

FSTO

Turbine Oil Varnish Removal Systems

FSTO is the complete oil conditioning solution for turbine and compressor lube oil. FSTO treats both soluble and insoluble forms of oxidation by-products to remove and prevent varnish deposits and deliver guaranteed results.

Utilizing ICB technology, FSTO removes the soluble varnish feedstock, acids and protects the anti-oxidant additive package while VTM high efficiency post filter removes insoluble by-products and will deliver unimaginably low ISO cleanliness codes so you can use your clean, in-service oil longer than ever before.



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Sized just right.

Not every job calls for a Goliath sized solution. When it comes to small turbine lube oil and compressor reservoirs with contamination problems, the FSTO is sized just right. Sizing and flow rate options mean you get the perfect solution tailored specifically to your systems.



Reverse varnish formation.

Even before MPC values climb, trending acid number can be a leading indicator of trouble ahead. By removing oxidation by-products, FSTO restores the solubility of your oil which in turn chemically removes varnish deposits in your system. The continuous process goes even further by removing the acids from your system on a molecular level, meaning you're free and clear of varnish and its underlying causes.

Continuous varnish control.

Combined VTM and ICB technologies continuously remove soluble and insoluble oxidation by-products so that your turbines operate uninhibited by varnish. With the added benefits of increasing the lifespan of AO packages, implementing the FSTO to your filtration regime will make unit trips and unplanned downtime a thing of the past.



ISO Codes: right on target.

The same ultra-high efficiency particulate filter which removes insoluble oxidation by-products doubles up to deliver incredibly low ISO Codes and take the pressure off your on-board bearing lube, pump discharge, and servo filters, giving you an extension on the lifespans of both your oil and your critical components.

Extend your oil life.

FSTO prevents AO additive depletion, removes acids which negatively affect oxidative stability, and can even improve oil demulsibility to greatly extend the useful life of your oil. Every FSTO comes standard with sample ports in the right locations to arm you with access to consistently accurate and best practice samples.



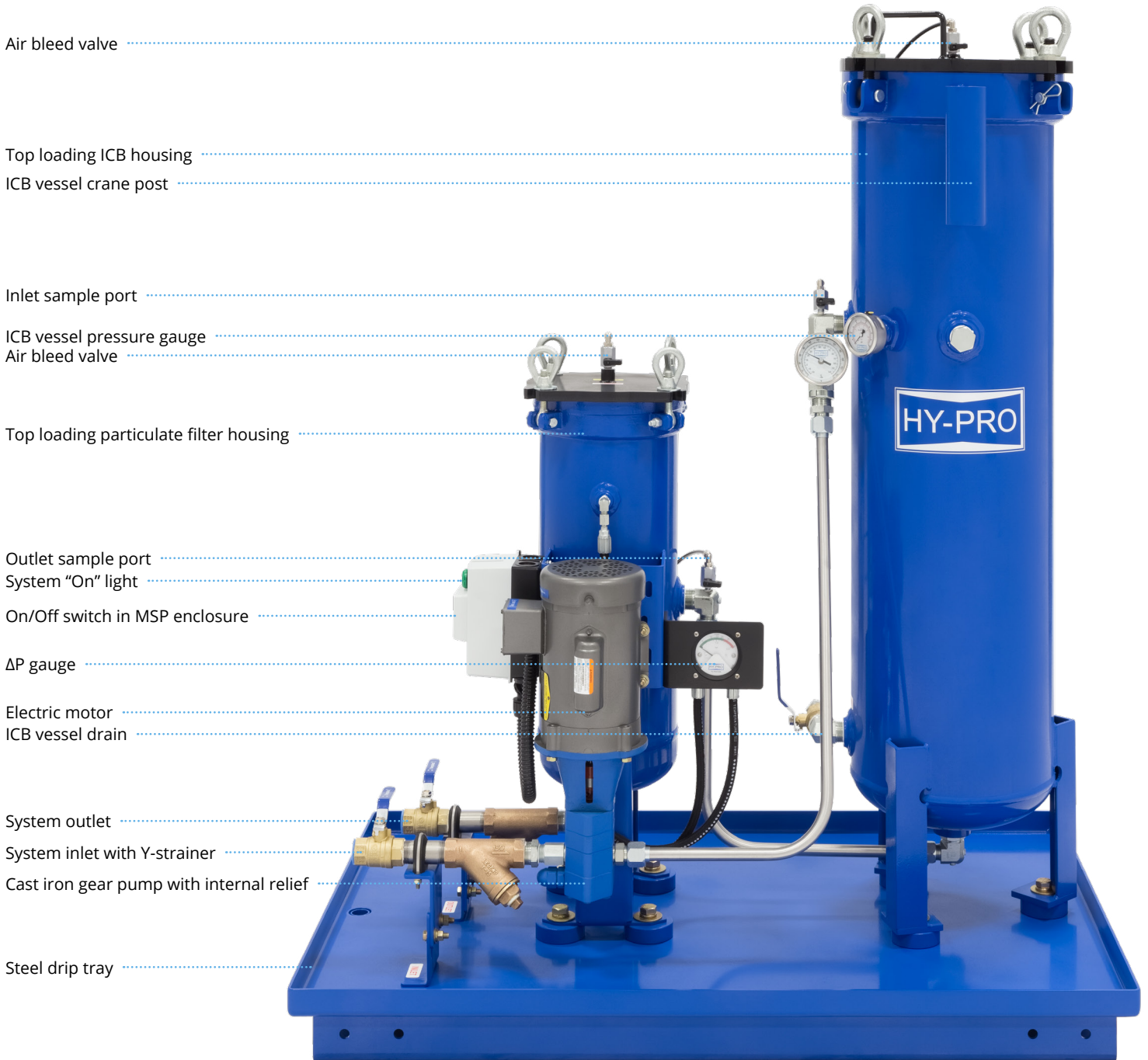
A league of its own.

ICB is used on over 400 turbine and compressor packages achieving over 40 million hours of operating experience. No other product in the market can match track record or experience level. ROI in a Frame 7ea Gas Turbine has been calculated at \$170,000 per year on a \$8000 average annual investment on lubricant maintenance.



FSTO Quick Reference Guide

FSTO4 model shown



Elements that go beyond industry standard.



ICB Advanced Resin Technology.

Turbine oil varnish deposits form when oil becomes saturated with oxidation by-products from fluid breakdown. ICB goes where other technologies can't to remove polar oxides on a molecular level. When varnish deposits are affecting servo valve response time, that means the oil is saturated. FSTO addresses this by removing dissolved oxidation by-products and restoring the oil's solubility. The restored oil dissolves deposits back into solution which can then be removed by the FSTO. The process repeats during recovery until the entire system and the oil are varnish free. That's when you see a white patch. Once the varnish is gone, FSTO continues to work by removing by-products as they form to prevent future deposits. ICB also slows anti-oxidant additive depletion to boost oil life. ICB is the only technology that treats the dissolved varnish during normal turbine operation to prevent varnish from forming.

HP107 for ISO Code Management.

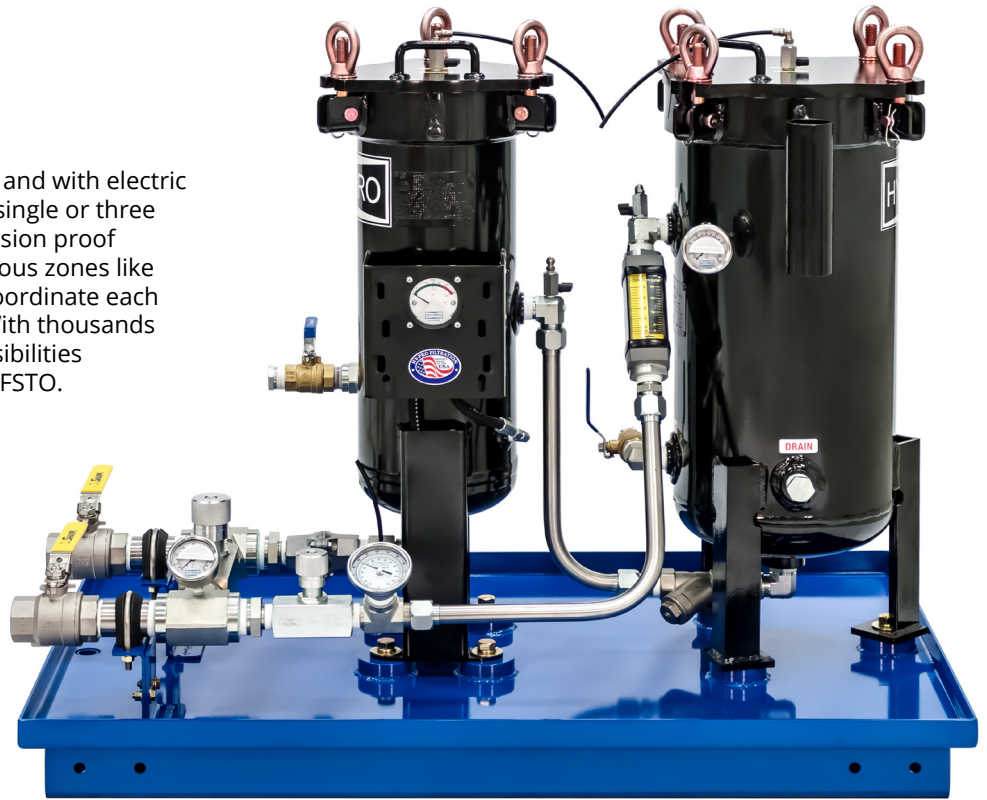
DFE rated advanced media technologies provide the highest level of particulate capture and retention so your equipment operates unimpeded by contamination. The coreless filter element in every FSTO delivers remarkably low ISO Codes, taking the dirt load off of critical system lube and hydraulic control filter elements (IGV, pump discharge). In addition to particulate control, the HP107 with VTM media also removes the insoluble oxidation by-products that are suspended in the oil, working hand-in-hand with the ICB media to rapidly reduce varnish potential and restore the health of your oil. The element is oversized to perform over a long element lifespan and to ensure low environmental and bottom line impact. To top it off, the HP107 element comes standard with an integral zero leak bypass so with every filter change, you get a new bypass along with peace of mind.



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Completely customizable.

The FSTO comes in a variety of flow rates and with electric options that range from 120 to 575 V ac, single or three phase. Or choose the pneumatic or explosion proof models to take your filtration into hazardous zones like you never thought possible. Even color coordinate each FSTO to your existing safety standards. With thousands of combinations to choose from, the possibilities are endless for what you can do with the FSTO.



VTK Varnish Test Kits

Condition monitoring is critical in staying ahead of lube oil degradation issues. Varnish Test Kits from Hy-Pro provide on-site access to laboratory grade Membrane Patch Colorimetric (MPC) testing as a key piece in predicting potential varnish problems before unit trip or fail-to-start conditions occur, all according to the world recognized ASTM D7843-12 standard for the measurement of insoluble oxidation by-products.



FSTO Specifications

Dimensions ¹	Height 72" (183 cm)	Length² 47.5" (121 cm)	Width² 31.5" (80 cm)	Weight 585 lbs (265 kg)
Connections	Inlet 1" FNPT with ball valve		Outlet 1" FNPT with ball valve	
Max Reservoir Size	FSTO05 600 gal (2,271 liters)	FSTO1 1,200 gal (4,542 liters)	FSTO2 2,500 gal (9463 liters)	FSTO4 5,000 gal (18,927 liters)
Element Configuration	Particulate + Insoluble Filter HP107L18-VTM710-C-V		ICB FSTO05: ICB600504-V FSTO1: ICB600504-V x 2 FSTO2: ICB600524 -V FSTO4: ICB600524-V x 2	
Seals	Fluorocarbon + silicone			
Operating Temperature	Fluid Temperature 86°F to 176°F (30°C to 80°C)		Ambient Temperature -4°F to 104°F (-20C to 40C)	
Materials of Construction	Housings Carbon steel with industrial coating		Tray Carbon steel with industrial coating	
Electric Motor	TEFC, 56-145 frame 0.5 hp, 1450-1750 RPM			
Motor Starter	MSP (motor starter/protector) in an IP65, aluminum enclosure with short circuit and overload protection.			
Pump	Cast iron, positive displacement gear pump with internal relief. Maximum pressure on pump inlet 15 psi (1 bar). Consult factory for higher pressures.			
Pump Bypass	Full bypass at 150 psi (10 bar)			
Pneumatic Option Air Consumption	~40 cfm @ 80 psi ³			
Media Description	VTM $\beta_{3(\text{C})} \geq 4000$ particulate, insoluble oxidation by-product and water removal media.		ICB Patented ion-exchange resin media for molecular removal of acids, varnish deposits, soluble oxidation by-products and dissolved metal ions from mineral based turbine oil.	
Fluid Compatibility	Petroleum and mineral based fluids only (standard). For phosphate ester and other specified synthetic fluids, see FSA (page 108) or contact factory.			
Hazardous Environment Options	Select pneumatic powered unit (Power Option 00) or explosion proof NEC Article 501, Class 1, Division 1, Group C+D. Call for IEC, Atex or other requirements.			

¹Dimensions are approximations taken from base model and will vary according to options chosen.
²Spill retention pan standard size. Consult factory for custom pan sizing.
³Air consumption values are estimated maximums and will vary with regulator setting.



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FSTO Part Number Builder

FSTO -

Flow Rate Indicator Power Options Special Options

Flow Rate¹

05	0.5 gpm (1.7 lpm)
1	1 gpm (3.7 lpm)
2	2 gpm (7.5 lpm)
4	4 gpm (15.1 lpm)

ΔP Indicator²

D	22 psid visual gauge + electric switch
E	22 psid visual gauge

Power Options Contact factory for options not listed	60 Hz, 1750 RPM	50 Hz, 1450 RPM	Pneumatic
	12 120 V ac, 1P	11 110 V ac, 1P	00 Pneumatically driven air motor & PD pump. FRL & flow meter included.
	22 208-230 V ac, 1P	21 220 V ac, 1P	
	23 208-230 V ac, 3P	40 380-440 V ac, 3P	
	46 460-480 V ac, 3P	52 525 V ac, 3P	
	57 575 V ac, 3P		

Explosion proof - Class 1, Division 1, Group D per NEC 501 – Ready for outdoor use
X_ Add X prefix to power option listed above. Not available with (00) Pneumatic Option.

Special Options

A	Air cooled heat exchanger (consult factory)
B	Complete filter bypass line
C	CE marked for machinery safety directive 2006/42/EC
D³	High filter ΔP auto shutdown
E	100 mesh cast iron basket strainer
F	Filter element ΔP gauge with tattle tale follower needle
H	Automatic high temp shut down (160°F, 71°C)
L³	High filter element ΔP indicator light
M	Total system flow meter (120 cSt max)
O	On-board PM-1 particle monitor & clean oil indicator light
S⁴	All wetted components 303 or higher stainless steel
U	CUL and/or CSA marked starter enclosure for Canada
V	Lifting eye kit
W	Automatic air bleed valve
Z	On site start-up training

¹Nominal flow rates at 60 Hz motor speeds.
²Particulate filter only. ICB housing is equipped with 0-100 psi static pressure gauge. Industrial, liquid filled.
³Requires ΔP Indicator option "D" selected.
⁴With exception to cast iron gear pump.

For all up to date option details and compatibilities, please reference our Contamination Solutions Price List or contact customer service.



Filtration starts with the filter(s).

Lower ISO Codes: Lower Total Cost of Ownership Hy-Pro filter elements deliver lower operating ISO Codes so you know your fluids are always clean, meaning lower total cost of ownership and reducing element consumption, downtime, repairs, and efficiency losses.

DFE Rated Filter Elements DFE is Hy-Pro's proprietary testing process which extends ISO 16889 Multi Pass testing to include real world, dynamic conditions and ensures that our filter elements excel in your most demanding hydraulic and lube applications.

Upgrade Your Filtration Keeping fluids clean results in big reliability gains and upgrading to Hy-Pro filter elements is the first step to clean oil and improved efficiency.

Advanced Media Options DFE glass media maintaining efficiency to $\beta_{3, \mu} > 4000$, Dualglass + water removal media to remove free and emulsified water, stainless wire mesh for coarse filtration applications, and Dynafuzz stainless fiber media for EHC and aerospace applications.

Delivery in days, not weeks From a massive inventory of ready-to-ship filter elements to flexible manufacturing processes, Hy-Pro is equipped for incredibly fast response time to ensure you get your filter elements and protect your uptime.

More than just filtration Purchasing Hy-Pro filter elements means you not only get the best filters, you also get the unrivaled support, training, knowledge and expertise of the Hy-Pro team working shoulder-to-shoulder with you to eliminate fluid contamination.



Want to find out more? Get in touch.

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