3M™ Novec™ Engineered Fluids – Solvent cleaning case study Ebook
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Introduction

For most users of precision cleaning solutions, their working environment is fast-moving and complex. Fortunately, there’s no longer a need to trade-off performance for sustainability and safety.

This eBook looks at real world case studies showing examples of how 3M™ Novec™ Engineered Fluids are helping businesses achieve their goals in key segments like Aerospace, Medtech, Automotive, and Electronics.

Compared to using an aqueous cleaning system, a closed-loop Novec cleaning solution eliminates water use – a valuable resource. Novec 73DE has no flashpoint and is low in toxicity, providing a safe working environment.

3M Novec fluids is a strong and non-flammable solvent with a stable composition. Once released, it has a short atmospheric lifetime and low global warming potential (GWP). This makes it environmentally sustainable and able to stand up to the toughest industry standards.

Many cleaning solvents are restricted for use due to environmental concerns, but Novec complies with all regulatory requirements, including the EU REACH (Registration, Evaluation, and Authorization of Chemicals) regulation.
3M™ Novec™ Engineered Fluids – Performance, Sustainability, Safety.

Product properties

3M™ Novec™ 73DE Engineered Fluid is a cleaning, rinsing and drying agent that has a stable composition at boiling point and is used for precision cleaning in a range of industries, including aerospace and medical devices.

The fluid easily penetrates tight spaces on complex parts due to a combination of low surface tension and low viscosity and removes all traces of dirt, grease and contaminants without leaving any residue.

Based on 3M proprietary segregated hydrofluoroether (HFE) chemistry, 3M Novec fluids have many properties that contribute to their diverse use. They are chemically and thermally stable with very low viscosity and surface tension, which allows them to evenly clean irregular surfaces, penetrating complex geometries and low-profile components.

They can be used on a wide variety of sensitive equipment such as printed circuit boards, medical devices, and aerospace parts. Within the aerospace market, for example, customers can use 3M Novec fluids prior to surface treatment, cleaning of engine parts or bearings.

HFE’s make the mixtures non-flammable and more efficient for cleaning complex geometries, thanks to their low surface tension. These properties, combined with low vapour diffusion rates, high liquid density and boiling points range (from 41 °C to 76 °C), mean 3M Novec fluids are easily incorporated into typical vapour degreasing equipment. They are easily contained and recirculated in these machines, avoiding loss of product during operation which significantly reduces the total process costs.
3M™ Novec™ Engineered Fluids – Performance, Sustainability, Safety.

We provide a variety of cleaning solvents to meet your demanding requirements without damaging the materials to be cleaned.

Material compatibility overview

At the following pages, case studies with a lot more details about specific cleaning challenges will be introduced.

This can be a good reference for your own cleaning challenges.
Improved cleaning of orthopaedic implants.

“Our main motivation was to improve the working environment at Beznoskåa, and the new regime has been well accepted. The machine is very easily operated and the whole process performs very well. For any MedTech companies who intend to improve the quality, safety or overall process of their cleaning regime, Novec fluids are definitely worth considering.”, comments Jiri Bichler, Head of Production

Beznoska is a Czech-based developer and manufacturer of implants and surgical tools for orthopaedic surgery.

They pride themselves on manufacturing innovation and have been awarded several patents for hip joints and ligament apparatus.

No room for error

Since Beznoska implants end up in the human body, there can be no compromise on cleaning of the devices during the manufacturing process. The devices must be 100% clean, as the smallest amount of contamination could cause a toxic burden for the patient, or failed integration of the implant, leading to loosening. Both scenarios could result in repeat surgery. From a manufacturing perspective, anything less than a positive result during periodic process evaluation leads to delay in product finishing and can cause additional costs to remedy.
Improved cleaning of orthopaedic implants.

The old regime
Previously, the cleaning regime for orthopaedic implants used a combination of alkaline and acidic industrial, water-based degreasers, cleaning the implants at elevated temperatures in an ultrasound bath. This was followed by rinsing in clean water and drying with compressed air, all operations being performed manually. The old regime was a very labour intensive process, requiring lengthy preparation at the start of each shift. An improved system was sought to simplify the whole process, and also improve the working environment for operators.

The new process
Now, an operator places the newly manufactured parts onto a tray, which is automatically grabbed by a robotic arm and transported into the 90 litre cleaning tank of the new MEG machine. The tank is divided into two sections. In the first one, parts are pre-cleaned in vapours of 3M™ Novec™ 72DA Engineered Fluid at a temperature of 42°C. The robotic arm then moves the tray into the second section. Here the tray is completely immersed in Novec fluid and the ultrasound is started, with tray movement applied for better cleaning.
Cost effective replacement of an aqueous cleaning system.

“The previous cleaning system not only took a long time, but involved a lot of manual stages, taking up valuable production time. It also left stains and spots on many of the parts which needed to be re-cleaned.“, comments 3M Business Development Executive, Cristiano Silva

3M™ Novec™ 73DE Engineered Fluid offers a high performance, environmentally sustainable degreasing and immersion cleaning solution.

The challenge

Switching to a smarter cleaning regime
One orthopaedic implants manufacturer has switched to the 3M™ Novec™ 73DE Engineered Fluid cleaning system for the components that it produces for the medical profession. Before switching to the 3M system, the company relied on an aqueous cleaning system to clean the implant parts and tools.

The process involved cleaning with water and detergent followed by several rinsing steps and then immersion in water before the parts were transferred to an energy-consuming hot drying chamber. Each cleaning cycle took up to an hour and was not effective, with a manual rework needed for one third of the parts after cleaning.

The solution

A precision cleaning solution for orthopaedic implant
The production of medical implants, such as replacement orthopaedic joints made from stainless steel and titanium, requires precision at every stage in the process.

This includes a robust cleaning stage to ensure that no residue, particles or contaminants are left on the implants before they are sterilized and dispatched to hospitals ready to be used in surgery.

3M™ Novec™ 73DE Engineered Fluid is a cleaning, rinsing and drying agent that has a stable composition at boiling point and is used for precision cleaning in the medical industry.

The fluid easily penetrates tight spaces on complex parts due to a combination of low surface tension and low viscosity and removes all traces of dirt, grease and contaminants without leaving any residue.
Cost effective replacement of an aqueous cleaning system.

“3M Novec fluid is gentle on all metallic substrates and offers a very effective way to clean complex parts, leaving no residue, particles or contaminants. This is essential for a component that is used in surgery. Our solution for this customer was a bespoke closed-loop cleaning solution made up of large tanks filled with Novec.

The parts are immersed in Novec and cleaned thoroughly in just 10 minutes, without leaving any spots or stains. The components are then lifted from the cleaning tank into the drying area, where the Novec solvent quickly evaporates without any further heating needed. The Novec fluid recirculates in the closed-loop system, creating an energy-efficient solution.”, comments 3M Business Development Executive, Cristiano Silva

Key insights

Calculating the total cost of ownership
3M Novec fluids are high performing, cost effective alternative to water-based cleaning solutions.

As well as delivering exceptional performance, the use of a Novec cleaning system not only increases productivity, but also lowers operating costs due to the short cycle times that are considerably faster and a significant reduction in energy consumption.

After the initial cost of the new equipment is recouped, the Novec cleaning system is about 60 per cent cheaper to run than an aqueous cleaning system based on the same yearly volume of parts cleaned. As well as saving time and money, switching to Novec is better for workers, and the environment too.
A precision cleaning solution for aircraft maintenance.

“The on-site cleaning process developed for the airline is a closed-loop system that recirculates the Novec fluid to create a cost-effective, energy-efficient process that has improved productivity. As well as offering an effective, consistent cleaning system, switching to Novec has also driven benefits for workers and the environment as it has low toxicity, a low global warming potential (GWP) and evaporates quickly.”, comments Rudi Van San, 3M Application Engineer.

With its reliance on highly sensitive equipment and electronic components, cleaning is a critical process for the aerospace industry.

In aircraft maintenance, for example, the cleaning of landing gear systems made from metals such as titanium requires a precision cleaning system that ensures that no residue, particles or contaminants are left behind before re-assembly.

The challenge

Cleaning landing gears with 3M™ Novec™ 73DE Engineered Fluid for precision and improved productivity

One national airline has adopted an immersion cleaning system using Novec for the precision cleaning of landing gears and other essential metallic parts during routine maintenance.

The components are then lifted from the cleaning tank into the drying area, where the Novec solvent quickly evaporates without any further heating needed, ready for visual inspection.
A precision cleaning solution for aircraft maintenance.

As well as being used in an immersion cleaning system, Novec can also be sprayed onto aircraft parts that are hard to remove.

Why choose Novec?

- The fluid is fully compatible with all metals, including titanium
- Cleaning is enhanced with mechanical agitation
- The system operates at low temperatures of around 50°C
- Parts are cleaned and dried quickly (around 10 minutes)
Oxygen compatibility with 3M™ Novec™ Engineered Fluids.

Oxygen systems cleaning is a critical application, with a high propensity for contamination, risk of contact with combustible residues and consequent increased risk of explosion. 3M Novec 7100 and 71DE fluids, hydrofluoroethers, have proven to be suitable in many critical Liquid Oxygen (LOX) / Gaseous Oxygen (GOX) cleaning applications.

3M™ Novec™ 71DE and 3M™ Novec™ 7100 Engineered Fluids offer a high performance, environmentally sustainable degreasing and immersion cleaning solution.

The challenge

3M Novec 7100 fluid has been tested and found to be compatible with liquid and gaseous oxygen and the materials typically utilised in these systems. It has been qualified by government and military bodies as well as commercial organisations for use in LOX / GOX cleaning. These qualifications include tube flushing, vapour degreasing and wiping. It is also used as a cleanliness verification fluid after cleaning operations to count potential remaining particles. When increased solvency is required, 3M Novec 71DE fluid is generally part of a two-step process. 3M Novec 71DE fluid is a cleaning, rinsing and drying agent that has a stable composition at boiling point (azeotropic blend).

Cleaning with 3M™ Novec™ 71DE Engineered Fluid combined with a 3M™ Novec™ 7100 Engineered Fluid flush contributes to process safety with both outstanding cleanliness and the capability of removing solvent residue.

3M™ Novec™ Engineered Fluids are an example of a technology used across a range of applications, including heat transfer, precision cleaning, coating, fire extinguishing and more.

Within medtech devices, customers can use 3M Novec fluids for precision cleaning and particulates removal from oxygen system parts, as well as for dissolving fluorinated oils and greases.

During an unpredictable period like the Covid crisis, companies have been mobilised in the manufacture of oxygen equipment such as medical ventilators.
Cleaning with 3M™ Novec™ 71DE Engineered Fluid combined with a 3M™ Novec™ 7100 Engineered Fluid flush contributes to process safety with both outstanding cleanliness and the capability of removing solvent residue.

Among different standard tests concerning the cleaning of oxygen systems, there are two main norms from the American Society for Testing and Materials (ASTM) that the product must comply with:

- ASTM G93: Standard Practice for Cleaning Methods and Cleanliness Levels for material and equipment used in oxygen-enriched environment.
- CGA G-4.1: Cleaning equipment for oxygen service (CGA: Compressed Gas Association)

3M Novec fluid has a low surface tension, is non-flammable with a stable composition and high solvency. This combines to make 3M Novec fluid a high performing, cost effective alternative to water-based cleaners.

3M Novec 7100 fluid may be used to thoroughly flush or rinse the system once cleaning with 3M Novec 71DE fluid is complete.

3M Novec 71DE fluid may be used as the sole cleaner in applications where complete evaporation/removal can be verified. Regardless of the method, verification of any oxygen component cleaning system should be established using procedures that have been reviewed and certified by qualified individuals or organisations.

Examples of applications/parts: Connectors, valves, cylinders, gauges and regulators

3M Novec fluids easily penetrate tight spaces on complex parts due to the combination of low surface tension and low viscosity and has been qualified by the major OEMs in the aerospace industry to clean hydraulic tubes.

Using 3M Novec fluid in a cleaning process can provide exceptional performance, lower operating costs, short cycle times, a high safety margin for workers and a low environmental impact.
3M™ Novec™ Engineered Fluids are designed to balance performance with favourable environmental and worker safety properties.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of proprietary 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, protective coatings, immersion cooling, advanced insulation media replacement solutions and several specialty chemical applications.


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