorobutyl ether, methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether have insignificant toxicity to aquatic organisms at their saturation point (Lowest LC50, EC50, or IC50 > substance water solubility). 1,2-Trans-dichloroethylene is harmful to aquatic organisms (10 mg/L < Lowest LC50, EC50, or IC50 < 100 mg/L). These compounds are highly volatile and have high Henry's Law constants and are thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

BIOCONCENTRATION:

Ethyl nonafluoroisobutylether, ethyl nonafluorobutylether, methyl nonafluoroisobutylether, and methyl nonafluorobutylether are highly insoluble and very volatile. Bioconcentration is therefore unlikely and not expected as they are not likely to enter aqueous waste streams from typical uses and disposal, or, in the case of a spill, remain in the aquatic or terrestrial compartments. The high potential for these components to move from aquatic or terrestrial environments to the atmosphere indicates bioconcentration is unlikely to occur as they are not expected to be bioavailable. Thus, emphasis has been placed on the atmospheric fate.

1,2-Trans-dichloroethylene has an octanol/water partition coefficient of <3 indicating it is unlikely to bioconcentrate.

ATMOSPHERIC FATE:

This product has Zero Ozone Depletion Potential (ODP).

Atmospheric Lifetime: approximately 6 days for 1,2-trans-dichloroethylene; approximately 4.7 years and 3.7 years for methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether, respectively; 0.8 years for the mixture of ethyl nonafluoroisobutyl ether and ethyl nonafluorobutyl ether.

Global Warming Potential (GWP): 320 (100 year ITH, WMO 1998 method) for methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether; 55 (100-yr ITH) for ethyl nonafluoroisobutyl ether and ethyl nonafluorobutyl ether using the calculation method outlined in Climate Change 2001; and essentially zero for 1,2-trans-dichloroethylene. GWP of product as formulated: approximately 43 (100-yr ITH).

Ethyl nonafluoroisobutylether, ethyl nonafluorobutylether, methyl nonafluoroisobutylether, and methyl nonafluorobutylether are exempt from the US EPA definition of a volatile organic compound (VOC).

Take precautions to prevent direct release to the environment.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Remove contaminated clothing and shoes. Immediately flush skin with large amounts of water. Get medical attention. Wash contaminated clothing and clean shoes before reuse.

Inhalation: Remove person to fresh air. If signs/symptoms develop, get medical attention.

If Swallowed: Do not induce vomiting unless instructed to do so by medical personnel. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get medical attention.

4.2 NOTE TO PHYSICIANS

Exposures resulting from intentional misuse and abuse may cause an increase in myocardial irritability. Do not administer sympathomimetic drugs unless absolutely necessary.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	396 ºC
Flash Point	*No Flash Point per ASTM D3278*
Flammable Limits - LEL	6.7 % volume
Flammable Limits - UEL	13.7 % volume

5.2 EXTINGUISHING MEDIA

Use fire extinguishers with class B extinguishing agents (e.g., dry chemical, carbon dioxide).

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Exposure to extreme heat can give rise to thermal decomposition. Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms,

waist and legs, face mask, and protective covering for exposed areas of the head.

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. Extreme conditions of heat (welding, open flame, misuse, or equipment failure) may produce decomposition products that include hydrogen fluoride and hydrogen chloride.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment. Call 3M-HELPS line (1-800-364-3577) for more information on handling and managing the spill. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Warning! A motor could be an ignition source and could cause flammable gases or vapors in the spill area to burn or explode. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible using non-sparking tools. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and MSDS. Place in a closed container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

Avoid eye contact with vapors, mists, or spray. Avoid breathing of vapors, mists or spray. Contents may be under pressure, open carefully. For industrial or professional use only. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS. Store work clothes separately from other clothing, food and tobacco products. Avoid contact with oxidizing agents. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Avoid skin contact. Avoid skin contact with hot material. Avoid continuous exposure of the material to extreme conditions of heat, i.e., above 150C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150C results in very slight decomposition of this product and, therefore, is a very conservative use temperature threshold. Applications involving exposure of the fluid to temperatures exceeding 150C should be reviewed with 3M Technical Service.

7.2 STORAGE

Store away from heat. Store out of direct sunlight. Store away from oxidizing agents. Keep container tightly closed. Keep container in well-ventilated area. Store away from strong bases. Contents may be under pressure if stored/shipped under elevated temperature. Open closure slowly to vent pressure.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Use with appropriate local exhaust ventilation. Provide appropriate local exhaust ventilation on open containers. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact with vapors, mists, or spray. Avoid eye contact.
The following eye protection(s) are recommended: Safety Glasses with side shields, Indirect Vented Goggles.

8.2.2 Skin Protection

Avoid skin contact with hot material. Wear appropriate gloves, such as Nomex, when handling this material to prevent thermal burns. Avoid skin contact.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Fluoroelastomer (Viton), Polyethylene/Ethylene Vinyl Alcohol.

8.2.3 Respiratory Protection

Avoid breathing of vapors, mists or spray. Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.

Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance. If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
1,2-TRANS-DICHLOROETHYLENE	ACGIH	TWA	200 ppm	
1,2-TRANS-DICHLOROETHYLENE	OSHA	TWA	200 ppm	
ETHYL NONAFLUOROBUTYL ETHER	3M	TWA - specific form	200 ppm	as total isomers
ETHYL NONAFLUOROISOBUTYL ETHER	3M	TWA - specific form	200 ppm	as total isomers
METHYL NONAFLUOROBUTYL ETHER	AIHA	TWA	750 ppm	
METHYL NONAFLUOROISOBUTYL ETHER	AIHA	TWA	750 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Liquid
Odor, Color, Grade:	clear, colorless with slight odor.

General Physical Form:	Liquid
Autoignition temperature	396 ºC
Flash Point	*No Flash Point per ASTM D3278*
Flammable Limits - LEL	6.7 % volume
Flammable Limits - UEL	13.7 % volume
Boiling point	45 ºC
Density	1.28 g/ml
Vapor Density	*No Data Available*
Vapor Pressure	330 mmHg [@ 25 ºC]
Specific Gravity	1.28 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	*Not Applicable*
Solubility in Water	Negligible
Evaporation rate	*No Data Available*
Volatile Organic Compounds	896 g/l [*Test Method:* South Cost Air Qual Mgmt Dist]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	896 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Viscosity	0.45 centipoise

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases; Strong oxidizing agents; Heat(excessive temperatures)

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Chloride	At Elevated Temperatures - extreme conditions of heat
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Component-Based Toxicology Information:

For the ethyl ether components:
A single positive response for cardiac sensitization was observed at an exposure level of 49,000 ppm.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>300 mg/l
Bluegill, Lepomis macrochirus	96 hours Lethal Concentration 50%	>190 mg/l

CHEMICAL FATE INFORMATION

Test Type	Result	Protocol
	See 3.3	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. As a disposal alternative, incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF and HCl. Facility must be capable of handling halogenated materials.
To reclaim or return, check product label for contact.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0212-2966-5, 98-0212-2967-3, 98-0212-2968-1, 98-0212-3162-0

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - Yes

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

The components of this product are in compliance with the chemical notification requirements of TSCA.

One or more of the components of this product have been notified to ELINCS (European List of Notified or New Chemical Substances). Certain restrictions apply. Contact the selling division for additional information.

The components of this product are listed on Japan's Chemical Substance Control Law List (also known as the Existing and New Chemical Substances List.)

The components of this material are in compliance with the new chemical notification requirements for the Korean Existing Chemicals Inventory.

All the components of this product are listed on China's Inventory of Chemical Substances.

Contact 3M for more information.

Additional Information: This material has been notified to CEPA and has received a limited volume permit(<10,000 kg/yr or <50,000 kg cumulative)

INTERNATIONAL REGULATIONS

Contact 3M for more information.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification
Health: 3 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities. The hazard ratings assigned to this product are based on the properties of combustion or decomposition products that can occur in an uncontrolled fire situation.

HMIS Hazard Classification
Health: 2 **Flammability:** 1 **Reactivity:** 0 **Protection:** X - See PPE section.
Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes: Not Applicable

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