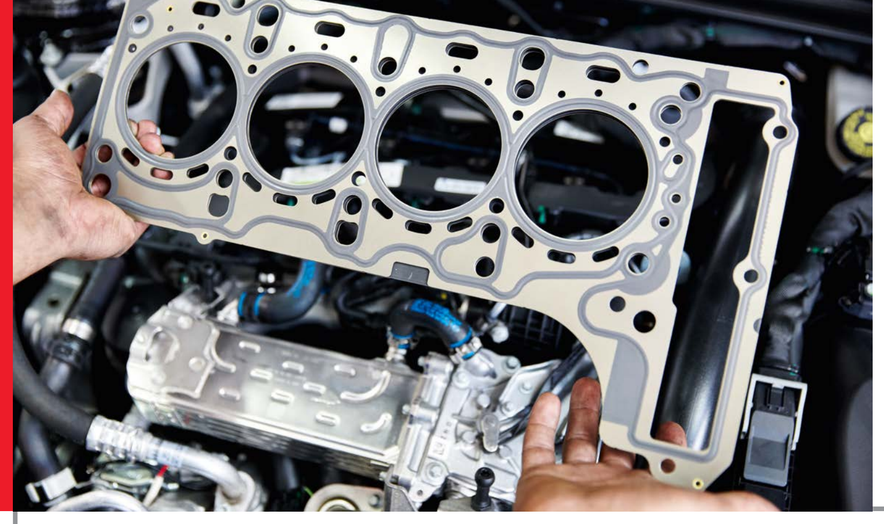
Metal layer (MLS) cylinder-head gaskets



elring

Das Original

Requirements and influences

Cylinder-head gaskets requirements

- Gas tight
- Coolant tight
- Oil tight
- Deformable
- Dynamic
- No re-torque
- Low distortion
- Resistant to chemical influences of combustion gas, lubricant/coolant
- Long-term durability

Influences on the cylinder-head gasket

Fuel gas temperature

+1,800 °C to +2,500 °C

Temperatures in the cylinder-head area

Petrol engines ≤ 270 °C, diesel engines ≤ 300 °C

Combustion pressure

Petrol engines ≤ 140 bar, diesel engines ≥ 270 bar

Deformation

The ignition pressure per ignition process causes the sealing gap to deform by 2 - 10 µm in stroke direction. Depending on the screw arrangement and dimensioning, sliding movements in crosswise direction can also occur due to bending of the cylinder head and cylinder tube.

Materials

Thermal stresses create additional sliding movements Sealing surfaces of the cylinder head/engine block from aluminium alloys, grey cast iron parts also possible.

Surface roughness

R_z 11 µm
R_{max} 15 µm

Coolant and lubricant

Water/frost/corrosion protection mixture
+80 °C – +110 °C; pressure 1 – 2 bar
engine oil +80 °C – +150 °C;
pressure 2 – 4 bar (warm) to 10 bar (cold)

The metal layer (MLS) structure at a glance

Half bead

Half beads create a two-line compression. They seal along the coolant and engine oil openings, along the screw holes and around the outer gasket contour.

Supporting layer

The key function of a supporting layer is to adapt the gasket thickness to the required installation conditions.

Full bead

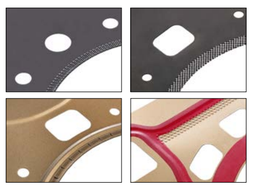
Full beads create a three-line compression on the circumference of the combustion chamber. This elastic sealing element enables extremely high ignition pressures to be sealed. Even under high dynamic sealing gap vibrations.

Function layer

These elastomer coated spring steel layers are fitted with elastic beads.

Stopper

The engine components are pre-tensioned elastically with a stopper around the circumference of the combustion chamber. This reduces the sealing gap vibrations caused by the gas force and also prevents excessive deformation of the full beads. Technologies: embossed stoppers, where we differentiate between embossings in the function layers (meanders, nubs) and in the supporting area (checks), as well as laser-welded stoppers and folded over stopper layers and segment stoppers



Flexible solutions: meander, check, segment and nub stoppers

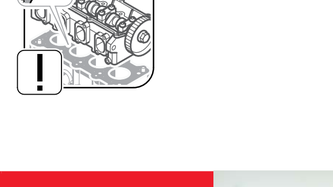
Professional assembly of the metal layer (MLS) cylinder-head gasket in 7 steps

Please follow the general installation instructions from the engine manufacturer

1. Sealing surfaces of the components (cylinder head/block) must be cleaned carefully, degreased and any coating or gasket residues removed.

2. Threaded holes for the cylinder-head screws must be cleaned of dirt and oil. Check threads for damage and smooth running.

3. Component surfaces must be checked:
- Material throw-ups must be removed with an oil stone
- Determine the evenness of the components over the entire component using a straightedge: lengthwise = 0.05 mm, crosswise = 0.03 mm scoring must be removed (specialist milling)



R_z 11 µm
R_{max} 15 µm

4. Cylinder-head gasket must be centred on the engine block (with no additional sealing compound):
- Take care that the coating is not damaged

5. Position the cylinder head
- Avoid damage to the sealing surface through scratches
- Watch out for any residues such as metal chips that could enter the gasket from the cylinder head

6. Cylinder-head screws
Recommendation from the vehicle manufacturer:
- Always replace cylinder-head screws and washers
- Grease the thread and screw contact surface lightly

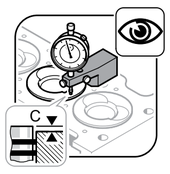
- If a washer is also installed, only grease between the washer and the screw head
- Note: Never grease the contact surface of the washer on the cylinder head

7. Screw tightening
- Observe the tightening sequence according to the manufacturer instructions
- If re-torquing is required, observe the re-torquing specifications

Selecting the right cylinder-head gasket for diesel engines

Cylinder-head gaskets with different thicknesses are usually available for diesel engines. To identify the correct cylinder-head gasket, the piston protrusion must be measured.

- The measuring points must be above the axis of the piston pin to avoid the influence of the piston tilting.
- Place the dial gauge on the cleaned cylinder block sealing surface and set to zero under pre-tension.



- Place the dial gauge on the cleaned piston and turn the crankshaft to determine the highest point.
- Repeat the process on measuring point 2 and measure on all pistons in the same way.

- C is the distance between the piston surface in the upper dead centre and the separating plane of the crankcase.
- Use the highest measured value to identify the correct thickness of the cylinder-head gasket based on the manufacturer specification.

Only new cylinder-head screws are 100 % safe!

Function and safety

Expansion shaft screws are required for the function of cylinder-head gaskets. The way in which cylinder-head screws work plays a key role here.

The cylinder-head screws can be elongated plastically by several millimetres compared with the original state due to

– the tightening process with torque plus rotation angle (= plastic elongation of the screw) and

– the engine designs, e.g. aluminium-aluminium pairing (= additional plastic elongation during the first warm-up of the engine).

In addition to changes in the strength and expansion properties of the screw material, the elongation of the screw also reduces the cross-section. If this screw is reused, there is a risk that the applied screw force can no longer be absorbed by the reduced cross-section. This results in screw breakage.
Used screws are also unable to achieve the specified screw force and the cylinder-head gasket will start to leak after a short time.

The torque specifications provided with every cylinder-head gasket must be observed!

Screw types

Roll shaft screws with a long thread

These screws have an extremely long thread section, which usually reaches to just below the screw head. The elastic and plastic elongation of the screw during tightening and in powered engine operation takes place in this area. The version with a long thread increases the elasticity, ensures even tension along the shaft and gives the screw a sufficient plastic deformation capacity. This guarantees the long-term durability of the entire cylinder-head sealing join.

Expansion coil screws

These are screws with a course single or multiple thread rolled into the shaft as an "expansion coil". Here to, the "expansion coil" increases the elasticity and ensures even tension distribution. The elastic flexibility of the expansion coil screw depends on the core diameter of the expansion coil profile chosen: The smaller the diameter, the closer it comes to the characteristic of an expansion shaft screw.

Roll shaft screws with short thread

With these screws, the thread is only rolled up to the maximum screw-in depth. The topmost thread absorbs the highest force and therefore usually undergoes a permanent plastic deformation.

Tightening sequence

The cylinder-head screws (e.g. 1 – 10 with the 4-cylinder engine; bottom figure) must be screwed in according to precisely defined tightening sequences (see manufacturer information). Like the tightening torques and tightening angles, these are specified by the engine and gasket manufacturers and are adapted to the relevant engine design.

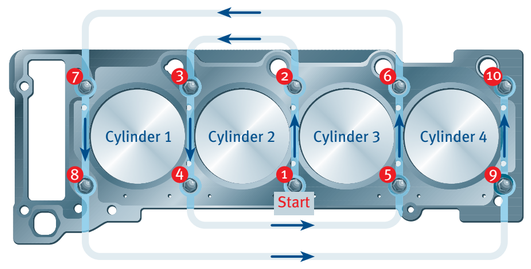
The screw tightening should take place in several increments and the individual steps could be as follows:

- 1. Step 20 Nm (i.e. tighten screws 1 – 10 with a tightening torque of 20 Nm)
- 2. Step 60 Nm (i.e. tighten screws 1 – 10 with a tightening torque of 60 Nm)
- 3. Step 90° (i.e. tighten screws 1 – 10 with a tightening angle of 90°)
- 4. Step 90° (i.e. tighten screws 1 – 10 with a tightening angle of 90° again)

The following rules applies to each tightening sequence:

The individual steps of the screw tightening always start in the centre of the engine (between cyl. 2 and cyl. 3; see example) and continue in spiral form or crosswise to both sides to the outer screws of cyl. 1 and cyl. 4.

This ensures that the cylinder head and the cylinder-head gasket are optimally braced with the crankcase.



Tightening sequence for cylinder head (example)

**If the specifications are not observed, unwanted tensions and warping occur on the engine components.
The result: leaks can occur in the cylinder-head gasket join.**

Instagram

YouTube

www.elring.com

C510368 0524 EN