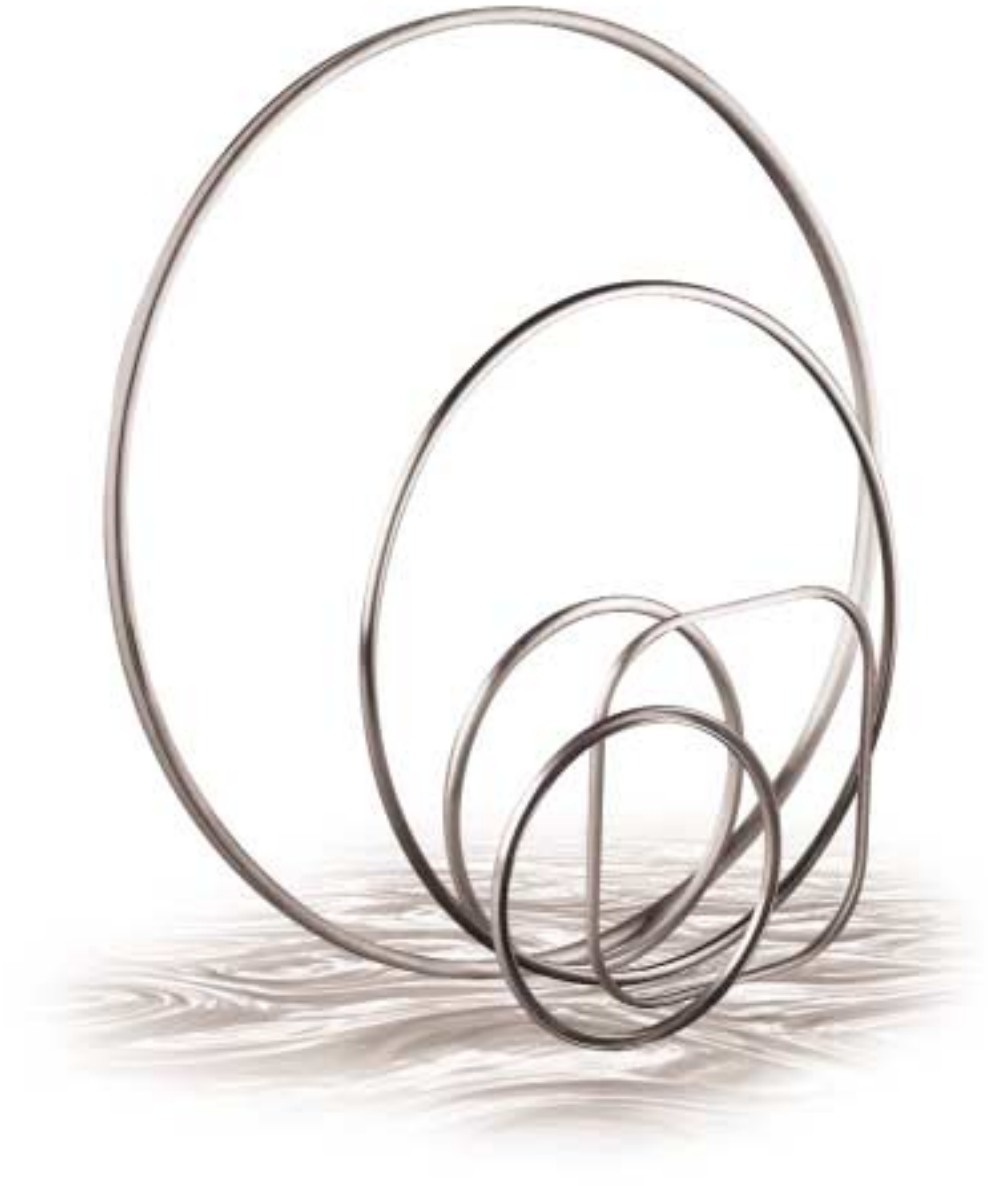
METAL C-RINGS



Garlock Helicoflex

High Performance Seals and Sealing Systems

GENERAL INFORMATION

Garlock Helicoflex Metal C-Rings are designed to provide a high sealing level under adverse working conditions whether the medium is gas or liquid.

SEALING CONCEPT

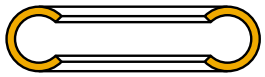
The sealing concept of Metal C-Rings is based on the elastic deformation of a metal "C" substrate which, during the compression cycle, gives a contact point on each sealing surface.
The substrate characteristics determine the compressive load of the seal. This load combined with an accurate compression rate results in a specific pressure which is directly related to the sealing level obtained. A certain specific pressure is necessary to make the seal flow into the flange imperfections. A softer surface treatment is available to increase the plasticity of the seal and reduce the specific pressure necessary to reach the desired sealing level.
Metal C-Rings require a controlled compression by some mechanical method such as a custom machined groove or a limiter of appropriate thickness.

GENERAL CHARACTERISTICS

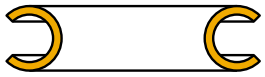
- Wide range of applications:
  - Dimensional: Diameters from 0.126 inches (3.20 mm) to 13.500 inches (343 mm)
    Cross sections from 0.032 inches (0.8 mm) to 0.250 inches (6.4 mm)
  - Temperature: Cryogenic to over 1400°F (760°)
  - Pressure: High Vacuum to 60000 PSI (4100 bar)
- Excellent springback
- Suited to different types of assemblies:
  - Internal Pressure
  - External Pressure
  - Axial Pressure
- Extended shelf life
- Excellent resistance to corrosion and radiation
- Minimum relaxation

For Additional Information, Please Consult Our Engineering Staff
1-800-233-1722

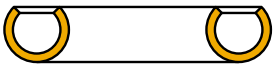
SEAL TYPES



INTERNAL PRESSURE



EXTERNAL PRESSURE



AXIAL PRESSURE

The seal opening should always face the system pressure to fully maximize the self energizing effect.

MATERIAL SELECTION

Temperature and media to be sealed determine the type of C-Ring material

MATERIAL	AVAILABILITY	TEMPERATURE
Stainless Steel	Optional	Cryogenic to 700 °F (371 °C)
Alloy 600	Optional	Cryogenic to 1000 °F (538 °C)
Alloy X-750	Standard	Cryogenic to 1400 °F (760 °C)
Alloy 718	Standard	Cryogenic to 1400 °F (760 °C)
Consult our engineering staff	Optional	Greater than 1400 °F (760 °C)

Consult our engineering staff for other available materials.
Since tensile strength and resilience of the seal are determined in part by metal temper, Garlock Helicoflex offers a choice of heat treatment (age hardening or annealing) according to AMS, MIL, ASTM or customer specification.

PLATING/COATING

Different coatings or platings are available to provide better plasticity which yields and conforms to the microscopic groove or flange irregularities.
The recommended surface treatments are :

PLATING/ COATING	THICKNESS	GROOVE FINISH	TEMPERATURE LIMITS
Teflon®	0.001/0.003 (0.03/0.08mm)	16-32 RMS (0.4-0.8 Ra µm)	cryogenic to 500 °F (260 °C)
	0.003/0.004 (0.08/0.10mm)		
Silver	0.001/0.002 (0.03/0.05mm)	16-63 RMS (0.4-1.6 Ra µm)	cryogenic to 1200 °F (649 °C)
	0.002/0.003 (0.05/0.08mm)		
Nickel	0.001/0.002 (0.03/0.05mm)	16-32 RMS (0.4-0.8 Ra µm)	cryogenic to 2200 °F (1204 °C)
None	N/A	<16 RMS (<0.4 Ra µm)	N/A

Consult our engineering staff for other available platings/coatings.

Y2 : Ideal Compressive Load
e2 : Ideal Compression

Load characteristics change with wall thickness and material. We have selected thicknesses : Thin(T) and Heavy(H). The linear compressive load also depends on the material and the diameter of the seal. If we consider Y2* as the linear load for X-750 and Km as material factor and Kd as diameter factor, the linear load Y2, under e2 will be :

Y2 = Km x Kd x Y2*

CS (Cross Section) = Tube Diameter

STANDARD WALL

Cross Section C.S.		WALL THICKNESS			
		Thin		Heavy	
in	mm	in	mm	in	mm
0.032	0.8	0.008	0.20	N/A	N/A
0.063	1.6	0.008	0.20	0.010	0.25
0.094	2.4	0.010	0.25	0.015	0.38
0.125	3.2	0.015	0.38	0.020	0.51
0.157	4.0	0.015	0.38	0.025	0.64
0.188	4.8	0.020	0.51	*	*
0.250	6.4	0.025	0.64	*	*

Y2* VALUES

Cross Section C.S.		Compression e2				Seating Load Y2*			
		Radial		Axial		Thin		Heavy	
in	mm	in	mm	in	mm	lb/in	DaN/cm	lb/in	DaN/cm
0.032	0.8	0.006	0.15	0.002	0.04	125	22	N/A	N/A
0.063	1.6	0.012	0.30	0.003	0.08	85	15	260	45
0.094	2.4	0.020	0.50	0.005	0.12	140	24	400	70
0.125	3.2	0.026	0.65	0.006	0.16	240	42	570	100
0.157	4.0	0.032	0.80	0.008	0.20	200	35	600	105
0.188	4.8	0.039	1.00	0.009	0.24	260	45	800	140
0.250	6.4	0.051	1.30	0.013	0.32	315	55	*	*

Km VALUES

MATERIAL	Km
X750	1.0
Alloy 718	1.15

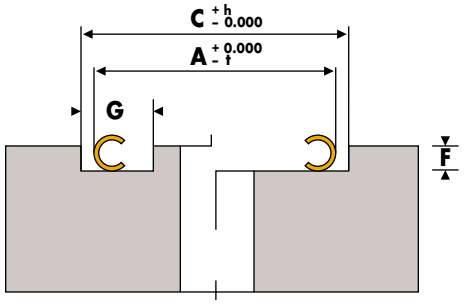
Kd VALUES

Diameter													
	from:	0.0″	0	0.75″	19	1.2″	30	2″	50	3″	75	6″	150	10″	250
	to:	0.75″	19	1.2″	30	2.0″	50	3″	75	6″	150	10″	250	18″	450
Kd Value		1.4		1.3		1.2		1.1		1.0		0.9		0.8	

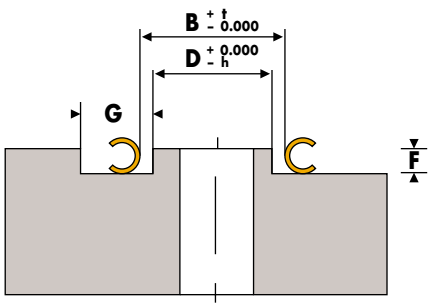
*Consult our engineering staff for other materials.

Dimensions in inches | Dimensions in mm

RADIAL PRESSURE SEAL



INTERNAL PRESSURE



EXTERNAL PRESSURE

SEAL		GROOVE		
Cross Section C.S.	Seal Diameter Range	Clearance* CL	Groove Depth F	Minimum Groove Width G
0.032	0.250 to 1.000	0.010	0.025/0.027†	0.040
0.063	0.375 to 8.000	0.010	0.049/0.051	0.075
0.094	0.500 to 13.500	0.010	0.072/0.076	0.105
0.125	1.000 to 13.500	0.010	0.097/0.103	0.135
0.157	2.000 to 13.500	0.010	0.123/0.129	0.170
0.188	3.000 to 13.500	0.010	0.148/0.154	0.200
0.250	4.000 to 13.500	0.010	0.196/0.204	0.260
0.8	3.2 to 25.4	0.25	0.64/0.69†	1.02
1.6	9.5 to 203.2	0.25	1.24/1.30	1.91
2.4	12.7 to 406.4	0.25	1.83/1.93	2.67
3.2	25.4 to 635.0	0.25	2.46/2.62	3.43
4.0	50.8 to 635.0	0.25	3.12/3.28	4.32
4.8	76.2 to 635.0	0.25	3.76/3.91	5.08
6.4	101.6 to 635.0	0.25	4.98/5.18	6.60

TOLERANCE		
Diameter	Seal Tolerance t	Groove Tolerance h
0.126 to 1.000	0.002	0.002
1.001 to 2.000	0.002	0.003
2.001 to 3.000	0.003	0.003
3.001 to 5.000	0.004	0.004
5.001 to 7.000	0.006	0.006
7.001 to 13.500	0.010	0.008
3.20 to 25.4	0.05	0.05
25.42 to 50.80	0.05	0.08
50.83 to 76.20	0.08	0.08
76.23 to 127.00	0.10	0.10
127.03 to 177.80	0.15	0.15
177.83 to 406.40	0.25	0.20

* Between Seal Diameter and Groove Diameter (does not include plating thickness)

† For CS=0.032 (0.8mm) only, the Groove Depth must be increased to allow for plating thickness.

Dimensions in inches
Dimensions in mm

Note: Consult our engineering staff for other available sizes.

EXAMPLE CALCULATIONS

Internal Pressure: Groove OD (C) = Seal OD (A) + Clearance (CL) + [Maximum plating thickness X 2]

Example: Seal OD = $3.625\ ^{+0.000}_{-0.004}$, CS = 0.094, Silver plated 0.001/0.002

Groove OD = 3.625 + 0.010 + [0.002 X 2] = $3.639\ ^{+0.004}_{-0.000}$, Depth = 0.072/0.076

External Pressure: Groove ID (D) = Seal ID (B) - Clearance (CL) - [Maximum plating thickness X 2]

Example: Seal ID = $4.500\ ^{+0.004}_{-0.000}$, CS = 0.125, Teflon® Coated 0.001/0.003

Groove ID = 4.500 - 0.010 - [0.003 X 2] = $4.484\ ^{+0.000}_{-0.004}$, Depth = 0.097/0.103

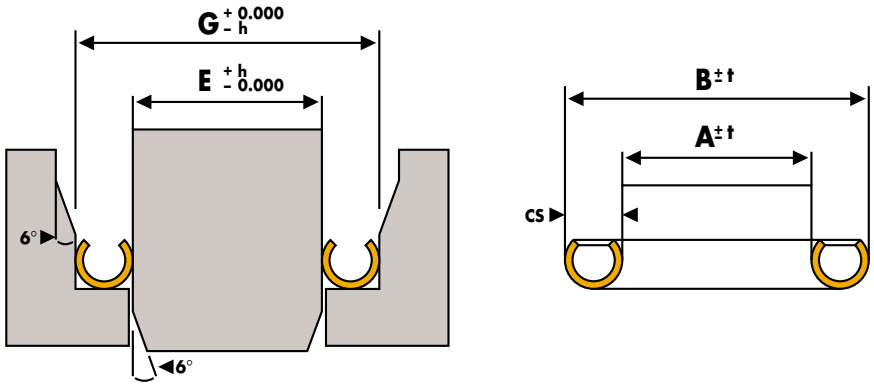
Axial Pressure: See next page for cavity design information.

Example: Seal OD (B) = 2.500 ± 0.001, Seal ID (A) = 2.312 ± 0.001, CS = 0.094, Ag plated 0.001/0.002

Cavity OD (G) = Seal OD (B) - 0.005 = $2.495\ ^{+0.000}_{-0.001}$

Cavity ID (E) = Seal ID (A) +0.005 = $2.317\ ^{+0.001}_{-0.000}$

AXIAL PRESSURE SEAL



Axial C-Rings are primarily used for static applications.
Consult our engineering staff for dynamic applications involving slight movement.

SEAL			CAVITY DESIGN		
Cross Section C.S.	Seal Diameter Range	Seal Tolerance t	Cavity OD G	Cavity ID E	Cavity Tolerance h
0.032	0.250 to 1.000	0.001	B - 0.002	A+0.002	0.001
0.063	0.375 to 1.500	0.001	B - 0.003	A+0.003	0.001
0.094	0.625 to 3.500	0.001	B - 0.005	A+0.005	0.001
0.125	0.750 to 6.000	0.001	B - 0.006	A+0.006	0.001
0.157	2.000 to 8.000	0.002	B - 0.008	A+0.008	0.002
0.188	3.000 to 10.000	0.002	B - 0.009	A+0.009	0.002
0.250	4.000 to 10.000	0.002	B - 0.013	A+0.013	0.002
0.8	4.80 to 25.4	0.03	B - 0.05	A+0.05	0.03
1.6	6.35 to 38.1	0.03	B - 0.08	A+0.08	0.03
2.4	7.90 to 88.9	0.03	B - 0.12	A+0.12	0.03
3.2	15.90 to 152.4	0.03	B - 0.16	A+0.16	0.03
4.0	50.80 to 203.2	0.05	B - 0.20	A+0.20	0.05
4.8	76.20 to 254.0	0.05	B - 0.24	A+0.24	0.05
6.4	101.60 to 254.0	0.05	B - 0.32	A+0.32	0.05

Dimensions in inches
Dimensions in mm

Note: Consult our engineering staff for other available sizes
Cavity Surface Finish: Seal contact areas should have a ≤16 RMS (0.4 Ra µm) Finish.

BFGoodrich

Garlock Helicoflex
PO Box 9889
2770 The Boulevard
Columbia, SC 29290 USA
Phone: 1-803-783-1880
Toll Free: 1-800-233-1722
Fax: 1-803-783-4279
www.helicoflex.com
www.garlock.net

Cefilac, S.A.
90 rue de la Roche-du-Geai
42029 Saint-Etienne, FRANCE
Phone: 011-33-4-77-43-51-00
Fax: 011-33-4-77-43-51-52

Garlock Sealing Technologies

Palmyra, NY, USA	1-315-597-4811	Fax: 1-315-597-3216
Paragould, AR, USA	1-870-239-4051	Fax: 1-870-239-4054
Houston, TX USA	1-281-459-7200	Fax: 1-281-458-0502
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Seoul, Korea	822-554-6341	Fax: 822-554-6343
Mexico City, Mexico	52-5-567-7011	Fax: 52-5-368-0418
Singapore	65-284-7873	Fax: 65-284-6089