M. I. 1752

*Rev. I
ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

MAINTENANCE INSTRUCTION

LUBRICATING OIL FOR DOMESTIC LOCOMOTIVE ENGINES

The necessity for correctly lubricating the moving parts of any apparatus is readily apparent. The recommendations, suggestions, and comments in this Maintenance Instruction are offered as a guide in selecting a suitable engine lubricating oil.

OIL QUALITY

It should be recognized that the only real measure of quality in a lubricating oil is its actual performance in the diesel engine. This is so because of the impossibility of establishing limits on all physical or chemical properties of oils which can affect their performance in the engine over a broad range of environmental influences.

The responsibility for recommending and consistently furnishing a suitable heavy duty oil must rest with the individual oil supplier.

OIL TYPE

An SAE 40 heavy duty additive type lubricating oil which conforms to the following specifications should be used in all engine applications.

Physical Properties	ASTM Designations	Unused Oil Limits
Saybolt Universal	D88 or D445	
Seconds at 100° F.		1100 Max.
Seconds at 210° F.		70 Min.
		85 Max.
Viscosity Index	D567	55 Min.
		75 Max.
Flash Point, °F.	D92	420° Min.
Fire Point, °F.	D92	475° Min.
Pour Point, °F.	D97	40° Max.
Zinc		10 ppm Max.

The oil should have a high resistance to oxidation, a low tendency toward the formation of carbon deposits, and shall be noncorrosive to silver metal at 285° F. Oils with adequate alkaline reserve and highly effective detergent dispersant systems are recommended.

We strongly recommend that zinc dithiophosphate or similar additives not be present. Oils containing more than 10 ppm zinc are considered excessively contaminated with zinc dithiophosphate additive and should not be used since they may not satisfactorily lubricate the reciprocating bearings used in these engines.

QUALIFICATION TESTS FOR ENGINE LUBRICATING OIL

A diesel engine lubricating oil must satisfactorily lubricate the entire engine under all conditions expected to be encountered. While the condition and performance of the engine are the criteria used in reaching a final judgment of oil suitability, there are several laboratory tests which are helpful in making preliminary evaluations. These tests are:

1. Physical properties (as previously noted)

2. Corrosion of metals

    a. Silver, copper - EMD No. L.O. 201 method

    b. Lead -- S.O.D. method No. 5321-1 (modified)

3. Overall evaluation of oxidation stability -EMD No. L.O. 201 method

a. Viscosity rise characteristics

b. Retention of alkalinity (additive)

c. Development of insolubles

4. A 25 hour silver lubricity test (2-567 engine).

*This bulletin is revised and supersedes all previous issues of this number.

DEVELOPMENT PROGRAM REQUIREMENTS FOR NEW OIL FORMULATIONS

The supplier of the base stock oil and the supplier of the additive are expected to conduct complete laboratory evaluations and bench tests by ASTM and EMD test methods. Electro-Motive will review and monitor the tests.

Engine tests should be conducted by the oil company or the additive supplier. When all results are in favorable agreement and within acceptable limits for a very good product, the oil formulation must be subjected to a silver lubricity engine test evaluation. Upon successful completion of this test, the lube oil formulation should then undergo a full scale field test in a minimum of three (3) EMD engines in heavy duty service for a period of not less than one year. After successful completion of the field tests, the oil can be considered satisfactory for general use but should be watched closely during the following two years.

Oil formulations established and proven by this development program must remain exactly the same without any change.
If an improvement program is desirable or necessary, the revised formulation must be evaluated by going through the complete development program.

USE OF ONE OIL

The use of a single brand name lubricating oil is recommended for locomotive fleets. This is a recommendation of long standing supported by observations of the performance of locomotive fleets lubricated with a single brand lubricating oil as compared with the performance of locomotive fleets lubricated with oil mixtures.

EMD LOBE OIL USAGE LIST

A list of oils being used and which Electro-Motive feels warrant recognition because of their field performance will be issued periodically. Section I will be brand name oils used by U.S. railroads. Section 11 will be rebrands or blends.

The brand name lube oils listed will have undergone all the required development stages of laboratory analysis, laboratory engine tests, field testing, and fleet operation in the field.

Environmental influences can affect lube oil performance and since not all lube oils react the same to these influences, any with borderline experiences will be so noted.

MIXING OF LUBRICATING OILS

Electro-Motive has always strongly recommended against mixing of oils. Combining lubricating oils with different additive components creates a chemical mixture which cannot be readily evaluated in a laboratory, nor can its performance in the field be reliably predicted.

If mixing of lubricating oils is mandatory, the following approach is suggested in an effort to minimize risk factors associated with an oil mixing practice.

1. The lubricating oils considered for mixing should contain the same additive package.

2. The number of lubricating oils to be mixed should be limited to no more than three for a given fleet operation.

3. The common additive should be selected from the list of available additive formulations in Section III of the Usage List.

4. The brand name oil which is the parent of the common additive selected should, because of its full qualification including fleet experience, be the primary component of the mixture.

5. Only premium base stocks should be considered for the other two components. Each base stock and additive formulation are to be evaluated by the standard procedures of laboratory analysis and laboratory engine testing.

The availability of laboratory qualified lubricating oils is summarized in the Common Additive Selection List in Section IV of the Lube Oil Usage List. This list describes the individual lubricating oil considered worthy to be candidates for mixing within each common additive family.

EVALUATION OF OIL MIXTURE

After the three common additive lube oils have been selected, an equally proportioned mixture of these oils should undergo laboratory analysis and laboratory engine evaluations. Upon satisfactory completion of these tests, the mixture should then be evaluated in at least three high horsepower units for a period of not less than one year.

RECLAIMED OIL

Considered as a general category, reclaimed oils are not recommended for lubrication of our engines.
If reclaimed oils are to be used, it is our judgment that their use requires a maximum of evaluation and control, and the following suggestions are offered:

1. The reclaimed oil must have the same additive package as the name brand oils with which it will be mixed.

2. The reclaimed oil must pass all analysis and quality control requirements of brand name oils.

3. It should be introduced into the main supply tank of the railroad facility at a rate not to exceed a 20% ratio.

4. Reclaimed oil should never be used as a full engine charge.

OIL CHANGES

Oil change intervals prescribed in the applicable Scheduled Maintenance Program are based on average operating conditions. When oil change intervals are extended, serious and costly engine problems may result. They occur when the heavy duty lubricating oil loses its detergent-dispersant properties allowing partially oxidized oil and other contaminants to form deposits in the engine.

Lube oil which has undergone severe additive depletion can lead to frictional failure of engine parts. This condition is recognized by TBN and pH values below recommended limits.

The baseline for laboratory action shown below is offered as a guide to maintenance forces in deciding what action to take after a laboratory report of the lube oil condition has been received.

Laboratory analysis of the oil is of equal importance as a guide to the condition of the lubricating oil and the condition of the engine. Both engine and oil conditions must be considered when planning to extend oil change intervals beyond those recommended.

FILTER CHANGES

Oil filter element replacements should be made as determined by scheduled pressure monitoring of the oil filter tank unless the replacement interval specified in the applicable Scheduled Maintenance Program or a laboratory lube oil analysis dictates earlier replacement. Replacement elements must be of the proper type and made of suitable materials. Elements intended for use with other types of engines are not suitable.

Where highly dispersant oils are employed, carbonaceous matter may be suspended so finely in the oil that it is essentially unfilterable. In such situations, it might appear that an extension of the filter element replacement interval would be practical. Caution should be exercised when contemplating such action. Filter materials have not yet been developed that will tolerate prolonged exposure to hot lube oil without deterioration and possible disintegration of the filter elements.

HIGH SULFUR FUELS

When diesel fuels are used that have a total sulfur content (per ASTM D-129) in excess of the recommended (M.I. 1750) 0.50% limit, but below 0.75%, it is strongly advised that an engine lubricating oil containing high detergentdispersant properties, and high alkaline reserve be used.

Engine lube oil formulations are currently being marketed which offer reserve alkalinity in the 8-13 TBN range (ASTM D-2896). The higher TBN oils will help control the adverse effects of high sulfur fuels. However, it is essential that reserve alkalinity (TBN, TAN, pH) be monitored on a regular basis, as shorter oil life will be experienced.

If the total sulfur content is in excess of 0.75%, it is suggested you contact Electro-Motive for assistance in selecting a suitable engine lubricating oil.

INTERPRETATION OF LURE OIL SAMPLE ANALYSIS

LUBE OIL ANALYSIS	BASIS FOR ANALYSIS	NORMAL No Action Required	BORDERLINE Take Extra Oil Samples	HIGH Correct Condition	RECOMMENDED ACTION Shut Down Engine. Drain Lube Oil. Change Filters.
Fuel Leak	Viscosity & Flash Point -- Check for dilution if flash point less than 400° F or oil viscosity drops 15% or more.	0 to 2% %	2 to 5% 0	Above 5% %	Borderline - find and fix fuel leak. High - check main bearings per maintenance manual.
Water Leak	Free Water	None		Any	Resample with dry container. Find and fix leak. Check main bearings per maintenance manual.__
	Chromate Inhib.	0 to 20 ppm	20 to 40 ppm	Above 40 ppm	Find and fix water leak. Check tube oil filter
	Boron Inhibitor	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	tank pressure.
Air Filtration	Silicon	0 to 5 ppm	5 to 10 ppm	Above 10 PPM	Improved air filter maintenance required.
Excessive Oxidation	Viscosity Rise, TBN, pH (p e r A STM 0664 method), & Pentane Insol.	Normal		Viscosity 30% rise,* TBN 0.5 min., pH 5.0, P.I. 2% max. Change oil.	If short oil life persists, check tube oil quality, fuel sulphur content, oil cooler efficiency, engine temperature controls, power output (governor and rack settings), engine condition (worn rings, cracked pistons, poor combustion), oil filtration, or oil pump suction leak.
Contaminated fuel (cracking cracking catalyst)	Aluminum Magnesium		Above 5 ppm		Check fuel cleanliness. Notify fuel supplier. If engine smokes, check injector calibration and tip erosion. Check if piston rings are excessively worn.
Oil Contami-nation	Zinc Silver	0 to 10 ppm 0-1 ppm	Above 10 ppm dangerous with values. 1-2 ppm	becomes more increasing Above 2 ppm	Check if oil is contacting galvanized or zinc painted surfaces. Check if make up oil in stock is within specifications. Notify tube oil supplier. Check for silver bearing fail u_res. Check if oil contains zinc or is corrosive to silver. Check for broken piston cooling tubes, inefficient oil cooler, or improper temperature control. Feel sides of insert bearings for signs of distress. Measure piston to head clearance with lead readings. Oil draining is not mandatory. Check strainers and bottom of oil pan for debris. Consider turbo bearing condition.
Abnormal Wear or Corrosion (Rapid increases within normal range should be considered borderline condition)	Chromium (Not appli cable if chromate coolant inhibitor is used)	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	Check for rapid wear of rings & liners.
	Copper	0 to 75 ppm	75 to 150 ppm	Above 150 ppm	Measure piston to head clearance with lead readings to locate worn piston thrust washers.
	Iron	0 to 75 ppm	75 to 125 ppm	Above 125 ppm	Check for rapid wear of rings & liners.
	Lead	0 to 50 ppm	50 to 75 ppm	Above 75 ppm	Most likely lead flash is dissolving off bearings. Premature lead removal, before bearings are broken in, can lead to bearing distress. Inspect and replace upper con rod bearings in service less than 6 months if lead flash has been removed from the unloaded area of the fishback bearing surface on turbocharged engines. If con rod bearings require replacement, wrist pin bearings should also be checked and replaced if lead flash has been removed.
In Combina-tion	Copper Iron Lead		Two out of in borderline	three elements or high range.	Check for debris under crankshaft gear indicative of gear train bushing distress. Check idler gear bearing clearances. Check main and con rod bearings per maintenance manual. Oil draining is not mandatory.

* In areas where fuel sulfur content exceeds 0.5% a TBN level of 1.0 should be maintained.