

# Upgrading from Cellulose to Glass

## First, understand media efficiencies.

When a filter element is rated at a particular micron size, it is said to remove particles of that particular size and larger from the fluids it is filtering. However, filter elements of different media with the same micron rating can have substantially different filtration efficiency. Filter efficiency is calculated by taking the ratio of particles upstream of (before) the filter to particles downstream of (after) the filter. The higher the ratio, the more efficient the filter and the less particles it allows to pass. There are two distinct ratings of filter efficiency, classified as nominal and absolute.

## Nominal Efficiency.

Nominal ratings refer to a degree of filtration at a particular micron by weight of solid particles. Filters rated as nominal (we're looking at you cellulose) have no maximum pore size, meaning while they may remove some 10 micron particles, they can still allow larger particles such as 200 micron to pass through and devastate components in the system.

## Absolute Efficiency.

Absolute ratings, such as most glass media filter elements are classified under, derive their value from the largest size particle which can pass through the pores of the media. Along with much greater efficiencies, glass elements have superior fluid compatibility versus cellulose with hydraulic fluids, synthetics, solvents, and high water based fluids.

## Cellulose vs Glass Elements.

Organic cellulose fibers can be unpredictable in size and effective useful life, while inorganic glass fibers are much more uniform in diameter and much smaller than cellulose fibers as seen in the images to the right (Figures 2 and 3).

The illustrated elements on the following page provide a visual representation of the efficiencies of both a cellulose and glass element at their respective efficiency ratings.

The cellulose element would typically achieve a code no better than 22/20/17. Runaway contamination levels at  $4\mu_{[c]}$  and  $6\mu_{[c]}$  are very common when cellulose media is applied in which a high population of fine particles exponentially generate more particles in a chain reaction of internally generated contaminants. The illustrated glass element would typically deliver an ISO Fluid Cleanliness Code of 18/15/8 to 15/13/9 or better depending upon the system conditions and ingress rate.

## Upgrading to Hy-Pro G8 Dualglass.

When upgrading to an absolute efficiency glass media element, the system cleanliness must be stabilized. During this clean-up period the glass element halts the runaway contamination as the ISO cleanliness codes are brought into the target cleanliness range. As the glass element removes years of accumulated fine particles, the element life might be temporarily short.

Once the system is clean the glass element can last up to 4~5 times longer than the cellulose element that was upgraded as shown in Figure 4.

Figure 1: Filter Efficiency Equation

$$\beta_{x_{[c]}} = \frac{\text{quantity particles } \geq X\mu_{[c]} \text{ upstream of filter}}{\text{quantity particles } \geq X\mu_{[c]} \text{ downstream of filter}}$$

Figure 2: Cellulose Filter Media

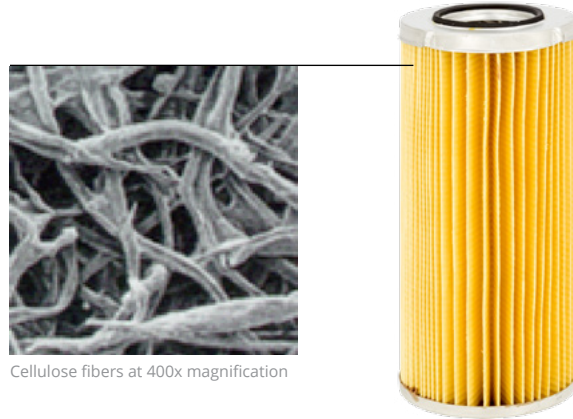
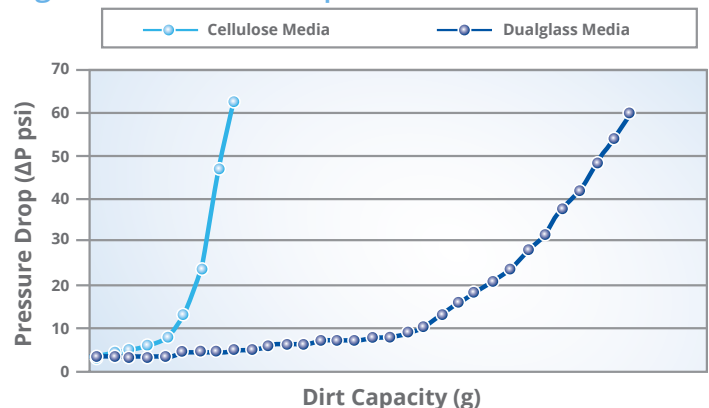


Figure 3: Glass Filter Media



Figure 4: Element Lifespan



# Cellulose: $\beta 10\mu_{[C]} = 2$

$$= \frac{50,000 \text{ Particles In}}{25,000 \text{ Particles Out}}$$

Dirt in

50,000 particles  $10\mu_{[C]}$  or larger

Dirt out

25,000 particles  $10\mu_{[C]}$  or larger



**50%**  
efficiency

# Glass: $\beta 10\mu_{[C]} = 1000$

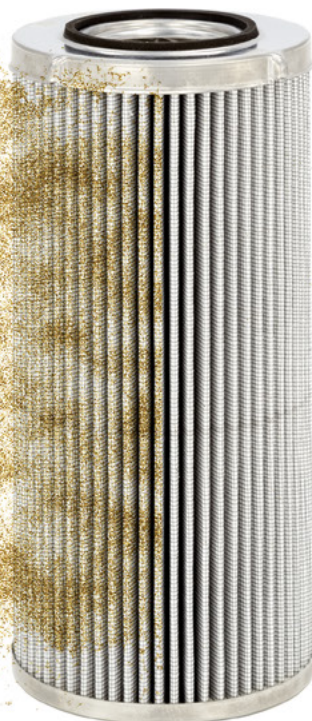
$$= \frac{50,000 \text{ Particles In}}{50 \text{ Particles Out}}$$

Dirt in

50,000 particles  $10\mu_{[C]}$  or larger

Dirt out

50 particles  $10\mu_{[C]}$  or larger



**99.9%**  
efficiency

**HY-PRO**