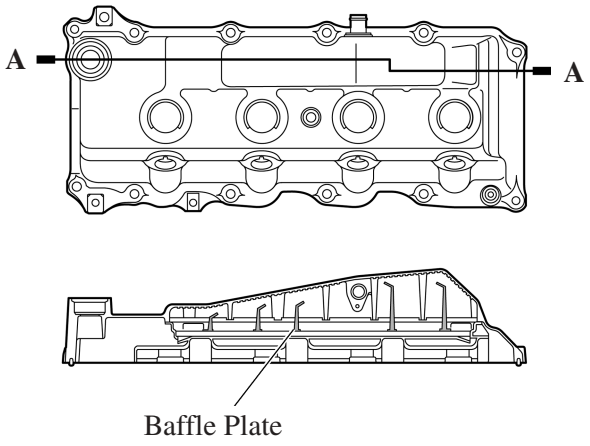
■ENGINE PROPER

1. Cylinder Head Cover

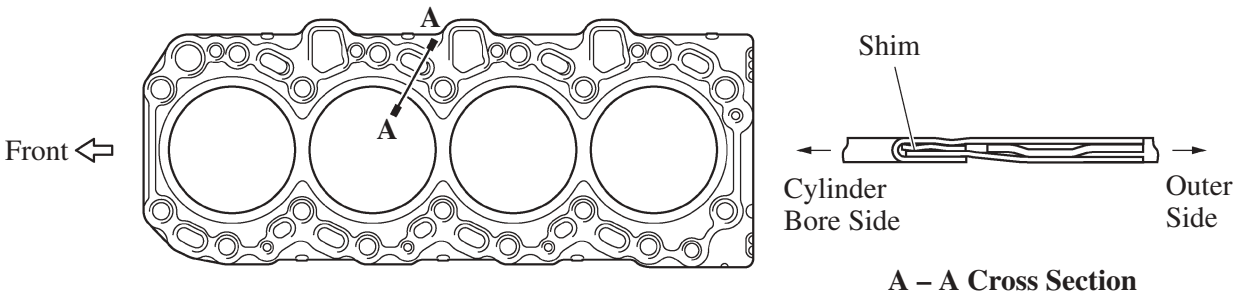
- The cylinder head cover is made of plastic to reduce weight and noise.
- A baffle plate is provided on the inside of the cylinder head cover to reduce the consumption of engine oil through blow-by gas.



A – A Cross Section 04ZEG014Y

2. Cylinder Head Gasket

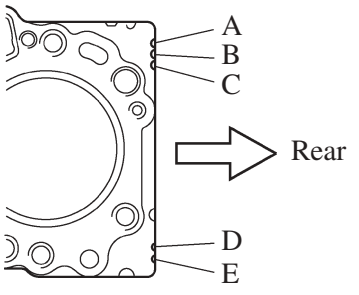
- A steel-laminate type cylinder head gasket is used.
- A shim has been added around the cylinder bore to increase the sealing surface, thus realizing excellent sealing performance.



A – A Cross Section 271EG100

Service Tip

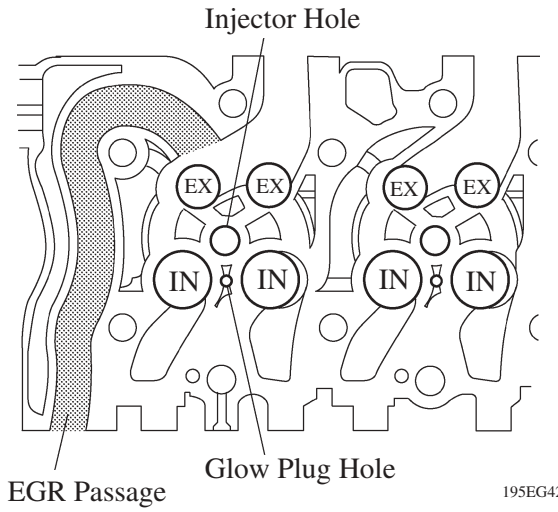
There are 5 sizes of cylinder head gaskets, marked “A”, “B”, “C”, “D”, or “E” according to piston protrusion. For details, refer to the Hiace Repair Manual (Pub. No. RM04Z0E).

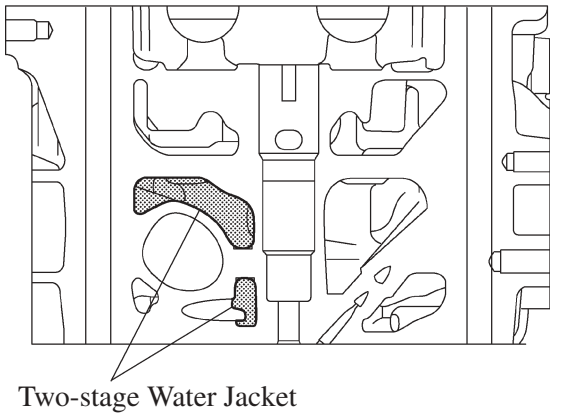


286EG59

3. Cylinder Head

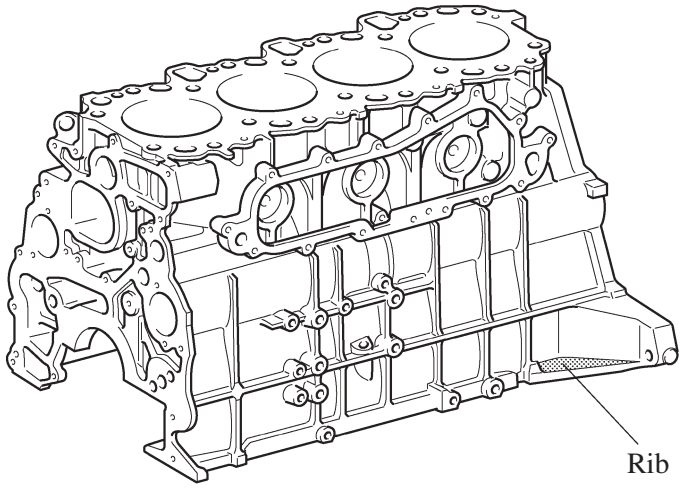
- The cylinder head is made of aluminum alloy. An injector has been located in the center of the combustion chamber in order to improve engine performance and clean emission.
- Two intake ports with different shapes have been combined to promote the mixture of fuel and air by optimizing the swirl in the cylinder.
- A vertical two-stage construction is used for the water jacket to improve cooling performance.
- A glow plug is placed between the intake ports of each cylinder to ensure startability.
- The passage for the EGR is provided in the cylinder head. By cooling the exhaust gas, it is possible to recirculate the great amount of exhaust gas.
- Plastic region tightening bolts are used for the cylinder head.





4. Cylinder Block

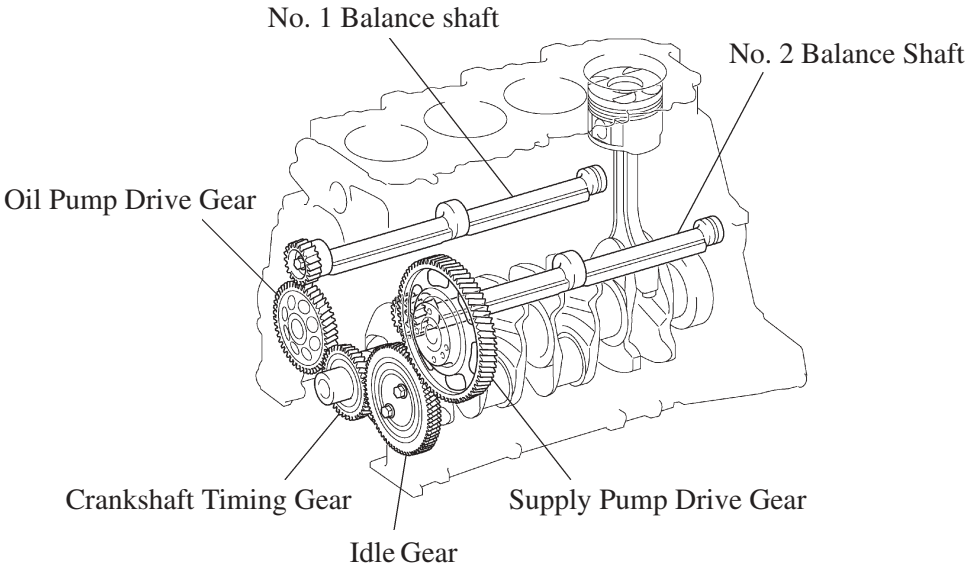
- The cylinder block is constructed of liner-less cast iron alloy.
- Ribs have been added to the block of the cylinder block to reduce engine vibration.



5. Balance Shaft

General

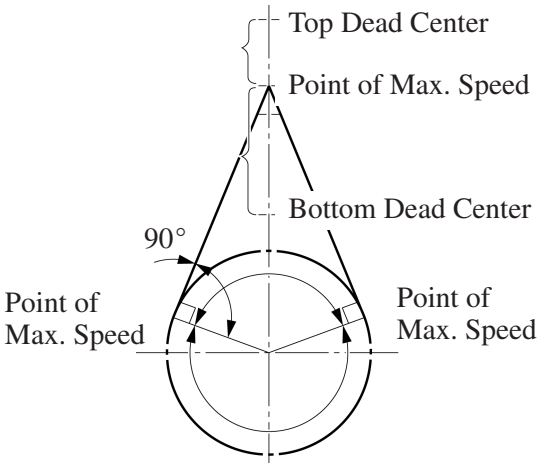
- For in-line 4 cylinder engines, the main cause of vibration is imbalanced inertial force of reciprocating parts such as the pistons and connecting rods. The 1KD-FTV engine vibration has been reduced by using 2 balance shafts to cancel the imbalanced inertial force, thereby reducing engine noise (booming noise).
- These balance shafts are built into the cylinder block. Driven by the timing gear, the balance shafts rotate at twice the speed of the crankshaft and in the opposite direction of each other.

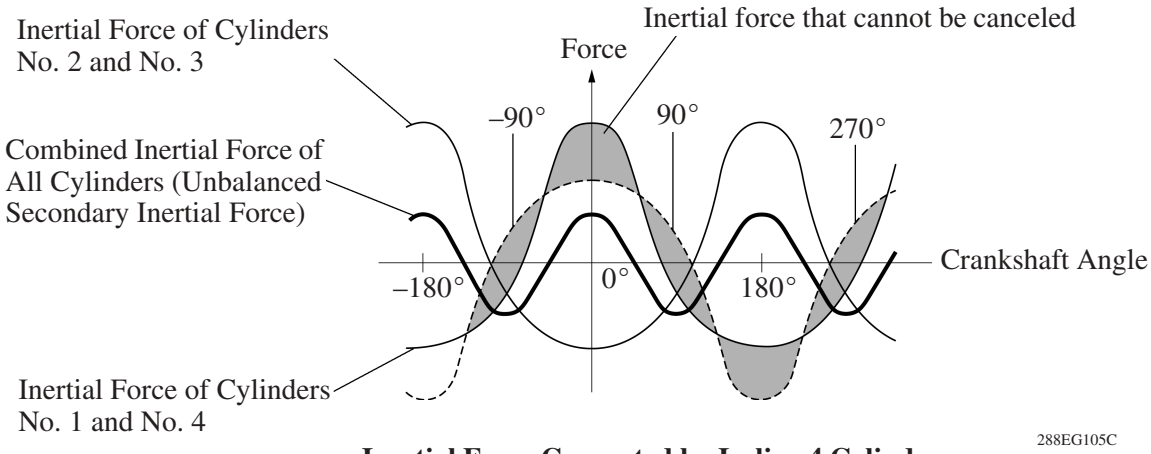


04ZEG001Y

Operation

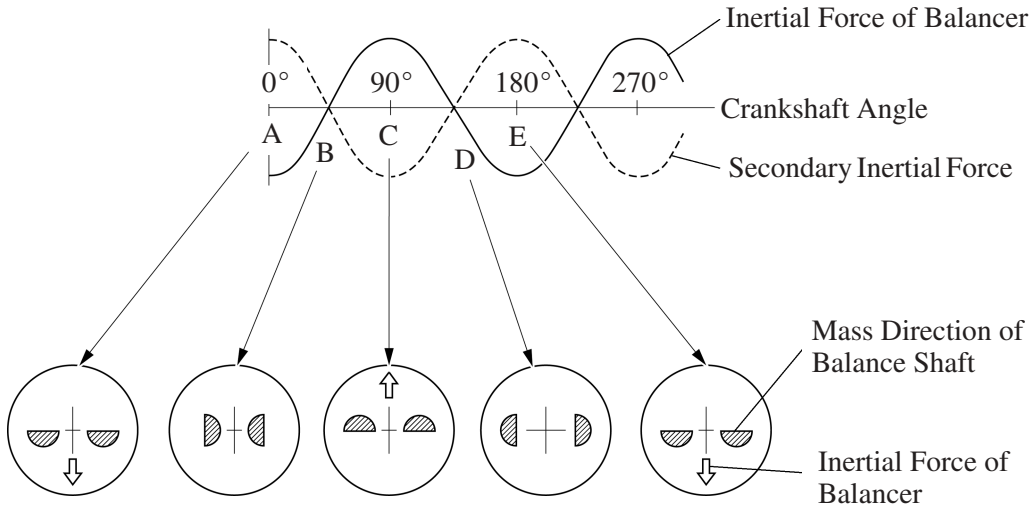
In the in-line 4-cylinder engine, the crankshaft angle for cylinders No. 1 and No. 4 are exactly at the opposite (180°) position of cylinders No. 2 and No. 3. Therefore, the inertial force of the pistons and the connecting rods of the former 2 cylinders and of the latter 2 cylinders almost cancel each other. However, because the position at which the piston reaches its maximum speed is located toward the top-dead-center from the center of the stroke, the upward inertial force is greater than the downward inertial force. This unbalanced secondary inertial force is generated twice for each rotation of the crankshaft.





Inertial Force Generated by In-line 4 Cylinders

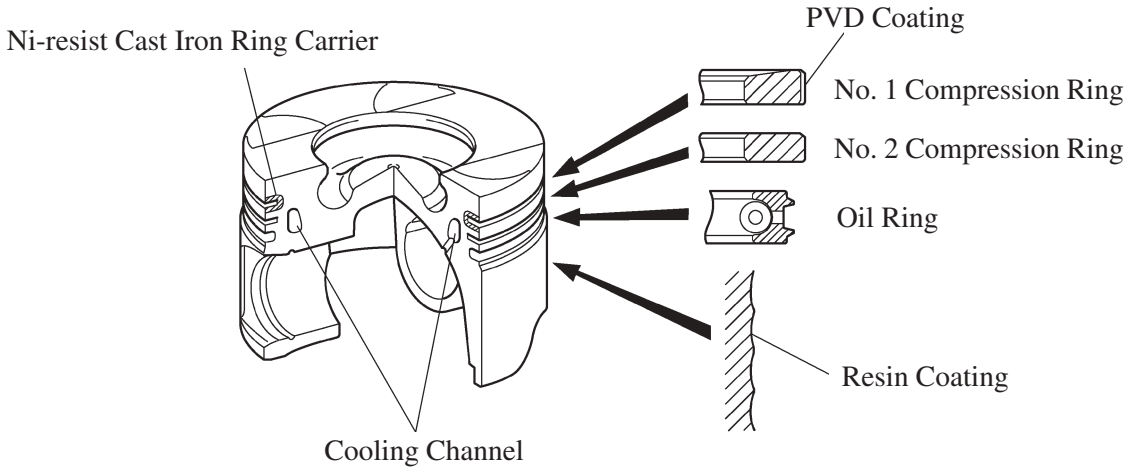
To cancel the unbalanced secondary inertial force, 2 balance shafts are rotated twice for each rotation of the crankshaft and generate inertial force in the opposite direction. Also, in order to cancel the inertial force generated by the balance shaft itself, the balance shaft actually consists of 2 shafts rotating in opposite directions.



Mass Direction of Balance Shaft at Crankshaft Angle

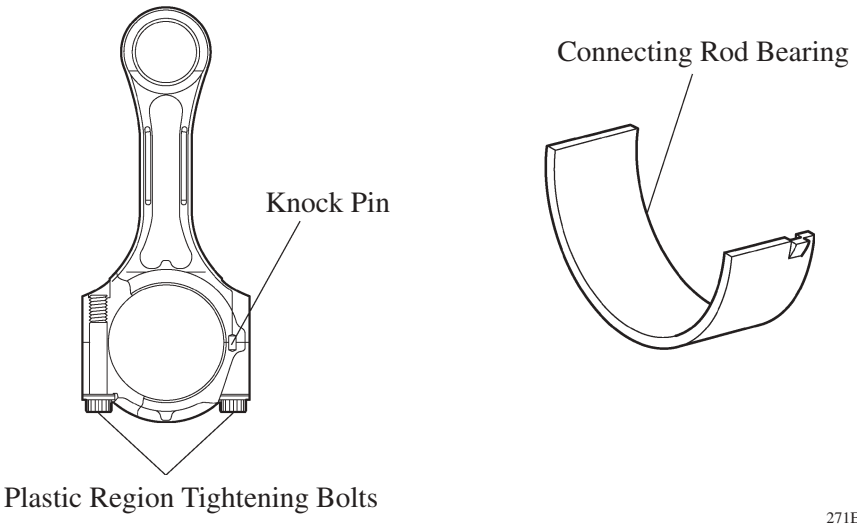
6. Piston

- In conjunction with the adoption of direct injection, piston provided in combustion chamber is used.
- The piston is made of aluminum alloy.
- A cooling channel has been provided to reduce the piston temperature.
- The top ring groove uses a Ni-resist cast iron ring carrier to improve wear resistance.
- The piston skirt has been coated with resin to reduce friction loss and improve initial seizure resistance.
- A PVD (Physical Vapor Deposition) coating has been applied to the surface of the No. 1 compression ring, in order to improve its wear resistance.



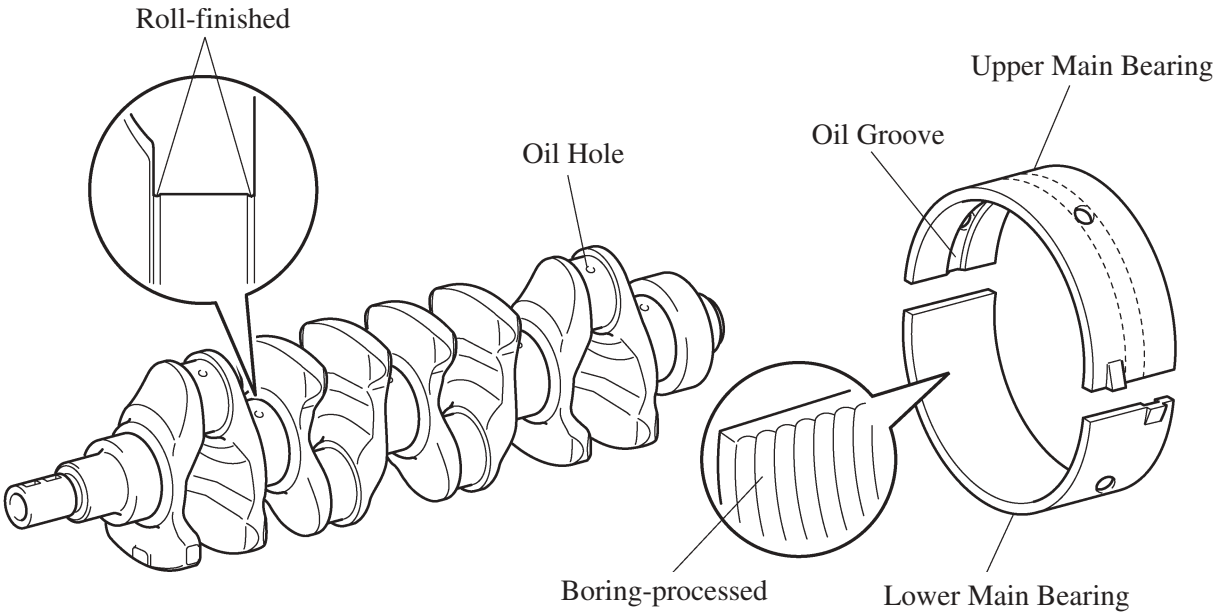
7. Connecting Rod and Connecting Rod Bearing

- The connecting rods are made of high-strength material to ensure the proper strength.
- Knock pins are used at the mating surfaces of the bearing caps of the connecting rod to minimize the shifting of the bearing caps during assembly.
- Plastic region tightening bolts are used.
- An aluminum bearing is used for the connecting rod bearings.



8. Crankshaft and Crankshaft Bearing

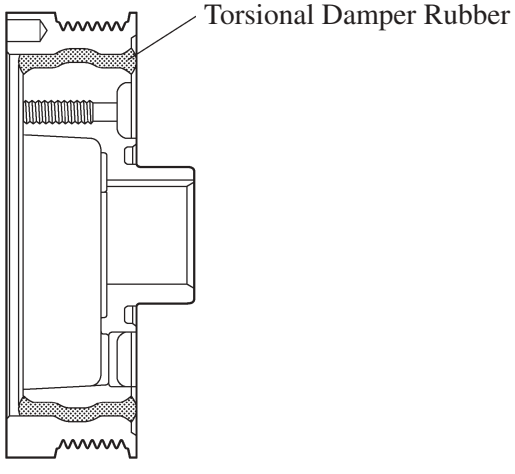
- The crankshaft has 5 journals and 8 balance weights.
- All pins and journal fillets are roll-finished to maintain adequate strength.
- The lining surface of the crankshaft bearing has been boring-processed to realize an optimal amount of oil clearance. As a result, cold-engine cranking performance has been improved and engine vibrations have been reduced.
- The upper main bearing has an oil groove around its inside circumference.



032EG38Y

9. Crankshaft Pulley

The rigidity of the torsional damper rubber has been optimized to reduce noise.



04ZEG004Y