

PF2 Machine Tool Product Bulletin

Focus: Solving contamination issues resulting from insufficient filtration on power units and machine tools.

APPLICATIONS

- Hy-Pro PF2 pressure filters are ideal for protecting control valves and other sensitive components.
- Machine tools without a pressure filter protecting valve manifolds after the pump.
- Power units on CNC lathes and milling equipment, Plastics injection molding, mobile equipment, and other small industrial machines with sensitive control valves.



The Problem - Insufficient filtration

Machine tools and power units are frequently designed without the filtration necessary to maintain recommended fluid cleanliness levels for the system. A fluid cleanliness case study of three CNC lathes (A, B, C) raised some concern. The only filtration present was either a coarse suction strainer or coarse return-line screen. Baseline oil analysis (see fig 1) revealed that the fluid cleanliness levels of the hydraulic fluids (per ISO 4406 code chart) were higher than recommended levels for the system components (see fig 2).

fig. 1

Machine	ISO code*
A	22 / 20 / 14
B	23 / 20 / 14
C	23 / 21 / 16

fig 2.

Pumps	<2000 psi	2000~3000	>3000 psi
Fixed gear	20/18/15	19/17/15	
Fixed vane	20/18/15	19/17/14	18/16/13
Fixed piston	19/17/15	18/16/14	17/15/13
Variable vane	18/16/14	17/15/13	
Variable piston	18/16/14	17/15/13	16/14/12
Valves		2000~3000	>3000 psi
Directional (solenoid)		20/18/15	19/17/14
Proportional		17/15/12	16/14/11
Servo Valve		16/14/11	15/13/10

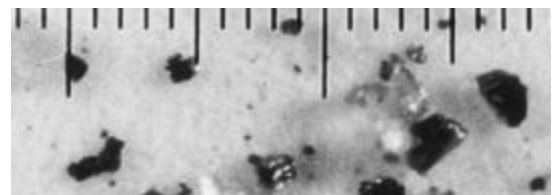
Contamination Basics & Sources

Particulate contamination is the number one cause of hydraulic component failure, and 70~75% of failures are related to surface degradation caused by mechanical wear.

Sources of particulate contamination

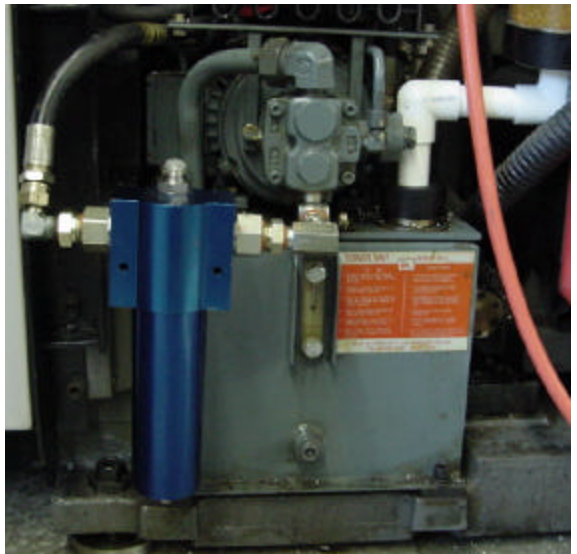
- Built-In contamination (assembly environment, dirty new components and hoses, metal fabrication)
- Ingested contamination (leaky reservoirs, no reservoir breather, worn rod wipers and bearing seals, dirty replacement components, system exposure during maintenance, new oil—see fig 3.)
- Internally generated contamination (abrasive wear, adhesive wear, stress related wear, corrosion, fluid breakdown)

Fig 3 (new oil typical ISO code 24/21/18).



Solution Part I - Hy-Pro PF2 System Clean-up

Fig 4.



The PF2 filter assembly, including $\beta_{12}[c] = 1000$ filter element and element condition indicator, was added to each of the three machines (see fig 4) after the pressure pump (piston type). After nine days of operation the indicators on machines A and C were signaling terminal pressure drop. At that time all three elements were serviced and the oil was analyzed (see fig 5). The ISO codes improved, but not to the level recommended for servo valves. The next step was to set target cleanliness codes and enhance the filtration efficiency to reach the target. The spent elements that were removed contained large particles including piping putty (from installation of new hoses) and other large debris that was not being removed by the suction strainer.

fig. 5

Mach.	ISO code before PF2	ISO code after 9 days ($\beta_{12}[c] = 1000$)
A	22 / 20 / 14	19 / 18 / 12
B	23 / 20 / 14	21 / 18 / 12
C	23 / 21 / 16	20 / 18 / 13

Solution Part II - Hy-Pro PF2 Enhanced Filtration and Target Cleanliness Codes

A target ISO Cleanliness Code of 16 / 14 / 11 (measured at filter effluent) was established for all three machines to protect and maximize piston pump and solenoid valve life. New filter elements were installed with a more efficient rating of $\beta_{5}[c] = 1000$ ($\beta_3 = 200$ according to old standards) to achieve the target. After 60 days of service the oil from all three machines was analyzed (see fig 7), even though none of the assemblies were indicating terminal pressure drop.

Machines B and C were able to attain the target while A did not, although adding of the PF2 made considerable improvement in cleanliness. The oil was sampled after 180 days using an on-line particle counter connected to the drain plug of the filter bowl. This location represents one of the dirtiest points on the system since the oil has been in through the system and in the reservoir. Sampling with an on-line particle counter and proper flushing techniques eliminates variables associated with bottle sampling. Figure 8 illustrates increased life expectancy for hydraulic components that can be realized by reducing fluid cleanliness codes. The benefits of clean fluid justify the cost of filtration.

fig. 7

Mach.	ISO code before PF2	ISO code after 60 days ($\beta_{5}[c] = 1000$)	ISO code after 180 days ($\beta_{5}[c] = 1000$)
A	22 / 20 / 14	17 / 15 / 11	11 / 9 / 7
B	23 / 20 / 14	15 / 13 / 8	13 / 11 / 9
C	23 / 21 / 16	16 / 12 / 10	14 / 11 / 9

fig. 8

Current ISO Code	Target ISO Code 2 x Life	Target ISO Code 3 x Life	Target ISO Code 4 x Life	Target ISO Code 5 x Life
28/26/23	25/22/19	22/20/17	20/18/15	19/17/14
27/25/22	23/21/18	21/19/16	19/17/14	18/16/13
26/24/21	22/20/17	20/18/15	19/17/14	17/15/12
25/23/20	21/19/16	19/17/14	17/15/12	16/14/11
25/22/19	20/18/15	18/16/13	16/14/11	15/13/10
23/21/18	19/17/14	17/15/12	15/13/10	14/12/9
22/20/17	18/16/13	16/14/11	15/13/10	13/11/8
21/19/16	17/15/12	15/13/10	13/11/8	-
20/18/15	16/14/11	14/12/9	-	-
19/17/14	15/13/10	13/11/8	-	-
18/16/13	14/12/9	-	-	-
17/15/12	13/11/8	-	-	-

Benefits of clean fluid

- Minimize unplanned equipment downtime.
- Reduce maintenance costs and labor.
- Reduce expensive component repair or replacement costs.
- Improve operating efficiency of equipment with sensitive components.
- Extend service life of fluids.

Adding a Hy-Dry desiccant breather to the reservoir assures that the air ingested is dry and clean. Reducing water content reduces chemical compound formation, biological growth, oxidation and extends fluid life. Hy-Dry breathers also control particulate contamination ingress down to $4\mu[c]$ or 2μ with absolute efficiency. Filler-breather caps commonly found on reservoirs don't properly control particulate contamination. Hy-Dry breathers also adsorb water and oil mist as the reservoir exhales. A full range of adapters is available to retro-fit any reservoir.

