



Race engine installation & maintenance.

Oiling System

Oil system priming before engine start up for wet sump system.

- When your engine is ready to be started for the first time, you must prime the oiling system to avoid dry start up.
- Remove the oil filter & fill with oil.
- Force compressed air through a breather hole while sealing the hole with a rag (pressurising the crankcase) until oil starts to flow from the oil filter mounting hole. Re-install the filter and start the engine while keeping a check on your oil pressure gauge.
- Chevrolet, Chrysler and Ford V8's can be primed with a special drive shaft before fitting the distributor.

Oil pressure

- Generally look for 8-10 PSI per 1,000 RPM. Eg. 40- 50 PSI @ 5,000 RPM (Hot)
- To alert the driver, we recommend using an oil pressure light set at 30 PSI minimum as a warning of a low or failing oil pressure or oil surge.

Oil filter inspection

- We recommend cutting open the oil filter at every filter change to check for any sign of foreign material in the oiling system.
- After cutting the filter open remove filter paper and wash out with thinners in a clean dish and inspect for metallic and non metallic particles. (Early warning signs can save costly damage.)

Oil Coolers

- After an engine bearing failure the oil cooler must be flushed clean professionally or replaced.

Gearbox Installation

- Check for gear-box misalignment by fitting the bell housing to the engine and fit a dial indicator base to the crankshaft while positioning the dial gauge inside the bell housings machined surface.

- *Rotate the motor and check for any runout on the indicator.*
- *Any TIR (Total indicator runout) over .010" can cause premature main bearing failure.*
- *Also check that the gear-box input shaft is not going too deep into the rear of the crankshaft.*
- *This will over load & burn up the thrust bearing and cause excessive crankshaft end float in a very short time.*

Cooling System

- *Flush the radiator before fitting a new engine.*
- *We recommend fitting a filter sock in the top radiator hose to catch any debris from the new engine. It is common for rust and scale to become loose and block the top radiator core's, resulting in a puzzling overheating problem. Inspect the sock regularly to avoid a flow restriction or blockage at that point.*
- ***Do not** add coolant to water for initial engine start up to allow resins in gaskets to heat set and cure properly.*
- *Check for water leaks before adding coolant to system. For best results use an engine coolant such as Prixmax RPC+ that **does not contain glycol** unless the engine will see temperatures below minus-7 Centigrade.*

Ignition System

- *Check that all ignition components are in good condition & correct for the application including, Spark plugs (heat range), Plug leads, Distributor, Ignition amplifier, Ignition coil.*
- *Set the ignition static timing & check the total ignition timing when running.*
- *During a dyno test session the best timing curve & total advance can be set-up for any particular race engine, avoid too much total advance.*

Fuel System

- *Check that all fuel system components are in good condition & correct for the application including, Fuel tank & lines, Fuel filter, fuel pump, Fuel shut off tap, secondary fuel filter, Fuel regulator, Fuel bypass valve Carburettor.*
- *Fuel tank should be cleaned, checked for damage & leaks, check condition of baffles, look for obstructions to pickup & return line, Test flow of breather.*
- *Clean & check all fuel lines & fittings for damage & leaks, take particular notice of any rub & abrasion marks.*

- *Replace or clean fuel filters as required & check flow.*
- *Fuel pump should be cleaned, inspected & adjusted as required.*
- *Regulator or Bypass should be cleaned & pressure checked.*
- *Carburettor should be cleaned, inspected & adjusted as required.*

Camshaft break-in

- *It is critical that the new engine start quickly and run at 2000 to 2500 RPM for the first 20 minutes of operation to break in the new camshaft and get the lifters rotating properly. This note does not apply to roller tappet camshafts.*
- *If for any reason there is a problem, stop the engine & finish off the remainder of the 20 minute session later without idling the engine.*

Cylinder head retention

- *Retention cylinder heads after initial run in period if required, MLS and TTY (torque to yield) do not require re-torqued.*

Weekly Maintenance:

1.) Check valve springs – The weak link in a current day racing engine is the valve spring. Buy a tester that can check them on the engine—Moroso makes one.

2.) Set valve lash – While you've got the valve covers off to check the valve springs, you should also check the valve lash. The best way is with the engine hot, but if you know how much the lash changes from hot to cold, you can do it without warming the engine.

3.) Inspect oil filter – If you have an inspection type filter (like an Oberg), you can just pull it apart and check for debris. If you have a standard paper type filter, you'll need to get a filter cutter to inspect the inside. Anything larger than metallic paint flakes should be of concern.

4.) Set ignition timing – Everyone knows how to set their own ignition timing, but the mistake people make is doing it with the engine cold. The difference between a cold and a hot engine can be as much as three degrees of timing.

If you think there is a problem:

1.) Check spark plugs – This is the first thing I tell people to do if they think they've got a problem. Pull all your plugs out and take a look – it will be obvious if one cylinder is having a problem.

2.) Do a leak-down test – If you think your engine is down on horsepower a leak-down test may help you locate the problem. It will find blown head gaskets; broken or stuck valves; and bent or burned valves. If you're missing a lot of power you'll need to see over 20% leakage.

3.) Inspect oil filter – Same as your weekly maintenance. If bearing problems are caught early by checking the filter, you may save thousand of dollars in repairs. A spun bearing will give little warning—if you think there is a problem, check the filter (it will be obvious).

4.) Check drain plug – If you're at the track and don't have a way to inspect your filter, the next best thing to do is check the magnetic drain plug (You do have one, right?).

5.) Inspect valvetrain – Check the valve spring pressure; valve lash; look for broken coils on inner or outer springs; broken rocker arms; missing lash caps or; broken or bent pushrods.

Procedure and Advice for starting your new Engine.

We have a common interest in the success and longevity of your engine and would like to share these helpful hints with you to make the installation easier.

HELPFUL HINTS

It is not recommended to fire up a new engine with a flat tappet camshaft using an aftermarket fuel injection system that has not been previously tuned to this engine. It is critical that the new engine start quickly and run at 1500 to 2500 RPM for the first 20 minutes of operation to break in the new camshaft and get the lifters rotating properly. Aftermarket fuel injection systems tend to need tuning right after installation and tuning a new system while breaking in the camshaft can be a distraction to the installer. This note does not apply to roller tappet camshafts.

Replace all Radiator and Heater hoses and clamps and install new Vacuum hoses.

Replace radiator with largest available or have your current radiator rodded out and inspected by a competent radiator shop. Your new engine will make much more power and HEAT than your old engine, increased power demands increased cooling.

Replace radiator cap with a high pressure unit. Every pound of cap pressure gives 3 degrees of boil over protection. A 17 pound cap equals 51 degrees of increased boil over protection.

Replace water pump and fan clutch. Always choose a thermal fan clutch. The less expensive non-thermal fan clutch will leave you with reduced cooling fan output when the engine temperature is the highest. This is asking for trouble. Thermal fan clutches are identified by the spring on the front, a good clutch is worth every penny. High quality electric fans are an option.

Replace all belts.

Check or replace engine mounts, a high horsepower engine will need reinforced engine mounts. Sometimes a safety chain or cable is bolted to the frame and the engine on the thrust side to keep from breaking that engine mount.

Check all pulleys for straightness, wear and alignment, remove any rust from the belt surface of the pulley, rust can sand your new belts quickly into used belts. Properly tension the new belts. If in doubt a Borouhgs belt tension gauge will give exact tension.

Check all wiring for fraying and cracks.

Check all brackets for cracks.

The ignition system must be new or in very good condition. Old plug wires tend to spark to ground or to other plug wires causing misfire, detonation and poor performance.

New Plugs, Plug Wires, Cap, and in older applications Points and condenser are highly recommended.

Be careful with the routing of the plug wires, poor routing can cause misfire in plug wires. The Distributor must be checked for proper advance curve and for wear. A worn distributor shaft can cause spark scatter and misfire problems.

Before installing a mechanical fuel pump make sure the fuel pump cam lobe is facing away from the pump. Failure to do this will result in a broken actuator arm on your new fuel pump.

If you have an engine oil cooler on your vehicle and had a previous engine bearing failure with associated debris in the oiling system the oil cooler **MUST BE REPLACED!!!!**

Cleaning does not get metal out of hoses and the old oil cooler." Failure to follow this advice results in cancellation of any warranty and engine bearing failure usually occurs in the first 5,000 miles.

Some shops have recently started offering a " Hot Oil flush procedure to clean used engine oil cooler's and lines. " This procedure offers promise but is still new. These shops use filtered oil at 220 degrees F and 100 pounds of pressure to flush debris from the engine oil cooler and transmission oil coolers and lines. This is the only system to show promise for potentially re-using old engine and transmission coolers and lines.

If the vehicle has not run for more than three (3) months, the gas tank should be drained and cleaned out and all gas lines should be flushed out. Old gasoline will turn to varnish and gum up all your new parts.

Many Valve train failures are a direct result of old fuel. Old fuel will coat the valves, pistons and exhaust guides and port with a shiny, stinky varnish like material that causes valves to stick, your new engine would need to be torn down and the heads rebuilt again.

If you have increased compression in this new engine you may have to mix octane boost with your gasoline to safely start your new engine. The needs of an 11:1 compression ratio engine are far different than a stock 8.5:1 ratio.

PRE-INSTALLATION/PRE-LUBE INSTRUCTIONS

If using a used flywheel or flexplate check for tooth wear and cracks. Flywheels are critical on hi-performance engines. Make sure the bolts are not too long and are torqued to proper specs using red Loctite. When using an automatic transmission, be sure you install the torque converter correctly. When mounting the transmission to engine you should have at least 1/2 inch between the converter and flexplate. If you do not have this clearance the

Torque converter is not properly installed on the transmission splines. Once the transmission is bolted to the engine, slide the converter forward and bolt it to the flexplate. Make sure that any new or used flexplates, flywheels and pressure plates are balanced.

Use a new hi-quality oil filter and fill with oil before installing. This will decrease priming times.

Fill engine with proper amount of oil and check with proper dipstick and tube. DO NOT USE ADDITIVES OR SYNTHETIC OILS! Non Detergent oils are a thing of the past and are not recommended any longer for modern engine break in. Use a high quality oil, multi-viscosity oils are just fine in a new engine.

Remove spark plugs to eliminate compression while priming the engine.

"Dry starts", a start up with no oil or with the engine not primed properly are the leading cause of premature engine failure. Prime the engine by actually spinning the oil pump with a proper priming tool and drill motor or speed handle while slowly turning the engine with a wrench at the front of pulley or the flywheel. (You will not get pressure if the oil pump is turned in the wrong direction) Continue with this procedure until oil pressure is indicated on the oil pressure gauge and oil is present at all the rocker arms.

Dry starting an engine can cause damage in as little as 20 seconds.

Check for oil leaks at this time!!!!!!!

If unable to pre-oil engine properly and mechanical experience prevents you from removing and reinstalling the distributor properly, the following procedures can be used to pre-oil the engine.

a. Remove coil wire and spark plugs, if not already removed.

b. Keeping an eye on the oil pressure gauge, crank the engine with spark plugs out and ignition disabled for 45 seconds!!

Oil pressure should climb after 10-15 seconds. If there is no oil pressure after 15 seconds stop, let the starter motor cool and check the gauge, fittings, lines, etc. Repeat the above procedure, you must have oil pressure to continue.

After adequate oil pressure is attained reinstall spark plugs and coil wire. You are now ready to start and break in your new engine.

INITIAL START UP PROCEDURE

After installing engine, fill radiator with water (no antifreeze) fill very slowly and listen for trapped air escaping. Allow any trapped air to burp out before continuing. Many engines today have very specific instructions for burping or purging air from the system. Check your manual for filling instructions. It is best to fill without a thermostat in place and to fill from the highest point available on the engine or to vent while filling using the highest point available.

Caution: Trapped air in the engine block or heads can cause total engine failure.

Allow one hour for coolant and engine block to acclimate. Cold water will shrink the cylinder walls and potentially cause piston damage at start up. You can eliminate this hour time delay by filling the radiator and engine with hot water rather than cold water. Hot water will expand the cylinder walls and help your new engine on start up. Using water at this time eliminates a big mess should any leaks occur during start-up. One loose clamp will let a hose pop off and antifreeze is an environmental hazard.

Re-check oil level. Check for water leaks.

Fill carburetor with gasoline through vent tubes to ensure a quick start.

Turn on heater and leave radiator cap off until thermostat opens, then add any additional water needed and seal the system. This will help prevent an air lock in the system.

Immediately after starting engine, bring the RPM up to 2000 and check the oil pressure. Shut off the engine immediately if you have no pressure. Check the fittings, lines and gauges.

Camshaft break in is necessary with flat tappet camshafts. Roller camshafts require no break in period.

If oil pressure is good, Run engine at 1500-2000RPMs to break in the camshaft for 30 minutes. This is a critical step for flat tappet camshaft survival.

Monitor the water temperature and Oil pressure during cam break in. Re-Tighten all clamps on rubber hoses, proper tension can be attained after engine is fully warmed up

and hoses soften.

While the cam is breaking in check timing to make sure you are close, final timing can be done after cam break in.

Once the camshaft break in has been completed, bring idle down to approximately 800-1000 RPMs (depending on the model of the engine).

AFTER CAMSHAFT BREAK IN:

SET TOTAL TIMING, Total timing is the combined total of vacuum, mechanical and electrical advance in the distributor. On most engines Total timing is achieved at 3000 to 3500 RPM. Total timing varies for specific engines. A naturally aspirated Chevy 350 with 9:1 compression might run great with 34 degree's total timing.

The same engine with a supercharger, nitrous or turbo charger could melt the pistons right out of the engine at 34degree's total timing, these engines might need a total timing of only 17 degrees. Know what you need before starting the engine.

Proper total timing varies for each engine manufacturer and each engine family within a manufacturer and is critical for top engine performance. Too much timing robs power and damages Pistons, Head Gaskets and Rod Bearings.

Check carefully for any vacuum, water or oil leaks.

Adjust carburetor, set floats, idle and idle mixture. Jetting may need to be adjusted up or down slightly due to weather, altitude, etc. Please read carburetor instructions prior to start-up.

Install the Air Cleaner and make sure all vacuum and air ducts are properly installed. Do not drive vehicle without the air cleaner installed. The Piston rings and cylinder walls are susceptible to damage from poor air filtering.

DRIVING PROCEDURE: NEW ENGINE

Run normally without holding engine at a steady speed for long periods of time. Loading the engine for short bursts will help seat the rings. You should not get any pinging or detonation from a properly tuned engine with the proper grade of gasoline. Do not let the engine overheat ever. You should be able to keep it within 20 degrees of the thermostat temperature at all times.

Change oil and filter after 300-500 miles. Be sure to add 50% antifreeze or RedLine Water Wetter (climate permitting) at this time. Re-tighten header and intake bolts once cooled down.

RECOMMENDED GUIDELINES & MAINTENANCE INTERVALS

Water temperature should never exceed 230 degrees in a worst case scenario. Any higher than 230 degrees and you risk head gasket failure and cracking of the head castings and more.

Oil Pressure Parameters - 20 PSI min at hot idle, 55-65 PSI at WOT. Oil temperature gauges are recommended (AutoMeter gauges highly recommended).

Thermostats should be Hi-flow design, either 160 degree or 180 degree depending on application and climate.

(computer controlled engines must stay at factory recommended temperature minimum for best performance, most use a 195 degree thermostat)

Replacement spark plugs must be of the proper heat range and style.

Spark plugs that are too hot will cause engine detonation issues and loss of power.

Adjustable vacuum advance should be no more than 10 degrees total. If pinging occurs during part throttle driving, reduce vacuum advance timing not initial or total timing.

During initial break in, check for oil, water, fuel and vacuum leaks frequently.

OIL AND FILTER CHANGE INTERVALS

Street driven performance vehicles should change the oil and filter every 2500-3500 miles.

Race engines should have oil and filter changes every one to two race weekends depending on the number of passes.

Shift points for your engine should not exceed 500RPM past peak horsepower RPM. Rev limiter should be set slightly above shift RPM.