

ELECTRIC VARIABLE VALVE TIMING ACTUATOR, HYDRAULIC VARIABLE VALVE TIMING ACTUATOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5]

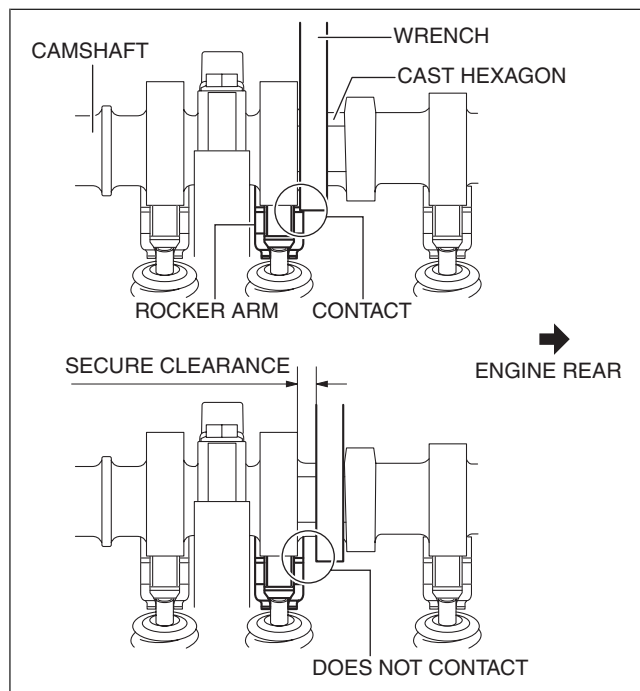
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Warning

- A hot engine can cause severe burns. Turn off the engine and wait until it is cool before servicing.

Caution

- Do not disassemble the electric variable valve timing actuator and hydraulic variable valve timing actuator because they are precision units.
- If the camshaft is rotated with the timing chain removed and the piston at the top dead center position, the valve may contact the piston and the engine could be damaged. When rotating the camshaft with the timing chain removed, rotate it after lowering the piston from the top dead center position.
- When rotating the camshaft using a wrench on the cast hexagon, the wrench may contact the rocker arm and damage the rocker arm. To prevent damage to the rocker arm when holding the camshaft on the cast hexagon, use a wrench on the rear side of the engine as shown in the figure to secure a clearance between the cam.

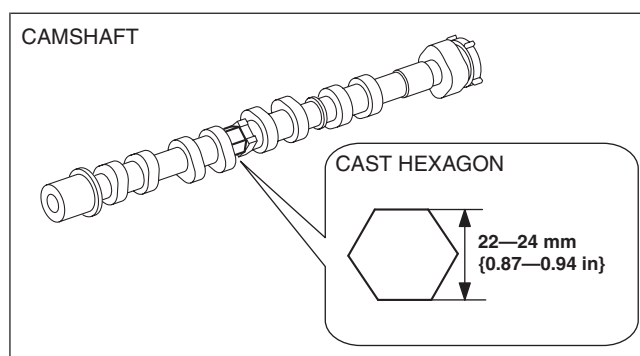


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Note

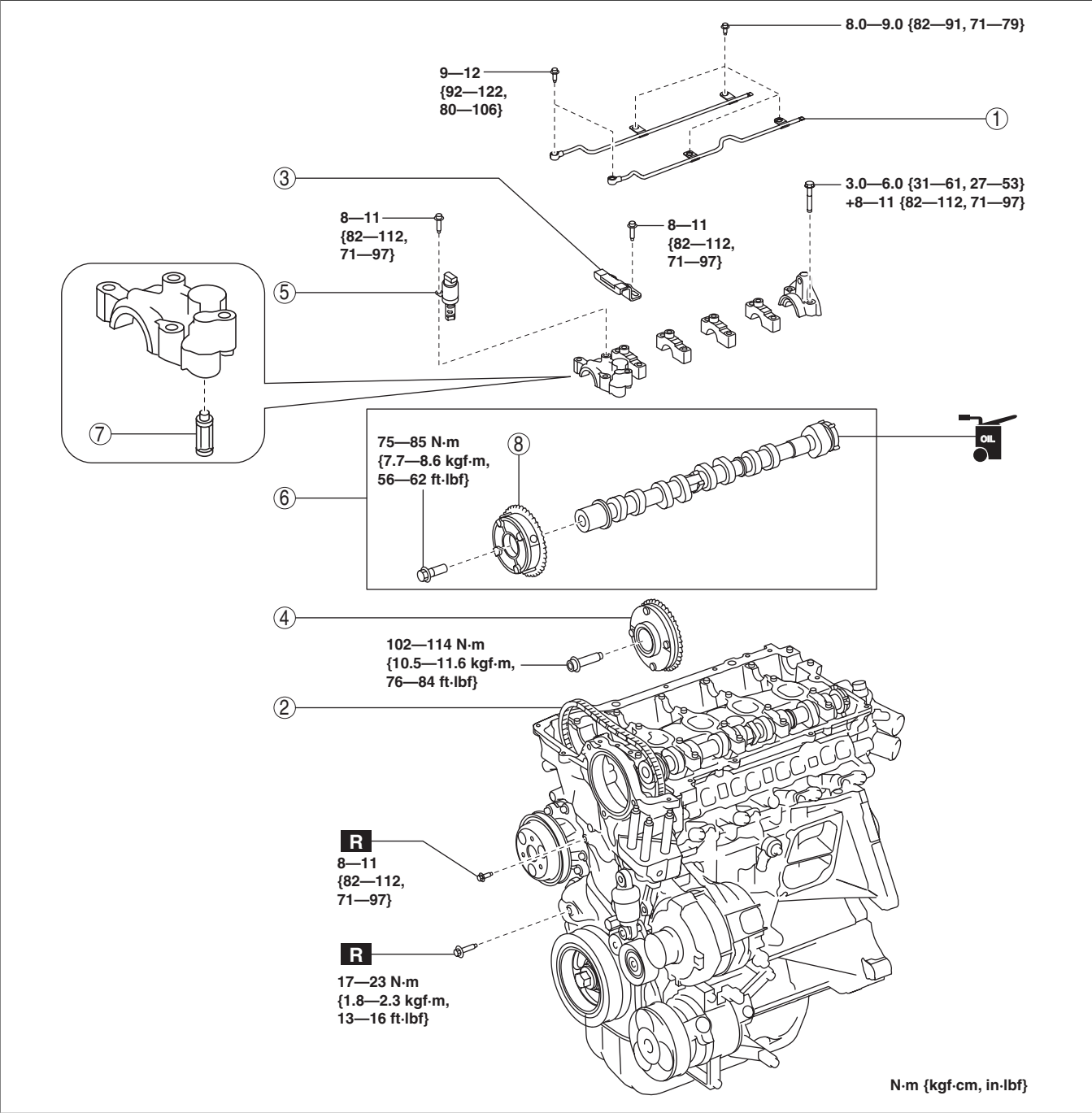
- Width at the cast hexagon of the camshaft is 22—24 mm {0.87—0.94 in}.

1. Disconnect the negative battery cable. (See NEGATIVE BATTERY CABLE DISCONNECTION/CONNECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) (See NEGATIVE BATTERY CABLE DISCONNECTION/CONNECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5 (WITHOUT i-stop)].)
2. Remove the plug hole plate. (See PLUG HOLE PLATE REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
3. Remove the ignition coil/ion sensors. (See IGNITION COIL/ION SENSOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
4. Remove the cylinder head cover. (See TIMING CHAIN REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
5. Remove the front under cover No.2. (See FRONT UNDER COVER No.2 REMOVAL/INSTALLATION.)
6. Remove the electric variable valve timing motor/driver. (See ELECTRIC VARIABLE VALVE TIMING MOTOR/DRIVER REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
7. Remove the vacuum pump. (Only when hydraulic variable valve timing actuator is removed.) (See VACUUM PUMP REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
8. Remove the high pressure fuel pump and rear housing. (Only when hydraulic variable valve timing actuator is removed.) (See HIGH PRESSURE FUEL PUMP REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
9. Remove in the order indicated in the table.



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10. Install in the reverse order of removal.
11. Start the engine and inspect the following:
- Ignition timing, idle speed and idle mixture. (See ENGINE TUNE-UP [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)



1	Oil shower pipe (See Oil Shower Pipe Installation Note.)
2	Timing chain (See Timing Chain Removal Note.) (See Timing Chain Installation Note.)
3	Chain guide (No.1)
4	Electric variable valve timing actuator (See Electric Variable Valve Timing Actuator Removal Note.) (See Electric Variable Valve Timing Actuator Installation Note.)
5	OCV

6	Hydraulic variable valve timing actuator and exhaust camshaft component (See Hydraulic Variable Valve Timing Actuator and Exhaust Camshaft Component Removal Note.) (See Hydraulic Variable Valve Timing Actuator and Exhaust Camshaft Component Installation Note.)
7	OCV oil filter
8	Hydraulic variable valve timing actuator (See Hydraulic Variable Valve Timing Actuator Removal Note.) (See Hydraulic Variable Valve Timing Actuator Installation Note.)

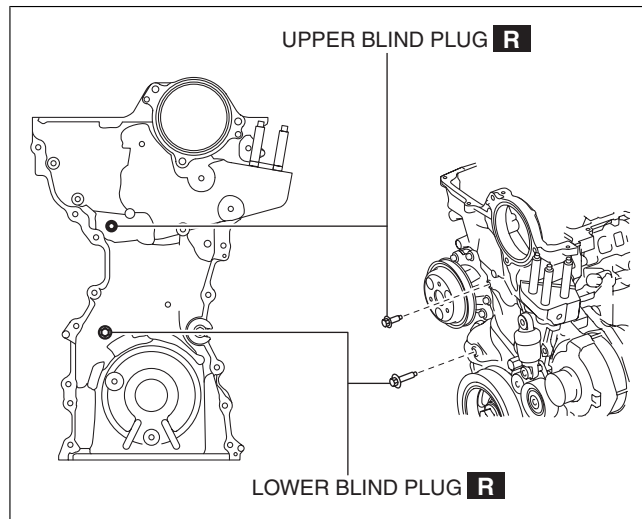
Timing Chain Removal Note

1. Release the tension on the timing chain using the following procedure:

Note

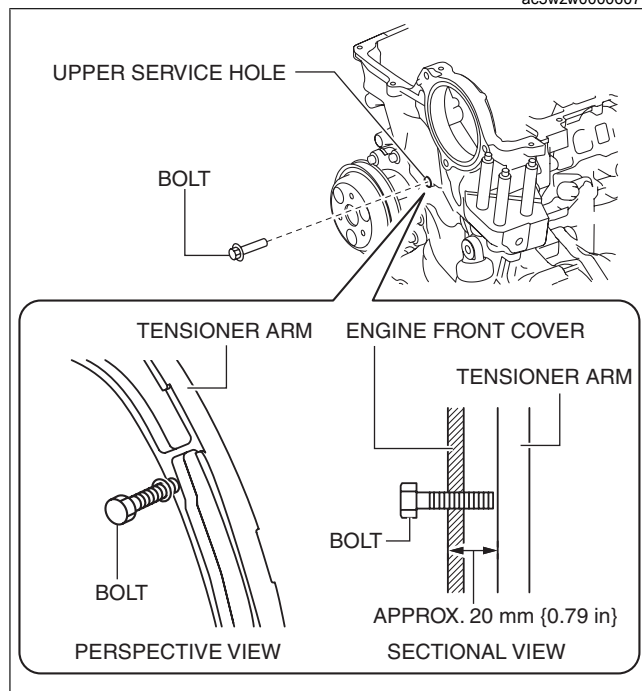
- Release the tension on the timing chain by securing the timing chain tensioner arm through the service hole on the engine front cover.

(1) Remove the blind plugs (upper and lower) on the engine front cover service holes.



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(2) Insert an M6 bolt (35—60 mm {1.4—2.3 in} length with thread to the end) to the upper service hole and tighten it until it contacts the tensioner arm, then loosen it **approx. 180 degrees** (set the bolt so that it sits slightly in front of the tensioner arm).



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Note

- The bolt contacts the tensioner arm when it is inserted **approx. 20 mm {0.79 in}**.

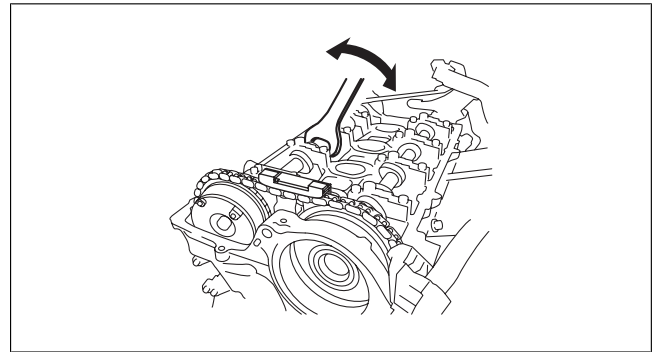
- Hold the exhaust camshaft using a wrench on the cast hexagon and move it back and forth a few times as shown in the figure. This will drain the oil from the chain tensioner and make the following servicing easier.

(3) Insert a precision screwdriver into the lower service hole.

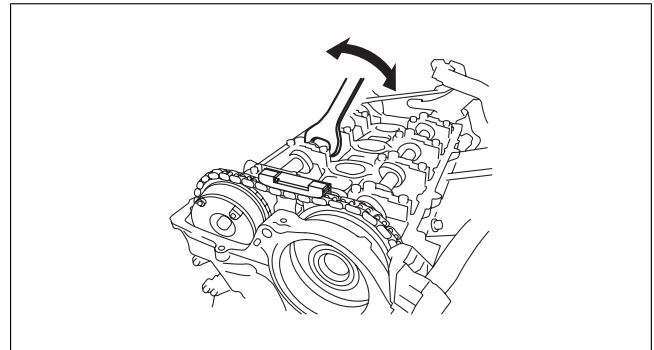
(4) While moving the exhaust camshaft back and forth in the direction of the arrow using a wrench on the cast hexagon, press down the link plate of the timing chain tensioner using a precision screwdriver and release the plunger lock.

Note

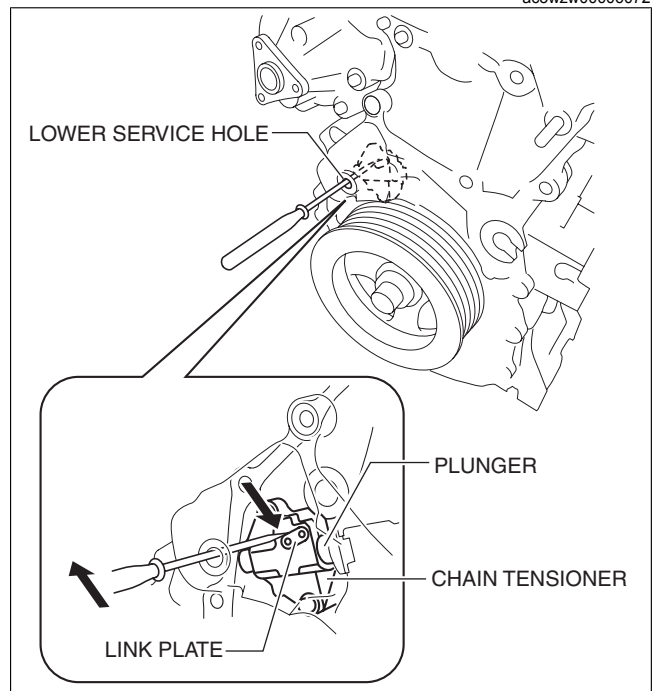
- When moving the exhaust camshaft back and forth, the timing chain pushes the plunger in the chain tensioner making it easier to operate the link plate.



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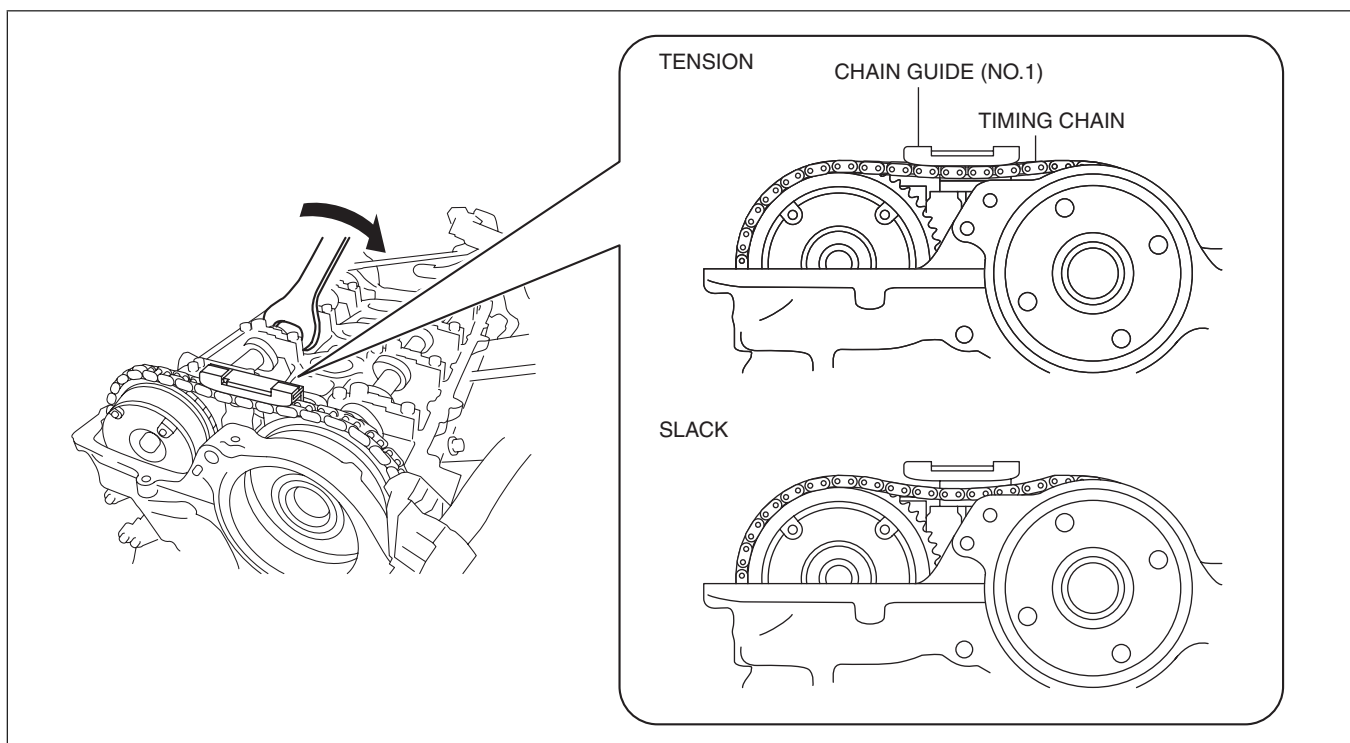


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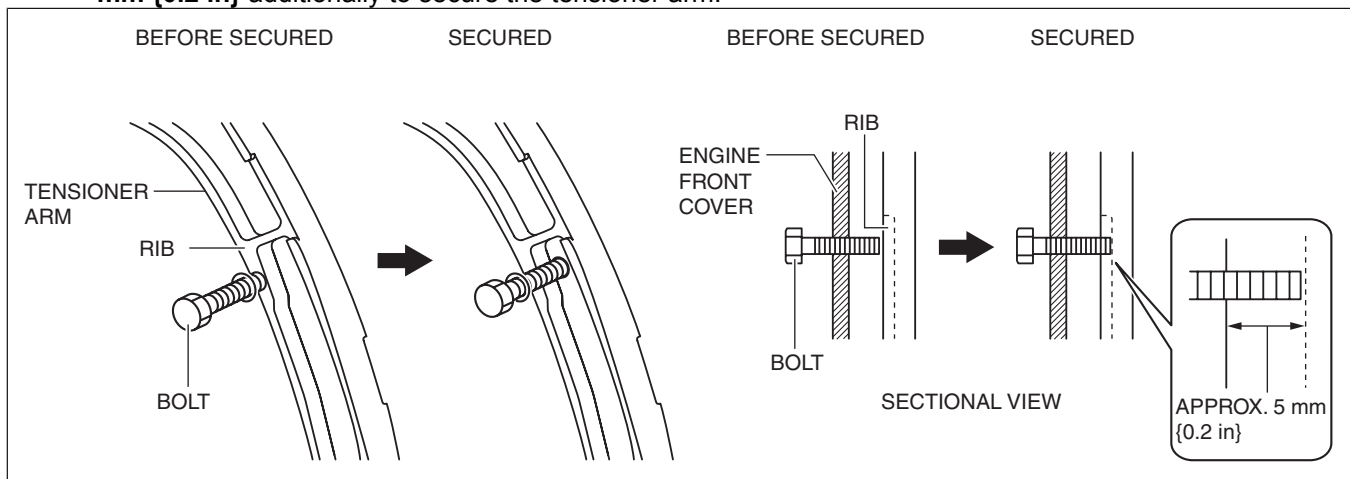
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(5) With the plunger lock released, rotate the exhaust camshaft clockwise until the timing chain loosens.



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- (6) With the chain loosened, tighten the M6 bolt in the upper service hole so that the bolt is inserted **approx. 5 mm {0.2 in}** additionally to secure the tensioner arm.



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- If the bolt cannot be inserted **approx. 5 mm {0.2 in}**, the plunger lock of the chain tensioner may not release, or the chain may not loosen enough. Return the bolt to the original position and restart the procedure from Step (3).

Note

- By rotating the exhaust camshaft clockwise, the timing chain pushes the tensioner arm and the rib position deviates. The entire tensioner arm can be secured by hooking the bolt onto the deviated rib.

- (7) After securing the tensioner arm, remove the chain guide (No.1).

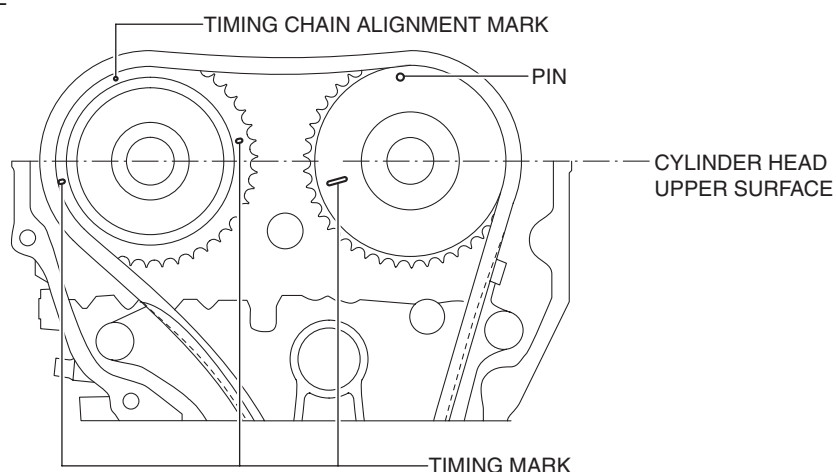
Electric Variable Valve Timing Actuator Removal Note

Caution

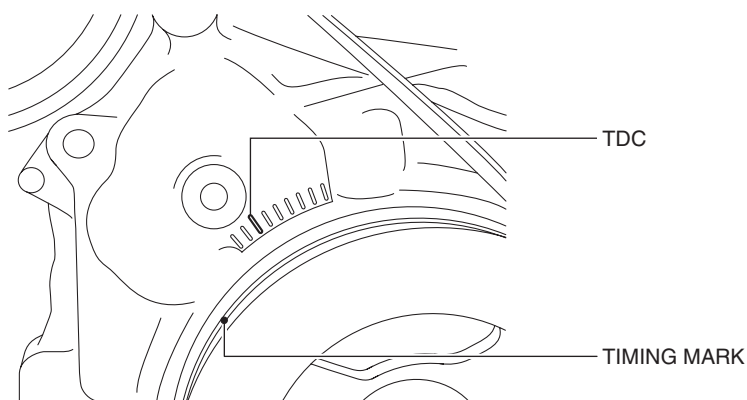
- Keep the timing chain pulled up during and after the work in which it has been set aside from the sprocket. If the chain falls down, it may disengage from the sprocket on the crankshaft side and deviate, leading to valve timing deviation.
- After servicing, always verify the valve timing.

1. Rotate the crankshaft clockwise so that cylinder No.1 is positioned around before top dead center (TDC) as shown in the figure.

CAMSHAFT SIDE



CRANKSHAFT SIDE

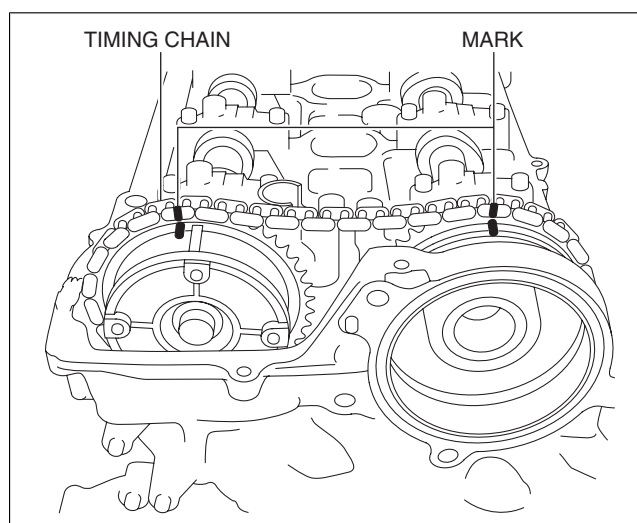


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Note

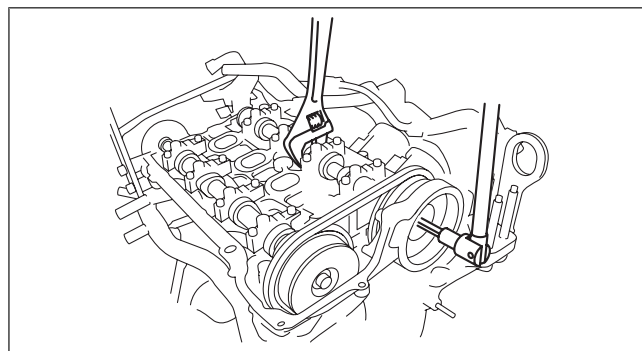
- With cylinder No.1 positioned around before top dead center (TDC), there is no large movement (rotation) of the exhaust camshaft when the timing chain is removed. Therefore, installation of the electric variable valve timing actuator to the camshaft will be easier. (If there is a large movement of the exhaust camshaft, installation of the electric variable valve timing actuator to the camshaft must be performed while loosening the chain by rotating the exhaust camshaft.)

- Mark the timing chain and each actuator so that they can be reassembled in the same condition as before removal.



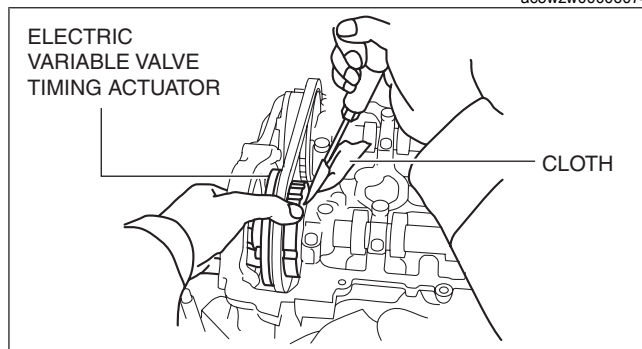
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3. Hold the intake camshaft using a wrench on the cast hexagon and remove the electric variable valve timing actuator installation bolt.



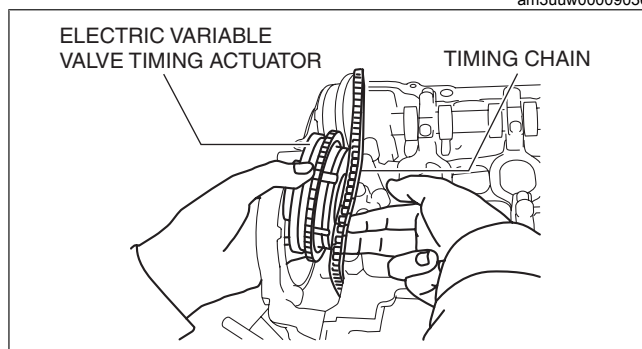
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4. Using a screwdriver wrapped in a clean cloth, lightly press the electric variable valve timing actuator to the front and separate the intake camshaft and the actuator.



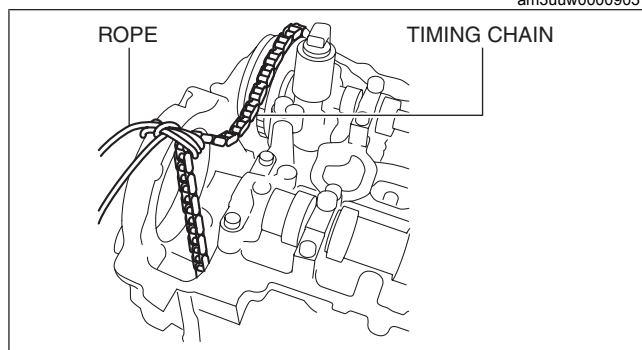
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5. Remove the timing chain from the exhaust and intake camshaft sprockets and set it aside, and remove the electric variable valve timing actuator.



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6. Return the timing chain to the exhaust camshaft sprocket, and pull the timing chain up and suspend it using a rope as shown in the figure.



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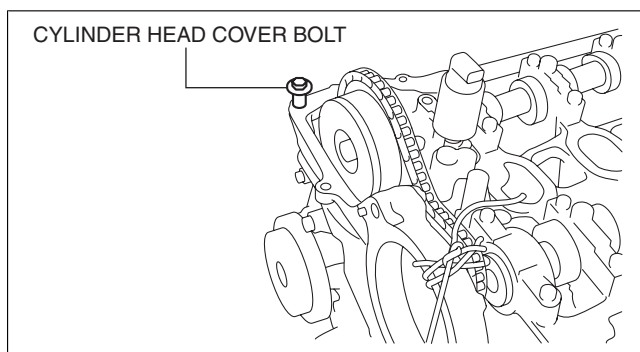
Hydraulic Variable Valve Timing Actuator and Exhaust Camshaft Component Removal Note

Caution

- Keep the timing chain pulled up during and after the work in which it has been set aside from the sprocket. If the chain falls down, it may disengage from the sprocket on the crankshaft side and deviate, leading to valve timing deviation.
- After servicing, always verify the valve timing.

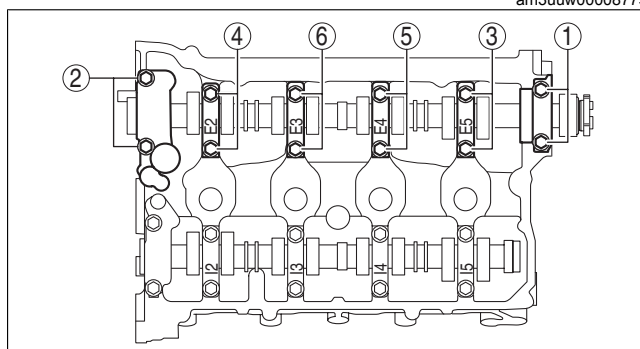
1. Leave the timing chain as it is, which was suspended after electric variable valve timing actuator removal.

2. Temporarily install the cylinder head cover bolt to the position shown in the figure to use it for suspending the timing chain.



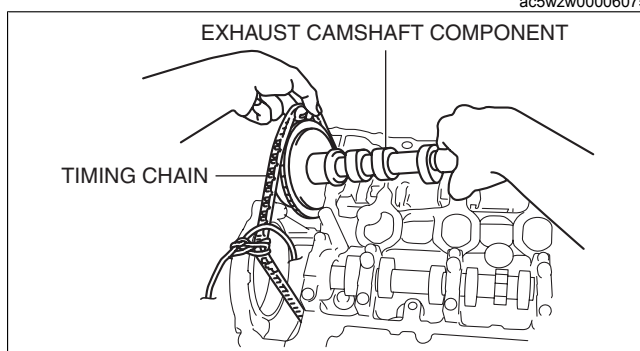
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3. Loosen the exhaust-side camshaft cap bolts in two or three passes in the order shown in the figure, and remove the camshaft caps.



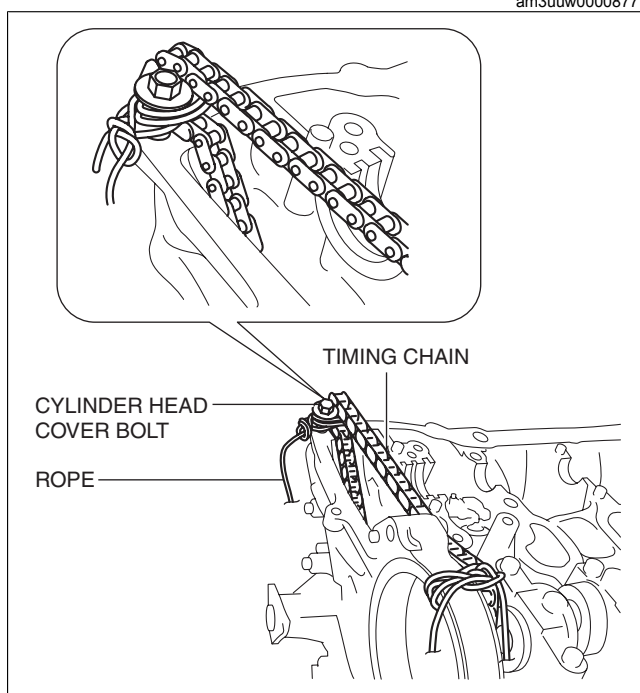
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4. While setting the timing chain aside, remove the hydraulic variable valve timing actuator and the exhaust camshaft as a single unit.



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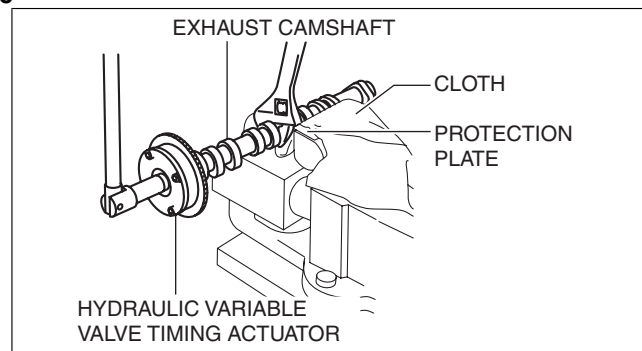
5. Pull up the timing chain and suspend it using a rope as shown in the figure.



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Hydraulic Variable Valve Timing Actuator Removal Note

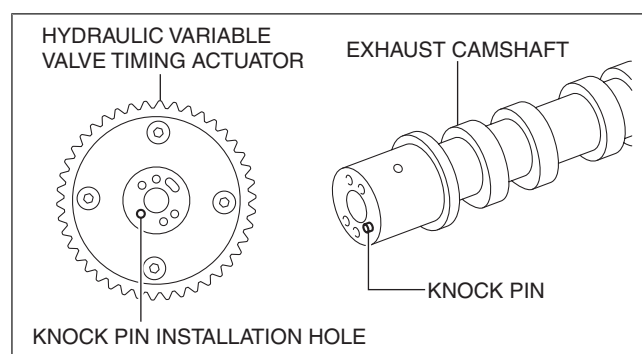
1. Lock the exhaust camshaft against rotation by holding the exhaust camshaft with a vise and securing the cast hexagon with a wrench.
2. Loosen the hydraulic variable valve timing actuator installation bolt and remove the actuator.



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Hydraulic Variable Valve Timing Actuator Installation Note

1. When replacing the hydraulic variable valve timing actuator, place a mark at the same position as the one placed before removal.
2. Align the knock pin on the end of the exhaust camshaft with the knock pin installation hole on the actuator side, and temporarily assemble the bolt.

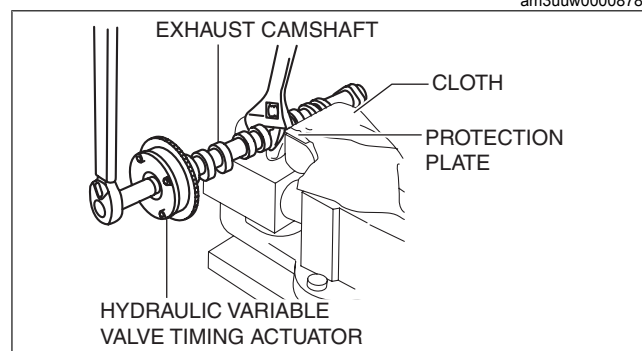


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3. Lock the exhaust camshaft against rotation by holding the exhaust camshaft with a vise and securing the cast hexagon with a wrench.
4. Tighten the hydraulic variable valve timing actuator installation bolt.

Tightening torque

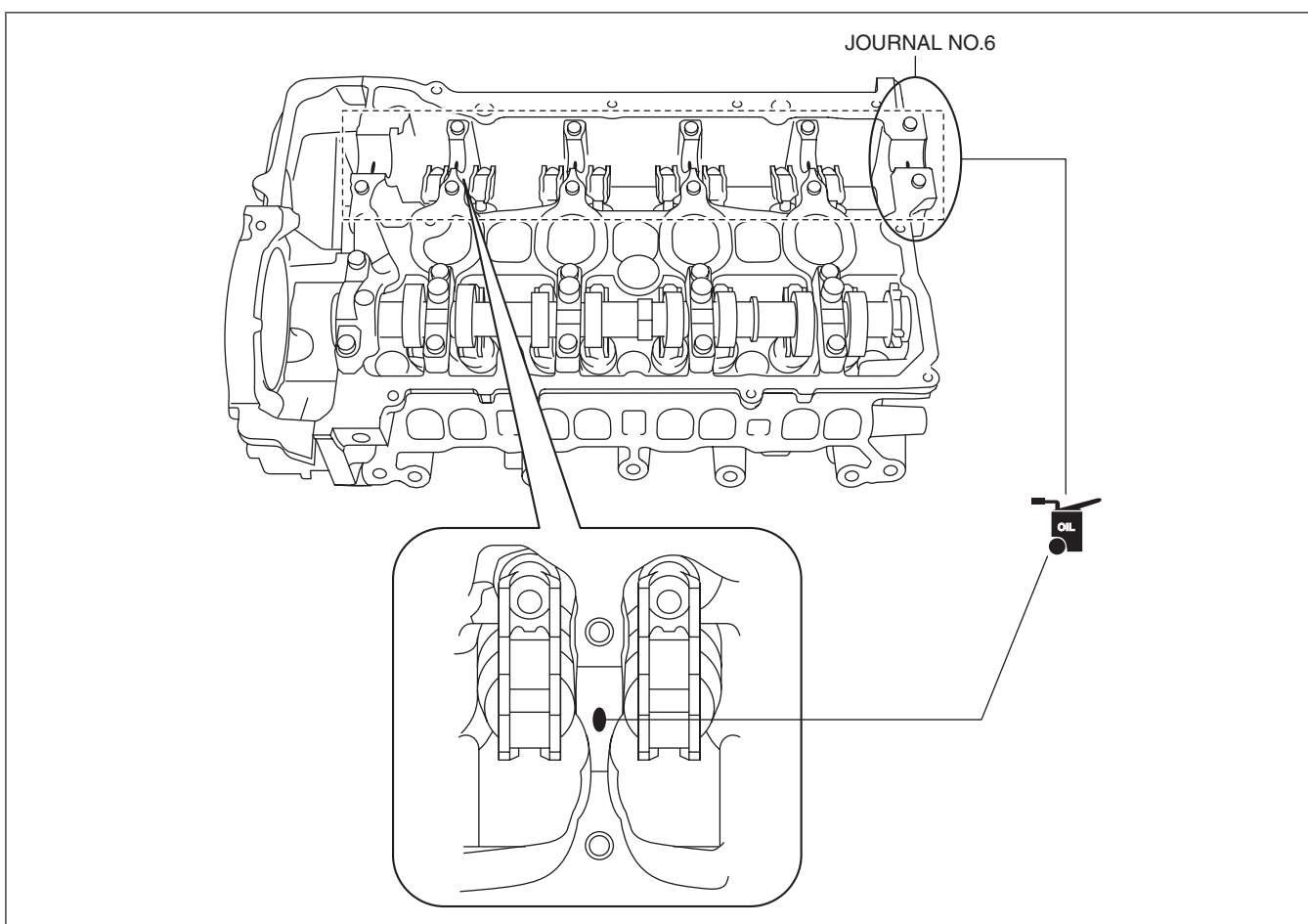
75—85 N·m {7.7—8.6 kgf·m, 56—62 ft·lbf}



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Hydraulic Variable Valve Timing Actuator and Exhaust Camshaft Component Installation Note

1. As shown in the figure, apply gear oil (SAE No. 90 or equivalent) or engine oil to the center area (exhaust side) of each journal of the cylinder head.

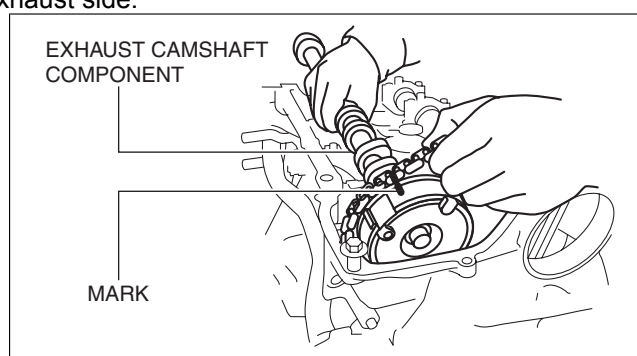


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Caution

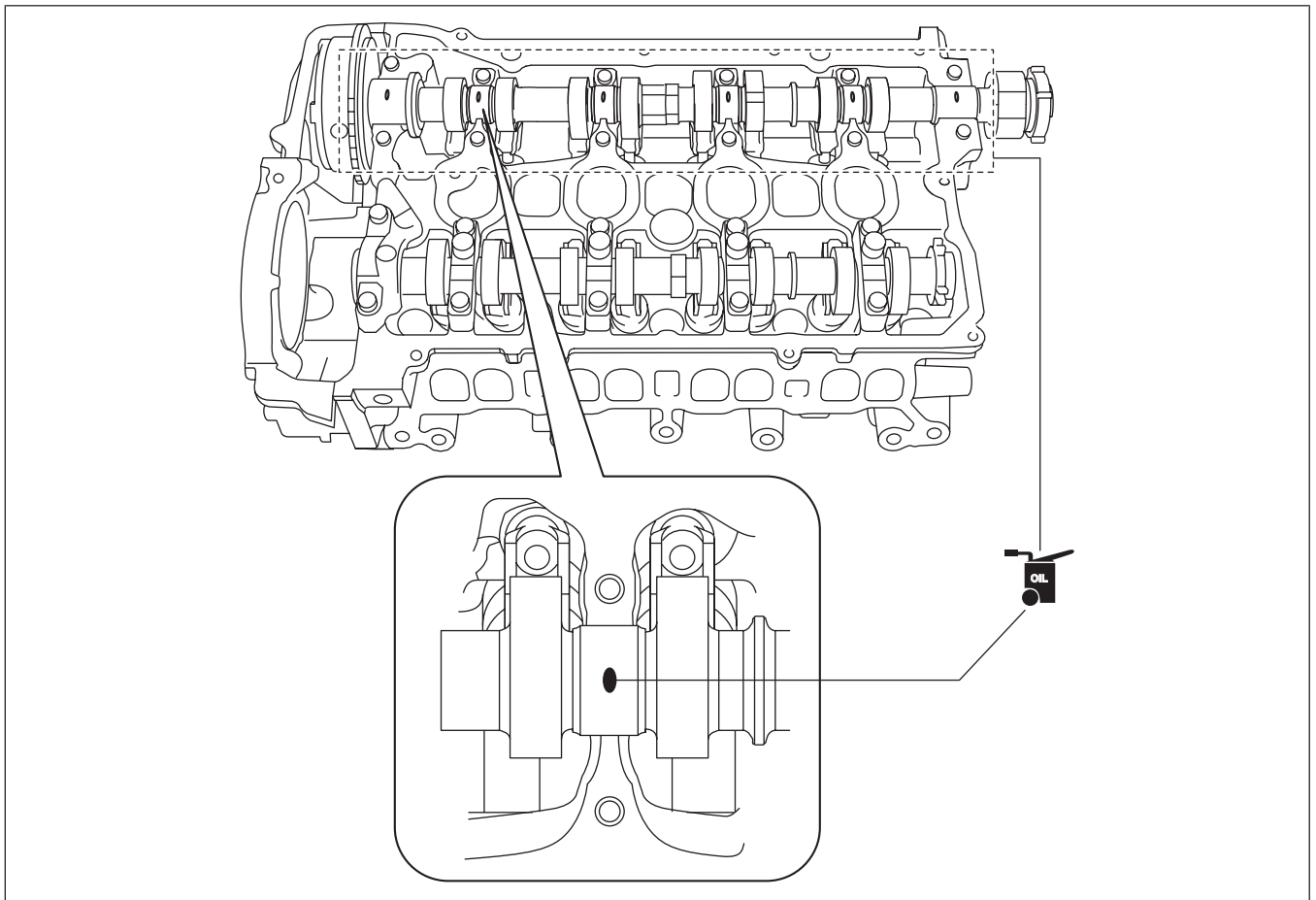
- Apply 0.05 ml {0.05 cc, 0.003 in³} or less of oil to journal No.6.

2. Apply gear oil (SAE No. 90 or equivalent) or engine oil to the following location of the exhaust camshaft.
 - Thrust surface of front journal
3. Remove the rope suspending the timing chain on the exhaust side.
4. While aligning the mark on the timing chain placed during removal with the one on the hydraulic variable valve timing actuator, place the exhaust camshaft component on the cylinder head.



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5. As shown in the figure, apply gear oil (SAE No. 90 or equivalent) or engine oil to the center area of each journal of the exhaust camshaft.



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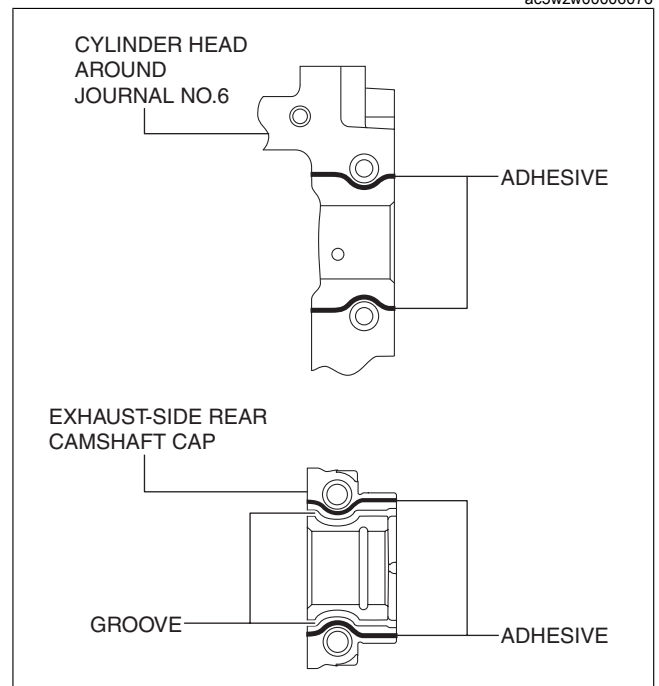
6. Apply adhesive agent (Loctite 962T) around journal No.6 of the cylinder head or the exhaust-side rear camshaft cap.

Caution

- Verify that there is no adhesive agent on the journal.

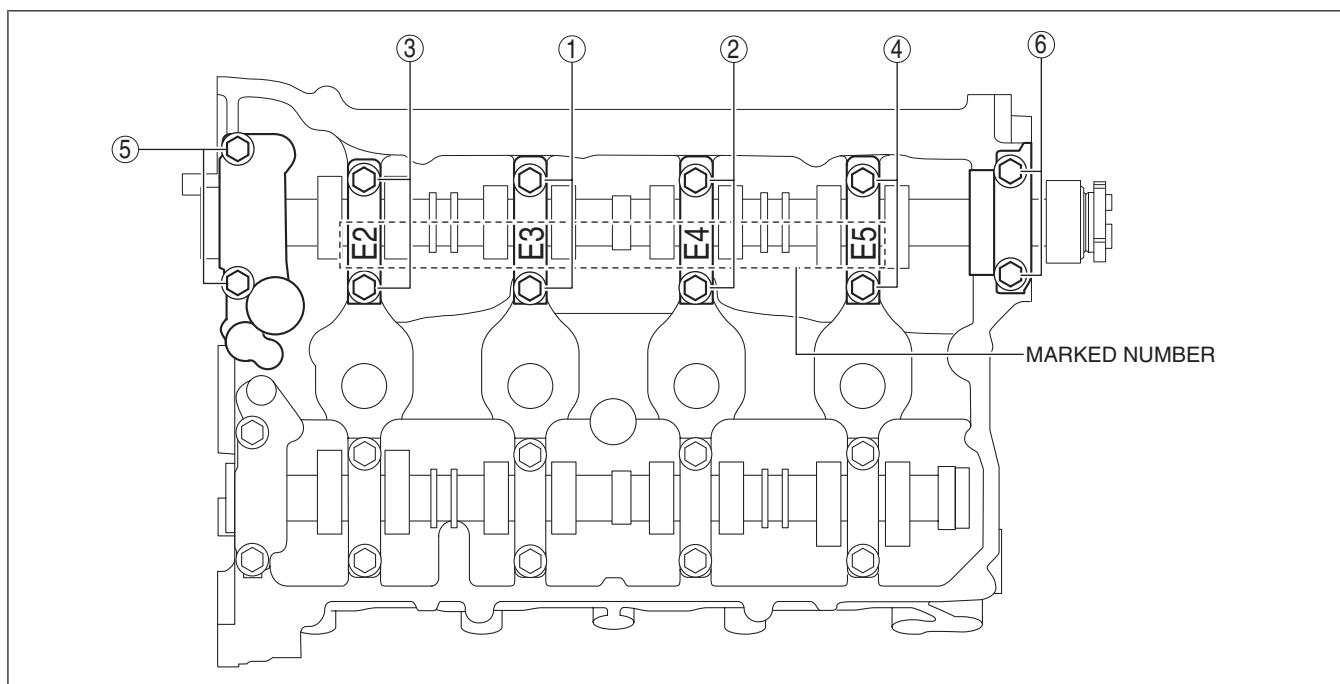
Adhesive agent bead width
0.5—1.5 mm {0.02—0.05 in}

7. Install the camshaft caps in the marked number order, and temporarily tighten the camshaft cap installation bolts in two or three passes evenly.



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8. Tighten the camshaft cap installation bolts in two steps in the order shown in the figure.



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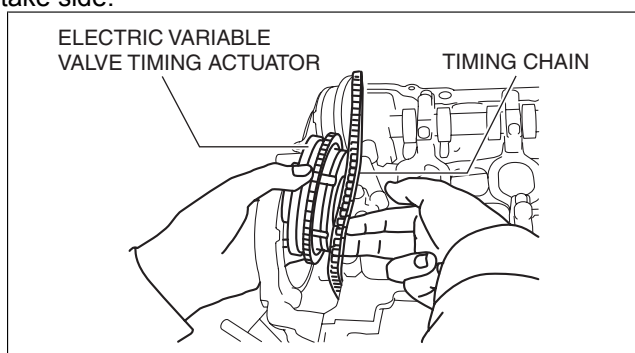
Tightening torque

First step: 3.0—6.0 N·m {31—61 kgf·cm, 27—53 in·lbf}

Second step: 8—11 N·m {82—112 kgf·cm, 71—97 in·lbf}

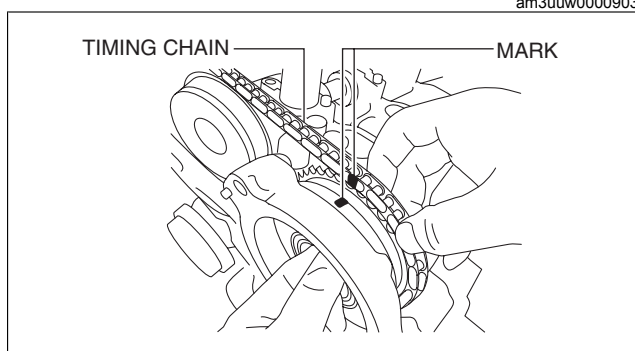
Electric Variable Valve Timing Actuator Installation Note

1. When replacing the electric variable valve timing actuator with a new one, place a mark at the same position as the one placed before removal.
2. Remove the rope suspending the timing chain on the intake side.
3. Remove the timing chain from the exhaust and intake camshaft sprockets and set it aside to the rear, then insert the electric variable valve timing actuator between the engine front cover and the cylinder head.
4. Return the timing chain to the exhaust camshaft sprocket.



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5. While aligning the mark on the timing chain placed during removal with the one on the electric variable valve timing actuator, engage the chain with the sprocket.

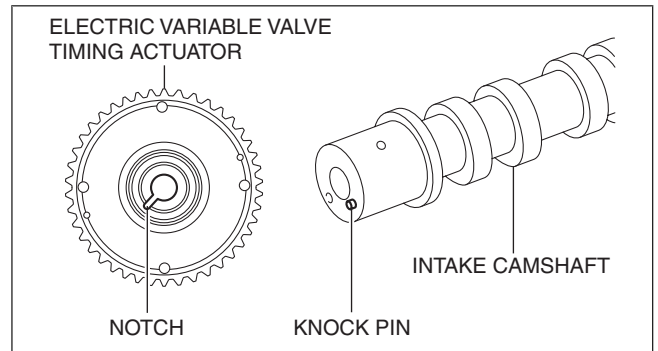


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6. Align the knock pin on the end of the intake camshaft with the notch on the actuator side, then assemble the actuator.

Note

- Adjust the knock pin with the notch while adjusting the knock pin position by rotating the camshaft.

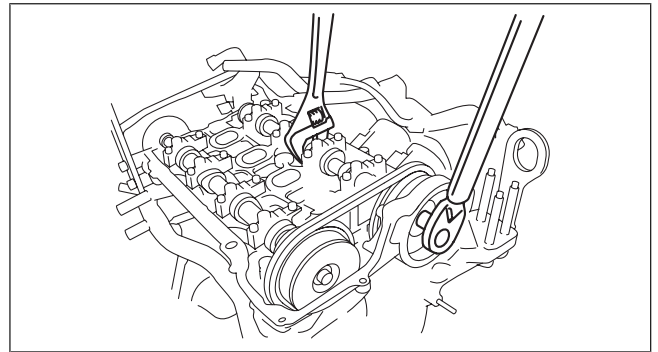


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7. Hold the intake camshaft using a wrench on the cast hexagon, and tighten the electric variable valve timing actuator installation bolt.

Tightening torque

102—114 N·m {10.5—11.6 kgf·m, 76—84 ft·lbf}



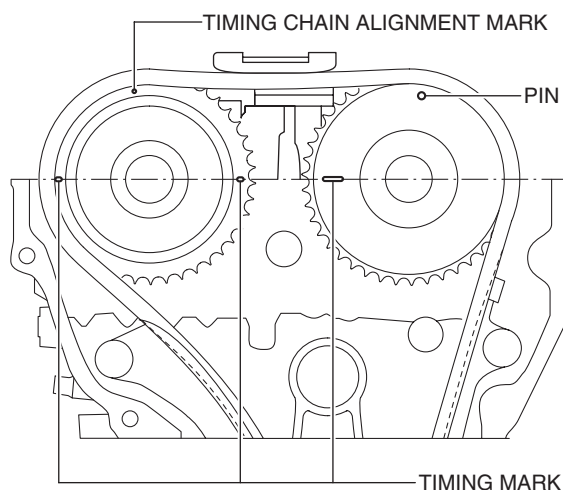
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Timing Chain Installation Note

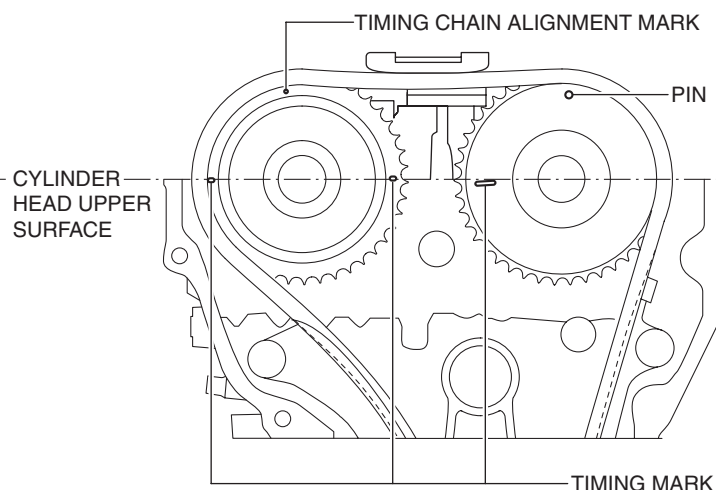
1. Install the chain guide (No.1).
2. Remove the bolt securing the tensioner arm and apply tension to the timing chain.
3. Rotate the crankshaft clockwise two turns and verify that the valve timing is correct.

CAMSHAFT SIDE

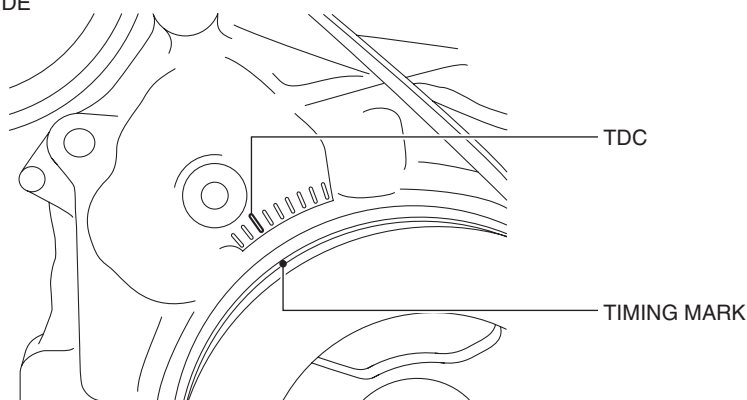
SKYACTIV-G 2.0



SKYACTIV-G 2.5



CRANKSHAFT SIDE



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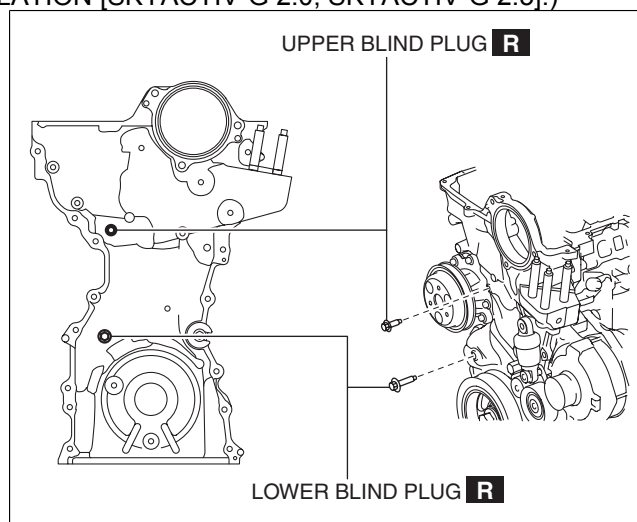
Note

- The timing mark of SKYACTIV-G 2.5 is not completely parallel with the upper surface of the cylinder head.
 - If the valve timing is not correct, remove the engine front cover and reassemble the timing chain to each sprocket. (See TIMING CHAIN REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
4. Install the blind plugs (upper and lower) for the engine front cover service holes.

Tightening torque

Upper: 8—11 N·m {82—112 kgf·cm, 71—97 in·lbf}

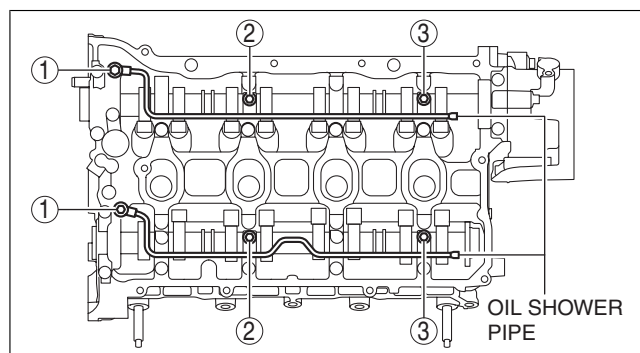
Lower: 17—23 N·m {1.8—2.3 kgf·m, 13—16 ft·lbf}



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Oil Shower Pipe Installation Note

1. Install the oil shower pipe in the order shown in the figure.



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Tightening torque

Installation position	Tightening torque
1	9—12 N·m {92—122 kgf·cm, 80—106 in·lbf}
2, 3	8.0—9.0 N·m {82—91 kgf·cm, 71—79 in·lbf}