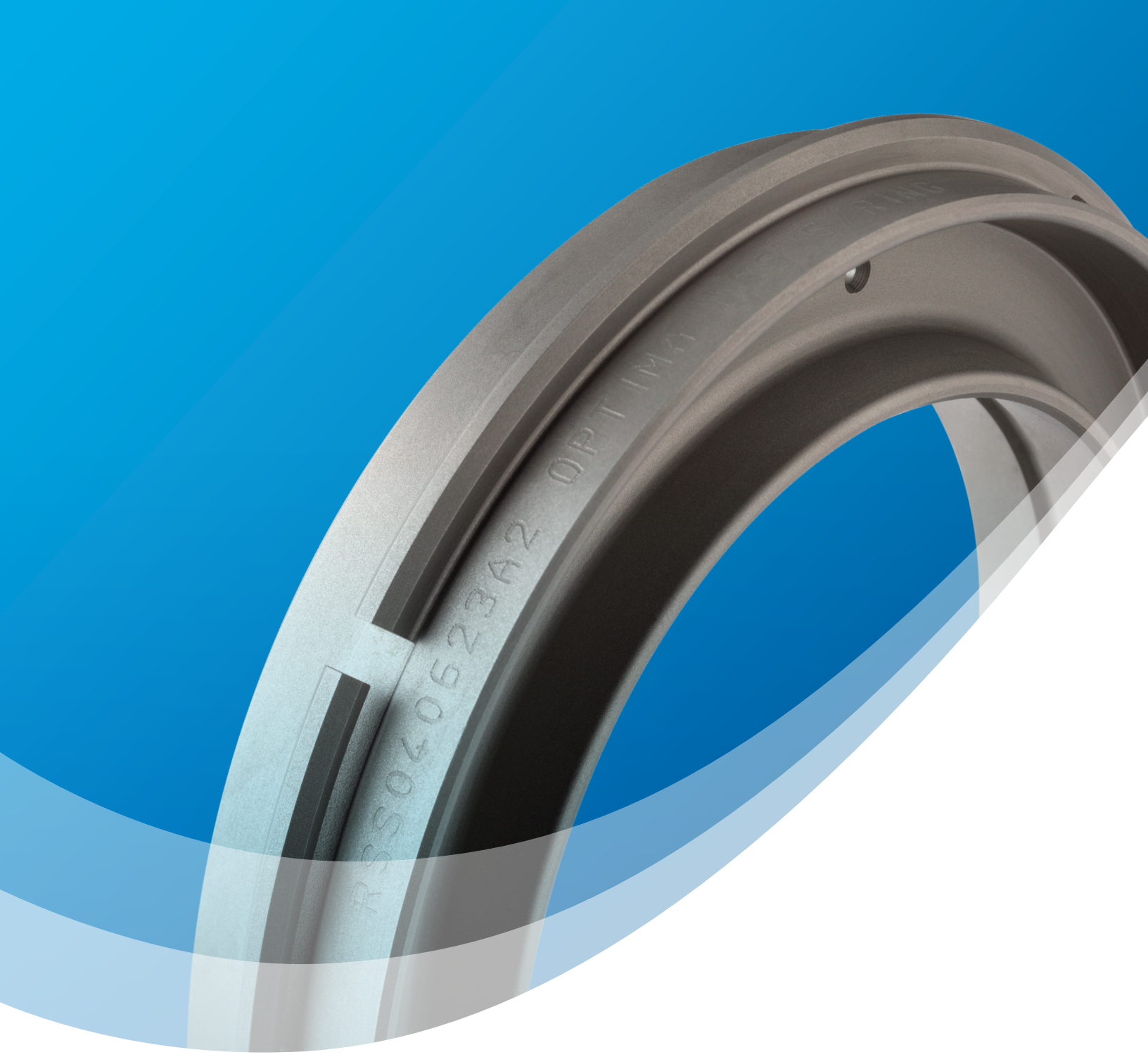

VECTOR DUOSEAL™ SEALRING

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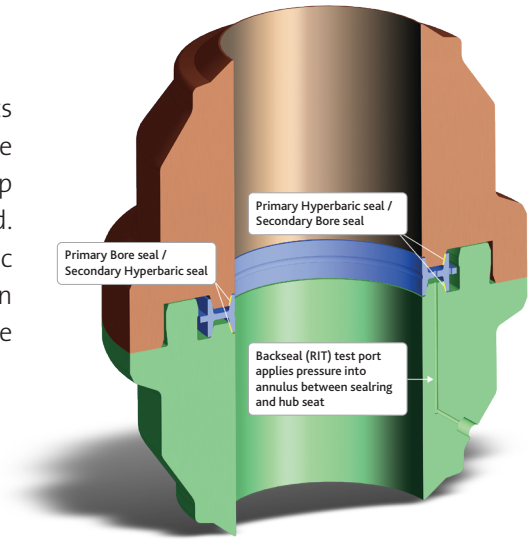
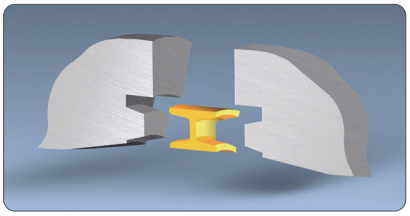
BI-DIRECTIONAL PRESSURE ENERGIZED DUAL SEAL FOR SUBSEA APPLICATIONS

The only dual acting metal-to-metal seal in the subsea connector world

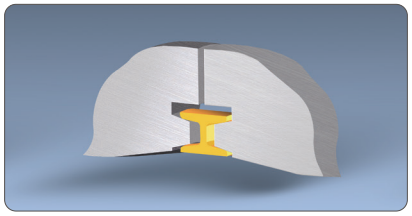
The Vector Duoseal™ is an API qualified metal-to-metal seal that prevents both internal and external leakage of fluids and gases. The joints may be Optima® subsea connectors, special or compact flanges, Techlok® clamp connectors, valve bonnets or any other joint where two seals are preferred. The bore seal capability has been PR2 qualified to 15,000 PSI. The hyperbaric seal acts to give a level of back up bore seal capability. The unique design of Vector Duoseal™ has independent internal and external seals with the capacity to carry out a reverse integrity (RIT) test on the seals.



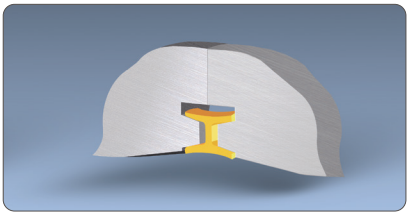
Energization: making the perfect seal



Fully open: The Duoseal is shown as being separate from both joint faces. It is most likely that the sealring would be sitting or located in one of the seat pockets.

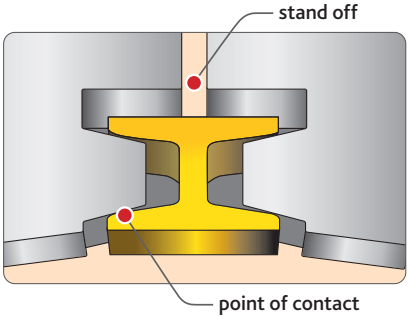


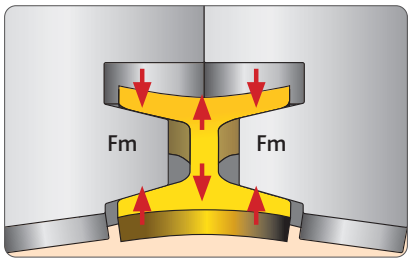
Point of stand off: Once the two faces have been pulled together, all four sealing surfaces are in contact. The stand off between the two faces can be seen.



Fully energized: The Vector Duoseal™ is self energizing from the point of standoff to fully closed. Once the joint is face to face, the sealring has gone to its maximum point of deflection. This creates the self-energization loads required for the seal to function.

It is the self-energization force "Fm" between the Vector Duoseal™ and seat that creates the initial seal of the joint. The rib between the inner and outer seals ensures energization occurs by reacting against this force.





NOTES: The self energization force is a fraction of seal geometry and is never sufficient to indent the hub faces.

OPERATING PRINCIPLES AND CHARACTERISTICS

Pressurization

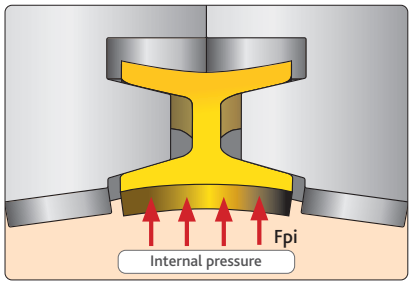
Once the joint is pressurized, the Vector Duoseal™ becomes pressure energized. This of course could be due to either internal or external pressure.

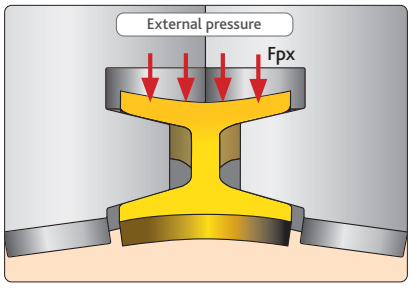
The pressure creates a seating force that further energizes either or both the inner and outer seals. In simple terms the radial sealing force for the inner and outer seals is as follows:

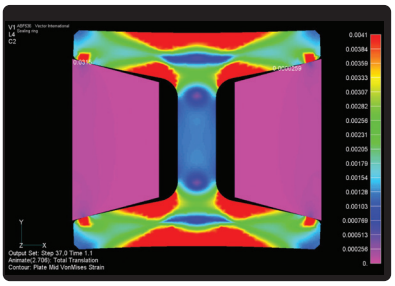
Internal sealing force = Fm + Fpi
External sealing force = Fm + Fpx

Therefore the greater the pressure the more sealing force exists. There is a maximum internal/external pressure that both the Duoseal™ and the joint can withstand; however this is much greater than normal operating pressures.

With the pressure differential between the internal and external values, the central rib will have a tendency to move towards the low pressure side. Finite Element Analysis and testing has shown that within the working limits of the Vector Duoseal™ the resulting deformations will not de-seat the outer pressure seal.







Characteristics

- Field proven up to NPS 36” and qualified at pressures up to 20,000psi
- For use in depths up to and exceeding 13,125ft (4,000m)
- Subsea, bidirectional, pressure energized sealing system provides internal and external pressure integrity
- Reusable seal which can be used as an integral part of the Vector Optima® connector, Vector Techlok® clamp connector or other licensed manufacturer products
- Spring retention: Sealring can be removed/replaced by ROV using dedicated Vector tooling (*1)

(*1) Also available:
- Seal Face cleaning tool
- Seal Removal tool

Downloadable version of flyer can be found online.

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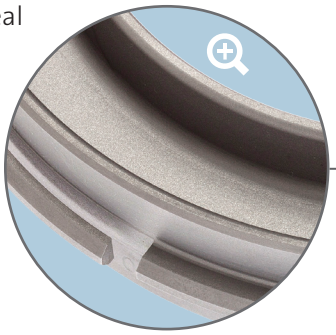
VECTOR DUOSEAL™ WITH RETENTION FINGERS

The retention fingers on the Vector Duoseal™ are designed to locate in a special groove on the inside profile of the male Optima® hub. The profile of the fingers and the special groove give a positive location for the Vector Duoseal™ to prevent accidental release due to impact or shock loads, while allowing the Seal Removal Tool to be inserted and reliably remove the sealring when required. The number of fingers depends on the size of the sealring.



(*1) Also available:
- Seal Face cleaning tool
- Seal Removal tool

Downloadable version of flyer can be found online.

Material selection & functionality

The Vector Duoseal™ can be manufactured from various materials, however most Duoseal™ sealrings installed subsea are made from Alloy 725 or similar. These materials are selected to utilize the higher strength and flexibility of the material. The seal face is inlaid with Alloy 625.

Standard gaskets (such as API 6A BX gaskets) are crushed into place when the connection is made, requiring the seal faces to be harder than the sealrings. The Duoseal™ does not operate in this fashion. It is energized predominantly in the elastic range of the material, so there is no need to have the seal face harder than the sealring.

Application	Hub/seat material	Recommended Duoseal™ Material	Comments
Subsea	Alloy 625 overlay	Alloy 725 Alloy 716 High strength Low alloy steel	Standard supply for all subsea applications For hydrotest and FAT only - at clients request
Topside piping and valves	Alloy 625 overlay Carbon Steel	Alloy 725 Alloy 716 High strength Low alloy steel	
Pressure Vessels	Various: dependent on vessel construction.	Suitable compatible high strength material	Seal selection on a "case by case" basis

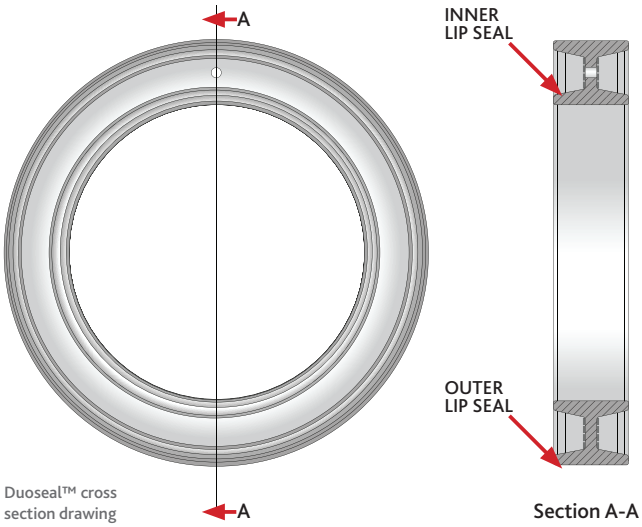
NOTE: Standard DUOSEALS are supplied with a MoS2/Graphite coating for low friction during assembly. For subsea service, silver coated sealrings are also available.

ANNULUS TEST AND DIMENSIONAL DATA

Annulus Test

The void between the inner and outer seals is ideal for carrying out a Reverse Integrity Test (RIT). This test will prove that the joint has been correctly assembled and that the seals are intact. The selected pressure for the RIT test is independent of either internal or external pressures and purely tests the seals pressure integrity in-situ. The RIT pressure is attempting to lift the sealring off the seat. If the force on the sealring lips is "Frit" in simple terms the following is true:

Internal sealing force = Fm – Frit
External sealing force = Fm – Frit



Duoseal™ cross section drawing

Section A-A

This means as the RIT pressure increases it will get closer to the make-up force. At the point where Fm=Frit the seal would no longer be in contact with the seat. The test is therefore set to be conservative in nature.

The Vector Duoseal™ is proven in sizes from 2" to 34" in water depths up to 13,125ft (4,000m) at temperatures ranging from –50°C to 150°C, and at pressures up to 15,000psi, making it suitable for most known subsea applications, and as an alternative to RIT rings for Topside joint integrity.

Ring Size	Outside Diameter		Inside Diameter		Ring Overall Length		Ring Weight	
	inch	mm	inch	mm	inch	mm	lbs	kg
20	3,38	85,7	2,00	50,8	0,83	21,0	0,68	0,3
24	3,88	98,4	2,50	64	0,83	21,0	0,81	0,4
30	4,38	111	3,00	76	0,83	21,0	0,93	0,4
34	4,88	124	3,50	89	0,83	21,0	1,06	0,5
40	5,63	143	4,00	102	1,00	25	1,63	0,7
44	6,13	156	4,50	114	1,00	25	1,78	0,8
50	6,63	168	5,00	127	1,00	25	1,95	0,9
54	7,13	181	5,50	140	1,00	25	2,12	1,0
60	7,75	197	6,00	152	1,13	29	3,10	1,4
64	8,25	210	6,50	165	1,13	29	3,32	1,5
70	8,75	222	7,00	178	1,13	29	3,55	1,6
74	9,25	235	7,50	191	1,13	29	3,77	1,7
80	9,75	248	8,00	203	1,13	29	4,00	1,8
82	10,00	254	8,25	210	1,13	29	4,11	1,9
84	10,25	260	8,50	216	1,13	29	4,23	1,9
86	10,50	267	8,75	222	1,13	29	4,34	2,0
90	10,88	276	9,00	229	1,19	30	5,13	2,3
94	11,38	289	9,50	241	1,19	30	5,39	2,4
100	11,88	302	10,00	254	1,19	30	5,64	2,6
104	12,38	314	10,50	267	1,19	30	5,90	2,7
110	12,88	327	11,00	279	1,19	30	6,16	2,8
114	13,38	340	11,50	292	1,19	30	6,42	2,9
120	13,88	352	12,00	305	1,19	30	6,52	3,0
124	14,38	365	12,50	318	1,19	30	6,93	3,1
130	14,88	378	13,00	330	1,19	30	7,19	3,3
134	15,38	391	13,50	343	1,19	30	7,45	3,4
140	16,00	406	14,00	356	1,25	32	8,61	3,9
144	16,50	419	14,50	368	1,25	32	9,10	4,1

Ring Size	Outside Diameter		Inside Diameter		Ring Overall Length		Ring Weight	
	inch	mm	inch	mm	inch	mm	lbs	kg
150	17,00	432	15,00	381	1,25	32	9,39	4,3
154	17,50	445	15,50	394	1,25	32	9,69	4,4
160	18,00	457	16,00	406	1,25	32	9,98	4,5
164	18,50	470	16,50	419	1,25	32	10,27	4,7
170	19,00	483	17,00	432	1,25	32	10,57	4,8
174	19,50	495	17,50	445	1,25	32	10,86	4,9
180	20,00	508	18,00	457	1,25	32	10,90	4,9
184	20,50	521	18,50	470	1,25	32	11,45	5,2
190	21,00	533	19,00	483	1,25	32	11,74	5,3
194	21,50	546	19,50	495	1,25	32	12,04	5,5
200	22,00	559	20,00	508	1,25	32	12,33	5,6
204	23,00	584	20,50	521	1,50	38	17,32	7,9
210	23,50	597	21,00	533	1,50	38	17,72	8,0
214	24,00	610	21,50	546	1,50	38	18,12	8,2
220	24,50	622	22,00	559	1,50	38	18,52	8,4
224	25,00	635	22,50	572	1,50	38	18,91	8,6
230	25,50	648	23,00	584	1,50	38	19,31	8,8
234	26,00	660	23,50	597	1,50	38	19,71	8,9
240	26,50	673	24,00	610	1,50	38	20,11	9,1
244	27,00	686	24,50	622	1,50	38	20,51	9,3
250	27,50	699	25,00	635	1,50	38	20,90	9,5
254	28,00	711	25,50	648	1,50	38	21,30	9,7
260	28,50	724	26,00	660	1,50	38	21,70	9,8
264	28,96	736	26,46	672	1,50	38	21,25	9,6
270	30,00	762	27,00	686	1,75	44	32,18	14,6
280	31,00	787	28,00	711	1,75	44	33,30	15,1
290	32,00	813	29,00	737	1,75	44	34,43	15,6
300	33,00	838	30,00	762	1,75	44	35,82	16,2

NOTES: 1) Materials for subsea use Alloy 725 or equivalent
2) Hydrotest rings available in AISI 4140
3) Intermediate and larger sizes available upon request
4) Contingency seals available for all sizes

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