



# ***Tankless Base System Installation Instructions***



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# Chapter One – Overview of Components

## 1.1 Necessary Tools

To start your installation it will be beneficial to have a few tools and supplies handy:

- A good sharp knife or hose cutter to cut the flexible fuel hose.
- A small tubing cutter for stock steel fuel lines.



*Tubing Cutter*

- Fuel Line Disconnect Set to disconnect fuel lines and fittings (not necessary on every vehicle so check your fuel line connections and plumbing prior to purchasing a set or keep your receipt.)



*Quick Disconnect Sets*

- Hand Vacuum Primer Pump for Priming Coolant and Fuel Lines and Troubleshooting (not necessary, but very handy and cuts down on priming frustration and allows for quick diagnosis of restriction or air issues.)



*Hand Vacuum Pump available at [www.goldenfuelsystems.com](http://www.goldenfuelsystems.com)*

- Some rags or shop towels to keep things wiped up and clean.
- Although you can use screwdrivers for the hose clamps it is highly recommended to purchase some nut drivers to tighten the hose clamps. They don't slip off and will be a great addition to your toolbox. You will need 1/4" and 5/16" nut drivers. They are cheap and easy to find at any hardware or automotive store.
- A screw gun or drill will also be handy. Again, 1/4 and 5/16 driver bits are a real help. The self-drilling screws for mounting the hardware of the kit are easily installed with the screw gun.
- A set of wire pliers (strippers and crimpers.)
- A tube of Teflon Pipe Joint Compound (also known as *pipe thread sealant*). *Special note: We do **not** recommend the use of Teflon tape in place of pipe joint compound. Teflon tape is much more likely to leak (either air in or fluid out.) We like the fool-proof 'smear-n-go' philosophy of the pipe joint compound.*
- 2" or larger hole saw to cut a hole in the trunk of your car (or the bed of your truck) to run the Triple Bypass Hose (3B hose.)

- Stock Fuel Filter. Stock fuel filters remain one of the most neglected areas of a diesel maintenance regime. This will prevent restriction issues and complicated diagnosis
- Supply of coolant for your vehicle, depending on year we recommend getting a **universal formula** to mix with all types of coolant.
- Digital Volt/Ohm meter. These are less than 20 dollars at most auto part stores and far superior to a test light. We do not recommend a test light because of its potential to damage complex computer circuits.

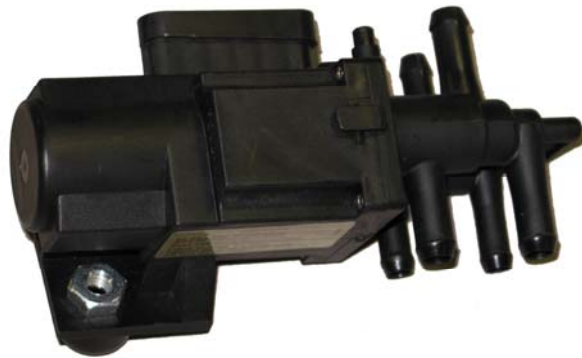
## 1.2 Preparing the Installation

The first step to ensure your installation will be as clean as possible is to study your stock fuel configuration. Find your diesel fuel filter, your injection pump, your lift pump (determine if your vehicle has an in-tank or external lift pump), your return lines, fuel lines, and such. Follow the flow of the stock fuel system as it makes its way from the fuel tank, to the injection system and finally, the return fuel back to the fuel tank. Once you have a solid idea of how the fuel flows on your current system, it will make the installation process much smoother.

There is no right or wrong way to start the installation. Some start with the plumbing, move on to mounting parts and then finishing the electrical while others do portions of the vehicle at the same time. You may also consider placement of the components first, then lay out the plumbing and finally finish with the electrical. Regardless of the installation procedure, properly planning the project will limit mistakes. Chapter One is a brief overview of the components for familiarization.

## 1.3 Components

### 1.3a Pollak Selector Valve



**Pollak 6-Port Valve**

The six port fuel selector valve can be mounted where it is most convenient. The material that the valve is mounted to does not matter because this valve receives its grounding from the wiring harness. Ensure that it is clear of any hot or moving parts. You can secure the valve with two 5/16"-18 x 1" bolts (included with the kit) or just use cable ties to hold it in place. You will generally mount the valve in an area as close to the engine as possible or in the engine, if possible. This allows for a faster purge of the SVO during shutdown. You may need to fabricate a bracket for it to mount securely. This valve must not be mounted after any high-pressure (60+ psi) fuel pumps. For example: on the 1999 and newer Ford Powerstrokes, the lift pump is a 60-70 psi pump and is mounted to the inside of the driver's side frame rail just under the drivers seat. This means that the best place to mount this valve is just to the rear of the lift pump along the same frame rail.



**Toggle Switch**

**The toggle switch** (provided with the 6 port fuel selector valve) will be mounted through a 15/32" hole usually on the dash within easy access of the driver. Pick somewhere that you can easily access for drilling and wiring. Be careful not to push too hard on the dash as you are drilling, so that you won't crack the panel. Push the toggle through the hole and secure it with the locator tab and nut provided in the Pollak switch box. Follow the supplied wiring instructions within the Pollak box.

### **1.3b Racor SVO Filter**



**6120**

#### **Racor 6120**

The 600 Series Filters all have mounting holes cast into the filter head. They will need to be bolted to a solid foundation in an upright position. Generally they will be mounted at the beginning of the fuel line run (close to the tank) or at the end of the fuel line run (close to the fuel selector valve). Either one is fine. The pluses and minuses for each have to be weighed by the individual owner and are usually decided by where it is the easiest to install with the least amount of modifications. The filter heads have seven ports. Four of them are inlets and three are outlets. They are designated by arrows that are cast into the head by the ports. Only one of each is to be used while the others will be plugged with the provided 3/8" NPT plugs. This allows multiple configurations for different applications.



**1000FH with the Exclusive GFS Thermostatically Controlled Heater 80°-140°**



**900FH with the Exclusive GFS Thermostatically Controlled Heater 80°-140°**

#### **Racor 900FH, 1000FH**

Racor filters must be mounted as close to vertical as possible. Do not exceed 10° from vertical or the assembly may not function properly. The see-thru contaminant collection bowl allows the operator to check for water and solid contamination at a glance. Overhead Clearance needed for Turbine Series Filters: 5” – 12”. Allow for at least 2” clearance under the unit for draining water from the collection bowl. Turbine series filter assemblies are designed to be installed on the vacuum side of the fuel transfer pump for best efficiency. These filters include an internal 12V, 300 watt Heater with Golden Fuel Systems exclusive thermostat so it turns on at 80° and safely raises the fuel up to 140° degrees.

**WARNING! DO NOT ACTIVATE THE HEATER WITHOUT FUEL IN THE FILTER! THIS CAN PERMANENTLY DAMAGE THE HEATER ELEMENT AND/OR FLTER! REMOVE THE FUSE IF THE FILTER IS GOING TO BE EMPTY OR NOT RUNNING FUEL THROUGH IT FOR EXTENDED PERIODS WHILE ACTIVATED (36 hours or more.)**

Adjustable one-piece clamp-type mounting brackets, with grade 5 fasteners, are included for ensured durability. One 2-micron Element is installed in the Filter. 2 adapter bushings for 3/8” MPT Fittings are included.

Elements other than genuine Racor cartridges will NOT open the shut--off valve and are not recommended for use with the new FH Turbine Series. The new element design will fit ALL older versions of Racor’s Turbine Series, however, old element stock (those with full colored end--caps and the single center bail handle) will not fit or open the shut--off valve in the new FH models.

### 1.3c Accessory Fuel Pump



**Accessory Fuel Pump**



**FASS HPFP**

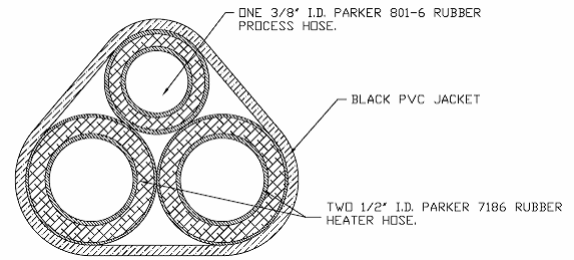
**Accessory Fuel Pump (actual pump may vary from image)**

The Accessory fuel pump is a 12 volt electric fuel pump that is used to assist pushing the SVO up to the factory lift pump. This just helps take some of the stress away from the lift pump. It is always to be installed on the outlet side of the veggie filter to prevent pressurizing and potentially damaging the Racor Filter. It can either be mounted directly to the filter or as close to the filter as possible. The 1999-newer Ford 7.3L Systems do not need an accessory fuel pump. On the 2003-newer Cummins and Chevy/GMC Duramax Systems, this accessory pump is replaced with a FASS HPFP Pump. The vacuum gauge tee must always be installed on the suction side of the pump, as close to the Racor filter as possible.

### 1.3d Triple Bypass (3B) Hose



**Triple Bypass Hose**



### **3B Hose**

This hose was designed exclusively by Golden Fuel Systems and produced by Parker for SVO use. The two 1/2" coolant hoses supply and return hot engine coolant to your hot SVO tank while simultaneously keeping the 3/8" fuel line hot from the tank to the engine compartment. These are 3 separate hoses encased in a rubberized PVC sheath. In addition, the bundled wires can be used for the Racor internal Heater (12 gauge), fuel level sender, accessory pump, etc.

This is the safest and most efficient way to run a heated fuel line. The hoses are extremely durable and can be run under the car without fear of rupture or failure. Plumbing of the Triple Bypass hose is a painless process as long as you've planned ahead. Plumbing diagrams are in the next Chapter.

#### **1.3e Vacuum/Pressure Gauge**



**Vacuum gauge – Color may vary**

The vacuum gauge allows one to monitor and diagnose the SVO system. The gauge registers resistance of the fuel moving through the fuel system. The normal operating vacuum the gauge will register depends on the vehicle, but should be around 1-2 inches of vacuum with a clean filter and good oil. When the vacuum reaches 10-15 inches of vacuum, this usually indicates a clogging fuel filter or another source of restriction. Make note of where on the gauge the vehicle starts to hesitate and "bogs" down and this is when the filter needs to be changed in the future. An air issue may be indicated with a "0" reading of vacuum or pressure.

#### **1.3f Fuel Level Sending Unit and Gauge**



**Fuel Gauge- Color may vary**

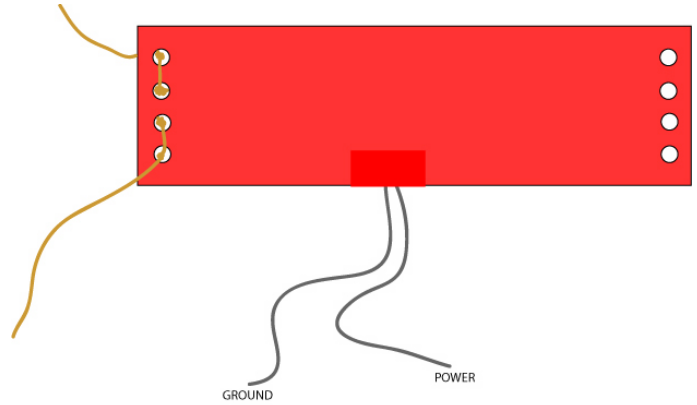
The Fuel level sending unit and external gauge allows one to monitor the fuel level in the SVO tank.

#### **1.3h External Heater Wrap (Racor 600 Series)**





DO NOT OVERLAP THE HEATER WRAP



The external heater wrap is secured by a shoelace style system. It should be tight but not overlapped. If it is overlapped then it is not the proper size for the filter element. It is better to have some exposed filter element so that the wrap will not overheat. The Golden Fuel Systems electric heater wrap is a 12 volt electric resistive wrap that we use to heat our vegetable oil filters. We recommend the wrap to be secured as tightly as possible on the lowest point of the filter housing but not overlapping itself. Ensure that the wrap is not pinched under any mounting brackets or between anything that could damage the internal wires. The wrap has two white wires. One wire is to be 12 volt key on fused power and the other wire is to be a ground. It does *not* matter which one you choose for which operation. The wrap is a resistance type heater element, so power and ground are interchangeable. We wire this through a relay that is controlled by the ignition key, but it may also be wired to a separate switch for added control. We recommend that the customer wraps the entire filter and heater wrap with the supplied bubble wrap insulation to prevent the heat from being wicked away.



## Chapter Two - Plumbing

You will find the recommended plumbing diagram attached with these instructions. Please follow the plumbing diagram appropriate for your vehicle. Below is an explanation on how to route the 3B Hose.

Most diesel engines employ two types of fuel pumps to ensure proper fuel supply. The lift pump is responsible for supplying the injection pump with all the fuel it needs. The injection pump is responsible for delivering fuel to the injectors in a precisely measured and timed sequence. The stock lift pump may be mounted in the engine, on the frame of the vehicle or in the tank. Please confirm the location before beginning installation. The original lift pump might have been replaced and relocated during the lifetime of the vehicle.

In some installations, it is possible to isolate the stock fuel filter. By removing it from the supply line, it may allow for faster purging times as there is no fuel filter to purge of SVO. **However, be aware that the stock filter is the last line of defense for the engine, so removing it removes any additional filtration benefits it provided.**

### 2.0 Routing Triple Bypass Hose

3B Hose is relatively easy to manipulate. It is flexible, yet durable, allowing for tight installations. The first step is to plan where to route the hose from the tank, under the vehicle and then into the engine compartment. You will need to take into account where your stock heater hoses are in the engine and where the Racor Filter and Pollak 6-Port Valve will mount. This will determine where the 3B hose will need to route, as well as where you will need to splice into the hose.

GFS Recommends starting with plumbing the 3B hose at the tank(s) and then running it under the vehicle, lightly securing it with the zip ties so that there is enough slack to move it if necessary. Please observe the included plumbing photos for tank plumbing, filter plumbing and engine plumbing. In most cases, the 3B Hose is routed on the driver's side of the vehicle.

Once inside the engine compartment with the 3B hose, you will need to trim back the rubber sheath to expose the individual hoses so they can route to the various points they will need to go to. You will have to split 4 feet or more of the 3B sheath because the fuel hose generally needs to be routed to the driver's side of the engine and the heater hoses generally need to be routed to the passenger's side of the vehicle.

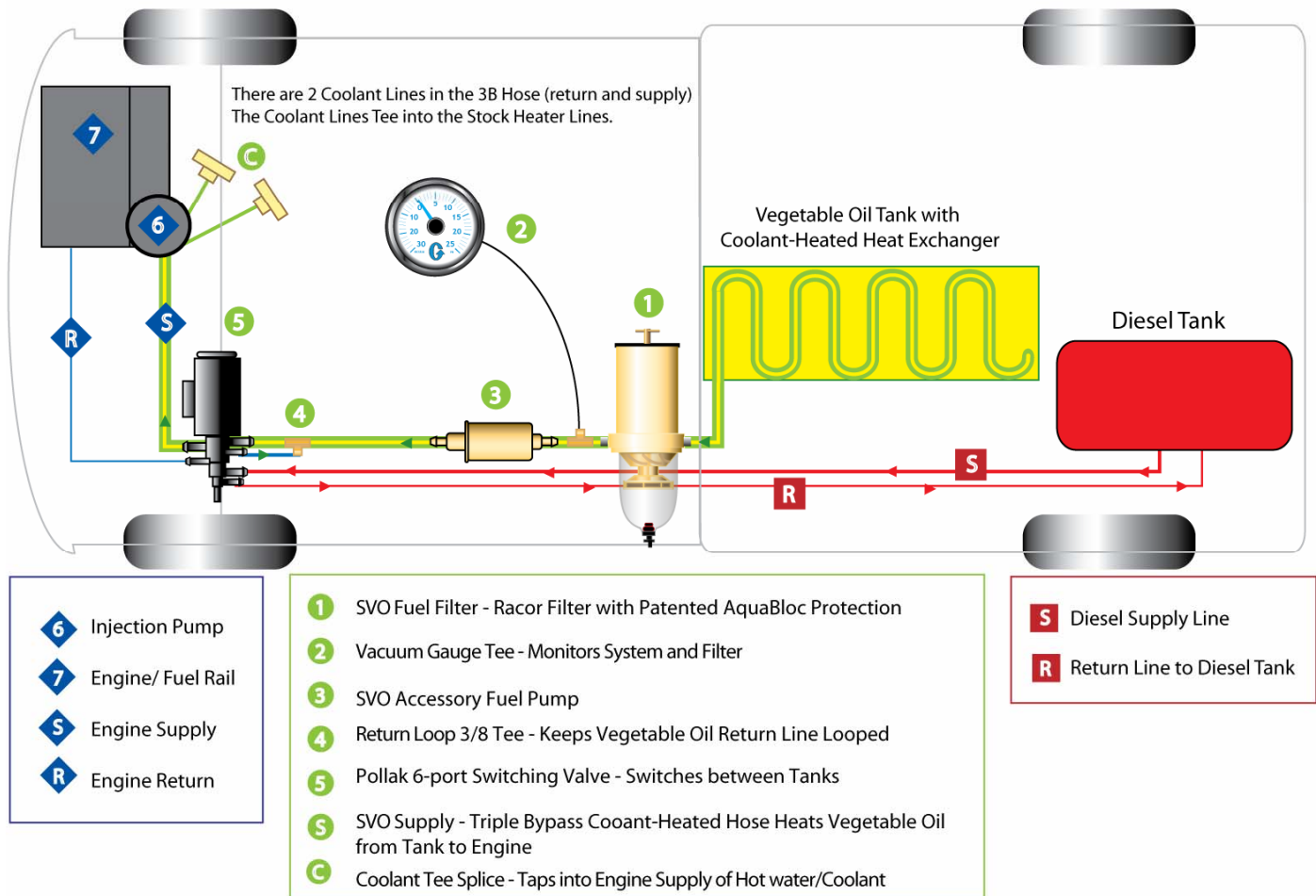
There is a Kevlar string inside the hose that you can pull on to split the sheath length wise. However, a hose knife is recommended to cut the sheath with speed and without finger burn. There is a clear wrapping inside the 3B hose that will be exposed when you split the sheath. This clear wrap is only there to protect the internal hoses from the shrink wrapping process during the 3B manufacturing process. You can discard any clear wrapping that you expose.

Once the 3B is initially routed you need to verify clearance between the hose and other moving parts and that there is enough slack at each end to make all connections before you trim the hose to length. Do not leave any SVO fuel hose exposed outside of the engine compartment. Insulate it with coolant lines and sheathing or bubble wrap, if necessary. Even a couple of inches of exposed SVO fuel hose in cold weather can create a slug of cold SVO that might result in restriction that will immobilize the SVO System. If anything is not satisfactory then you can correct it at this time.

In the engine compartment, decide which heater hoses you are going to splice into and where you will install the splice. You will need one supply hose and one return hose. GFS recommends waiting to perform the coolant splices so that it is the very last step to complete the installation as it will be quite wet once the heater hoses have been cut.

When ready to splice into the heater lines, start by placing a drip pan under the location of the cut. You will need the 5/8" x 5/8" x 1/2" tee's right at your fingertips after the cut to install quickly and reduce coolant loss. Use the hose cutter to cut the hose and install the two 5/8" x 5/8" x 1/2" tee's with the 4 large hose clamps. Some vehicles will require two 3/4" x 3/4" x 1/2" tees. Please contact us if your installation needs these tees.

Once your conversion is complete, be sure to check your coolant level and add fluid as needed. GFS recommends priming the coolant lines with a mix of Universal Coolant and water in the recommended ratio. While some installs lose almost no coolant when you cut into the heater hoses, others wind up with a serious loss, and replacement is mandatory! These coolant lines can be primed readily with a hand-held vacuum pump.



**General Plumbing Schematic**

## Chapter 3 - Converting an Existing Tank

Converting an existing tank isn't overly difficult, but it does require a bit more work than a standard conversion. This section covers only the tank modification, since everything under the hood is identical to a normal Golden Fuel Systems conversion.

**To install the Stainless Steel Hot Fox, you will need the following for installation:**

1. High-speed Drill with a 7/32"" drill bit.
2. 400 RPM Drill with ½" Chuck.
3. Needle Nose Pliers
4. 5/32" Hex Wrench (3/8" drive Preferred)
5. 1-5/8" Hole Saw
6. Oil-Resistant RTV High-temp Silicone
7. Large magnet (like one off the back of an old speaker).
8. Some shop rags.
9. Various wrenches and sockets (for removing and re-installing your tank).
10. Bucket or drain pan or something to drain your diesel into.
11. Floor jack (if the tank is mounted underneath the vehicle)
12. 4 jack stands (if the tank is mounted underneath the vehicle)
13. Hot Fox Heat Exchanger with Self Drilling Screws



**Hot Fox**

### Installation

If the tank is mounted beneath the vehicle, you will need to remove it. If the tank is in the bed of the vehicle, that is not necessary. Lift the vehicle with the floor jack (one end at a time) and support it all the way around with your jack stands. The higher you can get it in the air, the more comfortable you will be. Make sure that the vehicle is secure on the jack stands before attempting to remove the tank.

Remove the tank. Some removals are more difficult than others. It is best to remove as much fuel from the tank as possible to eliminate the weight when dropping it. This can be accomplished by pumping the fuel from the fill-port or ensuring that the level is low when doing the installation. It is a good idea to have a friend to help with the removal. Keep the jack handy to lower the tank to the ground.

Drain your tank of all diesel fuel that might be in it. Some tanks have a drain plug on the bottom, making draining very easy. Most, however, require removal of the tank, removing the fuel gauge sending unit, turning the tank upside down, and pouring the diesel fuel into a bucket. It is much safer and easier to have a second person helping you.

***Note:** Some vehicles require specialty tools to remove the fuel clips that attach the lines to the tanks. Consult your vehicle specific maintenance manual if needed, and be prepared to make a trip to the auto parts store.*

Once the tank is removed and emptied of diesel, it's time to start planning your surgery. Try to find a good flat spot big enough for the Hot Fox to seat comfortably on. Pay attention to height clearance as the Hot Fox will stick above the tank about 2". Also pay attention to the sending unit. Make sure that the Hot Fox does not interfere with the float arm. The Hot Fox is the Fuel Pick-up, so it may be mounted anywhere where it doesn't interfere with the float arm. When installing the Hot Fox, please follow the instructions included with the unit. You will not be installing a Backing Plate for most installations. Please use a bead of silicone in addition to the provided gasket to seal the unit and use the self-drilling screws to secure the unit. You should see a bit of silicon ooze out the sides of the sealing plate as you drill all the screws into place.

Once you are done cutting a hole in the tank, clean out the tank. You just ran a hole saw into your tank, causing metal shavings to fly into your tank. It's a good idea to get as many of them out as you can. You can put a little diesel back in there, slosh it around a bit, and pour it back out. We also snake our arm into the fuel sending unit port when applicable with a magnet, and scrape the magnet all along the bottom of the tank, picking up all the filings as it goes. We also finish up with a rag as well, just to be safe. Anything else left in the tank will be caught by the Racor filter. This means that the first fuel filter element might not last you as long as your future fuel filters will because it is filtering out the installation residue. We call this the 'break in' period.

### Remounting the Tank and Plumbing Fuel Lines

Now your tank is converted to heat and hold SVO. Before you place the tank back up into your vehicle or secure the tank to the vehicle, the 3B Hose will need to be plumbed. You can attach a pig-tail of the 3B to the Hot Fox, so it will be easier when mounting the tank if it's underneath the vehicle. You may need barb connectors to attach the lines together. These should be easily acquired at a local plumbing store. If there was a stock fuel pick-up unit, you will need to plug both the supply and return ports. Both the supply and return line will need to be plugged. Install all of the fuel line prior to mounting the tank underneath the vehicle.

You are now ready to hook up the 3B to the newly converted Golden Fuel Systems tank. Split just enough of the sheath back to expose enough coolant hose length and fuel hose length to make the connections without any kinks (usually 1-2 feet). Keep the length of the 3B intact for running under the the vehicle and connecting to the Pollak Switching valve and teeing into the coolant lines in the engine. Install one medium hose clamp per coolant hose, and push them completely onto the Hot Fox Coolant Ports (it doesn't matter which coolant hose hooks to which coolant fitting). Next, install one small hose clamp for the SVO Fuel Line, and push it completely onto the SVO fuel supply port .Once you tighten all the hose clamps then you are ready to reinstall the tank in the vehicle exactly as it was previously mounted.



**Hot Fox with Coolant Lines wrapped around Fuel Line**



**Dual Hot Foxes**



## Chapter Four – Wiring

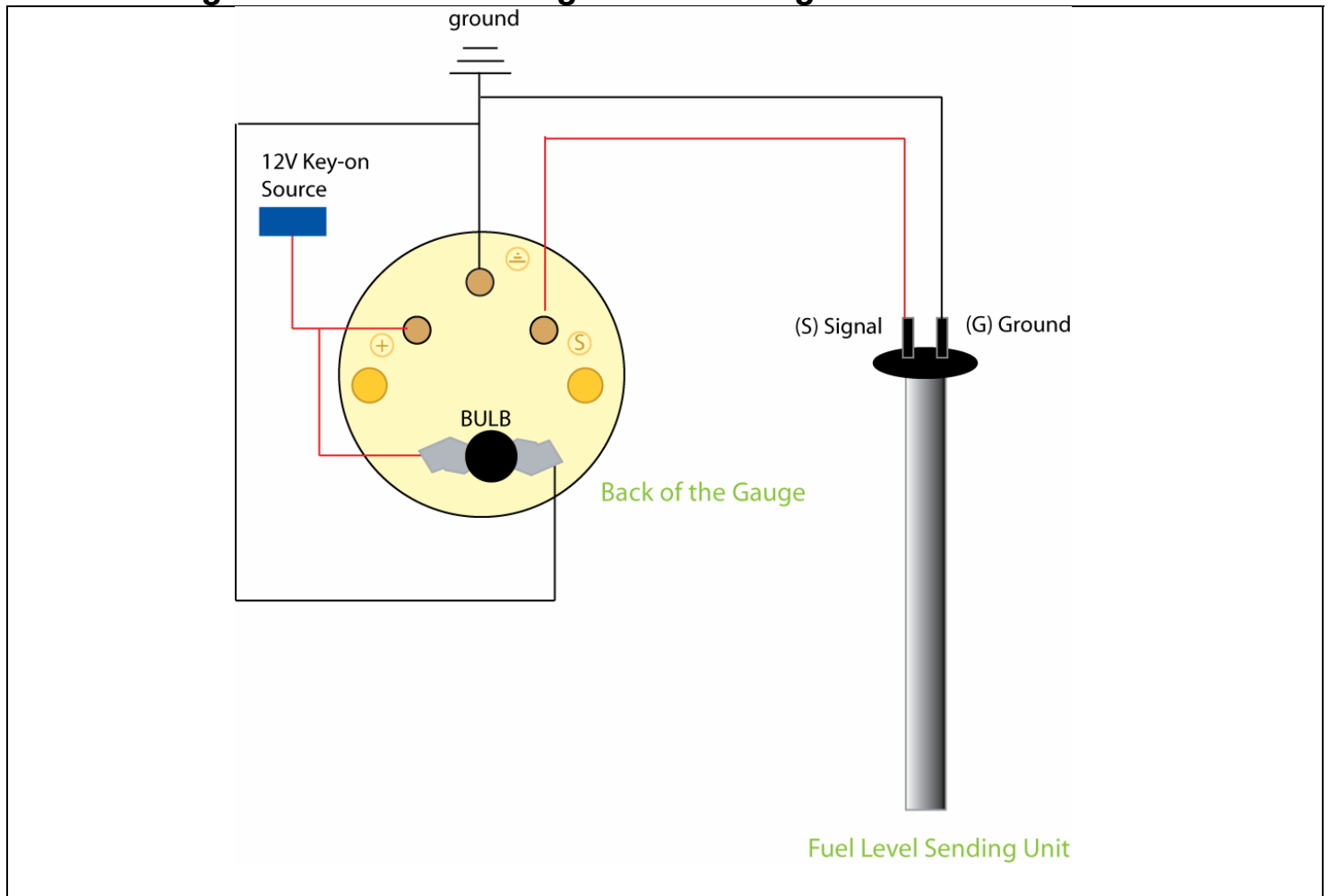
### 4.0 Pollak 6-port Selector Valve Wiring

When wiring the Pollak Valve, only Terminals D and E will be utilized. Ignore A, B and C. Please refer to your vehicles specific wiring diagram for more information.

### 4.1 Finding a 12 volt “key on” source

You will need a Digital Volt/Ohm meter (DVOM). You need to find a wire under the dash that only has 12 volts when the key is in the “RUN” position. It will not have power in the “OFF” position or the “ACCESSORY” position. You accomplish this by back-probing the wire with the red lead and then grounding the black lead. It should read 0.0 volts when the key is off but will read approximately 12 volts when you turn the key forward to the “RUN” position. This is two clicks forward, just before you begin operating the starter, when the dash lights and buzzers come on. **Please use a Digital Volt/Ohm meter, NOT a test light.** There have been countless issues of incorrect 12 Volt key-on Sources being found with test lights. Voltmeters are less than 20 dollars at most auto part stores and far superior to a test light. We also do not recommend a test light because of its potential to damage complex computer circuits.

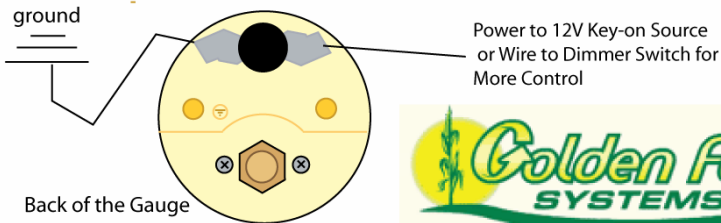
### 4.2 Wiring of Fuel Level Sending Unit and Gauge



### 4.3 Vacuum Gauge Set-up

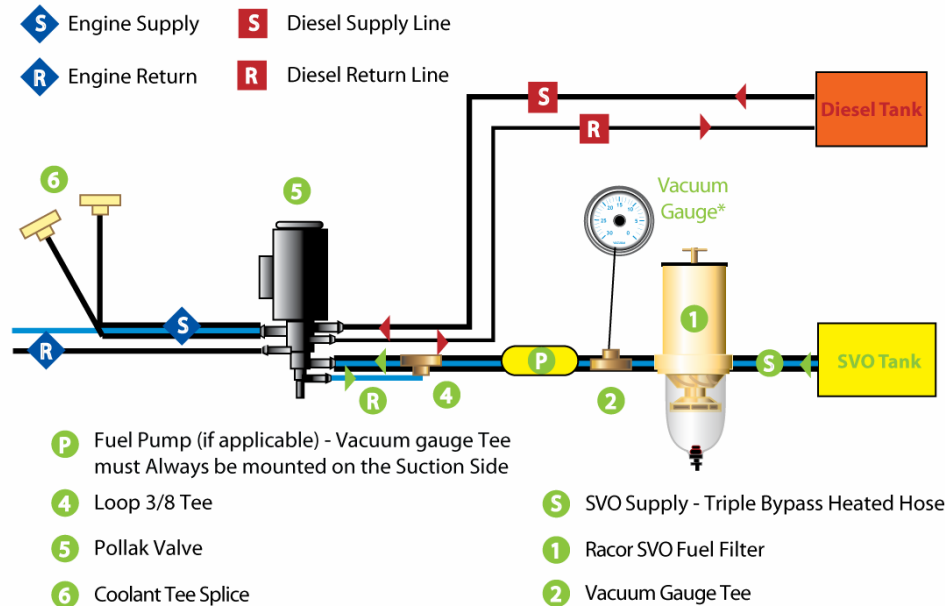
The vacuum/pressure gauge allows one to monitor and diagnose the SVO system. The gauge registers resistance of the fuel moving through the fuel system. When the vacuum reaches 10-15 inches of vacuum, this usually indicates a clogging fuel filter. Make note of where on the gauge the vehicle starts to hesitate and “bogs” down and this is when the filter needs to be changed in the future. Depending on the vehicle, there may be symptoms of restriction at any of these vacuum points mentioned.

#### Vacuum Gauge Wiring

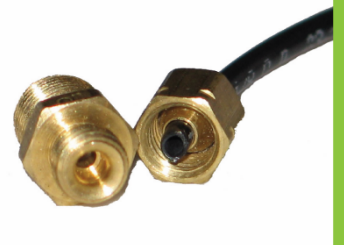


#### Vacuum Gauge Plumbing

If a specific Plumbing Diagram was provided for your vehicle, please follow the specific instructions



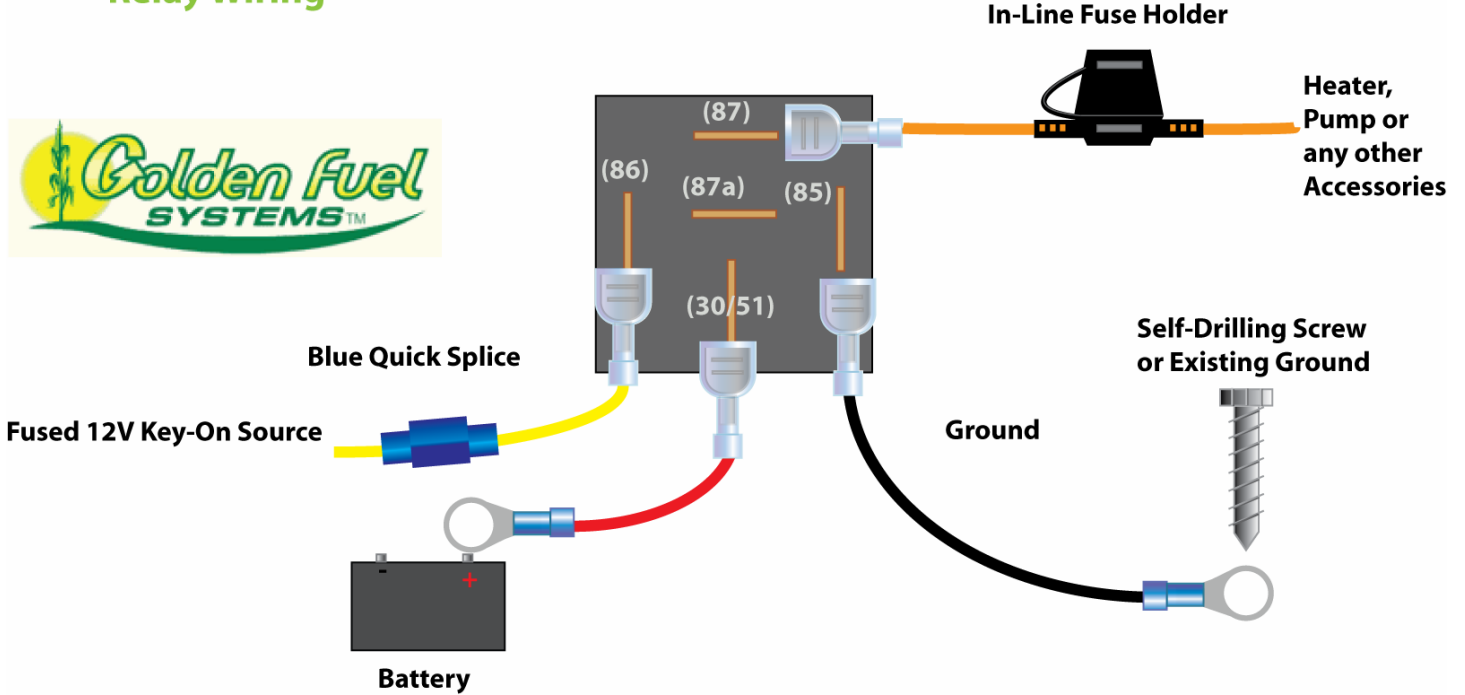
Install vacuum gauge between Filter and SVO Pump or right after the Pollak Valve (if system doesn't have SVO Fuel Pump) - engine side (reads restriction on both diesel and SVO.)





## 4.4 Wiring Relays

### Relay Wiring



When wiring the relay, label the relay with the accessory that it controls. Make a note of the wire colors and their respective functions, as well. Installing the relay on the driver's side fire wall is usually the most convenient location. Note: Relays may have 4 or 5 posts.

## Chapter 5 - Finishing the Conversion

### 5.0 Finishing Checklist

So you think you're all set and ready for a test drive? Let's run through this checklist to highlight the critical points of finishing the conversion.

- Make sure all Hose Clamps are tight.
- Check the grounds from relays, sending units and pumps to ensure metal contact.
- Insert all the fuses at this point.
- Remember to prime Filters with diesel or veggie (we recommend using the Mity-vac Hand Pump to pull fuel through or using the fuel pumps.) You may fill the filter with clean fuel to speed up the priming process, Remember, if using an electric pump to prime, don't let it run dry for too long.
- Remember to prime the lines with diesel or veggie (we recommend using the Mity-vac Hand Pump to Pull fuel through and check for air bubbles or use the fuel pumps to prime.)
- Change your stock filter so you know everything in the fuel line is new.
- Prime your coolant lines by using a pump or the old-fashioned way of driving and filling when the air bubbles work themselves out. Keep a couple of gallons of coolant with you in the vehicle when you go for the test drive and check the coolant level.
- Make sure you have at least half a tank of Diesel, but not full to the brim. You will most likely have to purge air bubbles in the veggie system to the diesel tank and you don't want to overflow a full tank. For more on air purging check section 5.2.

You should be all set at this point. Start on diesel and let the engine warm up to operating temperature. If you flip over to veggie, it should be a smooth transition. If you feel a hic-up or two, it might be an air bubble you need to work out of the system by "purging" the air to the diesel tank (switch back and forth between SVO and diesel.) Air in the system will cause a shuddering and jumping sensation eventually shutting the engine down, while clogged fuel filters will cause a slow restriction, leading to a gradual loss of power.

To operate the SVO system, always start and stop on diesel. This will ensure a clean start on diesel, preventing any hard starts. Once the engine is up to temperature (watch the stock temperature gauge until it reads normal operating temperature) switch over to SVO. At the end of your trip, switch back to diesel and drive for about 5 minutes (depends if the stock fuel filter is plumbed in-line with SVO.)

If you have any questions after this point please contact us via e-mail, fax or phone.

## Chapter 6 - Troubleshooting

### 6.0 Recently Installed System

**I switched over to SVO and the vehicle sputtered and coughed and the engine cut out. What should I do?**

Most likely, the fuel lines weren't primed properly and there was air left in the system that caused the engine to turn off. Prime the fuel line by disconnecting the SVO fuel line to the switching valve and turning the accessory fuel pump on or using a hand vacuum pump until the fuel flows without any air bubbles. Reconnect the fuel line to the switching valve and tighten the hose clamp. Make sure that you are on the un-looped diesel system when you attempt to start the vehicle. If the vehicle is air-locked it might take several attempts to start the vehicle again and to purge out the air from the system.

**I've been running the car for 15-20 minutes and the vehicle is up to temperature, but the tank isn't warm. What should I do?**

Most likely, the coolant lines weren't primed properly and there is air left in the system that isn't allowing the coolant to flow properly. Prime the coolant line with a water pump or hand primer pump. You might have to cycle the coolant a couple of times to purge the air pockets completely. Make sure to check your coolant level, as well.

### 6.1 Mature System

**I switched over to SVO and am experiencing acceleration issues and lack of Power. What Should I do?**

Most likely, there is restriction in the SVO system. This is usually caused by a clogged veggie filter. Change the veggie filter. Don't forget to prime it (fill it up with fuel) and make sure that it is sealed well.

**I changed my SVO Fuel Filter and am still experiencing acceleration issues and lack of Power. What should I do?**

If you are running a system that utilizes the stock fuel filter for both veggie and diesel, you might need to change the stock fuel filter.

**I changed the SVO and Stock fuel filter and am still experiencing acceleration issues and lack of power. What should I do?**

Most likely, there is some other source of restriction that will have to be traced down. Restriction can be caused by numerous foreign objects that get pulled up into the system or by cold veggie. If you found that your system was running fine in the warmer weather, but now has had a couple of hic-cups with the onset of cold weather, we would advise checking your system for any sources of heat leaking such as exposed fuel line, unwrap filters or coolant deficiencies. For the extreme cold climates, there are a couple of inline heaters and heated fuel pick-up upgrades available on our website. **Do not leave any blue fuel hose exposed. Insulate it with coolant lines and sheathing or bubble wrap, if necessary. Even a foot of exposed blue fuel line in cold weather can create a slug of cold SVO that might result in restriction that will immobilize the SVO System.**

**I switched over to SVO and my vehicle began to sputter and cough and the engine cut out. What should I do?**

Most likely, there is air that has been introduced to the system. If you just changed your fuel filter and didn't prime it properly, that could be the source. If you primed the filter properly, check to make sure that there is nothing loose on the filter. If nothing on the system has been changed recently, then the air leak will have to be traced down. A hand vacuum pump is convenient to trace down air leaks. Check all hose clamps and fittings for a secure fit, as well.

## 6.2 SVO Cold Starting

*You forgot to shut down on diesel!* This is part of the "SVO Learning Curve." Most folks running SVO have done it and chances are that you will, too. Every once in a while, we act like humans and forget to flip that switch before we shut down for the night. Don't panic, it's an easy fix and it doesn't harm your vehicle. Here are a few recipes that'll get you back on the road.

The first thing to do, before any of the following suggestions, is flip your fuel selector switch to Diesel. If the weather is above 45 or 50 degrees simply cycle your glow plugs twice and start the vehicle. It will likely require more cranking than normal but once it fires up it should clear out. Keeping your accelerator 50% engaged will help matters. If this approach doesn't work, try some of the suggestions below. These suggestions can be used separately or together (in the event of particularly harsh weather). **When cranking, be sure not to run your starter for more than 30 seconds at a time, allowing it a 60 second break between attempts, otherwise there is a risk of burning up your starter.**

1. **Plug in your block heater.** You can plug in your block heater and wait a couple of hours. Then cycle your glow plugs once or twice and she'll likely pop right off with minimal cranking of the starter. Just about every diesel has a block heater and sometimes they're worth their weight in gold.
2. **Place the vehicle in a heated garage.** If you are parked in a garage and it can be heated then by all means turn the furnace on.
3. **Heat via light.** You can place an incandescent or metal halide (fluorescent lights will not get hot enough) shop light shining on your injection pump, wait about an hour, cycle your glow plugs, and she should fire up!
4. **Hair dryer or heat gun.** Blast hot air on your injection pump and injectors until they feel warm. Cycle your glow plugs and crank her up.

## Chapter 7 - Gathering SVO

It is highly recommended that you watch the DVD Liquid Gold available from [www.goldenfuelsystems.com](http://www.goldenfuelsystems.com) that deals specifically with collecting and filtering oil. Pictures are worth a thousand words and moving pictures with commentary are priceless.

### 7.0 Seven Golden Rules of Gathering SVO

**Gathering Rule #1:** Drive around back and inspect the oil before asking the owner if you can take it. The last thing that you want to do is make contact with a manager and then get permission to take the oil only to find out that the oil is less than desirable.

**Gathering Rule #2:** When checking for oil quality, note the consistency, color, and clarity of the oil.

**Consistency** - Open the bin, peer in, and kick the side of the bin to generate a bit of a wave. If it doesn't move at all (provided it's not a concrete grease trap), walk away. Even in 30°F weather, there should be some fluidity to it (for more information on gathering in the cold, see the next section Wintertime Gathering, definitely worth your time).

**Color** - If, looking down into the bin, you note the color of the oil is creamy, thick and milky looking, decline the oil. While such oil is certainly usable, it usually eats up more time and filter bags than it's worth. The milkiess is more free fatty acids (aka FFA's) and likely more water than you want to mess with. The actual color does not matter. It can look like new Wesson oil straight off the shelf, light ice tea, or maple syrup. The color will vary mattering on the type of oil (canola, peanut, coconut, etc.), what was cooked in it, what temperature they cooked at, and how long it was used.

**Clarity** – This is the most important test of all. This test is for warm weather collecting. Find a clear container and take a sample of the oil. Hold the sample up to the sun or a bright light and check the clarity. You should be able to see through the oil to the other side. If you can see through it then by all means it is great oil and I would collect it for use in my vehicle. If it is just a little hazy then I would take the sample home with me and let it set for a while to see if the oil settles out. If in a couple days the sample that you took settles out and looks clear when held up to a light then it is good oil. I would go back and collect the oil. Then take the oil home and let it settle out for a few days (or a couple weeks if possible).

The longer you let the oil settle then the more sediment will settle out and the longer your pre-filter bags will last! If it is cold outside and the oil in the bin at the restaurant is thick and creamy I wouldn't walk away just yet. Take the oil sample just as you did before (in a clear container) but now you need to warm the oil up. Warming the oil up above the cloud point will melt any FFA's that have changed state. You can warm the oil by simply holding the container in front of the heater vent of your car or you can take the oil home and let it warm up and settle out there. The oil will slowly clear up and hopefully become translucent. Then you can make a decision on whether to collect and process it or not.

As you gain experience and knowledge with the visual and characteristic differences between good oil and bad oil you will be able to dip a stick into the bin and inspect the oil droplets as they fall off the stick. This is usually good enough for a seasoned Golden Fuel Systems burner to determine if it is worth their time in processing.

**Gathering Rule #3:** When proceeding to ask someone if you can take the oil, knock on the back door. All restaurants have a back door for receiving. Just knock on the door and ask the first person that answers the door if you can have their waste vegetable oil. Most of the time you will either get a 'yes' or a 'let me find out' and then they will find someone who does know. There is no real reason to bother the manager if you don't have to. This usually saves everyone time and hassle.

**Gathering Rule #4:** Don't bother with the practiced WVO speech about how you're working on this alternative fuel project and how you can run a diesel engine on waste vegetable oil and how you need their oil, etc. Most of

the time, they are busy with work and other customers and are not interested. If they're interested, they'll ask what you are using the oil for, at which point, you can go a little more in depth with your explanation if you want to. Otherwise, keep it short and sweet: "Do you mind if I take a little bit of your used vegetable oil?" usually does the trick.

**Gathering Rule #5:** Never take the oil without the restaurant's consent! This is the golden rule of oil gathering, and should never be broken. Doing so can spoil it for all WVO burners. Even if restaurant owners have to pay to dispose of their oil (like most of them do), they're still likely to view such unsolicited favors as thievery. There have been reports of people who did not ask permission and had the police called on them.

**Gathering Rule #6:** Once you start pumping, never pump past the settling line! The settling line is the point of the grease bin where all the solids have piled up, and the oil will be thick and creamy. You do not want to collect the creamy stuff. The creamy stuff will clog your pre-filter bags very quickly. Don't take oil from any lower than at least 2" above the settling line is a good rule of thumb to follow. We are all guilty of getting greedy for that wondrous, free, eco-friendly oil, but it's not worth your time and pre-filters to take the settled junk.

**Gathering Rule #7:** Never leave a mess at a restaurant grease bin. Try to keep your gathering as clean as possible. We don't want gatherers to be declined by restaurant owners because of the mess someone else made. They're giving us fuel, so let's return the favor by showing them the respect of a clean pull.

## Chapter 8 - Processing SVO for Fuel

Most people think that converting a vehicle to run WVO is the hard part, and getting the oil for fuel is the easy part. In reality, it's the opposite. While oil preparation is not overly difficult, there's a definite learning curve to it that's a very slow process, since you have to run it for a while in your vehicle and see how long it takes you to clog a filter before you know how clean it is. It is waste vegetable oil and it does take some work to get clean and the cleaner the better. So, here's our gleaned experience to yield the cleanest oil that time will allow.

Oil preparation actually starts with the gathering process. If you can, gather on a nice, sunny day, taking advantage of the sun's effect on the oil's viscosity. Not only does this aid in the settling process before you even gather the oil, it also prolongs the life of your gathering pump. Choose good, clean oil, pump from the top, and make sure your pump has a good strainer on the intake. If you're not using a gathering pump, use a pitcher (or something of the like), try to take from the highest point possible, and pour it through some panty-hose into your container. While you're pumping, watch the oil and search for the settling line. This is the point of the grease bin where all the solids have piled up, and the oil will turn thick and creamy. Don't take it from at least 2" above the settling line, as the stuff down there will just chew up pre-filter bags later on.

### 8.0 Letting Oil Settle

There are tons of ways to mass-filter oil out there, and the best rely on multiple stages. Settling is the process of allowing gravity to pull the heavy particles (solids) suspended in the oil to the bottom of its container. Properly applied heat can greatly aid in the settling process by reducing the viscosity of the oil. We accomplish this by painting the container black and setting it out in the sun. DO NOT use any type of open flame heat source under the container to aid in the oil processing. The intense localized heat will cause a convection current within the container which will stir up all of the contaminants that have settled to the bottom. This will negate all the work that gravity has already done for us. Not to mention the fact that propane is a fossil fuel, and using it to prepare our eco-friendly fuel defeats our overall purpose. We cannot say this enough! Settling is your friend! Take the time and let the solids settle out of your oil. Even waiting a mere week can make a huge impact on how clean your oil gets. However, most of us don't want to wait this long. Personally, I recommend at least two weeks, but you have to be the judge. It'll ensure you get the most out of your filter bags and the longest life possible from your Racor filter.

### 8.1 Pumping Oil

You will pump your oil many times during its preparation, whether it is gathering, filtering, or filling your fuel tank. Always pump from the top of your container. DO NOT put your suction filter at the bottom of the barrel. This will result in pumping up all the settled solids and cause you a lot of frustration, premature clogging of filter bags, and can also damage your gathering pump. Place the suction hose only a couple inches into the oil and start pumping. Continually monitor the suction hose and slowly lower it as the level of the oil drops, keeping it just under the surface. You should be able to see the submerged suction filter screen and will be able to see when you get to the settling line. Stop the pump before you get too deep. Now it is time to clean up and move on to the next gathering spot.

### 8.2 Filtering

After your oil has had some time to settle, it is then time to filter it. There are a couple of filtering methods. We use a couple of One-shot filtration units at the shop for their convenience, ease of use and unbeatable filtration properties. We filter down to 2 micron, matching or beating most vehicle stock filters. Filter bags are a great low-cost alternative, but don't have any water-filtration capabilities. You can make your own out of multi-layered bed sheets, or buy some Golden Fuel Systems 6-8 micron pre-filter bags. Our pre-filter bags can clean a hundred or more gallons before they clog but it is all relative to the quality of oil that you filter through the bags. If you try to filter really nasty creamy oil then the bag will clog rather quickly. If you use really good oil that has been settling for a couple of weeks then you will be able to get hundreds of gallons



through the bag before it clogs. If it's winter time, it's a good idea to warm the oil a bit before you run it through the bag. A low heat is best and propane burners are not recommended.

Convection is bad and will stir up all the settle deposits and redistribute them throughout the oil. You can use a submersible tank heater in your oil a couple of hours before you run it through the bag. We sell one style on our website that we have used for many years. Do not put it on the bottom of your container as this will also stir up any settled deposits with the thermal currents. Try leaving it suspended just about midway in your container. Do not get the oil too hot! We here at Golden Fuel Systems recommend pre-filtering oil that is between 80°F and 120°F. If the oil exceeds this temperature range then it is possible that it will cause the fibers of the pre-filter bags to stretch and will not work as designed. If you filter the oil at too hot of a temperature it is possible to let enough contaminants through the bag to seriously degrade the lifespan of your Racor filter on the vehicle.

Do not clean and re-use your filter bags for final filtration. We're not saying this to get you to buy more. We've tried our best to find a good way to clean and re-use the bags. We've turned them inside out and gently wrung them out. We've run hot water through them (backwards and forwards). We've washed them in a washing machine on the warm/cold cycle. Unfortunately, all attempts ended in stretched fibers and useless pre-filter bags. You may use them as a pre-pre-filter bag to catch large chunks and save on the new filter bags for final filtration.

After the oil is filtered, store your clean oil in a barrel or jug, preferably in the sun. Even the best of filters will still allow particles in the processed oil, and it never hurts to allow it to continue to settle in the ambient heat until you need it. When you're ready to pump it into your tank, be sure to pump off the top, as mentioned before, to get the cleanest of the crop. And you should still leave the last 4" or so, even of the clean stuff. Pour it into your next batch of unfiltered stuff and let it settle out again.

Don't ever think you can get away with not pre-filtering your oil. Every once in a while, you'll score some oil that's so prime looking that you know you can just run it right into your tank. Fight the temptation. No matter how good that oil looks, skipping the pre-filter stage will land you with clogged Racor filters. We speak from experience (but it was sooo clean! :). We don't want to rain on your pristine discovery of sweet oil; just think of how long your filter bags will last with this great stuff flowing through it!