Vacuum Handbook Appendix 3:

Knife Edge Flange Bolt Torque and Tightening Requirements

MPEX-00-ENG-002-A3

MATERIAL PLASMA EXPOSURE EXPERIMENT (MPEX)

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Revision History

Revision	Date	DESCRIPTION OF CHANGE	REVISION TYPE	
			Major	Minor
0	April 28, 2023	Initial Issue	☐	☐
			☐	☐
			☐	☐

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1 BOLT TORQUE

Bolt tightening torques and patterns are necessary to assure a leak tight vacuum seal on Conflat (CF) flanges. All fasteners and threads will be precision cleaned. This requires that lubrication is added to the threads to prevent galling. The following lubricants may be used on fasteners for MPEX Device CF flanges.

1. Apiezon H – preferred lubricant for temperatures up to 240 C
2. Dry Lubricants for temperatures exceeding 240 C
    a. Graphite
    b. MoS_2
    c. WS_2

Table *1-1* contains the specifications for bolt tightening torques by bolt size for Knife Edge / ConFlat Flanges. The table is for lubricated stainless-steel fasteners to stainless steel threads.

Table 1-1
Knife Edge Bolt Tightening Torque for Lubricated Stainless-Steel Fasteners, Flanges, and Threads

Bolt Size (UNF)	Flange Size	Recommended Torque (ft lb)	Maximum Torque (ft lb)
#8-32	1.33 CF	1.65	7
1/4/2028	2.75 CF	7.83	12
5/16/2024	4.5 CF to 10 CF	11.83	15
3/8/2024	13.25 CF to 16 CF	11.83	28.75

2 BOLT TIGHTENING PROCEDURE

1. Flanges should be aligned with gaskets and bolts finger tight.
2. Prior to tightening the bolts any further, it should be verified that the gasket is seated.
3. From finger tight, the bolts should be tightened ½ turn using the appropriate Bolt Tightening Patterns from section 3 of this document.
4. As the flange seats and gets tight, bolt tightening should be reduced to ¼ turn at a time
5. Flanges should then be tightened ¼ turn at a time, using the provided Bolt Tightening Patterns, until the recommended torque is achieved.
6. A leak check shall then be performed. If a leak is found, bolts should be tightened not more than ¼ turn at a time and not to exceed the maximum torque from Table A3-1.
7. If the maximum torque is reached and the connection still leaks, the bolts should be removed and the knife edges and gasket should be inspected for contamination and damage.

NOTE: For non-stainless-steel threads, the design engineer must evaluate thread pullout forces and bolt torque requirements for assuring a leak tight vacuum seal.

3 BOLT TIGHTENING PATTERNS

The following 4 figures show bolt tightening patterns to be used when tightening knife edge flanges on the MPEX project. For flange sizes not listed, please consult with the MPEX Vacuum Team.

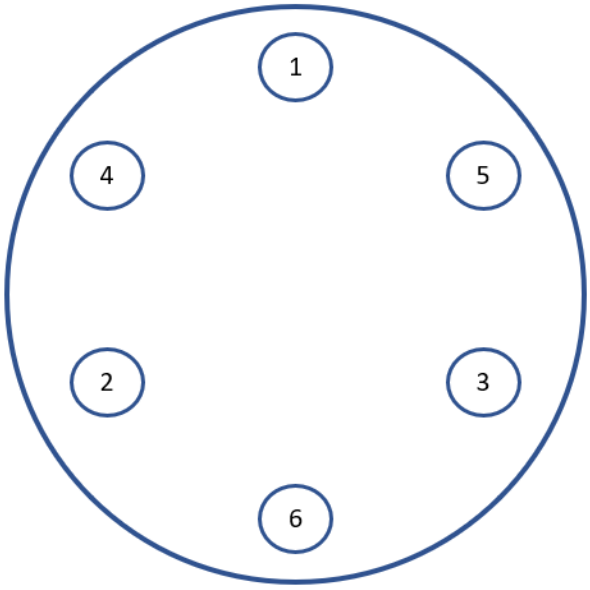


Figure A 3-1. 6 bolt flange tightening pattern

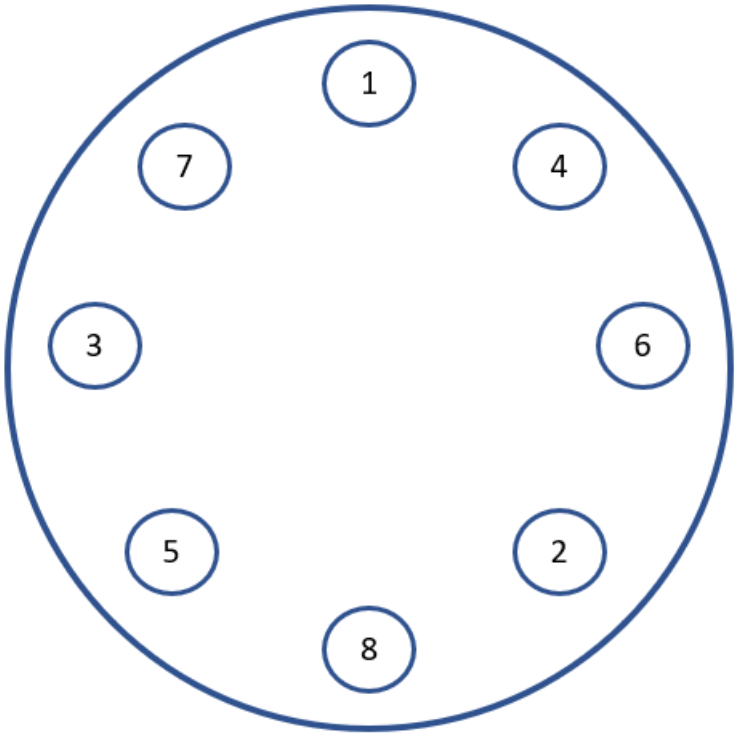


Figure A 3-2. 8 bolt flange tightening pattern

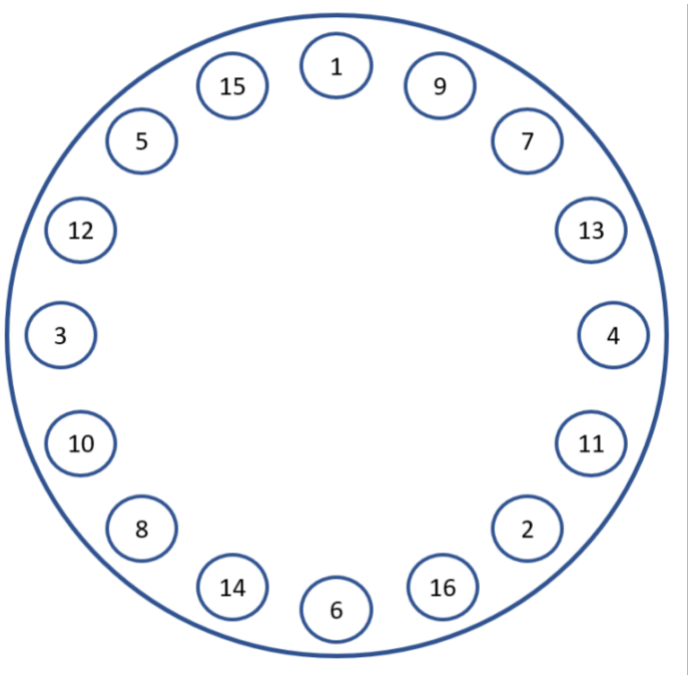


Figure A 3-3. 16 bolt flange tightening pattern

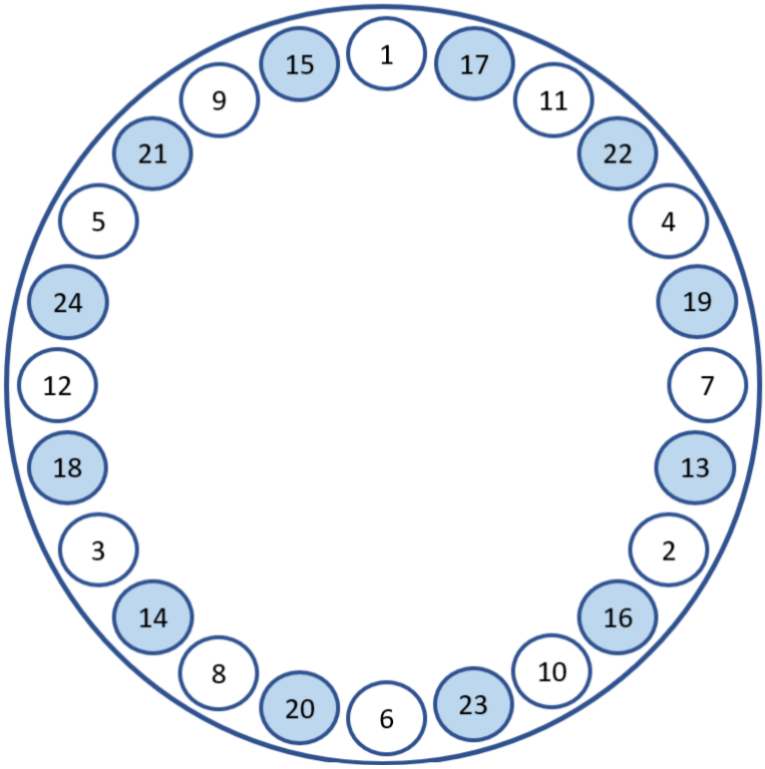


Figure A 3-4. 24 bolt flange tightening pattern