Filter Bag Design

How to compare different brands of filter bags

By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

Selecting a filter bag for your application can be a tedious task as there are several filter bag design characteristics to consider and sales literature tends to obfuscate critical aspects of their design, perhaps in an attempt to make it more difficult to cross-reference to a competitor's product. This article will highlight the basic design characteristics to focus on, provide methodology to narrow your options and will assist you with figuring-out which filter bags are compatible with your specific bag filter vessel.

Interestingly enough, filter bag manufacturers often obtain their materials from the same sources. The manufacturing process of the raw material is such that the efficiency of the media may vary by material run; the material manufacturers define the filter media's efficiency and the filter bag manufacturers bid on the materials, bringing us to the topic of "**filtration efficiency**".

The way filter bag manufacturers describe the retention of their filter bags is to refer to a particle size in micron units and state whether it is "nominal" or "absolute" retention. It is a common misunderstanding by customers that a 10 micron filter bag is a universal retention specification, but it is not.

An absolute rated filter bag will have an initial retention efficiency of 90 to >99% for the specified particle size. Such efficiencies are also expressed as having a specific BETA ratio. Learn more about filtration efficiency with our article: "Understanding Retention Efficiencies".

$$\textbf{Beta Ratio} = \frac{\textbf{Upstream particle counts}}{\textbf{Downstream particle counts}}$$

Example: A Beta Ratio of 5000 indicates that 4999 particles of a total of 5000 were retained during testing, resulting in an efficiency of 99.98%.

Absolute rated filter media is less common than the other alternative, "nominally rated" filter media. Absolute rated filter bags are significantly more expensive and tend to be used for very specific and critical processes which justify such efficiency. Applications in food, beverage, pharmaceutical and fine chemical processes often require absolute rated filter bags. They are also typically used downstream of nominally rated filter bags to maximize their retention of ultra-fine particles.

Nominally rated filter bags do not have a universal efficiency, rather each filter bag manufacturer determines what the acceptable "efficiency range" is for a given filter bag design. This approach provides them with some flexibility due to the inherent variations and cost differences associated with acquiring the filter media used to manufacture their filter bags.

Example: Brand "A" 1 micron nominally rated filter bag may only be 70% efficient for the initial retention of particles >1 micron and as the filter media becomes clogged the efficiency increases. That same 1 micron nominally rated filter bag may also be 99% efficient for retention of particles >25 microns. Brand "B" may only be 60% efficient and thus <99% efficient for >25 micron particle size retention.

Different brands of nominally rated filter bags are difficult to compare from an efficiency perspective because they do not have a specific efficiency (hence "nominal" description) and some manufacturers might have higher efficiency requirements than others, so the best way to compare "brand A with brand B" is to try each and see which provides the desired protection for the longest timeframe. In a nutshell, the retention size for nominally rated filter bags is only an estimate so you cannot become too focused on the "number", nominal retentions should get you close for comparison sake.

Determining if you require a nominal or absolute rated filter bag is the first step because your options for absolute rated bags are significantly less. From there you need to determine which "size" filter bag you require.

There are four "industry standard" filter bag sizes referred to as #1, #2, #3 and #4. In addition to these industry standard sizes manufacturers often have their own "non-standard" size filter bags for the obvious reason that if you have one of their filter vessels requiring a non-standard size filter bag, you are "stuck" using them for all of your filter bag requirements. Perhaps that is a bit cynical, there are advantages for some types of non-standard filter bags, especially when used in conjunction with non-standard filter housing designs to enable higher particle loading and flow rates.

SIZE	DIAMETER	LENGTH	AREA	VOLUME	MAX. FLOW RATE
1	7"	17"	2.6 ft²	2.0 gal.	90 GPM
2	7"	32"	5 ft²	4.5 gal.	180 GPM
3	4"	9"	0.8 ft²	0.5 gal.	25 GPM
4	4"	15"	1.5 ft²	0.7 gal.	50 GPM

The majority of filter bag housings require either #1 or #2 size filter bags and of those two sizes the #2 size is the most popular. Since not all retentions, materials of construction and design characteristics are available for all sizes, it is important to narrow your search for designs which are offered in the filter bag size you require.

The criteria used to compare filter bag designs are the same for both nominal and absolute retentions although due to the high efficiency of absolute rated retentions there are less variations to the inherent design.

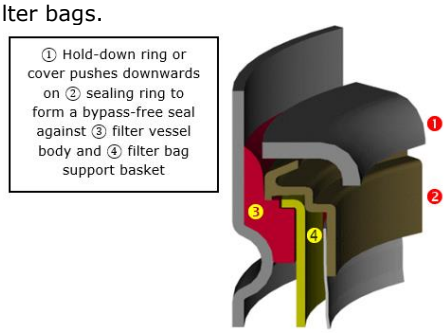
The material of construction needs to be compatible with your process and that is the next limiting factor. The two most common materials of construction are polypropylene and polyester felt; other materials include nylon, PTFE® and Nomex®. The sealing ring, which is at the open end of the filter bag, is also available in polypropylene and polyester with alternatives made of steel, stainless steel, Santoprene® and nylon depending upon the sealing ring design.

The filter bag seal with the filter bag vessel is critical to the actual filtration efficiency received. Many housings

are designed in such a way that the efficiency of absolute rated filter bags would exceed the potential filtration efficiency of the actual filter bag housing. The seal between the filter bag and housing needs to be congruent with the desired filtration efficiency.

The simplest method of forming a seal between a filter bag and vessel is using a round ring sewn within the opening of the filter bag to keep the opening "open". This also forces the outer circumference of the filter bag to seal against inner circumference of the filter vessel. This is not the most efficient seal and some bypass is expected.

The other type of seal is a deformable or "crush" seal which refers to the filter bag ring being forced to expand against the sealing surfaces of the filter vessel due to downwards force upon the top of the filter bag. If your filter bag housing has a hold-down ring between its cover and filter bag, you can use a crush seal style filter bag. This style will generally provide better efficiency for nominal retentions <25 microns and are used for all absolute rated filter bag designs. You can certainly acquire 1, 5, 10 and 25 micron filter bags without a crush seal, but if you experience bypass trying a crush seal style would be the next step before evaluating absolute rated filter bags.



Filter Bag Construction.
Less expensive filter bags are made of thinner materials and often have molded seams; the alternative to molded seams are sewn seams. Molded seams are limited to materials such as polypropylene and polyester and they are generally considered to be both more efficient and stronger – meaning less particles will bypass the filter bag seam and a full filter bag is less likely to break.

Welded filter bags tend to have a deformable seal design as the same process which welds the seams welds the sealing ring to the bags. When the material required is not available with a deformable seal, a sewn design is provided and it will have a standard ring seal.

A key consideration to selecting the best filter bag for your application is minimizing the frequency of replacing filter bags. Besides the annual cost of procuring filter bags, the labor hours required for changes, increased exposure to the process fluid, loss of process fluid and the cost for disposal all add to the overall overhead of a bag filtration system.

Filter bag changes can be minimized using designs which utilize a heavier/thicker material. Filter bags provide depth filtration and therefore thicker materials support a higher particle retention volume. Of course, filter bags made of thicker materials cost more, however they may cost three times as much but hold 4 or 5 times the volume of retained particles, reducing labor, disposal and procurement costs.

Absolute rated filter bags tend to be constructed of multiple layers of increasingly denser material to best distribute particle loading to maximize the overall volume of particles retained.

Lower cost filter bags reflect their design, so thinner materials coupled with a broader efficiency range can make one filter bag seem overpriced compared to another and this is the fallacy of simply looking at the stated nominal retention and price. It is easier to compare absolute rated filter bags because their specific efficiencies are stated in a universal way (BETA Ratio). This is why it is important to sample filter bags before changing brands. It is also why you need to determine the efficiency you require, whether your existing housing is supportive of that efficiency and factors related to frequency of filter bag changes.

All bag filter vessels are NOT alike. While there are (4) "industry standard" size filter bags, the seal between the filter bag and vessel is not universal. If the manufacturer of your filter vessel differs from the manufacturer of your filter bags, double-check with the filter bag manufacturer to ensure compatibility; they will often provide free samples to reassure you of fit and efficiency.

Over the years there have been many acquisitions and mergers in the filtration industry. Hayward acquired Loeffler Filter-Technik in 1998 and GAF Filter Systems in 1999, marketing the collective products under the "Hayward" brand. In 2005 Eaton's newly formed Filtration Division acquired these products from Hayward and they are now marketed under the "Eaton" brand.

Sometimes companies go out of business, for example Pall Corporation just announced effective January 2021 they would discontinue their Filter Specialists Inc. (FSI) product line of filter bags, so if you have an FSI vessel or have been using their filter bags you will need to go through this process of finding a suitable replacement.

This is where we come in! We can help you determine the filter bags compatible with your housing and process; this includes providing free samples to try. We will establish customer specific inventory in support of JIT delivery to reduce the potential of you not having replacement filter bags when needed. We can even suggest when it might make more sense to automate your process with a self-cleaning filter!

This brings us to the final step in your search for filter bags, contacting our company by phone or email today so we can put our decades of experience to work for you!

Visit us at https://fd-filterbags.com