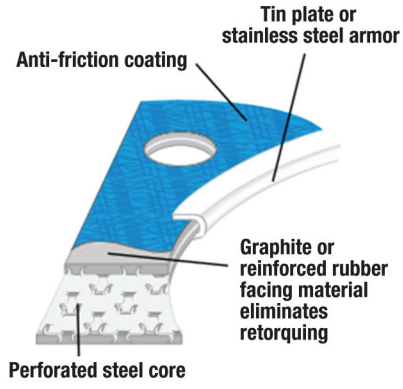
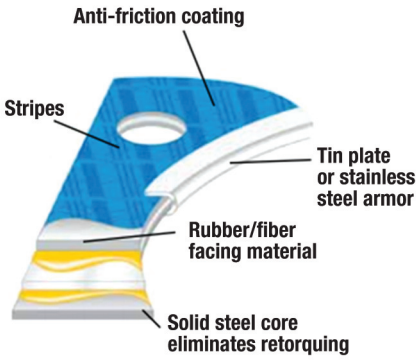
High-Performance Gaskets

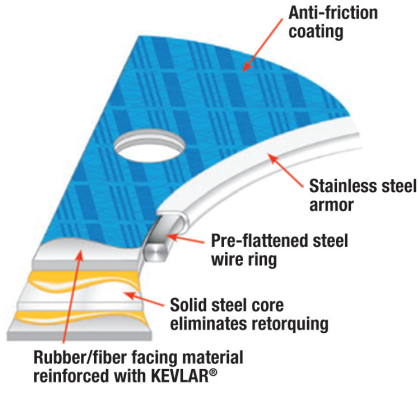
What's the difference?

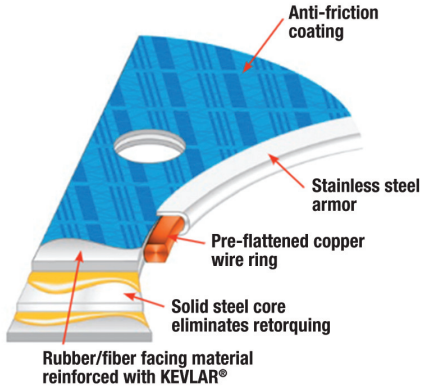
BY **BRIAN ROBERTS**

Gaskets and seals as we all know are used to seal the engine. Looking at the high-performance world the gaskets and seals used are often designed differently to meet the demands of the increased HP and pressures. In this article we will look at the reasons and advantages to using a high-performance or specialty gasket on an engine. You may ask when should I use a performance or specialty gasket instead of a traditional aftermarket gasket? This is a great question and depends on several factors. What is the operating environment the gasket will see? (High compression pressures, Boosted), (Salt or freshwater exposure) are a couple examples? If you can answer these it helps lead you towards your answer.









Let's take for example a marine application. If you are working on a marine engine you need to understand that potentially salt or fresh water will be circulated through the cooling system. This salt or fresh water is very corrosive to items like a head gasket that uses the body of the gasket to meter the coolant flow. Extended exposure to this water will eventually eat through the body of the gasket which might be a thin perforated or solid core steel. Once the material is eaten away the full opening in the water jacket of the head and block are exposed allowing more coolant to flow through the engine then designed and then the engine will run too cold. Using a marine gasket is key as it has a gasket body made from stainless-steel to combat the corrosion. This stainless-steel material should apply to any gasket directly exposed to salt water or fresh water. You can use a traditional aftermarket head gasket in place of a marine gasket but don't expect any longevity out of it. With all the time and expense to build the engine and labor to install the engine in the boat, it is not a wise choice to save money on head gaskets, use the marine version.

When working on a high-performance engine where combustion pressures are extremely high, the head gaskets combustion seal needs to be upgraded with better materials like stainless steel, thicker cores than traditional aftermarket to provide better radial strength. Sometimes on older composite head gaskets the armor material which wraps around the gasket body to form the combustion seal will have a wire ring inside of it to again increase the strength radially and provide high load on the combustion seal. Other designs have the wire ring groove cut into the head and the wire ring inserted into the groove to provide a more localized combustion seal. These designs get the job done on most street applications and have done so for many years.

For supercharged or boosted engines you should lean towards an O-Ring and copper head gasket or a MLS – Multi-Layered Steel head gasket which like the name implies uses multiple layers of stainless steels that have memory in them. Supercharged or boosted engines have very high cylinder pressures and create more heat, two things MLS gaskets are very good at handling. These gaskets provide great radial strength for the combustion pressure and have a dynamic capability to follow the unloading that occurs during head lift which is a fantastic benefit. The sealing beads are formed into the outer layers using hydraulic presses. These beads once formed into the material which has memory will act like a spring. Once it is compressed to it's final material thickness it forms the seal with the aid of a thin rubber coating to seal the imperfections in the surface finishes. As the engine fires the extreme pressure in the cylinders try to lift the head off the block. We are talking micro inches of movement but as the head lifts the memory in the material causes the gasket to follow the head up and down providing a continuously dynamic seal.

Since the MLS gasket material is solid core stainless steel for the active or outer layers and a solid core steel distance layer sandwiched together. This creates a gasket with great radial strength to combat high

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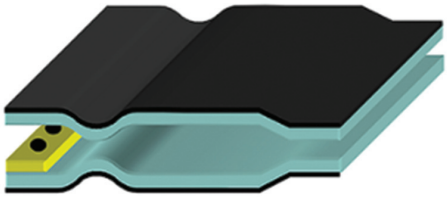
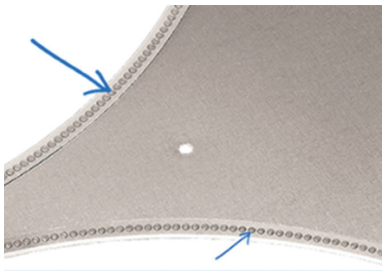
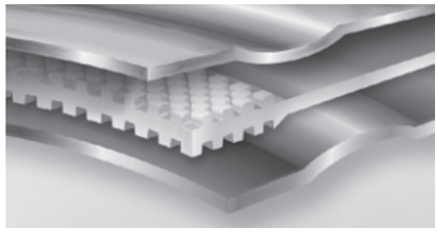
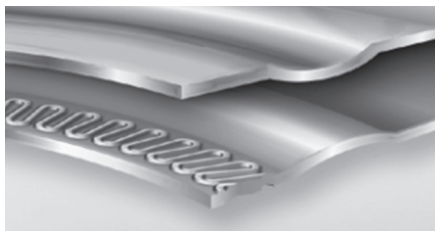


Embossments with LaserWeld

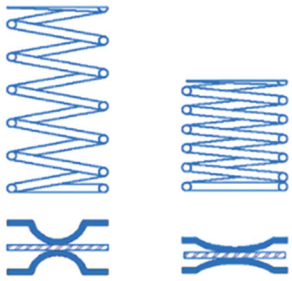


LaserWeld Stopper Layer



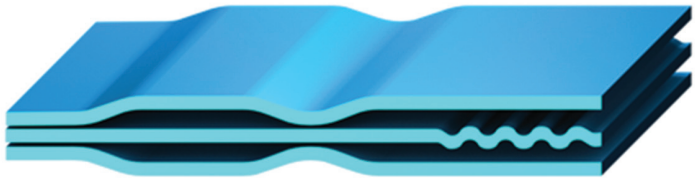


Various Stopper Designs also used in the industry



Sealing Beads Before Compression

Compressed Sealing Beads



cylinder pressures. It also allows for a wide variation of gasket thickness as a thicker or thinner distance layer can be placed between the two outer "active" layers. Companies like Cometic Gaskets takes advantage of this variability to provide builders many options to tailor the gasket to fit the compression ratio they may be shooting for. These MLS gaskets can still distort like older composite designs but there is usually a pre-ignition or detonation issue causing 2 flame fronts to converge and crash into each other. This will cause huge spikes in cylinder pressure that are beyond pressures seen during boost. This will kill a head gasket and or a piston if ran that way for an extended time. A properly tuned engine should not have an MLS head gasket issue unless something happens like a cooling issue or fuel issue that overheats the engine and causes excessive warpage that the head gasket cannot accommodate to.

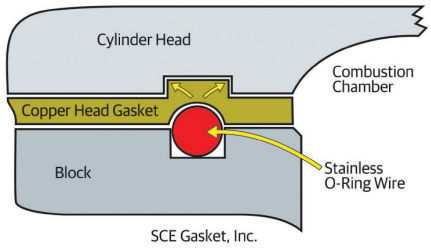
Some MLS head gaskets employ a stopper shim around the combustion seal that is either folded over onto itself, on one of the active layers or it can be welded to the distance layer. One method used to create the stopper is metal displacement which precisely deforms the metal into a very tight pattern like a waffle or waves. These tight deformations create a raised area above the actual material. This forms the stopper. The function of the stopper as Fel-Pro states on their laser welded design, "The LaserWeld stopper layer provides a positive stop, preventing over-compression. This ensures the sealing embossments maintain maximum recoverability and function as designed." The stopper also induces a more uniform sealing stress which helps minimize bore distortion and improve ring seal. The outer active layers act like a spring, see the comparison diagrams of a spring and an MLS cross section. The gasket will travel with the head as it lifts.

Another area that MLS Head gaskets are being utilized is in the performance diesel shops. The diesel engines are also being boosted beyond the original design and as such requires a better combustion seal. Shops are using the proven method of O-ringing the head or block but instead of copper they are using an MLS head gasket. Since the MLS gasket is not as malleable as Copper the O-ring protrusion needs to be reduced to maintain the fluid sealing portion of the gasket.

Looking at an older technology that is still in use today for high cylinder pressure applications is to O-Ring the head. This requires the head to have a small channel machined into the surface at a precise width and depth to receive a wire ring that protrudes from the surface of the head a predetermined amount. Then a copper head gasket is put on the engine to seal the fluids and the wire ring imbeds into the copper to form the combustion seal. This seal can accommodate very high cylinder pressures but has limitations on controlling leakage from head lift if it is present. Unlike MLS which can move dynamically with head lift, the copper is static and will not follow the head. Still copper and a wire ring are a good option for high performance engines that are boosted. Copper being a very malleable material can conform to rougher surface finishes compared to MLS which require smoother finishes. Companies like SCE Gaskets have been making these copper head gaskets for many years with great success. Below is a cross section of the O-Ring design to help better explain how the seal works.

Regardless of copper or MLS it is a good idea to switch to performance fasteners like an ARP stud to gain more clamp load to keep the head from lifting as much as with traditional bolts.

O-RING WITH RECEIVER GROOVE



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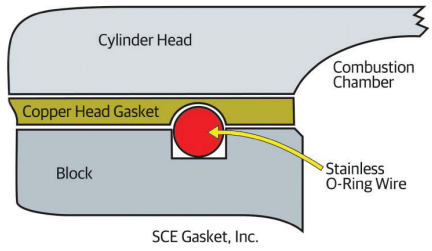

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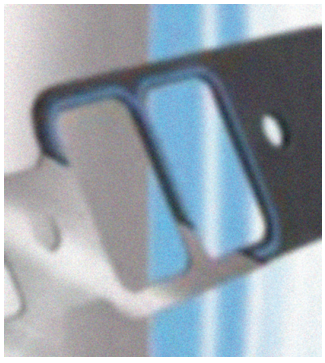
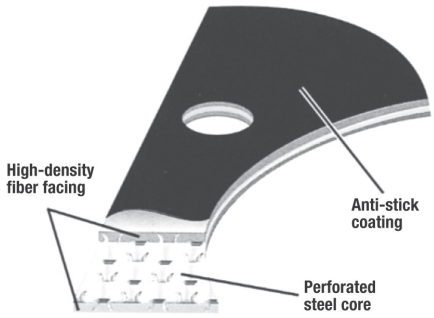
Performance Intake Gaskets

Leaning on the radial strength of a solid core material we should look at some performance intake gaskets that utilize a solid core with a fiber facing on each side. This solid core is good for high vacuum engines where the gasket can sometimes be pulled into the port if it is just a fiber gasket material. Here is an example of an intake gasket for a small block Chevy with a Siamese port, the thin wall between ports can be sucked in if no core is present. The one benefit of an intake gasket without a core is the ability to easily trim it to port match the intake and head. A simple razor blade will trim to the size required.



Exhaust Gaskets

Performance exhaust gaskets are made to handle high temps and flange motion seen on performance engines. Most performance exhausts systems use headers which are much lighter and less rigid than a cast iron piece. Since the headers are less rigid there is more chance for warpage from the heat cycles. The cylinder head and header are different materials, so the expansion and contraction rates are different causing the header to move or slide on the gasket. Performance exhaust gaskets are designed with these issues in mind and utilize a high-density fiber material on a perforated steel core that bites into the fiber and locks it in place. The fiber material is also coated to allow the header to slide on the gasket without tearing off the fiber that is mechanically attached to the core.



Valve Cover Gaskets

Performance valve cover gaskets like most HP gaskets uses a steel core for rigidity. Like intake gaskets the high vacuum performance engines like a big block Chevy. With the core in place the gasket will resist being sucked in or blown out. Many performance valve cover gaskets are made thicker than normal to add much needed clearance for aftermarket valvetrains.

While performance gaskets don't look all that different from traditional OEM or aftermarket gaskets. They are designed for the specific environment of performance engines and should be utilized for such engines to ensure that the labor time and parts costs are not compromised by a gasket not designed for the environment.■

Brian Roberts
AERA Technical Specialist
815-526-7347 • brian@aera.org

Images from: Fel-Pro Gaskets, SCE Gaskets, Elring Klinger AG, Dana Incorporated.