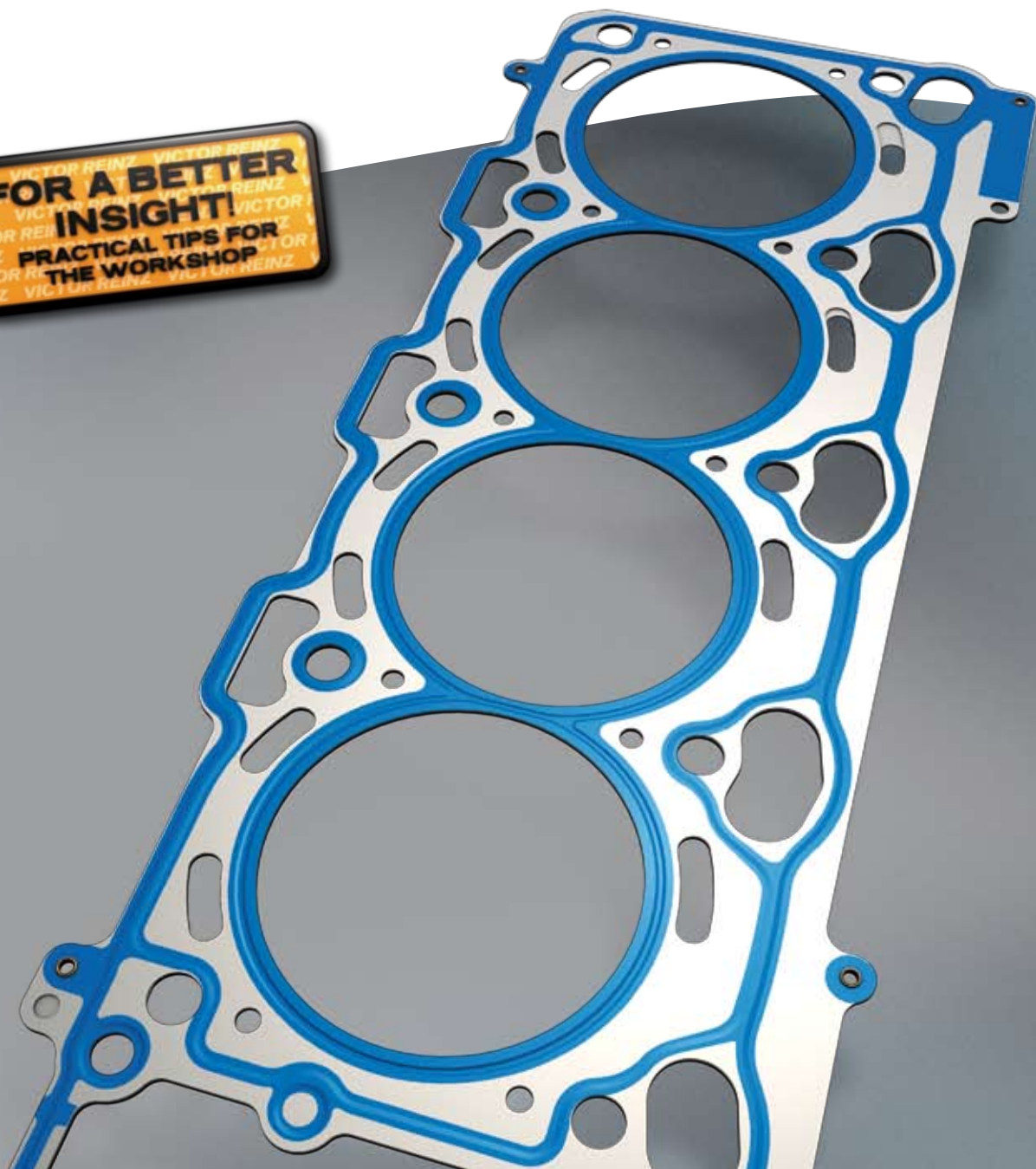




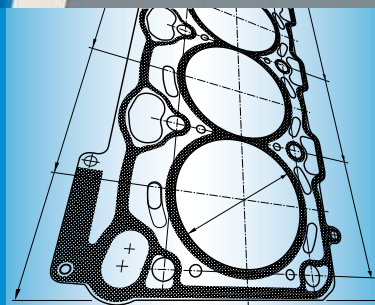
VICTOR REINZ®

Sealing Products



Multi-layer Steel (MLS) Cylinder Head Gaskets and Component Surfaces

Tips and Practical Information No. 1





Multi-layer Steel (MLS) Cylinder-Head Gaskets – Innovative Sealing Systems for New Engine Concepts

Trend-setting Developments

Improved torque and performance, better fuel economy, reduced emissions. During engine design, the development targets determine the demands placed on modern sealing systems. Increasingly high ignition pressures and temperatures lead to high stresses for head gaskets. The solution: Multi-layer steel cylinder-head gaskets – or simply MLS head gaskets.

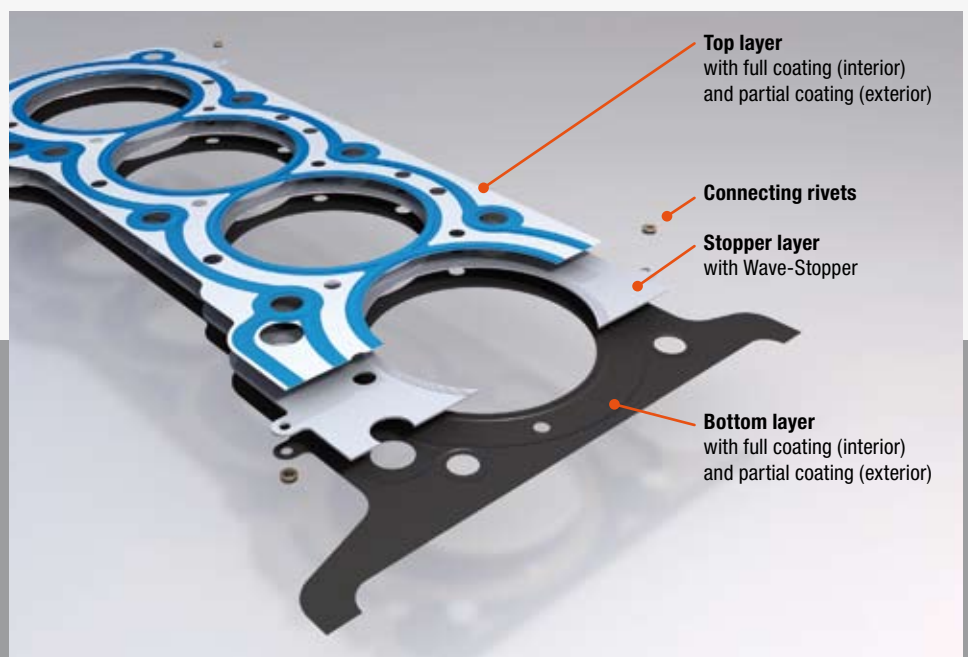
The first head gaskets were manufactured of asbestos fibres, covered with thin copper sheets and reinforced with metal beads around the combustion chambers. Up to the end of the 80s, the development of head gaskets was

dominated by asbestic materials, later rolled onto steel mesh or perforated sheets. Following the ban on asbestos, head gaskets were produced in practically the same way, but using asbestos-free materials (AFM).

By 1992 Dana Sealing Products had already developed and launched the first series-produced MLS head gaskets. Today, these gaskets are state-of-the-art, and enable development engineers worldwide to implement innovative new engine concepts.

Multi-layer Steel Offers Higher Sealing Potential

MLS head gaskets consist of two to five sheets of spring or carbon steel, which are sandwiched with the sealing material to form multi-layer steel head gaskets. For improved sealing of gases and liquids, beads around combustion chambers and oil/coolant passages increase the local sealing pressure (macro sealing), whilst full-surface or partial elastomer coatings provide additional sealing tightness (micro sealing).



▶ Typical 3-layer MLS head gasket with top sheet, active layer with Wave-Stopper, and bottom sheet beads plus full-surface (interior) and partial (exterior) elastomer coatings improve the sealing potential of these modern sealing systems. Beads for macro sealing, and elastomer coating for micro sealing.

Optimum Surface Finish for Better Sealing

Properties of Sealing Surfaces

Also in future, MLS head gaskets will represent the leading sealing concept. Already today, sealing between cylinder head and engine block is achieved almost exclusively by means of multi-layer steel head gaskets. However, it is not only the head gasket's quality that is responsible for perfect sealing. An equally important role is played by the surface qualities of cylinder head and engine block.

The demands placed on the surface finish are a decisive factor for

reliable sealing results. Therefore, it is essential that the specified values are observed when installing head gaskets. Hereby, there is no difference between composite gaskets and MLS gaskets.

Surface Deviations

The following surface deviations lead to reduced surface qualities of cylinder head and engine block:

- Component unevenness
- Component distortion
- Waviness (deviations in parallelism)
- Roughnesses (grooves and scores)

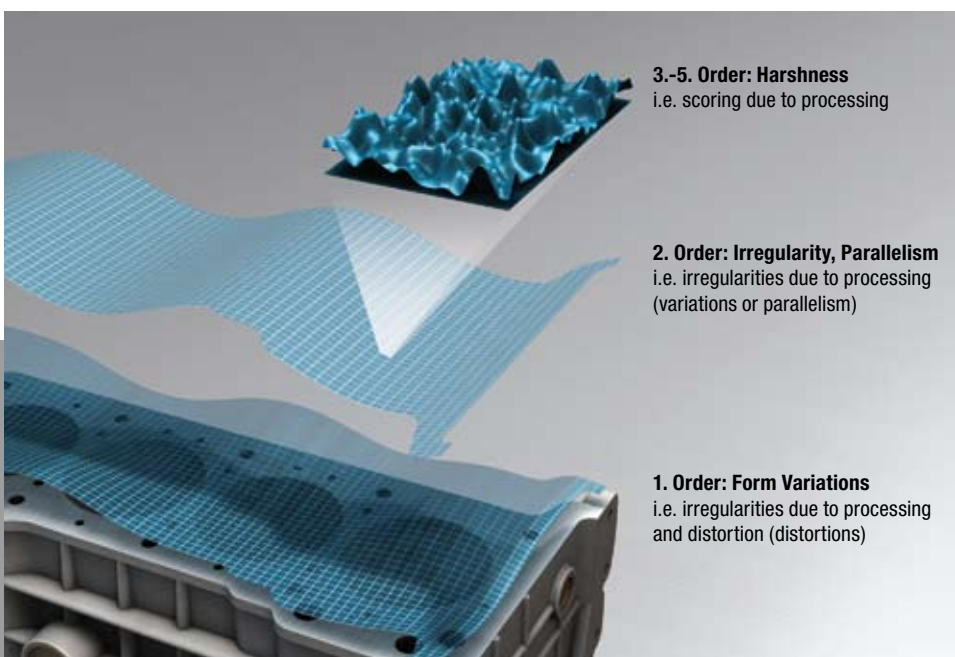
Component Unevennesses and Distortions

Component unevenness and distortion can be determined by means of a straightedge. Measurements are made using the light-gap method. The edge of the test device is placed on the surface, and moved over the bolt holes longitudinally and transversely. Hereby, any unevennesses are made visible by the light gap.

For passenger cars the measurement results over a longitudinal length of 100 mm must be less than 0.03 mm, and less than 0.05 mm over a length of 400 mm, whilst in the transverse direction they must be less than 0.03 mm over a length of 100 mm.

For commercial vehicles the measurement results over a longitudinal length of 100 mm must be less than 0.03 mm, and less than 0.10 mm over a length of 1,000 mm, whilst in the transverse direction they must be less than 0.03 mm over a length of 100 mm.

The standards for the surface texture of sealing surfaces are defined in DIN EN ISO 4287. The corresponding values are $R_z \leq 15 \mu\text{m}$ for roughness, and $P_t \leq 22 \mu\text{m}$ for profile depth. Consequently, cylinder head gaskets must provide comprehensive macro and micro sealing properties.



◀ *Example of influences of surface quality due to surface deviations on an engine block.*

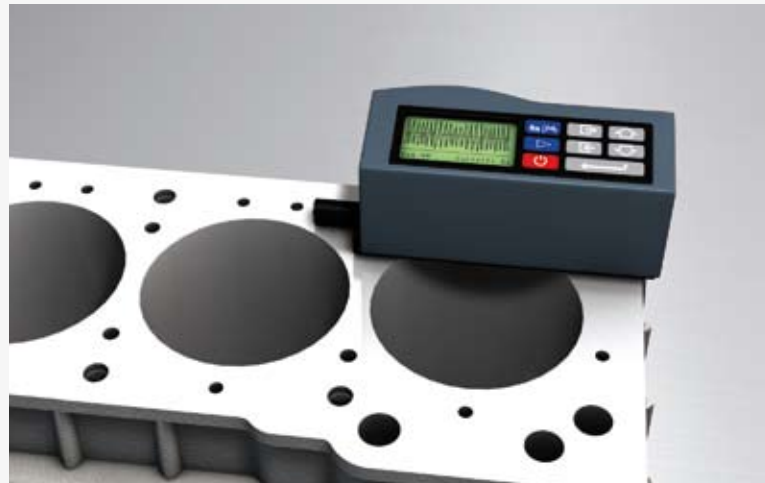
Waviness and Roughness

Waviness and roughness are measured with the help of a sensing probe that is moved horizontally over the sealing surface. Values should be less than $20\ \mu\text{m}$ for waviness, and between $7\ \mu\text{m}$ and $20\ \mu\text{m}$ for roughness.

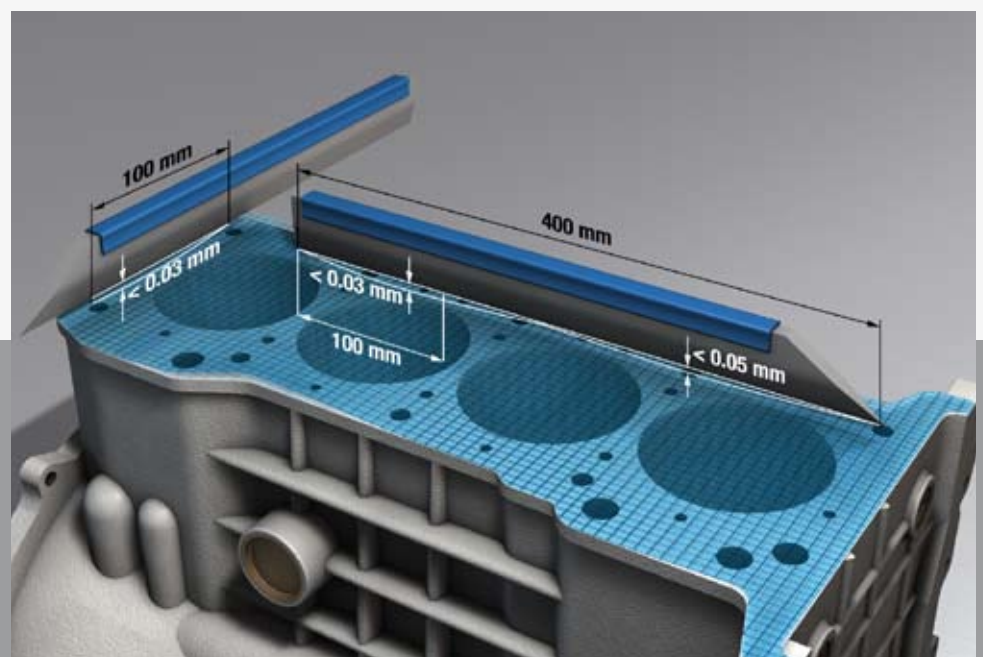
Amongst other results, evaluation of the recorded data gives the maximum roughness depth R_{max} . This is an important value for surface quality, as it indicates the largest possible leakage channel.

Practical Experience

In a large-scale test on 1,200 engine blocks with eight measurements per block, the measured values for R_{max} were between $8\ \mu\text{m}$ and $18\ \mu\text{m}$. Only very few surfaces exhibited R_{max} values up to $25\ \mu\text{m}$.



▲ *Maximum values for waviness and roughness (grooves and scores) practical measurement using a sensing probe, and indication of possible leakage channels.*



▶ *Maximum values for component unevenness and distortions for passenger cars. Practical measurement using a straightedge and the light-gap method.*

MLS Head Gaskets – The Optimum Solution for Every Surface Quality

The special design of multi-layer steel gaskets enables them to adapt to every surface texture, provided that the surface quality lies within the specified tolerances.

TIP FROM THE EXPERTS

Be sure to observe the demands placed on surface quality:

→ **Component unevenness for passenger cars**

*less than 0.03 mm over a longitudinal distance of 100 mm;
less than 0.05 mm over a longitudinal distance of 400 mm;
less than 0.03 mm over a transverse distance of 100 mm*

→ **Component unevenness for commercial vehicles**

*less than 0.03 mm over a longitudinal distance of 100 mm;
less than 0.10 mm over a longitudinal distance of 1,000 mm;
less than 0.03 mm over a transverse distance of 100 mm*

→ **Waviness**

less than 20 µm

→ **Roughness**

between 7 µm and 20 µm

If the above values are observed, MLS gaskets provide the most reliable seals. Only if the values are exceeded, will it be necessary to re-machine the surface.

Cylinder-head Bolts

Nowadays, manufacturers make exclusive use of so-called stretch bolts (waisted bolts). Without problems, these bolts can be extended beyond their elastic limit into the plastic region. When a certain tightening torque (pretorque) has been reached, the bolt is tightened further by a defined amount (prevailing angle or torque). If the torque-angle tightening method is used, retorquing of the head bolts is no longer necessary.

With the torque-angle method, the head bolts are elongated plastically, i.e. permanently. After disassembly, they are clearly longer than new bolts. For safety reasons, cylinder-head bolts should therefore always be used only once.

You Can Trust the Victor Reinz Specialists

High-quality Victor Reinz MLS head gaskets compensate component unevenness and distortion perfectly by means of controlled sealing contact pressure. Macro sealing is effected by correspondingly designed beads in the sealing areas of the outer spring steel layers. Excellent micro sealing is ensured by the additional conformability provided by elastomer coatings on the outer (head and block) layers, which adapt to the waviness and roughness (grooves and scores).

Victor Reinz MLS head gaskets offer reliable sealing for engine block and cylinder head surfaces with R_{\max} values up to 25 μm .

TIP FROM THE EXPERTS

With the torque-angle tightening method, the head bolts are elongated permanently. For safety reasons, cylinder-head bolts should therefore always be used only once.

Additional data on this subject is given in our Practical Information No. 2 (Cylinder-head bolts and head installation).

MLS – Increased Performance and Reliability

MLS and composite gaskets place the same demands on surface quality. Except for the torquing method used, there are no special differences to be observed during installation. Nonetheless: The future belongs to multi-layer steel gaskets.

Thanks to the significantly higher sealing potential, higher ignition pressures with simultaneously lower bolt tensions are possible. As a leading manufacturer of MLS head gaskets, Dana Sealing Products is excellently prepared for present and future trends in engine construction.

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Dana provides high-quality product solutions in four core areas of the vehicle – drivetrain, structural, sealing, and thermal systems. This lineup of technologies from one source is designed to offer flexibility to vehicle manufacturers around the world – whether in automotive centers or emerging markets – and ensures that customers get the latest state-of-the-art technologies, as well as products adjusted for specific local markets. With technology centers strategically located throughout the world, Dana engineers have the superior resources to develop, design, test, and manufacture to suit individual customer needs. This close collaboration allows Dana to create everything from advanced single components to fully integrated modular systems.

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