VSP technologies

NAR

Six Sigma Fluid Sealing Management

Why Do Gaskets Leak?

What they don't teach you in School about Bolted Flange Joints

RideTight® Training

- Typical year, 100 classes, 1000+ trained

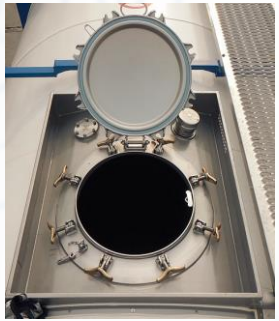
Prince George, VA | Kingsport, TN | Webster, TX | Parkersburg, WV | Lake Charles, LA | Baton Rouge, LA

RideTight® Compliance

- CFR 178.2 Applicability and Responsibility

B) With information specifying the type(s) and dimensions of the closures, including gaskets and any other components needed to ensure that the packaging is capable of successfully passing the applicable performance tests. This information must include any procedures to be followed, including closure instructions for inner packagings and receptacles, to effectively assemble and close the packaging for the purpose of preventing leakage in transportation. Closure instructions must provide for a consistent and repeatable means of closure that is sufficient to ensure the packaging is closed in the same manner as it was tested.

What are These Called and Why do They Leak?





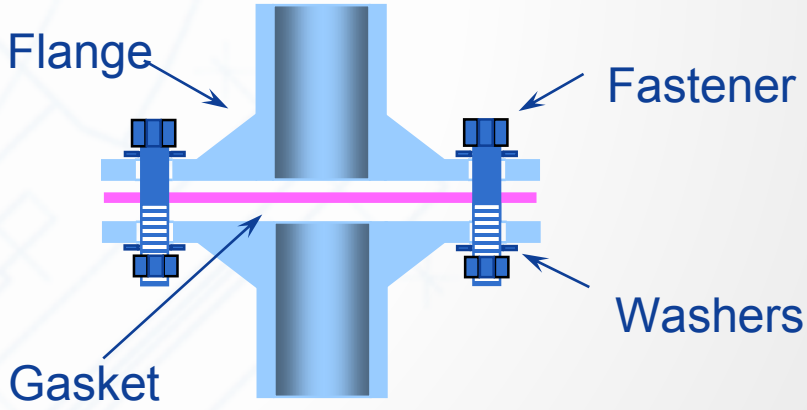


Flange Inspection and Cleaning

The Bolted Flanged Joint System

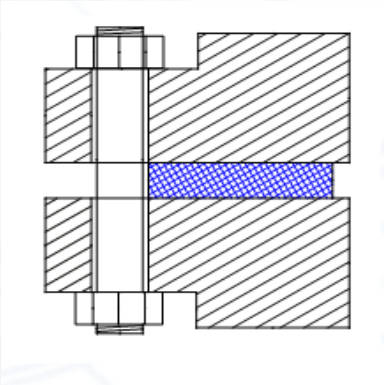
- Bolted Flanged Joint consists of
  - Flange
  - Fasteners and Washers (optional in some applications)
  - Gasket Material
    - Chemical Compatibility
    - Mechanical Requirements (min/max stress, pressure, temperature)
    - Assembly Considerations (Demonstration at booth)

- **All Three Must Work in Harmony**

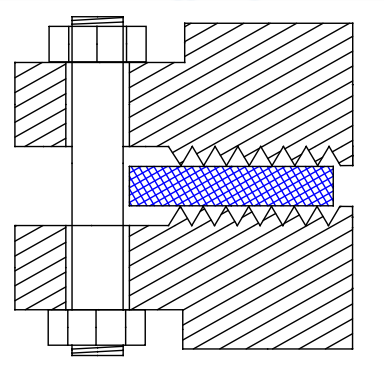


Examples of Tank Car Flanges

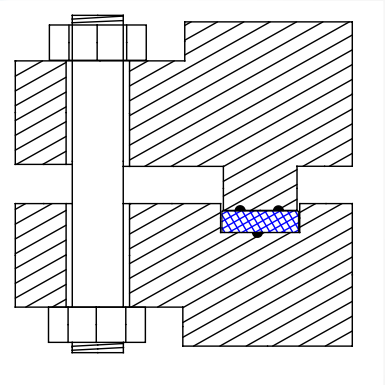
- Flange Sealing Surface Finish



Smooth



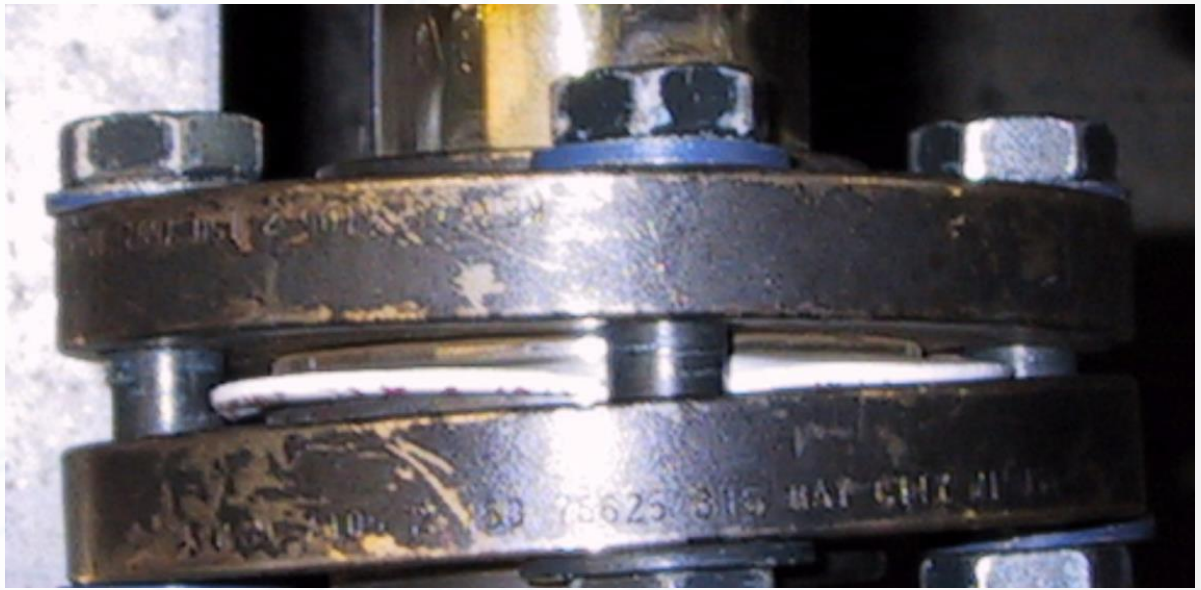
Serrated, or
Phonograph



Tongue & Groove
w/Witness Groove

Flange Assembly

- During Assembly ensure uniform gap between flanges around entire flange



Excessive Gasket Stress Caused by Flange Rotation

Fasteners

- Inspect and Clean the Fasteners if reusing

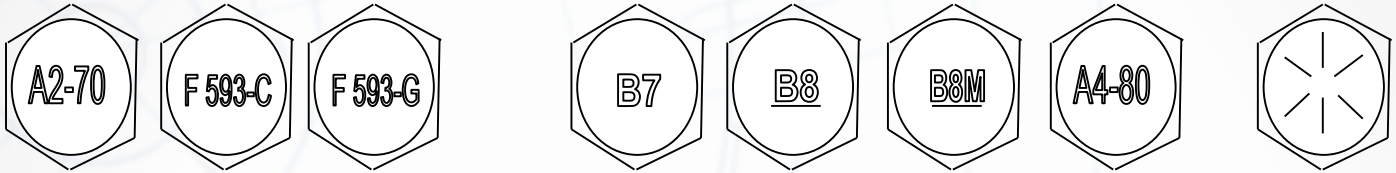
Thread Engagement

- One to three full threads exposed beyond each nut is a recommended “fit” that satisfies both of these guidelines

Extra threads showing

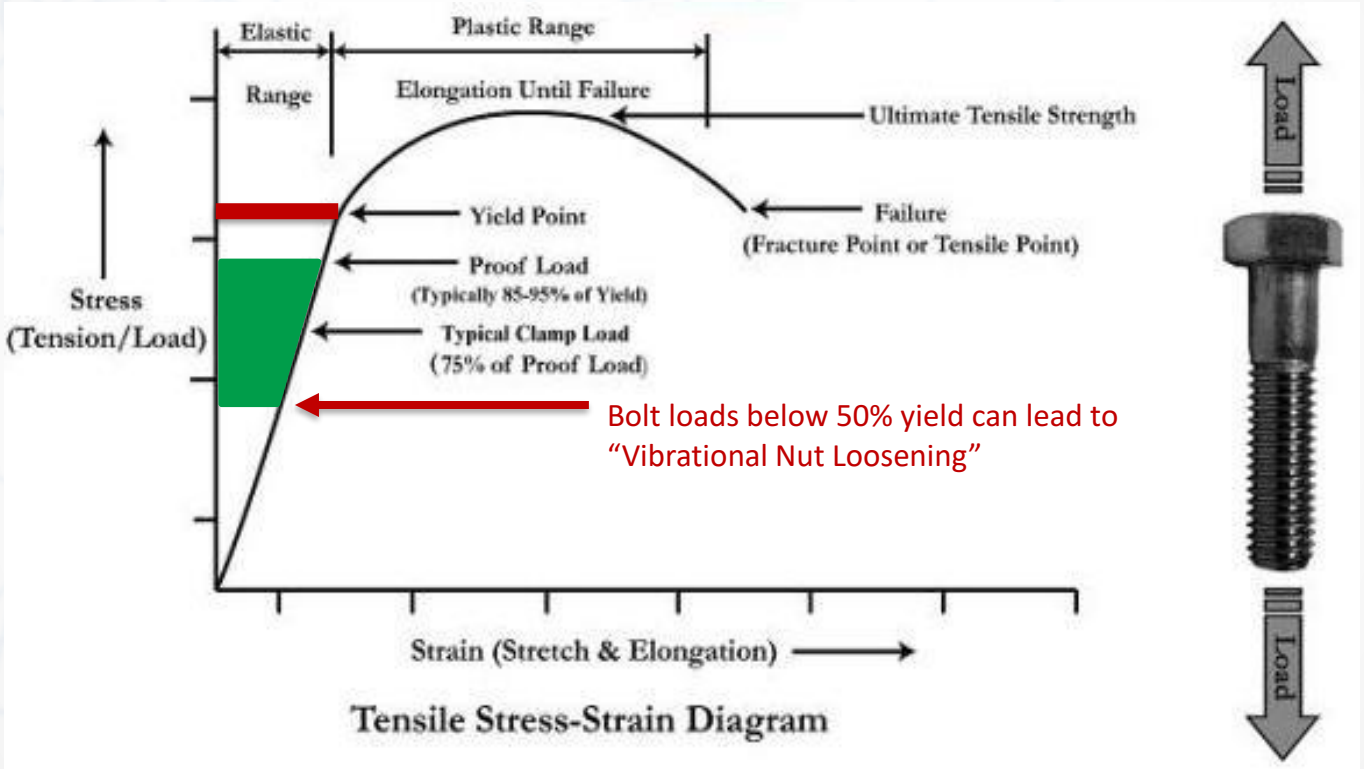
Nut threads visible

Basic Understanding of Fastener Specification



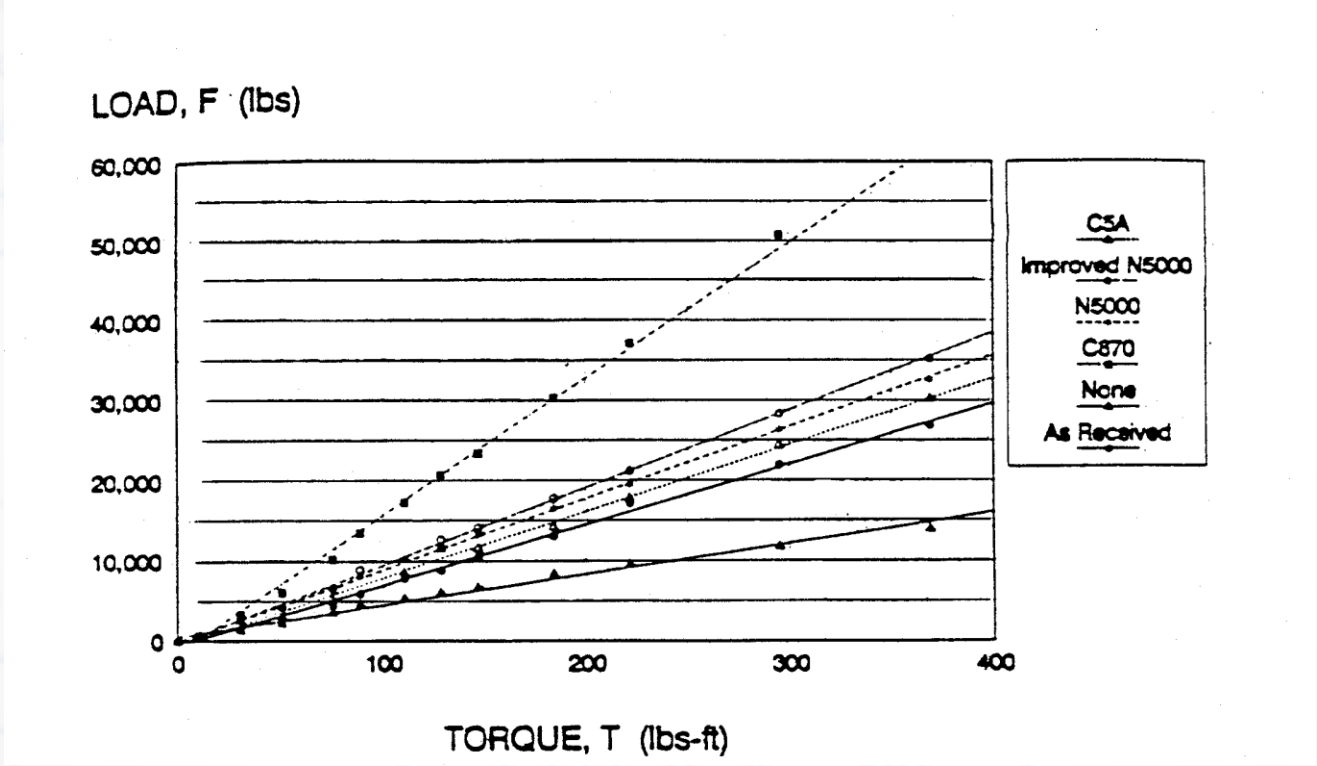
Marking	Diameter Range	Tensile (ksi)	Yield (ksi)
B8	1/4 or Larger	75	30
B8M	1/4 or Larger	75	30
F 593-C	1/4 to 5/8	100 to 150	65
F 593-G	1/4 to 5/8	100 to 150	65
A2-70	All Diameters	101	65
A4-80	All Diameters	116	87
B8M	1/4 thru 3/4	110	95
B8	1/4 thru 3/4	125	100
B7	Up to 2-1/2	125	105

Fastener Yield Curve



Clean and Lubricate Fastners

LOAD vs. TORQUE (DIFFERENT LUBRICANTS)



Some of the Gasket Materials Available

- Shelf Life, ReTorque, Hard/Soft

Code	Material	Type	Code	Material	Type	Code	Material	Type
P22	ANTIMONY LEAD	Lead	E01	BUNA-N(NITRILE)	Elastomer	P16	TASKLINE	PTFE
C13	DURLON® 8200	Compressed NA	E02	BUTYL	Elastomer	P18	TEADIT 1570	PTFE
C30	DURLON® 8300	Compressed NA	E20	EPDM	Elastomer	P25	TEADIT 1570E	PTFE
C14	DURLON® 8400	Compressed NA	E03	EPDM PC	Elastomer	P19	TEADIT 1580	PTFE
C15	DURLON® 8500	Compressed NA	E24	EPDM PC 70 DUROM	Elastomer	P31	TEADIT 1580E	PTFE
C17	FRENZELIT NOVATEC 825F	Compressed NA	E04	EPDM PURPLE	Elastomer	P28	TEADIT 1590	PTFE
C18	FRENZELIT NOVATEC 925F	Compressed NA	E05	FKM-A	Elastomer	P24	DURLON® 9600	PTFE - ePTFE
C01	GARLOCK 2900	Compressed NA	E06	FKM-B	Elastomer	P04	GORE-TEX GR®	PTFE - ePTFE
C02	GARLOCK 2930	Compressed NA	E18	FKM-GT	Elastomer	P32	GORE-TEX PRODURA®	PTFE - ePTFE
C03	GARLOCK BLUEGARD® 3000	Compressed NA	E07	GARLOCK 135	Elastomer	P17	INERTEX SQS®	PTFE - ePTFE
C04	GARLOCK BLUEGARD® 3200	Compressed NA	E19	GUM RUBBER	Elastomer	P12	KLINGERSIL® SOFTCHEM	PTFE - ePTFE
C05	GARLOCK BLUEGARD® 3300	Compressed NA	E08	HYPALON®	Elastomer	L01	LOAD-LOCK™	PTFE - ePTFE (expanded PTFE) with tang reinforcement
C06	GARLOCK BLUEGARD® 3400	Compressed NA	E21	KALREZ® 6375	Elastomer	P05	CYCLETIGHT®	PTFE - ePTFE with Corrugated Metal Insert
C07	GARLOCK BLUEGARD® 3700	Compressed NA	E23	NATURAL RUBBER	Elastomer	P11	GARLOCK TEPHONIC®	PTFE - ePTFE with Corrugated Metal Insert
C11	GARLOCK G-9900	Compressed NA	E11	NEOPRENE	Elastomer	P29	VSP PITA®	PTFE - ePTFE with Corrugated Metal Insert
C09	GARLOCK HTC 9800	Compressed NA	E12	RED RUBBER	Elastomer	P03	FLEXITALLIC SIGMA 500	PTFE HS-10
C10	GARLOCK HTC 9850	Compressed NA	E13	SILICONE	Elastomer	P30	FLEXITALLIC SIGMA 511	PTFE HS-10
C08	GARLOCK IFG® 5500	Compressed NA	E09	VITON® A	Elastomer	P35	FLEXITALLIC SIGMA 533	PTFE HS-10
C12	GARLOCK ST-706	Compressed NA	E10	VITON® B	Elastomer	P06	GARLOCK GYLON® 3500	PTFE HS-10
C19	JM CLIPPER 60	Compressed NA	E14	VITON® BROWN	Elastomer	P07	GARLOCK GYLON® 3504	PTFE HS-10
C29	KLINGER® QUANTUM	Compressed NA	E15	VITON® GF	Elastomer	P08	GARLOCK GYLON® 3510	PTFE HS-10
C21	KLINGERSIL® C-4300	Compressed NA	E25	VITON® GF-LT	Elastomer	P20	GARLOCK GYLON® 3511	PTFE HS-10
C20	KLINGERSIL® C-4401	Compressed NA	E22	VITON® GF-S	Elastomer	P09	GARLOCK GYLON® 3540	PTFE Microcelluar
C22	KLINGERSIL® C-4433	Compressed NA	E26	VITON® GF-S GOLD	Elastomer	P10	GARLOCK GYLON® 3545	PTFE Microcelluar with PTFE layer
C23	KLINGERSIL® C-5400	Compressed NA	E28	WHITE FDA EPDM	Elastomer	P13	DURLON® 9000	PTFE skived
C24	KLINGERSIL® C-8200	Compressed NA	E29	WHITE FDA VITON® A	Elastomer	P21	DURLON® 9000N	PTFE skived
C28	TEADIT 1000	Compressed NA	E16	WHITE NEOPRENE	Elastomer	P14	KLINGERSIL® TOPCHEM 2000	PTFE skived
C25	TEADIT 1001	Compressed NA	E17	WHITE NITRILE	Elastomer	P15	ORANGE SEALON	PTFE skived
C26	TEADIT 1076	Compressed NA	G09	KLINGERSIL® HL	Flexible Graphite (Homogenous)	P02	PTFE GLASS FILLED 25%	PTFE skived
C27	TETRAGLASS	Compressed NA	G08	TEADIT 2660	Flexible Graphite (Homogenous)	P01	VIRGIN TEFLON®	PTFE skived
S01	SPIRAL WOUND, STYLE R-304/FG 600-1500#	Spiral Wound	G11	ELASTAGRAPH	Flexible Graphite with Corrugated Metal Insert	P37	WHITE SEALON	PTFE skived
S02	SPIRAL WOUND, STYLE R-304/PTFE 600-1500#	Spiral Wound	G06	GARLOCK GRAPHON	Flexible Graphite with Corrugated Metal Insert			
S05	SPIRAL WOUND, STYLE R-316/ePTFE 150-600#	Spiral Wound	G01	SIGRAFLEX® HOCHD	Flexible Graphite with multiple layers of SS foil insert			
S06	SPIRAL WOUND, STYLE R-316/ePTFE 600-1500#	Spiral Wound	G04	GARLOCK GRAPHLO	Flexible Graphite with SS foil insert			
			G02	GRAFOIL® GHR	Flexible Graphite with SS foil insert			
			G07	KLINGERSIL® SLS	Flexible Graphite with SS foil insert			
			G14	TEADIT 2663	Flexible Graphite with SS foil insert			
			G05	GARLOCK GRAPHLO	Flexible Graphite with Tang Insert			
			G03	GRAFOIL® GHE	Flexible Graphite with Tang Insert			
			G13	KLINGERSIL® PSM	Flexible Graphite with Tang Insert			

Chemically Compatible

Typical GP Railcar Manway Gasket Damage

Buna-N (Nitrile) in Asphalt
[Buna-N = 200°F, Asphalt = 400°F]

Viton® in Asphalt [Viton® 450°F, Asphalt = 400°F]

Minimum Required Gasket Assembly Stress

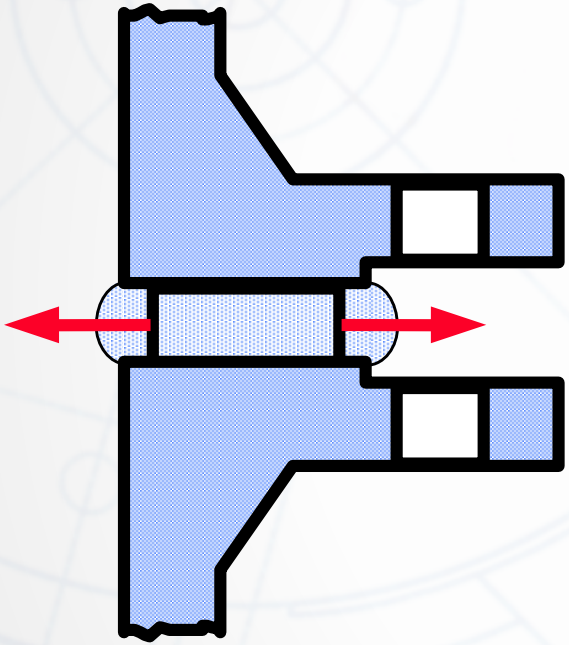
Gasket Stress (psi) = Total Bolt Load (lb) / Gasket Contact Area (in^2) => psi

$$Stress = \frac{Force}{Area}$$

Gasket Material	Minimum Gasket Stress to Seal (psi)	Maximum Gasket Stress (psi)
1/8" Thick Rubber (Elastomer)	500	**1,500**
Expanded PTFE w/Corrugated Insert	2,800	10,000 - 15,000
1/8" Thick Compressed Non-Asbestos	4,800	15,000
1/8" Filled PTFE	4,800	10,000 - 15,000

Over Compression of Gasket

Mechanical Requirements - Load Retention (Creep/Cold Flow)

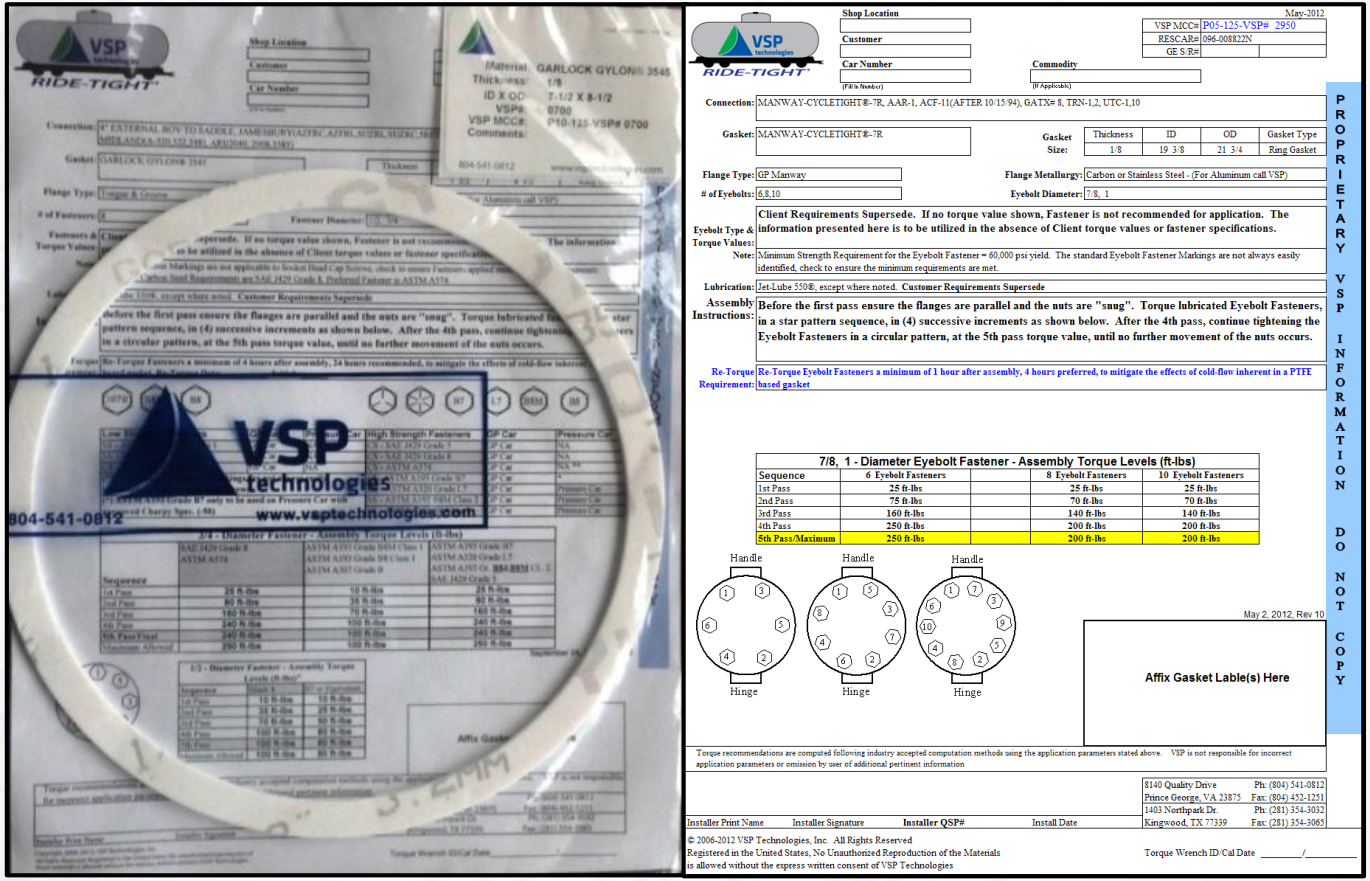


- **Gasket Creep/Cold Flow**
  - Gasket Stress Decreases
  - Loss of Fastener Pre Load
  - Fasteners more susceptible to “Vibration Loosening”

Ideally it is preferable to choose a material that does not relax

Example of Poor Gasket Design/Material Choice

VSP - QA/Sample Assembly Form



VSP technologies
RIDE-TIGHT

Shop Location
Customer
Car Number (Fill In Number)
Commodity (If Applicable)

May-2012

VSP MCC# P05-125-VSP# 2950
RESCAR# 096-008822N
GE S/R#

Connection: MANWAY-CYCLETIGHT®-7R, AAR-1, ACF-11(AFTER 10/15/94), GATX# 8, TRN-1,2, UTC-1,10

Gasket: MANWAY-CYCLETIGHT®-7R

Gasket Size:	Thickness	ID	OD	Gasket Type
	1/8	19 3/8	21 3/4	Ring Gasket

Flange Type: GP Manway
Flange Metallurgy: Carbon or Stainless Steel - (For Aluminum call VSP)
# of Eyebolts: 6,8,10
Eyebolt Diameter: 7/8, 1

Eyebolt Type & Torque Values: **Client Requirements Supersede. If no torque value shown, Fastener is not recommended for application. The information presented here is to be utilized in the absence of Client torque values or fastener specifications.**

Note: Minimum Strength Requirement for the Eyebolt Fastener = 60,000 psi yield. The standard Eyebolt Fastener Markings are not always easily identified, check to ensure the minimum requirements are met.

Lubrication: Jet-Lube 550®, except where noted. **Customer Requirements Supersede**

Assembly Instructions: **Before the first pass ensure the flanges are parallel and the nuts are "snug". Torque lubricated Eyebolt Fasteners, in a star pattern sequence, in (4) successive increments as shown below. After the 4th pass, continue tightening the Eyebolt Fasteners in a circular pattern, at the 5th pass torque value, until no further movement of the nuts occurs.**

Re-Torque Requirement: **Re-Torque Eyebolt Fasteners a minimum of 1 hour after assembly, 4 hours preferred, to mitigate the effects of cold-flow inherent in a PTFE based gasket**

7/8, 1 - Diameter Eyebolt Fastener - Assembly Torque Levels (ft-lbs)

Sequence	6 Eyebolt Fasteners		8 Eyebolt Fasteners	10 Eyebolt Fasteners
1st Pass	25 ft-lbs		25 ft-lbs	25 ft-lbs
2nd Pass	75 ft-lbs		70 ft-lbs	70 ft-lbs
3rd Pass	160 ft-lbs		140 ft-lbs	140 ft-lbs
4th Pass	250 ft-lbs		200 ft-lbs	200 ft-lbs
5th Pass/Maximum	**250 ft-lbs**		**200 ft-lbs**	**200 ft-lbs**

May 2, 2012, Rev 10

Affix Gasket Lable(s) Here

Torque recommendations are computed following industry accepted computation methods using the application parameters stated above. VSP is not responsible for incorrect application parameters or omission by user of additional pertinent information

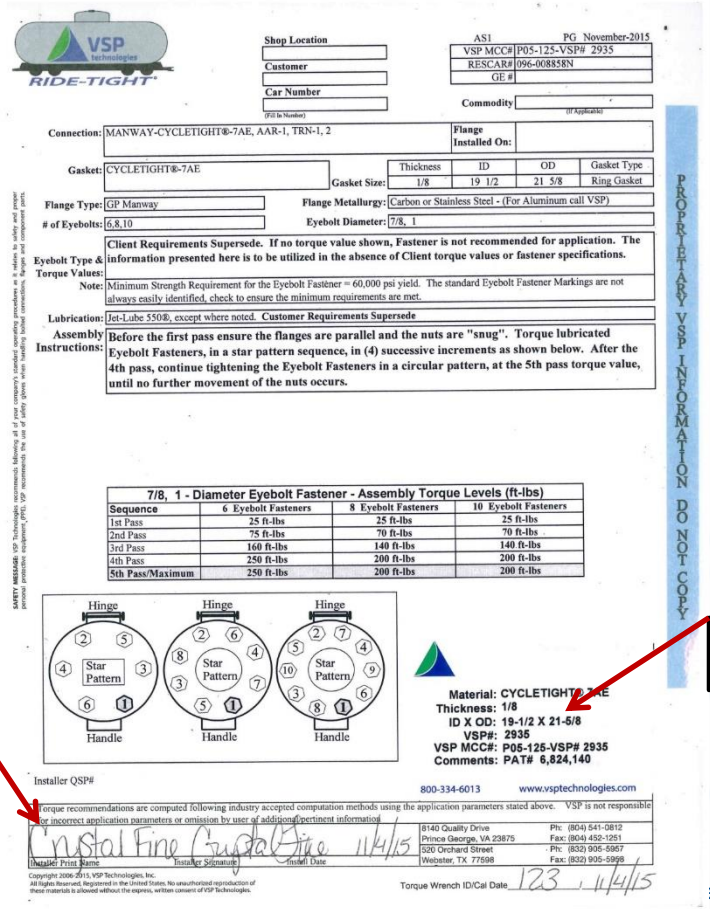
8140 Quality Drive, Prince George, VA 23875 Ph: (804) 541-0812 Fax: (804) 452-1251
1403 Northpark Dr., Kingwood, TX 77339 Ph: (281) 354-3032 Fax: (281) 354-3065

Installer Print Name | Installer Signature | **Installer QSP#** | Install Date

Torque Wrench ID/Cal Date _____/_____

PROPRIETARY VSP INFORMATION DO NOT COPY

VSP - QA/Completed Assembly Form



VSP technologies
RIDE-TIGHT

Shop Location
Customer
Car Number
(Fill In Number)

AS1 PG November-2015
VSP MCC# P05-125-VSP# 2935
RESCAR# 096-008858N
GE #
Commodity (If Applicable)

Connection: MANWAY-CYCLETIGHT®-7AE, AAR-1, TRN-1, 2
Flange Installed On:

Gasket: CYCLETIGHT®-7AE
Gasket Size:

Thickness	ID	OD	Gasket Type
1/8	19 1/2	21 5/8	Ring Gasket

Flange Type: GP Manway
Flange Metallurgy: Carbon or Stainless Steel - (For Aluminum call VSP)
# of Eyebolts: 6,8,10
Eyebolt Diameter: 7/8, 1

Eyebolt Type & Torque Values: **Client Requirements Supersede. If no torque value shown, Fastener is not recommended for application. The information presented here is to be utilized in the absence of Client torque values or fastener specifications.**

Note: Minimum Strength Requirement for the Eyebolt Fastener = 60,000 psi yield. The standard Eyebolt Fastener Markings are not always easily identified, check to ensure the minimum requirements are met.

Lubrication: Jet-Lube 550®, except where noted. **Customer Requirements Supersede**

Assembly Instructions: **Before the first pass ensure the flanges are parallel and the nuts are "snug". Torque lubricated Eyebolt Fasteners, in a star pattern sequence, in (4) successive increments as shown below. After the 4th pass, continue tightening the Eyebolt Fasteners in a circular pattern, at the 5th pass torque value, until no further movement of the nuts occurs.**

PROPRIETARY VSP INFORMATION DO NOT COPY

7/8, 1 - Diameter Eyebolt Fastener - Assembly Torque Levels (ft-lbs)

Sequence	6 Eyebolt Fasteners	8 Eyebolt Fasteners	10 Eyebolt Fasteners
1st Pass	25 ft-lbs	25 ft-lbs	25 ft-lbs
2nd Pass	75 ft-lbs	70 ft-lbs	70 ft-lbs
3rd Pass	160 ft-lbs	140 ft-lbs	140 ft-lbs
4th Pass	250 ft-lbs	200 ft-lbs	200 ft-lbs
5th Pass/Maximum	250 ft-lbs	200 ft-lbs	200 ft-lbs

Material: CYCLETIGHT®-7AE
Thickness: 1/8
ID X OD: 19-1/2 X 21-5/8
VSP#: 2935
VSP MCC#: P05-125-VSP# 2935
Comments: PAT# 6,824,140

Installer QSP#

800-334-6013 www.vsptechnologies.com

Torque recommendations are computed following industry accepted computation methods using the application parameters stated above. VSP is not responsible for incorrect application parameters or omission by user of additional pertinent information.

Crystal Fine Crystal Fine 11/4/15

Installer Print Name | Installer Signature | Install Date

8140 Quality Drive, Prince George, VA 23875 Ph: (804) 541-0812 Fax: (804) 452-1251
520 Orchard Street, Webster, TX 77598 Ph: (832) 905-5957 Fax: (832) 905-5998

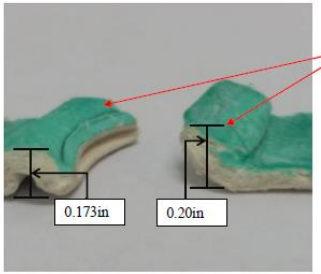
Torque Wrench ID/Cal Date 123 , 11/4/15

Gasket Label

Print Name, Sign Name, Date

Root Cause Failure Analysis – Overview

- Root Cause Failure Analysis are conducted for the following purposes:
  - Provide feedback for materials, processes, and practices
  - Assist Shippers in material change recommendations
  - Assist Shops for specific training
  - Quality Assurance: Continuous Improvement



Picture E –
Gasket Crimping / Folding / bending

Picture F –
No lubrication present

Picture F –
Gasket Crimping / Folding / bending

Picture F –
TIR Wire connection point

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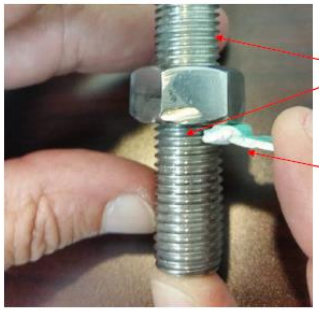
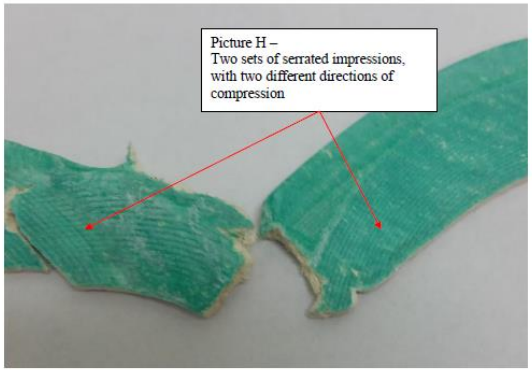
www.vsptechnologies.com



Picture G –
No lubrication present

Picture G –
Gasket Crimping / Folding / bending



Picture H –
Two sets of serrated impressions, with two different directions of compression

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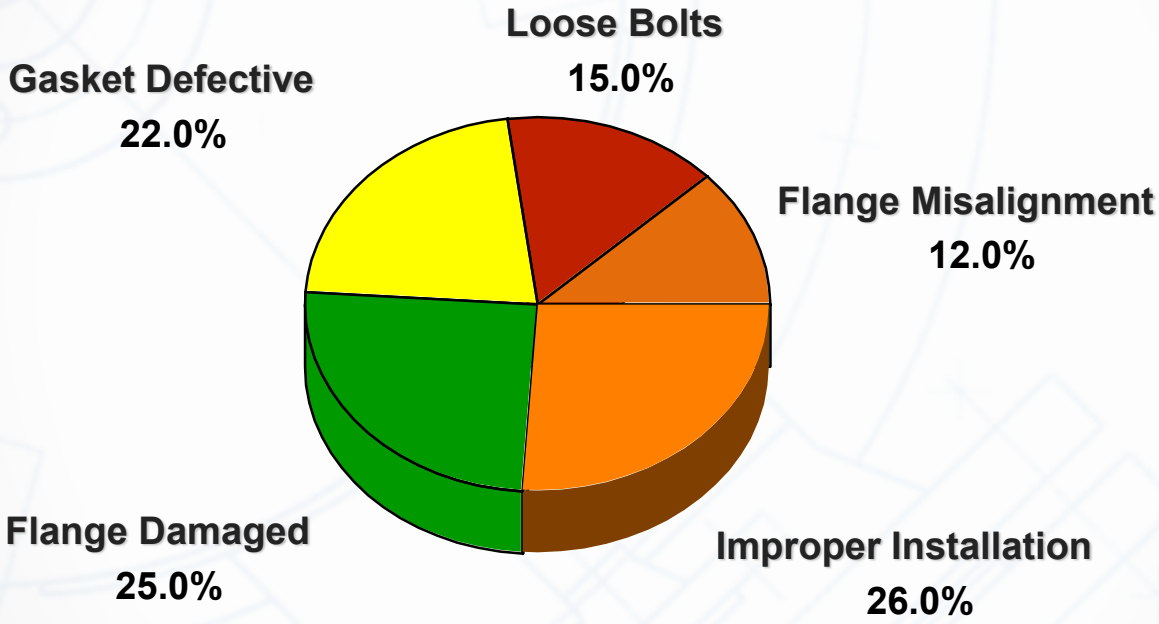
The Sealing System - Reasons for Gasket Leaks



Source: PVRC Study