# SEPARATOR OPERATION

- PRINCIPLE OF OPERATION
- CAPACITIES AND RETENTION TIME
- LEVEL CONTROL
- OIL METERING
- GAS METERING
- SAFETY FEATURES

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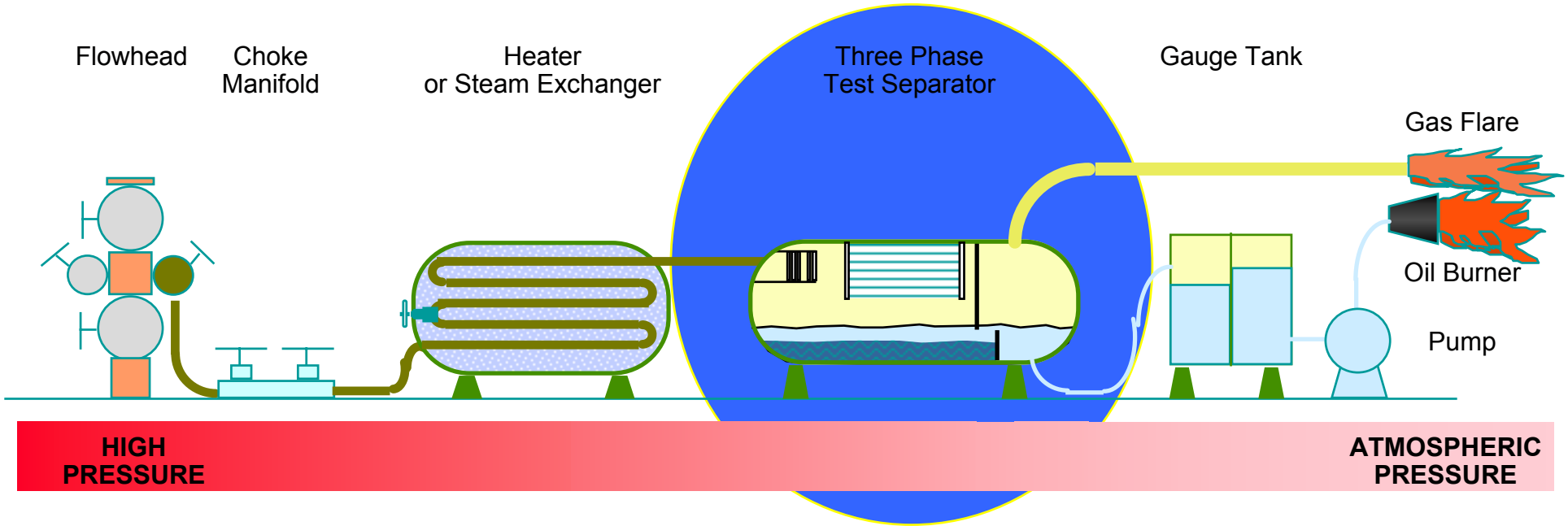
# SEPARATOR OPERATION

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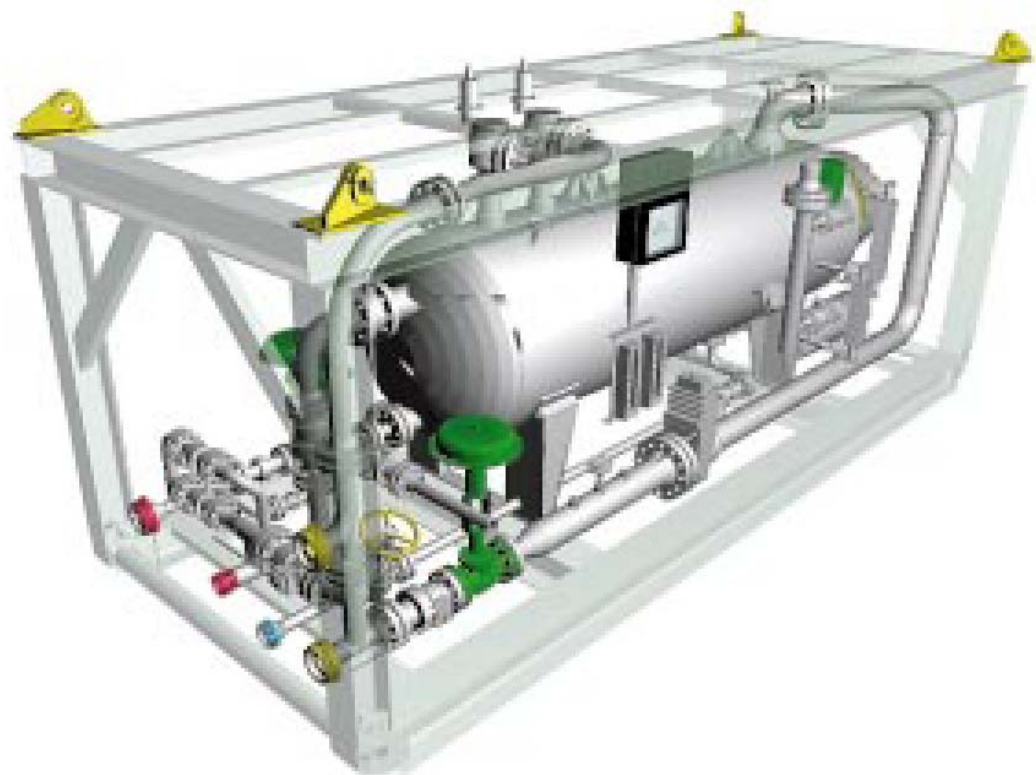
# SEPARATOR OPERATION



## Test separator

Test separators are versatile pieces of equipment that allow separation, metering and sampling of all phases of the effluent.

Because test separators are used on exploration wells where the effluent is unknown, they must be able to treat widely varying effluents such as gas, gas condensate, light oil, heavy oil and foaming oil, as well as oil containing water and impurities such as mud or solid particles.

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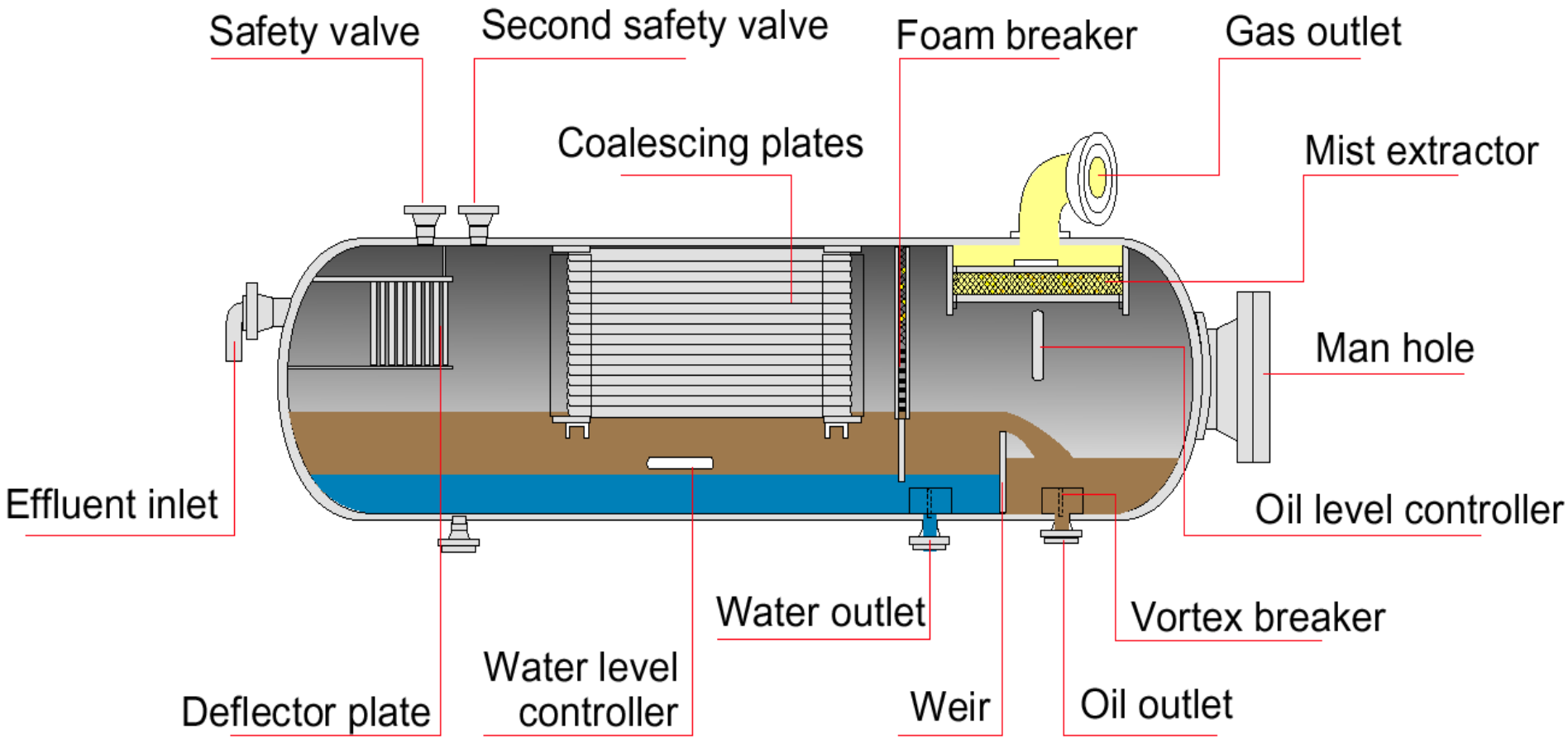
# SEPARATOR OPERATION

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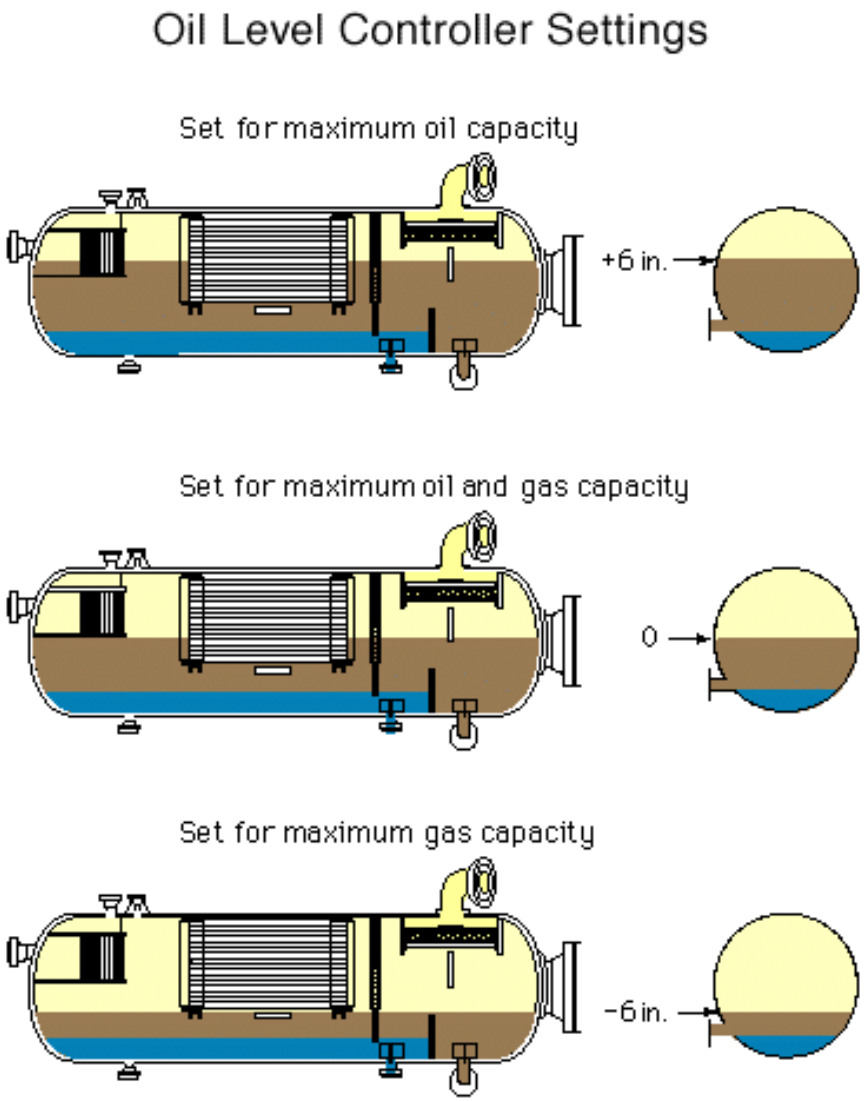
# SEPARATOR OPERATION




The vessel capacity for each phase depends on the current conditions of pressure and temperature and effluent properties such as:

- Viscosities and densities of the liquids, which are a function of the amount of dissolved gas vessel operating
- Liquid level
- Vessel internals
- Required liquid gas separator efficiency in terms of size of liquid droplet to be separated from the gas phase.

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# SEPARATOR OPERATION

| Type of Separator | Level Position | Liquid Capacity (BOPD) for 1-min Retention Time | Gas Capacity (MMscf/D) |
|---|---|---|---|
| SEP-T test separator 42 in. × 10 ft, 1440 psi | +6 in. / Center line / –6 in. | 0 5 10 15 20 | 0 10 20 30 40 50 60 70 80 90; 200 400 600 800 1000 1200 1440 |
| SEP-G test separator 42 in. × 15 ft, 720 psi | +6 in. / Center line / –6 in. | | 200 400 600 720 |
| SEP-N test separator 48 in. × 12.5 ft, 1440 psi | +6 in. / Center line / –6 in. | | 200 400 600 800 1000 1200 1440 |

The vessel capacity for oil versus liquid level and gas capacity versus pressure and liquid level.

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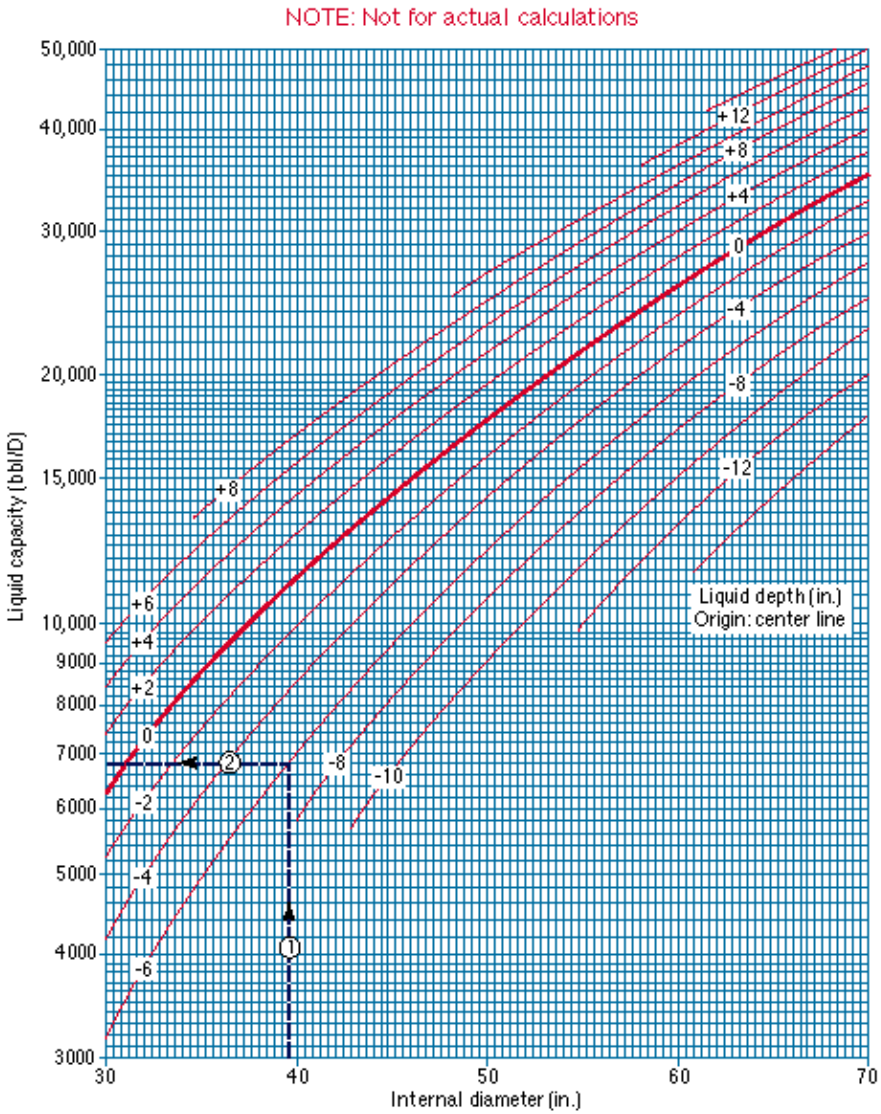
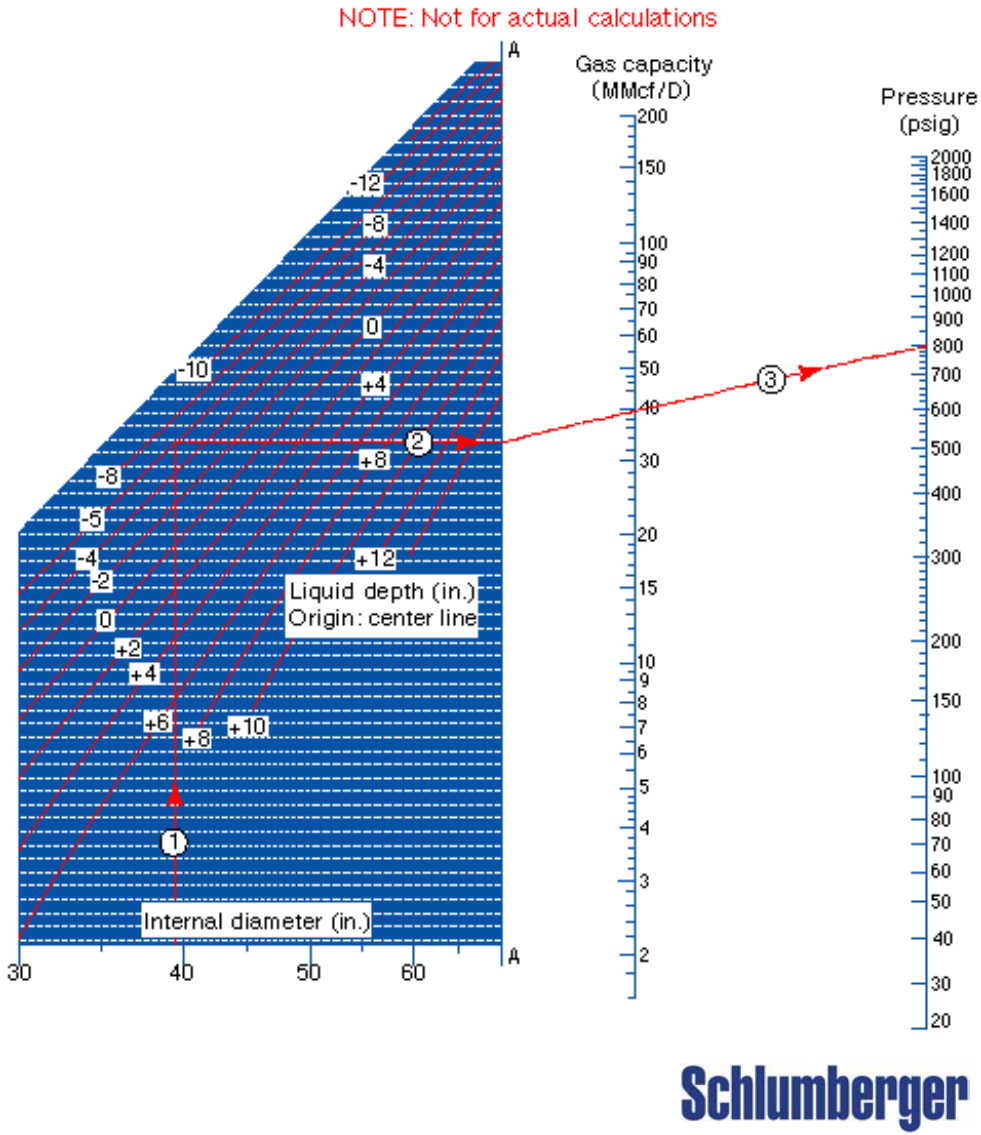
# SEPARATOR OPERATION

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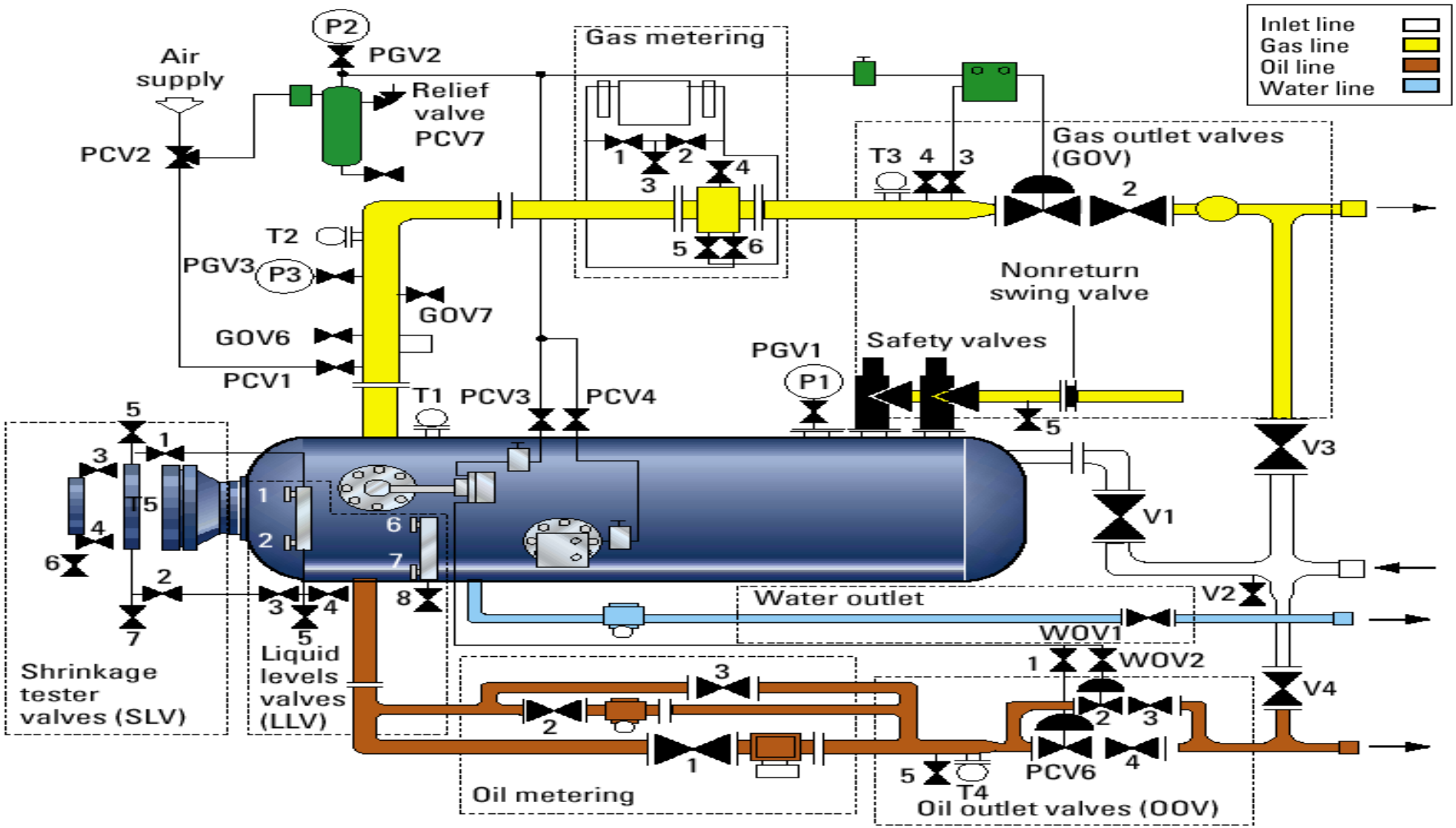
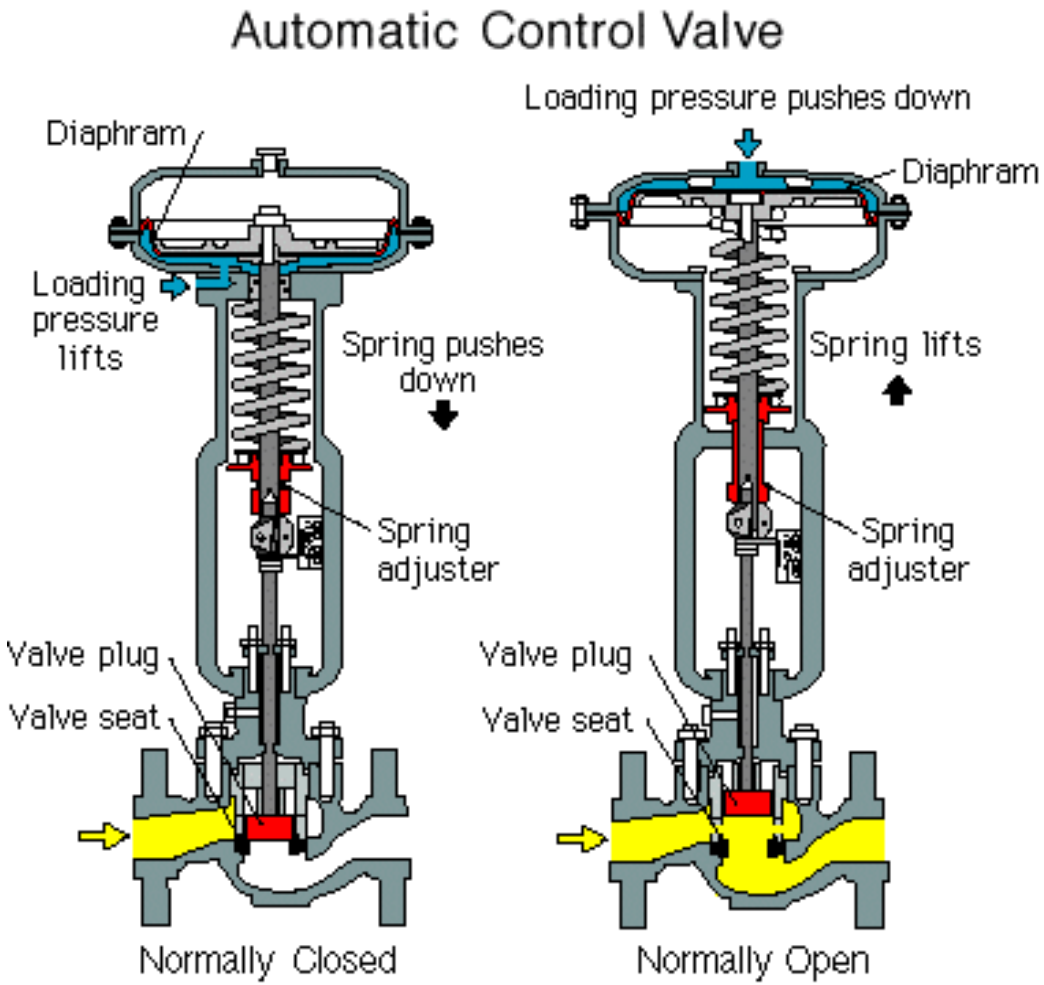


# SEPARATOR OPERATION




## Control systems

Gas line control: 'Wizard'
One 3" PCV (Pressure Control Valve)
*Fail Safe Open* to release vessel pressure if air supply is lost.

Oil line control: 'LevelTrol'
One 1" and one 2" LCV (Liquid Control Valve)
*Fail Safe Closed* to retain oil (minimize pollution) if air supply is lost.

Water line control: 'LevelTrol'
One 2" LCV (Liquid Control Valve)
*Fail Safe Closed* to retain liquid (minimize pollution) if air supply is lost.

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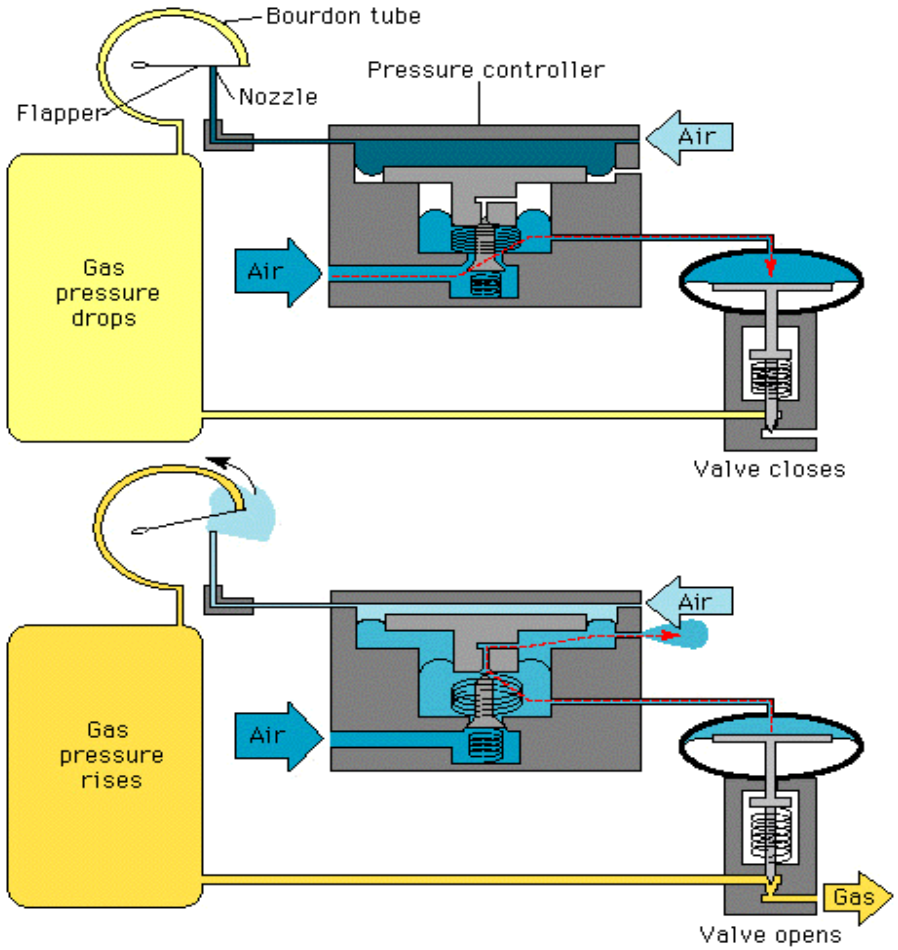
# SEPARATOR OPERATION




## Pressure control

When gas line pressure drops bourdon tube contracts closing nozzle, relay switches allowing pressure build up to close valve.

As gas line pressure rises bourdon tube expands opening relay and releasing pressure from valve allowing it to open.

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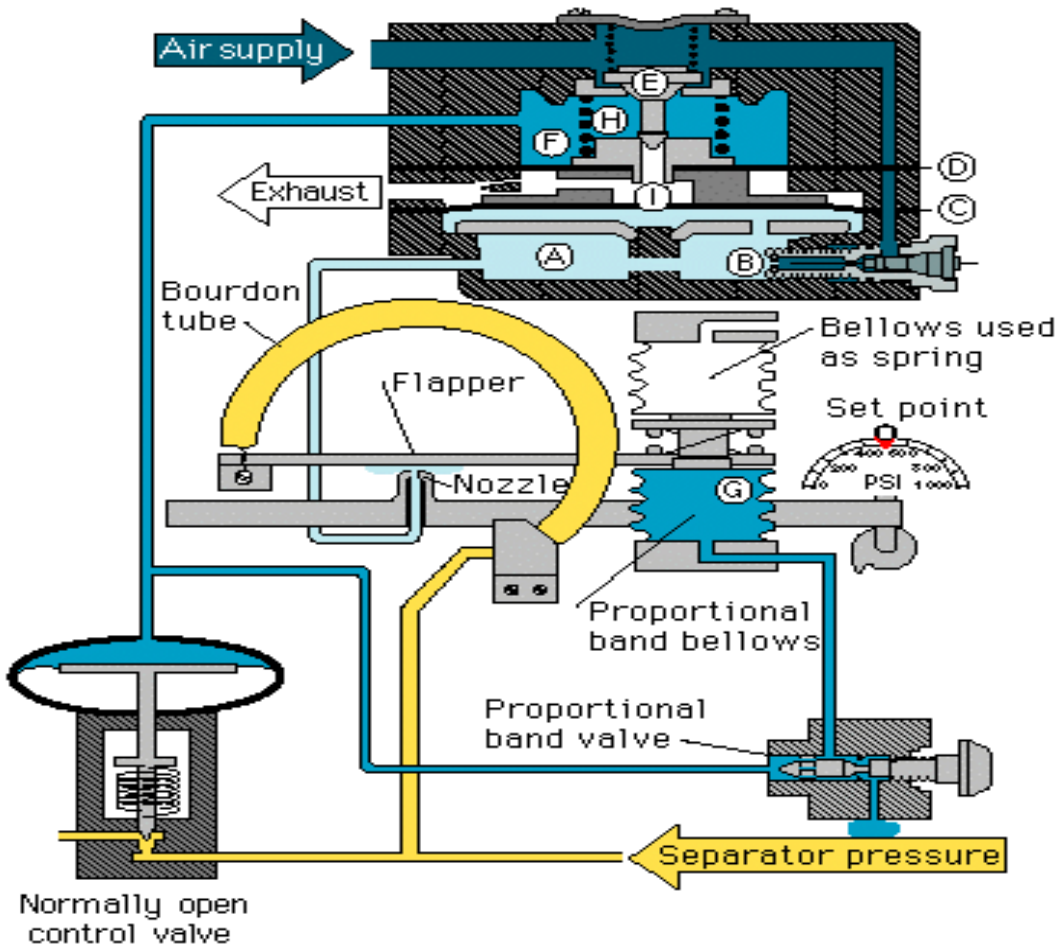
# SEPARATOR OPERATION




## Pressure control proportional band.

The proportional band valve reduces the response time of the valve to act as a damper and prevent oscillation of the valve, and therefore, reducing pressure oscillation in the Separator vessel.

Full range is 1500 psi

10 % on the PB ->

75 psi before valve open or close fully above and below set point

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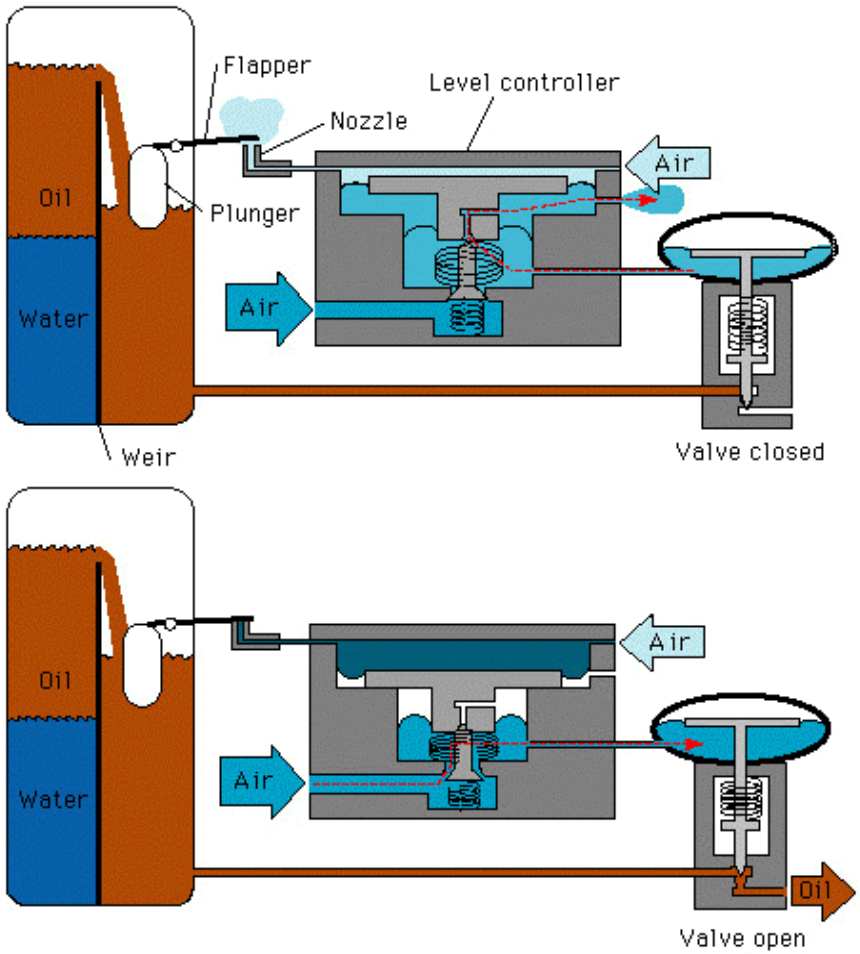
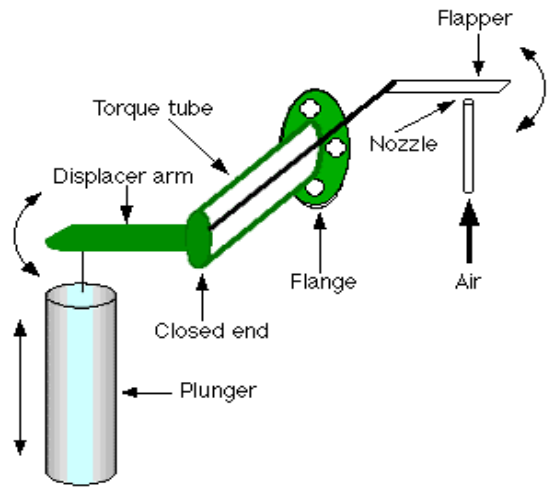
# SEPARATOR OPERATION




## Level control

With low level flapper nozzle is open to atmosphere. Pressure cannot build up and valve remains closed. As level increases float rises closing the nozzle with the float. Pressure builds up and valve opens.

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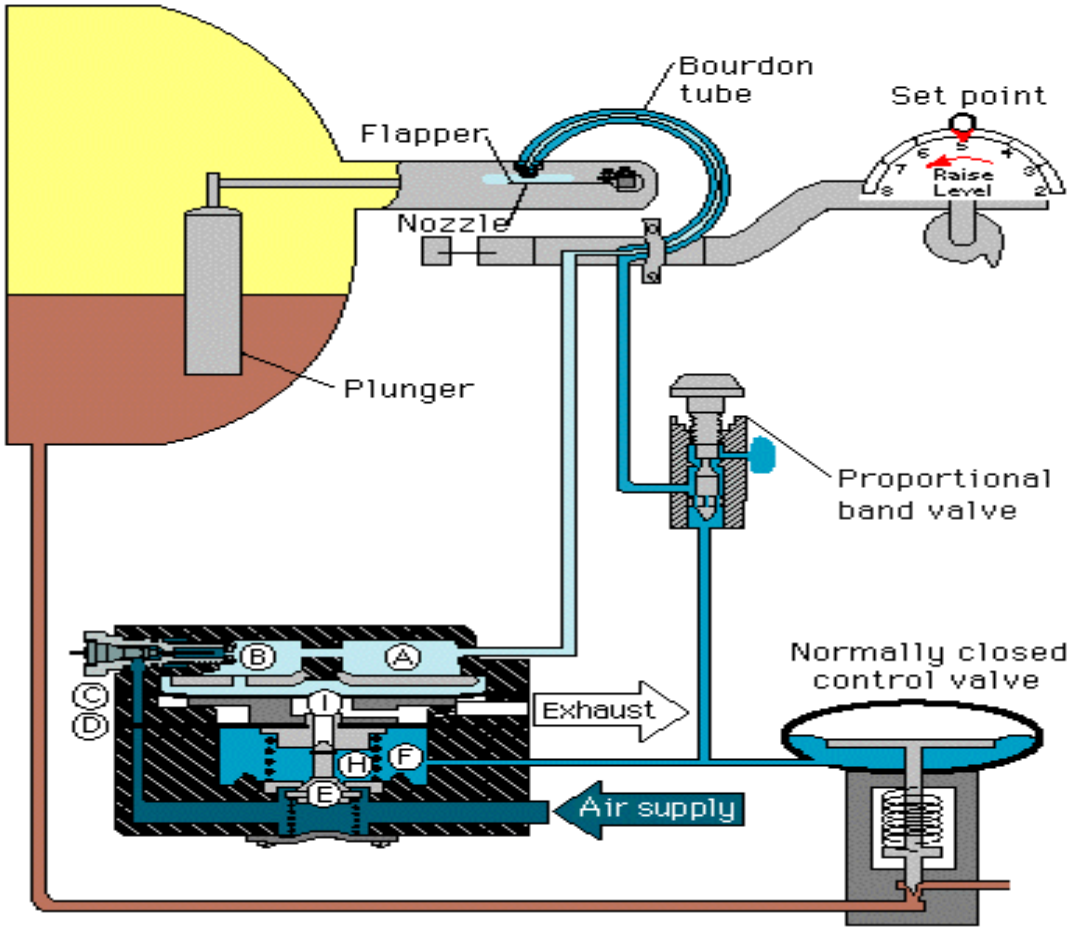


## Level control proportional band

The proportional band valve reduces the response time of the valve to act as a damper and prevent oscillation of the valve.

Full range is 12 inches
10 % on the PB ->
0.6 in before valve open or close fully above and below set point

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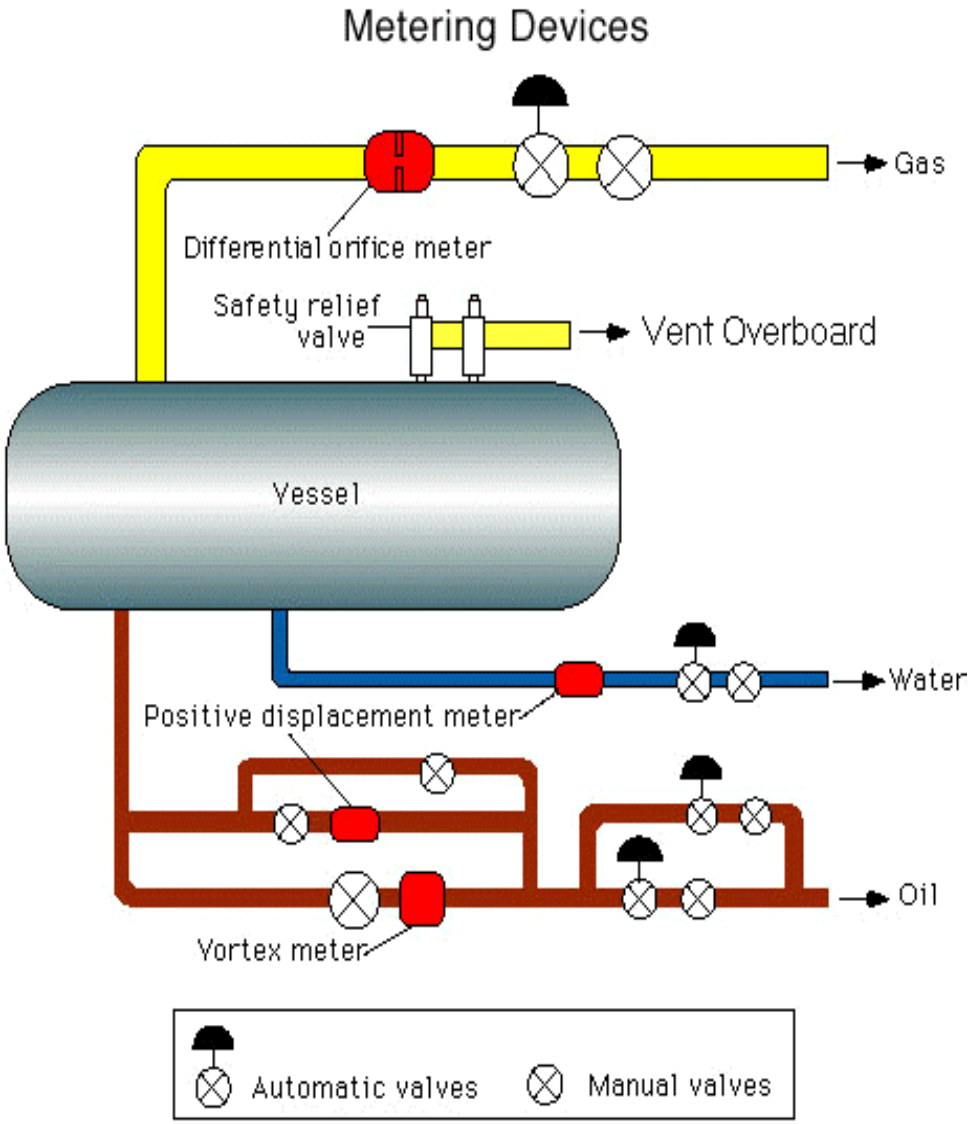
# SEPARATOR OPERATION




## Metering

Gas metering:

- Daniel orifice
- Barton chart recorder

Oil metering:

- 3" Rotron vortex meter, High flowrate
- 2" Floco positive displacement meter, Low flowrate

Water metering:

- 2" Floco positive displacement meter, 3 phase separation
- BSW at choke manifold, 2 phase separation

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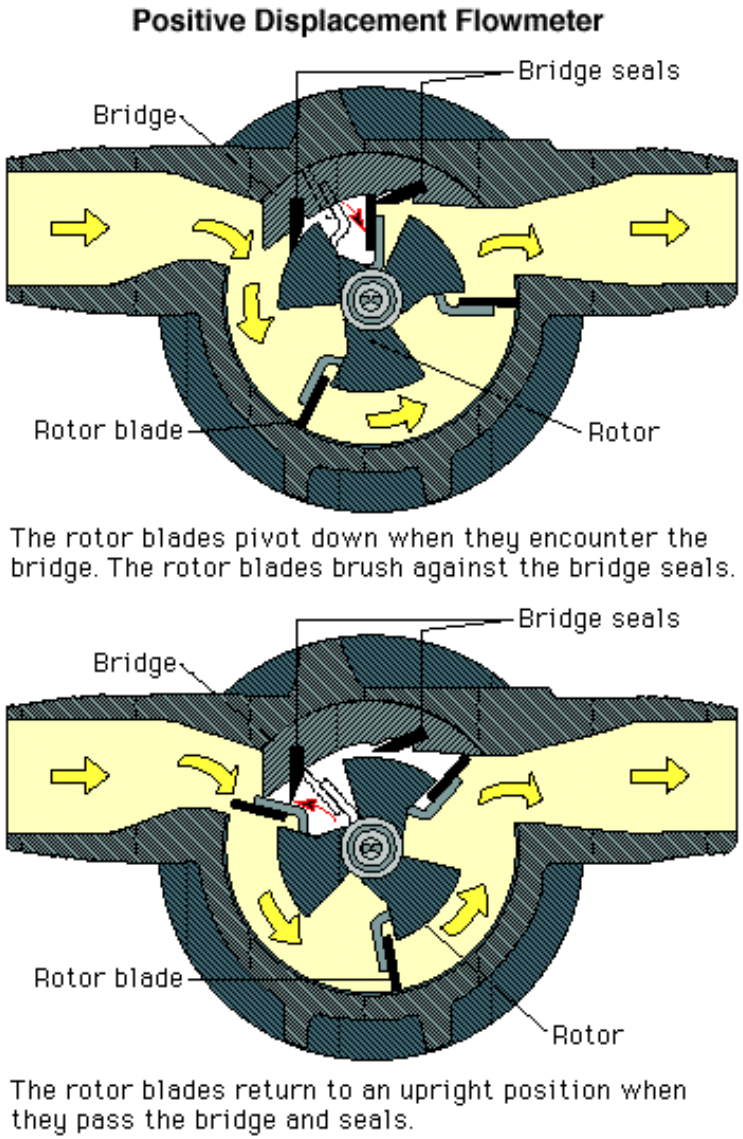
# SEPARATOR OPERATION




## Oil/water metering- Floco

The positive displacement meter measures the liquid passing through it by separating the liquid into segments and counting the segments. Liquid entering the meter strikes the bridge and is deflected downward, hitting the blades and turning the rotor in the right direction. The seals on the bridge prevent the liquid from returning to the inlet side. The rotor movement is transferred to a register (readout device) with magnetic coupling.

2-in. Positive displacement  meter 100 to 2200 bpd (up to 3400 bpd within 24 hours).

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# Oil/water metering- Floco

| | Meter | Register Part Number | Change Gear (Top) Driven | | Change Gear (bottom) Drive | | Magnetic Drive Gear Ratio | Magnetight Retrofit | |
|---|---|---|---|---|---|---|---|---|---|
| | | | No Teeth | Dia. | No Teeth | Dia. | | Kit No. | Part No |
|  | P2500-1 P2500-2 | 3059 | 30 | .670 | 27 | .670 | 40 :1 | 1 | 0500-0009A |
| | P2500-3 | 3059 | 20 | .460 | 36 | .860 | 40 :1 | 1 | 0500-0009A |

1. All listings on this sheet are standard issue

It is important to check the Floco gearing is set for the correct units especially when swapping between conventional and electronic sensors.

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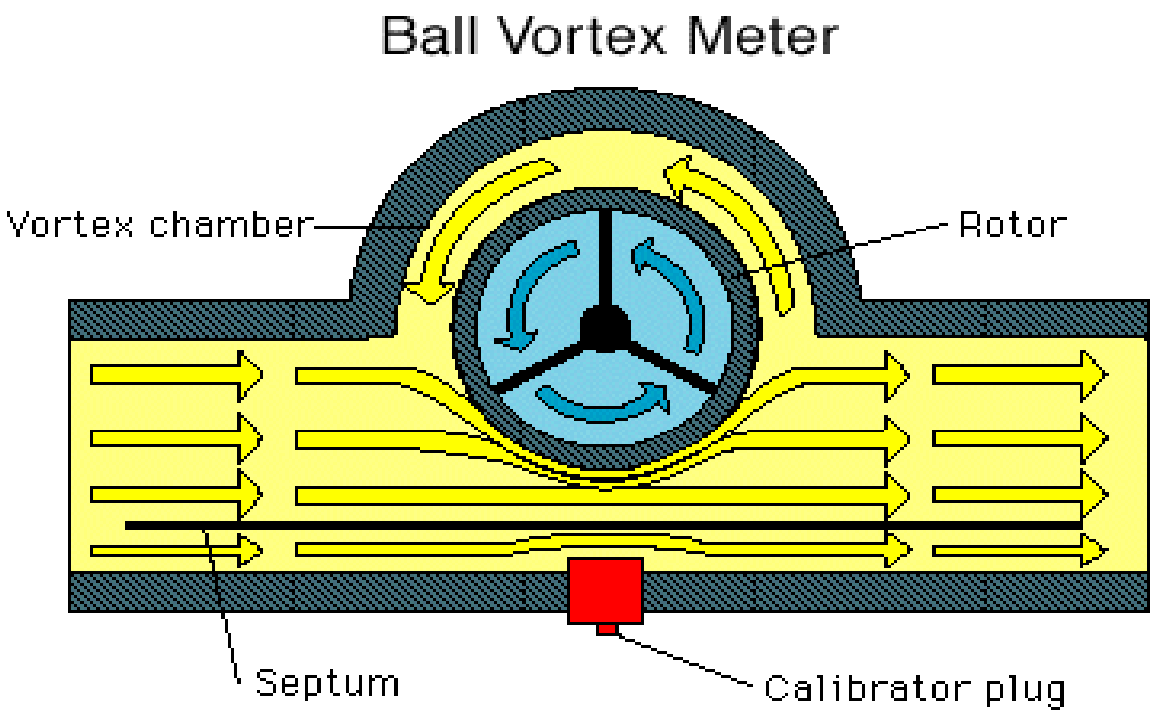
# SEPARATOR OPERATION




Meter type and rating in barrels per/day:

| | Ball bearings | Sleeve bearings |
|---|---|---|
| 2-in. Vortex meter | 850 to 6800 | 1700 to 8500 |
| 3-in. Vortex meter | 2000 to 17,000 | 3400 to 22,000 |

## Oil metering- Rotron

The ball vortex meter consists of a body with an offset chamber and a rotor that are mounted transversely to the flow stream. When liquid flows through the meter, a vortex is created in the offset chamber. The rotational velocity of the liquid vortex is proportional to the rate of flow. The rotor movement is transferred to a register (readout device) with magnetic coupling.

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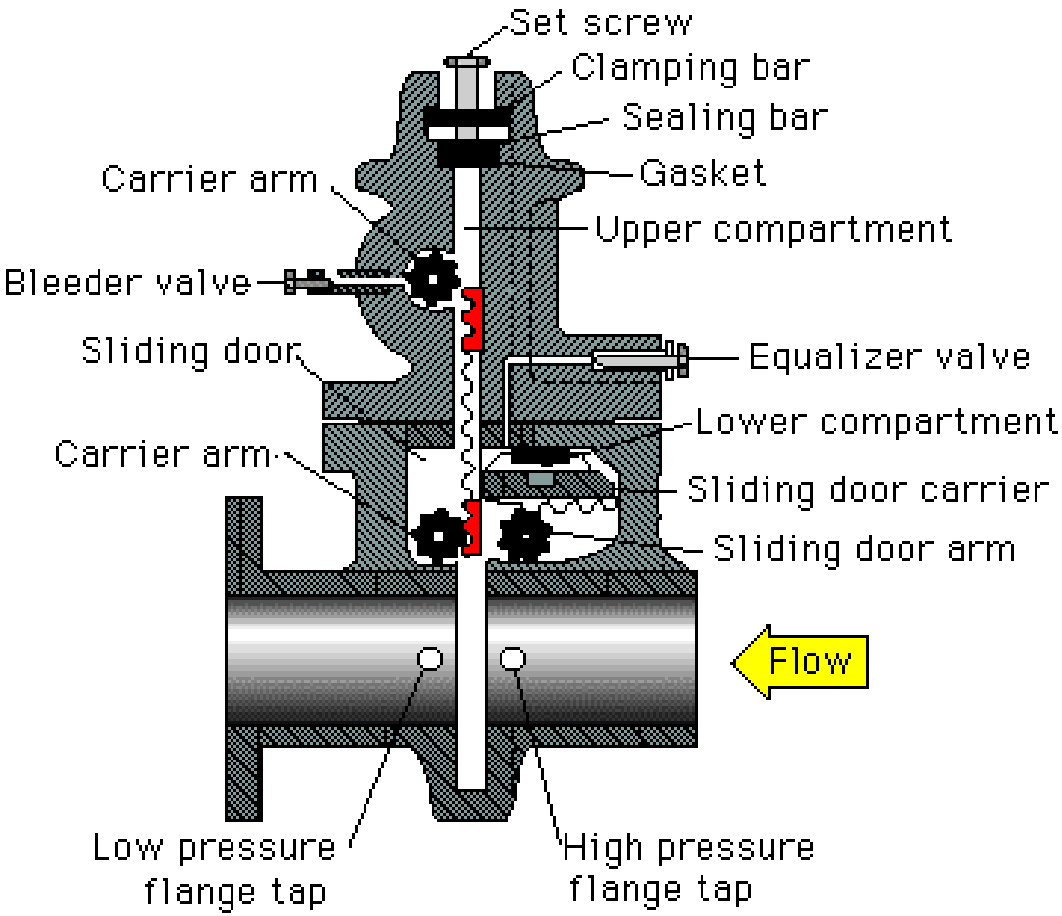
# Gas metering

The Daniel orifice meter: Orifice plate generates a differential pressure which when combined with Static pressure and gas temperature allows a gas rate to be calculated.

# SEPARATOR OPERATION




## Gas meter

At the beginning of a test, the gas flow rate is unknown. During the test, the gas flow rate may change; therefore, different sizes of orifice plates are used.

It's important to have an apparatus that allows the orifice plate to be changed without interrupting the gas flow. The orifice gas meter is designed for this purpose.

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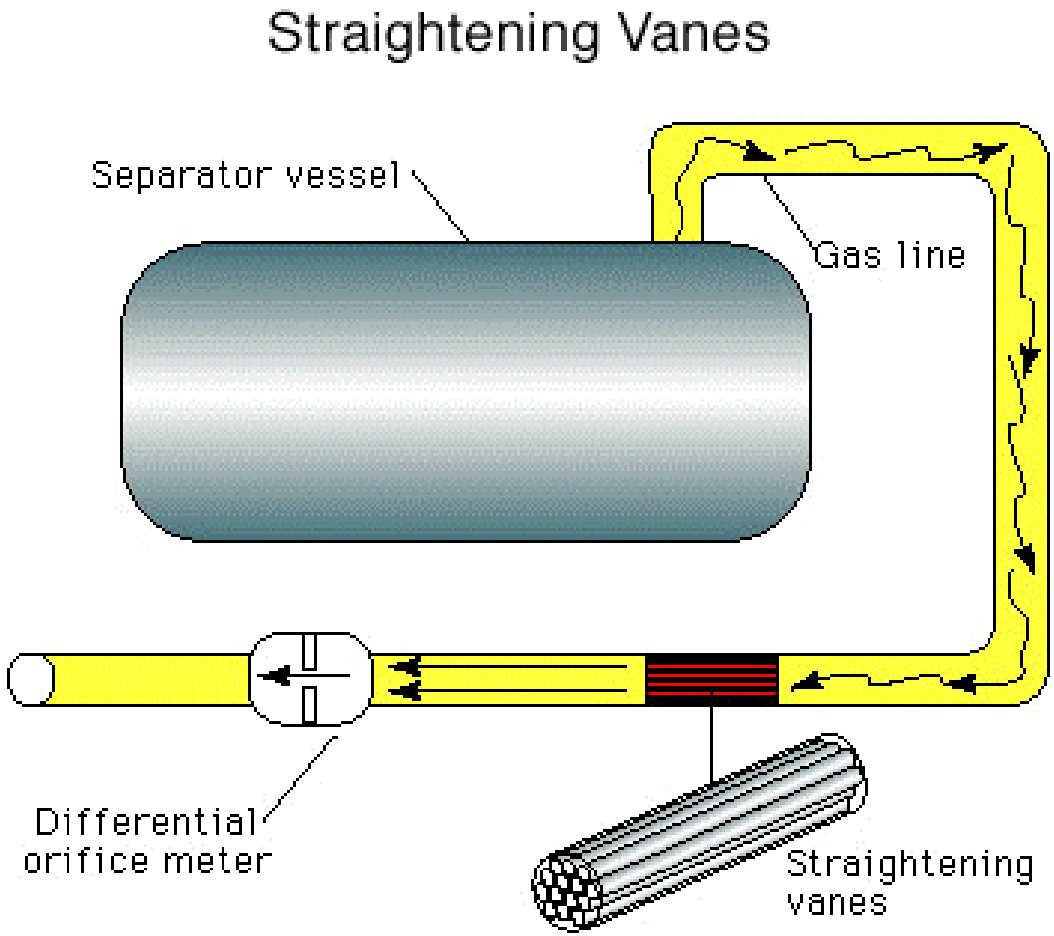
# SEPARATOR OPERATION




## Gas meter

To obtain accurate measurements, the flow of gas must be streamlined before it reaches the meter. An adequate length of straight pipe and straightening vanes (bundle of straight tubes fitted inside the pipe) are positioned before the meter to reduce the disturbances created by the elbows in the gas line.

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# SEPARATOR OPERATION

## Gas metering

To record the differential pressure, a measuring instrument called a differential pressure recorder is used. The high pressure side of the recorder is connected on the upstream side of the orifice and the low pressure side is connected on the downstream side. The movement of the recorder is transferred to a pen that records the differential pressure on a chart. The same chart is used to record the static pressure, measured downstream of the orifice plate. In addition, another pen is used to record the gas temperature.

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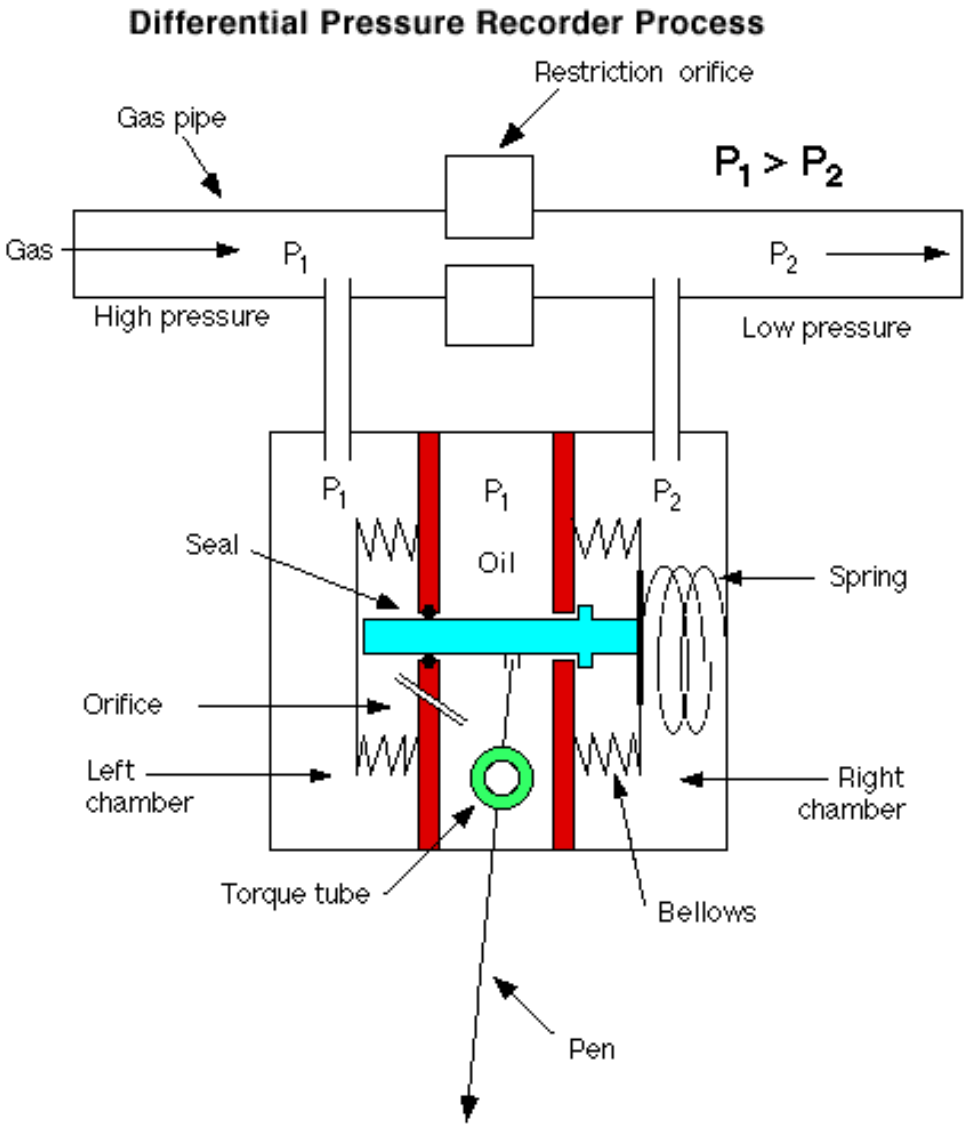
# SEPARATOR OPERATION




## Gas metering

Barton chart recorder

Records gas differential pressure (blue pen).

Records static pressure downstream Of orifice (red pen).

May also record gas line temperature (green pen).

Note: colors given are for the normal situation, check your rig up.

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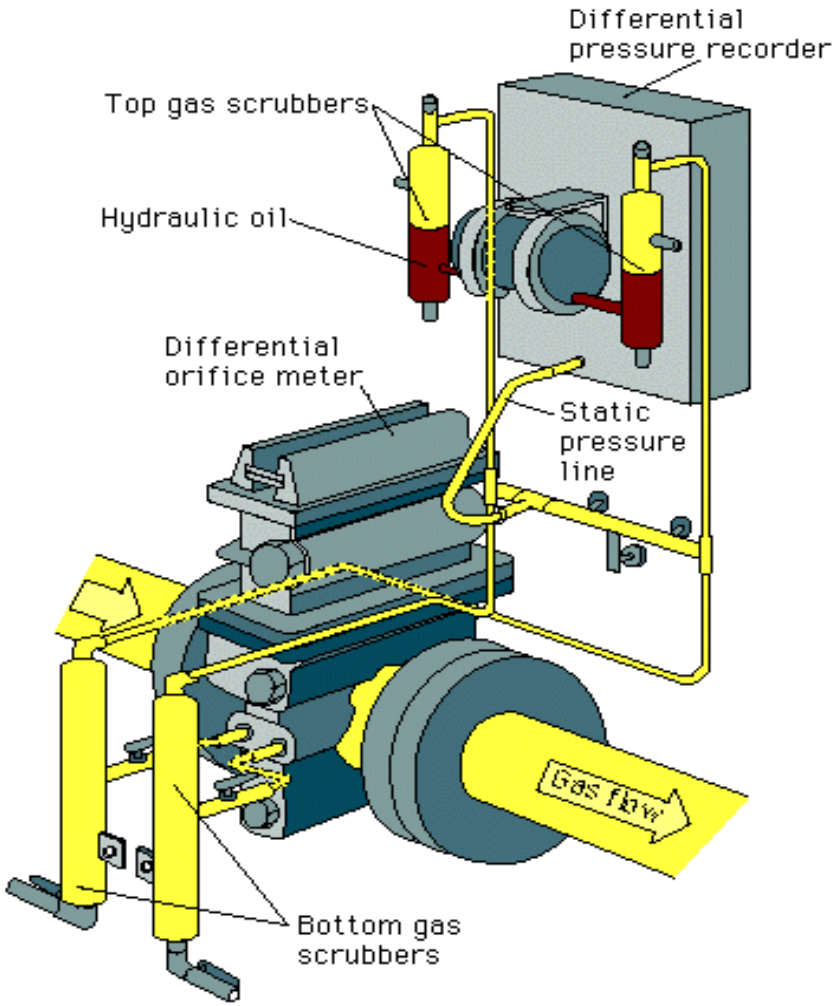
# SEPARATOR OPERATION




## Gas Scrubbers

The gas used to operate the differential pressure recorder is provided by the separator gas line. This gas is first filtered, on both the high and low pressure lines, using bottom gas scrubbers. These gas scrubbers are vertical pots where impurities, oil, and emulsion settle. Before the gas reaches the recorder, it is filtered again by the top gas scrubber. The top scrubbers act as a buffer between the gas and the recorder. In case the gas contains $H_2S$ or $CO_2$(sour gas), the top scrubbers can be filled with hydraulic oil or diesel to prevent direct contact between the gas and the recorder

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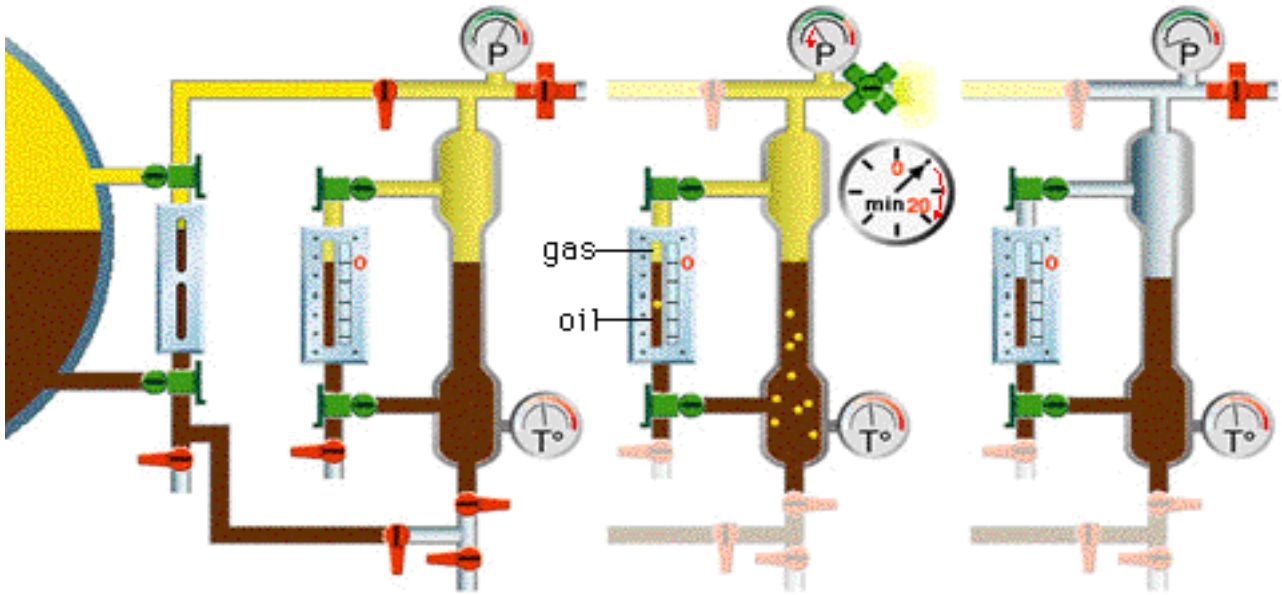
# SEPARATOR OPERATION




- Measures oil line shrinkage (Shr)
- Necessary for correction of oil and gas rates (GOR2)
- Requires temperature as well as volume reading (K)

## Shrinkage Tester

The shrinkage tester, usually attached to the oil sight glass of the separator, is used to estimate the shrinkage factor in the field. The shrinkage factor is a correction factor used in the oil volume computations. It represents the amount of dissolved gas in the oil that will be freed when the pressure drops from the separator pressure to the atmospheric pressure.

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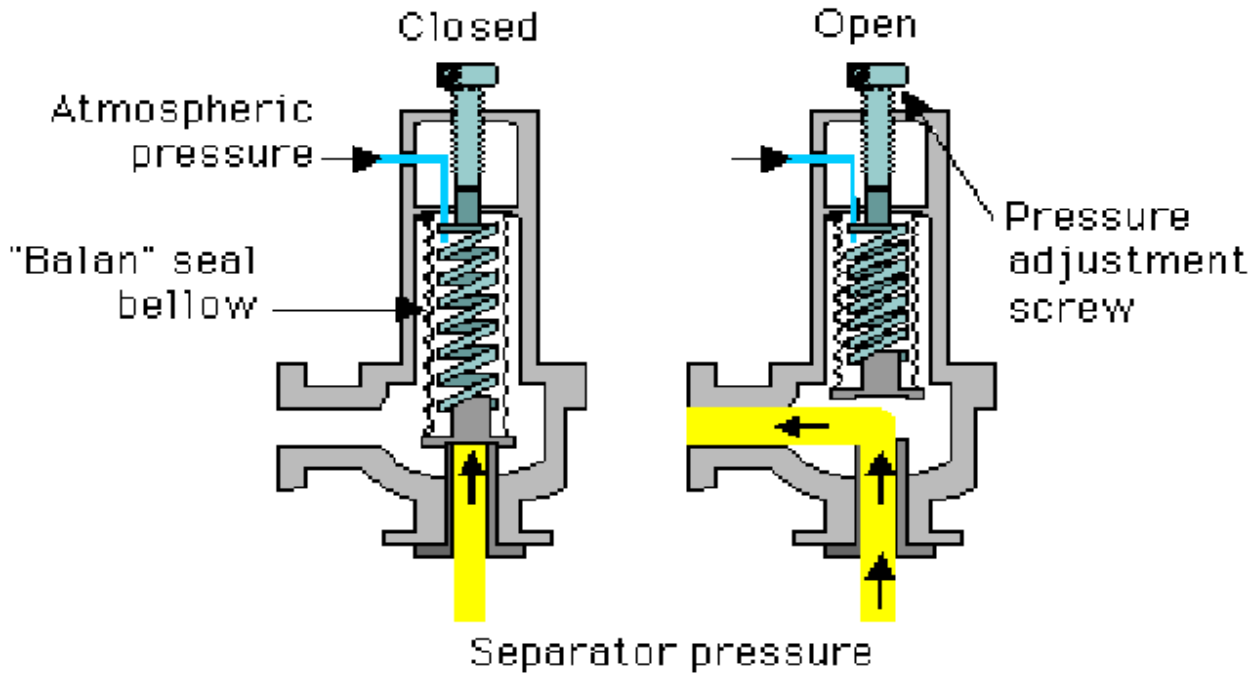
# SEPARATOR OPERATION




The picture shows a old type relief valve, this isn't the pilot operated valve. The basic principal can be understood by looking at this type. If the separator pressure acting on the piston exceeds the spring force acting opposite way the valve lifts from the seats and open.

## Relief valves

Relief valves are installed on all pressurized vessels to protect the vessel from being pressurized above it's working pressure. On the separator there is two valves, normally a pilot operated relief valve set to open when pressure exceeds working pressure.

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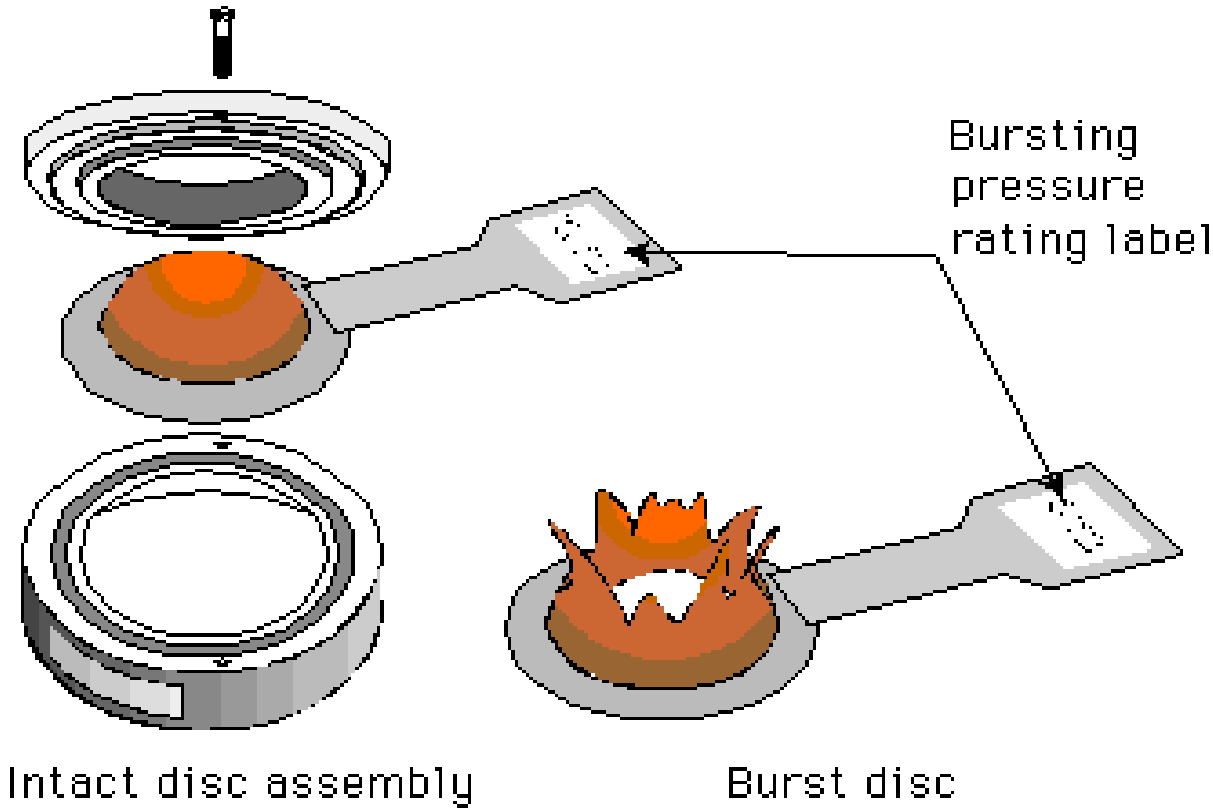
# SEPARATOR OPERATION




**Rupture disk.**

On old separators a rupture disk is installed instead of one of the relief valves. The rupture disk has a set pressure to open when pressure exceeds 110 % of the separators working pressure. The problem with the rupture disk is that it will not close when pressure in the vessel goes below working pressure.

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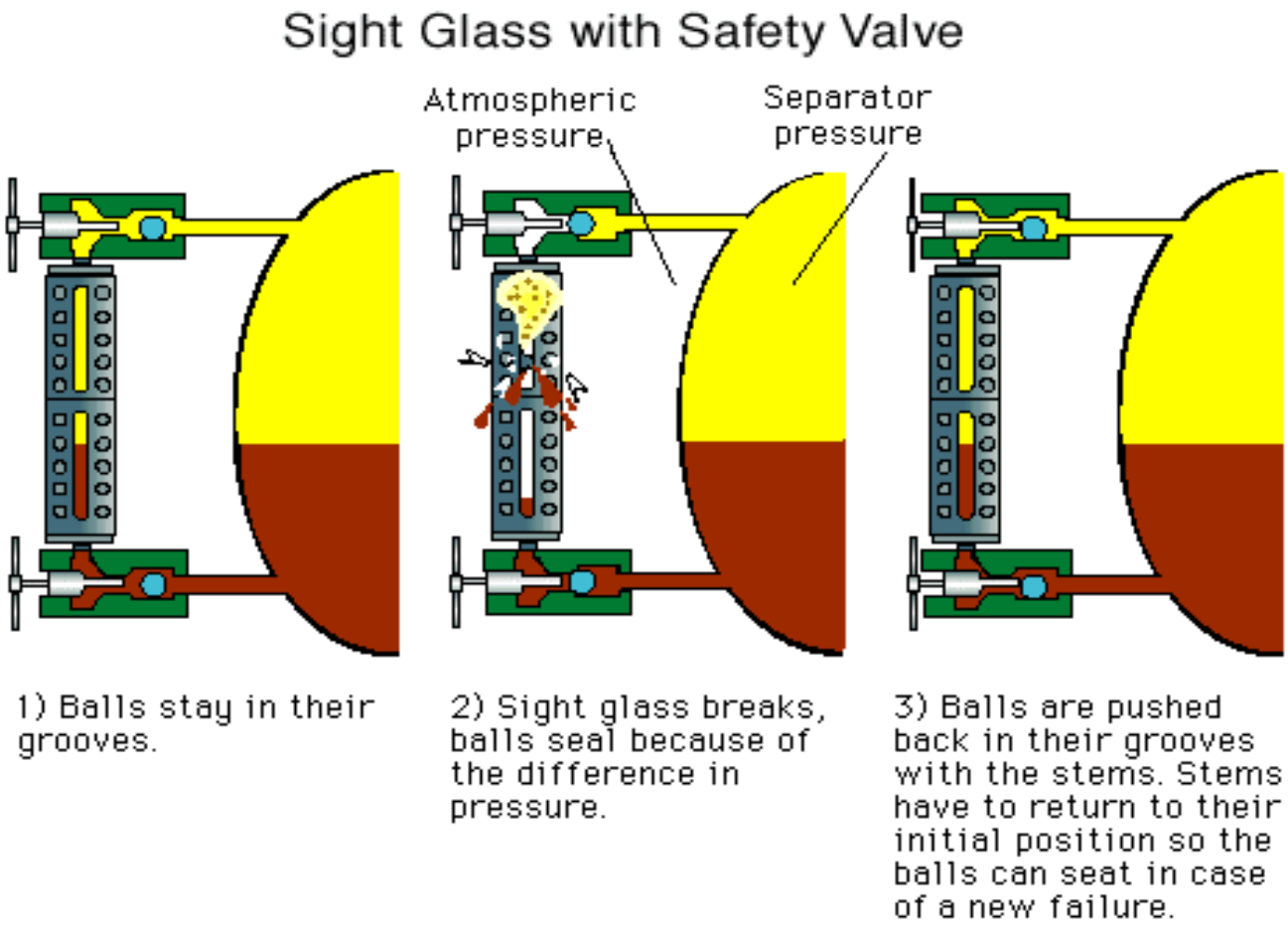


**Sight Glass, level indication.**

The sight glass is a weak point on the integrity of the separator. Because of this two safety valves are installed on the ports to the separator. Both will shut if the flow past them exceeds their design point.

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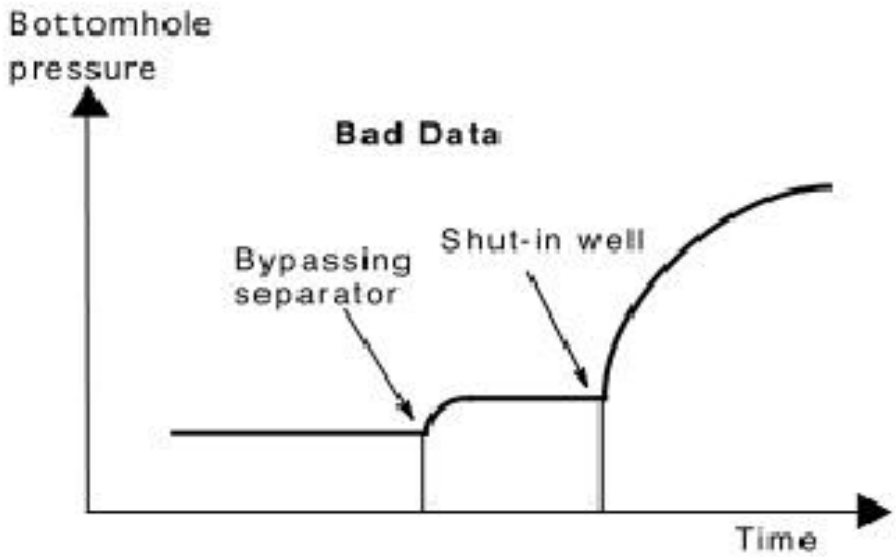
# DATA QUALITY

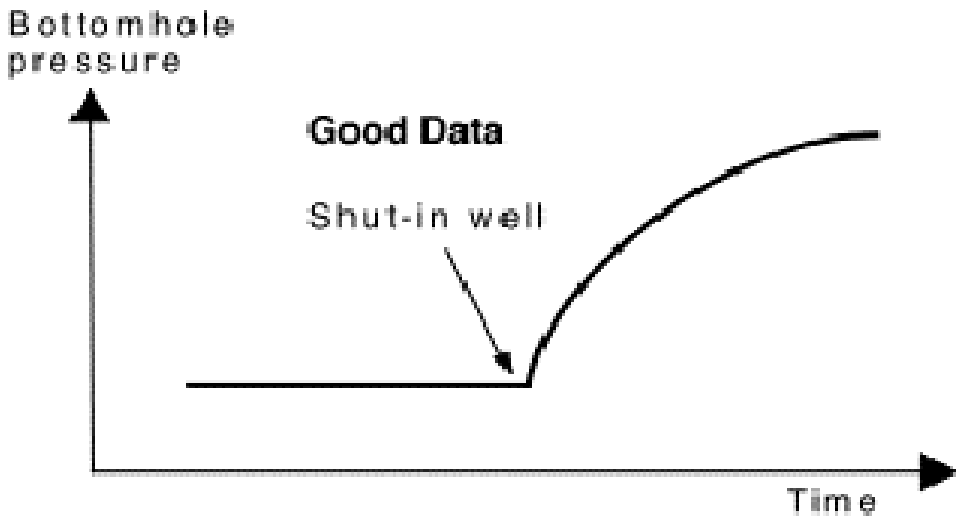
When taking separator readings always ensure:

- Oil meter readings are taken at the correct time for accurate rate calculations.
- Take readings at regular times, 5 min, 10 min, 15 min etc.
- BSW and SG's should be recorded at the time the sample was taken and not the reading.
- Completeness of data, e.g. oil SG and shrinkage are quoted with *temperature.*
- Only enter actual measurements, e.g do not enter the previous BSW reading because you forgot to take it this time.

# DATA QUALITY

If the separator is bypassed before shutting in the well the build up data necessary for interpretation may be damaged




If the well is shut in before bypassing the Separator a clean BHP curve is obtained for accurate interpretation.

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# SEPARATOR OPERATION

The END

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