GENERAL CATALOG

Advancing the Technology of Drilling
Shaffer
Company Background

Shaffer was founded by Mr. William D. Shaffer in 1928 as Shaffer Tool Works. The company was located in Brea, California.

The Shaffer flow bean valve was the first of many patents which became a part of the Shaffer product line. The Shaffer cellar gate valve, or as we know it today, the ram BOP (blowout preventer), was developed around 1932. The Shaffer Tool Works product line continued to grow to include wellhead equipment, Christmas trees (well completion equipment), downhole tools, and many specialty items as required by the oil industry.

In the mid to late 50s, Shaffer Tool Works was again on the cutting edge of oilfield technology in working with Texaco and Union Oil in the development of the first subsea well completion systems.

In 1968, Shaffer Tool Works, a family-owned company, was sold to the Rucker Corporation and became known as Rucker Shaffer.

In 1969, Rucker Shaffer moved their headquarters to their Beaumont, Texas manufacturing facility in an effort to consolidate all of their Shaffer operations in Texas. However, due to economic conditions, the Ram BOP operation was left in Brea, California.

In 1972, Shaffer again demonstrated its superior engineering ability in developing the Spherical blowout preventer. The Spherical blowout preventer was a new design of annular blowout preventer. This superior design stood head and shoulders over other annular BOPs, especially when used in a stripping operation.

In the early 70s, the Rucker Company added tensioner systems and drillstring motion compensators to the Rucker Shaffer product lines to meet the needs of the fast growing offshore oil industry.

In 1978, Shaffer was sold to NL Industries, and became known as NL Shaffer. At this time, Shaffer had manufacturing facilities in Brea, California; Beaumont, Texas; and Houston, Texas, which was their headquarters at that time. In the late 70s and early 80s Shaffer was growing by leaps and bounds as the petroleum industry skyrocketed.

In 1979, NL Shaffer purchased the Houston-based Koomey Control Systems from Stewart & Stevenson, thus making it possible for Shaffer to provide a more complete system for their customers including ram BOPs, Spherical BOPs, and control units as an integrated system. By 1982, NL Shaffer employed 2,352 employees worldwide.

Well, as they say, everything that goes up must come down. And certainly the petroleum industry was no exception. The mid to late 80s saw Shaffer downsized as a company as the petroleum industry plummeted.

On July 17, 1992, Shaffer joined with the Varco companies in a combined effort to develop complementary products and technologies that improve the safety and productivity of drilling rigs.

Today, Shaffer is continuously developing new products to support the drilling activities around the world—products that focus on improving process, equipping people, and expanding capabilities.
# Table of Contents

- Shaffer Company Background .......................................................... 2
- Equipment Package Development ...................................................... 4
- Underbalanced Drilling Products ....................................................... 5
- Spherical BOPs ................................................................................. 6
- NXT Ram BOP ................................................................................... 7
- Blowout Prevention Equipment .......................................................... 8
- Blowout Prevention Equipment .......................................................... 9
- Ram Assemblies ................................................................................ 10
- Ram Assemblies ............................................................................... 11
- Koomey Control Systems ................................................................. 12
- Koomey Control Systems ................................................................. 13
- Auxiliary Equipment ........................................................................ 14
- Riser String Packages ...................................................................... 15
- Tensioners ......................................................................................... 16
- Drill String Compensators ............................................................... 17
- Crown-Mounted Compensators ....................................................... 18
- Customer Support ............................................................................ 19
Equipment Package Development

**Varco International Rig Packages**

The rapid development towards ultra deep water applications have evolved a new frontier for the drilling industry. With this rapid growth, the challenges faced by rig suppliers were:

- Provide a new class of drilling rig to meet new operating conditions.
- Develop new operating capability and efficiency to justify the expense of new rigs.
- Offer project planning to a rigorous schedule without compromising the new design elements.
- Schedule a number of suppliers to work on the rig development team without conflict of interest.

There emerged a need to change the way we traditionally design and build drilling rigs. With the complexity of the equipment, there was a requirement to determine capability specifications and partner with suppliers to develop the new products required for these vessels.

In the last few years the Varco companies have built a skilled rig development team of critical equipment suppliers. Each Varco company, Shaffer, Varco Systems, M/D Totco, Varco BJ, and Rigtech, have been privileged to play collaborative roles in the development of oil and gas drilling operations aboard the industry's new-generation drilling rigs. The effect of this shared objective in new product development has opened doors of opportunity for oil and gas exploration. Their combined, integrated systems for drilling will deliver unprecedented levels of operating efficiency and meet the highest standards of safety, with consideration for both personnel and the natural environment. This long-term vision for a supplier team connected at the front end of their customers new build plans has offered a new era in the relationship between the supplier and their customer.

The five Varco companies have today integrated their capabilities, becoming a unique solutions provider working in concert with forward-looking drillers and operators around the world.

**Shaffer Rig Packages**

The long-standing, shared deep water development experiences between Shaffer and the drilling industry has provided a firm development foundation. By leveraging their expertise in a variety of drilling disciplines including equipment, engineering, controls and drilling technology, Shaffer has been at the forefront of new rig developments. Shaffer engineers have spearheaded advances in pressure control equipment, motion compensation, riser technology, and flow control products in the emerging deep water projects. In working together with their customers to develop drilling operations design parameters, Shaffer engineers took a disciplined approach to analyzing the options for providing new equipment solutions.

New process innovations and products such as Pressure Control While Drilling (PCWD) with Spherical BOPs, 1 million lb crown-mounted compensators, active heave compensation, riser recoil, bolt-less ram BOP doors, subsea ram changing, 2 million lb dog type riser, 3.5 million lb riser, and 250k riser tensioners have become regular parts of the new drilling vocabulary.

This list of new product developments from Shaffer has been combined with increased levels of project management, product integration and communication of control and information data between the rig systems to provide a unique and successful Varco solution. Shaffer's commitment to developing the right products for their customers has driven the new category of deep water drilling equipment with capabilities unsurpassed in existing rig fleets.

**Shaffer, Advancing the Technology of Drilling**
Shaffer has achieved a new dimension in the development of rotating blowout preventers with the introduction of a system for achieving Pressure Control While Drilling (PCWD®).

For the first time Shaffer has combined the features of its industry-accepted Spherical Blowout Preventer with state-of-the-art hydraulic control to create one practical system for underbalanced drilling. This system is the latest convergence of Shaffer technology and technical know-how in the aim for faster, safer drilling.

In another first, Shaffer has taken its PCWD system to new depths, offshore drilling. This benchmark application is not only important because it is offshore, but also because it is being utilized in the North Sea, one of the world's most hostile sea environments.

PCWD is a system for controlled application of underbalanced drilling techniques. When compared to conventional drilling methods, PCWD increases penetration rates while being less damaging to the drilling formation.

Conventional overbalanced drilling of production zones generally has a negative effect on overall well productivity. The associated costs are due primarily to formation damage. Because of this heightened cost factor, the oil industry is now turning to methods, such as underbalanced drilling, to increase productivity and reduce overall costs.

This system yields faster penetration rates, with less formation damage, all at lower costs.

PCWD System Features

- Proff tested to 10,000 psi
- 5,000 psi working pressure static
- 3,000 psi working pressure rotating
- 200 rpm
- Standard Spherical® BOP packer
  - Long stripping life
  - Metal reinforced
- API top & bottom connections standard
- Full 11” bore (135° under development)
- Minimum overall height 44”
- Weight 12,500 lbs
- Dedicated hydraulic control unit
  - Electronic PLC controlled
  - Multiplexed signals to reduce cable size
  - Can be certified for offshore use
Spherical BOPs

Wedge- & Bolted-Cover BOPs

The Shaffer Spherical BOP is one of the first lines of defense in controlling a well. When actuated, hydraulic pressure operates the piston, and in turn closes the spherical. The spherical's closure occurs in a smooth, simultaneous upward and inward motion, as opposed to horizontal motion.

The spherical geometry reduces the internal stresses and the friction between the sealing element and the BOP body. This is a rugged, reliable sealing element. Steel segments reinforce the sealing element without protruding into the wellbore when the element is open.

The element design enables a long stripping life, which translates into superior field life and less maintenance. Maintenance is easier as the element can be changed without contaminating the hydraulics.

The spherical design operates with a lower operating pressure, reducing the number of accumulators.

Shaffer Spherical BOPs are available in 1,000-10,000 psi working pressures with bore sizes from 4 5/8" to 30". An integral outlet is available on wedge cover Spherical BOPs.

Single & Dual Snubber BOPs

With the single and dual snubbing BOPs operation time is reduced by eliminating conventional ram to ram snubbing.

Both single and dual snubber blowout preventers have a working pressure of 5,000 and 10,000 psi. And just like the Spherical BOPs, the snubbers utilize the Shaffer 10,000 psi Spherical packing element with its field-proven cavity design. That explains why there is a long life under the harsh snubbing conditions of passing tool joints and couplings through the element.

In these single and dual snubbers, maintenance is also made faster and easier. The two piece snubbing element enables easy replacement with pipe in the well. For more assistance in rapid removal of the element, there is an hydraulically-operated, quick-release bonnet and an easy-lift upper housing. The easy-lift upper housing further assists in rapid snubbing element removal with hydraulic cylinders integral to the BOP housing. In all, only eight minutes are needed to replace a snubbing element.

Single & Dual Snubber BOPs

The Shaffer Spherical BOP is one of the first lines of defense in controlling a well. When actuated, hydraulic pressure operates the piston, and in turn closes the spherical. The spherical's closure occurs in a smooth, simultaneous upward and inward motion, as opposed to horizontal motion.

The spherical geometry reduces the internal stresses and the friction between the sealing element and the BOP body. This is a rugged, reliable sealing element. Steel segments reinforce the sealing element without protruding into the wellbore when the element is open.

The element design enables a long stripping life, which translates into superior field life and less maintenance. Maintenance is easier as the element can be changed without contaminating the hydraulics.

The spherical design operates with a lower operating pressure, reducing the number of accumulators.

Shaffer Spherical BOPs are available in 1,000-10,000 psi working pressures with bore sizes from 4 5/8" to 30". An integral outlet is available on wedge cover Spherical BOPs.

Single & Dual Snubber BOPs

With the single and dual snubbing BOPs operation time is reduced by eliminating conventional ram to ram snubbing.

Both single and dual snubber blowout preventers have a working pressure of 5,000 and 10,000 psi. And just like the Spherical BOPs, the snubbers utilize the Shaffer 10,000 psi Spherical packing element with its field-proven cavity design. That explains why there is a long life under the harsh snubbing conditions of passing tool joints and couplings through the element.

In these single and dual snubbers, maintenance is also made faster and easier. The two piece snubbing element enables easy replacement with pipe in the well. For more assistance in rapid removal of the element, there is an hydraulically-operated, quick-release bonnet and an easy-lift upper housing. The easy-lift upper housing further assists in rapid snubbing element removal with hydraulic cylinders integral to the BOP housing. In all, only eight minutes are needed to replace a snubbing element.
Representing the next generation in BOP designs, the NXT eliminates door bolts and integrates the Spherical with the rams, providing weight and space savings.

The safety features extend to faster and simpler maintenance. These features include a boltless door assembly where the doors are opened hydraulically from door mounted controls or from a remote control station. The remote operating capability combined with a Ram Changing System offers safer and more efficient operational automation. The NXT Ram Changing System offers significant impact on the schedule and configuration of ultra-deep subsea operations allowing ram configuration changes without tripping the stack. This system provides unique flexibility during subsea operations.

Closing pressure is maintained at 1,500 psi against full-working pressure, with decreased closing volume requirements, reducing the number of accumulator bottles needed to run the system.

The NXT is also designed to incorporate all of the leading changes in new BOP designs such as an UltraLock II automatic locking system, Type V Shear rams (capable of shearing 6-1/2” 8-135 pipe, and its casing Type V Shear is capable of shearing 13-3/8” casing), a no-weld cavity (seat seal, side, and wear pads are all replaceable), a floating ram block design (there is an improved life and a more sure seal).

<table>
<thead>
<tr>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure (psi)</td>
</tr>
<tr>
<td>Single Stud X Flange</td>
</tr>
<tr>
<td>Double Stud X Flange</td>
</tr>
<tr>
<td>Single Stud X Flange</td>
</tr>
<tr>
<td>Double Stud X Flange</td>
</tr>
<tr>
<td>Single Stud X Flange</td>
</tr>
<tr>
<td>Double Stud X Flange</td>
</tr>
<tr>
<td>Triple Stud X Flange</td>
</tr>
</tbody>
</table>
Blowout Prevention Equipment

Chasovoy Ram BOP

The Chasovoy ram, available for a 7\(\frac{1}{4}\)" bore size with working pressures of 3,000 and 5,000 psi, has a unique design which permits either manual or hydraulic operation.

The single-cavity model stands 11\(\frac{1}{4}\)" (286 mm) high. The unitized double-cavity (studded-studded) is only 20\(\frac{1}{2}\)" (521 mm) high.

SLX Ram BOP

The SLX introduced revolutionary enhancements to the industry-standard SL BOP.

In comparison to the SL, the SLX BOP has fewer door bolts and, with a roller-bearing hinge assembly, can be easily opened manually by a single person. Also, door bolt torque is reduced (as low as 1,000 lb-ft) and no hydraulic pressure is needed to open or close doors. When changing rams, no critical components are exposed and a max of 45° door swing is needed to remove the ram (57° on 18" SLX).

The no-weld cavity is a feature which lets customers upgrade their BOP to new condition without extensive in-shop repairs. This also means post-weld heat treatments are eliminated. This no-weld cavity has a replaceable seal seat, a replaceable skid plate and replaceable side pads.

The floating ram block design, with a mechanically-energized top seal, provides superior performance and sealing capability even after the ram cavity or upper body seat area is worn from years of service.

The rams fit within the ram cavity in the open position with no interface fit between the metal or elastomer seal components. An opening between the ram support skids creates a self draining body allowing mud and debris to be flushed from the cavity when the rams are opened.

The SLX operates at max. 1,500 psi to close the pipe rams and contain pressures on 10,000 and 15,000 psi stacks. With a lower operating pressure, the number of accumulator bottles required will be reduced. The overall height and weight is also reduced with optimization of pressure-containing components.

SL Ram BOP

The SL ram BOP has been a long-term industry standard providing consistent and reliable operation worldwide.

SL Ram BOPs are designed both for large bore subsea drilling and deep land drilling, at pressures from 3,000 to 15,000 psi. Bore sizes range from 7\(\frac{1}{4}\)" to 21\(\frac{1}{4}\)".
### Blowout Prevention Equipment

#### SL Specifications

<table>
<thead>
<tr>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single, 10&quot; Piston</td>
<td>Single, 14&quot; Piston</td>
<td>Single, 10&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 5,000 16% 10,000 11 13,000</td>
<td>Flange X Flange 10,000 11 13,000</td>
<td>Flange X Flange 10,000 21 3/4 37,600</td>
</tr>
<tr>
<td>Hub X Hub 5,000 16% 10,000 11 11,700</td>
<td>Hub X Hub 10,000 21 3/4 31,000</td>
<td>Hub X Hub 10,000 21 3/4 54,860</td>
</tr>
<tr>
<td>Stud X Stud 5,000 16% 10,000 11 11,100</td>
<td>Stud X Stud 10,000 11 11,000</td>
<td>Stud X Stud 10,000 21 3/4 49,372</td>
</tr>
<tr>
<td>Double, 10&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
<td>Double, 10&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 3,000 13% 2,700 10,000 16 13,000</td>
<td>Flange X Flange 10,000 13% 26,250</td>
<td>Flange X Flange 10,000 7 3/4 6,200</td>
</tr>
<tr>
<td>Hub X Hub 3,000 13% 2,700 10,000 12,850</td>
<td>Hub X Hub 10,000 7 3/4 6,900</td>
<td>Hub X Hub 10,000 7 3/4 12,950</td>
</tr>
<tr>
<td>Stud X Stud 3,000 13% 2,700 10,000 11,100</td>
<td>Stud X Stud 10,000 7 3/4 10,016</td>
<td>Stud X Stud 10,000 7 3/4 10,016</td>
</tr>
<tr>
<td>with 14&quot; piston add 1,400 lbs</td>
<td>with 14&quot; piston add 1,400 lbs</td>
<td>with 14&quot; piston add 1,400 lbs</td>
</tr>
<tr>
<td>Single, 10&quot; Piston</td>
<td>Single, 14&quot; Piston</td>
<td>Single, 10&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 5,000 13% 2,700 10,000 13% 15,550</td>
<td>Flange X Flange 10,000 13% 25,500</td>
<td>Flange X Flange 15,000 7 3/4 6,200</td>
</tr>
<tr>
<td>Hub X Hub 5,000 13% 2,700 10,000 12,850</td>
<td>Hub X Hub 10,000 13% 23,800</td>
<td>Hub X Hub 15,000 7 3/4 10,300</td>
</tr>
<tr>
<td>Stud X Stud 5,000 13% 2,700 10,000 11,100</td>
<td>Stud X Stud 10,000 13% 20,550</td>
<td>Stud X Stud 15,000 7 3/4 10,016</td>
</tr>
<tr>
<td>Double, 14&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 3,000 13% 2,700 10,000 13% 13,470</td>
<td>Flange X Flange 10,000 13% 28,500</td>
<td>Flange X Flange 15,000 7 3/4 12,950</td>
</tr>
<tr>
<td>Hub X Hub 3,000 13% 2,700 10,000 12,850</td>
<td>Hub X Hub 10,000 13% 26,600</td>
<td>Hub X Hub 15,000 7 3/4 12,950</td>
</tr>
<tr>
<td>Stud X Stud 3,000 13% 2,700 10,000 11,100</td>
<td>Stud X Stud 10,000 13% 25,828</td>
<td>Stud X Stud 15,000 7 3/4 12,950</td>
</tr>
<tr>
<td>with 14&quot; piston add 2,700 lbs</td>
<td>with 14&quot; piston add 2,700 lbs</td>
<td>with 14&quot; piston add 2,700 lbs</td>
</tr>
<tr>
<td>Single, 10&quot; Piston</td>
<td>Single, 14&quot; Piston</td>
<td>Single, 14&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 5,000 16% 2,700 10,000 13% 15,550</td>
<td>Flange X Flange 10,000 13% 25,500</td>
<td>Flange X Flange 15,000 7 3/4 6,200</td>
</tr>
<tr>
<td>Hub X Hub 5,000 16% 2,700 10,000 12,850</td>
<td>Hub X Hub 10,000 13% 23,800</td>
<td>Hub X Hub 15,000 7 3/4 10,300</td>
</tr>
<tr>
<td>Stud X Stud 5,000 16% 2,700 10,000 11,100</td>
<td>Stud X Stud 10,000 13% 20,550</td>
<td>Stud X Stud 15,000 7 3/4 10,016</td>
</tr>
<tr>
<td>Double, 14&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 3,000 16% 2,700 10,000 13% 14,095</td>
<td>Flange X Flange 10,000 16% 44,300</td>
<td>Flange X Flange 15,000 11-86 16,500</td>
</tr>
<tr>
<td>Hub X Hub 3,000 16% 2,700 10,000 12,850</td>
<td>Hub X Hub 10,000 16% 42,000</td>
<td>Hub X Hub 15,000 11-86 16,500</td>
</tr>
<tr>
<td>Stud X Stud 3,000 16% 2,700 10,000 11,100</td>
<td>Stud X Stud 10,000 16% 40,600</td>
<td>Stud X Stud 15,000 11-86 13,700</td>
</tr>
<tr>
<td>with 14&quot; piston add 2,700 lbs</td>
<td>with 14&quot; piston add 2,700 lbs</td>
<td>with 14&quot; piston add 2,700 lbs</td>
</tr>
<tr>
<td>Double, 10&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
<td>Double, 14&quot; Piston</td>
</tr>
<tr>
<td>Flange X Flange 10,000 7%\ 6,200</td>
<td>Flange X Flange 15,000 13% 29,050</td>
<td>Flange X Flange 15,000 12% 49,117</td>
</tr>
<tr>
<td>Hub X Hub 10,000 7%\ 6,200</td>
<td>Hub X Hub 15,000 13% 25,000</td>
<td>Hub X Hub 15,000 12% 49,117</td>
</tr>
<tr>
<td>Stud X Stud 10,000 7%\ 5,550</td>
<td>Stud X Stud 15,000 13% 22,285</td>
<td>Stud X Stud 15,000 12% 49,117</td>
</tr>
<tr>
<td>with 14&quot; piston add 1,350 lbs</td>
<td>with 14&quot; piston add 1,350 lbs</td>
<td>with 14&quot; piston add 1,350 lbs</td>
</tr>
</tbody>
</table>

#### SLX Specifications

<table>
<thead>
<tr>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
<th>Pressure (psi) Size (in.) Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single, Flange X Flange 5,000 18% 24,760</td>
<td>Flange X Flange 15,000 13% 23,670</td>
<td>Flange X Flange 15,000 18% 23,670</td>
</tr>
<tr>
<td>Hub X Hub 5,000 18% 23,600</td>
<td>Hub X Hub 15,000 13% 21,300</td>
<td>Hub X Hub 15,000 18% 21,300</td>
</tr>
<tr>
<td>Stud X Stud 5,000 18% 22,825</td>
<td>Stud X Stud 15,000 13% 20,270</td>
<td>Stud X Stud 15,000 18% 20,270</td>
</tr>
<tr>
<td>for double add 15,485 lbs</td>
<td>for double add 13,090 lbs</td>
<td>for double add 13,090 lbs</td>
</tr>
<tr>
<td>Single, Flange X Flange 10,000 18% 28,640</td>
<td>Flange X Flange 15,000 18% 42,000</td>
<td>Flange X Flange 15,000 18% 42,000</td>
</tr>
<tr>
<td>Hub X Hub 10,000 18% 24,900</td>
<td>Hub X Hub 15,000 18% 37,000</td>
<td>Hub X Hub 15,000 18% 37,000</td>
</tr>
<tr>
<td>Stud X Stud 10,000 18% 23,770</td>
<td>Stud X Stud 15,000 18% 32,000</td>
<td>Stud X Stud 15,000 18% 32,000</td>
</tr>
<tr>
<td>for double add 16,100 lbs</td>
<td>for double add 18,000 lbs</td>
<td>for double add 18,000 lbs</td>
</tr>
</tbody>
</table>
UltraLock II Ram Locking System

The UltraLock II locking system incorporates a mechanical locking mechanism within the piston assembly. This locking system is not dependent on closing pressure to maintain a positive lock. It uses flat tapered locking segments carried by the operating piston which engages another stationary tapered shaft located within the operating cylinder. Using SL-D rams, the UltraLock II has hang-off capabilities up to 600,000 pounds at full working pressure.

The system needs no adjustments, no matter the size of the pipe rams. Different size or type ram assemblies can be freely interchanged.

Only one hydraulic function is required to operate the cylinder's open/close function and the locking system. The system automatically locks in the closed position each time the piston assembly is closed. Once the operating piston is closed on the pipe, the locks are engaged until opening pressure is applied. Only hydraulic pressure can unlock and reopen the preventer.

Type V Shear Rams

The Shaffer Type V Shear ram enhances the features of Shaffer's T-72 shear ram by increasing the range of pipe that can be sheared without modification to the BOPs.

The Type V Shear rams are capable of shearing 6 5/8”, S-135 drill pipe, at less than 2,700 psi operator pressure. This typically allows the shear ram to be put in any ram cavity on the BOP stack without the addition of booster cylinders or control system upgrades.

The superior sealing characteristics of the Shaffer T-72 shear ram were maintained in the development of the Type V Shear ram.

Although NACE MR0175 does not necessarily require that the shear ram be H₂S compatible in order to declare a BOP stack to meet NACE requirements for H₂S service, Shaffer's standard Type V Shear directly meet NACE requirements for H₂S service.
Ram Assemblies

Casing Shear Rams

Shaffer has extended the capabilities of shear rams with a casing shear ram which meets the specific cutting needs to physically shear casing tubulars up to 13⅜" in an 18⅝" bore BOP.

Sheared casing example

Multi-Rams

Shaffer addresses the need for changing out rams on a tapered drillstring by offering Multi-Ram blocks to cover a range of varying IDs of drill pipe from 3⅛" to 5" and 5" to 7⅛".

The Multi-Ram introduces the potential for the elimination of additional ram BOPs to facilitate the changes in tubular OD on any given string.

UltraTemp Rams

Shaffer UltraTemp ram assemblies are designed to safely withstand wellbore pressures up to 15,000 psi and extreme temperatures up to 350 °F (177 °C) for prolonged periods. This translates into rigsite capability to safely evacuate personnel and equipment in the event of a major high temperature, high pressure kick.

Shaffer’s conservative testing procedures call for maintaining pressure and temperature for the duration of the test. Even with these stringent demands, the UltraTemp rams hold in witnessed testing.

Shaffer UltraTemp rams are designed to seal in temperatures as low as 20 °F. This eliminates the need to heat the BOPs and/or the test medium when the surface ambient temperature is low.
The development of drilling control and information system networks has propelled the advancement of all drilling equipment control towards significant changes in the new generation drilling rigs. Shaffer has led in these changes as part of the V-IGIS (Varco-Integrated Control and Information System) development group.

By using and applying touch screen control panel technology, today's control panels are part of a fault tolerant integrated control network. Details on the operational conditions of the equipment and drilling program are available from numerous operation and information screens located around the rig.

Screen configurations and diagnostic reporting improvements are also easily modified offering a capability to develop and upgrade the hardware and software systems with minimal impact to daily rig operations.

Deepwater Control Systems

Shaffer has introduced one of the first ultra-deep multiplex (MUX) control systems. By revisiting the well-proven MUX design and identifying critical successful components and adapting them for deeper water, Koomey product engineers developed a 4th generation of subsea control system.

This 4th generation deepwater system controls more than 100 functions on each pod, utilizing the efficient fiber optic cable system, eliminating the communication issues which would occur with a traditional control line communication at depths up to and exceeding 7,000 feet. All of the components used in the 4th generation MUX have been rated to operate in up to 10,000 feet water depths.

The dependable performance and reduced maintenance requirements, which Shaffer's Koomey brand is known for, was improved in the new system. Enhancements include reduction and elimination of hard piping, upgrading of materials, redesign of components for improved maintenance and extended service life. The Shaffer design has also lead the industry towards systems designed with maximum redundancy in mind as the time taken to run a control pod in deep water increases with the depth.
The electronic control unit uses field-proven GE Fanuc PLCs. This system's PLC architecture is fault tolerant and contains thorough diagnostic capabilities, providing superior maintainability and consistent uninterrupted performance.

All of the components are selected to be nonproprietary and available worldwide.

Deep Water Options

Shaffer offers a deepwater system (up to 110 functions), and an 80-function system, that takes full advantage of our existing 80-line pod, while upgrading it to an electro-hydraulic system.

Minute Man Control Systems

While the floating rig market uses the multiplexed electro-hydraulic or direct-hydraulic systems, high specification jack-ups are applying the lessons of the 4th Generation MUX systems for use in the Minute Man programmable logic control (PLC) unit for jack-ups and platforms as well as land and barge operations. With the introduction of fiber optics, the programmable logic control (PLC) systems for BOP control have advanced and the electro-hydraulic (EH) Minute-Man control systems offers unique ability for control system automation while offering a quick connection and disconnection of the control system to the control pod.

Hydraulic Systems

Direct hydraulic systems are available for use in water under 5,500-feet depth as well as land applications. A bias-pressure system improves response times of hydraulic systems in water depths in excess of 3,000'.

A variety of test units, workover units, panels and other options are available utilizing direct hydraulic and PLC control units.

Diverter Controls

Depending on customer requirements, Shaffer provides a diverter control system independent of the main hydraulic control unit or as a panel driven off of the main unit.

Land Units

Shaffer manufactures BOP control units sized from the largest rigs to workover requirements. Utilizing the dependable Koomey design, these systems provide years of service.

Upgrades are also available. Air, electric and hydraulic panels can be supplied as replacements for original antiquated panels, or for auxiliary use.

Shaffer also supplies various types of test units, from pumping/gauging units to complete self-contained testing systems.
Auxiliary Equipment

**Complete Shutoff Choke System**

A Shaffer drilling choke system provides fast, accurate well control through one or two chokes operated remotely from the rig floor. Fluids can be circulated from the wellbore while holding any desired back pressure rating of the choke.

Chokes are available for 5,000, 10,000, and 15,000 psi at up to 300 °F, suitable for H₂S service.

**Gate Valves**

Shaffer gate valves provide a wide range of choices in application style, trim, working pressure, and bore sizes.

There are additional choices low temp/high temp (350 °F), internal H₂S, and standard service. Also available are models which meet API 6A specifications for PSL-1, 2, and 3.

Type B™ (handwheel) and Type DB™ (hydraulic remote) come in 2½", 4½", 5,000, 10,000, and 15,000 psi. Type HB™ remotely operated subsea gate valves are available in 3½", 5,000 psi, 3¾" 10,000 and 15,000 psi.

**Choke and Kill Manifolds**

Shaffer choke and kill manifolds are manufactured for diverse applications from simple low pressure environments to extreme sour gas service.

Shaffer’s wide array of fixed, hand-adjustable and remotely-adjustable chokes can be furnished in a 5,000, 10,000 and 15,000 psi manifold—with or without a buffer chamber.

**Best Chokes**

Varco Best chokes come in various sizes and working pressures and, depending on the choice and application, can be used for extremely high pressure wells. It comes equipped with API flanges in working pressures of 5,000, 10,000, and 15,000 psi.

Best Maximum Performance Gage (MPG) chokes provide extended life and superior performance from Best’s cage trim design. Safety and cost effective operation are improved through the use of Best’s Wear Monitor. The reliability of the Model VB-100 stepping actuator has been proven through extensive laboratory and field testing.
Riser String Packages

**Shaffer Riser Spider**

The Shaffer riser spider is designed to support the riser string when running and retrieving through the rotary table. The split-design spider is hydraulically operated, compatible with all rotary tables, and can support up to 3.5 million pounds.

**Ultra Deep Water Riser**

Shaffer has lead new riser design with the introduction of the DT-2 2-million lb dog-type riser connections. As drilling depths have increased, Shaffer has introduced the first 3.5-million lb bolted-type flange connector, the Type FTH. It is designed for applications that meet API 16R class II. Operation of the FTH riser connector is simple and easy with current available riser makeup tool. With unidirectional field-replaceable, improved J-lock retention slot seal sub, the FTH riser requires minimum maintenance.

**Marine Riser Systems**

Shaffer offers a complete range of marine riser systems from shallow water to ultra deep drilling applications including riser analysis. By analyzing all design variables and drilling condition parameters, we ensure that the product is highly reliable, durable, and cost effective.

**Riser Fillup Valve**

Shaffer's riser fillup valve utilizes a simple and reliable design to prevent the collapse of the riser due to evacuation of the drilling fluid. The fillup valves are automatically actuated when mud level pressure falls below a specified minimum. Shaffer riser fillup valves are self-contained and independent of control lines.
Tensioners

Riser Tensioner

Riser Tensioners are available in several sizes including 80 kips, 120 kips, 160 kips, 200 kips, and 250k—the 80k riser tensioner can now be upgraded to 120k capacity. The available options for the deep water (160k, 200k, 250k, and 600k) tensioners include: motorized wire feed capabilities, storage integration, and riser recoil system integration.

A fixed orifice, factory fitted and sized for safe performance, provides operational dampening and extension speed control in case of tensioner release due to a broken wire rope. Installation on the rod side of the tensioner cylinder oil circuit ensures instant reaction of the control valve.

Also, to provide speed control and lubrication to the dynamic packing and bearings, an air-oil reservoir, operating at 20-40 psi low pressure, keeps the rod end of the tensioner cylinder full of oil. Air pressure vessels are rated to 2,400 psi operating pressure, enabling tensioner operation at full rating even at the midstroke position. Full ratings are achieved at approximately 2,100 psi.

Existing 80k tensioners can now be simply upgraded to 120k capacity with a simple cylinder replacement.

Riser Recoil

The Rucker riser recoil control system protects against damage caused by the tension ring impacting the rig or the LMRP impacting the BOP Stack or the ocean floor in the event of an unscheduled disconnection in deep water.

The graphs show a comparison of a deep water case with a Rucker riser recoil system installed and not installed.

The riser recoil system consists of velocity and energy control subsystems and an actuation panel.

Rucker riser recoil automation upgrade fully automates the riser recoil system. It adds a greater degree of precision and safety into the standard system using two heave indicators, and trend information. The system receives signals on the tensioner position, heave, and system pressure. The system analyzes this data, determines which valves to actuate, and times actuation correctly to allow sufficient pull to clear the LMRP without damage.
Drill String
Compensators

The original Rucker drill string compensator (DSC) is the leading motion compensating system of its kind in use today. Mounted between the traveling block and hook, it isolates the heaving motion of the vessel from the drill string. It minimizes wear between the drill string and the blowout preventer, marine riser and casing strings. Rucker DSCs, like other Rucker motion compensation equipment, have always had the significant performance advantage of using the hydropneumatic operating principle. DSCs are furnished with operating stroke lengths of 15, 18, 20, or 25 feet, depending on rig design and application. They can be manufactured to meet ASME, ABS, USCG, DNV, and other applicable codes.

During drilling operations, the Rucker DSC keeps the drill bit on the bottom of the hole within the weight limits set by the driller. For other operations, the system compensates for rig motion, maintaining a position relative to the ocean floor.

As the rig heaves upward, the compensator cylinders retract and the hook moves downward relative to the drill floor, while remaining at a constant level relative to the earth. The cylinder piston compresses the air through the hose into the air pressure vessels to maintain the preset tension level.

As the rig heaves downward, air from the air pressure vessels expands into the compensator cylinder, and the system works in reverse.

The Rucker DSC system achieves 400k, 600k, or 800k lb full rated compensation with only 2,260 psi. Rucker air pressure vessels and system components are manufactured to operate at 2,400 psi.

Other Special Features
- Faster response time
- Extended stroke operation
- Efficient air coupling between the compensator and air pressure vessels
- Compression-loaded cylinder design
- Long stroke design for rod end cushion deceleration of cylinder in the event of free release under load.
- Blind end cushion
- Patented speed limiting valve
- Low pressure air-oil reservoir
- Flexible linkage between cylinder and hook
- Locking option available
The simple geometry of the Rucker 600k, 800k, and 1,000k Crown-Mounted Compensator offers superior performance lowering weight on bit variation and wire rope wear. The proven durability and maintainability of the Rucker design contributes to lower maintenance costs.

The Rucker CMC consists of two vertically mounted compression-type cylinders attached to a rigid frame mounted to the derrick water table. Vertical cylinders impose the least load on rod bearings and less load on the derrick structure. Direct acting cylinders support the crown block above the water table utilizing all of the derrick height. The crown block is guided by one major guide column eliminating guide tracking alignment problems. A minor auxiliary guide track balances the system.

The fast line and deadline pass over large diameter sheaves, then are reeved through the traveling block and crown block sheaves, increase the life of the cable by approximately a factor of two.

The compensator is capable of hydraulically locking at any point along the compensating stroke. Retracting the cylinders, the crown block comes to rest on the cylinder support beams eliminating the need for a rotating or extending mechanical lock system. In this mode, with the cylinders not compensating, the fast line and deadline functions remain operational.

The speed control valve limits the extension speed of the cylinder if the drill string breaks while the Crown Mount Compensator is pressurized. If the cylinder extension speed exceeds the maximum operational speed by 15%, the valve closes down to limit the extension speed causing hydraulic back pressure in the rod end. The 1,000,000 lb CMC can optionally be mounted perpendicular to the block. This allows more accessibility to pipe handling equipment.

**Load Range Specification**

- **Stroke**: 25 feet
- **600k Load, cylinders compensating**: 600,000 pounds
- **Load, cylinders retracted**: 1,500,000 pounds
- **1,000k Load, cylinders compensating**: 1,000,000 pounds
- **Load, cylinders retracted**: 2,000,000 pounds
Customer Support

Shaffer is committed to supplying quality after-the-sale customer service. Our factory trained service engineers can use high quality original parts or reconditioned components to perform repairs to factory specification. With Customer Support Centers strategically located worldwide, Shaffer can keep your equipment in first class operating condition, 24 hours a day, 365 days a year. Whether your needs are in OEM (original equipment manufacturer) parts, factory repairs, or field repair/service, every Shaffer product is backed by over 65 years experience.

OEM Spare Parts

Shaffer's high quality OEM spare parts are vital to the safety and efficiency of your operation. Shaffer's parts are manufactured, inspected, and tested in-house to ensure that you get performance and quality every time under the most demanding conditions. Shaffer products are continuously upgraded to meet your changing requirements, and use of genuine OEM parts ensures optimum equipment performance. Comparison tests between Shaffer and non-OEM ram rubbers demonstrate that Shaffer manufactured ram rubbers outperform the others by as much as 81%.

Factory Specification Repairs

Because Shaffer repairs are performed to strict manufacturing specifications, you can depend on each repair to your pressure control or motion compensation equipment to be fully inspected, tested, and safe for continuing operations. Our repair operations are equipped with the latest in machining, welding, and coating technology so that each repair can be carried out quickly, safely, and efficiently. Every repair is backed by the knowledge of our full complement of technicians, engineers, and inspectors—all trained to provide attention to the smallest detail. Also, each Shaffer factory repair is fully warranted.

Factory Trained Service Technicians

Our team of factory-trained service technicians provide over 200 years of combined field experience. To help eliminate costly downtime caused by offsite repairs, our technicians can conduct field modifications and repairs. Our technicians can also troubleshoot your systems and make recommendations on maintenance and operation to improve performance.