



## CASE STUDY

### CUSTOMER

NATIONAL OILWELL VARCO, STEP ENERGY SERVICES

### LOCATION

CALGARY AB, CANADA / 2018

### EQUIPMENT

NEW-BUILD N2 PUMPER WELL SERVICING TRUCK

### APPLICATION

BUMPER-BUMPER FILTRATION

### PROVEN RESULTS



BREAK-IN  
WEAR  
REMOVED

ALL SYSTEMS  
PROTECTED



## INDUSTRY PARTNERS DRIVING RELIABILITY

STEP Energy Services (STEP) and National Oilwell Varco (NOV) are reliability leaders in the oil and gas downstream industry. STEP and NOV have partnered with OEI on multiple occasions to design and manufacture well servicing equipment that is outfitted with state-of-the-art magnetic filtration with the intent of driving reliability, safety, and cost savings.

STEP Energy Services holds themselves to their own high expectations for exceptional client services; through accountability, technical knowledge, purpose-built equipment and industry leading proactive maintenance programs. The team at NOV also prides themselves on harnessing experience and innovation to minimize risk, increase uptime and improve performance for drilling operations around the world.

As part of their proactive maintenance program, STEP Energy Services deploys OEI magnetic filtration on all major equipment components to protect fluids, gases, and lube oils against sub-micron wear contamination. To ensure the highest-quality builds, NOV collaborates with OEI to design filters that meet their new-build equipment installations, space restrictions and fluid application parameters.

## PUTTING MAGNETIC FILTRATION TO THE TEST

In 2018, NOV, STEP and OEI collaborated to outfit a new-build N2 Pumper with 13 uniquely designed OEI magnetic filters. To showcase the criticality of employing OEI filtration on new-build equipment, a test was run to determine how much break-in wear contamination is produced during initial operation.





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### TEST

Run the new-build N2 Pumper for 5 minutes with 13 OEI magnetic filters deployed on the various fluid applications. Evaluate how much break-in wear is produced to determine the criticality of magnetic filtration at the OEM level.

### RESULTS

After the first 5 minutes of runtime, every magnetic filter installed pulled significant amounts of wear contamination from the system. Without magnetic filtration, the contamination would continue to circulate through critical systems, wearing on components and causing premature failures. If left in the system, the break-in wear contamination would build throughout the N2 Pumper, damaging close tolerance components such as bearings, injectors, and valves, reducing operating life.

### MAIN ENGINE LUBE OIL

This engine oil filter is part of the OEI ADD-Vantage 9000 series. This filter replaces conventional spin-on and cartridge filters. It employs a magnetic element and a stainless steel cloth element in its design for high efficiency filtration. In this application, the filter is installed prior to traditional filtration to extend the life span of the OEM depth media filter which is only capable of filtering to 20-micron wear particle sizes. OEI technology captures particles down to 4 microns and below. This is critical in protecting bearings and other close tolerance components.

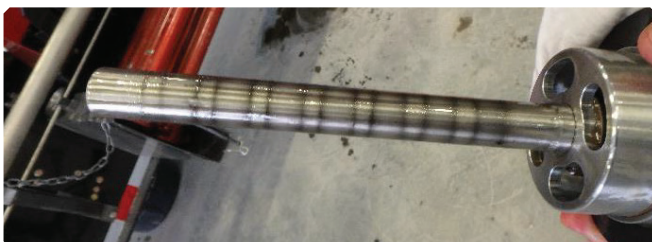


*This filter is working in conjunction with existing depth media filtration – because of the magnetic filtration, the conventional filtration is expected to last longer because the Magnetic Filter Element removes the fine contamination before hitting the depth media.*

**Arthur Fekete, Application Specialist, NOV**

### REMOTE ENGINE LUBE OIL

OEI supplies a remote filtration system for end users who prefer additional filtration that works with and enhances OEM filters. In terms of engine oil filtration, OEM filters are designed to maintain flow and are efficient in filtering wear contamination particles down to approximately 25 microns. OEI technology offers end users the option to install a remote magnetic filter in conjunction with the OEM filter. The OEI alternative, is installing a standalone ADD-Vantage 9000 dual filter with a cleanable, stainless-steel cloth element for large dirt and wear particles and a magnetic filter element to capture contaminants down to sub-micron levels.



*Engine oil filtration through remote filters allows us to incorporate magnetic filtration in a location other than directly on the engine. The package on these units was developed with remote filtration in line to offer depth media or exclusive OEI filtration separately.*

**Arthur Fekete, Application Specialist, NOV**





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### MAIN ENGINE COOLANT

OEI manufactures and markets the only full flow coolant filter. The magnetic filter scrubber operates with minimal flow restriction and removes wear contaminate particles to 4 microns and below. This system is designed to collect contamination from full flow coolant, a sanitary coupling and tri-clamp make servicing the magnetic filter element efficient. By deploying the filter in-line, minimal coolant is lost during cleaning.



*Coolant filtration is something that is becoming increasingly agreed upon to be important to us. Coolant filtration is important and is a neglected part of the system. The reason, as you can see, there is a lot of contamination in engine coolant systems that damages pumps, causes unnecessary wear to the mechanical parts in the coolant circuit.*

**Arthur Fekete, Application Specialist, NOV**

*Coolant filtration on the bigger horse power engines has always been there from the OEM, most of them are just a place to put coolant additives in then they can replace coolant additives to keep the coolant viable. Magnetic filtration is non-existent from the OEMs, absolutely non-existent. They do not, in my opinion, want magnetic filtration in the coolant system and that primarily is because 80% of the diesel engines that fail, fail on coolant systems. Why do they want to make it any better when the engines last longer and they don't sell engines or parts and pieces.*

**Dale Constantine, Reliability Specialist, STEP**

### TRACTOR ENGINE COOLANT

Coolant system failures account for a large percentage of diesel engine failure. Causes of coolant system failure can include wear contamination of the engine during the manufacturing process and the refining process of the glycol. The auxiliary engine coolant filtration is designed for full flow coolant contact with the magnetic filter using a light weight stainless steel tubing and a clamp connection system.



*Previous attempts at coolant filtration were only effective with partial flow. OEI's design allows for full flow which exposes the coolant to a significant surface area of the magnetic field thereby capturing more contamination.*

**Arthur Fekete, Application Specialist, NOV**







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“NOV has been proactively installing Magnetic Filtration as a primary and supplementary filtration to conventional filtration since 2009 – we like to use it as a protective device on equipment as well as offer customers a predictive failure analysis on equipment. This is the first opportunity to do a retrofit of full magnetic filtration installation on a customer's piece of equipment. Magnetic filtration has a history with NOV, Hydrarig and Innerflo. It wasn't so much about this unit as 10 years of applying OEI technology to provide better filtration and better equipment reliability and availability to our customers. NOV takes a different approach than other installers of filtration products – we try to analyze each application and size the filtration for flow, viscosity and the environment. This unit was a retrofit so we had to work harder to get the filters to integrate as well as possible on the unit to provide the best possible filtration for the customer STEP”

**- Arthur Fekete, Application Specialist, NOV**

### MAIN ENGINE DIESEL FUEL

This OEI main engine fuel scrubber is designed for low pressure. In this application, it is installed prior to the OEM traditional depth media filtration. This placement of the OEI magnetic filter serves to pre-filter the diesel fuel, extending the life of the conventional depth media filtration. This OEI scrubber provides filtration to submicron levels, meeting the standards for new tier four engines which require 5-micron cleanliness due to 30,000 psi operating pressures.



*Diesel fuel injectors, because of the extremely high operating pressures up to 30,000 PSI, will become scored if 5-micron wear particle cleanliness isn't maintained. Once scored or washed out from fine debris moving at high fluid velocities, filtration efficiency drops and emissions increase.*

**Arthur Fekete, Application Specialist, NOV**

*Recently a major engine manufacturer increased the pressure from tier 2 to tier 4 and that increased the rail pressure but using the exact same filters and fuel rail, they were unsuccessful. They immediately had to address the filtration. But yet that's the same injectors that I've been using for the last 5 years and having fail rates off of warranty that exceed any acceptable limit so we have on STEP's part partnered with depth media filtration companies and OEI to give us a package that's plug and play – mount it on the stationary equipment with the line in and line out and with the worst case scenario fuel coming to it we can filter to what is required – not what the OEM says it should be but even better and strip those particles down.*

**Dale Constantine, Reliability Specialist, STEP**





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### TRANSMISSION FLUID

Transmission oil filtration improves with the addition of the OEI ADD-Vantage 9000 inside-out filter. This version of inside-out flow allows for pressures up to 500 psi which is ideal for a transmission application. The inside-out flow allows for pre-filtration via the magnetic filter element, reducing the contamination loading on the stainless-steel cloth element.



*Automatic transmission use friction plates to engage the planetary gear sets for each of the gears. Because of the friction engagement and friction plates express contamination throughout the operation of the transmission.*

**Arthur Fekete**

**Application Specialist, NOV**

### WEBASTO FUEL

In fuel applications, filtration to sub-micron levels is critical because of the close-tolerance components in injectors. In this case, there is low-flow volume, so the inline scrubber is designed with a bullet style, billet-aluminum housing. This design is economical, light-weight, and provides maximum dwell time of fluid past the magnetic filter element.

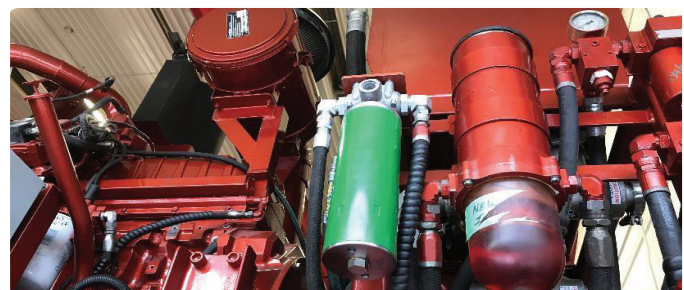
*We're relying completely on magnetic filtration to remove the contamination, there is no screen or depth media filter and we are using high density magnetic concentration to execute the filtration. The diesel fuel systems whether for engine injection systems, or for a device like the Webasto containing injectors, magnetic filtration is one of the few ways to get the fuel clean enough to protect the nozzles.*

**Arthur Fekete, Application Specialist, NOV**



### VAPORIZOR HIGH-PRESSURE FUEL

Vaporizer fuel filtration has a 1000 psi requirement. The requirement for submicron filtration is necessary because the diesel fuel, running at high velocity, causes rapid erosion of the fuel nozzles.







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### LUBE OIL (SUCTION)

This initial filtration between the sump and the lube oil pump provides pump protection and extends pump life. A triplex pump is gear driven; therefore, it creates high levels of contamination. Suction scrubbers further protect the pressurized depth media filtration in these systems.

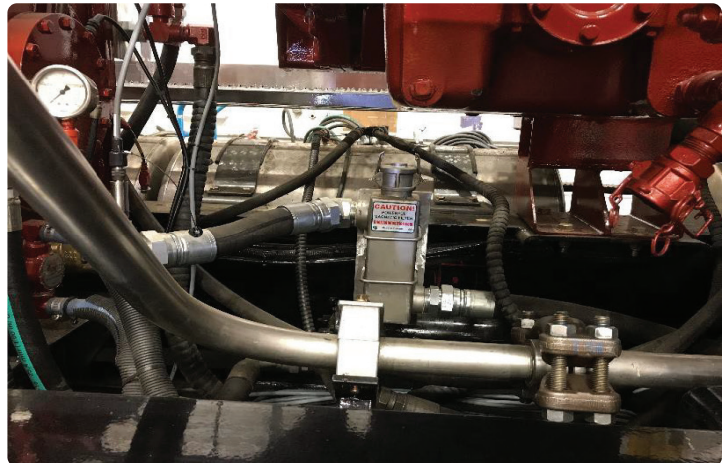


*Deployed in all hydraulic triplex high-pressure pumping applications. All scrubbers have low pressure drop so they work well with highly viscous oils without causing wear damage for the lube oil pump that lubricates the triplex device. Lube oil scrubbers are nearly a zero pressure drop device, so they are well suited for situations where restriction in the suction system can't be tolerated. If the suction scrubber magnetic element is pulled daily, operators become familiar with the appearance of the magnetic filer, if the characteristics of the particles attracted to the magnetic filter change, it can be used as a predictive maintenance tool to determine if the pump is okay to run or is damaged.*

**Arthur Fekete, Application Specialist, NOV**

### LUBE OIL (PRESSURE)

OEI markets its filtration technology as an enhancement to existing traditional filtration as well as a standalone solution for rotating equipment applications. NOV and STEP have embraced this innovative technology, and are forces of cultural change in the well service industry.



*Lube oil filtration for the np1000 NOV triplex required improvement to the existing depth media filtration provided. OEI's willingness to work with us to create a filtration product that included depth media filter required by our customer base and a magnetic filter element allowed us to create a single device that does both things for the customer. This product is inside - out flow – prefiltration by the Magnetic Filter Element and secondary filtration by the depth media element.*

**Arthur Fekete, Application Specialist, NOV**





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*“In the oil and gas service industries we’ve been increasingly competitive and the clients have demanded more reliability. We’ve used OEI magnetic filtration tech from the start at STEP Energy Services and we’ve increased the reliability of our equipment by 2-3 fold and increased the bottom line because you’re not having to address maintenance concerns because there are none – or they’re reduced down to a manageable account. The clients have recognized as well, that we have increased our safety because you’re not dispatching people for needless work. You’re doing only what you have to do and you’ve put all the equipment in to mitigate those concerns. Putting in regular depth media filtration and not addressing that you could have done 3-4x fold filtration by adding a magnetic filter is an error. So we’ve increased our reliability and profitability of equipment per hour of use.*

**- Dale Constantine, Reliability Expert, STEP Energy Services**

### HYDRAULIC FLUID (IN-TANK)

MIT is an acronym for mounted in-tank filtration. This product is a member of the OEI ADD-Vantage 9000 series and is designed for low-pressure drop applications. It is modeled after the inside-out flow technology which ensures the magnetic filter element provides the primary filtration, capturing a majority of debris before fluid reaches the secondary, stainless-steel cloth element. The OEI MIT Filter also functions as a return filter where back pressures are allowed, and finer micron, stainless-steel cloth elements are acceptable.



*The MIT Filter is used for case drain oil and because of the low pressure drop through OEI products, it allows us to do finite filtration without over pressuring pump and motor cases that could become damaged due to excessive back pressure.*

**Arthur Fekete, Application Specialist, NOV**

### HYDRAULIC FLUID (SUCTION)

Hydraulic suction scrubbers provide pump protection on start up and during continuous operation. They are installed as a low pressure drop filter to alleviate pump suction problems and to slow down fluid velocity and increase magnetic dwell time.

*The sanitary tri-clamp design was chosen because hydraulic tanks tend to be built from thin gage plate steel and we wanted to use a system that would reduce the weight and create less stress on the bottom of the tank.*

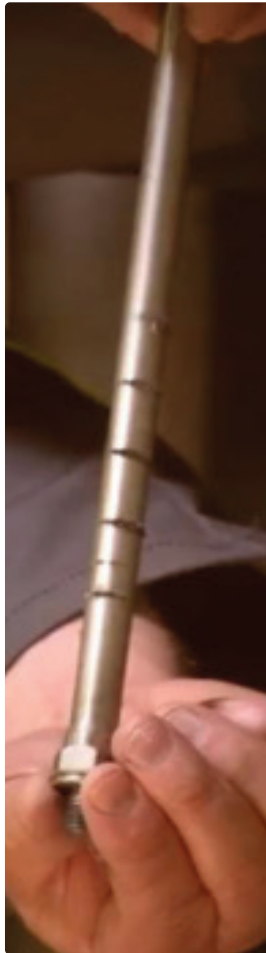
**Arthur Fekete, Application Specialist, NOV**





## LIQUID NITROGEN

NOV approached OEI regarding the application of magnetic filtration to the liquid nitrogen used in their N2 pumpers. The goal was to extend the cold ends of the pump. Initial testing identified a large amount of wear contamination, both ferrous and non-ferrous, in the nitrogen.



ROI

\$

ELIMINATE TRIPLEX  
PUMP SERVICING:  
**\$6,600**

ELIMINATE  
TRIPLEX PUMP  
REPLACEMENT:  
**\$30,000**

*Hydovac Canada and NOV are the only OEM's to install magnetic filtration on liquid nitrogen circuits. We consider it to be important because the magnetic scrubber protects the pumping elements that take the liquid nitrogen to 15000 PSI. Fluid cleanliness is very important and difficult to achieve on liquid nitrogen because of the formation of condensation in the circuit during start up. Most of the bulk nitrogen products customers purchase is extremely dirty and in this case the magnetic filter element has less than 6 hours of run time and the build up is considerable already. Without filtration that abrasive material would go into the 15,000 PSI pumping elements. On STEP equipment – triplex pump, there are three pumping elements and each one costs around 10,000 to buy new. To service every time they fail they cost 2200.*

**Arthur Fekete, Application Specialist, NOV**

*Recently with working with National Oilwell Varco or NOV Hydra Rig – Building our Nitrogen pumpers, we've put filtration on every fluid we could possibly find and one of them is the actual nitrogen were actually pumping. The components that pump that liquid because it is in liquid form are very critical, they need to be very clean but yet no one is filtering the N2. Its pumped and decanted like fuel is, just because it boils at atmosphere but were pumping it at a liquid doesn't mean it shouldn't be filtered. So we added N2 filtration with our trucks down at NOV hydrarig – and we were surprised by how much we were taking out of that liquid, out of that stream. We monitor how many cubes of nitrogen we pump and those critical components, how long they last.*

*As soon as you can increase those components by 1 day, 2 days, a month, months, its huge to the bottom line because they're extremely expensive. We're not talking a spark plug that costs \$12, were talking a cold end that's critical component. That's 5 of them, or 3 of them depending on the pump, and they're worth 20,000 a piece! We're talking a huge huge dollar value here. The longer we can go and get service out of that, we can increase our reliability and decrease our cost per pump of nitrogen per cube.*

**Dale Constantine, Reliability Specialist, STEP**



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