
NUCLEAR APPLICATIONS



Helicoflex

A division of Garlock Sealing Technologies

High Performance Seals and Sealing Systems

GENERAL INFORMATION

Garlock Helicoflex is a worldwide leader of manufacturing high performance metal seals in the nuclear industry. In addition to the nuclear industry, Garlock Helicoflex also services the Aerospace, Semi-conductor, Petrochemical, and Chemical Processing industries.

There are two principle styles of seals that Garlock Helicoflex manufactures for the nuclear industry: Helicoflex Metallic O-Ring and the Helicoflex Spring Energized Seal.

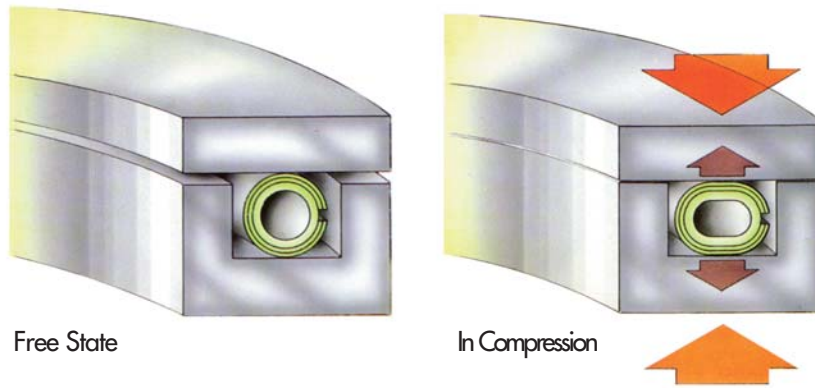
HELICOFLEX METALLIC O-RING

The first style, or seal design, is the Helicoflex Metallic O-Ring, which is manufactured of Alloy 718 or 304 Stainless Steel. Alloy 718 is the most common and preferred material of the O-Ring as compared to 304 SS because it offers optimum strength, springback and its resistance to radiation and corrosion. Both Alloy 718 and Type 304 SS O-Rings are plated with pure (99.95%) silver which is the actual sealing medium that deforms to the groove sealing surfaces.

HELICOFLEX SPRING-ENERGIZED SEAL

The Helicoflex Spring-Energized Seal is a high performance, flexible, metal seal. It has exceptional compression and elastic recovery properties, which approach those of elastomer seals while retaining the qualities demanded in an all-metal seal. The Helicoflex Seal is composed of a close-wound helical spring surrounded by two metal jackets. The inner jacket serves the purpose of transferring the resiliency of the helical spring to the outer jacket uniformly. The design of the Helicoflex Spring Energized Seal relies upon the elastic deformation of the outer jacket, which has greater ductility than that of the groove sealing surfaces. The outer jacket is composed of pure (99.95%) silver. The Helicoflex design does not depend upon the internal pressure from the reactor vessel to support the inside walls of the seal and therefore the inside diameter of the seal is not open to the radioactive steam and water as compared to Metal O-Rings.





GENERAL CHARACTERISTICS

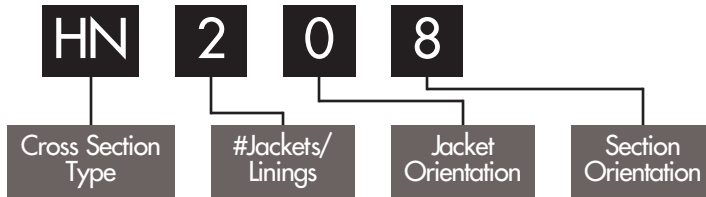
- Wide range of applications:
 - Dimensional: Diameters from 0.250 inches (6.3 mm) to over 300 inches (7.6 m)
Cross sections from 0.063 inches (1.6 mm) to over 0.625 inches (15.9 mm)
 - Temperature: Cryogenic to 1800°F (982°C)
 - Pressure: Ultra High Vacuum to 50,000 PSI (100,000 PSI under special conditions)
- Excellent springback: the spring energized Helicoflex is capable of compensating for flange distortions due to temperature and pressure cycling.
- Adaptable to a majority of standard flanges: ANSI, ISO, KF, ASA
- Suited to different types of assemblies:
 - metal/metal with groove
 - flat flanges with limiter/retainer
 - 3 face contact
- Extended shelf life
- Excellent resistance to corrosion and radiation
- Minimum relaxation: the Helicoflex's resilient spring compensates for relaxation ensuring positive seal contact.

Leading the Industry in Research & Development

Garlock Helicoflex, in conjunction with Garlock Sealing Technologies, Cefilac S.A. and the French Atomic Energy Commission, maintains state of the art seal testing facilities. Our testing equipment and capabilities include:

- Helium Leak Testing
- High Temperature Testing (over 2000°F)
- Cycle Testing (over 100K cycles)
- Cryogenic Shock Tests (-452°F)
- Hot Blow Out Test Version 2 (HOBT2)
- Scanning Electron Microscopy
- High Pressure Testing (>28,000 psi)
- Longevity / Life Cycle Testing
- Long Term Relaxation Test Bench
- Room Temperature Tightness (ROTT)
- Aged-Relaxation-Leakage & Adhesion (ARLA)
- Fire Safety (API 607)

CLASSIFICATION OF SEAL TYPE

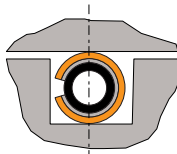


CONFIGURATION GUIDE

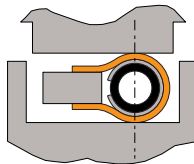
Cross Section Type	HN	single section								
	HNR	ground spring for precise load control (Beta Spring)								
	HNV	low load (Delta Seal)								
	HND	tandem Helicoflex seals								
	HNDE	tandem Helicoflex and elastomer seals note: "L" indicates internal limiter (ex: HLDE)								
Jacket/Lining	1 = 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

TYPICAL CONFIGURATIONS

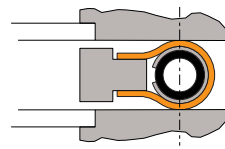
HN200
Groove assemblies



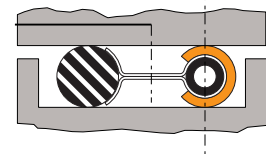
HN203
Tongue & groove



HN208
Raised face flanges - ANSI B16.5



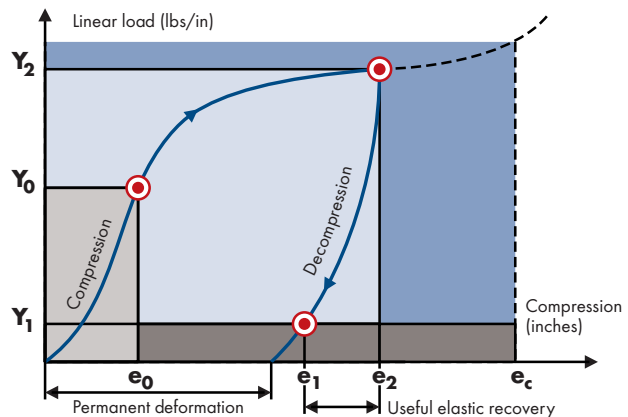
HNDE290
Leak check - inert gas purge



CHARACTERISTIC CURVE

DEFINITION OF TERMS

- Y_0 = load on the compression curve above which leak rate is at required level
- Y_2 = load required to reach optimum compression e_2
- Y_1 = load on the decompression curve below which leak rate exceeds required level
- e_2 = optimum compression
- e_c = Compression limit beyond which there is risk of damaging the spring



SEAL DIMENSIONS FOR METALLIC O-RINGS

The three most common tube diameters (C.S.) used for pressure vessels as shown below with the recommended relationship of tube diameter and wall thickness to the O-Ring diameter. Other tube diameters are also available for other nuclear applications; contact the factory for specific information.

ALLOY 718 O-RING & HN200: LOAD / DEFLECTION / SPRINGBACK

SEAL DIMENSIONS AND LOAD CHARACTERISTICS										HN200						
Compression Rate	.375"CS X .038 wall Diameter up to 180" Linear Load 2500 lb/in		9.5 X 0.95 up to 4.5m 450 DaN/cm		.500"CS X .050 wall Diameter 120" and up Linear Load 2500 lb/in		12.7 X 1.27 3m and up 450 DaN/cm		.625"CS X .063 wall Diameter 120" and up Linear Load 4000 lb/in		15.9 X 1.60 3m and up 700 DaN/cm		HN200 .520" CS Linear Load 3990 lb/in			
	Deflection in mm		Min. Springback in mm		Deflection in mm		Min. Springback in mm		Deflection in mm		Min. Springback in mm		Deflection in mm		Min. Springback in mm	
08%	0.030"	0.76	0.009"	0.23	0.040"	1.02	0.015	0.33	0.050"	1.27	0.017"	0.43	NA	—	NA	—
10%	0.037"	0.94	0.009"	0.23	0.050"	1.27	0.015	0.33	0.062"	1.57	0.017"	0.43	0.052"	1.32	0.017"	0.43
12%	0.045"	1.14	0.009"	0.23	0.060"	1.52	0.015	0.33	0.075"	1.91	0.017"	0.43	NA	—	NA	—
*16%	0.060"	1.52	0.009"	0.23	0.080"	2.03	0.015	0.33	0.100"	2.54	0.017"	0.43	NA	—	NA	—
17%	0.064"	1.63	0.009"	0.23	0.085"	2.16	0.015	0.33	0.106"	2.69	0.017"	0.43	NA	—	NA	—

Dimensions in inches | Dimensions in mm

RETAINER CLIPS INFORMATION

Two types of retainer clips are available. The first type is the clip that penetrates the slots in tubular type O-Rings. The second type is the bent retainer clip that holds the seal to the outer circumference of the groove. This second type clip can be used on both the HN200 style seal and Tubular O-Rings. Since second type does not penetrate the rings, the seal or ring may be installed without regard to the position of the slots. Contact your factory representative for conversion information for your reactor.

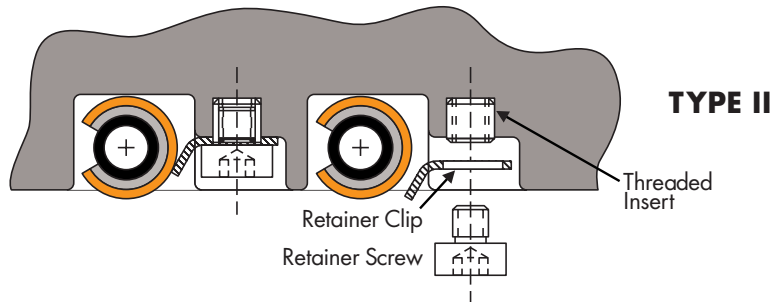
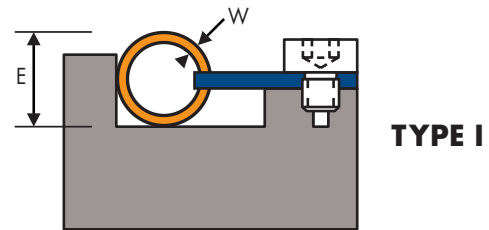
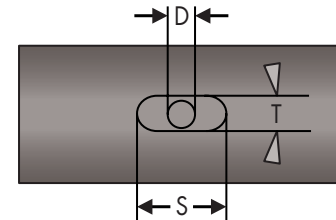
SLOT DIMENSIONS

E	0.375"	9.5	0.500"	12.7	0.625"	15.9
W	0.038"	1.0	0.050"	1.3	0.063"	1.6
S	0.281"	7.0	0.375"	9.5	0.438"	11.1
T	0.125"	3.2	0.205"	5.2	0.256"	6.5
D	0.070"	1.8	0.093"	2.4	0.125"	3.2

O-RING DIAMETER

NO. OF SLOTS

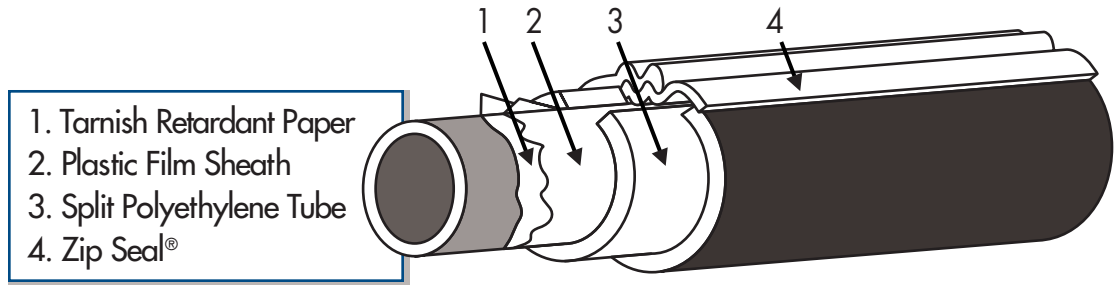
up to 72"	up to 1.8m	4
72" to 144"	1.8 to 3.6m	8
144" to 200"	3.6 to 5m	12
200" and up	5m and up	16 or 24



ZIP-SEAL®

Garlock Helicoflex developed Zip-Seal® Packaging to prevent scratches and other handling risks during transportation and unpacking. ALARA-minded Zip-Seal Packaging also serves to reduce radiation exposure time during unpacking and installation. All nuclear seals are packaged to prevent any damage during shipment. Additional special packaging is provided for overseas shipments.

Zip-Seal® Packaging Saves 50% Man REM Hours



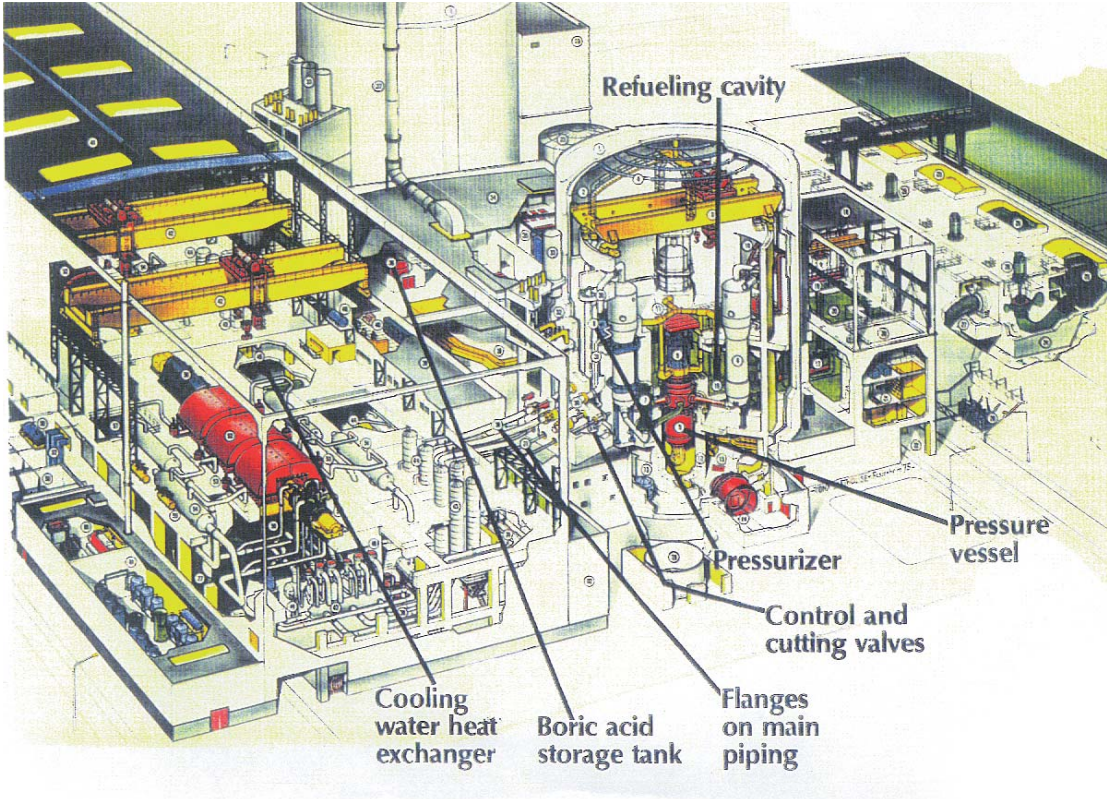
SHIPPING CRATE



Wooden shipping crate for Reactor Pressure Vessel Seal

Note: Shipping crate is transported only by way of specialized drop deck, dedicated freight carrier. In some cases, the crate may be designed for specific sea or air carriers.

MAIN LOCATION OF HELICOFLEX SEALS IN PWR'S



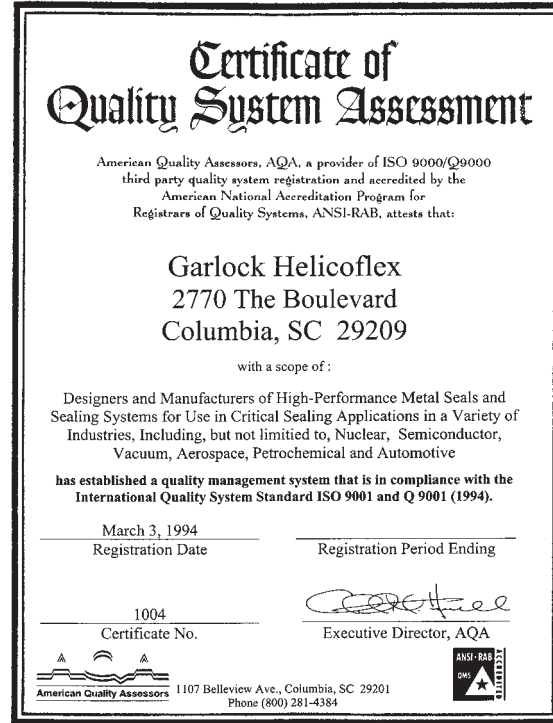
TN-32 Dry Storage Cask



TN-40 Dry Storage Cask

QUALITY SYSTEM ASSESSMENT

- ISO 9001
- Title 10 CFR 50 Appendix B
- ANSI/ASME N45.2
- Favorable Audits by NUPIC Members
- ANSI/ASME NQA-1
- ANSI/ASME Q91



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