

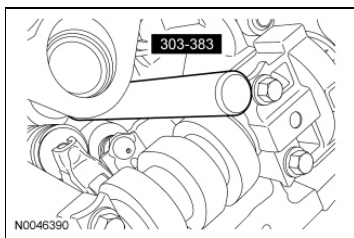
1. Lubricate the camshaft and camshaft journals with clean engine oil and install the camshaft.
2. Install the camshaft bearing caps in their original locations.
 - Lubricate the camshaft bearing caps with clean engine oil.
 - Position the front camshaft bearing cap.
 - Position the remaining camshaft bearing caps.
 - Install the bolts finger-tight.

3. **NOTE:** Lubricate the valve stem with clean engine oil prior to installation.

Install the valve into the cylinder head.

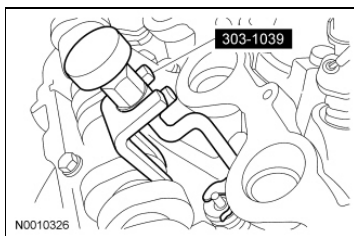
4. **NOTE:** Lubricate the valve seal and valve stem with clean engine oil prior to installation.

Using the Valve Stem Oil Seal Installer, install a new valve seal.



5. **NOTICE:** If the components are to be reinstalled, they must be installed into their original locations or engine damage may occur.

Using the Valve Spring Compressor, install the valve spring, the valve spring retainer and the valve spring retainer keys.

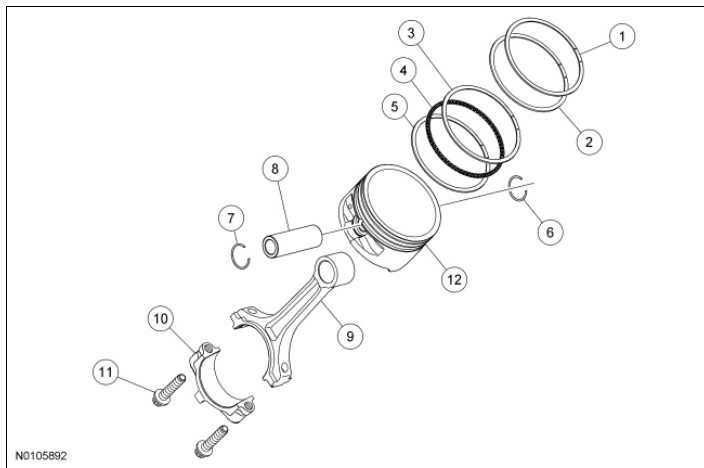


6. Repeat the previous 2 steps for each valve.
 7. Remove the bolts the front camshaft bearing cap and then the remaining bearing caps.
 8. Remove the camshaft.
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Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

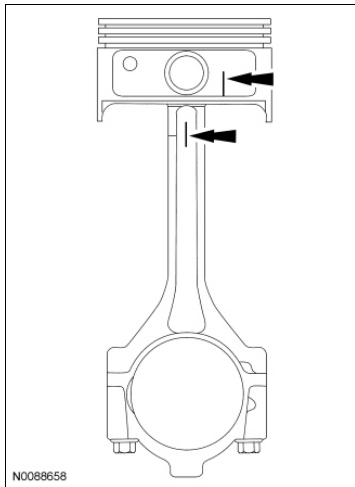


Item	Part Number	Description
1	6150	Piston compression upper ring
2	6152	Piston compression lower ring
3	6159	Piston oil control upper segment ring
4	6161	Piston oil control spacer
5	6159	Piston oil control lower segment ring
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin
9	6200	Connecting rod
10	--	Connecting rod bearing cap (part of 6200)
11	6414	Connecting rod bearing cap bolt (2 required)
12	6110	Piston

Disassembly

⚠ WARNING: Since the retainer ring has a tendency to spring out, cover the end of the pin bore with a hand or shop rag when removing the ring. Wear eye protection. Failure to follow these instructions may result in serious personal injury.

1. Remove the piston rings from the piston.
 - Discard the piston rings.
2. Mark the piston and connecting rod on the same side for assembly reference.

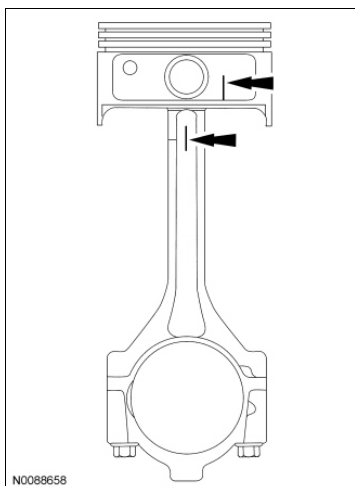


3. Remove the 2 piston pin retainers and the piston pin.
4. Separate the piston from the connecting rod.
5. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

Assembly

1. **NOTE:** The connecting rod must be installed into the piston with the marks made during disassembly on the same side. If a new piston or connecting rod is being installed, it can be installed in either direction.

Position the connecting rod in the piston.



2. Lubricate the piston pin and pin bore with clean engine oil.
3. Install the piston pin in the piston and connecting rod assembly.
4. Install the 2 piston pin retaining clips in the piston.

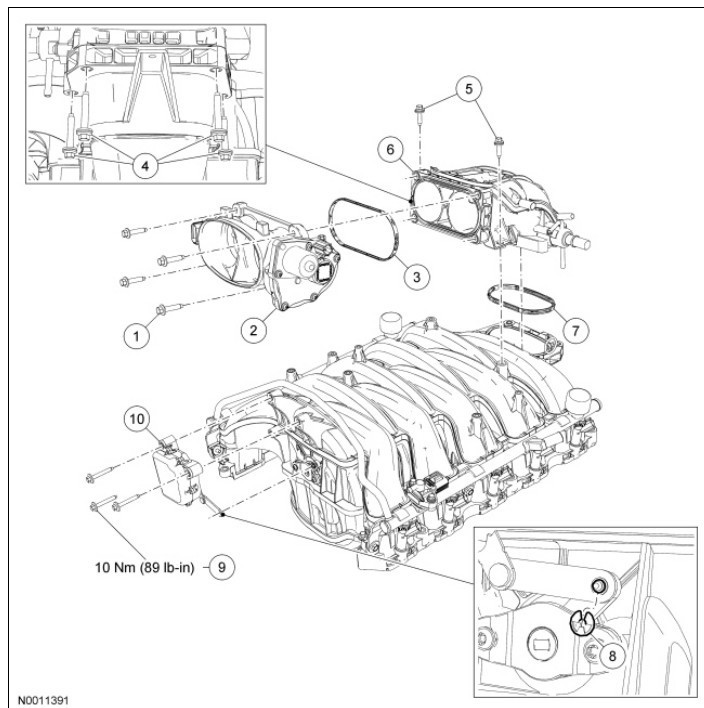
5. Lubricate the piston and the new piston rings with clean engine oil.
 6. Install the piston rings onto the piston.
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Intake Manifold Assembly

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

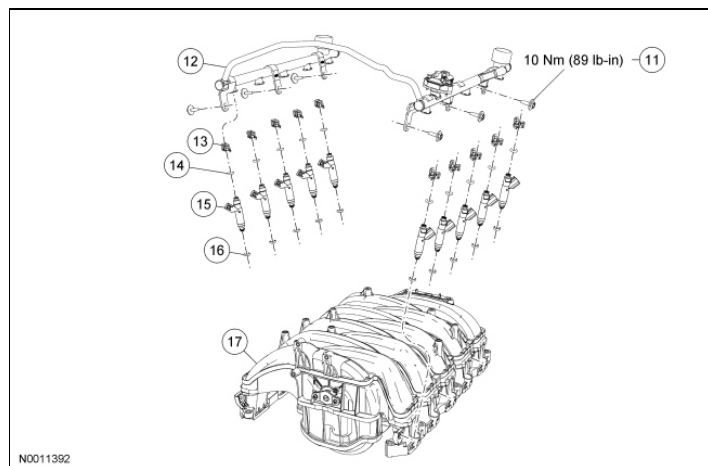
Throttle Body (TB) and Intake Manifold Runner Control (IMRC)



Item	Part Number	Description
1	W500215-S	Throttle Body (TB) bolt (4 required)
2	9F991	TB
3	9E936	TB gasket
4	W503280-S	Lower TB spacer bolts (4 required)
5	W503275-S	Upper TB spacer bolts (2 required)
6	9A589	TB spacer
7	9L437	TB spacer gasket

8	--	Intake Manifold Runner Control (IMRC) actuator pivot pin C-clip
9	W503917-S	IMRC actuator bolt (3 required)
10	9J559	IMRC actuator

Fuel Rail, Fuel Injectors and Intake Manifold



Item	Part Number	Description
11	W710700	Fuel rail bolt (6 required)
12	9F792	Fuel rail
13	9F907	Fuel injector-to-fuel rail locking clip (10 required)
14	9F798	Fuel injector-to-fuel rail O-ring seal (10 required)
15	9F593	Fuel injector (10 required)
16	9F798	Fuel injector-to-intake manifold O-ring seal (10 required)
17	9Y452	Intake manifold

Disassembly

1. Remove the 4 bolts and the Throttle Body (TB).
 - Discard the TB gasket.
2. Remove the 6 bolts and the TB spacer.
3. Remove the Intake Manifold Runner Control (IMRC) actuator rod C-clip.
4. Remove the 3 bolts and the IMRC actuator.
5. **NOTE:** The fuel rail and fuel injectors are removed as an assembly.

Remove the 6 bolts and the fuel rail assembly.
6. Remove the fuel injector-to-fuel rail locking clips and separate the fuel injectors from the fuel rail.
 - Discard the 2 O-ring seals from each fuel injector.

Assembly

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1. **NOTE:** Lubricate the new O-ring seals with clean engine oil prior to installation.

Install new O-ring seals on each of the fuel injectors.

2. Assemble the fuel injectors onto the fuel rail and install the locking clips.

3. Install the fuel rail and fuel injector assembly onto the intake manifold.

4. Install the 6 fuel rail bolts.

- Tighten to 10 Nm (89 lb-in).

5. Position the TB spacer.

6. Install the 2 upper TB spacer bolts in 2 stages:

- Stage 1: Tighten to 9 Nm (80 lb-in).
- Stage 2: Tighten an additional 90 degrees.

7. Install the 4 lower TB spacer bolts in 2 stages:

- Stage 1: Tighten to 9 Nm (80 lb-in).
- Stage 2: Tighten an additional 90 degrees.

8. Install a new gasket and the TB . Tighten the 4 bolts in 2 stages:

- Stage 1: Tighten to 9 Nm (80 lb-in).
- Stage 2: Tighten an additional 90 degrees.

9. Position the IMRC actuator and install the 3 bolts.

- Tighten to 10 Nm (89 lb-in).






10. Install the IMRC rod C-clip.

Engine

1. For information on engine assembly, refer to the F-Super Duty Workshop Manual.
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Engine

Special Tool(s)

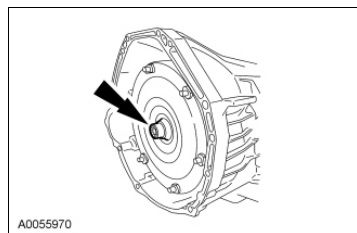
 <small>ST1596-A</small>	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 <small>ST1636-A</small>	Retainer, Torque Converter 307-346 (T97T-7902-A)
 <small>ST1438-A</small>	Strap Wrench 303-D055 (D85L-6000-A)
 <small>ST2176-B</small>	Support Bar, Engine 303-F070
 <small>ST2970-A</small>	Support Hook 303-F071

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Multi-Purpose Grease XG-4 and/or XL-5, or equivalents	ESB-M1C93-B

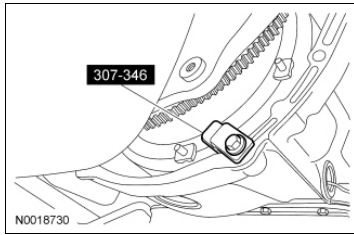
1. **NOTICE:** Prior to installation of the assembly, the torque converter pilot hub must be correctly lubricated or damage to the torque converter or the engine crankshaft can occur.

Lubricate the torque converter pilot hub with multi-purpose grease.

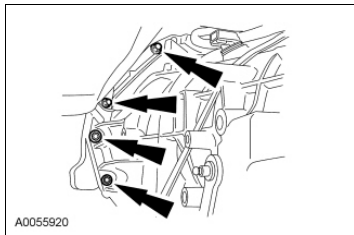


2. Rotate the torque converter so the green or orange paint daub on the converter is in the 12 o'clock position.

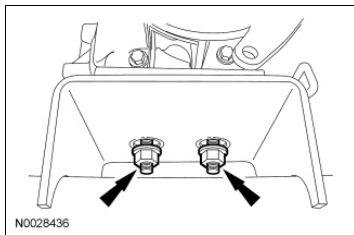
3. Once the transmission is in place, prior to holding it to the engine, remove the Torque Converter Retainer.



4. Install the 9 transmission-to-engine bolts.
 - Tighten to 47 Nm (35 lb-ft).



5. Position the crossmember to the transmission mount and loosely install the 2 nuts.

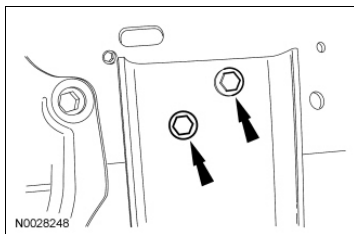


6. Lower the vehicle.

7. **NOTE:** LH shown, RH similar.

Install the 4 crossmember bolts and 4 nuts.

- Tighten to 81 Nm (60 lb-ft).



8. Using the Engine Support Bar and Support Hook, support the engine.

