

2009 Toyota Highlander Limited

2009 ENGINE Lubrication (1AR-FE) - Highlander

2009 ENGINE**Lubrication (1AR-FE) - Highlander****LUBRICATION SYSTEM****ON-VEHICLE INSPECTION****1. INSPECT ENGINE OIL LEVEL**

- a. Warm up and stop the engine, then wait for 5 minutes.
- b. Check that the oil level is between the low level and full level marks on the level dipstick.

If the level is low, check for leakage and add oil up to the full level mark.

NOTE: Do not fill the engine with oil to above the full level mark.

2. INSPECT ENGINE OIL QUALITY

- a. Check the oil for deterioration, water contamination, discoloration or thinning. If the quality is visibly poor, replace the oil and filter.

3. INSPECT OIL PRESSURE

- a. Remove the oil pressure switch assembly (See **OIL PRESSURE SWITCH**).
- b. Install an oil pressure gauge.
- c. Warm up the engine.
- d. Measure the oil pressure.

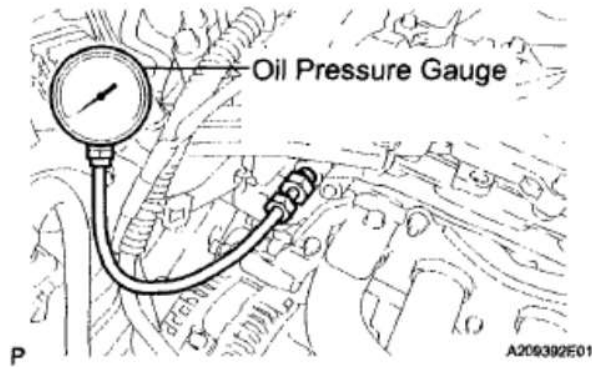
Standard Oil Pressure**STANDARD OIL PRESSURE**

Condition	Specified Condition
Idle	30 kPa (0.3 kgf/cm ² , 4.4 psi) or more
4000 rpm	260 kPa (2.7 kgf/cm ² , 38 psi) or more

- e. Remove the oil pressure gauge.
- f. Install the oil pressure switch assembly (See **INSTALLATION**).

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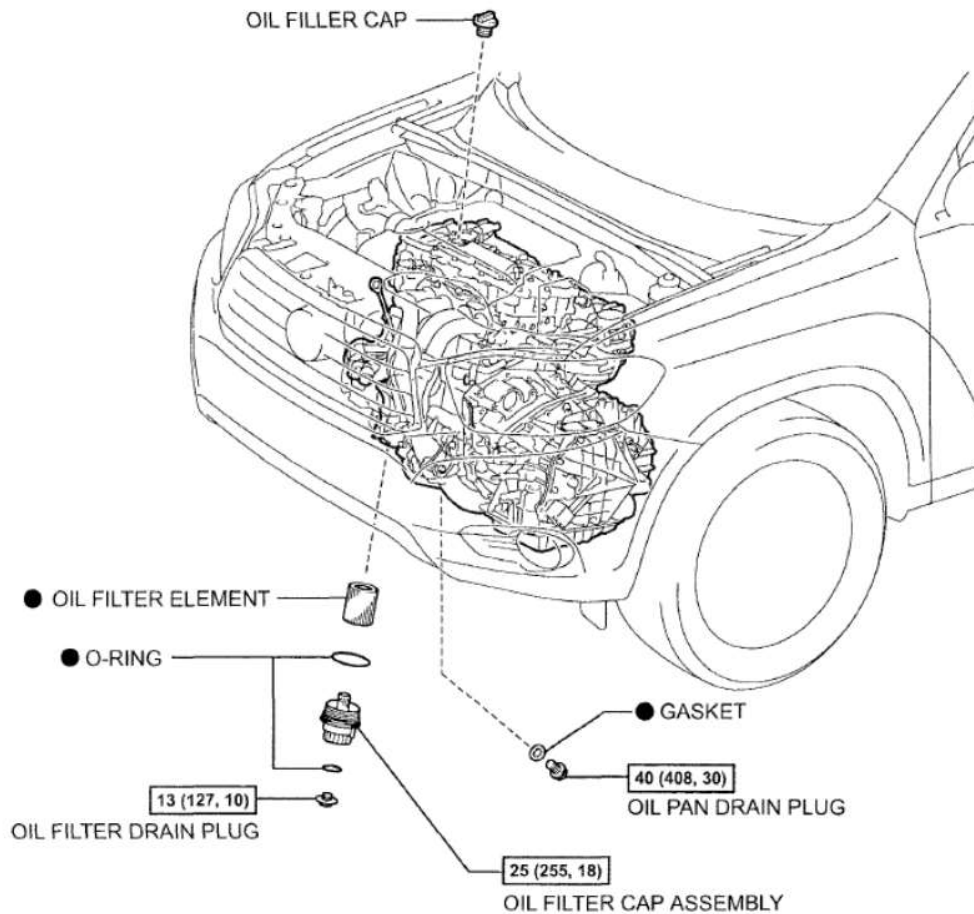
**Fig. 1: Measuring Oil Pressure**

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OIL AND OIL FILTER**COMPONENTS**

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[N*m (kgf*cm, ft.*lbf)]: Specified torque

● Non-reusable part

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Fig. 2: Identifying Oil And Oil Filter Component With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REPLACEMENT

CAUTION:

- Prolonged and repeated contact with engine oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Precautions should be taken when replacing engine oil to minimize the risk of your skin making contact with used engine oil. Protective clothing and gloves that cannot be penetrated by oil should be worn. The skin should be washed with soap and water, or use waterless hand cleaner, to remove any used engine oil thoroughly. Do not use

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gasoline, thinners, or solvents.

- **In order to protect the environment, used oil and used oil filters must be disposed of at designated disposal sites.**

1. DRAIN ENGINE OIL

- Remove the oil filler cap.
- Remove the oil pan drain plug and gasket, and drain the engine oil into a container.
- Clean and install a new gasket and the oil pan drain plug.

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)

2. REMOVE OIL FILTER CAP ASSEMBLY

- Connect a hose with an inside diameter of 15 mm (0.591 in.) to the pipe.

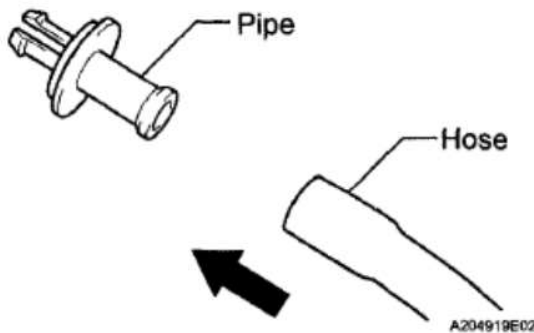


Fig. 3: Connecting Hose With An Inside Diameter Of 15 mm (0.591 in) To Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Remove the oil filter drain plug from the oil filter cap.

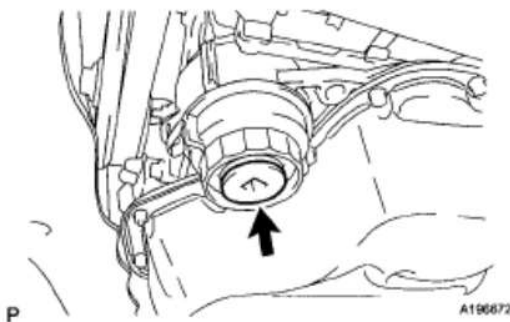


Fig. 4: Locating Oil Filter Drain Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Install the pipe to the oil filter cap.

NOTE: If the O-ring is removed with the drain plug, install the O-ring

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together with the pipe.

HINT:

Use a container to catch the draining oil.

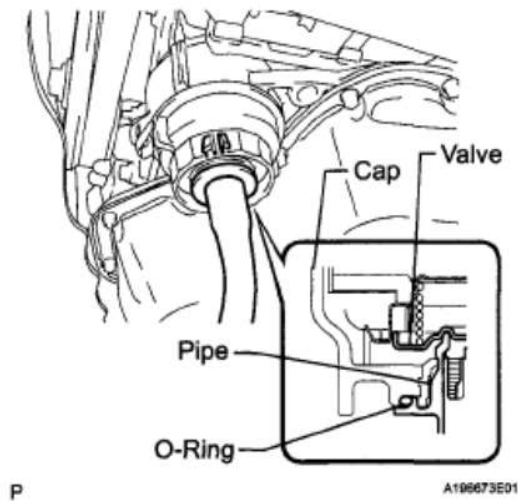


Fig. 5: Identifying Oil Filter Cap

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Check that the oil is drained from the oil filter. Then disconnect the pipe as shown in the illustration and remove the O-ring.

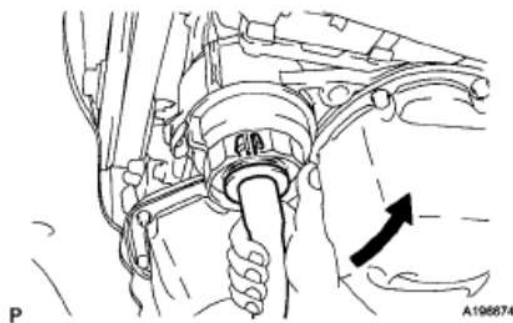


Fig. 6: Disconnecting Pipe

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Using SST, remove the oil filter cap.

SST 09228-06501

NOTE: Do not remove the oil filter bracket clip.

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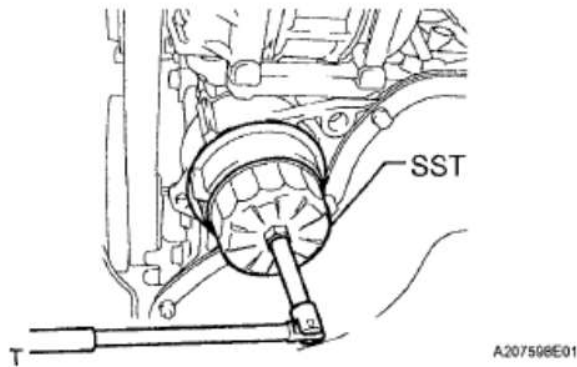


Fig. 7: Removing Oil Filter Cap

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- f. Remove the oil filter element and O-ring from the oil filter cap.

NOTE: Be sure to remove the cap O-ring by hand, without using any tools, to prevent damage to the cap O-ring groove.

3. INSTALL OIL FILTER CAP ASSEMBLY

- a. Clean the inside of the oil filter cap, its threads and its O-ring groove.

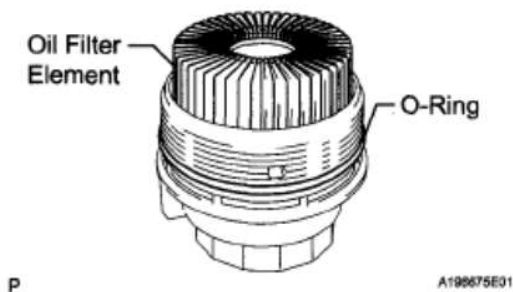


Fig. 8: Identifying Oil Filter Element And O-Ring

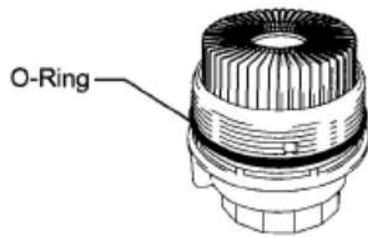
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.
- c. Set a new oil filter element into the oil filter cap.
- d. Remove any dirt or foreign matter from the installation surface of the engine.
- e. Apply a small amount of engine oil to the O-ring again and temporarily install the oil filter cap.

NOTE: Make sure that the O-ring does not get caught between the parts.

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Fig. 9: Identifying Oil Filter Cap O-Ring

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- f. Using SST, tighten the oil filter cap.

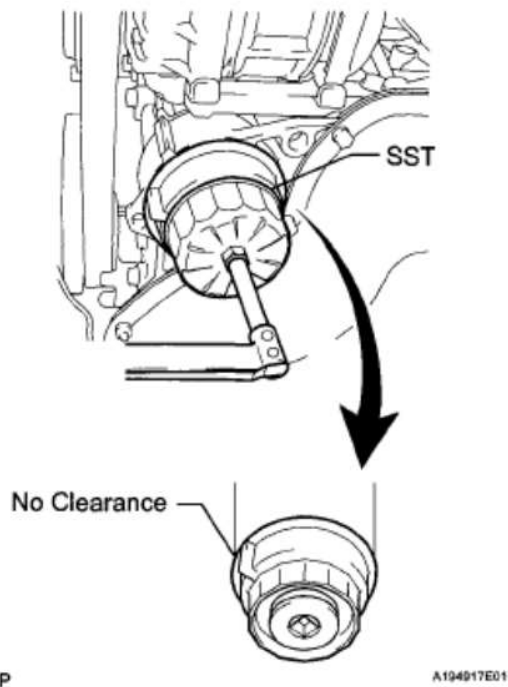
SST 09228-06501

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

NOTE: Make sure that the oil filter is installed securely as shown in the illustration.

- g. Apply a small amount of engine oil to a new drain plug O-ring, and install it to the oil filter cap.

NOTE: Before installing the O-ring, remove any dirt or foreign matter from the installation surface of the oil filter cap.



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Fig. 10: Tightening Oil Filter Cap

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- h. Install the oil filter drain plug.

Torque: 13 N*m (127 kgf*cm, 10 ft.*lbf)

NOTE: Be careful that the O-ring does not get caught between any surrounding parts.

4. ADD ENGINE OIL

- a. Add new oil.

Standard Oil Grade

STANDARD OIL GRADE

Oil Grade	Oil Viscosity
ILSAC multigrade engine oil	0W-20
	5W-20
	(0W-20 is the best choice for fuel economy and good starting in cold weather.)

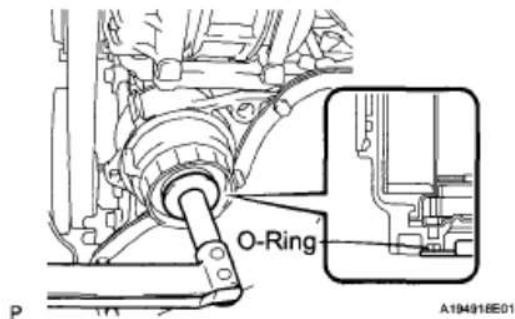


Fig. 11: Installing Oil Filter Drain Plug

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Capacity

STANDARD CAPACITY

Item	Specified Condition
Drain and refill with oil filter change	4.4 liters (4.6 US qts, 3.9 imp. qts)
Drain and refill without oil filter change	4.0 liters (4.2 US qts, 3.5 imp. qts)
Dry fill	5.7 liters (6.0 US qts, 5.0 imp. qts)

- b. Install the oil filler cap.

5. INSPECT FOR OIL LEAK

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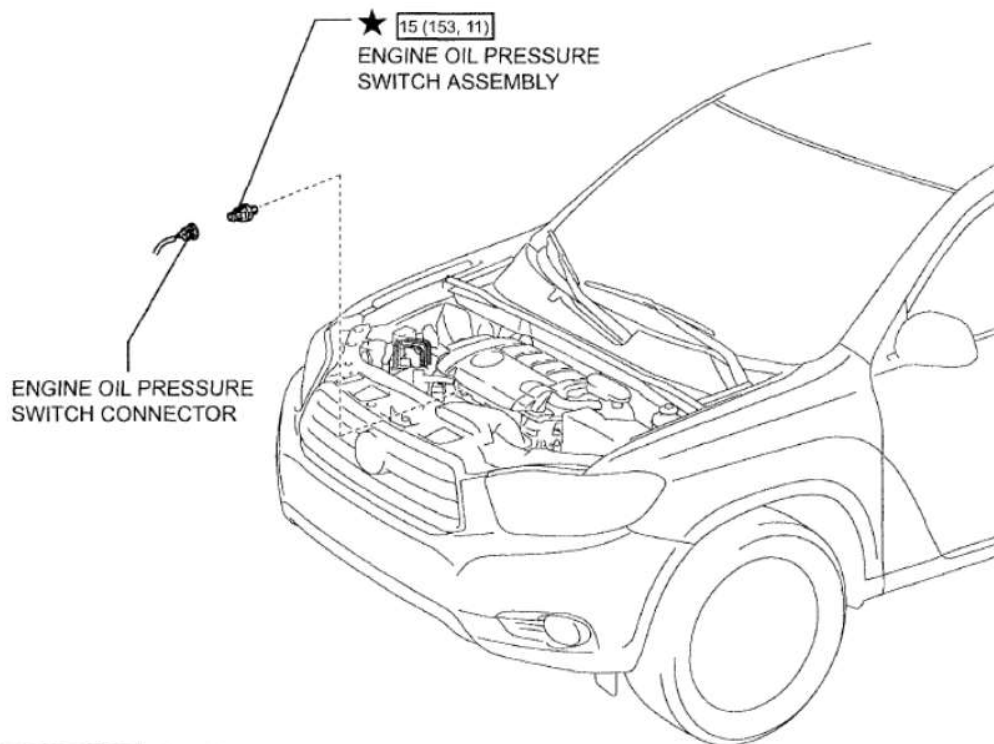
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- a. Start the engine. Make sure that there are no oil leaks from the areas that were worked on.

6. INSPECT ENGINE OIL LEVEL (See LUBRICATION SYSTEM)

OIL PRESSURE SWITCH

COMPONENTS



N*m (kgf*cm, ft.*lbf) : Specified torque

★ Precoated part

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Fig. 12: Identifying Oil Pressure Switch Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY**
 - a. Disconnect the oil pressure switch connector.
 - b. Using a 24 mm deep socket wrench, remove the oil pressure switch.

INSPECTION

1. **INSPECT ENGINE OIL PRESSURE SWITCH ASSEMBLY**
 - a. Disconnect the oil pressure switch connector.

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b. Start the engine.

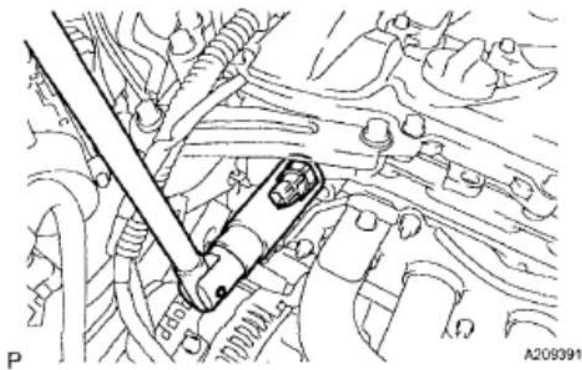


Fig. 13: Removing Oil Pressure Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Measure the resistance according to the value(s) in the table below.

Standard Resistance

STANDARD RESISTANCE

Tester Connection	Condition	Specified Condition
1 - Body ground	Engine stopped	Below 1 ohms
	Engine idling	10 kohms or higher

If the result is not as specified, replace the oil pressure switch assembly.

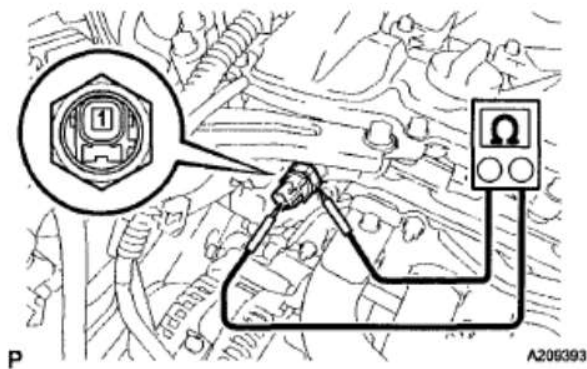


Fig. 14: Measuring Resistance Of Oil Pressure Switch Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

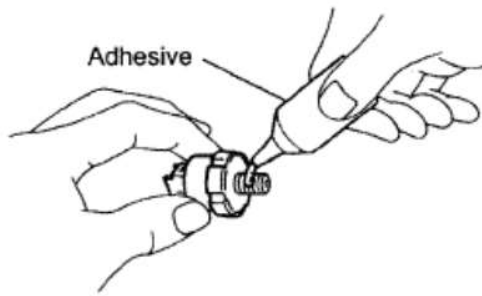
INSTALLATION

1. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

a. Apply adhesive to 2 or 3 threads of the oil pressure switch.

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Adhesive:**TOYOTA Genuine Adhesive 1344, Three Bond 1344 or equivalent.****NOTE: Do not let adhesive adhere to the oil hole.**

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Fig. 15: Applying Adhesive To Threads Of Oil Pressure Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using a 24 mm deep socket wrench, install the oil pressure switch.

Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)**NOTE: Do not start the engine within 1 hour of installation.**

- c. Connect the oil pressure switch connector.

2. INSPECT FOR OIL LEAK (See OIL PRESSURE SWITCH)

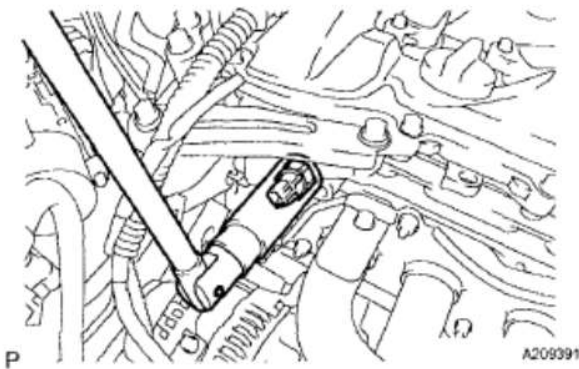


Fig. 16: Installing Oil Pressure Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OIL PUMP**COMPONENTS**

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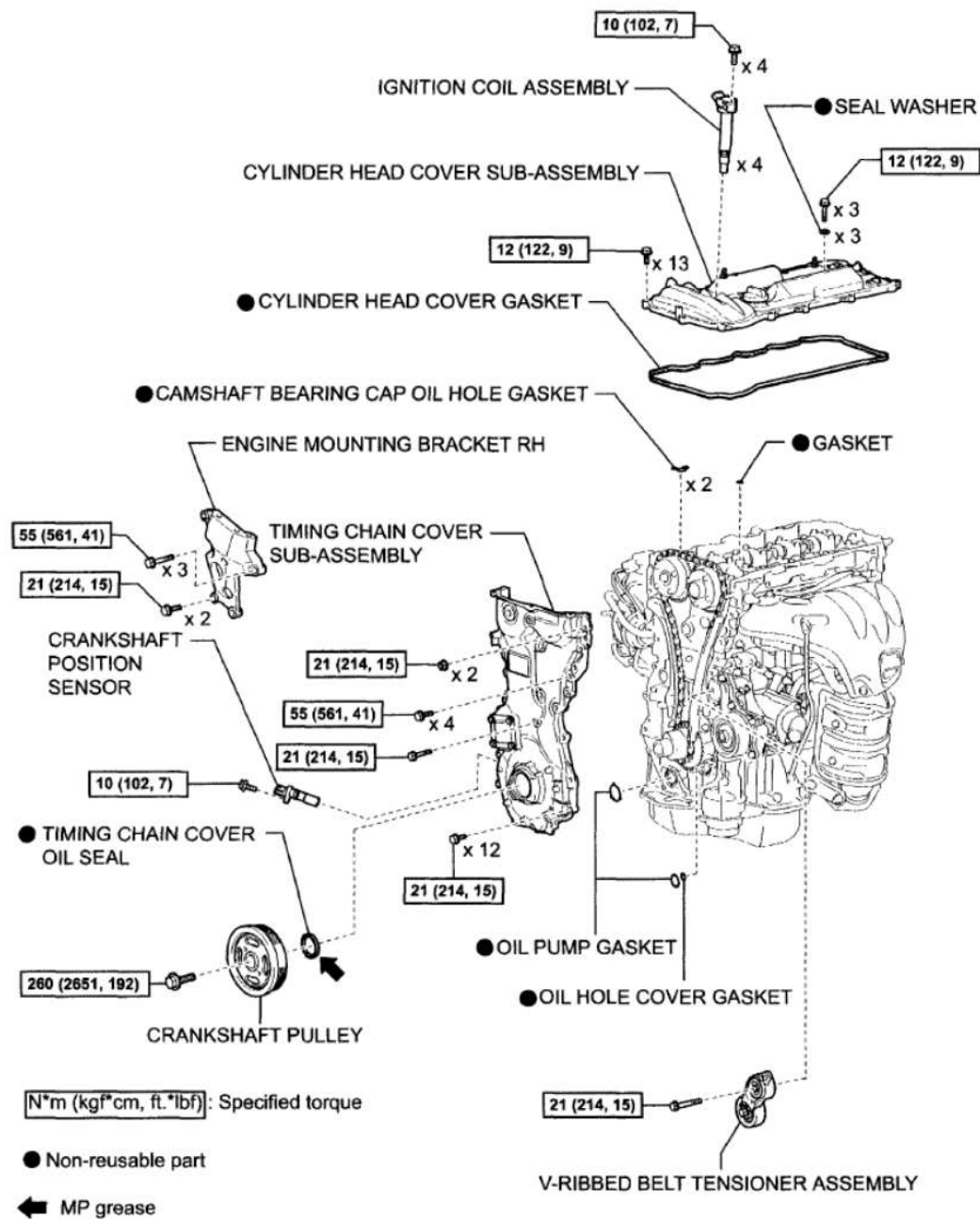


Fig. 17: Identifying Oil Pump Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

NOTE: Do not remove the oil pump or oil pump relief valve from the timing chain cover sub-assembly.

1. REMOVE ENGINE AND TRANSAXLE

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- a. Remove the engine and transaxle (See **REMOVAL**).
2. **REMOVE ENGINE WIRE**
3. **REMOVE IGNITION COIL ASSEMBLY** (See **REMOVAL**)
4. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY** (See **DISASSEMBLY**)
5. **REMOVE CRANKSHAFT POSITION SENSOR** (See **REMOVAL**)
6. **REMOVE CRANKSHAFT PULLEY** (See **DISASSEMBLY**)
7. **REMOVE ENGINE MOUNTING BRACKET RH**
 - a. Remove the 5 bolts and engine mounting bracket RH.
8. **REMOVE V-RIBBED BELT TENSIONER ASSEMBLY** (See **DISASSEMBLY**)

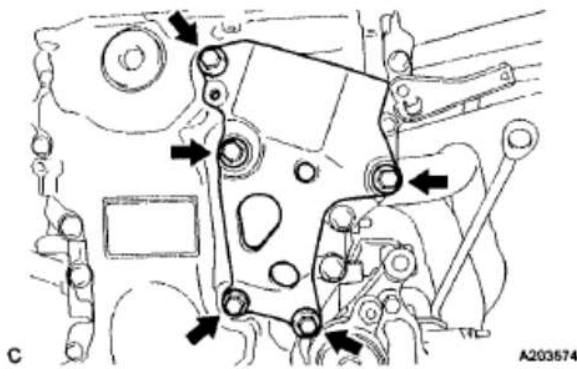


Fig. 18: Locating Engine Mounting Bracket RH Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **REMOVE TIMING CHAIN COVER SUB-ASSEMBLY**
 - a. Remove the 17 bolts and 2 nuts.

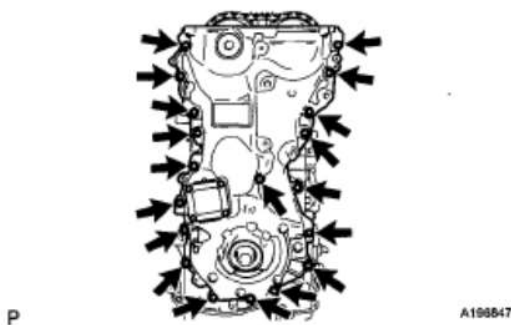


Fig. 19: Locating Timing Chain Cover Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the timing chain cover by prying between the timing chain cover and cylinder head, camshaft housing, cylinder block and stiffening crankcase with a screwdriver as shown in the illustration.

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NOTE: Be careful not to damage the contact surfaces of the cylinder head, camshaft housing, cylinder block, stiffening crankcase and chain cover.

HINT:

Tape the screwdriver tip before use.

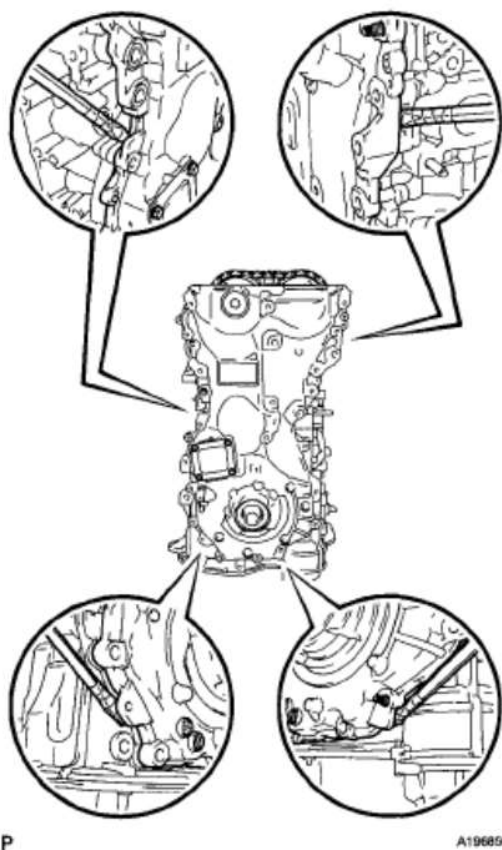


Fig. 20: Removing Timing Chain Cover By Prying
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Remove the 3 gaskets from the stiffening crankcase.

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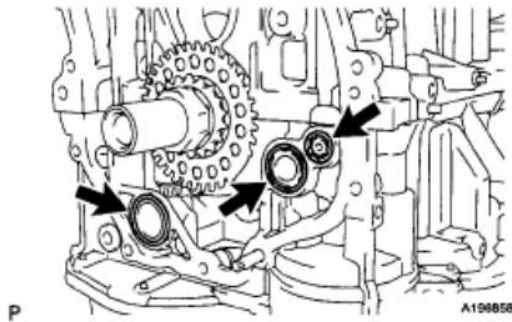


Fig. 21: Locating Stiffening Crankcase Gaskets

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. REMOVE TIMING CHAIN COVER OIL SEAL

- Using a screwdriver and wooden block, pry out the oil seal.

NOTE: Do not damage the surface of the oil seal press fit hole.

HINT:

Tape the screwdriver tip before use.

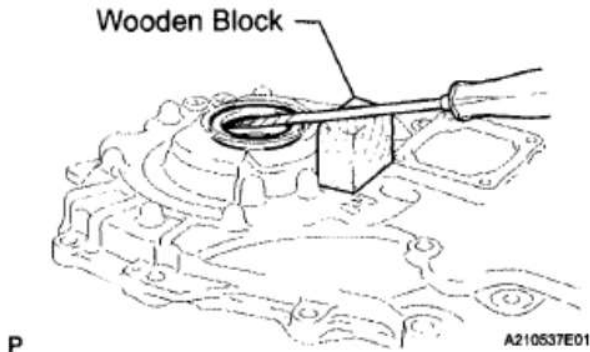


Fig. 22: Prying Out Oil Seal

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY

- Apply a light coat of engine oil to 3 new gaskets.
- Install the 3 gaskets to the stiffening crankcase.

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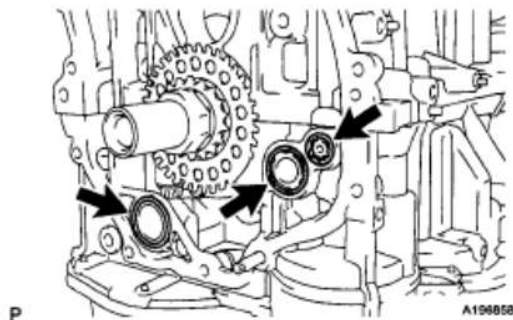


Fig. 23: Locating Stiffening Crankcase Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Align the drive rotor spline and the crankshaft timing sprocket as shown in the illustration.

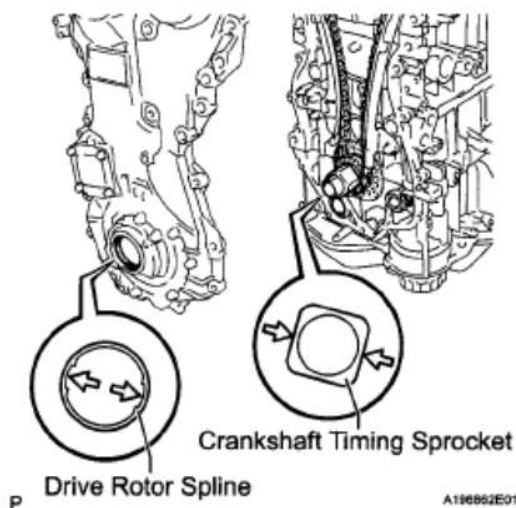


Fig. 24: Aligning Drive Rotor Spline And Crankshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Apply seal packing in a line to the timing chain cover as shown in the following illustration.

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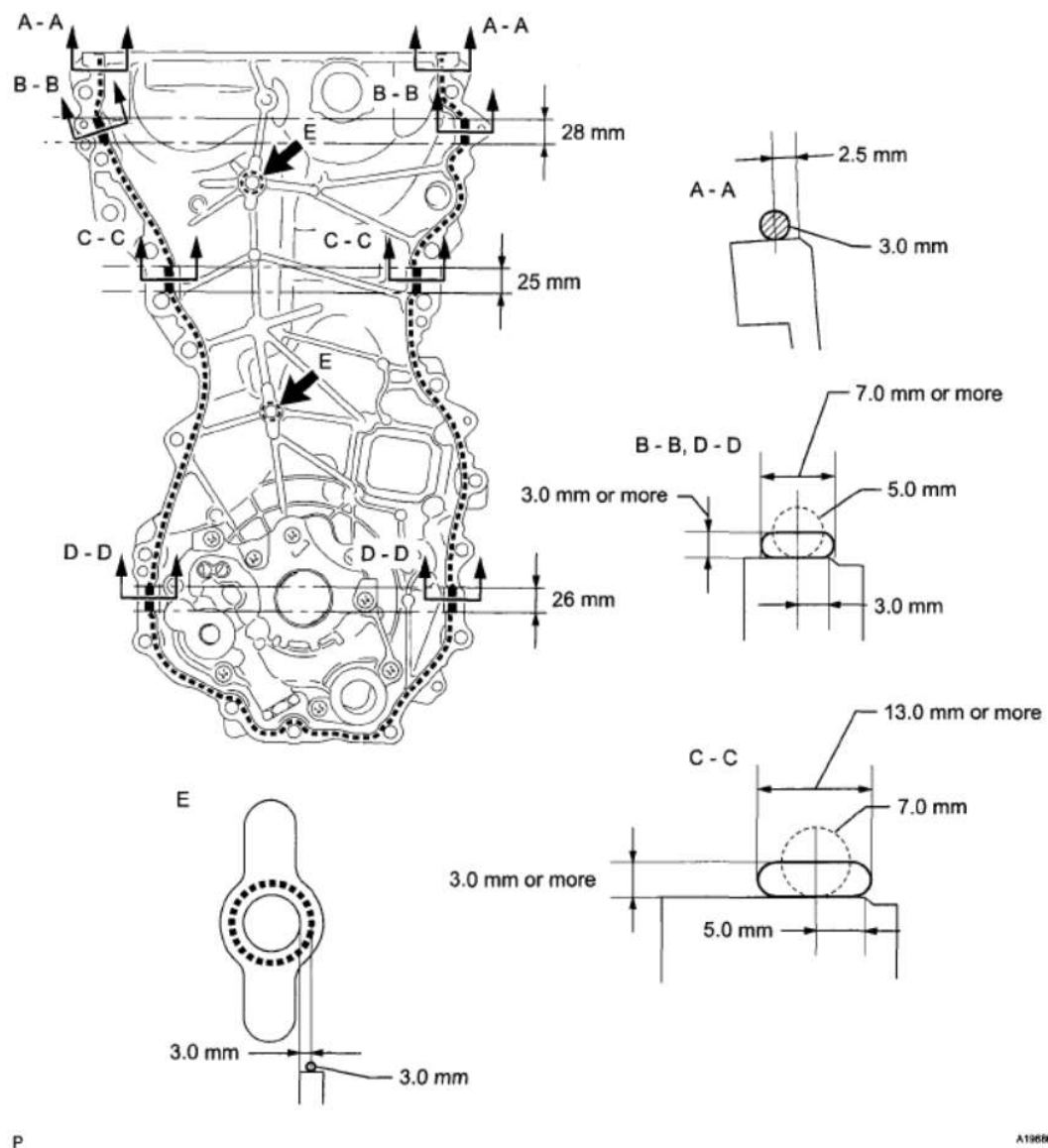


Fig. 25: Applying Seal Packing In Line To Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent.
Apply Seal Packing as Follows

SEAL PACKING REFERENCE CHART

Area	Seal Packing Diameter (Round)	Distance from Edge of Cover to Center of Seal Packing	Seal Packing Application Length
	Seal Pacing Dimension (Flat)		

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Dashed Line	3.0 mm (0.118 in.)	2.5 mm (0.0984 in.)	-
	-		
A-A	3.0 mm (0.118 in.)	2.5 mm (0.0984 in.)	-
	-		
B-B	5.0 mm (0.197 in.)	3.0 mm (0.118 in.)	28 mm (1.10 in.)
	7.0 mm (0.276 in.) or more wide and 3.0 mm (0.118 in.) or more thick		
C-C	7.0 mm (0.276 in.)	5.0 mm (0.197 in.)	25 mm (0.984 in.)
	13.0 mm (0.512 in.) or more wide and 3.0 mm (0.118 in.) or more thick		
D-D	5.0 mm (0.197 in.)	3.0 mm (0.118 in.)	26 mm (1.02 in.)
	7.0 mm (0.276 in.) or more wide and 3.0 mm (0.118 in.) or more thick		
E	3.0 mm (0.118 in.)	3.0 mm (0.118 in.)	-
	-		

NOTE:

- When the contact surfaces are wet, clean the surfaces with non-residue solvent before applying seal packing.
- Install the timing chain cover within 3 minutes and tighten the bolts within 10 minutes after applying seal packing.
- After applying seal packing to the timing chain cover, install the engine mounting bracket within 10 minutes.
- Do not apply oil for at least 4 hours after the installation.
- Do not start the engine for at least 4 hours after the installation.

e. Temporarily install the timing chain cover with the 17 bolts and 2 nuts.

Bolt Length**BOLT LENGTH**

Item	Length	Thread Diameter
Bolt A	30 mm (1.18 in.)	8 mm (0.315 in.)
Bolt B	35 mm (1.38 in.)	10 mm (0.394 in.)
Bolt C	45 mm (1.77 in.)	8 mm (0.315 in.)

NOTE:

Make sure there is no oil on the bolts. If there is oil on the bolts, clean them before installing them.

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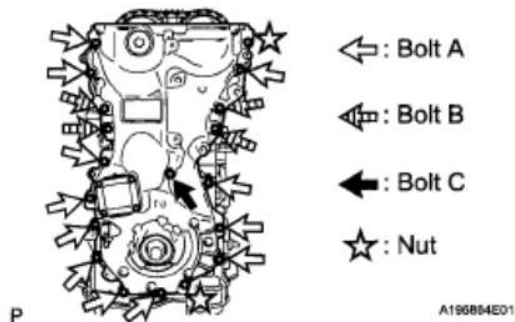


Fig. 26: Locating Timing Chain Cover Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- f. Tighten the 17 bolts and 2 nuts in several steps, in the sequence shown in the illustration.

Torque: for bolt 1, 2, 3 and 4

55 N*m (561 kgf*cm, 41 ft.*lbf)

except bolt 1, 2, 3 and 4

21 N*m (214 kgf*cm, 15 ft.*lbf)

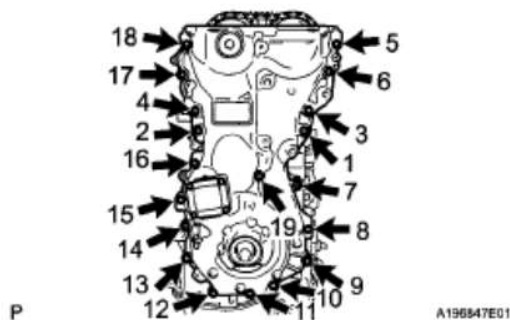


Fig. 27: Identifying Timing Chain Cover Bolts And Nuts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. INSTALL ENGINE MOUNTING BRACKET RH

- a. Install the engine mounting bracket, and install the 5 bolts in the order shown in the illustration.

Torque: for bolt 1, 2 and 3

55 N*m (561 kgf*cm, 41 ft.*lbf)

for bolt 4 and 5

21 N*m (214 kgf*cm, 15 ft.*lbf)

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NOTE: After applying seal packing to the timing chain cover, install the engine mounting bracket within 10 minutes.

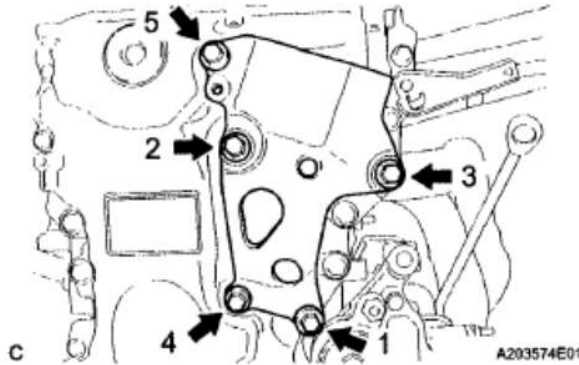


Fig. 28: Identifying Engine Mounting Bracket Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

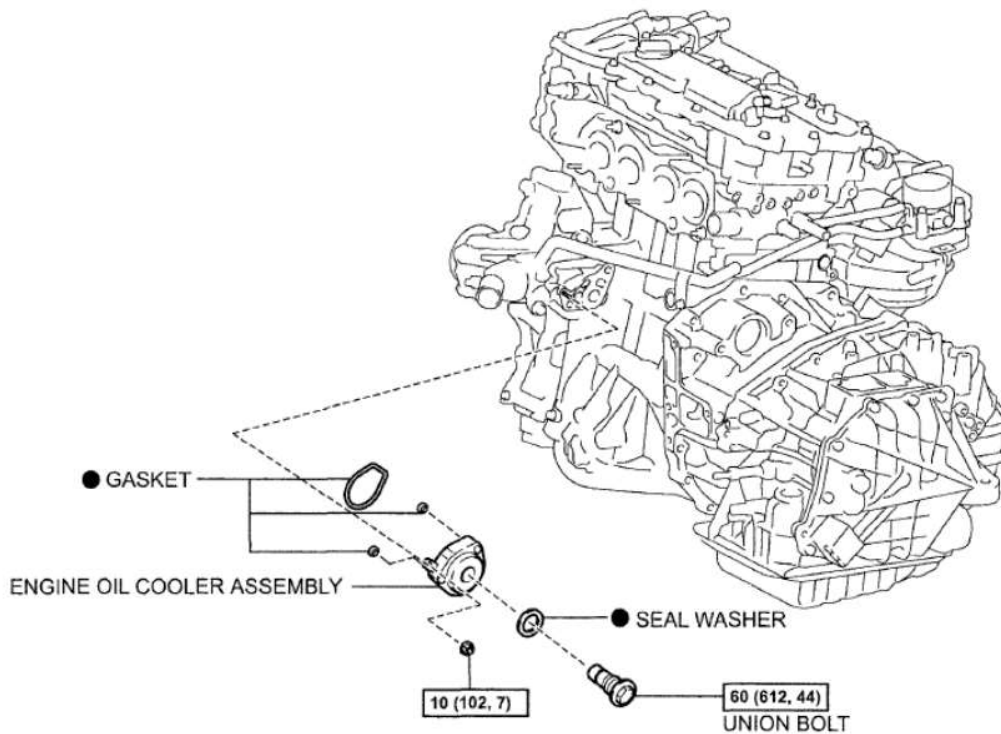
3. INSTALL TIMING CHAIN COVER OIL SEAL (See INSTALLATION)
4. INSTALL CRANKSHAFT PULLEY (See REASSEMBLY)
5. INSTALL CRANKSHAFT POSITION SENSOR (See REMOVAL)
6. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY (See REASSEMBLY)
7. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (See INSTALLATION)
8. INSTALL IGNITION COIL ASSEMBLY (See REMOVAL)
9. INSTALL ENGINE WIRE
10. INSTALL ENGINE AND TRANSAXLE
 - a. Install the engine and transaxle (See INSTALLATION).

ENGINE OIL COOLER

COMPONENTS

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[N*m (kgf*cm, ft.*lbf)]: Specified torque

● Non-reusable part

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Fig. 29: Identifying Engine Oil Cooler Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. REMOVE EXHAUST MANIFOLD ASSEMBLY

HINT:

See **REMOVAL**

2. DRAIN ENGINE OIL (See **REPLACEMENT**)

3. DRAIN ENGINE COOLANT (See **COOLANT**)

4. REMOVE ENGINE OIL COOLER ASSEMBLY

- Remove the nut, union bolt, seal washer and engine oil cooler assembly.
- Remove the 3 gaskets from the engine oil cooler assembly.

INSPECTION

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1. INSPECT ENGINE OIL COOLER

- a. Visually check the engine oil cooler for cracks or damage.

If cracks or damage are found, replace the engine oil cooler.

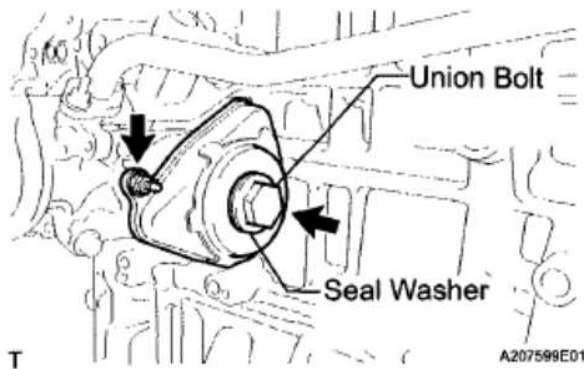


Fig. 30: Locating Nut, Union Bolt, Seal Washer And Engine Oil Cooler Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION**1. INSTALL ENGINE OIL COOLER ASSEMBLY**

- a. Clean the oil cooler contact surface on the cooler mounting.
- b. Apply a light coat of engine oil to 3 new gaskets.
- c. Install the 3 new gaskets to the engine oil cooler assembly.
- d. Temporarily install the engine oil cooler assembly with the union bolt, nut and a new seal washer.
- e. Tighten the bolt and nut in several steps, in the sequence shown in the illustration.

Torque: Union Bolt

60 N*m (612 kgf*cm, 44 ft.*lbf)

Nut

10 N*m (102 kgf*cm, 7 ft.*lbf)

2. INSTALL EXHAUST MANIFOLD ASSEMBLY

HINT:

See **INSTALLATION**

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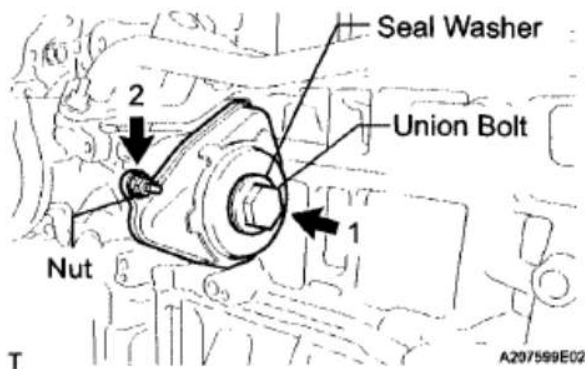


Fig. 31: Identifying Union Bolt And Nut Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **ADD ENGINE OIL** (See OIL PRESSURE SWITCH)
4. **ADD ENGINE COOLANT** (See COOLANT)
5. **CHECK ENGINE OIL LEVEL** (See LUBRICATION SYSTEM)
6. **INSPECT FOR OIL LEAK**