



Standard Specification for Dimensions of Knife-Edge Flanges¹

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1. Scope

1.1 This standard specifies the dimensions of knife-edge style flanges and their associated gaskets used in vacuum systems for pressures ranging from 10^5 Pa to 10^{-11} Pa. Such flanges are widely used throughout vacuum technology applications in semiconductor processing tools, surface analysis systems, space simulation systems, and general research requiring vacuum.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E673 Terminology Relating to Surface Analysis

2.2 *Other Standards:*³

ISO 4288:1996 Geometrical Product Specifications (GPS)—Surface Texture: Profile Method—Rules and Procedures for the Assessment of Surface Texture

3. Terminology

3.1 *Definitions*— For definitions used in this specification, see Terminology E673.

3.2 *Definitions of Terms Specific to This Standard:*

¹ This specification is under the jurisdiction of ASTM Committee E42 on Surface Analysis and is the direct responsibility of Subcommittee E42.13 on Vacuum Technology.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

3.3 *knife-edge flange, n*—Vacuum flanges seal with a metal gasket; two mating surfaces with identical circular (triangular profile) knife-edges are bolted together; a deformable metal gasket, captured between the knife-edges provides a leak-free seal.

3.3.1 *Discussion*—Vacuum flanges that seal with a metal gasket were originally developed as Conflat flanges (trade-mark) by the Varian Corporation.

3.4 *type, n*—Knife-edge flanges come in a variety of sizes; historically, the flange sizes were identified in North America as the flange's outside diameter (in inches) and in Europe as the maximum nominal bore of the tube (in millimetres) that might be welded to the flange; for this specification, the flange identification “type” is used where the type is approximately equal to the flange's outside diameter in inches.

4. Materials and Manufacture

4.1 *Flange*—Flanges must be manufactured from a sufficiently hard or hard-coated material to resist deformation of the knife-edge profile despite repeatedly forming a vacuum seal with metal gaskets.

4.2 *Gasket*—Gasket must be manufactured from a soft, annealed, or partially-tempered metal such that the mating flanges' knife-edges cause sufficient (initial) plastic deformation that a vacuum seal is accomplished.

5. Dimensions, Mass, and Permissible Variations

5.1 **Figs. 1-3 and Tables 1 and 2** contain the required dimensions and tolerances for rotatable and non-rotatable knife-edge vacuum flanges.

6. Workmanship, Finish, and Appearance

6.1 Knife-edge vacuum flanges are typically used in applications which require: (1) a high degree of leak integrity, and (2) the lowest possible contamination from outgassing. To achieve both characteristics, the finish of the flanges' knife-edges and gaskets must be free of visible cracks, pits, inclusions, scratches, and foreign materials. The knife-edge surfaces must have a 32 RMS finish or better as measured using ISO 4288:1996.

7. Keywords

7.1 flange; rotatable flange; vacuum seal; gasket; knife-edge; vacuum hardware; metal seal; vacuum fitting; metal gasket; outgassing

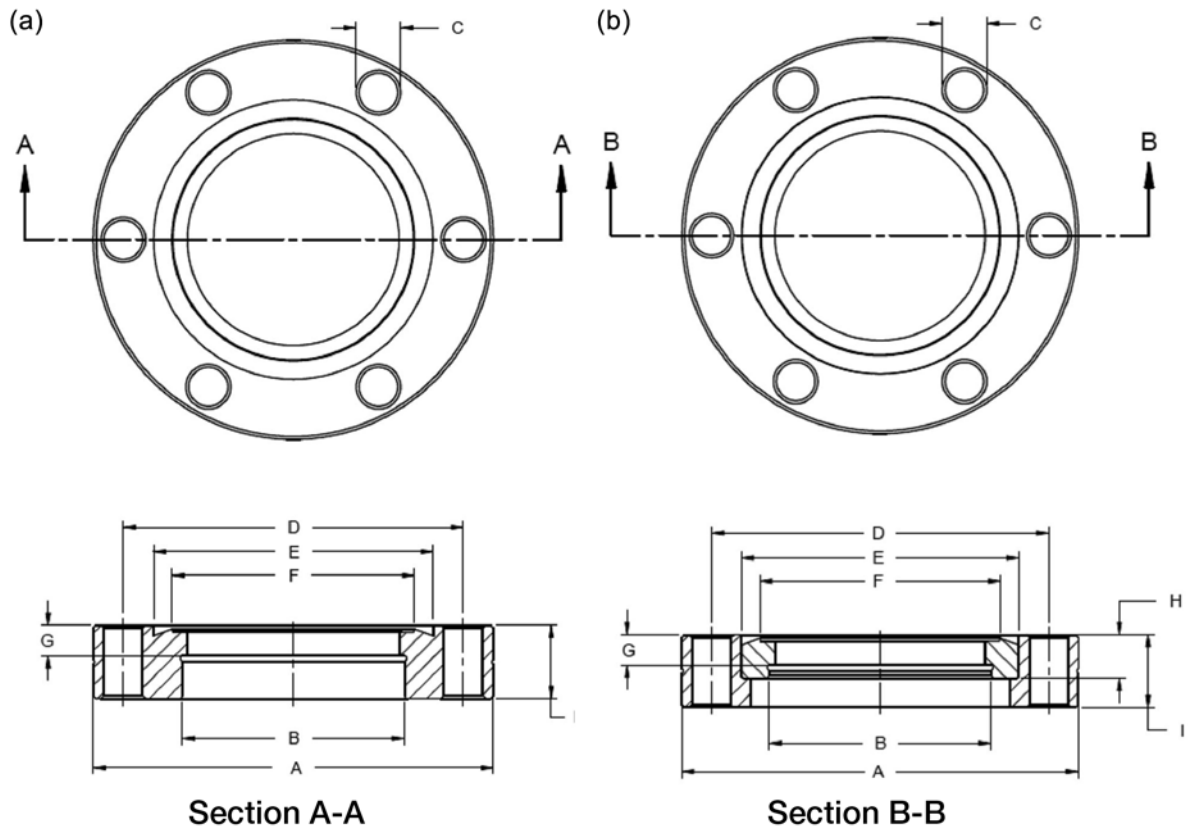


FIG. 1 Flange Dimensions: (a) Non-Rotatable Flange (b) Rotatable Flange

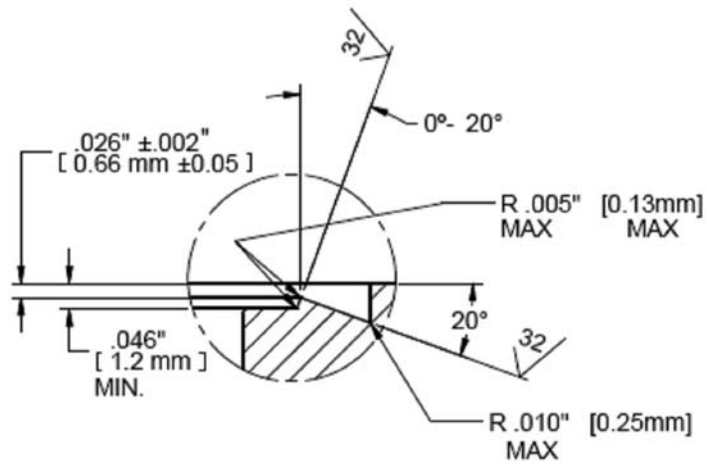


FIG. 2 Knife-Edge Detail



FIG. 3 Knife-Edge Gasket Dimensions

TABLE 1 Knife-Edge Flange Dimension

		A		B		C						D				E		F		G		H		I		
Type	Nominal Bore	Nominal Outside Diameter Tolerance ±0.030 in. (±0.75 mm)		Max Tube Diameter		Number of Bolt Holes		Bolt Hole Diameter		Bolt Thread		Bolt Circle		Position Tolerance of Bolt Holes		Seal Recess Diameter Tolerance ±0.004 in. (±0.10 mm)		Knife Edge Diameter Tolerance ±0.004 in. (±0.10 mm)		Setback Flange Face to Tube Seat Tolerance ±0.005 in. (±0.12 mm)		Depth of Receiver Seat for Insert (Max)		Flange Thickness (Min)		
		mm	in.	mm	in.			Min, mm	Max, mm	Min, in.	Max, in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	
1 in. OD	10CF	25.40	1.000	12.0	0.472	6	3.3	3.5	0.130	0.138	m3-05	n/a	17.5	0.689	0.1	0.004	13.49	0.531	10.49	0.413	3.00	0.118	n/a	n/a	6.0	0.236
1 1⁄8 in. OD	16CF	33.86	1.333	19.3	0.760	6	4.3	4.6	0.171	0.180	m4-07	#8-32	27.0	1.062	0.2	0.009	21.39	0.842	18.29	0.720	4.57	0.180	6.50	0.256	6.6	0.260
2 1⁄8 in. OD	25CF	53.98	2.125	25.7	1.010	4	6.7	6.9	0.264	0.273	m6-1.0	1⁄4 -28	41.3	1.625	0.2	0.009	33.02	1.300	27.69	1.090	4.32	0.170	7.06	0.278	11.4	0.450
2 3⁄4 in. OD	35CF	69.85	2.750	44.5	1.750	6	6.7	6.9	0.264	0.273	m6-1.0	1⁄4 -28	58.7	2.312	0.2	0.009	48.31	1.902	41.91	1.650	5.31	0.209	7.75	0.305	12.2	0.480
3 3⁄8 in. OD	50CF	85.73	3.375	51.0	2.008	8	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	72.4	2.850	0.2	0.009	61.75	2.431	55.88	2.200	5.72	0.225	9.80	0.386	15.2	0.600
4 1⁄2 in. OD	63CF	114.30	4.500	70.0	2.755	8	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	92.2	3.628	0.2	0.009	82.58	3.251	77.22	3.040	9.53	0.375	12.83	0.505	16.8	0.660
4 7⁄8 in. OD	75CF	117.48	4.625	76.2	3.000	10	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	102.4	4.030	0.2	0.009	91.69	3.610	85.14	3.352	9.53	0.375	13.13	0.517	18.5	0.730
6 in. OD	100CF	152.40	6.000	108.0	4.250	16	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	130.3	5.128	0.2	0.009	120.65	4.750	115.32	4.540	11.10	0.437	14.43	0.568	19.3	0.760
6 3⁄4 in. OD	125CF	171.45	6.750	127.0	5.000	18	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	151.6	5.969	0.2	0.009	141.73	5.580	136.35	5.368	11.68	0.460	15.54	0.612	20.8	0.820
8 in. OD	160CF	203.20	8.000	159.0	6.260	20	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	181.1	7.128	0.2	0.009	171.45	6.750	166.12	6.540	12.70	0.500	15.95	0.628	21.8	0.860
10 in. OD	200CF	254.00	10.000	206.0	8.110	24	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	231.9	9.128	0.2	0.009	222.28	8.751	216.92	8.540	12.70	0.500	17.25	0.679	24.1	0.950
12 in. OD	250CF	304.80	12.000	256.0	10.079	32	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	284.0	11.180	0.2	0.009	273.20	10.756	267.72	10.540	12.70	0.500	17.96	0.750	24.5	0.964
12 1⁄2 in. OD	265CF	317.50	12.500	267.0	10.512	30	8.4	8.6	0.331	0.340	m8-1.25	5⁄16 -24	295.0	11.614	0.2	0.009	285.19	11.228	280.01	11.024	12.70	0.500	18.69	0.736	24.5	0.964
13 1⁄4 in. OD	275CF	336.55	13.250	273.4	10.765	30	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	306.3	12.060	0.2	0.009	294.54	11.596	288.24	11.348	12.70	0.500	19.91	0.784	27.9	1.100
14 in. OD	295CF	355.60	14.000	306.0	12.047	30	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	325.3	12.809	0.2	0.009	313.36	12.337	308.03	12.127	12.70	0.500	19.91	0.784	28.3	1.114
14 1⁄4 in. OD	300CF	362.00	14.252	306.0	12.047	36	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	334.0	13.150	0.2	0.009	321.45	12.656	316.30	12.453	16.00	0.630	n/a	n/a	30.0	1.181
14 1⁄2 in. OD	305CF	368.30	14.500	306.0	12.047	32	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	338.1	13.311	0.2	0.009	326.40	12.850	320.00	12.598	12.70	0.500	10.03	0.395	28.0	1.102
16 1⁄2 in. OD	350CF	419.10	16.500	356.1	14.020	36	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	388.9	15.310	0.2	0.009	377.01	14.843	370.79	14.598	12.70	0.500	20.83	0.820	28.0	1.102
18 in. OD	400CF	457.20	18.000	406.5	16.004	36	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	431.8	17.000	0.2	0.009	419.30	16.508	414.00	16.299	15.88	0.625	n/a	n/a	28.5	1.122
18 1⁄2 in. OD	405CF	469.90	18.500	406.5	16.004	40	10.6	10.8	0.418	0.425	m10-1.5	3⁄8 -24	437.9	17.240	0.2	0.009	424.40	16.709	419.00	16.496	15.88	0.625	20.83	0.820	28.0	1.102

TABLE 2 Knife-Edge Gasket Dimension

Type	Thickness, L		Inside Diameter, J		Outside Diameter, K	
	in. Tolerance ± 0.003	mm Tolerance ± 0.07	in. Max	mm Max	in. Tolerance $+0.002, -0.002$	mm Tolerance ± 0.05
1 in. OD	0.080	2.03	0.335	8.5	0.524	13.31
1½ in. OD	0.080	2.03	0.643	16.3	0.838	21.29
2½ in. OD	0.080	2.03	1.013	25.7	1.290	32.77
2¾ in. OD	0.080	2.03	1.533	38.9	1.895	48.13
3¾ in. OD	0.080	2.03	2.015	51.2	2.425	61.60
4½ in. OD	0.080	2.03	2.813	71.5	3.243	82.37
4¾ in. OD	0.080	2.03	3.015	76.6	3.598	91.39
6 in. OD	0.080	2.03	4.009	101.8	4.743	120.47
6¾ in. OD	0.080	2.03	5.013	127.3	5.568	141.43
8 in. OD	0.080	2.03	6.010	152.7	6.743	171.27
10 in. OD	0.080	2.03	8.010	203.5	8.743	222.07
12 in. OD	0.080	2.03	10.007	254.2	10.749	273.02
12½ in. OD	0.080	2.03	10.500	266.7	11.221	285.01
13¼ in. OD	0.080	2.03	10.857	275.8	11.589	294.36
14 in. OD	0.080	2.03	11.813	300.1	12.330	313.18
14¼ in. OD	0.080	2.03	12.016	305.2	12.638	321.01
14½ in. OD	0.080	2.03	12.107	307.5	12.843	326.21
16½ in. OD	0.080	2.03	14.107	358.3	14.836	376.83
18 in. OD	0.080	2.03	15.807	401.5	16.501	419.13
18½ in. OD	0.080	2.03	15.970	405.6	16.702	424.23

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