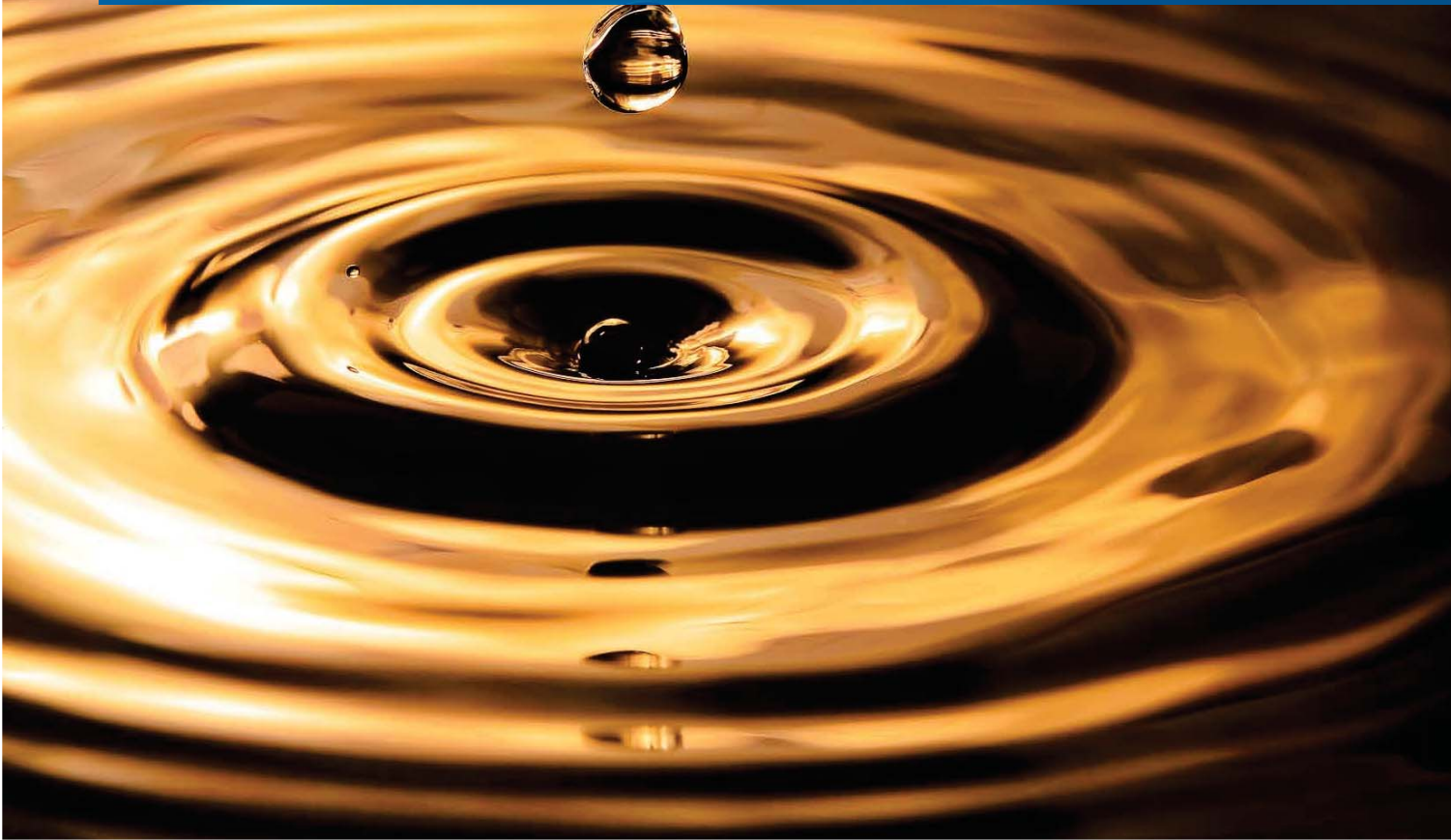


Hydraulic and Lubrication Oil Filters
Internormen Product Line



Cleaner
Fluids for
More
Efficient
Systems

EATON

Powering Business Worldwide



Eaton Filtration combines sales, engineering, manufacturing, customer service, and technical sales support into one focused business objective: Provide customers with optimum filtration solutions.

Eaton's Filtration business is a leader in manufacturing filtration products and solutions that include measurement, diagnostic and analysis technology.

Following a path of continuous improvement, Eaton has maintained quality as a fundamental corporate strategy and a hallmark of all products and services. Eaton's Internormen product line currently includes more than 4,000 hydraulic filter elements and corresponding filter housings.



Hydraulic System Cleanliness

Cleanliness is the measure of solid and liquid contamination found in hydraulic systems. Contamination is defined as any substance not part of a hydraulic system's working fluid.



The Importance of Cleanliness

- Provides maximum efficient productivity
- Improves control of spare parts through preventive maintenance and monitoring
- Reduces equipment downtime through scheduled inspections
- Minimizes safety hazards and prevents contamination-related failure
- Increases the life expectancy of system components, which both increases operating profitability and decreases maintenance costs
- Reduces repair costs and system downtime

The Occurrence of Contamination

There are three principal means through which contamination can occur in a typical hydraulic system.

It can be:

- Incorporated during system assembly
- Generated during system operation
- Ingested by the system during operation



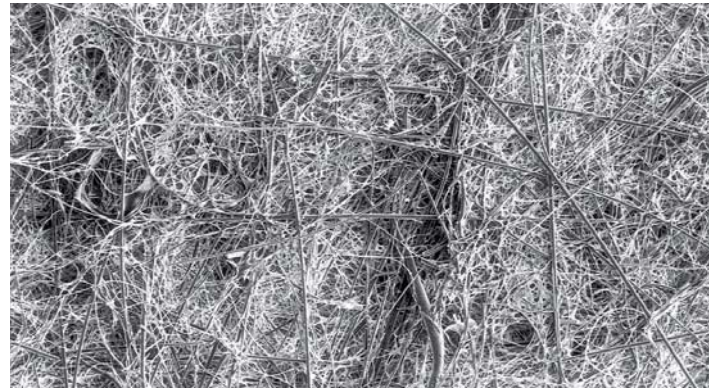
Eaton Filtration Services

- State-of-the-art testing lab facilities
- Equipment rentals
- Field service—inspections, field trials, start-up, repair, replacement, and maintenance
- Extensive network of sales/service representatives
- Worldwide technical support
- Product specialists dedicated to providing application engineering

Eaton Sustainability Commitment

Eaton is unwavering in our commitment to being sustainable by design—in the way we operate, through the design of our products, and through the energy and climate saving benefits our products deliver. Eaton issues a Sustainability Report as part of its Annual Report, available on www.eaton.com.

Filter Media

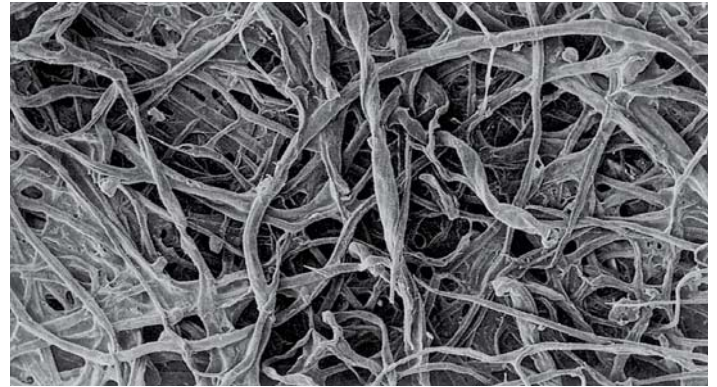


Interpor Fleece

Interpor Fleece (VG) Glass Fiber

Features:

- Deep filtration
- High particle holding capacity
- Best micron rating at high Δp
- Usable for mineral oils, emulsions, and for most synthetic hydraulic fluids and lubrication oils
- Filter fineness based on filtration quotient $\beta_{x(c)} \geq 200$:
4 $\mu\text{m}(c)$, 5 $\mu\text{m}(c)$, 7 $\mu\text{m}(c)$, 10 $\mu\text{m}(c)$, 15 $\mu\text{m}(c)$, and 20 $\mu\text{m}(c)$



Paper Matting

Paper Matting (P)

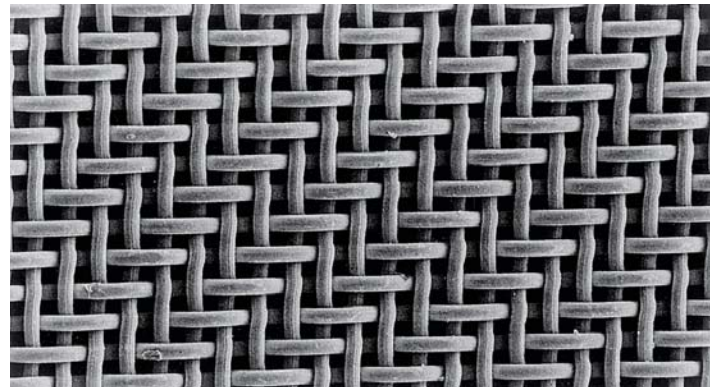
Features:

- Deep filtration
- Constructed of paper and polyester fiber
- High material stability and strength
- Available in 10 μm and 25 μm fineness

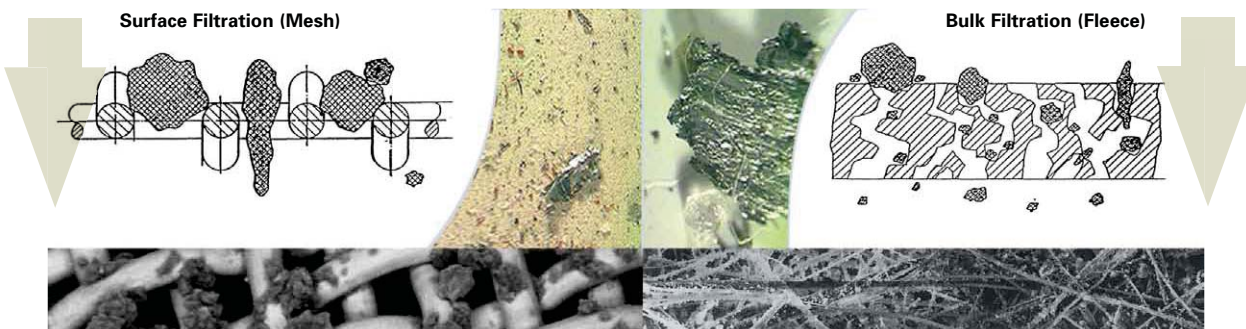
Stainless Steel Mesh (G)

Features:

- Surface filtration
- Provides high resistance filter elements (irrespective of the hydraulic fluid used)
- Partially cleanable
- Available in 25 μm , 40 μm , and 80 μm finenesses (other micron ratings on request)



Stainless Steel Mesh



Tank-mounted Return Line Filters



Series TEF, DTEF, TEFB, RF, TRW

Application: Mounted on top of the reservoir with the outlet port returning to the reservoir

Port size: up to -24 SAE (G 1-1/2), up to SAE 5", up to ANSI flange 8" (DN 200)

Operating pressure: 145 psi (10 bar)

Flow rates: TEFB up to 1902 gpm (7200 l/min), TRW up to 79 gpm (300 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Lightweight, easy to change, minimizes chance of oil spillage during element change and the resulting environmental concern

TEF - Removable bowl that prevents contamination from entering the reservoir during filter element change; multiple inlet ports are possible

TEFB - No additional breather port needed in the tank

TRW - Horizontal tank-mounted return line filters

Return Line Filters with Suction Connection

Series TRS, TNRS

Application: Tank-mounted return line filters with suction connection for mobile hydraulic applications having a minimum of two, independent hydraulic circuits

Port size: up to 3x20 SAE (G 1-1/4), up to SAE 2"

Operating pressure: 145 psi (10 bar)

Flow rate: up to 119 gpm (450 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Tank-top-mounted in-line filters supply clean suction flow and prevent cavitation; custom designs possible



Stainless Steel Pressure Filters



Series ELF

Application: For mounting in suction, pressure, and return lines

Port size: up to ANSI 10" (DN 250)

Operating pressure: 232 psi (16 bar)

Series EH

Application: Mounted in pressure lines

Port size: up to -24 SAE (G 1-1/2), up to SAE 2"

Operating pressure: up to 6090 (420 bar)

Series BEHD

Application: High filter efficiency at high volume flows; stainless steel filter battery

Port size: up to Avit 3"

Operating pressure: up to 4567.5 psi (315 bar)

Series EHD, EDU, EDA, EDSF

Application: Mount in suction, pressure, or return lines. The filter flow path can be changed to either of the two chambers

Port size: up to -16 SAE (G 1), up to SAE 4", ANSI 10"

Operating pressure: up to 4567.5 psi (315 bar)

Benefits: For continuous filtration without system shutdown, an internally-mounted, changeover ball valve makes it possible to switch from one filter to the other for servicing or changing filter while in the "off" position

EDA - Filters according to ASME

Change-over Pressure Filters

Series MDD, HDD

Application: For continuous operation. Mount in suction, pressure, or return lines

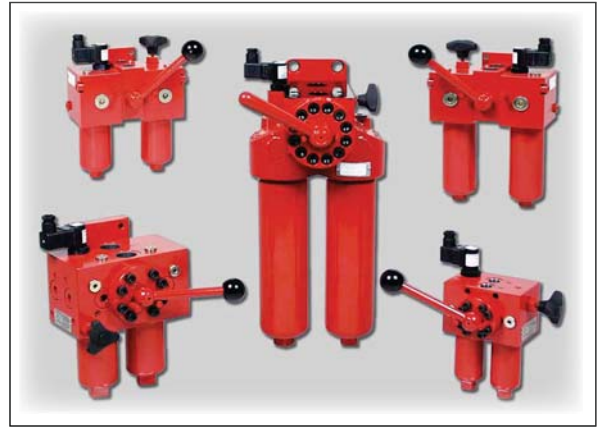
Port size: up to -16 SAE (G 1), up to SAE 2", Avit 2"

Operating pressure: up to 4567.5 psi (315 bar)

Flow rates: MDD up to 25 gpm (95 l/min), HDD up to 356 gpm (1350 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: For continuous filtration without system shutdown, the duplex design is equipped with a three-way change over valve. This makes it possible for the user to divert the flow to the second filter for servicing or changing



Series DU, DUV

Application: For continuous operation. Mount in suction, pressure, or return lines

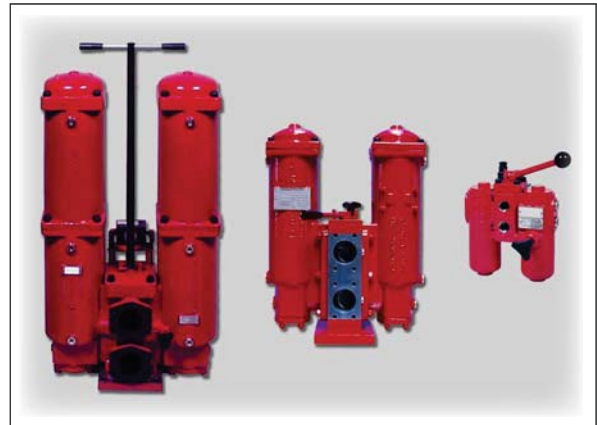
Port size: up to -12 SAE (G ¾), up to SAE 5"

Operating pressure: 464 psi (32 bar)

Flow rates: DU up to 1056 gpm (4000 l/min), DUV up to 528 gpm (2000 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: For continuous filtration without system shutdown, a rotary slide or ball valve is internally mounted. This makes it possible to switch from one filter to the other for servicing or changing filter while in the "off" position



Series DSF, DNR

Application: For continuous operation. Mount in suction, pressure, or return lines

Port size: SAE 5", ANSI flanges up to 10"

Operating pressures: 363 psi (25 bar), 232 psi (16 bar)

Flow rates: DSF up to 2642 gpm (10,000 l/min), DNR up to 2113 gpm (8000 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: For continuous filtration without system shutdown, the duplex design is equipped with a three-way change over valve. This makes it possible for the user to divert the flow to the second filter for servicing or changing



Series DA, DNA

Filters according to ASME

Application: For continuous operation. Mount in suction, pressure, or return lines

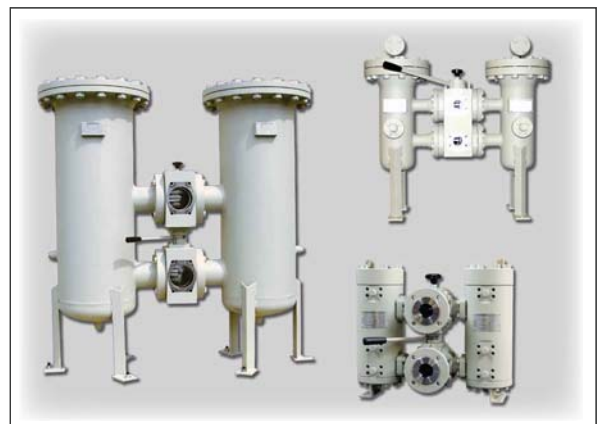
Port size: up to SAE 2", ANSI flange 4"

Operating pressure: 232 psi (16 bar), 580 psi (40 bar)

Flow rates: DA up to 264 gpm (1000 l/min), DNA up to 542 gpm (2050 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: For continuous filtration without system shutdown, the duplex design is equipped with a three-way change over valve. This makes it possible for the user to divert the flow to the second filter for servicing or changing





Pressure Filters

Series LF, RF

Application: Mounted in suction, pressure, and return lines

Port size: from -12 SAE (G ¾) up to ANSI flange 10"

Operating pressure: 145 psi (10 bar), 232 psi (16 bar), 363 psi (25 bar), 464 psi (32 bar)

Flow rate: up to 2642 gpm (10,000 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: RF- series filters have side inlets and bottom outlets on the same level



Pressure Filters, Pn > 1450 psi (100 Bar)

Series ML, MNL

Application: Mounted in pressure lines; threaded design

Port size: up to -24 SAE (G 1)

Operating pressure: up to 2320 psi (160 bar)

Flow rate: up to 119 gpm (450 l/min)

Filtration materials: Interpor fleece or stainless steel wire mesh

Benefits: Economical, lightweight filter for low to medium pressure applications. Requires minimal clearance during element change, saving valuable space



Series HP 31, 450

Application: Mounted in pressure lines; threaded design

Port size: up to -24 SAE (G 1-½), up to SAE 2"

Operating pressure: up to 6000 psi (420 bar)

Flow rate: up to 357 gpm (1350 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: In-line or flange mounting; various port and Δp indicator options. Possible to accommodate very high flow rates with a single housing



Pressure Filters, Pn > 1450 psi (100 Bar)

Series HP 170, 1351

Application: Flange mounted in pressure lines

Port size: up to SAE 2"

Operating pressure: up to 6000 psi (420 bar)

Flow rates: up to 357 gpm (1350 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: In-line or flange mounting; various port and Δp indicator options. Possible to accommodate very high flow rates with a single housing



Series HPW

Application: Flange or threaded mounting pressure filters for reversible filtration

Port size: up to -24 SAE (G 1-1/2), up to flange 2" (DN 50)

Operating pressure: up to 4568 psi (315 bar)

Flow rate: up to 106 gpm (400 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: For use where filtration can occur in both directions



Series HPV, MDV

Application: In-line pressure filters with cold start differential pressure valve

Port size: HPV up to -24 SAE (G 1-1/2), MDV up to -12 SAE (G 3/4)

Operating pressure: HPV up to 6000 psi (420 bar), MDV up to 2901 psi (200 bar)

Flow rates: HPV up to 119 gpm (450 l/min), MDV up to 40 gpm (150 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Guarantees permanent supply of clean oil. If the element clogs, change is forced, which means no damage is possible to the downstream components. Third port forces return to the reservoir

Manifold Mounted Pressure Filters, Pn > 1450 psi (100 Bar)

Series MNU, HNU, HPU, HPP

Application: Flange or manifold mounted in pressure lines

Port size: 1-1/4" (DN 32)

Operating pressure: 2320 psi (160 bar), 4568 psi (315 bar)

Flow rates: HPP up to 357 gpm (1350 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Simplified mounting saves valuable space and provides filtration directly at the point needed. Prevents contaminants from passing downstream during element changes



Manifold Mounted Pressure Filters, Pn > 1450 psi (100 Bar)

Series HPF, HPX, HPY

Application: Manifold mounted in pressure lines

Port size: up to 1-1/4" (DN 36)

Operating pressure: up to 4568 psi (315 bar)

Flow rates: HPF up to 357 gpm (1350 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Simplified mounting saves valuable space and provides filtration directly at the point needed. Prevents contaminants from passing downstream during element changes



Tank Mounted Suction Filters

Series AS, TS, TSW, ASF

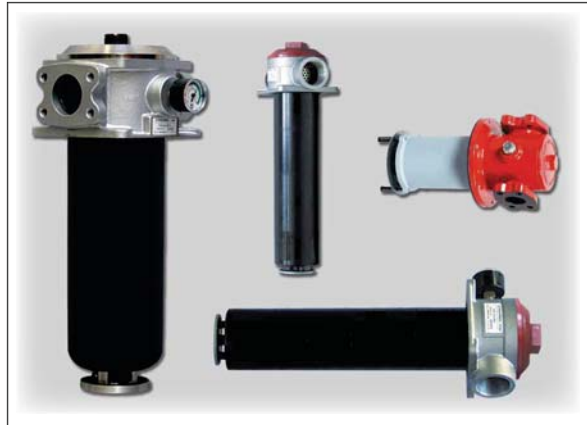
Application: Mounted to the side of the reservoir below oil levels. It is positioned vertically in the TS series or horizontally in the TSW series. The suction side faces the reservoir; a check valve prevents oil from draining from the reservoir during servicing.

Port size: up to -24 SAE (G 1-1/2), up to SAE 3-1/2"

Flow rate: up to 185 gpm (700 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh

Benefits: Suction filters can be serviced from the outside of the reservoir with no additional check valve needed



Off-line Filters

Series NF

Application: Partial flow filter for fine filtration of hydraulic and lubrication circuits; supplements the main filter

Port size: up to SAE 2-1/2"

Operating pressure: 232 psi (16 bar)

Flow rate: up to 264 gpm (1000 l/min)

Filtration materials: Paper, Interpor fleece, or stainless steel wire mesh.

Water absorption elements are also available

Benefits: Offers a large filtration area in a compact size allowing for high dirt-retaining capacity even with a small filter fineness. Filter element can be changed quickly and without tools



Tank Breathers

Series NBF, EBF, BFD, BF

Application: Assures that no contamination reaches the tank through air exchange or water condensation in the reservoir

Port size: up to BS PP 3 (G 3)

Flow rates: up to 925 gpm (3500 l/min)

Filtration materials:

NBF - Paper, Interpor fleece

EBF - Paper

TBF - Paper

BF, WP - Paper, Interpor fleece

BFD - Silica gel, Interpor fleece

Benefits: Protects system from airborne debris and/or moisture



Spin-on Filters

Series WPL

Application: In-line filter; mounted into pressure and return lines for all hydraulic systems

Port size: up to NPT 1-½" (G 1-½)

Flow rate: up to 69 gpm (260 l/min)

Filtration materials: Paper or Interpor fleece

Benefits: Easy maintenance. Die-cast aluminum construction saves overall weight. Use as suction or return filter



Clogging Indicators

Series AE, OE, O, E, VS

Application: Wide range of clogging indicators for hydraulic and lubrication systems

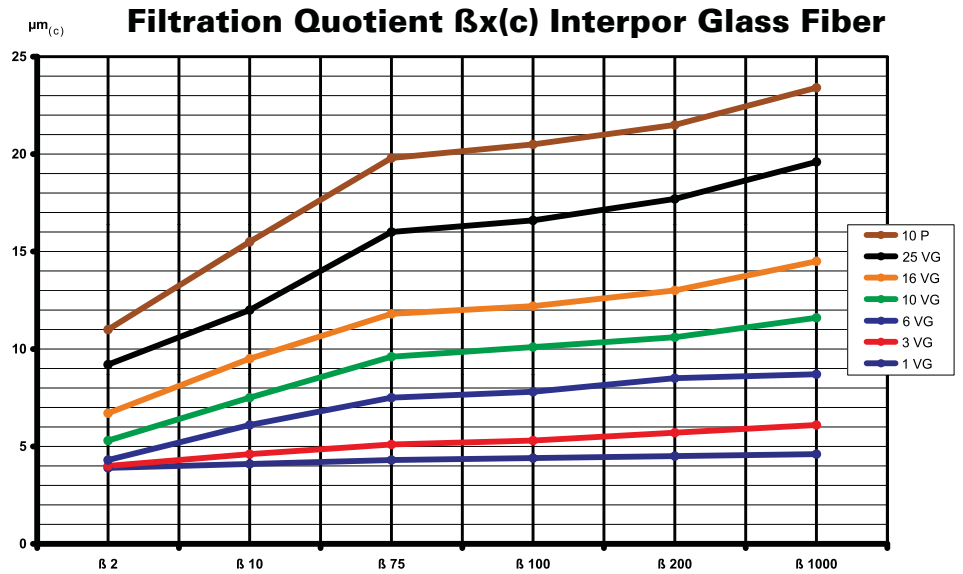
Types: Optical, electrical, optical-electrical, electronic. Available variations include: block execution, explosion-proof, thread execution, with reset function, and with control function

Benefits: Easy integration into automatic control systems, allows for continuous contamination control and pressure differential measuring, early identification of increased contamination, and optimal utilization of filter elements



Filter Efficiency Data

Multi-Pass Performance
According to ISO 16889



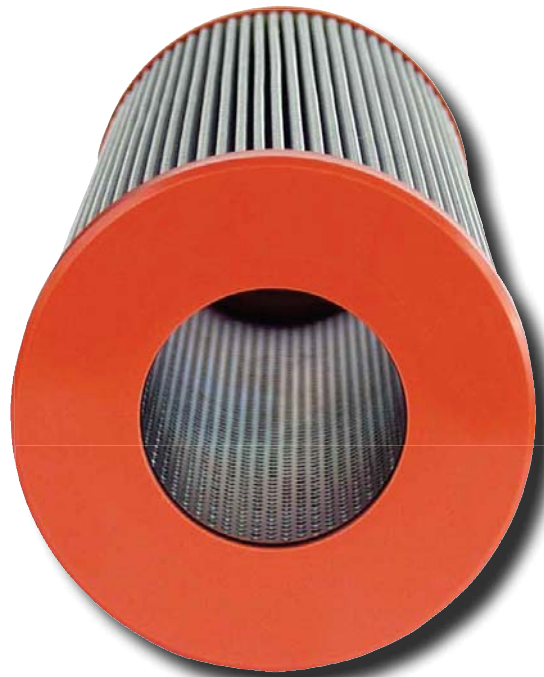
Calculation of the filtration quotient $\beta_{x(c)}$

$$\beta_{x(c)} = \frac{\text{amount of particles of the size } \geq x \mu\text{m}(c) \text{ before the filter}}{\text{amount of particles of the size } \geq x \mu\text{m}(c) \text{ after the filter}}$$

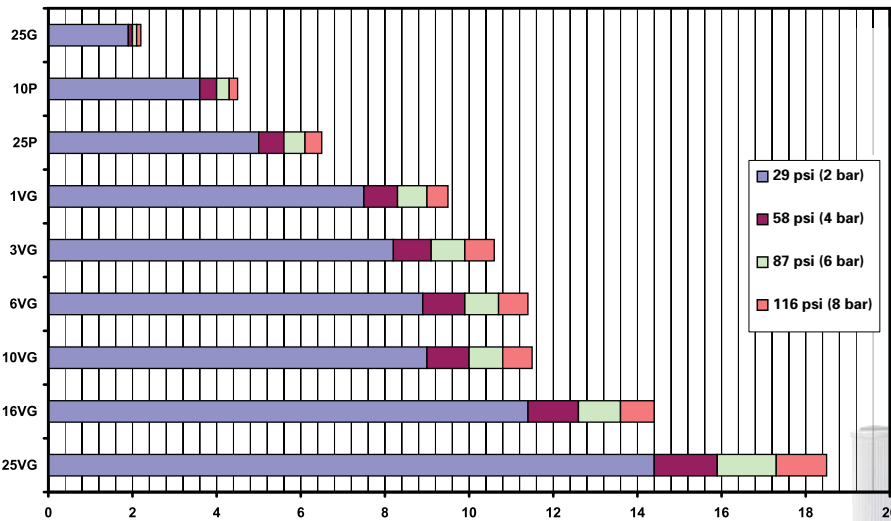
Conversion of filtration quotient $\beta_{x(c)}$ into filtration efficiency (in %)

$$\frac{\text{filtration quotient} - 1}{\text{filtration quotient}} \times 100 = \%$$

e.g. $\beta_{10(c)} = 200 \rightarrow \frac{(200-1)}{200} \times 100 = 99.5\%$



Dirt Holding Capacity According to ISO 16889



Dirt holding capacity according to ISO 16889 (test dust: ISO-MTD) of different filter media and filtration grades. Dirt holding capacities at 29, 58, 87, 116 psi (2, 4, 6, 8 bar) pressure differential.

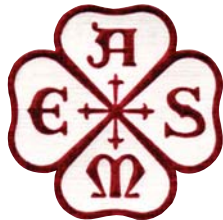


Systems Sensitivity and Optimal Cleanliness Class

The cleanliness of the oil in a hydraulic system is determined by the micron rating of the filter element, the specific contaminant, and the size and distribution of the particles in the fluid.

This table presents standard data values. To determine the quality of a particular oil, it should be analyzed using established procedures.

| System types Application case | Req. class acc. to ISO 4406:99 | Req. class acc. to NAS 1638 | Recommended Eaton's Internormen filter material |
|--|-----------------------------------|--------------------------------|--|
| Against fine soiling and gumming up of sensitive systems | 16/12/8 | 2-3 | 1 VG |
| | 17/13/9 | 3-4 | 3 VG |
| Heavy-duty servo motor systems; high pressure systems with long service life | 19/15/11 | 4-6 | 6 VG |
| Proportional valves; industrial hydraulics with high operating safety | 20/16/13 | 7-8 | 10 VG |
| Mobile hydraulics; common mechanical engineering, medium pressure systems | 22/18/14 | 7-9 | 16 VG |
| Heavy industries; low pressure systems; mobile hydraulics | 23/19/15 | 9-11 | 25 VG |



In addition to proprietary tests developed by Eaton Internormen Products, we test our filter elements according to the following ISO standards:

- ISO 2941** Verification of collapse/burst resistance
- ISO 2942** Verification of fabrication integrity
- ISO 2943** Verification of material compatibility with fluids
- ISO 3723** Method for end load testing
- ISO 3724** Verification of flow fatigue characteristics
- ISO 3968** Evaluation of pressure drop versus flow characteristics
- ISO 16889** Multi-pass method for evaluating filtration performance

Customer-specific filter solutions in-lab and on-site, are based on the work of research and development and design teams. These services are supported by computer analysis, measurement methods, the availability of necessary test stands according to ISO standards, and continuous production control of all filter elements.

The beta ratio of the filter element and its permanent efficiency are guaranteed for high pressure differentials. Filter materials, bonding and processing are regularly controlled by means of bubble-point tests; on our test stand, according to ISO 2942.

Eaton's Internormen elements can be supplied with 100% bubble-point tests and corresponding certificates on request.



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*Visit us online at eaton.com/filtration for
a complete list of Eaton's filtration products*

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