Garlock Style 3750 LEAK-GARD™ Gasketing

Value and Benefits

Improvement over traditional gaskets

- No loss of compressive load over time
- No degradation of gasket in oil service
- No weepage, as with vegetable fiber or cork gaskets

Proprietary compound reacts with oil to create a tight, long-lasting seal

- Actually increases bolt load and bolt load retention
- Fills in low spots in flanges; compensates for low load areas

Specifications†

Material	Synthetic fiber with proprietary rubber binder
Temperature, cont. operating	-40°F (-40°C) to +400°F (+204°C)
Pressure, max.	1,200 psig (83 bar)
P x T, max.††	
1/32" (0.8mm), 1/16" (1.6 mm)	350,000 (12,000)
1/8" (3.2 mm)	250,000 (8,600)

† Based on ANSI RF flanges at the maximum recommended torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Applications Engineering.

†† P x T = psig x °F (bar x °C)

Stops oil leakage in:

- Turbines
- Transformers
- Gear boxes
- Access covers
- Generators
- Lube oil
- Diesel fuel pumps

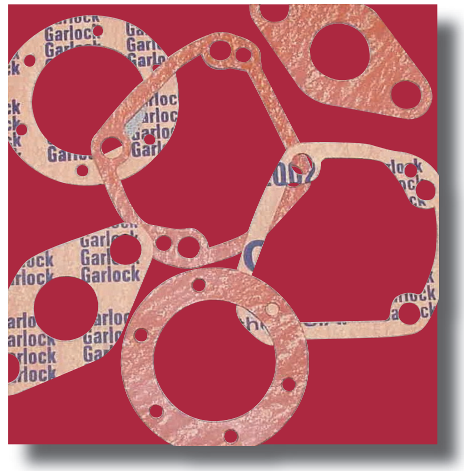
Garlock
SEALING TECHNOLOGIES®

Physical Properties

ASTM Test Method	Typical Physical Properties	Typical Results
ASTM F36	**Recovery,** %	52.3
ASTM F36	**Compressibility,** %	10.0
ASTM F38	**Creep Relaxation,** % 22 hrs @ 212°F (100°C)	22.0
ASTM F146	**Fluid Resistance after 5 hours immersion**	
	ASTM #1 Oil, 5 hours @ +300°F (+150°C) Thickness increase, %	22.5
	ASTM IRM #903 Oil, 5 hours @ +300°F (+150°C) Thickness increase, %	66.4
	ASTM Fuel B, 5 hours @ room temperature Thickness increase, %	22.0
ASTM F152	**Tensile Strength,** psi (N/mm²) Across Grain	3056 (21)

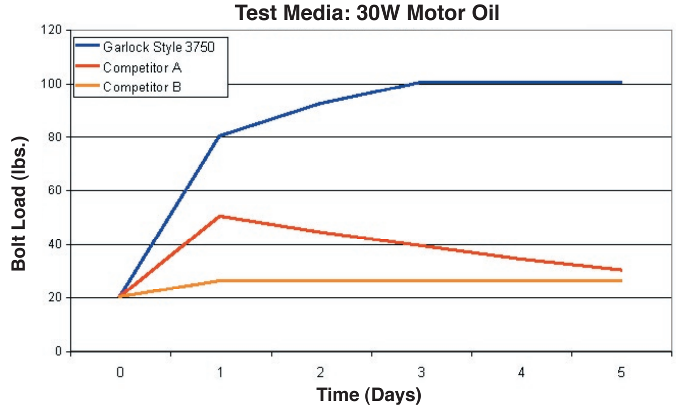
These values do not constitute specification limits. This is a general guide and should not be the sole means of selecting or rejecting this material.

Thickness measured with a 9 oz. weight before immersion and 3 oz. after immersion.



Bolt Load Generation Test

Initial Load: 20 lbs. Test Temperature: 300°F
Test Media: 30W Motor Oil



AUTHORIZED REPRESENTATIVE

ISO 9001:2000
Cert. #001762

WARNING:
Properties/applications shown throughout this brochure are typical. Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult Garlock. Failure to select the proper sealing products could result in property damage and/or serious personal injury.

Performance data published in this brochure has been developed from field testing, customer field reports and/or in-house testing.

While the utmost care has been used in compiling this brochure, we assume no responsibility for errors. Specifications subject to change without notice. This edition cancels all previous issues. Subject to change without notice.

GARLOCK is a registered trademark for packings, seals, gaskets, and other products of Garlock.

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LEAK-GARD® Style 3750

MATERIAL PROPERTIES*:

Color:	Red
Composition:	Synthetic fibers with a proprietary rubber binder
Fluid Services (see chemical resistance guide):	Aliphatic hydrocarbons, oils and gasoline
Temperature[1], °F (°C)	
Minimum:	-100 (-73)
Continuous Max:	+400 (+205)
Maximum:	+700 (+371)
Pressure[1], Maximum, psig (bar):	1200 (83)
P x T (max.)[1], psig x °F (bar x °C):	
1/32 and 1/16":	350,000 (12,000)
1/8"	250,000 (8,600)

TYPICAL PHYSICAL PROPERTIES*:

ASTM F36	**Compressibility** , average, %:	10	
ASTM F36	**Recovery**, %:	52	
ASTM F38	**Creep Relaxation,** %:	22	
ASTM F152	**Tensile**, Across Grain, psi (N/mm^2):	3056 (21)	
ASTM D149	**Dielectric Properties,** range, volts/mil.	1/16"	1/8"
	Sample conditioning	496	285
	3 hours at 250°F	-	-
	96 hours at 100% Relative Humidity:		
ASTM F586	**Design Factors**	1/16" & Under	1/8"
	"m" factor:	8.0[2]	7.5[2]
	"y" factor, psi (N/mm^2):	2500 (17.2)[2]	2300 (15.9)[2]

SEALING CHARACTERISTICS*

	ASTM F37B – Fuel A	ASTM F37B - Nitrogen	DIN 3535 – Nitrogen
Gasket Load, psi (N/mm2):	500 (3.5)	3000 (20.7)	4640 (32)
Internal Pressure, psig (bar):	9.8 (0.7)	30 (2)	580 (40)
Leakage			

IMMERSION PROPERTIES*- ASTM F146 Fluid Resistance after Five Hours

	ASTM #901 Oil 300°F (150°C)	ASTM #903 Oil 300°F (150°C)	ASTM Fuel A 70-85°F (20-30°C)	ASTM Fuel B 70-85°F (20-30°C)
Thickness Increase, (%)	<22.5[3]	<66.4[3]	-	<22[3]
Weight Increase, (%)	-	-	-	-
Tensile Loss (%)	-	-	-	-

Notes:

* This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties

[1] Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure, continuous operating temperature, minimum temperature or 50% of maximum PxT, consult Garlock Applications Engineering. Minimum temperature rating is conservative.

[2] The values shown are based on nitrogen (gas). Values would be lower if tests with oils or fuels.

[3] Thickness measured with a 9 oz. weight before immersion and 3 oz. after immersion.

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How to troubleshoot a gasket leak

Start by determining proper selection for service conditions.

Figure 1. Effects of overcompression on a rubber gasket in a raised-face flange

By Dave Burgess & Matt Tones, Garlock Sealing Technologies

Most plant personnel have been confronted with leaking flange connections in their piping systems. These leaks are most often the result of mechanical problems, for example, too much or insufficient gasket compression. Sometimes, however, the wrong gasket has been used for a particular service, and this needs to be determined at the outset of an investigation into the root cause(s) of a leak. The first step in troubleshooting leaks is to address the same factors that govern gasket selection in the first place: temperature, media, pressure and application.

Begin by comparing system operating temperatures to gasket ratings. It is preferable that the gasket be rated well above expected operating maximums. Cycling temperatures are harder on bolted joints than steady states, so note which is the case in the situation under investigation.

In addition, the gasket must be compatible with the media in the system, including the presence of any cleanouts or additives to the primary fluid. Caustic cleanouts, for example, will attack most fiber-based gaskets.

As with temperature, the pressure rating of the gasket should exceed the system's operating pressure. Note any periodic surges, spikes or hammering, and whether the service includes some form of heat tracing, which is commonly used on pipelines transporting products that solidify at ambient temperatures. This can create huge increases in pressure, which typically occur on startup when the heat trace begins to liquefy the process fluid, creating trapped pockets, or if the line is left completely full of a liquid and a section of pipe or vessel is closed at both ends.

The application can be regarded as the mechanical details of the joint, the primary consideration of which is the available compressive load on the gasket. This load determines if the gasket is appropriate for the assembly. Dividing the available compressive load generated by the fasteners in the flange assembly by the surface contact area of the gasket yields the expected compressive stress on the gasket. In addition to available load, note whether the flanges are raised- or flat-face. Observe surface finish and other mechanical factors, such as the depth of a recess when installing a gasket in a "groove-to-flat" arrangement.

Compressive load

Since gasket selection must be based on service conditions and the types of flanges used, these factors must be considered when troubleshooting a leak.

Available compressive load in a bolted joint largely determines whether a rubber-bound fiber sheet, polytetrafluoroethylene (PTFE) or metal gasket should be used.

If available stress is between 600 and 1,200 psi, a rubber gasket will work. At stresses below 600 psi, special gaskets might be required for a consistently tight seal.

In contrast, stresses above 1,200 psi can crush or split a rubber gasket, but still may be too low to form an effective seal with harder materials such as standard PTFE or rubber-bound fiber sheet gaskets (See Figure 1). These materials work best at stresses of 3,000 psi or more.

The available compressive load is also subject to the type of flange used. A forged steel flange can accommodate greater stresses than fiber reinforced plastic (FRP), plastic (PVC, CPVC, etc.) and cast iron flanges. Elastomer gaskets have the lowest load requirements and metal gaskets the highest, with greater crush resistance and internal pressure capability.

Leaks in flanged joints often result from the mechanics of the application, resulting in either too much or too little compressive load. This may be because incorrect or uneven loads are applied to the bolts, or because achieving the proper load given the flange design and available bolting is impossible. Under the same bolting, a flat-face flange with a full-face gasket will not apply the same compressive force as a raised-face flange with its smaller compressed area.

Among the types of flanges that typically produce low compressive gasket loads and attendant problems are the previously mentioned flat cast iron flanges commonly found in valves and pumps; glass-lined equipment; non-metallic flanges such as FRP, PVC, CPVC and HDPE; and rolled angle iron flanges for ductwork, vessels and vacuum service tanks.

Troubleshooting gaskets

Having addressed these considerations, the process of actually troubleshooting a leaking gasket begins with shutting down the system; draining off the pressure; emptying the fluid; and removing all nuts, bolts and washers. Then carefully remove the gasket from the flange, trying to keep it intact. Note, however, that even a partial gasket can be useful if its compressed thickness can be measured (See Figure 2).

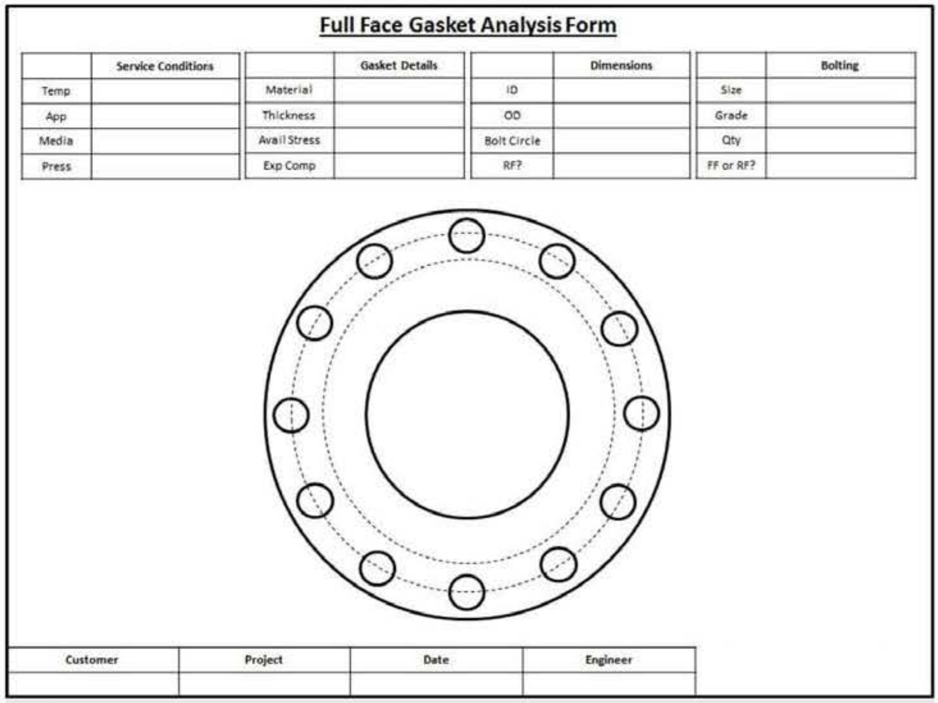
First examine the gasket to determine if it was damaged during installation. Look for rollover at the edge onto the seating surface, or an impression from the flanges showing it was not centered properly.

Also look for any visual clues or physical damage, such as a faint imprint indicating undercompression, heavy compression and splitting from overcompression and possible erosion. Caused by abrasive media, erosion is typically seen as a curved area that has been removed or has worn away at the gasket's inner diameter (I.D.). Unlike chemical attack, it is usually limited to one area with smooth edges (See Figure 3).

Check for the use of an anti-stick agent, anti-seize compound or silicone on the seating surfaces of the gasket and flanges. These can impair sealing performance by reducing the friction between the gasket and flanges, allowing the gasket to extrude, blow out or crush. Then inspect the seating surfaces of the gasket, looking for irregular impressions that might have been created by flange imperfections or old gasketing that was not completely removed before the new gasket was installed.

Finally, measure the thickness of the gasket all around the seating area using a micrometer with a flat measuring face. Sharp-pointed micrometers can dig into soft gaskets, yielding inaccurate measurements. Calipers are not usually helpful since the gasket may have uncompressed areas at the I.D. and outer diameter (O.D.), preventing them from measuring the true thickness in the compressed area.

These thickness measurements indicate whether a gasket was compressed adequately and evenly. If compression was greater toward the O.D. than the I.D. of the seating area, flange rotation or bending has occurred. Measuring the uncompressed thickness in two or three places is important for calculating compression as a percentage. Note that the original thickness of the gasket typically varies slightly from the nominal thickness, so it is important to know the actual uncompressed thickness.


Full Face Gasket Analysis Form

	Service Conditions		Gasket Details		Dimensions		Bolting
Temp		Material		ID		Size	
App		Thickness		OD		Grade	
Media		Avail Stress		Bolt Circle		Qty	
Press		Exp Comp		RF?		FF or RF?	

Customer	Project	Date	Engineer

Figure 2. Sample worksheet for recording notes and thickness measurements

Calculating compression

Once the thickness has been measured all the way around the gasket, calculate the compression as a percentage of the original thickness as follows:

$$\frac{\text{Original Thickness} - \text{Compressed Thickness}}{\text{Original Thickness}} \times 100$$

Example: Original thickness = 0.062"; Compressed thickness = 0.055"

Calculation: (0.062" – 0.055") / 0.062" x 100 = 11.3%

Compare this percentage to the expected compression, noting that available stress on the gasket is calculated using gasket surface area and available bolt load at reasonable bolt stress. In making this comparison, use the manufacturer's published compressibility values (based on ASTM F36 method), which are typically tested at 5,000 psi compressive stress for fiber and PTFE gaskets. Compression versus load curves also can be used. Compression on the used gasket that was well above or below the expected compression may indicate the cause of the leak.

Compression can often vary significantly from one section of a gasket to another, indicating misaligned flanges, improperly supported pipes or uneven loading of the bolts. Overcompression can crush or cause splitting in some gaskets, which can be mistaken for chemical attack in rubber gaskets that have been installed in raised-face flanges.

In some cases, manufacturers may be able to provide photographs showing the effects of crushing, chemical attack, erosion, "popcorning" from monomer polymerization and other common issues.

Effectively troubleshooting gasket leaks logically begins with determining if the proper gasket was selected for the given service conditions. This can accelerate the process by identifying issues that can subsequently be confirmed by examination of the failed gasket. The process can be further facilitated by submitting a sample of the used gasket to the manufacturer for analysis. FC


Figure 3. Effects of erosion on a PTFE gasket

Dave Burgess and Matt Tones are senior application engineers with Garlock Sealing Technologies, based in Palmyra, New York.