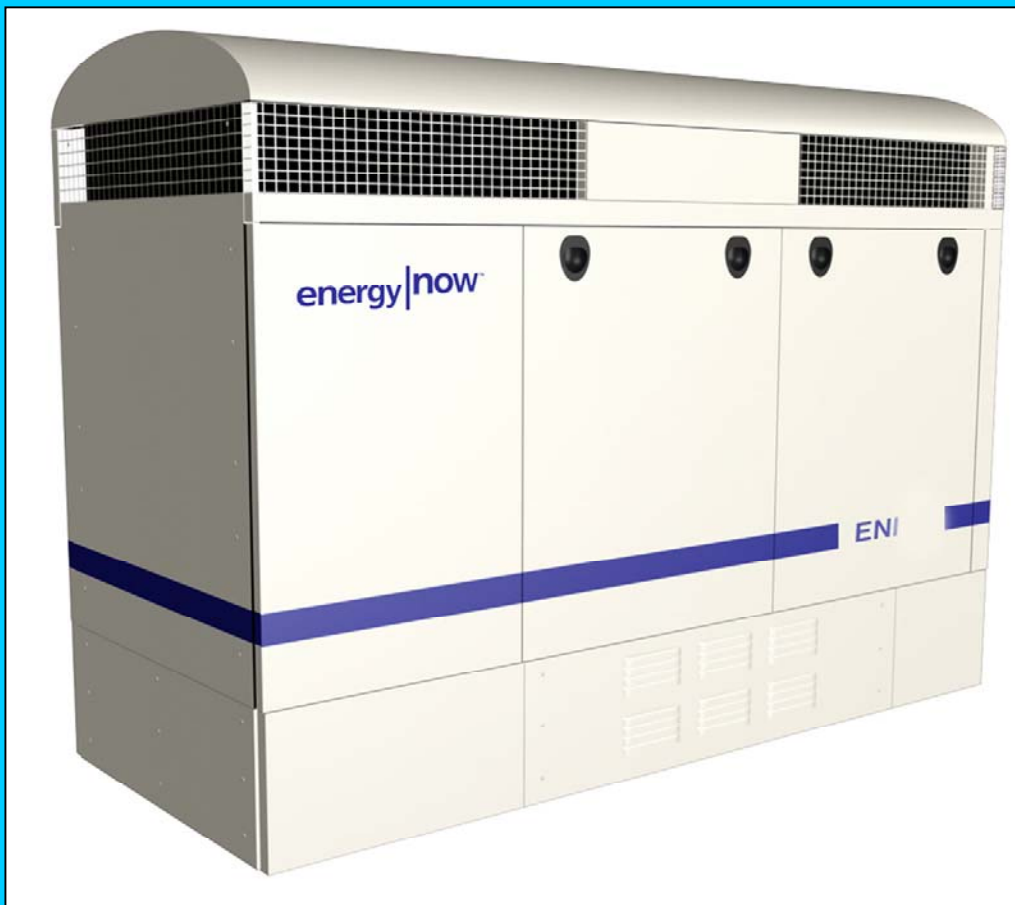

ENI 65 Induction

Maintenance Manual



Document: 25344-014
Revised: 11-2007

Table of Contents

| Item | Page |
|---|-------------|
| ENI 65 Maintenance Schedule | 2 |
| Oil and Filter Change Procedure | 3 |
| Air Filter Replacement Procedure | 11 |
| Serpentine Belt Inspection & Replacement Procedure | 16 |
| Spark Plug Replacement Procedure | 23 |
| Cylinder Head Removal Procedure | 27 |
| Cylinder Head Replacement Procedure | 43 |
| Engine Coolant Pump Removal Procedure | 58 |
| Engine Coolant Pump Installation Procedure | 62 |
| General Systems Inspection | 67 |

ENI 65 Maintenance Schedule

| Item | Scheduled Maintenance Every 1500 Hrs | Minor Overhaul Every 8000 Hrs | Major Overhaul Every 24000 Hrs |
|--------------------------------------|--|-------------------------------------|--------------------------------------|
| Engine Oil & Filter-Change | X | | |
| Check Fluid Levels | X | | |
| Engine Serpentine Belt-Inspect | X | | |
| Spark Plugs-Replace | X | | |
| Engine Air Filter-Clean & Inspect | X | | |
| General Systems Inspection | X | | |
| Engine Cylinder Heads-Replace | | X | |
| Spark Plug Wires-Replace | | X | |
| Engine Air Filter-Replace | | X | |
| Engine Coolant Pump-Replace | | X | |
| Tighten Electrical Panel Connections | | X | |
| Engine Assembly-Replace | | | X |
| Exhaust Tubing-Replace | | | X |
| Engine Coolant Hoses-Replace | | | X |
| Exhaust Blankets | | | X |

Service Parts Kits

| Item | I Power P/N | Package Usage |
|----------------------------|-------------|--|
| Scheduled Maintenance | 26084-001 | Low Temp Application |
| Scheduled Maintenance | 26084-002 | Standard Application |
| Minor Overhaul | 25345-001 | Low Temp Application |
| Minor Overhaul | 25345-002 | Standard Application |
| 8000 Hour Service Complete | 26085-001 | Low Temp Application |
| 8000 Hour Service Complete | 26085-002 | Standard Application |
| Major Overhaul | 25346-001 | Low Temp & Dual Element Cat. App. |
| Major Overhaul | 25346-002 | Low Temp & Single Element Cat. App. |
| Major Overhaul | 25346-003 | Stand. Temp & Dual Element Cat. App. |
| Major Overhaul | 25346-004 | Stand. Temp & Single Element Cat. App. |

OIL AND FILTER CHANGE PROCEDURE

Tools Required

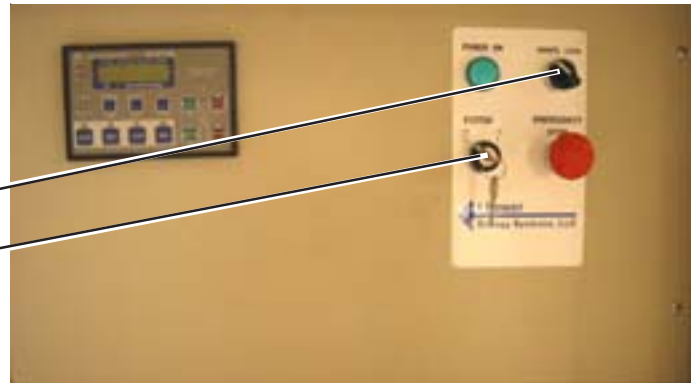
- Oil Filter wrench
- Oil catch pan, 10 gallon capacity (min)

WARNING:
Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine & turn the “**SYSTEM**” switch to “**OFF**”.

Remote Local Switch

System Switch



Caution:
The engine should be allowed to cool to avoid burns when working with engine parts

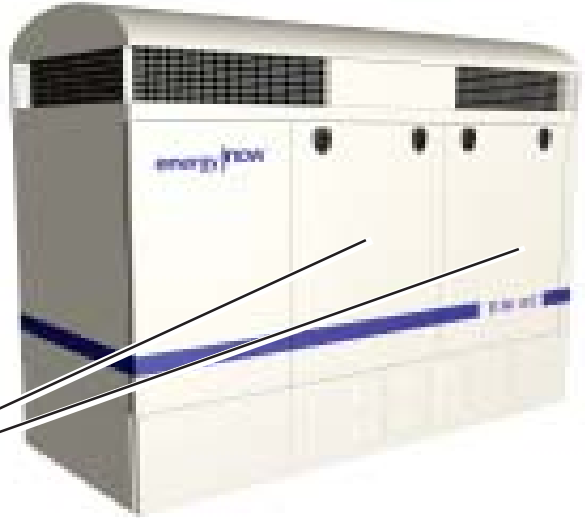
WARNING:
The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.

CB105



2. Remove Side Access Doors (both sides).



Side Access Doors (Left Side Shown)

3. Disconnect the battery negative cable(s).



Negative Cable(s)

4. Close the Oil Replenish Valve.

Oil Replenish Valve



5. Install a drain hose to the oil drain valve and run to the oil catch pan located outside the ENI 85 unit. Turn the oil drain valve open until oil completely drains.

Note:
A pump may be used to speed the draining process.

Oil Drain Valve



6. Remove the Left Lower Panel.

Left Lower Panel



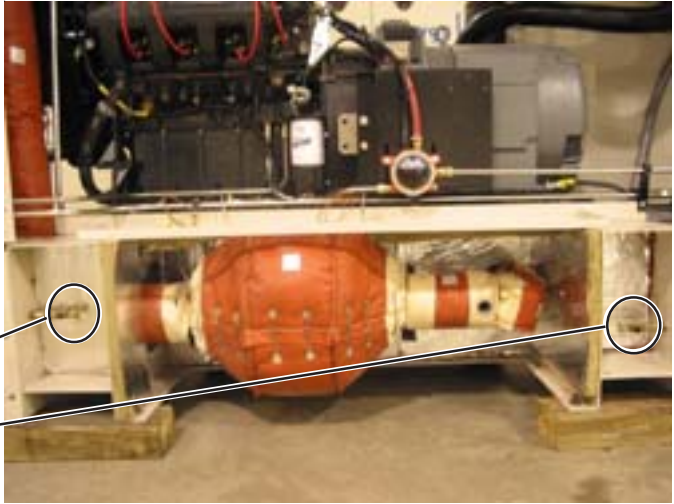
7. Locate the engine heat exchanger & oil auxiliary tank oil drain valves. Connect a hose from the valves to the Oil Catch Pan. Open the valves and drain completely.

Note:

A pump may be used to speed the draining process.

Engine Heat Exchanger Oil Drain Valve

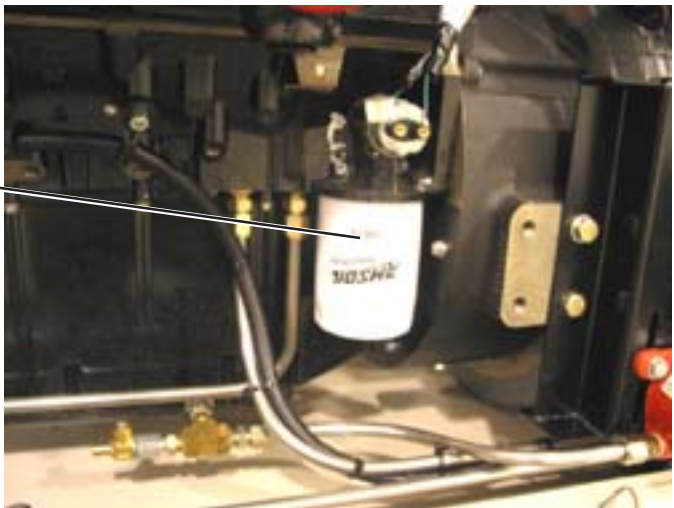
Auxiliary Oil Tank Drain Valve



8. Install an oil catch pan under the oil filter.

9. Remove the oil filter.

Oil Filter



10. Install a new oil filter by:

1. Lubricating the oil filter gasket with clean motor oil.
2. Install the filter.

TIGHTEN

Tighten per the manufacturers instruction on the filter or filter box. **DO NOT** over tighten. This may cause damage to the filter, gasket, or threads.

11. After the old oil has completely drained from the engine and heat exchanger, remove the drain hoses and close all the drain valves.

12. Fill the engine with new I Power recommended oil to the “FULL” mark on engine oil dipstick. (Approximately 9.5 qt.) (9 L).

Oil Fill Cap



13. Fill the engine oil 5 gallon Reserve Oil and the Oil Replenish Tanks..

Fill the 5 gallon oil reservoir.

Fill the Oil Replenish Tank



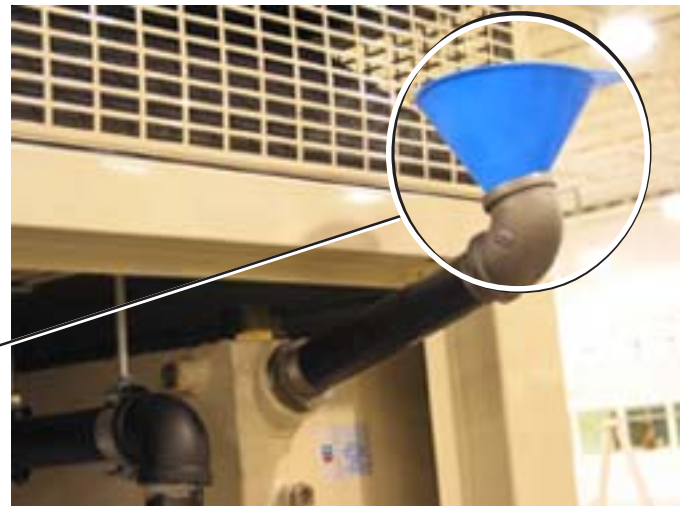
Suggested Fill Procedure - Reserve Oil Tank

A fill aid assembly can be helpful in filling the reserve tank. The parts in the assembly are:

1. 2 in X 1 1/2 in Bushing
2. 1 1/2 in X 12 in Pipe Nipple
3. 1 1/2 in X 90 deg Elbow
4. Funnel

Fill to the bottom of the fill opening.
A pump might be helpful to fill the funnel from a bulk oil container.

Fill Aid Assembly



Caution:

Use a ladder to safely reach the fill funnel with pour containers that can be safely handled.

14. Reconnect the negative terminal(s) at the battery.

Negative Battery Terminal(s)



15. Switch **CB105** to “ON”.

CB105



16. Restore power and fuel to the ENI 65 per normal procedures:
- Remove the lock out and turn on the utility power utility power.
 - Remove the lock out and turn on the fuel supply.

17. Start the engine by turning the “**SYSTEM**” switch to “**ON**” & pressing the “**TEST**” button on the GCP-21 controller.

Message button

18. Observe the oil pressure on the GCP-21 controller by pressing the “**MESSAGE**” button until the oil pressure value is displayed. Pressure should indicate in the **40 to 60 PSI** range. If the pressure is low, shut down the engine and investigate potential causes. Walk around the ENI 65 and look for leakage from the drain valves or the oil filter.

Test button

Stop button

19. Shut down the engine by pressing the “**STOP**” button. Investigate and repair any observed leakage.

20. Observe the engine oil level on the Dipstick. If below the “**ADD**” level, add oil until the oil level reaches the “**FULL**” mark.

Note:

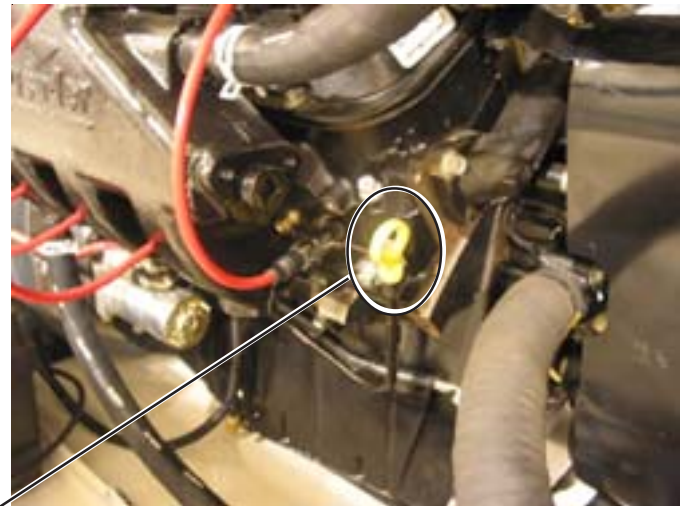
The dipstick should be pulled out slightly after inserting to relieve any pressure that might be trapped in the dipstick tube from inserting the dipstick. It is possible to get an artificially low reading and overfill the engine if the pressure is not relieved.

Dipstick

The 5 gallon oil tank should be checked for any trapped air by carefully loosening the fill cap and relieving any air that might be trapped at the top of the tank and top off the tank with oil if necessary.

21. Open the Oil Replenish Tank Valve.

Open Oil Replenish Valve



22. Replace the Left Lower Panel.

Left Lower Panel



23. Replace the Side Access Doors.

Side Access Doors (Left Side Shown)



24. Return the ENI 65 to service.

AIR FILTER REPLACEMENT PROCEDURE

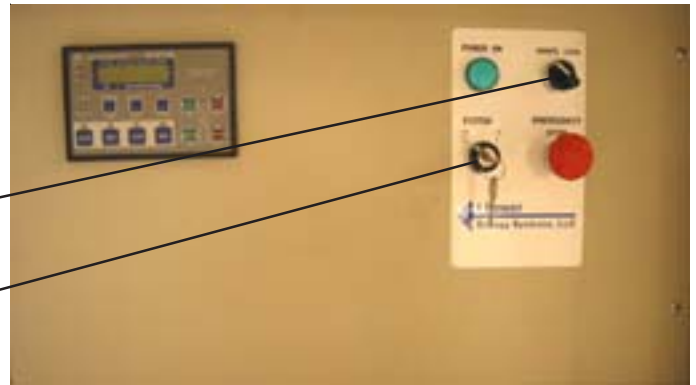
WARNING:

Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine by pressing the “**STOP**” button, & turn the “**SYSTEM**” switch to “**OFF**”.

Remote / Local Switch

System Switch



Caution:

The engine should be allowed to cool to avoid burns when working with engine parts

WARNING:

The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.



CB105

2. Remove the Left Side Access Doors

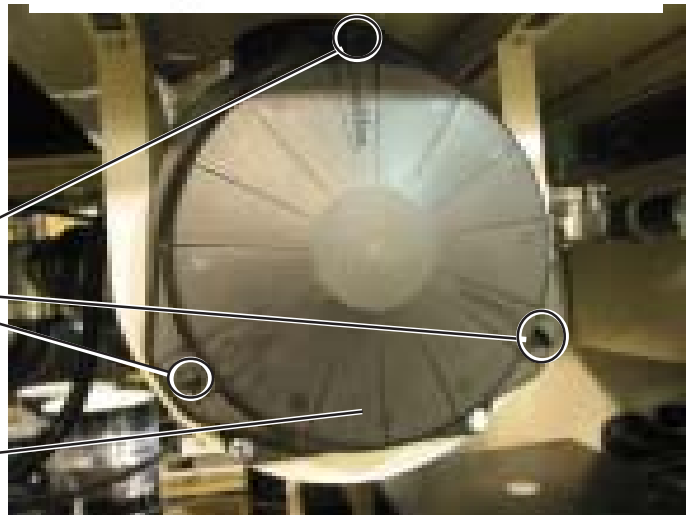
Left Side Access Doors



3. Observe the condition of the cover retaining screws. If any of the three are damaged or missing, a backfire might have occurred. Closely examine the rest of the air / fuel intake system for other signs of seal displacement or damage.

Retaining Screws

Cover



4. Disconnect the battery negative cable(s).

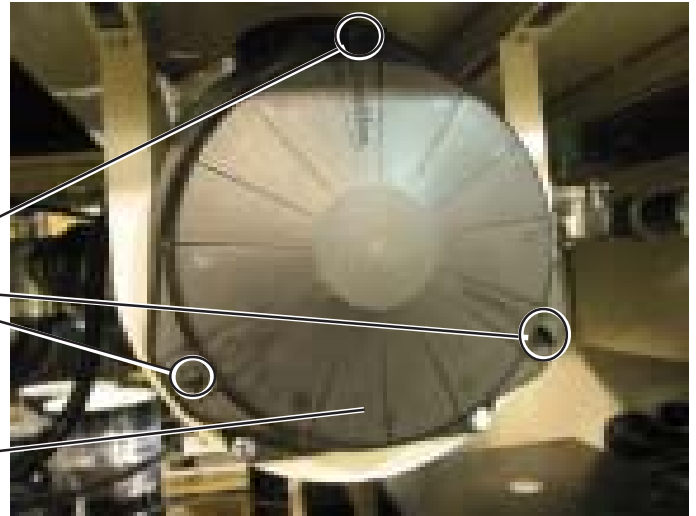
Negative Cable(s)



5. Remove the 3 retaining screws and remove the air cleaner cover.

Retaining Screws

Cover



6. Remove the Air Filter Element.

Air Filter Element

Filter Element Outer Structure



7. Clean the dirt out from inside the air cleaner housing. Take care not to allow dirt to enter the air passage to the mixer.

Wipe any dirt from the outside of the filter element. Be careful not to get injured by the sharp metal outer structure of the element

8. Reinstall the Air Filter Element. Push firmly into the housing to seal.

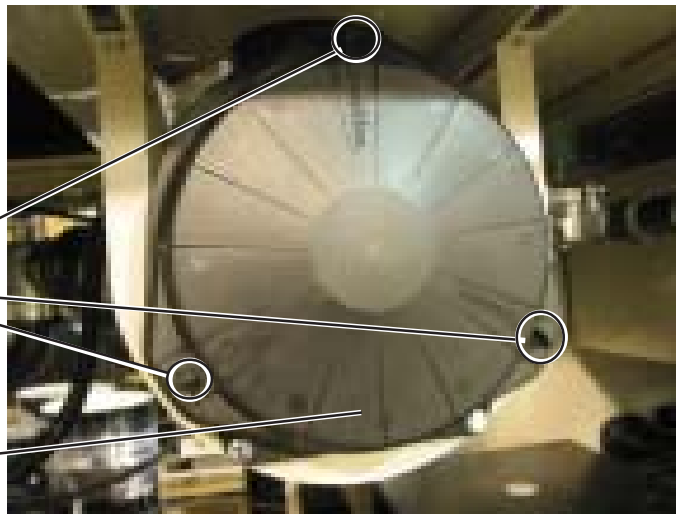
Note:

If the Filter Element has been damaged, replace with a new element.

9. Replace the Air Cleaner Cover and the 3 retaining screws.

Retaining

Cover



10. Switch **CB105** to "ON".

CB105



11. Restore power and fuel to the ENI 65 per normal procedures:
- Remove the lock out and turn on the utility power utility power.
 - Remove the lock out and turn on the fuel supply.

12. Reconnect the negative terminal(s) at the battery.



Negative Battery Terminal(s)

13. Replace the Left Side Access Doors.



Left Side Access Doors

14. Return the ENI 65 to service.

SERPENTINE BELT REPLACEMENT PROCEDURE

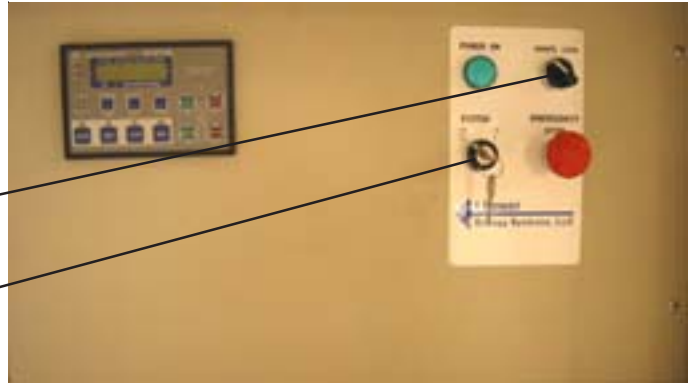
WARNING:

Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine by pressing the “**STOP**” button, & turn the “**SYSTEM**” switch to “**OFF**”.

Remote Local Switch

System Switch



Caution:

The engine should be allowed to cool to avoid burns when working with engine parts

WARNING:

The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.



CB105

2. Remove Side Access Doors (both sides).

Side Access Doors (left side shown)



3. Disconnect the battery negative cable(s).

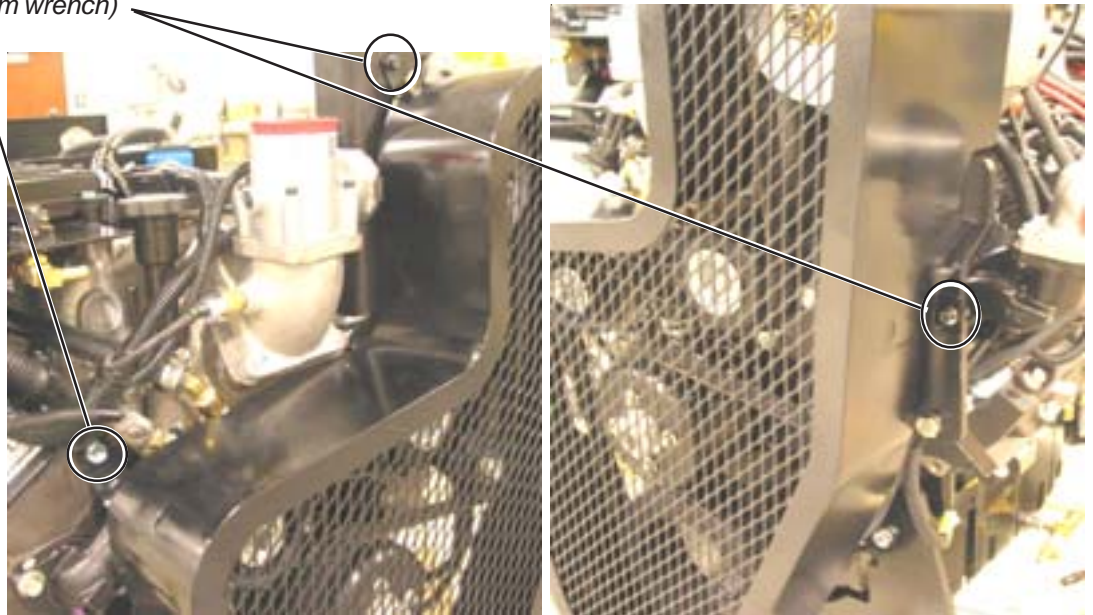
Negative Cable(s)



4. Unfasten belt guard retaining bolts. Move the belt guard forward, clear of the serpentine belt. **10 and 15 mm wrenches** are required.

Retaining Bolts (10 mm wrench)

Retaining Bolt (15 mm wrench)

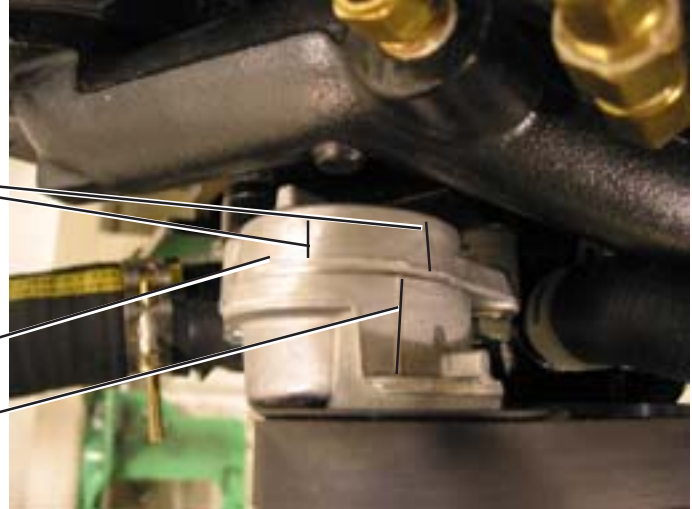


5. Observe the position of the wear indicator on the belt tensioner. If the indicator is in the “**WORN**” range, replace the serpentine belt.

Running Range

Worn Range

Position Indicator



6. Position a **15 mm drive wrench** on the serpentine belt tensioner arm and rotate the arm clockwise.

Wrench



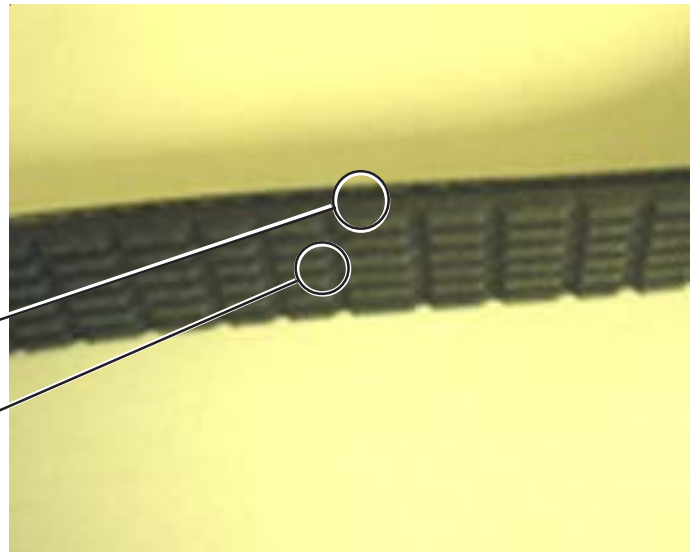
Warning:
Keep hands and fingers out from under tensioner and belt. Tensioner is spring loaded and will spring back if let loose.

7. Remove the belt from under drive belt tensioner.
8. Remove the belt from the pulleys.

9. Inspect the serpentine belt and pulleys.
a. Inspect the belt for cracks in the grooves or material build up (pilling) in the belt gooves more than **1/3 of the groove depth**. If either condition is found, replace the belt.

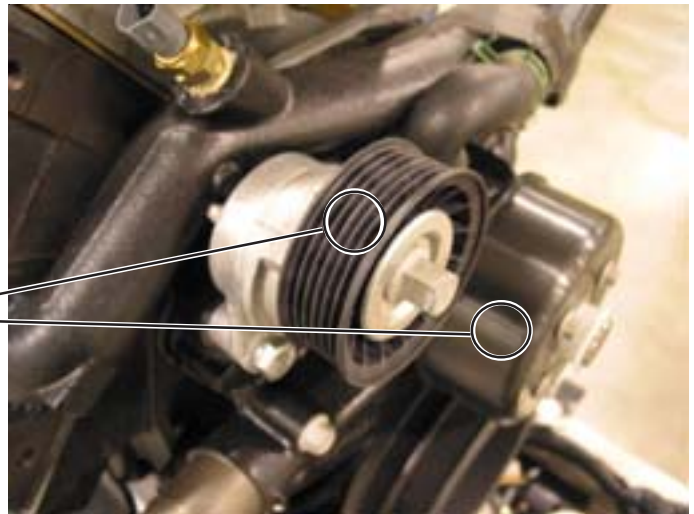
Check Belt For Cracks

Check Belt Grooves For Pilling



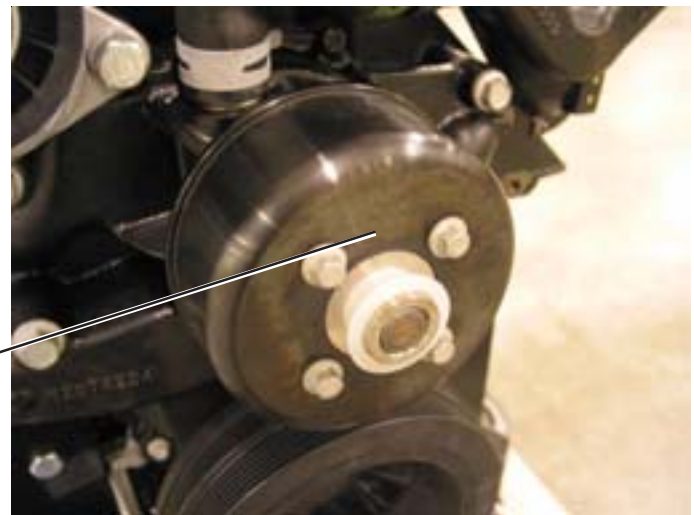
- b. Clean the pulleys with a suitable wire brush and check for bearing roughness. If bearing roughness is noted, change the component.

Clean Pulleys & Check Bearing Roughness



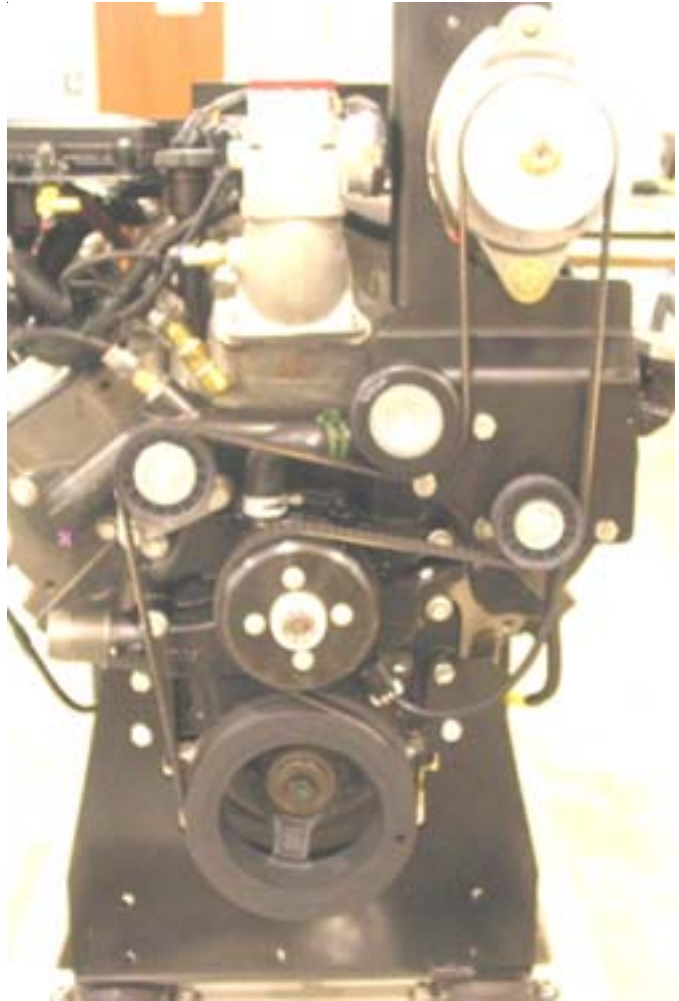
- c. Inspect the belt driven water pump and pulley
 1. Look for any signs of coolant leakage from the pump. If leakage is present, replace the water pump.
 2. Rotate the belt driven water pump pulley and note any roughness from the pump bearings. If roughness is noted, change the water pump.

Belt Driven Water Pump And Pulley



- 10. Check the bolts holding all the belt driven components for looseness. Tighten if loose.

11. Reinstall the belt or a new belt if needed referring to the picture for serpentine belt routing.



12. Position a **15 mm drive wrench** on the serpentine belt tensioner arm and rotate the arm clockwise.

Wrench



WARNING:
Keep hands and fingers out from under tensioner and belt. Tensioner is spring loaded and will spring back if let loose.

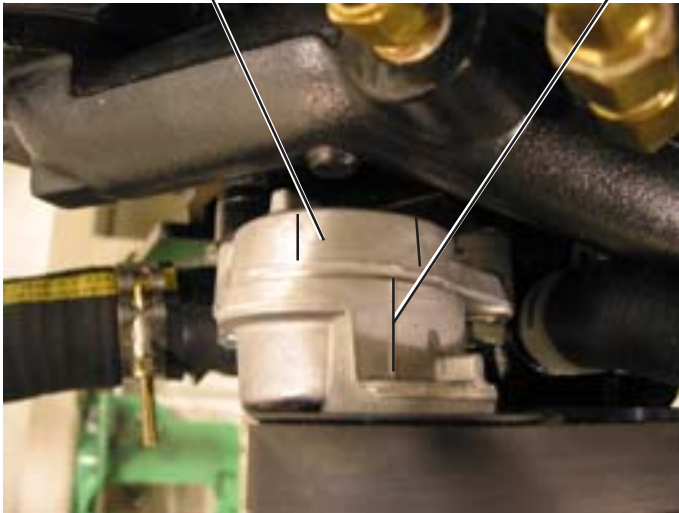
13. Feed the serpentine belt over the belt tensioner and release spring tension slowly.

14. Check the belt routing to ensure the following:

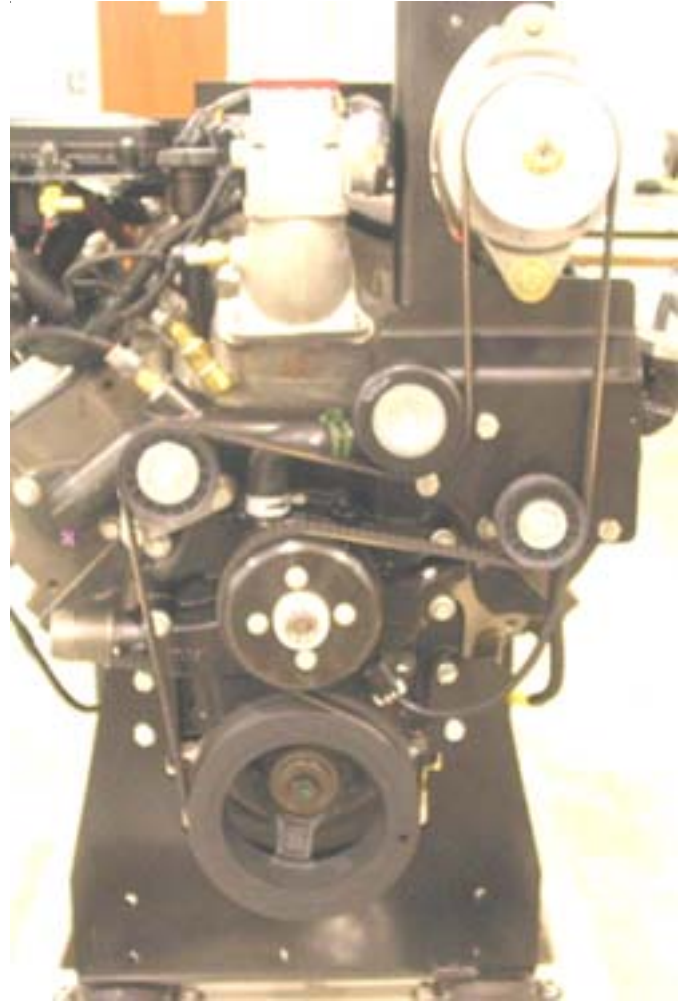
- Proper routing
- Belt is not twisted
- Belt is lined up correctly with pulley
- Belt is straight
- Check the belt tensioner to be sure wear indicator is in the “Run” area.

Wear Range

Wear Position Indicator



Belt Wear Indicator



15. Replace the belt guard.

16. Reconnect the negative terminal(s) at the battery.

Negative Battery Terminal(s)



17. Replace Side Access Doors.

Side Access Doors (left side shown)



18. Return the unit to service.

SPARK PLUG REPLACEMENT PROCEDURE

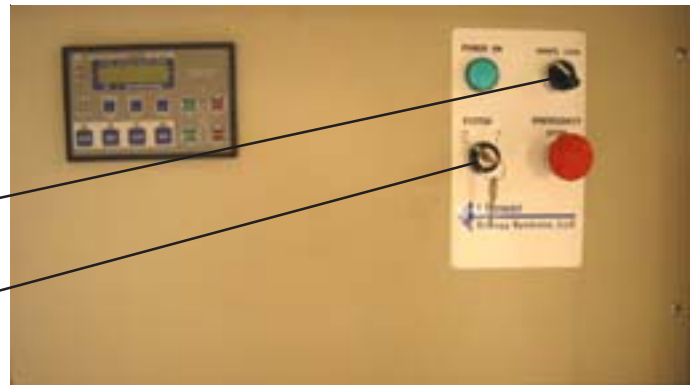
WARNING:

Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine by pressing the “**STOP**” button, & turn the “**SYSTEM**” switch to “**OFF**”.

Remote / Local Switch

System Switch



Caution:

The engine should be allowed to cool to avoid burns when working with engine parts

WARNING:

The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.



CB105

2. Disconnect battery negative cable(s).

Negative Cable(s)

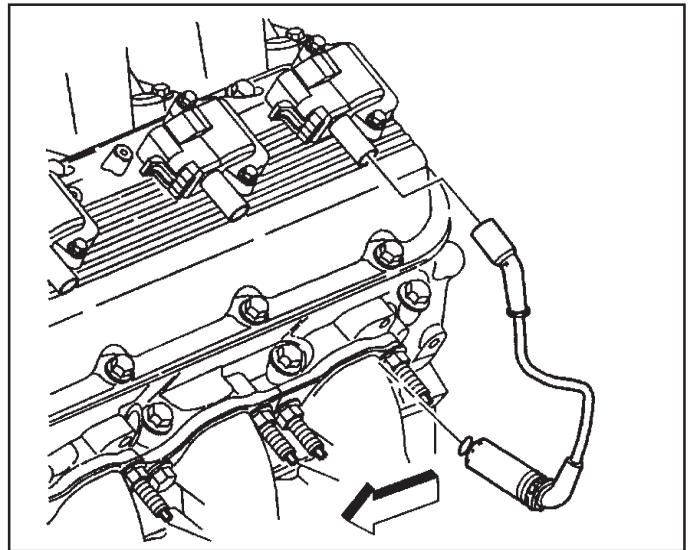


3. Remove the spark plug wires from the spark plugs.

- a. Remove in a twisting manor making sure not to damage the inner-spring.
- b. It may be necessary to use a set of needle nose pliers to unplug some of the wires from the spark plug. Clamp the steel cover at the spark plug connection and pop the wire off.

Caution:

Be careful not to damage the plug boots when removing from the plug.

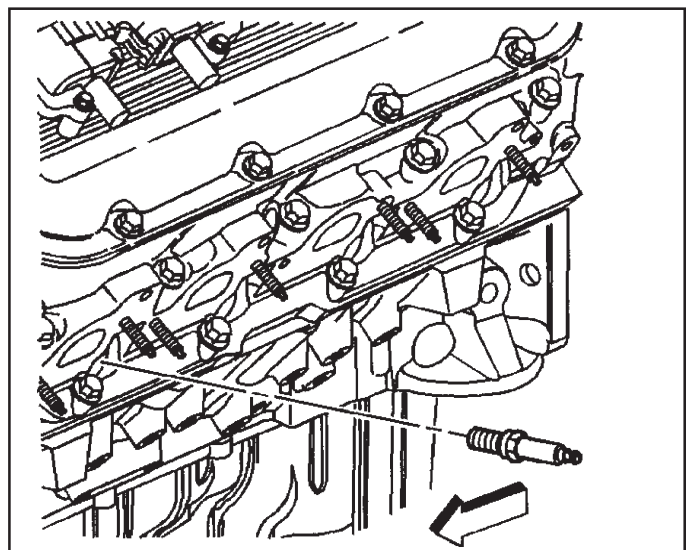


4. Remove the spark plug.

5. Replace with a new spark plug.

TIGHTEN

Tighten to **15 in lb (20 Nm)**. **DO NOT over tighten**. This may cause damage to the spark plug threads or the head assembly.

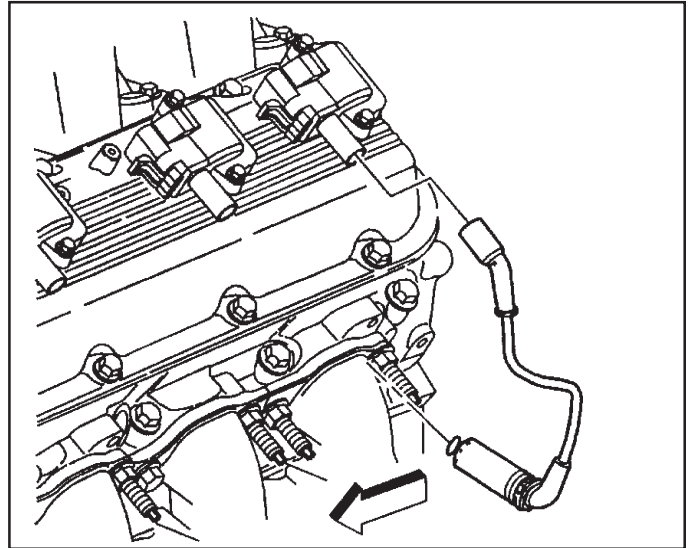


IMPORTANT:

Be sure to connect the Spark Plug Wire all the way on the Plug to ensure a good connection. The plug boot might interfere with the exhaust manifold bolt flange. If this occurs, turn the boot until clearance is achieved.

6. Inspect the spark plug wires for signs of heat damage or arcing. Replace any damaged wires with new wires of the same type. Contact I Power Energy Systems for information.

Install the wires on to the spark plugs using a silicone lubricant to ease installation.



7. Repeat entire procedure until all 8 spark plugs have been replaced. Check all connections to the spark plugs and coils, ensuring good contact.

8. Connect the battery negative cable(s).



Negative Cable(s)

WARNING:
The Utility Cabinet contains high voltage that can cause severe injury or death. The following procedure should only be performed by qualified personnel.

9. Switch **CB105** to “ON”.

CB105



10. Replace Side Access Doors.

Side Access Doors



11. Return the unit to service.

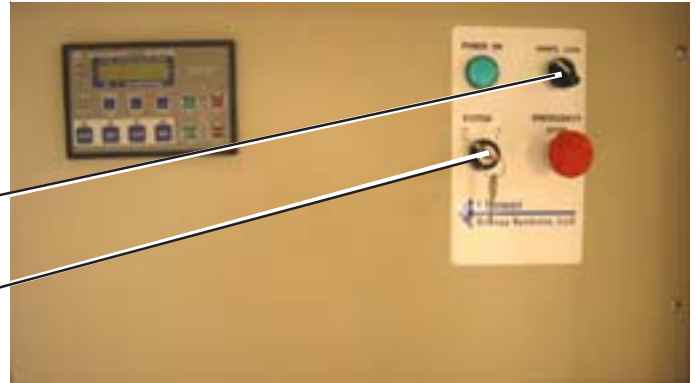
CYLINDER HEAD REMOVAL PROCEDURE

WARNING:
Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine by pressing the “**STOP**” button, & turn the “**SYSTEM**” switch to “**OFF**”.

Remote / Local Switch

System Switch



Caution:
The engine should be allowed to cool to avoid burns when working with engine parts

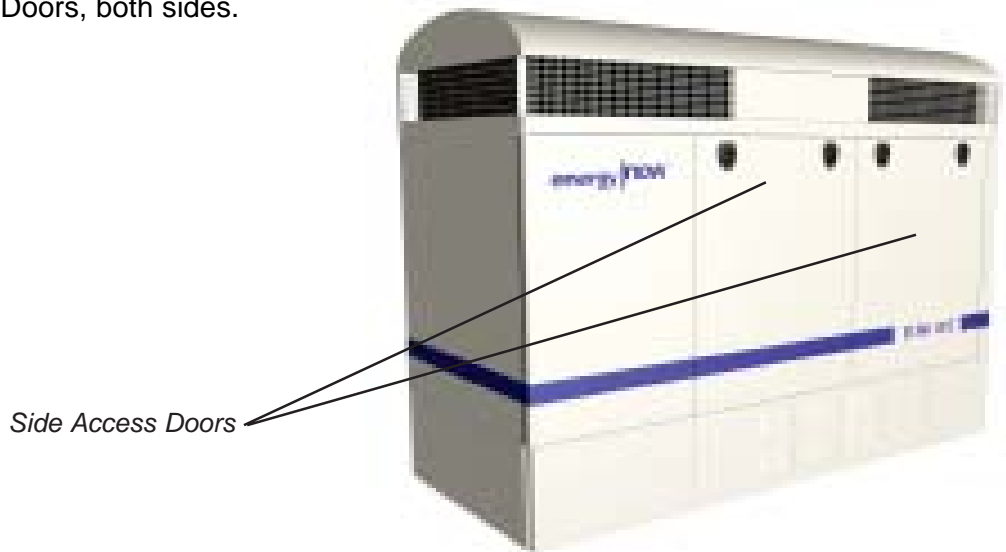
WARNING:
The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.



CB105

2. Remove the Side Access Doors, both sides.

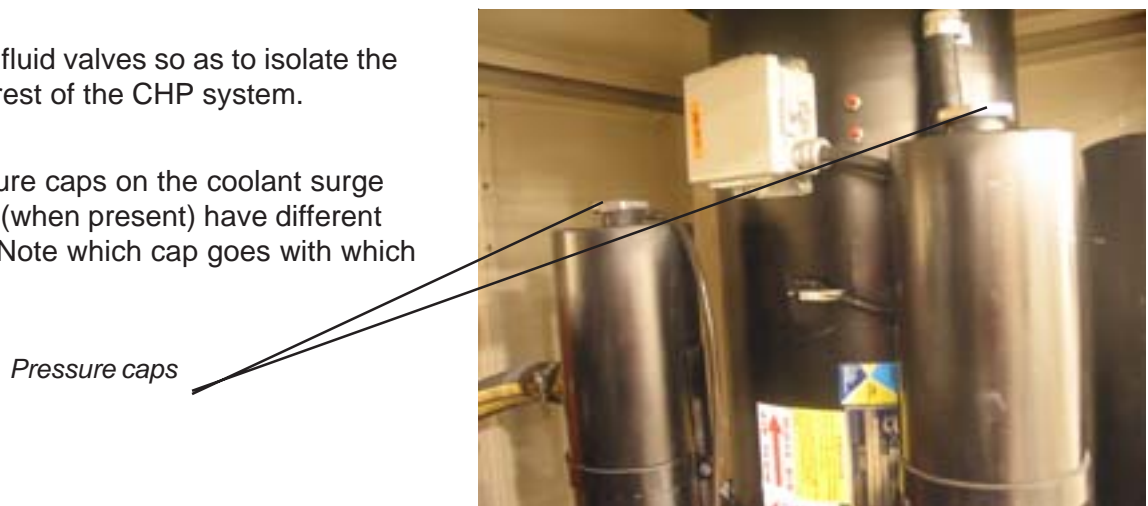


3. Disconnect battery negative cables.



4. Shut off all CHP fluid valves so as to isolate the ENI 65 from the rest of the CHP system.

Remove the pressure caps on the coolant surge tanks. The 2 tanks (when present) have different pressure settings. Note which cap goes with which tank.



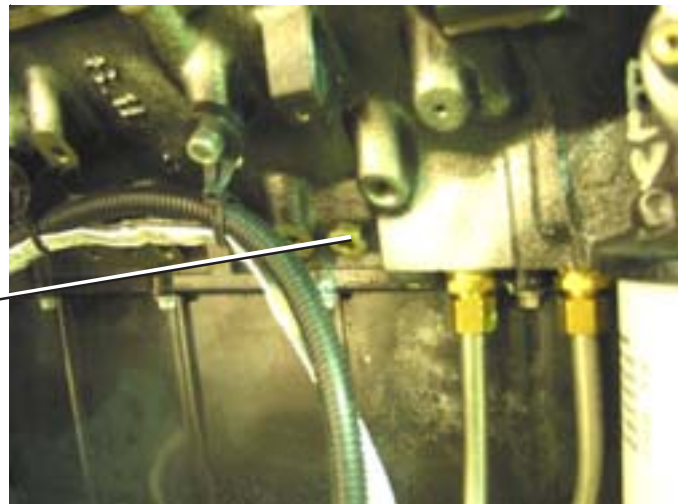
5. Drain the coolant from the engine water jacket and the engine waste heat recovery system.:

Engine Water Jacket - This is drained by removing the drain plugs in each side of the engine. These are located in the engine block below the cylinder heads. An **8 mm Allen wrench** is required. This portion of the system contains approximately **5 gallons (19 L) of coolant**.

A suitable container with adequate capacity must be located so as to capture the coolant coming from the drain holes once the plugs are removed. A funnel, or other similar device, is needed to direct coolant from the engine openings to the container.



Engine Drain Plug - Right Side

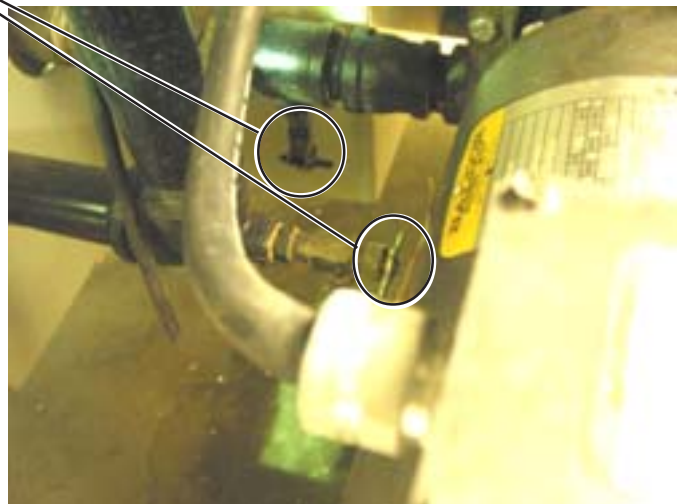


Engine Drain Plug - Left Side

Pipe Drains

Waste Heat Recovery System - This system is drained by opening a valve located in the piping at the front of the unit. A **1/2 in (12.7 mm) hose** is required to drain into a suitable container. This portion of the systems contains approximately **4 gallons (14 L) of coolant**.

A pump may be needed to move the coolant from the valve, through the hoses, to the container.



- 6. Remove the 4 bolts at the top of the liquid cooled exhaust manifolds (both sides of the engine). A **9/16 in wrench** is required.

Slide insulation up and remove the 4 bolts



- 7. Leave exhaust system in place through the head removal and replacement procedure. Take care not to bend or displace the exhaust piping.

View of exhaust system after the exhaust manifold and head has been removed



8. Disconnect the air intake tubing from the mixer by loosening the clamp at the attaching rubber fitting at the throttle body inlet. Use a common screw driver.

Loosen Clamp



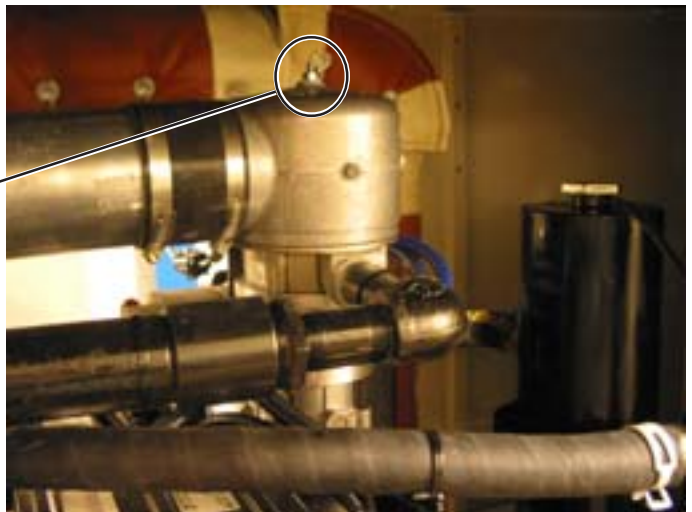
9. Loosen the clamp behind the air cleaner and remove the air tube from the gen-set. Use a 7/16 in deep well socket wrench.

Loosen Clamp



10. Remove the Mixer cover by removing the retaining nut at the top.

Retaining Nut



11. Remove the mixer cover and remove the 4 Allen screws that retain the mixer.

Mixer Cover

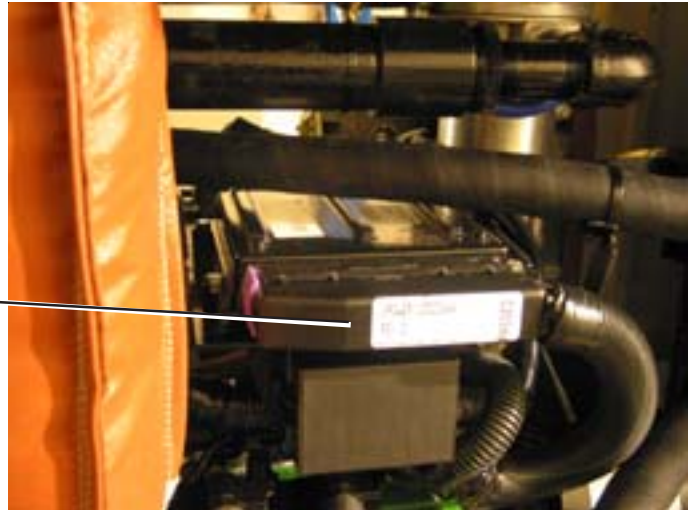
Mixer Retaining Screws



12. The Engine Controller mounting plate and harness must be removed.

- a. Disconnect the harness connector at the engine controller.

Engine Controller Connector



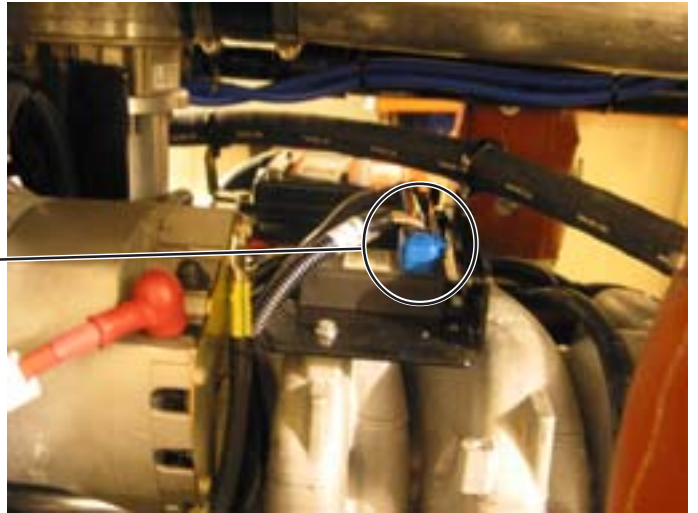
- b. Remove the mounting plate screws from the intake manifold. Use a **10 mm wrench**.

Mounting Plate Screws



c. Disconnect the UEGO harness connector

UEGO Connector



d. Remove the crankcase vent hose from the auxiliary port on the oil fill tube.

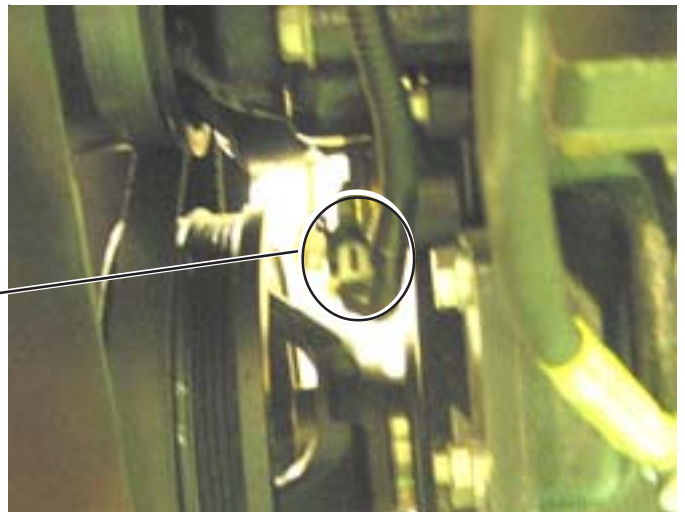
Crankcase Vent Hose connection



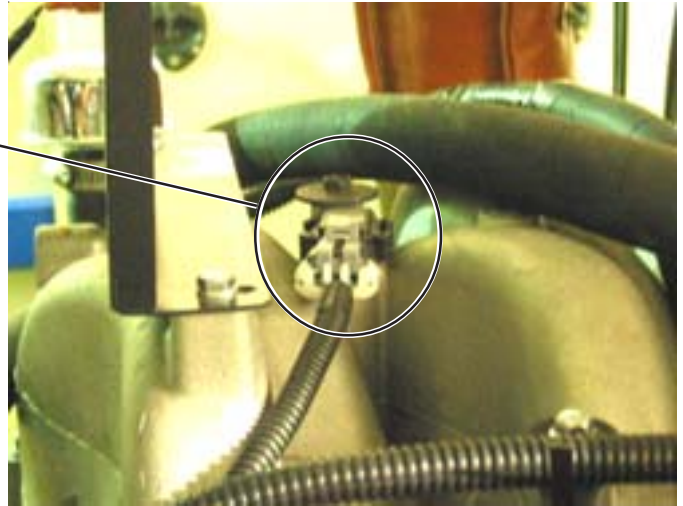
e. Carefully swing the mounting plate assembly off the intake manifold and set aside.

f. Disconnect the MAP sensor, cam position sensor, crank position sensor, coolant sensor, and the main ignition coil connectors (one on each side).

CamSensor



MAP Sensor

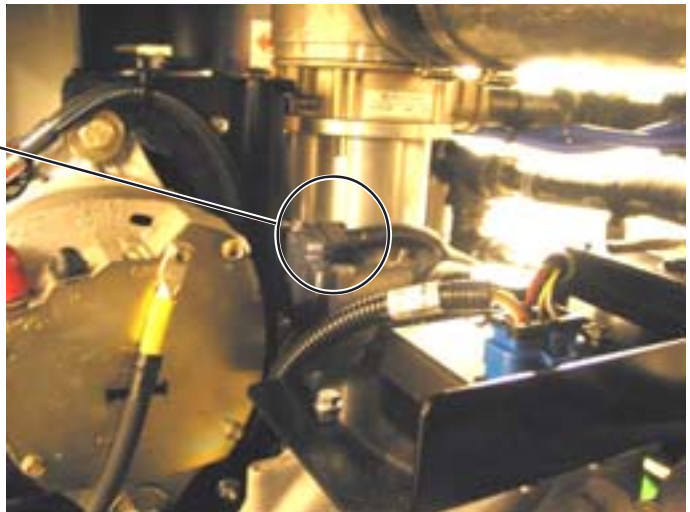


Intake Air Temperature

Coolant Sensor



Throttle Body Connector



- g. Disconnect the ignition coil main connectors (one on each valve cover).

Ignition Coil Connector



- h. Remove the engine harness power and ground wires from the belt driven alternator. A **7/16 in** and **5/16 in wrench** are required.

Engine Harness Power Connections



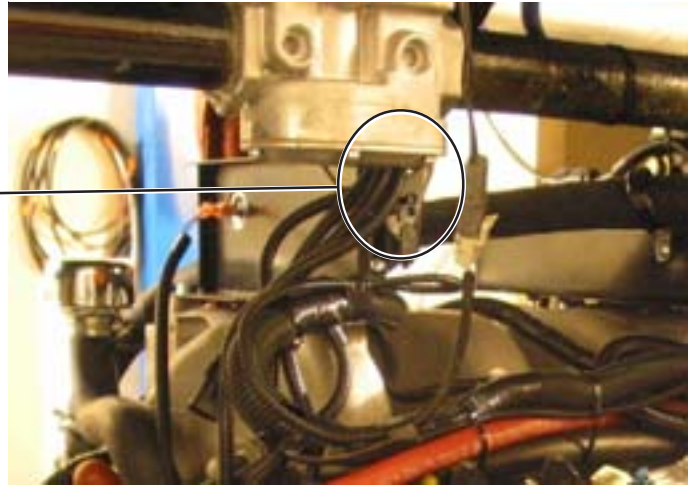
- i. Disconnect the oil pressure sender harness by removing the 2 thumb screws. Note the terminals where each wire is connected and mark on the wire end and the sender.

Oil Pressure Sender Thumb Screws



- j. Disconnect the Engine Harness Main Connector

Main Engine Harness Connector



- k. Remove all cable ties retaining the engine harness. Some of these are reusable with strap releases. Notes on harness dress and wire tie locations will be very useful when replacing the harness.

- l. Carefully pull the engine harness from the engine and place on top of the power generator.

13. Remove the bolt retaining the oil level indicator tube. A **1/2 in wrench** is required. Carefully lay the tube to the side.

Oil Level Indicator Tube Bolt



14. Remove the spark plug wires from the spark plugs. Remove the spark plugs. A **5/8 in Spark Plug wrench** is required. Refer to "Spark Plug Replacement Procedure", Page 23.

Note:

Twist the spark plug boot 1/2 turn to release it from the spark plug. Pull on the spark plug boot only. Do not pull on the plug wire or the wire could be damaged.

15. Remove the exhaust manifolds by removing the bolts holding the manifolds to the cylinder heads. A **13 mm socket wrench** is required.

Caution:
The manifolds weigh approximately 25 lbs each. A helper may be required to safely remove.

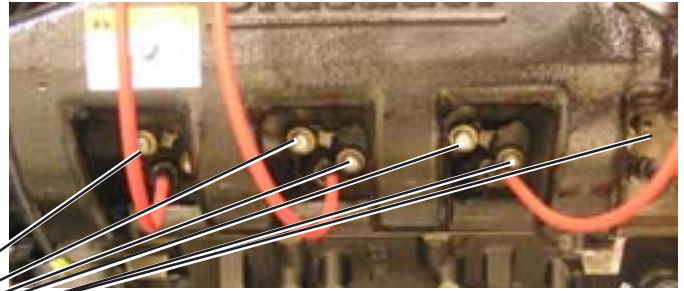
Carefully set the manifolds aside.

Manifold Mounting Bolts (8 per manifold)

Note:
A small amount of coolant may be retained in each manifold

16. Remove the bolts retaining the belt guard and move the guard forward clear of the belt. **10 & 15 mm wrenches** are required.

Belt Guard Retaining Bolts



17. Remove the serpentine belt. Refer to “Serpentine Belt Inspection & Replacement Procedure”, Page 16.

18. Remove the belt driven alternator by removing the top bolt, then the through bolt under the alternator. A **19 mm wrench** is required.

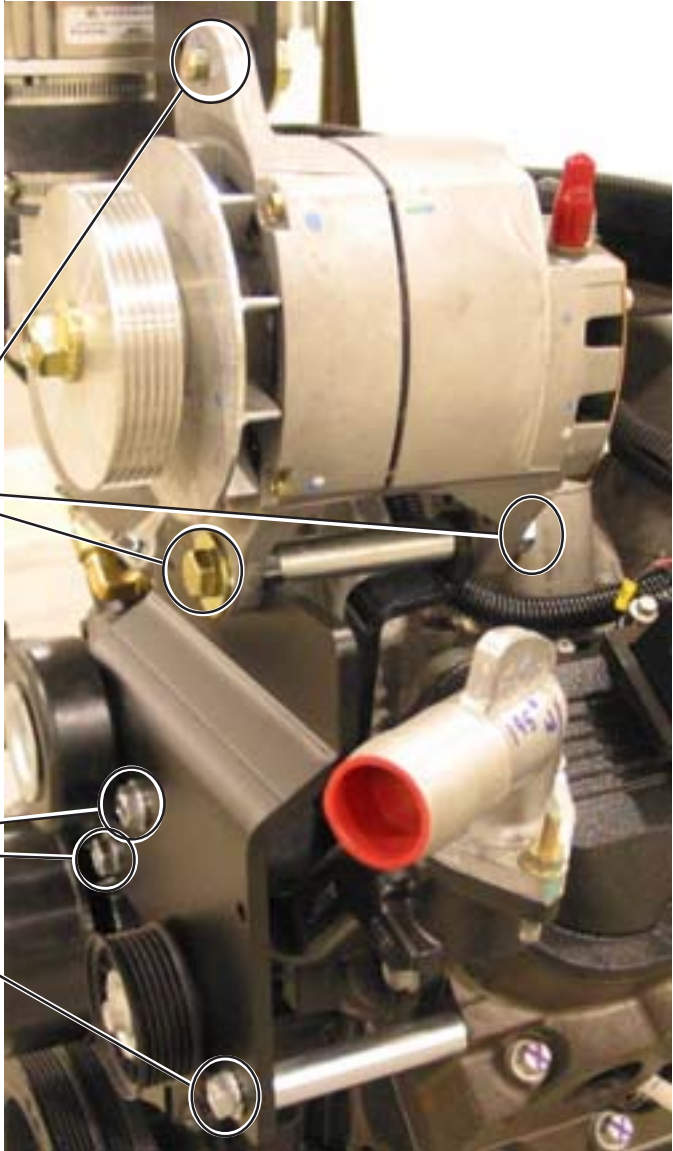
Note: Be sure all electrical connections have been removed.

Carefully set the alternator aside.

Alternator mounting bolts

19. Remove the alternator mounting bracket. A **17 mm wrench** is required.

Mounting Bracket Bolts



20. Remove the cooling system crossover pipe by removing the 4 bolts and gaskets. A **15 mm wrench** is required.

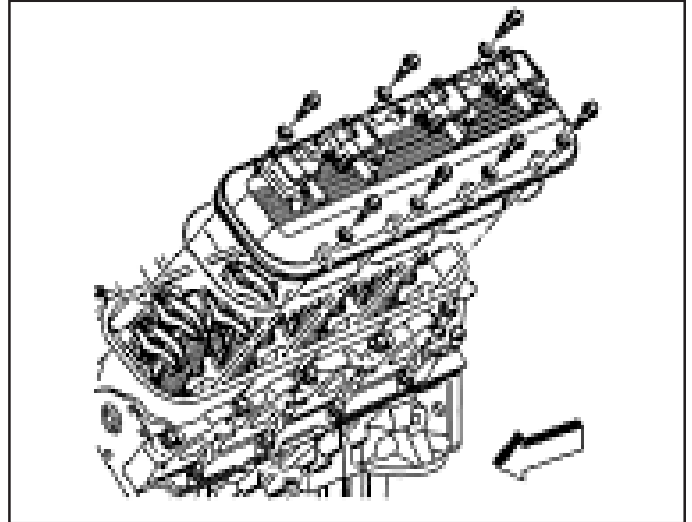
Crossover Pipe



21. Remove the valve rocker arm cover/ignition coil assemblies by removing the retaining bolts. A 10 mm socket wrench is required.

Note:

The valve rocker arm cover gasket may be reused if not removed from the rocker arm cover.



22. Remove the intake manifold bolts. A **10 mm socket wrench** is required.

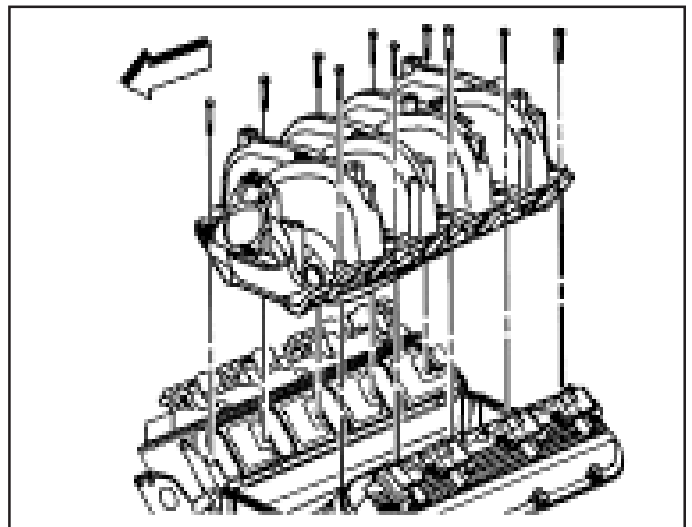
Remove the intake manifold and set aside.

Important:

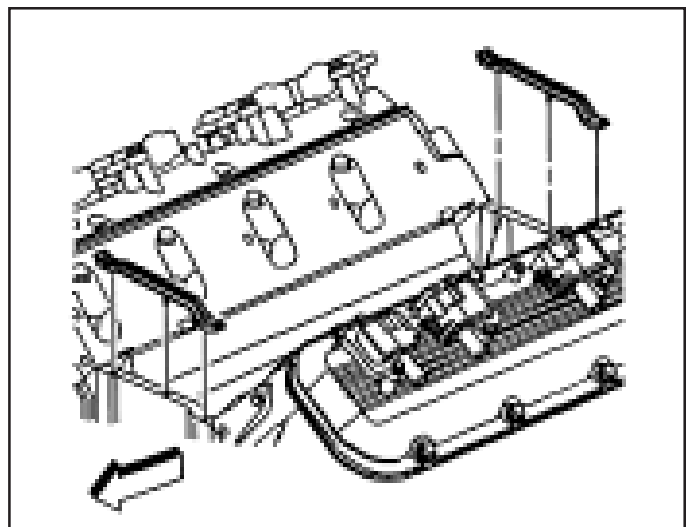
Do not attempt to loosen the manifold by prying under the gasket surface with any tool.

Important:

The intake manifold gaskets are not reusable and must be discarded.



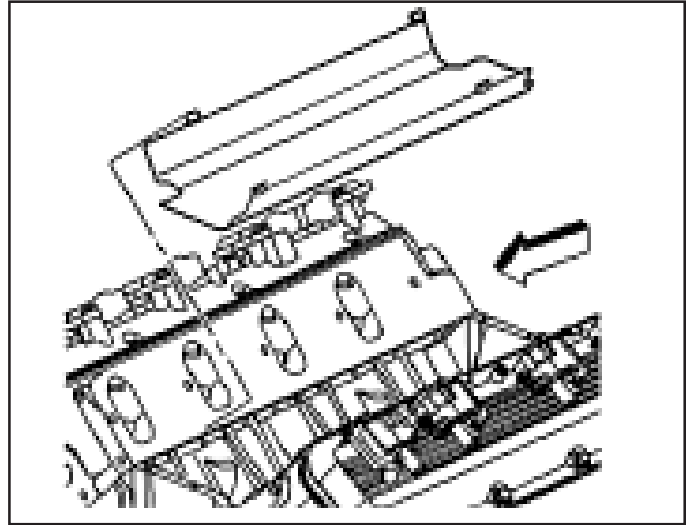
23. Remove and discard the lower intake manifold end seals.



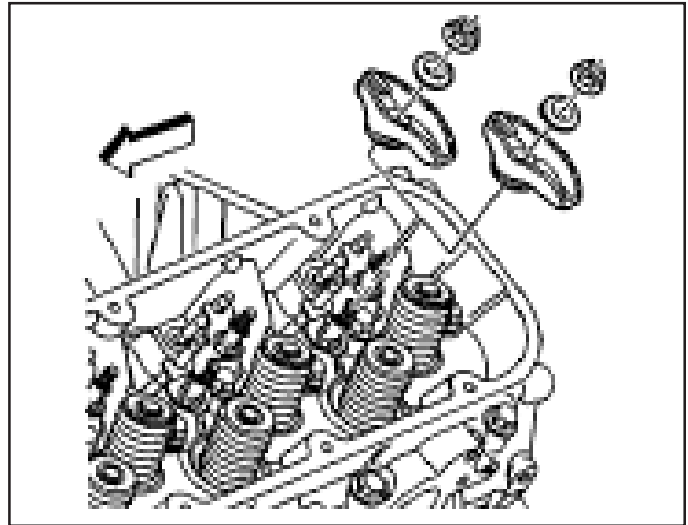
24. Remove the splash shield.

Important:

The splash shield is secured using a snap-fit. Do not distort the splash shield. The splash shield is reusable but should be cleaned of buildup and surface rust.



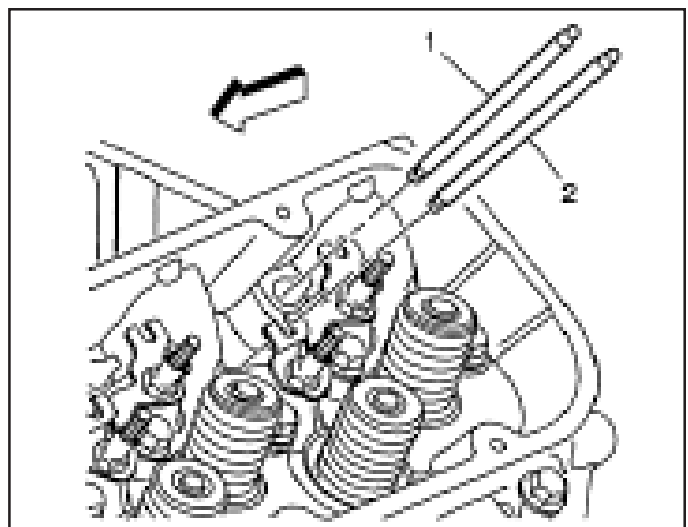
25. Remove the valve rocker arm nuts, the valve arm balls and the rocker arms. A **13 mm socket wrench** is required.



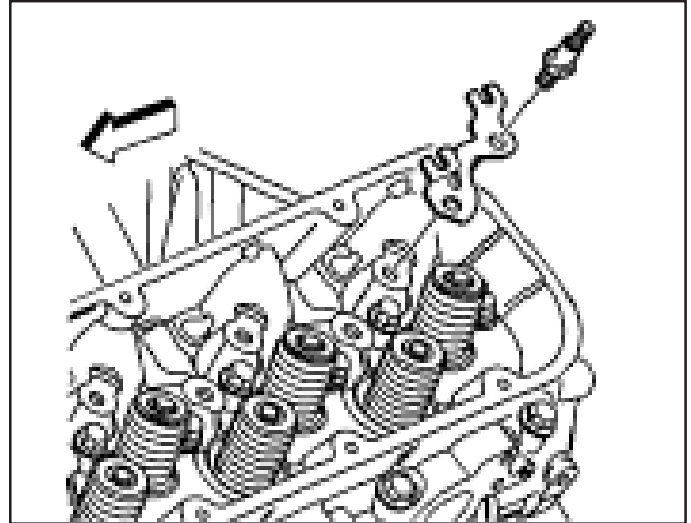
26. Remove the push rods by pulling them out.

Notice

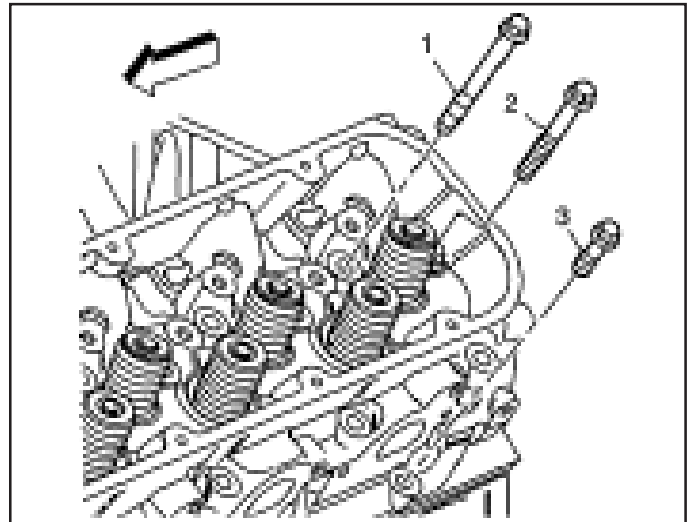
that the exhaust valve push rods are longer than the intake valve push rods and must not be mixed at reassembly.



27. Remove the valve rocker arm studs and pushrod guides. A **17 mm deep socket wrench** is required.



28. Remove the 36 cylinder head mounting bolts. A heavy duty **1/2 in drive with a 13 mm socket** is required along with an **extra long 1/2 in drive breaker bar**. The heads are retained by 2 locating dowel pins with the head bolts removed.

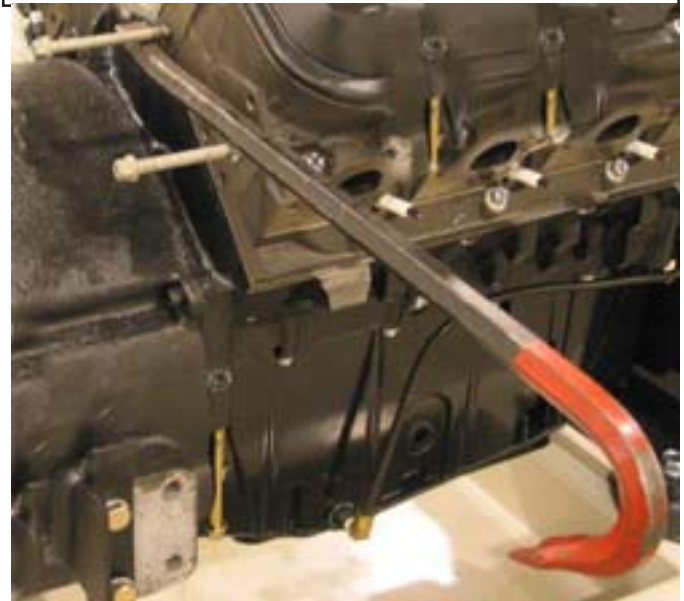


Important:
The cylinder head bolts are not reusable and must be discarded.

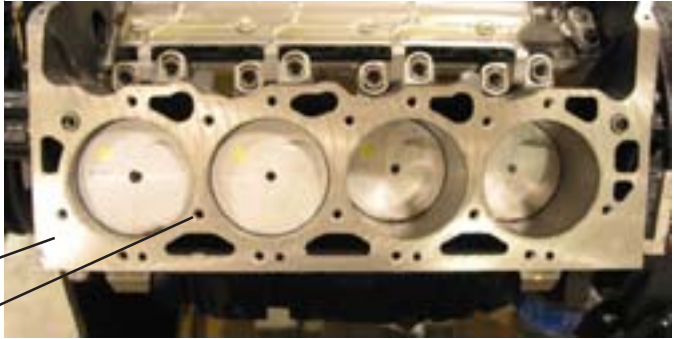
29. Remove the cylinder heads by carefully prying up on the cylinder head. This can be done by temporarily installing 2 used cylinder head bolts in the end of the head (to insure the head does not accidentally come off), then prying with a pry bar positioned between the bolts. The head should be pried up and away from the center of the engine.

WARNING:
Loosely reinstall 2 cylinder head bolts on each end of the head when prying to break the head loose to be sure the head does not come disengaged from the locating pins and, therefore, loose from the engine. Damage to the engine, head, or personal injury could result.

WARNING:
Extreme care must be taken in the head removal process. The heads weigh approximately 90 lbs (40.8 kg) and contain a small amount of coolant. The head removal process requires 2 people.



30. Prepare the exposed cylinder head mounting surfaces on the engine block for the new head by removing any gasket material that might have been retained from the old gasket. Also, the cylinder head mounting bolt threads in the engine block must be cleaned by using a **thread chasing tool of the correct size (10 mm X 1.25)**.



Clean Surfaces (Do not mar or scratch)

Chase All Bolt Threads

CYLINDER HEAD REPLACEMENT PROCEDURE

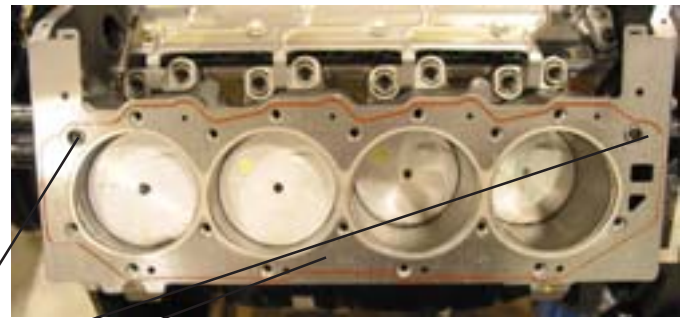
WARNING:

Wear safety glasses in order to avoid eye damage.

1. Check all cylinder head mounting surfaces to ensure all are free of debris.
2. Carefully position new cylinder head gaskets in position on the engine block. Be certain the locating dowels pass through the proper holes in the gaskets and the gasket is down against the engine block.

Note:

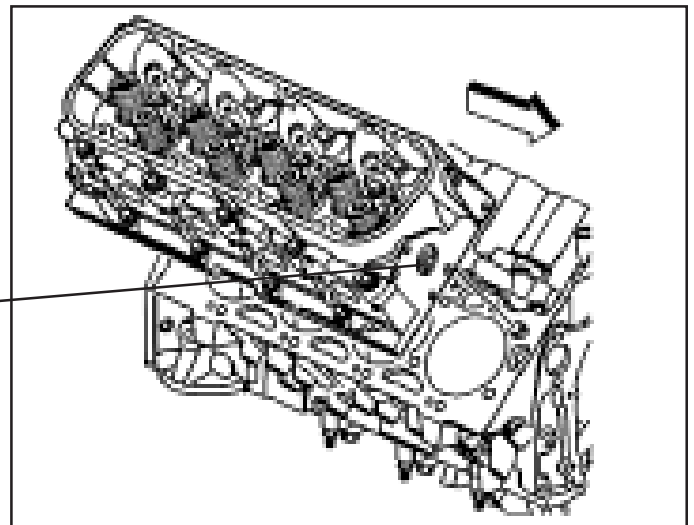
The cylinder head gaskets are specific to left and right and are not interchangeable.



Locating Pins

Gasket In Place (Left Shown)

3. With the help of an assistant, carefully place the new head into position onto the gasket. Be sure the dowel locators are in the proper holes in the head. The crossover pipe port must be toward the front of the engine. Take great care not to damage the gasket.



Crossover Pipe Port

4. Start the new cylinder head bolts by hand into the proper locations.

There are 3 different length bolts and must be positioned correctly. The long bolts are used in the center of the head, the medium length bolts are used at the inside, end of the head, and the short bolts are used across the outboard side of the head.

5. It is critical for the bolts to be torqued in the proper sequence with the specific procedure.

Note: The use of a special tool designed to accurately read bolt rotation angles is recommended. GM Special Tool J 36660-A Electronic Torque Angle Meter, or equivalent, is required.

Typical Torque Angle Meter

There are 3 steps (passes) to the procedure:

First Pass - Torque all bolts in the proper sequence shown in the diagram to 22 lb ft (30 Nm).

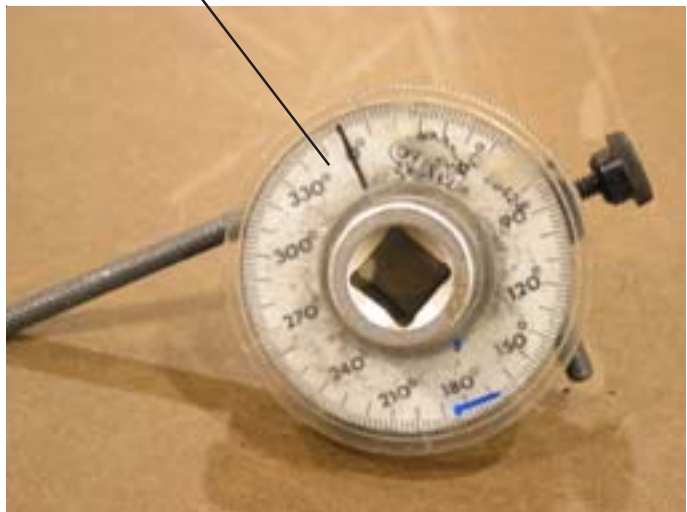
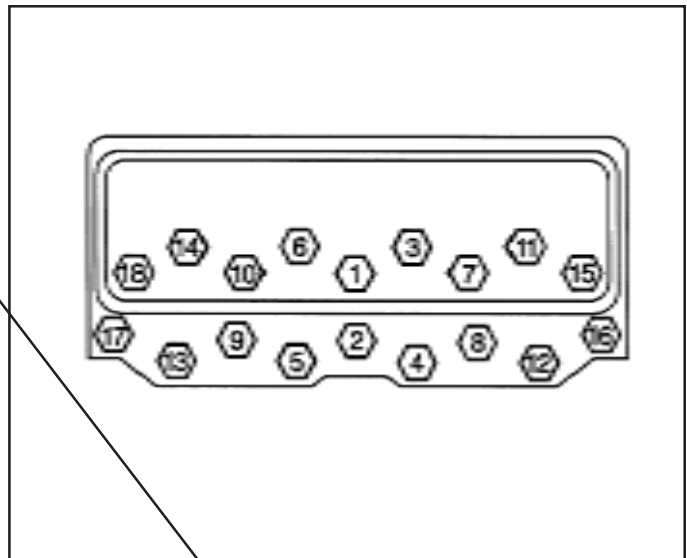
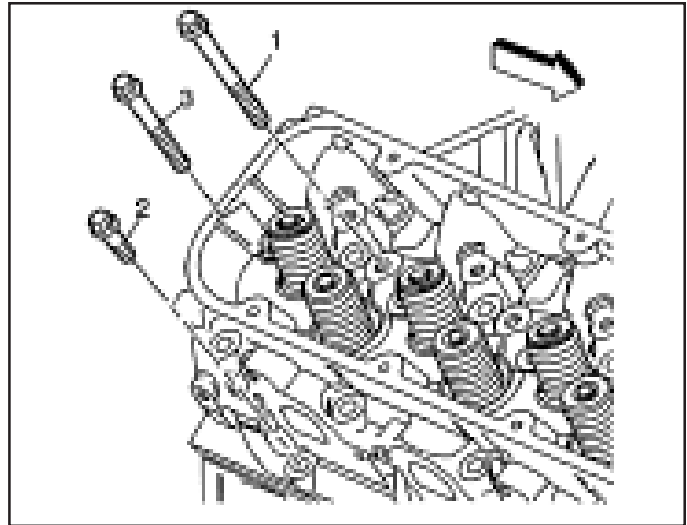
Second Pass - Retighten each bolt in proper sequence to 22 lb ft (30 Nm), then turn an additional 120 degrees.

**Third Pass - Tighten the long bolts
Be sure to continue using the same bolt sequence as used in the First Pass.**

(1,2,3,6,7,8,9,10,11,14,16, and 17) an additional 60 degrees. Tighten the medium length bolts (15, and 18) an additional 45 degrees. Tighten the short bolts (4,5,12, and 13) an additional 30 degrees.

Use a **0 to 37 lb ft (0 to 50 Nm) torque wrench** with a **13 mm socket** for the First & Second Passes.

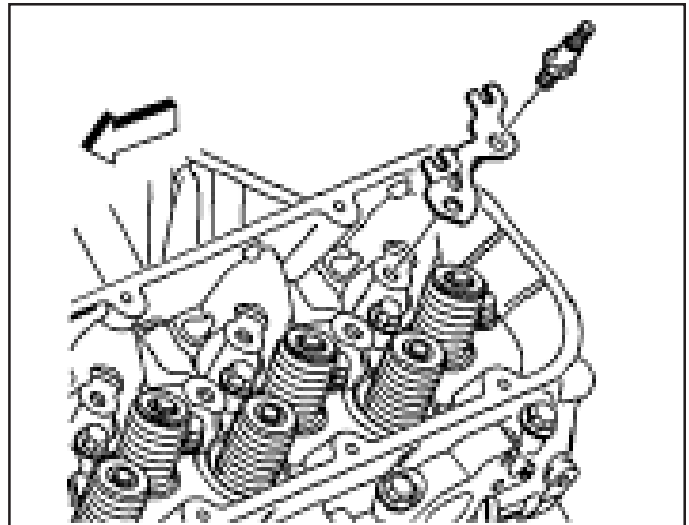
Use an **extra long 1/2 in drive breaker bar** for the Third Pass.



6. Apply sealer **GM P/N 12346004** or equivalent to the valve rocker arm stud-to-cylinder head threads.

Install the push rod guides and valve rocker arm studs onto the cylinder head. Tighten to **37 lb ft (50 Nm)**

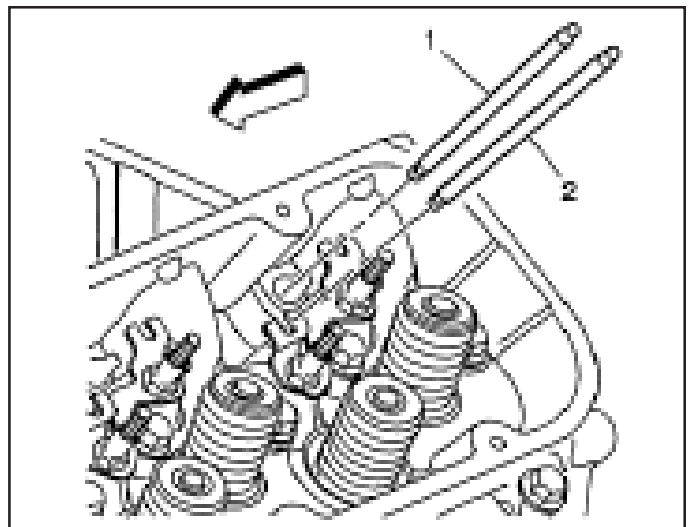
A **17 mm deep well socket wrench** must be used.



7. Install the valve push rods.

Important:

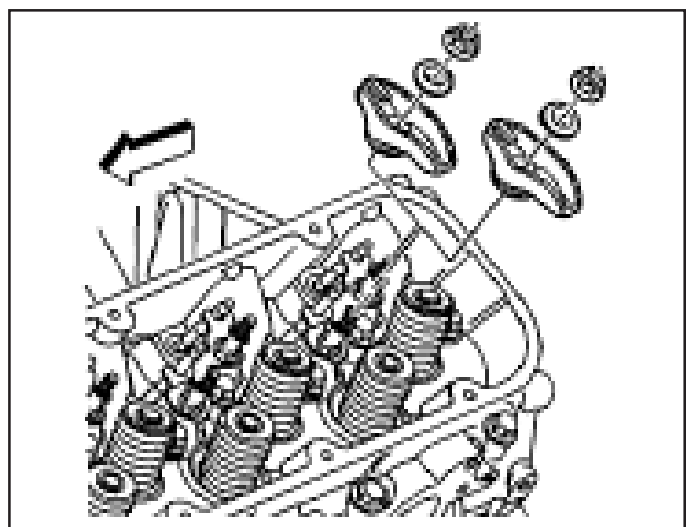
The engine uses different length rods for exhaust and intake valves. The exhaust valve rods are longer than the intake valve push rods.



8. Coat the valve rocker arms and valve rocker arms ball bearing surfaces with prelub **GM P/N 1052367** or equivalent.

Install the valve rocker arms, the valve rocker arm balls and the valve rocker arm nuts.

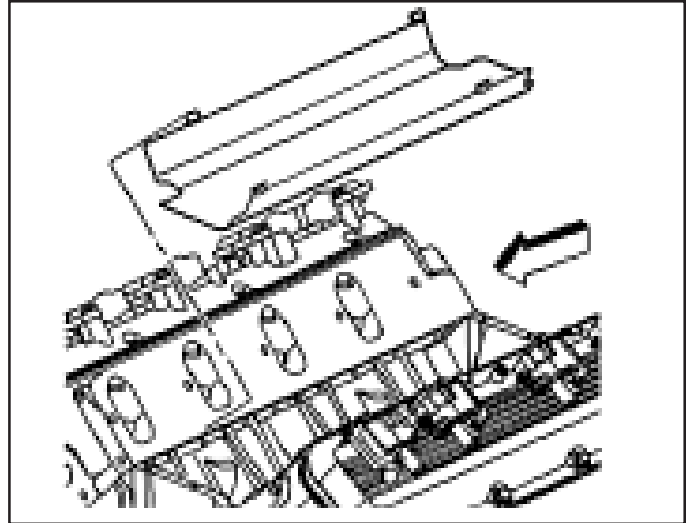
Tighten the valve rocker arm nuts slowly, to **18 lb ft (25 Nm)** while guiding the tips of the rocker arms over the tips of the halves.



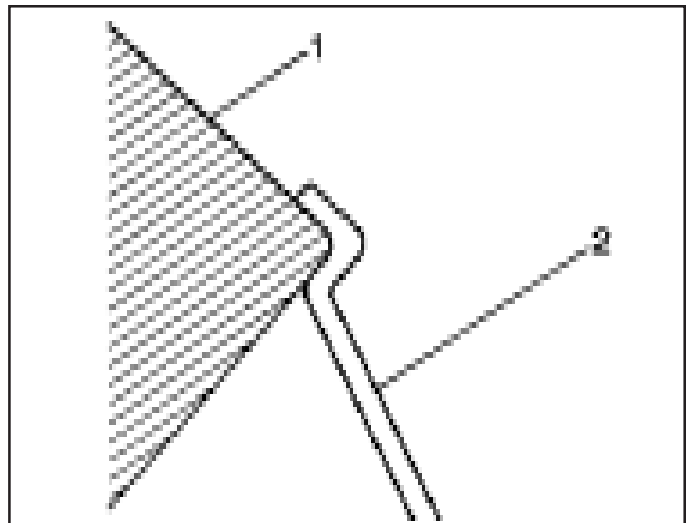
9. Install the splash shield

Important:

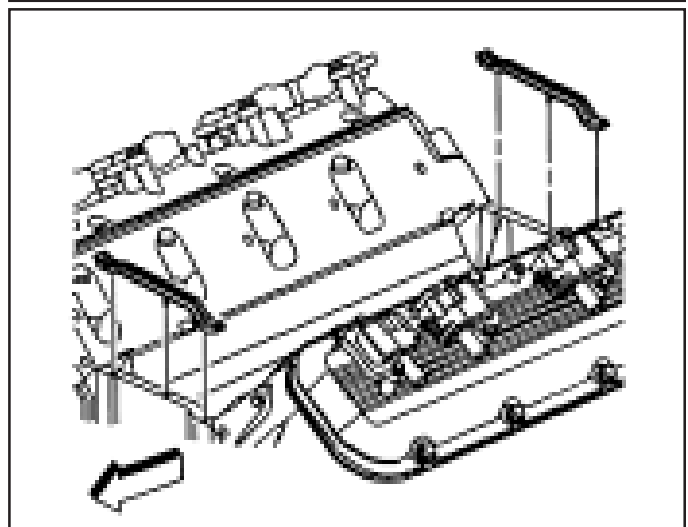
The splash shield is secured using a snap-fit. Take care not to distort the splash shield during installation..



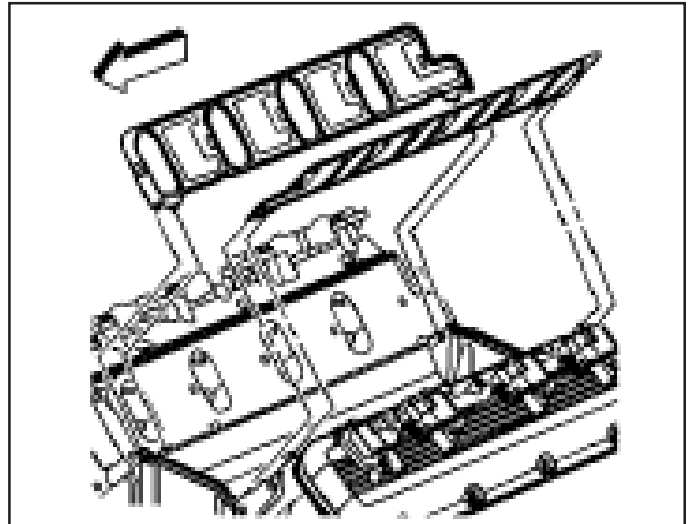
10. Ensure the splash shield (2) snap fits between the cylinder heads (1).



11. Install the new intake manifold end seals. Apply a light coat of silicone sealant over the entire length of the end seals. Place an added amount (1/4 X 1/4 inch) on top of the seals in each corner.

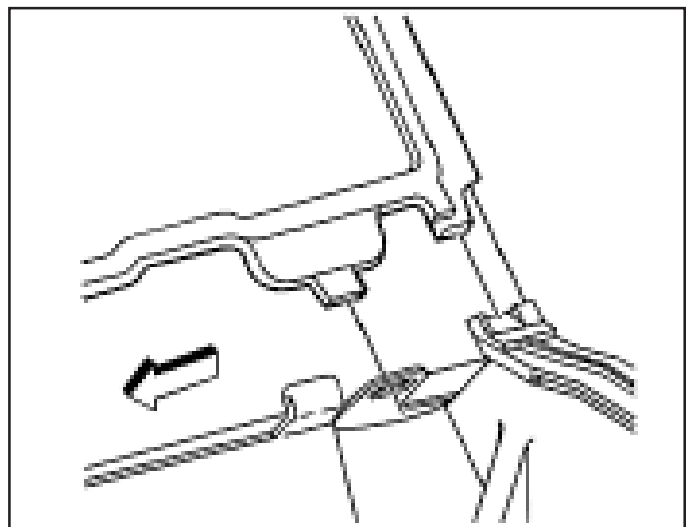


12. Install the new intake manifold side gaskets onto the cylinder heads. Ensure that the flame arrestors are securely positioned so that the wire mesh protrudes into the cylinder head intake port.



13. Ensure the intake manifold gasket tabs align with the hole in the head gasket.

Ensure the intake manifold gasket tabs align with the slot in the lower intake manifold seals.



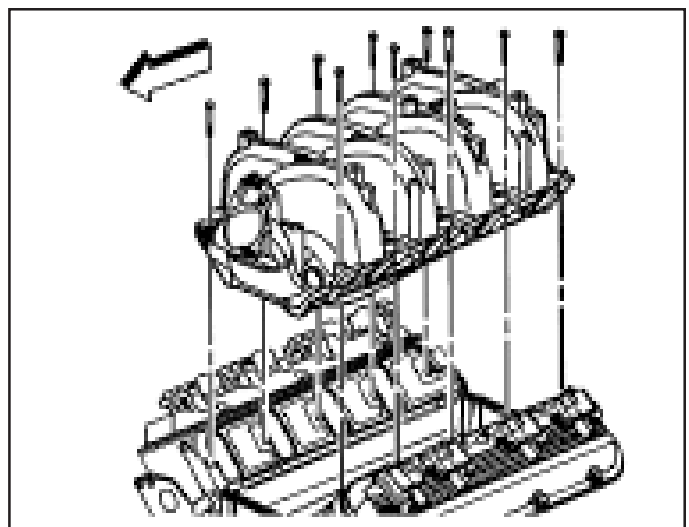
14. Install the intake manifold onto the engine block.

IMPORTANT:

The entire intake manifold tightening sequence must be followed exactly, or an oil leak resulting in engine damage may occur. Ensure the intake manifold is tightened without allowing the intake manifold to shift.

IMPORTANT:

The entire intake manifold tightening sequence must be promptly completed due to the anaerobic thread adhesive. The final pass of the tightening sequence must be completed before the adhesive starts to cure, or false torque readings and ineffective thread locking may result.



15. Apply thread adhesive **GM P/N 12345382** or equivalent to a **minimum of eight threads** of the intake manifold bolts.
16. Install the intake manifold bolts. Tighten the intake manifold bolts in sequence, using four passes:

First pass - Tighten the intake manifold bolts in sequence to 18 lb in (2 Nm) on the first pass.
Second pass - Tighten the intake manifold bolts in sequence to 18 lb in (2 Nm) on the second pass. Inspect the intake manifold joints for signs of intake manifold shifting. Correct as required.

Third pass - Tighten the intake manifold bolts in sequence to 88 lb in (10 Nm) on the third pass.

Fourth pass - Tighten the intake manifold bolts in sequence to 106 lb in (12 Nm) on the final pass.

A 10 mm socket wrench is required.

17. Install the valve rocker arm cover with gasket. A 10 mm socket wrench is required.

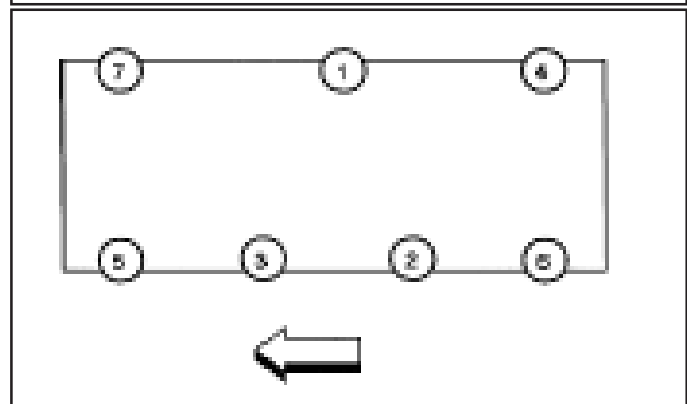
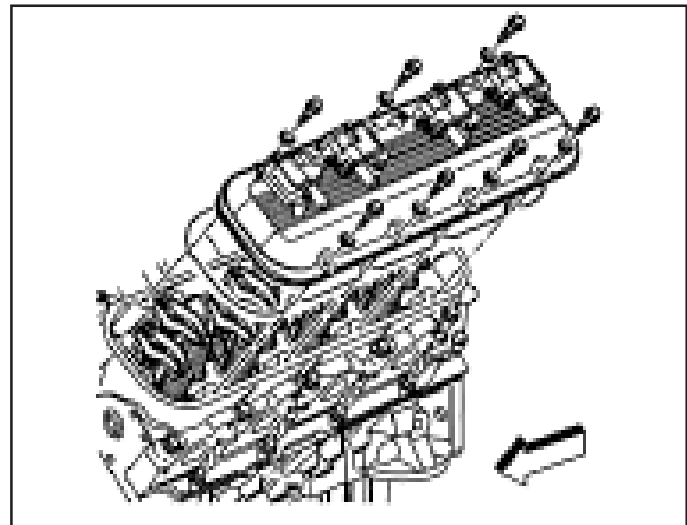
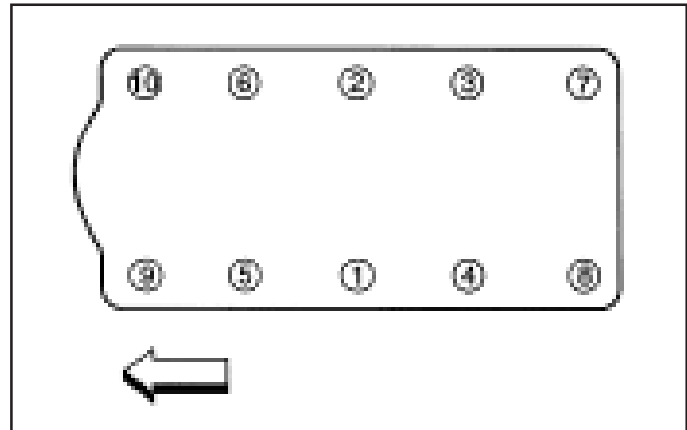
Important:

If the valve rocker arm cover gasket was removed from the valve rocker arm cover, install a NEW valve rocker arm cover gasket.

Tighten the valve rocker arm cover bolts in sequence using 2 passes:

Pass 1 - Tighten the valve rocker arm cover bolts in sequence to 54 in lb (6 Nm).

Pass 2 - Tighten the valve rocker arm cover bolts in sequence to 106 lb in (12 Nm).



18. Place the cooling system crossover gaskets and the crossover in position and start the retaining bolts.

Tighten the crossover bolts to **37 lb ft (50 Nm)**

A **15 mm wrench** is required.

Crossover Pipe



19. Install the belt driven alternator bracket.

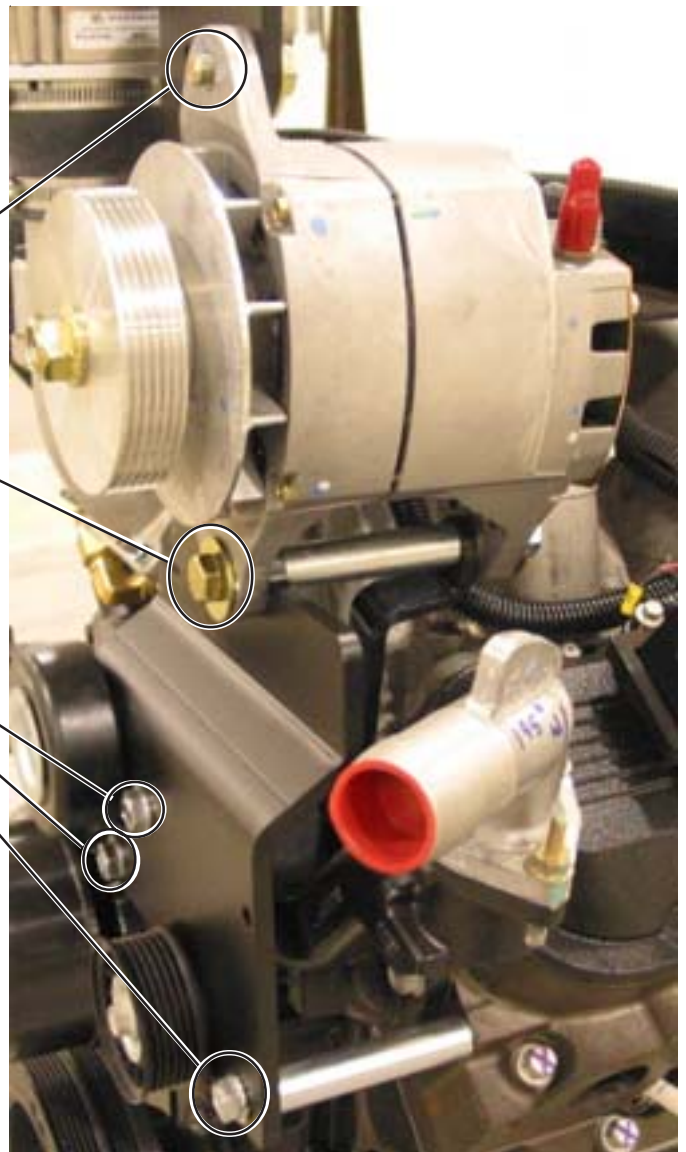
A **16 mm wrench** is required.

20. Install the belt driven alternator by installing the bottom bolt and nut, then the top bolt. A **19 mm wrench** is required.

Alternator Mounting Bolts - top

- bottom

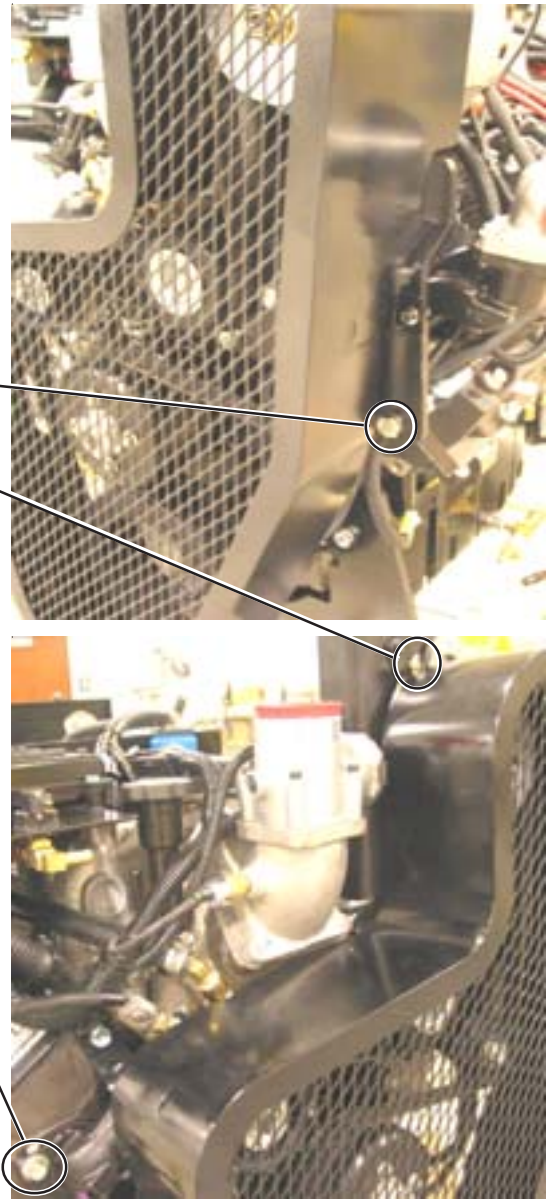
Mounting Bracket Bolts



21. Replace the serpentine belt. Refer to the "Serpentine Belt Inspection & Replacement Procedure", Page 16.

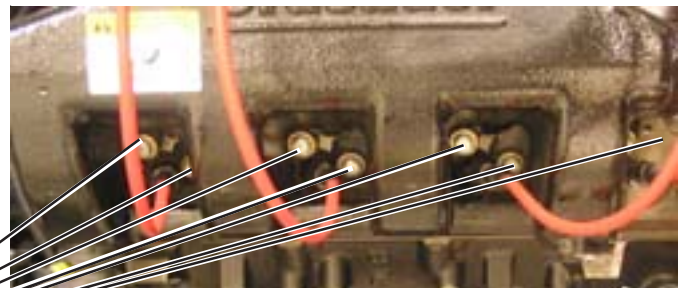
22. Move the belt guard into position and replace the retaining bolts. **10 & 15 mm wrenchs** are required.

Belt Guard Retaining Bolts



23. Install the exhaust manifolds using new exhaust manifold gaskets. A **13 mm socket wrench** is required.

Tighten the exhaust manifold bolts to **26 lb ft (35 Nm)**



Manifold Mounting Bolts (8 per manifold)

24. Install the spark plugs. A **5/8 in spark plug socket wrench** is required.
Tighten the spark plugs to **15 lb ft (20 Nm)**.

25. Install the spark plug wires to the spark plugs and the ignition coils.

Refer to “Spark Plug Replacement Procedure”, Page 23.

26. Move the oil level indicator tube into position and install the retaining bolt. A **13 mm wrench** is required.
Tighten the retaining bolt to **18 lb ft (25 Nm)**.

Oil Level Indicator Tube Bolt



26. Reinstall the engine harness onto the engine.

Notes taken at removal are critical to correct positioning of the harness.

Important:

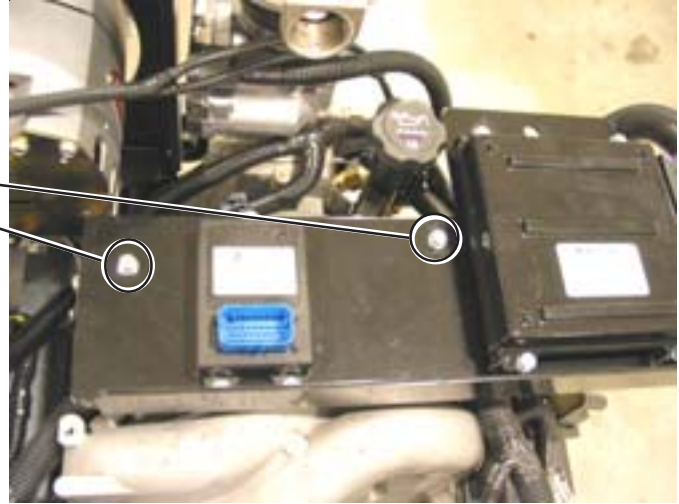
The engine harness is designed to fit the engine in one specific routing and position. Wire ties must be reinstalled in the same locations as originally produced. Other routings and positions can result in the harness not reaching all connectors or damage from sharp corners, tight spans, or hot locations.

IMPORTANT:

Fully install the spark plug wire by pushing on the exposed end of the spark plug boot. Do not push the spark plug wire on the spark plug by using the metal heat shield.

27. Remount the engine controller mounting plate and related components. A **10 mm wrench** is required.

Mounting Plate Screws



28. Connect all electrical connectors relating to the engine harness and UEGO system. Refer to removal procedures

29. Reconnect the crankcase vent hose to the auxiliary port on the oil fill tube.

Crankcase Vent Hose connection



30. Reposition the mixer to align the retention screws and replace the screws. Replace the mixer cover and retention nut.



31. Reinstall the air intake tube by reversing the removal procedure.

After positioning the tube, insert the ends in the rubber fittings, reposition the clamps as originally found and tighten. A **7/16 in deep well socket** and a **common screw driver** are required.

32. Position the exhaust flanges in position at the water cooled manifolds, put a new sealing gasket in place, and start the 4 attaching bolts by hand.

Attaching Bolts



Torque the 4 bolts on each manifold in 4 passes using a crossing pattern:

Pass 1 - 15 lb ft (20.3 Nm)

Pass 2 - 25 lb ft (33.9 Nm)

Pass 3 - 35 lb ft (47.5 Nm)

Pass 4 - 50 lb ft (67.8 Nm)

33. Plug in the oxygen sensor connector into the harness.

34. Replace the engine coolant drain plugs on both sides of the engine.

Coolant Drain Plug



35. Change the engine oil and filter per the "Oil & Filter Change Procedure", Page 3.

36. Be sure the coolant drain valve is closed. Fill the coolant systems by adding the recommended coolant in the top openings of the 2 tanks (if present). The coolant level should be filled to cover the top tank fitting.

Add Coolant



37. Replace pressure caps to the tanks. Note that there are 2 pressure level caps. The lower pressure cap must be on the tank in the engine cooling loop, and the high pressure cap on the tank in the CHP loop (if present).

Engine Cooling Loop Tank (Low Pressure Cap)

CHP Cooling Loop Tank (High Pressure Cap)



38. Reconnect the negative terminal(s) at the battery.

Negative Battery Terminal(s)



39. Switch **CB105** to “ON”.

CB105



40. Turn on the fuel supply and open the CHP system valves.
41. Start the engine by turning the “**SYSTEM**” switch to “**ON**” & pressing the “**TEST**” button on the GCP-21 controller...

Message button

Test button

Stop button



As the engine is running, observe the engine oil pressure and coolant temperature. If the oil pressure is low and the coolant temperature is high, stop the engine by turning the “**TEST**” switch to “**OFF**” and investigating the cause. Repair as required.

42. As the engine is running, walk around it to observe for any leakage:

Coolant system, particularly the drain valve, crossover pipe and heads.

Oil system.

Check for any apparent exhaust leakage at the water cooled manifolds, and the slip connection.

Turn off the engine by turning the “**TEST**” switch to “**OFF**” if any leakage is observed and repair.

WARNING:

Use caution since the exhaust gasses and exhaust pipes get hot very quickly and can cause burning.

43. After the coolant temperature and oil pressure have stabilized, stop the engine by pressing the “STOP” button, and turn the “SYSTEM” switch to the “OFF” position.

44. After the engine cools, proceed with the following:

- a. Re-torquing the bolts connecting the exhaust pipes to the water cooled manifolds to **50 lb ft (67.8 Nm)** using a crossing pattern.
- b. Reposition the insulating blanket at the slip joint to the original configuration and band.
- c. Check the coolant levels in the tanks and top off to cover the top pipe connections, if necessary.
- d. Check the engine oil level at the dipstick and add to “FULL” mark, if necessary.
- e. Open the oil replenish valve.



Oil Replenish Valve

Note: The dipstick should be pulled out slightly after inserting to relieve any pressure that might be trapped in the dipstick tube from inserting the dipstick. It is possible to get an artificially low reading and overfill the engine if the pressure is not relieved.

f. The 5 gallon oil tank should be checked for any trapped air by carefully loosening the fill cap and relieving any air that might be trapped at the top of the tank and top off.

45. Reinstall the access doors

Access Doors (left side shown)



46. Return the ENI 65 to service.

ENGINE COOLANT PUMP REMOVAL PROCEDURE

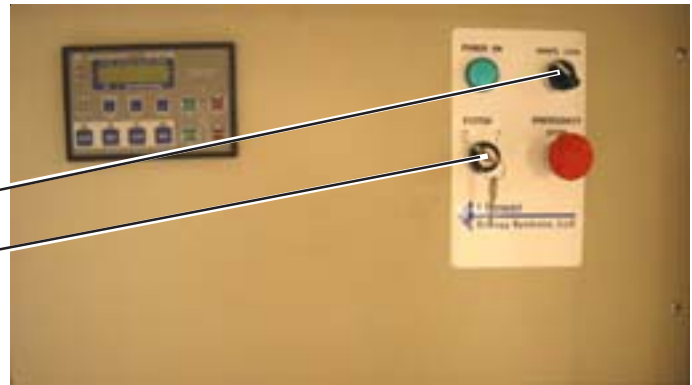
WARNING:

Wear safety glasses in order to avoid eye damage.

1. Turn the “**REMOTE LOCAL**” switch to “**LOCAL**”. Then, shut off the engine & turn the “**SYSTEM**” switch to “**OFF**”.

Remote Local Switch

System Switch


Caution:

The engine should be allowed to cool to avoid burns when working with engine parts

WARNING:

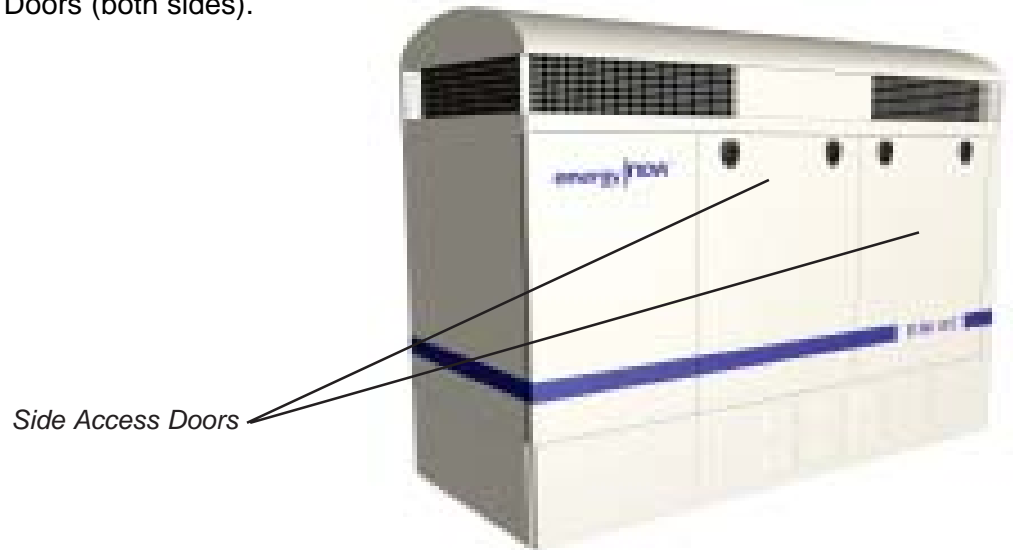
The unit must be locked out per normal procedures:

1. Turn off and lock out utility power
2. Turn off and lock out fuel supply
3. Turn off the separate power supply by turning CB105 to the “OFF” position.

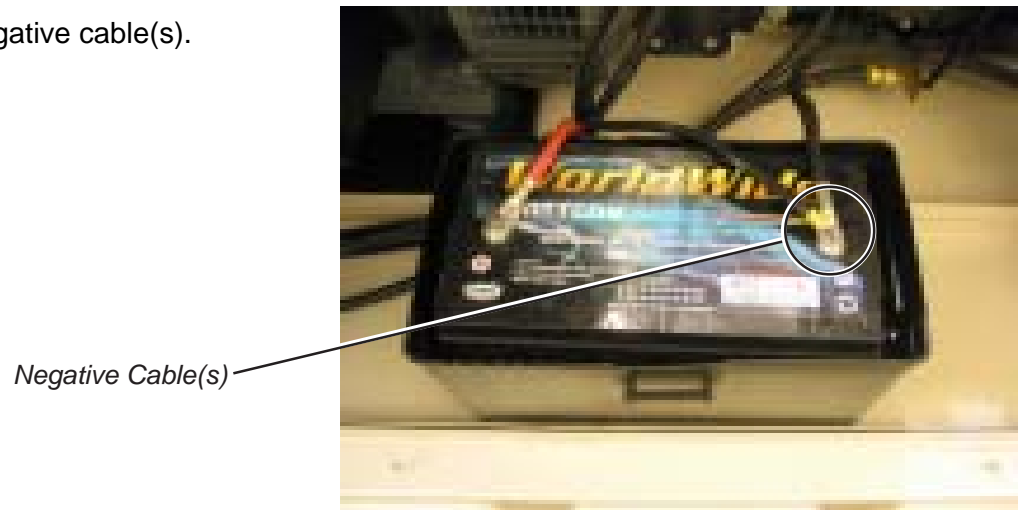
CB105



2. Remove the Side Access Doors (both sides).

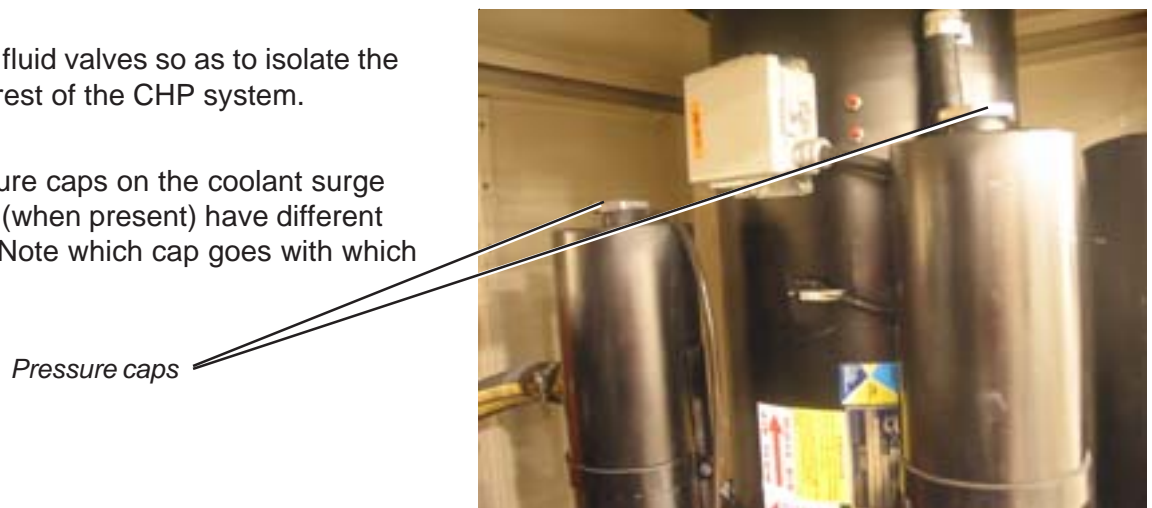


3. Disconnect the battery negative cable(s).



4. Shut off all CHP fluid valves so as to isolate the ENI 65 from the rest of the CHP system.

Remove the pressure caps on the coolant surge tanks. The 2 tanks (when present) have different pressure settings. Note which cap goes with which tank.



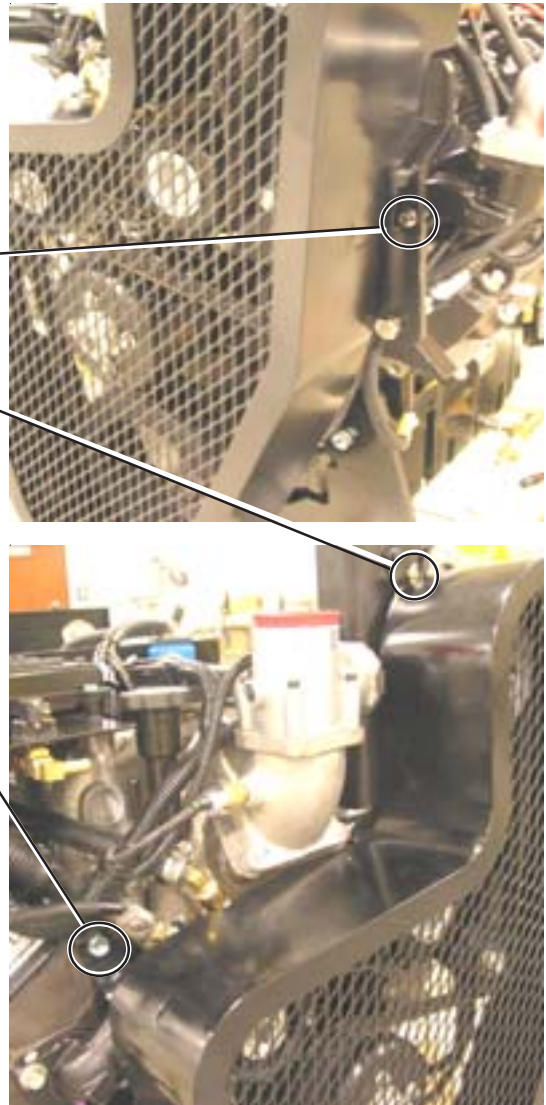
5. Waste Heat Recovery System - This system is drained by opening a valve located in the piping at the front of the unit. A **1/2 in (12.7 mm) hose** is required to drain into a suitable container. This portion of the systems contains approximately 4 gallons (14 L) of coolant.

A pump may be needed to move the coolant from the valve, through the hoses, to the container.



6. Remove the bolts retaining the belt guard and move the guard forward clear of the belt. **10 & 15 mm wrenches** are required.

Belt Guard Retaining Bolts

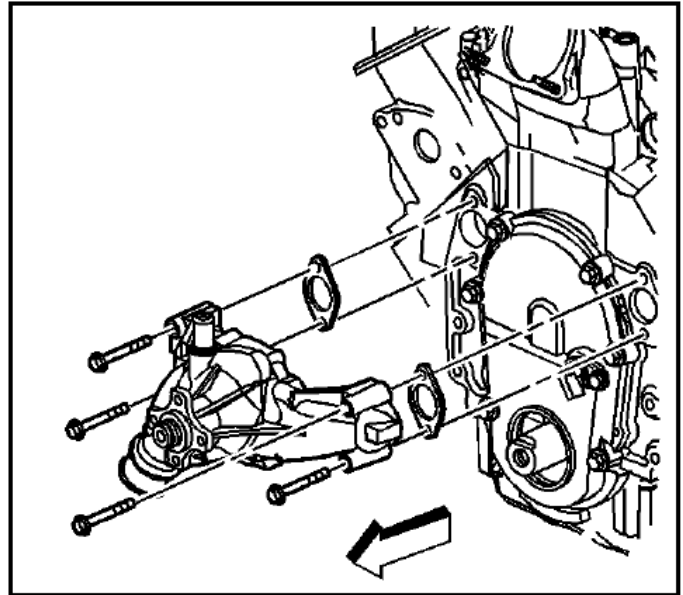


7. Remove the serpentine belt. Refer to “Serpentine Belt Inspection & Replacement Procedure”, Page 16.

8. Remove the water pump bolts.
A **15 mm wrench** is required.

9. Remove the water pump.

10. Remove and discard the water pump gaskets.



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ENGINE COOLANT PUMP INSTALLATION PROCEDURE

WARNING:

Wear safety glasses in order to avoid eye damage.

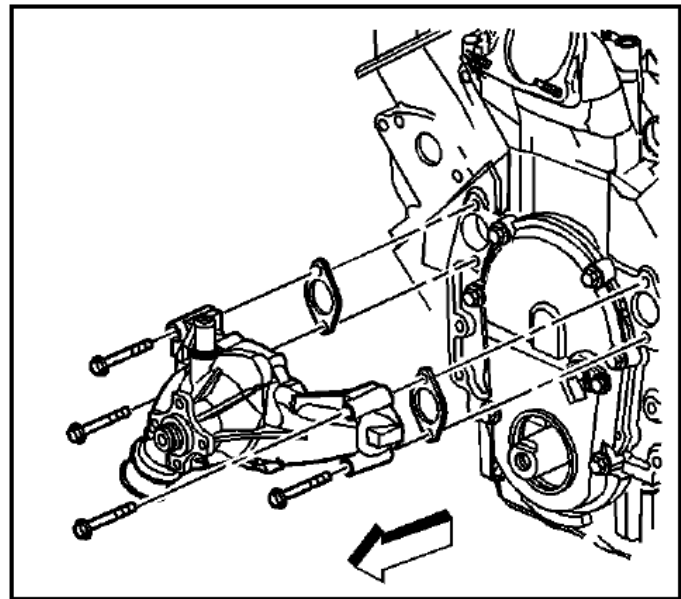
1. Place the new water pump and new gaskets into position on the front of the engine and start the retaining bolts.

A **15 mm wrench** is required.

2. Tighten the water pump retaining bolts to **37 lb ft (50 Nm)**.

3. Remove the pulley from the old water pump and install on the new pump

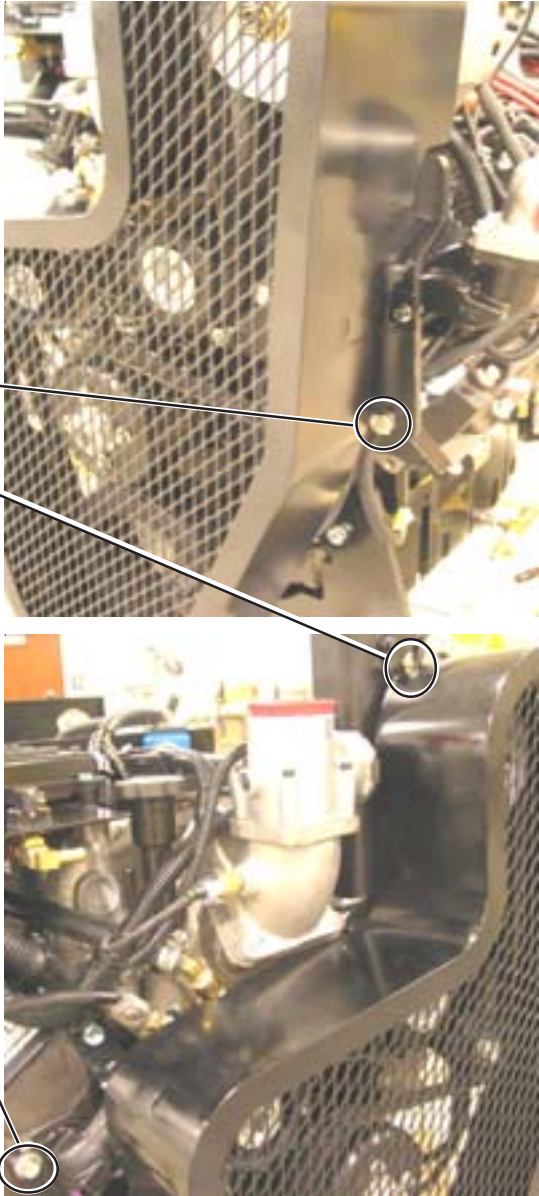
4. Replace the serpentine belt. Refer to the "Serpentine Belt Inspection & Replacement Procedure", Page 16.



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5. Move the belt guard into position and replace the retaining bolts. **10 & 15 mm wrenchs** are required.

Belt Guard Retaining Bolts



6. Be sure the coolant drain valve is closed. Fill the coolant systems by adding the recommended coolant in the top openings of the 2 tanks (if present). The coolant level should be filled to cover the top tank fitting.

Add Coolant



7. Replace pressure caps to the tanks. Note that there are 2 pressure level caps. The lower pressure cap must be on the tank in the engine cooling loop, and the high pressure cap on the tank in the CHP loop (if present).

Engine Cooling Loop Tank (Low Pressure Cap)

CHP Cooling Loop Tank (High Pressure Cap)



8. Reconnect the negative terminal(s) at the battery.

Negative Battery Terminal(s)



9. Reconnect the power supply by turning **CB105** to “ON”.

CB105



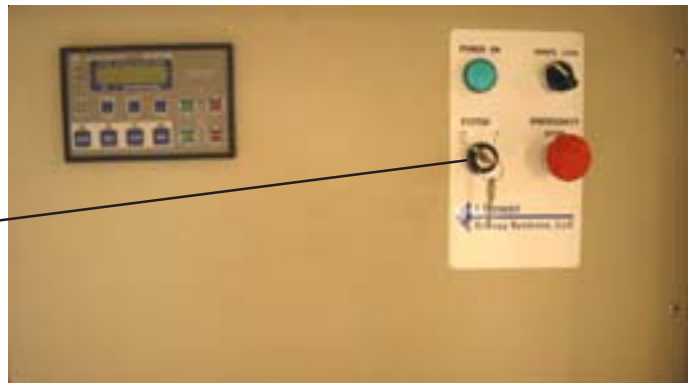
10. Open the CHP system valves.

11. Engine will now be started. Start the engine by turning the “**SYSTEM**” switch to the “**ON**” position and pressing the “**TEST**” button on the GCP-21 controller. The engine should start and run.

System Switch

Message Button

Test Button



As the engine is running, observe the coolant temperature. This is done by pressing the “**MESSAGE**” button until the engine temperature are displayed.



12. As the engine is running, walk around it to observe for any leakage in the coolant system, particularly the drain valve and coolant pump.
13. After the coolant temperature has stabilized, stop the engine by pressing the **“STOP”** button and turn the **“SYSTEM”** switch to the **“OFF”** position.
14. After the engine cools, check the coolant levels in the tanks and top off to cover the top pipe connections, if necessary.
15. Reinstall the access doors

Access Doors (left side shown)



16. Return the unit to service.

GENERAL SYSTEMS INSPECTION

General inspection of major ENI 65 systems must be done at regular service points to assure the ongoing reliability of the unit.

Exhaust System

The exhaust system must be inspected to insure no over heating or leakage has occurred.

1. After the access doors are removed, including the lower cover on the left side, follow the exhaust pipes from the exhaust manifold attachments to the last visible point after the catalytic converter.
 - a. An exhaust leak can be identified by the insulation blanket being discolored or having a hole burned through it.
 - b. Examine the panels on the left and right hand sides for signs of paint darkening that could indicate exposure to high temperature.
2. If a condition in Step 1 is identified, remove the damaged blanket and inspect the exhaust piping in the damaged location. Make the necessary repairs to the exhaust piping to correct the leak and install a new insulating blanket where heat damage has occurred

Coolant System

The coolant system consists of all the hoses, piping, and coolant connections within the ENI 85.

Hoses & Clamps

1. Inspect all hoses and clamps for the following conditions;
 - a. Cuts, abrasions, or bubbles in the hose. Minor indentations or irregularities in the outer surface of the hose is normal to the type of hose used and does not indicate a problem.

- b. Hose clamps loose or misplaced. Signs of leakage at the hose connection.
2. If any hose / clamp damage or problem with leakage is found, the hose must be replaced with new hoses of the same specification as original.

The hose clamps are specific for the location and new clamps must be used in repair or hose replacements of exactly the same part number as the original. Contact I Power Energy Systems for assistance.

Piping

Much of the cooling system in the ENI 65 is constructed with iron piping. The pipe connections should be inspected for signs of wetness or coolant dripping.

If leakage is observed, the connection must be taken apart and resealed, using Loctite 565 sealant.

Caution:
ANY FORM OF "STOP LEAK" MUST NEVER BE USED IN THE ENI 85. Failure of the cooling system will result.

Iron pipe plumbing skills are helpful in working with the CHP part of the ENI 65 system.

CHP Pump (if equipped)

Inspect the CHP coolant pump (if equipped) for signs of leakage where the pump drive shaft enters the pump between the motor and the pump. If leakage is observed, the pump must be replaced.

Exhaust Manifold

Inspect the connection of the exhaust pipe flange to the top of the exhaust manifolds for signs of coolant leakage. Leakage is indicated by streaks down the side of the manifolds.

If signs of leakage is noted, the connection must be taken apart and resealed using a new gasket.

Electrical System

SCM and Engine Harness

The SCM and Engine Harness must be inspected for any signs of damage such as heat disfigurement, particularly near the exhaust system, wear from abrasion, or any other damage that could cause premature failures.

The electrical connections must be checked to be sure the contacts are fully engaged and the connector bodies (if present) are firmly latch.

Battery

Both the positive and negative battery terminals must be inspected for corrosion and cleaned with a battery terminal cleaning brush if needed.

PVC System

Inspect the PVC system at the rear of the engine for any indication of oil leaking from the Breather Cap. If leakage is observed, the PVC valve and Breather Cap must be replaced.

Coolant Levels

The coolant levels for both the engine cooling loop and CHP loop must be checked for correct fill.

WARNING:

Care must be taken when opening the coolant fill tanks. The coolant can be under pressure and very hot and can cause serious injury

Carefully remove the pressure caps and observe the fluid level in the tanks. The fluid must be filled to the top of the highest hose / pipe connection. If the fluid is low, add the I Power Energy Systems approved coolant to the correct level as described above. Be careful not to overfill since this can cause fluid spewing due to heat expansion.



Breather Cap

PCV Valve



Coolant Fill Caps

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**ENI 65 Induction
Maintenance Manual**

Page Issued
11-07

Replaces