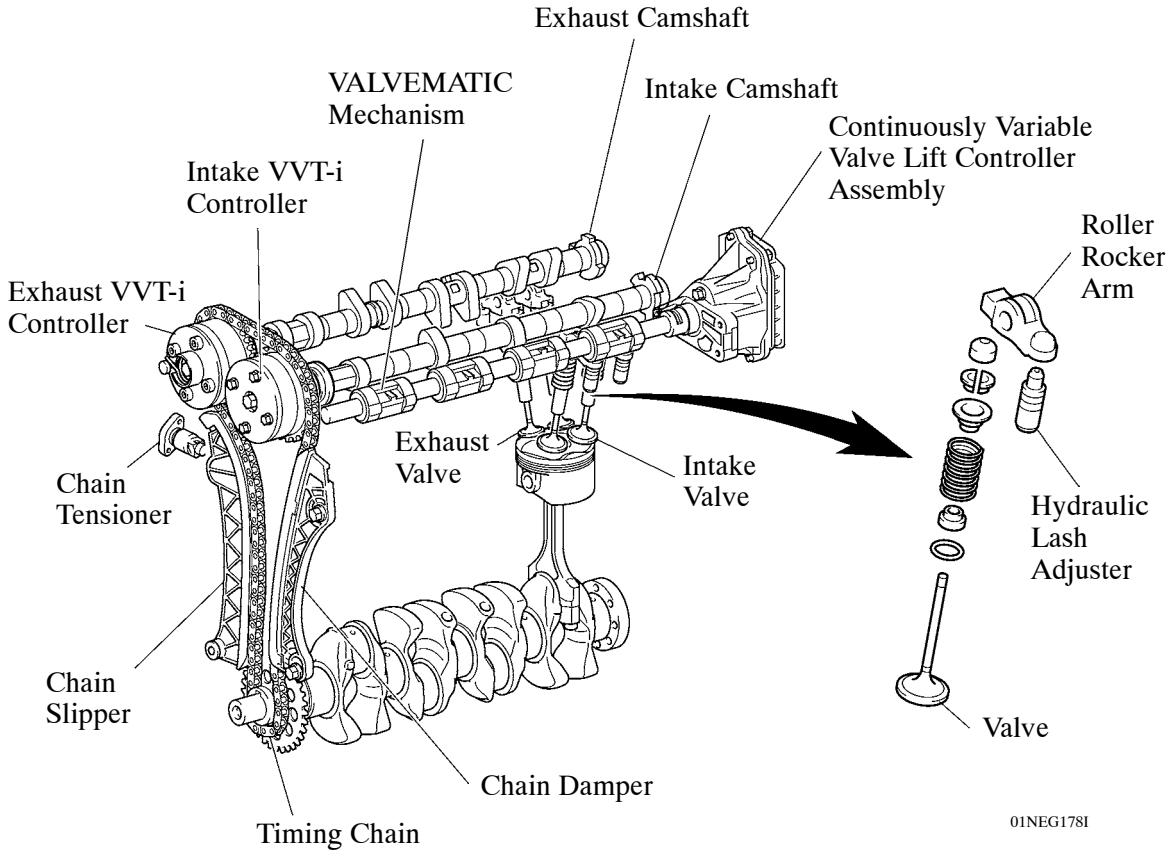
■VALVE MECHANISM

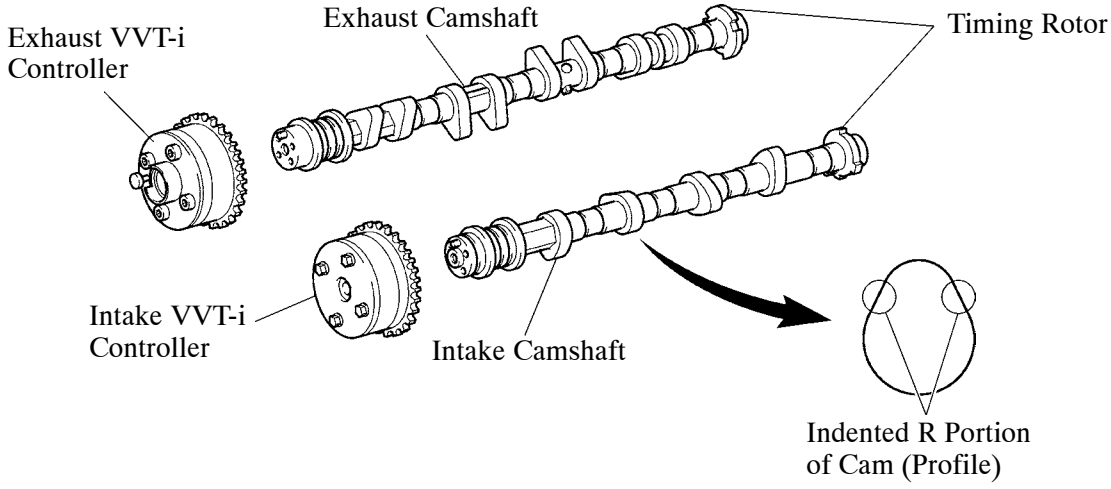
1. General

- Intake and exhaust efficiency has been increased due to the larger total port areas.
- This engine uses roller rocker arms with built-in needle bearings. This reduces the friction that occurs between the cams or oscillating cam and the areas (roller rocker arms) that push the valves down, thus improving fuel economy.
- Hydraulic lash adjusters, which maintain a constant zero valve clearance through the use of oil pressure and spring force, are used.
- The intake and exhaust camshafts are driven by a timing chain.
- This engine uses the VALVEMATIC, which effects continuously variable control of the amount of intake valve lift and intake valve action angle, and the Dual Variable Valve Timing-intelligent (Dual VVT-i) system, which controls the intake and exhaust valve timing. Through coordinate control, these systems optimally control the valve timing and amount of intake valve lift in accordance with the driving conditions. This achieves lower fuel consumption, higher engine performance, and fewer exhaust emissions.



2. Camshaft

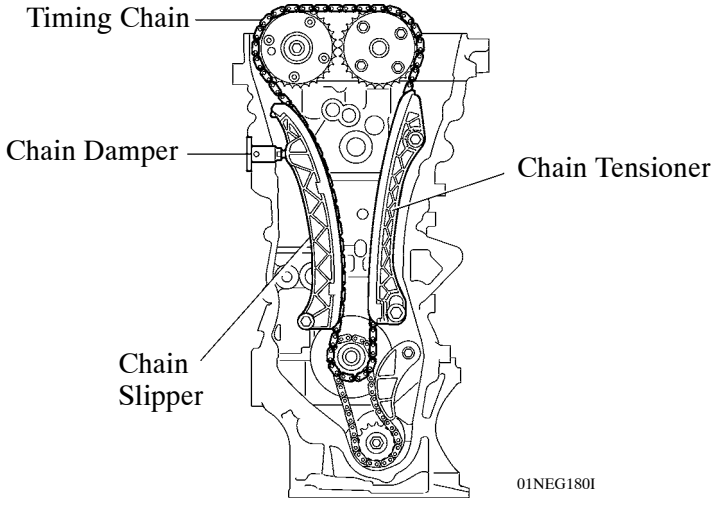
- The intake and exhaust camshafts are made of a cast iron alloy.
- An oil passage is provided in the intake and exhaust camshafts in order to supply engine oil to the VVT-i system.
- A VVT-i controller has been installed on each front of the intake and exhaust camshafts to vary the timing of the intake and exhaust valves.
- Together with the use of the roller rocker arm, the cam profile has been designed with an indented R (radius). This results in increased valve lift when the valve begins to open and finishes closing, helping to achieve enhanced output performance.
- A timing rotor for the camshaft position sensor is provided at each back end of the intake and exhaust camshafts.



Cam with Indented R 01NEG179I

3. Timing Chain and Chain Tensioner

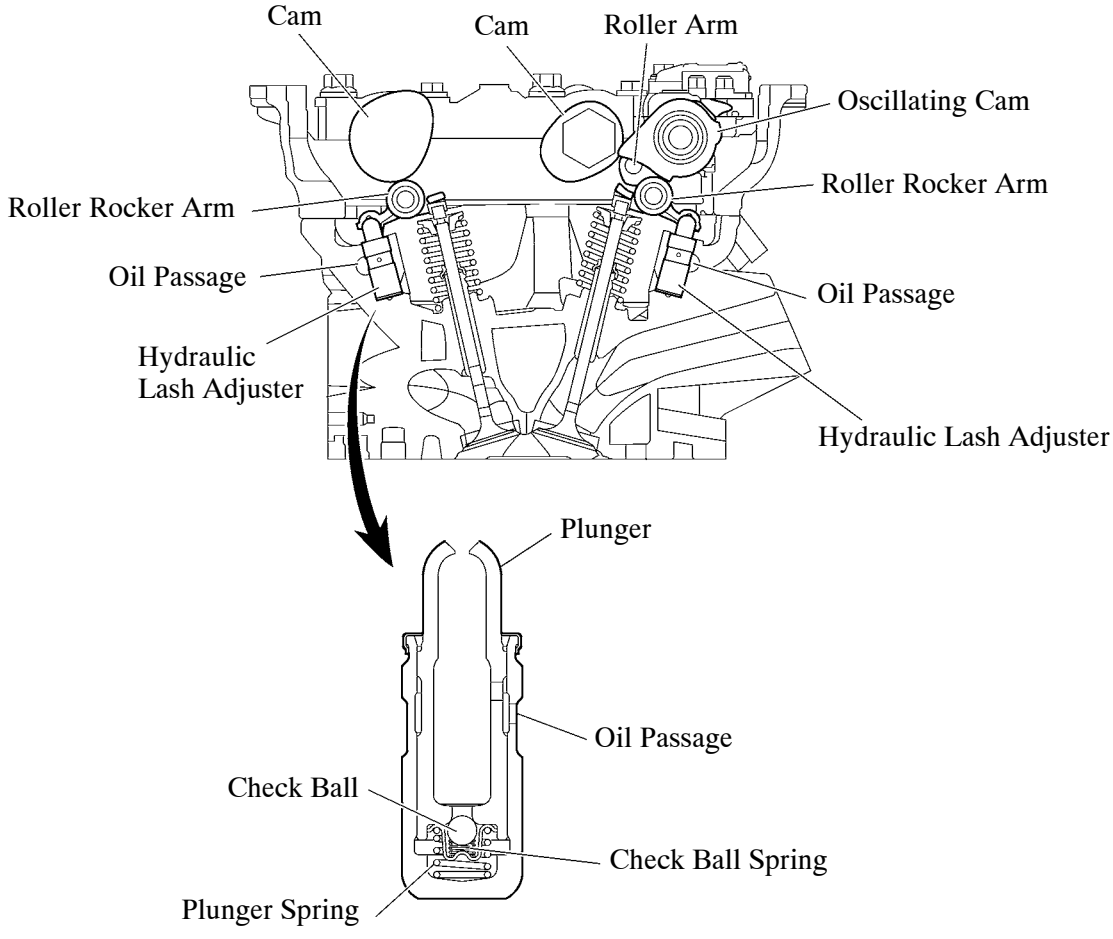
- A roller chain with an 8 mm (0.315 in.) pitch is used to make the engine more compact.
- The timing chain is lubricated by a timing chain oil jet. See page 34 for the location of the timing chain oil jet.
- The chain tensioner uses a spring and oil pressure to maintain proper chain tension at all times. The chain tensioner suppresses noise generated by the timing chain.
- The chain tensioner is a ratchet type with a non-return mechanism.
- To achieve excellent serviceability, the chain tensioner is constructed so that it can be removed and installed from the outside of the timing chain cover.



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4. Hydraulic Lash Adjuster

- The hydraulic lash adjuster, which is located at the fulcrum of the roller rocker arm, consists primarily of a plunger, a plunger spring, a check ball, and a check ball spring.
- The engine oil supplied by the cylinder head and the built-in spring actuates the hydraulic lash adjuster. The oil pressure and the spring force that act on the plunger push the roller rocker arm against the cam or oscillating cam, in order to adjust the valve clearance created during the opening and closing of the valve. As a result, engine noise has been reduced.

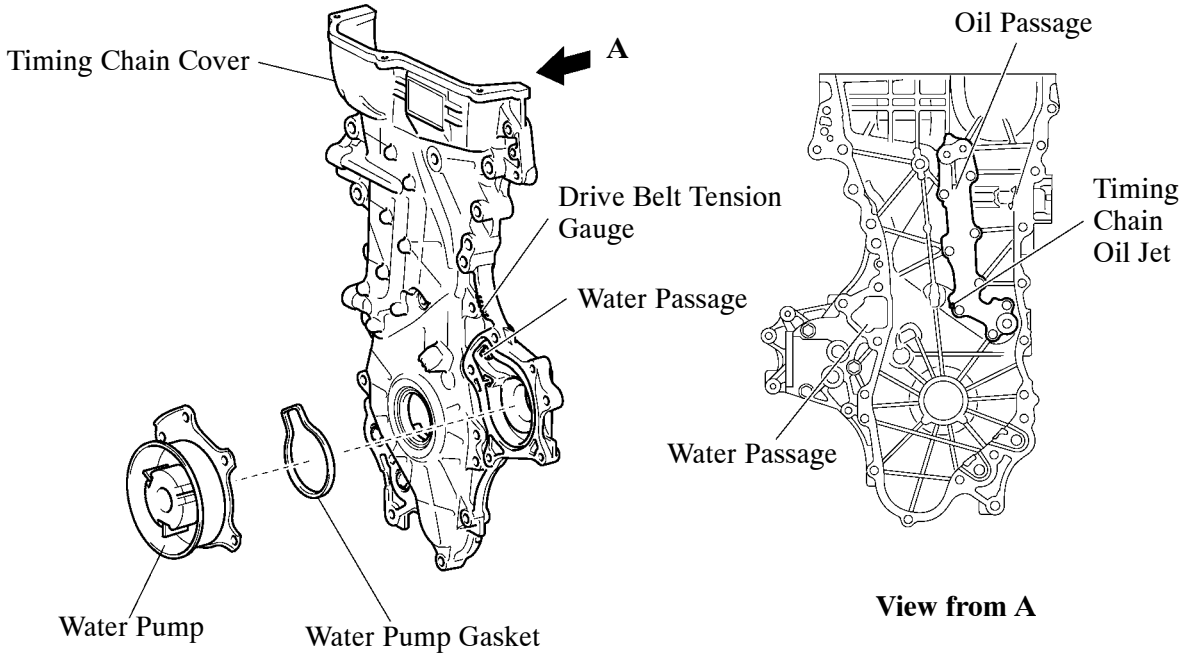


Service Tip

Valve clearance adjustment is not necessary because a hydraulic lash adjuster is used.

5. Timing Chain Cover

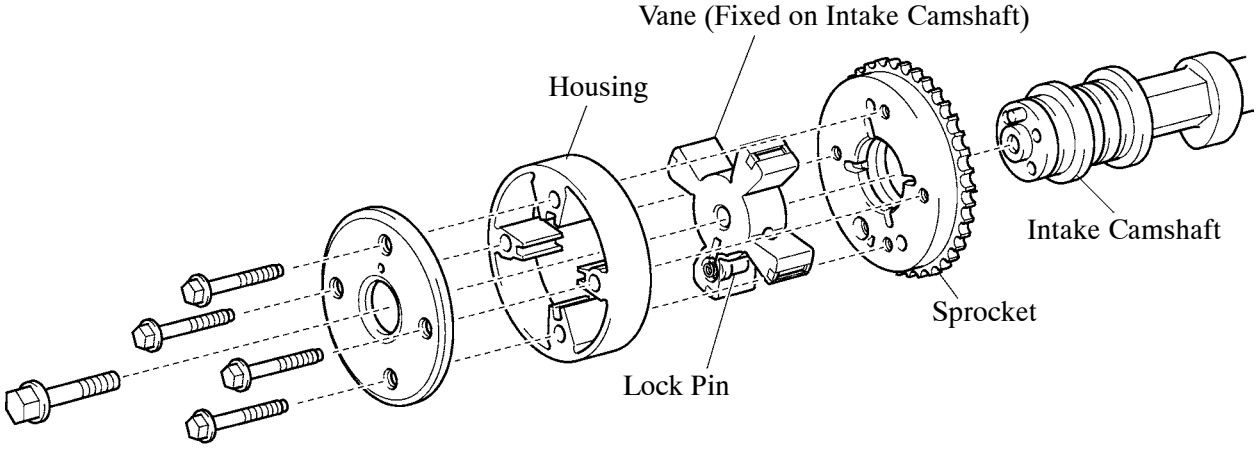
- An aluminum die-cast timing chain cover is used.
- The timing chain cover has an integrated construction consisting of the cooling system (water pump and water passage). Thus, the number of parts has been reduced for weight reduction.
- The oil passage is simplified by being provided on the timing chain cover.
- The timing chain oil jet is provided in the timing chain cover.
- A drive belt tension gauge is provided on the timing chain cover.

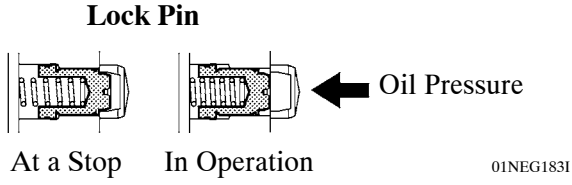


6. VVT-i Controller

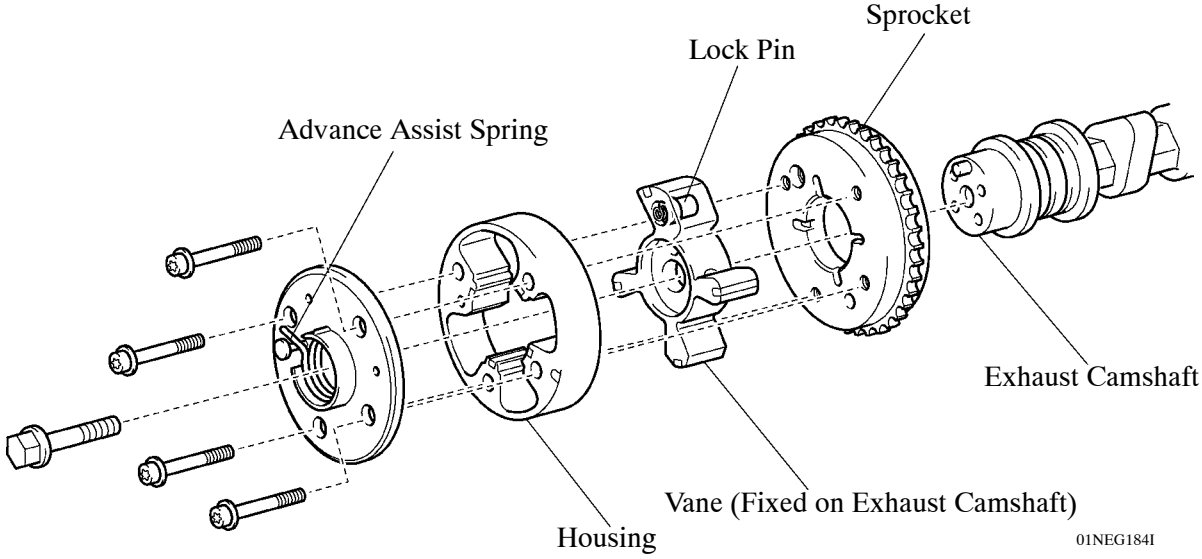
- Each controller consists of a housing driven from the timing chain and a vane coupled with the intake or exhaust camshaft.
- Both the intake and exhaust sides have a 4-blade vane.
- The oil pressure sent from the advanced or retarded side path at the intake and exhaust camshafts causes rotation in the VVT-i controller vane circumferential direction to vary the intake and exhaust valve timing continuously.
- When the engine is stopped, a lock pin locks the intake camshaft at the most retarded end and the exhaust camshaft at the most advanced end, to ensure that the engine starts properly.
- An advance assist spring is provided on the exhaust side VVT-i controller. This spring applies torque in the advance direction when the engine is stopped, thus ensuring the engagement of the lock pin.

▶ Intake Side VVT-i Controller ◀



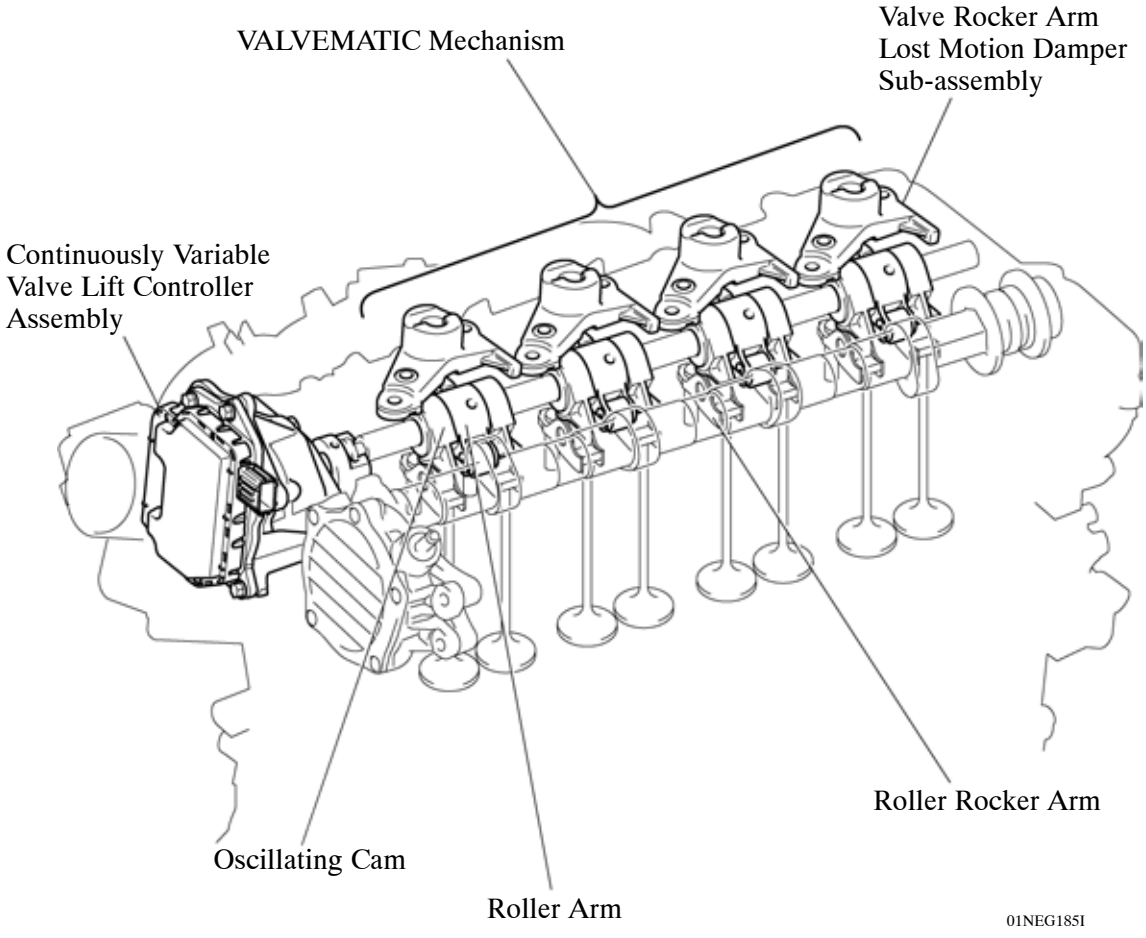


▶ Exhaust Side VVT-i Controller ◀

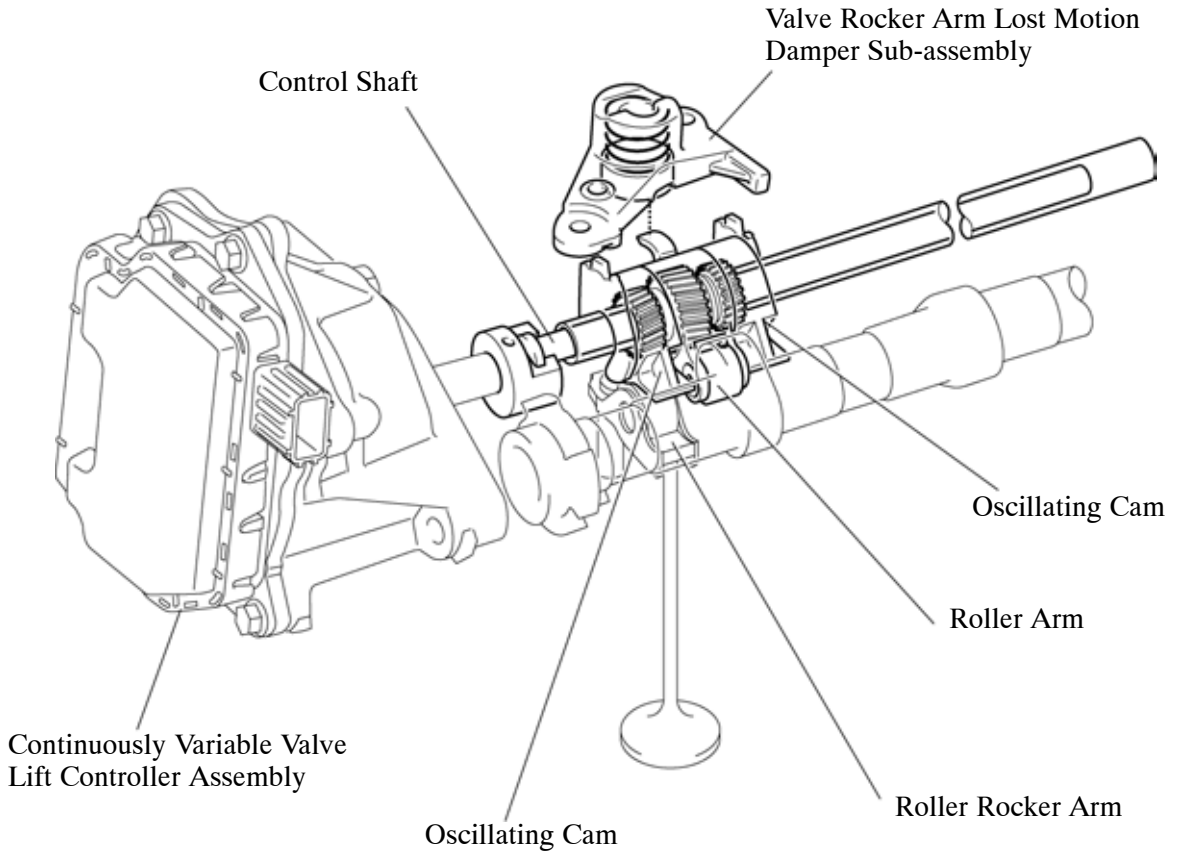


7. VALVEMATIC Mechanism

- The valve mechanism for the intake side uses the VALVEMATIC mechanism. The VALVEMATIC mechanism is operated by the continuously variable valve lift controller assembly.
- The cam on the camshaft pushes the roller arm, and the oscillating cam that rotates in the same way as the roller arm. Then, the oscillating cam pushes on the roller rocker arm, in order to open the intake valve.

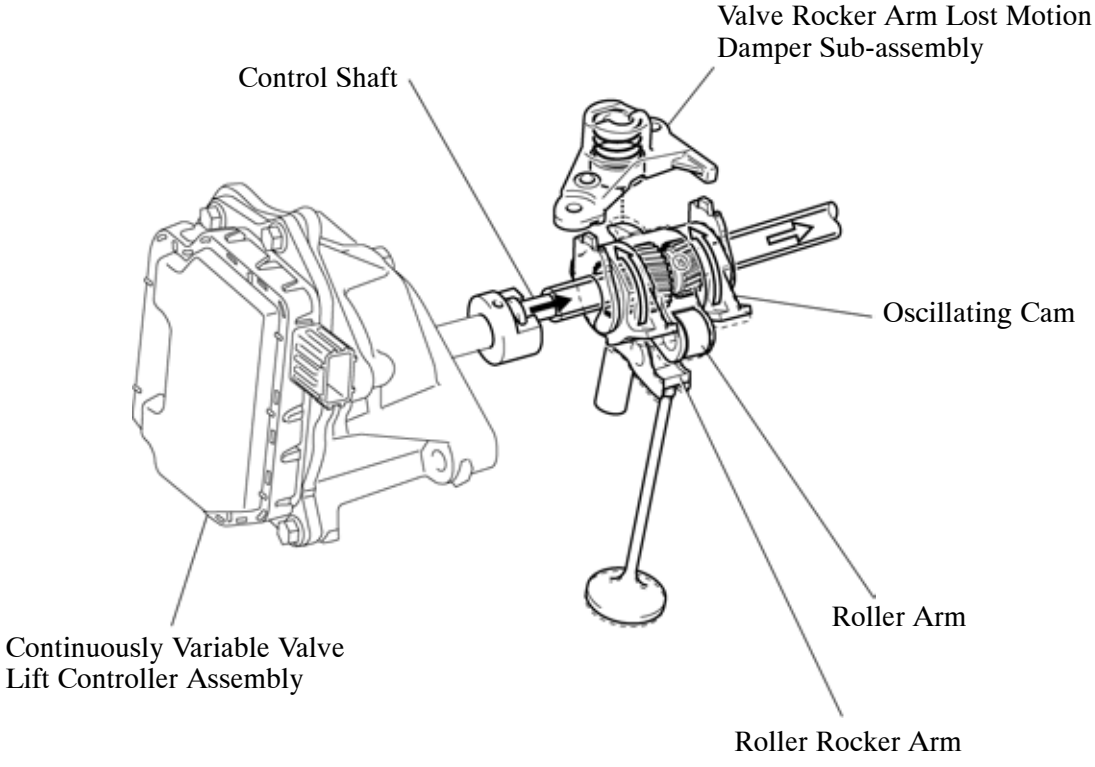


- The control shaft transmits the linear movement of the continuously variable valve lift controller assembly to the slider located inward of the roller arm and oscillating cam. Because the roller arm is held in place by the valve rocker arm lost motion damper sub-assembly, the slider's helical splines and the helical splines inside the roller arm cause the slider to rotate. As a result, the slider rotates the oscillating cam. The rotation of the oscillating cam varies continuously in order to continuously vary the amount of intake valve lift and intake valve action angle.

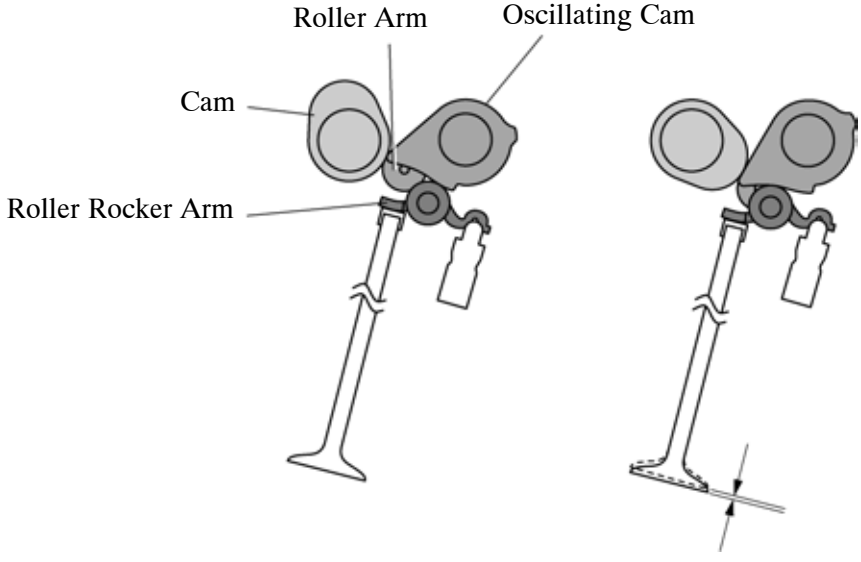


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- As the continuously variable valve lift controller assembly pushes on the control shaft, the oscillating cam rotates counterclockwise as seen from the continuously variable valve lift controller assembly. As a result, the pressure exerted on the roller rocker arm decreases, thus reducing the amount of valve lift.



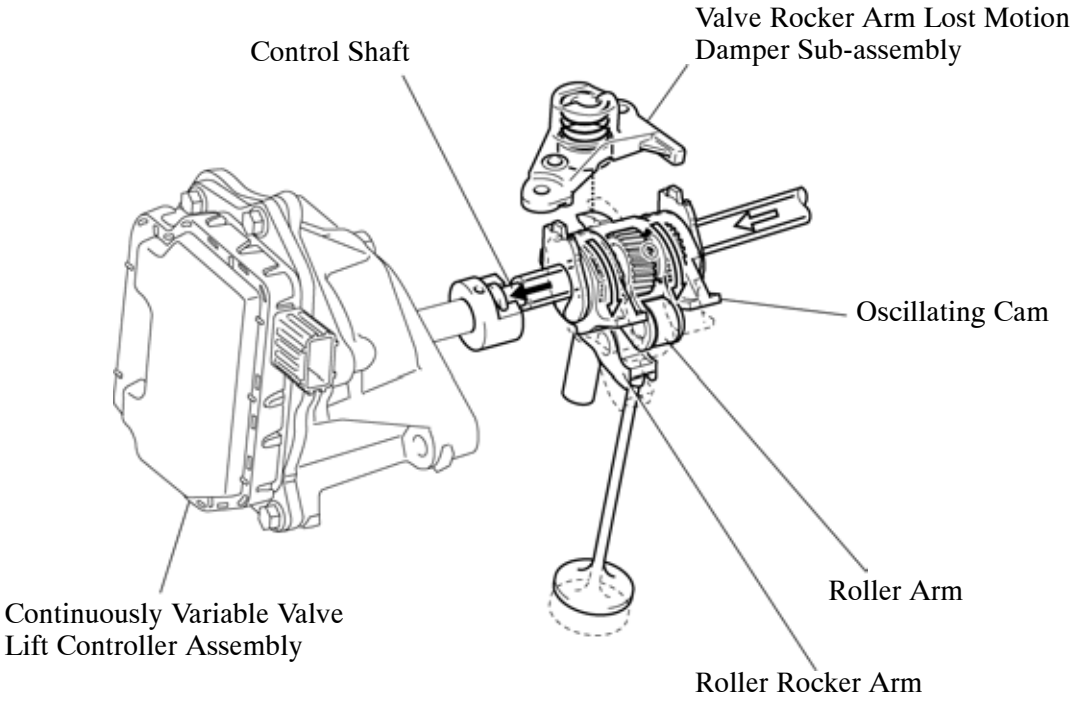
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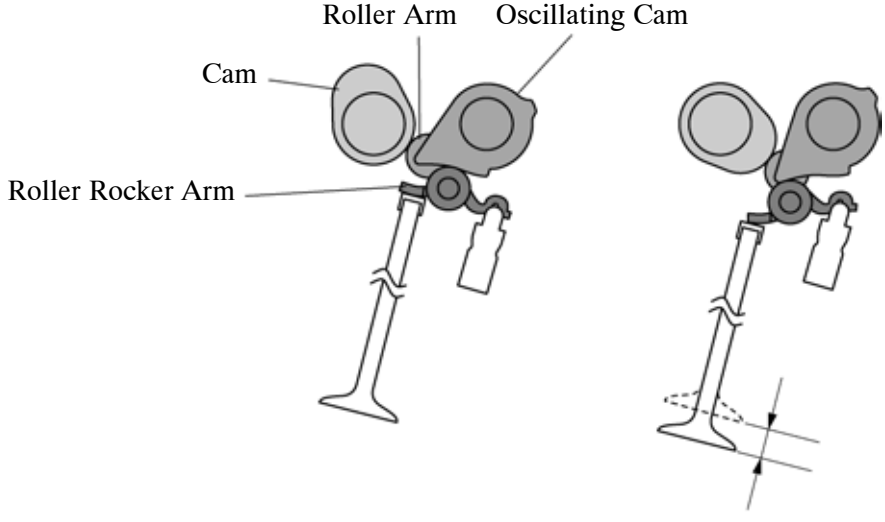
Initial Position **Minimum Amount of Valve Lift**

01NEG188I

- As the continuously variable valve lift controller assembly pulls on the control shaft, the oscillating cam rotates clockwise as seen from the continuously variable valve lift controller assembly. As a result, the pressure exerted on the roller rocker arm increases, thus increasing the amount of valve lift.



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Initial Position **Maximum Amount of Valve Lift**

01NEG190I