

# What is the impact of flange finish on gasket performance?

By Jan Kasprzyk, ESA Member

While nonmetallic flanges such as glass and reinforced plastic are used for some services, most flanges are metal. Metallic flange surfaces can range from a rough casting to the smoothness produced by lapping. A critical and fundamental aspect of sealing is the level of friction between the flange and gasket surfaces. The roughness of the flange faces can have a dramatic effect on gasket creep relaxation, blow out resistance and bolted joint tightness. Depending on the type of gasket used in the connection, different flange surface finishes should be utilized to optimize gasket performance.

## EN 1092-1

The CEN accredited EN 1092-1 requires that the flange face has a specified roughness to ensure the compatibility of the surface with the gasket and a high quality seal. This article is intended to be consistent with this standard.

## Metallic gaskets

As a general rule, metal gaskets and those with less conformable metallic contact surfaces require a very smooth surface finish. Given the creep resistance and structural stability of most metal gaskets, the two mating surfaces can create a very tight, reliable seal. Alignment, parallelism and flange finish must be within specified limits to achieve an optimal result. Metal gaskets such as solid metal and corrugated designs offer very little forgiveness to flange finish or bolting and assembly deficiencies. A typical flange surface finish

recommendation for these types of metal-contact gaskets is 1,6- $\mu\text{m}$  Roughness average (Ra) or smoother.

## Nonmetallic gaskets

Soft gaskets – such as compressed fiber sheet, graphite, PTFE and rubber that are more compressible – can be more forgiving to misalignment and out-of-parallelism of the flange. However, these materials, to varying degrees, are more susceptible to creep relaxation and movement while under a load. The flange surface finish can play a critical role in the gasket's service life and long term reliability. A smooth surface finish will not create the necessary friction between these mating surfaces, making a nonmetallic gasket more susceptible to creep under load. This creep can translate to a loss in bolted joint tightness and potential leakage. A rougher surface finish is generally recommended for soft, non-metal reinforced materials to create the necessary friction for stability and tightness between the mating surfaces. A typical surface finish recommendation for these materials is Ra 3,2 to 12,5  $\mu\text{m}$ .

## Semi-Metallic gaskets

These gaskets are made by combining soft nonmetallic materials as fillers, facings or insertions with a metallic core or cover. These combinations include spiral wound, corrugated and jacketed designs. The combination of the tougher, more creep resistant metal with a more conformable facing or filler—such as PTFE and flexible graphite provides serious advantages, particularly in more severe services. For those with facing and spiral wound gaskets, a wider range of surface finishes can be tolerated such as Ra 3,2 to 6,3  $\mu\text{m}$ . For

metal jacketed gaskets with soft filler, Ra 1,6 to 3,2  $\mu\text{m}$  is generally preferred.

## Flange surface finish definition

Raised and flat flange facings are machined with grooves, which may be either phonographic or concentric. The facing finish is judged by visual or tactile comparison with Roughness Average (Ra) Standards. Ra, stated in microinches ( $\mu\text{in}$ ) or micrometers ( $\mu\text{m}$ ), is shown as an AARH or RMS. While AARH and RMS are different methods of calculation, they give comparable results and are often used interchangeably. The more common finishes are represented in Figure 1.

Normally the manufacturer furnishes the "Stock Finish" unless the purchaser specifies otherwise. As Figure 1 illustrates, the following are comparative flange surface finishes:

1. *Stock Finish*: This is a continuous spiral or phonographic groove. Suitable for practically all general service conditions, it is the most widely used of any flange surface finish. The Ra finish typically ranges from 3,2 to 6,3  $\mu\text{m}$ . This finish is suitable for gaskets that have a soft conformable face. Under compression,

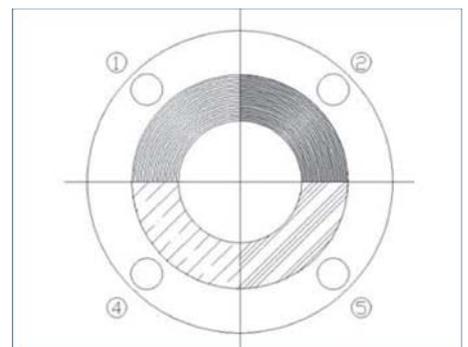


Figure 1. Comparative surface finishes

the soft face will embed into this finish, which helps create a seal, and a high level of friction is generated between the mating surfaces. The finish for these flanges is generated by a 1 mm or larger radius round nosed tool.

2. *Spiral Serrated*: This is also a continuous or phonographic spiral groove, but it differs from the stock finish in that the groove typically is generated using a 90 deg tool which creates a "V" geometry with 45 deg angled serration.

3. *Concentric Serrated* (Not depicted): As the name suggests, this finish is comprised of concentric grooves. A 90 deg tool is used and the serrations are spaced evenly across the face. This custom finish must be specified.

4. *Smooth Finish*: This finish shows no visually apparent tool markings. These finishes are typically utilized for gaskets with metal facings such as double jacketed, flat steel and corrugated metal. The smooth surfaces mate to create a seal and depend on the flatness of the opposing

faces to effect a seal. Ra finishes are typically smoother than 1,6  $\mu\text{m}$ .

5. *Lapped Finish (Cold Water Finish)*: Produced using a wide tool at high speeds, this finish is equivalent to a ground surface. It is mirror-like in appearance. Surfaces such as this are typically intended to be used without a gasket.

### Summary

Flange surface finish is a critical aspect of gasket performance. Metallic, semi-metallic

and nonmetallic gasket materials interact with flange surfaces differently. Each of these gasket types require specific ranges of surface finish for optimum gasket performance with lowest leakage and operational safety. Metallic gaskets require a smoother flange finish than either semi-metallic or nonmetallic. It is always best to consult with the gasket manufacturer to determine the best combination of flange surface finish, gasket design and gasket material(s).

The European Sealing Association (ESA) has produced this article as a guide towards Best Available Techniques for sealing systems and devices. These articles are published on a regular basis, as part of their commitment to users, contractors and OEM's, to help to find the best solutions for sealing challenges and to achieve maximum, safe performance during the lifetime of the seal. The ESA is the voice of the fluid sealing industry in Europe, collaborating closely with the Fluid Sealing Association (FSA) of the USA. This article is derived from an original article from our colleagues in the FSA, which first appeared as a Sealing Sense article in Pumps and Systems magazine. For more information, please visit [www.eurosealing.com](http://www.eurosealing.com)