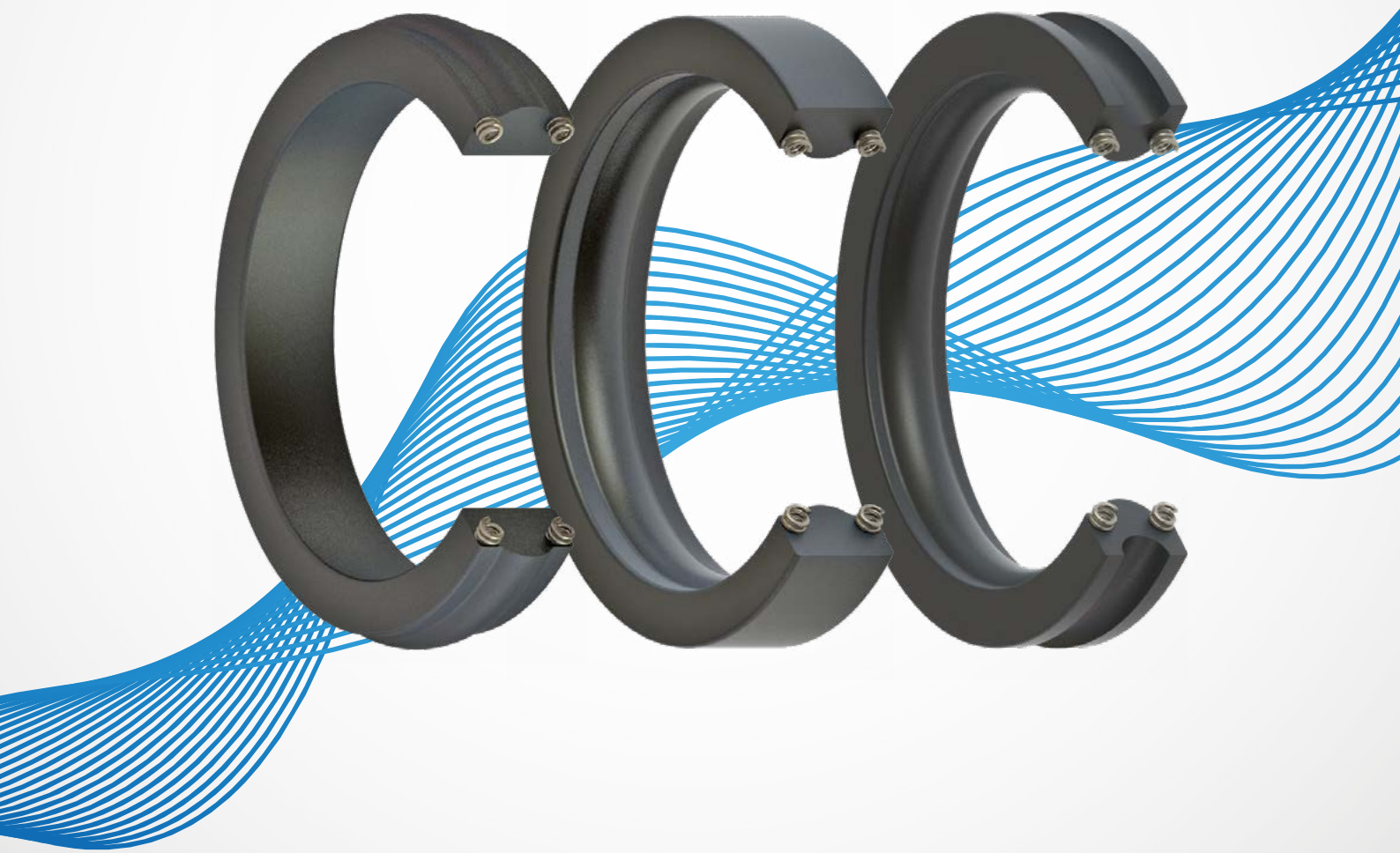
PPE
Precision Polymer Engineering

Spring Seals and FS Seals

for high pressure applications



Product Range

Piston orientation

Rod orientation

Spring Seals

Spring Seals (also known as S-Seals) are double acting elastomeric seals for static applications, featuring a pair of integrated anti-extrusion springs to ensure high-pressure resilience. The springs respond to pressure fluctuations in the system during operation, moving to close the clearance gap in the seal housing and prevent extrusion of the elastomer.

Spring Seals are available to suit Piston or Rod orientation grooves, Piston Spring Seals feature an external sealing bulb, and Rod Spring Seals an internal sealing bulb.

Spring Seals are commonly used in arduous oilfield applications where seals are subjected to:

- Large extrusion clearances
- High pressures
- Extremes in temperature
- Restricted and remote access for seal installation
- Chemical attack by oilfield media

Product Range

FS Seal

FS Seals

Similar in form and function to a rod orientation Spring Seals, FS seals are double acting static seals designed for use as casing and tubing hanger seals in wellheads. FS seals are designed for use against rough casing, with wide dimensional and geometrical tolerances and variable surface finishes, which can result in large clearance gaps between the mating parts of the wellhead.

An FS seal typically has a larger cross section than a Spring Seal to increase the sealing force on the casing while the recess in the seal back controls the radial compression on the seal by allowing it to deflect when in contact with a larger or out-of-round casing section.

As with Spring Seals, FS Seals feature a pair of integrated anti-extrusion springs to ensure high-pressure resilience. The springs respond to pressure fluctuations in the system during operation, moving to close the clearance gap in the seal housing and prevent extrusion of the elastomer. Due to the potential for larger clearances in the wellhead, the FS seal springs are of a larger coil diameter and thicker wire than a corresponding Spring Seal.

Unlike other casing and tubing seals, FS seals do not require pack-off operations following installation.

Elastomer Materials

EnDura®

The ultimate range of elastomers for sealing applications in the world's most aggressive high-pressure environments.

EnDura® materials have been developed by PPE for use in downhole, surface, and subsea oilfield equipment and offers excellent Rapid Gas Decompression (RGD) resistance.

Perlast® ICE

Perfluoroelastomers (FFKM) for sealing applications where chemical resistance and low temperature performance are critical.

Perlast® ICE materials have been developed by PPE to provide low permeability, so they are less prone to swelling, leading to extended in-service performance.

Spring Materials

Stainless Steel 316

X5CrNiMo17-12-2 is the ISO 15510 designation for a molybdenum-containing austenitic stainless-steel equivalent to DIN 1.4401, AISI 316 (UNS S31600) and SUS316.

Due to the chemical composition of 2-2.5% molybdenum, its corrosion resistance is excellent, especially in environments containing chloride and non-oxidizing acids.

Nickel Alloy 600

NiCr15Fe is the EN chemical designation for a nickel-chromium-iron alloy often used in engineering applications for its heat and corrosion resistance. It is non-magnetic, and the chromium component of its makeup provides good resistance to oxidation.

Equivalent to DIN 2.4816, UNS N06600, and BS NA 14.

Elastomer Material Grades

EnDura® V91K

A low temperature FKM terpolymer with excellent mechanical strength and RGD resistance making it ideal for high pressure applications. It has a wide thermal operating range and outstanding resistance to a broad range of oilfield chemicals including sour gas (H_2S), crude oil and many common oil additives.

Property	Typical Value
Material Type	FKM
Hardness, Shore A	89
Operating temperature	-41 to 225°C -42 to 437°F
Compression set 24 hrs @ 200°C (392°F)	10%
Tg	-35°C (-31°F)
TR10	-35°C (-31°F)

Perlast® ICE G90LT

A perfluoroelastomer that offers a market-leading combination of excellent chemical resistance, RGD resistance and low temperature capability. It has exceptional resistance to methanol, sour gas (H_2S), hot water, steam, oils, acids and amines and it's low permeability make it less prone to swelling.

Property	Typical Value
Material Type	FFKM
Hardness, Shore A	88
Operating temperature	-46 to 240°C -51 to 464°F
Compression set 24 hrs @ 200°C (392°F)	23%
Tg	-30°C (-22°F)
TR10	-31°C (-24°F)

EnDura® Z95X

A peroxide cured medium HNBR with outstanding mechanical properties and RGD performance. It is resistant to sour gas (H_2S), crude oil, lubricating agents and oil additives, and is generally first choice for applications involving carbon dioxide, water, drilling mud and amine corrosion inhibitors.

Property	Typical Value
Material Type	HNBR
Hardness, Shore A	87
Operating temperature	-29 to 180°C -20 to 356°F
Compression set 24 hrs @ 200°C (392°F)	20%
Tg	-27°C (-17°F)
TR10	-35°C (-31°F)

EnDura® Z85L

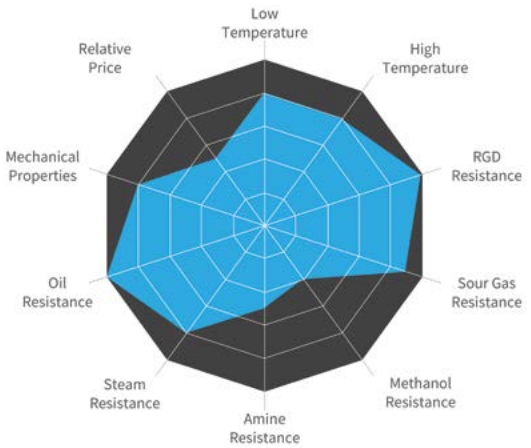
A HNBR compound specially developed for use in low temperature applications. Broad chemical resistance makes it ideal for use with crude oil, carbon dioxide and operating fluids including lubricators, drilling mud, oil additives and amine corrosion inhibitors.

Property	Typical Value
Material Type	HNBR
Hardness, Shore A	84
Operating temperature	-50 to 160°C -58 to 320°F
Compression set 24 hrs @ 200°C (392°F)	25%
Tg	-45°C (-49°F)
TR10	-46°C (-51°F)

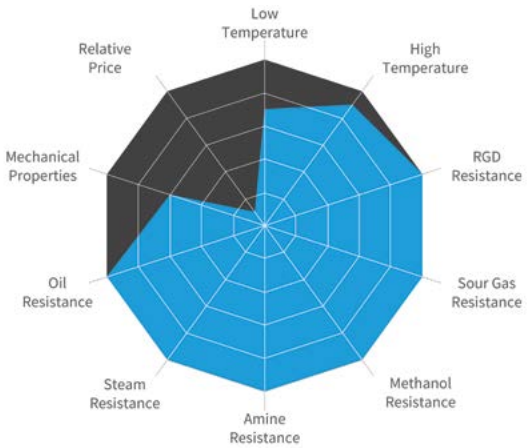
Elastomer Material Grades

RGD Testing	NORSOK M710	ISO 23939-2	NACE TM0297	TOTAL GSPVV142	SHELL SPE 85/301	Saudi Aramco 06-SAMSS-001
EnDura® V91K	✔	✔	✔	✔	✔	✔
EnDura® Z95X	✔	✔	✔	✔		
EnDura® Z85L			✔			
Perlast® ICE G90LT	✔	✔	✔	✔		
H_2S TESTING	**NORSOK 2%**	**NORSOK 25%**	**NACE TM0187**	**API 6A FF/HH**	**ISO 10423**	
EnDura® V91K	✔	✔	✔	✔	✔	
EnDura® Z95X	✔		✔	✔	✔	
EnDura® Z85L		✔		✔	✔	
Perlast® ICE G90LT	✔	✔		✔	✔	

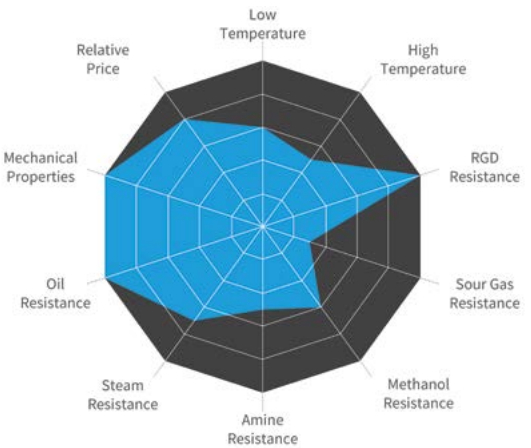
EnDura® V91K



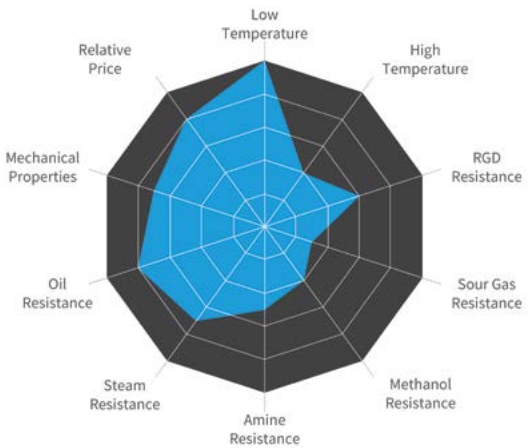
Perlast® ICE G90LT



EnDura® Z95X



EnDura® Z85L



Spring Seals

Sizes

Internal diameter (A): from 100mm to 360mm

Radial section (B): from 5mm to 10mm

Axial height (C): from 5mm to 12mm

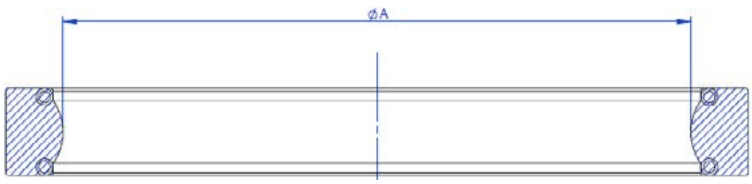
(The limits of the stated range cannot necessarily be applied simultaneously)

PPE custom designs Spring Seals to ensure optimum levels of radial squeeze, gland fill and stretch (Piston seal) or OD compression (Rod seals) for individual applications. Spring Seals can be installed as original equipment or retrofitted to existing hardware designed to accommodate O-rings with 1 or 2 back-up rings.

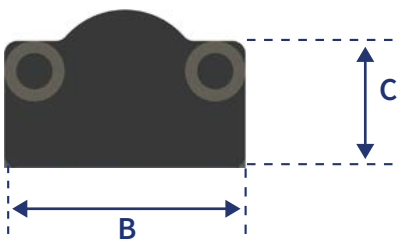
Materials

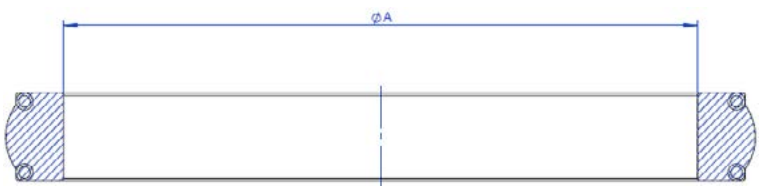
Elastomers: EnDura® V91K, Z95X, Z85L and Perlast® ICE G90LT

Springs: Stainless steel 316 and Nickel Alloy 600



Internal Diameter (A) of Rod Type Spring Seal





Internal Diameter (A) of Piston Type Spring Seal

FS Seals

Standard Sizes (API 5CT Casing and Tubing)

Nominal Casing Size (D)	Housing Bore (E)		Housing Depth (F)		Part no	
	Inch	mm	Inch	mm	Z95X	Z85L
4.500”	5.750	146.05	0.835	21.21	FSS-04500-05750-Z95XB0000	FSS-04500-05750-Z85LB0000
4.750”	6.000	152.40	0.835	21.21	FSS-04750-06000-Z95XB0000	FSS-04750-06000-Z85LB0000
5.000”	6.250	158.75	0.835	21.21	FSS-05000-06250-Z95XB0000	FSS-05000-06250-Z85LB0000
5.500”	6.750	171.45	0.835	21.21	FSS-05500-06750-Z95XB0000	FSS-05500-06750-Z85LB0000
5.750”	7.000	177.80	0.835	21.21	FSS-05750-07000-Z95XB0000	FSS-05750-07000-Z85LB0000
6.000”	7.250	184.15	0.835	21.21	FSS-06000-07250-Z95XB0000	FSS-06000-07250-Z85LB0000
6.625”	7.875	200.03	0.835	21.21	FSS-06250-07875-Z95XB0000	FSS-06250-07875-Z85LB0000
7.000”	8.250	209.55	0.835	21.21	FSS-07000-08250-Z95XB0000	FSS-07000-08250-Z85LB0000
7.625”	8.875	225.43	0.835	21.21	FSS-07625-08875-Z95XB0000	FSS-07625-08875-Z85LB0000
7.750”	9.000	228.60	0.835	21.21	FSS-07750-09000-Z95XB0000	FSS-07750-09000-Z85LB0000
8.625”	9.875	250.83	0.835	21.21	FSS-08625-09875-Z95XB0000	FSS-08625-09875-Z85LB0000
9.000”	10.250	260.35	0.835	21.21	FSS-09000-10250-Z95XB0000	FSS-09000-10250-Z85LB0000
9.625”	10.875	276.23	0.835	21.21	FSS-09625-10875-Z95XB0000	FSS-09625-10875-Z85LB0000
9.875”	11.125	282.58	0.835	21.21	FSS-09875-11125-Z95XB0000	FSS-09875-11125-Z85LB0000
10.750”	12.000	304.80	1.000	25.40	FSS-10750-12000-Z95XB0000	FSS-10750-12000-Z85LB0000
11.750”	13.125	333.38	1.000	25.40	FSS-11750-13125-Z95XB0000	FSS-11750-13125-Z85LB0000
11.875”	13.250	336.56	1.000	25.40	FSS-11875-13250-Z95XB0000	FSS-11875-13250-Z85LB0000
13.375”	14.750	381.00	1.000	25.40	FSS-13375-14750-Z95XB0000	FSS-13375-14750-Z85LB0000
13.625”	15.000	381.00	1.000	25.40	FSS-13625-15000-Z95XB0000	FSS-13625-15000-Z85LB0000

FS Seals

Sizes

FS Seals are designed to be retrofitted into API 5CT standard casing and tubing from 4.500” to 13.625” nominal casing size. Custom seals for non-standard hardware can be supplied in the range:

Internal diameter (A): from 4.000” to 15.000

Radial section (B): from 0.625” to 1.000”

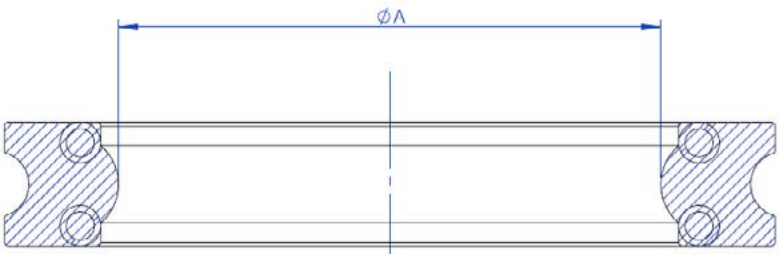
Axial height (C): from 0.625” to 1.000”

(The limits of the stated range cannot necessarily be applied simultaneously)

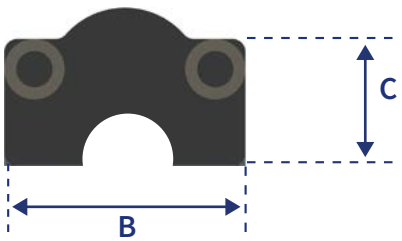
Materials

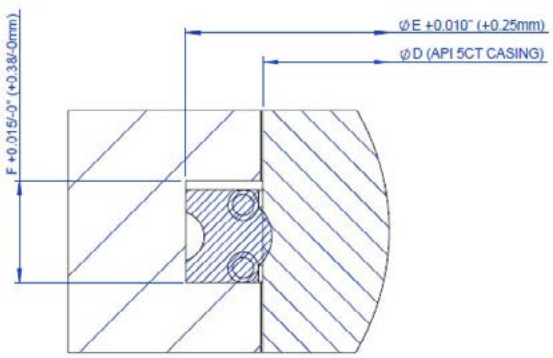
Elastomers: EnDura® Z95X and EnDura® Z85L

Springs: Stainless steel 316



Inside Diameter (A) of FS Seal





Housing Sizes for FS Seal

Typical Applications

Spring embedded seals are designed primarily for oil and gas applications and more specifically for downhole, wellhead, surface equipment, high-pressure pipelines and riser systems. Where extreme pressure is encountered, combined with extreme temperatures and aggressive media, then a spring seal from PPE is likely to be the best sealing solution.

Spring Seals

Spring Seals are commonly used in a variety of critical oil and gas duties:

- Down-hole
- Wellhead
- Surface equipment
- Valves and chokes
- X-Trees
- Tree Caps
- Running Tools
- Liner-Riser systems

FS Seals

FS Seals are used in a wellhead equipment:

- Casing seals
- Tubing hanger seals

Service Conditions

PPE's range of Spring Seals and FS Seals are designed for applications with pressures of up to 1,034 bar (15,000psi) and temperatures up to 240°C (464°F) depending on housing design, material choice and media.

Spring Seals of Perlast® ICE G90LT have been validated at 689bar (10,000psi) with a temperature range of -29°C (-20°F) to 177°C (350°F).

Spring Seals of EnDura® Z95X have been validated at 1,034bar (15,000psi) with a temperature range of -18°C (0°F) to 121°C (250°F) and at 1,034bar (15,000psi) with a temperature range of -5°C (23°F) to 149°C (300°F).

Spring Seals of EnDura® V91K have been validated at 689bar (10,000psi) with a temperature range of -18°C (0°F) to 155°C (311°F).

Benefits of Spring Seals and FS Seals

PPE's Spring Seals and FS Seals are available in a range of high-performance materials to ensure the correct solution is available regardless of the chemistry or temperature of the application. Our seals are fully engineered and can be designed around the individual application to provide the optimal product for extremes in temperature as well as high pressures.

- Prevent seal extrusion where there are large clearance gaps
- Easier to install than T-seals due to the integrated anti-extrusion system
- Eliminate assembly errors caused by multiple component systems such as T-seals
- Retro-fit existing grooves and glands
- Custom designs to suit individual applications
- High quality products ensure less downtime and reduced risk of failure
- Fast manufacturing and short lead times
- Comprehensive material range
- Fully engineered solutions designed to meet existing application requirements or new developments

Why PPE?

PPE is one of the world's leading manufacturers of high performance elastomer seals with an extensive range of sealing solutions specifically developed for the harsh environments encountered by the oil and gas industry. PPE has facilities in the UK, USA and Saudi Arabia providing local support to a global operating customer base.

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