

Flanges & Fittings

Section Two

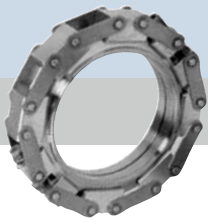


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Nor-Cal Products, Inc.
1967 South Oregon Street
Yreka, CA 96097 USA

Tel: **800-824-4166**
or 530-842-4457
Main Fax: 530-842-9130
Sales Fax: 530-841-9189
www.n-c.com





Flanges & Fittings

Chain Clamp Component General Information

SPECIFICATIONS

Tube OD sizes: $\frac{3}{4}$ to 4 inches

Materials

Flange: 304 stainless steel
Seal: Aluminum

Vacuum range: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range: -270°C to 150°C

All dimensions are in inches unless otherwise noted



Nor-Cal Products stocks a complete line of chain clamps and aluminum metal seals for converting elastomer seal NW (KF) and ISO flanges to UHV metal seals. They provide a number of benefits over elastomer seals: reduced outgassing, no permeation, no hydrocarbons, resistance to radiation and short half-life. Aluminum seals are used in high-energy physics, other UHV applications and, in some circumstances, cryogenic applications. Aluminum seals are reliable in high vibration or temperature cycling environments. Chain clamps and NW flanges are the standard vacuum flange for many Japanese semiconductor equipment manufacturers. The advantages over using the standard ISO flange are the time and space savings during assembly and the flexibility to form high vacuum or UHV seals.

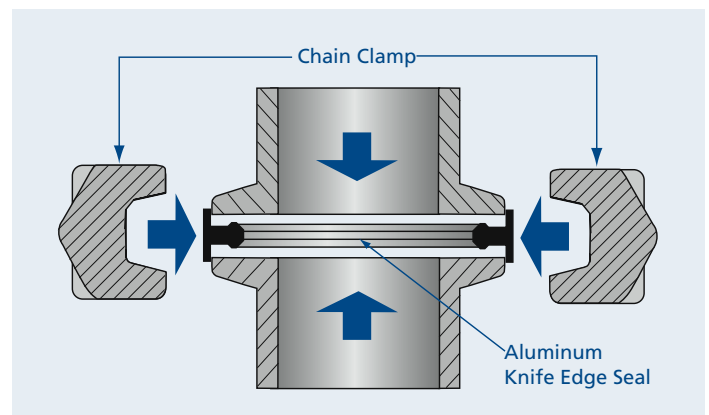
To install a metal seal on an existing NW flange, simply remove the standard clamp, centering ring and O-ring assembly. Replace them with an aluminum knife edge seal and chain clamp. (See diagram.). Standard ISO claw clamps can be used with aluminum seals to convert ISO flanges from high vacuum to UHV. Nor-Cal's large NW flanges are available in 63, 80 and 100 NW sizes from stock. Chain clamps are used to form either elastomer or metal seals with large NW flanges.

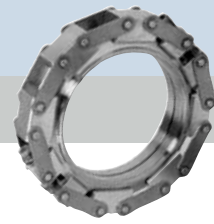
Aluminum Metal Seals

Aluminum seals locate on the centering ring groove (inner centering) or outside edge of the flange (outer centering) depending on the size. (Inner and outer centering versions are available for all NW flange sizes.) Aluminum knife-edges are compressed by the sealing surfaces of the mating flanges when the chain clamp or ISO claw clamp is tightened. The resultant seal has a helium leak rate of less than 1×10^{-11} standard cc/sec. and can be baked repeatedly to 150°C. Proper sealing occurs even if the flanges are slightly scratched or misaligned. The aluminum alloy is soft enough to make a good seal with reasonable force but will not flow at moderate temperatures. Seals will even work with aluminum flanges.

Large NW Flanges

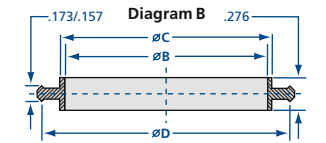
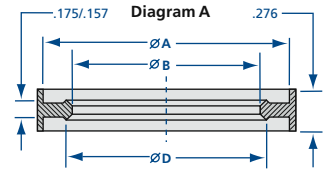
Nor-Cal offers blank and bored NW-63, NW-80 and NW-100 flanges that are compatible with other manufacturers' large QF, KF flanges made to the ISO 2961 specification. They can be used with chain clamps to form elastomer or aluminum metal seals. Elastomer seals are formed with standard ISO centering ring/O-ring assemblies and elastomer chain clamps. UHV connections are formed with aluminum metal seals and chain clamps intended for use with them. NW flanges are made from 304 stainless steel for 2.5 to 4.0 inch OD tube sizes. Flanges for tube sizes up to 28 inches OD or metric tube sizes can be supplied.





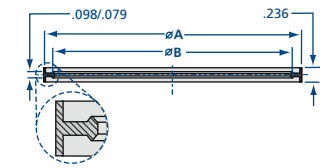
Aluminum Metal Seals for NW 16-63 Flanges

MODEL NUMBER	DIAGRAM	FLANGE	A	B	C	D
NW-16-MS-A	A	NW-16	1.18	0.63	-	0.91
NW-25-MS-A	A	NW-25	1.58	0.96	-	1.30
NW-40-MS-A	A	NW-40	2.16	1.58	-	1.89
NW-50-MS-A	B	NW-50	-	1.97	2.05	2.32
NW-63-MS-A	B	NW-63	-	2.68	2.76	3.03



Aluminum Metal Seals for NW 80-100 Flanges

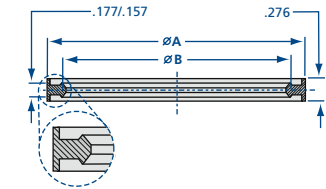
MODEL NUMBER	FLANGE	A	B
NW-80-MS-A	NW-80 Tapered	4.49	4.25
NW-100-MS-A	NW-100 Tapered	5.28	5.04



Aluminum Metal Seals for ISO Flanges

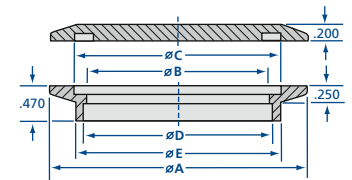
MODEL NUMBER	FLANGE	A	B	TORQUE (LB. IN.)	NUMBER CLAMPS*
ISO-63-MS-A	ISO-63	3.74	3.47	100	4
ISO-80-MS-A	ISO-80	4.33	4.06	100	6
ISO-100-MS-A	ISO-100	5.12	4.84	100	8

*Use with Nor-Cal ISO double or single claw clamps.



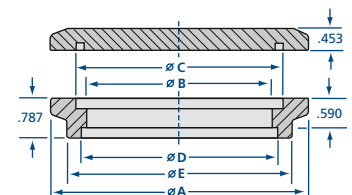
NW-63 Flanges

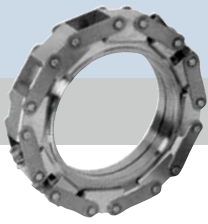
MODEL NUMBER	DESCRIPTION	A	B	C	D	E
NW-63-250	Bored for 2 1/2 inch tube OD	3.43	2.44	2.76	2.51	2.71
NW-63B	Blank	3.43	-	2.76	-	-



NW 80-100 Flanges

MODEL NUMBER	DESCRIPTION	A	B	C	D	E
NW-80-300	Bored for 3 inch tube OD	4.49	2.87	3.27	3.01	3.82
NW-80B	Blank	4.49	-	3.27	-	-
NW-100-400	Bored for 4 inch tube OD	5.28	3.87	4.02	4.01	4.61
NW-100B	Blank	5.28	-	4.02	-	-

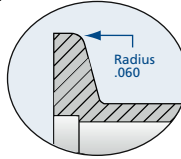




Flanges & Fittings

Chain Clamps

Nor-Cal Products stocks chain clamps for NW flanges in two styles: one with Teflon coated aluminum links and an uncoated version. The less expensive uncoated version is the preferred choice for sealing standard NW flanges with aluminum metal seals. The uncoated chain clamps can be used with Nor-Cal or other manufacturers' NW flanges with a radius of approximately .060 of an inch on the outer edge of the



non-sealing side. Most manufacturers' NW flanges have this feature. If the flanges to be sealed have a sharp edge, the Teflon coated chain clamps are required to ensure adequate sealing force for aluminum metal seals. Both versions use a single, hex head nut for closure. Stainless steel chain clamps and low cost composite chain clamps are available for elastomer NW connections.

Chain clamps for NW-63 flanges are similar to the NW-16 to 50 sizes. The style to use with NW-63 elastomer seals has a single knob for tightening. The clamp

used for sealing aluminum metal seals has a single hex head nut. Both have uncoated aluminum links, although Teflon coated aluminum versions are available.

Chain clamps for 80 to 100mm flanges are stocked in two styles: one with a single knob for elastomer seals and another with two allen head bolts for aluminum metal seals. Although chain clamps are bakeable to 150°C, the knobs should not be baked above 60°C. Chain clamps for tube sizes up to 28 inch OD can be supplied on request.

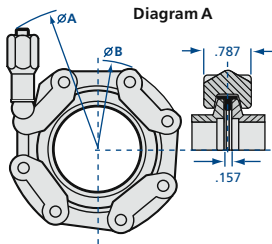


Diagram A

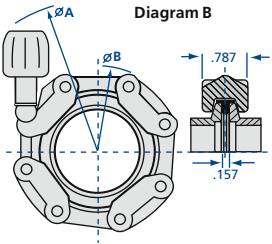


Diagram B

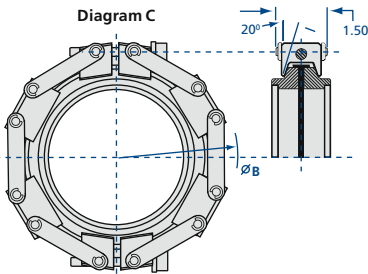


Diagram C

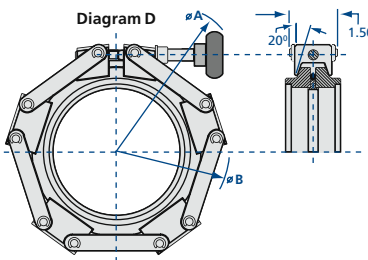


Diagram D

Chain Clamps for NW-16 to 50 Flanges – Aluminum Links

MODEL NUMBER	DIAGRAM	APPLICATION	A	B	MAXIMUM TEMPERATURE	TORQUE (LB. IN.) ELASTOMER / METAL
NW-16-CC-AN	A	Metal or Elastomer Seals	4.53	2.36	150°C	9 / 22
NW-25-CC-AN	A	Metal or Elastomer Seals	4.92	2.76	150°C	13 / 26
NW-40-CC-AN	A	Metal or Elastomer Seals	5.32	3.35	150°C	18 / 39
NW-50-CC-AN	A	Metal or Elastomer Seals	5.98	4.13	150°C	22 / 44

Chain Clamps for NW-16 to 50 Flanges - Teflon Coated Links*

MODEL NUMBER	DIAGRAM	APPLICATION	A	B	MAXIMUM TEMPERATURE	TORQUE (LB. IN.) ELASTOMER / METAL
NW-16-CC-TN	A	No radius, metal/elastomer	4.53	2.36	150°C	9 / 22
NW-25-CC-TN	A	No radius, metal/elastomer	4.92	2.76	150°C	13 / 26
NW-40-CC-TN	A	No radius, metal/elastomer	5.32	3.35	150°C	18 / 39
NW-50-CC-TN	A	No radius, metal/elastomer	5.98	4.13	150°C	22 / 44

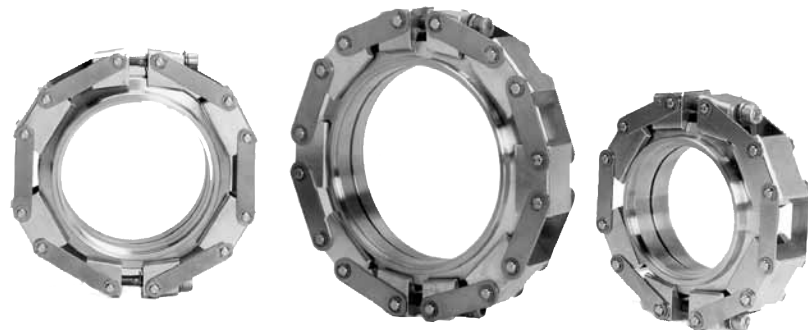
*Not radiation resistant

Chain Clamps for NW-63 Flanges

MODEL NUMBER	DIAGRAM	APPLICATION	A	B	MAXIMUM TEMPERATURE	TORQUE (LB. IN.) ELASTOMER / METAL
NW-63-CCV-AN	B	Elastomer seals only	6.69	4.72	100°C	-
NW-63-CC-AN	A	Metal or elastomer seals	6.30	4.72	150°C	22 / 44

Chain Clamps for NW-80 to 100 Flanges

MODEL NUMBER	DIAGRAM	APPLICATION	A	B	MAXIMUM TEMPERATURE	TORQUE (LB. IN.)
NW-80-CCV-AS	D	Elastomer seals only	9.61	6.06	150°C	-
NW-80-CC-TS	C	Metal seals only	-	6.30	150°C	75
NW-100-CCV-AS	D	Elastomer seals only	10.08	6.77	150°C	-
NW-100-CC-TS	C	Metal seals only	-	7.09	150°C	88



Flanges & Fittings

NW Flange General Information



SPECIFICATIONS

Tube OD sizes: 3/8 to 2 inches

Materials

Flange: 304 or 316L stainless steel
O-rings: Viton, Buna & silicone

Fittings

Tube finishes: Beadblast standard
(Tumbled & electropolish available)

Fasteners: Wingnut, SureSeal,
bulkhead & chain clamps

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

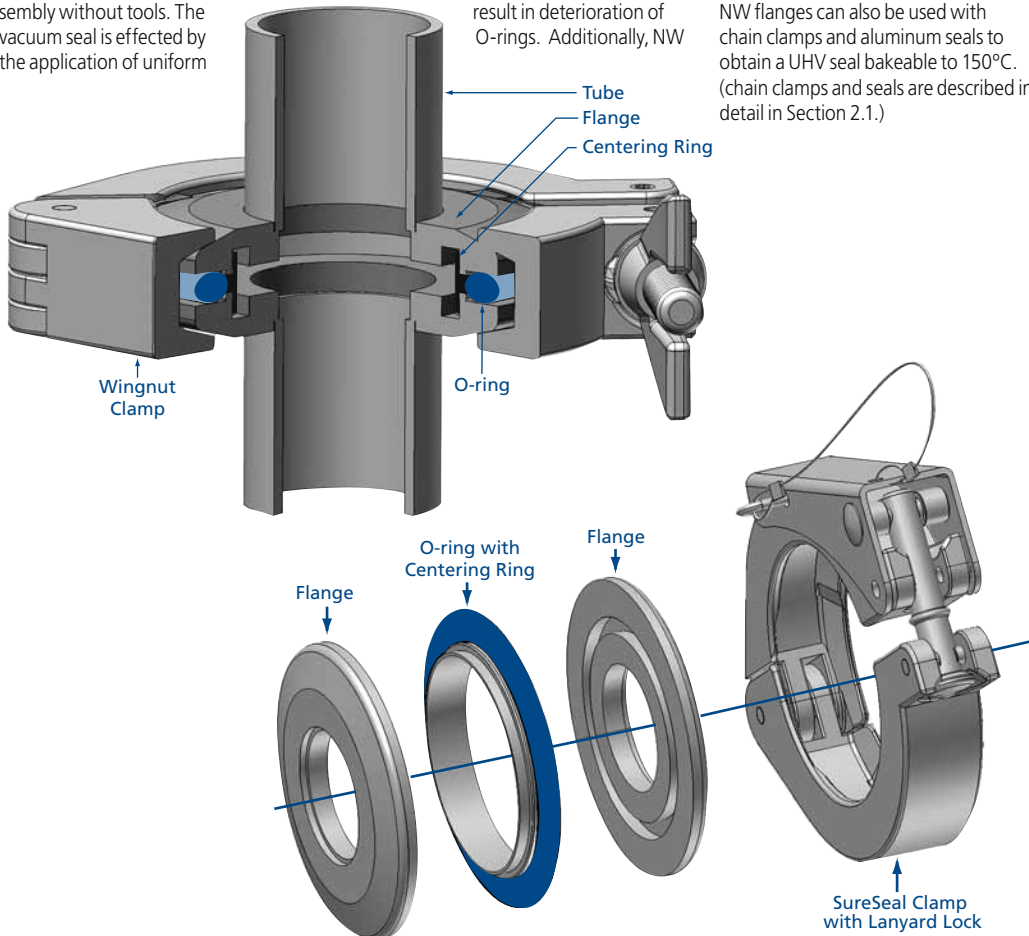
Temperature range

Viton: -20°C to 200°C
Silicone: -50° to 230°C
Buna: -30°C to 110°C
Metal seal: -270°C to 150°C

Nor-Cal NW flanges are designed to ISO 2861 specifications for standard USA tube sizes from 3/8 to 2 inches OD. They are compatible with other manufacturers' ISO-KF style flanges. NW flanges utilize an aluminum clamp with a single wingnut fastener or a lock-over-center clamp allowing frequent disassembly without tools. The vacuum seal is effected by the application of uniform

pressure from the clamp on the 15° surface of the 304 stainless steel flanges. The mating flange surfaces compress a Viton O-ring held in place by a centering ring. The resultant seal can be used in vacuum applications of up to 10^{-8} Torr and baked to 204°C, however sustained baking above 150°C may result in deterioration of O-rings. Additionally, NW

flanges allow components to be rotated before assembly for ease of component alignment. NW flanges are available on virtually all Nor-Cal components and fittings. Nor-Cal manufactures a full line of NW adapters so you can add to or build an entire system with NW components. (See adapters - Section 5.) NW flanges can also be used with chain clamps and aluminum seals to obtain a UHV seal bakeable to 150°C. (chain clamps and seals are described in detail in Section 2.1.)



New Products

Trapped Centering Rings



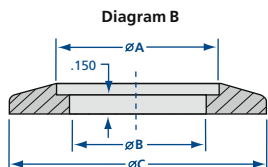
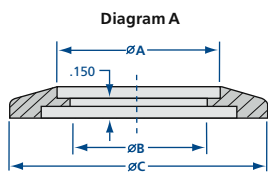
Nor-Cal trapped centering rings for NW flanges feature easy assembly with exact centering and are appropriate for vacuum or pressure by externally supporting the sealing ring. Trapped O-rings are intended for use where pressures range from rough vacuum to above atmosphere. Applications include vacuum pump exhaust lines and abatement tools.

All dimensions are in inches unless otherwise noted



Flanges & Fittings

NW Bored Blank Flanges & Blank Off Caps



NW Bored Blank Flanges (NWB)

MODEL NUMBER	DIAGRAM	TUBE OD	A	B	C
NW-10B-038	A	$\frac{3}{8}$	0.380	0.326	1.180
NW-10B-050	A	$\frac{1}{2}$	0.510	0.451	1.180
NW-16B-038	A	$\frac{3}{8}$	0.380	0.326	1.180
NW-16B-050	A	$\frac{1}{2}$	0.510	0.451	1.180
NW-16B-075	B	$\frac{3}{4}$	0.760	0.680	1.180
NW-25B-038	A	$\frac{3}{8}$	0.380	0.326	1.575
NW-25B-050	A	$\frac{1}{2}$	0.510	0.451	1.575
NW-25B-075	A	$\frac{3}{4}$	0.760	0.715	1.575
NW-25B-100	A	1	1.010	0.938	1.575
NW-40B-038	A	$\frac{3}{8}$	0.380	0.326	2.160
NW-40B-050	A	$\frac{1}{2}$	0.510	0.451	2.160
NW-40B-075	A	$\frac{3}{4}$	0.760	0.715	2.160
NW-40B-100	A	1	1.010	0.938	2.160
NW-40B-150	A	$1\frac{1}{2}$	1.510	1.438	2.160
NW-50B-038	A	$\frac{3}{8}$	0.380	0.326	2.950
NW-50B-050	A	$\frac{1}{2}$	0.510	0.451	2.950
NW-50B-075	A	$\frac{3}{4}$	0.760	0.715	2.950
NW-50B-100	A	1	1.010	0.938	2.950
NW-50B-150	A	$1\frac{1}{2}$	1.510	1.438	2.950
NW-50B-200	A	2	2.010	1.938	2.950

NW 316L Stainless Steel Bored Blank Flanges (NWB)

MODEL NUMBER	DIAGRAM	TUBE OD	A	B	C
NW-25B-100-316L	A	1	1.010	0.938	1.575
NW-40B-150-316L	A	$1\frac{1}{2}$	1.510	1.438	2.160
NW-50B-200-316L	A	2	2.010	1.938	2.950

SPECIFICATIONS

Tube OD sizes: $\frac{3}{8}$ to 2 inches

Materials

Flange: 304 or 316L stainless steel
O-rings: Viton, Buna & silicone

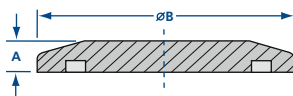
Fasteners: Wingnut, SureSeal, bulkhead & chain clamps

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C
Silicone: -50°C to 230°C
Buna: -30°C to 110°C
Metal seal: -270°C to 150°C



Blank Off Caps

MODEL NUMBER	A	B
NW-10B	0.200	1.180
NW-16B	0.200	1.180
NW-25B	0.200	1.575
NW-40B	0.200	2.160
NW-50B	0.200	2.950

316L Blank Off Caps

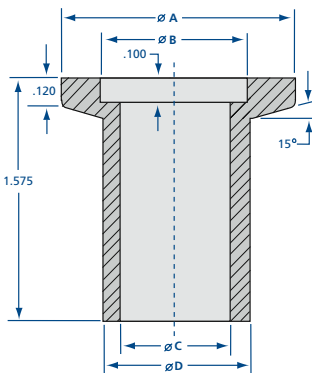
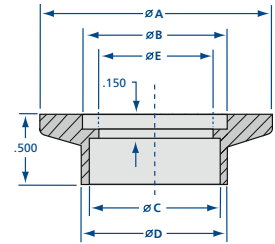
MODEL NUMBER	A	B
NW-16B-316L	0.200	1.180
NW-25B-316L	0.200	1.575
NW-40B-316L	0.200	2.160
NW-50B-316L	0.200	2.950

See Section 2.1 for metal seals



NW Socket Weld Flanges

MODEL NUMBER	TUBE OD	A	B	C	D	E
NW-10-SW	1/2	1.180	0.480	0.510	0.640	-
NW-16-SW	3/4	1.180	0.680	0.760	0.798	-
NW-25-SW	1	1.575	1.031	1.010	1.140	0.938
NW-40-SW	1 1/2	2.160	1.620	1.510	1.640	1.438
NW-50-SW	2	2.950	2.060	2.010	2.140	1.938



NW Long Weld Neck Flanges

MODEL NUMBER	A	B	C	D
NW-10FL	1.180	0.480	0.380	1/2
NW-16FL	1.180	0.680	0.625	3/4
NW-25FL	1.575	1.031	0.870	1
NW-40FL	2.160	1.620	1.370	1 1/2
NW-50FL	2.950	2.060	1.870	2

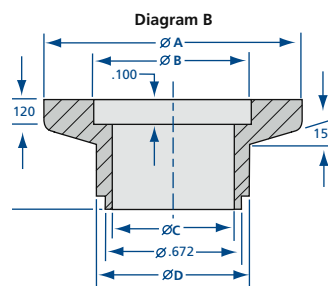
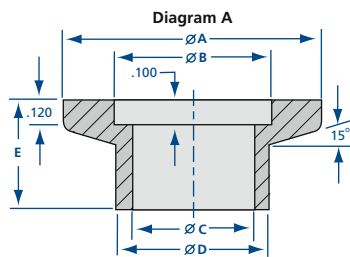
NW 316L Stainless Steel Long Weld Neck Flanges

MODEL NUMBER	A	B	C	D
NW-25FL-316L	1.575	1.031	0.870	1
NW-40FL-316L	2.160	1.620	1.370	1 1/2
NW-50FL-316L	2.950	2.060	1.870	2



NW Short Weld Neck Flanges

MODEL NUMBER	DIAGRAM	TUBE OD	A	B	C	D	E
NW-10F	A	1/2	1.180	0.480	0.380	1/2	0.500
NW-16F	B	3/4	1.180	0.680	0.625	3/4	0.560
NW-16FB	A	3/4	1.180	0.680	0.625	3/4	0.500
NW-25F	A	1	1.575	1.031	0.870	1	0.500
NW-40F	A	1 1/2	2.160	1.620	1.370	1 1/2	0.750
NW-50F	A	2	2.950	2.060	1.870	2	0.750



SPECIFICATIONS

Tube OD sizes: 3/8 to 2 inches

Materials

Flange: 304 or 316L stainless steel
O-rings: Viton, Buna & silicone

Fasteners: Wingnut, SureSeal, bulkhead & chain clamps

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C
Silicone: -50° to 230°C
Buna: -30°C to 110°C
Metal seal: -270°C to 150°C

See Section 2.1 for metal seals

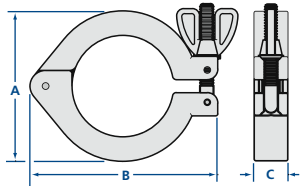
Flanges & Fittings

NW Assembly Hardware



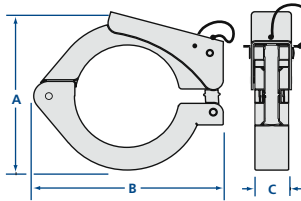
Nor-Cal Wing Nut and SureSeal NW Clamps feature special centering ribs and evenly distributed clamping force to assure uniform O-ring compression and reduce the probability of failure under loads. Additional hinge knuckles and tighter manufacturing tolerances result in precise alignment and reduced side play. Clamp opening is limited to facilitate one-handed installation in hard-to-reach spaces. In addition to the above features, the SureSeal clamp provides instant closure with a fixed geometry to attain optimal O-ring compression. All Nor-Cal NW clamps are designed and manufactured to meet Pneurop specifications for ISO-KF 10 through 50 flanges, so you can be confident of universal compatibility. We also provide chain clamps and metal seals for ISO-KF components to transform them from high vacuum to ultra-high vacuum connections.

NW Wing Nut Clamps



MODEL NUMBER	A	B	C
NW-10-CP	1.690	2.392	0.625
NW-16-CP	1.690	2.392	0.625
NW-25-CP	2.140	2.796	0.625
NW-40-CP	2.750	3.437	0.625
NW-50-CP	3.500	4.245	0.710

NW SureSeal Clamps



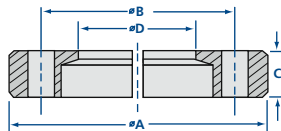
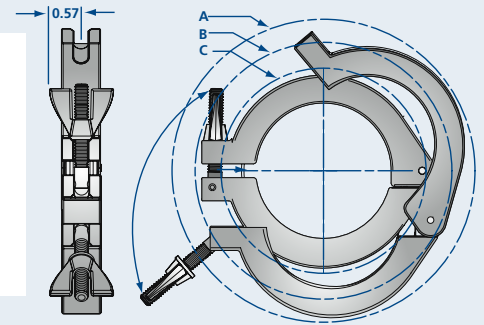
MODEL NUMBER	A	B	C
NW-10-SSC	1.750	2.392	0.741
NW-16-SSC	1.750	2.392	0.741
NW-40-SSC	2.947	3.437	0.741
NW-50-SSC	3.784	4.245	0.836

NW SureSeal Clamps with Lanyard

MODEL NUMBER	A	B	C
NW-10-SSC-L	1.750	2.392	0.741
NW-16-SSC-L	1.750	2.392	0.741
NW-40-SSC-L	2.947	3.437	0.741
NW-50-SSC-L	3.784	4.245	0.836

NW Clamp Clearance Details

CLAMP	FLANGE	MIN. DIA. TO INSTALL A	MAX. DIA. CLOSED B	MIN. DIA. CLOSED C
NW-10-CP	NW-10B	2.86	2.65	1.75
NW-16-CP	NW-16B	2.86	2.65	1.75
NW-25-CP	NW-25B	3.32	3.00	2.24
NW-40-CP	NW-40B	4.00	3.72	2.90
NW-50-CP	NW-50B	5.45	4.62	3.69

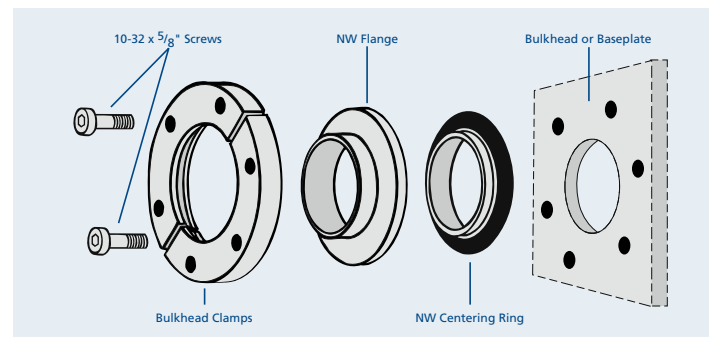


NW Bulkhead Clamps

MODEL NUMBER	A	B	C	NUMBER OF SCREWS	THROUGH HOLE D
NW-16-BCP	2.00	1.50	0.361	6	0.90
NW-25-BCP	2.37	1.89	0.387	6	1.26
NW-40-BCP	2.94	2.44	0.366	6	1.84
NW-50-BCP	3.75	3.25	0.404	8	2.35



Bulkhead clamps provide a simple means of fastening an NW flange to a baseplate. Each aluminum clamp is sold with stainless steel socket head cap screws and washers for attachment. Leave 0.075 inch minimum between the bottom of the tapped hole and the inside of the chamber wall.

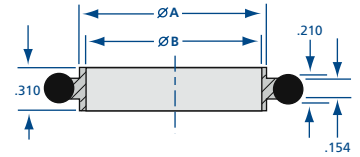




Nor-Cal offers aluminum and stainless steel centering rings for NW and ISO flanges. Buna, silicone and Viton O-rings are available for NW, while Buna and Viton are stocked for ISO centering rings. Aluminum ISO centering rings are provided with an aluminum spacer ring. Stainless steel ISO centering rings are also provided with aluminum spacer rings as an option.

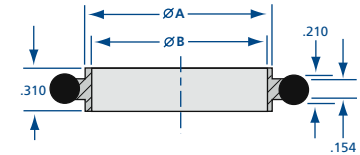
NW Aluminum Centering Rings with O-ring

MODEL NUMBER	O-RING MATERIAL	A	B
NW-10-CR-AV	Viton	0.478	0.456
NW-10-CR-AB	Buna	0.478	0.456
NW-16-CR-AV	Viton	0.669	0.625
NW-16-CR-AB	Buna	0.669	0.625
NW-25-CR-AV	Viton	1.024	0.984
NW-25-CR-AB	Buna	1.024	0.984
NW-40-CR-AV	Viton	1.614	1.570
NW-40-CR-AB	Buna	1.614	1.570
NW-50-CR-AV	Viton	2.047	1.967
NW-50-CR-AB	Buna	2.047	1.967



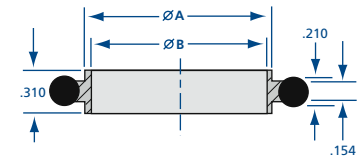
NW Stainless Steel Centering Rings with O-ring

MODEL NUMBER	O-RING MATERIAL	A	B
NW-10-CR-SV	Viton	0.478	0.456
NW-10-CR-SS	Silicone	0.478	0.456
NW-10-CR-SB	Buna	0.478	0.456
NW-16-CR-SV	Viton	0.669	0.625
NW-16-CR-SS	Silicone	0.669	0.625
NW-16-CR-SB	Buna	0.669	0.625
NW-25-CR-SV	Viton	1.024	0.984
NW-25-CR-SS	Silicone	1.024	0.984
NW-25-CR-SB	Buna	1.024	0.984
NW-40-CR-SV	Viton	1.614	1.570
NW-40-CR-SS	Silicone	1.614	1.570
NW-40-CR-SB	Buna	1.614	1.570
NW-50-CR-SV	Viton	2.047	1.967
NW-50-CR-SS	Silicone	2.047	1.967
NW-50-CR-SB	Buna	2.047	1.967

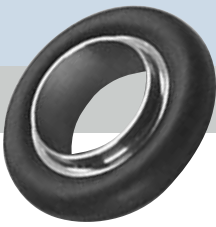


NW 316L Stainless Steel Centering Rings with O-ring

MODEL NUMBER	O-RING MATERIAL	A	B
NW-25-CR-SV-316L	Viton	1.024	0.984
NW-40-CR-SV-316L	Viton	1.614	1.570
NW-50-CR-SV-316L	Viton	2.047	1.967

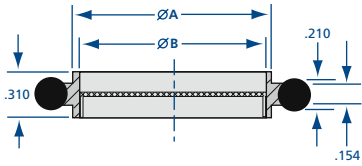


See page 26 for replacement O-rings



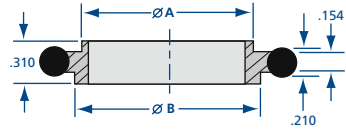
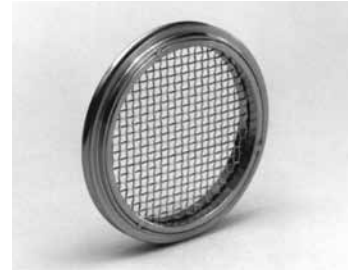
Flanges & Fittings

NW Centering Rings & Replacement O-rings



NW Screened Stainless Steel Centering Rings with Viton O-ring

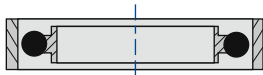
MODEL NUMBER	O-RING MATERIAL	A	B	MESH
NW-25-CR-SV-74	Viton	1.024	0.984	74
NW-40-CR-SV-74	Viton	1.614	1.570	74
NW-50-CR-SV-74	Viton	2.047	1.967	74



NW Reducer Stainless Steel Centering Rings with Viton O-ring

MODEL NUMBER	O-RING MATERIAL	A	B
NW-10/16-CR	Viton	0.48	0.67
NW-20/25-CR	Viton	0.87	1.02
NW-32/40-CR	Viton	1.34	1.61

Buna and Silicone O-rings available. Call for pricing.

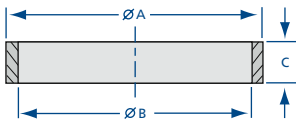


For dimensions refer to the centering ring/O-ring assembly drawing on the previous page and the overpressure ring diagram this page.

NW Stainless Steel Centering Rings with Viton O-ring and Over Pressure Ring

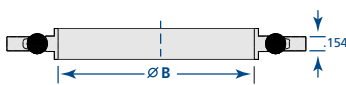
MODEL NUMBER	DESCRIPTION
NW-10-CR-SV-PR	Contains model numbers NW-10-PR and NW-10-CR-SV
NW-16-CR-SV-PR	Contains model numbers NW-16-PR and NW-16-CR-SV
NW-25-CR-SV-PR	Contains model numbers NW-25-PR and NW-25-CR-SV
NW-40-CR-SV-PR	Contains model numbers NW-40-PR and NW-40-CR-SV
NW-50-CR-SV-PR	Contains model numbers NW-50-PR and NW-50-CR-SV

Buna and Silicone O-rings available. Call for pricing.



NW Stainless Steel Overpressure Rings

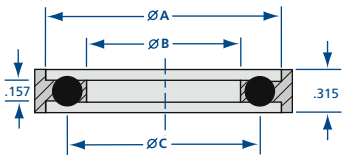
MODEL NUMBER	A	B	C	MAXIMUM PSIG
NW-10-PR	1.25	1.186	0.346	100
NW-16-PR	1.25	1.186	0.346	100
NW-25-PR	1.66	1.583	0.346	100
NW-40-PR	2.25	2.169	0.346	75
NW-50-PR	2.75	2.620	0.145	50



NW Stainless Steel Captured Centering Rings with Viton O-ring

MODEL NUMBER	O-RING MATERIAL	B	MAXIMUM PSIG
NW-16-CRC-SV	Viton	0.625	100
NW-25-CRC-SV	Viton	0.984	100
NW-40-CRC-SV	Viton	1.570	75
NW-50-CRC-SV	Viton	1.967	50

Buna and Silicone O-rings available. Call for pricing.



NW trapped centering rings are composed of an aluminum outer ring, Viton O-ring, and stainless steel centering ring

NW Stainless Steel Trapped Centering Rings with O-ring

MODEL NUMBER	O-RING MATERIAL	A	B	C
NW-10/16-CRT-SV	Viton	1.18	0.63	0.91
NW-25-CRT-SV	Viton	1.58	0.95	1.30
NW-40-CRT-SV	Viton	2.17	1.58	1.89
NW-50-CRT-SV	Viton	2.95	1.97	2.32

Buna and Silicone O-rings available. Call for pricing.

Viton O-Rings

MODEL NUMBER	FLANGE TYPE
NW-10-OR-V	NW-10
NW-16-OR-V	NW-16
NW-25-OR-V	NW-25
NW-40-OR-V	NW-40
NW-50-OR-V	NW-50

Silicone O-Rings

MODEL NUMBER	FLANGE TYPE
NW-10-OR-S	NW-10
NW-16-OR-S	NW-16
NW-25-OR-S	NW-25
NW-40-OR-S	NW-40
NW-50-OR-S	NW-50

Buna O-Rings

MODEL NUMBER	FLANGE TYPE
NW-10-OR-B	NW-10
NW-16-OR-B	NW-16
NW-25-OR-B	NW-25
NW-40-OR-B	NW-40
NW-50-OR-B	NW-50



SPECIFICATIONS

Tube OD sizes: 1/2 to 2 inches

Materials

Flange: 304 stainless steel
(316L available upon request)
O-rings: Viton, Buna & silicone

Fittings

Tube finishes: Beadblast standard
(Tumbled & electropolish available)

Fasteners: Wingnut, SureSeal,
bulkhead & chain clamps

Vacuum range

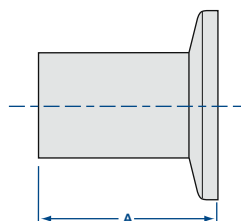
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C
Silicone: -50° to 230°C
Buna: -30°C to 110°C
Metal seal: -270°C to 150°C

See Section 2.1 for metal seals

Nor-Cal manufactures a complete line of NW vacuum fittings. The tube portions are fabricated from 304 stainless steel. 316L stainless steel can be supplied on request. Nor-Cal makes its own elbows, and all tees and crosses are made with the pulled-port technique. This allows smooth, crevice-free butt welds to provide the maximum in cleanliness for UHV applications. Bakeout range is up to 200°C. Nor-Cal fittings are also available with CF, ISO and ASA flanges. Standard finish is bead blasted. Electropolished finish can also be provided as an option. Call for pricing.



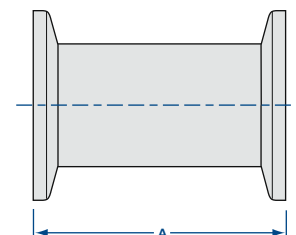
NW Half Nipples

MODEL NUMBER	TUBE OD	A
1N-NW-10	1/2	1.25
1N-NW-16B	3/4	1.15
1N-NW-25B	1	2.03
1N-NW-40B	1 1/2	2.40
1N-NW-50B	2	3.15



NW Full Nipples

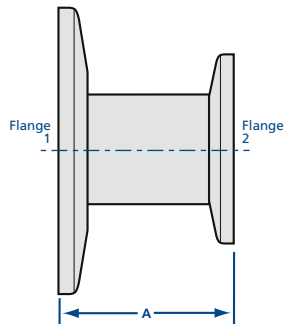
MODEL NUMBER	TUBE OD	A
2N-NW-10	1/2	2.50
2N-NW-16B	3/4	2.30
2N-NW-25B	1	4.06
2N-NW-40B	1 1/2	4.80
2N-NW-50B	2	6.30





Flanges & Fittings

NW Fittings



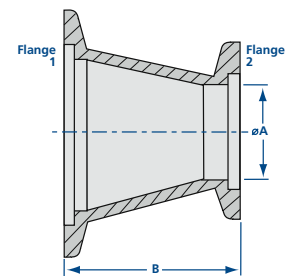
NW Reducer Nipples

MODEL NUMBER	FLANGE 1	FLANGE 2	TUBE OD	A
2NR-NW-16-10	NW-16	NW-10	1/2	1.40
2NR-NW-25-10	NW-25	NW-10	1/2	1.40
2NR-NW-25-16	NW-25	NW-16	3/4	1.30
2NR-NW-40-10	NW-40	NW-10	1/2	1.40
2NR-NW-40-16	NW-40	NW-16	3/4	1.30
2NR-NW-40-25	NW-40	NW-25	1	2.18
2NR-NW-50-10	NW-50	NW-10	1/2	1.40
2NR-NW-50-16	NW-50	NW-16	3/4	1.30
2NR-NW-50-25	NW-50	NW-25	1	2.18
2NR-NW-50-40	NW-50	NW-40	1 1/2	2.55



NW Conical Reducer Nipples

MODEL NUMBER	FLANGE 1	FLANGE 2	A	B
2NRC-NW-25-16	NW-25	NW-16	0.620	1.57
2NRC-NW-40-16	NW-40	NW-16	0.620	1.57
2NRC-NW-50-16	NW-50	NW-16	0.620	1.57
2NRC-NW-40-25	NW-40	NW-25	0.870	1.57
2NRC-NW-50-25	NW-50	NW-25	0.870	1.57
2NRC-NW-50-40	NW-50	NW-40	1.380	1.57

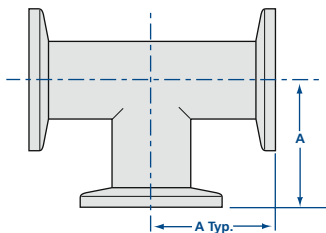


NW 316L Conical Reducer Nipples

MODEL NUMBER	FLANGE 1	FLANGE 2	A	B
2NRC-NW-40-25-316L	NW-40	NW-25	0.870	1.57
2NRC-NW-50-40-316L	NW-50	NW-40	1.380	1.57

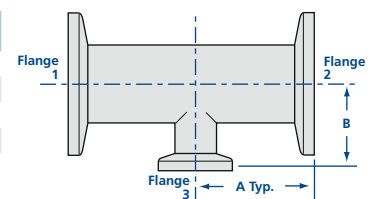
NW Tees

MODEL NUMBER	TUBE OD	A
3T-NW-10	1/2	1.25
3T-NW-16B	3/4	1.15
3T-NW-25B	1	2.03
3T-NW-40B	1 1/2	2.40
3T-NW-40H	1 1/2	2.56
3T-NW-50B	2	3.15
3T-NW-50H	2	2.76



NW Reducer Tees

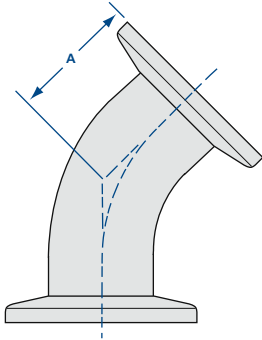
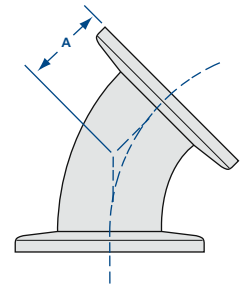
MODEL NUMBER	TUBE 1 & 2 ARM OD	TUBE 3 LEG OD	A	B
3TR-NW-25-16B	1	3/4	2.03	1.27
3TR-NW-40-16B	1 1/2	3/4	2.40	1.53
3TR-NW-40-25B	1 1/2	1	2.40	2.28
3TR-NW-50-16B	2	3/4	3.15	1.78
3TR-NW-50-40B	2	1 1/2	3.15	2.65





NW 45° Radius Elbows

MODEL NUMBER	TUBE OD	A
2K-NW-25	1	0.77
2K-NW-40	1½	1.08
2K-NW-50	2	1.39



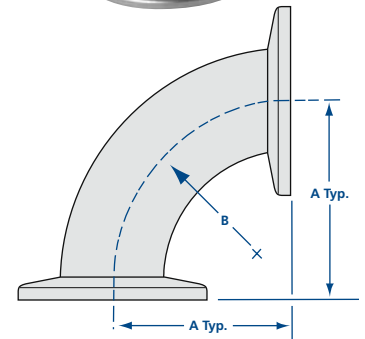
NW 45° Radius Elbows with Tangents

MODEL NUMBER	TUBE OD	A
2KL-NW-16	¾	0.91
2KL-NW-25	1	1.12
2KL-NW-40	1½	1.68
2KL-NW-50	2	1.99



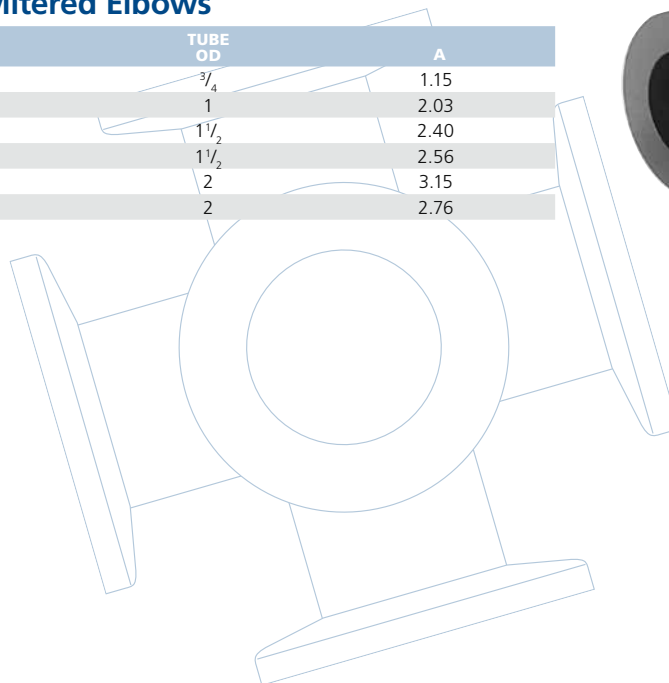
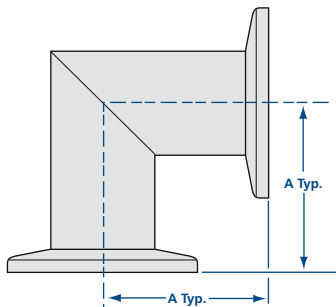
NW 90° Radius Elbows

MODEL NUMBER	TUBE OD	A	B
2E-NW-10	½	1.25	0.75
2E-NW-16B	¾	1.15	1.00
2E-NW-25B	1	1.65	1.50
2E-NW-40B	1½	2.40	2.25
2E-NW-40H	1½	2.56	2.25
2E-NW-40HL	1½	5.12	2.25
2E-NW-50B	2	3.15	3.00
2E-NW-50HL	2	5.51	3.00



NW 90° Mitered Elbows

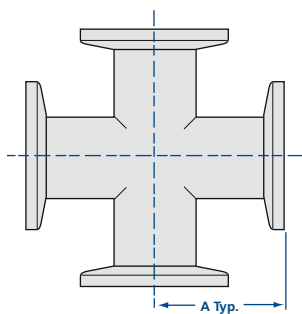
MODEL NUMBER	TUBE OD	A
2E-NW-16MB	¾	1.15
2E-NW-25MB	1	2.03
2E-NW-40MB	1½	2.40
2E-NW-40MH	1½	2.56
2E-NW-50MB	2	3.15
2E-NW-50MH	2	2.76





Flanges & Fittings

NW Fittings



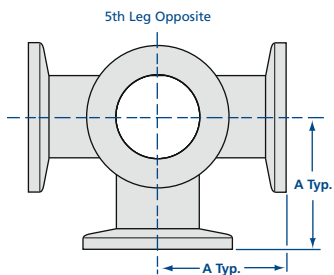
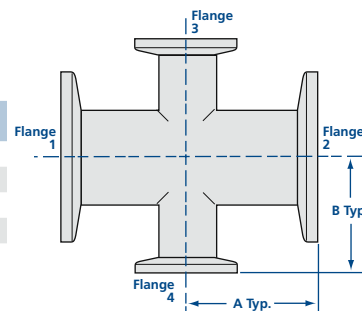
NW 4-Way Crosses

MODEL NUMBER	TUBE OD	A
4C-NW-10	1/2	1.25
4C-NW-16B	3/4	1.15
4C-NW-25B	1	2.03
4C-NW-40B	1 1/2	2.40
4C-NW-40H	1 1/2	2.56
4C-NW-50B	2	3.15
4C-NW-50H	2	2.76



NW Reducer Crosses

MODEL NUMBER	TUBE 1 & 2 OD	TUBE 3 & 4 OD	A	B
4CR-NW-25-16B	1	3/4	2.03	1.27
4CR-NW-40-16B	1 1/2	3/4	2.40	1.53
4CR-NW-40-25B	1 1/2	1	2.40	2.28
4CR-NW-50-16B	2	3/4	3.15	1.78
4CR-NW-50-40B	2	1 1/2	3.15	2.65



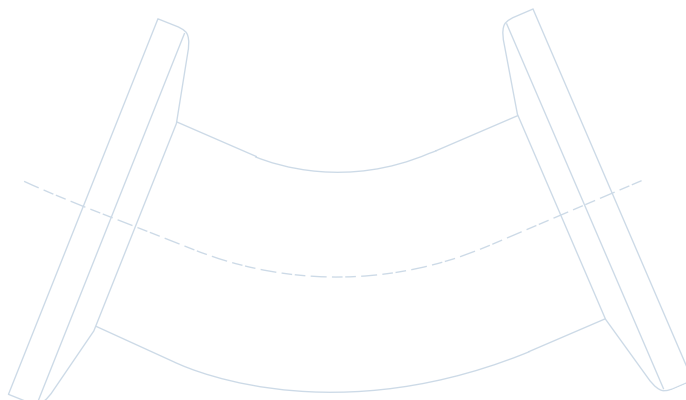
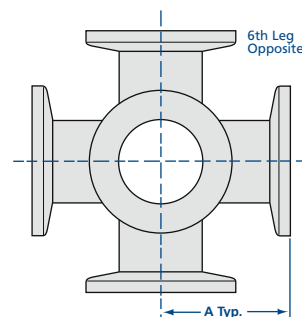
NW 5-Way Crosses

MODEL NUMBER	TUBE OD	A
5C-NW-16	3/4	1.50
5C-NW-25B	1	2.03
5C-NW-40B	1 1/2	2.40
5C-NW-50B	2	3.15



NW 6-Way Crosses

MODEL NUMBER	TUBE OD	A
6C-NW-16	3/4	1.50
6C-NW-25B	1	2.03
6C-NW-40B	1 1/2	2.40
6C-NW-50B	2	3.15



Flanges & Fittings

ISO Flange General Information



SPECIFICATIONS

General: Optional fastener or nonrotatable flanges with clearance bolt holes

Nominal OD sizes: ISO-63 to ISO-500

Tube OD sizes: 2 1/2 to 20 inches

Materials

Flange: 304 or 316L stainless steel

O-rings: Viton, Buna

Bolts: 18-8 stainless steel

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C

Buna: -30°C to 110°C

Metal seal: -270°C to 150°C

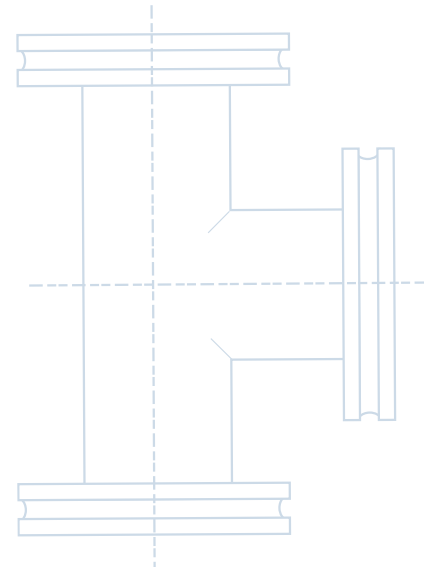
Nor-Cal ISO flanges and hardware are manufactured to the International Standards Organization specification so they can be mated to other manufacturers' ISO flanges. ISO flanges are made from Argon Oxygen Decarburization (AOD) 304 stainless steel. This material is certified to meet ASTM-240 and has less than 0.01% sulfur in order to prevent sulfur stringers. Grain size is 3 to 6 per ASTM E-112.

Maximum inclusion size is 2.5 per ASTM E-45. Normally our standard material is in the low carbon range for 304 stainless steel. For increased corrosion resistance, some sizes are available from stock in 316L stainless steel.

Optional fastener and nonrotatable ISO flanges are available from stock for 2 1/2 to 20 inch tube sizes. Both use a Viton

O-ring, held in place by a centering ring, to effect a seal with a vacuum range of 10^{-8} Torr. ISO components can be baked to 204°C.

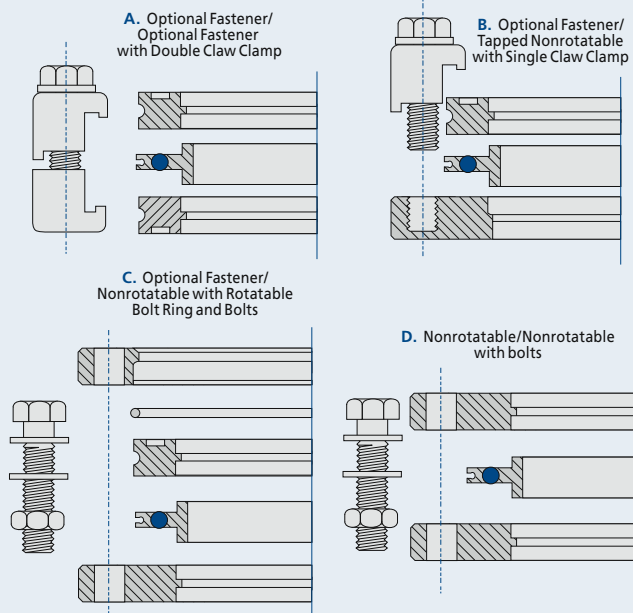
ISO flanges can also be used with standard clamps and aluminum seals to obtain a UHV seal bakeable to 150°C. Seals are described in detail in Section 2.1 of this catalog.

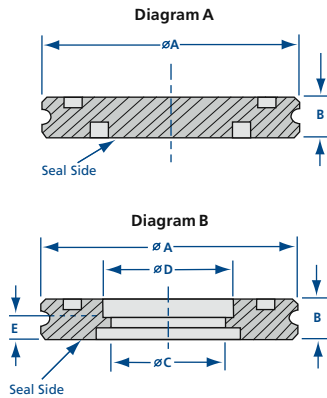


All dimensions are in inches unless otherwise noted

ISO Flange Assembly Instructions

Optional fastener flanges are joined around the periphery with clamps. Double claw clamps are used when a pair of OF flanges are joined (See diagram A.), or single claw clamps are used to join an OF flange to a tapped nonrotatable on a pump or gate valve. (See diagram B.) This fastening method allows the OF flange to be rotated for ease of component alignment. Additionally, a rotatable bolt ring can be used to fasten an OF flange to a nonrotatable flange using bolts. (See diagram C.) A retainer ring prevents the OF flange from slipping through the bolt ring. Nonrotatable ISO flanges are assembled with bolts. (See diagram D.) They do not allow rotation of bolt holes on mating flanges to align components.





ISO Optional Fastener Flanges

MODEL NUMBER	DIAGRAM	NOMINAL ID	A	B	C	D	E
ISO-63-000-OF	A	-	3.740	0.47	-	-	-
ISO-63-250-OF	B	2 1/2	3.740	0.47	2.438	2.510	0.250
ISO-80-000-OF	A	-	4.331	0.47	-	-	-
ISO-80-300-OF	B	3	4.331	0.47	2.938	3.010	0.250
ISO-100-000-OF	A	-	5.118	0.47	-	-	-
ISO-100-400-OF	B	4	5.118	0.47	3.910	4.010	0.250
ISO-160-000-OF	A	-	7.087	0.47	-	-	-
ISO-160-600-OF	B	6	7.087	0.47	5.875	6.020	0.375
ISO-200-000-OF	A	-	9.449	0.47	-	-	-
ISO-200-800-OF	B	8	9.449	0.47	7.875	8.020	0.375
ISO-250-000-OF	A	-	11.417	0.47	-	-	-
ISO-250-1000-OF	B	10	11.417	0.47	9.875	10.020	0.375
ISO-320-000-OF	A	-	14.567	0.67	-	-	-
ISO-320-1200-OF	B	12	14.567	0.67	11.875	12.020	0.375
ISO-320-1275-OF	B	12	14.567	0.67	12.420	12.770	0.375
ISO-400-000-OF	A	-	17.716	0.67	-	-	-
ISO-400-1600-OF	B	16	17.716	0.67	15.624	16.020	0.375
ISO-500-000-OF	A	-	21.653	0.67	-	-	-
ISO-500-2000-OF	B	20	21.653	0.67	19.624	20.020	0.375

ISO 316L Optional Fastener Flanges

MODEL NUMBER	DIAGRAM	NOMINAL ID	A	B	C	D	E
ISO-63-250-OF-316L	B	2 1/2	3.740	0.47	2.438	2.510	0.250
ISO-80-300-OF-316L	B	3	4.331	0.47	2.938	3.010	0.250
ISO-100-400-OF-316L	B	4	5.118	0.47	3.910	4.010	0.250



ISO Rotatable Bolt Ring and Retainer Ring

MODEL NUMBER	FLANGE SIZE	A	B	C
ISO-63-BR	ISO-63	4.331	5.118	0.472
ISO-80-BR	ISO-80	4.921	5.709	0.472
ISO-100-BR	ISO-100	5.709	6.496	0.472
ISO-160-BR	ISO-160	7.874	8.858	0.630
ISO-200-BR	ISO-200	10.236	11.220	0.630
ISO-250-BR	ISO-250	12.205	13.189	0.630
ISO-320-BR	ISO-320	15.551	16.732	0.787
ISO-400-BR	ISO-400	18.898	20.079	0.787
ISO-500-BR	ISO-500	22.835	24.016	0.787

SPECIFICATIONS

General: Optional fastener or nonrotatable flanges with clearance bolt holes

Nominal OD sizes: ISO-63 to ISO-500

Tube OD sizes: 2 1/2 to 20 inches

Materials

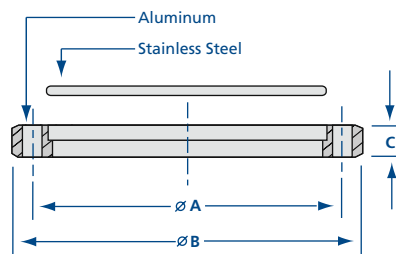
Flange: 304 or 316L stainless steel
O-rings: Viton, Buna
Bolts: 18-8 stainless steel

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C
Silicone: -50° to 230°C
Buna: -30°C to 110°C
Metal seal: -270°C to 150°C



Replacement Retainer Ring

MODEL NUMBER

ISO-63-RR

ISO-80-RR

ISO-100-RR

ISO-200-RR

ISO-250-RR

ISO-320-RR

ISO-400-RR

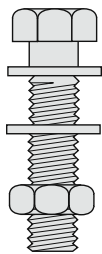
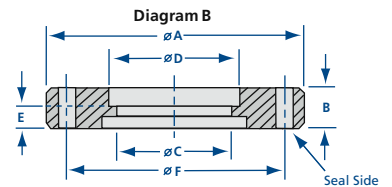
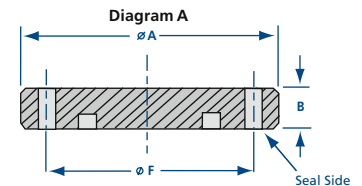
ISO-500-RR

See Section 2.1 for metal seals



ISO Nonrotatable Flanges

MODEL NUMBER	DIAGRAM	NOMINAL ID	A	B	C	D	E	F	BOLT HOLES	BOLT DIAMETER
ISO-63-000N	A	-	5.118	0.472	-	-	-	4.331	4	0.359
ISO-63-250N	B	2½	5.118	0.472	2.438	2.510	0.250	4.331	4	0.359
ISO-80-000N	A	-	5.709	0.472	-	-	-	4.921	8	0.359
ISO-80-300N	B	3½	5.709	0.472	2.938	3.010	0.250	4.921	8	0.359
ISO-100-000N	A	-	6.496	0.472	-	-	-	5.709	8	0.359
ISO-100-400N	B	4	6.496	0.472	3.910	4.010	0.250	5.709	8	0.359
ISO-160-000N	A	-	8.858	0.630	-	-	-	7.874	8	0.438
ISO-160-600N	B	6	8.858	0.630	5.875	6.020	0.375	7.874	8	0.438
ISO-200-000N	A	-	11.220	0.630	-	-	-	10.236	12	0.438
ISO-200-800N	B	8	11.220	0.630	7.875	8.020	0.375	10.236	12	0.438
ISO-250-000N	A	-	13.189	0.630	-	-	-	12.205	12	0.438
ISO-250-1000N	B	10	13.189	0.630	9.875	10.020	0.375	12.205	12	0.438
ISO-320-000N	A	-	16.732	0.787	-	-	-	15.551	12	0.551
ISO-320-1200N	B	12	16.732	0.787	11.760	12.020	0.375	15.551	12	0.551
ISO-320-1275N	B	12	16.732	0.787	12.420	12.770	0.375	15.551	12	0.551
ISO-400-000N	A	-	20.079	0.787	-	-	-	18.898	16	0.551
ISO-400-1600N	B	16	20.079	0.787	15.642	16.020	0.375	18.898	16	0.551
ISO-500-000N	A	-	24.016	0.787	-	-	-	22.835	16	0.551
ISO-500-2000N	B	20	24.016	0.787	19.642	20.020	0.375	22.835	16	0.551



ISO Bolt Kits

MODEL NUMBER	DESCRIPTION
B-ISO-63	(4) SS bolts, nuts & washers, M8 x 40mm
B-ISO-80	(8) SS bolts, nuts & washers, M8 x 40mm
B-ISO-100	(8) SS bolts, nuts & washers, M8 x 40mm
B-ISO-160	(8) SS bolts, nuts & washers, M10 x 50mm
B-ISO-200	(12) SS bolts, nuts & washers, M10 x 50mm
B-ISO-250	(12) SS bolts, nuts & washers, M10 x 50mm
B-ISO-320	(12) SS bolts, nuts & washers, M12 x 60mm
B-ISO-400	(16) SS bolts, nuts & washers, M12 x 60mm
B-ISO-500	(16) SS bolts, nuts & washers, M12 x 60mm

SPECIFICATIONS

General: Optional fastener or nonrotatable flanges with clearance bolt holes

Nominal OD sizes: ISO-63 to ISO-500

Tube OD sizes: 2½ to 20 inches

Materials

Flange: 304 or 316L stainless steel

O-rings: Viton, Buna

Bolts: 18-8 stainless steel

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

Temperature range

Viton: -20°C to 200°C

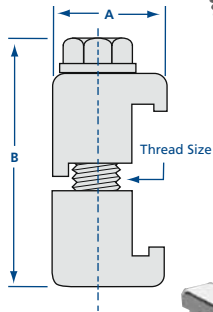
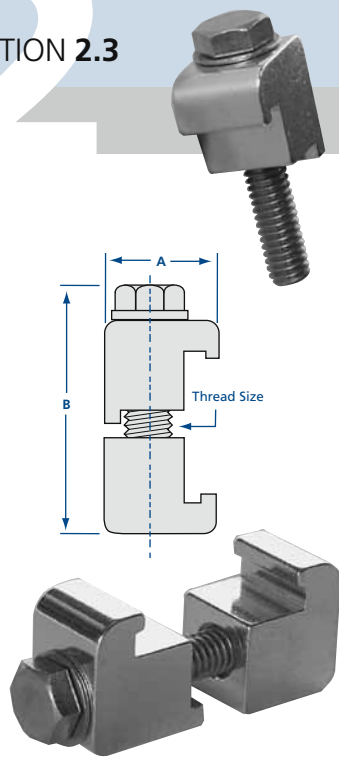
Buna: -30°C to 110°C

Metal seal: -270°C to 150°C

See Section 2.1 for metal seals

Flanges & Fittings

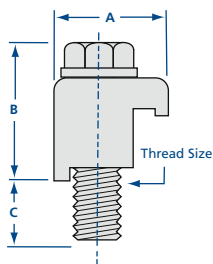
ISO Clamps



ISO Double Claw Aluminum Clamps

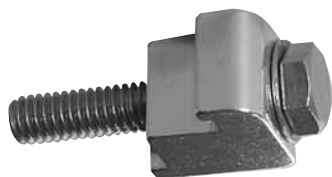
MODEL NUMBER	FLANGE SIZE	A	B	THREAD SIZE	CLAMPS REQUIRED
ISO-63-DCP	ISO-63	0.94	1.96	5/16-18	3-4
ISO-80-DCP	ISO-80	0.94	1.96	5/16-18	4-8
ISO-100-DCP	ISO-100	0.94	1.96	5/16-18	4-8
ISO-160-DCP	ISO-160	1.10	1.96	5/16-18	4-8
ISO-200-DCP	ISO-200	1.10	1.96	5/16-18	6-12
ISO-250-DCP	ISO-250	1.10	1.96	5/16-18	6-12
ISO-320-DCP	ISO-320	1.34	2.20	7/16-14	8-12
ISO-400-DCP	ISO-400	1.34	2.20	7/16-14	8-16
ISO-500-DCP	ISO-500	1.34	2.20	7/16-14	12-16

ISO Single Claw Aluminum Clamps

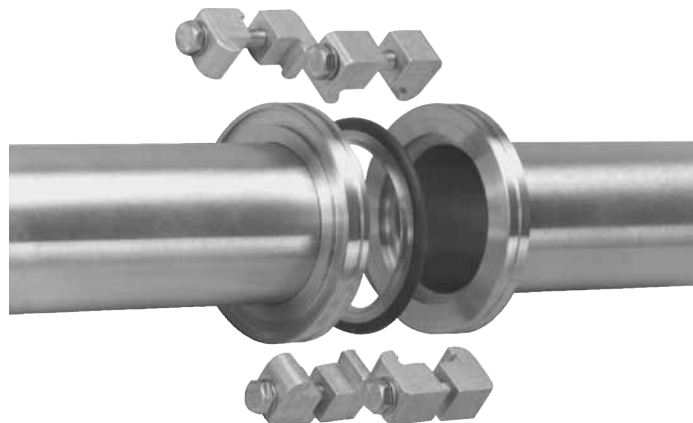


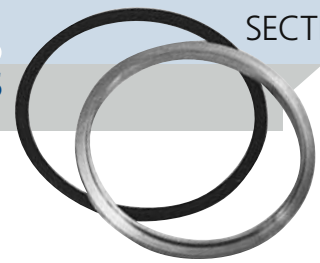
MODEL NUMBER	FLANGE SIZE	A	B	C	THREAD SIZE	CLAMPS REQUIRED
ISO-63-SCP	ISO-63	0.94	1.18	0.52	5/16-18	4
ISO-80-SCP	ISO-80	0.94	1.18	0.52	5/16-18	8
ISO-100-SCP	ISO-100	0.94	1.18	0.52	5/16-18	8
ISO-160-SCP	ISO-160	1.10	1.18	0.52	5/16-18	8
ISO-200-SCP	ISO-200	1.10	1.18	0.52	5/16-18	12
ISO-250-SCP	ISO-250	1.10	1.18	0.52	5/16-18	12
ISO-320-SCP	ISO-320	1.34	1.46	0.88	7/16-14	12
ISO-400-SCP	ISO-400	1.34	1.46	0.88	7/16-14	16
ISO-500-SCP	ISO-500	1.34	1.46	0.88	7/16-14	16

ISO Single Claw Aluminum Clamps – Metric



MODEL NUMBER	FLANGE SIZE	A	B	C	METRIC THREAD SIZE	CLAMPS REQUIRED
ISO-63-SCP-M	ISO-63	0.94	1.20	0.40	M8 x 1.25	4
ISO-80-SCP-M	ISO-80	0.94	1.20	0.40	M8 x 1.25	8
ISO-100-SCP-M	ISO-100	0.94	1.20	0.40	M8 x 1.25	8
ISO-160-SCP-M	ISO-160	1.10	1.20	0.40	M10 x 1.50	8
ISO-200-SCP-M	ISO-200	1.10	1.20	0.40	M10 x 1.50	12
ISO-250-SCP-M	ISO-250	1.10	1.20	0.40	M10 x 1.50	12
ISO-320-SCP-M	ISO-320	1.34	1.48	0.79	M12 x 1.75	12
ISO-400-SCP-M	ISO-400	1.34	1.48	0.79	M12 x 1.75	16
ISO-500-SCP-M	ISO-500	1.34	1.48	0.79	M12 x 1.75	16

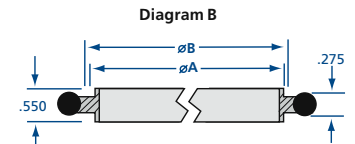
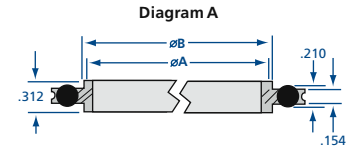




ISO Aluminum Centering Rings with O-ring and Aluminum Spacer Ring

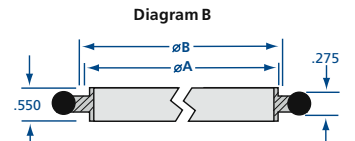
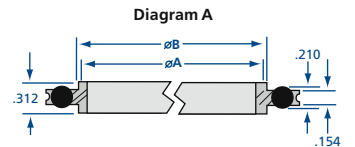
MODEL NUMBER	DIAGRAM	O-RING MATERIAL	A	B
ISO-63-CR-AV*	A	Viton	2.63	2.74
ISO-63-CR-AB*	A	Buna	2.63	2.74
ISO-80-CR-AV	A	Viton	3.14	3.25
ISO-80-CR-AB	A	Buna	3.14	3.25
ISO-100-CR-AV	A	Viton	3.89	4.00
ISO-100-CR-AB	A	Buna	3.89	4.00
ISO-160-CR-AV	A	Viton	5.90	6.01
ISO-160-CR-AB	A	Buna	5.90	6.01
ISO-200-CR-AV	A	Viton	8.26	8.37
ISO-200-CR-AB	A	Buna	8.26	8.37
ISO-250-CR-AV	A	Viton	10.14	10.25
ISO-250-CR-AB	A	Buna	10.14	10.25
ISO-320-CR-AV	B	Viton	12.32	12.51
ISO-320-CR-AB	B	Buna	12.32	12.51
ISO-400-CR-AV	B	Viton	15.55	15.75
ISO-400-CR-AB	B	Buna	15.55	15.75
ISO-500-CR-AV	B	Viton	19.53	19.72
ISO-500-CR-AB	B	Buna	19.53	19.72

*Machined centering ring.



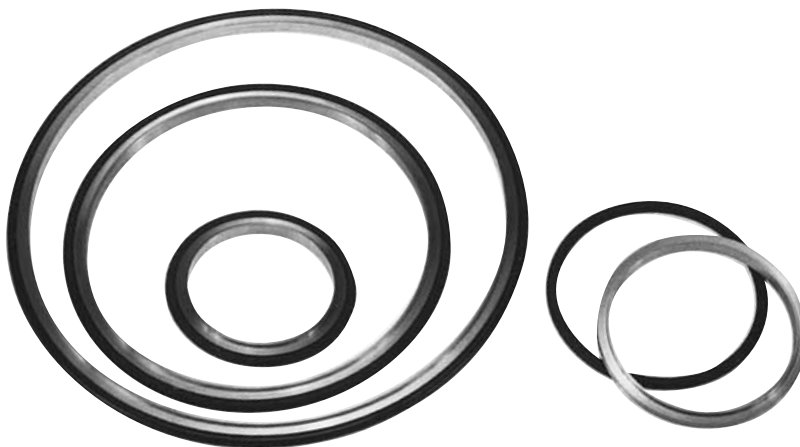
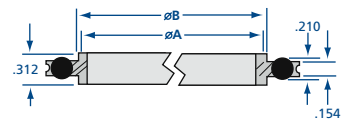
ISO Stainless Steel Centering Rings with O-ring and Aluminum Spacer Ring

MODEL NUMBER	DIAGRAM	O-RING MATERIAL	A	B
ISO-63-CR-SV	A	Viton	2.63	2.74
ISO-80-CR-SV	A	Viton	3.14	3.25
ISO-100-CR-SV	A	Viton	3.89	4.00
ISO-160-CR-SV	A	Viton	5.90	6.01
ISO-200-CR-SV	A	Viton	8.26	8.37
ISO-250-CR-SV	A	Viton	10.14	10.25
ISO-320-CR-SV	B	Viton	12.36	12.52
ISO-400-CR-SV	B	Viton	15.55	15.75



ISO 316L Stainless Steel Centering Rings with O-ring and Aluminum Spacer Ring

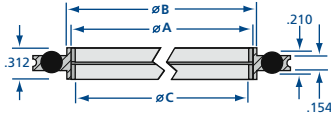
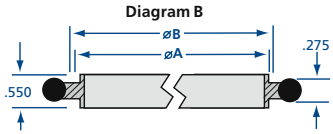
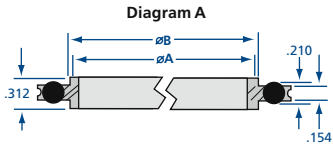
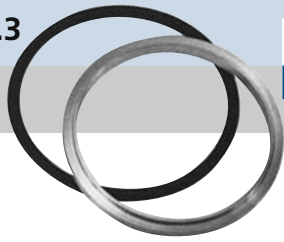
MODEL NUMBER	O-RING MATERIAL	A	B
ISO-63-CR-SV-316L	Viton	2.63	2.74
ISO-80-CR-SV-316L	Viton	3.14	3.25
ISO-100-CR-SV-316L	Viton	3.89	4.00



See next page for replacement O-rings
See Section 2.1 for metal seals

Flanges & Fittings

ISO Centering Rings



ISO Stainless Steel Centering Rings with O-ring

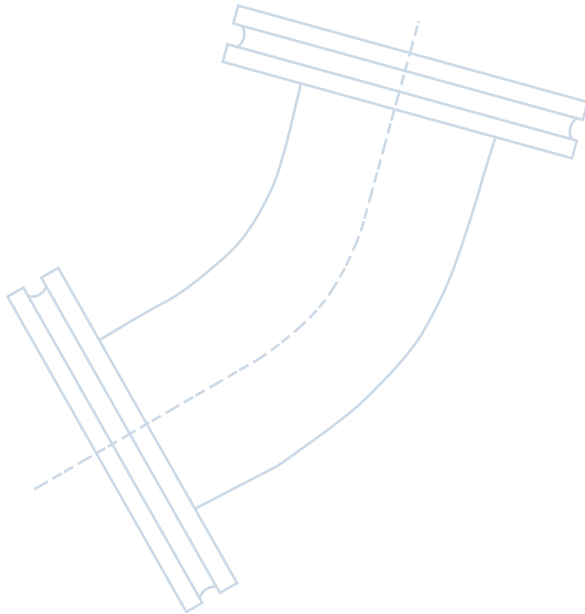
MODEL NUMBER	DIAGRAM	O-RING MATERIAL	A	B
ISO-63-CR	A	Viton	2.63	2.74
ISO-80-CR	A	Viton	3.14	3.25
ISO-100-CR	A	Viton	3.89	4.00
ISO-160-CR	A	Viton	5.90	6.01
ISO-200-CR	A	Viton	8.26	8.37
ISO-250-CR	A	Viton	10.14	10.25
ISO-320-CR	B	Viton	12.32	12.52
ISO-400-CR	B	Viton	15.55	15.74

See below for replacement O-rings.

ISO Screened Stainless Steel Centering Rings with O-ring and Aluminum Spacer Ring

MODEL NUMBER	O-RING MATERIAL	A	B	C	MESH (sq.in.)
ISO-63-CR-SV-16	Viton	2.63	2.74	2.38	16
ISO-80-CR-SV-16	Viton	3.14	3.25	2.87	16
ISO-100-CR-SV-16	Viton	3.89	4.00	3.50	16
ISO-160-CR-SV-16	Viton	5.90	6.01	5.50	16

Includes O-ring. See below for replacement O-rings.



Viton O-Rings

MODEL NUMBER	FLANGE TYPE
ISO-63-OR-V	ISO-63
ISO-80-OR-V	ISO-80
ISO-100-OR-V	ISO-100
ISO-160-OR-V	ISO-160
ISO-200-OR-V	ISO-200
ISO-250-OR-V	ISO-250
ISO-320-OR-V	ISO-320
ISO-400-OR-V	ISO-400
ISO-500-OR-V	ISO-500

Buna O-Rings

MODEL NUMBER	FLANGE TYPE
ISO-63-OR-B	ISO-63
ISO-80-OR-B	ISO-80
ISO-100-OR-B	ISO-100
ISO-160-OR-B	ISO-160
ISO-200-OR-B	ISO-200
ISO-250-OR-B	ISO-250
ISO-320-OR-B	ISO-320
ISO-400-OR-B	ISO-400
ISO-500-OR-B	ISO-500



See Section 2.1 for metal seals



Nor-Cal Products manufactures a complete line of ISO vacuum fittings with optional fastener or nonrotatable flanges. The tube portions are fabricated from 304 stainless steel. For increased resistance to corrosion in downstream semiconductor processes, some ISO flanges and fittings are available in 316L stainless steel. Nor-Cal makes its own elbows, and all tees and crosses are made with the pulled-port technique. This allows smooth, crevice-free butt welds to provide the maximum in cleanliness for UHV applications. Fittings are shown with OF flanges only. To order a fitting with nonrotatable flanges substitute “-N” for “-OF” in the model number. Fittings are also available with CF (Conflat style), NW (ISO-KF compatible) and ASA flanges. Standard finish is bead blasted. Electropolished finish also available. Call for pricing.



SPECIFICATIONS

General: Optional fastener or nonrotatable flanges with clearance bolt holes

Nominal OD sizes: ISO-63 to ISO-500

Tube OD sizes: 2½ to 20 inches

Tube finish: Beadblast, tumbled, or electropolish

Materials

Flange: 304 or 316L stainless steel

O-rings: Viton, Buna

Bolts: 18-8 stainless steel

Vacuum range

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Metal seal: $\geq 1 \times 10^{-11}$ Torr - UHV

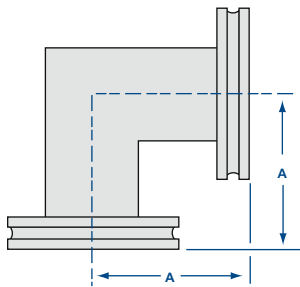
Temperature range

Viton: -20°C to 200°C

Buna: -30°C to 110°C

Metal seal: -270°C to 150°C

See Section 2.1 for metal seals



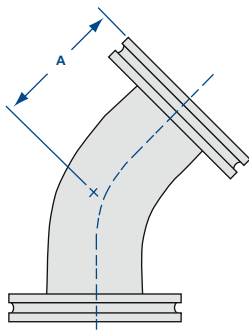
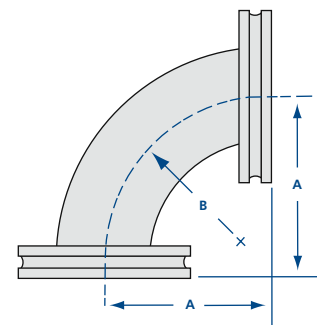
ISO 90° Mitered Elbows

MODEL NUMBER	TUBE OD	A
2E-ISO-63-OF-M	2½	3.25
2E-ISO-80-OF-M	3	3.50
2E-ISO-100-OF-M	4	4.13
2E-ISO-160-OF-M	6	5.38
2E-ISO-200-OF-M	8	7.38
2E-ISO-250-OF-M	10	9.88



ISO 90° Radius Elbows

MODEL NUMBER	TUBE OD	A	B
2E-ISO-63-OF	2½	4.00	3.75
2E-ISO-80-OF	3	4.75	4.50
2E-ISO-100-OF	4	6.25	6.00
2E-ISO-160-OF	6	9.38	9.00
2E-ISO-200-OF	8	12.38	12.00
2E-ISO-250-OF	10	15.38	15.00



ISO 45° Elbows with Tangents

MODEL NUMBER	TUBE OD	A
2KL-ISO-63-OF	2½	3.25
2KL-ISO-80-OF	3	3.93
2KL-ISO-100-OF	4	5.03

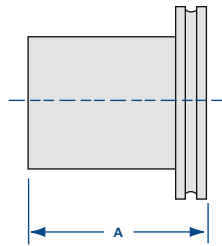




Flanges & Fittings

ISO Fittings

ISO Half Nipples



MODEL NUMBER	TUBE OD	A
1N-ISO-63-OF	2½	3.25
1N-ISO-63-OF-V	2½	4.00
1N-ISO-63-OF-H	2½	3.94
1N-ISO-80-OF	3	3.50
1N-ISO-80-OF-H	3	3.94
1N-ISO-100-OF	4	4.13
1N-ISO-100-OF-V	4	5.12
1N-ISO-100-OF-H	4	3.94
1N-ISO-160-OF	6	5.38
1N-ISO-160-OF-V	6	6.44
1N-ISO-160-OF-H	6	3.94
1N-ISO-200-OF	8	7.38
1N-ISO-250-OF	10	9.88
1N-ISO-320-OF	12	9.88
1N-ISO-400-OF	16	9.88
1N-ISO-500-OF	20	9.88



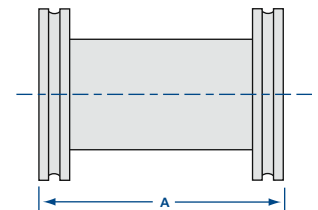
ISO 316L Half Nipples

MODEL NUMBER	TUBE OD	A
1N-ISO-63-OF-316L	2½	3.25
1N-ISO-80-OF-316L	3	3.50
1N-ISO-100-OF-316L	4	4.13



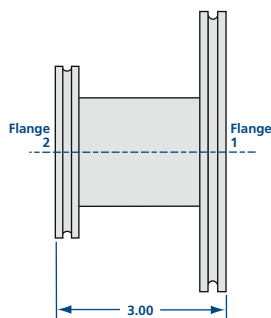
ISO Full Nipples

MODEL NUMBER	TUBE OD	A
2N-ISO-63-OF	2½	6.50
2N-ISO-80-OF	3	7.00
2N-ISO-100-OF	4	8.26
2N-ISO-160-OF	6	10.76
2N-ISO-200-OF	8	14.76
2N-ISO-250-OF	10	19.76
2N-ISO-320-OF	12	19.76
2N-ISO-400-OF	16	19.76
2N-ISO-500-OF	20	19.76



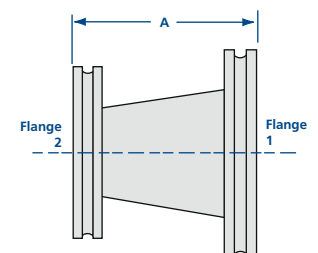
ISO Reducer Nipples

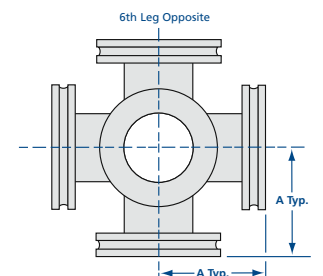
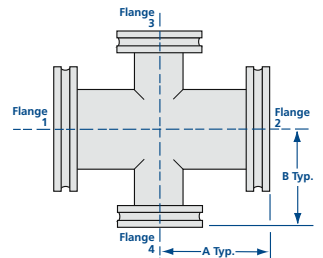
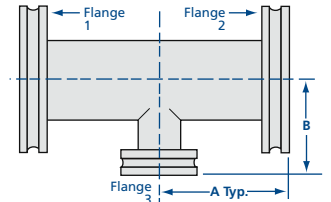
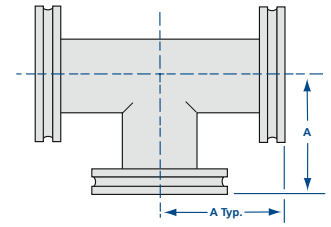
MODEL NUMBER	FLANGE 1	FLANGE 2	TUBE OD
2NR-ISO-80-63-OF	ISO-80	ISO-63	2½
2NR-ISO-100-63-OF	ISO-100	ISO-63	2½
2NR-ISO-100-80-OF	ISO-100	ISO-80	3
2NR-ISO-160-63-OF	ISO-160	ISO-63	2½
2NR-ISO-160-80-OF	ISO-160	ISO-80	3
2NR-ISO-160-100-OF	ISO-160	ISO-100	4
2NR-ISO-200-63-OF	ISO-200	ISO-63	2½
2NR-ISO-200-80-OF	ISO-200	ISO-80	3
2NR-ISO-200-100-OF	ISO-200	ISO-100	4
2NR-ISO-200-160-OF	ISO-200	ISO-160	6
2NR-ISO-250-63-OF	ISO-250	ISO-63	2½
2NR-ISO-250-80-OF	ISO-250	ISO-80	3
2NR-ISO-250-100-OF	ISO-250	ISO-100	4
2NR-ISO-250-160-OF	ISO-250	ISO-160	6
2NR-ISO-250-200-OF	ISO-250	ISO-200	8



ISO Conical Reducer Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
2NRC-ISO-80-63-OF	ISO-80	3	ISO-63	2½	4.12
2NRC-ISO-100-63-OF	ISO-100	4	ISO-63	2½	4.12
2NRC-ISO-100-80-OF	ISO-100	4	ISO-80	3	4.12



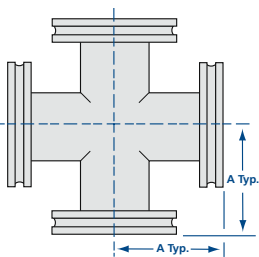


ISO Tees

MODEL NUMBER	TUBE OD	A
3T-ISO-63-OF	2 1/2	3.25
3T-ISO-80-OF	3	3.50
3T-ISO-100-OF	4	4.13
3T-ISO-160-OF	6	5.38
3T-ISO-200-OF	8	7.38
3T-ISO-250-OF	10	9.88

ISO Reducer Tees

MODEL NUMBER	FLANGE 1 & 2		FLANGE 3		A	B
	TYPE	ARM OD	TYPE	LEG OD		
3TR-ISO-80-63-OF	ISO-80	3	ISO-63	2 1/2	3.50	3.50
3TR-ISO-100-63-OF	ISO-100	4	ISO-63	2 1/2	4.13	4.00
3TR-ISO-100-80-OF	ISO-100	4	ISO-80	3	4.13	4.00
3TR-ISO-160-63-OF	ISO-160	6	ISO-63	2 1/2	5.38	5.00
3TR-ISO-160-80-OF	ISO-160	6	ISO-80	3	5.38	5.00
3TR-ISO-160-100-OF	ISO-160	6	ISO-100	4	5.38	5.13
3TR-ISO-200-63-OF	ISO-200	8	ISO-63	2 1/2	7.38	6.00
3TR-ISO-200-80-OF	ISO-200	8	ISO-80	3	7.38	6.00
3TR-ISO-200-100-OF	ISO-200	8	ISO-100	4	7.38	6.13
3TR-ISO-200-160-OF	ISO-200	8	ISO-160	6	7.38	6.38

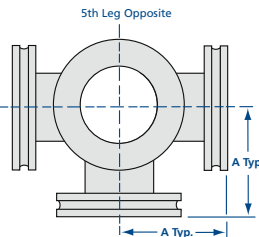


ISO 4-Way Crosses

MODEL NUMBER	TUBE OD	A
4C-ISO-63-OF	2 1/2	3.25
4C-ISO-80-OF	3	3.50
4C-ISO-100-OF	4	4.13
4C-ISO-160-OF	6	5.38
4C-ISO-200-OF	8	7.38
4C-ISO-250-OF	10	9.88

ISO 4-Way Reducer Crosses

MODEL NUMBER	FLANGES 1 & 2		FLANGES 3 & 4		A	B
	TYPE	ARM OD	TYPE	LEG OD		
4CR-ISO-80-63-OF	ISO-80	3	ISO-63	2 1/2	3.50	3.50
4CR-ISO-100-63-OF	ISO-100	4	ISO-63	2 1/2	4.13	4.00
4CR-ISO-100-80-OF	ISO-100	4	ISO-80	3	4.13	4.00
4CR-ISO-160-63-OF	ISO-160	6	ISO-63	2 1/2	5.38	5.00
4CR-ISO-160-80-OF	ISO-160	6	ISO-80	3	5.38	5.00
4CR-ISO-160-100-OF	ISO-160	6	ISO-100	4	5.38	5.13
4CR-ISO-200-160-OF	ISO-200	8	ISO-160	6	7.38	6.38



ISO 5-Way Crosses

MODEL NUMBER	TUBE OD	A
5C-ISO-63-OF	2 1/2	3.25
5C-ISO-80-OF	3	3.50
5C-ISO-100-OF	4	4.13
5C-ISO-160-OF	6	5.38
5C-ISO-200-OF	8	7.38
5C-ISO-250-OF	10	9.88



ISO 6-Way Crosses

MODEL NUMBER	TUBE OD	A
6C-ISO-63-OF	2 1/2	3.25
6C-ISO-80-OF	3	3.50
6C-ISO-100-OF	4	4.13
6C-ISO-160-OF	6	5.38
6C-ISO-200-OF	8	7.38
6C-ISO-250-OF	10	9.88



Flanges & Fittings

ASA Flange General Information

SPECIFICATIONS

General: Rotatable or nonrotatable flanges

Nominal OD sizes: 5 to 16 inches

Tube OD sizes: 2 to 12 inches

Materials

Flange: 304 stainless steel

O-rings: Viton

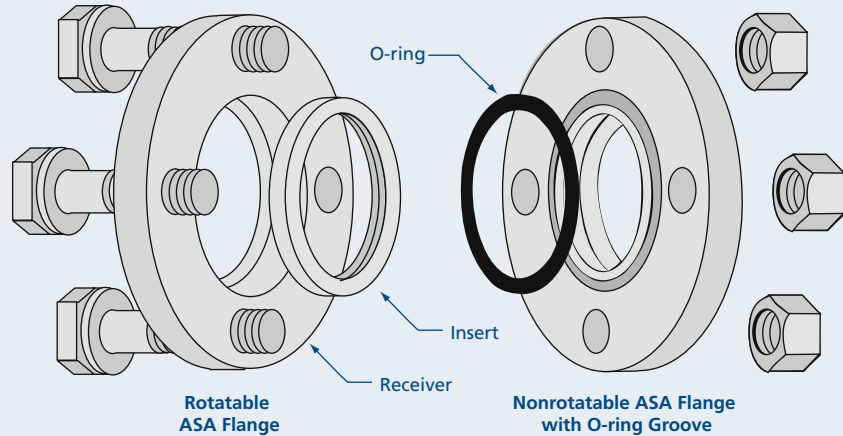
Bolts: 18-8 stainless steel

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20° to 204°C

Sustained: -20°C to 150°C

All dimensions are in inches
unless otherwise noted



Nor-Cal's ASA flanges are manufactured from specially treated 304 stainless steel. These flanges mate with standard 150 lb. ASA flanges or 150 ANSI flanges. They are available from stock for standard tube sizes from 2 to 12 inches. Larger sizes are available upon request.

ASA TO ANSI CONVERSION CHART

ASA	ANSI
5.0	1.5
6.0	2.0
7.5	3.0
9.0	4.0
11.0	6.0
13.5	8.0
16.0	10.0

Nuts and bolts are used to apply pressure between the mating flanges and a seal is effected when a Viton O-ring is compressed. ASA flanges can be baked to 204°C and have a vacuum range of up to 10^{-8} Torr. Besides being sold separately, they are available as standards on nipples, adapters, tees, crosses, elbows and valves.

Rotatable Flange Option

When components of several systems are used interchangeably, use of rotatable flanges is recommended. Assembly is facilitated by rotation of mating flanges, to align bolt holes. Nonrotatable ASA flanges, unlike rotatable, contain both sealing surface and bolt holes in one unit rather than two. This makes the nonrotatable flange less expensive, and therefore the preferred choice when mating component orientation is not a concern. All fittings are priced with nonrotatable flanges. For fittings with rotatable flanges, add the difference between a nonrotatable and rotatable flange of the desired size. Multiply by the number of rotatable flanges required. Be sure to specify the flange numbers which are rotatable.

O-Ring Groove Option

One of each pair of mating ASA flanges requires an O-ring groove. When ordering flanges with grooves indicate this by adding "-G" to the flange model number. An example would be a rotatable ASA-11 flange bored out for six inch OD tubing with a groove. The model number would be ASA-11-600R-G. The same rule applies when ordering a fitting or adapter flange with only one ASA flange. An example would be adapter flange model number ASA-6-338-200Z-G. When a fitting has more than one ASA flange, such as a four-way cross, indicate which flanges are desired with grooves by using the flange numbers on the drawing. If, for example, you desired a cross with ASA-9 flanges and a six inch tube OD with grooved flanges on the left and bottom ports, the model number would be 4C-ASA-9-600-G1-G3. Add the appropriate amount for each O-ring groove to the price of the fitting.



ASA Flanges - 5 to 9 Inch OD

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

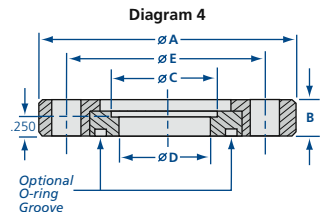
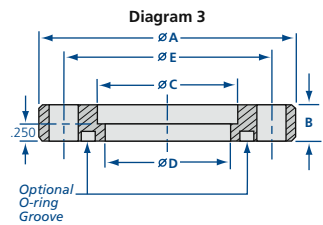
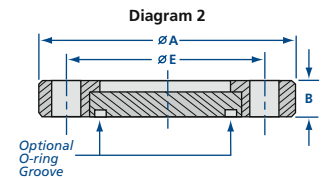
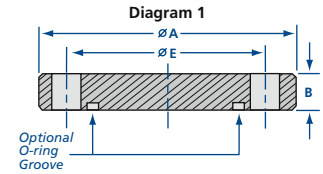
MODEL NUMBER	TYPE	DIAGRAM	A	B	C	D	E	BOLT HOLES NO.	BOLT HOLES SIZE
ASA-5-000N	Blank	1	5.00	0.500	-	-	3.880	4	0.625
ASA-5-200N	Bored	3	5.00	0.500	2.010	1.938	3.880	4	0.625
ASA-5-250N	Bored	3	5.00	0.500	2.510	2.438	3.880	4	0.625
ASA-5-000R	Blank	2	5.00	0.500	-	-	3.880	4	0.625
ASA-5-200R	Bored	4	5.00	0.500	2.010	1.938	3.880	4	0.625
ASA-5-250R	Bored	4	5.00	0.500	2.510	2.438	3.880	4	0.625
ASA-6-000N	Blank	1	6.00	0.500	-	-	4.750	4	0.750
ASA-6-300N	Bored	3	6.00	0.500	3.010	2.938	4.750	4	0.750
ASA-6-350N	Bored	3	6.00	0.500	3.510	3.438	4.750	4	0.750
ASA-6-000R	Blank	2	6.00	0.612	-	-	4.750	4	0.750
ASA-6-300R	Bored	4	6.00	0.612	3.010	2.938	4.750	4	0.750
ASA-6-350R	Bored	4	6.00	0.612	3.510	3.438	4.750	4	0.750
ASA-7.5-000N	Blank	1	7.50	0.500	-	-	6.000	4	0.750
ASA-7.5-400N	Bored	3	7.50	0.500	4.010	3.910	6.000	4	0.750
ASA-7.5-000R	Blank	2	7.50	0.612	-	-	6.000	4	0.750
ASA-7.5-400R	Bored	4	7.50	0.612	4.010	3.910	6.000	4	0.750
ASA-9-000N	Blank	1	9.00	0.500	-	-	7.500	8	0.750
ASA-9-400N	Bored	3	9.00	0.500	4.010	3.910	7.500	8	0.750
ASA-9-600N	Bored	3	9.00	0.500	6.020	5.875	7.500	8	0.750
ASA-9-000R	Blank	2	9.00	0.612	-	-	7.500	8	0.750
ASA-9-400R	Bored	4	9.00	0.612	4.010	3.910	7.500	8	0.750
ASA-9-600R	Bored	4	9.00	0.612	6.020	5.875	7.500	8	0.750

Model Number Definitions
N = Nonrotatable **R** = Rotatable

O-ring Groove Option

Indicate grooved flanges by adding “-G” to the end of the main part number. Add the appropriate cost for each grooved flange.

Example: ASA-9-000R-G



ASA Flange Hardware

MODEL NUMBER	FLANGE SIZE	DESCRIPTION
BA-5	ASA-5	(4) SS bolts (9/16-12 x 1.5) nuts and washers
OR-2-231	ASA-5	(1) Viton O-ring
BA-6	ASA-6	(4) SS bolts (5/8-11 x 1.5) nuts and washers
OR-2-238	ASA-6	(1) Viton O-ring
BA-7.5	ASA-7.5	(4) SS bolts (5/8-11 x 1.5) nuts and washers
OR-2-243	ASA-7.5	(1) Viton O-ring
BA-9	ASA-9	(8) SS bolts (5/8-11 x 1.5) nuts and washers
OR-2-259	ASA-9	(1) Viton O-ring

ASA Hardware for Mating to Gate Valves

MODEL NUMBER	FLANGE SIZE	DESCRIPTION
BA-6GV	ASA-6	(4) SS bolts (3/8-16x1.0) & reducer bushings (3/8 x 3/4)
BA-7.5GV	ASA-7.5	(4) SS bolts (3/8-16x1.0) & reducer bushings (3/8 x 3/4)
BA-9GV	ASA-9	(8) SS bolts (3/8-16x1.0) & reducer bushings (3/8 x 3/4)

SPECIFICATIONS

General: Rotatable and nonrotatable

Materials

Flanges: 304 stainless steel
 Gaskets: Viton
 Bolts: 18-8 stainless steel

Torque: 190 inch/lbs.

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20° to 204°C
 Sustained: -20°C to 150°C



Flanges & Fittings

ASA Flanges & Hardware

Diagram 1

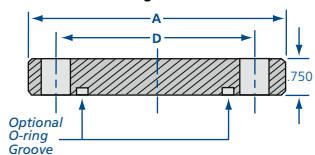


Diagram 2

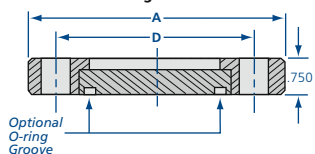


Diagram 3

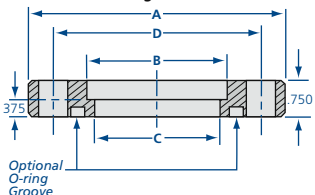
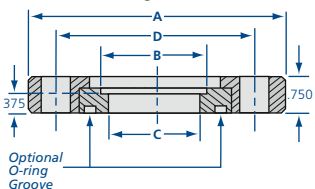


Diagram 4



ASA Flanges - 11 to 16 Inch OD

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

MODEL NUMBER	TYPE	DIAGRAM	A	B	C	D	BOLT HOLES	
							NO.	SIZE
ASA-11-000N	Blank	1	11.00	-	-	9.500	8	0.812
ASA-11-600N	Bored	3	11.00	6.020	5.875	9.500	8	0.812
ASA-11-800N	Bored	3	11.00	8.020	7.875	9.500	8	0.812
ASA-11-000R	Blank	2	11.00	-	-	9.500	8	0.812
ASA-11-600R	Bored	4	11.00	6.020	5.875	9.500	8	0.812
ASA-11-800R	Bored	4	11.00	8.020	7.875	9.500	8	0.812
ASA-13.5-000N	Blank	1	13.50	-	-	11.750	8	0.812
ASA-13.5-800N	Bored	3	13.50	8.020	7.875	11.750	8	0.812
ASA-13.5-1000N	Bored	3	13.50	10.030	9.875	11.750	8	0.812
ASA-13.5-000R	Blank	2	13.50	-	-	11.750	8	0.812
ASA-13.5-800R	Bored	4	13.50	8.020	7.875	11.750	8	0.812
ASA-13.5-1000R	Bored	4	13.50	10.030	9.875	11.750	8	0.812
ASA-16-000N	Blank	1	16.00	-	-	14.250	12	0.812
ASA-16-1000N	Bored	3	16.00	10.030	9.875	14.250	12	0.812
ASA-16-1200N	Bored	3	16.00	12.030	11.875	14.250	12	0.812
ASA-16-000R	Blank	2	16.00	-	-	14.250	12	0.812
ASA-16-1000R	Bored	4	16.00	10.030	9.875	14.250	12	0.812
ASA-16-1200R	Bored	4	16.00	12.030	11.875	14.250	12	0.812

Model Number Definitions
N = Nonrotatable R = Rotatable

O-ring Groove Option

Indicate grooved flanges by adding "G" to the end of the main part number. Add the appropriate cost for each grooved flange.

Example: ASA-9-000R-G

ASA Flange Hardware

MODEL NUMBER	SIZE	DESCRIPTION
BA-11	ASA-11	(8) SS bolts (3/4-10 x 2.25) nuts and washers
OR-2-266	ASA-11	(1) Viton O-ring
BA-13.5	ASA-13.5	(8) SS bolts (3/4-10 x 2.25) nuts and washers
OR-2-274	ASA-13.5	(1) Viton O-ring
BA-16	ASA-16	(12) SS bolts (3/4-10 x 2.25) nuts and washers
OR-2-278	ASA-16	(1) Viton O-ring

ASA Hardware for Mating to Gate Valves

MODEL NUMBER	SIZE	DESCRIPTION
BA-11GV	ASA-11	(8) SS bolts (3/8-16 x 1.0)
BA-16GV	ASA-16	(12) SS bolts (3/8-16 x 1.0)

SPECIFICATIONS

General: Rotatable and nonrotatable

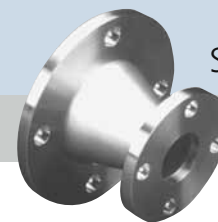
Material

Flanges: 304 stainless steel
Gaskets: Viton
Bolts: 18-8 stainless steel

Torque: 190 inch / lbs.

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20° to 204°C
Operating: -20°C to 150°C



Nor-Cal manufactures a complete line of flanged vacuum component fittings. The tube portions are fabricated from 304 stainless steel. On request, 316 stainless steel can be supplied. Nor-Cal makes its own elbows, and all tees and crosses are made with the pulled-port technique. This allows smooth, crevice-free butt welds to provide the maximum in cleanliness for UHV applications. Bake-out range is up to 200°C. Nor-Cal fittings are also available with CF (Conflat style), NW and ISO flanges.

SPECIFICATIONS

General: Rotatable and nonrotatable

Materials

Flanges: 304 stainless steel
Gaskets: Viton
Bolts: 18-8 stainless steel

Torque: 190 inch/lbs.

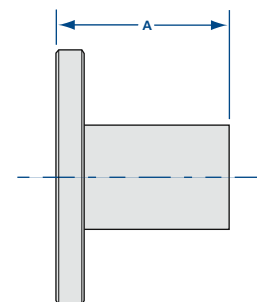
Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20° to 204°C
Sustained: -20°C to 150°C

ASA Half Nipples

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

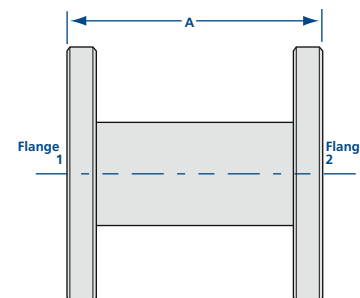
MODEL NUMBER	FLANGE OD	TUBE OD	A
1N-ASA-5-200	5.00	2	3.25
1N-ASA-5-250	5.00	2½	3.25
1N-ASA-5-250V	5.00	2½	4.00
1N-ASA-6-300	6.00	3	3.50
1N-ASA-7.5-400	7.50	4	4.13
1N-ASA-7.5-400V	7.50	4	5.12
1N-ASA-9-400	9.00	4	4.13
1N-ASA-9-400V	9.00	4	5.12
1N-ASA-9-600	9.00	6	5.25
1N-ASA-9-600V	9.00	6	6.31
1N-ASA-11-600	11.00	6	5.38
1N-ASA-11-600V	11.00	6	6.44
1N-ASA-11-800	11.00	8	7.38
1N-ASA-13.5-800	13.50	8	7.75
1N-ASA-13.5-1000	13.50	10	9.88
1N-ASA-16-1000	16.00	10	9.88
1N-ASA-16-1200	16.00	12	9.88



ASA Full Nipples

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

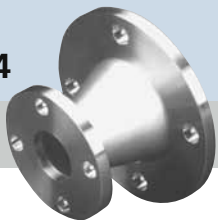
MODEL NUMBER	FLANGE OD	TUBE OD	A
2N-ASA-5-200N	5.00	2	6.50
2N-ASA-5-250N	5.00	2½	6.50
2N-ASA-5-250NV	5.00	2½	8.00
2N-ASA-6-300N	6.00	3	7.00
2N-ASA-7.5-400N	7.50	4	8.26
2N-ASA-7.5-400NV	7.50	4	10.24
2N-ASA-9-400N	9.00	4	8.26
2N-ASA-9-400NV	9.00	4	10.24
2N-ASA-9-600N	9.00	6	10.50
2N-ASA-9-600NV	9.00	6	12.62
2N-ASA-11-600N	11.00	6	10.76
2N-ASA-11-600NV	11.00	6	12.88
2N-ASA-11-800N	11.00	8	14.76
2N-ASA-13.5-800N	13.50	8	15.50
2N-ASA-13.5-1000N	13.50	10	19.76
2N-ASA-16-1000N	16.00	10	19.76
2N-ASA-16-1200N	16.00	12	19.76



O-ring Groove Option

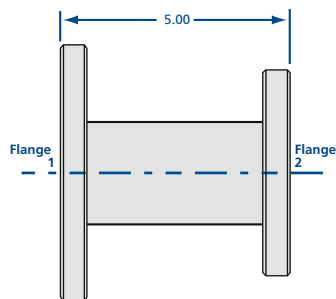
Indicate grooved flanges by adding "-G + Flange number from drawing" to the end of main part number. Add the appropriate cost for each grooved flange.

Example: 4C-ASA-9-600-G1-G3



ASA Reducer Nipples

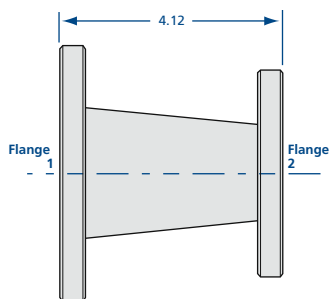
One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.



MODEL NUMBER	FLANGE 1	FLANGE 2	TUBE OD
2NR-ASA-9-5-N	ASA-9	ASA-5	2
2NR-ASA-9-6-N	ASA-9	ASA-6	3
2NR-ASA-9-7.5-N	ASA-9	ASA-7.5	4
2NR-ASA-11-5-N	ASA-11	ASA-5	2
2NR-ASA-11-6-N	ASA-11	ASA-6	3
2NR-ASA-11-7.5-N	ASA-11	ASA-7.5	4
2NR-ASA-11-9-N	ASA-11	ASA-9	6
2NR-ASA-13.5-5-N	ASA-13.5	ASA-5	2
2NR-ASA-13.5-6-N	ASA-13.5	ASA-6	3
2NR-ASA-13.5-7.5-N	ASA-13.5	ASA-7.5	4
2NR-ASA-13.5-9-N	ASA-13.5	ASA-9	6
2NR-ASA-13.5-11-N	ASA-13.5	ASA-11	8
2NR-ASA-16-5-N	ASA-16	ASA-5	2
2NR-ASA-16-6-N	ASA-16	ASA-6	3
2NR-ASA-16-7.5-N	ASA-16	ASA-7.5	4
2NR-ASA-16-9-N	ASA-16	ASA-9	6
2NR-ASA-16-11-N	ASA-16	ASA-11	8
2NR-ASA-16-13.5-N	ASA-16	ASA-13.5	10

Conical Reducer Nipples

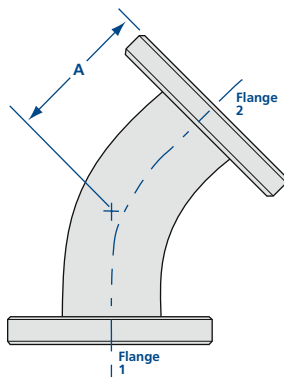
One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.



MODEL NUMBER	FLANGE 1 SIZE	FLANGE 1 TUBE OD	FLANGE 2 SIZE	FLANGE 2 TUBE OD
2NRC-ASA-6-5-N	ASA-6	3	ASA-5	2
2NRC-ASA-7.5-5-N	ASA-7.5	4	ASA-5	2
2NRC-ASA-7.5-6-N	ASA-7.5	4	ASA-6	3

ASA 45° Radius Elbows with Tangents

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.



MODEL NUMBER	FLANGE OD	TUBE OD	A
2KL-ASA-5-N	5.00	2	2.09
2KL-ASA-6-N	6.00	3	3.93
2KL-ASA-7.5-N	7.50	4	5.02
2KL-ASA-9-N	9.00	4	5.02

O-ring Groove Option

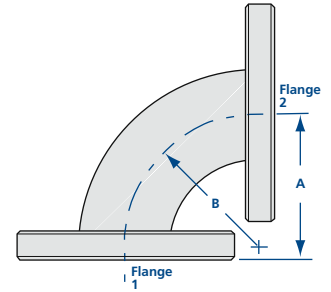
Indicate grooved flanges by adding "-G + Flange number from drawing" to the end of main part number. Add the appropriate cost for each grooved flange.
Example: 4C-ASA-9-600-G1-G3



ASA 90° Radius Elbows

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

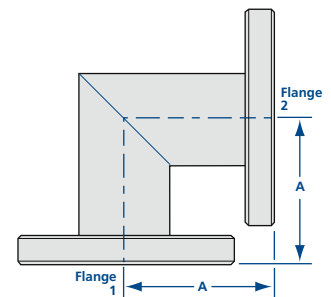
MODEL NUMBER	FLANGE OD	TUBE OD	A	B
2E-ASA-5-N	5.00	2	3.25	3
2E-ASA-6-N	6.00	3	4.75	4½
2E-ASA-9-N	9.00	4	6.25	6
2E-ASA-11-N	11.00	6	9.38	9
2E-ASA-13.5-N	13.50	8	12.38	12
2E-ASA-16-N	16.00	10	15.38	15



ASA 90° Mitered Elbows

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

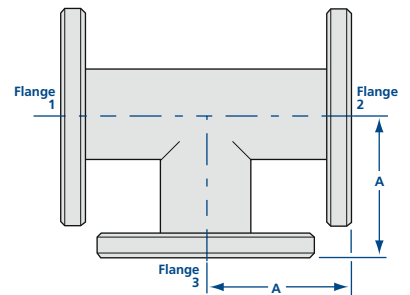
MODEL NUMBER	FLANGE OD	TUBE OD	A
2E-ASA-5-200NM	5.00	2	3.25
2E-ASA-5-250NM	5.00	2½	3.25
2E-ASA-5-250NMV	5.00	2½	4.00
2E-ASA-7.5-400NMV	7.50	4	5.12
2E-ASA-9-400NMV	9.00	4	5.12
2E-ASA-9-600NM	9.00	6	5.25
2E-ASA-9-600NMV	9.00	6	6.31
2E-ASA-11-600NMV	11.00	6	6.44
2E-ASA-11-800NM	11.00	8	7.38
2E-ASA-13.5-800NM	13.50	8	7.75
2E-ASA-13.5-1000NM	13.50	10	9.88
2E-ASA-16-1000NM	16.00	10	9.88



ASA Tees

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

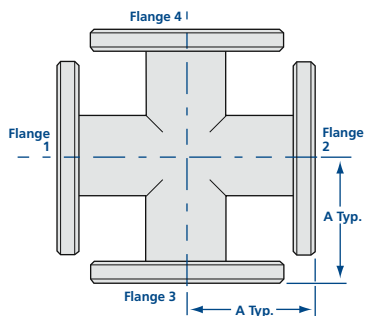
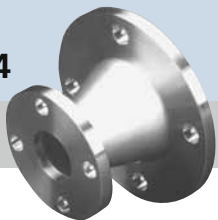
MODEL NUMBER	FLANGE OD	TUBE OD	A
3T-ASA-5-200N	5.00	2	3.25
3T-ASA-5-250N	5.00	2½	3.25
3T-ASA-5-250NV	5.00	2½	4.00
3T-ASA-7.5-400NV	7.50	4	5.12
3T-ASA-9-400NV	9.00	4	5.12
3T-ASA-9-600N	9.00	6	5.25
3T-ASA-9-600NV	9.00	6	6.31
3T-ASA-11-600NV	11.00	6	6.44
3T-ASA-11-800N	11.00	8	7.38
3T-ASA-13.5-800N	13.50	8	7.75
3T-ASA-13.5-1000N	13.50	10	9.88
3T-ASA-16-1000N	16.00	10	9.88



O-ring Groove Option

Indicate grooved flanges by adding "-G + Flange number from drawing" to the end of main part number. Add the appropriate cost for each grooved flange.

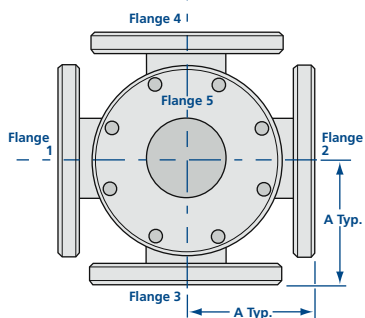
Example: 4C-ASA-9-600-G1-G3



ASA 4-Way Crosses

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

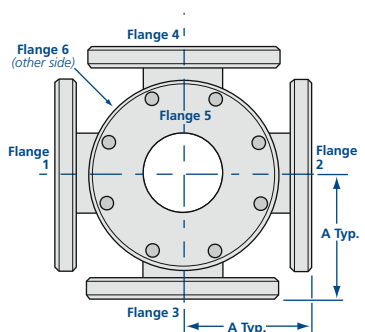
MODEL NUMBER	FLANGE OD	TUBE OD	A
4C-ASA-5-200N	5.00	2	3.25
4C-ASA-5-250N	5.00	2½	3.25
4C-ASA-5-250NV	5.00	2½	4.00
4C-ASA-7.5-400NV	7.50	4	5.12
4C-ASA-9-400NV	9.00	4	5.12
4C-ASA-9-600N	9.00	6	5.25
4C-ASA-9-600NV	9.00	6	6.31
4C-ASA-11-600NV	11.00	6	6.44
4C-ASA-11-800N	11.00	8	7.38
4C-ASA-13.5-800N	13.50	8	7.75
4C-ASA-13.5-1000N	13.50	10	9.88
4C-ASA-16-1000N	16.00	10	9.88



ASA 5-Way Crosses

One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

MODEL NUMBER	FLANGE OD	TUBE OD	A
5C-ASA-5-200N	5.00	2	3.25
5C-ASA-5-250N	5.00	2½	3.25
5C-ASA-5-250NV	5.00	2½	4.00
5C-ASA-7.5-400NV	7.50	4	5.12
5C-ASA-9-400NV	9.00	4	5.12
5C-ASA-9-600N	9.00	6	5.25
5C-ASA-9-600NV	9.00	6	6.31
5C-ASA-11-600NV	11.00	6	6.44
5C-ASA-11-800N	11.00	8	7.38
5C-ASA-13.5-800N	13.50	8	7.75
5C-ASA-13.5-1000N	13.50	10	9.88
5C-ASA-16-1000N	16.00	10	9.88



ASA 6-Way Crosses

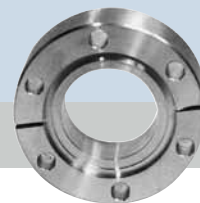
One of each pair of mating ASA flanges requires an O-ring groove. To specify grooved flanges refer to the instructions below.

MODEL NUMBER	FLANGE OD	TUBE OD	A
6C-ASA-5-200N	5.00	2	3.25
6C-ASA-5-250N	5.00	2½	3.25
6C-ASA-5-250NV	5.00	2½	4.00
6C-ASA-7.5-400NV	7.50	4	5.12
6C-ASA-9-400NV	9.00	4	5.12
6C-ASA-9-600N	9.00	6	5.25
6C-ASA-9-600NV	9.00	6	6.31
6C-ASA-11-600NV	11.00	6	6.44
6C-ASA-11-800N	11.00	8	7.38
6C-ASA-13.5-800N	13.50	8	7.75
6C-ASA-13.5-1000N	13.50	10	9.88
6C-ASA-16-1000N	16.00	10	9.88

O-ring Groove Option

Indicate grooved flanges by adding “-G + Flange number from drawing” to the end of main part number. Add the appropriate cost for each grooved flange.

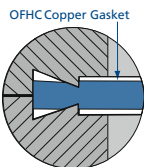
Example: 4C-ASA-9-600-G1-G3



Nor-Cal CF flanges are compatible with other Conflat style flanges and are available in sizes from 1 1/3 to 16 1/2 inch OD for 1/4 to 14 inch tube diameters. Normally our standard material is in the low carbon range for 304. Flanges are made from 304 that has been specially treated to remove impurities inherent in 300 series steels. Special UHV-flanges 4 1/2 inches OD and smaller can be made from 304 electroslag remelt (ESR) bar stock. ESR is a refining process that produces stainless steel with higher purity, fewer inclusions and more uniform grain structure to eliminate microscopic leak paths. Our standard flange material is certified to meet ASTM A-240 and has less than 0.01% sulfur to prevent sulfur stringers. Grain size is 3 to 6 per ASTM E-112. Maximum inclusion size is 2.5 per ASTM E-45. As specials, 304L and 316L material can be supplied in roll-forged rings.

Machining is consistent with good UHV practice. Machine coolant is sulfur free to reduce outgassing. State-of-the-art CNC machine centers are used to produce flanges with consistent high quality. Flanges are machine washed in approved aqueous detergent after machining. Chem-cleaning and clean room packaging are available.

CF flanges utilize an OFHC copper gasket to produce a vacuum tight seal up to 10^{-13} Torr, even when baked repeatedly to 450°C. When the copper gasket is compressed between the knife edges of CF flanges, its material flows laterally to fill surface imperfections.



Nor-Cal offers CF flanges in rotatable as well as nonrotatable versions. (Refer to diagram on page 48.) When components of several systems are used interchangeably, the use of rotatable flanges is recommended. Assembly is facilitated by rotating the receiver portion of the flange to align its bolt holes with those of the mating flange. The insert is welded to the tube or component and contains the knife edge portion of the CF flange.

Nonrotatable CF flanges, unlike rotatable, contain both sealing surface and bolt holes in one unit. This makes the nonrotatable flange less expensive, and therefore the preferred choice when mating component orientation is not a concern. All fittings are priced with a rotatable flange opposing a nonrotatable. For fittings with all nonrotatable flanges subtract the difference in price between a rotatable and nonrotatable flange of the desired size multiplied by the number of additional nonrotatable flanges.



SPECIFICATIONS

General: Rotatable or nonrotatable with tapped or clearance bolt holes

Nominal OD sizes: 1 1/3 to 16 1/2 inches

Tube OD sizes: 1/4 to 14 inches

Materials

Flange: 304 stainless steel
(316L available on request)

Gaskets: Viton, copper or silver plated
Bolts: 18-8 stainless steel or silver plated

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

Metal seal: -200°C to 450°C

Elastomer seal: -20°C to 150°C

New Products



Metric Flanges and Hardware

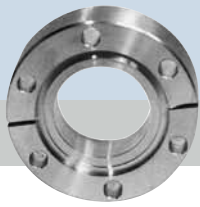
Nor-Cal now stocks bored metric tapped CF flanges in 2 3/4, 4 1/2, 6, 8 and 10 inch ODs. Other sizes are available upon request. Fasteners for metric flanges are stocked for each flange size.



Silver plated Gaskets and Bolts

We are now offering silver plated copper gaskets and bolt kits in a variety of sizes. Silver plated copper gaskets are recommended when the use of pure copper is unacceptable. Silver plated bolt kits offer an alternative to using anti-seize thread lubricant.

All dimensions are in inches unless otherwise noted



Flanges & Fittings

CF Flange Assembly Instructions

SPECIFICATIONS

General: Rotatable or nonrotatable flanges with tapped or clearance bolt holes

Nominal OD sizes: 1¹/₃ to 16¹/₂ inches

Tube sizes: 1/4 to 14 inches

Materials

Flange: 304 stainless steel
(316L available on request)

Gaskets: Viton, copper or silver plated

Bolts: 18-8 stainless steel or silver plated

Vacuum range

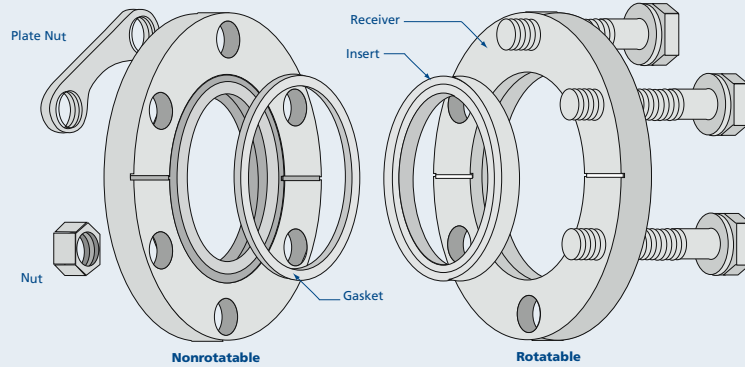
Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

Metal seal: -200°C to 450°C

Elastomer seal: -20°C to 150°C



Fastening Hardware

CF flanges are available with tapped or untapped holes. Tapped flanges are available in UNC/UNF or metric threads. Tapped flanges have through holes, so bolts may protrude slightly from the back of the flange when fastened to an untapped flange. Untapped CF flanges can be fastened to each other with stainless steel bolts and hex nuts or plate nuts. Plate nuts center themselves over two adjacent holes and can be held in place with one finger while the bolts are tightened. They are available for most flange sizes from 1¹/₃ to 10 inch ODs. As an alternative to hex head bolts, 12-point bolts are available for CF flanges from 2³/₄ to 10 inch ODs. Silver plated bolts eliminate the need for anti-seize compound in clean room environments.

Assembly Instructions for Nor-Cal CF (Conflat) Flanges

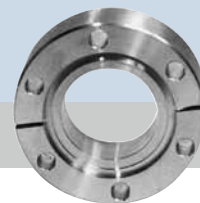
1. Apply a small amount of high temperature anti-seize compound to the bolt threads.
2. Check that both flange surfaces are clean and sealing edges are free from nicks and scratches.
3. Using clean, lint free gloves, unpack gasket.
4. Place gasket in the knife edge counterbore of nonrotatable flange.
5. Align the mating hole pattern and leak test grooves.
6. Install the proper bolts and tighten hand tight. Check to see that the flange faces are parallel.
7. Tighten the bolts 1/4 to 1/2 turns using a circular clockwise pattern until the flange faces are metal to metal.
8. Torque the fasteners to the listed value using the same pattern.

Torque Specifications*

NOMINAL OD	BOLT SIZE	TORQUE IN INCH / LBS
1 ¹ / ₃	8-32	28
2 ¹ / ₈	1/4 - 28	110
2 ³ / ₄	1/4 - 28	110
3 ³ / ₈	5/16 - 24	190
4 ¹ / ₂	5/16 - 24	190
4 ⁵ / ₈	5/16 - 24	190
6	5/16 - 24	190
6 ³ / ₄	5/16 - 24	190
8	5/16 - 24	190
10	5/16 - 24	190
12	5/16 - 24	190
13 ¹ / ₄	3/8 - 24	345
14	3/8 - 24	345
14 ¹ / ₂	3/8 - 24	345
16 ¹ / ₂	3/8 - 24	345

* Specifications for Nor-Cal supplied fasteners only

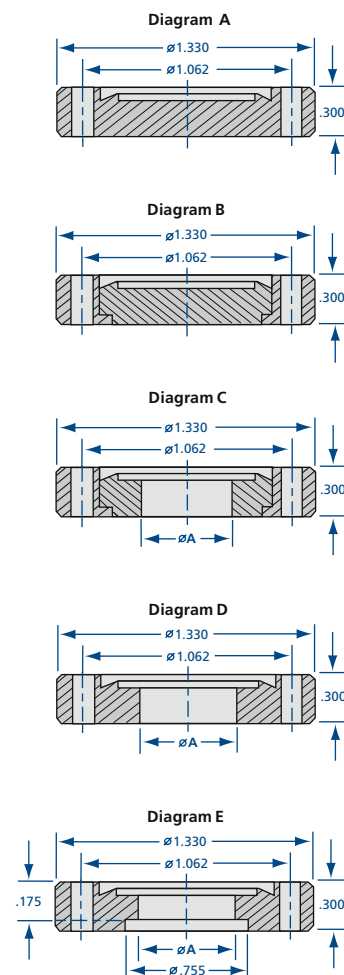




CF mini flanges are manufactured to the same high standard as our other CF flanges for 1/4, 3/8, 1/2, and 3/4 inch OD tube sizes. Nor-Cal offers special purpose, double-sided and zero-length reducer mini flanges along with fittings, viewports and feedthroughs in this size, so we can supply all the components necessary to build a complete table-top, small laboratory or gas handling system from stock.

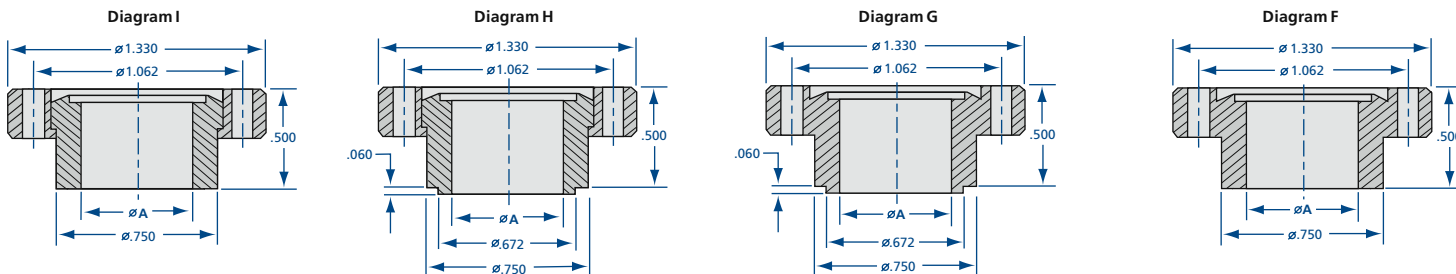
CF Mini Flanges

MODEL NUMBER	TYPE	DIAGRAM	A	BOLT HOLES	DIAMETER OR THREAD
133-000N	Blank	A	-	6	.172
133-000NK	Blank weld neck with weld prep	G	-	6	.172
133-025N	Bored	D	0.255	6	.172
133-038N	Bored	D	0.380	6	.172
133-050N	Bored	D	0.505	6	.172
133-075N	Counterbored for tube OD	E	0.625	6	.172
133-075NK	Bored weld neck with weld prep	G	0.625	6	.172
133-075NBK	Bored weld neck without weld prep	F	0.625	6	.172
133-000NT	Blank	A	-	6	8-32
133-000NKT	Blank weld neck with weld prep	G	-	6	8-32
133-025NT	Bored	D	0.255	6	8-32
133-038NT	Bored	D	0.380	6	8-32
133-050NT	Bored	D	0.505	6	8-32
133-075NT	Counterbored for tube OD	E	0.625	6	8-32
133-075NKT	Bored weld neck with weld prep	G	0.625	6	8-32
133-075NBKT	Bored weld neck without weld prep	F	0.625	6	8-32
133-000R	Blank	B	-	6	.172
133-000RK	Blank weld neck with weld prep	H	-	6	.172
133-025R	Bored	C	0.255	6	.172
133-038R	Bored	C	0.380	6	.172
133-050R	Bored	C	0.505	6	.172
133-075R	Bored	C	0.625	6	.172
133-075RK	Bored weld neck with weld prep	H	0.625	6	.172
133-075RBK	Bored weld neck without weld prep	I	0.625	6	.172
133-000RT	Blank	B	-	6	8-32
133-000RKT	Blank weld neck with weld prep	H	-	6	8-32
133-025RT	Bored	C	0.255	6	8-32
133-038RT	Bored	C	0.380	6	8-32
133-050RT	Bored	C	0.505	6	8-32
133-075RT	Bored	C	0.625	6	8-32
133-075RKT	Bored weld neck with weld prep	H	0.625	6	8-32
133-075RBKT	Bored weld neck without weld prep	I	0.625	6	8-32



Model Number Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes **R** = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes **K** = Weld neck with weld prep **BK** = Weld neck without weld prep



CF Mini Flange Hardware

MODEL NUMBER	DESCRIPTION
G-133	(10) OFHC copper gaskets
G-133-SP	(10) Silver plated copper gaskets
G-133V	(5) Viton gaskets
B-133	(25) SS 8-32 x .75" bolts, nuts & washers
B-133T	(25) SS 8-32 x .56" bolts & washers
B-133-SP	(25) Silver plated SS 8-32 x .75" bolts, nuts & washers
B-133T-SP	(25) Silver plated SS 8-32 x .56" bolts & washers
NP-075	(24) 8-32 plate nuts. See page 63.
KNP-075	(12) Plate nuts and (24) 8-32 x .75" bolts



SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Materials

Flanges: 304 stainless steel
 (316L available upon request)
 Gaskets: Copper, Viton or silver plated
 Bolts: 18-8 stainless steel or silver plated

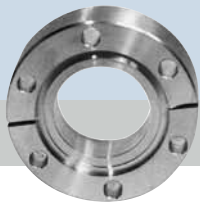
Torque: 28 inch/lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

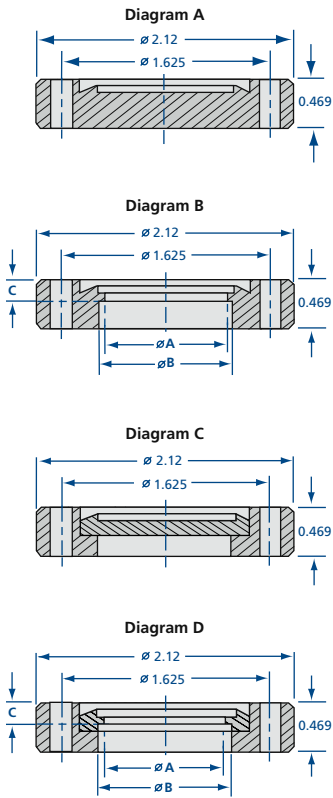
Temperature Range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C



Flanges & Fittings

CF Flanges and Hardware



CF Flanges - 2 1/8 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	ID A	B	C	BOLT HOLES	DIAMETER OR THREAD
212-000N	Blank	A	-	-	-	4	.265
212-025N	Bored	B	0.255	-	-	4	.265
212-050N	Bored	B	0.505	-	-	4	.265
212-075N	Bored	B	0.688	0.760	0.167	4	.265
212-100N	Bored	B	0.938	1.010	0.167	4	.265
212-000NT	Blank	A	-	-	-	4	1/4-28
212-025NT	Bored	B	0.255	-	-	4	1/4-28
212-050NT	Bored	B	0.505	-	-	4	1/4-28
212-075NT	Bored	B	0.688	0.760	0.167	4	1/4-28
212-100NT	Bored	B	0.938	1.010	0.167	4	1/4-28
212-000R	Blank	C	-	-	-	4	.265
212-025R	Bored	D	0.255	-	-	4	.265
212-050R	Bored	D	0.505	-	-	4	.265
212-075R	Bored	D	0.688	0.760	0.167	4	.265
212-100R	Bored	D	0.938	1.010	0.167	4	.265
212-000RT	Blank	C	-	-	-	4	1/4-28
212-025RT	Bored	D	0.255	-	-	4	1/4-28
212-050RT	Bored	D	0.505	-	-	4	1/4-28
212-075RT	Bored	D	0.688	0.760	0.167	4	1/4-28
212-100RT	Bored	D	0.938	1.010	0.167	4	1/4-28

Model Number Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes **R** = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes **M** = Metric tapped bolt holes

CF Flange Hardware - 2 1/8 Inch Nominal OD



MODEL NUMBER	DESCRIPTION
G-212	(10) OFHC copper gaskets
G-212V	(5) Viton gaskets
B-212	(25) SS 1/4-28 x 1 1/4" bolts, nuts & washers
B-212T	(25) SS 1/4-28 x 7/8" bolts & washers
B-212-12	(25) SS 12-pt. 1/4-28 x 1 1/4" bolts, nuts & washers
B-212T-12	(25) SS 12-pt. 1/4-28 x 7/8" bolts & washers

SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Materials

Flanges: 304 stainless steel
 (316L available upon request)
 Gaskets: Copper, Viton
 Bolts: 18-8 stainless steel

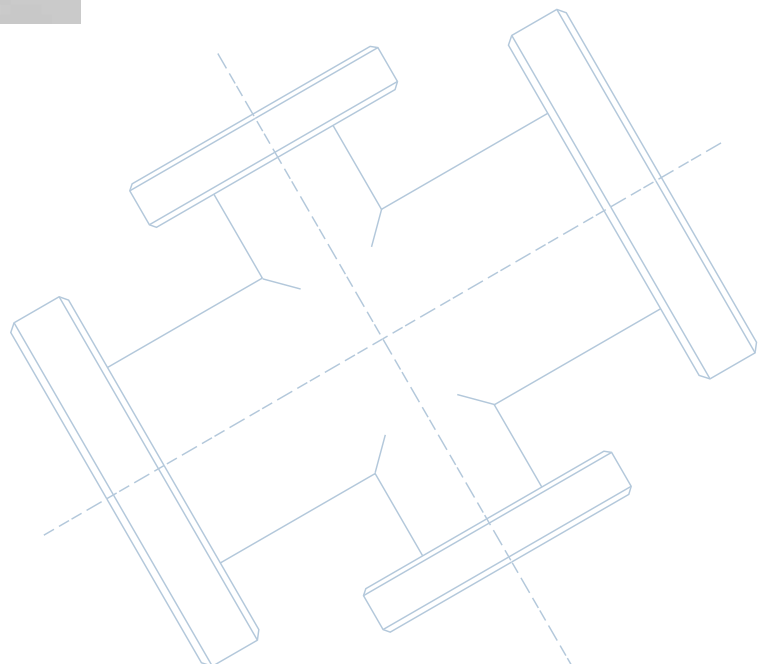
Torque: 110 inch/lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

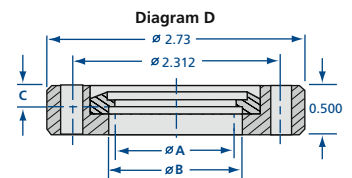
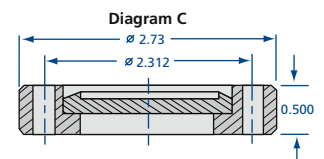
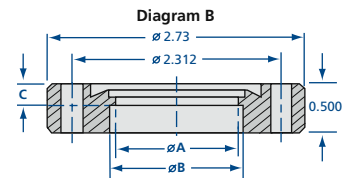
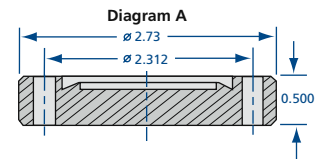
Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C





CF Flanges - 2 3/4 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	ID A	B	C	BOLT HOLES	DIAMETER OR THREAD
275-000N	Blank	A	-	-	-	6	.265
275-025N	Bored	B	0.255	-	-	6	.265
275-050N	Bored	B	0.505	-	-	6	.265
275-075N	Bored	B	0.688	0.760	0.209	6	.265
275-100N	Bored	B	0.938	1.010	0.209	6	.265
275-125N	Bored	B	1.188	1.260	0.209	6	.265
275-150N	Bored	B	1.438	1.510	0.209	6	.265
275-162N	Bored	B	1.560	1.635	0.209	6	.265
275-175N	Bored	B	1.620	1.760	0.209	6	.265
275-000NT	Blank	A	-	-	-	6	1/4-28
275-025NT	Bored	B	0.255	-	-	6	1/4-28
275-050NT	Bored	B	0.505	-	-	6	1/4-28
275-075NT	Bored	B	0.688	0.760	0.209	6	1/4-28
275-100NT	Bored	B	0.938	1.010	0.209	6	1/4-28
275-125NT	Bored	B	1.188	1.260	0.209	6	1/4-28
275-150NT	Bored	B	1.438	1.510	0.209	6	1/4-28
275-150NT-M	Metric, bored	B	1.438	1.510	0.209	6	M6
275-162NT	Bored	B	1.560	1.635	0.209	6	1/4-28
275-175NT	Bored	B	1.620	1.760	0.209	6	1/4-28
275-000R	Blank	C	-	-	-	6	.265
275-025R	Bored	D	0.255	-	-	6	.265
275-050R	Bored	D	0.505	-	-	6	.265
275-075R	Bored	D	0.688	0.760	0.209	6	.265
275-100R	Bored	D	0.938	1.010	0.209	6	.265
275-125R	Bored	D	1.188	1.260	0.209	6	.265
275-150R	Bored	D	1.438	1.510	0.209	6	.265
275-000RT	Blank	C	-	-	-	6	1/4-28
275-025RT	Bored	D	0.255	-	-	6	1/4-28
275-050RT	Bored	D	0.505	-	-	6	1/4-28
275-075RT	Bored	D	0.688	0.760	0.209	6	1/4-28
275-100RT	Bored	D	0.938	1.010	0.209	6	1/4-28
275-125RT	Bored	D	1.188	1.260	0.209	6	1/4-28
275-150RT	Bored	D	1.438	1.510	0.209	6	1/4-28



Model Number Definitions

N = Nonrotatable, clearance bolt holes NT = Nonrotatable, tapped bolt holes R = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes M = Metric tapped bolt holes

CF Flange Hardware - 2 3/4 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-275	(10) OFHC copper gaskets
G-275V	(5) Viton gaskets
G-275-SP	(10) Silver plated copper gaskets
B-275	(25) SS 1/4-28 x 1 1/4" bolts, nuts & washers
B-275T	(25) SS 1/4-28 x 1" bolts & washers
B-275-12	(25) SS 12-pt. 1/4-28 x 1 1/4" bolts, nuts & washers
B-275-12-SP	(25) Silver plated SS 12-pt. 1/4-28 x 1 1/4" bolts, nuts & washers
B-275T-12	(25) SS 12-pt. 1/4-28 x 1" bolts & washers
B-275T-12-SP	(25) Silver plated SS 12-pt. 1/4-28 x 7/8" bolts & washers
B-275T-M	(25) SS (metric) M6 x 1.00 x 25mm bolts & washers
NP-150	(24) 1/4-28 plate nuts. See page 63
KNP-150	(12) Plate nuts, (24) 1/4-28 x 1 1/4" bolts & washers
KNP-150-12	(12) Plate nuts, (24) 12-pt. 1/4-28 x 1 1/4" bolts & washers



SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance holes

Materials

Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton or silver plated
Bolts: 18-8 stainless steel or silver plated

Torque: 110 inch/lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C



Flanges & Fittings

CF Flanges and Hardware

Diagram A

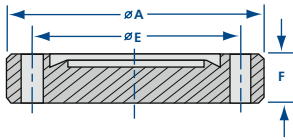


Diagram B

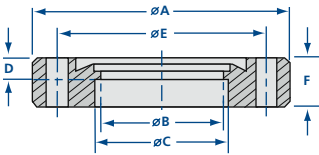


Diagram C

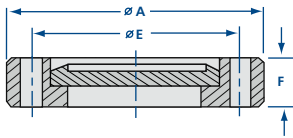
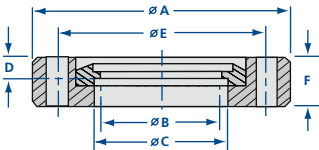


Diagram D



CF Flanges - 3³/₈ Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
338-000N	Blank	A	3.36	-	-	-	2.850	0.687	8	.332
338-150N	Bored	B	3.36	1.438	1.510	0.225	2.850	0.687	8	.332
338-200N	Bored	B	3.36	1.938	2.010	0.225	2.850	0.687	8	.332
338-000NT	Blank	A	3.36	-	-	-	2.850	0.687	8	5/16-24
338-150NT	Bored	B	3.36	1.438	1.510	0.225	2.850	0.687	8	5/16-24
338-200NT	Bored	B	3.36	1.938	2.010	0.225	2.850	0.687	8	5/16-24
338-000R	Blank	C	3.36	-	-	-	2.850	0.687	8	.332
338-150R	Bored	D	3.36	1.438	1.510	0.225	2.850	0.687	8	.332
338-200R	Bored	D	3.36	1.938	2.010	0.225	2.850	0.687	8	.332
338-000RT	Blank	C	3.36	-	-	-	2.850	0.687	8	5/16-24
338-150RT	Bored	D	3.36	1.438	1.510	0.225	2.850	0.687	8	5/16-24
338-200RT	Bored	D	3.36	1.938	2.010	0.225	2.850	0.687	8	5/16-24

CF Flanges - 4¹/₂ Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
450-000N	Blank	A	4.47	-	-	-	3.628	0.687	8	.332
450-150N	Bored	B	4.47	1.438	1.510	0.375	3.628	0.687	8	.332
450-200N	Bored	B	4.47	1.938	2.010	0.375	3.628	0.687	8	.332
450-250N	Bored	B	4.47	2.438	2.510	0.375	3.628	0.687	8	.332
450-000NT	Blank	A	4.47	-	-	-	3.628	0.687	8	5/16-24
450-150NT	Bored	B	4.47	1.438	1.510	0.375	3.628	0.687	8	5/16-24
450-200NT	Bored	B	4.47	1.938	2.010	0.375	3.628	0.687	8	5/16-24
450-250NT	Bored	B	4.47	2.438	2.510	0.375	3.628	0.687	8	5/16-24
450-250NT-M	Metric, Bored	B	4.47	2.438	2.510	0.375	3.628	0.687	8	M8
450-000R	Blank	C	4.47	-	-	-	3.628	0.750	8	.332
450-150R	Bored	D	4.47	1.438	1.510	0.375	3.628	0.750	8	.332
450-200R	Bored	D	4.47	1.938	2.010	0.375	3.628	0.750	8	.332
450-250R	Bored	D	4.47	2.438	2.510	0.375	3.628	0.750	8	.332
450-000RT	Blank	C	4.47	-	-	-	3.628	0.750	8	5/16-24
450-150RT	Bored	D	4.47	1.438	1.510	0.375	3.628	0.750	8	5/16-24
450-200RT	Bored	D	4.47	1.938	2.010	0.375	3.628	0.750	8	5/16-24
450-250RT	Bored	D	4.47	2.438	2.510	0.375	3.628	0.750	8	5/16-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes
 NT = Nonrotatable, tapped bolt holes
 R = Rotatable, clearance bolt holes
 RT = Rotatable, tapped bolt holes
 M = Metric tapped bolt holes

CF Flange Hardware - 3³/₈ Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-338	(10) OFHC copper gaskets
G-338-SP	(10) Silver plated copper gaskets
G-338V	(1) Viton gasket
B-338	(25) SS 5/16-24 x 1 3/4" bolts, nuts & washers
B-338T	(25) SS 5/16-24 x 1 1/4" bolts & washers
B-338-12	(25) SS 12-pt. 5/16-24 x 1 3/4" bolts, nuts & washers
B-338T-12	(25) SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
B-338-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 3/4" bolts, nuts & washers
B-338T-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 1/4" bolts, washers
NP-200	(24) 5/16-24 plate nuts. See page 63
KNP-200	(16) Plate nuts, (32) 5/16-24 x 1 3/4" bolts & washers
KNP-200-12	(16) Plate nuts, (32) 12-pt. 5/16-24 x 1 3/4" bolts & washers

CF Flange Hardware - 4¹/₂ Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-450	(10) OFHC copper gaskets
G-450-SP	(10) Silver plated copper gaskets
G-450V	(1) Viton gasket
B-450	(25) SS 5/16-24 x 2" bolts, nuts & washers
B-450T	(25) SS 5/16-24 x 1 1/4" bolts & washers
B-450-12	(25) SS 12-pt. 5/16-24 x 2" bolts, nuts & washers
B-450T-12	(25) SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
B-450-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 2" bolts, nuts & washers
B-450T-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
B-450-M	(25) SS (metric) M8 x 1.25 x 35mm bolts & washers
NP-250	(24) 5/16-24 plate nuts. See page 63
KNP-250	(16) Plate nuts, (32) 5/16-24 x 2" bolts & washers
KNP-250-12	(16) Plate nuts, (32) 12-pt. 5/16-24 x 2" bolts & washers

SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Materials

Flanges: 304 stainless steel
 (316L available upon request)
 Gaskets: Copper, Viton or silver plated
 Bolts: 18-8 stainless steel or silver plated

Torque: 190 inch/lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

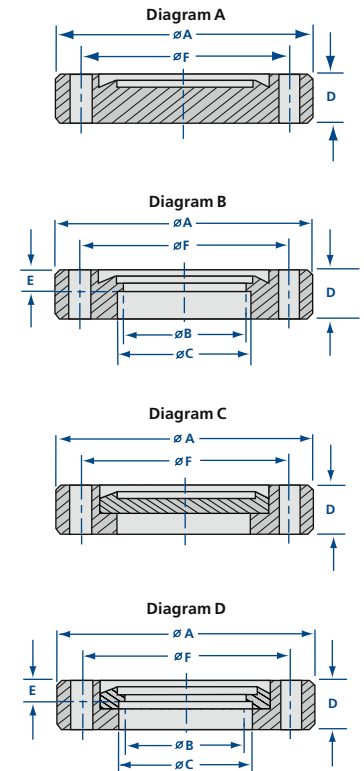
Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C





CF Flanges - 4 5/8 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
462-000N	Blank	A	4.61	-	-	0.812	-	4.030	10	.332
462-300N	Bored	B	4.61	2.938	3.010	0.812	0.281	4.030	10	.332
462-000NT	Blank	A	4.61	-	-	0.812	-	4.030	10	5/16-24
462-300NT	Bored	B	4.61	2.938	3.010	0.812	0.281	4.030	10	5/16-24
462-000R	Blank	C	4.61	-	-	0.812	-	4.030	10	.332
462-300R	Bored	D	4.61	2.938	3.010	0.812	0.281	4.030	10	.332
462-000RT	Blank	C	4.61	-	-	0.812	-	4.030	10	5/16-24
462-300RT	Bored	D	4.61	2.938	3.010	0.812	0.281	4.030	10	5/16-24



CF Flanges - 6 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
600-000N	Blank	A	5.97	-	-	0.781	-	5.128	16	.332
600-400N	Bored	B	5.97	3.910	4.010	0.781	0.438	5.128	16	.332
600-000NT	Blank	A	5.97	-	-	0.781	-	5.128	16	5/16-24
600-400NT	Bored	B	5.97	3.910	4.010	0.781	0.438	5.128	16	5/16-24
600-400NT-M	Metric, bored	B	5.97	3.910	4.010	0.781	0.438	5.128	16	M8
600-000R	Blank	C	5.97	-	-	0.844	-	5.128	16	.332
600-400R	Bored	D	5.97	3.910	4.010	0.844	0.438	5.128	16	.332
600-000RT	Blank	C	5.97	-	-	0.844	-	5.128	16	5/16-24
600-400RT	Bored	D	5.97	3.910	4.010	0.844	0.438	5.128	16	5/16-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes **R** = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes **M** = Metric tapped bolt holes

CF Flange Hardware - 4 5/8 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-462	(10) OFHC copper gaskets
G-462V	(1) Viton gasket
B-462	(25) SS 5/16-24 x 2 1/4" bolts, nuts & washers
B-462T	(25) SS 5/16-24 x 1 1/4" bolts & washers
B-462-12	(25) SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-462T-12	(25) SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
NP-300	(24) 5/16-24 plate nuts. See page 63
KNP-300	(20) Plate nuts, (40) 5/16-24 x 2 1/4" bolts & washers
KNP-300-12	(20) Plate nuts, (40) 12-pt. 5/16-24 x 2 1/4" bolts & washers



SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Materials

Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton and silver plated
Bolts: 18-8 stainless steel and silver plated

Torque: 190 inch / lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

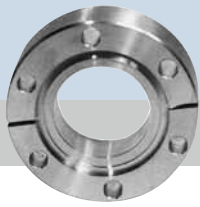
Temperature Range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C

CF Flange Hardware - 6 Inch Nominal OD

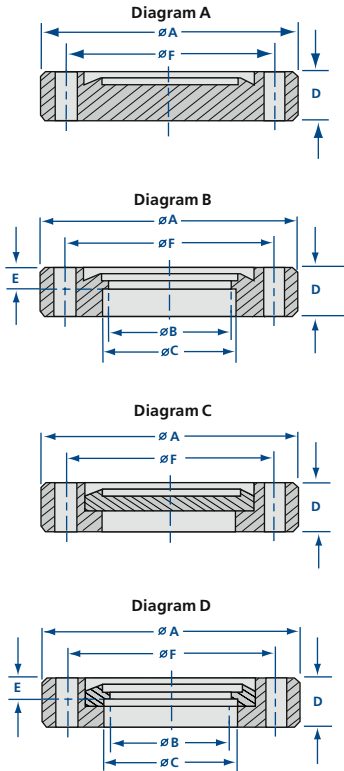
MODEL NUMBER	DESCRIPTION
G-600	(10) OFHC copper gaskets
G-600V	(1) Viton gasket
G-600-SP	(10) Silver plated copper gaskets
B-600	(25) SS 5/16-24 x 2 1/4" bolts, nuts & washers
B-600T	(25) SS 5/16-24 x 1 1/4" bolts & washers
B-600-12	(25) SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-600T-12	(25) SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
B-600-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-600T-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 1/4" bolts & washers
B-600T-M	(25) SS (metric) M8 x 1 1/4 x 35mm bolts & washers
NP-400	(24) 5/16-24 plate nuts. See page 63
KNP-400	(16) Plate nuts (32) 5/16-24 x 2 1/4" bolts & washers
KNP-400-12	(16) Plate nuts (32) 12-pt. 5/16-24 x 2 1/4" bolts & washers





Flanges & Fittings

CF Flanges and Hardware



CF Flanges - 6³/₄ Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
675-000N	Blank	A	6.73	-	-	0.844	-	5.969	18	.332
675-500N	Bored	B	6.73	4.875	5.010	0.844	0.460	5.969	18	.332
675-000NT	Blank	A	6.73	-	-	0.844	-	5.969	18	5/16-24
675-500NT	Bored	B	6.73	4.875	5.010	0.844	0.460	5.969	18	5/16-24
675-000R	Blank	C	6.73	-	-	0.844	-	5.969	18	.332
675-500R	Bored	D	6.73	4.875	5.010	0.844	0.460	5.969	18	.332
675-000RT	Blank	C	6.73	-	-	0.844	-	5.969	18	5/16-24
675-500RT	Bored	D	6.73	4.875	5.010	0.844	0.460	5.969	18	5/16-24

CF Flanges - 8 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
800-000N	Blank	A	7.97	-	-	0.875	-	7.128	20	.332
800-600N	Bored	B	7.97	5.875	6.020	0.875	0.500	7.128	20	.332
800-000NT	Blank	A	7.97	-	-	0.875	-	7.128	20	5/16-24
800-600NT	Bored	B	7.97	5.875	6.020	0.875	0.500	7.128	20	5/16-24
800-600NT-M	Metric, bored	B	7.97	5.875	6.020	0.875	0.500	7.128	20	M8
800-000R	Blank	C	7.97	-	-	0.937	-	7.128	20	.332
800-600R	Bored	D	7.97	5.875	6.020	0.937	0.500	7.128	20	.332
800-000RT	Blank	C	7.97	-	-	0.937	-	7.128	20	5/16-24
800-600RT	Bored	D	7.97	5.875	6.020	0.937	0.500	7.128	20	5/16-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes **R** = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes **M** = Metric tapped bolt holes

SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Material
 Flanges: 304 stainless steel
 (316L available upon request)
 Gaskets: Copper, Viton or silver plated
 Bolts: 18-8 stainless steel or silver plated

Torque: 190 inch/lbs.

Vacuum range
 Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range
 Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C

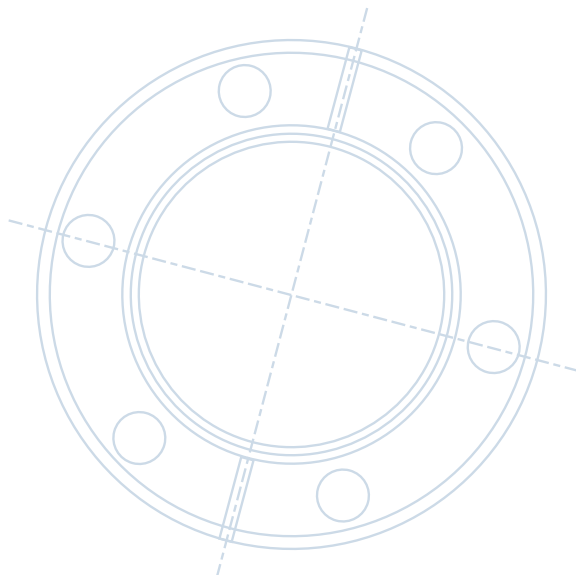


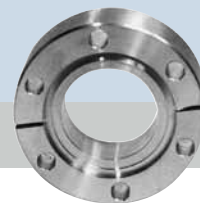
CF Flange Hardware - 6³/₄ Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-675	(10) OFHC copper gaskets
G-675V	(1) Viton gasket
B-675	(25) SS 5/16-24 x 2 1/4" bolts, nuts & washers
B-675T	(25) SS 5/16-24 x 1 1/2" bolts & washers
B-675-12	(25) SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-675T-12	(25) SS 12-pt. 5/16-24 x 1 3/4" bolts & washers

CF Flange Hardware - 8 Inch Nominal OD

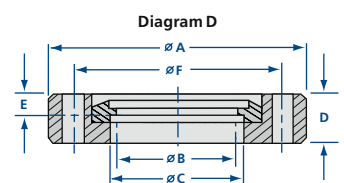
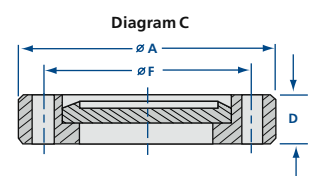
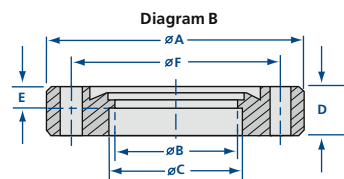
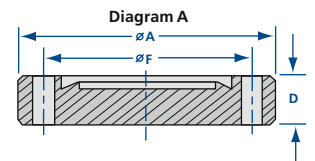
MODEL NUMBER	DESCRIPTION
G-800	(10) OFHC copper gaskets
G-800V	(1) Viton gasket
G-800-SP	(10) Silver plated copper gaskets
B-800	(25) SS 5/16-24 x 2 1/4" bolts, nuts & washers
B-800T	(25) SS 5/16-24 x 1 3/4" bolts & washers
B-800-12	(25) SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-800T-12	(25) SS 12-pt. 5/16-24 x 1 3/4" bolts & washers
B-800-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 2 1/4" bolts, nuts & washers
B-800T-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 3/4" bolts & washers
B-800T-M	(25) SS (metric) M8 x 1 1/4 x 45mm bolts & washers
NP-600	(24) 5/16-24 plate nuts. See page 63
KNP-600	(20) Plate nuts, (40) 5/16-24 x 2 1/4" bolts & washers
KNP-600-12	(20) Plate nuts, (40) 5/16-24 x 2 1/4" 12-pt. bolts & washers





CF Flanges - 10 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
1000-000N	Blank	A	9.97	-	-	0.968	-	9.128	24	.332
1000-800N	Bored	B	9.97	7.875	8.020	0.968	0.500	9.128	24	.332
1000-000NT	Blank	A	9.97	-	-	0.968	-	9.128	24	5/16-24
1000-800NT	Bored	B	9.97	7.875	8.020	0.968	0.500	9.128	24	5/16-24
1000-800NT-M	Metric, bored	B	9.97	7.875	8.020	0.968	0.500	9.128	24	M8
1000-000R	Blank	C	9.97	-	-	0.968	-	9.128	24	.332
1000-800R	Bored	D	9.97	7.875	8.020	0.968	0.500	9.128	24	.332
1000-000RT	Blank	C	9.97	-	-	0.968	-	9.128	24	5/16-24
1000-800RT	Bored	D	9.97	7.875	8.020	0.968	0.500	9.128	24	5/16-24



CF Flanges - 12 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	F	BOLT HOLES	DIAMETER OR THREAD
1200-000N	Blank	A	12.00	-	-	1.125	-	11.181	32	.332
1200-1000N	Bored	B	12.00	9.875	10.020	1.125	0.500	11.181	32	.332
1200-000NT	Blank	A	12.00	-	-	1.125	-	11.181	32	5/16-24
1200-1000NT	Bored	B	12.00	9.875	10.020	1.125	0.500	11.181	32	5/16-24
1200-000R	Blank	C	12.00	-	-	1.125	-	11.181	32	.332
1200-1000R	Bored	D	12.00	9.875	10.020	1.125	0.500	11.181	32	.332
1200-000RT	Blank	C	12.00	-	-	1.125	-	11.181	32	5/16-24
1200-1000RT	Bored	D	12.00	9.875	10.020	1.125	0.500	11.181	32	5/16-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes NT = Nonrotatable, tapped bolt holes R = Rotatable, clearance bolt holes
 RT = Rotatable, tapped bolt holes M = Metric tapped bolt holes

CF Flange Hardware - 10 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1000	(10) OFHC copper gaskets
G-1000V	(1) Viton gasket
G-1000-SP	(10) Silver plated copper gaskets
B-1000	(25) SS 5/16-24 x 2 1/2" bolts, nuts & washers
B-1000T	(25) SS 5/16-24 x 1 3/4" bolts & washers
B-1000-12	(25) SS 12-pt. 5/16-24 x 2 1/2" bolts, nuts & washers
B-1000T-12	(25) SS 12-pt. 5/16-24 x 1 3/4" bolts & washers
B-1000-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 2 1/2" bolts, nuts & washers
B-1000T-12-SP	(25) Silver plated SS 12-pt. 5/16-24 x 1 3/4" bolts & washers
B-1000T-M	(25) SS (metric) M8 x 1 1/4 x 45mm bolts & washers
NP-800	(24) 5/16-24 plate nuts. See page 63
KNP-800	(24) Plate nuts, (48) 5/16-24 x 2 1/4" bolts & washers
KNP-800-12	(24) Plate nuts, (48) 12-pt. 5/16-24 x 2 1/4" bolts & washers



SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Material

Flanges: 304 stainless steel (316L available upon request)
 Gaskets: Copper, Viton or silver plated
 Bolts: 18-8 stainless steel or silver plated

Torque: 190 inch/lbs.

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

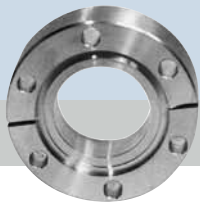
Temperature Range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C

CF Flange Hardware - 12 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1200	(1) OFHC copper gasket
B-1200	(32) SS 5/16-24 x 3" bolts, nuts & washers
B-1200T	(32) SS 5/16-24 x 1 3/4" bolts & washers





Flanges & Fittings

CF Flanges and Hardware

Diagram A

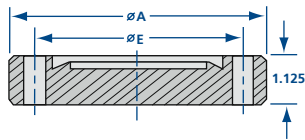


Diagram B

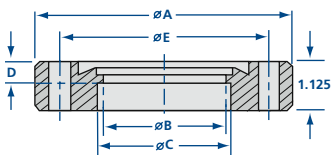


Diagram C

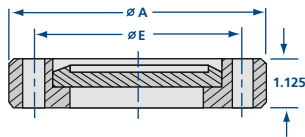
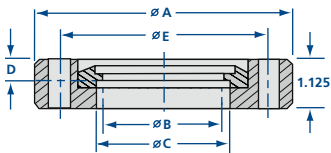


Diagram D



CF Flanges - 13 1/4 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	BOLT HOLES	DIAMETER OR THREAD
1325-000N	Blank	A	13.25	-	-	-	12.055	30	.390
1325-1000N	Bored	B	13.25	9.875	10.020	0.500	12.055	30	.390
1325-000NT	Blank	A	13.25	-	-	-	12.055	30	3/8-24
1325-1000NT	Bored	B	13.25	9.875	10.020	0.500	12.055	30	3/8-24
1325-000R	Blank	C	13.25	-	-	-	12.055	30	.390
1325-1000R	Bored	D	13.25	9.875	10.020	0.500	12.055	30	.390
1325-000RT	Blank	C	13.25	-	-	-	12.055	30	3/8-24
1325-1000RT	Bored	D	13.25	9.875	10.020	0.500	12.055	30	3/8-24

CF Flanges - 14 Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	BOLT HOLES	DIAMETER OR THREAD
1400-000N	Blank	A	14.00	-	-	-	12.810	30	.390
1400-1200N	Bored	B	14.00	11.875	12.030	0.500	12.810	30	.390
1400-000NT	Blank	A	14.00	-	-	-	12.810	30	3/8-24
1400-1200NT	Bored	B	14.00	11.875	12.030	0.500	12.810	30	3/8-24
1400-000R	Blank	C	14.00	-	-	-	12.810	30	.390
1400-1200R	Bored	D	14.00	11.875	12.030	0.500	12.810	30	.390
1400-000RT	Blank	C	14.00	-	-	-	12.810	30	3/8-24
1400-1200RT	Bored	D	14.00	11.875	12.030	0.500	12.810	30	3/8-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes NT = Nonrotatable, tapped bolt holes R = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes M = Metric tapped bolt holes

CF Flange Hardware - 13 1/4 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1325	(1) OFHC copper gasket
G-1325V	(1) Viton gasket
B-1325	(30) SS 3/8-24 x 3" bolts, nuts & washers
B-1325T	(30) SS 3/8-24 x 2" bolts & washers

CF Flange Hardware - 14 Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1400	(1) OFHC copper gasket
G-1400V	(1) Viton gasket
B-1400	(30) SS 3/8-24 x 3" bolts, nuts & washers
B-1400T	(30) SS 3/8-24 x 2" bolts & washers



SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Material
Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton
Bolts: 18-8 stainless steel

Torque: 345 inch/lbs.

Vacuum range
Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

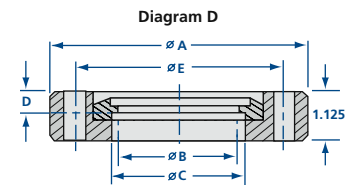
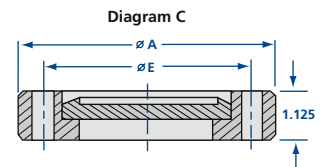
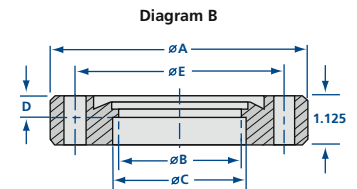
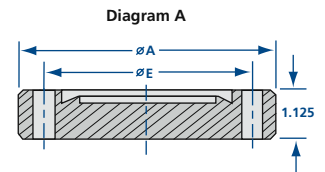
Temperature range
Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C





CF Flanges - 14½ Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	BOLT HOLES	DIAMETER OR THREAD
1450-000N	Blank	A	14.50	Blank	-	-	13.310	32	0.390
1450-1200N	Bored	B	14.50	11.875	12.020	0.500	13.310	32	0.390
1450-000NT	Blank	A	14.50	Blank	-	-	13.310	32	¾-24
1450-1200NT	Bored	B	14.50	11.875	12.020	0.500	13.310	32	¾-24
1450-000R	Blank	C	14.50	Blank	-	-	13.310	32	0.390
1450-1200R	Bored	D	14.50	11.875	12.020	0.500	13.310	32	0.390
1450-000RT	Blank	C	14.50	Blank	-	-	13.310	32	¾-24
1450-1200RT	Bored	D	14.50	11.875	12.020	0.500	13.310	32	¾-24



CF Flanges - 16½ Inch Nominal OD

MODEL NUMBER	TYPE	DIAGRAM	OD A	ID B	C	D	E	BOLT HOLES	DIAMETER OR THREAD
1650-000N	Blank	A	16.50	Blank	-	-	15.310	36	0.390
1650-1400N	Bored	B	16.50	13.750	14.020	0.500	15.310	36	0.390
1650-000NT	Blank	A	16.50	Blank	-	-	15.310	36	¾-24
1650-1400NT	Bored	B	16.50	13.750	14.020	0.500	15.310	36	¾-24
1650-000R	Blank	C	16.50	Blank	-	-	15.310	36	0.390
1650-1400R	Bored	D	16.50	13.750	14.020	0.500	15.310	36	0.390
1650-000RT	Blank	C	16.50	Blank	-	-	15.310	36	¾-24
1650-1400RT	Bored	D	16.50	13.750	14.020	0.500	15.310	36	¾-24

Model Number Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes **R** = Rotatable, clearance bolt holes
RT = Rotatable, tapped bolt holes **M** = Metric tapped bolt holes

CF Flange Hardware - 14½ Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1450	(1) OFHC copper gasket
B-1450	(32) SS ¾-24 x 3" bolts, nuts & washers
B-1450T	(32) SS ¾-24 x 2" bolts & washers



CF Flange Hardware - 16½ Inch Nominal OD

MODEL NUMBER	DESCRIPTION
G-1650	(1) OFHC copper gasket
B-1650V	(1) Viton gasket
B-1650	(36) SS ¾-24 x 3" bolts, nuts & washers
B-1650T	(36) SS ¾-24 x 2" bolts & washers

SPECIFICATIONS

General: Rotatable and nonrotatable with tapped or clearance bolt holes

Material

Flanges: 304 stainless steel
 (316L available upon request)
 Gaskets: Copper, Viton
 Bolts: 18-8 stainless steel

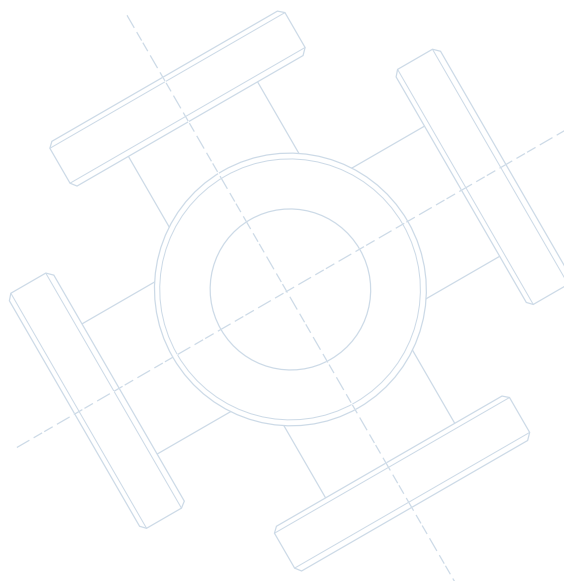
Torque: 345 inch/lbs.

Vacuum range

Metal seal: ≥1 x 10⁻¹³ Torr - UHV
 Elastomer seal: ≥1 x 10⁻⁸ Torr - High vacuum

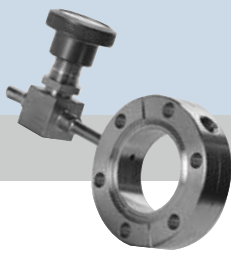
Temperature range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C



Flanges & Fittings

CF Special Purpose Flanges



SPECIFICATIONS

General: Nonrotatable with clearance bolt holes

Material

Flanges: 304 stainless steel
(316L available on request)
Gaskets: Copper, Viton
Bolts: 18-8 stainless steel

Torque: See page 48

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C

Nor-Cal's special purpose CF flanges are used as roughing accessories, accommodating thermocouple gauge tubes, up-to-air valves and/or NPT threaded fittings. Double-sided flanges are provided with one or more radially tapped holes. Blank flanges are provided with a single concentric $1/8$ " NPT tapped hole. Hardware for special purpose flanges is located on the appropriate flange size pages.



CF Double-Sided Special Purpose Flanges

MODEL NUMBER	FLANGE OD	FEATURE	DIAGRAM	A	B
133-D1	1.33	(1) $1/16$ " NPT hole	A	0.25	0.50
275-D1	2.75	(1) $1/8$ " NPT hole	A	0.38	0.75
133-D2	1.33	(2) $1/16$ " NPT holes	B	0.25	0.50
275-D2	2.75	(2) $1/8$ " NPT holes	B	0.38	0.75
133-DT	1.33	Thermocouple gauge tube	C	0.25	0.50
275-DT	2.75	Thermocouple gauge tube	C	0.38	0.75
133-DV	1.33	Up-to-air valve	D	0.25	0.50
275-DV	2.75	Up-to-air valve	D	0.38	0.75
133-DV-1/4 MVCR	1.33	Up-to-air valve & $1/4$ " Cajon male VCR fitting on valve	D	0.25	0.50
275-DV-1/4 MVCR	2.75	Up-to-air valve & $1/4$ " Cajon male VCR fitting on valve	D	0.38	0.75
133-DV-1/4 FVCR	1.33	Up-to-air valve & $1/4$ " Cajon female VCR fitting on valve	D	0.25	0.50
275-DV-1/4 FVCR	2.75	Up-to-air valve & $1/4$ " Cajon female VCR fitting on valve	D	0.38	0.75
133-DV-1/4 SWAG	1.33	Up-to-air valve & $1/4$ " Swagelok fitting on valve	D	0.25	0.50
275-DV-1/4 SWAG	2.75	Up-to-air valve & $1/4$ " Swagelok fitting on valve	D	0.38	0.75
133-D1V	1.33	(1) $1/16$ " NPT hole & up-to-air valve	F	0.25	0.50
275-D1V	2.75	(1) $1/8$ " NPT hole & up-to-air valve	F	0.38	0.75
133-DTV	1.33	Thermocouple gauge tube & up-to-air valve	E	0.25	0.50
275-DTV	2.75	Thermocouple gauge tube & up-to-air valve	E	0.38	0.75
133-DTV-1/4 MVCR	1.33	Thermocouple gauge tube & up-to-air valve with $1/4$ " Cajon male VCR fitting on valve	E	0.25	0.50
275-DTV-1/4 MVCR	2.75	Thermocouple gauge tube & up-to-air valve with $1/4$ " Cajon male VCR fitting on valve	E	0.38	0.75
133-DTV-1/4 FVCR	1.33	Thermocouple gauge tube & up-to-air valve with $1/4$ " Cajon female VCR fitting on valve	E	0.25	0.50
275-DTV-1/4 FVCR	2.75	Thermocouple gauge tube & up-to-air valve with $1/4$ " Cajon female VCR fitting on valve	E	0.38	0.75
133-DTV-1/4 SWAG	1.33	Thermocouple gauge tube & up-to-air valve with $1/4$ " Swagelok fitting on valve	E	0.25	0.50
275-DTV-1/4SWAG	2.75	Thermocouple gauge tube & up-to-air valve with $1/4$ " Swagelok fitting on valve	E	0.38	0.75
275-DS-MINI	2.75	(1) 1.33" OD side port	G	0.38	0.75

Diagram A

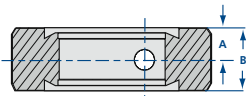


Diagram B

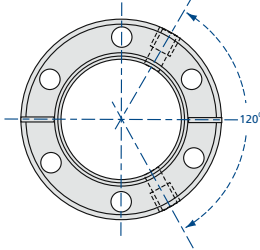


Diagram C

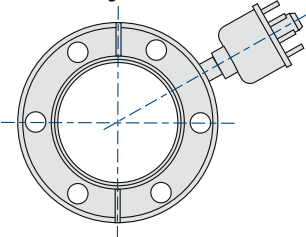


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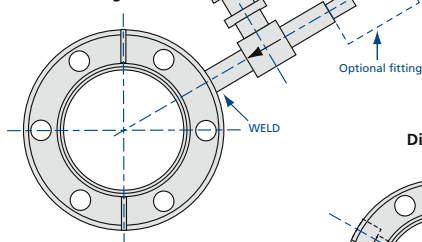


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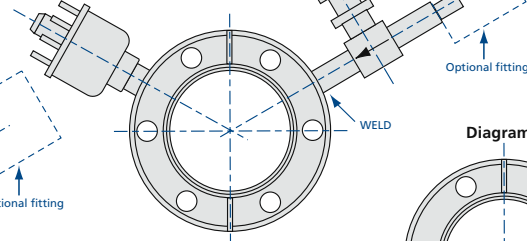


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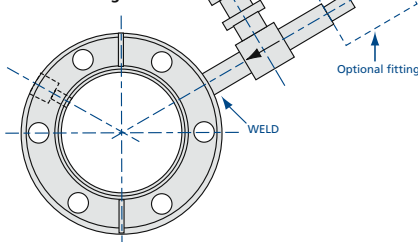
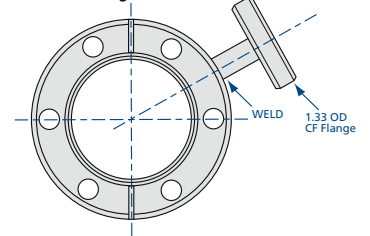
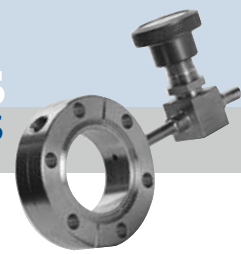


Diagram G





CF Straight-Through Special Purpose Flanges

MODEL NUMBER	FLANGE OD	FEATURE	DIAGRAM
133-ST	1.33	(1) 1/8" NPT hole	A
275-ST	2.75	(1) 1/8" NPT hole	A
133-STT	1.33	Thermocouple gauge tube	B
275-STT	2.75	Thermocouple gauge tube	B
133-STV	1.33	Up-to-air valve	C
275-STV	2.75	Up-to-air valve	C
133-STV-1/4 MVCR	1.33	Up-to-air valve and 1/4" Cajon male VCR fitting on valve	C
275-STV-1/4 MVCR	2.75	Up-to-air valve and 1/4" Cajon male VCR fitting on valve	C
133-STV-1/4 FVCR	1.33	Up-to-air valve and 1/4" Cajon female VCR fitting on valve	C
275-STV-1/4 FVCR	2.75	Up-to-air valve and 1/4" Cajon female VCR fitting on valve	C
133-STV-1/4 SWAG	1.33	Up-to-air valve and 1/4" Swagelok fitting on valve	C
275-STV-1/4 SWAG	2.75	Up-to-air valve and 1/4" Swagelok fitting on valve	C

SPECIFICATIONS

General: Nonrotatable with clearance bolt holes

Material

Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton
Bolts: 18-8 stainless steel

Torque: See page 48

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C

Diagram A

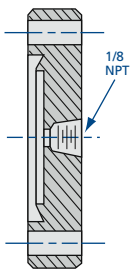


Diagram B

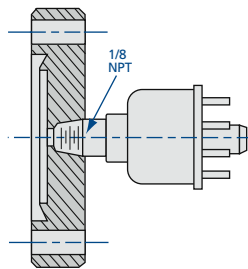
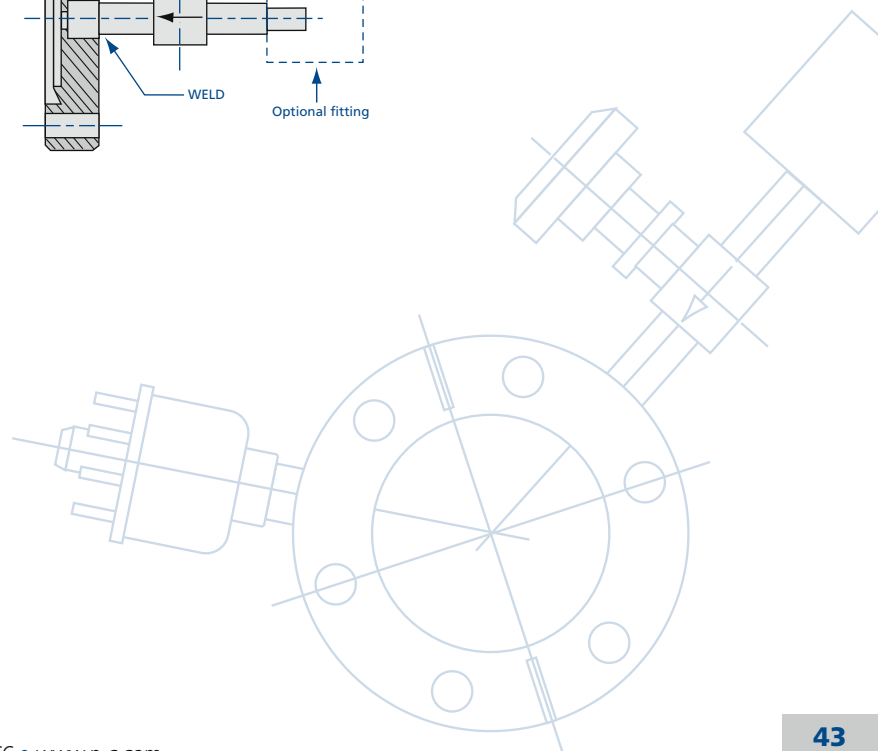
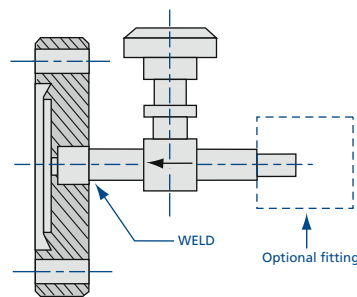
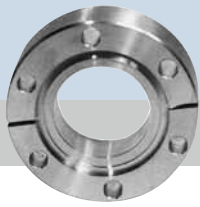


Diagram C





Flanges & Fittings

CF Double-Sided Flanges

Nor-Cal's double-sided flanges are identical to standard CF flanges except the same gasket-sealing detail is machined into both faces of the flange. These flanges can be inserted between like-sized flanges as spacers, orifice plates, or when radially drilled, as custom penetrations into vacuum systems.

CF Double-Sided Flanges - 1 1/3 thru 14 Inch Nominal OD

MODEL NUMBER	NOMINAL OD	MADE FROM	A	B
133-000D	1 1/3	133-000N	-	0.300
133-025D	1 1/3	133-000N	0.255	0.300
133-038D	1 1/3	133-000N	0.380	0.300
133-050D	1 1/3	133-000N	0.505	0.300
133-075D	1 1/3	133-000N	0.630	0.300
133-000DS	1 1/3	133-000NS	-	0.500
133-075DS	1 1/3	133-000NS	0.630	0.500
212-000D	2 1/8	212-000N	-	0.470
212-100D	2 1/8	212-000N	1.010	0.470
275-000D	2 3/4	275-000N	-	0.500
275-025D	2 3/4	275-000N	0.255	0.500
275-050D	2 3/4	275-000N	0.505	0.500
275-075D	2 3/4	275-000N	0.760	0.500
275-100D	2 3/4	275-000N	1.010	0.500
275-125D	2 3/4	275-000N	1.260	0.500
275-150D	2 3/4	275-000N	1.510	0.500
275-000DS	2 3/4	275-000NS	-	0.750
275-150DS	2 3/4	275-000NS	1.510	0.750
338-000D	3 3/8	338-000N	-	0.687
338-150D	3 3/8	338-000N	1.510	0.687
338-200D	3 3/8	338-000N	2.010	0.687
450-000D	4 1/2	450-000N	-	0.687
450-150D	4 1/2	450-000N	1.510	0.687
450-200D	4 1/2	450-000N	2.010	0.687
450-250D	4 1/2	450-000N	2.510	0.687
462-000D	4 5/8	462-000N	-	0.812
462-300D	4 5/8	462-000N	3.010	0.812
600-000D	6	600-000N	-	0.781
600-400D	6	600-000N	4.010	0.781
675-000D	6 3/4	675-000N	-	0.844
675-500D	6 3/4	675-000N	5.010	0.844
800-000D	8	800-000N	-	0.875
800-600D	8	800-000N	6.020	0.875
1000-000D	10	1000-000N	-	0.968
1000-800D	10	1000-000N	8.020	0.968
1325-000D	13 1/4	1325-000N	-	1.125
1325-1000D	13 1/4	1325-000N	10.020	1.125
1400-000D	14	1400-000N	-	1.125
1400-1200D	14	1400-000N	12.020	1.125

CF Double-Sided Flange Hardware

MODEL NUMBER	NOMINAL OD	DESCRIPTION
G-133	1 1/3	(10) OFHC copper gaskets
G-133V	1 1/3	(5) Viton gaskets
B-133D	1 1/3	(5) SS 8-32 x 1 1/4" bolts, nuts and washers
G-212	2 1/8	(10) OFHC copper gaskets
G-212V	2 1/8	(5) Viton gaskets
B-212D	2 1/8	(25) SS 1/4-28 x 1 3/4" bolts, nuts and washers
G-275	2 3/4	(10) OFHC copper gaskets
G-275V	2 3/4	(5) Viton gaskets
B-275DS	2 3/4	(25) SS 1/4-28 x 2" bolts, nuts and washers
B-275D	2 3/4	(25) SS 1/4-28 x 1 3/4" bolts, nuts and washers
KNP-150D	2 3/4	(6) Plate nuts, 1/4-28 x 2" (12) bolts and washers
G-338	3 3/8	(10) OFHC copper gaskets
G-338V	3 3/8	(1) Viton gaskets
B-338D	3 3/8	(25) SS 5/16-24 x 2 1/2" bolts, nuts and washers
G-450	4 1/2	(10) OFHC copper gaskets
G-450V	4 1/2	(1) Viton gaskets
B-450D	4 1/2	(25) SS 5/16-24 x 2 3/4" bolts, nuts and washers
G-462	4 5/8	(10) OFHC copper gaskets
G-462V	4 5/8	(1) Viton gaskets
B-462D	4 5/8	(25) SS 5/16-24 x 3" bolts, nuts and washers
G-600	6	(10) OFHC copper gaskets
G-600V	6	(1) Viton gaskets
B-600D	6	(25) SS 5/16-24 x 3" bolts, nuts and washers
G-675	6 3/4	(10) OFHC copper gaskets
G-675V	6 3/4	(1) Viton gaskets
B-675D	6 3/4	(25) SS 5/16-24 x 3" bolts, nuts and washers
G-800	8	(10) OFHC copper gaskets
G-800V	8	(1) Viton gaskets
B-800D	8	(25) SS 5/16-24 x 3" bolts, nuts & washers
G-1000	10	(10) OFHC copper gaskets
G-1000V	10	(1) Viton gaskets
B-1000D	10	(25) SS 5/16-24 x 3 1/2" bolts, nuts and washers
G-1325	13 1/4	(1) OFHC copper gaskets
G-1325V	13 1/4	(1) Viton gaskets

DS = Thicker than standard flange D = Double-sided flange, nonrotatable

SPECIFICATIONS

General: Nonrotatable with clearance bolt holes

Material

Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton
Bolts: 18-8 stainless steel

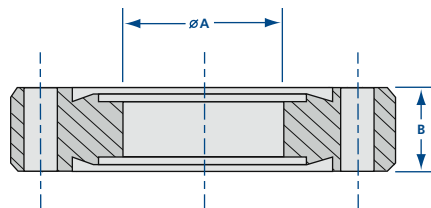
Torque: See page 48

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C





Nor-Cal's zero length reducer flanges are a convenient and inexpensive way to reduce a large flange for smaller vacuum plumbing and/or component connection. To list all possible reducer combinations would require excessive space, therefore only the most commonly used reducers are listed. If your requirement is not listed, please inquire.

CF Zero Length Reducer Flanges

MODEL NUMBER	SMALL FLANGE DETAIL	LARGE FLANGE DETAIL	A	B
212-133-075Z	133-000NT	212-000NT	0.625	0.470
275-133-075Z	133-000NT	275-000N	0.625	0.500
275-212-100Z	212-000NT	275-000NT	1.000	0.500
338-133-075Z	133-000NT	338-000N	0.625	0.687
338-212-100Z	212-000NT	338-000NT	1.000	0.687
338-275-150Z	275-000NT	338-000NT	1.500	0.687
450-133-075Z	133-000NT	450-000N	0.625	0.687
450-212-100Z	212-000NT	450-000N	1.000	0.687
450-275-150Z	275-000NT	450-000N	1.500	0.687
450-338-200Z	338-000NT	450-000NT	2.000	0.687
462-133-075Z	133-000NT	462-000N	0.625	0.812
462-212-100Z	212-000NT	462-000N	1.000	0.812
462-275-150Z	275-000NT	462-000N	1.500	0.812
462-338-200Z	338-000NT	462-000N	2.000	0.812
600-133-075Z	133-000NT	600-000N	0.625	0.781
600-212-100Z	212-000NT	600-000N	1.000	0.781
600-275-150Z	275-000NT	600-000N	1.500	0.781
600-338-200Z	338-000NT	600-000N	2.000	0.781
600-450-250Z	450-000NT	600-000N	2.500	0.781
600-462-300Z	462-000NT	600-000NT	3.000	0.781
675-133-075Z	133-000NT	675-000N	0.625	0.844
675-212-100Z	212-000NT	675-000N	1.000	0.844
675-275-150Z	275-000NT	675-000N	1.500	0.844
675-338-200Z	338-000NT	675-000N	2.000	0.844
675-450-250Z	450-000NT	675-000N	2.500	0.844
675-462-300Z	462-000NT	675-000N	3.000	0.844
675-600-400Z	600-000NT	675-000NT	4.000	0.844
800-133-075Z	133-000NT	800-000N	0.625	0.875
800-212-100Z	212-000NT	800-000N	1.000	0.875
800-275-150Z	275-000NT	800-000N	1.500	0.875
800-338-200Z	338-000NT	800-000N	2.000	0.875
800-450-250Z	450-000NT	800-000N	2.500	0.875
800-462-300Z	462-000NT	800-000N	3.000	0.875
800-600-400Z	600-000NT	800-000N	4.000	0.875
800-675-500Z	675-000NT	800-000NT	5.000	0.875
1000-133-075Z	133-000NT	1000-000N	0.625	0.968
1000-212-100Z	212-000NT	1000-000N	1.000	0.968
1000-275-150Z	275-000NT	1000-000N	1.500	0.968
1000-338-200Z	338-000NT	1000-000N	2.000	0.968
1000-450-250Z	450-000NT	1000-000N	2.500	0.968
1000-462-300Z	462-000NT	1000-000N	3.000	0.968
1000-600-400Z	600-000NT	1000-000N	4.000	0.968
1000-675-500Z	675-000NT	1000-000N	5.000	0.968
1000-800-600Z	800-000NT	1000-000N	6.000	0.968
1325-133-075Z	133-000NT	1325-000N	0.625	1.125
1325-212-100Z	212-000NT	1325-000N	1.000	1.125
1325-275-150Z	275-100NT	1325-000N	1.500	1.125
1325-338-200Z	338-000NT	1325-000N	2.000	1.125
1325-450-250Z	450-000NT	1325-000N	2.500	1.125
1325-462-300Z	462-000NT	1325-000N	3.000	1.125
1325-600-400Z	600-000NT	1325-000N	4.000	1.125
1325-675-500Z	675-000NT	1325-000N	5.000	1.125
1325-800-600Z	800-000NT	1325-000N	6.000	1.125
1325-1000-800Z	1000-000NT	1325-000N	8.000	1.125

SPECIFICATIONS

General: Nonrotatable with tapped or clearance bolt holes

Material

Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton or silver plated
Bolts: 18-8 stainless steel or silver plated

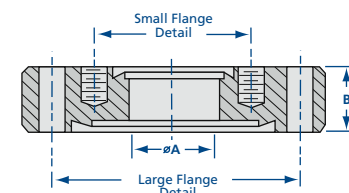
Torque: See page 48

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C



For gasket and hardware options please refer to appropriate flange page

Flange Detail Definitions

N = Nonrotatable, clearance bolt holes **NT** = Nonrotatable, tapped bolt holes



Flanges & Fittings

Aluminum to Stainless Steel Transitions

SPECIFICATIONS

General: Nonrotatable with clearance bolt holes

Material
Flanges: 304 stainless steel
(316L available upon request)
Gaskets: Copper, Viton or silver plated
Bolts: 18-8 stainless steel or silver plated

Torque: 190 inch/lbs.

Vacuum range
Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range
Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C

Nor-Cal's new Aluminum to Stainless Steel Transitions provide a reliable UHV seal for aluminum vacuum systems. An explosion bonded composite of aluminum, stainless steel and two other UHV materials make these transitions leak tight at UHV pressures. Transitions are welded to a stainless steel CF flange as a complete unit ready to weld to your aluminum chamber or beamline, or the transition can be purchased separately for welding to your own CF flange.

The explosion bonds have been tested for tensile, shear and thermal stress. Testing included thermal quenching from 773°K to 77°K. This process has shown vacuum integrity to better than 5×10^{-10} standard cc per second with wall thickness as thin as 0.025". Each unit is thermally cycled to 300°C. Helium leak testing is done before and after thermal cycling.

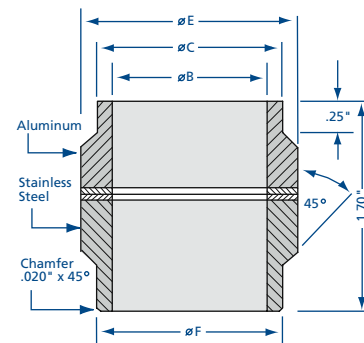
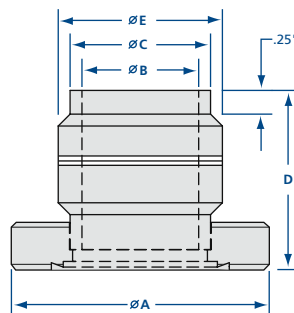


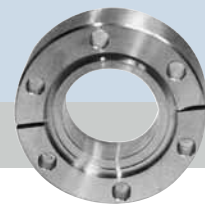
Applications

- Accelerators
- Synchrotrons
- Semiconductor processing

Aluminum to Stainless Steel Transitions

MODEL NUMBER	DESCRIPTION	A	B	C	D	E
ALST-075-CF	Nonrotatable CF	1.33	0.50	0.750	2.20	1.00
ALST-075	Transition only	-	0.50	0.750	-	1.00
ALST-150-CF	Nonrotatable CF	2.73	1.25	1.500	1.91	1.75
ALST-150	Transition only	-	1.25	1.500	-	1.75
ALST-250-CF	Nonrotatable CF	4.47	2.25	2.500	2.08	2.75
ALST-250	Transition only	-	2.25	2.500	-	2.75
ALST-400-CF	Nonrotatable CF	5.97	3.75	4.000	2.14	4.25
ALST-400	Transition only	-	3.75	4.000	-	4.25
ALST-600-CF	Nonrotatable CF	7.97	5.75	6.000	2.20	6.25
ALST-600	Transition only	-	5.75	6.000	-	6.25
ALST-800-CF	Nonrotatable CF	9.97	7.75	8.000	2.20	8.25
ALST-800	Transition only	-	7.75	8.000	-	8.25





Nor-Cal manufactures plate nuts for most sizes of CF flanges from 1 1/3 to 10 inches OD. These handy backing nuts center themselves over two adjacent bolt holes on the back side of a flange and can be held in place with one finger while bolts are tightened with a single wrench. Plate nuts are perfect for those hard to reach (and see) spaces that are encountered during system assembly and service.

Plate Nuts

MODEL NUMBER	FLANGE OD	THREAD SIZE	A	B	C	D
NP-075	1 1/3	8-32	0.80	0.3	0.53	0.15
NP-150	2 3/4	1/4-28	1.59	0.5	1.15	0.18
NP-200	3 3/8	5/16-24	1.75	0.5	1.09	0.22
NP-250	4 1/2	5/16-24	2.03	0.5	1.39	0.22
NP-300	4 5/8	5/16-24	1.75	0.5	1.25	0.22
NP-400	6	5/16-24	1.75	0.5	1.00	0.22
NP-600	8	5/16-24	1.75	0.5	1.12	0.22
NP-800	10	5/16-24	1.75	0.5	1.19	0.22

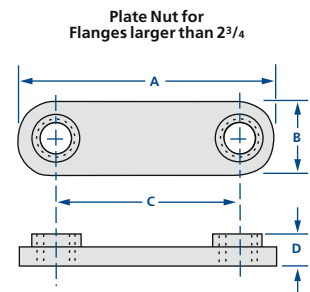
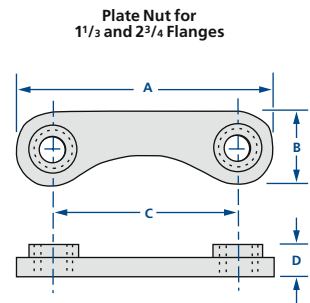
All plate nuts – 24 per package

Plate Nut Assembly Kits with Hex Head Bolts

MODEL NUMBER	FLANGE OD	DESCRIPTION
KNP-075	1 1/3	(12) Plate nuts (24) SS 8-32 x 3/4" bolts and washers
KNP-150	2 3/4	(12) Plate nuts (24) SS 1/4-28 x 1 1/4" bolts and washers
KNP-200	3 3/8	(16) Plate nuts (32) SS 5/16-24 x 1 3/4" bolts and washers
KNP-250	4 1/2	(16) Plate nuts (32) SS 5/16-24 x 2" bolts and washers
KNP-300	4 5/8	(20) Plate nuts (40) SS 5/16-24 x 2 1/4" bolts and washers
KNP-400	6	(16) Plate nuts (32) SS 5/16-24 x 2 1/4" bolts and washers
KNP-600	8	(16) Plate nuts (32) SS 5/16-24 x 2 1/4" bolts and washers
KNP-800	10	(24) Plate nuts (48) SS 5/16-24 x 2 1/2" bolts and washers

Plate Nut Assembly Kits with 12-pt. Bolts

MODEL NUMBER	FLANGE OD	DESCRIPTION
KNP-150-12	2 3/4	(12) Plate nuts (24) SS 12-pt. 1/4-28 x 1 1/4" bolts and washers
KNP-200-12	3 3/8	(16) Plate nuts (32) SS 12-pt. 5/16-24 x 1 3/4" bolts and washers
KNP-250-12	4 1/2	(16) Plate nuts (32) SS 12-pt. 5/16-24 x 2" bolts and washers
KNP-300-12	4 5/8	(20) Plate nuts (40) SS 12-pt. 5/16-24 x 2 1/4" bolts and washers
KNP-400-12	6	(16) Plate nuts (32) SS 12-pt. 5/16-24 x 2 1/4" bolts and washers
KNP-600-12	8	(20) Plate nuts (49) SS 12-pt. 5/16-24 x 2 1/4" bolts and washers
KNP-800-12	10	(24) Plate nuts (48) SS 12-pt. 5/16-24 x 2 1/2" bolts and washers





SPECIFICATIONS

General: Rotatable or nonrotatable with clearance bolt holes

Materials

Tube/Flanges: 304 stainless steel
(316L available on request)

Gaskets: Viton, copper or silver plated

Bolts: 18-8 stainless steel or silver plated

Torque: Refer to specific flange specs

Vacuum range

Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV

Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range

Metal seal: -200°C to 450°C

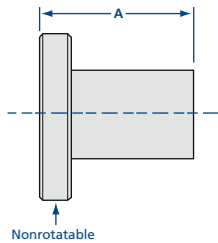
Elastomer: -20°C to 150°C



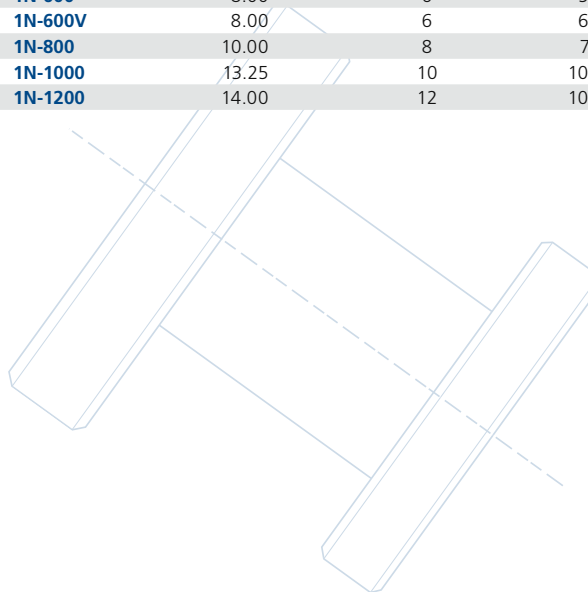
Nor-Cal manufactures a complete line of vacuum fittings with CF flanges. The tube portions are fabricated from 304 stainless steel. On request 316L stainless steel can be supplied. Nor-Cal makes its own elbows, and all tees and crosses are made with the pulled port technique. This allows smooth, crevice-free butt welds to provide the maximum in cleanliness for UHV applications. Bakeout range is up to 450°C.

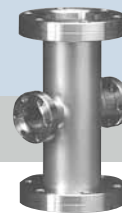
Standard finish is bead blasted. Electropolish can also be provided as an option. Call for pricing.

CF Half Nipples



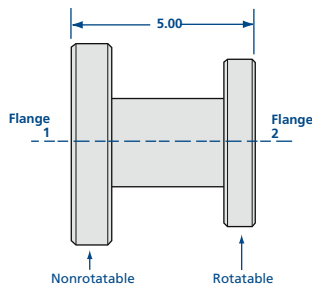
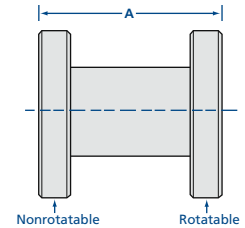
MODEL NUMBER	FLANGE OD	TUBE OD	A
1N-075	1.33	3/4	1.50
1N-100	2.12	1	2.05
1N-150	2.75	1 1/2	2.46
1N-200	3.38	2	3.22
1N-250	4.50	2 1/2	3.38
1N-250V	4.50	2 1/2	4.12
1N-300	4.62	3	3.53
1N-400	6.00	4	4.32
1N-400V	6.00	4	5.31
1N-600	8.00	6	5.50
1N-600V	8.00	6	6.56
1N-800	10.00	8	7.50
1N-1000	13.25	10	10.00
1N-1200	14.00	12	10.00





CF Full Nipples

MODEL NUMBER	FLANGE OD	TUBE OD	A
2N-075	1.33	3/4	3.00
2N-100	2.12	1	4.10
2N-150	2.75	1 1/2	4.92
2N-200	3.38	2	6.44
2N-250	4.50	2 1/2	6.76
2N-250V	4.50	2 1/2	8.24
2N-300	4.62	3	7.06
2N-400	6.00	4	8.64
2N-400V	6.00	4	10.62
2N-600	8.00	6	11.00
2N-600V	8.00	6	13.12
2N-800	10.00	8	15.00
2N-1000	13.25	10	20.00
2N-1200	14.00	12	20.00



CF Reducer Nipples

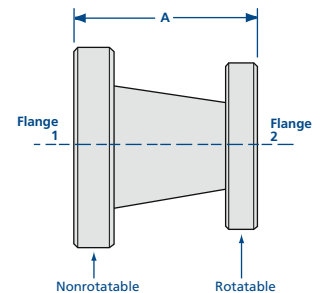
MODEL NUMBER	FLANGE 1 OD	FLANGE 2 OD	TUBE OD
2NR-600-275	6.00	2 3/4	1.50
2NR-800-275	8.00	2 3/4	1.50
2NR-800-450	8.00	4 1/2	2.50
2NR-800-600	8.00	6	4.00
2NR-1000-275	10.00	2 3/4	1.50
2NR-1000-450	10.00	4 1/2	2.50
2NR-1000-600	10.00	6	4.00
2NR-1000-800	10.00	8	6.00
2NR-1325-1000	13.25	10	8.00
2NR-1400-1200	14.00	12	10.00

Note: Reducer nipples with other CF flanges and different lengths are available upon request.



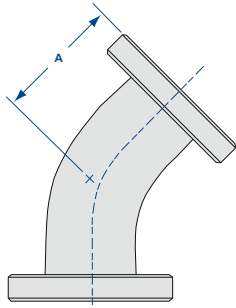
CF Conical Reducer Nipples

MODEL NUMBER	FLANGE 1 OD	FLANGE 1 TUBE OD	FLANGE 2 OD	FLANGE 2 TUBE OD	A
2NRC-212-133	2.12	1	1.33	3/4	2.04
2NRC-275-133	2.75	1 1/2	1.33	3/4	3.08
2NRC-275-212	2.75	1 1/2	2.12	1	2.75
2NRC-338-212	3.38	2	2.12	1	2.77
2NRC-338-275	3.38	2	2.75	1 1/2	2.81
2NRC-450-275	4.50	2 1/2	2.75	1 1/2	2.96
2NRC-450-338	4.50	2 1/2	3.38	2	2.98
2NRC-462-275	4.62	3	2.75	1 1/2	4.12
2NRC-462-338	4.62	3	3.38	2	4.13
2NRC-462-450	4.62	3	4.50	2 1/2	4.28
2NRC-600-338	6.00	4	3.38	2	4.29
2NRC-600-450	6.00	4	4.50	2 1/2	4.44
2NRC-600-462	6.00	4	4.62	3	4.34



Flanges & Fittings

CF Fittings



Both Flanges Rotatable

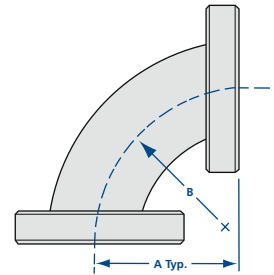
CF 45° Radius Elbow with Tangents

MODEL NUMBER	FLANGE OD	TUBE OD	A
2KL-075	1.33	3/4	0.94
2KL-100	2.12	1	1.14
2KL-150	2.75	1 1/2	1.74
2KL-200	3.38	2	2.07
2KL-250	4.50	2 1/2	3.37
2KL-300	4.62	3	3.96
2KL-400	6.00	4	5.22



CF 90° Radius Elbows

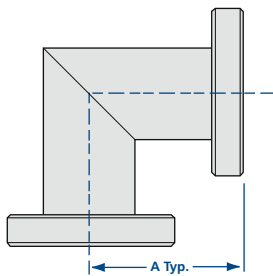
MODEL NUMBER	FLANGE OD	TUBE OD	A	B
2E-075	1.33	3/4	1.50	1.00
2E-100	2.12	1	1.67	1.50
2E-150	2.75	1 1/2	2.46	2.25
2E-200	3.38	2	3.22	3.00
2E-250	4.50	2 1/2	4.12	3.75
2E-300	4.62	3	4.78	4.50
2E-400	6.00	4	6.44	6.00
2E-600	8.00	6	9.50	9.00
2E-800	10.00	8	12.50	12.00
2E-1000	13.25	10	15.50	15.00



Both Flanges Rotatable

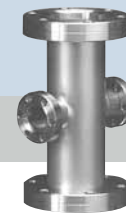
CF 90° Mitered Elbows

MODEL NUMBER	FLANGE OD	TUBE OD	A
2E-075M	1.33	3/4	1.50
2E-100M	2.12	1	2.05
2E-150M	2.75	1 1/2	2.46
2E-200M	3.38	2	3.22
2E-250M	4.50	2 1/2	3.38
2E-250MV	4.50	2 1/2	4.12
2E-300M	4.62	3	3.53
2E-400M	6.00	4	4.32
2E-400MV	6.00	4	5.31
2E-500M	6.75	5	4.71
2E-600M	8.00	6	5.50
2E-600MV	8.00	6	6.56
2E-800M	10.00	8	7.50
2E-1000M	13.25	10	10.00



Both Flanges Rotatable

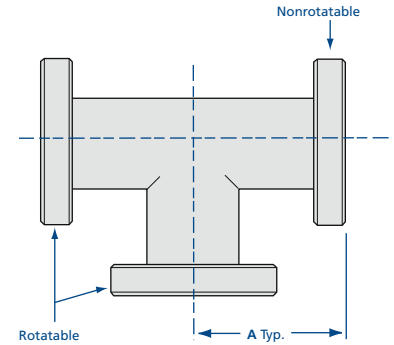




CF Tees

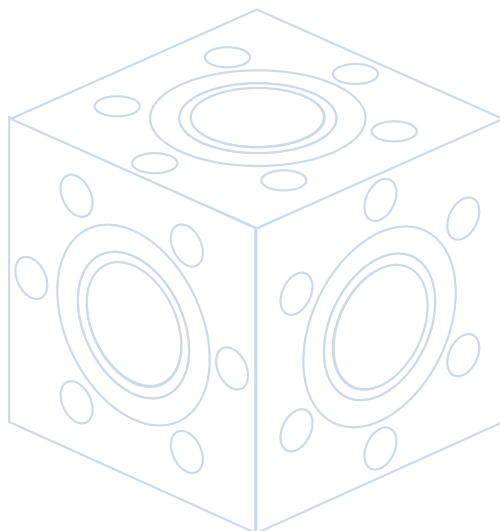
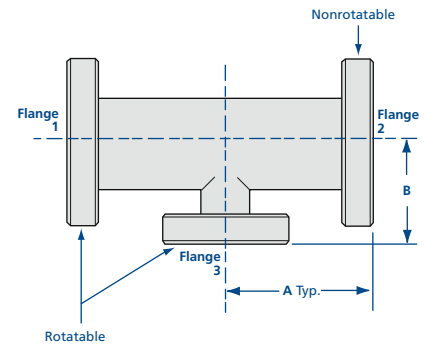
MODEL NUMBER	FLANGE OD	TUBE OD	A
3T-075	1.33	3/4	1.50
3T-100	2.12	1	2.05
3T-150	2.75	1 1/2	2.46
3T-200	3.38	2	3.22
3T-250	4.50	2 1/2	3.38
3T-250V	4.50	2 1/2	4.12
3T-300	4.62	3	3.53
3T-400	6.00	4	4.32
3T-400V	6.00	4	5.31
3T-500	6.75	5	4.71
3T-600	8.00	6	5.50
3T-600V	8.00	6	6.56
3T-800	10.00	8	7.50
3T-1000	13.25	10	10.00

Note: Reducer tees in other tube sizes are available upon request.



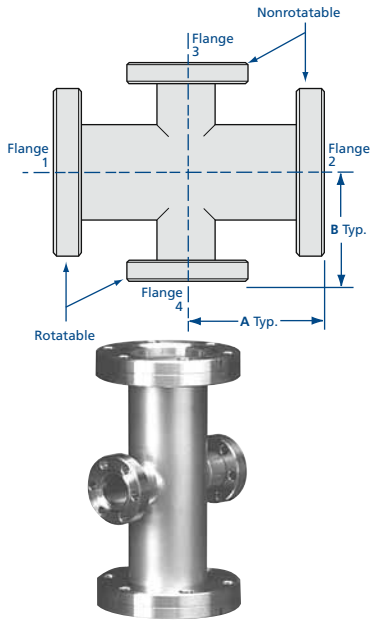
CF Reducer Tees

MODEL NUMBER	FLANGE 1 & 2 FLANGE OD	FLANGE 1 & 2 TUBE OD	FLANGE 3 FLANGE OD	FLANGE 3 TUBE OD	A	B
3TR-150-075	2.75	1 1/2	1.33	3/4	2.46	1.87
3TR-150-100	2.75	1 1/2	2.12	1	2.46	2.29
3TR-200-075	3.38	2	1.33	3/4	3.22	2.13
3TR-200-150	3.38	2	2.75	1 1/2	3.22	2.71
3TR-250-150	4.50	2 1/2	2.75	1 1/2	3.38	2.96
3TR-250-200	4.50	2 1/2	3.38	2	3.38	3.48
3TR-300-200	4.62	3	3.38	2	3.53	3.73
3TR-300-250	4.62	3	4.50	2 1/2	3.53	3.63
3TR-400-150	6.00	4	2.75	1 1/2	4.32	3.71
3TR-400-200	6.00	4	3.38	2	4.32	4.23
3TR-400-250	6.00	4	4.50	2 1/2	4.32	4.13
3TR-400-300	6.00	4	4.62	3	4.32	4.03
3TR-500-400	6.75	5	6.00	4	4.71	4.82
3TR-600-150	8.00	6	2.75	1 1/2	5.50	4.71
3TR-600-200	8.00	6	3.38	2	5.50	5.23
3TR-600-250	8.00	6	4.50	2 1/2	5.50	5.13
3TR-600-400	8.00	6	6.00	4	5.50	5.32
3TR-800-600	10.00	8	8.00	6	7.50	6.50



Flanges & Fittings

CF Fittings



CF Reducer Crosses

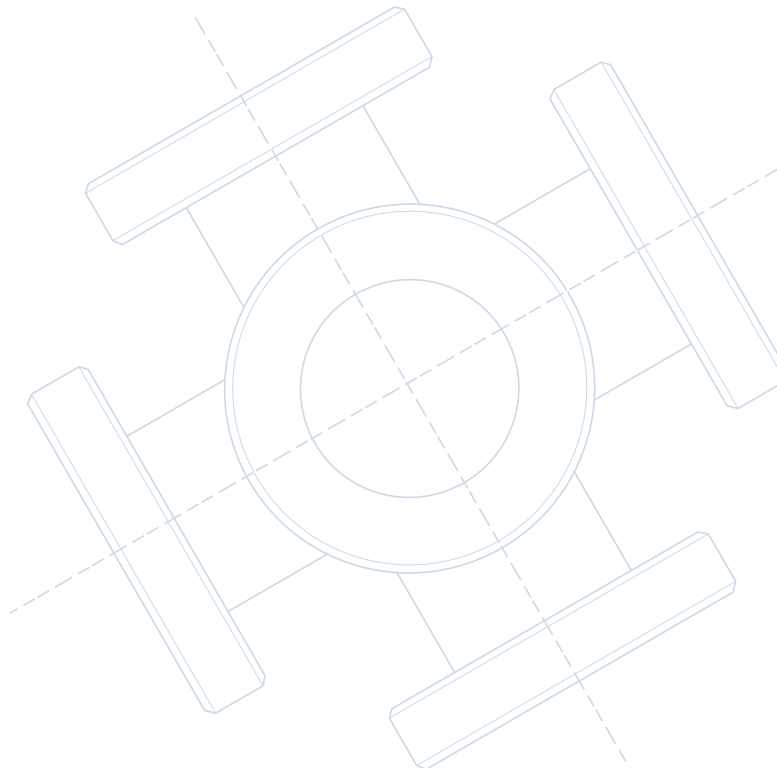
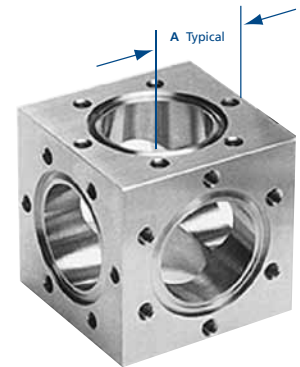
MODEL NUMBER	FLANGE 1 & 2 FLANGE OD	FLANGE 1 & 2 TUBE OD	FLANGE 3 & 4 FLANGE OD	FLANGE 3 & 4 TUBE OD	A	B
4CR-150-075	2.75	1½	1.33	¾	2.46	1.87
4CR-150-100	2.75	1½	2.12	1	2.46	2.29
4CR-200-075	3.38	2	1.33	¾	3.22	2.13
4CR-200-150	3.38	2	2.75	1½	3.22	2.71
4CR-250-150	4.50	2½	2.75	1½	3.38	2.96
4CR-250-200	4.50	2½	3.38	2	3.38	3.48
4CR-300-200	4.62	3	3.38	2	3.53	3.73
4CR-300-250	4.62	3	4.50	2½	3.53	3.63
4CR-400-150	6.00	4	2.75	1½	4.32	3.71
4CR-400-200	6.00	4	3.38	2	4.32	4.23
4CR-400-250	6.00	4	4.50	2½	4.32	4.13
4CR-400-300	6.00	4	4.62	3	4.32	4.03
4CR-500-400	6.75	5	6.00	4	4.71	4.82
4CR-600-150	8.00	6	2.75	1½	5.50	4.71
4CR-600-200	8.00	6	3.38	2	5.50	5.23
4CR-600-250	8.00	6	4.50	2½	5.50	5.13
4CR-600-400	8.00	6	6.00	4	5.50	5.32
4CR-800-600	10.00	8	8.00	6	7.50	6.50

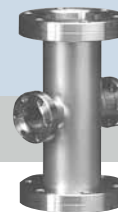
Note: Other reducer combinations can be supplied upon request.

CF 6-Way Cube Crosses

MODEL NUMBER	NOMINAL FLANGE SIZE	A
6C-075-CU	1.33	0.67
6C-150-CU	2.75	1.37
6C-250-CU	4.50	2.24
6C-400-CU	6.00	2.98
6C-600-CU	8.00	3.98

Note: Cube crosses are available in other sizes upon request

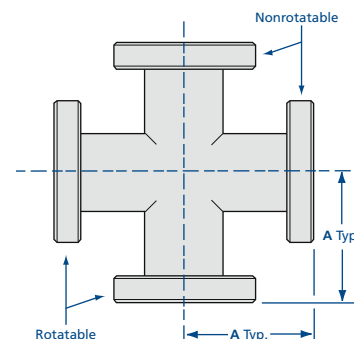




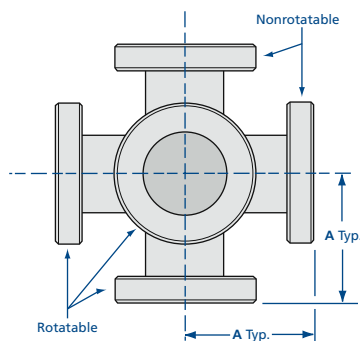
CF 4-Way Crosses



MODEL NUMBER	FLANGE OD	TUBE OD	A
4C-075	1.33	3/4	1.50
4C-100	2.12	1	2.05
4C-150	2.75	1 1/2	2.46
4C-200	3.38	2	3.22
4C-250	4.50	2 1/2	3.38
4C-250V	4.50	2 1/2	4.12
4C-300	4.62	3	3.53
4C-400	6.00	4	4.32
4C-400V	6.00	4	5.31
4C-500	6.75	5	4.71
4C-600	8.00	6	5.50
4C-600V	8.00	6	6.56
4C-800	10.00	8	7.50
4C-1000	13.25	10	10.00



CF 5-Way Crosses



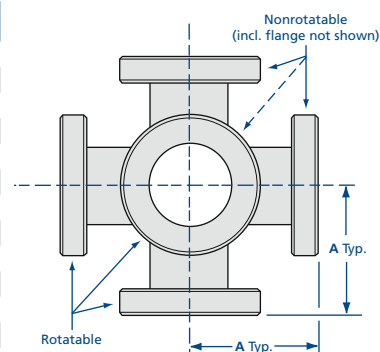
MODEL NUMBER	FLANGE OD	TUBE OD	A
5C-075	1.33	3/4	1.50
5C-100	2.12	1	2.05
5C-150	2.75	1 1/2	2.46
5C-200	3.38	2	3.22
5C-250	4.50	2 1/2	3.38
5C-250V	4.50	2 1/2	4.12
5C-300	4.62	3	3.53
5C-400	6.00	4	4.32
5C-400V	6.00	4	5.31
5C-500	6.75	5	4.71
5C-600	8.00	6	5.50
5C-600V	8.00	6	6.56
5C-800	10.00	8	7.50
5C-1000	13.25	10	10.00

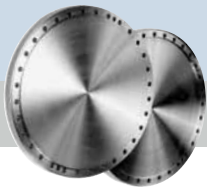


CF 6-Way Crosses



MODEL NUMBER	FLANGE OD	TUBE OD	A
6C-075	1.33	3/4	1.50
6C-100	2.12	1	2.05
6C-150	2.75	1 1/2	2.46
6C-200	3.38	2	3.22
6C-250	4.50	2 1/2	3.38
6C-250V	4.50	2 1/2	4.12
6C-300	4.62	3	3.53
6C-400	6.00	4	4.32
6C-400V	6.00	4	5.31
6C-500	6.75	5	4.71
6C-600	8.00	6	5.50
6C-600V	8.00	6	6.56
6C-800	10.00	8	7.50
6C-1000	13.25	10	10.00





Flanges & Fittings

Wire Seal Flanges

SPECIFICATIONS

General: Nonrotatable flanges with clearance bolt holes

Nominal OD sizes: 12³/₈ to 27¹/₈ inches

Tube OD sizes: 10 to 24 inches

Materials

Flange: 304 stainless steel
(316L available on request)

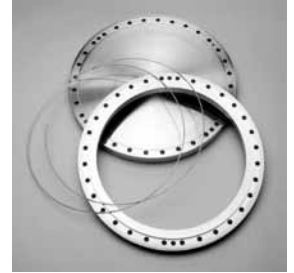
Gaskets: Copper

Bolts: 18-8 stainless steel

Vacuum range: ≥1 x 10⁻¹³ Torr - UHV

Temperature range: -200° to 450°C

Nor-Cal's wire seal flanges are designed for use on bell jars, custom vacuum chambers and related systems. Standard sizes range from 12 to 27 inch nominal OD for tube sizes from 10 to 24 inch OD. A male and female flange compress a 0.080 inch diameter OFHC copper wire to effect a seal. Gasket flow is confined by the geometry of the flange surfaces to the area of the seal. Minor nicks and scratches within this contact area are filled with crushed copper wire providing a seal that is leak tight at 10⁻¹³ Torr after repeated bake out to 450°C. Solid blanks are standard. Dished head blanks are offered as a lower cost alternative.

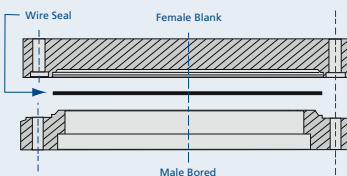


Wire Seal Flanges

MODEL NUMBER	OD A	B	C	D	E	F	BOLT HOLES
WS-12-000M	12.375	-	-	1.13	-	11.343	24
WS-12-1000M	12.375	9.750	10.020	1.13	0.630	11.343	24
WS-12-000F	12.375	-	-	1.13	-	11.343	24
WS-12-1000F	12.375	9.750	10.020	1.13	0.630	11.343	24
WS-14-000M	14.625	-	-	1.13	-	13.593	32
WS-14-1200M	14.625	11.750	12.020	1.13	0.630	13.593	32
WS-14-000F	14.625	-	-	1.13	-	13.593	32
WS-14-1200F	14.625	11.750	12.020	1.13	0.630	13.593	32
WS-17-000M	17.250	-	-	1.13	-	15.718	36
WS-17-1400M	17.250	13.750	14.020	1.13	0.630	15.718	36
WS-17-000F	17.250	-	-	1.13	-	15.718	36
WS-17-1400F	17.250	13.750	14.020	1.13	0.630	15.718	36
WS-19-000M	19.562	-	-	1.31	-	17.875	36
WS-19-1600M	19.562	15.750	16.020	1.31	0.630	17.875	36
WS-19-000F	19.562	-	-	1.31	-	17.875	36
WS-19-1600F	19.562	15.750	16.020	1.31	0.630	17.875	36
WS-22-000M	22.125	-	-	1.50	-	20.187	36
WS-22-1800M	22.125	17.750	18.020	1.50	1.000	20.187	36
WS-22-000F	22.125	-	-	1.50	-	20.187	36
WS-22-1800F	22.125	17.750	18.020	1.50	1.000	20.187	36
WS-27-000M	27.125	-	-	1.75	-	25.843	40
WS-27-2400M	27.125	23.625	24.020	1.75	1.125	25.843	40
WS-27-000F	27.125	-	-	1.75	-	25.843	40
WS-27-2400F	27.125	23.625	24.020	1.75	1.125	25.843	40

Wire Seal Flange Assembly Instructions

- Apply a small amount of high temperature anti-seize compound to the bolt threads.
- Check that both flange surfaces are clean and sealing edges are free from nicks and scratches.
- Using clean, lint free gloves, unpack gasket.
- Place seal over the sealing area on the male flange.
- Align the mating flange hole pattern and leak test grooves.
- Install the proper bolts and tighten hand tight. Check to see that the flange faces are parallel.
- Tighten the bolts 1/4 to 1/2 turns using a circular clockwise pattern until the flange faces are metal to metal.
- Torque the fasteners until leak tight using the same pattern. Never exceed maximum torque.

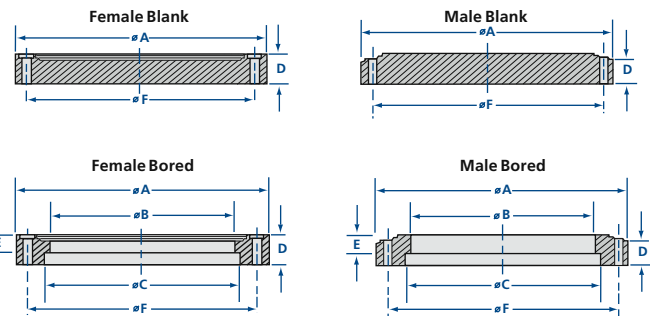


Torque Specifications

NOMINAL OD	BOLT SIZE	MAX. TORQUE INCH POUNDS
12	3/8 - 24	260
14	3/8 - 24	260
17	1/2 - 20	541
19	1/2 - 20	541
22	5/8 - 18	1,244
27	5/8 - 18	1,244

Model Number Definitions

M = Male flange F = Female flange



Wire Seal Flange Gaskets and Bolt Sets

MODEL NUMBER	FLANGE OD	DESCRIPTION	QUANTITY
WG-12	12.375	Copper gasket	1
WB-12	12.375	SS 3/8-24 x 2 1/2 bolts and nuts	24
WG-14	14.625	Copper gasket	1
WB-14	14.625	SS 3/8-24 x 2 1/2 bolts and nuts	32
WG-17	17.250	Copper gasket	1
WB-17	17.250	SS 1/2-20 x 2 3/4 bolts and nuts	36
WG-19	19.562	Copper gasket	1
WB-19	19.562	SS 1/2-20 x 3 bolts and nuts	36
WG-22	22.125	Copper gasket	1
WB-22	22.125	SS 5/8-18 x 3 1/2 bolts and nuts	36
WG-27	27.125	Copper gasket	1
WB-27	27.125	SS 5/8-18 x 4 bolts and nuts	40

All dimensions are called out in inches unless otherwise noted



Adapter Fittings

Nor-Cal Products provides a broad range of adapter fittings in order to connect two dissimilar types of components. They are made from 304 or 316L stainless steel and are TIG welded, cleaned and leak checked for vacuum service. Tube finishes are normally bead blasted. However, tumbled or electropolished finish can be provided upon request. Flanges and nipples used to adapt different sizes of the same flange type are called reducers. They are listed in the flanges and fittings section for the particular flange type. For example, CF zero length reducer flanges are listed in the CF section of Flanges and Fittings.

SPECIFICATIONS

Materials: 304 or 316L stainless steel

Vacuum range
 Metal seal: $\geq 1 \times 10^{-13}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

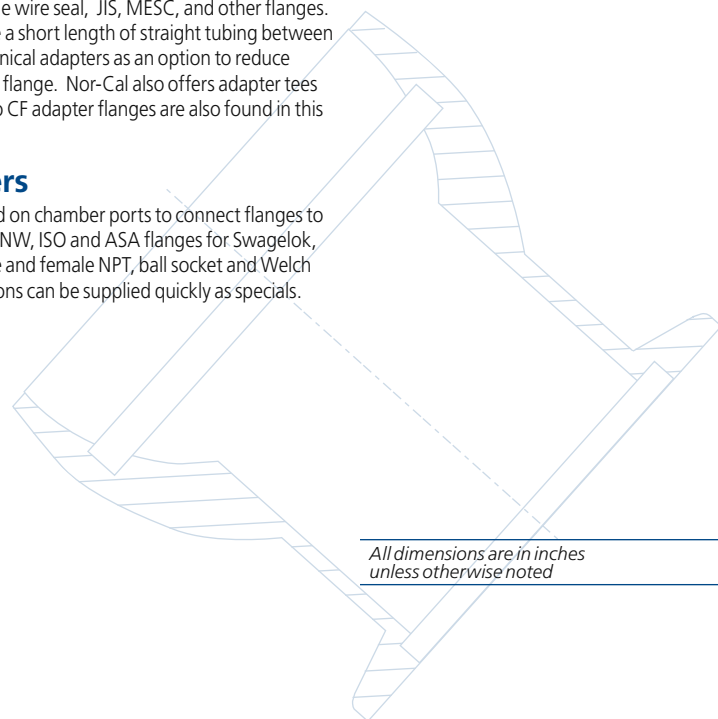
Temperature range
 Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C

Flange-to-Flange Adapters

Flange-to-flange adapter fittings are used as a transition between two dissimilar flange types. We offer adapter fittings with flange combinations for CF (Conflat), NW (ISO-KF), ISO and ASA (ANSI) components as standards. We frequently provide other flange combinations as specials. These include wire seal, JIS, MESG, and other flanges. Flange-to-flange adapter nipples usually have a short length of straight tubing between the two flanges. Where possible, we offer conical adapters as an option to reduce conductance loss at the opening of the larger flange. Nor-Cal also offers adapter tees and crosses with ISO and NW flanges. ASA to CF adapter flanges are also found in this section.

Flange-to-Fitting Adapters

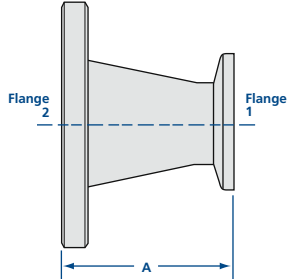
Flange-to-fitting adapters are commonly used on chamber ports to connect flanges to special fittings. Nor-Cal offers these with CF, NW, ISO and ASA flanges for Swagelok, male and female VCR, quick disconnect, male and female NPT, ball socket and Welch pump fittings as standards. Other combinations can be supplied quickly as specials.



All dimensions are in inches unless otherwise noted

Adapter Fittings

Flange-to-Flange



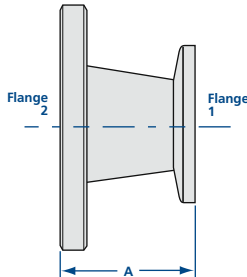
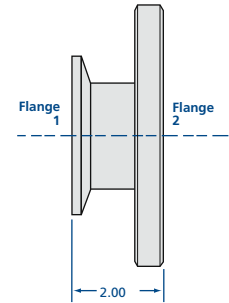
NW to CF Conical Adapter Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-NW-16-212	NW-16	3/4	2.12 CF	1	1.69
ANC-NW-16-275	NW-16	3/4	2.75 CF	1 1/2	2.73
ANC-NW-25-133	NW-25	1	1.33 CF	3/4	2.03
ANC-NW-25-275	NW-25	1	2.75 CF	1 1/2	2.73
ANC-NW-25-338	NW-25	1	3.38 CF	2	2.75
ANC-NW-40-133	NW-40	1 1/2	1.33 CF	3/4	3.03
ANC-NW-40-212	NW-40	1 1/2	2.12 CF	1	2.69
ANC-NW-40-338	NW-40	1 1/2	3.38 CF	2	2.75
ANC-NW-40-450	NW-40	1 1/2	4.50 CF	2 1/2	2.90
ANC-NW-40-462	NW-40	1 1/2	4.62 CF	3	4.06
ANC-NW-50-212	NW-50	2	2.12 CF	1	2.69
ANC-NW-50-275	NW-50	2	2.75 CF	1 1/2	2.73
ANC-NW-50-450	NW-50	2	4.50 CF	2 1/2	2.90
ANC-NW-50-462	NW-50	2	4.62 CF	3	4.06
ANC-NW-50-600	NW-50	2	6.00 CF	4	4.21



NW to CF Adapter Nipples

MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-NW-10-133	NW-10	1.33 CF	1/2
AN-NW-16-133	NW-16	1.33 CF	3/4
AN-NW-25-212	NW-25	2.12 CF	1
AN-NW-40-275	NW-40	2.75 CF	1 1/2
AN-NW-50-133	NW-50	1.33 CF	3/4
AN-NW-50-338	NW-50	3.38 CF	2



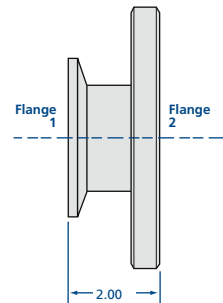
NW to ASA Conical Adapter Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-NW-25-ASA-5	NW-25	1	ASA-5	2	2.78
ANC-NW-40-ASA-5	NW-40	1 1/2	ASA-5	2 1/2	2.78
ANC-NW-40-ASA-6	NW-40	1 1/2	ASA-6	3	4.03
ANC-NW-50-ASA-5	NW-50	2	ASA-5	2 1/2	2.78
ANC-NW-50-ASA-6	NW-50	2	ASA-6	3	4.03
ANC-NW-50-ASA-7.5	NW-50	2	ASA-7.5	4	4.03



NW to ASA Adapter Nipples

MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-NW-16-ASA-5	NW-16	ASA-5	3/4
AN-NW-16-ASA-6	NW-16	ASA-6	3/4
AN-NW-16-ASA-7.5	NW-16	ASA-7.5	3/4
AN-NW-16-ASA-11	NW-16	ASA-11	3/4
AN-NW-25-ASA-6	NW-25	ASA-6	1
AN-NW-25-ASA-7.5	NW-25	ASA-7.5	1
AN-NW-25-ASA-9	NW-25	ASA-9	1
AN-NW-25-ASA-11	NW-25	ASA-11	1
AN-NW-40-ASA-7.5	NW-40	ASA-7.5	1 1/2
AN-NW-40-ASA-9	NW-40	ASA-9	1 1/2
AN-NW-40-ASA-11	NW-40	ASA-11	1 1/2
AN-NW-50-ASA-9	NW-50	ASA-9	2
AN-NW-50-ASA-11	NW-50	ASA-11	2



SPECIFICATIONS

Materials: 304 stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

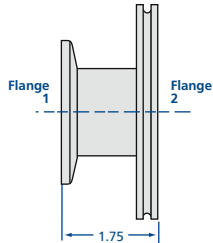
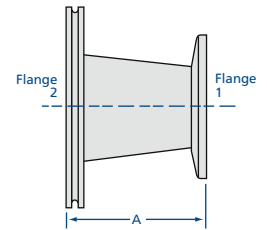
Temperature range: -20°C to 150°C

Note: Add suffix "-G" to model number if O-Ring Groove is required on ASA flange.
Call for ASA groove prices.



NW to ISO Conical Adapter Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-NW-40-ISO-63	NW-40	1 1/2	ISO-63	2 1/2	2.78
ANC-NW-40-ISO-80	NW-40	1 1/2	ISO-80	3	4.03
ANC-NW-50-ISO-63	NW-50	2	ISO-63	2 1/2	2.78
ANC-NW-50-ISO-80	NW-50	2	ISO-80	3	4.03
ANC-NW-50-ISO-100	NW-50	2	ISO-100	4	4.03



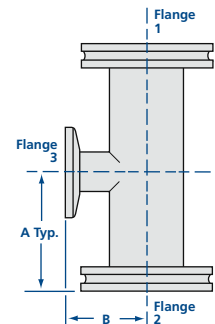
NW to ISO Adapter Nipples

MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-NW-16-ISO-63-OF	NW-16	ISO-63	3/4
AN-NW-25-ISO-63-OF	NW-25	ISO-63	1
AN-NW-25-ISO-80-OF	NW-25	ISO-80	1
AN-NW-25-ISO-100-OF	NW-25	ISO-100	1
AN-NW-40-ISO-100-OF	NW-40	ISO-100	1 1/2
AN-NW-50-ISO-160-OF	NW-50	ISO-160	2



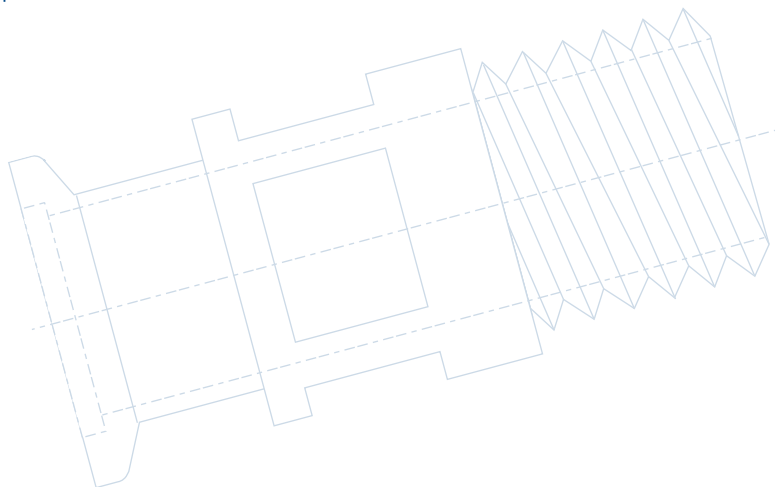
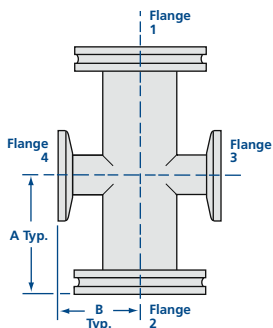
NW to ISO Adapter Tees

MODEL NUMBER	FLANGE 1 & 2		FLANGE 3		A	B
	TYPE	TUBE OD	TYPE	TUBE OD		
3TA-NW-40-ISO-63-OF	ISO-63	2 1/2	NW-40	1 1/2	3.25	2.90
3TA-NW-40-ISO-80-OF	ISO-80	3	NW-40	1 1/2	3.50	3.15
3TA-NW-40-ISO-100-OF	ISO-100	4	NW-40	1 1/2	4.13	3.65
3TA-NW-40-ISO-160-OF	ISO-160	6	NW-40	1 1/2	5.38	4.65
3TA-NW-50-ISO-63-OF	ISO-63	2 1/2	NW-50	2	3.25	3.40
3TA-NW-50-ISO-80-OF	ISO-80	3	NW-50	2	3.50	3.65
3TA-NW-50-ISO-100-OF	ISO-100	4	NW-50	2	4.13	4.15
3TA-NW-50-ISO-160-OF	ISO-160	6	NW-50	2	5.38	5.15



NW to ISO Adapter Crosses

MODEL NUMBER	FLANGE 1 & 2		FLANGE 3 & 4		A	B
	TYPE	TUBE OD	TYPE	TUBE OD		
4CA-NW-40-ISO-63-OF	ISO-63	2 1/2	NW-40	1 1/2	3.25	2.90
4CA-NW-40-ISO-80-OF	ISO-80	3	NW-40	1 1/2	3.50	3.15
4CA-NW-40-ISO-100-OF	ISO-100	4	NW-40	1 1/2	4.13	3.65
4CA-NW-40-ISO-160-OF	ISO-160	6	NW-40	1 1/2	5.38	4.65
4CA-NW-50-ISO-63-OF	ISO-63	2 1/2	NW-50	2	3.25	3.40
4CA-NW-50-ISO-80-OF	ISO-80	3	NW-50	2	3.50	3.65
4CA-NW-50-ISO-100-OF	ISO-100	4	NW-50	2	4.13	4.15
4CA-NW-50-ISO-160-OF	ISO-160	6	NW-50	2	5.38	5.15



SPECIFICATIONS

Materials: 304 stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20°C to 150°C

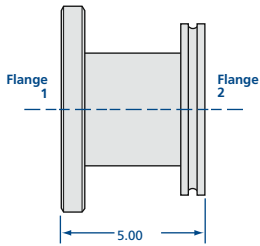
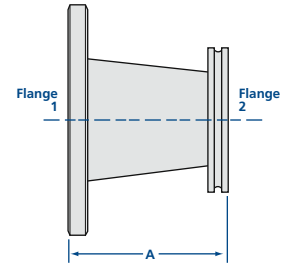
Adapter Fittings

Flange-to-Flange



CF to ISO Conical Adapter Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-275-ISO-63-OF	2.75 CF	1 1/2	ISO-63-OF	2 1/2	2.83
ANC-275-ISO-80-OF	2.75 CF	1 1/2	ISO-80-OF	3	4.08
ANC-338-ISO-63-OF	3.38 CF	2	ISO-63-OF	2 1/2	2.85
ANC-338-ISO-80-OF	3.38 CF	2	ISO-80-OF	3	4.10
ANC-338-ISO-100-OF	3.38 CF	2	ISO-100-OF	4	4.10
ANC-450-ISO-80-OF	4.50 CF	2 1/2	ISO-80-OF	3	4.25
ANC-450-ISO-100-OF	4.50 CF	2 1/2	ISO-100-OF	4	4.25
ANC-462-ISO-63-OF	4.62 CF	3	ISO-63-OF	2 1/2	4.16
ANC-462-ISO-100-OF	4.62 CF	3	ISO-100-OF	4	4.16
ANC-600-ISO-63-OF	6.00 CF	4	ISO-63-OF	2 1/2	4.31
ANC-600-ISO-80-OF	6.00 CF	4	ISO-80-OF	3	4.31



CF to ISO Adapter Nipples

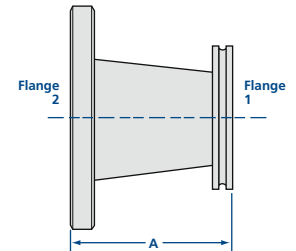
MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-450-ISO-63-OF	4.50 CF	ISO-63-OF	2 1/2
AN-462-ISO-80-OF	4.62 CF	ISO-80-OF	3
AN-600-ISO-100-OF	6.00 CF	ISO-100-OF	4
AN-800-ISO-160-OF	8.00 CF	ISO-160-OF	6
AN-1000-ISO-200-OF	10.00 CF	ISO-200-OF	8



ISO to ASA Conical Adapter Nipples

MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-ISO-63-OF-ASA-5	ISO-63	2 1/2	ASA-5	2	2.88
ANC-ISO-63-OF-ASA-6	ISO-63	2 1/2	ASA-6	3	4.13
ANC-ISO-63-OF-ASA-7.5	ISO-63	2 1/2	ASA-7.5	4	4.13
ANC-ISO-80-OF-ASA-5	ISO-80	3	ASA-5	2	4.13
ANC-ISO-80-OF-ASA-7.5	ISO-80	3	ASA-7.5	4	4.13
ANC-ISO-100-OF-ASA-5	ISO-100	4	ASA-5	2	4.13
ANC-ISO-100-OF-ASA-6	ISO-100	4	ASA-6	3	4.13

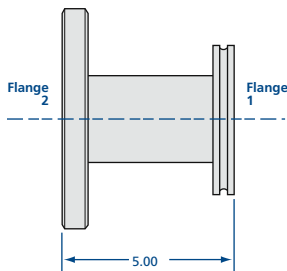
Note: Add suffix "-G" to model number if O-ring groove is required on ASA flange.
Call for groove prices.



ISO to ASA Adapter Nipples

MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-ISO-63-OF-ASA-11	ISO-63	ASA-11	2 1/2
AN-ISO-80-OF-ASA-6	ISO-80	ASA-6	3
AN-ISO-80-OF-ASA-11	ISO-80	ASA-11	3
AN-ISO-100-OF-ASA-7.5	ISO-100	ASA-7.5	4
AN-ISO-100-OF-ASA-9	ISO-100	ASA-9	4
AN-ISO-100-OF-ASA-11	ISO-100	ASA-11	4
AN-ISO-160-OF-ASA-9	ISO-160	ASA-9	6
AN-ISO-160-OF-ASA-11	ISO-160	ASA-11	6
AN-ISO-200-OF-ASA-11	ISO-200	ASA-11	8
AN-ISO-200-OF-ASA-13.5	ISO-200	ASA-13.5	8

Note: Add suffix "-G" to model number if O-ring groove is required on ASA flange.
Call for groove prices.



SPECIFICATIONS

Materials: 304 or stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20°C to 150°C

Adapter Fittings

Flange-to-Flange

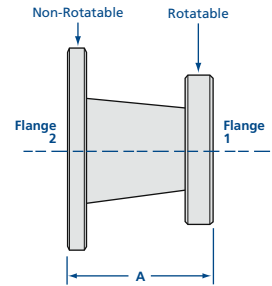


CF to ASA Conical Adapter Nipples

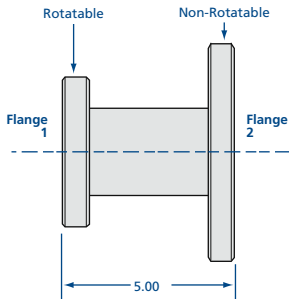


MODEL NUMBER	FLANGE 1		FLANGE 2		A
	TYPE	TUBE OD	TYPE	TUBE OD	
ANC-212-ASA-5	2.12 CF	1	ASA-5	2	2.79
ANC-275-ASA-5	2.75 CF	1 1/2	ASA-5	2	2.83
ANC-275-ASA-6	2.75 CF	1 1/2	ASA-6	3	4.08
ANC-338-ASA-5	3.38 CF	2	ASA-5	2 1/2	2.85
ANC-338-ASA-6	3.38 CF	2	ASA-6	3	4.10
ANC-338-ASA-7.5	3.38 CF	2	ASA-7.5	4	4.10
ANC-450-ASA-5	4.50 CF	2	ASA-5	2	3.00
ANC-450-ASA-6	4.50 CF	2 1/2	ASA-6	3	4.25
ANC-450-ASA-7.5	4.50 CF	2 1/2	ASA-7.5	4	4.25
ANC-462-ASA-5	4.62 CF	3	ASA-5	2	4.16
ANC-462-ASA-7.5	4.62 CF	3	ASA-7.5	4	4.16
ANC-600-ASA-5	6.00 CF	4	ASA-5	2	4.31
ANC-600-ASA-6	6.00 CF	4	ASA-6	3	4.31

Note: Add suffix "-G" to model number if O-ring groove is required on ASA flange.
Call for ASA groove prices.



CF to ASA Adapter Nipples



MODEL NUMBER	FLANGE 1 TYPE	FLANGE 2 TYPE	TUBE OD
AN-133-ASA-5	1.33 CF	ASA-5	3/4
AN-133-ASA-6	1.33 CF	ASA-6	3/4
AN-212-ASA-6	2.12 CF	ASA-6	1
AN-462-ASA-6	4.62 CF	ASA-6	3
AN-133-ASA-7.5	1.33 CF	ASA-7.5	3/4
AN-212-ASA-7.5	2.12 CF	ASA-7.5	1
AN-275-ASA-7.5	2.75 CF	ASA-7.5	1 1/2
AN-133-ASA-9	1.33 CF	ASA-9	3/4
AN-212-ASA-9	2.12 CF	ASA-9	1
AN-275-ASA-9	2.75 CF	ASA-9	1 1/2
AN-338-ASA-9	3.38 CF	ASA-9	2
AN-450-ASA-9	4.50 CF	ASA-9	2 1/2
AN-462-ASA-9	4.62 CF	ASA-9	3
AN-600-ASA-9	6.00 CF	ASA-9	4
AN-133-ASA-11	1.33 CF	ASA-11	3/4
AN-212-ASA-11	2.12 CF	ASA-11	1
AN-275-ASA-11	2.75 CF	ASA-11	1 1/2
AN-338-ASA-11	3.38 CF	ASA-11	2
AN-450-ASA-11	4.50 CF	ASA-11	2 1/2
AN-462-ASA-11	4.62 CF	ASA-11	3
AN-600-ASA-11	6.00 CF	ASA-11	4
AN-800-ASA-11	8.00 CF	ASA-11	6
AN-133-ASA-13.5	1.33 CF	ASA-13.5	3/4
AN-212-ASA-13.5	2.12 CF	ASA-13.5	1
AN-275-ASA-13.5	2.75 CF	ASA-13.5	1 1/2
AN-338-ASA-13.5	3.38 CF	ASA-13.5	2
AN-450-ASA-13.5	4.50 CF	ASA-13.5	2 1/2
AN-462-ASA-13.5	4.62 CF	ASA-13.5	3
AN-600-ASA-13.5	6.00 CF	ASA-13.5	4
AN-800-ASA-13.5	8.00 CF	ASA-13.5	6
AN-1000-ASA-13.5	10.00 CF	ASA-13.5	8
AN-133-ASA-16	1.33 CF	ASA-16	3/4
AN-212-ASA-16	2.12 CF	ASA-16	1
AN-275-ASA-16	2.75 CF	ASA-16	1 1/2
AN-338-ASA-16	3.38 CF	ASA-16	2
AN-450-ASA-16	4.50 CF	ASA-16	2 1/2
AN-462-ASA-16	4.62 CF	ASA-16	3
AN-600-ASA-16	6.00 CF	ASA-16	4
AN-800-ASA-16	8.00 CF	ASA-16	6
AN-1000-ASA-16	10.00 CF	ASA-16	8
AN-1325-ASA-16	13.25 CF	ASA-16	10

Note: Add suffix "-G" to model number if O-ring groove is required on ASA flange.
Call for groove prices.



SPECIFICATIONS

Materials: 304 or stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20°C to 150°C

Adapter Fittings

Adapter Flange and Flange-to-Fitting

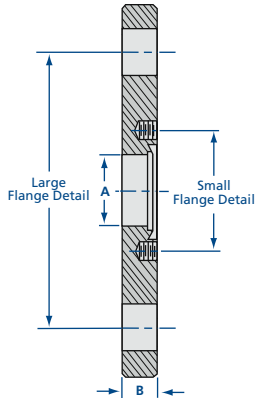


SPECIFICATIONS

Materials: 304 stainless steel

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature range: -20°C to 150°C



CF to ASA Adapter Flanges

MODEL NUMBER	SMALL FLANGE	LARGE FLANGE	A	B
ASA-5-133-075Z	133-000NT	ASA-5-000N	0.63	0.50
ASA-5-212-100Z	212-000NT	ASA-5-000N	1.00	0.50
ASA-5-275-150Z	275-000NT	ASA-5-000N	1.50	0.50
ASA-6-133-075Z	133-000NT	ASA-6-000N	0.63	0.50
ASA-6-212-100Z	212-000NT	ASA-6-000N	1.00	0.50
ASA-6-275-150Z	275-000NT	ASA-6-000N	1.50	0.50
ASA-6-338-200Z	338-000NT	ASA-6-000N	2.00	0.75
ASA-7.5-133-075Z	133-000NT	ASA-7.5-000N	0.63	0.50
ASA-7.5-212-100Z	212-000NT	ASA-7.5-000N	1.00	0.50
ASA-7.5-275-150Z	275-000NT	ASA-7.5-000N	1.50	0.50
ASA-7.5-338-200Z	338-000NT	ASA-7.5-000N	2.00	0.75
ASA-7.5-450-250Z	450-000NT	ASA-7.5-000N	2.50	0.75
ASA-9-133-075Z	133-000NT	ASA-9-000N	0.63	0.75
ASA-9-212-100Z	212-000NT	ASA-9-000N	1.00	0.75
ASA-9-275-150Z	275-000NT	ASA-9-000N	1.50	0.75
ASA-9-338-200Z	338-000NT	ASA-9-000N	2.00	0.75
ASA-9-450-250Z	450-000NT	ASA-9-000N	2.50	0.75
ASA-9-462-300Z	462-000NT	ASA-9-000N	3.00	0.75
ASA-9-600-400Z	600-000NT	ASA-9-000N	4.00	0.75
ASA-11-133-075Z	133-000NT	ASA-11-000N	0.63	0.75
ASA-11-212-100Z	212-000NT	ASA-11-000N	1.00	0.75
ASA-11-275-150Z	275-000NT	ASA-11-000N	1.50	0.75
ASA-11-338-200Z	338-000NT	ASA-11-000N	2.00	0.75
ASA-11-450-250Z	450-000NT	ASA-11-000N	2.50	0.75
ASA-11-462-300Z	462-000NT	ASA-11-000N	3.00	0.75
ASA-11-600-400Z	600-000NT	ASA-11-000N	4.00	0.75
ASA-11-800-600Z	800-000NT	ASA-11-000N	6.00	0.75



SPECIFICATIONS

Materials: 304 stainless steel

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

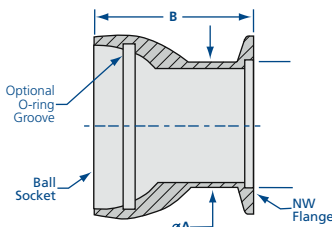
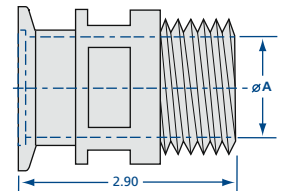
Temperature range: -20°C to 150°C



NW Welch Pump Adapters

MODEL NUMBER	USE WITH WELCH PUMP MODEL NUMBER	THREAD	TUBE ID A
AN-NW-16-1400	1399, 1400, 1410	3/8-18 NPSM x 1.00	0.450
AN-NW-16-1405	1405	3/4-20 NPSM x 1.00	0.562
AN-NW-25-1405	1405	3/4-20 NPSM x 1.00	0.562
AN-NW-25-1402	1380, 1402, 1403, 8806, 8811, 8816, 8821	1-20 NPSM x 1.00	0.750
AN-NW-40-1402	1380, 1402, 1403, 8806, 8811, 8816, 8821	1-20 NPSM x 1.00	0.750
AN-NW-40-1376	1373, 1376, 8831	1 1/2-12 NPSM x 1.00	1.125
AN-NW-40-1397	1374, 1397	1 3/4-20 NPSM x 1.00	1.375
AN-NW-50-1397	1374, 1397	1 3/4-20 NPSM x 1.00	1.375

Note: Includes aluminum gasket



NW Ball Socket Adapters

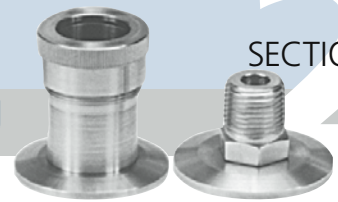
MODEL NUMBER	BALL SOCKET	FLANGE TYPE	TUBE OD A	B	O-RING SIZE
BS-50/30-NW	50/30	NW-40	1 1/2	1.90	-
BS-50/30G-NW	50/30	NW-40	1 1/2	1.90	2-224
BS-75/50-NW	75/50	NW-50	2	2.65	-
BS-75/50G-NW	75/50	NW-50	2	2.65	2-232

Note: "G" in model number indicates O-ring and O-ring groove.

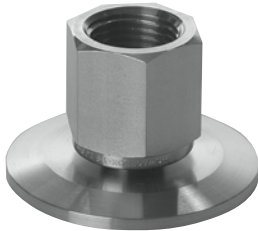


Adapter Fittings

Flange-to-Fitting



NW Female Pipe Adapters



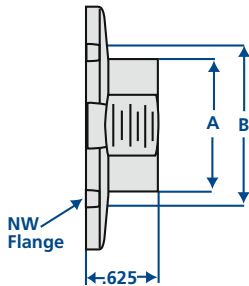
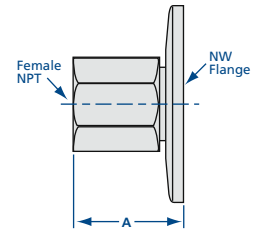
MODEL NUMBER	NPT	A
NW-10-1/8 FPT	1/8	0.92
NW-16-1/8 FPT	1/8	0.92
NW-25-1/8 FPT	1/8	0.92
NW-40-1/8 FPT	1/8	0.92
NW-50-1/8 FPT	1/8	0.92
NW-10-1/4 FPT	1/4	1.07
NW-16-1/4 FPT	1/4	1.07
NW-25-1/4 FPT	1/4	1.07
NW-40-1/4 FPT	1/4	1.07
NW-50-1/4 FPT	1/4	1.07
NW-16-1/2 FPT	1/2	1.44
NW-25-1/2 FPT	1/2	1.39
NW-40-1/2 FPT	1/2	1.39
NW-50-1/2 FPT	1/2	1.39
NW-25-3/4 FPT	3/4	1.45
NW-40-3/4 FPT	3/4	1.45
NW-50-3/4 FPT	3/4	1.45
NW-25-1 FPT	1	1.57
NW-40-1 FPT	1	1.57
NW-50-1 FPT	1	1.57

SPECIFICATIONS

Materials
 Flanges: 304 stainless steel
 NPT Fittings: 316L stainless steel

Vacuum range: $\geq 1 \times 10^{-6}$ Torr - High vacuum

Temperature range: -20°C to 150°C

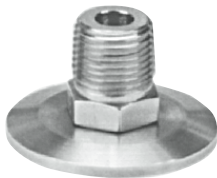


Machined NW Female Pipe Adapters

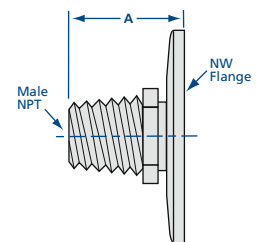
MODEL NUMBER	NPT	A FLAT	B OD
NW-16-1/8-FPTM	1/8	.625	.75
NW-16-1/4-FPTM	1/4	.625	.75
NW-25-1/8-FPTM	1/8	.875	1.0
NW-25-1/4-FPTM	1/4	.875	1.0
NW-40-1/8-FPTM	1/8	1.25	1.5
NW-40-1/4-FPTM	1/4	1.25	1.5



NW Male Pipe Adapters

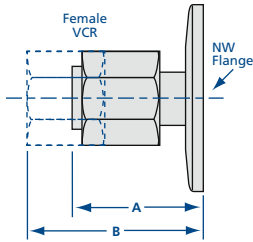
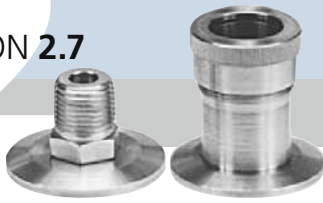


MODEL NUMBER	NPT	A
NW-10-1/8 MPT	1/8	0.89
NW-16-1/8 MPT	1/8	0.89
NW-25-1/8 MPT	1/8	0.89
NW-40-1/8 MPT	1/8	0.89
NW-50-1/8 MPT	1/8	0.89
NW-10-1/4 MPT	1/4	1.10
NW-16-1/4 MPT	1/4	1.10
NW-25-1/4 MPT	1/4	1.10
NW-40-1/4 MPT	1/4	1.10
NW-50-1/4 MPT	1/4	1.10
NW-16-1/2 MPT	1/2	1.35
NW-25-1/2 MPT	1/2	1.35
NW-40-1/2 MPT	1/2	1.35
NW-50-1/2 MPT	1/2	1.35
NW-25-3/4 MPT	3/4	1.35
NW-40-3/4 MPT	3/4	1.35
NW-50-3/4 MPT	3/4	1.35
NW-25-1 MPT	1	1.64
NW-40-1 MPT	1	1.64
NW-50-1 MPT	1	1.64



Adapter Fittings

Flange-to-Fitting



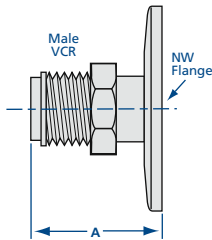
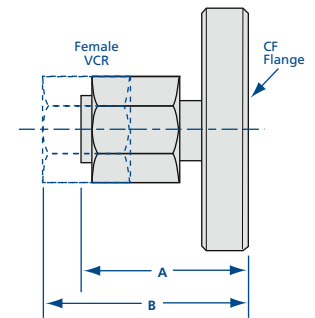
NW Female VCR Adapters

MODEL NUMBER	FLANGE TYPE	VCR SIZE	A	B
NW-10-1/4 FVCR	NW-10	1/4	1.46	1.96
NW-16-1/4 FVCR	NW-16	1/4	1.46	1.96
NW-25-1/4 FVCR	NW-25	1/4	1.46	1.96
NW-40-1/4 FVCR	NW-40	1/4	1.46	1.96
NW-50-1/4 FVCR	NW-50	1/4	1.46	1.96
NW-16-3/8 FVCR	NW-16	3/8	1.65	2.20
NW-25-3/8 FVCR	NW-25	3/8	1.65	2.20
NW-40-3/8 FVCR	NW-40	3/8	1.65	2.20
NW-50-3/8 FVCR	NW-50	3/8	1.65	2.20



CF Female VCR Adapters

MODEL NUMBER	FLANGE TYPE	VCR SIZE	A	B
133-1/4 FVCR	1.33 CF	1/4	1.36	1.88
133-3/8 FVCR	1.33 CF	3/8	1.55	2.13
275-1/4 FVCR	2.75 CF	1/4	1.36	1.88
275-3/8 FVCR	2.75 CF	3/8	1.55	2.13



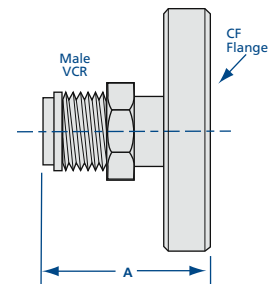
NW Male VCR Adapters

MODEL NUMBER	FLANGE SIZE	VCR SIZE	A
NW-10-1/4 MVCR	NW-10	1/4	1.46
NW-16-1/4 MVCR	NW-16	1/4	1.46
NW-25-1/4 MVCR	NW-25	1/4	1.46
NW-40-1/4 MVCR	NW-40	1/4	1.46
NW-50-1/4 MVCR	NW-50	1/4	1.46
NW-16-3/8 MVCR	NW-16	3/8	1.65
NW-25-3/8 MVCR	NW-25	3/8	1.65
NW-40-3/8 MVCR	NW-40	3/8	1.65
NW-50-3/8 MVCR	NW-50	3/8	1.65



CF Male VCR Adapters

MODEL NUMBER	FLANGE TYPE	VCR SIZE	A
133-1/4 MVCR	1.33 CF	1/4	1.46
133-3/8 MVCR	1.33 CF	3/8	1.65
275-1/4 MVCR	2.75 CF	1/4	1.46
275-3/8 MVCR	2.75 CF	3/8	1.65



SPECIFICATIONS

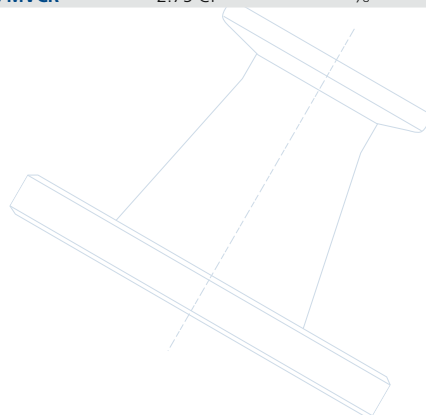
Materials

Flanges: 304 stainless steel
VCR Fittings: 316L stainless steel

Vacuum range:

NW Flange: $\geq 1 \times 10^{-8}$ Torr - High vacuum
CF Flange: $\geq 1 \times 10^{-10}$ Torr - UHV

Temperature range: -20°C to 200°C



Adapter Fittings

Flange-to-Fitting



NW Quick Disconnect Adapters

MODEL NUMBER	FLANGE TYPE	ID A	ID B	C
NW-10-1/4 QD	NW-10	1/4	0.187	1.48
NW-16-1/4 QD	NW-16	1/4	0.187	1.48
NW-25-1/4 QD	NW-25	1/4	0.187	1.48
NW-40-1/4 QD	NW-40	1/4	0.187	1.48
NW-10-3/8 QD	NW-10	3/8	0.281	1.62
NW-16-3/8 QD	NW-16	3/8	0.281	1.62
NW-25-3/8 QD	NW-25	3/8	0.281	1.62
NW-40-3/8 QD	NW-40	3/8	0.281	1.62
NW-16-1/2 QD	NW-16	1/2	0.406	1.79
NW-25-1/2 QD	NW-25	1/2	0.406	1.79
NW-40-1/2 QD	NW-40	1/2	0.406	1.79
NW-50-1/2 QD	NW-50	1/2	0.406	1.79
NW-25-3/4 QD	NW-25	3/4	0.625	1.93
NW-40-3/4 QD	NW-40	3/4	0.625	1.93
NW-50-3/4 QD	NW-50	3/4	0.625	1.93
NW-40-1 QD	NW-40	1	0.875	1.95
NW-50-1 QD	NW-50	1	0.875	1.95

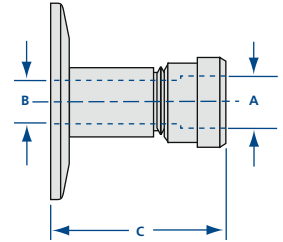
Note: On request, NW Quick Disconnects can be provided bored through for the tube OD. Add "-BT" suffix to the part number and call for price. Example: NW-10-1/4QD-BT

SPECIFICATIONS

Materials
 Flanges: 304 stainless steel
 QD Fittings: 316L stainless steel

Vacuum range: $\geq 1 \times 10^{-8}$ Torr - High vacuum

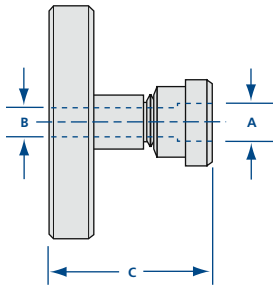
Temperature range: -20°C to 150°C



CF Quick Disconnect Adapters

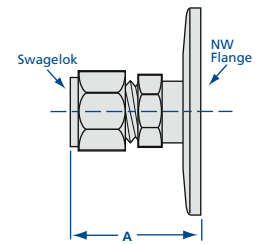
MODEL NUMBER	FLANGE OD	ID A	ID B	C
133-1/4 QD	1.33 CF	1/4	3/16	1.39
133-3/8 QD	1.33 CF	3/8	9/32	1.53
133-1/2 QD	1.33 CF	1/2	13/32	1.70
275-1/4 QD	2.75 CF	1/4	3/16	1.39
275-3/8 QD	2.75 CF	3/8	9/32	1.53
275-1/2 QD	2.75 CF	1/2	13/32	1.70
275-3/4 QD	2.75 CF	3/4	5/8	1.99
275-1 QD	2.75 CF	1	7/8	2.01

Note: On request, CF Quick Disconnects can be provided bored through for the tube OD. Add "-BT" suffix to the part number and call for price. Example: 133-1/4QD-BT



NW Swagelok Adapters

MODEL NUMBER	FLANGE TYPE	TUBE OD	A
NW-10-1/4 SWAG	NW-10	1/4	1.47
NW-16-1/4 SWAG	NW-16	1/4	1.47
NW-25-1/4 SWAG	NW-25	1/4	1.47
NW-40-1/4 SWAG	NW-40	1/4	1.47
NW-50-1/4 SWAG	NW-50	1/4	1.47
NW-10-3/8 SWAG	NW-10	3/8	1.63
NW-16-3/8 SWAG	NW-16	3/8	1.63
NW-25-3/8 SWAG	NW-25	3/8	1.63
NW-40-3/8 SWAG	NW-40	3/8	1.63
NW-50-3/8 SWAG	NW-50	3/8	1.63



CF Swagelok Adapters

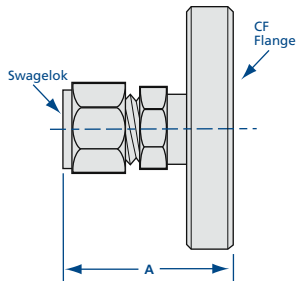
MODEL NUMBER	FLANGE TYPE	TUBE OD	A
133-1/4 SWAG	1.33 CF	1/4	1.37
133-3/8 SWAG	1.33 CF	3/8	1.58
275-1/4 SWAG	2.75 CF	1/4	1.37
275-3/8 SWAG	2.75 CF	3/8	1.54

SPECIFICATIONS

Materials
 Flanges: 304 stainless steel
 Swagelok Fittings: 316L stainless steel

Vacuum range: $\geq 1 \times 10^{-6}$ Torr - High vacuum

Temperature range
 NW Flange: -20°C to 200°C
 CF Flange: -200°C to 450°C





SPECIFICATIONS

Nominal ID sizes

Bellows: 3/4 to 4 inch
 PVC Hose: 1/2 to 2 inch
 Flex Couplings: 3/8 to 12 inch

Flange Types: NW, ISO, CF, ASA

Materials

Bellows: 316L or 321 stainless steel
 PVC Hose: Wire reinforced polyvinyl chloride
 Flanges: 304 stainless steel
 (316L available on request)

Vacuum Range

Metal seal: $\geq 1 \times 10^{-10}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum
 PVC Hose: $\geq 1 \times 10^{-2}$ Rough vacuum

Temperature Range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C
 PVC Hose: -4°C to 65°C

Options: Protective braided sleeving

Flexible Vacuum Connections

Flexible vacuum connections are typically made by using edge welded bellows, hydroformed flexible couplings and hoses or PVC hoses. Edge welded bellows provide the greatest stroke and flexibility, but are the most susceptible to damage. Edge welded bellows are also more expensive than the other flexible connections. Nor-Cal Products offers flexible couplings and flexible hoses as standards. Edge welded bellows assemblies can be provided in a variety of materials as specials. PVC hose offers a low cost alternative to stainless steel flexible hoses.

Flexible Hoses

Flexible stainless steel hoses are available in 3/4 to 4 inch diameters in standard lengths of 12, 18, 24 and 36 inches with NW, ISO, CF and ASA flanges. Hoses with NW and ISO flanges are also available in 10, 20 and 40 Inch (metric equivalent) lengths. CF and ASA flanged hoses have one rotatable and one nonrotatable flange for ease of bolt hole alignment. ASA flanged hoses may require an O-ring groove on one flange for proper installation. Be sure to specify. NW to CF adapter hoses provide a flexible transition between components with NW and CF flanges. NW hoses are available in medium wall "FH-" (0.010 Inch wall thickness), heavy wall "TH-" (0.017 Inches), and thin wall "LH-" (0.006 Inches). Thin wall hose is the perfect choice for applications requiring increased flexibility. Protective braiding is offered as a standard for NW and CF medium wall tubing "FHB-" in diameters up to and including 4 inches.

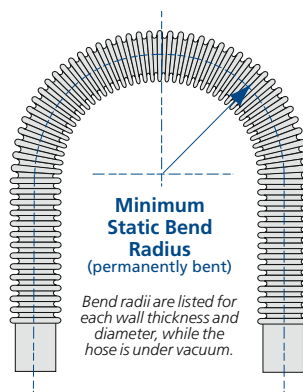


Flexible Couplings

Pressurizing the inside of thin wall stainless steel tubing inside a mold forms convolutions in flexible couplings and hoses. Generally speaking, when comparing flexible couplings to hoses, they are thinner walled, have more convolutions per inch resulting in greater flexibility and stroke, and are used for alignment or vibration isolation rather than as roughing lines. Being thinner, flexible couplings are more susceptible to mechanical damage than hoses. Nor-Cal's flexible couplings have more convolutions than comparable products, resulting in greater flexibility and lower spring rates. Maximum compression for flexible couplings is typically 20% of the convolution (flexible) length. Extension is typically 10%. Couplings are available in 321 or 316L stainless steel in various lengths with NW, ISO, CF and ASA flanges.

PVC Hoses

Plasticized PVC hoses can be used as a low cost rough vacuum line. An embedded spiral wire prevents the wall from collapsing under vacuum. Unlike edge welded bellows, flexible couplings and hoses, which are UHV compatible, PVC hoses should be used for rough vacuum due to their higher outgassing rate. Although it can be bent relatively easily, it cannot be compressed or extended. Order by the foot with or without NW flanges. Each length includes two hose clamps for installation.



All dimensions are in inches unless otherwise noted

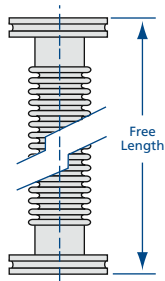
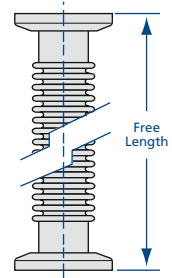
Spring rates are called out in pounds/inch



NW Flexible Couplings



MODEL NUMBER	FLANGE TYPE	BELLOWS ID	WALL THICKNESS	FREE LENGTH	SPRING RATE	COMPRESSED LENGTH
2FC-NW-10-1	NW-10	3/8	0.006	3.20	35	3.0
2FC-NW-10-2	NW-10	3/8	0.006	4.20	28	3.8
2FC-NW-10-3	NW-10	3/8	0.006	5.20	22	4.6
2FC-NW-16-1	NW-16	1/2	0.006	3.20	61	3.0
2FC-NW-16-2	NW-16	1/2	0.006	4.20	49	3.8
2FC-NW-16-3	NW-16	1/2	0.006	5.20	38	4.6
2FC-NW-25-1	NW-25	3/4	0.006	3.20	45	3.0
2FC-NW-25-2	NW-25	3/4	0.006	4.20	36	3.8
2FC-NW-25-3	NW-25	3/4	0.006	5.20	28	4.6
2FC-NW-40-1	NW-40	1 1/2	0.006	3.20	85	3.0
2FC-NW-40-2	NW-40	1 1/2	0.006	4.20	69	3.8
2FC-NW-40-3	NW-40	1 1/2	0.006	5.20	53	4.6
2FC-NW-40-6	NW-40	1 1/2	0.006	8.20	28	7.0
2FC-NW-50-1	NW-50	1 3/4	0.006	3.20	62	3.0
2FC-NW-50-2	NW-50	1 3/4	0.006	4.20	50	3.8
2FC-NW-50-3	NW-50	1 3/4	0.006	5.20	38	4.6



ISO Flexible Couplings

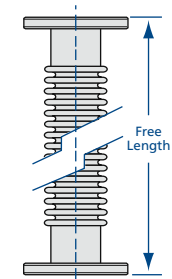
MODEL NUMBER	FLANGE TYPE	BELLOWS ID	WALL THICKNESS	FREE LENGTH	SPRING RATE	COMPRESSED LENGTH
2FC-ISO-250-4	ISO-63	2 1/2	0.008	7.00	80	6.20
2FC-ISO-300-4	ISO-80	3	0.008	7.00	78	6.20
2FC-ISO-400-4	ISO-100	4	0.010	7.00	75	6.20
2FC-ISO-600-4	ISO-160	6	0.010	7.00	130	6.20
2FC-ISO-800-4	ISO-200	8	0.010	7.00	83	6.20
2FC-ISO-1000-10	ISO-250	10	0.012	13.50	87	11.40



ASA Flexible Couplings

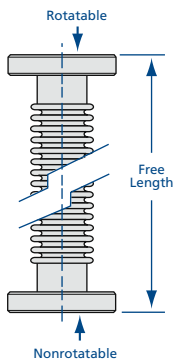
MODEL NUMBER	FLANGE OD	BELLOWS ID	WALL THICKNESS	FREE LENGTH	SPRING RATE	COMPRESSED LENGTH
2FC-ASA-5-200N-3	ASA 5	2	0.006	6.00	56	5.4
2FC-ASA-5-250N-4	ASA 5	2 1/2	0.008	7.00	80	6.2
2FC-ASA-6-300N-4	ASA 6	3	0.008	7.00	78	6.2
2FC-ASA-7.5-400N-4	ASA 7.5	4	0.008	7.00	75	6.2
2FC-ASA-9-400N-4	ASA 9	4	0.008	7.00	75	6.2
2FC-ASA-9-600N-4	ASA 9	6	0.010	7.00	130	6.2
2FC-ASA-11-600N-4	ASA 11	6	0.010	7.00	130	6.2
2FC-ASA-11-800N-4	ASA 11	8	0.010	7.00	83	6.2
2FC-ASA-13.5-800N-4	ASA 13.5	8	0.010	7.00	83	6.2
2FC-ASA-13.5-1000N-10	ASA 13.5	10	0.012	14.00	87	12.0
2FC-ASA-16-1000N-10	ASA 16	10	0.012	14.00	87	12.0
2FC-ASA-16-1200N-11.8	ASA 16	12	0.012	15.87	92	13.8

Note: Call for ASA O-ring groove pricing



CF Flexible Couplings

MODEL NUMBER	FLANGE TYPE	BELLOWS ID	WALL THICKNESS	FREE LENGTH	SPRING RATE	COMPRESSED LENGTH
2FC-075-1	1.33 CF	1/2	0.006	3.20	61	3.0
2FC-075-2	1.33 CF	1/2	0.006	4.20	49	3.8
2FC-075-3	1.33 CF	1/2	0.006	5.20	38	4.6
2FC-100-1	2.12 CF	3/4	0.006	3.20	45	3.0
2FC-100-2	2.12 CF	3/4	0.006	4.20	36	3.8
2FC-100-3	2.12 CF	3/4	0.006	5.20	28	4.6
2FC-150-1	2.75 CF	1 1/2	0.006	3.20	85	3.0
2FC-150-2	2.75 CF	1 1/2	0.006	4.20	69	3.8
2FC-150-3	2.75 CF	1 1/2	0.006	5.20	53	4.6
2FC-150-6	2.75 CF	1 1/2	0.006	8.20	28	7.0
2FC-200-3	3.38 CF	2	0.006	6.00	56	5.4
2FC-250-4	4.50 CF	2 1/2	0.008	7.00	80	6.2
2FC-300-4	4.62 CF	3	0.008	7.00	78	6.2
2FC-400-4	6.00 CF	4	0.008	7.00	75	6.2
2FC-500-4	6.75 CF	5	0.008	7.00	73	6.2
2FC-600-4	8.00 CF	6	0.010	7.00	130	6.2
2FC-800-4	10.00 CF	8	0.010	7.00	83	6.2



SPECIFICATIONS

Nominal ID sizes: 3/8 to 12 inches

Materials

Bellows: 316L or 321 stainless steel
Flanges: 304 stainless steel
(316L available on request)

Vacuum Range

Metal seal: $\geq 1 \times 10^{-10}$ Torr - UHV
Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - Highvacuum

Temperature Range

Metal seal: -200°C to 450°C
Elastomer seal: -20°C to 150°C

Flexible Hoses & Couplings

Flexible Stainless Steel Hoses



SPECIFICATIONS

Nominal ID sizes: 3/4 to 4 inch

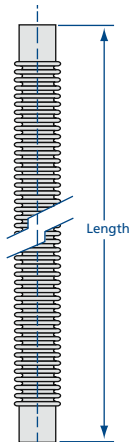
Materials

Bellows: 321 stainless steel
Tube ends: 304 stainless steel

Vacuum Range: $\geq 1 \times 10^{-10}$ Torr - UHV

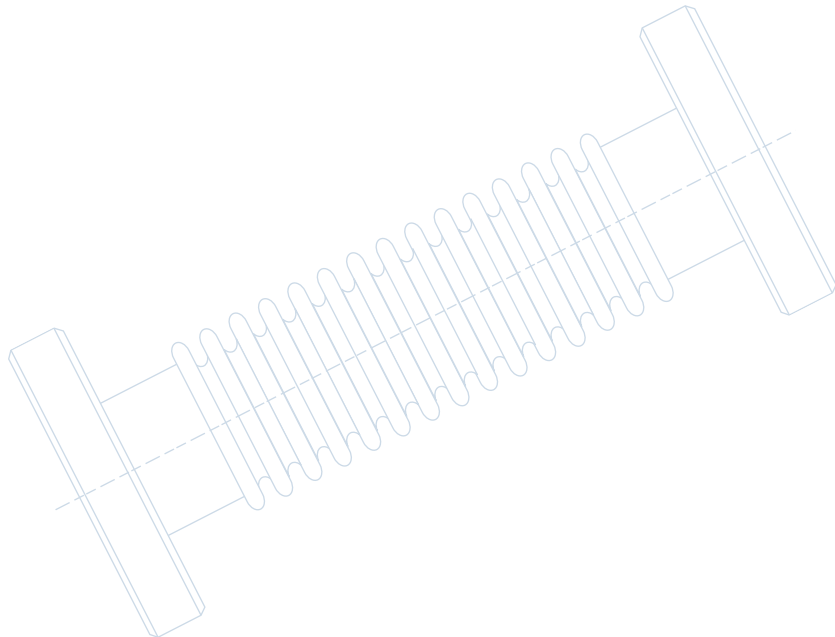
Temperature Range: -200°C to 450°C

Options: Protective braided sleeving



Flexible Stainless Steel Hoses without Flanges

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	WALL THICKNESS	STATIC BEND RADIUS
FH-075-12	3/4	1.11	12	0.008	1.26
FH-075-18	3/4	1.11	18	0.008	1.26
FH-075-24	3/4	1.11	24	0.008	1.26
FH-075-36	3/4	1.11	36	0.008	1.26
FH-100-12	1	1.37	12	0.008	1.46
FH-100-18	1	1.37	18	0.008	1.46
FH-100-24	1	1.37	24	0.008	1.46
FH-100-36	1	1.37	36	0.008	1.46
FH-150-12	1 1/2	2.06	12	0.010	2.16
FH-150-18	1 1/2	2.06	18	0.010	2.16
FH-150-24	1 1/2	2.06	24	0.010	2.16
FH-150-36	1 1/2	2.06	36	0.010	2.16
FH-200-12	2	2.55	12	0.012	3.50
FH-200-18	2	2.55	18	0.012	3.50
FH-200-24	2	2.55	24	0.012	3.50
FH-200-36	2	2.55	36	0.012	3.50
FH-250-12	2 1/2	3.34	12	0.016	4.25
FH-250-18	2 1/2	3.34	18	0.016	4.25
FH-250-24	2 1/2	3.34	24	0.016	4.25
FH-250-36	2 1/2	3.34	36	0.016	4.25
FH-300-12	3	3.99	12	0.016	6.00
FH-300-18	3	3.99	18	0.016	6.00
FH-300-24	3	3.99	24	0.016	6.00
FH-300-36	3	3.99	36	0.016	6.00
FH-400-12	4	4.83	12	0.016	8.60
FH-400-18	4	4.83	18	0.016	8.60
FH-400-24	4	4.83	24	0.016	8.60
FH-400-36	4	4.83	36	0.016	8.60





NW Flexible Stainless Steel Hoses – Thin Wall

MODEL NUMBER	FLANGE TYPE	NOMINAL ID	HOSE OD	OVERALL LENGTH	WALL THICKNESS	STATIC BEND RADIUS
LH-075-10-2NW	NW-16	3/4	1.02	10	0.006	3.0
LH-075-12-2NW	NW-16	3/4	1.02	12	0.006	3.0
LH-075-18-2NW	NW-16	3/4	1.02	18	0.006	3.0
LH-075-24-2NW	NW-16	3/4	1.02	24	0.006	3.0
LH-075-36-2NW	NW-16	3/4	1.02	36	0.006	3.0
LH-100-10-2NW	NW-25	1	1.37	10	0.006	4.0
LH-100-12-2NW	NW-25	1	1.37	12	0.006	4.0
LH-100-18-2NW	NW-25	1	1.37	18	0.006	4.0
LH-100-24-2NW	NW-25	1	1.37	24	0.006	4.0
LH-100-36-2NW	NW-25	1	1.37	36	0.006	4.0
LH-150-10-2NW	NW-40	1 1/2	1.91	10	0.006	6.0
LH-150-12-2NW	NW-40	1 1/2	1.91	12	0.006	6.0
LH-150-18-2NW	NW-40	1 1/2	1.91	18	0.006	6.0
LH-150-24-2NW	NW-40	1 1/2	1.91	24	0.006	6.0
LH-150-36-2NW	NW-40	1 1/2	1.91	36	0.006	6.0
LH-200-10-2NW	NW-50	2	2.45	10	0.006	7.5
LH-200-12-2NW	NW-50	2	2.45	12	0.006	7.5
LH-200-18-2NW	NW-50	2	2.45	18	0.006	7.5
LH-200-24-2NW	NW-50	2	2.45	24	0.006	7.5
LH-200-36-2NW	NW-50	2	2.45	36	0.006	7.5

NW Flexible Stainless Steel Hoses – Medium Wall

MODEL NUMBER	FLANGE TYPE	NOMINAL ID	HOSE OD	OVERALL LENGTH	WALL THICKNESS	STATIC BEND RADIUS
FH-075-10-2NW	NW-16	3/4	1.11	10	0.008	1.26
FH-075-12-2NW	NW-16	3/4	1.11	12	0.008	1.26
FH-075-18-2NW	NW-16	3/4	1.11	18	0.008	1.26
FH-075-20-2NW	NW-16	3/4	1.11	20	0.008	1.26
FH-075-24-2NW	NW-16	3/4	1.11	24	0.008	1.26
FH-075-36-2NW	NW-16	3/4	1.11	36	0.008	1.26
FH-075-40-2NW	NW-16	3/4	1.11	40	0.008	1.26
FH-100-10-2NW	NW-25	1	1.37	10	0.008	1.46
FH-100-12-2NW	NW-25	1	1.37	12	0.008	1.46
FH-100-18-2NW	NW-25	1	1.37	18	0.008	1.46
FH-100-20-2NW	NW-25	1	1.37	20	0.008	1.46
FH-100-24-2NW	NW-25	1	1.37	24	0.008	1.46
FH-100-36-2NW	NW-25	1	1.37	36	0.008	1.46
FH-100-40-2NW	NW-25	1	1.37	40	0.008	1.46
FH-150-10-2NW	NW-40	1 1/2	2.06	10	0.010	2.16
FH-150-12-2NW	NW-40	1 1/2	2.06	12	0.010	2.16
FH-150-18-2NW	NW-40	1 1/2	2.06	18	0.010	2.16
FH-150-20-2NW	NW-40	1 1/2	2.06	20	0.010	2.16
FH-150-24-2NW	NW-40	1 1/2	2.06	24	0.010	2.16
FH-150-36-2NW	NW-40	1 1/2	2.06	36	0.010	2.16
FH-150-40-2NW	NW-40	1 1/2	2.06	40	0.010	2.16
FH-200-10-2NW	NW-50	2	2.55	10	0.012	3.50
FH-200-12-2NW	NW-50	2	2.55	12	0.012	3.50
FH-200-18-2NW	NW-50	2	2.55	18	0.012	3.50
FH-200-20-2NW	NW-50	2	2.55	20	0.012	3.50
FH-200-24-2NW	NW-50	2	2.55	24	0.012	3.50
FH-200-36-2NW	NW-50	2	2.55	36	0.012	3.50
FH-200-40-2NW	NW-50	2	2.55	40	0.012	3.50

SPECIFICATIONS

Nominal ID sizes: 3/4 to 2 inch

Materials

Hose: 321 stainless steel
 Tube ends: 304 stainless steel
 Flanges: 304 stainless steel
 (316L available on request)

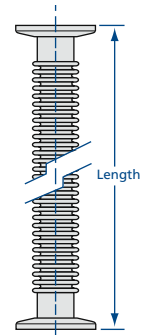
Vacuum Range

Metal seal: $\geq 1 \times 10^{-10}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C

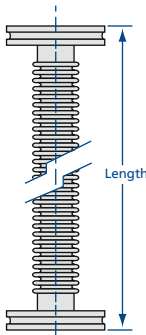
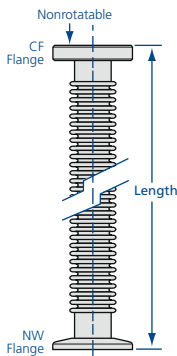
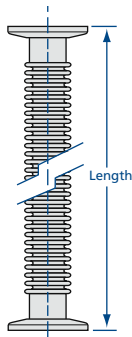
Options: Protective braided sleeving



Larger hose IDs and other flange configurations available upon request.

Flexible Hoses & Couplings

Flexible Stainless Steel Hoses



NW Flexible Stainless Steel Hoses – Thick Wall

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE TYPE	WALL THICKNESS	STATIC BEND RADIUS
TH-075-10-2NW	3/4	1.10	10	NW-16	0.017	2.13
TH-075-20-2NW	3/4	1.10	20	NW-16	0.017	2.13
TH-075-40-2NW	3/4	1.10	40	NW-16	0.017	2.13
TH-100-10-2NW	1	1.50	10	NW-25	0.017	2.88
TH-100-20-2NW	1	1.50	20	NW-25	0.017	2.88
TH-100-40-2NW	1	1.50	40	NW-25	0.017	2.88
TH-150-10-2NW	1 1/2	2.10	10	NW-40	0.020	3.50
TH-150-20-2NW	1 1/2	2.10	20	NW-40	0.020	3.50
TH-150-40-2NW	1 1/2	2.10	40	NW-40	0.020	3.50
TH-200-10-2NW	2	2.63	10	NW-50	0.020	5.25
TH-200-20-2NW	2	2.63	20	NW-50	0.020	5.25
TH-200-40-2NW	2	2.63	40	NW-50	0.020	5.25

NW/CF Flexible Stainless Steel Adapter Hoses – Medium Wall

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE 1 TYPE	FLANGE 2 TYPE	WALL THICKNESS	STATIC BEND RADIUS
FH-075-12-NW-CF	3/4	1.11	12	NW-16	CF-1.33	0.008	1.26
FH-075-18-NW-CF	3/4	1.11	18	NW-16	CF-1.33	0.008	1.26
FH-075-24-NW-CF	3/4	1.11	24	NW-16	CF-1.33	0.008	1.26
FH-075-36-NW-CF	3/4	1.11	36	NW-16	CF-1.33	0.008	1.26
FH-150-12-NW-CF	1 1/2	2.06	12	NW-40	CF-2.75	0.010	2.16
FH-150-18-NW-CF	1 1/2	2.06	18	NW-40	CF-2.75	0.010	2.16
FH-150-24-NW-CF	1 1/2	2.06	24	NW-40	CF-2.75	0.010	2.16
FH-150-36-NW-CF	1 1/2	2.06	36	NW-40	CF-2.75	0.010	2.16

ISO Flexible Stainless Steel Hoses – Medium Wall

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE TYPE	WALL THICKNESS	STATIC BEND RADIUS
FH-250-10-2ISO	2 1/2	3.34	10	ISO-63	0.016	3.15
FH-250-12-2ISO	2 1/2	3.34	12	ISO-63	0.016	3.15
FH-250-18-2ISO	2 1/2	3.34	18	ISO-63	0.016	3.15
FH-250-20-2ISO	2 1/2	3.34	20	ISO-63	0.016	3.15
FH-250-24-2ISO	2 1/2	3.34	24	ISO-63	0.016	3.15
FH-250-36-2ISO	2 1/2	3.34	36	ISO-63	0.016	3.15
FH-250-40-2ISO	3	3.99	40	ISO-63	0.016	3.15
FH-300-10-2ISO	3	3.99	10	ISO-80	0.016	3.82
FH-300-12-2ISO	3	3.99	12	ISO-80	0.016	3.82
FH-300-18-2ISO	3	3.99	18	ISO-80	0.016	3.82
FH-300-20-2ISO	3	3.99	20	ISO-80	0.016	3.82
FH-300-24-2ISO	3	3.99	24	ISO-80	0.016	3.82
FH-300-36-2ISO	3	3.99	36	ISO-80	0.016	3.82
FH-300-40-2ISO	4	4.83	40	ISO-80	0.016	3.82
FH-400-10-2ISO	4	4.83	10	ISO-100	0.016	4.45
FH-400-12-2ISO	4	4.83	12	ISO-100	0.016	4.45
FH-400-18-2ISO	4	4.83	18	ISO-100	0.016	4.45
FH-400-20-2ISO	4	4.83	20	ISO-100	0.016	4.45
FH-400-24-2ISO	4	4.83	24	ISO-100	0.016	4.45
FH-400-36-2ISO	4	4.83	36	ISO-100	0.016	4.45
FH-400-40-2ISO	4	4.83	40	ISO-100	0.016	4.45

SPECIFICATIONS

Nominal ID sizes: 3/4 to 4 inch

Materials

Hose: 321 stainless steel
 Tube ends: 304 stainless steel
 Flanges: 304 stainless steel
 (316L available on request)

Vacuum Range

Metal seal: $\geq 1 \times 10^{-10}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C

Options: Protective braided sleeving

ISO Flexible Stainless Steel Hoses – Thick Wall

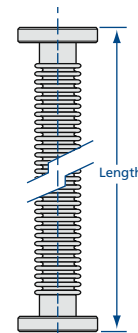
MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE TYPE	WALL THICKNESS	STATIC BEND RADIUS
TH-250-20-2ISO	2 1/2	3.10	20	ISO-63	0.020	8.00
TH-250-40-2ISO	2 1/2	3.10	40	ISO-63	0.020	8.00
TH-300-20-2ISO	3	3.92	20	ISO-80	0.020	9.00
TH-300-40-2ISO	3	3.92	40	ISO-80	0.020	9.00
TH-400-20-2ISO	4	4.82	20	ISO-100	0.020	13.00
TH-400-40-2ISO	4	4.82	40	ISO-100	0.020	13.00



CF Flexible Stainless Steel Hoses

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE OD	WALL THICKNESS	STATIC BEND RADIUS
FH-075-12-2CF	3/4	1.11	12	1.33	0.008	1.26
FH-075-18-2CF	3/4	1.11	18	1.33	0.008	1.26
FH-075-24-2CF	3/4	1.11	24	1.33	0.008	1.26
FH-075-36-2CF	3/4	1.11	36	1.33	0.008	1.26
FH-100-12-2CF	1	1.37	12	2.12	0.008	1.46
FH-100-18-2CF	1	1.37	18	2.12	0.008	1.46
FH-100-24-2CF	1	1.37	24	2.12	0.008	1.46
FH-100-36-2CF	1	1.37	36	2.12	0.008	1.46
FH-150-12-2CF	1-1/2	2.06	12	2.75	0.010	2.16
FH-150-18-2CF	1-1/2	2.06	18	2.75	0.010	2.16
FH-150-24-2CF	1-1/2	2.06	24	2.75	0.010	2.16
FH-150-36-2CF	1-1/2	2.06	36	2.75	0.010	2.16
FH-200-12-2CF	2	2.55	12	3.38	0.012	3.50
FH-200-18-2CF	2	2.55	18	3.38	0.012	3.50
FH-200-24-2CF	2	2.55	24	3.38	0.012	3.50
FH-200-36-2CF	2	2.55	36	3.38	0.012	3.50
FH-250-12-2CF	2-1/2	3.34	12	4.50	0.016	4.25
FH-250-18-2CF	2-1/2	3.34	18	4.50	0.016	4.25
FH-250-24-2CF	2-1/2	3.34	24	4.50	0.016	4.25
FH-250-36-2CF	2-1/2	3.34	36	4.50	0.016	4.25
FH-300-12-2CF	3	3.99	12	4.62	0.016	6.00
FH-300-18-2CF	3	3.99	18	4.62	0.016	6.00
FH-300-24-2CF	3	3.99	24	4.62	0.016	6.00
FH-300-36-2CF	3	3.99	36	4.62	0.016	6.00
FH-400-12-2CF	4	4.83	12	6.00	0.016	8.60
FH-400-18-2CF	4	4.83	18	6.00	0.016	8.60
FH-400-24-2CF	4	4.83	24	6.00	0.016	8.60
FH-400-36-2CF	4	4.83	36	6.00	0.016	8.60

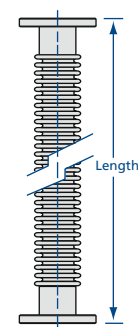
Note: See Braided Hose selection next page.



ASA Flexible Stainless Steel Hoses

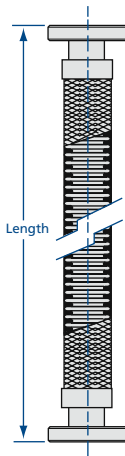
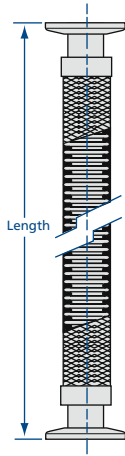
MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	DESCRIPTION	WALL THICKNESS	STATIC BEND RADIUS
FH-250-12-ASA	2 1/2	3.34	12	ASA-5 on one port	0.016	4.25
FH-250-12-2ASA	2 1/2	3.34	12	ASA-5 on both ports	0.016	4.25
FH-250-18-ASA	2 1/2	3.34	18	ASA-5 on one port	0.016	4.25
FH-250-18-2ASA	2 1/2	3.34	18	ASA-5 on both ports	0.016	4.25
FH-250-24-ASA	2 1/2	3.34	24	ASA-5 on one port	0.016	4.25
FH-250-24-2ASA	2 1/2	3.34	24	ASA-5 on both ports	0.016	4.25
FH-250-36-ASA	2 1/2	3.34	36	ASA-5 on one port	0.016	4.25
FH-250-36-2ASA	2 1/2	3.34	36	ASA-5 on both ports	0.016	4.25
FH-300-12-ASA	3	3.99	12	ASA-6 on one port	0.016	6.00
FH-300-12-2ASA	3	3.99	12	ASA-6 on both ports	0.016	6.00
FH-300-18-ASA	3	3.99	18	ASA-6 on one port	0.016	6.00
FH-300-18-2ASA	3	3.99	18	ASA-6 on both ports	0.016	6.00
FH-300-24-ASA	3	3.99	24	ASA-6 on one port	0.016	6.00
FH-300-24-2ASA	3	3.99	24	ASA-6 on both ports	0.016	6.00
FH-300-36-ASA	3	3.99	36	ASA-6 on one port	0.016	6.00
FH-300-36-2ASA	3	3.99	36	ASA-6 on both ports	0.016	6.00
FH-400-12-ASA	4	4.83	12	ASA-7.5 on one port	0.016	8.60
FH-400-12-2ASA	4	4.83	12	ASA-7.5 on both ports	0.016	8.60
FH-400-18-ASA	4	4.83	18	ASA-7.5 on one port	0.016	8.60
FH-400-18-2ASA	4	4.83	18	ASA-7.5 on both ports	0.016	8.60
FH-400-24-ASA	4	4.83	24	ASA-7.5 on one port	0.016	8.60
FH-400-24-2ASA	4	4.83	24	ASA-7.5 on both ports	0.016	8.60
FH-400-36-ASA	4	4.83	36	ASA-7.5 on one port	0.016	8.60
FH-400-36-2ASA	4	4.83	36	ASA-7.5 on both ports	0.016	8.60

Note: Call for O-ring groove pricing if required



Flexible Hoses & Couplings

Braided Stainless Steel Flexible Hoses



NW Flexible Stainless Steel Braided Hoses

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE TYPE	WALL THICKNESS	STATIC BEND RADIUS
FHB-075-12-2NW	3/4	1 1/4	12	NW-16	0.008	2.09
FHB-075-18-2NW	3/4	1 1/4	18	NW-16	0.008	2.09
FHB-075-20-2NW	3/4	1 1/4	20	NW-16	0.008	2.09
FHB-075-24-2NW	3/4	1 1/4	24	NW-16	0.008	2.09
FHB-075-36-2NW	3/4	1 1/4	36	NW-16	0.008	2.09
FHB-075-40-2NW	3/4	1 1/4	40	NW-16	0.008	2.09
FHB-100-12-2NW	1	1 5/8	12	NW-25	0.008	2.52
FHB-100-18-2NW	1	1 5/8	18	NW-25	0.008	2.52
FHB-100-20-2NW	1	1 5/8	20	NW-25	0.008	2.52
FHB-100-24-2NW	1	1 5/8	24	NW-25	0.008	2.52
FHB-100-36-2NW	1	1 5/8	36	NW-25	0.008	2.52
FHB-100-40-2NW	1	1 5/8	40	NW-25	0.008	2.52
FHB-150-12-2NW	1 1/2	2 1/4	12	NW-40	0.010	3.86
FHB-150-18-2NW	1 1/2	2 1/4	18	NW-40	0.010	3.86
FHB-150-20-2NW	1 1/2	2 1/4	20	NW-40	0.010	3.86
FHB-150-24-2NW	1 1/2	2 1/4	24	NW-40	0.010	3.86
FHB-150-36-2NW	1 1/2	2 1/4	36	NW-40	0.010	3.86
FHB-150-40-2NW	1 1/2	2 1/4	40	NW-40	0.010	3.86
FHB-200-12-2NW	2	2 3/4	12	NW-50	0.012	4.72
FHB-200-18-2NW	2	2 3/4	18	NW-50	0.012	4.72
FHB-200-20-2NW	2	2 3/4	20	NW-50	0.012	4.72
FHB-200-24-2NW	2	2 3/4	24	NW-50	0.012	4.72
FHB-200-36-2NW	2	2 3/4	36	NW-50	0.012	4.72
FHB-200-40-2NW	2	2 3/4	40	NW-50	0.012	4.72

CF Flexible Stainless Steel Braided Hoses

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE OD	WALL THICKNESS	STATIC BEND RADIUS
FHB-075-12-2CF	3/4	1 1/4	12	1.33	0.008	2.09
FHB-075-18-2CF	3/4	1 1/4	18	1.33	0.008	2.09
FHB-075-24-2CF	3/4	1 1/4	24	1.33	0.008	2.09
FHB-075-36-2CF	3/4	1 1/4	36	1.33	0.008	2.09
FHB-100-12-2CF	1	1 5/8	12	2.12	0.008	2.52
FHB-100-18-2CF	1	1 5/8	18	2.12	0.008	2.52
FHB-100-24-2CF	1	1 5/8	24	2.12	0.008	2.52
FHB-100-36-2CF	1	1 5/8	36	2.12	0.008	2.52
FHB-150-12-2CF	1 1/2	2 1/4	12	2.75	0.010	3.86
FHB-150-18-2CF	1 1/2	2 1/4	18	2.75	0.010	3.86
FHB-150-24-2CF	1 1/2	2 1/4	24	2.75	0.010	3.86
FHB-150-36-2CF	1 1/2	2 1/4	36	2.75	0.010	3.86
FHB-200-12-2CF	2	2 3/4	12	3.38	0.012	4.72
FHB-200-18-2CF	2	2 3/4	18	3.38	0.012	4.72
FHB-200-24-2CF	2	2 3/4	24	3.38	0.012	4.72
FHB-200-36-2CF	2	2 3/4	36	3.38	0.012	4.72

SPECIFICATIONS

Nominal ID sizes: 3/4 to 2 inch

Materials

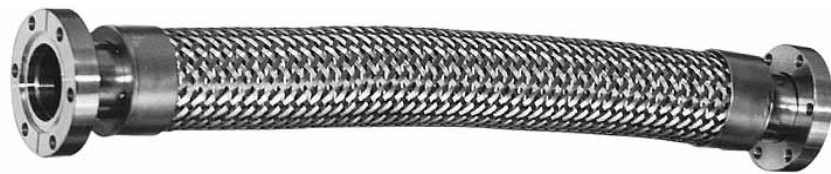
Bellows: 321 stainless steel
 Tube ends: 304 stainless steel
 Flanges: 304 stainless steel
 (316L available on request)

Vacuum Range

Metal seal: $\geq 1 \times 10^{-10}$ Torr - UHV
 Elastomer seal: $\geq 1 \times 10^{-8}$ Torr - High vacuum

Temperature Range

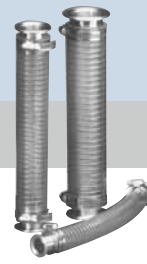
Metal seal: -200°C to 450°C
 Elastomer seal: -20°C to 150°C



Larger hose IDs and other flange configurations available upon request.

Flexible Hoses & Couplings

PVC Flexible Hoses

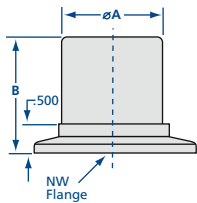
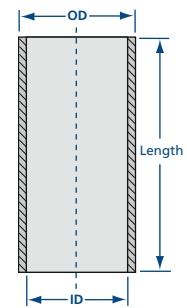


PVC Flexible Hoses

Each length includes two hose clamps for installation.

MODEL NUMBER	NOMINAL ID	HOSE OD	STATIC BEND RADIUS
PVC-050	1/2	0.813	2.00
PVC-075	3/4	1.125	3.00
PVC-100	1	1.375	4.00
PVC-150	1 1/2	2.000	6.00
PVC-200	2	2.500	8.00

Note: To order specify length required in feet as follows: PVC-100-5.0 and PVC-200-10.0



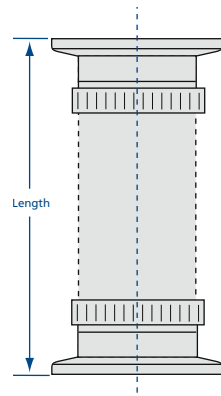
PVC Hose Nipples

MODEL NUMBER	FLANGE TYPE	NIPPLE MATERIAL	A	B
1HN-NW-10-050	NW-10	304 SS	0.50	1.26
1HN-NW-16-075	NW-16	304 SS	0.75	1.26
1HN-NW-25-100	NW-25	304 SS	1.00	1.50
1HN-NW-40-150	NW-40	304 SS	1.50	1.97
1HN-NW-50-200	NW-50	304 SS	2.00	2.17



PVC Hoses with NW Flanges

MODEL NUMBER	NOMINAL ID	HOSE OD	OVERALL LENGTH	FLANGE TYPE	STATIC BEND RADIUS
PVC-050-12-2NW	1/2	0.813	12	NW-10	2.00
PVC-050-24-2NW	1/2	0.813	24	NW-10	2.00
PVC-050-36-2NW	1/2	0.813	36	NW-10	2.00
PVC-050-72-2NW	1/2	0.813	72	NW-10	2.00
PVC-075-12-2NW	3/4	1.125	12	NW-16	3.00
PVC-075-24-2NW	3/4	1.125	24	NW-16	3.00
PVC-075-36-2NW	3/4	1.125	36	NW-16	3.00
PVC-075-72-2NW	3/4	1.125	72	NW-16	3.00
PVC-100-12-2NW	1	1.375	12	NW-25	4.00
PVC-100-24-2NW	1	1.375	24	NW-25	4.00
PVC-100-36-2NW	1	1.375	36	NW-25	4.00
PVC-100-72-2NW	1	1.375	72	NW-25	4.00
PVC-150-12-2NW	1 1/2	2.000	12	NW-40	6.00
PVC-150-24-2NW	1 1/2	2.000	24	NW-40	6.00
PVC-150-36-2NW	1 1/2	2.000	36	NW-40	6.00
PVC-150-72-2NW	1 1/2	2.000	72	NW-40	6.00
PVC-200-12-2NW	2	2.500	12	NW-50	8.00
PVC-200-24-2NW	2	2.500	24	NW-50	8.00
PVC-200-36-2NW	2	2.500	36	NW-50	8.00
PVC-200-72-2NW	2	2.500	72	NW-50	8.00



SPECIFICATIONS

Nominal ID sizes: 1/2 to 2 inch

Materials

Hose: Wire reinforced polyvinyl chloride (PVC)
 Nipples: 304 stainless steel
 Flanges: 304 stainless steel
 (316L available on request)

Vacuum Range: $\geq 1 \times 10^{-2}$ Rough vacuum

Maximum Temperature: -4° to 65°C



SPECIFICATIONS

Tube OD sizes: 1/2 to 12 inches

Materials: 304 or 316L stainless steel

Vacuum range: $\geq 1 \times 10^{-13}$ Torr

Temperature range: -200° to 450°C

Nor-Cal Products has manufactured stainless steel weld fittings for nearly forty five years. We worked with Lawrence Livermore National Laboratory in the 1960's to develop their specification for vacuum piping, which has become the standard in the industry. Weld fittings are commonly used in vacuum roughing lines on semiconductor process equipment and for forelines and pump exhaust lines in semiconductor subfabs.

All tees and crosses are fabricated with the pulled-port technique and full penetration butt welds. This provides crevice-free weld joints and the maximum in cleanliness for UHV applications. Weld fittings are available from stock in 304 stainless steel, and some sizes are stocked in 316L stainless steel for additional corrosion resistance. All weld fittings are available with various flange combinations. See appropriate section.



Tube Finishes

The standard finish for all weld fittings is tumbled, although there are some fittings that are not available with the tumbled finish. These weld fittings are bead-blasted and are designated by a "-B" suffix on the part number. (See photo at right) All weld fittings can be electropolished on request. Call for pricing.



Beadblasted Finish

Tumbled Finish

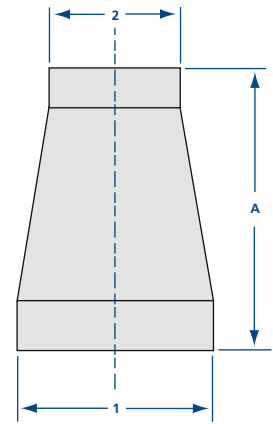
All dimensions are called out in inches unless otherwise noted



Conical reducers provide a compact means of adapting to a smaller diameter tube with minimal loss in conductance. They are available from stock in 304 stainless steel and some sizes are stocked in 316L stainless steel for additional corrosion resistance. Conical adapter nipples are available with various flange combinations. See appropriate section.

Conical Reducers

MODEL NUMBER	TUBE OD 1	TUBE OD 2	A	WALL THICKNESS
B-31W-100-075	1	3/4	1.38	0.065
B-31W-150-075	1 1/2	3/4	2.38	0.065
B-31W-150-100	1 1/2	1	2.38	0.065
B-31W-200-100	2	1	2.38	0.065
B-31W-200-150	2	1 1/2	2.38	0.065
B-31W-250-150	2 1/2	1 1/2	2.38	0.065
B-31W-250-200	2 1/2	2	2.38	0.065
B-31W-300-150	3	1 1/2	3.62	0.065
B-31W-300-200	3	2	3.62	0.065
B-31W-300-250	3	2 1/2	3.62	0.065
B-31W-400-150	4	1 1/2	3.62	0.065
B-31W-400-200	4	2	3.62	0.065
B-31W-400-250	4	2 1/2	3.62	0.065
B-31W-400-300	4	3	3.62	0.065
B-31W-600-300-B	6	3	5.50	0.074
B-31W-600-400-B	6	4	5.50	0.074
B-31W-600-400-HW	6	4	9.00	0.083

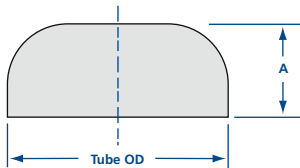


316L Conical Reducers

MODEL NUMBER	TUBE OD 1	TUBE OD 2	A	WALL THICKNESS
B-31W-200-100-316L	2	1	2.38	0.065
B-31W-200-150-316L	2	1 1/2	2.38	0.065
B-31W-300-200-316L	3	2	3.62	0.065
B-31W-400-150-316L-B	4	1 1/2	5.25	0.065
B-31W-400-200-316L	4	2	3.62	0.065

End Caps

MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-2W-050	1/2	0.050	0.32
G-2W-075	3/4	0.050	0.31
G-2W-100	1	0.060	0.43
G-2W-150	1 1/2	0.060	0.56
G-2W-200	2	0.060	0.75
G-2W-250	2 1/2	0.060	0.70
G-2W-300	3	0.074	0.67
G-2W-400	4	0.074	0.48
G-2W-450	4 1/2	0.074	0.51
G-2W-600	6	0.074	0.88
G-2W-800	8	0.074	0.83



End Cap Reducers

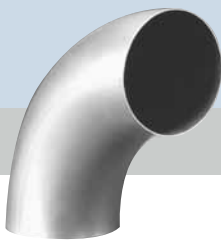
MODEL NUMBER	TUBE OD 1	TUBE OD 2	A
ECR-075-050	3/4	1/2	2.38
ECR-100-050	1	1/2	2.38
ECR-100-075	1	3/4	2.38
ECR-150-050	1 1/2	1/2	2.38
ECR-150-075	1 1/2	3/4	2.38
ECR-150-100	1 1/2	1	2.38
ECR-200-150	2	1 1/2	2.38
ECR-250-200	2 1/2	2	2.38
ECR-300-150	3	1 1/2	3.62
ECR-300-200	3	2	3.62
ECR-300-250	3	2 1/2	3.62
ECR-400-200-B	4	2	3.62
ECR-400-300-B	4	3	3.62
ECR-600-400-B	6	4	3.62
ECR-800-600-B	8	6	3.62

Other reducer combinations can be supplied upon request.

SPECIFICATIONS

- Tube OD sizes: 1 to 6 inches
- Materials: 304 or 316L stainless steel
- Vacuum range: $\geq 1 \times 10^{-13}$ Torr
- Temperature range: -200° to 450°C

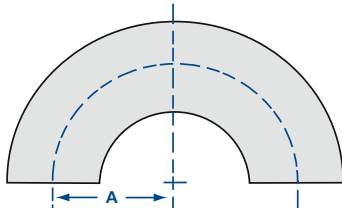
Weld Fittings Elbows



SPECIFICATIONS

- Tube OD sizes:** 1/2 to 10 inches
- Materials:** 304 or 316L stainless steel
- Vacuum range:** $\geq 1 \times 10^{-13}$ Torr
- Temperature range:** -200° to 450°C

Nor-Cal Products offers 180° return bend radius elbows in sizes up to 2 inches OD and 45° and 90° radius elbows in sizes up to 10 inches OD. Radius elbows offer the highest conductance geometry in a tube bend. All elbows are available from stock in 304 stainless steel, and some sizes are stocked in 316L stainless steel for additional corrosion resistance. We have added several 45° and 90° elbows with tangents to match other commonly available dimensions. Look for the HW suffix for elbows that match HPS weld fitting dimensions, for example. Elbows are also available with various flange combinations. See appropriate section.



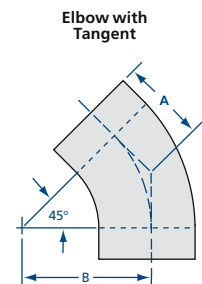
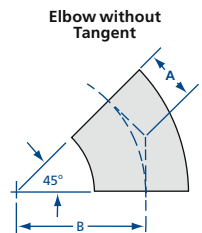
180° Return Bend Radius Elbows

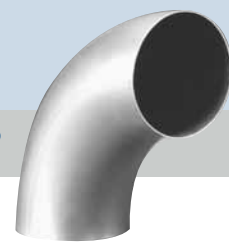
MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-2WU-050	1/2	0.049	0.75
G-2WU-075	3/4	0.035	1.00
G-2WU-100	1	0.065	1.50
G-2WU-150	1 1/2	0.065	2.25
G-2WU-200	2	0.065	3.00



45° Radius Elbows

MODEL NUMBER	TUBE OD	WALL THICKNESS	A	B	316L	TANGENT
G-2WK-050	1/2	0.049	0.31	0.75		
G-2WK-075	3/4	0.035	0.41	1.00		
G-2WK-075T	3/4	0.065	0.41	1.13		
G-2KL-075	3/4	0.035	0.76	1.00		✓
G-2WK-100	1	0.065	0.62	1.50		
G-2WK-100-316L	1	0.065	0.62	1.50	✓	
G-2KL-100	1	0.065	0.97	1.50		✓
G-2KL-100HW	1	0.065	1.19	1.50		✓
G-2KL-100-316L	1	0.065	0.97	1.50	✓	✓
G-2WK-150	1 1/2	0.065	0.93	2.25		
G-2WK-150-316L	1 1/2	0.065	0.93	2.25	✓	
G-2KL-150	1 1/2	0.065	1.53	2.25		✓
G-2KL-150HW	1 1/2	0.065	1.63	2.25		✓
G-2KL-150-316L	1 1/2	0.065	1.53	2.25	✓	✓
G-2WK-200	2	0.065	1.24	3.00		
G-2WK-200-316L	2	0.065	1.24	3.00	✓	
G-2KL-200	2	0.065	1.84	3.00		✓
G-2KL-200HW	2	0.065	2.31	3.00		✓
G-2KL-200-316L	2	0.065	1.84	3.00	✓	✓
G-2WK-250	2 1/2	0.065	1.55	3.75		
G-2WK-250-316L	2 1/2	0.065	1.55	3.75	✓	
G-2KL-250	2 1/2	0.065	3.00	3.75		✓
G-2WK-300	3	0.065	1.86	4.50		
G-2WK-300-316L	3	0.065	1.86	4.50	✓	
G-2KL-300	3	0.065	3.68	4.50		✓
G-2KL-300-316L	3	0.065	3.68	4.50	✓	✓
G-2WK-400	4	0.083	2.49	6.00		
G-2WK-400-316L	4	0.083	2.49	6.00	✓	
G-2KL-400	4	0.083	4.78	6.00		✓
G-2KL-400HW	4	0.083	4.81	6.00		✓
G-2KL-400-316L	4	0.083	4.78	6.00	✓	✓
G-2WK-600-B	6	0.083	3.73	9.00		
G-2WK-800-B	8	0.134	4.97	12.00		
G-2WK-1000-B	10	0.134	6.21	15.00		





90° Radius Elbows

MODEL NUMBER	TUBE OD	WALL THICKNESS	A	B	316L	TANGENT
G-2WC-050	1/2	0.049	0.75	0.75		
G-2WC-075	3/4	0.035	1.00	1.00		
G-2WC-075H	3/4	0.035	1.42	1.00		✓
G-2WC-100	1	0.065	1.50	1.50		
G-2WC-100-316L	1	0.065	1.50	1.50	✓	
G-2WC-100H	1	0.065	1.82	1.50		✓
G-2WC-100HW	1	0.065	2.06	1.50		✓
G-2WC-100H-316L	1	0.065	1.82	1.50	✓	✓
G-2WC-150	1 1/2	0.065	2.25	2.25		
G-2WC-150-316L	1 1/2	0.065	2.25	2.25	✓	
G-2WC-150H	1 1/2	0.065	2.41	2.25		✓
G-2WC-150HW	1 1/2	0.065	2.94	2.25		✓
G-2WC-150HL	1 1/2	0.065	4.97	2.25		✓
G-2WC-150H-316L	1 1/2	0.065	2.41	2.25	✓	✓
G-2WC-200	2	0.065	3.00	3.00		
G-2WC-200-316L	2	0.065	3.00	3.00	✓	
G-2WC-200H	2	0.065	4.06	3.00		✓
G-2WC-200HL	2	0.065	5.36	3.00		✓
G-2WC-200H-316L	2	0.065	4.06	3.00	✓	✓
G-2WC-250	2 1/2	0.065	3.75	3.75		
G-2WC-250-316L	2 1/2	0.065	3.75	3.75	✓	
G-2WC-250H	2 1/2	0.065	5.19	3.75		✓
G-2WC-300	3	0.065	4.50	4.50		
G-2WC-300-316L	3	0.065	4.50	4.50	✓	
G-2WC-300H	3	0.065	6.31	4.50		✓
G-2WC-400	4	0.083	6.00	6.00		
G-2WC-400-316L	4	0.083	6.00	6.00	✓	
G-2WC-400H	4	0.083	8.31	6.00		✓
G-2WC-600-B	6	0.109	9.00	9.00		
G-2WC-800-B	8	0.120	12.00	12.00		
G-2WC-1000-B	10	0.120	15.00	15.00		

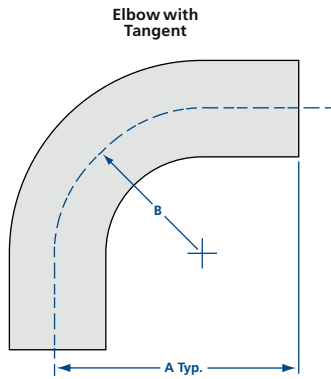
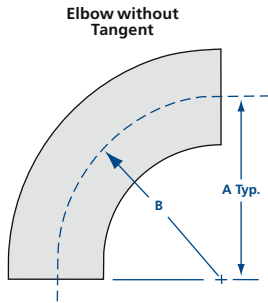
SPECIFICATIONS

Tube OD sizes: 1/2 to 10 inches

Materials: 304 stainless steel
(316L available upon request)

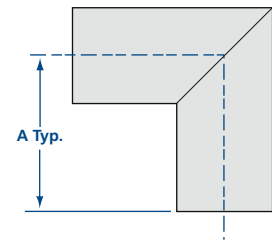
Vacuum range: $\geq 1 \times 10^{-13}$ Torr

Temperature range: -200° to 450°C



90° Mitered Elbow

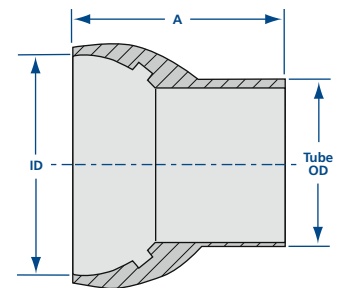
MODEL NUMBER	TUBE OD	WALL THICKNESS	A
E-075M	3/4	0.035	1.00
E-100M	1	0.065	1.88
E-150M	1 1/2	0.065	2.25
E-150MH	1 1/2	0.065	2.41
E-200M	2	0.065	3.00
E-200MH	2	0.065	2.61
E-250M	2 1/2	0.065	3.00
E-250MV	2 1/2	0.065	3.75
E-300M	3	0.065	3.25
E-400M	4	0.083	3.88
E-400MV-B	4	0.083	4.87
E-500M-B	5	0.083	4.25
E-600M-B	6	0.083	5.00
E-600MV-B	6	0.083	6.06
E-800M-B	8	0.120	7.00
E-1000M-B	10	0.120	9.50



Ball Sockets

MODEL NUMBER	ID	TUBE OD	A	O-RING SIZE
BS-50/30	2.00	1 1/2	1.75	-
BS-50/30-G	2.00	1 1/2	1.75	2-224
BS-75/50	3.00	2	2.50	-
BS-75/50-G	3.00	2	2.50	2-232

Note: "G" suffix in model number indicates O-ring and O-ring groove are provided.



Weld Fittings

Tees

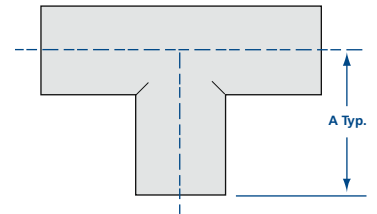


304 stainless steel tees and reducer tees are fabricated with the pulled-port technique and full penetration welds. This provides crevice-free weld joints and the maximum in cleanliness for UHV applications. Other sizes are available on request. We have added tees to match other commonly available dimensions. Look for the HW suffix for tees that match HPS weld fitting dimensions, for example. These fittings are also offered with various flange combinations. See appropriate flange section.



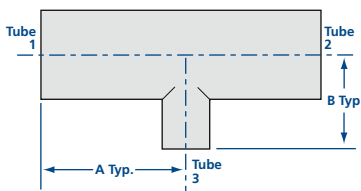
Tees

MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-7W-050	1/2	0.049	0.75
G-7W-075	3/4	0.035	1.00
G-7W-075HW	3/4	0.065	1.88
G-7W-075T	3/4	0.065	1.00
G-7W-100	1	0.065	1.88
G-7W-150	1 1/2	0.065	2.25
G-7W-150H	1 1/2	0.065	2.41
G-7W-200	2	0.065	3.00
G-7W-200H	2	0.065	2.61
G-7W-250	2 1/2	0.065	3.00
G-7W-250V	2 1/2	0.065	3.75
G-7W-300	3	0.065	3.25
G-7W-400	4	0.083	3.88
G-7W-400V	4	0.083	4.87
G-7W-500-B	5	0.083	4.25
G-7W-600-B	6	0.083	5.00
G-7W-600V-B	6	0.083	6.06
G-7W-800-B	8	0.120	7.00
G-7W-1000-B	10	0.120	9.50



Reducer Tees

MODEL NUMBER	TUBE 1 & 2 ARM OD	TUBE 3 LEG OD	A	B
G-7WR-100-050	1	1/2	1.88	1.00
G-7WR-100-075	1	3/4	1.88	1.12
G-7WR-150-050	1 1/2	1/2	2.25	1.25
G-7WR-150-075	1 1/2	3/4	2.25	1.38
G-7WR-150-100	1 1/2	1	2.25	2.13
G-7WR-200-050	2	1/2	3.00	1.50
G-7WR-200-075	2	3/4	3.00	1.63
G-7WR-200-100	2	1	3.00	2.38
G-7WR-200-150	2	1 1/2	3.00	2.50
G-7WR-250-150	2 1/2	1 1/2	3.00	2.75
G-7WR-250-200	2 1/2	2	3.00	3.25
G-7WR-300-150	3	1 1/2	3.25	3.00
G-7WR-300-200	3	2	3.25	3.50
G-7WR-300-250	3	2 1/2	3.25	3.25
G-7WR-400-150-B	4	1 1/2	3.88	3.50
G-7WR-400-200-B	4	2	3.88	4.00
G-7WR-400-250-B	4	2 1/2	3.88	3.75
G-7WR-400-300-B	4	3	3.88	3.75
G-7WR-500-400-B	5	4	4.25	4.38
G-7WR-600-150-B	6	1 1/2	5.00	4.50
G-7WR-600-200-B	6	2	5.00	5.00
G-7WR-600-250-B	6	2 1/2	5.00	4.75
G-7WR-600-400-B	6	4	5.00	4.88
G-7WR-600-500-B	6	5	5.00	4.75
G-7WR-800-600-B	8	6	7.00	6.00



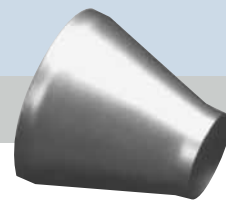
SPECIFICATIONS

Tube OD sizes: 1/2 to 10 inches

Materials: 304 or stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-13}$ Torr

Temperature range: -200° to 450°C

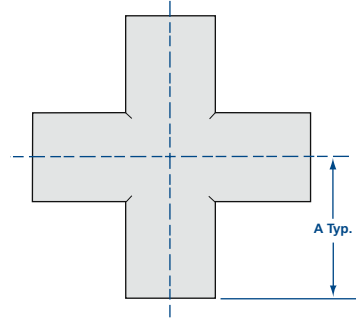


304 stainless steel crosses and reducer crosses are offered in a wide range of sizes as standard products. All crosses are fabricated with the pulled-port technique and full penetration butt welds. This provides crevice-free weld joints and the maximum in cleanliness for UHV applications. As always, other sizes are available on request. These fittings are offered with various flange combinations. See appropriate sections.

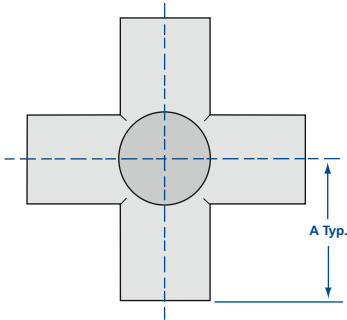
4-Way Crosses



MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-9W-050	1/2	0.049	0.75
G-9W-075	3/4	0.035	1.00
G-9W-100	1	0.065	1.88
G-9W-150	1 1/2	0.065	2.25
G-9W-150H	1 1/2	0.065	2.41
G-9W-200	2	0.065	3.00
G-9W-200H	2	0.065	2.61
G-9W-250	2 1/2	0.065	3.00
G-9W-250V	2 1/2	0.065	3.75
G-9W-300	3	0.065	3.25
G-9W-400	4	0.083	3.88
G-9W-400V	4	0.083	4.87
G-9W-500-B	5	0.083	4.25
G-9W-600-B	6	0.083	5.00
G-9W-600V-B	6	0.083	6.06
G-9W-800-B	8	0.120	7.00
G-9W-1000-B	10	0.120	9.50



5-Way Crosses



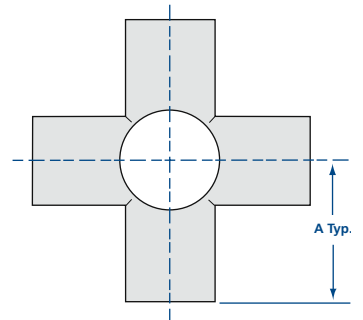
MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-10W-075	3/4	0.035	1.00
G-10W-100	1	0.065	1.88
G-10W-150	1 1/2	0.065	2.25
G-10W-200	2	0.065	3.00
G-10W-250	2 1/2	0.065	3.00
G-10W-250V	2 1/2	0.065	3.75
G-10W-300-B	3	0.065	3.25
G-10W-400-B	4	0.083	3.88
G-10W-400V-B	4	0.083	4.87
G-10W-500-B	5	0.083	4.25
G-10W-600-B	6	0.083	5.00
G-10W-600V-B	6	0.083	6.06
G-10W-800-B	8	0.120	7.00
G-10W-1000-B	10	0.120	9.50



6-Way Crosses



MODEL NUMBER	TUBE OD	WALL THICKNESS	A
G-11W-075	3/4	0.035	1.00
G-11W-100	1	0.065	1.88
G-11W-150	1 1/2	0.065	2.25
G-11W-200	2	0.065	3.00
G-11W-250	2 1/2	0.065	3.00
G-11W-250V	2 1/2	0.065	3.75
G-11W-300-B	3	0.065	3.25
G-11W-400-B	4	0.083	3.88
G-11W-400V-B	4	0.083	4.87
G-11W-500-B	5	0.083	4.25
G-11W-600-B	6	0.083	5.00
G-11W-600V-B	6	0.083	6.06
G-11W-800-B	8	0.120	7.00
G-11W-1000-B	10	0.120	9.50





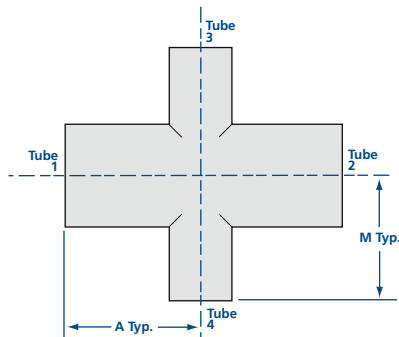
SPECIFICATIONS

Tube OD sizes: 3/4 to 12 inches

Materials: 304 or stainless steel
(316L available upon request)

Vacuum range: $\geq 1 \times 10^{-13}$ Torr

Temperature range: -200° to 450°C



Reducer Crosses

MODEL NUMBER	TUBE 1 & 2 ARM OD	TUBE 3 & 4 LEG OD	A	M
G-9WR-100-050	1	1/2	1.88	1.00
G-9WR-100-075	1	3/4	1.88	1.12
G-9WR-150-050	1 1/2	1/2	2.25	1.25
G-9WR-150-075	1 1/2	3/4	2.25	1.38
G-9WR-150-100	1 1/2	1	2.25	2.13
G-9WR-200-050	2	1/2	3.00	1.50
G-9WR-200-075	2	3/4	3.00	1.63
G-9WR-200-150	2	1 1/2	3.00	2.50
G-9WR-250-150	2 1/2	1 1/2	3.00	2.75
G-9WR-250-200	2 1/2	2	3.00	3.25
G-9WR-300-150	3	1 1/2	3.25	3.00
G-9WR-300-200	3	2	3.25	3.50
G-9WR-300-250	3	2 1/2	3.25	3.25
G-9WR-400-150-B	4	1 1/2	3.88	3.50
G-9WR-400-200-B	4	2	3.88	4.00
G-9WR-400-250-B	4	2 1/2	3.88	3.75
G-9WR-400-300-B	4	3	3.88	3.75
G-9WR-500-400-B	5	4	4.25	4.38
G-9WR-600-150-B	6	1 1/2	5.00	4.50
G-9WR-600-200-B	6	2	5.00	5.00
G-9WR-600-250-B	6	2 1/2	5.00	4.75
G-9WR-600-300-B	6	3	5.00	4.75
G-9WR-600-400-B	6	4	5.00	4.88
G-9WR-600-500-B	6	5	5.00	4.75
G-9WR-800-600-B	8	6	7.00	6.00

Other reducer combinations can be supplied upon request.



304 & 316L Stainless Steel Tubing

Nor-Cal's consumption of stainless steel tubing for its own products makes it possible to offer 304 and 316L stainless steel tubing in lengths up to 20 feet. 304 stainless steel tubing standard finishes are white pickled (Number 1 unpolished), bright annealed or polished OD and ID, depending on the size. 316L stainless steel tubing is offered with a bright annealed finish only. Bright annealed and polished tubing has been pickled and passivated. Polished tube can be described as No. 4 polished. The surface meets ASTM A270, and has received a 150 grit polish on the OD and 180 grit on the ID. Special cleaning, materials and surface finishes are available for an additional charge.



SPECIFICATIONS

Tube OD sizes: 1/2 to 12 inches

Materials: 304 or 316L stainless steel

Finishes: Bright Annealed, polished ID & OD & white pickled

Vacuum range: $\geq 1 \times 10^{-13}$ Torr

Temperature range: -200° to 450°C

MODEL NUMBER	SURFACE FINISH	TUBE OD	TUBE ID	WALL THICKNESS
SST-050	Bright annealed	1/2	0.402	0.049
SST-075	Bright annealed	3/4	0.680	0.035
SST-075-316L	Bright annealed	3/4	0.680	0.035
SST-100	Polished ID & OD	1	0.870	0.065
SST-100-316L	Bright annealed	1	0.870	0.065
SST-125	Bright annealed	1 1/4	1.120	0.065
SST-150	Polished ID & OD	1 1/2	1.370	0.065
SST-150-316L	Bright annealed	1 1/2	1.370	0.065
SST-162	Bright annealed	1 5/8	1.490	0.065
SST-175	Bright annealed	1 3/4	1.630	0.065
SST-200	Polished ID & OD	2	1.870	0.065
SST-200-316L	Bright annealed	2	1.870	0.065
SST-250	Polished ID & OD	2 1/2	2.370	0.065
SST-250-316L	Bright annealed	2 1/2	2.370	0.065
SST-300	Polished ID & OD	3	2.870	0.065
SST-300-316L	Bright annealed	3	2.870	0.065
SST-400	Polished ID & OD	4	3.834	0.083
SST-400-316L	Bright annealed	4	3.834	0.083
SST-500	White pickled	5	4.834	0.083
SST-600	White pickled	6	5.834	0.083
SST-800	White pickled	8	7.760	0.120
SST-1000	White pickled	10	9.760	0.120
SST-1200	White pickled	12	11.760	0.120

* Cutting fee applies, call for pricing. To order specify length required in feet as follows:
SST-400-20.0 (20" length of 4" OD tube) SST-150-316L-20.0 (20" length of 1.5" OD tube)