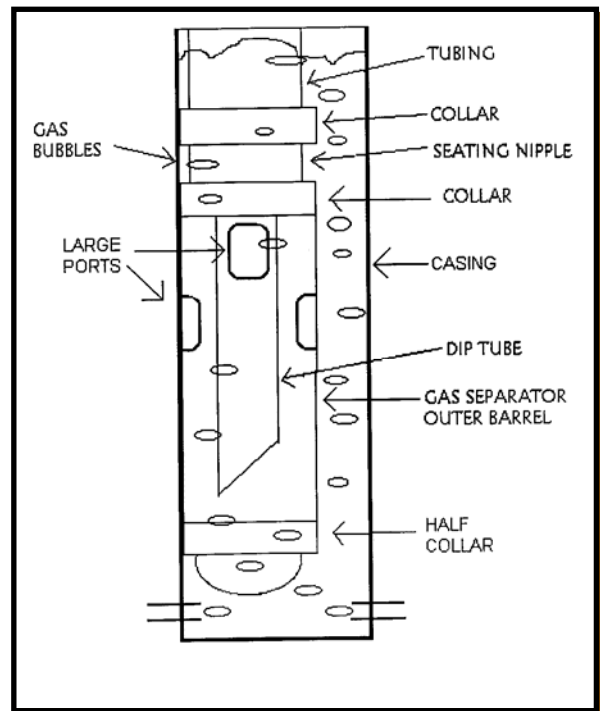


Echometer

Improved Collar-Size Gas Separator



- INCREASE OIL AND GAS PRODUCTION
- IMPROVE EFFICIENCY OF LIFT SYSTEM
- CORRECT ARTIFICIAL LIFT PROBLEMS CAUSED BY INCOMPLETE PUMP FILLAGE
- REDUCE OPERATING COST



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Improved Collar-Size Gas Separator

The Echometer Downhole Improved Collar-Size Gas Separator is installed when a well is operated at low efficiency due to poor natural gas separation or due to an inefficient downhole gas separator. The downhole Improved Collar-Size Gas Separator is used when the downhole pump is placed in the producing zone or above the producing zone. The characteristics of inefficient gas separation can be identified from the downhole pump having incomplete fillage, plus the casing annulus above the pump intake having a high gaseous liquid column. An acoustic liquid level test is used to indicate a high gaseous liquid column above the pump. In a sucker rod lifted well the analysis from a dynamometer test, performed at the same time as the acoustic liquid level test, is used to identify incomplete pump fillage. Periodic acoustic liquid level tests and dynamometer measurements should be performed to verify that the downhole gas separator is operating efficiently. Several common improper oil field production practices used to combat poor gas separation that result in high operating cost are: 1) tapping bottom with the pump, 2) running the pumping unit at excessive speed, 3) operating the pumping unit for excessive periods of time, or 4) increasing the tubing pressure or increasing the casing pressure. The proper procedure for correcting inefficient downhole gas separation is identifying the problem and correctly installing the downhole Improved Collar-Size Gas Separator in the well.

Progressive cavity pumps perform better when the pump is subjected to liquid flow only. The collar-size gas separator's "good gas separation" results in longer life for a progressive cavity pump, than a progressive cavity pump used above the formation without an efficient gas separator. Separation of free gas from the liquid entering the PC pumps will greatly increase the efficiency and prolong the life of progressive cavity pumps.

Specifications

These Improved Collar-Size Gas Separators are designed with thin-wall tubing, large ports and minimum lengths to optimize gas separation from the liquid that enters the pump. These separators have greater liquid and gas capacities than other gas separators. The gas separators are constructed from carbon steel. An extra cost option of constructing the gas separator completely from stainless steel is available upon request. The OD of the outer barrel of the gas separator is the same OD as the tubing collar. The collar at the top of the separator is attached to the bottom of the pump seating nipple. An optimum size dip tube is permanently mounted inside the outer barrel. A half-collar is located at the bottom of the separator with a bull plug attached to the bottom of the half-collar. A joint of tubing can be run below the bottom half-collar to act as a solids collection chamber if desired. The length of the gas separator is approximately 5.5 feet.

Collar-size Gas Separator Selection

A collar-size gas separator should be selected that is the same size as the tubing collar unless the pump capacity exceeds the gas separator capacity. Then, a larger gas separator should be selected that has a liquid capacity equal to or greater than the pump capacity. At high liquid

and gas rates, even an optimum size gas separator in limited size casing may not have the capacity to separate all of the liquid from the free gas at low pump intake pressures.

The collar-size gas separator design considers the pump capacity, dip tube liquid capacity, gas separator annular area liquid capacity, the large ports for liquid entry into the gas separator and the annular gas flow rate between the gas separator and the casing wall. The liquid capacity of a sucker rod pump can be calculated using a variety of techniques and software programs, including downloading from www.echometer.com a free wave-equation software program, Qrod. The casing annulus gas flow rate can be determined using a strip chart acoustic liquid level instrument, surface pressure gauge, and procedure given in the reference "Acoustic Determination of Producing Bottomhole Pressure," SPE 14254. The casing annulus gas flow rate can automatically be determined using the computerized portable Echometer Well Analyzer instrument.

Following are liquid capacities of the various gas separators. A larger size gas separator than tubing size can be used for larger liquid capacities. The thin-wall construction, large ports and proper size dip-tube result in maximum liquid and gas capacities. The table describes the gas capacity, which is a function of the casing size, gas separator size and well bore pressure surrounding the gas separator. The following table shows both the liquid and the gas capacities for various combinations of collar-size gas separators and various sizes of casing:

COLLAR-SIZE GAS SEPARATOR GAS AND LIQUID CAPACITY

| COLLAR SIZE EUE (Inch) | LIQUID CAPACITY (BPD) | GAS CAPACITY MCF/D* | | |
|------------------------------|-----------------------------|---------------------|------------------|--------------|
| | | 4 1/2" Casing | 5 1/2" Casing | 7" Casing |
| 2 3/8" (3.0" OD) | 230 | 35 | 76 | 154 |
| 2 7/8" (3.75" OD) | 415 | 11 | 52 | 130 |
| 3 1/2" (4.5" OD) | 600 | - | 23 | 101 |

*GAS CAPACITY AT 1 ATM.

A 2-7/8" collar-size gas separator has a capacity of approximately 415 BPD. The pump capacity should be less than 415 BPD or the separation of free gas from the liquid may not occur and free gas will be drawn into the pump. If the 2-7/8" separator is to be used on the inside of 5-1/2" casing, the maximum casing annulus gas flow rate for efficient operation of the gas separator is approximately 51 MCF per day at 1 ATM. The gas capacities shown are for a pump intake pressure of 1 ATM. If the pump intake pressure is higher than 1 ATM., then the gas capacity rating of the separator should be multiplied by the pump intake pressure in units of atmospheres. This limitation of 51 MCF/D would only exist if the well were produced with the casing valves open to atmosphere and liquid did not exist above the pump. Most wells are produced with casing pressures between 30 and 125 PSI that would cause a pressure at the collar-size gas separator of 3 to 10 atmospheres assuming that a limited amount of liquid exists above the pump. In this example the gas capacity shown should be multiplied by 3 if the casing pressure is approximately 30 PSIG and by 10 if the casing

pressure is approximately 125 PSIG. The gas capacity of the collar-size gas separator increases with the surrounding gas pressure.

Gas Separator Installation Instructions

Use a pipe wrench on the very ends of the gas separator only. Each end of the separator has a collar that is strong enough to be tightened with a pipe wrench. Do not put the pipe wrench on the center portion of the gas separator that is only 1/8" thick. Install the gas separator at least two joints below a tubing anchor, if a tubing anchor is used. This should allow the gas separator to lay against the casing wall which will improve its performance. Do not use a strainer nipple or a dip-tube below the pump because a steel dip-tube is already permanently installed inside of the gas separator. A volume chamber to hold debris can be run below this gas separator by installation of a joint of tubing (male thread) directly into the bottom of the gas separator. Be sure to seal the bottom of the joint of tubing with a bull plug. Do not have any perforations below the large ports that presently exist in the gas separator. If this separator is used in conjunction with a top hold-down pump, place a joint of tubing that is not perforated below the seating nipple that is slightly longer than the top hold-down pump. Install this gas separator on the bottom of the joint of tubing.

Seminars and Technical Papers

Training seminars discuss the use of the Improved Collar-Size Gas Separator to optimize a well's performance. Please refer to the technical paper available at this website for details of the design, construction, liquid capacities and gas capacities of the various separators. The paper describes downhole gas separation principles including setting the pump below the formation as well as a description of this collar-size gas separator, which is to be used when the pump is set in or above the formation. A list of seminars and of technical papers will be sent upon request. This information can be downloaded at www.echometer.com.

Shipping and Dimensions

The shipping weight of a 2 7/8" Collar-Size Gas Separator is 46 lbs. (25.4 Kg) and ships as one package approximately 5.5 feet long. Additional information about dimensions and weights can be supplied depending upon the particular Collar-Size Gas Separator desired.

| PART NUMBER | COLLAR-SIZE EUE, INCH | WEIGHT LBS. |
|-------------|-----------------------|-------------|
| EQ1930 | 2 3/8 (3.0" OD) | 46 |
| EQ1935 | 2 7/8 (3.75" OD) | 52 |
| EQ1940 | 3 1/2 (4.5" OD) | 75 |

Guarantee

The Improved Collar-Size Gas Separator is guaranteed for a period of one year. The guarantee covers defects in material and workmanship and is limited to replacement of parts and materials.