Revision
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# Pro Engine Instructions

Thank you for purchasing one of LC Engineering performance Toyota engines. Each Pro Engine is custom tailored to your specific application. These instructions are designed to serve as a general guide for the care and maintenance of your performance engine. Please spend a few minutes to read through the entire instruction sheet before you begin your installation. If you have any questions, contact our technical department at 928-855-6341.

This engine was assembled with a performance camshaft. This higher lift & duration camshaft will emit more valve train noise than a stock camshaft. This is normal. Follow the valve lash specification supplied on the camshaft card that came with these instructions. Check valve lash regularly.

LC Engineering technicians performed initial camshaft break-in. Your engine still needs a break-in period to achieve maximum engine life and performance. Please read and follow the guidelines closely.

## Installing the Engine

This engine comes with forged aluminum pistons instead of the stock cast aluminum style pistons. This style piston will require you to re-locate your knock sensor on fuel injected applications. Your new engine has a small tag on it to show you the new location of your knock sensor. This location has already been tapped to accept your stock knock sensor. **Failure to re-locate your knock sensor can result in engine damage!**

Follow factory recommendations for installation of clutch & flywheel assembly, crank pulley, starter, alternator, etc. A new pilot bearing has been installed on the crankshaft. Install engine in vehicle.

Make sure you install a ground strap on the back of the cylinder head to the firewall and/or chassis ground. Failure to hook up this ground strap could cause electrolysis, damaging the aluminum cylinder head.

Periodically check and clean all grounding connections. A good ground connection is as important as the positive connection to achieve maximum ignition system performance and spark plug fire.

We suggest that the following items be cleaned, inspected and replaced if necessary:

- Carburetor
- Fuel Pump, Fuel Filter & Fuel Lines
- Distributor, Distributor Cap & Rotor
- Coil, Plug Wires & Spark Plugs

- Radiator, Radiator Cap & Thermostat
- Fan Belts, All Hoses & Lines
- Harmonic Balancer or Power Pulley
- Flywheel or Flex Plate
- Pilot Bearing & Clutch Assembly
- Engine and Transmission Mounts

## Before Starting Your Engine

Check fuel quality. If vehicle has been in storage or not running for more that 30 days drain fuel tank and add fresh fuel. Purge old fuel from fuel lines before connecting to carburetor. Check system for adequate fuel pressure and delivered volume.

Check battery condition. If vehicle has been in storage or if battery is low, place on battery charger or replace.

Double-check your ignition wiring and firing order. (Firing Order 1-3-4-2) Set the static ignition timing. Improper ignition timing can damage your new engine. Set the timing carefully.

Install oil filter and fill engine with the proper amount of petroleum based engine oil. For break-in use premium petroleum grade oil such as Valvoline 20/50 HP or Castrol 20/50. **Do not use any synthetic oils or oil additives during the break-in period.** Synthetic oils or additives can be used after the 5,000-mile initial break-in period.

Fill cooling system with the proper amount of coolant. Do not start new engine with no coolant in the system. Excessive heat build-up could result, damaging your engine. Make sure the highest point in the cooling system is the filler cap. Air pockets in the cylinder head will cause heat damage

Inspect all vacuum hoses. Check the carb base and intake manifold for vacuum ports that need to be plugged. A vacuum leak could cause your new engine to run lean causing permanent engine damage.

## Initial Startup

Start engine. Follow procedures below:

**If engines fails to start immediately, stop and check ignition timing and fuel delivery. Prolonged cranking could cause premature engine failure.**

1. Run engine at 1500 rpm for 20 minutes.
2. Set total advanced ignition timing.

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3. Add coolant to radiator as needed.
4. After 20 minute period, set idle and re-check Ignition timing.

**Improper ignition timing at anytime can cause detonation or build excessive heat. Both will destroy your race engine. Be careful!**

## Initial Break-In

Your LC Engineering Pro Engine requires a short break-in period to insure proper performance. During the first 500 miles or 50 laps follow these guidelines:

- Do not operate for prolonged periods at any set engine rpm.
- Do not drive slowly with the transmission in high gear.
- Do not rev the engine at high rpm's excessively.
- Do not tow a trailer or put other heavy loads on the vehicle.
- **Do not use any synthetic oils or oil additives during the break-in period.**

**Circle Track Engines:** Break-in with easy warm-up laps. Do not drive around at a constant rpm. Accelerate and decelerate in the 2000 to 5000 rpm range. Monitor water temperature and oil temperature closely during the break-in period. Your LC Pro Engine may require a richer or leaner mixture than your old engine – check your jetting closely. **Never run the engine lean.**

| **Break-in Duration** | |
|---|---|
| **Pro Street** | **500 Miles** |
| **Drag Race** | **15-20 Easy Passes** |
| **Circle Track** | **50 Warm-up Laps** |

After the initial break-in duration, the engine oil and filter must be changed. Check the valve lash and re-torque the cylinder head. At this time it is a good idea to recheck the ignition timing. Look over the hoses for signs of leakage – water, fuel, and vacuum, etc.

## Care & Maintenance

Your LC Engineering Pro Engine requires a higher level of maintenance than a stock engine. Follow the recommended maintenance listed below for your engine application.

**Cam Card and Valve Adjustment:** Included in this packet of instructions is your camshaft card for your engine. Keep this cam card. It contains information on the camshaft timing and valve lash requirements for your engine. **Always check valve lash with the engine hot.** Valve lash should be checked after initial engine break-in. Check valve lash again at the recommended interval listed below for your engine application.

**Induction:** Many different types of induction systems are available for our Pro Engines – Holley 350-500 2 Barrel, Weber Duel Side Draft Carbs, Weber Two Barrel Carbs, and Fuel Injection. It is very important to set up your particular application to achieve maximum performance and longevity from your engine package. Always start with a

richer mixture and tune accordingly. Never jet too Lean or too Rich. See tuning guides for your application.

**Never run your engine without an air filtration system. LC recommends and stocks many different K&N filter systems.**

**Fuel:** Poor fuel quality is one of the causes of detonation and engine failure. Your Pro Engine is designed to run on quality racing gasoline only. DO NOT USE PUMP GAS IN YOUR RACE ENGINE. Check the following chart for minimum fuel requirements.

| Compression Ratio | Recommended Octane Rating |
|---|---|
| Up to 10:1 | 92+ Octane Premium Grade Gas |
| 11:1 + | 108 Octane Race Fuel |
| Blower/Turbo | Varies with Boost PSI |

**Ignition Timing:** Always use a performance distributor such as the LC Pro Distributor (Part # 17-100). Ignition timing is very important to achieve maximum power from your engine. While improper timing will always cause maximum destruction. **Never set your timing by ear. Use a timing light.** Preferably a delay style timing light to set total ignition timing.

Recommended timing will very from application to application, usually **a setting of 28° BTDC to 32° BTDC total timing will provide excellent results**.

**Spark Plugs:** Spark Plug recommendation will very on different applications. You will need to check and adjust to the proper heat range for your specific application. We recommend using an NGK Brand Plug.

| Application | Recommended Plug Range |
|---|---|
| Stock Toyota | BKR5E |
| Pro/Hot Street | BKR6E |
| 11:1 Comp or 0-10 P.S.I. | BKR7E |
| 12:1 Comp or 10-20 P.S.I. | BKR8E |
| 14:1 Comp or 20-30 P.S.I. | BKR9E |

**Plug Ranges: BKR5E ----- BRK9E**
**← HOT COLD →**

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Spark Plug Gap will vary depending on the application and ignition system. Usually a gap of .030 to .035 will provide excellent results. Learn to read your plugs. It is possible to require different heat ranges in a single engine application to achieve maximum performance.

Proper spark plug installation is important. Use a small amount of anti seize on the threads. For 14mm x .750 reach plugs, torque to 18-22 ft lbs. or 3/8" to ½" of a turn after the plug seats.

**Lubrication – Oil & Filter Recommendations:** We recommend using the System 1 oil filter. This filter is a take apart style that will enable you to inspect for contamination. The K&N Canister filter will provide excellent protection also. Both are available from LC Engineering.

You will need to make sure you have proper oil pressure for your new engines. Too much or too little oil pressure can cause damage to your new engine. We recommend a minimum of 10psi per 1,000rpm but more is not always better. So you do not need 90 – 100psi of oil pressure.

Recommendations for Oil will vary depending on the application, climate and oil operating temperatures. **Never use Synthetic oil for break-in.** For break-in use premium petroleum grade oil such as Valvoline 20/50 HP or Castrol 20/50.

Synthetic oils and oil additives may be used after the following break-in duration:

300-400 Laps Circle Track Racing
20-25 Easy/Hard Passes Drag Racing
4000 miles Pro Street

After proper break-in you can switch to premium synthetic oil such as:

| | |
|---|---|
| Royal Purple #41 | 10/40 |
| Mobil One | 10/40 |
| Castrol Synthetic | 10/40 |

**Cooling:** To produce the maximum performance you need to operate your engine at 195-200 degrees water temperature. Not colder and not hotter. While "Heat is Horsepower", too much heat will damage your engine. Always take water temperature readings from the water exiting the cylinder head.

**Maximum water temperature is 220 degrees. If you cannot control your water temperature you will damage your engine.**

Too Hot: Try using a LC Power Pulley with a thermostat or restrictor washer to slow the water down. This will provide additional cooling time in the radiator before returning to the block.

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It is very important for the fan shroud and/or ducting around the radiator to be properly fitted. This will force the air hitting the radiator to go through the radiator and not around it. Air going around the radiator will not cool the engine.

**Off-Road, Drag Race or Circle Track Engine Maintenance:** Change Oil, inspect oil filter and check valve lash after every event. Your Pro Engine should be freshened-up (rings, bearings & valve job) after 25-40 events or every season. Careful preventative maintenance is the key to long engine life. Most engines failures can be contributed to failed cooling systems, failed lubrication systems, improper fuel mixture, improper ignition timing and/or failed ignition systems. The result is increased expenses that are not necessary.

**Don't pay more, pay more attention!**

**Pro Street Engine Maintenance:** Your Pro Street Engine needs close attention paid to valve lash. Change the oil and inspect oil filter every 2000 miles. Watch the water temperature closely. Along with more power your Pro Engine will produce more heat. Any problems in the cooling system will be magnified with you new engine. Check fluid levels and monitor engine temperature closely.

| Miles | Recommended Service |
|---|---|
| 500 | Check Valve Lash, Visual Inspection |
| 2000 | Oil & Filter Change, Check Valve Lash |
| 4000 | Oil & Filter Change, Check Valve Lash |
| 4000 + | Recommended oil change interval every 2000 miles. Check Valve lash often. |

**Chassis Flex and Broken Engine Blocks**

All applications need to check for adequate chassis strength. If your chassis flexes under hard acceleration, you can break the Toyota engine block. If you notice an oil leak behind the oil filter, check the block for a crack in this location.

> **LC Engineering will not warranty any broken blocks caused by improper chassis design.**

To check your chassis design install an available engine block. Bolt the right side engine mount and transmission mount down leaving the left side unbolted. Using a floor jack under the left front corner of the frame, jack up the vehicle. Watch the unbolted left mount for movement. If you see any frame flex or movement between the mount and frame you have a design problem. The block does not make a good frame. Please make the necessary adjustments to ensure sound structural design.

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By fixing the frame flex problem you will not only save your engine, you will make your car handle better. A stiffer chassis will respond to setup changes better. This problem is seen especially on Celica's. Check all applications.

**Technical Support**

LC Engineering can provide you with technical assistance to achieve the maximum performance from your engine. You will need the following information available when requesting assistance.

Engine Model & Invoice # _____

Jetting:
- Carb Type _____
- Main Jet P _____
- Main Jet S _____
- Idle Jet _____
- Air Bleed _____

- Ignition System _____
- Distributor Type _____
- Total Timing _____
- Header Size _____
- Cam Grind _____
- Cam Index Degree _____
- Water Temp _____
- Oil Temp _____
- Type of Oil _____

Keep a record of what changes you have made and what the results were. With records, you can always return to a previous setup.

## Torque Guide

| | | | |
|---|---|---|---|
| Intake Manifold Bolts | 14 | Stock Rod Nuts | 46 |
| Exhaust Studs | 33 | Pro Rod Nuts | 50 |
| Flywheel Bolts | 80 | Oil Pan Bolt 79-84 | 4.5 |
| Crankshaft Pulley Bolt | 116 | Oil Pan Bolt 85-95 | 9 |
| Stock Head Bolts | 58 | Timing Cover - 8mm | 9 |
| Cylinder Head Studs | 90 | Timing Cover – 10mm | 29 |
| Main Cap Bolts | 76 | | |

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