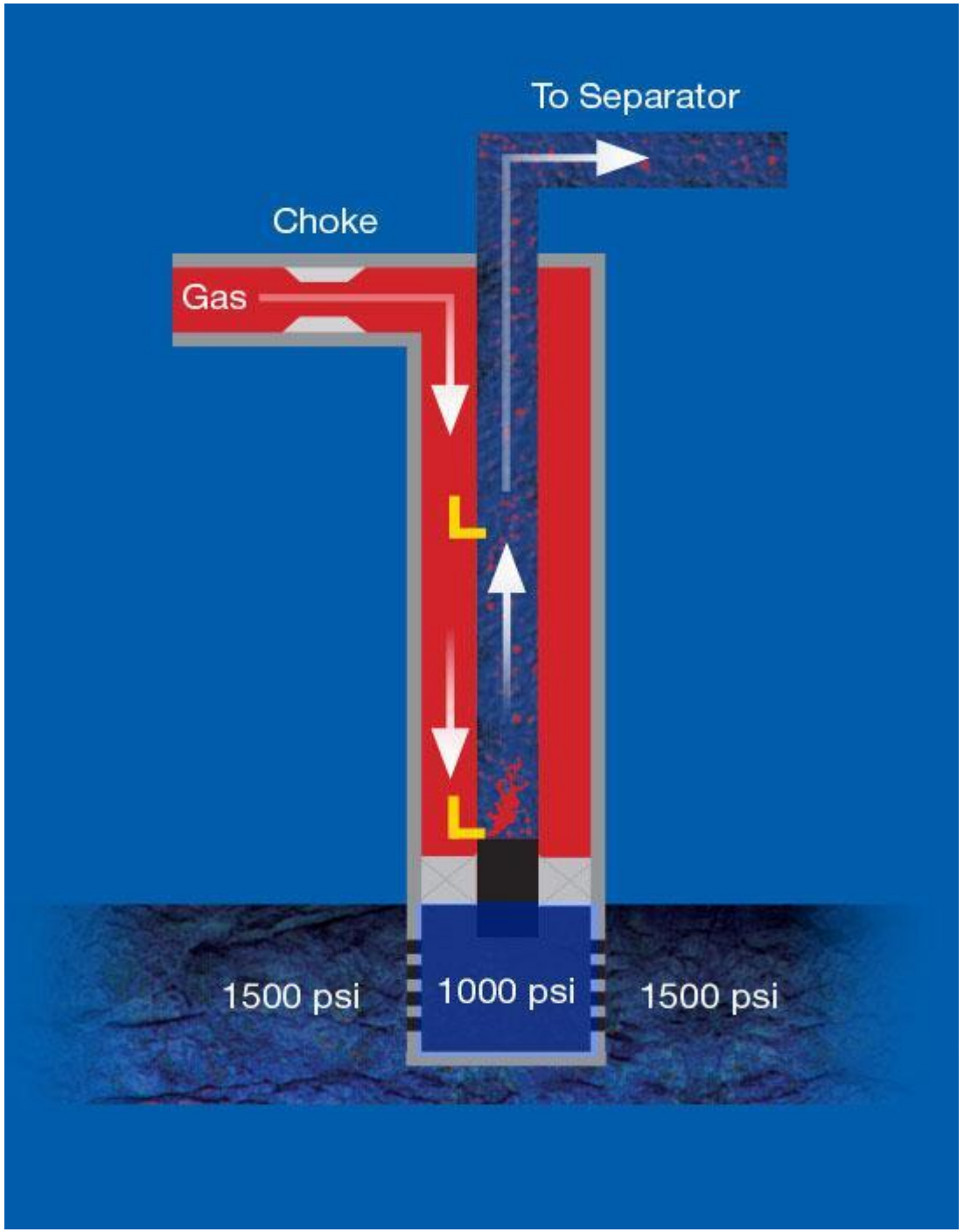
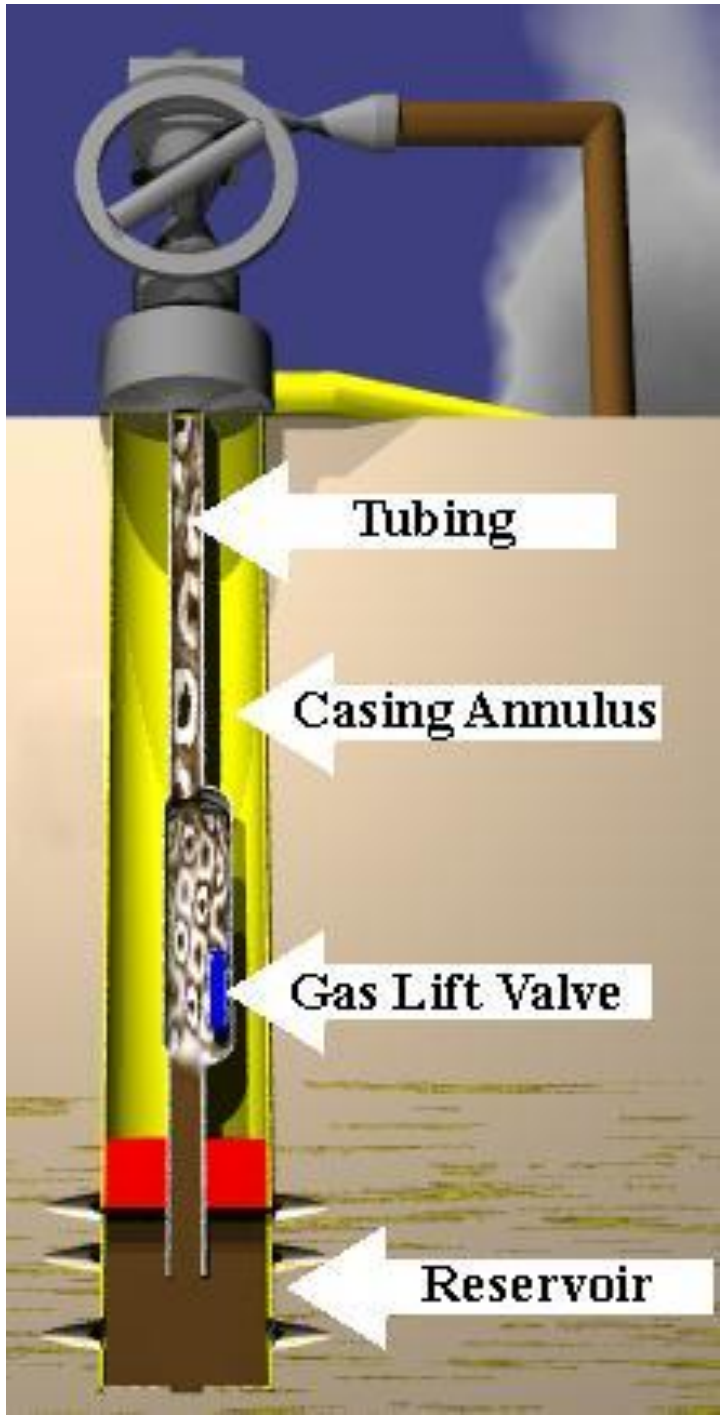

To Separator
Choke
Gas
1500 psi
1000 psi
1500 psi


Tubing
Casing Annulus
Gas Lift Valve
Reservoir

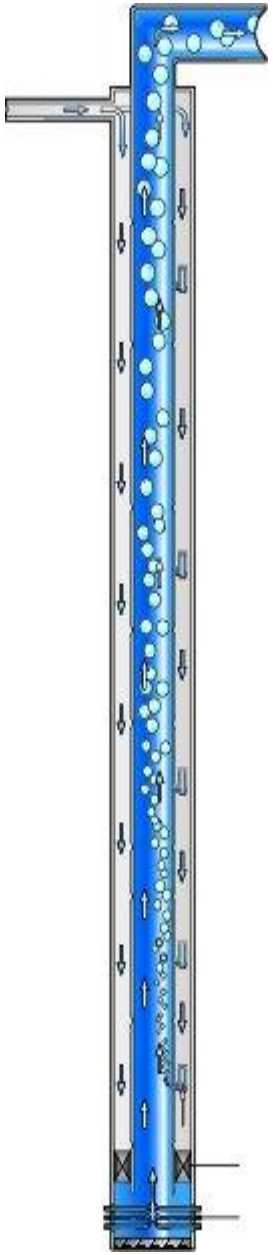
GAS LIFT

GAS LIFT

Purpose

Gas is injected down the well and the gas bubbles reduce the density of the fluid column to lift the oil from the well.

- Unload water from gas wells
- Wire line retrievable
- Excellent handling of sandy conditions
- Minimal moving parts
- Offshore applications



Gas lift is a method of artificial lift that uses an external source of high-pressure gas for supplementing formation gas to lift the well fluids. The principle of gas lift is that gas injected into the tubing reduces the density of the fluids in the tubing, and the bubbles have a “scrubbing” action on the liquids. Both factors act to lower the flowing bottomhole pressure (BHP) at the bottom of the tubing. There are two basic types of gas lift in use today:

- **Continuous-flow gas lift**
- **Intermittent-flow gas lift**

CONTINUOUS-FLOW GAS LIFT

The vast majority of gas lift wells are produced by continuous flow, which is very similar to natural flow.

In continuous-flow gas lift, the formation gas is supplemented with additional high-pressure gas from an outside source. Gas is injected continuously into the production conduit at a maximum depth that depends upon the injection-gas pressure and well depth. The injection gas mixes with the produced well fluid and decreases the density and, subsequently, the flowing pressure gradient of the mixture from the point of gas injection to the surface. The decreased flowing pressure gradient reduces the flowing bottomhole pressure below the static bottomhole pressure thereby creating a pressure differential that allows the fluid to flow into the wellbore.

Continuous-flow gas lift is recommended for high-volume and high-static BHP wells in which major pumping problems could occur with other artificial lift methods. It is an excellent application for offshore formations that have a strong waterdrive, or in waterflood reservoirs with good PIs and high gas/oil ratios (GORs). When high-pressure gas is available without compression or when gas cost is low, gas lift is especially attractive. Continuous-flow gas lift supplements the produced gas with additional gas injection to lower the intake pressure to the tubing, resulting in lower formation pressure as well.

ADVANTAGES OF CONTINUOUS GAS LIFT

- Gas lift is the best artificial lift method for handling sand or solid materials.
- Deviated or crooked holes can be lifted easily with gas lift. This is especially important for offshore platform wells that are usually drilled directionally.
- Gas lift permits the concurrent use of wireline equipment, and such downhole equipment is easily and economically serviced.
- The normal gas-lift design leaves the tubing fully open. This permits the use of BHP surveys, sand sounding and bailing, production logging, cutting, paraffin, etc.
- High-formation GORs are very helpful for gas-lift systems but hinder other artificial lift systems.
- Gas lift is flexible. A wide range of volumes and lift depths can be achieved with essentially the same well equipment.
- A central gas-lift system easily can be used to service many wells or operate an entire field.
- A gas-lift system is not obtrusive; it has a low profile. The surface well equipment is the same as for flowing wells except for injection-gas metering.
- Well subsurface equipment is relatively inexpensive. Also, major well workovers occur infrequently.
- Installation of gas lift is compatible with subsurface safety valves and other surface equipment.

DISADVANTAGES OF CONTINUOUS GAS LIFT

- Relatively high backpressure may seriously restrict production in continuous gas lift. This problem becomes more significant with increasing depths and declining static BHPs..
- Gas lift is relatively inefficient, often resulting in large capital investments and high energy-operating costs..
- Adequate gas supply is needed throughout life of project. If the field runs out of gas, or if gas becomes too expensive, it may be necessary to switch to another artificial lift method. In addition, there must be enough gas for easy startups.
- Operation and maintenance of compressors can be expensive
- There is increased difficulty when lifting low gravity (less than 15°API) crude because of greater friction, gas fingering, and liquid fallback.

INTERMITTENT-FLOW GAS LIFT

As the name implies, intermittent flow is the periodic displacement of liquid from the tubing by the injection of high-pressure gas. The action is similar to that observed when a bullet is fired from a gun. The liquid slug that has accumulated in the tubing represents the bullet. When the trigger is pulled (gas lift valve opens), high-pressure injection gas enters the chamber (tubing) and rapidly expands. This action forces the liquid slug from the tubing in the same way that expanding gas forces the bullet from the gun. The disadvantage of intermittent-flow gas lift is the "on/off" need for high-pressure gas, which presents a gas-handling problem at the surface and causes surging in the flowing bottomhole pressure that cannot be tolerated in many wells producing sand. Because of the intermittent production of the well, intermittent-flow gas lift is not capable of producing at as high a rate as continuous-flow gas lift. Intermittent flow should not be considered unless the flowing bottomhole pressure is low, and the well is gas lifting from the bottom valve.

The intermittent gas-lift method typically is used on wells that produce low volumes of fluid (approximately < 150 to 200 B/D), although some systems produce up to 500 B/D. Wells in which intermittent lift is recommended normally have the characteristics of high productivity index (PI) and low bottomhole pressure (BHP) or low PI with high BHP. Intermittent gas lift can be used to replace continuous gas lift on wells that have depleted to low rates or used when gas wells have depleted to low rates and are hindered by liquid loading.

ADVANTAGES INTERMITTENT GAS LIFT

Intermittent gas lift has many of the same advantages/disadvantages as continuous-flow gas lift, and the major factors to be considered are similar.

- Intermittent gas lift typically has a significantly lower producing BHP than continuous gas-lift methods.
- It has the ability to handle low volumes of fluid with relatively low production BHPs.

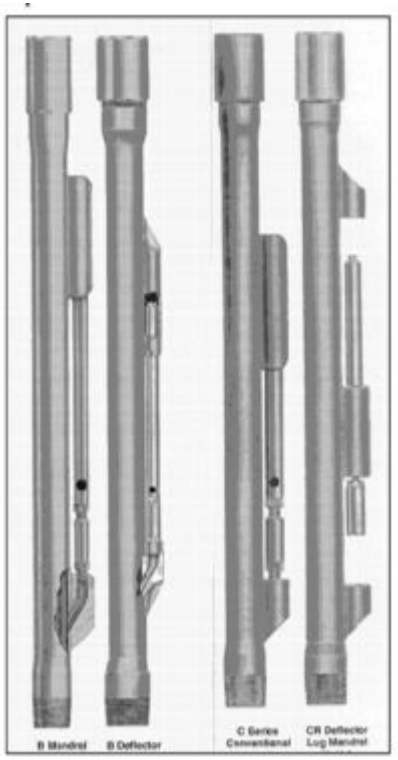
DISADVANTAGES INTERMITTENT GAS LIFT

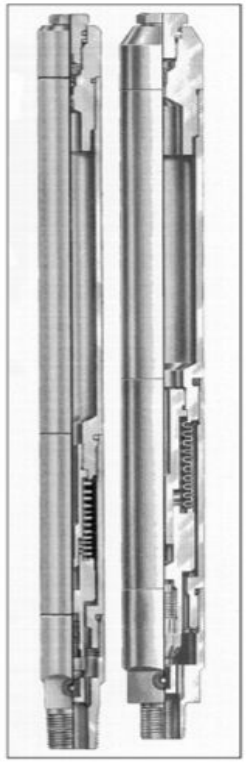
- Intermittent gas lift is limited to low volume wells.
- The average producing pressure of a conventional intermittent lift system is still relatively high when compared with rod pumping; however, the producing BHP can be reduced by use of chambers. Chambers are particularly suited to high PI, low BHP wells.
- The power efficiency is low. Typically, more gas is used per barrel of produced fluid than with constant flow gas lift. Also, the fallback of a fraction of liquid slugs being lifted by gas flow increases with depth and water cut, making the lift system even more inefficient.
- Fluctuations in rate and BHP can be detrimental to wells with sand control. The produced sand may plug the tubing or standing valve. Also, pressure fluctuations in surface facilities cause gas- and fluid-handling problems.
- Intermittent gas lift typically requires frequent adjustments.

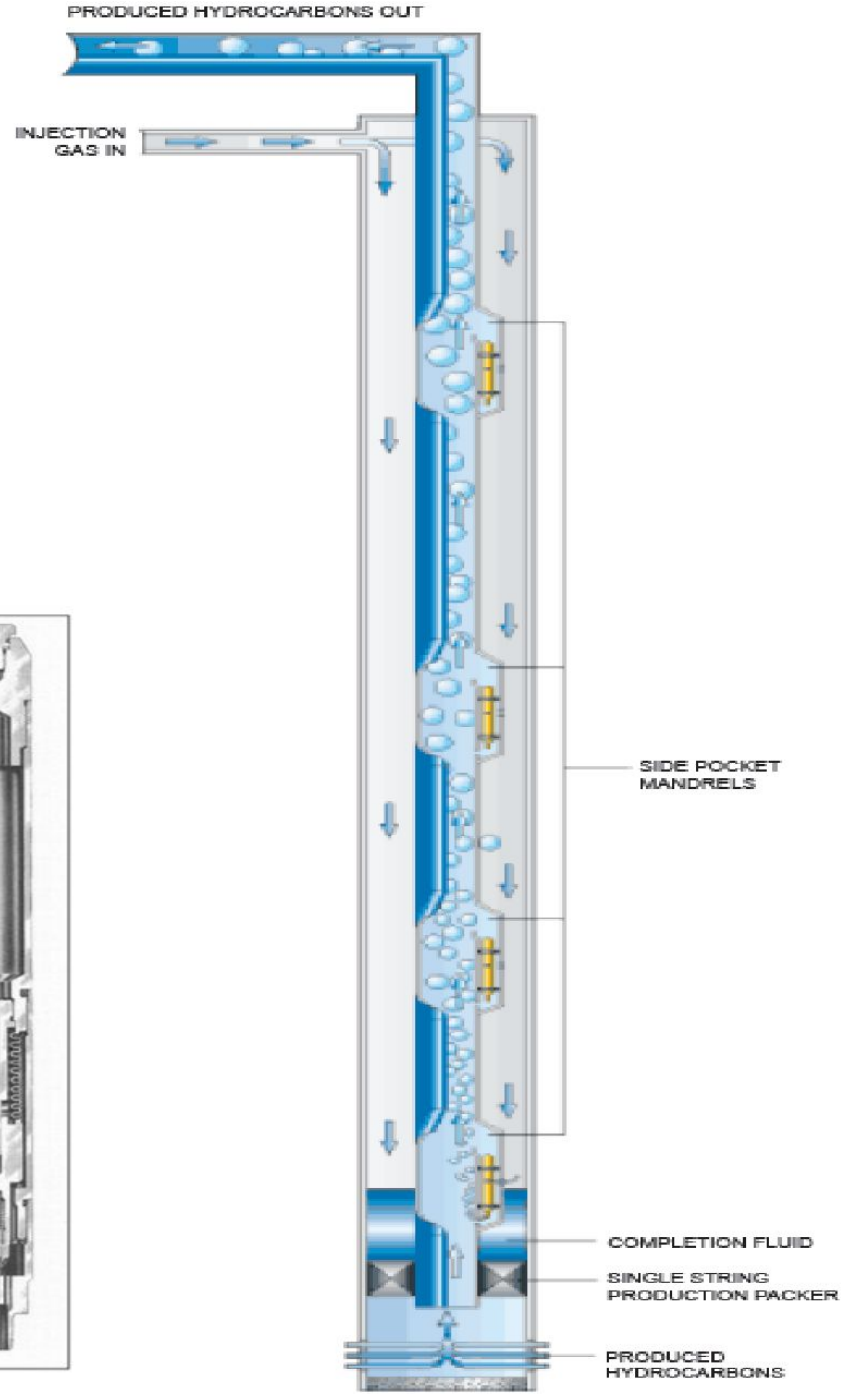
GAS LIFT

There are two main components of the gas lift system that are put inside the tubing string of the well.

1. Madrel
2. Valve







GAS LIFT SYSTEM LIMITATIONS

- Needs High-Pressure Gas Well or Compressor
- One Well Leases May Be Uneconomical
- Fluid Viscosity
- Bottom hole Pressure
- High Back-Pressure

GAS LIFT SYSTEM APPLICATION CONSIDERATIONS

- OperatingDepth5,000 -10,000’ TVD15,000’ TVD
- OperatingVolume100 -10,000 BPD30,000 BPD
- Wellbore 0-50° 70°Deviation Short to Medium Radius
- Corrosion Handling is Good to Excellent with Upgraded Materials
- Gas Handling
- Gravity Best in >15° API
- Servicing : Wireline or Work over Rig
- Prime Mover Type: Compressor
- Offshore Application: Excellent System
- Efficiency10% -30%

Artificial Lift Overview

	Rod Lift	PCP	Gas Lift	ESP	Plunger Lift
Depth (TVD)	<16,000'	<6,000'	<15,000'	<15,000'	<21,000'
Volume	<6,000 BPD	<6,000 BPD	<30,000 BPD	<54,000 BPD	<200 BPD
Temperature	<550° F	<300° F	N/A	<400° F	<550° F
Corrosion	Good to Excellent	Fair	Good to Excellent	Good	Excellent
Gas	Fair to Good	Good	Excellent	Fair	Excellent
Solids	Fair to Good	Excellent	Good	Fair	Fair
Fluid Gravity	>8° API	<35° API	>15° API	>10° API	>15° API
Servicing	Workover or Pulling Rig	Workover or Pulling Rig	Wireline or Workover Rig	Workover or Pulling Rig	Wellhead Catcher or Wireline
Prime Mover	Gas or Electric	Gas or Electric	Compressor	Electric Motor	Well's Energy
Offshore	Limited	Good	Excellent	Excellent	N/A
Efficiency	45% - 60%	40%-70%	10%-30%	35%-60%	N/A