Donaldson
FILTRATION SOLUTIONS

Clean Fuel & Lubricant Solutions

Comparing Fuel Filters and Micron (µ) Ratings

How Clean is Your Fuel?

No matter which filter you use, testing is the only way to know how clean your fuel truly is. Cleanliness test results are expressed by ISO 4406 Codes.

ISO 22/21/18 typical cleanliness upon dispensing in areas with ULSD. Actual cleanliness varies greatly by region and infrastructure.

ISO 18/16/13 minimum cleanliness level recommended by the Worldwide Fuel Charter over 10 years ago

ISO 14/13/11 today's recommended diesel cleanliness when dispensing into equipment

ISO Codes are three numbers that define the number and size-distribution of particles present in the fluid

Fuel at different cleanliness levels under a microscope:

A finer micron filter will collect smaller contamination from the fuel and may reach its dirt holding capacity more quickly. It may need replacing more often than a larger micron filter.

A good filter is low cost, high performance protection for expensive engine components.

The technology used in diesel engines to meet stringent emissions requirements is advancing at an unprecedented rate. Modern high pressure common rail systems provide higher levels of operational efficiency and reliability.

The resulting higher pressures and reduced tolerances require cleaner fuel than ever before. Customers who are concerned about their fuel cleanliness frequently ask "what micron rating is my current filter" and "do you have a finer micron filter I can use"?

The published *micron rating* (or particle size that a filter captures), does not fully convey an understanding of the performance of the filter – unless you also know the *efficiency* at which it is measured. The efficiency of a liquid filter on a given particle size is frequently described as either a Beta ratio (ß), or as a percentage (%). (Make sure that a manufacturer is testing to the industry accepted standards – allowing for true apples-to-apples comparisons.)

In other words, two filters that both claim to capture the same size particles or have the same micron rating may provide vastly different performance results.

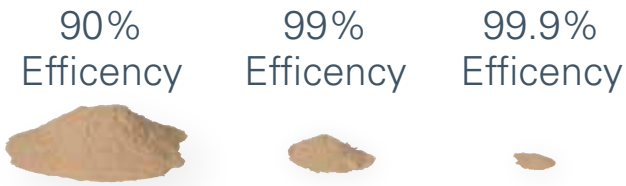
For example, when comparing two filters that are both rated at 5 microns, if filter A has an efficiency of 99% it will remove 99% of contaminant 5 microns and larger from the fuel. If filter B has an efficiency of 50% it will only remove 50%, or roughly half, of the same contaminant from your fuel. Filter B may allow up to 50 times more contamination to pass than filter A, a very different level of performance!

The higher levels of contamination in your fluid may result in accelerated wear, and ultimately, premature component failure.

Commonly used fuel filters may have multiple efficiency ratings describing their performance.

Dirt in Your Diesel

Before Delivery



$ß_{5(c)}$ = 10 (corresponds to 90%) | $ß_{5(c)}$ = 100 (99%) | $ß_{5(c)}$ = 1000 (99.9%)

For example, a filter may be described as being 50% efficient on 5 micron particles, 75% efficient on 12 micron particles and 98% on 23 micron particles. You cannot guess the efficiency of a liquid filter if you are only given the micron rating.

In summary, particle or micron sizing means little without a measure of efficiency. Efficiency does not describe a filter without a micron size. If you have any questions regarding the filter you are using or would like to use, please contact **Donaldson's Clean Solutions Team.**

What is Beta Ratio?

Beta ratio (ß) is a formula used to calculate filtration efficiency.

In a multi-pass test, fluid is continuously injected with a uniform amount of ISO test dust, then pumped through the filter. Filter effciency is determined by monitoring contamination levels upstream and downstream of the test filter at specific times. The upstream to downstream particle count ratio is known as the beta ratio.

A complicating factor when trying to determine the efficiency of a bulk filtration system is the multi-pass nature of these test methods, where the fuel passes through the filter multiple times. Bulk filtration is typically a transfer application or "single pass", because the diesel only passes through the filter once. Any remaining contaminant is passed directly along in the fuel flow. For this reason, it is generally advised that bulk filters be extremely efficient.

Indicates that testing was done with APC's calibrated with NIST fluid

$$ß_{10(c)} = 1000$$

1000 times more particles upstream than downstream that are 10µm and larger

$$\text{Beta ratio}_{(x)} = \frac{\text{particle count in upstream oil}}{\text{particle count in downstream oil}}$$

where (x) is a given particle size

Note: When interpreting filter efficiency rating, it's important to understand what the test standards are designed to do. The laboratory test standards are designed for comparison testing using very controlled parameters to ensure consistency and repeatability. The test standards use calibrated, controlled contaminant, and do not account for vibration and flow variations. The standards also use a specified testing fluid that will be different than diesel used in the field.

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Need a Clean Solution?
As a global organization, we have offices throughout the world. Please direct your inquiry to **clean.solutions@donaldson.com**. This will enable us to address your inquiry in the shortest possible time.

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