Gusmer Enterprises, Inc.®

Filter Retention: Understanding Nominal and Absolute Ratings

Understanding a filter's retention rating (pore size) and whether or not it is nominal, absolute, and what the filter's true particle retention will be is crucial to making sure the correct filter is selected for a process.

How is a filter's pore size determined?

There are no industry standard guidelines regarding how filter pore size, retention, or rating is determined. When assigning a filter its pore size, 0.45 µm for example, many factors are taken into consideration by the manufacturer including type of filter, removal efficiency, challenge testing, and ability to retain trapped particles.

What is an absolute rated filter?

Absolute ratings are one of the most varied claims in industry. One manufacturer may state that a filter must remove greater than 99% of particles at its pore size to be rated absolute, while others may rate a filter that only removes 90% of particles at its stated pore size as absolute. A manufacturer may also rate a pre, clarification, or depth filter as absolute due to high initial retention, but when its media may be susceptible to deformation or unloading thereby allowing particles larger than the pore size downstream. EMD Millipore only considers an integrity-testable membrane with validated retention of 10^7 at its stated pore size as being absolute.

What is a nominal rated filter?

A nominal filter is one that is not absolute. A nominal filter may not have a high retention at its selected pore size or may deform or allow particle bypass under certain conditions, such as excessive pressure. A nominal filter may also possess different retention characteristics with different process streams. EMD Millipore considers any filter that is not an integrity-testable membrane to be nominal, regardless of media or retention.

Are there absolute filters that are not integrity testable or have less than 10^7 retention?

Yes. In fact, some low-cost 0.45 µm membranes are now considered not absolute and may not be able to be reliably integrity tested. Gusmer does not supply any of these membranes. Some manufacturers consider retention of 90% sufficient for an absolute rating.

Can filters rated the same pore size have different retentions?

Yes. Many filters rated 1.0 µm, for example, may only retain 50% of 1.0 µm particles while others may retain 99% of 1.0 µm particles.

What can be used to determine a filter's true removal characteristics?

Particle or microbial challenge test results are often used with membranes or certain fine prefilters. With bulk depth filters, comparing the clean water pressure drop is a good indicator of retention at the stated pore size. These curves are often available on datasheets or can be requested from the filter manufacturer. In general, when comparing filters with the same pore size rating, the filter with the highest clean water pressure drop at a specific flow rate will often retain the highest percentage of particles at the stated pore size.

What is graded density and how does that affect retention?

Graded density is a property of many clarification and prefilters in which the upstream of the media is more open than the downstream and may not contribute as much to the stated retention. A graded density filter may have greater dirt holding capacity, but lower retention at its stated pore size. This can be a benefit when requiring a higher capacity but not necessarily needing a high retention, such as when there is a another downstream filter with high retention but low capacity.

What is membrane asymmetry and how does that affect retention?

Only symmetric membranes, such as PVDF, have the same retention throughout their depth. An asymmetric membrane, such as PES, may have a final retention of 0.45 µm but have a depth that is only 20% or less with the retention of 0.45 µm. The upstream depth comprising the majority of the filter is much more open than 0.45 µm and will not contribute much to the final retention.

How does EMD Millipore grade and rate its filters?

EMD Millipore only considers an integrity-testable membrane with validated retention of 10^7 as being absolute. EMD Millipore typically rates nominal filter pore sizes when that filter has greater than 99% retention at its stated pore size. A 0.5 µm nominal prefilter will remove at least 99% of particles at 0.5 µm.