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1. PURPOSE & SCOPE

1.1. The purpose of this procedure is to establish a program for the site's torque wrench storage and usage, torqueing practice, bolting and gasket application, and associated documentation in accordance with ASME guidelines and industry best practices.

1.2. This procedure is applicable to all construction, maintenance, and turnaround activities requiring bolting of flanged components.

1.3. All personnel assembling flanged connections are responsible for the information herein.

2. REFERENCES

OSHA 29 CFR 1910.119	Process Safety Management of Highly Hazardous Chemicals
ASME B16.5	Pipe Flanges and Flange Fittings
ASME B16.47	Large Diameter Steel Flanges
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME PCC-1	Guidelines for Pressure Boundary Bolted Flange Joint Assembly

3. RESPONSIBILITIES

3.1. Site Management are responsible for ensuring that this procedure is implemented by all employees and contractors, and that adequate resources are made available.

3.2. Maintenance Manager (or designee) is responsible for the maintenance of this document and periodic reviews.

3.3. Reliability Engineers are responsible for supporting technical needs that arise in the implementation of this procedure.

4. TORQUE WRENCH STORAGE

4.1. Torque wrenches shall be stored, checked in, and checked out from tool room.
4.2. Torque wrenches checked out from tool room shall be returned before the end of the day.
4.3. Torque wrenches shall be calibrated at least annually.
4.4. Torque wrenches shall be stored in a clean, dry location to prevent deterioration or ruining of calibration.
4.5. Torque wrenches shall be protected in storage to prevent jarring and handling from ruining of calibration
4.6. Torque wrenches should be cleaned after each use.
4.7. Torque wrenches shall be set it at their lowest torque setting when not in use.

5. TORQUE WRENCH USE

5.1. Torque wrenches shall never be used to loosen bolts.
5.2. Torque wrench shall be verified to have the proper scale (in-lbs, ft-lbs, etc.) prior to use.
5.3. The torque applied shall be between 20% and 100% of the full range of the wrench used.
5.4. A torque wrench that has been dropped or received a sharp blow shall not be used.
5.5. If a torque wrench is mishandled such that the calibration may be ruined, it shall be returned for calibration.
5.6. Any kind of extension to apply extra torque shall not be used without proper calculations. Instead, a larger torque wrench should be used.
5.7. The proper torque value shall be obtained from this procedure's appendices, manufacturer recommendations, or area reliability engineer.
5.8. Torque values in the Appendices shall only apply for metallic flanges. For composite or polymer flanges, consult Reliability Engineer or Mechanical Integrity department.
5.9. Manual torque wrenches shall not be used for any torque values over 600 ft-lbs. Additional information associated with the alternative torqueing equipment used, such as electric torque wrench model number, hydraulic torque wrench pump pressure, etc. should be recorded on the Flange Makeup Form.

6. FLANGE CONDITION

6.1. Flanges should be in good condition. There should not be excessive material loss in any section of the assembly.
6.2. Flanges should be on centerline. There should be no more than a 1/16-inch misalignment between flanges. Verify using a straight edge.
6.3. Flange faces should be parallel. There should be no more than a 1/32-inch difference between the widest and narrowest gap of the flange faces.
6.4. Flange faces should not have an excessive gap. There should be no more than twice the gasket thickness of space between the flange faces.

6.5. Flange faces should be clean. There should be no rust, debris, or remnants of the old gasket on the sealing surfaces.
6.6. Flange faces should be uniform. There should be a uniform surface finish of the sealing surfaces. Any sealing surface with defects or imperfections exceeding the tolerances listed in ASME B16.5 and B16.47 shall not be returned to service.
6.7. Flanged connections being torqued shall be uniquely identified for documentation in the Flange Makeup Form.

7. GASKET USAGE

7.1. New gaskets shall be used for each installation.
7.2. Spiral wound gaskets with inner rings may not protrude more than 0.06 inches into the flange bore per ASME B16.20.
7.3. Spiral wound gaskets should be carefully selected to ensure the proper metallurgy is used.
7.4. The characteristics of the spiral wound gasket should be captured on the Flange Makeup Form, since different styles can have different torques required to seal.
7.5. Gaskets are not required for new-to-new polymer-lined pipe connections.
7.6. Gaskets are required for new-to-old or old-to-old polymer-lined pipe connections.
7.7. Gaskets are required for connections between polymer-lined pipe and unlined pipe/equipment.
7.8. The following gaskets do not require retorque: VSP PITA®, VSP FR-PITA®

8. FASTENERS

8.1. New bolts and nuts shall be used for each installation.
8.2. Bolts and nuts shall only be reused if threads and coating (if applicable) are in like-new condition.
8.3. Fasteners must be hand tight before beginning torqueing.
8.4. If lubricant is required, it should be applied to all thread mating surfaces and nut bearing surfaces.
8.5. Fluoropolymer-coated fasteners should not have additional lubricant applied.
8.6. Nuts should have full thread engagement, and the bolt should extend no more than one bolt diameter past the end of the nut.
8.7. Washers are optional for metal flanges but are required for polymer and composite flanges.
8.8. Belleville washers, or conical spring washers, may be used for high temperature or high vibration applications under direction of the piping specification or area reliability engineer. The use of Belleville washers should be noted on the Flange Makeup Form.

9. TIGHTENING SEQUENCE

9.1. A proper tightening sequence shall be used. For flanges with 8 or fewer bolts, a crisscross pattern is sufficient. For flanges with more than 8 bolts, a number pattern is needed (see Appendices).
9.2. Bolt grouping methods are allowed for flanges with 36 or more bolts (see Appendices).
9.3. At least three incremental torque settings shall be used to achieve final torque.
9.3.1. The 1st increment shall be approximately 30% of the final torque required.
9.3.2. The 2nd increment shall be approximately 70% of the final torque required.
9.3.3. The 3rd increment shall be approximately 100% of the final torque required.

9.4. The same tightening sequence shall be used for each torqueing increment.
9.5. Additional passes shall be completed in a rotational pattern (clockwise around the flange) at 100% of the final torque required until nuts stop turning.
9.6. Fasteners shall be retorqued after 24 hours or one full equipment thermal cycle, whichever is sooner, to correct gasket creep relaxation. If this cannot be accomplished due to safety or operational requirements, retorqueing shall occur at the latest opportunity available within that time frame while equipment is not in service.

10. DOCUMENTATION

10.1. After the initial torqueing is complete, the Flange Makeup Form(s) shall be filled out by the craftsman performing the work. The Flange Makeup Form can be located at the end of this procedure.
10.2. Comments should be made for any unexpected issues that occurred or any missing information that would be useful.
10.3. The craftsman shall sign and date the form to signify the completion of the torqueing and compliance with this procedure.
10.4. The QA/QC inspector shall sign and date the form to signify the documentation contains adequate information and follows this procedure.
10.5. An alternative torque documentation form may be used if it contains at least the information present in the Westlake Flange Makeup Form.
10.6. The maintenance group shall file the completed Flange Makeup Form(s) or acceptable equal with the rest of the job paperwork.

11. TRAINING

11.1. Training on this procedure shall be required for all personnel that will be required to perform torqueing operations.
11.2. Initial training for maintenance employees and resident contractors shall be completed during the onboarding process.
11.3. Refresher training should be completed every 3 years or whenever an individual requests additional training.
11.4. Knowledge of this procedure should be verified through oral and written evaluation by the Maintenance Manager or Maintenance Supervisor.

APPENDICES

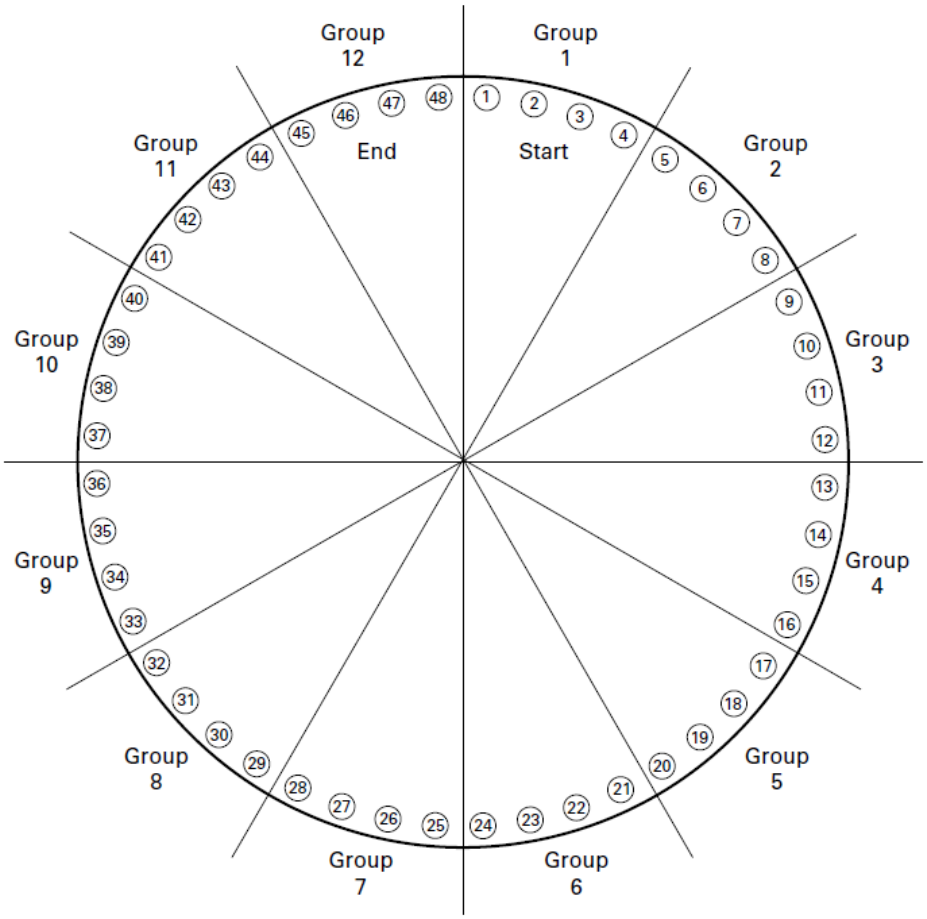
12. BOLT TIGHTENING SEQUENCES

Legacy Bolt Tightening Sequence for Single Tool Usage	
No. Bolts	Tightening Sequence for Cross-Pattern Passes
4	1-3-2-4
8	1-5-3-7 → 2-6-4-8
12	1-7-4-10 → 2-8-5-11 → 3-9-6-12
16	1-9-5-13 → 3-11-7-15 → 2-10-6-14 → 4-12-8-16
20	1-11-6-16 → 3-13-8-18 → 5-15-10-20 → 2-12-7-17 → 4-14-9-19
24	1-13-7-19 → 4-16-10-22 → 2-14-8-20 → 5-17-11-23 → 3-15-9-21 → 6-18-12-24
28	1-15-8-22 → 4-18-11-25 → 6-20-13-27 → 2-16-9-23 → 5-19-12-26 → 7-21-14-28 → 3-17-10-24
32	1-17-9-25 → 5-21-13-29 → 3-19-11-27 → 7-23-15-31 → 2-18-10-26 → 6-22-14-30 → 4-20-12-28 → 8-24-16-32
36	1-2-3 → 19-20-21 → 10-11-12 → 28-29-30 → 4-5-6 → 22-23-24 → 13-14-15 → 31-32-33 → 7-8-9 → 25-26-27 → 16-17-18 → 34-35-36
40	1-2-3-4 → 21-22-23-24 → 13-14-15-16 → 33-34-35-36 → 5-6-7-8 → 25-26-27-28 → 17-18-19-20 → 37-38-39-40 → 9-10-11-12 → 29-30-31-32
44	1-2-3-4 → 25-26-27-28 → 13-14-15-16 → 37-38-39-40 → 5-6-7-8 → 29-30-31-32 → 17-18-19-20 → 41-42-43-44 → 9-10-11-12 → 33-34-35-36 → 21-22-23-24
48	1-2-3-4 → 25-26-27-28 → 13-14-15-16 → 37-38-39-40 → 5-6-7-8 → 29-30-31-32 → 17-18-19-20 → 41-42-43-44 → 9-10-11-12 → 33-34-35-36 → 21-22-23-24 → 45-46-47-48
52	1-2-3-4 → 29-30-31-32 → 13-14-15-16 → 41-42-43-44 → 5-6-7-8 → 33-34-35-36 → 17-18-19-20 → 45-46-47-48 → 21-22-23-24 → 49-50-51-52 → 25-26-27-28 → 9-10-11-12 → 37-38-39-40
56	1-2-3-4 → 29-30-31-32 → 13-14-15-16 → 41-42-43-44 → 21-22-23-24 → 49-50-51-52 → 9-10-11-12 → 37-38-39-40 → 25-26-27-28 → 53-54-55-56 → 17-18-19-20 → 45-46-47-48 → 5-6-7-8 → 33-34-35-36
60	1-2-3-4 → 29-30-31-32 → 45-46-47-48 → 13-14-15-16 → 5-6-7-8 → 37-38-39-40 → 21-22-23-24 → 53-54-55-56 → 9-10-11-12 → 33-34-35-36 → 49-50-51-52 → 17-18-19-20 → 41-42-43-44 → 57-58-59-60 → 25-26-27-28
64	1-2-3-4 → 33-34-35-36 → 17-18-19-20 → 49-50-51-52 → 9-10-11-12 → 41-42-43-44 → 25-26-27-28 → 57-58-59-60 → 5-6-7-8 → 37-38-39-40 → 21-22-23-24 → 53-54-55-56 → 13-14-15-16 → 45-46-47-48 → 29-30-31-32 → 61-62-63-64
68	1-2-3-4 → 37-38-39-40 → 21-22-23-24 → 53-54-55-56 → 9-10-11-12 → 45-46-47-48 → 29-30-31-32 → 61-62-63-64 → 17-18-19-20 → 57-58-59-60 → 33-34-35-36 → 5-6-7-8 → 41-42-43-44 → 13-14-15-16 → 49-50-51-52 → 25-26-27-28 → 65-66-67-68

Alternative Bolt Tightening Sequence for Single Tool Usage	
No. Bolts	Bolt-Number Sequence to be Marked Clockwise on Flange
4	1, 3, 2, 4
8	1, 5, 3, 7, 2, 6, 4, 8
12	1, 9, 5, 3, 11, 7, 2, 10, 6, 4, 12, 8
16	1, 9, 5, 13, 3, 11, 7, 15, 2, 10, 6, 14, 4, 12, 8, 16
20	1, 17, 9, 5, 13, 3, 19, 11, 7, 15, 2, 18, 10, 6, 14, 4, 20, 12, 8, 16
24	1, 17, 9, 5, 13, 21, 3, 19, 11, 7, 15, 23, 2, 18, 10, 6, 14, 22, 4, 20, 12, 8, 16, 24
28	1, 25, 17, 9, 5, 13, 21, 3, 27, 19, 11, 7, 15, 23, 2, 26, 18, 10, 6, 14, 22, 4, 28, 20, 12, 8, 16, 24
32	1, 25, 17, 9, 5, 13, 21, 29, 3, 27, 19, 11, 7, 15, 23, 31, 2, 26, 18, 10, 6, 14, 22, 30, 4, 28, 20, 12, 8, 16, 24, 32
36	1, 33, 25, 17, 9, 5, 13, 21, 29, 3, 35, 27, 19, 11, 7, 15, 23, 31, 2, 34, 26, 18, 10, 6, 14, 22, 30, 4, 36, 28, 20, 12, 8, 16, 24, 32
40	1, 33, 25, 17, 9, 5, 13, 21, 29, 37, 3, 35, 27, 19, 11, 7, 15, 23, 31, 39, 2, 34, 26, 18, 10, 6, 14, 22, 30, 38, 4, 36, 28, 20, 12, 8, 16, 24, 32, 40
44	1, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 3, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 2, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 4, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40
48	1, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 3, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 2, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 4, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48
52	1, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 3, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 2, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 4, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48
56	1, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 3, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 2, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 4, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56
60	1, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 3, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 2, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 4, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56
64	1, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 3, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 2, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 4, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64
68	1, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 3, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 2, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 4, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64
72	1, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 69, 3, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 71, 2, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 70, 4, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64, 72
76	1, 73, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 69, 3, 75, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 71, 2, 74, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 70, 4, 76, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64, 72

80	1, 73, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 69, 77, 3, 75, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 71, 79, 2, 74, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 70, 78, 4, 76, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80
84	1, 81, 73, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 69, 77, 3, 83, 75, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 71, 79, 2, 82, 74, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 70, 78, 4, 84, 76, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80
88	1, 81, 73, 65, 57, 49, 41, 33, 25, 17, 9, 5, 13, 21, 29, 37, 45, 53, 61, 69, 77, 85, 3, 83, 75, 67, 59, 51, 43, 35, 27, 19, 11, 7, 15, 23, 31, 39, 47, 55, 63, 71, 79, 87, 2, 82, 74, 66, 58, 50, 42, 34, 26, 18, 10, 6, 14, 22, 30, 38, 46, 54, 62, 70, 78, 86, 4, 84, 76, 68, 60, 52, 44, 36, 28, 20, 12, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80, 88

13. BOLT GROUPING METHOD EXAMPLE FROM ASME PCC-1



Group	Bolts
1	1-2-3-4
2	5-6-7-8
3	9-10-11-12
4	13-14-15-16
5	17-18-19-20
6	21-22-23-24
7	25-26-27-28
8	29-30-31-32
9	33-34-35-36
10	37-38-39-40
11	41-42-43-44
12	45-46-47-48

Tightening sequence for 12 groups:

1-7-4-10 ↵
2-8-5-11 ↵
3-9-6-12

(The 12-group sequence is the same as a 12-bolt sequence; see Figure 3.)

GENERAL NOTE: This Figure is an illustration of how bolts may be grouped for tightening. Bolts may be grouped and tightened treating each group as one bolt in the tightening sequence. A suggested number of bolts for a group is the number contained within a 30 deg arc. However, potential gasket damage or flange misalignment should be considered when bolts are grouped.

14. TORQUE TABLES

Durlon 9000, 1/8" ring gasket	**Class 150 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	9	12	16	31	31	31	55	55	87	89	134	134	190	181	262
70%	16	22	28	37	73	73	73	129	129	204	208	312	312	444	421	610
100%	22	31	40	52	104	104	104	184	184	291	297	445	445	634	602	872
Notes:	Using 8000 psi target gasket stress per Durlon tables															

Durlon 9000, 1/8" ring gasket	**Class 300 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	9	17	19	37	20	39	54	55	89	103	151	180	230	224	258	417
70%	21	39	45	86	46	92	126	129	208	241	352	420	538	523	603	974
100%	30	56	65	123	66	132	179	184	297	344	502	599	768	747	861	1391
Notes:	Using 8000 psi target gasket stress per Durlon tables															

Durlon 9000, 1/8" full face gasket*	**Class 150 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	16	16	16	16	31	31	31	55	55	89	89	134	134	196	196	276
70%	37	37	37	37	73	73	73	129	129	208	208	312	312	457	457	643
100%	52	52	52	52	104	104	104	184	184	297	297	445	445	653	653	919
Notes:	Using 8000 psi target gasket stress per Durlon tables *Not recommended - bolt limited, most values don't achieve seating stress															

Durlon 9000, 1/8" full face gasket*	**Class 300 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	16	31	31	55	31	55	55	55	89	134	196	196	276	276	276	493
70%	37	73	73	129	73	129	129	129	208	312	457	457	643	643	643	1151
100%	52	104	104	184	104	184	184	184	297	445	653	653	919	919	919	1645
Notes:	Using 8000 psi target gasket stress per Durlon tables *Not recommended - bolt limited, most values don't achieve seating stress															

Flexitallic CGI, 1/8" SW gasket					**Class 150 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3*	4	6	8*	10	12*	14	16	18*	20	24
30%	7	11	15	16	31	31	31	55	55	89	89	134	134	196	196	276
70%	17	25	34	37	73	73	73	129	129	208	208	312	312	457	457	643
100%	25	35	48	52	104	104	104	184	184	297	297	445	445	653	653	919
Notes:	Using 25000 psi target gasket stress *Not recommended - bolt limited, does not achieve seating stress															

Flexitallic CGI, 1/8" SW gasket					**Class 300 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	18	33	18	36	53	55	89	104	160	139	208	249	275	429
70%	17	31	42	78	41	85	123	129	208	243	372	324	485	582	641	1000
100%	25	44	60	111	59	121	176	184	297	348	532	463	693	831	915	1429
Notes:	Using 25000 psi target gasket stress															

Flexitallic CGI, 1/8" SW gasket					**Class 600 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	18	33	18	36	77	102	160	181	190	214	305	423	388	536
70%	17	31	42	78	41	85	181	237	372	423	444	500	711	986	906	1250
100%	25	44	60	111	59	121	258	339	532	604	634	715	1016	1409	1294	1786
Notes:	Using 25000 psi target gasket stress															

VSP AB-326, 1/8" SW gasket					**Class 150 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	7	7	9	14	24	18	36	51	49	66	82	83	135	119	171
70%	16	16	16	21	33	56	41	84	120	114	154	192	194	314	277	400
100%	22	22	22	30	47	81	59	121	171	162	221	275	277	449	395	572
Notes:	Using 10000 psi target gasket stress															

VSP AB-326, 1/8" SW gasket					**Class 300 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	13	24	13	24	24	24	41	57	84	84	118	118	122	211
70%	16	31	31	55	31	55	55	56	95	134	196	196	276	276	284	493
100%	22	44	44	79	44	79	79	80	136	191	280	280	394	394	406	705
Notes:	Using 10000 psi target gasket stress															

VSP AB-326, 1/8" SW gasket					**Class 600 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	13	24	13	24	38	57	84	118	118	160	211	273	273	427
70%	16	31	31	55	31	55	89	134	196	276	276	374	493	638	638	996
100%	22	44	44	79	44	79	127	191	280	394	394	534	705	911	911	1423
Notes:	Using 10000 psi target gasket stress															

VSP PITA, 1/8" ring gasket					**Class 150 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	7	7	9	17	25	20	29	41	44	67	94	91	95	90	131
70%	16	16	16	21	39	57	47	67	96	102	157	218	212	222	211	305
100%	22	22	22	31	56	82	66	96	138	145	224	312	303	317	301	436
Notes:	Using 4000 psi target gasket stress															

VSP PITA, 1/8" ring gasket					**Class 300 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	13	24	13	24	27	32	50	57	84	90	118	118	129	211
70%	16	31	31	55	31	55	63	74	116	134	196	210	276	276	301	493
100%	22	44	44	79	44	79	90	106	166	191	280	300	394	394	430	705
Notes:	Using 4000 psi target gasket stress															

VSP PITA, 1/8" ring gasket	**Class 600 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	13	13	24	13	24	39	57	84	118	118	160	211	273	273	427
70%	16	31	31	55	31	55	91	134	196	276	276	374	493	638	638	996
100%	22	44	44	79	44	79	130	191	280	394	394	534	705	911	911	1423
Notes:	Using 4000 psi target gasket stress															

VSP FR-PITA, 1/8" full face gasket	**Class 150 FRP flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	-	-	3	3	6	8	8	11	14	17	24	29	23	32	29	32
70%	-	-	7	7	14	18	18	25	32	39	56	67	53	74	67	74
100%	-	-	10	10	20	25	25	35	45	55	80	95	75	105	95	105
Notes:	From VSP FR-PITA brochure															

PTFE-lined steel pipe, 1/8" liner	**Class 150 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14*	16*	18*	20	24
30%	-	-	5	8	15	22	17	25	36	38	59	48	48	70	-	-
70%	-	-	12	19	34	50	41	59	84	89	137	111	111	163	-	-
100%	-	-	18	27	49	72	58	84	120	127	196	159	159	233	-	-
Notes:	Using 3500 psi target gasket stress *Lowered based on Resistoflex specifications, doesn't reach target gasket stress															

Gore UPG, 1/8" ring gasket	**Class 150 metal flanges**										**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	7	9	12	16	31	31	31	55	55	87	89	134	134	190	181	262
70%	16	22	28	37	73	73	73	129	129	204	208	312	312	444	421	610
100%	22	31	40	52	104	104	104	184	184	291	297	445	445	634	602	872
Notes:	Using approximately 7,500 psi target gasket stress															

Gore UPG, 1/8" ring gasket					**Class 300 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	9	17	19	37	20	39	54	55	89	103	151	180	230	224	258	417
70%	21	39	45	86	46	92	126	129	208	241	352	420	538	523	603	974
100%	30	56	65	123	66	132	179	184	297	344	502	599	768	747	861	1391
Notes:	Using approximately 7,500 psi target gasket stress															

Gore UPG, 1/8" ring gasket					**Class 150 FRP raised-face flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	-	-	1	2	5	9	6	12	15	15	20	24	23	36	30	42
70%	-	-	3	6	11	21	14	28	35	35	46	56	53	84	70	98
100%	-	-	4	8	16	30	20	40	50	50	65	80	75	120	100	140
Notes:	From Gore Torque Guidelines brochure; assumes K = 0.15															

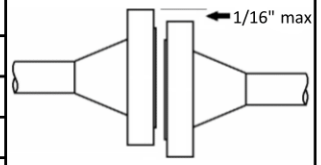
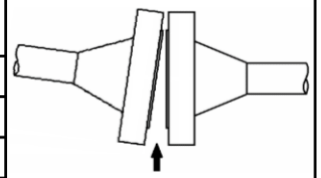
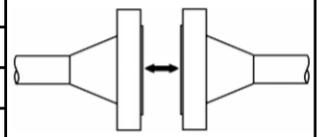
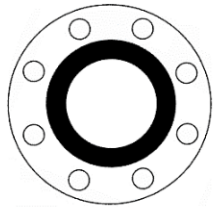
Viton, 1/8" full face gasket					**Class 150 metal flanges**						**New teflon-coated B7/L7 bolting**					
Torque (ft-lbs)	Nominal Pipe Size															
	½	¾	1	1½	2	3	4	6	8	10	12	14	16	18	20	24
30%	4	5	6	8	15	16	13	20	28	32	41	57	52	67	62	87
70%	10	13	15	18	35	38	31	45	64	74	95	135	120	155	145	205
100%	15	18	21	25	50	55	44	65	92	105	135	190	175	225	205	290
Notes:	Using approximately 1,000 psi target gasket stress															

Westlake Flange Makeup Form

Date: _____ Unit: _____ Torque Wrench S/N: _____

Time Started: _____ Area: _____ Torque Wrench Cal. Date: _____

WO#: _____ Line/Equip: _____ Torque Wrench Exp. Date: _____

Tag #							**Flanges on Centerline**  Verify using straight edge
Flange Size							
Flange Class							
Bolt Grade							
No. of Bolts							
Bolt Size							
Lubricant							**Flange Faces Parallel**
Gasket							
1st Pass (ft-lbs)							
2nd Pass (ft-lbs)							
3rd Pass (ft-lbs)							
Rotational Passes	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	 1/32" max gap difference
Retorque	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	**No Excessive Gap**
Retorque Date							
Retorque Time							
New bolts/nuts used	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	 2x gasket thickness max
Full thread engagement	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Washers used	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
New gasket used	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	**Flange Faces Clean**
Tightening sequence used	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Flanges on centerline	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Flange faces parallel	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Gap sufficiently small	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Flange faces clean	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
Good surface finish	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	 Ensure uniform surface finish

Comments: _____

Craftsman Name: _____ Sign: _____ Date: _____

Inspector Name: _____ Sign: _____ Date: _____