Beta Ratios Explained and Applied To Liquid Filter Selection

From American Filtration Society, Minute Article, November 2010, Frank Buehner

Liquid Filter Beta Ratios:

Absolute rated liquid filter selection is tied to the media micron rating, materials of construction, construction design, and particulate removal efficiency filter factor known as its Beta Ratio (Figures 1, and 2). Consider that Engineering and Purchasing usually see absolute rated liquid filter efficiencies from vendor data sheets and quotes listed at 99%, 99.9% or 99.98%. The micron ratings usually range from 0.1 microns to 100 microns for absolute rated filters.

The use of efficiency as a % is difficult to understand and explain. Why may a filter at 99.98% efficiency be significantly higher in price than a 99% filter? The Process Engineer making decisions for uptime, critical process efficiency, product quality, heat exchanger efficiency, and instrument accuracy, must understand the difference. The Purchasing Agent should understand this as well.

For example, what is the difference when the filter efficiency is 99% or 99.98% at 2 microns? We perform the calculation (Figures 1); we see that 99.98% efficiency equates to a Beta ratio of 5,000. A 99% efficiency filter has a Beta ratio of 100. The result: a Beta 5,000 filter will pass only 1 particle in 5,000 from the incoming stream greater than or equal to 2 microns. A Beta 100 filter will pass only 1 in 100 particles greater than or equal to 2 microns; a significant difference. Figure 1 describes a filter's effluent based upon three filter efficiencies.

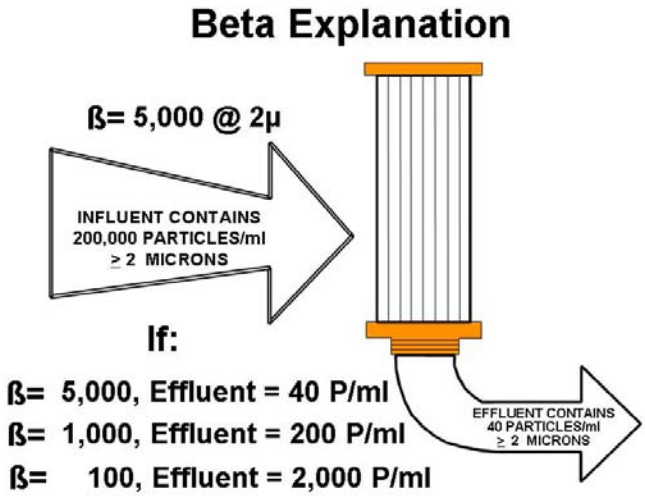

Figure 1

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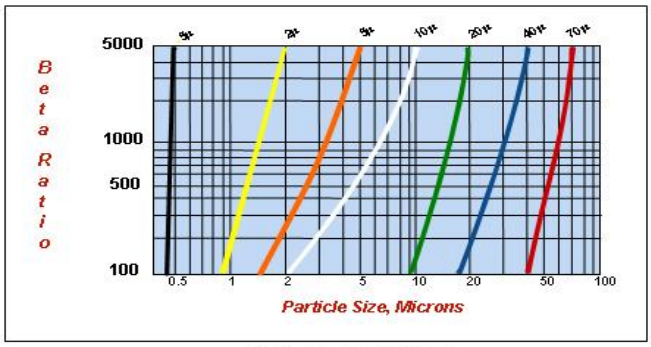
The filter manufacturer has tested their filters, built from media of different micron and beta ratios such as polypropylene, polyester, fiberglass, and cellulose in a single-pass flow system to develop the diagram in Figure 2. A single pass ensures a constant challenge of solids to the filter until it meets its fouled differential pressure, usually 25 psi for bag filters and 35 psi for cartridges.

$$\text{Beta Ratio } (\beta) = \frac{\text{Upstream Particle Count at Specified Size \& Larger}}{\text{Downstream Particle Count at Specified Size \& Larger}}$$



BETA CURVES

Each filter element will have a different Beta Ratio for every specified particle size. The determination of a variety of Beta values for the same filter provides a filter efficiency profile commonly referred to as a Beta Curve.

Filter Efficiency (%) = [(β-1)/β]x100%

Figure 2

How are the Beta Curves employed to select a filter for a particular application?

A portion of the fluid sample supplied to the filter manufacturer's test lab is first used to obtain the fluid's Total Suspended Solids (TSS) and Particle Size Distribution (PSD). A portion of the test sample is then employed, along with data from the MSDS to select media options most effective and least expensive for the fluid being filtered. The lab combines experience, TSS, PSD, temperature, solvent content, oil content, pH, and any other factors important for this application.

The test sample is filtered by peristaltic pump through selected media discs to optimize media, micron rating, beta ratio, and examine pressure drop at several flow rates. The selected media disc surface area is then scaled up to known filter surface areas for a bag or cartridge filter, either one already designed, or customized for the application.

For the owner, operator, specifying engineer, purchasing agent, maintenance manager, or filter distributor, a filter's efficiency is equally important as selecting the filter's micron rating when your process uptime is critical.

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