Filtration Products

Vickers
Filtration Master Catalogue

EATON
Powering Business Worldwide

Check out our full line of filtration products and accessories at *www.eaton.com/filtration*

Introduction to Eaton Filtration

Fluid Power is one of the most reliable and repeatable forms of power and motion control. When problems are encountered, 80% of the time they are related to inadequate contamination control practices. Eaton has more than a 75-year history of dedication to helping engineers develop, operate and maintain reliable, high quality power and motion control systems.

For a hydraulic or oil lubricated machine, the development of a target cleanliness level and the plan to achieve it is as much a part of system design as the selection of the pump, valves, actuators or bearings.

Vickers Systemic Approach to Contamination Control

- Set a target Cleanliness Level
- Select filters and filter placements to achieve target
- Sample fluid and confirm achievement

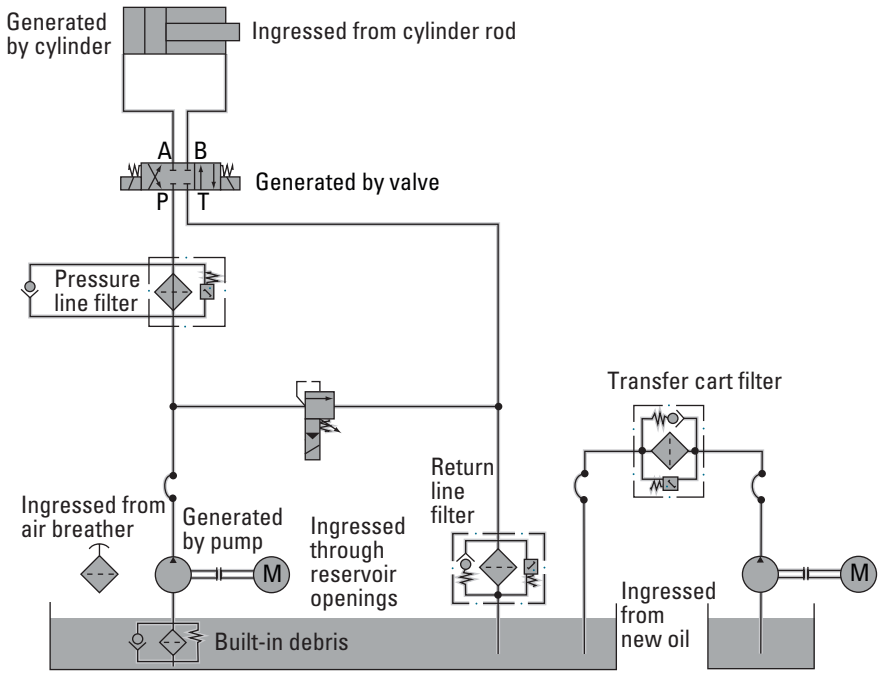
The systemic contamination control approach assures the user of the hydraulic system a cost effective approach to contamination control that allows the price of the filters and elements to be quickly recovered by the savings of improved performance, increased component life, increased oil life, increased uptime and fewer repairs.

The goal of systemic contamination control is always the same: to clean the fluid to the point that contamination is not a factor in the failure (catastrophic, intermittent, or degradation) of any component in the system during the desired useful life of that system.

The first step towards this goal is the setting of a target cleanliness level that takes into account the specific needs of the system.

Sources of Contamination

Eaton doc. 561, page 8



Once the target has been set, the next step is to select and position filters in the system so that the target can be achieved in a cost effective manner.

After the machine is in operation, the last and ongoing step is to confirm that the target cleanliness level is being maintained.

This is most often accomplished by sending a fluid sample to a particle counting laboratory that gives cleanliness code data to established standards. If the target is being met, the system only needs to have filters maintained and the fluid retested periodically. If the cleanliness target is not being achieved, corrective actions need to be taken. Sometimes a change in maintenance practices is needed, but at other times a shift to a finer grade of filter elements or additional filter housings may be needed.

There are four primary sources for solid contamination to enter a hydraulic fluid.

They are: contaminated new oil, built-in contamination, ingressed contamination and internally-generated contamination.

Eaton Fluid Analysis Service PN 894276

Introduction to Eaton Filtration

Contaminated New Oil

Although hydraulic and lubrication fluids are refined and blended under relatively clean conditions, the fluid travels through many hoses and pipes before it is stored in drums or in a bulk tank at the user's facility. At this point, the fluid is no longer clean as the fluid lines it has traveled through have contributed metal and rubber particles, and the drums have added flakes of metal or scale. Storage tanks are a real problem because water condenses in them causing rust particles. Contamination from the atmosphere can

Eaton Clean Cart

also find its way into the tank unless satisfactory air breathers are fitted.

If the fluid is stored under reasonable conditions, the principal contaminants on delivery to the machine will be metal, silica and fibers. With fluids from reputable suppliers, sampling has shown typical Cleanliness Levels of 17/16/14 or dirtier. Using a portable transfer cart fitted with a high efficiency filter, contamination should be removed from new fluids before the contamination enters and damages the components in the system.

Built-in Contamination

New machinery always contains a certain amount of built-in contamination. Care in system assembly and in new component flushing reduces this but never eliminates it. Typical built-in

Eaton H20 Gate Reservoir Breather BR110

contaminants are burrs, chips, flash, dirt, dust, fiber, sand, moisture, pipe sealant, weld splatter, paint and flushing solution.

Ingressed Contamination

Contamination from the immediate surroundings can be ingressed into the fluid power or lubrication system. On large installations, such as those within steelworks or automotive plants, it is relatively easy to know the environmental conditions, though they vary considerably. For example, a coke oven system operates in conditions very different from a similar system in a cold mill. For mobile equipment, there is a very wide variation in environmental conditions by application, location and even by weather conditions (i.e. high winds).

The key is to severely limit the access that environmental contamination has to enter the hydraulic or lubrication system. There are four major ways dirt can enter a system: reservoir vent ports (breathers), power unit or system access plates, components left open during maintenance and cylinder seals.

Generated Contamination

The most dangerous contamination to a system is the contamination generated by the system itself. These particles are "work hardened" to a greater hardness than the surface from which they came, and are very aggressive in causing further wear in the system. In a system running on properly cleaned fluid very few particles are generated, although all components (especially pumps) create a small amount of particles during routine operation. In a system where these particles are not quickly captured the elevated contamination levels will cause the number of additional generated particles to increase at a highly accelerated rate! The best way to prevent contamination generation within a system is to start with a clean (fully flushed) system and keep the system fluid clean.

Filter Element Initial Efficiency

The international standard for rating the efficiency of a hydraulic or lubrication filter is the Multipass Filter Performance Beta Test (ISO 16889). The results of this test are reported as a ratio of number of particles greater than a designated size upstream of the test filter compared with the number of same size particles downstream of the test filter. These results are then expressed as a Beta ratio. Most Eaton™ filters are rated at Beta x(c)=1000. See individual filter "Features and Benefits" for more detail.

BETA RATIOS AND CORRESPONDING EFFICIENCIES

Beta Ratios	Efficiency
1	0%
2	50.00%
5	80.00%
10	90.00%
20	95.00%
75	98.00%
100	99.00%
200	99.50%
1000	99.90%
5000	99.98%

Beta ratios and dirt capacity are only a guide to system cleanliness needs ref. Eaton doc. 561, page 19

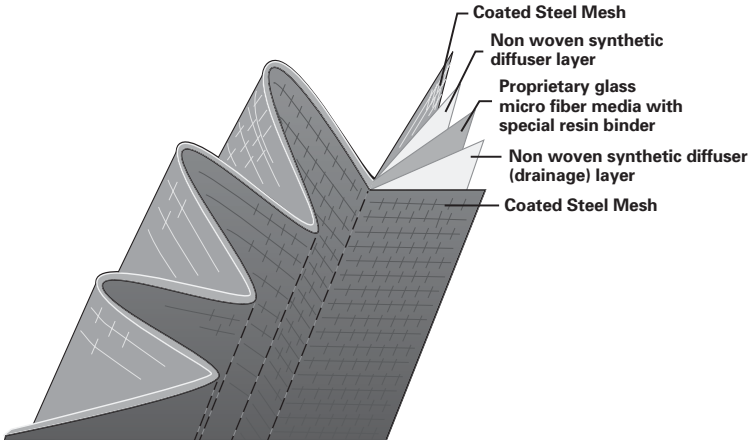
Multipass testing has greatly aided engineers in the development of better and more efficient filter elements, and it has helped the design engineer who needed to specify a filter element's performance. But, there's little correlation between multipass efficiencies and system cleanliness needs. In the final performance analysis, the goal is properly cleaned fluid and not just very high Beta ratios and dirt capacity. The most important information needed by a designer or user of a hydraulic system is the system cleanliness they can expect when that filter and media are properly installed in the system.

Each grade of Eaton high efficiency filter media construction is thoroughly multipass tested and then rated with the system cleanliness level expected to be achieved with the use of that product. The assumptions behind these cleanliness ratings are: 1) the filter sees full system flow, 2) the filter is the primary filter in the system, and 3) air breathers along with recognized maintenance practices will limit dirt ingression from the atmosphere.

A major problem in correlating multipass test claims to real world fluid cleanliness levels is that real systems operation greatly stresses the element. In active systems, flow rate changes (often several times a minute), pressure pulses (hundreds a minute), decompression shock waves, cold starts and other variables all work to degrade a filter's performance. In multipass testing the element is subject to one gradual rise in differential pressure as the element loads!

Flow fatigue test protocol (ISO 3724) leaves many important questions unanswered. Again the element is tested in laboratory conditions that cannot duplicate the interaction of the many forces working to stress and degrade the element. This laboratory test may fail to answer the question of how an aged element will perform during the latter part of its service life.

Eaton Media Construction



The best way to deal with this issue is to look at the construction and feel the element pleats. Are the pleats well supported? Do they flex under hand pressure? Any element that fails these simple tests will fail to maintain efficiency and integrity, and will not maintain the targeted cleanliness level.

Additionally, look at the pack construction. Steel wire mesh is very important in element construction. Wire keeps the pleats from flexing and gives the filter medium the support it needs to keep from failing due to fatigue. The downstream wire mesh also serves as a last chance protection in case of unexpectedly severe stress that causes element media rupture.

Filter Condition Indicators

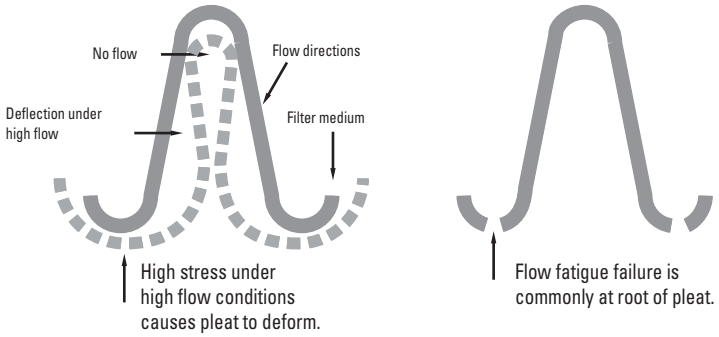
After the filters are placed within the system, the next consideration is how the user is going to know when to change the element. The answer recommended in DIN 24550 standard is to have all filters fitted with a differential pressure indicator that gives an easy-to-read indication that the element needs to be changed. Eaton

LIMITS ON CORRELATION BETWEEN "BETA" AND SYSTEM CLEANLINESS AND "DIRT CAPACITY" AND SERVICE LIFE

	Laboratory Procedure	Real World
Pressure Rise	One gradual rise	Thousands of changes
Fatigue Cycles	One	Millions
Element Aging	Minutes	Months
Element Life	One hour	800+ hours
Contaminant	AC fine test dust	Debris, water, gas
Challenge Rate	Constant	Always changing
Fluid Used	MIL 5606	Wide variety
Temperature	100°F (38°C)	-20°F to 200°F (-7° to 93°C)
Flow	Steady	Thousands of changes

indicators are designed to indicate at a pressure drop 20% below the bypass setting which equates to 95% of the element's service life. This indication before bypass feature was incorporated to allow safe operation of the machine until the next shift change or convenient maintenance opportunity.

In poorly supported elements, changes in flow and pressure drop cause the sides of element corrugations to flex and the root to stretch, giving rise to fatigue stresses. Dirt capacity is also lost as areas of the medium have no flow.
Eaton doc. 561, page 21



Element Service Life

As in any aspect of machine design or maintenance, cost of installation and operation are very important concerns. For filters, the length of time an element lasts in service and the initial cost of that element, combine to determine the economics of using that product.

The most important aspect of gaining long element service life is to minimize the ingression! Reservoirs need to be fitted with vent filters (=3µm) that remove the dirt before it enters the system. Access port and doors need to be kept sealed so that dirt cannot be drawn into the system. Cylinder rods that extend into contamination laden environments should be shielded to minimize the dirt being drawn into the system.

The second important aspect to long element service life is to keep the cleanliness level of the fluid at or below target. Periods of machine operation with dirty fluid cause accelerated internal wear that loads a filter element. (It's important the debris is caught as it saves the system, but it does cost the element part of its service life.) Always change an element on indication and always use genuine Eaton elements because of their consistent performance and superior strength under stress.

The third issue in long element service life is the "dirt capacity" of the element. This value is calculated as part of the multipass efficiency test. Because of the many differences between the test conditions and real system operation, different dirt capacity values do not correlate well to changes in element service life. Dirt capacity can only be used to compare elements under very specific laboratory situations, and as a result published dirt capacity values should be used as general information rather than specific comparable data.

Eaton elements are designed to give long life and reliable service in hydraulic or lubrication applications. This is achieved with our multi-layer construction. Each layer provides additional strength or capacity leading to overall superior performance. Some elements focus heavily on media structure only, which can give increased "dirt capacity" under laboratory conditions, but no increase in service life is experienced in real systems.

An often overlooked aspect of dirt capacity and service life is the effect of element area. When comparing an element of "x" area with an element of "2x" area, one would expect twice the life for the larger element. But, in real systems, the life extension is most often between 2.5 and 3.5 times as long. This is because the reduced flow density through a unit area of media allows for more effective contaminant capture. Larger elements are the most cost effective approach to contamination control from the perspective of operating costs.

Guide for Selecting Filters

Target Cleanlines

Using the Vickers Target Cleanliness Worksheet (#578), it is easy to determine the target ISO Cleanliness Level for a system. This target is based on the application's components and system dynamics.

Placement and Media

Use the chart below to help select the appropriate filter placement and grade of media to acheive the target cleanliness level. For more detail, consult the Eaton Guide to Systemic Contaminaton Control, your Vickers representative, or the ANSI System Standards for Stationary Industrial Machinery.

Filter Placement

The chart below helps engineers select the grade of Vickers media and the filter placement(s) that will acheive the required target cleanliness. It assumes the system will experience "average" ingression and that maintenance of the system will be consistent with current technology.

If in operation the system is running dirtier than expected, corrective actions should be initiated. Suggested corrective actions are:

- Check the indicator to see if the filters are on by-pass.
- Check the sources of ingression and correct problems.
- Check that the filters are positioned properly to see maximum fluid flow.
- Consider using a finer Pak grade
- Add additional filters to the system.

Note: All systems need a sealed reservoir with vent port filtration.

CAUTION

Before servicing the element, the bleed plug in filter housing must be loosened to relieve pressure. This will minimize fluid overflow.

Housing

The selected housing should be rated within the required flow and pressures of the application.

Important: If the system fluid's specific gravity (SG) is greater than 0.9 (for example, water glycol), the housing pressure drop (ΔP) should be corrected for actual application.

Specific Gravity Corrections for Pressure Drops

The filter housing flow curves in this catalog can be adjusted using the following equation:

Adjusted $\Delta P_{Housing}$ = ΔP_{Curve} x Actual SG ÷ 0.9

Bypass Valve

Bypass valve selection is based upon system requirements. According to ANSI Standard 12.2.6, filter assemblies whose elements cannot withstand full system differential pressure without damage should be equipped with bypass valves. Generally, a higher bypass pressure setting will allow for longer element life.

Some systems require filtration with no bypass, such as servo applications. Vickers H-Pak media is recommended for non-bypass systems.

Indicator

To meet ANSI Standard 12.2.5, filter assemblies should have a device to indicate when the filter requires servicing. Per ANSI Standard 12.2.6, the indicator should "trip" at approximately 80% of the bypass pressure setting. If using a non-bypass housing, an indicator selling of approximately 100 psid is recommended. Differential pressure indicators are rated 6,000 psi working, 3,500 psi fatigue.Δ

TARGET CLEANLINESS		RECOMMENDED FILTER PLACEMENT FOR HIGH INGRESSION SYSTEMS WITH FIXED VOLUME PUMPS.	RECOMMENDED FILTER PLACEMENT FOR SYSTEMS WITH VARIABLE VOLUME PUMPS.	RECOMMENDED FILTER PLACEMENT FOR HIGH INGRESSION SYSTEMS WITH VARIABLE VOLUME PUMPS.		
	Full flow pressure line or return line	Full flow pressure line or return line	Pressure line/ recirculating loop at 20% of system volume per minute	Pressure line plus return line plus recirculating loop	Recirculating loop at 20% of system volume per minute	Recirculating loop at 10% of system volume per minute
14/12/10	-	03	03	03	-	-
15/13/11	-	03	03	05	-	-
16/14/12	03	05	05	05 or 10	03	03
17/15/13	03	05	05	05 or 10	03	03
18/16/14	05	10	05 or 10	10	05	03
16/14/10	05 or 10	10	10	10	05 or 10	05

Guide for Selecting Filters

Surge Control

Surge Control is used on systems where spikes and surges in the hydraulic system could prematurely trip the indicator. Surge controls slow the indicator response. If the indicator encounters a continuous high differential pressure, it will trip at the rated setting.

Element

The Vickers element media grade should be selected to acheive the Target Cleanliness Level. The Vickers media construction should be chosen based upon system requirements such as flow characterstics, pressure surges and specific application conditions.

Important: If the system fluid's specific gravity (SG) is greater than 0.9 (for example, water glycol), the element pressure drop (ΔP) should be corrected.

H-Pak Construction

For systems where a bypass valve is undesirable, such as servo systems, the H-Pak media provides high collapse rated housing pressures. H-Pak media construction utilizes 304 stainless steel inner and outer mesh support along with heavier core tubes and media support to protect the system.

C-Pak Construction

C-Pak media uses five layer construction. C-Pak incorporates epoxy coated carbon steel as the two outer face layers to retain the inner media pak layers.

R-Pak Construction

The R-Pak spin-on filter elements are designed for low clean pressure drop and high efficiency. R-Pak incorporates a five layer media construction with outer layers of epoxy coated carbon steel wire to retain the inner media pak layers.

Viscosity Corrections for Pressure Drops

The element flow curves can be adjusted using the following equations:

Adjusted Clean $\Delta P_{Element}$ =

Actual viscosity in cP ÷ 29 x ΔP_{Curve}

Actual viscosity in cSt/32 x Actual SG ÷ 0.9 x ΔP_{Curve}

Actual viscosity in SUS/150 x Actual SG ÷ 0.9 x ΔP_{Curve}

A good "rule of thumb". To ensure satisfactory element life, the clean element pressure drop should generally be less than or equal to 40 percent of the indicator's rated differential pressure:

$\Delta P_{Element} = 0.4 \times \Delta P_{Indicator}$

The best way to extend element service life is to minimize ingression (vents, seals, cylinder rods) and maintain system cleanliness at or below the Target Cleanliness Level.

Fluid Analysis

Eaton Fluid Analysis Service

Eaton hydraulic components have a global reputation for quality, reliability and performance. That reputation is built on a tradition of customer service and we stand behind every one of our products.

Our Fluid Analysis Service follows that same tradition. We provide our customers with comprehensive fluid testing and diagnostic services, with detailed reports that are easy to understand.

To find out how the Eaton Fluid Analysis Service can help your operation, read on.

Then call us to get started.

A Name You Trust

Only one fluid analysis lab lets you put years of Eaton experience to work for you. So when the health of your hydraulic system is at stake, choose a partner with more than 75 years of experience. Contact your Eaton representative for more information on our Fluid Analysis Service.

Critical Analysis

Fluid is the lifeblood of every hydraulic power system. To keep yours running efficiently and effectively, you need to know what's in it. What you don't know can hurt you.

The Eaton Fluid Analysis Service analyzes hydraulic fluid in much the same way a medical lab tests a blood sample. Just as a blood test helps a doctor diagnose health problems, a sample of hydraulic fluid can help us pinpoint sources of contamination and determine whether or not your system uses adequate filtration.

We can help you reduce catastrophic equipment failures, maintain optimum component performance, and identify any substandard maintenance practices. Your bottom-line benefit is increased productivity.

Clear Benefits

We offer testing designed to tell you the most about your hydraulic fluid. We use sophisticated computer programs and laboratory diagnostic equipment such as an Energy Dispersive X-ray Fluorescence and an inductively coupled plasma spectrophotometer.

After we use this advanced equipment to provide the most detailed possible analysis of your hydraulic fluid, we create reports that are always easy to read and understand. By taking the mystery out of fluid analysis, we provide a service that clearly explains the benefits of clean fluid.

Comprehensive Testing

The Eaton Fluid Analysis Service is certified to ISO 12025 and offers a full range of tests specifically designed for the analysis of hydraulic and lubrication system fluid. Our laboratory equipment and test procedures provide an exact analysis of your hydraulic or oil lubricated system, and our drawdown particle isolation procedure ensures accurate results.

Our testing procedures can include:

Photomicrography: We scan and photograph a filter patch using an optical microscope to find particle size and type. The scanning process verifies the automatic particle count to identify samples needing special preparation. This provides confirmation of automatic counter results, and helps us see what contaminants are in the fluid.

Viscosity (ASTM D445): We use this test to determine the viscosity of your oil. Without proper hydraulic fluid viscosity, your equipment will suffer. Incorrect viscosity leads to fluid breakdown, inefficient equipment operation, premature system failure and damage to other components.

Water (ASTM E203): We determine the water content in hydraulic fluid, which helps us predict quality and performance characteristics for the fluid and system components. Excess water reduces the viscosity of hydraulic fluid, which increases the likelihood of adverse chemical reactions and degrades equipment performance.

Drawdown Particle Isolation: Using this test, we determine the insoluble contaminates in hydraulic fluids, both insoluble particles and gel-like matter, organics and inorganics. Used in conjunction with photomicrography, the drawdown patch helps us identify the source and type of fluid contaminants.

Automatic Particle Count (ISO 11500): We use a high-intensity laser light source and a photo sensor to count the number and size of particles in the fluid sample and then define contaminants according to size distribution and quantities. Automatic particle counting is quick, repeatable and accurate. It provides reliable information we can use to check against ISO Standard 4406, which defines the relationship between particle counts and hydraulic fluid cleanliness. This lets us determine exactly what corrective actions, if any, are needed. The lab is also capable of testing to the new ISO 4406(1999) standard (4µ, 6µ,14µ).

Spectrometric Analysis (ASTM D 5185): This shows us the concentration of oil-soluble elements and indicates the additives and trace metal content in the fluids. We use this technique to evaluate the condition of the additives in a fluid rather than its particulate contamination. Used in conjunction with automatic particle counting, it helps us accurately assess the cleanliness level of the fluid.

Energy Dispersive X-ray Fluorescence (ASTM E 1508): We perform Energy Dispersive X-ray Fluorescence (XRF) analysis on samples with extremely high concentrations of particulate contamination. By isolating chemical elements, we pinpoint contaminant types so we can establish their origins, and so you can take corrective action.

Fluid Analysis

Easy-to-Read Reports

We present your fluid test results in a format that is easy to understand. Results typically include these items:

Vacuum Pump PN 894279

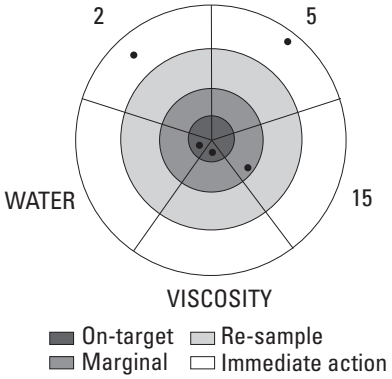
1. **Results Target:** A results target compares your actual fluid cleanliness results and your ideal cleanliness level. If you don't have a target level yet, we can use your sample to help you determine what it should be.

2. **Trend Information:** We evaluate data from your previous two samples along with the results of your current sample. This provides a trend analysis of critical measurements, and shows changes in the fluid over time.

   pH (ASTM E 70) represents the strength of acidity in hydraulic fluid, and is usually measured for water-containing hydraulic fluids (water/glycols, invert emulsions). Typical values are 8.5–10.5.

   Total Acid Number, or **TAN (ASTM D 974)**, is the amount of acid and acid-acting material constituents in hydraulic fluid. An increase in TAN indicates oxidation or acid contamination. Some hydraulic fluids exhibit higher acid numbers than others. Typical values are 0.1–3.0.

Fluid Test Results



Time	**TEST 1** Present	**TEST 2** Previous #1	**TEST 3** Previous #2
Viscosity @ 100°F cSt (SUS)	45.0 (210)	45.5 (212)	45.8 (213)
Water % Weight	0.03%	0.03%	0.03%
pH Note: pH is for water containing fluids only.	9.4	9.5	9.6
TAN mg KOH/gm Note: TAN is for synthetic fluids only.	2.1	2.0	2.1

Particle Count Summary

Time	**TEST 1** Present	**TEST 2** Previous #1	**TEST 3** Previous #2
>2µ	65,120	4,100	418
>5µ	12,220	1,250	88
>10µ	5,800	700	39
>15µ	900	250	22
>25µ	125	60	4
>50µ	12.0	5.0	1.0
Cleanliness Code	23/21/17	19/17/15	16/14/12

KIT FEATURES

Kit Part #	Automatic Particle Count ISO 11500	Water ASTM E203	TAN/PH (if applicable)	Viscosity ASTM D445	Photo Microscopy Drawdown Particle Isolation	Energy Dispersive XRF ASTM E1508 (if applicable)	Spectrographic Analysis ASTM D5185
894276P	•	•	•	•	•	•	
894277P	•	•	•	•	•	•	•

Each kit includes:

- Super clean sample bottle
- Packaging for sending sample
- Numbered test sample data form
- Fluid analysis service

Also available is PN 894279, Vacuum Pump for extracting oil sample, and PN 932339, Ultra Clean Bottle.

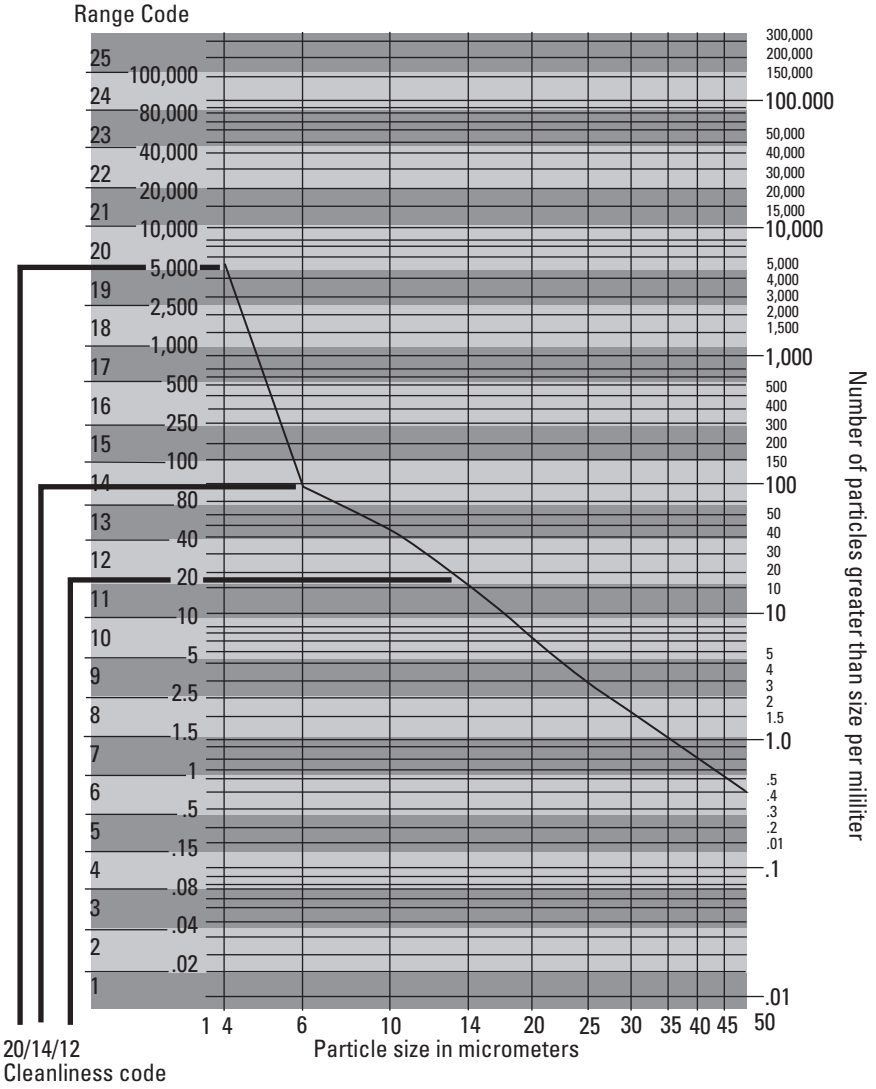
Items not in bold are non-standard and may have a longer lead time

Fluid Analysis

3. Cleanliness Code Graph: This graph uses the ISO 4406 standard for measuring and depicting the amount and size of particles per milliliter in hydraulic fluid, shown in a log-log2 graph that charts the amount of particles greater than certain micron sizes per milliliter of fluid.

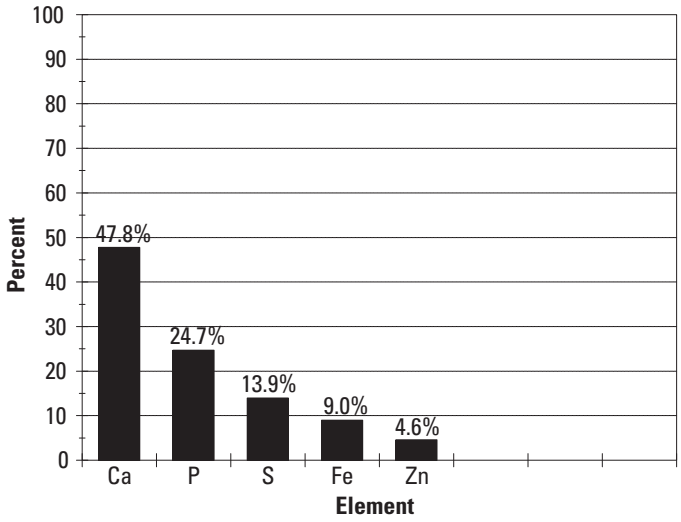
Recommendations: This section of the report provides you with valuable information on the cleanliness of your hydraulic system, as well as tips on maintaining or improving its current condition.

Cleanliness Code Graph



Sample XRF Analysis Results

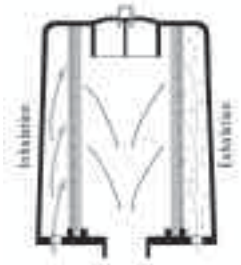
When a fluid sample shows high particulate contamination, we use Energy Dispersive X-ray Fluorescence (XRF) analysis to isolate and identify chemical elements. The results are shown in a graph like this.

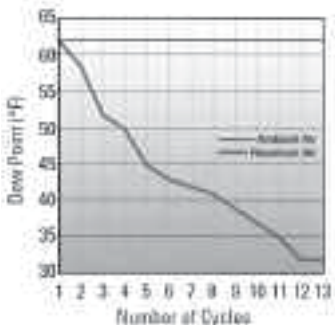


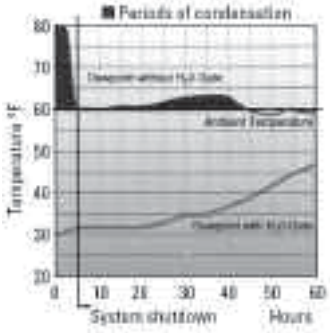
Breathers

Hydraulic reservoirs "breathe" air in and out as the oil level rises and falls. This circulating air contains particles and moisture that can cause corrosion, increase equipment wear and reduce fluid performance. In typical systems, the internal hydraulic fluid is warmer than the external environment. This difference in temperatures causes water vapor to form. Breathers protect your hydraulic system by filtering out damaging moisture and particles.

More than 25% of the samples sent to the Eaton Fluid Analysis Laboratory for analysis have significant water contamination. In an operating system, the H20-gate Vent Breather creates a moisture barrier when there is a 5°F (2°C) difference between reservoir and ambient temperature and when there is a 10% per minute exchange of air volume above the fluid. The Mobile-gate breather is smaller in size but is also $^1/_4$ the size and $^1/_2$ the capacity of the H20-gate. These temperature and air flow conditions are present in most hydraulic systems which employ a cylinder.







Part Numbers:

NPT Mobile-gate	**MBR110**
Flange Mobile-gate	**MBR120**
H20-gate	**BR110**
Dirt-gate	**BR210**

Performs as a gate

During the "inhalation" cycle, the proprietary media blocks the water vapor from entering the reservoir. During the "exhalation" cycle, the media allows the moisture in the reservoir air to exit. The moisture is carried off the media by the exiting air, restoring the media's water barrier capacity and the moisture barrier mechanism is not affected by the amount of exposure to moisture. The reservoir air is maintained at a low relative humidity and more importantly, at a lower dew point temperature than the ambient temperature.

Works even when the system is shut down.

The H20-gate and Mobile-gate Vent Breather retard the vapor equilibrium process and work to prevent condensation even after the system is shut and cooled down, such as overnight. As this chart illustrates, the dewpoint is slow to climb, even after the system temperature has dropped to the ambient temperature. Once the system has reached ambient temperature, condensation does not occur.

Reduces humidity inside reservoir.

The H20-gate and Mobile-gate Vent Breathers lower and stabilize the relative humidity of air inside the reservoir, leading to a lower dewpoint (Tdewpoint < Tambient = NO CONDENSATION) at a rate and amount that will be dependent upon several conditions: the ambient conditions, the internal reservoir heat, amount and frequency of reservoir air flow through the vent and the temperature of the reservoir surfaces.

BREATHER FEATURES

	H_2O-gate	Dirt-gate	Mobile-gate
Visual Indicator	•	•	•
Particle Control	•	•	•
Water/Moisture Control	•		•
Corrosion Resistant Housing	•	•	•
Flow Rate	708 L/min (187 USgpm)	708 L/min (187 USgpm)	473 L/min (125 USgpm)

Breathers

H2O-gate™ Reservoir Breather

Features/Benefits:

- Visual Mechanical Indicator: Actuates when particles have blocked the media, before the pump cavitates.
- Proprietary Media: Reduces dew point temperature to prevent condensation and is 99.7% efficient in blocking particles 3µ and larger.
- Reversible Flow Through Media: Allows for moisture to exit the reservoir.
- Media contains oil attractant layer to collect and return oil splashes.
- Easy Installation: Lightweight design can be hand tightened onto adapter.
- Durable Plastic Housing: Protects the media from external splashing.
- Superior breather filters both moisture and particles from air.
- Effective up to 121°C (250°F)
- Rated up to 25 SCFM

Part Numbers:

H20-gate	**BR110**
Bayonet Adapter	**924710**
Screw-in Adapter	**P-077002**

Dirt-gate™ Reservoir Breather

Features/Benefits:

- Visual Mechanical Indicator: Actuates when particles have blocked the media, before the pump cavitates.
- Easy Installation: Lightweight design can be hand tightened onto adapter.
- Durable Plastic Housing: Protects the media from external splashing.
- High Efficiency: (99% at 2 microns)
- Very Low Pressure Drop
- Filters out particles
- Effective up to 121°C (250°F)
- Rated up to 25 SCFM

Part Numbers:

Dirt-gate	**BR210**
Bayonet Adapter	**924710**
Screw-in Adapter	**P-077002**

Note:

This breather does not filter moisture from air.

Mobile-gate™ Filler Breather Assemblies

MBR120

MBR110

Features/Benefits:

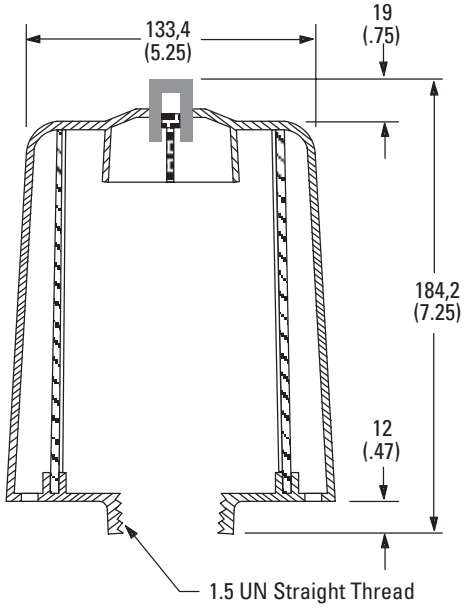
- Proprietary Media: Reduces dew point temperature to prevent condensation and is 99.7% efficient in blocking particles 10µ and larger.
- Water Barrier: Regenerates its water shedding capacity with each cycle.
- Reversible Flow Through Media: Allows for moisture to exit the reservoir.
- Easy Installation: Lightweight design can be hand tightened.
- Rugged metal housing is long lasting and ideal for mobile applications.
- Rated to 16.7 SCFM

Part Number

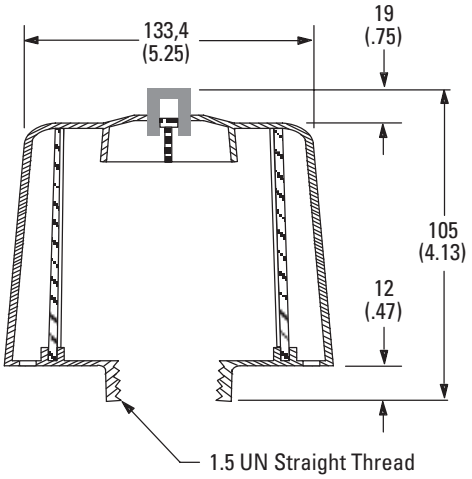
MBR110	**5002486**
MBR120	**5002487**

Items not in bold are non-standard and may have a longer lead time

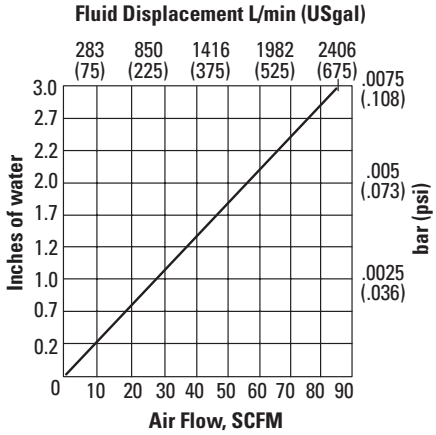
H2O-gate Specifications



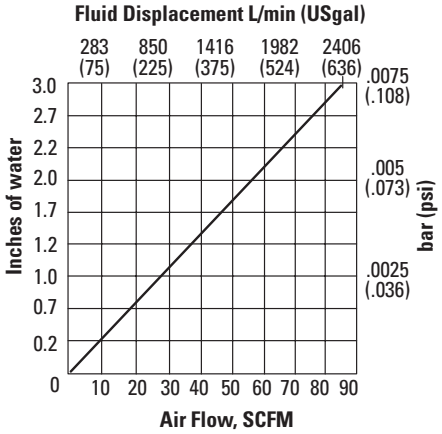
Dirt-gate Specifications



H2O-gate Pressure Drop

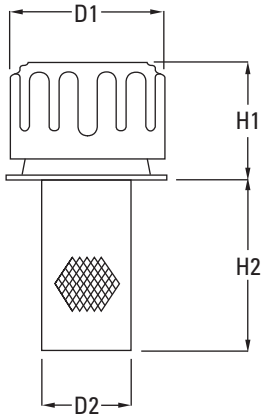


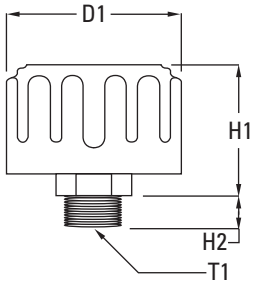
Dirt-gate Pressure Drop

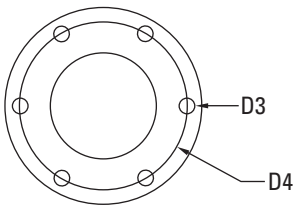


Mobile-gate Specifications

PART NUMBER	FLOW		DIMENSIONS (in)						
	USgpm	L/min	D1	D2	D3	D4	H1	H2	T1
MBR110	125	475	3.08	-	-		2.33	0.63	NPT 3/4
MBR120	125	475	3.08	1.88	-		2.50	3.50	-
MBR120 FLANGE	-	-	-	-	0.25	2.81	-	-	-

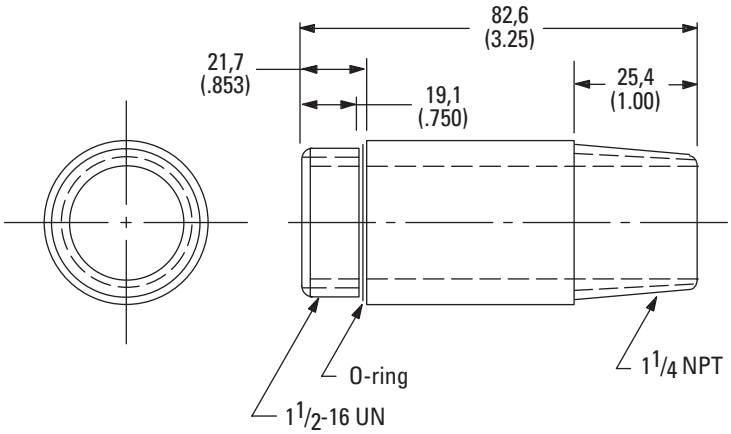




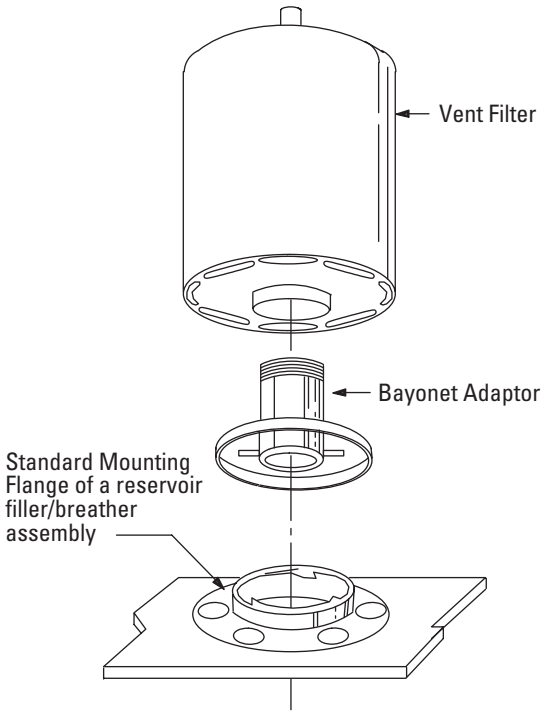


Installation Dimensions

Threaded Pipe Adaptor



Bayonet Adaptor



All Eaton Vent Filters are easily applied to reservoirs via Spin-On adaptors.

MODELS AND PART NUMBERS

Part Number	Description	Vent Filters Applicable
924710	Bayonet, no check	BR110, BR210
P-077002	Threaded pipe	BR110, BR210

Return Line Filters

General Data

Return line filters usually have spin-on type elements, cartridge elements in an in-line mounted housing, or cartridge elements within a housing that is mounted directly within the reservoir itself (sometimes referred to as an in-tank filter).

Return line filters may also be equipped with fluid sampling devices to monitor the fluid cleanliness level. Secondary ports may also be incorporated to add make-up fluid and ensure that the fluid is transferred through a filter before entering the system.

Return line filters are:

- An integral part of an effective contamination control solution.
- Ideal for systems where the pump is the sensitive component.
- An economic means of achieving the target cleanliness level.
- Often placed before the fluid enters the reservoir in order to prevent debris and particles from recirculating through the system.
- A crucial component when cylinders are present in the system. Cylinders potentially contribute a large amount of contamination ingression and return line filters are ideal for this type of control solution.
- Sometimes the only filters necessary (combined with a breather) when seeing the entire system flow on a continuous basis.
- Only a part of an effective contamination control solution when the system employs variable displacement pumps. Filters in systems like this may be supplemented by pressure and/or off-line filters.

Applications

- Stroke boom delimbers
- Drilling platforms
- Die cast machines/ injection molding
- Large machine tools

Return Line Filters

HV3R Series

Flows to 280 L/min (75 USgpm)
Pressures to 50 bar (725 psi)

Features and Benefits

- Beta Ratio: $\beta_{x(c)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards
- Visual and electrical indicators with lamp options for system design flexibility
- Fully serviceable without tools
- Zero leak by-pass valve construction
- Wide range of element lengths for maximum design flexibility
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels
- High collapse elements available for non-bypass applications

HV3R Series Filter and Element Model Code

Sample model code:

HV3R1SC4RLB2C05

DESIGN SPECIFICATIONS

Rated flow:	Length 1	160 L/min (42 USgpm)
	Length 2	240 L/min (63 USgpm)
	Length 4	280 L/min (74 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, oil-in-water and water-in-oil fluids Optional seals available for phosphate esters.
Temp range:		-30°C to 121°C (-22°F to 250°F)
Pressure rating:	Operating	50 bar (725 psi)
	Fatigue	50 bar (725 psi)
Material:	Head	Aluminum
	Bowl	Carbon Steel
	Collar	Carbon Steel
Dry weight: (Approximate)	Length 1	2,3 kg (5.1 lbs)
	Length 2	2,5 kg (5.5 lbs)
	Length 4	3,4 kg (7.5 lbs)

HV3R	*	**	*	**	*	*	*	**
1	2	3	4	5	6	7	8	9

1 Filter Series - HV3R

2 Element Collapse Rating

1 - 17 bar (250 psi) Low Collapse
4 - 207 bar (3000 psi) High Collapse

3 Port Options

BC - G 1-¼ to ISO 228
SC - 1.625 - 12UN SAE-20 str. Thd. (1-¼" tube)

4 Valve Options

1 - Non-Bypass
3 - Bypass set at 1.7 bar (25 psi)
4 - Bypass set at 3 bar (43 psi)
6 - Bypass set at 6 bar (87 psi)

5 Indicator Options

JN - No Indicator (plug), No Connector
QB - Electrical 1 bar (15 psi) Brad Harrison
QJ - Electrical 1 bar (15 psi) Hirschmann w 24V light
QK - Electrical 1 bar (15 psi) Hirschmann w 115V light
QL - Electrical 1 bar (15 psi) Hirschmann w 230V light
QH - Electrical 1 bar (15 psi) Hirschmann
LN - Visual (30 psi) No Connector
RB - Electrical 2 bar (30 psi) Brad Harrison
RJ - Electrical 2 bar (30 psi) Hirschmann w 24 volt light
RK - Electrical 2 bar (30 psi) Hirschmann w 115 volt light
RL - Electrical 2 bar (30 psi) Hirschmann w 230 volt light
RH - Electrical 2 bar (30 psi) Hirschmann
AN - Visual (70 psi) No Connector
UB - Electrical 4.9 bar (70 psi) Brad Harrison
UJ - Electrical 4.9 bar (70 psi) Hirschmann w 24 volt light
UK - Electrical 4.9 bar (70 psi) Hirschmann w 115 volt light
UL - Electrical 4.9 bar (70 psi) Hirshman w 230 volt light
UH - Electrical 4.9 bar (70 psi) Hirschmann

6 Seal Material

B - Buna-N
V - Viton-A
Viton is a registered trademark of E.I. DuPont

7 Assembly Length

mm (inch)
1 - 207 (8.15)
2 - 266 (10.47)
4 - 447 (17.6)

8 Element Construction

C - 17 bar (250 psi) Low Collapse
H - 207 bar (3000 psi) High Collapse
X - no element

9 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
***20**	22/**19/16** or better
XX	no element

Return Line Filters

HV3R Series

Flows to 280 L/min (75 USgpm)
Pressures to 50 bar (725 psi)

V3R * * * **

1 2 3 4 5

V3R Element Model Code

Sample model code:
V3RB1C05

1 Filter Element

V3R - For use with HV3R series housings

2 Seal Material

B - Buna-N
V - Viton-A

3 Element Length

mm (inch)
1 - 114 (4.5)
2 - 173 (6.8)
4 - 356 (14)

4 Element Construction

C - C-Pak (code 03, 05, 10, 20)
H - H-Pak (code 03, 05, 10)

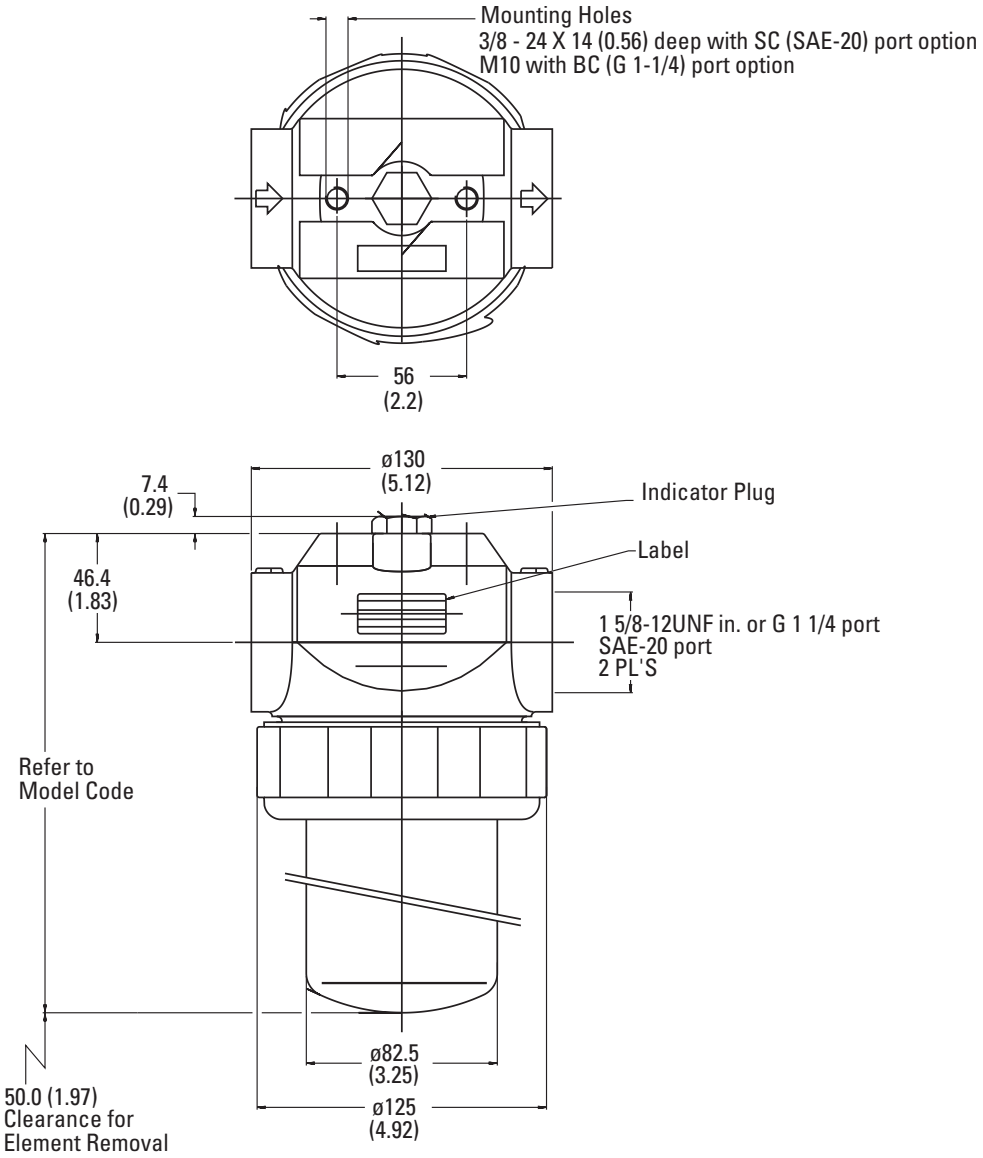
5 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
***20**	22/**19/16** or better

*** C - Pak only**

Housing Dimensions

mm (inch)



Items not in bold are non-standard and may have a longer lead time

Return Line Filters

HV3R Series

Flow Data

Flows to 280 L/min (75 USgpm)
Pressures to 50 bar (725 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

HV3R Filter Elements Flow Data

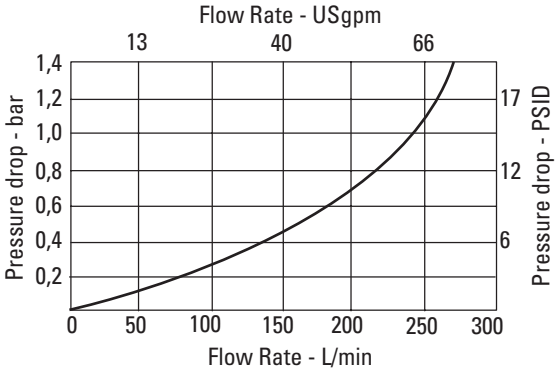
'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	20
C -pak	1	0.013 (0.717)	0.009 (0.479)	0.005 (0.252)	0.004 (0.193)
	2	0.008 (0.450)	0.006 (0.332)	0.004 (0.196)	0.002 (0.127)
	4	0.004 (0.220)	0.003 (0.170)	0.002 (0.092)	0.001 (0.071)
H -pak	1	0.017 (0.919)	0.010 (0.569)	0.006 (0.321)	xxx
	2	0.011 (0.578)	0.007 (0.374)	0.004 (0.214)	xxx
	4	0.006 (0.312)	0.003 (0.184)	0.002 (0.097)	xxx

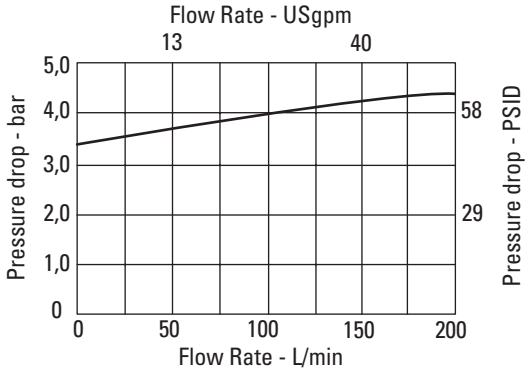
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Housing/Bypass Valve Flow Data

Housing



Bypass Valve



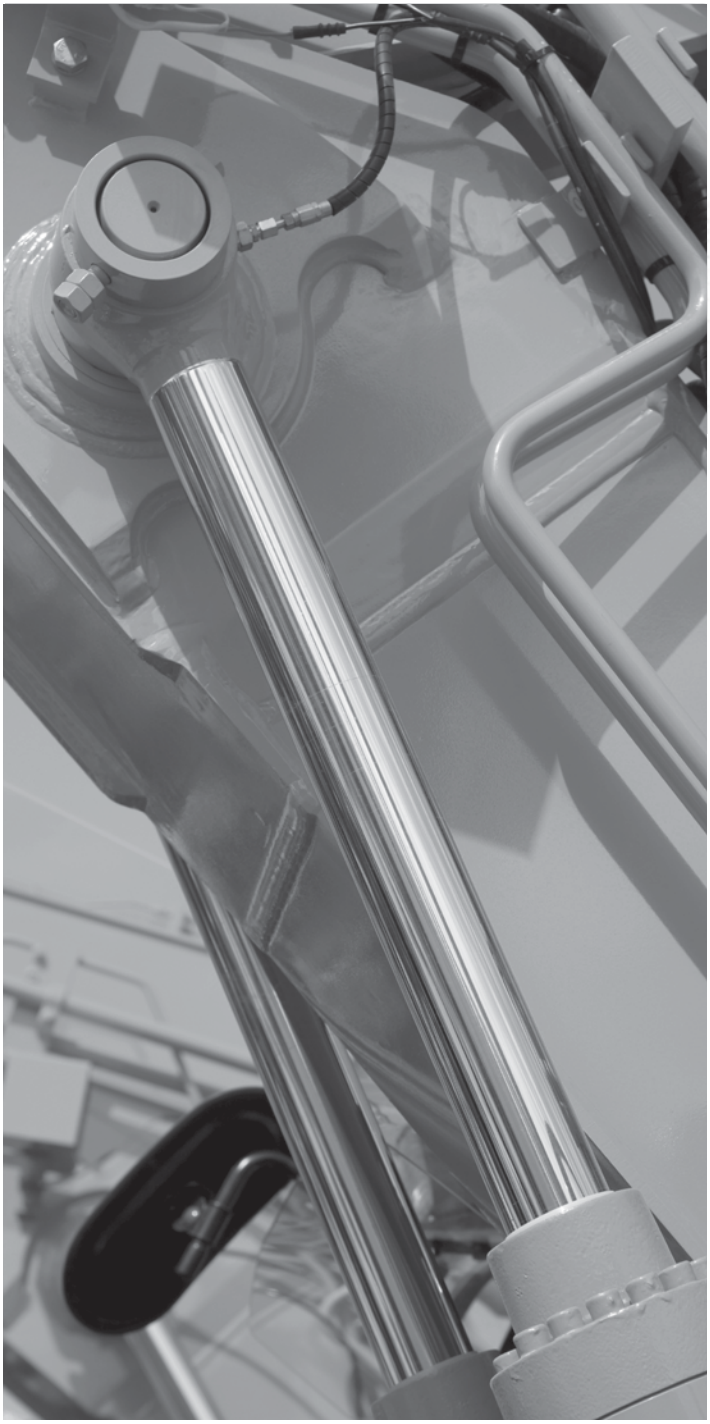
Sample ΔP Calculation : HV3R1SC4RLB2C05 - Filter assembly having '2' length filter element with micron rating code '05' at 100 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.7x 0.8/0.9	+	100 x 0.006 x 46/32 x 0.8/0.9
	=	0.620	+	0.76
	=	**1.38 bar**		

In-tank Filters

General Data

In-tank filters are a special type of low pressure return line filters. In-tank filters are mounted directly to the reservoir tank top and have an accessible head that is located outside of the reservoir while the body of the housing is located inside the reservoir. The exposed cover allows the element to be easily replaced as needed.



The filter housing may be equipped with diffusers to ensure that the returning oil energy is gradually dissipated within the reservoir fluid to minimize the potential for aerating or foaming of the oil. In addition, the diffuser helps direct the fluid outward against the walls of the reservoir to aid in the heat transfer capability of the reservoir.

Applications

- Forestry harvesting equipment such as delimbers and feller bunchers
- Injection molding or blow molding equipment
- Offshore drilling platform power units
- Machine tools
- Die cast machines

In-tank Filters
HF4RT Series

Flows to 454 L/min (120 USgpm)
Pressures to 7 bar (100 psi)

Pop-rivets for shipping purposes only. Remove prior to installation.

Features and Benefits

- Beta Ratio: $\beta_{X(C)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards.
- Conforms to HF4 specifications
- Gauge and electrical switch options available to monitor element loading
- In-tank configuration minimizes space requirements and potential system leakage points
- Optional secondary port allows filtration of a second return line without additional fittings or filtered fill port
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels. Optional extend tube allows smaller filtration unit to be used where needed

DESIGN SPECIFICATIONS

Rated flow:	Length 3	189 L/min (50 USgpm)
	Length 6	379 L/min (100 USgpm)
	Length 7	454 L/min (120 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, oil-in-water and water-in-oil fluids Optional seals available for phosphate esters.
Temp range:		-30°C to 121°C (-22°F to 250°F)
Pressure rating:	Operating	7 bar (100 psi)
	Fatigue	7 bar (100 psi)
Material:	Head	Aluminum
	Cover	Aluminum
	Bowl	Carbon Steel
Dry weight: (Approximate)	Length 3	4,5 kg. (10.0 lbs.)
	Length 6	6,6 kg. (14.5 lbs.)
	Length 7	8,4 kg. (18.6 lbs.)

HF4RT Series Filter and Element Model Code

Sample model code:

HF4RT1SD313XXBC05

HF4RT **1** ** * ** * ** * * **

1 2 3 4 5 6 7 8 9 10

1 Filter Series - HF4RT

2 Element Collapse Rating

1 - 10 bar (150 psi) Low Collapse

3 Port Options

BC - G1¼ to ISO 228
ME - 1½" - SAE 4 bolt Flange Code 61 (M12 x 1.75)
SD - 1.875 - 12 UN SAE-24 str. Thd. (1½" tube)
FE - 1½" - SAE 4 bolt Flange Code 61 (UNC)

4 Valve Options

3 - Bypass set at 1.7 bar (25 psi) cracking pressure
4 - Bypass set at 3 bar (43 psi) cracking pressure

5 Indicator Options*

XX - No indicator
GA - Gauge 0-4 bar (0-60psi)
GB - Gauge 0-10 bar (0-160psi)
MB - Electrical, 15 PSI Brad Harrison
RB - Electrical, 30 PSI Brad Harrison
MH - Electrical, 15 PSI Hirschmann
RH - Electrical, 30 PSI Hirschmann

6 Assembly Length
mm (inch)

3 - 378 (14.9)
6 - 584 (23)
7 - 787 (31)

7 Secondary Port

BC - G1¼ to ISO 228 - use with BC Inlet Port
SD - 1.875 - 12 UN SAE-24 str. Thd. (1½" tube) - use with SD Inlet Port
SZ - 2.50 - 12 UN SAE-32 str. Thd. (2" tube) - use with FE Inlet Port
XX - No Secondary Port

Note: No secondary port option is available with the ME inlet port option.

8 Seal Material

B - Buna-N
V - Viton-A

9 Element Construction

C - Standard Construction
X - no element

10 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better
XX	no element

* For indicator options, refer to Static Indicators on page 150.

In-tank Filters
HF4RT Series

Flows to 280 L/min (75 USgpm)
Pressures to 50 bar (725 psi)

V405 1 * * C **
1 2 3 4 5 6

V405 Element Model Code

Sample model code:
V4051B3C05

1 Filter Element
V405 - For use with HF4RT

2 Element Collapse Rating
1 - 10 bar (150 psi) Low Collapse

3 Seal Material
B - Buna-N
V - Viton-A

4 Element Length
mm (inch)
3 - 229 (9)
6 - 457 (18)
7 - 686 (27)

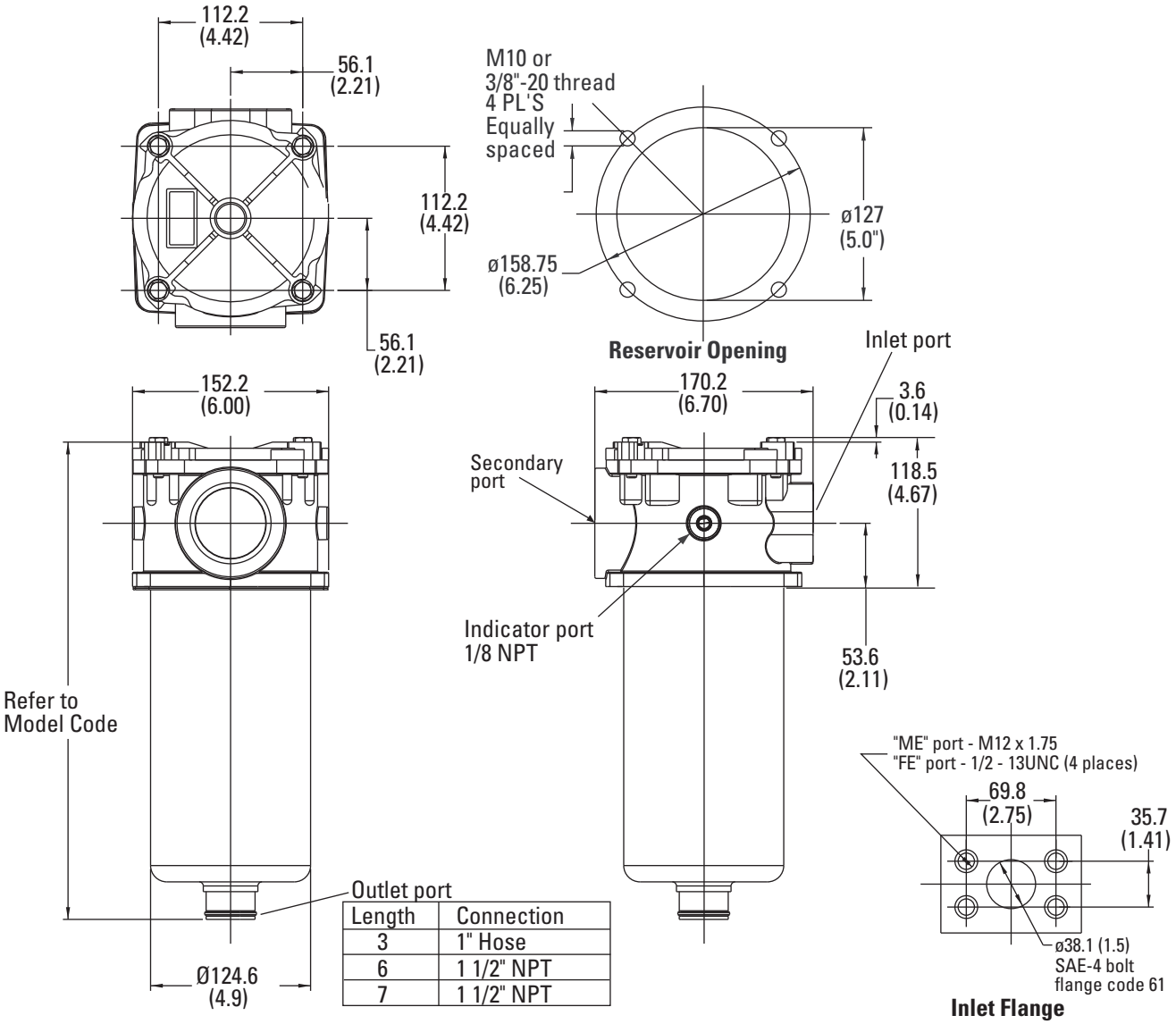
5 Element Construction
C - C-Pak (code 03, 05, 10, 20)

6 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better

Housing Dimensions

mm (inch)



Length	Connection
3	1" Hose
6	1 1/2" NPT
7	1 1/2" NPT

In-tank Filters

HF4RT Series

Flow Data

Flows to 280 L/min (75 USgpm)
Pressures to 50 bar (725 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

HF4RT Filter Elements Flow Data

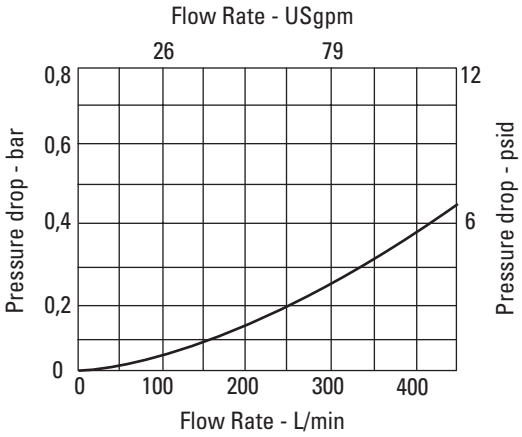
'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	20
C -pak	3	0.003 (0.168)	0.003 (0.140)	0.001 (0.078)	0.001 (0.044)
	6	0.001 (0.080)	0.001 (0.066)	0.001 (0.037)	0.001 (0.021)
	7	0.001 (0.051)	0.001 (0.043)	0.001 (0.024)	0.001 (0.013)

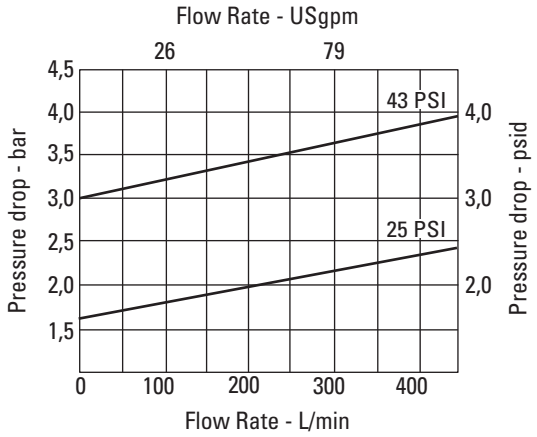
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Housing/Bypass Valve Flow Data

Housing



Bypass Valve



Sample ΔP Calculation : HF4RT1SD3XX3XXBC05 - Filter assembly having '3' length filter element with micron rating code '05' at 200 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.15 x 0.8/0.9	+	200 x 0.003 x 46/32 x 0.8/0.9
	=	0.130	+	0.76
	=	**0.89 bar**		

OF3 Series Inlet Strainers

Flows to 379 L/min (100 USgpm)

Features and Benefits

- Stainless steel elements have 149 micron (100 mesh) screen to protect hydraulic pumps from solid contaminants.
- Available flow rates to 379 L/min (100 USgpm). Higher rates can be achieved by using multiple strainers.
- Bypass valve available to prevent system shutdown.
- Element media is pleated for long life.
- Elements can be cleaned and reused.

General Data

These Vickers inlet strainers protect hydraulic pumps and control systems from solid contaminants. They should be used as immersion suction strainers on pump inlet lines.

Bypass Valve

An available integral relief valve parallels the element and is preset to open at a 3 psi pressure drop across the element. Element bypassing can be caused by excess flow rates, high fluid viscosity, dirt-loaded elements, or a combination of these.

Element Selection

The size and number of elements selected should be based on the maximum flow ratings listed on this page. The ratings are conservative, and a change in fluid viscosity should not significantly affect capacity.

Cleaning

The strainer elements should be cleaned periodically. Remove the elements from the reservoir, wash thoroughly in a suitable solvent, and blow dry with air from inside to outside.

Design Specifications

Rated flow:	
OF3-08	38 L/min (10 USgpm)
OF3-10	76 L/min (20 USgpm)
OF3-12	114 L/min (30 USgpm)
OF3-16	189 L/min (50 USgpm)
OF3-20	284 L/min (75 USgpm)
OF3-24	379 L/min (100 USgpm)
Fluid compatibility: These strainers are compatible with all commonly used hydraulic fluids, including phosphate esters and water based fluids.	
Temp range:	-40°C to +107°C (-40°F to +225°F)
Filtration:	Unit is supplied with 149 micron (100 mesh) wire cloth element.
Material:	
Head	Nylon
Element	Pleated stainless steel
Dry weight: (Approximate)	
OF3-08	0,3 kg (0.7 lbs)
OF3-10	0,4 kg (1.0 lbs)
OF3-12	0,6 kg (1.4 lbs)
OF3-16	0,8 kg (1.8 lbs)
OF3-20	1,0 kg (2.3 lbs)
OF3-24	1,4 kg (3.0 lbs)

Model Code

OF3 12 3RV 10

1 2 3 4

1 Model Series

OF3 - Inlet strainers

2 Port Size (NPTF)

08 - 1”
10 - $1^1/_4$”
12 - $1^1/_2$”
16 - 2”
20 - $2^1/_2$”
24 - 3”

3 Bypass Valve

3RV - 3 psi differential opening pressure
Blank - Omit if not required

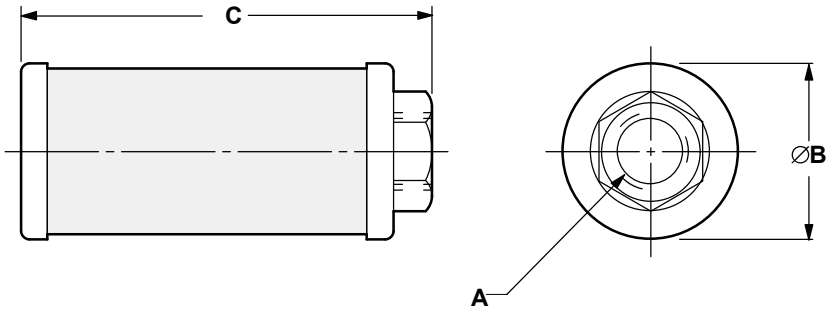
4 Design number

Subject to change. Dimensions remain the same for designs 10 through 19.

Installation Dimensions

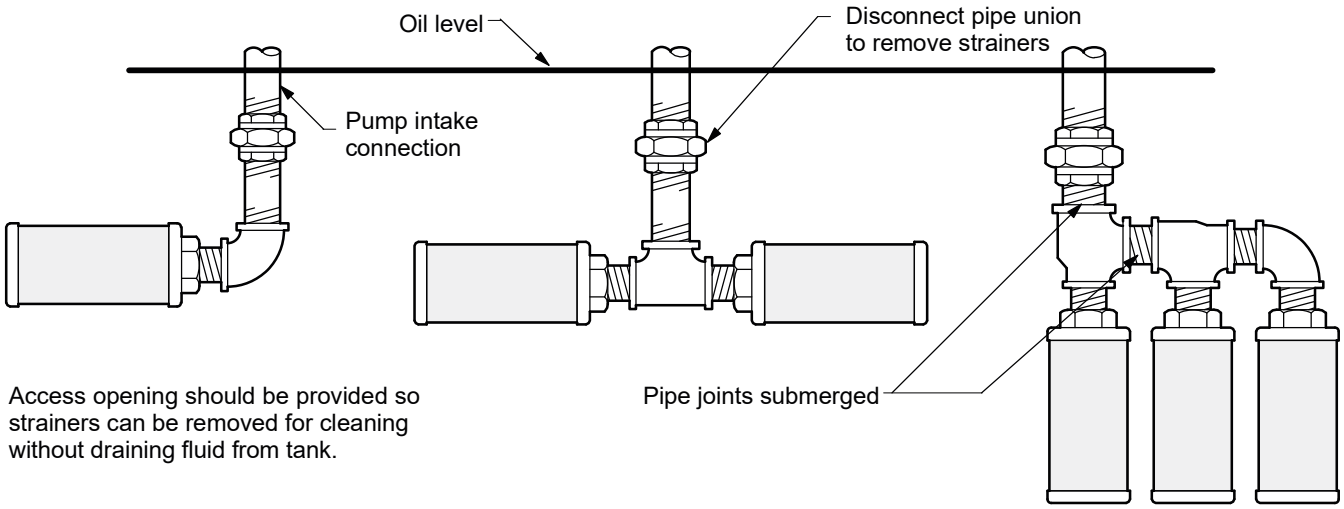
Inlet Strainer

mm (inch)



Model Series	Minimum Screen Area cm^2 (in^2)	**A** (NPTF pipe thread)	**B**	**C** ±3,2 (±0.125)
OF3-08	710 (110)	1”	67,8 (2.67)	135,9 (5.35)
OF3-10	1032 (160)	$1^1/_4$”	88,1 (3.47)	174,0 (6.85)
OF3-12	2194 (340)	$1^1/_2$”	101,6 (4.00)	250,2 (9.85)
OF3-16	2194 (340)	2”	101,6 (4.00)	250,2 (9.85)
OF3-20	2581 (400)	$2^1/_2$”	131,3 (5.17)	256,5 (10.10)
OF3-24	3226 (500)	3”	131,3 (5.17)	299,2 (11.78)

Typical Installations



Spin-on Filters

General Data

Spin-on filters typically consist of a head mounted directly in-line with the return piping and a canister containing an element which screws onto a threaded post. The canister seals to the head to prevent leakage.

These are an effective and economical choice of filter where the return line pressure is low and there are no large flow surges with the return line. They are also easily installed without specialty equipment or tooling.

Applications

- Agricultural equipment - tractors, spreaders, harvesters
- Metal forming presses
- Strapping systems
- Brush Chippers
- Turf maintenance equipment
- Small power units

Spin-on Filters
OFRS15

Flows to 57 L/min (15 USgpm)
Pressures to 7 bar (100 psi)

Features and Benefits

- Simple spin-on element design for easy maintenance
- Bypass valves prevent excessive pressure drop and accidental element collapse
- Two available ports for use as gauge and/or diagnostic ports

DESIGN SPECIFICATIONS

Rated flow:		57 L/min 15 USgpm)
Fluid compatibility:		Compatible with most most petroleum oil, water glycol, oil-in-water and water-in-oil fluids.
Temp range:		-40°C to +107°C (-40°F to +225°F)
Pressure rating:	Operating	7 bar (100 psi)
Material:	Head Bowl	Die cast aluminum Carbon steel
Dry weight:		1,0 kg (2.2 lbs.)

OFRS	15	*	*	***	*	*	*	**	10
1	2	3	4	5	6	7	8	9	10

OFRS15 Series Filter and Element Model Code

Sample model code:
OFRS15S2R03PBE1010

1 Filter Series - OFRS

2 Flow Rating
15 -15 USgpm (57 L/min)

3 Port Type
B - G1 to ISO 228
P - 1in NPT
S - 1.312-12 UN SAE-16 straight thd.

4 Assembly Length
mm (inch)
1 - 194,6 (7.7)
2 - 250,4 (9.9)
X - no element

5 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
R03	16/**14/12**
R05	18/**16/14**
R10	20/**18/15**
XXX -	no element

6 Pressure Gauge Option
P - Pressure gauge 0-8 bar (0-120 psi);l p/n 736129
C - Color Coded Pressure Gauge (For use with 1.7 bar (25 psi) bypass only); p/n P-232965-01
X - No Gauge

7 Inlet Gauge Port Location (1/8" NPT)
B - Location B
X - No Gauge

8 Outlet Gauge Port Location (1/8" NPT)
E - Location E
X - No Gauge

9 Bypass Valve
10 -Bypass valve set at 0.6 bar (10 psi)
25 - Bypass valve set at 1.7 bar (25 psi)

10 Design Number
10 - Standard Design

Spin-on Filters
OFRS15

Flows to 57 L/min (15 USgpm)
Pressures to 7 bar (100 psi)

V019 1 B * R **

1 2 3 4 5 6

V019 Element Model Code

Sample model code:
V0191B2R03

1 Series Designation
V019 - Filter element for use with OFRS15

2 Element Collapse Rating
1 - 10 bar (150 psi)

3 Seal Material
B - Buna–N

4 Element Length
mm (inch)
1 - 147 mm (5.8 in)
2 - 203 mm (8.0 in)

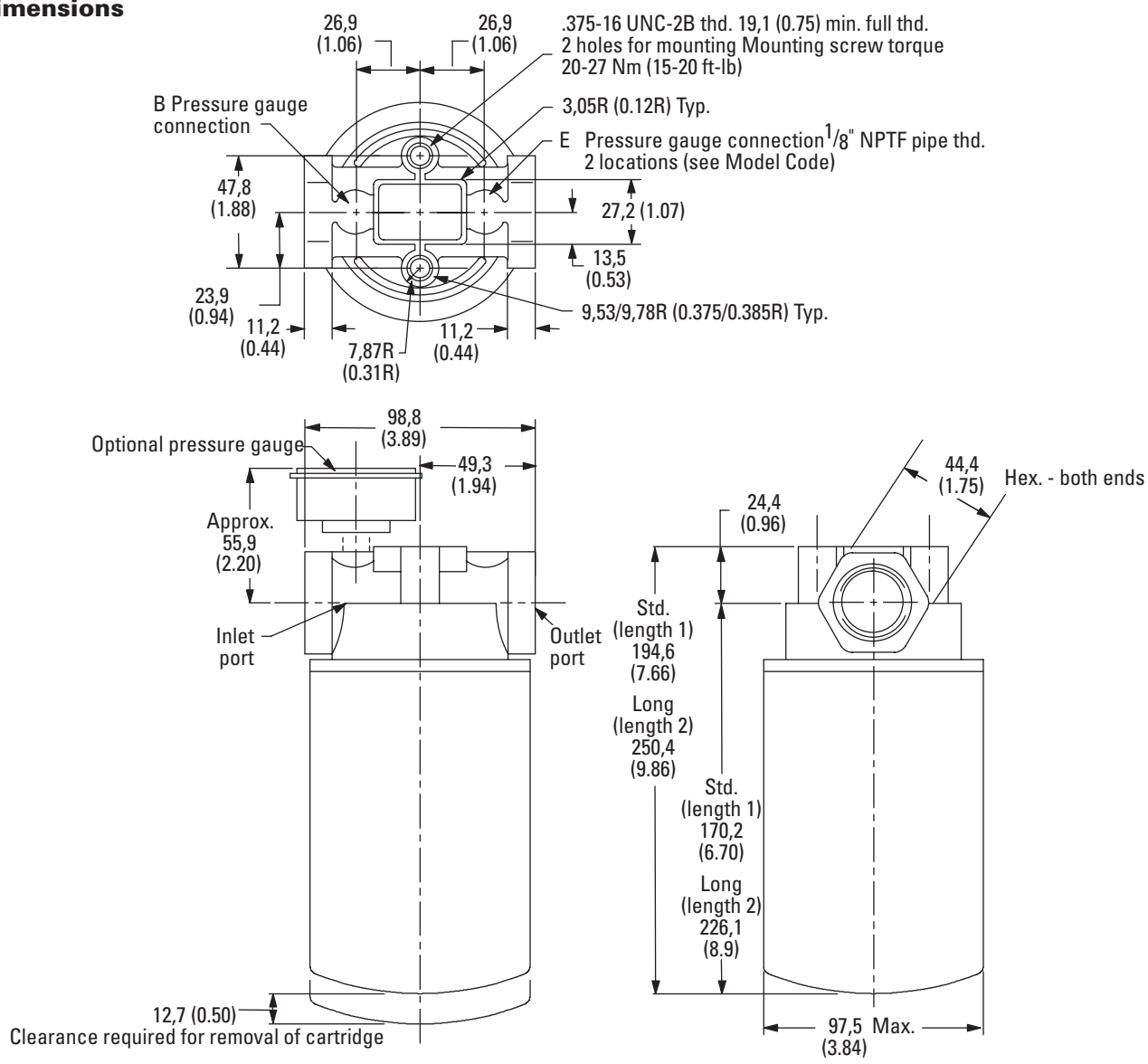
5 Element Construction
R - R–Pak

6 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12**
05	18/**16/14**
10	20/**18/15**

Housing Dimensions

mm (inch)



Spin-on Filters

OFRS15

Flow Data

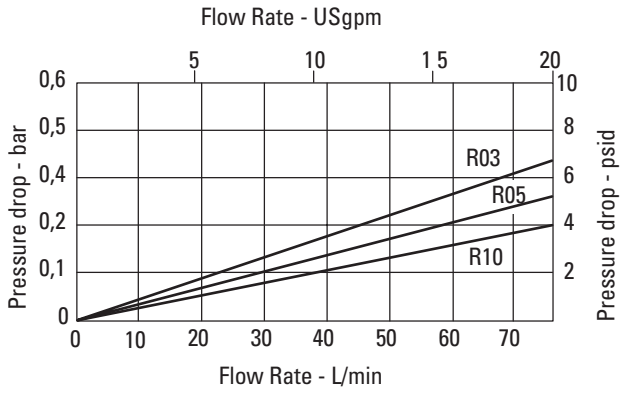
Flows to 60 L/min (15 USgpm)
Pressures to 7 bar (100 psi)

Flow versus pressure drop:

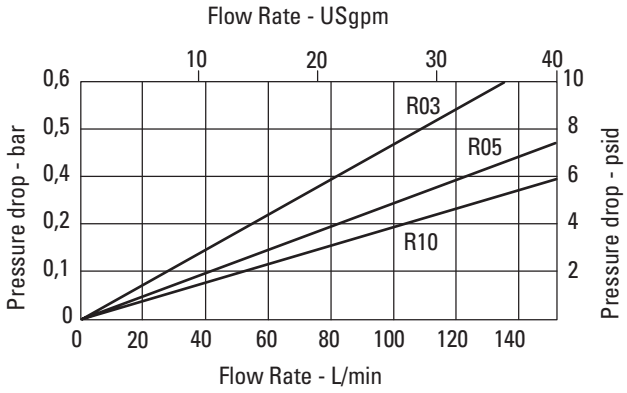
150 SUS (32 cSt) oil with specific gravity of ≤0.9

Element Flow Data

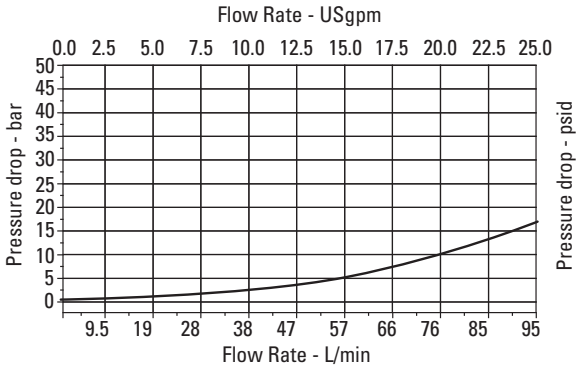
OFRS 15 Element Length 1

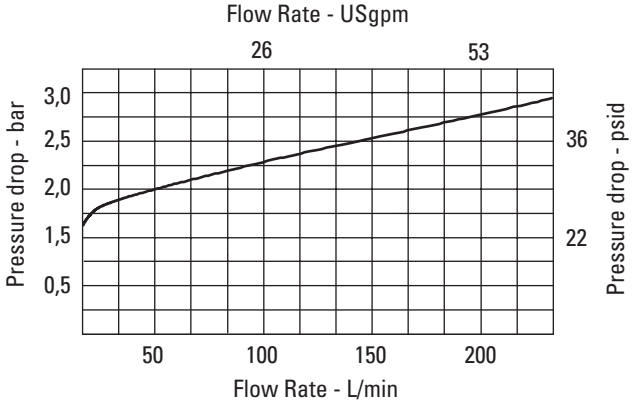


OFRS 15 Element Length 2



Housing/Bypass Valve Flow Data





Sample ΔP Calculation : OFRS15S2R03PBE1010 - Filter assembly having '2' length spinon filter element with micron rating code '03' at 50 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing ΔP from graph x sp.gr.(actual)/0.9	+	Element ΔP valve from from graph(bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.4 x 0.8/0.9	+	0.08 x 46/32 x 0.8/0.9
	=	0.350	+	0.1
	=	**0.45 bar**		

Spin-on Filters
HS22 Series

Flows to 450 L/min (120 USgpm)
Pressures to 14 bar (200 psi)

Features and Benefits

- Designed to comply with ANSI specifications and ISO cleanliness standards
- Dual flow path design maximizes flow capability and service life
- Spin-on element make servicing fast and easy
- High efficiency replacement elements in standard configurations (R-Pak) to meet Target Cleanliness Levels

DESIGN SPECIFICATIONS

Rated flow:	Length 1 Length 2	227 L/min (60 USgpm) 454 L/min(120 USgpm)
Fluid compatibility		Compatible with most petroleum ol, water glycol, oil-in-water and water-in-oil fluids
Temp range:		-32°C to +107°C (-25°F to +225°F)
Pressure rating:	Operating	14 bar (200 psi)
Material:	Head	Aluminum
Dry weight:	Length 1 Length 2	7.3 kg (16 lbs) 8.6 kg (19 lbs)

HS22	1	FE	*	*	N	B	*	*	**
1	2	3	4	5	6	7	8	9	10

HS22 Series Filter and Element Model Code

Sample model code:
HS22**FE**D32NB2R05

1 Filter Series - HS22

2 Element Collapse Rating
1 - 150 psi Low Pressure

3 Port options
FE - 1-1/2" SAE 4 bolt Flange Code 61 (UNC)

4 Valve options
3 - Bypass set at 1.7 bar (25 psi) cracking pressure
4 - Bypass set at 3 bar (50 psi) cracking pressure

5 Indicator options
1 - No indicator
2 - 13.7 bar (200 psi) gauge
4 - 4 bar (60 psi) gauge

6 Receptical
N - None

7 Seal material
B - Buna-N

8 Assembly Length
mm (inch)
1 - 253 (10)
2 - 355 (14)
X - No Element

9 Element Construction
R - R-Pak (code 3, 5,10, 20)
W- Water Removal (10, length 2 only)
X - No Element

10 Fluid cleanliness rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better
XX	No Element

Spin-on Filters
HS22 Series

Flows to 450 L/min (120 USgpm)
Pressures to 14 bar (200 psi)

V021 1 B * * **

1 2 3 4 5 6

V021 Element Model Code

Sample model code:
V0211B1R03

1 Filter Element
V021 - Filter element for use with HS22 and OFRS-60 series filters (R-Pak construction only)

2 Element Collapse Rating
1 - 10 bar (150 psi) Low Pressure

3 Seal Material
B - Buna-N

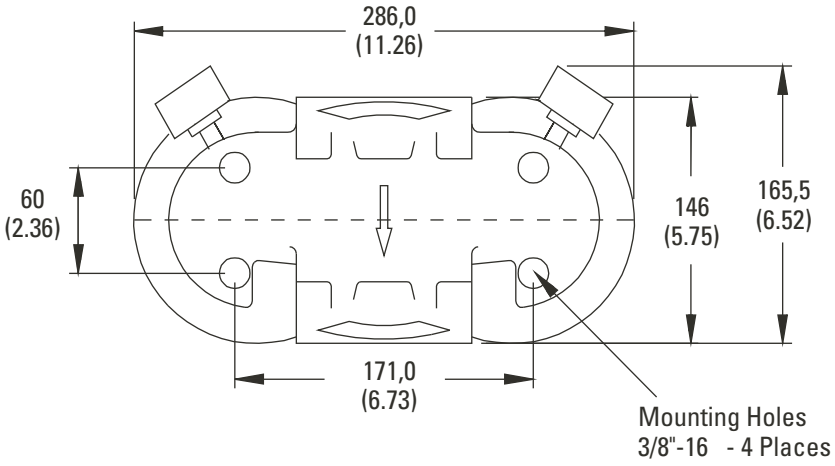
4 Canister Length
mm (inch)
1 - 184 (7)
2 - 286 (11)

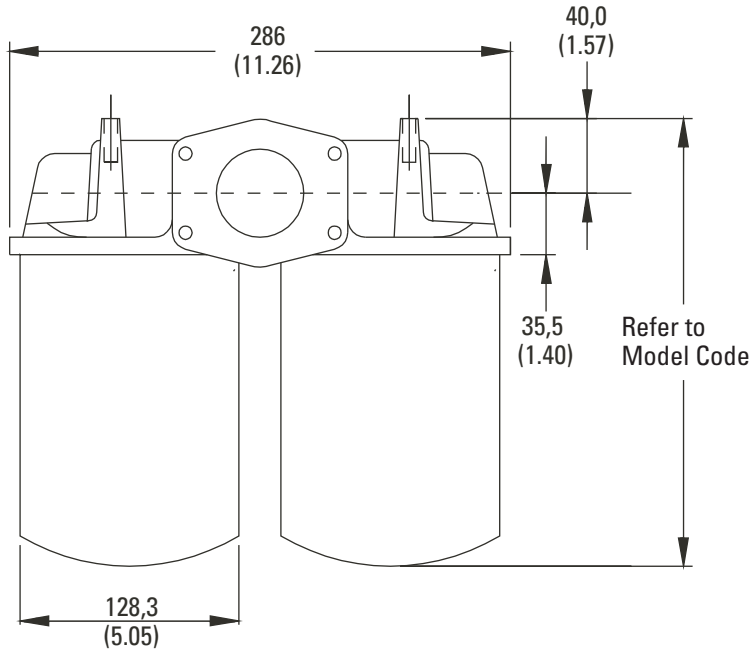
5 Element Construction
R - R-Pak (code 3, 5,10, 20)
W- Water Removal (Code 10, length 2 only)

6 Fluid Cleanliness Rating

Code	Target fluid cleanliness level	Element construction
03	16/**14/12**	R-Pak
05	18/**16/14**	R-Pak
10	20/**18/15**	R-Pak or water removal
20	22/**19/16**	R-Pak

Housing Dimensions
mm (inch)





Spin-on Filters

HS22 Series

Flow Data

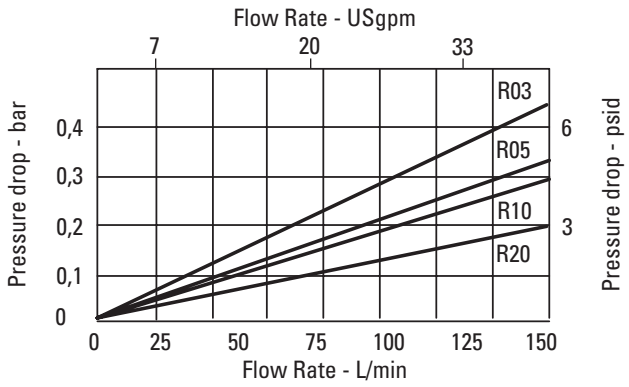
Flows to 450 L/min (120 USgpm)
Pressures to 14 bar (200 psi)

Flow versus pressure drop:

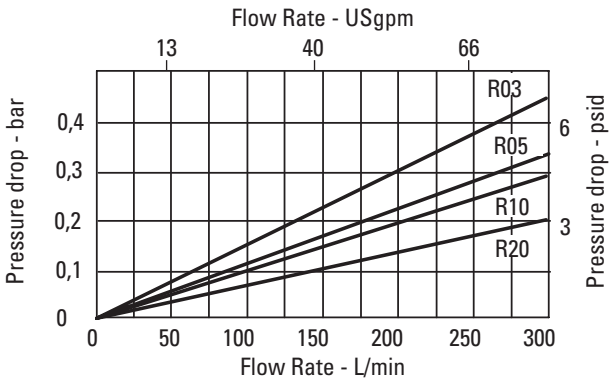
150 SUS (32 cSt) oil with specific gravity of ≤0.9

Element Flow Data

HS22 R-Pak Element Length 1

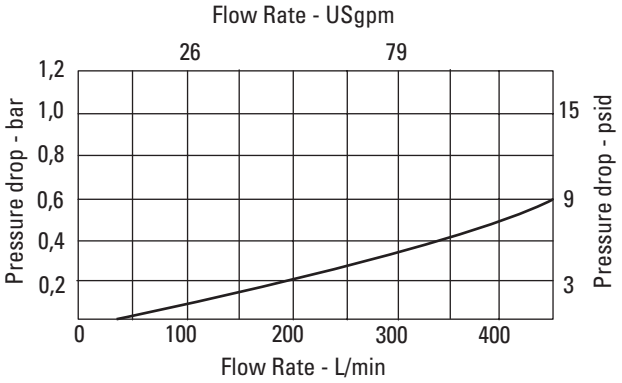


HS22 R-Pak Element Length 2

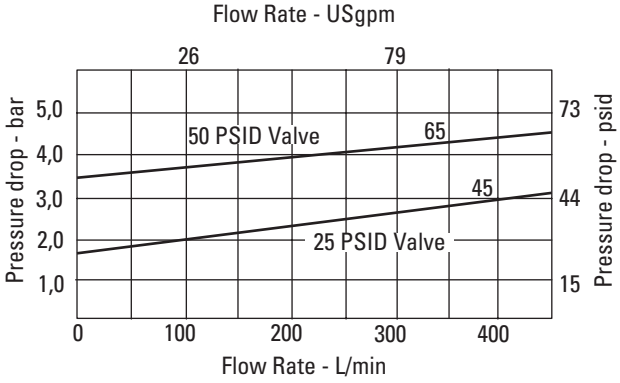


Housing/Bypass Valve Flow Data

Housing



Bypass Valve



Sample ΔP Calculation : HS221SD32NB2RO5 - Filter assembly having '2' length filter element with micron rating code '05' at 250 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing ΔP from graph x sp.gr.(actual)/0.9	+	Element ΔP valve from from graph(bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.3 x 0.8/0.9	+	0.37 x 46/32 x 0.8/0.9
	=	0.260	+	0.47
	=	**0.73 bar**		

Pressure Filters

General Data

Pressure filters are used to protect downstream components from contamination levels beyond the recommended cleanliness target. Because they are typically sized for the output of the pump, pressure filters tend to be smaller than return line filters when cylinders are present. In systems using accumulators, pressure filters must be sized according to the large effective flow rates present during parts of the duty cycle.

In some applications, pressure filters are used as isolation filters to protect specific components such as proportional or servo valves. Typically these filters are non-bypass and employ elements that are capable of withstanding full system differential pressure without collapsing. While these filters are sized to handle only a specific components' required flow, the use of high collapse elements result in a higher cost than elements used in housings with bypass valves. Most isolation filters are direct-mounted beneath the valve which can save space as well as reduce plumbing costs.

Applications

- Paper Mills
- Steel Mills
- Injection molding machines
- Motion bases
- Sawmill equipment
- Flight simulators
- Test and simulation equipment
- Entertainment stage equipment
- Hydrostatic drives
- Power generation turbine control systems

Pressure Filters
ECF Series

Flows to 19 L/min (5 USgpm)
Pressures to 200 bar (3,000 psi)

Features and Benefits

- Integrated throwaway element which is screwed into the manifold port for last chance filtration

DESIGN SPECIFICATIONS

Rated flow:		19 L/min (5 USgpm)
Fluid compatibility:		Compatible with all petroleum-/oil-based and synthetic fluids. Not rated for use with fluoro-rubber or ethylene propylene seals.
Temp range:		-30°C to +121°C (-22°F to 250°F)
Pressure rating:	Operating	200 bar (3000 psi)
Cavity:		BC20-S3
Material:	Head Bowl	Aluminum Aluminum
Dry weight: (Approximate)		0,11 kg (0.25 lbs)

ECF Series Filter and Element Model Code

Sample model code:
ECF1SB1J3CV025

ECF	1	SB	1	J	3	*	V	***
1	2	3	4	5	6	7	8	9

1 Filter Series - ECF

2 Element Collapse Rating
1 - 17 bar (250 psi) low collapse

3 Port Options
SB - 1.312-12 UN SAE-16 straight thread

4 Valve Options
1 - Non-Bypass (Screw directly into cavity)

5 Indicator Options
J - No indicator

6 Assembly Length
mm (inch)
3 - 80.2 (3.16)

7 Element Construction
C - Standard construction
M - Wire screen

8 Seal Material
V - Viton-A

9 Fluid Cleanliness

Code	Fluid Cleanliness Rating	Element Construction
015	20/**18/15**	C-Pak
025		Wirescreen
100		Wirescreen

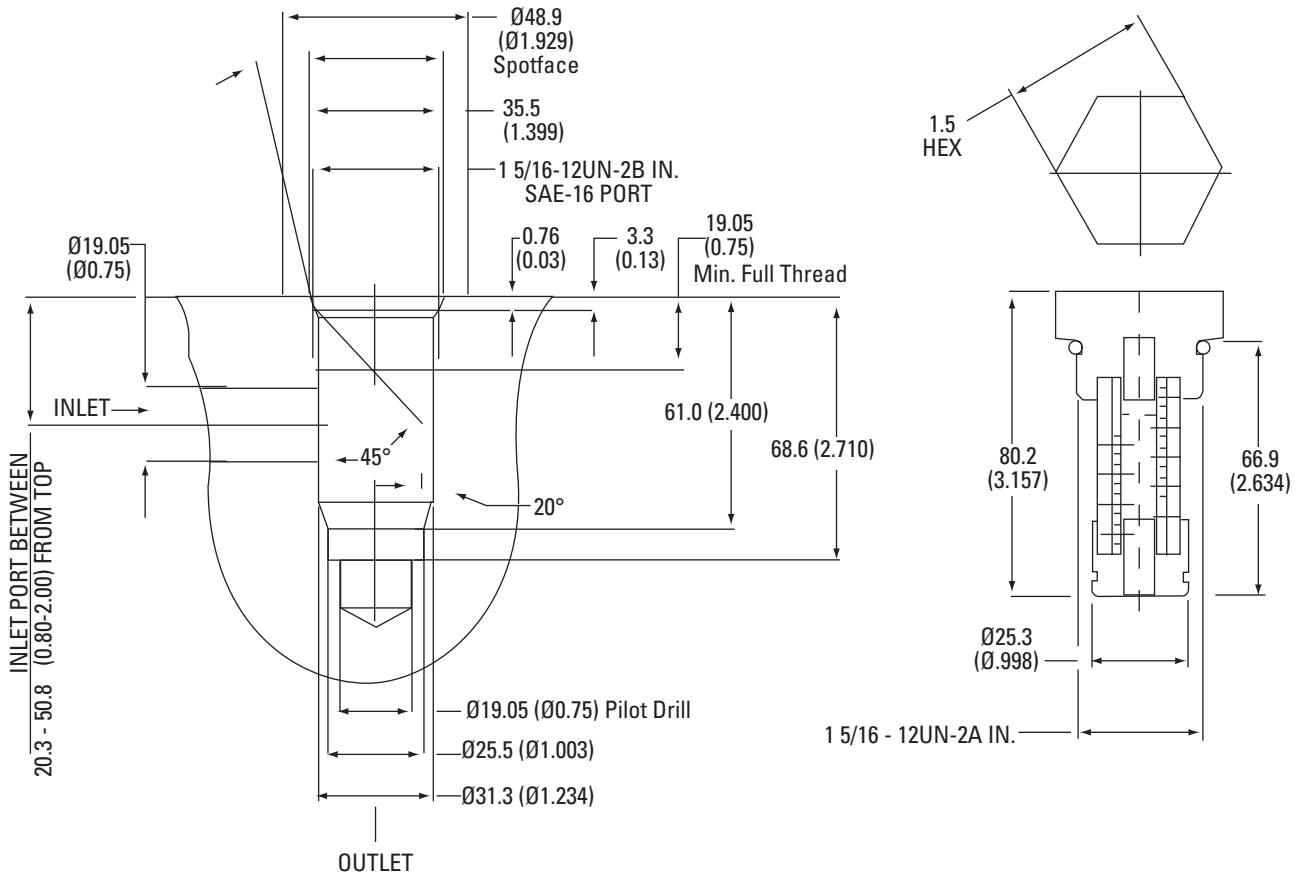
Pressure Filters

Flows to 19 L/min (5 USgpm)
Pressures to 207 bar (3,000 psi)

ECF Series

Housing Dimensions

mm (inch)

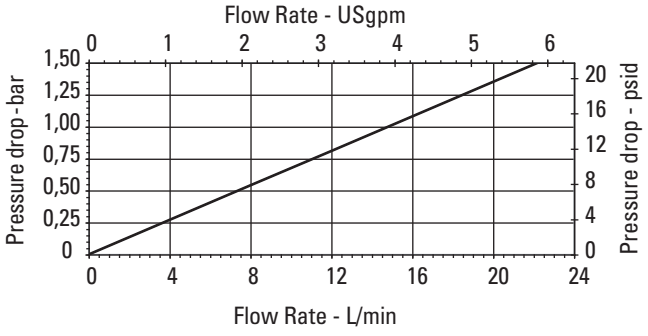


Housing/Element Flow Data

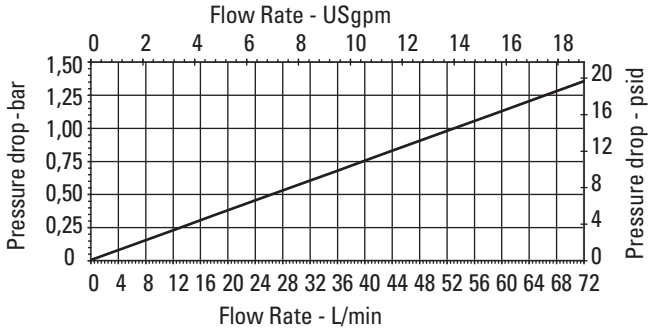
Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

ECF15



ECF 25/150



Pressure Filters
HF2P Series

Flows to 90 L/min (24 USgpm)
Pressures to 280 bar (4,000 psi)

Features and Benefits

- Beta Ratio: $\beta_{x(c)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards
- Visual, electrical, and electrical indicators with lamp options for system design flexibility
- Conforms to HF2 automotive specifications
- Compact design for use with servo and proportional valves
- Manifold mounting option for system flexibility
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels
- High collapse elements available for non-bypass applications

DESIGN SPECIFICATIONS

Rated flow:	Length 1 Length 2	45 L/min (12 USgpm) 91 L/min (24 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, water glycol, oil-in-water and water-in-oil fluids. Optional seals available for phosphate esters.
Temp range:		-26°C to +121°C (-15°F to +250°F)
Pressure rating:	Operating Fatigue	280 bar (4000 psi) 280 bar (4000 psi)
Material:	Head Bowl	Ductile iron Carbon Steel
Dry weight: (Approximate)	Length 1 Length 2	4,6 kg (10.1lbs) 5,9 kg (134lbs)

HF2P Series Filter and Element Model Code

Sample model code:

HF2P1SA4LNB2C05

HF2P	*	**	*	**	*	*	*	**
1	2	3	4	5	6	7	8	9

1 Filter Series - HF2P

2 Element Collapse Rating

1 - 17 bar (250 psi) Low Collapse
4 - 207 bar (3000 psi) High Collapse

NOTE: Use 1 only with bypass valve or monitored P indicator.

3 Port Options

BA - G3/4 to ISO 228
SA - 1.062 - 12UN SAE-12 ($^3/_4$" tube)
WS - Subplate mounting

4 Valve Options

1 - Non-Bypass
4 - Bypass set at 2.9 bar (43 psi) cracking pressure
6 - Bypass set at 6 bar (90 psi) cracking pressure

5 Indicator Options

AN - Visual 4.9 bar (70 psi), No Connector
JN - No Indicator (plug), No Connector
LN - Visual 2 bar (30 psi), No Connector
ON - Visual 7.9 bar (115 psi), No Connector
RB - Electrical 2 bar (30 psi), Brad Harrison
RH - Electrical 2 bar (30 psi), Hirschmann
RJ - Electrical 2 bar (30 psi), Hirschmann w 24 volt light
RK - Electrical 2 bar (30 psi), Hirschmann w 115 volt light
RL - Electrical 2 bar (30 psi), Hirschmann w 230 volt light
TB - Electrical 7.9 bar (115 psi), Brad Harrison
TH - Electrical 7.9 bar (115 psi), Hirschmann
TJ - Electrical 7.9 bar (115 psi), Hirschmann w 24 volt light
TK - Electrical 7.9 bar (115 psi), Hirschmann w 115 volt light
TL - Electrical 7.9 bar (115 psi), Hirschmann w 230 volt light
UB - Electrical 4.9 bar (70 psi), Brad Harrison
UH - Electrical 4.9 bar (70 psi), Hirschmann
UJ - Electrical 4.9 bar (70 psi), Hirschmann w 24 volt light
UK - Electrical 4.9 bar (70 psi), Hirschmann w 115 volt light
UL - Electrical 4.9 bar (70 psi), Hirschmann w 230 volt light

6 Seal Material

B - Buna-N
V - Viton-A

7 Assembly Length

mm (inch)
1 - 211.9 (8.3)
2 - 304.9 (12.0)

8 Element Construction

C - 17 bar (250 psi) Low Collapse
H - 207 bar (3000 psi) High Collapse
X - no element

9 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better
XX	no element

Pressure Filters
HF2P Series

Flows to 90 L/min (24 USgpm)
Pressures to 280 bar (4,000 psi)

V304 * * * * **

1 2 3 4 5 6

V304 Element Model Code

Sample model code:
V3041B1C05

1 Filter Element
V304 - For use with HF2P series filters

2 Element Collapse Rating
1 - 17 bar (250 psi) (C-Pak only)
5 - 207 bar (3000 psi) (H-Pak only)

3 Seal Material
B - Buna-N
V - Viton-A

4 Element Length
mm (inch)
1 - 101 (4)
2 - 203 (8)

5 Element Construction
C - C-Pak (code 03, 05, 10, 20)
H - H-Pak (code 03, 05, 10)

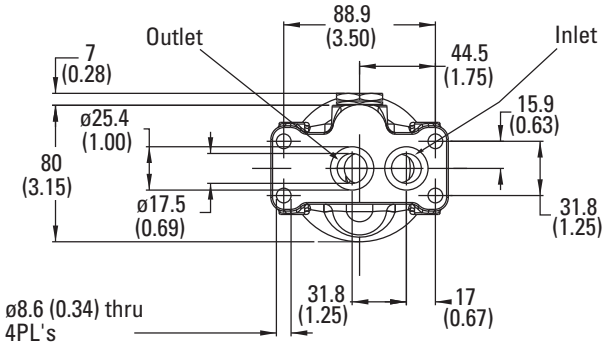
6 Fluid Cleanliness Ratings

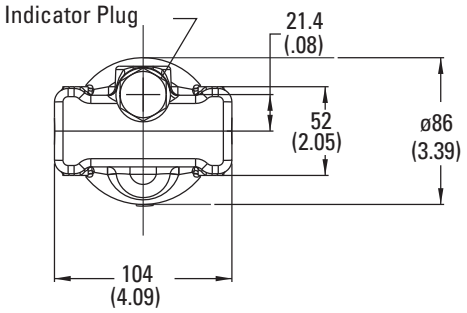
Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better

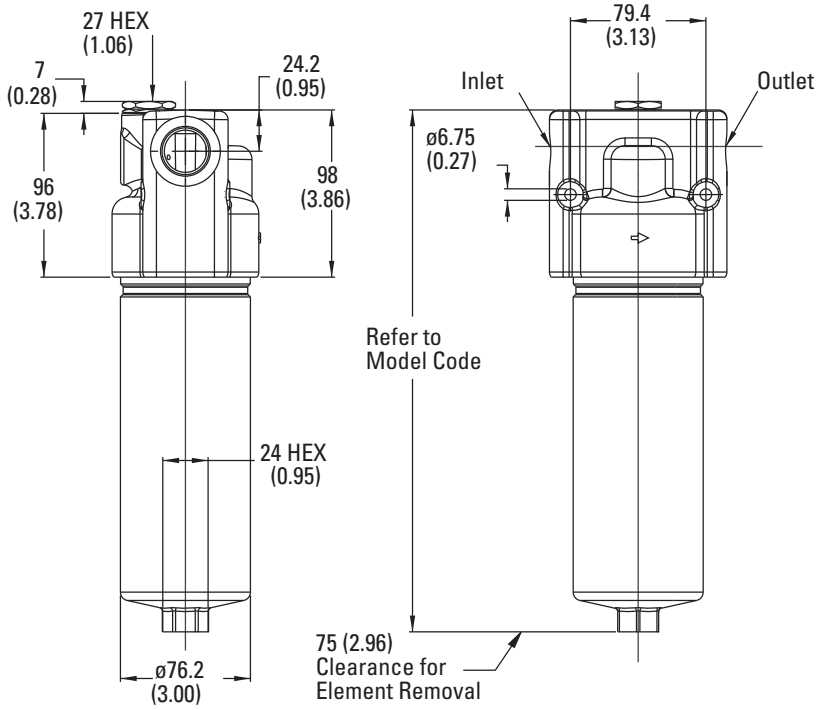
Housing Dimensions

mm (inch)

Subplate Mounting







Pressure Filters

HF2P Series

Flow Data

Flows to 90 L/min (24 USgpm)
Pressures to 280 bar (4,000 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

HF2P Filter Elements Flow Data

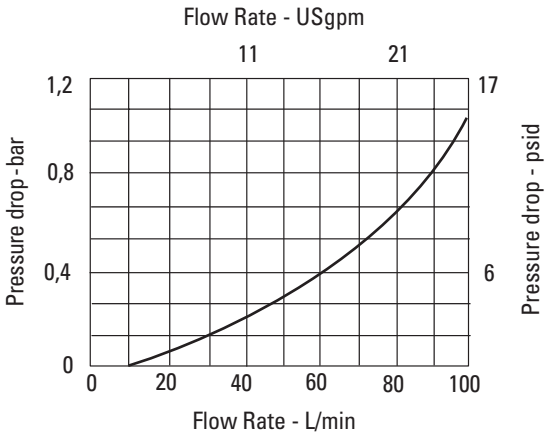
'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	25
C - pak	1	0.037 (2.046)	0.032 (1.735)	0.017 (0.924)	0.010 (0.531)
	2	0.018 (1.011)	0.016 (0.858)	0.008 (0.457)	0.005 (0.262)
H - pak	1	0.044 (2.396)	0.031 (1.688)	0.019 (1.026)	xxx
	2	0.021 (0.865)	0.015 (0.820)	0.009 (0.499)	xxx

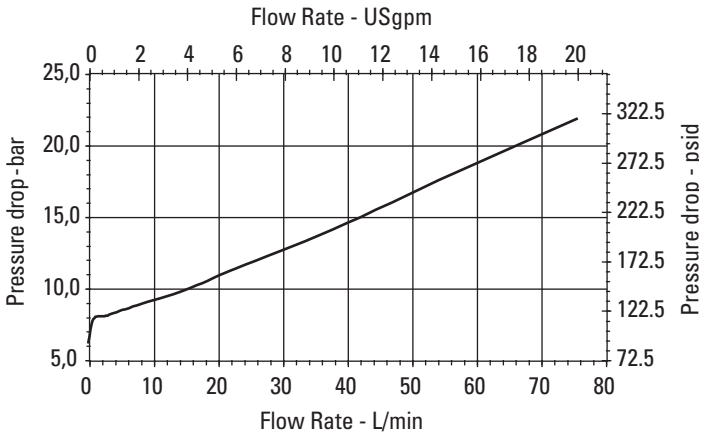
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Housing/Bypass Valve Flow Data

Housing



Bypass Valve



Sample ΔP Calculation : HF2P1SA4LNB2C05 - Filter assembly having '2' length filter element with micron rating code '05' at 50 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.26 x 0.8/0.9	+	50 x 0.016 x 46/32 x 0.8/0.9
	=	0.220	+	1.01
	=	**1.23 bar**		

Pressure Filters
MF2P Series

Flows to 113.5 L/min (30 USgpm)
Pressures to 275.5 bar (4,000 psi)

Features and Benefits

- Beta Ratio: $\beta_{X(c)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards
- Visual, electrical, and electrical indicators with lamp options for system design flexibility
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels
- Poppet type leak by-pass valve construction

DESIGN SPECIFICATIONS

Rated flow:	Length 5 Length 7	68 L/min (18 USgpm) 113.5 L/min (30 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, oil-in-water and water-in-oil fluids. Optional seals available for phosphate esters.
Temp range:		-26°C to +121°C (-15°F to +250°F)
Pressure rating:	Operating Fatigue	276 bar (4000 psi) 276 bar (4000 psi)
Material:	Head Bowl	Ductile iron Steel
Dry weight: (Approximate)	Length 5 Length 7	3,9 kg (8.3 lbs) 4,5 kg (9.9 lbs)

MF2P Series Filter Assembly Model Code

Sample model code:

MF2P1SA5ANB5C05

MF2P	1	SA	5	**	*	*	*	**
1	2	3	4	5	6	7	8	9

1 Filter Series - MF2P

2 Element Collapse Rating

1 - 17 bar (250 psi) Low Collapse

3 Port Options

SA - 1.062 - 12UN SAE-12 ($^3/_4$" tube)

4 Valve Options

5 - Bypass set at 100 psi (7 bar) cracking pressure

5 Indicator Options

AN - Visual 4.9 bar (70 psi), No Connector
JN - No Indicator (plug), No Connector
UB - Electrical 4.9 bar (70 psi), Brad Harrison
UJ - Electrical 4.9 bar (70 psi), Hirschmann w 24 volt light
UK - Electrical 4.9 bar (70 psi), Hirschmann w 115 volt light
UL - Electrical 4.9 bar (70 psi), Hirschmann w 230 volt light
UH - Electrical 4.9 bar (70 psi), Hirschmann

6 Seal Material

B - Buna-N
V - Viton-A

7 Assembly Length

mm (inch)
5 - 210 (8.27)
7 - 263 (10.36)

8 Element Construction

C - 250 psi Low Collapse
X - no element

9 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better
XX	no element

Pressure Filters
MF2P Series

Flows to 113.5 L/min (30 USgpm)
Pressures to 275.5 bar (4,000 psi)

**V0512 * * C **

1 2 3 4 5

V0512 Element Model Codes

Sample model code:
V0512B5C05

1 Filter Element
V0512 - For use with MF2P series housings

2 Seal Material
B - Buna-N
V - Viton-A

3 Element Length
mm (inch)
5 - 117 (5)
7 - 169 (7)

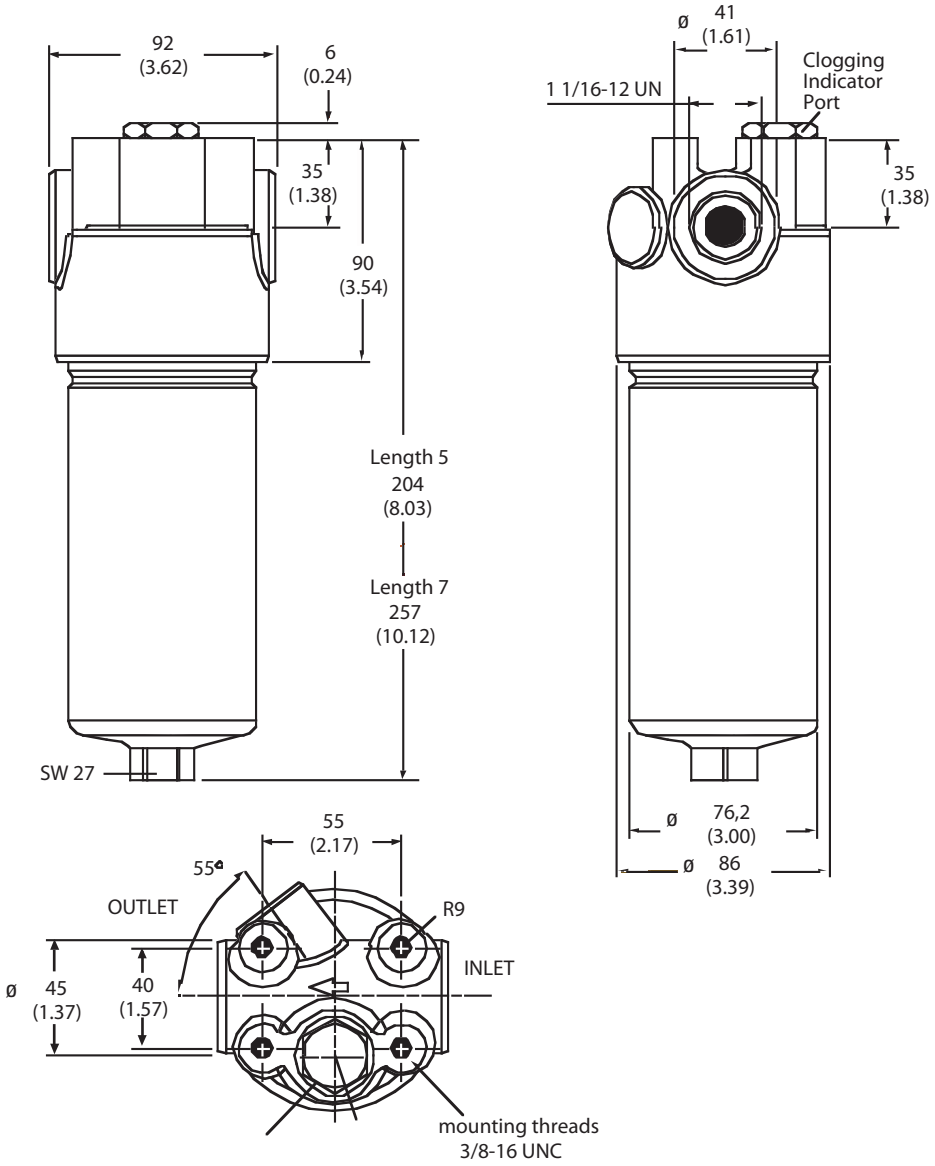
4 Element Construction
C - C-Pak (code 03, 05, 10, 20)

9 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better

Housing Dimensions

mm (inch)



Pressure Filters

MF2P Series

Flow Data

Flows to 113.5 L/min (30 USgpm)
Pressures to 275.5 bar (4,000 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤ 0.9

MF2P Filter Elements Flow Data

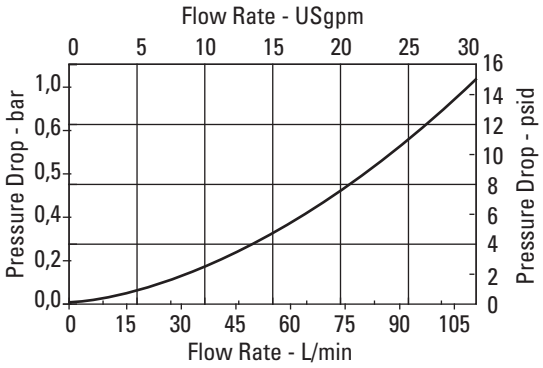
'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	25
C - pak	5	0.014 (0.750)	0.011 (0.602)	0.008 (0.443)	0.005 (0.263)
	7	0.009 (0.509)	0.008 (0.411)	0.005 (0.290)	0.003 (0.169)

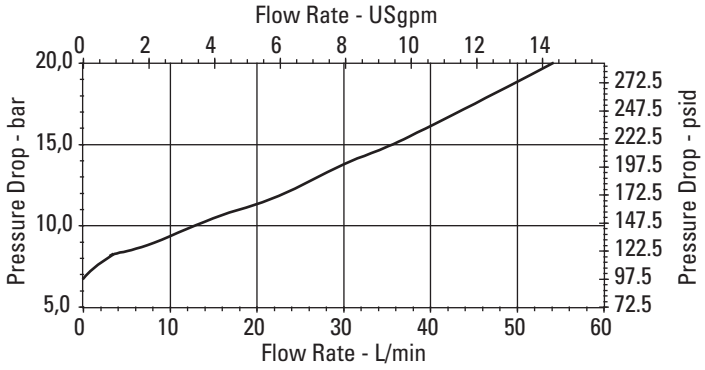
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Housing/Bypass Valve Flow Data

Housing



Bypass



Sample ΔP Calculation : MF2P1SA5UNB5C05 - Filter assembly having '5' length filter element with micron rating code '05' at 50 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.3 x 0.8/0.9	+	50 x 0.011 x 46/32 x 0.8/0.9
	=	0.260	+	0.69
	=	**0.95 bar**		

Pressure Filters
HF4P Series

Flows to 570 L/min (150 USgpm)
Pressures to 345 bar (5,000 psi)

Features and Benefits

- Beta Ratio: $\beta_{x(c)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards
- Visual and electrical indicators with lamp options for system design flexibility
- Conforms to HF4 specifications
- Fatigue rated to 3500 psi for maximum reliability in rugged applications
- Top loading design to ease maintenance and minimize spillage
- Multiple filter element lengths for design flexibility
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels
- High collapse elements available for non-bypass applications

DESIGN SPECIFICATIONS

Rated flow:	Length 3	189 L/min (50 USgpm)
	Length 6	379 L/min (100 USgpm)
	Length 7	568 L/min (150 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, water glycol, oil-in-water and water-in-oil fluids. Optional seals available for phosphate esters.
Temp range:		-26°C to +121°C (-15°F to +250°F)
Pressure rating:	Operating	345 bar (5000 psi)
	Fatigue	240 bar (3500 psi)
Material:	Head	Ductile Iron
	Bowl	Carbon Steel
	Lid	Ductile Iron
Dry weight: (Approximate)	Length 3	28,8 kg (63.4 lbs)
	Length 6	38,7 kg (85.3 lbs)
	Length 7	51,5 kg (113.6 lbs)

Series Filter and Element Model Code

Sample model code:
HF4P1SD4LNB6C05

HF4P * ** * ** * * * **

1 2 3 4 5 6 7 8 9

1 Filter Series - HF4P

2 Element Collapse Rating
1 - 10 bar (150 psi) Low Collapse
4 - 207 bar (3000 psi) High Collapse

3 Port options
BD - G1½ to ISO 228
ME - 1½" SAE 4 bolt Flange Code 61 (M12 x 1.75)
MR - 1½" SAE 4 bolt Flange Code 62 (M16 x 2.0)
SD - 1.875 - 12 UN SAE-24 str. Thd. (1½" tube)
FE - 1½" SAE 4 bolt Flange Code 61 (UNC)
FR - 1½" SAE 4 bolt Flange Code 62 (UNC)
WS - Subplate mounting

4 Valve options
1 - Non-Bypass
4 - Bypass set at 2.9 bar (43 psi) cracking pressure
6 - Bypass set at 6 bar (90 psi) cracking pressure

5 Indicator options
AN - Visual 4.9 bar (70 psi), No Connector
LN - Visual 2 bar (30 psi), No Connector
JN - No Indicator (plug), No Connector
RB - Electrical 2 bar (30 psi), Brad Harrison
RJ - Electrical 2 bar (30 psi), Hirschmann w 24 volt light
RK - Electrical 2 bar (30 psi), Hirschmann w 115 volt light
RL - Electrical 2 bar (30 psi), Hirschmann w 230 volt light
RH - Electrical 2 bar (30 psi), Hirschmann
TB - Electrical 7.9 bar (115 psi), Brad Harrison
TJ - Electrical 7.9 bar (115 psi), Hirschmann w/ 24 volt light
TK - Electrical 7.9 bar (115 psi), Hirschmann w/ 115 volt light
TL - Electrical 7.9 bar (115 psi), Hirschmann w/ 230 volt light
TH - Electrical 7.9 bar (115 psi), Hirschmann
UB - Electrical 4.9 bar (70 psi), Brad Harrison
UJ - Electrical 4.9 bar (70 psi), Hirschmann w 24 volt light
UK - Electrical 4.9 bar (70 psi), Hirschmann w 115 volt light
UL - Electrical 4.9 bar (70 psi), Hirschmann w 230 volt light
UH - Electrical 4.9 bar (70 psi), Hirschmann

6 Seal material
B - Buna-N
V - Viton-A

7 Assembly Length
mm (inch)
3 - 447 (17.6)
6 - 685.3 (27)
7 - 923.5 (36.4)

8 Element construction
C - 10 bar (150 psi) Low Collapse
H - 207 bar (3000 psi) High Collapse
X - no element

9 Fluid cleanliness rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20*	22/**19/16** or better
XX	no element

* C-Pak only

Pressure Filters
HF4P Series

Flows to 570 L/min (150 USgpm)
Pressures to 345 bar (5,000 psi)

V405 * * * * **
1 2 3 4 5 6

V405 Element model code

(Meets HF4 Standard)

Sample model code:
V4051B3C03

1 Filter Element - V405

2 Element Collapse Rating
1 - 10 bar (150 psi)
4 - 206.9 bar (3000 psi) High Collapse
NOTE: Use 1 only with bypass valve or monitored delta P indicator.

3 Seals
B - Buna-N
V - Viton-A

4 Element Length
mm (inch)
3 - 229 (9)
6 - 457 (18)
7 - 686 (27)

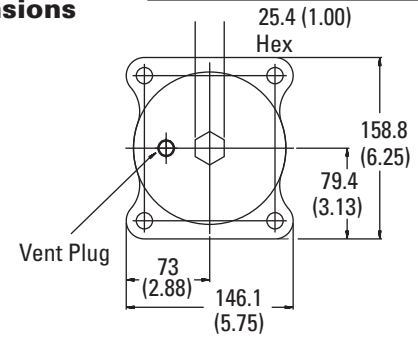
5 Element Construction
C - C-Pak (code 03, 05, 10, 20)
H - H-Pak (code 03, 05, 10)

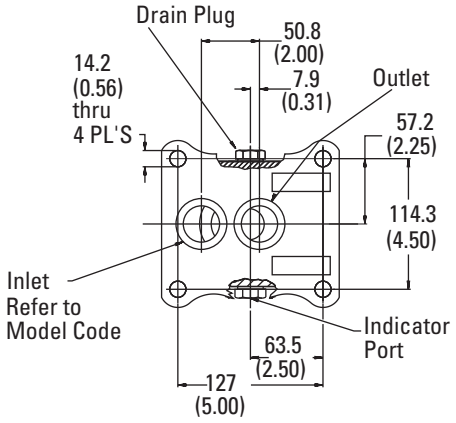
6 Fluid Cleanliness Rating

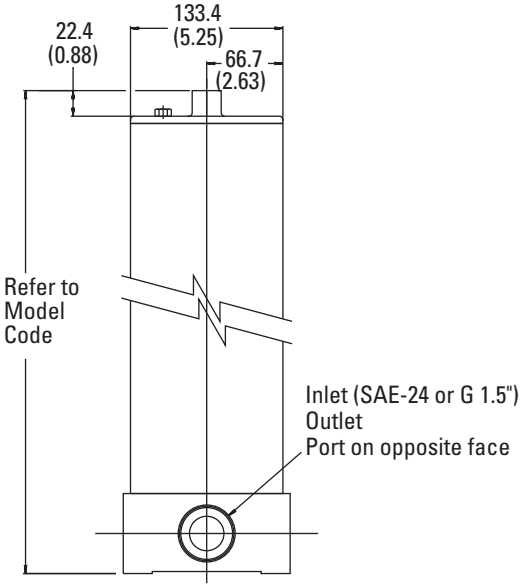
Code	Target fluid cleanliness level
03	16/**14/12**
05	18/**16/14**
10	20/**18/15**
20	22/**19/16**

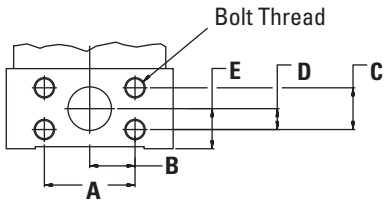
Housing Dimensions

mm (inch)

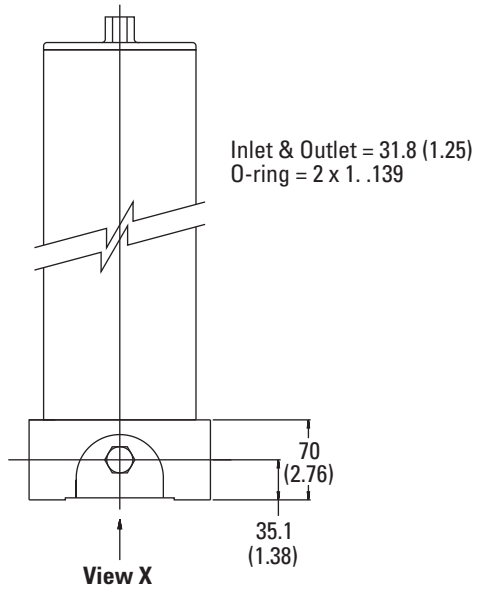








View X - Subplate Mounting



View X

	A	B	C	D	E
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
ME	69.8 (2.75)	37.9 (1.375)	35.7 (1.406)	17.9 (.703)	35.1 (1.38)
MR	79.3 (3.125)	39.4 (1.56)	36.5 (1.437)	18.2 (.718)	35.1 (1.38)
FE	69.8 (2.75)	37.9 (1.375)	35.7 (1.406)	17.9 (.703)	35.1 (1.38)
FR	79.3 (3.125)	39.4 (1.56)	36.5 (1.437)	18.2 (.718)	35.1 (1.38)

Pressure Filters

HF4P Series

Flow Data

Flows to 570 L/min (150 USgpm)
Pressures to 345 bar (5,000 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

HF4P Filter Elements Flow Data

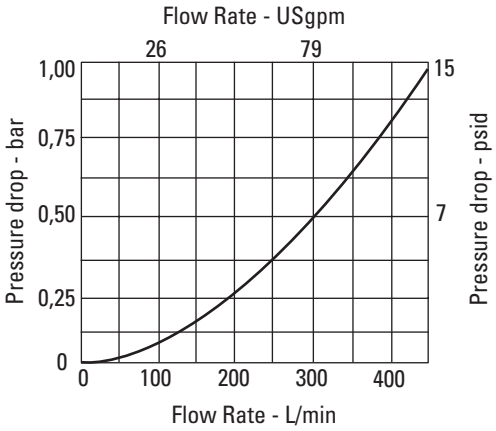
'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	20
C -pak	3	0.003 (0.168)	0.003 (0.140)	0.001 (0.078)	0.001 (0.044)
	6	0.001 (0.080)	0.001 (0.066)	0.001 (0.037)	0.001 (0.021)
	7	0.001 (0.051)	0.001 (0.043)	0.001 (0.024)	0.001 (0.013)
H -pak	3	0.004 (0.206)	0.003 (0.145)	0.002 (0.088)	xxx
	6	0.002 (0.096)	0.001 (0.068)	0.001 (0.041)	xxx
	7	0.001 (0.062)	0.001 (0.044)	0.001 (0.026)	xxx

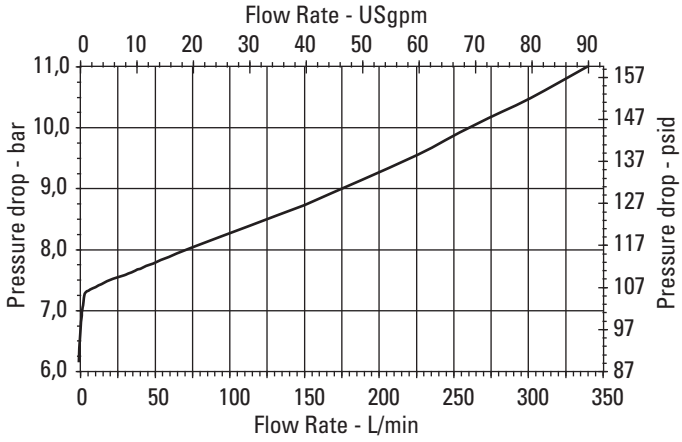
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Housing/Bypass Valve Flow Data

Housing



Bypass Valve



Sample ΔP Calculation : HF4P1SD4LNB6C05 - Filter assembly having '6' length filter element with micron rating code '05' at 200 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.26 x 0.8/0.9	+	200 x 0.001 x 46/32 x 0.8/0.9
	=	0.220	+	0.25
	=	**0.47 bar**		

Pressure Filters
HF3P Series

Flows to 454 L/min (120 USgpm)
Pressures to 410 bar (6,000 psi)

Features and Benefits

- Beta Ratio: $\beta_{X(C)}$ = 1000 to ISO 16889
- Designed to comply with ANSI specifications and ISO cleanliness standards
- Visual, electrical, and electrical indicators with lamp options for system design flexibility
- Conforms to HF3 automotive specifications
- Fatigue rated to 6000 psi for maximum reliability in the most rugged applications
- Reverse flow valve option for hydrostatic transmission applications
- Multiple filter element lengths for design flexibility
- High efficiency replacement elements in standard configurations (C-Pak) to meet Target Cleanliness Levels
- High collapse elements available for non-bypass applications

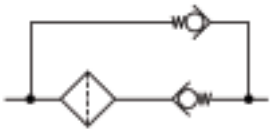
DESIGN SPECIFICATIONS

Rated flow:	Length 1	106 L/min (28 USgpm)
	Length 2	208 L/min (55 USgpm)
	Length 4	344 L/min (91 USgpm)
	Length 5	454 L/min (120 USgpm)
Fluid compatibility:		Compatible with most petroleum oil, water glycol, oil-in-water and water-in-oil fluids. Optional seals available for phosphate esters.
Temp range:		-26°C to +121°C (-15°F to +250°F)
Pressure rating:	Operating	410 bar (6000 psi)
	Fatigue	410 bar (6000 psi)
Material:	Head	Ductile iron
	Bowl	Carbon Steel
Dry weight:	Length 1	20,3 kg (44.8lbs)
(Approximate)	Length 2	22,5 kg (49.5lbs)
(Approximate)	Length 4	28,5 kg (62.9lbs)
(Approximate)	Length 5	43,4 kg (95.7lbs)

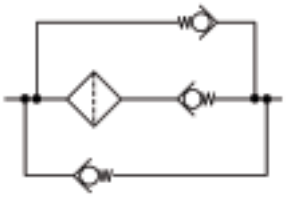
HF3P Series Filter and Element Model Code

Sample model code:

HF3P1SB4LNB2C05



Reverse Flow Non-bypass
(Valve Option 8)



Reverse Flow Bypass
(Valve Option 9)

HF3P	*	**	*	**	*	*	*	**
1	2	3	4	5	6	7	8	9

1 Filter Series - HF3P

2 Element Collapse Rating

1 - 17 bar (250 psi) Low Collapse
4 - 207 bar (3000 psi) High Collapse

3 Port Options

BB - G1 to ISO 228
BD - G1-½ to ISO 228
ME - 1-½" SAE 4 bolt Flange Code 61 (M12 x 1.75)
MJ - 2" SAE 4 bolt Flange Code 61 (M12 x 1.75)
MU - 2" SAE 4 bolt Flange Code 62 (M20 x 2.5)
SB - 1.312 - 12 UN SAE-16 str. Thd. (1" tube)
SD - 1.875 - 12 UN SAE-24 str. Thd. (1-½" tube)
FE - 1½" SAE 4 bolt Flange Code 61 (UNC)
FJ - 2" SAE 4 bolt Flange Code 61 (UNC)
FU - 2" SAE 4 bolt Flange Code 62 (UNC)

4 Valve Options

1 - Non-Bypass
4 - Bypass set at 2.9 bar (43 psi) cracking pressure
6 - Bypass set at 6 bar (90 psi) cracking pressure
8 - Reverse Flow Valve Non-Bypass*
9 - Reverse Flow Valve 2.9 bar (43 psi) Bypass*

* Reverse flow bypass available with BD, MU, SD and FU ports only.

5 Indicator Options

AN - Visual 4.9 bar (70 psi), No Connector
JN - No Indicator (plug), No Connector
KN - Visual 1 bar (15 psi), No Connector
LN - Visual 2 bar (30 psi), No Connector
ON - Visual 7.9 bar (115 psi), No Connector
RB - Electrical 2 bar (30 psi), Brad Harrison
RH - Electrical 2 bar (30 psi), Hirschmann
RJ - Electrical 2 bar (30 psi), Hirschmann w 24 volt light
RK - Electrical 2 bar (30 psi), Hirschmann w 115 volt light
RL - Electrical 2 bar (30 psi), Hirschmann w 230 volt light
TB - Electrical 7.9 bar (115 psi), Brad Harrison
TH - Electrical 7.9 ba (115 psi), Hirschmann
TJ - Electrical 7.9 bar (115 psi), Hirschmann w 24 volt light
TK - Electrical 7.9 bar (115 psi), Hirschmann w 115 volt light
TL - Electrical 7.9 bar (115 psi), Hirschmann w 230 volt light
UB - Electrical 4.9 bar (70 psi), Brad Harrison
UH - Electrical 4.9 bar (70 psi), Hirschmann
UJ - Electrical 4.9 bar (70 psi), Hirschmann w 24 volt light
UK - Electrical 4.9 bar (70 psi), Hirschmann w 115 volt light
UL - Electrical 4.9 bar (70 psi), Hirschmann w 230 volt light

6 Seal Material

B - Buna-N
V - Viton-A

7 Assembly Length

mm (inch)
1 - 230 (9.1)
2 - 293 (11.5)
4 - 414 (16.3)
5 - 569 (22.4)

8 Element Construction

C - 17 bar (250 psi) Low Collapse
H - 207 bar (3000 psi) High Collapse
X - no element

9 Fluid Cleanliness Rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better (C-Pak only)
XX	no element

Pressure Filters

HF3P Series

Flows to 454 L/min (120 USgpm)
Pressures to 420 bar (6,000 psi)

V602 * * * * **

1 2 3 4 5 6

V602 Element Model Code

Sample model code:

V6021B1C03

1 Filter element

V602 - For use with HF3P, series filters

2 Element collapse rating

1 - 17 bar (250 psi) Collapse
4 - 207 bar (3000 psi) High Collapse

NOTE: Use 1 only with bypass valve.

3 Seal material

B - Buna-N
V - Viton-A

4 Element length

mm (inch)

1 - 101 (4)
2 - 203 (8)
4 - 330 (13)
5 - 406 (16)

5 Element construction

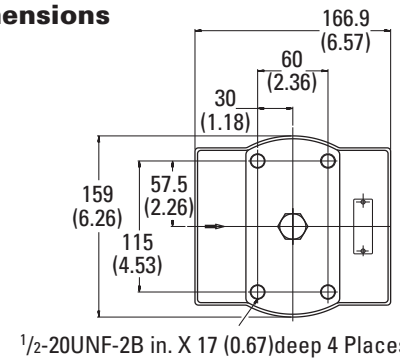
C - C-Pak (code 03, 05, 10, 20)
H - H-Pak (code 03, 05, 10)

6 Fluid cleanliness rating

Code	Target fluid cleanliness level
03	16/**14/12** or better
05	18/**16/14** or better
10	20/**18/15** or better
20	22/**19/16** or better

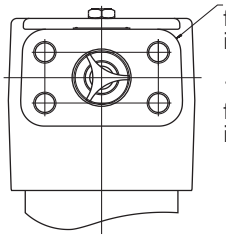
Housing Dimensions

mm (inch)



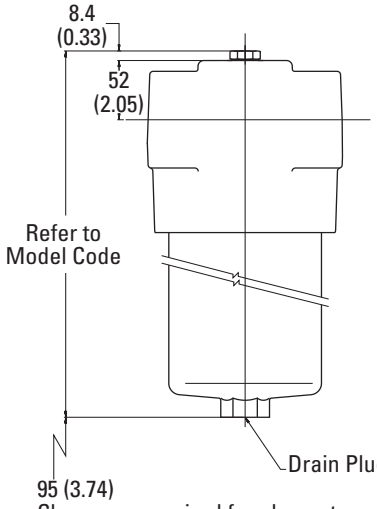
1/2-20UNF-2B in. X 17 (0.67)deep 4 Places

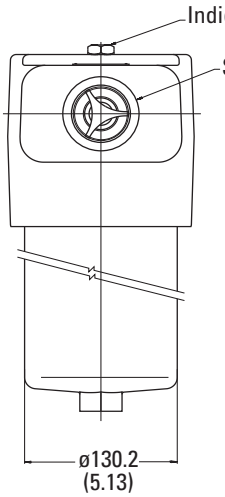
Inlet & Outlet Porting



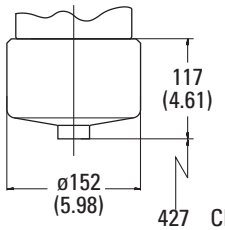
1 1/2" or 2" SAE flange code 61, inch or metric

1 1/2" or 2" SAE flange code 62, inch or metric



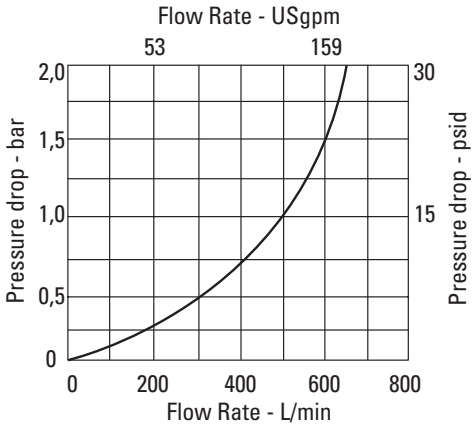


16" Housing

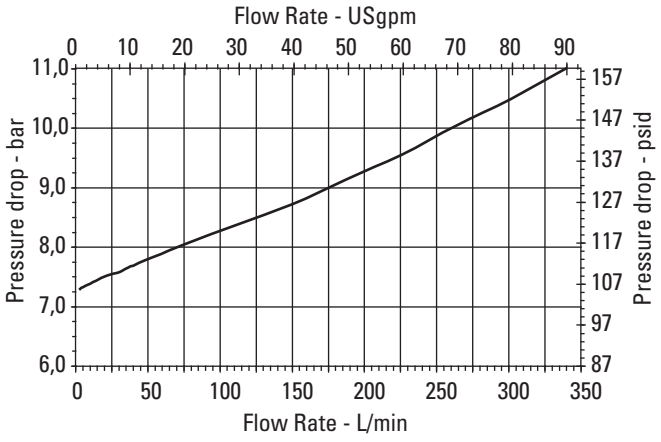


Housing/Bypass Valve Flow Data

Housing



Bypass Valve



Pressure Filters

HF3P Series

Flow Data

Flows to 454 L/min (120 USgpm)
Pressures to 420 bar (6,000 psi)

Flow versus pressure drop:

150 SUS (32 cSt) oil with specific gravity of ≤0.9

Element Flow Data

HF3P Filter Elements

'K' factor - bar/lpm (psi/gpm)

ELEMENT TYPE / SIZE		MICRON RATING			
		03	05	10	20
C -pak	1	0.011 (0.589)	0.009 (0.499)	0.005 (0.266)	0.003 (0.153)
	2	0.005 (0.288)	0.004 (0.241)	0.002 (0.135)	0.001 (0.076)
	4	0.003 (0.175)	0.003 (0.146)	0.001 (0.082)	0.001 (0.046)
	5	0.002 (0.132)	0.002 (0.110)	0.001 (0.061)	0.001 (0.034)
H -pak	1	0.017 (0.936)	0.012 (0.659)	0.007 (0.401)	xxx
	2	0.008 (0.455)	0.006 (0.320)	0.004 (0.195)	xxx
	4	0.005 (0.273)	0.004 (0.192)	0.002 (0.117)	xxx
	5	0.004 (0.206)	0.003 (0.145)	0.002 (0.088)	xxx

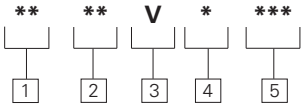
Note: For flow in gpm, use the values inside the brackets.
Note: The values for bar/lpm have been rounded to the third decimal.

Sample ΔP Calculation : HF3P1SB4LNB2C05 - Filter assembly having '2' length filter element with micron rating code '05' at 100 L/min flow rate using a hydraulic fluid at 46 cSt viscosity & specific gravity (sp.gr.)0.8.

ΔP Assembly	=	ΔP Housing	+	ΔP Element
	=	Housing factor from graph x sp.gr.(actual)/0.9	+	Flow Rate (Lpm) x Element 'K' factor (bar/lpm) x [actual cSt / 32] x [Sp.Gr(actual) / 0.9]
	=	0.12 x 0.8/0.9	+	100 x 0.001 x 46/32 x 0.8/0.9
	=	0.100	+	0.127
	=	**0.22 bar**		

DESIGN SPECIFICATIONS

Material:	PV/PE Series PHV/PHE Series	Aluminum Stainless Steel
Fluid compatibility:	Compatible with most petroleum oil, oil-in-water and water-in-oil fluids. Optional seals available for phosphate esters.	
Installation Torque:	PV/PE Series PHV/PHE Series	33 Nm (24 lbs-ft) 100 Nm (74 lbs-ft)
Temp range:		-26°C to +120°C (-15°F to +250°F)
Switch Rating (all models):		3A@24VDC 5A@250VAC
Dry weight: (Approximate)	PV PHV PE PHE	55g (0.1lbs) 110g (0 2lbs) 150g (0.3lbs) 250g (0.6lbs)
Pressure rating:	PV/PE Series PHV/PHE Series	210 bar (3000PSI) 420 bar (6000PSI)



Indicator Model Code

1 Indicator type and pressure rating

PV - visual 210 bar (3000psi)
PE - electrical 210 bar (3000psi)
PHV- visual 420 bar (6000psi)
PHE - electrical 420 bar (6000psi)

2 Pressure setting

1B - 1 bar (15psid)
2B - 2 bar (30psid)
5B - 5 bar (75psid)
8B - 8 bar (115psid)

3 Seal material

V - Viton-A

4 Connector

B - Brad Harrison 5 Pin
H - Hirschmann
N - None (use with PV indicators)

5 Light option

L24 - 24 Volt Lamp
L115 -115 Volt Lamp
L230 -230 Volt Lamp

INDICATOR OPTIONS (3000 PSI - USE WITH FILTER MODELS HV6R, HV3R)

Description	Model	Filter Assembly Code Letters
POPUP VISUAL 15 psi	PV 1B VN	KN
POPUP VISUAL 30 psi	PV 2B VN	LN
POPUP VISUAL 70 psi	PV 5B VN	AN
BRAD HARRISON 5 PIN ELECTRICAL 15 psi	PE 1B V B	QB
BRAD HARRISON 5 PIN ELECTRICAL 30 psi	PE 2B V B	RB
BRAD HARRISON 5 PIN ELECTRICAL 70 psi	PE 5B V B	UB
HIRSCHMANN ELECTRICAL 15 psi	PE 1B V H	QH
HIRSCHMANN ELECTRICAL 30 psi	PE 2B V H	RH
HIRSCHMANN ELECTRICAL 70 psi	PE 5B V H	UH
HIRSCHMANN VISUAL ELECTRICAL 15 psi - L24	PE 1B V H L24	QJ
HIRSCHMANN VISUAL ELECTRICAL 30 psi - L24	PE 2B V H L24	RJ
HIRSCHMANN VISUAL ELECTRICAL 70 psi - L24	PE 5B V H L24	UJ
HIRSCHMANN VISUAL ELECTRICAL 15 psi - L115	PE 1B V H L115	QK
HIRSCHMANN VISUAL ELECTRICAL 30 psi - L115	PE 2B V H L115	RK
HIRSCHMANN VISUAL ELECTRICAL 70 psi - L115	PE 5B V H L115	UK
HIRSCHMANN VISUAL ELECTRICAL 15 psi - L230	PE 1B V H L230	QL
HIRSCHMANN VISUAL ELECTRICAL 30 psi - L230	PE 2B V H L230	RL
HIRSCHMANN VISUAL ELECTRICAL 70 psi - L230	PE 5B V H L230	UL

Accessories

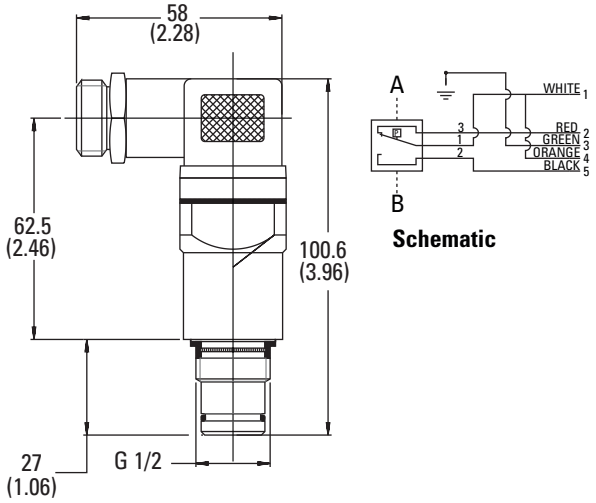
Differential Indicators

INDICATOR OPTIONS (6,000 PSI - USE WITH FILTER MODELS HF2P, HF3P, HF3PS, HF4, MF2P)

Description	Model	Filter Assembly Code Letters
Popup Visual 30psi	PHV 2B VN	LN
Popup Visual 70 Psi	PHV 5B VN	AN
Popup Visual 115 Psi	PHV 8B VN	ON
Brad Harrison 5 Pin Electrical 30 Psi	PHE 2B V B	RB
Brad Harrison 5 Pin Electrical 70 Psi	PHE 5B V B	UB
Brad Harrison 5 Pin Electrical 115 Psi	PHE 8B V B	TB
Hirschmann Electrical 30 Psi	PHE 2B V H	RH
Hirschmann Electrical 70 Psi	PHE 5B V H	UH
Hirschmann Electrical 115 Psi	PHE 8B V H	TH
Hirschmann Visual Electrical 30 Psi - L24	PHE 2B V H L24	RJ
Hirschmann Visual Electrical 70 Psi - L24	PHE 5B V H L24	UJ
Hirschmann Visual Electrical 115 Psi - L24	PHE 8B V H L24	TJ
Hirschmann Visual Electrical 30 Psi - L115	PHE 2B V H L115	RK
Hirschmann Visual Electrical 70 Psi - L115	PHE 5B V H L115	UK
Hirschmann Visual Electrical 115 Psi - L115	PHE 8B V H L115	TK
Hirschmann Visual Electrical 30 Psi - L230	PHE 2B V H L230	RL
Hirschmann Visual Electrical 70 Psi - L230	PHE 5B V H L230	UL
Hirschmann Visual Electrical 115 Psi - L230	PHE 8B V H L230	TL
Indicator Plug	3040056	—

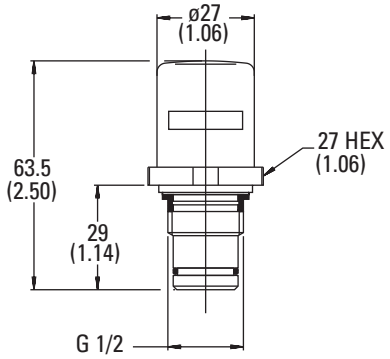
Differential Indicator Dimensional Schematics

PE * B V B
PHE * B V B

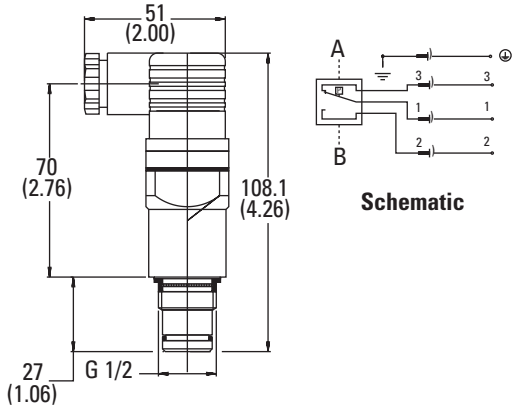


Schematic

PV * B VN

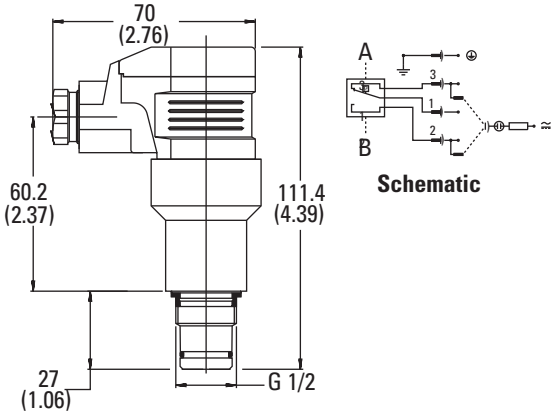


PE * B V H
PHE * B V H



Schematic

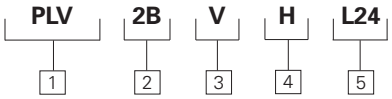
PE * B V H L * *
PHE * B V H L * *



Schematic

Accessories

Static Indicators



Indicator Model Code

1 Indicator type and pressure rating

PLV - Visual
PLE - Electrical
SLV - Visual
SLE - Electrical

2 Pressure setting

1B - 1 bar (15psid)
2B - 2 bar (30psid)
5B - 5 bar (75psid)
1.4B - 1.4 bar (20psid)

3 Seal Material

V - Viton-A

4 Connector

B - Brad Harrison 5 Pin
N - Hirschmann
H - None

5 Light Options

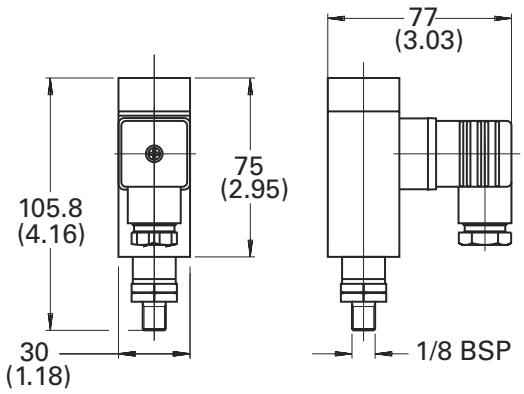
L24 - 24 Volt Lamp
L115 - 115 Volt Lamp
L230 - 230 Volt Lamp
N - None

	INDICATORS FOR ORFM SERIES LENGTH 1-4 & HF4RT SERIES	EATON MODEL CODE	INDICATORS FOR ORFM SERIES-LENGTH 5-7; ORF1300 SERIES & DRT SERIES	EATON MODEL CODE
KN	Visual, 15 PSI, No connector	PLV 1B V N N	Visual, 15 PSI, No connector	SLV 1B V N N
MH	Electrical, 15 PSI, Hirschmann	PLE 1B V H N	Electrical, 15 PSI, Hirschmann	SLE 1B V H N
MB	Electrical, 15 PSI, Brad Harrison	PLE 1B V B N	Electrical, 15 PSI, Brad Harrison	SLE 1B V B N
MJ	Electrical, 15 PSI, Hirschmann w 24 Volt light	PLE 1B V H L24	Electrical, 15 PSI, Hirschmann w 24 Volt light	SLE 1B V H L24
MK	Electrical, 15 PSI, Hirschmann w 115 Volt light	PLE 1B V H L115	Electrical, 15 PSI, Hirschmann w 115 Volt light	SLE 1B V H L115
ML	Electrical, 15 PSI, Hirschmann w 230 Volt light	PLE 1B V H L230	Electrical, 15 PSI, Hirschmann w 230 Volt light	SLE 1B V H L230
LN	Visual, 30 PSI, No connector	PLV 2B V N N	Visual, 30 PSI, No connector	SLV 2B V N N
RH	Visual, 30 PSI, Hirschmann	PLE 2B V H N	Visual, 30 PSI, Hirschmann	SLE 2B V H N
RB	Electrical, 30 PSI, Brad Harrison	PLE 2B V B N	Electrical, 30 PSI, Brad Harrison	SLE 2B V B N
RJ	Electrical, 30 PSI, Hirschmann w 24 Volt light	PLE 2B V H L24	Electrical, 30 PSI, Hirschmann w 24 Volt light	SLE 2B V H L24
RK	Electrical, 30 PSI, Hirschmann w 115 Volt light	PLE 2B V H L115	Electrical, 30 PSI, Hirschmann w 115 Volt light	SLE 2B V H L115
RL	Electrical, 30 PSI, Hirschmann w 230 Volt light	PLE 2B V H L230	Electrical, 30 PSI, Hirschmann w 230 Volt light	SLE 2B V H L230
AN	Visual, 70 PSI, No connector	PLV 5B V N N	Visual, 70 PSI, No connector	SLV 5B V N N
UH	Electrical, 70 PSI, Hirschmann	PLE 5B V H N	Electrical, 70 PSI, Hirschmann	SLE 5B V H N
UB	Electrical, 70 PSI, Brad Harrison	PLE 5B V B N	Electrical, 70 PSI, Brad Harrison	SLE 5B V B N
UJ	Electrical, 70 PSI, Hirschmann w 24 Volt light	PLE 5B V H L24	Electrical, 70 PSI, Hirschmann w 24 Volt light	SLE 5B V H L24
UK	Electrical, 70 PSI, Hirschmann w 115 Volt light	PLE 5B V H L115	Electrical, 70 PSI, Hirschmann w 115 Volt light	SLE 5B V H L115
UL	Electrical, 70 PSI, Hirschmann w 230 Volt light	PLE 5B V H L230	Electrical, 70 PSI, Hirschmann w 230 Volt light	SLE 5B V H L230

Accessories

Electrical Pressure Switch

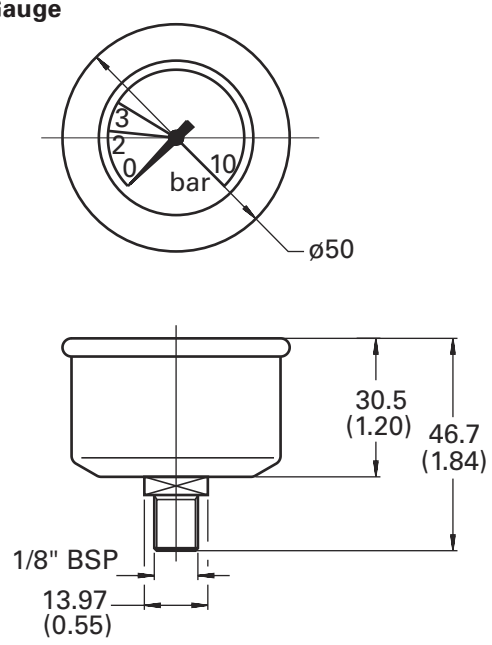
Hirschmann Connector



HOUSING	PART NUMBER
DRT	3039708 Electrical Switch 30 psi Hirschmann Connector

Gauge

0-10 Bar Gauge



HOUSING	PART NUMBER
DRT	3039703 Gauge 0 - 10 Bar

Note: Gauges indicate pressure in both bar and psi

Accessories
Indicator Switch

Schematic Wiring Diagram

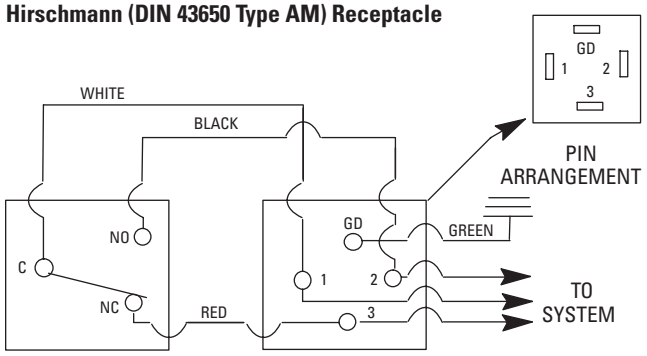
Note: The female connector is to be furnished by the customer.

Note: When fitting indicator, torque to 41-47 Nm.

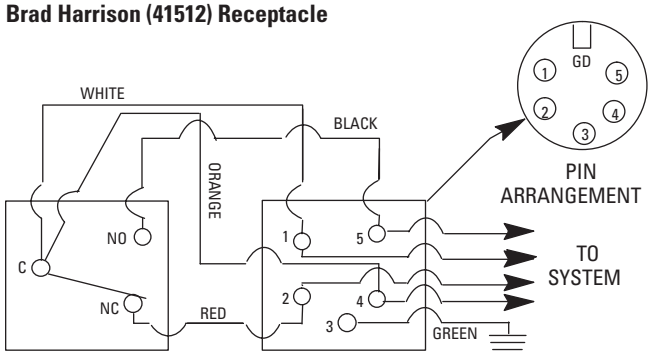
ELECTRICAL

Switch:	SPDT
Rating:	7 amps, resistive 4 amps, inductive 2 amps, lamp load @28 VDC, 115 VAC 60 Hz & 220 VAC 50 Hz or 60 Hz

Hirschmann (DIN 43650 Type AM) Receptacle



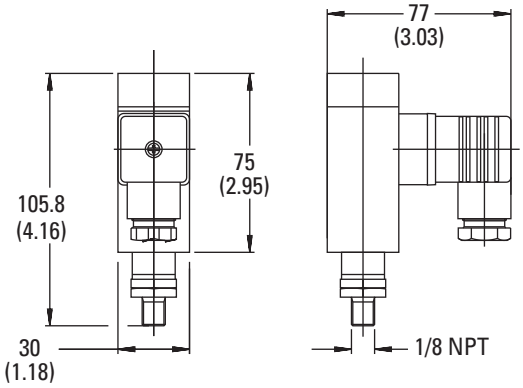
Brad Harrison (41512) Receptacle



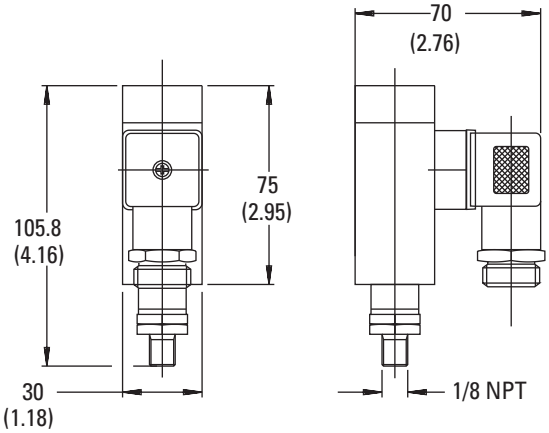
Electrical Pressure Switch

HOUSING	PART NUMBER
HF4RT	3039705 Electrical Switch 15 psi Brad Harrison Connector 3039707 Electrical Switch 15 psi Hirshmann Connector
HF4RT	3039706 Electrical Switch 30 psi Brad Harrison Connector 3039708 Electrical Switch 30 psi Hirshmann Connector

Hirshmann Connector



Brad Harrison Connector



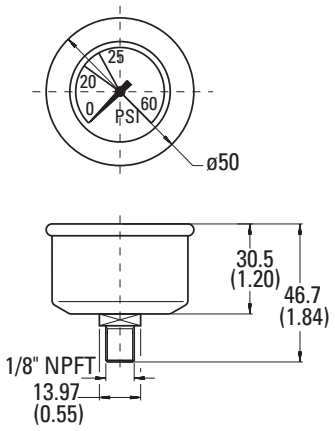
Accessories

Gauge

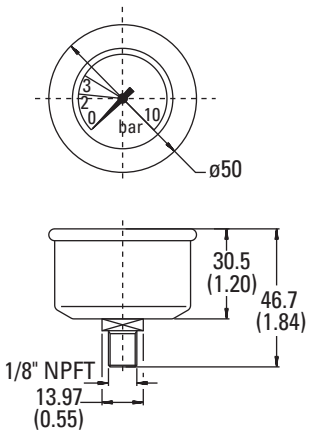
HOUSING	PART NUMBER
HF4RT	3039703 Gauge 0-160 psi (use with 43 psi Bypass Valve) 3039704 Gauge 0-60 psi (use with 25 psi Bypass Valve)

Note: Gauges indicate pressure in both bar and psi

0-4 Bar (0-60 PSI) Gauge



0-10 Bar (0-160 PSI) Gauge

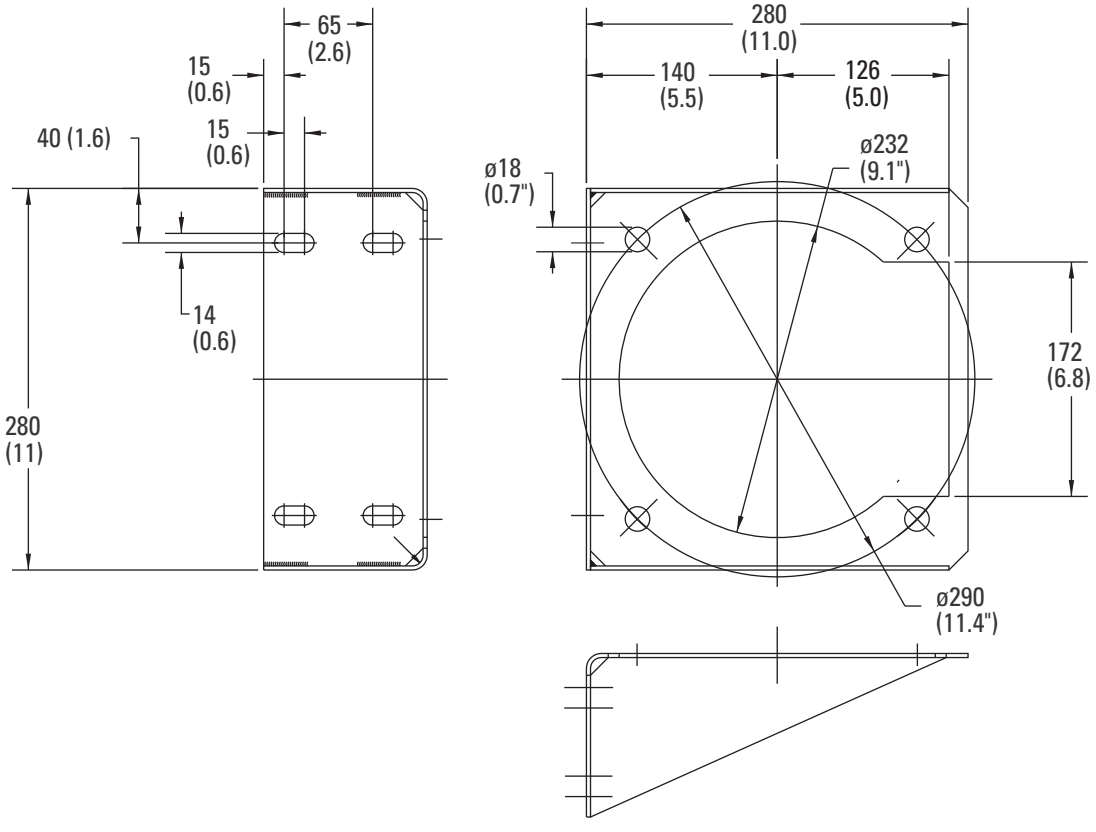


Mounting Bracket

HV6R Housing

mm (inch)

Order part number 3039702



Accessories
Gauge

Seal Kits

Note
Seal kits include all soft goods to fully service a unit.

SERIES	SEAL TYPE	SEAL KIT PART #
HV6R	Buna-N	3039688
	Viton-A*	3039689
HV3R	Buna-N	3039690
	Viton-A	3039691
HF4RT	Buna-N	3039692
	Viton-A	3039693
HF2P	Buna-N	3039694
	Viton-A	3039695
HF3P	Buna-N	3039696
	Viton-A	3039697
HF3PS	Buna-N	3039698
	Viton-A	3039699
HF4P	Buna-N	3039700
	Viton-A	3039701
OFR60/ 120	Buna-N	590021
	Viton-A	591761 (Bowl seal only)
OFR15/ 30	Buna-N	226214
	Viton-A	262422 (Bowl seal only)

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Notes

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