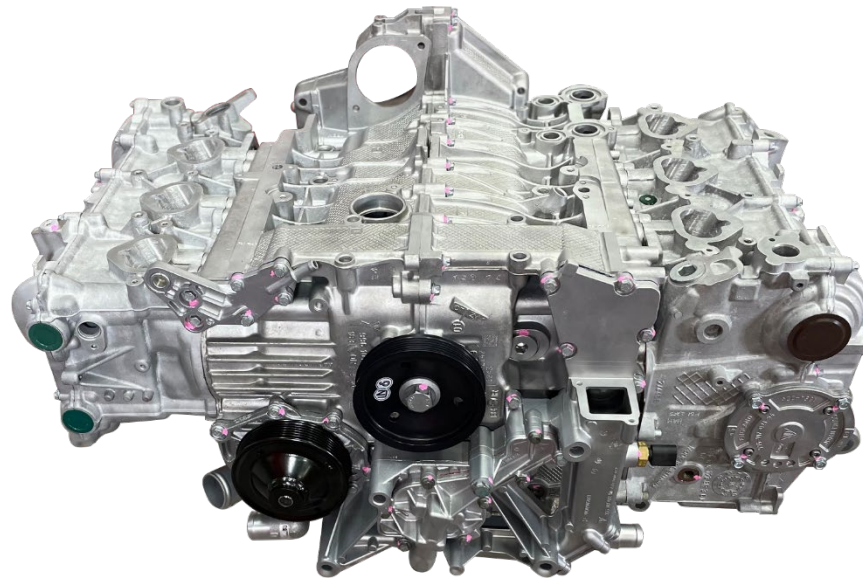




LN ENGINEERING LLC
FLAT 6 INNOVATIONS (FSI)



**REPLACEMENT M96/M97 ENGINE
IMPORTANT INSTALLATION INFORMATION
AND MAINTENANCE DIRECTIVES
FOR CERTIFIED ENGINE INSTALLERS**



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FSI engines have been carefully remanufactured to precision standards. The engine will perform properly if both the technician carrying out the installation and the vehicle owner follow the guidelines provided in this directive. If the engine installer or vehicle owner does not follow these directives, has poor situational awareness, or executes poor judgment, the engine can suffer damage or premature failure that may exclude it from being covered under warranty. **When in doubt, direct all questions and comments in writing to support@LNengineering.com.**

The following is a partial list of causes for a remanufactured engine to fail early in service. When a properly remanufactured engine fails to give satisfactory service, it is usually due to: damage to pistons 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, contaminants in the oil such as dirt, or coolant seepage; excessive piston and cylinder wear caused by ineffective air filtering, coolant seepage, or (most commonly) excessively rich air-fuel ratio.

The leading cause for issues related to engine break-in for engines equipped with NSC-plated cylinders is from over-enrichment of the fuel system. Engines that “run rich” will wash down cylinder bores and never achieve ring seal. Vehicles with original equipment core engines that have suffered previously scored cylinders are especially susceptible to over-enrichment concerns. We have seen remanufactured engines suffer failures due to enrichment issues at start-up and during break-in from faulty injectors or other issues resulting in incorrect fuel trims. As a result, **RND Engines mandates that NEW FUEL INJECTORS be fitted to all engines under all circumstances. “Cleaned” fuel injectors are not acceptable. ENGINES THAT HAVE NOT BEEN OUTFITTED WITH NEW FUEL INJECTORS AT THE TIME OF INSTALLATION WILL IMMEDIATELY HAVE THEIR WARRANTY VOIDED! NO EXCEPTIONS!**

Genuine Porsche or OEM components are required. **USE OF SUBSTANDARD AFTERMARKET OR PERFORMANCE COMPONENTS ARE NOT AUTHORIZED.** For example, use of incorrectly oiled reusable air filters may foul MAF sensors, aftermarket exhaust or sport catalysts may cause rich running, and aftermarket ECU tuning may raise or eliminate safety limitations such as rev limiters and monitors that may prevent a check engine light from coming on due to incorrect engine operation. Use of ANY of these types of components will immediately void the engine warranty. **WHEN IN DOUBT, CONTACT LN ENGINEERING FOR CLARIFICATION.**

During break-in and intermediate period following break-in the engine is the most susceptible to issues from over- enrichment. Due to this we require that fuel trim values, crankcase manometer readings, MAF & O2 sensor readings, etc. be recorded by the installing technician and submitted to LN Engineering with the warranty registration by the vehicle owner or shop performing the installation.



Document all service history for warranty purposes for the first one year/ 12,000 miles. If any warranty claim is made, the full service history of the vehicle and engine will be requested.

Please forward proof of purchase for new fuel injectors to the vehicle owner to be returned with the warranty registration documents, including an itemized invoice for all new components fitted to the engine at time of installation. Items not listed will be assumed to have been re-used from the original engine. FSI is not responsible for engine damage or failure due to failure of engine ancillaries including but not limited to injectors, sensors, wiring, rubber or plastic hoses or lines, intake or exhaust, or emissions components.



The installer, customer, and FSI all have a vested interest in the success of this engine. We all mutually want it to perform correctly provide a long and satisfactory life for its owner. We recommend taking these precautions from first-hand experience.

- ▶ Proper air-fuel ratio is vital in today's engines. Be sure the fuel injection system has been fitted, cleaned, and offers no compromises. 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 re-torqued in proper sequence if required. Air seepage can cause lean air-fuel ratio which causes detonation. Check fuel pump for proper pressure, and replace fuel filter (if equipped). Check manifolds for cracks or other potential vacuum leaks (especially plastic intakes!) by smoke testing the engine.



ALWAYS USE NEW FUEL INJECTORS!

Drain 100% of the old fuel from the vehicles fuel tank and replace with Top Tier or ethanol free high octane. Use of Driven Injector Defender is recommended.

- ▶ Check electronic sensors and sending units for proper connection. Vacuum lines must be properly routed and connected to the appropriate fittings to ensure operation of emission control devices and related engine controls. In 996 models clean the X59 1/2 connectors with electric parts cleaner and look for corroded pins.

Important! Replace air filter with OEM paper elements. Thoroughly check engine accessories which are to be reused. Clean them internally and externally before installing. Over-oiled washable filters kill MAF sensors!

- ▶ 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 Porsche coolant, mixed 50/50 with distilled water and Driven Cooling System Protector.
- ▶ Vacuum coolant lift fill tool must be used to fill the coolant.
- ▶ Before releasing the engine for regular service, check the air-fuel ratio, record all fuel trim values on the customer's invoice as FRA / RKAT values. Caution the driver against "lugging" and over-revving.
- ▶ Be sure to prime the oil system as directed in the initial startup directive that we have provided to you. (Chapter 3, "Initial Startup")

- ▶ Ensure that the vehicle has had a "hard reset" (battery disconnected from both terminals, and cables bridged using a test light (incandescent bulb) performed, along with a "system reset" or "vehicle handover" via the appropriate scan tool. This is ultra-important, else the adaptive learning, and calculated values from the prior engine will be applied to the new engine, via the engine control unit!
- ▶ Never add cold water to the cooling system while the engine is running. The engine should be allowed to run at normal operating temperature.
- ▶ Start engine and run at fast idle, approximately 2000 RPM, and check the oil pressure. Run the engine for 30 minutes even though coolant may rise to operating temperature in a few minutes.
- ▶ Initial break-in oil fill will then need to be changed out for LN 607-7177 oil.
- ▶ After changing the oil 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. Repeatedly accelerate to 50 MPH and decelerate by using engine braking. Repeat this procedure at least 5 times from a rolling start in different gears. NOTE: Applying high loads to the engine for short bursts followed by high vacuum with engine braking causes increased ring pressure against the cylinder walls and helps to seat the rings. YOU MAY NOTE SMOKE EMITTED FROM EXHAUST WHEN DOING THIS!



DRIVE NORMALLY BUT NOT AT CONTINUOUS HIGH SPEEDS OR UNDER SUSTAINED HEAVY LOADS FOR THE FIRST 500 MILES. IT IS IMPORTANT TO USE THE WHOLE RPM RANGE DURING BREAK-IN FOR BEST RESULTS.



Never get the engine coolant or oil temperature over 210F during break-in when running break-in oil



Use of a semi- or full synthetic oil or any friction modified oil or additives during the break-in period (7500 miles) will void the warranty!



The installation and initial start-up of any engine that has been subject to the updated processes and components of an RND engine is critical. Due to our approach with the M96/ M97 engine platform it is important that installers and technicians don't utilize their previous experiences with factory or otherwise "rebuilt" engines when working with an engine manipulated and remanufactured by FSI. **PAY ATTENTION TO OUR DIRECTIVES!**



We have provided these step-by-step instructions for the removal and replacement of the engine for all Porsche models that use the M96/ M97 engine, for those who are not familiar with the processes.

The installation of the engine is straightforward and basically like any other M96/M97 installation; however, we expect the installer to utilize attention to detail in some areas that can lead to issues that we must avoid. When installing the engine pay close attention to the following:

First and foremost - the installer of this engine has been tasked with an important role and must work with the proper mindset to achieve a successful installation, first start, break in, and service of this engine. Attention to detail, common sense, and organization are essential values to the success of an engine installer.

CLEAN ALL ANCILLARY COMPONENTS THOROUGHLY, ESPECIALLY THE INSIDE OF INTAKE MANIFOLDS!

For street cars always use approved coolant- there is no substitute for this. For race and DE engines that use distilled water and must see constant flushes (3 times yearly) to avoid corroded engine internals, we highly recommend the use of Driven CSP especially when straight water is used in the cooling system.

Use distilled water to charge the cooling system, mixed 50/50 with Porsche coolant or OEM Pentofrost. CSP additive is compatible with factory approved coolants.

It is required that an "air lift system" be utilized to charge the cooling system for the first time. These systems create a vacuum on the entire cooling system and then will draw coolant into the system. This is a superior method of filling a large, complex cooling system like those found in modern Porsches, where conventional filling will most certainly lead to air pockets in the system, often in the cylinder heads or around the cylinders. These air pockets can lead to hot spots, and localized cracks within the engine. This can happen without experiencing the symptoms of an overheated engine, and can occur within minutes of the startup of a new engine. These air pockets can lead to engine damage initially, or later in the engine's life. If you do not have the proper vacuum- filling tool, one must be sourced prior to charging the cooling system. This is required! Do not utilize gravity filling methods!

- ▶ Fill and bleed the cooling system thoroughly using the “air lift” style of system charging, along with the typical process of opening the heater circuit. We prefer to leave the system under vacuum for 20-30 minutes to remove air pockets, to ensure there are no leaks within the system. Be sure to turn the heater on “Max” to ensure the heater core is open. Repeat the process after the engine initially fires and circulates coolant for 2-3 minutes. It is imperative that ALL AIR POCKETS are removed; else cracked cylinders and heads are a real possibility. The “air lift” system virtually eliminates chances of air pockets, as it works from a vacuum principle. The air-lift will also find cooling system leaks and other deficiencies before the system is charged with coolant, because a leaky system will not hold vacuum. SSF Auto Parts carries the Hazet Coolant Vacuum Fill Tool, part # 4801-1. Also, order 4801- 2/3 Vacuum Fill Cone, when purchasing this system. Baum Tools B9696 coolant vacuum fill lift tool can be used as well.
- ▶ Expect the engine to “burp” coolant the first few times the engine warms to the point of the thermostat opening. This loss of coolant is normal and proves that the conventional methods do not remove all air pockets as well as the air- lift system will. Do not be alarmed!
- ▶ Vehicles that have experienced failed engines where intermix of oil and coolant have existed, must be treated with extreme care before the FSI engine is started for the first time. The cooling system must be thoroughly cleaned, and flushed until no remaining intermix is apparent in the expansion tank. Petroleum from the intermixed oil that has found its way into the cooling system will destroy hoses in just a matter of a few days. It is common to replace hoses, lines and radiators after an intermix condition occurs, to avoid the failure.

***Always replace O2 Sensors when any engine has suffered an intermix failure, as coolant has proven to foul O2 Sensors very quickly and can cause an over- rich condition for the new engine.**
- ▶ In some cases, all hoses and even the radiators and heater core (made of plastics) can also fail after an intermix condition, so replacement is recommended.

***All vehicles that have intermixed coolant and oil in the coolant reservoir must have the reservoir replaced, along with the coolant cap, and bleeder valve assembly. See Chapter 4 “Important facts about cars with prior intermix failures”**
- ▶ A new Genuine Porsche coolant expansion tank should always be fitted when installing the engine. A cracked tank may lead to cooling system and engine failure.
- ▶ Use Porsche approved power steering fluid ONLY.
- ▶ Ensure all grounds for the wire harness are installed and tight. Also ensure that the main power lead to the engine is also tight, failure to do this will kill the alternator and wire harness in short order.
- ▶ Exercise fastener control, keep loose hardware away from intake ports. Always keep intake ports taped, or covered up, until the intake manifold is fitted. Check inside intake manifolds for loose hardware, or pieces from the previously failed engine. **CLEAN THE INTAKE!** Foreign object debris kills and is not covered under the engine’s warranty!
- ▶ After the engine has been driven for at least 30 miles, perform a crankcase Manometer Reading with the engine at idle, and the AC system turned off. Idle speed should be less than 950 RPM to perform this test. Use CR Tools Manometer CR-TOOL-CVMT available from LN Engineering or similar manometer. Record value.
- ▶ **NEVER USE AFTERMARKET ENGINE OR TRANSAXLE MOUNTS!** This includes semi-solid, and solid mounts alike. These confuse the engine’s knock sensing abilities, and create reduced ignition timing, and elevated exhaust gas temperatures, as well as lower power, and even fuel trim adjustments.
- ▶ Never utilize aftermarket induction, exhaust, or any other aftermarket components with this engine, unless approved or recommended!
- ▶ Utilize Driven Injector Defender fuel system cleaner in the first tank of fuel that the new engine will be broken in on. Continued use of Injector Defender along with Top Tier fuels is recommended.
- ▶ Inspect wire harness and connectors; replace if wires are brittle, cracked or harness is otherwise damaged.
- ▶ Ensure that all routing of the wire harness is correct, failure to do this may create an instance where wires are pinched during installation, creating a host of other issues.
- ▶ Check the secondary air system to ensure all components are in good condition. Ensure the exhaust gaskets that are used have the proper secondary air passages and are not restricted compared to the OEM units previously in service.
- ▶ It is MANDATORY that all plastic tubing leading to the AOS system is replaced. If not, these can crack, leading to increased fuel trim, poor running and engine failure due to over enrichment. The same goes for dipstick tubes and oil fill tubes.
- ▶ Ensure the clutch disc is aligned correctly and is the proper unit for the flywheel that’s used, as well as the transaxle. It is very easy to become confused and fit the clutch disc backward in many of these vehicles. Pay close attention to how the previous arrangement was disassembled.

- ▶ Ensure the clutch/ disc/ release bearing assembly is correct for the VIN of the vehicle, and that you have received the proper components, as there are times that items are mis-packaged. Always compare replacement components with those that were previously fitted.
- ▶ DO NOT LUBRICATE THE INPUT SHAFT or release bearing. Doing so will contaminate the clutch disc and lead to slippage.
- ▶ Ensure that all flywheel bolts are REPLACED with genuine fasteners and pressure plate bolts are torqued to factory specified values.



Never, under any circumstances, utilize a single mass/ lightweight flywheel with this engine. Doing so will void any and all warranty.

- ▶ If the vehicle is equipped with a Tiptronic transaxle, ensure that all vacuum hoses are connected. Ensure that torque converter to flex plate fasteners are REPLACED with new genuine fasteners. Consider replacing the torque converter seal at this time.
- ▶ Pay attention to bolt lengths when fitting the engine to the transaxle. Long and short bolts may become mixed up and if this occurs a long bolt can break through the crankcase, leading to immediate failure.
- ▶ NEVER overfill the engine with oil! Doing this is a fairly certain method of extending the break-in period for “ring seal” and will lead to forced oil consumption. Keep the oil level just above the minimum level on the oil level dipstick or electronic gauge. Avoid filling to the top “max” line at all costs. The normal operating range is the entire area between the low and high max points. An engine that is filled to the top line is considered over- filled and will consume oil.
- ▶ Only check the engine oil each morning before operation and only on level ground. These engines are notorious for retaining oil in the timing chain wells, cylinder heads, and elsewhere after shutdown. This oil takes hours to return to the oil sump, so checking oil using any other method other than what is described here will create a scenario where the engine operates over- filled with oil. The engine can have a full-load of oil, but all of this oil may not be in the sump where it is sampled. This is critical!

- ▶ Check the dual mass flywheel second- mass deflection using the LUK Dual- Mass Flywheel Diagnostic Tool available from SSF Auto Parts, with the part # 400 0080 10. Flywheels with too much deflection will create misfires at start up, may have chattering clutches, or make noise. A new DMF must be installed. Do not use single mass flywheels – this will void your warranty.
- ▶ Install a new gas cap and oil filler cap. The age of the vehicles fitted with these engines require this. These caps are cheap and help avoid problems.
- ▶ Remove all intake, exhaust, and crankcase port block offs systematically. Remove these one by one as you install the subcomponents that take their places. This reduces chances of foreign object debris entering the engine and creating devastating damage. All these block offs and cap plugs must be fitted to the core engine before return.
- ▶ It is imperative that any fuel that has been stored in the tank over one month is drained! The storage life of today’s fuel is horrible and can lead to all sorts of issues with new engines. Maybe the prior engine had a failure that was induced by contaminated fuel? We have seen this before and it can and will destroy any replacement engine. Fuel induced failures are not covered by the RND Engines warranty, for obvious reasons.
- ▶ All vehicles prior to 2001 have a replaceable fuel filter, all vehicles 2001 and newer do not. It is highly required that the vehicle fitted with a fuel filter, have the filter replaced.
- ▶ Replace Fuel Injectors with new Genuine Porsche or equivalent units. No “rebuilt” injectors.
- ▶ Replace the MAF Sensor.
- ▶ Check the coil packs; most are cracked and even if not, have weak spark and require replacement.
- ▶ Clean the intake manifold and ensure no debris is present that could be ingested by the new engine.
- ▶ Oxygen (o2) sensors should always be replaced! If the engine suffered a cylinder failure causing excessive oil consumption or there was intermix, both upstream and downstream sensors must be replaced as a precaution as aged or damaged sensors may cause poor operation including over-fueling that can cause damage to a fresh engine.
- ▶ Remember, the MAF and O2 sensors are used by the DME to determine the amount of fuel that is needed.

- ▶ Prior to start up, use a PIWIS/ Autologic, or Durametric or similar scan tool to remove all prior codes, making note (screen capture) of them before erasing them.
- ▶ A vehicle handover or system adaptation must be carried out before first start.



Prior to start up it is critical to perform a “vehicle handover” and “system reset” to remove old codes and adaptive/ safety retardation/ fuel trim values from the previous engine. The vehicle does not know that the engine has been replaced, so a “re-boot” is required of the ecu to restart the adaptation process. Its very easy for the failed engine to have a bad aos or maf sensor and the ecu will have stored memory of this issue, which will enrich the cylinders and effectively compromise them within a few miles or minutes when the engine is running too rich. This is a critical issue and must be carried out!

Note to Installers: The FSI Engine is a sealed engine. If service is necessary that requires any fasteners to be removed, the technician must contact LN Engineering for instructions prior to the repair or alternation being made. Failure to do so shall void the engine’s warranty. If ANY Technical Support is necessary during the installation process, please open a support ticket at <https://support.lnengineering.com> or email support@LNengineering.com



UTILIZE ATTENTION TO DETAIL DURING INSTALLATION. WATCH FOR STRAY FASTENERS OR ANYTHING THAT MIGHT FALL INTO THE INTAKE OR ENGINE AND CAUSE A CATASTROPHIC FAILURE OR ENGINE DAMAGE.

- ▶ Under no circumstance shall the items that are fitted to the FSI engine be removed and replaced with other similar or “believed to be superior” components. Install the engine exactly as it was delivered. Any unauthorized modifications will void the warranty.
- ▶ Install 100% of the items that have been shipped with the engine. These are included to reduce the chances of a warranty issue; however, shops in the past have failed to install these items, based on the condition of the customer’s old parts. Doing this will end the engine warranty immediately! Engine damage caused by a failure of a used ancillary part is not covered by the warranty. When in doubt, replace with a new Genuine Porsche or OEM part.
- ▶ Do not use aftermarket “cold air” intake.
- ▶ Always remove the front bumper and clean debris from the radiators of any Boxster, Cayman, or 911! Debris restricting airflow through the radiators can cause the engine to run hotter than normal.
- ▶ Do not use aftermarket grilles over radiator inlets. They can lead to elevated operating temperatures.
- ▶ Ensure that both radiator cooling fans operate on both low and high settings, if not these must be repaired before the vehicle is released to the customer.
- ▶ Verify all radiator duct work is present and aligned with the bumper cover.
- ▶ CSF Radiators can be fitted as an upgrade to the OEM radiators. Adding a third radiator to all vehicles not originally optioned with one is highly recommended.
- ▶ If the car is going to be tracked, a power steering cooler and 2qt deep sump should be fitted. Consider adding a sump guard. An Accusump can also be added. For additional protection from oil starvation a high flow oil filter must be used along with the appropriate engine oil.



The engine should not be subjected to track use or any other performance driving event until the engine is completely broken in.



The installer/shop is expected to document installation and perform engine break in before delivering the car to the owner!

INITIAL START UP

- ▶ Ensure the battery has a FULL CHARGE; do not attempt to start a new engine with a weak battery.
- ▶ All engines ship from the FSI facility with no oil in their crankcases. This means you must fill the engine with the proper amount of oil prior to start up! A total of 10 quarts of oil will be necessary to achieve this, but first fill with 9 quarts, then re- check after the first test fire. Additional oil may be necessary. DO NOT OVERFILL!



A conventional non-friction-modified break-in oil is required for initial start up. Use of any other oil including semi- or full-synthetic oils will void the warranty. Break in oil will be run for the first 30 minutes. The oil must then be drained and filter changed. Refill with LN 607-7177 oil.

- ▶ FSI engines are shipped as long blocks. You must fit your existing sub- systems onto the engine. Take your time and evaluate each item closely before re-installing it. Failure to do this may cause a failure of the replacement engine.
- ▶ Break in oil CANNOT be used for on track events and must be kept to a maximum of 210 degrees Fahrenheit. Above this temperature the break in oil rapidly experiences thermal breakdown and will create lower oil pressures and engine wear. Race engines using break in oil must be broken in on a chassis dyno or at the track during a test day with no more than 15 minutes of driving at 50% and never at competition speeds or loads. Refer to Chapter 3 / “First Track Usage” for more info.
- ▶ After filling the engine with break in oil, start the engine, but only allow it to run for one second to help build oil pressure in the system before immediately shutting it off. Repeat this process five times consecutively, or until the oil pressure indicator is no longer illuminated with at least 2 bar oil pressure indicated on the pressure gauge. DO NOT ALLOW THE ENGINE TO RUN WITH LESS THAN ONE BAR OIL PRESSURE AT START UP! Some engines that have been sitting a while after our procedures will take longer to gain oil pressure- this is normal.
- ▶ The M96/M97 engine performs poorly when attempting to remove spark plugs and/ and the DME relay and crank for oil pressure. Do not attempt this, as your efforts will not be successful. You will end up damaging the rod and main bearings. The best procedure is a repeated one second lightning fast start up, and a lightning fast shut down. These are to be performed in succession until the engine has the oil system primed.
- ▶ DO NOT REMOVE THE OIL FILTER AND PRE- FILL WITH OIL PRIOR TO STARTING.
- ▶ Once fired, allow the engine to run at 2,000 RPM for 30 minutes to assist with the “work hardening” of the new lifters to their respective cam lobes. Avoid allowing the engine to idle during this period at all costs. If a mechanic discovers an issue or leak occurs, shut down the engine before addressing the issue. Do not allow the engine to idle. Restart initial break-in after correcting the issue.
- ▶ Oil pressure will vary a bit after initial start-up, so do not be alarmed as the system is bleeding air from the oil.
- ▶ After run-in, bleed the cooling system one more time to eliminate any air in the system after the coolant has circulated through the bypass circuits and heater core, reaching full operating temperature.
- ▶ Check for fluid leaks and pay close attention to any signs of fuel leakage at the connections as well as for leaking power steering fluid.
- ▶ Fire the engine back up and cycle the steering wheel from lock to lock to bleed the power steering system, you will likely have to add power steering fluid after doing this.
- ▶ Setting the climate control system to “heat” and the temperature to “high” will open the heater circuit and will start the bleeding of any residual air from the cooling system during initial running of the replacement engine. This should have also been done before the coolant fill procedure.
- ▶ Check the OBDII values for fuel trim and codes. RECORD FRA/ RKAT AND ANY OTHER FUEL TRIM VALUES ON THE CUSTOMER INVOICE after initial break-in. Incorrect fuel trims require immediate corrective action of engine damage will occur.

- ▶ Vehicle VAL file must be submitted with warranty registration. A screenshot showing vehicle over-rev data must also be included.
- ▶ A throttle adaptation may be necessary, turn on all consumers and allow the engine to idle to start this process. All E-gas cars can have the throttle adaptation process sped up by turning the key on for 30 seconds, then back off.
- ▶ Lifters will be noisy during the first few minutes of start up. They will remain this way until the engine has been driven for the first time and the oil has reached full operating temperature and having filled the hydraulic lifters completely.
- ▶ Vehicles with engines that had previously experienced cylinder failures, intermix, or a failed AOS will have smoky, smelly exhausts at start up, and this may continue for several days after the engine has been replaced. The smells can occur for weeks or months after the new engine has been fitted. Heavily fouled catalytic convertors will need to be replaced.
- ▶ Engines that have experienced fouled exhaust systems (with coolant or oil) can be expected to trigger O2 sensor and catalytic converter codes. This holds true with vehicles that featured a prior engine failure where intermixed oil and coolant had occurred

FIRST DRIVE

- ▶ Drive the car normally once up to temperature. Pretend the engine hasn't been replaced - this is a key to success. DON'T BABY IT!
- ▶ Focus on paying attention to the engine and "seating the rings" properly.
- ▶ Have situational awareness, but don't be hyper- sensitive.
- ▶ To "seat the rings" of an engine with Nickies™ cylinders slowly accelerate in second gear up to 6,000 RPM and then abruptly remove your foot from the throttle and allow the engine to 'brake" completely back to idle speed while remaining in second gear. Ensure the engine is at operating temperature (coolant and oil!) before doing this. Ensure the engine has seen at least 20 miles of driving before carrying out this procedure.
- ▶ Repeat this process at least 5 times consecutively and ensure the coolant temperatures are 180F when this is being carried out. This forces the rings to seal up under extreme cylinder pressure changes, basically forcing the process to occur much quicker than normal.

- ▶ Long sustained downhill grades are great for engine break in. These allow the engine to be placed into gear to "engine brake" the vehicle, again forcing the rings to seat. When descending a long grade (at least 4% is required) keep engine RPM at 4,000 and allow the engine to "brake" the vehicle. This is by far the BEST way to break-in the engine, from a ring seal perspective.
- ▶ Thermal cycling of this engine is critical to long term success! A thermal cycle is defined as a period of driving time that allows for one complete warm up of the engine, followed by a complete cool down of the engine. This process will help the LN Engineering "machined in" cylinders to stay straighter for a longer period, and will enhance ring seal. Drive the car to work, allow it to cool for 6 hours, then fire it back up again, that's the definition of a full thermal cycle.
- ▶ It is both normal and expected that the new engine will consume oil. This may occur as early as the first drive, and can extend to and past the first 7,500 miles of use, in some cases, depending on how the engine is broken in. This is why FSI does not recommend switching to a synthetic oil until the engine has 7500 miles on it. A conventional, non-friction-modified oil such as LN 607-7177 is required until the engine has at least 7,500 miles on it

***Report oil consumption greater than 1 quart per 600 miles to LN Engineering. This is normal and expected, however we may ask for some data from the engine to ensure that all items have been properly addressed by the installer.**

- ▶ Do not overfill the engine with oil! Keep the oil level just above the minimum with the maximum level halfway between the low and full marks as indicated on the instrument cluster. If the car has a dipstick, verify level with dipstick.
- ▶ Never top off the oil with a semi- or full-synthetic oil or any oil with friction modifiers. Even the slightest bit of synthetic oil can cause the cylinder bores to glaze over and lose ring seal, resulting in increased oil consumption. Use of oil additives can also negatively affect ring seal.
- ▶ Allow the engine to get to the minimum oil level point of the gauge, or dipstick before adding ANY oil. Avoid "topping off" with small amounts of oil at points above the minimum fill line. Once the level has reached "minimum", then add ½ quart of oil. This should return the oil level to the center of the measurement range which is our recommended maximum. NOTE: This may take several minutes for all oil to reach the area where it can be measured.

- ▶ Avoid constant “topping off” of the oil, this makes it easy to over- fill, or for the engine to appear to be consuming more oil than it really is.
- ▶ Don’t be hyper- sensitive to oil level. This is an almost certain way to induce paranoia and create mechanical issues.
- ▶ After the first drive, bring the car back to the shop, look for leaks and perform an OBDII scan and interrogation of the DME to verify OBD2 readiness and fuel trims.
- ▶ After the first drive it is normal for fuel trim values to be a bit odd, as well as other variables in the OBDII system, don’t panic, it’s still fresh!
- ▶ The OBDII system will not show “readiness” for 150-350 miles following the new engine’s installation. During this period, the engine will fail an emissions test due to “readiness”.

The installer may note oil seepage at the point where the cylinder head meets the crankcase. This is due to a thermally activated sealant being used on the OEM cylinder head gasket that must be heated multiple times before it will bond to create an adequate seal. The M96 is well known for leaking and it is common for some leak-prone areas to weep, even when the proper sealants have been used. If this is noted, do not report it, just wipe the oil away, and wait for it to cease in a couple hundred miles.

BREAK-IN PERIOD

Many believe that modern engines do not require a break in period.

A proper break-in will net a better running, longer last, smoother performing engine that will consume less oil and will have higher performance. Due to this we have developed our own break in regimen developed over a period of more than a decade of real world experience based on empirical data. The processes that you will read about in this documentation defy conventional wisdom. Trust that if these are followed, that your FSI engine will live a healthy life, because everything matters from the first time the engine fires up. During break in the engine must see as many thermal cycles as possible with varying loads and speeds. Long trips and use of cruise control should be avoided at all costs.

The break-in is a crucial period for any new engine. The more processes and new parts that are applied to the engine, the more extensive and crucial the break-in period will be.

During the break-in period oil consumption is normal and expected.

BREAK-IN SERVICE (AFTER THE FIRST 30 MINUTES)

- ▶ Drain break-in oil
- ▶ Remove oil filter and inspect for debris. The magnetic oil drain plug will have a grayish film on its face. This is normal and comes from timing chain, piston rings, camshafts and lifters break-in.
- ▶ Replace the oil filter with the appropriate Napa Gold filter. Do not pre-fill the oil filter
- ▶ Fill the engine with the LN 607-7177 oil for the intermediate service. Do not use semi- or full-synthetic oils, friction-modified oils, or any oil additives.
- ▶ Upon restart, go through the initial start-up/ shut off process until the oil pressure indicator is no longer illuminated, then start the engine. This ensures the engine does not have a “dry start”.

BREAK-IN SERVICE (AFTER THE FIRST 1000 MILES)

- ▶ Drain intermediate oil
- ▶ Remove oil filter and inspect for debris. The magnetic oil drain plug will have a grayish film on its face. This is normal and comes from timing chain, piston rings, camshafts and lifters break-in.
- ▶ Note: Some fine ferrous and non-ferrous material is normal to find in the filter, and the sum of a new engine, during and beyond the break in period.
- ▶ Fill the engine with the LN 607-7177 oil for the intermediate service. Do not use semi- or full-synthetic oils, friction-modified oils, or any oil additives.
- ▶ Replace the oil filter with the appropriate Napa Gold filter. Do not pre-fill the oil filter.
- ▶ Upon re-start, go through the initial start-up/ shut off process until the oil pressure indicator is no longer illuminated, then start the engine. This ensures the engine does not have a “dry start”.

THE INTERMEDIATE PERIOD

The intermediate period is the time just after break-in and just before the engine is released for normal service using full synthetic oil (no sooner than 7500 miles). During this period, the engine is still highly vulnerable to its operating environment, fuel-enrichment, and driving style. During intermediate period there is to be no track service, no DE/Autocross and long trips of sustained speeds and the use of cruise control should be avoided at all costs

During the intermediate period oil consumption is normal and expected.

DRIVING ESSENTIALS

The following should be adhered to during the first 7,500 miles of operation. This is known as the “intermediate period”. The recommended conventional non-friction-modified oil to be used during the intermediate period is LN 607-7177.

- ▶ Only perform checks of the engine oil level after the car has sat overnight on a flat surface. If the oil is checked without having sat overnight on a flat surface, the level indicator will not give an accurate reading. Adding oil at this point to the engine can easily cause the engine to be overfilled with oil. Do not be hyper-sensitive to oil level!
- ▶ Always use TOP TIER PREMIUM FUEL with octane rating of 91 or higher! We recommend Shell V Power, especially when winter blend fuels are offered in North America (September - March). Use non-ethanol enriched fuels where available. Never use fuels with more than 10% ethanol content.
- ▶ Use Driven Injector Defender at least every 2,500 miles. No other fuel additives are recommended.

NOTE: Ethanol Free or Shell V-Power gasoline may not be readily available in all countries, states, and provinces of North America

- ▶ If the engine is installed in winter, do not start the car and allow it to idle for a long period of time before driving. This will keep the engine “cooler” longer, and will result in the enrichment of fuel to continue for a longer period than is optimum for a new engine. Cold start equals more fuel; remember – fuel is not a lubricant.

- ▶ By driving the car, it will warm faster, and will reduce the amount of time that the over-enrichment from the cold start system occurs. This is imperative, as over-enriched engines may never see proper ring seal.
- ▶ Avoid short drives trips of less than 5 minutes, as these never allow the engine to properly thermal cycle. *A puff of smoke at start up is nothing to be alarmed about. This is normal and expected. This is most common if the engine is started up, then shut down without being fully warmed up when taking short drives, though it can happen at any time.
- ▶ Avoid long trips during the intermediate period! This holds true even if the engine is shut down from time to time, or speeds are varied, or if the trip is mostly back roads.
- ▶ Avoid “lugging” the engine, shift up at 3,000-3,500 RPM.
- ▶ Avoid high aggressive revving past 6,000 RPM.
- ▶ Stay off the rev limiter.
- ▶ Avoid the track! DE and Autocross included! If the activity requires a helmet to participate, we refer to that as a “track activity.”

5000 MILE SERVICE

- ▶ Drain intermediate oil
- ▶ Remove oil filter and inspect for debris. The magnetic oil drain plug will have a grayish film on its face. This is normal and comes from timing chain, piston rings, camshafts and lifters break-in.
- ▶ Note: Some fine ferrous and non-ferrous material is normal to find in the filter, and the sump of a new engine, during and beyond the break in period.
- ▶ Fill the engine with the LN 607-7177 oil for the intermediate service. Do not use semi- or full-synthetic oils, friction-modified oils, or any oil additives.
- ▶ Replace the oil filter with the appropriate Napa Gold filter. Do not pre-fill the oil filter.
- ▶ Upon re-start, go through the initial start-up/ shut off process until the oil pressure indicator is no longer illuminated, then start the engine. This ensures the engine does not have a “dry start”.
- ▶ Ensure the service decal placed on the windshield reflects the 5,000-mile, 6-month service interval required for the oil that has been filled during this service.
- ▶ Use of semi- or full synthetic or friction-modified oils is not recommended before 7,500 miles; use of an A40 approved oil such as Liqui Moly LM 2040 is recommended after the engine has more than 7,500 miles on it.

DYNO TEST

- ▶ After three hours of run time and at least 5 thermal cycles, feel free to find a chassis dyno to evaluate the engine, but refrain from excessive consecutive runs, keeping in mind that the break in oil and coolant must stay below 210F.
- ▶ If testing an engine on the dyno that has less than 5K miles on it following our services, the engine will make less HP due to several factors. Break-in and intermediate oils are not formulated for maximum power. A new engine is never as strong as one with several thousand miles under its belt.
- ▶ OIL TEMPERATURES IN THE M96 ENGINE RUN HOTTER THAN THE COOLANT!
- ▶ The oil temperature values that are fed to a Durametric, Autologic, or PIWIS device are a calculated value and not always accurate. Coolant temperature reported on the dash may not be accurate.
- ▶ While on the dyno, monitor and log air/ fuel ratios. Over-enrichment, or “running rich,” will wash the oil from the bores. Remember, fuel is solvent! This will increase wear and can cause glazed cylinders and loss of ring seal. If this occurs the engine must be torn down, cylinders honed, and rings replaced. DO NOT RUN THE ENGINE RICH! (Rich is defined as 13.5:1 AFR or lower with an engine fitted with catalytic converters)
- ▶ Do not perform a full dyno run before the coolant temperature is at 180F, and the oil temperature is at 160F.
- ▶ Pay close attention not to over rev the engine while on the dyno, doing so will void the warranty.
- ▶ Typically, a maximum of 8 dyno “pulls” are necessary to reach a successful evaluation of the engine’s power.
- ▶ Remember: A chassis dyno tests for wheel HP, so these values will be less than the Porsche output rating of your engine, which was taken at the flywheel. Typical drivetrain losses can be as high as 25%.

FIRST TRACK USAGE

- ▶ Ensure the engine has accumulated 7,500 miles of street driving before assuming any track activities, and has seen all services and inspections carried out as prescribed.
- ▶ Your FSI Engine does not come fitted with the required 2 quart deep sump for track use. Operating the engine on track without the required oil system upgrades may cause engine damage due to oil starvation.

- ▶ NEVER TRACK THE CAR WITH BREAK IN OR INTERMEDIATE OIL IN THE ENGINE!
- ▶ Drive your first event at 50% of the vehicle’s capability for the first few sessions. You can’t rush success, but you can rush failure.
- ▶ Remember when your Porsche street-car goes to the track, it becomes a race car, so you need to treat it as such. This is true even with an FSI Engine, because everything we do is impacted by oil choice and service interval.
- ▶ Ensure the engine is filled with the appropriate viscosity RACE OIL that we have specified for your engine, as street oils are not optimized for track use. Be sure to observe recommended shorter service intervals required for race oils and track use. Depending on track conditions and oil temperatures, a higher viscosity oil may be required.
- ▶ It is acceptable to switch back and forth between street oils to race oils, however we do recommend sticking to one brand to prevent additive clash caused by cross-pollination.
- ▶ Carry out an oil service both before and just after a track event! Race oils are low detergent and are not designed to be run longer than 500 miles. Race oil does not provide adequate storage protection, so be sure to change your oil out for a street oil after each track event. Not following these directives will compromise the engine.
- ▶ Do not “hot lap” the car. This means you should skip a session between your times on the track. When the car comes off track, drive on back roads near the track to allow the engine and brakes to cool off. You never want to shut off a hot engine or park a hot car right after coming off track. Practicing this regimen will reduce oil temperatures much more quickly, and more effectively than driving to the paddock and shutting the engine down. Shutting down immediately after track activities will send a sharp temperature spike through the engine and the oil for a few minutes after shutting down. This means your next session will start with hotter oil and coolant and increase the chances of oil starvation due to a lack of film strength created by thermal breakdown.
- ▶ Ensure engine oil temperatures remain below 240F during on track sessions. We recommend adding a standalone oil temperature gauge for accurate readings. Additional oil cooling may be required.
- ▶ Ensure engine coolant temperature remains below 225F during track sessions. FSI engines are equipped with overheat tabs on the block and heads. Warranty is void if these are damaged, missing, melted, or otherwise tampered with.
- ▶ Remember: Taking your FSI engine to the track, AX, or any other non-street driving event will result in immediate discontinuation of the engine’s warranty.

POINTERS

- ▶ Remember, start-up is when most wear occurs in engines. Avoid repeated start-ups and shutdowns with a fresh engine.
- ▶ The engine will consume oil for the first 5K miles of service. Some engines will continue to consume oil longer. Engines with Nikasil bores typically consume more oil than those with Alusil or Lokasil bore. Increased oil consumption does not mean increased wear. Oil consumption is both normal and expected for this engine.
- ▶ You may note a spike in consumption at the first service where full synthetic oil is used.
- ▶ Oil consumption can also vary based on factor such as what fuel is used, whether you are running a winter blend, or a fuel's ethanol content. Some oils have a greater affinity to fuels and can cause increased oil consumption.
- ▶ Avoid short drives or excessive idling.
- ▶ Avoid long distance runs with sustained high speeds using cruise control.
- ▶ When the engine first fires up it will be loud as the lifters and tensioners must pressurize; this noise may last for several minutes or until the first time the engine sees elevated RPM. This is normal.
- ▶ We cannot stress enough the necessity for proper break in and servicing according to the directives outlined in this document.
- ▶ Remember: The FSI engine is significantly different than a stock engine in many ways and must be treated as such.
- ▶ IT IS POSSIBLE THAT YOU'LL DO EVERYTHING RIGHT AND AS DIRECTED AND YOU MAY STILL SUFFER A FAILURE AT THE TRACK, BECAUSE THE TRACK BREEDS ISSUES. A bad day at the track is still better than a good day at the office; engine failure, vehicle failure, or even loss of your own life is what each of us assumes when we go to the track, even for DE activities.

Please take the installation, break-in, and subsequent services outlined in this document very seriously. Follow our procedures and ask questions. The only thing that matters to us is the success of our FSI Engine in your Porsche vehicle. We are here to help.



NEED HELP? OPEN A TECHNICAL SUPPORT TICKET
AT [HTTPS://SUPPORT.LNENGINEERING.COM](https://support.lnengineering.com)
OR EMAIL [SUPPORT@LNENGINEERING.COM](mailto:support@lnengineering.com)



If the engine that is being replaced has experienced a failure with intermixed oil and coolant, the following steps must be taken:

- ▶ Approach with care.
- ▶ The cooling system must be cleaned extensively prior to the installation of the replacement engine.
- ▶ The use of agents that are designed to clean intermixed cooling systems will decrease the amount of time that's required to perform the post intermix flushes and clean up after the engine has been test fired.
- ▶ Inspect all cooling system hoses for signs of degradation due to exposure to the petroleum found in the intermixed oil and coolant. It is routine for hoses to become soft and spongy after being exposed to intermix for only a few days/ weeks, requiring replacement.
- ▶ If the vehicle is equipped with Tiptronic transmission, ensure that the transaxle oil/ coolant heat exchanger has not failed, leading to the intermixed condition.
- ▶ Extensive flushes will be necessary after the initial test firing of the engine to remove residual intermixed contaminants from the cooling system.
- ▶ Replace all O2 sensors due to coolant fouling.
- ▶ Replace coolant tank, with cap, and bleeder valve assembly.
- ▶ Residual intermix will float in the expansion tank as it is the highest point in the cooling system. It is normal and expected that even after extensive cleaning that intermixed oil and coolant will make its way to the reservoir. This is because often the coolant does not get hot enough to purge the intermixed gunk from the radiators and cooling system. Hotter coolant will help this final amount of material to shed from the cooling system. If any residual does return, flush the system again, or until no residual returns.
- ▶ Watch for the low coolant indicator, and if it does turn on, top off the cooling system with the appropriate coolant mixed with distilled water.
- ▶ If there's allow coolant warning or the coolant temperature increases over normal levels, immediately shut down the engine to troubleshoot.
- ▶ In some cases, replacement of contaminated components including hoses, radiators, lines, and heat exchangers may be required.

See also information in Chapter 3.



All engines must be broken in with specific engine lubricants at required intervals. The key to engine reliability and longevity is proper scheduled maintenance and service.



Synthetic oil is not to be used for break-in or until engine has at least 7,500 miles. Engine oil additives should never be used. Engine is not to be run on track using break-in oils. Use of a semi- or full synthetic oil, friction-modified oil, or any oil additives during break-in or intermediate period will void any warranty.



INITIAL BREAK IN (30 MIN)

The break-in oil for initial break-in must be run for 30 minutes before being changed. Driven BR40 or LN 607-7177 should be used for initial break-in.



1000 MI SERVICE

At 1000 miles, perform engine oil and filter change. LN 607-7177 oil should be used. Record manometer readings and fuel trim values at time of service.



5000 MI SERVICE

At 5000 miles, perform engine oil and filter change. LN 607-7177 oil should be used. Record manometer readings and fuel trim values at time of service.



REGULAR OIL SERVICE

Do not switch to semi- or full synthetic or friction-modified oils before 7,500 miles. After the engine has more than 7,500 miles on it, use of an A40 approved oil such as Liqui Moly LM 2040 is recommended, with normal service intervals no longer than 6 months or 5,000 miles (severe duty requires more frequent service intervals).



TRACK USE

Street oils are not recommended for track use including auto-x or drivers education events. Joe Gibbs Racing Driven® XP9 Race oil is recommended for this purpose. Higher ambient temperatures or where extreme conditions may warrant use of DRIVEN XP6 15W50 oil..

 **The installer will need to document the installation and provide copies to the customer. Please submit a copy electronically to info@LNEngineering.com to validate the installation and activate the warranty.**

PRIOR TO ENGINE FIRST STARTUP

- ▶ Take screen shots with Durametric, PIWIS, or similar Porsche system tester recording current hours, VIN, mileage, and over-revs stored in the DME at time of new engine installation.

AFTER ENGINE INSTALLATION

- ▶ Once the engine has been run sufficiently to set all the OBD2 monitors, it is important to verify and record fuel trim values including oxygen sensor and MAF readings to ensure the fuel trims are correct.
- ▶ After engine break in, but prior to releasing the vehicle to the customer, record manometer readings and fuel trim values.
- ▶ Submit all recorded values for fuel trim and manometer as well as information from the DME to LN Engineering, including VAL file and over-rev data screenshot.
- ▶ Supply an itemized invoice showing all parts installed or replaced at the time of engine installation, including consumables, to LN Engineering.
- ▶ Be sure to include customer contact and vehicle information for our records, including VIN.
- ▶ Additional information may be requested by LN Engineering once above documentation is submitted electronically to info@LNEngineering.com.