Intake manifold gaskets have come a long way over the decades from simple paper/fiber type gaskets to the modern rubber and MLS variety. Understanding the requirements of these technologies will help improve your success in sealing. Early vehicles utilized felt gaskets to seal the engine. This was an improvement for its time but lacked serious sealing capabilities. Next came the fiber based gaskets commonly known as paper gaskets. These are not just paper, they are specially blended fibers and binders for oil, coolant and fuel environments. These gaskets worked well in engines for decades with some enhancements along the way like adding sealing beads printed on the gasket itself. This provided a localized sealing area with higher concentration of load where the printing was placed. This was done for applications where the gasket material itself was not enough to conform to the flanges to provide an adequate seal. Other enhancements were the addition of a solid core with fiber material mechanically or chemically attached on each side. This core provided a rigid frame to better withstand pressure like between Siamese intake ports where the fiber blend by itself would tend to get sucked into the port. The solid core also provides reduction in torque loss from gasket material relaxation.

Sealers

Most all fiber products do not require the use of additional sealers. Using these sealers like RTV on fiber products can causes issues. The extra material can cause the fiber to shift out of position like a watermelon seed squeezed between your fingers. It can also damage the material if too much is added in specific places that over compress the material and split it causing a potential leak. Unless specified do not use sealers with this material. Spray tac is fine to hold a gasket in place for assembly but avoid RTV for that purpose.

Modern Intake Gaskets – Rubber (Elastomers)

Today’s engines use more sophisticated materials to help improve emissions and last through manufacturer’s warranty periods. Material like molded rubber and MLS (Multi-Layered Steel) are common. For plastic intake manifolds, the common seal is a PIP (Press In Place) molded rubber gasket. This pre-formed piece is pressed into a channel in the manifold and provides a seal the can accommodate some minor non-parallel surfaces and or manifold warpage. Early plastic manifolds had warpage issues that the OE’s have since addressed. Not all rubber is created equal, each compound has specific properties that help seal, oil, coolant or Fuel. Some lower cost manufacturers off shore use high amounts of filler that increases compression set. Compression set is percent of “Set” rubber has after being compressed and heat aged over time. Lab tests are done to simulate this value. The seal should not lose more than 25% of its original height.

Example: A rubber seal measures .080” high pre-test. After testing the height or “Set” should not be below .060” tall or 25% of the original .080” height. Higher than 25% compression set reduces the seals ability to maintain proper load amounts needed to seal and compensate for flange motion. The lower cost gasket might be affordable but like they say. You get what you pay for.
Modern Engine Intake Gaskets – MLS & RCM
The newest intake manifold gasket materials used today are MLS (Multi-Layered Steel) or RCM (Rubber Coated Metal) much like head gaskets, MLS material is multiple (Usually 2 Layers) of rubber coated metal. The rubber chemically attached to the metal is very thin. Rubber coating thickness is usually around .001”. This thin rubber coating requires surface finishes that are smooth. Too rough a surface finish will not allow the coating to fill in all the peaks and valley’s leading to leak paths. RCM (Rubber Coated Metal) is a single layer gasket and is sometime used on intake manifold application. Both RCM & MLS have surface finish requirements that need to be followed for successful sealing. See surface finish recommendations below. Sealers should not be used with MLS or RCM gaskets and only as directed for rubber gaskets.

SURFACE ROUGHNESS
(All values are in microinch - μin)
Ra is average roughness height / Rz is average peak-to-valley roughness height(3)
• Intake or Exhaust Manifolds (Cast Iron or Aluminum)
  Maximum: 60 Ra (360 Rz)
  Minimum: 30 Ra (180 Rz)

Intake Manifold Machining for “V” Engines
The AERA Technical Committee offers the following information to consider for maintaining correct mating angles and alignment on “V” style engines. Refer to this intake manifold and cylinder head machining formula to maintain proper alignment. After machining surface “A” on most V style cylinder heads, it becomes necessary to matching the intake manifold side of the head or the intake manifold surface “B” as shown in Figure 1.

If the head is machined and more than .010” is removed, the bolt holes in the intake manifold and head may not line up when reassembled. To correct this condition, remove material from surface “B” of the head or intake manifold. The amount to be removed varies with the degree at which the head is machined. The chart below shows the amount to be removed from the intake side of the cylinder head so the holes line up.

HEAD ANGLE IN DEGREES (To Reach 90°)

<table>
<thead>
<tr>
<th>Angle</th>
<th>Formula</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°</td>
<td>Amount Removed at “A” x 1.1</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>10°</td>
<td>Amount Removed at “A” x 1.2</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>15°</td>
<td>Amount Removed at “A” x 1.4</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>20°</td>
<td>Amount Removed at “A” x 1.7</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>25°</td>
<td>Amount Removed at “A” x 2.0</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>30°</td>
<td>Amount Removed at “A” x 3.0</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>35°</td>
<td>Amount Removed at “A” x 4.0</td>
<td>Amount to be removed at “B”</td>
</tr>
<tr>
<td>40°</td>
<td>Amount Removed at “A” x 8.0</td>
<td>Amount to be removed at “B”</td>
</tr>
</tbody>
</table>

For example: Let’s assume .015” was removed from surface “A” on a small block 90° Chevy V-8 style head. Surface “B” (Fig. 1) as shown above is at 10° angle to surface “A”. Using the formula above proceed as follows:

.015” x 1.2 = .018” the amount to be removed on the intake side of both heads.

When resurfacing modern V style cylinder heads, where the intake manifold serves as the lifter valley cover, it is also necessary to remove material at “B & C”. To do so, use the formula for the correct angles and multiplier.

After these type cylinder heads and machined the center section of the intake manifold may contact the block “C” before it contacts the surface “B” of the head. To correct this condition material must be removed from the cylinder block or intake at “C” as shown in Figure 2.

The amount to be removed is determined in the following manner. Let’s assume .015” was removed from surface “A” 10°. Multiply that amount by 1.71 to determine the amount to be removed at “C”.

.015” x .171 = .02565 the amount to be removed from the block on surface “C” that is using 10° intake surface angle.

AERA Technical Specialist Brian Roberts has over 20 years of experience in the automotive aftermarket, including time at Federal-Mogul (Fel-Pro), Modern Silicone Technologies and Dana Corporation as a Product Engineer and Product Manager. He has a wealth of information in gasket development, production and distribution; in particular, the engine sealing process and solving problem applications. For more information, email: brian@aera.org.