# Choosing between the various types of gasket materials

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Many variables affect the selection of a gasket for a pipe flange, valve or pump. One is the particular style of gasket, another is the type or types of material used in the specified design.
Gaskets are produced from a wide array of materials including rubbers (elastomers), compressed fibres, polytetrafluoroethylene (PTFE), flexible graphite, micas and metals. Metals can also be combined with the above mentioned non-metallic materials to make a reinforced or semi-metallic gasket.
Each material, or combination of materials, offers specific properties to aid effective sealing under a given set of operating conditions. These include temperature, pressure and the media being sealed. The operating condition dictates which material will provide the best service in the application.
The choice can also be influenced by local and/or international regulations like fugitive emissions and other considerations such as fire safety and food contact.
So how do you choose which gasket type and/or material is best for your pump, valve or piping application?

## Design compatibility

The first factor to consider is the type of flange. There are conditions under which many of the gasket types listed above will seal adequately, but selection is restricted to only one or two because of the flange design. The possibilities with raised face and full face flanges are more universal compared with tongue and groove or spigot/recess type flanges. Ring type joint (RTJ) flanges have limited options.
The finish applied to the sealing surface, as well as field conditions should also help determine the selection of materials and designs. A rough surface finish (above $R_a$ = 6.3 µm) requires the use of a more conformable material to fill flange voids and imperfections. More rigid materials can be utilized in conjunction with smoother flange finishes. In general the most generic flange roughness is a roughness between $R_a$ 3.2 and 6.3 µm. In any case the design should be considered as the baseline for duplication or improvement.

## Flange design

Bolting and flange design vary from application to application and have a significant impact on the performance of the chosen gasket type in their flange assembly.
The bolt quantity, size, material grade that are used to apply the load to a gasket should be considered when selecting gasket materials. Less rigid flanges and/or flanges designed with minimal bolting will perform better with a non-metallic gasket due to its better conformability under low load. PTFE lined and plastic flanges for example have minimal bolting and this results in low gasket seating stresses. On the other hand, tongue and groove flanges can apply very high gasket stresses which could result in damaging gasket materials *that are not designed for extreme loads*. Minimum, effective and maximum stress calculations should be performed to determine the gaskets suitability for the application. The maximum load for non-metallic gasket materials is dependent on gasket width and thickness too. Gasket manufacturers can provide information regarding these values for a specific material to aid in the decision making process. With this information flange calculations according to the required design regulations such as ASME VIII and EN-13445 can be performed using EN-1591 for example.

## Pressure and temperature

Piping systems, heat exchangers, valves and other equipment can operate at a very high temperature and/or pressure. Introducing elevated temperatures will increase creep and creep relaxation of materials and the maximum allowable seating stress will also decrease with higher temperatures. This will have a big influence on the use of soft materials. High pressures require more bolt load to contain the media which leads to higher surface stresses.
Elevated temperatures and increased pressures have mixed degrading effects on sealing materials depending on the material type and design. These negative effects increase exponentially when both conditions are present simultaneously. Most gasket manufacturer recommendations are based on collective consideration of all variables. However, those who ultimately specify the material for service should use these recommendations as guidelines and make decisions based on experience and safety factor requirements.

## Chemical Resistance

The nature of the media being sealed is another important factor in gasket selection whether gas or liquid. The gasket material must also be as chemically resistant to the medium to ensure the gasket will perform successfully for the duration of its commission.
There are many resources available to determine chemical resistance of a selected material and whether it is compatible with a given process. However, these recommendations are usually very general and do not take into consideration factors that can impact the level of compatibility such as temperature, pressure and gasket exposure in a flanged application. For some materials the seating stress of the gasket is important to create a dense enough material to prevent the media penetrating into the sealing material.
Final selection is best made when based on application history, available chemical compatibility testing, or recommendations from the gasket manufacturers.

## Legislation/approvals

Due to local and international regulations, gaskets and gasket materials do sometimes need additional approvals for certain industries. For example materials for food, pharmaceutical or water applications must be approved by migration and/or extraction tests. Also in some countries gaskets must be certified for environmental legislations, such as the German clean air act (TA-Luft)

## Value versus cost

The total value of the gasket should be considered, rather than purchase price alone.
Purchase price is typically small when compared with cost of equipment, installation labour, down time due to gasket failure, or lack of equipment availability. The true value of any given gasket is best measured by its reliability in the intended application, not purchase price exclusively.

## Conclusion

There are many options to consider when selecting gasket materials and designs for bolted flange applications. Many of these factors are interdependent and effected or amplified by other variables.
In cases requiring an improvement over the existing design, materials and new designs are available from gasket manufacturers to solve specific problems. Gasket design and material choice have a significant effect on equipment reliability. Proper selection and specification require the designer to achieve a balance between the proper conditions, loading variables, and operating parameters to select a material and design that will give the best economic and/or technical solution.

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