1 7 06-15

Service Information Bulletin

SUBJECT	DATE
SPN 1323 (MCM) (GHG14); SPN 1324 (MCM) (GHG14); SPN 1325 (MCM) (GHG14); SPN 1326 (MCM) (GHG14); SPN 1327 (MCM) (GHG14); SPN 1328 (MCM) (GHG14);	July 2015

Additions, Revisions, or Updates

Publication Number / Title	Platform	Section Title	Change
DDC-SVC-MAN-0084 DDC-SVC-MAN-S084	DD Platform	SPN 1323/FMI 31 - GHG14	Added note and fault codes in step 6. Steps 1,2,3, and 24 were added.
		SPN 1324/FMI 31 - GHG14	
		SPN 1325/FMI 31 - GHG14	
		SPN 1326/FMI 31 - GHG14	
		SPN 1327/FMI 31 - GHG14	
		SPN 1328/FMI 31 - GHG14	

DEMAND PERFORMANCE™

13400 Outer Drive, West, Detroit, Michigan 48239-4001
Telephone: 313-592-5000
www.demanddetroit.com

2 SPN 1323/FMI 31 - GHG14

Idle Smoothness Control/Cylinder #1 Misfire At Idle

Table 1.

SPN 1323/FMI 31	
Description	This Fault Code Sets when the Motor Control Module (MCM) Detects That Cylinder #1 Has Low rpm Speed with the Injector Commanded to Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) - Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

WARNING: PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1323/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle.
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System". Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 651/FMI any
    - SPN 3659/FMI any
    - SPN 7384/FMI any
    - SPN 2797/FMI any
    - SPN 4257/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 2.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #1 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover" .
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #1. Refer to section "Valve Lash Adjustments" . Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash" Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test". Is the mechanical cylinder compression reading for cylinder #1 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter". Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #1. Repair as necessary.
    b. No; replace the fuel injector in cylinder #1. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

3 SPN 1324/FMI 31 - GHG14

Idle Smoothness Control/ Cylinder #2 Misfire At Idle

Table 3.

SPN 1324/FMI 31	
Description	This Fault Code Sets When The Motor Control Module (MCM) Detects That Cylinder #2 Has Low rpm Speed with The Injector Commanded To Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) - Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

WARNING: PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1324/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle.
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System". Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 652/FMI any
    - SPN 3660/FMI any
    - SPN 7385FMI any
    - SPN 2797/FMI any
    - SPN 4257/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 4.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #2 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover" .
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #2. Refer to section "Valve Lash Adjustments". Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash" Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test" . Is the mechanical cylinder compression reading for cylinder #2 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter". Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #2. Repair as necessary.
    b. No; replace the fuel injector in cylinder 2. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

4 SPN 1325/FMI 31 - GHG14

Idle Smoothness Control/ Cylinder #3 Misfire At Idle

Table 5.

SPN 1325/FMI 31	
Description	This Fault Code Sets when the Motor Control Module (MCM) Detects That Cylinder #3 Has Low rpm Speed with the Injector Commanded to Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) - Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

WARNING: PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1325/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System" . Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 653/FMI any
    - SPN 3661/FMI any
    - SPN 7386/FMI any
    - SPN 2797/FMI any
    - SPN 4257/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 6.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #3 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover".
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #3. Refer to section "Valve Lash Adjustments". Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash" Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test". Is the mechanical cylinder compression reading for Cylinder #3 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter". Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #3. Repair as necessary.
    b. No; replace the fuel injector in cylinder 3. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

5 SPN 1326/FMI 31 - GHG14

Idle Smoothness Control/Cylinder #4 Misfire At Idle

Table 7.

SPN 1326/FMI 31	
Description	This Fault Code Sets when the Motor Control Module (MCM) Detects That Cylinder #4 Has Low rpm Speed with the Injector Commanded to Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

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Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1326/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle.
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System". Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 654/FMI any
    - SPN 3662/FMI any
    - SPN 7387/FMI any
    - SPN 2798/FMI any
    - SPN 4258/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 8.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #4 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover".
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #4. Refer to section "Valve Lash Adjustments". Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash". Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test". Is the mechanical cylinder compression reading for cylinder #4 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter" . Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #4. Repair as necessary.
    b. No; replace the fuel injector in cylinder 4. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

6 SPN 1327/FMI 31 - GHG14

Idle Smoothness Control/Cylinder #5 Misfire At Idle

Table 9.

SPN 1327/FMI 31	
Description	This Fault Code Sets when the Motor Control Module (MCM) Detects That Cylinder #5 Has Low rpm Speed with the Injector Commanded to Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) - Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

WARNING: PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1327/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle.
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System". Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 655/FMI any
    - SPN 3663/FMI any
    - SPN 7388/FMI any
    - SPN 2798/FMI any
    - SPN 4258/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 10.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #5 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover" .
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #5. Refer to section "Valve Lash Adjustments" . Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash" Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test". Is the mechanical cylinder compression reading for cylinder #5 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter" . Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #5. Repair as necessary.
    b. No; replace the fuel injector in cylinder 5. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

7 SPN 1328/FMI 31 - GHG14

Idle Smoothness Control/Cylinder #6 Misfire At Idle

Table 11.

SPN 1328/FMI 31	
Description	This Fault Code Sets when the Motor Control Module (MCM) Detects That Cylinder #6 Has Low rpm Speed with the Injector Commanded to Max Fueling for a count of two with all conditions met.
Monitored Parameter	Engine rpm
Typical Enabling Conditions	- Engine Speed Steady between 600 to 950 rpm - Engine Coolant Temperature between 65°C (149°F) and 114°C (237° F) - Engine Fuel Temperature between 0°C (32°F) and 150°C (302° F)
Monitor Sequence	None
Execution Frequency	Once per drive cycle when enabling conditions are met.
Typical Duration	5 Seconds
Dash Lamps	CEL, MIL
Engine Reaction	25% Derate
Verification	Ensure the ignition has been off for a minimum of 5 minutes prior to the last ignition on. Meet all enabling conditions. Let the Engine Idle for 5 minutes. (Fault code status will become pending with one detected failure and active with the second).

NOTE: DO NOT use the Idle Speed Balance (ISB) test in DiagnosticLink ® for ANY misfire at idle testing.

Check as follows:

Possible causes:

- Valve Lash Out Of Adjustment
- Valve Train Damage/Failure
- Bent Valve
- Valve Face/Seat Damage
- Stuck Jake Brake
- Bearing Failure
- Bent Connecting Rod
- Cylinder Liner Damage
- Piston Ring Damage
- Failed Cylinder Head Gasket
- Failed Fuel Injector

WARNING: PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

CAUTION: ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

WARNING: BODILY INJURY

To avoid injury from a falling component, ensure an appropriately rated lifting device is used. Moving the component without an appropriately rated lifting device could result in the component falling, which could cause serious personal injury and component damage. Never stand beneath a suspended load.

WARNING: PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

1. Is the Motor Control Module (MCM) software version 4.7.0.0 with fuel map ZGS 002 or higher?
   a. Yes; Go to step 7.
   b. No; update device software and Go to step 2.

WARNING: PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

2. Does the engine exhibit knocking noise while running.
   a. Yes; Go to step 8.
   b. No; Go to step 3.
3. Ensure the ignition has been off for a minimum of five minutes prior to the last ignition on. Go to step 4.
4. Run the engine until Engine Coolant temperature is between 65°C (149°F) and 114°C (237°F) and Engine Fuel Temperature is between 0°C (32°F) and 150°C (302°F). Go to step 5.
5. Run the engine at a constant engine speed between 600 to 950 rpm for five minutes then Go to step 6.
6. Does SPN 1328/FMI 31 become pending or active?
   a. Yes; Go to step 10.
   b. No; release vehicle.
7. Does the engine exhibit knocking noise while running?
   a. Yes; Go to step 8.
   b. No; Go to step 10.
8. Remove the EGR hot pipe and check for raw fuel. Was raw fuel found?

a. Yes; Refer to section "Test-E - Two-Filter Fuel System".
b. No; reinstall EGR hot pipe and Go to step 9.

9. Refer to section "Aerated Fuel Test – Two-Filter Fuel System". Was the fuel system found to be aerated?
   a. Yes; make necessary repairs, perform verification in fault code chart header.
   b. No; Refer to section "Different Engine Noise".

NOTE: Faults are listed in diagnostic priority from top to bottom.

10. Are there any of the following faults present?
    - SPN 656/FMI any
    - SPN 3664/FMI any
    - SPN 7389/FMI any
    - SPN 2798/FMI any
    - SPN 4258/FMI any
    - SPN 1322/FMI any
    - SPN 5357/FMI any
    - SPN 190/FMI 0, 14, or 15
    - SPN 636/FMI 2, 8, 10, or 11
    - SPN 723/FMI 8, 10, or 11
    - SPN 157/FMI any
    - SPN 164/FMI any
    - SPN 520268/FMI any

    a. Yes, repair fault with the highest priority listed above. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 11.
11. Check the maximum engine speed in DDEC Reports. You must view the Life-To-Date data instead of Trip Activity data. Life-To-Date data can be found by selecting the "View" drop down menu, then selecting "Life-To-Date", and then selecting "Engine". In the resulting page view, look at the Peak Engine rpm and the date it occurred. Is the maximum engine speed greater than the values shown in the chart below?

Table 12.

12 Lobe Intake Camshaft	2800 rpm
6 Lobe Intake Camshaft	3000 rpm

    a. Yes; Go to step 12.
    b. No; Go to step 13.
12. View past warranty and repair history to determine if both camshafts were replaced after the engine overspeed. Were the Camshafts replaced?
    a. Yes; Go to step 13.
    b. No; replace both camshafts. Inspect the engine brake rocker arms for loose actuator piston retainers and loose or missing return springs. Perform verification in fault code chart header to verify repairs.
13. Connect a battery charger to the vehicle to maintain sufficient battery voltage while cranking.
14. Use DiagnosticLink to perform the relative compression test. Refer to section "Relative Cylinder Compression Test". Is the relative compression reading for cylinder #6 within 10% of the highest cylinder reading?
    a. Yes; Go to step 24.
    b. No; Go to step 15.
15. Turn the engine OFF.
16. Disconnect the battery charger.
17. Remove the rocker cover. Refer to section "Removal of the Rocker Cover".
18. Visually inspect the rocker arms, rollers on the rocker shafts and the lobes on the camshafts. Are the rocker arms, rollers or camshafts damaged?
    a. Yes; replace the damaged components. Perform verification in fault code chart header to verify repairs.
    b. No; Go to step 19.

19. Check the valve lash clearance for cylinder #6. Refer to section "Valve Lash Adjustments". Is the valve lash within specification?
    a. Yes; Go to step 20.
    b. No; adjust the valve lash to the correct clearance. Perform verification in fault code chart header to verify repairs.
20. Check the engine brake lash. Refer to section "Setting the Engine Brake Lash". Is the engine brake lash within specification?
    a. Yes; Go to step 22.
    b. No; Go to step 21.
21. Inspect the engine brake piston actuator. Is the engine brake piston actuator constantly engaged or stuck in the extended position?
    a. Yes; replace the engine brake rocker arm. Refer to section "Removal of Camshaft and Rocker Shaft/Engine Brake Assembly". Perform verification in fault code chart header to verify repairs.
    b. No; set the correct engine brake lash. Refer to section "Setting the Engine Brake Lash" Perform verification in fault code chart header to verify repairs.
22. Connect the battery charger to maintain proper cranking speed.
23. Perform the mechanical cylinder compression test. Refer to section "Mechanical Cylinder Compression Test". Is the mechanical cylinder compression reading for cylinder #6 344 kPa (50 psi) lower than any of the other cylinders?
    a. Yes; disconnect the battery charger and remove the cylinder head. Refer to section "Symptom Diagnostics - Low Engine Compression" to check for the cause of the loss of compression.
    b. No; Go to step 24.
24. Remove and inspect the engine oil filter. Refer to section "Replacement of the Oil Filter". Is there an excessive amount of metal present in the oil filter?
    a. Yes; remove the oil pan and inspect the bearings starting with the bearings near cylinder #6. Repair as necessary.
    b. No; replace the fuel injector in cylinder 6. Refer to section "Removal of the Fuel Injector - Two-Filter System". Perform verification in fault code chart header to verify repairs.

