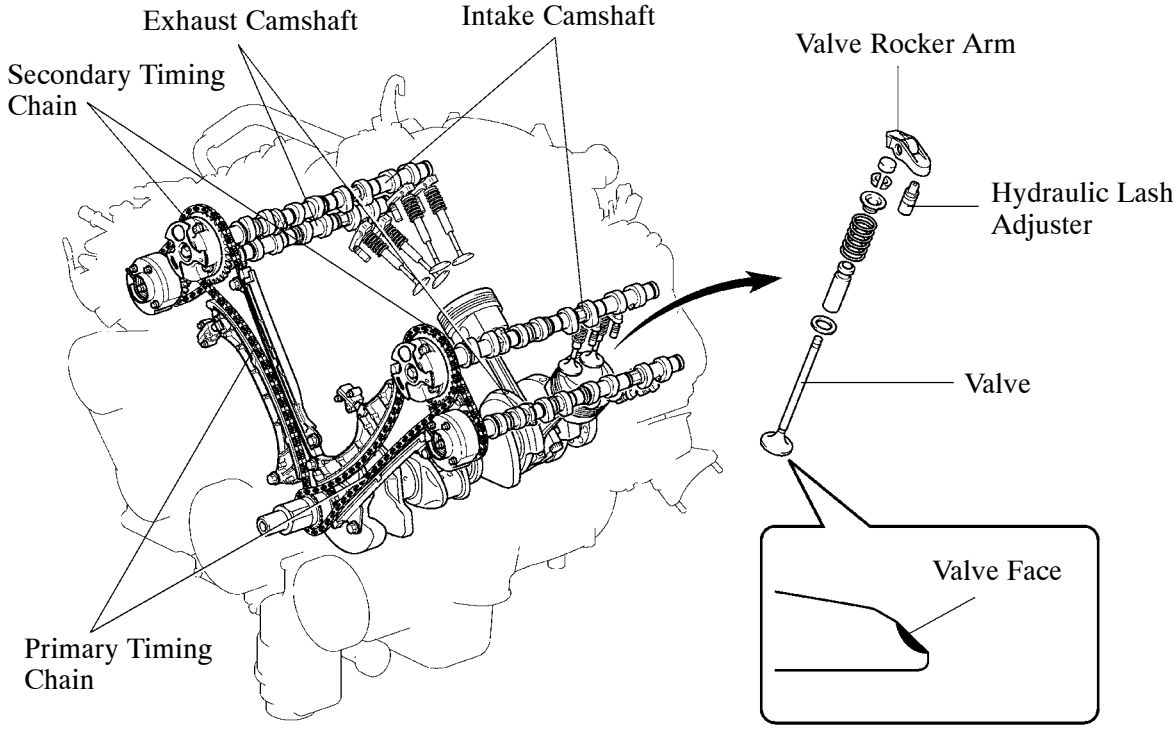
5. Valve Mechanism

General

- Each cylinder of this engine has 2 intake valves and 2 exhaust valves. Intake and exhaust efficiency is increased due to the larger areas of all the ports.
- This engine uses roller rocker arms with built-in needle bearings. This reduces the friction that occurs between the cams and the valve rocker arm sub-assemblies that push the valves down, thus improving fuel economy.
- Valve lash adjuster assemblies, which maintain a constant zero valve clearance through the use of oil pressure and spring force, are used.
- To ensure highly accurate valve timing, separate primary timing chains are driven by the crankshaft in order to rotate the intake camshafts of the left and right banks. The exhaust camshafts are driven by the intake camshaft of the respective bank via secondary timing chains.
- This engine has a Dual VVT-i (Variable Valve Timing-intelligent) system which controls the intake and exhaust camshafts to provide optimal valve timing according to driving conditions. Using this system, lower fuel consumption, higher engine performance, and reduced exhaust emissions have been achieved. For details of the Dual VVT-i control, see page 74.

— Change From 3UR-FE Engine —

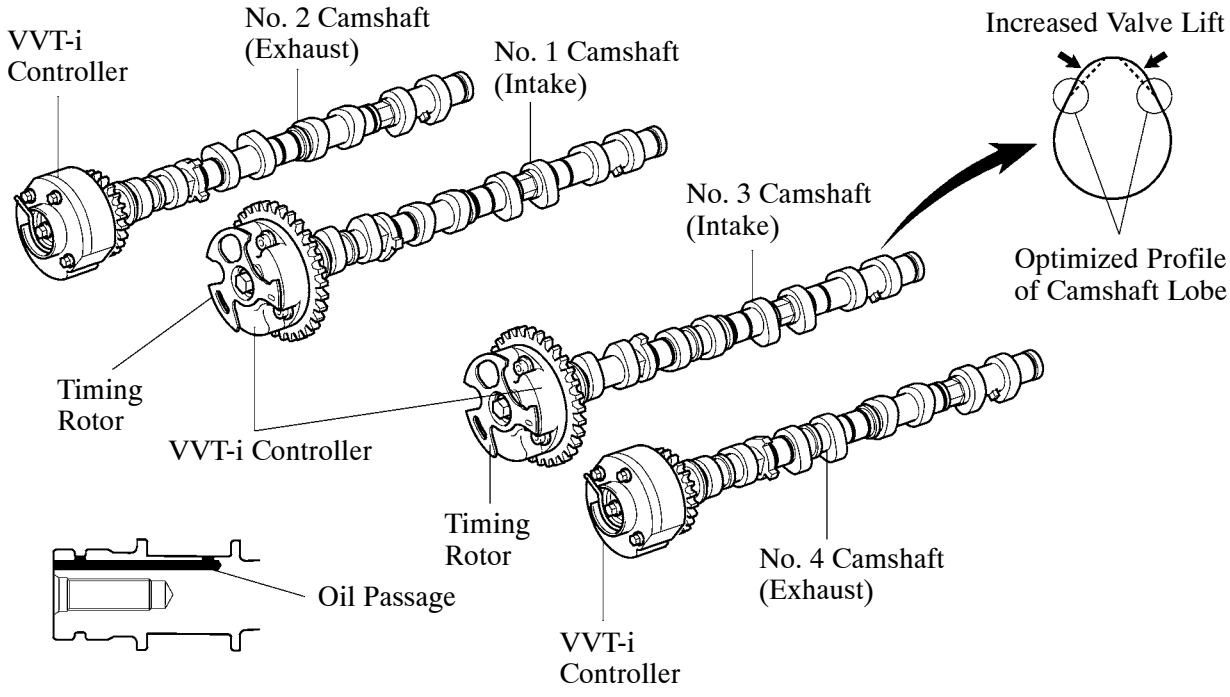
- Hard-facing alloy is used for the intake valve face.
- The use of hard-facing alloy on the exhaust valve face has been discontinued.



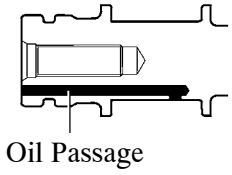
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Camshaft

- The camshafts are made of cast iron alloy.
- Oil passages are provided in the intake and exhaust camshafts in order to supply engine oil to the VVT-i system.
- VVT-i controllers are installed on the 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 arms, the cam profile has been optimized. This results in increased valve lift when the valve begins to open and finishes closing, helping to achieve enhanced output performance.



Cross Section of End of Intake Camshaft

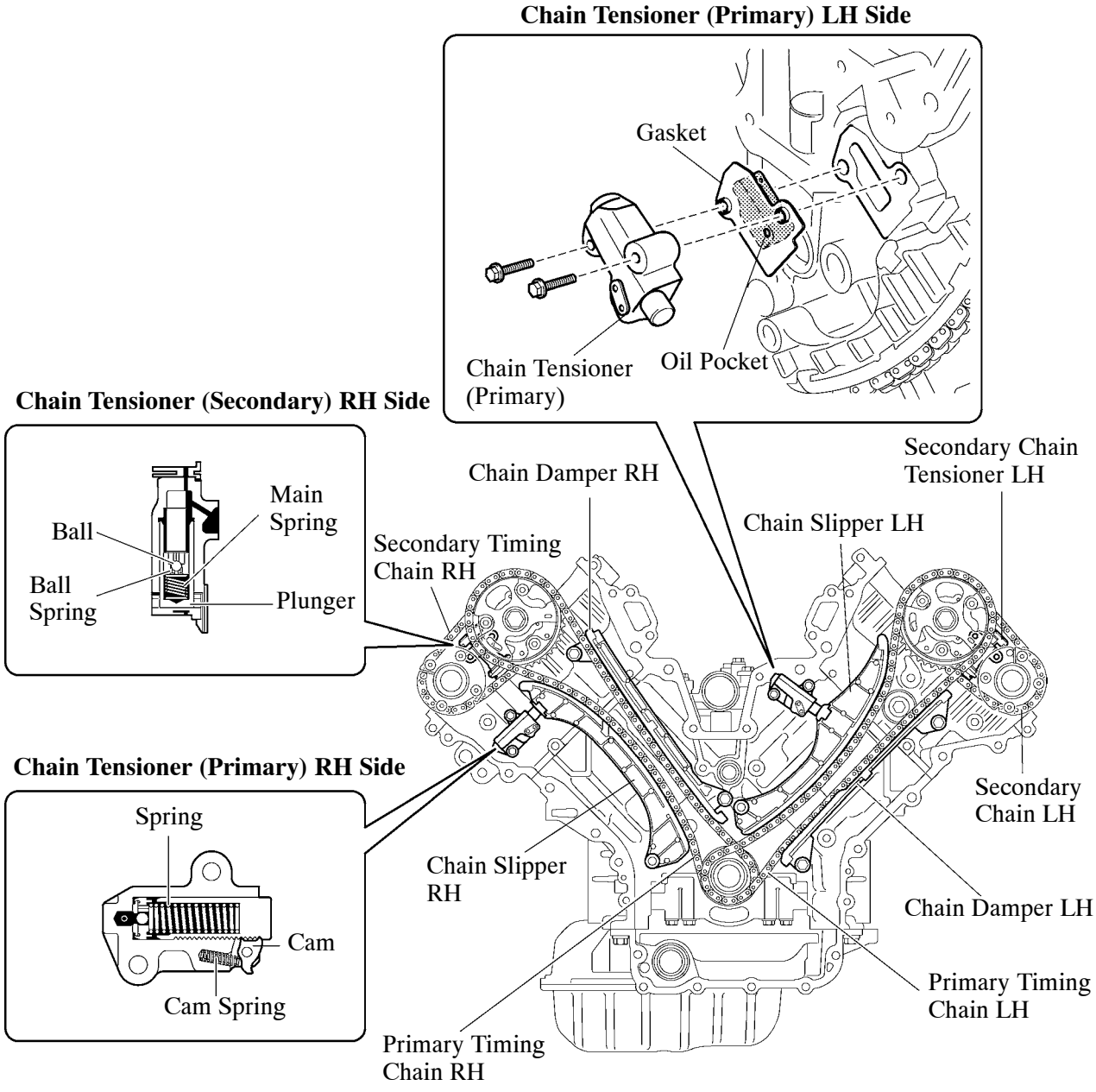


Cross Section of End of Exhaust Camshaft

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Timing Chains and Chain Tensioners

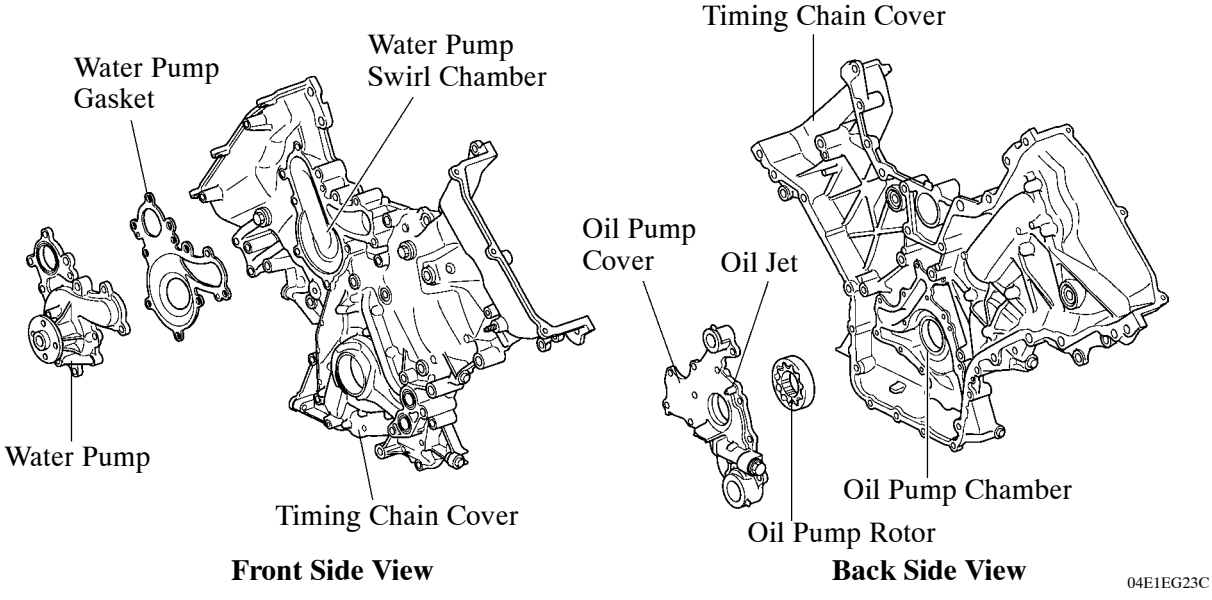
- Both the primary and secondary chains use roller chains with a pitch of 9.525 mm (0.375 in.).
- A timing chain tensioner is provided for each primary timing chain and secondary timing chain in each bank.
- Both the primary and secondary chain tensioners use oil pressure and a spring to maintain proper chain tension at all times. The tensioners suppress noise generated by the timing chains.
- The chain tensioner for the primary timing chain is a ratchet type with a non-return mechanism. Furthermore, an oil pocket creates oil pressure when the engine is started, and simultaneously applies oil pressure to the chain tensioner. This prevents the timing chain from flapping and reduces noise.



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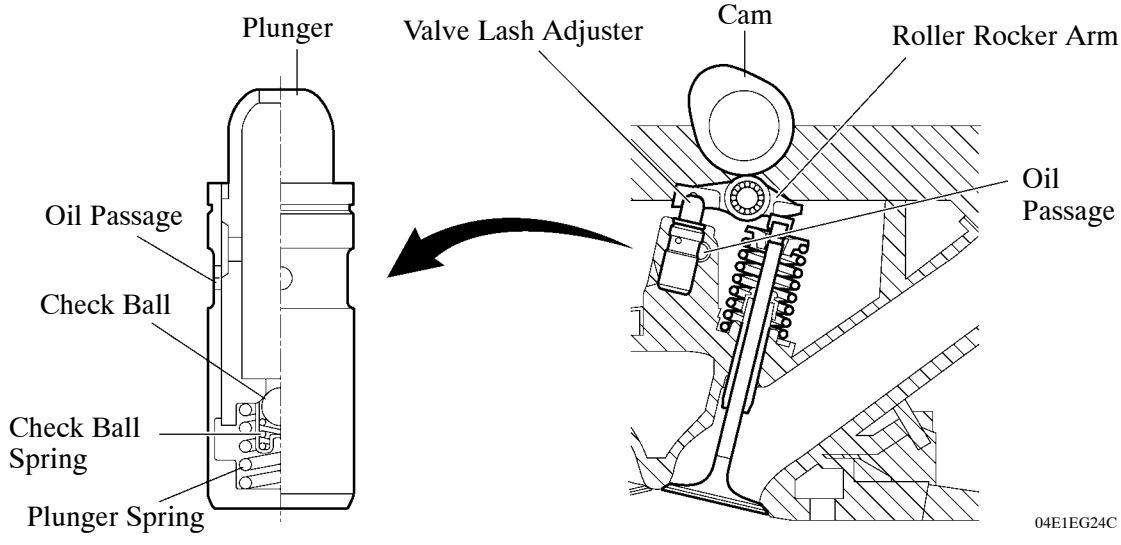
Timing Chain Cover

- The timing chain cover has an integrated construction consisting of the cooling system (water pump and water passage) and the lubrication system (oil pump and oil passage). Thus, the number of parts has been reduced, resulting in a weight reduction.
- An oil jet is provided in the oil pump cover to lubricate the timing chains.



Hydraulic Lash Adjuster

- The valve lash adjuster assemblies, which are located at the fulcrum (pivot point) of the roller rocker arms, each consist primarily of a plunger, a plunger spring, a check ball, and a check ball spring.
- The engine oil supplied from the cylinder head and the built-in spring actuates the valve lash adjuster. The oil pressure and the spring force that act on the plunger push the roller rocker arm against the cam. This adjusts the clearance between the valve stem and rocker arm, and thus prevents the generation of noise during the opening and closing of the valves. As a result, engine noise has been reduced.



Service Tip

Valve clearance adjustment is not necessary because valve lash adjusters are used on this model.