

Fuel Filter Service



Training Manual

2008 SERVICE CHAMP INC.

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Fuel Filter Service Training

Introduction

Today's gasoline engines are very complex. Many intricate parts and systems must function together to deliver optimum engine performance. Of all the systems operating in vehicles today the most neglected system is the fuel system. Of this system, the fuel filter is by far the most forgotten.

Gasoline engines require a constant high pressure flow of clean fuel. Contaminants from within the fuel system can greatly hamper engine performance and fuel economy. The fuel filter's function is to maintain the system by trapping dirt, rust and scale. This protects sensitive fuel system components and allows them to function as they were designed. Changing the fuel filter as part of a preventative maintenance program is not only essential for engine life and performance, but required to maintain vehicle warranties.

As part of the Quick Lube service offering, the fuel filter service fits well into the preventative maintenance schedule line of thinking. Quick Lube Centers address a customer's vehicle fluid and filter needs. Fuel filters go hand in hand with this philosophy. The service is essential and necessary.

For the most part the service can be performed in the time it takes to do an oil change. With proper procedures in place the service can be quick, safe and clean. Taking the time to explain the necessity of the service to the customer would be time well spent. A few dollars spent on regular maintenance could save costly repairs in the future.

Something to Keep in Mind

There is a misconception that the fuel filter is included in a basic tune up. Generally, a tune up consists of spark plug replacement only. General repair facilities will usually inspect the vehicle and make recommendations on the related parts requiring replacement. This may include spark plug wires, air filter, PCV valve, cap and rotor (if equipped) and the fuel filter. Thus, there is no guarantee that the fuel filter would be replaced during a tune up. It is important that technicians verify the extent of the tune up with the customer and recommend a fuel filter replacement if one was not performed.

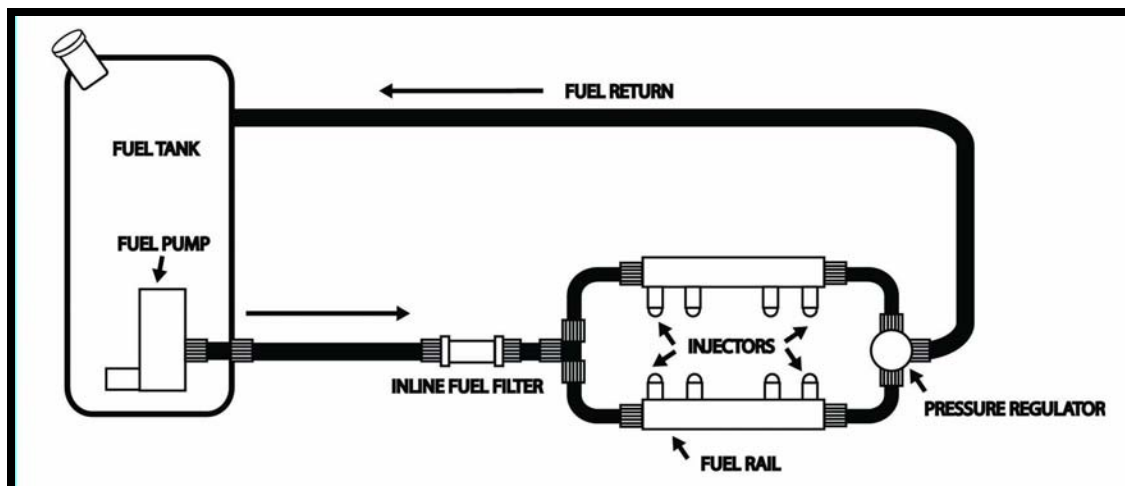
1-0 The Basics

Carbureted vehicles are quickly becoming a thing of the past. For the most part, the majority of fuel filters being serviced will be on fuel injected vehicles. Fuel injection fuel filters are larger and unlike the carbureted filters they are usually situated underneath the vehicle. There are a few applications however that are still situated in the engine compartment.

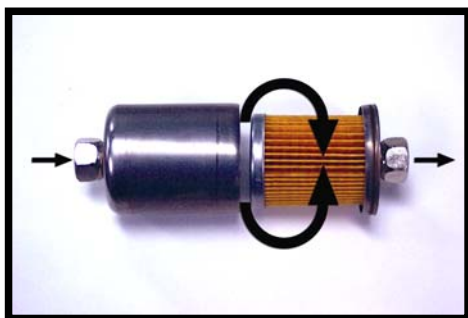
A basic fuel injection system is comprised of:

1. A **fuel tank** which houses an electronic **fuel pump**
2. An in-line **fuel filter**
3. A **fuel rail** which feeds the **fuel injectors**
4. A **fuel pressure regulator**.

Together their function is to efficiently deliver fuel to the vehicle's engine.



Fuel injection filters are constructed either using steel or engineered polymer (plastic). There is an inlet attached to the fuel line coming from the fuel tank and an outlet leading clean filtered fuel to the engine. The direction of flow is usually marked with a flow arrow or with the word "out" stamped on the filter. The side stamped "out" goes towards the engine. Inside the filter is the filtering media constructed of phenolic paper. This media is held together with metal end caps adhered to the media with plastisol adhesive.



With some applications, it is possible to install the filter in the reverse direction. In this instance the life of the filter will be greatly reduced. Fuel flows over the outside of the filtration media through to the inner core, and out of the filter to the engine. Installing the filter in the reverse direction forces the fuel to flow through the inside of the media and then outwards, thus limiting filtration surface area.

If one was to compare a fuel injection filter to an oil filter, there would be little difference. Both have an inlet as well as an outlet, both are encased and both have a similar internal construction. Where the similarity ends is where the oil filter in a clogged condition has a by-pass feature. If the oil system is neglected and the filter becomes clogged, there is either a by-pass valve in the filter or in the engine that will divert oil away from the filter and direct it to the critical components of the engine. Comparatively fuel filters, if neglected become clogged and eventually will stop the flow of fuel to the engine. This in turn will stop the engine and leave the vehicle's operator stranded.

Even the smallest restriction in a fuel filter can compromise the efficiency of a vehicle's engine. Most fuel injected vehicles are computerized. These vehicle computers do an excellent job in compensating when a part or system begins to fail or falter. They can mask a problem but in doing so can create another. In the case of a partially clogged fuel filter, the computer can increase fuel pressure to compensate for the lack of flow. This is done by increasing fuel pump pressure. The vehicle's operator may never know a problem existed. The only problem with this scenario is that the fuel pump has to work over-time to make up the difference. All this extra work can cause premature fuel pump failure.

The electronic fuel pumps found in fuel injected vehicles are very expensive and require significant shop labor to replace. The lesson here is to maintain the system with basic scheduled preventative maintenance and avoid the costly repairs.

A clean fuel filter allows the fuel pump to operate without strain, provides the correct flow of fuel to the engine, increases engine performance and pickup, and delivers a smoother idle. The fuel filter service is enhanced when combined with a fuel system cleaning application, such as **Heartland or Full Throttle products**.

1-1 Safety

There is an element of risk when working with flammable liquids. As such, ensure that the center is a non-smoking facility and that no smoking by either staff or customers takes place. During the process of a fuel filter replacement it is inevitable that fuel will be spilt. Because of this, extra care must be taken in properly containing and storing captured fuel and properly disposing of any fuel-saturated items. The amount of fuel spilled will depend on how efficient technicians are at performing the service. This efficiency will increase with the frequency of fuel filter replacement

It is fuel vapor rather than raw fuel that will ignite with an ignition source. Fuel vapor is very difficult to see. This being the case, it is essential that any spilled fuel be absorbed or cleaned up quickly. In the case where fuel is spilled on a technician's uniform, the uniform should be removed. If not, fuel vapor may linger and travel with the employee causing a potential hazard.

It is very important to ensure that the technician and the work area be equipped with the appropriate safety equipment. Because we are dealing with pressurized fuel lines, extra care must be taken to keep fuel away from the technician's eyes. The technician should wear proper head gear and safety goggles. Ensure that a serviced fire extinguisher is near by and accessible. Have a fuel catch pail at hand. Wearing

disposable nitrile rubber gloves helps keep fuel off hands. A good tip is to wrap a rag around each wrist to collect fuel spill (if any).

Pour any captured fuel into an approved fuel container. Clean up any spilled fuel and dispose of the rag in a flame proof container (Service Champ part # 30484). Place the old fuel filter in a metal container, have it taken outside to a safe marked area and allow the fuel in the filter to evaporate. Once the fuel in the filter has evaporated, place it in the used oil filter container for disposal. A vented fuel filter is safe to be removed with the old oil filters. It is cleaner and has fewer contaminants.

1-2 The Service

1. Qualify the Vehicle and Identify the Need

Important! The fuel filter replacement service is always confirmed by the technician whom will service the fuel filter. The majority of the time this will be the lower technician. Most fuel filters are located underneath the vehicle however there are some exceptions where the fuel filter is located underneath the hood. If it is determined that a service is required, ask the servicing technician to determine the accessibility and suitability first.

After the vehicle has stopped inside the bay, the lower technician should locate the fuel filter while waiting for the oil change service details to determine three important elements:

- 1) Whether the filter is accessible
- 2) Whether the filter, fittings/connectors and lines are serviceable
- 3) Whether a replacement filter is in stock

1. The filter must be accessible and should have a replacement time factor of about five to ten minutes (Caravan models exempted). If there is no significant volume of customers waiting for service, this factor can be waived, as long as the application does not incur long delays. Accessible simply means “Can you get to the filter without undue hassles?”

2. Check the condition of the old fuel filter, line fittings/connectors and the fuel lines. Once the filter is located, check the filter for signs of apparent age. Look for heavy rust, scale or OE markings on the filter. Slight rust and scale are within acceptable replacement limits. Inspect the line fittings/connectors and the lines from the filter back to the gas tank and from the filter to the engine. Care should be taken in trying to identify any potential problems.

With metal lines pay close attention to areas with bends in the line or areas where the lines may be attached to the chassis. These are areas susceptible to corrosion. Should the fuel filter connections and/or fuel lines be severely corroded advise the upper technician not to offer the service but to inform the customer of the situation and to have the fuel lines inspected at a general repair facility or dealership. It is highly recommended to spray Penetrating Oil (Service Champ part # 80052) onto threaded areas to make removal easier.

With nylon lines, inspect for hair-line cracks, discoloration or kinking. Nylon line is quickly becoming the fuel line of choice. Its resilience, durability and versatility make it a natural choice for this purpose. Ultimately with both metal and nylon line inspections, what we are trying to prevent is a difficult situation. The lines surrounding the fuel filter may seem fine but once the service commences and the lines are disturbed, a “pinched” or broken line may result. If a line were to break, however, fuel repair lines are available to rectify the problem quickly and easily.

3. Once the vehicle is qualified for service, determine the replacement filter number. The technician can obtain the year, make and model of the vehicle and verify the application. Ensure that the replacement filter is in stock and then inform the upper technician to proceed with the fuel filter offer to the customer.

***** ***Always check the application guide for the correct filter*** *****

1-3 The Offer

Standard customer approach After the “go ahead” to offer the fuel filter service has been received and confirmed with the lower technician, the upper technician should write the service installation price on the customer’s work order and approach the customer.

1-4 The Script

“Mr. ___ / Ms. ___, our store offers a fuel filter replacement service. With this service your old, clogged fuel filter is removed and replaces it with a new warranty approved filter. Do you know when the old fuel filter was last changed?”

“No, why should I change the filter?”

“The function of the vehicle’s fuel filter is to trap and remove harmful contaminants from the fuel system. Over time and during normal vehicle operation, the fuel filter will become clogged with contaminants. When this happens, the fuel flow to the engine becomes restricted and slows. This will result in decreasing performance and put undue strain on your fuel pump. Replacing the filter allows fuel flow to return to normal, reduces the fuel pump strain and restore overall engine performance.”

“Would you like to have this service done for you today? It costs \$XX.xx and takes about five minutes to do?”

“Sure, go ahead.”

“Thank you. We’ll start the fuel filter service right away”

If the customer declines the offer;

“No not today.”

“Thank you. I have included our installed price on your receipt. It is guaranteed for the next “xx” days. Please feel free to return here anytime to have this service done.”

Up-Sell Option

When the service is completed present the old fuel filter to the customer. Tap the old filter and pour out some of the residual fuel. This should be done from the old filter’s inlet. This residual fuel is usually dark in colour and full of contaminants. This not only reinforces the importance of a properly maintained fuel filter but also the need to maintain the fuel system.

In many cases, both the fuel filter and the fuel system need attention. Replacing the dirty fuel filter will provide an easier flow of gasoline to the engine and an improvement in performance. To further improve the overall operating system of the engine, add ***Heartland or Full Throttle fuel system cleaning products*** to the service. The customer’s needs, regularity of service and budget will dictate which option works best for them.

“Now that we have taken care of your fuel filter, it is a good time to address the fuel system itself. Adding one of our guaranteed fuel system cleaning services to the fuel filter replacement will greatly enhance the overall engine performance, clean out build up and moisture in the gas tank and fuel lines and remove performance robbing carbon deposits from the fuel injectors. Would you like to add this to your fuel filter replacement service? It’s an additional \$XX.xx.”

1-5 Replacing Fuel Filters

Before the service begins, ensure that the keys have been removed from the ignition. The upper technician should remove the gas cap to release the tank pressure and then replace the cap tightly. The lower tech should be notified once this is done.

After receiving the confirmation for the fuel filter service, the lower technician should obtain the new fuel filter and filter removal tools. Have two fuel line caps or plugs ready. Have the overhead doors raised slightly to improve air circulation.

Loosen the fuel line fitting/connector closest to the fuel tank using the correct tool. Catch any fuel spill in a catch basin. Quickly seal the line using the applicable cap or plug. This is important, because should excess air be allowed to enter the fuel line, back pressure may develop and create a surge of fuel. Remove the second fuel filter fitting or connector. Remove the old filter from the chassis mountings. The filter is either attached to the chassis by a bracket or with a clamp. Remove the old filter and place it in the catch basin. Inspect the fuel line fittings/connectors for signs of wear or damage. Ensure that all O-rings are intact and in place. Attach the new filter to the fuel line beginning with the line on the engine side and then on the fuel

tank side. **Verify that the fuel flow direction is correct.** Ensure that the fittings are tight and secure, and that the filter is securely in place. Wipe away any fuel spilled.

Inform the upper technician that the fuel filter replacement service has been completed and to give notification when the vehicle is ready for start up. Just before the engine start up, pressure check the fuel filter. To do this, the ignition should be turned to the accessory position to allow the fuel system to prime. The system is primed when the “hum” from the fuel pump, stops. To prevent a “hesitated” start this process may be required twice). During the priming process, inspect the fuel line to ensure that the new fuel filter and the connections are not leaking. Start the vehicle. Should a leak be noticed during either the priming process or during start up, inform the upper technician to shut the engine off immediately. Refit the fuel filter and check again. Seal one of the new fuel filter fittings with a dab of Tamper Seal (Service Champ part # 30393). Do not use spray paint.

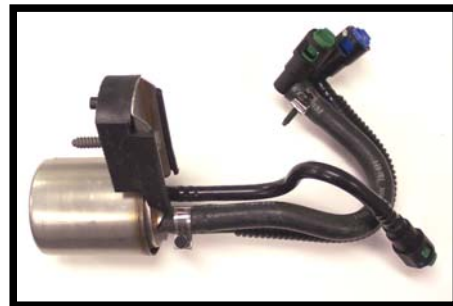
Return all tools to the fuel filter tool box.

1-6 Closing the Service

During the service invoice review, confirm the fuel filter service and the installed price to the customer. It is always a good idea to reinforce the sale of a large ticket item or service. Showing the customer the old dirty/rusted filter allows them to see an item that otherwise they would not have access to. In some cases the customer may assume what they are paying for is an “old style” carbureted fuel filter instead of a fuel injection filter (See pictures). It is best to invest the time and ensure the customer fully understands what they have purchased. By doing so, you not only educate your customer but help them “feel good” about their purchase.



Carbureted Fuel Filters



Fuel Injection Filter (Dodge Neon)

2-0 Fuel Line Fittings and Connectors

Before attempting the removal of a fuel filter inspect the vehicle and qualify it for service. As previously mentioned, a thorough inspection of the fittings/connectors, the lines and the filter must be made to prevent any potential problems. In the instance that a line or fitting is damaged or broken, a quick line or connector repair can be performed with little effort (see fuel line repair section 4).

2-1 Hose Clamps

Fuel filters can be secured to fuel lines using various methods. In the early days of electronic fuel injection, filters were attached to rubber fuel injection line using fuel injection clamps (pictured). There are still a few domestic and import applications using this hose and clamp combination. It is important to note that you must use fuel injection clamps for fuel injection applications. Using regular “worm gear” type clamps (pictured) can cut into the hose, possibly creating leaks.

Having the right tools for the job makes all the difference. Using the correct nut driver allows for proper clamp torque and helps prevent “stripping” clamps. To begin, loosen the clamp on one side. Slowly and carefully remove the fuel line. Inspect the clamp and line. Repeat the process on the opposite side.

Reinstall the line on the new filter. The fuel line should be pulled up tight to the end of the filter tube. Install the clamp just before the filter tube flare (pictured) and torque the clamp. Repeat the process on the opposite side.

In line replacement situations, it is essential that rubber fuel injection line be used in fuel injection applications and not regular carbureted fuel line. Each hose is pressure rated for the specific fuel application and should not be interchanged.



Worm Gear Clamp



Fuel Injection Clamp



Proper Clamp Installation

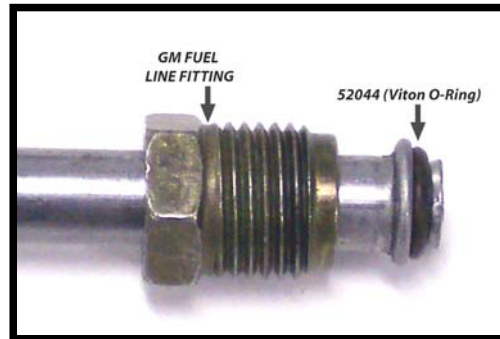
2-2 GM Threaded Line Fittings

This style of fittings can be found on most late model GM cars and trucks. They can be quick and easy to remove if the lines and fittings are in good working order. If they have been exposed to the elements without protection, they may require extra attention. Using good quality Penetrating Oil (Service Champ part # 80052) prior to service can simplify the removal process.

To begin, clean any debris or build up around the connectors. To remove the filter, a 5/8” flare nut wrench is required to ensure a proper grip on the line fitting and to prevent rounding of this fitting. These threaded fittings are attached to the vehicle’s fuel lines and therefore must be reused. Make sure the filter is fixed in place. If not, use either an opened end wrench or a pair of Vise-grip® pliers on one of the filter nuts to hold it in place while the fitting is removed. Marring the filter nut with the Vise-grip® pliers is not an issue as the old filter will be discarded. Once the fitting is broken loose, manually thread off the fitting. Repeat this process on the other side to remove the filter. Once removed, inspect the lines and fittings and replace the Viton O-ring (Service Champ part # 52044) found on the end of both the fuel lines (pictured).



GM Threaded Fitting Removal



Fitting Components

Viton O-rings are fuel resistant and under no circumstances must these be substituted with common neoprene O-rings. It is this Viton O-ring that provides the seal between the line and the filter. The function of the threaded line fitting is to secure the fuel line to the filter. As such, care must be taken not to over-torque these fittings.

Once the Viton O-rings are installed, it is always good practice to coat the section of steel fuel line underneath the threaded line fitting with anti-seize compound. This will prevent corrosion that often causes the fitting to fuse to the line. This fusing is the most common cause of line breakage in subsequent services.

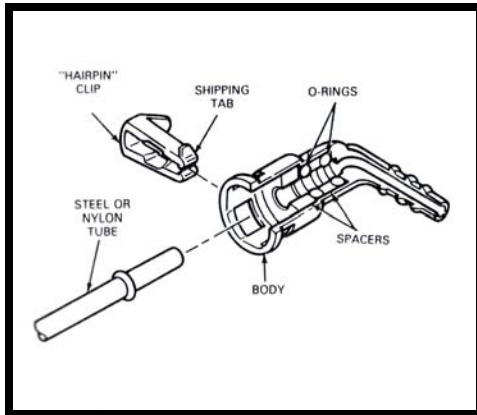
To finish up, install the new fuel filter with the directional arrow pointing towards the vehicle's engine. Place a small amount of Silicone Lube (Service Champ part # 80070) on the threads of the line fittings. Manually thread the line fittings onto the fuel filter and using the 5/8" flare nut wrench tighten the fitting securely (approx. 18 ft/lbs). Secure the filter to the clamp on the chassis and spray the bracket with a small amount of Silicone Lube. Using Silicone Lube will help protect the metal components and make easy work of future services.

2-3 Ford Hairpin Clip Connector

Ford has been using the hairpin style connector since it started using fuel injection in its vehicle in the mid 80's. This style connector can still be found on some late model vehicles today. The entire mechanism (pictured) is comprised primarily of nylon and incorporates two Viton O-rings within the connector body. These O-rings seal the fuel line to the filter tube. The function of the hairpin clip is to secure the line to the filter keeping the connection together. Over time however, it can become brittle and crack or break. If this should occur the use of repair lines will be necessary (see fuel repair section 4).

To begin, first loosen the bracket holding the filter to the chassis. Next, clean any debris or build-up around the connectors. Break the shipping tab off of the hairpin clip (pictured). This will allow the hairpin clip to be removed. Push the line towards the filter and hold for easier removal. Spread the two legs of the clip and push up on

the clip. Remove the clip and separate the filter from the line. Repeat this process on the opposite side of the filter.



Ford Connector Cross-section



Hairpin Clip Installed

For re-installation, lightly coat both filter tubes with Silicone Lube. This will lubricate the O-rings in the connector body when the filter is re-installed. Failure to do so may cause the O-rings to dry and be pulled out in subsequent services. Next, put the filter in place with the directional arrow pointing towards the vehicle's engine. Beginning with one side, insert the filter tube into the connector body and install the new hairpin clip supplied with the new filter. When doing so, make sure the clip head points away from the filter (pictured) and that each leg of the clip slips through both of the slots in the connector body. An audible "click" is heard once it is secured. Repeat this process for the opposite side of the filter.

Never reuse old clips as the shipping tabs are broken off in their removal. The tabs function as a locking mechanism to prevent the accidental release of the line during normal vehicle operation. Secure the filter to the clamp on the chassis and spray the clamp with a small amount of Silicone Lube. There will be some play in the fuel line but this is normal. Once the line is pressurized, the hairpin clip will come up tight against the flare in the filter tube.

2-4 Metal Body Connector (MBC)

The metal body connector is used in many variations by Ford, Chrysler and GM. GM and Chrysler incorporate a special release tool fixed to the metal body connector for their applications (discussed later). Ford uses this connector primarily on their full-size trucks. Ford requires a specific tool to be applied to their metal body connector for release (pictured). There are two variations of these tools.

The first is the metal "scissor" tool (Service Champ part # 3321) and the other (Service Champ part # 46363) is a plastic variation of the #3321 but with a shorter profile. Both of these release tools perform the same function. Personal preference dictates which one will be used. Refer to section 3-3 for specific applications for release tool part # 46363 where space and clearance is an issue.

The metal body connector is constructed to incorporate three Viton O-rings in the throat for the connector. The O-rings create the seal between the fuel line and the

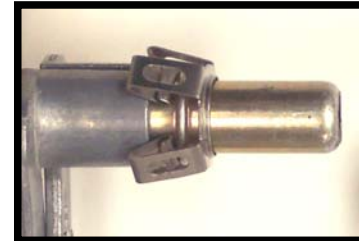
fuel filter tube. At the mouth of the connector is a ring of four metal teeth (pictured). These metal teeth provide the locking mechanism for the connector. When connected to the filter, the teeth lock onto the flare of the filter tube (pictured). Once inserted into the metal body connector the purpose of the release tool is to spread the metal teeth to allow the release from the filter tube flare.



#3321 (top) #46363 (bottom)

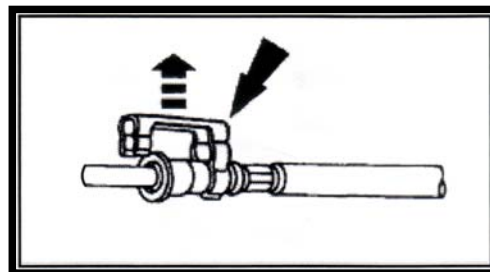


Teeth Removed from MBC

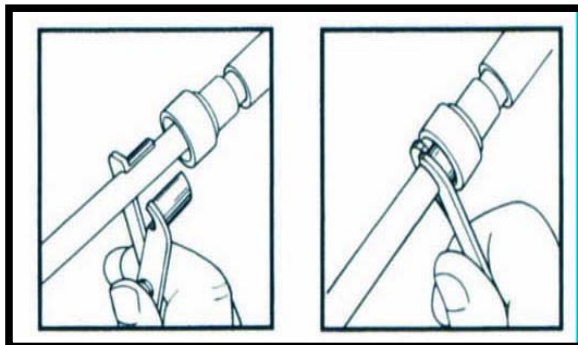


Scissor Tool Spreading Metal Teeth

To service the Ford applications, first loosen the bracket holding the filter to the chassis. Then clean any debris from the area surrounding the connectors. Pull up on the safety clip (pictured) to allow access to the mouth of the metal body connector. Spray Penetrating Oil into the mouth of the connector and wait a few minutes to allow the oil to work in. This is always a good practice because of the tendency for corrosion with these applications. If there is excessive corrosion, it is always a good idea to take hold of the filter and the line and gently try to work it back and forth to loosen any corrosion and to free up the connection.



Ford Safety Clip



To release the line, take a hold of the filter and the line and push them towards each other and hold. Then insert the release tool (pictured) push away from the filter. The tool will stop against the flare on the filter tube. The metal teeth will spread and the fuel line will release from the filter. Repeat the process on the opposite side. Remove the old filter from inside the chassis bracket.

For re-installation, lightly coat both filter tubes with Silicone Lube. This will lubricate the O-rings in the connector body once the new filter is reinstalled. Failure to do so may cause the O-rings to dry and be pulled out in subsequent services. Install the new filter into the chassis bracket with the directional arrow on the filter pointing to the vehicle's engine. To reinstall the fuel line, simply push the line onto the fuel filter

tube until a “click” is heard. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the metal teeth will come up tight against the filter tube flare. To finish, reinstall the safety clips on both ends of the filter.

2-5 Chrysler/Dodge Metal Body Connector



The Chrysler metal body connector is identical to the Ford connector. The only difference is that Chrysler incorporates a release button in their metal body connector. The black plastic release button (pictured) is locked into the head of the metal body connector and takes the place of the “scissor” tool. When the button is pushed into the metal body connector, the metal teeth in the connector will spread and the fuel line will release from the filter.

With most applications, it is possible to perform the service by just using ones fingers. In tight space applications, using the Chrysler release tool (Service Champ part # 434) is required to assist release. Personal preference will dictate which method is used.

To begin, clean any debris from the area surrounding the connectors. Spray Penetrating Oil into the mouth of the connector and wait a few minutes to allow the oil to work. This is always a good practice because of the tendency for corrosion with these applications. The release button acts as a shield to keep large debris out but can also act as a barrier to trap debris and moisture once it enters the connector. If there is an excessive corrosion, it is always a good idea to take hold of the filter and the line and gently try to work it back and forth to loosen any corrosion and free up the connection.

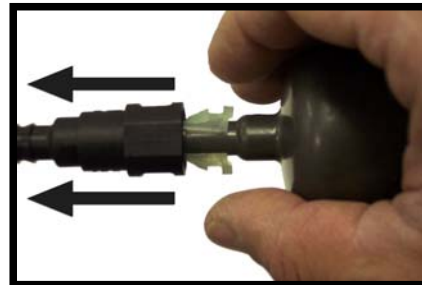
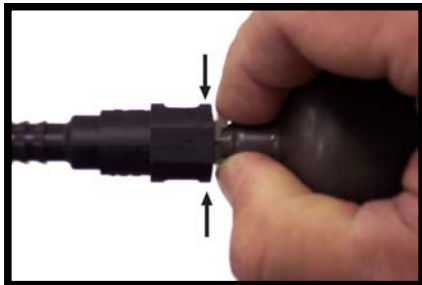
For re-installation, lightly coat both filter tubes with Silicone Lube. This will lubricate the O-rings in the connector body when the filter is re-installed. Failure to do so may cause the O-rings to dry and be pulled out in subsequent services. Install the new filter into the chassis bracket with the directional arrow on the filter pointing to the vehicle’s engine. To reinstall the fuel line, simply push the line onto the fuel filter tube until a “click” is heard. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the metal clips will come up tight against the filter tube flare.

2-6 GM/Chrysler Duck Bill (Pinch Clip) Connector

The “duck bill” connector design has been utilized by GM for the last 15+ years and by Chrysler for the last 10. The design is mechanically simple and constructed primarily of plastic and neoprene components. The connector body is constructed to incorporate three Viton O-rings in the throat for the connector. As with the metal body connector, the O-rings create the seal between the fuel line and the fuel filter tube. The connector is secured to the filter tube using a “duck bill” plastic clip. These clips are replaced with every service. The old clips should be discarded with the old filter. The advantages to this system are its simplicity and resistance to corrosion.

To begin the service, first loosen the bracket holding the filter to the chassis or remove the bolt securing the filter bracket to the chassis. If the application requires you to do the latter, spray the bolt with Penetrating Oil prior to removal. These bolts often break when corroded. These bolts are necessary to fix the filters in place on the chassis and in the case of filters with plastic casings they are used as a ground against static electricity.

Clean any debris from the area surrounding the connectors. To release the line, take hold of the filter and the line and push them towards each other and hold. Next, using either your fingertips or a pair of needle nose pliers, press both tabs together at the same time. The connector body will pull away from the filter tube. Remove the line from the filter tube. Repeat this process on the opposite side.



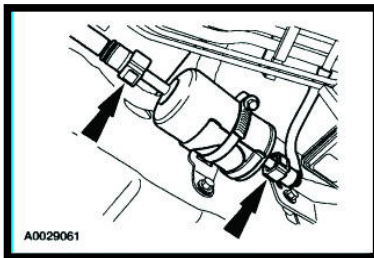
For re-installation, lightly coat both filter tubes with Silicone Lube. This will lubricate the O-rings in the connector body when the filter is reinstalled. Failure to do so may cause the O-rings to dry and be pulled out in subsequent services. Install the new filter into the chassis bracket (if required) or bolt it to the chassis. Ensure that the directional arrow on the filter is pointing to the vehicle's engine. To reinstall the fuel line, simply push the line onto the fuel filter tube until a “click” is heard. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the “duck bill” clip will secure the connector tight against the filter tube flare.

2-7 Ford/GM Push Button Design

Some 2002+ Ford and 2004+ GM vehicles incorporate built in pressure release (push button) connector body. These connectors are constructed primarily of plastic and neoprene components. The connector body is constructed to incorporate three Viton O-rings in the throat for the connector. These O-rings create the seal between the fuel line and the fuel filter tube.

The push button mechanism in this connector utilizes a reusable clip which looks very similar to Ford's "hairpin" clip but with a flat top (pictured). These clips fit into the connector body and are incorporated into the locking mechanism. When depressed, the legs of the clip spread to release the flare on the filter tube. It is important to note that these clips can break or wear out over time so keeping a number in stock is a good idea.

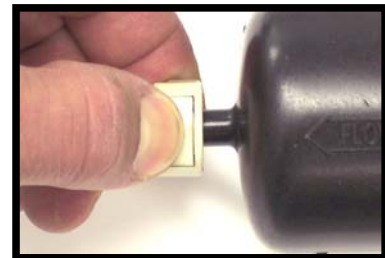
The positioning of these connectors, vary with application. The push button may be positioned on top or it may be facing down (pictured). As such, in the latter situation identifying the connector may be difficult. To help with this, simply grab hold of the connector and pinch both ends. This will depress the button regardless of which side it is located on.



Ford Windstar



Both Sides of Connector



Pinch Both ends to Release

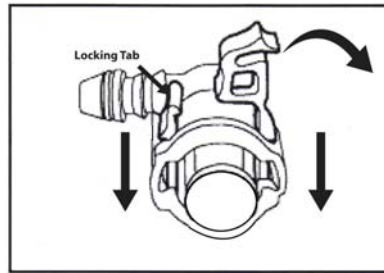
To begin the service, clean any debris from the area surrounding the connectors. Next, loosen the bracket holding the filter to the chassis or remove the bolt securing the filter bracket to the chassis. To release the line, take hold of the filter and the line and push them towards each other and hold. Pinch both ends of the connector and the line will release from the filter (pictured).

For reinstallation, lightly coat the filter tube with Silicone Lube to lubricate the O-rings in the connector body. Install the new filter into the chassis bracket (if required) or bolt it to the chassis. Ensure that the directional arrow on the filter is pointing to the vehicle's engine. Next, push the line onto the fuel filter tube until a "click" is heard. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the plastic clip will secure the connector tight against the filter tube flare.

2-8 Ford/GM “Safety Pin” Clip

The “Safety pin” connector can be found on some Ford Explorer trucks and some GM car applications (Chevrolet Cavaliers, Pontiac Sunfires etc.). These new connectors are made of plastic and utilize Viton O-rings in the connector to seal the filter tube to the fuel line. This new connector uses a unique securing method not found on other connectors. The locking mechanism in these new connectors resembles a safety pin.

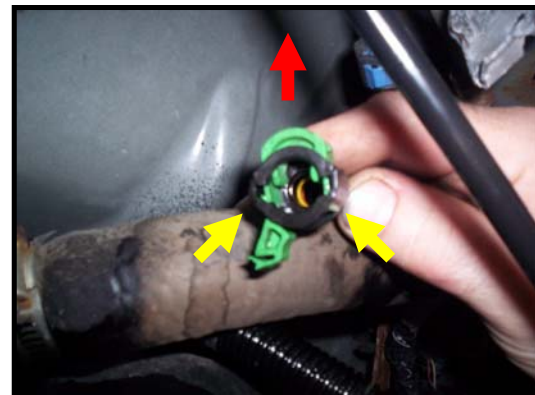
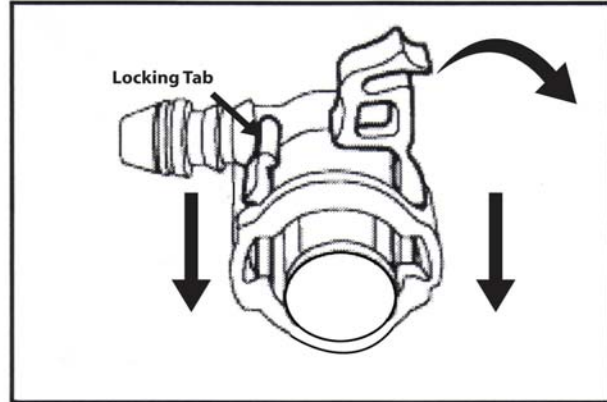
The “safety pin” design is utilized by the connector body clip. This clip is reusable and cannot be replaced. The lid of the clip is hinged and locked into place with a locking tab. The clip is moved up and down within the connector body at various times during the service. When in the “locked position” the clip is pulled up and tight to the filter tube with the lid snapped down and locked in place. When in the “release position”, the clip is slid all the way down to allow the filter tube to be removed.



To begin the service, first loosen the bracket holding the filter to the chassis or remove the bolt securing the filter bracket to the chassis. Clean any debris from the area surrounding the connectors. Take hold of the filter and the line and push them towards each other and hold. Next push the lid of the clip down and pull back on the locking tab. This will release the lid. To release the line from the filter tube slide the entire clip down. This will allow the flare of the filter tube to slide out and away from the connector.

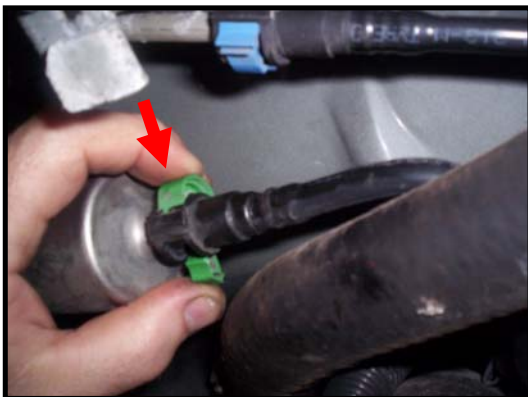
For re-installation, lightly coat the filter tube with Silicone Lube to lubricate the O-rings in the connector body. Install the new filter into the chassis bracket (if required) or bolt it to the chassis. Ensure that the directional arrow on the filter is pointing to the vehicle’s engine. Install the filter completely into the connector. Pull the clip up and tight against the filter tube. Next, snap the lid down locking it in place with the locking tab. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the plastic clip will secure the connector tight against the filter tube flare.

Ford/GM Safety Pin Clip



To release, press down on the hinge arm and pull locking tab away. The hinge arm can now swing free.

Next pinch both the tab and the arm towards each other and push both into the connector body. The whole pin clip will move up and come to a stop. Remove the filter tube. Do not attempt to totally remove the clip from connector body.



To re-install filter, insert the filter tube into the connector, snap the clip down and swing the hinge arm back into the locked position.

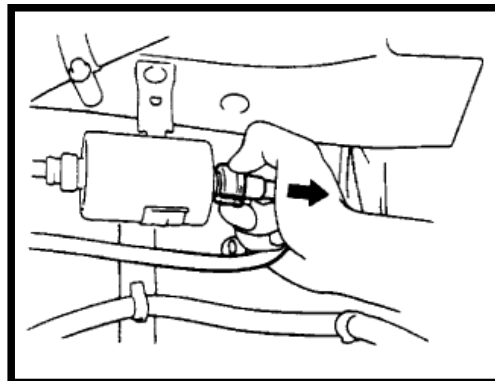
3-0 Specific Applications

3-1 GM Metal Body Connector (“Black Mushroom Clip”)

Mid 1990’s to early 2000 Chevrolet Cavalier, Malibu and Pontiac Sunfire vehicles using Service Champ filter # 52073 incorporate a threaded metal line fitting at one end and a metal body connector (with a built-in release tool – “Black mushroom clip”) at the other end of the filter (pictured). The internal components of this metal body connector are identical to the connector described in section 2-4. The exception is the attached “Black mushroom clip”.

The “Black mushroom clip” as it is most commonly referred to, is the release tool used to disconnect the filter from the line. This clip is fixed to the line and is used in place of the scissor tool, seen in section 2-4. As such no other release tools are required for this application. By design this clip works well, however, over time and with exposure to the elements release can become difficult.

To begin the service, loosen the bracket holding the filter to the chassis. Next clean any debris from the area surrounding the metal line fitting and the metal body connector. Spray Penetrating Oil on the threaded metal line fitting and into the mouth of the connector and around the “Black mushroom clip”. Wait a few minutes to allow the oil to work. It is also recommended to take hold of the clip and spin it as it is fixed to the line to break it free of any dirt or corrosion.



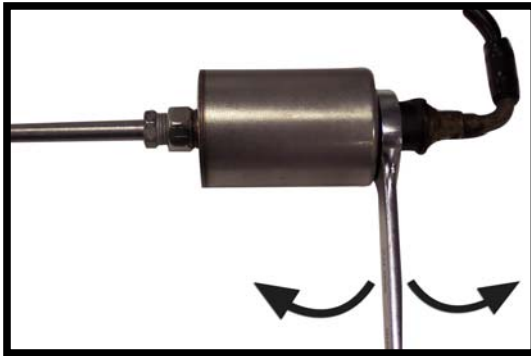
Proper grip for connector release

To remove the metal threaded line fitting at one end of the filter (Refer to section 2-2). For the end with the metal body connector and the “Black mushroom clip” grasp the filter and the line and push them towards each other and hold. Next, with your index finger and thumb grasp the “Black mushroom clip” and pull away from the filter. This process will cause the metal teeth in the connector to spread and allow the release of the filter.

For re-installation of the threaded metal line fitting, replace the Viton O-ring on the line and place a small amount of Silicone Lube on the threads of the line fitting. Manually thread the line fittings onto the fuel filter and using the 5/8” flare nut wrench, tighten the fitting securely (approx. 18 ft/lbs). Secure the filter to the clamp on the chassis and spray the bracket with a small amount of Silicone Lube.

Before reinstalling the metal body connector onto the filter tube, lightly coat both filter tube and the throat of the metal body connector with silicone lube. This will lubricate the metal teeth and the O-rings in the connector body when the filter is reinstalled. Failure to do so may cause the O-rings to dry and be pulled out in subsequent services. To reinstall the fuel line, just push the line onto the fuel filter tube until a “click” is heard. There will be some play in the fuel line once connected. This is normal and should not be of concern. Once the line is pressurized, the metal teeth in the connector will come up tight against the filter tube flare.

This vehicle application can be problematic if the components of the metal body connector are extremely corroded or if the vehicle has been treated with tar-based undercarriage rust protection. Tar-based rust protection is effective when new, however if not maintained the solvents in the rust protection will deplete over time. This in turn will cause the coating to become dry and hard. This will not only hamper the release mechanism of the metal body connector but it can also trap moisture inside the connector resulting in corrosion. The corrosion in the metal body connector can prevent the four metal teeth in the connector from releasing properly. If this happens, do the following.



Enlist the help of a co-worker as this method requires three hands. Take hold of the filter and the line and push them towards each other and hold. Next take a 19mm or 20mm open end wrench and wedge it up and in between the clip and the filter (pictured). The thickness of your wrench will dictate whether this will be effective or not. Next, hold the wrench at the boxed end (for leverage) and “rock” the wrench back and forth remembering to

continue to keep pushing the line towards the filter. The use of the wrench as the wedge will force the “Black mushroom clip” into the connector, spread the teeth and eventually release the filter.

If all else fails, the section of line with the metal body connector can be cut out and replaced with a custom fuel repair line, Service Champ part # 3073 (see fuel line repair section). The new repair line can be quickly installed in minutes for an effective repair.

To replace the line, simply position the repair line over the existing line and mark for



the cut. Cut out the old nylon fuel line and connector and install the replacement repair line. Ensure that the two compression clamps provided are fed through and on the line before attaching the new repair line to the existing fuel line. Move the clamps into place. Using a pair of crimping pliers, lightly pinch each clamp firmly. The new line uses a “pinch clip” (as seen in section 2-6) in place of the metal body connector and the “Black mushroom clip”.

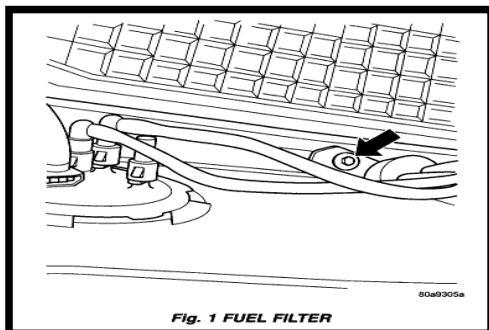
3-2 Dodge Caravan

One of the most commonly missed fuel filter applications is that of the 1996 and newer Dodge Caravan and Plymouth Voyager minivans. This service is often missed because this fuel filter looks drastically different (pictured) than most and is located just above the fuel tank and out of sight. This filter incorporates three molded fuel line extensions (an inlet, an outlet and a return) with fittings attached. This is the opposite of the majority of vehicles which have the connectors attached to the vehicle's fuel lines. The added benefit of this type of fuel filter is that with every service, new fittings are new filter. This is a great benefit for subsequent services.



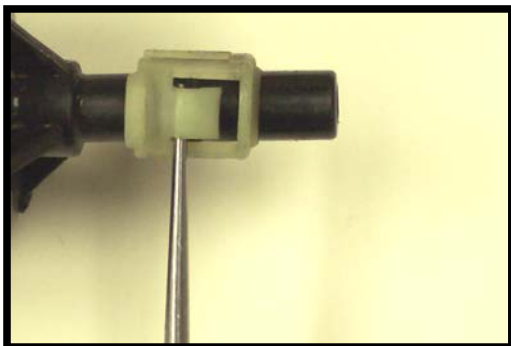
These vehicles can quite easily be serviced with the correct procedures. The fuel filter is positioned on top of the fuel tank, and is accessed by partially lowering the vehicle's plastic fuel tank. Note that the Caravan and Grand Caravan from 1996 to 2000 use two separate part numbers. Service Champ part # 56070 is shorter in length and is used on the short wheelbase models and Service Champ part # 56069 is longer and is used on the longer wheelbase or Grand Caravan/Voyager models. 2001 and newer models only use Service Champ part # 56078 for both long and short wheelbase models. It is imperative that an applications guide be utilized as these parts are not interchangeable and should never be substituted for each other.

To begin the service, spray the fuel tank holding strap bolts with penetrating oil. Wait a few minutes to allow the oil to work. While waiting, clean any debris from the area surrounding the fuel filter connections. Next lower the fuel tank strap bolt closest to the engine a few inches. Then lower the fuel tank strap bolt at the rear of the fuel tank the same amount. It is not necessary to remove these straps. The tank slowly lowers as the bolts are loosened and will tilt slightly towards you. This allows access to the filter and sufficient room to perform the service.



To begin the filter removal, first remove the filter's braided ground strap attached to the vehicle. The new filter has a new ground strap so if the old ground strap is damaged during removal, do not be concerned. Next locate the small bolt used to secure the filter (pictured) and remove.

To disconnect the line fittings refer to section 2-6 as these connectors utilize the same “duck billed” pinch clamps. The order of removal should be the front line first followed by the two at the rear. Once all fittings are disconnected, pull the old filter out. The new filter comes supplied with new “duck billed” pinch clips for each of the filter’s line connectors. These new clips should be installed on the vehicle’s fuel lines before reconnecting the fuel filter’s line connectors.



Removing the old clip can be done with a small screw driver or pick (pictured). The new clips can be installed on the vehicle’s fuel lines by simply sliding the clips onto the line and snapping into place.

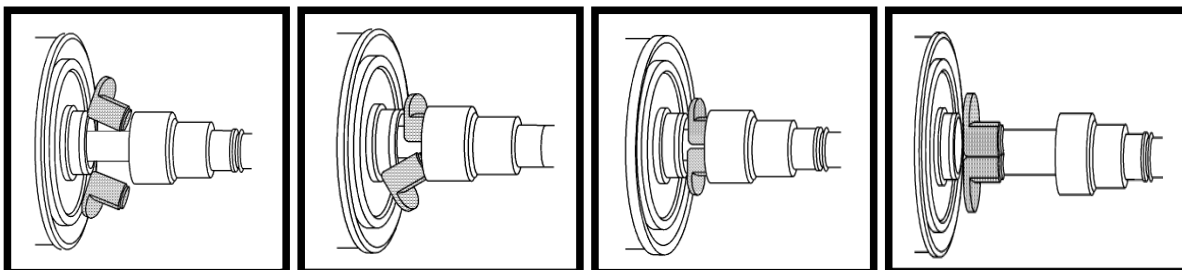
Next feed the new filter in and set in place. The filter’s molded fuel lines are positioned so that it is impossible to install backwards. One line goes towards the front of the vehicle and two towards the rear. The two at the rear utilize different sized lines (3/8” and 5/16”) to prevent incorrect installation.

Once the supplied clips are installed, secure the filter with the small bolt removed with the old filter. Reinstall the fuel line onto the filter’s fittings. One at a time, push the line onto the fuel filter fitting until a “click” is heard. Reinstall the braided ground strap from the filter onto the vehicle. Next tighten the rear fuel tank strap bolt securely and then the front tank strap bolt.

3-3 2002 and newer GM Trucks

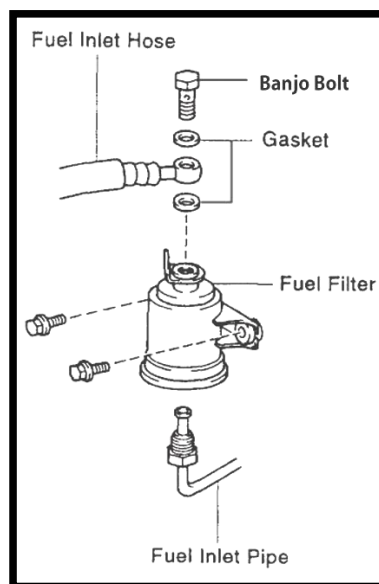
Some 2002 and newer GM Trucks utilize a metal body connector on one end of the fuel filter and a threaded metal line fitting on the other. Due to the space and clearance between the metal body connector and the filter, Service Champ part # 46363 (pictured in section 2-4) must be used to release the connector from the filter tube. The inserts on this tool are shorter than part # 3321 and allow a proper fit into the metal body connector. The preparation and process are similar as outlined in section 2-4.

After the preparation is complete, feed the tool around and into the metal body connector (pictured). To release the line, take hold of the filter and the line and push them towards each other and hold. Then push the release tool away from the filter. The tool will stop up against the flare on the filter tube. The metal teeth will spread and the fuel line will release from the filter.



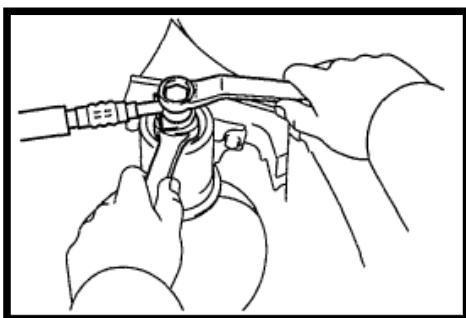
3-4 Imports

As mentioned in section 2-1, there are numerous import applications which still utilize fuel injection clamps to secure the fuel filter to the rubber fuel injection line. Nissan, Mazda, Suzuki, Subaru, Kia, VW and BMW all use this method. Other import manufacturers like Honda, Toyota and Hyundai use an altogether different configuration to attach the filter to the fuel lines. The inlet line threads into the bottom of the filter while the outlet line is attached using a union or banjo bolt to the top of the filter (pictured).



These applications can be quick and effortless to remove if the lines and fittings are in good working order. If they have been exposed to the elements without protection, they may require extra attention. When dealing with metal fittings using Penetrating Oil prior to a service should be normal practice and can greatly assist the removal process.

To begin, use a flare nut wrench to loosen the inlet line. The flare nut wrench is required to ensure a proper grip on the line fitting and to prevent rounding. This threaded fitting is attached to the fuel line and will be reused. As such, extra attention must be taken to prevent damaging it. Once loose, manually “unthread” the line fitting from the filter.



The outlet line resembles a line used in vehicle braking systems. This line sits in a cradle and is attached to the filter using a bolt with copper gaskets at either end. To remove this line place an open-end wrench on the filter nut just below the fuel line and another on the banjo/union bolt (pictured). Remove the banjo/union bolt followed by the fuel line. Discard the old copper gaskets as they will not be reused. Remove the bolts holding the filter in place and dispose of the old filter.

To finish, spray the filter mounting bolts with Silicone Lube and bolt the new filter in place. For the inlet line, it is always good practice to coat the section of steel fuel line underneath the threaded line fitting with anti-seize compound (Service Champ part # 80078). This will prevent corrosion that often causes the fitting to fuse to the line. This fusing is frequently the cause of line breakage in subsequent services. Unlike the GM vehicles there are no Viton O-rings to replace. Manually thread the line fitting onto the filter. Tighten the line to the filter using a flare nut wrench (approx. 20-22 ft/lbs).

For the outlet line, clean the banjo/union bolt and coat with silicone lube. Install one copper gasket onto the bolt, feed it through the line, place the line in the filter's cradle, install the second copper gasket against the fuel line and manually tighten the bolt. With a boxed-end wrench torque the bolt accordingly (approx. 20-22 ft/lbs).

3-5 2005 Cobalt/Pursuit, 2003 and Newer Ion



Cobalt - from back

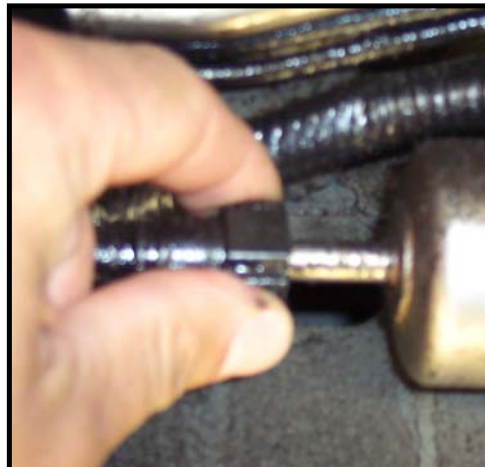
For DS connector

1. Insert scissor tool into filter
2. Tool will release metal teeth in filter to disconnect line



For two PS connectors

Each connector has two buttons on either end that must be depressed simultaneously for release.



3-6 2005 + Ford Freestar/Ranger



2005 + Ford Freestar

Both connectors incorporate a thin push button design



2005 + Ford Ranger

All three connectors incorporate a thin push button design

To Release Connectors



Push the fuel line and the fuel filter together and depress the colored button



OR

If space is limited inserting the scissor tool into the plastic connector will work as well

3-7 Ford Escape/Mazda Tribute Box Clip



Top view of the box clip connector



Bottom view of the box clip connector

The two small teeth on either side of the connector must be pushed towards each other and then up into the connector.



The top of the connector will move up as one piece and come to a stop. This will allow the filter tube to be removed. The box clip should not be totally removed from the connector. To re-install, insert filter tube and snap box clip down into locked position.

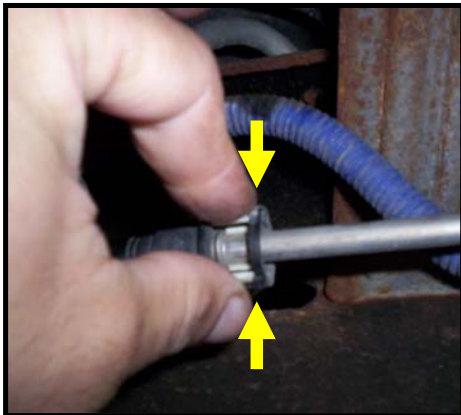
3-8 Ford/Mazda R-Clip Design



R clip connector top view



R clip connector bottom view

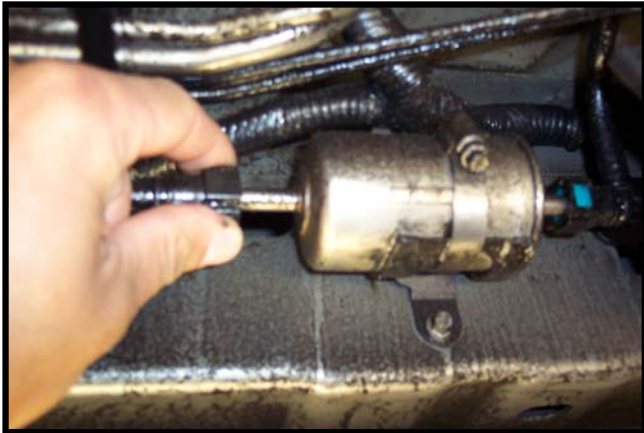
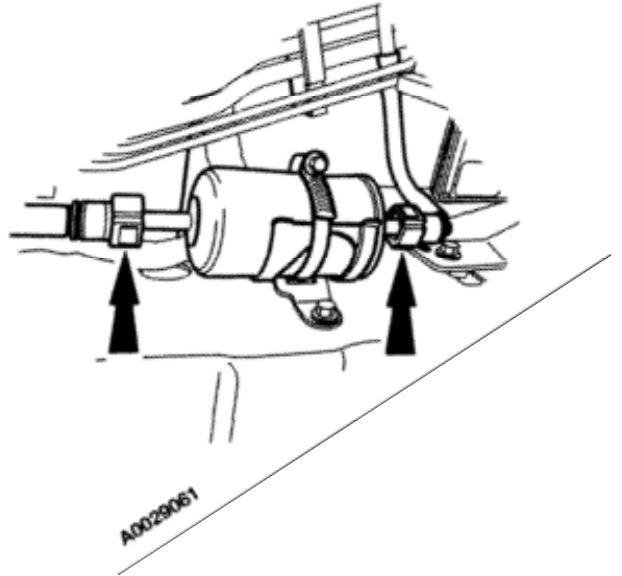


To remove "R" clip pinch both clip legs together and push entire clip up and into the connector body.



The "R" clip will come to a stop. Do not attempt to totally remove clip from connector body. To re-install, insert filter tube and snap "R" clip down into locked position.

3-9 Windstar Blue Push Button



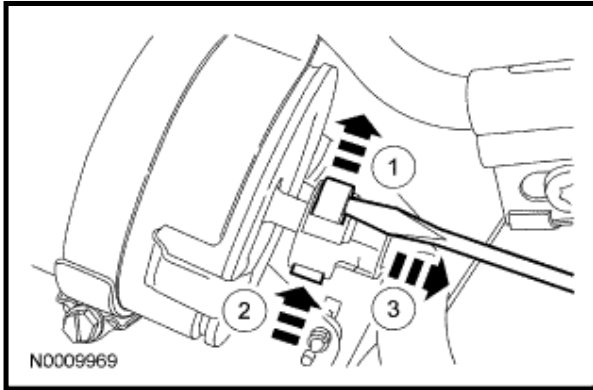
To release push both top and bottom blue buttons simultaneously.



Both buttons are connected as one working release mechanism. This must not be removed and cannot be replaced.

3-10 2005 Ford Taurus/2004+ Ford F-150 (Blue "T" Clip)

2005 Ford Taurus



For rear fuel filter connector

1. Lift connector lock up but not out
2. Depress push-button release
3. Remove line from filter tube

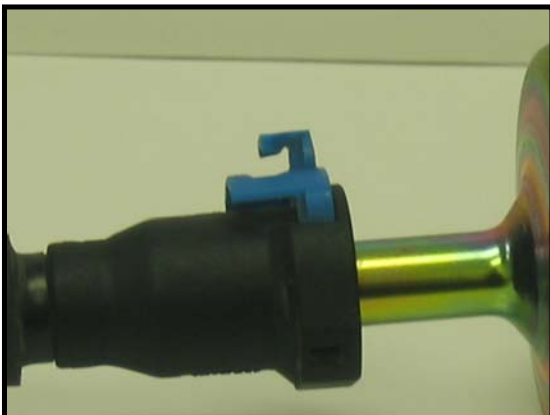
2004 + Ford F-150 (Blue "T" clip)



At first glance one may think that this is a push-button style connector.



The "T" clip is actually a lock that is disengaged when the scissor tool is inserted into the connector.



The "T" clip pops up when the scissor tool is inserted and must be pushed down after the new fuel filter is installed.

4-0 Fuel Line Repair

It can not be emphasized enough that the fuel filter service should be one approached with great caution and care. If done correctly there should be very few problems. However as with any service, there is that possibility for error and one must be prepared for any potential problems. It is important to have the correct products and tools for the job. This will not only make the service quick but will help in solving potential problems quickly and effectively. It is highly recommended to keep all service related tools in a specific tool box or case.

The most common problems that can occur with this service are either a fuel line can “kink” or break or a fuel line fitting or connector can break or come apart. If either of these scenarios occurs the only solution is the use of fuel repair lines. There are a variety of lines available for most applications (see listing below). In a matter of minutes the old line and connector can be removed and a replacement line can be spliced into place. The end result is a quick and clean solution to an otherwise difficult situation.

FUEL LINE REPAIR KITS

"STEEL TYPE"

- Repair leaking or rusted steel fuel lines.
- Includes instructions, O-rings and flare union.



SERVICE CHAMP#	POP CODE	TYPE	FITTING	LINE	LENGTH	GENERAL APPLICATION	INDUSTRY#
3060	A	Steel	16mm	3/8"	18"	GM - Pressure Side	800-153
3061	B	Steel	14mm	5/16"	18"	GM - Return Side	800-151
3064	B	Steel	16mm	3/8"	12"	GM - Pressure Side	800-162
3065	C	Steel	14mm	5/16"	12"	GM - Return Side	800-166
3066	B	Steel	16mm	3/8"	4"	GM - Pressure Side	800-170

2107 Tubing Cutter: Useful tool for fuel line repair service (see page155).

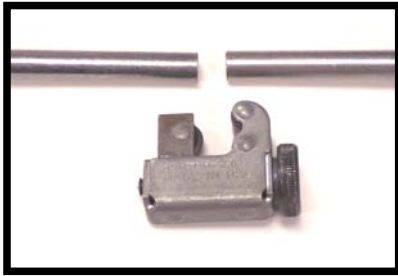
"NYLON TYPE"

- Kit repairs nylon fuel lines.
- Comes assembled with instructions and needed adapters.



SERVICE CHAMP#	POP CODE	TYPE	FITTING	LINE	LENGTH	GENERAL APPLICATION	INDUSTRY#
3068K	A	Nylon	5/16" (90 Degree)	5/16"	12"	Ford	800-051
3069K	A	Nylon	5/16" (180 Degree)	5/16"	12"	Ford	800-050
3070	B	Nylon	5/16" (180 Degree)	5/16"	18"	Ford	800-054
3071	C	Nylon	5/16" (180 Degree)	5/16"	18"	Dodge	800-057
3072	C	Nylon	3/8" (180 Degree)	3/8"	18"	GM / Dodge	800-058
3073	B	Nylon	3/8" (90 Degree)	3/8"	18"	GM / Dodge	800-059
3074	C	Nylon	5/16" (Degree)	5/16"	18"	Dodge	800-060

4-1 Metal Fuel Line Repair



As previously mentioned, it is important to pay close attention to applications that use metal fuel lines. Existing rust and corrosion can cause a fuel line to break. In the case that a line breaks or “kinks” use a small tube cutter (Service Champ part # 2107) to cut out the affected section (pictured). With the tube cutter it is imperative to start a consistent cutting line. An initial cutting line that wanders will make cutting very difficult. Once the line is cut, the old section can be replaced. To do this, use the **correct length** of the **correct diameter** fuel injection hose (5/16” or 3/8”) **and the correct fuel injection clamps** (#4 or #6). Ensure that the hose and clamp are attached to clean, rust free metal line and that the fuel injection clamps are torqued accordingly.



The same process applies if the line fitting becomes corroded, worn or fused to the fuel line. Simply cut the affected line out with a small tube cutter, making sure the cut is made at a point where there is clean rust free metal. Then using the components included in your line repair kit, splice the old metal line to the replacement line and fitting. This is done using the supplied section of fuel injection hose and fuel injection clamps. For the best results, butt the old and new line together in the fuel injection hose before clamping (pictured).



The best defense is always a good offense. It is good practice to include a fuel filter and fuel line inspection as part of your offering. Also, it is beneficial for subsequent services to spray penetrating oil on vehicles equipped with metal fitting. This small investment will save you time and money in the future.

4-2 Nylon Fuel Line Repair

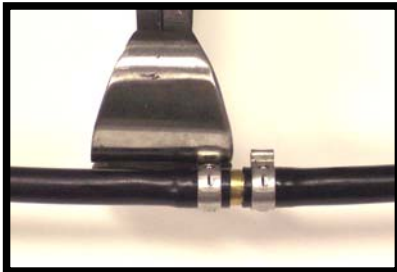
Repairing nylon fuel lines can be as easy if not easier than repairing metal fuel lines. If a section of nylon line becomes broken cracked or “pinched” simply cut out the affected section with a pair of nylon tube cutters. Keep in mind that the repair splice comes in 12” sections with easy to install unions at either end. Using the correct diameter nylon fuel line splice (5/16” or 3/8”), install the repair splice at one end and then the other. This is done quite easily due to the low-profile pre-installed barbs used in the kit (Service Champ part # 800-300). Ensure that the four compression clamps provided are fed through and on the line before attaching the repair line at either end. Move the clamps into place to clamp the lines at either end of the union. Using a pair of crimping pliers, lightly pinch each clamp firmly.



If a nylon connector breaks or comes apart during the service, a quick repair can be made in minutes. The most difficult part of the process is the identification of the repair line to be used.



There are many variations and combinations used in these repair kits so it is essential to do some preliminary work. First, the style and type (90 degree or 180 degree) of connector must be identified. Next, identify the diameter of this connector (5/16" or 3/8"). Then, identify the diameter of the nylon line used (5/16" or 3/8") with the connector.



Once the correct repair line is identified and sourced, cut out the affected line with a pair of nylon tube cutters. Use the repair line selected to mark the length to be cut out. Install the chosen repair line onto the old line using the low-profile union pre-installed on the repair line. ***Make sure the compression clamps provided are fed through and on the line before attaching the repair line.*** This step will prevent having to remove an installed line. Move the clamps into place at either end of the union. Using a pair of crimping pliers, lightly pinch each clamp firmly.