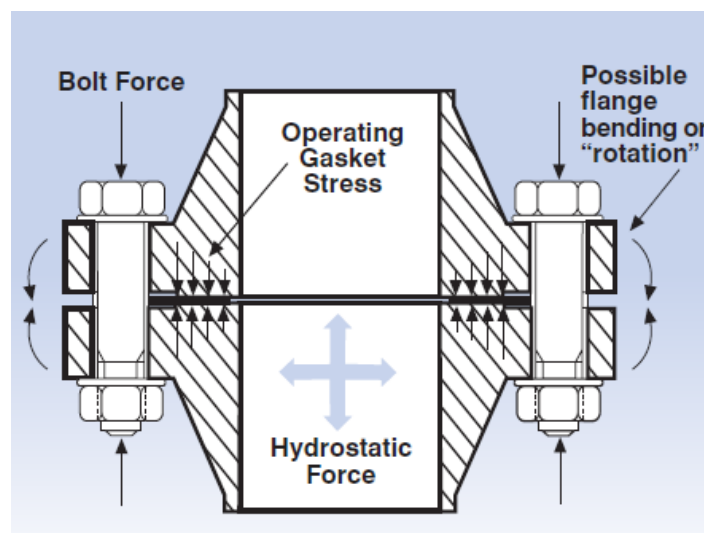


BASIC GASKET APPLICATION GUIDE & MATERIAL SELECTION



Application / Function

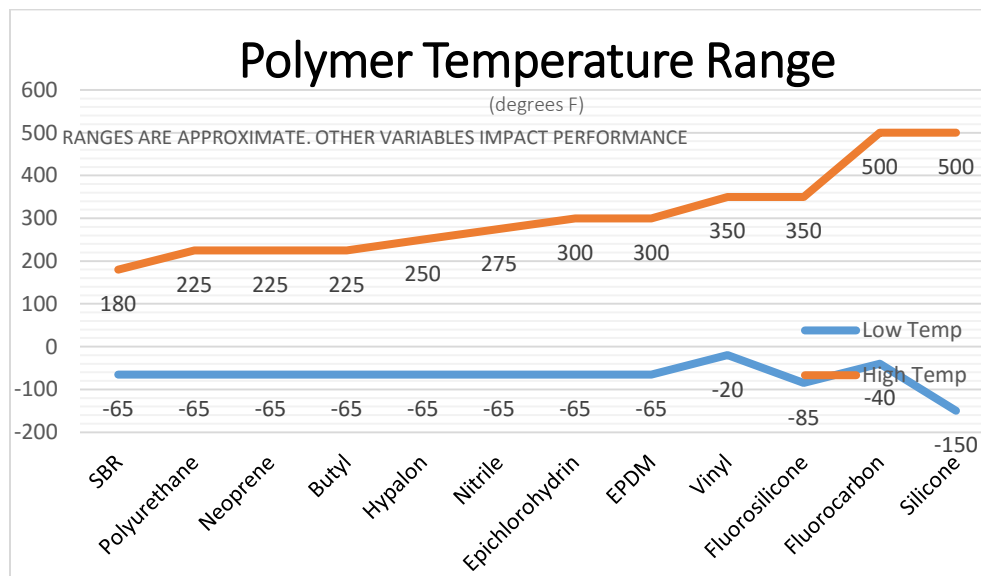
Because gaskets are generally low cost and appear to be simple, the criticality of their role in a device is often overlooked. They usually don't garner much attention until there is a problem with an application or if there are high maintenance cost to service the gasket. A gasket's main function is to provide a robust seal of a gas or a liquid throughout the life of the application. The gasket compensates for the imperfections between the mating surfaces to be sealed. This is done by utilizing external forces to compress the gasket material into the imperfections between the mating surfaces. If the perfect mating surfaces could be achieved and maintained through the life of the application there would be no need for a gasket.



A solid understanding of the application parameters will enable the gasket designer to optimize the gasket to insure a robust seal. Every gasket application is unique but there are common elements that must be addressed to optimize the understanding of what the gasket is up against in the application.

Temperature

This is the starting point for determining which material is optimum for the application. Temperature can alter the characteristics of the gasket such as the sealing properties, compression set and maximum allowable stress even if all of the mechanical elements of the joint are properly installed. It is important to take into consideration both internal and external temperatures. Gaskets that are exposed direct sunlight can see internal temperatures to over 140°F. Gaskets that are exposed to freezing temperatures can crack and become stiff or brittle. Gaskets that experience cycling for cold to warm will exhibit higher compression set. Determining the temperature range of the application is essential in the proper selection of a gasket.



There are many materials that cover similar temperature ranges so more elements have to be taken into consideration.

Internal Pressure

As a system is pressurized, the joint can deform. Gasket materials are now being rated with a P x T factor that provides for max limits of temperature and pressure combined.

Media

The media is the fluid or gas to which the gasket will be exposed. Gas is generally harder to seal than a liquid. Once a material with an acceptable pressure/temperature range has been identified it is important to determine if it is compatible with media being sealed. Various chemicals impact the both the structural integrity and functional properties of the material. Chemical resistance of the gasket material is important because without it, the other properties of the gasket are irrelevant. It is also important to keep in mind the effect temperature has on chemical resistance. Temperature causes many fluids to become more aggressive. Therefore, a fluid that can be sealed at ambient temperature, may adversely affect the gasket at a higher temperature.



UV & Ozone

UV & Ozone exposure are potential causes of degradation in rubber gaskets. It is important to note that ozone does not just come from the atmosphere but can be generated in electrical enclosures that house high voltage electrical components. UV and ozone breakdown the carbon bonds in the backbone polymers. Drying, cracking, flaking, hardening and scaling are signs of degradation that can be symptomatic of UV or Ozone exposure. Organic rubber gaskets such as Buna-S (SBR), Buna-N (Nitrile), natural rubber, synthetic isoprene break down relatively quickly in UV exposure. Silicone and EPDM are two of the better UV resistant elastomer materials.

EMI / RFI Management Requirements

Manufactures of consumer, automotive, aerospace and industrial electronics are required to meet Federal EMI standards for their products. EMI (electromagnetic interference) is emitted by internal wires and components can act as emitting antennas. To control EMI radiation, electronic components are completely encased in a conductive enclosure. It is critical that the lid and enclosure have complete contact. To accomplish this a conductive gasket is required. EMI gaskets regularly perform EMI attenuation as well as environmental sealing.

Other Considerations

In certain applications such as drinking water or food environments, other mandates exist. For example, gasket materials may have to meet FDA compliance, NSF (National Sanitary Foundation), or WRAS (Water Regulations Advisory Scheme) which are approved for potable water.

There are other industry standards that often have to be met. Examples include UL (international safety), MIL spec (military), ASTM (American society for testing and materials), and AMS (aerospace material spec) and others.



Materials

Elastomers

Elastomers are one of the most common and affordable materials used in gaskets. They have a wide range of characteristics and are generally readily available. Click on the link below to assist in narrowing the search for the optimum elastomeric material for your application.

[GENERAL-PROPERTIES-OF-ELASTOMERS](#)

Plastics

Engineered plastics are also a very common material for gaskets. They also have a wide range of characteristics that can be found to assist in most types of applications. Click on the link below to assist in narrowing the search for the optimum plastic material for your application:

[GENERAL-PROPERTIES-OF-PLASTICS](#)

Cork

Cork is a lightweight, stable material that cannot be penetrated by water. It exhibits excellent compressibility, virtually no lateral flow and high oil resistance. It is resistant to wear and is unaffected by temperature extremes.

Cork & Rubber

This material is a combination of granulated cork and a synthetic rubber polymer. This gives the product the high resilience and flexibility of rubber along with the compressibility of cork. The rubber is added to provide the ability to seal and provide chemical compatibility while helping to resist fungus, acid and weather conditions. The ratio is usually 70% cork to 30% rubber binder. Cork rubber material is available in a wide variety of rubber options to best suit the chemical resistance requirement of the gasket.

Compressed Non-asbestos

Compressed non-asbestos materials combine non-asbestos fibers such as fiberglass and aramid fibers with rubber to enhance the temperature and pressure performance of the gasket. Combining inorganic and organic fibers with rubber and fiberglass allows for a range of variants that have different mechanical specifications. These compressed non-asbestos gaskets provide excellent ability to seal, torque retention, and heat resistance that eliminates the need for asbestos. In addition to compressed sheets, there are similar engineered composite materials often referred to as beater mix. As with compressed non-asbestos, these materials combine fibers, elastomers and other non-asbestos materials to make specialized gasket materials to meet precise application standards. There are numerous brands and models of compressed non-asbestos and beater mix materials. [COMPRESSED-SHEET](#)

Foam

Foam is made with a number of different components, which affect its performance. Examples include EPDM, polyester, polyurethane, PVC, silicone, melamine and others. Foam is generally measured by its density (in pounds). Foam is available in open or closed cell. This pertains to the cellular makeup of the material. Generally, open-cell foams are used for interior applications, acoustical applications and other light industrial applications. Closed-cell foam is a more common industrial gasket material with has more structural strength, heat resistance, UV resistance and stability.

Sponge

Sponge is generally made with one or more elastomers, using different manufacturing and curing procedures than with standard calendared elastomers. The composition of the elastomers used in the sponge affect its performance. Sponge is also available in open or closed-cell and generally has a more heavy duty use than foam.

Insulating materials

There are a number of materials used for their insulating characteristics in applications where electrical shielding, insulating, or other conductive issues are present. We commonly work with Nomex, Kapton and blends of the two materials to satisfy electrical insulating requirements. Other materials used in electrical applications include Copaco, Polyurethane foam, fiberglass, Teflon coated fiberglass, certain cork, and others.



Fibre gaskets

Fiber materials are available in a broad range of thicknesses, hardness, and colors. The materials most frequently used include:

Vegetable Fiber Gaskets

This is a treated cellulose fiber material impregnated with protein glue and a glycerin binder. It is commonly referred to as Detroit. It is strong, flexible, resists heavy pressure and is compressible. It is resistant to oils, water, alcohol, grease, air, gas, gasoline and other solvents and is temperature resistant up to 250°F. It is also available with cork granules.

Vulcanized Fiber Gaskets

This is a hard, durable, chemically pure cellulose product that contains no resin or bonding agents. It has superior flatness, high mechanical strength, and excellent resistance to heat and cold. It is light weight and has excellent tear resistance. Vulcanized fiber also has excellent electrical properties.

Fish Paper Gaskets (Electrical Grade)

The electrical grade of vulcanized fiber is referred to as fish paper. It exhibits excellent electrical insulating properties, is lightweight and non-magnetic. Fish paper is resistant to solvents, oils, grease, corrosion, wear and abrasion.

Cellulose Fiber / Synthetic or Nitrile Rubber Binder

This material is produced by the beater-addition process. It demonstrates good fluid resistance, mostly against cold and warm oils, fuels, water, and anti-freeze. It exhibits good dimensional stability and flexibility. The selection of styles we carry vary in characteristics such as density, swelling, fluid absorbency, and compressibility. It has a maximum temperature range of 350°F.

Felt

There are generally two categories of felt. Wool or wool blend felt and synthetic felt.

Wool or pressed felt is an economical material for gaskets. It is made by compressing layers of wool fiber into a specific density and thickness using heat, moisture and pressure. Key properties of felt include high liquid absorption capacity, a low coefficient of friction, excellent solvent resistance, stability in oil and excellent resilience. Felt is not affected by UV and maintains a constant sealing pressure regardless of wear or minor misalignment. They will not become brittle or disintegrate under normal operating conditions. Felt gasket material is available in a wide range of thicknesses, colors, styles and densities. Pressed felt is identified by the S.A.E. standards F-1 through F-55 and is available in various thicknesses, wool content, and densities. [S.A.E.-SPECIFICATION-PRESSED-WOOL-FELT-PRODUCTS](#)

Synthetic felt is generally made from polyester, polypropylene and aramid fiber. The benefit of synthetic felt is that it can be manufactured using different materials and patterns to meet desired specifications of weight, air flow and density.

Others

Please visit our full material list and contact us at any time to discuss your applications and our available materials that might fit your application.



Pressure Sensitive Adhesive (PSA)

PSA can be applied to many different materials and part configurations. PSA provides a way to cut costs and increase production rates by facilitating complex assembly processes. Proper positioning of a gasket or synthetic part during the assembly process is a common challenge. Parts with the appropriate PSA enable the gasket to be removed, adjusted and reapplied onto the correct location in the application. PSA applied parts are used extensively in the electronics, medical devices, automotive, computer, and mobile device markets. Most, if not all, materials are able to accept PSA if surface conditions and/or preparation can allow for PSA application with or without heat assist.

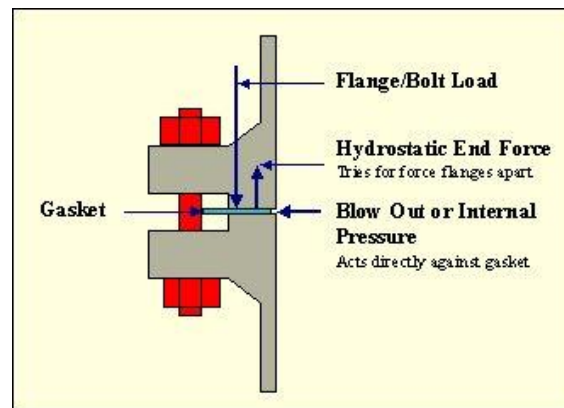
Although acrylic PSA accounts for the majority of pressure sensitive adhesives supplied on gaskets, rubber and silicone based adhesives are also available.

Adhesives	Advantages	Disadvantages
Rubber Based	<ul style="list-style-type: none">• Excellent tack and adhesion• Bonds well to most surfaces• Achieves ultimate adhesion quickly• Economically priced	<ul style="list-style-type: none">• Poor elevated temperature resistance• Fair chemical, U.V. and oxidation resistance• Difficult to reposition
Acrylic Based	<ul style="list-style-type: none">• Good temperature resistance• Good chemical, U.V. and oxidation resistance• Repositionable	<ul style="list-style-type: none">• Low initial bond strength, but builds over time• More expensive than rubber based
Silicone Based	<ul style="list-style-type: none">• Good elevated temperature resistance• Moderate chemical and oxidation resistance• Excellent U.V. resistance	<ul style="list-style-type: none">• More expensive than acrylic• Reasonable adhesion

Mechanical Elements

Clamp Load

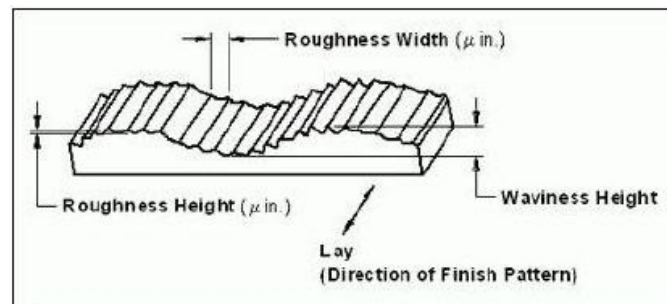
It is critical to determine the clamp load or seating pressure required to compress or seat the gasket so that it adequately compensates for the imperfections in the mating surfaces. Clamp load must be applied uniformly across the entire seating area and it must be enough to maintain the seating stress as the bolts or gasket materials relax due to temperature or pressure fluctuations. The number, size and grade of the bolts used in the joint determines the load available. The load on the contact area of the gasket determines the compressive load available to seat the gasket. Once this information is determined the choice of materials can be narrowed based on their compression limits, compression set, relaxation and creep characteristics.



Exceeding compression limits can crush or tear gaskets as well as burst cells in closed cell foams. Compression set in rubber materials is the measurement of how much a material does not rebound after being compressed for a period of time at a specific temperature. It loses its ability to return to its original thickness. It is important for applications that are subject to periodic compression and recompression such as covers, boxes, and enclosures. Compression set is expressed as a percentage. The lower the percentage, the better the material resists permanent deformation under a given deflection and temperature range. Stress relaxation is the material's ability to provide counter pressure. Over time polymers will relax and it will take less force to compress the material. Generally a material with a good compression set will exhibit good stress relaxation. Creep is the long term deformation of the material as a result of being under a constant load.

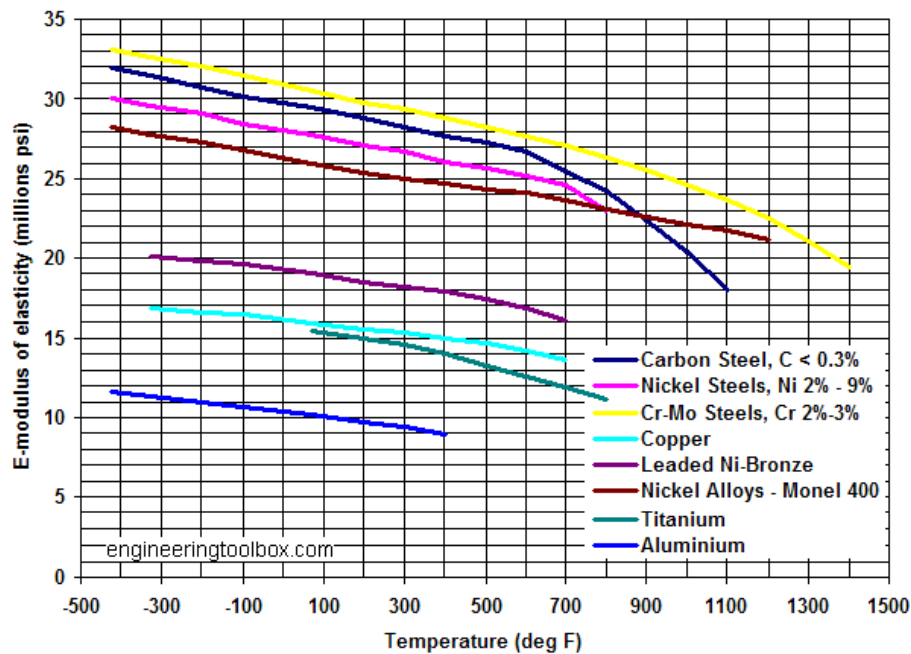
Surface Finish

The surface finish of the mating parts has a definite effect on the ability of the gasket to create a seal. Gasket thickness depends on the sealing surface finish and tolerances. Thicker gaskets handle more flange irregularity. Because they compress more they conform better to warped or corroded flanges by filling in the voids caused by the irregularities. The thicker the gasket the more it relaxes and the higher the creep/relaxation requiring the fasteners to be continually re-torqued to maintain the integrity of the sealed joint. Thinner gaskets are preferred because they have lower leak rates due to smaller surface areas. Smaller surface area also enables more resistance to pressure and the potential for gasket blowout. In addition, thinner gaskets maintain the tension in the joint better due to lower creep/relaxation characteristics. Gaskets with higher compressibility values will not require the same thickness as harder, less compressible types. It is recommended that metal surfaces be machined to a finish of 125-500 micro inches AARH, with 250 micro inches AARH being the optimum for non-metallic gaskets. Dissimilar mating surfaces should be avoided.



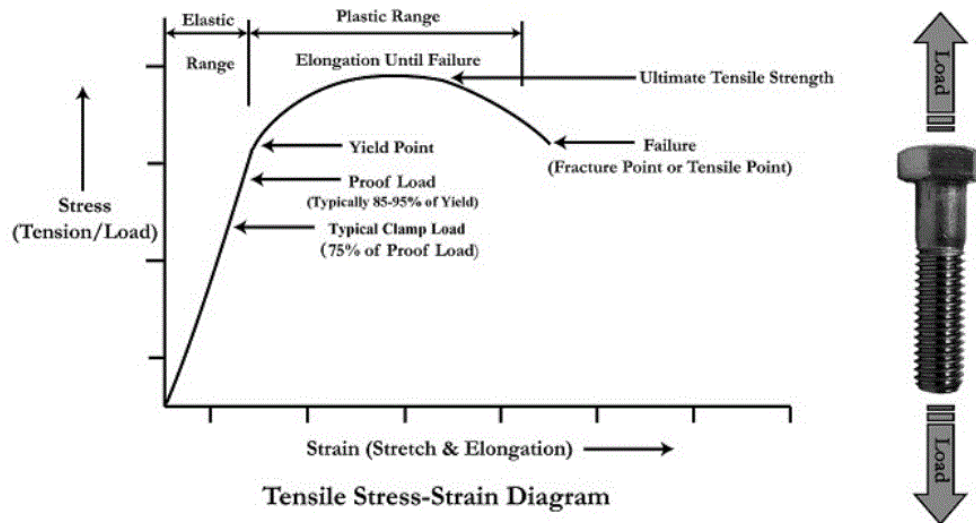
Flange Stiffness

The strength or stiffness is a function of the elastic modulus of the material. A higher elastic modulus will provide more stiffness and will generally allow the flange to more evenly distribute bolt load.



Bolts

Bolts can be looked at as springs that are stretched to develop a clamp load. The more a bolt is stretched the greater the seating stress on the gasket. Bolts should be of sufficient strength to achieve proper compression of the gasket, to not only seal the joint, but to maintain the seal without exceeding the yield strength of the bolts being used. The yield point is the point where the elastic limit of the bolt is exceeded and it no longer provides a clamp load.



Bolt grade, size and head style (bearing surface) impact the clamp load on the gasket. Things to consider when choosing bolt styles are:

- Higher grade bolts are less susceptible to creep relaxation
- Higher number of threads are less susceptible to creep relaxation
- Length and type of bolts affect creep relaxation
- The larger the bearing surface under the head the better clamp distribution

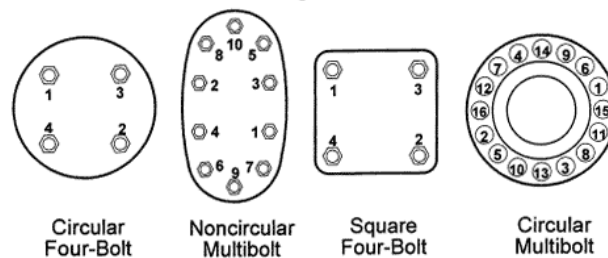
Installation Guidelines

Many joint leaks are caused by improperly installed gaskets. There are basic guidelines to be followed when installing a gasket.

- Be sure surface finish and flatness are satisfactory.
- Tighten the bolts to compress the gasket uniformly. This means going from side to side around the joint.
- Use a torque wrench, well-lubricated fasteners, and hardened flat washers to ensure correct initial loading.
- All bolts should be tightened in one-third increments, according to proper bolting patterns.
- Make a final check pass at the target torque value moving consecutively from bolt to bolt.
- Re-torque 12 to 24 hours after initial installation.
- Improper bolt placement or the incorrect number of bolts can cause material to blow out under internal pressure.

Correct Bolting Patterns

Figure 1



The information supplied in this document is intended only as a guide. Selecting the right gasket design and material is critical to the effective operation of a reliable joint. It involves taking into account a wide variety of application parameters. It is hoped that this guide has assisted the reader in developing a better understanding of those parameters and has provided assistance in determining gasket design and material options. Due to the number of variables involved in sealing a joint it is recommended that all gaskets be tested in the actual application.

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