Purolator

HIGH PERFORMANCE FILTER MEDIA

HYDRAULIC AND LUBRICATING SYSTEMS

ISO CLEANLINESS CODES

Microfil® III filter elements shown are the 9600, 8900 and 1400 series elements.

The most widely used method for representing fluid cleanliness is the International Standards Organization (ISO) Code Level. Purolator generates and reports the code level of contaminant in accordance with ISO 4406, “Solid Contamination Level Code.” The resultant cleanliness code is a three-code number. The first code describes the number of particles greater than 4 microns, the second code describes the number of particles greater than 6 microns and the third greater than 14 microns. This new code has been accepted by the ISO standards committee since it more closely defines the contamination level.

ISO codes range from 1 to 28 and represent particle counts from 0.01 to 2,500,000 particles, respectively. (See inset). For example, an ISO cleanliness standard for protection of a servovalve may be 14/11/8, which indicates 80-160 particles greater than 4 micron, 10-20 particles greater than 6 micron, and 1.3-2.5 particles greater than 14 microns.

Purolator engineers have painstakingly validated every filter element design to determine clean flow rate versus pressure drop, dirt holding capacity, and element collapse pressure for that element.

ISO 4406 CODE LEVELS

ISO Code	Particle Count Range (per ml)	
	Minimum (included)	Maximum (excluded)
1	0.01	0.02
2	0.02	0.04
3	0.04	0.08
4	0.08	0.16
5	0.16	0.32
6	0.32	0.64
7	0.64	1.3
8	1.3	2.5
9	2.5	5.0
10	5.0	10
11	10	20
12	20	40
13	40	80
14	80	160
15	160	320
16	320	640
17	640	1300
18	1300	2500
19	2500	5000
20	5000	10000
21	10000	20000
22	20000	40000
23	40000	80000
24	80000	160000
25	160000	320000
26	320000	640000
27	640000	1300000
28	1300000	2500000

The multipass test procedure, ISO 16889, which was used to calculate and measure this test data, uses a higher ingression level than you would typically see in the field. The contaminant used in the multipass test is ISO medium test dust, which has a known particle size distribution. This standardized test dust is being run to a standard test procedure with a known, standardized test fluid. These factors enhance the ability to get comparable test results for identical tests run at different laboratories.

Since the contaminant ingression rate is greater in the multipass test, the filter element ratings would be considered worst case scenarios. Filtration performance greater than the element rating would be expected under most operating conditions.

By analyzing the customer’s hydraulic oil and comparing these results to the filter element performance data and the desired cleanliness code for that application, Purolator engineers can recommend a Purolator element capable of attaining the desired cleanliness level. For the most cost effective filtration program, Purolator recommends following a periodic oil analysis program, replacing elements before the filter goes into bypass, and using original Purolator elements to increase machine uptime and prolong the life of critical hydraulic components.

The data presented is applicable for most cases. Please check with your Purolator representative to discuss your unique filtration situation.

Scanning Electron Microscopy photomicrograph of Microfil® III media. Magnification 500X

MICROFIL® III MEDIA AND ELEMENTS

Purolator's Microfil® media was the first to employ micro-fine glass fibers. This revolutionary design provided customers finer filtration with improved contaminant capacity and filter element life. Since then, Microfil media have been engineered and improved to provide even better filtration performance. Now, Purolator offers Microfil® III high performance filter elements which provide a unique composite construction for maintaining superior hydraulic or lubricating oil cleanliness.

Microfil III media are made from micro-fine glass fibers which are randomly laid into a multilayered web. The media are impregnated with proprietary resins and thermally cured for strength and stability. They are engineered with a tapered pore geometry to provide superior contaminant capacity. Larger pores are located on the upstream surface, with finer and finer pores in the depth of the media. This proven media design philosophy gives Microfil III superior on-stream life versus competitive elements. Proprietary mathematical models of pore geometry allow us to fine-tune this layered construction to maximize contaminant capacity. All Microfil III elements are designed and tested to provide $ß_x \geq 200$ filtration efficiency. Microfil III elements are offered in standard grades of 1, 3, 6, 12, 20, and 25 microns. They are designed and tested to withstand 150 psid collapse pressure.

All Microfil III element designs are thoroughly tested to provide superior performance over all competitive elements. Purolator was the first filter company to adopt multipass testing as a way to characterize and define filter element performance. Today, these tests are considered industry standards for understanding a product's filtration efficiency, clean flow performance, contaminant capacity, and on-stream life. We test all of our filter element designs in this manner to predict performance versus customer requirements or competitive products.

We also subject Microfil III elements to collapse tests, high pulse flow fatigue tests, cold and hot soak tests, and environmental tests to prove their resistance to failure in cold-start applications.

Microfil® III filter elements shown are the 8900, 9700 and 9600 series elements.

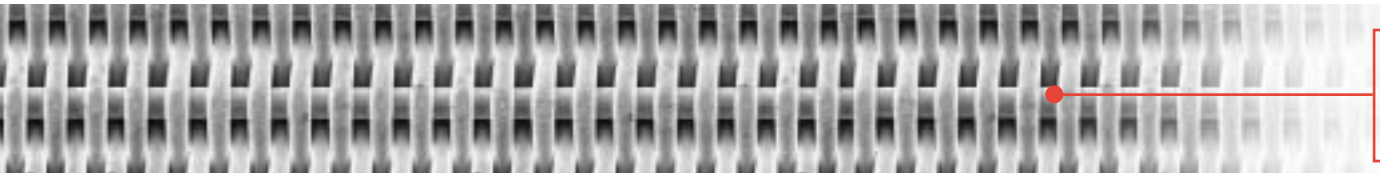
Scanning Electron Microscopy photomicrograph of Micropleat® III media. Magnification 500X

MICROPLEAT® MEDIA AND ELEMENTS

Micropleat® media are made from resin-impregnated cellulose materials. The media are then pleated and assembled into economical Micropleat disposable elements. Micropleat elements are rated at $ß_x \approx 2$, and come in standard grades of 5, 10, 20 and 40 microns. They are designed and tested to withstand 150 psid collapse pressure.

Micropleat elements are specified where an economical filter is required, or where a prefilter is used to minimize contaminant loading to a more sophisticated final filter.

Micropleat® elements shown are (left to right) 1200, 1100, and 9700 series.



Scanning Electron Microscopy photomicrograph of Poromesh® media. Magnification 100X

POROMESH® MEDIA AND ELEMENTS

Poromesh® sintered wire cloth media are multiple layers of wire cloth which are pleated to maximize filter area and on-stream life. Purolator's proprietary sintering process metallurgically bonds each woven wire to adjacent wires to maintain the desired micron rating of the media – even under severe pressures. Poromesh media are made from 316/316L stainless steel wire cloth for excellent corrosion resistance and high temperature tolerance. The sintering process further improves the corrosion resistance of the media by relieving the stresses worked into the wires during the weaving operation. No other manufacturer offers this feature.

The multi-layered pleated construction makes Poromesh elements particularly suited for rugged usage. The pleating provides maximum filtration area, flow distribution, and dirt holding capacity. Support meshes prevent collapse and bunching of pleats at high differential pressures. Yet a Poromesh element is easily cleaned in suitable solvents for reuse.

Most Poromesh elements are electron beam welded – a Purolator exclusive. This process permanently joins the endfittings, filter medium and perforated center support core. Performed in a vacuum chamber, electron beam welding eliminates heat distortion, oxidation, and sensitization, providing superior product quality at reduced costs.

Standard Poromesh elements are rated at 2, 5, 10, 20 and 40 microns nominal and are designed to withstand 150 and 300 psid collapse pressures. For 4500 psid collapse pressure elements, please consult Purolator.

Poromesh® filter elements shown are (from left to right) 1300, 1100, and 1400 series elements.

MULTIPASS FILTER TESTING

Purolator utilizes the multipass filter test method, in accordance with ISO 16889 and NFPA T.3.10.8.8, to verify the efficiency of the filter media, and determine the dirt holding capacity of the filter elements. The clean flow rate pressure drop of an element is very important, but more important is the performance of the same filter when subjected to dirt loading conditions. The multipass filter test helps the user select the filter needed for his or her application. In the multipass test, a specified concentration of contaminant is injected upstream of the test filter at a known rate. Particle counters accurately measure the size and quantity of upstream particles per known volume of fluid (number of particles upstream), and the size and quantity of particles downstream of the filter (number of particles downstream). The oil passing through the test filter loops around the system and receives another injection of contaminant. The contaminated oil is presented to the test filter where most of the contaminant is trapped. This cycle continues until the test filter has trapped enough contaminant to cause the pressure drop across the test filter to reach 50 psid, the terminal point of the test. At this point, the test is halted and the upstream and downstream particle counts for a given micron size rating are compared.

Computerized Multi-Pass Test Stand

BETA RATIO

The resulting comparison is called the filter's beta ratio, which is simply the number of particles of a given micron size upstream divided by the number of particles of the same micron size downstream. For example, for a beta ratio of particles 3 microns in size with 50,000 upstream particles and 250 downstream particles, we would have:

$$ß_{3(c)} = \frac{\text{\# of particles 3 microns in size upstream of test filter}}{\text{\# of particles 3 microns in size downstream of test filter}} = \frac{50{,}000}{250} = 200$$

In words, this filter would have a rating described as "beta sub 3 equals 200."

(Frequently the beta ratio is stated as "greater than or equal to" 200 to imply it is no worse than 200.)

EFFICIENCY

The efficiency of a filter is noted as one minus one over beta times 100%. For this filter at 3 microns, the efficiency would be: $(1\text{-}1/ß_3) \times 100\% = (1\text{-}1/200) \times 100\% = 99.5\%$ efficient. Note that as the beta ratio changes from 75 to 100 to 200, the corresponding efficiency changes from 98.67% to 99% to 99.5%.

A filter which is 99.5% efficient at 3 microns captures 99.5 out of 100 three micron particles presented to the filter.

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Purolator Facet, Inc. has been a leader in aerospace hydraulic filtration for decades. Our filter system and element technology are now available to the industrial market with a full line of hydraulic filters, elements, and accessories. If you have a hydraulic or lubrication filtration requirement, call Purolator. We have what it takes to keep your project moving.

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