TOP HOLD-DOWN VS BOTTOM HOLD-DOWN SUCKER ROD PUMPS UNDERSTANDING THE PROS AND CONS

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ABSTRACT

This paper will help with understanding the fundamental advantages and disadvantages of running a Top Hold-Down Sucker Rod pump compared to the advantages and disadvantages of running a Bottom Hold-Down Sucker Rod pump, see Figure A for diagrams. In addition, it will help with understanding what type of well conditions and parameters to consider when deciding between the Bottom Hold-Down pump and the Top Hold-Down pump configurations.

INTRODUCTION

Getting back to the basics of the sucker rod drawn pump. Even though the oil industry is always changing and coming up with new inventive ideas, sometimes we need to get back to the basic understanding and design of the sucker rod drawn pump. The two sucker rod pumps we will be looking at are the Bottom Hold-Down pump advantages and disadvantages compared to the Top Hold-Down pump advantages and disadvantages. Many installations for sucker rod pumps for artificial lift can efficiently use one of these types of pumps without resorting to specialty sucker rod pumps.

OBJECTIVE

To give those new to the oil industry, a basic understanding of the Pros and Cons of running a Top Hold-Down designed pump compared the Pros and Cons of running a Bottom Hold-Down designed pump. To those veterans of the oil industry, a refresher of the two pumps designs. In addition, to take a look at a chart that will help you make a sound decision on pump setting depths.

WHAT YOU NEED TO KNOW

It is important to have a basic understanding of the different sucker rod pump barrel wall thicknesses. A heavy-wall barrel has a 3/16" wall thickness, in most pump sizes, that gives the barrel increased strength and allows the barrel to be used at greater depths. The deeper the pump is set, the greater the hydrostatic pressure on the barrel. A thin-wall barrel has a 1/8" wall thickness, in most pump sizes, which at greater depths a thin-wall barrel can split, causing catastrophic pump failure.

TOP HOLD DOWN PUMP (PROS)

The primary advantage of running the Top Hold-Down pump into a well with sand problems is due to the location of the pump's discharge. The discharge on a Top Hold-Down pump is immediately positioned above the seating nipple. This allows fluid to be discharged near the seating nipple, keeping sand from settling around the "No-Go" on the Hold-Down and reduces the chance of expensive stripping jobs.

In Gassy wells, the Top Hold-Down arrangement allows the pump's intake to be located below the seating nipple and possibly below the perforations, which benefits gas separation. In addition, since the pump intake is below the seating nipple it can produce fluid from a lower level equal to the length of the sucker rod pump, when compared to a Bottom Hold-Down pump, and thus pump the well down further.

An advantage in corrosive production conditions for the Top Hold-Down pump is that the outside of the pump is exposed to the active well fluids and corrosion-treatment chemicals, such that corrosion is treated and minimized.

TOP HOLD-DOWN PUMP (CONS)

The Top Hold-Down pump has depth limitations to consider before running. The pump seating depth chart from API 11AR, Figure D, will help determine if this pump is a viable option. This pump is susceptible to bursting pressures on the down stroke, especially during fluid or gas pound situations. Fluid load on the down stroke also puts a tensile load condition on the pump barrel. Both of these sources of stress are more detrimental with thin wall barrels than heavy wall barrels.

The barrel outside diameter (OD) of either a thin wall barrel or heavy wall barrel will have to be considered when running a Top Hold-Down pump. This is important because the entire pump must pass through the seating nipple. Figure B shows what size Top Hold-Down or Bottom Hold-Down sucker rod pump can be run within various sizes of tubing.

The Metallurgy of the barrel is another consideration before running this pump configuration. You need to know if the metallurgy of the barrel is Carbon Steel, Brass, 4-6% chrome corrosion resistant steel, or Nickel-Copper alloy because that will limit the depth the Top Hold-Down pump can be ran due to the various material tensile and yield strengths, reference Figure D.

The cup-type seating nipple type is very important because the inside diameter of the seating nipple compared to the outside diameter of the pump barrel will determine if the barrel will slide through the seating nipple. Two types of seating nipples are available; the “standard” type and the “API” type. For 2-3/8” tubing the inside, diameters are the same for these two types of seating nipples and Top Hold-Down pumps or Bottom Hold-Down pumps can be used with either type of seating nipple. However, for 2-7/8” and 3-1/2” tubing the larger (+.030”) “API” type seating nipple is the only seating nipple large enough on its inside diameter to accept a Top Hold-Down pump.

BOTTOM HOLD-DOWN PUMP (PROS)

The Bottom Hold-Down pump is the most common placement of the hold-down. The Bottom Hold-Down pump is the most rugged insert sucker rod pump configuration available. A heavy wall Bottom Hold-Down pump configuration can be ran at greater depths than a thin wall type. The fluid pressure in the tubing gives pressure support to the outside of the pump barrel during pumping operations for both heavy and thin wall types, and is especially helpful during fluid or gas pound situations.

It should be noted that the advantage of a thin wall sucker rod pump over a heavy wall sucker rod pump is that a larger pump can be utilized for higher fluid production rates. This is true for both Bottom and Top Hold-Down pumps. Please refer to Figure B to note the larger size for a thin wall pump (RW) than a heavy wall pump (RH) for the same size tubing.

BOTTOM HOLD-DOWN PUMP (CONS)

The Bottom Hold-Down pump in a well that produces sand or scale (particulates) could cause an adverse condition. Particulates can drop back into the annulus between the pump and tubing, above the seating nipple, thus sticking the pump in the tubing. Then the rods and tubing have to be stripped out together to retrieve the pump, which is an expensive alternative for the oil company. A Brush Sand Seal or Expandable Sand Seal can be installed near the top of a Bottom Hold-Down pump to help keep particulates from accumulating in this area, reference Figure C.

This area from the seating nipple to the fluid discharge at the upper end of a Bottom Hold-Down pump is also a stagnant fluid area which is difficult to chemically treat and thus can accelerate corrosion on the outside of the pump barrel.

CONCLUSION

There are things to know when deciding on running either a Top Hold-Down configuration or a Bottom Hold-Down configuration sucker rod pump. The well depth (refer to chart in Figure D), the well conditions, tubing size (reference Figure B), and seating nipple (API or Non API)

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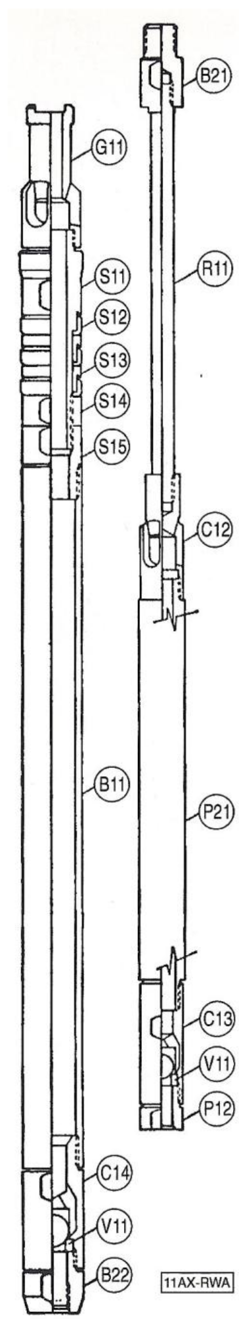
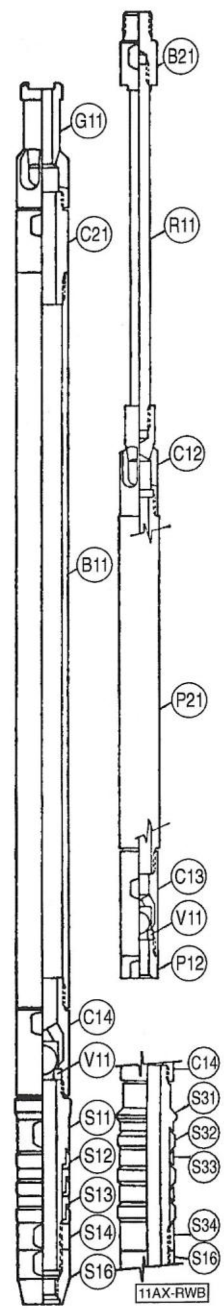
Figure A



Top Hold-Down,
Thin Wall Barrel Illustrated



Bottom Hold-Down,
Thin Wall Barrel Illustrated

From API 11AX

Figure B

TABLE OF CASING/TUBING/PUMP SIZE

Casing Size	Tubing Size, Max	Sucker Rod Size, Max	RW Insert Pump, Max	RXB* Insert Pump, Max	RH Insert Pump, Max	TH Tubing Pump, Max	Oversize Tubing Pump, Max
2-3/8", 4.7#	1-1/4" Reg. 1.660" OD, 1.380" ID, 1.286" drift	1/2" (1" OD Cplgs)	1"	n/a	n/a	1-1/4"	1-1/2"
2-7/8", 6.5#	1-1/2" Reg. (1.900" OD, 1.610" ID, 1.516" Drift)	5/8", Slim Hole Cplgs	1-1/4"	n/a	n/a	1-1/2"`	2"
3-1/2", 7.7-10.2#	2-1/16" Integral Jnt	3/4", Slim Hole Cplgs	1-1/4"	1-1/4"	n/a	1-1/2"	2"
4", 9.5-14.0#	2-3/8"	7/8" Slim Hole Cplgs	1-1/2"	1-1/2"	1-1/4"	1-3/4"	2-1/4"
4-1/2", 9.5-12.6#	2-7/8" Spec Clear Cplg	1", Slim Hole Cplgs	2"	2"	1-3/4"	2-1/4"	2-3/4"
5", 11.5-20.3#	2-7/8"	1" Slim Hole Cplgs	2"	2"	1-3/4"	2-1/4"	2-3/4"
5-1/2", 14-20#	3-1/2" Flush Joint	1-1/8"	2-1/2"	n/a	2-1/4"	2-3/4"	3-3/4"
6-5/8", 20-28#	3-1/2"	1-1/8"	2-1/2"	n/a	2-1/4"	2-3/4"	3-3/4"
7", 17-29#	4-1/2"	1-1/8"	3-1/4"	n/a	2-3/4"	3-3/4"	4-3/4"
7-5/8" and Larger	4-1/2"	1-1/8"	3-1/4"	n/a	2-3/4"	3-3/4"	5-3/4"

* The RXB pump has a heavy wall barrel that is internally threaded the same as an RW pump, but has a larger outside diameter. It can only be used as a bottom hold-down pump since the outside diameter of the barrel is too large to pass through a seating nipple.

Note: <u>These are maximum sizes.</u> Smaller tubing, sucker rods or pumps can be used than those shown for any particular row of maximum size choices.

Figure C

Settable Sand Seal

Brush Type Sand Seal
(Patent Pending)

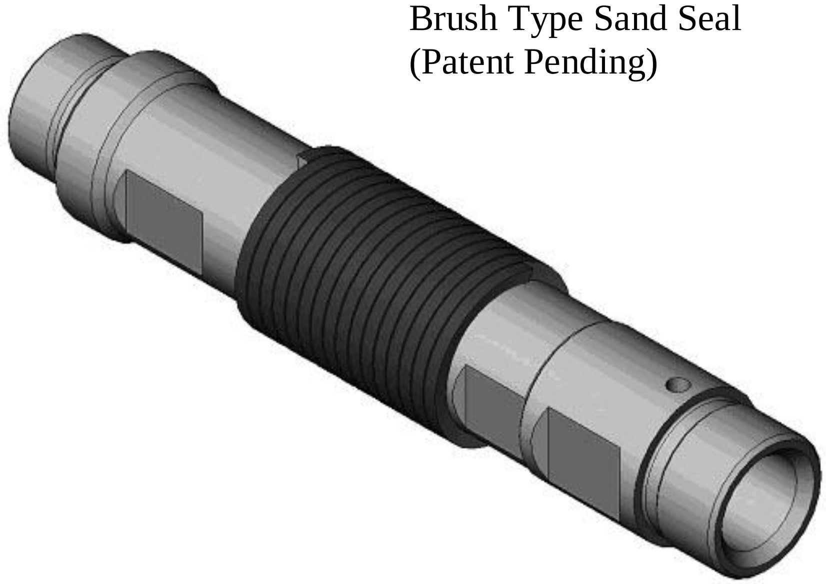


Figure D

Table 7—Pump Setting Depths (ft) for Common Barrel Materials
(FS = 1.25; SF = 1.00; SG = 1.00)

Bore Size	1.25	1.50	1.75	2.00	2.25	2.50	2.75
(Matl: Low Carbon Steel: Su = 80 ksi, S = 32 ksi; Sy = 60 ksi)							
RWA, RSA	6,394	5,520	—	3,732	—	3,183	—
RWB, RSB, & RWT	16,936	14,705	—	9,727	—	6,362	—
RHA	8,321	8,818	6,749	—	4,876	—	—
RHB, RHT	27,148	24,249	21,897	—	18,323	—	—
TH, TP	—	—	10,019	—	7,763	—	6,262
TH, TP (Tapered Thread)	—	—	8,187	—	7,047	—	5,726
EXT CPLGS*							
w/RHA	7,568	6,118	4,706	—	3,824	—	—
w/RHB	25,728	28,714	20,708	—	17,294	—	—
(Matl: Admiralty Brass: Su = 75 ksi; S = 25.0 ksi; Sy = 60 ksi)							
RWA, RSA	4,989	4,306	—	2911	—	2,482	—
RWB, RSB & RWT	16,936	14,704	—	9727	—	6,362	—
RHA	6,490	6,878	5,264	—	3,802	—	—
RHB, RHT	27,148	28,714	21,897	—	18,323	—	—
TH, TP	—	—	7,815	—	6,062	—	4,890
TH, TP (Tapered Thread)	—	—	6,386	—	5,496	—	4,466
EXT CPLGS*							
w/RHA	5,913	4,780	3,675	—	2,986	—	—
w/RHB	25,728	24,249	20,708	—	17,294	—	—

Bore Size	1.25	1.50	1.75	2.00	2.25	2.50	2.75
(Matl: 4-6% CR Steel, Carbonitrided: Su = 109 ksi; S = 43.6 ksi; Sy = 70 ksi)							
RWA, RSA	8,711	7,520	—	5,084	—	4,337	—
RWB, RSB, & RWT	19,759	17,016	—	10,782	—	6,814	—
RHA	11,337	12,015	9,195	—	6,643	—	—
RHB, RWT	31,672	28,291	25,546	—	21,376	—	—
TH, TP	—	—	13,655	—	10,577	—	8,531
TH, TP (Tapered Threads)	—	—	11,155	—	9,602	—	7,801
EXT CPLGS*							
w/RHA	10,312	8,336	6,412	—	5,210	—	—
w/RHB	30,016	33,500	24,159	—	20,176	—	—
(Matl: NI-CXU Alloy; Su = 82 ksi; S = 32.0 ksi; Sy = 55 ksi)							
RWA, RSA	6,553	5,658	—	3,825	—	3,263	—
RWB, RWT	15,525	13,480	—	11,209	—	8,199	—
RHA	8,529	9,038	6,917	—	4,998	—	—
RHB, RHT	24,886	22,229	20,072	—	16,796	—	—
TH, TP	—	—	10,459	—	5,984	—	4,752
TH, TP (Tapered Threads)	—	—	8,392	—	7,223	—	5,869
EXT CPLGS*							
w/RHA	7,757	6,271	4,823	—	3,919	—	—
w/RHB	23,584	26,322	18,982	—	15,853	—	—

*The limiting setting depth should be that of the specific RHA or RHB with which the extension coupling is used.

From API 11AR