

# Guide #5

## Cleaning a Fuel Tank

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This guide provides general information needed to clean a fuel tank. It is assumed that this is a tank that has shown some or many of the typical symptoms of contamination, such as:

- Visibly dark or black fuel
- Signs of floating debris in the fuel
- Fuel filters covered with black and/or slime
- Unusually short fuel filter life
- Sludge in the tank
- Water in the tank
- Smoke coming from engine exhaust

All storage tanks naturally accumulate water, solids and sludge resulting from condensation and the degradation of fuel and oil. The more fuel we turn over through a tank, the more debris and water will accumulate in the bottom. The [AXI Mobile Tank Cleaning \("MTC"\) System](#) is compact, easy to operate and extremely versatile. It is ideal for use:

- in marinas, to clean tanks on board all types of vessels
- at construction sites
- in remote areas with on-site fuel storage for heavy equipment
- in service trucks maintaining standby generators
- in truck/vehicle depots
- in hydraulic oil tanks



[AXI Fuel Conditioning and Filtration Systems](#) eliminate the need for costly, periodic manual tank cleaning, while stabilizing and extending the shelf life of fuel. This is extremely important for all applications of long-term fuel storage, especially emergency power generators.

AXI has a range of mobile tank cleaning systems to address every size tank. Although the process may vary slightly between very small tanks and very large tanks, this guide will describe the problem and the process so that a professional commercial tank cleaning enterprise as well as a do-it-yourselfer will benefit from understanding the process and procedures.

The AXI systems can be divided into categories based on two determining factors:

1. Use the proper system for the size tank(s) to be cleaned:
  - a. Use the TK-240 Portable Tank Cleaning ("PTC") System to clean tanks up to 1,000 gallons.



Before

After

- b. Use one of the Mobil Tank Cleaning (“MTC”) Systems to clean tanks over 1,000 gallons up to 10,000 gallons
  - c. Use one of the High Capacity (“HC”) Systems for tanks over 10,000 gallons.
2. Use the proper system based on the time you have to perform the job:
- a. The PTC System operates at 4 Gallons Per Minute (“GPM”).
  - b. The MTC System, with 3 different cart mounted systems to choose from, operates at 8, 15 or 26 GPM. If you have a lot of time, you can use the 8 GPM System for all tanks between 1,000 gallons and 10,000 gallons. But if you must put an employee to work treating many tanks, or your time is valuable, you may wish to use a higher flow rate system. Note, however, that sometimes the tank limits your choice. Using the 26 GPM system will work on a 1,000 gallon tank, but some smaller tanks have small openings for inserting the hoses (both the suction hose and return hose often goes into the same tank opening) and the larger 26 GPM MTC System requires a six inch opening for both hoses.
  - c. The HC Systems operate at 50, 90 or 150 GPM, and are only appropriate for larger tanks.



TK-240 Portable Tank Cleaning System (PTC)

Although the [TK-240 PTC System](#) does an excellent job of occasionally cleaning a severely contaminated tank up to 1,000 gallons, it should mostly be used for preventative maintenance that is performed intermittently. Daily sever service will shorten the operational life of the pump, being a 12 volt unit. This system is good for individuals, farms, and repair shops requiring fuel circulation and fuel transfer systems.

Regular sever service performed on tanks larger than 1,000 gallons is better suited to the [Mobil Tank Cleaning \(MTC\) cart mounted systems](#), especially when coupled with a [PF-10 or PF-30 Pre-Filter System](#) (sold separately) for constant sever service in cleaning a wide range of known contaminated tanks, such as a tank servicing company would encounter. The several different MTC systems each perform on a range of tank sizes and some allow for variable flow rates to provide flexibility in performing jobs of varying size. These systems are ideal for marinas that service many vessels, servicing back up power generators in far-ranging locations, construction companies with equipment operating under dirty and difficult conditions, train locomotives, industrial complexes with varying tank cleaning needs, etc.

The High Capacity (HC) pallet mounted systems provide variable high volume flow rates and are recommended for the larger tanks found at service stations, industrial facilities, facilities with large fuel storage capacity for emergency power (data centers, hospitals, etc.), and fuel distribution facilities. The [HC Tank Cleaning Systems](#) have a PF-30 Pre-Filter standard. The HC System is ideal for a tank cleaning service that must quickly service many tanks over a wide region, and the high flow rates allow for greatly reduced labor costs.



Mobil Tank Cleaning System (MTC)

Although the rate and speed of the fuel treatment process may vary greatly, the process and steps to be followed are very nearly the same. The PTC System has only one inlet and one outlet, the MTC Systems have two possible outlets, and the HC Systems have three outlets. The multiple outlets provide for great flexibility during different phases of the tank cleaning process. As you read more about the process, keep this in mind that, if you are considering a PTC System, read past the references to changing the outlet port being used.

## Supplies

Having the right supplies available makes any job easier. The following is a list of materials that you may need. Although each may not be mentioned in the following description of procedures, you will understand the need for each as you read on. Keep in mind that you will be working with fuel and safety procedures should be followed. If you are not sure what safety procedures are required, please use a professional to perform your tank cleaning needs.

- White buckets
- Funnels
- Oil absorbing sheets for clean up
- Tank opening torque wrench
- Spare filters for your tank cleaning system
- Clear intake/suction hose and black pressure discharge hose
- [Suction pump for taking fuel samples](#)
- Clear plastic bottles or jars for fuel samples
- [AXI AFC-705 Diesel Fuel Catalyst](#)
- [Kolor Kut Water Finding Paste](#)
- [Liqui-Cult Fuel Test Kits](#)
- Power cord extension
- Filter wrench
- Filter gasket creme
- Containers (slop tank) of a size necessary to properly dispose of water, sludge, debris, and fuel not being re-circulated (check local regulations for what is needed to properly dispose of such waste materials)
- [The Water Eliminator](#)



High Capacity Tank Cleaning System (HC)

### **Preparation**

Evaluate the characteristics of the tank to be cleaned so you know how to approach the task at hand:

1. What is the capacity of the tank?
2. What is the depth of the tank? – determines the suction pipe length required.
3. Is the tank divided into sections?
4. Where is the lowest point of the tank and can it be accessed? -- May permit draining water and sludge from the bottom of the tank.
5. What is the type of fuel and age?
6. If weather is threatening rain, a tent or canopy may be required.
7. Is the tank less than full? – calculate amount of contents. May be advisable to fill the tank to accomplish a cleaning of the entire inside surface area of the tank.

The operating manuals for the tank cleaning systems contain numerous warnings, operating tips and cautionary statements that must be followed to assure safe operation. You should not operate this equipment without first thoroughly reviewing the operating manual that is included with each unit and also is available at the [Literature page at www.diesel-fuels.com web site](#).

### **Before Beginning**

Determining the severity and extent of the problem is the first step. Using the [Fluid Sampling suction pump \(the FS-100 at www.diesel.com\)](#), pump fuel up the tubing line into a sample bottle, ideally taking the sample of fuel from the center of the tank (if the tubing will not stay straight, run the tubing through a piece of 1/2 inch PVC pipe and use tape to hold it in place—place the pipe down to the depth necessary for the end of the tube to be at the desired level of the tank, whether the mid point or the bottom— for larger tanks, use a [AXI TS Fluid Sampler – three sizes are offered on the www.diesel-fuels.com web site](#)). Label the sample bottle as the “before” fuel sample.

Inspect the fuel condition and label the sample bottle. Is it dark and hazy? Hazy fuel indicates water has emulsified or mixed in the fuel. Dark fuel indicates older fuel that has degraded and its combustibility has been compromised.

If the tank has a fuel fill that allows for access to the contents and you are able to reach to the bottom of the tank, use a measuring stick or rod with some [Kolor Kut Water Finding Paste](http://www.diesel-fuels.com) (available through [www.diesel-fuels.com](http://www.diesel-fuels.com)) to determine how much water has separated from the fuel and is in the bottom of the tank. Spread a small amount of the paste on the side of the rod and run the end of the stick down to the bottom of the tank, then remove the stick and inspect the paste. If it has changed colors, it has touched water. If the bottom two inches of the paste changed colors, then you have two inches of water in your tank.

If an accumulation of debris is suspected, this can be confirmed by using a length of ½ inch tubing (PVC or electrical conduit tubing), cut to a manageable length. Using the tubing like a soda straw, place your thumb over one end of the tubing to hold in air. Put the other end down into the tank to the very bottom. Then remove your thumb from the top end to allow whatever liquid or debris that is in the bottom of the tank to fill the tube. Again place your thumb over the end of the tube, remove the tube from the tank, and then empty the contents of the tube into a two litre plastic soda bottle (preferably clear) placed inside a five-gallon bucket (to catch any spillage). Do this several times inspecting the contents of the soda bottle. Are you removing fuel or water? Are there signs of sludge or debris in the liquid? Is the fuel hazy? Deposit a sample of the bottom material removed into a sample container and label as the “before” bottom sample.

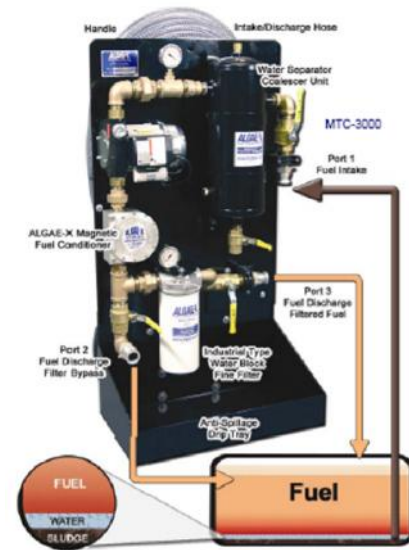
Using the above information on the amount of water and sludge to be removed, determine the size of the slop tank, time required for removal, whether a pre-filter is required to deal with a badly contaminated situation, number of cycles required to return the fuel to a clear and bright condition, filter type to start with, and how many and type of filter elements will be needed for the job.

Connecting the [TK 240](#) to the Battery:

1. TK systems are equipped with either a 12 V DC or 24 V DC motor. Connect the positive pole of your battery with the red wire connector of the TK first and then the black wire to the negative battery pole.
2. After the initial hook up check system operation to insure the pump is running in the right direction.
3. If the motor is running in the opposite direction or is not running at all, reverse the two electrical leads.
4. Prime the pump and strainer.
5. In marine applications, the TK system can be used in connection with the existing onboard primary filter/water separator. Hooked up in this way, the fuel can flow from the tank to the onboard primary filter, through the TK and then back to the tank, either through the return line, an inspection port or the fill pipe. Please make sure the flow rate of your existing primary filter matches the flow rate of the TK.
6. The TK system is now ready for action.

### **Priming The System**

Before turning on the pump make sure the entire suction side of the MTC system (suction hose, separator, plumbing, pump, strainer ...) is primed and filled with oil/diesel fuel. Running the pump dry could cause pump damage and cause the pump to not operate properly. It is recommended that to install an oversized, low restriction foot valve to keep the system primed, especially if the MTC is located above the fuel level in the tank (e.g. underground storage tank). The separator/coalescer has to be full at all times to perform properly.



### **Tank Cleaning**

In Phase One of tank cleaning, bulk water and sludge are removed from the tank into a separate container for disposal. We highly recommend attaching a straight wand or pipe with a minimum inside diameter being the same inner diameter as the suction hose (with the pipe cut at an angle at the end that goes into the tank) to reach the lowest part of the tank bottom.

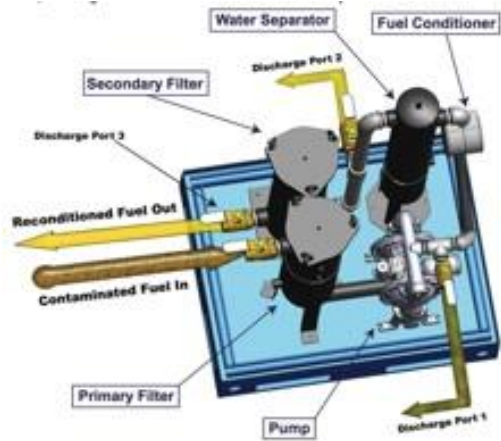
Place the end of the discharge hose in an appropriate-size container (Phase One only). Try to not agitate the fuel in

the tank and stir up and disperse water and sediment from the tank bottom throughout the fuel – this will make it more difficult to remove later on.

In Phase One the fuel bypasses the filter (or with the TK-240, the filter element is removed or a screen is used to filter course materials). With the MTC, the Separator/Coalescer and AXI Magnetic Fuel Conditioner works in conjunction removing free water, sludge, and particulate, as small as 5 micron, from the tank. The system is not in a re-circulating mode during this phase. The fuel enters through Port 1 and exits through Port 2 on the MTC System (discharge port 1 on the HC System) into a separate waste container. The materials being removed at this point will need to



be removed and properly disposed of.



Start the pump motor and be ready to immediately stop it. The MTC vane pump will start pumping as long as the system is primed and the suction lift is not excessive. The flow of fuel can be observed in the see-through suction hose. Watch for a steady flow of fuel into the container. Once the fluid begins to fill the discharge container, immediately switch off the motor and inspect the discharged fluid. Resume pumping and continue the above procedure until water and sludge have been removed from tank bottom and primarily fuel is discharged from the return hose. When you start cleaning a tank with a significant amount of sludge and/or water and you do not stop the pump as frequently as needed, the separator of the TK-240 will become overfull allowing the contaminant into the pump strainer of the TK-240. This will clog the little strainer, protecting the pump, in a matter of seconds.

To remove as much of the free water and sludge as possible, the section of hose with a straight wand or pipe attached should be placed at the deepest part of the tank. If possible, move the suction hose/pipe to different areas of the tank to more efficiently vacuum the sludge off the bottom.

After removing the bulk of the water and sludge from the tank, switch off the pump. Then, drain all water and debris from the hose and the water separator into an appropriate bucket placed under the drain valve.



After removing all water and as much sludge as possible, add the AFC-705 to the tank. The use of [AXI AFC-705 Fuel Catalyst](#) is an essential part of any tank cleaning procedure to more rapidly and efficiently decontaminate and clean the entire fuel system.



If the tank is very dirty, you should consider removing the water and sludge from the bottom of the tank on day one, and add a heavy dose (1 ounce to 20 gallons of fuel) of [AFC-705 Diesel Fuel Catalyst](#) (see the [www.diesel-fuels.com](http://www.diesel-fuels.com) web site) after removing the free-water and sludge and allow it to soak for 24 hours. Adding the AXI Fuel Catalyst (AFC-705) to the tank will speed up the cleaning process by breaking down and dissolving the sludge covering the tank walls and baffles. AFC-705 will decontaminate areas and sections of the tank that are out of reach of the suction hose. Using a higher concentration of one to twenty five hundred (1:2500 – 1 ounce to 20 gallons) instead of the normal preventative maintenance dosage of one to five

thousand (1:5000 – 1 ounce to 40 gallons) has proven to be very helpful in accelerating the rate of dissolving the sludge. Even higher doses of AFC-705 may be necessary depending on contamination level of fuel.

The [AFC-705](#) cleans the surfaces of the tank walls, the tight corners of the tank and, if there are baffles in the tanks, those baffles. It is strongly recommended that a tank treatment be performed on full tanks. If the tank is only half full, than the upper half of the tank will not be cleaned and when new fuel is introduced in with the treated fuel, the contamination on the tank walls that was not removed will re-contaminate the entire tank.

[AFC-705](#) is a full spectrum fuel additive containing combustion catalyst, surfactant, detergent, dispersant, corrosion inhibitor, lubricity enhancers and fuel stabilizer that eliminates the need for expensive toxic biocides. An important component of AFC-705, the surfactant, acts to break down the surface tension between any remaining residual water and the fuel, allowing the residual water to emulsify up into the fuel. As the fuel, with the emulsified water, is circulated through the tank cleaning system, a water block filter removes the emulsified water and completes the water removal step.



In Phase Two, the MTC system is set up for re-circulating mode with the discharge hose routed back into the tank. The MTC System has the discharge hose still affixed at port one, but the discharge hose is moved to discharge port 2 on the HC System. If there is considerable contaminant in the tank, we recommend you stop the pump shortly after priming and check for free water and sludge by draining the water separator (MTC and HC Systems). It may be necessary to depress the air purge valve on top of the separator after opening the drain valve. Catch the water and sludge in a bucket and add it to the slop tank for proper disposal.

Repeating this process and observing the fuel flow will indicate how long the pump should run before it is necessary to drain the separator. The Tank Cleaning System should be kept running in the Phase Two re-circulating mode until clean fuel samples can be drained from the separator. Phase Two will continuously remove free water and particles as small as 5 micron using only the water separator and [AXI Fuel Conditioner](#). The fuel enters in Port 1 and returns back to the tank from Port 2 (discharge port 3 on the HC System). The fuel bypasses the filter, which will economize on consumable filter elements. Phase two will restore the fuel to a clear and bright condition. Note that emulsified water will still be in the fuel until the filter elements are used in the system in a later phase, so the fuel may appear hazy.



In Phase Three, the MTC system is still in a re-circulating mode. It is at this point that we recommend the attachment of the [Digital Flow Meter](#) (see [www.diesel-fuels.com](http://www.diesel-fuels.com) web site) to allow for the monitoring of the flow rate of fuel through the system and the system performance. During use of the digital flow meter, you should use at least an 800 micron filter bag in the primary filter (HC System) to protect the meter.

As the fuel being circulated is being returned to the same vessel from which it came, some portions of the fuel will be treated several times in a single circulation of the tank capacity, while other portions of the fuel will not be circulated, and hence will not be treated at all. For this reason, we recommend that the volume of fuel to be treated be circulated at least three times (as measured by the digital flow meter). A more complete treatment will be accomplished if the volume of fuel in the tank is circulated five times and is often necessary the first time a tank is cleaned.

The fuel enters through Port 1 and exits through Port 2 (discharge port 3 on the HC System) back to the tank. In addition to the water separator and [AXI Fuel Conditioner](#), this phase incorporates the water block/fine filter. Phase Three will restore the fuel to its optimal clear and bright condition. Initially, use the fine particulate filters to remove the finest invisible particles down to 3 micron. Then replace the filter elements with the water block filter elements to remove the entrained and emulsified water. Monitor the pressure gauge on the filter head (or gauge on

the HC secondary filter housing). When the pressure reaches 20 - 25 PSI, or reaches the red area it is time to change the filter. The MTC-3000 is equipped with a differential pressure indicator that will pop up when the filter needs to be changed.



Before replacing the filter element, place an appropriate container under the drain valves. Open both the drain valve on the separator and the drain valve under the pump. Use the air purge valve on top of the separator to make sure all fluid has been drained from the system before changing the filter. The water block filters are used to remove entrained and emulsified water from the fuel/oil stream.

Saturation of water block filter will cause the pressure drop over the filter to increase. When the pressure drop over the filter blocks the fuel flow and the filter element is not changed, the bypass valve in the pump may open and the system will idle. This should only be allowed to happen for no more than 30 seconds. Apply a film of lubricating oil to the gasket of the new filter. Screw filter on to the flow adaptor until the gasket is tight and secure (an additional 1/2 to one turn after the filter makes contact with the gasket). Check for leaks when re-starting and pressurizing the system. The material trapped inside the filter can be inspected to better understand the types of contaminants that have been removed from the tank.

We do not recommend running the system unattended:

- The pump may run dry
- The Separator/Coalescer may overflow into the pump when not drained on time
- The system may build up too much pressure
- The return hose may jump out of the tank causing a spill

### **DRAINING AND STORING THE SYSTEM**

Before releasing the quick disconnect couplings, allow all fuel to flow out of the hoses by draining the system or take the suction hose out of the tank while the pump is still running and wait until the system is purged and empty. Place an appropriate container under each drain valve. Open both the valve on the separator and the valve under the pump. Use the air purge valve on top of the separator to make sure all of the fluid can be drained from the system. Opening the valves and the air purge valve will allow fuel to flow down and out of both hoses into the tank.

Pump Strainer/Y-Strainer (MTC-500) — Check the pump strainer (located on pump head of MTC-1000/3000) or Y-Strainer (MTC-500) frequently for debris and clean as necessary.

Fuel/Oil Separator/Coalescer — The separator/coalescer is a closed dynamic separator/coalescer that does not require any consumables. When draining water and sludge from the separator:

1. Place an appropriate container under the drain valve
2. Open the drain valve and close when observing clean fuel
3. Push the air-purge valve to allow air in and fuel to flow out

The Separator/coalescer needs to be serviced and flushed from time to time. This can be done by removing the top plug, opening the drain valve on the bottom and flushing the separator to make sure no debris and contaminants restrict the flow.

Pump — Check pump for leaks, worn vanes and if bypass valve operates correctly. We highly recommend carrying a spare pump. The MTC pump can be easily changed in a matter of minutes by opening the unions and/or short hose connections. Spare part kits are also available for all MTC pumps. Keep the pump lubricated and pour some oil into pump head for storage.

[AXI LG-X Fuel Conditioner](#) — Ferrous particles and rust can collect inside the LG-X unit and over time cause a flow restriction and/or diminish its effectiveness. Open the lid of the LG-X Fuel Conditioner by unscrewing the lid screws and clean the magnet and fuel chamber. Inspect O-rings prior to reassembly. A spare O-Ring and screws are included in the spare parts kit and should be kept handy.

Suction and Discharge Hoses — We recommend replacing the suction hose every year and the discharge hose every two years. Heavy use, visual deterioration, damage or poor condition and excessive wear can require an even earlier change.



After Cleaning the Tanks:

1. Stabilize the Fuel. [AFC-705 Diesel Fuel Catalyst](#) should be used to stabilize the fuel in tanks used for long-term fuel storage. If you are in a region where the use additives that meet Tier 4 regulations are required, AFC-710 is Tier 4 compliant and should be used to stabilize the fuel, prevent sludge build-up, and eliminate the need for expensive and toxic biocides. When no AXI re-circulating system or STS Automatic Filtration System is in place, AFC-705 or AFC-710 will maintain fuel quality and prevent formation of solids for six to twelve months. Added during the tank cleaning phase it is not necessary to use AFC-705 again for 6 months or more.
2. Prevent Water from Accumulating. The use of [AXI Water Eliminators](#) will prevent water from accumulating in the tank. The Water Eliminators will absorb and remove any future water from condensation or other sources. Preventing water accumulation eliminates microbial growth and the need for toxic biocides.
3. Monitor Fuel Quality. [Liqui-Cult Fuel Test Kits](#) are ideal to monitor your fuel supply for microbial contamination. The tests quantify bacterial and fungal activity.
  - ALGAE-X<sup>®</sup> Tank Cleaning Systems significantly lower operating costs, save fuel, eliminate periodic tank cleaning and the build up of solids, sludge and acids.
  - ALGAE-X<sup>®</sup> Technology enhances personnel safety and addresses environmental concerns by preventing the need for costly toxic biocides.

### **Conclusion:**

Changes in refining process to reduce sulfur and introduce blends that include bio-fuels have shortened the shelf life of diesel fuel. Reliable power requires the implementation of unique and innovative fuel optimization and maintenance technologies to adequately protect engines and protect the integrity of stored fuel beyond filtration and separation.

Fuel degradation is an inevitable, natural process, and organic contamination is beyond filtration. For your system to be effective when the lights go out, you need something more.

Implementing a preventative maintenance procedure for keeping water out of your tank must include regular testing for water and organic contamination, semi-annual treatments with the [ALGAE-X<sup>®</sup> AFC-705 Diesel Fuel Catalyst](#), and periodic treatment with a fuel polishing system. ALGAE-X<sup>®</sup> provides the entire package, and we look forward to being your preferred source of fuel treatment systems.



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