OIL FILTRATION SYSTEMS®
A CLARK-RELIANCE COMPANY

The Basics of High Velocity Oil Flushing

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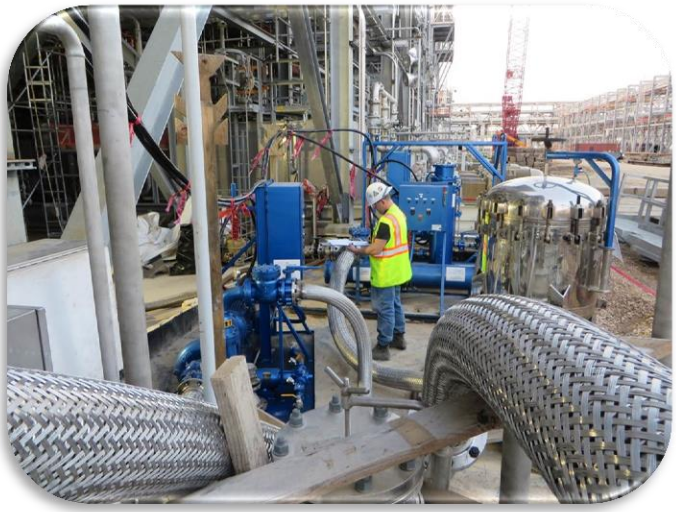
High Velocity Oil Flushing (HVOF) is performed to remove contaminants from the piping and tubing of critical hydraulic and lube oil systems.



Pre-Commissioning High Velocity Oil Flush at LNG Plant

It is an essential maintenance process that is designed to extend the life of rotating equipment, keeping turbines, compressors, engines, etc. operating at their optimal level, and improving their overall reliability.

Contaminants can and will enter hydraulic and lube oil piping in many different ways during construction, commissioning, repairs/maintenance, and when failure events occur. These contaminants range from pipe scale, welding slag, metal shavings, dirt, dust, water, rags, etc. If left within the piping or tubing circuits prior to start-up, these contaminants can compromise the potential lifetime of critical hydraulic and rotating equipment from the outset – no matter how clean the oil in the reservoir is maintained.

High Velocity Oil Flush of Cooler Bundles

The commissioning process of newly installed or repaired rotating equipment should include "polishing" the hydraulic or lube oil (filtering it to achieve the OEM specified cleanliness level), along with High Velocity Oil Flushing to remove harmful contaminants from the piping and/or tubing itself.

By performing a High Velocity Oil Flush at the appropriate time, reliability professionals can keep their long-term maintenance costs down, while extending the useable life of critical hydraulic and rotating equipment.

Why Should High Velocity Oil Flushing Be Performed?

Always HVOF

Pre-Commissioning – Probably the most important time to perform High Velocity Oil Flushing, and one that is often overlooked in the planning phase. A comprehensive flush procedure should include all piping circuits, including spool pieces, rundown tanks, and coolers. The HVOF will remove all contaminants from the piping or tubing that was introduced during construction.

Always HVOF

Routine Maintenance – There are many different ways that contaminants get into a lube oil system during normal operation and planned maintenance or overhaul work. HVOF should be performed periodically as part of a "best practices" maintenance and reliability program.

Always HVOF

Machine Failure – When critical components (bearings, etc.) suffer failure, wear metals and other contaminants often accumulate in the lube oil piping. After repair or replacement of the component has been done, HVOF should be performed to restore the cleanliness of all piping and tubing.

Consider HVOF

Oil Replacement – When changing to a different oil product within a lube oil system, it is often recommended to conduct a HVOF to displace all old oil from the piping, thereby minimizing the blending of two different oils. A small amount of sacrificial "flushing" oil is often needed to perform this procedure.

NO SYSTEM HAS EVER FAILED FROM BEING TOO CLEAN!

Initial Inspection Screen
(Before Flush)

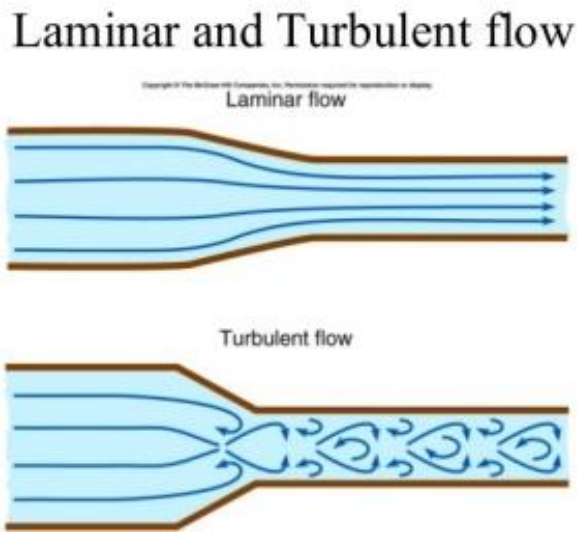
Inspection Screen
(After Flush)

Initial Sample
(Pre-Flush)
ISO 21/12/18

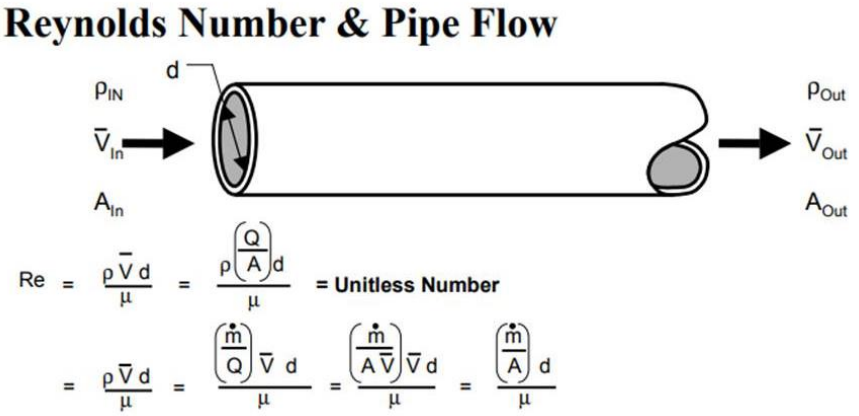
Final Sample
(Post-Flush)
ISO 16/14/11

How Does High Velocity Oil Flushing Work?

The theory behind a HVOF is straightforward. Normal "laminar" flow of oil allows particulate contamination to accumulate on the walls of piping or tubing. Higher "turbulent" flow dislodges all particulate contamination from the walls of the piping or tubing, and the contaminants are then captured and removed by filtration downstream. This process is "High Flow" but "Low Pressure", and normal operating pressures are never exceeded. If the contaminants do not break free during the HVOF, then they are much less likely to dislodge when the machine is in standard operation at lower service flow rates.



In engineering terms, "turbulent flow" through piping or tubing is defined as a Reynolds Number >4,000, but it is often recommended to achieve a Reynolds Number >8,000 for better (and faster) results. A rule of thumb often used to determine "turbulent flow" is to achieve 3X the normal operating flow rate of the existing pump(s).



Because Reynolds Number is a calculation based on the diameter of the piping, the oil flow rate, and the oil viscosity, most flush procedures call for the oil to be heated (sometimes to temperatures as high as 170 degrees F). This significantly lowers the oil viscosity, and dramatically increases the Reynolds Number (or turbulent flow) for optimal flush performance.

What Are The Basic Steps Included In A High Velocity Oil Flush?

- Oil to be used for flushing is filtered using high efficiency 5-Micron pleated microglass filter elements rated Beta>1000 to achieve OEM specified cleanliness level (typically ISO 16/14/11)

- Oil to be used for flushing is heated to the specified temperature (typically 150 degrees F or higher)

- "Jumpers" are installed in the piping circuit wherever necessary to bypass critical components

- High Flow Flushing Skid is used to pump oil through the piping at an optimal flow rate to achieve a Reynolds Number >4,000 or greater. Onboard pumps are sometimes used, but they often cannot generate high enough flow rate for optimal flush performance, so Offline High Flow Flushing Skids are preferred for faster results.

- High efficiency 5-Micron pleated microglass filter elements rated Beta>1000 are used either in-line with the High Flow Flushing Skid or in a kidney-loop on the reservoir to achieve OEM specified cleanliness level (typically ISO 16/14/11)

- High Velocity Oil Flushing of piping continues uninterrupted for a specified period of time (typically 36-hours), and then screens and/or oil samples are evaluated until stringent cleanliness criteria are met.

- After flushing is completed, the lube oil reservoir is often drained and manually cleaned with lint free rags. Clean filtered oil is then pumped back into the reservoir.

Confined Space Entry Reservoir Cleaning

What Are "Jumpers"?

Bypassing certain components of the hydraulic or lube oil circuit is usually necessary to prevent flow restriction, and to avoid damage that could otherwise be caused by over-pressure. These components typically include bearings, pumps, and valves. To bypass these components, "jumpers" (short hose sections with appropriate fittings) are installed in the piping circuit to allow flow around them. Often, these "jumpers" are fabricated specifically for the job.

Jumpers Installed On Lube Oil Piping

Is 'Special' Flushing Oil Required?

Usually not. Heating the oil with low watt density heaters and pumping it at a high flow rate (but low pressure) through the piping does not harm the oil whatsoever, so the normal "in-service" hydraulic or lube oil is typically used for the flushing operation, and then used for service. During the High Velocity Oil Flush, the oil is filtered and "polished", so it meets or exceeds the OEM cleanliness specification.

One exception is when a "Cleaning Agent" is needed to help dissolve and remove Varnish from the metal surfaces inside the lube oil system, or to help break up stubborn sludge deposits inside of a Thermal Transfer System. In this case, a Cleaning Agent is added to the oil prior to the flush, and several steps that include draining and disposing the "sacrificial" oil are implemented. After a Varnish Flush or Heat Transfer System Flush is complete, a New Oil Fill is often required to ensure optimal cleanliness.

How To Maximize The Effectiveness Of A High Velocity Oil Flush

- High efficiency pleated microglass filter elements rated Beta>1000 per ISO 16889 should be used in a kidney loop configuration on the reservoir while flushing to "polish" the oil.

Reverse Flow Manifold

- A reverse-flow manifold can be used to flush the piping in both directions, helping to dislodge particles in all sections of the piping circuit.

- Heating and cooling cycles can be used during the flush, and the resulting expansion and contraction of piping can help dislodge particles that adhere to the walls of the piping.

- "Pipe Vibrators" are often used while flushing to help dislodge particles from the inside of the piping. Dead blow hammers at pipe elbows are also commonly used to induce vibration.

- The introduction of small amounts of nitrogen gas immediately downstream of the pump is sometimes used to create a "bubbling" effect that can help dislodge stubborn particles for a more effective flush.

- A lower viscosity flush oil is sometimes used to achieve a higher Reynolds Number. This is common when the in-service oil is higher viscosity (i.e. engines, gearboxes, etc.).

Pipe Vibrator

Summary

SERVICE:
Oil Filtration Systems has highly trained Field Service Professionals capable of performing High Velocity Oil Flushing Services anywhere in the world.

All of our technicians have extensive safely qualifications and credentials – SAFETY FIRST!

SALES:
Oil Filtration Systems manufactures a wide range of High Velocity Oil Flushing Equipment, including:

- High Flow Flushing Skids
- Multi-Element and Multi-Bag Filter Housings
- Oil Heater Skids
- Reverse Flow Manifolds
- Vacuum Dehydration Oil Purification Systems (VDOPS)

RENTALS:
We have the largest and best maintained RENTAL FLEET of High Velocity Oil Flushing Equipment available in the USA.

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