

# NUCLEAR

Nuclear Reactor Pressure Vessel Seals



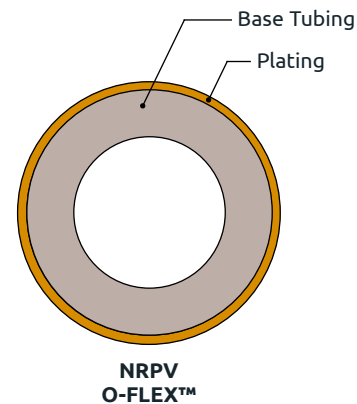
## SEALING CONCEPT

*Technetics Group is the world's leading manufacturer of Nuclear Reactor Pressure Vessel (RPV) Closure Head Seals. In addition, Technetics Group sealing technology is used extensively as primary seals on spent fuel storage and transportation casks.*



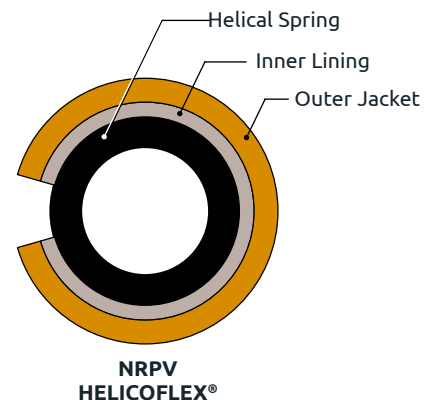
## O-FLEX™ METAL O-RINGS

The O-FLEX™ is manufactured of Alloy 718 or Stainless Steel 304 tubing. Alloy 718 is the most common and preferred material because it offers optimum strength, spring back and resistance to radiation and corrosion. The base tubing is plated with pure (99.95%) silver. This combination of elastic core (tubing) with deformable plastic layer (silver) provides durable sealing for traditional Nuclear Reactor Pressure Vessels.



## HELICOFLEX® SPRING ENERGIZED SEALS

The HELICOFLEX® seal is a high performance, flexible, metal seal that has exceptional compression and elastic recovery properties. The HELICOFLEX® seal is composed of a close-wound helical spring surrounded by two metal jackets. The spring is selected to have a specific compression resistance. During compression, the resulting specific pressure forces the jacket to yield and fill the flange imperfections while ensuring positive contact with the flange sealing faces. Each coil of the helical spring acts independently and allows the seal to conform to surface irregularities on the flange surface. This combination of elasticity and plasticity makes the HELICOFLEX® seal the best choice for ageing reactors.



## TECHNETICS GROUP

EnPro Industries companies

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EnPro Industries companies

### RPV CLOSURE HEAD SEALS

These seals are the primary seal for the reactor pressure vessel. Typically, the seals are used in tandem with an inner and outer seal for redundancy. The seals are positioned in the reactor pressure vessel head with clips and screws for easy installation and assembly.

### CONTROL ROD DRIVE (CRD) SEALS

PTFE coated O-FLEX™ seals for CRD mechanisms.

### SPENT FUEL CASKS

Primary seals for casks used in the storage and transportation of spent fuel assemblies.

### OTHER APPLICATIONS

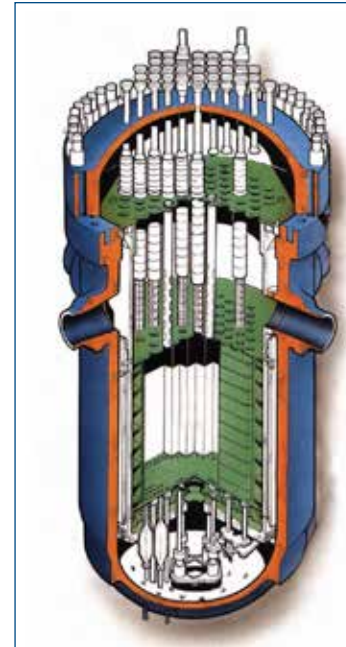
Steam Turbines  
Primary Loop  
Valves  
Waste Heat Systems  
Steam Pressurizer

### REACTOR TYPES

BWR – All Types  
PWR – All Types  
Gas Cooled  
Navy Nuclear

### QA SYSTEM ASSESSMENT

ISO 9001  
Title 10 CFR 50 Appendix B  
ANSI / ASME N45.2  
Favorable Audits by NUPIC Members  
ANSI / ASME NQA-1  
KTA 1401



RPV Closure Lid



RPV O-FLEX™ Seals with installation clips

(Photos courtesy of AREVA)

**GENERAL SERVICES**

- Global leader for more than 50 years in nuclear RPV seal design and manufacturing. References available.
- RPV seal design and manufacturing for most PWR Nuclear Power Plants (NPP) and all BWR NPPs worldwide and to major NSSS worldwide. References available.
- Spent fuel cask seal design to all major spent fuel (transportation and storage) casks manufacturers worldwide. Reference available.
- Individual RPV seal design and recommendations for newly built PWR and BWR units.
- Seal and retainer design improvements to meet today's industries requirements of tight outage itineraries and ALARA requirements.
- Qualified and experienced on-site field services to evaluate the cause of numerous RPV seal problems, i.e. for RPV seal leakages, etc.
- Nuclear seal qualification services for new applications.
- Quality Assurance program based on the requirements of 10 CFR 50 Appendix B, ASME, N45.2, ASME Boiler and Pressure Vessel Codes V and IX, NUPIC audited.
- 3<sup>rd</sup> party evaluation available for on-site laser scan & repair of mating surfaces, reactor pressure vessel flange, and pressure vessel closure head grooves.
- NPP field staff training available, i.e. handling, installation, removal of RPV seals.
- Airfreight packaging and crating and airfreight arrangement for quick response transportation (airfreight capability limitation given by seal design).

**TECHNETICS GROUP EMERGENCY RESPONSE**

- Emergency response for outage. Spare RPV seals available on demand.
- 24/7 emergency service phone (803) 695-3553 (U.S.A.)
- 24 - 36 hour worldwide emergency site service available, on request.

## NUCLEAR RPV CLOSURE HEAD SEALS

RPV O-FLEX™				ALLOY 718 BASE TUBING		
Free Height	Wall Thickness	Recommended Diameter Range	Seating Load (PCI) Y <sub>2</sub> <sup>*</sup>	Installation Compression e <sub>2</sub>	Installation Compression %	Total Springback (Min.)
0.375	0.038	40 to 180	2500	0.030	8%	0.009
				0.037	10%	0.009
				0.045	12%	0.009
				<b>0.060</b>	<b>16%</b>	<b>0.009</b>
0.500	0.050	120 to >180	2500	0.064	17%	0.009
				0.040	8%	0.015
				0.050	10%	0.015
				0.060	12%	0.015
0.625	0.063	120 to >180	4000	<b>0.080</b>	<b>16%</b>	<b>0.015</b>
				0.085	17%	0.015
				0.050	8%	0.017
				0.062	10%	0.017
0.625	0.063	120 to >180	4000	0.075	12%	0.017
				<b>0.100</b>	<b>16%</b>	<b>0.017</b>
				0.106	17%	0.017

Dimensions in inches

NOTE: Recommended compression % for NRPV O-FLEX™ is 16%

\* PCI = Pounds force per Circumferential Inch

RPV HELICOFLEX®: HN200				HIGH TEMPERATURE ALLOY SPRING		
Free Height	Wall Thickness	Recommended Diameter Range	Seating Load (PCI) Y <sub>2</sub> <sup>*</sup>	Installation Compression e <sub>2</sub>	Installation Compression %	Total Springback (Min.)
0.520	N/A	40 to >180	4000	0.052	10%	0.017

Dimensions in inches

RPV Closure Head Seals are typically held in the pressure vessel head with specially designed clips. Technetics Group recommends a clip be located at a minimum every 30" of seal circumference. This will ensure that the seal is securely held in place.

**TYPE I**

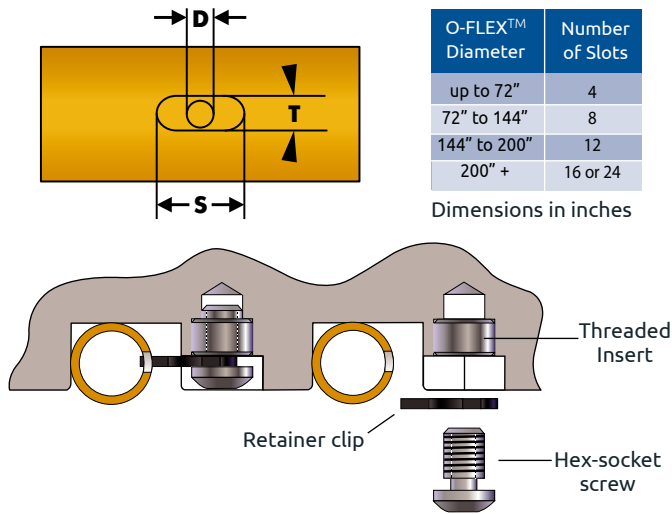
This clip can only be used with the traditional O-FLEX™ RPV seal. This clip is designed to penetrate either a slot (most common) or a hole in ID of the O-FLEX™.

**TYPE I CLIP (O-FLEX™ ONLY)**

Free Height	Wall Thickness	Slot Length S	Slot Width T	Hole Diameter D
0.375	0.038	0.281	0.125	0.070
0.500	0.050	0.375	0.205	0.093
0.625	0.063	0.438	0.256	0.125

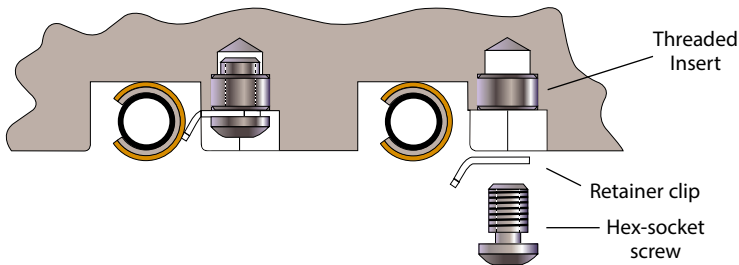
Dimensions in inches

NOTE: Type I clip can be used with a slot or hole (depending on ring design)



**TYPE II**

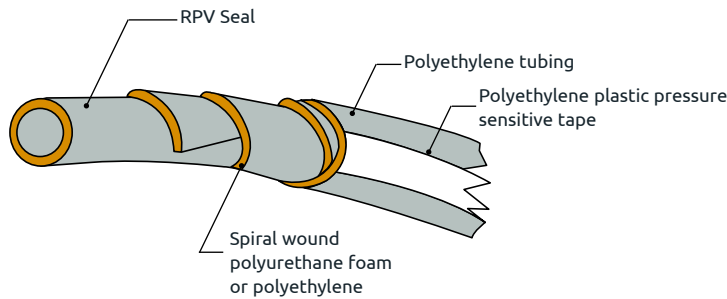
This style clip can be used with either the O-FLEX™ or the HELICOFLEX® RPV seals. It is designed to hold the seal to the outer circumference of the groove without having to penetrate the ring through a slot. This makes seal installation easier since the seal does not require special alignment.



**RPV CLOSURE HEAD SEAL PACKAGING**

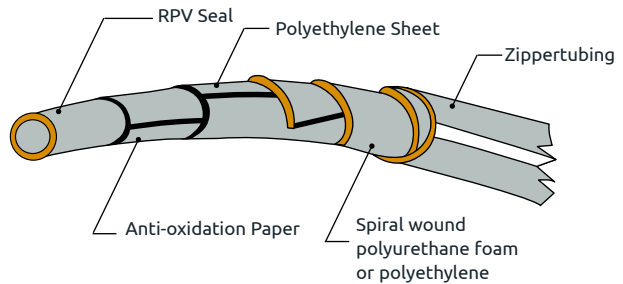
Technetics Group offers two styles of protective packaging for RPV seals:

**Regular “Casement Tubing”**



**ZIPPER LOCK TUBING PACKAGING**

This is a packaging upgrade that was developed using ALARA minded principles. This packaging is designed to be removed quickly and therefore reduce radiation exposure time during unpacking and installation.



**SHIPPING**

Individually wrapped seals are securely packaged in wooden crates. Special provisions are made for extra protection during overseas shipments. Typically, the crate is transported by way of a specialized drop deck freight carrier. However, some crates may be custom designed for specialty ocean or air freight carriers.

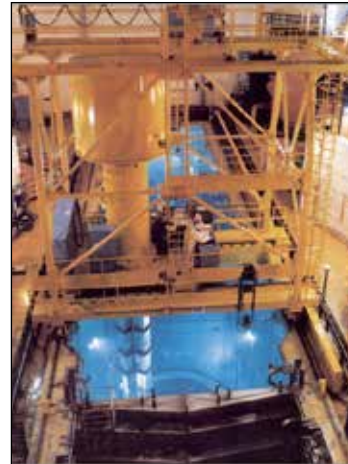


TN-40 Dry Storage Cask

Technetics Group metal seals offer the performance and flexibility to meet stringent spent fuel cask requirements. The HELICOFLEX® seal in particular can be made in a wide variety of geometries and shapes to meet the demanding requirements of cask designers. Typical seal types are listed below. Please contact Applications Engineering to discuss your cask requirements.

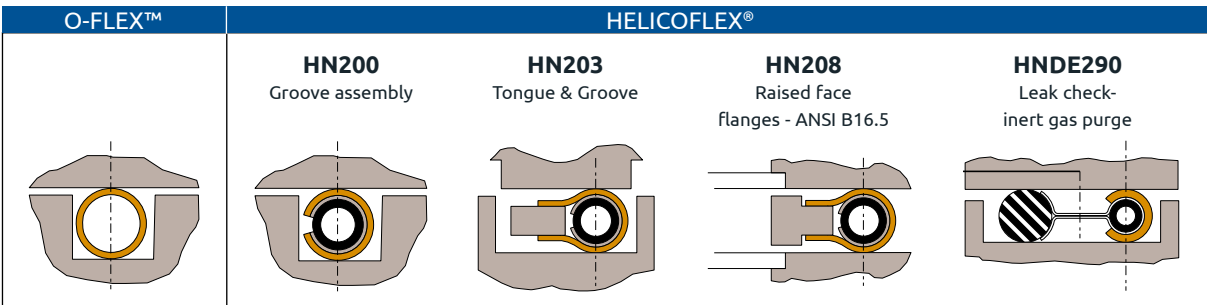
**TYPICAL CASK SEAL LOCATIONS:**

- Cask Lid Closures
- Fill Ports
- Drain Ports



TN-32 Dry Storage Cask

**TYPICAL CONFIGURATIONS**



# APPLICATIONS DATA SHEET

Tel: 800-233-1722 Fax: 803-783-4279

E-Mail: sales@technetics.com



EnPro Industries companies

COMPANY: _____	PHONE: _____
CONTACT: _____	FAX: _____
ADDRESS: _____	E-MAIL: _____
	DATE: _____

**APPLICATION: (please attach customer drawing / sketch)**

Brief Description: \_\_\_\_\_

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Annual quantities: \_\_\_\_\_ RFQ Quantities: \_\_\_\_\_

Is This a New Design?       Yes       No      Are Modifications Possible?       Yes       No

Drawing or Sketch Attached?       Yes       No      What is the Seal Type?       Shaped       Circular

**SERVICE CONDITIONS:**

Media: _____	Life Expectancy: _____
Working Temperature: _____	Max/Proof Pressure: _____ @ Temp. = _____
Working Pressure: _____	Max Temperature: _____ @ Pressure = _____
Pressure Direction: <small>(Internal/External/Axial)</small> _____	<b>Target Sealing Level:</b> Helium: _____ Std.cc/sec
Pressure Cycles: _____	Flow Rate: _____ cc/minute
Temperature Cycles: _____	Other: _____

**FLANGE DETAILS: (Please Provide Drawing)**

Amount of Flange Movement in Service: (Inches)      Radial: \_\_\_\_\_      Axial: \_\_\_\_\_      #Cycles: \_\_\_\_\_

Material: \_\_\_\_\_ Thickness: \_\_\_\_\_

Groove / Counter Bore: \_\_\_\_\_ Please list dimensions in Groove Details section

ANSI Raised Face      Size: \_\_\_\_\_ # Rating: \_\_\_\_\_      Face Surface Finish: \_\_\_\_\_ (RMS)

Flange(s) with Clamping System: (ISO,KF, etc)      Standard: \_\_\_\_\_      Size: \_\_\_\_\_

Other: \_\_\_\_\_ Description: \_\_\_\_\_ (Please Provide Drawing)

**GROOVE DETAILS: (Please Provide Drawing)**

Type (Rectangular, Dovetail, etc.): \_\_\_\_\_

Outer Diameter: _____ Tolerance: _____	Depth: _____ Tolerance: _____
Inner Diameter: _____ Tolerance: _____	Finish (RMS) _____ Type: _____

Finish Type: lathe (circular), endmill (multi-directional), other

**BOLTING DETAILS: (Please Provide Drawing)**

Size: _____	Type / Grade: _____
Number: _____ Bolt Circle _____	Tapped / Through: _____

**OTHER:**

Special coating / plating specification: \_\_\_\_\_

Special quality / inspection specifications: \_\_\_\_\_

Other: \_\_\_\_\_