HIGH PERFORMANCE SEALING

Flexpro®

serrated solid metal core
soft, conformable sealing material

Flexitallic®

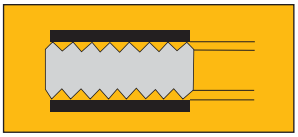
Flexpro® GASKETS

FOR ENHANCED JOINT INTEGRITY

The FLEXPRO® gasket has been providing an extremely tight, reliable seal in a wide range of applications throughout Europe since its development in Germany over 89 years ago. Flexitallic is pleased to provide more detailed information on the FLEXPRO® gasket design.

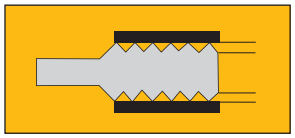
Recently included in ASME B16.20 (rev. 2012), the FLEXPRO® gasket is comprised of a concentrically serrated solid metal core with a soft, conformable sealing material bonded to each face. The soft facing material provides low stress gasket seating, while the serrated geometry of the metal core enhances sealing performance by inducing stress concentrations on the sealing surfaces. The serrations minimize lateral movement of the facing material, while the metal core provides rigidity and blowout resistance.

The FLEXPRO® gasket exhibits excellent compressibility and recovery characteristics, maintaining joint tightness under pressure and temperature fluctuations, temperature differential across the flange face, flange rotation, bolt stress relaxation, and creep. Suitable from vacuum to extremely high pressure applications.



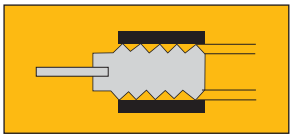
Style PN

Style PN FLEXPRO® gaskets are selected for use in confined locations, including male and female, tongue and groove, and recessed flange arrangements.



Style ZG

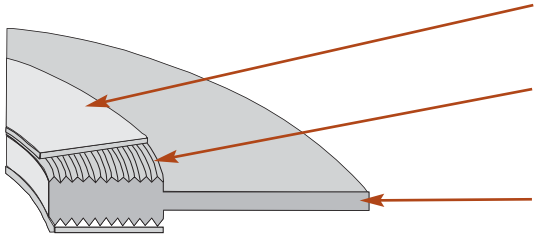
Variation of the PN FLEXPRO®, utilizes an integral outer locating ring for correct gasket positioning within the mating flange bolt circle. Style ZG FLEXPRO® gaskets are recommended for use on standard raised face and flat face flange assemblies.



Style ZA

The Style ZA FLEXPRO® is a slight variation of the Style ZG. The integral outer locating ring is replaced by a loose fitting independent ring which is preferred where flange differential radial thermal expansion may be encountered. These rings may also be spot welded.

COMPOSITE CONSTRUCTION WITH A SERRATED CORE



Soft, conformable facing

Serrated surface machined on solid metal core

Optional outer ring for centering; can be integral or floating

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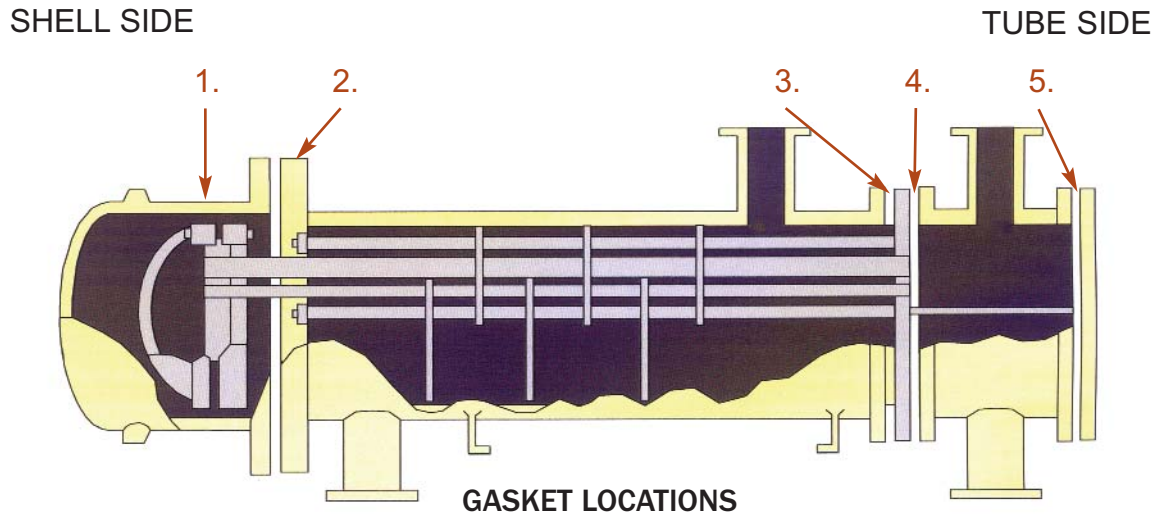
Making the world safer and cleaner through engineered sealing solutions

IDEAL FOR HEAT EXCHANGER FLANGES

Although suitable for use on standard ASME flanges in a wide range of difficult applications, the FLEXPRO® gasket is proving to be especially suitable as a reliable, cost effective alternative to jacketed gaskets that are commonly used in heat exchanger applications. Use of the Flexitallic FLEXPRO® gasket will ensure a reliable seal, from initial hydrotest through difficult operating conditions. FLEXPRO® gaskets are suitable for use on TEMA flanges, and when required, pass partition ribs can be supplied in any configuration. The FLEXPRO® gasket provides a high integrity, low seating stress seal, and is ideal for heat exchanger applications with limited bolt load or lighter weight flanges.



GASKET LOCATIONS

1. Floating Head
2. Shell Cover
3. Shell to Tubesheet
4. Tubesheet to Channel Box
5. Channel Box Cover

STANDARD CORE MATERIALS

Standard core thickness is 0.125" (nominal); other thicknesses and materials are readily available to suit specific applications.

STANDARD FACING MATERIALS

Standard facing thickness is 0.020"; other thicknesses and materials are readily available to suit specific applications.

FLANGE SURFACE FINISH REQUIREMENTS

The ideal flanges surface finish for use with Flexitallic FLEXPRO® gaskets is 125 - 250 m-inch Ra.

Core Material	Max. Temperature
Stainless Steel	1000 - 1600°F (535 - 870°C)
Carbon Steel	1000°F (535°C)
Brass	500°F (260°C)
Copper	600°F (315°C)
Aluminum	800°F (425°C)
Monel	1500°F (815°C)
Nickel	1200°F (650°C)
Inconel	2000°F (1100°C)

Facing Material	Max. Temperature	Seating Stress at Room Temp	
		Min. psi (Mpa)	Max. psi (Mpa)
Thermiculite®	1800°F (982°C)	2500 (17)	72500 (500)*
Flexicarb Flexible Graphite	842°F (450°C)	2500 (17)	72500 (500)*
PTFE	500°F (260°C)	2500 (17)	72500 (500)*
Corriculite	432°F (222°C)	2500 (17)	72500 (500)*

*While high stresses have been utilized, Flexitallic Engineering should be contacted for operating stresses above 40,000 psi.

Independent PVRC Testing Confirms Superior Tightness
Room Temperature Tightness (ROTT) Behavior Characterization

PERFORMANCE IN ROTT TESTS

The results of two ROTT tests conducted at TTRL[1] on Flexitallic FLEXPRO® gaskets are shown in Figure 1.

At the highest Part A stress level (S5 - 15160 psi), Tp values above 55000 were obtained. A tp of 55000 corresponds to a Helium leak rate of approximately 1 x 10^{-6} mg/s for an 800 psig pressure.

Part B test data indicates that this gasket maintains superior tightness during stress cycling.

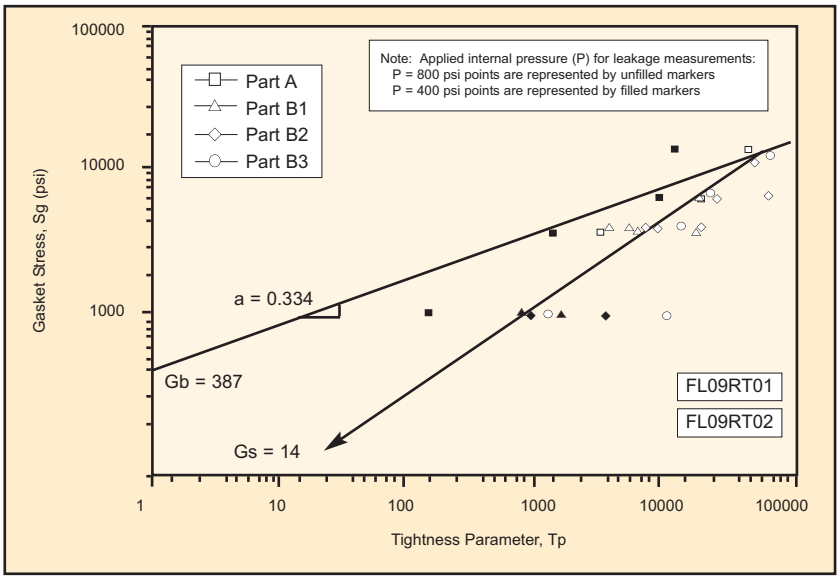


Figure 1 - ROTT Test Results

GASKET CONSTANTS

The calculated gasket constants are reported in the table below, along with computed values of S100, S1000 and the maximum Tp value obtained in the ROTT tests.

The ROTT behavior characterization of a gasket consists of:

- Performing a minimum of two ROTT tests on NPS 4 samples
- Treating and reporting ROTT data on the basis of the Tightness Parameter Concept
- Calculating the PVRC Gasket constants, Gb, "a" and Gs, according to the proposed ASTM Standard
- Reporting the gasket constants and characteristics

Gb	a	Gs	S_{100}	S_{1000}	T_PMAX
387 psi	0.334	14 psi	1802 psi	3888 psi	55000

Table 1 - PVRC Constants

m	y
2	2500 psi

Table 2 - ASME Constants

ROTT TEST PROCEDURE

The ROTT test includes a gasket load sequence (5 stress levels, S1 to S5), called Part A, which represents the initial joint tightening and gasket seating. The maximum stress level (S5) is 15160 psi for metallic gaskets. Part A is interrupted at its three highest stress levels to run unload-reload sequences, called Parts B1, B2, B3 which simulate joint relaxation and re-tightening. At each stress level, Helium leakage is measured (for two pressures in Part A and one pressure in Part B).

ROTT test data are plotted in the form of Gasket Stress, Sg, vs. Tightness Parameter, Tp, on a log-log scale. The tightness parameter, Tp, is a measure of the ability of an installed gasket to control its leakage performance in a pressurized flange joint. Tp is proportional to the pressure causing a small leak and inversely proportional to the square of the leak. The higher Tp, the tighter the joint. A joint that is 10 times tighter than another leaks 100 times less (at the same pressure).

GASKET CONSTANTS Gb, "a", AND Gs

The new PVRC tightness based gasket constants are determined from the results of two or more ROTT tests. Together constants Gb and "a" together define an initial seating performance line. The combined effect of Gb, and "a" is best represented by the value of STP = Gb x Tpa calculated for typical values of Tp such as 100 or 1000. For example S100 = Gb (100)a. Constant Gs independently represents operation. Low values of Gb, "a", Gs, S100 and S1000 are favorable.

[1]*Tightness Testing and Research Laboratory - Ecole Polytechnique of Montreal*

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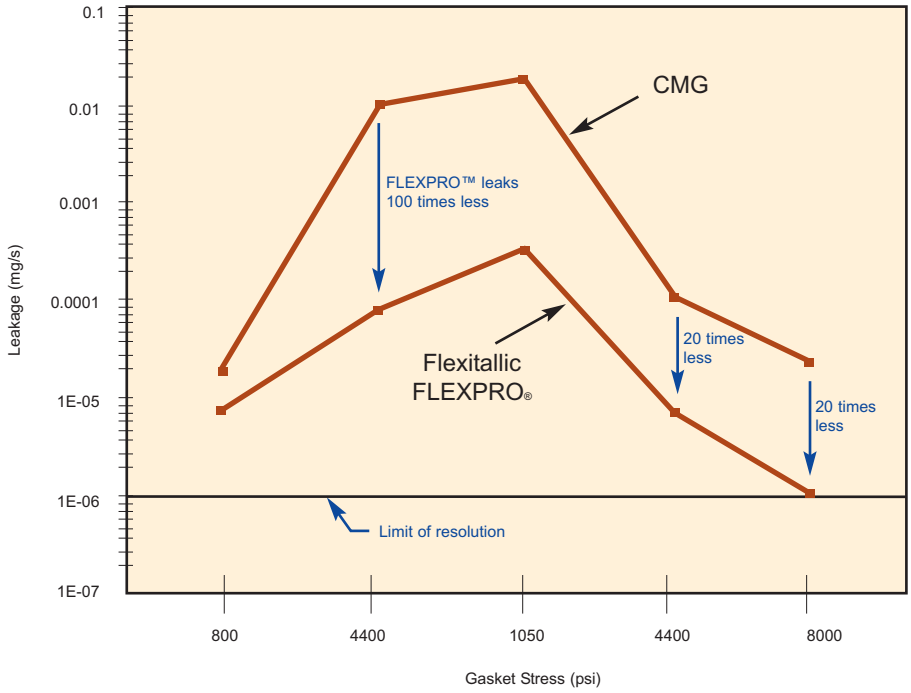
Cycling Comparison

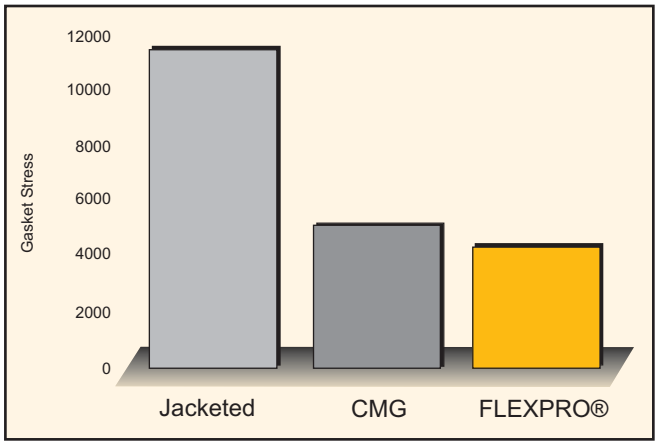
During operation, unloading of a bolted-gasketed joint can occur due to pressurization, fluctuation in pressure and temperature, thermal effects, joint relaxation, etc. PVRC test data confirms the superior ability of the FLEXPRO® gasket to maintain tightness under these cyclic loading conditions. As shown in the graph, when gasket stress is reduced from 8000 psi to 4400 psi, the Flexitallic FLEXPRO® gasket leaks 100 times less than the corrugated metal gasket (CMG). When subsequently reloaded to a gasket stress of 4400 psi and 8000 psi, the FLEXPRO® gasket leaks 20 times less than the CMG. A TIGHTER JOINT IS A SAFER JOINT!

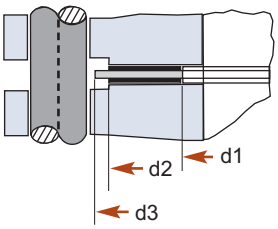


HELIUM AT 800 PSI

T3 Tightness

The PVRC developed method for characterizing gasket performance specifies three classes of tightness. T1 (economy), T2 (standard), and T3 (tight). A tightness class of T3 represents a mass leak rate per unit diameter, of 0.00002 mg/sec-mm. This graph shows that the Flexitallic FLEXPRO® gasket achieves a tightness class of T3 at the lowest seating stress when compared to other types of gaskets. Results are based on PVRC test data, using a gasket with dimensions of 20 x 21-1/2" diameter, with (20) 1" diameter bolts, and an assembly efficiency of 0.075. The Flexitallic FLEXPRO® gasket is ideal for use in applications with limited bolt load and lighter weight flanges.





Style ZG & ZA

STYLE ZG & ZA To Suit ASME B16.5 and BS 1560 Flanges Class 150 up to 2500									
Dimensions in inches			150	300	400	600	900	1500	2500
NPS	d1	d2	d3						
1/2	29/32	1-5/16	1-7/8	2-1/8	2-1/8	2-1/8	2-1/2	2-1/2	2-3/4
3/4	1-1/8	1-9/16	2-1/4	2-5/8	2-5/8	2-5/8	2-3/4	2-3/4	3
1	1-7/16	1-7/8	2-5/8	2-7/8	2-7/8	2-7/8	3-1/8	3-1/8	3-3/8
1-1/4	1-3/4	2-3/8	3	3-1/4	3-1/4	3-1/4	3-1/2	3-1/2	4-1/8
1-1/2	2-1/16	2-3/4	3-3/8	3-3/4	3-3/4	3-3/4	3-7/8	3-7/8	4-5/8
2	2-3/4	3-1/2	4-1/8	4-3/8	4-3/8	4-3/8	5-5/8	5-5/8	5-3/4
2-1/2	3-1/4	4	4-7/8	5-1/8	5-1/8	5-1/8	6-1/2	6-1/2	6-5/8
3	3-7/8	4-7/8	5-3/8	5-7/8	5-7/8	5-7/8	6-5/8	6-7/8	7-3/4
3-1/2	4-3/8	5-3/8	6-3/8	6-1/2	6-3/8	6-3/8	7-1/2	7-3/8	---
4	4-7/8	6-1/16	6-7/8	7-1/8	7	7-5/8	8-1/8	8-1/4	9-1/4
5	5-15/16	7-3/16	7-3/4	8-1/2	8-3/8	9-1/2	9-3/4	10	11
6	7	8-3/8	8-3/4	9-7/8	9-3/4	10-1/2	11-3/8	11-1/8	12-1/2
8	9	10-1/2	11	12-1/8	12	12-5/8	14-1/8	13-7/8	15-1/4
10	11-1/8	12-5/8	13-3/8	14-1/4	14-1/8	15-3/4	17-1/8	17-1/8	18-3/4
12	13-3/8	14-7/8	16-1/8	16-5/8	16-1/2	18	19-5/8	20-1/2	21-5/8
14	14-5/8	16-1/8	17-3/4	19-1/8	19	19-3/8	20-1/2	22-3/4	---
16	16-5/8	18-3/8	20-1/4	21-1/4	21-1/8	22-1/4	22-5/8	25-1/4	---
18	18-7/8	20-7/8	21-5/8	23-1/2	23-3/8	24-1/8	25-1/8	27-3/4	---
20	20-7/8	22-7/8	23-7/8	25-3/4	25-1/2	26-7/8	27-1/2	29-3/4	---
22	22-7/8	24-7/8	26	27-3/4	27-5/8	28-7/8	---	---	---
24	24-7/8	26-7/8	28-1/4	30-1/2	30-1/4	31-1/8	33	35-1/2	---

STYLE ZG & ZA in Accordance with DIN 2697 PN64 Up to PN400								
Dimensions in mm			64	100	160	350	320	400
DN	d1	d2	d3					
10	22	40	56	56	56	67	67	67
15	25	45	61	61	61	72	72	77
25	36	68	82	82	82	82	92	103
40	50	88	102	102	102	108	118	135
50	62	102	112	118	118	123	133	150
65	74	122	137	143	143	153	170	192
80	90	138	147	153	153	170	190	207
100	115	162	173	180	180	202	229	256
125	142	188	210	217	217	242	274	301
150	165	218	247	257	257	284	311	348
(175)	190	260	277	287	284	316	358	---
200	214	285	309	324	324	358	398	442
250	264	345	364	391	388	442	488	---
300	310	410	424	458	458	---	---	---
350	340	465	486	512	---	---	---	---
400	386	535	543	---	---	---	---	---

Flexpro® GASKETS

Proven Performance in the Field . . .

TYPICAL APPLICATIONS:

Note: These are just examples of some typical applications.

HYDROGEN Design Temperature - 850°F Design Pressure - 3,000 psi	**NATURAL GAS** Design Temperature - Ambient Design Pressure - 600 psi
HEAT TRANSFER FLUID Design Temperature - 575°F Design Pressure - 290 psi	**EXHAUST GAS** Design Temperature - 1300°F Design Pressure - 20 psi
STEAM Design Temperature - 575°F Design Pressure - 250 psi	**HYDROGEN** Design Temperature - 900°F Design Pressure - 800 psi

Superior Performance by Design . . .

Wide Range of Materials	Core and facing materials to suit almost any application
Reproducible Construction	Assures consistency from lot to lot
Easy to Handle and Install	Rigid core facilitates easy handling, less damage
Wide Pressure Range	Suitable from Vacuum to Class 2500 and higher, reduces inventory requirements
Wide Temperature Range	Suitable from cryogenics to 2000°F (1100°C) depending on core and facing materials
Low Seating Stress	Ideal for light flanges with limited available bolt load, as well as highly loaded flanges
Conformable Surfaces	Soft, conformable surface layers accommodate minor dings, nicks and scratches that are detrimental to other types of gaskets; also less susceptible to inaccurate bolting. Suitable for use on a wide range of surface finishes.
Proven Design	Over 85 years of experience in difficult service throughout the world
Firesafe	Flexible graphite, Thermiculite, and metal cores are inherently firesafe
Wide Application	Available for standard and special flanges, in circular and non-circular shapes
Replaces Jacketed Gaskets	Direct replacement for jacketed gaskets in most applications
Cost Effective	Longer life, less maintenance, reduced emissions, and can be refurbished
Available in Segmented Construction	Facilitates assembly into applications with limited access

Flexitallic®

change™ THERMICULITE™ SIGMA Flexpro

FLEXITALLIC US, LLC
6915 HWY 225, Deer Park, TX 77536
T I 281.204.2400 F I 281.204.2415

FLEXITALLIC US, LLC
35238 E HWY 30, Geismar, LA, 70734
T I 225.442.3580 F I 281.604.2501

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