Prior to converting your process to 3M™ Novec™ Engineered Fluids, 3M recommends you complete this Equipment Evaluation Survey and return it to your 3M representative or 3M authorized distributor. In response, 3M will evaluate your process and provide you with recommendations on how to modify existing equipment for effective and efficient operation with Novec fluids.

Company
Contact
Address
Title
City, State/Province
Phone
Zip Code
Fax
Your 3M Authorized Distributor

Equipment
Degreaser
Manufacturer
Model
Serial Number

Dimensions of Opening
Length
Width
Cover: Type
Power
Manual
House
Type
Process Chiller Temp. °F

Condensing
Refrigeration Temp. °F
Chilled Water Temp. °F
Other Temp. °F

Safety Controls
Liquid Temp. Setting
High Temp. Setting
Safety Vapor Setting
Vapor Up Setting
Other (name) Setting

Still
Manufacturer
Model
Serial Number

Cleaning Cycle
Immersion
Spray
Vapor

Process
Parts Cleaned
Type
Qty Per Load
Weight of Load
Type of Material

Current Solvent Usage (MO/WK)
Gallons

Cleanliness Standards
Visual
Ionic Testing
Water Break
Other

Guidelines for converting a cleaning process to 3M™ Novec™ Engineered Fluids

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- **Equipment Selection** | 5
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  - Boil Sump Filtration | 6
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- **General Operation Practices** | 10
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- **3M Equipment Evaluation Survey** | Back Cover Flap
Prior to converting your process to 3M™ Novec™ Engineered Fluids, 3M recommends you complete this Equipment Evaluation Survey and return it to your 3M representative or 3M authorized distributor. In response, 3M will evaluate your process and provide you with recommendations on how to modify existing equipment for effective and efficient operation with Novec fluids.

**Company**
- Contact
- Address
- City, State/Province
- Phone
- Zip Code
- Fax
- Your 3M Authorized Distributor

**Equipment**

<table>
<thead>
<tr>
<th>Degreaser</th>
<th>Still</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Model</td>
</tr>
<tr>
<td>Power Type</td>
<td>Heater</td>
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<tr>
<td>Proofover Chiller Temp. °F</td>
<td>Steam</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Condemning</th>
<th>Refugiaction Temp. °F</th>
<th>Chilled Water Temp. °F</th>
<th>Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Safety Controls</th>
<th>Liquif Temp. Setting</th>
<th>High Temp. Setting</th>
<th>Safety Vapor Setting</th>
<th>Vapor Up Setting</th>
<th>Other (name) Setting</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Parts Cleaned</th>
<th>Current Solvent Usage (MO/WK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Gallons</td>
</tr>
<tr>
<td>Qty. Per Load</td>
<td>Cleanliness Standards</td>
</tr>
<tr>
<td>Weight of Load</td>
<td>Visual</td>
</tr>
<tr>
<td>Type of Material</td>
<td>Ionic Testing</td>
</tr>
<tr>
<td>Cleaning Cycle</td>
<td>Water Break</td>
</tr>
<tr>
<td>Imersion</td>
<td>Other</td>
</tr>
<tr>
<td>Spray</td>
<td>Vapor</td>
</tr>
</tbody>
</table>

**Guidelines for converting a cleaning process to 3M™ Novec™ Engineered Fluids**

<table>
<thead>
<tr>
<th>3M Specialty Materials</th>
<th>3M Specialty Materials</th>
<th>Sumitomo 3M Limited</th>
<th>Asia Pacific and Latin America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>North America</td>
<td>Europe</td>
<td>Europe</td>
</tr>
<tr>
<td>3M Specialty Materials</td>
<td>3M Specialty Materials</td>
<td>Sumitomo 3M Limited</td>
<td>3M Confidential Solution</td>
</tr>
<tr>
<td>700</td>
<td>7000</td>
<td>3M Specialty Solutions</td>
<td>C1611-5/0/3 176-123</td>
</tr>
<tr>
<td>7100</td>
<td>7200</td>
<td>3M Specialty Solutions</td>
<td>3M Specialty Solutions</td>
</tr>
<tr>
<td>71DE</td>
<td>71DA / 71IPA</td>
<td>3M Specialty Solutions</td>
<td>3M Specialty Solutions</td>
</tr>
</tbody>
</table>

**Hydrofluoroethers**

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Introduction

Cleaning systems utilizing 3M™ Novec™ Engineered Fluids (hydrofluoroethers) are similar to, in many aspects, CFC-113 and HCFC-141b cleaning systems and can be used as direct replacements in a number of cleaning applications. In many cases, Novec engineered fluids cleaning systems can be evaluated and implemented without any modification to existing vapor degreasers. However, there are some differences that may require machine adjustments or other equipment modifications to ensure effective and economical process operation. These guidelines provide information which may be helpful when it is necessary to modify existing degreasing equipment to use Novec fluids.

The equipment required for these processes is similar to CFC-113 cleaning equipment. 3M azeotropes and blends can be used in single- or multiple-sump systems. Single-sump systems are generally limited to vapor phase cleaning and may require some flow (spray) stream rinsing. The Novec fluid cleaning process effectively cleans many oils, waxes and greases.

3M™ Novec™ Engineered Fluid Cleaning Process Descriptions

Novec engineered fluids are used in neat, azeotrope, and co-solvent cleaning processes.

Neat Cleaning

The Novec fluid neat cleaning process can use either 3M™ Novec™ Engineered Fluid HFE-7100 or HFE-7200 without additional solvents in applications that require a single component cleaning fluid and relatively low solvent power. The equipment required is similar to conventional CFC-113 or HCFC-141b cleaning equipment. HFE-7100 or HFE-7200 fluids can be used in single- or multiple-sump systems. Single-sump systems are generally limited to vapor phase cleaning and may require some flow (spray) stream rinsing. The Novec fluid neat cleaning process effectively cleans light oils, particulate contamination and halogenated lubes and oils.

Azeotrope/Blends Cleaning

The Novec fluid azeotrope cleaning system consists of two fluids. 3M™ Novec™ Engineered Fluid HFE-71DA (consisting of Novec engineered fluid HFE-7100 and Trans 1,2-dichlorethylene) and 3M™ Novec™ Engineered Fluid HFE-7100, Trans 1,2-dichlorethylene and ethanol). Both of these fluids are true azeotropes with constant composition at their boiling points. These fluids are suitable in applications requiring a stronger solvent mixture such as degreasing and defluxing.

3M™ Novec™ Engineered Fluid HFE-71IPA (consisting of Novec fluid HFE-7100 and 5% IPA) is suitable for light soils and applications requiring a more polar solvent.

Co-Solvent Cleaning

The Novec fluid co-solvent cleaning process operates with HFE-7100 fluid as a rinsing and drying agent in combination with a solvating/cleaning agent selected for the cleaning application. The 3M co-solvent process utilizes cleaning and rinsing agents that are miscible and of significantly different volatility and composition. The Novec fluid co-solvent system requires multi-sump capabilities and is effective for cleaning heavy oils, greases, fingerprints and fluxes. Additional information on solvating agents is provided on page 9.
The first step in converting to 3M™ Novec™ Engineered Fluids is selecting the appropriate cleaning process. Process selection is based upon the anticipated soils, substrates, parts geometry and throughput. The Novec fluid Cleaning Process Selection Guidelines (Table 1) are intended to assist in process selection. Cleaning trials may also be required.

### Table 1
3M™ Novec™ Engineered Fluid Cleaning and Degreasing Process Selection Guidelines

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple Plastic Parts</td>
<td>OK</td>
<td>Check for compatibility$^2$</td>
<td>OK$^3$</td>
<td>Light Oils&lt;br&gt;Halogenated Lubes&lt;br&gt;Particulates</td>
<td>Medium Oils&lt;br&gt; Silicone Oils&lt;br&gt; Lubricants&lt;br&gt; Release Agents&lt;br&gt; Some Waxes</td>
<td>Heavy Oils&lt;br&gt; Hydrocarbon Greases&lt;br&gt; Silicone Greases&lt;br&gt; Buffing Compounds&lt;br&gt; Polishing Agents&lt;br&gt; Fingertips&lt;br&gt; Flux Residue</td>
</tr>
<tr>
<td>Complex Plastic Parts</td>
<td>OK</td>
<td>Check for compatibility$^2$</td>
<td>OK$^3$</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Simple Metal Parts</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex Metal Parts</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple Circuit Boards</td>
<td>Not Applicable</td>
<td>OK</td>
<td>OK</td>
<td>Not Applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex Circuit Boards</td>
<td>Not Applicable</td>
<td>OK</td>
<td>OK</td>
<td>Not Applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple Coils</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex Coils</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ball/Roller Bearings</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catheters</td>
<td>OK</td>
<td>Check for compatibility$^2$</td>
<td>Not Applicable</td>
<td>Check for compatibility$^2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elastomer Parts</td>
<td>OK</td>
<td>Check for compatibility$^2$</td>
<td>OK$^3$</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass Parts</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$ Representative examples; not a complete list.

$^2$ The Novec fluid HFE-71DE and HFE-71DA azeotropes are incompatible with many plastics.

$^3$ Compatibility testing required.

Note: In cases where neat or azeotrope processes are not appropriate or applicable, the co-solvent process should be considered due to its capability to clean the broad range of soils.
Equipment Selection

3M™ Novec™ Engineered Fluids can be used in most new and existing conventional multi-sump cleaning systems. The Novec fluid neat, azeotrope and blend processes can also be used in single-sump systems. In many cases, no or minimal modifications are required in order to effectively use existing equipment. Schematics of standard vapor degreasing equipment and fully modified equipment are shown in Figures 1 and 2, respectively. The Equipment Evaluation Survey in the back of this brochure can assist you in determining the utility of existing equipment.

Prior to conducting cleaning evaluations in your plant to verify the effectiveness of Novec fluids in existing equipment, 3M recommends that appropriate seals be installed to avoid leaks. If the equipment is currently operating with HCFC-141b, the existing seals should be compatible with Novec fluids. Buna N and EPDM gaskets are compatible with 3M™ Novec™ Engineered Fluid HFE-7100, HFE-7200 and HFE-711PA. Use only EPDM gaskets with 3M™ Novec™ Engineered Fluid HFE-71DE and HFE-71DA, and with co-solvent processes.

When using Novec fluids in an ongoing cleaning process, 3M recommends that additional equipment modifications be considered in order to optimize the process effectiveness and economics by increasing agitation and minimizing fluid emissions.

---

Figure 1
Conventional Vapor Degreasing Equipment

---

Figure 2
Fully-Modified Vapor Degreasing Equipment

---

1 Fully-modified equipment can result in optimum performance and economy when used with Novec fluid processes.
Optimizing Existing Equipment

3M™ Novec™ Engineered Fluid process equipment is similar to conventional vapor degreasers. For some applications the primary modification to be considered for optimum cleaning performance is the addition of agitation (mechanical and/or ultrasonic). In addition, 3M urges customers to implement procedures that will minimize vapor emissions. The following equipment designs and features should be considered, if not already present:

- 100%–125% freeboard
- a filtration system in the boil sump
- ultrasonics in the rinse sump and (if needed) boil sump
- chiller coil(s) above the condensing coils
- an auxiliary heater (if needed)
- safety sensor adjustments

Each of these items is discussed below.

**Freeboard (100%–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. If not already present, a sliding cover should be added to the machine. A sliding cover is preferable to a lift-off or hinged cover since lift-off or hinged covers create a pumping or suction action when removed, which can increase fluid/vapor losses.

**Boil Sump Filtration**
Filters are recommended for removing particulate matter from the system. Steel tubing with compression fittings or welded stainless steel pipe is recommended. If threaded fittings are being used, seal with Loctite™ 290 thread sealant and an appropriate primer; however, 3M DOES NOT RECOMMEND the use of threaded pipe connections. The boil filter pump is sized to recirculate the tank volume once every 10–15 minutes at a pressure sufficient to go through the filters. Welded pipe dictates the use of raised-face flanged connections around the boil filter pump. This allows easy access to the pump for maintenance. Valves should be placed such that the boil filter pump can be removed or serviced without draining the machine. The boil sump filters can be cartridge or bag. The filter's particle size specifications are to be consistent with the needs of the process.

**Ultrasonics**
In most cases, submersible transducers are preferred because they are easy to install. Some working space will be taken up when submersibles are used. If the submersibles are placed on the bottom of the boil sump, the top of the weir can be extended to make up for lost height in the boil sump. In these cases, care must be taken to avoid reducing the height of the vapor zone. If the submersibles are placed in the bottom of the boil sump, they must be on legs so they do not interfere with heat transfer in the tank. Several manufacturers have developed commercially available ultrasonic systems that are effective for use in both the boil and rinse sumps.

**Chiller Coils**
Chiller coils above the primary condensing 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). The condensing coils can be smooth surfaced, but finned tubing is preferred for chiller coils. The chiller coils must be placed directly above the condensing coils. Depending on ambient humidity, the chiller coils may require a defrost cycle to prevent formation of ice and a reduction in cooling efficiency. Two separate lines on the chiller coils allow one to be defrosted while the other maintains the cold blanket. A third set of dehumidifying coils located at the top of the cleaner is not required to minimize the emissions of vapors, and should not be used.

**Auxiliary Heater**
An auxiliary heater can be added to the boil sump if additional heating capacity is required. There should be enough heat available to provide a distillation (boil-up) rate from the boil/cleaning sump that is 1 to 2 times the volume of the rinse sump per hour. The higher boil-up rate will provide more efficient cleaning and higher parts throughput. The refrigeration system must have adequate capacity to remove any additional heat provided.
Safety Sensor Adjustments

The safety sensor(s) on existing equipment may require adjustment in order to function effectively with 3M™ Novec™ Engineered Fluids. Figure 3 illustrates typical locations and operations of the safety sensors.

1. Safety Vapor Control Sensor (SVC)–Turns off heat if vapors rise above the primary cooling coil.
2. High Temperature Control (HTC)–Turns off heat if heating element becomes exposed to air (or otherwise becomes extremely hot).
3. Liquid Temperature Control (LTC)–Turns off heat based on set point of boiling solvent tank, as related to contamination build-up in boiling tank.
4. Vapor Up Control (VUC)–Indicates machine is at operating temperature.

The recommended settings for the four safety sensors described above are given in the table below.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Neat Cleaning System</th>
<th>Neat Cleaning System</th>
<th>Azeotrope Cleaning System</th>
<th>Co-Solvent Cleaning System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Novec fluid HFE-7100 &amp; HFE-71IPA Boiling Point 140°F (60°C)</td>
<td>Novec fluid HFE-7200 Boiling Point 172°F (78°C)</td>
<td>Novec fluid HFE-71DE Boiling Point 104°F (41°C)</td>
<td>Boiling Point 144°F–194°F (62°C–90°C)</td>
</tr>
<tr>
<td>1. SVC</td>
<td>122°F (50°C)</td>
<td>154°F (68°C)</td>
<td>90°F (32°C)</td>
<td>122°F (50°C)</td>
</tr>
<tr>
<td>2. HTC</td>
<td>158°F (70°C)</td>
<td>190°F (88°C)</td>
<td>122°F (50°C)</td>
<td>18°F (10°C) above B.P.</td>
</tr>
<tr>
<td>3. LTC</td>
<td>149°F (65°C)</td>
<td>185°F (85°C)</td>
<td>113°F (45°C)</td>
<td>9°F (5°C) above B.P.</td>
</tr>
<tr>
<td>4. VUC</td>
<td>131°F (55°C)</td>
<td>167°F (75°C)</td>
<td>97°F (36°C)</td>
<td>131°F (55°C)</td>
</tr>
</tbody>
</table>

Minimizing Vapor Loss

Cutting vapor loss helps reduce costs and environmental impact of any solvent cleaning process. 3M recommends that customers review and implement as many of the containment and recovery procedures as possible. These procedures include extending the freeboard and adding freeboard chiller coils as discussed above. Additional fluid containment procedures include:

1. Reduce the potential for leaks with 3M™ Novec™ Engineered Fluids HFE-7100, HFE-7200 and HFE-71IPA by using Buna N or EPDM gaskets and seals. Use only EPDM gaskets with 3M™ Novec™ Engineered Fluid HFE-71DE and HFE-71DA, and with co-solvent systems.
2. Minimize dragout losses by using a programmable hoist system.
3. Check periodically for leaks in piping and pumps. A halogen leak detector is recommended.
4. Avoid threaded pipe fittings.
Part Processing

The ideal boil-up and agitation rate is based upon the anticipated soils, substrates, parts geometry and throughput. Part Processing Boil-Up and Agitation Rate Guidelines are intended to assist in identifying optimal cleaning conditions. Cleaning trials may also be required. For additional help in optimizing your cleaning application, call your 3M sales representative or a 3M authorized 3M™ Novec™ Engineered Fluid distributor.

Table 3
Part Processing Boil-Up and Agitation Rate Guidelines

<table>
<thead>
<tr>
<th>Agitation and Boil-up¹</th>
<th>Low (Agitation provided from boil and slight spray bar action)</th>
<th>Medium (Agitation from pump action in spray bars)</th>
<th>High (Standard for Ultrasonic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 x Boil-up rate</td>
<td>• Open structure metal parts (no close tolerances)</td>
<td>• Ultrasonics not appropriate</td>
<td>• Parts with tight clearances and small amounts of carry-over</td>
</tr>
<tr>
<td></td>
<td>• Parts with large heat capacity</td>
<td>• Small amounts of carry-over² are present</td>
<td></td>
</tr>
<tr>
<td>MEDIUM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 x Boil-up rate</td>
<td>• Open structure parts not suited to ultrasonics</td>
<td>• Ultrasonics not appropriate</td>
<td>• Parts with tight clearances and medium carry-over</td>
</tr>
<tr>
<td></td>
<td>• Medium carry-over present</td>
<td>• Medium carry-over present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Open structure parts with medium heat capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 x Boil-up rate</td>
<td>• Open structure plastic parts with low heat capacity</td>
<td>• Ultrasonics not appropriate</td>
<td>• Parts with open blind holes (typical of electrical connectors)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Large carry-over</td>
<td></td>
</tr>
</tbody>
</table>

¹ “Boil-up” is the rate at which material is vaporized from the boil sump (lbs./hr.), divided by the number of lbs. of material in a completely filled rinse sump.

² “Carry-over” is the solvent and soil carried from the cleaning sump to the rinse sump during cleaning. Examples of parts with high, medium and low carry-over are: (high) electric motor windings, unsealed electrical connectors, and small nested parts; (medium) electric coil windings, assembled bearings, and printed circuit boards; (low) unassembled bearings and single parts.
The recommended solvating agents for the 3M™ Novec™ Engineered Fluid co-solvent process are manufactured by Petroferm, Inc. These solvating agents (e.g., SA-70, SA-24) have been tested and approved for use with 3M™ Novec™ Engineered Fluid HFE-7100.

In addition, there are other solvating agents that can be used in the Novec fluid co-solvent cleaning process.

Combinations of these solvating agents are possible. The solvating agent selected will depend on the cleaning application and the efficiency of the solvating agent chosen must be verified by the user. Your 3M representative and your 3M authorized distributor can offer guidance in solvating agent selection.

### Table 4

3M™ Novec™ Engineered Fluids Materials Compatibility

Testing on 3M™ Novec™ Engineered Fluid HFE-7100 and HFE-71IPA indicate good compatibility with a variety of metals, plastics and elastomers. Novec fluid HFE-7100 is compatible with the following substrates (one hour of exposure at boiling temperature).

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

3M™ Novec™ Engineered Fluid HFE-71DE and HFE-71DA are compatible with the following substrates (one hour of exposure at boiling temperature).

<table>
<thead>
<tr>
<th>Metal</th>
<th>Plastics</th>
<th>Elastomers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>Parts containing</td>
<td>Parts containing</td>
</tr>
<tr>
<td>Copper</td>
<td>plastic materials</td>
<td>elastomeric materials</td>
</tr>
<tr>
<td>Carbon Steel</td>
<td>should be evaluated</td>
<td>should be evaluated</td>
</tr>
<tr>
<td>302 Stainless Steel</td>
<td>for compatibility</td>
<td>for compatibility</td>
</tr>
<tr>
<td>Brass</td>
<td>prior to cleaning</td>
<td>prior to cleaning</td>
</tr>
<tr>
<td>Zinc</td>
<td>with Novec fluids</td>
<td>with Novec fluids</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>HFE-71DE and</td>
<td>HFE-71DE and</td>
</tr>
<tr>
<td>Tantalum</td>
<td>HFE-71DA</td>
<td>HFE-71DA</td>
</tr>
<tr>
<td>Titanium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tungsten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu/Be Alloy C172</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium Alloy AZ31B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
General Operation Practices

The following operating practices are recommended to reduce vapor and dragout losses and to ensure parts are thoroughly cleaned, rinsed and dried.

1. Eliminate drafts near the cleaning equipment. Drafts increase vapor losses by causing disturbances in the vapor-air interface.

2. A sliding cover is recommended to minimize vapor-air interface disturbances. Opening the cover slowly will reduce vapor losses.

3. Do not begin cleaning operations until the equipment is at operating temperature. This will help ensure the parts are adequately heated and that the rinsing agent will evaporate when the parts are raised into the freeboard area.

4. The parts processing rate established for your equipment should not be exceeded. Inadequate residence times result in liquid being removed with the part (dragout), thereby increasing fluid losses. Suitable residence times should be established to ensure that parts are completely cleaned, rinsed and dried. Automation with a programmable hoist system can ensure that the processing time is maintained at the established rate.

5. Use spray only if required and then only below the cooling coils. Misdirected spraying can splash above the coils and increase losses.

6. Arrange parts so that fluids drain readily. Some parts can trap fluids, making them more difficult to rinse and increasing fluid dragout losses. Tumbling the parts before removing them from the vapor zone will help remove excess fluid.

7. Do not lift parts above the vapor zone when transferring from the boiling sump to the rinsing sump.

8. Follow machine safety, operating and maintenance procedures.

9. Perform regular checks for fluid leaks from the equipment, especially piping, valves, and housings.

10. Do not place hands below the vapor line. To place parts in sumps, use hooks, automated equipment or long-handled baskets.

11. Monitor fluid usage and locate leaks if usage increases.

Frequently Asked Questions

This section presents questions frequently asked by customers converting equipment to one of the 3M™ Novec™ Engineered Fluids cleaning processes.

Why do I sometimes need new or optimized equipment?

New equipment or modifications to existing equipment can help reduce fluid losses and improve the economy of the process. In addition, several other design features can help improve cleaning performance and throughput when added to existing machines.

Can my existing vapor degreaser be optimized?

Customers can evaluate the process in existing equipment without optimizing to confirm performance. If your vapor degreaser is a conventional, two-sump batch vapor degreaser and in relatively good condition, it could be optimized for a Novec fluid process. 3M recommends customers contact an approved Novec fluid equipment manufacturer for a quotation and/or new process equipment price and availability. 3M authorized distributors or 3M sales representatives can recommend qualified equipment specialists.

What safety features should 3M™ Novec™ Engineered Fluid systems have?

There are a number of safety features that are used on all equipment including Novec fluid process equipment. While not all of the features are listed here, they include: sensors to monitor the liquid level in the boil sump, sensors to detect vapor flow above the cooling coils, a thermostat to control the heat source in the boil sump, a coolant flow switch to sense the incoming cooling water, and a manual reset thermostat to de-energize the heat source if the condenser coolant exceeds the upper temperature limit.

How do I locate 3M™ Novec™ Engineered Fluid leaks?

There are a number of detection devices available including common halogen leak detectors used in refrigeration servicing that will respond to Novec fluids. Contact your local 3M authorized distributor or 3M sales representative for recommendations.

Who are the equipment vendors approved to make 3M™ Novec™ Engineered Fluid process equipment?

Contact names, addresses, and phone numbers for the approved equipment manufacturers in the United States, Asia and Europe are available from 3M and 3M authorized distributors.
Prior to converting your process to 3M™ Novec™ Engineered Fluids, 3M recommends you complete this Equipment Evaluation Survey and return it to your 3M representative or 3M authorized distributor. In response, 3M will evaluate your process and provide you with recommendations on how to modify existing equipment to effectively and efficiently operate with Novec fluids.

Company  
Contact  
Address  
City, State/Province  
Phone  
Zip Code  
Your 3M Authorized Distributor

### Equipment

**Degreaser**
- Manufacturer: [Insert Manufacturer]
- Model: [Insert Model]
- Serial Number: [Insert Serial Number]

**Dimensions of Opening**
- Length: [Insert Length]
- Width: [Insert Width]
- Circle: Type: [Insert Type]
- Power: Manual
- Hose: [Insert Type]
- Freeboard Chiller Temp: °F

**Condemning**
- Refrigeration Temp: °F
- Chilled Water Temp: °F
- Other: [Insert Other Temp]

**Safety Controls**
- Liquid Temp. Setting: [Insert Setting]
- High Temp. Setting: [Insert Setting]
- Safety Vapor Setting: [Insert Setting]
- Vapor Up Setting: [Insert Setting]
- Other (name): [Insert Setting]

**Heat**
- Elc: [Insert Elc]
- Volt: [Insert Volt]
- Phase: [Insert Phase]
- Steams: [Insert Steams]
- PSCO: [Insert PSCO]

**Cleaning Cycle**
- Immersion: [Insert Immersion]
- Spray: [Insert Spray]
- Vapor: [Insert Vapor]

**Parts Cleaned**
- Type: [Insert Type]
- Qty: [Insert Qty]
- Wt. of Load: [Insert Wt. of Load]

**Type of Material**
- Cleaning Cycle: [Insert Cleaning Cycle]
- Solvent Usage (MO/WK): [Insert Solvent Usage]

**Cleanliness Standards**
- Visual: [Insert Visual]
- Ionic Testing: [Insert Ionic Testing]
- Water Break: [Insert Water Break]
- Other: [Insert Other]

Guidelines for converting a cleaning process to 3M™ Novec™ Engineered Fluids

**Company Contact**
- Address: [Insert Address]
- City, State/Province: [Insert City, State/Province]
- Phone: [Insert Phone]
- Zip Code: [Insert Zip Code]
- Your 3M Authorized Distributor

Important Notice to Purchaser: The information in this publication is based on tests that we believe are reliable. Your results may vary due to differences in test types and conditions. You must evaluate and determine whether the product is suitable for your intended application. Since conditions of product use are outside of our control and vary widely, the information is treated as useful but not as a guarantee of performance. There are no express or implied warranties, including the warranties of merchantability or fitness for a particular purpose, on this product. The user assumes all risk of injury or property damage that may result. In no event will 3M be liable for any special, incidental, or consequential damages based on breach of warranty or contract, negligence, strict tort, or any other theory.

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