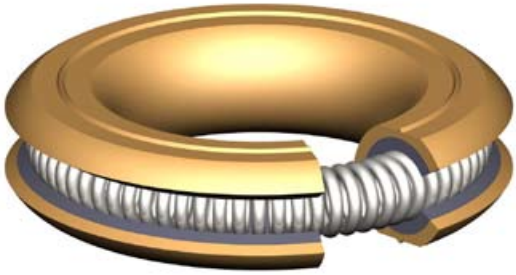
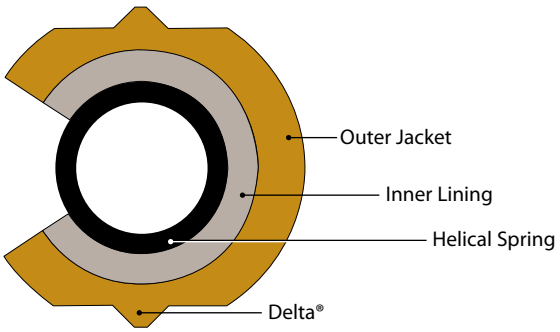
Sealing Concept

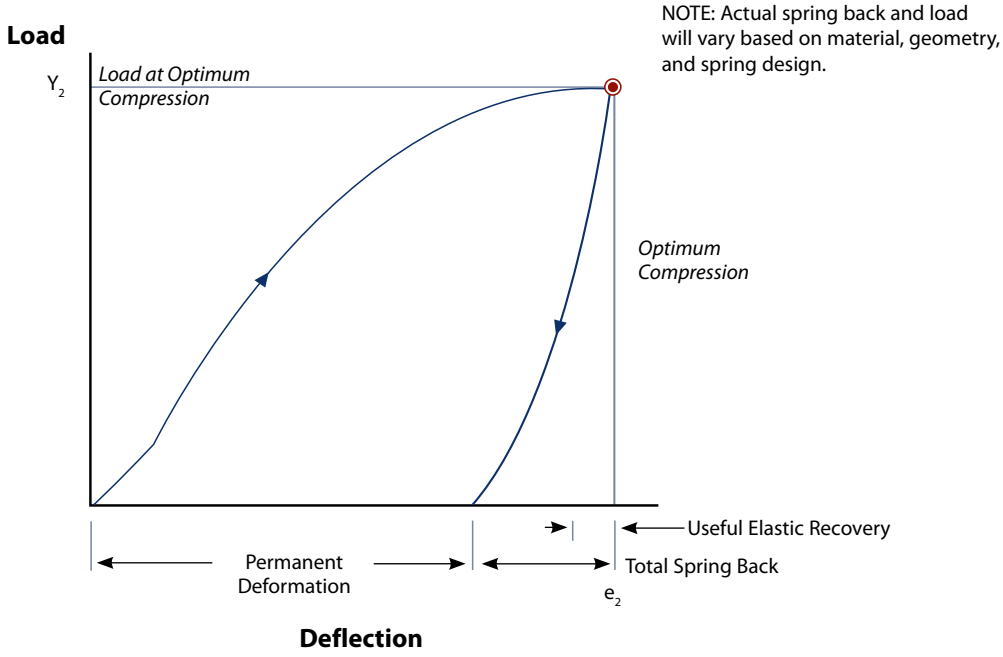


The Delta® seal is a member of the Helicoflex family of spring energized seals. The sealing principle of the Helicoflex family of seals is based upon the plastic deformation of a jacket that has greater ductility than the flange materials. This occurs between the sealing face of a flange and an elastic core composed of a close-wound helical spring. The spring is selected to have a specific compression resistance. During compression, the resulting specific pressure forces the jacket to yield and ensures positive contact with the flange sealing faces. Each coil of the helical spring acts independently and allows the seal to conform to irregularities on the flange surface.

The Delta® seal is unique in that it uses two small ridges or "Deltas" on the face of the seal. The load required to plastically deform the jacket material is greatly reduced by concentrating the compression load on the Deltas. The resulting high contact stress in the seal track makes the Delta seal an excellent choice for ultra-high vacuum applications that require ultra-low Helium leak rates. There is typically no risk of damaging the flange sealing surfaces as long as the minimum hardness requirements are maintained.



Typical Load Deflection Curve



Leak Performance

Delta seals can provide Helium leak rate performance of < 1x10-11 std.cc/sec (per meter of seal circumference). Actual leak rate will depend on seal jacket, cavity/flange finish, bolting, hardware robustness and cleanliness level.

Classification of Seal Type

Cross Section Type	HNV low load (Delta Seal)									
Jacket/ Lining	1 = jacket only					2 = jacket with inner lining				
Jacket Orientation	0	1	2	3	4	5	6	7	8	9
Section Orientation	0	1	2	3	4	5	6	7	8	9

Example

HNV	2	0	0
Cross Section Type	# Jackets/ Lining	Jacket Orientation	Section Orientation

Delta® Characteristic Values

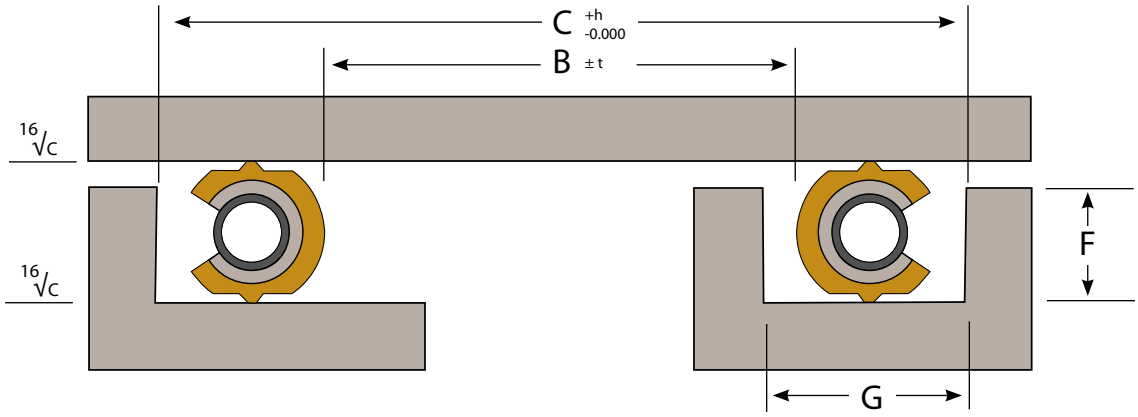
Jacket Material	Free Height	Seal Type	Installation Compression e_2	Seal Diameter	Seating Load PCI Y2	Maximum Temperature °F	°C
Aluminum	0.075	HNV100	Contact Applications Engineering				
	0.102	HNV200	0.028	0.750 to 8.000	800	428	220
	0.130	HNV200	0.031	1.000 to 16.000	800	482	250
	0.157	HNV200	0.035	2.000 to 20.000	800	536	280
	0.189	HNV200	0.035	3.000 to 30.000	800	536	280
	0.220	HNV200	0.039	4.000 to 40.000	860	608	320
	0.264	HNV200	0.043	5.000 to 50.000	860	644	340
Silver	0.067	HNV100	Contact Applications Engineering				
	0.094	HNV200	0.024	0.750 to 6.000	915	536	280
	0.122	HNV200	0.024	1.000 to 12.000	915	572	300
	0.154	HNV200	0.028	2.000 to 18.000	915	662	350
	0.185	HNV200	0.031	3.000 to 20.000	915	698	370
	0.213	HNV200	0.031	4.000 to 20.000	970	752	400
	0.256	HNV200	0.035	5.000 to 20.000	1030	842	450
Copper	0.065	HNV100	Contact Applications Engineering				
	0.092	HNV200	0.017	0.750 to 8.000	1030	716	380
	0.120	HNV200	0.021	1.000 to 16.000	1030	716	380
	0.155	HNV200	0.025	2.000 to 18.000	1030	788	420
	0.179	HNV200	0.025	3.000 to 20.000	1030	842	450
	0.210	HNV200	0.025	4.000 to 30.000	1030	896	480
	0.250	HNV200	0.029	5.000 to 30.000	1085	968	520
Nickel (Annealed)	0.065	HNV100	Contact Applications Engineering				
	0.092	HNV200	0.017	0.750 to 8.000	1030	788	420
	0.120	HNV200	0.021	1.000 to 16.000	1030	896	480
	0.155	HNV200	0.025	2.000 to 18.000	1030	1022	550
	0.179	HNV200	0.025	3.000 to 20.000	1030	1112	600
	0.210	HNV200	0.025	4.000 to 30.000	1030	1202	650
	0.250	HNV200	0.029	5.000 to 30.000	1085	1202	650
Stainless Steel	Contact Applications Engineering						

Dimensions in inches

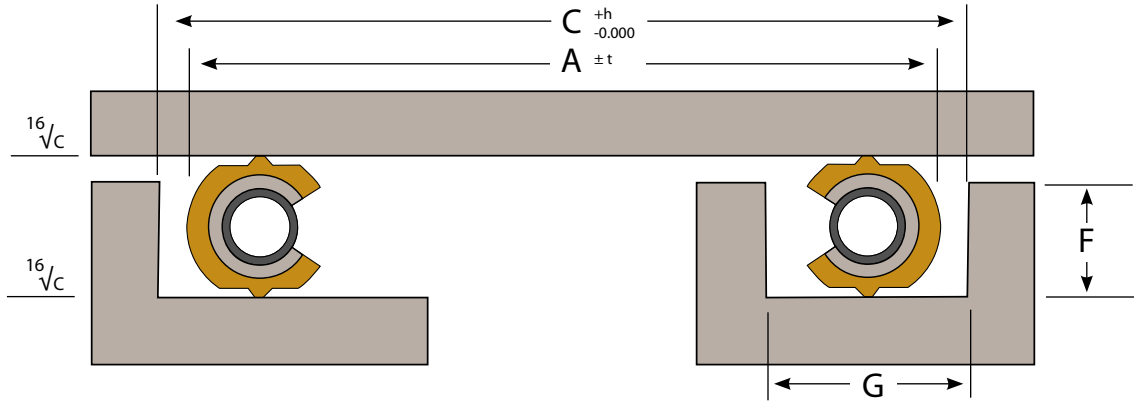
NOTES:

1. PCI = Pounds force per circumferential inch.
2. Seating load (Y_2) is an approximation and may vary based on groove clearance, seal diameter and tolerance. Seating load is for circular seals only.
3. The customer must verify that system bolts and flanges can generate the required seating load without warping or distorting.
4. The customer must test and verify that the seal design meets customer designated performance requirements.
5. Seal type HNV100 is available as an option only. Type HNV200 is preferred due to its protective inner lining and can be expected to produce better results.
6. Contact Applications Engineering for low pressure applications.

Internal Vacuum: Seal Type HNV200



External Vacuum: Seal Type HNV220



Seal and Groove Sizing Calcuations

The equations below can be used for basic groove calculations. Applications that have significant thermal expansion may require additional clearance. Please contact Applications Engineering for design assistance.

Determining Seal Diameter:

Internal Vacuum	External Vacuum
< 12″ B = C - X - 2 (Seal Section x 0.933)	A = C - X
≥ 12″ Contact Applications Engineering	

Determining Groove Diameter:

Internal Vacuum	External Vacuum
< 12″ C = B + X + 2 (Seal Section x 0.933)	C = A + X
≥ 12″ Contact Applications Engineering	

Tolerancing: See chart

Where: A = Seal Outer Diameter
B = Seal Inner Diameter
C = Groove Outer Diameter
X = Diametrical Clearance

Delta® Groove Dimensions

Seal						Groove					
Jacket Material	Free Height	Seal Section	Seal Type	Seal Diameter Range	Seal Tolerance t^3	Diametical Clearance x	Seating Load PCI Y_2	Groove Tolerance h	Groove Depth F	Groove Width G (Min)	Min. Flange Hardness (Vickers)
Aluminum	0.075	0.079	HNV100	-	-	Contact Applications Engineering					
	0.102	0.106	HNV200	0.750 to 8.000	0.005	0.020	800	0.010	0.075 ± 0.002	0.150	65
	0.130	0.134	HNV200	1.000 to 16.000	0.005	0.030	800	0.010	0.099 ± 0.002	0.180	65
	0.157	0.161	HNV200	2.000 to 20.000	0.005	0.030	800	0.010	0.122 ± 0.002	0.210	65
	0.189	0.193	HNV200	3.000 to 30.000	0.005	0.035	800	0.010	0.154 ± 0.003	0.245	65
	0.220	0.228	HNV200	4.000 to 30.000	0.005	0.040	860	0.010	0.180 ± 0.003	0.280	65
	0.264	0.272	HNV200	5.000 to 30.000	0.005	0.040	860	0.010	0.220 ± 0.003	0.320	65
Silver	0.067	0.071	HNV100	-	-	Contact Applications Engineering					
	0.094	0.098	HNV200	0.750 to 6.000	0.005	0.020	915	0.010	0.070 ± 0.002	0.140	120
	0.122	0.126	HNV200	1.000 to 12.000	0.005	0.020	915	0.010	0.098 ± 0.002	0.165	120
	0.154	0.157	HNV200	2.000 to 18.000	0.005	0.025	915	0.010	0.126 ± 0.002	0.200	120
	0.185	0.189	HNV200	3.000 to 20.000	0.005	0.030	915	0.010	0.154 ± 0.003	0.235	120
	0.213	0.220	HNV200	4.000 to 20.000	0.005	0.030	970	0.010	0.180 ± 0.003	0.265	120
	0.256	0.264	HNV200	5.000 to 20.000	0.005	0.035	1030	0.010	0.220 ± 0.003	0.315	120
Copper	0.065	0.069	HNV100	-	-	Contact Applications Engineering					
	0.092	0.096	HNV200	0.750 to 8.000	0.005	0.020	1030	0.010	0.075 ± 0.001	0.130	130
	0.120	0.124	HNV200	1.000 to 16.000	0.005	0.020	1030	0.010	0.098 ± 0.002	0.160	130
	0.155	0.159	HNV200	2.000 to 18.000	0.005	0.025	1030	0.010	0.130 ± 0.002	0.200	130
	0.179	0.183	HNV200	3.000 too 20.000	0.005	0.025	1030	0.010	0.154 ± 0.002	0.225	130
	0.210	0.218	HNV200	4.000 to 30.000	0.005	0.025	1030	0.010	0.185 ± 0.002	0.255	130
	0.250	0.257	HNV200	5.000 to 30.000	0.005	0.030	1085	0.010	0.220 ± 0.003	0.300	130
Nickel (Annealed)	0.065	0.069	HNV100	-	-	Contact Applications Engineering					
	0.092	0.096	HNV200	0.750 to 8.000	0.005	0.020	1030	0.010	0.075 ± 0.001	0.130	220
	0.120	0.124	HNV200	1.000 to 16.000	0.005	0.020	1030	0.010	0.098 ± 0.002	0.160	220
	0.155	0.159	HNV200	2.000 to 18.000	0.005	0.025	1030	0.010	0.130 ± 0.003	0.200	220
	0.179	0.183	HNV200	3.000 to 20.000	0.005	0.025	1030	0.010	0.154 ± 0.002	0.225	220
	0.210	0.218	HNV200	4.000 to 30.000	0.005	0.025	1030	0.010	0.185 ± 0.002	0.255	220
	0.250	0.257	HNV200	5.000 to 30.000	0.005	0.030	1085	0.010	0.220 ± 0.003	0.300	220
Stainless Steel	Contact Applications Engineering					Contact Applications Engineering					

NOTES:

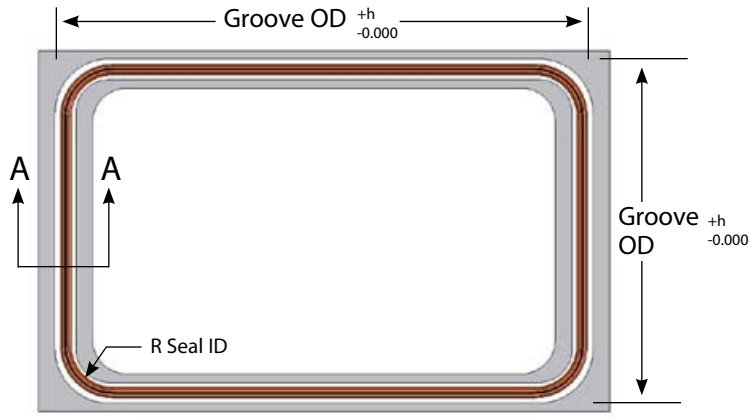
1. Contact Applications Engineering for additional sizes.
2. Seal type HNV100 is available as an option only. Type HNV200 is preferred due to its protective inner lining and can be expected to produce better results.
3. Seal diameters ≥ 12" may require special tolerancing. Contact Applications Engineering for design assistance.

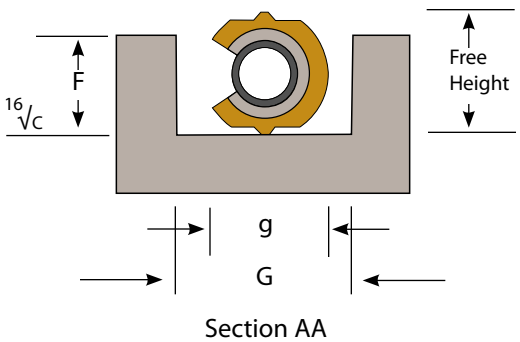
Shaped Seal: Delta® Groove Dimensions

Seal								Groove			
Jacket Material	Free Height	Seal Section g	Seal Type	Installation Compression e_2	Seating Load PCI Y_2	Seal Tolerance t	Bend Radius ID R (Min)	Groove Tolerance h	Groove Depth F	Groove Width G (Min)	Min. Flange Hardness (Vickers)
Aluminum	0.075	0.079	HNV100	Contact Applications Engineering				Contact Applications Engineering			
	0.102	0.106	HNV200	0.028	1200	Fit Template	0.750	0.010	0.075 ± 0.002	0.170	65
	0.130	0.134	HNV200	0.031	1050	Fit Template	1.000	0.010	0.099 ± 0.002	0.200	65
	0.157	0.161	HNV200	0.035	1050	Fit Template	1.125	0.010	0.122 ± 0.002	0.230	65
	0.189	0.194	HNV200	0.035	1050	Fit Template	1.375	0.010	0.154 ± 0.003	0.265	65
	0.220	0.228	HNV200	0.039	1170	Fit Template	1.500	0.010	0.180 ± 0.003	0.300	65
	0.264	0.272	HNV200	0.043	1200	Fit Template	1.750	0.010	0.220 ± 0.003	0.340	65
Silver	0.067	0.071	HNV100	Contact Applications Engineering				Contact Applications Engineering			
	0.094	0.098	HNV200	0.024	1050	Fit Template	0.625	0.010	0.070 ± 0.002	0.160	120
	0.122	0.126	HNV200	0.024	1150	Fit Template	0.875	0.010	0.098 ± 0.002	0.185	120
	0.154	0.157	HNV200	0.028	1100	Fit Template	1.000	0.010	0.126 ± 0.002	0.220	120
	0.185	0.189	HNV200	0.031	1100	Fit Template	1.250	0.010	0.154 ± 0.003	0.225	120
Copper	0.065	0.069	HNV100	Contact Applications Engineering				Contact Applications Engineering			
	0.092	0.096	HNV200	0.017	1100	Fit Template	0.625	0.010	0.075 ± 0.001	0.150	130
	0.120	0.124	HNV200	0.021	1350	Fit Template	0.875	0.010	0.098 ± 0.002	0.180	130
	0.155	0.159	HNV200	0.025	1275	Fit Template	1.000	0.010	0.130 ± 0.002	0.220	130
	0.179	0.183	HNV200	0.025	1275	Fit Template	1.125	0.010	0.154 ± 0.002	0.245	130
Nickel (Annealed)	0.065	0.069	HNV100	Contact Applications Engineering				Contact Applications Engineering			
	0.092	0.096	HNV200	0.017	1100	Fit Template	0.625	0.010	0.075 ± 0.001	0.150	220
	0.120	0.124	HNV200	0.021	1350	Fit Template	0.875	0.010	0.098 ± 0.002	0.180	220
	0.155	0.159	HNV200	0.025	1275	Fit Template	1.000	0.010	0.130 ± 0.003	0.220	220
	0.179	0.183	HNV200	0.025	1275	Fit Template	1.125	0.010	0.154 ± 0.002	0.245	220
Stainless Steel	Contact Applications Engineering										

NOTES:

1. PCI = Pounds force per circumferential inch.
2. Seating Load (Y_2) is an approximation and may vary based on groove clearance, seal diameter and tolerance. Load values may be slightly higher in corner radii.
3. Seal type HNV100 is available as an option only. Type HNV200 is preferred due to its protective inner lining and can be expected to produce better results.
4. Seal Tolerance: Seal is manufactured to fit customer supplied/purchased groove template.
5. All machining and polishing marks must follow seal circumference.





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