MACER

Gasket and Sealing Technologies Pvt. Ltd.

Gaskets

at a Glance

Gasket and Sealing Technologies Pvt. Ltd.

Introduction

Gasket and Sealing Technologies Pvt. Ltd. is a leading manufacturer of precision-engineered gaskets, seals, and related products for diverse industrial applications. Our focus is on developing and delivering superior-quality products that offer excellent performance and reliability, helping our customers achieve optimal efficiency and productivity. Our flagship brand, Macer, represents our commitment to excellence and innovation in gasket manufacturing.

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About Us

At Gasket and Sealing Technologies Pvt. Ltd., we are a leading manufacturer of high-quality spiral wound gaskets,Kammprofile Gaskets, Jacketed Gaskets, Fibre Gaskets specializing in providing reliable sealing solutions for a wide range of industries. With our dedication to quality, innovation, and customer satisfaction, we have established ourselves as a trusted name in the gasket manufacturing industry. Our promoters have over 50 years of experience in this particular industry. Over the past 5 decades with our hard work and commitment we have served various industries in their sealing solutions. After understanding the industry and catching the emotions of the client we decided to launch our brand MACER with only one purpose in mind, we will provide quality products at the most affordable price.

We take pride in our ISO 9001:2015 certification, a testament to our unwavering dedication to quality management systems. This internationally recognized certification demonstrates our commitment to delivering exceptional products and services consistently.

Our Vision

Our vision is to be a world-class provider of sealing solutions, setting new standards for quality, performance, and customer service. We strive to continuously improve our products and processes, exceed customer expectations, and contribute to the success of our clients by delivering exceptional sealing solutions that ensure operational efficiency and reliability.

Our Mission

Our mission is to design, manufacture, and supply gaskets of superior quality, precision, and durability. We aim to be at the forefront of technological advancements in the gasket industry, constantly innovating and adapting to meet the evolving needs of our customers. Through our commitment to excellence, we aim to build long-lasting partnerships with our clients, providing them with the highest level of service and support.

MACER

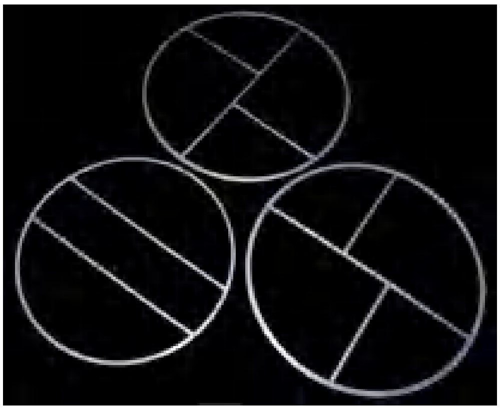
We are dedicated to :

- **Quality :** We adhere to stringent quality control measures throughout the manufacturing process to ensure that our gaskets meet the highest industry standards. We utilize advanced technologies and employ skilled professionals to deliver products of uncompromising quality.
- **Innovation :** We embrace innovation and invest in research and development to stay ahead of industry trends. By leveraging the latest technologies and materials, we continually improve our proucts to meet the ever-changing demands of our customers.
- **Customer Satisfaction :** Customer satisfaction is at the heart of everything we do. We prioritize understanding our customers' needs, providing personalized solutions, and delivering products on time, every time. We aim to build strong, long-term relationships with our clients based on trust, reliability, and mutual success.
- **Sustainability :** We are committed to conducting our business in an environmentally responsible manner. We strive to minimize our ecological footprint by implementing sustainable practices, reducing waste generation, and optimizing energy efficiency in our operations.

With our company, Gasket and Sealing Technologies Pvt. Ltd., and our brand, Macer, you can trust that you are partnering with a reputable and forward-thinking organization that is dedicated to providing exceptional sealing solutions. We look forward to serving you and contributing to your success with our high-quality gaskets

MACER® takes great pride in having achieved universal acceptance for providing gaskets used in sealing applications where extreme mechanical and thermal performance demands are considered routine.

There are many companies in the sealing industry. Very few can boast the quality of products, quality of service and quality of people found at ***MACER***®.



Introduction

For years, many different types of gasket have been used to seal bolted connections. Few people in industry give them much thought until problems arise. This document is intended to promote a clearer understanding of how gaskets work, and how to avoid common pitfalls in their use. Let us first define what a gasket is - imagine writing a technical dictionary and needing to define what a gasket is or does. One might simply suggest that it is something for sealing flanges on pipe-work or process equipment. The ***MACER***® definition should help the reader to picture how the gasket functions.

Thus the gasket has to react to the forces generated by the bolts, and therefore the work and energy imparted to the bolted joint becomes 'stored' within the gasket itself.Gaskets can be classified into three main categories:

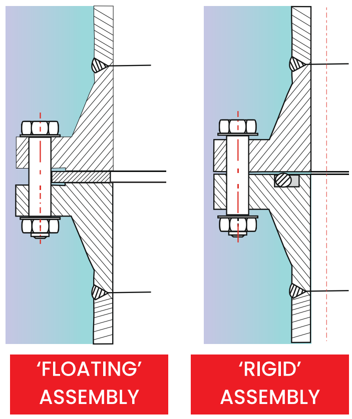
- **Non-Metallic**
  (Elastomers, Cork, Compressed Fibre, Graphite, PTFE etc.)
- **Semi-Metallic**
  (Spiral-Wound, Clad Joints, Kammprofile, etc.)
- **Metallic**
  (API Ring Joints, Lens Rings etc.)

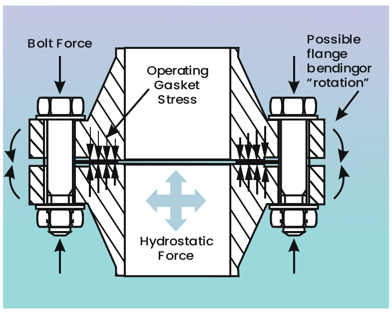
Each has its own advantages, and the semi-metallic & metallic will be described further in this manual. The maximum service conditions (operating pressure for example) for semi-metallic gaskets will be higher than for non-metallic, and fully metallic joints are likely to be used at even higher operating conditions.

"A device for sealing two surfaces, by storing energy between them."

Bolted Joint Assemblies

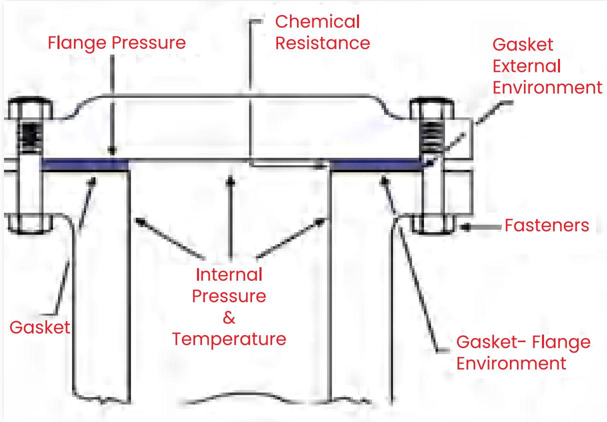
There are two main types of bolted joint assembly, which can be considered to be 'floating' and 'rigid' in their basic characteristics. A 'floating' assembly is one where there is no metal to metal contact after bolting the flanges. This would be the commonly encountered raised face flange having a fibre-based material gasket. Here, for an increase in system pressure a higher gasket stress would be required. However, with increasing bolt force the gasket undergoes greater compression.Additionally the bending moment on the flanges is increased, so that the bolts, flanges and gasket could all be considered to be 'spring elements' within the system (though the gasket is often a highly nonlinear element in its load-recovery behaviour). A 'rigid' assembly, is where metal to metal contact occurs after bolting. An example of a 'rigid' assembly can be illustrated by an O-ring in a recess. Once the flanges have achieved a metal-to-metal contact, then further tightening of the bolts against the system pressure has no further effect upon the sealing element. As an O-ring is self-energising, then the degree of sealing should be good, provided no extrusion gap exists between the flanges.





Forces Acting in a Bolted Joint Assembly

The initial boltload generated upon tightening is transferred to the gasket via the flanges. This initial seating stress compresses the gasket and tightens it within itself. The hydrostatic forcegenerated by the system pressure, tends to 'unload' and reduce the stress on the gasket.The stress remaining on the gasket is considered to be the 'operating' or'residual' stress. It is this degree of stress, or energy left in the joint that will determine the degree of tightness achieved in the system.It should be noted that on a raised face assembly such as the one shown here, there will be some deflection of the flanges themselves ('flange' 'rotation'). This is a function of the load applied, the flange material and the geometry of the flanges. Thus, the operational stress towards the outside edge of the gasket tends to be greater than on the inside edge. The mechanics concerning flange rotation are altered with flat-faced flanges. The overall contact area of a full-face joint can be typically twice as much as an inside bolt circle (IBC gasket).



Gasket **Behaviour**

Section 2

a Stress Relaxation

The stress relaxation performance or the stress retention property of a gasket is vital in maintaining the level of energy stored in the joint, which effects the seal. Relaxation can occur at the flange-gasket interface as well as within the gasket material itself. This characteristic is particularly relevant in relation to non-metallic sheet jointing materials, where there are internationally recognised test procedures for examining relaxation effects. These involve stressing the gasket to a pre-determined amount and subjecting it to elevated temperatures for a given time (16 hours at 3000C for example). At the end of the test the remaining stress level is measured, where materials giving the higher readings are generally considered to be more successful. Materials having a high rubber/ elastomer content for example, may be expected to relax significantly as the rubber/elastomer decays at temperature. It should be well noted that for fibre sheet jointing materials, that thick materials exhibit increased relaxation over thin ones. Thus, the thinnest gasket possible should always be used, and need only be sufficiently thick to take up any flange distortion and misalignment.

b Tensile Strength

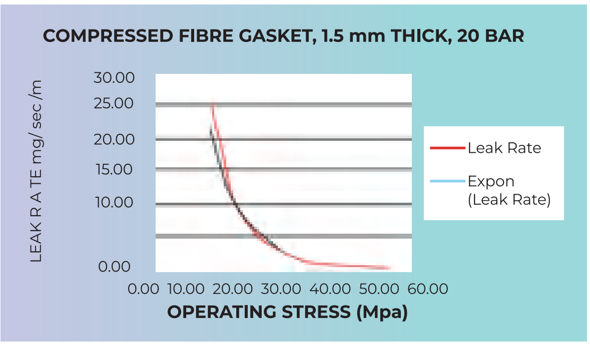
Tensile strength is not necessarily the most important function of a gasket material. Expanded graphite for example is relatively weak, though it performs very well as a gasket material, with a high degree of sealability in a wide range of media. If a gasket is adequately loaded on a flange with the correct surface finish, then the clamping forces resist the tendency for the joint to 'blow-out' at pressure. However, if the joint is relatively thick (i.e. with a significant area exposed to the system pressure) and inadequately compressed, then the internal pressure forces on the inside edge have to be resisted by the tensile strength of the gasket. Again, the thinner the gasket the less relaxation will occur internally as well as exposing less area to the system pressure that is trying to force the gasket from between the flanges.

c Effect of Flange Surface Finish

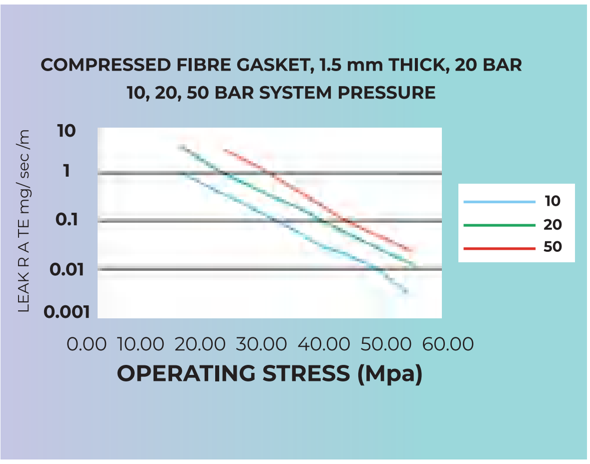
Normally, standard piping flanges are supplied with a light gramophone-finish groove across the gasket seating face (see following table for typical values) These values are suitable for non-metallic and semi-metallic gaskets, whereas values for metallic gaskets are specified within relevant international standards, e.g. API 6A for ring joint gaskets. This finish tends to 'grip' the gasket material and thereby limits the creep across the flange faces. Note that the surface finish should not be so rough as to allow a leak path under the gasket, where the gasket is unable to deform effectively to fill the gramophone groove. The use of pastes on the gasket surface may actually worsen sealing performance as these can fill-in the surface finish allowing stress relaxation to occur. Any flange damage (e.g. steam cutting, etc.) should be rectified before a joint is re-made. The spirally grooved, "gramophone" surface finishes as specified in common flange standards such as BS 1560, generally provide a good surface for most gasket types.These usually recommend that the flange faces be machined with a spiral groove in accordance with the table below. Individual attention should be given to applications involving searching gases or high vacuum sealing. As a general rule we prefer flange finishes of between 3.2 and 6.3μm Ra as being the recommended surface for use with spiral-wound gaskets, and 6.3 to 12.5μm Ra for compressed fibre materials, though both types should give acceptable performance over the complete range of finish shown. Note: Wherever possible, the mating flanges should be of the same material and machined identically. It is also important that the flange surfaces are flat, free of imperfections, and as far as practicable are parallel.

d Load-Sealability

It is a fact that all gaskets leak to varying degrees. For example, whilst an assembly may be built and hydro-tested successfully, if it were pressurised with helium for example and the flange encapsulated, it may be possible to detect a small mass-leak rate of the helium, after a period of time, using a mass-spectrometer. This leak-rate might otherwise be considered undetectable in general industrial terms, though the load-sealability tests that are conducted by gasket manufacturers and research bodies are invaluable when looking at critical sealing applications.



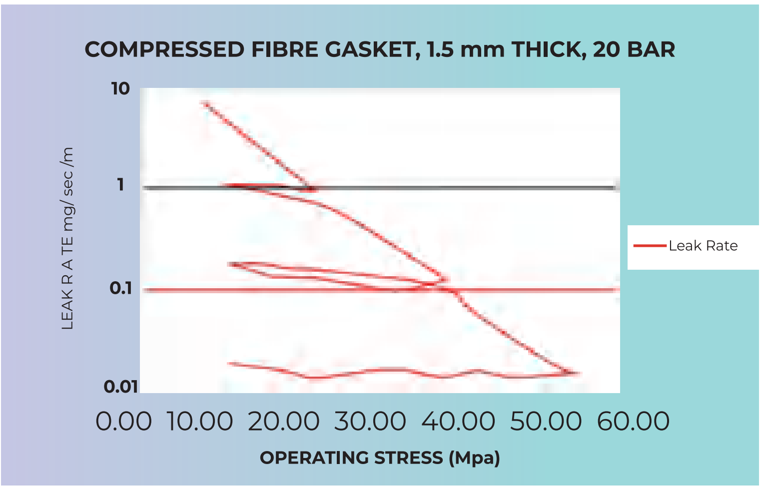
A curve of the load-compression characteristics will be very similar, again showing how the material densifies under increasing stress as any micro-porosity is closed within the material structure. The gasket becomes increasingly hard to compress with increasing applied stress. Most gasket sealing tests are done on a loading-unloading cycle to see the effects of leakage as the gasket stress is reduced (by the hydrostatic force for example), after being loaded to a higher value. It is usually better to create a log-linear plot of the load sealability results. If this is done, then a reasonably straight line is produced as per the example adjacent:



Method of Machining	Approximate Depth of Serration	Approximate Radius of Tools Nose	Approximate Pitch of Serration	Rz	µm	Ra	µm
				min	max	min	max
Turning	0.05 mm	1.6 mm	0.8 mm	12.5	50	3.2	12.5
Other than turnin				12.5	25	3.2	6.3

We must assume that in the free, uncompressed state, that a non-metallic gasket may have some internal porosity, as when manufactured, the material may not be perfectly homogenous. Thus, any micro porosity holes in the structure will allow leakage until the applied seating stress causes them to close.

As the gasket densifies under load, such porosity becomes increasingly less and the joint continues to tighten becoming progressively more dense.Therefore, a load leakage test on a gasket will tend to produce an exponential-decay curve format thus.



Note from this graph that as the gasket densifies, then the slope of the data lines changes. Thus, the sealing properties are quite complex, depending upon the initial and operational stress levels that are likely to occur in service. Note that flange rotation effects will further complicate the theoretical stress levels upon the gasket element.

For a given operating stress on a gasket, the leak-rate will increase with increasing system pressure, as indicated in the graph adjacent:

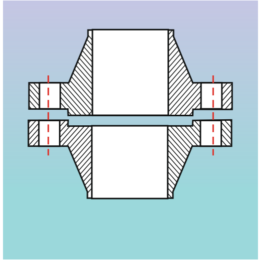
Similarly, for a sheet gasket material, the leak-rate increases with material thickness, roughly in a proportional manner, (i.e. double the gasket thickness produces double the leak rate).

Flange Types & Standards

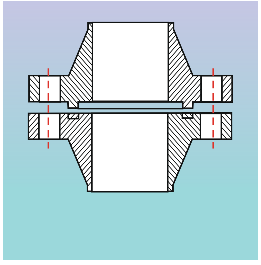
Flange standards

There are many common flange standards available, though perhaps the most widely used are ASME, DIN and BS. There are of course a large number of other national standards in all countries around the world, though many have their origins in the ASME or DIN series flanges.

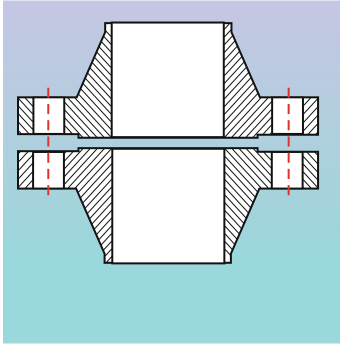
There are a wide variety of flange styles, configurations and applicable standards as shown herewith, though in general industry the raised face flange is perhaps the most common type regularly employed.



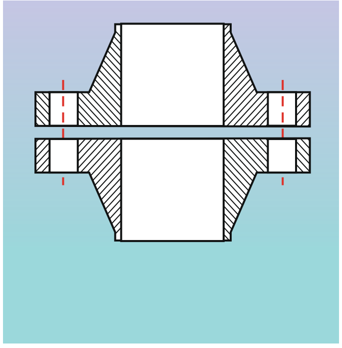
RAISED FACE



MALE & FEMALE



FLAT FACE



SPIGOT & RECESS

a ASME

The ASME B16.5 flanges are in widespread use all around the world on power stations, refineries, chemical plants and most other major industrial facilities. This standard covers flanges from 1/2" to 24" nominal bore, which are classified in pressure ratings in pounds per square inch (p.s.i.), such as classes 150, 300, 600, 900, 1500, and 2500. Note that these are pressure ratings at elevated temperatures, as for example a class 150 flange is rated to 290 p.s.i. (20 bar) at ambient.

Large diameter ASME flanges (above 24" and up to 60" N.B.) are covered by the ASME B16.47 standard. This has two main categories - Series A and Series B. The Series A covers flanges formerly known as MSS-SP44 (Manufacturers Standardization Society) whereas Series B covers those from API 605 (American Petroleum Institute), which tend to be more compact. There are other large diameter flange standards such as the Taylor Forge classes 175 and 350, as well as the American Water Works Association (AWWA) flanges.

Heat exchangers are commonly produced having male & female flanges of class 150, 300, or 600 etc., but manufactured to TEMA (Tubular Equipment Manufacturers Association) dimensions

b DIN

By comparison to the ASME flanges, the DIN series are rated with PN numbers which indicate the nominal pressure rating in bar. These for example are PN 6, PN10, PN16, PN25, and PN 40 where, unlike the ASME flanges, the pressure ratings relate to ambient temperature. This metric series of flanges are now covered by pan European standards such as EN1092, for these PN rated flanges.

c BS

The BS10 flange standard is rarely used, though of course many of these flanges still remain in service at a large number of industrial sites. These flanges are classified by a letter system, for example Table E, Table H, Table J etc. in increasing order of service pressure rating.

d Relevant Gasket Standards

For ASME flanges, then cut gaskets from non-metallic sheet materials, are covered by ASME B16.21 or BS EN 12560 part 1 (formerly BS7076 pt.1). Spiral wound joints for these are made in accordance with ASME B16.20 (formerly to API 601), or to BS 3381 or BS EN 12560 part 2. The ASME B16.20 standard also covers metal jacketed gaskets and API ring joints. For DIN series flanges, gaskets are cut from sheet materials in accordance with EN 1514 part 1, with spiral wound joints being made to EN 1514 part 2. The BS EN 12560 and BS EN 1514 have additional sections covering other gasket types such as PTFE envelopes and corrugated metallic gaskets in parts 3 and 4 respectively. As for BS 10 flanges, the cut gasket dimensions are given in BS 3063. In terms of gasket material testing standards, then compressed sheet materials are often tested in accordance with standards such as BS 7531 , or DI N 3535 and ASTM F36, where these standards require testing of material properties such as stress relaxation, compression, recovery and gas permeability amongst others.

Gasket Types

a Semi-Metallic

Combination of non-metallic filler for compressibility and metal for strength, resilience and chemical resistance. Used typically at higher temperatures and pressures than non-metallic types.

Spiral-Wound

The *MACER*® range of spiral-wound gaskets are widely used on high pressure joints throughout industry world-wide. These are generally used for higher temperatures and pressures. A variety of metals are available for the winding strip as well as for the support rings. The standard pipeline gaskets are nominally 4.5 mm thick and compressed to a working thickness of 3.2/3.45 mm.

At large diameters (typically over 1.2 metres) then a thicker gasket of 7.3mm thickness is generally used. On raised face flanges, the gaskets have an outer support ring which locates inside the bolt PCD, and they can also be supplied with an inner ring. These are usually for the higher pressure systems, or processes having high flow rates or abrasive media, as the inner ring reduces turbulence at the pipe bore.

On spigot / recess flanges a simple sealing element gasket is usually used with no additional support rings, and the flanges are dimensioned to achieve the .correct gasket compression when metal to metal contact is reached. In these cases the gaskets should be designed having the correct inner and outer clearances for the recess used.

Metal Jacketed

Single and double-jacketed metal clad gaskets have mostly been traditionally used as heat exchanger gaskets. Metals such as soft iron, carbon steel and stainless are used to encase a soft filler material, usually a non asbestos millboard. It should be noted that some heat exchanger flanges have stress raising 'nubbins' on one face, and the non seamed side of a double jacketed gasket is intended to go against this face, so it is important that the joint is fitted the correct way around in the assembly

Kammprofiles

The *MACER*® gasket type is generally a solid metal ring having a serrated tooth form profile on each side. A covering layer of graphite or PTFE is applied, which becomes compressed into the serrated surface when the gasket is loaded. These gaskets have a good level of sealing tightness and are frequently used to replace metal-jacketed joints on heat exchangers. They can also be provided with a slot-leg locating ring as a 'Multi-Fit' design (see Page 35), to reduce stores inventory.

b Metallic

Manufactured from one metal or a combination of metals in a variety of shapes and sizes for high temperature or pressure use. Due to the high pressures involved, the seating stresses are necessarily large to give sufficient gasket deformation to overcome any flange surface imperfections and to overcome the high system pressure forces.

Oval & Octagonal

These are commonly used on oilfield applications, and details of these joints are given in well recognised standards ASME B 16.20 and API 6A. The gaskets sit in a recess in the flange face, which has 230 angled walls. Some stand-off exists between the flanges, though PTFE inner spacers can be supplied to reduce the effects of erosion and the build-up of dirt on the flange face inside the gasket. Similarly, sponge rubber protectors are sometimes used to keep the area clean outboard of the gaskets and around the bolts. For hydro testing purposes, rubber-covered ring joint gaskets are available, to avoid damaging the flange recesses.

RX & BX

The RX joints are an unequal bevel octagonal ring, and are considered to be a pressure-energised or pressure-assisted seal. The BX is also octagonal, though shorter in profile and designed to go into a recess that comes metal-to-metal when the flanges are tightened. These are used on very high pressure flanges up to 20,000 p.s.i. rating.

Semi-Metallic Gaskets

Gaskets can be manufactured in accordance with all relevant gasket standards to suit the following designations :

- ASME B16.5
- BS 1560
- BS 10
- ASME B16.47 SERIES B (API 605)
- ASME B16.47 SERIES A (MSS-SP 44)
- BSEN 1092 (BS 4504)
- DIN FLANGES
- JIS FLANGES
- FRENCH NF STANDARD

Introduction

Semi-metallic gaskets are widely used on the following services :

Steam

- boiler handhole, tubecap and manhole assemblies
- steam and feed water pipe flanges
- feed water heaters
- valve bonnets
- autoclaves

Steam

- catalytic cracking plant
- vessel closures
- platformers
- line flanges
- heat exchangers
- valve bodies

Marine

- boilers
- de-aerators
- economisers
- main feed pumps
- main steam lines
- LP and HP feed .
- air ejectors
- water heaters
- diesel engines

Nuclear

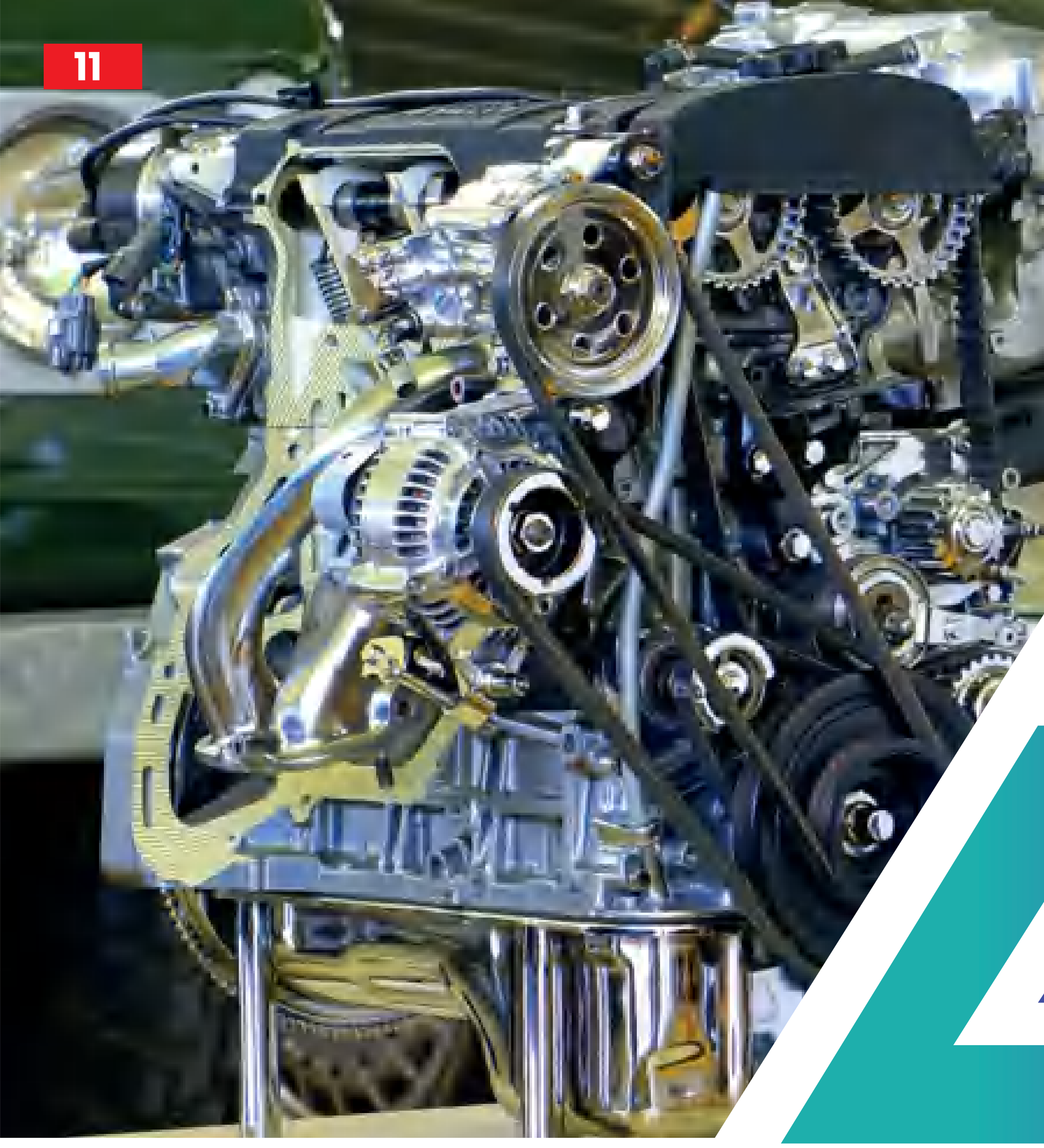
- cooling circuit flange (helium and carbon dioxide)
- high temperature gas lines
- pressure vessels
- valves

Hydraulic

- high pressure line flanges
- pump and valve bodies

Flange standards

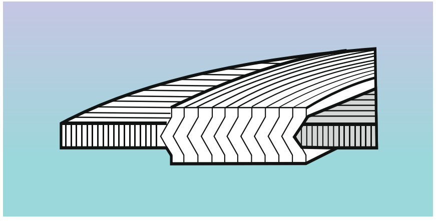
N.B. Gaskets for non standard flanges are also readily available

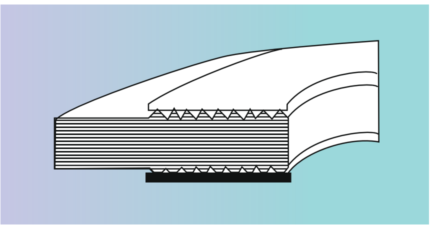


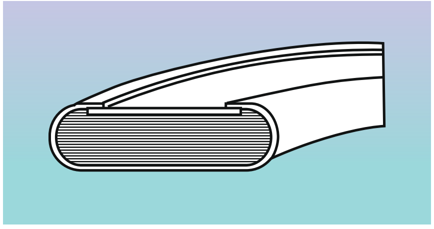
MACER® **Spiral Wound Gaskets**

MACER® **Kammprofiles Gaskets**

Metal Jacketed Gaskets







MACER®
Spiral wound gaskets

MACER® Gaskets are manufactured from V-shaped metal strips, spirally wound with an inlay of filler between each turn. At the start and conclusion of the spiral form, several continuous turns of the metallic windings are securely welded together.

The construction is capable of infinite variety as the number of metal plies in relation to filler plies can be increased or decreased. The metal and filler material can be varied to suit practically any service conditions.

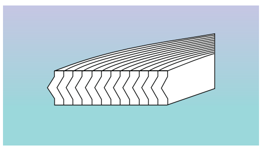
The use of steel supporting rings on the inside or outside of the spiral wound portion (or both) permits the application of ***MACER***® to be extended to flat or raised face flanges under high pressure lines.

Features

MACER® Gaskets are manufactured from V-shaped metal strips, spirally wound with an inlay of filler between each turn. At the start and conclusion of the spiral form, several continuous turns of the metallic windings are securely welded together.

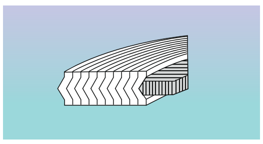
- Available in materials capable of withstanding temperatures from the cryogenic range to at least 1000^0 C
- Can, in standard form , seal pressures up to 350 bar. Higher pressures can be considered on request.
- Maintain a seal under conditions of thermal cycling or vibration.
- Resist corrosion and leave flange faces clean
- Do not require ground or lapped flange clean.
- Are quick to fit and remove
- Can often be used on bowed or pitted flanges.
- Offer good performance on difficult dry gas or high vacuum applications.

Gasket profiles



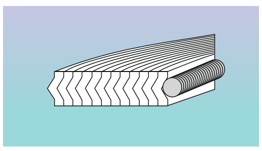
Type C

Basic construction style. Suitable fortongue and groove, male and female or flat face and recess flanges.



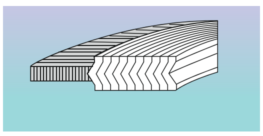
Type C/IR

Identical to the Type C but fitted with the protective inner ring which gives high pressure and temperature capabilities with improved sealing performance. Used on male and female flanges.



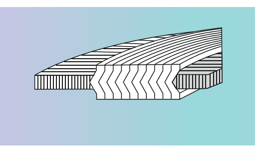
Type H and H/IW

In appearance these are identical to Type C but specifically designed for the sealing of manholes, hand holes, tubecaps and plugs in boilers and vessels. They can be produced in a wide variety of shapes, the most common being circular, obround, square, oval and diamond. The H/IW incorporates a stainless steel wire on the inner surface which protects in the inner windings and reduces the risk of extrusion under compression.



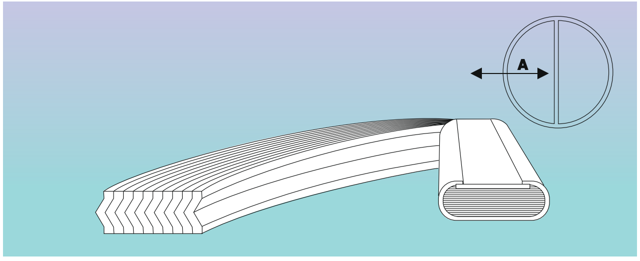
Type SG

As Type C but fitted with an external ring which accurately centralises the sealing element. In addition the ring provides extra radial strength and acts as a compression stop. Generally used on raised face and flat face flanges.



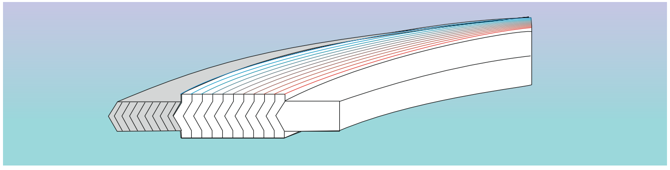
Type SG/IR

Identical to the Type SG but also fitted with an inner ring to prevent damage to the gasket bore and inner windings. It also acts as a heat shield and corrosion barrier and improves recovery characteristics and sealing performance.



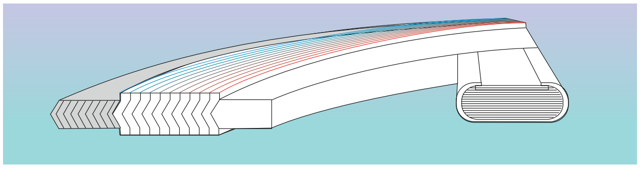
Type TE

This type is identical to the Type C but is fitted with pass-partition bars for use on heat exchangers and vessels. The bars are usually manufactured metal-jacketed gaskets but can also be solid metal faced with graphite, PTFE or soft jointing material.



Type WG and WG/IR

Designed to suit the relatively narrow seating space on many heat exchangers by utilising a spirally wound steel centring ring instead of a solid ring. WG/IR has a solid inner ring.



Type WG /TE and WG/IR/TE

Identical to the WG profile but fitted with partition bars.
WG/IR/TE has an inner ring.

***whilst we do not generally recommend above 3550mm, we have supplied type SG/IR in excess of 5 metres diameter.**

MACER® manufacturing parameters

The standard ***MACER***® Type SG and SG/IR gaskets are produced with a sealing element thickness of 4.5mm and 3.0mm centring ring/inner rings. However, virtually all types are available in a variety of thicknesses from 2.5mm to 7.3mm nominal. The following tables specify the various nominal and corresponding recommended compressed thicknesses together with maximum and minimum diameters for each thickness

SIZES NOMINAL THICKNESS	MINIMUM DIAMETER	MAXIMUM DIAMETER
2.5mm (0.098”)	10mm (3/8”)	300mm (12”)
3.2mm (0.125”)	10mm (3/8”)	760mm (30”)
4.5 (0.175”)	10mm (3/8”)	1520mm (60”)
7.3mm (0.285”)	60mm (2.3/8”)	3550mm (140”)*

MACER® gasket compression

MACER® gaskets must be compressed by a specific degree if maximum service potential is to be realised.

NOMINAL THICKNESS	COMPRESSED THICKNESS THICKNESS
2.5mm (0.098”)	1.9/2.1mm (0.075/0.083”)
3.2mm (0.125”)	2.4/2.6mm (0.095/0.105”)
4.5 (0.175”)	3.2/3.45mm (0.125/0.135”)
7.3mm (0.285”)	5.00/5.25mm (0.197/0.207”)

Note : Due to the compression characteristics of PTFE, full compression may not always be achieved. If flange face contact is essential then special clearances can be considered.

MACER® materials

METAL WINDING STRIP	FILLER MATERIAL		TEMPERATURE LIMITS
304	STANDARD PURITY GRAPHITE 'SPG'		500 C (Oxidising conditions)
304L	(98% MIN. PURITY)		600 C (Inert/reducing media)
316	HIGH PURITY GRAPHITE 'HPG')		650 C (Steam)
316L	(99.7% MIN. PURITY		
320			
310	COMPRESSED NON-ASBESTOS		500 C
321	FIBRE 'XA'		
347			
17-7 PH	PTFE 260 C		
ALLOY 20			
MONEL 400 & K500	HIGH TEMPERATURE FILLER 'HTF'		1000 C
NICKEL200 INCONEL 600, 625 & 750	INNER & OUTER RING MATERIAL		
INCOLOY 800 & 825	CARBON STEEL*	310	TITANIUM
TITANIUM	304	321	HASTELLOY B2 & C726
HASTELLOY B2 & C276	304L	MONEL 400	COPPER
COPPER	316	NICKEL 200	ZIRCONIUM
ZIRCONIUM	316L	INCONEL 600, 625 & X-750	DUPLEX
DUPLEX	320	INCOLOY PTFE 800 & 825	(INNER RINGS ONLY)

The most widely used material for winding metal is SS 316L and is usually used with carbon steel or stainless steel flanges. The standard inner ring material is also SS 316L. It is normal practice for the inner ring and windings to be the same as, or compatible with, the flange metal. This practice prevents corrosion and differential expansion problems. For very high temperatures or highly corrosive applications, alternative materials may be chosen for both windings and inner rings. PTFE inner rings can be supplied for highly corrosive media.As standard, the centring rings are supplied in carbon steel with an anti corrosion coating/treatment primarily to prevent corrosion in storage. The use of stainless steel for centring rings is quite common where the external flange environment conditions are corrosive to carbon steel, or temperature conditions prohibit the use of carbon steel.

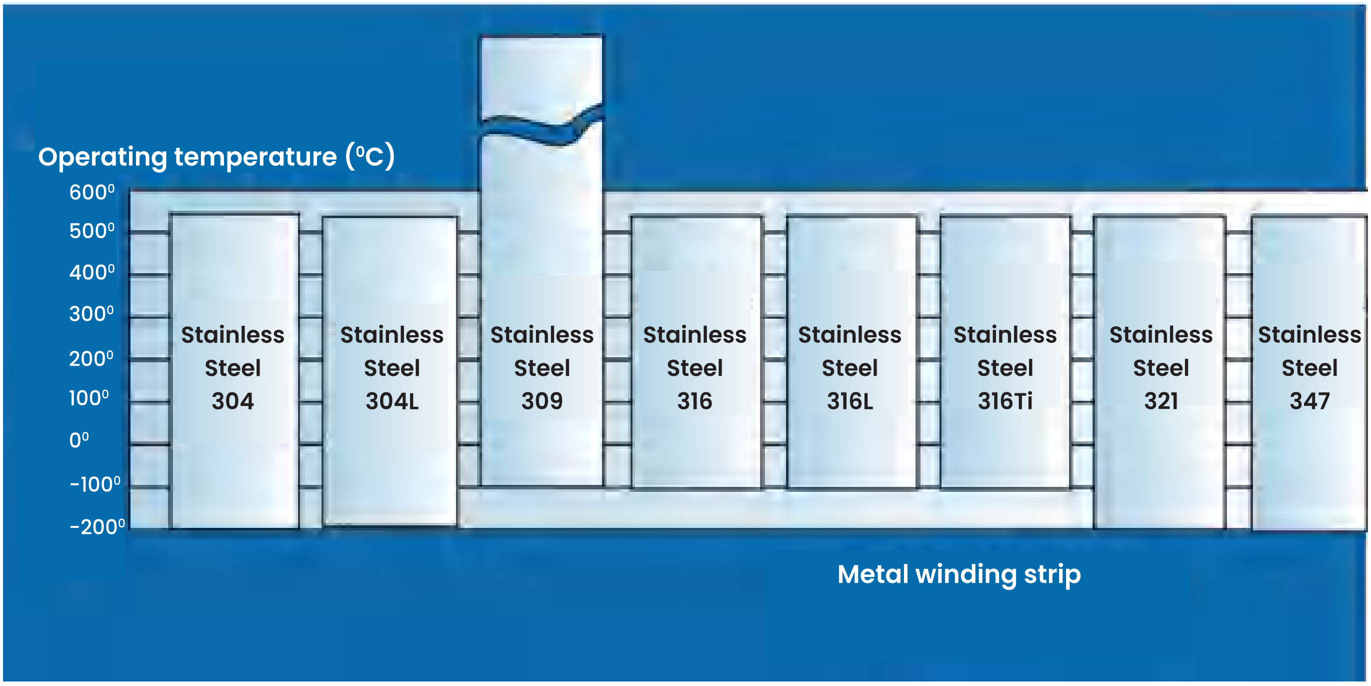
* As standard supplied with a paint coating to inhibit corrosion during storage. Other protective coatings, eg. Zinc plating with a chrome passivate, are available on request.

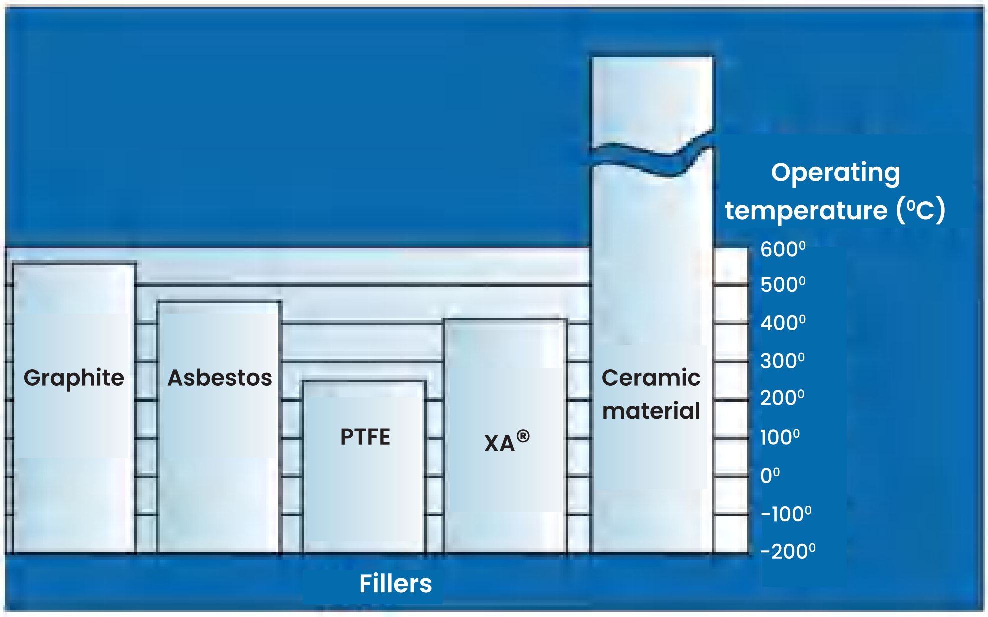
MACER® materials

Material (trade name)	DIN specification	DIN material nr.	AISI ASTM UNS	B.S.	Hardness HB / HV*	Temp. [°c] min. max	Volumetric mass [g/cm3]
Soft Iron (armco)	-	1.1003	-	-	90 - 100	- 60 500	7.85
Steel (LCS)(1)	RSt. 37.2	1.0038	-	-	100 - 130	- 40 500	7.85
Stainless Steel 304	X5 CrNi 18	1.4301	304	304S15/16/31	130 - 180	-250 550	7.9
Stainless Steel 304L	X2CrNi 189	1.4306	304L	304S11	130 - 190	-250 550	7.9
Stainless Steel 309	X15CrNiSi 2012	1.4828	309	309S24	130 - 190	-100 1000	7.9
Stainless Steel 316	X5CrNiMo 1810	1.4401	316	316S31/33	130 - 180	-100 550	7.9
Stainless Steel 316L(2)	X2CrNiMo 1810	1.4404	316L	316S11/13	130 - 190	-100 550	7.9
Stainless Steel 316Ti	X10CrNiMoTi 1810	1.4571	316Ti	320S31	130 - 190	-100 550	7.8
Stainless Steel 321	X10CrNiTi 189	1.4541	321	321S12/49/87	130 - 190	-250 550	7.9
Stainless Steel 347	X10CrNiNb 189	1.4550	347	347S31	130 - 190	-250 550	7.9
Aluminium	Al 99.5	3.0255	-	-	20 - 23	-250 300	2.73
Silver	-	-	-	-	28*	-250 750	10.5
Lead	Pb 99.9	2.3040	-	-	4*	-250 220	11.5
Copper	-	2.0090	-	-	50 - 80	-250 400	8.9
Nickel 200	Ni 99.2	2.4066	NO2200	3072 - 76 NA11	90 - 120	-250 600	8.9
Monel 400®	NiCu 30 Fe	2.4360	NO4400	3072 - 76 NA13	110 - 150	-125 600	8.8
Inconel 600®	NiCr 15 Fe	2.4816	NO6600	3072 - 76 NA14	120 - 180	-100 950	8.4
Incoloy 800®	X 10NiCrAlTi 3220	1.4876	NO8800	3072 - 76 NA15	140 - 220	-100 850	8.0
Incoloy 825®	NiCr 21 Mo	2.4858	NO8825	3072 - 76 NA16	120 - 180	-100 450	8.14
Hastelloy B2®	NiMo 28	2.4617	NI065	-	170 - 230	-200 450	9.2
Hastelloy C276®	NiMo16Cr15W	2.4819	NI0276	-	170 - 230	-200 450	8.9
Titanium	Ti 99.8	3.7025	-	-	110 - 140	-250 350	4.5

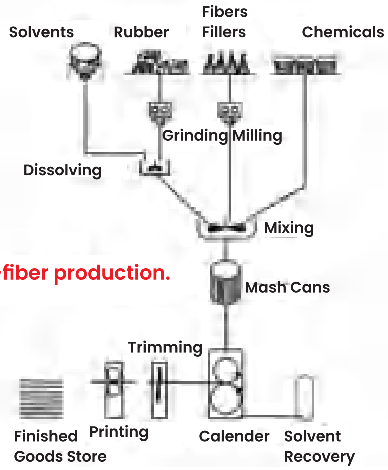
(1) generally applied for the centring ring and ASTM A285-82 GR-C
(2) generally applied for the metal component of the gasket which should be made of non-corroding material

Material	Temperature [°C] Min.	Max	Max. operating pressure [Bar]	Gastightness	Application
Graphite	-200	550	250	Good	Aggressive media
PTFE	-200	250	100	Good	Aggressive media
Asbestos	-150	450	100	Fair	Liquids
XA®	-100	400	100	Fair	Liquids
Ceramic	-200	1100	100	Poor	Very high temperatures

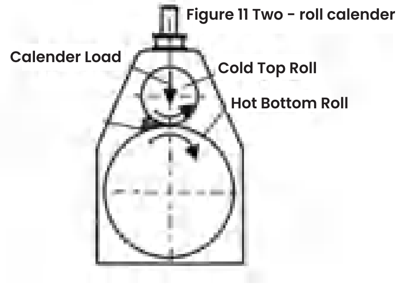

Operating temperature (⁰C)
600⁰
500⁰
400⁰
300⁰
200⁰
100⁰
0⁰
-100⁰
-200⁰
Stainless Steel 304
Stainless Steel 304L
Stainless Steel 309
Stainless Steel 316
Stainless Steel 316L
Stainless Steel 316Ti
Stainless Steel 321
Stainless Steel 347
Metal winding strip


Graphite
Asbestos
PTFE
XA®
Ceramic material
Operating temperature (⁰C)
600⁰
500⁰
400⁰
300⁰
200⁰
100⁰
0⁰
-100⁰
-200⁰
Fillers

MACER® materials

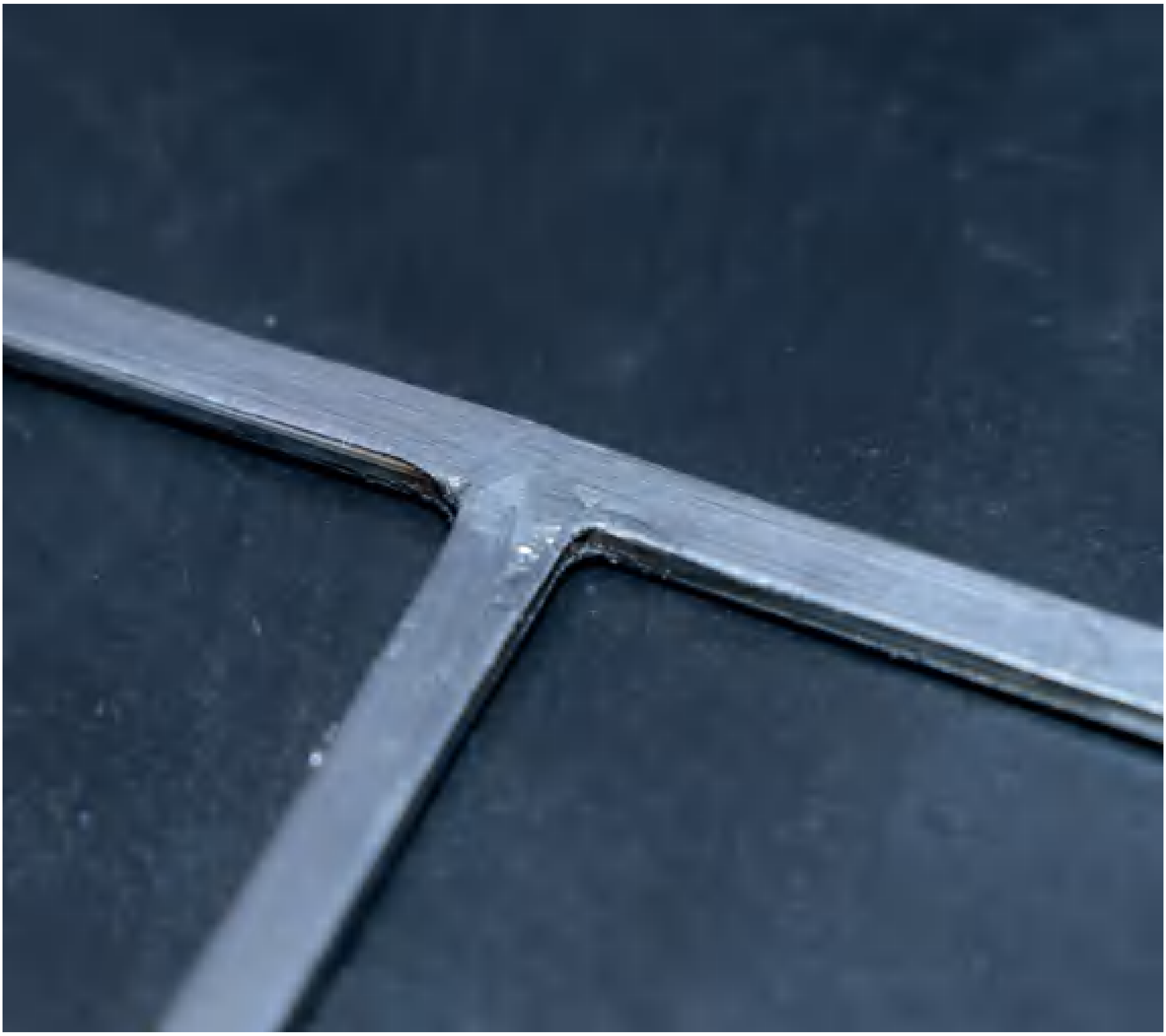


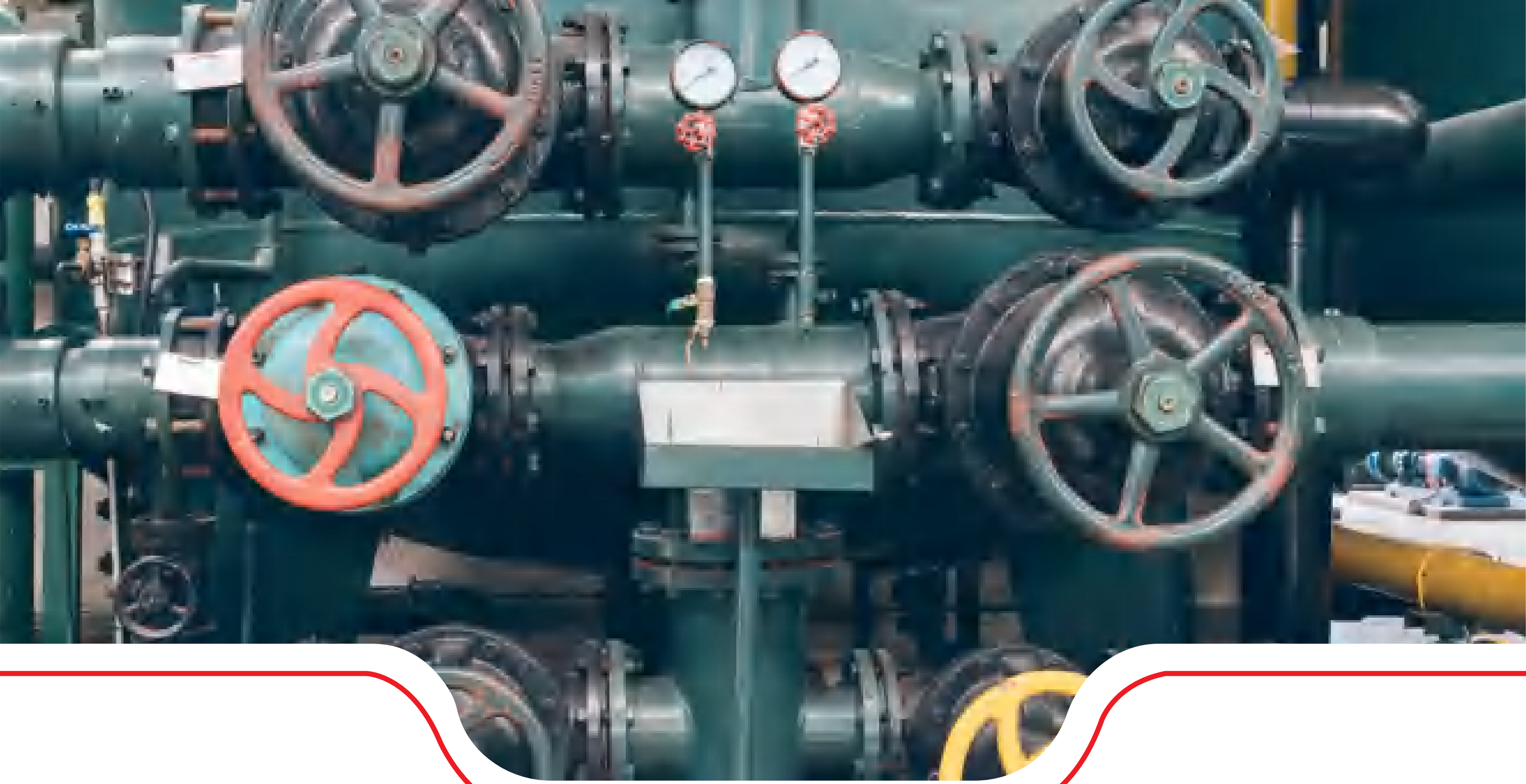
Compressed-fiber production.



ADVANTAGES OF EXPANDED GRAPHITE AS FILLER MATERIAL :

- Safer to use
- Fire safe
- No adhesion problems.
- Resistance to a wide range of chemicals.
- Less effort required to effect seal.
- Very versatile.
- Best general alternative to compressed asbestos fibre for the majority of applications.
- Maximum temperature in steam 65⁰ deg.C.
- Inert.





TESTING

ASME B16.20 - 1998 Reaffirmed 2004

3.2.6 gasket compression. Spiral wound gaskets, NPS ½", NPS ¾" and NPS 1" in classes 150, 300 and 600 shall be designed so that a uniform bolt stress, based on the nominal bolt root diameter, of 25000 psi will compress the gasket to thickness of 0.130 in. +/-0.005 in. All other gasket sizes and classes shall be Designed so that a uniform bolt stress of30000 psi will compress the gasket to a thickness of 0.130 in. +/-0.005 in. The test specified above is a proof test only.

COMPRESSIBILITY & SEALABILITY TEST

MACER® lolode

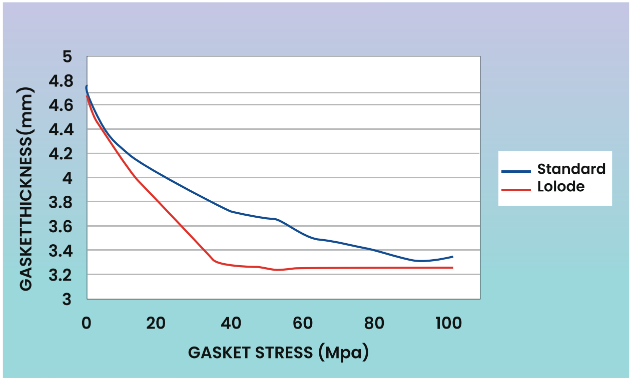
Spiral wound gaskets

Some methods of calculation of the bolt load required to compress conventional spiral wound gaskets, result in figures which appear to over - stress the standard bolting of many ASME B16.5 class 150 and some 300 flanges.

Spiral wound gaskets have been used successfully on these flange classes for many years. However a lot more attention has recently been paid to the amount of compression that is actually achieved when standard bolting is employed. The replacement of asbestos with expanded graphite (SPG) filler, has improved this situation by producing equivalent sealing performance under lower compressive forces, as well as allowing greater compression for a given bolt load.

It must be acknowledged that on certain flanges, the amount of available bolting may be insufficient to achieve the degree of compression normally recommended by gasket manufacturers without exceeding the recommended bolt stress levels given in the flange design codes. However, in practice gaskets have been found to be capable of sealing performance especially with class 150 and 300 flanges, even through the gasket may not be fully compressed to the guide ring.

Typical load-compression comparison



The ***Lolode*** gasket has been developed to satisfy those requirements for maximum sealing element compression, using the bolt stress figure of 25,000 p.s.i. given for certain material grades shown in the ASME code. The expanded graphite (SPG) filled ***Lolode*** , has the basic design and properties of a standard *MACER*®spiral wound gasket, but it has been carefully engineered to enable compression down to the guide ring under the limited load provided by ASME B16.5 or BS 1560 class 150 or 300 flanges.

Lolode gaskets are available to ASME B16.20 and BS 3381 dimensions to suit class 150 and 300 flanges from 1/2" to 24" nominal bore.

(Note that the large diameter flanges to ASME B16.47 Series A and B do not suffer the same poor ratio of gasket area to bolt area as the smaller flanges such as 3" and 8" class 150, and hence ***Lolode*** gaskets are not required for these flanges).

The graph above shows a comparison of the amount of compression obtained at a given gasket stress for the ***Lolode*** version compared to a standard *MACER*® SPG filled spiral wound gasket. It can be seen that the Lolode compresses down to the nominal guide ring thickness of 3.3mm at a significantly lower level of stress than the standard gasket.

GASKET DIMENSIONS

MACER® Type SG suitable for BS 1560 /ASME B 16.5 flanges - Metric Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20														
	Sealing Element							Centring Ring Outside Diameter						
Nominal Bore	Inside Diameter					Outside Diameter		Class Rating						
	150-	400-	900	1500	2500	150-	900-	150	306	400	600	900	1500	2500
½	19.1	19.1	19.1	19.1	19.1	31.8	31.8	47.6	54.0	54.0	54.0	63.0	63.5	69.9
3/4	25.4	25.4	25.4	25.4	25.4	39.7	39.7	57.2	66.7	66.7	66.7	69.9	69.9	76.2
1	31.8	31.8	31.8	31.8	31.8	47.6	47.6	66.7	73.0	73.0	73.0	79.4	79.4	85.7
1 1/4	47.6	47.6	39.7	39.7	39.7	60.3	60.3	76.2	82.6	82.6	82.6	88.9	88.9	104.8
1 ½	54.0	54.0	47.6	47.6	47.6	69.9	69.9	85.7	95.3	95.3	95.3	98.4	98.4	117.5
2	69.9	69.9	58.7	58.7	58.7	85.7	85.7	104.8	111.1	111.1	111.1	142.9	142.9	146.1
2 1/2	82.6	82.6	69.9	69.9	69.9	98.4	98.4	98.4	123.8	130.2	130.2	165.1	165.1	168.3
3	101.6	101.6	95.3	92.1	92.1	120.7	120.7	136.5	149.2	149.2	168.3	174.6	174.6	196.9
4	127.0	120.7	120.7	117.5	117.5	149.2	149.2	174.6	181.0	177.8	193.7	206.4	209.6	235.0
5	155.6	147.6	142.9	142.9	142.9	177.8	177.8	196.9	215.9	212.7	241.3	247.7	254.0	279.4
6	182.6	174.6	174.6	171.5	171.5	209.6	209.6	222.3	250.8	247.7	266.7	288.9	282.6	317.5
8	233.4	225.4	222.3	215.9	215.9	263.5	257.5	279.4	308.0	304.8	320.7	358.8	352.4	387.4
10	287.3	274.6	276.2	266.7	269.9	317.5	311.2	339.7	362.0	358.8	400.1	435.0	435.0	476.3
12	339.7	327.0	323.9	323.9	317.5	374.7	368.3	409.6	422.3	419.1	457.2	498.5	520.7	549.3
14	371.5	362.0	35536	362.0	406.4	400.1	450.9	485.8	482.6	492.1	520.7	577.9		
16	422.3	412.8	412.8	406.4	463.6	457.2	514.4	539.8	536.6	565.2	574.7	641.4		
18	474.7	469.9	463.6	463.6	527.1	520.7	549.3	596.9	593.7	612.8	641.4	704.9		
20	525.5	520.7	520.7	514.4	577.9	571.5	606.4	654.1	647.7	682.6	698.5	755.7		
24	628.7	628.7	628.7	616.0	685.8	679.5	717.6	774.7	768.4	790.6	838.2	901.7		

Dimensions in mm

GASKET DIMENSIONS

MACER® Type SG suitable for BS 1560 /ASME B 16.5 flanges - Imperial Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20														
	Sealing Element							Centring Ring Outside Diameter						
Nominal Bore	Inside Diameter					Outside Diameter		Class Rating						
	150-300	400-600	900	1500	2500	150-600	900-2500	150	300	400	600	900	1500	2500
½	0.75	0.75	0.75	0.75	0.75	1.25	1.25	1.88	2.13	2.13	2.13	2.50	2.50	2.75
3/4	1.00	1.00	1.00	1.00	1.00	1.56	1.56	2.25	2.63	2.63	2.63	2.75	2.75	3.00
1	1.25	1.25	1.25	1.25	1.25	1.88	1.88	2.63	2.88	2.88	2.88	3.13	3.13	3.38
1/1/4	1.88	1.88	1.56	1.56	1.56	2.38	2.38	3.00	3.25	3.25	3.25	3.50	3.50	4.13
11/2	2.13	2.13	1.88	1.88	1.88	2.75	2.75	3.38	3.75	3.75	3.75	3.88	3.88	4.63
2	2.75	2.75	2.31	2.31	2.31	3.38	3.38	4.13	4.38	4.38	4.38	5.63	5.63	5.75
2 1/2	3.25	3.25	2.75	2.75	2.75	3.88	3.88	4.88	5.13	5.13	5.13	6.50	6.50	6.63
3	4.00	4.00	3.75	3.63	3.63	4.75	4.75	5.38	5.88	5.88	5.88	6.63	6.88	7.75
4	5.00	4.75	4.75	4.63	4.63	5.88	5.88	6.88	7.13	7.00	7.63	8.13	8.25	9.25
5	6.13	5.81	5.81	5.63	5.63	7.00	7.00	7.75	8.50	8.38	9.50	9.75	10.00	11.00
6	7.19	6.88	6.88	6.75	6.75	8.25	8.25	8.75	9.88	9.75	10.50	11.38	11.13	12.50
8	9.19	8.88	8.75	8.50	8.50	10.38	10.13	11.00	12.13	12.00	12.63	14.13	13.88	15.25
10	11.31	10.81	10.88	10.50	10.63	12.50	12.25	13.38	14.25	14.13	15.75	17.13	17.13	18.75
12	13.38	12.88	12.75	12.75	12.50	14.75	14.50	16.13	16.63	16.50	18.00	19.63	20.50	21.63
14	14.63	14.25	14.00	14.25	16.00	15.75	17.75	19.13	19.00	19.38	20.50	22.75		
16	16.63	16.25	16.25	16.00	18.25	18.00	20.25	21.25	21.13	22.25	22.63	25.25		
18	18.69	18.50	18.25	18.25	20.75	20.50	21.63	23.50	23.38	24.13	25.25	27.75		
20	20.69	20.50	20.50	20.25	22.75	22.50	23.88	25.75	25.50	26.88	27.50	29.75		
24	24.75	24.75	24.75	24.25	27.00	26.75	28.25	30.50	30.25	31.13	33.00	35.50		

Dimensions in inches

GASKET DIMENSIONS

MACER® Type SG suitable for ASME B16.47 Series A flanges - Metric Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20															
Nominal Bore	Sealing Element										Centring Ring Outside Diameter				
	150		300		400		600		900		Class Rating				
	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	150	300	400	600	900
26	673.1	704.9	685.8	736.6	685.8	736.6	685.8	736.6	685.8	736.6	774.7	835.0	831.9	866.8	882.7
28	723.9	755.7	736.6	787.4	736.6	787.4	736.6	787.4	736.6	787.4	831.9	898.5	892.2	914.4	946.2
30	774.7	806.5	793.8	844.6	793.8	844.6	793.8	844.6	793.8	844.6	882.7	952.5	946.2	971.6	1009.7
32	825.5	860.4	850.9	901.7	850.9	901.7	850.9	901.7	850.9	901.7	939.8	1006.5	1003.3	1022.4	1073.2
34	876.3	911.2	901.7	952.5	901.7	952.5	901.7	952.5	901.7	952.5	990.6	1057.3	1054.1	1073.2	1136.7
36	927.1	968.4	955.7	1006.5	955.7	1006.5	955.7	1006.5	958.9	1009.7	1047.8	1117.6	1117.6	1130.3	1200.2
38	977.9	1019.2	971.6	1016.0	971.6	1022.4	990.6	1041.4	1035.1	1085.9	1111.3	1054.1	1073.2	1104.9	1200.2
40	1028.7	1070.0	1022.4	1070.0	1025.5	1076.3	1047.8	1098.6	1098.6	1149.4	1162.1	1114.4	1127.1	1155.7	1251.0
42	1079.5	1124.0	1073.2	1120.8	1076.3	1127.1	1104.9	1155.7	1149.4	1200.2	1219.2	1165.2	1177.9	1219.2	1301.8
44	1130.3	1177.9	1130.3	1181.1	1130.3	1181.1	1162.1	1212.9	1206.5	1257.3	1276.4	1219.2	1231.9	1270.0	1368.4
46	1181.1	1228.7	1177.9	1228.7	1193.8	1244.6	1212.9	1263.7	1270.0	1320.8	1327.2	1273.2	1289.2	1327.2	1435.1
48	1231.9	1279.5	1235.1	1285.9	1244.6	1295.4	1270.0	1320.8	1320.8	1371.6	1384.3	1324.0	1346.2	1390.7	1485.9
50	1282.7	1333.5	1295.4	1346.2	1295.4	1346.2	1320.8	1371.6			1435.1	1375.0	1403.4	1447.8	
52	1333.5	1384.3	1346.2	1397.0	1346.2	1397.0	1371.6	1422.4			1492.3	1428.8	1454.2	1498.6	
54	1384.3	1435.1	1403.4	1454.2	1403.4	1454.2	1428.8	1479.6			1549.4	1492.3	1517.7	1555.8	
56	1435.1	1485.9	1454.2	1505.0	1454.2	1505.0	1479.6	1555.8			1606.6	1543.1	1568.5	1612.9	

Dimensions in mm

GASKET DIMENSIONS

MACER® Type SG suitable for ASME B16.47 Series A flanges - Imperial Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20															
Nominal Bore	Sealing Element										Centring Ring Outside Diameter				
	150		300		400		600		900		Class Rating				
	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	150	300	400	600	900
26	26.50	27.75	27.00	29.00	27.00	29.00	27.00	29.00	27.00	29.00	30.50	32.88	32.75	34.13	34.75
28	28.50	29.75	29.00	31.00	29.00	31.00	29.00	31.00	29.00	31.00	32.75	35.38	35.13.	36.00	37.25
30	30.50	31.75	31.25	33.25	31.25	33.25	31.25	33.25	31.25	33.25	34.75	37.50	37.25	38.25	39.75
32	32.50	33.88	33.50	35.50	33.50	33.50	33.50	33.50	33.50	33.50	37.00	39.63	39.50	40.25	42.25
34	34.50	35.88	35.50	37.50	35.50	35.50	35.50	37.50	35.50	37.50	39.00	41.63	41.50	42.25	44.75.
36	36.50	38.13	37.63	39.63	37.63	39.63	37.63	39.63	37.75	39.75	41.25	44.00	44.00	44.50	47.25
38	38.50	40.13	38.50	40.00	38.25	40.25	39.00	41.00	40.75	42.75	43.75	41.50	42.25	43.50	47.25
40	40.50	42.13	40.13	42.13	40.38	42.38	41.25	43.25	43.25	45.25	45.75	43.88	44.38	45.50	49.25
42	42.50	44.25	42.25	44.13	42.38	44.38	43.50	45.50	45.25	47.25	48.00	45.88	46.38	48.00	51.25
44	44.50	46.38	44.50	46.50	44.50	46.50	45.75	47.75	47.50	49.50	50.25	48.00	48.50	50.00	53.88
46	46.50	48.38	46.38	48.38	47.00	49.00	47.75	49.75	50.00	52.00	52.25	50.13	50.75	52.25	56.50
48	48.50	50.38	48.63	50.63	49.00	51.00	50.00	52.00	52.00	54.00	54.50	52.13	53.00	53.75	58.50
50	50.50	52.50	51.00	53.00	51.00	53.00	52.00	54.00			56.50	54.25	55.25	57.00	
52	52.50	54.50	53.00	55.00	53.00	55.00	54.00	56.00			58.75	56.25	57.25	59.00	
54	54.50	56.50	55.25	57.25	57.25	57.25	56.25	58.25			61.00	58.75	59.75	61.25	
56	56.50	58.50	57.25	59.25	57.25	59.25	58.25	61.25			63.25	60.75	61.75	63.50	
58	58.50	60.50	59.50	61.50	59.25	61.25	60.50	62.50			65.50	62.75	63.75	65.50	
60	60.50	62.50	61.50	63.50	61.75	63.75	62.75	64.75			67.50	64.75	66.25	68.25	

Dimensions in inches

GASKET DIMENSIONS

MACER® Type SG suitable for ASME B16.47 Series B flanges - Metric Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20															
Nominal Bore	Sealing Element									Centring Ring Outside Diameter					
	150		300		400		600		900		Class Rating				
	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	150	300	400	600	900
26	673.1	698.5	673.1	711.2	666.8	698.5	663.6	714.4	692.2	749.3	725.5	771.5	746.1	765.2	838.2
28	723.9	749.3	723.9	787.4	714.4	749.3	704.9	755.7	743.0	800.1	776.3	825.5	800.1	819.2	901.7
30	774.7	800.1	774.7	812.8	765.2	806.5	777.9	830.3	806.5	857.3	827.1	885.8	857.3	879.5	958.9
32	825.5	850.9	825.5	863.6	812.8	860.4	831.9	882.7	863.6	914.4	881.1	939.8	911.2	933.5	1016.0
34	876.3	908.1	876.3	914.4	866.8	911.2	889.0	939.8	920.8	717.6	935.0	993.8	962.0	997.0	1073.2
36	927.1	958.9	927.1	965.2	917.6	965.2	939.8	990.6	946.2	997.0	987.4	1047.8	1022.4	1047.8	1124.0
38	974.7	1009.7	1009.7	1047.8	971.6	1022.4	990.6	1041.4	1035.1	1085.9	1044.6	1098.6	1073.2	1104.9	1200.2
40	1022.4	1063.6	1060.5	1098.6	1025.5	1076.3	1047.8	1098.6	1098.6	1149.4	1095.4	1149.4	11271.1	1155.7	1251.0
42	1079.5	1114.4	1111.3	1149.4	1076.3	1127.1	1104.9	1155.7	1149.4	1200.2	1146.2	1200.2	1177.9	1219.2	1301.8
44	1124.0	1165.2	1162.1	1200.2	1130.3	1181.1	1162.1	1212.9	1206.5	1257.3	1197.0	1251.0	1231.9	1270.0	1368.4
46	1181.1	1224.0	1216.0	1254.1	1193.8	1244.6	1212.9	1263.7	1270.0	1320.8	1255.7	1317.6	1289.1	1327.2	1435.1
48	1231.9	1270.0	1263.7	1311.3	1244.6	1295.4	1270.0	1320.8	1320.8	1371.6	1306.5	1368.4	1346.2	1390.7	1485.9
50	1282.7	1325.6	1317.6	1355.7	1295.4	1346.2	1320.8	1371.6			1357.3	1419.2	1403.4	1447.8	
52	1333.5	1376.4	1368.4	1406.5	1346.2	1397.0	1371.6	1422.4			1408.1	1470.0	1454.2	1498.6	
54	1384.3	1422.4	1403.4	1454.2	1403.4	1454.2	1428.8	1479.6			1463.7	1530.4	1517.7	1555.8	
56	1444.6	1478.0	1479.6	1524.0	1454.2	1505.0	1479.6	1530.4			1514.5	1593.9	1568.5	1612.9	
58	1500.2	1528.8	1535.1	1573.2	1505.0	1555.8	1536.7	1587.5			1579.6	1655.8	1619.3	1663.7	
60	1557.3	1585.9	1589.1	1630.4	1568.5	1619.3	1593.9	1644.7			1630.4	1706.6	1682.8	1733.6	

Dimensions in mm

GASKET DIMENSIONS

MACER® Type SG suitable for ASME B16.47 Series B flanges - Imperial Dimensions

SUPPLIED IN ACCORDANCE WITH ASME B 16.20															
Nominal Bore	Sealing Element									Centring Ring Outside Diameter					
	150		300		400		600		900		Class Rating				
	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	150	300	400	600	900
26	26.50	27.75	27.00	29.00	27.00	29.00	27.00	29.00	27.00	29.00	30.50	32.88	32.75	34.13	34.75
28	28.50	29.75	29.00	31.00	29.00	31.00	29.00	31.00	29.00	31.00	32.75	35.38	35.13.	36.00	37.25
30	30.50	31.75	31.25	33.25	31.25	33.25	31.25	33.25	31.25	33.25	34.75	37.50	37.25	38.25	39.75
32	32.50	33.88	33.50	35.50	33.50	33.50	33.50	33.50	33.50	33.50	37.00	39.63	39.50	40.25	42.25
34	34.50	35.88	35.50	37.50	35.50	35.50	35.50	37.50	35.50	37.50	39.00	41.63	41.50	42.25	44.75.
36	36.50	38.13	37.63	39.63	37.63	39.63	37.63	39.63	37.75	39.75	41.25	44.00	44.00	44.50	47.25
38	38.50	40.13	38.50	40.00	38.25	40.25	39.00	41.00	40.75	42.75	43.75	41.50	42.25	43.50	47.25
40	40.50	42.13	40.13	42.13	40.38	42.38	41.25	43.25	43.25	45.25	45.75	43.88	44.38	45.50	49.25
42	42.50	44.25	42.25	44.13	42.38	44.38	43.50	45.50	45.25	47.25	48.00	45.88	46.38	48.00	51.25
44	44.50	46.38	44.50	46.50	44.50	46.50	45.75	47.75	47.50	49.50	50.25	48.00	48.50	50.00	53.88
46	46.50	48.38	46.38	48.38	47.00	49.00	47.75	49.75	50.00	52.00	52.25	50.13	50.75	52.25	56.50
48	48.50	50.38	48.63	50.63	49.00	51.00	50.00	52.00	52.00	54.00	54.50	52.13	53.00	53.75	58.50
50	50.50	52.50	51.00	53.00	51.00	53.00	52.00	54.00			56.50	54.25	55.25	57.00	
52	52.50	54.50	53.00	55.00	53.00	55.00	54.00	56.00			58.75	56.25	57.25	59.00	
54	54.50	56.50	55.25	57.25	57.25	57.25	56.25	58.25			61.00	58.75	59.75	61.25	
56	56.50	58.50	57.25	59.25	57.25	59.25	58.25	61.25			63.25	60.75	61.75	63.50	
58	58.50	60.50	59.50	61.50	59.25	61.25	60.50	62.50			65.50	62.75	63.75	65.50	
60	60.50	62.50	61.50	63.50	61.75	63.75	62.75	64.75			67.50	64.75	66.25	68.25	

Dimensions in inches

GASKET DIMENSIONS

MACER® Type SG suitable for BS 1560/ASME B16.5 flanges

SUPPLIED IN ACCORDANCE WITH BS3381

Nominal Bore	Sealing Element					Centring Ring Outside Diameter				
	Inside Diameter			Outside Diameter		Class Rating				
	150	300-1500	2500	150-600	150	300	600	900	1500	2500
1/2	18.7	18.7	18.7	32.2	47.6	54	54	63.5	63.5	69.9
3/4	26.6	25.0	25.0	40.1	57.2	66.2	66.7	69.9	69.9	76.2
1	32.9	31.4	31.4	48.0	66.7	73	73	79.4	79.4	85.9
1 1/4	45.6	44.1	39.3	60.7	76.2	82.6	82.6	88.9	88.9	104.8
1 1/2	53.6	50.4	47.2	70.3	85.7	95.3	95.3	98.4	98.4	117.5
2	69.5	66.3	58.3	86.1	104.8	111.1	111.1	142.9	142.9	146.1
2 1/2	82.2	79.0	69.5	98.8	123.8	130.2	130.2	165.1	165.1	168.3
3	101.2	94.9	91.7	121.1	136.5	149.2	149.2	168.3	147.6	196.9
4	126.6	120.3	117.1	149.6	174.6	181	193.7	206.4	209.6	235
5	153.6	147.2	142.5	178.2	196.9	215.9	241.3	247.7	254	279.4
6	180.6	174.2	171.1	210.0	222.3	250.8	266.7	288.9	282.6	317.5
8	231.4	225.0	215.5	263.9	279.4	308	320.7	358.8	352.4	387.4
10	286.9	280.6	269.5	317.9	339.7	362	400.1	435	435	476.3
12	339.3	333.0	323.5	375.1	409.6	422.3	457.2	498.5	520.7	549.6
14	371.1	364.7		406.8	450.9	485.8	492.1	520.7	577.9	
16	421.9	415.5		464.0	514.4	539.8	565.2	574.7	641.4	
18	475.9	469.5		527.5	549.3	596.9	612.8	638.2	704.9	
20	526.7	520.3		578.3	606.4	654.1	682.6	698.5	755.7	
24	631.4	625.1		686.2	717.6	774.7	790.6	838.2	901.7	

Dimensions in mm

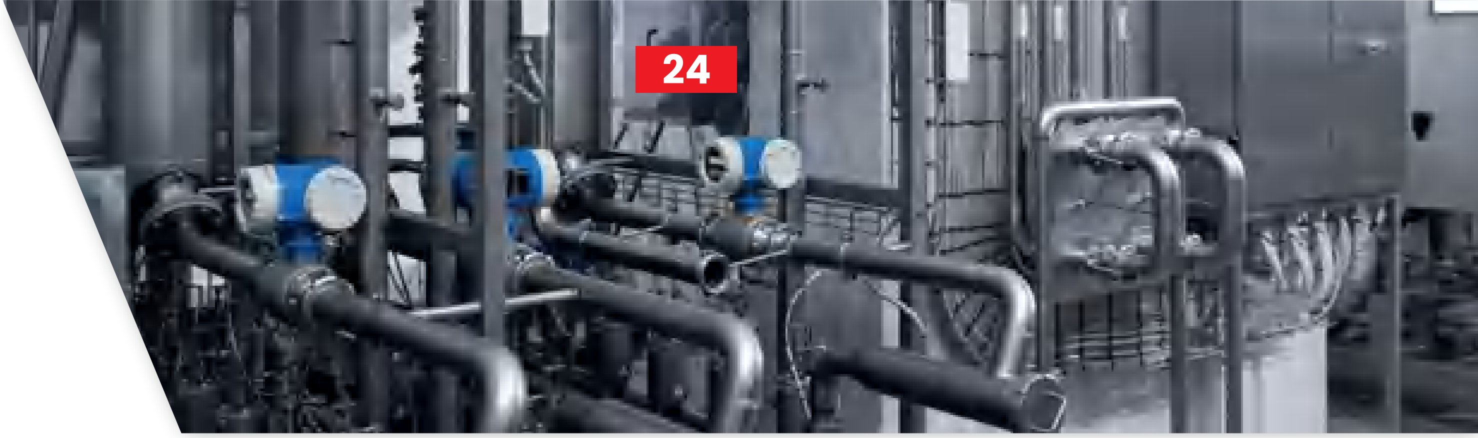
Up to 40 Bar dimensions in accordance with EN 1514-2

GASKET DIMENSIONS

MACER® Type SG suitable for DIN/EN 1092 flanges

Nominal Bore	Sealing Element				Centring Ring Outside Diameter						
	10 bar - 40 bar		64 bar - 160 bar		10 bar	16 bar	25 bar	40 bar	64 bar	100 bar	160 bar
	I/D	O/D	I/D	O/D	DIN 2632	DIN2633	DIN 2634	DIN 2635	DIN 2636	DIN 2637	DIN 2638
10	24	36	24	36	48	48	48	48	58	58	58
15	28	40	28	40	53	53	53	53	63	63	63
20	34	47	34	48	63	63	63	63	74	74	74
25	41	55	41	56	73	73	73	73	84	84	84
32	50	66	50	67	84	84	84	84	90	90	90
40	56	72	56	74	94	94	94	94	105	105	105
50	68	86	68	88	109	109	109	109	115	121	121
65	84	103	81	102	129	129	129	129	140	146	146
80	97	117	97	120	144	144	144	144	150	156	156
100	123	144	120	142	164	164	170	170	176	183	183
125	148	170	148	174	194	194	196	196	213	220	220
150	177	200	177	205	220	220	226	226	250	260	260
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58
10	24	36	24	36	48	48	48	48	58	58	58

Dimensions in inches



GASKET DIMENSIONS

MACER® Type SG suitable for BS 10 Welded Neck flanges

Nominal Bore	Sealing Element		Centring Ring		Sealing Element		Centring Ring					Sealing Element						Centring Ring	
	Table		Table	Table	Tables		Table	Table	Table	Table	Table	Table S		Table S		Table			Table
	D,E	D		E	F,H,J,K,R		F	H	J	K	R	(1931)		(1962)		T		S	T
	I/D	O/D	O/D	O/D	I/D	O/D	O/D	O/D	O/D	O/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	O/D	O/D
1/2	1.03	1.47	2.13	2.13	1.03	1.53	2.13	2.63	2.63	2.63	2.63	0.75	1.25	0.75	1.25	0.75	1.25	2.75	3.25
3/4	1.25	1.69	2.38	2.38	1.25	1.75	2.38	2.63	2.63	2.63	2.63	1.00	1.56	1.00	1.56	1.00	1.56	2.75	3.25
1	1.56	2.06	2.75	2.75	1.56	2.56	2.19	2.81	2.81	3.13	3.13	1.25	1.88	1.25	1.88	1.25	1.88	3.25	3.50
11/4	1.88	2.38	2.94	2.94	1.88	2.50	3.25	3.25	3.25	3.25	3.25	1.50	2.19	1.50	2.19	1.63	2.31	3.50	3.88
11/2	2.13	2.63	3.38	3.38	2.13	2.75	3.50	3.50	3.50	3.50	3.75	3.75	3.75	1.75	2.50	1.88	2.63	4.00	4.50
2	2.63	3.13	3.88	3.88	2.63	3.25	4.38	4.38	4.25	4.38	4.38	2.25	3.00	2.25	3.13	2.38	3.25	4.50	5.00
21/2	3.25	3.88	4.38	4.38	3.25	4.00	5.13	5.13	5.00	5.00	5.00	2.75	3.50	2.88	3.75	3.00	3.88	5.00	5.63
3	3.81	4.44	5.13	5.13	3.81	4.56	5.88	5.88	5.75	5.75	5.75	3.25	4.00	3.38	4.25	3.50	4.50	5.63	6.50
31/2	4.31	4.94	5.88	5.88	4.31	5.06	6.38	6.38	6.25	6.38	6.38	3.75	4.50	3.88	4.75	4.00	5.13	6.63	7.38
4	4.88	5.50	6.38	6.38	4.88	5.63	6.88	6.88	6.75	6.88	6.88	4.25	5.00	4.38	5.38	4.50	5.63	7.00	8.13
5	5.88	6.50	7.63	7.63	5.88	6.75	8.50	8.50	8.38	8.38	8.38	5.25	6.00	5.38	6.38	5.50	6.75	8.38	9.63
6	6.88	7.50	8.63	8.50	6.88	7.75	9.50	9.50	9.38	9.38	9.38	6.25	7.00	6.38	7.38	6.50	7.75	9.75	11.25
7	7.88	8.63	9.63	9.50	7.88	8.88	10.75	10.75	10.63	10.50	10.50	7.38	8.25	7.38	8.63	7.50	9.00	11.38	13.13
8	8.88	9.63	10.88	10.75	8.88	9.88	12.00	12.00	11.88	11.50	11.75	8.38	9.25	8.38	9.63	8.50	10.00	12.75	14.50
9	9.88	10.63	12.13	12.00	9.88	10.88	13.13	13.13	13.00	13.00	13.00	9.38	10.25	9.50	10.75	9.63	11.25	14.13	16.13
10	10.88	11.63	13.25	13.25	11.00	12.00	14.13	14.13	14.00	14.00	14.25	10.38	11.25	10.50	11.88	10.63	12.25	15.50	17.75
11	11.88	12.63	14.25	14.25	12.00	13.00	15.13	15.13	15.00	15.13	15.88	11.38	12.50	11.50	12.88	11.63	13.25	17.13	19.25
12	12.88	13.75	15.25	15.13	13.00	14.13	16.38	16.38	16.25	15.88	16.88	13.63	12.63	12.63	14.00	12.75	14.50	18.50	20.75
13	14.50	15.38	16.50	16.38	14.25	15.38	17.50	17.50	17.38	17.75	18.25	13.38	14.63	13.63	15.13	13.75	15.50	19.75	22.00
14	15.50	16.38	17.63	17.63	12.25	16.38	18.50	18.50	18.38	18.75	19.50	14.38	15.75	14.63	16.13			21.25	
15	16.50	17.38	18.63	18.63	16.25	17.38	19.50	19.50	19.38	20.00	20.50	15.38	16.88	15.75	17.25			24.25	
16	17.50	18.38	19.63	19.63	17.50	18.75	20.75	20.75	20.63	21.00	21.75	16.38	17.88	16.75	18.38			24.25	
17	18.63	19.63	20.88	20.75	18.50	19.88	22.00	22.00	21.88	22.25	22.75								
18	19.63	20.63	22.13	22.13	19.50	20.88	22.88	22.88	22.75	24.38	25.13								
19	20.63	21.63	23.13	23.13	20.63	22.13	24.13	24.13	24.00										
20	21.63	22.63	24.38	21.63	23.13	25.38	25.38	25.25	26.50	27.25									
21	22.63	23.75	25.75	25.63	25.50	22.63	24.38	26.38	26.38	26.25									
22	23.63	24.75	26.50	26.50	23.63	25.38	27.38	27.25	28.75	28.75	29.75								
23	24.63	25.75	27.50	27.50	24.63	26.38	28.50	28.38											
24	25.63	26.75	28.75	28.63	25.63	27.38	29.50	29.50	29.38										

Dimensions in inches

GASKET DIMENSIONS

MACER® Type SG/IR suitable for BS 1560/ ASME B16.5 flanges - Metric Dimension

SUPPLIED IN ACCORDANCE WITH ASME B 16.20

Nominal Bore	Inner Ring Inside Diameter					Sealing Element Inside Diameter					Sealing Element Out side Diameter		Centring Ring Outside Diameter Class Rating						
	150-300	400-600	900	1500	2500	150-300	400-600	900	1500	2500	150-600	900-2500	150	300	400	600	900	1500	2500
1/2	14.3	14.3	14.3	14.3	14.3	19.1	19.1	19.1	19.1	19.1	31.8	31.8	47.6	54.0	54.0	54.0	63.5	63.5	69.9
3/4	20.6	20.6	20.6	20.6	20.6	25.4	25.4	25.4	25.4	25.4	39.7	39.7	57.2	66.7	66.7	66.7	69.9	69.9	76.2
1	27.0	27.0	27.0	27.0	27.0	31.8	31.8	31.8	31.8	31.8	47.6	47.6	66.7	73.0	73.0	73.0	79.4	79.4	85.7
1 1/4	38.1	38.1	33.3	33.3	33.3	47.6	47.6	39.7	39.7	39.7	60.3	60.3	76.2	82.6	82.6	82.6	88.9	88.9	104.8
1 1/2	44.5	44.5	41.3	41.3	41.3	54.0	54.0	47.6	47.6	47.6	69.9	69.9	85.7	95.3	95.3	95.3	98.4	98.4	17.5
2	55.6	55.6	52.4	52.4	52.4	69.9	69.9	58.7	58.7	58.7	85.7	85.7	104.8	111.1	111.1	111.1	142.9	142.9	146.1
2 1/2	66.7	66.7	63.5	63.5	63.5	82.6	82.6	69.9	69.9	69.9	98.4	98.4	123.8	130.2	130.2	130.2	165.1	165.1	168.3
3	81.0	78.7	78.7	78.7	78.7	101.6	101.6	95.3	92.1	92.1	120.7	120.7	136.5	149.2	149.2	149.2	168.3	174.6	196.9
4	106.4	102.6	102.6	97.8	97.8	127.0	120.7	120.7	117.5	117.5	149.2	149.2	174.6	181.0	177.8	193.7	206.4	209.6	235.0
5	131.8	128.3	128.3	124.5	124.5	155.6	147.6	147.6	142.9	142.9	177.8	177.8	196.9	215.9	212.7	241.3	247.7	254.0	279.4
6	157.2	154.9	154.9	147.3	147.3	182.6	174.6	174.6	171.5	171.5	209.6	209.6	222.3	250.8	247.7	266.7	288.9	282.6	317.5
8	215.9	205.7	196.9	196.9	196.9	233.4	225.4	222.3	215.9	215.9	263.5	257.2	279.4	308.0	304.8	320.7	358.8	352.4	387.4
10	268.3	255.3	246.1	246.1	246.1	287.3	274.6	276.2	266.7	269.9	317.5	311.2	339.7	362.0	358.8	400.1	435.0	435.0	476.3
12	317.5	307.3	292.1	292.1	292.1	339.7	327.0	323.9	323.9	317.5	374.7	368.3	409.6	422.3	419.1	457.2	498.5	520.7	549.3
14	349.3	342.9	320.7	320.7		371.5	362.0	355.6	362.0		406.4	400.1	450.9	485.8	482.6	492.1	520.7	577.9	
16	400.1	389.9	374.7	368.3		422.3	412.8	412.8	406.4		463.6	457.2	514.4	539.8	536.6	565.2	574.7	641.4	
18	449.3	438.2	425.5	425.5		474.7	469.9	463.6	463.6		527.1	520.7	549.3	596.9	593.7	612.8	638.2	704.9	
20	500.1	489.0	482.6	476.3		525.5	520.7	520.7	514.4		577.9	571.5	606.4	654.1	647.7	682.6	698.5	755.7	
24	603.3	590.6	590.6	577.9		628.7	628.7	628.7	616.0		685.8	679.5	717.6	774.7	768.4	790.6	838.2	901.7	

Dimensions in mm

GASKET DIMENSIONS

MACER® Type SG/IR suitable for BS 1560/ ASME B16.5 flanges - Imperial Dimension

SUPPLIED IN ACCORDANCE WITH ASME B 16.20

Nominal Bore	Inner Ring Inside Diameter					Sealing Element Inside Diameter					Sealing Element Out side Diameter		Centring Ring Outside Diameter Class Rating						
	150-300	400-600	900	1500	2500	150-300	400-600	900	1500	2500	150-	900-2500	150	300	400	600	900	1500	2500
½	0.56	0.56	0.56	0.56	0.75	0.75	0.75	0.75	0.75	0.75	1.25	1.25	1.88	2.13	2.13	2.13	2.50	2.50	2.75
3/4	0.81	0.81	0.81	0.81	0.81	1.00	1.00	1.00	1.00	1.00	1.56	1.56	2.25	2.63	2.63	2.63	2.75	2.75	3.00
1	1.06	1.06	1.06	1.06	1.06	1.25	1.25	1.25	1.25	1.25	1.88	1.88	2.63	2.88	2.88	2.88	3.13	3.13	3.38
1 1/4	1.50	1.50	1.31	1.31	1.31	1.88	1.88	1.56	1.56	1.56	2.38	2.38	3.00	3.25	3.25	3.25	3.50	3.50	4.13
1 1/2	1.75	1.75	1.63	1.63	1.63	2.13	2.13	1.88	1.88	1.88	2.75	2.75	3.38	3.75	3.75	3.75	3.88	3.88	4.63
2	2.19	2.19	2.06	2.06	2.06	2.75	2.75	2.31	2.31	2.13	3.38	3.38	4.13	4.38	4.38	4.38	5.63	5.63	5.7
2 1/2	2.62	2.62	2.50	2.50	2.50	3.25	3.25	2.75	2.75	2.75	3.88	3.88	4.88	5.13	5.13	5.13	6.50	6.50	6.63
3	3.19	3.10	3.10	3.10	3.10	4.00	4.00	3.75	3.63	3.63	4.75	4.75	5.38	5.88	5.88	5.88	6.63	6.88	7.75
4	4.19	4.04	4.04	3.85	3.85	5.00	4.75	4.75	4.63	4.63	5.88	5.88	6.88	7.13	7.00	7.63	8.13	8.25	9.25
5	5.19	5.05	5.05	4.90	4.90	6.13	5.81	5.81	5.63	5.63	7.00	7.00	7.75	8.50	8.38	9.50	9.75	10.00	11.00
6	6.19	6.10	6.10	5.80	5.80	7.19	6.88	6.88	6.75	6.75	8.25	8.25	87.25	9.88	9.75	10.50	11.38	11.13	12.50
8	8.50	8.10	7.75	7.75	7.75	9.19	8.88	8.75	8.50	8.50	10.38	10.13	1.00	12.13	12.00	12.63	14.13	13.88	15.25
10	10.56	10.5	9.69	9.69	9.69	9.69	11.31	10.81	10.88	10.50	10.63	12.50	12.25	13.38	14.25	14.13	15.75	17.13	18.75
12	12.50	12.10	11.50	11.50	11.50	13.38	12.88	12.75	12.75	12.50	14.75	14.50	16.13	16.63	16.50	18.00	19.63	20.50	21.63
14	13.75	13.50	12.63	12.63	14.63	14.25	14.00	14.25		16.00	15.75	17.75	19.13	19.00	19.38	20.50	22.75		
16	15.75	15.35	14.75	14.50	16.63	16.25	16.25	16.00		18.25	18.00	20.25	21.25	21.13	22.25	22.63	25.25		
18	17.69	17.25	16.75	16.75	18.69	18.50	18.25	18.25		20.75	20.50	21.63	23.50	23.38	24.13	25.13	27.75		
20	19.69	19.25	19.00	18.75	20.69	20.50	20.50	20.25		22.75	22.50	23.88	25.75	25.50	26.88	27.50	29.75		
24	23.75	23.25	23.25	22.75	24.75	24.75	24.75	24.25		27.00	26.75	28.25	30.50	30.25	31.13	33.00	35.50		

Dimensions in inches

GASKET DIMENSIONS

Inner Ring Inside Diameters for Spiral Wound Gaskets

USED IN ASME B16.47 SERIES A FLANGES					
Flange Size	Pressure Class				
(NPS)	150	300	400	600	900 (1,2)
26	25.75	25.75	26.00	25.50	26.00
28	27.75	27.75	28.00	27.50	28.00
30	29.75	29.75	29.75	29.75	30.25
32	31.75	31.75	32.00	32.00	32.00
34	33.75	33.75	34.00	34.00	34.00
36	35.75	35.75	36.13	36.13	36.25
38	37.75	37.50	37.50	37.50	39.75
40	39.75	39.50	39.38	39.75	41.75
42	41.75	41.50	41.38	42.00	43.75
44	43.75	43.50	43.50	43.75	45.50
46	45.75	45.38	46.00	45.75	48.00
48	47.75	47.63	47.50	48.00	50.00
50	49.75	49.00	49.50	50.00	
52	51.75	52.00	51.50	52.00	
54	53.50	53.25	53.25	54.25	
56	55.50	55.25	55.25	56.25	
58	57.50	57.00	57.25	58.00	
60	59.50	60.00	59.75	60.25	

GENERAL NOTES: *a. The inner ring thickness shall be 0.117 ins to 0.131 ins b. The inside diameter tolerance is +/- 0.12 ins*
c. Rings are suitable for use with pipe wall 0.38 ins or thicker

Dimensions in inches

NOTES: *1. Inner ring are required for Class 900 gaskets 2.There are no class 900 flanges NPS 50 and larger*

GASKET DIMENSIONS

Inner Ring Inside Diameters for Spiral Wound Gaskets

USED IN ASME B16.47 SERIES B FLANGES					
Flange Size	Pressure Class				
(NPS)	150	300	400	600	900 (1,2)
26	25.75	25.75	25.75	25.38	26.25
28	27.75	27.25	27.63	27.00	28.25
30	29.75	29.75	29.63	29.63	30.75
32	31.75	31.75	31.50	31.25	33.00
34	33.75	33.75	33.50	33.50	35.25
36	35.75	35.75	35.38	35.50	36.25
38	37.75	38.25	37.50	37.50	39.75
40	39.75	40.25	39.38	39.75	41.75
42	41.75	42.75	41.38	42.00	43.75
44	43.75	44.25	43.50	43.75	45.50
46	45.75	46.38	46.00	45.75	48.00
48	47.75	48.50	47.50	48.00	50.00
50	49.75	49.88	49.50	50.00	
52	51.75	51.88	51.50	52.00	
54	53.75	53.75	53.25	54.25	
56	56.00	56.25	55.25	56.25	
58	58.19	58.44	57.25	58.00	
60	60.44	61.31	59.75	60.25	

GENERAL NOTES: *a. The inner ring thickness shall be 0.117 ins to 0.131 ins b. The inside diameter tolerance is +/- 0.12 ins*
c. Rings are suitable for use with pipe wall 0.38 ins or thicker

Dimensions in inches

NOTES: *1. Inner ring are required for Class 900 gaskets 2.There are no class 900 flanges NPS 50 and larger Class 900 flange*
3. See pages 22 and 23 for Sealing element and guide ring dimensions.

GASKET DIMENSIONS

MACER® Type SGIR suitable for BS 1560/ASME B 16.5 flanges

SUPPLIEDIN ACCORDANCE WITH BS 3381

Nominal Bore	Inner ring I/D Minimum	Sealing Element Inside Diameter			Outside Diameter	Centring Ring Outside Diameter Class Rating					
		150	300-1500	2500	150-2500	150	300	600	900	500	2500
½	14.3	18.7	18.7	18.7	32.2	47.6	54	54	63.5	63.5	69.9
3/4	20.6	26.6	25	25	40.1	57.2	66.7	66.7	69.9	69.9	76.2
1	27	32.9	31.4	31.4	48	66.7	73	73	79.4	79.4	85.9
11/4	34.9	45.6	44.1	39.3	60.7	76.2	82.6	82.6	88.9	88.9	104.8
11/2	41.3	53.6	50.4	47.2	70.3	85.7	95.3	95.3	98.4	98.4	117.5
2	52.4	69.5	66.3	58.3	86.1	104.8	111.1	111.1	142.9	142.9	146.1
21/2	63.5	82.2	79	69.5	98.8	123.8	130.2	130.2	165.1	165.1	168.3
3	77.8	101.2	94.9	91.7	121.1	136.5	149.2	149.2	168.3	174.6	196.9
4	103.2	126.6	120.3	117.1	149.6	174.6	181	193.7	206.4	209.6	235
5	128.5	153.6	147.2	142.5	178.2	196.9	215.9	241.3	247.7	254	279.4
6	154	180.6	174.2	171.1	210	222.3	250.8	266.7	288.9	282.6	317.5
8	203.2	231.4	225	215.5	263.9	279.4	308	320.7	358.8	352.4	387.4
10	254	286.9	280.6	269.5	317.9	339.7	362	400.1	435	435	476.3
12	303.22	339.3	333	323.5	375.1	409.6	422.3	457.2	498.5	520.7	549.6
14	342.99	371.1	364.7		406.8	450.9	485.8	492.1	520.7	577.9	
16	393.7	421.9	415.5		464	514.4	539.8	565.2	574.7	641.4	
18	444.5	475.9	469.5		527.5	549.3	596.9	612.8	638.2	704.9	
20	495.3	526.7	520.3		578.3	606.4	654.1	682.6	698.5	755.7	
24	596.9	631.4	625.1		686.2	717.6	774.7	790.6	838.2	901.7	

Dimensions in mm

Up to 40 Bar dimensions in accordance with EN 1514-2

GASKET DIMENSIONS

MACER® Type SGIR suitable for DIN/EN 1092 flanges

Nominal Bore	Inner ring I/D Minimum	Sealing Element 10 bar - 40 bar		Sealing Element 64 bar-160 bar		Centring Ring Outside Diameter 10bar	16 bar	25 bar	40 bar	64 bar	100 bar	160 bar
		I/D	O/D	I/D	O/D	DIN 2632	DIN 2633	DIN 2634	DIN 2635	DIN 2636	DIN 2637	DIN 2638
10	15	24	36	24	36	48	48	48	48	58	58	58
15	19	28	40	28	40	53	53	53	53	63	63	63
20	24	34	47	34	48	63	63	63	63	74	74	74
25	30	41	55	41	56	73	73	73	73	84	84	84
32	39	50	66	50	67	84	84	84	84	90	90	90
40	45	56	72	56	74	94	94	94	94	105	105	105
50	56	68	86	68	88	109	109	109	109	115	121	121
65	72	84	103	81	102	129	129	129	129	140	146	146
80	84	97	117	97	120	144	144	144	144	150	156	156
100	108	123	144	120	142	164	164	170	170	176	183	183
125	133	148	170	148	174	194	194	196	196	213	220	220
150	160	177	200	177	205	220	220	226	226	250	260	260
175	184	200	224	200	231	250	250	256	268	280	290	287
200	209	229	255	225	256	275	275	286	293	312	327	327
250	262	283	310	283	319	330	331	343	355	367	394	391
300	311	332	360	332	369	380	386	403	420	427	461	461
350	355	375	405	375	413	440	446	460	477	489	515	
400	406	426	458	426	466	491	498	517	549	546	575	
450	452	477	512			541	558	567	574			
500	508	528	566	528	572	596	620	627	631	660	708	
600	610	635	675	635	683	698	737	734	750	768	818	
700	710	735	778	735	785	813	807	836	855	883	956	
800	811	836	879	836	886	920	914	945	978	994		
900	909	934	980	934	989	1020	1014	1045	1088	1114		

Dimensions in inches

GASKET DIMENSIONS

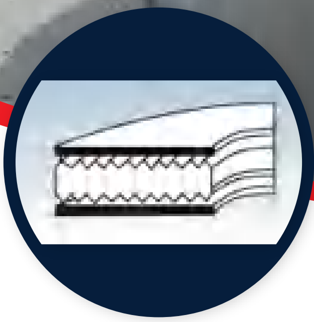
MACER® Type SG/IR suitable for BS 10 Welded Neck flanges

Nominal Bore	Inner Ring		Sealing Element		Centring Ring		Sealing Element		Centring Ring									Centring Ring	
	Tables D-R	Tables S,T	Tables D,E	Tables D	Table E	Table F	Table F,H,J,K,R		Table F	Table H	Table J	Table K	Table R	Table S (1931)		Table T		Table S	Table T
	I/D	O/D	O/D	O/D	I/D	O/D	O/D	O/D	O/D	O/D	O/D	I/D	O/D	I/D	O/D	I/D	O/D	O/D	O/D
½	0.56	0.63	1.03	1.47	2.13	2.13	2.13	1.03	1.53	2.13	2.63	2.63	2.63	1.06	1.56	1.06	1.56	2.75	3.25
3/4	0.81	0.88	1.25	1.69	2.38	2.38	1.25	1.75	2.38	2.63	2.63	2.63	2.63	1.38	1.88	1.38	1.88	2.75	3.25
1	1.06	1.13	1.56	2.06	2.75	2.75	1.56	2.19	2.81	2.81	2.81	3.13	3.13	1.63	2.19	1.63	2.19	3.25	3.50
1 1/4	1.31	1.38	1.88	2.38	2.94	2.94	1.88	2.50	3.25	3.25	3.25	3.25	3.25	1.88	2.50	1.88	2.50	3.50	3.88
1 1/2	1.58	1.63	2.13	2.63	3.38	3.38	2.13	2.75	3.50	3.50	3.50	3.75	3.75	2.13	2.81	2.13	2.81	4.00	4.50
2	2.06	2.13	2.63	3.13	3.88	3.88	2.63	3.25	4.38	4.38	4.25	4.38	4.38	2.63	3.44	2.63	3.44	4.50	5.00
2 1/2	2.56	2.63	3.25	3.88	4.38	4.38	3.25	4.00	5.13	5.13	5.00	5.00	5.00	3.13	3.94	3.25	4.06	5.00	5.53
3	3.06	3.13	3.81	4.44	5.13	5.13	3.81	4.56	5.88	5.88	5.75	5.75	5.75	3.63	4.44	3.75	4.69	5.63	6.50
3 1/2	3.56	3.63	4.31	4.94	5.88	5.88	4.31	5.06	6.38	6.38	6.25	6.38	6.38	4.13	4.94	4.25	5.31	6.63	7.38
4	4.06	4.13	4.88	5.50	6.38	6.38	4.88	5.63	6.88	6.88	6.75	6.88	6.88	4.75	5.69	4.75	5.81	7.00	8.13
4 1/2	4.56	4.63	5.38	6.00	6.88	6.88	5.38	6.25	7.50	7.50	7.38	7.38	7.38	5.25	6.13	5.25	6.38	7.50	9.00
5	5.06	5.13	5.88	6.50	7.63	7.63	5.88	6.75	8.50	8.50	8.38	8.38	8.38	5.75	6.63	5.75	6.88	8.38	9.63
6	6.06	6.13	6.88	7.50	8.63	8.50	6.88	7.75	9.50	9.50	9.38	9.38	9.38	9.38	6.75	7.63	6.75	7.88	9.75
7	7.06	7.13	7.88	8.63	9.63	9.50	7.88	8.88	10.75	10.75	10.63	10.50	10.50	7.75	8.88	7.25	9.13	11.38	13.13
8	8.06	8.13	8.88	9.63	10.88	10.75	8.88	9.88	12.00	12.00	11.88	11.50	11.75	8.88	10.00	8.88	10.25	12.75	14.50
9	9.06	9.13	9.88	10.63	12.13	12.00	9.88	10.88	13.13	13.13	13.00	13.00	13.00	9.88	11.00	9.88	11.38	14.13	16.13
10	10.06	10.13	10.88	11.63	13.25	13.25	11.00	12.00	14.13	14.13	14.00	14.00	14.25	10.88	12.13	10.88	12.38	15.50	17.75
11	11.06	11.13	11.88	12.63	14.25	14.25	12.00	13.00	15.13	15.13	15.00	15.13	15.88	11.88	13.13	11.88	13.38	17.13	19.25
12	12.06	12.13	12.88	13.75	15.25	15.13	13.00	14.13	16.38	16.38	16.25	15.88	16.88	12.88	14.13	12.88	14.63	18.50	20.75
13	13.06	13.13	14.50	15.38	16.50	16.38	14.25	15.38	17.50	17.50	17.38	17.75	18.25	13.88	15.25	13.88	15.63	19.75	22.00
14	14.06	14.13	15.50	16.38	17.63	17.63	15.25	16.38	18.50	18.50	18.38	18.75	19.50	14.88	16.25			21.25	
15	15.06	15.13	16.50	17.38	18.63	18.63	16.25	17.38	19.50	19.50	19.38	20.00	20.50	15.88	17.25			22.88	
16	16.06	16.13	17.50	18.38	19.63	19.63	17.50	18.75	20.75	20.75	20.63	21.00	21.75	16.88	18.38			24.25	
17	17.06		18.63	19.63	20.88	20.75	18.50	19.88	22.00	22.00	21.88	22.25	22.75						
18	18.06		19.63	20.63	22.13	22.13	19.50	20.88	22.88	22.88	22.75	24.38	25.13						
19	19.06		20.63	21.63	23.13	23.13	23.13	20.13	20.63	22.13	24.13	24.13	24.00						
20	20.06		21.63	22.63	24.38	24.38	21.63	21.63	23.13	25.38	25.38	25.25	26.50	27.25					
21	21.06		22.63	23.75	25.63	25.50	22.63	24.38	26.38	26.38	26.25								
22	22.06	23.63	24.75	26.50	26.50	23.63	25.38	27.38	27.38	27.25	28.75	29.75							
23	23.06	24.63	25.63	25.75	27.50	27.50	24.63	26.38	28.50	28.38									
24	24.06		25.63	26.75	28.75	28.63	25.63	27.38	29.50	29.38									

Dimension in inches

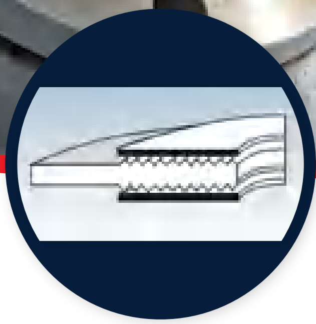
Spiral wound gaskets to ASME B 16.20 can be identified by the colour coding on the outside of the guide ring.
The soild colour denotes the grade of winding material, and coloured stripes identify the filler material used.

Gasket profiles



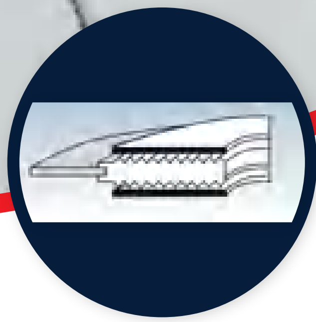
Type CK

Parallel root core for use in confined location including male and female, tongue and groove and recessed flange arrangements.



Type SGK

Parallel root core with integral centring rip_ for correct gasket positioning within the flange bolt circle. Type SG is recommendec for use on standard raised face and flat face flanges.



Type LGK

Parallel root core with loose fitting centring ring which reduces the possibility of damage to the core as a result of mechanical and thermal shock.

MACER®

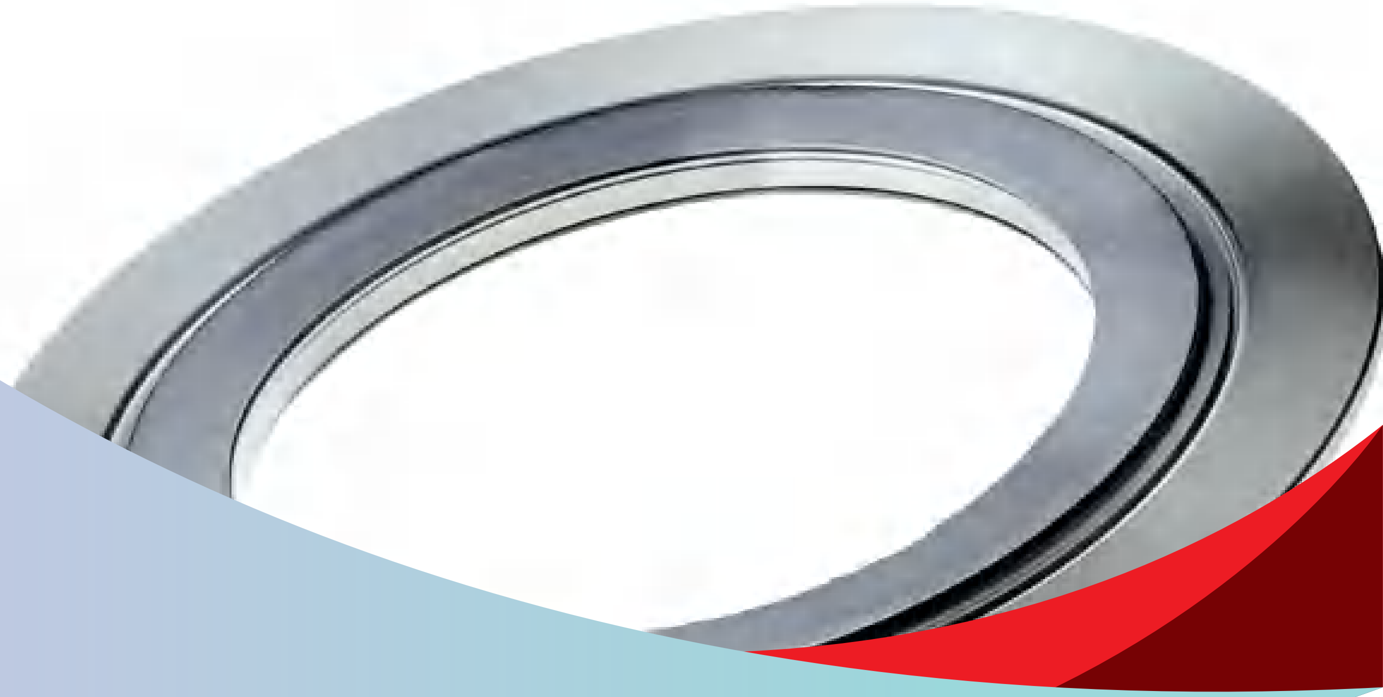
Kammprofile gasket

Kammprofile gaskets consist of a metal core with concentric serrated grooves on each side and the addition of a soft layer of sealing material bonded to each face. Selection of the metallic core material and sealing layer materials is dependent on the service duty.

The serrated metallic core is very effective for sealing in applications where high temperatures, high pressures and fluctuating conditions exist and can be used without sealing layers, but there is a risk of flange damage, especially at high seating load . The sealing layers protect the flange surfaces from damage and also offer excellent sealing properties when supported by the serrated metallic core.

Advantages

- Can seal pressures up to 250 bar.
- Can withstand temperatures up to 1000°C dependent on core and layer materials used
- Can maintain effective sealing performance in varying temperature and pressure conditions.
- Will not damage flange surface and can be removed easily.
- The serrated metallic core can be reused, subject to inspection after clearing and relayering .
- Can be made to suit existing arrangements, without modification.



Gasket materials

***MACER** ™ gaskets are available to order in a wide variety of component materials*

CORE SOFT MATERIAL	FACING MATERIAL	TEMPERA TURE LIMITS
304 304L 316 316 STAINLESS 320 STEEL 321 347 310	ST ANDARD PURITY GRAPHITE SPG' (98% min, purity) HIGH PURITY GRAPHITE 'HPG' (99.7% min. purity) NON-ASBEST OS FIBRE 'XA' (various proprietary grades)	500⁰ C (oxidising conditions) 600⁰ C (inert/reducing media) 650⁰ C (steam) 450⁰ C approx.
Monel 400 & K500 Nickel 200	PTFE	260⁰ C
Inconel 600, 625&X750 Incoloy 800 & 825	HIGH TEMPERATURE FILLER 'HTF'	1000⁰ C

Manufacturing parameters

Normally supplied with a 3.0mm or 4.0mm thick core and covering layers 0.5mm thick, but can also be supplied in other thicknesses.Diameters from 10mm N.B. upwards can be manufactured and the size limitation for each type of ***MACER™*** gasket is as follows:

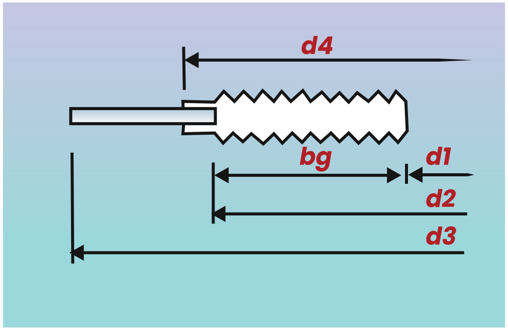
Type CK *up to 5000mm diameter*
Type SGK *up to 2000mm diameter*
Type LGK *up to 2000mm diameter*
For heat exchanger applications see Page 39 for typical pass partition bar configuration.

GASKET DIMENSIONS

Kammprofiles to suit - ASME B16.5/BS 1560 flanges

NPS	Sealing (mm)			Location ring -d3 (mm) Class					
	d1	d2	d4	150	300	600	900	1500	2500
1/2"	23.0	33.3	37.3	48	54	54	64	64	70
3/4"	28.6	39.7	43.7	57	67	67	70	70	76
1"	36.5	47.6	51.6	66	73	73	79	79	86
1 1/4"	44.4	60.3	64.3	76	83	83	89	89	105
1 1/2"	52.4	69.8	73.8	86	95	95	98	98	1B
2	69.8	88.9	92.9	105	1	1	143	143	146
2 1/2"	82.5	101.6	105.6	124	130	130	165	165	168
3"	98.4	123.8	127.8	136	149	149	168	175	197
4"	123.8	154.0	158.0	175	181	194	206	210	235
5"	150.8	182.6	186.6	197	216	241	248	254	279
6"	177.8	212.7	216.7	222	250	267	289	283	318
8"	228.6	266.7	270.7	279	308	321	359	352	387
10"	282.6	320.7	324.7	340	362	400	435	435	476
12"	339.7	377.8	381.8	410	422	457	499	521	550
14"	371.5	409.6	413.6	451	486	492	521	578	581
16"	422.3	466.7	470.7	514	540	565	575	641	644
18"	479.4	530.2	534.2	549	597	613	638	705	
20"	530.2	581.0	585.0	606	654	683	699	756	
24"	631.8	682.6	686.6	718	755	791	838	902	

MACER®gasket dimensions (½"to 24" NSP)

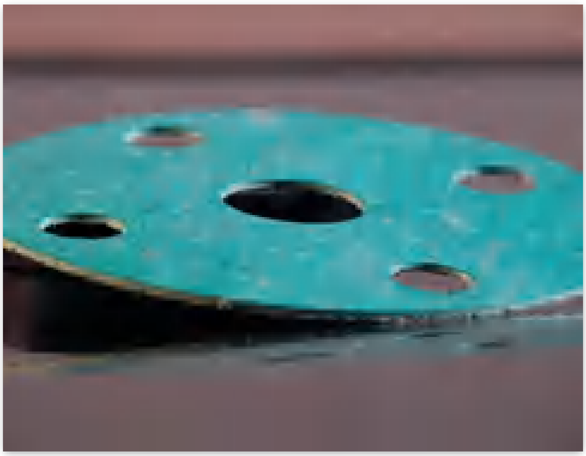


GASKET DIMENSIONS

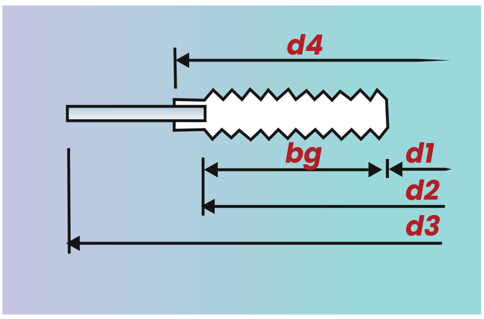
Kammprofiles to suit - ASME B16.47 Series A flanges

	Class 150				Class 300				
NPS	Sealing elements (mm)			Ring		Sealing element (mm)			Ring
	d1	d2	d4	d3	NPS	d1	d2	d4	d3
26"	673.1	704.8	708.8	774.7	26"	685.8	736.6	740.6	835.1
28"	723.9	755.7	759.7	831.1	28"	736.6	787.4	791.4	898.6
30"	774.7	806.5	810.5	882.6	30"	793.8	844.6	848.6	952.5
32"	825.5	860.6	864.6	939.8	32"	850.9	901.7	905.7	1006.6
34"	876.3	911.4	915.4	990.6	34"	901.7	952.5	956.5	1057.4
36"	927.1	968.5	972.5	1047.7	36"	955.8	1006.6	1010.6	1117.6
38"	977.9	1019.3	1023.3	1111.2	38"	977.9	1016.0	1020.0	1054.1
40"	1028.7	1070.1	1074.1	1162.0	40"	1022.4	1070.1	1074.1	1114.5
42"	1079.5	1124.0	1128.0	1219.2	42"	1073.2	1120.9	1124.9	1165.3
44"	1130.3	1178.1	1232.9	1276.3	44"	1130.3	1181.1	18Б.1	1219.2
46"	1181.1	1228.9	1232.9	1327.1	46"	1 178.1	1228.9	1232.9	1273.3
48"	1231.9	1279.7	1283.7	1384.3	48"	1235.2	1286.0	1290.0	1324.1
50"	1282.7	1333.5	1337.5	1435.1	50"	1295.4	1346.2	1350.2	1377.9
52"	1333.5	1384.3	1388.3	1492.2	52"	1346.2	1397.0	1401.0	1428.7
54"	1384.3	1435.1	1439.1	1549.4	54"	1403.4	1454.2	1458.2	1492.2
56"	1435.1	1485.9	1489.9	1606.5	56"	1454.2	1505.0	1509.0	1543.0
58"	1485.9	1536.7	1540.7	1663.7	58"	1511.3	1562.1	1566.1	1593.8
60"	1536.7	1587.5	1591.5	1714.5	60"	1562.1	1612.9	1616.9	1644.6

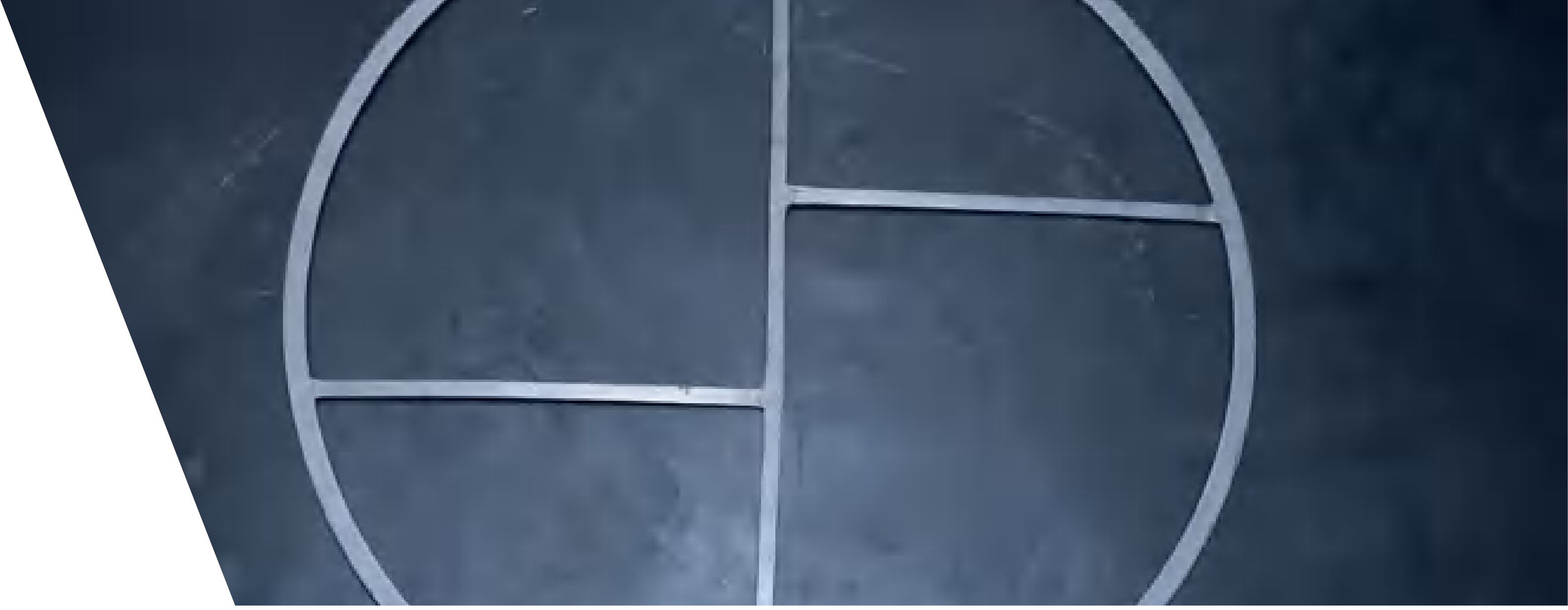
Dimensions in mm



MACER® gasket dimensions (above 24" NSP



Dimensions as per Spiral Wound gasket sizes in ASME B16.20, table 10, suit Series A flanges



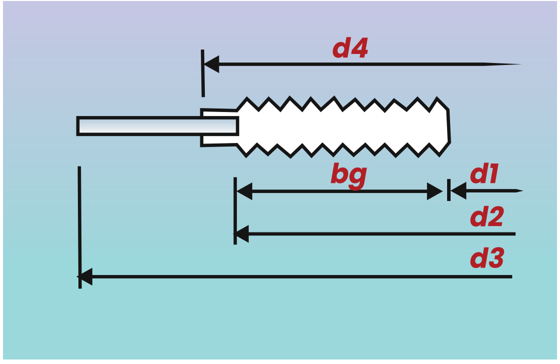
GASKET DIMENSIONS

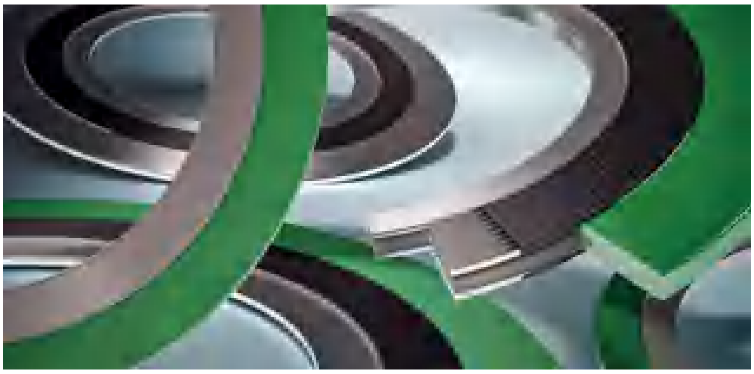
Kammprofiles to suit - ASME B16.47 Series A flanges continued

	Class 600				Class 900				
NPS	Sealing elements (mm)			Ring	Sealing element (mm)				Ring
	d1	d2	d4	d3	NPS	d1	d2	d4	d3
26"	685.8	736.6	740.6	866.9	26"	685.8	736.6	740.6	882.6
28"	736.6	787.4	791.4	914.4	28"	736.6	787.4	791.4	946.1
30"	793.8	844.6	849.6	971.5	30"	793.8	844.6	849.6	1009.6
32"	850.9	901.7	905.7	1022.3	32"	850.9	901.7	905.7	1073.1
34"	901.7	952.5	956.5	1073.1	34"	901.7	952.5	956.5	1136.6
36"	955.8	1006.6	1010.6	1130.3	36"	958.9	1009.7	1013.7	1200.1
38"	990.6	1041.4	1045.4	1104.9	38"	1035.1	1085.9	1089.9	1200.1
40"	1047.8	1098.6	1102.6	1155.7	40"	1098.6	1149.4	1153.4	1250.9
42"	1104.9	1155.7	1159.7	1219.2	42"	1149.4	1200.2	1204.2	1301.7
44"	1162.1	1212.9	1216.9	1270.0	44"	1206.5	1257.3	1261.3	1368.5
46"	1212.9	1263.7	1267.7	1327.1	46"	1270.0	1320.8	1324.8	1435.1
48"	1270.0	1320.8	1324.8	1390.6	48"	1320.8	1371.6	1375.6	1485.9
50"	1320.8	1371.6	1375.6	1447.8	50"				
52"	1371.6	1422.4	1426.4	1498.6	52"				
54"	1428.8	1479.6	1483.6	1555.7	54"				
56"	1479.6	1530.4	1534.4	1612.9	56"				
58"	1536.7	1587.5	1591.5	1663.7	58"				
60"	1593.9	1644.7	1648.7	1733.5	60"				

Dimensions in mm

MACER® gasket dimensions (above 24" NSP)





Dimensions as per Spiral Wound gasket sizes
in ASME B16.20, table 10, suit Series A flanges

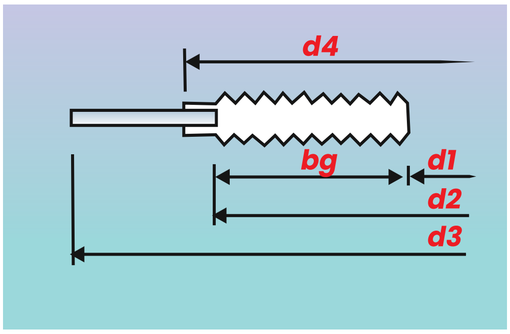
GASKET DIMENSIONS

Kammprofiles - DIN/BS EN 1092 flanges

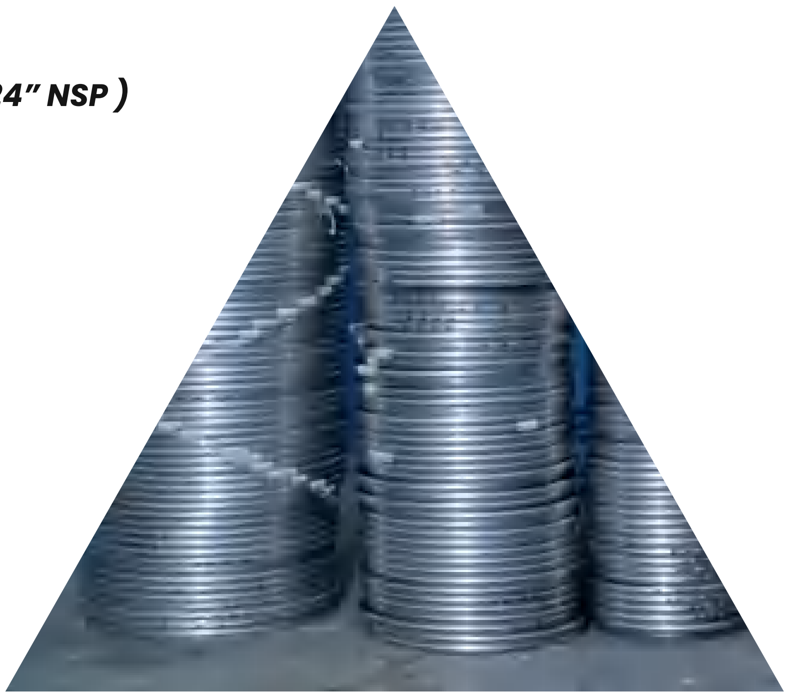
DN	d1	d4			Location ring OD d3									
		PN 10	PN 64/ 160	PN 250/ 400	PN 10	PN 16	PN 25	PN 40	PN 64	PN 100	PN 160	PN 250	PN 300	PN 400
10	22	36	36	36	46	46	46	46	56	56	56	67	67	67
15	26	42	42	42	51	51	51	51	61	61	61	72	72	
20	31	47	47	47	61	61	61	61						
25	36	52	52	52	71	71	71	71	82	82	82	83	92	104
32	46	62	62	66	82	82	82	82						
40	53	69	69	73	92	92	92	92	103	103	103	109	119	135
50	65	81	81	87	107	107	107	107	113	119	119	124	134	150
65	81	100	100	103	127	127	127	127	137	143	143	153	170	192
80	95	115	115	121	142	142	142	142	148	154	154	170	190	207
100	118	138	138	146	162	162	168	168	174	180	180	202	229	256
125	142	162	162	178	192	192	194	194	210	217	217	242	274	301
150	170	190	190	212	217	217	224	224	247	257	257	284	311	348
175	195	215	215	245	247	247	254	265	277	287	284	316	358	402
200	220	240	248	280	272	272	284	290	309	324	324	358	398	442
250	270	290	300	340	327	328	340	352	364	391	388	442	488	
300	320	340	356	400	377	383	400	417	424	458	458	436		
350	375	395	415		437	443	457	474	486	512				
400	426	450	474		489	495	514	546	543	572				
450	480	506			539	555		571						
500	530	560	588		594	617	624	628	657	704				
600	630	664	700		695	734	731	747	764	813				
700	730	770	812		810	804	833	852	879	950				
800	830	876	886		917	911	942	974	988					
900	930	982	994		1017	1011	1042	1084	1108					
1000	1040	1098	1110		1124	1128	1154	1194	1220					
1200	1250	1320	1334		1341	1342	1364	1398	1452					
1400	1440	1522			1548	1542	1578	1618						
1600	1650	1742			1772	1764	1798	1830						
1800	1850	1914			1972	1964	2000							
2000	2050	2120			2182	2168	2230							
2200	2250	2328			2384	2378								
2400	2450	2512			2594									
2600	2650	2728			2794									
2800	2850	2952			3014									

Dimensions in mm

MACER® gasket dimensions (above 24" NSP)



Dimensions taken from EN 1514 for EN 1092 flanges



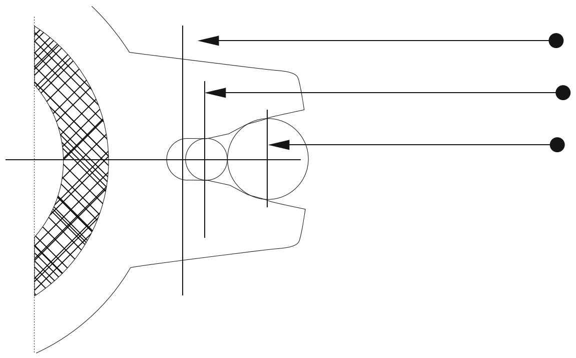
MACER®

Multifit gaskets

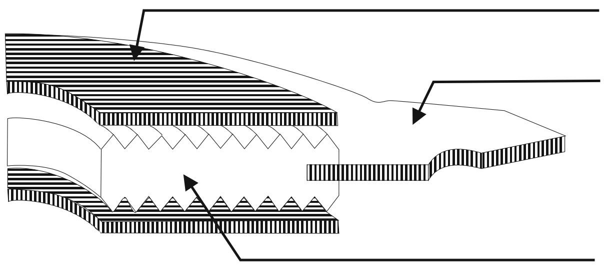
"One size fits all"

In the most popular piping classes (ASME 150,300,600 & DIN PN 10-100) only ONE gasket is required for each nominal bore size ½ through to 24" and 10 NB to 600 NB

User well proven Kammprofile gasket technology with specialy designed sealing element and location rings.



Standard gasket profile

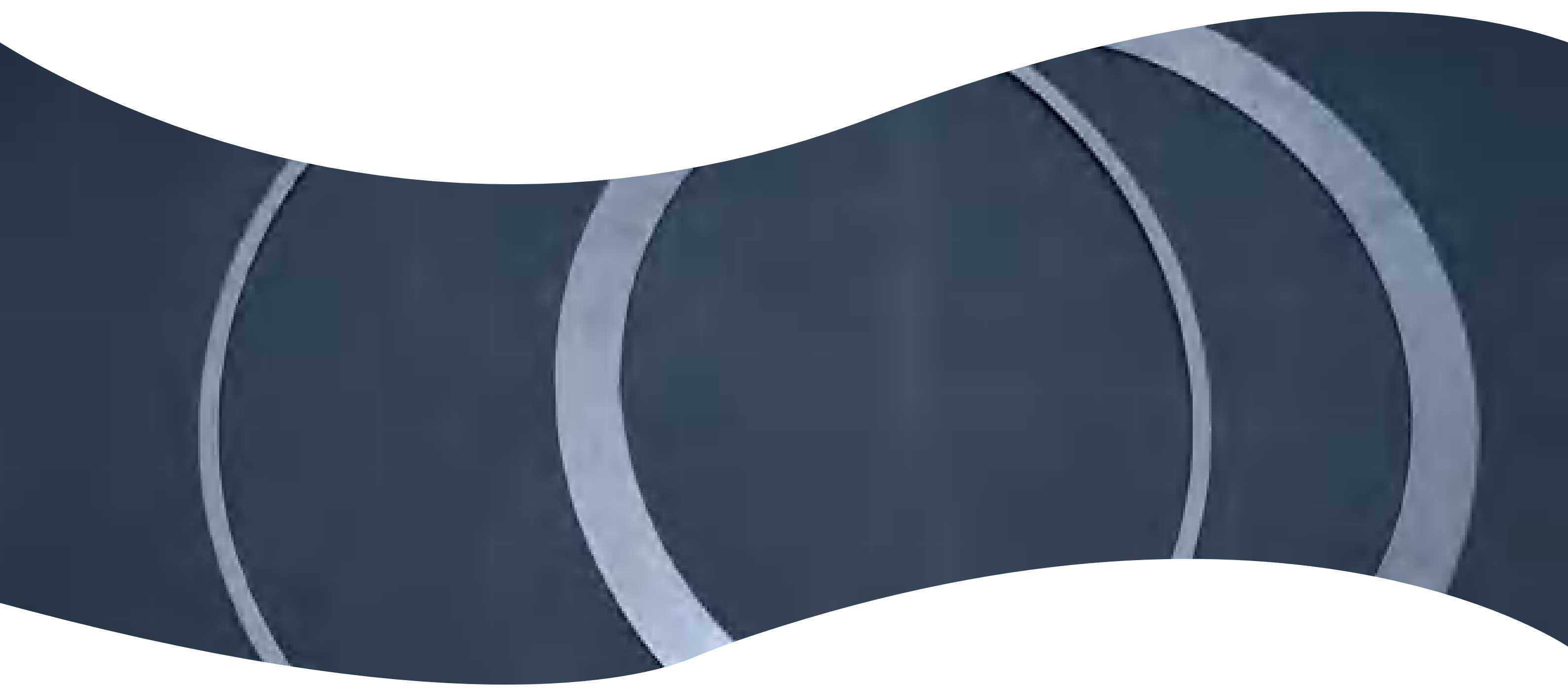


The cost effective Kammprofile

- Kammprofile consistency & performance.
- Self loading.
- Reduces & simplifies inventory.
- Minimises 'out of stock' risk.
- Reduces 'lifetime' cost.
- Re-usable 'clip in' outer guides.
- Re-usable sealing elements with new facings.
- Full range of materials available.
- Other sizes on application.

How to Order

- Quantity
- Nominal bore & pressure rating, e.g. 2" 150-600
- Flange description e.g. ASME, DIN
- Material combination e.g. 316L/graphite.



Spiral wound & Kammprofiles gaskets

Chemical suitablity guide

MET ALLIC COMPONENT	SS 304L 321 , 347	SS 31 6, 31 6L	NICKEL 200	MONEL 400	INCONEL 625
STEAM	A	A	A	A	A
STEAM CONDENSA TE	A	A	A	A	A
WATER	A	A	A	A	A
AIR	A	A	A	A	A
ACETIC ACID (50% @boiling)	C	B	B	A	B
ACETIC ANHYDRIDE (boiling)	A	A	A	A	A
ACET ONE (boiling)	A	A	A	A	A
ALUMINIUM CHLORIDE (20°C)	D	C	B	B	C
AMMONIA LIQUOR (boiling)	A	A	C	C	A
AMMONIUM CHLORIDE (50 % Boiling)	B	A	A	A	B
AMMONIUM NITRA TE (boiling)	A	A	E	E	B
ANILINE (concentrated@ 20°C)	A	A	A	A	A
BARIUM CHLORIDE (Boiling)	B	A	B	A	B
CHROMIUM PLA TING BA TH (20°C)	A	A	C	C	A
CITRIC ASCID(15% boiling)	B	A	B	A	A
COPPER SULPHA TE (Saturated/boiling)	A	A	C	C	C
CREOSOTE/T AR (hot)	A	A	A	A	A
ETHER (20°C)	A	A	A	A	A
ETHYL ALCOHOL(boiling)	A	A	A	A	A
ETHYL CHLORIDE (20°C)	A	A	A	A	A
ETHYLENE CHLORIDE (20°C)	A	A	A	A	A
FERRIC CHLORIDE (1% @ 20°C)	B	A	B	C	C
FLUORINE (20°C)	E	E	A	A	A
FORMALDEHYDE (formalin 40%)	B	A	A	A	A
FORMIC ACID (5% @ 65°C ,still)	B	A	A	A	A
FUEL OIL(hot)	A	A	B	B	A
FUEL OIL(+ sulphuric acid)	C	B	B	B	B
HYDROCHLORIC ACID (20°C)	E	E	B	B	C
HYDROFLUOSILICIC ACID (20°C)	E	D	A	A	B
HYDROGEN PEROXIDE (boiling)	B	A	O	O	O
HYDROGEN SULPHIDE (wet)	B	A	A	A	A
KEROSENE	A	A	A	A	A
LACTIC ACID (10% @ 65°C)	C	B	B	B	B
LINSEED OIL(20°C)	A	A	A	A	A
MAGNESIUM CHLORIDE (5% hot)	C	B	A	A	A
MAGNESIUM SULPHA TE (hot)	A	A	A	A	A

MET ALLIC COMPONENT	SS 304L 321,	SS 31 6, 31 6L	NICKEL 200	MONEL 400	INCONEL 625
METHYLALCOHOL(65°C)	C	B	A	A	A
NAPHTHA(20°C)	A	A	A	A	A
NICKEL CHLORIDE SOLUTION (20°C)	A	A	B	B	B
NICKEL SULPHATE (hot/cold)	A	A	A	A	A
NITRIC ACID (50% @ 20°C)	A	A	E	E	A
NITRIC ACID (65% @ boiling)	B	B	E	E	D
OIL - CRUDE (hot/cold)	A	A	A	A	A
OIL - VEG/MINERAL (hot/cold)	A	A	A	A	A
OXALIC ACID (10% boiling)	D	C	B	A	B
PHENOL	A	A	A	A	A
PHOSPHORIC ACID (10% @ 20°C)	C	B	B	B	B
PICRIC ACID (70%)	A	A	O	O	O
POT ASSIUM BICHROMATE (20°C)	A	A	A	A	A
POT ASSIUM CHLORIDE(5% boiling)	A	A	A	A	A
POT ASSIUM HYDROXIDE (50% boiling)	B	A	A	A	A
POT ASSIUM NITRATE (5% hot)	A	A	A	A	A
POT ASSIUM SULPHATE (5% hot)	A	A	A	A	A
POTASSIUM SULPHIDE (salt)	A	A	A	A	A
SEA WATER	A	A	A	A	A
SEW AGE	A	A	A	A	A
SODIUM CARBONATE (5%@ 65°C)	A	A	A	A	A
SODIUM CHLORIDE (saturated/boiling)	B	A	B	C	C
SODIUM HYDROXIDE	A	A	A	A	A
SODIUM HYPOCHLORITE (5% still)	B	A	C	C	C
SODIUM NITRA TE (fused)	C	B	A	B	A
SODIUM SULPHATE (20°C)	A	A	A	A	A
SULPHUR DIOXIDE (MOIST 20°C)	B	A	D	C	C
SULPHUR (WET)	B	A	B	B	A
SULPHURIC ACID (10% @ 20°C)	C	B	B	A	C
SULPHURIC ACID (fuming @20°C)	C	B	C	B	B
SULPHUROUS ACID (saturated 190°C)	C	B	E	E	E
TANNIC ACID (65°C)	A	A	A	A	A
TRICHLORACETIC ACID (20°C)	E	E	B	B	B
ZINC CHLORIDE (5% boiling)	B	B	B	B	B
ZINC SULPHATE (25% Boiling)	A	A	A	A	A

Notation :

A Fully resistant (less than 0.009mm penetration per month)
B Satisfactory (0.009mm - 0.09mm per month)
C Fairly resistant (0.09mm - 0.025mm per month)
D Slightly resistant (0.25mm - 0.9mm per month)
E Non-resistant (over 0.9mm per month)O Insufficient data available

Where chemical compatibility is not indicated, or a chemical is not listed, please consult our technical services team for a recommendation to be made

Due to the complexity of making a recommendation for any given duty, this section on chemical compatibility is intended only as a guide. The possible effect of elevated temperatures should be considered when determining the compatibility of these products with a chemical. If necessary, please contact our technical services team for assistance.

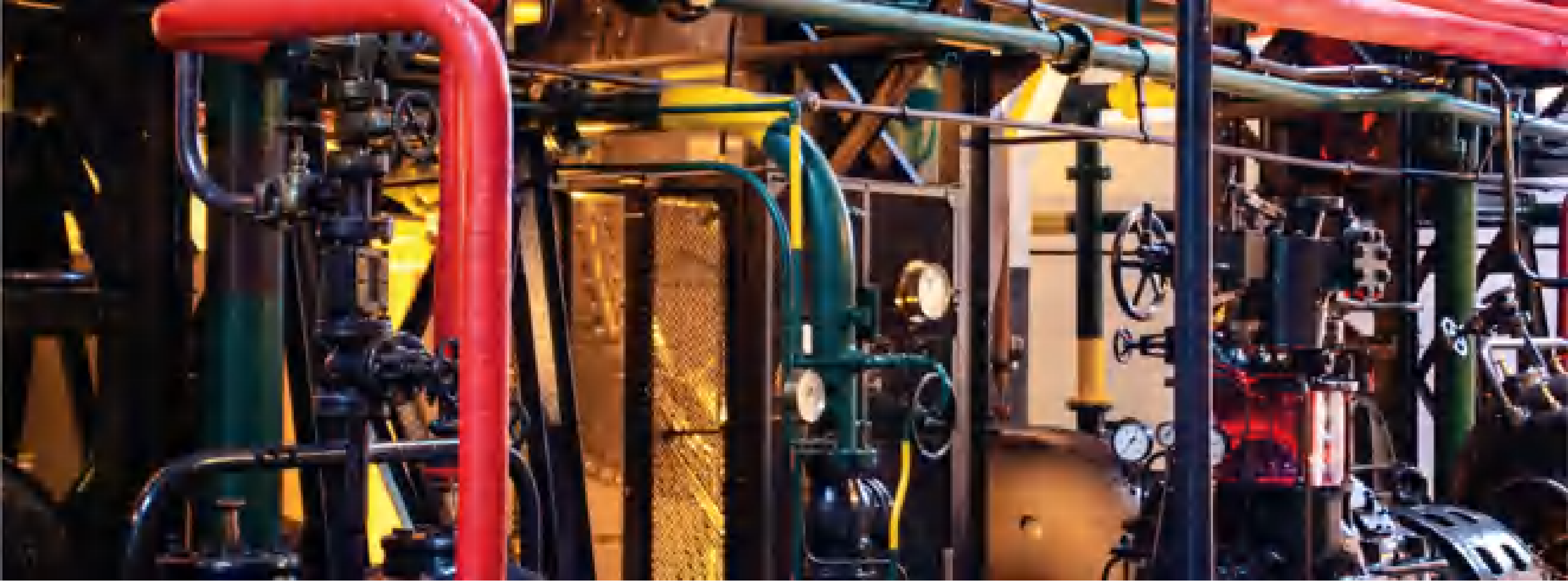
Filler and facing materials:

EXPANDED GRAPHITE: See details for Supagraph Plain Sheet

HTF (HIGH TEMPERATURE FILLER): When used with suitable winding steel grades, this material resists the majority of common media including; hot oil, fuels, acid, alcohols and esters. It should NOT be used with sulphuric, phosphoric, hydrofluoric or other strong mineral acids.

PTFE (WITH 25% GLASS FIBRE): This material is chemical inert to most media, with a few exceptions as follows :-
It offers only fair resistance to : ammonium hydroxide, bromine, chromic acid,hydroboric acid, hydrochloric acid, hydrocyanic acid, nitric acid (0.50%), phenol and sodium hydroxide.

It should NOT be used with :- fluorosilicic acid, hydrofluric acid, hydrogen sulphide solution or sodium silicate.



Metal
jacketed gaskets

These gaskets are specially designed and widely used for heat exchangers, autoclaves, columns, pressure vessels, flue stacks, boilers, gas mains, valve bonnets, pumps and similar services.

The gaskets are manufactured from a soft, pliable filler core surrounded by a metal jacket chemically and thermally resistant to the working conditions, which may totally or partially enclose the filler.

The majority of these types of gasket are supplied in circular form but can be manufactured to other shapes to suit individual requirements. The method of manufacture enables gaskets to be produced with almost no size limitation. They are produced in different styles to API, ASME, DIN and BS standards.

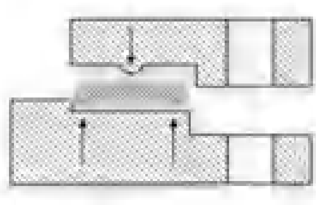
Metal jacketed gaskets are frequently required with pass partition bars, which may be manufactured by two methods, either with 'integral' bars or with bars welded onto the main gasket. Both methods have advantages and we are able to supply to either method of construction.

Integral bars

This method of construction ensures that the gaskets have uniform hardness around the main periphery of the primary seal and along the pass partition bars. As there is a solid join between the bars and the main gasket, the construction is more robust and eliminates the possibility of seepage of the media into the core of the gasket. This construction is recommended for the sealing of hazardous fluids. We recommend that this style has at least a 10mm radius at all intersections, this maintains a continuous metal overlap, which prevents splitting of the metal.

Welded bars

This method of construction has distinct commercial advantages as it allows full material utilisation. Welding is carried out using methods which ensure that metal hardening is minimized.

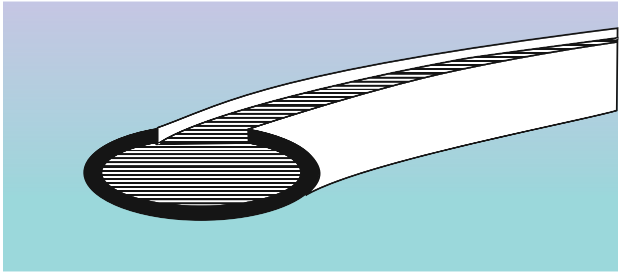


Flange nubbins

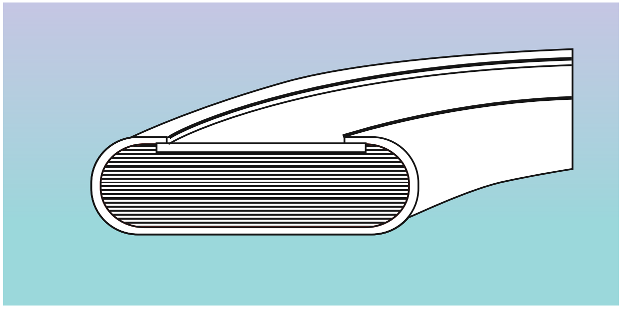
Flange nubbins are often used to increase stress and in such cases, care must be taken to install the gaskets with the seamed face on the opposite side.

The gasket seam should be on the opposite side to any fange nubbin (s)

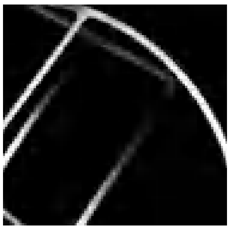
Metal jacketed gasket Styles

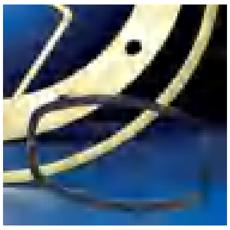


M120 Single jacketed Soft filler - open type



M123 Double jacketed Soft filler - totally enclosed





Metal jacketed gasket materials

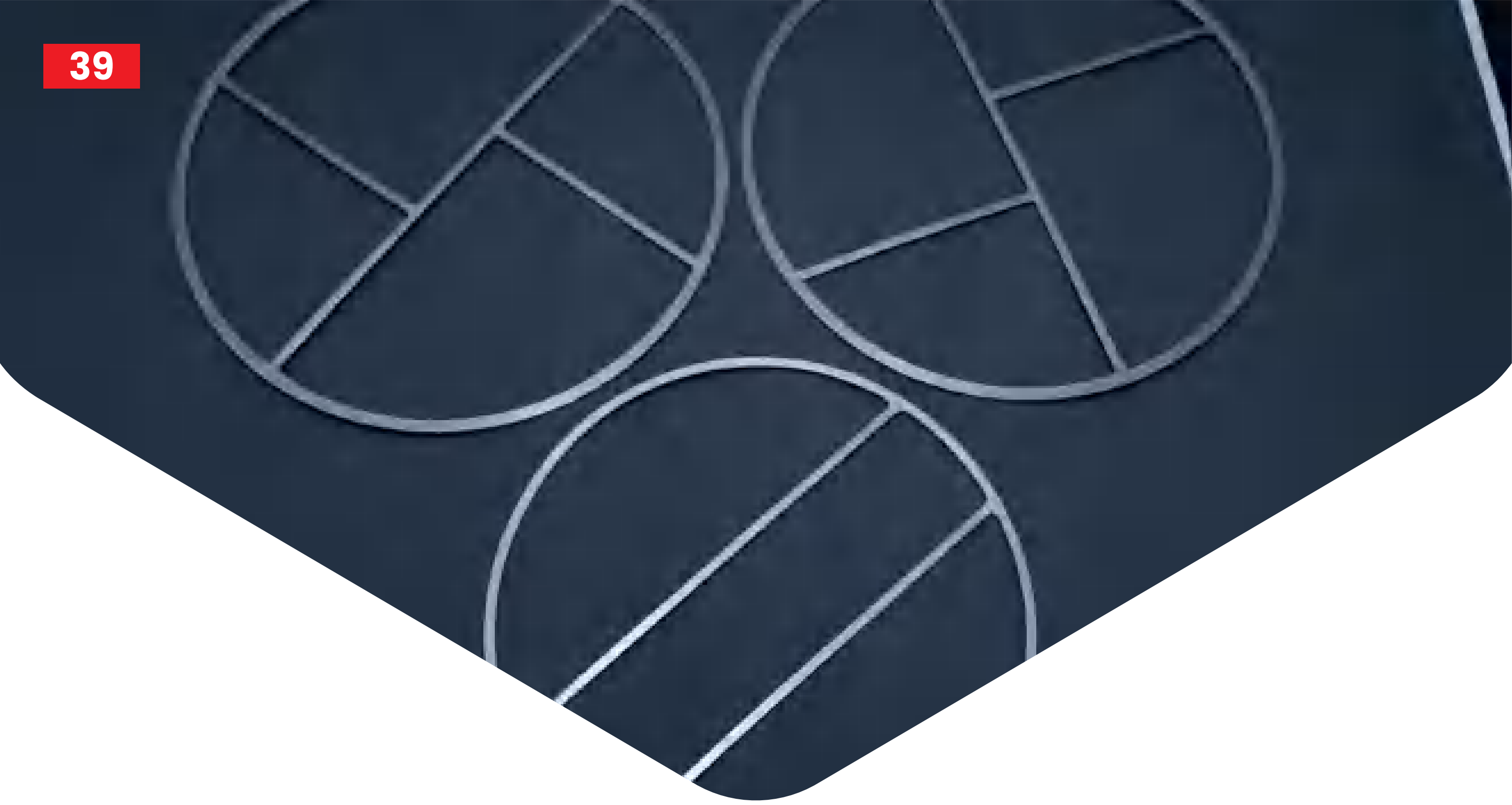
Metal Jacket

Metals are only used in the annealed condition and limit the hardness of the metal in line with international standards as shown.

Fillers

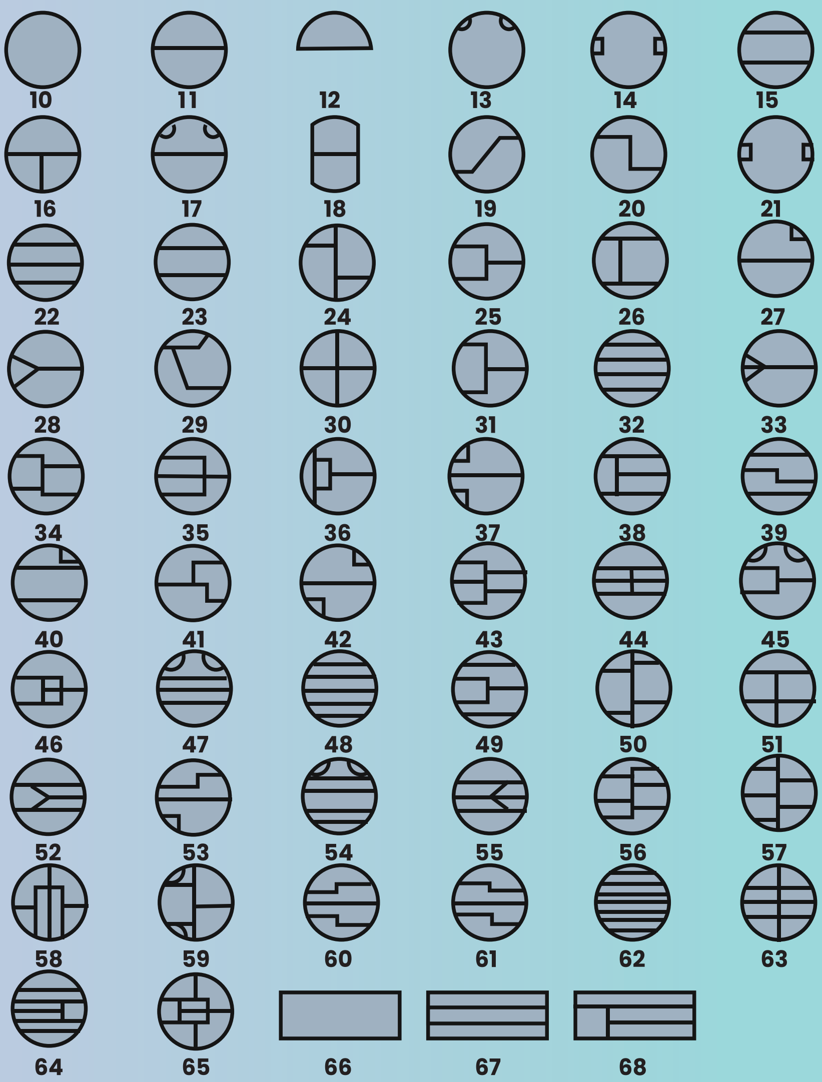
Selection of the correct filler is important and as standard we use a soft non-asbestos filler. This material is constructed from inorganic fibre and inert fillers, suitably bonded, which produces a material having very similar characteristics to those of asbestos millboard. A data sheet on this material is available on request. Alternative fillers include expanded graphite, PTFE & compressed non-asbestos fibre.

	MAXIMUM HARDNESS BRINELL
SOFT IRON	90
LOW CARBON STEEL	120
S304 STAINLESS STEEL	160
S316 STAINLESS STEEL	160
S321 STAINLESS STEEL	160
TITANIUM	
BRASS	
COPPER	
ALUMINIUM	
Fe 4/6% chrome ½% MOLY	130
410 11/13% chrome	170
NICKEL	
MONEL	
INCONEL	



Metal Jacketed Gaskets
Kammprofile Gaskets
Spiral Wound Gaskets

Heat Exchanger gasket shapes
- Typical pass partition bar configurations



MACER®
Metal ring joint gaskets

Protection

Soft iron and low carbon steel ring joint gaskets to API Standard 6A are supplied with zinc plating to 0.0002" - 0.0005" thick unless otherwise specified. Other platings are also available, if preferred. Unplated rings are treated with a rust preventive fluid.

During storage and handling it is very important that the mating faces (the oval radius or the chamfered face) are not damaged as this can lead to leakage when the ring joint is used in its particular application.

To afford the maximum degree of protection, MACER offer as an extra feature individual vacuum packaging. Gaskets are vacuum packed using a strong clear film onto a stout backing board. This style of packaging ensures full protection of the gasket, whilst allowing visual inspection of its condition and marking.

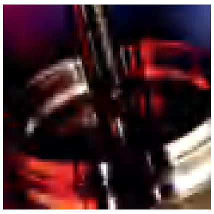
METAL	MAXIMUM HARDNESS IDENTIFICATION ROCKWELL B
SOFT IRON	56 (90 BHN) D
LOW CARBON STEEL	68 (120 BHN) S
F5 ALLOYS STEEL (4/6% Cr,1/2%Mo)	72 (130 BHN) F5
410 ALLOYS STEEL (11/13%Cr)	86 (170 BHN) S410
304 STAINLESS STEEL	83 (160 BHN) S304
304L STAINLESS STEEL	83 (160 BHN) S304L
316 STAINLESS STEEL	83 (160 BHN) S316
316L STAINLESS STEEL	83 (160 BHN) S316L
347 STAINLESS STEEL	83 (160 BHN) S347
321 STAINLESS STEEL	83 (160 BHN) S321
825 NICKEL ALLOY	93 (200 BHN) 825

Materials

Gasket metal should be selected to suit the service conditions and should be of a hardness lower than the flange metal. At MACER, the annealing process of the metal and the machining is carefully controlled to keep the hardness of the gasket below the maximum allowable, to ensure correct flow and sealing without damage to the flange surfaces.Checks carried out during manufacture ensure that the hardness of the finished product does not exceed the figures stated below.

The styles described are manufactured as standard and are available ex-stock or to short leadtimes. When ordering please submit the following data :

- *Gasket standard .*
- *Relevant ring number or nominal pipe size with rating.*
- *Material required.*
- *Oval or octagonal shape for style "R" gaskets.*
- *Quantity and required delivery.*



The principal types of material are:

Other stainless and super alloy steels, Duplex, Monel, Inconel, Incoloy, Nickel other materials are available. Based on almost 50 years of experience, Moorflex have established specifications to ensure gasket suitability. Certification and compliance with NACE MR0175 are standard features.

Identification and traceability

For convenience in ordering, numbers are assigned to gaskets and prefixed by the letter 'R','AX' or 'BX', followed by the material identification. Marking is effected so as not to injure the contact faces, nor to harmfully distort the gasket. MACER use only low stress DOT stamps approved to NACE standards in order to ensure that stresses are not introduced into the gasket.

All non-API gaskets are typically marked MACER R45 S316. Gaskets complying to API Standard 6A are additionally marked with API Monogram Licence No., Product Specification Level 4 and date of manufacture. (It is standard procedure for MACER to supply API 6A gaskets to PSL4) All API gaskets are typically marked:-**MACER 6A-0038 R45 S316-412/2001** (December 2001).

Traceability of material and constant monitoring of manufacture are essential for effective quality control. All MACER ring joint gaskets carry a **Material Reference Number**, which directly relates to the batch of material from which it was manufactured The MRN number is applied to the gasket in the same way as the identification marks. This reference is included in material certificates, thus ensuring full traceability of supply.

Series ‘R’ manufactured to the standards

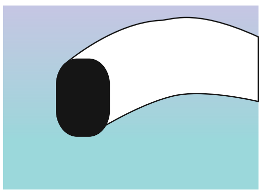
ASME B 16.20 - API Std 6A BS EN 12560-5

			HEIGHT					NORMINAL BORES			
Ring Number	Pitch	Width	Oval	Octagonal	Width of Flat on octagonal ring	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
R1	1.344	0.25	0.44	0.38	0.17		0.5	0.5			
R12	1.563	0.313	0.56	0.5	0.206				0.5	0.5	
R13	1.688	0.313	0.56	0.5	0.206		0.75	0.75			0.5
R14	1.75	0.313	0.56	0.5	0.206				0.75	0.75	
R15	1.875	0.313	0.56	0.5	0.206	1					
R16	2	0.313	0.56	0.5	0.206		1	1	1	1	0.75
R17	2.25	0.313	0.56	0.5	0.206	1.25					
R18	2.375	0.313	0.56	0.5	0.206		1.25	1.25	1.25	1.25	1
R19	2.563	0.313	0.56	0.5	0.206	1.5					
R20+	2.688	0.313	0.56	0.5	0.206		1.5	1.5	1.5	1.5	
R21	2.844	0.438	0.69	0.63	0.305						1.25
R22	3.25	0.313	0.56	0.5	0.206	2					
R23+	3.25	0.438	0.69	0.63	0.305		2	2			1.5
R24+	3.75	0.438	0.69	0.63	0.305				2	2	
R25	4	0.313	0.56	0.5	0.206	2.5					
R26+	4	0.438	0.69	0.63	0.305		2.5	2.5			2
R27+	4.25	0.438	0.69	0.63	0.305				2.5	2.5	
R28	4.375	0.5	0.75	0.69	0.341						
R29	4.5	0.313	0.56	0.5	0.206	3					
R30	4.625	0.438	0.69	0.63	0.305		3	3			
R31 +	4.875	0.438	0.69	0.63	0.305		3	3	3		
R32	5	0.5	0.75	0.69	0.341						3
R33	5.188	0.313	0.56	0.5	0.206	3.5					
R34	5.188	0.438	0.69	0.63	0.305		3.5	3.5			
R35+	5.375	0.438	0.69	0.63	0.305					3	
R36	5.875	0.313	0.56	0.5	0.206	4					
R37+	5.875	0.438	0.69	0.63	0.305		4	4	4		
R38	6.188	0.625	0.88	0.81	0.413						4
R39+	6.375	0.438	0.69	0.63	0.305					4	
R40	6.75	0.313	0.56	0.5	0.206	5					
R41+	7.125	0.438	0.69	0.63	0.305		5	5	5		
R42	7.5	0.75	1	0.94	0.485						5
R43	7.625	0.313	0.56	0.5	0.206	6					
R44+	7.625	0.438	0.69	0.63	0.305					5	
R45+	8.313	0.438	0.69	0.63	0.305		6	6	6		
R 46+	8.313	0.5	0.75	0.69	0.341					6	
R47+	9	0.75	1	0.94	0.485						6
R48	9.75	0.313	0.56	0.5	0.206	8					
R49+	10.625	0.438	0.69	0.63	0.305		8	8	8		

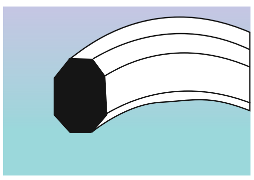
All dimensions are in inches. denotes API Std. 6ARing Joint gaskets.

Gasket styles and types

Series ‘R’ Oval



Series ‘R’ Octagonal



The **type R oval** configuration is the original ring joint design and was followed by the **type R octagonal** which offered more specific sealing contact areas. Both types can be used with flanges having the standard ring joint flat bottom groove and hold off flanges by a specified amount, relying entirely on correctly applied initial bolt-load for their proper operation in service.

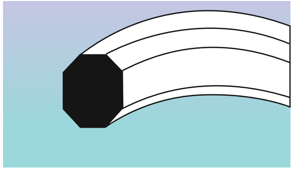
Available in ring numbers R11 through R105 to suit the following flange specifications.

NOMINAL PIPE SIZE	CLASS RATING AND STANDARD
½”-24” 150	150-2500 ASME B16.5 and BS1560
26” - 36”	300-600 MSS Sp44 and BS 3293
26” - 36”	900 MSS SP 44
11/2” - 20	API Spec. 6A

			HEIGHT						NORMINAL BORES		
Ring Number	Pitch	Width	Oval	Octagonal	Width of Flat on octagonal ring	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
R50+	10.625	0.625	0.88	0.81	0.413					8	
R51	11	0.875	1.13	1.06	0.583						8
R52	12	0.313	0.56	0.5	0.206	10					
R53+	12.75	0.438	0.69	0.63	0.305		10	10	10		
R54+	12.75	0.625	0.88	0.81	0.413					10	
R55	13.5	1.125	1.44	1.38	0.78						10
R56	15	0.313	0.56	0.5	0.206	12					
R57+	15	0.438	0.69	0.63	0.305		12	12	12		
R58	15	0.875	1.13	1.06	0.583					12	
R59	15.625	0.313	0.56	0.5	0.206	14					
R60	16	1.25	1.56	1.5	0.879						12
R61	16.5	0.438	0.69	0.63	0.305		14	14			
R62	16.5	0.625	0.88	0.81	0.413				14		
R63+	16.5	1	1.31	1.25	0.681					14	
R64	17.875	0.313	0.56	0.5	0.206	16					
R65+	18.5	0.438	0.69	0.63	0.305		16	16			
R66+	18.5	0.625	0.88	0.81	0.416				16		
R67	18.5	1.125	1.44	1.38	0.78					16	
R68	20.375	0.313	0.56	0.5	0.206	18					
R69+	21	0.438	0.69	0.63	0.305		18	18			
R70+	21	0.75	1	0.94	0.485				18		
R71	21	1.125	1.44	1.38	0.78					18	
R72	22	0.313	0.56	0.5	0.206	20					
R73+	23	0.5	0.75	0.69	0.641		20	20			
R74+	23	0.75	1	0.94	0.485				20		
R75	23	1.25	1.56	1.5	0.879					20	
R76	26.5	0.313	0.56	0.5	0.206	24					
R77	27.25	0.625	0.88	0.81	0413		24	24			
R78	27.25	1	1.31	1.25	0.681				24		
R79	27.25	1.375	1.75	1.63	0.977					24	
R80	24.25	0.313		0.5	0.206	22					
R81	25	0.563		0.75	0.377		22	22			
R82+	2.25	0.438		0.63	0.305						
R84+	2.5	0.438		0.63	0.305						
R85+	3.125	0.5		0.69	0.341						
R86+	3.563	0.625		0.81	0.413						
R87+	3.938	0.625		0.81	0.413						
R88+	4.875	0.75		0.94	0.485						
R89+	4.5	0.75		0.94	0.485						
R90+	6.125	0.875		1.06	0.583						
R91+	10.25	1.25		1.5	0.879						
R92	9	0.438		0.63	0.305						
R93	29.5	0.75		0.94	0.485		26	26			
R94	31.5	0.75		0.94	0.485		28	28			
R95	33.75	0.75		0.94	0.485		30	30			
R96	36	0.875		1.06	0.583		32	32			
R97	38	0.875		1.06	0.583		34	34			
R98	40.25	0.875		1.06	0.583		36	36			
R99+	9.25	0.438		0.63	0.305						
R100	29.5	1.125		1.38	0.78				26		
R101	31.5	1.25		1.5	0.879				28		
R102	33.75	1.25		1.5	0.879				30		
R103	36	1.25		1.5	0.879				32		
R104	38	1.375		1.63	0.977				34		
R105	40.25	1.375		1.63	0.977				36		

All dimensions are in inches. denotes API Std. 6ARing Joint gaskets.

Series 'RX'



As well-head pressures increased to 700 bar (10,000lbf/in^2) and beyond, flanges designed with type 'R' oval or octagonal rings became excessively heavy, requiring impractically large bolts to perform the double duty of holding pressure while keeping the gasket compact.The solution to this problem was found inhigher strength materials and the development of the 'RX' and 'BX' series joint which are pressure energised. (The higher the contained pressure, the tighter the seal). The 'RX' Style Ring Joint has the unique self-sealing action. The outside bevels of the ring make the initial contact with the groove as the flanges are brought together, thus pre-loading the gasket against the grooved outer surfaces. Internal pressure during service increases this loading and, therefore, the gasket's sealing performance. Available in ring numbers RX20 through RX215 to suit the following flange specifications:

NOMINAL PIPE SIZE	CLASS RATING AND STANDARD
1 ½"- 20"	720 - 5,000 API 6B Flanges

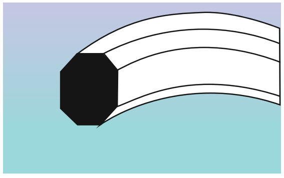
Series 'RX' manufactured to the standards

ASME B 16.20 - API Std 6A

GASKET DIMENSIONS				PRESSURE CLASS RATING			
Ring No.	I/D	O/D	Height	720-960 2000	2900	3000	5000
						Nominal Pipe Size	
RX 20	2.313	3.000	0.750	1.1/2		1.1/2	
RX 23	2.672	3.672	1	2			
RX 24	3.234	4.172	1			2	2
RX 25	3.625	4.313	0.750				3.1/8
RX 26	3.469	4.406	1	2.1/2			
RX 27	3.719	4.656	1			2.1/2	2.1/2
RX 31	4.359	5.297	1	3		3	
RX35	4.859	5.797	1				3
RX37	5.359	6.297	1	4		4	
RX 39	5.859	6.797	1				4
RX 41	6.609	7.547	1	5		5	
RX 44	7.109	8.047	1				5
RX 45	7.797	8.734	1	6		6	
RX 46	7.688	8.750	1.125				6
RX47	8.094	9.656	1.625				8
RX 49	10.109	11.047	1	8		8	
RX50	9.844	11.156	1.250				8
RX 53	12.234	13.172	1	10		10	
RX 54	11.969	13.281	1.250				10
RX 57	14.484	15.422	1	12		12	
RX63	15.266	17.391	2				14
RX 65	17.984	18.922	1	16			
RX 66	17.719	19.031	1.250			16	
RX 69	20.484	21.422	1	18			
RX 70	20.094	21.656	1.625			18	
RX 73	22.406	23.469	1.250	20			
RX 74	22.094	23.656	1.625			20	
RX 82	1.734	2.672	1		1		
RX 84	1.984	2.922	1		1.1/2		
RX 85	2.484	3.547	1		2		
RX 86	2.891	4.078	1.125		2.1/2		
RX 87	3.266	4.453	1.125		3		
RX 88	4.109	5.484	1.250		4		
RX 89	3.672	5.109	1.250		3.1/2		
RX 90	5.188	6.875	1.750		5		
RX 91	8.922	11.297	1.781		10		
RX 99	8.734	9.672	1	8		8	
RX 201	1.573	2.026	0.445				1.3/8
RX 205	2.016	2.453	0.437				1.13/16
RX 210	3.094	3.844	0.750				2.9/16
RX 215	4.609	5.547	1				4.1/16

All dimensions are in inches. ^ Denotes API Std. 6A Ring Joint Gaskets.

Style 'BX' Ring joint Gaskets can only be used with special 'BX' grooves and are not interchangeable with the Style 'RX' series.



Series 'BX'

Designed to API specifications for use with grooved flanges on special applications involving high pressure up to 20,000 p.s.i. the 'BX' series is available in ring numbers BX 150 through BX 303 to suit the following flange specifications:

NOMINAL PIPE SIZE	CLASS RATING AND STANDARD
1 /16" - 21 /4"	5,000-20,000 API 6 BX Flanges

Series 'BX' manufactured to the standards

ASME B 16.20 - API Std 6A

GASKET DIMENSIONS				PRESSURE CLASS RATING					
Ring No.	I/D	O/D	Height	2000	3000	5000	10000	15000	20000
				Nominal Pipe Size					
BX 150	2.110	2.842	0.366				1.1 1/16	1.1 1/16	
BX 151	2.250	3.008	0.379				1.13/16	1.13/16	
BX 152	2.528	3.334	0.403				2.1/16	2.1/16	2.1/16
BX 153	3.078	3.974	0.448				2.9/16	2.9/16	2.9/16
BX 154	3.624	4.600	0.488				3.1/16	3.1/16	3.1/16
BX 155	4.705	5.825	0.560				4.1/16	4.1/16	4.1/16
BX 156	7.901	9.637	0.733				7.1/16	7.1/16	7.1/16
BX 157	9.941	11.593	0.826			9	9		
BX 158	12.038	13.860	0.911				11	11	11
BX 159	14.776	16.800	1.012				13.5/8	13.5/8	13.5/8
BX 160	14.768	15.850	0.938			13.5/8			
BX 161	18.071	19.347	1.105			16.3/4			
BX 162	17.600	18.720	0.560			16.3/4	16.3/4	16.3/4	
BX 163	20.528	21.896	1.185			18.3/4			
BX 164	20.527	22.463	1.185				18.3/4	18.3/4	
BX 165	23.139	24.595	1.261			21.1/4			
BX 166	23.140	25.198	1.261				21.1/4		
BX 167	28.864	29.896	1.412	26.3/4					
BX 168	28.864	30.128	1.412		26.3/4				
BX 169	5.813	6.831	0.624				5.1/8		
BX 170	7.464	8.584	0.560				6.5/8	6.5/8	
BX 171	9.409	10.529	0.560				8.9/16	8.9/16	
BX 172	11.993	13.113	0.560				11.5/32	11.5/32	
BX 303	32.237	33.573	1.494	30	30				

Dimensions in inches

Calculation Methods

As stated in section 2, the load-sealability characteristics of a gasket are quite complex. Incorporating these effects into a reliable flange design method has been the objective of designers for many years, and a number of flange design codes are now well recognised. The ASME VIII and DIN 2505 codes are well established and successfully in use. However, certain limitations in these codes have lead to research and development of alternatives, such as the PVRC and CEN methods. Macer recognises both the merits and limitations of all the methods which have been summarised and commented upon in the following paragraphs. Individual design parameters will dictate the most appropriate method and for further advice on gasket selection and relevant load sealability requirements, please contact our technical specialists.

a ASME VIII

The ASME code has been used for many years to design flanges, though has a number of recognised flaws when it comes to determining a suitable bolt load with regard to gasket sealing. Calculations are performed to determine greater of either the operating or initial forces using the following formulae.

The factors 'm' and 'y' are the 'gasket factor' and initial seating stress values respectively. One problem is that the code does not utilise the whole gasket contact area in the calculation. In the formulae above, the "effective width" is 'b' and the "effective diameter" is 'G'. The system pressure is designated as 'P' in these equations. If we consider a common raised-face flange, then the contact width of the gasket element (from the raised face outside diameter to the gasket inside diameter) is designated as 'N'. The basic width is then calculated as being 1/2 this value and called b The "effective width" Othen depends upon the value of be being greater or less than 1/4", though in the majority of cases this is likely. If b is Ogreater than 1/4", then the effective width is calculated as:-

(Or for cases where b_0 is equal or less than 1/4", then b = b_0) OThe effective diameter 'G' is simply the outside contact diameter less 2 x b_o Therefore, the actual gasket contact area is usually far greater in reality that the calculated figure by this method. Note also that the gasket factor 'm' is effectively a multiplier of the system pressure as an operating stress. However as shown in section 2, the actual sealing performance of a gasket is more realistically a 3 dimensional, exponential decay curve, rather than a single number.

Again, as per section 2, we know that it is the operational stress that defines gasket sealability. There seems to be no real reason to try and link initial gasket seating loads (i.e. for compression purposes, to take up flange flatness etc.) with the 'm' factor which is related to the operating stress requirement for a given system pressure. However, when originally devised in the 1930's and 1940's, the relationship existed between the factors of :-

$$(2m-1) \times 180 = y$$

(using y in units of p.s.i, and rounding-off the m factor to the nearest 0.25)Thus, for compressed fibre gaskets, a lower y value was determined for the thicker materials, presumably because they would deform more readily to make a crude seal against whatever flange distortion existed. Thus, from the relationship above, the thicker materials also gained a lower m factor, suggesting that they -would give better sealing performance. However, again as per section 2 of this manual we know that thicker materials not only have a greater tendency to stress-relax, but also have a greater number of micro-porosity channels where leakage can occur. Indeed, in searching gas sealability tests, then a 3 mm , thick compressed fibre jointing material tends to leak at approximately twice the rate of a 1.5 mm sample of the same material at a given operating stress.

a ASME VIII

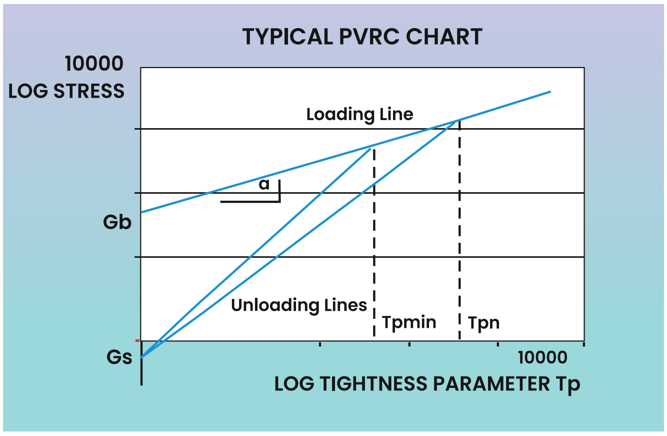
This method also employs gasket factors that are used to determine the bolt load requirement. There are the maximum and minimum stress levels for installation at ambient temperature, as well as a maximum stress at elevated temperature

The maximum initial gasket stress allowable is a function of the width to thickness ratio to avoid crushing effects on soft materials. This method also has an 'm' factor, though uses the actual contact width of the gasket in the calculations. Thus, this method is less likely to produce insufficient gasket stressthan by ASME VIII, especially as the minimum initial gasket stress values given in the code are fairly conservative.

Another popular European design method used to determine bolt load requirements is the AD-Merkblatt B7, where again the initial and operating bolt load requirements are determined using gasket factors. These are kl, k0 and KD, which relate to the effective widths and deformation resistance of the gaskets concerned.Note that both of the above methods are now generally tending to .be replaced by the new EN 1591 design method.

c PVRC

For a number of years the Pressure Vessel Research Council has recognised some of the inadequacies of the ASME code andsought to provide a better means of calculating the required gasket loading. The proposed calculation requires gasket data to be developed from a series of loading and unloading leak tightness tests in order to obtain coefficients to describe the sealing performance of the gasket.This method uses the concept of 'Tightness Parameter', where the gasket sealability is related to a dimensionless number thus:



This formula essentially relates the test pressure to atmospheric pressure, and the measured leak rate against a unitary leak rate measured in mg/sec/mm diameter of gasket. The index of 0.5 suggests that doubling the system pressure will in fact produce a fourfold increase in leak rate, though this is perhaps a worst-case scenario for most gaskets.The coefficients used in the calculation are G , a, and G and are derived from the b ssealablility test as shown in the Typical PVRC Chart.

There is some debate about the reliability and repeatability of the coefficients as they are derived from the log-log plot of an assumed square-law relationship, so relatively minor changes in leak rate during the test could affect the final data reduction.

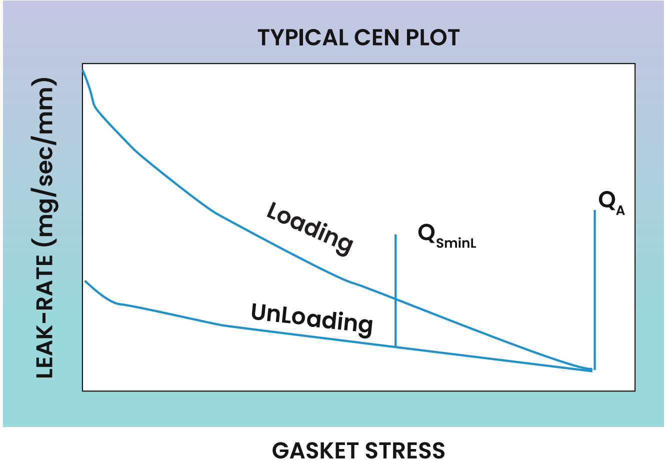
However, the coefficients are at least derived from actual tightness testing, so the calculation becomes realistic in terms of typical in-service performance of the gasket.

d CEN

Like the PVRC method, this uses loadingunloading gasket sealing tests to determine the gasket performance characteristics. They are used in a flange calculation method (EN1591) which is quite iterative and complex in nature. As a gasket is loaded, some flange rotation may occur, changing the effective stress on the gasket from the inside to outside contact position (as described previously in section 1).The gasket seals differently in the unloading phase of the test compared to the loading cycle. If we consider that a gasket is loaded to point Q initially, and Aunloaded by the hydrostatic to the operating stress Q as shown in the SminLdiagram below, then we can see that the sealability decreases slightly between these two points. However, the sealability is generally better than when this stress level was applied during the loading phase.

As mentioned in section 1, the unloading modulus of the gasket changes with increased initial stress. Therefore, the change in sealability between QA and Q_{SminL}will change depending upon the actual value of Q applied. This standard uses Athe unloading modulus of the gasket in the calculations to examine the stiffness of the gasket as a part of the overall joint stiffness. The EN 1591 method looks at the required sealability from loading-unloading tests. By knowing the degree of unloading on the joint from the hydrostaticforces and the tightness level desired, it is possible to calculate the flange deflection and effective gasket stress for a given bolt load. Therefore, changes to the flange geometry and' applied bolt load will determine the amount of flange rotation, the change in gasket stress across the sealing element, both in the initial and operating conditions, and therefore the degree of tightness achieved.The problem with this method is that it can be quite iterative and complex, though computer programmes are becoming available which will make the calculation method easier to perform.

The degree of gasket testing required can also be considerable, and work is underway to look at combining the methodologies of both the CEN and PVRC testing to harmonise the test protocols.



Best Practice

(A) Do's and Don'ts

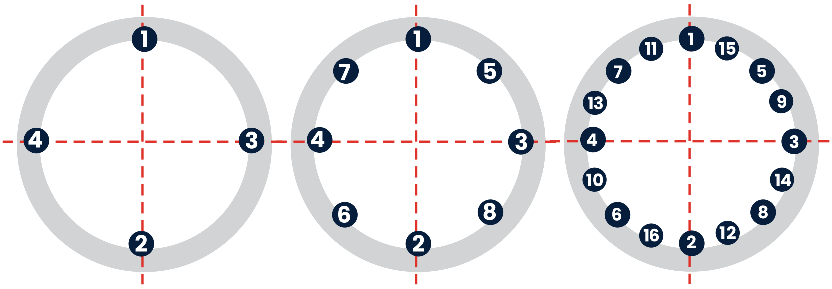
- Mating flanges should be of the same type and correctly aligned .
- Fasteners should be selected to ensure that they do not exceed their elastic limit at the required tension.
- Do not re-torque elastomer bound compressed non-asbestos gaskets after exposure to elevated temperatures (they may well have hardened and are at risk of cracking).
- Ensure that fasteners show no signs of corrosion, which might affect their load bearing capacity.
- Nuts should have a specified proof load 20% greater than the UTS of the fastener.
- Hardened steel washers of the same material as the nuts should always be used.
- A thread lubricant or anti galling compound should be used on bolting as appropriate, but only a thin uniform coating should be applied. Where stainless steel is used, it should be ensured that such coating are suitable for use.
- A thread lubricant or anti galling compound should be used on bolting as appropriate, but only a thin uniform coating should be applied. Where stainless steel is used, it should be ensured that such coating are suitable for use.
- Fasteners and/or gasket should never be re-used.
- Good quality gasket should always be procured from reputable suppliers only.
- Gasket should be kept as thin as possible.
- Gasket should never be hammered out against the flange, it will also damage the gasket and thereby reduce gasket performance.
- When cutting full-face gaskets, the bolt holes should be cut first, followed by the gasket outer and inner diameters. Note that if the bolt holes are fairly close to the gasket O/D, then punching out the holes last may produce enough street to crack the gasket at this point.
- Gasket should be stored in a cool dry place, away from heat humidity , direct sunlight, ozone sources, water, oil and chemicals.
- They should also be stored flat (i.e. not hung on hooks).
- Avoid the use of Jointing compounds and pastes. These can lubricate the flange gasket interface and encourage stress relaxation effects.

Gasket Installation

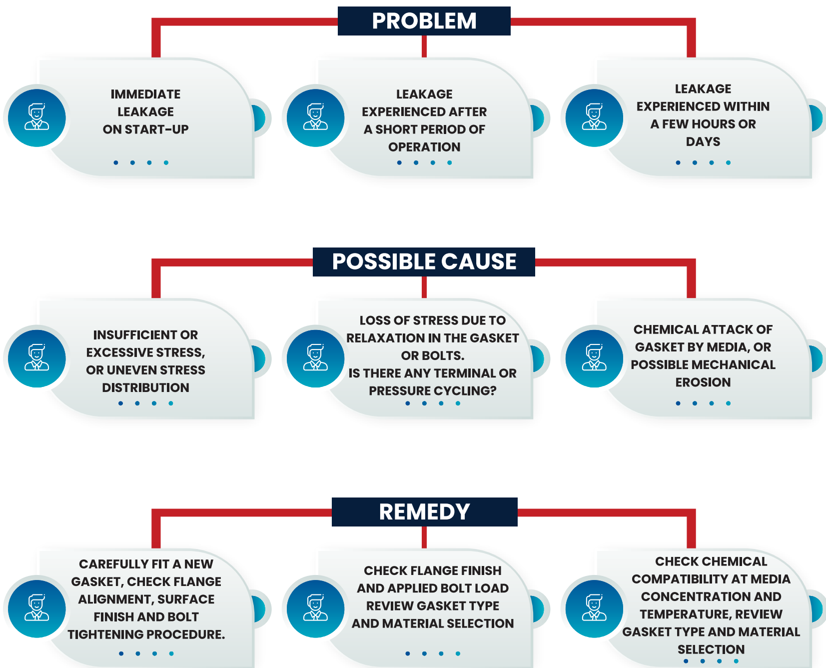
(B) Bolt Tightening

Gasket should be tightened evenly in at least three, or even four stages using an opposed-pattern as illustrated here. Be aware that "cross-talk " exists between

tightens and the gasket compresses, another boit may loosen. Therefore, a final pass around all of the bolts at the end is suggested to ensure that all remain tight.



(C) Troubleshooting



Bolting

Having determined the gasket loading requirement, consideration must be given to the best materials and tightening methods to achieve this loading. As mentioned previously the overall joint integrity is essentially a function of three main criteria: Correct gasket selection to suit the operating conditions and the overall bolted joint strength / stiffness. Quality of the joint components - the gasket manufacture, flange and bolt materials, etc. Installation competence - ensuring that the gasket is fitted correctly, with the design seating stress applied both accurately and evenly.

(A) Materials

Commonly used bolting materials and standards include BS 4882 and ASTM A 193.It should be noted that stainless fasteners (e.g. "B8") have a significantly lower strength than alloy steel materials ("B7"). Care should be taken to select a bolt material having sufficient yield strength so as to be able to apply adequate gasket stress whilst retaining a margin of safety, bearing in mind the. variance of torque tension scatter that may be possible during tightening.Note also, that especially with some exotic bolt materials and at elevated temperatures, the true onset of yield may be below the theoretical value. Bolt material standards such as those mentioned above should be consulted for details of maximum recommended stresses and operating temperatures.

(B) Tightening Methods

Torque vs. Tension

Whilst torque is often recommended as a method for loading bolts in order to achieve a reasonable gasket stress, it should be noted that because of the variance in nut and thread friction which is particularly difficult to control, then the theoretical relationship is not particularly accurate. Here, F is the axial load requirement, A is the across-flats dimension of the nut (i.e. the outside diameter of nut and washer contact), and D is the washer inside diameter. The friction coefficients under the head of the nut, and on the thread (μ ,μ) will h talmost certainly be difficult to determine. The effective diameter (d), the epitch of the threads (p), and half the thread form angle (0), are all readily available in engineering manuals for common thread forms.

Simplified Formula

In simplified form, for lubricated fasteners, washers, nuts etc, the approximate relationship between torque and fastener may be represented as:

Torque = 0.2 x Load x Diameter

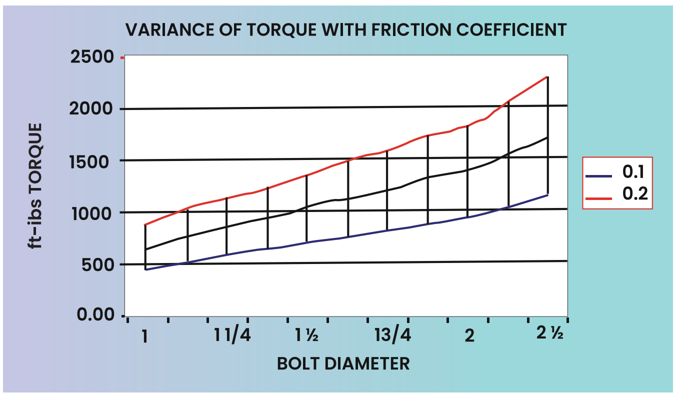
Obviously, the units used must be consistent with the system being used (for example if torque is required in ft-Ibs, then for bolts in inches, the value must be divided by 12 etc.). Compared to the more complex formula given above, then the simplified formula shown here is often deemed sufficient for purpose, as accurately gauging the coefficient of friction can be extremely difficult. However - please note that the accuracy of applied torque vs. actual fastener tension achieved, can be typically +/- 60%.

The effect of the friction coefficient on the variance of the torque-tension relationship can readily be seen on the following graph.

Here we use a nominal 0.15 as being the friction both on the thread and on the nut washer interface on a conventional UNC threaded fastener. Using the more complex formula given above, we can see that a change of only + 0.05 on the friction coefficient can vary the torque required by typically 30%.

Hydraulic Tensioning

Hydraulic tensioners have a number of advantages when it comes to tightening large bolts in particular, and can provide significant amounts of tightening power. They offer the ability to be linked together, so that a number of bolts may be tightened in unison. However, some compliance exists in the tensioner system (e.g. embedding of the nut and washer, and thread deflection etc.), so that some overload is required to compensate for the relaxation once the tensioner has been de-pressurised. The degree of torque imparted to the nut collar when the nut is 'run-down' the fastener: also has an effect on the amount of load-transfer relaxation that occurs when the tensioner is de-pressurised.



FLANGE DIMENSIONS

Bolting Data for ASME B16.5

Nominal Bore	ASME Class 150 Flange O/D Inch	Flange O/D mm	No of Bolt Holes	Hole Diameter Inch	Hole Diameter mm	Bolt PCD Inch	Bolt PCD mm	ASME Class 300 Flange O/D Inch	Flange O/D mm	No of Bolt Holes	Hole Diameter Inch	Hole Diameter mm	Bolt PCD Inch	Bolt PCD mm
½	3 ½	88.9	4	5/8	15.9	2 3/8	60.3	3 3/4	95.3	4	5/8	15.9	2 5/8	66.7
¾	3 7/8	98.4	4	5/8	15.9	2 3/4	69.9	4 5/8	117.5	4	3/4	19.1	3 1/4	82.6
1	4 ¼	108.0	4	5/8	15.9	3 1/8	79.4	4 7/8	123.8	4	3/4	19.1	3 1/2	88.9
1 ¼	4 5/8	117.5	4	5/8	15.9	3 1/2	88.9	5 1/4	133.4	4	3/4	19.1	3 7/8	98.4
1 ½	5	127.0	4	5/8	15.9	3 7/8	98.4	6 1/8	155.6	4	7/8	22.2	4 1/2	114.3
2	6	152.4	4	3/4	19.1	4 3/4	120.7	6 1/2	165.1	8	7/8	22.2	5	127.0
2 1/2	7	177.8	4	3/4	19.1	5 1/2	139.7	7 1/2	190.5	8	7/8	22.2	6 7/8	149.2
3	7 1/2	190.5	4	3/4	19.1	6	152.4	8 1/4	209.6	8	7/8	22.2	6.5/8	168.3
4	9	228.6	8	3/4	19.1	7 1/2	190.5	10	254.0	8	7/8	22.2	7 7/8	200.0
5	10	254.0	8	7/8	22.2	8 1/2	215.9	11	279.4	8	7/8	22.2	9 1/4	235.0
6	11	279.4	8	7/8	22.2	9 1/2	241.3	12 1/2	317.5	12	7/8	22.2	10 5/8	269.9
8	131/2	342.9	8	7/8	22.2	11 3/4	298.5	15	381.0	12	1	25.4	13	330.2
10	16	406.4	12	1	25.4	14 1/4	362.0	17 1/2	444.5	16	1 1/8	28.6	15 1/4	387.4
12	19	482.6	12	1	25.4	17	431.8	20 1/2	520.7	16	1 1/4	31.8	17 3/4	450.9
14	21	533.4	12	1 1/8	28.6	18 3/4	476.3	23	584.2	20	1 1/4	31.8	20 1/4	514.4
16	23 1/2	596.9	16	1 1/8	28.6	21 1/4	539.8	25 1/2	647.7	20	1 3/8	34.9	22 1/2	571.5
18	25	635.0	16	1 1/4	31.8	22 3/4	577.9	28	711.2	24	1 3/8	34.9	24 3/4	628.7
20	27 1/2	698.5	20	1 1/4	31.8	25	635.0	30 ½	774.7	24	1 3/8	34.9	27	685.8
24	32	812.8	20	1 3/8	34.9	29 1/2	749.3	36	914.4	24	1 5/8	41.3	32	812.8

FLANGE DIMENSIONS

Bolting Data for ASME B16.5

Nominal Bore	ASME Class 600 Flange O/D Inch	Flange O/D mm	No of Bolt Holes	Hole Diameter Inch	Hole Diameter mm	Bolt PCD Inch	Bolt PCD mm	ASME Class 900 Flange O/D Inch	Flange O/D mm	No of Bolt Holes	Hole Diameter Inch	Hole Diameter mm	Bolt PCD Inch	Bolt PCD mm
1/2	3 3/4	95.3	4	5/8	15.9	2.5/8	66.7	4 3/4	120.7	4	7/8	22.2	3 1/4	82.6
3/4	4 5/8	117.5	4	3/4	19.1	3 1/4	82.6	5 1/8	130.2	4	7/8	22.2	3 1/2	88.9
1	4 7/8	123.8	4	3/4	19.1	3 1/2	88.9	5 7/8	149.2	4	1	25.4	4	101.6
1 1/4	5 1/4	133.4	4	3/4	19.1	3 7/8	98.4	6 1/4	158.8	4	1	25.4	4 3/8	111.1
1 1/2	6 1/8	155.6	4	7/8	22.2	4 1/2	114.3	7	177.8	4	1 1/8	28.6	4 7/8	123.8.
2	6 1/2	165.1	8	3/4	19.1	5	127.0	8 1/2	215.9	8	1	25.4	6 1/2	165.1
2 1/2	7 1/2	190.5	8	7/8	22.2	5 7/8	149.2	9 5/8	244.5	8	1 1/8	28.6	7 1/2	190.5
3	8 1/4	209.6	8	7/8	22.2	6 5/8	168.3	9 1/2	241.3	8	1	25.4	7 ½	190.5
4	10 3/4	273.1	8	1	25.4	8 1/2	215.9	11 1/2	292.1	8	1 1/4	31.8	9 1/4	235.0
5	13	330.2	8	1 1/8	28.6	10 1/2	266.7	13 3/4	349.3	8	1 3/8	34.9	11	279.4
6	14	355.6	12	1 1/8	28.6	11 1/2	292.1	15	381.0	12	1 1/4	31.8	12 1/2	317.5
8	16 1/2	419.1	12	1 1/4	31.8	13 3/4	349.3	18 1/2	469.9	12	1 1/2	38.1	15 1/2	393.7
10	20	508.0	16	1 3/8	34.9	17	431.8	21 1/2	546.1	16	1 1/2	38.1	18 1/2	469.9
12	22	558.8	20	1 3/8	34.9	19 1/4	489.0	24	609.6	20	1 1/2	38.1	21	533.4
14	23 3/4	603.3	20	1 1/2	38.1	20 3/4	527.1	25 1/4	641.4	20	1 5/8	41.3	22	558.8
16	27	685.8	20	1 5/8	41.3	23 3/4	603.3	27 3/4	704.9	20	1 3/4	44.5	24 1/4	616.0
18	29 1/4	743.0	20	1 3/4	44.5	25 3/4	654.1	31	787.4	20	2	50.8	27	685.8
20	32	812.8	24	1 3/4	44.5	28 1/2	723.9	33 3/4	857.3	20	2 1/8	54.0	29 1/2	749.3
24	37	939.8	24	2	50.8	33	838.2	41	1041.4	20	2 5/8	66.7	351/2	901.7

FLANGE DIMENSIONS

Bolting Data for ASME B16.5

Nominal Bore	ASME Class 1500							ASME Class 2500						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
½	4 3/4	120.7	4	7/8	22.2	3 1/4	82.6	5 1/4	133.4	4	7/8	22.2	3 1/2	88.9
3/4	5 1/8	130.2	4	7/8	22.2	3 1/2	88.9	5 1/2	139.7	4	7/8	22.2	3 3/4	95.3
1	5 7/8	149.2	4	1	25.4	4	101.6	6 1/4	158.8	4	1	25.4	4 1/4	108.0
1 1/4	6 1/4	158.8	4	1	25.4	4 3/8	111.1	7 1/4	184.2	4	1 1/8	28.6	5 1/8	130.2
1 1/2	7	177.8	4	1 1/8	28.6	4 7/8	123.8	8	203.2	4	1 1/4	31.8	5 3/4	146.1
2	8 1/2	215.9	8	1	25.4	6 1/2	165.1	9 1/4	235.0	8	1 1/8	28.6	6 3/4	171.5
21/2	9 5/8	244.5	8	1 1/8	28.6	7 1/2	190.5	10 1/2	266.7	8	1 1/4	31.8	7 3/4	196.9
3	10 1/2	266.7	8	1 1/4	31.8	8	203.2	12	304.8	8	1 3/8	34.9	9	228.6
4	12 1/4	311.2	8	1 3/8	34.9	9 1/2	241.3	14	355.6	8	1 5/8	41.3	10 3/4	273.1
5	14 3/4	374.7	8	1 5/8	41.3	11 1/2	292.1	16 1/2	419.1	8	1 7/8	47.6	12 3/4	323.9
6	15 1/2	393.7	12	1 1/2	38.1	12 1/2	317.5	19	482.6	8	2 1/8	54.0	14 ½	368.3
8	19	482.6	12	1 3/4	44.5	15 1/2	393.7	21 3/4	552.5	12	2 1/8	54.0	17 1/4	438.2
10	23	584.2	12	2	50.8	19	482.6	26 1/2	673.1	12	2 5/8	66.7	21 1/4	539.8
12	26 1/2	673.1	16	2 1/8	54.0	22 1/2	571.5	30	762.0	12	2 7/8	73.0	24 3/8	619.1
14	29 1/2	749.3	16	2 3/8	60.3	25	635.0							
16	32 1/2	825.5	16	2 5/8	66.7	27 3/4	704.9							
18	36	914.4	16	2 7/8	73.0	30 1/2	774.7							
20	38 3/4	984.3	16	3 1/8	79.4	32 3/4	831.9							
24	46	1168.4	16	3 5/8	92.1	39	990.6							

FLANGE DIMENSIONS

Bolting Data for DIN/EN 1092

Nominal Bore	DIN/EN 1092 Pn10							DIN/EN 1092 Pn16						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
10	90	3.54	4	14	0.55	60	2.36	90	3.54	4	14	0.5560	60	2.36
15	95	3.74	4	14	0.55	65	2.56	95	3.74	4	14	0.55	65	2.56
20	105	4.13	4	14	0.55	75	2.95	105	4.13	4	14	0.55	75	2.95
25	115	4.53	4	14	0.55	85	3.35	115	4.53	4	14	0.55	85	3.35
32	140	5.51	4	18	0.71	100	3.94	140	5.51	4	18	0.71	100	3.94
40	150	5.91	4	18	0.71	110	4.33	150	5.91	4	18	0.71	110	4.33
50	165	6.50	4	18	0.71	125	4.92	165	6.50	4	18	0.71	125	4.92
65	185	7.28	4 or 8	18	0.71	145	5.71	185	7.28	4 or 8	18	0.71	145	5.71
80	200	7.87	8	18	0.71	160	6.30	200	7.87	8	18	0.71	160	6.30
100	220	8.66	8	18	0.71	180	7.09	220	8.66	8	18	0.71	180	7.09
125	250	9.84	8	18	0.71	210	8.27	250	9.84	8	18	0.71	210	8.27
150	285	11.22	8	22	0.87	240	9.45	285	11.22	8	22	0.87	240	9.45
200	340	13.39	8	22	0.87	295	11.61	340	13.39	12	22	0.87	295	11.61
250	405	15.94	12	22	0.87	350	13.78	405	15.94	12	26	1.02	355	13.98
300	460	18.11	12	22	0.87	400	15.75	460	18.11	12	26	1.02	410	16.14
350	520	20.47	16	22	0.87	460	18.11	520	20.47	16	26	1.02	470	18.50.
400	580	22.83	16	26	1.02	515	20.28	580	22.83	16	30	1.18	525	20.67
450	640	25.20	20	26	1.02	565	22.24	640	25.20	20	30	1.18	585	23.03
500	715	28.15	20	26	1.02	620	24.41	715	28.15	20	33	1.30	650	25.59
600	840	33.07	20	30	1.18	725	28.54	840	33.07	20	36	1.42	770	30.31

FLANGE DIMENSIONS

Bolting Data for DIN/EN 1092

Nominal Bore	DIN/EN 1092 Pn25							DIN/EN 1092 Pn40						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm		mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
10	90	3.54	4	14	0.55	60	2.36	90	3.54	4	14	0.55	60	2.36
15	95	3.74	4	14	0.55	65	2.56	95	3.74	4	14	0.55	65	2.56
20	105	4.13	4	14	0.55	75	2.95	105	4.13	4	14	0.55	75	2.95
25	115	4.53	4	14	0.55	85	3.35	115	4.53	4	14	0.55	85	3.35
32	140	5.51	4	18	0.71	100	3.94	140	5.51	4	18	0.71	100	3.94
40	150	5.91	4	18	0.71	110	4.33	150	5.91	4	18	0.71	110	4.33
50	165	6.50	4	18	0.71	125	4.92	165	6.50	4	18	0.71	125	4.92
65	185	7.28	8	18	0.71	145	5.71	185	7.28	8	18	0.71	145	5.71
80	200	7.87	8	18	0.71	160	6.30	200	7.87	8	18	0.71	160	6.30
100	235	9.25	8	22	0.87	190	7.48	235	9.25	8	22	0.87	190	7.48
125	270	10.63	8	26	1.02	220	8.66	270	10.63	8	26	1.02	220	8.66
150	300	11.81	8	26	1.02	250	9.84	300	11.81	8	26	1.02	250	9.84
200	360	14.17	12	26	1.02	310	12.20	375	14.76	12	30	1.18	320	12.60
250	425	16.73	12	30	1.18	370	14.57	450	17.72	12	33	1.30	385	15.16
300	485	19.09	16	30	1.18	430	16.93	515	20.28	16	33	1.30	450	17.72
350	555	21.85	16	33	1.30	490	19.29	580	22.83	16	36	1.42	510	20.08
400	620	24.41	16	36	1.42	550	21.65	660	25.98	16	39	1.54	585	23.03
450	670	27.38	20	38	1.42	600	23.62	685	26.97	20	39	1.54	610	24.02
500	730	28.74	20	36	1.42	660	25.98	755	29.72	20	42	1.65	670	26.38
600	845	33.27	20	39	1.54	770	30.31	890	35.04	20	48	1.89	795	31.30

FLANGE DIMENSIONS

Bolting Data for BS 10

Nominal Bore	BS 10 TABLE D							BS 10 TABLE E						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
1/2	3 3/4	95.3	4	9/16	14.3	2 5/8	66.7	3 3/4	95.3	4	9/16	14.3	2 5/8	66.7
3/4	4	101.6	4	9/16	14.3	2 7/8	73.0	4	101.6	4	9/16	14.3	2 7/8	73.0
1	4 1/2	114.3	4	9/16	14.3	3 1/4	82.6	4 1/2	114.3	4	9/16	14.3	3 1/4	82.6
1 1/4	4 3/4	120.7	4	9/16	14.3	3 7/16	87.3	4 3/4	120.7	4	9/16	14.3	3 7/16	87.3
1 1/2	5 1/4	133.4	4	9/16	14.3	3 7/8	98.4	5 1/4	133.4	4	9/16	14.3	3 7/8	98.4
2	6	152.4	4	11/16	17.5	4 1/2	114.3	6	152.4	4	11/16	17.5	4 1/2	114.3
2 1/2	6 1/2	165.1	4	11/16	17.5	5	127.0	6 1/2	165.1	4	11/16	17.5	5	127.0
3	7 1/4	184.2	4	11/16	17.5	5 3/4	146.1	7 1/4	184.2	4	11/16	17.5	5 3/4	146.1
3 1/2	8	203.2	4	11/16	17.5	6 ½	145.1	8	203.2	8	11/16	17.5	6 1/2	165.1
4	8 1/2	215.9	4	11/16	17.5	7	177.8	8 1/2	215.9	8	11/16	17.5	7	177.8
5	10	254.0	8	11/16	17.5	8 1/4	209.6	10	254.0	8	11/16	17.5	8 1/4	209.6
6	11	279.4	8	11/16	17.5	9 1/4	235.0	11	279.4	8	7/8	22.2	9 1/4	235.0
7	12	304.8	8	11/16	17.5	10 1/4	260.4	12	304.8	8	7/8	22.2	10 1/4	260.4
8	13 1/4	336.6	8	11/16	17.5	111/2	292.1	13 1/4	336.6	8	7/8	22.2	111/2	292.1
9	14 1/2	368.3	8	11/16	17.5	12 3/4	323.9	14 1/2	368.3	12	7/8	22.2	12 3/4	323.9
10	16	406.4	8	7/8	22.2	14	355.6	16	406.4	12	7/8	22.2	14	355.6
12	18	457.2	12	7/8	22.2	16	406.4	18	457.2	12	1	25.4	16	406.4
13	19 1/4	489.0	12	7/8	22.2	17 1/4	438.2	19 1/4	489.0	12	1	25.4	17 1/4	438.2
14	20 3/4	527.1	12	1	25.4	18 1/2	469.9	20 3/4	527.1	12	1	25.4	18 1/2	469.9

FLANGE DIMENSIONS

Bolting Data for BS 10

Nominal Bore	BS 10 TABLE F							BS 10 TABLE H						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
1/2	3 3/4	95.3	4	9/16	14.3	2 5/8	66.7	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6
3/4	4	101.6	4	9/16	14.3	2 7/8	73.0	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6
1	4 3/4	120.7	4	11/16	17.5	3 7/16	87.3	4 3/4	120.7	4	11/16	17.5	3 7/16	87.3
1 1/4	5 1/4	133.4	4	11/16	17.5	3 7/8	98.4	5 1/4	133.4	4	11/16	17.5	3 7/8	98.4
1 1/2	5 1/2	139.7	4	11/16	17.5	4 1/8	104.8	5 1/2	139.7	4	11/16	17.5	4 1/8	104.8
2	6 1/2	165.1	4	11/16	17.5	5	127.0	6 1/2	165.1	4	11/16	17.5	5	127.0
2 1/2	7 1/4	184.2	8	11/16	17.5	5 3/4	146.1	7 1/4	184.2	8	11/16	17.5	5 3/4	146.1
3	8	203.2	8	11/16	17.5	6 1/2	165.1	8	203.2	8	11/16	17.5	6 1/2	165.1
3 1/2	8 1/2	215.9	8	11/16	17.5	7	177.8	8 1/2	215.9	8	11/16	17.5	7	177.8
4	9	228.6	8	11/16	17.5	7 1/2	190.5	9	228.6	8	11/16	17.5	7 1/2	190.5
5	11	279.4	8	7/8	22.2	9 1/4	235.0	11	279.4	8	7/8	22.2	9 1/4	235.0
6	12	304.8	12	7/8	22.2	10 1/4	260.4	12	304.8	12	7/8	22.2	10 1/4	260.4
7	13 1/4	336.6	12	7/8	22.2	11 1/2	292.1	13 1/4	336.6	12	7/8	22.2	11 1/2	292.1
8	14 1/2	368.3	12	7/8	22.2	12 3/4	323.9	14 1/2	368.3	12	7/8	22.2	12 3/4	323.9
9	16	406.4	12	1	25.4	14	355.6	16	406.4	12	1	25.4	14	355.6
10	17	431.8	12	1	25.4	15	381.0	17	431.8	12	1	25.4	15	381.0
12	19 1/4	489.0	16	1	25.4	17 1/4	438.2	19 1/4	489.0	16	1	25.4	17 1/4	438.2
13	20 3/4	527.1	16	1 1/8	28.6	18 ½	469.9	20 3/4	527.1	16	1 1/8	28.6	18 1/2	469.9
14	21 3/4	552.5	16	1 1/8	28.6	19 1/2	495.3	21 3/4	552.5	16	1 1/8	28.6	19 1/2	495.3

FLANGE DIMENSIONS

Bolting Data for BS 10

Nominal Bore	BS 10 TABLE J							BS 10 TABLE K						
	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm	Inch	mm	No of Bolt Holes	Inch	mm	Inch	mm
	Flange O/D			Hole Diameter		Bolt PCD		Flange O/D			Hole Diameter		Bolt PCD	
1/2	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6
3/4	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6	4 1/2	114.3	4	11/16	17.5	3 1/4	82.6
1	4 3/4	120.7	4	11/16	17.5	3 7/16	87.3	5	127.0	4	11/16	17.5	3 3/4	95.3
1 1/4	5 1/4	133.4	4	11/16	17.5	3 7/8	98.4	5 1/4	133.4	4	11/16	17.5	3 7/8	98.4
1 1/2	5 1/2	139.7	4	11/16	17.5	4 1/8	104.8	6	152.4	4	7/8	22.2	4 1/2	114.3
2	6 1/2	165.1	4	7/8	22.2	5	127.0	6 1/2	165.1	8	11/16	17.5	5	127.0
21/2	7 1/4	184.2	8	7/8	22.2	5 3/4	146.1	7 1/4	184.2	8	7/8	22.2	5 3/4	146.1
3	8	203.2	8	7/8	22.2	6 1/2	165.1	8	203.2	8	7/8	22.2	6 1/2	165.1
31/2	8 1/2	215.9	8	7/8	22.2	7	177.8	9	228.6	8	1	25.4	7 1/4	184.2
4	9	228.6	8	7/8	22.2	7 1/2	190.5	9 1/2	241.3	8	1	25.4	7 3/4	196.9
5	11	279.4	8	1	25.4	9 1/4	235.0	11	279.4	12	1	25.4	9 1/4	235.0
6	12	304.8	12	1	25.4	10 1/4	260.4	12	304.8	12	1	25.4	10 1/4	260.4
7	13 1/2	336.6	12	1	25.4	11 1/2	292.1	13 1/2	342.9	12	1 1/8	28.6	11 1/2	292.1
8	14 1/2	368.3	12	1	25.4	12 3/4	323.9	14 1/2	368.3	12	1 1/8	28.6	12 1/2	317.5
9	16	406.4	12	1 1/8	28.6	14	355.6	16	406.4	16	1 1/8	28.6	14	355.6
10	17	431.8	12	1 1/8	28.6	15	381.0	17	431.8	16	1 1/8	28.6	15	381.0
12	19 1/4	489.0	16	1 1/8	28.6	17 1/4	438.2	19 1/4	489.0	16	1 1/4	31.8	17	431.8
13	20 3/4	527.1	16	1 1/4	31.8	18 1/2	469.9	21 1/2	546.1	16	1 3/8	34.9	19	482.6
14	21 3/4	552.5	16	1 1/4	31.8	19 1/2	495.3	22 1/2	571.5	16	1 3/8	34.9	20	508.0

THREAD DIMENSIONS

Bolting - UNC/UNF:

UNS					
Bolt Diameter	Pitch	Effective Diameter	Root Diameter	Stress Area	Stress Area
INCH	TPI	INCH	INCH	IN^2	mm^2
1/2	13	0.450	0.406	0.144	92.73
9/16	12	0.508	0.460	0.184	118.87
5/8	11	0.566	0.514	0.229	147.62
3/4	10	0.685	0.627	0.338	218.15
7/8	9	0.803	0.739	0.467	301.01
1	8	0.919	0.847	0.612	394.81
1.1/8	8	1.044	0.972	0.798	514.54
1.1/4	8	1.169	1.097	1.008	650.11
1.3/8	8	1.294	1.222	1.242	801.51
1.1/2	8	1.419	1.347	1.502	968.75
1.5/8	8	1.544	1.472	1.785	1151.83
1.3/4	8	1.669	1.597	2.094	1350.73
1.7/8	8	1.794	1.722	2.426	1565.48
2	8	1.919	1.847	2.784	1796.05
2.1/4	8	2.169	2.097	3.572	2304.71
2.1/2	8	2.419	2.347	4.459	2876.71
2.3/4	8	2.669	2.597	5.444	3512.04
3	8	2.919	2.847	6.527	4210.72
UNF					
1/2	20	0.468	0.439	0.161	104.03
9/16	18	0.526	0.494	0.205	131.98
5/8	18	0.589	0.557	0.258	166.28
3/4	16	0.709	0.673	0.375	242.19
7/8	14	0.829	0.787	0.513	330.81
1	12	0.946	0.898	0.667	430.60
1.1/8	12	1.071	1.023	0.861	555.30
1.1/4	12	1.196	1.148	1.079	695.83
1.3/8	12	1.321	1.273	1.321	852.19
1.1/2	12	1.446	1.398	1.588	1024.39
1.5/8	12	1.571	1.523	1.879	1212.42
1.3/4	12	1.696	1.648	2.195	1416.29
1.7/8	12	1.821	1.773	2.536	1635.99
2	12	1.946	1.898	2.901	1871.53
2.1/4	12	2.196	2.148	3.705	2390.10
2.1/2	12	2.446	2.398	4.607	2972.02
2.3/4	12	2.696	2.648	5.607	3617.27
3	12	2.946	2.898	6.705	4325.87

THREAD DIMENSIONS

Bolting - Metric

Bolt Diameter	Pitch	Effective Diameter	Root Diameter	Stress Area	Stress Area
mm	mm	mm	mm	IN^2	mm^2
8	1.25	7.07	6.30	0.054	35.06
10	1.5	8.89	7.97	0.086	55.79
12	1.75	10.71	9.64	0.126	81.30
14	2	12.54	11.31	0.173	111.68
16	2	14.54	13.31	0.236	152.28
18	2.5	16.20	14.67	0.290	187.11
20	2.5	18.20	16.67	0.370	238.74
22	2.5	20.20	18.67	0.460	296.66
24	3	21.85	20.01	0.533	343.91
27	3	24.85	23.01	0.697	449.59
30	3.5	27.51	25.36	0.851	548.76
33	3.5	30.51	28.36	1.055	680.39
36	4	33.16	30.71	1.242	801.13
39	4	36.16	33.71	1.486	958.71
42	4.5	38.83	36.07	1.707	1101.30
45	4.5	41.83	39.07	1.991	1284.83
48	5	44.44	41.41	2.243	1447.33
52	5	48.44	45.41	2.681	1729.61
56	5.5	52.14	48.77	3.099	1999.10
60	5.5	56.14	52.77	3.609	2328.66
64	6	59.80	56.12	4.089	2638.23
68	6	63.80	60.12	4.673	3014.96

THREAD DIMENSIONS

Bolting - BSW/BSF

BSW					
Bolt Diameter	Pitch	Effective Diameter	Root Diameter	Stress Area	Stress Area
INCH	TPI	INCH	INCH	IN^2	mm^2
1/2	12	0.447	0.393	0.138	89.34
9/16	12	0.509	0.456	0.18	117.92
5/8	11	0.567	0.509	0.227	146.50
11/16	11	0.629	0.571	0.283	182.54
3/4	10	0.686	0.622	0.336	216.73
7/8	9	0.804	0.733	0.464	299.14
1	8	0.920	0.840	0.608	392.39
1.1/8	7	1.034	0.942	0.766	494.37
1.1/4	7	1.159	1.067	0.972	627.41
1.1/2	6	1.393	1.287	1.410	909.78
1.3/4	5	1.622	1.494	1.906	1229.73
2	4.5	1.858	1.715	2.507	1617.29
2.1/4	4	2.090	1.930	3.173	2046.84
2.1/2	4	2.340	2.180	4.011	2587.72
2.3/4	3.5	2.567	2.384	4.813	3105.15
3	3.5	2.817	2.634	5.834	3764.00
BSF					
1/2	16	0.460	0.420	0.152	98.10
9/16	16	0.523	0.483	0.198	127.95
5/8	14	0.579	0.534	0.243	156.90
11/16	14	0.642	0.596	0.301	194.12
3/4	12	0.697	0.643	0.352	227.39
7/8	11	0.817	0.759	0.487	314.40
1	10	0.936	0.872	0.642	414.09
1.1/8	9	1.054	0.983	0.814	525.47
1.1/4	9	1.179	1.108	1.027	662.39
1.3/8	8	1.295	1.215	1.237	798.08
1.1/2	8	1.420	1.340	1.496	964.97
1.5/8	8	1.545	1.465	1.779	1147.71
1.3/4	7	1.659	1.567	2.043	1317.93
2	7	1.909	1.817	2.725	1758.19
2.1/4	6	2.143	2.037	3.431	2213.24
2.1/2	6	2.393	2.287	4.300	2774.41
2.3/4	6	2.643	2.537	5.268	3398.91
3	5	2.872	2.744	6.192	3994.89

Conversion factors :

To convert	Into :	Multiply by:
ft-lbs	Nm	1.356
Nm	ft-lbs	0.7375
p.s.i.	Mpa	0.006897
MPa	p.s.i.	145
p.s.i.	bar	0.06897
bar	p.s.i.	14.5
lbs	kg	0.4536
kg	lbs	2.2046

Temperatures :

°C	°F
-200	-328
-50	-58
0	32
20	68
38	100
50	122
100	212
150	302
200	392
250	482
260	500
300	572
316	600
350	662
371	700
400	752
427	800
450	842
500	932
538	1000

Metallic Materials

Material	Trade Name	Description	Temperature range	Comments
Low carbon steel	-	Sheet forged or rolled steel,sometimes referred to as Soft Iron or Armco	-50 to 540ºC	For general application only
316	-	An 18-12 chromium/nickel austenitic stainless steel, containing appoximately 2% molybdenum content for high temperature strength	815ºC max	Excellent corrosion resistance, but subject to stress corrosion cracking and intergranular corrosion with certain media. Carbide precipitation may occur above 540 C
316L	-	Variation of 316, carbon content reduced to 0.03% maximum	815ºC max	Reduced stress corrosion cracking and intergranular corrosion due to reduced carbon content
304	-	An 18-8 chromium/nickel austenitic stainless steel	540ºC max	Excellent corrosion resistance, but subject to stress corrosion cracking and intergranular corrosion at elevated temperatures
304L	-	Variation of 304, Carbon content reduced to 0.03% maximum	540ºC max	Reduced to stress corrosion, cracking and intergranular corrosion due to reduced carbon content
321	-	An 18-10 chromium/nickel austenitic stainless steel, with a titanium addition	870ºC max	Subject to stress corrosion, Reduced possibilities of intergranular corrosion
347	-	An 18-10 chromium/nickel austenitic	870ºC max	Similar properties as 321. High temperature resistance
317	-	stainless steel, with the addition of columbium (niobium)	815ºC max	Reduced stress corrosion cracking and intergranular corrosion due to reduced carbon content
410		An 18-13 chromium/nickel 3% molybdenum austenitic stainless steel	850ºC max	Excellent high temperature strength/corrosion properties. Excellent resistance to oxidation, nitriding and carbonisation
Titanium	Titanium	A 13% chromium, 0.15% carbon martensitic alloy steel	1095ºC max	Excellent high temperature corrosion resistance and outstanding in oxidizing medias
Alloy 600	Inconel 600°	High purity titanium material	1095ºC max	Excellent high temperature strenght/corrosion properties, Excellent resistance to oxidation, nitriding and carbonisation
Alloy 625	Inconel 625°	A nickel/chromium alloy, with substantial additions of molybdenum and colombium (niobium)	1095ºC max	Outstanding corrosion resistance in a wide range of acid, neutral and alkaline environments
Alloy 800	Incoloy 800°	A 32% nickel, 20% chromium, 46% iron alloy steel	1095ºC max	Excellent high temperature resistance
Alloy 825	Incoloy 825°	A nickel, chromium, iron molybdenum, and copper alloy steel	1095ºC max	High resistance to hot acid conditions and outstanding resistance to streess corrosion Cracking
Alloy 200	Nickel 200	Commercially pure (99.6%) wrought nickel	760ºC max	High resistance to various reducing chemicals and caustic alkalies
Alloy 400	Monel°400	A 67% nickel/30% copper alloy steel	820ºC max	High resistance to hydrofluoric acid
Alloy B2	Hastelloy°B2	A nickel /molybdenum alloy steel	1095ºC max	Excellent chemical resistance to hydrochloric acid, sulphuric, acetic and phosphoric acids
Alloy C276	Hastelloy°C276	A nickel/ chromium/molybdenum alloy steel	1095ºC max	Excellent corrosion resistance to both oxidizing and reducing media
Alloy 20	Carpenter 20	An iron/chromium/iron alloy steel	760ºC max	Specifically developed for applications requiring resistance to sulphuric acid
Alloy X-750	Inconel°X-750	A nickel/chromium/iron alloy steel	1095ºC max	Precipitation hardened, high resistance steel
Aluminium	-	Commercially pure wrought aluminium	425ºC max	Excellent ductility and workability
Brass	-	Commercial Copper/zinc alloy	260ºC max	General corrosion resistance
Copper	-	Commercially pure copper	315ºC max	Genral corrosion resistance

Information in this publication and otherwise supplied to users is based on our general experience and is given in good faith, but because of factors which are outside our knowledge and control and affect the use of products, no warranty is given or implied with respect to such information. Specifications are subject to change without notice. Statements of operating limits quoted in this publication are not an indication that these values can be simultaneously applied

HEALTH WARNING:

If PTFE (e.g. Fluolion) products are heated to elevated temperatures, fumes will be produced which may give unpleasant effects, if inhaled. Whilst some fumes are emitted below 300⁰ C, the effect at these temperatures is negligible Care should be taken to avoid contaminating tobacco with PTFE particles or dispersion which may remain on hands or clothing. Health & Safety data sheets are available on request.

Worldwide equivalents for stainless steel materials:

UK	USA	DIN	FRANCE	ITALY	SPAIN	SWEDEN	JAPAN
BS	AISI/SAE	DIN/W .Nr	AFNOR	UNI	UNE	SS	JIS
304S15	304	X5CrNi 18 9/1.4301	Z6CN18.09	X5cRnl 18 10	XX5CrNi10 10	2332	SUS 304
304S12	304L	X2CrNi 18 9/1.4306	Z2CN18.10	X2cRnl 18 11	X2CrNi 19 10	2352	SUS 304L
309S24	309	X15CrNiSi2012/1.4828	Z15CrNiSi20.12	Z15CrNiSi20 12	2333	SUH 309	
-	310	XX15CrNiSi25 20/1.4841	Z12CNS25.20	X16CrNiSi25 20	X15CrNiSi25 20	-	SUH 310
316S16	316	X5CrNiMo18 10/1.4401	Z6CND17.11	X5CrNiMo17 12	X5CrNiM 17 12	-	SUS 316
316S11							
316S12	316L	X2CrNiMo 18 10/1.4404	Z2CND18.13	X2CrMo 17 12	X2CrNiMo17 12	2347	SUS 316L
320S31		-					
320S17	316Ti	X10CrNiMoT i18 10/1.4571	Z6CNDT17.12	X6CrNiMo Ti17 12	X6CrNiMoT i17 12	2350	
321S12	321	X10CrNiT i18 9/1.4541	Z6CNT18-10	X6CrT i 18 11	X7CrNiT i18 11	2337	SUS 321
347S51	347	X10CrNiNb18 9/1.4550	Z6CNNb 18.10	X6CrNiNb1811	X7CrNiNb18 11	2338	SUS 347
410S21	410	X10Cr13/1.4006	Z12C13	Xx12Cr13			SUS 410

Material	Colour	
Carbon Steel	Silver	
304	Yellow	
304L	No colour	
316L	Green	
347	Blue	
321	Turquoise	
Monel 400	Orange	
Nickel 200	Red	
Titanium	Purple	
Hastelloy B	Brown	
Inconel 600 or 625	Gold	
Inconel 800 or 825	White	
Filler	**Stripe** Colour	
PTFE	White	
Mica-graphite	Pink	
Flexible graphite	Grey	
Ceramic	Light green	

Ring Joint Gasket Metals

Metal	Maximum hardness identification Rockwell B
Soft Iron	56 (90 BHN) D
Low Carbon Steel	68 (120 BHN) S
F5 Alloy Steel (4.6% Cr , 1/2% Mo)	72 (130 BHN) F5
410 Alloy Steel (11/13% Cr)	86 (170 BHN) S410
304 Stainless Steel	83 (160 BHN) S304
304L Stainless Steel	83 (160 BHN) S304
316 Stainless Steel	83 (160 BHN) S316
316L Stainless Steel	83 (160 BHN) S3161
347 Stainless Steel	83 (160 BHN) S347
321 Stainless Steel	83 (160 BHN) S321
825 Nickel Alloy	93 (200 BHN) 825

Spiral wound gaskets to ASME B16.20 can be identified by the colour coding on the outside of the guide ring. The soild colour denotes the grade of winding material, and coloured stripes identify the filler material used.

Bolt Material Strengths:

Bolt Grade	0.2% Proof Stress (Mpa)	Proof Load Stress (Mpa)	Max. Suggested Bolt Stress (Mpa)
ISO 898 Grade 8.8	640	600	510
ISO 898 Grade 10.9	900	830	706
ISO 898 Grade 12.9	1080	970	825
ASTM A194 Grade B7/L7	725	640	540
ASTM A194 Grade B7M/L7M	550	484	340
ASTM A194 Grade B16	725	64	540
ASTM A194 Grade B8	205	144	126
BS 6105 Stainless A1/A2/A4 Grade 50	210	147	107
BS 6105 Stainless A1/A2/A4 Grade 70	450	315	230
BS 6105 Stainless A1/A2/A4 Grade 70	600	420	286

Notes :- 1)

Proof loads for stainless steels and "B" grades are approximate values and based upon experience.

Notes :- 2)

Maximum bolt stresses for "B" and "A" grades are specified in BS 4882 and BS 6105 Values for the stainless steels (e.g. B8 and the "A" grades) must be adhered to. The "B" grade low alloy steels can safely be loaded to the values listed above.

Notes :- 3)

The maximum values for the "B" steels (except B8) and ISO steels are based upon approximately 85% of the listed proof load, as the true onset of yield can often be detected at a slightly lower than theoretical stress point.

MACER

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