

# Pressure Control Equipment



Trust us with your most valuable asset, your people.

Putting safety first and backed by decades of experience in pressure control manufacturing, our equipment line is a trusted industry name comprising of brands such as Shaffer™, T3™, and Koomey™. From dependable, configurable BOP stacks to the BOP control system supporting them, we provide you with what you need to keep your crew safe, your rig operating smoothly and your well under control. We also stand behind our products in the field through support from any of our aftermarket locations.

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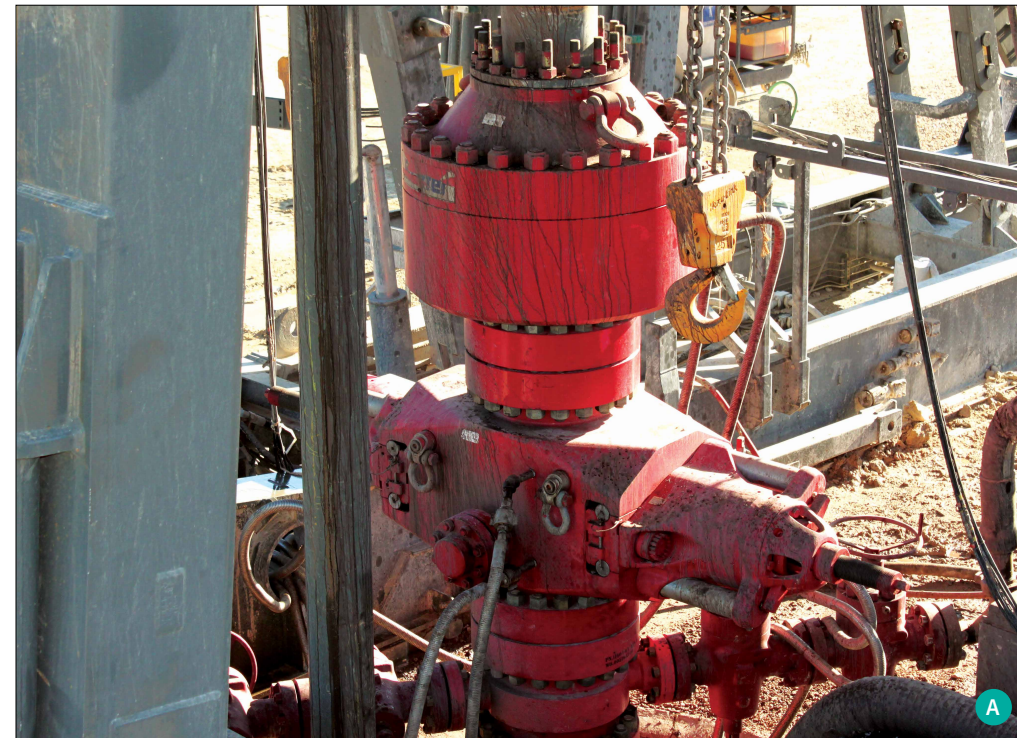


## Shaffer™ Spherical BOP

As the first line of defense in controlling your well, your spherical BOP needs to be responsive, able to tackle the first sign of unwanted well pressure. Stepping up to the challenge, our hydraulically actuated Shaffer™ Spherical BOP seals around the pipe or the unoccupied well bore to stand guard against unwanted pressure. Combined with our rugged Ram BOPs to form the rest of your BOP stack, our well control equipment is continually working to protect your people and your assets.

# Features and Benefits

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A. BOP stack: LXT Single Ram BOP (bottom) and Spherical BOP (top)

**Simple, reliable construction so you can trust your BOP to operate independent of working conditions**

- Compact
  - Construction consists of only five major parts
- Wide range of tubular size accommodations**
- Can reliably seal on almost any shape or size of kelly, drill pipe, tool joint, drill collar, casing or wireline

**Simple actuation for consistent performance**

- Hydraulically operated piston closes the packing element in a smooth simultaneous upward and inward motion
- Simple hydraulic system; only two hydraulic connections required
- Sealing element provides positive seal after hundreds of tests to full working pressure

**Easy operation for maximized uptime**

- Wear rings on moving parts prevent metal-to-metal contact to help eliminate costly repairs
- Simple construction reduces number of moving parts - only five major parts: upper and lower housing, sealing element, adapter ring and piston

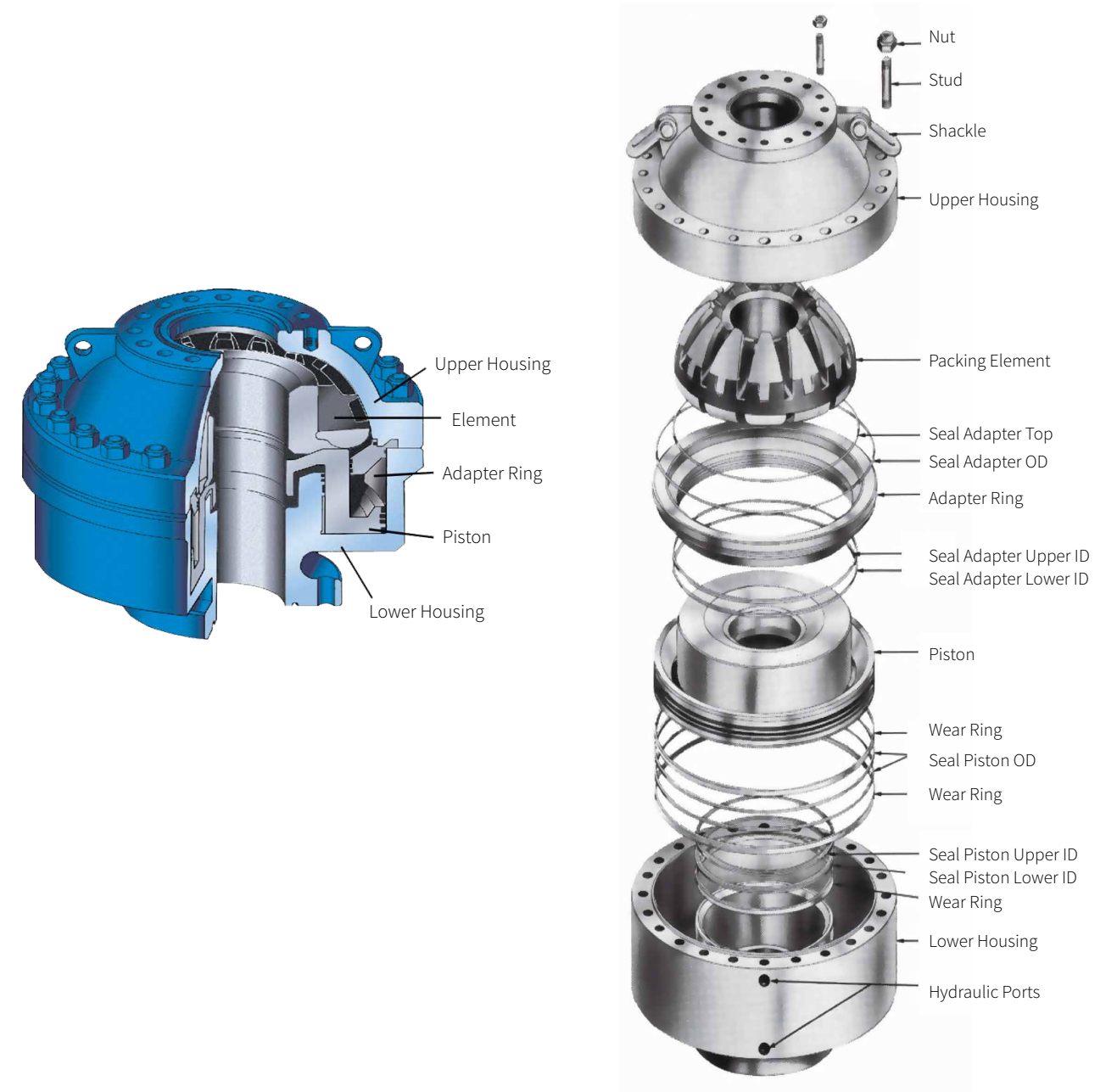
**Certifications**

- Suitable for H<sub>2</sub>S Service per NACE MR0175
- Manufactured and monogrammed with API Specification 16A
- Manufactured in accordance with NACE MR0175 per API Specification 16A, Temperature T20, Standard nitrile packing element: 40°F to 180°F

To accommodate a wide range of sizes and pressures, the Shaffer™ Spherical BOP comes in two different configurations - bolted cover and wedge cover - covered in more detail on the next pages. Additionally, we also provide a more in-depth look at the sealing element, the main component of producing a reliable, positive seal every time.

# Bolted Cover Configuration

- Allows the spherical BOP to accommodate smaller sizes and lower working pressures
- Upper housing fastens to the lower housing with studs and nuts



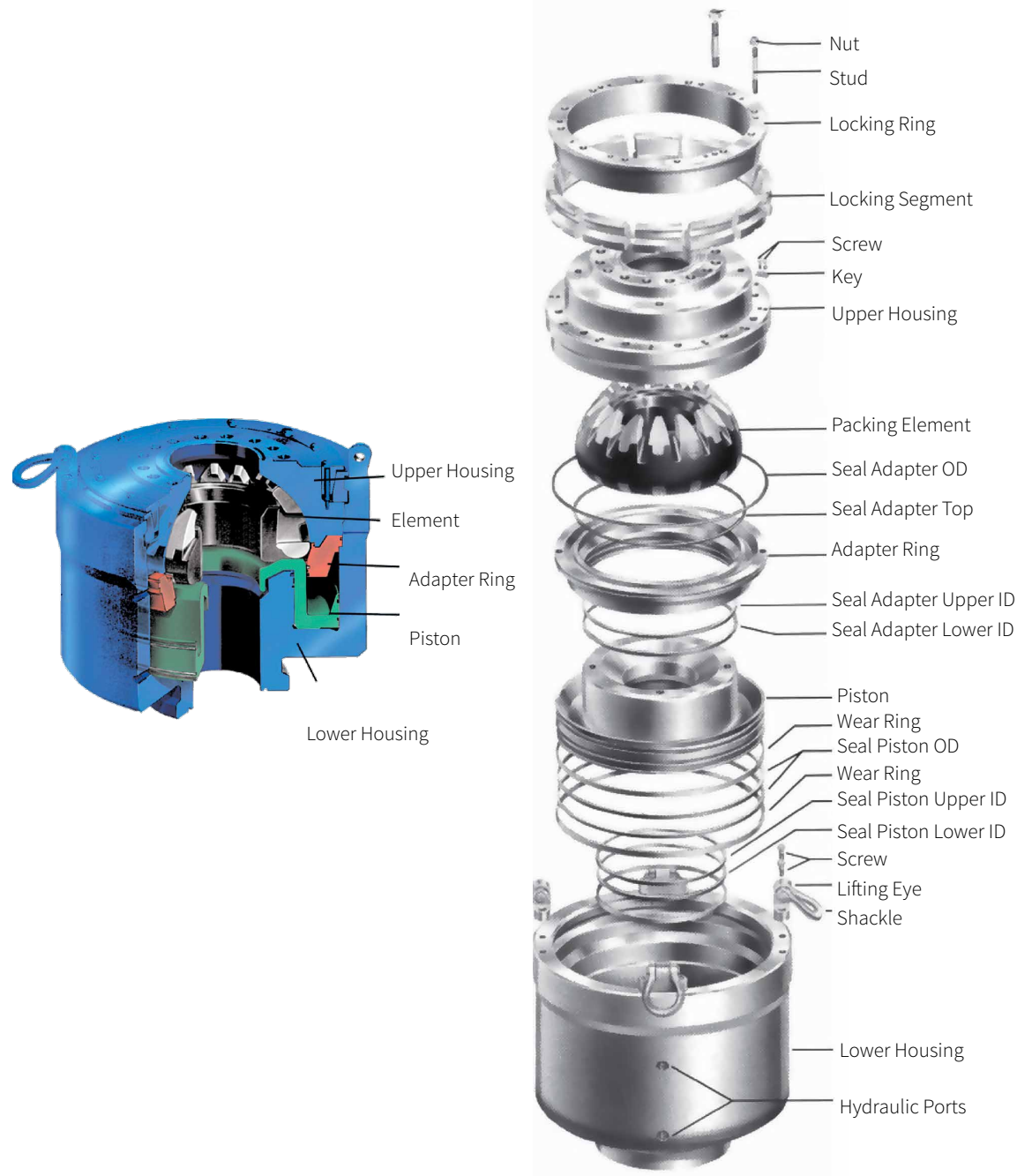
Specifications

Spherical BOP - Bolted Cover Configuration

| Working Pressure (psi) | Bore Size (inches) |        |   |    |        |        |        |        |        |              |
|------------------------|--------------------|--------|---|----|--------|--------|--------|--------|--------|--------------|
|                        | 4 1/16             | 7 1/16 | 9 | 11 | 13 3/4 | 16 3/4 | 18 3/4 | 20 3/4 | 21 3/4 | 30 (not API) |
| 10,000                 | X                  | X      |   |    |        |        |        |        |        |              |
| 5,000                  |                    | X      | X | X  | X      |        |        |        |        |              |
| 3,000                  |                    | X      | X | X  |        |        |        | X      |        |              |
| 2,000                  |                    |        |   |    |        |        |        |        | X      |              |
| 1,000                  |                    |        |   |    |        |        |        |        |        | X            |

# Wedge Cover Configuration

- Allows the spherical BOP to accommodate larger sizes and higher working pressures
- Upper housing fastens to the lower housing with locking segments and locking ring



## Specifications

Spherical BOP - Wedge Cover Configuration

| Working Pressure (psi) | Bore Size (inches)             |                                |   |    |                                |                                |                                |                                |                                |              |
|------------------------|--------------------------------|--------------------------------|---|----|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------|
|                        | 4 <sup>1</sup> / <sub>16</sub> | 7 <sup>1</sup> / <sub>16</sub> | 9 | 11 | 13 <sup>5</sup> / <sub>8</sub> | 16 <sup>3</sup> / <sub>4</sub> | 18 <sup>3</sup> / <sub>4</sub> | 20 <sup>3</sup> / <sub>4</sub> | 21 <sup>3</sup> / <sub>4</sub> | 30 (not API) |
| 10,000                 |                                |                                |   | X  | X                              |                                | XX                             |                                |                                |              |
| 5,000                  |                                |                                |   |    | X                              | XX                             | XX                             |                                | XX                             |              |
| 3,000                  |                                |                                |   |    |                                |                                |                                |                                |                                |              |
| 2,000                  |                                |                                |   |    |                                |                                |                                |                                |                                |              |
| 1,000                  |                                |                                |   |    |                                |                                |                                |                                |                                |              |

XX - Wedge and Dual Wedge Configurations Available

# 13<sup>5</sup>/<sub>8</sub>" 5,000 psi SBOP Sealing Element



B. Sealing Element for Spherical BOP

### A more in-depth look

- Custom-molded hemispherical shapes of proprietary elastomer, reinforced with steel segments
- Seated in the Spherical BOP (SBOP) and compressed during closing to create sealing barrier at interface
- To close, piston pushes the bottom of element upward against the spherical shape of upper housing, carrying the rubber toward the center of the bore and closing around the drill string
- Steel segments move into wellbore to support rubber as it contains the well pressure below
- If no drill string is in the BOP, the piston continues to rise, forcing element to seal across open bore to create a complete shut off (CSO)

### Testing

- API qualification testing conducted on 13-5M Shaffer™ SBOP element's elastomer compound and 275°F critical service elastomer per API 16A
- Factory Acceptance Testing conducted on each element prior to conducting API qualification tests
- Nitrile elastomer and high temperature tests

### Passed API Specification 16A:

- API Fatigue
- API Low Temperature, including 33°F
- API High Temperature, including 275°F
- API Sealing Characteristics



## Ram BOPs

To further control your well pressures and safeguard your crew and equipment, Ram BOPs supplement the spherical BOP on your BOP stack to provide another layer of protection. These BOPs operate differently from the Spherical BOP by applying pressure to the pipe through a set of block rams acting horizontally against each other to control unwanted pressure. Our Ram BOPs have been tested in the field for decades and will tackle whatever drilling pressure control challenges you have.

6012 Ram BOPs

6011i Ram BOPs

LXT Ram BOPs

# Features and Benefits

# Certifications | Specifications

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A. BOP stack: 6012 Single Ram (bottom), 6012 Double Ram (middle), Spherical (top)



B. Same BOP stack pictured on left-hand page on rig



C. 6012 Single Ram BOP D. 6012 Double Ram BOP

**Simple, reliable construction so you can trust your BOP to operate independent of working conditions**

- Rugged, powerful and capable of operating in harsh environments and extreme temperatures
- Proven trip package is standard and includes Xylan coating in through bore, ram cavities, and all wellbore wetter surfaces
- Stainless steel inlay included in all ring grooves as a standard offering
- Hard coatings on dynamic sealing surfaces

**Configurable to accommodate a wide variety of possibilities**

- Optional large bore bonnets and tandem boosters to provide maximum shearing force
- Optional Model 6000 Shear Ram or Shear Blind Rams (SBRs)
- Design supports single or multiple ram bore configurations

**Easy operation and servicing for maximized uptime**

- Simple hydraulic system; only two hydraulic connections required per ram
- Hydraulically actuated doors for ease of service and ram replacement
- Manual locking screws come standard to ensure ram position in event of hydraulic pressure loss
- Full line of replacement parts available

**Certifications**

- Bodies manufactured from forged materials that meet H<sub>2</sub>S service in accordance with NACE MR0175

**Specifications**

- Available bore sizes: 7 1/16" to 26 3/4"
- Available pressures: 2,000 psi WP to 15,000 psi WP
- Full line of replacement parts available
- Design supports single or multiple ram bore configurations

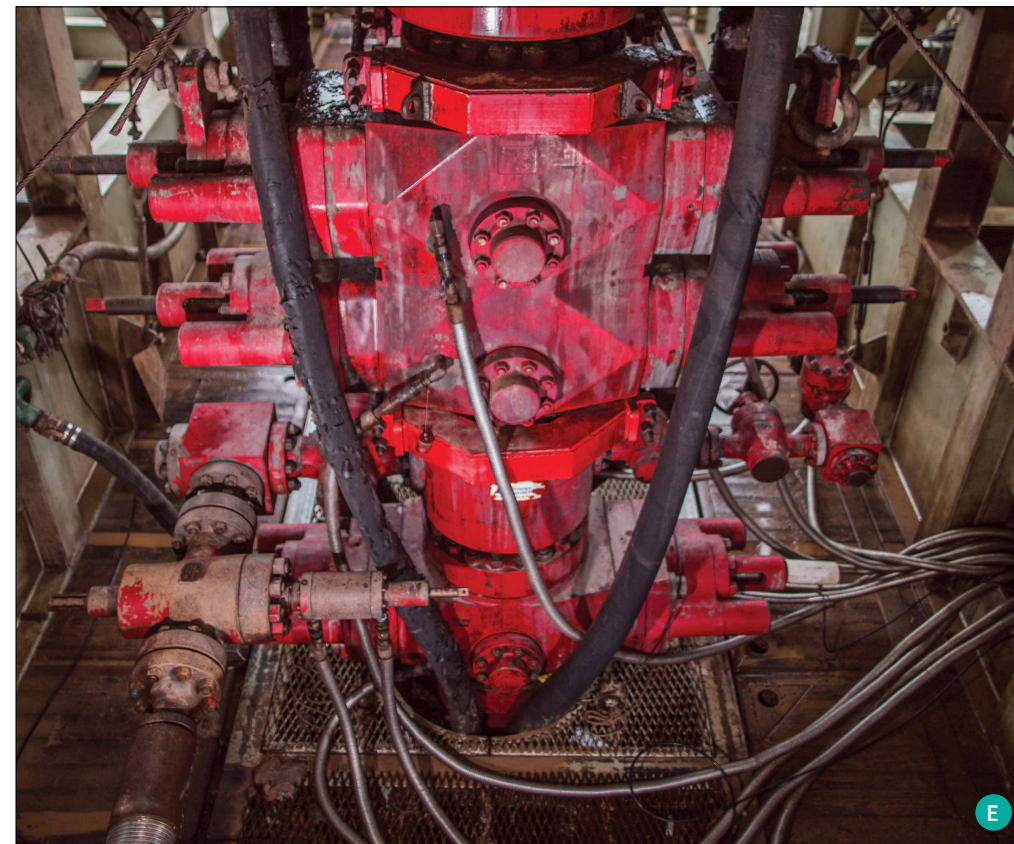
**Optional Features**

- Shear Blind Rams or Model 6000 Shear Blind Rams
- Large bore shear bonnet
- Tandem boosters to provide maximum shearing force

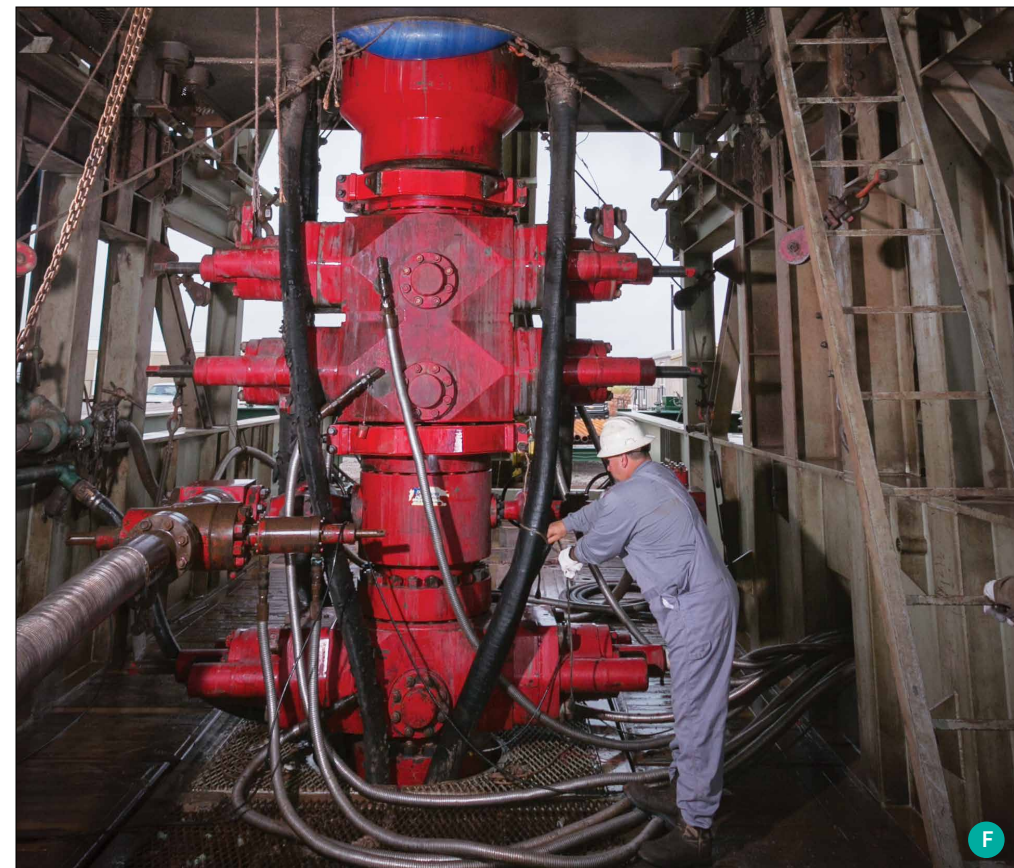
# Specifications

# 6000 Shear Ram for the 6012

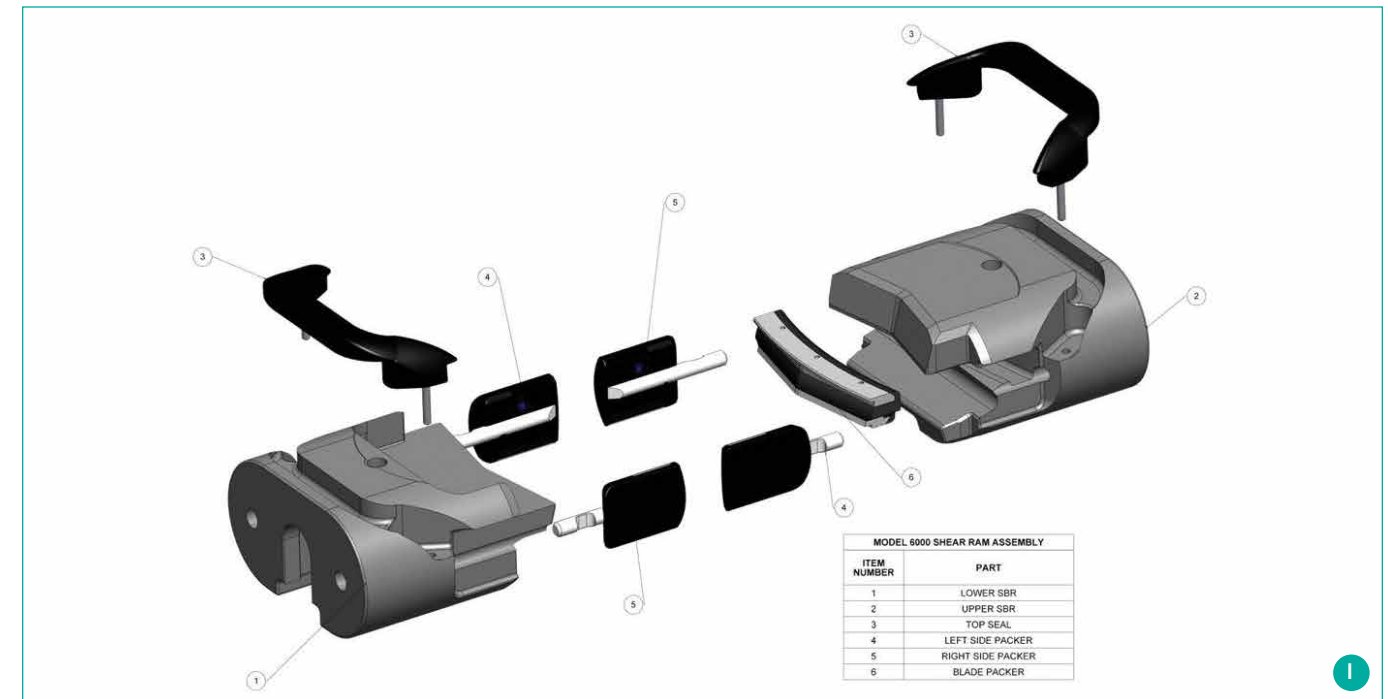
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E. BOP stack: 6012 Single Ram (bottom), 6012 Double Ram (middle), 6012 Spherical BOP (top)



F. Crew member servicing same BOP stack as pictured above



G. 6000 Shear Ram H. 6012 Single Ram BOP I. 6000 Shear Ram Diagram

**Simple, reliable construction so you can trust your BOP to operate independent of working conditions**

- Energized sealing capabilities
- Ability to shear pipe numerous times without affecting operating or sealing
- Fold over shoulder bends lower section of sheared pipe, allowing clearance for ram to close and seal

**Compact construction for versatile performance and minimized stack height**

- Ability to shear and seal eliminates need for additional cavity and keeps stack height to a minimum
- Ability to be used as a blind ram during normal drilling operations

**Certifications**

- Conforms to NACE MR0175 requirements for integral blade shearing sealing rams
- Qualified to API 16A fatigue tests

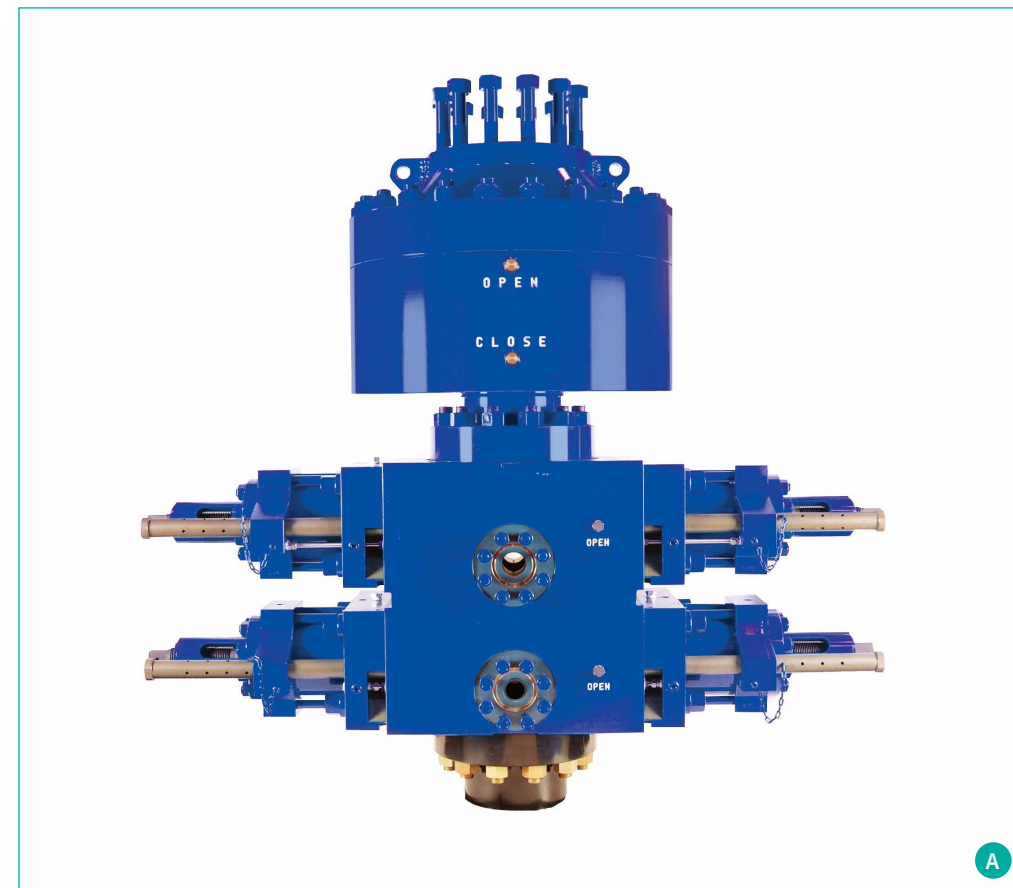
**Specifications**

- Designed to work with the 6012 Ram BOP and replaces the standard Shear Blind Ram (SBR)
- Available sizes: 11" and 13 5/8"
- Available pressures: 3,000 psi WP to 10,000 psi WP



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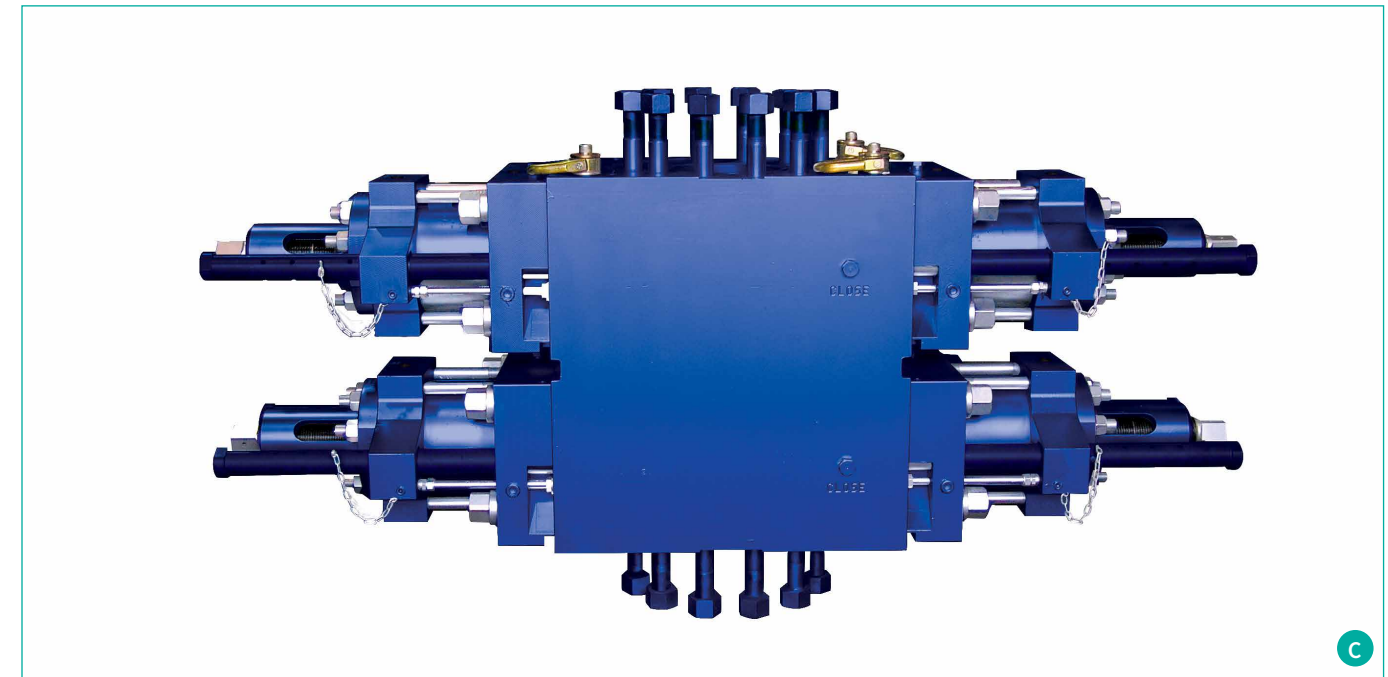
A. BOP stack: 6011i Double Ram BOP (bottom) and Spherical BOP (top)

|   |   |  |
|---|---|--|
| <p><b>Simple, reliable construction so you can trust your BOP to operate independent of working conditions</b></p> <ul style="list-style-type: none"> <li>• Rugged, powerful and capable of operating in harsh environments and extreme temperatures</li> <li>• Wellbore pressure containing components from forged steel</li> </ul> <p><b>Compact construction for versatile performance and minimized stack height</b></p> <ul style="list-style-type: none"> <li>• Unique internal porting reduces overall weight while still allowing for the manual</li> </ul> | <p>opening and closing of bonnet assemblies for ram change out</p> <p><b>Configurable to accommodate a wide variety of possibilities</b></p> <ul style="list-style-type: none"> <li>• Accepts fixed bore and variable bore rams of 6012 Ram BOP to ensure greater parts support and expanded options</li> <li>• Design supports single or multiple ram bore configurations</li> </ul> | <p><b>Easy operating and servicing to maximize uptime</b></p> <ul style="list-style-type: none"> <li>• Simple hydraulic system; only two hydraulic connections required per ram</li> <li>• Manual locking screws come standard to ensure ram position in event of hydraulic pressure loss</li> <li>• Full line of replacement parts available</li> </ul> |
|---|---|--|

# Certifications | Specifications



B. 6011i Single Ram BOP



C. 6011i Double Ram BOP

|  |   |   |
|--|---|---|
| <p><b>Certifications</b></p> <ul style="list-style-type: none"> <li>• Meets API 16A requirements</li> <li>• Meets H<sub>2</sub>S sour service requirements in accordance with NACE MR0175</li> </ul> | <p><b>Specifications</b></p> <ul style="list-style-type: none"> <li>• Available bore sizes: 7 1/16" to 11"</li> <li>• Available pressures: 3,000 psi WP and 5,000 psi WP</li> <li>• Design supports single or multiple ram bore configurations</li> <li>• Full line of replacement parts available</li> </ul> | <p><b>Optional Features</b></p> <ul style="list-style-type: none"> <li>• Fixed bore pipe rams</li> <li>• Variable bore rams</li> <li>• Flanges or hub end connections if standard studded end connections will not suffice</li> </ul> |
|--|---|---|

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A. BOP stack: LXT Single Ram BOP (bottom) and Spherical BOP (top)

**“Boltless locking door” system allows for faster, safer and more reliable ram changes**

- Patented quick access “boltless locking door” assembly enables opening and closing of BOP door
- Twin lock bars used to manually lock/unlock the door from the BOP body; for increased safety and quicker ram changes, these bars can be removed without the need of special tools or

extra personnel, making the process easier than with the conventional door bolts

- One-piece block assembly
- Easy ram access for faster and easier ram servicing

**Configurable to accommodate a wide variety of shearing possibilities**

- Compatible with Low Force Shear (LFS™) Ram with optional booster
- Single or multiple ram bore configurations supported

**Safe, simplified design**

- Lightweight and compact
- Less manpower needed to service BOP and access rams, reducing injury risk
- Quicker ram changes and easier ram servicing
- No need to hammer bolts - beneficial for confined areas

**Specifications**

- 13 5/8” bore and 10,000 psi WP

**Certifications**

- Manufactured to API 16A and NACE MR0175-2000 standards
- Standard H<sub>2</sub>S service

# Low Force Shear (LFS™) Ram for the LXT



B. Low Force Shear (LFS) Ram

**Reduced shear force needed for more efficient performance**

- Multiple shearing and sealing capabilities enhance shear ram reliability and extend length of BOP stack deployment
- Reduced shear force required - shears drill pipe with an average of 50% of the hydraulic reserve stored pressure needed by V-type shear, leaving additional pressure for an additional boost if needed
- Ability to shear some of the highest grades of pipe

**Fish manipulation for maximized uptime**

- Ability to seal while in hang-off position; while shearing, the lower shear ram holds onto lower segment of pipe to prevent fishing operation
- No additional force required to manipulate fish
- No seal tearing when opening against the fish

**Specifications**

- Designed to work best with the Shaffer™ Shear and LXT BOP family
- Able to shear 5 7/8” - 27 lb/ft drill pipe without booster
- Uses 50% less pressure to shear than that of V-type shear
- Temperature Range: 28°F to 180°F (-2.2°C to 82.2°C)

**Coupled with the large operator 14”, the following shearing capabilities are gained:**

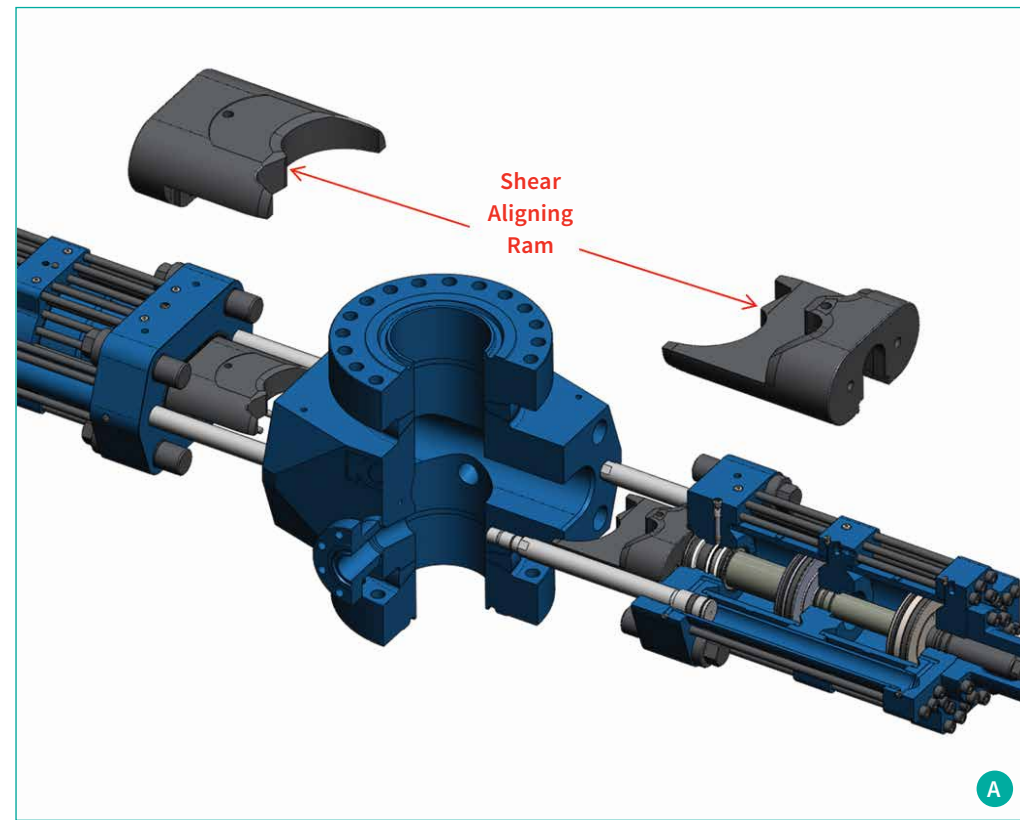
- High end shearing requirements
- Greater diameter of pipe can be sheared in the same bore



## SAR™ System

Our SAR System is the catch-all solution to an uncontrolled well. If needed, it can center and completely shear through pipe to close off the well. When it counts, this ram system will get the job done.

# Features and Benefits



**Versatile, dependable design so you can trust your BOP to operate independent of working conditions**

- Self-centering design alleviates concern of off-center drill pipe and allows ram to cut through pipe and casing regardless of position of wellbore
- Sweeps 100% of BOP through bore
- Impedes flow and clears bore, allowing upper blind ram to close and seal
- Field-tested, proven design

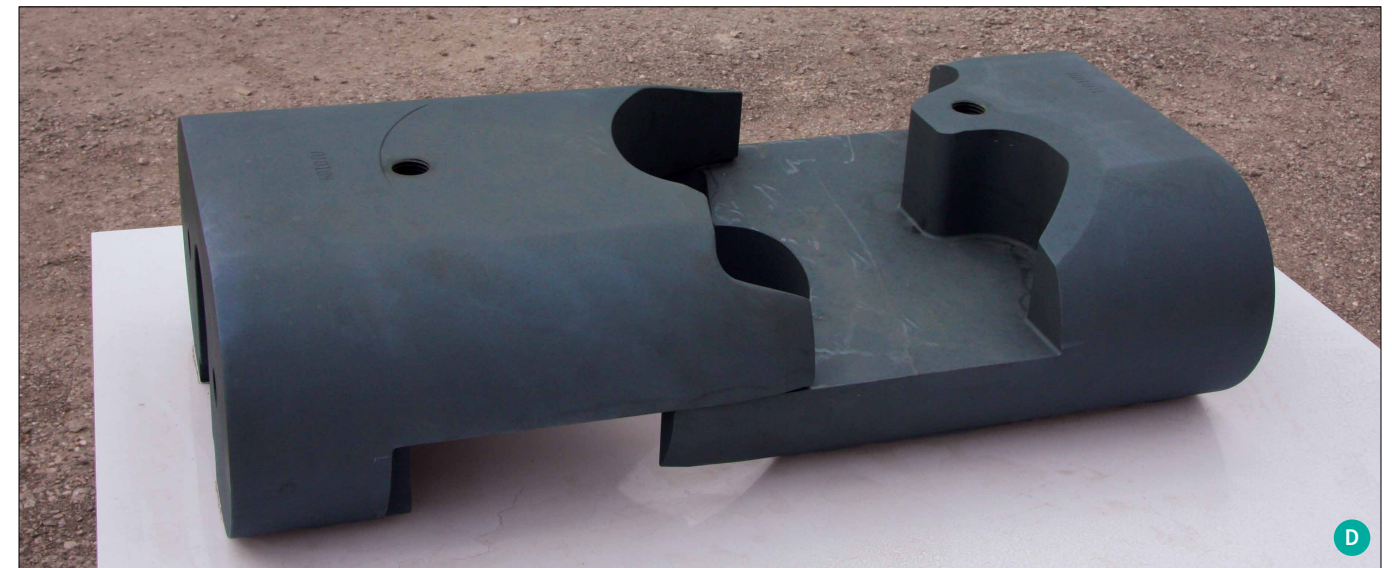
**Optimized design for increased efficiency**

- Patented SAR blade technology with about 35% reduction of force required to shear pipe than required with standard Shear Blind Rams (SBRs)
- Multiple shearing operations can be completed with minimum effect on shearing performance

**Specifications**

- Design specifically for 6012 Ram BOP line
- System consists of closing booster, ram and bonnet
- Robust bonnet design operates with hydraulic pressure up to 5,000 psi
- Shears up to 11¾" diameter casing in 13⅝" bore BOP
- Supplies 1.01 million lb of shearing force at 4,500 psi hydraulic pressure
- Only requires 19.2 gallons of hydraulic reservoir to function bonnets
- Sealed hydraulic system
- Internally ported hydraulics

# Specifications



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## BOP Koomey™ Control Unit

Behind every dependable BOP stack is a dependable control unit. Without a quality control unit, even the most advanced BOP stack will fall short. With over 25 years of building experience and over 700 units shipped to date, we have the support and expertise needed to give you the most reliable control unit to get the job done safely and effectively. Not only that, we will configure your units to your specific needs. Safeguard your rig investment and most importantly, your crew, with our tried-and-true control units.

# Features and Benefits | Certifications

# Specifications

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A. BOP Control System Unit



B. BOP Control System Unit

**Safe and dependable**

- Minimum triple redundancy ensures dependability in worst scenarios
- API 16D rated alarm systems to alert operator of potential issues and if drilling operations should stop to prevent a possible uncontrolled well situation
- Complete diverter controls with sequencing options and indicators

**Configurable and compatible**

- Units can be configured to constricted dimensions, specific mobility restrictions or other requirements
- Units work with most PLC manufacturers' control equipment to be compatible with your rig electronics
- Controls and alarms configured to best support your specific BOP stack and rig needs
- Standardized units offered for cost savings and quick delivery

**Quality construction**

- Components have been field tested for decades to ensure dependability, maximum life and minimal downtime service
- New units are made with the newest PLC programming and screens

**Certifications**

- Manufactured and monogrammed to API 16D, maintaining most compact footprint configurations
- API 16D rated alarm systems
- Units can be designed and manufactured to any specification including ATEX, all European Directives, API, API 16D, GOST, Norsok, DNV, ABS and all major oil companies' specifications

**BOP control panel, electronic controls and alarms**

- Units can be designed and manufactured to any specification required around the world
- Complete diverter controls with sequencing options and indicators
- Complete customizing screen options to pick and choose the BOP stack layout

- to match your drilling and diverter stacks
- BOP monitoring system to record fluid volumes for each BOP/valve function, number of functions, time per function, all pressure readings during functions, pump flow output and maintenance schedules
- Moving BOP options for touchscreens

**Various BOP control panel alarming options**

- Low Accumulator Pressure
- Low Manifold Pressure
- Low Rig Air Pressure
- Low Reservoir Fluid Level
- Shear Ram Activation Alarm
- Low Shear Ram Boost System Pressure
- Excessive Motor Run Indication
- Motor Vibration Alarm

- Reservoir Fluid Temperature and Heat Controls
- Timers to indicate full Ram Closure
- Flow Meter Indicator
- Communication Failure
- On Emergency Battery Back-up
- Low Battery Back-up PLC Remote
- Emergency Nitrogen Back-up Alarm and Pressure

**Featured BOP Koomey™ Control Unit Models**

| Model              | Style    | Volume Size (Gallons) | Drive Assembly                   | Number of Stations | Skid Option | Remote Panel             |
|--------------------|----------|-----------------------|----------------------------------|--------------------|-------------|--------------------------|
| 2B302646B11T3P-API | 264-EH6S | 264                   | 2 Electric pumps                 | 6                  | Stationary  | Touchscreen PLC          |
| B302646B11T33A-API | 264-PP6R | 264                   | 1 Electric and 3 Pneumatic pumps | 6                  | Roll Skid   | Pneumatic Remote Control |
| 2B603608B15T3P-API | 360-EH8S | 360                   | 2 Electric pumps                 | 8                  | Stationary  | Push Button PLC          |
| C10445B11T3A       | 44-EP5C  | 44                    | 1 Electric pump                  | 5                  | Compact     | Pneumatic Remote Panel   |



## Research and Development Facility

Our pressure control equipment is developed and tested in our state-of-the-art research and development facility to ensure that your equipment is of the highest quality and will work when needed.

## Manufacturing Facility

The central hub for our BOP manufacturing, our facility in Houma, Louisiana, is equipped to construct BOPs with safety and reliability as top priorities.

## Aftermarket Services

Our support for your operations goes beyond supplying equipment. Our aftermarket division helps maintain your equipment and assist your crew through our local service and repair centers, training facilities, FAST trucks, field service and technical support centers.

## Research and Development Facility

|  |           |
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A. 6012 Double Ram BOP in Test Bay B. 6012 Ram BOP C. Monitoring Station Outside Text Bay; Dashboard System Above

D. Team member servicing BOP in Test Bay

### State-of-the-art Facility Dedicated to Producing Quality Pressure Control Equipment to Maximize Uptime in the Field

Conducting about 30 to 40 tests a week, our research and development facility is continually working to make sure that our pressure control equipment delivers the best operational and safety performance. Our strict testing procedures, advanced qualification and monitoring technology, continuing pursuit for improvement, and commitment to overall safety are all to ensure that you have dependable equipment that will operate as needed and keep your rig running smoothly, minimizing downtime and keeping your rig crew safe.

#### Overall Facility Features

- Eight (8) large and five (5) small test bays; two (2) test pits
- Multiple assembly areas and in-house fabrication area
- In-house hyperbaric chamber
- Advanced alarming system for safety and to promote communication and awareness throughout facility
- Various water and oil hydraulic systems
- Dashboard communication system set up throughout facility to reduce downtime and quickly relay information - displays show statuses of all tests being conducted and tests on-deck. The system also displays if attention from engineering or other staff is needed.
- Quality control area in-house to reduce downtime and get pressure control equipment into the field more efficiently - liquid penetrant, magnetic particle inspection and ultrasonic testing

#### Test Bay Features

- Data acquisition system (customized to various inputs and outputs with up to 200 samples per second)

- Video test monitoring and recordings; internal bay cameras with zoom technology and can be placed inside bore
- All pressurized hydraulic pumps needed for bay tests are located outside of bay with fluid brought in via pressurized lines for noise reduction and increased safety
- Test bay walls are 30 inches thick, lined with sand and concrete, and ballistic tested to ensure testing safety
- Automated pressure testing eliminates unsafe manual testing situations

#### Testing Capabilities

- Pressure testing: up to 30,000 psi
- Temperature testing: -15°F to 350°F
- Fatigue testing
- Sealing characteristics testing
- Factory acceptance testing
- Stripping life testing
- Pull down testing
- Shear testing
- Magnetic particle testing
- Dye penetrant testing



E. Closed Large Test Bays at Pressure Control R&D Facility



## Manufacturing Facility

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A. CNC Vertical Milling Machine



B. 6012 Single and Double Ram BOPs lined up for delivery

Initially a part of T3™, our pressure control facility located in Houma, Louisiana joined NOV in 2013 and is the central hub for the manufacturing of all land BOPs including the Spherical, 6012 Ram, 6011i Ram and LXT BOPs. Outfitted with advanced manufacturing and testing machinery necessary to produce quality pressure control equipment, this facility also has a devoted staff - including several 30+ year tenured personnel - all dedicated to safety first when it comes to both constructing your equipment and upholding the facility's notable safety record.

### Certifications and Testing

- API 16A
- API 6A
- ISO
- Full in-house Factory Acceptance Testing

### Overall Facility Features

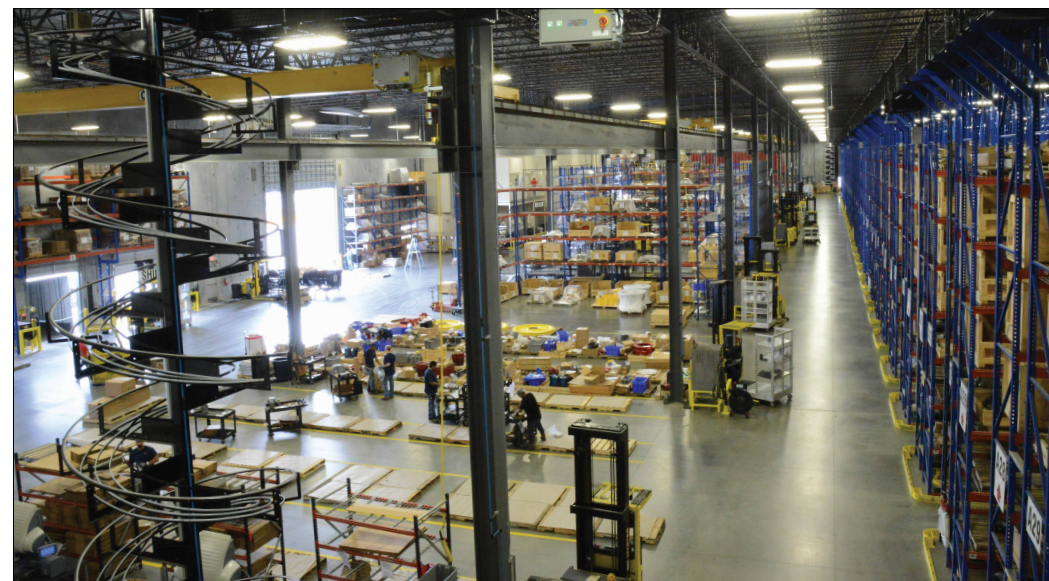
- Full BOP manufacturing and testing capabilities
- CNC milling machine
- CNC horizontal and vertical lathes
- Pressure testing equipment
- Multiple assembly areas and in-house fabrication area
- Quality control testing to latest API requirements in-house to reduce downtime and get pressure control equipment into the field more efficiently
- 100,000 square feet of manufacturing and testing space
- 3.5 acres of available staging and storage area
- Overhead crane capacity



C. Facility Floor with CNC Vertical Mills on left-hand side and CNC Lathes on the right-hand side

## Rig Aftermarket Services

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NOV is with you every step of the way

### Field Service

Our growing staff of proven field service personnel is available 24/7 to support all NOV products. Knowledgeable field service technicians can quickly deploy to your operating site to resolve your equipment issues, whether structural, mechanical, electrical or software-related. Our FAST solution service trucks are stocked with an extensive list of NOV Top Drive, Iron Roughneck, BOP, EDS, and Amphion™ replacement parts, filters, consumables and tools to get your NOV equipment running at OEM specifications. Expert on-call technicians are ready to provide FAST, on-site service and repair.

### Training

Field technicians train extensively on NOV Rig Systems product lines including competency training and evaluations through our NOV technical colleges and training facilities to ensure the highest quality service and support for your equipment repairs on-site.

### Repair

Our highly skilled shop technicians overhaul, repair, rebuild, and recertify a wide range of NOV equipment to the NOV Quality Assurance and OEM specifications—using only OEM parts. Our worldwide network of repair centers provides unrivaled quality customer service, on-time

delivery and unmatched technical integrity. In addition, equipment exchange programs are available at various facilities. Through the Used Equipment Refurbishment Program, we provide viable, short turnaround solutions to immediate capital equipment needs, complete with data books and certificates of conformance as required.

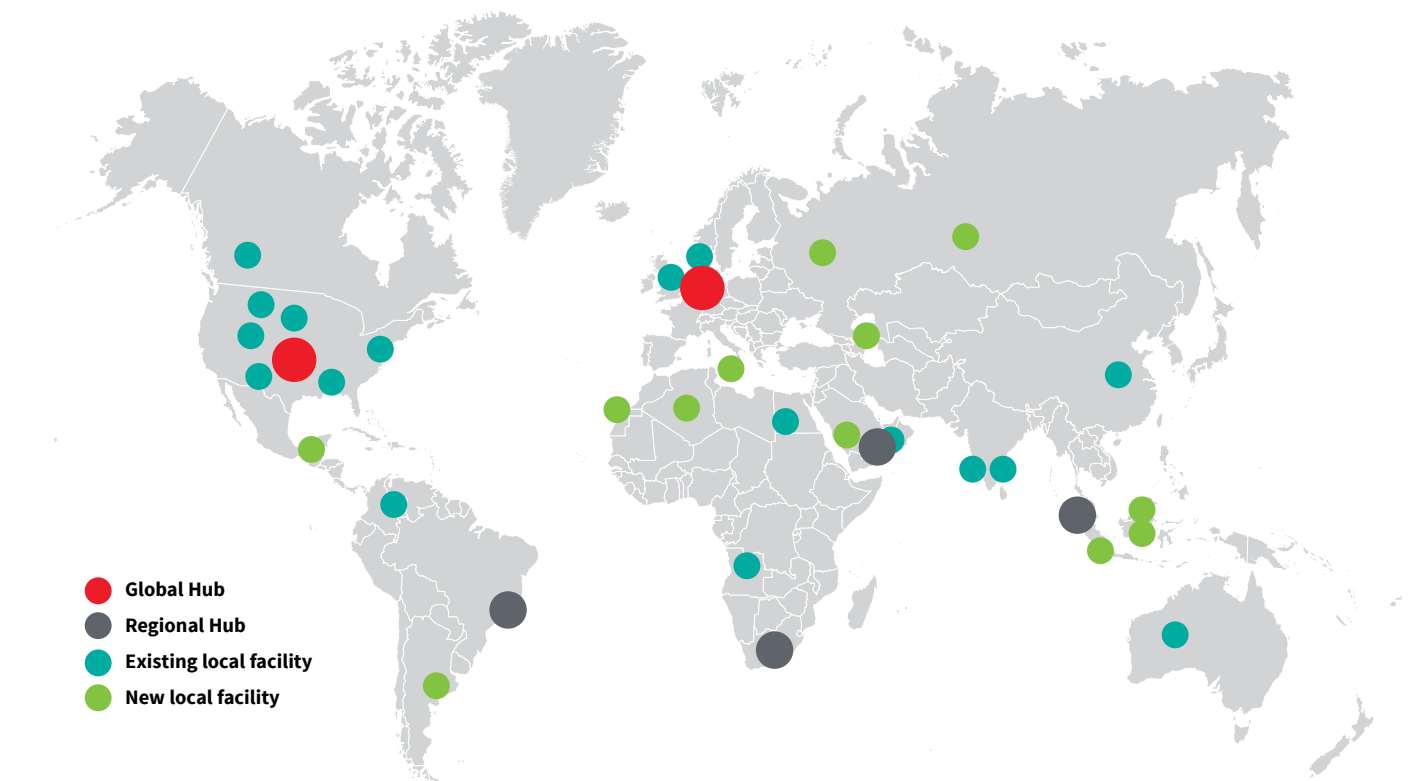
### Technical Support

One phone call to one of our technical support centers initiates a technical support team of multi-skilled backgrounds to troubleshoot and resolve your worldwide equipment needs, 24/7/365. Our team of highly skilled and experienced technical support members work together with our global pool of qualified field service technicians and subject matter experts to keep your rigs operating. The technical support team utilizes our web-based application “Tracker” to record, manage, and resolve issues.

### Field Engineering

Our field engineering groups offer the unique service of providing one-off, rig-specific equipment designs, modifications and solutions to your rig-specific issues.

For 24/7 Support Services: [+1 281 569 3050](tel:+12815693050)



Comprehensive Aftermarket Products and Services

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