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Fluid Contamination Under Control with Innovative Products, Support and Solutions.

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Fluid Contamination Under Control With...

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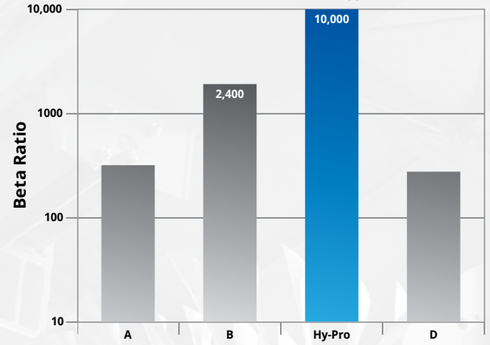
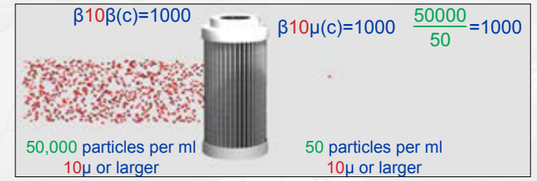
ISO 16889 Multipass Testing

Validation to antiquated minimum industry standard ISO 16889 testing guidelines.

Figure 9: ISO 16889 Multi-Pass

Time Weighted Beta Ratio Comparison for $\beta 7\mu_{[c]}$>1000 Filter Element



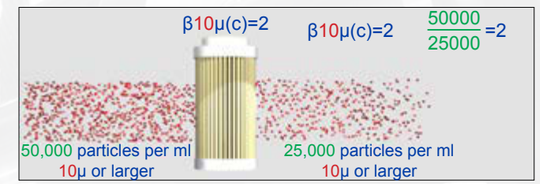


Achieve a Higher Efficiency

Hy-Pro filter elements are validated to achieve $\beta x_{[c]}$=1000 and greater beta ratios. Glass media elements only rated to $\beta x_{[c]}$= 75~200 can allow ISO fluid cleanliness codes to increase by two to three codes per size. This will lengthen the time interval necessary to achieve target cleanliness codes.

Upgrade Cellulose to G8 Glass for Cleaner Fluid

Glass media is the standard for high performance filters yet many systems still use antiquated cellulose media technology. Recapture control of runaway contamination levels and high ISO cleanliness codes by upgrading all cellulose filters to Hy-Pro elements featuring G8 Glass media. Once the system has stabilized the glass element will outlast the cellulose by 3-5 times.

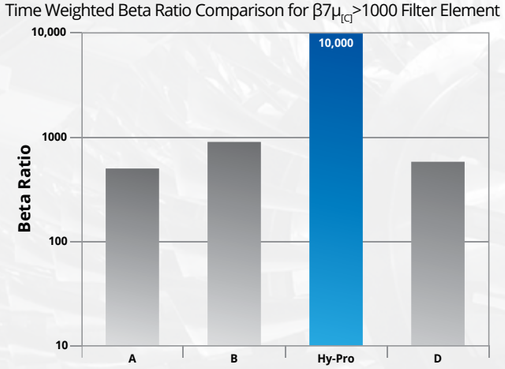


Dynamic Filter Efficiency (DFE) Multipass Performance Testing

Hy-Pro has developed the highest industrial standard for measuring filter performance. Performance in a dynamic system is simulated with rapid and frequent flow rate changes that represent the stresses a filter experiences when in service.

DFE Multi-Pass

Time Weighted Beta Ratio Comparison for $\beta 7\mu_{[c]}$>1000 Filter Element



DFE Dynamic Filter Efficiency

See the Hy-Pro Difference

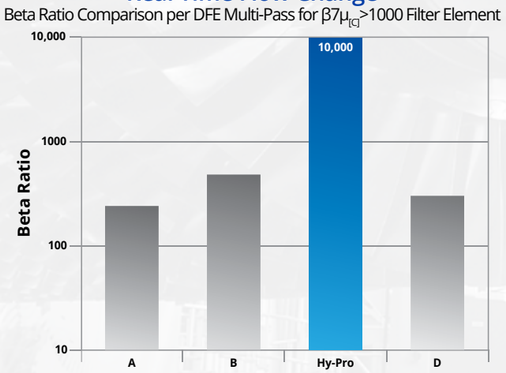
The Hy-Pro Oil Analysis Patch Kit (PTK1) provides an inside look at system contamination levels and particle type. Reference manual allows quick visual correlation from patch result to approximate ISO Code. Reference manual also helps to identify various types of contamination visually.

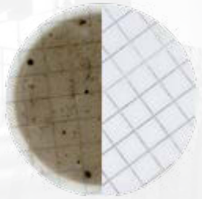
Contaminant Capture and Retention

Don't assume that a filter element will retain the particles it has captured. DFE testing reveals that filter elements designed and validated ONLY to antiquated industry standard ISO 16889 (ISO4572) multipass testing are prone to discharge previously captured contamination. When subjected to real world dynamic conditions highly concentrated clouds of contaminate are released by some filter elements This can inhibit reliability, cause severe damage, and accelerate failure of sensitive components. With DFE rated Hy-Pro elements you get clean fluid under normal AND severe operating conditions.

Real Time Flow Change

Beta Ratio Comparison per DFE Multi-Pass for $\beta 7\mu_{[c]}$>1000 Filter Element





The Difference is Clear - Cleaner Fluid

The patch test collects all contaminate 1.2μ and larger in 25ml of fluid from a fluid sample 100x field microscope magnification. The dirty patch shows the fluid condition with an inferior element, and the clean patch shows the difference in cleanliness after the Hy-Pro element was installed.

Develop a Target Fluid Cleanliness Program

We'll help you formulate a plan to achieve and maintain target fluid cleanliness levels. Arm yourself with the training, tools and practices to operate more efficiently and save money.

Roller Contact Bearing

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

Hydraulic Component

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

Cleaner Fluid, Longer Component Life

Lab and field tests prove time and again that Hy-Pro filters deliver lower ISO cleanliness codes, and do it with greater consistency. Improving and stabilizing fluid cleanliness can increase hydraulic component and bearing life exponentially. Cleaner fluid also yields reduced downtime, more reliable equipment performance, fewer maintenance hours, longer fluid life and reduces costly component replacement or repair expenses.

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High Performance Filter Elements
Reduce vendors, consolidate inventory and clean up your system by replacing all major filter manufacturers and OEM spare elements with Hy-Pro upgrades. Replacements for Pall, Parker, Hydac, Schroeder, PTI, EPE, Internormen, Donaldson, Stauff, MP Filtri, Mahle, Fairey Arlon, General Electric, Hilco, Taisei Kogyo, Bosch, Rexroth, Kaydon and many more.

High Pressure Filter Assemblies
High pressure applications require cleaner fluid. Achieve and maintain target fluid cleanliness even under severe operating conditions. Rated up to 8700 psi (615 bar).

Coreless Filter Elements
Reduce rising disposal costs and minimize environmental impact. Hy-Pro elements do not sacrifice performance or structural integrity for disposability.

Duplex Filter Assemblies
A range of sizes, ports, and bypass valve settings are available along with true differential pressure indicators. Available up to 3,000 psi (210 bar) with flow rates up to 4,500 gpm (16,875 lpm).

DFE Rated Filter Elements & Filter Assemblies

Dynafuzz Stainless Steel Fiber Filter Elements
High performance protection against corrosive fluid & high temperatures.

Hy-Dry Desiccant Breathers and Suction Strainers
Remove water from the air that your system inhales and capture oil mist and fume exhaust. Prolong fluid life, maintain fluid lubricity, minimize rust, oxidation and acid production. Hy-Dry also works to enhance filter performance by removing particulate contamination down to 2 micron with 100% efficiency. No reservoir or gearbox should be without one. Suction strainers are available with stainless mesh media and without bypass.

No-Spark Discharge Filter Elements
Prevent oil degradation caused by thermal events associated with element spark discharge and anti-oxidant additive depletion while extending useful fluid life. Eliminate sparking without sacrificing fluid cleanliness.

High Flow Filter Assemblies
Featuring coreless element technology with single element and multi-element vessel designs. Ideal for lube, off-line, process fluid, bulk oil handling, and other high flow applications. ASME code stamps available. Rated up to 4000 gpm (15,000 lpm).

Water Removal Filter Elements
G8 Dualglass media co-pleated with water removal scrim to produce a filter that can remove water while maintaining $\beta x_{[C]}$=1000 efficiency down to 1μ / 2.5$\mu_{[C]}$

In-Tank Return and Spin-On Filter Assemblies
A range of sizes, ports, and bypass valve settings are available along with true differential pressure indicators. Available up to 150 psi (10 bar) with flow rates up to 200 gpm (750 lpm).

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Off-line and Mobile Filtration Systems
Filter new fluids during transfer and replenishment (top-off). Flush fluids already in service with high efficiency elements (portable side loop) in addition to existing filtration. Remove particulate, water and varnish contamination. Condition bulk oil before use.

Turbine Oil and Diesel Coalesce Conditioning
Meet target cleanliness levels and rapidly remove water to saturation point. Automatic water drain and 24/7 unattended operation. Standard units available from 1 - 600 gpm (3.8 - 2271 lpm).

FPL - Dedicated Off-Line Filtration
Ideal for hydraulic fluids (ISO VG22 ~ ISO VG68) on compressors or compressor lube and small hydraulic reservoirs.

LCS - Liquid Conditioning Station
Remove particulate contamination and water from your fluid before it enters your systems and clean up your lube room. Customizable tank labels, quantities, volumes, materials of construction, etc. to meet your exact needs.

FC - Mobile Off-Line Filtration
Ideal for hydraulic fluid transfer and conditioning oil in service. Remove particles and water. (ISO VG22 ~ ISO VG150).

Fluid Conditioning Equipment

VUD - Vacuum Dehydrator
Remove free and dissolved water from hydraulic, lube and transformer oils down to 20 PPM with Hy-Pro Vac-U-Dry. Extend fluid and component life by removing harmful water contamination. See the process rapidly remove water with clear vacuum chamber and condensate tank covers. Standard units available from 1 - 100 gpm (3.8 - 378 lpm).

FCL - Mobile Off-Line Filtration
Ideal for high viscosity lube and hydraulic oils (ISO VG22 ~ ISO VG680). High efficiency elements to 1 micron and water absorbing capabilities.

FSLD - Duplex High Viscosity Off-Line Filtration
Ideal for high viscosity lube and hydraulic oils (ISO VG22 ~ ISO VG680). Ideal for gearbox applications.

CFU - Compact Filter Unit
Ideal for hydraulic fluid transfer and conditioning oil in service. Remove particles and water. (ISO VG22 ~ ISO VG150).

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ECR - Electrostatic Contamination Removal
Removes Thermal Degradation Sub-Micron Particles

SVR - Soluble Varnish Removal System
Stops Fail to Start and Unit Trips and Reconditions Turbine Lube Oil Systems

FSTO - Turbine Lube Oil Varnish Removal
Prevents Varnish Related Servo Valve Failures

Varnish, Sludge, Acid and Sub-Micron Particle Removal

Prevent fail to starts and fluid condemnation by eliminating varnish and acid problems. Hy-Pro has developed solutions for all fluid types to address these issues and more. Contact us to find out which solution is right for you and keep your plant running at peak productivity!

ICB- Dry Ion Charge Bonding
Acid Scavenging Elements for Phosphate Ester EHC Systems

FSVAW - AW Oil Filtration System
High Efficiency Particulate Removal (< 0.7m), Water & Insoluble Sludge & Varnish Removal

FSA - Phosphate Ester Fluid Conditioning
Ideal for Maintaining Steam Turbine EHC Fire Resistant Fluids

FSJL - Aeroderivative Fluid Conditioning System
Ideal for Maintaining Steam Turbine EHC Fire Resistant Fluids

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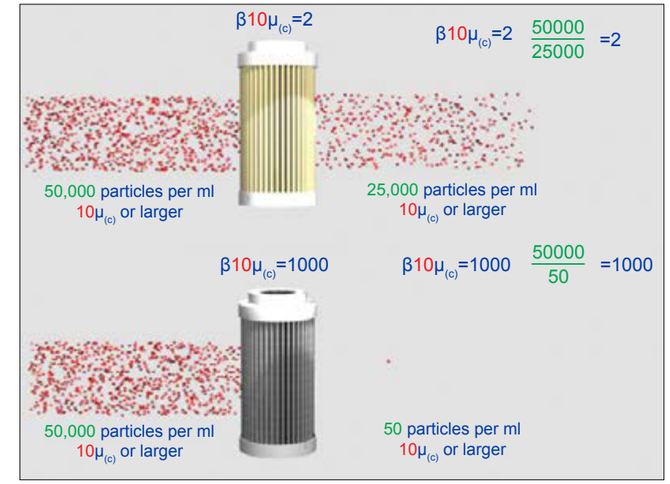
Hy-Pro G8 Dualglass Upgrade from Cellulose Media

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”.

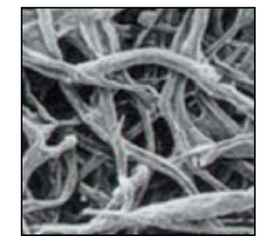
Elements of different media with the same “micron rating” can have substantially different filtration efficiency. Figure 1 provides a visual representation of the difference between absolute and nominal filter efficiency.

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.

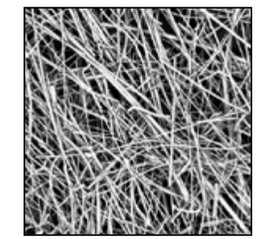
The cellulose element would typically achieve a code no better than 22/20/17. Runaway contamination levels at $4\mu_{(c)}$ and $6\mu_{(c)}$ are very common when cellulose media is applied where a high population of fine particles exponentially generate more particles in a chain reaction of internally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



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



Cellulose fibers

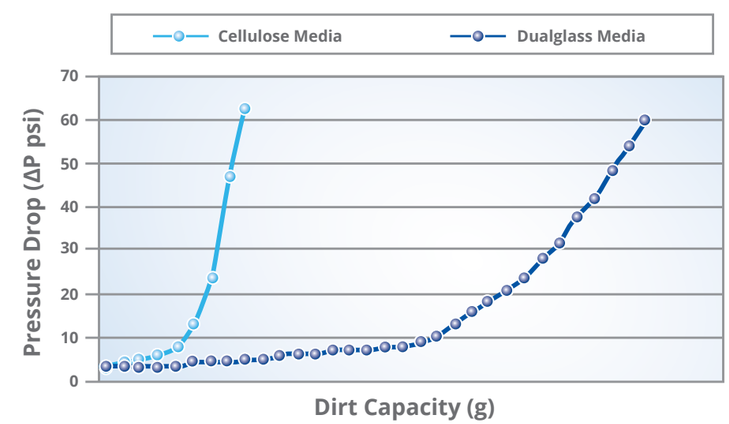


Glass fibers

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.



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UNDERSTANDING ISO CODES

Understanding ISO Codes - The ISO cleanliness code (per ISO4406-1999) is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes $4\mu_{(c)}$, $6\mu_{(c)}$ and $14\mu_{(c)}$. The ISO code is expressed in 3 numbers (example: 19/17/14). Each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger. It is important to note that each time a code increases the quantity range of particles is doubling and inversely as a code decreases by one the contaminant level is cut in half.

ISO 4406:1999 Code Chart		
Range Code	Particles per Milliliter	
	More Than	Up To/Including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Particle Size	Particles per Milliliter	ISO 4406 Code Range	ISO Code
$4\mu_{(c)}$	**151773**	**80000~160000**	**24**
$4.6\mu_{(c)}$	87210		
$6\mu_{(c)}$	**38363**	**20000~40000**	**22**
$10\mu_{(c)}$	8229		
$14\mu_{(c)}$	**3339**	**2500~5000**	**19**
$21\mu_{(c)}$	1048		
$38\mu_{(c)}$	112		
$68\mu_{(c)}$	2		

Particle Size	Particles per Mil-liliter	ISO 4406 Code Range	ISO Code
$4\mu_{(c)}$	**69**	**40~80**	**13**
$4.6\mu_{(c)}$	35		
$6\mu_{(c)}$	**7**	**5~10**	**10**
$10\mu_{(c)}$	5		
$14\mu_{(c)}$	**0.4**	**0.32~0.64**	**6**
$21\mu_{(c)}$	0.1		
$38\mu_{(c)}$	0.0		
$68\mu_{(c)}$	0.0		

Succeed with a Total Systems Cleanliness Approach

Developing a Total System Cleanliness approach to control contamination and care for fluids from arrival to disposal will ultimately result in more reliable plant operation and save money. Several steps to achieve Total Systems Cleanliness include: evaluate and survey all hydraulic and lubrication systems, establish an oil analysis program and schedule, insist on specific fluid cleanliness levels for all new fluids, establish a baseline and target fluid cleanliness for each system, filter all new fluids upon arrival and during transfer, seal all reservoirs and bulk tanks, install high quality particulate and desiccant breathers, enhance air and liquid filtration on existing systems wherever suitable, use portable or permanent off-line filtration to enhance existing filtration, improve bulk oil storage and handling during transfer, remove water and make a commitment to fluid cleanliness.

The visible cost of proper contamination control and total systems cleanliness is less than 3% of the total cost of contamination when not kept under control. Keep your head above the surface and avoid the resource draining costs associated with fluid contamination issues including:

- Downtime and lost production
- Component repair/replacement
- Reduced useful fluid life
- Wasted materials and supplies ($)
- Root cause analysis meetings
- Maintenance labor costs
- Unreliable machine performance
- Wasted time and energy ($)

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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 $\beta x_{[c]} = 1000$ ($\beta x = 200$)	Pressure 138-207 bar 2000 - 3000 psi	Media $\beta x_{[c]} = 1000$ ($\beta x = 200$)	Pressure > 207 bar > 3000 psi	Media $\beta x_{[c]} = 1000$ ($\beta x = 200$)
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

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Quality

The same commitment to quality that helped us achieve ISO 9000 certification is an integral part of the culture of Hy-Pro. Quality is in the fiber of everything we do whether it is customer service, engineering, manufacturing, product development or customer training and support. Put the Hy-Pro team to work for you.

Industry Standards

All Hy-Pro filter and element designs are validated per ISO industry standards

ISO 2941 Collapse and Burst Resistance
ISO 2942 Fabrication and Integrity Test
ISO 2943 Material Compatibility with Fluids
ISO 3724 Flow Fatigue Characteristics
ISO 3968 Pressure Drop vs Flow Rate
ISO 16889 Multi-Pass Performance Test

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Wyoming, MI 49509 USA
www.asrworldwide.com
616-942-6273
ANAB

American Systems Registrar, LLC, a provider of third-party system registration and accredited by the ANSI-ASQ National Accreditation Board attests that:

HY-PRO CORPORATION
6810 LAYTON ROAD
ANDERSON, IN 46011

with a scope of:

DESIGN AND MANUFACTURE OF FLUID FILTRATION COMPONENTS AND SYSTEMS

has established a quality management system that is in conformance with the International Quality System Standard

ISO 9001:2008

ASR Certificate Number:	1459
Date of Certification:	August 20, 2015
Date of Certification Expiration:	August 19, 2018
Revision:	
Re-Issue Date:	

President

CERTIFICATE OF REGISTRATION

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