Element Technical Data Fundamentals

Performance Specifications/ Filtration Ratings

Schroeder filter elements meet a wide variety of requirements in today's workplace, from the simplest to the most sophisticated fluid power systems. Established industry standards enable users to select the optimal filter element for any application.

Filter elements are rated on the basis of their ability to separate contaminants of certain sizes from a fluid, under specific operating conditions. Filtration ratings can be measured by analyzing three areas of performance:

(1) efficiency or absolute rating and percent efficiency,

(2) dirt holding capacity (DHC), and

(3) the pressure drop across the element at a specific absolute efficiency.

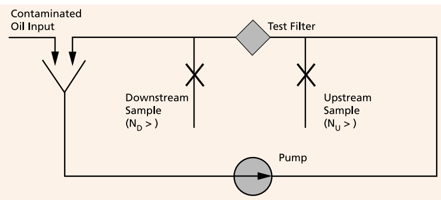
The Multi-pass Test

Filter element efficiency ratings and capacities are determined by conducting a multi-pass test under controlled laboratory conditions. This is a standard industry test with procedure published by the International Standards Organization (ISO), the American National Standards Institute (ANSI), and the National Fluid Power Association (NFPA). The multi-pass test yields reproducible test data for appraising the filtration performance of a filter element including its particle removal efficiency. These test results enable the user to: (1) compare the quality and specifications offered by various filter element suppliers and (2) select the proper filter element to obtain the optimal contamination control level for any particular system.

Hydraulic fluid (Mil. Spec. 5606) is circulated through a system containing the filter element to be tested. Additional fluid contaminated with ISO MTD Test Dust is introduced upstream of the element being tested. Fluid samples are then extracted upstream and downstream of the test element.

Dirt holding capacity is defined as the total grams of ISO MTD Test Dust added to the system to bring the test filter element to terminal pressure drop.

Figure 5. Multi-Pass Test Schematic



Filtration Ratio (Beta) ISO 4572 vs. ISO 16889

Due to the changes in the way particles are measured and the fact that a new test dust (ISO MTD) is now utilized, a new standard for multi-pass testing was necessary. This new standard, ISO 16889, replaces the old Multi-Pass Test Standard, ISO 4572.

The filtration ratio (more commonly referred to as the Beta ratio) is, in fact, a measure of the particle capture efficiency of a filter element.

ISO 4572 (Old)

$$\beta_x = \frac{\text{number of particles upstream @ } x \text{ microns}}{\text{number of particles downstream @ } x \text{ microns}}$$

where x is a specified particle size.

ISO 16889 (New)

$$\beta_{x(c)} = \frac{\text{number of particles upstream @ } x(c) \text{ microns}}{\text{number of particles downstream @ } x(c) \text{ microns}}$$

where x(c) is a specified particle size.

$$\text{Example: } \beta_{10} = \frac{400}{100} = 4$$

This particle capture efficiency can also be expressed as a percent by subtracting the number 1 from the Beta (in this case 4) and multiplying it by 100:

$$\text{Efficiency}_{10} = \frac{(4-1)}{4} \times 100 = 75\%$$

The example is read as "Beta ten is equal to four, where 400 particles, 10 microns and larger, were counted upstream of the test filter (before) and 100 particles, 10 microns and larger, were counted downstream of the test filter (after)."

The filter element tested was 75% efficient in removing particles 10 microns and larger.

Percent Efficiency

To calculate a filter element's percent efficiency, subtract 1 from the Beta, divide that answer by the Beta, then multiply by 100.

	Example Per ISO 4572 (old):	*Example Per ISO 16889 (new):*
Step 1:	$\beta_{10} \geq 75$	$\beta_{10}(c) \geq 75$
Step 2:	75 - 1 = 74	75 - 1 = 74
Step 3:	74 ÷ 75 = .987	74 ÷ 75 = .987
Step 4:	.987 x 100 = 98.7%	.987 x 100 = 98.7%

Using a calculator with a % key, you can use the shortcut version.

	Example Per ISO 4572 (old):	*Example Per ISO 16889 (new):*
Step 1:	$\beta_{10} \geq 200$	$\beta_{10}(c) \geq 200$
Step 2:	200 - 1 = 199	200 - 1 = 199
Step 3:	199 ÷ 200 = 99.5%	199 ÷ 200 = 99.5%

Absolute Rating

ISO 16889 replaces ISO 4572 as the International Standard for Multi-pass Testing. It provides a common testing format for filter manufacturers to rate filter element performance. For convenience, Betas are shown in this catalog for both old and new Multi-pass standards (ISO 4572 and 16889, respectively.)

According to ISO 16889, each filter manufacturer can test a given filter element at a variety of flow rates and terminal pressure drop ratings that fit the application, system configuration and filter element size. Results may vary depending on the configuration of the filter element tested and the test conditions.

Currently, there is no accepted ISO, ANSI, or NFPA standard regarding absolute ratings. Some filter manufacturers use $\beta_X(c) \geq 75$ (98.7% efficiency) for their absolute rating. Others use $\beta_X(c) \geq 100$ (99.0% efficiency), $\beta_X(c) \geq 200$ (99.5% efficiency), or $\beta_X(c) \geq 1000$ (99.9% efficiency). Performance of Schroeder elements is shown in the Element Performance Chart for each filter housing in Sections 3, 4 and 5 at a number of filtration ratios to allow the user to evaluate our performance against that of our competitors.

Dirt Holding Capacity

Dirt holding capacity (DHC) is the amount of contaminant (expressed in grams) the element will retain before it goes into bypass. All other factors being equal, an element's DHC generally indicates how long the element will operate until it needs to be replaced. The element's life span is directly related to the cost of operating the filter.

Dirt holding capacity, sometimes called "apparent capacity," is a very important and often overlooked factor in selecting the right element for the application. The dirt holding capacity of an element is measured in grams of ISO medium test dust contaminant as determined from the multi-pass test (ISO 16889). When selecting filter elements, it is beneficial to compare the dirt holding capacities of elements with similar particle removal efficiencies.

Table 7. Typical Dirt Holding Capacities for Z Media Elements (ISO MTD and 50 ppm ASA)

Element Size	Medium				
	Z1	Z3	Z5	Z10	Z25
N	12	12	9	11	11
NN	15	16	13	15	15
C	25	26	22	28	28
CC	57	58	46	62	63
A	25	26	22	28	28
K	112	115	86	108	93
BB	268	275	218	272	246
18L	200	205	165	203	184
8T	51	52	43	55	53
M	—	105	—	104	—
8Z	51	52	43	55	56
KT	—	—	—	56	—
9V	55	57	45	52	48
14V	102	105	83	104	94
7E	23	24	19	26	28
9C	57	58	46	62	63
6R	15	15	12	14	25

Pressure Drop

When sizing a filter, it is important to consider the initial differential pressure (ΔP) across the element and the housing. Elements offering a lower pressure drop at a high Beta efficiency are better than elements with a high ΔP at the same efficiency. At every level of filtration, Schroeder's Excellement® Z media elements offer the best combination of high efficiency, high dirt holding capacity, and low pressure drop.

Collapse Rating

The collapse (crush) rating of a filter (determined by ISO 2941/ANSI B93.25) represents the differential pressure across the element that causes it to collapse. The collapse rating of a filter element installed in a filter housing, with a bypass valve, should be at least two times greater than the full flow bypass valve pressure drop. The collapse rating for filter elements used in filter housings with no bypass valve should be at least the same as the setting of the system relief valve upstream of the high-crush element. When a collapse element becomes clogged with contamination all functions downstream of the filter will become inoperative.