



Engine Installation Manual

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PLEASE READ THIS MANUAL CAREFULLY AS WELL AS ANY INSTRUCTIONS AND PRODUCT BULLETINS INCLUDED WITH THE ENGINE.

Engine Purchased: _____

Sales Order #: _____

Date Purchased: _____

INSTALLATION BREAK-IN AND MAINTENANCE INSTRUCTIONS

Proper installation is extremely important to avoid costly mistakes that can void your warranty. Correct installation, verifying and replacing engine support system components, and proper maintenance will lead to a long-lasting engine. If you are not confident in your ability please do not take on the responsibility of installing this engine, you may be liable for any damage resulting from improper installation or support system failure.

Please note that for the **first 5,000 miles** of the break-in we do not recommend towing anything over 5,000lbs. Once the 5,000 mileage has occurred the truck can then tow it's capacity.

FOR ANY QUESTIONS CALL (901) 553-9847

This information contains partial instructions and is intended to be a guide only

Surface Conditioning Disc Warning

THE AERA TECHNICAL COMMITTEE OFFERS THE FOLLOWING INFORMATION REGARDING THE USE OF GRINDING DISCS AS OBTAINED FROM THE GENERAL MOTORS CORPORATION.

- When cleaning engine gasket sealing surfaces, surface conditioning discs (typically constructed of woven fiber or molder bristles) that contain abrasives, such as a high amount of Aluminum Oxide, are NOT RECOMMENDED. The information contained in this bulletin supersedes any previously published GM service information regarding the use of surface conditioning discs and pertains to all current and previously manufactured engines.
- The use of such surface conditioning discs dislodges Aluminum Oxide from the discs and metal particles, which can lead to premature engine bearing failure. In some cases, this failure occurs in as little as 1,000 miles or less after the repair has been made.
- Surface conditioning discs may grind the component material and embed it into the disc. This can result when more aggressive pressure is applied during the cleaning/grinding of the gasket surface.
- Abrasive pads will produce fine grit that the oil filter will not be able to remove from the oil. The grit that cannot be filtered out has been known to cause engine damage. Abrasive pads can easily remove enough material to round cylinder head surfaces. This has been known to affect the gasket's ability to seal, especially in the narrow seal area between the combustion chamber and the coolant jackets. Abrasive pads can also remove enough material to affect the cylinder head, block oil pan rail, and intake manifold runner flatness, which can cause coolant and oil leaks. It takes only about 15 seconds to remove .008" of metal with an abrasive pad.
- To clean such gasket mating surfaces, General Motors recommends the use of a razor blade or plastic gasket scraper. When cleaning gasket surfaces, please note the following:
 - When using a razor blade type gasket scraper, use a new razor blade for each cylinder head and corresponding block surface.

- Hold the blade as parallel to the gasket surface as possible. This will ensure that the razor blade does not gouge or scratch the gasket surface.
- Do not gouge or scrape the combustion chamber surfaces.
- Do not gouge or scratch any engine-sealing surface during the cleaning process.

The appearance of the gasket surface is not critical- the feel is. There is a possibility that there will be some indentations from the gasket left in the cylinder head after all the gasket material is removed. The new gasket will fill these small indentations when it is installed.

Pre-Installation

FOR THE OVERALL HEALTH OF YOUR NEW CHOATE ENGINE, AND TO ASSIST US IN DIAGNOSING ANY WARRANTY ISSUES THAT MAY ARISE, THE FOLLOWING STEPS **MUST** BE FOLLOWED UPON INSTALLATION OF EVERY ENGINE PLATFORM. WE REQUEST FOR EVERY STEP, PHOTOGRAPHS AND DOCUMENTATION OF ADHERENCE TO THIS INSTALLATION MANUAL BE RECORDED. WE WILL NEED THE FOLLOWING INFORMATION TO REGISTER YOUR WARRANTY.

When you first receive the engine

- Carefully inspect the item for damage in transit. Any shipping damage should be noted on the shipping receipt before signing and returning it to the driver. Call immediately and we will give instructions.
- Inspect the item to ensure it is the same as the unit you're replacing. It is the installer's sole responsibility to verify fitment before attempting to install the item. Be sure to check if the engine is a manual or automatic transmission.
- Read all warning tags and any additional information or product bulletins supplied with the engine.
- Have the most recently updated shop manuals available for information on factory specifications (torque, timing, etc.)
- **Find out what caused the old engine to fail.** This is the most important step in pre-installation; address the issue so it does not cause the new engine to fail and void your warranty. **(Document on Warranty Registration)**

Check all your existing components now

- Clean any parts which are to be reused, including bolts.
- Clean and photograph exhaust and intake manifolds. These need to be clean of any rust or debris. Debris from the previous engine including piston, piston ring, valve, and valve seal material can be trapped in the intake manifold, intake plenum, and EGR system. This debris will be recycled into the new engine and will cause it to fail, voiding your warranty.
- Photograph new air filter and filter housing. These should also be clean and/or new.
- Photograph the seated torque converter in the transmission with a measurement of the bellhousing mounting surface of the transmission to the face of the converter. Incorrect installation of the torque converter will damage the transmission and will at the very least reduce the life of your new engine.
- Check all gasket and seal surfaces for damage. Clean the gasket mating surfaces of all parts being transferred from the old engine with a gasket scraper or razor blade. **DO NOT CLEAN ANY SURFACE WITH SURFACE CONDITIONING DISCS OR ABRASIVE PAD/ BRISTLE DEVICES** as these can cause contamination to the new engine and/or damage the surfaces so they don't seal (See "Surface Conditioning Discs warning").
- Only use gasket adhesive where required by the gasket manufacturer or vehicle manufacturer.

Installation Checklist

IT IS THE INSTALLER'S RESPONSIBILITY TO DIAGNOSE, REPAIR, REPLACE, AND VERIFY THE PROPER OPERATION OF ALL ENGINE SUPPORT SYSTEMS.

Recommended parts to inspect, clean, and replace if necessary

- Pickup tube and Pick up screen
- Thermostats and seal
- Radiator cap
- Water pump
- Fuel pump
- Intake manifold and Exhaust Manifold
- Oil Filter
- Fuel Filter
- Air Filter
- Crankcase Filter
- PCV Valve
- Radiator Hoses
- Pulleys
- EGR
- Motor and Transmission Mounts
- Catalytic Converter
- DPF system
- Injectors
- High Pressure Fuel Pump

OIL COOLER, OIL PUMP, WATER PUMP, AND AIR COMPRESSOR (where applicable) MUST BE REPLACED

- Ensure that fuel galley plugs are installed in the rear of heads!!
- Check for engine interference.
- Primed engine and verified oil pressure with a manual gauge.
- Filled oil, coolant, and all necessary fluids to the manufacturers recommended levels.
- Pull a vacuum on coolant systems to ensure all air is evacuated from systems.
- Adjust valve lash where required.
- Checked exhaust back pressure and recorded it on the warranty registration card.
- Completed proper engine break-in as outlined in the guide.

- Filled out and sent back the warranty registration card to the manufacturer.

DAMAGE TO THE NEW ENGINE CAUSED BY ENGINE SUPPORT SYSTEMS (FUEL, COOLING, ETC.) IS NOT COVERED BY YOUR WARRANTY.

Installation

ALL EMISSION SYSTEMS MUST HAVE A WELL-DOCUMENTED CLEANING SCHEDULE WITH RECEIPTS PRESENTED AT ANY TIME OF WARRANTY.

Check the engine for interference

- Rotate the crankshaft by hand a minimum of four complete revolutions before engaging the starter. Small pieces such as sockets, nuts, bolts, etc. That may have been dropped into the intake manifold or intake ports during installation will cause catastrophic failure to the new engine. If you cannot rotate the engine by hand **STOP IMMEDIATELY** and inspect for foreign debris in the engine.

Prior to oil fill

- Install new oil cooler and document with a photograph. A dirty oil cooler can clog lifters or more, causing massive damage to your new engine. **(Document on Warranty Registration)**
- For 6.4 and 6.0 Powerstroke, photograph oil bypass plug and oil drain back valve. If these are not working properly you will have oil delivery and/or filtration issues. **(Document on Warranty Registration)**
- To be sure injectors are installed correctly and are not leaking fuel, place a clean and empty catch pan under the oil drain plug and remove the drain plug. We recommend placing the vehicle's ignition key away from the cab to ensure no accidental dry starts occur.
 - Next, actuate the fuel pump for 30 minutes via a scan tool, taking a **VIDEO** of a stopwatch at the beginning and end of the process.
 - Then, inspect the catch pan for fuel. If fuel is present, repair, and repeat the testing process. **(Document on Warranty Registration)**
- Ensure all grounds are attached to engines and documents. **(Document on Warranty Registration)**

- Photograph oil and type being used with an oil filter. **(Document on Warranty Registration)**

Prior to first crank

- Monitor and document exhaust back pressure and barometric pressure with key on, engine off. **(Document on Warranty Registration)**
- Add the appropriate volume of break-in oil. Monitor and document oil pressure and ambient temperature before and during initial start up. **(Document on Warranty Registration)**
- Prior to adding coolant, pull a vacuum on the coolant system and hold it for 3 minutes with the vacuum pump turned off. Document with a **VIDEO**. If the system holds a vacuum, you should have no leaks. **(Document on Warranty Registration)**
- Fill the system with the appropriate coolant and remove any air in the system. We recommend using a vacuum system to install your coolant. These systems do a better job at ensuring there are no air pockets within the engine. **(Document on Warranty Registration)**

Prime the engine

- This is essential to avoid a dry start issue that will cause the engine to fail and void your warranty.
- Disable the fuel and ignition system.
- Using a pressurized pre-lube engine oiling system is the preferred method. These are available from the engine manufacturer for an additional cost or can be purchased at most parts retailers.
- Make sure that oil flows to the top of the engine and into the rocker arms.
- After priming and purging the oiling system check and adjust oil levels as needed.
- Fill the new filter with oil.
- Fill the cooling system to the manufacturer's recommended level
- Use the proper antifreeze/water concentration of the original equipment manufacturers' recommendations.
- Bleed cooling systems according to vehicle manufacturer guidelines; if this is not done overheating will occur.

Initial start-up

- After the first crank, monitor and document oil pressure, ambient temperature, oil temperature, and coolant temperature at full operating temperature. Monitor and document mass air flow readings while the engine is idle. **(Document on Warranty Registration)**
- Drive truck 30-45 minutes.

Break-In

BREAK-IN OIL AND OIL FILTER MUST BE INSTALLED PRIOR TO INITIAL START-UP PROCEDURES.

What is break-in oil?

- Break-in oil is a critical component of an engine rebuild. It allows controlled friction in low-load areas like piston rings.
- It provides exceptional protection to areas with high loads, such as the camshaft and lifters.
- An engine rebuild is a complex procedure that can take weeks or months to complete. The engine break-in process is the final step in the journey.
- This ensures that all surfaces within the engine are fully mated, particularly the piston rings and valvetrain. A proper break-in is vital to a successful build. For this reason, it is crucial to choose the correct engine lubricant. Engine break-in oil is a specialized oil with a complex job.
- They use conventional oils because they provide both full hydrodynamic films and allow for sufficient friction and heat to properly wear mating parts together.
- Synthetic engine oils can actually prolong break-in time and potentially glaze cylinders, which will incapacitate proper ring seating. This is because synthetic engine oils inherently have lower friction coefficients.

Break-in oil vs. Regular motor oil

- Break-in oil is typically conventional-based lubricants containing zinc/phosphorus (ZDDP) and moly anti-wear compounds.
- ZDDP forms a polar attraction to surfaces in the engine and creates a sacrificial layer. This prevents metal-to-metal contact in areas where a full-fluid oil film cannot exist.
- Molybdenum disulfide is a sulfate-based additive that protects against corrosion and oxidation while also reducing friction. It should be noted that it's important that break-in oil contains an aggressive detergent/dispersant package to trap contaminants and metal particles, keeping them away from engine parts.

Why do I need to use break-in oil?

- Because of ever-increasing limits on formulations, engine oils at your local auto parts store or big-box retailers contain low amounts of ZDDP. Experts believe that ZDDP is corrosive to emissions devices in high concentrations.
- Today's spec engine oils have 30% less ZDDP chemistry than they did just 15 years ago. ZDDP is the bread-and-butter of anti-wear chemistry. For this reason, spec engine oils are not good for performance engines. In fact, they could cause your flat tappet camshaft to quickly fail. Low ZDDP levels can also negatively affect roller cams.
- High ramp rate, high lift camshafts, and stiffer valve springs, which are common in performance applications, can increase the load on the cam beyond what spec oils can handle.
- Break-in oil provides an advanced level of protection because it contains a higher quantity of additives.
- This brings us to the topic of intended wear – what “breaking in” actually refers to. The controlled (intended) wear inside the cylinder prevents oil from being burned off at an increased rate due to oil building up between the piston and cylinder. Break-in oil assists in the designed wear process so that regular engine oil can subsequently maintain ongoing protection of the engine.

Why do I need to use break-in oil?

- Use break-in oil only long enough to seat the engine. We recommended Driven racing break-in diesel motor oil. Use the correct oil based on climate temperatures. BR 30 (-20°F → 0°F) BR 40 (0°F → 32°F) DBR 15W-40 (32°F → and above).
- It's OK to use the Driven racing break-in diesel motor oil with the 6.7 Power Stroke. Use the break-in oil for only 50 miles. Allow the engine to reach full operating temperature. The abrasive wear caused by engine break-ins can increase exponentially. Therefore, it's important to change the oil as soon as a proper break-in has occurred.

Check exhaust back pressure

- Verify back pressure through a scan tool or manual gauge to ensure the scan tool shows barometric pressure when the engine is off. SCT does not allow for correct back pressure. Warm up the engine and run it at a steady 2200 rpm, then read the gauge.
- Checking exhaust back pressure is important because a restricted exhaust system means that the exhaust system is not functioning properly which can lead to premature engine failure including but not limited to burnt valves, scored pistons, or blown head gaskets.
- Engine failure caused by a restricted exhaust system is not covered under your warranty (no matter who you buy the engine from) so it is in everyone's best interest to measure back pressure when installing. **(Document on Warranty Registration)**

Record back pressure results

- 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 the engine, let it idle, and monitor oil pressure and oil temperature. Record oil pressure when cold and again at 180 degrees of oil temp. Both recordings are to be taken at idle. **(Document on Warranty Registration)**
- Never use "Tap" water as it will cause rust to the engine block. Distilled water with the correct coolant mixture that is required by the manufacturer.
- Though coolant may rise to operating temperature in a few minutes. If applicable, adjust tappets. If the coolant should "boil over," stop the engine and allow it to cool, then start the process over.

EXTREMELY IMPORTANT

- If the engine is a 6.4 Powerstroke or a 6.6 Duramax LB7 at this time remove the dipstick and check the oil level. Because of the design, the fuel lines run under the valve cover.
- Fuel can enter the crankcase damaging the lower bearings which would NOT BE COVERED under warranty. Be sure to verify the oil is not "growing" on the dipstick.
- Checking multiple times over the course of the next few weeks can save an engine! This is a MAJOR issue that can easily be resolved if found soon enough.
- If the Engine is a 6.0 Powerstroke verify that you installed the proper glow plugs, 2003-2007 engines must use ZD-32 glow plugs to prevent catastrophic damage to the engine.
- Damage resulting from improper glow plug installation will not be covered under warranty.

- Retorque cylinder heads and manifolds if required by the manufacturer.
- Start the engine again and make a test run on the road at 30 MPH in the “drive” range or select the proper gears for standard transmissions.
- Periodically accelerate to 50 MPH and decelerate rapidly. Repeat this procedure at least 10 times.
- Applying loads to the engine for short periods of time causes increased ring pressure against the cylinder walls and helps to seat the rings. This is especially important because you are “breaking in” the engine. The rapid deceleration increases the vacuum and gives extra lubrication to the piston and ring assemblies.
- Driving the vehicle for approximately 25-40 miles under the above conditions will accomplish the initial break-in of rings, bearings, and mating surfaces.

CHANGE THE INITIAL BREAK-IN OIL AND FILTER AT THIS STAGE. THIS IS AT NO MORE THAN 50 MILES.

Next 500 miles

- For the first oil change, 15w-40 conventional or semi-synthetic is recommended. 10w-30 is recommended for the 6.7 Ford Powerstroke.
- Do not drive at continuous speeds for long periods; always vary your speed.
- Do not tow a trailer or put any heavy loads on the vehicle to avoid “lugging”.
- It is recommended to check oil and coolant levels daily or every 100 miles.
- Avoid idling for long periods which can lead to cylinder “glazing”.

After 500 miles or no more than 750 miles

- Change the engine oil and oil filter.
- Schaeffer’s 7,000 Series CK-4 oil is recommended.
- Check fuel and cooling system components.
- If applicable or recommended by the manufacturer, adjust valves and retorque cylinder heads and manifolds.
- Do not use full synthetic oil for the first 20,000 miles. Partial synthetic oil is approved.
- Do not use any GF-S oils. The use of this oil will void all warranties.
- The use of Rotella oil is not recommended as of December 2016.

Maintenance

- Perform scheduled maintenance as outlined in your vehicle's owner manual. If you are unsure or have questions about routine maintenance, call the manufacturer.
- Failure to perform routine maintenance can result in engine damage that may not be covered under your warranty. Retain all records (invoices, receipts, repair orders, etc) related to service or maintenance performed on your engine or engine support system.
- In the event of a product failure you will be required to provide copies of maintenance records and installation invoices.
- Don't forget to complete your warranty registration.

Maintenance Log

FOR YOUR CONVENIENCE YOU CAN USE THIS LOG FOR A QUICK REFERENCE TO DOCUMENT MAINTENANCE/SERVICE PERFORMED ON YOUR ENGINE OR ENGINE SUPPORT SYSTEM. KEEP YOUR ORIGINAL RECORDS, INVOICES, RECEIPTS, AND REPAIR ORDERS AS WELL. THEY MAY BE REQUIRED IN THE EVENT OF A WARRANTY.

Date	Mileage	Work Performed	Shop name or location	Invoice/repair order number

Warranty Overview

THE WARRANTY INFORMATION PROVIDED BELOW IS A GENERAL OVERVIEW. FOR COMPLETE WARRANTY DETAILS PLEASE REFER TO THE ACTUAL WARRANTY DOCUMENT PROVIDED WITH THE SALE. IF YOU DID NOT RECEIVE A COPY OF THE LIMITED WARRANTY AND WARRANTY REGISTRATION, CALL US IMMEDIATELY.

- The warranty registration card must be returned to the manufacturer within 45 days of installation and the manufacturer must have warranty registration information on file or the warranty is void.
- Except as noted, warranty coverage is on parts and labor when the product is installed at an APPROVED repair facility only; no labor coverage is provided on self-installed items.
- Labor will be reimbursed based on the ALLDATA labor time guide at a maximum of \$50 per hour or shop rate, whichever is lower.
- The manufacturer's warranty is intended to provide coverage for defects in the parts and workmanship of the part provided by the manufacturer only.

Warranty is not intended to cover the following

- Normal wear
- Improper maintenance
- Failure caused by parts that are not supplied by manufacturer failure resulting from overheating (usually but not limited to burnt/leaking head gaskets, burnt/melted/broken piston or piston rings, damaged cylinder heads, faulty injectors, oils seals from turbo, faulty contaminants in intercooler, dirty or improperly installed air filters, non-approved air filters, “dusting” of engine, etc.)
- Repair or replacement of engine support systems including belts, hoses, filters, cooling, fuel, etc.
- Repair or replacement resulting from an accident.
- Products used in competition, racing, off-road or modified applications.
- Failure resulting from abuse or misuse.
- Failure resulting from electrolysis.
- Products installed in applications not originally equipped with the product purchased.
- Crankshaft thrust surface failure (caused by excessive forward pressure on the crank).
- Repairs performed or attempted without authorization.
- Damage to the engine caused by stale, contaminated or deteriorated fuel.
- Failure caused by lack of lubrication.
- Failure or damage caused by dirt or debris.
- Failure caused by excessive vibration.
- Failure or component failure caused by use of alternative fuels.

Additional warranty Information

- Any product repaired or replaced under an approved warranty claim will carry the remainder of the original warranty (the warranty does not start over).
- The manufacturer is not liable for loss of profits, sales, income, injury to person or property, towing charges, rental car expenses, storage fees, telephone expenses, freight, substitute transportation, lodging, fluids, filters, shop expenses, or unauthorized repairs.
- The manufacturer will (at their discretion) repair, replace, or refund the product once the manufacturer determines the product is defective. All warranty claims are pending the analysis of the failed product.
- See the actual Limited Warranty document for full details of coverage and restrictions.

<p>Daily Driver Work Horse</p>	<p>5 year/100,000 miles 3 years on parts and labor 2 years on parts</p>
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	\$50 labor
Commercial use	1 year/20,000 miles *Extended warranty can be purchased for \$1500.00 3 year/ 60,000 miles
Model C Engines	12 months or 12,000 miles, whichever occurs first.
Cylinder Heads	6 Months, parts only.



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