

NUCLEAR SEALING SYSTEMS

NUCLEAR SEAL TECHNICAL DATA

Dual-seal inflatable sealing systems for PWR steam generator isolation, reactor coolant system maintenance, and critical nuclear outage applications. Engineered and manufactured in the USA.

Dynamic Rubber Inc. manufactures inflatable seal systems engineered for pressurized water reactor (PWR) maintenance and outage operations. Our dual-seal configuration provides passive fail-safe redundancy for steam generator channel head isolation, RCS nozzle sealing, and containment penetration applications. Every seal is custom-manufactured to application-specific bore dimensions at our facility in Mt Prospect, Illinois. With over 30 years of experience in custom inflatable seals, DRI provides direct engineer access, rapid prototyping, and in-house compound formulation for the most demanding nuclear environments.

DUAL-SEAL SYSTEM CONFIGURATION

WET SEAL PRIMARY BARRIER

Faces the reactor coolant system. Provides primary pressure boundary against RCS fluid. Designed for direct exposure to borated water and RCS chemistry.

- Direct contact with borated RCS water
- Fabric-reinforced construction for pressure retention
- Radiation-resistant elastomer compound
- Monitored inflation pressure via remote console
- Custom bore geometry for exact nozzle fit

DRY SEAL SECONDARY BARRIER

Provides redundant isolation on the maintenance side. Passive fail-safe design requires no active monitoring or intervention to maintain isolation.

- Independent inflation circuit from wet seal
- Maintains isolation if primary seal is compromised
- Annulus space between seals for leak detection
- Same construction and material as wet seal
- Pressure-monitored via remote console

KEY APPLICATIONS

PWR Steam Generator Isolation

Channel head isolation for inspection, tube plugging, and maintenance. Seals against up to 40 ft (12.2 m) water head when refueling pool is flooded.

RCS Nozzle Sealing

Hot leg (typ. 42" bore) and cold leg (typ. 30" bore) nozzle isolation for reactor coolant system loop maintenance operations.

Outage Critical Path Reduction

Enables parallel refueling and steam generator maintenance, reducing critical-path outage duration per steam generator.

Containment Penetration Seals

Custom inflatable seals for containment penetration isolation and secondary barrier applications in nuclear facilities.

2x

DUAL-SEAL REDUNDANCY

100%

PASSIVE FAIL-SAFE

Custom

BORE SIZING

USA

MANUFACTURED

TECHNICAL SPECIFICATIONS

SEAL SYSTEM SPECIFICATIONS

PARAMETER	SPECIFICATION
System Configuration	Dual-seal: wet seal (primary) + dry seal (secondary) with monitored annulus
Seal Construction	Fabric-reinforced inflatable elastomer; peroxide-cured compounds available for extended service life
Reinforcement Fabrics	Kevlar, Fiberglass, Nylon, Dacron (application-dependent)
ASTM Material Compliance	Special ASTM material callouts to meet nuclear industry requirements; legacy/discontinued callout experience
Bore Sizing	Custom to application – typical PWR nozzles: 30" (cold leg) to 42" (hot leg)
Hydrostatic Head Capacity	Up to 40 ft (12.2 m) water column (flooded refueling cavity)
Inflation Pressure	15–45 psig typical (1.25–1.45× pressure differential per application)
Inflation Medium	Compressed air or nitrogen; remote pressurization via monitoring console
Fail-Safe Mode	Passive – secondary seal maintains isolation without active intervention
Leak Detection	Annulus space between wet and dry seals; continuously pressure-monitored
Installation	Field-installable; tool-free inflation via quick-connect fittings
Tolerancing	Tight-tolerance molding capability on large-bore parts; precision fit for critical sealing surfaces
Monitoring	Computerized pressurization control and monitoring station (remote operation)
Additional Seal Types	Window/glass seals, testing seals, non-fabric small-diameter seals, combination seal assemblies

ELASTOMER PROPERTIES

PROPERTY	EPDM	SILICONE	BUTYL (IIR)
MECHANICAL PROPERTIES			
Hardness (Shore A)	40–80	40–80	40–75
Tensile Strength	500–2,500 psi (3.4–17.2 MPa)	200–1,500 psi (1.4–10.3 MPa)	300–2,000 psi (2.1–13.8 MPa)
Elongation at Break	300–600%	100–700%	300–600%
Compression Set (ASTM D395)	9–25%	10–40%	15–35%
Tear Resistance (ASTM D624)	Good–Excellent	Fair–Good	Good
Cure System	Sulfur or peroxide cure	Peroxide / platinum cure	Sulfur or resin cure
ENVIRONMENTAL RESISTANCE			
Temperature Range	–40°F to +300°F (–40°C to +150°C)	–65°F to +450°F (–54°C to +232°C)	–40°F to +250°F (–40°C to +120°C)
Radiation Resistance	Up to 10 ⁷ rads cumulative	Good (methylphenyl grades)	Moderate – chain scission at high dose
Steam / Hot Water	Excellent	Limited – susceptible to hydrolysis	Good
Gas Impermeability	Moderate	Low	Excellent (lowest permeability)
Ozone / UV / Weathering	Excellent	Excellent	Excellent

CHEMICAL COMPATIBILITY – RCS ENVIRONMENT

COMPATIBLE MEDIA

- Borated water (H₃BO₃ up to 2,500 ppm)
- Demineralized water
- Steam (saturated, to rated temp)
- Lithium hydroxide (LiOH pH control)
- Hydrazine (N₂H₄ oxygen scavenger)
- Decontamination chemicals (verify compound)

NOT RECOMMENDED

- Hydrocarbon solvents (EPDM/Butyl)
- Petroleum-based oils and fuels
- Concentrated mineral acids
- Strong oxidizers (verify concentration)
- Chlorinated solvents (verify exposure)

● Compatible ● Verify with DRI ● Not recommended

DESIGN, QUALITY & ORDERING

DESIGN FEATURES

Passive Fail-Safe Redundancy

Dual-seal system maintains isolation without active monitoring. Secondary dry seal provides fully independent backup if primary wet seal is compromised.

Custom Bore Dimensions

Every seal manufactured to exact bore specifications. Accommodates non-standard, replacement, and legacy steam generator nozzle geometries.

Remote Pressurization & Monitoring

Quick-connect fittings to computerized remote monitoring console. All inflation, pressure monitoring, and leak detection from outside radiation area.

Fabric Reinforcement Options

Kevlar, Fiberglass, Nylon, or Dacron reinforcement fabric embedded in seal walls for higher inflation pressure and greater differential capability.

Custom Compound Formulation

In-house compounding with peroxide-cure options for extended seal life in nuclear environments vs. traditional sulfur-cured compounds.

Legacy & Replacement Seals

Experience with older discontinued ASTM material callouts for replacement seals in aging nuclear plants and legacy steam generator configurations.

Combination Seal Assemblies

Multi-component seal assemblies with multiple fail-safe barriers for applications requiring additional redundancy beyond dual-seal configuration.

Rapid Prototyping & Iteration

Prototype seals for fit and function verification before production. Critical when outage schedules are tight or designs are evolving.

QUALITY CONTROL & DOCUMENTATION

ITEM	DESCRIPTION
Dimensional Inspection	100% inspection of bore dimensions, wall thickness, and seal geometry against engineering drawing tolerances
Inflation / Leak Test	Each seal assembly pressure-tested at rated inflation pressure; held for minimum duration to verify zero leakage
Material Certification	Compound batch traceability with material test reports: hardness, tensile strength, elongation, specific gravity
Visual Inspection	Surface finish, fabric placement, bond integrity, valve and fitting inspection per DRI quality procedures
Documentation Package	Certificate of Conformance, material certifications, dimensional report, and test results shipped with each order
Traceability	Full material and process traceability from raw compound through finished seal assembly

APPLICABLE STANDARDS & REFERENCES

ASTM D2000 (Rubber Classification)

ASTM D395 (Compression Set)

ASTM D412 (Tensile / Elongation)

ASTM D2240 (Durometer Hardness)

ASTM D624 (Tear Resistance)

ISO 9001:2015 (DRI Certified)

DISCUSS YOUR NUCLEAR SEALING APPLICATION

DRI engineers are available to review your bore dimensions, operating environment, and outage requirements. We provide application-specific material recommendations, prototype seals for fit verification, and full documentation packages.

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