Date 1-1-89

# MC-9 MAINTENANCE MANUAL

# SECTION 9

# FUEL SYSTEM

# MC-9 MAINTENANCE MANUAL

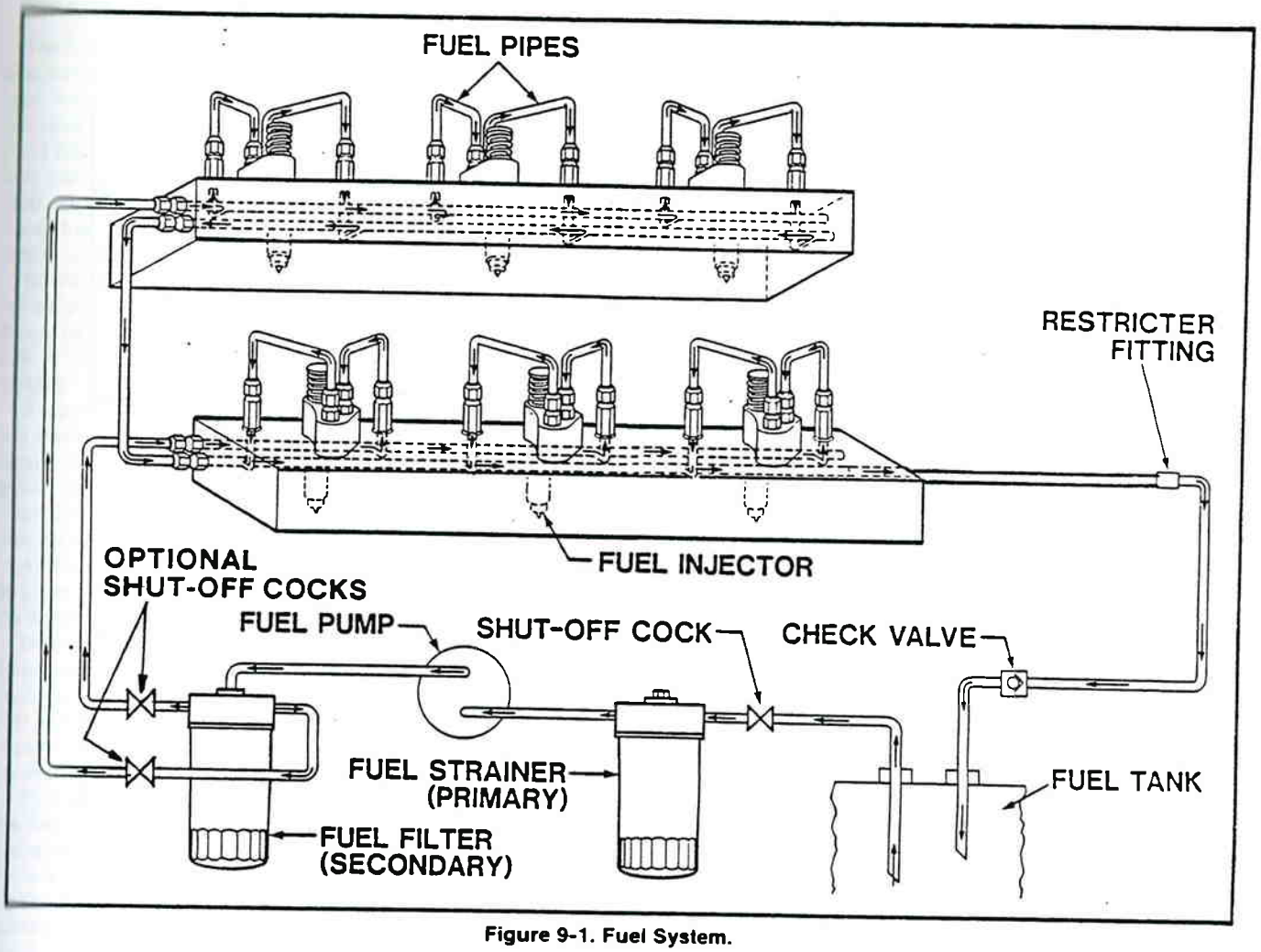


**Figure 9-1. Fuel System.**

## FUEL SYSTEM

The fuel system consists of a fuel tank, fuel lines, filter, strainer, pump, fuel manifolds (integral in cylinder heads), fuel pipes (inlet and outlet), and injectors. The fuel system is illustrated in figure 9-1. For further information on engine fuel system components, consult the appropriate Detroit Diesel Engine Service Manual.

Fuel is drawn from the tank, through the primary filter entering the fuel pump at the inlet side. The fuel is then forced through the secondary filter into the manifold and then to the inlet side of the injectors. Surplus fuel returns from the outlet side of the injectors to outlet fuel pipes, into the return manifold and back to the fuel tank. The accelerator linkage connects the accelerator pedal to the governor. Engine speed is controlled through the governor; details may be found in Detroit Diesel Engine Service Manuals.

### DIESEL FUEL

The quality of fuel oil used for high-speed diesel engine operation is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels.

Detroit Diesel Allison designs, develops and manufactures commercial diesel engines to operate on diesel fuels classified by the ASTM as Designation D-975 (grades 1-D and 2-D). These grades are very similar to grades DF-17 DF-2 of Federal Specifications VV-F-800.

Burner fuel (furnace oils or domestic heating fuels) generally require an open flame for satisfactory combustion. The ignition quality (cetane rating) of burner fuel (ASTM D-396) is poor compared to diesel fuels (ASTM D-975).

In some regions, however, fuel suppliers may distribute one fluid that is marketed as either diesel fuel (ASTM D-975) or domestic heating fuel (ASTM D-396) sometimes identified as burner, furnace or residential fuel. Under these circumstances, the fuel should be investigated to determine whether the properties conform with those indicated in the Fuel Oil Selection Chart (figure 9-2).

| TYPICAL APPLICATION | GENERAL FUEL CLASSIFICATION | BOILING POINT (MAX.) | CETANE NO. (MIN.) | SULFUR CONTENT (MAX.) |
|---|---|---|---|---|
| City Buses | No. 1-D | 550°F (288°C) | 45 | 0.30% |
| All Other Applications | Winter No. 2-D<br>Summer No. 2-D | 675°F<br>675°F (357°C) | 45<br>40 | 0.50%<br>0.50% |

**Figure 9-2. Fuel Oil Selection Chart.**

| Specification or Classification Grade | VV-F-800 DF-1 | ASTM D-975 1-D | VV-F-800, DF-2 | | ASTM D-975 2-D |
|---|---|---|---|---|---|
| | | | North America | Other | |
| Flash Point, min. | 38°C<br>100°F | 38°C<br>100°F | 52°C<br>125°F | 56°C<br>133°F | 52°C<br>125°F |
| Carbon Residue (10% residuum), mass % max. | 0.15 | 0.15 | 0.35 | 0.20 | 0.35 |
| Water & Sediment, % by vol. max. | — | 0.05 | — | — | 0.05 |
| Ash, % by wt. max. | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| Distillation Temperature, 90% by vol. recovery, min. | — | — | — | — | 282°C<br>540°F |
| max. | 288°C<br>550°F | 288°C<br>550°F | 338°C<br>640°F | 357°C<br>675°F | 338°C<br>640°F |
| End Point max. | 330°C<br>626°F | — | 370°C<br>698°F | 370°C<br>698°F | — |
| Viscosity | | | | | |
| Kinematic, cSt, min. @ 40°C | 1.3 | 1.3 | 1.9 | 1.8 @ 20°C. | 1.9 |
| Saybolt, SUS, min. @ 100°F | — | — | — | — | 32.6 |
| Kinematic, cSt, max. @ 40°C | 2.9 | 2.4 | 4.1 | 9.5 @ 20°C. | 4.1 |
| Saybolt, SUS, max. @ 100°F | — | 34.4 | — | — | 40.1 |
| Sulfur, mass % max. | 0.50 | 0.50 | 0.50 | 0.70 | 0.50 |
| Cetane No., min. | 45 | 40 | 45 | 45 | 40 |

**Figure 9-3. Federal Specifications and ASTM Diesel Fuel Properties.**



The Fuel Oil Selection Chart will also serve as a guide in the selection of the proper fuel for various applications. The fuels used must be clean, completely distilled, stable, and non-corrosive. Distillation range, cetane number, sulfur content, and cloud point are four of the most important properties of diesel fuels that must be controlled to insure satisfactory engine operation. Engine speed load and ambient temperature all influence diesel fuel selection with respect to distillation range and cetane number.

During cold weather engine operation, the cloud point (temperature at which wax crystals begin to form in diesel fuel) should be 10°F (0°C) below the lowest expected fuel temperature in order to prevent clogging of the fuel filters by wax crystals.

A reputable fuel oil supplier is the only one who can assure you that the fuel you receive meets the distillation end point, cetane number, sulfur content, and cloud point property limits shown in the Fuel Oil Selection Chart. The responsibility for clean fuel that meets Detroit Diesel Allison specifications lies with the fuel supplier as well as the operator.

At temperatures below 32°F (0°C) particular attention must be given to cold weather starting aids for efficient engine starting and operation.

Numerous fuels meeting the properties shown in Fuel Oil Selection Chart (figure 9-2) may be used in Detroit Diesel engines. Figure 9-3 shows some of the alternate fuels (some with sulfur and/or cetane limits) that have been used in Detroit Diesel engines. Among these are No. 1 and No. 2 diesel fuels, kerosene, aviation turbine (jet) fuels, and burner fuels.

Fuel selected should be completely distilled material. That is, the fuel should show at least 98% by volume recovery when subjected to ASTM D-86 distillation. Fuels marketed to meet Federal Specification VV-F-800 (grades DF-1 and DF-2) and ASTM Designation D-975 (grades 1-D and 2-D) meet the completely distilled criteria. The differences in properties of VV-F-800 and ASTM D-975 fuels are shown in figure 9-3.

Fuel oil should be clean and free of contamination. Storage tanks and stored fuel should be inspected regularly for dirt, water or water-emulsion sludge, and cleaned if contaminated. Storage instability of the fuel can lead to the formation of varnish or sludge in the tank. The presence of these contaminants from storage instability must be resolved with the fuel supplier.

## PROPOSED ASTMD D-975, GRADE 3-D

TMC/MCI does not recommend the use of proposed grade 3-D diesel fuel in any of its engines. This grade of fuel was proposed, but not accepted by the ASTM.

The grade 3-D which was proposed is undesirable in that it possesses poor ignition quality (i.e. lower cetane); allows greater sulfur content (up to 0.7% by weight); allows the formation of more carbon deposits (Conradson carbon residue); and allows the blending of heavier, more viscous boiling point fractions that are difficult to burn. The latter tend to increase combustion chamber deposits. This type of fuel usually manifests poor cold weather properties (wax formation tendencies). In addition, the poor ignition quality adversely affects noise and emission levels.

## DRAINED LUBE OIL IN DIESEL FUEL

TMC/MCI does not recommend the use of drained lubricating oil in diesel fuel. Furthermore, Detroit Diesel Allison will not be responsible for any detrimental effects which it determines resulted from this practice.

## ALCOHOL, DIESOHOL, GASOHOL AND GASOLINE IN DIESEL FUEL

Very small amounts of isopropyl alcohol (isopropanol) may be used to preclude fuel line freeze-up in winter months. No more than one pint of isopropyl alcohol should be added to 125 gallons of diesel fuel for adequate protection.

**CAUTION: Commercially marketed diesohol or gasohol or gasoline should never be added to diesel fuel. An explosion and fire hazard exists if these blends are mixed and/or burned.**

## POLICY ON FUEL ADDITIVES

TMC/MCI does not recommend or support the use of any supplementary fuel additives. These include all products marketed as fuel conditioners, smoke suppressants, masking agents, deodorants, and tune-up compounds.

**NOTE: TMC/MCI warranty applicable to Detroit Diesel engines provides in part that the provisions of such warranty shall not apply to any engine unit which has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel recommendations may not be within the coverage of the warranty.**

## FUEL SULFUR

The sulfur content of the fuel should be as low as possible to avoid premature wear, excessive deposit formation, and minimize the sulfur dioxide exhausted into the atmosphere. Limited amounts can be tolerated, but the amount of sulfur in the fuel and engine operating conditions can influence corrosion and deposit formation.

All diesel fuels contain a certain amount of sulfur. Too high a sulfur content results in excessive cylinder wear. For most satisfactory engine life, fuels containing less than 0.5% sulfur should be used.

The detrimental effect of burning high sulfur fuel is reflected in Detroit Diesel lube oil change interval recommendations. Detroit Diesel recommends that the Total Base Number (TBN-ASTM D-664) of the lube oil be monitored frequently and that the oil drain interval possibly reduced. Consult the Fuel Oil Selection Chart (figure 9-3).

**NOTE: TMC/MCI recommends the use of No. 1-D diesel fuel in all applications; however, No. 2-D is acceptable.**

### DISTILLATION END POINT

Fuel can be burned in an engine only after it has been vaporized. The temperature at which fuel is completely vaporized is described as the distillation end point (ASTM D-86). The distillation (boiling) range of diesel fuels should be low enough to permit complete vaporization at combustion chamber temperatures.

Combustion chamber temperature depends on ambient temperature, engine speed, and load. Poor vaporization is more apt to occur during severely cold weather, prolonged engine idling and light load operation. Therefore, engines will show better performance operating under these conditions when lower distillation end point fuels are used. Consult the Fuel Oil Selection Chart (figure 9-2).

### IGNITION QUALITY — CETANE NUMBER

There is a delay between the time the fuel is injected into the cylinder and the time that ignition occurs. The duration of this delay is expressed in terms of cetane number (rating). Rapidly ignited fuels have high cetane numbers (50 or above). Slowly ignited fuels have low cetane numbers (40 or below). The lower the ambient temperature, the greater the need for a high cetane fuel that will ignite rapidly.

Difficult starting may be experienced if the cetane number of the fuel is too low. Furthermore, engine knock and puffs of white smoke may be experienced during engine warm-up especially in severely cold weather when operating with a low cetane fuel. If this condition is allowed to continue for a prolonged period, harmful deposits will accumulate within the combustion chamber. Consult the Fuel Oil Selection Chart (figure 9-2).

## FUEL SYSTEM PRIMING

There can be a problem restarting an engine after it has run out of fuel. After the fuel is exhausted from the tank, it is pumped from the primary filter and sometimes partially removed from the secondary filter before the fuel supply is insufficient to sustain engine firing. The primary filter and secondary filter must be free of air in order for the system to provide adequate fuel for the injectors.

When the engine runs out of fuel, the following procedures must be performed before restarting.

1. Fill the fuel tank with the recommended fuel. If only partial filling is possible, add a minimum of 10 gallons (38 liters).
2. To prime or purge the system, disconnect the line from the fuel pump, then apply fuel under pressure (60-80 psi — 413-552 kPa) to the inlet of the secondary filter. If the system is to be purged of air as well, allow fuel to flow freely from the fuel return line until a solid stream without air bubbles is observed.
3. Reconnect the fuel line, start the engine and check for leaks.

**NOTE: It may be necessary to remove a valve rocker cover and loosen a fuel pipe nut in order to bleed any trapped air from the fuel system. Ensure that the fuel pipe nut is retightened before installing the rocker cover.**

### FUEL FLOW CHECK

A fuel flow check may be made by disconnecting the flexible fuel return line from the fitting at the rear bulkhead. Place the end of the return line in a convenient receptacle. As fuel must pass through the return line restriction fitting, do not disconnect the line at the bracket on top of the engine.

1. For non-turbocharged engines, start and run the engine at 1200 RPM. A fuel flow of 0.8 gallons (3 liters) per minute is specified with a fuel line restriction fitting having an .080" (.203 mm) spill orifice.
2. For turbocharged engines start and run the engine at 1800 RPM. A fuel flow of 1.4 gallons (5.3 liters) per minute is specified with a fuel line restriction fitting having a .070" (1.78 mm) spill orifice.
3. Dip the end of the return line into the fuel container. Air bubbles rising to the surface indicates that air is being drawn into the fuel system on the suction side of the fuel pump. If air is present, tighten all fuel line connections between fuel tank and fuel pump.

If fuel flow is insufficient for satisfactory engine performance, check for faulty fuel lines, clogged filters or malfunctioning fuel pump.

## FUEL TANK REMOVAL

A welded aluminum fuel tank with a capacity of 144 gallons (545 liters) is mounted behind the front axle. Fueling is performed through a door in the body paneling behind the right front wheelhousing. Provisions are made in the body paneling for access to the fuel tank should removal be necessary. A whistle type device is provided to indicate when tank is 95% full.

1. Prior to removal, the fuel tanks should be completely drained. Remove the exterior fuel tank door and the bar that secures the fuel tank in place.
2. Disconnect the feed and return fuel lines. If the coach is equipped with a fuel gauge, disconnect the wire leading to the sender.
3. Ensure that the filler neck is clear, then carefully slide the fuel tank out of the compartment.

**NOTE: On coaches without an auxiliary fuel tank, it will be necessary to raise the tank approximately ½" (12 mm) to allow the closing plate to clear the cutout in the floor.**

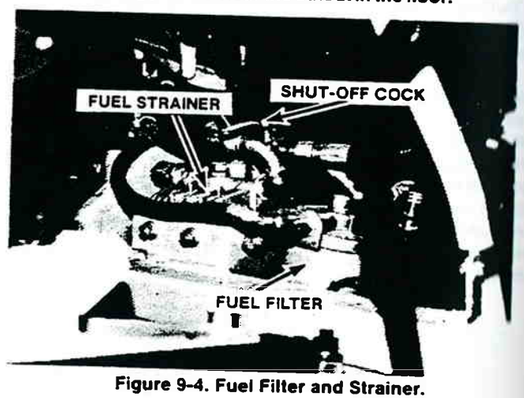


**Figure 9-4. Fuel Filter and Strainer.**



## FUEL STRAINER AND FILTER

The fuel system is equipped with a filter and strainer for additional protection of the injectors. The filter and strainer and fuel line connections are shown in figure 9-4. Refer to the Detroit Diesel Engine Service Manual for instructions on disassembly, cleaning and other service procedures.

Every 10,000 miles (16,000 km), open the drain at the bottom of the fuel tank to drain off any water or sediment.

The service interval at which the strainer and filter should be changed is determined by operating conditions and cleanliness of fuel used.

Before removing the fuel filter or strainer, close the shut-off cock which is installed at the primary filter inlet (figure 9-4). An optional shut-off cock may also be installed between the fuel pump and the secondary strainer. If present, close it also. Both of these valves are installed to prevent fuel from draining out of the lines while the filters are being serviced. In the case of the optional one, it also prevents the fuel pump from emptying and thereby losing its prime.

To change the strainer or fuel filter, remove by turning counterclockwise. To replace, turn on clockwise and tighten 2/3 of a turn after contacting gasket. New gaskets should be used with each replacement.

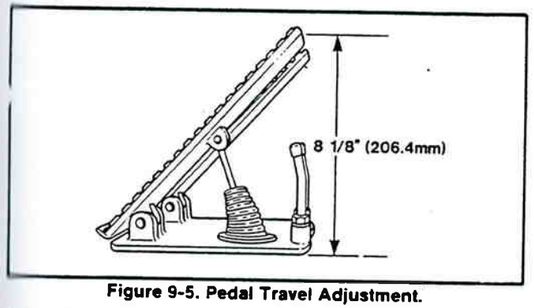


**Figure 9-5. Pedal Travel Adjustment.**

## ACCELERATOR AND BRAKE PEDAL TRAVEL

**NOTE: The following accelerator adjustment procedure is applicable only to a coach with a non-electronically controlled engine (non-DDEC).**

1. Remove the spare tire and inspection panel from the tire compartment.
2. Shorten the accelerator bell crank rod until the pedal reaches 8⅛" (206.4 mm). Measure from the floor to the underside tip of pedal. See figure 9-5.

**CAUTION: After shortening the accelerator rod, check for excess threads protruding in the clevis and binding on the lever. Excess threads must be cut off if they interfere with the lever.**

**NOTE: The pedal stop must be installed with the bend as shown in figure 9-5. The tip of the stop must also line up with the recess on the underside of the pedal.**

3. Adjust the brake pedal rod as required until the brake pedal height is the same as the accelerator pedal height.

**NOTE: The brake pedal must be adjusted to ensure the application valve is being fully applied. Care must be taken not to allow the roller on the application valve to go over center.**

After the pedal heights have been adjusted, the accelerator pedal stop must be adjusted as follows to ensure full fuel position of governor lever:

4. Disconnect the transmission modulator cable at governor bell crank (coaches equipped with automatic transmission).
5. Depress the accelerator pedal and adjust the stop to ensure full travel.
6. While the accelerator is fully depressed, adjust the modulator cable (automatic transmission) by pulling it out to its full limit of travel and adjusting the ball joint so that the bolt will engage with the hole in the governor bell crank while the cable is fully extended and the accelerator fully depressed.
7. With the engine at fast idle, depress the accelerator pedal fully, engine RPM should not rise. If RPM increases, the spring link is completely compressed to a solid link by too much pedal travel. In this case, the pedal stop should be raised.

## TRANSMISSION MODULATOR VALVE

A single action, pneumatic cylinder modulator valve mounted on the transmission is used in the air throttle control system. It provides the transmission with a signal proportional to the throttle position to control the transmission shift pattern.

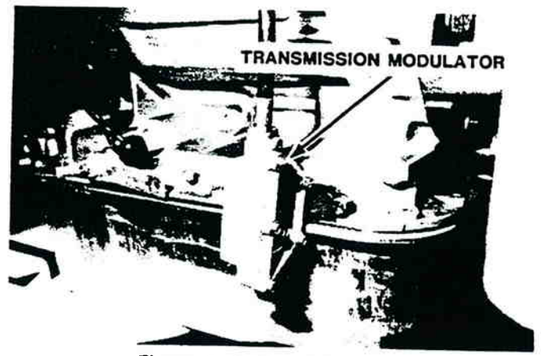


**Figure 9-6. Modulator Valve**

When the accelerator treadle is depressed, the throttle control moves toward the full throttle position. Simultaneously, the piston in the modulator valve extends and provides the throttle valve with a modulating force. When the pedal is released and the throttle returns to idle, modulating force drops to zero.

The modulator valve is non-serviceable and if its condition is suspect, it must be replaced as a unit.

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## AIR CLEANER (OIL TYPE)

### DESCRIPTION AND OPERATION

Some earlier MC-9 coaches are equipped with a heavy duty oil bath air cleaner. Located in the engine compartment, the air cleaner is accessible through the left hand side engine compartment service door.

Air flows through the left hand radiator and enters the cleaner through the top inlet. As the air passes through the filter element, dirt is trapped in the oil. The oil is condensed as it passes back up through the air cleaner body so that only clean dry air passes through the outlet to the engine. The condensed oil returns to the cup where the dirt settles and the clean oil is recirculated.

### MAINTENANCE

Efficient engine operation depends on proper maintenance and service. Radiator shutters and blower dampers must work in conjunction with each other. If these assemblies have the air supply closed off, a decided increase in fuel consumption can occur. Periodic checks should be made to determine that no leaks are present in the connections and duct work in the system. Otherwise, dust-laden air may bypass the air cleaner and enter the engine.

The intervals at which the air cleaner should be serviced will vary, depending on the amount of dust present in the air, service conditions, seasons, etc. However, the service intervals should be frequent enough to ensure that no appreciable amount of sludge builds up in the air cleaner cup.

In areas where conditions are ideal, servicing the air cleaner every 150 hours or 5,000 miles (8,000 km) is sufficient, whereas in other regions it may be necessary to service the air cleaner daily. In all cases the oil cup should be serviced when ½" (12.5 mm) of sludge has been collected in the bottom of either of the two oil cups.

### AIR CLEANER COMPONENTS

The air cleaner is comprised of four separate units that work in conjunction with each other to clean the air.

The body assembly filters the air and condenses the oil from the air stream ensuring that only clean dry air enters the engine.

The removable element assembly extracts a major part of the dust from the air stream, decreasing the load to the fixed wire element. The element is removable for cleaning, thus reducing the need for frequent body removal and fixed element service.

The inner cup acts as a baffle in directing oil-laden air to the element. It also controls the amount of oil in circulation and meters the oil flow to the element.

The oil cup supports the inner cup and the removable element assembly. It is also a reservoir for oil and a settling chamber for dirt.

### OIL CUP SERVICING

At regular intervals, as outlined previously, the air cleaner should be serviced as follows:

1. Support the bottom of the air cleaner assembly so that it does not drop when the clamps are detached.
2. Detach the two side clamps, remove the bottom oil cup and remove the element assembly.
3. Pour out the oil and remove the inner cup. Remove all sludge and wipe clean.
4. Reassemble the inner cup in the outer cup and refill them both to the indicated oil level.

**NOTE: MCI/TMC recommends the same oil specified for the engine crankcase for use in the air cleaner.**

**CAUTION: Do not overfill or underfill the oil cups. Overfilling causes a lack of capacity, whereas underfilling will result in a lack of efficient air cleaning.**

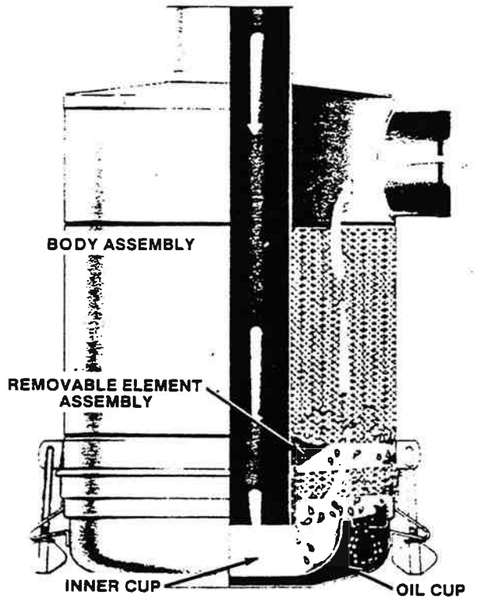


**Figure 9-6A. Oil Type Air Cleaner.**



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### REMOVABLE ELEMENT SERVICING

The first step in servicing the removable element assembly is to hold a strong light as close to the element as possible. An even, bright pattern of light through the wire element means that the element is clean. A dull pattern of light means that the element is partially plugged with dirt and should be cleaned or replaced. To clean the air cleaner, proceed as follows:

1. Wash the element thoroughly with solvent and blow dry with compressed air.
2. Inspect the lower portion of the air cleaner body and the center tube each time the oil cup is serviced.

If there is any sign of sludge build-up or plugging, the body should be removed and cleaned. At least once a year the body should be removed and serviced in the following manner:

1. Remove the oil cups and removable element assembly.
2. Check and clean the center tube.
3. Spray solvent through the air outlet with sufficient force and volume to produce a hard, even stream out the bottom of the body. Reverse flushing in this manner will remove all dirt from the fixed element.

**CAUTION: Always cover the engine air intake while the air cleaner is being serviced.**

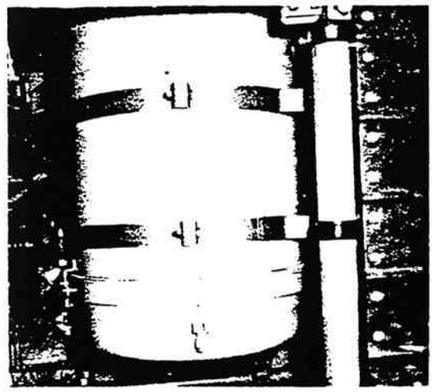

**Figure 9-6B. Oil Type Air Cleaner Installed.**

### GENERAL SERVICING

The air cleaner should be routinely inspected for leaks. A damaged air cleaner can seriously affect the performance and life of the engine. The following simple service practices are easily made while the engine is being serviced:

1. Inspect all connections for mechanical tightness and be sure that the air cleaner outlet port is not fractured.
2. If the air cleaner has been dented or damaged, inspect all connections immediately.
3. In the event that adjustments do not correct air leakage, replace necessary parts.

### FILTER INSPECTION CHECK-OFF

Check the following items at regular intervals:

1. Mounting Bolts and Brackets
2. Air Cleaner Body Damage
3. Restriction Indicator Connection (Leak)
4. Body to Inlet Joint (Damage)
5. Body to Outlet Joint (Leak)
6. Connections to Engine (Leak, Damage)
7. Filter Element (Dirty, Damage)

## AIR CLEANER (DRY TYPE)

### DESCRIPTION AND OPERATION

The later MC-9 coach is equipped with a dry-type air cleaner with a replaceable filter located at the rear of the coach. The air cleaner is accessible through the left hand side engine compartment service door.

Air flows through the left hand radiator and enters the air cleaner through the top inlet. As air passes through the air cleaner, dirt is deposited in the filter element, allowing clean air to flow through the outlet into the engine.

### INSPECTION

A routine inspection of the air induction system will help to prolong engine life.

The air filter restriction indicator (see figure 9-7) should be checked daily to ensure that the filter element does not require changing.

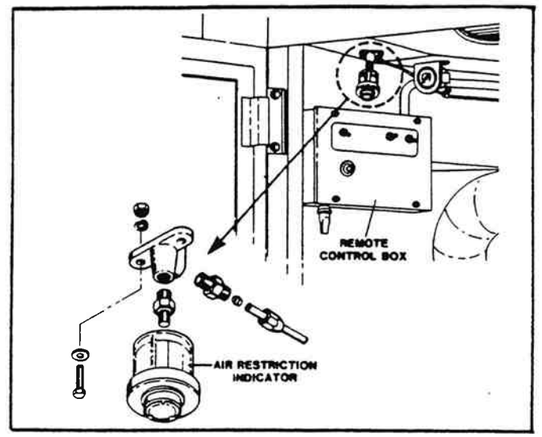


**Figure 9-7. Restriction Indicator.**

At each engine oil change the air cleaner should be inspected as follows:

1. Check for proper mounting of air cleaner assembly.
2. Check the air cleaner body for cracks and dents, and ensure that the cover is fastened securely.
3. Check the air cleaner clamps at the inlet and outlet ports to ensure that there are no air leaks.

### AIR CLEANER REMOVAL/INSTALLATION

1. Loosen the clamps at the air cleaner inlet and outlet ports and disconnect the line from the air cleaner to the air filter restriction indicator.
2. Support the bottom of the air cleaner so that it does not drop when the mounting bands are loosened.
3. Remove the capscrews and nuts from the bands and remove the air cleaner from the coach.

To install the air cleaner, reverse the removal procedure. Ensure that all mounting hardware is fastened tightly and that all air lines are properly connected, preventing the entry of dirt.

### REPLACING THE FILTER ELEMENT

1. Remove the air cleaner assembly, as outlined previously.
2. Remove the twelve nuts that secure the air cleaner cover and remove the cover and filter element.
3. Wipe the inside of the air cleaner body, as well as the inlet and outlet ports, with a clean damp cloth.
4. Install the new element, ensuring that the open end of the element is facing the inlet port on the air cleaner cover.
5. Install the cover and tighten the twelve nuts to 7 ft. lbs. ±1 ft. lb. (95 Nm ±1.3 Nm). Follow the recommended tightening sequence.

**NOTE: Before installing the cover, check the condition of the gasket and replace if necessary.**

6. Install the air cleaner into the coach.

### TROUBLESHOOTING

#### Short Element Life

*Air cleaner inlet restricted.* Ensure that no foreign material is blocking inlet pipe.

*Air filter element too small.* Replace element with one of correct size as per Parts Manual.

*Dirty element.* Replace.

*Damaged or improperly calibrated restriction indicator.* Replace restriction indicator.

#### Airborne Contaminants Entering Engine

*Damaged element.* Check the element for dents before installing. Never use an element which shows obvious signs of damage.

*Leaky gaskets.* Before reassembly, ensure gaskets will seal correctly. Look for dust trails which indicate leaky gaskets. Replace any brittle or damaged gaskets.

*Leaky air inlet.* Examine air inlet for cracks or loose flange joints.

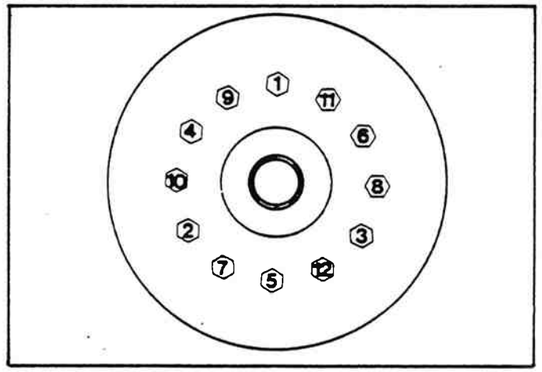


**Figure 9-8. Cover Nut Tightening Sequence.**

### GENERAL CAUTIONS

A. Never operate the vehicle without an element in the air filter assembly.

B. Use only original equipment filter elements.

C. Whenever element has been removed from filter body, clean inside of filter body with a clean, damp cloth.

D. Do not ignore the warning given by the air restriction indicator. To do so is to invite serious engine damage.

E. Store new elements in a protected area free from dust and damage.

F. Use the proper element when replacing element in filter.

G. Dirty elements should not be washed or reused.



### CRUISE CONTROL (OPTION)

Cruise control is a driver controlled, automatic speed control system designed for use on heavy duty highway vehicles.

The system incorporates the following features:

A. Set/Resume - permits vehicle speed to be set or to resume a previously set speed after disengagement.

B. Accelerate/Coast - permits vehicle speed increase or decrease with control switches.

C. Top speed, Set limit - prevents cruise control use above a preset maximum vehicle speed.

The cruise control system may be turned on at any time; however, vehicle speed must be greater than approximately 20 mph (32 kmh) before the speed can be set. (The 20 mph minimum speed may vary due to tire size and rear-end ratio.)

**CAUTION: The cruise control system should not be used in heavy traffic or when road surfaces are slippery.**

### OPERATION

Turning The System On.–Flip the Cruise Control switch on.

Setting The Vehicle Speed — Accelerate vehicle to desired speed above approximately 20 mph (32 kmh) and momentarily depress and release the SET side of the Set/Resume switch release accelerator pedal. Cruise control system will not accept speed settings below approximately 20 mph (32 kmh).

Increasing Vehicle Speed Setting — A previously selected set speed may be increased by one of two methods:

a. Depress and hold Resume switch until desired speed is obtained. While Resume switch is depressed, vehicle speed will increase by one mph per second. When switch is released, new speed is set.

b. Depress accelerator pedal until desired speed is obtained and depress Set switch. When driving with cruise control in use, speed may be increased for passing, etc., by depressing accelerator in normal procedure. When foot is removed from accelerator pedal, cruise control will return vehicle to set speed.

1. Decreasing Vehicle Speed Setting — There are two methods of decreasing a previously selected speed setting:

a. Lightly depress brake and allow vehicle to coast to desired speed and depress and release Set switch. Depressing the brake pedal slightly disengages the system.

b. Depress and hold the SET side of the Set/Resume switch until the desired speed is obtained and release Set switch. While the Set switch is set, the vehicle will "coast" down to speed. When the switch is released, the system will be set at the new speed.

Shifting Gears (Standard Transmission) — With cruise control in use, the transmission may be shifted in the normal procedure without disengaging cruise control. When the clutch pedal is depressed, the cruise control will disengage, allowing the shift to be completed. When the clutch is released, the cruise control will engage; adjusting engine rpm to the new gear selection in order to maintain the set speed, provided the vehicle speed has not dropped below approximately 20 mph (32 kmh).

Resuming Automatic Operation After Brake Application — Accelerate vehicle to a speed above approximately 20 mph (32 kmh) and depress and release Resume switch. Resume feature will automatically return the vehicle speed to the prior to the brake application and maintain that speed. The Resume feature will not operate if:

a. Vehicle speed is below approximately 20 mph (32 kmh).
b. Cruise control system has been turned off.
c. Vehicle ignition or ON/OFF switch has been turned off.

Cancelling Automatic Operation — Cancelling the cruise control automatic operation is accomplished by one of four methods:

**NOTE: Any objectionable vehicle motion when system is disengaged can be minimized by placing foot on accelerator before disengaging cruise control.**

a. Turn off the ON/OFF switch.
b. Turn the ignition or kill switch off.

**NOTE: a & b cancels automatic operation and Resume feature will not operate.**

c. Make a slight brake application.
d. Slow vehicle speed to 20 mph (32 kmh) below the "set speed."

**NOTE: c & d cancels automatic control but Resume feature can be used if automatic operation is desired.**