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

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)

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.

Helicoflex Spring Energized Seals

FREE STATE IN COMPRESSION

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- Fire Safety (API 607)
CLASSIFICATION OF SEAL TYPE

<table>
<thead>
<tr>
<th>Cross Section Type</th>
<th>#Jackets/ Linings</th>
<th>Jacket Orientation</th>
<th>Section Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HN</td>
<td>2</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

CONFIGURATION GUIDE

<table>
<thead>
<tr>
<th>Cross Section Type</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HN</td>
<td>single section</td>
</tr>
<tr>
<td>HNR</td>
<td>ground spring for precise load control (Beta Spring)</td>
</tr>
<tr>
<td>HNV</td>
<td>low load (Delta Seal)</td>
</tr>
<tr>
<td>HND</td>
<td>tandem Helicoflex seals</td>
</tr>
<tr>
<td>HNDE</td>
<td>tandem Helicoflex and elastomer seals</td>
</tr>
<tr>
<td>note: “L” indicates internal limiter (ex: HLDE)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Jacket/Lining</th>
<th>1 = jacket only</th>
<th>2 = jacket with inner lining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacket Orientation</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Section Orientation</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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

![Characteristic Curve Diagram](image-url)
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

<table>
<thead>
<tr>
<th>ALLOY 718 O-RING</th>
<th>HN200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>Diameter</td>
</tr>
<tr>
<td>5/8 in</td>
<td>5/8 in</td>
</tr>
<tr>
<td>3/4 in</td>
<td>3/4 in</td>
</tr>
</tbody>
</table>

SEAL DIMENSIONS AND LOAD CHARACTERISTICS

<table>
<thead>
<tr>
<th>Seal Type</th>
<th>Load / Deflection / Springback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>Linear Load</td>
</tr>
<tr>
<td>5/8 in</td>
<td>3950 lb/in</td>
</tr>
<tr>
<td>3/4 in</td>
<td>2500 lb/in</td>
</tr>
<tr>
<td>1&quot;</td>
<td>7000 lb/in</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type</th>
<th>E</th>
<th>W</th>
<th>S</th>
<th>T</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.375&quot;</td>
<td>0.038&quot;</td>
<td>0.281&quot;</td>
<td>0.125&quot;</td>
<td>0.070&quot;</td>
</tr>
<tr>
<td>II</td>
<td>0.500&quot;</td>
<td>0.050&quot;</td>
<td>0.375&quot;</td>
<td>0.205&quot;</td>
<td>0.093&quot;</td>
</tr>
</tbody>
</table>

O-RING DIAMETER

<table>
<thead>
<tr>
<th>Diameter</th>
<th>NO. OF SLOTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 72&quot;</td>
<td>4</td>
</tr>
<tr>
<td>72&quot; to 144&quot;</td>
<td>8</td>
</tr>
<tr>
<td>144&quot; to 200&quot;</td>
<td>12</td>
</tr>
<tr>
<td>200&quot; and up</td>
<td>16 or 24</td>
</tr>
</tbody>
</table>

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

1. Tarnish Retardant Paper
2. Plastic Film Sheath
3. Split Polyethylene Tube
4. Zip Seal®

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

On-Site Applications

TN-32 Dry Storage Cask

TN-40 Dry Storage Cask

For Additional Information, Please Consult Our Engineering Staff
1-800-233-1722
The technical data contained herein is by way of example and should not be relied on for any specific application. Garlock Helicoflex will be pleased to provide specific technical data or specifications with respect to any customer’s particular applications. Use of the technical data or specifications contained herein without the express written approval of Garlock Helicoflex is at user’s risk and Garlock Helicoflex expressly disclaims responsibility for such use and the situations which may result therefrom.

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Certificate of
Quality System Assessment

American Quality Assessors, AQA, a provider of ISO 9000/Q9000
third party quality system registration and accredited by the
American National Accreditation Program for
Registrars of Quality Systems, ANSIRAB, attests that:

Garlock Helicoflex
2770 The Boulevard
Columbia, SC 29209

has established a quality management system that it is compliant with the

March 3, 1994
Registration Date

1004
Certificate No.

Executive Director

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Catalog Reference: Nuc Rev 2