

**Integrated**

# Series 88

CF COMPONENT  
ULTRA HIGH VACUUM FITTINGS  
SIZES 1 1/3" TO 4 5/8"

**Process Solutions**

WWW.MKSINST.COM



Manufactured by MKS to industry standards, Series 88 components are a full line of metal-sealed stainless steel CF flanges and fittings that are interchangeable with ultra high vacuum equipment made by other manufacturers.

MKS offers a complete system of interfacing components including valves, which allows rapid assembly without welding, brazing, or soldering. Most sizes and types of fittings are available for immediate shipment from MKS' distribution centers located throughout North America, Asia, and Europe.

## Applications

Series 88 CF flanges are suitable for applications requiring a very clean environment, ultra high vacuum conditions, high temperature, or where critical or dangerous materials must be contained or excluded. These include:

1. Difficult applications with corrosive, radioactive, toxic or air sensitive materials.
2. Materials creation and processing such as molecular beam epitaxy.
3. Analytical instrumentation including Auger electron spectrometers, mass spectrometers, and electron microscopes.
4. High energy physics installation such as accelerators and fusion devices.

## Description

Series 88 is a line of CF-style fittings that are the standard for ultra high vacuum applications. They use a flat gasket placed between two knife edges to provide a vacuum tight seal. Mating flanges have identical profiles, i.e., they are sexless, eliminating the need to store two types or worry about compatibility.

Made with very high purity stainless steel and meticulous cleaning procedures, Series 88 CF components are suitable for use in the ultra high vacuum applications to below  $10^{-13}$  Torr and in temperatures from  $-196^{\circ}$  to  $500^{\circ}\text{C}$ . The material characteristics of the flanges, seals, screws, and nuts are selected to provide high performance throughout a wide temperature range. Rotatable and nonrotatable flanges in sizes from mini 1-1/3 to 4-5/8 inches (34 to 117 mm) are available with several bore sizes to fit a range of tube diameters.

MKS uses the latest automated equipment to provide the highest quality and consistency. Very high purity type 304 stainless steel is selected to have few inclusions. Combined with MKS' surface treatment and cleaning procedures, this minimizes outgassing, permeability, and leakage. Proper hardness is maintained to prevent the knife edge from deteriorating.

## Installation

CF components are assembled by inserting a gasket between the two flange faces, then securing the assembly with bolts. (See Figure 1.) Bolts should be tightened diagonally, versus sequentially around the circumference, for a secure vacuum seal. Assembly is cost effective through reuse of components and inch dimensional stubs, sockets, and tubes. The foolproof design provides leak tight joints consistently.

A variety of sealing hardware is available, such as plate nuts, dodecagon (12 point head) bolts, Viton® seals, and individually wrapped copper and silver-plated copper gaskets protected from corrosion and mechanical damage.

Plate nuts furnish the fastest, most convenient method to close flanges, reduce required clearance, assemble with one wrench, and are especially good in limited accessibility. Assembly time reduces greatly, because bolts are easier to start and tighten. The clearance needed is half that of regular nuts. They eliminate the need and cost for tapped flanges.

MKS is one of very few CF manufacturers who offer silver plated bolts, including the convenient dodecagon (12 point head) style, which greatly reduce the risk of seizure or breakage.

Copper gaskets make these flanges self-centering and the standard leak grooves simplify troubleshooting and gasket removal. MKS guarantees its CF flanges and fittings to be leak free. OFHC copper gaskets are cleaned, insured to be scratch free, individually sealed, and ready for use. Individual packaging protects flange seal surfaces.

Silver-plated copper gaskets are available for systems that require frequent high-temperature bakeout. This prevents oxides from forming during the bakeout, which could contaminate the system.

The Viton CF gasket offered by MKS has a unique notching in the design, allowing less outgassing than most elastomer seals.

CF flanges remain leak tight even after repeated cycling of the temperature over a wide range. The availability of both tapped and clearance bolt holes gives great flexibility.

Type 304 stainless steel is suited for assembly by tungsten inert gas (TIG) welding; simple fusion welding without filler metal is preferred. Users may braze components to the CF flanges if desired. CF flanges seal properly when the faces of mating flanges contact each other.

The rotatable versions simplify alignment with the bolt holes of other system components and give infinitely rotatable joints. All fittings have at least one rotatable flange for easy alignment. Nonrotatable flanges provide better knife edge protection. The precise tolerances to which MKS fabricates its CF flanges insure an exact fit every time.



# Series 88 Components

Standard size inch tubing provides easy and economical connection to the user's equipment. Series 88 components include double-sided flanges to allow the addition of ports through their circumference with least cost and space. Zero length reducers permit maximum design flexibility, while minimizing the need for custom made components, conductance loss, and surface area. In these, knife edge profiles of various sizes are machined onto the opposite sides of a flange.

Full and half nipples, adapters to a variety of other connection elements, wide angle viewing windows for visual or photographic observation in all metal vacuum systems, tees, elbows, crosses, and flexible metal hoses for vibration isolation and movement give the line added versatility.

With its extensive engineering capabilities, MKS provides custom designed and manufactured shapes and sizes of components. Custom vacuum chambers can be fabricated as well as unique space and time saving fittings and adapters.

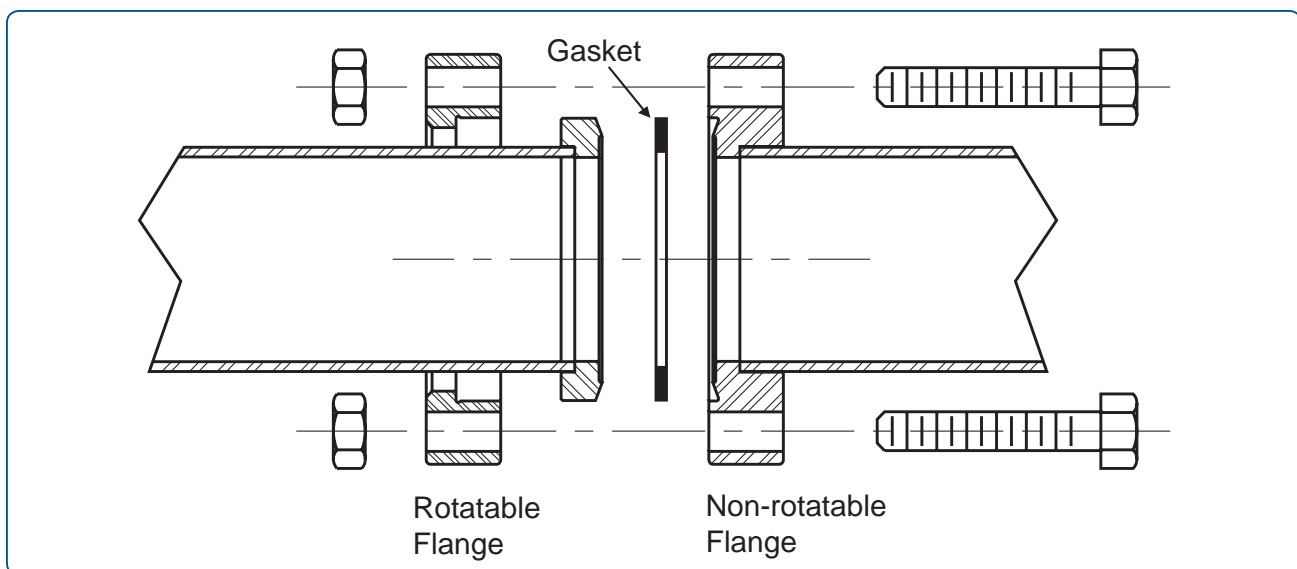
**Table 1 - Gaskets and Torque**

Size	Metal Gasket Dimensions in/(mm)		Maximum Torque for Sealing ft./lbs (Newton-meters)
	Outer Diameter	Inner Diameter	
1 1/3"	0.84/(21)	0.64/(16)	5/(7)
2 1/8"	1.29/(33)	1.01/(26)	16/(22)
2 3/4"	1.90/(48)	1.45/(37)	16/(22)
3 3/8"	2.43/(62)	2.01/(51)	26/(35)
4 1/2"	3.24/(82)	2.51/(64)	26/(35)
4 5/8"	3.60/(91)	3.01/(76)	26/(35)

Note: Metal gaskets are .08" thick.

## Specifications

Minimum Pressure (with metal seals)	10 <sup>-13</sup> Torr
Leak Check	< 10 <sup>-9</sup> std-cc/s
Materials	
Components	Type 304 Stainless Steel
Gaskets	Copper, Silver Plated Copper or Viton
Bolts	Type 304 Stainless or Silver Plated Stainless
Metal Gasket Thickness	.08"/(2.03 mm)



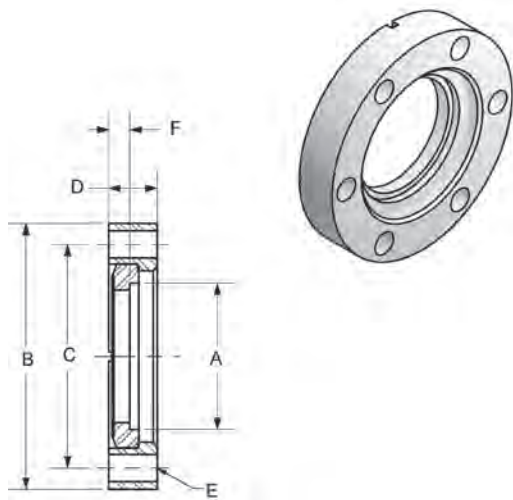
**Figure 1 —**  
CF Flange Installation



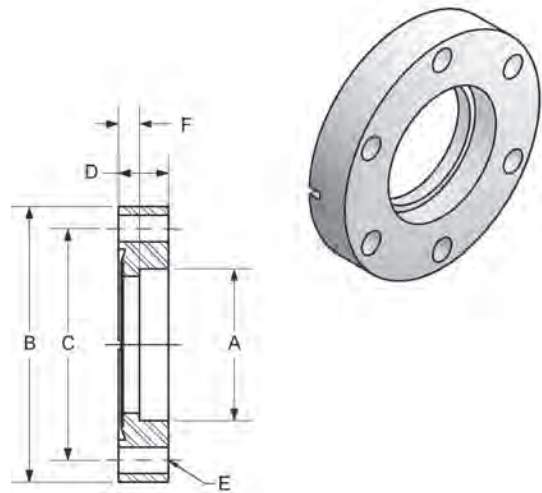
### CF Flange Dimensions

in/(mm)

Flange Size	A Nominal Tube Diameter	B Flange Outside Diameter	C Bolt Circle Diameter	D Thickness	E Number of Holes	Tapped Holes Thread	Thru Holes Diameter	F Face to Counter Bore
1 1/3	.75 (19)	1.33 (34)	1.06 (27)	.30 (8)	6	8-32	.172 (4.3)	.18 (4.6)
2 1/8	1.00 (25)	2.12 (54)	1.62 (41)	.50 (13)	4	1/4-28	.265 (6.7)	.17 (4.3)
2 3/4	1.50 (38)	2.75 (70)	2.31 (59)	.50 (13)	6	1/4-28	.265 (6.7)	.21 (5.3)
3 3/8	2.00 (51)	3.38 (86)	2.85 (72)	.69 (18)	8	5/16-24	.332 (8.4)	.22 (5.6)
4 1/2	2.50 (64)	4.50 (114)	3.63 (92)	.69 (18)	8	5/16-24	.332 (8.4)	.38 (9.6)
4 5/8	3.01 (76)	4.61 (118)	4.03 (102)	.75 (19)	10	5/16-24	.332 (8.4)	.38 (9.6)



Rotatable



Non-Rotatable



# Ordering Information

CF Flanges				in/(mm)
Flange Size	For Tubing OD	Rotatable / Non-Rotatable	Bolt Holes	Part Number
1 1/3	Blank	Rotatable	Thru	100881014
1 1/3	Blank	Rotatable	Tapped	100881021
1 1/3	Blank	Non-Rotatable	Thru	100881000
1 1/3	Blank	Non-Rotatable	Tapped	100881007
1 1/3	.75 (19)	Rotatable	Thru	100881018
1 1/3	.75 (19)	Rotatable	Tapped	100881025
1 1/3	.75 (19)	Non-Rotatable	Thru	100881004
1 1/3	.75 (19)	Non-Rotatable	Tapped	100881011
2 1/8	Blank	Rotatable	Thru	100882010
2 1/8	Blank	Rotatable	Tapped	100882015
2 1/8	Blank	Non-Rotatable	Thru	100882000
2 1/8	Blank	Non-Rotatable	Tapped	100882005
2 1/8	.25 (6)	Rotatable	Thru	100882011
2 1/8	.25 (6)	Rotatable	Tapped	100882016
2 1/8	.25 (6)	Non-Rotatable	Thru	100882001
2 1/8	.25 (6)	Non-Rotatable	Tapped	100882006
2 1/8	.50 (13)	Rotatable	Thru	100882012
2 1/8	.50 (13)	Rotatable	Tapped	100882017
2 1/8	.50 (13)	Non-Rotatable	Thru	100882002
2 1/8	.50 (13)	Non-Rotatable	Tapped	100882007
2 1/8	.75 (19)	Rotatable	Thru	100882013
2 1/8	.75 (19)	Rotatable	Tapped	100882018
2 1/8	.75 (19)	Non-Rotatable	Thru	100882003
2 1/8	.75 (19)	Non-Rotatable	Tapped	100882008
2 1/8	1.00 (25)	Rotatable	Thru	100882014
2 1/8	1.00 (25)	Rotatable	Tapped	100882019
2 1/8	1.00 (25)	Non-Rotatable	Thru	100882004
2 1/8	1.00 (25)	Non-Rotatable	Tapped	100882009
2 3/4	Blank	Rotatable	Thru	100883014
2 3/4	Blank	Rotatable	Tapped	100883021
2 3/4	Blank	Non-Rotatable	Thru	100883000
2 3/4	Blank	Non-Rotatable	Tapped	100883007
2 3/4	.25 (6)	Rotatable	Thru	100883015
2 3/4	.25 (6)	Rotatable	Tapped	100883022
2 3/4	.25 (6)	Non-Rotatable	Thru	100883001
2 3/4	.25 (6)	Non-Rotatable	Tapped	100883008
2 3/4	.50 (13)	Rotatable	Thru	100883016
2 3/4	.50 (13)	Rotatable	Tapped	100883023
2 3/4	.50 (13)	Non-Rotatable	Thru	100883002
2 3/4	.50 (13)	Non-Rotatable	Tapped	100883009
2 3/4	.75 (19)	Rotatable	Thru	100883017
2 3/4	.75 (19)	Rotatable	Tapped	100883024
2 3/4	.75 (19)	Non-Rotatable	Thru	100883003
2 3/4	.75 (19)	Non-Rotatable	Tapped	100883010
2 3/4	1.00 (25)	Rotatable	Thru	100883018
2 3/4	1.00 (25)	Rotatable	Tapped	100883025
2 3/4	1.00 (25)	Non-Rotatable	Thru	100883004
2 3/4	1.00 (25)	Non-Rotatable	Tapped	100883011
2 3/4	1.25 (32)	Rotatable	Thru	100883019
2 3/4	1.25 (32)	Rotatable	Tapped	100883026
2 3/4	1.25 (32)	Non-Rotatable	Thru	100883005
2 3/4	1.25 (32)	Non-Rotatable	Tapped	100883012
2 3/4	1.50 (38)	Rotatable	Thru	100883020
2 3/4	1.50 (38)	Rotatable	Tapped	100883027
2 3/4	1.50 (38)	Non-Rotatable	Thru	100883006
2 3/4	1.50 (38)	Non-Rotatable	Tapped	100883013
2 3/4	1.75 (45)	Rotatable	Thru	100883065
2 3/4	1.75 (45)	Rotatable	Tapped	100883067
2 3/4	1.75 (45)	Non-Rotatable	Thru	100883064
2 3/4	1.75 (45)	Non-Rotatable	Tapped	100883066



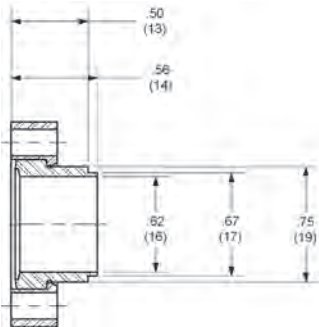
**CF Flanges in/(mm)**

Flange Size	For Tubing OD	Rotatable / Non-Rotatable	Bolt Holes	Part Number
3 3/8	Blank	Rotatable	Thru	100884006
3 3/8	Blank	Rotatable	Tapped	100884009
3 3/8	Blank	Non-Rotatable	Thru	100884000
3 3/8	Blank	Non-Rotatable	Tapped	100884003
3 3/8	1.50 (38)	Rotatable	Thru	100884007
3 3/8	1.50 (38)	Rotatable	Tapped	100884010
3 3/8	1.50 (38)	Non-Rotatable	Thru	100884001
3 3/8	1.50 (38)	Non-Rotatable	Tapped	100884004
3 3/8	2.00 (51)	Rotatable	Thru	100884008
3 3/8	2.00 (51)	Rotatable	Tapped	100884011
3 3/8	2.00 (51)	Non-Rotatable	Thru	100884002
3 3/8	2.00 (51)	Non-Rotatable	Tapped	100884005
4 1/2	Blank	Rotatable	Thru	100885008
4 1/2	Blank	Rotatable	Tapped	100885012
4 1/2	Blank	Non-Rotatable	Thru	100885000
4 1/2	Blank	Non-Rotatable	Tapped	100885004
4 1/2	1.50 (38)	Rotatable	Thru	100885009
4 1/2	1.50 (38)	Rotatable	Tapped	100885013
4 1/2	1.50 (38)	Non-Rotatable	Thru	100885001
4 1/2	1.50 (38)	Non-Rotatable	Tapped	100885005
4 1/2	2.00 (51)	Rotatable	Thru	100885010
4 1/2	2.00 (51)	Rotatable	Tapped	100885014
4 1/2	2.00 (51)	Non-Rotatable	Thru	100885002
4 1/2	2.00 (51)	Non-Rotatable	Tapped	100885006
4 1/2	2.50 (64)	Rotatable	Thru	100885011
4 1/2	2.50 (64)	Rotatable	Tapped	100885015
4 1/2	2.50 (64)	Non-Rotatable	Thru	100885003
4 1/2	2.50 (64)	Non-Rotatable	Tapped	100885007
4 5/8	Blank	Rotatable	Thru	100885504
4 5/8	Blank	Rotatable	Tapped	100885506
4 5/8	Blank	Non-Rotatable	Thru	100885500
4 5/8	Blank	Non-Rotatable	Tapped	100885502
4 5/8	3.00 (76)	Rotatable	Thru	100885505
4 5/8	3.00 (76)	Rotatable	Tapped	100885507
4 5/8	3.00 (76)	Non-Rotatable	Thru	100885501
4 5/8	3.00 (76)	Non-Rotatable	Tapped	100885503

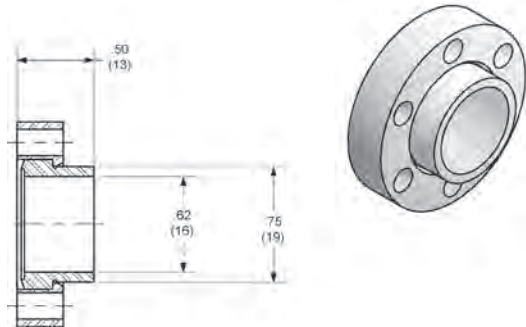


# Ordering Information

Mini 1 1/3" CF Weld Stubs				in/(mm)
For Tubing OD/Wall	Rotatable/ Non-Rotatable	Bolt Holes	Weld Prep	Part Number
Blank	Rotatable	Thru	Yes	100881015
Blank	Rotatable	Tapped	Yes	100881022
Blank	Non-Rotatable	Thru	Yes	100881001
Blank	Non-Rotatable	Tapped	Yes	100881008
.25/.035 (6.4/.89)	Rotatable	Thru	Yes	100881016
.25/.035 (6.4/.89)	Rotatable	Tapped	Yes	100881023
.25/.035 (6.4/.89)	Non-Rotatable	Thru	Yes	100881002
.25/.035 (6.4/.89)	Non-Rotatable	Tapped	Yes	100881009
.50/.035 (12.7/.89)	Rotatable	Thru	Yes	100881017
.50/.035 (12.7/.89)	Rotatable	Tapped	Yes	100881024
.50/.035 (12.7/.89)	Non-Rotatable	Thru	Yes	100881003
.50/.035 (12.7/.89)	Non-Rotatable	Tapped	Yes	100881010
.75/.035 (19.0/.89)	Rotatable	Thru	Yes	100881019
.75/.035 (19.0/.89)	Rotatable	Tapped	Yes	100881026
.75/.035 (19.0/.89)	Non-Rotatable	Thru	Yes	100881005
.75/.035 (19.0/.89)	Non-Rotatable	Tapped	Yes	100881012
.75/.065 (19.0/1.65)	Rotatable	Thru	No	100881020
.75/.065 (19.0/1.65)	Rotatable	Tapped	No	100881027
.75/.065 (19.0/1.65)	Non-Rotatable	Thru	No	100881006
.75/.065 (19.0/1.65)	Non-Rotatable	Tapped	No	100881013



Long Weld Stub with Weld Prep

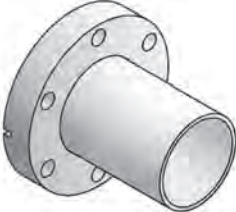
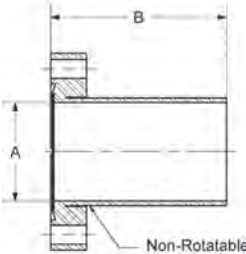


Long Weld Stub without Weld Prep



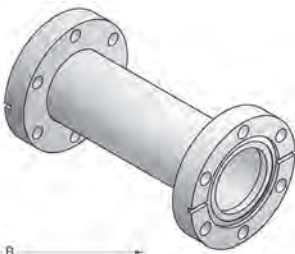
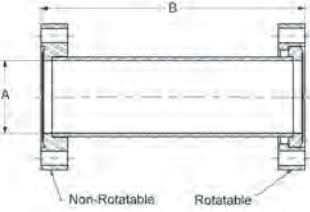
### CF Half Nipple

in./(mm)

  <ul style="list-style-type: none"> <li>• Butt weld</li> <li>• For use with orbital welders</li> <li>• Thru holes</li> </ul>	Flange Size	For Tubing Size (OD)	A	B	Part Number
	1 1/3	.75 (19)	.62 (16)	1.50 (38)	100881046
2 1/8	1.00 (25)	.87 (22)	2.05 (52)	100882040	
2 3/4	1.50 (38)	1.37 (35)	2.43 (62)	100883049	
3 3/8	2.00 (51)	1.87 (47)	3.21 (82)	100884027	
4 1/2	2.50 (64)	2.37 (60)	4.13 (105)	100885032	
4 5/8	3.00 (76)	2.87 (73)	4.93 (125)	100885531	

### CF Full Nipple

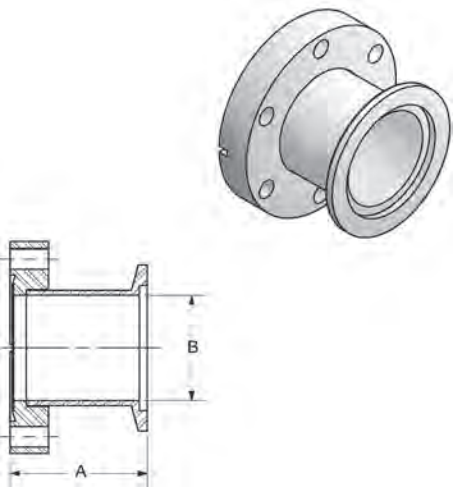
in./(mm)

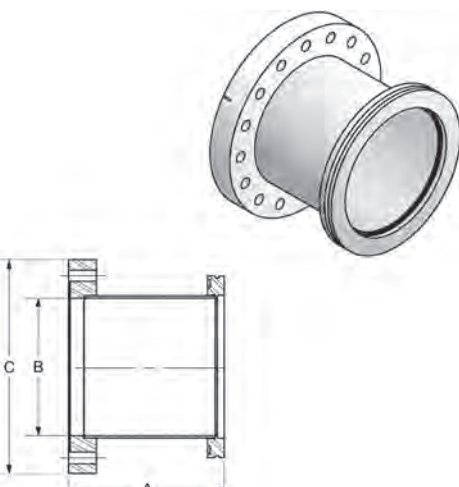
  <ul style="list-style-type: none"> <li>• Special lengths to order</li> <li>• Thru holes</li> </ul> <p>* Includes 12 mesh screen, 1/2" in from rotatable port</p>	Flange Size	For Tubing Size (OD)	A	B	Part Number
	1 1/3	.75 (19)	.62 (16)	3.00 (76)	100881047
2 1/8	1.00 (25)	.87 (22)	4.10 (104)	100882041	
2 3/4	1.50 (38)	1.37 (35)	4.92 (125)	100883050	
2 3/4*	1.50 (38)	1.37 (35)	4.00 (102)	100883069	
3 3/8	2.00 (51)	1.87 (47)	6.42 (163)	100884028	
4 1/2	2.50 (64)	2.37 (60)	8.26 (210)	100885033	
4 5/8	3.00 (76)	2.87 (73)	9.88 (250)	100885532	





# Ordering Information

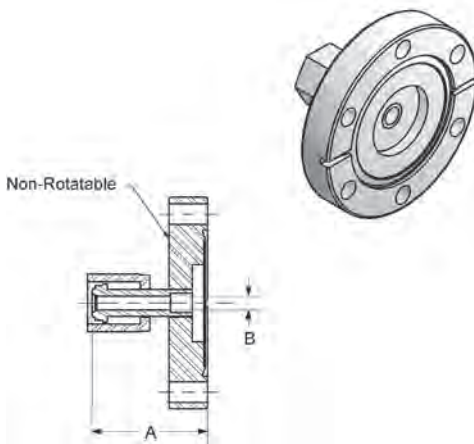
Adapter, ISO-KF to CF					in./(mm)
 <ul style="list-style-type: none"> <li>Stainless steel type 304</li> </ul>	Flange Size (KF)	Flange Size (CF)	A	B	Part Number
	NW 16	Mini 1 1/3	2.08 (53)	0.62 (16)	100315601
	NW 16	2 3/4	1.78 (45)	0.62 (16)	100315611
	NW 25	2 1/8	1.89 (48)	0.87 (22)	100319812
	NW 25	2 3/4	1.78 (45)	0.87 (22)	100315603
	NW 40	2 3/4	1.78 (45)	1.33 (34)	100315605
	NW 50	2 3/4	2.11 (54)	1.37 (35)	100319813
	NW 50	4 1/2	1.95 (50)	1.83 (46)	100315606

Adapter, ISO-MF Flange to CF Flange					in./(mm)
 <ul style="list-style-type: none"> <li>Stainless steel type 304</li> <li>Special adapters available upon request</li> </ul>	Flange Size	A	B	C	Part Number
	NW 63 to 4 1/2" CF	4.33 (110)	2.37 (60)	4.50 (114)	100762206



**Adapter, CF to VCR® Female\***

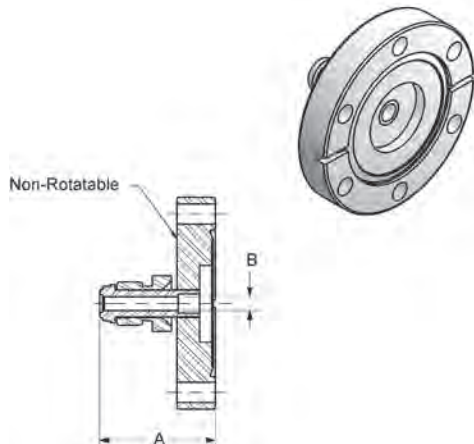
**in./(mm)**

 <p>Non-Rotatable</p>	Flange Size	A	B	VCR Size	Part Number
	1 1/3 to 4 VCR	1.43 (36)	.19 (5)	1/4	100881049
	2 1/8 to 4 VCR	1.50 (38)	.19 (5)	1/4	100882032
	2 1/8 to 8 VCR	1.69 (43)	.41 (10)	1/2	100882033
	2 1/8 to 12 VCR	2.19 (56)	.62 (16)	3/4	100882036
	2 3/4 to 4 VCR	1.50 (38)	.19 (5)	1/4	100883054
	2 3/4 to 8 VCR	1.69 (43)	.41 (10)	1/2	100883057
	2 3/4 to 12 VCR	2.19 (56)	.62 (16)	3/4	100883058
	3 3/8 to 4 VCR	1.80 (46)	.19 (5)	1/4	100884033
	3 3/8 to 8 VCR	1.88 (48)	.41 (10)	1/2	100884035
	3 3/8 to 12 VCR	2.38 (60)	.62 (16)	3/4	100884037

• Thru holes  
• VCR-compatible parts may be used

**Adapter, CF to VCR® Male\***

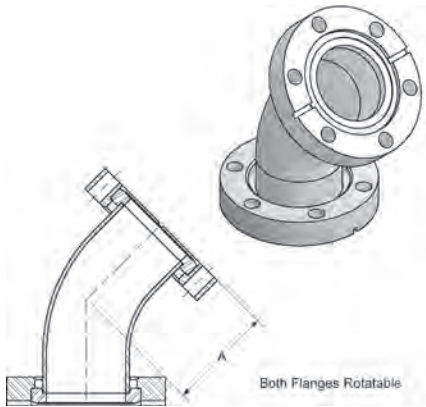
**in./(mm)**

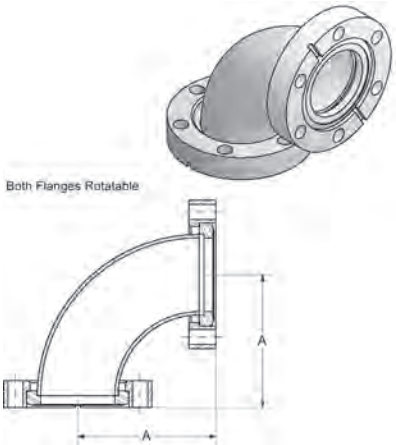
 <p>Non-Rotatable</p>	Flange Size	A	B	VCR Size	Part Number
	1 1/3 to 4 VCR	1.43 (36)	.19 (5)	1/4	100881050
	2 1/8 to 4 VCR	1.50 (38)	.19 (5)	1/4	100882031
	2 1/8 to 8 VCR	1.69 (43)	.41 (10)	1/2	100882034
	2 1/8 to 12 VCR	2.19 (56)	.62 (16)	3/4	100882035
	2 3/4 to 4 VCR	1.50 (38)	.19 (5)	1/4	100883055
	2 3/4 to 8 VCR	1.69 (43)	.41 (10)	1/2	100883056
	2 3/4 to 12 VCR	2.19 (56)	.62 (16)	3/4	100883059
	3 3/8 to 4 VCR	1.80 (46)	.19 (5)	1/4	100884032
	3 3/8 to 8 VCR	1.88 (48)	.41 (10)	1/2	100884034
	3 3/8 to 12 VCR	2.38 (60)	.62 (16)	3/4	100884036

• Thru holes  
• VCR-compatible parts may be used



# Ordering Information

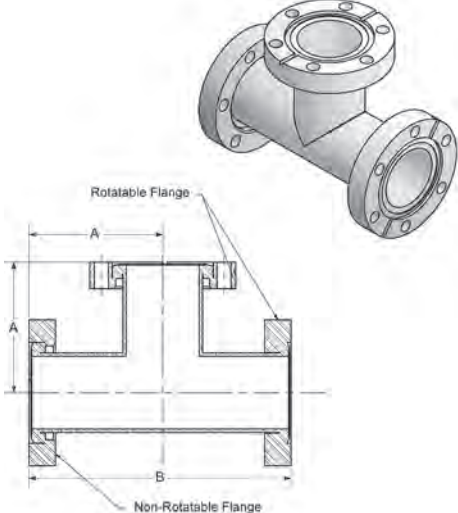
CF Elbow 45° Smooth Radius				in./(mm)
 <p>Both Flanges Rotatable</p> <ul style="list-style-type: none"> <li>Flanges same size on both sides</li> </ul>	Flange Size	For Tubing OD	A	Part Number
	1 1/3	.75 (19)	.81 (21)	100881052
	2 1/8	1.00 (25)	1.35 (34)	100882038
	2 3/4	1.50 (38)	1.82 (46)	100883061
	3 3/8	2.00 (51)	2.53 (64)	100884039
	4 1/2	2.50 (64)	3.37 (86)	100885037
	4 5/8	3.00 (76)	4.05 (103)	100885528

CF Elbow 90° Smooth Radius				in./(mm)
 <p>Both Flanges Rotatable</p> <ul style="list-style-type: none"> <li>Flanges same size on both sides</li> </ul>	Flange Size	For Tubing OD	A	Part Number
	1 1/3	.75 (19)	1.50 (38)	100881030
	2 1/8	1.00 (25)	2.22 (56)	100882039
	2 3/4	1.50 (38)	2.46 (63)	100883030
	3 3/8	2.00 (51)	3.21 (82)	100884014
	4 1/2	2.50 (64)	4.13 (105)	100885018
	4 5/8	3.00 (76)	4.86 (123)	100885529



**CF Tee**

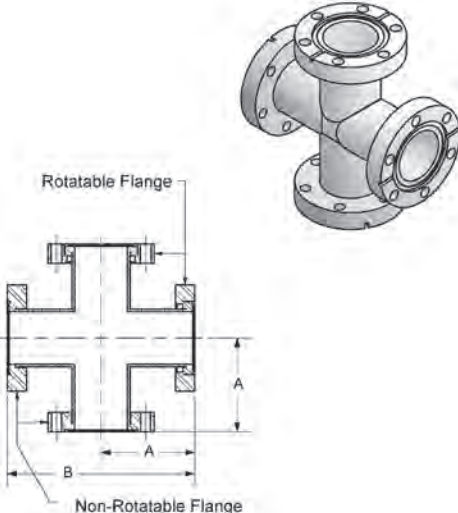
**in./(mm)**

	Flange Size	For Tubing OD	A	B	Part Number
	1 1/3	.75 (19)	1.50 (38)	3.00 (76)	100881028
	2 1/8	1.00 (25)	2.06 (52)	4.12 (105)	100882042
	2 3/4	1.50 (38)	2.46 (63)	4.92 (125)	100883028
	3 3/8	2.00 (51)	3.21 (82)	6.42 (166)	100884012

• Flanges same size on all sides

**CF Cross**

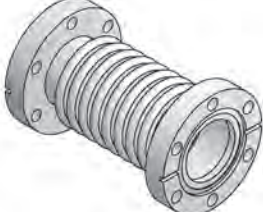
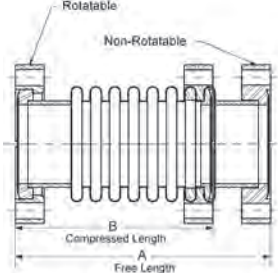
**in./(mm)**

	Flange Size	For Tubing OD	A	B	Part Number
	1 1/3	.75 (19)	1.50 (38)	3.00 (76)	100881029
	2 1/8	1.00 (25)	2.06 (52)	4.12 (105)	100882043
	2 3/4	1.50 (38)	2.46 (63)	4.92 (125)	100883029
	3 3/8	2.00 (51)	3.21 (82)	6.42 (166)	100884013

• Flanges same size on all sides



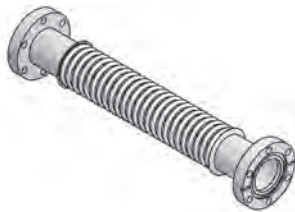
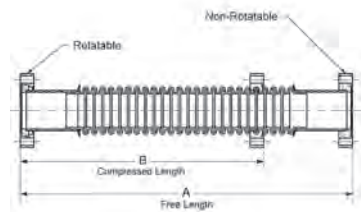
# Ordering Information

Bellows Section						in./(mm)
 	Flange Size	Static Bend Radius	A	B	Spring Rate (lb/in)	Part Number
	1 1/3	3.0 (76)	4.15 (105)	3.80 (97)	70	100881045
	2 1/8	4.0 (102)	3.41 (86)	3.20 (81)	58	100882028
	2 3/4	5.5 (140)	4.15 (105)	3.20 (81)	61	100883047
	3 3/8	8.0 (203)	4.29 (109)	3.20 (81)	58	100884025
<ul style="list-style-type: none"> <li>• Type 321 stainless steel</li> <li>• Flexible coupling for vibrations and alignment</li> <li>• Thru holes</li> </ul>						



## Thin Wall Metal Hose

in./(mm)

 	Flange Size	Static Bend Radius	A	B	Wall Thickness	Spring Rate (lb/in)	Part Number
	<ul style="list-style-type: none"> <li>Type 321 stainless steel</li> <li>Special lengths to order</li> <li>Both ends must be supported for the 4 1/2 and 6 inch sizes</li> </ul>	1 1/3	1.63 (41)	11.3 (287)	7.8 (198)	.006 (.152)	27
	1 1/3	1.63 (41)	21.2 (539)	13.8 (351)	.006 (.152)	12	100881033
	1 1/3	1.63 (41)	40.9 (1039)	25.6 (650)	.006 (.152)	9	100881034
	2 1/8	1.38 (35)	11.3 (287)	7.8 (198)	.006 (.152)	16	100882020
	2 1/8	1.38 (35)	22.1 (561)	14.7 (373)	.006 (.152)	7	100882021
	2 1/8	1.38 (35)	41.8 (1062)	26.5 (673)	.006 (.152)	3	100882022
	2 3/4	2.50 (64)	12.3 (312)	8.7 (221)	.006 (.152)	9	100883032
	2 3/4	2.50 (64)	22.1 (561)	14.1 (358)	.006 (.152)	4	100883033
	2 3/4	2.50 (64)	41.9 (1064)	25.0 (635)	.006 (.152)	2	100883034
	3 3/8	3.25 (83)	13.3 (338)	10.5 (267)	.006 (.152)	13	100884016
	3 3/8	3.25 (83)	23.2 (589)	17.0 (432)	.006 (.152)	6	100884017
	3 3/8	3.25 (83)	42.9 (1090)	29.8 (757)	.006 (.152)	3	100884018
	4 1/2	6.75 (172)	13.8 (351)	9.1 (231)	.006 (.152)	15	100885020
	4 1/2	6.75 (172)	23.7 (602)	16.2 (412)	.006 (.152)	7	100885021
	4 1/2	6.75 (172)	43.4 (1102)	30.3 (770)	.006 (.152)	3	100885022

## Flange Protector Caps

Flange Size	Description	Part Number
1 1/3	Flange protector cap, plastic	100003050
2 1/8	Flange protector cap, plastic	100005285
2 3/4	Flange protector cap, plastic	100003049
3 3/8	Flange protector cap, plastic	100003048



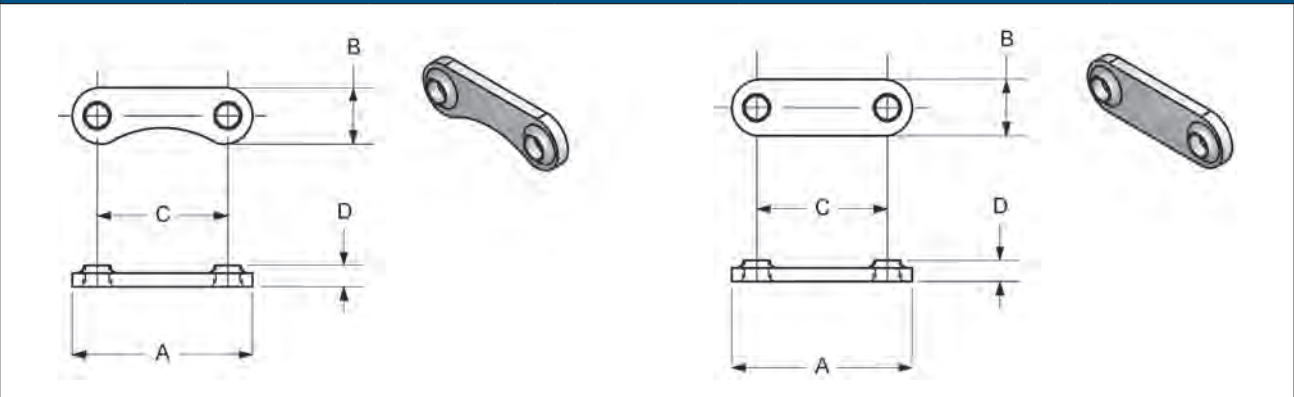
# Ordering Information

CF Hardware			
Flange Size	Description	Quantity	Part Number
1 1/3	Bolt Set, Tapped, 8-32 x 0.56	25	100889029
1 1/3	Bolt Set, Tapped, 8-32 x 0.62	25	100889030
1 1/3	Bolt Set, Tapped, 8-32 x 0.75	25	100889031
1 1/3	Bolt Set, Tapped, 8-32 x 0.50	25	100889032
2 1/8, 2 3/4	Bolt Set, Tapped, 1/4-28 x 1.00	25	100889033
3 3/8, 4 1/2, 4 5/8	Bolt Set, Tapped, 5/16-24 x 1.25	25	100889035
1 1/3	Bolt/Nut Set, Thru, 8-32 x 0.75	25	100889047
1 1/3	Bolt/Nut Set, Thru, 8-32 x 0.87	25	100889147
1 1/3	Bolt/Nut Set, Thru, 8-32 x 0.75, Ag	25	100889048
1 1/3	Bolt/Nut Set, Thru, 8-32 x 0.87, Ag	25	100889148
2 1/8, 2 3/4	Bolt/Nut Set, Thru, 1/4-28 x 1.25	25	100889049
2 1/8, 2 3/4	Bolt/Nut Set, Thru, 1/4-28 x 1.38	25	100889150
3 3/8	Bolt/Nut Set, Thru, 5/16-24 x 1.75	25	100889051
4 1/2	Bolt/Nut Set, Thru, 5/16-24 x 2.00	25	100889053
4 5/8	Bolt/Nut Set, Thru, 5/16-24 x 2.25	25	100889055
1 1/3	Bolt/Nut Set, Double-Sided, 8-32 x 1.25	25	100889123
1 1/3	Bolt/Nut Set, Double-Sided, 8-32 x 1.25, Ag	25	100889124
2 1/8, 2 3/4	Bolt/Nut Set, Double-Sided, 1/4-28 x 1.75	25	100889125
2 3/4	Bolt/Nut Set, Double-Sided, 1/4-28 x 2.00	25	100889126
2 3/4	Bolt/Nut Set, Double-Sided, 1/4-28 x 2.50	25	100889153
3 3/8	Bolt/Nut Set, Double-Sided, 5/16-24 x 2.50	25	100889130
4 1/2	Bolt/Nut Set, Double-Sided, 5/16-24 x 2.75	25	100889127
4 5/8	Bolt/Nut Set, Double-Sided, 5/16-24 x 3.00	25	100889128
1 1/3	Viton Seal, Beveled Edge	5	100889020
2 1/8	Viton Seal, Beveled Edge	5	100889021
2 3/4	Viton Seal, Beveled Edge	5	100889022
3 3/8	Viton Seal, Beveled Edge	5	100889023
4 1/2	Viton Seal, Beveled Edge	5	100889024
4 5/8	Viton Seal, Beveled Edge	5	100889025

CF Hardware			
Flange Size	Description	Quantity	Part Number
1 1/3	Silver-Plated Copper Gasket	1	100889181
2 1/8	Silver-Plated Copper Gasket	1	100889182
2 3/4	Silver-Plated Copper Gasket	1	100889183
3 3/8	Silver-Plated Copper Gasket	1	100889184
4 1/2	Silver-Plated Copper Gasket	1	100889185
4 5/8	Silver-Plated Copper Gasket	1	100889186
1 1/3	Copper Gasket, Etched, Individually Sealed	10	100889103
2 1/8	Copper Gasket, Etched, Individually Sealed	10	100889104
2 3/4	Copper Gasket, Etched, Individually Sealed	10	100889105
3 3/8	Copper Gasket, Etched, Individually Sealed	10	100889106
4 1/2	Copper Gasket, Etched, Individually Sealed	10	100889107
4 5/8	Copper Gasket, Etched, Individually Sealed	10	100889108



## Plate Nut Sets



### Plate Nut (24 per package)

Flange Size	Thread Size	A	B	C	D	Part Number
1 1/3	8-32	.80"	.30"	.53"	.15"	100889071
2 3/4	1/4-28	1.41"	.50"	1.16"	.18"	100889072
3 3/8	5/16-24	1.75"	.50"	1.09"	.22"	100889073
4 1/2	5/16-24	2.03"	.50"	1.39"	.22"	100889074

### Plate Nut and Bolt Sets

Flange Size	Description	Part Number
1 1/3	Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 8-32 x 0.75	100889077
2 3/4	Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 1/4-28 x 1.25	100889079
3 3/8	Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24 x 1.75	100889081
4 1/2	Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24 x 2.00	100889083

### Plate Nut and Dodecagon (12 pt) Silver Plated Bolt Sets

Flange Size	Description	Part Number
1 1/3	Dodecagon Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 8-32 x 0.75	100889090
2 3/4	Dodecagon Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 1/4-28 x 1.25	100889092
3 3/8	Dodecagon Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24 x 1.75	100889094
4 1/2	Dodecagon Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24 x 2.00	100889096

### Dodecagon (12 pt) Bolts with Nuts and Washers\*

Flange Size	Description	Part Number
2 1/8, 2 3/4	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Tapped, 1/4-28 x 1.00	100889042
2 1/8, 2 3/4	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Thru, 1/4-28 x 1.25	100889062
2 1/8, 2 3/4	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Thru, 1/4-28 x 1.38	100889151
3 3/8, 4 1/2, 4 5/8	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Tapped, 5/16-24 x 1.25	100889044
4 1/2	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Thru, 5/16-24 x 2.00	100889066
3 3/8	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Thru, 5/16-24 x 1.75	100889064
4 5/8	Dodecagon Bolt/Nut/Washer Set, Silver Plated, Thru, 5/16-24 x 2.25	100889068

\* Note: There are 25 bolts, nuts, and washers per package.





# Numerical Listing

100003048	Flange Protector Cap, 3 3/8"	100881049	Adapter, 1 1/3" to 4 VCR-F
100003049	Flange Protector Cap, 2 3/4"	100881050	Adapter, 1 1/3" to 4 VCR-M
100003050	Flange Protector Cap, 1 1/3"		
100005285	Flange Protector Cap, 2 1/8"	100881052	45° Elbow, 1 1/3"
100315601	Adapter, ISO-KF to CF, NW 16 to 1-1/3" CF	100882000	Flange, 2 1/8", Blank, Nonrotatable, Thru
100315603	Adapter, ISO-KF to CF, NW 25 to 2-3/4" CF	100882001	Flange, 2 1/8", 0.25", Nonrotatable, Thru
100315605	Adapter, ISO-KF to CF, NW 40 to 2-3/4" CF	100882002	Flange, 2 1/8", 0.50", Nonrotatable, Thru
100315606	Adapter, ISO-KF to CF, NW 50 to 4-1/2" CF	100882003	Flange, 2 1/8", 0.75", Nonrotatable, Thru
100315611	Adapter, ISO-KF to CF, NW 16 to 2-3/4" CF	100882004	Flange, 2 1/8", 1.00", Nonrotatable, Thru
100319812	Adapter, ISO-KF to CF, NW 25 to 2 1/8" CF	100882005	Flange, 2 1/8", Blank, Nonrotatable, Tapped
100319813	Adapter, ISO-KF to CF, NW 50 to 2 3/4" CF	100882006	Flange, 2 1/8", 0.25", Nonrotatable, Tapped
		100882007	Flange, 2 1/8", 0.50", Nonrotatable, Tapped
		100882008	Flange, 2 1/8", 0.75", Nonrotatable, Tapped
100762206	Adapter, MF to CF, NW 63 to 4.5" CF	100882009	Flange, 2 1/8", 1.00", Nonrotatable, Tapped
		100882010	Flange, 2 1/8", Blank, Rotatable, Thru
		100882011	Flange, 2 1/8", 0.25", Rotatable, Thru
100881000	Flange, 1 1/3", Blank, Nonrotatable	100882012	Flange, 2 1/8", 0.50", Rotatable, Thru
100881001	Weld Stub, 1 1/3", w/ wp, Blank, Nonrotatable, Thru	100882013	Flange, 2 1/8", 0.75", Rotatable, Thru
100881002	Weld Stub, 1 1/3", w/ wp, .25", Nonrotatable, Thru	100882014	Flange, 2 1/8", 1.00", Rotatable, Thru
100881003	Weld Stub, 1 1/3", w/ wp, .50", Nonrotatable, Thru	100882015	Flange, 2 1/8", Blank, Rotatable, Tapped
100881004	Flange, 1 1/3", 0.75", Nonrotatable, Thru	100882016	Flange, 2 1/8", 0.25", Rotatable, Tapped
100881005	Weld Stub, 1 1/3", w/ wp, .75", Nonrotatable, Thru	100882017	Flange, 2 1/8", 0.50", Rotatable, Tapped
100881006	Weld Stub, 1 1/3", w/o wp, .75", Nonrotatable, Thru	100882018	Flange, 2 1/8", 0.75", Rotatable, Tapped
100881007	Flange, 1 1/3", Blank, Nonrotatable, Tapped	100882019	Flange, 2 1/8", 1.00", Rotatable, Tapped
100881008	Weld Stub, 1 1/3", w/ wp, Blank, Nonrotatable, Tapped		
100881009	Weld Stub, 1 1/3", w/ wp, .25", Nonrotatable, Tapped	100882020	Thin Wall Metal Hose, 1.38", 2 1/8"
100881010	Weld Stub, 1 1/3", w/ wp, .50", Nonrotatable, Tapped	100882021	Thin Wall Metal Hose, 1.38", 2 1/8"
100881011	Flange, 1 1/3", 0.75", Nonrotatable, Tapped	100882022	Thin Wall Metal Hose, 1.38", 2 1/8"
100881012	Weld Stub, 1 1/3", w/ wp, .75", Nonrotatable, Tapped		
100881013	Weld Stub, 1 1/3", w/o wp, .75", Nonrotatable, Tapped	100882028	Bellows Section, 2 1/8"
100881014	Flange, 1 1/3", Blank, Rotatable, Thru	100882031	Adapter, 2 1/8" to 4 VCR-M
100881015	Weld Stub, 1 1/3", w/ wp, Blank, Rotatable, Thru	100882032	Adapter, 2 1/8" to 4 VCR-F
100881016	Weld Stub, 1 1/3", w/ wp, .25", Rotatable, Thru	100882033	Adapter, 2 1/8" to 8 VCR-F
100881017	Weld Stub, 1 1/3", w/ wp, .50", Rotatable, Thru	100882034	Adapter, 2 1/8" to 8 VCR-M
100881018	Flange, 1 1/3", 0.75", Rotatable, Thru	100882035	Adapter, 2 1/8" to 12 VCR-M
100881019	Weld Stub, 1 1/3", w/ wp, .75", Rotatable, Thru	100882036	Adapter, 2 1/8" to 12 VCR-F
100881020	Weld Stub, 1 1/3", w/o wp, .75", Rotatable, Thru		
100881021	Flange, 1 1/3", Blank, Rotatable, Tapped	100882038	45° Elbow, 2 1/8"
100881022	Weld Stub, 1 1/3", w/ wp, Blank, Rotatable, Tapped	100882039	90° Elbow, 2 1/8"
100881023	Weld Stub, 1 1/3", w/ wp, .25", Rotatable, Tapped		
100881024	Weld Stub, 1 1/3", w/ wp, .50", Rotatable, Tapped	100882040	Half Nipple, 2 1/8", 1.00"
100881025	Flange, 1 1/3", 0.75", Rotatable, Tapped	100882041	Full Nipple, 2 1/8", 1.00"
100881026	Weld Stub, 1 1/3", w/ wp, .75", Rotatable, Tapped		
100881027	Weld Stub, 1 1/3", w/o wp, .75", Rotatable, Tapped	100882042	Tee, 2 1/8"
		100882043	Cross, 2 1/8"
100881028	Tee, 1 1/3"		
100881029	Cross, 1 1/3"		
100881030	90° Elbow, 1 1/3"		
100881032	Thin Wall Metal Hose, 1.63", 1 1/3"	100883000	Flange, 2 3/4", Blank, Nonrotatable, Thru
100881033	Thin Wall Metal Hose, 1.63", 1 1/3"	100883001	Flange, 2 3/4", 0.25", Nonrotatable, Thru
100881034	Thin Wall Metal Hose, 1.63", 1 1/3"	100883002	Flange, 2 3/4", 0.50", Nonrotatable, Thru
		100883003	Flange, 2 3/4", 0.75", Nonrotatable, Thru
		100883004	Flange, 2 3/4", 1.00", Nonrotatable, Thru
		100883005	Flange, 2 3/4", 1.25", Nonrotatable, Thru
		100883006	Flange, 2 3/4", 1.50", Nonrotatable, Thru
		100883007	Flange, 2 3/4", Blank, Nonrotatable, Tapped
		100883008	Flange, 2 3/4", 0.25", Nonrotatable, Tapped
100881045	Bellows Section, 1 1/3"	100883009	Flange, 2 3/4", 0.50", Nonrotatable, Tapped
100881046	Half Nipple, 1 1/3", .75"	100883010	Flange, 2 3/4", 0.75", Nonrotatable, Tapped
100881047	Full Nipple, 1 1/3", 0.75"	100883011	Flange, 2 3/4", 1.00", Nonrotatable, Tapped
		100883012	Flange, 2 3/4", 1.25", Nonrotatable, Tapped
		100883013	Flange, 2 3/4", 1.50", Nonrotatable, Tapped



100883014	Flange, 2 3/4", Blank, Rotatable, Thru	100884012	Tee, 3 3/8"
100883015	Flange, 2 3/4", 0.25", Rotatable, Thru	100884013	Cross, 3 3/8"
100883016	Flange, 2 3/4", 0.50", Rotatable, Thru	100884014	90° Elbow, 3 3/8"
100883017	Flange, 2 3/4", 0.75", Rotatable, Thru		
100883018	Flange, 2 3/4", 1.00", Rotatable, Thru	100884016	Thin Wall Metal Hose, 3.25", 3 3/8"
100883019	Flange, 2 3/4", 1.25", Rotatable, Thru	100884017	Thin Wall Metal Hose, 3.25", 3 3/8"
100883020	Flange, 2 3/4", 1.50", Rotatable, Thru	100884018	Thin Wall Metal Hose, 3.25", 3 3/8"
100883021	Flange, 2 3/4", Blank, Rotatable, Tapped		
100883022	Flange, 2 3/4", 0.25", Rotatable, Tapped	100884025	Bellows Section, 3 3/8"
100883023	Flange, 2 3/4", 0.50", Rotatable, Tapped		
100883024	Flange, 2 3/4", 0.75", Rotatable, Tapped	100884027	Half Nipple, 3 3/8", 2.00"
100883025	Flange, 2 3/4", 1.00", Rotatable, Tapped	100884028	Full Nipple, 3 3/8", 2.00"
100883026	Flange, 2 3/4", 1.25", Rotatable, Tapped		
100883027	Flange, 2 3/4", 1.50", Rotatable, Tapped	100884032	Adapter, 3 3/8" to 4 VCR-M
		100884033	Adapter, 3 3/8" to 4 VCR-F
100883028	Tee, 2 3/4"	100884034	Adapter, 3 3/8" to 8 VCR-M
100883029	Cross, 2 3/4"	100884035	Adapter, 3 3/8" to 8 VCR-F
100883030	90° Elbow, 2 3/4"	100884036	Adapter, 3 3/8" to 12 VCR-M
		100884037	Adapter, 3 3/8" to 12 VCR-F
100883032	Thin Wall Metal Hose, 2.50", 2 3/4"	100884039	45° Elbow, 3 3/8"
100883033	Thin Wall Metal Hose, 2.50", 2 3/4"		
100883034	Thin Wall Metal Hose, 2.50", 2 3/4"	100885000	Flange, 4 1/2", Blank, Nonrotatable, Thru
		100885001	Flange, 4 1/2", 1.50", Nonrotatable, Thru
100883047	Bellows Section, 2 3/4"	100885002	Flange, 4 1/2", 2.00", Nonrotatable, Thru
		100885003	Flange, 4 1/2", 2.50", Nonrotatable, Thru
100883049	Half Nipple, 2 3/4", 1.50"	100885004	Flange, 4 1/2", Blank, Nonrotatable, Tapped
100883050	Full Nipple, 2 3/4", 1.50"	100885005	Flange, 4 1/2", 1.50", Nonrotatable, Tapped
		100885006	Flange, 4 1/2", 2.00", Nonrotatable, Tapped
100883054	Adapter, 2 3/4" to 4 VCR-F	100885007	Flange, 4 1/2", 2.50", Nonrotatable, Tapped
100883055	Adapter, 2 3/4" to 4 VCR-M	100885008	Flange, 4 1/2", Blank, Rotatable, Thru
100883056	Adapter, 2 3/4" to 8 VCR-M	100885009	Flange, 4 1/2", 1.50", Rotatable, Thru
100883057	Adapter, 2 3/4" to 8 VCR-F	100885010	Flange, 4 1/2", 2.00", Rotatable, Thru
100883058	Adapter, 2 3/4" to 12 VCR-F	100885011	Flange, 4 1/2", 2.50", Rotatable, Thru
100883059	Adapter, 2 3/4" to 12 VCR-M	100885012	Flange, 4 1/2", Blank, Rotatable, Tapped
		100885013	Flange, 4 1/2", 1.50", Rotatable, Tapped
100883061	45° Elbow, 2 3/4"	100885014	Flange, 4 1/2", 2.00", Rotatable, Tapped
		100885015	Flange, 4 1/2", 2.50", Rotatable, Tapped
100883064	Flange, 2 3/4", 1.75", Nonrotatable, Thru	100885018	90° Elbow, 4 1/2"
100883065	Flange, 2 3/4", 1.75", Rotatable, Thru		
100883066	Flange, 2 3/4", 1.75", Nonrotatable, Tapped	100885020	Thin Wall Metal Hose, 6.75", 4 1/2"
100883067	Flange, 2 3/4", 1.75", Rotatable, Tapped	100885021	Thin Wall Metal Hose, 6.75", 4 1/2"
		100885022	Thin Wall Metal Hose, 6.75", 4 1/2"
100883069	Full Nipple w/ Screen, 2 3/4", 1.50"		
		100885032	Half Nipple, 4 1/2", 2.50"
100884000	Flange, 3 3/8", Blank, Nonrotatable, Thru	100885033	Full Nipple, 4 1/2", 2.50"
100884001	Flange, 3 3/8", 1.50", Nonrotatable, Thru		
100884002	Flange, 3 3/8", 2.00", Nonrotatable, Thru	100885037	45° Elbow, 4 1/2"
100884003	Flange, 3 3/8", Blank, Nonrotatable, Tapped		
100884004	Flange, 3 3/8", 1.50", Nonrotatable, Tapped	100885500	Flange, 4 5/8", Blank, Nonrotatable, Thru
100884005	Flange, 3 3/8", 2.00", Nonrotatable, Tapped	100885501	Flange, 4 5/8", 3.00", Nonrotatable, Thru
100884006	Flange, 3 3/8", Blank, Rotatable, Thru	100885502	Flange, 4 5/8", Blank, Nonrotatable, Tapped
		100885503	Flange, 4 5/8", 3.00", Nonrotatable, Tapped
100884007	Flange, 3 3/8", 1.50", Rotatable, Thru	100885504	Flange, 4 5/8", Blank, Rotatable, Thru
100884008	Flange, 3 3/8", 2.00", Rotatable, Thru	100885505	Flange, 4 5/8", 3.00", Rotatable, Thru
100884009	Flange, 3 3/8", Blank, Rotatable, Tapped	100885506	Flange, 4 5/8", Blank, Rotatable, Tapped
100884010	Flange, 3 3/8", 1.50", Rotatable, Tapped	100885507	Flange, 4 5/8", 3.00", Rotatable, Tapped
100884011	Flange, 3 3/8", 2.00", Rotatable, Tapped		



# Numerical Listing

100885528	45° Elbow, 4 5/8"	100889077	Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 8-32x0.75, 1 1/3"
100885529	90° Elbow, 4 5/8"	100889079	Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 1/4-28x1.25, 2 3/4"
100885531	Half Nipple, 4 5/8", 3.00"	100889081	Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24x1.75, 3 3/8"
100885532	Full Nipple 4 5/8", 3.00"	100889083	Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24x2.00, 4 1/2"
100889020	Viton Seal, Beveled Edge (5), 1 1/3"	100889090	Dodecagon Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 8-32x0.75, 1 1/3"
100889021	Viton Seal, Beveled Edge (5), 2 1/8"	100889092	Dodecagon Plate Nut/Bolt Set: 12 Plate Nuts, 24 Bolts/Washers, 1/4-28x1.25, 2 3/4"
100889022	Viton Seal, Beveled Edge (5), 2 3/4"	100889094	Dodecagon Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24x1.75, 3 3/8"
100889023	Viton Seal, Beveled Edge (5), 3 3/8"	100889096	Dodecagon Plate Nut/Bolt Set: 16 Plate Nuts, 32 Bolts/Washers, 5/16-24x2.00, 4 1/2"
100889024	Viton Seal, Beveled Edge (5), 4 1/2"	100889103	Copper Gasket, Etched, 1 1/3"
100889025	Viton Seal, Beveled Edge (5), 4 5/8"	100889104	Copper Gasket, Etched, 2 1/8"
100889029	Bolt Set, Tapped, 8-32x0.56, 1 1/3"	100889105	Copper Gasket, Etched, 2 3/4"
100889030	Bolt Set, Tapped, 8-32x0.62, 1 1/3"	100889106	Copper Gasket, Etched, 3 3/8"
100889031	Bolt Set, Tapped, 8-32x0.75, 1 1/3"	100889107	Copper Gasket, Etched, 4 1/2"
100889032	Bolt Set, Tapped, 8-32x0.50, 1 1/3"	100889108	Copper Gasket, Etched, 4 5/8"
100889033	Bolt Set, Tapped, 1/4-28x1.00, 2 1/8", 2 3/4"	100889123	Bolt/Nut Set, Double-Sided, 8-32x1.25, 1 1/3"
100889035	Bolt Set, Tapped, 5/16-24x1.25, 3 3/8", 4 1/2", 4 5/8"	100889124	Bolt/Nut Set, Double-Sided, 8-32x1.25, 1 1/3"
100889042	Dodecagon Bolt/Nut/Washer Set, Tapped, 1/4-28x1.00, 2 1/8", 2 3/4"	100889125	Bolt/Nut Set, Double-Sided, 1/4-28x1.75, 2 1/8", 2 3/4"
100889044	Dodecagon Bolt/Nut/Washer Set, Tapped, 5/16-24x1.75, 3 3/8", 4 1/2", 4 5/8"	100889126	Bolt/Nut Set, Double-Sided, 1/4-28x2.00, 2 3/4"
100889047	Bolt/Nut Set, Thru, 8-32x0.75, 1 1/3"	100889127	Bolt/Nut Set, Double-Sided, 5/16-24x2.75, 4 1/2"
100889048	Bolt/Nut Set, Thru, 8-32x0.75, 1 1/3"	100889128	Bolt/Nut Set, Double-Sided, 5/16-24x3.00, 4 5/8"
100889049	Bolt/Nut Set, Thru, 1/4-28x1.25, 2 1/8", 2 3/4"	100889130	Bolt/Nut Set, Double-Sided, 5/16-24x2.50, 3 3/8"
100889051	Bolt/Nut Set, Thru, 5/16-24x1.75, 3 3/8"	100889147	Bolt/Nut Set, Thru, 8-32x0.87, 1 1/3"
100889053	Bolt/Nut Set, Thru, 5/16-24x 2.00, 4 1/2"	100889148	Bolt/Nut Set, Thru, 8-32x0.87, 1 1/3"
100889055	Bolt/Nut Set, Thru, 5/16-24x2.25, 4 5/8"	100889150	Bolt/Nut Set, Thru, 1/4-28x1.38, 2 1/8", 2 3/4"
100889062	Dodecagon Bolt/Nut/Washer Set, Thru, 1/4-28x1.25, 2 1/8", 2 3/4"	100889151	Dodecagon Bolt/Nut/Washer Set, Thru, 1/4-28x1.38, 2 1/8", 2 3/4"
100889064	Dodecagon Bolt/Nut/Washer Set, Thru, 5/16-24x1.75, 3 3/8"	100889153	Bolt/Nut Set, Double-Sided, 1/4-28x2.50, 2 3/4"
100889066	Dodecagon Bolt/Nut/Washer Set, Thru, 5/16-24x2.00, 4 1/2"	100889181	Silver-Plated Copper Gasket (1), 1 1/3"
100889068	Dodecagon Bolt/Nut/Washer Set, Thru, 5/16-24x2.25, 4 5/8"	100889182	Silver-Plated Copper Gasket (1), 2 1/8"
100889071	Plate Nut Set, 8-32, 1 1/3"	100889183	Silver-Plated Copper Gasket (1), 2 3/4"
100889072	Plate Nut Set, 1/4-28, 2 3/4"	100889184	Silver-Plated Copper Gasket (1), 3 3/8"
100889073	Plate Nut Set, 5/16-24, 3 3/8"	100889185	Silver-Plated Copper Gasket (1), 4 1/2"
100889074	Plate Nut Set, 5/16-24, 4 1/2"	100889186	Silver-Plated Copper Gasket (1), 4 5/8"





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