



ALL METAL FILTERS



LAUNCH VEHICLE FILTERS



METAL MESH FILTERS



ETCHED DISC FILTERS



PROPELLANT MANAGEMENT DEVICES

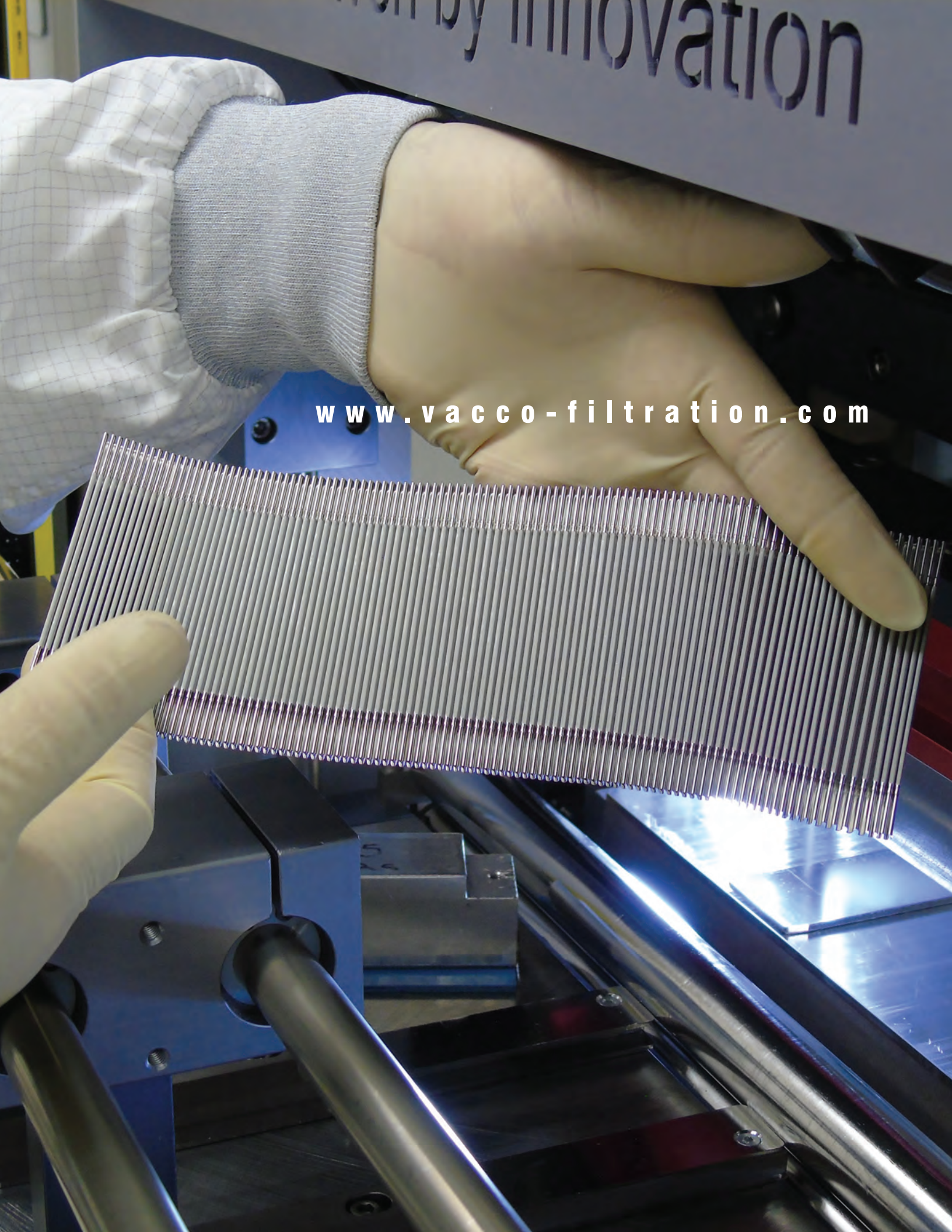
COMMERCIAL • DEFENSE • SPACE

VACCO

—Filtration™
AN ESCO TECHNOLOGIES COMPANY

by innovation

www.vacco-filtration.com



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About Us

VACCO Industries is a leading supplier of “all metal” filtration solutions including Metal Mesh, Etched Disc, and PMD for various applications. VACCO provides filters and filtration sub-systems for many industries including Space, Launch vehicle, Satellite, Ground support, Commercial and Defense.

VACCO’s high performance metal mesh filters are constructed from porous metallic media, primarily stainless steel woven cloth, and are used to control particulate contaminants. Principal applications are among space systems. VACCO products are commonly specified space vehicle system, as well as attendant ground support equipment and test equipment. VACCO also manufactures filter products for aircraft and missile applications. In addition to serving the aerospace and defense industries, VACCO filters are also found in numerous commercial applications; in particular the healthcare and the printing industry.

VACCO’s etched disc filters are constructed from thousands of stacked metallic discs that have been chemically micro-machined with microscopic flow channels on the surface of each stacked disc to enable precision filtration. VACCO utilizes these etching capabilities to produce etched disc filters for satellites and spacecraft and launch vehicles. VACCO etch discs are used in NASA satellites and critical Military applications.



Etched Disc Filters

Disc Filters



PMD Devices



Multiple Filter Options



Inline Filter Case and Element



Unique Manufacturing Approach

Although filters are designed to block the passage of particles, most new filters are actually delivered with built-in contaminants present. Built-in contaminants are released during exposure to mechanical vibration, zero gravity, or other conditions encountered during operations. Thus, filtration devices frequently release particles into the fluid stream that are larger than the filter's maximum rated pore size.

While many high-technology applications are either unaware or unconcerned about this condition, VACCO's aerospace industry customers regard product cleanliness requirements as essential. Most space applications are open-loop flow systems that must work upon initial startup without malfunction (as compared with a closed-loop hydraulic system which can purge itself after several cycles of operation). In order to better serve this special need, VACCO initiated an extensive study to identify and isolate the sources of particulate contamination. The result was a completely new design approach that eliminates contaminants normally entrapped during the manufacturing cycle.

Typically, filters are fabricated complete and then submitted to time-consuming chemical cleaning processes. The VACCO approach is to start with pre-cleaned components and to minimize the opportunity of adding contaminants by assembling the filters in a controlled; clean room environment. VACCO operates a Class 10,000 clean room where all space-related products are fabricated. Filters not requiring stringent cleanliness certification are assembled more economically in dust-limited manufacturing areas.



Testing

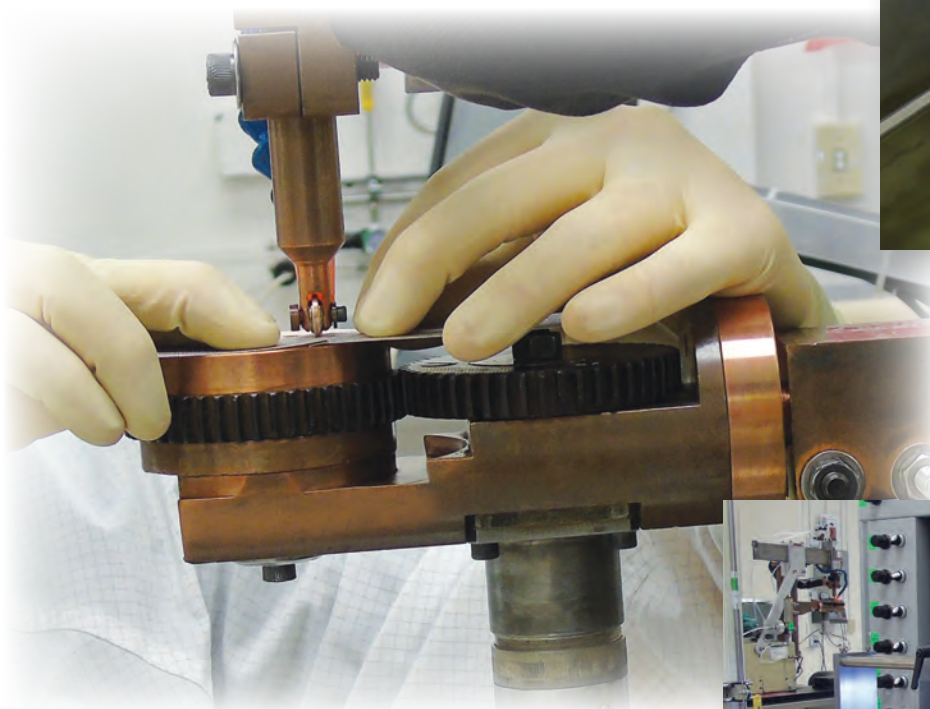


Inspection



VACCO Clean Room

Unique Manufacturing Approach



Resistance welding in clean room

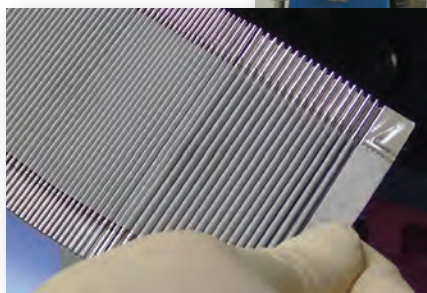


Bubble Point Testing
per ARP 901



Screen pleating inside clean room

Collector
assembly



Pleated screen with
patented foil edge



Clean room packaging

A composite image showing a space shuttle launch. The main shuttle is in the center, angled upwards, with its orange external tank and white boosters. Various spacecraft components are floating in orbit around it, including a large silver cone-shaped object on the left, a small satellite with solar panels in the upper center, and a black cone-shaped object on the right. The Earth's blue and white surface is visible in the background.

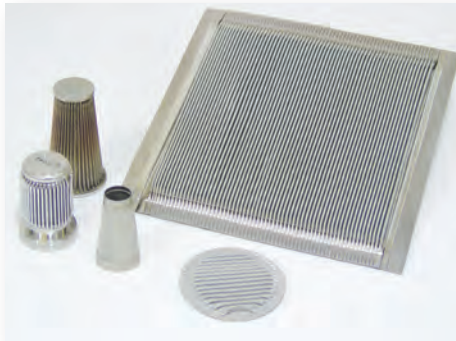
SECTION 1

SPACE QUALIFIED PRODUCTS

VACCO
—Filtration™

Space Qualified Products

VACCO supplies propellant management devices and filters for the United States and European space programs. Product offerings include inline recleanable filters, inline welded filters, Tee-type filters and housings, and vacuum jacketed assemblies and elements.



Disc Filters and pleated screen filters

Metal Mesh Technology

VACCO wire mesh filters are used in Crewed Spacecraft, satellites, aircrafts, launch vehicles and ground support equipment. Wire mesh filters provide reliable filtration for various systems in the Space sector. VACCO has been supplying critical Space qualified metal mesh filters for over 30 years.



Etched disc filters

Etched Disc Technology

VACCO etched disc filters provide extreme cleanliness, low weight and absolute filtration for Space programs. VACCO etched discs have been and continue to be used in satellites, life critical applications, critical defense projects and NASA missions.



PMD devices

Propellant Management Devices (PMD)

VACCO propellant management devices (PMD) are primarily used to separate free gas from liquid propellants. PMDs are used in Space vehicles, Aircrafts and missile systems that use liquid propulsion systems.



Facilities



Clean Room



Pre-cleaning



Bubble Point Testing
Filter w/Foil

Filters Built Under Clean Room Conditions

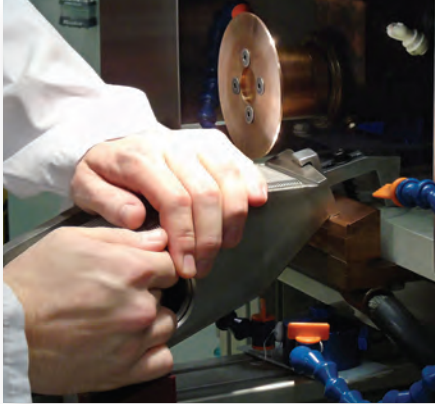
Manufacturing, cleaning, testing and packaging operations are performed in a specially designed Class 10,000 clean room. Once the filter media is admitted into the clean room, no portion is again exposed to an uncontrolled environment. Numerous cleaning operations are performed at logical stages of manufacturing, and upon completion where cleanliness is verified and certified in accordance with the applicable specification. Cleanliness levels never before possible are reached on a production basis.

Pre-cleaning of Media

Once a filter is assembled, the entrapment areas in a filter element are nearly impossible to reach and flush out with any degree of reliability. Prior to releasing for fabrication, each filter is individually cleaned by ultrasonic and flushing methods. These methods use highly filtered fluids and concentrate the cleaning action over individual small sections.

Patented Design Provides Key to Precision Cleanliness

VACCO encapsulates the micronic wire cloth and felt metal edges. Encapsulation eliminates the wire ends from breaking off and contaminating the fluid being filtered. This patented feature also precludes the entrapment of contaminants during fabrication, prevents oxidation of the media and eliminates distortion of the end fittings during welding. Final machining after welding is not required.



Resistance Welding

Patented Welding Process

This patented process prevents overheating and oxidation of the filter media. It involves welding two narrow strips of stainless steel foil to each edge of the precut, cleaned wire cloth, thereby encapsulating the raw wire edges. This foiled media is then pleated and the foiled ends are coined, and heliarc welded to thin, machined burn-down flanges on the end fittings. The delicate media itself is never crushed or distorted nor are the fine wires melted in welding.

Filter Drying



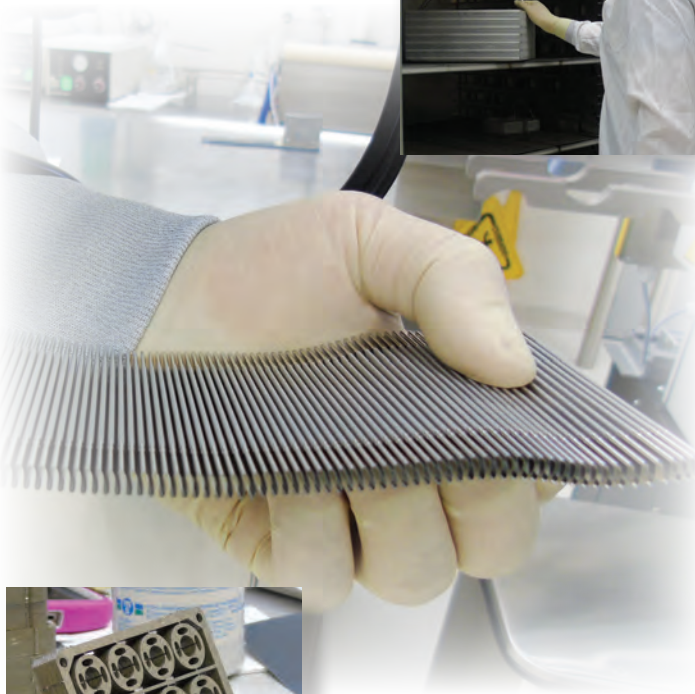
Qualification Testing

Filters may be qualification tested as individual components or with their host system. Most filters for space applications are qualification tested as separate components. VACCO operates a diverse test laboratory capable of performing functional and environmental tests including:

- Bubble Point Helium Leak
- Degree of Filtration (GBR)
- Dirt Capacity
- Flow vs. Pressure Drop
- High and Low Temperature
- Humidity
- Impulse
- Life Cycle
- Proof and Burst Pressure
- Temperature Shock

The following test media are available:

- Alcohol
- De-ionized Water
- Helium
- MIL-H-83282
- Nitrogen
- Skydrol LD-4



Pleated material Inspection



Etched Disc



Facilities

Verification

Final cleaning and cleanliness level tests are conducted in accordance with customer requirements and industry standards; e.g. ARP 599. Since the filter media was cleaned in the detail condition and during intermediate points of manufacture, the cleaning is simplified and the highest level of cleanliness is readily achieved.

Analysis

Fluid analyses are performed using VACCO's unique closed-loop system in which the total effluent from the filter flows directly through a view-collector, is analyzed, and all particles are graded for size and counted for quantity. The facilities are stringently controlled by methods and processes as defined in VACCO's Quality Assurance Manual and are employed as required to meet government and customer specifications.

End Results: Optimized Filter Cleanliness

VACCO filters do not have built-in contaminants which ensures the fluid coming from the filter will meet the specified cleanliness requirements, starting with the first usage.

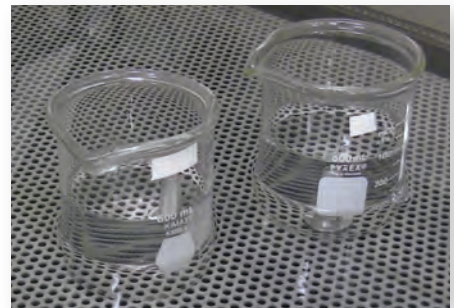
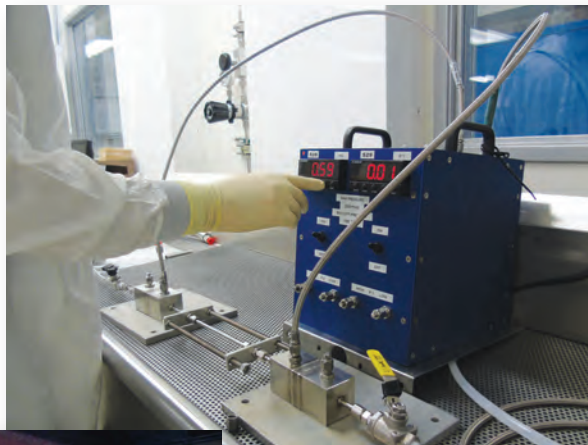
VACCO Laboratory Capabilities

- Liquid Flow Benches
 - De-ionized Water and Alcohol:
100-300 gpm at 100 psig
100 gpm at 400 psig
- Gas Flow Bench
 - GN₂ and He:
400 scfm at 6,000 psig
1250 scfm at vacuum flow
- Proof and Burst Pressure
 - Hydrostatic up to 36,000 psig
 - Pneumatic up to 50,000 psig
- Helium Mass Spectrometer to 6,000 psig
1 x 10⁻⁴ to 240 x 10⁻¹⁰ scc/sec, -100 °F to ambient
- Impulse Testing, Flow Cycling and Water Hammer
- MIL-STD-810 Temperature Shock
from -100 to +400 °F
- Cold Shock to -300 °F
- Contaminant Capacity
- Degree of Filtration (GBR)
- Tensile Testing
- Weld Micro Sectioning, Etching Cleanliness Verifications
- Bubble Point Verification of Micron Pore Size

Weld/Clean Room

- Random Flow Clean Room
- Clean Room
- Bubble Point Area
- Dedicated Resistance Weld Center in the Clean Room
- Deionized water and Alcohol Cleaning per ARP 599 Requirements
- Separate Pre-Clean Center with facilities for the following:
 - Alkaline Cleaning
 - Passivation
 - Pickling
 - Ultrasonic Rinsing
 - Weld Scale Removal
 - Electro-polish

Flow Testing



Cleaning



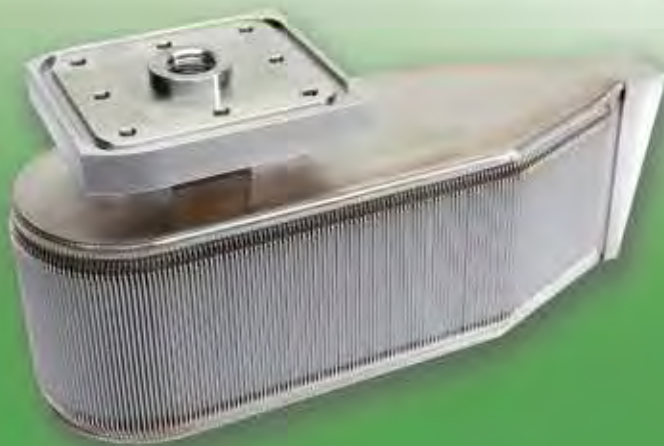
Disc Punch



Packaging

SECTION 2

M E T A L M E S H P R O D U C T S



VACCO
— Filtration™

Propellant Management Devices (PMD)

Propellant Management Devices (PMD) that are used to separate free gas from liquids. The principle derives from the phenomenon that once a material containing fine pores or openings is wetted with a liquid, it will allow free flow of the liquid, but will resist flow of a gas. Gas is caused when the liquid forms a film across the pore openings, and gas bubbles form and break this film in order to pass through. This resistance to gas flow is caused by the size of the opening and the surface tension of the wetting liquid. The smaller the opening, and the higher the surface tension, the more pressure is required to force the gas bubble through the material.

The fine screen material used in filters provides many very small openings, making it ideal for use in surface tension devices. VACCO's knowledge of the characteristics of liquid and gas flow, through fine wire mesh, provides the proven experience that makes us a leader in the field of surface tension devices.

There are many possible applications for the Propellant Management Devices (PMD). For example, they are used to control the flow of liquids from storage tanks of space vehicles operating under zero gravity, where gas pressure is used to displace the liquid from the tank. They are also used in liquid systems, where undesirable gas bubbles can form from the liquid's progressive breakdown.





Propellant Management Devices (PMD) and Surface Tension Elements (STE)

Table 1: PMDs

System	Customer
JSF Missile	Kongsberg
Intelsat/GOES	Ford Aerospace, Fansteel
MARS Explorer	Planetary Science Institute (PSI)
Tomahawk Missile	Raytheon
Hayabusa 2 PMD	Mitsubishi Heavy Industries (MHI)
Hayabusa PMD	Mitsubishi Heavy Industries (MHI)
Pegasus 4th Stage PMD	Orbital Sciences Corporation (OSC)
Gas Trap for Space Suit	UTC Aerospace Systems
Cryogenic Engine LAD Configuration 2	The Boeing Company
Cryogenic Engine Liquid Acquisition Device (LAD)	The Boeing Company
Harpoon Missile	McDonnell Douglas Aircraft Corporation *
Peacekeeper Missile 4th Stage	McDonnell Douglas Aircraft Corporation *
Space Shuttle AFT Propulsion System PMD	NASA/McDonnell Douglas Aircraft Corporation *
Space Shuttle Collector RCS Tank PMD	NASA/Martin Marietta Corporation #
Advanced Rocket Engine Refillable Trap Assembly	McDonnell Douglas Aircraft Corporation *
USAF Cryogenic Engine Toroidal Tank (LAD)	McDonnell Douglas Aircraft Corporation *, Ball Aerospace
SDI Program	Aerojet Rocketdyne
IR&D Unit	McDonnell Douglas Aircraft Corporation *

* McDonnell Douglas Aircraft Corporation (now Boeing)

Martin Marietta Corporation (now Lockheed Martin)

Standard Filter Applications

Space Applications

- Fuel Systems
- Propulsion Systems
- Bacteria Filter
- Hydraulic Systems
- Cryogenic Systems
- Water Vapor
- Water Separator
- Fuel Cell (rotating screen)
- Environmental Control Unit

Missile Applications

- Oxygen (liquid and gaseous)
- Nitrogen (liquid and gaseous)
- Fuel Valve
- Reaction Control Systems
- Cooling System
- Turbine Oil
- Propellant Tank Pressurization System
- Ground Support Equipment





Bi-Directional Filters for 6000 psi Systems

F16 SERIES

VACCO is a leading designer of filter products and systems for military and aerospace applications.

VACCO offers filters for service in hydraulic, fuel, and other liquid/vapor systems on board aircraft, missiles, marine and combat vehicles. Successfully proven in the most demanding space-related applications, the F16 Series Filters offer improved performance features and greater design flexibility.

The F16 is so-named because each end fitting is machined from one-inch (sixteen-sixteenths) bar stock. This hex size allows a large pleated filter disc to be used, resulting in extended filter life and reduced pressure drop.



F16 Series filters

Bi-Directional Capability

By specifying one or more optional support plates, the designer can tailor a filter to meet his unique requirements. A single downstream support will increase the allowable filter pressure differential to an operating pressure of 3000 psid. If a second support plate is used on the other side of the pleated filter disc, the assembly becomes suitable for bi-directional applications.

The support plates offer increased strength and should be utilized whenever element differentials can exceed 50 psi. Typical applications include high contamination loadings, water hammer effects and systems that undergo rapid pressurization. The F16 Series Filter is ideal for burst disc and rapid pressurization applications.



Bubble-Point Testing

Applications

Reliability of fluid systems can be improved by placing secondary filters near critical system components. These secondary filters act to control large particle contaminations and can be positioned upstream of contamination-sensitive components (such as check or servo valves, gauges, orifices or nozzles) or downstream of contamination generators (such as pumps, motors, brakes, transmissions, breathers or fill tubes). The support plates do not appreciably increase pressure drop through the filter.



Resistance Welding

Bi-Directional Filters for 6000 psi Systems

F16

F16 means sixteen-sixteenths (one inch) across the hex flats. This dimension is constant regardless of the line size selected.

Choice of End Fittings

A wide variety of assemblies are possible by combining different male and female fitting halves.

Absolute Particle Control

F16 Series filters are bubble point certified.

TIG Welded Reliability

Single weld seam retains all components. Designed for 6000 psi systems

Stainless Steel Construction

300 series stainless steel end fittings filter disc and support plates.

Standard Sealing Locations

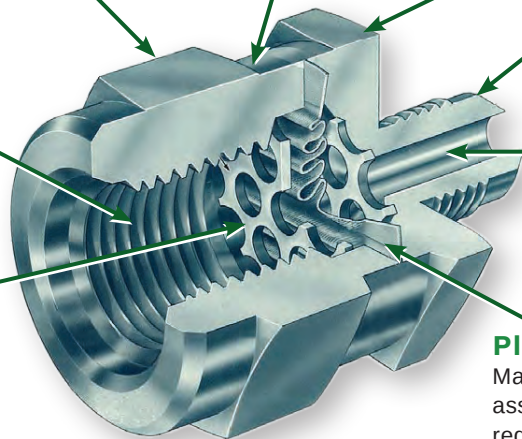
Accommodates all standard seals including O-ring and compression types.

Zero Media Migration

Circumference of filter disc is incorporated into weld zone entrapping all edge wires and preventing media migration.

Pleated Filter Disc

Maximum area in minimum volume assures long service life and reduces pressure drop.



Fully Bi-Directional

Optional support plates allow high differential pressures in one or both flow directions. ΔP can equal 3000 psid without distorting the filter disc.

Many Filter Ratings Available

Choose from ratings of 2 to 250 micrometers absolute.

Many More Variations Possible

Consult the factory for special end fittings, materials, micron ratings or other pressure applications. F16 series filters can be readily adapted for unique applications.

Design Flexibility

F16 Series Filters are a family of stainless steel components that can be assembled the way you need them. Different fitting types and line sizes can be combined. A wide range of micron ratings is available from 2 to 250 micrometers. Optional features such as support plates and lock wire holes add greater design potential. VACCO bubble point certifies each filter.

Special end-fitting configurations, materials, or micron ratings can be ordered. Higher pressure designs are also available. Please contact our Applications Engineer.

Summary of Features

- Bi-directional flow capability
- Wide variety of end fittings available
- 6000 psi service (15,000 psi burst)
- All stainless steel construction
- Filter ratings from 2 to 250 microns
- Minimum effective filter area of 1.90 in²
- TIG welded construction
- Temperature range from -423° F to 800° F



F16 SERIES

Table 1: Optional Support Plates

1	Number	Location
A	None	
B	One	Outlet fitting (down-stream)
C	Two	Each fitting for bi-directional flow

P/N Code



Remarks

The optional support plate feature is what makes the VACCO F16 Series Filter unique. Each plate can withstand a differential pressure of 3000 psi. Filters can be used in high contamination locations without fear of particle release. Water hammer and sudden pressure pulsations can be tolerated. Use of two plates makes the F16 Series filter truly bi-directional.

Table 2: Filtration Ratings

2 Absolute	Nominal (Ref)
005	X5
010	2X
015	2
018	5
025	10
040	20
075	40
*	100
*	200

**When absolute ratings are not shown, order by Nominal rating. VACCO does not certify bubble-points of 100 micrometers or greater.*

P/N Code



Remarks

Absolute ratings shown are accepted industry standards for the mesh weaves used. VACCO performs a bubble-point test on each filter.

Table 3: Fitting Types

Specification	Line Size		
3 4	1/4"	3/8"	1/2"
Male Fittings			
IAW MS 18229	4F	6F	8F
MS 33655	4T	6T	8T
MS 33657	4U	6U	8U
MS 33677 (ANPT)	4M	6M	8M
MS 24385 (USAF)	4Y	6Y	8Y
KC 105 (NASA)	4Z	6Z	8Z
2514 C (Flareless Tube, similar to MS 33514)	4C	6C	8C
2514 D (MS 33656 less flared nose)	4D	6D	8D
Female Fittings			
MS 33649	4B	6B	8B
MIL-P-7105 (ANPT)	4P	6	-
MS 16142 (SHIPS)	4R	6R	8R
MC 240 (NASA)	4V	6V	8V

P/N Codes

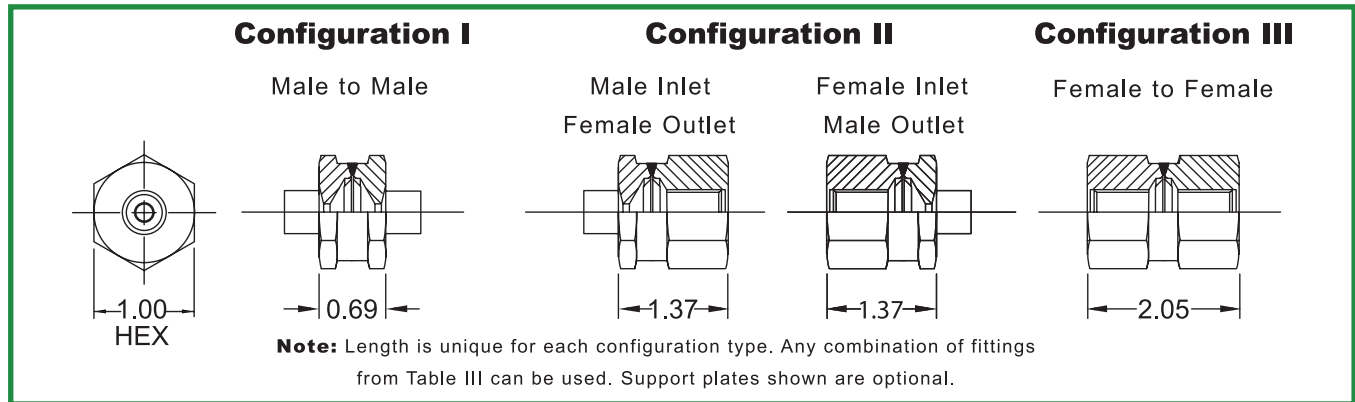


Remarks

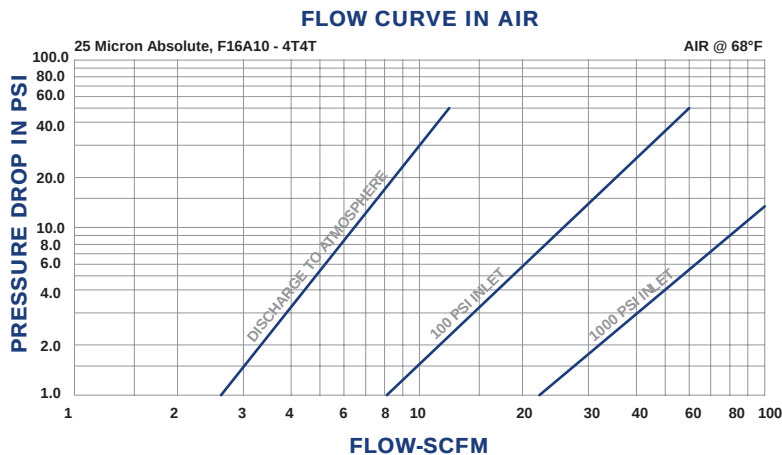
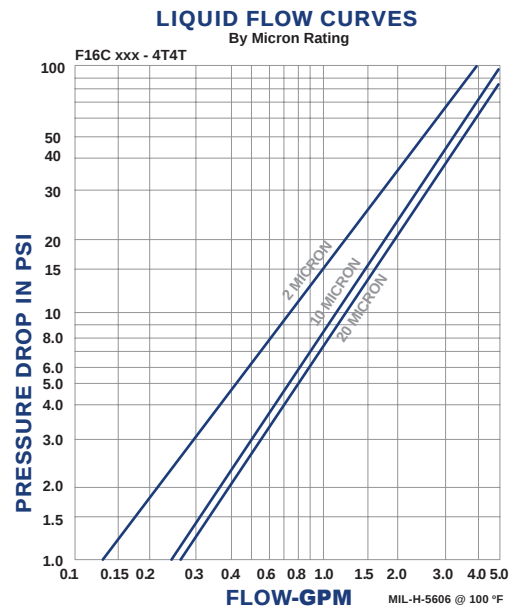
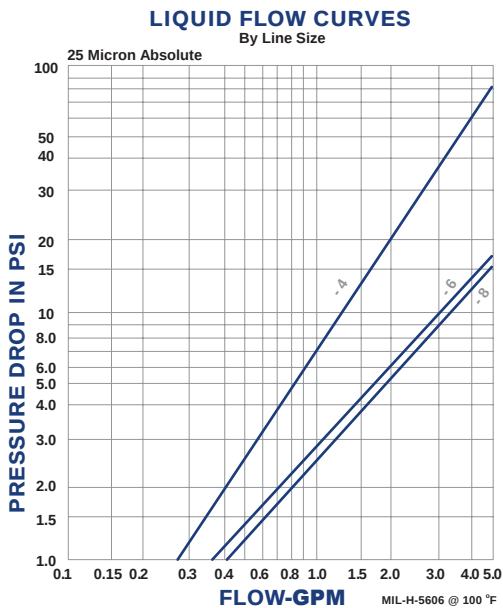
Other fitting types are available by special order. Please contact our Applications Engineer.

Bi-Directional Filters for 6000 psi Systems

Physical Characteristics



Flow Performance Curves

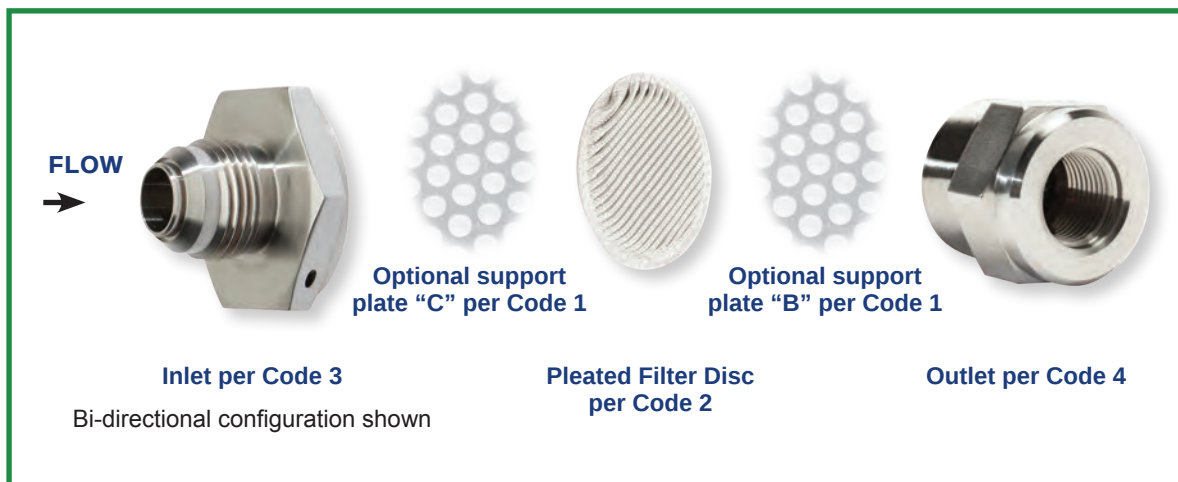


These performance curves are calculated engineering estimates. Actual performance may be influenced by line size, filter rating and number of support plates.



F16 SERIES

How to Order



BASIC PART NUMBER: F16 -

1 **2** **3** **4** **5**

SUPPORT PLATES (see Table I)

CODE	QUANTITY
A	None
B	One (downstream)
C	Two (bi-directional flow)

LOCKWIRE HOLES
Standard filter has none
- leave blank
"W" option has two in each fitting half

OUTLET SIZE AND TYPE
(see Table III)

INLET SIZE AND TYPE
(see Table III)

MICRON RATING (Absolute)
(see Table II)

EXAMPLE:
F16 C 025 - 4T 6B W

LOCKWIRE HOLES - leave blank if none

OUTLET PORT - is 3/8 inch line size
Female Boss O-ring port per MS33649-6

INLET PORT - is 1/4 inch line size
Male tube per MS33656-4

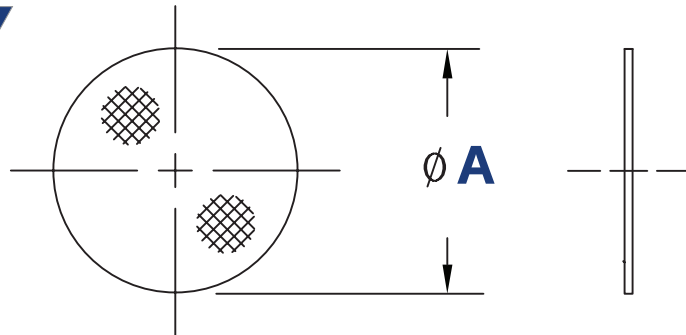
MICRON RATING - 25 micrometer absolute filter disc

SUPPORT PLATES - Two support plates allowing bi-directional operation at differential pressure to 3000 psid

Flat Disc Filter

F-4315

DASH NO.	A	DASH NO.	A
1	0.455/0.445	36	0.373/0.362
2	0.500/0.490	37	1.860/1.850
3	0.339/0.329	38	1.10/1.350
4	0.260/0.240	39	0.390/0.380
5	0.390/0.380	40	0.835/0.825
6	0.157/0.152	41	0.192/0.182
7	0.135/0.125	42	0.300/0.280
8	0.310/0.305	43	0.125/0.115
9	0.750/0.740	44	0.153/0.159
10	0.339/0.329	45	0.153/0.159
11	0.339/0.329	46	0.433/0.423
12	0.250/0.245	47	0.533/0.547
13	0.490/0.480	48	1.855/1.845
14	0.0945/0.0900	49	0.339/0.329
15	0.217/0.213	50	0.630/0.620
16	0.305/0.295	51	0.305/0.295
17	0.339/0.329	52	0.305/0.295
18	0.553/0.547	53	2.046/2.036
19	0.305/0.295	54	0.680/0.670
20	0.305/0.295	55	0.750/0.740
21	0.125/0.120	56	1.005/0.985
22	0.985/0.980	57	0.500/0.490
23	0.985/0.980	58	1.740/1.700
24	0.255/0.245	59	0.312/0.307
25	1.855/1.845	60	0.312/0.307
26	2.350/2.330	61	0.500/0.490
27	2.350/2.330	62	1.260/1.240
28	5.880/5.860	63	0.260/0.240
29	0.600/0.580	64	0.840/0.830
30	0.233/0.213	65	0.740/0.735
31	1.855/1.845	66	1.005/0.985
32	1.855/1.845	67	0.393/0.390
33	0.455/0.445	68	2.740/2.725
34	0.500/0.485	69	1.005/0.985
35	1.860/1.850	70	1.605/1.545



ORDERING INFORMATION

BASIC DASH MICRON
 P/N NO CODE
 F-4315-5P 10
 P = PASSIVATION
 - = NO PASSIVATION

* NOTE: 1. Material - "Microweave" wire mesh (304L CRES.)
 2. When passivation is specified, passivate mesh per AMS 2700 type 6

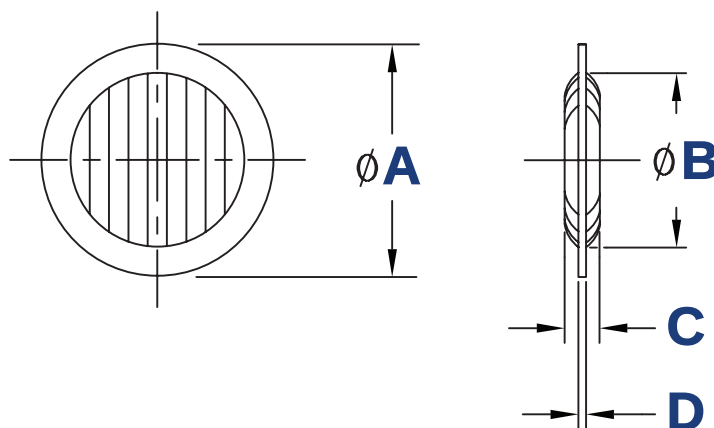
MICRON CODE	MICRON RATING	
	NOM.	ABS.
2X	2	10
2	2	15
5	5	18
10	10	25
20	20	40
40	40	75
75	75	/
100	100	/
200	200	/
250	250	/
300	300	/



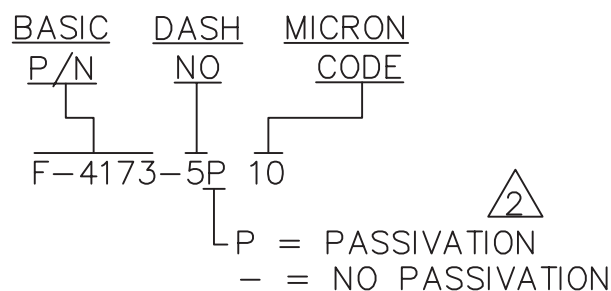
Pleated Disc Filter

F-4173

DASH NO.	A	B	C	D	APPROX. EFF. AREA IN ² (REF)
	+0.000 -0.010	±0.010	(REF)		
1	0.380	0.300	0.100	0.015	0.22
2	0.505	0.420	0.150	0.020	0.66
3	0.630	0.490	0.155	0.030	0.91
4	0.755	0.615	0.170	0.030	1.60
5	1.005	0.875	0.170	0.030	3.30
6	1.375	1.250	0.170	0.030	6.60
7	0.700	0.615	0.125	0.020	1.20
8	0.505	0.375	0.125	0.020	0.44
9	0.630	0.490	0.100	0.015	0.60
10	0.505	0.420	0.100	0.015	0.44
11	0.700	0.615	0.170	0.030	1.62
12	0.570	0.490	0.155	0.025	0.91
13	0.605	0.500	0.150	0.030	0.94
14	0.755	0.585	0.170	0.030	1.46
15	0.443	0.360	0.130	0.020	0.42
16	0.585	0.480	0.100	0.015	0.58
17	0.600	0.490	0.155	0.025	0.91
18	1.335	1.250	0.170	0.030	6.60
19	0.505	0.290	0.100	0.015	0.21
20	0.700	0.550	0.170	0.030	1.29
21	0.975	0.800	0.172	0.030	2.76
22	1.990	1.860	0.170	0.030	15.0
23	1.255	0.920	0.170	0.030	3.62
24	1.875	1.625	0.375	0.060	22.0
25	1.880	1.625	0.170	0.030	11.3
26	0.630	0.490	0.155	0.020	1.28
27	0.260	0.188	0.080	0.012	0.071
28	2.000	1.750	0.190	0.060	13.50
29	5.630	5.420	0.250	0.045	0.190
30	2.500	1.800	0.190	0.060	15.5
31	1.229	1.060	0.170	0.030	4.8
32	1.005	0.670	0.170	0.030	1.90
33	1.505	1.250	0.170	0.030	6.68
34	5.255	4.750	0.170	0.030	96.5
35	0.955	0.800	0.172	0.030	2.76
36	0.835	0.730	0.150	0.020	2.01
37	0.310	0.230	0.100	0.030	0.133
38	1.380	0.900	0.170	0.030	3.47
39	1.750	1.230	0.170	0.030	6.47
40	0.440	0.300	0.100	0.015	0.22
41	0.260	0.190	0.090	0.015	0.082
42	0.380	0.275	0.100	0.015	0.22
43	0.340	0.250	0.100	0.015	0.20
44	0.488	0.296	0.100	0.015	0.22
45	3.00	2.686	0.250	0.045	45.30
46	0.410	0.360	0.130	0.020	0.42



ORDERING INFORMATION



- * NOTE:
1. Material - "Microweave" wire mesh (304L CRES.)
 2. When passivation is specified, passivate mesh per AMS 2700 type 6

MICRON CODE	MICRON RATING	
	NOM.	ABS.
2X	2	10
2	2	15
5	5	18
10	10	25
20	20	40
40	40	75
75	75	/
100	100	/
200	200	/
250	250	/
300	300	/

Straight-in-Line 600 psi

A compact, lightweight, inline filter for reliable, economical filtration protection.

Positive Protection

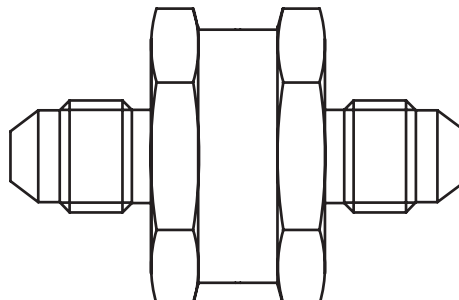
"Microweave" pleated element filters out contaminant particles as small as two microns (ten microns absolute).

Easily Recleaned

Back-flushing with solvent or other cleaning methods readily restores the useful life of the filter.

Element Material Withstands Extreme Temperatures and Corrosive Conditions

Suitable for virtually any fluid service at temperatures of -423°F to 800°F.



How to Order

EXAMPLE

BASIC MODEL

42

1

FILTRATION RATING

4210

2

MATERIALS

4210T

3

CONNECTIONS

4210T - 2MP

2

MATERIALS HOUSING

304 STAINLESS STEEL

CODE

T

(Please contact our Applications Engineer.)

1

FILTRATION RATING - MICRONS

NOMINAL	ABSOLUTE	CODE
2	10	2X
2	15	2
5	18	5
10	25	10
20	40	20
40	75	40
75	-	75
100	-	100
200	-	200
250	-	250
300	-	300

3

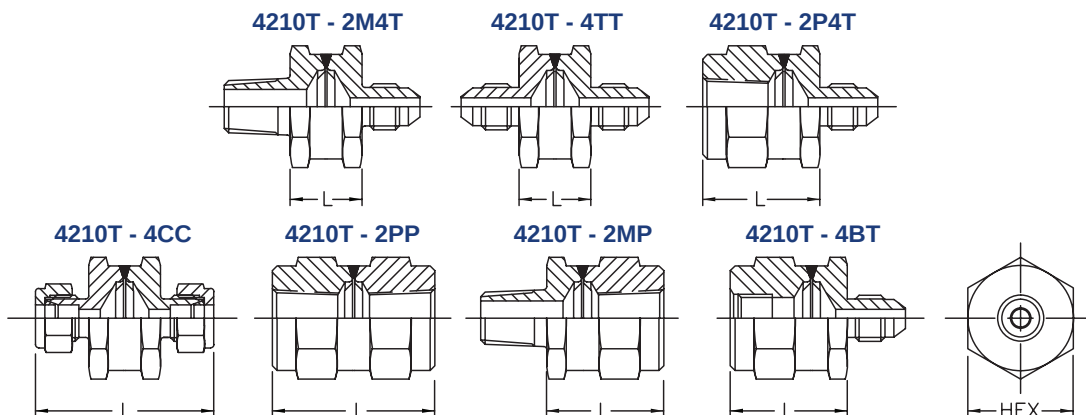
CONNECTIONS - (INLET/OUTLET)

SIZE	CODE	TYPE
Number indicates pipe size in 1/8" increments. Tube size in 1/16" increments. Example: 2P is 1/4" Female pipe. 4T is 1/4" Male Tube.	P -	Female Pipe
	M -	Male Pipe
	B -	Female Tube (MS33649)
	T -	Male Tube (MS33656)
	C -	Circle Lok Tube



4200 SERIES

Connection Combinations



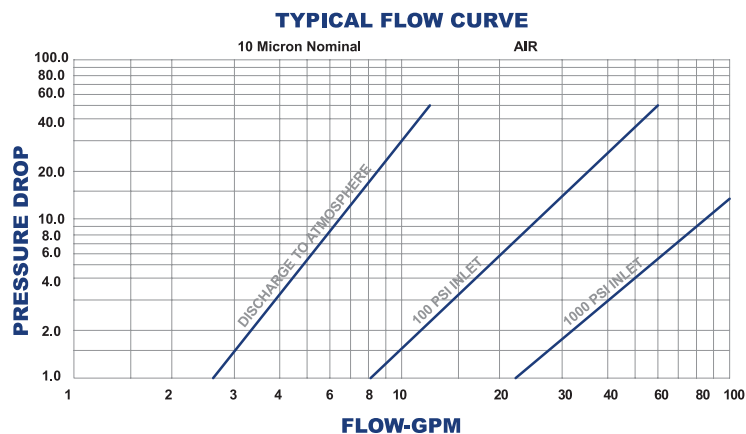
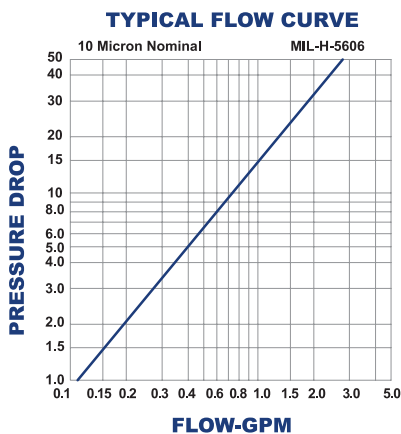
Any end connection combination consistent with hex size can be ordered. For end connections up to 3/8" straight thread and 1/4" NPT are rated to 6000 psi operating pressure.

Other connections up to 3/4" straight thread and 1/2" NPT are rated to 3000 psi operating pressure.

Circle Lok connections are limited to 3000 psi.

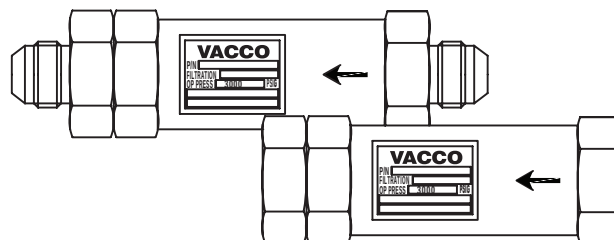
FILTER NUMBER	DIMENSION "L" (NOMINAL)	HEX	END CONNECTIONS		EFFECTIVE ELEMENT AREA
			INLET	OUTLET	
4210T - 2M4T	0.68	1.00	1/4" Male Pipe	1/4" Male Pipe	1.6 in ²
4210T - 4TT	0.68	1.00	1/4" Male Pipe	1/4" Male Pipe	1.6 in ²
4210T - 2P4T	1.10	1.00	1/4" Female Pipe	1/4" Male Pipe	1.6 in ²
4210T - 2MP	1.10	1.00	1/4" Male Pipe	1/4" Female Pipe	1.6 in ²
4210T - 4BT	1.10	1.00	1/4" Female Pipe	1/4" Male Pipe	1.6 in ²
4210T - 2PP	1.58	1.00	1/4" Female Pipe	1/4" Female Pipe	1.6 in ²
4210T - 2CC	2.02	1.00	1/8" Circle Lok	1/8" Circle Lok	1.9 in ²
4210T - 4CC	2.21	1.00	1/4" Circle Lok	1/4" Circle Lok	1.9 in ²
4210T - 6CC	2.37	1.00	3/8" Circle Lok	3/8" Circle Lok	1.9 in ²

Not recommended for pressure drop in excess of 50 psi.



Straight-in-Line 3000 psi

For moderately high pressure systems up to 3000 psi. Recleanable microweave stainless steel elements provide high strength to prevent collapse at severe differential pressure conditions. Filtration ratings as low as two microns nominal.



Technical Data

Proof Pressure 4,500 psig Housings..... 304 Stainless Steel AISI
Burst Pressure 7,500 psig

How to Order

EXAMPLE

		FILTER ASSEMBLY	REPLACEMENT ELEMENT
1	BASIC MODEL	43	415
	CONNECTION TYPE	43/25	
2	MATERIALS	4325G	415 G
3	FILTRATION RATINGS	4325G - 10	415-10
4	ELEMENT CONSTRUCTION	4325G - 10T	415G-10T
5	SEALS	4325G - 10TK	415G-10TK

1 BASIC MODEL NUMBER

CONNECTION TYPE	SIZE**	FILTER ASSEMBLY	REPLACEMENT ELEMENT
MS 33649	-4	4311	411
MS 33649	-6	4312	412
MS 33649	-8	4313	413
MS 33649	-10	4314	414
MS 33649	-12	4315	415
MS 33649	-16	4316	416
Pipe, Female(NPT)	1/8"	4322	412
Pipe, Female(NPT)	1/4"	4323	413
Pipe, Female(NPT)	3/8"	4324	414
Pipe, Female(NPT)	1/2"	4325	415
Pipe, Female(NPT)	3/4"	4326	416
MS 33656	-4	4341	411
MS 33656	-6	4342	412
MS 33656	-8	4343	413
MS 33656	-10	4344	414
MS 33656	-12	4345	415
MS 33656	-16	4346	416

**Other sizes available, Please contact our Applications Engineer.

2 MATERIALS

HOUSING	ELEMENT BOND	CODE
304 S.S.	Weld	G

3 FILTRATION RATING - MICRONS		
NOMINAL	ABSOLUTE	CODE
2	10	2X
2	15	2
5	18	5
10	25	10
20	40	20
40	75	40
75	-	75
100	-	100
200	-	200
250	-	250
300	-	300

4 ELEMENT CONSTRUCTION

MEDIA	MIN.COLLAPSE	CODE
Pleated Microweave	3250 psid	T

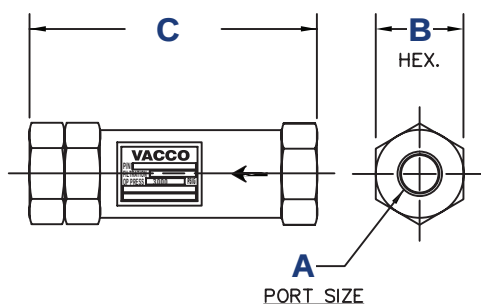
5 SEALS		
MATERIAL	TYPICAL SERVICES	CODE
Buna-N	General Purpose	L
	-65 °F to 225 °F	
Ethylene, Propylene	Skydrol, Air, Steam	E
	-65 °F to 300 °F	
Kalrez	Amines, Bases, Solvents	H
	-65 °F to 500 °F	
MIL-P-25732	Hydraulic or Pneumatic	K
	-65 °F to +275 °F	
Viton	Fuels, Aromatics	N
	-20 °F to +350 °F	



4300 SERIES

Dimensions and Flow Data

FEMALE PORTS



MODEL NUMBER	4311 -	4312 4322	4313 4323	4314 4324	4315 4325	4316 4326
A Tube (MS33649)	-4	-6	-8	-10	-12	-16
Pipe (NPT)	-	1/8"	1/4"	3/8"	1/2"	3/4"
B	1.000	1.500	1.500	2.000	2.000	2.375
C	4.810	4.750	6.000	6.440	7.750	8.750
Element Area (1)	8.5 in ²	15 in ²	25 in ²	40 in ²	60 in ²	95 in ²
Rated Flow (2)	1.2	3.5	6.0	10.5	16.0	29.0
Rated Flow (3)	15.0	40.0	75.0	150.0	195.0	450.0
Rated Flow (4)	75.0	210.0	375.0	750.0	1000.0	2500.0
Weight - lb	0.80	1.8	2.1	3.9	4.2	7.1

(1) Pleated Microweave

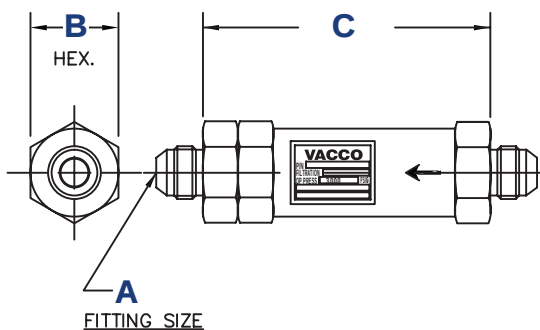
(2) Hydraulic Fluid per MIL-H-5606 @ 100 °F, gpm

(3) Air @ 100 psig, scfm

(4) Air @ 3000 psig, scfm

NOTE: Pressure Drop @ rated flow is less than 10 psid

MALE PORTS



MODEL NUMBER	4341	4342	4343	4344	4345	4346
A (MS33656)	-4	-6	-8	-10	-12	-16
B	1.000	1.500	1.500	2.000	2.000	2.375
C	4.120	4.250	5.500	5.810	7.000	8.250
Element Area (1)	8.5 in ²	15 in ²	25 in ²	40 in ²	60 in ²	95 in ²
Rated Flow (2)	1.2	3.5	6.0	10.5	16.0	29.0
Rated Flow (3)	15.0	40.0	75.0	150.0	195.0	450.0
Rated Flow (4)	75.0	210.0	375.0	750.0	1000.0	2500.0
Weight - lb	0.71	1.6	2.0	4.1	4.7	7.5

(1) Pleated Microweave

(2) Hydraulic Fluid per MIL-H-5606 @ 100 °F, gpm

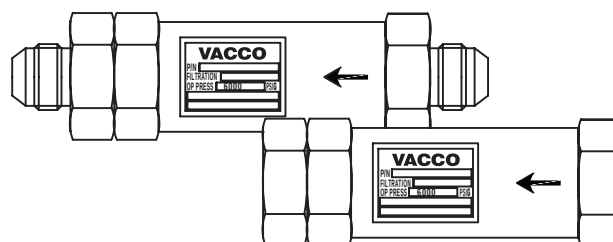
(3) Air @ 100 psig, scfm

(4) Air @ 3000 psig, scfm

NOTE: Pressure Drop @ rated flow is less than 10 psid

Straight-in-Line 6000 psi

For high pressure systems up to 6000 psi. Rugged 17 - 4 PH stainless steel housings. Recleanable microweave stainless steel elements provide high strength to withstand severe differential pressures condition and operate over extreme temperature ranges. Filtration ratings as low as two microns nominal.



Technical Data

Proof Pressure 9,000 psig Housings..... 17 - 4 PH Stainless Steel
Burst Pressure 24,000 psig

How to Order

1

BASIC MODEL

44

413

2

MATERIALS

4423G

413 G

3

FILTRATION RATINGS

4423G - 10

413-10

4

ELEMENT CONSTRUCTION

4423G - 10T

413G-10T

5

SEALS

4423G - 10TK

413G-10TK

1

BASIC MODEL NUMBER

CONNECTION TYPE	SIZE**	FILTER ASSEMBLY	REPLACEMENT ELEMENT
MS 33649	-4	4411	411
MS 33649	-6	4412	412
MS 33649	-8	4413	413
MS 33649	-10	4414	414
MS 33649	-12	4415	415
MS 33649	-16	4416	416
Pipe, Female(NPT)	1/8"	4422	412
Pipe, Female(NPT)	1/4"	4423	413
Pipe, Female(NPT)	3/8"	4424	414
Pipe, Female(NPT)	1/2"	4425	415
Pipe, Female(NPT)	3/4"	4426	416
MS 33656	-4	4441	411
MS 33656	-6	4442	412
MS 33656	-8	4443	413
MS 33656	-10	4444	414
MS 33656	-12	4445	415
MS 33656	-16	4446	416

2

MATERIALS

HOUSING

17-4 PH S.S.

ELEMENT BOND

Weld

CODE

G

3

FILTRATION RATING - MICRONS

NOMINAL	ABSOLUTE	CODE
2	10	2X
2	15	2
5	18	5
10	25	10
20	40	20
40	75	40
75	-	75
100	-	100
200	-	200
250	-	250
300	-	300

4

ELEMENT CONSTRUCTION

MEDIA	MIN.COLLAPSE	CODE
Pleated Microweave	3250 psid	T
Pleated Microweave	4500 psid	V

5

SEALS

MATERIAL	TYPICAL SERVICES	CODE
Buna-N	General Purpose	L
	-65 °F to 225 °F	
Ethylene, Propylene	Skydrol, Air, Steam	
	-65 °F to 300 °F	E
Kalrez	Amines, Bases, Solvents	
	-65 °F to 500 °F	H
MIL-P-25732	Hydraulic or Pneumatic	
	-65 °F to +275 °F	K
Viton	Fuels, Aromatics	
	-20 °F to +350 °F	N

**Other sizes available, Please contact our Applications Engineer.

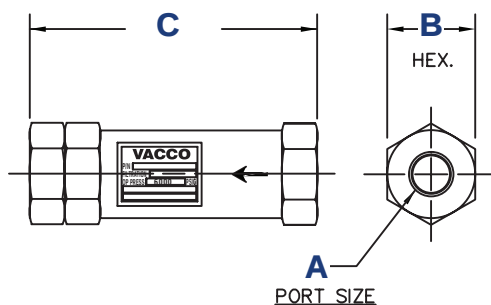
**Other sizes available, Please contact our Applications Engineer.



4400 SERIES

Dimensions and Flow Data

FEMALE PORTS



MODEL NUMBER		4411 -	4412 4422	4413 4423	4414 4424	4415 4425	4416 4426
A	Tube (MS33649)	-4	-6	-8	-10	-12	-16
	Pipe (NPT)	-	1/8"	1/4"	3/8"	1/2"	3/4"
B		1.000	1.500	1.500	2.000	2.000	2.250
C		4.810	4.750	6.000	6.440	7.750	8.750
Element Area (1)		8.5 in²	15 in²	25 in²	40 in²	60 in²	95 in²
Rated Flow (2)		1.2	3.5	6.0	10.6	16.0	29.0
Rated Flow (3)		15.0	40.0	75.0	150.0	195.0	450.0
Rated Flow (4)		75.0	210.0	375.0	750.0	1000.0	2500.0
Weight - lb		0.80	1.8	2.1	3.9	4.2	7.1

(1) Pleated Microweave

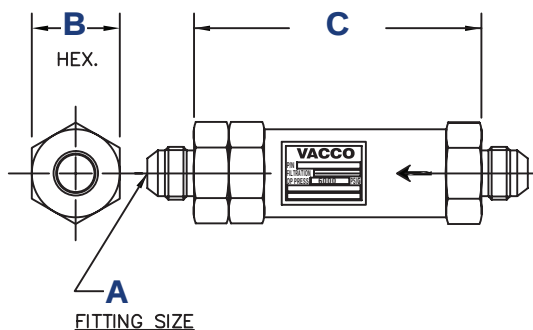
(2) Hydraulic Fluid per MIL-H-5606 @ 100°F, gpm

(3) Air @ 100 psig, scfm

(4) Air @ 3000 psig, scfm

NOTE: Pressure Drop @ rated flow is less than 10 psid

MALE PORTS



MODEL NUMBER	4441	4442	4443	4444	4445	4446
A (MS33656)	-4	-6	-8	-10	-12	-16
B	1.250	1.500	1.500	2.000	2.000	2.250
C	4.120	4.250	5.500	5.810	7.000	8.380
Element Area (1)	8.5 in ²	15 in ²	25 in ²	40 in ²	60 in ²	95 in ²
Rated Flow (2)	1.2	3.5	6.0	10.6	16.0	29.0
Rated Flow (3)	15.0	40.0	75.0	150.0	195.0	450.0
Rated Flow (4)	75.0	210.0	375.0	750.0	1000.0	2500.0
Weight - lb	0.71	1.6	2.0	4.1	4.7	7.5

(1) Pleated Microweave

(2) Hydraulic Fluid per MIL-H-5606 @ 100°F, gpm

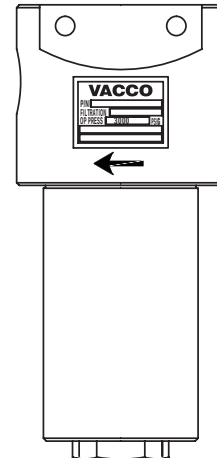
(3) Air @ 100 psig, scfm

(4) Air @ 3000 psig, scfm

NOTE: Pressure Drop @ rated flow is less than 10 psid

Tee Type Filter Single Stage 3000 psi

Single Stage 4500 Series filters are available with either recleanable microweave or depth-type sintered fiber media.



How to Order

EXAMPLE			
	FILTER ASSEMBLY	REPLACEMENT ELEMENT	
1 BASIC MODEL	45	586	
2 CONNECTION TYPE	4586		
3 MATERIALS	4586A	586 A	
4 FILTRATION RATINGS	4586A -10	586A-10	
5 ELEMENT CONSTRUCTION	4586A -10A	586-10A	
6 SEALS	4586A -10AL	586A-10AL	
7 ACCESSORIES	4586A -10AL-V	586A-10AL	

1 BASIC MODEL NUMBER	
CONNECTION TYPE	SIZE**
Pipe, Female	1/2"
Pipe, Female	1/2"
Pipe, Female	3/4"
Pipe, Female	3/4"
Tube, Female(SAE)	3/4"
Tube, Female(SAE)	3/4"
Tube, Female(SAE)	1"
Pipe, Female	1"
Pipe, Female	1 1/4"

2 MATERIALS	
HOUSING	ELEMENT BOND
Aluminum	Epoxy
Aluminum	Weld

3 FILTRATION RATING - MICRONS	
NOMINAL	ABSOLUTE
1	3
2	5
2	10
2	15
5	18
10	25
20	40
40	75
75	-
100	-
200	-
250	-
300	-

4 ELEMENT CONSTRUCTION	
MEDIA	MIN.COLLAPSE
Pleated Microweave	150 psid
Pleated Microweave	3250 psid
Pleated Microweave	4500 psid

5 SEALS	
MATERIAL	TYPICAL SERVICES
Buna-N	General Purpose
Ethylene, Propylene	Skydrol, Air, Steam
MIL-P-25732	Hydraulic or Pneumatic
Viton	Fuels, Aromatics

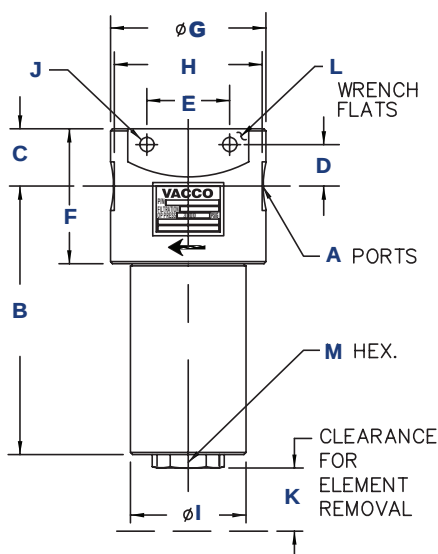
6 ACCESSORIES - (See Optional)	
S = ΔP Ports (1/8"NPT)	V = Visual ΔP Indicator
R = Bypass Relief Valve	TE = ΔP Electrical Indicator

**Other sizes available, Please contact our Applications Engineer.



4500 SERIES

Dimensions and Flow Data



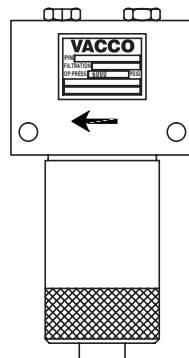
Model Number	4535 4575	4585 4595	4536 -----	4586 4576	4587 -----	4588 -----
A	1/2" NPT 3/4" SAE	1/2" NPT 3/4" SAE	3/4" NPT -----	3/4" NPT 1" SAE	1" NPT -----	1 1/4" NPT -----
B	6.47	8.35	8.33	9.07	9.60	12.10
C	1.38	1.38	1.38	1.38	1.87	1.87
D	1.00	1.00	1.00	1.00	1.37	1.37
E	2.00	2.00	2.00	2.00	2.25	2.25
F	3.25	3.25	3.25	3.25	4.25	4.25
G	3.75	3.75	3.75	3.75	5.00	5.00
H	3.38	3.38	3.38	3.38	4.42	4.42
I	2.78	2.78	2.78	2.78	3.40	3.40
J	0.345	0.345	0.345	0.345	0.406	0.406
K	4.80	6.70	6.70	7.40	7.37	9.87
L	2.75	2.75	2.75	2.75	4.00	4.00
M	1.50	1.50	1.50	1.50	1.50	1.50

Hydraulic Fluid per MIL-H-5605 @ 100 °F gpm

ELEMENTS	PRESSURE DROP	4535 4574	4585 4595	4536 -----	4586 4576	4587 -----	4588 -----
10μ nom. microweave	10 psi max.	16.0	16.0	24.0	30.0	43.0	65.0
10μ nom. sintered fiber	10 psi max.	10.5	16.0	20.0	24.0	35.0	50.0
3μ abs. sintered fiber	10 psi max.	5.0	6.5	8.0	12.0	16.0	24.0
10μ nom. sintered fiber 10μ nom. microweave	10 psi max.	8.0	10.0	14.0	18.0	-	-
3μ abs. sintered fiber 15μ abs. microweave	10 psi max.	4.0	5.0	6.0	8.0	-	-
Weight-lb	(single stage with sintered fiber element)	4.0	4.5	4.5	5.0	9.25	10.5

Tee Type Filter Single Stage 3000 psi / 6000 psi

Element can easily be removed for cleaning or replacement without disturbing line connections. Ports provided in head for differential pressure indicator installation. Indicators available as optional equipment.



Technical Data

4700 Series

Proof Pressure 4,500 psig
Burst Pressure 12,000 psig

4800 Series

Proof Pressure 9,000 psig
Burst Pressure 24,000 psig

How to Order

EXAMPLE

		FILTER ASSEMBLY	REPLACEMENT ELEMENT
1	BASIC MODEL	47	416
	CONNECTION TYPE	4715	
2	MATERIALS	4715G	416 G
3	FILTRATION RATINGS	4715G-10	416G-10
4	ELEMENT CONSTRUCTION	4715G-10T	416G-10T
5	SEALS	4715G-10TK	416G-10TK
6	ACCESSORIES	4715G-10TK-T	416G-10TK

1 BASIC MODEL NUMBER

4700 / 4800 Series CONNECTION TYPE	SIZE**	FILTER ASSEMBLY		REPLACEMENT ELEMENT
		4700 Series	4800 Series	
MS 33649	-6	4712	4812	413
MS 33649	-8	4713	4813	414
MS 33649	-12	4715	4815	416
Pipe, Female	1/4"	4723	4823	414
Pipe, Female	1/2"	4725	4825	416

**Other sizes available, Please contact our Applications Engineer.

2 MATERIALS HOUSING

Stainless Steel

ELEMENT BOND
Weld

CODE
G

3 FILTRATION RATING - MICRONS

NOMINAL	ABSOLUTE	CODE
1	3	X3
2	5	X4
2	10	2X
2	15	2
5	18	5
10	25	10
20	40	20
40	75	40
75	-	75
100	-	100
200	-	200
250	-	250
300	-	300

4 ELEMENT CONSTRUCTION

MEDIA	MIN. COLLAPSE	CODE
Pleated Microweave	3250 psid	T
Pleated Microweave	4500 psid	V*

*4800 Series only

5 SEALS MATERIAL

TYPICAL SERVICES	CODE
Buna-N	L
General Purpose	
-65 °F to 225 °F	
MIL-P-25732	
Hydraulic or Pneumatic	
-65 °F to +275 °F	K
Viton	
Fuels, Aromatics	
-20 °F to +350 °F	N

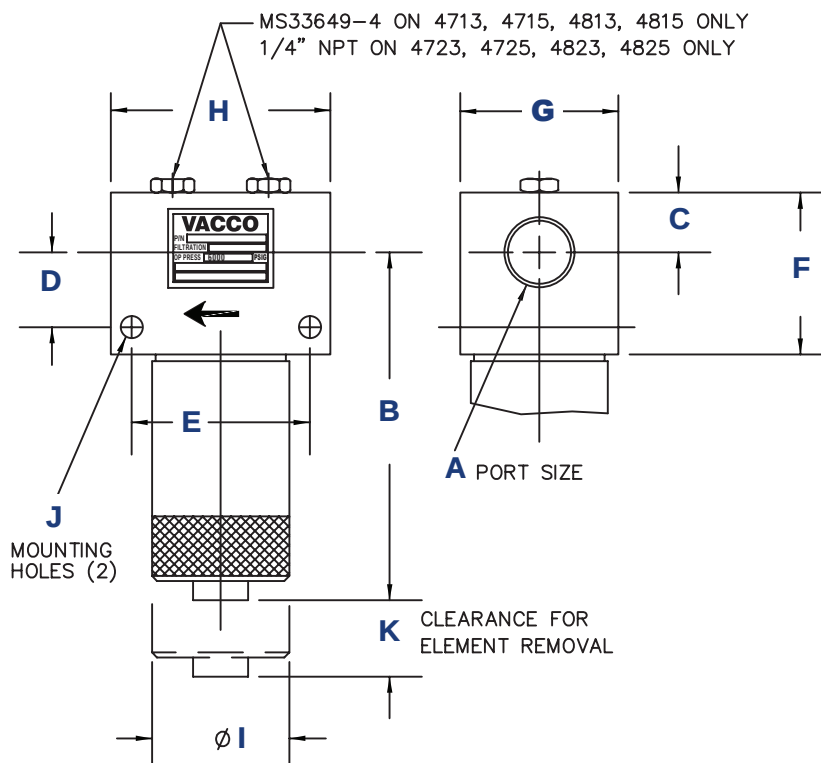
6 ACCESSORIES - (See Optional)

T = ΔP Indicator TE = ΔP Electrical Indicator
R = Bypass Relief Valve



4700 / 4800 SERIES

Dimensions and Flow Data



Model Number		4712	4713 4723	4715 4725
		4812	4813 4823	4815 4825
A	Tube	MS33656-6	MS33619-8	MS33619-12
	Pipe	-	1/4" NPT	1/2" NPT
B		5.44	5.61	7.92
C		1.03	.87	1.07
D		-	.77	1.38
E		1.75	3.00	3.25
F		2.45	2.45	2.95
G		2.00	2.45	2.95
H		2.46	3.62	4.00
I		1.50	2.00	2.50
J		.265	.265	.406
K		4.0	4.0	6.0
Weight lb		4.9	7.5	13.2

Element Area (1)	25 in ²	40 in ²	100 in ²
Rated Flow (2)	3.5	6.0	16.0
Rated Flow (3)	40.0	75.0	195.0
Rated Flow (4)	210.0	375.0	1000.0

(1) Pleated Microweave

(2) Hydraulic Fluid per MIL-H-5606 @100 °F - gpm

(3) Air @ 100 psig, scfm

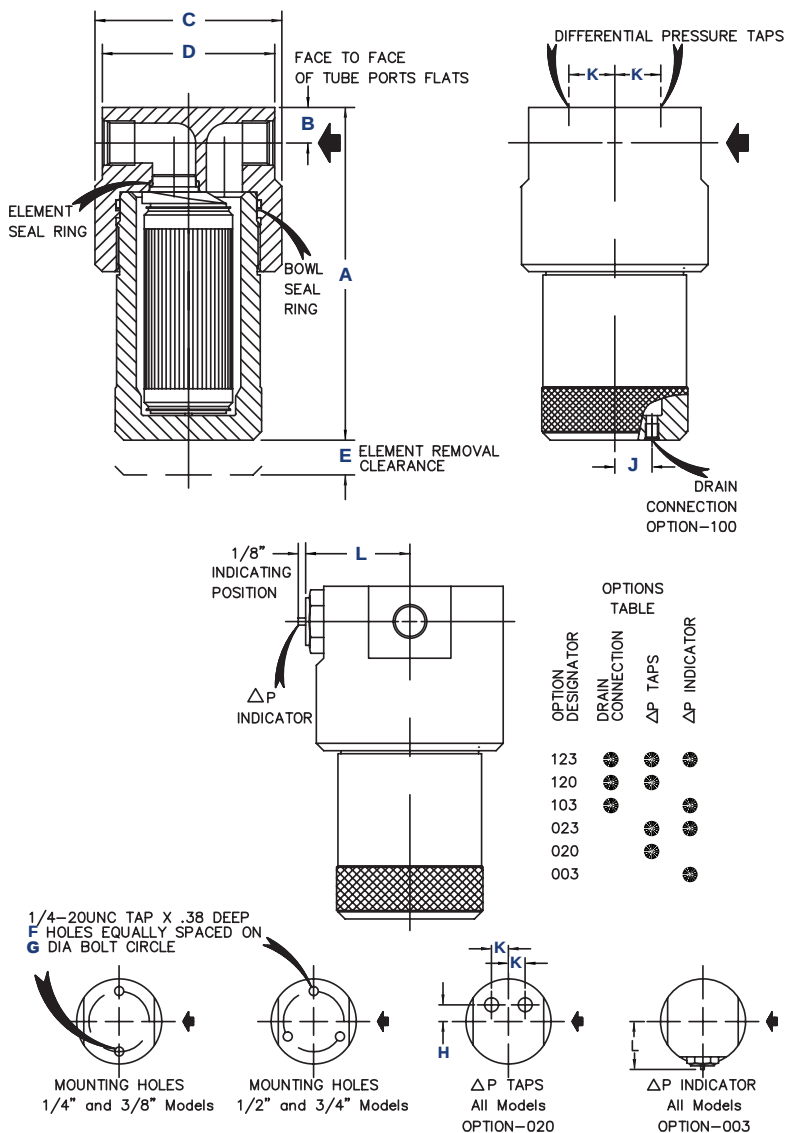
(4) Air @ 3000 psig, scfm

NOTE: Pressure drop @ rated flow is less than 10 psi.



WFR SERIES

Dimensions and Flow Data



INSTALLATION AND SERVICING

The filter has been leak checked, and is ready for installation. WFR series filters may be mounted in any position and are supported by the connecting piping or by means of mounting holes shown at left. The element is cleanable by reverse flushing. The filter bowl should be removed and replaced by hand only.

NOTES

1. Replacement seal kits shown are for standard models only (without Δ P Indicator). To order seal kit for models with Δ P Indicator, specify filter part number shown on nameplate.
2. Replacement seal kits contain all seals. Replacement elements are delivered complete with all seals.

REPLACEMENT SEAL KITS

Buna-N	Teflon	Butyl	Viton
WSR-1-4	WSR-2-4	WSR-3-4	WSR-4-4
WSR-1-6	WSR-2-6	WSR-3-6	WSR-4-6
WSR-1-8	WSR-2-8	WSR-3-8	WSR-4-8
WSR-1-12	WSR-2-12	WSR-3-12	WSR-4-12

SIZE	PART NUMBER	FILTER AREA (in ²)	C _v	APPROX. WEIGHT (lb)	REPL. ELEMENT	A MAX.	B	C	D	E	F	G	H	J	K	L
1/4	WFR□-□-4PP	23	0.5	2.0	WFR□-□-4	3.4	0.38	2.00	-	1.88	2	1.25	0.44	-	3/8	-
	WFR□-□-4BB								1.84							
3/8	WFR□-□-6PP	50	1.3	4.5	WFR□-□-6	4.75	0.50	2.50	-	2.50	2	1.75	0.34	0.31	3/8	-
	WFR□-□-6BB								2.34							
1/2	WFR□-□-8PP	75	2.6	8.0	WFR□-□-8	6.05	0.62	3.25	-	3.25	3	2.25	0.44	0.50	5/8	2.03
	WFR□-□-8BB								3.00							
3/4	WFR□-□-12PP	150	7.0	12.0	WFR□-□-12	7.40	0.75	4.00	-	4.00	3	2.50	0.59	0.50	5/8	2.41
	WFR□-□-12BB								3.68							

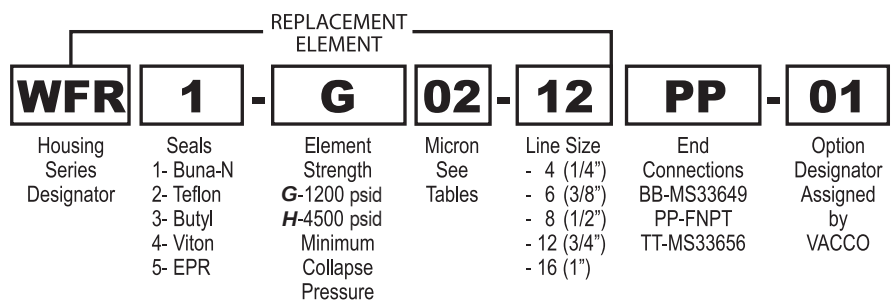
ELEMENT STRENGTH AND MICRON RATING

SEAL MATERIAL

Material Other materials available on special order



DESIGNATOR	FILTER RATING MICRONS	
	NOMINAL	ABSOLUTE
02	2	14
05	5	18
10	10	25
17	17	45
40	40	70
74	74	105
104	104	150
140	140	225
150	150	240



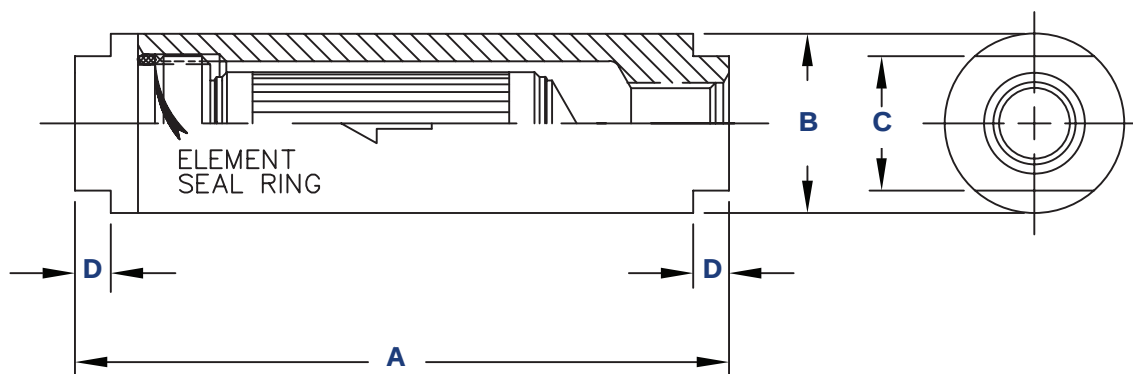


WFL SERIES

Dimensions and Flow Data

REPLACEMENT SEAL KITS				
Buna-N	Teflon	Butyl	Viton	ERP
WSL-1-4	WSL-2-4	WSL-3-4	WSL-4-4	WSL-5-4
WSL-1-6	WSL-2-6	WSL-3-6	WSL-4-6	WSL-5-6
WSL-1-8	WSL-2-8	WSL-3-8	WSL-4-8	WSL-5-8
WSL-1-12	WSL-2-12	WSL-3-12	WSL-4-12	WSL-5-12
WSL-1-16	WSL-2-16	WSL-3-16	WSL-4-16	WSL-5-16

BB STYLE AND MS33649 PORTS

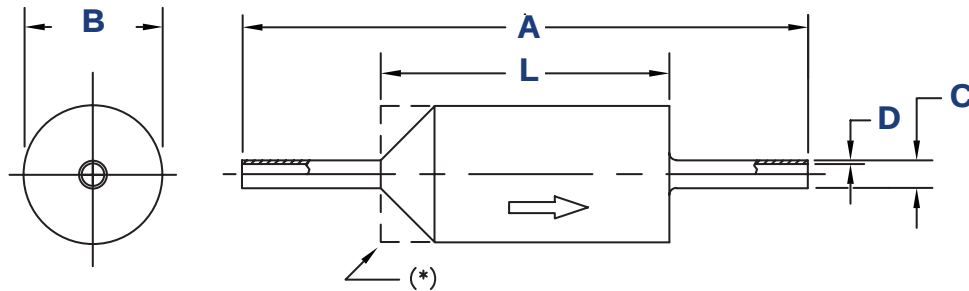


SIZE	PART NUMBER	FILTER AREA (in ²)	C _v	APPROX. WEIGHT (lb)	REPLACEMENT ELEMENT	FEMALE TUBE BB			
						A	B	C	D
1/4	WFL□-□-4BB	6	0.74	0.5	WL-□-4B	3.65	1.00	.75	0.20
3/8	WFL□-□-6BB	18	1.3	1.5	WL-□-6B	4.60	1.75	1.50	0.20
1/2	WFL□-□-8BB	30	3.2	2.2	WL-□-8B	5.75	1.75	1.50	0.20
3/4	WFL□-□-12BB	55	8.0	5.0	WL-□-12B	7.30	2.25	2.00	0.30
1	WFL□-□-12BB	125	12.0	7.0	WL-□-16B	10.61	2.62	2.25	0.50

ELEMENT STRENGTH
AND MICRON RATING

SEAL MATERIAL

Space Qualified Tube Stub Filters



Configurations

VACCO P/N	DIMENSIONS					TUBE STUBS INLET/OUTLET	OP. PRESS. psig	PROOF psig	FILTRATION MICRON	MAX. CLEAN ΔP		W/FLUID TYPE	FLUID COMPATIBILITY	WEIGHT (lb)
	A	B	C	D	L					FLOW RATE	psid			
14241-589	5.10	1.30	0.50	0.035	2.50	Ø.500/Ø.500	450	1650	20	1.1 lb/sec	13.0	J	I, U	0.70
14911-501 *	7.00	3.04	0.50	0.035	4.00	Ø.500/Ø.500	325	600	40	0.70 lb/sec	2.0	J	D,E,G,I,O,U	3.00
15122-503	4.75	1.25	0.25	0.020	2.25	Ø.250/Ø.250	1050	1575	70	0.166 lb/min	4.0	K	D,E,H	0.33
15228-579	7.00	3.04	0.50	0.035	4.00	Ø.500/Ø.500	400	900	25	0.70 lb/sec	2.0	J	D,E,G,I,O,U	3.00
15228-595	4.72	1.25	0.25	0.020	2.00	Ø.250/Ø.250	377	566	10	0.166 lb/min	1.0	J	I, U	0.33
15228-601	5.10	1.25	0.25	0.028	2.60	Ø.250/Ø.250	250	375	25	0.22 lb/sec	5.0	F	D,E,G,H	0.55
15228-610	5.10	1.25	0.25	0.028	2.60	Ø.250/Ø.250	265	375	25	0.15 lb/sec	0.5	J	I, U	0.35
15241-508	8.15	0.87	0.625	0.016	5.65	Ø.625/Ø.625	250	500	18	0.44 lb/sec	0.5	J	D, E, H, I, U	0.19
15241-509	8.15	0.87	0.625	0.016	5.65	Ø.625/Ø.625	250	500	18	0.22 lb/sec	0.5	J	D, E, H, I, U	0.19
15241-525	6.75	1.25	0.504	0.025	4.50	Ø.504/Ø.504	181	375	15	0.48 lb/sec	0.5	F	D,E,G,H	0.30
15241-573 *	5.33	1.25	0.25	0.016	2.20	Ø.250/Ø.250	600	900	15	0.015 lb/sec	3.0	J	F, I, U	0.33
15241-579	7.25	1.38	0.625	0.020	5.75	Ø.625/Ø.625	195	590	25	0.50 lb/sec	0.5	F	S, T, Z	0.40
15241-580	5.50	1.38	0.625	0.020	4.00	Ø.625/Ø.625	195	590	25	0.3 lb/sec	0.5	I	E, J, S, T, U	0.40
15241-647	6.25	1.25	0.25	0.016	3.00	Ø.250/Ø.250	600	1002	15	0.05 lb/sec	1.0	J	I, U	0.40
15241-669 *	5.28	1.25	0.251	0.016	2.20	Ø.251/Ø.251	609	914	15	0.0154 lb/sec	2.9	J	I, U	0.33
15241-686	5.85	1.25	0.25	0.028	3.50	Ø.250/Ø.250	540	1100	15	0.35 lb/sec	6.0	J	I, U	0.50
15241-693 *	5.23	1.25	0.25	0.020	2.38	Ø.250/Ø.250	450	675	15	0.02 lb/sec	1.0	J	B, D, E, I, U	0.29
15241-704	5.85	1.00	0.187	0.020	2.00	Ø.187/Ø.187	500	1000	18	0.03 lb/sec	0.5	J	I, U	0.35
15241-722	6.20	1.75	0.250	0.016	3.20	Ø.250/Ø.250	600	900	10	0.04 lb/sec	2.0	J	I, U	0.28
15267-602	7.00	3.04	0.50	0.035	4.00	Ø.500/Ø.500	400	900	10	0.70 lb/sec	2.0	U	I, J	3.00
15267-627-1	6.80	1.53	0.250	0.028	3.30	Ø.250/Ø.250	400	900	10	0.02 lb/sec	0.5	J	B, D, E, O	0.40
15267-632	6.32	1.35	0.540	0.046	4.60	Ø.540/Ø.540	380	2000	10	0.66 lb/sec	5.0	U	I, J	0.88
15267-636	5.50	0.90	0.250	0.028	3.00	Ø.250/Ø.250	3000	4500	10	0.0186 lb/sec	1.0	D	E, I, J, U	0.65
15267-642-1 *	6.00	1.53	0.250	0.028	3.00	Ø.250/Ø.250	400	900	10	0.075 lb/sec	2.0	D	E, I, J, U	0.50
15267-642-2 *	6.00	1.53	0.250	0.028	3.00	Ø.250/Ø.250	400	900	10	0.075 lb/sec	2.0	D	E, I, J, U	0.50
15267-650	4.06	1.25	0.750	0.028	4.20	Ø.750/Ø.750	400	750	10	1.0 lb/sec	3.0	U	I, J	0.70
15267-653 *	6.00	1.53	0.250	0.035	3.00	Ø.350/Ø.350	602	903	10	6.0 lb/min	3.0	U	D, I, J	0.55
15267-654	8.80	1.25	0.250	0.035	5.80	Ø.350/Ø.350	4000	4500	10	135 scfm	0.5	E	D	1.90
15312-501-1	6.00	1.50	0.375	0.035	3.00	Ø.375/Ø.375	400	900	25	0.075 lb/sec	2.0	J	D,E,I,U	0.75

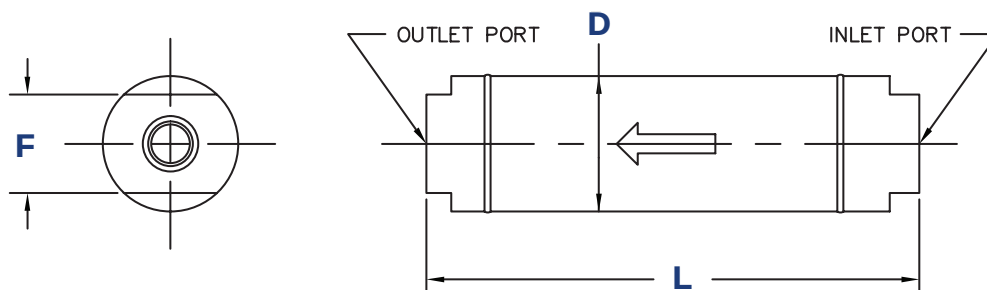
NOTE: (*) Rectangular Type Configuration

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - GO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				



Space Qualified Inline Filters



Configurations

VACCO P/N	DIMENSIONS			$\triangle$ 1	PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	FILTRATION MICRON	FLOW RATE @ 70 °F MAX. ΔP			FLUID COMPATIBILITY	WEIGHT (lb)
	L	D	F						GN ₂	WATER	psid		
14288 - 633 - 1	5.00	1.62	1.25	T	MC240 - 4	6000	9000	10	100 scfm	1.5 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 2	5.00	1.62	1.25	T	MC240 - 6	6000	9000	10	300 scfm	5 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 3	5.00	1.62	1.25	T	MC240 - 8	6000	9000	10	500 scfm	10 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 4	6.25	2.50	2.00	T	MC240 - 12	6000	9000	10	1200 scfm	20 gpm	12	B,D,E,G,K,O,V	5.65
14288 - 633 - 5	6.25	2.50	2.00	T	MC240 - 16	5300*	7950*	10	2000 scfm	40 gpm	12	B,D,E,G,K,O,V	5.65
14288 - 633 - 6	8.00	3.50	3.25	T	MC240 - 20	5200*	7800*	10	3200 scfm	65 gpm	12	B,D,E,G,K,O,V	14.30
14288 - 633 - 7	8.00	3.50	3.25	T	MC240 - 24	4600*	6900*	10	4200 scfm	100 gpm	12	B,D,E,G,K,O,V	14.30
14288 - 633 - 8	5.00	1.75	1.25	T	MC240 - 4	6000	9000	10	100 scfm	1.5 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 9	5.00	1.75	1.25	T	MC240 - 6	6000	9000	10	300 scfm	5 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 10	5.00	1.75	1.25	T	MC240 - 8	6000	9000	10	500 scfm	10 gpm	12	B,D,E,G,K,O,V	2.10
14288 - 633 - 11	6.25	2.75	2.00	T	MC240 - 12	6000	9000	10	1200 scfm	20 gpm	12	B,D,E,G,K,O,V	5.65
14288 - 633 - 12	6.25	2.75	2.00	T	MC240 - 16	5300*	7950*	10	2000 scfm	40 gpm	12	B,D,E,G,K,O,V	5.65
14288 - 633 - 13	8.00	3.75	3.25	T	MC240 - 20	5200*	7800*	10	3200 scfm	65 gpm	12	B,D,E,G,K,O,V	14.30
14288 - 633 - 14	8.00	3.75	3.25	T	MC240 - 24	4600*	6900*	10	4200 scfm	100 gpm	12	B,D,E,G,K,O,V	14.30
14288 - 634 - 1	5.00	1.37	1.00	T	MC240 - 4	400	600	10	6 scfm	1.5 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 2	5.00	1.37	1.00	T	MC240 - 6	400	600	10	20 scfm	5 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 3	5.00	1.37	1.00	T	MC240 - 8	400	600	10	35 scfm	10 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 4	6.25	1.87	1.67	T	MC240 - 12	400	600	10	80 scfm	20 gpm	12	B,D,E,G,K,O,V	1.90
14288 - 634 - 5	6.25	1.87	1.67	T	MC240 - 16	400	600	10	150 scfm	40 gpm	12	B,D,E,G,K,O,V	1.90
14288 - 634 - 6	8.00	2.50	2.18	T	MC240 - 20	400	600	10	250 scfm	65 gpm	12	B,D,E,G,K,O,V	3.50
14288 - 634 - 7	8.00	2.50	2.18	T	MC240 - 24	400	600	10	375 scfm	100 gpm	12	B,D,E,G,K,O,V	3.50
14288 - 634 - 8	5.00	1.37	1.00	T	MC240 - 4	400	600	10	6 scfm	1.5 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 9	5.00	1.37	1.00	T	MC240 - 6	400	600	10	20 scfm	5 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 10	5.00	1.37	1.00	T	MC240 - 8	400	600	10	35 scfm	10 gpm	12	B,D,E,G,K,O,V	1.25
14288 - 634 - 11	6.25	1.87	1.67	T	MC240 - 12	400	600	10	80 scfm	20 gpm	12	B,D,E,G,K,O,V	1.90
14288 - 634 - 12	6.25	1.87	1.67	T	MC240 - 16	400	600	10	150 scfm	40 gpm	12	B,D,E,G,K,O,V	1.90
14288 - 634 - 13	8.00	2.50	2.18	T	MC240 - 20	400	600	10	250 scfm	65 gpm	12	B,D,E,G,K,O,V	3.50
14288 - 634 - 14	8.00	2.50	2.18	T	MC240 - 24	400	600	10	375 scfm	100 gpm	12	B,D,E,G,K,O,V	3.50

NOTE: Unless Otherwise Specified

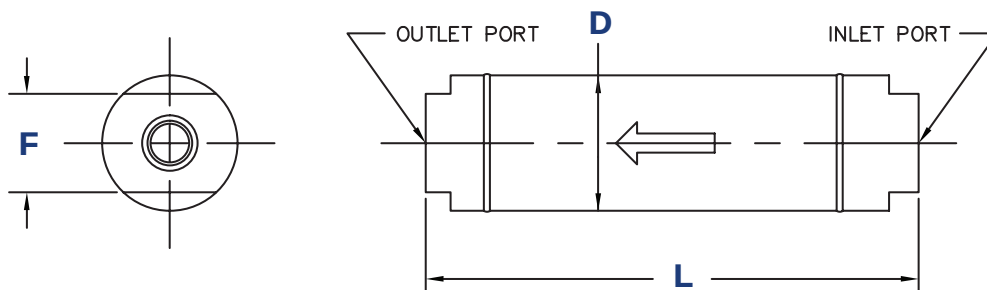
* Max. allowable pressures are dictated by NASA's limits on tube fittings

- 1 Housing Construction
T - Two Piece Threaded Housing
W - One Piece Welded Housing

FLUID TYPE CODE

A - Air B - Water C - Hydraulic Oil D - GN₂ E - GHe F - N₂O₄ G - Freon H - DI H₂O I - MMH J - UDMH
K - GO₂ L - Skydrol M - JP - 4&5 N - Fluorine O - Alcohol P - MIL-L-7808 Q - MIL-H-8446 R - MIL-H-5606 S - LO₂ T - LH₂
U - N₂H₄ V - GH₂ W - RFNA X - WFNA Y - CTFE Z - LHe

Space Qualified Inline Filters



Configurations

VACCO P/N	DIMENSIONS			2	PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	FILTRATION MICRON	FLOW RATE @ 70 °F MAX. ΔP			FLUID COMPATIBILITY	WEIGHT (lb)
	L	D	F						GN ₂	WATER	psid		
A 14288 - 635 - 1	5.00	1.37	1.00	W	MC240 - 4	400	600	10	6 scfm	1.5 gpm	12	D, E, F, K, S	1.25
A 14288 - 635 - 2	5.00	1.37	1.00	W	MC240 - 6	400	600	10	20 scfm	5 gpm	12	D, E, F, K, S	1.25
A 14288 - 635 - 3	5.00	1.37	1.00	W	MC240 - 8	400	600	10	35 scfm	10 gpm	12	D, E, F, K, S	1.25
A 14288 - 635 - 4	6.25	1.87	1.67	W	MC240 - 12	400	600	10	80 scfm	20 gpm	12	D, E, F, K, S	1.90
A 14288 - 635 - 5	6.25	1.87	1.67	W	MC240 - 16	400	600	10	150 scfm	40 gpm	12	D, E, F, K, S	1.90
A 14288 - 635 - 6	8.00	2.50	2.18	W	MC240 - 20	400	600	10	250 scfm	65 gpm	12	D, E, F, K, S	3.50
A 14288 - 635 - 7	8.00	2.50	2.18	W	MC240 - 24	400	600	10	375 scfm	100 gpm	12	D, E, F, K, S	3.50
B 14288 - 635 - 8	5.00	1.37	1.00	W	MC240 - 4	400	600	10	6 scfm	1.5 gpm	12	D, E, F, I, O, T, V	1.25
B 14288 - 635 - 9	5.00	1.37	1.00	W	MC240 - 6	400	600	10	20 scfm	5 gpm	12	D, E, F, I, O, T, V	1.25
B 14288 - 635 - 10	5.00	1.37	1.00	W	MC240 - 8	400	600	10	35 scfm	10 gpm	12	D, E, F, I, O, T, V	1.25
B 14288 - 635 - 11	6.25	1.87	1.67	W	MC240 - 12	400	600	10	80 scfm	20 gpm	12	D, E, F, I, O, T, V	1.90
B 14288 - 635 - 12	6.25	1.87	1.67	W	MC240 - 16	400	600	10	150 scfm	40 gpm	12	D, E, F, I, O, T, V	1.90
B 14288 - 635 - 13	8.00	2.50	2.18	W	MC240 - 20	400	600	10	250 scfm	65 gpm	12	D, E, F, I, O, T, V	3.50
B 14288 - 635 - 14	8.00	2.50	2.18	W	MC240 - 24	400	600	10	375 scfm	100 gpm	12	D, E, F, I, O, T, V	3.50
C 14288 - 635 - 15	5.00	1.37	1.00	W	MC240 - 4	400	600	10	6 scfm	1.5 gpm	12	D, E, G	1.25
C 14288 - 635 - 16	5.00	1.37	1.00	W	MC240 - 6	400	600	10	20 scfm	5 gpm	12	D, E, G	1.25
C 14288 - 635 - 17	5.00	1.37	1.00	W	MC240 - 8	400	600	10	35 scfm	10 gpm	12	D, E, G	1.25
C 14288 - 635 - 18	6.25	1.87	1.67	W	MC240 - 12	400	600	10	80 scfm	20 gpm	12	D, E, G	1.90
C 14288 - 635 - 19	6.25	1.87	1.67	W	MC240 - 16	400	600	10	150 scfm	40 gpm	12	D, E, G	1.90
C 14288 - 635 - 20	8.00	2.50	2.18	W	MC240 - 20	400	600	10	250 scfm	65 gpm	12	D, E, G	3.50
C 14288 - 635 - 21	8.00	2.50	2.18	W	MC240 - 24	400	600	10	375 scfm	100 gpm	12	D, E, G	3.50
C 14288 - 635 - 22	10.00	1.87	1.67	T	MC240 - 12	90	135	10		2.7 gpm	12	D, E, G	2.70
14241 - 563	6.00	1.38	1.38	T	MC240 - 12	750	1,125	25	2,500 scfm		30	E	1.50
14241 - 564	6.00	1.62	1.62	T	MC240 - 8	3,200	4,800	25	0.8 lb/sec		25	A, D	3.00
14241 - 573	4.20	1.50	1.50	T	1/4 AMCO tube	10,000	20,000	18	0.03 lb/sec		15	E	2.15
14241 - 593	8.00	1.87	1.62	W	1/4 AMCO tube	400	600	20	125 scfm	20 gpm	9	B, D, E, G	*
14267 - 588	5.18	1.87	1.87	T	MC240 - 6	3,200	4,800	10	0.1 lb/sec		3	D	2.75
14328 - 502	5.18	1.87	1.87	T	MC240 - 12	3,200	4,800	175	1.60 lb/sec		325	A, D, E	2.40
14903 - 503 - 1	10.00	3.22	3.38	T	MC240 - 16	4,000	6,000	5		29 gpm	36	A, B, D, E	*
14903 - 503 - 2	15.80	3.97	3.00	T	MC240 - 24	4,000	6,000	5		65 gpm	36	A, B, D, E	*
15228 - 591	5.25	1.25	1.00	W	MS33649 - 08	400	800	25	0.3 lb/sec		0.5	I, J, U	1.20
15241 - 713 - 1	3.65	1.00	0.75	T	1/4 NPT	3,000	6,000	18		N/A	12	D, E, I, J, O, U	*

NOTE: Unless Otherwise Specified

1 Fluid Service Markings:
A Oxidizer Systems
B Fuel Systems
C Other Fluids

2 T - Two Piece Threaded Housing
W - One Piece Welded Housing

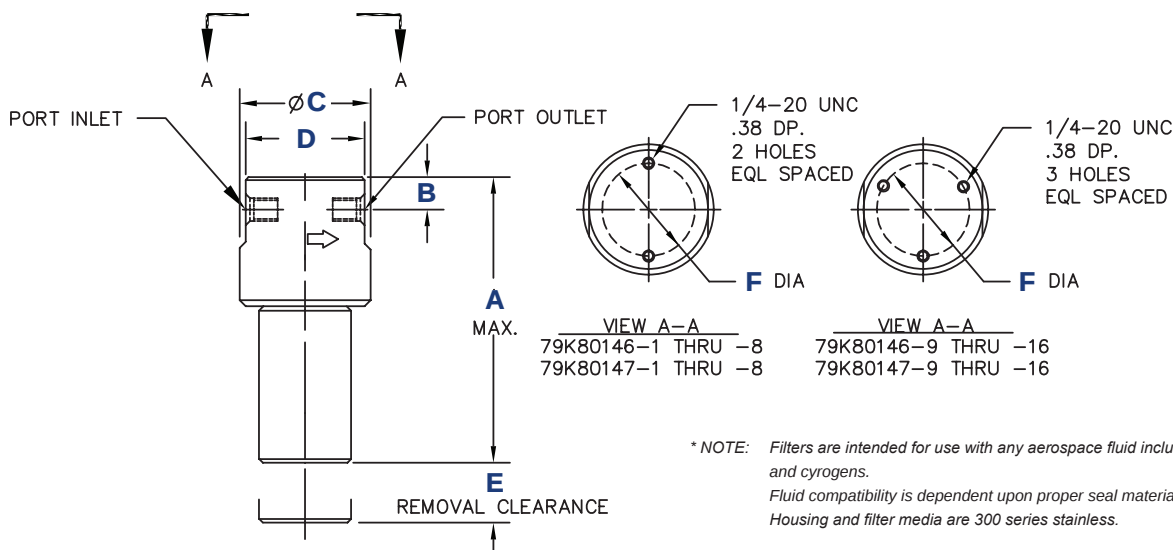
* Please contact our Applications Engineer

FLUID TYPE CODE

A - Air B - Water C - Hydraulic Oil D - GN₂ E - GHe F - N₂O₄ G - Freon H - DI H₂O I - MMH J - UDMH
K - GO₂ L - Skydrol M - JP - 4&5 N - Fluorine O - Alcohol P - MIL-L-7808 Q - MIL-H-8446 R - MIL-H-5606 S - LO₂ T - LH₂
U - N₂H₄ V - GH₂ W - RFNA X - WFNA Y - CTFE Z - LHe



NASA Qualified GSE Filters



Dimensions and Flow Data

NASA P/N	VACCO P/N	DIMENSIONS						PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	ABSOLUTE MICRON	MAX. CLEAN ΔP @ 70°F @6000 PSI		WEIGHT (lb)
		A	B	C	D	E	F					GN ₂ FLOW RATE	psid	
79K80146 -1	FR1564 - 0204	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	10	270 scfm	50	2.0
79K80146 -2	FR1564 - 0504	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	15	280 scfm	50	2.0
79K80146 -3	FR1564 - 1004	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	25	290 scfm	50	2.0
79K80146 -4	FR1564 - 4004	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	70	290 scfm	50	2.0
79K80146 -5	FR1564 - 0206	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	10	580 scfm	50	4.5
79K80146 -6	FR1564 - 0506	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	15	620 scfm	50	4.5
79K80146 -7	FR1564 - 1007	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	25	645 scfm	50	4.5
79K80146 -8	FR1564 - 4006	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	70	645 scfm	50	4.5
79K80146 -9	FR1564 - 0208	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	10	1450 scfm	50	8.0
79K80146 -10	FR1564 - 0508	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	15	1525 scfm	50	8.0
79K80146 -11	FR1564 - 1008	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	25	1625 scfm	50	8.0
79K80146 -12	FR1564 - 4008	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 12	6000	9000	70	1625 scfm	50	8.0
79K80146 -13	FR1564 - 0212	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	10	2800 scfm	50	12.0
79K80146 -14	FR1564 - 0512	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	15	2950 scfm	50	12.0
79K80146 -15	FR1564 - 1012	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	25	3250 scfm	50	12.0
79K80146 -16	FR1564 - 4012	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	70	3250 scfm	50	12.0
79K80147 -1	F -4699 - 2/10	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	10	270 scfm	50	1.92
79K80147 -2	F -4699 - 5/15	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	15	280 scfm	50	1.92
79K80147 -3	F -4699 - 10/25	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	25	290 scfm	50	1.92
79K80147 -4	F -4699 - 40/70	3.25	0.38	2.00	1.84	1.88	1.25	MC240 - 4	6000	9000	70	290 scfm	50	1.92
79K80147 -5	F -5004 - 2/10	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	10	580 scfm	50	3.82
79K80147 -6	F -5004 - 5/15	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	15	620 scfm	50	3.82
79K80147 -7	F -5004 - 10/25	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	25	645 scfm	50	3.82
79K80147 -8	F -5004 - 40/70	4.56	0.50	2.50	2.34	2.50	1.75	MC240 - 6	6000	9000	70	645 scfm	50	3.82
79K80147 -9	F -5007 - 2/10	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	10	1450 scfm	50	7.5
79K80147 -10	F -5007 - 5/15	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	15	1525 scfm	50	7.5
79K80147 -11	F -5007 - 10/25	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	25	1625 scfm	50	7.5
79K80147 -12	F -5007 - 40/70	5.88	0.62	3.25	3.00	3.00	2.25	MC240 - 8	6000	9000	70	1625 scfm	50	7.5
79K80147 -13	F -5010 - 2/10	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	10	2800 scfm	50	14.2
79K80147 -14	F -5010 - 5/15	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	15	2950 scfm	50	14.2
79K80147 -15	F -5010 - 10/25	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	25	3250 scfm	50	14.2
79K80147 -16	F -5010 - 40/70	7.25	0.75	4.00	3.68	4.00	2.50	MC240 - 12	6000	9000	70	3250 scfm	50	14.2

FLUID TYPE CODE

A - Air
K - GO₂
U - N₂H₄

B - Water
L - Skydrol
V - GH₂

C - Hydraulic Oil
M - JP - 4&5
W - RFNA

D - GN₂
N - Fluorine
X - WFNA

E - GHe
O - Alcohol
Y - CTFE

F - N₂O₄
P - MIL-L-7808
Z - LHe

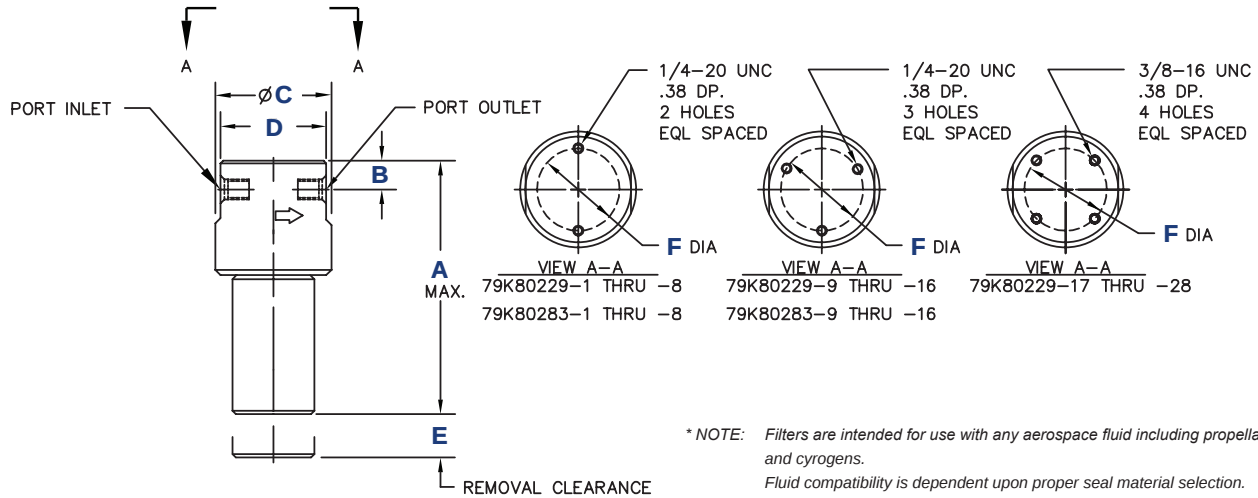
G - Freon
Q - MIL-H-8446

H - DI H₂O
R - MIL-H-5606

I - MMH
S - LO₂

J - UDMH
T - LH₂

NASA Qualified GSE Filters



Dimensions and Flow Data

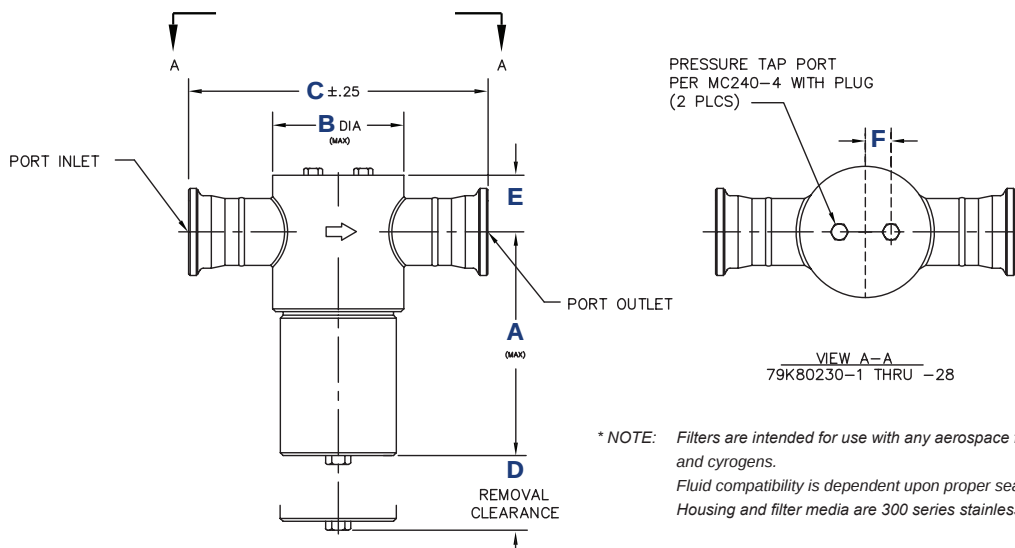
NASA P/N	VACCO P/N	DIMENSIONS						PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	ABSOLUTE MICRON	MAX. CLEAN ΔP @ 70°F @6000 PSI		WEIGHT (lb)
		A	B	C	D	E	F					GN ₂ FLOW RATE	psid	
79K80229-1	24104-010	3.75	0.38	2.34	2.25	2.38	1.50	MC240-4	9600	14400	10	160 scfm	50	2.5
79K80229-2	24104-020	3.75	0.38	2.34	2.25	2.38	1.50	MC240-4	9600	14400	20	180 scfm	50	2.5
79K80229-3	24104-040	3.75	0.38	2.34	2.25	2.38	1.50	MC240-4	9600	14400	40	190 scfm	50	2.5
79K80229-4	24104-100	3.75	0.38	2.34	2.25	2.38	1.50	MC240-4	9600	14400	100	200 scfm	50	2.5
79K80229-5	24106-010	5.00	0.50	2.75	2.50	3.25	1.75	MC240-6	6900	10350	10	290 scfm	50	4.5
79K80229-6	24106-020	5.00	0.50	2.75	2.50	3.25	1.75	MC240-6	6900	10350	20	300 scfm	50	4.5
79K80229-7	24106-040	5.00	0.50	2.75	2.50	3.25	1.75	MC240-6	6900	10350	40	315 scfm	50	4.5
79K80229-8	24106-100	5.00	0.50	2.75	2.50	3.25	1.75	MC240-6	6900	10350	100	330 scfm	50	4.5
79K80229-9	24108-010	6.38	0.62	3.50	3.23	3.50	2.25	MC240-8	7400	11100	10	790 scfm	50	8.6
79K80229-10	24108-020	6.38	0.62	3.50	3.23	3.50	2.25	MC240-8	7400	11100	20	810 scfm	50	8.6
79K80229-11	24108-040	6.38	0.62	3.50	3.23	3.50	2.25	MC240-8	7400	11100	40	830 scfm	50	8.6
79K80229-12	24108-100	6.38	0.62	3.50	3.23	3.50	2.25	MC240-8	7400	11100	100	840 scfm	50	8.6
79K80229-13	24112-010	7.75	0.75	4.25	3.96	4.50	3.00	MC240-12	6500	9750	10	1350 scfm	50	15.7
79K80229-14	24112-020	7.75	0.75	4.25	3.96	4.50	3.00	MC240-12	6500	9750	20	1380 scfm	50	15.7
79K80229-15	24112-040	7.75	0.75	4.25	3.96	4.50	3.00	MC240-12	6500	9750	40	1410 scfm	50	15.7
79K80229-16	24112-100	7.75	0.75	4.25	3.96	4.50	3.00	MC240-12	6500	9750	100	3430 scfm	50	15.7
79K80229-17	24116-010	9.50	1.00	4.50	4.12	7.25	3.50	MC240-16	5300	7950	10	1860 scfm	50	31.7
79K80229-18	24116-020	9.50	1.00	4.50	4.12	7.25	3.50	MC240-16	5300	7950	20	1880 scfm	50	31.7
79K80229-19	24116-040	9.50	1.00	4.50	4.12	7.25	3.50	MC240-16	5300	7950	40	1900 scfm	50	31.7
79K80229-20	24116-100	9.50	1.00	4.50	4.12	7.25	3.50	MC240-16	5300	7950	100	1910 scfm	50	31.7
79K80229-21	24120-010	11.00	1.34	5.25	4.56	9.50	4.25	MC240-20	5200	7800	10	2100 scfm	50	47.5
79K80229-22	24120-020	11.00	1.34	5.25	4.56	9.50	4.25	MC240-20	5200	7800	20	2130 scfm	50	47.5
79K80229-23	24120-040	11.00	1.34	5.25	4.56	9.50	4.25	MC240-20	5200	7800	40	2150 scfm	50	47.5
79K80229-24	24120-100	11.00	1.34	5.25	4.56	9.50	4.25	MC240-20	5200	7800	100	2160 scfm	50	47.5
79K80229-25	24124-010	14.00	1.70	6.00	5.40	12.50	4.75	MC240-24	4600	6900	10	4800 scfm	50	61.8
79K80229-26	24124-020	14.00	1.70	6.00	5.40	12.50	4.75	MC240-24	4600	6900	20	4900 scfm	50	61.8
79K80229-27	24124-040	14.00	1.70	6.00	5.40	12.50	4.75	MC240-24	4600	6900	40	4950 scfm	50	61.8
79K80229-28	24124-100	14.00	1.70	6.00	5.40	12.50	4.75	MC240-24	4600	6900	100	4980 scfm	50	61.8
79K80283-1	24267-630-1	3.25	0.38	2.00	1.84	1.88	1.25	MC240-4	6000	9000	10	270 scfm	50	2.0
79K80283-2	24267-630-2	3.25	0.38	2.00	1.84	1.88	1.25	MC240-4	6000	9000	15	280 scfm	50	2.0
79K80283-3	24267-630-3	3.25	0.38	2.00	1.84	1.88	1.25	MC240-4	6000	9000	25	290 scfm	50	2.0
79K80283-4	24267-630-4	3.25	0.38	2.00	1.84	1.88	1.25	MC240-4	6000	9000	70	290 scfm	50	2.0
79K80283-5	24267-630-5	4.56	0.50	2.50	2.34	2.50	1.75	MC240-6	6000	9000	10	580 scfm	50	4.5
79K80283-6	24267-630-6	4.56	0.50	2.50	2.34	2.50	1.75	MC240-6	6000	9000	15	620 scfm	50	4.5
79K80283-7	24267-630-7	4.56	0.50	2.50	2.34	2.50	1.75	MC240-6	6000	9000	25	645 scfm	50	4.5
79K80283-8	24267-630-8	4.56	0.50	2.50	2.34	2.50	1.75	MC240-6	6000	9000	70	645 scfm	50	4.5
79K80283-9	24267-630-9	5.88	0.62	3.25	3.00	3.00	2.25	MC240-8	6000	9000	10	1450 scfm	50	8.0
79K80283-10	24267-630-10	5.88	0.62	3.25	3.00	3.00	2.25	MC240-8	6000	9000	15	1525 scfm	50	8.0
79K80283-11	24267-630-11	5.88	0.62	3.25	3.00	3.00	2.25	MC240-8	6000	9000	25	1625 scfm	50	8.0
79K80283-12	24267-630-12	5.88	0.62	3.25	3.00	3.00	2.25	MC240-8	6000	9000	70	1625 scfm	50	8.0
79K80283-13	24267-630-13	7.25	0.75	4.00	3.68	4.00	2.50	MC240-12	6000	9000	10	2800 scfm	50	12.0
79K80283-14	24267-630-14	7.25	0.75	4.00	3.68	4.00	2.50	MC240-12	6000	9000	15	2950 scfm	50	12.0
79K80283-15	24267-630-15	7.25	0.75	4.00	3.68	4.00	2.50	MC240-12	6000	9000	25	3250 scfm	50	12.0
79K80283-16	24267-630-16	7.25	0.75	4.00	3.68	4.00	2.50	MC240-12	6000	9000	70	3250 scfm	50	12.0

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - CO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				



NASA Qualified GSE Filters



Dimensions and Flow Data

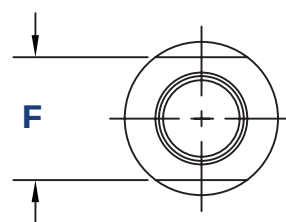
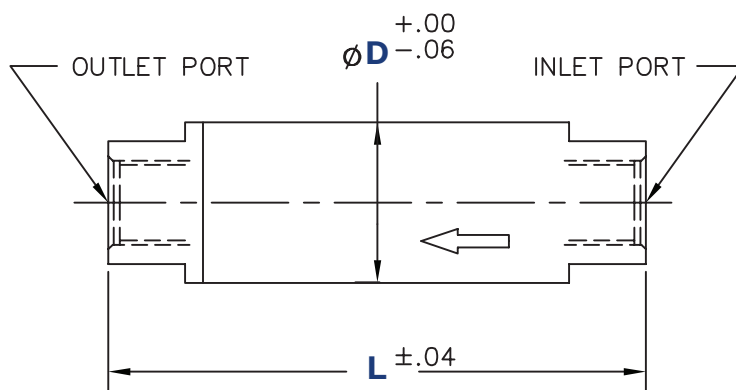
NASA P/N	VACCO P/N	DIMENSIONS						PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	ABSOLUTE MICRON	MAX. CLEAN ΔP @ 70°F OR PRESS		WEIGHT (lb)
		A	B MAX.	C	D	E REF.	F REF.					GN ₂ FLOW RATE	psid	
79K80230-1	24116-010-GR4	8.50	4.50	9.00	7.25	1.37	1.00	1GR4 HUB	6000	9000	10	920 scfm	20	27.5
79K80230-2	24116-020-GR4	8.50	4.50	9.00	7.25	1.37	1.00	1GR4 HUB	6000	9000	20	951 scfm	20	27.5
79K80230-3	24116-040-GR4	8.50	4.50	9.00	7.25	1.37	1.00	1GR4 HUB	6000	9000	40	974 scfm	20	27.5
79K80230-4	24116-100-GR4	8.50	4.50	9.00	7.25	1.37	1.00	1GR4 HUB	6000	9000	100	990 scfm	20	27.5
79K80230-5	24116-010-GR5	8.50	4.50	9.00	7.25	1.37	1.00	1GR5 HUB	6000	9000	10	1247 scfm	20	27.5
79K80230-6	24116-020-GR5	8.50	4.50	9.00	7.25	1.37	1.00	1GR5 HUB	6000	9000	20	1270 scfm	20	27.5
79K80230-7	24116-040-GR5	8.50	4.50	9.00	7.25	1.37	1.00	1GR5 HUB	6000	9000	40	1301 scfm	20	27.5
79K80230-8	24116-100-GR5	8.50	4.50	9.00	7.25	1.37	1.00	1GR5 HUB	6000	9000	100	1332 scfm	20	27.5
79K80230-9	24116-010-GR7	8.50	4.50	9.00	7.25	1.37	1.00	1GR7 HUB	6000	9000	10	2045 scfm	20	27.5
79K80230-10	24116-020-GR7	8.50	4.50	9.00	7.25	1.37	1.00	1GR7 HUB	6000	9000	20	2075 scfm	20	27.5
79K80230-11	24116-040-GR7	8.50	4.50	9.00	7.25	1.37	1.00	1GR7 HUB	6000	9000	40	2084 scfm	20	27.5
79K80230-12	24116-100-GR7	8.50	4.50	9.00	7.25	1.37	1.00	1GR7 HUB	6000	9000	100	2094 scfm	20	27.5
79K80230-13	24116-010-GR11	8.50	4.50	9.00	7.25	1.37	1.00	1GR11 HUB	4325	6488	10	2160 scfm	20	32.5
79K80230-14	24116-020-GR11	8.50	4.50	9.00	7.25	1.37	1.00	1GR11 HUB	4325	6488	20	2190 scfm	20	32.5
79K80230-15	24116-040-GR11	8.50	4.50	9.00	7.25	1.37	1.00	1GR11 HUB	4325	6488	40	2215 scfm	20	32.5
79K80230-16	24116-100-GR11	8.50	4.50	9.00	7.25	1.37	1.00	1GR11 HUB	4325	6488	100	2245 scfm	20	32.5
79K80230-17	24124-010-GR11	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR11 HUB	6000	9000	10	2961 scfm	20	46.5
79K80230-18	24124-020-GR11	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR11 HUB	6000	9000	20	3029 scfm	20	46.5
79K80230-19	24124-040-GR11	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR11 HUB	6000	9000	40	3068 scfm	20	46.5
79K80230-20	24124-100-GR11	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR11 HUB	6000	9000	100	3092 scfm	20	46.5
79K80230-21	24124-010-GR14	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR14 HUB	6000	9000	10	2531 scfm	20	46.5
79K80230-22	24124-020-GR14	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR14 HUB	6000	9000	20	2579 scfm	20	46.5
79K80230-23	24124-040-GR14	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR14 HUB	6000	9000	40	2613 scfm	20	46.5
79K80230-24	21124-100-GR14	12.50	6.00	13.00	10.50	1.58	1.50	1-1/2GR14 HUB	6000	9000	100	2636 scfm	20	46.5
79K80230-25	24132-010-GR14	15.00	6.00	14.00	14.50	2.00	1.50	2GR14	6000	9000	10	8478 scfm	20	78.0
79K80230-26	24132-020-GR14	15.00	6.00	14.00	14.50	2.00	1.50	2GR14	6000	9000	20	8541 scfm	20	78.0
79K80230-27	24132-040-GR14	15.00	6.00	14.00	14.50	2.00	1.50	2GR14	6000	9000	40	8604 scfm	20	78.0
79K80230-28	24132-100-GR14	15.00	6.00	14.00	14.50	2.00	1.50	2GR14	6000	9000	100	8627 scfm	20	78.0

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - GO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				

NASA KSC GSE Filters

79K80231



Dimensions and Flow Data

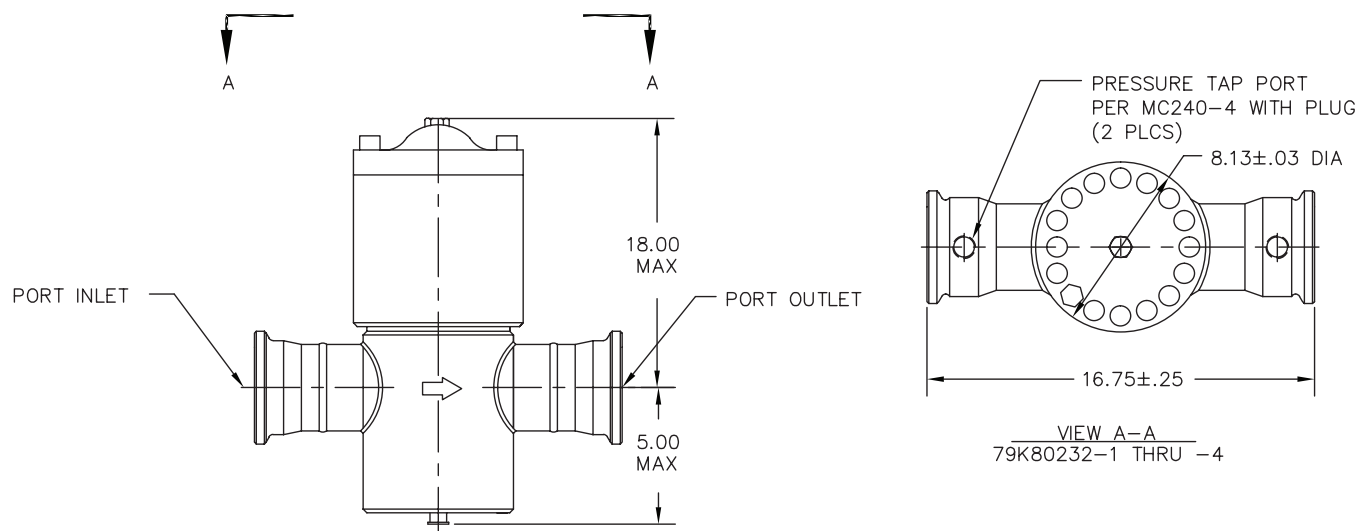
NASA P/N	VACCO P/N	DIMENSIONS			PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	FILTRATION MICRON	FLOW RATE @ 70°F	MAX. CLEAN ΔP @ RATED FLOW RATE (psid)	WEIGHT (lb)
		D	F	L							
79K80231 -1 & 29	14104 - 010	2.00	1.62	5.00	MC240 - 4	6900	10350	10	180 scfm GN ₂	20	1.5
79K80231 -2 & 30	14104 - 020	2.00	1.62	5.00	MC240 - 4	6900	10350	20	190 scfm GN ₂	20	1.5
79K80231 -3 & 31	14104 - 040	2.00	1.62	5.00	MC240 - 4	6900	10350	40	200 scfm GN ₂	20	1.5
79K80231 -4 & 32	14104 - 100	2.00	1.62	5.00	MC240 - 4	6900	10350	100	205 scfm GN ₂	20	1.5
79K80231 -5 & 33	14106 - 010	2.00	1.62	6.00	MC240 - 6	6900	10350	10	310 scfm GN ₂	20	4.0
79K80231 -6 & 34	14106 - 020	2.00	1.62	6.00	MC240 - 6	6900	10350	20	320 scfm GN ₂	20	4.0
79K80231 -7 & 35	14106 - 040	2.00	1.62	6.00	MC240 - 6	6900	10350	40	330 scfm GN ₂	20	4.0
79K80231 -8 & 36	14106 - 100	2.00	1.62	6.00	MC240 - 6	6900	10350	100	340 scfm GN ₂	20	4.0
79K80231 -9 & 37	14108 - 010	2.00	1.62	6.00	MC240 - 8	7400	11100	10	800 scfm GN ₂	20	5.0
79K80231 -10 & 38	14108 - 020	2.00	1.62	6.00	MC240 - 8	7400	11100	20	830 scfm GN ₂	20	5.0
79K80231 -11 & 39	14108 - 040	2.00	1.62	6.00	MC240 - 8	7400	11100	40	850 scfm GN ₂	20	5.0
79K80231 -12 & 40	14108 - 100	2.00	1.62	6.00	MC240 - 8	7400	11100	100	860 scfm GN ₂	20	5.0
79K80231 -13 & 41	14112 - 010	2.62	2.00	8.00	MC240 - 12	6500	9750	10	1470 scfm GN ₂	20	8.0
79K80231 -14 & 42	14112 - 020	2.62	2.00	8.00	MC240 - 12	6500	9750	20	1500 scfm GN ₂	20	8.0
79K80231 -15 & 43	14112 - 040	2.62	2.00	8.00	MC240 - 12	6500	9750	40	1520 scfm GN ₂	20	8.0
79K80231 -16 & 44	14112 - 100	2.62	2.00	8.00	MC240 - 12	6500	9750	100	1530 scfm GN ₂	20	8.0
79K80231 -17 & 45	14116 - 010	2.62	2.00	8.00	MC240 - 16	5300	7950	10	2025 scfm GN ₂	20	14.0
79K80231 -18 & 46	14116 - 020	2.62	2.00	8.00	MC240 - 16	5300	7950	20	2050 scfm GN ₂	20	14.0
79K80231 -19 & 47	14116 - 040	2.62	2.00	8.00	MC240 - 16	5300	7950	40	2070 scfm GN ₂	20	14.0
79K80231 -20 & 48	14116 - 100	2.62	2.00	8.00	MC240 - 16	5300	7950	100	2080 scfm GN ₂	20	14.0
79K80231 -21 & 49	14120 - 010	3.50	2.87	10.00	MC240 - 20	5200	7800	10	2260 scfm GN ₂	20	22.0
79K80231 -22 & 50	14120 - 020	3.50	2.87	10.00	MC240 - 20	5200	7800	20	2310 scfm GN ₂	20	22.0
79K80231 -23 & 51	14120 - 040	3.50	2.87	10.00	MC240 - 20	5200	7800	40	2340 scfm GN ₂	20	22.0
79K80231 -24 & 52	14120 - 100	3.50	2.87	10.00	MC240 - 20	5200	7800	100	2370 scfm GN ₂	20	22.0
79K80231 -25 & 53	14124 - 010	3.50	2.87	13.00	MC240 - 24	4600	6900	10	5100 scfm GN ₂	20	28.0
79K80231 -26 & 54	14124 - 020	3.50	2.87	13.00	MC240 - 24	4600	6900	20	5200 scfm GN ₂	20	28.0
79K80231 -27 & 55	14124 - 040	3.50	2.87	13.00	MC240 - 24	4600	6900	40	5250 scfm GN ₂	20	28.0
79K80231 -28 & 56	14124 - 100	3.50	2.87	13.00	MC240 - 24	4600	6900	100	5280 scfm GN ₂	20	28.0

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - GO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				



NASA Qualified GSE Filters



*** NOTE:** Filters are intended for use with any aerospace fluid including propellants and cryogenics.
Fluid compatibility is dependent upon proper seal material selection.
Housing and filter media are 300 series stainless.

Dimensions and Flow Data

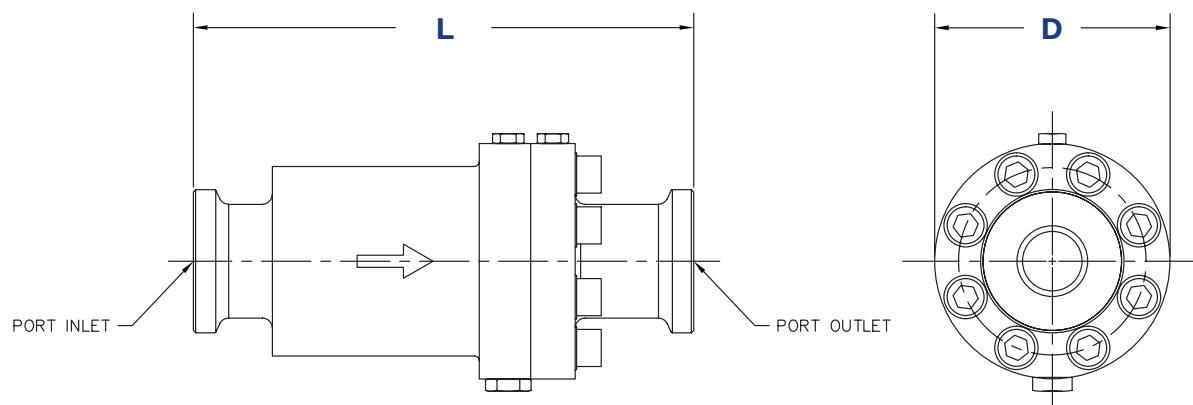
NASA P/N	VACCO P/N	PORT	OP. PRESS. psig	PROOF psig	ABSOLUTE MICRON	FLOW RATE GN ₂	MAX. CLEAN ΔP, 70°F @ OP. PRESS.	WEIGHT (lb)
		INLET\OUTLET					psid	
79K80232-1	44148-010-GR25	3GR 25	6000	9000	10	15200 scfm	20	300
79K80232-2	44148-020-GR25	3GR 25	6000	9000	20	15300 scfm	20	300
79K80232-3	44148-040-GR25	3GR 25	6000	9000	40	15400 scfm	20	300
79K80232-4	44148-100-GR25	3GR 25	6000	9000	100	15400 scfm	20	300

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - GO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				

NASA Qualified GSE Filters

14115 / 14121



Dimensions and Flow Data

SPEC NO	VACCO P/N	DIMENSIONS		PORT INLET/OUTLET	OP. PRESS. psig	PROOF psig	ABSOLUTE MICRON	MAX. CLEAN ΔP @ 70°F OP. PRESS		WEIGHT (lb)
		L	D					GN ₂ FLOW RATE	psid	
110 GM-GM05	14115-505	12.75	5.96	2 R-Con SCH XXS HUB	6000	9000	400	GN ₂ 19.5 LB/sec	50	60
110 GM-GM05	14121-506	18.50	10.50	4 R-Con SCH XXS HUB	6000	9000	100	GHe/GN ₂ 64.0 LB/sec	50	105
110 GM-GM05	14121-507	12.75	5.96	2 R-Con SCH XXS HUB	6000	9000	100	GN ₂ 10.0 LB/sec	50	60

FLUID TYPE CODE

A - Air	B - Water	C - Hydraulic Oil	D - GN ₂	E - GHe	F - N ₂ O ₄	G - Freon	H - DI H ₂ O	I - MMH	J - UDMH
K - GO ₂	L - Skydrol	M - JP - 4&5	N - Fluorine	O - Alcohol	P - MIL-L-7808	Q - MIL-H-8446	R - MIL-H-5606	S - LO ₂	T - LH ₂
U - N ₂ H ₄	V - GH ₂	W - RFNA	X - WFNA	Y - CTFE	Z - LHe				



ΔTEL Differential Pressure Indicator

Purpose

The ΔTEL provides an indication or warning that the filter element is nearing the end of its service life.

Application

As the filter element loads up with contaminant and flow remains consistent, the upstream pressure increases. Thus, differential pressure across the element occurs.

Indication

Once the filter element reaches a predetermined differential pressure, the ΔTEL registers by extending a red button for visual indication. The VACCO design is also configurable to support remote signaling through an electrical interface.

Description and Operation

The ΔTEL design offers improvement in reliability, serviceability and integrity over other designs by this minimizing weight (low mass density). This design allows reliable operation during high “G” load transients and can with stand shock levels excelling 50G along the longitudinal axis. The design also incorporates a pick-a-part configuration which allows for disassembly/assembly without staking or crimping. The VACCO ΔTEL indicator meets or exceeds the applicable portions of MIL-F-8815.

Indication is achieved via upstream pressure overcoming a spring biased piston, thus carrying a pole magnet through a ring magnet. As the pole magnet traverses the ring magnet, a toggle action occurs producing the positive indication. The red indicator button will remain in the actuated mode until it is manually reset by depressing.

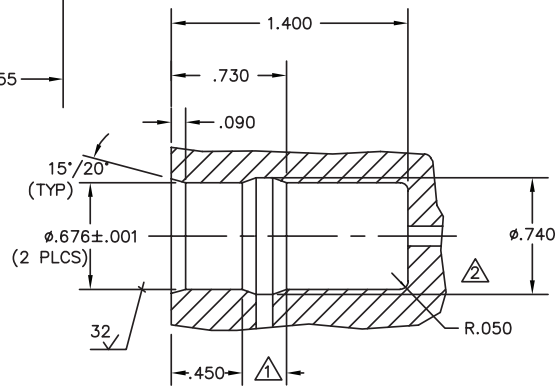
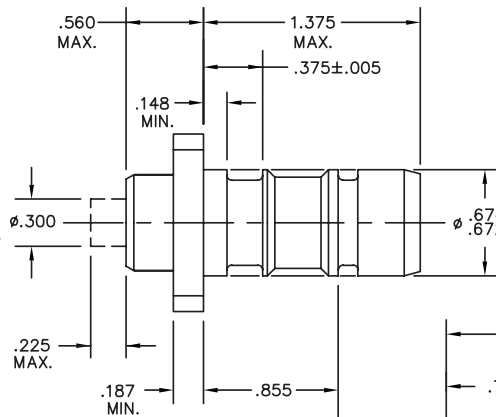
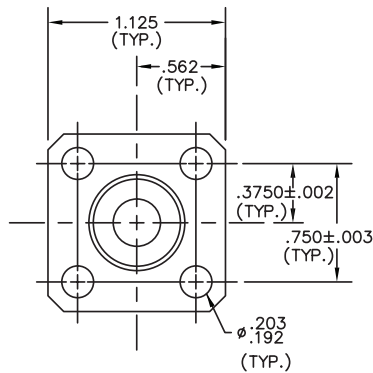
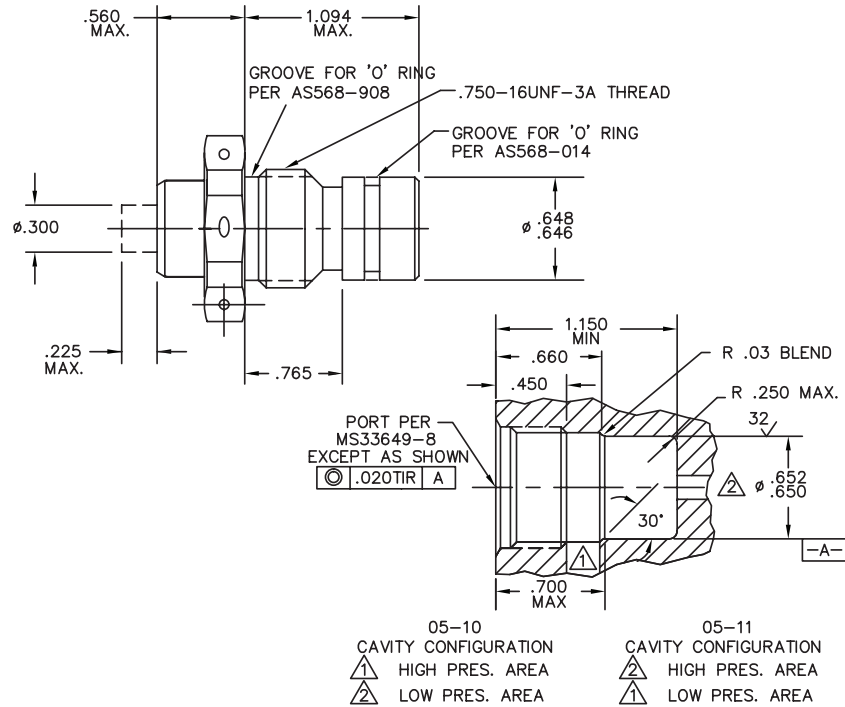
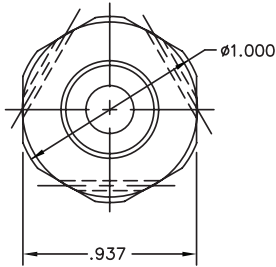
The ΔTEL design isolates the fluid area (piston) from the indicating portion (ambient atmosphere) via a machined barrier. There are no seals; consequently, any potential leakage paths are eliminated.

The ΔTEL Indicator is also available with a thermal lockout feature that prevents indication during cold starts. Additionally, a surge control can be incorporated to prevent indication during pressure transients. VACCO applications engineers should be consulted for further details.

Technical Data

Material	Aluminum (std)	Indicating Pressures	15 ± 2.5 psid
Optional	Corrosion Resistant Steel		25 ± 3.0 psid
Seals (Electrometric).....	Buna “N” (std)		35 ± 5.0 psid
	Viton (std)		50 ± 8.0 psid
	EPR (std)		70 ± 10 psid
	Others Upon Request		100± 15 psid
Pressure Data			120 ± 20 psid
Operating.....	5,000 psig	Others Upon Request	
Proof.....	7,000 psig	Thermal Lockout	350 ± 150 °F
Burst	12,500 psig		560 ± 240 °F
Surge Control.....	Optional		1000 ± 150 °F
Per MIL-F-8815			

Envelope Drawings



05-12 CAVITY CONFIGURATION
 ▲ LOW PRES. AREA
 ▲ HIGH PRES. AREA

05-13 CAVITY CONFIGURATION
 ▲ LOW PRES. AREA
 ▲ HIGH PRES. AREA

INFORMATION FOR ORDERING DIFFERENTIAL PRESSURE INDICATORS

ASSEMBLY PART NUMBER

ADD 'C' FOR SURGE CONTROL

CODE	SEAL OPTION
-1	BUNA 'N'
-2	
-3	VITON
-4	EPR

CODE	SETTING
015	15 ± 2.5 PSID
025	25 ± 3.0 PSID
035	35 ± 5.0 PSID
050	50 ± 8.0 PSID
070	70 ± 10.0 PSID
100	100 ± 15.0 PSID
120	120 ± 20.0 PSID

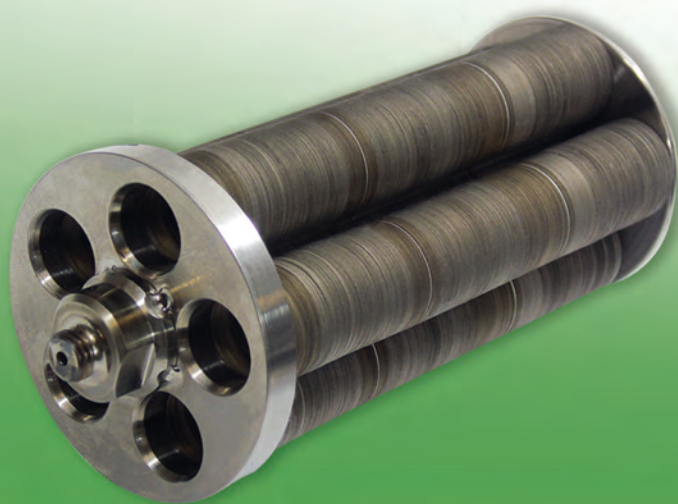
CODE	SETTING
035	35 ± 15°F
056	56 ± 24°F
100	100 ± 20°F

*PER MIL-F-8815

REFER TO CAVITY CONFIGURATION FOR PROPER PRESSURE PORTING

SECTION 3

ETCHED DISC FILTERS



VACCO
— Filtration™

What We Do

VACCO's etched disc filters are constructed from thousands of stacked metallic discs that have been chemically micro-machined with microscopic flow channels on the surface of each stacked disc to enable precision filtration from 2 micron to 100 micron absolute. VACCO uses these etching capabilities to produce etched disc filters for satellite and spacecraft applications. VACCO has been a leading supplier of etched disc filters for the satellites and spacecraft industry.

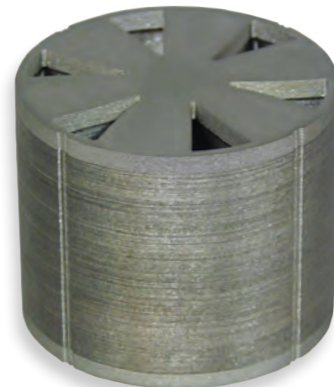


Diffusion Bonding

VACCO is a leader in metal diffusion bonding with over 60 years of diverse experience. Metal diffusion bonding is most suitable in applications where two different metals need to be joined. This method is widely used for production of thin-metal components and parts with very complex shapes.

VACCO's in-house vacuum furnace enables diffusion bonding of components consisting of titanium without deformation or residual stress. All metal diffusion bonding projects are calculated to satisfy exact pressure measurements by taking into consideration key material parameters, including surface finish, flatness, thickness, and hermetic seal requirements. Our expert team at VACCO understands the importance of controlling all process variables to produce accurate and strong metal bonds. VACCO's photo etching and diffusion bonding processes are widely used in the production of sensor devices, cooling devices, fuel cells, sound suppression devices, and micro- fluid channeling devices.

Parts with thicknesses that range from 0.001" through 1", manufactured from a variety of materials, including titanium and iron-nickel alloy, can be joined using our diffusion bonding process.

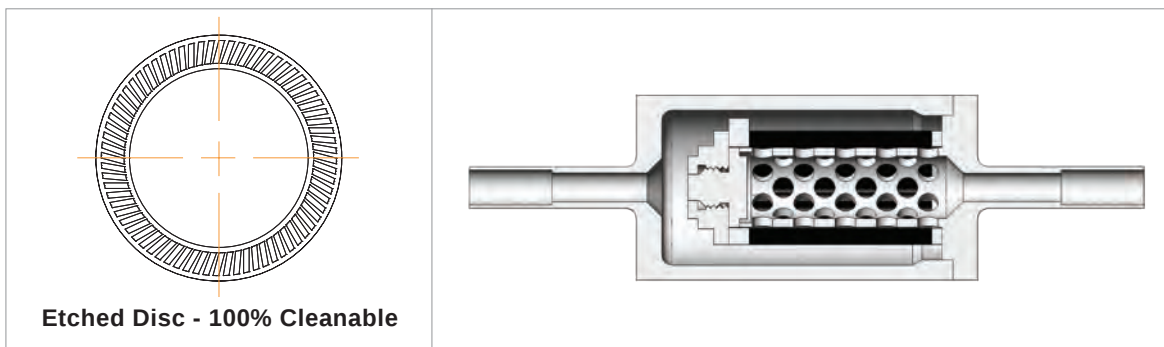


VACCO Patented No. 6,510,948B1



Etched Disc Filter

VACCO's Etched Disc Filter is a unique component consisting of chemically etched discs, stacked one on top of the other, to provide absolute filtration, superior element strength, extreme cleanliness, and zero media migration. The combination of filter media material, low weight, design and flight qualifications, and other unique features make the etched disc filter a great choice for various space and satellite applications. These filters have been the preferred choice for space flight and other mission and life critical applications since the early 1960's. A typical etched disc is shown below:



Advantages of Etched Disc Filters:

- Geometrically defined fluid flow path resulting in absolute (100%) entrapment of particles greater in size than the flow path
- Capable of 100% delta pressure drop
- Wide range of absolute filtration ratings – as low as 2 microns absolute

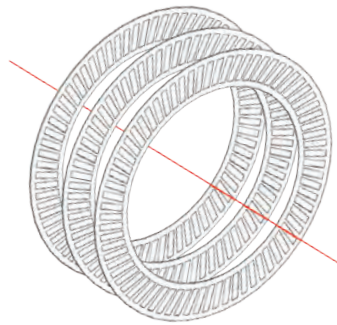
Etched Disc Filter

Absolute Filtration

Etched disc filters are manufactured under highly controlled conditions. Each flow passage is chemically etched into the disc material using technology which is similar to that used in the electronics industry. A filter component is assembled by precisely stacking a set of chemically etched disks with flow passages of consistent dimensions which are held to extremely tight tolerances. The resulting component is a highly porous, monolithic filtration medium which is as strong as the parent material. In this way, a flow path is identically reproduced for each filter due to the strict controls placed on the process.

Initial Cleanliness and Media Migration

The etched disc filter can be cleaned individually prior to assembly. Each individual disc is cleaned prior to stacking on the mandrel. This step ensures that no manufacturing dirt is left on the discs to contaminate the environment. All manufacturing contamination is removed from the discs prior to assembly. The manufacturing process of the etched discs assures complete cleanliness. Etched discs are chemically etched and then thoroughly cleaned prior to element stacking; no welding is performed on the etched disc media. Media migration is never a concern with the etched disc filter due to its inherent design characteristics. Each etched disc is fully and solidly supported to prevent relative motion and assure unsurpassed strength. The etched disc filter has consistently demonstrated that no media migration occurs even when exposed to severe shock, acceleration, or vibration environments.





Heritage Filters

VACCO etched disc filters have been supplied to the space industry since the early 1960's. From their first satellite application for Hughes Aircraft in the mid-1960's to the latest Orion Program, VACCO precision etched disc filters have provided absolute filtration for helium pressurization, liquid propulsion, and the latest in xenon propulsion systems. VACCO's etched disc filters have flown aboard human spaceflight programs and many satellite and scientific missions, including, but not limited to:

Human Spaceflight Highlights

- Space Launch System (SLS), NASA-Boeing
- Orion Multi-Purpose Crew Vehicle (MPCV), Lockheed-Martin
- Orion MPCV-European Service Module (MPCV-ESM), NASA-Airbus
- CST-100 Starliner, Boeing
- International Space Station (ISS), International Consortium
- Automated Transfer Vehicle (ATV), ESA
- STS - Space Shuttle, NASA
- Apollo / Gemini / Mercury

Satellite Highlights

- GPS III, Lockheed-Martin
- AS 2100, Lockheed-Martin
- Eurostar, Airbus DS
- FS-1300, Space Systems/Loral (SSL)
- Eagle Class Bus, Northrop Grumman*
- HS-393, HS-601, HS-601HP, HS-702; Hughes/Boeing Satellite Systems
- QuickBird (BCP-2000 Bus), Ball Aerospace
- Spacebus, Thales Alenia Space
- DS2000, Mitsubishi Electric (MELCO)

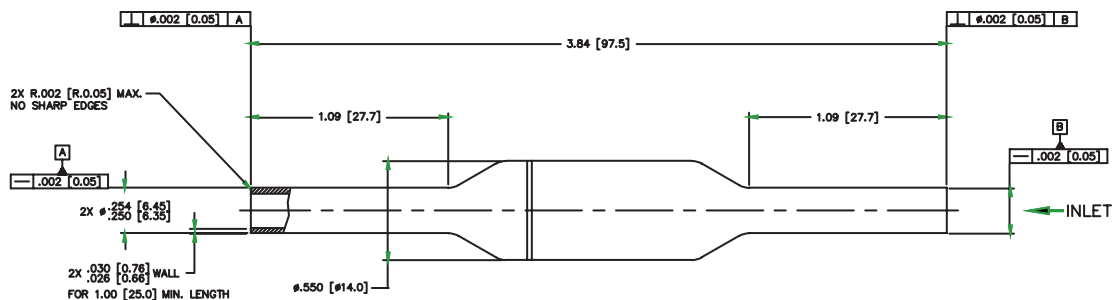
Scientific Mission Highlights

- James Webb Space Telescope (JWST), NASA/ESA/CSA (2018 scheduled launch)
- OSIRIS-REx, Lockheed-Martin
- Mars Science Laboratory, NASA-JPL
- Cassini Mission, NASA-JPL
- Mars Global Surveyor, NASA-JPL
- Mars Pathfinder, NASA-JPL
- Viking 1 and 2, NASA
- Pioneer 10 and 11, NASA
- Voyager 1 and 2, NASA-JPL

F1D10588-01



High pressure low gas flow miniature Etched Disc filter: Use qualified filter part number: F1D10588-01 as a baseline.



Materials of Construction	Titanium alloy
Filtration	40 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	4350 / 8700 / 17400 psi
Leakage	$< 1.0 \times 10^{-6}$ sccs GHe at MEOP external
Delta P and Flow	0.725 psid @ 0.000077 lb/sec of GHe from 319 to 4350 psig at 70 °F
Temperature	-22 to 104 °F
Environmental	24.0 Grms random vibration
Mass	0.053 lb max

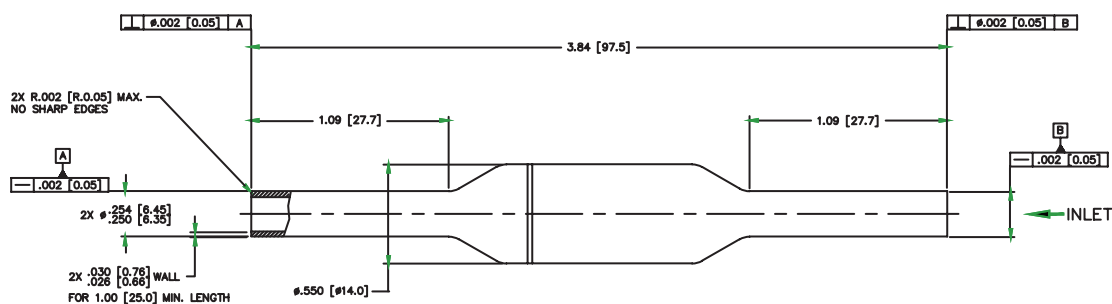
Additional Sizes And Configurations Available.



F1D10807-02

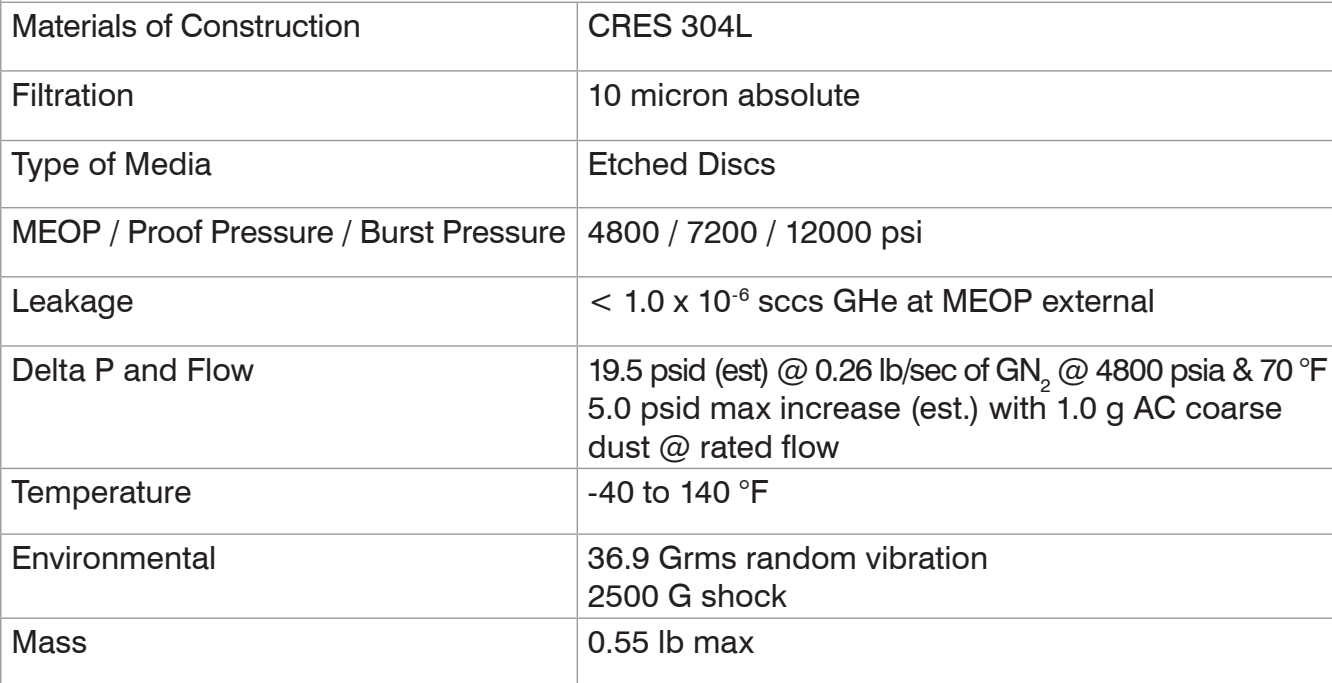


Low liquid flow miniature Etched Disc filter: Use qualified filter part number: F1D10807-02 as a baseline.



Materials of Construction	Titanium alloy
Filtration	15 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	300 /1000 / 12500 psi
Leakage	$< 1.0 \times 10^{-6}$ sccs GHe at MEOP external
Delta P and Flow	1.50 psid @ 0.01539 lb/sec of N_2H_4 9.0 psid max. with 45 mg of AC coarse dust added
Temperature	14 to 140 °F
Environmental	24.0 Grms random vibration
Mass	0.053 lb max

Additional Sizes And Configurations Available.



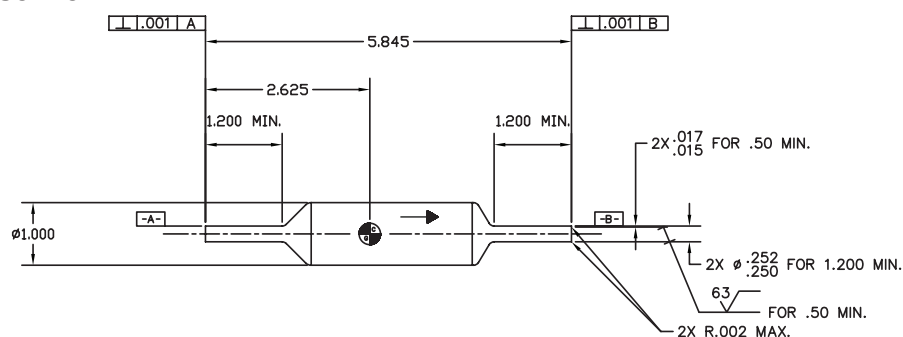
56 © **VACCO Industries** - A subsidiary of ESCO Technologies Inc.



F1D10638-01



Low liquid flow Etched Disc filter: Use qualified filter part number: F1D10638-01 as a baseline.



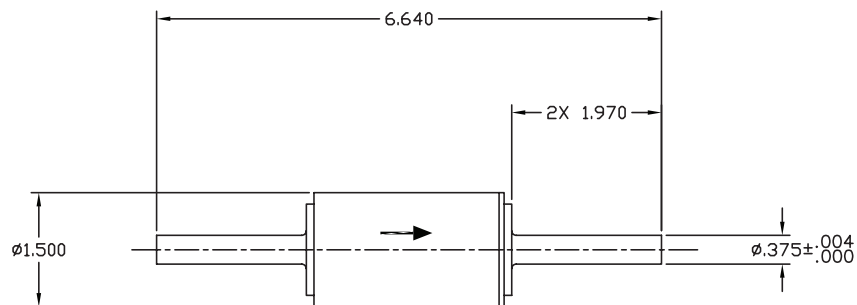
Materials of Construction	Titanium alloy
Filtration	15 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	600 / 900 / 1500 psi
Leakage	$< 1.0 \times 10^{-6}$ sccs GHe at MEOP external
Delta P and Flow	7.0 psid @ 0.15 lb/sec of N_2H_4 15.0 psid max with 0.250 mg AC coarse dust @ rated flow
Temperature	+40 to 120 °F
Environmental	36.9 Grms random vibration 2500 G shock
Mass	0.40 lb max

Additional Sizes And Configurations Available.

F1D10397-04



Low liquid flow Etched Disc filter: Use qualified filter part number: F1D10397-04 as a baseline.



Materials of Construction	Titanium alloy
Filtration	25 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	319 / 638 / 1276 psi
Leakage	$< 1.0 \times 10^{-6}$ sccs GHe at MEOP external
Delta P and Flow	1.6 psid @ 1.35 gpm of H ₂ O (actual test result) 3.77 psid max. @ 0.187 lb/sec of N ₂ O ₄ with 0.75 g of AC coarse dust added
Temperature	+32 to 140 °F
Environmental	24.0 Grms random vibration
Mass	0.353 lb max

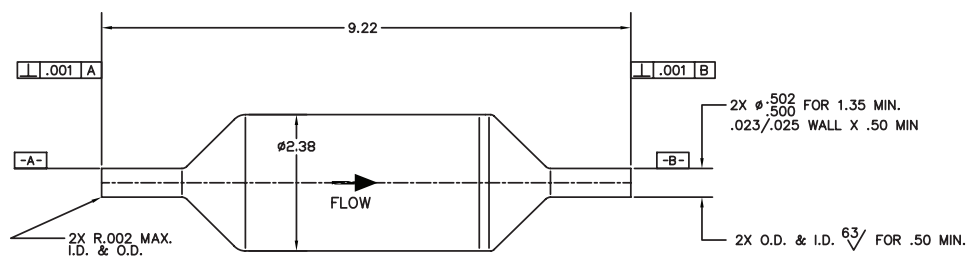
Additional Sizes And Configurations Available.



F1D10639-01



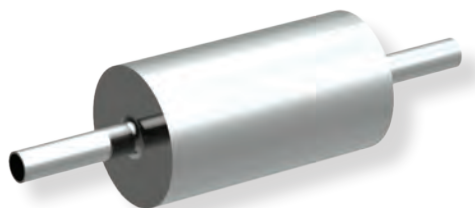
Medium liquid flow Etched Disc filter: Use qualified filter part number: F1D10639-01 as a baseline.



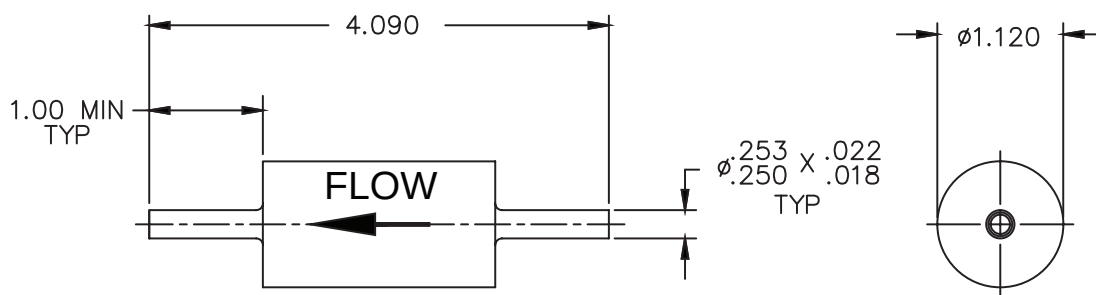
Materials of Construction	CRES 304L
Filtration	15 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	500 / 750 / 1250 psi
Leakage	$< 1.0 \times 10^{-6}$ sccs GHe at MEOP external
Delta P and Flow	5.0 psid (cal) @ 0.90 lb/sec of N_2H_4 or 0.80 lb/sec of N_2O_4 10.0 psid max increase (est.) with 1.2 g AC coarse dust @ rated flow
Temperature	+40 to 120 °F
Environmental	36.9 Grms random vibration 2500 G shock
Mass	2.20 lb max

Additional Sizes And Configurations Available.

F1D10286-02



2 micron abs etched disc filter: Use filter part number: F1D10286-02 as a baseline.

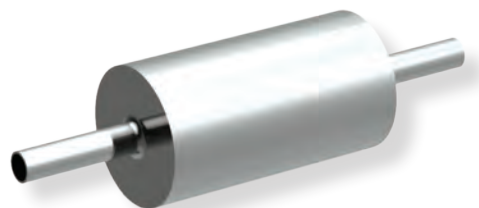


Materials of Construction	Titanium alloy
Filtration	2 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	4200 / 6300 / 16800 psi
Delta P and Flow	0.30 psid @ 0.0113 scfm of GN ₂ @ 295 psig & 70 °F (actual test result) 6.5 psid (cal) @ 0.212 scfm (6 NL/min) of GN ₂ @ 5002 psig (345 bar) & 70 °F
Temperature	+10 to 170 °F
Environmental	25.32 Grms random vibration
Mass	0.25 lb max

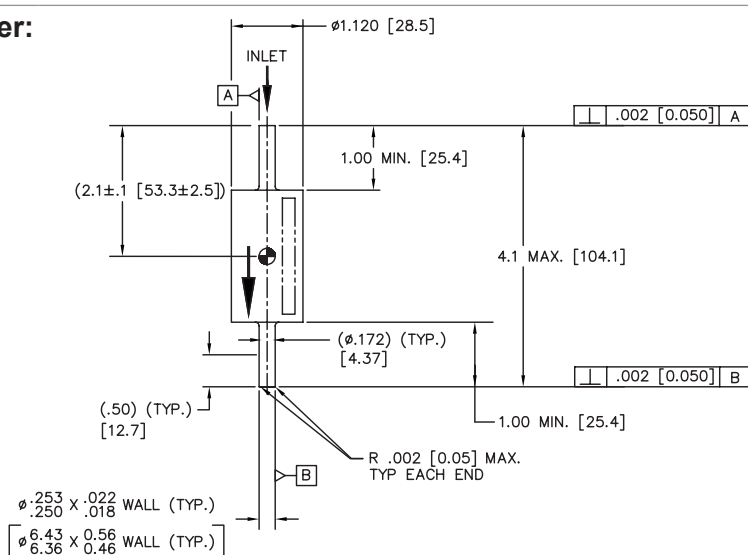
Additional Sizes And Configurations Available.



F1D10784-01



**For Xenon application, etched disc filter:
Use filter part number:
F1D10784-01 as a baseline.**



Materials of Construction	Titanium alloy
Filtration	5 micron absolute
Type of Media	Etched Discs
MEOP / Proof Pressure / Burst Pressure	2610 / 5220 / 10440 psi
Delta P and Flow	1.45 psid max. @ 0.20 mg/s of xenon @ MEOP
Temperature	+14 to 140 °F
Environmental	24.3 Grms random vibration
Mass	0.25 lb max

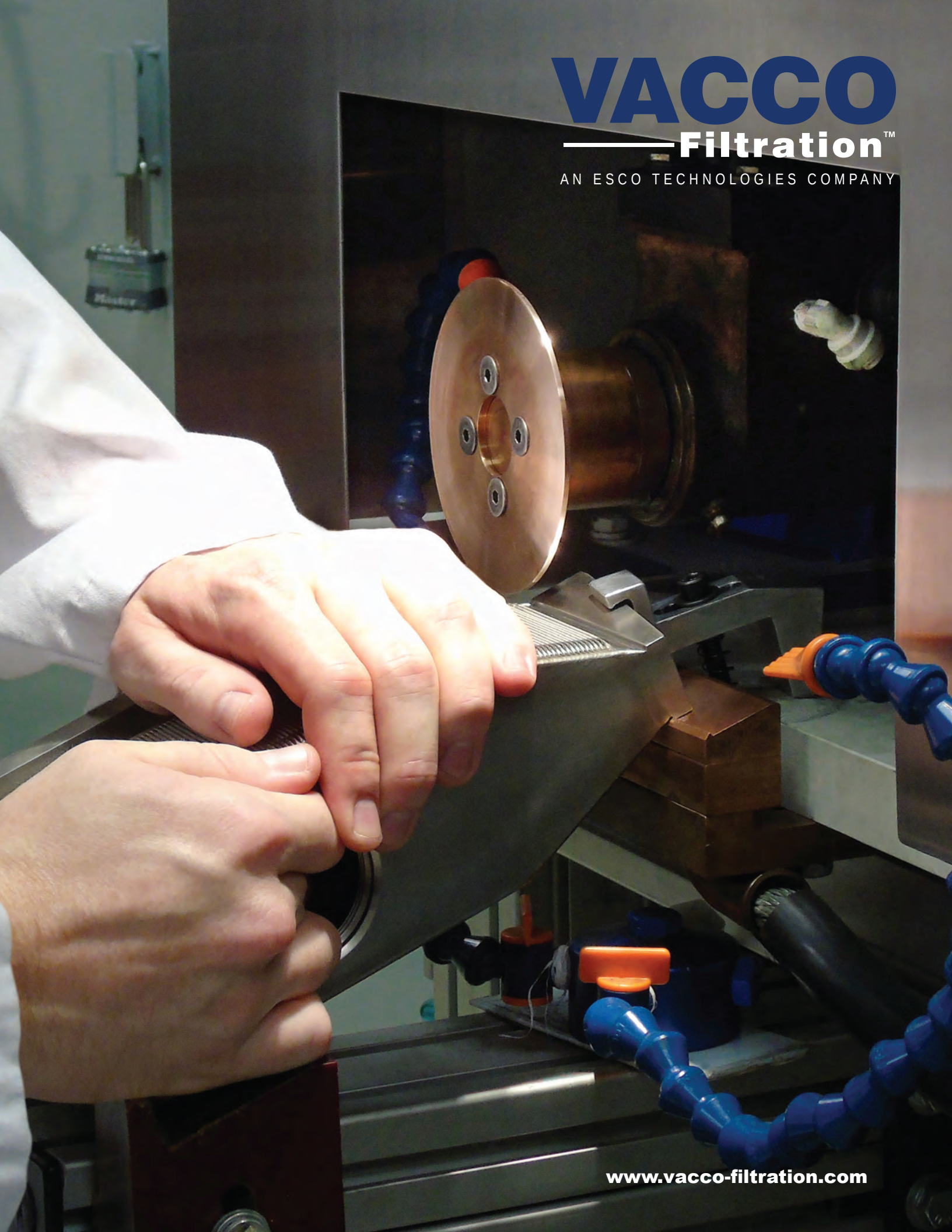
Additional Sizes And Configurations Available.

NOTES

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Filtration™

AN ESCO TECHNOLOGIES COMPANY

Corporate Office

10350 Vacco Street
South El Monte, CA 91733
+1 (626) 443-7121 (telephone)
+1 (626) 442-6943 (facsimile)

www.vacco-filtration.com



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