







Shaffer Ram BOPs

Shaffer Ram BOPs Outstanding Features

Shaffer ram BOPs offer field-proven reliability in sealing around drill pipe and across open hole and for shearing drill pipe.

- Minimum maintenance space is required. Shaffer rams have a low overall height compared with other ram preventers.
- Single, double and triple models are available. The double and triple models save space and weight by combining two or three ram compartments into one unitized body.
- Full environmental H₂S trim, conforming to API and NACE requirements, is available.
- Self-draining body has a ram compartment with skids to support the rams and a sloped bottom which allows mud and sand to drain back into the well bore. This keeps the ram cavity free of caked mud and debris.
- Ram rubbers have a long life in routine drilling operations and in stripping.
- Rams can be changed easily without breaking or remaking hydraulic connections, even with pipe in the hole.
- Single piston hydraulic operators have a minimum number of working parts. This assures high reliability and low maintenance.
- Flanged, hubbed or studded connections are available for end connections and side outlets of most models.

Ram BOP Sizes and Models								
Working Pressure (psi)	Bore (in.)							
	4 1/16	7 1/16	9	11	13 5/8	16 3/4	18 3/4	21 1/4
15,000								
10,000								
5,000								
3,000								
2,000								

 Chasovoy™
  NXT™
  SL™
  LWST™
  LWPT™
  SLX™

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Ram BOP Sizes and Models

Shaffer Ram BOPs

Shaffer Currently Offers Four Basic Models of Ram Blowout Preventers

NXT® Models

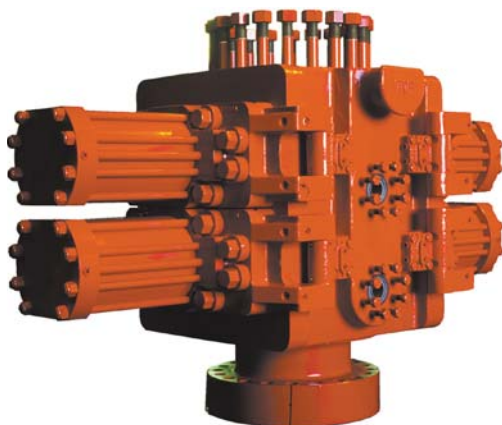
The newest of the Shaffer ram preventers, they offer no-weld cavity and boltless BOP doors. Replaceable parts to the cavity eliminate post weld heat treatments. The seal seat, skid plate and side pads can be replaced upgrading the BOP cavity tolerances to as new condition.



NXT®

SL/SLX Models

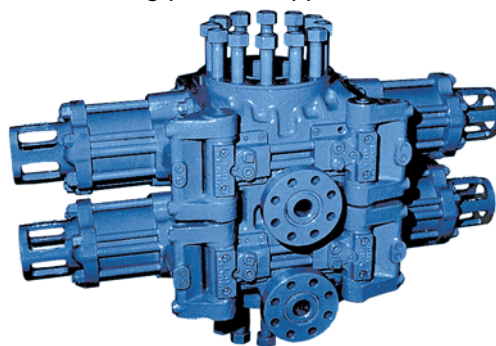
These Shaffer field-proven ram preventers are designed for high pressure, critical service operations, deep land drilling and subsea service.



SL/SLX™

LWS Models

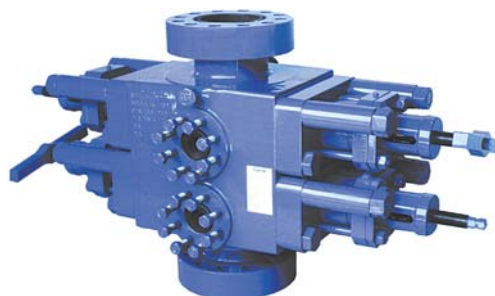
Perhaps the best known Shaffer ram preventers, these are ideal for smaller bore, lower working pressure applications.



LWS™

Chasovoy Models

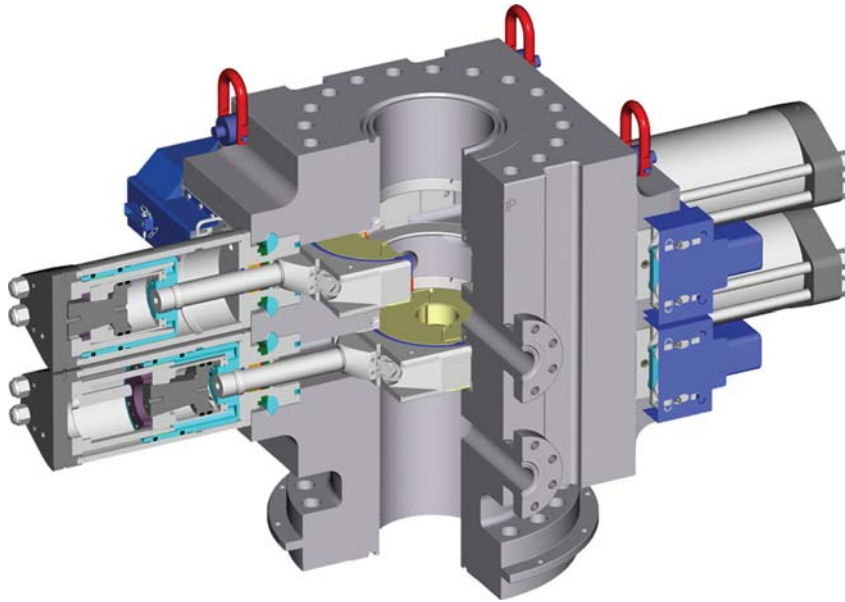
These lightweight, compact preventers incorporate a unique design which permits either manual or hydraulic operation and are ideal for well servicing, workover, fracking and low pressure drilling.



Chasovoy™

Shaffer NXT® Ram BOPs

NXT® Double BOP



Shaffer's NXT® BOP offers a number of benefits and has significantly improved safety and efficiency, with quick access using boltless doors.

Special Features

- Boltless BOP doors — In the area of drilling and safety, the new NXT® BOP door locking system has enabled automatic opening and closing of NXT® BOP doors, representing a major step toward automation of BOP servicing.
- Simple manual mechanical door actuation at the ram door is also available.
- Reduced Weight — (lightest BOP system in the industry).
- Reduced Height — (smallest BOP system in the industry). Achieved by eliminating the flange connection below the annular and connecting bolts thru the base of the annular directly to the ram body.
- Improved Safety — There is now less manpower needed to service the BOP as well as reduction of injuries related to BOP ram access.

- Reduced Time for Ram Changes — Ram changes go from 4 hours to 40 minutes. With the replacement of the large door bolts in ram BOPs, Shaffer has eliminated the manual practice of using brute force to torque up a series of large bolts.

Model NXT™ Hydraulic System

Hydraulic power to operate a Model NXT® ram BOP can be furnished by any standard oil field accumulator system.

Hydraulic passages drilled through the body eliminate the need for external manifold pipes between the hinges. Each set of rams requires only one opening and one closing line. There are two opening and two closing hydraulic ports, clearly marked, on the back side of the BOP. The extra hydraulic ports facilitate connecting the control system to the preventer.

A standard hydraulic accumulator unit will close any Model NXT® ram with rated working pressure in the well bore.

Shaffer NXT® Ram BOPs

Model NXT®

UltraLock™ 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.

Model NXT® Poslock System

NXT® preventers equipped with Poslock pistons are locked automatically in the closed position each time they are closed. The preventers will remain locked in the closed position even if closing pressure is removed. Open hydraulic pressure is required to reopen the pistons.

The hydraulics required to operate the Poslock are provided through opening and closing operating ports. Operation of the Poslock requires no additional hydraulic functions, such as are required in some competitive ram locking systems.

Model NXT® Manual-Lock Systems

Manual-lock pistons move inward and close the rams when closing hydraulic pressure is applied. If desired, the rams can be manually locked in the closed position by turning each locking shaft to the right until it shoulders against the cylinder head. Should hydraulic pressure fail, the rams can be manually closed and locked. They cannot be manually reopened.

Door Operating Principle

The NXT® "Boltless Door" assembly is mechanized using hydraulics to lock, unlock, open and close the door. The lock and unlock process is done with hydraulic cylinders mounted on the doors used to engage and disengage a locking bar system. These load bearing lock bars, housed in the door grooves, lock the door and body together.

Control Manifold Option

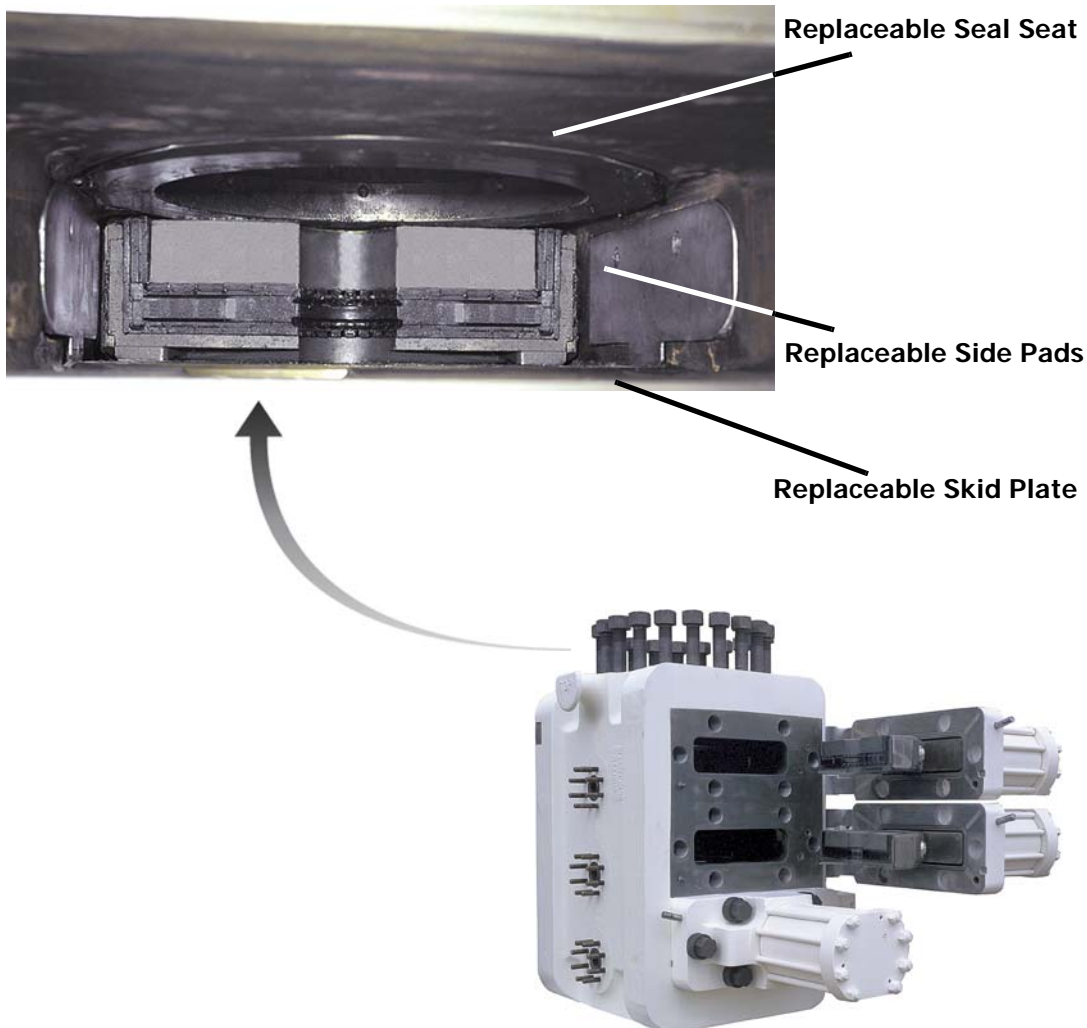
Hydraulic door functions are operated through a control manifold assembly. The assembly is mounted to a plate for convenient customer installation.

Shaffer No-Weld Cavity Ram BOPs

Shaffer introduced a no-weld cavity feature in the SLX model ram blowout preventer. The no-weld cavity is a feature which allows upgrade of the BOP to new condition. Post-weld heat treatments are eliminated.

This no-weld cavity has a replaceable seal seat, a replaceable skid plate and replaceable side pads.

The no-weld cavity is standard on the NXT® ram BOP, an available option on the SLX ram BOP, and available as a retrofit on some SL ram BOP sizes.

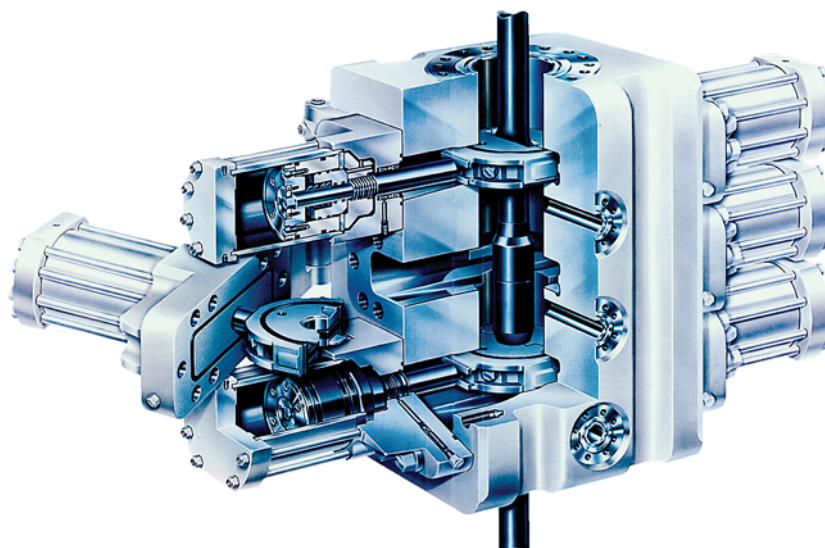


Shaffer SL/SLX Ram BOPs

Shaffer Model SL/SLX ram blowout preventers are the product of more than 80 years of experience in building ram BOPs to meet the changing demands of the petroleum industry. SL models incorporate the improvements made in the LWS preventer line over the past 44 years — improvements resulting from continuing research to ensure that Shaffer preventers meet or surpass the latest industry requirements.

Special Features

- Flat doors simplify ram changes. To change the rams, apply opening hydraulic pressure to move the rams to the full open position. Vent hydraulic pressure. Remove the door cap screws and swing the door open. Remove the ram from the ram shaft and replace it. It is not necessary to apply closing hydraulic pressure to move the rams inward to clear the door.
- SL Model door seals (most sizes) have a hard backing molded into the rubber. This backing prevents extrusion and pinching at all pressures to assure long seal life.
- SLX Model features a Pressure-Energized Door Seal. This new design cartridge seal assembly employs a radial seal to pressure assist a face seal and prevent extrusion. This feature allows reduced door bolt torque.
- Internal H₂S trim is standard. All major components conform to API requirements.
- Maximum ram hardness is R_c22 to insure H₂S compatibility of pipe and blind rams. Shear rams have some harder components.
- Poslock operators lock the rams automatically each time they are closed. This eliminates the cost of a second hydraulic function to lock. It also simplifies emergency operation because the rams are both closed and locked just by activating the close function.
- Manual-lock and Poslock pistons can be interchanged on the same door by replacing the ram shaft, piston assembly and cylinder head.
- Wear rings eliminate metal-to-metal contact between the piston and cylinder to increase seal life and virtually eliminate cylinder bore wear.
- Lip type piston seals are long-wearing polyurethane with molybdenum disulfide molded in for lifetime lubrication.
- Lip type ram shaft seals hold the well bore pressure and the opening hydraulic pressure.
- Secondary ram shaft seals permit injection of plastic packing if the primary lip type seal ever fails. Fluid dripping from the weep hole in the door indicates that the primary seal is leaking and that the secondary seal should be energized.



SL Triple BOP

Shaffer SL/SLX Ram BOPs

Special Features, Continued

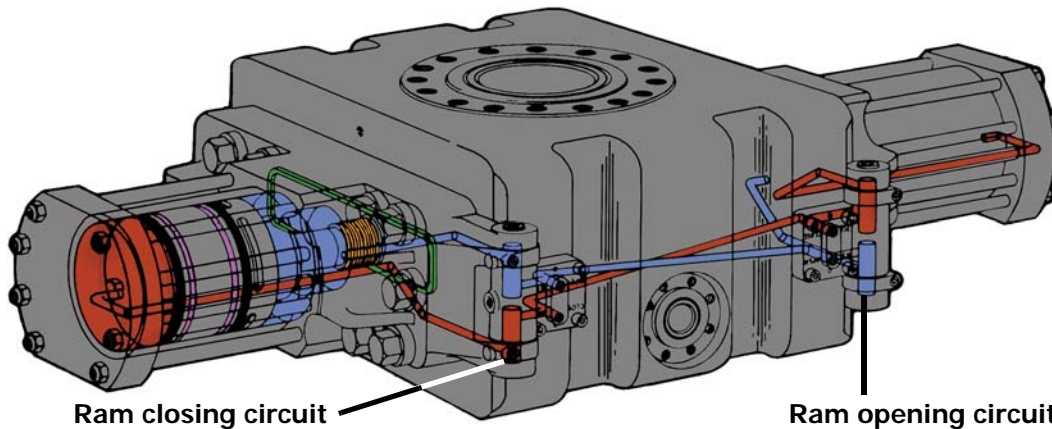
- Rams are available which will support a 600,000 pound drill string when a tool joint is lowered onto the closed rams. These rams conform to H₂S requirements.
- Shear rams cut drill pipe and seal in one operation. Most common weights and grades of drill pipe are sheared with less than 1,500 psi hydraulic pressure using 14" cylinders. Some grades and weights require higher hydraulic pressures.

Model SL/SLX Hydraulic System

Hydraulic power to operate a Model SL/SLX ram BOP can be furnished by any standard oil field accumulator system.

Hydraulic passages drilled through the body eliminate the need for external manifold pipes between the hinges. Each set of rams requires only one opening and one closing line. There are two opening and two closing hydraulic ports, clearly marked, on the back side of the BOP. The extra hydraulic ports facilitate connecting the control system to the preventer.

A standard hydraulic accumulator unit will close any Model SL/SLX ram with rated working pressure in the well bore, except for the 7 1/16", 11" and 13 5/8" -15,000 psi BOPs, which require 2,200 psi. However, these units will close against 10,000 psi well pressure with less than 1,500 psi hydraulic pressure.



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SL Single BOP

Shaffer SL/SLX Ram BOP Operation

Model SL/SLX UltraLock™ 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 ram. 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.

Model SL/SLX Poslock System

SL/SLX preventers equipped with Poslock pistons are locked automatically in the closed position each time they are closed. The preventers will remain locked in the closed position even if closing pressure is removed. Open hydraulic pressure is required to reopen the pistons.

The hydraulics required to operate the Poslock are provided through opening and closing operating ports. Operation of the Poslock requires no additional hydraulic functions, such as are required in some competitive ram locking systems.

Model SL/SLX Manual-Lock System

Manual-lock pistons move inward and close the rams when closing hydraulic pressure is applied. If desired, the rams can be manually locked in the closed position by turning each locking shaft to the right until it shoulders against the cylinder head. Should hydraulic pressure fail, the rams can be manually closed and locked. They cannot be manually reopened.

The manual locking shafts are visible from outside and provide a convenient ram position indicator. Threads on the manual locking shaft are enclosed in the hydraulic fluid and are not exposed to corrosion from mud and salt water or to freezing.

Rams are opened by first turning both locking shafts to their unlocked position, then applying opening hydraulic pressure to the pistons, which move outward and pull the rams out of the well bore.

Shaffer LWS Ram BOP Operation

Model LWS blowout preventers have been the most popular Shaffer Ram Preventers and have met the demanding pressure control requirements of the drilling industry for more than 20 years. Many of the features incorporated in the most advanced SL models are included in the LWS design.

Special Features

- Rams are available which will support a 600,000 pound drill string load when a tool joint is lowered onto the closed rams. These rams conform to H₂S requirements.
- Secondary ram shaft seals are furnished on all LWS preventers except 4 1/16" 5,000 and 10,000 psi; 7 1/16" 5,000 psi; and 11" 3,000 psi BOPs.
- Rams are easily replaced. They slide horizontally onto the ram shaft except on the 4 1/16" 10,000 psi BOP where the ram mounts onto the ram shaft from above.
- Poslock operators are available on the 4 1/16" 5,000 and 10,000 psi, 20 3/4" 3,000 psi and 21 1/4" 2,000 psi LWS BOPs.
- Manual-lock operators are furnished on all LWS BOPs not equipped with Poslock operators.
- Maximum ram hardness is R_C22 to insure H₂S compatibility of pipe and blind rams. Shear rams have some harder components.

Model LWS Hydraulic System

The hydraulic pressure required to close an LWS BOP is below 1,500 psi with rated well pressure in the bore. Any standard 1,500 psi oil field accumulator system can be used to actuate these BOPs.

External hydraulic manifold pipes conduct the fluid between the hinges on all sizes except the 4 1/16" 5,000 and 10,000 psi, 20 3/4" 3,000 psi and 21 1/4" 2,000 psi LWS BOPs.

Model LWS Poslock System

LWS Preventers equipped with Poslock pistons are locked automatically in the closed position each time they are closed. The preventers will remain locked in the closed position even if closing pressure is removed. Opening hydraulic pressure is required to reopen the pistons.

The hydraulics required to operate the Poslock are provided through opening and closing operating ports. Operation of the Poslock requires no additional hydraulic functions, such as are required in some competitive ram locking systems.

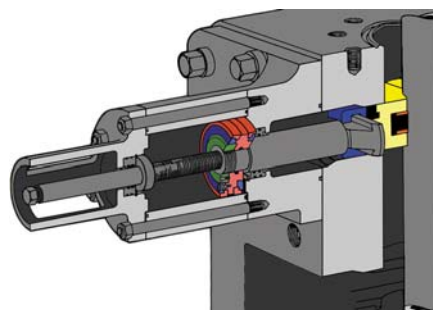
Shaffer LWS Ram BOP Operation

Model LWS Manual-Lock System

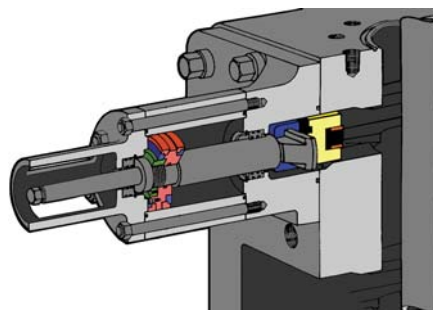
Manual-lock pistons move inward and close the rams when closing hydraulic pressure is applied. If desired, the rams can be manually locked in the closed position by turning each locking shaft to the right until it shoulders against the cylinder head. Should hydraulic pressure fail, the rams can be manually closed and locked. They cannot be manually reopened.

The manual locking shafts are visible from outside and provide a convenient ram position indicator. Threads on the manual locking shaft are enclosed in the hydraulic fluid and are not exposed to corrosion from mud and salt water or to freezing.

Rams are opened by first turning both locking shafts to their unlocked position, then applying opening hydraulic pressure to the pistons, which move outward and pull the rams out of the well bore.



LWS Manual Lock, closed and locked



LWS Manual Lock, open

Shaffer Chasovoy Ram BOP

Features

Shaffer's Chasovoy ram BOP was developed to satisfy a number of design, operational and economic criteria and now offers the following advantages:

- Unique design permits either manual or hydraulic operation
- Manual operation incorporates innovative and proprietary design
- Lightweight, short, transportable and easy to install
- Simple parts replacement
- Economical, but designed to Shaffer's high standards of performance and rugged reliability.

Manual or Hydraulic Operation

The ability of the Chasovoy to close or open the rams manually makes it truly unique. To close both rams simultaneously in the manual mode requires a single drive shaft to be activated. Turning the drive shaft clockwise moves the active piston inward and displaces fluid to the close side of the slave piston. Turning the drive shaft counter clockwise opens the rams. The maximum torque to close and seal the rams is only 735 ft lbs. To operate the Chasovoy ram BOP hydraulically, simply disengage the drive shaft from the (active) piston and connect to the accumulator unit to the open and close ports of the preventer. The Chasovoy can be converted from manual to hydraulic operation in the field.

Compact and Easy to Handle

Chasovoy ram BOPs are lightweight, short and easy to handle during transportation, and quick to install at the site. The single model stands 11 1/4" high. The unitized double (studded-studded) is only 20 1/2" high, which is significantly shorter than two singles stacked together. This can make a real difference when rig space is at a premium.

Parts Replacement

Parts replacement in the Chasovoy has been made simple. Ram change accessibility is accomplished by removing the operator body bolts and sliding the operator away from the body along the two support rods. This permits quick ram change and ram rubber replacement.

Shaffer Standards

The Chasovoy is designed to Shaffer's standards of performance and reliability: rugged and Always in Control during workover, well servicing, fracking and drilling operations. Shaffer technology has been developed through 65 years of BOP engineering and manufacturing experience. This experience gives the Chasovoy ram BOP sealing ability you can count on, with smooth, positive opening and closing action. Shaffer also has a well earned reputation for providing reliable pressure control equipment for all environments and conditions.

Additional Features:

- Available in a 200 mm, 345 bar and 7 1/16" 3,000 psi 180 mm, 207 bar models.
- Ram shaft and hydraulic piston seals are proven lip type design for longer life and maximum protection.



Chasovoy Double BOP

Shaffer Model NXT Specifications

Model NXT® Specifications

Working Pressure (PSI)			15,000	10,000		5,000	
Bore (Inches)			18 3/4	18 3/4	13 5/8	18 3/4	13 5/8
Model			NXT	NXT	NXT	NXT	NXT
Piston Size (Inches)			14	14	14	14	14
Poslock	L (Length-Inches)		137 1/4	137 1/4	See Note 1	137	See Note 1
	F (Inches)		49 5/8	49 5/8	See Note 1	45 1/4	See Note 1
	G (Inches)		68 5/8	68 5/8	See Note 1	68 1/2	See Note 1
Booster (Poslock)	L (Length-Inches)		204 3/4	204 3/4	See Note 1	See Note 1	See Note 1
	F (Inches)		73 5/8	73 5/8	See Note 1	See Note 1	See Note 1
	G (Inches)		104 1/4	104 1/4	See Note 1	See Note 1	See Note 1
Manual-Lock	L (Length-Inches)		See Note 1	See Note 1	138 3/4	164 3/8	138 3/4
	F (Inches)		See Note 1	See Note 1	39 7/8	51 5/8	39 7/8
	G (Inches)		See Note 1	See Note 1	67 3/4	82	67 3/4
UltraLock IIB	L (Length-Inches)		137 1/4	137 1/4	126 5/8	137	126 5/8
	F (Inches)		49 3/4	49 3/4	40 3/4	45 1/4	40 3/4
	G (Inches)		80 3/8	80 3/8	48 1/8	68 1/2	48 1/8
X (Angle) Min. angle to remove ram assembly			50°	50°	45°	45°	45°
W (Width)			61 7/8	61 7/8	41 1/4	52 1/2	41 1/4
H (Height) Inches	Single	Studded	44 1/4	44 1/4	23 1/8	34	23 1/8
		Flanged	78 1/2	72 3/4	42	56 1/4	40 1/8
		Hubbed	61 1/8	61 1/8	34 7/8		34 7/8
	Double	Studded	55 5/8	55 5/8	43 1/8	46 3/8	40 1/4
		Flanged	88 3/4	84 1/4	61 1/2	68 5/8	57 1/4
		Hubbed	72 5/8	72 5/8	54 7/8		52 1/2
	Triple	Studded	72 5/8	72 5/8	76	66 3/4	76
		Flanged	105 3/4	103 3/8	94 3/4	88 3/4	80 1/4
		Hubbed	89 3/4	89 5/8	87 3/4		82 3/8
D (Inches)			28 5/8	28 5/8	21 1/2	28 5/8	21 1/2
E (Inches)			28 5/8	28 5/8	19 3/4	28 5/8	19 3/4
I (Inches)			20	20	22 7/8	20	22 7/8
J (Inches)			17 3/8	17 3/8	17 3/8	9 1/2	17 3/8
K (Inches)	Single	Studded	15 3/4	15 5/8	4 5/8	7 3/8	4 5/8
		Flanged	32 3/8	32 1/4	15 5/8	18 1/4	13 1/2
		Hubbed	24 1/8	24 1/8	10 1/2		10 3/4
	Double	Studded	7 3/4	7 3/4	5 3/8	4 1/4	4 5/8
		Flanged	24 3/8	22 1/8	15 5/8	15 1/8	13 1/2
		Hubbed	16 1/4	16 1/4	10 3/4		10 3/4
	Triple	Studded	7 3/4	7 3/4	5 1/2	4 1/4	4 5/8
		Flanged	24 3/8	22 1/8	15 5/8	15 1/8	13 1/2
		Hubbed	16 1/4	16 1/4	10 3/4		10 3/4
M (Inches)	Single	Studded	18 1/4	18 1/4	7 1/8	14 1/2	7 1/8
		Flanged	35 1/8	33 3/4	17 7/8	25 5/8	18
		Hubbed	26 3/4	26 3/4	13		13
	Double	Studded	15 5/8	15 5/8	7 1/8	11	7 1/8
		Flanged	32 1/4	32 1/4	17 7/8	22 1/8	18
		Hubbed	24 1/8	24 1/8	13		13
	Triple	Studded	15 5/8	15 5/8	7 1/8	11	7 1/8
		Flanged	32 1/4	32 1/4	18	22 1/8	18
		Hubbed	24 1/8	24 1/8	13		13

Shaffer Model NXT Specifications

Model NXT® Specifications (Continued)

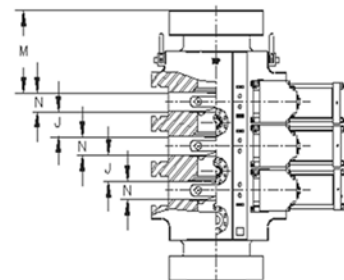
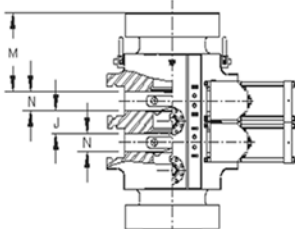
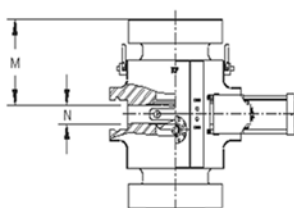
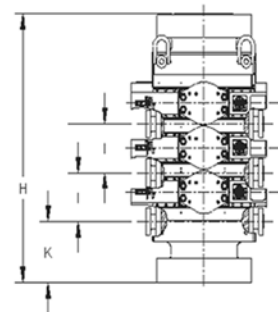
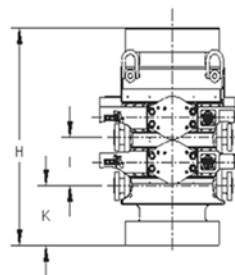
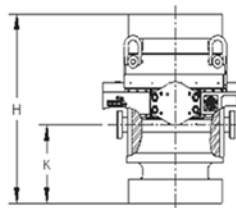
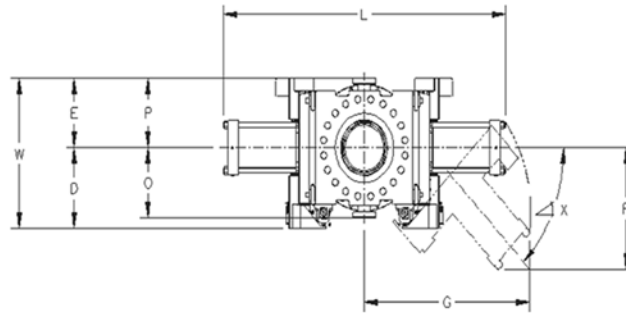
Working Pressure (PSI)				15,000	10,000		5,000	
Bore (Inches)				18 3/4	18 3/4	13 5/8	18 3/4	13 5/8
Model				NXT	NXT	NXT	NXT	NXT
Piston Size (Inches)				14	14	14	14	14
N (Inches)				7 1/2	7 1/2	5 1/2	7 1/2	5 1/2
O2 (Inches)	3-inch			28 5/8	28 5/8	19 7/8	26 5/8	19 7/8
	4-inch			30	30	20 1/2	53 3/4	20 1/2
P2 (Inches)	3-inch			26 1/2	26 1/2	19 7/8	26 5/8	19 7/8
	4-inch			29 7/8	29 7/8	20 3/8	53 3/4	20 3/8
Total Weight Without Rams (Lbs.)	Single	Studded		28783	28783	9263	20735	9263
		Flanged		38783	35633	11345	24835	9985
		Hubbed		31383	30583	9963		9763
	Double	Studded		40060	40060	18582	29485	18582
		Flanged		50060	46910	20664	33585	19304
		Hubbed		42660	41860	19282		19082
	Triple	Studded		54095	54095	27901	38235	27901
		Flanged		64095	60945	29983	42335	28623
		Hubbed		56695	55895	28601		28401
Weight Breakdown (Lbs.)	1 Ram Assembly with Holder			565	565	160	536	160
	Door Assembly (1 each)			3270	3270	2391	2780	2391
	Body	Single	Studded	22243	22243	4481	15175	4481
			Flanged	32243	29093	6563	19275	5203
			Hubbed	24843	24043	5181		4981
	Body	Double	Studded	26980	26980	9018	18365	9018
			Flanged	36980	33830	11100	22465	9740
			Hubbed	29580	28780	9718		9518
	Body	Triple	Studded	34475	34475	13555	21555	13555
			Flanged	44475	41325	15637	25655	14277
Hubbed			37075	36275	14255		14055	
Poslock	Closing Ratio			13.94	13.94	See Note 1	10.85	See Note 1
	Opening Ratio			2.58	2.58	See Note 1	2.67	See Note 1
	Gallons to Close			14.04	14.04	See Note 1	14.04	See Note 1
	Gallons to Open			13.02	13.02	See Note 1	12.74	See Note 1
Booster (Poslock)	Closing Ratio			25.49	25.49	See Note 1	25.49	See Note 1
	Opening Ratio			2.67	2.67	See Note 1	2.67	See Note 1
	Gallons to Close			31.22	31.22	See Note 1	31.22	See Note 1
	Gallons to Open			29.92	29.92	See Note 1	29.92	See Note 1
Manual-Lock	Closing Ratio			12.94	12.94	12.94	10.07	12.94
	Opening Ratio			2.58	2.58	8.72	2.67	8.72
	Gallons to Close			13.14	13.14	10.70	13.14	10.70
	Gallons to Open			13.14	13.14	10.70	12.84	10.70
Ultralock IIB	Closing Ratio			13.94	13.94	13.94	10.85	13.94
	Opening Ratio			2.58	2.58	8.72	2.67	8.72
	Gallons to Close			16.74	16.74	14.12	16.74	14.12
	Gallons to Open			15.72	15.72	13.28	15.44	13.28
Maximum Ram Size (Inches)				13.375	13.375	10.750	13.375	10.750

NOTES:

1. To be developed.
2. For flanged side outlets. Studded or hubbed side outlets are shorter.

Pressure Control

Shaffer Model NXT Specifications



Single

Double

Triple

NXT Dimensions

Shaffer Model SL/SLX Specifications

Model SL/SLX Specifications, 15,000 and 10,000 PSI

Working Pressure (PSI)			15,000						10,000					
Bore (Inches)			18 3/4	13 5/8	11	7 1/16	7 1/16	21 1/4	18 3/4	16 3/4	13 5/8	11	7 1/16	7 1/16
Model			SL	SL/SLX	SL	SL	SL	SL	SL	SL	SL/SLX	SL	SL	SL
Piston Size (Inches)			14	14	14	10	14	14	14	14	14	14	10	14
Poslock	L (Length-Inches)		134 3/4	123	111 3/4	79	103 5/8	136 1/4	129 3/8	127 1/4	109	102 7/8	79	103 5/8
	F (Inches)		53 3/8	48	38	—	38 1/8	42 1/16	42 1/16	42 1/8	37 3/4	36 9/16	28 1/8	38 1/8
	G (Inches)		77 3/4	75	66 5/8	48 7/8	58 7/8	84 1/8	81	79 5/16	65 15/16	62 1/8	48 7/8	58 7/8
Manual-Lock	L (Length-Inches)		—	142 3/4	135 7/32	79	128 1/2	—	—	—	128 3/4	122 3/4	79	128 1/2
	F (Inches)		—	51 5/8	42 17/64	25 1/4	42 3/4	—	—	—	40 5/8	39 1/2	25 1/4	42 3/4
	G (Inches)		—	77 1/2	74 21/64	46	63 1/2	—	—	—	68 3/4	65	46	63 1/2
Min. angle to remove ram assembly			57°	49°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
W (Width)			55 5/8	56 1/2	46 7/8	30 1/8	30 1/8	53 15/16	56 7/8	55 1/8	43 1/16	38 9/16	30	30
H (Height) Inches	Single	Studded	41	38 1/2	26 3/4	22 7/8	22 7/8	40	36 15/16	33 1/2	28	23 1/2	22 7/8	22 7/8
		Flanged	—	64 1/2	50 1/2	39 1/4	39 1/4	71	64 1/2	56 7/8	48 1/8	42 7/8	39 3/8	39 3/8
		Hubbed	—	—	—	—	—	—	52	49 1/2	38 7/8	—	—	—
	Double	Studded	59 1/4	58 1/4	43 3/4	36 5/8	—	59 1/4	54 3/4	51 3/4	46	40 7/8	36 5/8	—
		Flanged	92 1/2	84 1/4	67 1/2	53 1/8	—	88 3/4	82 5/16	75 1/8	66 1/8	60 1/4	52 3/4	—
		Hubbed	79	—	—	—	—	—	71 3/4	67 3/4	56 7/8	52 1/4	—	—
	Triple	Studded	—	—	73 1/4	—	—	—	74	—	—	—	—	—
		Flanged	—	—	—	—	—	—	97 5/16	—	—	—	—	—
		Hubbed	—	—	—	—	—	—	89	—	—	—	—	—
D (Inches)			27 1/2	26 1/2	19 1/2	12 1/2	12 1/2	22 7/8	26 1/8	25 1/4	20	17 3/16	12 1/2	12 1/2
E (Inches)			28 1/8	30	27 3/8	17 5/8	17 5/8	30 3/4	30 3/4	29 7/8	23 1/16	21 3/8	17 1/2	17 1/2
I (Inches)			20	19 3/4	17	13 3/4	13 3/4	19 1/4	19 1/4	19 1/4	18	17 3/8	13 3/4	13 3/4
J (Inches)			12 3/4	11 1/4	11	8 3/4	8 3/4	15 1/4	11 1/4	11 1/4	11 1/2	11 3/8	8 3/4	8 3/4
K (Inches)	Single	Studded	14	12 1/2	8	4 3/4	4 3/4	13 3/8	11 7/8	10 1/8	8 5/8	6 1/4	4 3/4	4 3/4
		Flanged	—	25 1/2	19 7/8	13	13	28 7/8	25 5/8	21 15/16	18 1/8	15 15/16	13 1/8	13 1/8
		Hubbed	—	—	—	—	—	—	19 1/8	18 1/8	13 9/16	—	—	—
	Double	Studded	13 1/8	12 1/2	8	4 3/4	—	13 3/8	11 1/8	10 1/8	8 1/8	6 1/4	4 3/4	—
		Flanged	29 3/4	25 1/2	19 7/8	13	—	28 1/8	24 15/16	21 5/16	18 3/16	15 15/16	12 7/8	—
		Hubbed	23	—	—	—	—	—	19 5/8	17 5/8	13 9/16	11 15/16	—	—
	Triple	Studded	—	—	8 5/8	—	—	—	11 1/8	—	—	—	—	—
		Flanged	—	—	—	—	—	—	22 25/32	—	—	—	—	—
		Hubbed	—	—	—	—	—	—	18 5/8	—	—	—	—	—

Shaffer Model SL/SLX Specifications

Model SL/SLX Specifications, 15,000 and 10,000 PSI (Continued)

Working Pressure (PSI)			15,000						10,000					
Bore (Inches)			18 3/4	13 5/8	11	7 1/16	7 1/16	21 1/4	18 3/4	16 3/4	13 5/8	11	7 1/16	7 1/16
Model			SL	SL/SLX	SL	SL	SL	SL	SL	SL	SL/SLX	SL	SL	SL
Piston Size (Inches)			14	14	14	10	14	14	14	14	14	14	10	14
M (Inches)	Single	Studded	16 3/4	15	10 1/4	8 15/16	8 15/16	16	14 7/16	12 3/4	10 3/4	8 3/4	8 15/16	8 15/16
		Flanged	—	28	22 1/8	17 1/8	17 1/8	31 1/2	28 1/4	24 1/2	20 13/16	18 7/16	17 1/16	17 1/16
		Hubbed	—	—	—	—	—	—	22 1/4	20 3/4	16 3/16	—	—	—
	Double	Studded	16	15	10 1/4	8 15/16	—	16	13 3/4	12 3/4	10 3/4	8 3/4	8 15/16	—
		Flanged	32 5/8	28	22 1/8	17 3/16	—	31 1/16	27 17/32	23 15/16	20 13/16	18 7/16	17 1/16	—
		Hubbed	25 7/8	—	—	—	—	—	22 1/4	20 1/4	16 3/16	14 7/16	—	—
	Triple	Studded	—	—	10 1/4	—	—	—	13 3/4	—	—	—	—	—
		Flanged	—	—	—	—	—	—	25 13/32	—	—	—	—	—
		Hubbed	—	—	—	—	—	—	22 1/4	—	—	—	—	—
N (Inches)			7 1/4	8 1/2	6	5	5	8	8	8	6 1/2	6	5	5
O1 (Inches)	2-inch		—	—	33 1/2	19	19	36 1/2	33 1/8	32 1/2	27 1/2	24 7/16	19	19
	3-inch		33 5/8	33 5/8	27 3/8	19	19	37 1/2	34 3/8	33 1/2	28 11/16	25 5/8	19 7/16	19 7/16
	4-inch		—	35 1/16	28 13/16	27 13/16	27 13/16	38 1/4	35 1/8	34 1/4	29 1/4	26 3/16	—	—
P1 (Inches)	2-inch		—	—	30 1/2	20 15/16	20 15/16	35 7/8	33 1/4	32 3/8	27 1/2	24 7/16	20 15/16	20 15/16
	3-inch		33 5/8	33 1/2	27 3/8	21 3/4	21 3/4	36 7/8	34 1/4	33 3/8	28 11/16	25 5/8	21 1/4	21 1/4
	4-inch		34	34 15/16	28 13/16	27 15/16	27 15/16	37 5/8	35	34 1/8	29 1/4	26 3/16	—	—
Total Weight Without Rams (Lb)	Single	Studded	—	25,860	13,700	5,781	6,900	31,130	25,300	25,828	13,200	11,100	5,550	6,900
		Flanged	—	29,050	16,500	6,200	7,550	37,600	30,700	28,500	15,550	13,000	6,200	7,550
		Hubbed	—	—	—	—	—	31,800	27,100	26,600	13,700	11,708	—	—
	Double	Studded	50,000	41,940	24,700	10,016	12,350	48,705	44,792	40,600	23,400	20,560	9,900	11,350
		Flanged	60,000	45,130	27,400	10,300	12,950	54,860	49,117	44,300	25,500	21,780	9,830	12,300
		Hubbed	—	—	—	—	—	49,372	44,903	42,000	23,800	21,790	—	—
Weight Breakdown (Lb)	1 Ram Assembly with Holders		565	523	381	150	150	551	589	527	504	366	150	150
	Door Assembly (1 each)		3,452	3,790	5,044	1,100	1,992	3,138	3,049	3,347	2,675	2,595	972	1,992
	Body Single	Studded ²	—	17,435	7,700	3,050	3,050	22,920	18,500	18,558	7,800	5,932	3,100	3,100
		Flanged	—	21,470	11,000	3,800	3,800	30,700	23,985	21,750	10,450	7,600	3,750	3,750
		Hubbed	—	—	—	—	—	25,030	20,400	19,900	8,600	6,518	—	—
	Body Double	Studded ²	33,100	25,935	13,200	4,750	4,750	33,725	30,000	27,200	12,700	9,100	4,900	4,600
		Flanged	43,100	29,970	16,500	5,550	5,550	41,320	35,300	30,600	15,200	11,400	5,440	5,440
		Hubbed	—	—	—	—	—	35,832	31,475	29,000	13,400	10,411	—	—
Closing Ratio			10.85	7.11	7.11	7.11	13.94	7.11	7.11	7.11	7.11	7.11	7.11	13.94
Opening Ratio			1.68	2.14	2.80	3.37	7.14	1.63	1.83	2.06	4.29	7.62	3.37	7.14
Gallons to Close			14.62	11.56	9.40	2.72	6.00	16.05	14.55	14.47	10.58	9.45	2.72	6.00
Gallons to Open			13.33	10.52	8.10	2.34	5.57	13.86	13.21	12.50	10.52	7.00	2.34	5.57
Maximum Ram Size (Inches)			13 3/8	10 3/4	8 5/8	5 1/2	5 1/2	16	16	13 3/8	10 3/4	8 5/8	5 1/2	5 1/2
Door Screw Across Flats (inches)			3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
Door Screw Torque (ft lb)			6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600

NOTES:

1. For flanged side outlets. Studded or hubbed side outlets are shorter.
2. Includes studs and nuts.

Shaffer Model SL/SLX Specifications

Model SL/SLX Specifications, 5,000 and 3,000 PSI

Working Pressure (PSI)			5,000				3,000
Bore (Inches)			16 ³ / ₄	16 ³ / ₄	13 ⁵ / ₈	13 ⁵ / ₈	13 ⁵ / ₈
Model			SL	SL	SL/SLX	SL/SLX	SL
Piston Size (Inches)			10	14	10	14	10
Poslock	L (Length-Inches)		116 ¹ / ₂	118 ³ / ₈	105 ¹ / ₈	108	105 ¹ / ₈
	F (Inches)		37 ⁵ / ₈	39 ⁹ / ₁₆	35 ¹ / ₁₆	37 ³ / ₈	35 ¹ / ₁₆
	G (Inches)		69 ² / ₃	71 ¹¹ / ₁₆	62 ¹ / ₃₂	64 ³ / ₈	62 ¹ / ₁₆
Manual-Lock	L (Length-Inches)		141 ¹ / ₂	—	130 ¹ / ₄	—	130 ¹ / ₄
	F (Inches)		43 ⁹ / ₁₆	—	41 ¹ / ₁₆	—	41 ¹ / ₁₆
	G (Inches)		75 ¹¹ / ₁₆	—	68 ¹ / ₁₆	—	68 ¹ / ₁₆
Min. angle to remove ram assembly			45°	45°	45°	45°	45°
W (Width)			46 ³ / ₄	46 ³ / ₄	40 ³ / ₄	40 ³ / ₄	40 ³ / ₄
H (Height) Inches	Single	Studded	25	25	17 ¹ / ₄	17 ¹ / ₄	17 ¹ / ₄
		Flanged	43 ¹ / ₂	43 ¹ / ₂	33 ³ / ₈	33 ³ / ₈	30 ⁵ / ₈
		Hubbed	37 ³ / ₄	37 ³ / ₄	29 ¹ / ₄	29 ¹ / ₄	—
	Double	Studded	42 ⁷ / ₈	42 ⁷ / ₈	34	34	34
		Flanged	61 ³ / ₈	61 ³ / ₈	50 ¹ / ₈	50 ¹ / ₈	47 ³ / ₈
		Hubbed	55 ⁵ / ₈	55 ⁵ / ₈	46	46	—
	Triple	Studded	—	—	—	—	—
		Flanged	—	—	—	—	—
		Hubbed	—	—	—	—	—
D (Inches)			21 ⁵ / ₈	21 ⁵ / ₈	19 ³ / ₈	19 ³ / ₈	19 ³ / ₈
E (Inches)			25 ¹ / ₈	25 ¹ / ₈	21 ³ / ₈	21 ³ / ₈	21 ³ / ₈
I (Inches)			17 ⁷ / ₈	17 ⁷ / ₈	16 ³ / ₄	16 ³ / ₄	16 ³ / ₄
J (Inches)			12 ³ / ₈	12 ³ / ₈	12 ¹ / ₄	12 ¹ / ₄	12 ¹ / ₄
K (Inches)	Single	Studded	6 ¹ / ₈	6 ¹ / ₈	4 ⁷ / ₁₆	4 ⁷ / ₁₆	4 ⁷ / ₁₆
		Flanged	15 ³ / ₈	15 ³ / ₈	12 ⁷ / ₁₆	12 ⁷ / ₁₆	11 ¹ / ₈
		Hubbed	12 ¹ / ₂	12 ¹ / ₂	10 ⁷ / ₁₆	10 ⁷ / ₁₆	—
	Double	Studded	6 ¹ / ₈	6 ¹ / ₈	4 ⁷ / ₁₆	4 ⁷ / ₁₆	4 ⁷ / ₁₆
		Flanged	15 ³ / ₈	15 ³ / ₈	12 ⁷ / ₁₆	12 ⁷ / ₁₆	11 ¹ / ₈
		Hubbed	12 ¹ / ₂	12 ¹ / ₂	10 ⁷ / ₁₆	10 ⁷ / ₁₆	—
	Triple	Studded	—	—	—	—	—
		Flanged	—	—	—	—	—
		Hubbed	—	—	—	—	—
M (Inches)	Single	Studded	9 ³ / ₄	9 ³ / ₄	6 ³ / ₈	6 ³ / ₈	6 ³ / ₈
		Flanged	19	19	14 ⁷ / ₁₆	14 ⁷ / ₁₆	13 ¹ / ₁₆
		Hubbed	16 ¹ / ₈	16 ¹ / ₈	12 ³ / ₈	12 ³ / ₈	—
	Double	Studded	9 ³ / ₄	9 ³ / ₄	6 ³ / ₈	6 ³ / ₈	6 ³ / ₈
		Flanged	19	19	14 ⁷ / ₁₆	14 ⁷ / ₁₆	13 ¹ / ₁₆
		Hubbed	16 ¹ / ₈	16 ¹ / ₈	12 ⁷ / ₁₆	12 ⁷ / ₁₆	—
	Triple	Studded	—	—	—	—	—
		Flanged	—	—	—	—	—
		Hubbed	—	—	—	—	—

Pressure Control

Shaffer Model SL/SLX Specifications

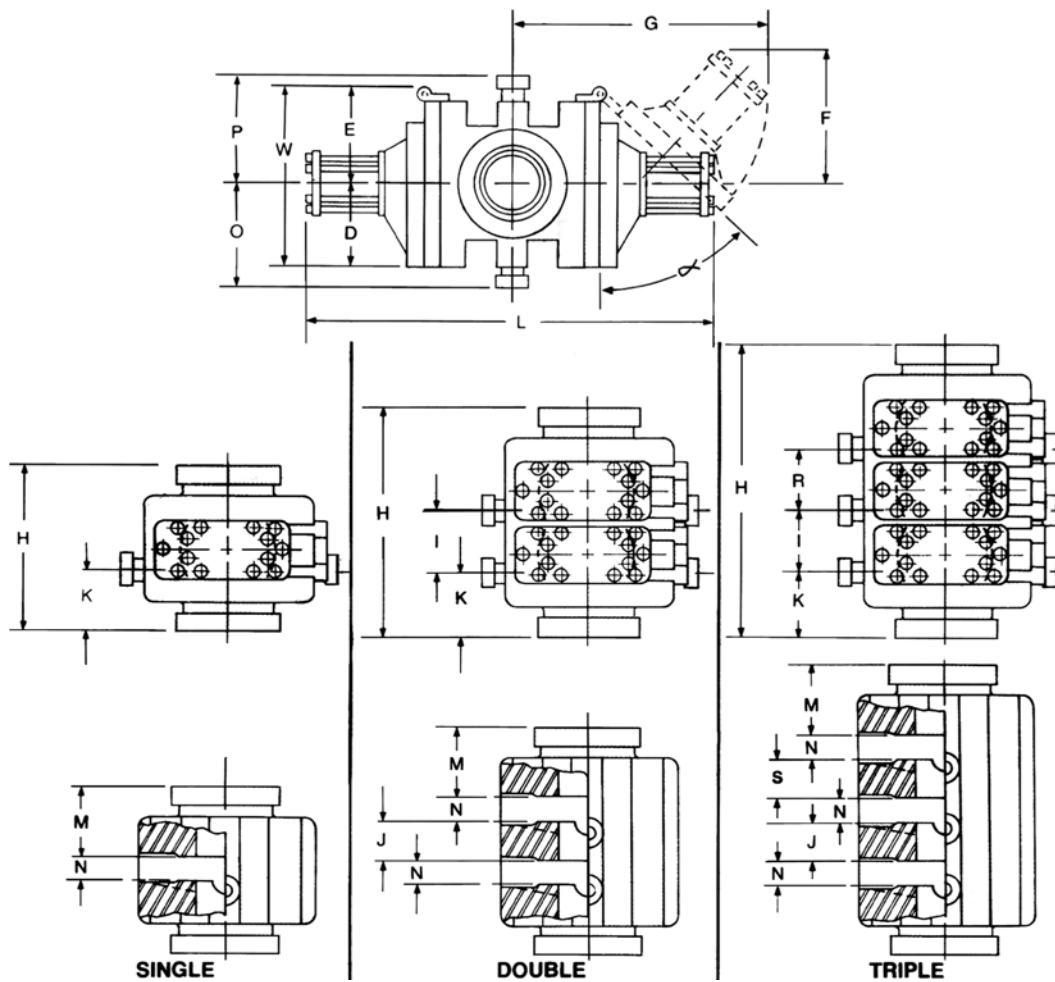
Model SL/SLX Specifications, 5,000 and 3,000 PSI (Continued)

Working Pressure (PSI)			5,000				3,000
Bore (Inches)			16 3/4	16 3/4	13 5/8	13 5/8	13 5/8
Model			SL	SL	SL/SLX	SL/SLX	SL
Piston Size (Inches)			10	14	10	14	10
N (Inches)			5 1/2	5 1/2	4 1/2	4 1/2	4 1/2
O1 (Inches)	2-inch		28 1/16	28 1/16	22 3/4	22 3/4	23 15/16
	3-inch		28 5/16	28 5/16	24 3/8	24 3/8	23 1/8
	4-inch		28 1/16	28 1/16	22 3/4	22 3/4	23 1/2
P1 (Inches)	2-inch		28 1/16	28 1/16	22 3/4	22 3/4	23 15/16
	3-inch		28 5/16	28 5/16	24 3/8	24 3/8	23 1/8
	4-inch		28 1/16	28 1/16	22 3/4	22 3/4	23 1/2
Total Weight Without Rams (Lbs.)	Single	Studded	14,095	—	7,800	9,200	8,400
		Flanged	15,500	—	8,985	10,200	8,430
		Hubbed	12,850	—	8,400	9,600	7,924
	Double	Studded	25,285	—	15,620	18,400	15,350
		Flanged	27,169	28,000	16,900	19,100	16,500
		Hubbed	25,886	—	15,912	18,700	15,548
Weight Breakdown (Lbs.)	1 Ram Assembly with Holders		255	—	334	334	334
	Door Assembly (1 each)		2,872	2,872	2,362	2,362	2,362
	Body Single	Studded ²	8,570	8,750	3,800	4,100	4,150
		Flanged	10,400	10,400	5,400	5,900	4,706
		Hubbed	9,600	9,600	4,700	4,700	4,200
	Body Double	Studded ²	14,700	14,900	8,100	8,100	8,000
		Flanged	16,500	16,500	9,300	9,300	8,700
		Hubbed	15,750	15,750	8,500	8,691	8,100
Closing Ratio			5.54	10.85	5.54	10.85	5.54
Opening Ratio			2.03	5.77	3.00	10.02	3.00
Gallons to Close			6.07	11.76	5.44	11.00	5.44
Gallons to Open			4.97	10.67	4.46	10.52	4.46
Maximum Ram Size (Inches)			13 1/8	13 1/8	10 3/4	10 3/4	10 3/4
Door Screw Across Flats (Inches)			3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
Door Screw Torque (ft lbs)			6,600	6,600	6,600	6,600	6,600

NOTES:

1. For flanged side outlets. Studded or hubbed side outlets are shorter.
2. Includes studs and nuts.

Shaffer Model SL/SLX Specifications



SL/SLX BOP Dimensions

Pressure Control

Shaffer Model LWS Specifications

Model LWS Specifications, 10,000 and 5,000 PSI

Working Pressure (PSI)			10,000		5,000				
Bore (Inches)			7 1⁄16	4 1⁄16	11	11	9	7 1⁄16	4 1⁄16
Model			LWS	LWS	LWS	LWS	LWS	LWS	LWS
Piston Size (Inches)			14	6	14	8 1⁄2	8 1⁄2	6 1⁄2	6
Poslock	L (Length-Inches)		—	—	10 1⁄4	—	—	—	—
	F (Inches)		—	—	37 7⁄8	—	—	—	—
	G (Inches)		—	—	57	—	—	—	—
Manual-Lock	L (Length-Inches)		74 3⁄4	42 1⁄4	—	89 1⁄4	79 1⁄8	58 1⁄4	42 1⁄4
	F (Inches)		26 3⁄4	14 1⁄8	—	29 3⁄8	27 7⁄16	20 3⁄8	14 1⁄8
	G (Inches)		43 3⁄8	23 13⁄16	—	46 5⁄8	46 5⁄16	32 1⁄2	23 13⁄16
W (Width)			30 7⁄8	15 3⁄8	28 3⁄4	28 3⁄4	23 1⁄16	21 1⁄2	15 11⁄16
H (Height) Inches	Single	Studded	23 3⁄4	15 3⁄4	19 1⁄2	19 1⁄2	14 1⁄2	15	15 3⁄4
		Flanged	39 7⁄8	20 3⁄4	37	37	30 1⁄8	28 1⁄4	20 3⁄4
		Hubbed	—	—	30 1⁄16	30 1⁄16	22	—	—
	Double	Studded	43 1⁄2	—	33	33	29 1⁄2	26 3⁄4	—
		Flanged	59 5⁄8	—	50 1⁄2	50 1⁄2	45 7⁄16	40	—
		Hubbed	—	—	43 9⁄16	43 9⁄16	37	—	—
D (Inches)			13 3⁄8	6 7⁄16	12 5⁄8	12 5⁄8	11	9 3⁄16	6 7⁄16
E (Inches)			17 1⁄2	8 15⁄16	16 1⁄8	16 1⁄8	12 1⁄16	12 5⁄16	9 1⁄4
I (Inches)			21 3⁄4	—	15 1⁄2	15 1⁄2	15	11 3⁄4	—
J (Inches)			17 1⁄4	—	11	11	10 1⁄2	7 1⁄4	—
K (Inches)	Single	Studded	7 1⁄8	—	5 1⁄2	5 1⁄2	3 1⁄4	3 3⁄4	—
		Flanged	15 3⁄16	7 1⁄8	14 1⁄4	14 1⁄4	11 1⁄16	10 3⁄8	—
		Hubbed	—	—	10 25⁄32	10 25⁄32	7	—	—
	Double	Studded	6 1⁄8	—	4 1⁄2	4 1⁄2	3 1⁄4	3 3⁄4	—
		Flanged	14 3⁄16	7 1⁄8	13 1⁄4	13 1⁄4	11 1⁄4	10 3⁄8	7 1⁄8
		Hubbed	—	—	9 25⁄32	9 25⁄32	7	—	—
M (Inches)	Single	Studded	9 5⁄8	5 7⁄16	7	7	5	5	3 7⁄8
		Flanged	17 3⁄4	8 7⁄8	15 3⁄4	15 3⁄4	12 3⁄16	11 5⁄8	8 7⁄8
		Hubbed	—	—	12 9⁄32	12 9⁄32	8 3⁄4	—	—
	Double	Studded	8 5⁄8	—	6	6	5	5	—
		Flanged	16 3⁄4	—	14 3⁄4	14 3⁄4	12 13⁄16	11 5⁄8	—
		Hubbed	—	—	11 9⁄32	11 9⁄32	8 3⁄4	—	—
N (Inches)			4 1⁄2	3	4 1⁄2	4 1⁄2	4 1⁄2	4 1⁄2	3
O¹ (Inches)	2-inch		20 5⁄8	9 5⁄8	20 1⁄16	20 1⁄16	18 7⁄16	14 1⁄2	12 9⁄16
	3-inch		21 13⁄16	—	21 11⁄16	21 11⁄16	20 1⁄16	14 3⁄4	—
	4-inch		22 3⁄8	—	20 1⁄16	20 1⁄16	—	14 1⁄2	—
P¹ (Inches)	2-inch		20 5⁄8	12 9⁄16	19 13⁄16	19 13⁄16	18 7⁄16	15 1⁄16	9 5⁄8
	3-inch		21 13⁄16	—	21 7⁄16	21 7⁄16	20 1⁄16	16 1⁄16	—
	4-inch		22 3⁄8	—	19 13⁄16	19 13⁄16	—	18 7⁄8	—

Shaffer Model LWS Specifications

Model LWS Specifications, 10,000 and 5,000 PSI (Continued)

Working Pressure (PSI)			10,000		5,000				
Bore (Inches)			7 1⁄16	4 1⁄16	11	11	9	7 1⁄16	4 1⁄16
Model			LWS	LWS	LWS	LWS	LWS	LWS	LWS
Piston Size (Inches)			14	6	14	8 1⁄2	8 1⁄2	6 1⁄2	6
Total Weight Without Rams (Lbs.)	Single	Studded	6,130	830	6,000	4,150	2,870	1,385	830
		Flanged	6,665	975	6,670	4,820	3,230	1,585	975
		Hubbed	6,295	—	6,250	4,400	2,820	—	—
	Double	Studded	11,905	—	—	7,725	5,750	2,504	—
		Flanged	12,435	—	—	8,385	6,110	2,706	—
		Hubbed	12,066	—	—	7,975	5,700	—	—
Weight Breakdown (Lbs.)	1 Ram Assembly with Holders		64	30	130	130	76	64	30
	Door Assembly (1 each)		1,854	200	1,871	946	785	301	200
	Body Single	Studded	2,286	430	1,995	1,995	1,125	670	430
		Flanged	2,955	575	2,925	2,925	1,660	980	575
		Hubbed	2,586	—	2,245	2,245	1,250	—	—
	Body Double	Studded	4,350	—	3,674	3,674	2,436	1,190	—
		Flanged	5,018	—	4,600	4,600	2,970	1,502	—
		Hubbed	4,650	—	3,917	3,917	2,560	—	—
Closing Ratio			10.63	8.45	16.00	5.57	5.57	5.45	8.45
Opening Ratio			15.22	4.74	3.41	2.09	3.00	1.93	4.74
Gallons to Close			5.18	0.59	9.50	2.98	2.58	1.45	0.59
Gallons to Open			5.25	0.52	8.90	2.62	2.27	1.18	0.52
Maximum Ram Size (Inches)			5 9⁄16	2 7⁄8	8 5⁄8	8 5⁄8	7	5 9⁄16	2 7⁄8
Door Screw Across Flats (Inches)			2 3⁄16	1 7⁄8	1 1⁄2	1 1⁄2	1 5⁄8	1 1⁄4	1 7⁄8
Door Screw Torque (ft lbs)			3,100	500	1,500	1,500	1,500	910	500

NOTES:

1. For flanged side outlets. Studded or hubbed side outlets are shorter.

Shaffer Model LWS Specifications

Model LWS Specifications, 3,000 and 2,000 PSI

Working Pressure (PSI)			3,000				2,000		
Bore (Inches)			20 3/4	20 3/4	20 3/4	11	21 1/4	21 1/4	21 1/4
Model			LWS	LWS	LWS	LWS	LWS	LWS	LWS
Piston Size (Inches)			10	14	8 1/2	6 1/2	10	14	8 1/2
Poslock	L (Length-Inches)		117 1/8	132 1/8	—	—	117 1/4	132 1/4	—
	F (Inches)		41 3/8	48	—	—	41 3/8	48	—
	G (Inches)		67 7/8	73 3/8	—	—	67	75 1/8	—
Manual-Lock	L (Length-Inches)		—	161 3/4	127 1/2	72 5/8	—	161 3/4	127 1/2
	F (Inches)		—	54 5/16	42	23 15/16	—	54 5/16	42
	G (Inches)		—	79 15/16	67 5/8	39 31/32	—	79 15/16	67 5/8
W (Width)			41 1/4	41 1/4	41 1/4	25 15/16	40 7/8	40 7/8	40 7/8
H (Height) Inches	Single	Studded	23 1/8	23 1/8	23 1/8	14 1/2	23 1/8	23 1/8	23 1/8
		Flanged	41 5/8	41 5/8	41 5/8	27 1/8	37 3/4	37 3/4	37 3/4
		Hubbed	35 3/8	35 3/8	35 3/8	22	34 5/8	34 5/8	34 5/8
	Double	Studded	49 1/4	49 1/4	49 1/4	29 3/8	49 1/4	49 1/4	44 7/16
		Flanged	67 3/4	63	63	42	63 7/8	59 1/16	59 1/16
		Hubbed	62	55 15/16	49 1/4	36 7/8	57	60 3/4	55 15/16
D (Inches)			17 3/8	17 3/8	17 3/8	11 9/16	17 1/4	17 1/4	17 1/4
E (Inches)			23 5/8	23 5/8	23 5/8	14 3/8	23 5/8	23 5/8	23 5/8
I (Inches)			26 1/2	21 5/16	21 5/16	14	26 1/8	26 1/8	21 5/16
J (Inches)			20 1/8	20 1/8	20 1/8	9 1/2	20 1/8	20 1/8	15 5/16
K (Inches)	Single	Studded	6	6	6	3 7/8	6	6	6
		Flanged	15 1/4	15 1/4	15 1/4	10 3/16	13 5/16	13 5/16	13 5/16
		Hubbed	—	—	—	7 5/8	11 3/4	11 3/4	11 3/4
	Double	Studded	6	6	6	4 5/16	6	6	6
		Flanged	15 1/4	15 1/4	15 1/4	10 5/8	13 5/16	13 5/16	13 5/16
		Hubbed	—	11 3/4	13	8 1/16	11 3/4	11 3/4	11 3/4
M (Inches)	Single	Studded	7 1/8	7 1/8	7 1/8	4 3/8	7 1/8	7 1/8	7 1/8
		Flanged	16 3/8	16 3/8	16 3/8	10 11/16	14 7/16	14 7/16	14 7/16
		Hubbed	—	—	—	8 1/8	12 7/8	12 7/8	12 7/8
	Double	Studded	—	—	—	4 13/16	7 1/8	7 1/8	7 1/8
		Flanged	16 3/8	16 3/8	16 3/8	11 3/16	14 7/16	14 7/16	14 7/16
		Hubbed	—	—	—	8 9/16	12 7/8	12 7/8	12 7/8
N (Inches)			7	7	7	4 1/2	6	6	6
O ¹ (Inches)	2-inch		25 7/8	25 7/8	25 7/8	16 3/4	25 7/8	25 7/8	25 7/8
	3-inch		25 1/16	25 1/16	26 5/16	15 3/4	26 5/16	26 5/16	26 5/16
	4-inch		25 7/16	25 7/16	25 7/16	16 1/8	25 7/16	25 7/16	25 7/16
P ¹ (Inches)	2-inch		25 7/8	25 7/8	25 7/8	17 3/16	25 7/8	25 7/8	25 7/8
	3-inch		25 1/16	25 1/16	26 5/16	17 3/16	26 5/16	26 5/16	26 5/16
	4-inch		25 7/16	28 3/8	25 7/16	18	25 7/16	25 7/16	25 7/16

Shaffer Model LWS Specifications

Model LWS Specifications, 3,000 and 2,000 PSI (Continued)

Working Pressure (PSI)			3,000				2,000		
Bore (Inches)			20 3/4	20 3/4	20 3/4	11	21 1/4	21 1/4	21 1/4
Model			LWS	LWS	LWS	LWS	LWS	LWS	LWS
Piston Size (Inches)			10	14	8 1/2	6 1/2	10	14	8 1/2
Total Weight Without Rams (Lb)	Single	Studded	7,810	10,068	7,448	2,116	7,647	9,905	7,285
		Flanged	8,912	11,170	8,550	2,580	8,347	10,605	7,985
		Hubbed	7,537	9,795	7,175	2,150	7,774	10,032	7,412
	Double	Studded	15,338	19,854	14,615	4,096	15,180	19,700	14,455
		Flanged	16,440	20,955	15,715	4,560	15,880	20,400	15,155
		Hubbed	15,062	19,580	14,340	4,130	15,305	19,822	14,582
Weight Breakdown (Lb)	1 Ram Assembly with Holders		435	435	435	111	435	435	435
	Door Assembly (1 each)		1,756	2,885	1,575	490	1,756	2,885	1,575
	Body Single	Studded	3,760	3,760	3,760	1,000	3,790	3,790	3,790
		Flanged	5,400	5,400	5,400	1,600	4,835	4,835	4,835
		Hubbed	4,025	4,025	4,025	1,170	4,262	4,262	4,262
	Body Double	Studded	7,776	7,776	7,776	2,000	7,810	7,810	7,810
		Flanged	9,415	9,415	9,415	2,600	8,855	8,855	8,855
		Hubbed	8,038	8,038	8,038	2,170	8,281	8,281	8,281
	Closing Ratio			8.16	16.00	5.57	5.45	8.16	16.00
Opening Ratio			1.15	2.21	0.78	1.16	1.15	2.21	0.78
Gallons to Close			7.80	14.50	5.07	1.74	7.80	14.50	5.07
Gallons to Open			6.86	13.59	4.46	1.45	6.86	13.59	4.46
Maximum Ram Size (Inches)			16	16	16	8 5/8	16	16	16
Door Screw Across Flats (Inches)			1 5/8	1 5/8	1 5/8	1 1/4	1 5/8	1 5/8	1 5/8
Door Screw Torque (ft lb)			1,200	1,200	1,200	910	1,200	1,200	1,200

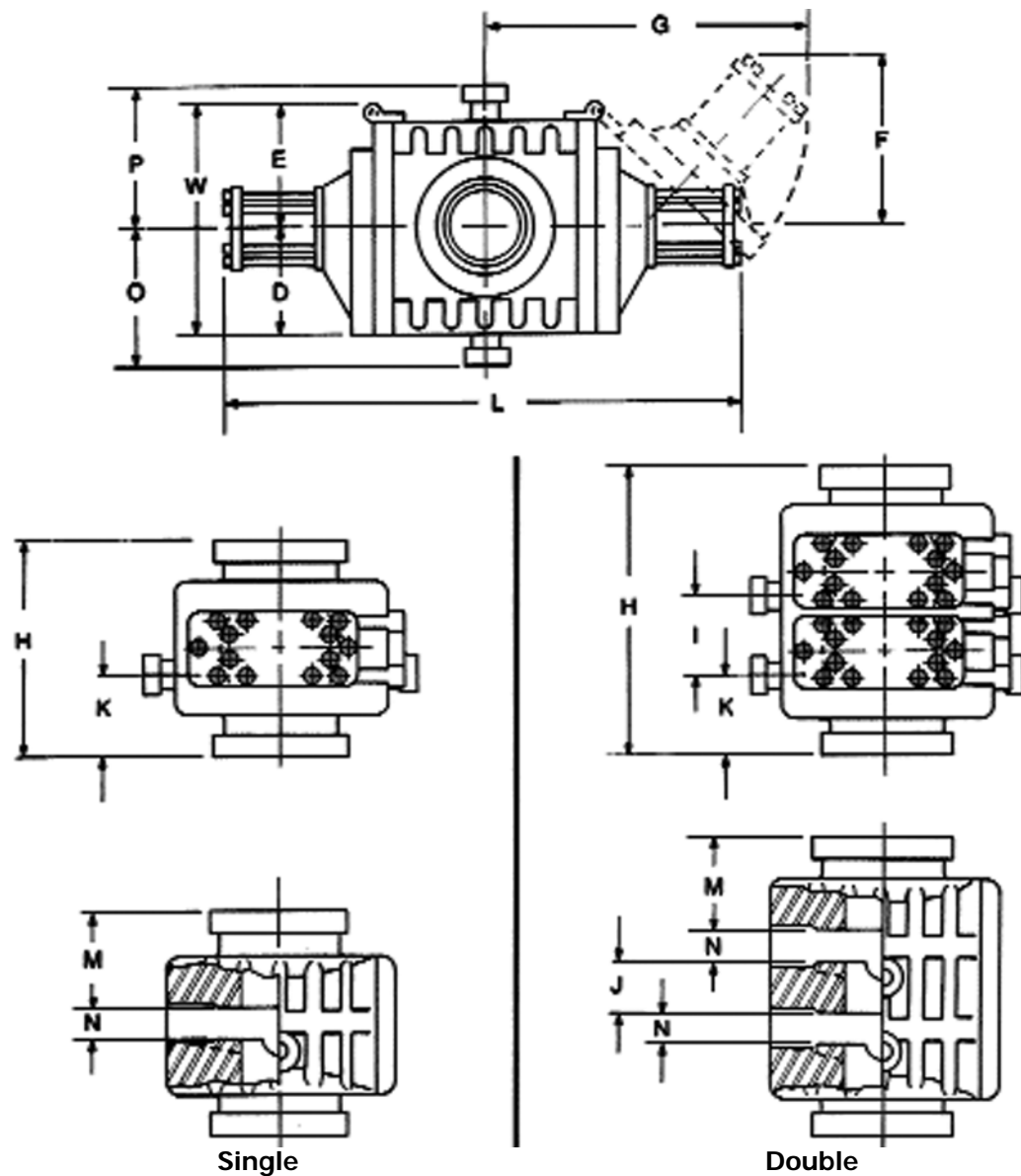
NOTES:

1. For flanged side outlets. Studded or hubbed side outlets are shorter.

Pressure Control

Shaffer Model LWS Specifications

LWS Dimensions



Shaffer Model Chasovoy Specifications

Chasovoy Dimensions

Dimensions and Weights				
		Flange X Flange	Stud X Stud	Stud X Flange
Approximate Weight	Single, lb (kg)	1,600 (726)	1,400 (635)	1,500 (680)
	Double, lb (kg)	2,800 (1,270)	2,600 (1,180)	2,700 (1,225)
A) Overall Height, less studs	Single, in. (mm)	24.63 (625.6)	11.25 (285.5)	18.00 (457.2)
	Double, in. (mm)	33.88 (860.6)	20.50 (520.7)	27.25 (692.2)
B1) Overall Length, in. (mm), Bonnets Closed, Locked		64.50 (1,638.3)	64.50 (1,638.3)	64.50 (1,638.3)
B2) Overall Length, in. (mm), Ram Change, Both Bonnets Open		80.75 (2,051.0)	80.75 (2,051.0)	80.75 (2,051.0)
C) Overall Width, in. (mm)		20.62 (523.7)	20.62 (523.7)	20.62 (523.7)
D) Opening through Preventer, in. (mm)		7.062 (179.4)	7.062 (179.4)	7.062 (179.4)
1 Ram Assembly (weight)		44 lb	44 lb	44 lb
Working Pressure, psi (bar) ¹		5,000 (345)	5,000 (345)	5,000 (345)
Test Pressure, psi (bar)		10,000 (690)	10,000 (690)	10,000 (690)
Maximum Torque to Close and Seal the Rams, ft lb (N-m)		735 (996)	735 (996)	735 (996)

NOTES:

1. Working Pressure may be 3,000 psi (207 bar) depending on end connection.

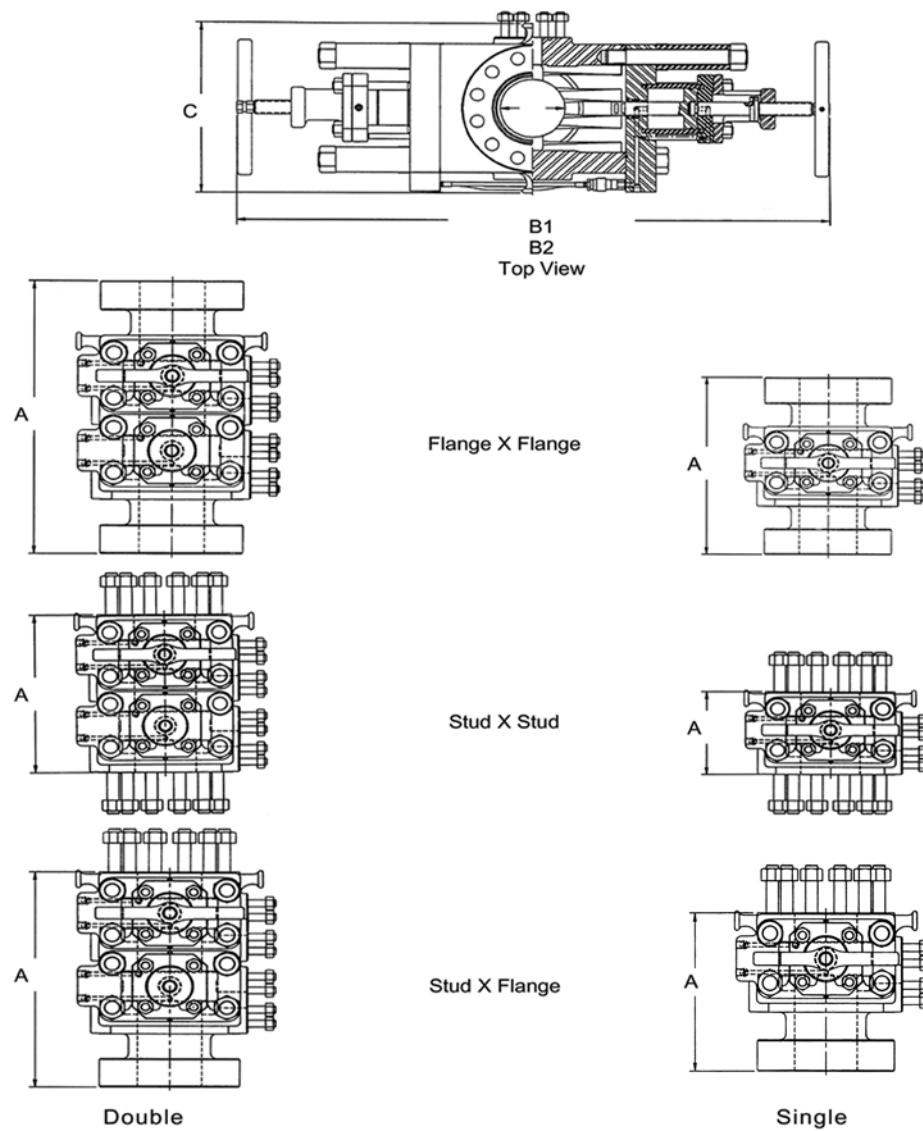
Chasovoy BOP Hydraulic Cylinder

Operating Characteristics		
	To Close	To Open
Maximum Operating Pressure, psi (bar)	3,000 (207)	3,000 (207)
Ratio	8.47:1	8.47:1
Volume of Fluid US gal (liters)	.6 (2.27)	.6 (2.27)
Piston Stroke, in. (mm)	4.062 (103.2)	4.062 (103.2)

Pressure Control

Shaffer Chasovoy BOP Dimensions

Chasovoy BOP Dimensions



Shaffer Ram BOP Ordering Information

Ordering

When ordering Shaffer ram BOPs, specify the following:

1. Locking System required — UltraLock™, Poslock or Manual Lock.
2. Single, double or triple.
3. Bore size, working pressure, connections (studded, flanged or hubbed) and ring grooves. API ring grooves will be supplied, unless otherwise specified.
4. Side outlets required:
 - a. Size, working pressure, type (studded, flanged or hubbed) and ring grooves. API ring grooves will be supplied, unless otherwise specified.
 - b. Locations:
 - Below which ram(s).
 - Front and/or back (hinge side).
5. Rams to be furnished.
 - a. Type:
 - Blind (complete shut-off).
 - Pipe or casing size rams.
 - Shear requirements.
 - b. Location of each set of rams.
6. Special features available:
 - a. Stainless steel or inconel lined ring grooves.
 - b. For low temperature certification (below -20° F), advise your Shaffer sales representative of your requirements.
 - c. Full environmental H₂S (internal H₂S trim standard).
 - d. The no-weld cavity is standard on the NXT ram BOP, an available option on the SLX ram BOP, and available as retrofit on some SL ram BOP sizes.

Shaffer SL/SLX BOP Pipe Rams

Rams are designed to last longer. Ram rubbers receive most of their wear during routine closing and pressure testing. To simulate this, rams were installed in BOPs, closed, pressure tested to working pressure, opened and retested for hundreds of cycles.

Extrusion plates extend vertically to support the sides of the ram rubber, as shown. This securely anchors the rubbers next to the ram block and reduces wear at this point.

Wide vertical faces give additional ram rubber strength for longer life in 10,000 psi and higher working pressures.

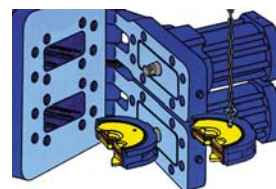
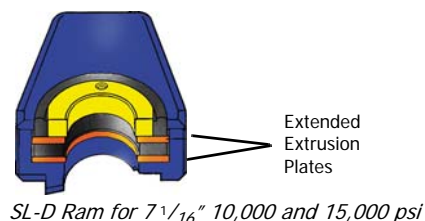
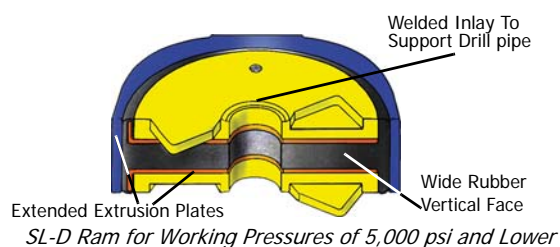
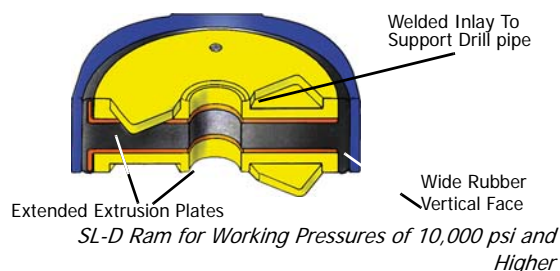
Model SL/SLX round-head ram shaft accepts Model LWS rams on all sizes which replace an LWS BOP so that spare rams can be used, except on 11"-10,000 psi BOP. The 13 5/8" - 10,000 psi has rectangular head shaft.

Model SL rams mount horizontally on all SL preventers except 15,000 psi and 7 1/16"-10,000 psi models, on which they mount vertically. The double button head mounting adds necessary strength in the 15,000 psi application.

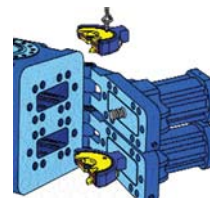
Model SL rams are for regular duty. They do not have the hard inlay around the pipe bore and will not support drill pipe on the 18° tool joint taper. Otherwise, Models SL/SLX and SL-D rams are identical.

Model SL-D rams will support a 600,000-pound drill string load when a tool joint is lowered onto the closed rams. These rams comply with API and NACE H₂S specifications. A patented, H₂S-compatible, hard inlay is welded around the pipe bore, to cut into the 18° taper on the bottom of the tool joint and form a supporting shoulder. The remainder of the ram block is alloy steel with hardness below Rc22.

A square-shouldered hang-off tool allows Model SL/SLX rams to support drill pipe by eliminating the 18° tool joint taper. The hang-off tool also eliminates damage to the 18° taper on the tool joint and extends the life of Model SL-D rams if repeated hang-offs are planned.



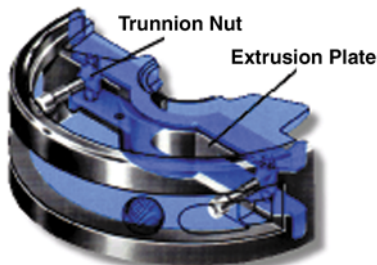
SL Rams Mount Horizontally on Preventers Rated for Working Pressure of 10,000 psi and lower, except 7 1/16" 10,000 psi



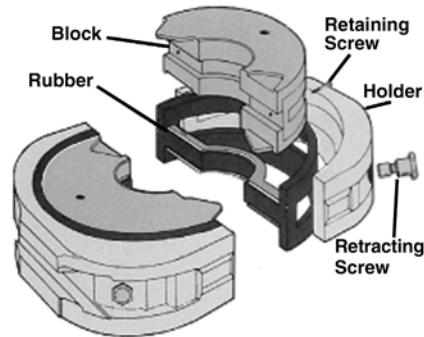
SL Rams Mount Vertically on Preventers Rated for Working Pressure of 15,000 psi and on the 7 1/16" - 10,000 psi

Shaffer SL/SLX BOP Pipe Rams

- Most pipe ram assemblies consist of three major pieces — the ram block, the ram rubber and the ram holder. The ram rubber is placed on the ram block, then the block and rubber are anchored to the ram holder to make the complete ram assembly. Some sizes have a separate top seal.
- In most Shaffer rams, two retracting (shoulder) screws secure the ram holder to the ram block but permit the block to move slightly in the holder to ensure positive alignment of the rubber faces as sealing contact occurs.
- The ram rubber is mechanically secured to the block/holder assembly to keep the rubber in place under extreme pressures. Design of the ram block to ram holder anchoring mechanism permits the block to move slightly in the holder to allow controlled extrusion of the rubber to effect a tighter, more reliable seal.



- The ram rubber is secured to the ram block by two retaining screws which fit into trunnion nuts. The trunnion nuts extend through holes in the two steel extrusion plates molded into the rubber to control extrusion of the rubber.
- Floating rams ensure a positive seal at low and high pressure, even after the ram cavity has been worn by years of service. As the rams close, the following sequence of events occurs:
 1. The rubber faces contact each other and the pipe.
 2. The blocks move slightly to achieve alignment.
 3. Further closing movement causes the rubber faces to seal around the drill pipe and against each other. Simultaneously, the ram holder pushes against the semi-circular top seal and extrudes it upward to seal against the seat of the BOP body. This effects an initial seal even after years of wear have increased the clearance between seat and block



4. As well pressure increases, the block moves up and closes the clearance below the seat.
- Self-centering of pipe is accomplished by angular guides protruding alternately on top and bottom of ram blocks designed to close around a single string of pipe. This self-centering feature automatically aligns the pipe string with the ram bore, even if the string hangs off center.
 - Continuous, molded ram rubber has no separation between the semicircular top seal and the horizontal face seal in most sizes.
 - Rubber compounds for all oil field conditions are available.
 - New Multi-Ram rams will seal on pipe sizes in a range of 2 $\frac{3}{8}$ " through 7" O.D. (see [Multi-Ram Sizes Offered](#) for ranges) and are available for many model BOPs. If the drill string is tapered, this can eliminate one of the ram BOPs normally included in the stack and still permit effective closing on both the smaller and larger of the two diameters.

Pressure Control

Shaffer Model NXT and Ultra Temp Pipe Rams

NXT Pipe Rams

Pipe O.D. Inches	5,000 PSI 13 5/8	5,000 PSI 18 3/4	10,000 PSI 13 5/8	10,000 PSI 18 3/4	15,000 PSI 18 3/4
C.S.O	NXT	—	NXT	—	—
2 3/8	NXT/NXT-D	NXT	NXT/NXT-D	NXT	NXT
2 7/8	NXT/NXT-D	NXT	NXT/NXT-D	NXT	NXT
3 1/2	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
4	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
4 1/2	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
5	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
5 1/2	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
6 5/8	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D	NXT/NXT-D
7	NXT	NXT	NXT	NXT	NXT
7 5/8	NXT	NXT	NXT	NXT	NXT
8 5/8	—	NXT	—	NXT	NXT
9 5/8	NXT	NXT	NXT	NXT	NXT
10 3/4	NXT	—	NXT	—	—
13 3/8	—	NXT	—	NXT	NXT

For part numbers, contact your local Shaffer representative.

Ultra Temp (U/T - U/T-D) Rams

Pipe O.D. Inches	5,000 PSI 18 3/4	10,000 PSI 18 3/4	15,000 PSI 11 SL	15,000 PSI 11 Type SL-86	15,000 PSI 13 T-88	15,000 PSI 18 3/4
3 1/2	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
4	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
4 1/2	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
5	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
5 1/2	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
6 5/8	U/T-D	U/T-D	U/T	U/T	U/T-D	U/T-D
7	U/T	U/T	U/T	U/T	U/T-D	U/T-D
9 5/8	U/T	—	—	—	—	U/T

For part numbers, contact your local Shaffer representative.

Shaffer Model SL/SLX Pipe Rams

Model SL/SLX Pipe Rams

Pipe O.D. Inches	3,000 PSI	5,000 PSI			10,000 PSI					15,000 PSI			
	13 5/8	13 5/8	16 3/4	7 1/16	11	13 5/8	16 3/4	18 3/4	21 1/4	7 1/16	11	13 5/8	18 3/4
C.S.O	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL, SLX, SL-D, SLX-D	SL
7/16	SL	SL	—	—	—	—	—	—	—	—	—	—	—
1.315	SL	SL	SL	SL	SL	SL	SL	—	—	SL	SL	SL	—
1.660	SL	SL	SL	SL	SL	SL	SL	—	—	SL	SL	SL	—
1.900	SL	SL	SL	SL	SL	SL	SL	—	—	SL	SL	SL	—
2 1/16	SL	SL	—	SL	—	—	—	—	—	SL	—	—	—
2 3/8	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL/SLX	SL
2 7/8	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL/SLX	SL
3 1/2	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL	SL or SL-D	SL, SLX, SL-D, SLX-D	SL or SL-D
3 5/8	SL or SL-D	SL or SL-D	—	—	—	—	—	—	—	—	—	—	—
4	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL	SL or SL-D	SL, SLX, SL-D, SLX-D	SL or SL-D
4 1/8	SL or SL-D	SL or SL-D	—	—	—	—	—	—	—	—	—	—	—
4.200	SL or SL-D	SL or SL-D	—	—	—	—	—	—	—	—	—	—	—
4 1/2	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL	SL or SL-D	SL, SLX, SL-D, SLX-D	SL or SL-D
4 5/8	SL or SL-D	SL or SL-D	—	SL or SL-D	SL-D	SL or SL-D	—	—	—	—	—	—	—
5	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL	SL or SL-D	SL, SLX, SL-D, SLX-D	SL or SL-D
5 1/2	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL or SL-D	SL	SL or SL-D	SL, SLX, SL-D, SLX-D	SL or SL-D
5 9/16	SL or SL-D	SL or SL-D	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	SL	—	—	—	—	—	—	—
6 1/2	SL	SL	—	—	—	—	—	—	—	—	—	—	—
6 5/8	SL	SL	SL	—	SL	SL	SL	SL or SL-D	SL	—	SL	SL, SLX, SL-D, SLX-D	SL
7	SL	SL	SL	—	SL	SL	SL	SL	SL	—	SL	SL/SLX	SL
7 5/8	SL	SL	SL	—	SL	SL	SL	SL	SL	—	SL	SL/SLX	SL
7 3/4	—	—	—	—	—	SL	—	—	—	—	—	—	—
8 5/8	SL	SL	SL	—	SL	SL	SL	SL	SL	—	SL	SL/SLX	SL
9 5/8	SL	SL	SL	—	—	SL	SL	SL	SL	—	—	SL/SLX	SL
10 1/4	—	—	—	—	—	—	—	—	SL	—	—	—	—
10 3/4	SL	SL	SL	—	—	SL	SL	SL	—	—	—	SL/SLX	SL
11 1/4	—	—	—	—	—	—	—	—	SL	—	—	—	—
11 3/4	—	—	SL	—	—	—	SL	SL	—	—	—	—	SL
12 1/4	—	—	—	—	—	—	—	—	SL	—	—	—	—
13 3/8	—	—	SL	—	—	—	SL	SL	SL	—	—	—	SL
16	—	—	—	—	—	—	—	SL	SL	—	—	—	—
18 1/8	—	—	—	—	—	—	—	—	SL	—	—	—	—

For part numbers, contact your local Shaffer representative.



Pressure Control

Shaffer Chasovoy and LWS Pipe Rams

Chasovoy Pipe Rams

3,000 PSI	3,000 PSI	3,000 PSI	3,000 PSI	5,000 PSI	5,000 PSI	5,000 PSI	5,000 PSI
7 1/16"	180 mm			7 1/16"	180 mm	7 7/8"	200 mm
CSO	CSO	—	—	CSO	CSO	—	—
1 1/4"	32 mm	—	—	1 1/4"	32 mm	—	—
1.315"	33 mm	—	—	1.315"	33 mm	—	—
1.660"	42 mm	—	—	1.660"	42 mm	—	—
1.900"	48 mm	—	—	1.900"	48 mm	—	—
2 1/16"	52 mm	—	—	2 1/16"	52 mm	—	—
2 3/8"	60 mm	—	—	2 3/8"	60 mm	—	—
2 7/8"	73 mm	2 7/8"	73 mm	2 7/8"	73 mm	2 7/8"	73 mm
3 1/2"	89 mm	3 1/2"	89 mm	3 1/2"	89 mm	3 1/2"	89 mm
4"	102 mm	—	—	4"	102 mm	—	—
4 1/2"	114 mm	4 1/2"	144 mm	4 1/2"	114 mm	4 1/2"	144 mm
5"	127 mm	—	—	5"	127 mm	—	—
5 1/2"	140 mm	—	—	5 1/2"	140 mm	—	—
—	—	6 5/8"	168 mm	—	—	6 5/8"	168 mm

For part numbers, contact your local Shaffer representative.

LWS Pipe Rams

Pipe O.D. Inches	2,000 PSI	3,000 PSI		5,000 PSI				10,000 PSI	
	21 1/4	11	20 3/4	4 1/16	7 1/16	9	11	4 1/16	7 1/16
C.S.O	70-H	70-H	70-H	77	61	70-H	70-H	77	61
1.050	—	—	—	—	—	—	—	77	—
1.315	—	70-H	—	77	61	70-H	70-H	77	61
1.660	—	70-H	—	77	61	70-H	70-H	77	61
1.900	—	70-H	—	77	61	70-H	70-H	77	61
2 1/16	—	70-H	—	—	61	70-H	70-H	—	61
2 3/8	70-H	70-H	70-H	77	61	70-H	70-H	77	61
2 7/8	70-H	70-H	70-H	77	61	70-H	70-H	77	61
3 1/2	73	70-H	73	—	61	70-H	70-H	—	61
3.700	—	—	—	—	—	—	70-H	—	—
4	73	70-H	73	—	61	70-H	70-H	—	61
4 1/8	—	70-H	—	—	—	—	70-H	—	—
4.200	—	70-H	—	—	—	—	—	—	—
4 1/2	73	70-H	73	—	61	70-H	70-H	—	61
4 5/8	—	70-H	—	—	—	—	—	—	—
4 3/4	—	70-H	—	—	61	—	—	—	61
5	73	70-H	73	—	61	70-H	70-H	—	61
5 1/2	73	70-H	73	—	61	70-H	70-H	—	61
5 3/4	70-H	—	70-H	—	—	—	—	—	—
6	70-H	—	70-H	—	—	—	—	—	—
6 5/8	70-H	70-H	70-H	—	—	—	70-H	—	—
7	70-H	70-H	70-H	—	—	—	70-H	—	—
7 5/8	70-H	70-H	70-H	—	—	—	70-H	—	—
9 5/8	70-H	—	70-H	—	—	—	—	—	—
10 1/4	70-H	—	70-H	—	—	—	—	—	—
10 3/4	70-H	—	70-H	—	—	—	—	—	—
11 3/4	70-H	—	70-H	—	—	—	—	—	—
13 3/8	70-H	—	70-H	—	—	—	—	—	—
14 3/4	70-H	—	—	—	—	—	—	—	—
16	70-H	—	70-H	—	—	—	—	—	—

For part numbers, contact your local Shaffer representative.

Shaffer Shear Rams

Type 72 Shear Rams

These rams shear pipe and seal the well bore in one operation. They also function as blind or CSO (complete shut-off) rams for normal operations.

To ensure adequate shearing force, 14" pistons should be used when operating Type 72 shear rams. These pistons are standard in all BOPs rated at 10,000 psi working pressure and higher. On most lower pressure preventers, optional 14" pistons can be supplied for shearing instead of the standard 10" pistons. When shearing pipe in a subsea BOP stack, 3,000 psi closing pressure should be used.

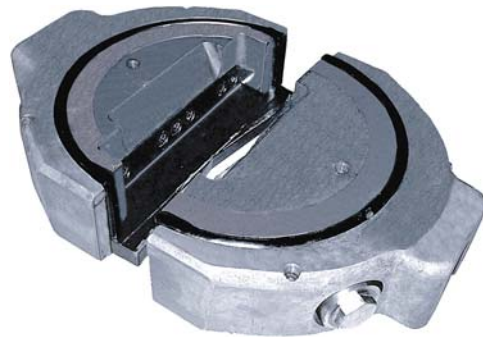
When shearing, the lower blade passes below the sharp lower edge of the upper ram block and shears the pipe. The lower section of cut pipe is accommodated in the space between the lower blade and the upper holder. The upper section of cut pipe is accommodated in the recess in the top of the lower ram block.

Closing motion of the rams continues until the ram block ends meet. Continued closing of the holders squeezes the semicircular seals upward into sealing contact with the seat in the BOP body and energizes the horizontal seal. The closing motion of the upper holder pushes the horizontal seal forward and downward on top of the lower blade, resulting in a tight sealing contact. The horizontal seal has a molded-in support plate which holds it in place when the rams are open.

The hydraulic closing pressure normally required to shear drill pipe is below 1,500 psi accumulator pressure in BOPs with 14" pistons. However, this varies, depending on the size, weight and grade of pipe. When shearing pipe in a subsea BOP stack, 3,000 psi closing pressure should be used. On 21 1/4" 2,000 psi and 11" 5,000 psi Model LWS BOPs, optional 14" pistons can be supplied for shearing instead of the standard 10" and 8 1/2" pistons.

Type V Shear

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.



V Shear Ram

Type V Shear ram is capable of shearing at 20% lower pressures than the standard shears. 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.

CV Shear

The CV shear rams use Shaffer's existing V-Shear technology to reduce shear operating pressures while obtaining a reliable seal afterwards. The CV shear ram was developed in response to industry needs for shearing in specific types of applications.

The CV blocks shear and seal within a standard Shaffer 18 3/4" NXT BOP cavity. They are available in Shaffer 18 3/4" BOPs with pressure ratings of 5,000; 10,000 and 15,000 psi.

Casing Shear

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 13 3/8" in an 18 3/4" bore BOP.



Casing Shear

Shaffer Multi-Rams

Multi-Rams

Shaffer Multi-Rams can reduce stack height. One set of Multi-Rams closes to seal on pipe sizes ranging from 3 1/2" to 5 1/2" O.D. Rams need not be changed then when running a tapered drill string within this range. In many cases, it also is not necessary to add another ram BOP to the stack to accommodate drill string O.D. changes.

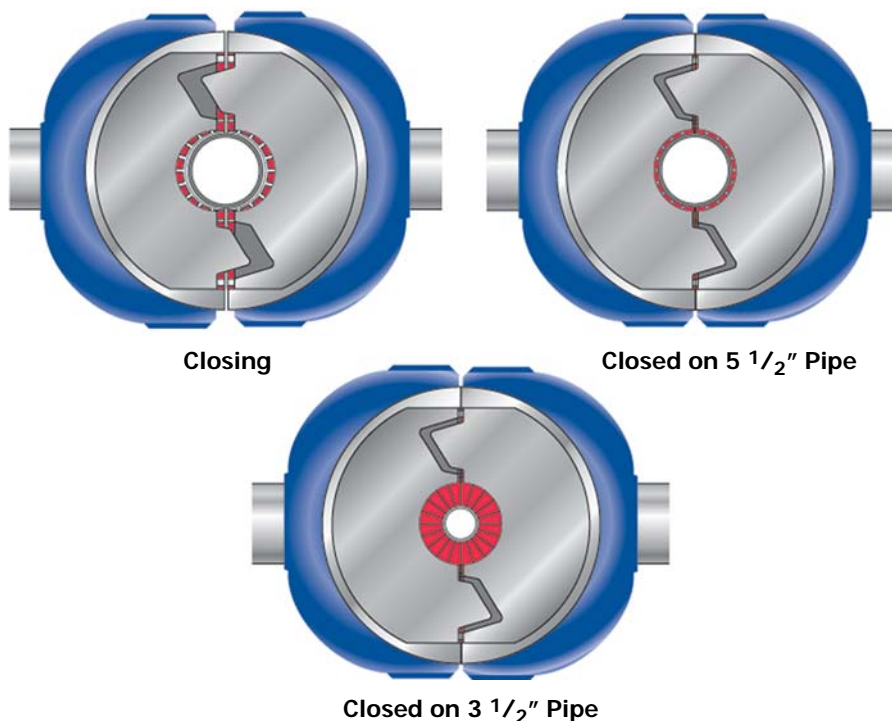
Requirements from the U.S. Geological Survey in OCS Order No. 2 call for four ram BOPs and one annular BOP in the stack when using a tapered drill string. Two ram BOPs would be for the larger drill pipe, and one ram BOP would be for the smaller drill pipe. The fourth ram would contain a blind ram assembly. In the case of a subsea stack, the blind ram would be a blind/shear ram.

The Shaffer Multi-Ram, however, can replace one of the large pipe rams and the small pipe ram — thus reducing the stack to three ram BOPs and one annular BOP. The major advantages are cost savings and the

reduction of stack height — especially important in view of height limitations on offshore structures.

The Multi-Ram meets the USGC requirements for sealing capabilities around tapered drill string. A Shaffer ram BOP equipped with Multi-Rams counts as two ram BOPs — even though it is only one. The Multi-Rams can seal off on both the larger and the smaller drill strings.

Shaffer Multi-Rams interchange with standard rams and with blind/shear rams. You simply open the BOP doors, remove the existing rams and install the Multi-Rams. The Multi-Rams use the same holder and retracting screws as the other ram assemblies. The only new parts are the ram block, top seal and the special packing assembly. When the Multi-Rams close on the drill string, there are steel segments molded into the ram rubbers which move radially inward, decreasing the bore size. Needless to say, substantial rig time is saved in not having to change ram assemblies to accommodate changes in drill pipe sizes.



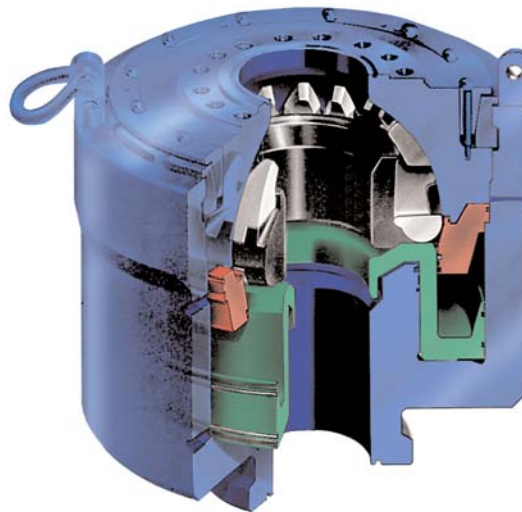
Shaffer Multi-Ram Sizes

Multi-Ram Sizes Offered

Bore Size (Inches) Working Pressure (PSI) Model	Pipe Size Range (Inches)	Pipe Suspension (000 lbs.)							
		2 3/8	2 7/8	3 1/2	4	4 1/2	5	5 1/2	6 5/8
7 1/16, 3,000 Sentinel	2 3/8 - 2 7/8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7 1/16, 5,000 LWS	2 3/8 - 3 1/2	0	0	0	N/A	N/A	N/A	N/A	N/A
7 1/16, 10,000 SL	2 3/8 - 3 1/2	50	50	300	N/A	N/A	N/A	N/A	N/A
7 1/16, 15,000 SL	2 3/8 - 3 1/2	50	50	300	N/A	N/A	N/A	N/A	N/A
7 1/16, 10/15,000 LWS	2 3/8 - 3 1/2	0	0	0	N/A	N/A	N/A	N/A	N/A
11, 5,000 LWS	2 7/8 - 5	N/A	N/A	0	0	400	600	N/A	N/A
11, 10,000 SL	2 3/8 - 3 1/2	0	0	0	N/A	N/A	N/A	N/A	N/A
11, 10,000 SL	3 1/2 - 5	N/A	N/A	0	0	400	600	N/A	N/A
13 5/8, 5,000 SL/LWS	2 7/8 - 5 1/2	N/A	0	0	0	0	600	600	N/A
13 5/8, 5,000 SL/LWS	4 1/2 - 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13 5/8, 10,000 SL	5 - 6 5/8	N/A	N/A	N/A	N/A	N/A	400	400	N/A
13 5/8, 10,000 SL	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
13 5/8, 10,000 SL	2 3/8 - 3 1/2	N/A	N/A	400	N/A	N/A	N/A	N/A	N/A
13 5/8, 15,000 SL	3 1/2 - 5	N/A	N/A	N/A	200	200	400	600	N/A
13 5/8, 15,000 SL	5 - 7	N/A	N/A	N/A	200	200	400	600	N/A
16 3/4, 5,000 SL/LWS	3 1/2 - 5	N/A	0	200	200	200	600	600	N/A
16 3/4, 5,000 SL/LWS	5 - 7	N/A	N/A	N/A	200	200	400	400	600
16 3/4, 10,000 SL	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
18 3/4, 5,000 SLX/NXT	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
18 3/4, 5,000 SLX/NXT	5 - 7	N/A	N/A	N/A	N/A	N/A	300	300	600
18 3/4, 10,000 SL/SLX/NXT	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
18 3/4, 10,000 SL/SLX/NXT	5 - 7	N/A	N/A	N/A	N/A	N/A	300	300	600
18 3/4, 10,000 SL/SLX/NXT	5 - 6 5/8	N/A	N/A	N/A	N/A	N/A	N/A	400	600
18 3/4, 15,000 SL/NXT	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
18 3/4, 15,000 SL/SLX/NXT	3 1/2 - 5 1/2	N/A	N/A	200	200	400	600	600	N/A
18 3/4, 15,000 SL/NXT	5 - 7	N/A	N/A	N/A	N/A	N/A	300	300	600
20 3/4, 3,000 LWS	3 1/2 - 5 1/2	N/A	N/A	200	200	200	600	600	N/A
20 3/4, 3,000 LWS	4 1/2 - 7	N/A	N/A	N/A	N/A	300	300	300	600
21 1/4, 2,000 LWS	3 1/2 - 5 1/2	N/A	N/A	200	200	200	600	600	N/A
21 1/4, 2,000 LWS	4 1/2 - 7	N/A	N/A	N/A	N/A	300	300	300	600
21 1/4, 5,000 SL	3 1/2 - 5	N/A	N/A	200	200	400	600	N/A	N/A
21 1/4, 5,000 SL	5 - 7	N/A	N/A	200	200	200	600	600	N/A

For part numbers, contact your local Shaffer representative.

Shaffer Spherical™ Blowout Preventers



Wedge Type SBOP

Shaffer Spherical™ blowout preventers are compact, annular type BOPs which seal reliably on almost any shape or size — kellys, drill pipe, tool joints, drill collars, casing or wireline. Sphericals also provide positive pressure control for stripping drill pipe into and out of the hole. They are available in bolted cover, wedge cover, dual wedge cover and NXT models.

- Rugged, reliable sealing element provides positive seal after hundreds of tests to full working pressure.
- Strong, simple construction — only five major parts.
- Compact body saves space. Height is 15 to 20% less than height of some other annular BOPs.
- Simple hydraulic system. Only two hydraulic connections are needed.
- Wear rings on moving parts prevent metal-to-metal contact. This feature prolongs preventer life.

- Suitable for H₂S service. Standard models are suitable for internal H₂S service, and simple bolt and lifting shackle changes convert them for external H₂S service.
- Servicing is easy. Element can be changed without getting mud or grit into the hydraulic system.
- Steel segments reinforce sealing element but do not protrude into well bore when element is open.
- Element design provides long stripping life.

Shaffer Spherical™ Blowout Preventers

Spherical BOP Sizes and Models										
Working Pressure (psi)	Bore (in.)									
	4 1/16	7 1/16	9	11	13 5/8	16 3/4	18 3/4	20 3/4	21 1/4	30
10,000										
5,000										
3,000										
2,000										
1,000										


Wedge-Cover
Spherical BOP




Dual Wedge-Cover
Spherical BOP




Bolted-Cover
Spherical BOP




Integral NXT
BOP Model



Shaffer Spherical™ BOP Features

Rugged, Reliable Sealing Element

The success of Shaffer Sphericals is due primarily to the ruggedness and reliability of their sealing element. Hundreds of pressure tests to full working pressure have proven its ability to maintain a positive seal.

Furthermore, impartial tests conducted in an industry program sponsored by 22 companies, including all three major BOP manufacturers, have shown that the Shaffer Spherical's element lasts two to four times longer than elements in other annular preventers. The element retains its ability to return to the fully opened position much longer than other sealing packers.

The long sealing life of the element gives Shaffer Sphericals a high degree of reliability and keeps maintenance costs, as well as operating costs, to a minimum.

Strong Simple, Construction

Spherical blowout preventers consist of just five major parts - the upper and lower housing, the sealing element, an adapter ring, and a piston. This simple design provides a rugged, reliable preventer and ease of service in the field.

Spherical models in smaller sizes or with lower working pressures have bolted covers. Those in larger sizes or with higher working pressures have wedge covers. In bolted cover models, the upper housing fastens to the lower housing with studs and nuts. Wedge cover models fasten with locking segments and a locking ring.

Shaffer Spherical™ Blowout Preventers

Space Saving Design

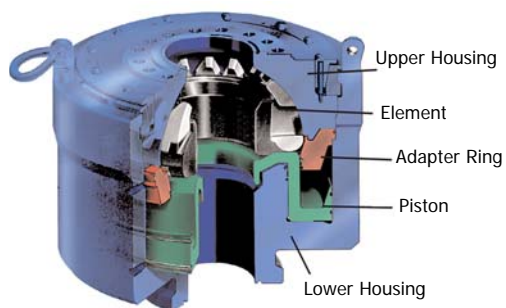
Sphericals are generally 15 to 20% shorter than comparable annular preventers — a big advantage when installation space is limited.

The NXT design further reduces weight and height by eliminating the flange connection below the annular and connecting bolts through the base of the annular directly to the ram body.

For applications that require two Sphericals, dual wedge cover preventers incorporate two sealing elements, adapter rings and pistons into one housing. Each sealing assembly operates independently of the other, yet the dual preventer is up to 20% shorter than two singles stacked one on top of the other.

Low Operating Pressure

All Shaffer Sphericals operate at 1,500 psi, whereas some competitive units require much higher pressures, thus increasing accumulator size and cost to meet code requirements.



Wedge Cover Spherical BOP

Protection Against Wear

Wear rings prolong the life of the piston and the piston seals by eliminating metal-to-metal contact between the piston and the lower housing of the preventer.

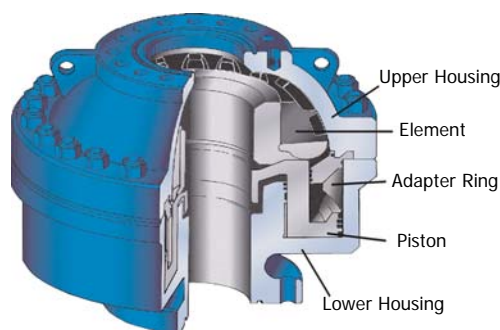
Wiper seals are used in places where debris might accumulate between metal parts and accelerate wear. Wide clearances allow any debris to flow off the wiper seals without damaging metal sealing surfaces.

All dynamic seals are lip type, specially made to seal against moving parts with minimum wear.

Suitable for H₂S and Arctic Service

Shaffer standard Sphericals meet all applicable American Petroleum Institute (API) and National Association of Corrosion Engineers (NACE) requirements for internal H₂S service. Field conversion for external H₂S service involves changing only the studs, nuts and lifting shackles.

Arctic models which meet API 16A specifications for low temperature service also are available.



Bolted Cover Spherical BOP

Simple Hydraulic System

Shaffer Sphericals require only two hydraulic connections — one for opening and one for closing. On some of the larger models, additional ports are provided for convenience when attaching hydraulic lines.

Shaffer Spherical™ Blowout Preventers

Easy Servicing

Servicing a Shaffer Spherical preventer in the field is simple. The upper housing lifts off for easy access to all internal components.

The adapter ring protects the piston and hydraulic chamber from mud and grit while the element is being changed. Only one seal is disturbed. This is not true of some other annular preventers.

Steel Segments Reinforce Sealing Element

Steel segments molded into the element partially close over the rubber to prevent excessive extrusion when sealing under high pressures. These segments always move out of the well bore when the element returns to the open position, even when the element is worn far beyond normal replacement condition.

Long Stripping Life

Stripping operations are undoubtedly the most severe application for any preventer because of the wear the sealing element is exposed to as the drill string is moved through the preventer under pressure.

Only the top portion of the rubber in the Shaffer Spherical's sealing element contacts the drill string or kelly. Most of the rubber is held in reserve for sealing only as abrasion makes it necessary. This large reservoir of rubber makes it possible to strip into or out of a deep hole without replacing the element during the trip.

Long stripping life is especially valuable in offshore use because an annular preventer closed on drill pipe from a floating vessel is constantly stripping due to vessel motion. Typically, Shaffer Spherical element life in offshore service averages more than a year - a real tribute to its durability and sealing power.

Smooth, Dependable Action

Stripping is smooth with a Shaffer Spherical because the element opens and closes so easily. The steel segments molded into the rubber make metal-to-metal sliding contact with the sphere of the housing. This provides a much lower coefficient of friction than rubber-to-metal contact. Well pressure assists will not cause it to overseal, since the element's design and method of energization counteract the well bore pressure acting on the piston.

During stripping out, well pressure and pipe movements are in the same direction. Rubber compresses firmly against the steel segments at the top of the element, but rubber at the bottom is only lightly compressed. This creates a "funnel effect" that makes it easy for a tool joint to enter the sealing element. Hydraulic pressure bleeds off, allowing the element to expand and accommodate the larger O.D. of the tool joint.

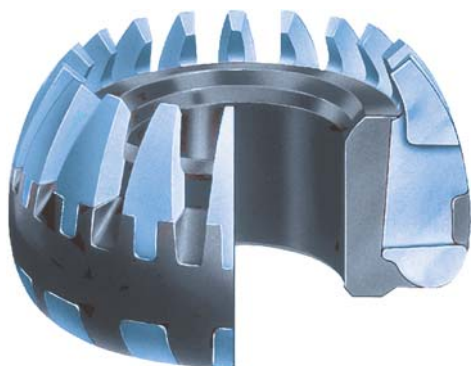
When stripping in, well pressure and pipe movement oppose each other. Well pressure compresses the rubber portion of the element against the steel segments as the tool joint moves down into the Spherical.

Shaffer Spherical™ Blowout Preventers

Choice of Rubber Compounds

Sealing elements are available in natural and nitrile rubber compounds. This allows the Spherical to be fitted for any type of service — water base mud, oil base mud, and low temperature.

Natural rubber offers excellent fatigue and wear life in water base muds and operates well in lower temperatures. This allows the Spherical to be fitted for any type of service — water base mud, oil base mud, and low temperature.



Sealing Element

Ordering a Spherical BOP

When ordering a Shaffer Spherical BOP, specify the following:

1. Integral (NXT), Single or Dual
2. Bore size and working pressure
3. Connections:
 - Bottom connection. Studded, flanged or hubbed required. Give size, working pressure and ring groove. Unless specified otherwise, API ring groove will be supplied.
 - Top connection. Studded, flanged or hubbed required. Give size, working pressure, and ring groove. Unless specified otherwise, API ring groove will be supplied.
4. Element — nitrile or natural rubber.
5. Special features desired. These can include stainless steel or inconel ring grooves, low temperature (below -20° F) certification for metallic parts, or hydrogen sulfide trim (internal or full environmental).

Shaffer Spherical™ Blowout Preventers

Spherical BOP Specifications -- Bolted and Wedge Cover Models 10,000 and 5,000 PSI

Working Pressure (PSI)		10,000					5,000						
Bore (Inches) Cover Configuration		18 3/4 Wedge	13 5/8 Wedge	11 Wedge	7 1/16 Bolted	4 1/16 Bolted	21 1/4 Wedge	18 3/4 Wedge	16 3/4 Wedge	13 5/8 Bolted	11 Bolted	9 Bolted	7 1/16 Bolted
A (Inches)		76 1/4	64 1/2	57	43	23	71	66 1/4	60	50	44 3/4	40	29
B (Inches)		70 7/8	59 5/8	53 1/4	28 7/8	16 9/16	66 5/8	62 1/4	56 1/4	34 1/8	29 1/4	25	19 3/4
C (Inches)		72	59	53	—	—	69 1/2	64 5/8	56 3/4	—	—	—	—
D (Inches)		38	22 7/8	21 1/8	17 7/8	9 3/4	32 1/4	28 7/8	23 7/16	18 1/2	17 1/8	14 13/16	11 3/4
E (Inches)		8 1/2	6 5/8	6	4 1/2	2 3/8	5 1/2	7	4 3/4	4 1/2	2 3/4	2 13/16	2 3/4
F (Inches)		18 5/8	14 9/16	12 7/8	11 1/8	6	22 3/16	18 7/8	16	12	12 5/8	10 1/4	7 3/4
G (Inches)		27 11/16	21 15/16	20 1/4	19 5/16	11 3/8	22 11/16	18 3/8	15 3/4	20 5/8	17 11/16	16	13 3/4
H (Inches)		4 7/16	4 1/2	4 3/8	9 1/4	6 1/4	4 1/8	4 3/4	6 5/16	8	6 7/8	7 1/8	6 5/16
I (Inches)		9/16	3/8	5/8	2 3/4	1 1/2	15/16	1/4	1 5/16	2 11/16	2 9/16	2 5/16	1 7/8
J (Inches)		40	30	15	—	—	15	15	15	—	—	—	—
K (Inches x 45°)		3	2	1 1/2	1 1/2	1/2	3	2	1 3/4	1 1/4	1	1	1/2
L (Inches)		66	53 3/8	47 1/2	—	—	61 3/8	57	51	—	—	—	—
M (Inches)		15	15 1/2	10 1/2	—	—	15 3/8	12 1/4	7	—	—	—	—
N (Inches)	Flanged Bottom	13 11/16	10 3/4	9 1/2	7 5/16	5 3/4	11 1/2	11	9 1/8	7 13/16	8 7/16	7 7/16	6 5/8
	Studded Bottom	1	1 9/16	2	13/16	1	1 1/2	2	13/16	1/2	1 1/16	7/16	1 1/4
	Hubbed Bottom	8	6 1/2	5 3/4	4 1/16	3 1/4	8	8	6 1/2	5 5/8	4 1/2	3 7/8	3 3/4
Hydraulic Conn.: NPT (Qty.)		2 (4)	2 (4)	2 (2)	1 1/4 (2)	3/4 (2)	2 (4)	2 (4)	2 (2)	1 1/2 (2)	1 1/4 (2)	1 1/4 (2)	1 (2)
Hydraulic Fluid (Gallons)	Close	85.0	40.16	30.58	17.20	2.38	61.37	48.16	33.26	23.58	18.67	11.05	4.57
	Open	66.0	32.64	24.67	13.95	1.95	47.76	37.61	25.61	17.41	14.59	8.72	3.21
Maximum Operating psi		1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
No. Lifting Shackles		4	4	4	2	2	4	4	4	2	2	2	2
Capacity (Lbs.)		280,000	280,000	280,000	100,000	19,000	280,000	280,000	280,000	100,000	68,000	48,000	26,000
Flanged Bottom	Height (Inches)	72 3/4	58 3/8	53	42 1/4	25 1/2	66	60	51 15/16	44 15/16	41 1/2	36 1/2	30 7/8
	Weight (Lbs.)	57,050	32,475	23,000	10,600	1,850	44,500	36,100	22,900	13,650	9,550	6,800	3,175
Studded Bottom	Height (Inches)	60 3/4	49 3/16	45 1/2	35 3/4	20 3/4	55	51	43 5/8	37 5/8	33 13/16	29 1/2	25 1/2
	Weight (Lbs.)	54,950	31,175	22,375	10,275	1,800	42,500	34,750	22,000	13,100	9,275	6,500	3,075
Hubbed Bottom	Height (Inches)	67 1/16	54 1/8	49 1/4	39	23	63 1/2	57	49 5/16	42 3/4	37 9/16	32 15/16	28
	Weight (Lbs.)	50,075	31,575	22,550	10,400	1,800	43,200	35,400	22,525	13,250	9,300	6,625	3,125

Pressure Control

Shaffer Spherical™ Blowout Preventers

Spherical BOP Specifications -- Bolted and Wedge Cover Models 10,000 and 5,000 PSI (Continued)

Working Pressure (PSI)		10,000					5,000						
Bore (Inches)	Cover Configuration	18 3/4 Wedge	13 5/8 Wedge	11 Wedge	7 1/16 Bolted	4 1/16 Bolted	21 1/4 Wedge	18 3/4 Wedge	16 3/4 Wedge	13 5/8 Bolted	11 Bolted	9 Bolted	7 1/16 Bolted
Clamp No.		27	15	22	10	6	26	27	19	13	10	8	7
Wt. (Lbs.)	Element	1,525	675	525	250	35	1,450	1,250	825	550	450	275	125
	Piston	4,625	2,650	1,950	1,100	150	4,500	3,400	2,250	1,675	1,150	900	425
	Adapter Ring	3,525	1,875	1,175	700	125	2,400	1,900	1,050	800	600	450	135
	Upper Housing ¹	11,625	7,175	5,600	3,550	650	8,800	6,500	4,375	3,800	2,600	2,000	975
	Flanged Lower Housing ²	31,875	18,300	11,400	4,550	800	25,500	21,250	13,325	6,350	4,425	2,900	1,375
	Studded Lower Housing	29,775	17,000	10,775	4,225	750	23,500	19,200	12,425	5,800	4,150	2,600	1,275
	Hubbed Lower Housing	29,900	17,400	10,950	4,350	750	24,300	20,550	12,950	5,950	4,175	2,725	1,325
Miscellaneous ³		3,875	1,800	2,350	450	90	1,850	1,800	1,075	475	325	275	140
Seal Ring		BX-164	BX-159	BX-158	BX-156	BX-155	BX-165	BX-163	BX-162	BX-160	RX-54	RX-50	RX-46
Bonnet Nut – Across Flats (In.)		2 Note ⁴	1 5/8 Note ⁴	1 5/8 Note ⁴	3 1/2	2 3/8	2 Note ⁴	2 Note ⁴	1 5/8 Note ⁴	3 1/2	3 1/8	2 3/4	2 3/8
Stud Torque (Ft Lbs.)		1,500	260 Note ⁴	260 Note ⁴	3,100	900	500 Note ⁴	500 Note ⁴	260 Note ⁴	3,100	2,200	1,500	900

NOTES:

1. Bolted cover includes top studs, nuts and shackles. Wedge cover includes top studs and nuts.
2. Bolted cover does not include top studs and nuts. Wedge cover includes shackles.
3. Bolted cover: bonnet studs/nuts, seals. Wedge cover: locking ring, locking studs/nuts, locking segments, jack screws, nuts, seals.
4. Locking ring nuts.

Shaffer Spherical™ Blowout Preventers

Spherical BOP Specifications — Bolted and Wedge Cover Models 3,000, 2,000 and 1,000 PSI

Working Pressure (PSI)		3,000					2,000	1,000
Bore (Inches) Cover Configuration		20 3/4 Bolted	13 5/8 Bolted	11 Bolted	9 Bolted	7 1/16 Bolted	21 1/4 Bolted	30 Bolted
A (Inches)		54 1/8	46 3/8	39 7/8	35 1/2	29	49	71
B (Inches)		39 1/4	31 1/2	26 1/2	24	19 1/4	39 1/4	49 3/4
C (Inches)		—	—	—	—	—	—	—
D (Inches)		21 3/16	16 1/8	13 7/16	13 5/8	11 5/8	20 9/16	24 3/4
E (Inches)		3 3/4	3 3/4	2 1/16	1 7/8	2 5/8	3 1/8	4 1/4
F (Inches)		14 7/32	10 7/8	10 1/8	10 1/4	7 3/4	15 13/16	17 1/2
G (Inches)		21 13/32	19 5/8	14 3/4	14 9/16	13 3/4	21 1/16	34 7/16
H (Inches)		8	6 1/4	5	4 7/8	4	8	9
I (Inches)		3	2 5/8	1 7/8	1 15/16	2	3	3
J (Inches)		—	—	—	—	—	—	—
K (Inches x 45°)		5/8	1	1	3/4	1/2	5/8	1 1/2
L (Inches)		—	—	—	—	—	—	—
M (Inches)		—	—	—	—	—	—	—
N (Inches)	Flanged Bottom	9	6 7/16	5 15/16	5 13/16	5	7 3/8	9 1/2
	Studded Bottom	—	1/4	3/8	3/8	1	13/16	1
	Hubbed Bottom	—	3 1/2	3 3/4	—	—	5 1/2	—
Hydraulic Conn.: NPT (Qty.)		1 1/2 (2)	1 1/2 (2)	1 (2)	1 (2)	1 (2)	1 1/2 (2)	2 (4)
Hydraulic Fluid (Gallons)	Close	43.4	23.50	11.00	7.23	4.92	32.59	122.00
	Open	26.9	14.67	6.78	5.03	3.43	16.92	55
Maximum Operating psi		1,500	1,500	1,500	1,500	1,500	1,500	1,500
No. Lifting Shackles		2	2	2	2	2	2	2
Capacity (Lbs.)		100,000	68,000	34,000	34,000	19,000	100,000	100,000
Flanged Bottom	Height (Inches)	48 7/16	40 11/16	32 7/8	32 1/2	29 1/8	46 1/8	65 5/8
	Weight (Lbs.)	14,600	9,500	5,825	4,775	2,900	10,850	28,750
Studded Bottom	Height (Inches)	—	34 1/2	27 1/16	27 1/16	25 3/8	—	57 1/8
	Weight (Lbs.)	—	8,850	5,675	4,675	2,850	10,150	28,025
Hubbed Bottom	Height (Inches)	—	37 3/4	30 11/16	—	—	44 1/4	—
	Weight (Lbs.)	—	9,325	5,683	—	—	10,200	—

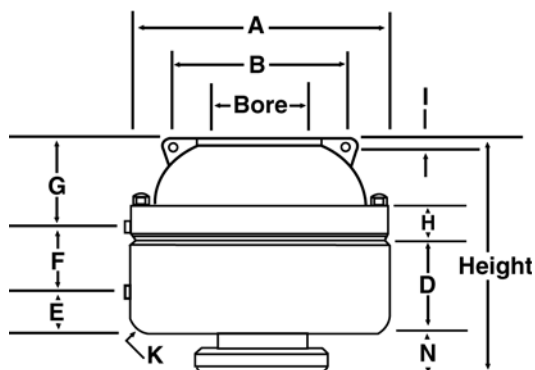
Shaffer Spherical™ Blowout Preventers

Spherical BOP Specifications — Bolted and Wedge Cover Models 3,000, 2,000 and 1,000 PSI (Continued)

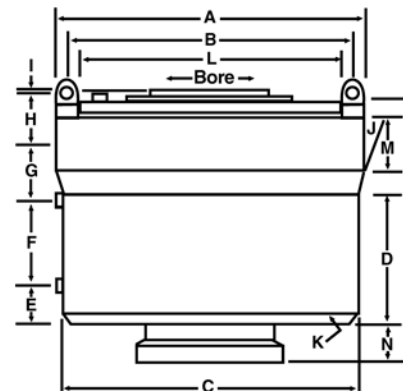
Working Pressure (PSI)		3,000					2,000	1,000
Bore (Inches) Cover Configuration		20 3/4 Bolted	13 5/8 Bolted	11 Bolted	9 Bolted	7 1/16 Bolted	21 1/4 Bolted	30 Bolted
Clamp No.		—	11	9	—	—	18	—
Wt. (Lbs.)	Element	950	550	325	275	125	950	2,875
	Piston	2,485	1,225	950	625	425	2,485	5,025
	Adapter Ring	840	425	250	275	125	475	1,050
	Upper Housing ¹	3,660	2,850	1,575	1,350	775	3,050	6,575
	Flanged Lower Housing ²	6,745	3,775	2,475	2,125	1,325	4,725	9,850
	Studded Lower Housing	—	3,525	2,325	2,025	1,275	4,025	9,125
	Hubbed Lower Housing	—	3,600	2,350	—	—	4,075	—
Miscellaneous ³		400	275	250	125	125	275	900
Seal Ring		R-74	RX-57	RX-53	RX-49	RX-45	RX-73	R-95
Bonnet Nut — Across Flats (In.)		3 1/8	2 15/16	2 3/4	2 3/8	2	2 9/16	3 1/2
Stud Torque (Ft Lbs.)		2,200	1,800	1,500	900	500	1,200	3,100

NOTES:

1. Bolted cover includes top studs, nuts and shackles. Wedge cover includes top studs and nuts.
2. Bolted cover does not include top studs and nuts. Wedge cover includes shackles.
3. Bolted cover: bonnet studs/nuts, seals.
Wedge cover: locking ring, locking studs/nuts, locking segments, jack screws, nuts, seals.



Bolted-Cover Spherical BOP



Wedge-Cover Spherical BOP

Shaffer Spherical Bolted Cover BOPs

Spherical BOP Parts — Bolted Cover Models

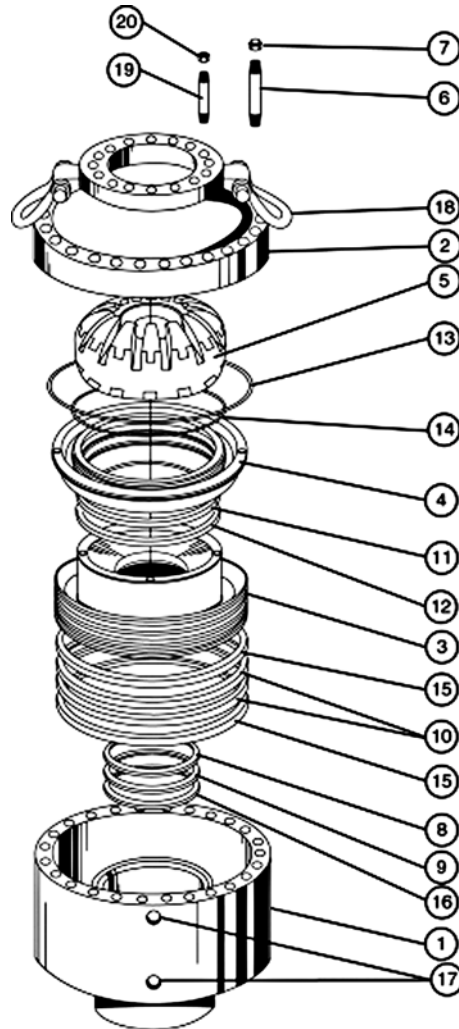
Item No.	Description	Qty. Req.	No. Req. Spare Parts												
	Working Pressure (psi)			10,000	5,000	5,000	5,000	5,000	3,000	3,000	3,000	3,000	3,000	2,000	1,000
	Bore (Inches)			7 1/16	13 5/8	11	9	7 1/16	20 3/4	13 5/8	11	9	7 1/16	21 1/4	30
1	Lower Housing-Flanged	1		150982	152451	152406	152232	152173	156512	151974	152019	152178	152420	152204	155274
2	Upper Housing-Studded	1		150983	152453	152328	151002	151392	156513	150735	150486	150992	150717	150749	155272
3	Piston	1		150984	152148	152326	151003	150718	156523	156400	150498	152837	150718	155623	155983
4	Adapter Ring	1		150985	151933	152323	152236	152163	156521	151964	152026	152827	151831	152183	155984
5	Sealing Element														
	Nitrile (Blue)			150987	150576	150810	150996	150847	150799	150576	150578	150996	150847	150799	155393
	Natural (Red)			150988	150577	150809	152272	150848	150800	150577	150579	152272	150848	150800	155392
6	Stud	1 Set ¹		150989	150659	150648	150999	150730	156528	155661	150487	155663	150721	150832	155408
7	Nut	1 Set ¹		020111	020111	020110	020108	020106	020110	020109	020108	020106	020104	020107	020111
8	Seal-Piston I.D. Upper	1	1	031102	031097	031113	031110	031105	031108	031111	031099	031110	031105	031108	031225
9	Seal-Piston I.D. Lower	1	1	031102	030770	031152	031002	031000	030761	030780	031101	031002	031000	030761	031225
10	Seal-Piston O.D.	2	2	030765	031029	031018	030765	030780	031013	030782	030765	031012	030780	030767	031226
11	Seal-Adapter I.D.-Upper	1	1	031100	031096	031114	031109	031104	031107	031096	031098	031109	031104	031107	031224
12	Seal-Adapter I.D.-Lower	1	1	031100	030771	030781	031037	031002	031018	030771	030761	031037	031002	031018	031224
13	Seal-Adapter O.D.	1	1	030773	030772	030783	031126	030408	031031	031011	030760	030784	030408	031019	031020
14	Seal-Adapter Top	1	3	031035	031094	031115	031036	030405	031027	030773	031095	031145	030244	031027	031021
15	Wear Ring-Piston	2		150613	150613	150613	150613	150613	150613	150613	150613	150613	150613	150613	150613
16	Wear Ring-Lower Housing	1		150613	150613	150613	150613	150613	150613	150613	150613	150613	150613	150613	150613
17	Pipe Plug	2		066328	066329	066328	066328	066335	066329	066335	066335	066335	066335	066329	066330
18	Anchor Shackle	2		060498	060498	060497	060494	060496	060498	060497	060499	060499	060500	060498	060498
19	Stud for Top API Flange	1 Set ¹		011020	011023	011026	011023	012262	011028	011016	011015	011014	011011	011023	011035
20	Nut for Top API Flange	1 Set ¹		020000	020012	020014	020012	020011	020015	020011	020011	020011	020003	020012	020015
NS ²	Wear Ring-Adapter	1		150613	150613	152344	n/a	152344	152344	n/a	n/a	n/a	152344	152344	150613
NS ²	Eye Bolts	2		050243	050243	050243	050243	050243	050243	050243	050243	050243	050243	050243	150912
NS ²	Hammer Wrench	1		050713	050713	050825	050823	050821	050285	050824	050823	050821	050819	050822	050713
	Size (Inches)			2 1/4	2 1/4	3 1/8	2 3/4	2 3/8	3 1/8	2 15/16	2 3/4	1 1/2	2	2 9/16	3 1/2
NS ²	Pipe Plug 1/4" NPT			065008	065008	065008	065008	065008	065008	065008	065008	065008	065008	065008	065008
NS ²	Seal Kit ³	1		155050	155070	155030	155076	155079	156527	155073	155075	155077	155078	155067	155412
NS ²	Accumulator Kit ⁴	1		152715	152717	152716	152716	152715	152717	152717	152715	152715	152715	152717	155970

NOTES:

1. Part number shown is for one each. Quantity varies with size of spherical.
2. NS Not shown.
3. Not a standard accessory. Includes all recommended spare seals, Items 8 through 14.
4. Not a standard accessory.

Pressure Control

Shaffer Spherical Bolted Cover BOPs



Bolted Cover SBOP

Shaffer Spherical Wedge Cover BOPs

Spherical BOP Parts — Wedge Cover Models

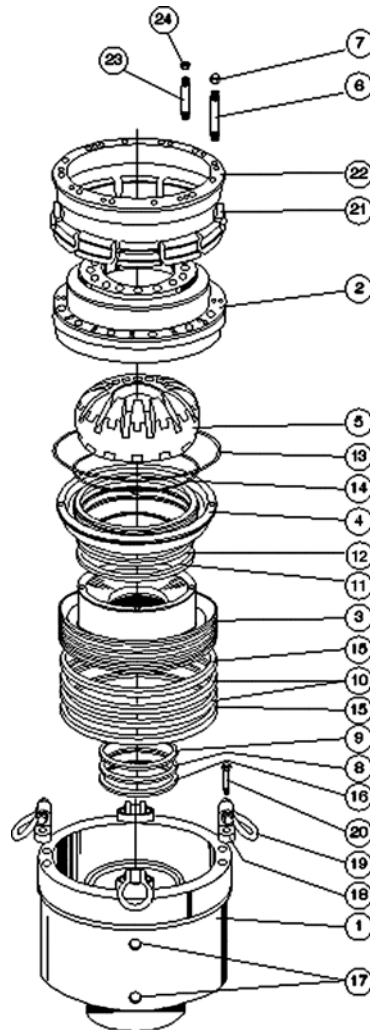
Item No.	Description	Qty. Req.	No. Req. Spare Parts							
				10,000	10,000	10,000	5,000	5,000	5,000	5,000
				18 3/4	13 5/8	11	21 1/4	18 3/4	16 3/4	13 5/8
1	Lower Housing-Hubbed	1	—	156559	155008	—	—	151356	150948	151643
	Lower Housing-Flanged		—	156473	152940	152345	150762	151397	151692	155458
2	Upper Housing	1	—	156474	152704	152341	150763	151357	151191	151649
3	Piston	1	—	156124	157506	152362	150764	151358	158180	152148
4	Adapter Ring	1	—	157227	152701	155166	156600	156570	152668	151933
5	Sealing Element	1	1							
	Nitrile (Blue)			155295	152693	152373	150853	151361	150851	150576
	Natural (Red)			155294	152694	152374	150854	151362	150852	150577
6	Stud	1 Set ¹	—	156171	152709	152351	150889	150889	150753	150753
7	Nut	1 Set ¹	—	020348	020102	020102	020104	020104	020102	020102
8	Seal-Piston I.D. Lower	1	1	031014	031146	031100	031018	030765	031012	030770
9	Seal-Piston I.D. Upper	1	1	031236	031146	031100	031088	031082	031086	031097
10	Seal-Piston O.D.	2	2	031237	031013	030767	031024	031048	031013	031029
11	Seal-Adapter I.D.-Lower	1	1	031235	031148	031160	031025	031046	031014	030771
12	Seal-Adapter I.D.-Upper	1	1	031235	031148	031160	031299	031294	031085	031096
13	Seal-Adapter O.D.	1	1	031234	031015	031119	031026	031053	031015	030772
14	Seal-Adapter Top	1	3	031365	031150	031120	031055	031053	031065	031094
15	Wear Ring-Piston	2		150613	150613	150613	150613	150613	150613	150613
16	Wear Ring-Lower Housing	1	—	150613	150613	150613	150613	150613	150613	150613
17	Pipe Plug-2" NPT	2	—	—	—	2023957	—	—	2023957	—
	2" NPT	4	—	2023957	2023957		2023957	2023957		—
	1 1/2" NPT	2	—	—	—	—	—	—	—	066329
18	Lifting Eye		—	156566	156566	156566	156566	156566	156566	150819
19	Anchor Shackle	2	—	060488	060495	060495	060495	060495	060495	060498
20	Socket Head Cap Screw	8	—	010895	010895	010895	010895	010895	010895	010875
21	Locking Segment	1 Set ¹	—	156128	156953	152355	150767	151363	150825	151658
22	Locking Ring	1	—	156130	152700	152352	150888	151364	150826	151660
23	Stud for Top API Flange	1 Set ¹	—	012231	012264	012254	011030	011029	011026	011024
24	Nut for Top API Flange	1 Set ¹	—	020016	020014	020013	020015	020015	020014	020012
NS ²	Wear Ring-Adapter	1	—	150613	n/a	150613	152344	150613	n/a	152344
NS ²	Jack Screw	6	—	156172	150867	150867	150867	150867	150867	150867
NS ²	Eye Bolt-1" -BUN	2	—	150912	150912	150912	150912	150912	150912	150912
NS ²	Hammer Wrench	1	—	050819	050817	050817	050819	050819	050817	050817
	Size (Inches)		—	1 1/4	1	1	1 1/4	1 1/4	1	1
NS ²	Pipe Plug 1/4" NPT	1	—	065008	065008	065008	065008	065008	065008	065008
NS ²	Seal Kit ³	1	—	155566	155045	155168	155066	155068	155069	155070
NS ²	Accumulator Kit ⁴	1	—	155970	155970	155970	155970	155970	155970	152717

NOTES:

1. Part number shown is for one each. Quantity varies with size of spherical.
2. NS Not shown.
3. Not a standard accessory. Includes all recommended spare seals, Items 8 through 14.
4. Not a standard accessory.

Pressure Control

Shaffer Spherical Wedge Cover BOPs



Wedge Cover SBOP

Shaffer Spherical Dual Wedge Cover BOPs

Spherical BOP Specifications – Wedge Cover Dual Models

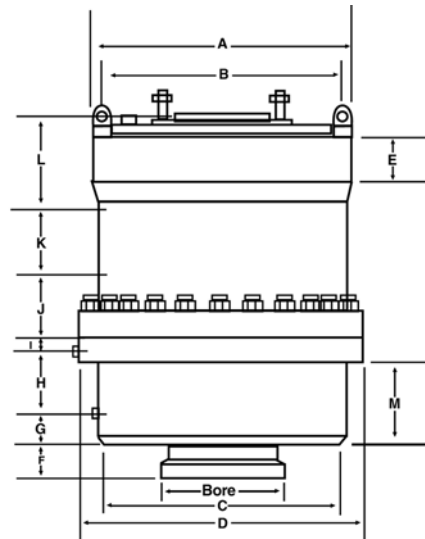
Working Pressure (PSI)		5,000		
Bore (Inches) Cover Configuration		21 1/4	18 3/4	16 3/4
		Wedge	Wedge ¹	Wedge
Dimensions (Inches)	A	71	66 1/4	60
	B	66 7/8	62 1/4	56 1/4
	C	69 1/2	64 5/8	56 3/4
	D	80 1/4	75 1/4	67 3/8
	E	15 3/8	12 1/4	7
	F	9	8	7 1/2
	G	5 1/2	7	4 3/4
	H	22 5/16	18 7/8	16
	I	3 5/16	2 5/8	2 3/4
	J	18 5/8	17 1/2	15 1/2
	K	22 3/16	18 7/8	16
	L	26 13/16	23 1/8	22 1/16
	M	22 3/16	20 3/4	15 3/4
Hydraulic Connection: NPT (Qty.)		2 (8)	2 (8)	2 (4)
Hydraulic Fluid – Close (Gallons) ²		61.37	48.16	33.26
Open (Gallons) ²		47.76	37.61	25.61
Recommended Operating Pressure (psi)		1,500	1,500	1,500
Number of Lifting Shackles		4	4	4
Capacity (Lbs.)		280,000	280,000	280,000
Studded Bottom	Height (Inches)	98 1/16	90	78 7/8
	Weight (Lbs.)	88,300	68,300	47,100
Hubbed Bottom	Height (Inches)	103 11/16 ³	96 ³	84 9/16 ³
	Weight (Lbs.)	89,000	68,900	47,750
Flanged Bottom	Height (Inches)	108 1/16	99	87 3/16
	Weight (Lbs.)	90,200	69,600	48,000
Clamp Number (Hub Connection)		26	27	28

Spherical BOP Specifications – Wedge Cover Dual Models (Continued)

Working Pressure (PSI)	5,000		
Bore (Inches) Cover Configuration	21 1/4	18 3/4	16 3/4
	Wedge	Wedge ¹	Wedge
Element	1,450 ⁴ (lbs)	1,250 ⁴ (lbs)	825 ⁴ (lbs)
Piston	4,500 ⁴ (lbs)	3,400 ⁴ (lbs)	2,250 ⁴ (lbs)
Adapter Ring	2,300 ⁴ (lbs)	1,900 ⁴ (lbs)	1,050 ⁴ (lbs)
Upper Housing	8,800 (lbs)	6,500 (lbs)	4,375 (lbs)
Intermediate Housing	38,500 (lbs)	27,000 (lbs)	18,500 (lbs)
Studded Lower Housing	21,300 (lbs)	19,200 (lbs)	12,100 (lbs)
Hubbed Lower Housing	22,000 ³ (lbs)	20,000 (lbs)	12,750 (lbs)
Flanged Lower Housing	23,200 (lbs)	20,700 (lbs)	13,000 (lbs)
Miscellaneous	3,200 (lbs)	2,500 (lbs)	3,875 (lbs)
Seal Ring (Flanged/Studded Connections)	BX-165	BX-163	BX-162
Locking Ring Nut – Across Flats (Inches)	2	2	1 5/8
Torque (Ft. Lbs.)	500	500	260
Housing Nut – Across Flats (Inches)	3 1/8	3 1/8	3 1/8
Torque (Ft Lbs.)	6,600	6,600	6,600

NOTES:

1. 10,000 psi is available.
2. Per element.
3. 10,000 psi HUB.
4. Each – two required.



Pressure Control

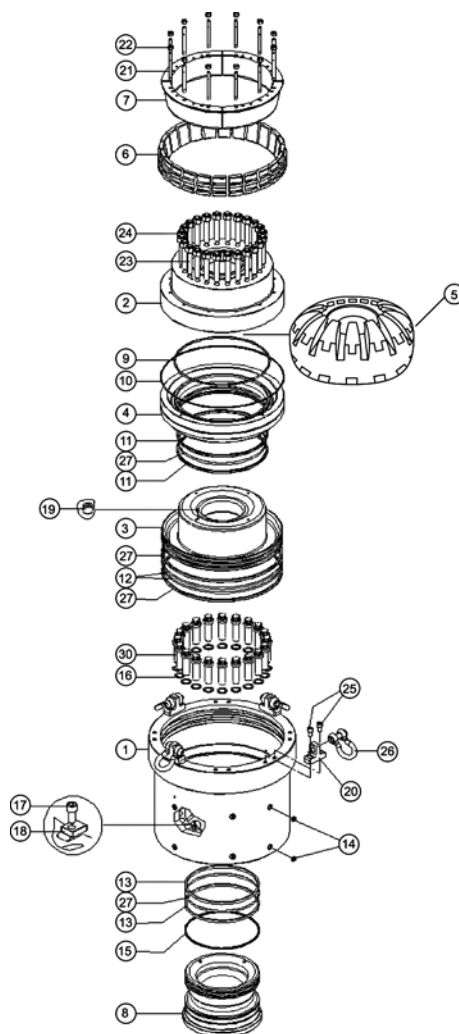
Shaffer Spherical NXT Integral BOP

Integral Spherical BOP

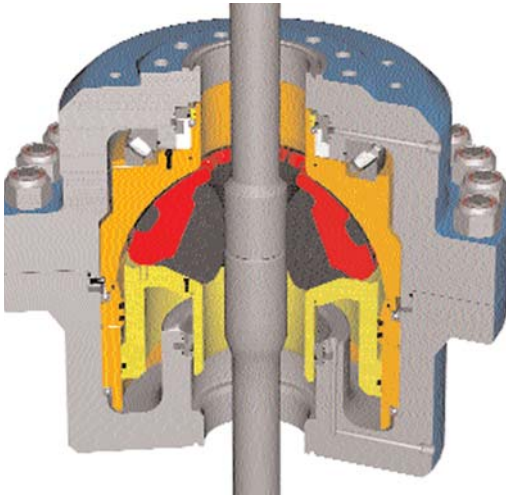
Item	Description
1	Lower Housing
2	Upper Housing
3	Piston
4	Adapter Ring
5	Sealing Element Nitrile (Blue) Natural (Red)
6	Locking Segment
7	Locking Ring
8	Stump
9	Seal – Sym “U”
10	Seal – Adapter O.D.
11	Seal – Adapter I.D. Upper
12	Seal – Piston O.D.
13	Seal – Piston I.D.
14	Plug – SAE
15	Seal – Stump
16	Seal – 3” Cap Screw
17	Screw
18	Clip – Retainer, Stump
19	Plug – Skt Hd.
20	Life Eye
21	Stud
22	Nut
23	Stud
24	Nut
25	Screw
26	Anchor Shackle
27	Wearband
28 ¹	Jack Screw
30	Screw

NOTES:

1. NS Not Shown



Shaffer Underbalanced Drilling Products



Pressure Control While Drilling System

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

- Proof 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 connection standard
- Full 11" bore
- 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

Shaffer Type 79 Rotating BOPs

Type 79 Rotating BOP

The Shaffer Type 79 rotating blowout preventer is a versatile, rotating wellhead which seals tightly around kelly, drill pipe, drill collar, tubing or casing. It can be used for drilling in areas susceptible to kicks or blowouts, drilling under pressure, drilling with reverse circulation and circulating with gas or air. It lets you drill with well bore pressure up to 500 psi and strip pipe into or out of the hole at pressures up to 500 psi with the stationary pipe stripper. The Type 79 can be furnished with a bell nipple adapter when drilling conditions do not require a rotating assembly.

Operation of the Type 79 is very simple. The kelly rotates the kelly drive assembly, which turns the rotating sleeve and the stripper rubber attached to it.

Fast changes are routine with the Shaffer Type 79. A quick-release bonnet makes it simple to switch between rotating assembly, stationary pipe stripper and bell nipple extension, or to pull the rotating assembly to change the drill bit or stripper rubber.

Reliable seals encircle the rotating sleeve, which turns smoothly in double roller bearings.

During drilling, the stripper rubber rotates with the drill string. The only wearing action on the rubber is the kelly sliding through as hole is made.

While tripping in or tripping out, the stripper rubber expands to let tool joints or pipe couplings through without losing its seal.

All maintenance and replacement of parts for the Type 79 can be performed with standard mechanics' tools.

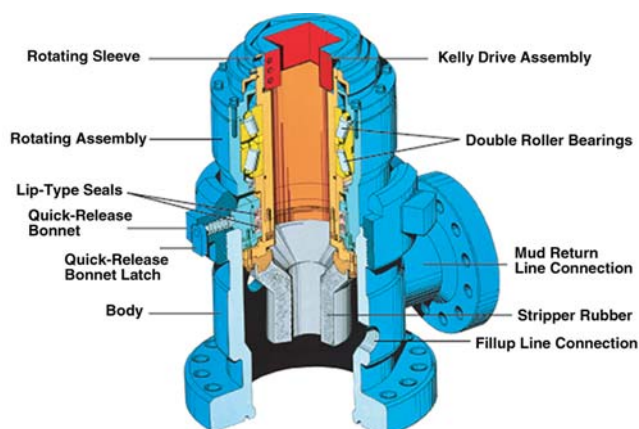
Type 79 Complete Assemblies

Each with 2" Nominal LP
Fillup Line Connection

API Bottom Flange Size ¹	Side Outlet Flange Size	Trim
11-3,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S
11-5,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S
11-10,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S
13 5/8-3,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S
13 5/8-5,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S
13 5/8-10,000	7 1/16" – 3,000 psi	Standard & Internal H ₂ S
	9" – 3,000 psi	Standard & Internal H ₂ S

NOTES:

1. 500 psi maximum working pressure of the unit.



Type 79 RBOP

Shaffer Gate Valves for Manual and Remote Operation

Three basic models of Shaffer gate valves are offered — Type B, Type DB and Type HB.

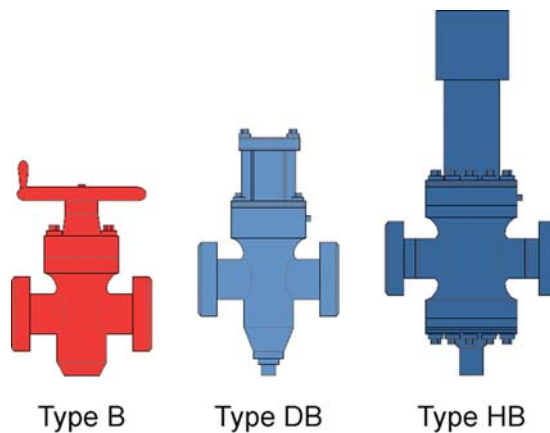
Shaffer Type B gate valves are designed specifically for choke and kill manifold service and use as isolation valves for outlets on BOP stacks. One-piece, slab-type gates seal fluids from either direction and are particularly suited to the demanding conditions of mud service. The seal is always effected against the downstream seat, and upstream pressure is in the body cavity at all times. This feature lowers handwheel torque requirements.

Type DB hydraulic valves are very reliable in choke and kill manifold applications which require remotely operated valves. The Type DB is produced by mounting a Type DB hydraulic operator on a Type B valve body that is equipped with a tail rod prep. This modification can be made without welding on the valve body.

Type HB hydraulic valves are widely used in subsea BOP stack applications which require remotely operated choke and kill line valves adjacent to the blowout preventers.

Gate Valves—Sizes and Models				
Working Pressure (psi)	Bore (inches)			
	2 1/16	3 1/16	3 1/8	4 1/16
5,000				
10,000				
15,000				

Other sizes may be available upon request.



Shaffer Gate Valves

Valve Features

- Elastomeric seal between gate and seat assures long, trouble-free life in oil, water or gas applications. Gate and seats are hardened and precision ground.
- Body cavities are filled with grease to resist accumulation of foreign materials and hydrates in the body. Water, mud or the line fluid which accumulates in the body cavity can be displaced by removing the bleeder plug near the bottom and pumping grease through the bonnet.
- Zero standoff between bonnet and body prevents corrosion of bonnet bolt threads.
- Servicing in the field is easy. No special tools are required, and all parts are completely interchangeable.
- Reduced-hardness bonnet bolts can be used without de-rating the working pressure, which makes the valve especially attractive for H₂S service.
- All valve models are available with H₂S trim which meets API 6A and NACE specifications.
- Arctic models are available which meet API 6A specifications for low temperature 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.

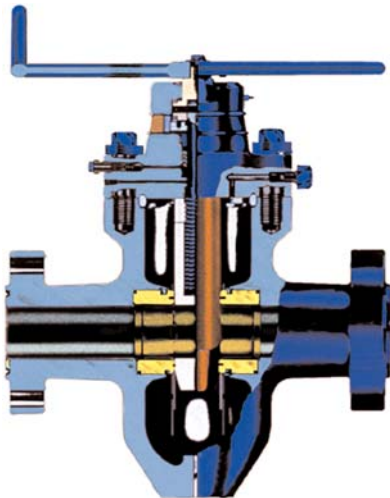
Type B (handwheel) and Type DB (hydraulic remote) come in 2 1/16" - 4 1/16", 5,000, 10,000 and 15,000 psi.



Shaffer Type B Gate Valves

5,000 and 10,000 PSI Type B Valves

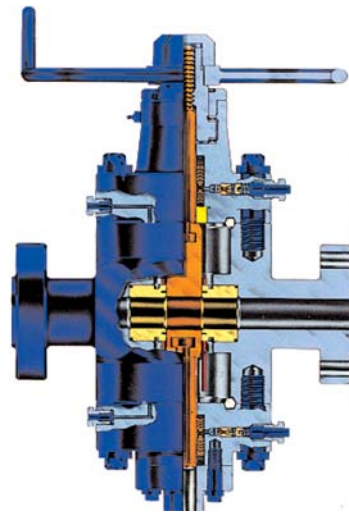
- Shaffer Type B 5,000 and 10,000 psi valves have been field proven by years of operation in virtually every type of service.
- Stems are non-rising and the stem packing is a highly reliable V-type seal. Plastic secondary seals can be activated to keep the valve in service if needed.
- Back seat allows replacement of stem packing with full line pressure in the valve, if necessary. After the valve is back seated, the back seat test screw can be opened to verify that the back seat is holding before the stem packing is removed.
- High capacity needle bearings carry the thrust load in the valve stem. These bearings are lubricated through a grease fitting in the bearing housing, and any excess grease vents through a bleed hole located 180° from the fitting. The bleed hole is covered by an O-ring to keep foreign materials out of the bearing housing.



Type B 5,000 and 10,000 psi Valve

15,000 PSI Type B Valves

- Low handwheel torque is achieved — even at full working pressure — because the rising stem is pressure-balanced by an equal size tail rod.
- Lubricated needle bearings eliminate most of the friction for longer wear.
- V-type packing on stem and tail rod is pressure activated. This reliable seal is similar to the ram shaft seal used in Shaffer ram blowout preventers.
- Plastic secondary seal on both stem and tail rod can be activated if a leak should occur. This will keep the valve in service until the stem packing can be replaced.

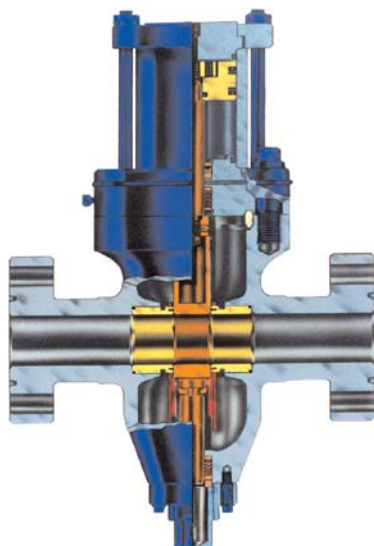


Type B 15,000 psi Valve

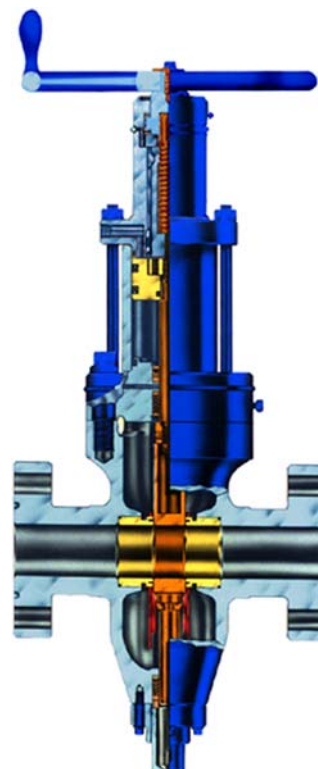
Shaffer DB Hydraulic-Operated Gate Valves

5,000, 10,000, 15,000 PSI Type DB Valves

- Rising stem is pressure balanced by a tail rod to prevent a fluid lock from forming in the valve cavity.
- Less than 1,500 psi hydraulic pressure will operate any type DB valve, even under the most adverse conditions, so these valves can be used with most standard drilling rig BOP control systems.
- Hydraulic operators are tested to 6,000 psi to ensure safe operation with up to 3,000 psi operating pressure.
- Piston stops against cylinder head or bonnet, so there is never excessive stress in the stem or the gate.
- Stem packing vent between the well-pressure packing and the hydraulic-pressure packing gives an early warning if either of these packings should start to leak. This vent also increases packings life by preventing fluid accumulation between the two packings. The outer end of the event is covered by an O-ring to keep foreign material out.
- Valve stems in 5,000 and 10,000 psi DB valves have a pressure-energized polyurethane seal backed up with a modular bearing.
- Valve stems and tail rods in 15,000 psi DB valves have a pressure-energized V-type packing assembly, which contains a lantern ring and is backed up by a modular bearing and an aluminum bronze packing ring. If a well fluid leak should occur, plastic secondary seals on both the stem and tail rod can be activated to keep the valve in service until a convenient shut-down can be scheduled to replace the packing. Caution should be exercised when operating a valve with the secondary seals energized because over-tightening the plastic injection screw can cause excessive wear of the valve stem and seats.
- Handwheel-operated manual override can be used to close a type DB valve if hydraulic power is lost, or to lock the valve in closed position. It cannot be used to open the valve.
- The manual override can be operated with full working pressure in the line and can be added or removed while the valve is in service.



Without Manual Override



With Manual Override

Shaffer Type HB Hydraulic-Operated Gate Valves for Subsea Sys-

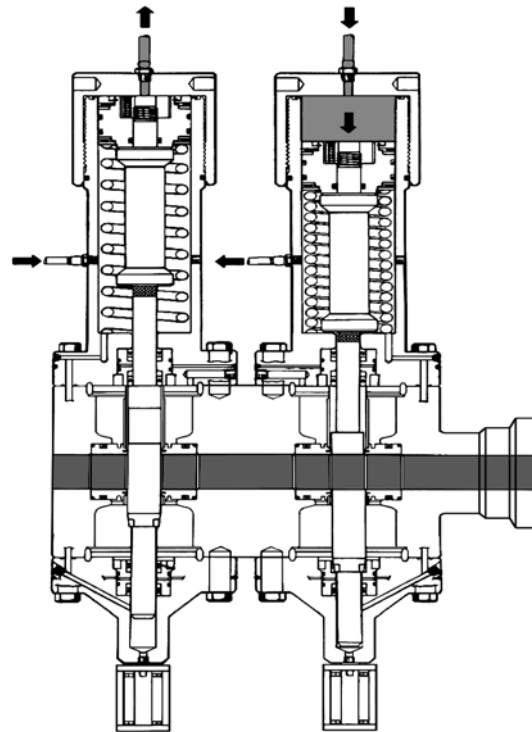
5,000 and 10,000 PSI Type HB Valves

- One, or two, hydraulic lines can be used to operate a Type B valve, and it's easy to convert from one arrangement to the other. Such conversions are sometimes necessary when a stack is modified and a greater or lesser number of control functions becomes available.
- Pressure is sealed from either direction, and so the BOP stack can be tested separately from the choke and kill lines.
- HB valves cannot be pressure locked. This is prevented by the pressure balancing tail rod and the use of a downstream seal.
- Less than 1,500 psi hydraulic pressure will operate any Type HB valve, even under the most adverse conditions, and so any standard drilling rig hydraulic system can be used.
- Cylinders are tested to 6,000 psi to assure safer operation up to 3,000 psi hydraulic pressure.
- Thrust bearings between spring and piston allow the spring to rotate as it is compressed and extended. This reduces spring stress and increases spring life. It also removes the turning moment from the piston and stem assembly, increasing the life of those components.
- Spring can be removed safely during maintenance operations because it is decompressed as the cylinder cap is unscrewed. After the spring is completely decompressed, several additional turns are required to remove the cylinder cap.
- Cylinder cap is easy to remove because thrust bearings on top of the piston eliminate most of the friction as the cap is unscrewed. The Acme threads are plated for corrosion resistance.
- There is never excessive stress in the stem or gate. This is because the piston stops against the cylinder cap or a positive stop on the stem.
- Stem packing vent between the well-pressure packing and the hydraulic-pressure packing prevents hydraulic operating fluid from being contaminated by well fluid should the well-pressure packing fail. This vent also increases packing life by preventing fluid accumulation between the two packings. The outer end of the vent is covered by an O-ring to keep foreign material out.

The HB valve with short sea chest requires two hydraulic lines — one to pump and hold

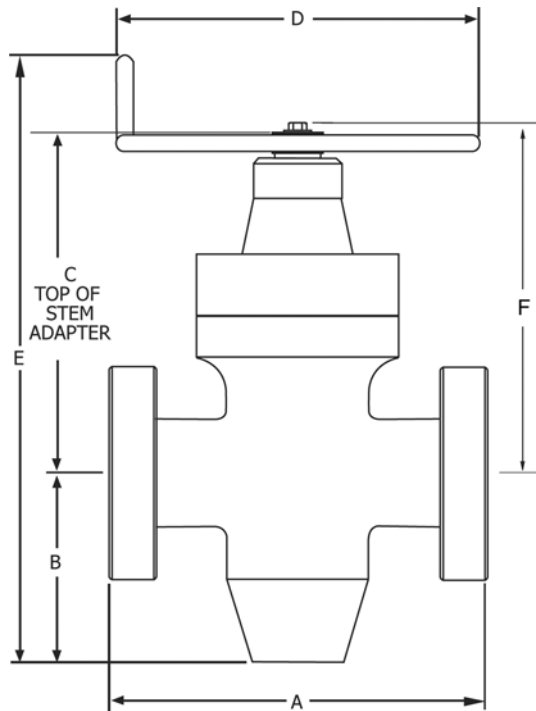
the valve open and the other to close it. Should the hydraulic pressure fail for any reason, the spring closes the valve. No line fluid is displaced while the valve is opened because the pressure-balancing tail rod is the same diameter as the stem.

Periodically, valves used in drilling mud service should be cycled several times with clear water in the line. This will help remove solids that can accumulate in the valve cavity.



Pressure Control

Shaffer Type B Valve



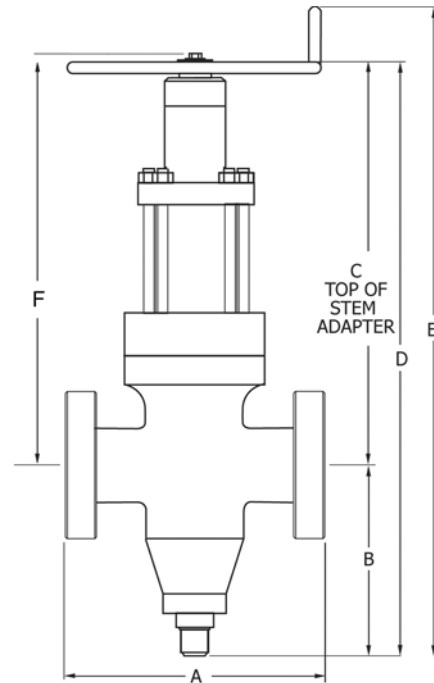
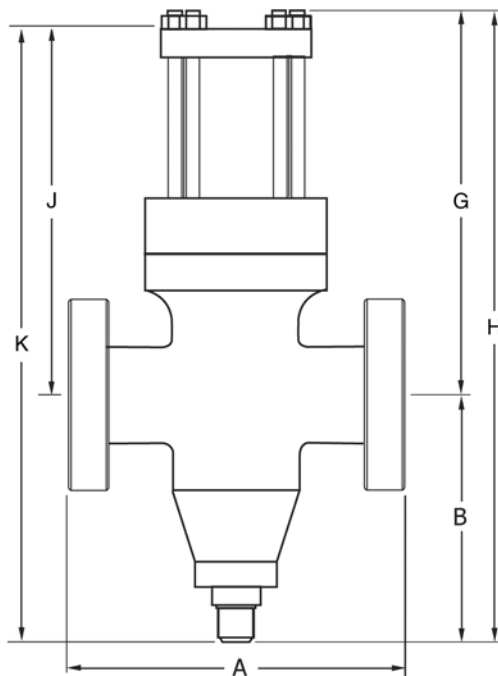
Shaffer Type B Valves Handwheel-Operated, Flanged Specifications

WORKING PRESSURE (PSI)	5,000			10,000			15,000		
BORE SIZE (Inches)	2 1/16	3 1/8	4 1/16	2 1/16	3 1/16	4 1/16	2 1/16	3 1/16	4 1/16
A (Inches)	14 5/8	18 5/8	21 5/8	20 1/2	24 3/8	26 3/8	19	23 9/16	29
B (Inches)	5 1/8	9 5/16	11 3/16	7 1/2	11 7/16	13 1/16	13 1/16	16 5/8	19 7/8
C (Inches)	13 7/16	16 5/8	19 5/16	15 3/8	19 1/16	20 1/2	16 3/4	18 13/16	20 13/16
D (Inches)	14	18	20 1/2	20 1/2	20 1/2	25 1/2	18	23	23
E (Inches)	22 1/4	29 7/8	35	27 3/8	35	38 1/16	32 3/8	42 5/16	47 9/16
F (Inches)	14 1/18	17 1/4	19 15/18	16	19 11/16	21 1/8	117 5/8	22 7/16	26 5/16
G (NO. TURNS TO OPEN)	14	21	27	14	24	30	12	16	20
WEIGHT (LBS)	185	365	535	360	725	1025	470	1070	1150

Shaffer Type DB Valve

Type DB Valve Specifications

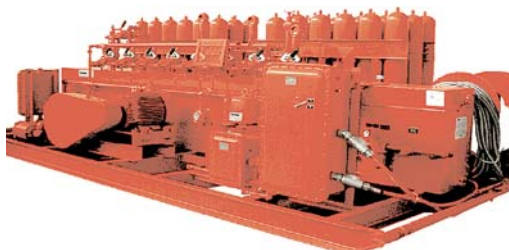
WORKING PRESSURE (PSI) BORE SIZE (INCHES)		5,000			10,000			15,000		
		2 1/16	3 1/8	4 1/16	2 1/16	3 1/16	4 1/16	2 1/16	3 1/16	4 1/16
Hydraulic Fluid (Gallons)	Open	.20	.25	.40	.20	.40	.50	.29	.40	.50
	Close	.15	.20	.35	.15	.35	.45	.26	.35	.45
With or Without Manual Override	A (Inches)	14 5/8	18 5/8	21 5/8	20 1/2	24 3/8	26 3/8	19	23 9/16	29
	B (Inches)	11 5/8	13 1/2	17 3/4	11 11/16	17 13/16	19 7/16	13 1/16	16 5/8	19 7/8
With Manual Override	C (Inches)	30 3/4	28 1/2	33 9/16	33 1/8	33 5/16	34 3/4	34 15/16	33 15/16	36 3/8
	D (Inches)	42 3/8	42	51 5/16	44 13/16	51 1/8	54 3/16	48	50 9/16	56 1/4
	E (Inches)	46 5/16	45 15/16	55 1/4	47 3/4	55 1/16	58 1/8	50 15/16	54 1/2	60 3/16
	F (Inches)	31 3/8	29 1/8	34 5/32	32 3/4	33 15/16	35 3/8	35 9/16	34 9/18	37
	Weight (Lbs)	565	450	750	650	750	1025	700	1200	1250
Without Manual Override	G (Inches)	23 1/4	21	24 1/4	24 5/8	24 3/8	25 13/16	26 5/16	24 3/4	27 1/8
	H (Inches)	34 7/8	34 1/2	42	36 5/16	42 3/16	45 1/4	39 3/8	41 3/8	47
	J (Inches)	22 1/4	20	23 7/16	23 5/8	23 5/32	24 19/32	25 1/16	23 25/32	28 7/32
	K (Inches)	33 7/8	33 1/2	41 3/18	35 5/18	40 31/32	44 1/32	38 1/8	40 13/32	48 3/32
	Weight (Lbs)	510	400	675	600	700	925	650	900	1200



Shaffer Control Systems

Koomey Control Systems

Shaffer is able to offer unmatched experience and knowledge in BOP control systems as the **only** supplier of original Koomey products in the industry today. Koomey has a tradition of continuously leading the development of BOP controls, and Shaffer is carrying on the brand tradition with today's new generation of BOP control systems.



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



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. These control systems offer the 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 feet.

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



Deepwater Control Systems

Shaffer introduced one of the first ultra-deep multiplex (MUX) control systems.

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 Shaffer design has 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 depth.

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.

Shaffer Control Systems

ROV Interfaces

Shaffer integrates standard ROV API 17H dual function, dual taper ROV receptacles and hot stabs to interface to any subsea function. These receptacles are integrated into panels mounted on the stack outboard perimeter for easy ROV access. Each panel is fitted with ROV holds for easy interface.

Additionally, Shaffer offers a subsea hydraulic quick disconnect interface for ROV hotline integration. ROV operable valves can also be integrated for accumulator isolation, ROV function hydraulic lock in and manual accumulator venting.

ROV monitoring of subsea systems provided by Shaffer is also available. Currently offered are pod pressure and accumulator pressure gauges.

An automatic release ROV tether for emergency stack recovery is also available.

For Extremely Cold Climate Drilling

Shaffer provides special BOP control systems — land or offshore — designed for low temperature conditions.



For Workover Drilling

Small truck or trailer-mounted accumulator/pump units with choice of electric or rig air power or gasoline or diesel engine power.

Options and Accessories Tailor BOP Controls to Your Requirements

- Type and size of accumulator/pump unit.
- Type of main power for pumps.
- Type of auxiliary power for pumps.
- Number of auxiliary pumps.
- Kind of valve manifold.
- Choice of air or electric control for driller's panel.
- Choice of air or electric control for remote, auxiliary control panel.
- Nitrogen backup system.
- Low accumulator pressure alarm.
- Low fluid alarm.
- Low rig air pressure alarm.
- And many other options, depending on whether drilling on land or offshore, extent or readout information desired, etc.

Pressure Control

Shaffer Control Systems

Shaffer Conventional BOP Control Systems for Land, Platform and Jackup Rigs

The general procedure for selecting a BOP control system is outlined in [Selecting The Proper BOP Control System](#). This tells you the basic accumulator/pump unit size and capacity. The next step is to select specific components for a system to meet your requirements.

Basic Accumulator/Pump Unit

Model designations (which identify nominal accumulator capacity) are explained elsewhere in this section. Choose either electric or air for basic pump power. Then, select air operated or electric operated auxiliary pump capacity equal to basic capacity.

Driller's Control Panel

Select this according to recommendations on [You Can Determine any Driller's](#)

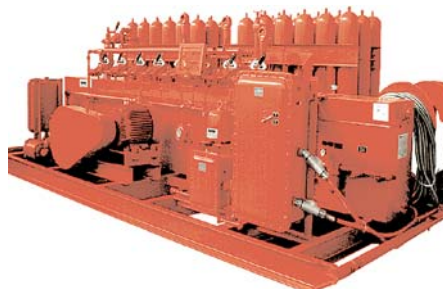
Control Panel with This Model Designation System.

Auxiliary Panel

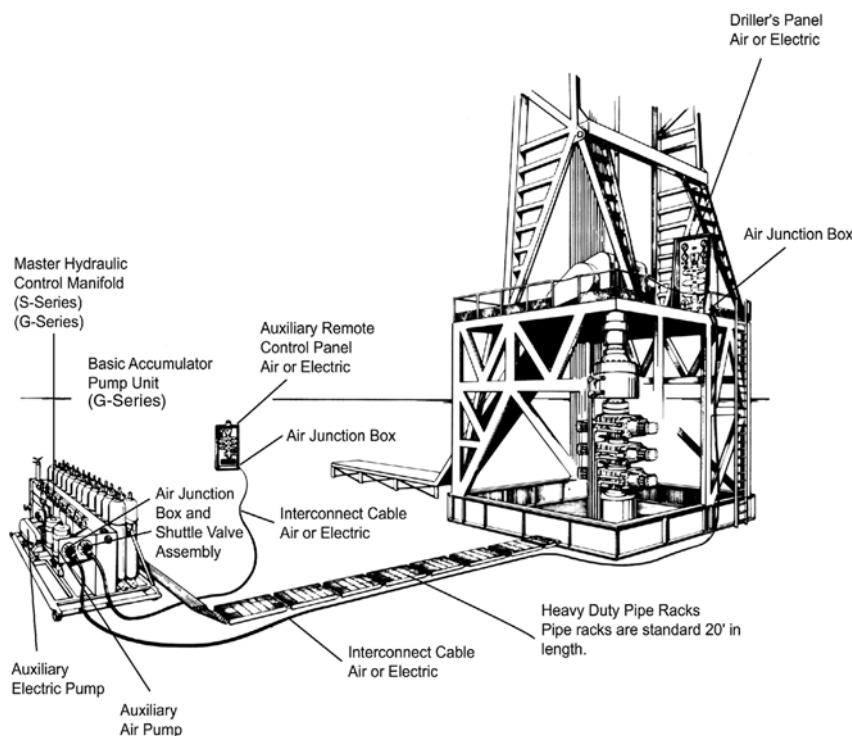
Auxiliary panels, including model number designations are explained in [Auxiliary Control Panel Designations](#).

High Pressure Machined Manifolds

A 4" machined manifold is provided for the accumulator bottles, and a 2" machined manifold is furnished for the header of the 4-way valves that control the ram preventers and gate valves.



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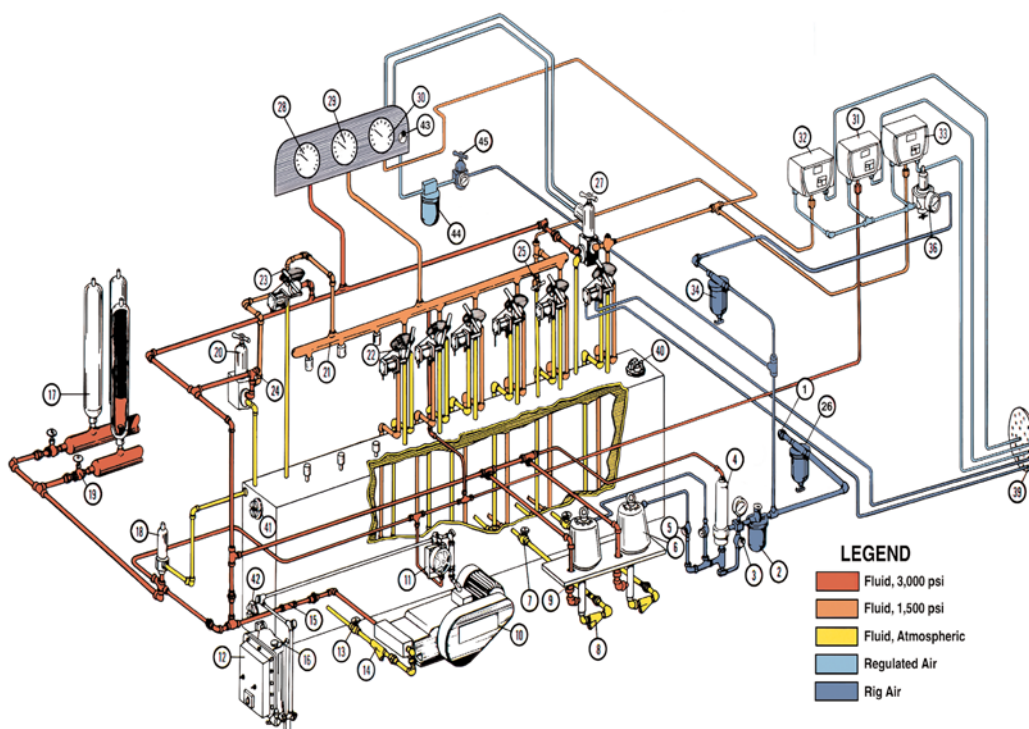


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Shaffer Control Systems

Shaffer Schematic — Typical Conventional BOP Control System

1. Customer Air Supply: Normal air supply is at 125 psi. Higher air pressure may require an air regulator.
2. Air Lubricator: Located on the air inlet line to the air operated pumps. Use SAE 10 lubricating oil.
3. Air Bypass Valve: To automatic hydro-pneumatic pressure switch. When pressures higher than the normal 3,000 psi are required, open this valve. Keep closed at all other times.
4. Automatic Hydro-Pneumatic Pressure Switch: Pressure switch is set at 2,900 psi cut-out when air and electric pumps are used. Otherwise, set at 3,000 psi for air pumps alone. Adjustable spring tension control.
5. Air Shut-off Valves: Manually operated — normally open, close to service the air operated hydraulic pumps.
6. Suction Strainer: One for each air operated hydraulic pump or suction line. Must be open except when servicing pump or suction strainer.
7. Suction Strainer: One for each air operated hydraulic pump suction line. Has removable screens. Clean every 30 days.
8. Check Valve: One for each air operated hydraulic pump delivery line.
9. Electric Motor Driven Triplex Pump Assembly.
10. Automatic Hydro-Electric Pressure Switch: Pressure switch is set at 3,000 psi cut-out and 2,750 psi cut-in. Adjustable.
11. Electric Motor Starter (Automatic): Automatically starts or stops the electric motor driving the triplex pump. Works in conjunction with the automatic hydro-electric pressure switch and has a manual overriding on-off switch.



Shaffer Control Systems

13. Suction Shut-Off Valve: Manually operated, normally open. Located in the suction line of the electric pump.
14. Suction Strainer: Located in the suction line of the electric pump. Clean every 30 days.
15. Check Valve: Located in the delivery line of the triplex pump.
16. Electric Power: Customer's connections.
17. Accumulators: Check nitrogen precharge in accumulator system every 30 days. Nitrogen precharge should be 1,000 psi +/- 10%.
CAUTION: Use NITROGEN when adding to precharge. Other gases and air may cause fire and/or explosion.
18. Accumulator Relief Valve: Valve set to relieve at 3,300 psi.
19. Fluid Strainer: Located on the inlet side of the pressure reducing and regulating valves. Clean strainer every 30 days.
20. Pressure Reducing and Regulating Valve — Manually Operated: Adjust to the required continuous operating pressure of ram type BOPs.
21. Main Valve Header: 5,000 psi W.P., 2" machined.
22. 4-Way Valves: With air cylinder operators for remote operation from the controls panels. Keep in standard operating mode (open or close), NEVER IN CENTER POSITION.
23. Bypass Valve: With air cylinder operator for remote operation from the controls panels. In "Low — 1,500" position, it puts regulated pressure on main valve header (21), and in "High — 3,000" position, it puts full accumulator pressure on the main valve header. Keep in "Low — 1,500" position unless 3,000 psi (or more) is required on ram type BOPs.
24. Accumulator Bank Isolator Valves: Manually operated, normally open.
25. Hydraulic Bleeder Valve: Manually operated — normally closed.

NOTE: This valve should be kept OPEN when precharging the accumulator bottles.

26. Panel-Unit Selector: Manual 3-way valve. Used to apply pilot air pressure to the air operated pressure reducing and regulating valve, either from the air regulator on the unit or from the air regulator on the remote control panel.
 27. Pressure Reducing and Regulating Valve — Air Operated: Reduces the accumulator pressure to the required annular BOP operating pressure. Pressure can be varied for stripping operations. Maximum recommended operating pressure of the annular preventer should not be exceeded.
 28. Accumulator Pressure Gauge.
 29. Manifold Pressure Gauge.
 30. Annular Preventer Pressure Gauge.
 31. Pneumatic Pressure Transmitter for Accumulator Pressure.
 32. Pneumatic Pressure Transmitter for Manifold Pressure.
 33. Pneumatic Pressure Transmitter for Annular Pressure.
 34. Air Filter: Located on the supply line to the air regulators.
 35. Air Regulator for Pressure Reducing and Regulating Valve — Air Operated.
 36. Air Regulator for Pneumatic Transmitter (33) for Annular Pressure.
 37. Air Regulator for Pneumatic Pressure Transmitter (31) for Accumulator Pressure.
 38. Air Regulator for Pneumatic Pressure Transmitter (32) for Manifold Pressure.
- NOTE: Air regulator controls for pneumatic transmitters normally set at 15 psi. Increase or decrease air pressure to calibrate panel gauge to hydraulic pressure gauge on unit.
39. Air Junction Box: To connect the air lines on the unit to the air lines coming from the remote control panels through air cable.
 40. Hydraulic Fluid Fill Port.
 41. Inspection Plug Port.
 42. Reservoir Drain Plug.

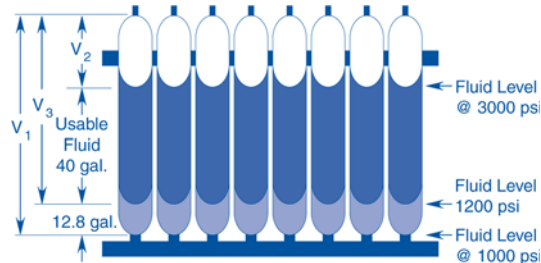
Shaffer Control Systems

The Shaffer BOP Control system takes the following factors into consideration in recommending the 3,000 psi accumulator units:

1. Fluid in the “close” lines tends to flow back into the reservoir tanks on accumulator units. This is because the accumulators normally are located at a lower position than the preventer stacks at a point 100 to 150 feet distant from the well bore, and the four-way valves on the accumulator units are placed in the open position until an emergency calls for the close position. However, with the high pressure and reserve capacity of the Shaffer 3,000 psi accumulator unit, minimum time is lost while the close lines become completely refilled after the valve is turned from open to close.
2. Most four-way valves lose some of their fluid capacity due to “interflow” when the valves move from “open” to “close”. The 50% reserve in Shaffer’s system more than compensates for this.
3. Frequently, there is fluid loss through the packing of the preventer units. Again, the reserve of Shaffer’s system takes this into consideration. The 50 percent reserve of Shaffer’s 3,000 psi accumulator system provides faster, more dependable closing of the preventers under blowout conditions than lower pressure accumulator systems. The latter may function satisfactorily under atmospheric pressure but dangerously slow in the emergency of blowout conditions.



Typical separator type accumulator



Separator Type Accumulators

Separator type accumulators in Shaffer’s G Series BOP Control systems are one of several features developed by Shaffer engineers to provide maximum certainty in BOP control. Other features include auxiliary pump systems to give redundancy in critical emergencies, dual manifold design to provide the proper pressure to ram type and annular type BOPs at all times, pressure reducing and regulator valves, quick-opening bypass valves, high pressure strainers, heavy duty chain drive on pumps, baffled hydraulic control fluid reservoirs, and extra heavy piping and unions.

The 11 gallon separator-type accumulators meet 7,500 psi test requirements to give a generous safety margin for 3,000 psi control systems. The accumulators’ metal shells are manufactured from a single piece of chrome-molybdenum steel and are designed with a 4 to 1 safety margin above the maximum working pressure.

Field repair is accomplished easily and does not affect compliance with the ASME, USCG, or DNV codes. When the accumulator is to be removed for a bladder change, an important safety feature holds the fluid port assembly in place mechanically — so that the accumulator cannot be disassembled until all remaining nitrogen gas inside the bladder is released.

Note: Piston type accumulators are available upon request.

Pressure Control

Shaffer Control Systems

Calculating Accumulator Size for Typical BOP Stack

Blowout Preventer Equipment	Gallons To Close
Typical Annular BOPs (13 5/8" 5,000 psi W.P.) after normal wear	23.6
Three typical Ram BOPs (13 5/8" 10,000 psi W.P.) (3 x 11.6 gallons)	34.8
Total Gallons for Full Closure of All Preventers	58.4
Plus 50% Safety Factor	29.2 ¹
Total Gallons Including Safety Factor	87.6

NOTES:

1. Safety factor of 50% is recommended to provide for complete replenishment of fluid in "close" lines at time preventers are activated. This safety factor also allows for loss of fluid capacity due to "interflow" in the four-way valves and possible loss through the packing of the preventer units.

Calculation Of Accumulator Size For 3,000 PSI System

Usable Fluid Calculation; $P_1V_1 = P_2V_2 = P_3V_3$

Where P = Pressure (psi) in absolute units
(gauge reading plus 15 psi)
 V = Volume of Nitrogen

Subscripts $_1$ = Pre-charge Condition (1,000 psi)
 $_2$ = Fully Charged Condition (3,000 psi)
 $_3$ = Discharged or Used (1,200 psi)

Volume of fluid stored in each 11-gallon accumulator bottle:
(10 gallons nominal capacity)

$$V_2 = \frac{P_1V_1}{P_2}$$

$$V_2 = \frac{(1015)(10)}{(3015)}$$

$$V_2 = \frac{3.4 \text{ Gallons of Nitrogen}}{10 - 3.4 = 6.6 \text{ Gallons of Control Fluid Stored in Each Accumulator}}$$

Usable Fluid To 1,200 psi:

$$V_3 = \frac{(1015)(10)}{(1215)}$$

$$V_3 = \frac{8.4 \text{ Gallons of Nitrogen}}{10 - 8.4 = 1.6 \text{ Gallons of Control Fluid Remaining}}$$

Therefore, by subtracting the remaining control fluid from the stored fluid:

$$6.6 - 1.6 = 5.0 \text{ Gallons of Usable Fluid}$$

By noting that the 5 gallons of fluid is $\frac{1}{2}$ the total Volume, a simple method for calculations can be used.

Simple Method

The minimum allowable pressure is considered to be 1,200 psi. The recommended pre-charge for 3,000 psi accumulators is 1,000 psi. Thus, the nominal (fluid and nitrogen volume) accumulator size may be calculated simply from the following factors:

3000 PSI System:

Gallons to close + safety factor x 2.0. Using the same BOP stack as above, the results are as follows:

87.6 gallons x 2.0 = 175.2 gallons. Rounding off to the next higher increment of 10 gallons it is evident that 180 gallons (total fluid and nitrogen volume) are required.

Shaffer Control Systems

Selecting The Proper BOP Control System

1. Determine the size, working pressure, type and quantity of preventers and gate valves to be operated.
2. Refer to the Accumulator Size Recommendations for the accumulator size that will effectively operate the BOP stack.
3. Determine the pump capacity recommended for the system. To do this, obtain the total number of gallons required to close all preventers on an open hole, plus, open one hydraulically operated gate valve. Then, divide the total number of gallons by 3.0 minutes, and this will give the gallons per minute output required of the pump system.
4. The basic accumulator size and pump capacity are now known. Decide upon the basic type of control system preferred and select the components necessary for a system that meets all requirements.

Recommended Specifications: Control Systems For Surface-Installed BOPs

The following general specifications meet most drilling requirements, but they are to serve as guidelines only. It is the responsibility of the equipment user to meet specific requirements of each drilling job.

Accumulator/Pump Units — General

Response Time. The control system should be capable of closing each ram type preventer within 6 seconds for preventer sizes up to 13-5/8" 10,000 psi, and capable of closing annular-type preventers within 19 seconds for sizes up to 13-5/8" 5,000 psi. For preventers requiring larger volumes, 1 1/2" valving on the control manifold should be specified.

Volumetric Capacity. All BOP control systems should incorporate an accumulator unit with a volume adequate to close all preventers (with pumps inoperative), while retaining a pressure of 200 psi minimum above the precharge pressure but not less than 1,200 psi.

Accumulator Manifolding. Accumulator manifolds or headers should be constructed with a minimum number of restrictions such

as small fittings and shut-off valves. Large internal diameter, machined manifolds are preferable because of minimum restrictions to flow and few potential leak paths — which are characteristic of screwed or welded types. Shut-off valves between the accumulators and 4-way control valves should be avoided. Each accumulator bottle should not have its own shut-off valve. Bottles should be repaired only during times when the rig activities do not require the control system and blowout preventers to be in service. The entire accumulator system should be bled down to zero pressure prior to working on the the accumulator bottles.

Pumps and Power Systems

Pump Capacity

Pump capacity should be able to close all preventers on an open hole — plus opening one hydraulically operated gate valve — within 3.0 minutes or less, with the accumulator bottles removed from service, and attain a minimum pressure of 1,200 psi.

Pump Sizing

GPM output requirements are calculated and proper combination of pumps selected to meet current API standards.

Dual Air/Electric Pumps

A separate source of power should be available to operate the pump system, such as a combination of air operated and electrically operated pumps, with each pump source supplying approximately equal GPM output. If the primary pumps are electric, utilizing regular rig electric power, and if auxiliary pumps are operated, the rig air system for the auxiliary pumps should be independent of regular rig air and electric power. Conversely, if the basic pumps are air operated, utilizing regular rig air, and if the auxiliary pumps are electric, the electric pumps should have the proper size independent generator available continuously. For standard 3,000 psi systems, all pumps should activate automatically when system pressure drops to approximately 2,700 psi.

Other Power Combinations

A system with only multiple air operated pumps should have two separate air supplies so that at least half of the total GPM capacity continues to operate if the rig's primary power systems are off. Similarly, a system with only multiple electric pumps should have two separate sources of electric power to ensure continued operation of at least half of the GPM

Shaffer Control Systems

capacity if the rig's primary power systems are off. Nitrogen backup systems may be supplied as a secondary power source for closing BOPs. They are also inexpensive insurance as a third source of power for emergency use.

Control Valves

Clearly marked nameplates should tell which preventer or hydraulic valve each 4-way valve operates and give the valve position (OPEN and CLOSE only). During drilling operations, valves should be left in either the OPEN or CLOSE position — ***never in the center position.***

Gauges

Large-face, easy-to-read gauges on BOP control panels should indicate the accumulator system operating pressure (accumulator pressure), the pressure downstream of the ram preventer regulator (manifold pressure), and the pressure downstream of the annular preventer regulator (annular pressure).

Fittings

All manifolding should have a minimum number of flow restrictions, i.e., elbows, crosses, tee, manual gate valves. Manual gate valves, which do not clearly indicate open and closed position, easily could be left in a closed position when they should be left open.

Operating Fluid and Reservoir

A clean, lightweight, high quality hydraulic control fluid, which is capable of being mixed with potable water, should be used as the operating fluid. Do not use motor oil, kerosene, diesel fuel, chain oil or petroleum products containing aromatics which can damage rubber components and seals.

Reservoir capacity should equal approximately twice the usable fluid capacity of the accumulator system. Access ports of at least 4" I.D. at each end of the reservoir for visual inspection of the inside of the reservoir and to allow detection of any leaking components on the manifold. Internal baffles in the reservoir should restrict fluid movement when the unit is transported.

Driller's Controls — General

Driller's control panels on the rig floor near the driller should have a power source independent of the accumulator/pump unit. Complete destruction of the driller's

panel, interconnecting cable or hose must not interfere with accumulator/pump operation. Hydraulically operated panels which receive their hydraulic operating fluid from the main accumulator system are not acceptable unless designed so that the destruction of the panel or the interconnecting hoses will not cause the accumulator system to be drained. Air operated panels, electrically operated panels and self-contained hydraulic panels (having their own hydraulic pump, accumulator and reservoir) are acceptable.

A graphic display of the BOP stack on each control panel indicates clearly the position and operation of each BOP function and the position of each control valve. Gauges indicate accumulator pressure, manifold pressure and annular BOP pressure.

All driller's control panels — whether air, electric or hydraulic operated — have a sufficient number of valves to remotely operate all 4-way valves on the master hydraulic control manifold to either the OPEN or CLOSE position.

Air Operated Control Panels

In addition to the general specifications mentioned above, air operated remote control panels should have a valve allowing remote operation of the regulator bypass valve on the ram preventers' hydraulic manifold. A master air valve is required and must be activated before air flows to the other valves. Remote regulation of the annular pressure regulator should be incorporated into the panel. Air communication between the remote control panel and the hydraulic control manifold should be via multi-tube, bundled, flame-resistant hoses of minimum $\frac{3}{8}$ " O.D.

Electric Operated Control Panels

Electric operated remote control panels have indicating lights to show the status of the last command sent to each of the preventer functions. Control of the regulator bypass valve for the ram preventers (located on the hydraulic control manifold) are incorporated into the panel. A master panel pushbutton is recommended to activate all function switches. This requires a two-handed operation — guarding against accidental operation of BOPs by someone unintentionally bumping a pushbutton. Remote control of hydraulic pressure to the annular preventer should be included in the panel. All components must be explosion-proof — either by enclosure or by a nitrogen purge system.

Hydraulic Operated Control Panels

Besides meeting the applicable general specifications, hydraulic operated driller's panels require a master hydraulic valve which must be activated before hydraulic pressure flows to the function valves. Remote regulation of the annular pressure regulator should be incorporated into the panel.

Surface Control Electric Remote Control Interface

Advantages of PLC based, fiber-optic remote control communications vs. direct multi-conductor electric remote cable.

- Safer, noise-free operation
- Accidental damage to fiber-optic interconnecting cable does not cause any BOP control functions to operate.
- Only remote communications will be lost, providing a safer method of remote control.
- Outside electrical interference is eliminated for a "noise-free" communications signal.

Easier Cable Installation

- Fiber-optic cable is lighter and smaller in diameter than the standard 60 to 90 multi-conductor electric cable previously used, allowing a shorter installation phase.

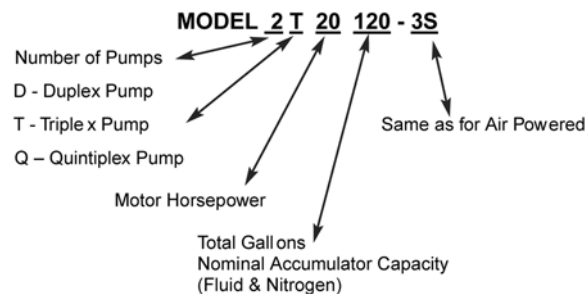
Pressure Control

Shaffer Control Systems

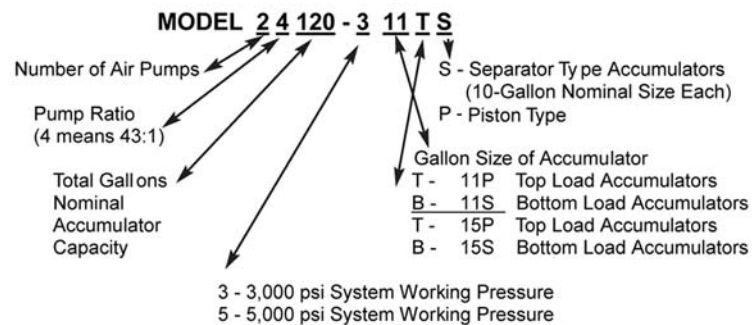
Model Designations — Accumulator/Pumping Units

You Can Determine Any Conventional System with this Model Designation System

Example — Electric Powered Accumulator/Pump Units



Example — Air-Powered Accumulator/Pump Units



Shaffer Control Systems

Electric Powered Pump Assemblies for 3,000 PSI Systems

Unit Mounted. These pump assemblies can be mounted on the basic air operated accumulator unit to provide a dual source of power and to reduce pump-up time.

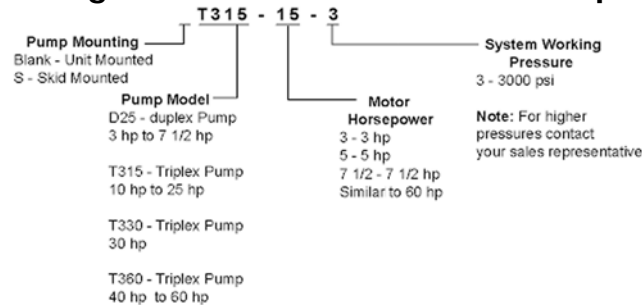
Separate Skid Mount Available. For accumulator units already out in the field, this pump assembly can be skidded, sent to location and readily connected to any accumulator system to provide more fluid power.

Heavy Duty Chain and Sprocked Drive. This drive system has a life expectancy of more than 20 years. There are no belts to tighten or slip when the pump is needed.

Reciprocating Plunger Pump. Unlike rotary piston vane type pumps, this heavy duty pump will stay in service when dust or small contaminants accidentally get into the accumulator system.

Explosion-Proof Design. The electric motor, starter and pressure switch are completely explosion-proof.

Model Number Designation for Electric-Driven Pump Assemblies



Model Number Designation for Electric Driven Pump Assemblies

Model Number	Overall GPM At 3,000 PSI (211 kg/cm ²)		Approximate Overall Dimensions and Weight							
			Width		Depth		Height		Dry Weight	
	Gallons	Liters	Inches	mm	Inches	mm	Inches	mm	Lbs.	kg
Unit-Mounted Pump Assemblies										
D25-3-3	1.14	4.32	39	991	20	508	32	813	612	278
D25-5-3	2.19	8.29	39	991	20	508	32	813	612	278
D25-7 1/2-3	2.50	9.46	39	991	24	610	34	864	657	298
T315-10-3	4.55	17.22	57	1448	27	686	34	864	882	400
T315-15-3	6.40	24.23	57	1448	27	686	35	889	952	432
T315-20-3	8.70	32.93	57	1448	27	686	36	914	1002	455
T315-25-3	11.40	43.15	57	1448	29	727	39	991	1130	513
T330-30-3	14.20	53.75	68	1727	44	1118	44	1118	1395	633
T360-40-3	20.20	76.47	68	1727	44	1118	45	1142	1810	821
T360-50-3	25.20	95.39	68	1727	44	1118	45	1142	1895	860
T360-60-3	30.00	113.56	70	1778	45	1143	47	1194	2230	1012
Skid-Mounted Pump Assemblies										
SD25-3-3	1.14	4.32	39	991	20	508	40	1016	650	295
SD25-5-3	2.19	8.29	39	991	20	508	40	1016	650	295
SD25-7 1/2-3	2.50	9.46	39	991	24	610	40	1016	700	318
ST315-10-3	4.55	17.22	57	1448	27	686	48	1219	930	422
ST315-15-3	6.40	24.23	57	1448	27	686	48	1219	1000	454
ST315-20-3	8.70	32.93	57	1448	27	686	48	1219	1150	522
ST315-25-3	11.40	43.15	57	1448	27	686	48	1219	1180	535
ST330-30-3	14.20	53.75	68	1727	46	1168	50	1270	1450	658
ST360-40-3	20.20	76.47	68	1727	46	1168	50	1270	1865	846
ST360-50-3	25.20	95.39	68	1727	46	1168	50	1270	1950	885
ST360-60-3	30.00	113.56	70	1778	48	1219	54	1372	2290	1039

DGE25 Duplex Pump Gasoline Engine Driven - Contact Shaffer.
SDGE25 Duplex Pump Gasoline Engine Driven - Contact Shaffer.



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Shaffer Control Systems



The Shaffer G series control manifolds are designed for the fastest possible response in a BOP control system. They are the ultimate in dependability and are virtually maintenance-free because of their rugged, heavy duty components and construction. Some of their features are:

Dual Manifold

Because different pressures are applied to annular preventers, controls for the annular must have independent pressure regulation. The dual manifold provides one manifold for the annular preventer and a separate manifold for control of the other preventers. Each regulator operates independently.

These manifolds are built to meet ASME, DNV, NPD and Lloyds specifications.

High Pressure Strainers

Strainers are provided upstream of the regulators and 4-way control valves to remove possible contaminants which could damage shear seals in the valves. Possibility of repair downtime is minimized.

Quick-Opening Bypass

On manifolds with two regulators, the regulator controlling pressure to the rams and gate valves is provided with a quick-opening, 1" 4-way bypass valve. This valve normally remains in the "Low-1,500" position, which directs the 3,000 psi system pressure through the regulator to reduce it to 1,500 psi or to the required setting. In an emergency, the bypass valve is placed in the required setting. In an emergency, the bypass valve is placed in the "High-3,000" position, allowing the full 3,000 psi to flow to the preventers.

This provides quicker closure of the preventer and eliminates damage or wear from high pressure sand and gas against rams or other seal elements.

Machined Manifold

A machined manifold is provided for the 4-way valves operating rams and gate valves to minimize the restriction and leakage.

Large Face Gauges

Large 6-inch G series gauges ensure easy readability. The three gauges for accumulator, manifold and annular pressure are all mounted on a heavy welded panel and connect by stainless steel tubing to pressure pick-up points.

Steel Covered Diaphragms

When air regulators are specified, they are heavy duty, with rubber diaphragms enclosed in steel housings to eliminate exposure to the elements or accidental puncture.

High-Flow Regulators

Large 1 1/2" high flow regulators are available and are recommended for preventers requiring large fluid volumes. High flow 4-way valves are also provided with the 1 1/2" regulators to ensure rapid flow and fast dumping of excess pressure when stripping. The 1 1/2" regulating system should be specified for use with large annular or diverter type preventers requiring large fluid volumes.

Shaffer encases its air regulators in heavy duty steel. There are no exposed rubber components that can be damaged, punctured or that can deteriorate from exposure to extreme climates and temperatures.

Shaffer Control Systems

Control Manifolds for Minute Man System

Although the accumulator/pump unit for Shaffer's Minute Man BOP control system is similar to that for a conventional system, there are three important differences. First, the unit connects to the BOP stack by a single multi-tube hose bundle instead of a multiplicity of hard piping lines. Second, the hose bundle connection at the stack is to a pilot-operated valve manifold. Third, the master hydraulic control manifold on the accumulator/pump unit controls the manifold near the stack rather than operates the stack directly.

To operate the BOPs, the air or electric operated driller's panel signals the master hydraulic control manifold on the accumulator/pump unit. These signals then transmit through the hydraulic pilot lines in the hose bundle connecting to the valve manifold near the stack. The valves at this manifold operate the BOPs. Working fluid for this operation is through a one-inch diameter hose centered in the hose bundle.

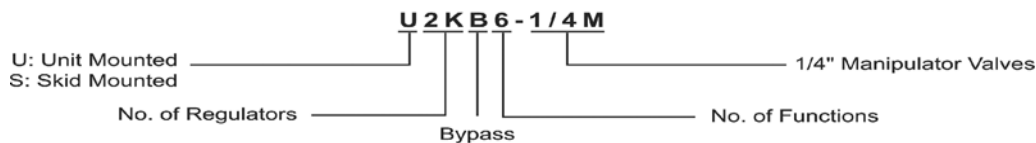
The original Minute Man System was an open end system developed for multi-well platform rigs in the North Sea in 1973. Open-end

systems vent the operating fluid (biodegradable, non-polluting) at the stack mounted manifold when a BOP function is completed. Only a single one-inch operating fluid line is centered in the hose bundle.

Most Minute Man Systems for land rigs require a closed system design with two one-inch operating fluid lines centered in the hose bundle. They use the same fluid as the open-end system or any good grade of control fluid, and the spent operating fluid returns to the reservoir at the accumulator/pump unit through the second one-inch line in the bundle. Thus, surface BOP control systems can have the two primary benefits of the Minute Man BOP control system — the simplicity of the single hose bundle connection to the stack area and the fast response of the high pressure operating fluid released from the manifold right at the stack.

The master hydraulic control manifold for all Minute Man Systems is equipped with all of the necessary $\frac{1}{4}$ " 3,000 psi working pressure, 4-way control valves for operation of the BOP stack. The manifold can be equipped for remote operation by either air or electric driller's and auxiliary panels. Complete control of the BOP stack is available from this

manifold if the driller's panel becomes inoperable or is destroyed.



Control Manifold Designations

Control Manifold Designations

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Model Number	Approximate Overall Dimensions and Weight							
	Width		Depth		Height		Weight	
	Inches	mm	Inches	mm	Inches	mm	Lbs.	kg
U2KB4-1/4M	66	1677	33	839	27	686	532	242
U2KB5-1/4M	72	1829	33	839	27	686	568	258
U2KB6-1/4M	78	1982	33	839	27	686	604	274
U2KB7-1/4M	84	2134	33	839	27	686	640	291

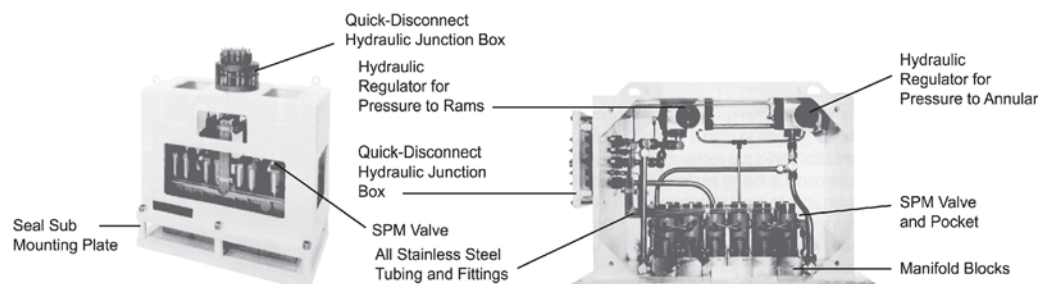
NOTE: Skid-mounted manifolds (Model numbers begin with "S") are the same width and depth but are 57" in height and 200 lbs. heavier.



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Pressure Control

Shaffer Control Systems



The stack manifold for the Minute Man System was developed to close the preventer faster and to connect more quickly with the BOP control system. The manifold features a high flow, quick-acting hydraulic dual pilot SPM control valve that reduces closing times. This valve has a C_v of 8.6 and has been laboratory tested to simulate over 42,000 preventer operations. Thousands of these valves have proved their field-dependability in subsea BOP systems worldwide. Fluid for the control valves is regulated by two $\frac{3}{4}$ " full-flow, hydraulically piloted regulators. Because these regulators are located in the stack manifold near the preventers, more sensitive pressure settings are possible for normal or stripping operations.

The manifold's modular design affords fast, simple field modification. To provide long service life and corrosion protection, the manifold structure is sandblasted and

phosphated prior to painting. All tubing and fittings in the manifold are stainless steel. The addition of a vent check valve on each SPM valve prevents false actuation of the control valves in the event of pilot pressure loss. A quick-disconnect junction box on the stack manifold ensures fast hookup with the BOP control system and eliminates the need for pipe connections.

For two-stack systems on jackup rigs or multi-well platform rigs, the manifold can be provided with seal sub discharge connections. These allow the manifold to be moved quickly from one stack to another. The optimum system utilizes two complete stack manifolds — one manifold for each stack. The manifolds can be mounted permanently on each stack. Then, when changing from one stack to another, only the quick-disconnect junction box — with the control hose bundle attached — need be switched from one stack manifold to another.

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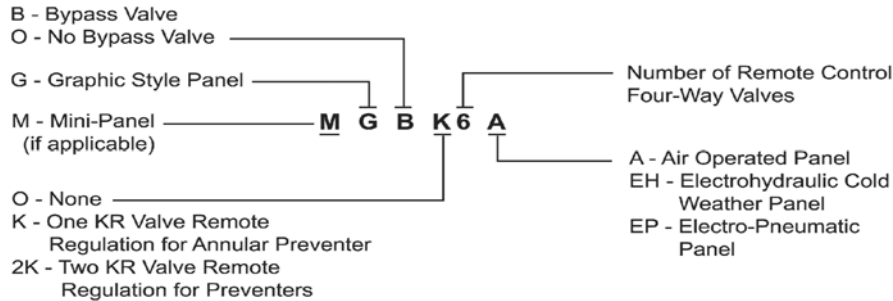
Model Number	Approximate Overall Dimensions and Weight								
	Number of Stack Functions	Width		Depth		Height		Weight	
		Inches	mm	Inches	mm	Inches	mm	Lbs.	kg
MMCP-2K-8	4	58.5	1486	38.5	978	38.5	978	1500	680
MMCP-2K-10	5	58.5	1486	38.5	978	38.5	978	1600	726
MMCP-2K-12	6	58.5	1486	38.5	978	38.5	978	1700	771
MMCP-2K-14	7	58.5	1486	38.5	978	38.5	978	1800	816
MMOP-2K-8	4	58.5	1486	38.5	978	38.5	978	1500	680
MMOP-2K-10	5	58.5	1486	38.5	978	38.5	978	1600	726
MMOP-2K-12	6	58.5	1486	38.5	978	38.5	978	1700	771
MMOP-2K-14	7	58.5	1486	38.5	978	38.5	978	1800	816
MMCS-2K-8	4	58.5	1486	38.5	978	46.5	1181	2000	907
MMCS-2K-10	5	58.5	1486	38.5	978	46.5	1181	2100	952
MMCS-2K-12	6	58.5	1486	38.5	978	46.5	1181	2200	998
MMCS-2K-14	7	58.5	1486	38.5	978	46.5	1181	2300	1043
MMOS-2K-8	4	58.5	1486	38.5	978	46.5	1181	2000	907
MMOS-2K-10	5	58.5	1486	38.5	978	46.5	1181	2100	952
MMOS-2K-12	6	58.5	1486	38.5	978	46.5	1181	2200	998
MMOS-2K-14	7	58.5	1486	38.5	978	46.5	1181	2300	1043



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Shaffer Control Systems

You Can Determine any Driller's Control Panel with This Model Designation System



Enter choices in the boxes. This gives the correct designation of the recommended panel.

- Determine the type of panel preferred. Either large free standing or the smaller panel for wall or custom mounting.
 - Blank — Free standing panel.
 - M — Mini panel for wall mounting or custom mounting.
- G — Graphic display of the BOP stack showing preventers in their respective locations. All panels in this line have graphic displays.
- Determine if remote control of the bypass valve is required. The bypass valve is on the master hydraulic control manifold and, when open, allows full 3,000 psi to be applied to the ram preventers.
 - O — No remote control valve in the driller's panel for bypass control.
 - B — Remote control of the bypass included in the driller's panel.
- Determine the number of regulators on the master hydraulic control manifold that must be controlled from the driller's panel.
 - O — No remote control of regulators on master hydraulic control manifold.
 - K — Remote regulation of pressure going to annular preventer.
 - 2K — Remote regulation of pressure going to annular preventer and also to rams and gate valves.
- Determine the number of 4-way valves on the master hydraulic

manifold. This should equal the number of functions on the BOP stack.

Examples:

1 annular, 2 rams, 1 kill valve = 4

1 annular, 3 rams, 1 choke valve, 1 kill valve = 6

- Determine the type of power supply.
 - A — Air operated panel with air cylinders for 4-way valves on the master hydraulic control manifold.
 - EH — Electric operated panel with solenoids and hydraulic cylinders for 4-way valves on the master hydraulic manifold. EH (electro-hydraulic) panels are recommended for extremely cold weather applications.
 - EP — Electric operated panel with solenoids and air cylinders for 4-way valves on the master hydraulic manifold. The EP panels are referred to as electro-pneumatic.

Place number in the following to determine the model number for panel.

1 2 3 4 5 6
 + + + + + = Driller's panel recommended

Pressure Control

Shaffer Control Systems

The model GBK-A driller's control panel is typical of the kind of panel selected most often by Shaffer customers. These panels incorporate the graphic outline design of the BOP stack. This provides drillers with easily understandable controls that can be operated with speed and certainty during emergency conditions. The graphics help avoid errors in controlling kicks and preventing blowouts.

These control panels are connected to the accumulator/ pump unit in such a manner that if they are destroyed, control of all preventers can be done at the master hydraulic control manifold located on the accumulator/ pump unit.

Driller's Air Operated Control Panels

Model Number	Approximate Dimensions (Less Lift Eyes)								Junction Box Required	Air Cable Required
	Width		Depth		Height		Weight			
	Inches	mm	Inches	mm	Inches	mm	Lbs.	kg		
Free-Standing Control Panels										
GOK3A	34.5	876	20.5	521	76.0	1930	471	214	JB-12	No.12
GBK3A	34.5	876	20.5	521	76.0	1930	487	221	JB-12	No.12
GBK4A	34.5	876	20.5	521	76.0	1930	495	225	JB-16	No.14
GBK5A	34.5	876	20.5	521	76.0	1930	503	228	JB-16	No.16
GBK6A	34.5	876	20.5	521	76.0	1930	511	232	RB-24	No.19
GBK7A	44.5	1130	20.5	521	76.0	1930	737	334	RB-24	No.24
GBK8A	48.5	1232	20.5	521	76.0	1930	745	338	RB-24	No. 24
GBK9A	48.5	1232	20.5	521	76.0	1930	753	342	RB-24	No.24
GBK10A	48.5	1232	20.5	521	76.0	1930	761	345	RB-31	No.31
Wall-Mounted Control Panels										
MGOK3A	26.0	660	20.5	521	42.0	1067	145	66	JB-12	No.12
MGBK3A	26.0	660	20.5	521	42.0	1067	145	66	JB-12	No.12
MGBK4A	26.0	660	20.5	521	42.0	1067	148	67	JB-16	No.14
MGBK5A	26.0	660	20.5	521	42.0	1067	148	67	JB-16	No.16

Note: The control panels listed above also can be used as auxiliary control panels, with complete or partial duplication of the master panels. Electric pilot lights also are available. Air cylinders, tubing and air transmitters necessary for connection to the master hydraulic manifold are included with the driller's panel. Interconnecting control hoses and junction boxes are separate items. Refer to table above for correct hose and junction box required for the system.

Shaffer Control Systems

BOP and Diverter Electro-Pneumatic Control Replacement Upgrade



Driller's Electric Operated Control Panels

The Shaffer electric operated panels for the driller's control of BOPs also incorporate the graphic outline design. This enables drillers to understand quickly the BOP equipment available to them to deal with emergency conditions. The graphics help avoid errors in controlling kicks and preventing blowouts.

Pushbutton light assemblies for each of the BOP stack components indicate the present position of each BOP function. The status lights burn continuously. Operating the pushbuttons signals the electrohydraulic or electropneumatic solenoids at the master hydraulic control manifold on the accumulator/pump unit. This gives almost instantaneous operation of the hydraulic or pneumatic cylinders located on the 4-way valves.

Shaffer has been manufacturing the world proven Koomey® BOP Control Systems for over 70 years. As part of our continued commitment to improving this equipment in the field and supporting our existing customers, we have been designing and manufacturing CENELEC Certified Control System Upgrades for use in Hazardous Areas.

Special Features:

- Individually designed to fit existing control system arrangements.
- PLC Control of all memory and alarm functions.
- Fully "CENELEC" certified components for use in Hazardous Areas.
- Stainless steel enclosures to IP65 for environmental protection.
- Reverse engraved mimic display of BOP stack arrangement.



Pressure Control

Shaffer Control Systems

Selecting Your Auxiliary Remote Control Panels

Most customers select the GARC panel for driller's control and the MARC mini-panel for remote control.

In order to designate the control panel you require, use the following information.

1. Determine the type of panel preferred. Either large self-standing or the smaller panel for wall or unique mounting.
 - GARC — Graphic Air Remote Control. This is free-standing with graphic display of the BOP stack.
 - MARC — Mini Air Remote Control. This is wall or custom mounted but without graphic display of the BOP stack.
 - ARC — Air Remote Control. Free-standing but without graphic display of the BOP stack.
 - MGARC - Mini-Air Remote Control. Wall or custom mounted with graphic display of the BOP stack.
 - GERC — Graphic electric remote control. Wall or custom mounted with graphic display of the BOP stack. A stand for this panel is optional.
2. Determine the number of 4-way valves on the master hydraulic manifold that would be operated from the remote panel. This should equal the numbers of functions on the BOP stack.

Examples:

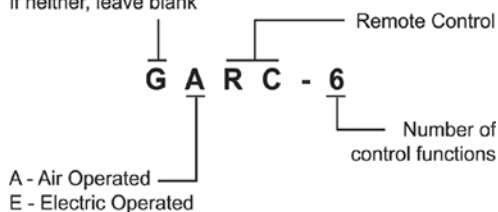
1 annular, 2 rams, 1 kill valve = 4

1 annular, 3 rams, 1 choke valve, 1 kill valve
= 6



Auxiliary Control Panel Designations

M - Mini-Panel
G - Graphic panel
if neither, leave blank



Shaffer Control Systems

Electric Operated Auxiliary Remote Control Panels

These electric operated panels are compact for wall mounting. They are equipped with a graphic display of the BOP stack, a NEMA-12 watertight enclosure, and indicating lights that show the status of the preventers (i.e., open or close). The customer should specify the length of the interconnect cable required to connect the panel to the master hydraulic control manifold located on the accumulator/pump unit.



Electric Operated Auxiliary Remote Control Panels

Model Number	Overall Approximate Dimensions							
	Width		Depth		Height		Weight	
	Inches	mm	Inches	mm	Inches	mm	Lbs.	Kg
GERC-1	24.0	610	10.5	268	24.0	610	52	24
GERC-2	24.0	610	10.5	268	24.0	610	52	24
GERC-3	24.0	610	10.5	268	24.0	610	53	24
GERC-4	24.0	610	10.5	268	24.0	610	53	24
GERC-5	24.0	610	10.5	268	24.0	610	54	25
GERC-6	24.0	610	10.5	268	24.0	610	54	25
GERC-7	24.0	610	10.5	268	24.0	610	55	25
GERC-8	24.0	610	10.5	268	24.0	610	55	25
GERC-9	24.0	610	10.5	268	24.0	610	56	25

Shaffer Control Systems

Miscellaneous Controls

Free Standing Hydraulic Diverter Controls

Shaffer provides a variety of hydraulic diverter controls. Each can be mounted integrally with the BOP hydraulic control manifold or can be mounted separately on its own skid. You have a choice of $\frac{3}{4}$ " or $1\frac{1}{2}$ " regulators and 1" or $1\frac{1}{2}$ " 4-way control valves for diverter controls. The choice of size depends upon fluid requirements.

Hydraulic diverter controls also can include a heavy duty gauge and an air cylinder for remote control operations. If remote pressure regulation is desired, diverter controls are furnished with an air pilot regulator. This regulator features a unit/remote selector valve and a pneumatic transmitter.

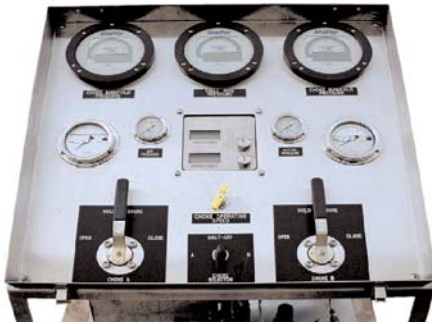
Hydraulic diverter controls also can be supplied in a free-standing panel design. This panel, with graphic representation of the diverter installation, includes pressure regulators, gauges, and a control valve necessary for diverter operation. A bladder type accumulator is furnished as a surge dampener. Air cylinders can be included for remote operation. Hydraulic supply and return connections — as well as connections for remote panel operation — are positioned conveniently.

Shaffer 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.



Choke and Kill Manifolds

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

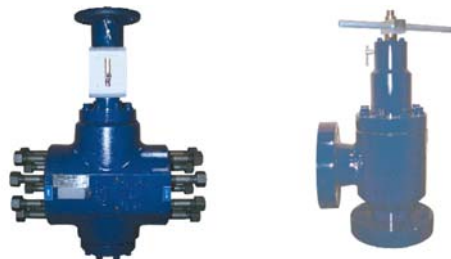
Shaffer's wide array of fixed, hand-adjustable and remotely-adjustable chokes can be furnished in a 5,000, 10,000 and 15,000 psi manifold — with or without a buffer chamber.



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 Cage (MPC) 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 VBS-100 stepping actuator has been proven through extensive laboratory and field testing.



Shaffer 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.



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.



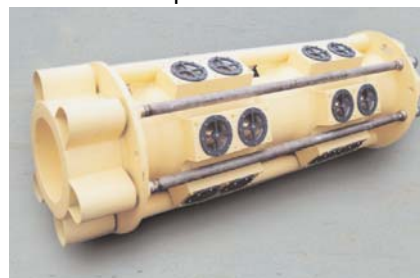
Ultra Deep Water Riser

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 H. Operation of the FTH riser connector is simple and easy with current available riser makeup tool. With uni-directional field-replaceable, improved J-lock retention slot seal sub, the FTH riser requires minimum maintenance.



Riser Fillup Valve

Shaffer's riser fillup valve utilizes a simple and reliable design to prevent the collapse of the riser due to the 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.



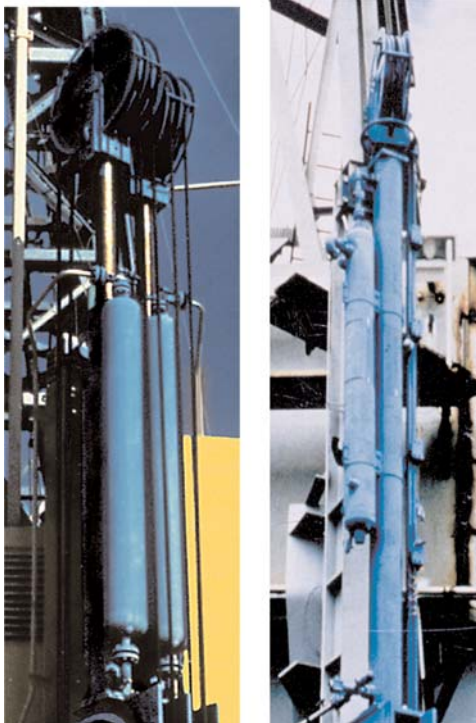
Shaffer Riser Tensioners

Riser Tensioners

Shaffer tensioners provide continuous, reliable axial tension to the marine riser pipe and guide lines on floating drilling rigs. The design principles and techniques of these tensioner systems have been proven in years of service on many of the world's floating drilling rigs.

Riser tensioner systems range in capacity from 320,000 to 3,000,000 lbs. with 50' wire line travel. They utilize up to 12 compression loaded tensioners, each rated at 80,000, 100,000, 120,000, 160,000, 200,000 and 250,000 lbs. Larger systems are available on request.

Guide line tensioners, also used on pod lines and TV lines, have a 16,000 lb. capacity with 40' wire line travel.



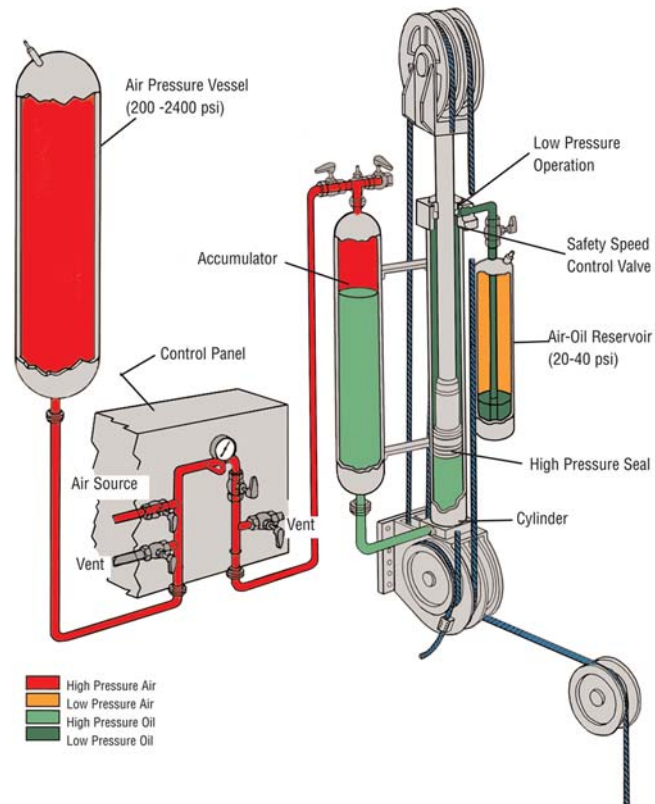
Special Features

- Full rated tensioners have been designed and developed to provide long-life operations at 100% of rating at the mid-stroke position.
- A fixed orifice is factory fitted and sized for safe, effective performance. It provides operational damping and extension speed control in case of free release of the tensioner by a broken wire rope. Installation on the rod side of the tensioner cylinder oil circuit assures instant reaction of the orifice.
- Air pressure vessels are rated at 2,400 psi operational pressure, enabling operation of tensioners at full rating, even at the mid-stroke position. Full ratings are achieved at approximately 2,100 psi.
- Proven cylinder design assures long life at maximum rating with simple field maintenance.
- High pressure rod seal design operates at low pressure, thus providing reliable, extended life.
- Air-oil reservoir, operating at low pressure of 20-40 psi, keeps the rod end of the tensioner cylinder filled with oil, providing speed control and lubrication to the dynamic packing and bearings.
- Compact modular control panel has stainless steel valves and piping, giving long life and easy add-on capacity.

Motion Compensation

Shaffer Riser Tensioners

Riser Tensioner



Riser Tensioners Currently Available

Wire Rope Tensioner Stroke/Weight Chart		
Wire Rope Tensioner	Stroke	Weight
14,000 lbs.	40 ft.	2,800 lbs.
16,000 lbs.	40 ft.	4,000 lbs.
60,000 lbs.	40 ft.	18,500 lbs.
80,000 lbs.	50 ft.	22,500 lbs.
80,000 lbs. Dual	50 ft.	44,000 lbs.
120,000 lbs.	50 ft.	29,800 lbs.
120,000 lbs. Dual	50 ft.	55,900 lbs.
160,000 lbs.	50 ft.	45,400 lbs.
200,000 lbs.	50 ft.	51,000 lbs.
250,000 lbs.	66 ft.	67,400 lbs.

Shaffer Riser Recoil Systems

Riser Recoil

Riser recoil control systems must address two potential problems associated with emergency disconnection of deep water drilling risers:

- Preventing a collision between the lower marine riser package (LMRP) and the stack,
- Controlling any impact between the riser and the vessel.

Since the solution to either of these problems has an adverse affect on the other, these conditions must be considered together. Therefore, to avoid a collision between the stack and the LMRP when the vessel heaves downward, the riser recoil control system must allow riser velocity to quickly move the LMRP away from the stack. At the same time, the system must also limit riser velocity and kinetic energy to control impact between the riser and the vessel. Finally, these conditions must occur within the stroke limits of the slip joint.

Shaffer's riser recoil control system consists of both standard and specially designed actuated valves. These valves are arranged to reduce maximum riser energy as well as tensioner terminal velocity by isolating a portion of the system energy and limiting pressure drop available to the cylinder through a restricted port.

By reducing the volume of power air pressure vessels (APVs) accessible to the tensioners, the energy available for transfer to the riser and, therefore, a maximum riser energy, is reduced. This reduction is accomplished by closing actuated valves on preselected APVs. Reducing the APV volume does not affect acceleration of the riser at the critical time immediately after disconnect because no pressure change is introduced. As the LMRP moves clear of the stack, cylinder pressure decreases, thus reducing acceleration of the riser.

Maximum tensioner velocity is controlled by Shaffer designed valves installed between the hydraulic fluid accumulator and the inlet port of each tensioner. When actuated, these valves place an appropriate size restriction in the tensioner cylinder inlet flow path. This restriction introduces a pressure drop proportional to the velocity of the fluid passing through the port. The reduction of pressure decreases the overpull. This limits maximum riser velocity to an acceptable level. The replaceable restriction also provides more flexibility to comply with each customer's specific requirements. In order to coordinate the operation of the riser recoil control system with riser disconnect, Shaffer's riser recoil control system is designed to be triggered by an external signal, usually from the vessel's emergency disconnect system (EDS). The system can be adjusted to operate immediately when triggered or after a preset delay. The riser recoil control system can also be triggered from alternate sources or from combinations of sources (e.g. EDS and a heave sensor) as required by the customer.

Selection of the correct riser recoil control system depends on the following criteria:

- Maximum anticipated heave state during a riser disconnect,
- Riser weight,
- Overpull,
- Operational procedures.

Contact your Shaffer sales representative for more information on riser recoil control system requirements.

Motion Compensation

Shaffer Drill String Compensators

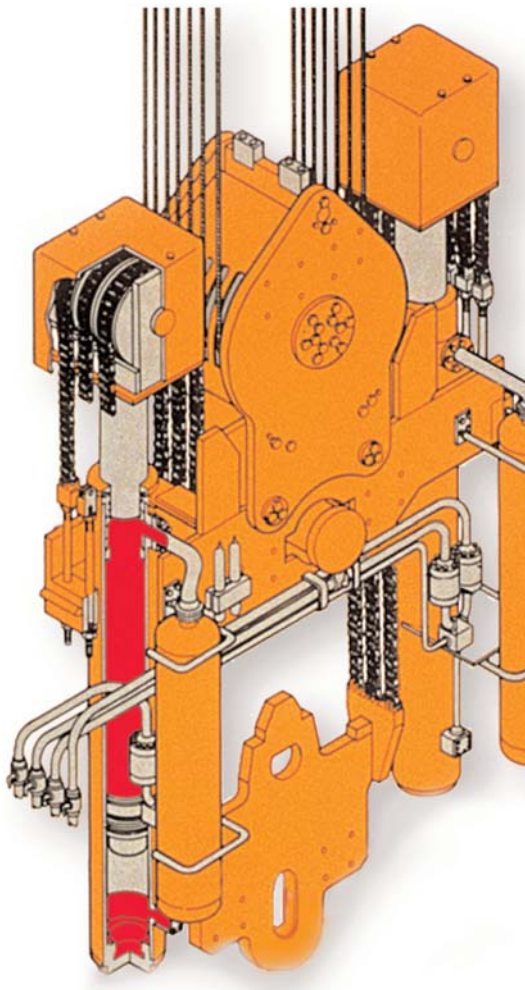
Drill String Compensators

The Shaffer Drill String Compensator (DSC) is the most popular system of its kind in use today. It is mounted between the traveling block and hook. This 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. Shaffer DSCs, like other Shaffer motion compensation equipment, use the hydro-pneumatic 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.

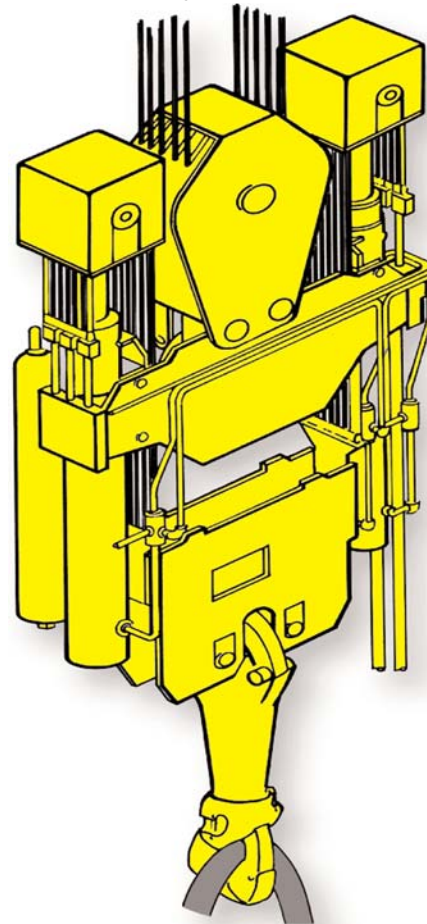
During drilling operations, the Shaffer DSC keeps the drill bit on the bottom of the hole within the weight limits set by the driller. For other operations, the system compensates for rig motion, maintaining a position relative to the ocean floor.

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.



150



600K

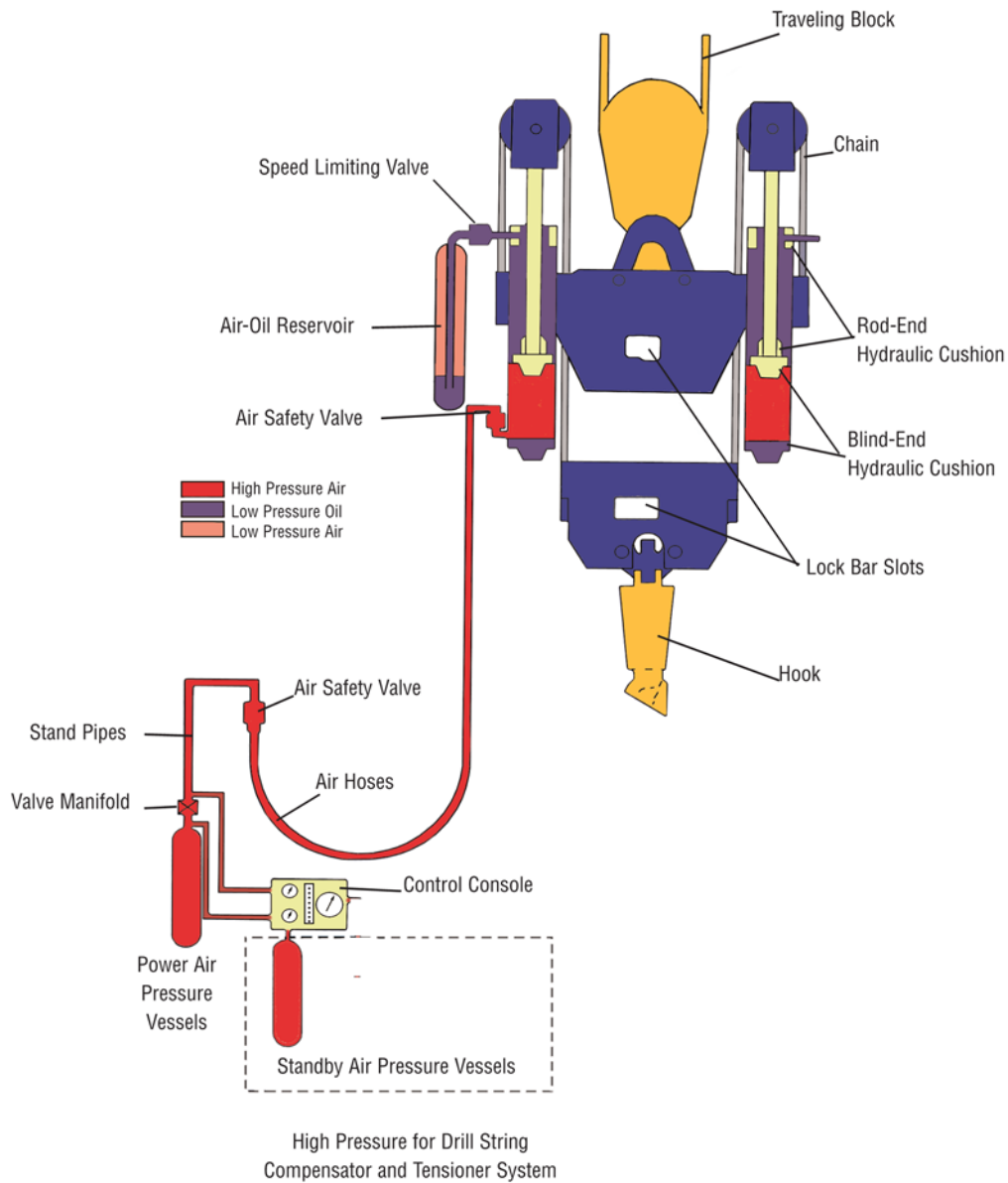
400K



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Shaffer Drill String Compensators

Drill String Compensator (In-Line)



Shaffer Drill String Compensators

Shaffer DSCs, by compensating for vertical heave motion of the drilling vessel, minimize wear inside the BOP stack and on the marine riser and casing string. Wear on the ram BOP seals and annular BOP elements also is minimized. There is virtually no motion of the drill string while the blowout preventers are closed. In addition, the BOP stack can be landed without abrupt motion changes, and the setting of the packers and drill stem test tools is easier.

Other Special Features Include:

- Constant bit weight control — You get higher penetration rates and longer drill bit life.
- Faster response time — The Shaffer air system, in contrast with a hydraulic system, eliminates system shock pressure and permits faster compensation action.
- Complete control by driller — Console at driller's station provides full control of compensator load and monitoring of stroke position. Mechanical lock bar is activated at console to lock the hook and traveling block together — a foolproof method to prevent dropping the load accidentally. The bar cannot be disengaged unless the tension setting exceeds the hook load.
- Extended stroke operation — This delivers 25 feet of compensation from 12 feet of cylinder stroke, reducing installation height and the wear on bearings and packing.
- Full rated compensation at lower pressure — Although other systems require 3,500 psi to equal Shaffer system ratings, the Shaffer system achieves 400,000, 600,000 or 800,000 lb. full rated compensation with only 2,400 psi maximum psi. Shaffer air pressure vessels and system components are manufactured to operate at 2,400 psi.
- Efficient air coupling between the compensator and air pressure vessels — This reduces pressure drop from line flow losses. There is less hook load variation with stroke action.
- Four spiral-wire — wrapped air hoses — Long life is assured. Concentric stainless steel cables prevent loose end movement in case of hose failure. Operation is possible with three hoses if one should fail. In-line air safety valves at each end of each air hose close instantly in the remote event of an air hose failure. This would prevent air pressure (tension) loss and any possibility of damage to equipment or injury to personnel.
- Compression-loaded cylinder design — This has evolved from more than 26 years of experience with riser tension applications. You get efficient operation with controlled loading and long life. There is minimum cylinder friction because only one set of dynamic packing is exposed to high pressure and is protected and lubricated by the oil circuit. This results in less hook load variation with stroke action.
- Long stroke design for rod end cushion — This assures safe deceleration of cylinder in the event of free release under load.
- Blind end cushion — This eliminates mechanical shock otherwise encountered when the traveling block is raised to put full string weight on the hook.
- Patented speed limiting valve — This assures safe operation by controlling and limiting the maximum speed at which the cylinder may extend. This in-line valve closes when the maximum safe rod speed is exceeded, preventing damage to cylinder and adjacent equipment.
- Low pressure air-oil reservoir — Operating at 20-40 psi, this keeps the cylinder rod end filled with oil for speed control and continuous lubrication and damping.
- Flexible linkage between cylinder and hook — The leaf chain design provides an efficient, flexible power linkage and assures concentric loading of the cylinder. Lateral loads are eliminated. Equipment life is extended.
- Hydraulic locking option available — The Shaffer 600K/800K DSC offers an option to permit locking of the cylinders in any stroke position. In a locked position, the 600K DSC can support a static load up to 600,000 lbs. The 800K DSC can support a static load up to 800,000 lbs.
- Mechanical locking of hook plate to DSC main frame allows static load capabilities of 1,500,000 lbs. on 600K DSC and up to 2,000,000 lbs. on 800K DSC.
- Rigid DSC connection to traveling block — This feature of the 600K DSC increases stability, reduces weight by 2,900 lbs., and increases clearance in the derrick by about 17 1/2". Also available for 800K DSC.

Shaffer Drill String Compensators

Drill String Compensators — Capacities & Dimensions

Drill String Compensator Assembly	400,000 lb. DSC				600,000 lb. DSC		800,000 lb. DSC
	15 ft	18 ft	20 ft	25 ft	18 ft	25 ft	25 ft
Estimated Weight on Traveling Block	44,400 lb	46,000 lb	47,600 lb	50,600 lb	62,000 lb	68,000 lb	90,500 lb
Estimated Weight with Traveling Block	62,400 lb	64,000 lb	65,600 lb	68,600 lb	82,500 lb	88,500 lb	112,000 lb
Compensation							
Hook Load (Compensating)	400,000 lbs				600,000 lbs		800,000 lbs
Hook Load (Locked Position)	1,000,000 lbs				1,500,000 lbs		1,625,000 lbs
Hook Load (Extended)	400,000 lbs				1,000,000 lbs		
Compensating Travel	15 ft	18 ft	20 ft	25 ft	18 ft	25 ft	25 ft
Compensator Cylinders (Two per Assembly)							
Bore Diameter	15 in				19 in		21.5 in
Stroke	7 1/2 ft	9 ft	10 ft	12 1/2 ft	9 ft	12 1/2 ft	12 1/2 ft
Maximum Allowable Working Pressure	2,400 psi				2,400 psi		2,400 psi
Air / Oil Reservoirs (Two per Assembly)	70 U.S. gals				130 U.S. gals		130 U.S. gals
Nominal Working Pressure (Panel Set)	15 to 80 psi				30 to 80 psi		30 to 80 psi
Valve Manifold Assembly Approximate Weight	1,200 lbs				2,700 lbs		3,000 lbs
Standpipe Valve Assembly							
Approximate Weight	1,200 lbs (2 ea)				1,500 lbs (1 ea)		8,500 lbs (1 ea)
Driller's Control Console							
Approximate Width	40 in				40 in		40 in
Approximate Height	57 in				57 in		57 in
Approximate Depth	25 in				25 in		25 in
Approximate Weight	500 lbs				500 lbs		500 lbs
Hose Bundle							
Number of High Pressure Air Hoses	4				4		6
Number of Lock Bar Air Hoses	2				2		2
Number of Electric Cables	1				1		1
Number of Low Pressure Hoses	1				3		3
Approximate Total Weight	1,800 lbs				3,600 lbs		7,000 lbs
Oil	Compenol™				Compenol™		Compenol™
Air Pressure Vessel							
Volume	1,650 U.S. gals				2,750 U.S. gals		2,750 U.S. gals
Length	224 in				224 in		224 in
Height	28 1/2 in				28 1/2 in		28 1/2 in
Width	30 1/2 in				30 1/2 in		30 1/2 in
Weight	4,400 lbs				4,400 lbs		4,400 lbs
Max. Pressure (Relief Valve Setting)	2,400 psi				2,400 psi		2,400 psi
Flange Pipe Size (NPS)	2 in				2 in		2 in

NOTES:

1. 2,000,000 upgrade available, contact Shaffer representative.

Shaffer Drill String Compensators

Drill String Compensator — Upgrade from 400K TO 600K

The 400K Rucker Drill String Compensator (DSC) can now be upgraded to achieve a compensating capacity of 600,000 lbs. in a 400K frame.

Why Upgrade?

The modern need for an increase in compensating capacity is driven by the following considerations:

- Deeper waters and deeper drilling depths increase hook loads.
- Horizontal or deviated wells result in increased drill string/casing weights for 'medium' vertical depth wells.
- Addition of top drive or other equipment increased the dead weight on the hook, thereby reducing the net compensating capacity.
- Operational safety concerns prefer the stack to be landed with one controlling handle on the drill string compensator rather than relying on coordination between the compensator and riser tensioner controls.

Options for an Upgrade

Options for upgrading a 400K DSC have historically included installing a 600K DSC or a CMC. The 400K to 600K upgrade was developed as a less expensive option to consider. This upgrade maintains the 1,000,000 lb. mechanically locked hook load capabilities of the existing compensator. It increases the rated hook load capacity from 400,000 lbs. to 600,000 lbs.

How is it Done?

The upgrade package is designed to increase the hook load capacity to 600,000 lbs. while minimizing the number of components being replaced.

The significant components replaced include:

- Cylinders of a larger diameter installed within the existing main frame.
- Chains are replaced with 500K chain.
- Fork blocks, chain adjustment rods, cross beam blocks, sheaves, and hook frame lifters are upgraded.
- A new hook load gauge reflecting the higher capacity is provided for the driller's console.
- Upgrade piping.
- Miscellaneous hardware.

The upgraded system continues to operate at the existing design pressure. The new cylinders incorporate fewer component parts, special low friction packing, and rod end volume designed to use the existing air-oil reservoirs.

Contact your Shaffer sales representative to further discuss upgrading your 400K DSC to 600K.

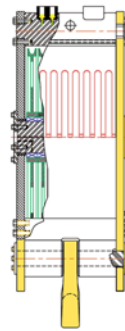
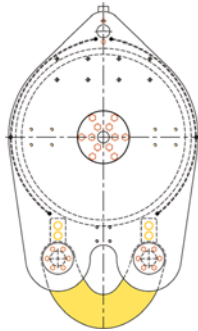


Motion Compensation

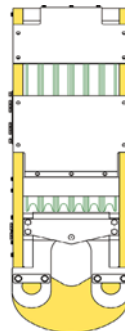
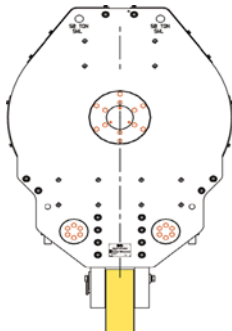
Shaffer Traveling Blocks

Traveling Blocks

Description	No. of Sheaves	Sheave Diameter (Inches)	Rope Size Diameter (Inches)
400K, Integral DSC	6	60	1.50
750T, Integral DSC	7	65	1.63
750T, Integral DSC	7	60	1.50
750T, Integral DSC	7	66	1.50
750T, Integral DSC	7	60	1.50
750T, Integral DSC	7	65	1.63
750T, Integral DSC	7	65	1.75
750T, Integral DSC	8	65	1.50
825T, Integral DSC	8	65	1.75
825T, Integral DSC	8	78	2.00
1000T, Integral DSC	8	68	2.00
750T, Inline Bail	8	68	1.75
1000T, Inline Bail	7	78	2.00
1000T, Inline Bail	8	68	2.00
500T, Std. Bail	6	60	1.63



"Flat" Traveling Block



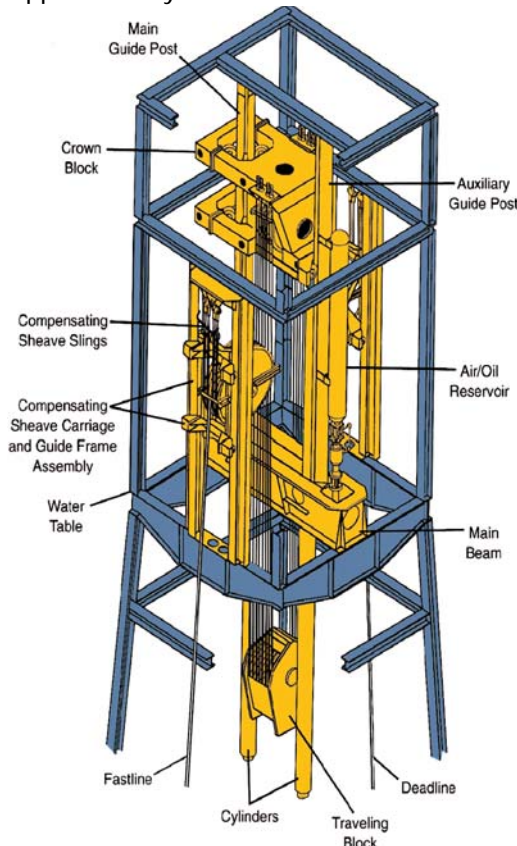
"Standard" Traveling Block

Shaffer Crown Mounted Compensators

Crown Mounted Compensators

The Shaffer Crown Mounted Compensator 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.

Wire Line Compensation — The fast line and deadline pass over large diameter sheaves, then are reeved through the traveling block and crown block to the deadline anchor. The large deadline and fast line sheaves, greater in diameter than the traveling block and crown block sheaves, increase the life of the cable by approximately a factor of two.



Hydraulic Lock — The compensator is capable of locking at any point along the compensating stroke. Retracting the cylinders, the crown block comes to rest on the cylinder support beam, 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.

Speed Control (Valve) — This valve limits the extension speed of the cylinder if the drill string breaks while the Crown Mounted Compensator is pressurized. If the cylinder extension speed exceeds the maximum operational speed by 15%, the valve closes down to limit the extension speed.

Special Features

- Single, rugged, modular construction
- Rigidly mounted to derrick water table
- Compression type cylinders require lower operating pressure
- Hydraulic lock feature reduces time during tripping
- Air compression results in better response time than viscous hydraulic driven cylinders
- Derrick height and weight kept to a minimum
- Adaptable to existing derricks

Load Range Specifications

Load Range Specification	
600K	
Stroke	25 feet
Load, cylinders compensating	600,000 pounds
Load, cylinders retracted	1,500,000 pounds
800K	
Stroke	25 feet
Load, cylinders compensating	800,000 pounds
Load, cylinders retracted	2,000,000 pounds
1,000K	
Stroke	25 feet
Load, cylinders compensating	1,000,000 pounds
Load, cylinders retracted	2,000,000 pounds

Shaffer Direct Line Compensators

Direct Line Compensators

The direct line compensator (DLC) is an in-line compensator system mounted in the drill string for orientation and soft landing of subsea components. The system consists of a cylinder assembly made up in the drill string, a service loop to the derrick, two 312 gallon air pressure vessels, a control manifold to regulate pressure, and a control panel to operate the manifold.

The system operates on 2400 psi maximum clean air or nitrogen and is capable of compensating loads of up to 650,000 pounds in heave conditions of ± 2 feet. The bottom connection of the cylinder is designed with an integral swivel to allow manual rotation of supported load.

The control panel allows monitoring of load, pressure and stroke position of cylinder as

well as fast and slow increase and decrease of pressure to control position of load. Electrical is 120 VAC explosion proof in panel and at manifold and 24 VDC at cylinder.

Direct Line Compensators

Specifications		
Dimension:	190 in x 71 in x 41 in	
Weight:	15,500 lbs.	
Capacity:	600,000 lbs.	
Operating Pressure:	Rod End	2400 psi max.
	Blind End	Atmosphere
Media:	Rod End	Nitrogen or Clean Air (Two 312 Gallon APVs)
	Blind End	Compenol (100 Gallons)
End Connections:	Same as existing drill string	



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650K DLC



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