

Metallic Gaskets





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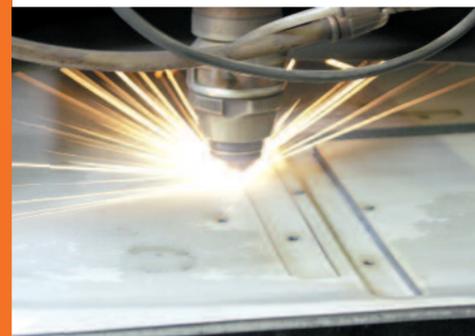
Creating an effective, safe and sustainable environment exceeding the needs of industry

Over the years we have enhanced our technical facilities to develop new products and provide guidance and training programmes for some of the world's largest chemical and petrochemical plants, expanding our operations into the Middle East and Kazakhstan.

We have a dedicated Research & Development team who ensure high quality technical support for all our products. We constantly look to provide a balanced mix of quality sealing product with a warmth of service.

This brochure outlines our metallic range of products and provides guidelines on their correct selection, storage and assembly.

For more information on any of the areas covered please contact our sales or technical team, or visit www.novusealing.co.za



Welding and profiling

High technology and high performance welding and profiling machines provide quality and integrity through all our metallic product range.

Manufacturing

The fabrication of metallic products is subject to stringent quality control and test procedures.

Specification

The specifications for each order are continually checked on every product. Accuracy and precision in every application ensures that quality standards are second to none.

Many factors affect the suitability of a gasket in a given application making it difficult to determine which is the correct one for the duty. In heat exchanger applications, factors such as relative flange movement can complicate gasket selection still further and it is important that the attributes of each gasket type are fully understood.

To help you make an informed choice on gasket selection the table below lists the advantages and disadvantages of each gasket under various conditions.

This table should be used as a general guide for selection only.



Camprofile Gaskets

Camprofile Gaskets consist of a metal core, generally stainless steel, with concentric grooves on either side. A sealing layer is normally applied to both faces and depending on the service the material for this layer can be graphite, PTFE, Novus sheet material, Hi-temp or metal (e.g. aluminium or silver). Camprofile gaskets are ideal for both standard pipe and heat exchanger applications.



Corrugated Gaskets

Corrugated Metal Gaskets consist of a corrugated metal core, normally stainless steel, with a soft facing layer applied to each face. The corrugations provide resilience and reduce the sealing surface area of the gasket while the soft layer ensures outstanding sealing, even at low loads. Particularly suited as a replacement to metal jacketed gaskets.



Spiral Wound Gaskets

Spiral Wound Gaskets consist of a 'V' shaped metal strip spirally wound in combination with a soft filler material, normally graphite, PTFE or Hi-Temp. The metal strip provides outstanding recovery whilst the flexible filler ensures excellent sealing. Depending on the application the gasket can be specified with outer and/or inner rings.



Metal Jacketed Gaskets

Metal Jacketed Gaskets consist of soft filler material encapsulated in a metallic material. The filler material provides the gasket with compressibility and resilience while the jacket confers compressive strength and blow out resistance.

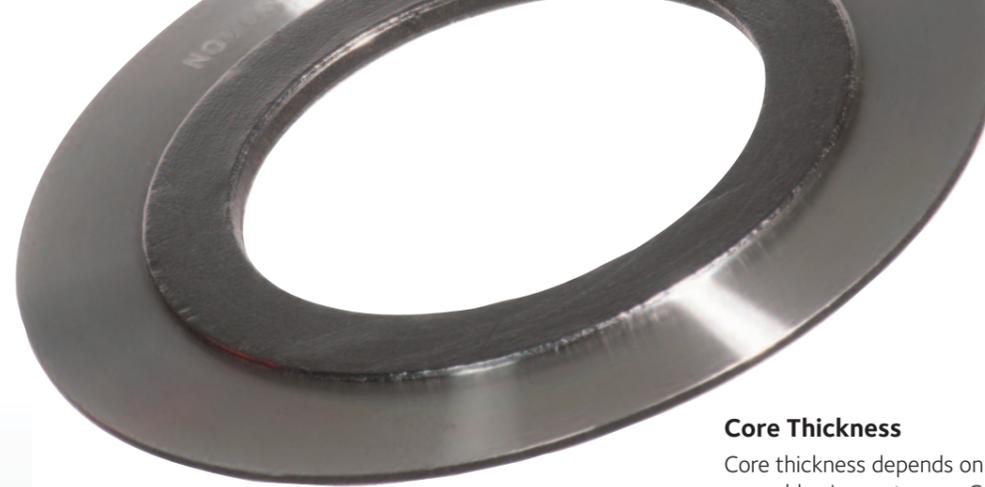


Ring Type Joints

Ring Type Joints are designed to concentrate the bolt load over a small area thus producing high seating stresses. As the ring type material should always be softer than the mating flanges, the high seating stress causes 'plastic-flow' of the ring joint in the flange faces creating the seal.

TIGHTNESS	EXCELLENT	EXCELLENT	EXCELLENT	AVERAGE	EXCELLENT
HANDLING	EXCELLENT	GOOD	AVERAGE	EXCELLENT	EXCELLENT
THERMAL CYCLING	EXCELLENT	EXCELLENT	GOOD	AVERAGE	AVERAGE
LOW SEATING STRESS	EXCELLENT	EXCELLENT	AVERAGE	AVERAGE	AVERAGE
HIGH SEATING STRESS	EXCELLENT	GOOD	EXCELLENT	GOOD	EXCELLENT
NARROW FLANGE WIDTH	EXCELLENT	AVERAGE	AVERAGE	EXCELLENT	AVERAGE
EMISSIONS	EXCELLENT	EXCELLENT	EXCELLENT	AVERAGE	EXCELLENT
RECYCLING	YES	NO	NO	NO	NO

Camprofile Gaskets



Camprofile Gasket Characteristics

Camprofile gaskets consist of a metal core, generally stainless steel, with concentric grooves on either side. A sealing layer is usually applied on both sides and depending on the service the material for this layer can be graphite, PTFE (Teflon), Novus sheeting material, Hi-temp or metal (e.g. aluminium or silver). Camprofiles can be used without sealing layers to provide an excellent seal but there is a risk of flange surface damage especially at high seating stresses. The sealing layers protect the flange surface from damage in addition to providing an excellent seal at low bolt stress.

Properties

Camprofiles have a number of properties which make them unique:

- Highly suitable for varying temperatures and pressures
- Less sensitive to assembly faults (inaccurate bolt tightening)
- Suitable for light and heavy designed flanges
- Dependent upon the layer material camprofile gaskets can resist temperatures up to 1000°C
- Resistant to media pressures > 400 bar
- When assembled the remaining thickness of the sealing material is extremely low (0.1 - 0.2mm), thus reducing leaks, fail rates and environmental pollution
- The gasket will not damage the flange surface and can be easily removed
- Camprofile cores are re-usable after cleaning, inspection and relayering with new sealing material. This is of particular interest in the case of heat exchanger gaskets
- Reduces maintenance costs and leakage - thanks to camprofile's high sealing performance and reliability.

Seating Stress Range

The camprofile gasket offers reliable sealing performance when seated within the following seating stress ranges. The below are based on parallel form gaskets. The values have slight variations for convex forms of camprofiles.

LAYER MATERIAL	SEATING STRESS		
	MIN (N/mm ²)	OPT (N/mm ²)	MAX (N/mm ²)
GRAPHITE	20	90	400
PTFE	20	90	350
NOVUS SHEET	40	125	200
SILVER	125	240	450
HI-TEMP	40	100	250

Flange Surface Finish

The recommended flange surface finish for camprofiles with sealing layers is from 3.2 to 6.3µm Ra (125-250 RMS), this is also referred to as a smooth finish.

Core Thickness

Core thickness depends on the assembly circumstances. Generally a 3mm core is recommended but for large diameter gaskets above 1.5m it is advisable to use a 4mm core for purposes of stability.

Styles M21LM and M41LM are available in 4mm thickness only due to their construction.

	CORE THICKNESS (mm)	THICKNESS AFTER ASSEMBLY (core + layers) (mm)
RECOMMENDED	3	Approx 3.1-3.4
>1.5m M21LM M41LM	4	Approx 4.1-4.4

M18, M20, M21

Advantages of parallel root cores
Uniform spread of stress at the cams. Uniform spread of stress across the flange surface.

M38, M40, M41

Advantages of convex root cores
Highly suitable for underbolted flanges. Effective seal at low stress. The gasket design ensures a high seating stress area in the centre of the seal face and a lower seating stress towards the outside edges of the seal face.

Gasket Profiles

All profiles feature as standard a 1mm cam pitch and a maximum groove depth of 0.5mm. Alternative profiles are available on request e.g. 1.5mm cam pitch and a maximum groove depth of 0.75mm (DIN profile).

Profile Selection

With or without centering ring

Camprofile gaskets with centering rings ensure optimum gasket positioning between the bolts.

Loose or integral centering rings

Thermal shock conditions may damage camprofiles with integral centering rings (thermal tension may cause cracks in the core). This is prevented by using camprofile gaskets with loose or floating guide rings.

The centering rings on styles M21LM and M41LM allow for expansion and contraction without reactionary forces being applied to the core.

Optimal gasket performance is ultimately ensured by the quality of flange surface finish and correct assembly.

Camprofile Gasket shapes

In addition to the round profiles, gaskets can be made in a variety of shapes, oval, rectangular and exchanger with pass bars.

Correctly dimensioned gasket drawings are required to make non-standard gaskets and gasket shapes.

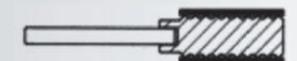
GASKET PROFILES



M18L
Parallel root core with integral centering ring



M20L
Parallel root core without centering ring for male/female, tongue/groove and grooved flanges



M21LM
Parallel root core with floating centering ring attached outside the sealing ring



M38L
Convex root core with integral centering ring



M40L
Convex root core without centering ring for male/ female, tongue/groove and grooved flanges



M41LM
Convex root core with floating centering ring, attached outside the sealing ring



Camprofile Gaskets

Core Material Selection

Core Material

The core material is generally fabricated in material identical to the piping system to prevent corrosion problems.

Stainless Steel 316L camprofiles cores are generally used with carbon steel pipe systems to prevent gasket corrosion.

The recommended camprofile metal cores are shown in the table below.

Camprofile Gaskets M21L and M41L

During recent years, modified gaskets have been introduced and these are now included in our manufacturing programme.

Generally camprofile gaskets are manufactured with a 0.5mm thick floating centering ring. Based on intensive research and practical tests, in cooperation with major users, a 1.5mm thick floating centering ring was developed featuring a unique outer edge attachment.

The M21LM and M41LM styles offer the following advantages:

- The floating centering ring is stable and free from expansion stresses
- No distortion of the centering ring by the threads of the bolts, as sometimes occurs in vertical assemblies, causing the camprofile to be positioned eccentrically. This also increases the possibility of re-use, reducing costs
- User friendly - the 1.5mm thick guide ring reduces the risk of operator injury during handling
- The floating guide ring allows for expansion without applying mechanical stress to the camprofile core.

MATERIAL (Trade name)	IDENTIFICATION	DIN SPECIFICATION	DIN MATERIAL NO.	B.S.	AISA ASTM UNS	TEMPERATURE (°C)		DENSITY (GR/CM ³)
						MIN	MAX	
Low Carbon Steel	S	R St 3.72	-	-	-	-40	500	7.85
Stainless Steel 304	S304	X5 Cr Ni 18	1.4301	304S15/16/13	304	-250	550	7.90
Stainless Steel 304 L	S304L	X2 Cr Ni 18 9	1.4306	304S11	304L	-250	550	7.90
Stainless Steel 309	S309	X15 Cr Ni Si 20 12	1.4828	309S24	309	-100	1000	7.90
Stainless Steel 316	S316	X5 Cr Ni Mo 18 10	1.4401	316S16	316	-100	550	7.90
Stainless Steel 316 L ⁽¹⁾	S316L	X2 Cr Ni Mo 18 10	1.4404	316S11/13	316L	-100	550	7.90
Stainless Steel 316Ti	316Ti	X10 Cr Ni Mo Ti 18 10	1.4571	320S31	316Ti	-100	550	7.80
Stainless Steel 321	S321	X10 Cr Ni Ti 18 9	1.4541	321S12/49/87	321	-250	550	7.90
Stainless Steel 347	S347	X10 Cr Ni Nb 18 9	1.4550	347S31	347	-250	500	7.90
Stainless Steel 410	S410	X6 Cr 13	1.4000	410S21	410	-20	850	7.80
254SMO	6Mo	X1CrNiMoCuN20187	1.4547	-	S31254	-100	500	8.00
Duplex	2205	X2 Cr Ni Mo N 22 5 3	1.4462	318S13	S31803/32205	-40	300	7.80
Super Duplex	2507	X2 Cr Ni Mo N 25 6 3	1.4410	-	S32750	-40	300	7.80
Aluminium	AL 1050	A1 99 5	3.0255	1B	A91050	-250	300	2.71
Silver	Ag	-	-	-	-	-250	750	10.50
Copper	Cu	SF - Cu	2.0090	C106	C12200	-250	400	8.90
Nickel 200	Ni200	Ni 99 2	2.4066	3072-76 NA11	N02200	-250	600	8.90
Monel 400	400	Ni Cu 30 Fe	2.4360	3072-76 NA13	N04400	-125	600	8.80
Inconel 600	600	Ni Cr 15 Fe	2.4816	3072-76 NA14	N06600	-100	950	8.40
Inconel 625	625	Ni Cr 22 Mo 9 Mb	2.4856	3072-76 NA21	N06625	-50	450	8.44
Incoloy 800	800	X10 Ni Cr A1 Ti 3220	1.4876	3072-76 NA15	N08800	-100	850	8.00
Incoloy 825	825	Ni Cr 21 Mo	2.4858	3072-76 NA16	N08825	-100	450	8.14
Hastelloy B2	B2	Ni Mo 28	2.4617	-	N10665	-200	450	9.20
Hastelloy C276	C276	Ni Mo 16 Cr 15 W	2.4819	-	N10276	-200	450	8.90
Titanium	Ti2	Ti 99 8	3.7025	TA2	R50400	-250	350	4.50

(1) Standard Material for Camprofile Gaskets

LAYER MATERIAL	TEMPERATURE (°C)		MAXIMUM OPERATING PRESSURE	GAS TIGHTNESS	APPLICATION
	MIN	MAX			
Graphite	-200	450	400	Good	Aggressive Media
Graphite APX2	-200	500	400	Good	Aggressive Media
PTFE	-200	260	150	Good	Aggressive Media
Novus Sheet	-100	250	100	Good	Moderate Media
Silver	-200	750	250	Good	Aggressive Media
Hi-Temp	-200	1000	20	Average	Gases
Hi-Temp + APX2	-200	800	100	Good	Gases

Layer Material Selection

The table above may be used to determine the appropriate sealing layer material. We recommend the use of graphite layers for most applications. Only in cases where graphite may cause media contamination, or is not chemically resistant, should an alternative material layer be chosen.

Graphite

Graphite is a universal, high quality, non asbestos sealing material featuring:

- Very good chemical resistance
- Resistance to high fluctuating temperatures and pressures
- Non ageing properties
- Excellent gas tightness qualities.

Graphite APX 2

Inhibited grade for oxidation resistance. Ideal for use at temperatures above the limit recommended for standard graphite grades. Often used in combination with Novus Hi-Temp for high temperature applications.

PTFE

PTFE is a high quality synthetic material featuring:

- Excellent chemical resistance
- Temperature resistant up to 260°C
- Good ageing resistance
- Excellent gas tightness.

Novus Sheet

Novus sheet materials consist of synthetic fibre compounds with rubber binders and material fillers.

Silver

Silver is a precious metal combining excellent gas tightness and chemical resistance properties. Generally used in applications requiring gas tightness at elevated temperatures.

Hi-Temp

Hi-Temp is a mica-based material suitable for high temperature applications, often used in combination with graphite up to temperatures of 800°C.

HOW TO ORDER

Please specify the following when ordering camprofile gaskets.

- Style of camprofile gasket
- Nominal pipe bore, pressure rating and flange standard
- Materials of core and sealing layer
- For non standard flanges please specify gasket dimensions.

EXAMPLE:

The following example illustrates how to order a camprofile gasket (information in bold print is stamped on the centering ring - if present; otherwise the information is printed on the packaging):

M41LM – Style M41LM

- convex root-form camprofile with floating externally attached centering ring

4"–300lbs – The gasket is suitably dimensioned for 4" flanges, 300lbs pressure rating

316L – Camprofile core of 316L stainless steel

Graphite – Graphite sealing layer



Corrugated Gaskets



Corrugated Gasket Characteristics

Novus corrugated gaskets comprise a corrugated metallic core, normally stainless steel, with a soft facing layer applied to each face. The corrugations provide resilience and reduce the sealing contact surface area of the gasket while the soft layer ensures outstanding sealing, even at low loads. These gaskets are particularly suited for heat exchanger applications as a replacement to metal jacketed gaskets.

Heat Exchanger Applications

Heat exchanger flanges, owing to the difference in thickness of the mating flanges, heat and expand at different rates.

This differential expansion can cause radial shearing of the gasket and therefore it is critical that a gasket is selected which resists radial shear and maintains a seal even under thermal cycling conditions.

Corrugated metal gaskets have a proven record in problematic exchanger applications, offering low relaxation, high resistance to radial shear and high levels of tightness. For this reason these gaskets are replacing more traditional gasket styles such as metal jacketed particularly on these applications.

Properties

- Excellent resistance to radical shear
- Creates a tight seal at low bolt loads
- Can be used when there is insufficient bolt load to seal spiral wound gaskets
- Outstanding resistance to thermal cycling
- Safe to handle and fit
- Excellent thermal and chemical stability
- Tolerant to flange imperfections

Practical Benefits

- No sharp edges for safe handling
- Excellent rigidity ensures easy posting between flanges
- Does not stick to flanges

Seating Stress Range

Corrugated gaskets offer reliable sealing performance when seated within the following seating stress ranges.

SEATING STRESS (20°C)		
MINIMUM (N/mm ²)	OPTIMUM (N/mm ²)	MAXIMUM (N/mm ²)
20	90	200

Thickness

Available in 1.5mm, 2mm and 3mm.

Flange Surface Finish

The recommended flange surface finish for corrugated gaskets with sealing layers is from 3.2 to 6.3µm Ra (125-250 RMS), this is also referred to as a smooth finish.

Sizing Guidelines

DIN Sizes 10, 16, 25, 40 bar. ANSI Sizes Class 150 and 300lb. Other sizes available on request. Also available for vessel and non-standard applications.

Chemical Suitability

PH Range 0-14.

LAYER MATERIAL	TEMPERATURE (°C)		MAXIMUM OPERATING PRESSURE	GAS TIGHTNESS	APPLICATION
	MIN	MAX			
Graphite	-200	450	150	Good	Aggressive Media
Graphite APX2	-200	500	150	Good	Aggressive Media
PTFE	-200	260	50	Good	Aggressive Media
Hi-Temp + APX2	-200	800	100	Good	Gases

Layer Material Selection

The table (below) may be used to determine the appropriate sealing layer material. We recommend the use of graphite layers for most applications. Only in cases where graphite may cause media contamination, or is not chemically resistant, should an alternative layer material be chosen.

Graphite

Graphite is a universal, high quality, non asbestos sealing material featuring very good chemical resistance, resistance to high fluctuating temperatures and pressures, non ageing properties plus excellent gas tightness.

Graphite APX 2

Inhibited grade for oxidation resistance. Ideal for use at temperatures above the limit recommended for standard graphite grades. Often used in combination with Novus Hi-Temp for high temperature applications.

PTFE

PTFE is a high quality synthetic material featuring excellent chemical resistance, temperature resistant up to 260°C, good ageing resistance 1 and excellent gas tightness.

Hi-Temp

Hi-Temp is a mica based material suitable for high temperature applications, often used in combination with graphite up to temperatures of 800°C.

HOW TO ORDER

Please specify the following when ordering corrugated gaskets.

- Standard of the gasket (flange standard)
- Nominal size and pressure class
- Materials - core filler

EXAMPLE:

Novus CMG
Dimensions – ASME B16.20
2" 150lbs
SS316 Core
Graphite coating layer

Spiral Wound Gasket Characteristics

The sealing element of the spiral wound gasket consists of a V-shaped metal strip spirally wound in combination with a soft sealing material filler. The metal strip provides outstanding resilience, while the flexible sealing filler guarantees excellent sealing.

Due to this combination of materials, the spiral wound gasket is suitable for sealing under severely fluctuating temperature and pressure conditions. Depending on the application the spiral wound gasket can be specified with outer and/or inner rings.

Properties

- Spiral wound gaskets are suitable for use across a wide gasket stress range.
- Spiral Wound gaskets can be used to seal fluid pressures up to 400 bar and from cryogenic temperatures up to 1000°C.
- Spiral Wound gaskets are robust and simple to install.
- The outer guide ring simplifies assembly and prevents blow-out of the gasket.
- By combining different winding materials and metals, the gasket can be tailored to suit a wide variety of operating conditions.
- The gasket is easy to remove after service and does not cause any damage to the flange faces.



Gasket Stress Range

Novus spiral wound gaskets should preferably be mounted within the gasket stress ranges shown in this chart to ensure leak free connections.

Flange Surface Finish

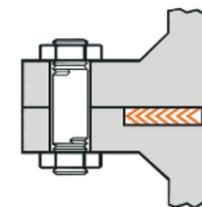
The recommended surface roughness of the flange faces, between which a spiral wound gasket is to be mounted, is 3.2 – 6.3µm Ra (125 – 250 RMS), also referred to as smooth finish.

Gasket Stress Range:

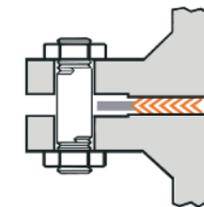
FILLER	SINGLE SIDE CONFINED			BOTH SIDES CONFINED		
	GASKET STRESS (20°C)			GASKET STRESS (20°C)		
	MIN (N/mm ²)	OPT (N/mm ²)	MAX (N/mm ²)	MIN (N/mm ²)	OPT (N/mm ²)	MAX (N/mm ²)
Graphite	50	95	180	50	120	400
PTFE	50	80	130	50	110	250
Hi-Temp + APX2	55	95	130	50	120	250

Standard Gasket Profiles

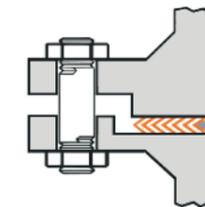
We produce the following types of spiral wound gaskets.



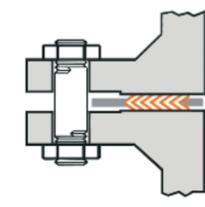
Type RF1
The gasket consists of a sealing filler and V-shaped metal strip wound in combination. This profile is usually applied to tongue/groove flanges.



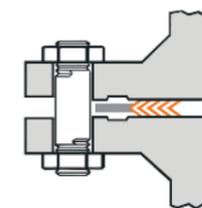
Type SG
The standard spiral wound gasket format identical to Novus RF1 but fitted with an outer centering ring (applied to raised face flanges). An integral centering guide ring ensures fast, accurate centering of the gasket on the flange. Provides additional radial strength to prevent gasket blow-out and acts as a compression stop.



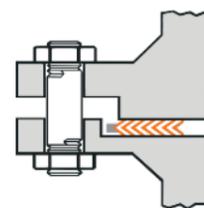
Type RF-IR
Spiral wound gasket for male/female flanges consisting of a wound component fitted with an inner ring to bring the gasket flush with the pipe bore to prevent inward buckling.



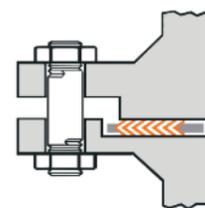
Type SG-IR
Identical to Novus SG but also fitted with an inner ring to prevent inward buckling at the windings.



Type SG-RTJ
A standard spiral wound gasket (SG Type) with dimensions tailored to Ring Joints (RTJ) flanges.



Type HX-R
This type of gasket consists of a wound component fitted with a narrow wound centering ring. Centering windings ensure correct centering in flush flanges (e.g. in heat exchangers).



Type HX-RIR
This gasket is identical to HX-R but also fitted with an inner ring, rendering this gasket type suitable for mounting in male and female flanges.

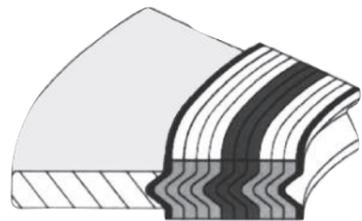
Spiral Wound Gaskets



Special Profiles

Profile with a GT - Zone

In the event of a graphite filled spiral wound gasket possibly causing an undesirable reaction between the graphite and the medium to be sealed, or of possible medium contamination, the problem can be solved by using a spiral wound gasket with a GT - Zone.



The spiral wound element of a Novus GT - Zone gasket consists of outer windings of Hi-Temp material with a central winding zone made of graphite or PTFE (depending on the operating conditions) to improve gas tightness. This results in a spiral wound gasket with the following properties:

- Can be used at higher temperatures
- Has excellent sealing properties

Combined with the other advantages of a spiral wound gasket, the spiral wound with a GT - Zone may be used in a wide range of operating conditions and applications.

Special Shapes

Spiral wound gaskets can be produced in a wide variety of shapes, such as oval and pear-shape, with pass partition bars and many other types. Generally, the pass partition bars on spiral wound gaskets are manufactured as metal-jacketed bars. A variety of alternatives are available.

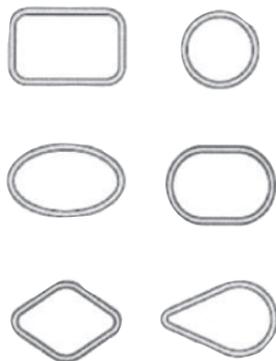
Type MH

This spiral wound gasket is identical to the RF1 profile but oval shaped to fit manholes.



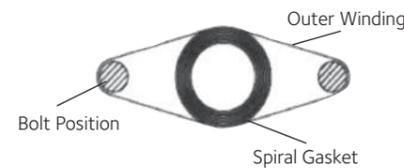
Type TC/HH

This type of gasket is for hand holes and special flange assemblies (tube cap and hand hole covers). They are available in square, rectangular, oval, diamond and pear shapes. A drawing specifying the correct dimensions are required to manufacture special shapes.



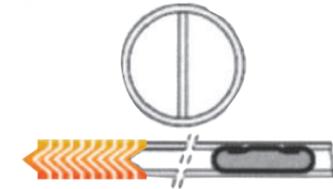
Type WL

This gasket is identical to RF1 but fitted with an outer winding. Centering is achieved by positioning the winding over two bolts opposite each other.



Type HE

Fitted with pass partition bars for use on heat exchangers and vessels, this gasket type is otherwise identical to the RF1 profile. Metal - jacketed bars have a thinner design than that of spiral wound gasket material.



The bars are fixed through welding.

Type HE-SG

Fitted with an outer centering ring, the HE-SG is otherwise identical to the HE profile.



Type HE/SG-IR

Fitted with an outer centering ring and an inner ring, the HE/SG-IR is otherwise identical to the HE profile.



Guide Rings and Material Selection

Benefits of the Centering Ring

The spiral wound gasket outer centering ring provides the following benefits:

- Optimum location between the bolts
- Protection of the spiral wound element
- Additional security against gasket blow-out
- Acts as compression limiter preventing overloading and over compression of the spiral wound element
- Prevents radial-flow of soft fillers, such as PTFE.

For these reasons it is preferable to use spiral wound gaskets with outer centering rings.

The outer ring is marked with nominal size, pressure class, standard and materials.

Benefits of the Inner Ring

The spiral gasket inner ring provides the following benefits:

- Prevents radial-flow of soft fillers, such as PTFE + Graphite
- Reduces turbulence-minimising flow resistance
- Acts as a heat shield when the spiral wound gasket is subjected to high temperatures.

Inner and outer rings are particularly recommended for use on spiral wound gaskets exceeding class 600lbs, but specifically recommended for high temperatures and pressures to optimise the operational reliability of the spiral wound sealing element. Inner rings are mandatory for PTFE filled spirals.

Material Selection

The material selected for the inner ring and winding metal is usually the same as the flange metal. This prevents corrosion and differential expansion problems. The outer centering ring is generally manufactured from carbon steel with an anti-corrosion treatment. However, the ring may also be manufactured in the same metal as the flange to prevent corrosion problems.

The table below lists the application limits and specifications of alloys used in the manufacture of spiral wound gaskets.

MATERIAL (TRADE NAME)	IDENTIFICATION	DIN SPECIFICATION	DIN MATERAIL NO.	B.S.	AISA ASTM UNS	TEMPERATURE (°C)		DENSITY (GR/CM ³)
						MIN	MAX	
Low Carbon Steel	S	R St 3.72	-	-	-	-40	500	7.85
Stainless Steel 304	S304	X5 Cr Ni 18	1.4301	304S15/16/13	304	-250	550	7.90
Stainless Steel 304 L	S304L	X2 Cr Ni 18 9	1.4306	304S11	304L	-250	550	7.90
Stainless Steel 309	S309	X15 Cr Ni Si 20 12	1.4828	309S24	309	-100	1000	7.90
Stainless Steel 316	S316	X5 Cr Ni Mo 18 10	1.4401	316S16	316	-100	550	7.90
Stainless Steel 316 L ⁽¹⁾	S316L	X2 Cr Ni Mo 18 10	1.4404	316S11/13	316L	-100	550	7.90
Stainless Steel 316Ti	316Ti	X10 Cr Ni Mo Ti 18 10	1.4571	320S31	316Ti	-100	550	7.80
Stainless Steel 321	S321	X10 Cr Ni Ti 18 9	1.4541	321S12/49/87	321	-250	550	7.90
Stainless Steel 347	S347	X10 Cr Ni Nb 18 9	1.4550	347S31	347	-250	500	7.90
Stainless Steel 410	S410	X6 Cr 13	1.4000	410S21	410	-20	850	7.80
254SMO	6Mo	X1CrNiMoCu N 2018 7	1.4547	-	S31254	-100	500	8.00
Duplex	2205	X2 Cr Ni Mo N 22 5 3	1.4462	318S13	S31803/32205	-40	300	7.80
Super Duplex	2507	X2 Cr Ni Mo N 25 6 3	1.4410	-	S32750	-40	300	7.80
Aluminium	AL 1050	A1 99 5	3.0255	1B	A91050	-250	300	2.71
Nickel 200	Ni200	Ni 99 2	2.4066	3072-76 NA11	N02200	-250	600	8.90
Monel 400	400	Ni Cu 30 Fe	2.4360	3072-76 NA13	N04400	-125	600	8.80
Inconel 600	600	Ni Cr 15 Fe	2.4816	3072-76 NA14	N06600	-100	950	8.40
Inconel 625	625	Ni Cr 22 Mo 9 Mb	2.4856	3072-76 NA21	N06625	-50	450	8.44
Incoloy 800	800	X10 Ni Cr Al Ti 3220	1.4876	3072-76 NA15	N08800	-100	850	8.00
Incoloy 825	825	Ni Cr 21 Mo	2.4858	3072-76 NA16	N08825	-100	450	8.14
Hastelloy B2	B2	Ni Mo 28	2.4617	-	N10665	-200	450	9.20
Hastelloy C276	C276	Ni Mo 16 Cr 15 W	2.4819	-	N10276	-200	450	8.90
Titanium	Ti2	Ti 99 8	3.7025	TA2	R50400	-250	350	4.50

Standard Material for Spiral Wound Windings

Spiral Wound Gaskets

Filler Material Selection

The table opposite may be used to select the correct filler. It should be pointed out that graphite will be the optimum filler in most cases. Only where graphite could cause media contamination, or is not chemically resistant, should the use of another type of filler material be recommended. In such cases, an alternative solution might be to select a gasket with a GT-zone.

Graphite

Graphite is universally chosen because of its good chemical resistance, resistance to ageing, good gas tightness and ability to operate at high temperatures.

APX2

APX2 is an oxidation resistant graphite which offers the same excellent sealing characteristics of graphite but can be used at higher service temperatures.

Standard Fillers

LAYER MATERIAL	TEMPERATURE (°C)		MAXIMUM OPERATING PRESSURE (BAR)	GAS TIGHTNESS	APPLICATION
	MIN	MAX			
Graphite	-200	450	400	Good	Aggressive Media
Graphite APX2	-200	500	400	Good	Aggressive Media
PTFE	-200	260	150	Good	Aggressive Media
Hi-Temp	-200	1000	5	Average	Gases
Hi-Temp + APX2	-200	800	100	Good	Gases

Non standard materials are available on request

PTFE

PTFE is a high quality synthetic material with the following characteristics: excellent chemical resistance, resistance to 260°C, resistant to ageing, excellent gas tightness.

Hi-Temp

Hi-Temp is mica based material suitable for high temperature applications, often used in combination with graphite (GT-zone).

HOW TO ORDER

Please specify the following when ordering Spiral Wound Gaskets.

- Type of Spiral wound gasket required
- Standard of the gasket (flange standard)
- Nominal size and pressure class
- Material:
 - Inner ring
 - Metal winding
 - Filler
 - Outer ring

EXAMPLE:

Novus SG-IR
 Dimensions – ASME B16.20
 2" 150lbs
 SS316L
 SS316L
 Graphite
 Carbon Steel



Metal Jacketed Gaskets

Metal Jacketed Gasket Characteristics

Metal jacketed gaskets consist of a metal cover and a 'soft' sealing material filler.

The sealing filler provides outstanding resilience, while the metal jacket guarantees good sealing and protects the filler against pressure conditions, fluctuating temperatures and corrosion.

A wide variety of materials are available to guarantee satisfactory sealing. The metals listed on the next page are standard, other metals are available on request.

This type of gasket is being replaced by either Camprofiles (see pages 4-7) or corrugated metal products (see pages 8-9).

Welded Metal Jacketed Gaskets

Welded metal jacketed gaskets are manufactured in a wide range of sizes and styles. Generally they are used in Heat Exchangers, Vessels, Pumps, Autoclaves, Engines, Valves, and Exhaust Systems.

Metal jacketed gaskets require machined flange faces, high bolt loads and exact flange alignment to ensure an effective seal. It is for this reason that we recommend the use of Camprofile or Corrugated Metal Gaskets for most applications.

One-piece

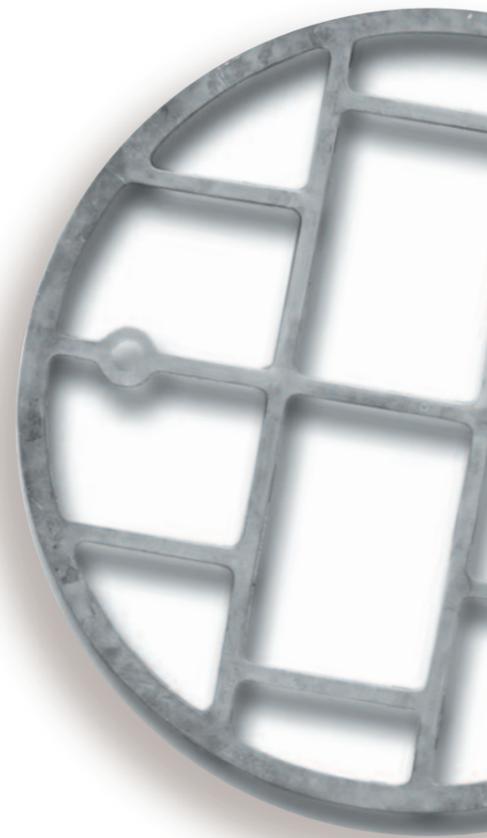


Welded



Welded bar metal jacketed gaskets offer the following benefits over one-piece gaskets with integral bars:

- **Lower price** - Typical cost savings 10% to 40% (depending on material)
- **Quicker delivery** - Less time to manufacture
- **Technically superior and safer** - Extra sealing safeguards give a better gasket
- **Longer sealing life** - Bars seal independently of the outer ring.



Gasket Profiles

Metal jacketed gaskets can be produced in a variety of styles. The diagram below shows the standard range of shapes for vessels and heat exchangers.

When ordering metal jacketed gaskets with pass-partition bars, a drawing with the exact dimensions and positions is required.

Flange Surface Finish

We recommend a maximum flange surface finish of 1.6µm.

Jacket material:	Profiles
Stainless Steel	S2
Aluminium	
Copper	S3
Brass	
Titanium	S4
Silver	
Carbon Steel	S4A
Soft Iron	
Monel	S6
Inconel	
Incoloy	S7
Nickel	
Hastelloy	S8
Non Asbestos	
Millboard	S9
PTFE	
Uniflon	S12
Graphite	

Type S6 Seating Stress

SEATING STRESS (20°C)		
MINIMUM (N/mm ²)	OPTIMUM (N/mm ²)	MAXIMUM (N/mm ²)
80	110	180

Standard Vessel and Heat Exchanger Profiles

The illustrations opposite represent standard Novus spiral wound gasket shapes for vessel and heat exchanger flanges.

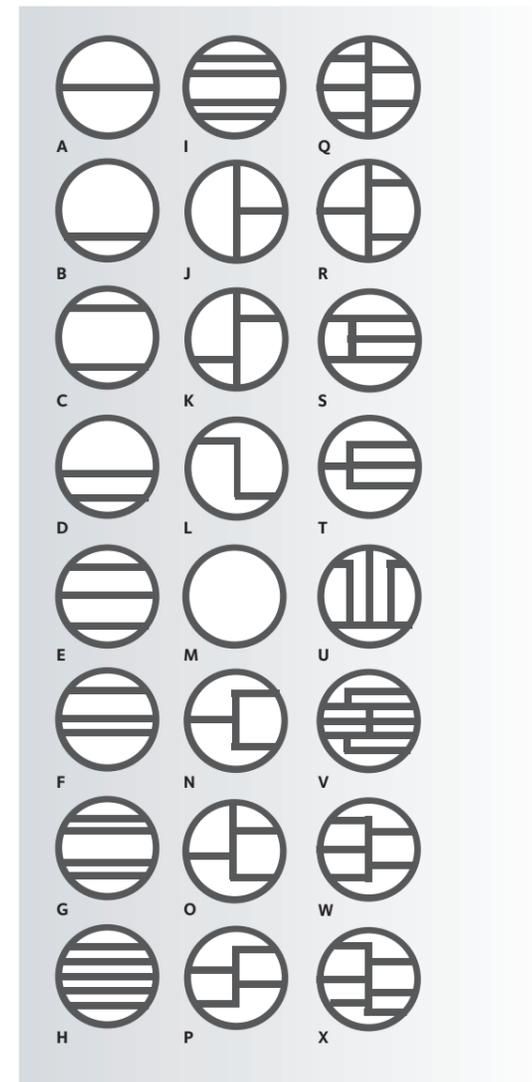
Standard Metals

- Aluminium
- Copper
- Stainless Steel
- Monel
- Nickel
- Hastelloy
- Soft Iron
- Brass
- Inconel
- Incoloy
- Silver
- Titanium

Standard Fillers

- PTFE
- Non-asbestos Millboard
- Graphite

Standard Vessel & Heat Exchanger Profiles



Installation of Novus Metallic Gaskets

In order to ensure the optimum service life of Novus metallic gasket materials it is not only important to choose the correct material for the application but to install and maintain it correctly.

The following guidelines are designed to assist the end user in the assembly of Novus gasket materials.

Flange Condition

- Remove the old gasket and check that the flange faces are clean and free from indentations and scoring. Radial (cross face) scoring is a particular concern and can lead to joint leakage.
- For camprofiles, corrugated metal and spiral wound gaskets, a surface finish of between 3.2µm to 6.3µm Ra (125 to 250 micro inch) is recommended; for metal ring joints a surface finish of between 0.8µm and 1.6µm is recommended (dependent on style) and for metal jacketed gaskets a surface finish of 1.6µm Ra is recommended. Use a surface finish comparator e.g. Novus comparator to check flange finish (right).
- Check that the flange faces are parallel or that the pipework is sufficiently flexible to allow the flanges to be pulled parallel and concentric without excessive bolt loads.

Gasket

- Always use a new gasket
- Check that the gasket is in good condition and that the dimensions are correct for the class and size of the flanges
- Do not use jointing compounds, grease or lubricants with Novus metallic gasket materials. These compounds can affect the contact friction between the gasket and the flange and can lead to creep and premature joint failure
- If there is a requirement to fix the gasket to the flange prior to assembly (e.g. large vertical flanges) then a light dusting of spray adhesive e.g. 3M 77 spray may be used. The adhesive should be applied sparingly and in isolated areas, and must be compatible with the fluid medium.

Bolting

- Ensure the bolt and nut threads are clean. Apply bolt lubrication to the bolt and nut threads and to the face of the nut to be tightened. Do not apply grease or bolt lubricant to the joint face. After cleaning and lubrication it should be possible to run the nut along the full length of the bolt by hand. If this is not possible the bolts and nuts should be refurbished or replaced
- Scrape, wire brush or file as necessary the back face of each flange where the bolt heads and nuts are to sit, ensuring that the surfaces are clean and flat
- If possible use hardened flat washers to ensure even transfer of the load.

Installation

- Ensure that the gasket is installed centrally
- It is recommended that the bolts are tightened using a controlled method such as torque or tension. If using a torque wrench, ensure that it is accurately calibrated
- Tighten bolts in a star-like crossing pattern in the following sequence
- Finger tighten nuts
- Tighten to 30% of the final load
- Tighten to 60% of the final load
- Tighten to full load
- Make a final tightening sequence, working around the flange, tightening each bolt in turn until the specified torque is achieved.

After Installation

Check that the flange faces are parallel using a suitable tool e.g. Novus Flange Gap Tool (below).



HOW TO ORDER

Please specify the following when ordering metal jacketed gaskets.

- Type of metal jacketed gasket required
- Standard of the gasket (flange standard)
- Nominal size and pressure class

- Material - Jacket and Filler

EXAMPLE:

Novus Metal Jacketed Type S6
Dimensions: ASME B16.20
2" 150lbs
SS316, Non-asbestos Millboard

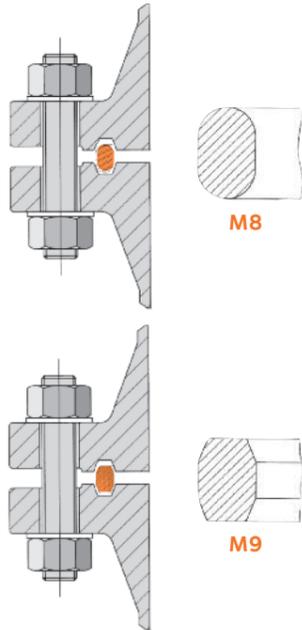
Novus Ring Type Joints

Ring Type Joints

Ring type joints are designed to concentrate the bolt load over a small area thus producing high seating stresses. As the ring type material should always be softer than the mating flanges, the high seating stress causes 'plastic-flow' of the ring joint in the flange faces creating the seal.

Ring Type Joint Profiles

Type R Ring Type Joints

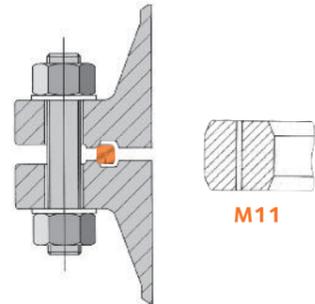


Novus models M8 and M9

M8 model R oval section and M9 model R octagonal section ring type joints are designed for flanges with standard ring type grooves. These standard shapes are used to seal pressures up to 5,000 psi in accordance with API 6A.

The octagonal cross section has a higher sealing efficiency than the oval cross section and is therefore preferred. The oval section ring joints were originally designed for the now obsolete round bottom groove. Both the oval and the octagonal cross section are interchangeable on the flat bottom groove design.

Type BX Ring Type Joints



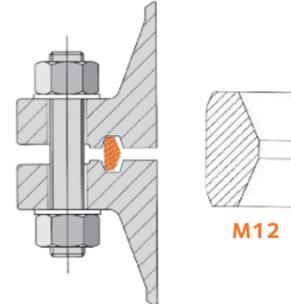
Novus model M11/M11S

M11 model BX ring type joints are designed for pressures up to 20,000 psi, suitable only for use with API type BX flanges and grooves.

The gasket has a square cross section with bevelled corners. The average diameter of the ring joint is slightly greater than that of the flange groove. This way, when the ring joint is seated, it stays pre-compressed by the outside diameter, creating high seating stress.

The M11S Model SBX ring type joint is the same design as the BX ring, however the suffix 'S' indicates that additional pressure equalisation holes have been drilled in accordance with API 17D for use on sub sea wellhead and christmas tree equipment.

Type RX Ring Type Joints



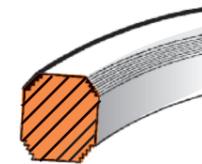
Novus model M12/M12S

M12 model RX ring type joints are designed for pressures up to 5,000 psi.

A pressure activated ring joint, its shape is designed so that the fluid pressure increases sealability. The outside sealing surface of the ring joint makes the initial contact with the flange. As the internal pressure rises the contact pressure between ring joint and flange also increases. This is sometimes referred to as a pressure activated ring joint. due to the shape of the gasket. High seating pressures are created increasing the sealability. This design characteristic makes the RX ring joint more resistant to vibrations, pressure surges and shocks that occur during oil well drilling.

M12S Model SBX ring type joint is the same in design to the RX ring, however, the suffix 'S' indicates that additional pressure equalisation holes have been drilled in accordance with API 17D for use on sub sea wellhead and christmas tree equipment.

We supply a range of specialised Ring Type Joints for critical and non standard applications to suit the requirements of the petrochemical industry.



Cam-ORJ

The Cam-ORJ is a standard API 6A octagonal ring joint but with the four angled seating surfaces concentrically serrated and faced with oxidation inhibited graphite. The gasket offers the high sealing efficiency associated with the octagonal design but with the added benefit of being capable of sealing flanges with minor damage. Under compression the graphite flows into minor imperfections creating a tight seal.

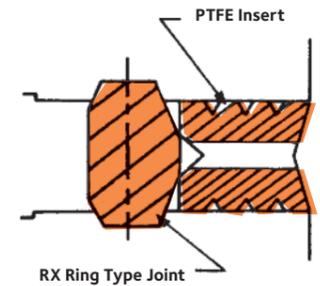
The Cam-ORJ is available in a range of Alloy materials and in sizing to suit ASME B16.5 or API 6A flanges.



Novus model M8R and M9R

Rubber Coated Ring Type Joints

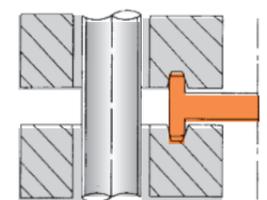
This is an octagonal/oval section ring type joint generally soft iron or low carbon steel totally enclosed in a nitrile rubber coating. Widely used in pressure testing procedures, minimising any damage to the flange.



Novus model M12PI

Ring Type Joints with PTFE Inserts

M12 model RX ring type joints can be supplied with PTFE inserts. Designed to reduce turbulent flow and eliminate ring joint and flange corrosion. The insert is specially designed with radially drilled holes ensuring the self-energising performance is not affected. The insert is located between the inside diameter of the ring joint and the bore of the flange. On assembly, the insert is captured between the flanges, filling the void between ring joint and flange bore.



Blind Ring Type Joints

These specialised ring type joints are designed and manufactured for the customer who has a requirement to blank off flanges and pipe work. The joints are standard rings but with a machined metallic centre.

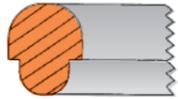
Blind ring type joints can be supplied in a variety of materials.

(Continued on page 20)

Novus Ring Type Joints



Ring Type Joint Profiles



Combination Ring Type Joints

This ring type joint consists of two different sizes having the same pitch diameter, used for sealing and flange joint where the mating flanges have different ring groove dimensions or profiles.

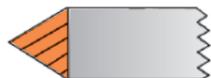
These ring type joints can be produced with either octagonal or oval facings, however they are not manufactured in accordance with API specification.



Lens Rings

This is a contact seal for use in high pressure piping systems and in pressure vessel heads. Lens rings have a spherical surface that requires special matching of the flanges. Effective sealing is obtained at relatively low bolt loads.

These ring type joints are manufactured in accordance with DIN 2696. For enquiries complete drawings must be supplied.



Delta Rings

This is a pressure actuated ring used primarily on pressure vessels and valve bonnets at pressures in excess of 5000 psi. Internal pressure forces the delta ring material to expand.

As with the Lens rings, all enquiries and orders should be sent with complete drawings.



Seating Stress

SEATING STRESS (20°C)				
MATERIAL	IDENTIFICATION	MINIMUM (N/mm ²)	OPTIMUM (N/mm ²)	MAXIMUM (N/mm ²)
Soft Iron	D	235	350	525
Low Carbon Steel	S	265	400	600
A182FS	FS	400	600	900
SS304	S304	335	500	750
SS316	S316	335	500	750
SS321	S321	335	500	750
SS347	S347	335	500	750

For other materials please contact our technical department

Seating Stress

To achieve a reliable seal, the ring type joint should be assembled within the seating stress parameters shown in the table above.

Flange Surface Finish

The ring type joint and the sealing face of the groove must be free of indentations, score marks, tool and chatter marks.

The maximum flange surface finish for M8, M9, model R, M12 model RX is 1.6µm RA (63RMS).

The maximum flange surface finish for M11 model BX is 0.8µm RA (32RMS).

HOW TO ORDER

Please specify the following when ordering Novus ring type joints.

- Ring type joint model
- Ring number/size & pressure rating
- Material/identification
- Flange standard

EXAMPLE:

M8 R Oval
R16/Class 1" 3/600lbs
Soft Iron or D
ASME/ANSI B16.5

Note: This can be abbreviated to R16D Oval RTJ

Hardness of Ring Type Joint Materials

On installation, the material of the ring joint has to be softer than that of the flange to avoid damage.

This table provides comparative data of ring type joint material hardness values.

MATERIAL (TRADE NAME)	IDENTIFICATION	DIN SPECIFICATION	DIN MATERIAL NO.	B.S.	AISA-ASTM UNS	MAXIMUM HARDNESS		TEMPERATURE (°C)		DENSITY (GR/CM ³)
						BRINELL HB	ROCKWELL B HRB	MIN	MAX	
Soft Iron	D	-	-	-	-	90	56	-40	500	7.85
Low Carbon Steel	S	R st 37.2	-	-	-	120	68	-40	500	7.85
F5	FS	5 Cr 0.5 mo	1.7362	-	A182FS	130	72	-40	650	7.83
SS304	S304	X5Cr Ni 18	1.4301	304S15/16/13	304	160	83	-250	550	7.83
SS304L	S304L	X2 Cr Ni 18.9	1.4306	304S11	304L	160	83	-250	550	7.90
SS309	S309	X15 Cr Ni Si 20.12	1.4828	304S24	309	160	83	-100	1000	7.90
SS316	S316	X5 Cr Ni Mo 18.10	1.4401	316S16	316	160	83	-100	550	7.90
SS316L	S316L	X2 Cr Ni Mo 18.10	1.4404	316S11/13	316L	160	83	-100	550	7.90
SS316Ti	S316Ti	X10 Cr Ni Mo Ti 18.10	1.4571	320S31	316Ti	160	83	-100	550	7.80
SS321	S321	X10 Cr Ni Ti 18.9	1.4541	321S12/49/87	321	160	83	-250	550	7.90
SS347	S347	X10 Cr Ni Nb 18.9	1.4550	347S31	347	160	83	-250	500	7.90
SS410	S410	X6 Cr 13	1.4000	410S21	410	170	86	-20	850	7.80
254SMO	6Mo	X1Cr Ni Mo Cu N20.18.7	1.4547	-	S31254	180	89	-100	500	8.00
Duplex	2205	X2 Cr Ni Mo N 22.5.3	1.4462	31853	S31803/32205	230 approx	99	-40	300	7.80
Super Duplex	2507	X2 Cr Ni Mo N 25.6.3	1.4410	-	S32750	230 approx	99	-40	300	7.80
Aluminium	AL 1050	A1 99.5	3.0255	1B	A91050	30	-	-250	300	2.71
Silver	Ag	-	-	-	-	28 (HV)	-	-250	750	10.50
Copper	Cu	SF-Cu	2.0090	C106	C12200	80 approx	-	-250	400	8.90
Brass	CuZn37	Cu Za 37 (M563)	20321	CZ108	C27200	60 approx	-	-100	350	8.50
Nickel 200	Ni 200	Ni 99.2	2.4066	3072-76 NA11	NO2200	110	62	-250	600	8.90
Monel 400	400	Ni Cu 30 Fe	2.4360	3072-76 NA13	NO4400	150	80	-125	600	8.80
Inconel 600	600	Ni Cu 15 Fe	2.4816	3072-76 NA14	NO6600	150	80	-100	950	8.40
Inconel 625	625	Ni Cr 22 Mo 9 Mb	2.4856	3072-76 NA21	NO6625	150	80	-50	450	8.44
Incoloy 800	800	X10 Ni Cr A1 Ti 3220	1.4876	3072-76 NA15	NO8800	150	80	-100	850	8.00
Incoloy 825	825	Ni Cr 21 Mo	2.4858	3072-76 NA16	NO8825	195	92	-100	450	8.14
Hastelloy B2	B2	Ni Mo 28	2.4617	-	N10665	230	99	-200	450	9.20
Hastelloy C276	C276	Ni Mo 16 Cr 15 W	2.4819	-	N10276	210	95	-200	450	8.90
Titanium	Ti2	Ti 99.8	3.7025	TA2	R50400	215 approx	96	-250	350	4.50

* Brinell hardness measured with 3000kg, and 10mm diameter hardened steel ball. Softer materials i.e. copper & brass are measured with 500kgs and 10mm diameter hardened steel ball.

* Rockwell B hardness is measured with 100kg and 1.60mm diameter steel ball.

Technical & testing services

Technical Support

Our product and service offering is underpinned by high quality technical support from a team of engineers acknowledged as one of the most experienced, knowledgeable and customer-focused in our industry.

We are active members of the European Sealing Association and our engineers contribute to international technical committees including ASME and European standards organisations.

The knowledge and experience of our technical team allows us to provide rapid response to customer enquiries as well as provide innovative and practical solutions to even the most problematic sealing application.

Our engineers are available 24/7 to assist you with:

- **Product recommendations**
- **Joint design and calculations**
- **Installation guidance**
- **On-site support**
- **Innovative software solutions**
- **Failure analysis and solutions**

Testing Service

We have dedicated test facilities for the development of new products, the control of quality and the solving of application problems. The range and breadth of equipment places the company at the forefront of sealing technology.

Our facilities allow us to replicate the conditions under which a flanged joint operates in service. The data gathered can be used to ensure that the most suitable gasket is being employed and that it is properly loaded to withstand the operating conditions.

Our testing capability extends across all industries and includes:

- **High temperature and pressure service**
- **Heat exchangers**
- **Compressors**
- **Aerospace engines**
- **Valve and pump testing**

Training for the future



The Academy of Joint Integrity

Training Courses

The Academy of Joint Integrity offers Accredited and Awareness Training Courses to all personnel who are actively involved in the assembly and tightening of flanged bolted connections. Mentoring and assessment programmes complement the training provision. All training courses will be delivered by industry professionals with current and relevant experience in the field.

The Academy is a member of the Energy Institute and has contributed to the latest UK Oil and Gas best practice guidelines, specific to Joint Integrity Management. The Academy is also an active member of an ASME sub-committee, developing new initiatives for Pressure Boundary Bolted Flange Joint Assembly.

Academy training courses incorporate Energy Institute, European (EN1591 part 4) and ASME PCC-1-2010 methods and procedures.

Location

The Academy has dedicated facilities in Aberdeen, Teesside, Humberside and West Yorkshire.

Training is also offered within our overseas operations.

Courses

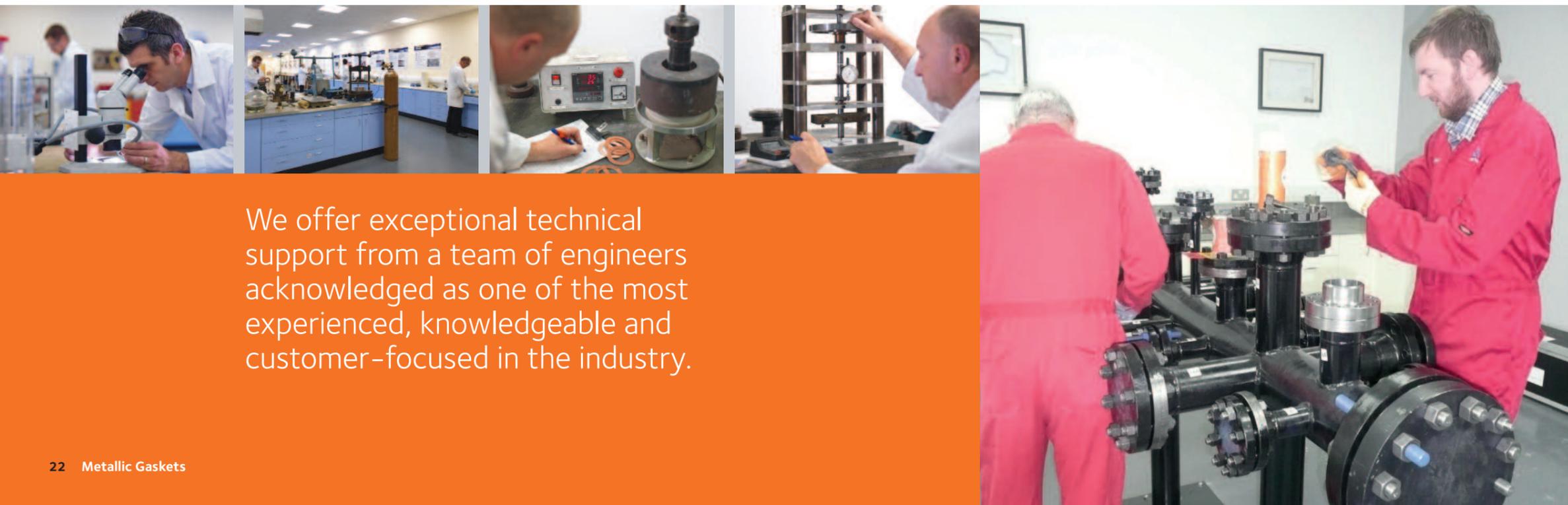
Training can be delivered in a variety of ways:

- **At the clients premises, utilising mobile training rigs and equipment**
- **At the Academy, utilising our purpose built training centres**
- **Via 'Blended Training' using a web based learning portal with a unique E-Learning programme.**

Benefits

- **Legislation compliance**
- **Motivated workforce with best practice skills**
- **Reduced costs with increased asset integrity**
- **Access to the latest technical standards and procedures**
- **Sealing and integrity modules providing greater knowledge**
- **Alliance and structured support from a world class technical / training team.**

For further information on the range of courses available, visit www.academyofjointintegrity.com



We offer exceptional technical support from a team of engineers acknowledged as one of the most experienced, knowledgeable and customer-focused in the industry.

Petrochemical industry operations and maintenance involve many complex and potentially hazardous activities, and it is imperative that the industry can develop and demonstrate the competence of personnel involved in this work. The focused training and verification provided by The Academy of Joint Integrity courses delivers a reliable and comprehensive solution, allowing operating companies to assure the competence of personnel and supporting the overall integrity management ambition.

Dr Kevin McQuillan
Special Projects Director
SABIC Manufacturing



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