MOTOR VEHICLE LUBRICANTS AND LUBRICATION

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1. GENERAL

1.01 Due to extensive revisions, arrows indicating changes have been omitted.

1.02 Essentially a lubricant is used to separate one or more moving parts from actual surface contact with each other or with a fixed part and to dissipate heat resulting from friction caused by movement of the parts and in the case of an automobile engine also the heat from combustion.

1.03 In the case of a fixed bearing the weight of the moving part is carried on a film of oil or grease introduced between the surface of the part and the surface on which it moves. As lubricants tend to thin out and deteriorate under high temperatures, thus losing their weight supporting ability, it is necessary that bearing temperatures be kept as low as possible in order to prevent direct contact between the moving part and its bearing. In the case of a rapidly rotating part such as a motor vehicle engine crankshaft, this is accomplished by a continuous flow of fresh oil from the crankcase.

1.04 As the load supporting requirements and temperature conditions encountered in the lubrication of a motor vehicle vary, and easy engine starting, minimum wear and economy of operation bear a close relationship to the use of proper lubricants, it is essential that the proper type and viscosity of lubricant recommended by the manufacturer be used for lubricating the various parts of the vehicle.

1.05 Oils and lubricants used for motor vehicle lubrication are, in general, mineral products into which additives of various types may be introduced during the manufacturing process to meet certain specific lubrication requirements.

2. VISCOSITY

2.01 Many varieties of oils and lubricants are available. However, outside the quality of the product, the most important feature involved is that they be of the proper viscosity to meet the conditions encountered, since frictional wear and oil consumption are more or less dependent on this property.

2.02 The viscosity of an oil is a measure of its body or fluidity and, in general, all oil manufacturers use an S.A.E. (Society of Automotive Engineers) number to designate this property. The higher the number the heavier the oil body. However, this coding does not in any way designate other characteristics of the product such as flash point, corrosive value, acidity, stability and oxidation value, etc, which enter into the specification requirements for an oil or lubricant.

3. SELECTION OF ENGINE CRANKCASE OIL

3.01 To provide a workable guide for selecting engine crankcase oils, the American Petroleum Institute (API) has developed a system of engine service classification. Letters are used to identify engine oils as to their suitability for the various conditions encountered in motor vehicle operation. The service classification is shown in two general categories: one of gasoline engine oils and the other for diesel engine oils.

3.02 Each service type is defined below and the corresponding letter designation shown.

Service ML — Service typical of gasoline and other spark ignition engines used under light and favorable operating con-

ditions, the engines having no special lubricating requirements and having no design characteristics sensitive to deposit formation.

Service MM — Service typical of gasoline and other spark ignition engines used under moderate to severe operating conditions, but presenting problems of deposit or bearing corrosion control when crankcase oil temperatures are high.

Service MS — Service typical of gasoline and other spark ignition engines used under unfavorable or severe types of operating conditions, and where there are special lubricant requirements for deposit, wear or bearing corrosion control, due to operating conditions or to engine design or fuel characteristics.

Service DG — Service typical of diesel engines in any operation where there are no severe requirements for wear or deposit control due to fuel, lubricating oil or to engine characteristics.

Service DM — Service typical of diesel engines operating under severe conditions or using fuel of a type normally tending to promote deposits and wear, but where there are design characteristics or operating conditions which may make the engine either less sensitive to fuel effects or more sensitive to residues from lubricating oil.

Service DS — Service typical of diesel engines operating under very severe conditions, or having design characteristics, or using fuel tending to produce excessive wear or deposits.

3.03 Military specifications are also commonly used to identify an "oils" performance level. However, oil suppliers certify this identification only when supplying oil to the United States Government Agencies.

3.04 Manufacturers of automotive engines recommend Type MS motor oil for use in gasoline engines that are subjected to the varied operating conditions such as are normally encountered in Bell System fleet operations.

3.05 The surest method for selecting the proper type of motor oil for maximum engine life is used oil analysis.

3.06 USED oil analysis will accurately reveal the performance level required of an oil for any type of fleet operation and will also determine safe oil drain schedules.

3.07 A USED oil analysis program can be arranged with most major oil suppliers.

4. TRANSMISSION AND REAR AXLE LUBRICANTS

4.01 In order to meet the loads imposed on the lubricating film by the gear design and application, special lubricants have been developed for use in transmissions and rear axles where lubrication requirements can not be met by the use of mineral oils alone.

4.02 All oils compounded to increase their load carrying capacity may be identified as Extreme Pressure (E.P.) Lubricants. However, the term Extreme Pressure, although indicating a load carrying capacity greater than that of mineral oil alone, does not define the actual load carrying capacity of the compound. Accordingly, further identification to determine the applicability of the material is required. To facilitate such determination, manual transmission and rear axle lubricants are divided into four general types.

(a) ***Regular Type Gear Lubricant***

This is a straight mineral oil type lubricant.

(b) ***Worm Type Gear Lubricant***

This is a lubricant designed to meet the requirements of a truck type worm gear rear axle under very severe conditions of service.

(c) ***Mild Type E.P. Gear Lubricant***

This is a lubricant which has been compounded to meet the lubrication requirements where regular type gear lubricant does not have the required load carrying capacity under severe service conditions.

(d) ***Multi-purpose Type Gear Lubricant***

This is a lubricant for use where there is need, due to design and other factors, for a lubricant having the highest possible load carrying capacity at practically all times.

4.03 S.A.E. viscosity numbers are used to designate the body or fluidity of transmission and rear axle lubricants in a similar manner to that for engine crankcase oil as follows: S.A.E. 80, 90, 140 and 250. However, there is no direct relationship between the viscosity numbers chosen for transmission and rear axle lubricants and those for engine crankcase oil, i.e., the viscosity characteristics or body of transmission and rear axle lubricants will not necessarily be correspondingly greater than those of engine oils.

4.04 As indicated in Paragraph 6.02 of this Practice, the lubricant used in the transmission and that used in the rear axle of a particular vehicle must be in accordance with the vehicle manufacturer's recommendations.

4.05 There is only one universally accepted specification covering passenger car and truck automatic transmission fluids. That is Type A, Suffix A Specification. This qualification can be verified by the AQ-ATF followed by several digits and the suffix letter A. Do not use oils that use a designation such as AF-ATF followed by the letter A.

5. ENGINE LUBRICATION

5.01 The difference in the mechanical condition of engines, driving speeds, maintenance and fuels used has a very definite effect on the oil consumption of a motor vehicle engine. Accordingly, the engine oil supply should be checked frequently. If it is the responsibility of the operator to check the engine oil level this should be done each time the fuel tank is replenished.

5.02 Where additional oil is required between oil changes, only oil of the proper viscosity for the minimum or maximum temperatures which will be encountered, depending on the season, should be added. Where, due to mechanical condition of the engine, excessive oil consumption is experienced, use of a higher viscosity oil may be required. Where unusual service conditions are encountered premium or heavy duty oils may be required.

5.03 The current engine manufacturing practice is to furnish a "dip rod" or oil indicator in the side of the engine crankcase for use in determining the crankcase oil level. While different markings indicating various oil levels may appear on the various indicators, the general practice should be to maintain the oil level well within the safety range which is usually indicated by two marks widely spaced on the rod. Preferably, the level should be maintained within one quart of "Full" but not above the "Full" mark.

5.04 Improved lubricating oils and improved engine designs have greatly increased the life of good lubricating oils. However, it is still necessary to change crankcase oil whenever it becomes contaminated with harmful foreign matter or combustion products.

5.05 In general, it is more practicable in Bell System fleet operation to make oil changes on a time-interval basis rather than on a mileage basis. On passenger cars and trucks not equipped with winches and ordinarily traveling 10,000 miles or less a year, oil should be changed four times a year. On all other cars and trucks, including those trucks which are equipped with winches, the oil change should be made six times a year. The change time should be gauged so as to properly change from cold weather to warm weather oil or vice versa. These oil change periods do not apply to new engines where the initial oil change recommendations of the vehicle manufacturer should apply. They also do not apply to engines on which major repairs have been made. All such engines should be changed initially in accordance with the manufacturer's recommendation for a new engine before applying the interval schedule.

5.06 While the time intervals given in Paragraph 5.05 should be satisfactory for motor vehicles in Bell System fleets, conditions encountered locally may indicate the need for some variation. Driving over dusty roads or through dust storms introduces abrasive material, the detrimental effects of which are somewhat alleviated by the air cleaner. However, if the oil becomes contaminated, the crankcase should be drained promptly to prevent harmful engine wear. Short runs in cold weather, such as city driving, do not permit the thorough "warming

up" of the engine and water may form in the crankcase from condensation of moisture produced by burning of the fuel or engine temperature changes. Under normal conditions this water will be removed by the crankcase ventilator. However, in the event of its freezing, it may interfere with proper oil circulation. If water accumulates, it should be removed by draining the crankcase as frequently as required.

5.07 When changing oil the engine should be permitted to reach normal operating temperature before the oil is drained. If the oil is drained when the engine is cold, some of the benefits to be gained by changing oil are to a large extent lost. The slower moving cold oil will not carry with it some of the suspended foreign matter which will continue to cling to the sides of the crankcase.

5.08 For the majority of motor vehicle engines used in Bell System fleets six viscosities of oil should care for engine lubrication.

S.A.E. 5W	S.A.E. 10
S.A.E. 10W	S.A.E. 20
S.A.E. 20W	S.A.E. 30

Under certain conditions the manufacturer's recommendations or operating conditions may require use of a higher viscosity oil. The viscosity numbers shown above include both summer and winter lubricants for use generally under temperature conditions given in Paragraph 5.09. The letter "W" following the viscosity number of certain of these designations indicates that the viscosity or fluidity of the oil is determined at 0° F. rather than 210° F. as is the case with oils not having this additional symbol.

5.09 The viscosity or body of an oil required for engine lubrication will, to some extent, vary depending on climatic conditions and the vehicle manufacturer's recommendations should be followed. The following table outlines the viscosities generally applicable for use under the temperatures indicated. In the winter season, the viscosity chosen should not be based on the existing temperature at time of changing oil but on the minimum temperature anticipated; in summer, the maximum anticipated temperatures.

ANTICIPATED TEMPERATURES	USE VISCOSITY GRADE INDICATED
Not lower than 32° F.	S.A.E. 20W or S.A.E. 20
As low as plus 10° F.	S.A.E. 20W
As low as minus 10° F.	S.A.E. 10W
Below minus 10° F. for a protracted period of time.	S.A.E. 5W where available otherwise S.A.E. 10W plus 10% kerosene

Unless the viscosity of oil is selected on the basis of its fluidity at the anticipated minimum temperature during the winter season, difficulty in starting may be experienced at each sudden drop in temperature.

5.10 On engines equipped with oil filter, if there is evidence at any time that the filter is not keeping the oil clean, the filter (or if it is equipped with a removable cartridge, the cartridge) should be replaced. In general, the oil filter cartridge should be replaced at the time the engine oil is changed. In the case of a unit type oil filter it may be desirable to replace that type with a replaceable cartridge type when servicing is required.

5.11 Engine generator, starter motor, distributor and water pump, where required, should be lubricated at 2000-mile intervals or as indicated on the specific vehicle lubrication chart.

5.12 At the 2000-mile chassis lubrication the engine carburetor air cleaner should be inspected. If the cleaner is of the oil bath type and the sump contains excessive sediment remove and clean with kerosene. Dry and refill with oil of the viscosity recommended by the manufacturer. Where the cleaner is not of the oil bath type, remove the cover and the filter element. Wash element in kerosene. Dry and dip in engine oil before replacing it. Paper filters should be cleaned and replaced per manufacturer's recommendation.

6. CHASSIS LUBRICATION

6.01 Except for certain specific units a motor vehicle chassis should be lubricated at 2000-mile intervals.

6.02 As the lubrication requirements for motor vehicle transmissions and rear axles differ due to the gear designs, applications and operating conditions, premature wear and subsequent high and costly maintenance can result from improper lubrication. Accordingly, it is important that the lubricant recommended by the vehicle manufacturer be used in the respective transmission and rear axles. This applies particularly where automatic, semiautomatic transmissions, fluid couplings or torque converters are involved and which may require special lubricants.

6.03 The lubricant level in the transmission and rear axles should be maintained at the proper level. Avoid mixing different makes and types of rear axle lubricants in order to minimize damage which may result from possible incompatability between the respective lubricants.

6.04 Unless otherwise recommended by the manufacturer's manual, transmission and rear axle lubricants should not be changed. Unless the old lubricant indicates contamination, (See Paragraph 6.03), it is unnecessary to flush the units. Where flushing appears desirable use a light oil. Steam, water, raw kerosene, gasoline, alcohol or special solvents should not be used. Make certain that all flushing material is removed.

6.05 Front wheel bearings should normally be inspected and repacked every 10,000 miles. When repacking, the bearings should be thoroughly cleaned and all old grease should be completely removed. Repacking is best accomplished with a packer cone which is faster, cleaner and more thorough than hand packing. It is not necessary to pack the hub full of grease since this will cause aeration of grease and leakage. However, a light smear on the spindle and hub cavity surfaces should be used to prevent rusting.

6.06 Steering gear lubricant should be of a type which will remain fluid at low temperatures and should be maintained at the filler plug level. Use the grade and viscosity recommended by the manufacturer. When lubricating the steering gear case, add only a sufficient amount to bring the level up to the plug. Excessive lubrication or lubricant forced above that level may result in forcing lubricant up the steering gear tube to the steering wheel.

6.07 Universal joints should be lubricated at intervals recommended in the manufacturer's lubrication charts using the type of lubricant recommended.

6.08 In order to insure proper lubrication of spring shackles, spindle bolt bearings and similar load support bearings, it is frequently necessary to raise the weight of the vehicle from the part being lubricated. If this is not done, the lubricant may not penetrate the bearing properly and a load supporting film of oil or grease will not completely cover the surface to be lubricated.

6.09 Oily or greasy surfaces resulting from the lubrication of a motor vehicle rapidly collect dirt and grit which, if it reaches the various wearing parts, causes premature wear. Accordingly, all surplus lubricant, which may exude from the part as new lubricant is forced in, should be removed.

6.10 If a chassis is to be steam-cleaned or washed with high temperature water, lubrication should be done subsequent to cleaning.

7. HANDLING AND PROTECTING LUBRICANTS

7.01 Cleanliness in handling and applying a lubricant is essential to avoid excessive wear. Dirt and abrasive particles which might be introduced with the lubricant can result in increased maintenance. Utensils used for oil should be kept clean and reserved for that purpose only. Fittings on the chassis for reception of a grease gun should be cleaned before the gun is applied; the nozzle of the grease gun should also be clean before making connection to the fitting. Containers for storing lubricants should be kept covered to prevent contamination of the contents.