ENGINE INSTALLATION PROCEDURES AND INSTRUCTIONS

TO INSTALLING **PAGE 1 OF 12**
MECHANIC OR TECHNICIAN

This engine has been carefully remanufactured to precision standards. It will perform properly IF certain steps are taken by the person making the installation.

An engine is a complex component that requires the highest degree of technical knowledge to install. It is recommended that you, the installer, have an ASE certificate or the equivalent before you accept the RESPONSIBILITY for properly installing the engine.

When a properly remanufactured engine fails to give satisfactory service, it can be due to detonation, pre-ignition or "lugging", overheating due to improperly working cooling system or a lean burn condition, excessively rich air-fuel ratio, under-lubrication, dirt, improperly cleaned covers, reusing the oil cooler, coolant seepage, ineffective air filtering. The above mention reasons for failure are the responsibility, under the control, of the installing mechanic/technician not the engine builder.

BEFORE INSTALLING THIS REMANUFACTURED ENGINE IT IS CRUCIAL THAT YOU DETERMINE WHAT CAUSED THE PREVIOUS ENGINE'S FAILURE!

In order to insure trouble free operation of your remanufactured engine, you must determine what caused the previous engine to fail and correct it. After correcting the cause of the previous engine's failure, please read and following installation procedures.

CAUTION, ***these recommended installation procedures and instructions are a partial list intended only as a guide. If you are not qualified to undertake this installation, do not attempt it as you may be liable for resulting engine failure.***

Replacing all of the following with a new or rebuilt/remanufactured unit is recommended: valve lifters, oil pump, push rods, rocker arms, oil pump with new screen, spark plugs, points (if applicable), condenser, motor mounts, oil filters, air filters, water pump, thermostat, PCV valve & grommets and clean lines (Note: A plugged line or faulty valve may cause excessive oil consumption and blow by), carburetor (may be rebuilt) and make sure the EGR valve is operating to OEM specifications.

Following the manufacturer's installation procedures; especially proper torque values. Inspect the rocker cover baffle for possible restrictions.

Contamination is an engine's worst enemy. We recommend that you thoroughly clean parts that will be attached to the rebuilt/remanufactured engine.

Any and all parts not included with the remanufactured engine or engine component should be cleaned properly before installing on a new remanufactured engine.

INSPECTION OF ENGINE
PRIOR TO INSTALLATION

- Check for freight damage and dirt contamination of the engine.
- Check for proper valve train timing.
- Check that ALL oil gallery plugs are installed, tight and sealed.
- Check that ALL freeze plugs are installed and sealed.
- Check that temperature recording labels or heat tabs on the block and the heads are installed.
- Check application of the product – make sure the mounting holes, bell housing, crankshaft snout, flywheel mounting flange, bolt hole patterns, pilot shaft hole, smog/non-smog application, etc., are the same on new products as they are on the old by comparing casting numbers.
- Clean all accessories to be transferred to the new product from the old one. Resurfacing of the old intake manifold and machine gasket surfaces is recommended.

TIMING COVERS / REAR SEAL HOUSINGS

- Inspect for erosion, breakage, warpage, porosity and abnormal wear patterns.
- Measure covers containing oil pump for wear and replace if not within OE tolerances.

- Install new timing chain tensioners, dampeners, etc.
- Install camshaft seals and seal cam caps.
- **Camshaft and rear main seals not installed by the engine remanufacturer are not covered by the engine warranty!!**

VALVE LIFTERS –
Flat, Roller, HLC (Hydraulic Lash Compensators)

- Install new lifters and inspect push rods in short blocks to avoid camshaft wear & premature failure.
- Do not preload lifters (it causes undo stress to the camshaft and lifters which may lead to early failure).
- Lifter rattle at cold start is not uncommon, and does not cause engine damage. Roller & OHC lifters may take up to 1000 miles to bleed and remove all air pockets. Always use 5W30 oil on OHC and roller applications.
- Roller lifters may be reused if within OE specs.
- Hydraulic Lash Compensators (HLC) are generally reusable, but may need to be purged of all air.

DRIVE PULLEY / TIMING BELT INSTALLATION
(Harmonic Balancer)

- Check seal surface of pulley hub and repair or replace if grooved or damaged (harmonic balancer seal surface wear sleeves may be available).
- Do not install the harmonic balancer with a hammer.
- Lubricate seal surface prior to installation to prevent damage to seal.
- Check outer ring for slippage as this could cause "O" timing mark to not indicate top dead center.
- Replace balancers set in rubber. (The interior rubber deteriorates with age, allowing the balancer to slip, possibly causing timing problems and detonation, overheating, vibration and unexplained noises).

- Properly install and position timing belt pulleys for belt installation.
- Do not over tighten timing belt. This will result in damage.

CYLINDER HEAD TORQUE

- Properly torque cylinder head at installation to OE specifications in the correct sequence. (Use new bolts when OE requires).
- **Re-torque cylinder head gaskets at 1,000 miles. *Exceptions*: Iron cylinder heads and torque to yield head bolts.**

VALVE ADJUSTMENT.

- Consult shop service manual for dry lash setting for nonadjustable rocker arms.
- Properly adjust valves cold and again after bringing the engine up to normal operating temperature.
- **Check and adjust valves at 1000 miles (if applicable).**

INTAKE MANIFOLD MUST BE CLEANED

- Clean off carbon (remove steel heat shield, if equipped, clean and reinstall).
- Magnetic particles inspect or die check for cracks.
- Blow out with compressed air to avoid having foreign material enter combustion chamber.
- Remove baffle (where applicable) so that all collected contaminants can be removed.
- All EGR passages must be cleaned and free of obstruction.
- Do not over torque manifold bolts. Use OE torque specifications and sequence ONLY.

- Do not glass bead intake manifolds to clean.
- Check water outlet for corrosion.

ROCKER ARM ASSEMBLIES

- Check for wear and replace if necessary (remanufactured units are available).
- Confirm proper shaft installation as some can be installed upside down. Excessive oil consumption may result.

DISTIBUTOR

- Check bushing, mechanical advance, vacuum advance and total advance. **NOTE: Total advance should not exceed 34 degrees BTDC.** Improper advance will cause detonation. Detonation will cause piston damage and can happen very quickly. New pistons will appear to explode or self destruct. **Broken or damaged pistons are the result of piston to valve contact, foreign objects introduced into the combustion chamber or detonation and are not covered by the engine warranty!!**
- Check to see that the distributor is fully engaged and locked in the oil pump to proper depth.
- Adjust ignition timing to factory specifications.
- Check distributor drive gear for wear and replace as needed.

FUEL SYSTEM

- Carefully service or replace all aspects of the fuel system, i.e. pump, lines, carburetor or fuel injection components. **NOTE:** Fuel injectors are not designed to operate properly after 90,000 miles. Improperly working injectors will cause a lean burn condition and will lead to excessive combustion operating temperatures. This condition will lead to a failed head gasket and or damaged pistons and rings. **The engine warranty does not cover head gasket failure!!**
- **Diesel engines: replace injector pump, injectors and glow plugs.**
- Check fuel lines for breaks and crimps. Use only approved steel lines.

- Check fuel pump for proper pressure.

- Check double diaphragm type for faulty vacuum booster which may pump oil through the intake system.

FILTERS

- Replace all filters at time of installation and at O.E. recommended intervals. These filters include air, oil, fuel and crankcase.

- Use cleaning procedures outlined previously above to clean air cleaner housing, crankcase vent tubes coolers, air compressors, Donaldson valves, etc.

THRUST BEARINGS

- Adjust clutch to proper free pedal BEFORE starting engine, NOT after.

- Check crankshaft end thrust before and after bolting transmission to engine.

- **PLEASE NOTE!!!** – excessive main bearing thrust wear may be caused by the following:

  - ✓ Clutch not adjusted properly
  - ✓ Interference between pilot shaft and crankshaft
  - ✓ Interference between torque converter & crankshaft
  - ✓ Torque converter ballooning
  - ✓ Blockage and/or restriction of transmission oil cooler
  - ✓ Bent, kinked, or damaged supply lines

Preventing the causes of thrust
bearing failure is the responsibility
of the installing technician!
Thrust bearing failure is not covered by the engine warranty!!

RADIATOR /COOLING SYSTEM

- Recore or replace the radiator and test flow.
- Verify thermal conductivity. Minimum of 25 degrees F temperature differential between inlet and exhaust.
- Always replace pressure cap and thermostat.
- Prime cooling system before starting engine.
- Check electric cooling fan operation.
- Check worn belts, hoses and water pump.
- Check temperature with special high heat formula.
- Check temperature sending unit fan switch.

HEAT RISER OR EXHAUST THERMOSTAT CONTROL

- Check to see if unit is free and operating properly.
- Lubricate with special high heat formula.
- Make sure hot air door opens freely on air cleaner.

OIL SYSTEM

- Fill to proper level.

- **IMPORTANT!!!!**

  Applications using non-roller lifters & camshafts must use a "BREAK-IN" motor oil with ZDDP !!! Regular motor oils no longer have Zinc and Phosphorous (ZDDP). These were used by the motor oil manufacturers as anti-wear additives. You can also purchase a ZDDP additive from your local auto parts store or the major camshaft manufacturers. Note: Use of regular motor oils or API SN rated motor oils will cause lifter & camshaft failure!!!

- **All other applications must use a motor oil with high levels of Zinc and Phosphorous (min. Zinc 1500ppm / min. Phosphorous 1350ppm).**
- **We recommend Brad Penn PENN-GRADE 1 (10W-30) High Performance motor or equalevent oil after break-in.**

- # WARNING!!!

- **Do not use synthetic motor oils or a synthetic blend without the minimum levels of Zinc and Phosphorous until you have 3000 miles on the engine. Synthetic motor oils will prevent the engine from proper break-in (piston rings, bearings, camshaft & lifters).**

- Use only OE specified lubricants or equivalent to full levels before operation.
- We recommend 5W30 on all OHC applications.

- **PRIME ENGINE!!!!!**

- Use a pressure tank at about 40 pounds pressure to prime (pre-lube) engine as this will insure vital parts are lubricated properly to avoid dry start.

- Crankshaft driven oil pumps: remove back cover and pack pump cavity with petroleum jelly.

- **If pressure tank is unavailable, use an aftermarket assembly lubricator kit for prelubing of system before initial fire up (follow recommended procedures). Call for further information. NOTE: Do not prime engine by cranking. This will result in damage!!**

- Install new oil pump and pickup screen. Install new oil filter filled with new oil prior to installation.

- Check oil pump intermediate shaft for correct size and shape to match distributor and oil pump, if applicable.

- Oil pump must be primed before starting. (Run at 800 rpm intervals before releasing to customer for use to assure proper cylinder lubrication.)

- Replace oil pressure sending unit.

RUBBER GOODS

- Don’t overlook small parts such as belts, hoses (those that carry liquid and air) and motor mounts which become weak and worn with age. We suggest that these items be replaced at time of engine replacement.

ACCESSORIES

- Be sure to service and inspect accessories such as alternator, starter, water pump, air compressor, fuel system, EGR valves and all sensors to avoid premature engine failure.

FLYWHEEL

- On engines that use a 1-piece full circle rear main seal and flangeless flywheel mounting system, over torque of the flywheel bolts may distort the seal area and cause an oil leak.

- Some applications require sealer used on crank bolts.

ENGINE START-UP

- Check oil pressure.

- Check for proper oil supply to cylinder head.

- Engine should start, excessive cranking will cause damage.

- **Run engine @ 2000 - 2500 RPM continually for 20 - 30 minutes to break in the camshaft. Improper camshaft break-in re result in premature camshaft lobe and lifter wear. Premature camshaft lobe and lifter wear is not covered under this warranty.**

- Check water temperature.

- Check for oil and water leaks.

- Install radiator cap after coolant is observed to be circulating (some thermostats air lock and prevent proper circulation of coolant).

- Let engine cool, re-torque cylinder heads, intake manifold and re-adjust valves.

- Re-start engine, check cooling system function and engine CO level before road test. Road test and inspect for oil and water leaks.

- **Engine oil should be replaced after the first 500 miles and every 3000 thereafter.**

MODULATOR VALVE
(Located on automatic transmission)

- Pull off lines, if valve is defective, oil may be present.
- Replace if above condition is observed, as it may allow transmission fluid to enter engine through vacuum system and prevent proper ring seal.

EXHAUST MANIFOLD PRESSURE & SYSTEM

- Replace oxygen sensor with a low pressure gauge.
- Run engine at 2500 RPM for 1 minute.
- High pressure reading should be less than 2.5 pounds.
- A pressure reading over 2.5 pounds indicates an exhaust system restriction which will cause engine damage. Check catalytic converters and exhaust systems for restrictions.
- Inspect exhaust manifold for internal and external cracks, especially on marine applications.

ENGINE ANALYSIS

- Make an engine analysis data sheet (either a diagnostic printout or handwritten form) showing the status of the engine and the Engine Support System before installation, after installation and at the 500 mile checkup.
- Check engine and service engine soon lights (computer-control problems).
- Check for any trouble codes, this may be a clue to why the engine previously failed.
- Check for correct vacuum hose routing and for vacuum leaks.
- Replace distributor, wiring, coil and spark plugs to avoid poor performance. On V-8's, check plug routing.
- Final road test vehicle, do not return to customer unless you consider vehicle to be operating according to OE specifications.

- Give customer printout of exhaust gas analysis.

- On computerized emission control systems, check the fallowing items that are applicable:

    - **Load sensors**
    - **M.A.P.**
    - **V.A.C.**
    - **BARO**
    - **Throttle position sensor (TPS)**
    - **Stepper motor**
    - **Mixture control solenoid**
    - **Incorrect PROM (on GM cars)**
    - **Catalytic Converter Sensor**
    - **EGO Sensor**
    - **EGR flow sensor**
    - **Airflow sensor**
    - **Coolant temperature sensor**
    - **Crankshaft position sensor**
    - **Engine RPM sensor**
    - **Electronic spark controls**
    - **Idle speed control (ISC)**
    - **Air temperature sensor**
    - **Air conditioning sensor (switch)**
    - **Knock sensor**
    - **Halleffect switch**
    - **Turbo boost limiting system (waste gate)**
    - **Torque converter clutch**
    - **Road speed sensor**
    - **Oil and temperature sending unit/gauges ***

* The failure in some of these sensors can result in abnormal combustion temperatures and pressures, blown head gaskets, burnt pistons, piston scuffing and burnt valves, bearing failure and lack of power may result in eventual engine failure. **These conditions are beyond the control of the remanufacturing process and are not covered by the engine warranty!!**

WARRANTY ACTIVATION FORM

Invoice #: _____Purchase Date:_____

Name: _____

Address: _____

City: _____ State:_____ Zip:_____

Phone: _____

Part #: _____W.O. #_____

Size: _____ Model_____

VIN or Code: _____

Year(s): _____Make_____

Mileage: _____

Comments: _____

Installation Date: _____

Installed By: _____

Phone:_____

Date of 500 Mile Check-up & 1st Oil Change:_____

We do not issue your activation number until you have completed the 500 mile check up & 1st oil change.
I have read and followed the installation instructions. I also agree and understand the terms of this conditional warranty:

Customer Signature_____ Date: _____

ACTIVATION NUMBER_____

MAIL TO:
ENGINE WARRANTY
8222 SE 6th Ave.
PORTLAND, OREGON 97202

We will mail your warranty activation number once we receive this activation form. If you do not receive your activation number within 14 days after mailing this form please call Toll Free 800-235-3913.