Plastic Injection Molding Hydraulic Filter Upgrade

The Problem:

The operators of a plastic injection molding facility sought an improvement in fluid cleanliness and believed that an upgrade to Hy-Pro elements from the originally installed filter elements was the best solution. A test compared on-line particle counts of the fluid after filtration by both the original element and the Hy-Pro Filtration filter element upgrade.

The Solution:

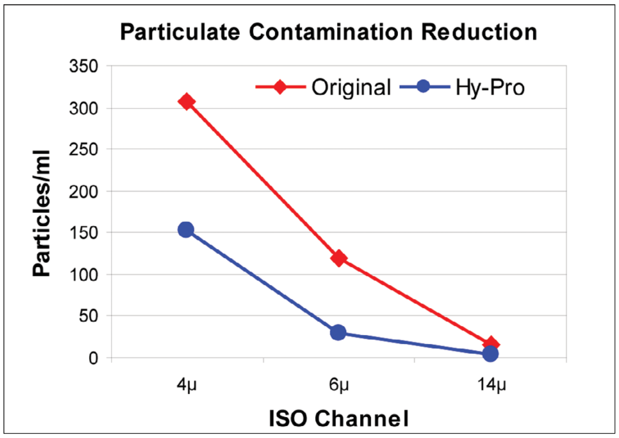
Hy-Pro Filtration Filter Element Upgrade - The original filter element on board (rated $\beta 7_{[c]} > 1000$) was upgraded to a Hy-Pro HP894L14-6MB filter element designed for high production plastic molding machines.

The Results:

The Hy-Pro element immediately dropped the ISO fluid cleanliness codes substantially (see tables and graph below). The Hy-Pro element caused a **50% reduction in $4\mu_{[c]}$** (and larger) particles, a **75% reduction in $6\mu_{[c]}$** (and larger) particles and a **75% reduction in $14\mu_{[c]}$** (and larger) particles.

The Conclusion:

Plastic injection molding machines require a high level of precision from hydraulic pumps to avoid under or over-filling the die. Fouled hydraulic pumps no longer operating at full capacity due to fluid contamination lead to serious quality issues. Installing Hy-Pro filter elements on your plastic injection molding machines will increase your systems' efficiency and reliability.



Original Element	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	15	14	11
Actual Particles per Milliliter	306.9	~120	~15

Hy-Pro Element Upgrade	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	14	12	9
Actual Particles per Milliliter	153.1	~30	~3.75

ISO fluid cleanliness codes can sometimes be deceiving because what appears to be only a one or two number decrease in any channel is actually a significant improvement. Take as an example the $6\mu_{[c]}$ channel in the two tables above: the original cleanliness code was 14 while the same channel after the upgrade was 12. This may seem minor at first glance but a closer look at the data reveals the magnitude of the improvement:

- The actual number of particles was reduced by a multiple of 4 decreasing from 120 to 30 particles per ml.
- There were 75% fewer particles $6\mu_{[c]}$ in the fluid causing additive depletion and generating wear particles.

HY-PRO

TARGET ISO CODES

When setting target ISO fluid cleanliness codes for hydraulic and lubrication systems it is important to keep in mind the objectives to be achieved. Maximizing equipment reliability and safety, minimizing repair and replacement costs, extending useful fluid life, satisfying warranty requirements, and minimizing production down-time are attainable goals. Once a target ISO cleanliness code is set following a progression of steps to achieve that target, monitor it, and maintain it will yield justifiable rewards for your efforts. Make an impact on reliability by controlling contamination.

Set the Target.
The first step in identifying a target ISO code for a system is to identify the most sensitive component on an individual system, or the most sensitive component supplied by a central reservoir. If a central reservoir supplies several systems the overall cleanliness must be maintained, or the most sensitive component must be protected by filtration that cleans the fluid to the target before reaching that component.

Other Considerations.
Table 1 recommends conservative target ISO cleanliness codes based on several component manufacturers guidelines and extensive field studies for standard industrial operating conditions in systems using petroleum based fluids. If a non-petroleum based fluid is used (i.e. water glycol) the target ISO code should be set one value lower for each size ($4\mu_{(c)}/6\mu_{(c)}/14\mu_{(c)}$). If a combination of the following conditions exists in the system the target ISO code should also be set one value lower:

- Component is critical to safety or overall system reliability.
- Frequent cold start.
- Excessive shock or vibration.
- Other severe operation conditions.

Recommended* Target ISO Cleanliness Codes and media selection for systems using petroleum based fluids per ISO4406:1999 for particle sizes $4\mu_{(c)}$ / $6\mu_{(c)}$ / $14\mu_{(c)}$

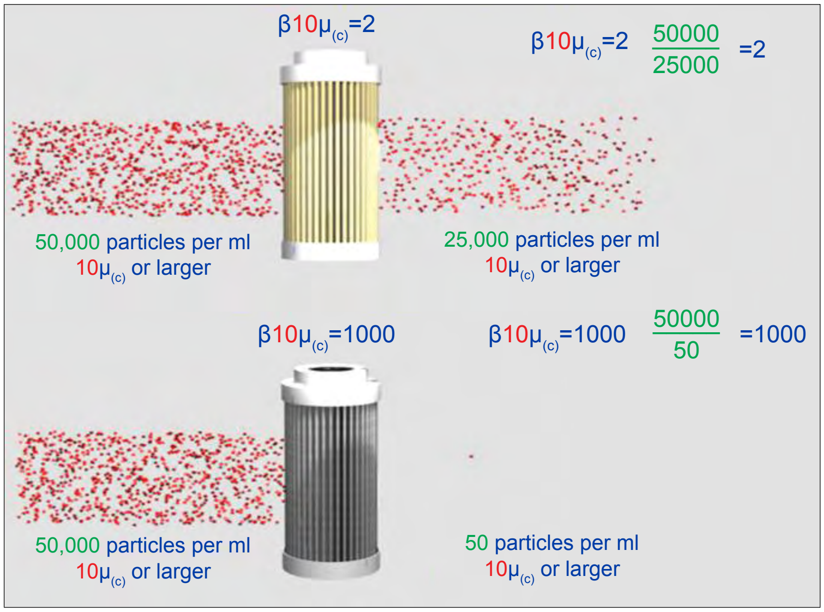
Pumps	Pressure < 138 bar < 2000 psi	Media $\beta x_{[c]}$ = 1000 (βx = 200)	Pressure 138-207 bar 2000 - 3000 psi	Media $\beta x_{[c]}$ = 1000 (βx = 200)	Pressure > 207 bar > 3000 psi	Media $\beta x_{[c]}$ = 1000 (βx = 200)
Fixed Gear	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/15	$12\mu_{(c)}$ (12μ)	-	-
Fixed Piston	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)	17/15/12	$7\mu_{(c)}$ (6μ)
Fixed Vane	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Variable Piston	18/16/13	$7\mu_{(c)}$ (6μ)	17/15/13	$7\mu_{(c)}$ (6μ)	16/14/12	$5\mu_{(c)}$ (3μ)
Variable Vane	18/16/13	$7\mu_{(c)}$ (6μ)	17/15/12	$5\mu_{(c)}$ (3μ)	-	-
Valves						
Cartridge	18/16/13	$12\mu_{(c)}$ (12μ)	17/15/12	$7\mu_{(c)}$ (6μ)	17/15/12	$7\mu_{(c)}$ (6μ)
Check Valve	20/18/15	$22\mu_{(c)}$ (25μ)	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/14	$12\mu_{(c)}$ (12μ)
Directional (solenoid)	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Flow Control	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Pressure Control (modulating)	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)	17/15/12	$7\mu_{(c)}$ (6μ)
Proportional Cartridge Valve	17/15/12	$7\mu_{(c)}$ (6μ)	17/15/12	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)
Proportional Directional	17/15/12	$7\mu_{(c)}$ (6μ)	17/15/12	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)
Proportional Flow Control	17/15/12	$7\mu_{(c)}$ (6μ)	17/15/12	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)
Proportional Pressure Control	17/15/12	$7\mu_{(c)}$ (6μ)	17/15/12	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)
Servo Valve	16/14/11	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)	15/13/10	$5\mu_{(c)}$ (3μ)
Bearings						
Ball Bearing	15/13/10	$5\mu_{(c)}$ (3μ)	-	-	-	-
Gearbox (industrial)	17/16/13	$12\mu_{(c)}$ (12μ)	-	-	-	-
Journal Bearing (high speed)	17/15/12	$7\mu_{(c)}$ (6μ)	-	-	-	-
Journal Bearing (low speed)	17/15/12	$7\mu_{(c)}$ (6μ)	-	-	-	-
Roller Bearing	16/14/11	$7\mu_{(c)}$ (6μ)	-	-	-	-
Actuators						
Cylinders	17/15/12	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)	15/13/10	$5\mu_{(c)}$ (3μ)
Vane Motors	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Axial Piston Motors	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)	17/15/12	$7\mu_{(c)}$ (6μ)
Gear Motors	20/18/14	$22\mu_{(c)}$ (25μ)	19/17/13	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Radial Piston Motors	20/18/15	$22\mu_{(c)}$ (25μ)	19/17/14	$12\mu_{(c)}$ (12μ)	18/16/13	$12\mu_{(c)}$ (12μ)
Test Stands, Hydrostatic						
Test Stands	15/13/10	$5\mu_{(c)}$ (3μ)	15/13/10	$5\mu_{(c)}$ (3μ)	15/13/10	$5\mu_{(c)}$ (3μ)
Hydrostatic Transmissions	17/15/13	$7\mu_{(c)}$ (6μ)	16/14/11	$5\mu_{(c)}$ (3μ)	16/14/11	$5\mu_{(c)}$ (3μ)

*Depending upon system volume and severity of operating conditions a combination of filters with varying degrees of filtration efficiency might be required (I.e. pressure, return, and off-line filters) to achieve and maintain the desired fluid cleanliness.

Example		ISO Code	Comments
Operating Pressure	156 bar, 2200 psi		
Most Sensitive Component	Directional Solenoid	19/17/14	Recommended Baseline ISO Code
Fluid Type	Water Glycol	18/16/13	Adjust Down One Class
Operating Conditions	Remote Location, Repair Difficult, High Ingression Rate	17/15/12	Adjust Down One Class, Combination of Critical Nature, Severe Conditions

Hy-Pro G8 Dualglass Upgrade from Cellulose Media

Glass media has superior fluid compatibility versus cellulose with hydraulic fluids, synthetics, solvents, and high water based fluids. Glass media also has a significant filtration efficiency advantage over cellulose, and is classified as "absolute" where cellulose media efficiency is classified as "nominal".

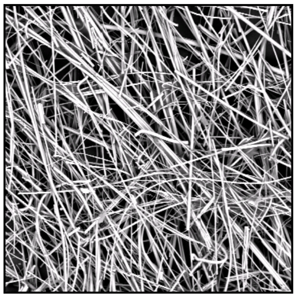


Elements of different media with the same "micron rating" can have substantially different filtration efficiency. Figure 1 provides a visual representation of the difference between absolute and nominal filter efficiency.

The illustrated glass element would typically deliver an ISO Fluid Cleanliness Code of 18/15/8 to 15/13/9 or better depending upon the system conditions and ingression rate.

The cellulose element would typically achieve a code no better than 22/20/17. Runaway contamination levels at $4\mu_{(c)}$ and $6\mu_{(c)}$ are very common when cellulose media is applied where a high population of fine particles exponentially generate more particles in a chain reaction of internally generated contaminate.

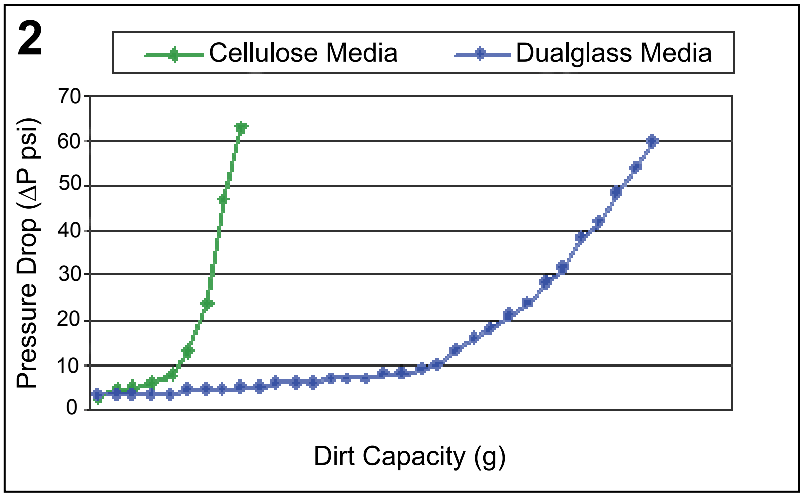
Inorganic glass fibers are much more uniform in diameter and are smaller than cellulose fibers. Organic cellulose fibers can be unpredictable in size and effective useful life. Smaller fiber size means more fibers and more void volume space to capture and retain contaminate.



Upgrading to Hy-Pro G8 Dualglass

Glass media has much better dirt holding capacity than cellulose. When upgrading to an absolute efficiency glass media element the system cleanliness must be stabilized. During this clean-up period the glass element halts the runaway contamination as the ISO cleanliness codes are brought into the target cleanliness range. As the glass element removes years of accumulated fine particles the element life might be temporarily short.

Once the system is clean the glass element can last up to 4~5 times longer than the cellulose element that was upgraded as shown in figure 2.



Cleaner Fluid, Longer Component & Fluid Life, More Uptime!

Roller Contact Bearing

Current ISO Code	Target ISO Code	Target ISO Code	Target ISO Code	Target ISO Code
	2 x Life	3 x Life	4 x Life	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	-		
16/14/11	13/11/8	-		
15/13/10	13/11/8	-		
14/12/9	13/11/8	-		

Laboratory and field tests prove time and again that Hy-Pro filters consistently deliver lower ISO fluid cleanliness codes.

Improving fluid cleanliness means reduced downtime, more reliable equipment, longer fluid life, fewer maintenance hours, and reduces costly component replacement or repair expenses.

Hydraulic Component

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

Develop a Fluid Cleanliness Target

Hy-Pro will help you develop a plan to achieve and maintain target fluid cleanliness. Arm yourself with the support, training, tools and practices to operate more efficiently, maximize uptime and save money.

New Oil is Typically Dirty Oil...

New oil can be one of the worst sources of particulate and water contamination.

25/22/19 is a common ISO code for new oil which is not suitable for hydraulic or lubrication systems. A good target for new oil cleanliness is 16/14/11.