

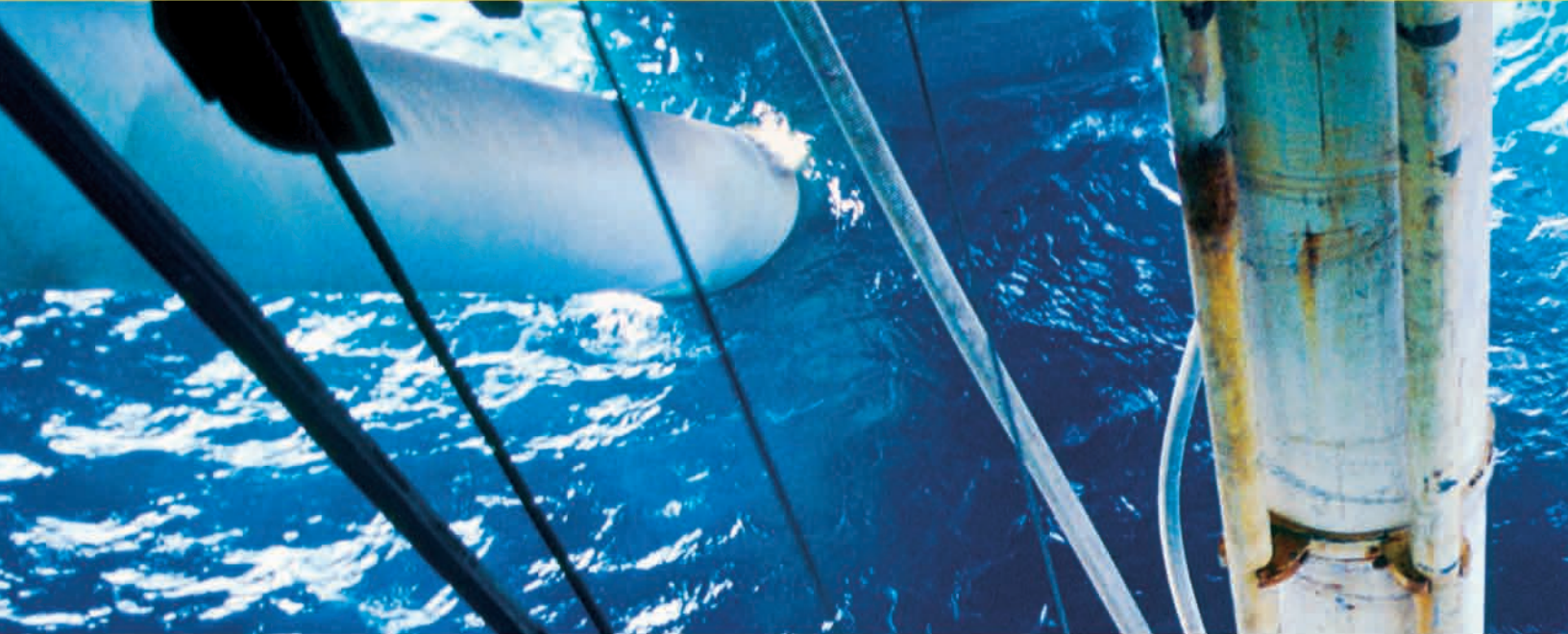


ABC
Subsea

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

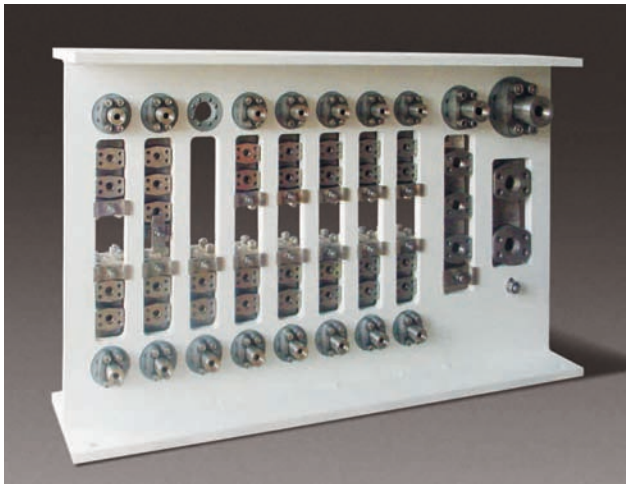
For the past 30 years, ABCO Subsea has manufactured hundreds of sturdy VBR assemblies made of polyurethane, steel or a hybrid combination of the two materials.



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 Topside 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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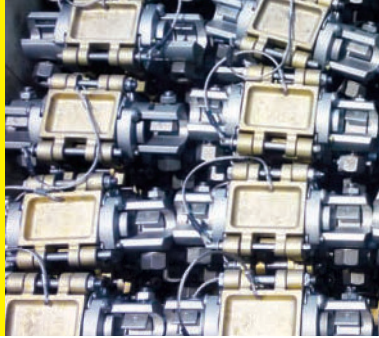




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A/R CLAMP BASE



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.

ABCOSubsea 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

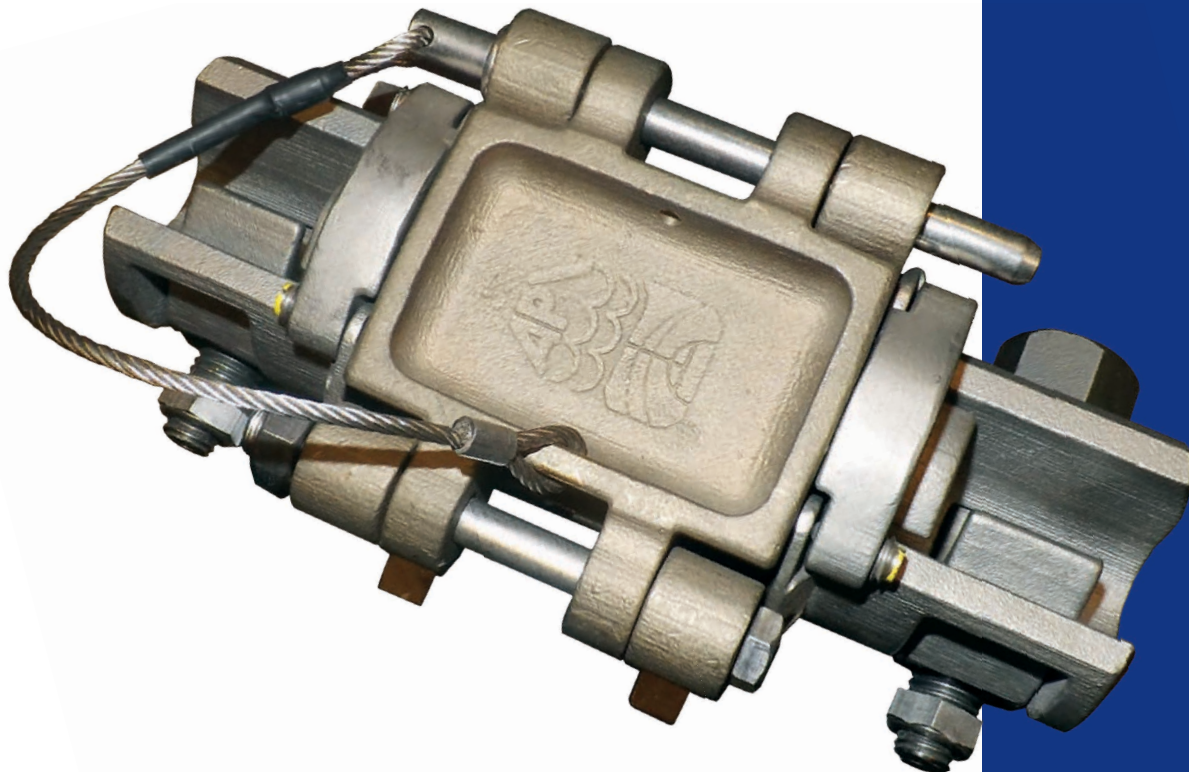
Technical Data

| | 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

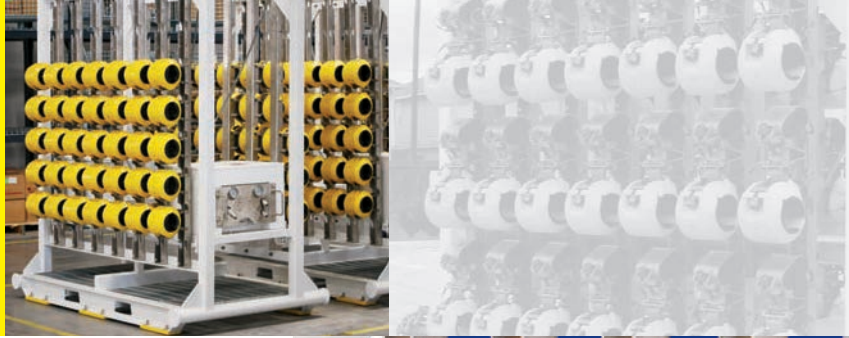


Material Specs:

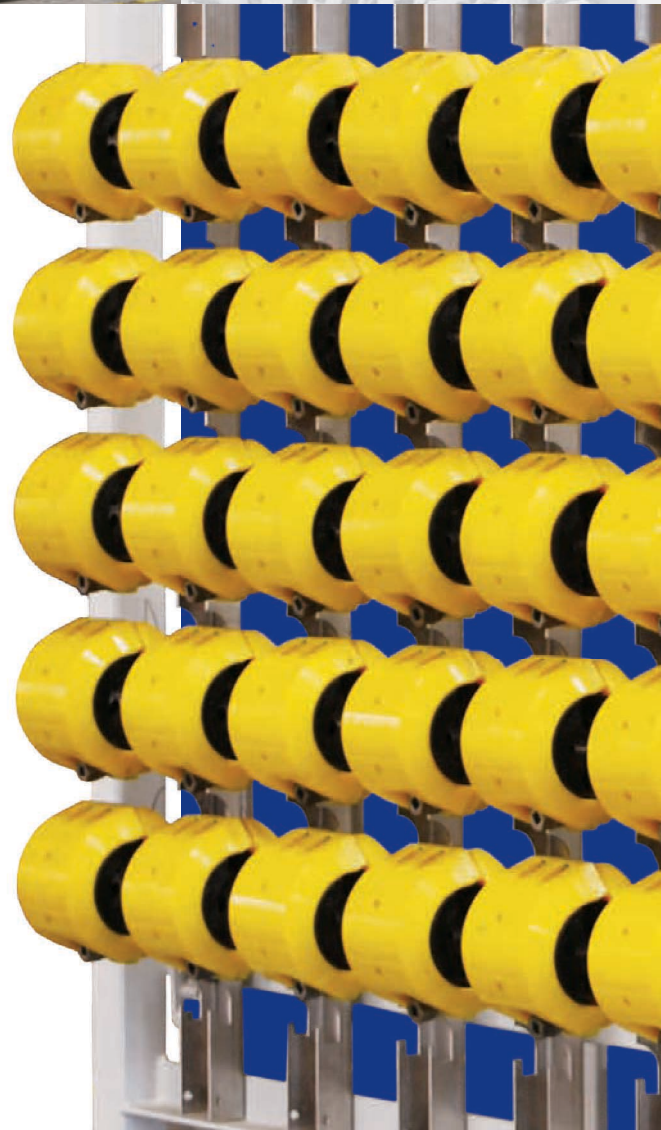
| | |
|-----------------------|--------------------------|
| Material Designation: | Ether-based Polyurethane |
| Durometer: | 50A – 70D |
| Specific Gravity: | 1.04 – 1.60 |



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 |



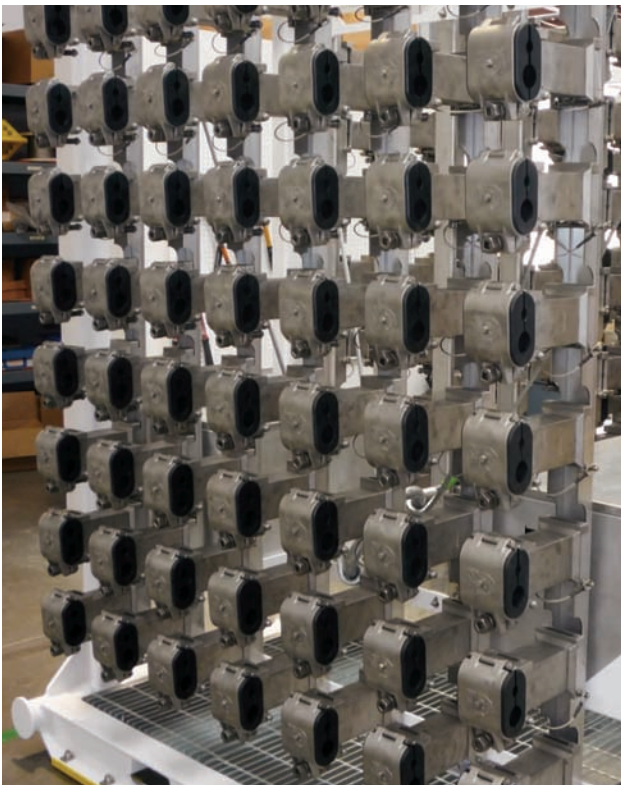
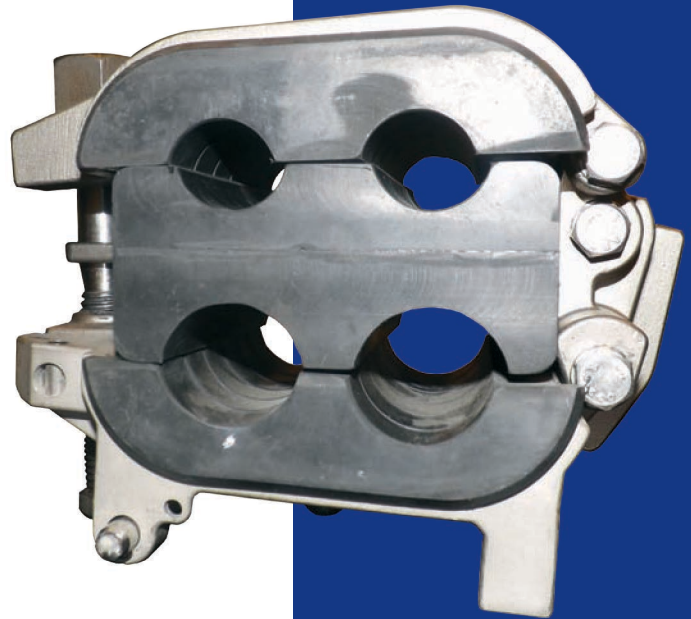
HSDW CLAMP



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% |

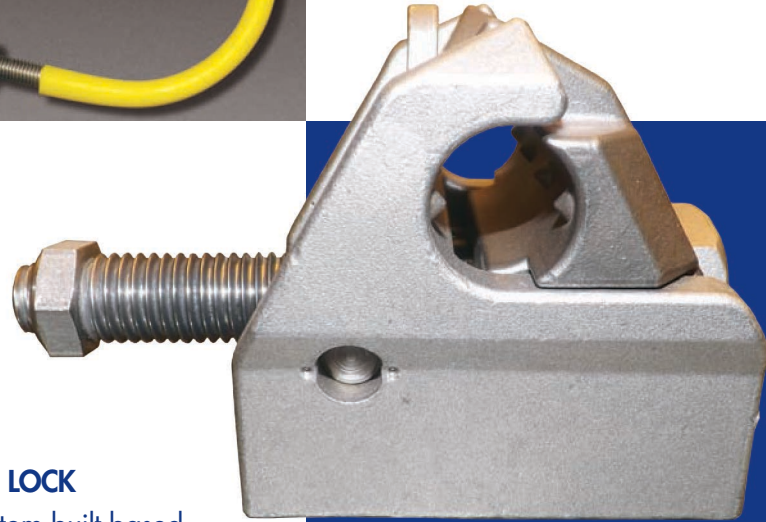
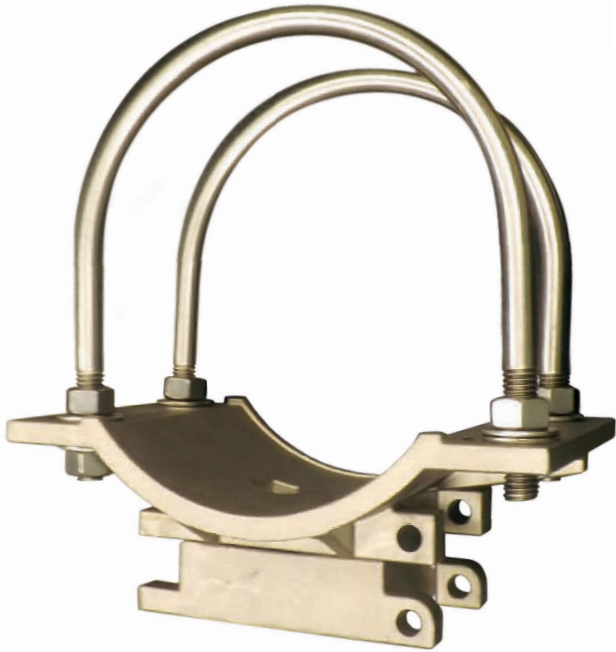
| RUBBER INSERTS | |
|-----------------------|--------------------------|
| Material Designation | Nitrile Butadiene Rubber |
| Manufacturing Process | Injection Molded |
| Elongation at break | 440% |

MOUNTING OPTIONS



DOUBLE U-BOLT

- Urethane protection available
- Custom built to any size pipe



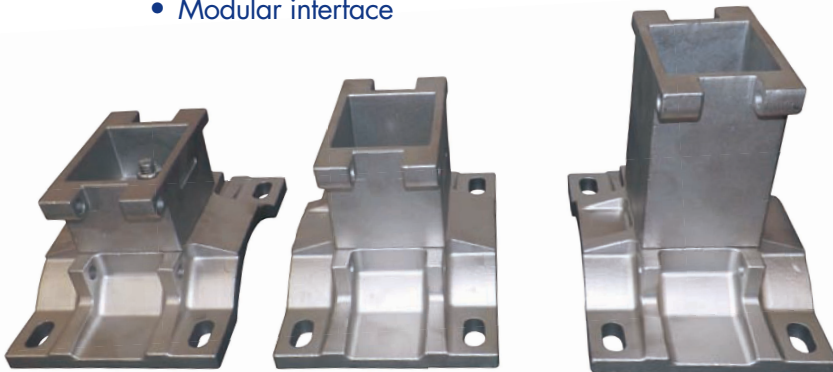
CABLE LOCK

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



SADDLE BRACKETS

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



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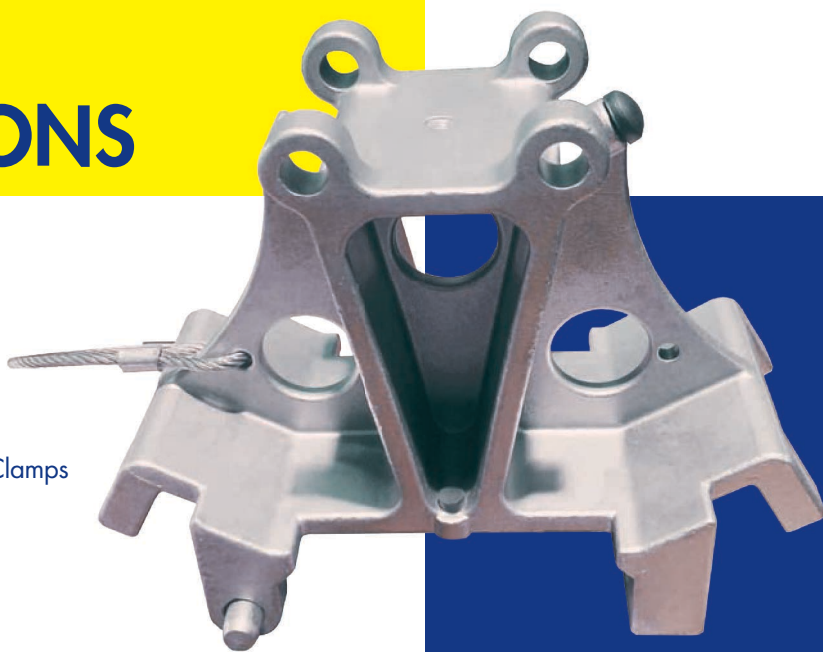
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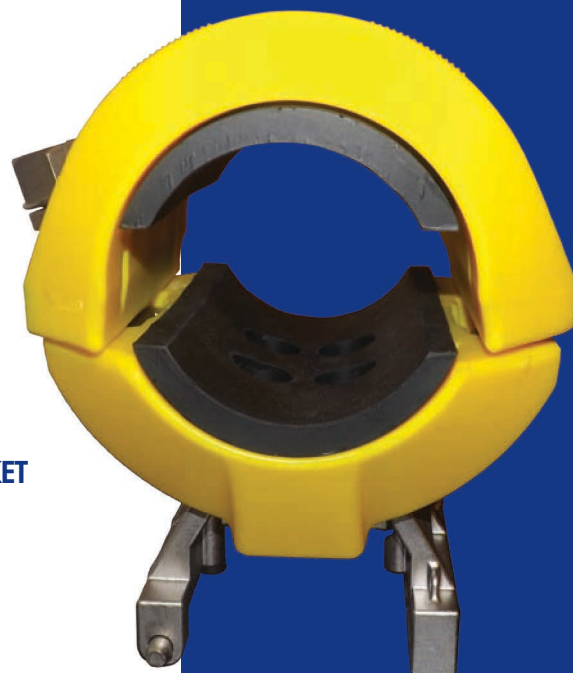
MOUNTING OPTIONS

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, and can accommodate lines with outside diameters (OD) ranging from 1/2" to 16". Polyurethane VBRs are generally manufactured to accommodate lines with ODs ranging from 1.5–2.5".

Advantages:

- Custom designed
- In-house design and verification testing
- Neutrally buoyant
- Resistant to biofouling



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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 Design (Fixed Pitch Length)

| | 1.5" | 3" LW | 3" | 4" | 5" |
|------------------------------------|--------------|--------------|--------------|--------------|--------------|
| Assembly PN's: | 2288.xx | 2473.xx | 2280.xx | 2012.xx | 2208.xx |
| Weight per segment in air (lbs): | 1.04 | 1.45 | 5.80 | 5.06 | 6.83 |
| Weight per segment in water (lbs): | 0.12 | 0.17 | 0.68 | 0.59 | 0.80 |
| Nom. Max Segment ID: | 1.75" | 3.125" | 3.125" | 4.25" | 5.50" |
| Max Umbilical OD: | 1.63" | 3.0" | 3.0" | 4.125" | 5.375" |
| Segment OD: | 5.0" | 6.59" | 8.55" | 9.36" | 10.61" |
| Segment Pitch Length: | 3.68" | 3.81" | 7.33" | 6.03" | 6.10" |
| Flange Interface: | 4"-300# ANSI | 4"-300# ANSI | 4"-300# ANSI | 6"-300# ANSI | 6"-300# ANSI |
| Min Locking Bend Radius: | 20" | 22" | 40" | 40" | 54" |
| Static Moment (ft.lbf): | 380 | 1,290 | 1,920 | 2,250 | 4,720 |
| Dynamic Moment (ft.lbf): | 565 | 1,880 | 2,790 | 3,270 | 6,880 |
| Ultimate Moment (ft.lbf): | 880 | 2,910 | 4,330 | 5,080 | 10,670 |

Long Radius Design (Variable Pitch Length)

| | M4 | | M5 | | M7 | | M9 | |
|--|---------------|-------------|---------------|-------------|---------------|--------------|----------------|-------------|
| Assembly PN's: | 2510.xx | | 2782.xx | | 2924.xx | | 2874.xx | |
| Segment OD: | 11.75" | | 13.25" | | 15.70" | | 18.37" | |
| Flange Interface: | 8"– 300# ANSI | | 8"– 300# ANSI | | 8"– 300# ANSI | | 10"– 300# ANSI | |
| Nom. segment ID: | min 2.75" | max 4.3" | min 4.25" | max 5.5" | min 3.63" | max 7.13" | min 7.13" | max 9.5" |
| Typical Static Moment (ft.lbf): | 10,930 | | 18,500 | | 25,130 | | 51,390 | |
| Typical Typical Dynamic Moment (ft.lbf): | 16,930 | | 27,750 | | 37,690 | | 77,090 | |
| Ultimate Moment (ft.lbf): | 22,400 | | 37,930 | | 51,510 | | 105,400 | |
| Locking Bend Radius: | min 52" | max 398" | min 63" | max 730" | min 78" | max 777" | min 75" | max 870" |
| Segment Length: | 13.5" | 39.6" | 13.0" | 36.7" | 16.0" | 40.3" | 17.2" | 44.2" |
| Weight per segment in air (lbs): | 13.7 | 39.4 | 15.8 | 38.9 | 28.9 | 73.7 | 37.5 | 90.4 |
| Weight per segment in water (lbs): | 2.0 | 5.8 | 2.3 | 5.7 | 4.2 | 10.8 | 5.5 | 13.2 |

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

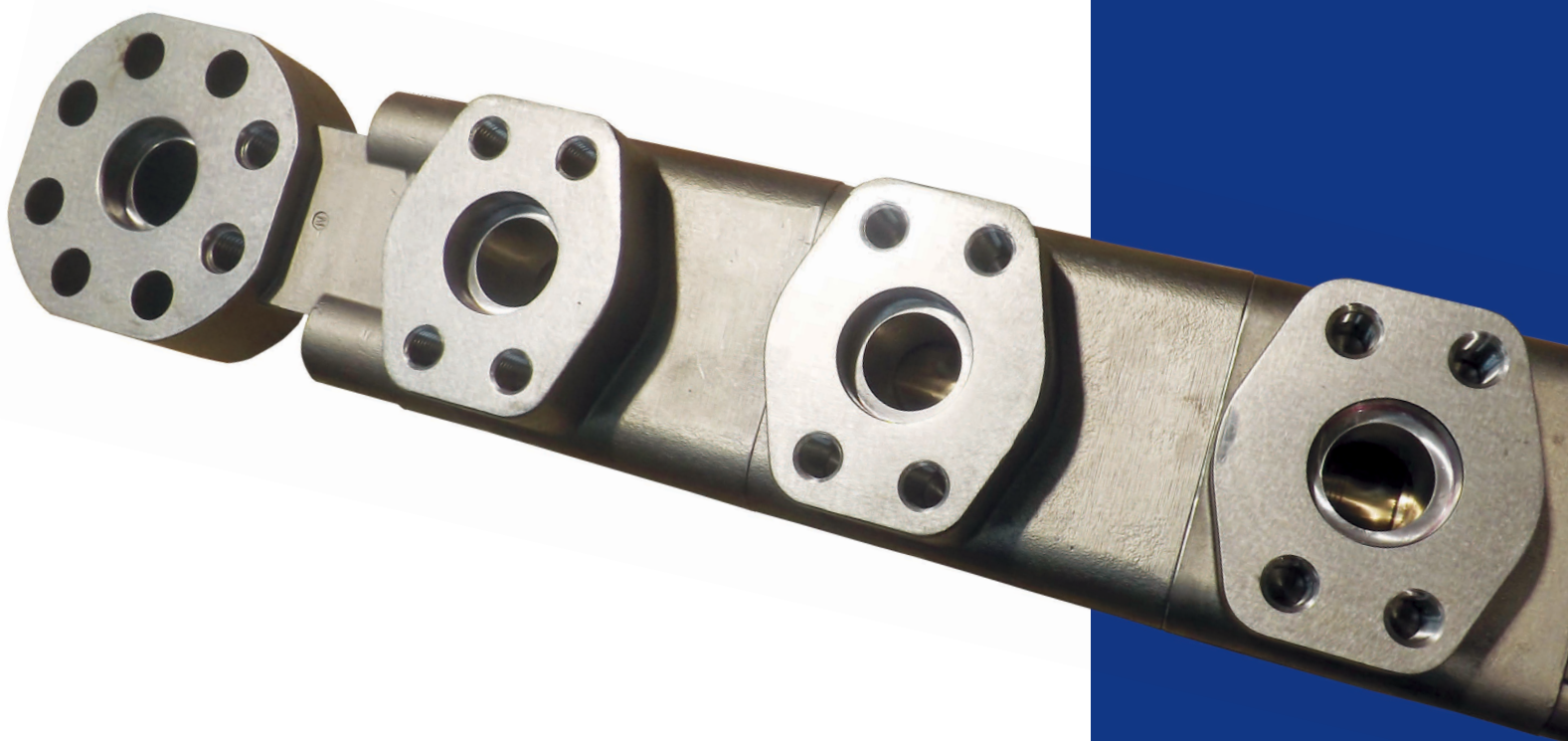


Available Port and Pressure Ratings:

| 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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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 |

