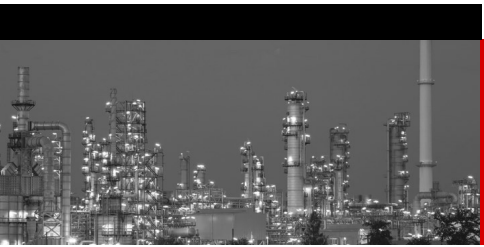
QUEST
SEALING SOLUTIONS



INDUSTRIAL

GASKET & BOLTING

HANDBOOK

Introduction

QUEST is recognized as a Canadian leader in the distribution and manufacturing of industrial products for critical fluid sealing processes. The wide variety of sealing solutions provided by QUEST have been important tools for many industries including the Refining, Chemical Process, and Power Generation industries. Our products have helped a number of industries achieve the goal of an emission-free environment within their facilities.

Our product range is manufactured to national and international standards together with specific customer designs.

The Products You Need

Twenty Four Seven

When You Need Them

Quality

We are driven to offer outstanding service, innovative product solutions, cost effective manufacturing, and quality finished goods inventory. We intend to achieve a standard of excellence in an industry that expects the best from a company whose employees are empowered and committed to continuous improvement using our Quality Management System. We are determined, as an organization, to meet the needs of our customers and exceed their expectations regarding quality, availability, reliability, performance and safety, while maintaining a competitive spirit.

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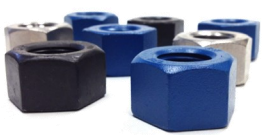
QUESTFAST®

Industrial Fasteners

MATERIAL SELECTION

Quest Gasket has a full range of bolting products manufactured in an extensive range of materials with a wide choice of finishes and treatments. All products are machined to fine tolerances and to high performance specifications to meet the rigorous demands of worldwide industries.



Threaded-Nuts

ASTM A194, Latest Revision, Grade 2H

Suitable for high temperatures and high pressure conditions.

ASTM A194, Grade 2HM

Similar to 2H nuts except this grade is designed for use in corrosive environments.

ASTM A194, Latest Revision, Grade 4

Heat treated molybdenum steel nuts suitable for severe temperature and pressure conditions.

ASTM A194, Latest Revision, Grade 7L

New stamping as per ASTM is 7L. Heat treated chrome-molybdenum steel nuts suitable for extreme temperature and pressure conditions. Suitable for sub-zero service conditions and have minimum Charpy impact values of ASTM spec. A320. Grade 7 down to 150°F.

ASTM A194, Grade 7ML

New stamping as per ASTM is 7ML. Similar to grade 7L nuts except this grade is designed for use in corrosive environments.

ASTM A194, Grade 8/8M

Stainless steel nuts designed for use in corrosive environments.

Threaded-Studs

ASTM A193, Grade B7

A heat treated chromium-molybdenum steel widely used for medium high temperature service.

(Liquid quench -50 to 900°F. Air quench -40 to 900°F)

ASTM A193, Grade B7M

Similar to B7 studs except that the minimum yield and tensile strength requirements are reduced and the hardness controlled to 235 Brinell maximum.

Designed for use in corrosive environments. (-50 to 900°F)

ASTM A193, Grade B16

A heat treated chromium-molybdenum steel for high pressure, high temperature service. (-50 to 1100°F)

ASTM A320, Grade L7

This grade is intended for low temperature service down to minus 150°F and has a minimum Charpy impact value of 20 ft. lbs. at this temperature. (-150 to 1100°F)

ASTM A320, Grade L7M

Similar to L7 studs except that the minimum yield and tensile strength requirements are reduced and the hardness controlled to 235 Brinell maximum. This stud is designed for use in low temperature corrosive environments. (-150 to 1100°F)

ASTM A320, Grade L43

This grade is intended for low temperature service down to minus 150°F and has a minimum Charpy impact value of 20 ft. lbs. at this temperature. Available in sizes up to 4 in. (-150 to 1100°F)

ASTM A193, Grade B8

These Chromium-Nickel (AISI 304) austenitic steel studs are used in corrosive environments. (-325 to 1500°F)

ASTM A193, Grade B8M

These Chromium-Nickel Molybdenum (AISI 316) austenitic steel studs are used in corrosive environments. (-325 to1500°F)

FASTENER COATINGS

Surface preparation

Xylan coatings (or any thin-film coating) cannot by themselves provide complete corrosion protection. For maximum performance, primers or pretreatments are required.

Types of corrosion-mitigating coatings

These fall into three common categories: barrier, inhibitive and sacrificial.

- **A barrier** coating stands between the metal fastener and the environment. This is usually an organic coating with fillers that help stop moisture or vapor from permeating the film to the metal and becoming an electrolyte.

- **An inhibitive** coating is usually an organic coating with corrosion inhibitors, such as zinc phosphates, and chromates. In addition to acting as barriers, they help prevent corrosion by using pigments that provide an inhibitive effect, reacting with the absorbed moisture in the coating, then reacting with the steel to passivate it and decrease its corrosive characteristics.

- **A sacrificial** coating is usually a metal or inorganic coating containing metal particles (often zinc). If the coating is damaged, they act as a sacrificial anode and corrode to protect the steel substrate, sacrificing themselves by galvanic action. These can also be electroplated like zinc or cadmium.

Zinc Electroplating

Zinc electroplating line provides quick turnaround and cost effectiveness for your plated bolt requirements.

Our zinc plating process, with clear trivalent conversion, offers:

- Hexavalent Chrome Free processing eliminates the toxic chemicals found in yellow chromate.
- Excellent Corrosion Resistance—Exceeding that of yellow chromate, and achieving 200-400 hours to white corrosion in ASTM B-117 Salt Spray.
- Increased Temperature Tolerance to 300-400°F for many hours with no effect on corrosion resistance or color.
- Cost Effective - This new clear chromate costs no more than yellow chromate.

Xylan® Overview

Xylan has long been the benchmark of our line of industrial coatings. Registered in most countries around the world, Xylan is used to identify our low-friction, wear-resistant composites of fluoropolymers and reinforcing binder resins.

They are first and foremost dry-film lubricants; however, they have many desirable secondary properties. These lubricants are combined in a matrix with the newest high-temperature organic polymers resulting in “plastic alloys” formulated to provide unique and desirable properties. They can “work” under heavy loads, at high temperatures, in chemical and corrosive environments, and combinations thereof. In the industrial world, they are known as “extreme performance coatings.”

Ten reasons why you should use Xylan coatings:

1. Low friction: CoF as low as 0.02.
2. Wear resistance: even under extreme pressures.
3. Corrosion and chemical resistance in most environments.
4. Weather resistance.
5. Wide temperature operating range.

Xylan 1070

Xylan 1070 general purpose coatings were the first Xylan fastener coatings, introduced in the mid-1970s and still going strong. They provide outstanding lubrication for predictable makeup and break-out torque, and they have outstanding chemical resistance.

Temperature Range: -425°F (-255°C) to 550°F (290°C) continuously.

Xylan 1070 has added corrosion inhibitors.

Xylan 1424

Xylan 1424 is the environmentally friendlier version of the 1000 series coatings. Xylan 1424 series coating can be made in any color, including white. They also have better chemical resistance to bases than the 1000 series.

Xylan 1424 series reaches complete cure at 400°F (205°C), ideal for most coating operations.

Xylan 1424 series coatings work best for onetime installations, where the fastener will be coated, installed, and left alone.

Temperature Range: -40°F (-40°C) to 350°F (175°C).

6. Flexible curing schedule: ambient to 750°F (400°C).
7. Wide color range: color-code your product.
8. Pliability.
9. Machinability.
10. Excellent adhesion

MECHANICAL REQUIREMENTS

ASTM A193/A193M

ASTM A194/A194M

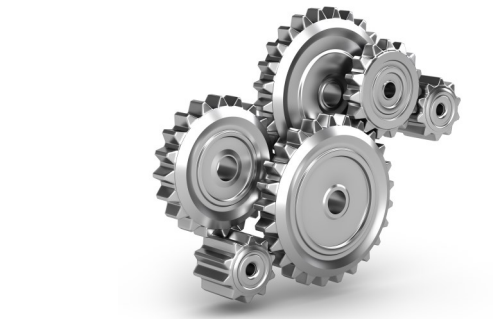
ASTM A320/A320M

STUDS

- TABLE 1—B7, B7M
- TABLE 2—L7, L7M
- TABLE 3—B8 CLASS 1, CLASS 2
- TABLE 4—B8M CLASS 1, CLASS 2

NUTS

- TABLE 5—2H, 2HM, 4, 7L, 7LM, B8, B8M
- TABLE 6— IMPACT VALUES 4, 7L, 7LM, L43



NOTES FOR TABLES 1—4

1. To meet the tensile requirements, the Brinell hardness shall be over 200 HB (93 HRB).

2. Class 1 is solution treated. Class 2 is solution treated and strain hardened. Austenitic steels in the strain-hardened condition may not show uniform properties throughout the section particularly in sizes over 3/4" in diameter.

3. For sizes 3/4" in diameter and smaller, a maximum hardness of 241 HB (100 HRB) is permitted.

4. To meet the tensile requirements, the Brinell hardness shall not be less than 200 HB or 93 HRB.

MECHANICAL REQUIREMENTS—TABLE 1

ASTM A193 ASTM A320 GRADE	SIZE	MINIMUM TEMPERING TEMP. °F (°C)	TENSILE STRENGTH MIN. KSI (MPA)	YIELD STRENGTH MIN. KSI (MPA)	ELONGATION 2" (50mm) MIN. %	REDUCTION OF AREA MIN. %	HARDNESS MAXIMUM
B7	2-1/2" & under	1100 (593)	125 (860)	105 (725)	16	50	321 HB (35HRC)
	over 2-1/2" to 4"	1100 (593)	115 (790)	95 (655)	16	50	321 HB (35HRC)
B7M Note 1	2-1/2" & under	1150 (620)	100 (690)	80 (550)	18	50	235 HB (99HRB)
	over 2-1/2" to 4"	1150 (620)	100 (690)	80 (550)	18	50	235 HB (99HRB)

MECHANICAL REQUIREMENTS—TABLE 2

ASTM A193 ASTM A320 GRADE	SIZE	MINIMUM TEMPERING TEMP. °F (°C)	TENSILE STRENGTH MIN. KSI (MPA)	YIELD STRENGTH MIN. KSI (MPA)	ELONGATION 2" (50mm) MIN. %	REDUCTION OF AREA MIN. %	HARDNESS MAXIMUM
L7	2-1/2" & under	Quenched and Tempered 1100 (593)	125 (860)	105 (725)	16	50	-
L7M Note 4	2-1/2" & under	Quenched and Tempered 1150 (620)	100 (690)	80 (550)	18	50	235 HB (99HRB)

MECHANICAL REQUIREMENTS—TABLE 3

GRADE	ASTM A193 ASTM A320 SIZE	MINIMUM TEMPERING TEMP. °F (°C)	TENSILE STRENGTH MIN. KSI (MPA)	YIELD STRENGTH MIN. KSI (MPA)	ELONGATION 2" (50mm) MIN. %	REDUCTION OF AREA MIN. %	HARDNESS MAXIMUM
B8 Class 1 Note 2, 3	All Diameters	Carbide Solution Treated	75 (515)	30 (205)	30	50	223 HB (96HRB)
B8 Class 2 Note 2	3/4" & under	Carbide Solution Treated & Strain Hardened	125 (860)	100 (690)	12	35	321 HB (35HRC)
	over 3/4" to 1"		115 (790)	80 (550)	15	35	
	over 1" to 1-1/4"		105 (725)	65 (450)	20	35	
	over 1-1/4" to 1-1/2"		100 (690)	50 (345)	28	45	

MECHANICAL REQUIREMENTS—TABLE 4

ASTM A193 ASTM A320 GRADE	SIZE	MINIMUM TEMPERING TEMP. °F (°C)	TENSILE STRENGTH MIN. KSI (MPA)	YIELD STRENGTH MIN. KSI (MPA)	ELONGATION 2" (50mm) MIN. %	REDUCTION OF AREA MIN. %	HARDNESS MAXIMUM
B8M Class 1 Note 2, 3	All Diameters	Carbide Solution Treated	75 (515)	30 (205)	30	50	223 HB (96HRB)
B8M Class 2 Note 2	3/4" & under	Carbide Solution Treated & Strain Hardened	110 (760)	95 (655)	15	45	321 HB (35HRC)
	over 3/4" to 1"		100 (690)	80 (550)	20	45	
	over 1" to 1-1/4"		95 (655)	65 (450)	25	45	
	over 1-1/4" to 1-1/2"		90 (620)	50 (345)	30	45	

MECHANICAL REQUIREMENTS—TABLE 5

ASTM A-194 ASME SA-194		MINIMUM TEMPERING	BRINELL	ROCKWELL HARNDESS	
GRADE	CLASS AND SIZE	TEMP °F (°C)	HARDNESS	C SCALE	B SCALE
2H	Up to and including 1-1/2"	850 (455)	248 - 327	24 - 35	95 min.
	Over 1-1/2"		212 - 327	35 max.	
2HM	All Sizes	1150 (620)	159 - 235		84 to 99
L7M	All Sizes	1150 (620)	159 - 235		84 to 99
7L	All Sizes	1100 (595)	248 - 327	24 - 35	
B8 & B8M	All Sizes		126 - 300	32 max	60 min

* In order to meet the tensile requirements, the hardness shall be no less than 200 HB or 93 HRB .

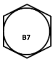
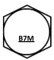
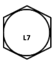
MECHANICAL REQUIREMENTS—TABLE 6

Impact Energy Absorption Requirements

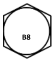
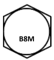
Bolting for Low-Temperature Service

ASTM A320 | A320M GRADE	TEST TEMP. °F (°C)	MINIMUM AVERAGE IMPACT VALUE FOR EACH SET OF 3 SAMPLES 10 x 10 x 50mm ft. - lbs. (Joules)
L7	-150 (-101)	20 (27)
L7M	-100 (-73)	20 (27)
L43	-150 (-101)	20 (27)

FASTENER IDENTIFICATION MARKINGS

Identification Grade Mark	Specification	Material	Nominal Size Range (in.)	Mechanical Properties: Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)	Hardness Min	Hardness Max
 B7	ASTM A193 Grade B7	AISI 4140, 4142, OR 4105 Quenched and Tempered	1/4 to 2-1/2	--	105,000	125,000	--	321 HB or 35 HRC
			Over 2-1/2 to 4	--	95,000	115,000		
			Over 4 to 7	--	75,000	100,000		
 B7M	ASTM A193 GRADE B7M		1/4 to 4	--	80,000	100,000	--	235 HB or 99 HRC 235 BHN or 99 HRB
			Over 4 to 7	--	75,000	100,000		
 L7	ASTM A320 Grade L7	AISI 4140, 4142, OR 4105 Quenched and Tempered	1/4 to 2-1/2	--	105,000	125,000	--	--
 L7M	ASTM A320 Grade L7M		1/4 to 2-1/2	--	80,000	100,000	--	235 HB or 99 HRB

FASTENER IDENTIFICATION MARKINGS

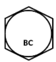
Identification Grade Mark	Specification	Material	Nominal Size Range (in.)	Mechanical Properties				
				Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)	Hardness	
							Min	Max
 B16	ASTM A193 Grade B16	CrMoVa Alloy Steel	2-1/2 and under Over 2-1/2 to 4 Over 4 to 8		105,000 95,000 85,000	125,000 115,000 100,000	--	321 BH or 35 HRC
 B8	ASTM A193 Grade B8 Class 1	AISI 304	1/4 and larger	--	30,000	75,000	--	223 BH or 96 HRB
 B8M	ASTM A193 Grade B8M Class 1	AISI 316					--	223 BH or 96 HRB
 B8SH	ASTM A193 Grade B8 Class 2	AISI 304 Strain Hardened	1/4 to 3/4 Over 3/4 to 1 Over 1 to 1-1/4	-- -- --	100,000 80,000 65,000	125,000 115,000 105,000	--	321 HB or 35 HRC
 B8MSH	ASTM A193 Grade B8M Class 2	AISI 316 Strain Hardened	1/4 to 3/4 Over 3/4 to 1 Over 1 to 1-1/4 Over 1-1/4 to 1 -1/2	-- -- --	95,000 80,000 65,000 50,000	110,000 100,000 95,000 90,000	--	321 HB or 35 HRC

QUEST

QUESTFAST®
Industrial Fasteners

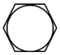
FASTENER IDENTIFICATION MARKINGS

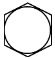
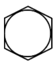
Identification			Nominal Size	Mechanical Properties				
							Hardness	
Grade Mark	Specification	Material	Range (in.)	Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)	Min	Max
 A325	ASTM A325 Type 1	Medium Carbon Steel, Quenched and Tempered	1/2 to 1	85,000	92,000	120,000	24 HRC	35 HRC
			1-1/8 to 1-1/2	74,000	81,000	105,000	19 HRC	31 HRC
 A325	ASTM A325 Type 2	Low Carbon Martensitic Steel, Quenched and Tempered	1/2 to 1	85,000	92,000	120,000	24 HRC	35 HRC

 A325	ASTM A325 Type 3	Atmospheric Corrosion Resisting Steel, Quenched and Tem-pered	1/2 to 1 1-1/8 to 1-1/2	85,000 74,000	92,000 81,000	120,000 105,000	24 HRC 19 HRC	35 HRC 31 HRC
 BC	ASTM A354 Grade BC		1/4 to 2-1/2 2-3/4 to 4	105,000 95,000	109,000 99,000	125,000 115,000	26 HRC 22 HRC	36 HRC 33 HRC

QUESTFAST®
Industrial Fasteners

FASTENER IDENTIFICATION MARKINGS

Identification			Nominal Size	Mechanical Properties				
Grade Mark	Specification	Material	Range (in.)	Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)	Hardness	
							Min	Max
 No Grade Mark	SAE J429 Grade 1	Low or Medium Carbon Steel	1/4 to 1-1/2	33,000	36,000	60,000	70 HRB	100 HRB
	ASTM A307 Grades A&B	Low Carbon Steel	1/4 to 4	--	--	60,000	A - 69 HRB B - 69 HRB	A - 100 HRB B - 95 HRB
	SAE J429 Grade 2	Low or Medium Carbon Steel	1/4 to 3/4	55,000	57,000	74,000	80 HRB	100 HRB
			Over 3/4 to 1-1/2	33,000	36,000	60,000	70 HRB	100 HRB

	SAE J429 Grade 5		1/4 to 1 Over 1 to 1-1/2	85,000 74,000	92,000 81,000	120,000 105,000	25 HRC 19 HRC	34 HRC 30 HRC
	SAE J429 Grade 8 ASTM A354 Grade BD	Medium Carbon Alloy Steel, Quenched and Tempered	1/4 to 1-1/2	120,000	130,000	150,000	33 HRC	39 HRC
 A490	ASTM A490	Alloy Steel, Quenched and Tempered	1/2 to 1-1/2	120,000	130,000	150,000 min 170,000 max	33 HRC	38 HRC

FASTENER IDENFICIATION MARKING

NOTES:

1. In addition to the indicated grade marking, all grades included in this table must be marked for manufacturer identification.

2. While hex heads are shown, grade markings apply equally to products with other head configurations.

3. Hardness value are Brinell.

4. A325 Type 1 bolts may also be marked with 3 radial lines 120 degrees apart in addition to the A325 marking.

5. The bolt manufacturer, at his option, may add other markings to indicate the use of atmospheric corrosion resistant steel.

6. A354 Grade BD products, in sizes 1-1/2" and smaller, are identified as shown and, at the manufacturer's option, may have the letters BD added. Larger sizes are marked only BD.

7. Specifications:

SAE J429 Mechanical and material requirements for externally threaded fasteners

ASTM A307 Carbon steel externally threaded standard fasteners

ASTM A449 Quenched and tempered steel bolts and studs

ASTM 325 High strength bolts for structural steel joints

ASTM A354 Quenched and tempered alloy steel bolts, studs and other externally threaded fasteners

ASTM A490 Heat treated steel structural bolts, 150 ksi minimum tensile strength

ASTM A193-B7 Quenched and tempered alloy steel heavy hex bolts

STUD & BOLT THREAD PITCHES

BOLT DIAMETER (Inches)	STUD UN THREADS (Inches)	BOLT UNC THREADS (Inches)	BOLT UNF THREADS (Inches)	WRENCH SIZES (Heavy Hex)
1/4"	20	20	28	
5/16"	18	18	24	
3/8"	16	16	24	
7/16"	14	14	20	
1/2"	13	13	20	7/8
9/16"	12	12	18	
5/8"	11	11	18	1-1/16
3/4"	10	10	16	1-1/4
7/8"	9	9	14	1-7/16
1"	8	8	12	1-5/8
1-1/8"	8	7	12	1-13/16
1-1/4"	8	7	12	2
1-3/8"	8	6	12	2-3/16
1-1/2"	8	6		2-3/8
1-5/8"	8	Not Defined		2-9/16
1-3/4"	8	5		2-3/4
1-7/8"	8	Not Defined		2-15/16
2"	8	4-1/2		3-1/8
2-1/4"	8	4		3-1/2
2-1/2"	8	4		3-7/8
2-3/4"	8	4		4-1/4
3"	8	4		4-5/8
3-1/4"	8	4		5
3-1/2"	8	4		
3-3/4"	8	4		
4"	8	4		

MEASUREMENT INFORMATION

Measurement Ordering Information:

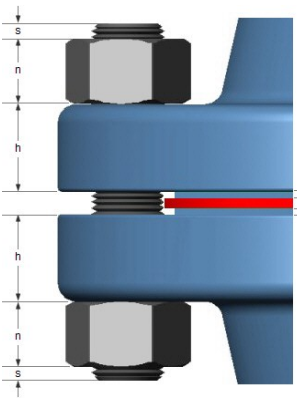
We suggest conforming to the Industrial Fasteners Institute® measures as shown above, known as first-thread-to-first-thread measurement (L). Flat chamfer points are not included in this measurement. Ordering by overall length is known as end-to-end measurement as should be clearly specified when ordering. Hex Bolts are measured from under the head to the tip of the bolt.

Tolerances on Stud Bolt Lengths:

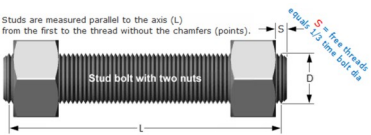
All our studs have been manufactured according to the requirements of ANSI standard B16.5, as outlined by the Industrial Fasteners Institute®. The length Tolerances are as follows:

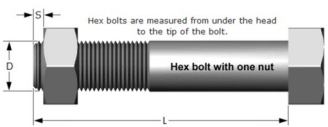
Length in Inches	Tolerances in Inches
Lengths up to 12”	+ or - 1/16
Lengths over 12”	+ or - 1/8

The stud bolt theoretical length can be calculated by means of the formula: L = 2 (s + n + h + rf) + g



- s = free threads (equals 1/3 time bolt diameter)
- n = nut thickness (equals nominal bolt diameter)
- h = flange thickness
- rf = height of raised face for class 150 and class 300 height of raised face is included in h height
- g = gasket thickness approximately 1/8”





U-BOLT WASHERS

Bolt Size	Outside Diameter	Inside Diameter	Thickness	Approx. Lbs. per M Pcs	Approx. pcs per Carton
3/8	0.813	0.406	0.138	15.3	3,500
7/16	0.922	0.469	0.138	20	2,700
1/2	1.125	0.526	0.187	42	1,300
9/16	1.187	0.593	0.187	44.2	1,200
5/8	1.25	0.656	0.187	48	1,100
3/4	1.375	0.781	0.187	54	950
7/8	1.5	0.906	0.187	60	830
1	1.625	1.031	0.187	66	680
1 1/8	2.25	1.156	0.25	208	250
1 1/4	2.25	1.312	0.25	186	220

SAE WASHERS

Bolt Size	Outside Diameter	Inside Diameter	SAE Thick-ness	Approx. per M Pcs	Approx. per Carton
1/2	1.063	0.531	.074/.121	17.8	2,800
5/8	1.313	0.656	.074/.121	27.1	1,850
3/4	1.469	0.813	.108/.160	44.7	1,050
7/8	1.75	0.938	.108/.160	64.6	775
1	2	1.063	.108/.160	85	585
1 1/8	2.25	1.25	.108/.160	109	460
1 1/4	2.5	1.375	.136/.192	151	335
1 3/8	2.75	1.5	.136/.192	181	275
1 1/2	3	1.625	.136/.192	212	230

F436 WASHERS

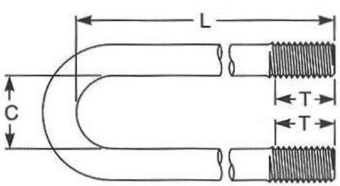
Bolt Size	Outside Diameter	Inside Diameter	F436 Thick-ness	Approx. per M Pcs	Approx. per Carton
1/2	1.063	0.531	.097/.177	20	2,500
5/8	1.313	0.688	.122/.177	35	1,250
3/4	1.469	0.813	.122/.177	41.2	1,125
7/8	1.75	0.938	.136/.177	71	625
1	2	1.063	.136/.177	93.8	500
1 1/8	2.25	1.188	.136/.177	120	375
1 1/4	2.5	1.375	.136/.177	144	300
1 3/8	2.75	1.531	.136/.177	174	275
1 1/2	3	1.625	.136/.177	208	250
1 5/8	3.25	1.77	.178/.280	311	150
1 3/4	3.375	1.875	.178/.280	328	130
1 7/8	3.5	2	.178/.280	345	135
2	3.75	2.125	.178/.280	398	100
2 1/4	4	2.407	.240/.340	568	60
2 1/2	4.5	2.657	.240/.340	734	30
2 3/4	5	2.907	.240/.340	921	30
3	5.5	3.157	.240/.340	1129	30

TYPE 137 STANDARD PIPE DIMENSIONS

Pipe Size	Material Diameter	C	L	T	Approx. wt. per 100
1/2"	1/4"	15/16	3 1/4	2 3/8	7.4
3/4"	1/4"	1 1/8	3 5/16	2 3/8	7.7
1"	1/4"	1 3/8	3 7/16	2 3/8	8.1
1/2"	3/8"	15/16	3 1/4	2 3/8	19
3/4"	3/8"	1 1/8	3 5/16	2 3/8	19.7
1"	3/8"	1 3/8	3 7/16	2 3/8	21
1 1/4"	3/8"	1 11/16	3 3/4	2 3/8	22.5
1 1/2"	3/8"	2	4	2 1/2	24.3
2"	3/8"	2 7/16	4 1/2	2 1/2	27.3
2 1/2"	1/2"	2 15/16	5 1/4	3	57.3
3"	1/2"	3 9/16	5 13/16	3	63.5
3 1/2"	1/2"	4 1/16	6 5/16	3	69.4
4 "	1/2"	4 9/16	6 13/16	3	74.9
5"	1/2"	5 5/8	7 13/16	3	86.7
6"	5/8"	6 3/4	9 1/2	3 3/4	162
8"	5/8"	8 3/4	11 1/2	3 3/4	200.4
10"	3/4"	10 7/8	13 13/16	4	364.6
12"	7/8"	12 7/8	16 1/16	4 1/4	561.7
14"	7/8"	14 1/8	17 5/16	4 1/4	619.8
16"	7/8"	16 1/8	19 5/16	4 1/4	676.6
18"	1"	18 1/8	21 11/16	4 3/4	1040
20"	1"	20 1/8	23 11/16	4 3/4	1130
24"	1"	24 1/8	27 11/16	4 3/4	1330
30"	1"	30 1/8	33 11/16	4 3/4	1620
36"	1"	36 1/8	39 11/16	4 3/4	1900

AVAILABLE MATERIALS

- Plain Finish
- Zinc Plated
- Stainless Steel
- Above U-Bolts furnished with 2 nuts assembled.
- Rubber Coated available upon request.



U-Bolt, Round Bend

ANSI B16.5 BOLTING CHART

ANSI 150 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	1/2	4	2 1/4	-	-
3/4	1/2	4	2 1/2	-	-
1	1/2	4	2 1/2	3	R15
1 1/4	1/2	4	2 3/4	3 1/4	R17
1 1/2	1/2	4	2 3/4	3 1/4	R19
2	5/8	4	3 1/4	3 3/4	R22
2 1/2	5/8	4	3 1/2	4	R25
3	5/8	4	3 1/2	4 1/4	R29
3 1/2	5/8	8	3 1/2	4 1/4	R33
4	5/8	8	3 1/2	4 1/4	R36
5	3/4	8	3 3/4	4 1/2	R40
6	3/4	8	4	4 1/2	R43
8	3/4	8	4 1/4	4 3/4	R48
10	7/8	12	4 3/4	5 1/4	R52
12	7/8	12	4 3/4	5 1/2	R56
14	1	12	5 1/4	6	R59
16	1	16	5 1/2	6	R64
18	1 1/8	16	6	6 1/2	R68
20	1 1/8	20	6 1/4	7	R72
22	1 1/4	20	6 1/2	7 1/4	R80
24	1 1/4	20	7	7 3/4	R76

ANSI B16.5 BOLTING CHART

ANSI 300 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	1/2	4	2 1/2	3	R11
3/4	5/8	4	3	3 1/4	R13
1	5/8	4	3 1/4	3 1/4	R16
1 1/4	5/8	4	3 1/4	3 3/4	R18
1 1/2	3/4	4	3 1/2	4	R20
2	5/8	8	3 1/2	4 1/4	R23
2 1/2	3/4	8	4	4 1/2	R26
3	3/4	8	4 1/4	5	R31
3 1/2	3/4	8	4 1/4	5	R34
4	3/4	8	4 1/2	5 1/4	R37
5	3/4	8	4 3/4	5 1/4	R41
6	3/4	12	4 3/4	5 3/4	R45
8	7/8	12	5 1/2	6 1/4	R49
10	1	16	6 1/4	7 1/4	R53
12	1 1/8	16	6 3/4	7 1/2	R57
14	1 1/8	20	7	7 3/4	R61
16	1 1/4	20	7 1/2	8 1/4	R65
18	1 1/4	24	7 3/4	8 1/2	R69
20	1 1/4	24	8 1/4	9 1/4	R73
22	1 1/2	24	8 3/4	9 3/4	R81
24	1 1/2	24	9 1/4	10 1/4	R77

ANSI B16.5 BOLTING CHART

ANSI 400 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	1/2	4	3	3	R11
3/4	5/8	4	3 1/2	3 1/2	R13
1	5/8	4	3 1/2	3 1/2	R16
1 1/4	5/8	4	3 3/4	3 3/4	R18
1 1/2	3/4	4	4 1/4	4 1/4	R20
2	5/8	8	4 1/4	4 1/4	R23
2 1/2	3/4	8	4 3/4	4 3/4	R26
3	3/4	8	5	5	R31
3 1/2	7/8	8	5 1/2	5 1/2	R34
4	7/8	8	5 1/2	5 1/2	R37
5	7/8	8	5 3/4	5 3/4	R41
6	7/8	12	6	6	R45
8	1	12	6 3/4	6 3/4	R49
10	1 1/8	16	7 1/2	7 1/2	R53
12	1 1/4	16	8	8	R57
14	1 1/4	20	8 1/4	8 1/4	R61
16	1 3/8	20	8 3/4	8 3/4	R65
18	1 3/8	24	9	9	R69
20	1 1/2	24	9 1/2	9 1/2	R73
22	1 5/8	24	10	10 1/2	R81
24	1 3/4	24	10 1/2	11	R77

ANSI B16.5 BOLTING CHART

ANSI 600 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	1/2	4	3	3	R11
3/4	5/8	4	3 1/4	3 1/4	R13
1	5/8	4	3 1/2	3 1/2	R16
1 1/4	5/8	4	3 3/4	3 3/4	R18
1 1/2	3/4	4	4 1/4	4 1/4	R20
2	5/8	8	4 1/4	4 1/2	R23
2 1/2	3/4	8	5	5 1/4	R26
3	3/4	8	5	5 1/4	R31
3 1/2	7/8	8	5 1/2	5 1/2	R34
4	7/8	8	5 3/4	6	R37
5	1	8	6 1/2	6 1/2	R41
6	1	12	6 3/4	7	R45
8	1 1/8	12	7 3/4	8	R49
10	1 1/4	16	8 1/2	8 3/4	R53
12	1 1/4	20	8 3/4	9	R57
14	1 3/8	20	9 1/4	9 1/2	R61
16	1 1/2	20	10	10 1/4	R65
18	1 5/8	20	10 3/4	11	R69
20	1 5/8	24	11 1/2	11 3/4	R73
22	1 3/4	24	12	12 1/2	R81
24	1 7/8	24	13	13 1/2	R77

ANSI B16.5 BOLTING CHART

ANSI 900 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	3/4	4	4	4 1/4	R12
3/4	3/4	4	4 1/4	4 1/2	R14
1	7/8	4	4 3/4	5	R16
1 1/4	7/8	4	5	5	R18
1 1/2	1	4	5 1/4	5 1/2	R20
2	7/8	8	5 1/2	5 3/4	R24
2 1/2	1	8	6 1/4	6 1/4	R27
3	7/8	8	5 1/2	5 3/4	R31
4	1 1/8	8	6 1/2	6 3/4	R37
5	1 1/4	8	7 1/2	7 1/2	R41
6	1 1/8	12	7 1/2	7 3/4	R45
8	1 3/8	12	8 1/2	8 3/4	R49
10	1 3/8	16	9	9 1/4	R53
12	1 3/8	20	9 3/4	10	R57
14	1 1/2	20	10 1/2	11	R62
16	1 5/8	20	11	11 1/2	R66
18	1 7/8	20	12 3/4	13 1/4	R70
20	2	20	13 1/2	14 1/4	R74
24	2 1/2	20	17	18	R78

ANSI B16.5 BOLTING CHART

ANSI 1500 LB

NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	3/4	4	4	4 1/4	R12
3/4	3/4	4	4 1/4	4 1/2	R14
1	7/8	4	4 3/4	5	R16
1 1/4	7/8	4	5	5	R18
1 1/2	1	4	5 1/4	5 1/2	R20
2	7/8	8	5 1/2	5 3/4	R24
2 1/2	1	8	6 1/4	6 1/4	R27
3	1 1/8	8	6 3/4	7	R35
4	1 1/4	8	7 1/2	7 3/4	R39
5	1 1/2	8	9 3/4	9 3/4	R44
6	1 3/8	12	10	10 1/2	R46
8	1 5/8	12	11 1/4	11 3/4	R50
10	1 7/8	12	13 1/4	13 1/2	R54
12	2	16	14 3/4	15 1/4	R58
14	2 1/4	16	16	16 3/4	R63
16	2 1/2	16	17 1/2	18 1/2	R67
18	2 3/4	16	19 1/4	20 1/4	R71
20	3	16	21	22 1/4	R75
24	3 1/2	16	24	25 1/2	R79

ANSI B16.5 BOLTING CHART

ANSI 2500 LB					
NOMINAL PIPE SIZE	DIAMETER OF STUDS	NO. OF STUDS	STUD BOLT LENGTHS		RING JOINT GASKET NO.
			RAISED FACED	RING JOINT	
1/2	3/4	4	4 3/4	4 3/4	R13
3/4	3/4	4	4 3/4	5	R16
1	7/8	4	5 1/4	5 1/2	R18
1 1/4	1	4	6	6	R21
1 1/2	1 1/8	4	6 1/2	6 3/4	R23
2	1	8	6 3/4	7	R26
2 1/2	1 1/8	8	7 3/4	8	R28
3	1 1/4	8	8 1/2	9	R32
4	1 1/2	8	9 3/4	10 1/4	R38
5	1 3/4	8	11 3/4	12 1/4	R42
6	2	8	13 1/2	14	R47
8	2	12	15	15 1/2	R51
10	2 1/2	12	19	20	R55
12	2 3/4	12	21	22	R60

API FLANGE BOLTING CHART

2,000 LB W.P.				
NOMINAL SIZE	**GASKET API NUMBER**	**NUMBER OF STUDS**	**STUD BOLT DIAMETER**	**STUD BOLT LENGTH**
2 1/16	R23	8	5/8	4 1/2
2 9/16	R26	8	3/4	5
3 1/8	R31	8	3/4	5 1/4
4 1/16	R37	8	7/8	6
5 1/8	R41	8	1	6 3/4
7 1/16	R45	12	1	7
9	R49	12	1 1/8	8
11	R53	16	1 1/4	8 3/4
13 5/8	R57	20	1 1/4	9
16 3/4	R65	20	1 1/2	10 1/4
21 1/4	R73	24	1 5/8	11 3/4
26 3/4	BX167	20	1 3/4	13 3/4

API FLANGE BOLTING CHART

3,000 LB W.P.				
NOMINAL SIZE	**GASKET API NUMBER**	**NUMBER OF STUDS**	**STUD BOLT DIAMETER**	**STUD BOLT LENGTH**
3 1/8	R31	8	7/8	6
4 1/16	R37	8	1 1/8	7
5 1/8	R41	8	1 1/4	7 3/4
7 1/16	R45	12	1 1/8	8
9	R49	12	1 3/8	9
11	R53	16	1 3/8	9 1/2
13 5/8	R57	20	1 3/8	10 1/4
16 3/4	R66	20	1 5/8	11 3/4
20 3/4	R74	20	2	14 1/2
26 3/4	BX168	24	2	17

API FLANGE BOLTING CHART

	5,000 LB W.P.			
NOMINAL SIZE	**GASKET API NUMBER**	**NUMBER OF STUDS**	**STUD BOLT DIAMETER**	**STUD BOLT LENGTH**
2 1/16	R24	8	7/8	6
2 9/16	R27	8	1	6 1/2
3 1/8	R35	8	1 1/8	7 1/4
4 1/16	R39	8	1 1/4	8
5 1/8	R44	8	1 1/2	10
7 1/16	R46	12	1 3/8	10 3/4
9	R50	12	1 5/8	12
11	R54	12	1 7/8	13 3/4
13 5/8	BX160	16	1 5/8	12 1/2
16 3/4	BX162	16	1 7/8	14 1/2
18 3/4	BX163	20	2	17 1/2
21 1/4	BX165	24	2	18 3/4

API FLANGE BOLTING CHART

10,000 LB W.P.				
NOMINAL SIZE	GASKET API NUMBER	NUMBER OF STUDS	STUD BOLT DIAMETER	STUD BOLT LENGTH
1 13/16	BX151	8	3/4	5
2 1/16	BX152	8	3/4	5 1/4
2 9/16	BX153	8	7/8	6
3 1/16	BX154	8	1	6 3/4
4 1/16	BX155	8	1 1/8	8
5 1/8	BX169	12	1 1/8	8 3/4
7 1/16	BX156	12	1 1/2	11 1/4
9	BX157	16	1 1/2	13
11	BX158	16	1 3/4	15
13 5/8	BX159	20	1 7/8	17 1/4
16 3/4	BX162	24	1 7/8	17 1/2
18 3/4	BX164	24	2 1/4	22 1/2
21 1/4	BX166	24	2 1/4	24 1/2

API FLANGE BOLTING CHART

15,000 LB W.P.				
NOMINAL SIZE	GASKET API NUMBER	NUMBER OF STUDS	STUD BOLT DIAMETER	STUD BOLT LENGTH
1 13/16	BX151	8	7/8	5 1/2
2 1/16	BX152	8	7/8	6
2 9/16	BX153	8	1	6 3/4
3 1/16	BX154	8	1 1/8	7 1/2
4 1/16	BX155	8	1 3/8	9 1/4
5 1/8	BX169	12	1 1/2	11 1/2
7 1/16	BX156	16	1 1/2	12 3/4
9	BX157	16	1 7/8	15 3/4
11	BX158	20	2	19 1/4
13 5/8	BX159	20	2 1/4	21 1/4
18 3/4	BX164	20	3	26 3/4

API FLANGE BOLTING CHART

20,000 LB W.P.				
NOMINAL SIZE	**GASKET API NUMBER**	**NUMBER OF STUDS**	**STUD BOLT DIAMETER**	**STUD BOLT LENGTH**
1 13/16	BX151	8	1	7 1/2
2 1/16	BX152	8	1 1/8	8 1/4
2 9/16	BX153	8	1 1/4	9 1/4
3 1/16	BX154	8	1 3/8	10
4 1/16	BX155	8	1 3/4	12 1/4
7 1/16	BX156	16	2	17 1/2
9	BX157	16	2 1/2	22 1/2
11	BX158	20	2 3/4	23 3/4
13 5/8	BX159	20	3	30

NOTES

BOLT TORQUE VALUES NOTES

Standard Bolt Torque

1. Tightening torque values from the formula **T=KDP**, where **T** = tightening torque, lb. ft. **K** - torque friction coefficient, **D** = nominal bolt diameter, in.; and **P** = bolt clamping load developed by tightening, lb.

Note: Dry K = 0.22, Lubed K = 0.17

2. No proof load has been established by ASTM. Value shown in table are assumed at 95% of yield strength.

3. Proof load is the published number that full size headed bolts are tested to. The bolt is stressed up to the proof load value, and if there is no deformation, elongation, or fracture, then the bolt is deemed to have passed. For bolting specifications that do not have a published proof load, it is usually calculated at 92% of ultimate yield strength.

4. Clamp load is also known as preload or initial load in tension on bolt. Clamp load (lb.) is calculated by arbitrarily assuming useable bolt strength is 75% of bolt proof load (PSI) times the stress area (sq. in.) of threaded section of each bolt size. Higher or lower values of clamp load can be used depending on the application requirements and the judgment of the designer. The Maximum Bolt Torque chart is based on these values.

5. It is not generally recommend that bolt stress be above 60,000 psi (60ksi). Extreme operating conditions such as high temperature may reduce bolt yield strength. Caution should be used in these applications.

BOLT TORQUE VALUE NOTES

Gasket Bolt Torque

Gasket Bolt Charts are suggested torque values using ASTM A193 B7 bolting or equal yield strength bolt material and ASME B16.5 raised face flanges.

Charts are based on Friction Factor (K) of 0.17

Use correct size and new bolts, studs, nuts, washers. Multiply torques values by 0.70 for PTFE coated bolting. Lubricate on bolt threads and nut faces with compatible anti-seize. The charts give the torque value for the final pass. After hand tightening, torqueing must follow a cross bolting sequence. There shall be 3 complete passes (30%, 60%, 100% of final pass torque). Once final torque is achieved, a minimum of 2 clockwise passes to be applied until there is no further nut rotation.

ASME B16.20-2017 states that inward bucking of spiral wound gaskets has been identified as a potential problem. It is recommended that inner rings be used.

Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult QUEST. Failure to select proper sealing products could result in property damage and/or serious personal injury.

Ring Type Joint Gasket Bolt Torque

The torque values reprinted in these tables are guidelines only and are the exclusive property of API.

Note: Calculations based on K = 0.07 for PTFE (Teflon/Xylan) coatings and K = 0.13 for commonly available anti-seize lubricants.

All values are approximate. No assumption of liability by API or Quest is implied or assumed for the use of this information.

MAXIMUM BOLT TORQUE VALUES

ALLOY STEEL BOLT ASTM A193 B7, A320 L7

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	Tensile Stress Area (Sq. Inch)	Yield Strength = 105 ksi Bolt Stress = 75 ksi		
			Clamp Load P. Lbs.	Dry FT-LB Torque	Lubed FT-LB Torque
1/2	13	0.142	10,616	97	75
5/8	11	0.226	16,908	194	150
3/4	10	0.334	25,022	344	266
7/8	9	0.462	34,544	554	428
1	8	0.606	45,317	831	642
1 1/8	8	0.790	59,136	1,220	942
1 1/4	8	1.000	74,791	1,714	1,324
1 3/8	8	1.234	92,281	2,326	1,798
1 1/2	8	1.492	111,609	3,069	2,372
1 5/8	8	1.775	132,772	3,955	3,057
1 3/4	8	2.082	155,771	4,998	3,862
1 7/8	8	2.414	180,607	6,208	4,797
2	8	2.771	207,279	7,600	5,873
2 1/4	8	3.557	266,131	10,978	8,483
2 1/2	8	4.442	332,328	15,232	11,770

MAXIMUM BOLT TORQUE VALUES

ALLOY STEEL BOLT ASTM A193M B7M, A320 L7M

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	Tensile Stress Area (Sq. Inch)	Yield Strength = 80 ksi Bolt Stress = 57 ksi		
			Clamp Load P. Lbs.	Dry FT-LB Torque	Lubed FT-LB Torque
1/2	13	0.142	8,088	74	57
5/8	11	0.226	12,882	148	114
3/4	10	0.334	19,064	262	203
7/8	9	0.462	26,319	422	326
1	8	0.606	34,527	633	489
1 1/8	8	0.790	45,056	929	718
1 1/4	8	1.000	56,983	1,306	1,009
1 3/8	8	1.234	70,310	1,772	1,370
1 1/2	8	1.492	85,035	2,338	1,807
1 5/8	8	1.775	101,159	3,014	2,329
1 3/4	8	2.082	118,683	3,808	2,942
1 7/8	8	2.414	137,605	4,730	3,655
2	8	2.771	157,927	5,791	4,475
2 1/4	8	3.557	202,766	8,364	6,463
2 1/2	8	4.442	253,202	11,605	8,968

MAXIMUM BOLT TORQUE VALUES

LARGE DIAMETER

ALLOY STEEL BOLT ASTM A193 B7, A320, L43

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	Tensile Stress Area (Sq. Inch)	Yield Strength = 95 ksi Yield Strength Recommended: 84.5 ksi Bolt Stress = 60 ksi		
			Clamp Load P. Lbs.	Dry FT-LB Torque	Lubed FT-LB Torque
2 3/4	8	5.425	326,628	16,692	12,725
3	8	6.506	391,722	21,839	16,648
3 1/4	8	7.686	462,727	27,947	21,305
3 1/2	8	8.963	539,643	35,099	26,757
3 3/4	8	10.339	622,469	43,378	33,069
4	8	11.813	711,206	52,866	40,302

MAXIMUM BOLT TORQUE VALUES

LARGE DIAMETER BOLTS

ALLOY STEEL BOLT ASTM A193M B7M

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	Tensile Stress Area (Sq. Inch)	Yield Strength = 80 ksi Bolt Stress = 57 ksi		
			Clamp Load P. Lbs.	Dry FT-LB Torque	Lubed FT-LB Torque
2 3/4	8	5.425	309,234	15,591	12,047
3	8	6.506	370,861	20,397	15,762
3 1/4	8	7.686	438,085	26,103	20,170
3 1/2	8	8.963	510,904	32,783	25,332
3 3/4	8	10.339	589,320	40,516	31,308
4	8	11.813	673,332	49,378	38,155

SUGGESTED BOLT TORQUE VALUES AT CORRESPONDING BOLT STRESSES

ALLOY STEEL BOLTS: ASTM A193 B7, A320 L7, A193M B7M, A320 L7M

See Bolt Torque Value Notes

Stud Dia (Inches)	Threads Per Inch	Tensile Stress Area (Sq. Inch)	Bolt Stress = 60 ksi		Bolt Stress = 45 ksi	
			Tension F (lbf)	Lubed Torque (ft-lbf)	Tension F (lbf)	Lubed Torque (ft-lbf)
1/2	13	0.142	8,514	60	6,385	45
5/8	11	0.226	13,560	120	10,170	90
3/4	10	0.334	20,068	213	15,051	160
7/8	9	0.462	27,704	343	20,778	258
1	8	0.606	36,345	515	27,259	386
1 1/8	8	0.790	47,427	756	35,570	567
1 1/4	8	1.000	59,982	1,062	44,987	797
1 3/8	8	1.234	74,010	1,442	55,508	1,081
1 1/2	8	1.492	89,511	1,902	67,133	1,427
1 5/8	8	1.775	106,484	2,451	79,863	1,839
1 3/4	8	2.082	124,929	3,097	93,697	2,323
1 7/8	8	2.414	144,848	3,848	108,636	2,886
2	8	2.771	166,238	4,710	124,679	3,533
2 1/4	8	3.557	213,438	6,803	160,079	5,103
2 1/2	8	4.442	266,528	9,440	199,896	7,080

SUGGESTED BOLT TORQUE VALUES AT CORRESPONDING BOLT STRESSES

ALLOY STEEL BOLTS: ASTM A193 B7, A320 L7, A193M B7M, A320 L7M

See Bolt Torque Value Notes

Stud Dia (Inches)	Threads Per Inch	Tensile Stress Area (Sq. Inch)	Bolt Stress = 30 ksi		Bolt Stress = 25 ksi ⚠ (Low Torque)	
			Tension F (lbf)	Lubed Torque (ft-lbf)	Tension F (lbf)	Lubed Torque (ft-lbf)
1/2	13	0.142	4,257	30	3,547	25
5/8	11	0.226	6,780	60	5,650	50
3/4	10	0.334	10,034	107	8,362	89
7/8	9	0.462	13,852	172	11,543	143
1	8	0.606	18,172	257	15,144	215
1 1/8	8	0.790	23,714	378	19,761	315
1 1/4	8	1.000	29,991	531	24,993	443
1 3/8	8	1.234	37,005	721	30,838	601
1 1/2	8	1.492	44,755	951	37,296	793
1 5/8	8	1.775	53,242	1,226	44,368	1,021
1 3/4	8	2.082	62,465	1,549	52,054	1,291
1 7/8	8	2.414	72,424	1,924	60,353	1,603
2	8	2.771	83,119	2,355	69,266	1,963
2 1/4	8	3.557	106,719	3,402	88,933	2,835
2 1/2	8	4.442	133,264	4,720	111,053	3,933

API FLANGE (RTJ) SUGGESTED BOLT TORQUE VALUES

BOLTING TORQUE VALUES RECOMMENDED BY API-6A 20th EDITION

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	ASTM A193/194, A320 (B7, L7) Yield Strength = 105 ksi Bolt Stress = 52.5 ksi		
		Tension F (lbf)	Torque Xylan (ft.-lbf)	Torque Lubed (ft.-lbf)
1/2	13	7,450	35	**59**
5/8	11	11,865	68	**115**
3/4	10	17,559	118	**200**
7/8	9	24,241	188	**319**
1	8	31,802	279	**474**
1 1/8	8	41,499	401	**686**
1 1/4	8	52,484	553	**953**
1 3/8	8	64,759	739	**1,281**
1 1/2	8	78,322	962	**1,677**
1 5/8	8	93,173	1,226	**2,146**
1 3/4	8	109,313	1,534	**2,696**
1 7/8	8	126,741	1,890	**3,332**
2	8	145,458	2,297	**4,061**
2 1/4	8	186,758	3,276	**5,822**
2 1/2	8	233,212	4,500	**8,030**

API FLANGE (RTJ) SUGGESTED BOLT TORQUE VALUES

BOLTING TORQUE VALUES RECOMMENDED BY API-6A 20th EDITION

See Bolt Torque Value Notes

Stud Dia. (inches)	Threads Per Inch (TPI)	ASTM A193M/194M, A320M (B7M, L7M) Yield Strength = 80 ksi Bolt Stress = 40 ksi		
		Tension F (lbf)	Torque Xylan (ft.-lbf)	Torque Lubed (ft.-lbf)
1/2	13	5,676	27	**45**
5/8	11	9,040	52	**88**
3/4	10	13,378	90	**153**
7/8	9	18,469	143	**243**
1	8	24,230	213	**361**
1 1/8	8	31,618	305	**523**
1 1/4	8	39,988	421	**726**
1 3/8	8	49,340	563	**976**
1 1/2	8	59,674	733	**1,278**
1 5/8	8	70,989	934	**1,635**
1 3/4	8	83,286	1,169	**2,054**
1 7/8	8	96,565	1,440	**2,539**
2	8	110,825	1,750	**3,094**
2 1/4	8	142,292	2,496	**4,436**
2 1/2	8	177,685	3,429	**6,118**

SPIRAL WOUND SUGGESTED BOLT TORQUE VALUES

GASKET: STYLE 913M (WITH INNER AND OUTER RINGS)

See Bolt Torque Value Notes

Nominal Pipe Size	150	300	400	600	900	1500	2500
1/2	28	28	---	28	---	80	85
3/4	43	43	---	57	---	100	85
1	50	72	---	86	---	160	125
1 1/4	57	101	---	86	---	200	220
1 1/2	57	151	---	159	---	275	320
2	122	108	---	86	---	200	220
2 1/2	122	144	---	122	---	300	320
3	122	173	---	180	265	400	450
3 1/2	122	202	---	300	---	---	---
4	122	202	325	296	500	650	750
5	202	202	325	448	840	1000	1300
6	202	202	325	448	590	900	2000
8	202	325	506	614	950	1400	2000
10	325	506	614	867	950	2400	3500
12	325	723	867	867	1130	2500	5000
14	506	614	867	1193	1330	3200	
16	506	867	1193	1410	1830	4500	
18	723	1012	1193	1880	3000	6000	
20	723	1012	1410	1880	3000	7730	
24	1012	1410	2603	3471	5000	12750	

KAMMPROFILE SUGGESTED BOLT TORQUE VALUES

GASKET: STYLE 946 (WITH LOOSE LOCATING OUTER RING)

See Bolt Torque Value Notes

Nominal Pipe Size	150	300	400	600	900	1500	2500
1/2	40	40	---	40	---	80	85
3/4	60	65	---	60	---	100	85
1	60	90	---	85	---	160	125
1 1/4	60	105	---	85	---	200	220
1 1/2	60	170	---	160	---	275	320
2	120	90	---	85	---	200	220
2 1/2	120	115	---	160	---	300	320
3	125	160	---	180	265	400	450
3 1/2	120	200	---	300	---	---	---
4	115	200	320	330	500	650	750
5	200	200	320	470	840	1000	1300
6	200	200	320	470	590	900	2000
8	225	320	500	650	950	1400	2000
10	320	500	620	875	950	2400	3500
12	320	710	875	875	1130	2500	5000
14	500	535	875	1020	1330	3200	
16	405	835	1200	1335	1830	4500	
18	650	835	1200	1900	3000	6000	
20	595	835	1400	1900	3000	7730	
24	835	1200	2600	3000	5000	12750	

CORRUGATED METAL SUGGESTED BOLT TORQUE VALUES

GASKET: TEADIT® 905 METALBEST® AND GARLOCK ® GRAPHONIC®

See Bolt Torque Value Notes

Nominal Pipe Size	905 METALBEST®		GRAPHONIC®	
	150	300	150	300
1/2	60	60	37	37
3/4	60	120	60	67
1	60	120	60	89
1 1/4	60	120	60	120
1 1/2	80	200	60	200
2	120	90	120	120
2 1/2	120	130	120	188
3	160	160	120	200
3 1/2	120	200	---	---
4	115	200	120	200
5	230	260	200	200
6	260	210	200	200
8	260	320	200	320
10	420	500	320	490
12	420	710	320	710
14	650	535	490	710
16	405	835	490	1000
18	650	835	710	1000
20	595	835	710	1000
24	835	1300	1000	1600

SHEET GASKETING SUGGESTED BOLT TORQUE VALUES

GASKET: TEADIT® COMPRESSED FIBER, TEALON™, QUIMFLEX 24SH, FLEXIBLE GRAPHITE 2660, 2661, 2663, AND GARLOCK® COMPRESSED FIBER AND GYLON® GASKETS

See Bolt Torque Value Notes

Nominal Pipe Size	TEADIT®		GARLOCK®	
	150	300	150	300
1/2	28	28	28	28
3/4	43	43	40	51
1	50	72	53	67
1 1/4	57	101	60	102
1 1/2	57	151	60	151
2	122	108	120	108
2 1/2	122	144	120	141
3	122	173	120	200
3 1/2	122	202	120	200
4	122	202	120	200
5	202	202	200	200
6	202	202	200	200
8	202	325	200	320
10	325	506	320	490
12	325	723	320	710
14	506	614	490	652
16	506	867	490	912
18	723	1012	710	1000
20	723	835	710	1000
24	1012	1410	1000	1552

INSULATION GASKET SUGGESTED BOLT TORQUE VALUES

See Bolt Torque Value Notes

Nominal Size	150	300	400	600	900	1500	2500
1	40	80	80	80	110	110	170
1 1/4	40	80	110	110	170	170	300
1 1/2	40	110	110	110	240	240	400
2	80	110	110	110	170	170	300
2 1/2	80	150	150	150	240	240	400
3	110	150	150	150	215	370	600
3 1/2	80	150	180	200			
4	100	180	180	225	450	650	650
5	120	180	215	350	650	1000	1500
6	130	170	215	320	455	820	2300
8	130	265	320	450	820	1400	2400
10	215	320	450	650	850	2100	4900
12	220	450	650	675	870	2300	7900
14	320	450	625	820	1125	3400	
16	320	650	820	1125	1430	4300	
18	450	650	820	1430	2230	6200	
20	450	650	1100	1400	2300	7800	
22	460	1125	1425	1775			
24	650	1200	1775	2230	5500	13000	
26	650	1400	1750	2200	7400		
28	650	1500	2200	2300	8400		
30	650	1700	2300	2360	9500		
32	1000	2000	2300	3900	10500		
34	1000	2250	2350	3950	12400		
36	1100	2300	2350	5500	13800		
38		2300	4800	7000			
40	1100	2400	5200	7200			
42	1150	2400	5500	7400			

INSULATION GASKET SUGGESTED BOLT TORQUE VALUES

Pressure	150	300	400	600	900	1500	2500
Operating	285	740	990	1480	2220	3705	6170
Hydro Test	455	1135	1510	2245	3355	5585	9280

Torque Values obtained based on above Working and Hydro Test Pressures (psi)

BOLT TORQUE SEQUENCE NOTES

When Installing the gasket and tightening cold, refer to Bolt Torque Sequence Charts. "Hot Flow" of the gasket material may occur under operating conditions, resulting in loss of Bolt Pressure. It is advisable therefore, to re-tighten bolts after operating temperature has been reached - preferably at Zero Line Pressure and Ambient Temperature. Under no circumstances should the system be allowed to return to operating Temperature WITHOUT re-checking and re-tightening bolts where needed.

To provide even sealing pressure on a flange gasket kit it is recommended that the bolts be "snugged" up in the sequence shown until the flange faces are in contact with the gasket. After the flange faces are in contact with the gasket, firmly tighten the bolts in the same sequence.

Note: G10/Viton or G10/Teflon Gaskets do not grease seal prior to installation.

QUEST

4 TO 20 HOLE, BOLT TORQUE SEQUENCE

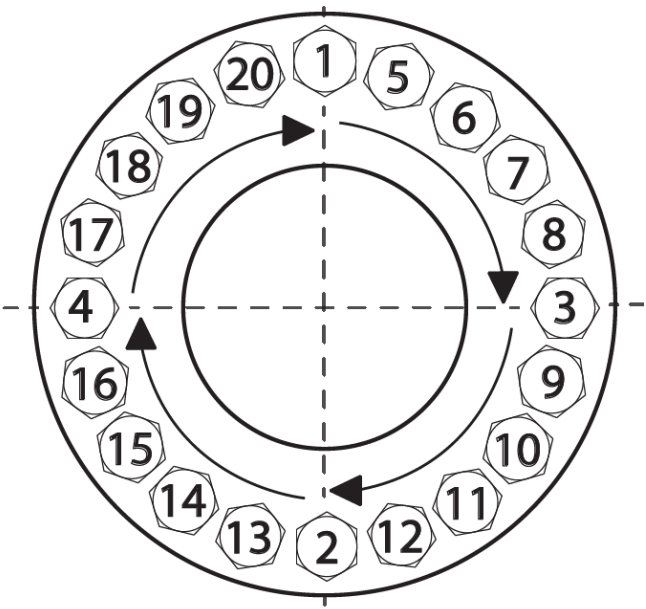
Number bolts or flange holes with a “marker” as shown in the diagram.

Install each bolt with their nuts, washers and hand tighten the nuts following the numerical sequence of the diagram. The flanges should be parallel and contacting uniformly across the gasket. If tools are used to bring the flanges together the maximum force should be equal or less than 10% of the target force. The stud length should have at least two threads protrude beyond the nut.

Steps:

1. Tighten studs 1, 2, 3 and 4 with 30% of the final torque or force. Ensure the flanges are parallel.
2. Tighten studs 1, 2, 3 and 4 with 60% of the final torque or force. Ensure the flanges are parallel.
3. Tighten studs 1, 2, 3 and 4 with 100% of the final torque or force. Ensure the flanges are parallel.
4. Tighten all studs with 100% of the final torque or force in a circular pass. Ensure the flanges are parallel.
5. Repeat the fourth (4) step until the nuts no longer turn.

4 TO 20 HOLE, BOLT TORQUE SEQUENCE



QUEST

24 HOLE, BOLT TORQUE SEQUENCE

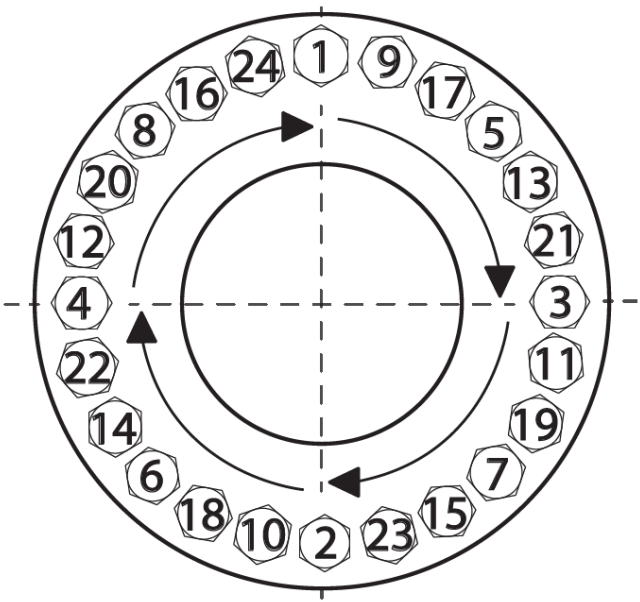
Number bolts or flange holes with a “marker” as shown in the diagram.

Install each bolt with their nuts, washers and hand tighten the nuts following the numerical sequence of the diagram. The flanges should be parallel and contacting uniformly across the gasket. If tools are used to bring the flanges together the maximum force should be equal or less than 10% of the target force. The stud length should have at least two threads protrude beyond the nut.

Steps:

1. Tighten all studs in the numerical sequence as shown with 30% of the final torque or force. Ensure the flanges are parallel.
2. Tighten all studs in the numerical sequence as shown with 60% of the final torque or force. Ensure the flanges are parallel.
3. Tighten all studs in the numerical sequence as shown with 100% of the final torque or force. Ensure the flanges are parallel.
4. Tighten all studs with 100% of the final torque or force in a circular pass. Ensure the flanges are parallel.
5. Repeat the fourth (4) step until the nuts no longer turn.

24 HOLE, BOLT TORQUE SEQUENCE



QUEST

24 OR MORE HOLE, BOLT TORQUE SEQUENCE

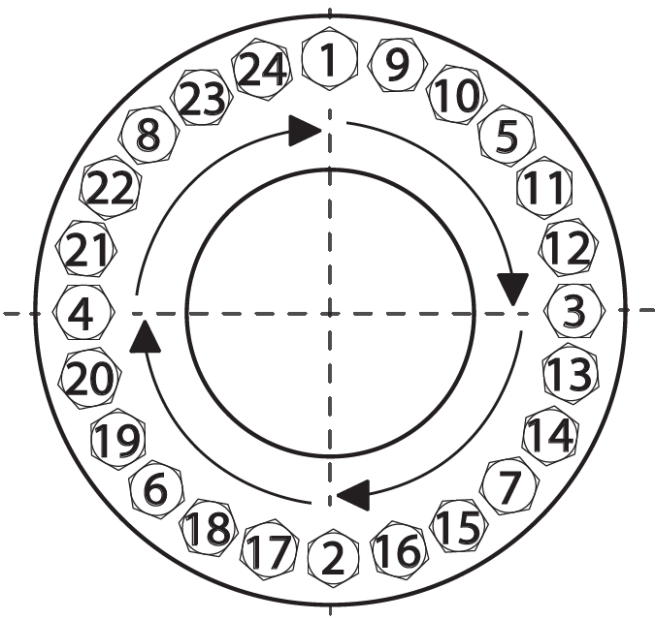
Number bolts or flange holes with a “marker” as shown in the diagram.

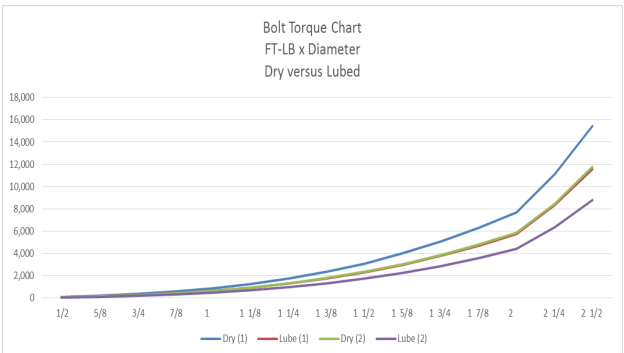
Install each bolt with their nuts, washers and hand tighten the nuts following the numerical sequence of the diagram. The flanges should be parallel and contacting uniformly across the gasket. If tools are used to bring the flanges together the maximum force should be equal or less than 10% of the target force. The stud length should have at least two threads protrude beyond the nut.

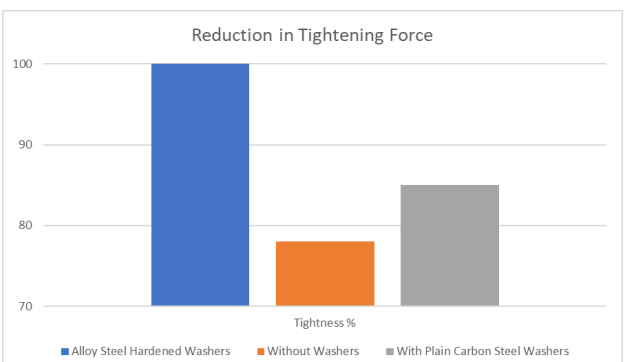
Steps:

1. Tighten studs 1, 2, 3, 4, 5, 6, 7 and 8 with 30% of the final torque or force. Ensure the flanges are parallel.
2. Tighten studs 1, 2, 3, 4, 5, 6, 7 and 8 with 60% of the final torque or force. Ensure the flanges are parallel.
3. Tighten studs 1, 2, 3, 4, 5, 6, 7 and 8 with 100% of the final torque or force. Ensure the flanges are parallel.
4. Tighten all studs with 100% of the final torque or force in a circular pass. Ensure the flanges are parallel.
5. Repeat the fourth (4) step until the nuts no longer turn.

24 OR MORE HOLE, BOLT TORQUE SEQUENCE




Bolt Torque Chart
FT-LB x Diameter
Dry versus Lubed
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1/2
5/8
3/4
7/8
1
1 1/8
1 1/4
1 3/8
1 1/2
1 5/8
1 3/4
1 7/8
2
2 1/4
2 1/2
Dry (1)
Lube (1)
Dry (2)
Lube (2)


Reduction in Tightening Force
100
90
80
70
Tightness %
Alloy Steel Hardened Washers
Without Washers
With Plain Carbon Steel Washers

LUBRICATION AND WASHERS EFFECT ON FRICTION

It is recommended to tighten with a torque wrench using lubricated studs along with hardened washers to reduce friction between the threads on the stud and nut and the flange surface with the nut. The graphs show the reduction in the tightening force when lubricant or washers are used or not.

ANTI-SEIZE

QUEST approved thread lubricants **Piko-Lube™** and **JET-LUBE® 550®** are available. They are used as part of our best practices Bolted Joint Integrity program. These products are non-metallic, lead free, high-temperature, heavy duty anti-seize and lubricating compounds.

GASKET NOTES

The following pages provide general information on different types of available gasket materials. These include:

- Metal Gaskets: Ring Type Joint
- Semi-Metallic Gaskets: Kammprofile, Spiral Wound, Corrugated Metal, and Double Jacketed
- Soft Gaskets: Elastomers, Compressed Fiber, Graphite, Teflon, Tealon, and Expanded PTFE
- Insulation Gaskets: Phenolic, G10-Viton, G10-Teflon, VCS G10-316SS-Teflon

Important note:

* Consult material data sheets to determine specific pressure, temperature and chemical resistance. Properties and application parameters shown are typical. Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult with Quest. Failure to select proper sealing products could result in property damage and/or serious personal injury.

NOTES

Style R - Oval and Octagonal:

The octagonal cross section has a higher sealing efficiency than the oval and would be the preferred gasket. Only oval cross section can be used in the old type round bottom groove. The newer flat bottom groove design will accept either the oval or the octagonal cross section. They seal by an initial line contact or a wedging action as the compressive forces are applied. The hardness of the ring should always be less than the hardness of the flanges.

Style BX and RX:

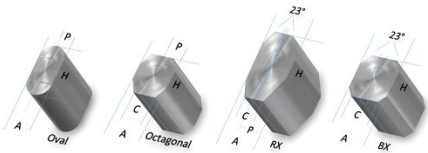
The BX ring gasket differs from the standard oval or octagonal shape in that it is square in cross section and tapers in each corner. BX can only be used in API 6BX flanges. RX ring gaskets are similar in shape to the standard octagonal ring joint gasket but their cross section is designed to take advantage of the contained fluid pressure in effecting a seal.

Rubber Coated Test Ring

This is a Ring Joint gasket totally enclosed in a Nitrile rubber coating. The Ring Joint gasket material is usually soft iron or low carbon steel. This gasket is designed for multiple uses as a test ring.

Eco—Test Ring

Quest was first to introduced a new flange test seal, which is both superior in performance to rubber seals and capable of being reused 10 x more than the conventional test rings, thus saving on costs. Eco—Test Rings fits all standard R, RX and BX housings and is available in any diameter.

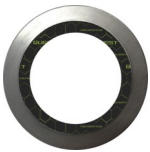


Material	Designation	Temperature Minimum (°C)	Temperature Maximum (°C)	Maximum Hardness Rockwell B	Maximum Hardness Brinell
Soft Iron	D/S*	-40	500	56	90
Soft Iron	D	-40	500	56	90
Low Carbon Steel	S	-40	500	68	120
304 SS	304	-250	550	83	160
316 SS	316	-100	550	83	160
347 SS	347	-250	500	83	160
625	625	-50	450	89	180
825	825	-100	450	92	195

* D/S dual stamped ring joint gaskets meet the maximum hardness specification for D and can be used in applications where S designated ring type joint gaskets are used based on hardness requirements. Where S is the only stamp, they can not be used in applications requiring D designated hardness requirements.

Rubber Coat Material	Hardness Shore A Durometer	Tensile Strength (psi)	Ultimate Elongation (%)	Compression Set	Temperature
Nitrile (NBR)	80	1000 min.	350 min.	22 hrs. @ 100°C 40% max	-30 to 190°F -34 to 88°C
Eco Test Material	**Hardness Shore A Durometer**	**Density g/cm³**	**Tensile Strength N/ mm²**	**Elongation %**	**Temperature**
Eco-Ring Test	95	1.2	50	330	-4 to 230°F -20 to 110°C

QUEST



QUESTPRO™ KAMMPROFILE

Kammprofile Gaskets consist of a stainless metal core, with concentric grooves on either side. A sealing layer is applied to both faces and depending on the service the material for this layer can be Graphite, ePTFE, or a Hi-Temp Sheet material.

QUESTFLEX® SPIRAL WOUND

Spiral Wound Gaskets consist of a 'V' shaped metal strip spirally wound in combination with a soft filler material, Graphite, PTFE or Hi-Temp. The metal strip provides outstanding recovery as the flexible filler ensures excellent sealing. Depending on the application the gasket can be specified with outer and/or inner rings.

	Kammprofile Gaskets	Spiral Wound Gaskets
Tightness	Excellent	Excellent
Handling	Excellent	Average
Thermal Cycling	Excellent	Good
Low Seating Stress	Excellent	Average
High Seating Stress	Excellent	Excellent
Narrow Flange Width	Excellent	Average
Emissions	Excellent	Excellent

CORRUGATED METAL

Corrugated Metal Gaskets consist of a corrugated stainless metal core, 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.

METAL JACKETED

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.

	Corrugated Gaskets	Metal Jacketed Gaskets
Tightness	Excellent	Average
Handling	Good	Excellent
Thermal Cycling	Excellent	Average
Low Seating Stress	Excellent	Average
High Seating Stress	Good	Good
Narrow Flange Width	Average	Excellent
Emissions	Excellent	Average

SEMI-METALLIC MATERIAL INFORMATION

Filler or Facing Material	Temperature (°C)		Maximum Operating Pressure (psi)
	Minimum	Maximum	
GRAPHITE	-200	450	5,800
APX-2 GRAPHITE	-200	500	5,800
QUIMFLEX® PTFE	-200	260	2,175
HI-TEMP COGEBIMICA®	-200	1000	290
HI-TEMP + APX-2	-200	800	1,450

Material (Trade Name)	Identification	Temperature (°C)	
		Minimum	Maximum
Low Carbon Steel	S	-40	500
Stainless Steel 304	304	-250	550
Stainless Steel 304 L	304L	-250	550
Stainless Steel 316	316	-100	550
Stainless Steel 316 L(1)	316L	-100	550
Stainless Steel 321	321	-250	550
Stainless Steel 347	347	-250	500
Stainless Steel 410	410	-20	850
Duplex	2205	-40	300
Super Duplex	2507	-40	300
Aluminum	AL 1050	-250	300
Copper	Cu	-250	400
Nickel 200	Ni200	-250	600
Monel 400	400	-125	600
Inconel 600	600	-100	950
Inconel 625	625	-50	450
Incoloy 800	800	-100	850
Incoloy 825	825	-100	450
Hastelloy B2	B2	-200	450
Hastelloy C276	C276	-200	450
Titanium	Ti2	-250	350

SEATING STRESS RANGE (20°C)

Kammprofile (Camprofile)		psi	
Layer Material	Minimum	Optimum	Maximum
Graphite	2900	13000	58000
PTFE	2900	13000	50000
Hi-Temp	5800	14500	36250

Spiral Wound Single Side Confined		psi	
Filler	Minimum	Optimum	Maximum
Graphite	7250	13800	26000
PTFE	7250	11600	20000
Hi-Temp	8000	13800	20000

Spiral Wound Both Sides Confined		psi	
Filler	Minimum	Optimum	Maximum
Graphite	7250	17400	58000
PTFE	7250	16000	36250
Hi-Temp	8000	17400	36250

Corrugated Metal Gaskets		psi	
Layer Material	Minimum	Optimum	Maximum
Graphite or PTFE	2900	10000	29000

Double Jacket		psi	
Material	Minimum	Optimum	Maximum
LCS or Stainless	11600	16000	26000

QUEST

SPIRAL WOUND GASKET COLOR CODE CHART

QUESTFLEX®

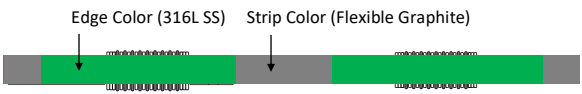
Spiral Wound

FILLER MATERIAL

(EDGE OF GUIDE RING STRIP COLOR)

PTFE	**White Stripe**
Ceramic	**Light Green Stripe**
Flexible Graphite	**Gray Stripe**
Phyllosilicate (HTG)	**Light Blue Stripe**

SPIRAL WOUND GASKET COLOR CODE CHART



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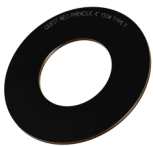
STANDARD WINDING MATERIAL

(EDGE OF GUIDE RING COLOR)

304 SS	Yellow	Incoloy	White
316L SS	Green	Titanium	Purple
317L SS	Maroon	Alloy 20	Black
347 SS	Blue	Carbon Steel	Silver
321 SS	Turquoise	Hastelloy B	Brown
Monel	Orange	Hastelloy C	Beige
Inconel	Gold	Phos. Bronze	Copper
Nickel	Red		



RING TYPE JOINT

The Type D Phenolic Ring Type Joint Gasket is available for ring type joint flanges with pressures up to 15,000 psi.

NITRILE PHENOLIC

The Nitrile Faced Phenolic Gasket is for general service applications. This Isolating Gasket is an excellent economical option.

Retainer Material	Description	Water Absorption %	Tensile Strength PSI
CE	Canvas Phenolic	3.5	12,000
G7	Glass Silicone	.09	22,000
G10	Fiberglass Epoxy	.01	40,000
G11	Fiberglass Epoxy	.20	43,000
XPN	Nitrile Phenolic	1.5	18,000
XP	Phenolic	1.5	18,000

Sealing Material	Min Operating Temperature	
	°F	°C
Nitrile	-60	-51
Viton®	-75	-59
EPDM	-40	-40
Teflon®	-100	-73

QUESTGUARD®

Corrosion Protection

QUEST

QUESTGUARD™ GRE

The QUESTGUARD™ GRE gasket is a excellent performance Isolating Gasket. Generally supplied with a G10 Retainer and Viton or Teflon Sealing Element.

QUESTGUARD™ HP

The QUESTGUARD™ HP is a high performance Isolating Gasket. Supplied with Epoxy Facing on 316SS core and Spring Energized Teflon Sealing Element.

Retainer	Compression	Dielectric Values	Max. Operating
CE	34,000	400	257 °F
G7	40,000	400	400 °F
G10	66,000	800	248 °F
G11	63,000	900	347 °F
XPN	45,000	600	266 °F
XP	45,000	600	266 °F

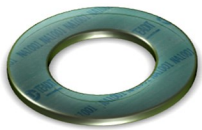
Sealing Material	Max Operating Temperate	
	°F	°C
Nitrile	240	115
Viton®	400	204
EPDM	250	121
Teflon®	450	232

RUBBER

Elastomer Gaskets offer excellent compressibility and recovery. Maximum temperate ranges from 170°F—400°F. Wide variety of chemical compatibility between grades of material.

Major characteristics include:

- High Resilience, being extremely elastic
- Low bolt torque require to seal
- Various polymers with different physical and chemical characteristics



COMPRESSED FIBER

Compressed Fiber gaskets are produced from a combination of fibers and bonded with elastomers to provide flexibility and elasticity. High temperatures and pressure and its low cost compared with performance makes it the product of choice to fabricate industrial gaskets.

Major characteristics include:

- High Resistance to seating stress
- Low creep relaxation
- Wide range of operating temperatures and pressures
- Resistance to an extensive range of chemicals

Properties	Typical Rubber	Typical Non-Asbestos
Maximum Pressure	150 psi	1000 to 2000 psi
Temperature	-40°F to 200°F (Silicone & Viton to 400°F)	-40°F up to 1000°F
Chemical Resistance	Average	Average

Properties shown are typical. See Gasket Notes.

GRAPHITE

Graphite is one of the most reliable sealing materials. It offers excellent resistance to acids, alkaline solutions and organic composites. It has excellent temperature range of –400°F to 5400°F, in reducing or neutral service without contact with Oxygen. For oxidant service the upper limit is 840°F.
Major characteristics include:

- High temperature
- High conformability to flange irregularity
- Excellent chemical resistance

TEFLON

Teflon is the most widely used plastic for industrial sealing. The only products that chemically attack Teflon is liquid alkaline metals and free fluorine. Teflon gaskets are used in services where it is necessary to have a high chemical resistance. Teflon also has excellent properties for electrical insulation, anti-stick, impact resistance and low friction coefficient.

Major characteristics include:

- Excellent Resistance to chemical attack
- Good Temperature
- Excellent electrical Insulation
- Excellent Anti-Stick

Properties	Typical Graphite	Typical Teflon
Maximum Pressure	2000 psi	1200 psi
Temperature	–400°F up to 5400°F Oxidant service to 840°F	–450°F up to 500°F
Chemical Resistance	Good	Excellent

Material	Grade	Hardness Shore A Durometer	Tensile Strength (psi)	Ultimate Elongation (%)	Compression Set	Temperature °F (°C)
Natural (NR)	Industrial	35 +/-5	2500 min.	500 min.	22 hrs. @ 70°C 50% max.	-20 to 180 (-29 to 82)
Red Rubber (SBR)	Commercial	80 +/-5	600 min.	100 min	22 hrs. @ 70°C 50% max.	-20 to 180 (-29 to 82)
Neoprene (CR)	Industrial	65 +/-5	1000 min.	300 min.	22 hrs. @ 100°C 80% max.	-20 to 190 (-29 to 88)
Neo-Nylon (CR)	Industrial	75 +/-5	1400 min.	250 min.	22 hrs. @ 100°C 35% max.	-20 to 212 (-29 to 100)
Nitrile (NBR)	Industrial	65 +/-5	1000 min.	350 min.	22 hrs. @ 100°C 40% max.	-30 to 190 (-34 to 88)
Hydrogenated Nitrile (HNBR)	Premium	70 +/-5	1450 min.	400 min.	70 hrs. @ 150°C 23% max.	-49 to 320 (-49 to 160)

Material	Grade	Hardness Shore A Durometer	Tensile Strength (psi)	Ultimate Elongation (%)	Compression Set	Temperature °F (°C)
Ethylene-Propylene (EPDM)	Industrial	65 +/-5	800 min.	300 min.	22 hrs. @ 70°C 50% max.	-40 to 250 (-40 to 121)
Silicone (SI)	Commercial	60 +/-5	1130 min.	300 min.	70 hrs. @ 150°C 16% max.	-65 to 392 (-54 to 200)
Viton Fluoroelastomer (FKM) 66% Fluorine	Industrial	75 +/-5	1200 min.	225 min.	24 hr. @ 200°C 20% max.	-20 to 350 (-29 to 177)
Viton Fluoroelastomer (FKM) 66% Fluorine	Commercial	75 +/-5	1200 min.	175 min.	24 hr. @ 200°C 20% max.	-20 to 400 (-29 to 204)
Viton Fluroelastomer (FKM) B 68% Fluorine	Premium	80 +/-5	1800 min.	350 min.	24 hr. @ 200°C 20% max.	-20 to 450 (-29 to 232)

PROPERTIES	SERVICE	NA1001	NA1076	NA1080	NA1081	NA1082	NA1085	NA1100	NA1122
Material	Binder	NBR	CR	SBR	NBR	NSF-61	CSM	NBR	NBR
	Fiber	Aramid	Aramid	Aramid	Aramid	Certified	Aramid	Carbon	Inorganic
Temperature °F (°C)	Min.	-40 (-40)	-40 (-40)	-40 (-40)	-40 (-40)	-40 (-40)	-40 (-40)	-40 (-40)	-40 (-40)
Temperature °F (°C)	Continu-ous	460 (240)	392 (200)	500 (260)	500 (260)	500 (260)	392 (200)	518 (270)	800 (430)
Temperature °F (°C)	Max.	750 (400)	700 (370)	716 (380)	750 (400)	750 (400)	460 (240)	840 (450)	1000 (550)
Pressure	Continu-ous	725 (50)	Vacuum to 725 (50)	725 (50)	725 (50)	1160 (80)	725 (50)	1000 (70)	1480 (100)
Pressure	Max.	1595 (110)		1015 (70)	1595 (110)	1595 (110)	1015 (70)	1885 (130)	2177 (150)

ASTM	ASTM METHOD	NA1001	NA1076	NA1080	NA1081	NA1082	NA1085	NA1100	NA1122
Density, g/cm³	---	1.83	1.7	1.96	1.92	1.95	1.7	1.7	1.6
Compressibil-ity %	F-36A	7-17	7-17	7-17	7-17	5-15	5-15	5-15	7-17
Recovery, Minimum %	F-36A	45	46	45	50	50	40	50	40
Tensile Strength, across grain psi	F-152	1670	1740	2030	1820	1740	2030	2175	1305
Ignition Loss %	F-495	34	31	28	26	27	37	50	23.5
Creep Relaxa-tion %	F-38	25	20	22	22	20	26	22	-
Torque Re-tention Mpa	DIN 52913	28	-	37	37	36	28	35	43

PROPERTIES	SERVICE	2900 / 2950	3000	3200 / 3400	3700	3760-U	5500	9800 / 9850	9900
Material	Binder	NBR	NBR	SBR	EPDM	NSF-61	NBR	SBR 9800/ NBR 9850	NBR
	Fiber	Aramid	Aramid	Aramid	Aramid	Proprie-tary	Inorganic	Carbon	Graphite
Temperature °F (°C)	Min.	-100 (-75)	-100 (-75)	-100 (-75)	-100 (-75)	-100 (-75)	-100 (-75)	-100 (-75)	-100 (-75)
Temperature °F (°C)	Continu-ous	400 (205)	401 (205)	400 (205)	400 (205)	400 (205)	550 (290)	650 (340)	650 (340)
Temperature °F (°C)	Max.	700 (370)	701 (370)	700 (370)	700 (370)		800 (425)	900 (480)	1,000 (540)
Pressure	Continu-ous	1,000 (70)	1,000 (70)	1,200 (83)	1,200 (83)	500 (34.5)	1,200 (83)	2,000 (138)	2,000 (138)

QUEST

PROPERTIES	SERVICE	2900 / 2950	3000	3200 / 3400	3700	3760-U	5500	9800 / 9850	9900
Density,	---	1.68	1.6	1.6	1.6	1.36	1.6	1.68	1.76
Compressibil-ity %	F-36A	8	8	10	10	15	10	8	9
Recovery, Minimum %	F-36A	50	50	50	50	40	>50	>55	>55
Tensile Strength, across grain psi	F-152	1500	2150	2250	1800	1000	1,500	1,800	1,800
Creep Relaxa-tion %	F-38	25	21	18	20	30	25	15	9
Sealability	F-37B Fuel A (Nitrogen)	0.5 (1.00)	0.2 (0.6)	0.3 (0.7)	0.3 (0.7)	0.2 (0.40)	0.3 (1.0)	0.3 (0.6)	0.3 (0.6)

SPECIFICATION	ASTM METHOD	3500	3504	3510	3540	3545
Color	---	Fawn	Blue	Off-White	White	White
Composite	---	Silica	Alumino Silicate Microspheres	Barium Sulfate	Microcellular PTFE	Microcellular PTFE w/ Rigid Core
Sealability (ml/hr.)	F-37	0.22	0.12	0.04	0.25	0.15
Creep Relaxation %	F-38	18	40	11	10	15
Compressibility Range %	F-36	7-12	25-45	4-10	70-85	60-70
Recovery %, Minimum	F-36	>40	>30	>40	>8	>15
Tensile Strength (N/mm²)	F-152	14	14	14	---	---

SPECIFICATION	ASTM METHOD	3500	3504	3510	3540	3545
Temperature Limits	---	-450°F (-268°C) to 500°F (260°C)				
Pressure x Temperature (psig x °F (bar x °C), 1/16"	---	350,000 (12,000)				
Pressure x Temperature (psig x °F (bar x °C), 1/8"	---	250,000 (8,600)				

QUEST

PRODUCT DATA FOR GRAPHITE

PROPERTIES	2660 FGS	2661 FGF (FOIL)	2663 FGT (TANG)
Material	Homogenous	0.002 316SS	0.005 316SS
Temperature °F (°C) Minimum	-328 (-200)		
Temperature °F (°C) Maximum In Air	842 (450)		
Temperature °F (°C) Maximum in Steam	1202 (650)		
Temperature °F (°C) Maximum in reducing or inert media	5400 (3000)		
Pressure, psi	2000		
Bulk Density (lbs./ft^3)	62.4		
Compressibility %	45	35	35
Recovery %	20	18	18
Tensile Strength, psi	650	5000	5000
Creep Relaxation	5	12	10
Carbon Content	98% min.		
Sulfur	$\leq$ 750 ppm max.		
Leachable Chlorides, ppm	<30		

PRODUCT DATA FOR GRAPHITE-KEVLAR

PROPERTIES	NOVATEC 825F	NOVATEC 925F	NOVATEC XP
Material	Graphite-Kevlar	Graphite-Kevlar	Graphite-Kevlar
Color	Cranberry	Grape	Blue
Temperature °F (°C) Minimum	-40 (-40)	-40 (-40)	-40 (-40)
Temperature °F (°C) Maximum	825 (440)	925 (500)	1000 (540)
Pressure, psi	1500	2000	2500
Bulk Density (lbs./ft^3)	62	98	109
Compressibility %	45	12	7
Recovery %	10	43	60
Tensile Strength, psi	600	1500	2300
Leachable Chlorides, ppm	<100		

QUEST

PRODUCT DATA FOR QUIMFLEX 24 SH

Expanded Teflon

SPECIFICATION	ASTM	VALUES
Temperature Limits	-450°F to 500°F	
Pressure Limits	Vacuum to 2900 psi	
pH Range	0-14 except molten alkali metals and elemental fluorine	
FDA/USDA	Approved	
Specific Gravity	---	0.85
Compressibility %	F-36	45
Recovery %	F-36	14
Sealability (ml/hr. Leakage) Fuel A	F-37B	0
Sealability (ml/hr. Leakage) Nitrogen	F-37B	0.02
Creep Relaxation % @ 212°F	F-38	32
Creep Relaxation % @ 73°F	F-38	16

Restructured Teflon

PRODUCT DATA FOR TEALON™

SPECIFICATION	ASTM METHOD	TEALON 1570	TEALON 1580	TEALON 1590
Temperature Limits	---	-350°F (-210°C) to 500°F (260°C)		
Pressure x Temperature (psig x °F (bar x °C), 1/16"	---	350,000 (12,000)		
Pressure x Temperature (psig x °F (bar x °C), 1/8"	---	250,000 (8,600)		
Color	---	Blue	Bone - White	Fawn
Composite	---	Glass	Barium Sulfate	Silica
Sealability (ml/hr.)	F-37	0.12	0.04	0.2
Creep Relaxation %	F-38	40	24	18
Compressibility Range %	F-36	30-50	4-10	7-12
Recovery %, Minimum	F-36	30	40	40
Tensile Strength (N/mm^2)	F-152	14	14	14

*ASTM tests based on 0.8mm (1/32")

EXPANDED PTFE JOINT SEALANT TAPE

TEADIT 24B , 24BB and 25BI are a non-asbestos gasket material made from pure, expanded, virgin PTFE. The expanded PTFE products have unique strength and pressure resistance, without the cold flow and creep characteristics of the sintered PTFE.

TEADIT 24B Joint Sealant Tape

Because of the excellent thermal and chemical resistance of **TEADIT 24 B,** it can be used in a wide variety of static applications in nearly all kinds of the industry. The exceptional malleability of expanded PTFE can compensate for out-of-parallel and/or damaged sealing surfaces and allows use with stress sensitive connections and applications where only a limited flange load is available, for example, plastic and glass flanges.

Typical applications are the sealing of flanges, pump housings, compressors, handhole and manholes, air ducts, compensators, heat exchangers and many more.

TEADIT 24BB Gasket Tape

Gaskets can be cut and/or punched from **TEADIT 24 BB**, which can be installed in areas where there is not enough room to install a gasket tape like TEADIT 24B.

Typical applications are the sealing of flanges, housings of pumps, gearboxes and compressors, handhole and manholes, air ducts, compensators, heat exchangers, chemical reactors, and many more.

EXPANDED PTFE JOINT SEALANT TAPE

TEADIT 25 BI—Multi Directional Expanded Gasket Tape

Due to its excellent malleability and adaptability – 25 BI is particularly well suited to compensate for irregularities or damages on the sealing areas, as well as for all stress-sensitive joints.

A special manufacturing process results in almost equal tensile strength in both the longitudinal and cross direction. As a result of this, the material does not change its width under compression. This is in stark contrast to normal expanded PTFE tapes! TEADIT 25 BI, because of this property, is extremely well suited as a gasket material for narrow sealing areas and in all applications where a defined gasket width (under load) is required. Typical applications are enameled and glass flanges, heat exchangers, large flanges and containers, pressure vessels, suction filters and strainers, etc.

Technical Data			
	24B	24BB	24BI
Temperature Range	- 240°C up to +260°C, for short periods up to +310°C		
Chemical Resistance	pH 0-14 except molten alkali metals and elemental fluorine at high temperature and pressure		
Pressure Resistance	Vacuum to 200 bar (2900 psi)		
Density (g/cm³)	0.65	0.75	0.7
Aging Resistance	Does not age		
Color	White		

TEADIT® M & Y CHART

COMPRESSED NON-ASBESTOS	Thickness (mm)	" m " (no units)	" y " (psi)
NA 1001	1.6	2	3500
	3.2	2	3500
NA 1040	1.6	2.5	3500
	3.2	3.2	3000
NA 1081	1.6	2.2	4000
	3.2	2.2	4000
NA 1082	1.6	2	3500
	3.2	2	4000
NA 1085	1.6	2.5	2500
	3.2	6.8	3500
NA 1100	1.6	2.9	3500
	3.2	4.1	3500
NA 1122	1.6	3	6000
	3.2	3	6000
NA 1076	1.6	5	5500
	3.2	4	6500
NA 1092	1.6	2.9	4000
	3.2	4.5	5000

m = Gasket Factor

Y = Minimum Gasket Stress

Note: There is no procedure to determine “m” and “y”. The values for “m” and “y” in these tables are based on laboratory tests conducted by Teadit® and validated in successful actual service applications.

TEADIT® M & Y CHART

TEALON (RESTRUCTURED PTFE)	Thickness (mm)	" m " (no units)	" y " (psi)
TF 1570	1.5	2	1500
	3	2	1500
TF 1580	1.5	2	1800
	3	2	1500
TF 1590	1.5	4.4	2500
	3	3.5	2000

EXPANDED PTFE	" m " (no units)	" y " (psi)
24B, 24BB, 24SH	2	2800

FLEXIBLE GRAPHITE	" m " (no units)	" y " (psi)
2660 (FGS)	1.5	900
2661 (FGF)	2	1000
2663 (FGT)	2	2800

SEMI-METALLIC	" m " (no units)	" y " (psi)
Kammprofile	4	4500
Spiral Wound	3	10000
Corrugated Metal	4	4500
Double Jacket (Carbon Steel)	3.25	5500
Double Jacket (Stainless Steel)	3.5	7600

GARLOCK® M & Y CHART

Style	Thickness (Inches)	" m " (no units)	" y " (psi)
3000	1/16"	4.2	3050
	1/8"	5.2	4400
3200/3400	1/16"	3.5	2100
	1/8"	6.6	3000
3300	1/16"	2.1	3050
	1/8"	4	3500
3500	1/16"	5	2750
	1/8"	5	3500
3504	1/16"	3	1650
	1/8"	2.5	3000
	3/16"	2.5	3000
	1/4"	2.5	3000
3510	1/16"	2	2350
	1/8"	2	2500
3535	1/4"	2	3000
3540	1/16"	3	1700
	1/8"	3	2200
	3/16"	2	2200
	1/4"	2	2500

"M" and "Y" data are to be used for flange designs only as specified in the ASME Boiler and Pressure Vessel Code Division 1, Section VIII, Appendix 2. They are not meant to be used as gasket seating stress values in actual service. Garlock bolt torque tables give that information and should be used as such.

GARLOCK® M & Y CHART

Style	Thickness (Inches)	" m " (no units)	" y " (psi)
3545	1/16"	2.6	1500
	1/8"	2	2200
	3/16"	2	2200
	1/4"	7	3700
(In envelope)	1/8"	2	800
3565	1/16"	2.8	1400
	1/8"	3.7	2300
	3/16"	5.5	2800
	1/4"	6	2800
3700	1/16"	3.5	2800
	1/8"	6.7	4200
5500	1/16"	6.6	2600
	1/8"	6.6	3300
9800	1/16"	3.5	2350
	1/8"	8	3200
9850	1/16"	6.5	2550
	1/8"	8	2800
9900	1/16"	4.5	4100
	1/8"	6	4100
Stress Saver® 370	1/8"	2	400
Stress Saver® XP	1/8"	0.5	100
Stress Saver® 3504	1/8"	2	400

The Bolted Joint Assembly

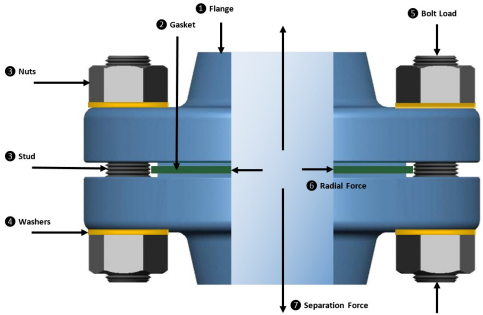
The Gaskets and Fasteners are an essential part of the joint system's integrity. Although the least expensive items in the system, the correct gasket and the correct installation method can save unnecessary downtime, lost production, health and safety concerns, and reduce fugitive emissions.

Flange Load

It is the force, which compresses the flanges against the gasket.

The seating stress initially applied to the gasket, besides causing flow of the gasket material, must:

- Compensate for the separation force caused by the internal pressure
- Be sufficient to maintain a residual stress on the gasket, avoiding leakage



1 Flange	Connects piping, valves, pumps and other related components together
2 Gasket	Maintains a static seal between the adjacent flanges; prevents the passage of media across the flanged connection
3 Fasteners	The stud and nuts provide the compressive force required to bring the flanges together and compress the gasket
4 Washer	Protect the flange and nut, reduce friction, and enhances load distribution
5 Bolt Load	It is the total load exercised by the bolts
6 Radial Force	Originated by the internal pressure; it tends to blow out the gasket
7 Separation Force	Originated by internal pressure; it tends to separate the flanges
7 Lubrication	Lubrication generates less friction and must be compatible with the fasteners and process service temperatures

Gasket Installation Guide

Successfully sealing a flanged connection is dependent upon all components of a well-designed flange system working well together.

This guide provides guidance to maintenance operators, engineers and fitters, to ensure successful gasket installation and assembly of bolted flange connections.

It is intended to complement other plant approved installation procedures.

Tools required

Specific tools are required for cleaning and tensioning the fasteners. Additionally, always use standard safety equipment and follow good safety practices.

- Calibrated torque wrench, hydraulic or other tensioner
- Wire brush (brass if possible)
- Helmet
- Safety goggles
- Lubricant
- Other plant-specified equipment

Clean

Remove all foreign material and debris from:

- Seating surfaces
- Fasteners (bolts or studs)
- Nuts
- Washers

Use plant-specified dust control procedures

Examine

- **Examine fasteners** (bolts or studs), **nuts** and **washers** for defects such as burrs or cracks
- **Examine flange surfaces** for warping, radial scores, heavy tool marks, or anything prohibiting proper gasket seating
- **Replace components** if found to be defective. If in doubt, seek advice

Align flanges

- Align flange faces and bolt holes without using excessive force
- Report any misalignment

Install gasket

- Ensure gasket is the specified size and material
- Examine the gasket to ensure it is free of defects
- Carefully insert the gasket between the flanges
- Make sure the gasket is centered between the flanges
- Do not use jointing compounds or release agents on the gasket or seating surfaces unless specified by the gasket manufacturer
- Bring flanges together, ensuring the gasket isn't pinched or damaged

Lubricate load-bearing surfaces

- Use only specified or approved lubricants (see page 73 for recommendation)
- Liberally apply lubricant uniformly to all thread, nut and washer load-bearing surfaces.
- Ensure lubricant doesn't contaminate either flange or gasket face

How to Apply Bolt Lubricant

- When you apply lubricant, be certain that all valleys of the stud bolt threads are filled.
- Once the nut is hand tightened, you should see a bead of lubricant extruding from beneath the nut. This indicates that the lubrication has been applied to all working surfaces that will experience friction when torque is applied.
    - ◊ Stud Threads
    - ◊ Nut Threads
    - ◊ Nut Face to Flange Face

Install and tighten fasteners

- **Always use proper tools:** calibrated torque wrench or other controlled tensioning device
- **Consult your gasket manufacturer** for guidance on torque specifications. See Torque Tables.
- **Always torque in a cross bolt tightening pattern.** See Bolt Torque Sequence Charts.

Tighten the nuts in multiple steps

- **Step 1** - tighten all nuts initially by hand (larger bolts may require a small hand wrench
- **Step 2** - torque each nut to ~30% of full torque
- **Step 3** - torque each nut to ~60% of full torque
- **Step 4** - torque each nut to full torque, again still using the cross bolt tightening pattern (larger diameter flanges may require additional tightening passes)
- **Step 5** - apply at least one final full torque to all nuts in a clockwise direction until all torque is uniform (larger diameter flanges may require additional passes)

Re-tightening

- **Caution:** consult your gasket manufacturer for guidance and recommendations on re-tightening
- **Do not** re-torque rubber based, asbestos-free gaskets after they have been exposed to elevated temperatures unless otherwise specified
- Re-torque fasteners exposed to aggressive thermal cycling
- All re-torqueing should be performed at ambient temperature and atmospheric pressure


51F

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Stuffing Box Packing

Braided Compression Packing is used in valves, pumps, expansion joints, rotating and reciprocating shafts, steam turbines, high temperature motor-actuated slide valves, centrifugal and rotary food processing

equipment, blenders, mixers, agitators, cookers, dryers, washer journals, liquor pumps, refiners, and digesters. Industries include hostile environments of hydrocarbon processing, pulp and paper, and power generation.

Certified Low-Emission Products Available

Braided Compression Packing

- Carbon Fiber and Graphite
- Expanded PTFE
- Synthetic Yarn
- Aramid (Kevlar) Yarn
- Expanded PTFE-Graphite
- Ramie
- Oxygen Service
- Injectable Packing
- Eco-Seal

Packing Accessories

- Packing Extraction Pullers
- Replacement Tips
- Solid Picks
- Tool Box

POLISHED ROD STUFFING BOX PACKING

Our LUBRIKUP® Polished Rod Packing is available in most stuffing box sizes and configurations, ensuring that you have the right product for your application. We offer packing for everything from basic applications to extreme temperatures and chemicals.

LUBRIKUP® Cone Packing, LONG-LIFE™, and LUBRIPAK™ are constructed of proprietary rubber compounds to ensure optimal performance and a long-lasting seal. Our Fluid-Seal™ Rod Packing (FSRP) has center rings that flare open under pressure creating a tight seal to optimize performance with low emission boxes or very high pressures. Our Fluid-Seal™ Cone Packing (FSCP) and Fluid-Seal™ Dome Packing (FSDP) use the same pressure activated technology as our FSRP sets and are available for those interested in improved

EXPANSION JOINTS

Expansion Joints offer superior performance, reliability and service life, resulting in improved plant safety and increased mechanical integrity of equipment. All of our expansion joints carry safety ratings that exceed product specifications in areas such as pressure and movement. Non-metallic expansion joints and flexible couplings are ideally suited for a wide variety of industries.

- Piping Expansion Joints
- Ducting & Low Pressure

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CONVERSION FACTORS

METRIC UNIT	IMPERIAL VALUE PER ONE METRIC UNIT	METRIC VALUE PER ONE IMPERIAL UNIT	IMPERIAL UNIT
liter	0.2642	3.7854	gallon (us)
degree C	1.8 + 32	-32 ÷ 1.8	degree F
meter	1.0938	0.9144	yard
kgf/cm²	14.2230	0.0703	lbf/sqin
kgf-m	7.2330	0.1383	lbf-ft.
kg	2.2046	0.4536	lb
megapascal (Mpa)	145.0000	0.0069	lbf/sqin
megapascal (Mpa)	10.0000	0.1000	bar
km	0.6210	1.6093	mile
newton	0.2248	4.4482	lbf
newton	0.1020	9.8067	kgf
Meter	3.2808	0.3048	foot
Square meter	10.7639	0.0929	square foot
millimeter	0.0394	25.4000	inch
square millimeter	0.0016	654.1600	square inch

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PRODUCT CATEGORY BRANDS

QUESTFLEX®
Spiral Wound

QUESTSEAL®
Gasket Materials

QUESTFAST®
Industrial Fasteners

QUESTPRO®
Kammprofile

QUESTCLEAN®
Hygienic Product

QUESTGUARD®
Corrosion Protection

QUESTRAM®
Sealing Elements

QUESTFLOW™
Flow Control

A Better Gasket by Design™

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TEADIT

Lamons
MANUFACTURING AND SERVICE CO

Garlock
an EnPro Industries family of companies

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