

Pipe Size (in.)	ASME B16.21 Ring Gasket, Ft-Lbs (N-M)					
	Fasteners: A193-B7 or B16 lubricated with a never seize type lubricant, k=0.17					
	Class 150			Class 300		
	Min. <sup>[1, 2]</sup>	Optimal <sup>[1, 3]</sup>	Max. <sup>[4, 5]</sup>	Min. <sup>[1, 2]</sup>	Optimal <sup>[1, 3]</sup>	Max. <sup>[4, 5]</sup>
1/2	10 (14)	25 (33)	25 (33)	10 (14)	25 (34)	25 (34)
3/4	15 (20)	30 (41)	35 (48)	15 (20)	45 (61)	45 (61)
1	15 (20)	35 (48)	50 (68)	20 (27)	55 (75)	60 (81)
1 1/4	25 (34)	45 (61)	75 (102)	35 (47)	80 (108)	90 (122)
1 1/2	30 (41)	60 (82)	80 (109)	50 (68)	140 (190)	145 (197)
2	65 (88)	120 (163)	160 (217)	35 (47)	80 (108)	100 (136)
2 1/2	80 (108)	120 (163)	160 (217)	50 (68)	125 (169)	135 (183)
3	115 (156)	150 (203)	160 (217)	75 (102)	180 (244)	200 (271)
3 1/2	65 (88)	120 (163)	160 (217)	85 (115)	180 (244)	225 (305)
4	80 (109)	120 (163)	160 (217)	105 (142)	215 (292)	285 (386)
5	120 (163)	215 (292)	280 (380)	140 (190)	215 (292)	285 (386)
6	155 (211)	230 (312)	285 (386)	120 (163)	195 (264)	285 (386)
8	215 (291)	285 (386)	285 (386)	195 (264)	315 (427)	460 (624)
10	210 (284)	345 (468)	460 (624)	215 (292)	385 (522)	490 (664)
12	280 (380)	400 (542)	460 (624)	330 (447)	570 (773)	735 (997)
14	355 (481)	515 (698)	685 (929)	295 (400)	570 (773)	640 (868)
16	340 (461)	515 (698)	675 (915)	420 (569)	795 (1078)	900 (1220)
18	500 (678)	755 (1024)	1010 (1369)	465 (630)	885 (1200)	1020 (1383)
20	160 (217)	755 (1024)	1010 (1369)	530 (719)	885 (1200)	1120 (1519)
22	610 (827)	1060 (1437)	1415 (1918)	760 (1030)	1425 (1932)	1600 (2169)
24	670 (909)	1060 (1437)	1415 (1918)	850 (1152)	1425 (1932)	1740 (2359)

Disclaimer: This is a general guide only and TFC/GRI, does not accept responsibility for negligence or misuse of this information.

**General Notes:**

- a) Torque Values are in ft.-lbs. and assume new A193 Gr. B7 or B16 fasteners with 2H heavy hex nuts; with studs, nuts and the nut bearing surfaces lubricated with a never-seize type lubricant (k = 0.17).
- b) A193 Gr. B7 & B16 fasteners have the same yield strength up to 4" diameter. There are "no" fasteners above 4" diameter in this chart.
- c) All torque values are based on using a "calibrated" torque wrench.
- d) All torque values in the chart above are based on using the tensile area of the fastener.
- e) All torque values in chart are rounded to nearest 5 ft.-lbs.

**Footnotes:**

<sup>[1]</sup> Torque values are based using ASME B16.5-2017 MAWP (Maximum Allowable Working Pressure) at ambient in the gasket stress calculation.

**Min. Torque Values:**

<sup>[2]</sup> Min. torque values are based achieving 4,800 psi gasket stress without exceeding 80,000 psi bolt stress or PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

**Optimal Torque Values:**

<sup>[3]</sup> Optimal torque values are based on a target of 7,000 to 12,000 psi optimum gasket stress without exceeding 80,000 psi bolt stress or PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

- Cases where torque equals ≤ 60,000 bolts stress
- Cases where torque equals > 60,000 ≤ 75,000 bolts stress
- Cases where torque equals > 75,000 ≤ 80,000 bolts stress

**Max. Torque Values:**

<sup>[4]</sup> Max. torque values are based on; max allowable 15,000 psi gasket stress; PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding, or 80,000 psi bolt stress, whichever occurs 1st. Note: In some cases the max. torque values may be equal to the optimal torque values in order to optimize gasket stress levels.

<sup>[5]</sup> 1/2" through 1 1/2" NPS & 3 1/2" NPS due to "No Data" on flange yielding; Max. torque values are set to achieve max gasket stress of 15,000 or 80,000 psi bolt stress, whichever occurs 1st.

- Cases where torque is based on 80,000 bolts stress.
- Cases where torque is based on PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.
- Cases where torque is based on max. allowable 15,000 psi gasket stress.

Pipe Size (in.)	ASME B16.20 SWG Gasket, Ft-Lbs (N-M)					
	Fasteners: A193-B7 or B16 lubricated with a never seize type lubricant, k = 0.17					
	Class 150			Class 300		
	Min. <sup>[1, 2]</sup>	Optimal <sup>[1, 3]</sup>	Max. <sup>[4, 5]</sup>	Min. <sup>[1, 2]</sup>	Optimal <sup>[1, 3]</sup>	Max. <sup>[4, 5]</sup>
1/2	20 (27)	35 (47)	55 (75)	20 (27)	35 (47)	55 (75)
3/4	25 (34)	50 (68)	80 (109)	30 (41)	65 (88)	100 (136)
1	35 (47)	70 (95)	80 (109)	45 (61)	90 (122)	135 (183)
1 1/4	40 (54)	*75 (102)	80 (109)	50 (68)	100 (136)	150 (203)
1 1/2	55 (75)	*75 (102)	80 (109)	85 (115)	165 (224)	250 (339)
2	90 (122)	*150 (203)	160 (217)	45 (61)	90 (122)	115 (156)
2 1/2	105 (142)	*150 (203)	160 (217)	65 (88)	125 (169)	170 (230)
3	150 (203)	**150 (203)	160 (217)	100 (136)	185 (251)	225 (305)
3 1/2	85 (116)	*150 (203)	160 (217)	110 (149)	210 (285)	285 (386)
4	110 (150)	*150 (203)	160 (217)	145 (197)	*265 (359)	285 (386)
5	160 (218)	*265 (359)	280 (380)	180 (244)	*265 (359)	285 (386)
6	230 (313)	**265 (359)	285 (386)	170 (230)	*265 (359)	285 (386)
8	285 (386)	***285 (386)	285 (386)	285 (386)	*430 (583)	460 (624)
10	315 (427)	*430 (583)	460 (624)	310 (420)	560 (759)	675 (915)
12	430 (583)	**435 (590)	460 (624)	480 (651)	865 (1173)	990 (1342)
14	545 (739)	*645 (875)	685 (929)	425 (576)	760 (1030)	795 (1078)
16	545 (739)	**645 (875)	675 (915)	635 (861)	*1105 (1498)	1115 (1512)
18	870 (1180)	**945 (1281)	1005 (1363)	740 (1003)	*1200 (1627)	1210 (1641)
20	775 (1051)	*945 (1281)	1005 (1363)	830 (1125)	*1290 (1749)	1300 (1763)
22	635 (861)	*930 (1261)	1415 (1918)	1050 (1424)	*1830 (2481)	2330 (3159)
24	1135 (1539)	**1325 (1796)	1415 (1918)	1325 (1796)	*2150 (2915)	2165 (2935)

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**General Notes:**

- a) Torque Values are in ft.-lbs. and assume new A193 Gr. B7 or B16 fasteners with 2H heavy hex nuts; with studs, nuts and the nut bearing surfaces lubricated with a never-seize type lubricant (k = 0.17).
- b) A193 Gr. B7 & B16 fasteners have the same yield strength up to 4" diameter. There are "no" fasteners above 4" diameter in this chart.
- c) All torque values are based on using a "calibrated" torque wrench.
- d) All torque values in the chart above are based on the use of an inner/outer ring style (DRI) spiral wound gasket.
- e) All torque values in the chart above are based on using the tensile area of the fastener.
- f) All torque values in chart are rounded to nearest 5 ft.-lbs.

**Footnotes:**

<sup>[1]</sup> Torque values are based using ASME B16.5-2017 MAWP (Maximum Allowable Working Pressure) at ambient in the gasket stress calculation.

**Min. Torque Values:**


<sup>[2]</sup> Min. torque values are based achieving 12,500 psi gasket stress or at minimum above 10,000 psi gasket stress without exceeding 80,000 psi bolt stress or PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.


 Cases where gasket stress is >10,000 < 12,500 psi

**Optimal Torque Values:**

<sup>[3]</sup> Optimal torque values are based on 25,000 psi optimum gasket stress without exceeding 80,000 psi bolt stress or 500 psi below PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

 Cases where torque equals ≤ 60,000 bolts stress

 Cases where torque equals > 60,000 ≤ 75,000 bolts stress


 Cases where torque equals > 75,000 ≤ 80,000 bolts stress

\*Cases where gasket stress is ≥ 15,000 < 25,000 psi, \*\*Cases where gasket stress is ≥ 12,500 < 15,000 psi, \*\*\*Cases where gasket stress is ≥ 10,000 < 12,500 psi


**Max. Torque Values:**

<sup>[4]</sup> Max. torque values are based on; max allowable 40,000 psi gasket stress; PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding, or 80,000 psi bolt stress, whichever occurs 1st. Note: In some cases the max. torque values may be equal to the optimal torque values in order to optimize gasket stress levels.

<sup>[5]</sup> 1/2" through 1 1/2" NPS & 3 1/2" NPS due to "No Data" on flange yielding; Max. torque values are set to achieve max gasket stress of 40,000 or 80,000 psi bolt stress, whichever occurs 1st.

 Cases where torque is based on 80,000 bolts stress.

 Cases where torque is based on PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

 Cases where torque is based on max. allowable 40,000 psi gasket stress.

Pipe Size (in.)	ASME B16.20 SWG Gasket, Ft-Lbs (N-M)					
	Fasteners: A193-B7 or B16 lubricated with a never seize type lubricant, k = 0.17					
	Class 400			Class 600		
	Min. [1, 2]	Optimal [1, 3]	Max. [4, 5]	Min. [1, 2]	Optimal [1, 3]	Max. [4, 5]
1/2	20 (27)	35 (47)	55 (75)	20 (27)	35 (47)	55 (75)
3/4	35 (47)	65 (88)	100 (136)	35 (47)	65 (88)	100 (136)
1	45 (61)	90 (122)	135 (183)	45 (61)	90 (122)	135 (183)
1 1/4	50 (68)	100 (136)	150 (203)	55 (75)	100 (136)	150 (203)
1 1/2	90 (122)	170 (230)	250 (339)	95 (129)	170 (230)	250 (339)
2	50 (68)	90 (122)	125 (169)	50 (68)	95 (129)	135 (183)
2 1/2	70 (95)	130 (176)	185 (251)	75 (102)	135 (183)	185 (251)
3	100 (136)	190 (258)	260 (353)	110 (149)	195 (264)	275 (373)
3 1/2	180 (244)	345 (468)	455 (617)	190 (258)	355 (481)	455 (617)
4	210 (285)	395 (536)	420 (569)	225 (305)	410 (556)	455 (617)
5	270 (366)	*430 (583)	455 (617)	335 (454)	600 (813)	685 (929)
6	250 (339)	*430 (583)	455 (617)	305 (414)	550 (746)	685 (929)
8	405 (549)	*645 (875)	685 (929)	500 (678)	880 (1193)	1005 (1363)
10	475 (644)	*785 (1064)	795 (1078)	580 (786)	1010 (1369)	1370 (1857)
12	705 (956)	**735 (997)	745 (1010)	620 (841)	1070 (1451)	1300 (1763)
14	600 (813)	*885 (1200)	930 (1261)	735 (997)	1250 (1695)	1620 (2196)
16	860 (1166)	*1250 (1695)	1260 (1708)	1045 (1417)	1775 (2407)	2165 (2935)
18	920 (1247)	*1440 (1952)	1515 (2054)	1455 (1973)	2470 (3349)	3195 (4332)
20	1135 (1539)	*1650 (2237)	1665 (2257)	1385 (1878)	2305 (3125)	2930 (3973)
22	1230 (1668)	*2075 (2813)	2145 (2908)	1535 (2081)	*2450 (3322)	2905 (3939)
24	1670 (2264)	*2450 (3322)	2710 (3674)	2055 (2786)	3335 (4522)	4050 (5491)

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**General Notes:**

- a) Torque Values are in ft.-lbs. and assume new A193 Gr. B7 or B16 fasteners with 2H heavy hex nuts; with studs, nuts and the nut bearing surfaces lubricated with a never-seize type lubricant (k = 0.17).
- b) A193 Gr. B7 & B16 fasteners have the same yield strength up to 4" diameter. There are "no" fasteners above 4" diameter in this chart.
- c) All torque values are based on using a "calibrated" torque wrench.
- d) All torque values in the chart above are based on the use of an inner/outer ring style (DRI) spiral wound gasket.
- e) All torque values in the chart above are based on using the tensile area of the fastener.
- f) All torque values in chart are rounded to nearest 5 ft.-lbs.

**Footnotes:**

[1] Torque values are based using ASME B16.5-2017 MAWP (Maximum Allowable Working Pressure) at ambient in the gasket stress calculation.

**Min. Torque Values:**

[2] Min. torque values are based achieving 12,500 psi gasket stress or at minimum above 10,000 psi gasket stress without exceeding 80,000 psi bolt stress or PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

**Optimal Torque Values:**

[3] Optimal torque values are based on 25,000 psi optimum gasket stress without exceeding 80,000 psi bolt stress or 500 psi below PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

- Cases where torque equals ≤ 60,000 bolts stress
- Cases where torque equals > 60,000 ≤ 75,000 bolts stress
- Cases where torque equals > 75,000 ≤ 80,000 bolts stress

\*Cases where gasket stress is ≥ 15,000 < 25,000 psi, \*\*Cases where gasket stress is ≥ 12,500 < 15,000 psi, \*\*\*Cases where gasket stress is ≥ 10,000 < 12,500 psi

**Max. Torque Values:**

[4] Max. torque values are based on; max allowable 40,000 psi gasket stress; PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding, or 80,000 psi bolt stress, whichever occurs 1st. Note: In some cases the max. torque values may be equal to the optimal torque values in order to optimize gasket stress levels.

[5] 1/2" through 1 1/2" NPS & 3 1/2" NPS due to "No Data" on flange yielding; Max. torque values are set to achieve max gasket stress of 40,000 or 80,000 psi bolt stress, whichever occurs 1st.

- Cases where torque is based on 80,000 bolts stress.
- Cases where torque is based on PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.
- Cases where torque is based on max. allowable 40,000 psi gasket stress.

Pipe Size (in.)	ASME B16.20 SWG Gasket, Ft-Lbs (N-M)								
	Fasteners: A193-B7 or B16 lubricated with a never seize type lubricant, k = 0.17								
	Class 900			Class 1500			Class 2500		
	Min. [1, 2]	Optimal [1, 3]	Max. [4, 5]	Min. [1, 2]	Optimal [1, 3]	Max. [4, 5]	Min. [1, 2]	Optimal [1, 3]	Max. [4, 5]
1/2	30 (41)	55 (75)	85 (115)	30 (41)	55 (75)	85 (115)	35 (47)	60 (81)	85 (115)
3/4	40 (54)	80 (108)	120 (163)	45 (61)	85 (115)	120 (163)	50 (68)	90 (122)	120 (163)
1	70 (95)	130 (176)	190 (258)	75 (102)	135 (183)	190 (258)	85 (115)	145 (197)	190 (258)
1 1/4	110 (149)	210 (285)	315 (427)	120 (163)	220 (298)	315 (427)	155 (210)	270 (366)	360 (488)
1 1/2	160 (217)	305 (414)	450 (610)	175 (237)	315 (427)	450 (610)	225 (305)	385 (522)	505 (685)
2	105 (142)	200 (271)	295 (400)	115 (156)	210 (285)	295 (400)	150 (203)	260 (353)	340 (461)
2 1/2	155 (210)	290 (393)	415 (563)	170 (230)	300 (407)	415 (563)	220 (298)	370 (502)	470 (637)
3	165 (224)	295 (400)	415 (563)	260 (353)	445 (603)	585 (793)	345 (468)	555 (752)	655 (888)
4	315 (427)	555 (752)	750 (1017)	425 (576)	715 (969)	915 (1241)	620 (841)	965 (1308)	1095 (1485)
5	460 (624)	795 (1078)	1060 (1437)	695 (942)	1155 (1566)	1445 (1959)	1000 (1356)	1550 (2102)	1685 (2285)
6	380 (515)	655 (888)	865 (1173)	575 (780)	935 (1268)	1145 (1552)	1565 (2122)	2355 (3193)	2505 (3396)
8	630 (854)	1055 (1430)	1330 (1803)	975 (1322)	1550 (2102)	1830 (2481)	1530 (2074)	*2120 (2874)	2255 (3057)
10	630 (854)	1010 (1369)	1210 (1641)	1575 (2135)	2470 (3349)	2770 (3756)	2690 (3647)	*3225 (4373)	3435 (4657)
12	730 (900)	1190 (1613)	1460 (1979)	1665 (2257)	2510 (3403)	2655 (3600)	4180 (5667)	*5175 (7016)	5510 (7471)
14	905 (1227)	1455 (1973)	1740 (2359)	2055 (2786)	*2665 (3613)	2815 (3817)	-	-	-
16	1205 (1634)	1900 (2576)	2165 (2935)	3125 (4237)	*4480 (6074)	4730 (6413)	-	-	-
18	1910 (2590)	3075 (4169)	3640 (4935)	4445 (6027)	*6230 (8447)	6670 (9043)	-	-	-
20	2235 (3030)	3450 (4678)	3830 (5193)	5680 (7701)	*7600 (10304)	8025 (10880)	-	-	-
24	3680 (4989)	*5425 (7354)	5730 (7769)	9180 (12446)	*11770 (15958)	12415 (16833)	-	-	-

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**General Notes:**

- a) Torque Values are in ft.-lbs. and assume new A193 Gr. B7 or B16 fasteners with 2H heavy hex nuts; with studs, nuts and the nut bearing surfaces lubricated with a never-seize type lubricant (k = 0.17).
- b) A193 Gr. B7 & B16 fasteners have the same yield strength up to 4" diameter. There are "no" fasteners above 4" diameter in this chart.
- c) All torque values are based on using a "calibrated" torque wrench.
- d) All torque values in the chart above are based on the use of an inner/outer ring style (DRI) spiral wound gasket.
- e) All torque values in the chart above are based on using the tensile area of the fastener.
- f) All torque values in chart are rounded to nearest 5 ft.-lbs.

**Footnotes:**

<sup>(1)</sup> Torque values are based using ASME B16.5-2017 MAWP (Maximum Allowable Working Pressure) at ambient in the gasket stress calculation.

**Min. Torque Values:**

<sup>(2)</sup> Min. torque values are based achieving 12,500 psi gasket stress or at minimum above 10,000 psi gasket stress without exceeding 80,000 psi bolt stress or PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

**Optimal Torque Values:**

<sup>(3)</sup> Optimal torque values are based on 25,000 psi optimum gasket stress without exceeding 80,000 psi bolt stress or 500 psi below PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.

	Cases where torque equals ≤ 60,000 bolts stress
	Cases where torque equals > 60,000 ≤ 75,000 bolts stress
	Cases where torque equals > 75,000 ≤ 80,000 bolts stress

\*Cases where gasket stress is ≥ 15,000 < 25,000 psi, \*\*Cases where gasket stress is ≥ 12,500 < 15,000 psi, \*\*\*Cases where gasket stress is ≥ 10,000 < 12,500 psi

**Max. Torque Values:**

<sup>(4)</sup> Max. torque values are based on; max allowable 40,000 psi gasket stress; PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding, or 80,000 psi bolt stress, whichever occurs 1st. Note: In some cases the max. torque values may be equal to the optimal torque values in order to optimize gasket stress levels.

<sup>(5)</sup> 1/2" through 1 1/2" NPS & 3 1/2" NPS due to "No Data" on flange yielding; Max. torque values are set to achieve max gasket stress of 40,000 or 80,000 psi bolt stress, whichever occurs 1st.

	Cases where torque is based on 80,000 bolts stress.
	Cases where torque is based on PCC-1 2019 FEA SA105 Max. Stud Stress Before Flange Yielding.
	Cases where torque is based on max. allowable 40,000 psi gasket stress.