W O R L D W I D E

Novus Sealing and our distributors are fully committed to ensuring our customers throughout the world receive the highest level of quality and technical support for our products and services. Our technical specialists can provide expertise on all issues associated with sealing performance.

Novus Sealing Limited, Hunsworth Lane, Cleckheaton, West Yorkshire, England BD19 3UJ

Tel: +44 (0)1274 878787 **Fax:** +44 (0)1274 862588 **www.**novussealing.com **e-mail:**mailbox@novussealing.com

Novus Sealing Pty Ltd., 15 Vinnicombe Drive, Canning Vale, Perth, Western Australia 6155

Tel: +61 (08) 9455 2155 **Fax:** 61+ (08) 9455 2165 **www.**novussealing.com.au **e-mail:**mailbox@novussealing.com.au

Novus Sealing Technology (Shanghai) Ltd., Room 1002, No.738 Shang Cheng Road, Shanghai, China 200120, P.R. China

Tel: +86 21 6102 8975 **Fax:** 0086 21 6102 8976 **www.**novussealing.com.cn **e-mail:**mailto:zhuyaqi@novussealing.com.cn

Novus Sealing Limited, 87 Radio Street, Alberton North, Johannesburg, Gauteng, South Africa

Tel: +27 (0)11 865 4807 **Fax:** +27 (0)11 902 2173 **www.**novussealing.com.za **e-mail:**deon.novussa@vodamail.co.za

Certificate No. 18566
BS EN ISO 9001:2000

Certificate No. 18566
BS EN ISO 14001:2004

AS/NZS ISO 9001:2000
Lic: QEC 5296
SAI Global

Semi-Metallic Gaskets

Manufacturers and distributors of sealing and jointing materials.

Camprofile, Spiral Wound, Corrugated and Metal Jacketed Gaskets

Semi-Metallic Gaskets

Novus Sealing Limited manufacture and supply a variety of high quality sealing products designed for flange applications in the industrial and manufacturing sectors. The Novus ethos is to provide honesty, reliability and a high level of service and dependability through all aspects of its business, adding value to its products and ensuring a sustained competitive edge.

Over the years Novus have enhanced their technical facilities to develop new products and provide guidance and training programmes for some of the world's largest chemical and petrochemical plants. Novus have a dedicated Research & Development Team who ensure high quality technical support for all Novus products. Novus constantly look to provide a balanced mix of quality sealing products with a warmth of service.

Novus Sealing continues to invest in quality and environmental systems such as ISO9001, ISO14001 and are currently working towards the ISO18001 approval. Novus also supply API6a approved Ring Type Joints for the oil industry. Novus Sealing has won the highly commended "International Business of the Year" award and has developed its training facilities in the UK as well as opening new operations in Australia, South Africa and China. Novus products are traditional in function but the company's outlook is progressive and evolving.

Contents

This brochure outlines our semi-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 support team.

Welding and profiling

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

Manufacturing

The fabrication of semi - 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.

Production

The dedicated production facility for semi-metallic products has been purpose built for efficiency and ease of order management.

The People

All our production staff undergo a continuous training programme which includes customer awareness, product application and industry courses.

Many factors affect the suitability of a gasket in a given application making it often 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, therefore it is important that the attributes of each gasket type are fully understood.

To help you make an informed choice on gasket selection the following table gives 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

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 or metal (e.g. Aluminium or silver). Camprofile gaskets are ideal for both standard pipe and heat exchanger applications.

Corrugated Gaskets

Corrugated Metal Gasket

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

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

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 provides compressive strength and blow out resistance.

	Camprofile Gaskets	Corrugated Gaskets	Spiral Wound Gaskets	Metal Jacketed Gaskets
Tightness	Excellent	Excellent	Excellent	Average
Handling	Excellent	Good	Average	Excellent
Thermal Cycling	Excellent	Excellent	Good	Average
Low Seating Stress	Excellent	Excellent	Average	Average
High Seating Stress	Excellent	Good	Excellent	Good
Narrow Flange Width	Excellent	Average	Average	Excellent
Emissions	Excellent	Excellent	Excellent	Average
Recycling	Yes	No	No	No

Full details of all dimension tables can be found on our website -

www.novussealing.com

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 duty the material for this layer can be graphite, PTFE (Teflon), Novus sheeting material 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

The wide seating stress range (minimum to maximum seating stress) of the gasket makes it:

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

Layer Material	Seating Stress (20°C)		
	Min (N/mm²)	Opt (N/mm²)	Max (N/mm²)
Graphite	20	90	400
PTFE	20	90	350
Novus Sheet	40	125	200
Silver	125	240	450
Hi-Temp	40	100	250

The above are based on parallel form gaskets. The values have slight variations for convex forms of camprofiles.

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.

	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

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

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).

M18L
Parallel root core with integral centering ring

M20L
Parallel root core without centering ring for male/female, torque & 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

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. Note: camprofiles are available with predetermined breaking points.

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

Camprofile Gasket shapes

In addition to the round gaskets, camprofiles 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.

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/cm³)
						Minimum	Maximum	
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 316 Ti	S316TI	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	X1Cr Ni Mo Cu N 20187	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	NO6625	-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 Selection

The following table may be used to determine the appropriate sealing layer material. Novus recommend the use of graphite layers for most applications. Only in cases where graphite may cause media pollution, 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.

The standard graphite used has an ash content of < 2% and chloride content of < 50ppm. Other graphite qualities are available on request.

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 mineral fillers.

Layer Material	Temperature (°C) Min	Max	Maximum Operating Pressure (Bar)	Gas Tightness	Application
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	Gas and Liquids
Silver	-200	750	250	Good	Aggressive Media
Hi-Temp	-200	1000	20	Average	Gases
Hi-Temp + APX2	-200	800	100	Good	Gases

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.

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.

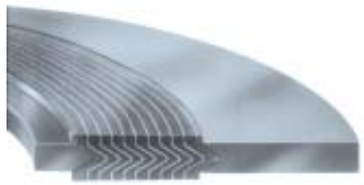
316L - Camprofile core of 316L stainless steel.

Graphite - Graphite sealing layer

Spiral Wound Gaskets

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.

Gasket Stress Range:

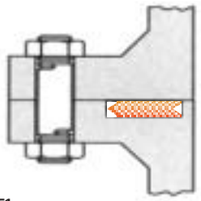
Filler	Single side confined			Both sides confined		
	Gasket Stress (20°C)			Gasket Stress (20°C)		
	Min (N/mm2)	Opt (N/mm2)	Max N/mm2)	Min (N/mm2)	Opt (N/mm2)	Max (N/mm2)
Graphite	50	95	180	50	120	400
PTFE	50	80	130	50	110	250
Hi-Temp	55	95	130	50	120	250

Flange Surface Finish

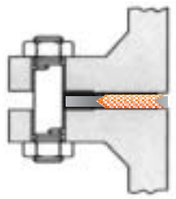
The recommended surface roughness of the flange faces, between which a spiral wound gasket is to be mounted, is 3.2 - 6.3 µm Ra (125 - 250 RMS), also referred to as smooth finish.

Standard Gasket Profiles

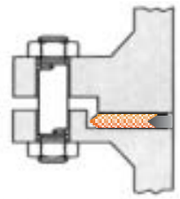
Novus produces the following types of spiral wound gaskets.



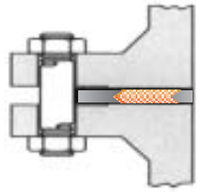
Type RF1
The gasket consists of a sealing filler and V-shaped metal strip wound in combination. This profile is usually applied to tongue/groove flanges.



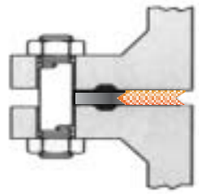
Type SG
The standard spiral wound gasket format identical to Novus RF1 but fitted with an outer centering ring (applied to raised face flanges). An integral centering guide ring ensures fast, accurate centering of the gasket on the flange. Provides additional radial strength to prevent gasket blow-out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



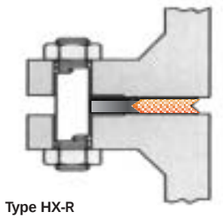
Type RF-IR
Spiral wound gasket for male/female flanges consisting of a wound component fitted with an inner ring to bring the gasket flush with the pipe bore to prevent inward buckling.



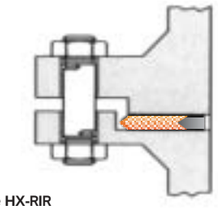
Type SG-IR
Identical to Novus SG but also fitted with an inner ring to prevent inward buckling at the windings.



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).

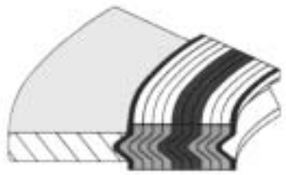


Type HX-RIR
This gasket is identical to HX-R but also fitted with an inner ring, rendering this gasket type suitable for mounting in male and female flanges.

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.



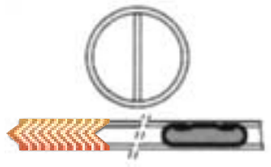
The spiral wound element of a Novus GT - Zone gasket consists of outer windings of Hi-Temp ceramic material with a central winding zone made of graphite or PTFE (depending on the operating conditions) to improve gas tightness.
This results in a spiral wound gasket with the following properties:

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.



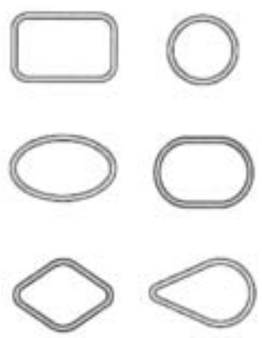
Type MH

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

Type TC/HH

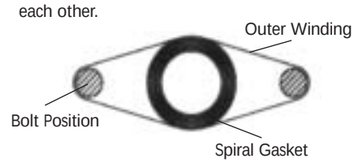
This type of gasket is for hand holes and special flange assemblies (tube cap and hand hole covers). They are available in e.g. square, rectangular, oval, diamond and pear shapes.

A drawing specifying the correct dimensions are required to manufacture special shapes.



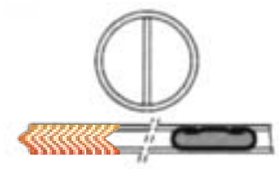
Type WL

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 gasket 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 Material No.	B.S.	AISA ASTM UNS	Temperature (°C)		Density (gr/cm³)
						Minimum	Maximum	
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 316 Ti	S316TI	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	X1Cr Ni Mo Cu N 20 18 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	NO6625	-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

Standard Material for Spiral Wound Windings

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

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

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

Standard fillers

Layer Material	Temperature (°C) Min	Max	Maximum Operating Pressure (Bar)	Gas Tightness	Application
Graphite	-200	450	400	Good	Aggressive Media
Graphite APX2	-200	500	400	Good	Aggressive Media
PTFE	-200	260	100	Good	Aggressive Media
Hi-Temp	-200	1000	5	Average	Gases
Hi-Temp + APX2	-200	800	100	Good	Gases

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

Non standard materials are available on request.

How to Order

A correct purchase order should contain the following information.

	Example
1. Type of the spiral wound gasket required	Novus SG-IR
2. Standard of the gasket (flange standard)	Dimensions: ASME B16.20
3. Nominal size and pressure class	2” 150lbs
4. Material - inner ring	SS316
- Metal winding	SS316
- Filler	Graphite
- Outer ring	Carbon Steel

LAMONS® LAMONS GASKET COMPANY

The Novus WRI-LP Gasket

In recent years the petroleum refining industry has placed an increasing emphasis on the safety of the use of Hydrofluoric Acid in petroleum refineries. Refineries use the Hydrofluoric acid in a manufacturing process called ‘alkylation’ which is increasingly important in producing a high quality gasoline. Hydrofluoric Acid is hazardous and corrosive and if accidentally released can form a vapour cloud. In the past five years, there have been a number of accidental releases at major petroleum refineries. Chemical plants utilise HF acid as a process media and experience similar difficulties.

Flange corrosion due to the aggressiveness of Hydrofluoric Acid has been prevalent in chemical units for many years causing expensive maintenance, repair and replacement costs. Scheduled maintenance includes cutting and replacing small diameter flanges that are corroded. Larger flanges are welded and re-faced when corrosion is too extreme. It is not uncommon to cut off or re-machine in excess of 25% of the flanges on site.

The Traditional Solution

Spiral wound gaskets that are typically specified for this service are manufactured using monel winding metal and flexible graphite filler material, carbon steel outer ring and a filled PTFE inner ring or monel inner ring. The unsupported ring of filled PTFE contributes little to seal tightness and can be distorted during installation. The lack of tightness will not prevent the flange corrosion that occurs on the inside diameter of the joint.

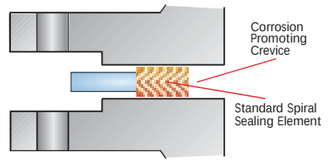
Monel inner rings can increase the flange corrosion by causing a crevice between flange and inner ring.

The Novus Solution

The WRI-LP design utilises a unique camprofile style machined inner ring that is encapsulated by a layer of PTFE. This PTFE coating is very durable and chemically resistant. Flexible graphite or PTFE can be utilised as covering layers for the machined serrations. The camprofile style inner ring is designed to match the ID of the pipe bore, thus creating an extremely tight seal that protects the entire flange surface. This arrangement gives a ‘dual’ seal where the primary seal consists of the faced camprofile type inner ring, the secondary seal is created by the graphite winding element contained within the spiral wound type gasket.

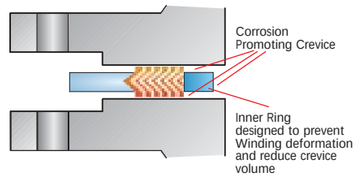
The life of the flange is extended by the protection created by the WRI-LP and the joint maintains fire safety by utilising graphite covering layers over the inner ring.

WRI-LP Flange Seal Configurations



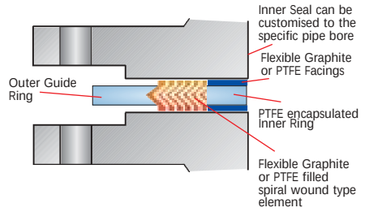
Traditional Solution

This illustration gives a typical standard spiral wound arrangement. This profile creates a significant void between the inside diameter of the gasket and the ID of the pipe bore where severe flange erosion can occur.



Traditional Solution

This illustration shows a profile using a standard inner ring constructed of PTFE. There are significant sizing problems that can occur using this material and a low level of tightness is achieved once compressed in the flange. Flange erosion can still be an issue when using this seal arrangement.



The Novus Solution

This illustration depicts the **WRI-LP** gasket design. Under compression, the entire flange surface is protected and a tight seal is achieved across the complete raised face of the flange.

Corrugated Gaskets

Novus Corrugated Gaskets comprise of 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 many of the older technologies such as metal jacketed particularly on heat exchangers.

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**
- **Precompressed graphite resistant to damage and marking during fitting**
- **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/mm²)	Optimum (N/mm²)	Maximum (N/mm²)
20	70	200

Thickness

Available in 1.5mm, 2mm and 3 mm

Flange Surface Finish

The recommended flange surface finish for corrugated gaskets with sealing layers is from 3.2 to 6.3um 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 Selection

Layer Material	Temperature (°C) Min	Max	Maximum Operating Pressure (Bar)	Gas Tightness	Application
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 following table may be used to determine the appropriate sealing layer material. Novus recommend the use of graphite layers for most applications. Only in cases where graphite may cause media pollution, 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 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

A correct purchase order should contain the following information.

1. Standard of the gasket (flange standard)
2. Nominal size and pressure class
3. Material - core filler

Example

Novus CMG
Dimensions: ASME B16.20
2” 150lbs
SS316 Core
Graphite Coating Layer

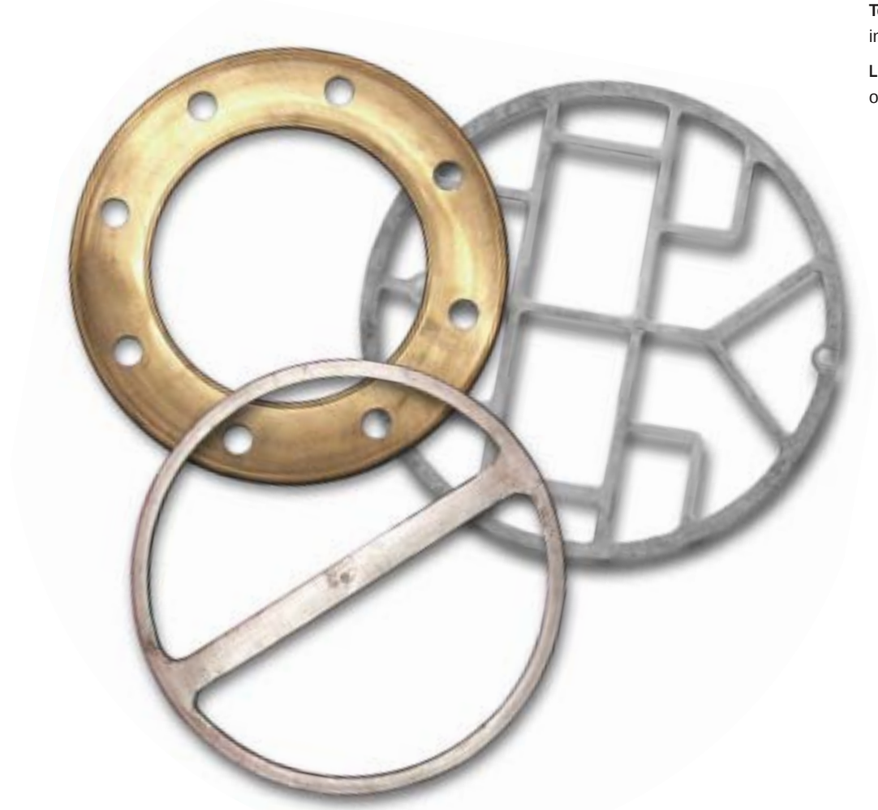
Metal Jacketed Gaskets

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 excellent sealing and protects the filler against pressure conditions, fluctuating temperatures and corrosion.

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

This type of gasket is being replaced by either Camprofiles (see page 3-6) or corrugated metal products (see page 13-14).



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 Novus recommend the use of Camprofile or Corrugated Metal Gaskets for heat exchanger 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 1.6um.

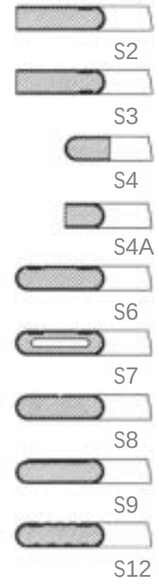
Jacket material:

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

Filler materials:

Non Asbestos Millboard
PTFE
Uniflon
Graphite

Profiles



Type S6 Seating Stress

Seating Stress (20°C)		
Minimum (N/mm²)	Optimum (N/mm²)	Maximum (N/mm²)
80	110	180

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 and heat exchanger profiles

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

How to Order

A correct purchase order should contain the following information.

1. Type of the Metal Jacketed gasket required
2. Standard of the gasket (flange standard)
3. Nominal size and pressure class
4. Material - Jacket and Filler

Example

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

Control of Flanged Joints

Flange leaks are of major importance to petrochemical and chemical plants.
It is estimated that around 30% of heat exchangers will leak in a refinery at some point often at huge cost to the plant, both in terms of business loss and also in damage to plant and environment.

Root cause analysis shows that failures of flanged joints can be traced to one of the following three factors:

*** Design issues, particularly associated with the loading of the joint or material selection**

*** The condition of the gasket, bolt or flange face or piping system**

*** Improper assembly, including inadequate loading or installation**

Of the three, flange design itself is rarely the root cause of the problem, and it is rare for failures to result in a flange redesign. Analysis shows that most joint failures are associated with component selection, damaged or defective components or improper assembly.

Novus Sealing has a world class reputation in the prevention and elimination of leaking joints on site. Our reputation is based upon success in providing innovative and practical solutions to petrochemical plants throughout the world. On the following pages you will find details of the some of the products and services we offer in the maintenance and care of flanged joints.

For more information please contact our technical team. Tel +44 (0)1274 878787

Industrial Training Programmes can be tailored to suit different plant requirements

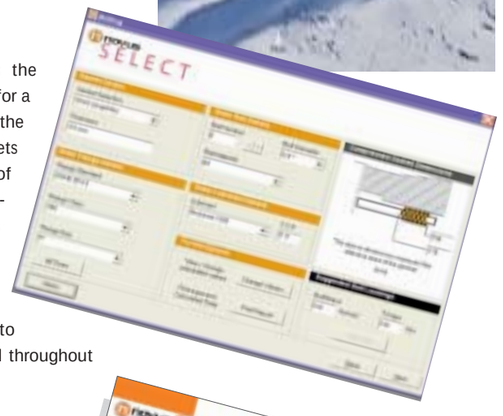
Novus Select Software

The suitability of a gasket material in a given application is dependent on a number of factors including chemical resistance, temperature and pressure capability, flange material and flange configuration and resistance to thermal cycling. Choosing the right material for the application can be a difficult and confusing task.

It is equally critical that the prescribed bolt loadings are sufficient to seat the gasket under the service conditions without overloading the gasket, bolting or flange. Consideration must be given to the minimum and maximum seating stress of the gasket as well as the relaxation of the gasket and studs and must allow for any variation in actual versus specified load through inaccuracies in bolt loading.

Novus has developed Novus Select, a user-friendly software program designed to help with both selection and installation of our products. The program utilises material compatibility data combined with practical know how to simplify the selection process, helping you make an informed choice about which is the correct gasket for the application.

Novus Select also calculates the required bolt stress and torque for a given application based on the material limits of both gaskets and bolts AND the effects of relaxation and assembly variation on the gasket stress. Its user friendly interface simplifies the calculation process for both standard and non-standard designs helping to ensure that the gasket will seal throughout its service life.



SELECT

The program can also be modified by Novus to accommodate plant specific requirements.
The list of gaskets, bolt grade or lubricant type can be refined to include only those which are used on site, making the program ideal for plant based use.

Training Programme 'Control of Flanged Joints'

The reliability of the flanged joint depends critically on competent control of the joint making process. It is common to put considerable effort into the design process only for improper assembly to lead to joint failure. Therefore it is important that joint making is undertaken by trained and validated technicians who have an understanding of the procedure and the underlying principles and practice.

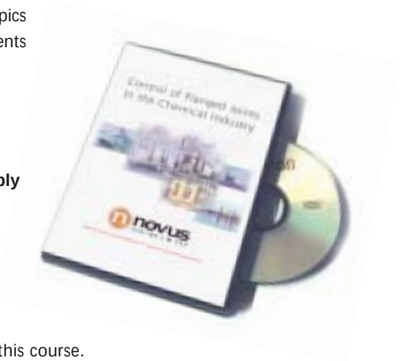
The Control of Flanged Joints is an industry recognised training program designed to ensure that all individuals with responsibilities in connection with ensuring the safe control of flange joints are trained and validated as competent to undertake these responsibilities. The program, produced in conjunction with a major global petrochemical company and leading bolt service company, is based around a video presentation of best practices and utilises an intelligent bolting system to explain and demonstrate these principles.
This unique training method allows key areas of joint making e.g. the need to use bolt lubricant, to be clearly understood.

Training on-site

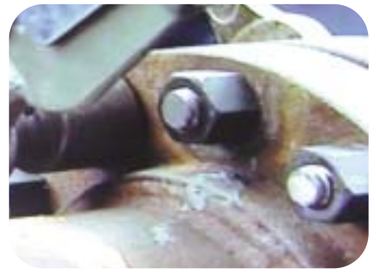
Training Programmes can be carried out on-site or at the Novus Training Centre.

The training covers a broad spectrum of topics which can be tailored to suit requirements including:

*** Introduction**
*** Leaks and Emissions**
*** Flange Design Issues**
*** Flange Joint Preparation and Assembly**
*** Systems and Procedures**
*** Records and Traceability**
*** Tightening Joints On-Line**
*** Emission Monitoring**
*** Control of Fugitive Emissions**



There is also a DVD which accompanies this course.



A DVD presentation explains the principles of best practice.

In addition to the above program Novus also offer courses on a range of other topics associated with flanged joint sealing including: gasket manufacture and technology, software aided selection, installation and environmental compliance.

Novus Joint Making Procedures

Reliable flange joint making requires that all individuals involved in the process are aware of their role and implement their duties correctly. Efficient systems and procedures, together with careful training and validation are essential in what can be a hectic maintenance schedule. It has been shown that organisations that put effort into the development of joint making systems and procedures consistently have better results and have a more highly motivated workforce. This fact is recognised by the HSE Safety Notice 2/2000 Bolting of flanged joints for pressurised systems.

Novus Technical have assisted a number of plants throughout the world in the production of joint making procedures.
The procedures are based on best practice, combining our expertise in joint making with practical know how, but are always tailored to plant requirements.

For more information contact our Technical Services Team +44 (0)1274 878787.

Novus Testing Services

In some circumstances, analysis of the mechanics of a flanged joint by calculation or finite element modelling is insufficient to predict performance of in service. In such cases, it is necessary to use application testing to replicate the conditions under which the flanged joint will operate. The data gathered from such testing can be used to ensure that the most suitable gasket is being employed and that it is properly loaded to withstand the service conditions.

Novus technical facilities allow application testing under wide range of service conditions. In this capacity, the company has a world wide reputation for solving even the most problematic applications including:

High temperature cyclic exchangers
Air compressor flanges
Aerospace engine flanges
High pressure applications
Material compatibility

Testing can be conducted on one of our test rigs or if required using the customer's own equipment.

Our use of Intelligent fasteners allow the load in each bolt to be accurately applied and more importantly monitored through the testing cycle even at elevated temperatures. This allows service effects such joint relaxation to be analysed and a solution implemented.

Novus Joint Integrity Database

It is good practice to maintain records of joint making activity. This means that flanged joints can be traced back to the technician who assembled them and that relevant data on the assembly process can be documented.

HSE guidance note 2/2000 places responsibilities on duty holders in regard to the making of flanged joints, and in addition to emphasising the above issues requires that duty holders maintain adequate records of all joint making activity. The Novus Exchanger Database is designed to ensure that the joint making process is recorded and traceable.

Novus Flange Joint Tool Kit

Poor flange assembly is the most common cause of gasket leakage and yet experience shows that good practice is relatively simple to achieve: Trained technicians working to clear procedures and with the correct equipment will result in a properly assembled flange.

Novus flange joint tool kit complements our Joint Making procedures in assisting technicians in the making of properly assembled and reliable flanged joints. Each kit contains a number of effective tools that help to ensure that the flange has the correct surface finish, is properly aligned and is assembled correctly.

Novus flange joints kits each contain:

- **A flange gap tool**
- **A Flange Surface Comparator**
- **A torch for checking flange surface condition**
- **A Engineering handbook**

Leak Detection and Repair Programmes

The most effective method of controlling fugitive emission from process equipment is through the implementation of a structured leak detection and repair (LDAR) program. By identifying the source of the emission and then taking action to eliminate or minimise it, major gains can be made through emission reduction.

In most cases action taken to reduce fugitive emissions offers excellent financial payback, enabling the client to sell product that would otherwise be lost to the environment.

Novus LDAR is the UK's leading fugitive emissions control company with a wealth of experience in the identification and repair of equipment leaks.

- **Cost effective method for major emission reductions.**
- **Compliance with environmental legislation.**
- **Application of Best Available Technology**
- **Major savings from reduction in product loss.**
- **Improvements in process efficiency.**
- **Increased plant safety.**

Installation of Novus Semi-Metallic Gaskets

In order to ensure the optimum service life of Novus semi-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 most applications a surface finish of between 3.2µm to 6.3µm Ra (125 to 250 micro inch) is recommended. 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.
- 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
- Out of flat or pitted flanges may require thicker filler or facing materials to accommodate the imperfections.
- 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 semi-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.