



SERVICE DEPARTMENT

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

MAINTENANCE INSTRUCTION

LUBE OIL FILTRATION

INTRODUCTION

Proper lubricating oil filtration is essential to engine life and efficient, reliable operation. To fully realize the importance of adequate filter maintenance, it is helpful to understand the "full flow" lube oil system briefly described below. (Refer to the Engine and Locomotive Service Manuals for complete system information.)

The scavenging oil pump draws oil out of the engine oil pan sump through the suction strainers. Oil is pumped under pressure through the main lube oil filter and oil cooler before returning to the strainer housing located at the front of the engine. The main oil and piston cooling oil pumps draw from this supply of filtered, cooled, lube oil to lubricate the engine. In addition, on turbocharged equipment, the lubricating oil to the turbocharger (from the main oil pump) passes through the turbocharger filter, prior to delivery to the turbocharger. Full flow filtration ensures that all of the lubricating oil is filtered before it is supplied to the engine.

A bypass valve is provided in the filter tank, however, and will open and bypass lube oil around the filter elements during conditions of cold oil start, or when filter elements are plugged. The filter bypass valve ensures adequate lube oil to the engine, and prevents excessive scavenging oil pump outlet pressures. The valve opens at differential pressures above 207 kPa (30 psid).

NOTE: If the main lube oil filters are operated in the "plugged" condition for too long, it is likely that the turbo filter will plug in time and cause a low oil pressure shutdown.

Proper filter elements correctly installed and maintained, will ensure against bypass during normal operation.

DESCRIPTION

Basically, two types of lubricating oil filter assemblies are used, the single tank-multiple element models, Fig. 1 and the two element-multiple tank model, Fig. 2. Many variations of the two basic assemblies exist. Usage is dependent upon application. (See applicable Parts Catalog.)

Replaceable filter elements, Fig. 3, remove contaminants and impurities from the oil as it flows through the filtering media. The cartridge type element is composed of an outer perforated shell surrounding a pleated cotton-paper filter material, a perforated metal center tube, and end caps. Cageless waste elements remain available for older locomotive usage only. (See "Filter Element Characteristics.")

SINGLE TANK FILTER

INTERNALLY MANIFOLDED SEVEN-ELEMENT FILTER HOUSING

Effective February 1977, the internally manifolded seven-element filter housing, Fig. 1, replaced the earlier standard design seven-element filter on production equipment. (See Service Data for replacement part numbers.)

The internal manifold concept results in a standpipe effect which retains 75% of the oil in the filter tank during normal shutdown. Oil is prevented from draining back through the scavenging pump into the strainer box through the use of an improved positive sealing valve located in the strainer box. Therefore, startup pressure and oiling is virtually immediate.

A hinged cover closes the open end of the tank, and is held tightly by the cover hold-down nuts which should be torqued to 75-81 N-m (55-60 ft-lbs). A 19 mm (3/4") sight glass is provided in

*Information contained herein is applicable to equipment being produced as of the date of publication.

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Fig. 1 - Seven Element Single Tank Filters
Fig. 2 - Multiple Tank Filter

the cover to allow for visual check of lube oil level in the filter tank, and to govern certain procedures prior to engine start. (See applicable Engine Maintenance and Operator's Manuals for "Starting Procedures.") The 6.4 mm (1/4") male "quick disconnect" pressure fitting for monitoring filter pressure drop is also located in the cover near the sight glass. To prevent oil leakage during operation, a gasket is used between the cover and rim of the tank. Flanged inlet and outlet connections are located side-by-side at the lower end of tank opposite the cover. Because of the new inlet location, the bypass valve has been positioned at the top of the filter, providing much improved accessibility for periodic maintenance. The filter drain connection is positioned at the bottom. In some installations, a separate drain line (not shown) extends from the filter to a valve in the engine mounted strainer housing.

Internally, the filter is compartmentalized by a "false bottom" separator plate. The separator plate is located approximately 305 mm (12") from the end plate. The filter is divided into the element section which receives the unfiltered oil, and the discharge compartment which receives the filtered oil. A pictorial diagram, Fig. 4, shows the lube oil filter flow pattern described below, and a cross-section is shown in Fig. 5.

Oil is pumped from the strainer box through the scavenging pump into the internal inlet manifold (standpipe) where it continues to the top mounted inlet manifold. Oil passes through the openings and circulates through the pleated cotton-paper media of the filter elements. The filtered oil flows through the center of the elements and standpipes to the discharge compartment outlet, where it is directed to the oil cooler.

Fig. 4 - Pictorial Diagram Lube Oil Filter Flow Pattern

Fig. 5 - Internally ManifolDED Seven Element Filter Simplified Cross-Section REPLACING STANDARD SEVEN-ELEMENT TANK WITH INTERNALLY MANIFOLDED SEVEN-ELEMENT TANK

The internally manifolded tank is interchangeable with the older design seven-element tank, however, due to the new location of the inlet, a minor change in inlet piping from the scavenging pump to the tank inlet is required.

FOUR-ELEMENT FILTERS

Four-element filters, Fig. 6, are basically the same as seven-element filters except the four-element design does not employ the internal manifold/ standpipe design. This is not necessary because of the shorter fill time (due to lower capacity) of the smaller four-element tanks. As a result, startup oiling very similar to that of the seven-element tank is achieved without the need of internally manifolding.

The oil enters the element compartment through the inlet hole, and passes through the pleated cotton-paper filter elements flowing down the center of each element and into the discharge compartment. The bypass valve is provided to permit oil circulation in the event of cold oil or plugged filter elements. If the oil pressure exceeds 207 kPa (30 psid), the valve opens and the oil flows directly from the element compartment into the discharge compartment.

FILTER ELEMENT CHARACTERISTICS PLEATED COTTON-PAPER

The filter element is made up of pleated filter paper, a metal center tube and end caps, and a paper outer jacket. The filter paper is corrugated to maintain pleat spacing, and to allow the lube oil to pass between the center tube and the filter paper. The metal center tube supports the inside diameter formed by the filter paper pleats. The outer jacket, and/or netting, is bonded to the outer edges of the pleats to maintain spacing.

Filter element life is primarily dependent on a combination of two factors: (1) Contaminant holding capacity; and, (2) filter paper structural stability. When high dispersant lube oils are used, contaminant plugging of the filter paper is not usually the major factor in establishing filter element life. Structural stability of the filter paper, therefore, becomes the primary factor governing element life. The filter paper and phenolic resins deteriorate, in time, in hot lube oil. The rate at which this occurs is dependent on the inherent characteristics of the paper media, resin, and on oil temperature. Because there are many possible paper and resin combinations, coupled with variable lube oil temperature environment, a positive filter element life cannot be predicted for all filter element applications.

This deterioration results in loss of the structural strength necessary to resist the pressure differential across the element. As deterioration occurs, the filter paper corrugations around the center tube start to collapse, and the pressure drop across the element consequently increases. The more the corrugations collapse, the more the filter paper gathers around the center tube, resulting in a rapidly increasing pressure drop across the element. When this condition is severe, the filter paper can be extruded into the holes in the center tube. Once the filter starts collapsing, service life becomes very short. The final result is that the filter plugs, causing the oil to bypass the filter elements.

The structural stability of the filter paper is also affected by the presence of water in the lube oil. The pressure drop accelerates when this occurs. The longer the filter elements have been in service, the more sensitive they are to the presence of water.

COTTON WASTE FILTER (OLDER APPLICATIONS)

Cageless cartridges have tapered sections of loose waste packed uniformly into the cartridge

Fig. 6 - Four Element Filters

between a knit cotton double-layered inner and outer sock. Both layers of inner sock are wire tied to the perforated center tube which is open at the bottom, and end capped at the top. A reinforcing spring supports the inside diameter of the center tube. Oil filtration is accomplished through media penetration and holding capacity. Because of their inability to provide full flow filtration, waste filters are no longer recommended for EMD applications.

SINGLE TANK FILTER ELEMENTS

All current single tank lube oil filters are supplied with pleated cotton-paper elements. However, some older units used the cageless cotton waste element.

MULTIPLE TANK FILTER ELEMENTS The two element multiple tank filter uses pleated cotton-paper elements.

MULTIPLE TANK FILTER

The two element tank filter assembly shown in Fig. 2, has two individual filter housings mounted on a common base. Each housing contains one filter element.

The base is divided into inlet and outlet manifolds. The filter housings are located above openings to these manifolds so the outside of the filter element is connected to the inlet manifold,

and the center or discharge portion of the element is connected to the oil outlet manifold. Flanged pipes to each manifold are provided for external oil line connections. Internal bypass valves, Fig. 7, operate simultaneously so oil can bypass the filter elements in the event of high pressure caused by cold oil or dirty elements, or oil flow in excess of the element capacity.

Fig. 7 - Internal Bypass Relief Valve Assembly Each individual housing is provided with a removable cover to permit application and removal of the filter elements. The cover is bolted to the housing, and a gasket seals the cover.

MAINTENANCE

ELEMENT CHANGEOUT AND FILTER TANK CLEANING

Maintenance intervals of the lube oil filter should be established so the elements are changed prior to being bypassed. In addition, lube oil filter tank pressure monitoring should be performed regularly. Unusual conditions which warrant flushing of the diesel engine lubricating system also require element replacement. See applicable Scheduled Maintenance Program and M.I. 1757.

BYPASS VALVES

The filter bypass valves should be removed, cleaned, and inspected at intervals specified in the applicable Scheduled Maintenance Program.

A single spring external bypass valve, Fig. 8, is located inside the oil discharge compartment on the single tank type filter. The two element multiple tank filter has three internal bypass valves located in the base of the filter, Fig. 7.

EXTERNAL BYPASS VALVE

1. After the oil has been drained from the filter housing, the filters removed, and the housing cleaned, remove the four hold-down nuts from the bypass valve port cover. Remove the

Fig. 8 - Single Spring External Bypass Valve Assembly
valve assembly and discard the port cover gasket.

2. Wash the valve assembly in solvent to remove sludge and varnish. Carefully inspect assembly after cleaning. If poppet stem or valve body guide shows wear, install replacement parts.

3. Test valve spring by compressing it to a height of 92 mm (3-5/8"). If pressure test indicates values outside of those shown under Specifications, install a new spring.

4. Reinstall bypass valve assembly in filter. Ensure proper seating through placement of the three light guide springs.

5. Apply a new port cover gasket, and the port cover.

6. Tighten the cover hold-down nuts to 81.4 N-m (60 ft-lbs) torque, using standard tightening procedure.

MULTIPLE TANK INTERNAL BYPASS VALVE 1. After draining the tank, remove the hexagon plug, slotted head screw plug, spring, and piston.

2. Clean and inspect the parts, and check the springs for proper tension. Minimum lengths of springs should not be less than 73 mm (2-7/8") under a compressive load of 27.2 kg (60 lbs). If the springs do not meet these requirements, new springs should be installed.

3. Reassemble the valves by inserting the piston (closed end first), and insert the spring. Apply the spring screw plug all the way to the stop. Apply a new gasket on the hexagon plug and tighten it in place.

SERVICE DATA TANK APPLICATION CHART

Standard Design Tank Internally Manifolder Tank

8411945 9096754

9098654 9327661

8362640 9330811 FILTER ELEMENTS

Pleated Cotton Paper

. 8345482

Cageless Waste 8275432 BYPASS VALVE ASSEMBLY

EXTERNAL TYPE 8320705

Poppet Valve 8322839

Valve Guide 8322840

Valve Spring 8317190

INTERNAL TYPE 8213373

Valve Spring 8282144

PRESSURE FITTING "QUICK DISCONNECT". 9321340 PRESSURE TEST KIT. SPECIFICATIONS

Weight required to compress valve spring 8317190 92 mm (3-5/8") must not be less than 182 kg (400 lbs) or more than 227 kg (500 lbs). Poppet stem wear step should not exceed 0.25 mm (.010") (0.51 mm [.020"1 on the diameter.) The valve body pilot should not exceed 13.34 mm (.525") bore diameter.

REFERENCES

Flushing The Diesel Engine Lubricating System M.I. 1757

Lubricating Oil For Domestic Locomotive Engines M.I. 1752

Lubricating Oil For Marine Engines M.I. 1760

Lubricating Oil For Export Locomotive Engines M.I. 1761

Lubricating Oil For Industrial Power Engines M.I. 1762

Lubricating Oil For Drill Rig Engines M.I. 1763

Replacement Of Lube Oil Strainer Housing Drain Valves M.I. 9618