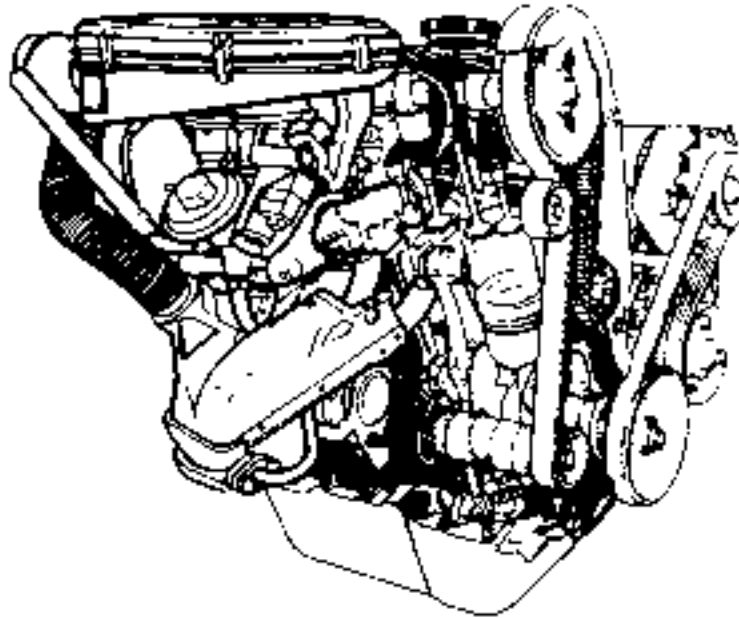


"BREAK-IN" PROCEDURES FOR REMANUFACTURED ENGINES



This engine has been rebuilt to give long, satisfactory service. Protect your investment by following these instructions before installing or starting the engine.

Suggested PreCAUTIONs for Remanufactured Engines

This engine has been carefully remanufactured to precision standards, and will perform properly if certain steps are taken by the mechanic making the installation. Following is a list of causes for a remanufactured engine to fail early in service, and suggested procedures to prevent failure. When a properly remanufactured engine fails to give satisfactory service, it is usually due to: **burning piston heads** caused by detonation, pre-ignition or "lugging"; **piston scuffing or seizing** usually caused by overheating or excess fuel; **bearing and crankshaft wear** caused by under-lubrication, dirt or coolant seepage; **excessive piston and cylinder wear** caused by dirt, ineffective air filtering, coolant seepage or excessively rich, air-fuel ratio.

**The customer and the remanufacturer
have a mutual interest in this engine.
We both want it to perform and
give long and satisfactory life.**

We recommend these precautions:

1. Be sure to prime the oil pump, oil lines and fill the oil filters with oil using an auxiliary pump, operating the internal oil pump with a hand drill, or an external pressure tank connected to the oil pressure gauge or sending unit fitting before starting the engine. It is desirable to fill the crankcase in this manner. If using an air pressure tank be sure it does not run out of oil and blow air through the lines.
2. Proper air-fuel ratio is vital in today's engines. Be sure the carburetor or fuel injection system has been remanufactured to manufacturer's specifications. Manifold and cylinder head surfaces should be

- checked and in good condition (resurface if necessary). Be sure the cylinder heads and manifolds are torqued and retorqued in proper sequence if required. Air seepage can cause lean air-fuel ratio which causes detonation. Check fuel pump for proper pressure.
3. Ignition or diesel fuel injection system should be properly serviced or calibrated, and engine timing corrected. Proper valve lash or clearance is very important.
 4. Be sure to use spark plugs of the correct heat range and gap as specified by the engine manufacturer. Check electronic sensors and sending units for proper operation. Vacuum lines must be properly routed and connected to the appropriate fittings to ensure operation of emission control devices and related engine controls.
 5. Check the exhaust thermostat control (commonly called the heat riser) to be certain it is free and operating properly. Check the exhaust gas recirculation valve (EGR valve) for proper operation. Clean the intake manifold to remove deposits from the various passages.
 6. Rebuild or replace the radiator and hose lines to ensure they are free from deposits so that the cooling system can function properly. Restrictions can cause overheating. Thermostats should be checked or replaced with one of the correct temperature. Use the proper pressure cap as specified by the engine manufacturer, and make sure it is properly seated.
 7. **Important** - replace filter elements. Thoroughly check engine accessories which are to be reused. Clean them **internally** and **externally** before installing.
 8. The coolant used should be compatible with aluminum engine components and blended to a mixture of no more than 60% antifreeze and 40% water. We recommend that a good sealer with rust inhibitors be added to the cooling system. This will tend to prevent rust and scale deposits and guard against coolant seepage.
 9. Before releasing the engine for regular service, check the air-fuel ratio. Caution the driver against "lugging."

RECOMMENDED "BREAK-IN" PROCEDURES FOR REMANUFACTURED ENGINES

Protect the investment you have in your engine. Take the time to read and follow these recommendations.

CAUTION

1. Before starting the engine for the first time, be sure it has been properly pre-lubricated.
2. Never add cold water to the cooling system while the engine is running. The engine should be allowed to run at normal operating temperature.
3. Start engine and run at fast idle, approximately 1500 RPM, and check the oil pressure. Run the engine for 30 minutes even though coolant may rise to operating temperature in a few minutes. Adjust tappets, if required, carburetor and ignition timing. If the coolant should "boil over," stop engine and allow to cool. Then start again and proceed as above.
4. When required retorqued cylinder heads and manifolds to engine manufacturer's specifications in proper sequence. Readjust tappets if necessary.
5. Start engine again and make a test run on the road at 30 MPH in "drive" range or select the proper gears for standard transmission. Periodically accelerate to 50 MPH and decelerate rapidly. Repeat this procedure at least 10 times. For a large truck or industrial engine, accelerate in intermediate gears as above.

NOTE: Applying loads to the engine for short periods of time causes increased ring pressure against the cylinder walls and helps to seat the rings. This is especially important because you are "breaking-in" the engine with heavy duty oils. The rapid deceleration increases vacuum and gives extra lubrication to the piston and ring assemblies.

Engine or Vehicle Service Recommendations

Passenger Cars

Drive normally but not at continuous high speeds or under heavy loads for the first 500 miles. Change oil and filters after 500 miles.

Trucks

Operate the vehicle with light loads up to 500 miles and avoid "lugging." Occasional acceleration and deceleration in proper gear during this period is advisable. Change oil and filters after 500 miles of service.

Industrial Engines

Follow the above instructions and operate under partial loads for several hours. Change oil and filters after approximately 20 hours of operation.

As required by the engine or gasket manufacturer, after 1000 miles of service, retorque cylinder heads and manifolds to proper specifications. Readjust tappets when required. We suggest this be done again after 5000 miles. We know that this means extra work, but it assures long and satisfactory engine performance.

DESIGNATION, IDENTIFICATION AND DESCRIPTIONS OF OIL CATEGORIES API Engine Service Description

Letter Designations: **SA, SB, SC, CA, CB**

Oils with this designation are considered obsolete and should not be used unless specifically authorized by the engine manufacturer.

Letter Designation: **SD**

1968 Gasoline Engine Warranty Maintenance Service ...typical of gasoline engines in 1968 - 1970 models of passenger cars and some trucks operating under engine manufacturer's warranties in effect during those model years. Oils designed for this service provide more protection against high - and low-temperature engine deposits, wear, rust, and corrosion in gasoline engines than oils which are satisfactory for API Engine Service Categories SC and may be used when category SC is recommended.

Letter Designation: **SE**

1972 Gasoline Engine Warranty Maintenance Service ...typical of gasoline engines in passenger cars and some trucks beginning with 1972 and certain 1971 models operating under engine manufacturer's warranties. Oils designed for this service provide more protection against oil oxidation, high temperature engine deposits, rust and corrosion in gasoline engines than oils which are satisfactory for API Engine Service Categories SD or SC and may be used when either of these categories is recommended.

Letter Designation: **SF**

1980 Gasoline Engine Warranty Maintenance Service ...typical of gasoline engines in passenger cars and some trucks beginning with 1980 - 1988 model years operating under engine manufacturer's recommended maintenance procedures. Oils developed for this service provide increased oxidation stability and improved anti-wear performance relative to oils that meet the minimum requirements for API Service Category SE. These oils provide protection against engine deposits, rust and corrosion. Oils meeting API Service Category SF may be used where categories SE, SD or SC are recommended.

Letter Designation: **SG**

1989 Gasoline Engine Service - Service typical of gasoline engines in present passenger cars, vans and light trucks operating under manufacturer's recommended maintenance procedures. Category SG quality oils include the performance properties of API Service Category CC. (Certain manufacturers of gasoline engines require oils also meeting API Service Category CD). Oils developed for this service provide improved control of engine deposits, oil oxidation and engine wear relative to oils developed for previous categories. These oils also provide protection against rust and corrosion. Oils meeting API Service Category SG may be used where categories SF, SE, SF/CC or SE/CC are recommended.

SH

This oil classification came to the industry in 1992 to replace the SG oil and provide better protection against rust, oxidation, sludge, varnish as well as providing extended component life expectancy. It is currently still available, however it is obsolete for PCMO licensing. It can be used only with API CF, CF-2, DF-4 and CG-4 when displayed in the API service symbol and the C category appears first.

SJ

This oil classification came to the industry in 1996 to replace the SH oil with continued refinements to the SH oil. It is currently available and acceptable for use in engines manufactured previous to the year 2,000.

ILSAC GF-3

(ILSAC, International Lubrication Standardization & Approval Committee)

This oil meets the current automotive manufacturer requirements for their newest lines of engines and will be used in 2,000 automotive engines. There were earlier versions used before the year 2000. The ILSAC grades are described as SAE 0W-20, 0W-30, 5W-20, 5W-30, 10W-30. These oils have improved overall oil performance while increasing fuel economy while providing emission systems protection.

Letter Designation: **CC**

Moderate Duty Diesel and Gasoline Engine Service - Service typical of certain naturally aspirated, turbocharged, or supercharged diesel engines operated in moderate to severe-duty service and certain heavy-duty gasoline engine. Oils designed for this service provide protection from high-temperature deposits and bearing corrosion in these diesels and also from rust corrosion, and low-temperature deposits in gasoline engines. These oils were introduced in 1961.

Letter Designation: **CD**

Severe Duty Diesel Engine Service - Service typical of certain naturally aspirated turbocharged or supercharged diesel engines where highly effective control of wear and deposits is vital or when using fuels of wide quality range including high sulfur fuels. Oils designed for this service were introduced in 1955 and provide protection from bearing corrosion and from high-temperature deposits in these diesel engines.

Letter Designation: **CD-II**

Severe Duty Two-Stroke Cyclic Diesel Engine Service - Service typical of two-stroke cycle diesel engines requiring highly-effective control over wear and deposits. Oils designed for this service also meet all performance requirements of API Service Category CD.

Letter Designation: **CE**

Severe Duty Diesel Engine Service - Service typical of certain naturally aspirated, turbocharged or supercharged heavy duty diesel engines manufactured since 1983 and operated under both low speed - high load and high speed - high load conditions. Oils designed for this service must meet the requirements of API Engine Service Category CC and CD.

LUBRICANT RECOMMENDATIONS FOR "BREAKING-IN" REMANUFACTURED ENGINES

Follow the recommendations of the engine manufacturer for the proper viscosity and type of oil to be used during and after the "break-in" period.

It is important to use heavy-duty detergent oils which contain an EP (extreme pressure) additive right from the start. Special "break-in" oils should not be used unless specified by the manufacturer. Older engines without oil filters may require special considerations, such as the use of non-detergent oils unless otherwise specified by the manufacturer.

Consult the owner's or service manual for the latest manufacturer's recommendation on oil selection.

See the accompanying chart for additional information on the type of engine oils currently in production and available for use with today's engines

SAE Motor Oil Viscosity Classifications

Since 1911, the petroleum industry has used the SAE Crankcase Oil Viscosity Classification System to describe and classify motor oils according to their ability to flow at various temperatures. The grades in common used today are: 5W, 10W, 15W, 20, 30, 40 and 50. The "W" indicates the oil is suitable for use during low ambient temperatures such as during the winter months. For instance, oils designated at 5W-30 provide adequate lubrications at -13°F (-25°C). Multigrade oils are able to maintain their viscosity over a wide range of temperatures. An oil designated as 10W-40 performs as well as a 10W designated oil at low temperatures, and as well as a single grade 40 designated oil at high temperatures.

Synthetic Motor Oils

The introduction of synthetic motor oils dates back to World War II and they are often described as the "oil of the future." Synthetic oils are man made, manufactured in a laboratory rather than pumped out of the ground and refined. They offer a variety of advantages over natural oils from better fuel economy, stability over a wide range of temperatures and operating conditions and longevity.

However, the use of synthetic engine oils is not recommended for the "break-in" period. Its outstanding ability to reduce wear by virtually eliminating friction between moving components is not desirable for a "break-in" oil. Certain predictable amounts of friction are required for proper "break-in" of piston and piston rings. AERA does not recommend the use of synthetic engine oils for the first 5,000 miles of service. Thereafter it is up to the vehicle owner to weight the cost of more expensive synthetic motor oils, manufacturer's oil classification recommendations and drain intervals.

Abbreviations and Symbols

API - American Petroleum Institute

SAE - The Society of Automotive Engineers

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Break in Procedures

This information is provided from the best available sources, however, AERA does not assume responsibility for data accuracy or consequences of its applications. Please be aware that this pamphlet is not a warranty.
