Fleetguard®

Materials Supplied

Item #	Description	Quantity
1	Funnel assembly with aluminum compression nut	1
2	Buna O-ring (size -210) 1/8" dia x 1" OD (w/spares for filter patch)	2
3	1 μm Whatman® Nuclepore membrane (25mm x 100 count)	1
4	2 μm Fleetguard® media patches (service part # SP72066) (25 mm x 100 count)	1
5	25 mm Perforated metal support screen	2
6	Media vacuum adaptor with hose barb and vacuum release valve	1
7	Tygon® PVC fuel tubing for pump (1/8" ID x 1/4" OD x 90cm)	2
8	Buna O-ring (size -221) 1/8" x 1-11/16" (w/spares for PC bottles)	2
9	PC Vacuum Bottle, 1 L, Translucent, 50 mm cap w/ adaptors	2
10	Vampire® brand Folding Stand Vacuum Pump with gauge	1

Item #	Description	Quantity
11	Buna-N O-ring 1/8 fractional width, Dash number 212 (w/spares for pump)	2
12	4 oz clear vacuum bottles, spare O-rings and screen	2
13	Aluminum compression nut adapter with quick connect and internal shutoff (LC series chrome plated brass valve)	1
14	Tygon® PVC fuel tubing for siphon adapter (1/4" ID x 3/8" OD x 40 cm) with PLC series shut-off valve	2
15	Spare tubing for both funnel and siphon	2
16	250 ml plastic beakers	4
17	Stop watch	1
18	Tweezers	1
19	Work Instructions / Data Interpretation / Overview	1
20	Gloves	1
21	Protective case	1

The kit comes complete with hardware for two modes of performing fuel cleanliness testing. One mode uses a funnel adapter while the other uses a siphon method. No additional tools are required for successfully testing your fuel.

Service Instructions

Introduction

Contamination in fuel comes from various sources and is the primary reason for fuel filter plugging and reduced filter life. Contaminant varies widely in composition, including inorganic and organic materials that may cause a variety of failures from premature wear, corrosion, sticking of parts or other issues, all of which reduce performance. Adding to this complex problem is the fact that contamination can be present in the fuel source or can enter during fuel delivery, storage or handling. It is extremely important that fuel be filtered at the point of use with modern diesel engines. While clogging fuel filters may be a nuisance, they are present to protect equipment from further problems that can be very expensive to remedy. Traditionally, laboratory-grade equipment and environments have been the only means for testing fuel samples to determine cleanliness. A simple, portable method for testing fuel cleanliness can provide a resource for analysis of fuel and allow both troubleshooting and periodic inspection of delivered fuel, integrity of storage and transportation tanks and all points throughout the process.

The Fleetguard FK36000 Portable Fuel Cleanliness Analysis Kit is designed to be the preliminary, or even primary, test to determine fuel quality with respect to "filter-ability" of fuel. This kit provides an accelerated and cost-effective test for detection of organic and inorganic contamination in hydrocarbon-based fuels. The kit requires no power or additional tools and is easy to set up and use. The method relies on the principle of filtration of fluids through a known filter media as the fuel filters on engines perform. A 2 μm pore size media (SP72066) and a 1 μm pore membrane are supplied. For fuels where particulate contamination is problematic, the 2um media can be used effectively for testing. For fuels where chemical contamination is problematic, the 1um media membrane is more sensitive and suitable for testing. Other media and pore sizes could be used with the kit, but are not included. Cummins Filtration has diligently worked to build confidence in the results of the FK36000 test kit and find agreement with both internal methods and the Cummins Filtration modified ASTM 2068 Filter Blocking Tendency test.
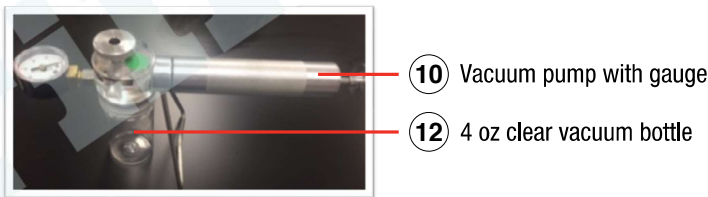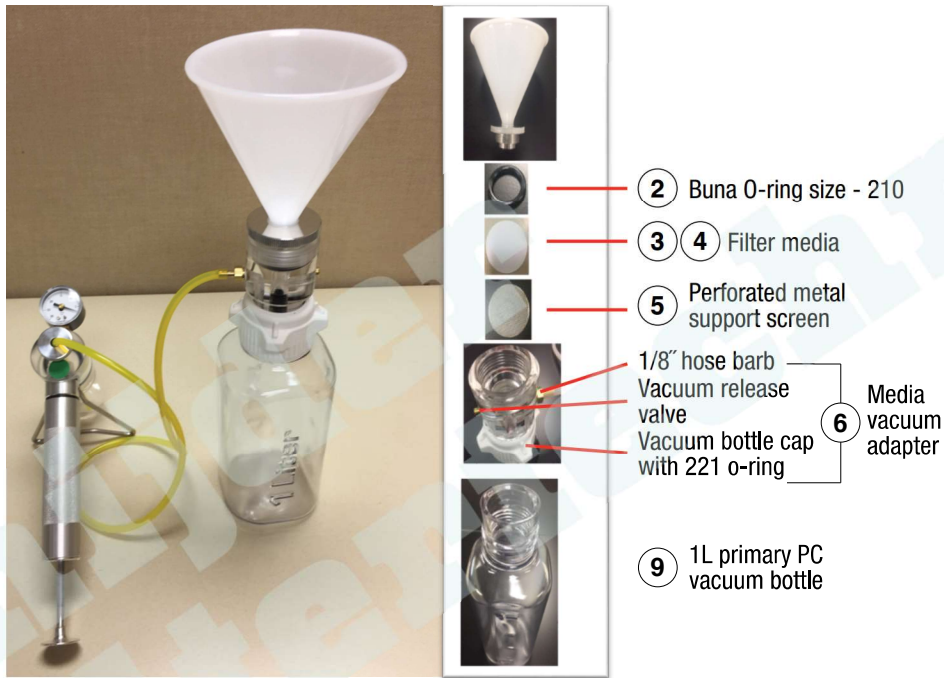
Important Precautions, Safety Instructions, and Disclaimers

⚠ **This product uses vacuum to move fluids and is only intended for use with diesel fuels. ULSD, biodiesel and blends including kerosene with low vapor pressure and high flash point are the ONLY acceptable fuels.**

⚠ **The product is NOT intended for use with gasoline or any other high vapor pressure or low flash point solvents. These may form a highly flammable vapor when vacuum is applied.**

⚠ **If user is unsure of the fluids to be analyzed, consult an expert in the determination of materials.**

⚠ **The product components should not be used at elevated temperature above about 45 °C (113 °F) or placed in an oven at any time.**
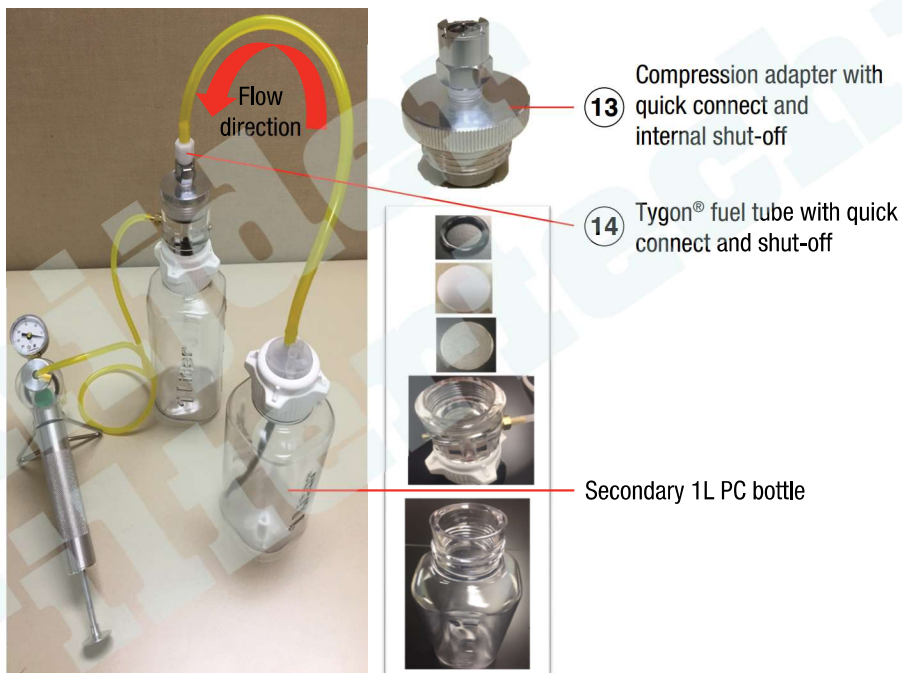
In addition:

- Please follow any OSHA or locally required safety precautions on-site for handling of diesel fuels and always use recommended PPE (Personal Protective Equipment) when handling fuel and performing this test. This may include:

⚠ **Safety glasses, gloves and the use of anti-static materials in the workplace.**
- **Do not use the vacuum pump to apply suction to hands or other body parts.**
- **Beware of sharp edges that may be present on threaded fittings, filter support screen, or any other components of the kit.**
- **The components of the kit are for cleanliness testing and not for storage of fuels. While all materials are compatible with fuel, it is not recommended to use the PC bottles for fuel storage.**

Funnel Mode

2 Buna O-ring size - 210

3 4 Filter media

5 Perforated metal support screen

1/8″ hose barb
Vacuum release valve
Vacuum bottle cap with 221 o-ring

6 Media vacuum adapter

9 1L primary PC vacuum bottle

10 Vacuum pump with gauge

12 4 oz clear vacuum bottle

Siphon Mode

Flow direction

13 Compression adapter with quick connect and internal shut-off

14 Tygon® fuel tube with quick connect and shut-off

Secondary 1L PC bottle

Funnel Mode – Assembly and Test Procedure

1. Remove all the required parts form the protective case and make sure all the parts are free of any type of contaminant or moisture.
2. Check that the vacuum bottle cap is in place and held on by the large O-ring underneath it in the groove of the clear acrylic media vacuum adaptor.
3. Connect one end of the small diameter Tygon® tube (1/8" ID x 1/4" OD) to the hose barb on the side of the clear acrylic media vacuum adaptor.

Figure 1. Acrylic media vacuum adaptor

Note: the cap only needs to be snug as the applied vacuum will naturally seal the container.

4. First place a perforated metal support screen inside the media adaptor, then using clean tweezers place the 25 mm media of either 1 μm membrane or the 2 μm Fleetguard® media (SP72066).
5. First remove any colored cover or separator sheets and discard, then carefully place the media with grooved side facing the metal screen. Grooved side is the downstream side of the patch.
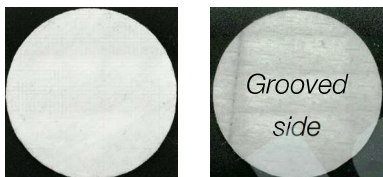

Figure 2. Media Patch

6. If using the 1 μm Whatman® Nuclepore membrane remove the blue cover sheet and place the membrane with the shiny side of the membrane facing up.
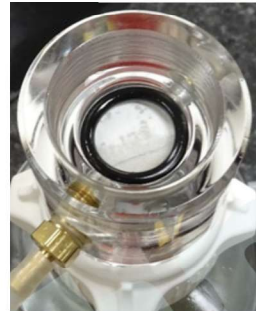7. Place the small diameter rubber o-ring on top of the filter media.

Figure 3. O-ring placement

8. Connect the funnel assembly to the now assembled media vacuum adaptor to compress the O-ring which sits in on the filter media, sealing the media and chamber. The connection needs to be secure but not overly tight. No wrenches are needed.

Figure 4. Connecting the funnel assembly

9. Loosen the compression knob on top of the hand held vacuum pump unit. Insert the other end of the small diameter Tygon® fuel tubing into the inlet provided in the knob making sure it reaches inside the 4 oz clear vacuum bottle and snug the knob. This bottle should NOT have fluid reach it but is a safety to prevent liquid from reaching the pump.

Figure 5. Inserting the Tygon® fuel tubing

Performing a Test

1. The sample used for the test should be a representative of fuel delivery tank or vehicle or other device under consideration. Example: If the fuel is collected from a delivery tank make sure a sample is collected from the start and end or if collected from a bulk tank, make sure it is from the top and bottom of the bulk tank.
2. Usually 1L of fuel is required, but the test may provide more resolution using a 2L fuel sample using the 2 µm media patch or by using an additional 1 L of fuel if the 1 µm membrane is used.
3. Take care that external contaminants like dust do not enter the bottle, beakers, or the sample itself, as this can falsely exaggerate results. A best practice would be to rinse with clean fuel (from previous test) before performing a test and especially after a test with results from poor quality and dirty fuel.
4. Remember to recycle the fuel appropriately after testing. It can be returned to a vehicle or storage tank.
5. Pour approximately 250 ml into each of the four plastic beakers. Volumes need to be consistent but there is no need to try to be overly precise.

Figure 6. Filling the plastic beakers

6. Make sure the filter media of choice is in place and funnel closed snuggly and ready to use. Then pour the first 250 ml into the funnel.

Figure 7. Pouring the first 250 ml into the funnel

7. Start the timer and immediately begin pumping the hand vacuum pump until the vacuum gauge reads between 15 -20 mm of Hg. This might take anywhere between 10-14 secs and is considered part of the accumulated test time. Consistency from test to test is important with similar speed of pumping and vacuum level reached. If 17 mm of Hg is a comfortable vacuum level on the first pour then attempt to achieve 17 mm of Hg on each of the rest.

Figure 8. Checking the vacuum gauge

8. Check that the vacuum stays within the 15-20 mm of Hg range during the entire test, ideally attempting to stay about +/- 1mm during all test. An occasional pump or two may be required to keep vacuum up as many fuels will release dissolved and entrained air. Again consistency of the test is important from batch to batch.
9. Stop the timer when the entire 250 ml has passed through the media. In some cases of dirtier fuels if 10 minutes or more has passed since the start of the test and the fuel no longer appears to be dripping from the filter holder the test may be terminated. Record the time.

Figure 9. Recording the time

10. If the vacuum gauge does not read zero before the next pour, use the vacuum release valve to reduce the level back to zero range. A slight or partial push works better than a hard full push.

Figure 10. Using the vacuum release valve

11. Repeat the test up to 3 more times with additional 250 ml volumes. If the time for any pour reaches 10- 15 minutes and appears to no longer be draining there is no need to continue any of the subsequent pours, especially if ≥ 15 minutes. Sometimes additional pours with up to another 1L of fuel will provide resolution for fuels that appear very clean with just 1L.
12. Use the Data interpretation card (DI card) to assess the quality of fuels.

13. After each type of media patch has been used, start with a new 1L of fuel.
14. After the test, if the vacuum is not gone down use the vacuum release valve to bring the vacuum to zero before taking the patch out.
15. Carefully remove the patch using the tweezers. These patches may be saved for comparison purposes or in some situations special arrangements may have been made to analyze contaminants on the patch by an analytical lab. If so, store and label the patch which may be more easily sent by mail than a fuel sample. Wrapping in aluminum foil then placing in a labeled Ziplock® style bag is ideal.
16. Before running another sample and particularly if dirty fuel was found it would be best to rinse the funnel assembly, bottle and beakers with the next sample to be tested or with the clean fuel generated by the previous test.
17. Use the Data interpretation card (DI card) to assess the quality of fuels.

Siphon Mode - Assembly and Test Procedure

1. Only the 2 µm patch is recommended for use in siphon mode. The fine 1 µm membrane is easily vapor locked and may never prime or produce a result.
2. Place the 2 µm media patch in the media vacuum adaptor as described in the previous section.
3. For siphon mode remove the funnel and connect the aluminum Adapter with in-line LC series quick connector to the media vacuum adaptor.

Figure 11. Connecting the aluminum adapter

4. Collect 1L of fuel in the secondary PC bottle.
5. Connect the large Tygon® fuel tubing (1/4" ID x 3/8" OD) with quick connect and internal shut-off valve on one end to the inlet on the secondary 1L PC bottle cap. This port will have the siphon tube that extends down inside the bottle.

Figure 12. Connecting the Tygon® fuel tubing

6. Make sure that the primary 1L PC bottle is connected to the vacuum pump as described in the previous section.
7. Use the hand vacuum pump to generate vacuum between 15 -20 mm of Hg. An occasional additional pump or two may be required to maintain vacuum level once test begins.
8. Now snap together the quick connect fitting from the siphon bottle to the test fixture and immediately start the timer.

Figure 13. Quick connect matched up

9. The PC bottles are graduated and can be used to record time as the 250 ml, 500 ml, 750 ml and 1L of fuel is collected. It will be better to record each time as it passes the mark then determine the time for each volume later as the test may run very quickly.
10. After the test, if the vacuum has not gone down use the vacuum release valve to bring the vacuum to zero before taking the patch out.
11. Carefully remove the patch using the tweezers and place it in the zip lock bag for further analysis.
12. Before running another sample and particularly if dirty fuel was found take care to rinse the assembly with the clean fuel or the next fuel to be tested.
13. Use the Data interpretation card (DI card) to assess the quality of fuels.

Basic Guide

- **Sample Collection for the test-** The sample used for the test should be a representative of fuel delivery tank or vehicle or other device under consideration. Example: If the fuel is collected from a delivery tank make sure a sample is collected from the start and end or if collected from a bulk tank, make sure it is from the top and bottom of the bulk tank. If you are doing a 'before' and 'after' comparisons, especially if you have made changes to supply chain, make sure sample is collected at the same points for comparisons.

- The 2 µm Fleetgaurd® SP72066 media patch is ideal for most applications in assessing the quality of unknown fuels. It is able to capture finer contaminants than most diesel filters.

- When using the **2 µm Fleetguard® SP72066 media patch** with either the **funnel adapter or siphon mode, 1 liter of fuel is required for each test. Sometimes better resolution may be desired using a second liter of fuel when it is very clean.**

- The 1 µm Whatman® Np membrane requires an **additional 1 liter** of fuel and must only use the funnel mode since it is not compatible with the siphon function.

- The 1 µm Whatman® membrane in funnel mode is intended for certain applications where fuel quality must be very high in order to achieve long service intervals. *The 1 µm membrane is preferred when analysis of contaminants is required. This requires prior arrangements with an outside laboratory.*

- For either media, **1 liter of fuel is divided into four equal parts of approximately 250 ml each**, with the **time of flow** recorded for each amount as in detailed instructions.

- For funnel mode, each 250 ml is transferred to the funnel and vacuum of 15-17 mm of Hg is used to pass this fuel through the either 2 µm or 1 µm media. Time for each pour is recorded.

- **For Siphon mode,** the 2nd PC bottle is used to collect fuel and the assembly is used as directed to pass 1L fuel through the 2 µm media, the PC bottles are graduated and thus help record time for each part of 250 ml.

- If fuel is clean, little time change will occur between equal amounts. For many fuels, the times should be less than 1 minute. However if first time is under 1 minute followed by the second time of 2 minutes it begins to indicate dirty fuel but it is still recommended that the test be carried out until much longer times are seen to bring resolution to the test.

- If any of the 4 pours reaches 10-15 minutes, the test can be terminated as this would indicate that the fuel is of 'poor' quality. Under such situations, it is not necessary to continue testing.

- The first time may appear slower up to 2-3 minutes due to technique, viscosity, and temperature effects but if the times remain similar or constant (not increasing), it will still indicate a clean fuel.

- Some variability is expected between users; however, precise measurement of milliliters fuel, vacuum level, or seconds of time is not critical. Precision at the level of tens of seconds and up to a minute is all that is required. Users are looking for a significant increase in time of flow with consistent technique if the fuel quality is poor.