# SIMPLICITY IN VRU BY USING A BEAM GAS COMPRESSOR

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Abstract: Vapor Recovery Units are often expensive, complicated to operate and unable to deal with High H2S and liquids. The Beam Gas Compressor is a product that has served the measure of time after 35 years of operation its durability is now being shown as a vapor recovery unit. Without the need of a control panel and scrubber tank the hydraulically driven Beam Gas Compressor (HyBGC) can be easily serviced by most oil field personnel. No special schooling or training is necessary. Without the need for a control panel there is no need for special automation technical service. Making the HyBGC the perfect VRU for small to medium size companies. Majors too, anyone needing consistent and reliable emissions control.

Historical development: The Beam Gas Compressor®, BGC, uses a single cylinder to reduce the pressure in the annulus of the sucker rod pumped well and then discharges the gas back into the surface flowline or sales line. The resulting removal of the backpressure on the formation allows more gas to flow at a quicker rate, while also improving the efficiency of the downhole pump with greater fillage percentages. The pumping unit uses the torque creation of its prime mover at the middle of each stroke and the BGC takes advantage of this torque at the top and bottom of the stroke. It is at this point the torque is typically converted into heat as the pumping unit does not require it, the BGC converts this wasted heat to torque to compress the gas in the BGC. Compared with conventional reciprocating compressors, the beam gas compressor has a number of advantages. Perhaps the greatest advantage is the greater compression ratio that can be achieved than a comparable single stage reciprocating compressor. The BGC offers up to a 9 to 1 compression ration vs 3-4 to 1 for other reciprocating systems. The higher compression ratio is achieved by the way heat is dissipated when gas is compressed. The large cylinder and slow speed allow much more heat to be dissipated over every stroke. For typical rod pumped installations, this greater compression ratio allows the beam compressor to deliver gas into a wider range of pipeline pressures without having to have multiple stages.

While the beam gas compressor is very effective for a single well, sometimes we find the pumping unit configuration and run time is not sufficient to compress high volumes of gas. To extend the applications of the high compression ratios of the Beam Gas Compressor®, a standalone version was developed that has its own prime mover. This prime mover is a fluid drive system that is comprised of a hydraulic pump, a motor and a directional valve. As a standalone device, the Hydraulic Beam Gas Compressor® (HyBGC) can now accommodate a continuous run schedule that can accommodate multiple wells for well head compression and tank batteries for vapor recovery.

Basic Description:

The HyBGC uses hydraulic technology that is proven over many decades in combination with Beam Gas Compressor® technology developed over 35 years ago to provide exceptional compression and durability.
The Beam Gas Compressor® has internal proprietary seals and packing that can be used without external lubrication and operated to temperatures exceeding 400 degree Fahrenheit. It also is impervious to hydrogen sulfide, carbon dioxide, injected chemical treatments and now steam. The Fluid Drive System is simple to operate and can be controlled thru a patent pending algorithm controller that gives the well's the ability to produce at maximum efficiencies. Utilizing an optional swash plate style pump and proportional valve the system can vary its stroke per minute on a moment by moment basis to control the desired suction pressure.

The main adaptation to convert from a Beam Gas Compressor® to a HyBGC is the addition of the hydraulic cylinder and insertion of the middle head with a triple redundant seal. This seal is what keeps the hydraulic fluid in the top chamber and the gas in the bottom chamber. The pressure that is created in the hydraulic chamber expands the seals and prevents any leakage of gas back into the fluid.

Below are examples of how much gas can be moved by different sizes of HyBGC.
(The Hydraulic cylinder is a standard diameter size and stroke length is equal to the BGC. The BGC compression cylinder diameter can be sized to match the demands of any location. Below are a few examples)

Table 1-provides a range of cylinder and volume rating based on strokes per minute and suction pressure, for these examples the discharge pressure can vary from 150 psi up to 500 psi while maintaining the 9 to 1 compression ratio.

Advantages over reciprocating gas compressors

Every reciprocating gas compressor in the world must have a filtration system, scrubber tank and pump to remove fluid from the scrubber tank. This is because any fluid that enters the compression chamber will create severe fluid pound and damage or disable the compressor. With the HyBGC this is *not necessary.* The HyBGC is the only compressor system in the world able to move fluid, as well as, wet high BTU gas in every stroke. This is a revolutionary concept and allows for much more flexibility in installations of the HyBGC. Fluid pressure is fluid pressure regardless of it being in the top or bottom cylinder the control panel simply reacts to pressure and pushes the fluid down the flowline.

The HyBGC does not require frequent service for maintaining is fluid level, filters, or the many other problems and this can be seen by looking at the parts of a screw compressor that are not needed. Fig. 1

Lack of emissions. Reciprocal compressors by the nature of their design have “blow by”. This is where gas under compression will blow by the piston and its seals out of the compression chamber creating an environmental emission into the atmosphere. When you consider these systems often operate at 900-1500 cycles per minute and a small amount of gas is emitted on every stroke these amounts can be significant.
The HyBGC, on the other hand, has a high pressure hydraulic cylinder sitting on top of a low pressure gas compressor chamber. Gas is unable to escape the compressor cylinder because of the nature of our common seals between the two cylinders. The compression chamber of the HyBGC is a closed system with no opportunity for emissions to escape to the atmosphere.

Hydrogen Sulfide is often very disastrous for reciprocating gas compressors, especially the ones used for vapor recovery. The HyBGC utilizes a coated piston rod that is 2.5 inches in diameter with all internal parts protected with nickel coating including a corrosion protected cylinder making the entire system impervious to the caustic nature of H2S.

They HyBGC can be utilized in a steam flood to allow a well to be operated as if it were vented. The proprietary nature of the seals and packing utilized in the High Temperature System allows for the unit to operate to a temperature of over 400 degrees Fahrenheit. And as described above a scrubber system is not required to handle the condensation of the steam from any changes in pressure or temperature that may occur as the gas goes thru the system.

Advantages over conventional beam gas

With its own prime mover the Beam Gas Compressor® is no longer bound to a pumping unit that cannot operate the BGC sufficiently to compress the volume of gas the well produces. The HyBGC can be set to run at the speed necessary to move the volume of gas that is produced by the well or tank battery. With the addition of the “McCoy Algorithm” the optimum speed can be derived that will produce the most production.

The ability of the HyBGC to move fluid slugs is also an advantage over other types of compression including the Pumping Unit model of the Beam Gas Compressor® which is designed to compress wet gas condensate and not fluid slugs.

Maintenance and run time experience

Similarly to the Beam Gas Compressor® the HyBGC is very easy to maintain. With basic components of motor and pump they can easily be repaired by roustabout crews with minimum down time. A serious problem and downtime would result in equipment failures resulting in repair and replacement of parts with other compression systems. Typically the Beam Gas Compressor® operates at rates in excessive of 99.4% of the year compared to reciprocating compressors of 94% or less. This difference in runtime can easily be translated into lost production on a yearly basis.

To date on average our HyBGC systems have required one service trip per 15 months.

- Typical economics

  A Beam Gas Compressor® usually is priced about 2/3 – of reciprocal compressors as it has no fluid scrubber system or prime mover. A HyBGC is a single staged compression system and requires no fluid scrubber system. Cost Comparison is listed in Table 3

Regulatory compliance improvements
Quad OOOO has become relevant and the lack of emissions from the HyBGC offer a significant advantage in this area.

This legislation – 40 CFR 60 Subpart OOOO – is commonly referred to as “Quad O.” It states that as of April 12, 2013, all storage tanks must have a control device in place 60 days following startup or by April 2014, whichever is later. The EPA categorizes a “control device” as either an enclosed combustor or a vapor recovery device. 1
In addition the newly established standards will regulate volatile organic compound emissions from gas wells, centrifugal compressors, reciprocating compressors, pneumatic controllers and storage vessels. 2
So this will eliminate many types of compression unless they utilize an enclosed combustor or some other system to prevent emissions. All of which are not necessary for the HyBGC

In Conclusion

They Hydraulic Beam Gas Compressor® is a significant step forward in vapor recovery systems allowing ease of operation, maintenance and training to come to the oil field. Its capacity to handle virtually any gas stream in most any environment allows it to have tremendous flexibility. This HyBGC System of compression will offer the operator the ability to easily test his formations capacity to increase production when the back pressure is relieved.

References

1- http://abutec.com/quad-o-compliance/
2- http://en.wikipedia.org/wiki/Vapor_recovery

| BGC Model 6 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 48 | spm | 0 | 10 | 20 | 50 |
| | 3 | 5.72 | 9.97 | 14.21 | 26.93 |
| | 4 | 7.63 | 13.29 | 18.94 | 35.90 |
| | 5 | 9.54 | 16.61 | 23.68 | 44.88 |
| | 6 | 11.45 | 19.93 | 28.41 | 53.85 |
| | 7 | 13.36 | 23.25 | 33.15 | 62.83 |
| | 8 | 15.27 | 26.57 | 37.88 | 71.81 |

| BGC Model 8 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 48 | spm | 0 | 10 | 20 | 50 |
| | 3 | 10.18 | 17.72 | 25.26 | 47.88 |
| | 4 | 13.57 | 23.63 | 33.68 | 63.84 |
| | 5 | 16.97 | 29.53 | 42.10 | 79.80 |
| | 6 | 20.36 | 35.44 | 50.52 | 95.76 |
| | 7 | 23.75 | 41.35 | 58.94 | 111.73 |
| | 8 | 27.15 | 47.25 | 67.36 | 127.69 |

| BGC Model 10 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 48 | spm | 0 | 10 | 20 | 50 |
| | 3 | 15.90 | 27.69 | 39.47 | 74.81 |
| | 4 | 21.21 | 36.91 | 52.62 | 99.75 |
| | 5 | 26.51 | 46.14 | 65.78 | 124.68 |
| | 6 | 31.81 | 55.37 | 78.93 | 149.62 |
| | 7 | 37.11 | 64.60 | 92.09 | 174.56 |
| | 8 | 42.41 | 73.83 | 105.24 | 199.49 |

| BGC Model 6 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 60 | spm | 0 | 10 | 20 | 50 |
| | 3 | 7.16 | 12.46 | 17.76 | 33.66 |
| | 4 | 9.54 | 16.61 | 23.68 | 44.88 |
| | 5 | 11.93 | 20.76 | 29.60 | 56.10 |
| | 6 | 14.31 | 24.91 | 35.51 | 67.32 |
| | 7 | 16.70 | 29.07 | 41.43 | 78.54 |
| | 8 | 19.08 | 33.22 | 47.35 | 89.76 |

| BGC Model 8 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 60 | spm | 0 | 10 | 20 | 50 |
| | 3 | 12.72 | 22.15 | 31.58 | 59.85 |
| | 4 | 16.97 | 29.53 | 42.10 | 79.80 |
| | 5 | 21.21 | 36.92 | 52.63 | 99.75 |
| | 6 | 25.45 | 44.30 | 63.15 | 119.71 |
| | 7 | 29.69 | 51.68 | 73.68 | 139.66 |
| | 8 | 33.93 | 59.07 | 84.20 | 159.61 |

| BGC Model 10 | | Suction Pressure | | | |
|---|---|---|---|---|---|
| 60 | spm | 0 | 10 | 20 | 50 |
| | 3 | 19.88 | 34.61 | 49.33 | 93.51 |
| | 4 | 26.51 | 46.14 | 65.78 | 124.68 |
| | 5 | 33.13 | 57.68 | 82.22 | 155.85 |
| | 6 | 39.76 | 69.21 | 98.67 | 187.02 |
| | 7 | 46.39 | 80.75 | 115.11 | 218.19 |
| | 8 | 53.01 | 92.28 | 131.55 | 249.36 |

Table 1 - shows different volume of gas capacity at different suction pressures and stroke length with varying diameters of gas cylinders.

**Table 2** **Hydraulic horse power and volumes of gas in a 36 inch stroke unit**

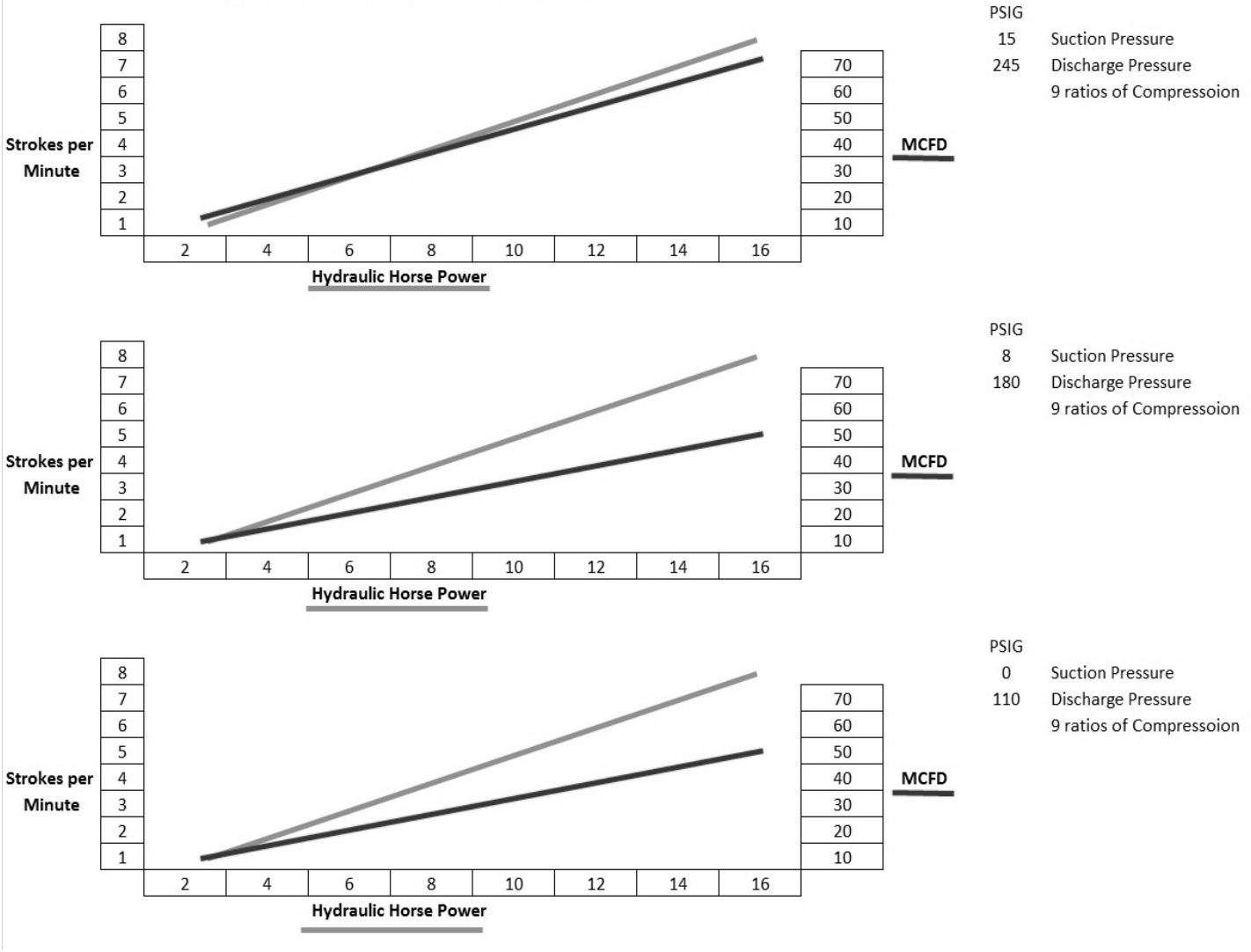
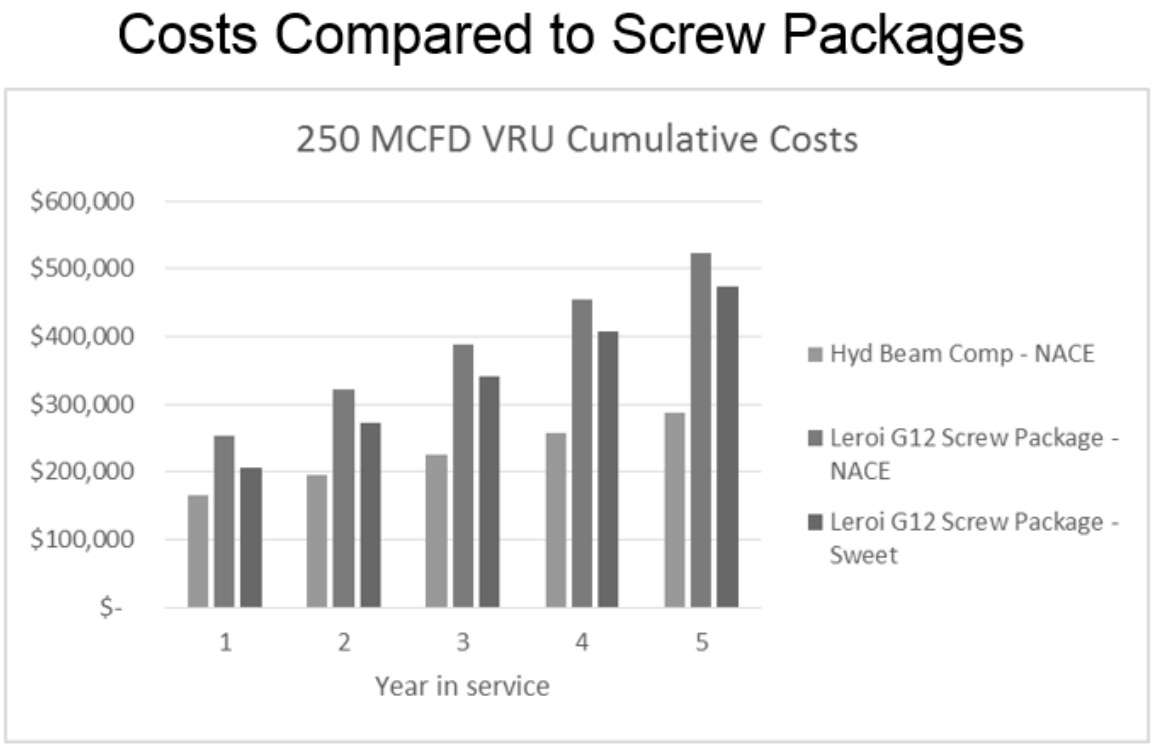



Table 2 - Illustrates the relationship between hydraulic horse power need to compress volumes of gas into different flowline pressures




250 mcfd from
4 ounces suction to 100 psi discharge – This unit is the one we wan to develop next

Table 3 - The relative difference in cost of servicing a HyBGC vs alternative methods of compression

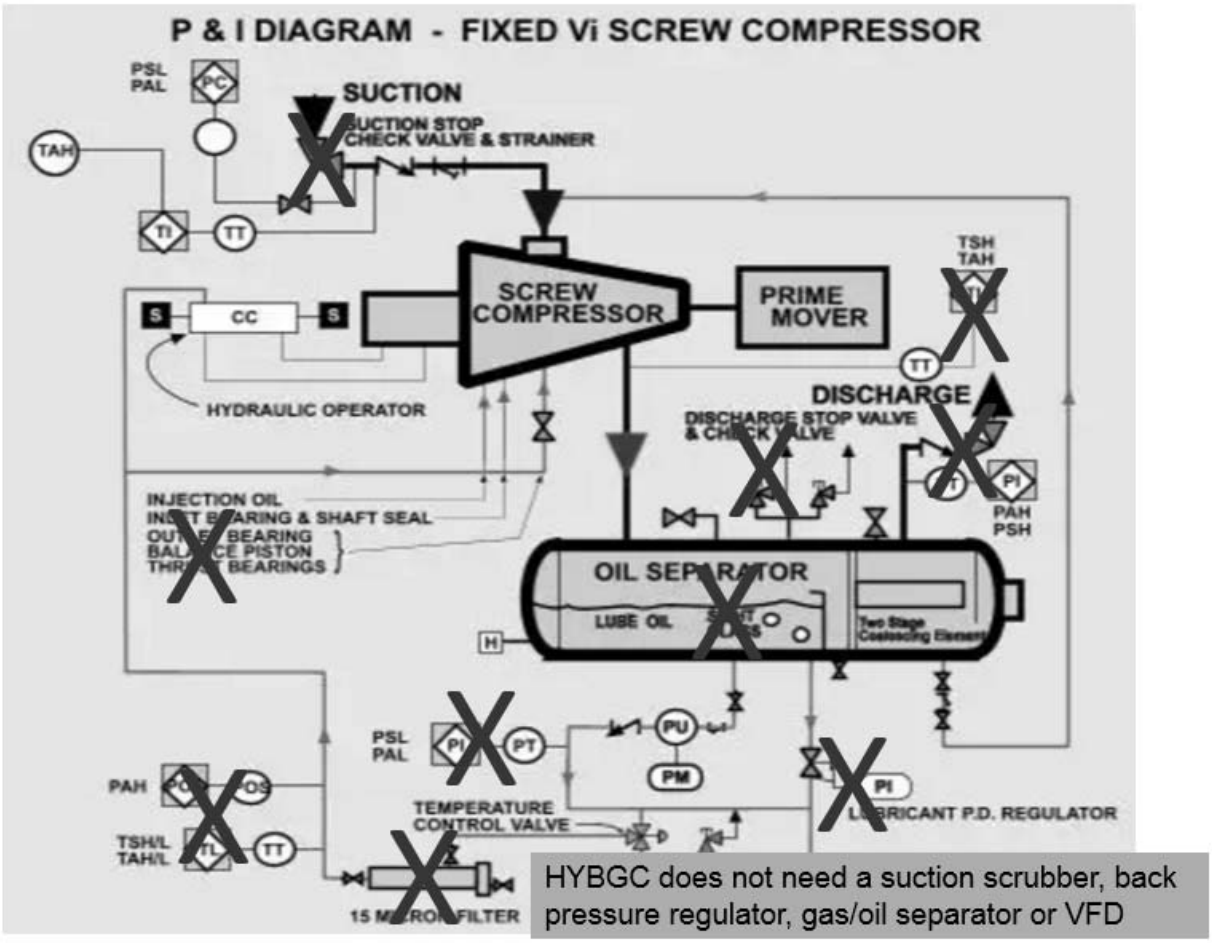
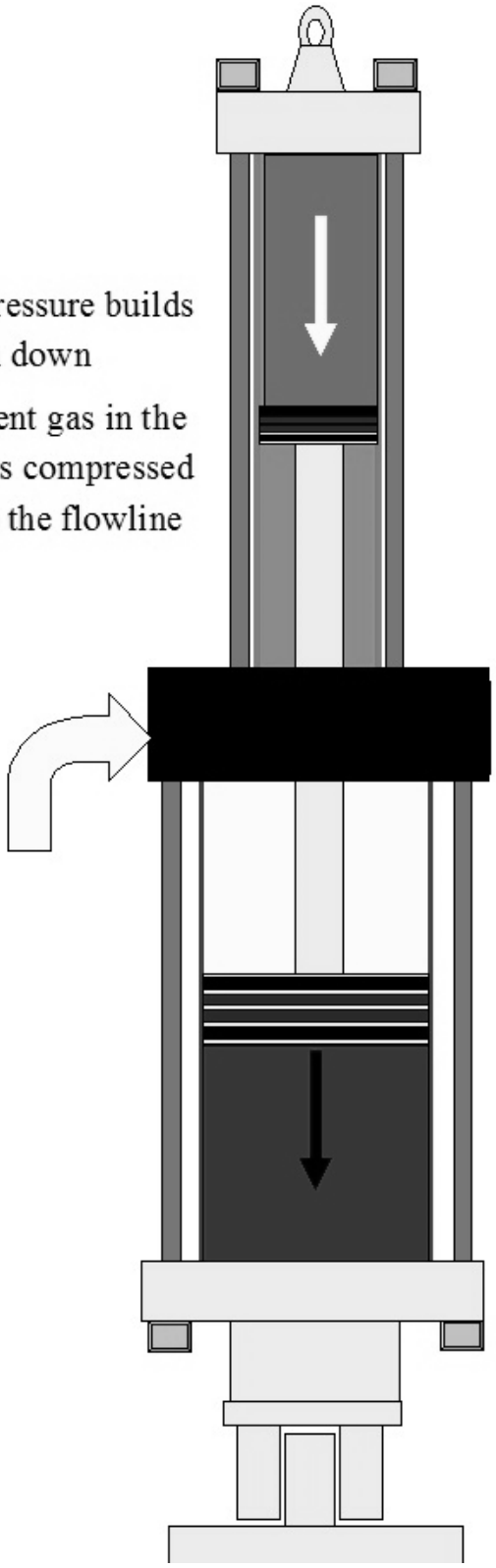



Figure 1 – Parts of a Screw Compressor not needed by at HyBGC

Hydraulic fluid pressure builds and pushes piston down

With this movement gas in the bottom chamber is compressed and discharged to the flowline



Gas is sucked into the upper chamber on the downward stroke and will be compressed on the subsequent upward stroke

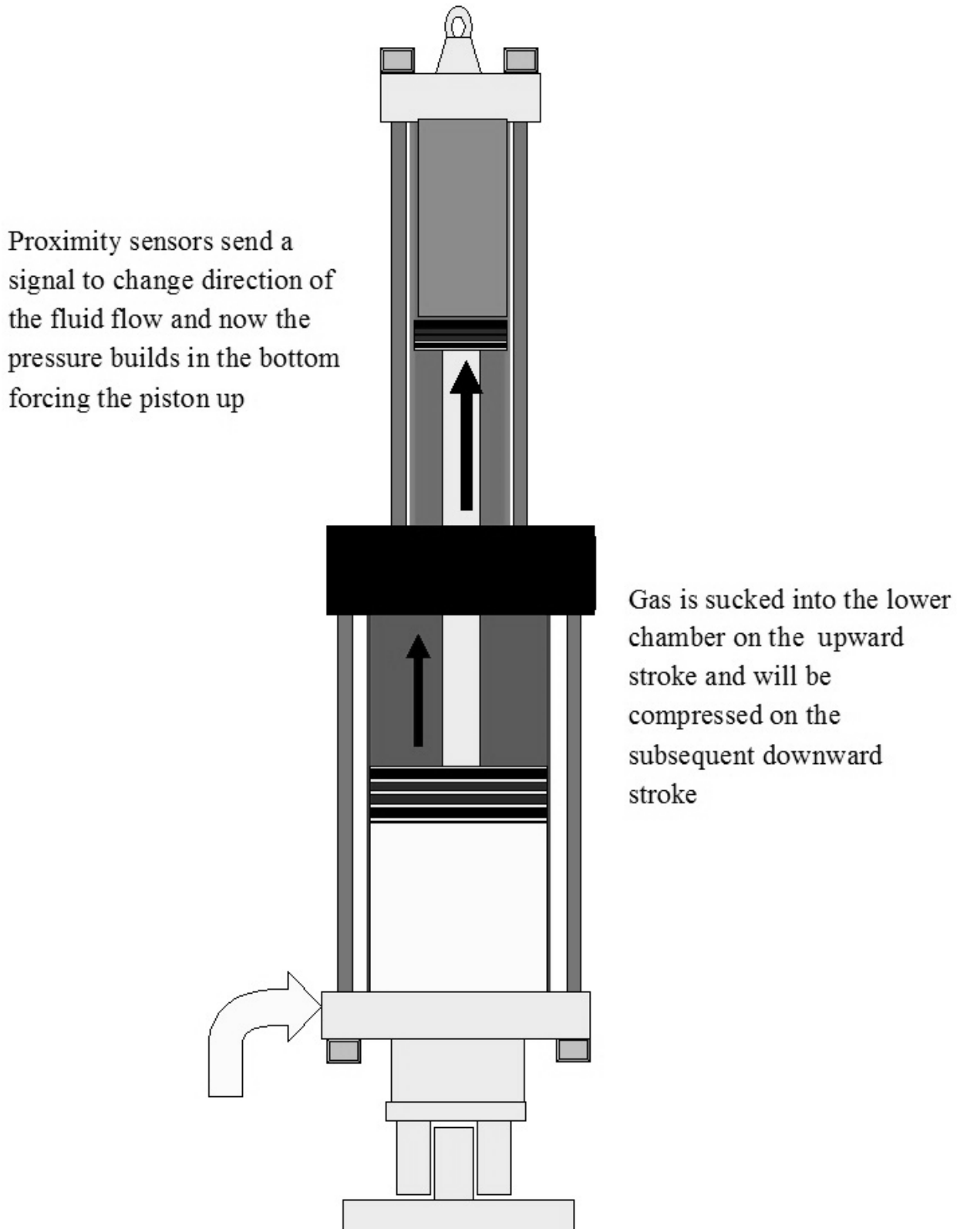
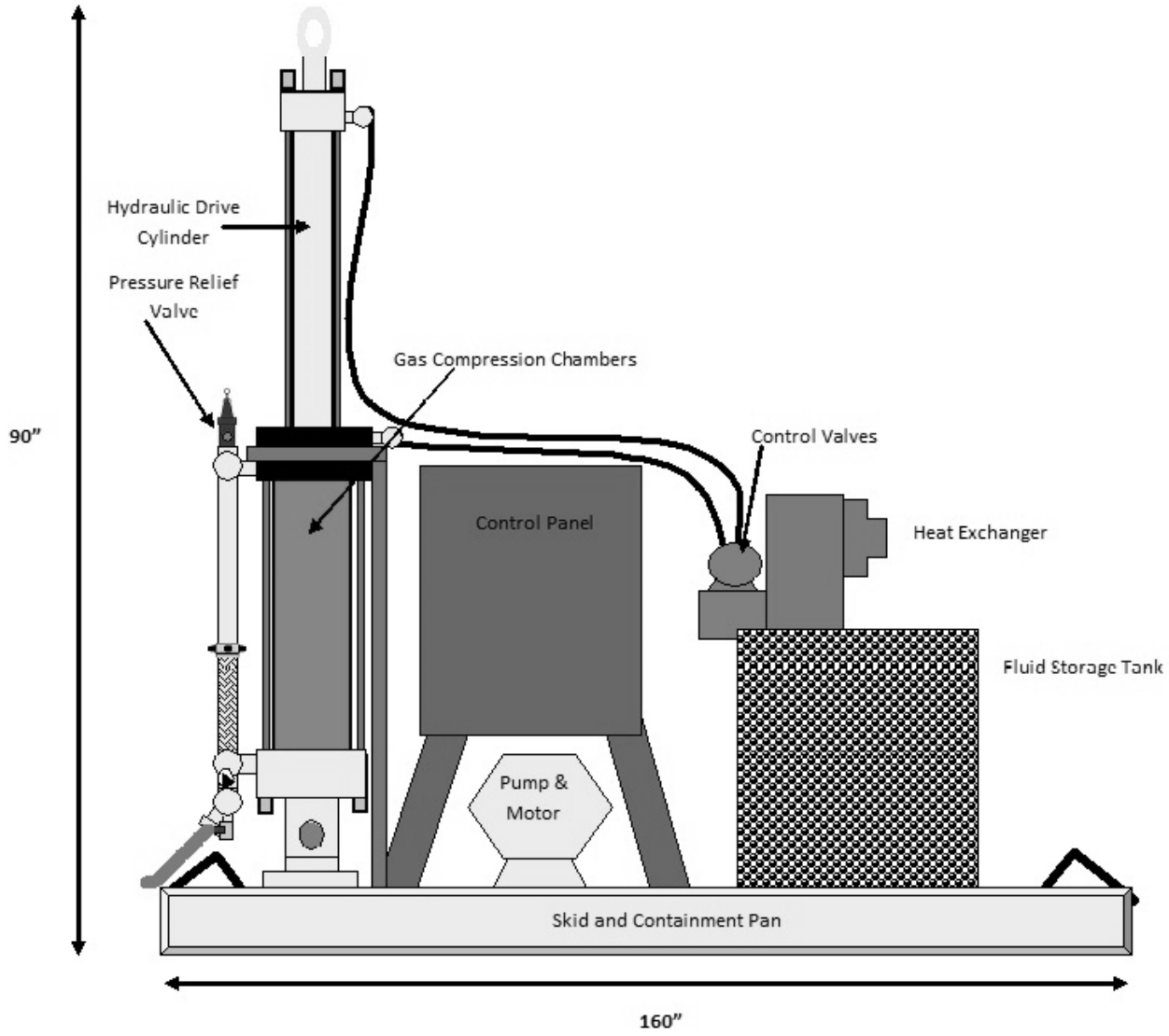



Figure 2- Movement of Gas and fluid thru the HyBGC




Typical Layout of a HyBGC

HyBGC on location as a wellhead compressor


As a Vapor Recovery Unit