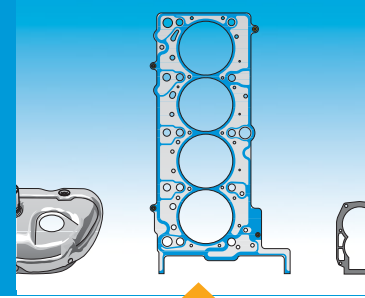




Cylinder head gaskets

Advanced MLS technology – every layer built for top performance



VICTOR REINZ®

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Treat it rough, make it tough:
While your customer enjoys a fast
drive, the head gasket is working
extra hard. It's good to know it's
made by VICTOR REINZ.



Better ideas. Manufactured by VICTOR REINZ.

ALWAYS A STEP AHEAD

For more than 50 years, VICTOR REINZ has been an established name among the world's top automobile manufacturers by providing top-quality products. Reliable products and on-time delivery are as much a part of VICTOR REINZ as our innovative design and systems competence. At VICTOR REINZ, good ideas continue to evolve, and our head gaskets continue to improve. This spirit of innovation enables us to find new ways to permanently upgrade the performance of our head gaskets – and, in turn, your engine. We will continue to meet the demands of engine builders now and into the future.

Beyond our competitors

At VICTOR REINZ, we understand the demands placed on the sealing of today's cylinder heads – and we've developed the solution. We call it **Advanced MLS[®] technology**. But we don't stop there. We also utilize the most advanced equipment, the most rigorous testing standards, FEA[®] compliant hardware and software, expert knowledge, and long years of experience to provide products that truly stand out in the marketplace. And perhaps most importantly, every employee at VICTOR REINZ is truly committed to serving our customers. So when you choose VICTOR REINZ, you'll benefit from even more than the most advanced gaskets – you'll also receive consulting, development, production, logistics, and service competence at the highest level.



Sealing Products – VICTOR REINZ:

A global presence

In 2003, the Dana Corporation consolidated and reorganized its five gasket, shielding system and valve cover system facilities into a central, clearly defined division: **Sealing Products - VICTOR REINZ**. As a world leader in gasket production we now provide service and support from 19 locations in Europe, North America, South America and Japan. You'll find us in every important automotive manufacturing hub, providing the most innovative system solutions in the world.

Performance defined

- Recognized for providing the world's most innovative gasket solutions
- Top-quality products and high process reliability
- Holistic systems competence
- Uniform, worldwide access to consulting, development, production, logistics, and servicing at the highest level through new organizational structure

MLS[®] = Multi-layer steel

FEA[®] = Finite element analysis



People Finding A Better Way[®]

Always faster, always better – from the initial concept to series production

STREAMLINED PRODUCTION CYCLES

Every business aims to perform faster and better. But this is especially important in the fast-evolving automotive sector.

How can we do it so quickly?

Time and again, our customers are surprised by the short lead times at VICTOR REINZ. We do this by employing all the necessary experts in-house, from development to series production. Our design system is also compatible with your in-house CAD system, whether it's CATIA, ProEngineer, IDEAS, or Unigraphics. In addition, we can also perform all the important validation tests on-site with our own equipment. By having all our resources in-house, we can greatly reduce handling times. As a result, based solely on the engine's specifications, we can deliver head gaskets directly to your assembly line, ready for installation.

Smart combinations

Aligning conventional development tools with one other can result in significant time savings.

One example: At VICTOR REINZ we not only test the head gaskets with FEA computer programs – we also use modern prototyping procedures to build functional models at a very early stage. When testing the specific sealing functions, for instance, the prototypes supply extremely valuable data. This process enables us to determine in advance whether a head gasket's performance is maximized, so that individual functions don't require optimization later.

Quality from the start

Some 70 percent of an automobile's components come from external suppliers. This means the quality of a vehicle depends greatly on the quality of the supplied products. And because quality cannot be improved later, we understand that intelligent product design, exact planning, and compatible engineering from the start will ensure quality assurance in product development and manufacturing.

Partners with the best

VICTOR REINZ's know-how has been appreciated by the European automotive industry for decades. From the MCC Smart to the Maybach V12 engine to the high-tech head gaskets for Formula One racing engines, VICTOR REINZ supplies complete gasket systems.

Our aim is to continue partnering with the best, by providing top-quality products and service. See our reference list at www.reinz.com for details.

ISO/TS 16949: Including DIN EN ISO 9001, VDA 6.1 and EAQF 94 as well as specific customer requirements from GM, DaimlerChrysler, and all German auto makers.

DIN EN ISO 14001

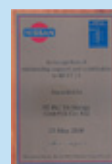
Steinbeis-
Initiative
»Customers
evaluate
suppliers«

Dana
Leadership
Award

Nissan: NX 96,
Next 21 Recognition
Award

Volvo Cars Award
of Excellence

Spirit of
Innovation



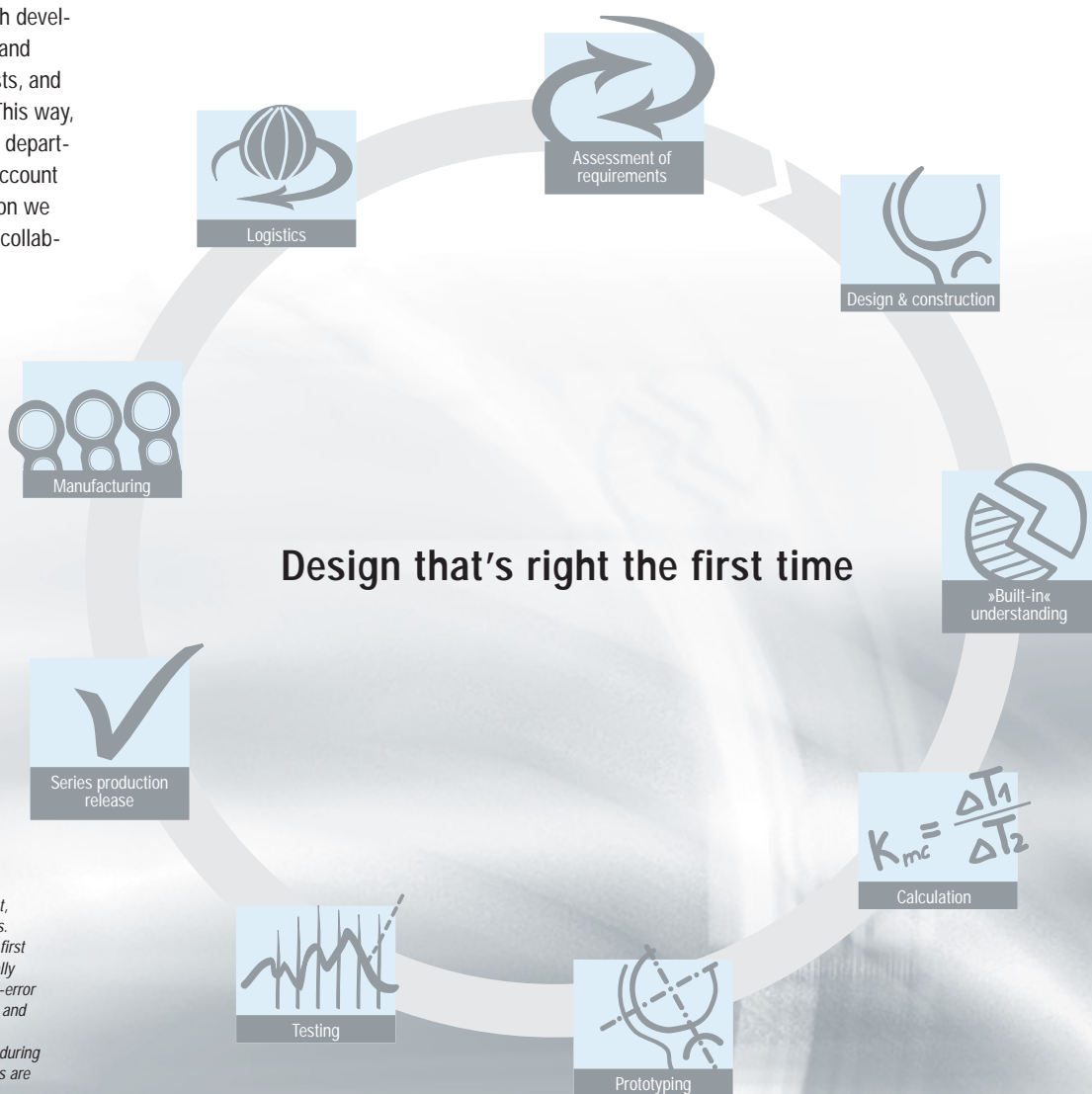
The quality system: the high standard of our quality management system is reflected in the many certificates and prizes awarded by our customers – we are also pleased that the environment profits from our work, as a number of environmental compatibility certificates prove.

Design that's right the first time

STEPS TO OPTIMUM PRODUCT DESIGN

Transforming vision into reality

Our project teams consist of application engineers who work together with developers, designers, manufacturing and quality experts, logistics specialists, and buyers to find the best solution. This way, the knowledge of every involved department and supplier is taken into account from the beginning. For this reason we also value close and permanent collaboration with our customers.



During every phase of product development, VICTOR REINZ avoids detours and blind alleys. We know we have done a good job when the first prototype goes into series production practically unchanged. At VICTOR REINZ, repeat trial-and-error prototyping is a thing of the past. Today, clear and direct communication with the customer, plus computer-aided analysis, reduces time spent during the testing stage and ensures that our designs are correct from the start.



Responsibility from beginning to end

PROACTIVE DEVELOPMENT PARTNERSHIP YOU CAN TRUST

We look forward to being your partner throughout the process, and we welcome open dialogue – whether it's during the contract development phase or in the form of purposeful, objective product consultation. The scope of VICTOR REINZ expertise covers all aspects from development through to logistics. Here are a few highlights:



Assessment of requirements: The earlier the better

It pays to consult with us at an early stage. A cylinder head gasket has many specific functions. Often, it's not only a question of sealing different media from each other, but also of minimizing component distortion. If all functional requirements are considered from the start, complications and loss of time are greatly reduced during subsequent project stages.

In fact, you will notice this enthusiasm and attention to detail from your first consultation with our application and development engineers. Similarly, our design procedures are straightforward. We require just a few decisive parameters: combustion processes and pressures, cylinder diameter, web width, number of bolts and bolt clamping force, a few specifications of engine block and cylinder head materials, plus the surface roughness and its geometry. From there, the rest is determined by our engineers in joint discussions.



Design and construction: Built to fit

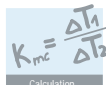
Obviously, engines are not built up around the cylinder head gasket. In practice, the opposite is true. Attention to product design combined with high-quality materials is the basis for functional, reliable, high-quality head gaskets.

Thinking beyond our competitors is a standard procedure at VICTOR REINZ: During the design phase, for example, we visualize the assembly sequence in the production line, and during repair work, we consider the packaging aspects. We also consider recycling issues and clean separation of the materials used.



Interfaces: »Built-in« understanding

Cylinder head gaskets from VICTOR REINZ not only fit into the engines, but also into the 3D computer-design worlds of our customers. We speak the same language as your designers, and supply the geometric data of the required head gasket in the specified data format, using the fastest available online data transmission methods.



Finite element analysis (FEA): Working smarter from the start

A great amount of the development time – and therefore costs – required in the past can now be saved by means of component simulations in computers, i.e. simulated tests using virtual models. By the same token, practical experience positively influences the FEA programs at VICTOR REINZ. This continuous refinement of our computing models and simulations mean that our programs get smarter over time. The result: All relevant functional parts and critical areas of the entire composite structure of engine block, head gasket and cylinder head are examined in detail during the FEA calculations in the design phase, leading to optimum gasket development.

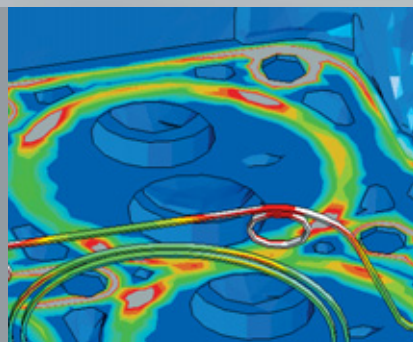
The first step during FEA involves analyzing the clamped status of the entire engine block, including head, cylinder head gasket and head bolts. After unclamping the structure, which corresponds to a setting of the components, a realistic simulation is carried out, taking temperatures and ignition pressures into account. Similarly, all nonlinearities are considered, especially the resilience characteristics of the beads.

VICTOR REINZ developmental engineers think and work in conjunction with our customers' development departments. This leads to the high efficiency that gives our customers a leading edge, and permits our products to be adapted quickly to changing conditions.



Prototyping: Equal to the final product

We also differ from other suppliers by providing close-to-production tooling from the start. After the sheets have been coated on series production equipment, and the gasket contour has been cut with lasers, the beads of the head gasket are stamped with our embossing tools. These tools are produced on our premises quickly and cost-effectively. Your advantage: Prototypes are of the same quality as the later series gaskets – with few deviations. Modern CNC-controlled measurement equipment ensures optimum quality monitoring. Subsequently, all relevant data are recorded in a technical document.



Scientific methods instead of chance: the application of FEA makes many empirical approaches superfluous during the design of a cylinder head gasket.



An entirely new level of quality for prototypes – made possible by VICTOR REINZ with close-to-production tooling.



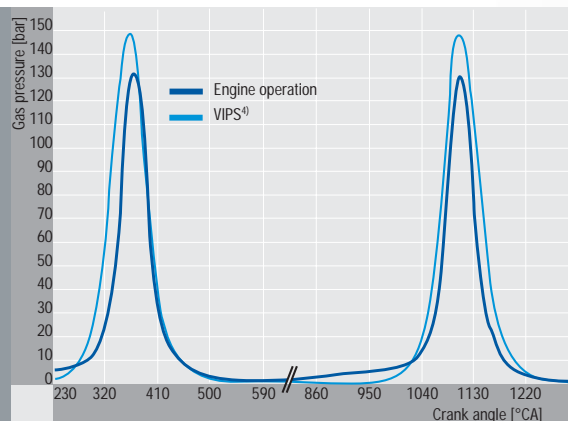
Testing: Tougher than practical use

Apart from using modern engine test methods, we also carry out extensive tests in our chemical and physical laboratories. As a customer, you choose between numerous testing and simulation possibilities, and you determine the testing scope and budget with us. This ensures that you receive optimum value during the testing phase.

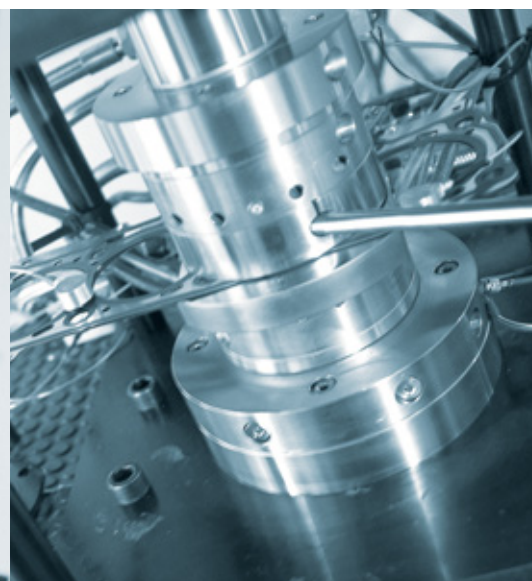
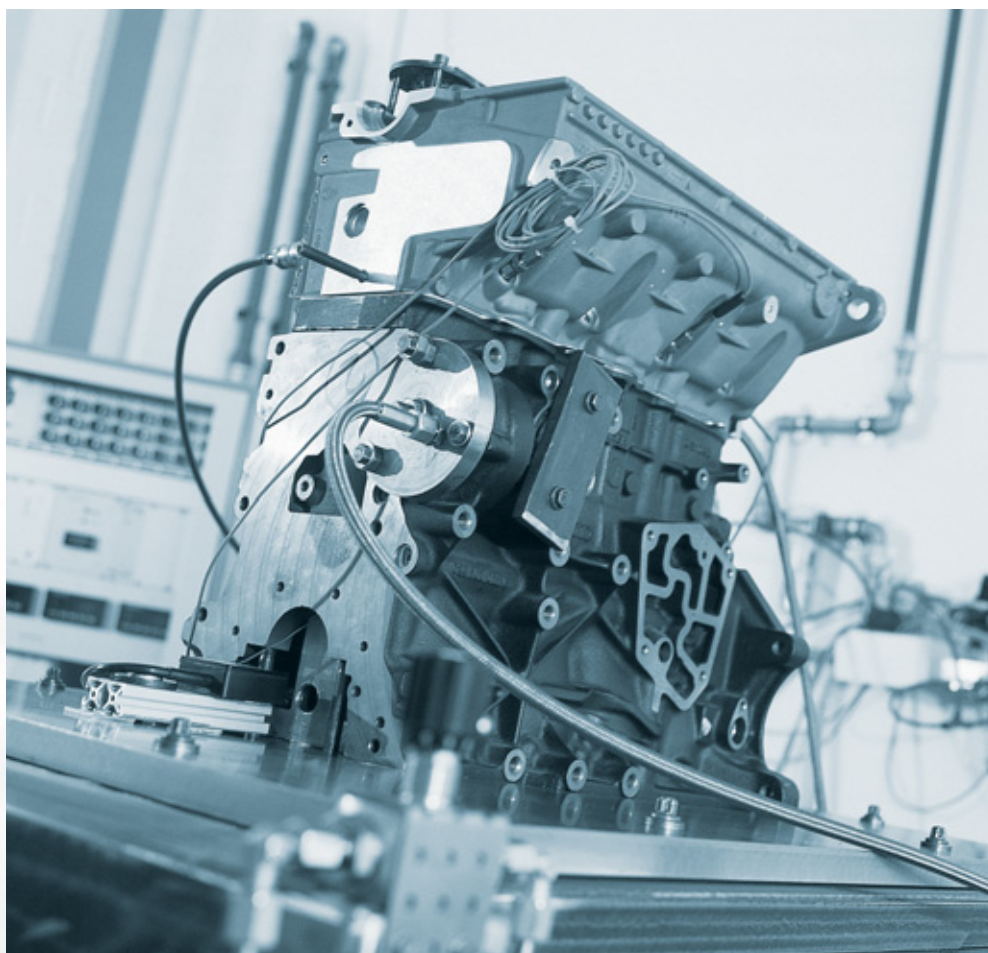
In addition, through Dana Sealing Products and its five development centers in Neu-Ulm, North America, Japan, and Brazil, VICTOR REINZ has worldwide access to 27 engine test stands and associated laboratories for analysis and static/dynamic pre-testing. All activities are coordinated by the **Competence Center R & D**.

Laboratory tests (excerpt)

- RPM 550 ³⁾: By means of a pressure-sensitive film (Fuji film), the distribution of surface pressure over the head gasket is determined, scanned, and evaluated electronically.
- RPM 528 ³⁾: By means of resonance pulsers and simulators, various conditions (temperature, pressure, sealing gap movement) are simulated, and conclusions drawn about the head gasket's endurance life.
- Engine simulation test stand VIPS ⁴⁾: This test stand was specially developed by VICTOR REINZ for the highly realistic simulation of engine operation under actual ignition sequence and with simulated temperatures – only the engine block and cylinder head with valves and head bolts are required for this test. This obviates expensive runs on conventional engine test stands, and is also environmentally friendly, because the engine is not fired. Initial tests with the pneumatic engine simulation test stand can be made at a very early stage – even before the complete engine is ready to run.
- Static/dynamic sealing gap measurement: Sensors fitted in the head gasket measure the relative movement between engine block and cylinder head.
- Measurement of bolt force and the torquing sequence and method: Torques and torque angles are measured with a special wrench, and bolt forces are determined ultrasonically. The recorded measurement results of torque and torque angle versus bolt force permit comprehensive analyses of the sealed joint's properties.
- Porosity and roughness test: First, a static pressure test is performed at room temperature, followed by a sealing tightness test under thermal/dynamic loading. Engine block and cylinder head are replaced by steel plates with a defined porosity (simulation of blowholes of defined size by means of bores) and roughness (through surface milling).



Under pressure – realistic pressure curves also with simulated conditions.



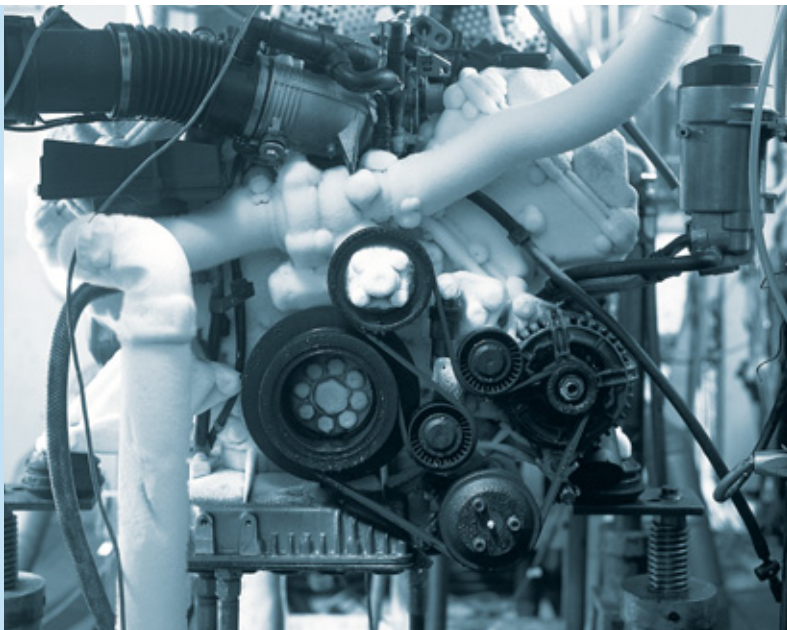
Tough as steel, great performance – our MLS designs in the bead fracture simulator.

Simpler, faster, environmentally compatible, and cheaper – a simulated engine run on the pneumatic test stand VIPS ⁴⁾.

³⁾ RPM = REINZ-Prüf-Methode (REINZ Test Method): Numerous laboratory test procedures are described in corresponding RPMs, and represent testing methods that are widely accepted in the industry.

⁴⁾ VIPS = Variable Internal Pressure (Pneumatic) Simulator, with defined control of pressure, temperature and speed.

From icy cold to burning hot – the thermal shock test at -30 °C causes engine and head gasket to age several years within hours.



Engine test stands

The examinations conducted on engine test stands range from straightforward endurance tests to low-temperature thermal shock tests with freely selectable temperatures, loads, and speed gradients.

- Nitrogen pressure test: Before and during engine operation, the individual combustion chambers are subjected to internal pressures up to 120 bar using nitrogen. Functionality and sealing potential of the cylinder head gasket is evaluated by monitoring the adjacent combustion chambers and the surrounding coolant channels.
- Electronic distortion and roughness measurements on the deck surfaces of engine block and cylinder head, before and after the engine is run.
- Measuring the change in bolt force:

Using ultrasonics, the preload of head bolts can be determined before, during, and after an engine run.

- Analysis and evaluation of adjoining components: Frictional damage, scoring, bead measurement, and surface pressure distribution after the engine test run.

Documentation

- All test results are summarized and explained in a comprehensive test report. This simplifies and speeds up subsequent fine-tuning with your engine designers and builders.



Quality assurance: Beyond the standards

At VICTOR REINZ, we have a name for our quality assurance process – systematic quality. This process provides intelligent quality management for rational zero-error production for production reliability and efficiency beyond the current standards. During the testing phase, we simulate the manufacturing process by using close-to-series tooling. This enables us to test cylinder head gaskets in close to their final state without delay, complete with a detailed test report and quality certificates for all the materials used, as required for sample approval. Subsequently, we can immediately begin pre-series and series production.

VICTOR REINZ has already been certified in accordance with the latest (2002) issue of ISO/TS 16949, which is accepted by all automobile manufacturers worldwide. Moreover, our Environmental Management System complies with DIN EN ISO 14001 for the use of environmentally compatible technologies. Obviously, these standards and official certificates have high practical significance, but equally important is our internal approach to ensuring product quality and environmental awareness. Rest assured that our employees are truly committed to maintaining the strong relationships and high level of confidence we've developed over the years with our customers – it's something that can't be measured, but which we continually provide.

In this way, our head gaskets provide optimum customer value: excellent manufacturing that leads to top quality and maximum functionality and durability.



Logistics and packaging: Custom designed for your line

VICTOR REINZ delivers your head gaskets packed and ready for installation directly to your assembly line, thus simplifying your logistics. We also design packaging to maximize economic, ecological, and logistic aspects. To ensure that »just-in-sequence« really means quality up to the assembly line, we employ logistic tracking systems such as DLL, CMMS3, and eCAP.

Put us to the test!

- Responsibility from beginning to end from a single source
- State-of-the-art development and prototyping tools
- Worldwide access to services
- Coordination through the **Competence Center R & D** in Neu-Ulm
- Systematic quality assurance – from production at VICTOR REINZ up the customer's assembly line



Manufacturing: Efficient and cost-effective

Flexible, fast, and cost-effective manufacturing are made possible at VICTOR REINZ by utilizing the most modern technologies in our production lines and clusters. The head gasket's final properties are influenced decisively and specifically by the individual processing stages and their sequence.

All of our technical efforts and the best product quality would be in vain, if the last link in the chain is not just as perfect as all the preceding ones. That's why every day at VICTOR REINZ, we strive to turn satisfied customers into delighted customers.

Welcome to VICTOR REINZ.



Concentrated performance – our entire development knowledge is focused on high-end products.



Minimized time and cost factors through automated production lines.



Worldwide product availability: Wherever your facility is located, you'll find us close by.

Advanced MLS technology has a name

RETALL®

The demands placed on cylinder head gaskets in modern engines are increasing: Lower overall weight, reduced engine rigidity, minimum bolt / ignition force ratio with simultaneously increasing engine torque and power necessitate new engine concepts with even smaller volumes and web widths. Fortunately, the solution is simple: RETALL® (REINZ METALL).

VICTOR REINZ began developing the advanced RETALL® MLS technology before there was even a demand for it. So when European automakers began building direct-injection diesel engines and highly charged gasoline engines at the beginning of the '90s, VICTOR REINZ was the first to supplier to offer technically mature multi-layer steel (MLS) technology - RETALL® – a high-performance gasket that continues to provide design freedom to engine builders, while still maintaining sufficient creative scope for tomorrow's challenges.

THE CONCEPT

Technically, the cylinder head gasket is the most demanding flat gasket in an engine, sealing the combustion chambers, coolant and lubricant channels, and bolt holes from each other. The cylinder head gasket transfers the forces between cylinder head and engine block, and therefore has a significant influence on the distribution of loads in the overall engine system and on cylinder distortion.

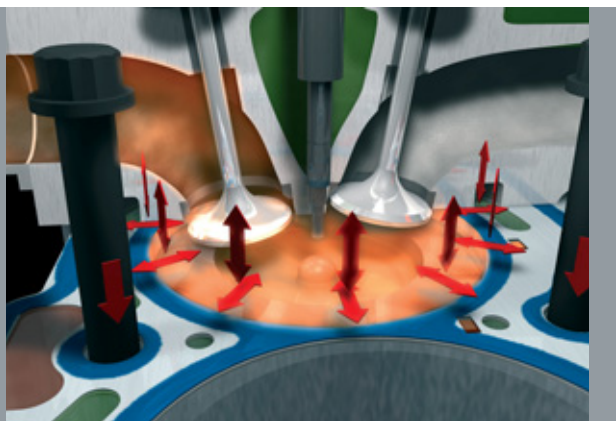
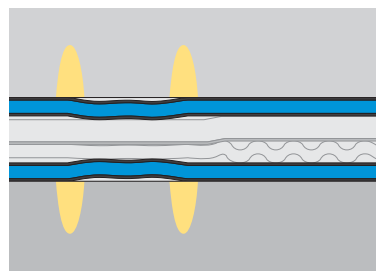
Depending on the engine's design, a modern RETALL® head gasket consists of one to five steel layers. For instance, highly charged diesel engines require a far more sophisticated MLS design than small-bore low-power gasoline engines.

BASIC CONSTRUCTION

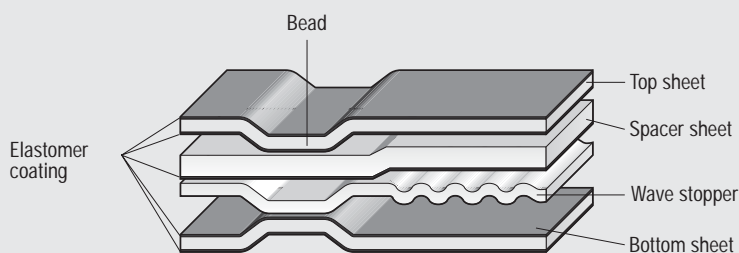
Cover and bottom sheets

These beaded functional layers consist of high-quality spring steel, and provide macro sealing against the engine block, the cylinder head, and the intermediate layers.

Due to the stiffness of the steel, the defined beads generate high line pressures around the combustion chambers as well as in the head gasket's backland for sealing the coolant and lubricant channels. Moreover, the cover and bottom sheets assist in the reduction of component distortions.



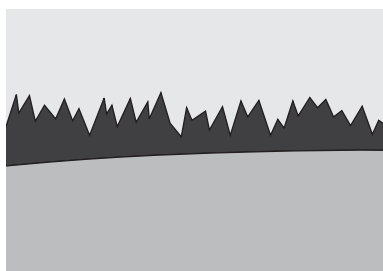
Basic functions of a cylinder head gasket – sealing against a variety of media.



Functionality and quality – layer by layer.

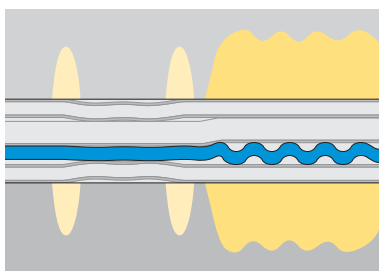
Elastomer coating

The elastomer coating on both sides of the active layers provides reliable micro sealing against engine block and cylinder head, and between the layers. It also exhibits very good sliding properties, high media resistance, and function-optimized flow characteristics.



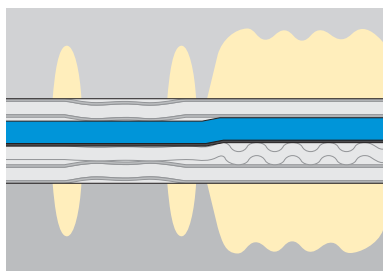
Combustion chamber stopper

By increasing the height around the combustion chamber, the surface pressure can be increased, thus preventing the beads of the active layers from being flattened (stopper function). Defined hole cross-sections are used to control the distribution of coolant in the head and engine.



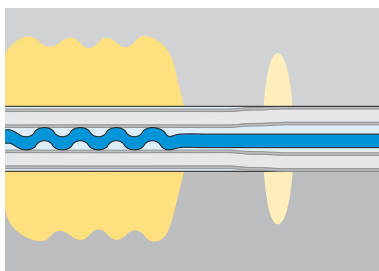
Spacer sheet

Suitable dimensioning of the spacer sheet, which acts as a design and variable element to modify the installed thickness, facilitates an elastic/plastic adaptation to the combustion chamber.



Backland stopper

Similarly, the surface pressure can be increased selectively in specified areas of the gasket's backland. For example, this enables additional support to be provided to the outer cylinders, thus counteracting any flexure of the cylinder head. In this way, distortion of cylinder liners and main bearing webs can be optimized.



Obligatory head gasket requirements

- Advanced MLS technology with special supporting, coating, stopper, and design elements
- Control of high component dynamics and combustion pressures as well as unfavorable bolt / ignition force ratios
- Sealing for modern engine concepts such as open-deck designs or compact constructions with extremely narrow webs

CHARACTERISTIC FEATURES

Modern engines place high chemical, physical, and structural demands on MLS head gaskets, which must be designed with high resistance to aggressive combustion gases and different media; high temperature resistance up to 240 °C and rapid temperature variations of more than 200 K; strongly varying and pulsating combustion pressures up to 120 bar with gasoline engines and above 200 bar with diesel engines; and different head bolt lengths, to mention just a few.

Chemical/physical demands

- high temperature resistance
- high thermal conductivity
- high mechanical strength
- high sealing potential
- cross-sectional tightness
- corrosion resistance
- low setting tendency to eliminate the need for retorquing

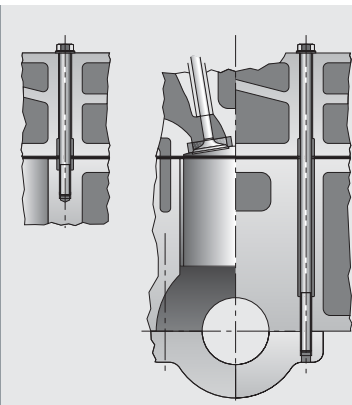
Structural demands

- adaptation to different surfaces (roughness, porosity)
- tight tolerances for shape and position
- tight tolerances for installed thickness
- variable degrees of installed thickness
- narrow webs
- reduced emissions through smaller crevice volumes
- simple installation
- recyclability

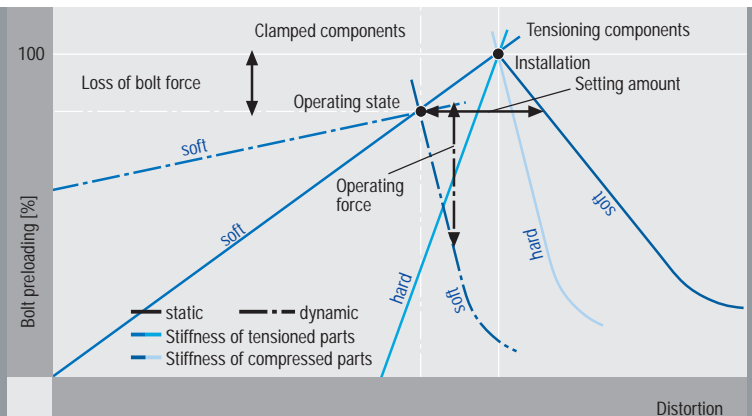
FUNCTIONAL ELEMENTS

Depending on the functions that cylinder head gaskets must perform, they are fitted with different functional elements. These elements represent the freedom of design that defines MLS head gaskets. They are:

- selected material
- coatings
- bead geometry of the active layers
- stopper design, and
- number of layers.



Different bolt lengths in an engine with tension bolts – one of numerous challenges for cylinder head gaskets.



Static and dynamic clamping diagram with hard and soft characteristics.

DETERMINANT ENGINE PROPERTIES

VICTOR REINZ engineers consider the following engine-related properties when designing the functional elements of an MLS head gasket:

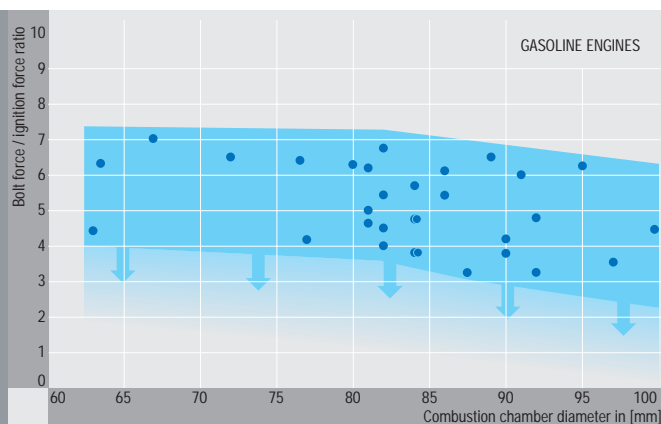
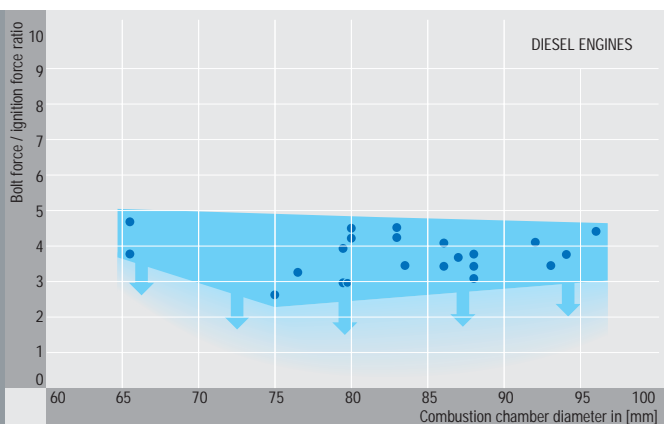
- Combustion type (spark ignition or diesel)
- Max. combustion pressure
- Cylinder head and block design
- Geometry, e.g. combustion chamber diameter
- Locations of coolant & oil channels
- Web widths
- Material (e-modulus, stiffness, hardness, and temperature coefficient)
- Roughness of the components
- Construction (closed deck, open deck, liners)
- Head bolts quantity and location
- clamping force (tolerances)
- bolt torque (elastic or plastic)
- bolt / ignition force ratio F_b / F_{ignit}
- Installed thickness
- Special requirements, e.g. solution for three-land junction

VICTOR REINZ considers these functional elements, creating MLS designs that ensure maximum performance and service life under the strictest engineering conditions.

Head bolt / ignition force ratio

An ideal MLS design is determined primarily by the clamped state of the »engine block - gasket - cylinder head - head bolts« structure. The design is also influenced by the bolt / ignition force ratio F_b / F_{ignit} , which determines how much the bolt forces apply sealing pressure to counteract the combustion pressure. Thus, the ratio F_b / F_{ignit} should not be less than 3.0 because otherwise the demands placed on the head gasket would increase disproportionately. This value is described as the gasket's safety factor. Furthermore, the ratio determines the outlay required to achieve optimum pressure distribution. During installation, the head gasket undergoes plastic and elastic deformation.

However, the relationship of these two portions varies strongly depending on the MLS design, and therefore has an influence on the basic behavior of the entire sealed joint.



Diesel engine (table at left) and gasoline engine (table at right). Challenge for modern automobile engines: the increasingly unfavorable bolt force / ignition force ratio.

Materials that make sense

TESTED QUALITY

The outstanding functional properties and top performance of MLS head gaskets from VICTOR REINZ are not only due to the innovative design and experience in manufacturing, but also because of precise material selection. All materials (and their delivery conditions) for our head gaskets are specified precisely in our proprietary REINZ Standards. We utilize a wide selection of sheet metals with different properties and coatings to provide maximum flexibility in terms of performance, durability, and price.

SHEET METAL PROPERTIES

Top sheet and bottom sheet

High quality, springy stainless steels are used exclusively for the active layers of the gasket. Cover and bottom sheets must be able to follow the movements of the sealing gap. Even after the beads have been embossed, the employed spring steels must retain very good resilient properties, high tensile strength, and optimum corrosion resistance.

Conventional stoppers

For conventional stoppers, we utilize a selection of steel ranging from high-carbon steel to stainless steel, depending on the required stopper design.

Wave and trapezoidal stoppers

For stoppers with wave or trapezoidal design, only spring steels are used.

Spacer sheet

Spacer sheets have the widest range of design options. Because the spacer sheet can perform either as a functional layer or as a thickness-determining layer, different types of steel are used ranging from stainless steel to carbon steel with various hardnesses and thicknesses. To protect carbon steel from corrosion, they can be either aluminium plated or zinc galvanized.

Best quality – layer for layer

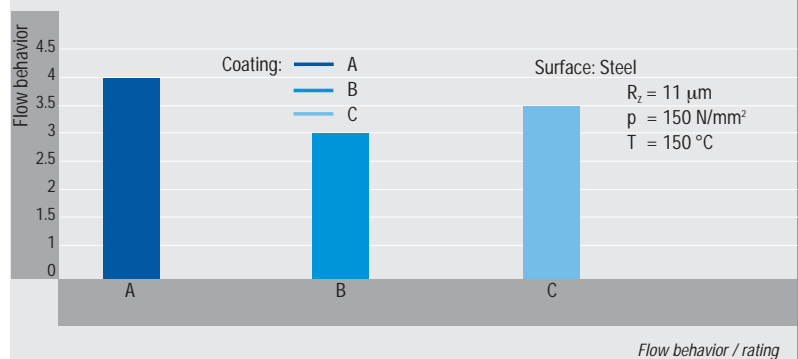
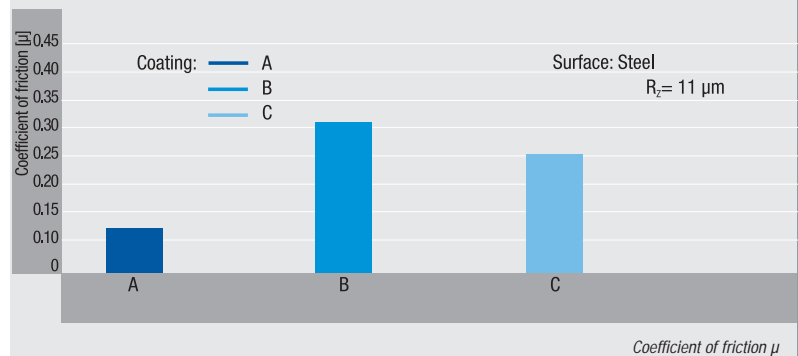
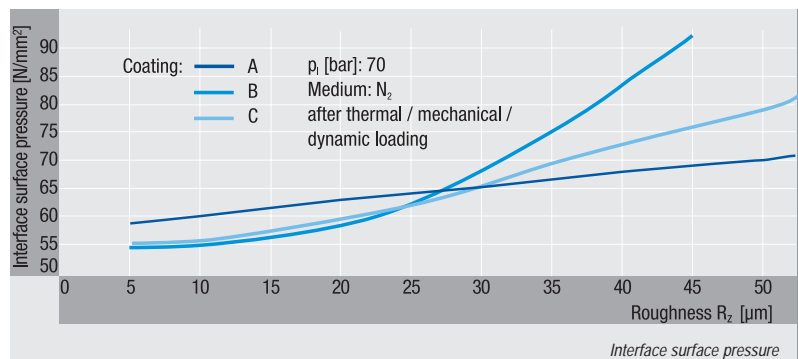


If the spacer sheet is to be flanged or beaded in the stopper area, the steel selected should be easily embossed, and also meet functional requirements such as load resistance, adaptability, and damping. Similarly, the combustion chamber design, the MLS design, and the installed thickness determine the functional properties of the spacer sheet.

ELASTOMER QUALITIES

Before being used in the production process, the elastomer coatings are tested for the correct formula, viscosity, and solids content to ensure optimum functional properties. Following the production process, the exact layer thickness, adhesion properties, etc. are also tested to ensure optimal operation in rough, everyday applications.

Perfect micro sealing – the use of different elastomer qualities ensures optimum functional properties.



The perfect fit – elastomer coatings

Function

Elastomer coatings serve for micro sealing. Through controlled sealing pressure, the coating fills and adapts to the surface roughnesses, scratches, and porosities of the engine block and cylinder head. There are two types: full-surface and partial coatings. Only high-quality fluoropolymers are used by VICTOR REINZ.

Properties

The coating's plastic properties ensure reliable sealing, also with problematic surfaces. Excess material is able to flow out of the high-pressure area, forming beads that provide additional sealing. Therefore, the coating withstands up to 240 °C without affecting its properties. The chemical resistance towards aggressive media such as combustion gases or coolant additives is excellent.

FULL-SURFACE COATING

Design

The active spring steel layers of an MLS cylinder head gasket are coated on both sides with elastomer layers of varying thicknesses. On the inner side, a thin coating is required for micro sealing between the individual layers. A bonding agent ensures good adhesion between the steel layers and the fluoro-elastomer coating. Non-stick surfaces on both the head and the block sides ensure easy disassembly by preventing the head gasket from adhering to the components. They also prevent individual gaskets from sticking together during transport to the assembly line.

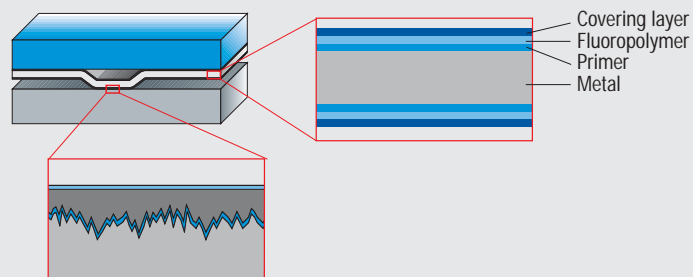
INSULATING COATING

Design

The insulating coating is a special type of full-surface coating. It is applied as an intermediate layer between top and/or bottom sheet layers and the soft fluoroelastomer coating, which serves for micro sealing.

Properties

The insulating coating is a hard coating with low electrical conductivity, thus preventing corrosion. As a functional coating, it exhibits high abrasion resistance, i.e. functional safety.



An effective means against roughness, scratches, and porosities – VICTOR REINZ elastomer coatings.

PARTIAL COATING

Design

Partial coatings are only applied in the areas around the combustion chambers, liquid channel openings, and beads. A bonding agent ensures good adhesion between the steel layers and the fluoro-elastomer coating. As with full-surface coating, non-stick surfaces both on the head and the block sides ensure easy disassembly by preventing the head gasket from adhering to the components, and also prevent individual gaskets from sticking together during transport to the assembly line. The VICTOR REINZ process permits the application of several coatings with different physical properties and in different layer thicknesses. This enables design engineers to react even more effectively to structural specifications, as well as specific component and material properties. Especially with blowhole problems, the layer thickness can be adapted variably in the respective areas.

Properties

Partial coating has similar chemical/physical properties as full-surface coating. The advantage of a partial coating is improved thermal conductivities between engine block, gasket, and cylinder head.

Component distortions are prevented by the faster equalization of component temperatures. In addition to easily recyclable scissors, up to 70 % less coating material is beneficial to the environment.

Application

For new engine generations, such as open deck designs or the use of cast aluminium engine blocks, or for modern gasoline and diesel engines with high specific outputs, partial coating eliminates sealing problems from the start. Especially with open deck designs, selective exclusion of coolant areas effectively prevents coating detachment.

Combination

For particularly difficult sealing tasks, e.g. the presence of blowholes or corrosion problems, full-surface coating can also be combined with partial coatings or an insulating layer.



Extend functionality by combining different coatings.

(a) Full-surface coating

(b) Partial coating

(c) Insulating coating

Under pressure – Beads

Beads are embossed into active layers of spring steel sheet (top and bottom sheets) for increased local line pressures. They provide sealing against combustion gases around the combustion chamber, and against coolant and oil at the corresponding openings. Beads are responsible for macro sealing. They selectively convert bolt forces into sealing forces, and are available as full or half beads.

FULL BEADS

Function

During installation of the cylinder head gasket, the full beads are compressed up to the stopper height or to the point where the bead resistance equals the bolt clamping force. Due to the resilience of the spring steel sheet, a full bead creates four single lines with high line pressure. Full beads effectively equalize the dynamic sealing gap movements between cylinder head and engine block, also with extremely high ignition pressures.

Design

Full beads are specified by

- bead depth Y
- side angle X , and
- crown width V .

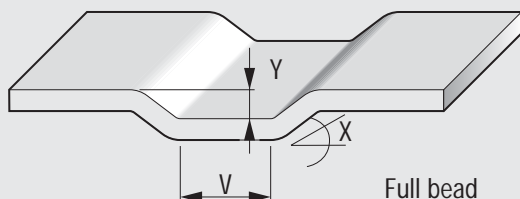
Properties

Main influencing factors of the bead properties are:

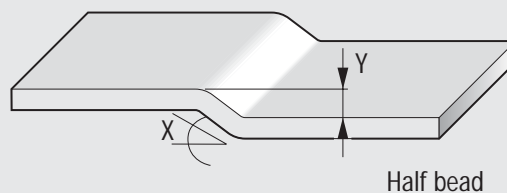
- geometry
- steel sheet quality and thickness
- the production process

Using these criteria it is possible to create a wide range of full beads with defined properties for loading and resilience – beads that exhibit widely differing characteristics and load absorption abilities.

Depending on engine block and cylinder head rigidity, materials used for crankcase and cylinder head, bolt forces, and available space, softer or harder full beads are used. Full beads with smaller values for side angle X are softer, have a flatter spring characteristic, and a higher permanent load resistance.



Maximum pressure put on the line – the full bead.



Line pressure applied selectively – the half bead.

The permanent load resistance of harder full beads can be influenced considerably by the manufacturing process. High mechanical and thermal stability ensure uniform bead properties during the head gasket's entire service life.

Application

Full beads are used primarily for sealing the combustion chambers. Maximum line pressures and optimum resilience properties are necessary around combustion chambers.

HALF BEADS

Function

The half beads are compressed during installation of the cylinder head gasket. Due to the elasticity of the spring steel sheet, a half bead creates two single lines with high line pressure.

Design

Half beads are specified by
 → bead depth Y , and
 → side angle X .

Properties

The properties of half beads are determined by the same factors as full beads.

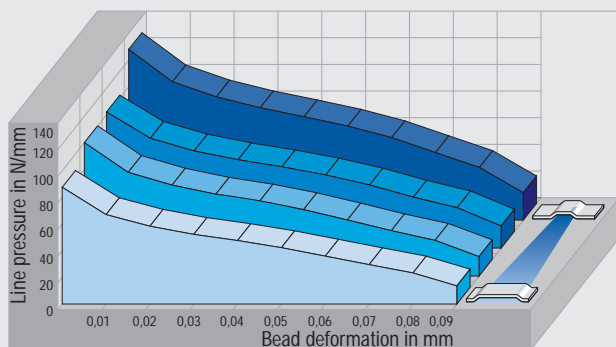
Application

Half beads generate lower line pressures than full beads, and are primarily used to seal against coolant and oil in the backland of the head gasket, around the bolt holes, and along the gasket's outer contour. Due to the lower line pressure of the half beads in the gasket's backland, the main sealing pressure of the full beads around the combustion chambers is maintained.

BEAD COMBINATIONS

Note

Numerous bead combinations are possible to better meet individual engine sealing demands.



Load absorption of different bead geometries.

Halting the action – Stoppers

Two types of combustion chamber sealing methods are used with MLS head gaskets: Gaskets without support for the combustion chamber bead, and those with support – namely, with stoppers. Stoppers are designed as α -stoppers, Ω -stoppers, symmetrical U-beads with Hard-Coating® VR, Wave-Stoppers® or trapezoidal stoppers. They are integrated in an active layer or are fitted as a supplementary layer between the active functional layers. Simultaneously, stopper designs enable better topographic adaptation to the adjoining components to be achieved.

Function

Stoppers facilitate additional gasket areas with high surface pressure. The combustion chamber stopper represents the first sealing stage against combustion gases at the combustion chamber. Stoppers limit the spring travel of full beads, enabling the engine block and cylinder head to be clamped more tightly. This permits the more clear reduction of the dynamic

sealing gap movements. The full bead maintains a defined working range with higher elasticity and better permanent load resistance.

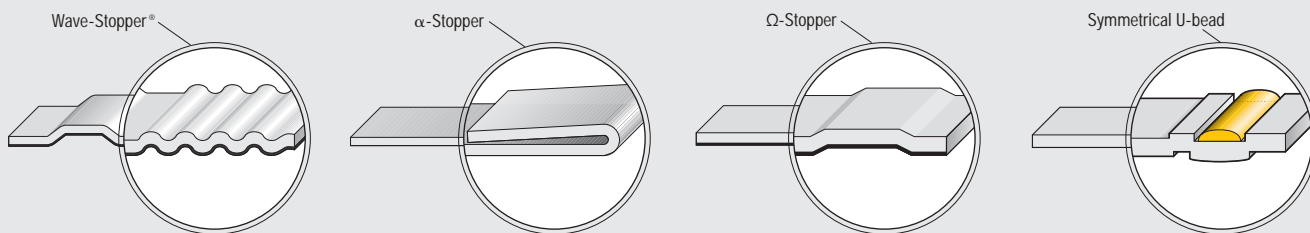
Design

The stopper is a swelling in the area of the combustion chambers. There are numerous layout options for the stopper. Depending on which is chosen, the combustion chamber stopper is generally located in front of the combustion chamber bead. Stoppers can be implemented as separate sheet layers or they can be integrated into existing sheet layers. The stopper layout is a primary design factor of MLS head gaskets.

Properties

Depending on engine design, the installed thickness of an MLS head gasket varies, and is comprised of metal layer thicknesses and stopper height. Less stiff engine designs exhibit increased engine dynamics. This can lead to leaks at the combustion chamber or

to fractured beads. This type of problem can be overcome by greater clamping forces, additional stopper layers, functional layers, or a topographic adaptation. For example, topographic adaptation enables cylinder distortion to be reduced drastically.



Different stoppers – the optimum solution for every area of application.

A SPECIAL CASE: THE STOPPERLESS GASKET

Function

With a stopperless head gasket, the area between the combustion chamber and cooling water jacket is sealed exclusively by means of full beads around the combustion chamber.

Design

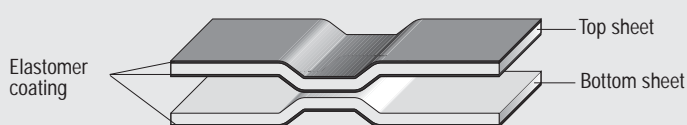
In general, increased sealing gap movements occur with a stopperless head gasket. In order to ensure a long service life despite these movements, the forces are distributed over several layers. In this case, the bead must be of a special design.

Properties

During installation, the beads are strongly compressed. Force transfer around the combustion chamber is low. This results in lower component distortion with simultaneously reduced oil consumption.

Application

Stopperless gaskets are used primarily in gasoline engines with a rigid construction and low dynamic sealing gap movement.



MLS cylinder head gasket without stopper.

WAVE-STOPPER®

Design

Concentric »waves« are embossed in the active functional layer of the spring steel sheet around the combustion chamber. Normally, the Wave-Stopper® consists of two to five individual waves. The Wave-Stoppers® characteristics are influenced by the number of waves, their separation, radius, and the sheet thickness. By means of partially terminated waves, the head gasket can be individually adapted to the engine's component stiffness.

By varying the wave symmetry, it is possible to ensure symmetrical limitation of bead compression in the different layers at the height specified by the Wave-Stopper®. Depending on the gasket's design, wave height can be varied upwards or downwards. The Wave-Stopper® also permits single-layer (SLS) head gasket designs.

Properties:

Elastic/plastic characteristics

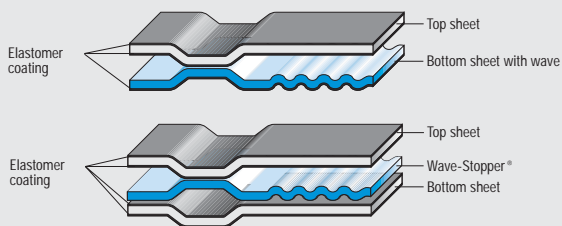
Wave-Stoppers® exhibit pronounced plastic/elastic characteristics. Height and width of the individual waves

determine the Wave-Stoppers® properties. If the Wave-Stopper® has an elastomer coating, the latter is forced into the wave valleys when compressed, thus forming concentric rings. These provide additional micro sealing around the combustion chamber.

Properties:

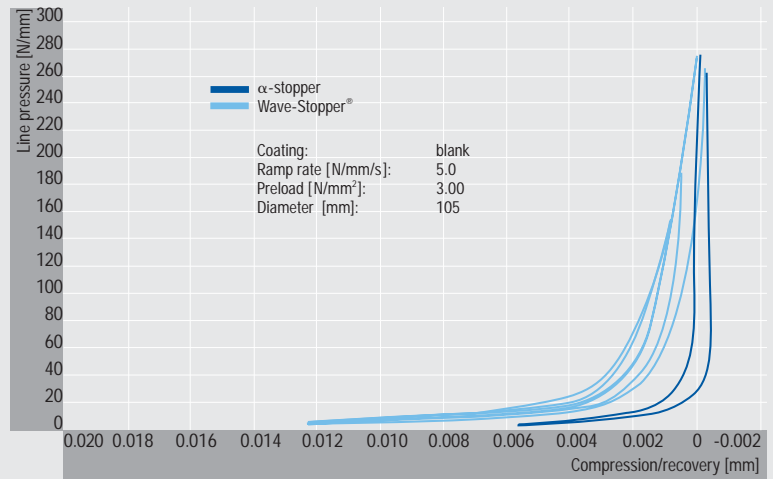
Topographic adaptation

In order to take advantage of the entire area around the combustion chamber, an additional height profile can be included in the Wave-Stopper®. For example, the stopper height is then reduced around the head bolts, thus directing the local excess forces into the areas between the bolts. Consequently, the full elastic adaptation of the Wave-Stopper® is maintained in all areas with different heights. This topographic adaptation creates a highly uniform pressure image. Due to the great degree of design freedom, Wave-Stoppers® can always adapt perfectly to changing engine stiffness. Thanks to this behaviour, pressure peaks are equalized under all operating conditions, and the pressures on the surrounding components are harmonized.

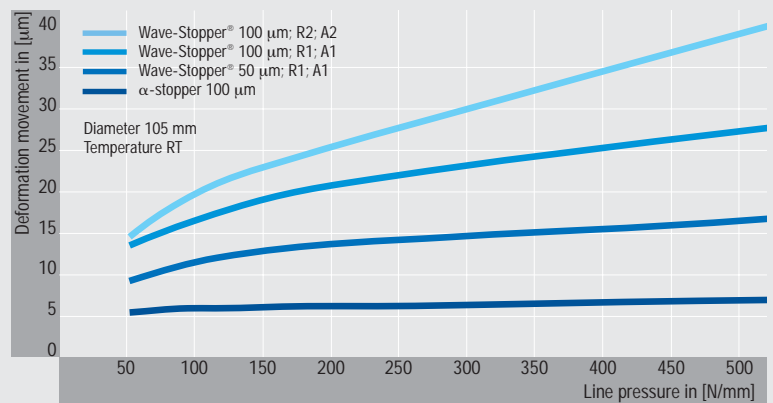


Concept with freedom of design – Wave-Stoppers®.

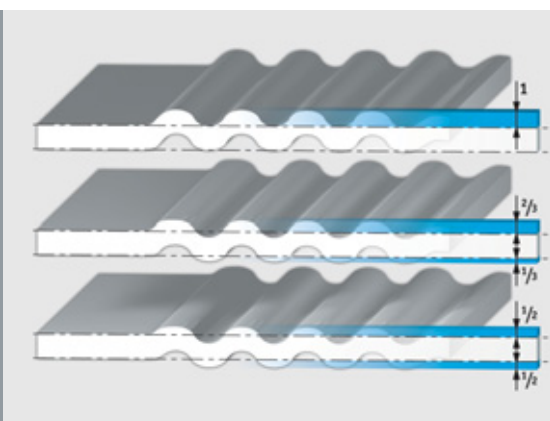
Examples of constructional possibilities for Wave-Stopper® design.



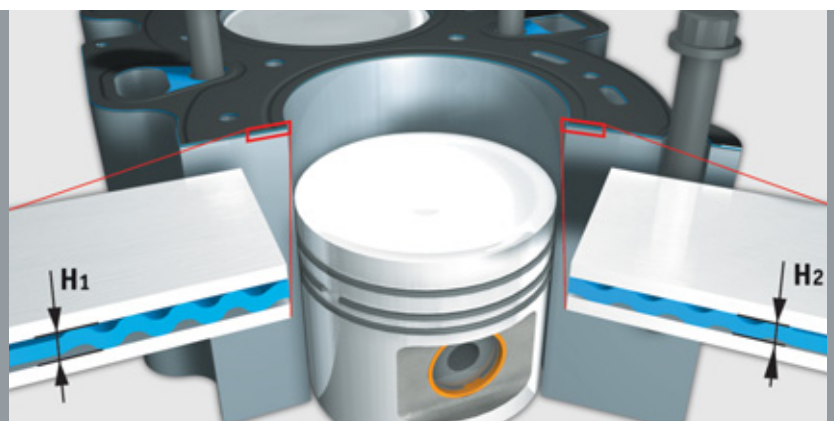
Plastic/elastic behavior of α-stopper and Wave-Stopper®.



Comparison of deformation movement for α-stopper and Wave-Stopper®.



Options for asymmetrical / symmetrical stopper distribution.



Topographic adaptation of Wave-Stoppers® provides selective functional control.

TRAPEZOIDAL STOPPER

Design

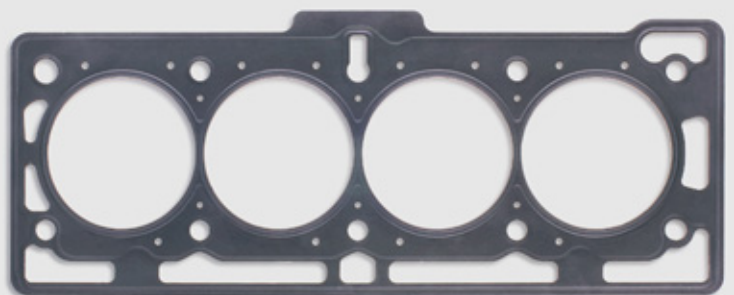
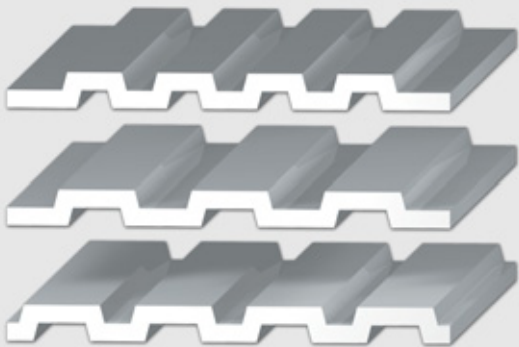
The trapezoidal stopper is a modification of the Wave-Stopper®. The same functional dependencies as the Wave-Stopper® applies to the trapezoidal stopper, particularly when it comes to the number of trapezoids, their separation and radius, the sheet thickness, and the variations in symmetry.

Properties

As a modified Wave-Stopper®, the trapezoidal stopper exhibits a pronounced elastic/plastic and topographic behavior. Contrary to the Wave-Stopper®, however, the surface pressure and therefore the surface pressure amplitude can be adapted selectively by increasing the contact area. Thus, at operating temperatures, pressure peaks above the yield point (and the associated »pitting«) can be avoided at points of direct contact with soft materials.

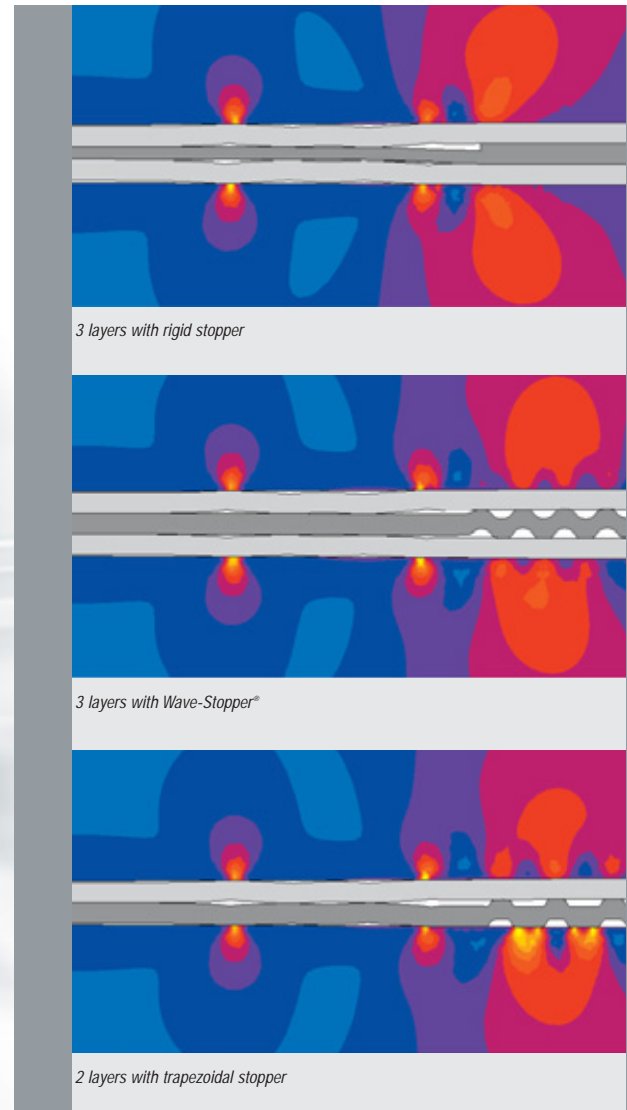
Application

When used in full-aluminium engines, trapezoidal stoppers can be integrated into the active layer facing a component surface, thus saving one material layer. This permits the use of single-layer head gaskets with integrated stopper in full-aluminum engine designs, and also in small-displacement engines with less sealing gap movement.

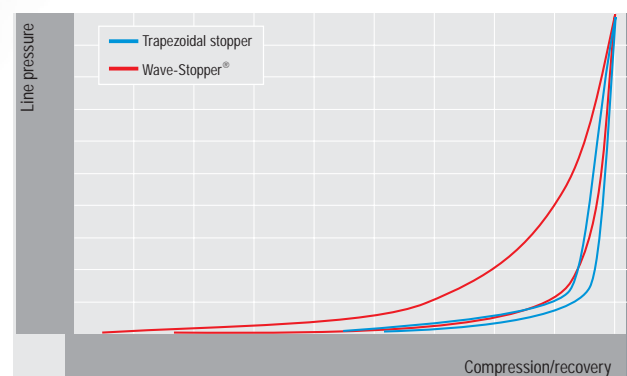


Trapezoidal design options.

The world's first single layer head gasket with trapezoidal stopper – of course by VICTOR REINZ.



Comparison of component stresses with different stopper designs.



Increased stiffness through trapezoidal shape.

α - STOPPER

Design

The α-stopper is a highly flexible and formable stainless steel or steel sheet between the active layers, which is folded at the combustion chamber. Stopper height is determined by the material thickness, and additional adaptation is achieved through special shaping by VICTOR REINZ.

Properties

The α-stopper is a plastic/elastic stopper with comparably low adaptability. Compression of the adjoining sealing layers is influenced by the orientation of the α-stopper.

Ω - STOPPER

Design

The Ω-stopper is embossed into the spacer sheet, and is compatible with the contour of a full bead (omega shape). Thicker carbon steels with special tensile and flexing properties are used.

Properties

The Ω-stopper is designed to deform only in certain areas, e.g. in the immediate vicinity of bolt holes. This results in plastic/elastic adaptation to the engine block and cylinder head. With multi-layer MLS designs, Ω-stoppers in the spacer sheets lead to symmetrical pressure distribution in bottom and top sheets.

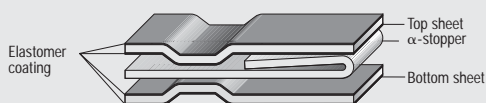
SYMMETRICAL U-BEAD WITH HARD-COATING® VR

Design

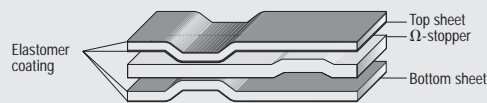
The symmetrical U-bead is a modification of the Ω-stopper. In contrast to the Ω-stopper, a raised profile is embossed on both sides of the spacer sheet. To increase stopper stiffness even more, the U-bead channel can be filled with Hard-Coating® VR. Hard-Coating® VR is a composite material made of metal and synthetic resin, which is applied to the spacer sheet by means of screen-printing.

Properties

The symmetry of the raised profiles prevents the total compression of full beads in the active layers on both sides of the spacer sheet. Apart from this functional extension, the symmetrical U-bead exhibits improved plastic/elastic adaptability due to the design freedom provided by the Hard-Coating® VR. This ensures a considerably better uniform pressure distribution along the entire border of the combustion chamber.



α-stopper – the plastic/elastic stopper.



For high engine dynamics – the Ω-stopper.

STOPPER COMBINATIONS

Hard-Coating® VR is an elastic/plastic stopper. Because of its variable height and width, it can be adapted optimally to the stiffness of the surrounding components. The most defining characteristic of Hard-Coating® VR lies in its higher non-compressibility under load. Moreover, Hard-Coating® VR has very good media resistance, and withstands temperature up to 240 °C.

Design

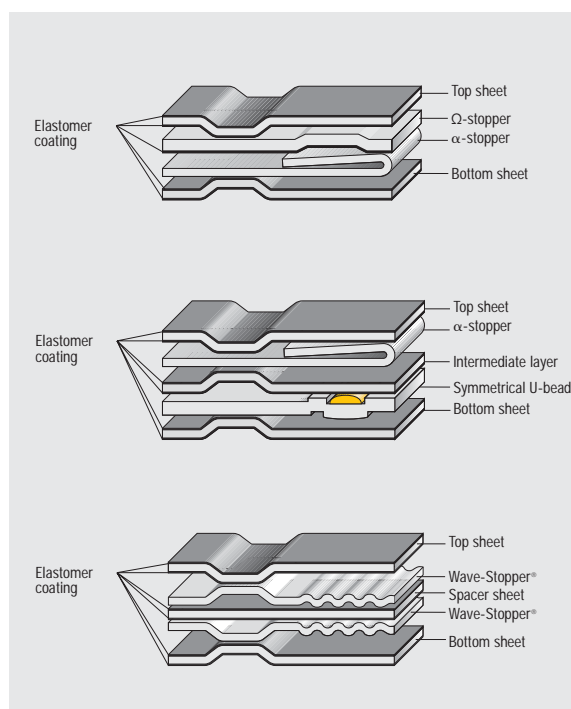
Depending on the application, combining different types of stoppers is also possible for demanding sealing tasks with high combustion pressures and different component stiffnesses. Combinations consist of α-stoppers and plastic/elastic stoppers (Ω-stoppers or symmetrical U-bead with Hard-Coating® VR).

Function

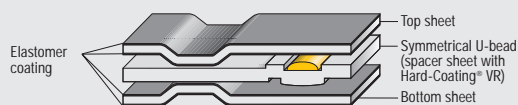
Combining stoppers can help compensate for discrepancies between component stiffnesses of the engine block and cylinder head, as well as highly dynamic sealing gap movements. Thus they contribute to a high sealing potential for cylinder head gaskets.

Note

The application of different stopper combinations depends on the design of an MLS head gasket. Examples of different MLS designs and stopper applications are given on pages 34/35.



Stopper combinations – for highly dynamic sealing gap movements.



Even more adaptable – symmetrical U-bead with Hard-Coating® VR

Special solutions

»BACKLAND« STOPPER REDUCES COMPONENT DISTORTIONS

The maximum compression height of the combustion chamber beads, and the clamping of the surrounding components, have a decisive influence on the sealing potential and service life of the entire sealed joint. By integrating an additional backland wave or trapezoidal stopper, combining these two elementary functions enables the reduction of component distortions introduced by high bolt forces and the gasket, and permits selective application of the force lines.

At selected points in the backland of the head gasket, additional wave or trapezoidal stoppers can be integrated as supports. Compared with the combustion chamber stopper, these elastic/plastic stoppers have a reduced height, and can also be designed with individual height profiles for topographical adaptation. These options can provide additional support for the outer cylinders, thus counteracting cylinder head flexure as well as distortion of cylinder liners and main bearing webs. Correct

matching of the backland stopper, combined with specific topography of the combustion chamber stopper, enables an identical pressure image to be obtained at the outer sides of the first and last cylinders.

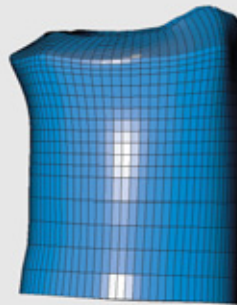
FLAT SHEET SEALS »BLOWHOLES«

It's a common problem: shorter cycle times during the production of cast components such as engine blocks, cylinder heads, or timing covers lead to an increase of entrapped gases, or "blowholes", which represent a growing microsealing problem for head gaskets. The patented flat sheet from VICTOR REINZ can help alleviate this micro sealing problem.

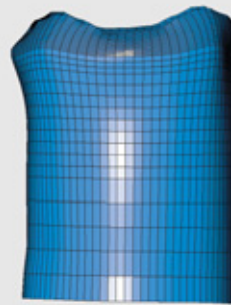
The resilient top or bottom sheet ensures effective pressure distribution over a larger area. Due to its outstanding yield properties, the elastomer coating on the component side is pressed into the blowholes and seals them reliably. The coating can be applied to the flat sheet over the entire surface or partially, and in variable layer thicknesses.



Stopper layer with topographical backland stopper.



10.9 Bolt quality without
backland wave



10.9 Bolt quality with
backland wave

Cylinder distortions enlarged 400 times

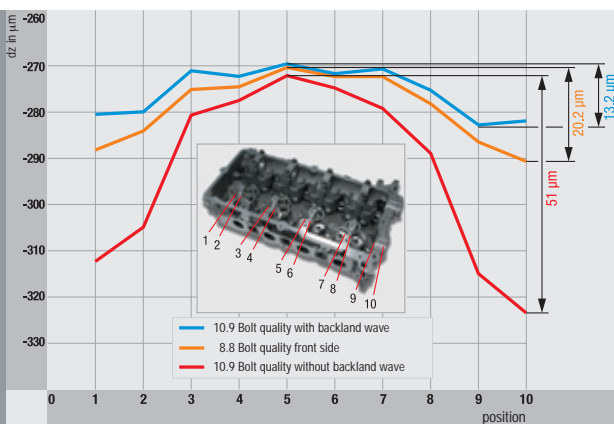
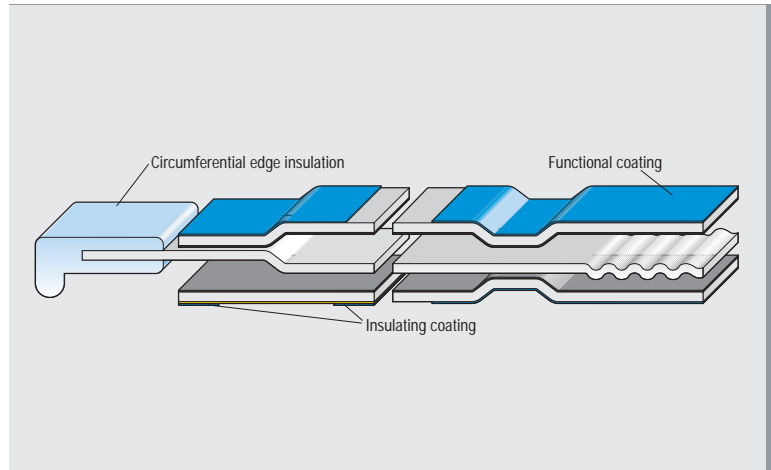
Comparison of cylinder shape without additional measures, and with integrated backland stopper.

CIRCUMFERENTIAL EDGE INSULATION PREVENTS CORROSION

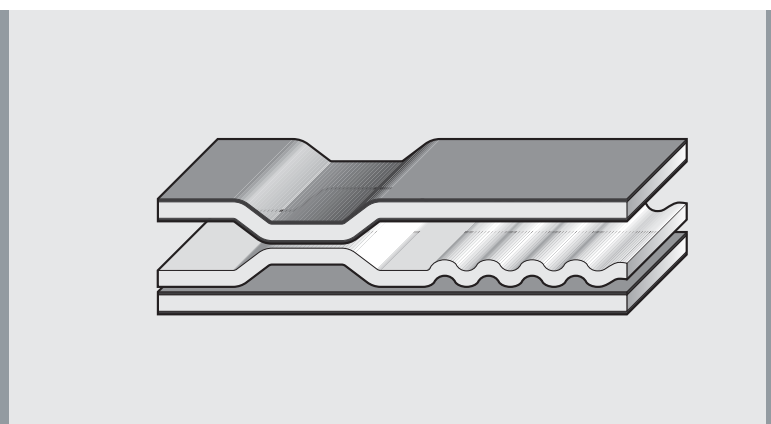
There is a new problem posed by engines designed using magnesium: corrosive electrochemical potentials arise along the bare punched edges at the outer contour of the individual head gasket sheets.

VICTOR REINZ has come up with an effective solution to this problem: Using the »edge molding procedure«, an elastomer sealing lip is injection molded along the outer edge of an intermediate sheet in the head gasket. Together with an insulating coating that has low electrical conductivity on the top and/or bottom sheet, the molded sealing lip interrupts the electrochemical potentials, thus providing effective corrosion protection.

No chance for corrosion – the circumferential edge insulation on head gaskets for modern magnesium alloy engines.



Comparison of distortion of the camshaft bearing webs without additional measures, and with integrated backland stopper.



Secure sealing of blowholes – with the patented flat sheet solution from VICTOR REINZ.

Three's a crowd

»THREE-LAND JUNCTION«

Special measures are required with T-joints, the so-called »three-land junctions«. These occur at the points where an additional component, such as a timing cover, crosses the joint between engine block and cylinder head, so that two sealed surfaces are at right angles to each other. Due to manufacturing tolerances, slight steps and sealing gaps occur at the surface junctions. Depending on the mounting situation, VICTOR REINZ offers a number of patented solutions.

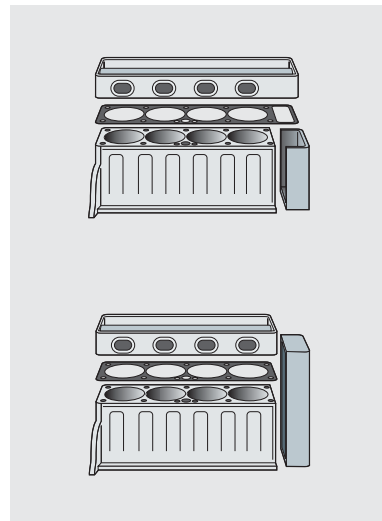
Function

Additional, plastic sealing compounds are applied to the layers of the MLS head gasket or in the form of a pasty material in a reservoir between the layers. As the gasket is compressed during installation, the sealing compound is forced into the gap between

engine block, cylinder head, and the third component, (such as the timing cover), providing a reliable seal between all three components.

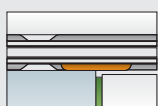
Properties

Due to its excellent flow properties, the plastic/elastic sealing compound extrudes into even the smallest gaps without reducing the surface pressure at the beads. The sealing compounds withstand temperatures up to 200 °C, and are resistant towards media such as engine oils or coolants.

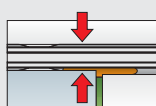


Examples of three-land junctions with a timing cover.

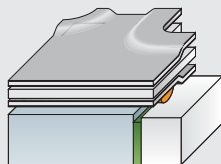
SDE



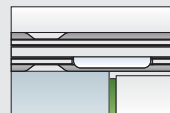
unclamped state



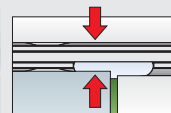
clamped state



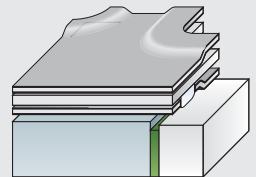
QD



unclamped state



clamped state



Three-land junction with foamed sealing bead.

Three-land junction with silicone impression.

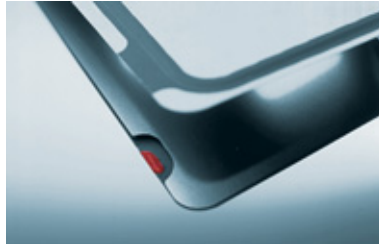
SDE – THE SIMPLE SOLUTION



Principle

In the gap area of the components, a sealing bead is formed onto top and/or bottom sheet, which is fully compressed during gasket installation.

DX – THE ALTERNATIVE SOLUTION



Principle

A moldable plastic sealing compound is printed onto the spacer sheet. A cutout in the top and/or bottom sheet limits the sealing compound from being over compressed.

QD – THE PREFERRED SOLUTION



Principle

A moldable silicone compound is printed onto the spacer sheet. A cutout in the top and/or bottom sheet limits the silicone compound from being over compressed.

RESERVOIR – THE SPECIAL SOLUTION



Principle

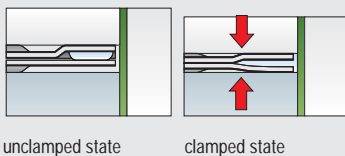
The reservoir solution is applicable for MLS designs with at least three layers. A reservoir for the non-curing sealing compound is embossed into the intermediate sheet.

During gasket installation, the sealing compound is pressed out of the reservoir into the gap between the components. Top and/or bottom sheets have a cutout to permit an unhindered flow of the sealing compound.

Application

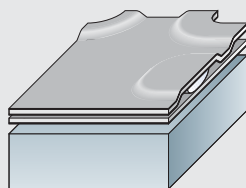
Depending on component dynamics, surface pressure, and installed thickness, the proper three-land junction solution is chosen to achieve an optimum sealing potential.

DX

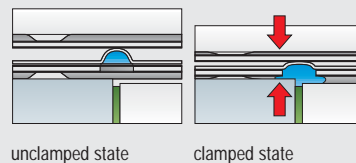


unclamped state

clamped state

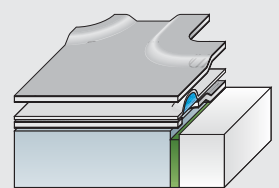


Reservoir solution



unclamped state

clamped state



Three-land junction with UV-cured sealing compound.





Three-land junction with reservoir.

For every problem...

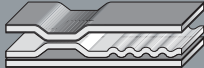
...THE IDEAL SOLUTION



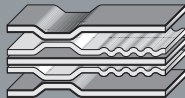


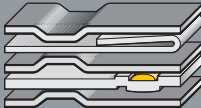



No two engine designs are the same. Equally varied are the demands placed on the design of MLS head gaskets. The following tables show different MLS designs using 1 to 5 layers, and their application possibilities.

Application examples for MLS designs



1 layer	2 layers
 <p>Installed thickness 0.32 - 0.40 mm</p> <p>Application</p> <ul style="list-style-type: none"> → Gasoline engines with lower dynamics and installed thickness 	 <p>Installed thickness 0.48 - 0.63 mm</p> <p>Application</p> <ul style="list-style-type: none"> → Gasoline engines with higher dynamics and reduced installed thickness
	 <p>Installed thickness 0.48 - 0.68 mm</p> <p>Application</p> <ul style="list-style-type: none"> → Gasoline engines with high dynamics and reduced installed thickness
	 <p>Installed thickness 0.40 - 0.50 mm</p> <p>Application</p> <ul style="list-style-type: none"> → Gasoline engines with lower dynamics → Preferred for reducing distortions

Special engines

3 layers
 <p>Installed thickness 0.60 - 0.85 mm</p> <p>Application</p> <ul style="list-style-type: none"> → Gasoline engines with high dynamics → Blowholes in the engine block

3 layers		4 layers		5 layers
				
Installed thickness 0.65 - 0.90 mm		Installed thickness 1.30 - 2.10 mm		Installed thickness 1.20 - 2.45 mm
Application <ul style="list-style-type: none"> Gasoline engines with high dynamics Diesel engines with lower dynamics 		Application <ul style="list-style-type: none"> Diesel engines High dynamics High combustion pressures 		Application <ul style="list-style-type: none"> High-end diesel engines High dynamics High combustion pressures High installed thickness
				
Installed thickness 0.80 - 1.85 mm		Installed thickness 1.10 - 2.00 mm		Installed thickness 1.35 - 2.30 mm
Application <ul style="list-style-type: none"> Gasoline engines with higher installed thickness Diesel engines 		Application <ul style="list-style-type: none"> Gasoline and diesel engines 		Application <ul style="list-style-type: none"> Diesel engines High dynamics High combustion pressures High installed thickness
				
Installed thickness 0.70 - 0.90 mm				
Application <ul style="list-style-type: none"> Design with high dynamics Gasoline and diesel engines 				
				
Installed thickness 0.50 - 0.80 mm				
Application <ul style="list-style-type: none"> Gasoline engines with lower dynamics Preferred for reducing distortions 				
				
Installed thickness 1.10 - 1.80 mm				
Application <ul style="list-style-type: none"> Gasoline and diesel engines 				

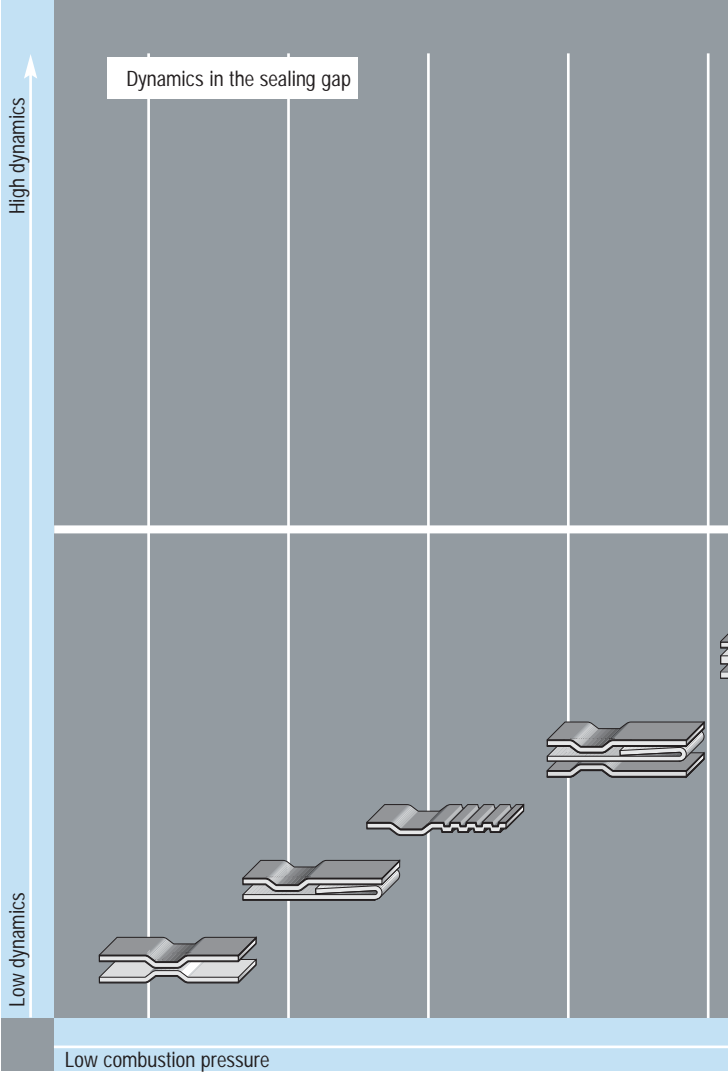
Application examples for different MLS designs:
1-, 2-, 3-, 4- and 5-layer versions.

3 layers	5 layers
	
Installed thickness 0.70 - 0.90 mm	Installed thickness 1.10 - 1.50 mm
Application <ul style="list-style-type: none"> Gasoline engines Al/Mg crankcase With medium dynamics 	Application <ul style="list-style-type: none"> Gasoline engines Al/Mg crankcase With high dynamics

Performance in every layer

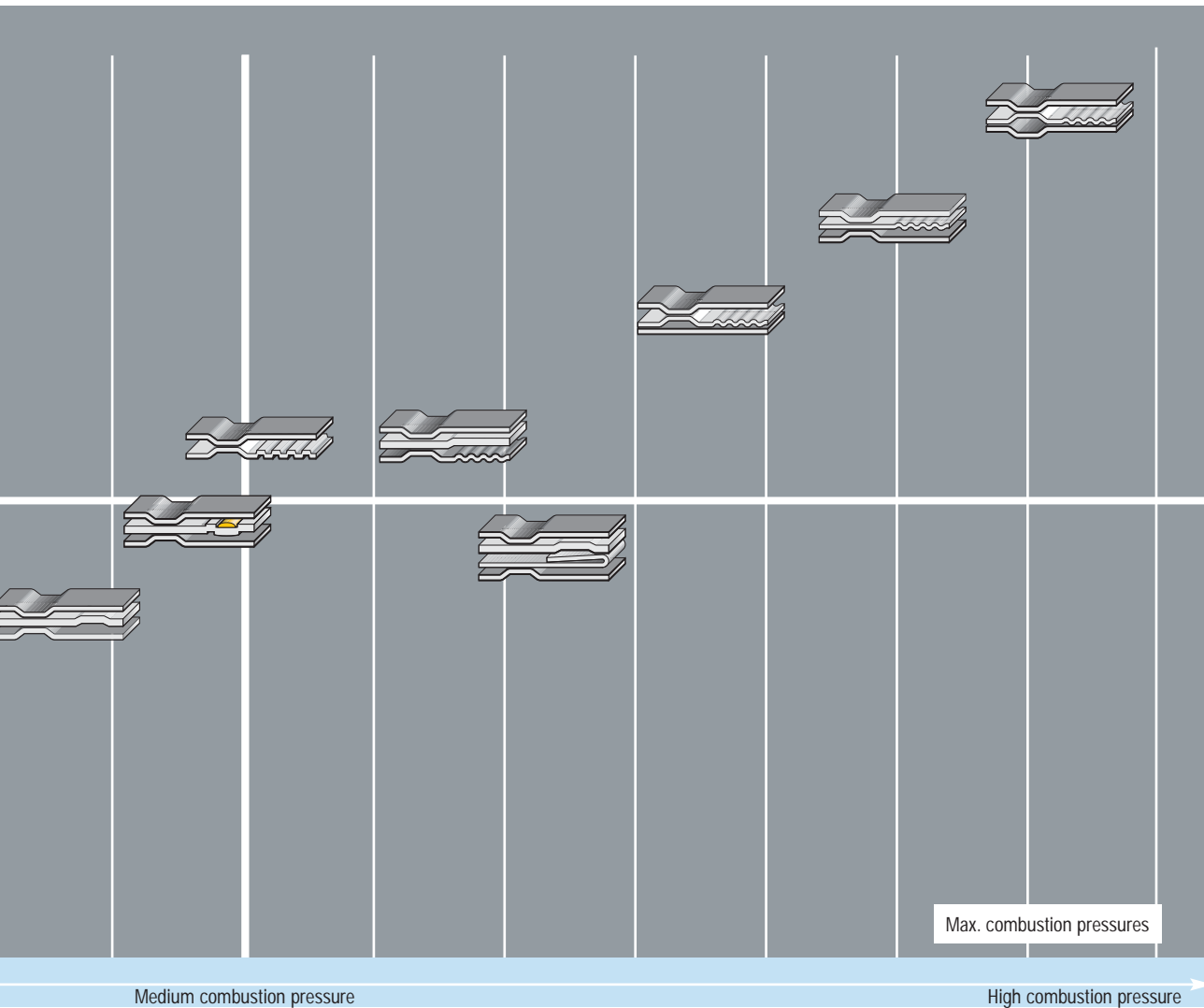
GASOLINE ENGINES

The different functional elements for MLS head gaskets permit a wide range of combinations. MLS gasket designs are determined mainly by the following engine properties: Specific output, peak combustion pressure, stiffness and force transfer, and engine dynamics. The engine dynamics lead to conclusions about engine design and stiffness. The matrix at right shows the performance of different MLS designs dependant upon specific engine output and dynamics.



Performance matrix of different MLS designs for gasoline engines.

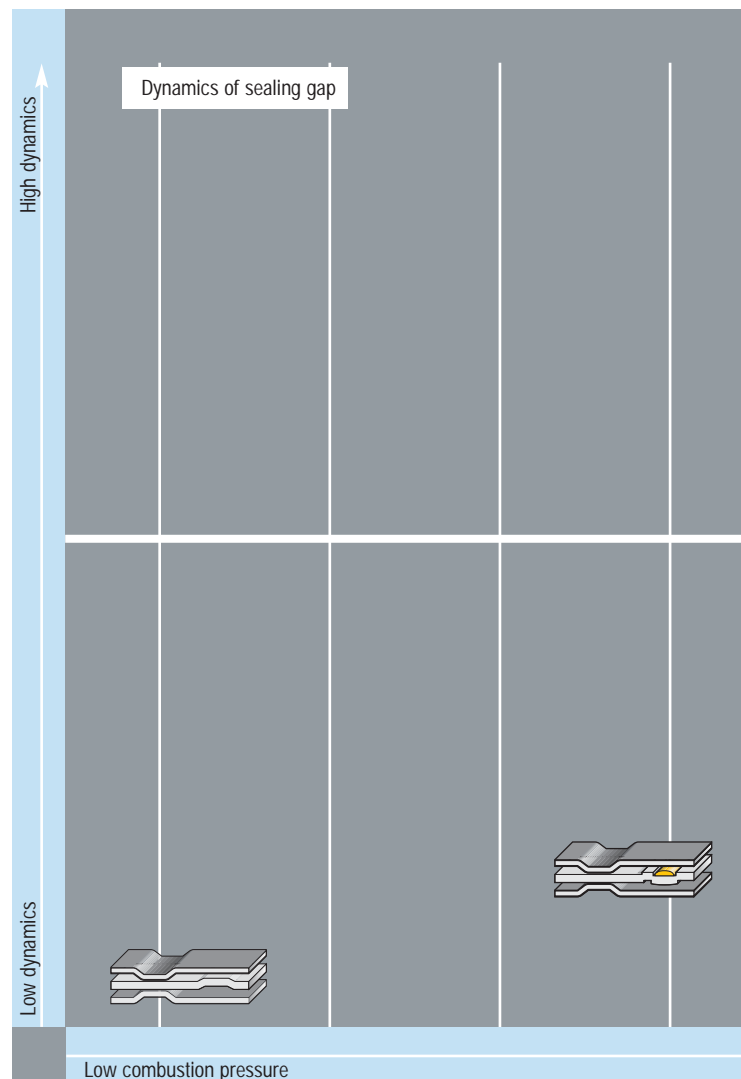




Ensuring the surface pressure level

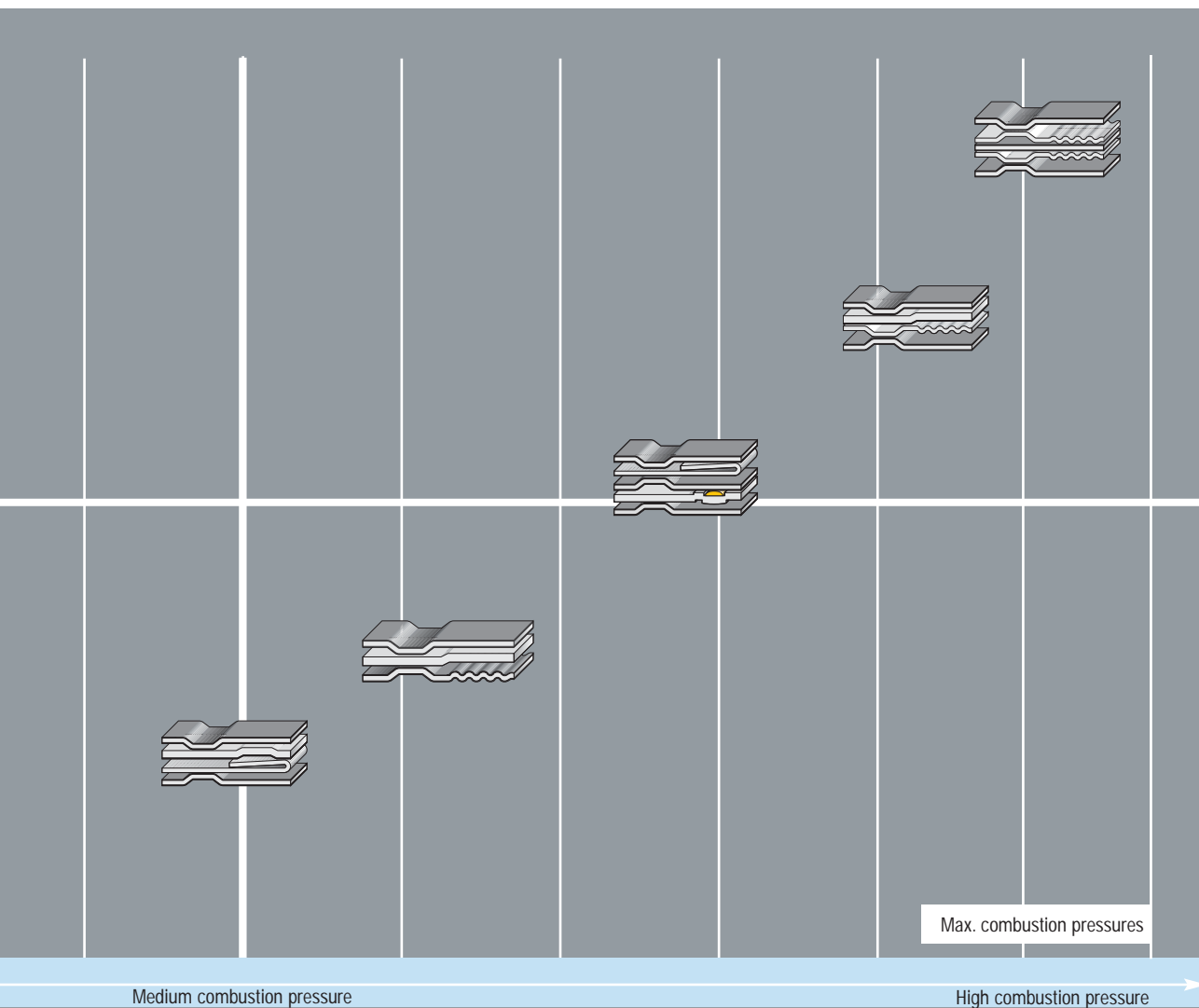
DIESEL ENGINES

VICTOR REINZ engineers have the experience to design plastic/elastic sealing characteristics that will follow the engine's deformations under all operating conditions, while also ensuring that the surface pressures do not fall below the levels needed for reliable sealing.



Performance matrix of different MLS designs for diesel engines.





A vision for the future

HELPING CREATE FUTURE ENGINE CONCEPTS

By constantly evaluating market and technology trends, VICTOR REINZ is helping make visions become reality. In fact, many of today's engine standards are based on innovative solutions from VICTOR REINZ. So it's no wonder that VICTOR REINZ has developed a strong reputation for ongoing, outstanding product innovations in the automotive industry.

HELPING TO SECURE THE WORLD'S MOBILE FUTURE

Lower emissions and improved fuel efficiency are just two of many trends that future engine builders must comply with. The following development trends place increasingly high demands on cylinder head gaskets and their performance:

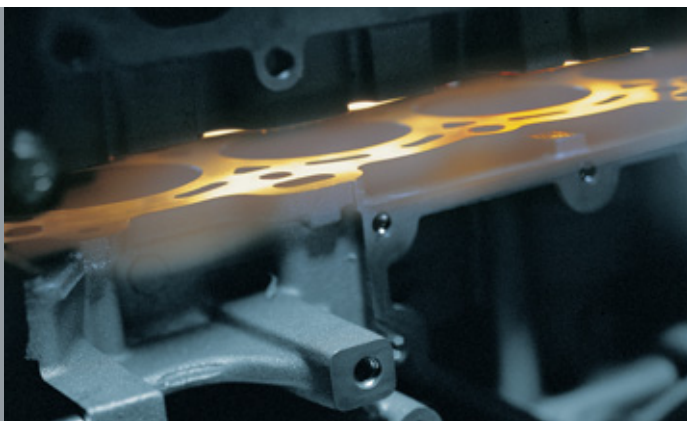
- higher combustion pressures through higher engine outputs
- increased thermal loading
- higher vibration dynamics through reduced component stiffness of lightweight designs
- more aggressive media from newly developed engine oils and coolants
- exhaust gas recirculation
- lightweight engine construction

SENSORICS®

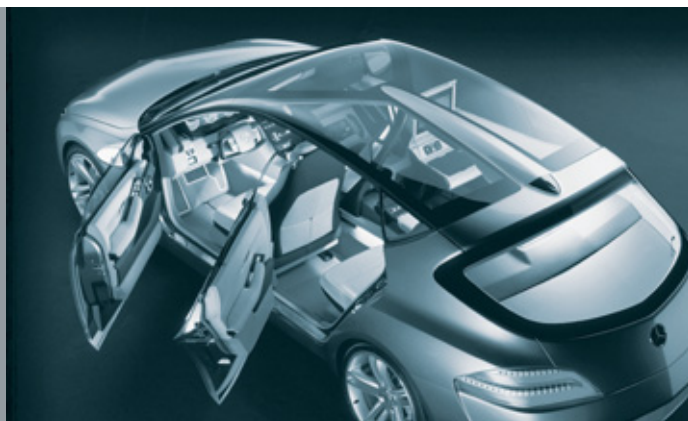
In the future, a cylinder head gasket will no longer be simply a sealing element – it will be an intelligent component in the overall engine system. In fact, at VICTOR REINZ the future is now: SensorICS® – the intelligent MLS head gasket with integrated pressure and temperature sensors – helps provide an intelligent engine management and cooling system.

PRESSURE MEASUREMENT Δp

To further reduce emissions and improve fuel consumption in future combustion engines, measuring the combustion pressure is a must. This measurement will enable the engine system to influence the combustion process far more precisely. Through active control factors including injection time and quantity, as well as EGR ratio, the engine can maximize its operation, and emissions and fuel consumption are reduced.



High combustion pressures, high component temperatures, increasing vibration dynamics. What does the future hold?



With VICTOR REINZ, automotive visions come true.

TEMPERATURE MEASUREMENT ΔT

VICTOR REINZ is also developing temperature sensors that will supply data to the engine management system directly from inside the engine – permitting the coolant flow to be controlled according to particular specifications for optimum exploitation of the generated heat. Exact, requirement-dependent heat management of the coolant circuit will enable the engine and catalytic converter to reach their ideal operating temperatures much more quickly. Similar application possibilities are also possible in the areas of optimized combustion and on-board diagnostics. These technological advances will provide higher engine efficiency while simultaneously reducing harmful emissions, lowering fuel consumption, and lengthening the service life of critical components.



High-tech for tomorrow's automobiles. Intelligent sensor technology for even cleaner and more efficient combustion engines.

WHAT WILL THE FUTURE BE LIKE?

Naturally, we cannot predict the future of the automobile. But we do have clear conceptions about the future of cylinder head gaskets. Because the future already exists in our development departments. You can learn more about these exciting developments by requesting more information; simply give us a call and we will send an information package to you.



"Made possible by VICTOR REINZ"

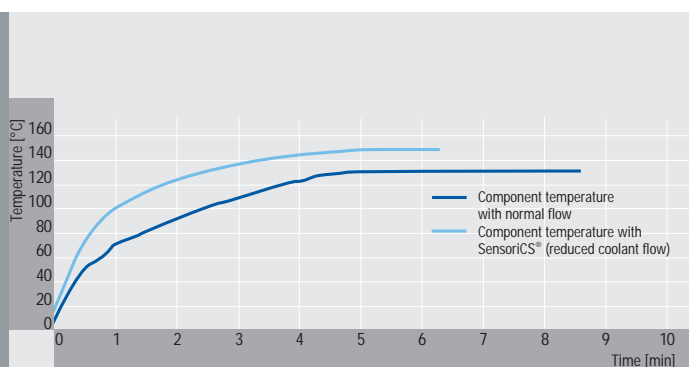
Our contributions toward the future of the automotive industry:

- Systematic evaluation of market and technology trends
- Continuous adaptation of current technologies to changing conditions in order to meet the developmental trends of modern combustion engines
- Development of intelligent product innovations (active SensorICS® head gasket for measuring pressure and temperature differences)
- Contribution toward weight reduction in engine designs
- Contribution toward emission reduction through distortion-optimized solutions

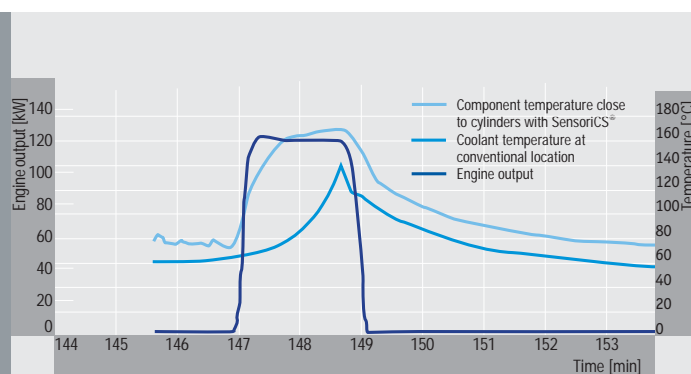
Publication: Enhanced Functionality for Cylinder Head Gaskets. Advanced Development of the Wave-Stopper®, MTZ Issue 10/2003

Publication: Cylinder Head Gaskets with Integrated Temperature Sensors. Detecting Component Temperatures in the Heart of the Engine, MTZ Issue 12/2002.

Publication: New Technology for Multi-Layer Steel Cylinder Head Gaskets, MTZ Issue 10/2001



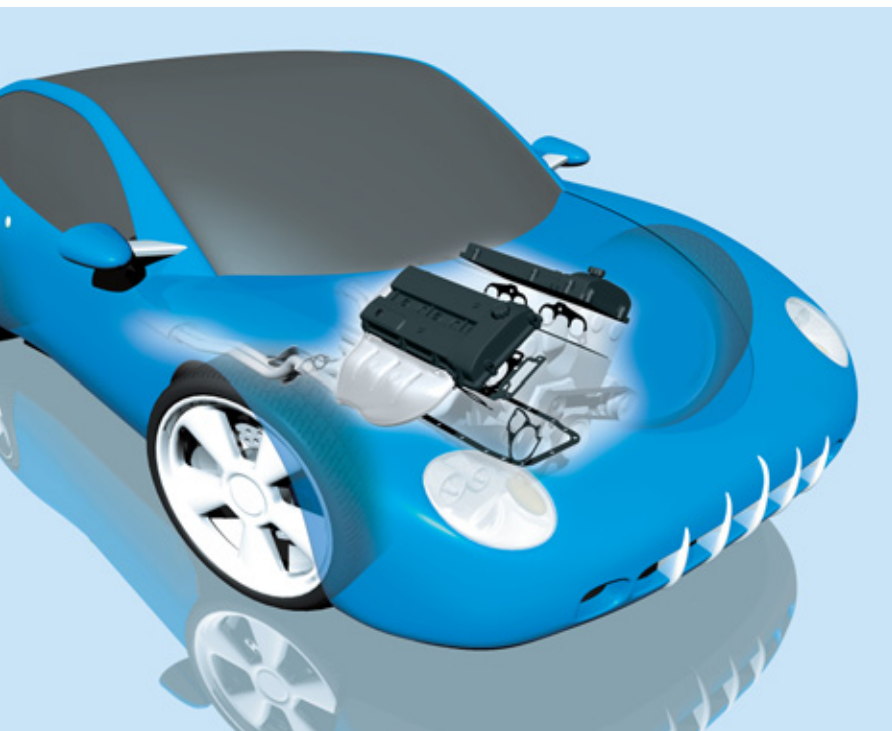
High temperature gradient for fast attainment of the ideal operating temperatures of engine and catalytic converter.



Fits tight. And in touch with the future: SensorICS®. Fast temperature signals to the engine management system.

The VICTOR REINZ product range

EXCELLENT IN ALL AREAS



When it comes to the powertrain, we feel completely at home. So it's no wonder that our specialties are not limited to sealing the cylinder head. The name VICTOR REINZ stands for innovative gasket systems – from the engine and transmission through to the exhaust system – including shielding and valve cover systems.



Innovative technologies for the powertrain come from VICTOR REINZ.



VICTOR REINZ – a step ahead of the competition.

The entire world of gasket technology

- Single and multi-layer metal gaskets (RETALL®)
- Metal gaskets with elastomer coating (Progression®)
- Metal gasket with fiber coating (MatriCS®)
- High-temperature gaskets (Xtreme®, thermoglide®)
- Sensor gaskets for temperature and pressure measurement (SensoriCS®)
- Composite gaskets (AFM®)
- Screen-printed gaskets
- Molded rubber gaskets (CIPG¹⁾, FIPG²⁾)
- Injected rubber gaskets
- Shielding systems for thermal and acoustic insulation
- Multi-functional valve cover systems with integrated air/oil separation systems
- Customized solutions for commercial vehicle applications

CIPG¹⁾ = Cured in place gasket

FIPG²⁾ = Fluid in place gasket



VICTOR REINZ in the Dana network

SYNERGY AND TECHNOLOGY TRANSFER BENEFITS OUR CUSTOMERS

As part of the Dana Corporation, VICTOR REINZ has the resources to provide you the best solutions worldwide – including ideas, service and products in automotive manufacturing hubs located in points around the globe. All our facilities are networked in order to maximize our knowledge and efficiencies to serve you better.

AUTOMOTIVE ORIENTATION IN THE XXL FORMAT

As one of the largest independent automotive suppliers, the Dana Corporation is represented on every continent. Dana Sealing Products employs 3,900 specialists alone, part of the Dana network of 45,000 employees worldwide. These specialists develop and manufacture innovative gasket systems for the international automotive industry on four continents. We also serve emerging markets providing worldwide access to Dana's expertise.

Our experts in every division of the Dana Corporation, together with our customers, develop the most advanced innovations based on true company synergy. This multi-discipline approach allows us to see the big picture, supplying state-of-the-art components, modules, systems, and complete assemblies matched to the needs of the global automotive market.

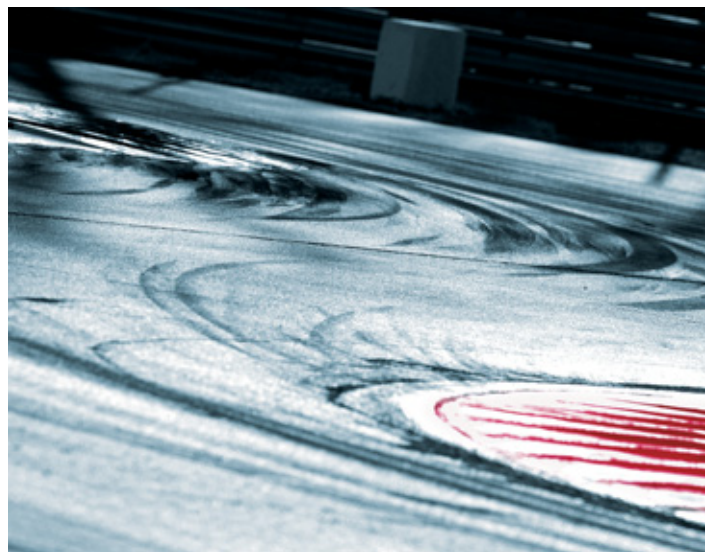
As a result of this company synergy, we at VICTOR REINZ have become even faster, more innovative, and more competitive than ever before. Our purchasing, development, and sales advantages are passed on directly to our customers. And that's not all.

TRENDSETTING CELLS – TECHNOLOGICAL MILESTONE

The Dana Corporation is committed to promoting mobility, today and into the future. At our facility in Neu-Ulm, VICTOR REINZ is already engaged in the production of series-ready components for fuel cells. We are on the threshold of a technology that will no longer be hampered by emissions challenges in regard to today's combustion engines.

For these developments and anything else the future holds in store, you can be confident that with VICTOR REINZ, you'll always benefit from the most advanced developments inspired by the close cooperation of our experts worldwide.

Today. Tomorrow. And as long as there are automobiles.



Solution for the future: Series-ready bluepack® fuel cell stack »Made in Neu-Ulm«.

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People Finding A Better Way®