



ABCO
Subsea

Proven technology
below and beyond

ABCO Subsea

Since 1981, we've saved our clients millions of dollars in downtime with our proven product lines and problem-solving innovations. From a BOP stack all the way up to the inside of a derrick, ABCO Subsea has manufactured products that increase efficiency and decrease expenses to help you bring energy to the world.



Vertebrae Bend Restrictors

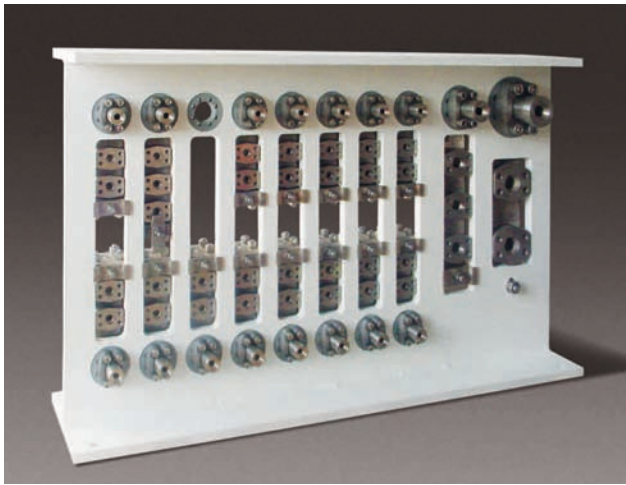
For the past 30 years, ABCO Subsea has manufactured hundreds of sturdy VBR assemblies made of polyurethane, steel or a hybrid combination of the two materials.



Clamps

Our clamping systems are installed on more than 100 offshore rigs and provide constant reliability in some of the world's harshest conditions.

- Pod hose clamps
- Umbilical clamps
- MUX clamps
- Derrick clamps
- Custom clamps



Hydraulic Valves

ABCO Subsea designed and patented the first Multi-Input Shuttle Valve more than three decades ago. Today, the company is one of the world's leading providers of BOP shuttle valves to the offshore industry.

ABCO Subsea

A family-owned company, ABCO Subsea is now a multimillion dollar corporation with products on over 100 drilling rigs around the globe. Our customer list includes all of the major drilling operators and drilling contractors around the world.



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Engineered Solutions

We take pride in being able to design custom devices for particularly challenging situations. Some of our recent engineering triumphs have included:

- A Torsion Umbilical Termination Assembly designed to interface between an umbilical and a hydraulic control system
- An Anti-Rotation Clamp Base that prevents wire rope from coiling around an umbilical under tension
- A Hydraulic Power Unit to deliver control fluids to subsea stacks and topside controls



Custom-built Umbilical Management

Our roller sheaves and arch supports are installed on dozens of rigs around the world, each custom designed to meet a client's specific umbilical requirements.

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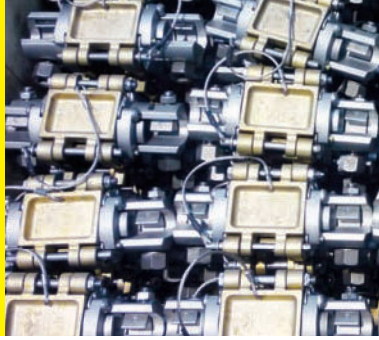




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A/R CLAMP BASE



Axially Rotating Clamp Bases grip a wire rope and allow the wire rope to rotate under the application of longitudinal tension. The A/R Clamp Base enables free movement of umbilicals in alternating currents without entanglement, and allows for clear rotation between sub-assemblies. The A/R Clamp Base is made of stainless steel and aluminum bronze.

ABCO Subsea developed the A/R Clamp Base in support of a client challenged by a wire rope becoming coiled around an umbilical during deployment.

Advantages:

- Common tooling – torque wrench socket is identical to clamps
- Secure over-water handling
- Full rotation under full load
- No loose parts



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A/R CLAMP BASE

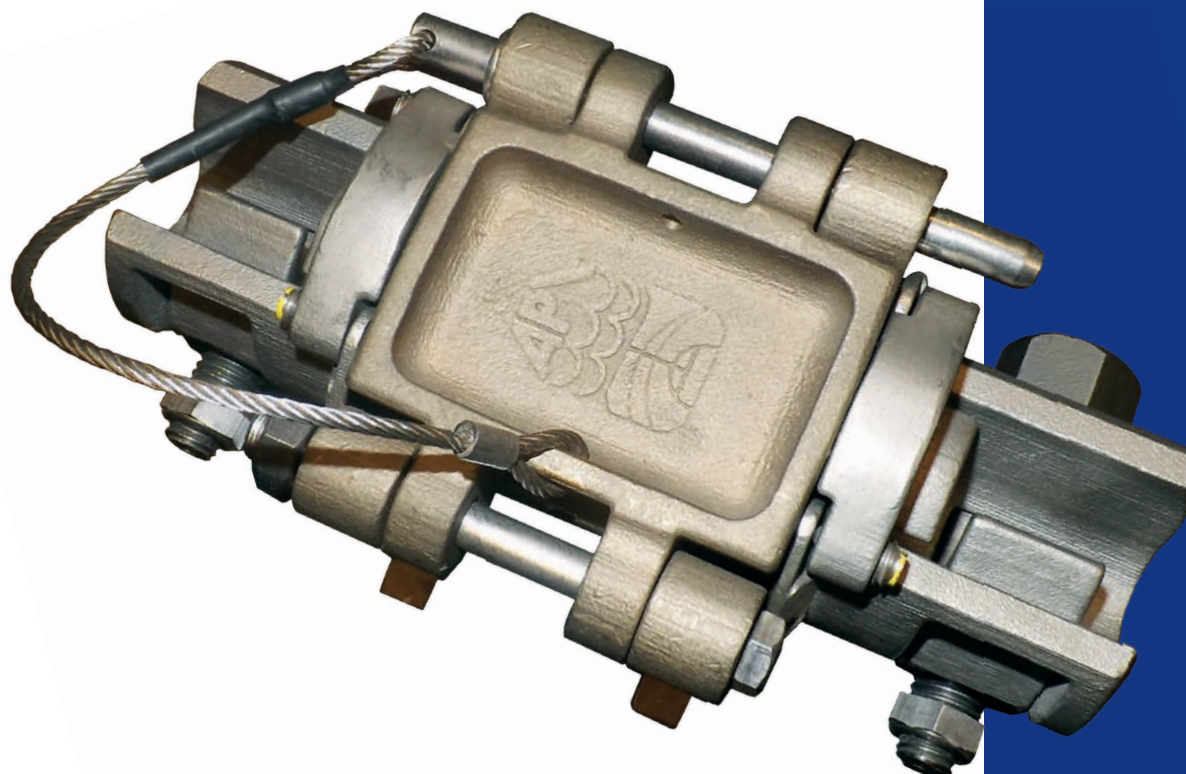
Technical Data

	AR-3 (100)	AR-3 (175)
Weight in Air:	15.4 lbs (6.98 kg)	19.5 lbs (8.84 kg)
Weight in Water:	13.7 lbs (6.21 kg)	17.2 lbs (7.80 kg)
Length:	9.1" (231.14 mm)	9.1" (231.14 mm)
Width:	4.9" (124.46 mm)	4.9" (124.46 mm)
Height:	3.5" (88.9 mm)	4.35" (107.95 mm)
Cable Size Range:	0.75 – 1.75" (19.05 – 44.45 mm)	1.5 – 2" (38.1 – 50.8 mm)

Material Specs:

AR CLAMP BASE BODY	
Material Designation	316–L Stainless Steel
Manufacturing Process	Lost Wax Investment Casting

FASTNERS	
Material Designation	316–L Stainless Steel
Manufacturing Process	Cold Formed



BEND STIFFENERS

Bend Stiffeners are used on umbilicals, cables and flexible pipe where dynamic loading creates a need for constant dynamic protection. Bend Stiffeners are made of polyurethane and may incorporate a metal insert or flange.

Advantages:

- Custom built to your application
- High durability
- Cost effective solution for dynamic load exposure

ABCO Subsea designs and manufactures Bend Stiffeners in any diameter and any length.



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BEND STIFFENERS

Technical Data



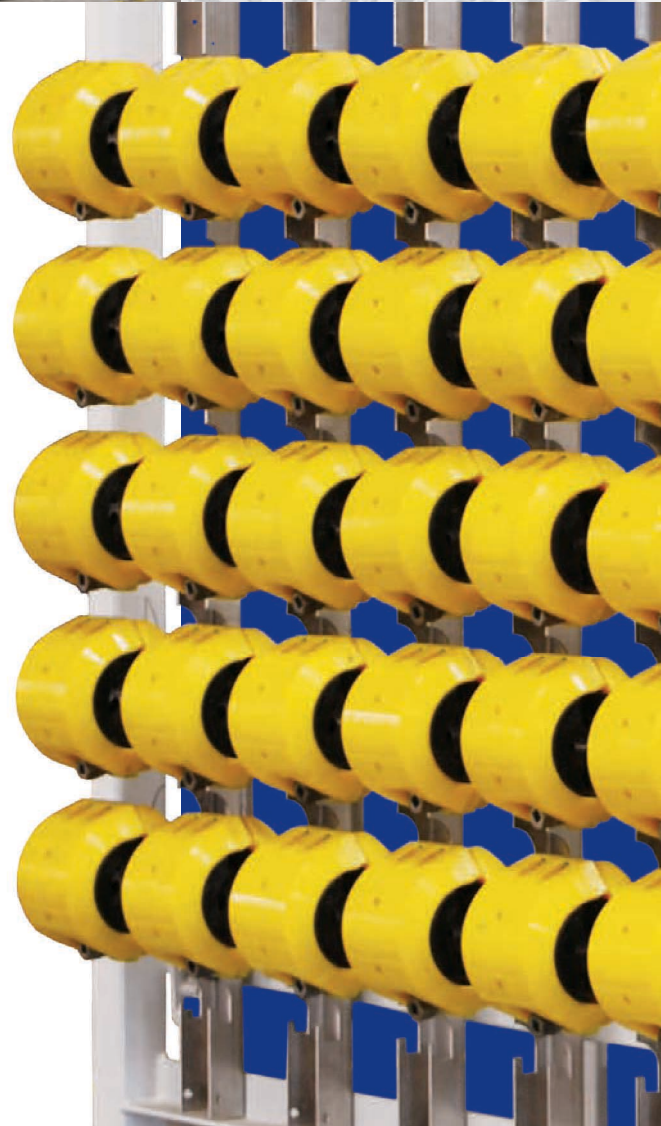
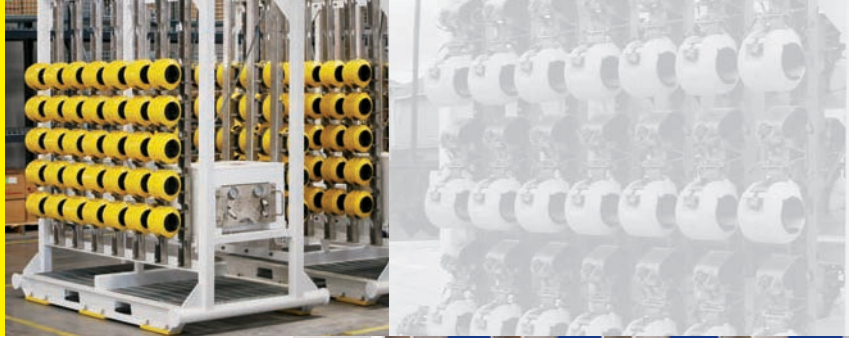
Material Specs:

Material Designation:	Ether-based Polyurethane
Durometer:	50A – 70D
Specific Gravity:	1.04 – 1.60



CLAMP RACKS

ABCO Subsea's Clamp Rack System allows customers to protect and manage clamps on a rig while also improving operational efficiencies. Clamp Racks come with a built-in storage compartment to hold wrenches, hoses, fasteners and other equipment used in the proper installation of ABCO Subsea's clamps. An air regulator allows for rig air to be brought to the rack, then regulated down to the proper pressure so that clamps are not over-torqued. Each rack comes with two 50' air hoses and two air ratchets.



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CLAMP RACKS

Technical Data



Air Regulator Data:

Inlet Pressure Range	0-125 psig
Quick Disconnect Inlet	1/2"
Supply Outlet Range	60-100 psi (30-60 ft-lbf of torque)

Structural Data:

Clamp Rack Material	Carbon Steel
Paint	3-Coat Epoxy
Welding Standards	AWS D 1.1 or ASME Section 8

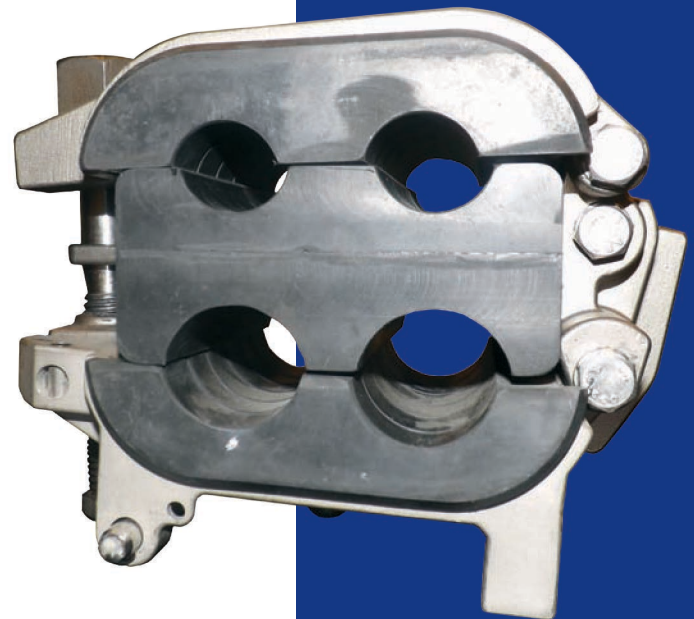
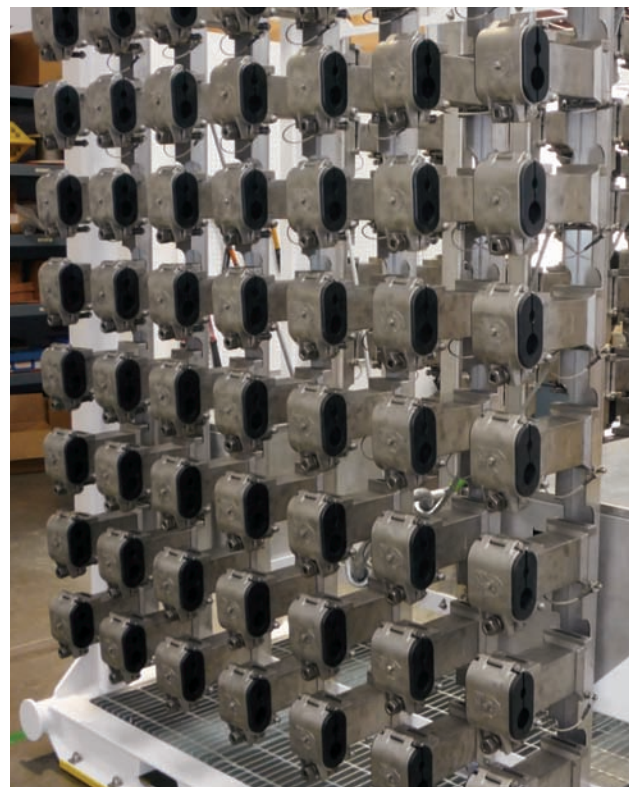


HSDW CLAMP

HSDW (High Strength Deep Water) Clamps are developed to meet the deepwater BOP control requirements of multiplex and hydraulic hot line installation on drilling risers. These clamps provide up to a sustained tension of 2000-lbf without inducing jacket slip or damaging the umbilical in the grip process. HSDW Clamps are made from stainless steel shells with customizable nitrile inserts and can be secured to a variety of mounting options.

Available in customizable sizes:

- A 2" HSDW Clamp that can hold up to 2 lines with a maximum line diameter of 2"
- A 3" HSDW Clamp that can hold up to 3 lines with a maximum line diameter of 3"
- A double-decker HSDW Clamp that can hold up to 4 lines with a maximum line diameter of 2"



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HSDW CLAMP

Technical Data



ABCO Subsea manufactures HSDW clamps in two sizes to accommodate nominal 2" and 3" lines. A Double-Decker HSDW Clamp is also available and can hold up to four lines. Generally, these clamps have a grip strength up to 2,000 lbf.

	2" HSDW Clamp	3" HSDW Clamp	Double Decker HSDW Clamp
Weight in Air:	10 lbs. (4.5 kg)	12.6 lbs. (5.7 kg)	13.57 lbs. (6.2 kg)
Weight in Water:	7.7 lbs. (3.5 kg)	8.9 lbs. (4.0 kg)	9.91 lbs. (4.5 kg)
Length:	7.05" (179.1 mm)	8.3" (210.8 mm)	7.95" (201.9 mm)
Width:	5.3" (134.6 mm)	5.3" (134.6 mm)	5.3" (134.6 mm)
Height:	4.6" (116.8 mm)	5.4" (137.2 mm)	6.4" (162.6 mm)
Pipe Size Range:	4" OD to 6.75" OD	4" OD to 6.75" OD	4" OD to 6.75" OD
# of Lines per Clamp:	1 or 2	1, 2, or 3	up to 4
Max Line OD:	2.0" (50.8 mm)	3.0" (76.2 mm)	2" (50.8 mm)

Material Specs:

CLAMP SHELL AND MOUNTING BRACKETS	
Material Designation	316 – L Stainless Steel
Manufacturing Process	Lost Wax Investment Casting
Tensile (min.)	81,000 psi
Yield (min.)	42,000 psi
Elongation at break	50%

FASTENERS	
Material Designation	316 – L Stainless Steel
Manufacturing Process	Cold Formed
Tensile (min)	85,000 psi
Yield (min)	45,000 psi
Elongation at break	50%

RUBBER INSERTS	
Material Designation	Nitrile Butadiene Rubber
Manufacturing Process	Injection Molded
Elongation at break	440%

MOUNTING OPTIONS

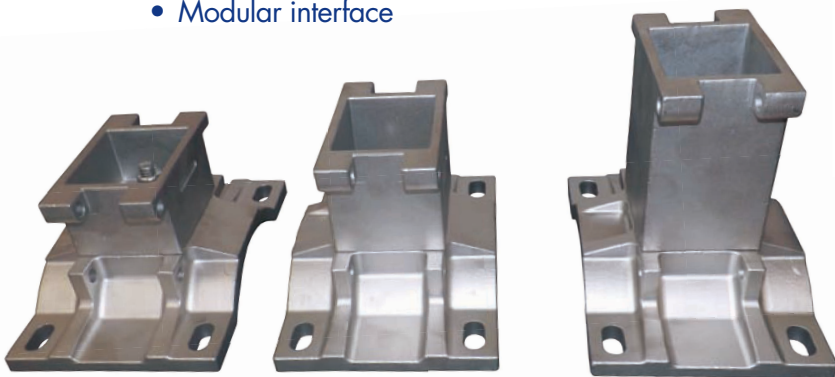
DOUBLE U-BOLT

- Urethane protection available
- Custom built to any size pipe



SADDLE BRACKETS

- 4"-6" with custom sizes available
- 316-L Stainless Steel
- Modular interface



CABLE LOCK

- Custom built based on cable size
- 316-L Stainless Steel



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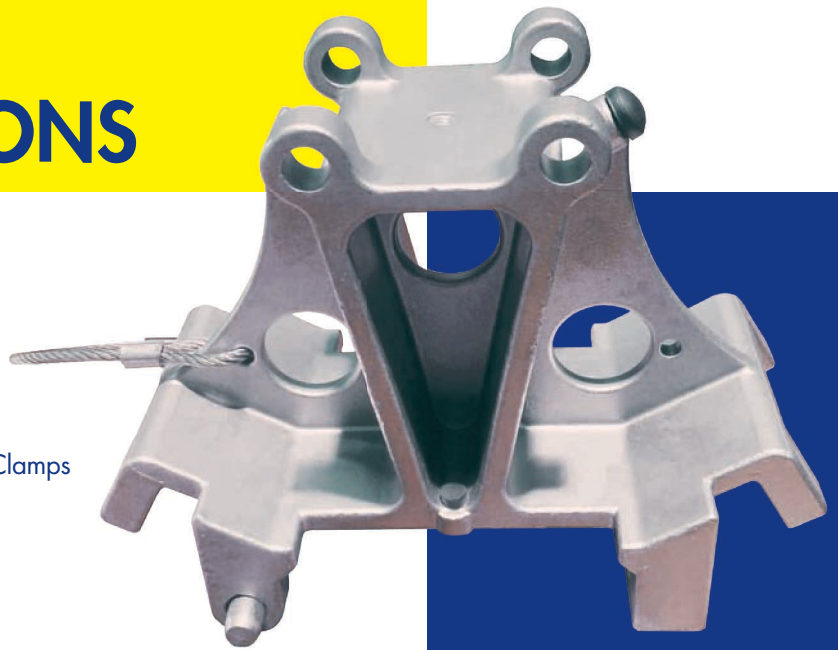
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MOUNTING OPTIONS

Y-BRACKET

- Holds two clamps
- 316-L Stainless Steel
- Modular interface with all standard ABCO Subsea Clamps



DOUBLE ADAPTER BRACKET



ADAPTER BRACKET

POLYURETHANE VERTEBRAE BEND RESTRICTORS



ABCO Subsea has manufactured and sold more than 1,200 Vertebrae Bend Restrictor (VBR) assemblies over the past 30 years. VBRs are available in polyurethane, steel or a hybrid combination of both materials. Polyurethane VBRs can accommodate lines with outside diameters ranging from 1/2" to 12" and steel VBRs can accommodate lines with outside diameters up to 16".

Advantages:

- Custom designed
- In-house design and verification testing
- Resistant to biofouling
- Standard ANSI B16.5 flange bolt pattern at interface
- Omni-directional freedom of rotation

Additional Custom Features (Available Upon Request):

- Different colors for line identification
- Hinged with fully retained locking mechanism
- Handling eyes
- Gripping segments
- Large bending range segments (only in X-series)
- Custom interface adapters



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POLYURETHANE VERTEBRAE BEND RESTRICTORS

Technical Data

* All data below applies to polyurethane vertebrae bend restrictors.

ABCO Subsea also manufactures steel VBR assemblies.

Material Specs:

Material Designation	70 D or 85 D, Ether-based Polyurethane
Manufacturing Process	Atmospheric Cast
Specific Gravity	1.16 – 1.20
Standard Color	Yellow

Design Parameters for X-Series Vertebrae Bend Restrictor (VBR)

	X150	X300	X4000	X6000
Segment Weight in Air Range:	1 lbf [4.4 N]	~1.5 lbf [~7 N]	5 - 8 lbf [22 - 36 N]	10 - 14 lbf [44 - 62 N]
Maximum ID:	1.6 in. [40.6 mm]	3.13 in. [79.5 mm]	4.25 in. [108 mm]	6.25 in. [159 mm]
Segment OD:	5 in. [127 mm]	6.5 in. [217 mm]	8.9 in. [226 mm]	11.5 in. [292 mm]
Segment Pitch Length Range:	3.7 in. [94 mm]	3.8 in. [97 mm]	7.7 in. [196 mm] 11.6 in. [295 mm] 15.4 in. [391 mm]	9.2 in. [234 mm] 11.1 in. [282 mm] 15.4 in. [291 mm]
Flange Interface Options:	2 in. CL 150	4 in. CL 300	4 in. CL 150 4 in. CL 300 6 in. CL 300	6 in. CL 150 6 in. CL 300 8 in. CL 300
LBR Options:	30 in. [762 mm] 35 in. [889 mm]	58 in. [1.5 m] 90 in. [2.3 m] 120 in. [3.0 m] 162 in. [4.1 m]	40 in. [1 m] 60 in. [1.5 m] 80 in. [2.0 m]	48 in. [1.2 m] 58 in. [1.5 m] 80 in. [2.0 m]
Typical Maximum Static Moment:	355 ft*lb [0.48 kN*m]	1.67 kip*ft [2.26 kN*m]	1.2 kip*ft [1.6 kN*m]	1.3 kip*ft [1.8 kN*m]
Typical Maximum Dynamic Moment:	500 ft*lb [0.68 kN*m]	2.33 kip*ft [3.17 kN*m]	1.7 kip*ft [2.3 kN*m]	1.8 kip*ft [2.5 kN*m]
Typical Ultimate Moment:	875 ft*lb [1.19 kN*m]	4.1 kip*ft [5.55 kN*m]	3 kip*ft [4 kN*m]	3.2 kip*ft [4.4 kN*m]

Design Parameters For Standard M-Series Vertebrae Bend Restrictor (VBR)

	M5	M7	M9	M12
Segment Weight in Air Range:	16-39 lbf [71-174 N]	27-66 lbf [120-294 N]	49-88 lbf [218-391 N]	67-127 lbf [298-565 N]
Maximum Segment ID:	5.5 in. [140 mm]	7.1 in. [180 mm]	9.5 in. [241 mm]	12 in. [305 mm]
Segment OD:	13.2 in. [335 mm]	15.7 in. [399 mm]	18.4 in. [467 mm]	22.3 in. [566 mm]
Segment Pitch Length Range:	8-32 in. [215-813 mm]	10-35 in. [254-889 mm]	14-39 in. [356-991 mm]	16-45 in. [406-1140 mm]
Flange Interface Options:	8 in. ANSI CL 300	8 in. ANSI CL 300	10 in. ANSI CL 300	12 in. ANSI CL 300
LBR Options:	63-728 in. [1.6-18.5 m]	78-777 in. [2.6-19.7 m]	92-870 in. [2.3-22.1 m]	187-1029 in. [4.8-26.1 m]
Typical Maximum Static Moment:	19.6 kip*ft [26.6 kN*m]	25.1 kip*ft [34.1 kN*m]	51.4 kip*ft [69.7 kN*m]	95.1 kip*ft [129 kN*m]
Typical Maximum Dynamic Moment:	29.4 kip*ft [39.8 kN*m]	37.7 kip*ft [51.1 kN*m]	77.1 kip*ft [104.5 kN*m]	142.6 kip*ft [193.4 kN*m]
Typical Ultimate Moment:	40.2 kip*ft [54.4 kN*m]	51.5 kip*ft [69.8 kN*m]	105.4 kip*ft [142.8 kN*m]	190.6 kip*ft [258 kN*m]

SB CLAMP

SB (Swing Bolt) Clamps are designed for securing BOP pod umbilicals and other lines. The clamps are wire or pipe mounted. SB Clamps are made from polyurethane shells, customizable nitrile rubber inserts and 316 stainless steel. SB Clamps can secure lines from 1.5" – 6" in diameter.

Advantages:

- Light weight
- Resistant to biofouling
- Durable
- No loose parts
- Common tooling

Model	Line OD	Grip Strength
SB-3	1.5" – 3.4"	<1,000 lbf
SB-4	3.4" – 4.5"	<1,200 lbf
SB-6	4.5" – 6"	<1,600 lbf



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SB CLAMP

Technical Data



	SB-3*	SB-4*	SB-6*
Weight in Air:	12.9 lbs (5.85 kg)	13.46 lbs (6.10 kg)	17.54 lbs. (7.95 kg)
Weight in Water:	7.2 lbs (3.26 kg)	9.2 lbs (4.17 kg)	9.8 lbs. (4.44 kg)
Length:	6.5" (165.1 mm)	6.7" (170.2 mm)	6.5" (165.1 mm)
Width:	7.5" (190.5 mm)	7.7" (195.6 mm)	9.47" (240.53 mm)
Height:	7.9" (200.66 mm)	9.4" (238.76 mm)	11" (279.4 mm)
Max Line OD:	3.4" (86.36 mm)	4.5" (114.3 mm)	6" (152.4 mm)

*Measurements include Clamp assembled with an adapter bracket.

Material Specs:

CLAMP SHELL	
Material Designation	Polyurethane
Manufacturing Process	Atmospheric Cast

BRACKETS AND MOUNTING HARDWARE	
Material Designation	316 – L Stainless Steel
Manufacturing Process	Lost Wax Investment Casting
Tensile	81,000 psi
Yield	42,000 psi
Elongation	50%

RUBBER INSERTS	
Material Designation	60 – 4 Nitrile Rubber
Manufacturing Process	Injection/Compression Molded
Tensile	3,200 psi
Elongation	480%

MULTI-INPUT SHUTTLE VALVES



ABCO Subsea patented the first Multi-Input Shuttle Valves for the offshore industry more than 30 years ago. The valves are manufactured with two to seven input ports.

Advantages:

- Flexible unitization
- Modular design
- 90 degree port orientation
- Efficient piping/hosing options
- Custom interface available
(NPT, SAE, Autoclave, UN O-Ring, others)
- API 16 compliant

Size	Ports	Standard Working pressure*
.25"	2 – 7	6,000 psi
.5"	2 – 7	6,000 psi
1"	2 – 7	6,000 psi
1.5"	2 – 7	6,000 psi

* Higher pressures available

ABCO Subsea offers a recertification program for its valves deployed in the field where customers are welcome to return valves to be re-tested and certified for extended use. ABCO Subsea also provides training courses on the maintenance and assembly of its BOP hydraulic shuttle valves.



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MULTI-INPUT SHUTTLE VALVES

Technical Data



Available Port and Pressure Ratings:

Port Specification	Size-inch	MAOP-psi
NPT	1/4 through 1/2"	4,500
UN O-Ring	7/16"	5,000
	3/4"	5,000
	1 through 1 1/2"	3,000
SAE Flange	1/2 through 1 1/2"	6,000
Autoclave	9/16"	10,000

Flow Coefficient:

Valve Size	Flow Coefficient
1/4"	4
1/2"	8
1"	16
1-1/2"	24



STEEL VERTEBRAE BEND RESTRICTORS



ABCO Subsea has manufactured and sold more than 1,200 Vertebrae Bend Restrictor (VBR) assemblies over the past 30 years. VBRs are available in polyurethane, steel or a hybrid combination of both materials, and can accommodate lines with outside diameters (OD) ranging from 1/2" to 16." Steel VBRs are normally manufactured to accommodate lines with ODs ranging from 4-16".

Advantages:

- Custom designed for larger load conditions
- In-house design verification and FEA stress analysis
- Cathodic anodes available
- Unique cartilage joint design
- In-house load testing



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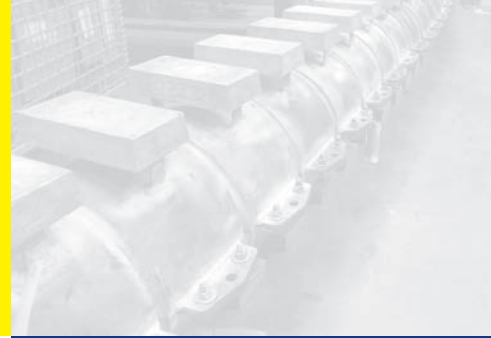
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STEEL VERTEBRAE BEND RESTRICTORS

Technical Data



Material Specs:

Steel Strength	36 –70 ksi yield
Anode	Aluminum Alloy
Subsea Epoxy Coating	3-part
Stress Wafer	70 –D Ether-based Polyurethane

