

MC-9 MAINTENANCE MANUAL

SECTION 9

FUEL SYSTEM

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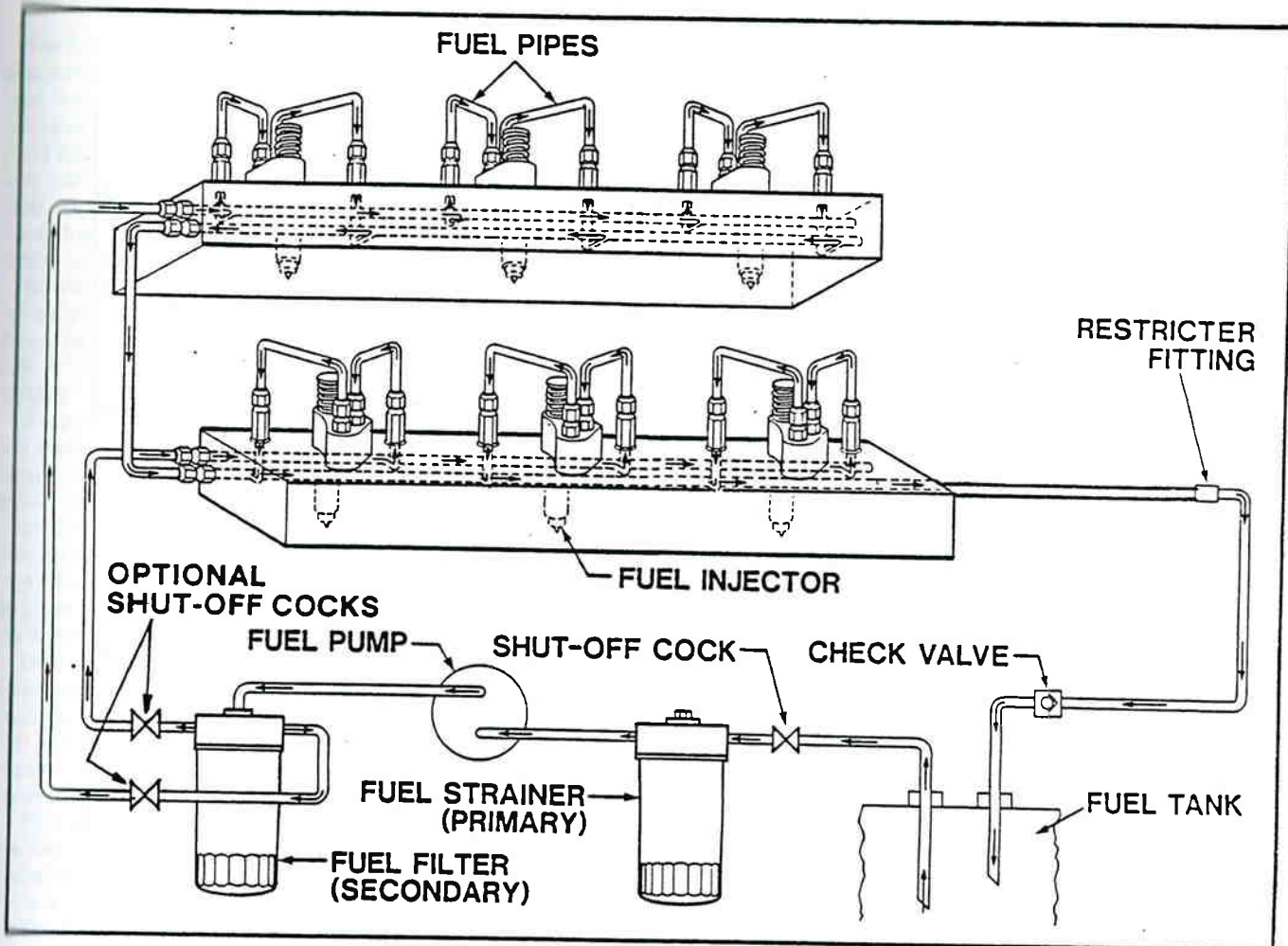


Figure 9-1. Fuel System.

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).

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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 Summer No. 2-D	675°F 675°F (357°C)	45 40	0.50% 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 100°F	38°C 100°F	52°C 125°F	56°C 133°F	52°C 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 540°F
max.	288°C 550°F	288°C 550°F	338°C 640°F	357°C 675°F	338°C 640°F
End Point max.	330°C 626°F	—	370°C 698°F	370°C 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.

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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 ASTM 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, DIESEHOL, 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.