INTERIM TIER 4 ENGINE

FILL 'ER UP!

Diesel-fuel cleanliness becomes more critical as fuel systems in low-emissions engines are designed with increasingly precise tolerances and operate at higher pressures.

Has your company given serious consideration as to how emissions will affect future fleet-asset management? If you are interested in alternative fuels, can your new Interim Tier 4 equipment work with them?

If you've already thrown your hat into the Interim Tier 4 ring, or are about to, you need to be aware of what this technology requires from you on your end.

One concern expressed by some contractors is that Interim Tier 4 engines are finicky.

Well, if finicky means less tolerant of contaminants, then yes, it is true. But good filtration and common sense will go a long way to stopping any problems before they have a chance to do harm to your new equipment.

THE ULSD LOWDOWN

Interim Tier 4 engines require Ultra Low Sulfur Diesel (ULSD), which has a sulfur content of less than 15 ppm. Large refiners and importers have been required to meet this criteria by the U.S. Environmental Protection Agency (EPA) since June 2010. However, small refiners have until June 2014. They can continue to supply Low-Sulfur Diesel (LSD), which is anything between 500 ppm and 16 ppm. Non-road diesel over 500 ppm from any supplier is prohibited.

So contractors need to shop carefully, paying attention to what ppm they are putting in their fleet's engines. Never, ever put LSD fuel in an Interim Tier 4 engine.

What harm can too many ppms do? Plenty, so read on.

SULFUR IS YOUR ENEMY

Nitrogen oxides and particulates are the two most harmful diesel-pollutant emissions. The new "clean diesel" technology relies on a two-part punch to take care of these: ULSD fuel and exhaust after-treatment, such as a diesel particulate filter (DPF) and a diesel oxidation catalyst (DOC). Too much sulfur (above 15 ppm) causes more-than-normal regeneration within the DPF as it tries to get rid of the extra sulfur. Too much sulfur also eventually deactivates the catalytic converter as well as irreversibly damages the particulate trap, nullifying their control benefits.

"Deactivate" is a bit neutral. Think more along the lines of: too much sulfur creates a

ticking time bomb that will lead to a major failure and the need to replace expensive components.

So, in essence, ULSD is what makes the other aspects of "clean diesel" work. And in case you were wondering, engine and equipment manufacturers are NOT responsible for damages caused by the improper use of fuel. Warranties will be voided.

KEEPING IT CLEAN

Because Interim Tier 4 engines operate at extremely high pressures, they are not tolerant of the kind of contaminants that typically hide in diesel-fuel tanks: water, microbes, and byproducts of the fuel-aging process.

Do not rely on your equipment's own fuel filter to take care of the problem; you need to go much further back in the fuel-supply chain. Processes used ten years ago won't work now.

START WITH YOUR BULK STORAGE CONTAINERS

Consider using the smallest tank practical, and store bulk fuel inside, away from temperature extremes. This helps prevent condensation and microbial growth, and ensures frequent turnover in fuel so it stays fresh. When fuel is first delivered, put a sample in an approved container. If it is hazy or has floating debris, there is a problem.

Fuel should be filtered as it is transferred into bulk-storage tanks. The goal is to have fuel cleanliness at ISO 4406 contamination codes 14/13/11 or better. Diesel fuel typically arrives at 22/21/18. The outflow of bulk tanks should be filtered as well.

Storage tanks should be installed on a gradient to allow water to collect at the low end for easy removal via a water separator. Use of desiccant breathers for tank ventilation will help keep water out of the tank. Galvanized tanks should be avoided. Diesel fuel reacts with the zinc and zinc alloys to form unstable compounds that can result in engines that are rough running and low powered.

If you currently have an underground storage tank, you might want to consider changing over to an above-ground one. This allows for easier filtration and water removal.

Consider tank cleaning when filters get plugged at an alarming rate. Carefully screen companies that offer this service as cleaning a tank properly can be difficult.

IN ADDITION...

Approach fuel additives with caution. Fuel cannot contain additives that use metals. Metals commonly found in many fuel additives, such as zinc, calcium, phosphorus, and molybdenum, will quickly plug the DPF and destroy the DOC. Use of a biocide to control microbial growth is recommended.

Always check with the engine manufacturer to see what additives meet their approval. In addition to biocides, some other additives to explore are a cetane improver, flow improver, wax crystal modifier, anti-icer, lubricity enhancer (sulfur is a lubricant, so less sulfur means less lubricity), and a storage/anti-oxidant stabilizer.

You should also check with the manufacturer as to the use of biofuels or fuel blending. Biodiesel, which is also a surfactant, creates major problems for the use of fuel water separators.

Best practices when storing diesel fuel involve filtering fuel as it enters the bulk-storage tank (1), controlling water via proper tank breathers (2) and perhaps a proprietary drying system (3), and filtering fuel when dispensed into vehicles.

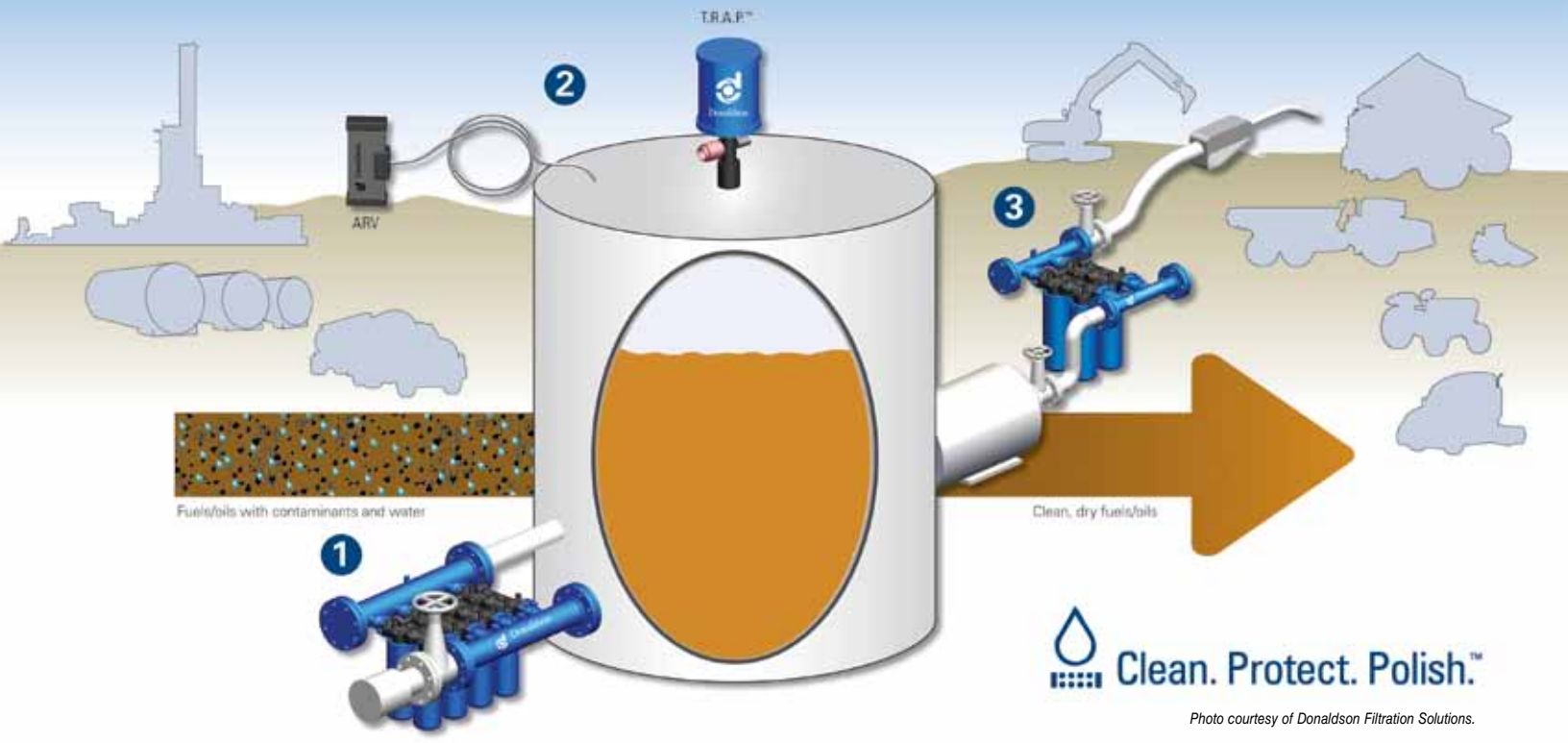


Photo courtesy of Donaldson Filtration Solutions.

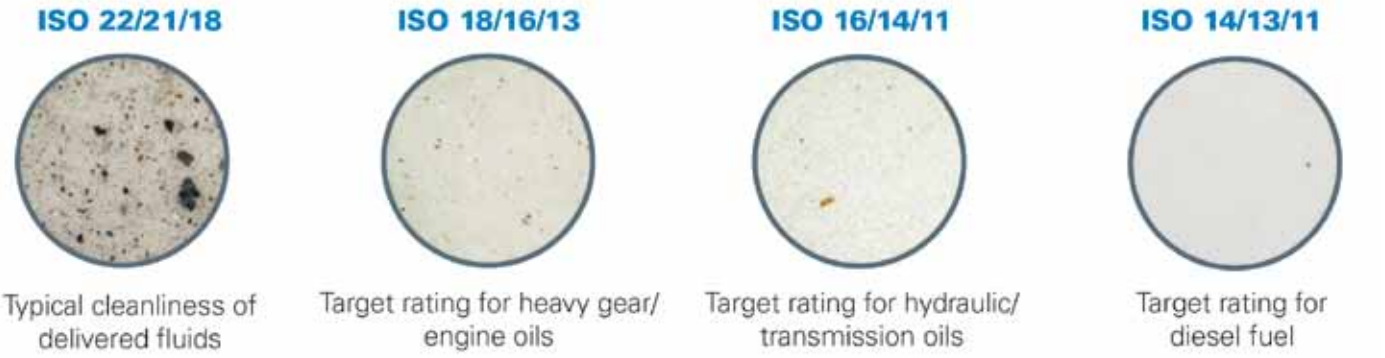


Photo courtesy of Donaldson Filtration Solutions.

FILLING THE MACHINE

If a portable tank is used to ferry fuel to the field, be sure to mount it at an angle with a drain at the low end to eliminate water. You might even consider not using any fuel from the bottom quarter of the tank, to reduce the probability of suctioning up water and debris.

The portable fuel-tank outlet filter should have the ability to deliver fuel at ISO 14/13/11. Even then the onboard filter must filter it to meet the engine manufacturer's recommended cleanliness, usually one to two times cleaner. By using a high-efficiency filter on the outlet prior to dispensing, most contaminants or fuel-related issues that would plug onboard filters are prevented from being transferred.

But even as some contaminants may make it through the bulk filter system, the levels will be drastically reduced and give your equipment its best chance at making it to the next service interval, eliminating the high costs of unplanned downtime.

On the machine, proper fuel-system maintenance is critical. Replace fuel filters at the manufacturer's recommended intervals. Drain the primary filter as often as needed. Follow guidelines for periodically draining off water. Keep the fuel tank's debris screen in place. Periodically replace the fuel tank breather.

Fuel filters cannot for any reason be "pre-filled." Pre-filling fuel-filter bowls allows for contaminants to bypass the fuel filter and enter the high-pressure fuel system where they will cause damage.

Lastly, be sure to clean debris around the fuel tank's cap — there is no point going through all the earlier filtration steps if you let dirt and debris on the machine itself fall into the fuel tank.

CONCLUSION

The results of the new Interim Tier 4 technology for diesel engines are quite remarkable — especially when compared to traditional diesel technology. Particulates are more than 100-fold lower. NOx and PM mass emissions are now comparable to compressed natural gas and gasoline. For example, organic carbon emissions have been reduced by 96 percent; elemental carbon by 99 percent; metals and elements by 98 percent; alcohols and organic acids by 81 percent. Even the particulate matter itself is now chemically different than before.

One California study found that commercially cooked hamburgers emit more particulate matter than 2007-2012 model-year clean-diesel trucks! The study showed that the majority of particulate emissions now come from brake and tire wear, with diesel emissions making up a small and declining

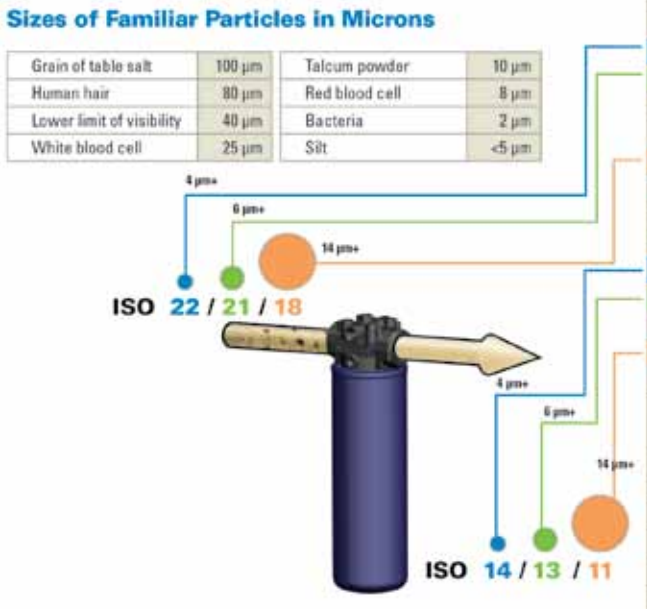
Typical cleanliness of diesel fuel arriving for bulk storage is ISO 22/21/18 and target cleanliness when dispensed should approach ISO 14/13/11, says Donaldson.

factor. And the key part of this reduction is due to the shift to ULSD fuel.

So the finicky nature of Interim Tier 4 engines as it comes to fuel cleanliness is well worth the extra filtration.

In a future article, FOCUS will take a look at the diesel particulate filter and how regeneration works.

The material in this article came from a variety of sources including Construction Equipment magazine, Cummins' service bulletins, Association of Equipment Distributors/Diesel Technology Forum, EMA Truck and Engine Manufacturers Association, U.S. Department of Energy, Donaldson, AEMP, and Kawasaki Wheel Loaders.



Range of number of particles per milliliter

Code	More Than	Up to & Including
24	8,000,000	16,000,000
23	4,000,000	8,000,000
22	2,000,000	4,000,000
21	1,000,000	2,000,000
20	500,000	1,000,000
19	250,000	500,000
18	130,000	250,000
17	64,000	130,000
16	32,000	64,000
15	16,000	32,000
14	8,000	16,000
13	4,000	8,000
12	2,000	4,000
11	1,000	2,000
10	500	1,000
9	250	500
8	130	250
7	64	130
6	32	64
5	16	32
4	8	16
3	4	8
2	2	4
1	1	2