



**NanoNet**<sup>TM</sup> Advanced Filtration Media.



## Fleetguard® Fuel Filters with NanoNet Media.

Do you want a fuel filter that...

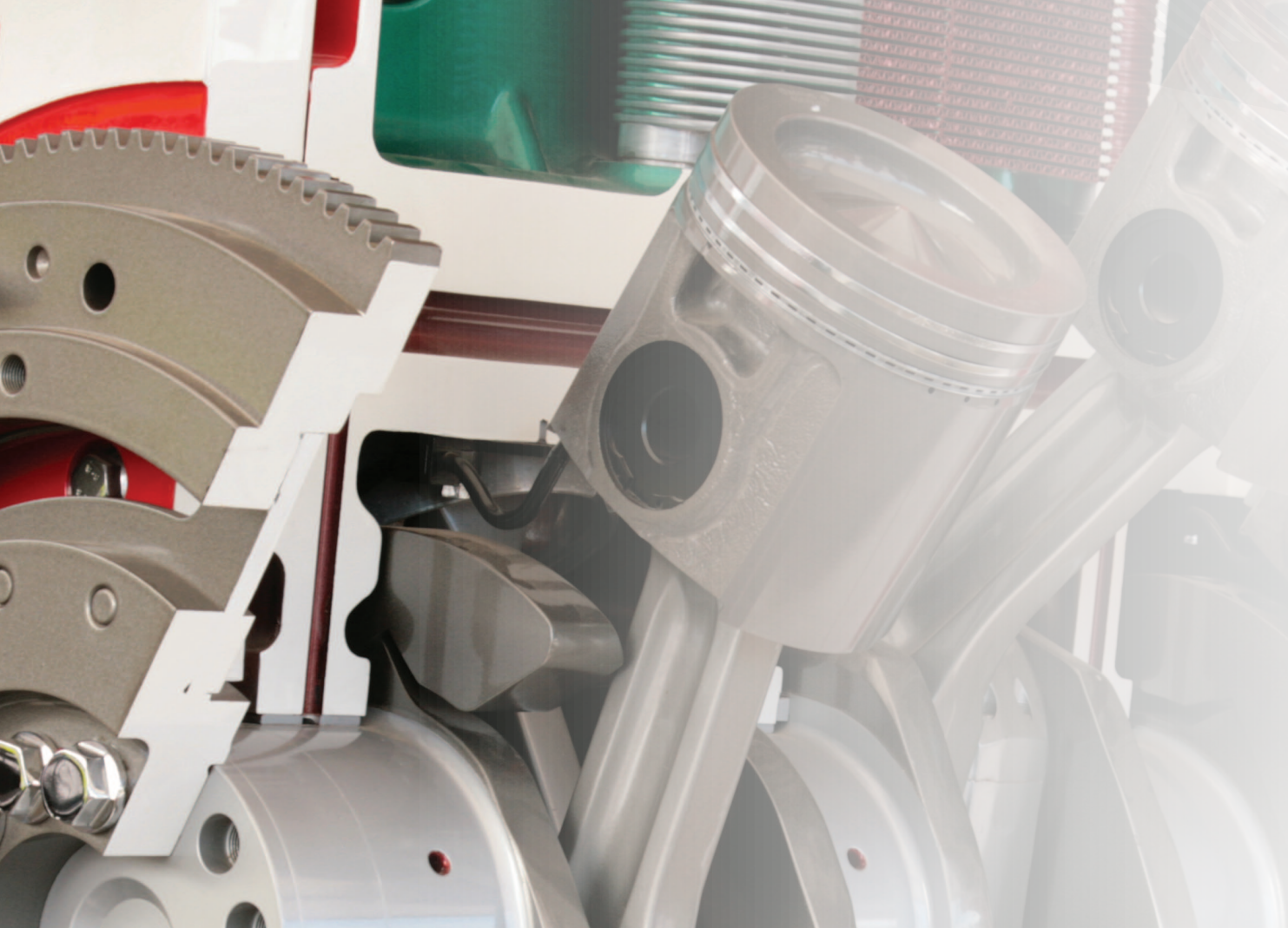
- protects your injectors better throughout the filter's service interval?
- is not affected by water in fuel like conventional cellulose filters?
- traps and retains contaminants even under real world vibration and flow surge?
- can extend service intervals, maintain high efficiency, reduce downtime and maintenance costs?

NanoNet advanced media technology provides the absolute best in filtration performance so you can depend on your equipment to get the job done every time.

Why NanoNet Media?

**NanoNet**<sup>TM</sup>

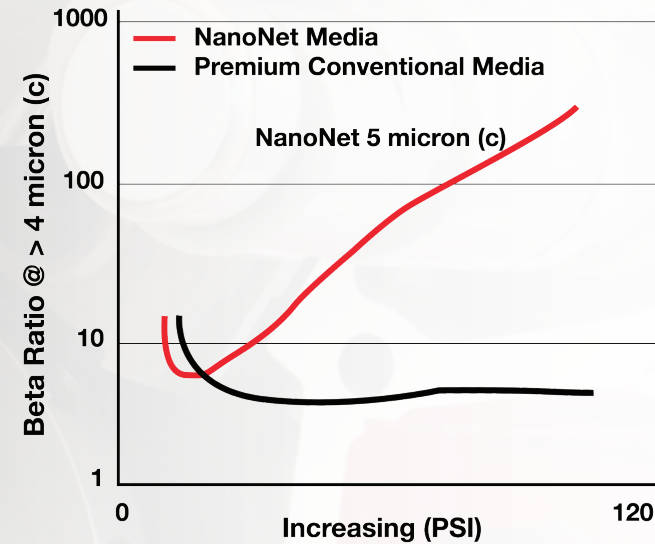




## Solution: Cleaner Fuel with NanoNet.

NanoNet advanced media provides the best known defense from contaminants in fuel to help keep your fuel injection equipment healthy. Maintaining a clean fuel system is critical in order to meet increasingly tough standards for modern diesel engines.

### Performance Under Pressure



NanoNet media, the American Filtration Society's *2013 New Product of the Year* winner, is available in a range of Fleetguard fuel filtration products.

## Changing the Environment.

### Problem: Tougher Standards Require Cleaner Fuel.

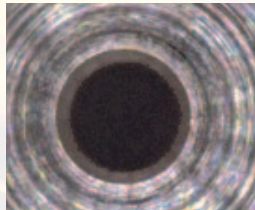
Today's tougher governmental regulations mean fuel systems have to be more efficient (better fuel economy while maintaining lower emissions). These stringent standards have led to the use of High Pressure Common Rail (HPCR) fuel injection systems which require ultra-clean fuel. HPCR systems are more susceptible to damage by contaminants because of smaller component clearances, meaning that clean fuel is more important than ever.

Removes and retains **10-13X** more contaminants than competitive media.

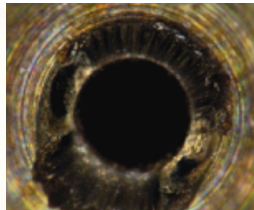


## Solution: Increased Protection with NanoNet.

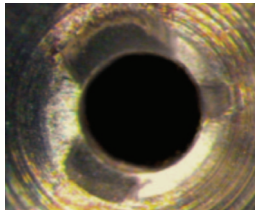
NanoNet removes and retains particles to protect fuel injection equipment, even in locations where fuel contamination levels are dangerously high. In a Cummins test specifically designed to damage fuel injectors in 50 hours or less, dust is systematically fed into the fuel system during engine operation. While other filters permit injector failure, the Fleetguard Fuel Filter with NanoNet media provides injectors with extreme protection against fuel contaminants.



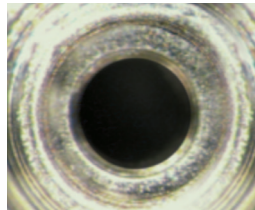
New Diesel Metering Valve (DMV) Seat



Field Failure After Teardown Observation



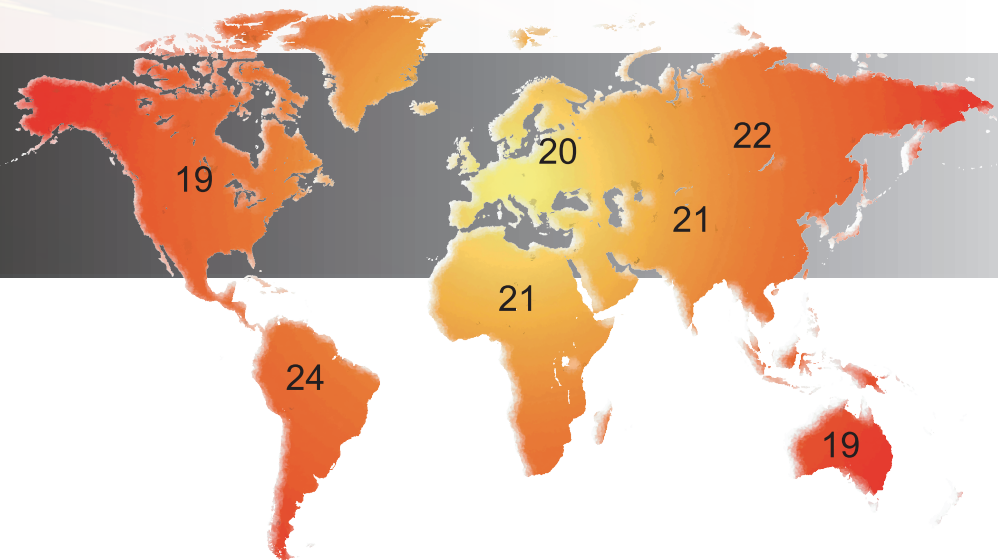
Dust in Fuel Test with Conventional Prem. Filtration - Failure in Less Than 50 Hours



Dust in Fuel with NanoNet Filtration No Wear After 190 Hours

Cleanliness of Diesel Fuel from Public Fueling Stations

**ISO Recommended Cleanliness: 18**



## Good News for Bad Fuel.

### Problem: Contaminated Fuel.

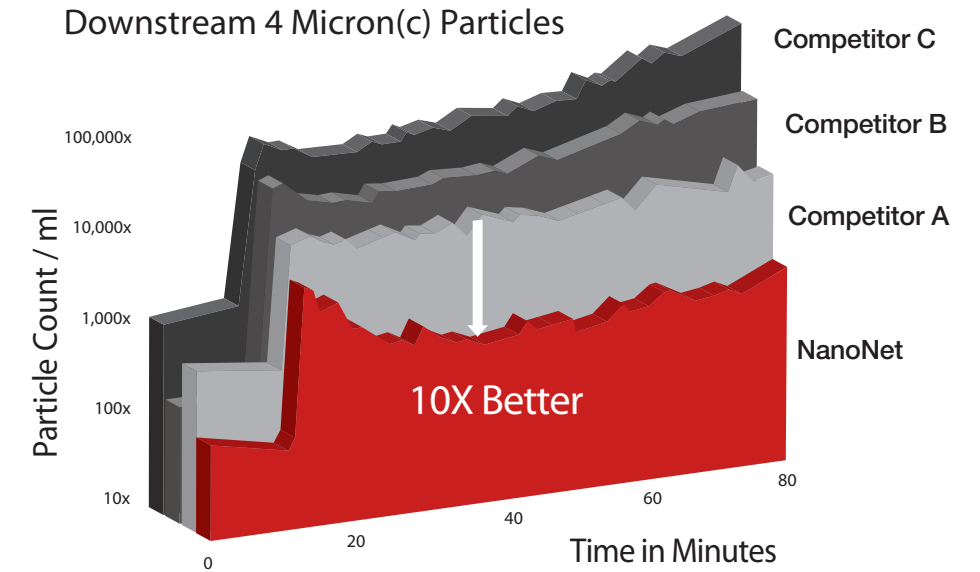
Dirty fuel is a commonly increasing problem across the world, causing major concern for today's precision engines. Global fuel analyses demonstrate that fuel contamination levels have doubled over the past several years. In 3.8 litres (1 gal.) of fuel, the average contamination level of particles greater than 4 microns is over 18 million. Because fuel cleanliness is largely unregulated, fuel system providers and engine manufacturers are forced to develop countermeasures that combat contamination.





## Solution: Better Injector Performance with NanoNet.

10-13 times more effective at removing 4 micron particulate contaminants than competitive media, NanoNet is best at protecting injectors against the release of particles during engine vibration and fuel surge. This allows fuel injectors to perform like new over the course of their life.



## Injector Protector.

### Problem: Loss Of Fuel Economy.

Inefficient fuel filtration can lead to wear of injector components. This wear can result in over-fueling, deposits, increased nozzle wear, reduced performance and a drop in fuel efficiency. In today's economy, that's a bigger problem than ever.



New Injector Spray Pattern

Damaged Injector Spray Pattern

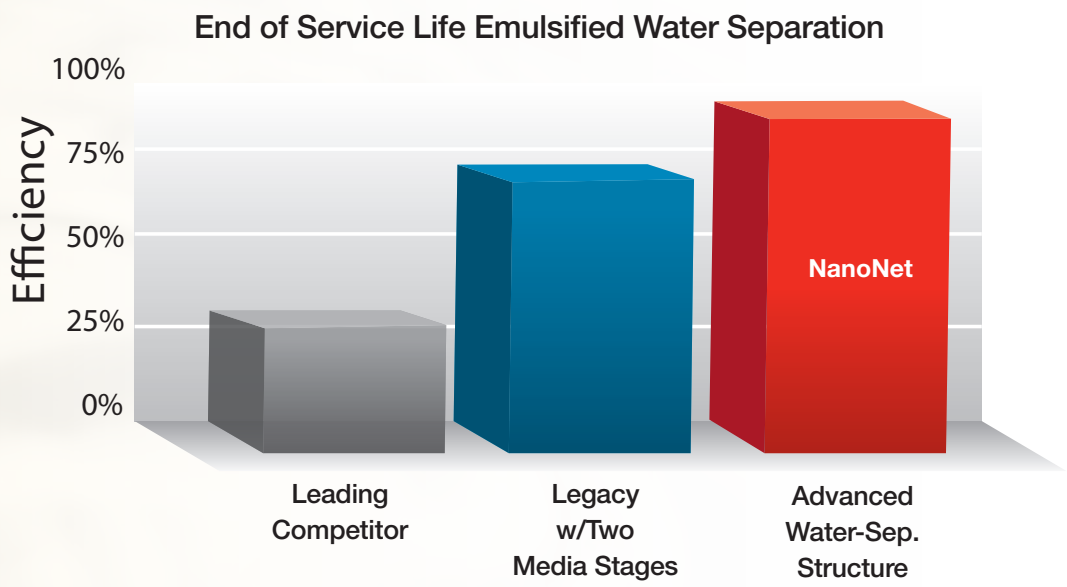
Damaged injectors can result in over-fueling of the cylinder causing fuel deposits, increased wear and reduced fuel economy.





## Solution: 100% Synthetic NanoNet Media.

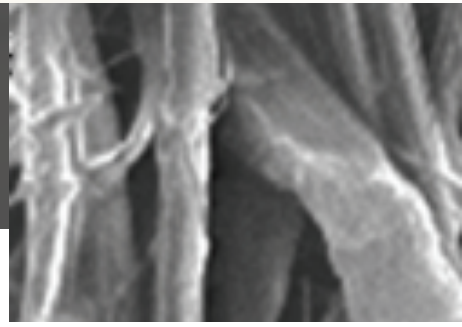
Unlike traditional media, NanoNet media contains no cellulose fibers, so it is essentially waterproof. The unique composition will not become waterlogged, and unlike conventional filters it provides the structural integrity needed for a high level of performance. NanoNet provides three times more protection throughout the life of the filter than the next best competitive product.



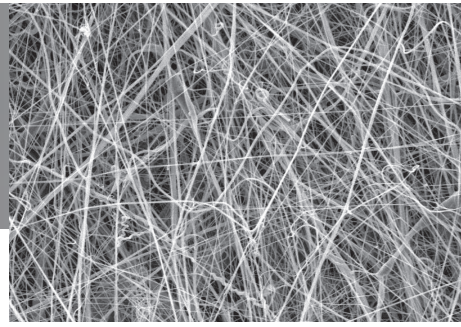
## Separates Water.

### Problem: Water Contamination in Fuel.

While water is essential for all life, it wreaks havoc on a fuel injection system. It acts as growth medium for organisms that plug filters and can also cause corrosion and deposits. At cold temperatures, water freezes and reduces fuel flow in the system, decreasing engine performance. Water contamination reduces fuel lubricity and can cause a variety of fuel system problems such as injectors that get stuck open.

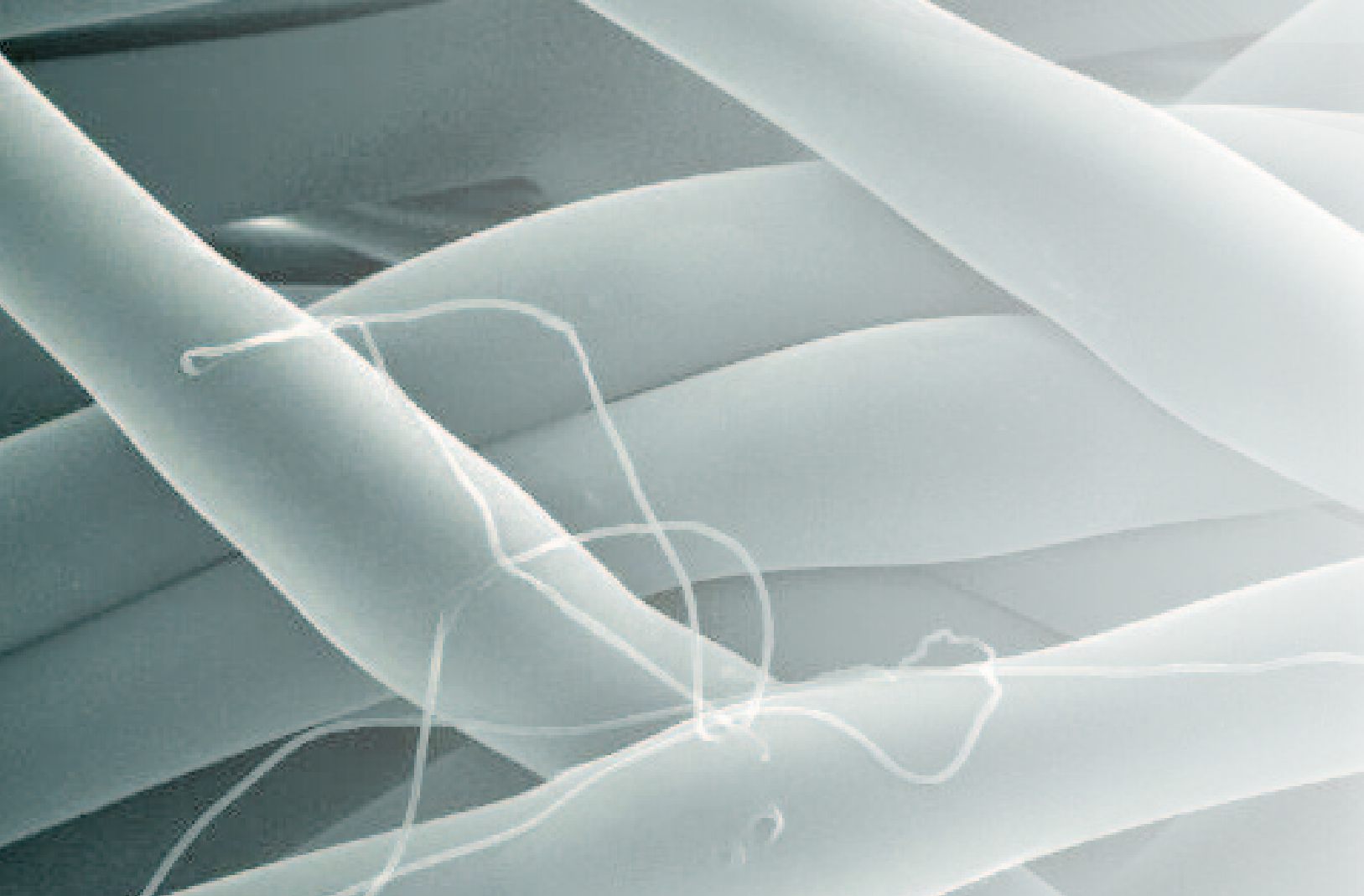


Legacy media is a blend of coarse (15-30 micron) cellulose fibers and varying amounts of sub micron synthetic (glass and polyester fibers)



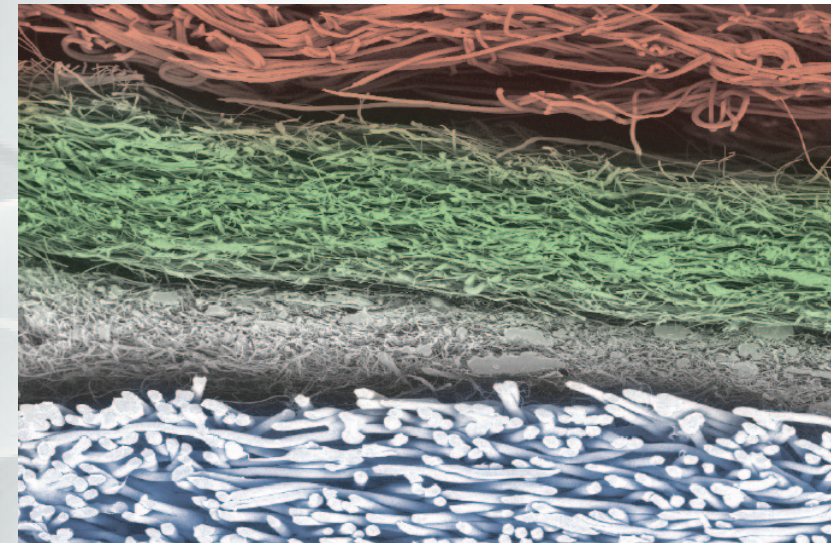
Synthetic nanofiber media is entirely sub micron polymer fiber (no glass fibers and no paper/cellulose fibers)





## Solution: Multiple Layers of Technology.

NanoNet features many distinct layers of protection to remove and retain particles as small as 4 microns (that's 12 times smaller than the smallest particle visible to the human eye) in a composite media structure. NanoNet fuel filtration media removes and retains 10 times more particles than competitive media to deliver superior protection and performance, preventing engine damage.



Top Meltblown Layer

Middle Meltblown Layer

Nanofiber Layer

Structural Support Layer

## Performance Under Pressure.

### Problem: Fuel System Fluctuations.

Over time, fuel filters become contaminated. Ongoing transients such as vibration, flow surge and pressure fluctuation can release captured particles from conventional filter media. These released particles can negatively affect fuel system performance and durability.

Over **10X more effective** than competitive products at removing and retaining particles, all in media no thicker than a dime.



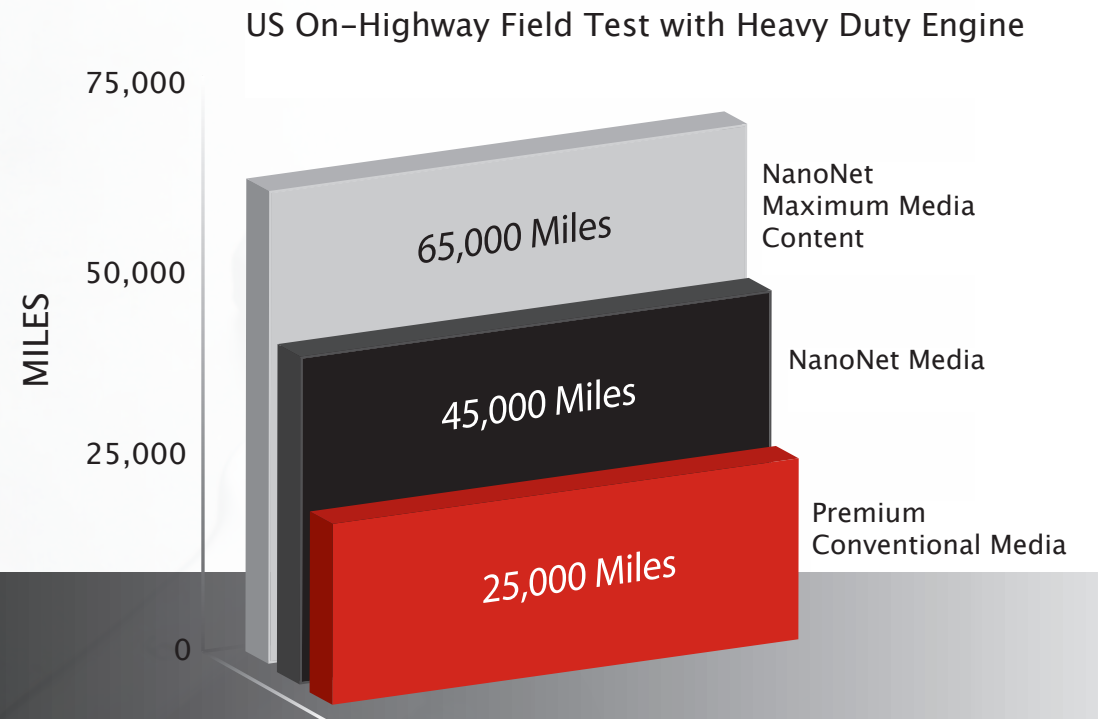




Time Lost is **Money Lost.**

## Solution: Fuel System Durability with NanoNet.

NanoNet media provides optimum fuel system protection which can help reduce operating costs by extending the time between service intervals. In one specific US On-Highway field test using one of our more than 150 test engines, up to 40,000 miles of longer fuel filter life was seen with NanoNet media. While fuel filters with conventional media become less effective as time passes and pores start to plug, NanoNet works more like an air filter, collecting a higher percentage of particles while retaining high fuel flow characteristics over time.



## Problem: Excessive Downtime and Maintenance Costs.

Engine problems really mean lost time and lost money. While maintenance is a necessity, it also means downtime and added costs. And those costs aren't limited to replacement parts and the labor associated with them. Thousands of dollars can be lost every day the equipment is out of service.

- Replacing fuel injectors can cost over **\$3,000.00.**
- Major components in the fuel injection system can cost over **\$7,000.00.**
- Failed injectors can cause internal engine damage and ruin the after-treatment system, **dramatically increasing repair costs.**





## Solution: Cummins Filtration Proprietary Testing.

As part of Cummins Inc, Cummins Filtration has developed proprietary tests in addition to industry standard testing to evaluate fuel filtration, even in the most adverse conditions. This has been done to guarantee the dependability of NanoNet in today's diesel engine applications.

NanoNet media works to remove particles with high efficiency and then retains the particles, even during flow surge and vibration during operating conditions. The testing has led to the development of greatly improved particle removal and retention under both static and transient conditions.

Cummins Filtration raises the bar by going above and beyond industry requirements, exceeding standards and setting new levels of performance.

Cummins Filtration Proprietary Testing

Industry Standard Testing

## Real World Analysis.

### Problem: Test Standards Stop Short of Real World Conditions.

Industry standards that test how a fuel filter performs under transient, real world conditions such as vibration and fuel surge currently do not exist for diesel fuel filtration. Many fuel filters perform well at particle removal under static conditions, but under transient conditions, particles are not always retained and they pass through the filter.

Raising the bar by conducting up to **14** additional tests that go far beyond the required industry standards.





## Solution: Fleetguard Fuel Filters with NanoNet Technology.

Proven field results are what set NanoNet media apart from the competition.

On-engine test experience for NanoNet includes hundreds of engines, over one-hundred thousand hours of test cell and Off-Highway testing, and millions of miles of On-Highway testing. Competitors can claim it, but we can prove it.

NanoNet has been in production since September 2011 and at least 230,000 NanoNet products are commercially in use today. Cummins has rigorously tested the technology so that you can count on NanoNet dependability, every single time.



## Proving It **Every Day.**

### Problem: Poor Real World Performance of Competitor Products.

Other manufacturers make claims about their filters and base those claims on results from relatively easy tests that do not simulate real world operating conditions. As a part of Cummins Inc, Cummins Filtration utilizes a vast array of customized rig-tests, engine test cells and real world On/Off Highway fleets to test and prove Fleetguard products under the harshest conditions.

- **Over 150,000 hours of test cell experience is 17 years testing.**
- **More than 75,000 hours of Off-Highway testing equals 8 years.**
- **24,140,160 kilometers (15 million miles) of On-Highway testing is 600x around Earth.**



## The Start of Something Good.

Fuel filters are only the start of many innovative Fleetguard products that feature NanoNet technology. Learn more at [cumminsfiltration.com](http://cumminsfiltration.com).

## Wherever You Are, We Are.

Fleetguard products are available at over 33,000 retail locations worldwide. For the one nearest you, go to [cumminsfiltration.com](http://cumminsfiltration.com). In North America, customers who want more information or have questions about NanoNet can call 1-800-22FILTER (1-800-223-4583).



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