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## GENERAL INSTALLATION PROCEDURES

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# **WARNING!**

When cleaning gasket sealing surfaces on new and remanufactured engines and/or cleaning parts from the failed engine to be reused, the use of surface conditioning discs that contain abrasives, such as aluminum oxide, may cause premature bearing failure.

**THE USE OF SURFACE CONDITIONING DISCS IS STRICTLY FORBIDDEN.**  
**(i.e., SCOTCH BRITE™, ROLO BRISTLE DISCS™, Soc Att™, ABRASIVE DISCS)**

If the original engine failed either catastrophically or due to bearing failure, the engine oil cooler must be replaced. If the vehicle is equipped, the oil lines must be removed from the vehicle and thoroughly flushed or replaced. Warranty data show that more than half of all warranty claims for premature failures are associated with lack of proper lubrication. **Failure to perform these repairs will void your Goodwrench Engine Warranty.**

Before installing any engine, verify that you have the correct engine for the application. Refer to the appropriate Vehicle Chassis Service manual for proper repair procedures and specifications (i.e., fastener torque, torque sequencing, ignition timing, valve adjustment, coolant fill, air purge and fluid volumes).

Some engines have been remanufactured subsequent to the model year of the vehicle and may contain design refinements not included in the original service information (i.e., 1989 engines may incorporate design features normally found in newer models). If future service is necessary for the engine, consult the GM Parts Catalog, GM Part and Accessories information bulletins and dealer service bulletins for proper service parts and service procedures necessary to accommodate these revisions.

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## TRANSFERABLE ENGINE COMPONENTS

Take out the old engine, mount it on an engine stand, and carefully remove those components that are to be transferred to the new engine. The following list of components should be removed and inspected for wear and damage. If the components are damaged or were the cause of the original engine failure, they should be replaced.

- **Harmonic Balancer**
  - Many times, the harmonic balancer's sealing surface is damaged or warped. The balancer should be carefully inspected and, if necessary, replaced to prevent a leak in the front cover seal.
- **Intake Manifold**
  - Inspect the intake manifold's machined surfaces for flatness using a straight edge. If the manifold is warped or the machined sealing surfaces are damaged, it may not seal properly, allowing water and other contaminants to enter the combustion chamber or lubricating system.
  - Check for cavitation erosion or pitting.
  - Check for obstructions or carbon in the internal EGR or exhaust crossover passages. Check for cracks at the bolt holes and the sensor mounting holes.
  - Always clean the intake manifold thoroughly before placing it on the new engine. Any foreign objects within the intake manifold could be drawn into the combustion chamber and cause considerable damage to the pistons, valves, heads and other vital parts of the engine.
  - **Warning** - Do not use any form of blasting media and/or surface conditioning discs when cleaning the intake manifold.
- **Valve Covers**
  - Inspect the sealing surfaces of the valve covers for flatness and check for cracks at the flanges and bolt holes. If any cracks are found on the covers, they must be replaced. Do not try to repair them.
  - Clean the covers and check for loose baffles at the fill holes and PCV outlets. Replace the cover(s) if they are defective.
- **Oil Pan**
  - Inspect the oil pan rail for flatness. Check for cracking at the pan radius area and at the bolt holes. Check the front and rear oil pan seat rails for cracks or damage. If cracks are found replace the oil pan. Do not try to repair them.
  - Inspect the oil drain plug for stripped threads or a loose weld nut. Do not try to repair cracks or a loose weld nut.
- **Front Cover and Lower End**
  - Replace the crankshaft seal in the front cover. Do not use the old seal.
  - Inspect the cover for cracks and heat checks, as well as inspecting the bolt holes for cracks. The blind holes will also need to be checked for cracks, as well as pulled threads and restricted depth. If any cracks are found, replace the cover.
- **Mechanical Fuel Pump**
  - Clean the fuel pump and inspect the wear pad on the drive arm. Remember that mechanisms inside the pump wear. If the fuel pump has many miles on it or if excessive wear is present, replace it.
- **Flywheel / Flex Plate / Ring Gear**
  - Check the flywheel for flatness using a dial indicator. Refer to the manufacturer's published information regarding exact specifications. Check for damaged teeth on the ring gear or flywheel. Replace if worn or damaged.
  - Inspect the mounting holes and the torque converter or pressure plate mounting holes for cracks or wear. Inspect the clutch contact surfaces for heat cracking and discoloration. If cracks are found, replace the plate.
  - **On manual transmission vehicles, the crankshaft pilot bearing must be transferred or replaced as required.**

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### TRANSFERABLE ENGINE COMPONENTS - cont.

- **Exhaust Manifold**
  - Inspect the manifold flanges for flatness and for carbon 'witness' marks, indicating a leak. If leaks are present or the exhaust manifold sealing surfaces are not flat, replace it with a new manifold.
  - Check the manifold for cracks, especially the external EGR connections, the exhaust pipe flanges, and the manifold mounting flanges. Compare the mounting hole spacing on individual runners to the new cylinder head for exhaust manifold shrinkage. If there is shrinkage, replace the manifold.
- **Pressure Plate / Release Bearing**
  - Inspect the clutch contact surface for heat checking or cracks. Check the release fingers for wear and even height.
  - Check the release bearing for facial wear and smooth rotation and the pressure plate for flatness.
- **Clutch Disc**
  - The clutch disc will need to be inspected for oil contamination and excessive wear, such as heat cracking of frictional material, worn frictional material, loose rivets and broken springs. If any of these conditions occur, replace the clutch disc.
- **Water Pump**
  - It is recommended to replace the water pump when installing a new engine. However, if the old pump is reused, check for cavitation erosion, impeller looseness, front seal leakage and smooth bearing feel. Replace the pump if it shows signs of wear.
- **Spark Plug Wires**
  - Thoroughly inspect the wires and boots for cracking, tearing, carbon tracking or other signs of damage. Suspect wires should be replaced.
- **Distributor (if applicable)**
  - Inspect the distributor for signs of oil contamination.
  - The drive gear should be checked for honed teeth. The shaft should rotate freely, with no side play, and the body and block seals should be free from distortion and cuts.
  - The cap/rotor should be free of corrosion, cracks and burrs. The distributor/oil pump drive should be free of nicks, burrs, and chipped teeth. If any of these conditions are present, replace the distributor.
- **Other Transferable Components**
  - Alternator (generator) and relative brackets
  - Air conditioning compressor
  - Power steering pump
  - Sensors
  - All pulleys and other bracketry

Ensure that all components are clean, all gasket material is removed, and they are free of wear and cracks. If any of these components can not be cleaned or repaired to good working order or are not within the manufacturer's specifications, replace them. Remember to be careful when cleaning aluminum components so that the sealing surfaces are not nicked or gouged.

When cleaning gasket sealing surfaces on new and remanufactured engines and/or cleaning parts from the failed engine to be reused, the use of surface conditioning discs that contain abrasives, such as aluminum oxide, may cause premature bearing failure.

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### NON-TRANSFERABLE ENGINE COMPONENTS

Some components off the old engine will not be able to be used on the new replacement engine. This is because they will hinder the performance of the engine if they are not replaced. Or, they are part of routine maintenance and the opportunity to replace them should not be overlooked.

- **Oil Filters**
  - Oil Filters must always be replaced.
- **Thermostat**
  - The thermostat previously used in the original engine may be clogged or is worn out. The thermostat must be replaced prior to installing the new engine.
- **Oil Pump, Pick-up Tube and Screen**
  - These components come with the new engine.
- **PCV Valve and Crankcase Breather Filter**
  - These should be replaced to ensure that the emission standards of the engine are met and to prevent sludge, caused by gasses, and oil to build up in the crankcase.
- **Spark Plugs**
  - Be sure the new spark plugs are the proper heat range for the vehicle and engine application.
  - Failure to change the plugs or to get the proper heat range can cause the plugs to misfire, resulting in damage to the pistons through pre-ignition detonation.
  - Be sure the spark plug has the proper gap and seat for the vehicle application to avoid damage to the piston or blow-by damage.
- **Air Filters**
  - If the air filter is not replaced on a regular basis, the particles not being filtered can cause accelerated wear on the cylinder walls, piston rings and bearings
  - A dirty air filter can act as a choke and affect fuel consumption and engine performance.
- **Cooling System Sealing Tabs**
  - Necessary to Aid in sealing porosity and to clean silicates from the water pump shaft to prevent shaft seal damage.
- **Fuel Filter**
- **Engine Oil**
- **Antifreeze / Coolant**
- **Engine Oil Cooler (with every bearing failure)**

While the engine is apart and out of the vehicle, replace basic maintenance parts such as filters, hoses and belts.

- **Fuel Filters**
  - Used filters can become clogged, restricting fuel flow.
- **Hoses**
  - Hoses become brittle with age and may need to be replaced. Check the service manual for the vehicle application for proper hose replacement types and part numbers.
- **Belts**
  - Belts become brittle with age or glazed if they have been slipping. Check the service manual for the vehicle application for the proper belt replacement types and part numbers.

Take time to check the working condition of components such as the starter motor, cooling fan motor, battery and battery cables and fuel injectors. These components may need to be replaced in order for the new engine to function properly.

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## INSTALLATION PROCEDURES

### *Flush the Cooling System*

A properly functioning cooling system is one of the most important items in installing an engine. It is important to rid the system of corrosion and other contaminants to ensure that the new engine has the proper heat transfer taking place. Otherwise, the engine will over heat and cause considerable damage. In addition to flushing the system, take time to verify the reliability and overall quality of the entire system, including the radiator and hoses. Flush the radiator thoroughly and check for blockages. Replace or inspect hoses and check for cracks, rips, brittleness and soft spots. By ensuring the entire cooling system is in proper working order, the chance of repeat engine failure is significantly reduced.

If the old engine is still running, flush the cooling system before removing the old engine. If the engine is not running, be sure to flush the cooling system immediately after replacing it with the new engine. Refer to the service manual for the specific instructions for flushing the cooling system for the vehicle.

After flushing the cooling system, add cooling system tabs (part number 1051687). Cooling system tabs aid in sealing porosity in aluminum and remove silicates from the water pump shaft that form from the coolant.

### *Installation*

The following is an outline of the steps involved in installing an engine. They give a general overview of the order in which the transferable components from the old engine should be placed on the new engine. To begin, mount the engine on an engine stand with the oil pan facing upwards, intake valley facing downwards. Throughout the entire installation process, be sure to torque all bolts and other fasteners according to the manufacturer's specifications.

1. Install the oil pump and the oil pump shaft. **Fill the pump with GM E.O.S., part number 1052367, to aid in the initial suction and priming of the pump.** Do not use white lithium grease to pack the oil pump. This grease won't breakdown and will clog oil passages, which could cause engine oil starvation and seizing.
2. Install the new oil pick-up tube and screen and the crankshaft oil slinger. Be sure not to install the oil screen too close to the oil pan. Installing it too close can hinder the pick-up of oil causing oil starvation and seizing. Be sure to check the service manual for proper distance specifications.
3. Pour 1/4 of a can of GM E.O.S., part number 1052367, over the crankshaft, distributing it over the entire length of the crank.
4. Install the front cover using a front cover alignment tool. Apply gasket adhesive to the assembly to keep the gaskets in place during installation. Lubricate the front cover crankshaft seal with clean engine oil or E.O.S.
  - Be sure to seal the bolts that are entering the water jackets with RTV sealant.
  - Put the RTV sealant in the damper key slot to seal the key to the keyway.
5. Install the damper using the damper installation tool. Be sure to visually inspect the alignment before proceeding.
6. Install the water pump.
  - Be sure to coat the bolts that enter the water jackets with sealant.
  - Apply RTV sealant to the front cover and block joint.
7. Place the oil pan gasket on the block rail applying sealant at the mating corners. Be sure to properly align the oil pan, gasket and block. Be sure the drain plug is tight.

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## GENERAL INSTALLATION PROCEDURES

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### INSTALLATION PROCEDURES cont.

8. Rotate the engine on the engine stand so that the intake valley is facing up and the oil pan is facing down.
9. Pour the remainder of the E.O.S. over the rocker arm assemblies and camshaft.
10. **Pre-lube the engine with A.P.I. Starburst certified motor oil.** Pre-lubing the engine is necessary to avoid dry start damage. The most efficient way to pre-lube the engine is to use the **J-45299 engine pre-luber**. This will work on all applications. However, if no engine pre-luber is available and the engine has a mechanical distributor, the engine can be pre-lubed by priming the oil pump with a hand-held drill.

Using an oil pump priming tool or distributor shaft, rotate the oil pump with a drill at 200 to 500 RPM for two minutes after pressure builds up in the engine. This is to flush any debris from the engine without a load on the bearings while maximum clearances are present. Be sure to rotate the drill in the same direction as the distributor.

11. Install the intake manifold side gaskets and the end seals on the block and cylinder heads, placing RTV sealant on the corners.
12. Install the intake manifold, making sure to tighten the bolts in the proper sequence. Refer to the service manual for that vehicle and application for the specific sequence. Tighten the bolts from the inside out, alternating sides and criss-crossing front to back. If the intake manifold does not seal properly to the heads, water and other contaminants can enter the combustion chamber causing considerable damage.
13. Install the valve covers and be sure to tighten those fasteners in the proper sequence. The valve covers need to seal properly to avoid damage to the engine. Refer to the service manual for that vehicle and applications for the specific sequence and torque values.
14. Set the static ignition timing. Refer to the service manual for the proper procedure.
15. Install the exhaust manifold(s).
16. Install the fuel pump and fuel lines being sure of proper routing for the fuel lines.
17. Install the vacuum hoses. Check hoses for condition and replace as necessary.
18. Install the components listed below:
  - Front end bracketry
  - Crankshaft pulley
  - Water pump pulley
  - Air conditioning compressor
  - Air pump
  - Alternator (generator)
  - Power steering pump
  - All sensors that were removed from the original engine
  - Engine mounts (engine to frame)
  - External EGR components

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## GENERAL INSTALLATION PROCEDURES

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### INSTALLATION PROCEDURES cont.

19. Remove the engine from the engine stand.
20. Install the flywheel and clutch components.
21. Install the engine in the vehicle.

#### ***After Installation***

Before the initial start up:

- Make sure the battery is fully charged.
- Make sure the engine has been pre-lubed, the oil is at its proper level, and the engine is pressurized completely.
- Check the transmission fluid, power steering fluid, brake fluid and coolant levels and condition. Change as necessary.
- Pressure check the cooling system, not exceeding 20 psi (138 kPa).
- Check hoses, cylinder head and freeze plugs.
- Check the radiator core, transmission oil cooler and the drain cock.
- Be sure the radiator cap maintains pressure and is the correct application.

Check the routing of the various other components, such as:

- Belts - check the tension and adjust them accordingly
- Electrical harnesses - check the ignition wiring and firing order, and the harnesses and wires to the alternator (generator), cooling fan, starter, sensors and the carburetor
- Intake system - check the ducts, filters and vacuum hoses for proper placement and condition
- PCV system - check the hoses and clamps for proper placement and condition
- Fuel lines - check for proper placement and condition
- Refer to the Vehicle Emissions Control information label for the proper hose routings.

#### ***After Initial Start-up Checklist***

Check for fluid leaks in the following areas:

- The entire fuel system
- Valve / Camshaft cover gaskets
- Cylinder head gaskets
- Oil filter
- Oil level indicator
- Oil pressure sending unit
- Cup plugs or pipe plugs at the end of the oil passages
- Oil pan gaskets
- Oil pan front and rear end seals
- Crankshaft front and rear seals
- Side bolts

*Note:* If any leaks are found but the source of the leak is not detectable, use the 'black light and dye kit' or the 'pressure method' to pinpoint the source of the leak.

- GM engine oil fluorescent tracer dye, part number 12345795
- GM transmission fluorescent tracer dye, part number 12345796
- GM coolant system fluorescent tracer dye, part number 12345797

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## GENERAL INSTALLATION PROCEDURES

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### INSTALLATION PROCEDURES cont.

Check for fluid levels and conditions of the following:

- Engine Oil
  - Check for factory recommended pressure (see manual).
  - Verify oil level is at manufacturer's recommended amount.
- Engine Coolant
  - Make sure the thermostat is functioning properly.
  - Be sure the coolant is flowing freely through the system and that no blockages are present.

Check the following fluids for level, color and smell. Drain and flush before refilling, if necessary. Refer to service manual for further details.

- Transmission fluid
- Power steering fluid
- Brake fluid

#### ***Abnormal Noises***

With engine running, listen for noises such as:

- Detonation
- Exhaust leaks
- Vacuum leaks
- Tapping / Knocking
- Loose or broken attaching components
- Drive belts

Dynamic ignition timing should be set at this time, if applicable. Incorrect timing is a common cause of engine failure. Be sure the vehicle's timing is correct. If unsure about specifications or procedures used in adjusting the timing and the idle speed, check the manufacturer's published information. Also, refer to the Vehicle Emission Control information label for specifications.

Check the engine vacuum. Install a vacuum gage at the intake manifold. The vacuum gage should read steady at approximately 18 in Hg at idle or above depending on the altitude. A low vacuum reading may indicate a restricted exhaust system, while a fluctuating vacuum may indicate internal engine concerns.

Other items:

- Cylinder heads, retorque if necessary
- Check belt tension, if applicable
- Check component routing

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## GENERAL INSTALLATION PROCEDURES

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### INSTALLATION PROCEDURES cont.

#### ***Engine Break-In***

Once the engine has been successfully installed and the oil pump has been primed, start the engine and let it idle at 1600 to 2000 RPM for 10 to 20 minutes allowing the oil pressure and temperature to stabilize. Refer to the service manual for the proper pressure range. During this time, where applicable, adjust the timing and valve clearance and check for leaks.

Road test the vehicle for a minimum of 10 miles (16.09 km) with combined city and highway driving. Do not exceed 50 miles per hour (80 kph) or use any fast throttle responses.

Instruct the customer that the first service interval for changing oil and the oil filter should be between 300 and 500 miles (500 km and 800 km). For subsequent service, refer to the manufacturer's recommended intervals.