Fluid Contamination Solution:

Achieving and Maintaining Caterpillar Service Center Five Star Rating

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Contamination Under Control . . . Hy-Pro Will Have You Seeing Stars

Understanding The CAT Specification

75% of component failures are the result of surface degradation caused by contamination. Unfiltered new oil is one of the worst sources of particulate contamination, and is typically not suitable for engines, transmissions, or hydraulic systems. Caterpillar is now requiring fluid cleanliness standards for all fluid power and engine lube systems. Table 1 specifies the required ISO fluid cleanliness codes for each system. CAT recommends cleaning new oil to a minimum of ISO 16/13 before adding.

Table 1 - System Type	CAT system ISO Code 5µ/15µ or 6µ[c]/14µ[c]
Engine oil, All new fluids	16/13
Hydraulic system	18/15
Transmission, non-electro hydraulic	21/17*
Transmission, electro- hydraulic	18/15

The specification requires that there is a filter on the end of each dispensing hose in the service bays and on all service trucks. Routine oil analysis is also necessary to quantify the actual fluid cleanliness and to ensure that required cleanliness is being achieved at all times.

Delivering Clean Fluid . . . How Did They Do It?

The system depicted in photo 1 was installed at Michigan CAT Novi. The small wall mounted filter assemblies filter the fluids used in the service area. The large floor mounted filter assemblies filter the fluids as they are transferred from bulk tank to the mobile service trucks. Target cleanliness is achieved by mounting filters in series with the right combination of filter elements for each type of fluid. Mounting the filters in series ensures that the new oil is filtered two to three times as it is dispensed either during in-shop service, on the way from bulk tank to service truck, or from service truck to field located equipment.

In-house Fluid Filtration for the Service Area

Photo 2 shows the filtration system to clean fluid delivered from bulk tanks to the service area hose reel dispensers. Each fluid type has a specific combination of filter assemblies and filter elements to achieve the CAT desired cleanliness. The filter assembly includes an internal bypass valve and visual differential indicator to signal the need for element replacement. There is also a log to document oil analysis history and verify that target ISO codes are being maintained. Table 2 details the setup of the filters in series and the media ratings by housing.

Table 2 Filtration Equipment In-house service	New fluid target 5µ/15µ or $6\mu_{[c]}/14\mu_{[c]}$	Pneumatic Transfer Pump 3~5 gpm	PFH152N8* Series Filter			ISO Code Result Achieved
			Filter 1	Filter 2	Filter 3	
Engine Oil (15-40)	16/13 or lower	550 psi (5 to 1)	$7\mu_{[c]}$	$7\mu_{[c]}$	$7\mu_{[c]}$	15/12
Hydraulic Oil (10WT)	16/13 or lower	550 psi (5 to 1)	$5\mu_{[c]}$	$2.5\mu_{[c]}$	-	14/11
Transmission (50WT)	16/13 or lower	550 psi (5 to 1)	$5\mu_{[c]}$	$2.5\mu_{[c]}$	-	14/11
Transmission (30WT)	16/13 or lower	550 psi (5 to 1)	$5\mu_{[c]}$	$2.5\mu_{[c]}$	-	14/11

Bottle samples were taken from the dispensing gun to quantify fluid cleanliness as it enters the machine. The hydraulic and transmission fluid ISO code results were measured with a portable laser particle counter. The engine oil sample cleanliness was quantified by a visual inspection of the contaminant from 25ml of fluid with the PTK1. The PTK1 patch test kit utilizes a 100x magnification field microscope to view actual system contaminant. Laser particle counters used in typical oil analysis labs can yield incorrect results for engine oils. Caterpillar recommends using the S.O.S. program for all oil analysis. Sampling ports for direct on-line particle counting yield the most accurate results and avoid sampling error associated with bottle sampling.

In-house Fluid Filtration - Continued

Photo 3 shows the filter assemblies mounted in series for the engine oil. Three identical assemblies containing 7µ[c] filter elements (7 micron absolute) attain the target fluid cleanliness by filtering the oil three times before it travels through the hose reel and is ultimately dispensed into the machine. Mounting brackets are also available to simplify installation. As the elements load with contaminant the optical indicators will change from green to red. This is the signal to replace the filter element. If the system is operated for extended intervals with the indicator showing red the bypass valve will open allowing unfiltered oil to pass.

Fluid Filtration for Off-site Service & Equipment

Photo 4 shows the system that filters the fluids as they are transferred from bulk tanks to service trucks. Larger, base mounted filter assemblies are used since the flow rate is 25 gpm instead of 5 gpm in the service area. The principle of filtering the engine oil three times and the hydraulic and transmission fluids two times is applied here as well. The fluids are filtered once as they are transferred from bulk tank to truck (filter 1 in table 3) and then the fluid is filtered once or twice more as it is dispensed from the truck to the machine (filters 2,3 in table 3). The pumps on the truck are similar in flow rate to the 3~5 gpm pumps used for in-house service so the smaller PFH152N8* filter works very well.

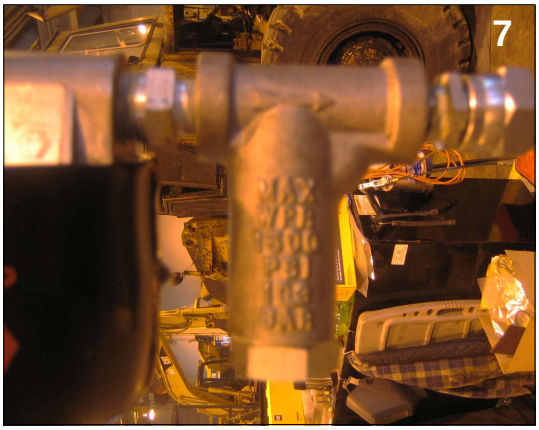
Hy-Dry Desiccant breathers were installed on all tanks to prevent water and particulate contaminant from entering the bulk tanks (photo 5). The Hy-Dry breathers control particulate contamination down to 4µ[c] with 99.95% efficiency. The desiccant adsorbs the water as the air entering the reservoir passes through the breather. As the breather collects water the desiccant changes color from gold to dark green which signals the need for replacement.

Table 3 Filtration Equipment Off-site service	New fluid target 5µ/15µ 6µ[c]/14µ[c]	Pneumatic Transfer Pump 25 gpm	Filter 1 To Truck LF*5*M18	Filter 2 On Truck PFH152N8*	Filter 3 On Truck PFH152N8*	ISO Code Result Achieved
Engine Oil (15-40)	16/13	110 psi (1 to 1)	7µ[c]	7µ[c]	7µ[c]	15/12
Hydraulic Oil (10WT)	16/13	110 psi (1 to 1)	5µ[c]	2.5µ[c]	-	14/11
Transmission (50WT)	16/13	110 psi (1 to 1)	5µ[c]	2.5µ[c]	-	14/11
Transmission (30WT)	16/13	110 psi (1 to 1)	5µ[c]	2.5µ[c]	-	14/11

Photo 6 shows two PFH152N8* filter assemblies mounted in series that represent filters 2 and 3 (of table 3) on board the service truck for filtering the engine oil. Only one filter is used on the truck to filter the hydraulic and transmission fluids.

Last Chance Strainer Before Dispenser

The CAT spec recommends installing a filter directly before the dispenser. This can be satisfied by adding an in-line strainer (see photo 7) to protect against any large debris resulting from shedding in the hoses after passing through the high efficiency filters. The strainer serves as a last chance filter and satisfies the CAT spec. Installing bulky and heavy filter assemblies to the dispenser will make handling more difficult and is not necessary if proper filtration is installed and maintained near the transfer pumps.



Step 1: Survey the Existing Fluid Transfer / Dispensing System

Before a filtration system can be designed the existing equipment must be surveyed to determine the possibility of adding filtration to it, and if so what type of filter assemblies are suitable. The following information is necessary to design the filtration system:

	Bulk Tanks to In-house Service	Bulk Tanks to Truck	Truck to Equipment
Pump Type (ie air pump 550 psi, 5 to 1)			
Operating pressure (specify psi or bar)			
Flow rate / Output (specify gpm or lpm)			

Step 2: Designing a Filtration System to Achieve Required Cleanliness

Employing the principle of filtering new oils 2~3 times with filters mounted in series can yield fluid that meets target cleanliness levels without changing dispensing procedures. The alternative to creating multiple passes with filters mounted in series is to circulate and contain the cleaned fluid. The problem with such a method is that it creates extra steps and requires more man hours. Installing several filters in series will create a flow restriction that might be noticeable when the filter elements are loaded. Filter sizing and media selection relating to fluid type and flow rate is critical. We suggest the following steps when adding a filtration system to existing fluid transfer and dispensing equipment:

1. **Contact your distributor or call Hy-Pro for technical assistance.**
2. Survey the existing equipment - Pump type, Operating pressure, Volume/flow rate, etc.
3. Define the fluid type - Hydraulic, Transmission, Engine oil (**DO NOT select media finer than β7[c] = 1000 for engine oil applications**).
4. Filter Assembly Selection - When sizing for new oil applications (dirty) over sizing for element life is important. Refer to product literature for specific sizing recommendations. Remember that several filters will be installed in series so the aggregate pressure drop of the filters must be considered.
5. Install Hy-Dry desiccant breathers on all reservoirs to minimize particulate and water contamination that enters the system.
6. Develop an oil analysis plan for quantifying fluid cleanliness (on-line particle counting, bottle sampling, S.O.S., Patch test). Counting engine oil with laser particle counters can yield high particle counts. Specify engine oil when using S.O.S. analysis or use visual analysis.
7. Develop a plan for documenting oil analysis results to ensure that the desired fluid cleanliness is achieved, maintained, and the results are documented for historical archives and trend analysis. The oil analysis plan should include repeatable procedures for collecting samples.