General Information

Selection Guide

Technical Data

Installation Instruction

PSI Flange Isolation Kits and Sealing Gaskets

Pipeline Accessories

Aramco Overseas Company B.V.

As a result of the inspection lot 107000051269, your manufacturing plant is approved to supply the following 9COMs:

9COM	Description
6000000366	GASKET KIT INSULATING; AB. SLEEVES AND GASKETS, CONSISTING OF WASHERS, SLEEVES AND GASKETS

Shell Global Solutions

CERTIFICATE OF ACCEPTANCE

Shell Global Solutions

CERTIFICATE OF ACCEPTANCE

Petroleum Development Oman L.L.C.

CERTIFICATE OF REGISTRATION - PRODUCT VENDOR

CERTIFICATE NUMBER: 103921

First Registered With PDO: Date of Issue: 07/04/2006

PETROLEUM DEVELOPMENT OMAN LLC

CERTIFIES THAT:

Manufacturer: Pipeline Seal & Insulator Co Ltd
Country of Origin: UK
Local Agent: Middle East Petroleum Services LLC
Postal Address: P.O. Box 1531, PC 133 Al Athaibah - Sultanate of Oman

IS REGISTERED WITH THE COMPANY AS AN APPROVED PRODUCT VENDOR WITH EFFECT FROM THE DATE OF ISSUE OF THIS CERTIFICATE FOR THE FOLLOWING PRODUCT GROUP CATEGORIES:

Corrosion Monitoring & Cathodic Protection

SAID AL KINDY (FPS)
HEAD BUSINESS SERVICES

NB: THIS CERTIFICATE IS VALID UNTIL: 06/04/2010

About PSI

For nearly 50 years Pipeline Seal and Insulator Co. Ltd, have been a technology leader in the field of high quality sealing and isolating products used to guarantee the safe flow of fluids passing through pipeline transmission, distribution and process piping systems.

An installed base of thousands upon thousands of gaskets and flange isolation kits, effectively sealing and maintaining the integrity of corrosion mitigation programmes everywhere, confirms the effectiveness and reliability of the PSI system. In fact, PSI flange isolation products are relied upon for applications subjected to the most severe conditions (both internal and external), for specialised or exotic fluids or for applications subject to extreme temperature and pressure fluctuations.

Flange isolation products include a wide selection of isolating/ sealing gaskets along with a variety of sleeves and washers. For maximum flexibility, components may be ordered separately or as part of complete flange isolation kits.

PSI has manufacturing and sales facilities worldwide. All PSI facilities are ISO 9001:2000 certified with extensive quality control procedures to ensure total compliance with product performance and reliability standards.

Types and styles

Type ‘E’ Gaskets

Type ‘E’ gaskets extend to the outside diameter of the flange. They feature precision located bolt holes, to automatically centre the gasket, and offer maximum protection against foreign material ‘shorting-out’ the flange. Type ‘E’ gaskets may be ordered in any one of the following configurations:

- LineSeal® sealing gaskets
- LineBacker® sealing gaskets
- GasketSeal® sealing gaskets
- Rubber faced phenolic gaskets
- Plain phenolic gaskets

Type ‘F’ Gaskets

Type ‘F’ gaskets are made to fit within the bolt hole circle of the flange. The O.D. of the gasket extends out to the I.D. of the bolt hole circle for good protection against foreign material ‘shorting-out’ the flange. Type ‘F’ gaskets may be ordered in any one of the following configurations:

- LineSeal® sealing gaskets
- LineBacker® sealing gaskets
- GasketSeal® sealing gaskets
- Rubber faced phenolic gaskets
- Plain phenolic gaskets

When configured as a LineBacker® sealing gasket, the sealing element may be positioned anywhere between the I.D. of the gasket and I.D. of the bolt circle.

Type ‘D’ Gaskets

Type ‘D’ gaskets are available for RTJ flanges but the LineBacker® sealing gasket is an excellent alternative to ‘D’ gaskets because the sealing element may be positioned anywhere between the I.D. of the gasket and I.D. of the ring groove. Teflon is a registered trademark of DuPont Dow Elastomer.

Insulating gaskets

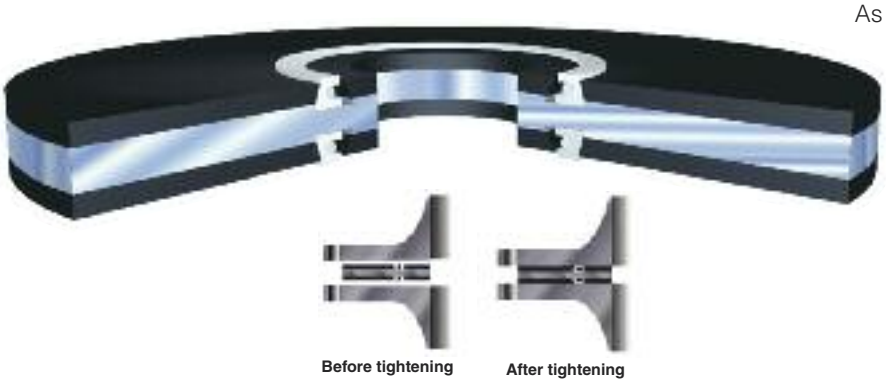
LineSeal® Sealing Gaskets

LineSeal® sealing gaskets have been specially designed to withstand corrosive environments including high concentrations of CO2, H2S and aggressive inhibitors.

LineSeal® gaskets utilise PTFE (Teflon®) spring energised seals which offer an extremely high quality seal which eliminates costly leaks and provides a solution for fugitive emissions. As with all PSI gaskets which utilise sealing elements in a retainer, the seals can position so as to effectively seal and isolate flanges of all types including ANSI, ASME, MSS, BS, DIN, AS and others.

As well as utilising PTFE (Teflon®) seals, the PSI LineSeal® gaskets can also accommodate other sealing elements such as AFLAS, VITON, NITRILE and KALREZ. This dramatically increases the options available for matching gasket materials to service and environmental conditions.

PSI LineSeal® withstands severe critical service conditions including vibration, temperature and pressure fluctuations. As well as offering a safe seal in harsh environments, LineSeal® outstanding electrical insulation properties also offer the solution for cathodic protection systems. Refer to the chart for the LineSeal® sealing gasket temperature ranges and material compatibilities.



Before tightening

After tightening

Approval by
Shell Global Solutions

LineBacker® Sealing Gaskets

LineBacker® sealing gaskets utilise a patented rectangular sealing element, referred to as a "quad" ring, in combination with a unique groove designed to effectively seal and isolate flanges of all types.

With the unique "quad" ring design, elastic memory is provided for elastomers not normally associated with this characteristic.

Materials such as AFLAS, PTFE (Teflon®) and KALREZ may therefore be used as sealing elements which dramatically increases the options available for matching gasket materials to service and environmental conditions. This greater variety of materials also provides excellent temperature and chemical range compatibility. LineBacker® sealing gaskets are self energising with theoretical near zero ‘m’ and ‘y’ factors resulting in effecting a positive seal without excessive bolt loads required with flat gaskets. Refer to chart for LineBacker® sealing gasket temperature range and material compatabilities.

Before tightening

After tightening

Approval by
Shell Global Solutions

PSI Gaskets

Insulating gaskets

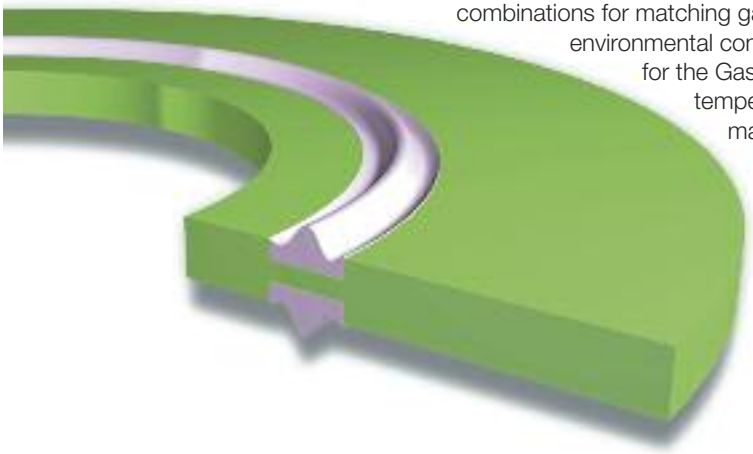
GasketSeal® Sealing Gaskets

GasketSeal® sealing gaskets are considered one of the most effective methods for sealing and isolating flanges of all types.

The gasket consists of two moulded semi 'O' rings (with precise crown to void ratio) mounted in grooves on opposite sides of an isolating retainer. While maintaining all the advantages of a full 'O' ring seal, the semi 'O' ring seal eliminates the need for a sealing groove in the flange face to reduce problems associated with alignment. GasketSeal® gaskets are self energising with theoretical near zero 'm' and 'y' factors resulting in effecting a positive seal without excessive bolt loads required with flat gaskets. GasketSeal® sealing gaskets are available in a wide variety of retainer and sealing element combinations for matching gaskets to service and environmental conditions. Refer to the chart for the GasketSeal® sealing gasket temperature ranges and material compatibilities.

Before tightening

After tightening

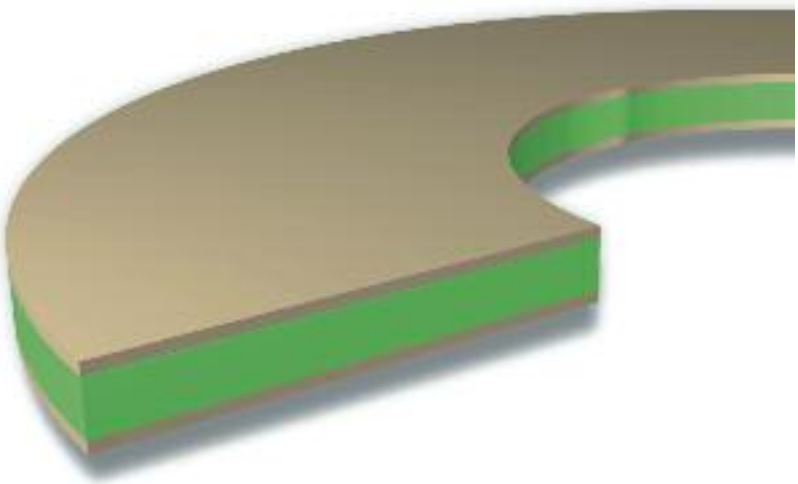


Rubber Faced Phenolic Gaskets

Rubber faced phenolic gaskets have been used as standard "flat" isolating gaskets in the oil and gas industries for many years.

Soft neoprene rubber sheets are factory applied to both sides of a laminated phenolic retainer providing an effective sealing surface. The temperature limit of these gaskets is approximately +175° F. (80° C.)

Note: Due to improved sealing characteristics and retainer/ seal element options, LineSeal®, LineBacker® or GasketSeal® sealing gaskets should be considered in lieu of rubber faced phenolic gaskets whenever possible.



PSI Flange isolation kits

Sleeves and washers

Isolating Sleeves

Isolating sleeves are available in the following materials:

- Mylar
- Polyethylene
- Phenolic
- Nomex
- G-7 silicon glass
- G-10 epoxy glass
- G-11 epoxy glass

Designed to easily fit over standard size flange bolts/studs within standard size bolt holes, PSI isolating sleeves have a wall thickness of 1/32" (0.79mm) and are used with separate isolating and steel washers. They are available for standard American bolt sizes from ½" (12.7mm) to 3½" (88.9mm) as well as metric bolt sizes from 12mm and larger.

Isolating Washers – Standard ⅛" Thick

Isolating washers are available in the following materials:

- High strength glass clad phenolic
- G-3 high temp. phenolic
- G-7 silicon glass
- G-10 epoxy glass
- G-11 epoxy glass

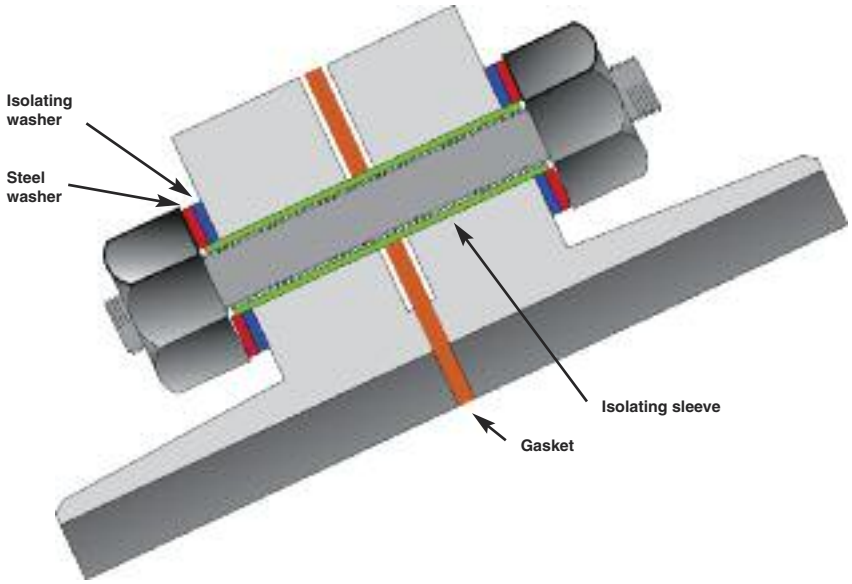
Designed to provide tough, positive isolation. PSI isolating washers are available for bolt sizes from ½" (12.7mm) to 3½" (88.9mm) and are made to fit over the isolating sleeves.

One-piece Sleeves and Washers

Moulded from acetyl resin and available for bolt diameters from ½" to 1½" (12.7 to 38.1mm), one-piece sleeves and washers are structurally tough but limited to applications where the flange temperature does not exceed +180°F (+80°C) and compressive loads do not exceed 18,000 psi. They are generally used as single washer sets because they're moulded to specific lengths and, in many instances, are longer than the thickness of a single flange. A washer centring ring positions the steel washer on the unit properly to avoid uneven pressures on the washers.

Note: G-10 one-piece sleeve/washer assembly available for additional strength and convenience.

Full length sleeve, double washer set configuration



Steel Washers

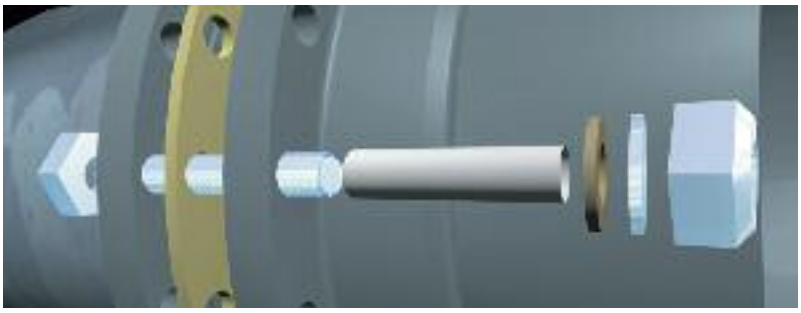
Steel washers are designed to fit over the isolating sleeve or the retainer ring on the one-piece sleeves and washers. The outside diameter is sized to fit within the bolt facing on ANSI standard flanges. They are made of ⅛" (3.2mm) thick plated hot-rolled steel.

PSI Flange isolation kits

Sleeves and washers

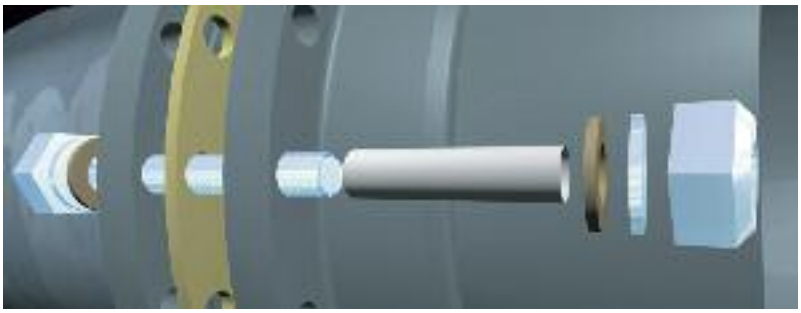
Single Washer Set

In buried applications, single washer configurations may be used to allow the cathodic protection (CP) current to reach the nuts and bolts. If desired, nuts on the opposite side of the cathodically protected flange may be included as part ot the CP system.



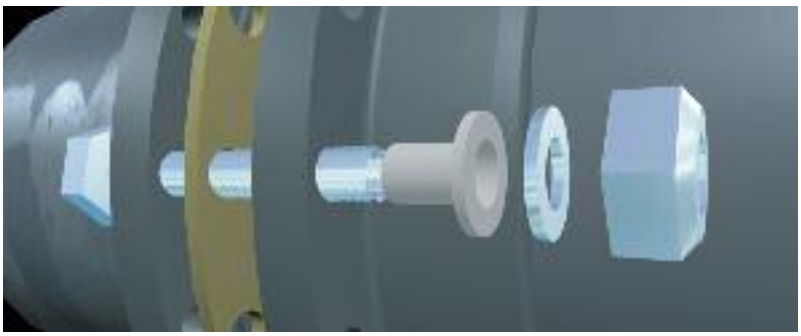
Double Washer Set

Double washer configurations may be used for added protection against the possibility of 'shorting out' the nuts and bolts. In addition, double washer sets electrically isolate the nuts and bolts from both flanges.



One-piece Washer Set

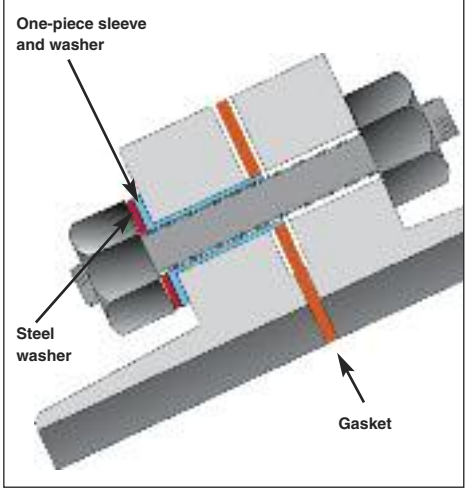
Easier to install, one-piece sleeves also allow the inspector a visual indication of sleeve usage. Due to the relatively low compressive strength of this material, its use is not recommended for high pressure or large diameter flanges that require high torque loads.



Sleeves and Washers

Sleeves and washers are enclosed in a strong polyethylene bag to eliminate any possibility of loss. A chart showing the recommended sequence for tightening flange bolts is also included with each kit, as well as with each individual gasket.

One-piece sleeve and washer set



PSI Common LineSeal®, LineBacker® and GasketSeal® sealing gasket

Physical properties

GASKET MATERIAL							
ASTM	**Test Method**	**Plain Phenolic**	**Rubber Faced Phenolic**	**G-3 Hi-Temp Phenolic Glass**	***G-7 Silicone Glass**	**G-10 Epoxy Glass**	**G-11 Epoxy Glass**
D149	Dielectric strength volts/mil (short time)	500	500	550	350-400	800	550
D659	Compressive strength (psi)	25,000	25,000	50,000	40,000	65,000	60,000+
D229	Water absorption (%)	1.6	1.6	0.7	0.07	0.04	0.07
D257	Insulation resistance meg. ohms	40,000	40,000	46,000	2,500	200,000	200,000
D790	Flexural strength (psi)	22,500	22,500	60,000	27,000	65,000	62,000
D638	Tensile strength (psi)	20,000	20,000	42,000	25,000	51,000	42,500
D732	Shear strength (psi)	10,000	10,000	18,000	20,000	21,000	22,000
	Temp. range °F	-65 to +220	-65 to +175	-65 to +392	Cryogenic to +450	Cryogenic to +302	Cryogenic to +356
	Temp. range °C	-54 to +104	-54 to +79	-54 to +200	Cryogenic to +232	Cryogenic to +150	Cryogenic to +180

***G-7 material should not be used with hydrocarbons – not even trace amounts**

SEAL ELEMENT TEMPERATURE LIMITS					
	Nitrile	**Viton**	**Teflon**	**Neoprene**	**EPDM**
Degrees Fahrenheit	-40 to +250	-20 to +350	Cryogenic to +450	-40 to +175	-65 to +300
Degrees Celsius	-40 to +121	-29 to +177	Cryogenic to +232	-40 to +79	-54 to +149

Consider **both** retainer and seal element temperature limits together for LineSeal®, LineBacker® and GasketSeal® sealing gaskets

PSI Sleeves and washers

Physical properties

SLEEVE MATERIAL									
ASTM	**Test Method**	**Poly -ethylene**	**Mylar**	**Nomex**	**Phenolic**	***G-7 Silicone Glass**	**G-10 Epoxy Glass**	**G-11 Epoxy Glass**	**One-piece Moulded Acetal**
D149	Dielectric strength volts/mil (short time)	400	4,000	400	400	350	400	400	1,200
D659	Compressive strength (psi)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18,000
D229	Water absorption (%)	0.01	0.8	N/A	1.6	0.10	0.10	0.10	1,200
	Temp. range (°F)	-30 to +180	-75 to +300	-65 to +450	-20 to +225	Cryogenic to +450	Cryogenic to +302	Cryogenic to +320	-30 to +180
	Temp. range (°C)	-34 to +82	-59 to +149	-54 to +232	-29 to +107	Cryogenic to +232	Cryogenic to +150	Cryogenic to +160	-34 to +82
D790	Flexural strength (psi)	7,000	13,000	20,000	16,000	20,000	55,000	55,000	1,400
	Cut through resistance (ft/lbs)	1,800	3,500	4,000	No test	No test	16,000	No test	3,400

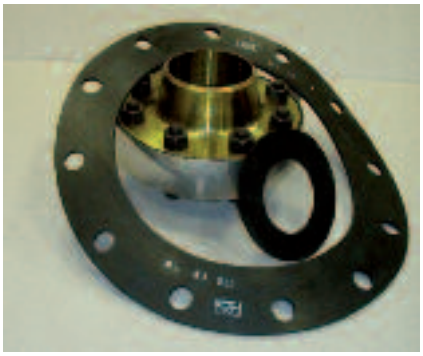
***G-7 material should not be used with hydrocarbons – not even trace amounts**

1/8" WASHER MATERIAL							
ASTM	**Test Method**	**Phenolic**	**G-3 Hi Temp. Phenolic**	***G-7 Silicone Glass**	**G-10 Epoxy Glass**	**G-11 Epoxy Glass**	**One-piece Moulded Acetal**
D149	Dielectric strength volts/mil (short time)	500	550	350-400	800	550	1,200
D659	Compressive strength (psi)	33,000	50,000	40,000	65,000	60,000+	18,000
D229	Water absorption (%)	1.6	0.7	0.07	0.04	0.07	0.22
	Temp. range (°F)	-65 to +300	-65 to +392	Cryogenic to +450	Cryogenic to +302	Cryogenic to +356	-30 to +180
	Temp. range (°C)	-54 to +149	-54 to +200	Cryogenic to +232	Cryogenic to +150	Cryogenic to +180	-34 to +82

***G-7 material should not be used with hydrocarbons – not even trace amounts**

EPDM Sealing Gaskets

General Information



Full face and I.B.C. and insulating gaskets can be manufactured to any diameter.

Gaskets can be supplied in varying thicknesses from 0.5mm to 12mm.

Gaskets are approved for use with potable water and are approved to Wrc standards.

PSI EPDM gaskets can be ordered individually or part of an Insulation Kit.

EPDM

The PSI range of EPDM gaskets offer durability and strength. For gaskets having a thickness greater than 3mm we insert a polyester scrim which adds strength to the durable EPDM gasket material. This polyester scrim insertion reduces the risk of damage to the gasket by the possible over tightening the flanges. See the table overleaf for further details of the scrim insertions.

"E" Type Gasket
Full Face

"F" Type Gasket
I.B.C.

How To Order

To order EPDM sealing/insulating gaskets please indicate the following:

1. Quantity
2. Pipe Size
3. Pressure Rating (DIN, BS)
4. Gasket Application
5. Material Thickness
6. Gasket Type (E or F)
7. Type of Flange (Weld Neck, slip-on, RTJ, etc.)
8. Contact your local distributor or PSI GmbH

EPDM Sealing Gaskets

Technical Information

Material Specification

MaterialEPDM (Ethylene-Propylene-(Diene) Copolymer	
Classification	Non-conductive, suitable for potable water. BS2494 BS 6920. WRC approved.
Polyester Scrim Insertion	< 3mm thickness – no scrim insertion 4-5mm thickness – 1 ply polyester scrim insertion >6mm thickness – 2 ply polyester scrim insertion
Colour	Black
Durometer Hardness “A”	70 + 5 Deg. Shore
Tensile Strength (Min.)	5 MPA
Elongation Min.	700%
Temp. (Short Term 10 hours)	+150°C
Temp. (Continuous 1000 hours)	-30 to +120°C
Compression set at 70°C for 24 hours	31%
Oil Resistance No.1 @ 20°C No.1 @ 100°C No.3 @ 20°C No.3 @ 100°C Fuel B (Petrol) @ 40°C	Fair Unsatisfactory Unsatisfactory Unsatisfactory Unsatisfactory
Shelf Life (Initial Storage)	10 year + 5
Permeability to gases	Fairly low
Flame resistance	Poor
Conductivity	Non-Conductive> 10 x 12 Ohms to infinity
Resilience	Very Good
Tear Strength	Good 22 KN/M
Weight M2 @ mm	4.38 Kg
Line call out reference	MBA 705

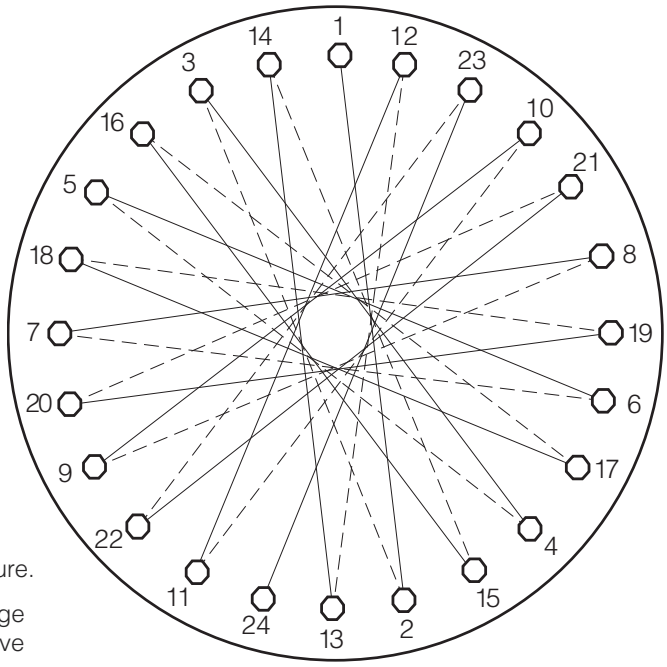
Performance data and technical information provided herein is intended for guideline purposes only. Suitability of product configurations for specific applications should be determined by the user.

PSI Flange Isolation

Installation Instruction

How to tighten the flange bolts

1. Clean flanges.
2. Insert gasket between flange faces.
3. Insert isolating sleeves in bolt holes.
4. (If using stud bolts run one nut on one end until end of nut is flush with stud bolt). Place one steel washer and one isolating washer over bolt and insert in bolt hole.
5. Fit one isolating washer and one steel washer on protruding bolt end. Hand-tighten the nuts.
6. Tighten bolts alternately across the diameter of the flange (see drawing above).
7. Always use torque wrench to ensure even tightening.
8. Do not overtighten or leakage may occur.
9. Ensure that bolts are well lubricated.
10. No grease on sealing surfaces.



The example shows 24 bolts. With flanges having a different number of bolts you should generally follow the same procedure.

In order to achieve an even distribution of pressure at the flange sealing ring we recommend to tighten the bolts as shown above until the flange faces and the sealing ring are in contact.

If relatively soft and flexible gaskets are used (eg. Durlon) and tightened in a cold condition, the sealing material may relax when the system is put into operation, and the bolts may turn loose. We therefore recommend to re-tighten the bolts **after the operating temperature has been reached** - if possible without the operating pressure and at ampiente temperature.

In any case the bolts should be checked and re-tightened, if required, after the initial operation and before bringing the system back from ambiente temperature to the operating temperature.

Suggested Flange Isolation Material Compatibility

Technical Information

Medium	Retainer	Seal	Sleeve	Washer	Temp.Range °F	Temp. Range °C
Acetone	Phenolic	EPDM	Mylar	Phenolic	+32 to +80	0 to +27
Air	G-10	Nitrile	Mylar	Phenolic	-40 to +225	-40 to +107
Ammonia Dry	G-10	Teflon	Mylar	G-10	-65 to +220	-54 to +104
Ammonia (wet)***	G-10	Teflon	Mylar	G-10	+32 to +100	0 to +38
Bleach	G-10	Teflon	Mylar	G-10	+32 to +80	0 to +27
Butylene (Butidiene)	G-10	Teflon	G-10	G-10	+32 to +100	0 to +38
Carbon Dioxide	G-10	Nitrile	Mylar	G-10	+32 to +150	0 to +66
Caustic Soda (NaOH)	CONSULT FACTORY					
Cryogenic	G-10	Teflon	G-10	G-10	-300 to +280	-184 to +138
Ethanol	G-10	EPDM	Mylar	G-10	+32 to +100	0 to +38
Ethylene (Ethene)	G-10	Teflon	G-10	G-10	+32 to +80	0 to +27
Fuel Oil	G-10	Viton	Mylar	G-10	-20 to +280	-29 to +138
Gas, Natural	Phenolic	Nitrile	Mylar	Phenolic	-40 to +220	-40 to +104
Gas, sour	G-10	Viton	Mylar	Phenolic	-20 to +220	-29 to +104
Gasoline	G-10	Teflon	Mylar	G-10	-65 to +225	-54 to +107
Hydrogen	G-10	Nitrile	Mylar	G-10	-40 to +250	-40 to +121
Jet Fuel	G-10	Viton	Mylar	G-10	-20 to +225	-29 to +107
LNG	G-11	Teflon	G-10	G-10	-300 to +100	-184 to +38
Mercaptan	G-10	Teflon	Mylar	G-10	-20 to +80	-29 to +27
Methanol	G-10	Teflon	Mylar	G-10	+32 to +100	0 to +38
MTBE	G-10	Special Nitrile	G-10	G-10	+32 to +80	0 to +27
Nitrogen	Phenolic	Nitrile	Mylar	Phenolic	-40 to +220	-40 to +104
Oil, Crude	G-10	Viton	Mylar	G-10	-20 to +280	-29 to +138
Oxygen **	G-10	Teflon	G-10	G-10	-65 to +250	-54 to +121
Pentane	G-10	Teflon	G-10	G-10	+32 to +80	0 to +27
Propane	G-10	Nitrile or Teflon	G-10	G-10	+32 to +80	0 to +27
Propylene	G-10	Viton	G-10	G-10	+32 to +80	0 to +27
Sewage	G-10	Viton	Mylar	G-10	-20 to +280	-29 to +138
Spent Liquor	G-10	Teflon	G-10	G-10	+32 to +100	0 to +38
Steam	CONSULT FACTORY					
Styrene	G-10	Teflon	G-10	G-10	+32 to +80	0 to +27
Sulphur (Molten)	G-10	Teflon	G-10	G-10	+32 to +280	0 to +138
Tolulene	G-10	Victon or Teflon	G-10	G-10	+32 to +150	0 to +66
Water (hot)	G-10	EPDM	Mylar	G-10	+175 to +280	+79 to +138
Water (portable)	G-10	EPDM	Mylar	G-10 or Phenolic	+32 to +280	0 to +138
Water (Sea)	G-10	EPDM	Mylar	G-10 or Phenolic	+32 to +280	0 to +138
White Liquor	G-10	Teflon	G-10	G-10	+80 to +280	+27 to +138

** = These are organic materials that will feed a fire if a leak occurs and an ignition source exists.

*** = Ammonia (wet) – Data to +100° F (+38°C) only (same materials as dry).

For pipe diameters over 24" or ANSI class pressure ratings of 600# or greater, use **G-10 sleeves and G-10 washers** where temperatures and other conditions permit.

General Note:

The Foregoing performance data are intended as guidelines only. Performance suitability for any specific applications should be determined by the user.

Variation in temperature, pressure, concentration or mixtures acting synergistically may preclude suggested service use.

Material Selection is at the sole risk of the user. Consult with a specialist or PSI factory for specific applications.

PSI's responsibilities will be limited to those listed in the PSI standard warranties.