



Understanding Engine Oil Contamination and Filtration

Oil contamination and filtration can be easily understood when you have a basic of knowledge of the three critical oil filtration requirements, the challenges around meeting those requirements, and the available solutions.

Oil Filtration Requirements

Engine oil filters are challenged with three main requirements:

- To remove the size of contaminant determined to be the most detrimental to the engine, which is *efficiency*
- To have the *capacity* to hold that contaminant for the recommended service interval
- To have the ability to allow the oil to continue to flow through the filter and be cleaned even as the restriction in the filter increases. This is *cold flow ability*.

Efficiency is the measure of filtration performance. For example, a filter with 50% efficiency removes half the contaminants in oil at a given particle size. The efficiency of filters should always be made using the same contaminant and standard tests.

Micron rating is a rating given to a filter characterizing efficiency of particle removal at a given size and test method (i.e. 10 μ m at 95.0% efficiency per ISO 4548-12). Without all three components a micron rating cannot be directly compared to another rating.

Cold flow represents any condition that causes restriction to the oil through the filter. Cold temperatures or oil that has become thick due to high soot and sludge levels can cause this restriction.

The filter can also cause this restriction due to too high an efficiency. The result of too high a restriction is the opening of the by-pass valve, allowing unfiltered oil to circulate in the engine. While this condition is necessary to ensure lubrication and cooling to prevent engine failure, it does increase wear and shorten engine life. Hence a high performing oil filter requires having the right balance of efficiency, capacity and cold flow ability.

Efficiency, capacity and cold flow ability requirements are critical, and necessary to ensure optimum engine life and performance. The optimal balance of these three requirements can only be accurately determined through real world testing that imitates the conditions found in a real world operating environment.

Cummins Filtration has the most resources dedicated to research and development in the industry today. Fleetguard™ lube filters are designed, based on this real world on-engine testing, to provide the optimal levels of efficiency, capacity and cold flow ability. Fleetguard™ oil filters are designed to meet or exceed the original equipment specifications for service intervals and as a result, provide the best engine protection.



Real World testing facility
in Cookeville, TN

Challenges of Oil Filtration Requirements

In order to appreciate the technological advantages of Fleetguard products, we must first understand the challenges due to oil contamination in the engine. We will then look at the various types of filtration media, review their pros and cons, and then we can fully understand why Cummins Filtration manufactures filters the way it does.

First, let's understand contamination in current diesel engines, and the contamination we expect on the next generation of diesel engines. Contaminants in diesel engine lubrication systems are classified in two main categories- organic and inorganic.

Organic contamination, otherwise known as sludge, is made up of all the by-products of combustion and comprises approximately 75% of the total contaminants found in diesel engine oil. It will plug a filter, limiting its ability to filter out other harmful contaminants. Abrasive soot will cause wear in tight tolerance areas such as fuel injector adjuster screws, adversely effecting fuel economy and engine performance. Soot causes oil thickening and increases engine wear, and sludge causes filter plugging.

Inorganic contaminant, referred to as dust, is made up of dirt, gasket material, core sand and wear metal. In addition to organic contamination, it is also directly responsible for the wear in a diesel engine. Some competition refers to dust holding capacity. However, a filter's dust-holding capacity is not an accurate indicator of a filter's performance. Real world testing shows that 75% of the contamination in the oil is from sludge. A high performance filter offers capability to hold sludge along with dust in the oil.

Cummins Filtration has found that by controlling these organic and inorganic contaminants, we can reduce wear in the engine and greatly increase engine life. So the filter challenge is this: remove the wear causing material, be able to hold the tremendous amount of sludge and dust dispersed in the oil, and do it all without plugging. That is the ideal balance between efficiency, capacity and cold flow ability.

Filtration Design Solutions

To meet these challenges, Cummins Filtration has developed technologically advanced media and filtration designs.

Full Flow Filtration and Synthetic Media

Full flow filtration refers to filtration that filters the full amount of oil that then lubricates, cools and seals critical engine components. In the past, various types of media, from cellulose (paper) to synthetics have been used in full flow filters.



The latest generation of filtration media, StrataPore™, was designed and manufactured by Cummins Filtration. StrataPore™ media eliminates many of the drawbacks of older synthetic media and is the first truly extended service media.

StrataPore™ is a multilayered product. Each of the layers provide a varying degree of finer micron rating. By combining layers of material, each with a higher micron rating, a media with superior efficiency is produced. Also, due to the small fiber size, flow restriction is minimized (great cold flow ability) providing much greater capacity. Remember the balanced design goal of high efficiency, high capacity and good cold flow ability, all of which are accomplished with the StrataPore™ media.

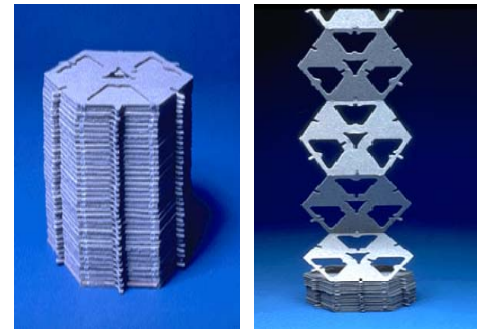
Bypass Filtration and Stack Disc Media

Engine manufacturers have incorporated bypass filters into their engine filtration systems for years. Bypass filtration refers to the filters that filter or super clean a small percentage of the oil at a finer size of contaminant than full flow, and then return the cleaned oil back to the oil sump. Eventually all the oil is subjected to this extra filtration, with many positive results. Bypass filters have consistently provided longer engine life by removal of the finer wear causing dust contaminants that the full flow filters may be unable to remove. Bypass filters can additionally assist for sludge removal.

According to Cummins Service Bulletin 3810340-04, “except for the B series model, all turbocharged Cummins engines must use bypass filtration and bypass filtration is strongly recommended for use on all naturally aspirated engines.”

Years of testing and design have shown that pleated paper bypass filters do not provide adequate engine protection. They are unable to meet the strict requirements of fine contaminant removal, and plug very easily with sludge. It is because of these reasons that Cummins Filtration has developed specially designed media for bypass filtration.

Cummins Filtration stack disc media, first used in the Fleetguard™ LF777 bypass filter, is made from compressed cellulose with a patented cutout design. Since the fibers are compressed together, no resins are required, eliminating the inherent negative qualities of typical cellulose. As the bypassed oil flows through the stack of tightly spaced discs of media, much finer wear-causing contaminants like dust are removed. As an added bonus, stack disc absorbs sludge from the oil. Since stack disc media has a high affinity for sludge, the partnership between StrataPore™ and stack disc produces a true extended service filter, capable of controlling both abrasives and sludge.



Stacked Disk Media

Combo Lube Filters with Synthetic and Stack Disc Media

Since the mid 1980's, Cummins Filtration has incorporated both the full flow filter and bypass filter in one unique spin on “combo” design, used on many Cummins Engine applications.

By using StrataPore™ media in the full flow section and stack disc media in the bypass section, one combo filter can outperform the standard two filter configuration. This provides many benefits to the customer including:

- High efficiency and capacity StrataPore™ full flow media with great cold flow ability
- High efficiency stack disc media with sludge removal ability
- Fewer filters to change, decreasing service time
- Fewer filters to inventory
- Fewer filters to dispose of



Combination filtration with patented Venturi Nozzle

According to Cummins Service Bulletin 3810340-04, "Cummins engines are fitted at the factory with a quality Fleetguard™ combination lubricating oil filter, which contains both a full flow and bypass filter in one filter can. Many of them are a Venturi™ design which directs all of the oil flow to vital engine parts instead of returning a portion of it to the pan. These filters provide the optimum balance of fine filtration for protection and rugged construction designed for long filter life."

Cummins Filtration, using the proven combo filter technology found on Cummins applications, has developed Fleetguard Venturi™ combo filters for many Caterpillar, Detroit, Mack and other applications. Customers can now have all the advantages of finer efficiency to reduce engine wear, higher contaminant capacity for extended service intervals and great cold flow ability to ensure adequate oil flow and lubrication in all conditions.

For more information about these and all Cummins Filtration products, visit cumminsfiltration.com or contact Customer Assistance at 1-800-22-FILTER (1-800-223-4583).