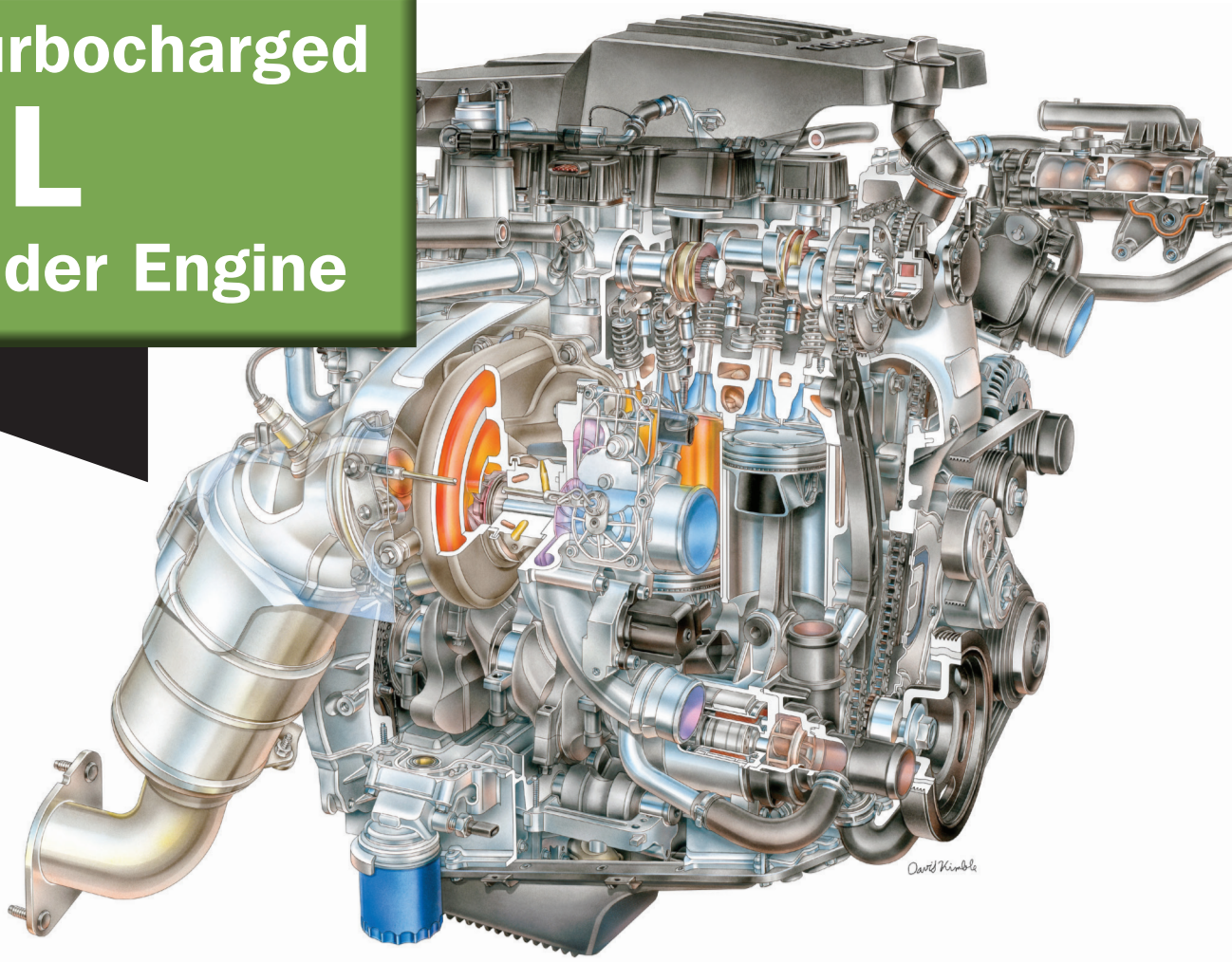
TECH LINK

Mid-July 2019, Volume 21, No. 14

New Turbocharged 2.7L 4-Cylinder Engine



The new 2.7L turbocharged 4-cylinder engine (RPO L3B) available on 2019-2020 Silverado 1500 (LT and RST models) and Sierra 1500 (SLE and Elevation models) offers capability and efficiency in a lightweight package.

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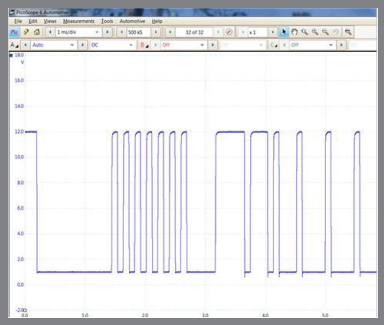


LIN Bus Diagnosis

see page 6

New Turbocharged 2.7L 4-Cylinder Engine

The 2.7L turbo engine is built off of the new cylinder set strategy (CSS) architecture and features Active Fuel Management (AFM), Spark Ignited Direct Injection (SIDI), Dual Overhead Camshafts (DOHC), and Variable Valve Timing (VVT). It generates 310 horsepower and 348 lb.-ft. of torque, taking only 1.93 seconds to reach 90% of peak torque at 1,500 RPM.

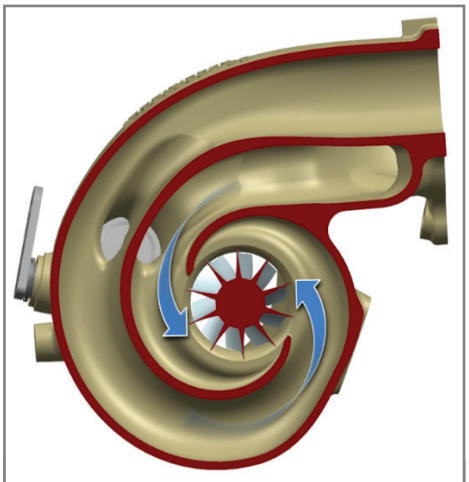
Compared with the 4.3L V6 engine available on Silverado and Sierra models, the 2.7L turbo engine delivers better performance in a lighter package. It weighs 80 lbs. (36 kg) less and provides 13% better fuel economy. The engine produces 9% more horsepower and 14% more torque than the 4.3L V6, providing power for a one second faster run from 0–60 MPH (6.8 seconds).

The light weight of the 2.7L engine was accomplished by using an aluminum high pressure die cast block, lower crankcase extension, and a composite intake air fuel module and oil pan.

TURBOCHARGED PERFORMANCE

The new turbocharged engine was designed to deliver performance along with fuel efficiency. It has a dual-volute turbocharger that optimizes exhaust pulses energy to reduce turbo lag and increases the low-speed torque required in a truck application.

The dual-volute turbocharger uses an electrically-actuated wastegate for a fast boost response and improved engine efficiency. The wastegate valve opens and closes a passage beside the turbine wheel within the turbocharger housing, which allows excess exhaust pressure to bypass the turbine into the downstream exhaust.



Dual-volute turbocharger

The electronic wastegate actuator addresses the disadvantages inherent with a pressure/vacuum-actuated system. The electric actuator operates the wastegate much faster than the pneumatically actuated system, allowing for more precise control of the wastegate in all operating conditions since valve positioning isn't inhibited by the weight of the actuator spring and transient pressures within the system.

Each engine cycle the Engine Control Module (ECM) learns the position of the wastegate valve. Learn or reset procedures are required whenever the turbocharger, wastegate actuator, related component or sensor is replaced or serviced, including:

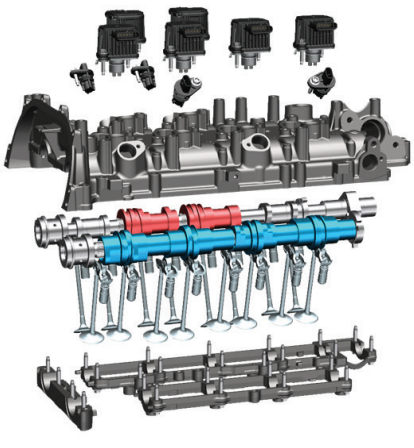
- Turbocharger or actuator replacement – turbocharger wastegate learn
- Turbocharger, actuator replacement, related sensor, or intake air duct – intake system learned values reset

SCS VALVETRAIN

To better balance power output with fuel economy, the engine also has an innovative Sliding Cam Valve Lift System (SCS) that modifies camshaft timing under changing engine demand.

The Sliding Cam Valve Lift System (SCS) has three distinct operating modes. The SCS system enables the ECM to change the camshaft lift profile of the intake and exhaust camshafts while the engine is running. The SCS has four intake camshaft profile actuators and two exhaust camshaft profile actuators that vary the camshaft lift profile sleeve position axially on the camshaft in response to commands from the ECM.

Power Profile: High Lift — Full capacity, conventional lift and duration. In this profile, all four cylinders are active and all valves open to their maximum lift for when the full capability of the engine is needed.



The SCS system has three unique-sized cam lobes on each camshaft profile slider.

Economizer Profile: Low Lift — Reduced capacity (3 mm lift) changes the duration of the valve opening and closes the valve early. In this profile, all four cylinders are still active, but all intake valves open to a lower lift height to help save fuel under medium load conditions, such as highway driving.

Ultimate Fuel Economy Profile: AFM — Cylinder deactivation, used for increased fuel economy in light load conditions, such as highway cruising. In Active Fuel Management (AFM) mode, cylinders 2 and 3 are deactivated.

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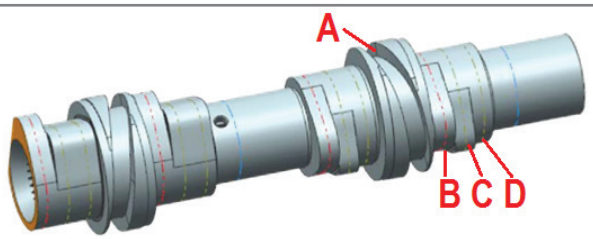


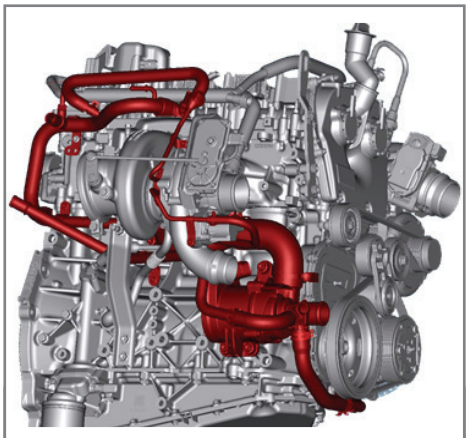
A. Sliding groove to slide cam lobe
B. High valve lift
D. Low valve lift
D. No valve lift

Each camshaft has two profile sleeves with different height cam lobes and a detent ball and spring under each sleeve that helps hold the profile sleeve into position. The SCS profile actuator solenoids push out an actuator guide pin into the shifting groove machined into the camshaft lift profile sleeve. When the guide pin engages the sleeve, it causes it to shift axially on the camshaft, causing the unique-sized cam lobes to be placed over the intake and exhaust valves and modify valve lift and duration.

ACTIVE THERMAL MANAGEMENT

A new active thermal management cooling system on the engine is used to control the coolant temperature, sending heat where it is needed to reduce friction and to heat the passenger compartment while also cooling the engine and transmission. As a result, cold start friction is reduced while combustion efficiency and exhaust cooling is enhanced during warm engine operation.

Coolant flow is supplied through the entire active thermal management system by an electric water pump mounted to the bottom left side of the engine. The ECM controls the water pump over the Local Interconnect Network (LIN).

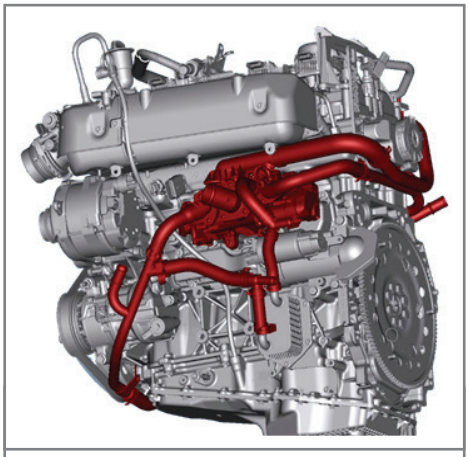


Electric water pump

The main rotary valve and the block rotary valve are combined into one unit called the coolant control valve. The main rotary valve distributes coolant to the transmission and engine oil heat exchangers as well as the radiator and cabin heat exchangers. The block rotary valve provides coolant flow for engine block temperature control as well as cabin heating during warm-up.

DESIGNED FOR DURABILITY

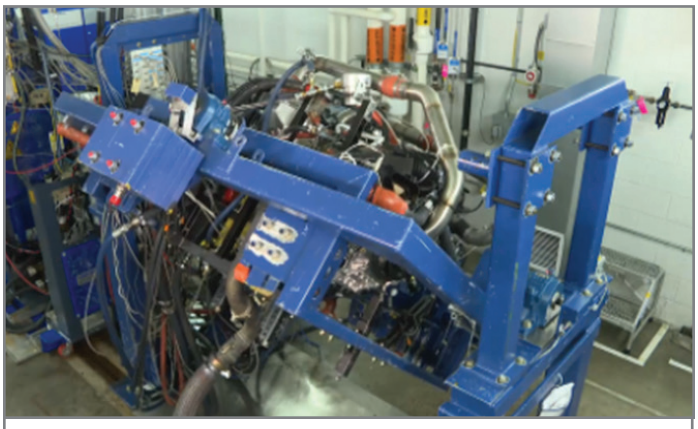
The 2.7L turbo engine was designed and validated specifically for the Silverado and Sierra full-size trucks.



Coolant control valve

Components designed for long-lasting durability include:

- Pistons with iron ring carriers and fully machined crowns
- Forged steel crankshaft with hardened journals
- Tri-metal bearings
- Hardened billet steel camshaft lobe packs
- High-wear resistance 8 mm roller timing drive chain
- Electric water pump that provides after-run for shut-down cooling



The new engine went through over one million miles of testing.

Throughout development, the new engine accumulated an equivalent of over one million miles of over-the-road validation testing in order to meet the durability standards of the legendary small block engine.

▶ Thanks to Kevin Luchansky and Jeff Kropp

6.6L V8 Gasoline Engine Exchange

The 6.6L V8 gasoline engine (RPO L8T) available on 2020 Silverado 2500/3500 and Sierra 2500/3500 models is now under the engine exchange program for the 2020 model year.

The engine exchange program is administered by the GM Product Quality Center (PQC). Dealerships are required to call the PQC, not GM Technical Assistance (TAC), to request an exchange. Prior to calling the PQC, complete the OEM Engine Exchange worksheet in #PIP5656. The information on the worksheet will minimize the time spent on the telephone and avoid the need of a second call to the PQC.

The PQC may refer the technicians to TAC if additional diagnosis is required. TAC will be available for product inquiries that do not require assembly replacement. Engine block and internal components along with any component in which a cylinder head has to be removed to perform the repair will require an engine exchange.

6.6L V8 gasoline engine

The following serviceable components may be removed and serviced without exchange.

- Accessory Drive
- A/C Compressor
- All Engine Sensors
- All Cooling System Hoses
- Brackets
- Camshaft Covers
- Coolant Pump
- Coolant System Bypass Pipe
- Coolant System Radiator Inlet/Outlet Pipes
- Coolant Outlet Assembly
- Crankshaft Damper
- Engine Control Module (ECM)
- Engine Cover / Beauty Cover
- Engine Mounts/Transaxle Mounts
- Engine Oil Cooler
- Engine Wiring Harness
- Exhaust Manifold / Gasket
- Flywheel / Flex Plate
- Fuel Injectors
- Fuel Injector Wiring Harness
- Fuel Rail
- Fuel Pipes & HP Fuel Pump Assembly
- Generator
- Hi / Lo Pressure Fuel Lines
- Heater Outlet / Inlet Fittings
- Ignition System (Coil, Spark Plugs)
- Intake Air Ducts and related components
- Intake Air Temperature Sensor
- Intake Manifold
- Knock Sensors
- MAP or Baro Sensor
- Mass Air Flow Sensor
- Oil Fill Cap
- Oil Filter
- Oil Level Indicator and Tube
- Oil Pressure Switch
- Oil Pressure Control Solenoid Valve
- PCV Hose(s)
- PCV System
- Starter Motor Assembly
- Thermostat Housing/Gasket
- Throttle Body/Related Components
- Vacuum Pump and Lines
- Vapor Vent Lines/Seals

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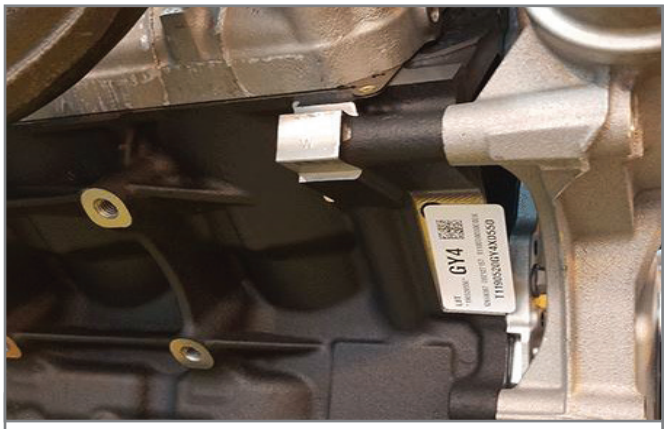
ENGINE BROADCAST CODE

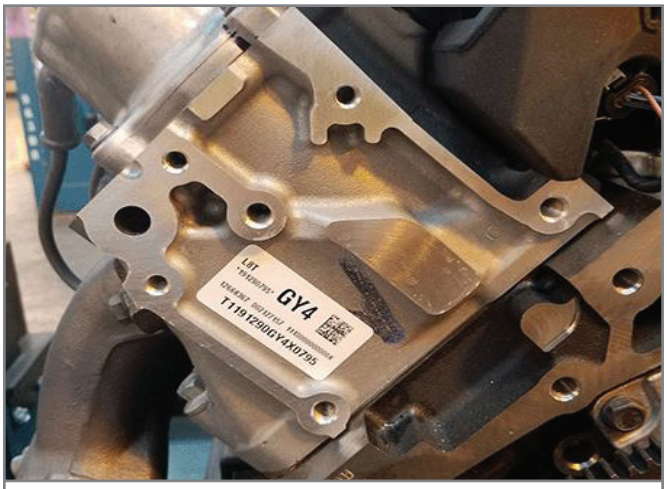
The engine broadcast code, which is needed on the engine exchange worksheet, can be found in two locations on the engine.

The engine broadcast code is located near the front of the engine, on the right-hand side of the block.

The engine broadcast code also is located on the rear of the engine on the left-hand cylinder head.



Code near the front of the engine



Code near the rear of the engine

If diagnosis leads to replacing the 6.6L V8 engine assembly, contact the PQC by opening a new case using the Dealer Case Management (DCM) system. From the DCM home page, click New PQC Case on the Technical Assistance tab.

TIP: Do not clear any DTCs prior to contacting the PQC.

Refer to #PIP5656 for additional information about completing the necessary forms for an engine exchange.

▶ Thanks to Tim Lightfoot

Throttle Body Connector Terminal Tension

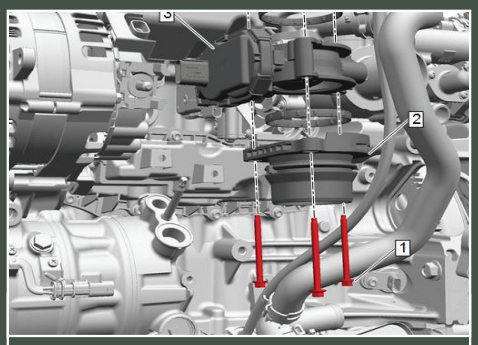
Some 2019 XT4 models equipped with the 2.0L 4-cylinder engine (RPO LSY) and 2019 Silverado 1500 and Sierra 1500 models equipped with the 2.7L 4-cylinder engine (RPO L3B) may have a Reduced Engine Power message displayed on the Driver Information Center and DTCs P2101 (Throttle Actuator Position Performance) and/or P1516 (Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance) set as current or history in the Engine Control Module (ECM). These conditions may be caused by a possible throttle body internal gel contamination issue.

Review the appropriate Service Information diagnostics for the set DTCs.

VEHICLES BUILT BEFORE FEBRUARY 2019

If the diagnosis leads to ECM replacement and the vehicle was built prior to February 2019, do not replace the ECM.

First, inspect the terminal tension at the ECM and throttle body. Verify there are no wiring-related issues present between the ECM and throttle body.



Inspect the connector (#3) terminal tension at the throttle body (LSY engine

If there are not any wiring- or terminal-related issues found, replace the throttle body assembly and re-evaluate the condition.

VEHICLES BUILT AFTER FEBRUARY 2019

If the diagnosis leads to ECM replacement and the vehicle was built after February 2019, complete the ECM replacement procedure following the appropriate Service Information and re-evaluate the condition.

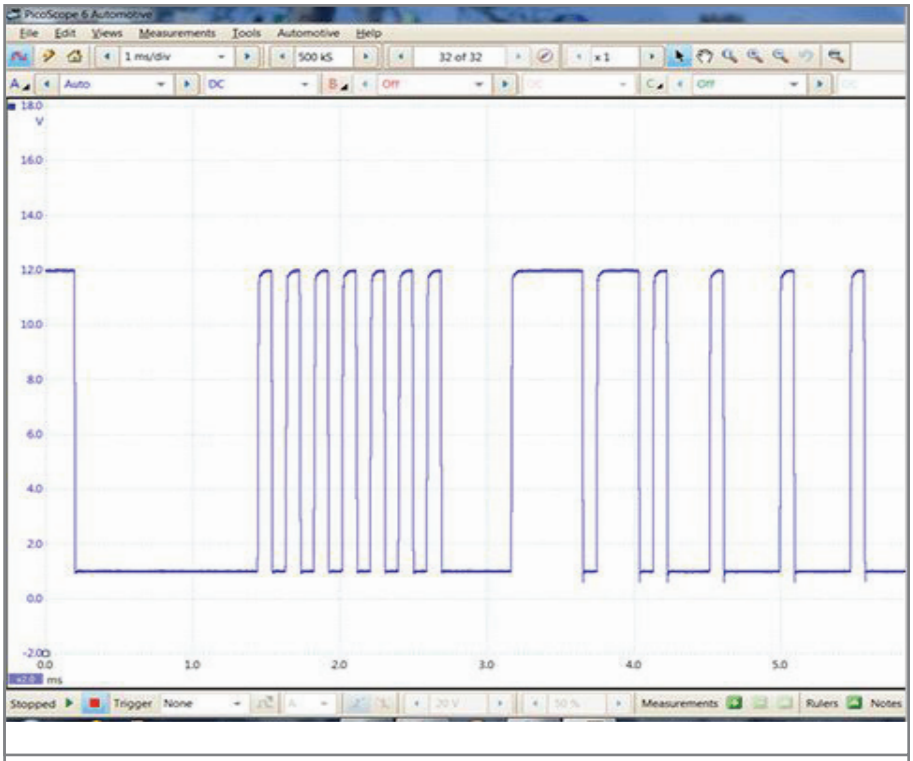
Refer to #PIP5660 for additional information.

▶ Thanks to Robert Halas

LIN Bus Diagnosis

Smart motors, switches, and sensors that use Local Interconnect Network (LIN) buses can be found on many 2014-2020 GM passenger cars and trucks. The LIN bus consists of a single wire and is used to exchange information between one master control module (such as an ECM, BCM, etc.) and one or more slave/smart device(s), such as switches, sensors, motors, etc. The LIN bus is relatively simple and exchanges data at a slower rate than other GMLAN buses.

LIN buses are not wired to the DLC, so the scan tool does not communicate directly on a LIN bus. The scan tool will communicate with the master control module of the LIN bus in order to command outputs or read parameters from the slave/smart device(s). If serial data communication is lost between any of the LIN devices on the LIN bus network, the master control module will set a no communication code against the non-communicating LIN device.



Each component on the LIN bus will send out approximately 11-12 volts and then toggle that voltage low when communicating.

Each component on the LIN bus (master and any slave devices) will send out approximately 11-12 volts and then toggle that voltage low when communicating, LIN 1. Because the LIN bus voltage ranges between 12 volts and 1 volt, it's important to have proper battery voltage while performing diagnostics. Install the EL-50313 Midtronics GR8 Battery Tester/Charger or equivalent on the vehicle while diagnosing a LIN bus to avoid a false reading. When a LIN bus is at rest or not communicating, it will read approximately 11–12 volts.

In most cases, when the ignition is turned on, the master control module will wake up the slave device(s) via the LIN bus. If the slave device does not wake up, the master control module will set a DTC for that device and will continue to try and wake up the slave device, which can be seen by the toggling voltage on the LIN bus.

However, in some cases, the slave device will wake up the master control module. For example, the door ajar switch is hard-wired to the driver's window motor. The driver's window motor has a LIN bus to the BCM. When the driver's door is opened, the ajar switch closes, signaling to the driver's window motor to send a LIN message to the BCM. The message wakes up the BCM and it communicates to the vehicle that the driver's door is open. As result, the BCM will turn on the interior dome lights and start waking up other modules.

DIAGNOSTIC TIPS

Here are a few diagnostic tips for the LIN bus circuit. The LIN bus schematic is used as an example in some of the tips. Always follow the appropriate diagnostics in the Service Information.

- If a LIN bus has more than one slave device, check to see if the other devices are working. Looking at the schematic, if the customer's concern was that the rear wiper was not operating, check to see if the rear power windows operate. This can help in narrowing down the area of concern.
- The LIN bus is a single wire and many faults are basic failures, such as opens, high resistance, shorts to ground/power, poor terminal drag, or connectors not fully seated. Use the proper terminal test probes to inspect for these types of failures.
- Testing/monitoring the voltage of the LIN bus can help determine what type of failure may have occurred.
- Check the output voltage from the master control module: With the master control module connected, disconnect the slave device and turn on the ignition. At the slave device, inspect for the toggling voltage from the master control module

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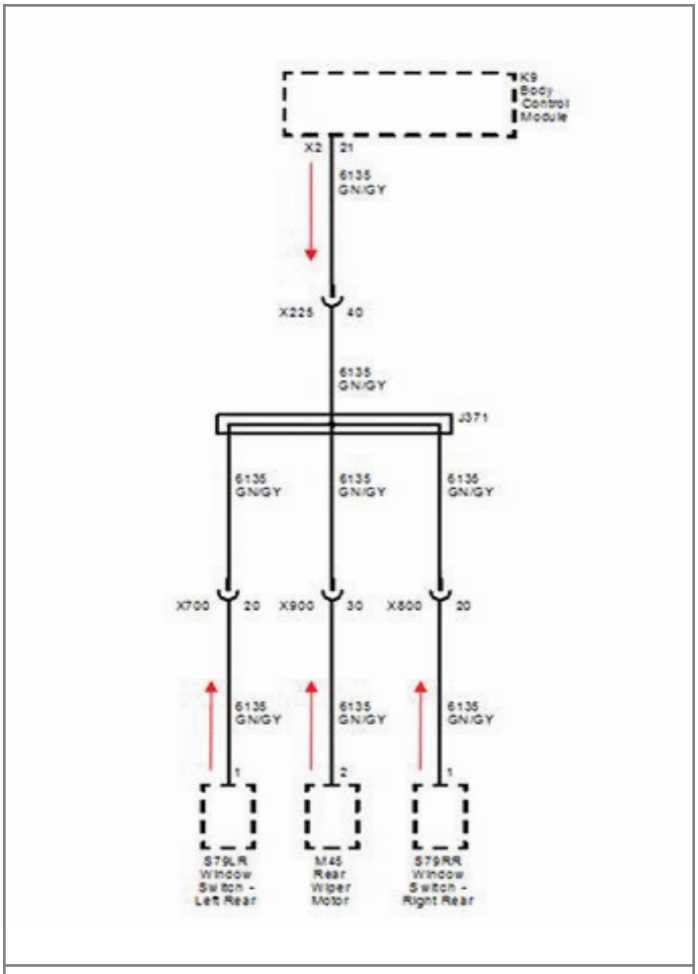
on the LIN bus. If using the EL-50772 Insulation Multimeter set to "peak" min/max, the voltages will be approximately 12 volts max and 1 volt min. If the voltage is present but not toggling, it could indicate a short to power. If the voltage is not present, it could indicate an open or short to ground.

TIP: Certain types of shorts on a LIN bus circuit can cause the module to shut down and stop outputting the 11–12 volts until the fault is no longer present and the ignition/power is cycled or DTCs are cleared.

- Check the output voltage from the slave device(s). With the slave device in question plugged in, disconnect the master control module and all other slave device(s) on the same LIN bus. At the master control module, check the output voltage from the slave device, which will be a steady 11–12 volts. There are a few things to keep in mind when testing the output voltage from the slave devices:

  1. Most slave devices have a hot at all times feed and no switched ignition inputs. In these cases, the ignition does not need to be turned on to test for the output voltage. Always check the wiring diagram for the slave device to determine if it has power at all times or if it has a switched ignition. If it has a switched ignition feed, when the master control module is unplugged, the slave device may not be powered on. In these cases, the slave device will need to have power applied to the switched ignition input before testing.
  2. When testing the LIN bus output voltage from a slave device, which has a switched ignition, some devices will only have the steady 11–12 volts output for a few seconds before it will drop to 0 volts. This is because the testing is done with the master control module disconnected and, when the slave device does not establish communication from the master control module, it can shut down the LIN bus output voltage.
  3. If there is more than one slave device, keep in mind that each slave device is sending out an output voltage. In these cases, the other slave device(s) will need to be disconnected along with the master control module before checking the output voltage from the slave device in question.



Typical LIN bus schematic

If no voltage is found coming from the slave device, it could indicate poor terminal tension at the LIN bus terminal, the slave device was not powered on (missing power or ground), or the slave device

If the voltage is present, check that the correct part number slave device is installed. Slave device part numbers change from year to year yet the different devices may look similar.

Thanks to Jim Will

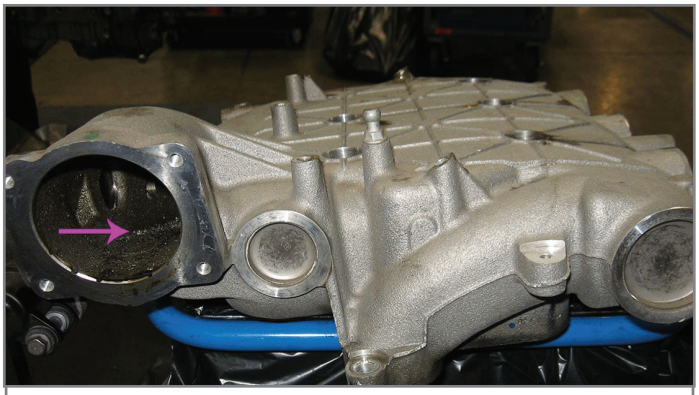
Cleaning and Transferring Components After Severe Internal Engine Damage

When replacing an engine due to internal damage on 2019 and prior GM passenger cars and trucks, extreme care should be taken when transferring components from the failed engine to a new GM Genuine Parts service engine.

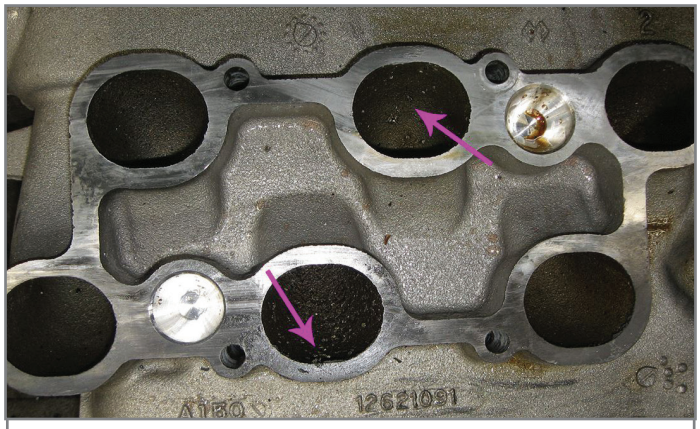
Any components transferred from a failed engine must be cleaned and inspected prior to installation onto the new engine. Damage can occur to the replacement engine if the intake manifold is not properly cleaned or replaced if necessary or, in the case of a damaged catalytic converter, if debris is drawn back into the engine.

INTERNAL DAMAGE

Internal engine damage may have resulted in the potential discharge of internal engine component debris into the intake manifold from any broken pistons or bent, broken, or missing intake valves. Broken valves and pistons as well as piston-to-cylinder head damage all create material debris that scatters throughout the induction system.



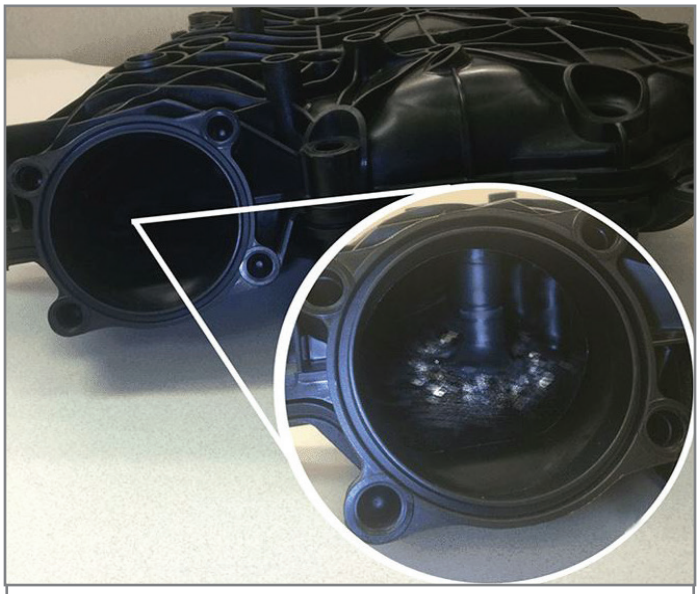
Debris in Aluminum Intake Manifold — Throttle Body Opening



Debris in Aluminum Intake Manifold — Ports to Cylinder Heads

After removing the intake manifold from the damaged engine, inspect all of the cylinder head intake ports to see if the valve heads are still present and not bent. Usually when the valve heads are missing or sufficiently bent, internal engine component debris will be present to varying degrees in the intake port of the cylinder head. If there is any debris present in the throttle body opening or any of the cylinder head intake ports, the intake manifold should be replaced.

COMPLEX CONFIGURATION



Debris in Plastic Intake Manifold — Throttle Body Opening

The complex inlet runner and plenum configuration of most of the intake manifolds make thorough and complete component cleaning difficult. In addition, it is nearly impossible to verify the complete removal of debris due to the complex configuration, making replacement a requirement if any debris is present.

Looking at an internal view of the plastic intake manifold lower half (the plastic intake manifold cannot be disassembled), the intake port to cylinder head opening is just one of several areas where debris can collect.

Reinstallation of an intake manifold removed from an engine with deposits of internal engine component debris may result in the ingestion of any remaining debris into the new service engine, which will lead to damage or potential failure of the new service engine long block.

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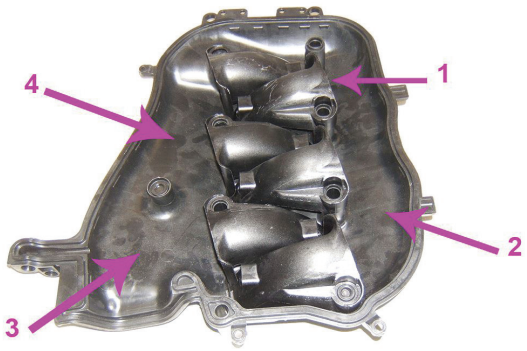


1. Intake port to cylinder head opening
2., 3., 4. Areas where debris can collect

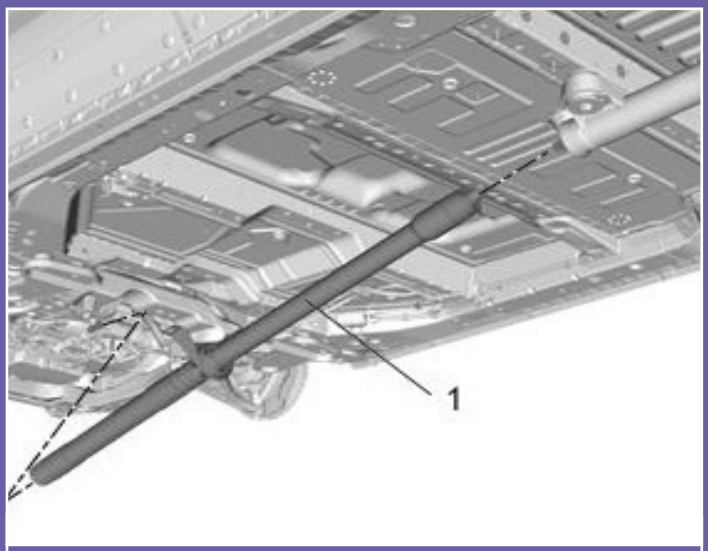
CATALYTIC CONVERTER FAILURES

When catalytic converter failures occur and the inner brick becomes plugged and breaks apart, the catalytic converter material can be drawn back into the engine during valve overlap and transfer throughout the intake manifold and into the cylinder. Any such material transfer can cause heavy wear to piston rings and cylinder walls. In addition, misfires and oil consumption are the byproducts of ingested catalytic converter material into the combustion chamber and cylinder bores.

For additional information on engine replacement after engine damage, refer to the latest version of Bulletin #00-06-01-026.

▶ Thanks to Larry Yaw

Whine Sound from Under Vehicle



Propeller shaft

A whine sound may be heard coming from under the vehicle on some 2019-2020 Envision models equipped with the 2.0L 4-cylinder engine (RPO LTG) and the 9T60 automatic transmission (RPO M3T). The sound may be radiating from the driveline while at cruising speeds with light throttle input or while coasting at 30-60 mph (48-60 km/h). The sound may be found more prominent when the transmission is cold and slowly diminishes as the transmission warms up.

If this sound is heard, it may be caused by a drive chain internal to the 9-speed transmission. The sound radiates through the propeller shaft.

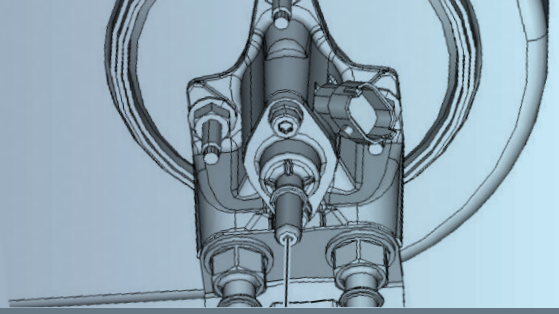
Replace the propeller shaft with a newly designed propeller shaft that has been released. The new propeller shaft has an integrated tuned vibration absorber designed to mitigate the whine sound.

Refer to two-piece propeller shaft replacement in the appropriate Service Information.

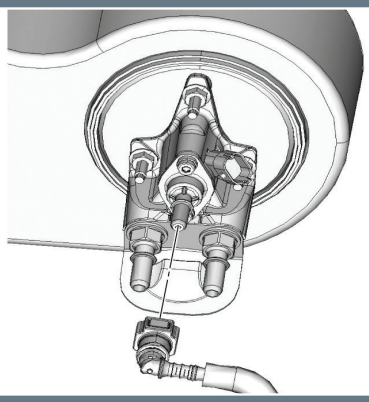
Refer to #19-NA-166 for additional information and the part number.

▶ Thanks to Kris Villegas

DEF Injector Replacement

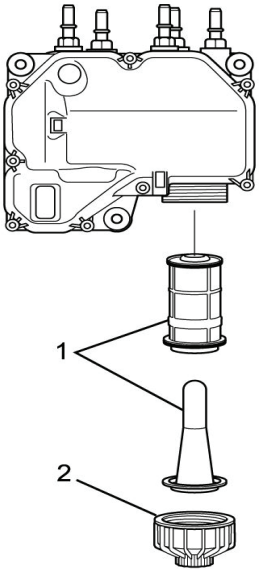


Some 2016-2019 Chevrolet Low-Cab Forward (LCF) trucks equipped with the 3.0L diesel engine (RPO IZ3) or 5.2L diesel engine (RPO I1B) may have an illuminated Check Engine MIL and DTC P208E (DEF Injector) set in the Diesel Exhaust Fluid (DEF) control module.



DEF injector

Follow the appropriate Service Information diagnostics for DTC P208E. The DEF control module detects DEF injector sticking by monitoring current change when commanded on. An expected current change should be detected when the interval valve is operated. DTC P208E will set when the DEF control module detects that the current change is small when the DEF injector is commanded on longer than 120 seconds, which indicates a stuck DEF injector.



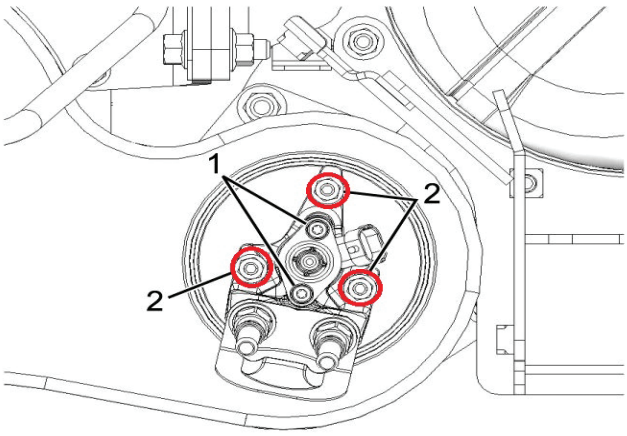
1. DEF supply pump filter kit
2. Filter cover

RETURN DEF INJECTOR AND DEF SUPPLY PUMP FILTER ELEMENT

If diagnostics lead to replacing the DEF injector, replace the DEF supply pump filter element as well as the DEF injector. Place the supply pump filter element in a bag to be returned with the DEF injector.

The DEF supply pump filter element is contained in the DEF supply pump on the chassis. Remove the filter cover to access the filter kit.

DEF INJECTOR



1. Do not remove the 2 bolts.
2. Remove the 3 nuts to disconnect the injector.

The DEF injector is attached to the mixer chamber located between the Diesel Particulate Filter (DPF) housing and the Selective Catalytic Reduction (SCR) housing.

When removing the DEF injector, do not disassemble the DEF injector by removing the two central bolts on the injector. Disconnect the injector by remove the three nuts on the outer edges of the injector. If the two bolts are removed instead, the resin portion may be damaged and the sealing performance may be lost, resulting in an exhaust gas leak. Also, do not reuse the gasket.

During installation, use a clean cloth to wipe off any foreign matter attached to the DEF injector. Using air to blow off any foreign matter may cause it to enter in the urea passage, resulting in a failure.

Once the DEF injector has been installed, perform the DEF injector data reset procedure for the DEF control module using SPS.

Refer to #PIP5662 for additional information.

▶ Thanks to Richard Renshaw

INSTALLING
the Rearview Camera Kit

The factory-provided Rearview Camera Kit (RPO 5N5) available on 2019 Silverado 1500 and Sierra 1500 models and 2020 Silverado 2500HD/3500HD and Sierra 2500HD/3500HD models include a camera, extension harness and mounting bracket. These components are shipped with the vehicle from the assembly plant in a separate parts bag inside the large dealer prep bag.

Information for installing the Rearview Camera Kit can be found on the GM Upfitter website at gmupfitter.com. The information is not available in the Service Information.

Review the latest version of GM Upfitter Integration Bulletin 152: Adding or Installing a Rearview Camera – FST New Body Style. To view the bulletin, select the Technical Bulletins tab on the GM Upfitter website home page and then select Show All Bulletins.

Bulletin 152: Adding or Installing a Rearview Camera – FST New Body Style

CAMERA INSTALLATION

The rearview camera calibration for camera operation is installed at the assembly plant as part of RPO 5N5.

Along with the camera, the kit includes 20 feet of cable along with a fixed, zero-pitch mounting bracket. Optimal camera location is 38-inches above the ground on the vehicle center line.

▶ Thanks to Scott Fibranz

TECHLINK

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