

## Multiphase Separators



Gas Liquid Separator

### Product Definition

Crude oil wells contain oil, gas, water and various contaminants. To optimize field production, Frames Multiphase Separators perform the primary separation of other phases from crude. Multiphase separators are usually the first and most comprehensive set of equipment in the upstream oil production field, with downstream equipment completely dependent on the proper functioning of the multiphase separators.

Using state-of-the-art technologies, Frames Multiphase Separators guarantee adequate separation, with our clients benefiting from 30 years of process knowledge supported by Frames in-house CFD and R&D expertise.

### Product Description

Multiphase separators are used to separate vapors from the liquid phase, which can be a single continuous phase or a mixture of two immiscible phases.

Frames supplied the following types of multiphase separators:

- 2-phase and 3-phase
- HP (High Pressure), LP (Low Pressure), IP (Intermediate Pressure)
- Free Water KO Drum
- Inlet Separator
- Test Separator
- WOSEP (Water Oil Separator)
- KOD (Knock-out Drum)
- Degasser

#### Vessel orientation

Multiphase vessels can be horizontally or vertically oriented, depending on plot space and transportation limits. Horizontal vessels are preferred for high operating capacity and processing capabilities, while vertical vessels are preferred when the incoming liquid flow is limited.

#### Separator aspect ratio

The aspect ratio of the separator is defined as the ratio of its (L) length or height over its (D) diameter. Typically, the L/D ratio varies between 2.5 and 6 for horizontal separators. However, the L/D ratio depends on specific cases for separation performance and is determined on a case-by-case basis.

#### Liquid retention time

Liquid retention time, or residence time, is the period during which a liquid phase resides in the separator's gravity separation zone. While this period can range from 1 to 10 minutes depending on the properties of the liquid and the upstream and downstream variations, normal retention times are from 2 to 5 minutes.

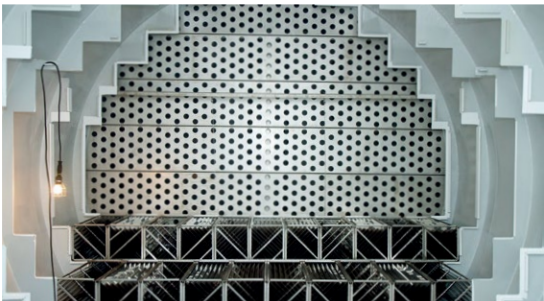
#### Droplet settling time

Once the liquid droplet is allowed to settle through a continuous vapor phase, the settling velocity depends on particle size, drag force and densities of the vapor and liquid phases. Droplet velocity is determined by Stoke's law.

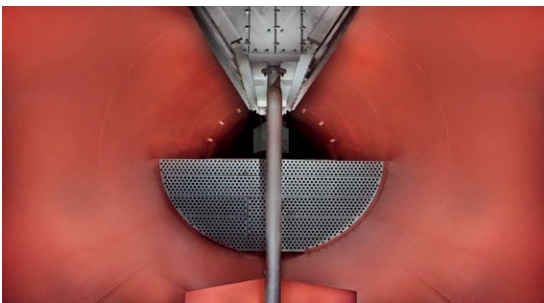
# Multiphase Separators



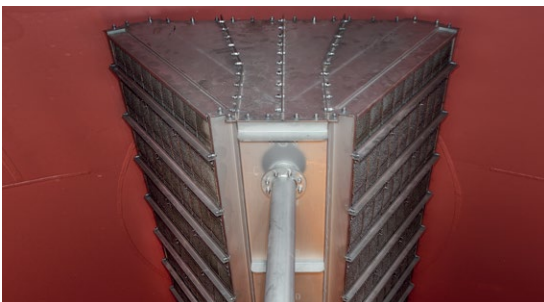
Skids Mounted 3-Phase Separators



Liquid Liquid Separator



Vessel with Camling Baffle, Vane Pack & FAVID



Vane Pack

## Separation performance

Separator design is governed by:

- G/L performance: Normally acceptable performance is maximum liquid carryover in the gas phase of 0.1 USG/MMSCF
- L/L performance: Normally acceptable performance is 2% for water in oil, and 1000 ppm for oil in water.

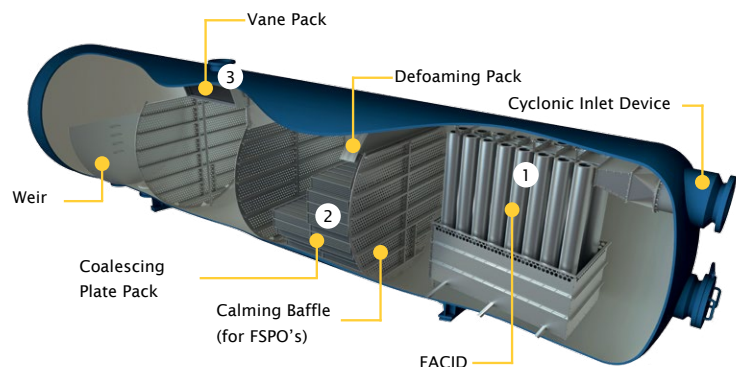
## Slugs

If required, the inlet of production separators is designed to receive 'slugs' from the upstream oil/gas flow. To achieve this, the 2-phase or 3-phase separator acts as a slug catcher, with attention given to the separator's size, slug volume and incorporation of a robust inlet device and calming baffles.

## Process Description

In a Frames Multiphase Separator, the crude oil mixture passes through an inlet device to disperse the momentum of the incoming fluids. Primary/bulk separation as well as flow distribution occurs in the inlet section (1). From the inlet section, the fluids are given adequate settling time to allow the heavier phase to settle beneath the light phase, while the flashed-off gas-phase occupies the free area above the liquids (2). Additionally, liquid-liquid separation enhancer internals such as plate pack coalescers are added to provide stringent performance guarantees.

Liquid levels are maintained by weirs and control valves. A gas-liquid separation device (typically a demisting device) is placed at the outlet section (3). This device ensures separation of small liquid particles in the gas phase by coalescence. Oil at the specified guarantee level is discharged at the oil outlet nozzle, while water and gas are discharged through their respective outlets.



# Multiphase Separators

For offshore applications such as an FPSO's, Frames uses in-house CFD capabilities to study the negative effects of wave motions, and provides solutions which minimize phase re-mixture.

With three decades of separation experience coupled with in-house knowledge and computational fluid dynamics (CFD), Frames is able to optimize vessel design, so our clients benefit from lower CAPEX and OPEX.

## Project Management

At Frames, we know that precise project management is only the starting point for completing complex oil and gas projects. Our clients can rely on sharp thinking and a deep understanding of their operating conditions to find the best solution. Our quality management system focuses on a process of continuous improvement, and our team is always looking for new solutions that improve productivity, cut operating costs, and give our clients a competitive edge.

In a challenging industry, we understand that safety is a priority. We also know that in order to deliver maximum value to our clients we must complete each project on schedule, in spec and within budget.

At Frames, our close-knit team of engineering experts is open, honest, and focused on delivering you the best possible outcomes. We are passionate about the oil and gas industry, and have been a leading provider of safe, high-productivity systems for more than 30 years.

## Technical Details

- Optimization of vessel dimensions
- CFD verification of design
- Range of products: HP, LP, KOD, scrubbers
- 2-phase and 3-phase separators
- Custom-made equipment
- Wider turndown
- Lower sensitivity towards Sand
- Lower fouling

## Added Value Frames

- Designed to match your unique crude oil composition and operating conditions
- 30 years of experience in generating the maximum value from the wellhead
- Robust and reliable units that drive downstream productivity
- Compact design that easily integrates into your production facility
- Cost-efficient units with low operating costs

## References (selection)

- Haoud Berkaoui Project - Sonatrach, Algeria
- Kharir Field - Total E&P, Yemen
- Gathering Centers - KOC, Kuwait
- Nakhla II - Wintershall, Libya
- Orinoco Belt - PDVSA, Venezuela
- Shaybah - Saudi Aramco, Saudi Arabia
- Rumaila field - BP Iraq N.V., Iraq
- Wafra Field / MGC Revamp - WJO, Kuwait
- Asab Field - ADCO, United Arab Emirates
- SARB Field Development Project - ADMA OPCO, United Arab Emirates
- Tyra South East Field - Maersk, Denmark
- Al Shaheen Block 5 - Maersk Oil Qatar, Qatar
- PB Litoral A Platform - PEMEX, Mexico
- Greater Stella - Ithaca Energy, United Kingdom
- Cluster 7 Field - ONGC, India
- P-63 FPSO - Petrobras, Brazil
- P-75 / P-77 FPSO - Petrobras, Brazil
- Cidade de Ilhabela FPSO - SBM, Brazil
- Mangaratiba FPSO (MV-24) - Modec, Brazil
- Stones FPSO - Shell, USA

## Contact

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# Frames Family Tree



Onshore

Offshore

Floaters

## Oil & Water



## Gas



## Flow Control & Safeguarding



### Multiphase Separation

- Production Separators (High & Low Pressure)
- Test Separator
- Degasser & Knock-Out Drum
- Water Oil Separator (WOSEP)

### Compact Inline Separation

- SwirlSep

### Electrostatic Coalescers

- Dehydrator
- Desalter

### Produced Water Treatment

- Deoiling & Desanding Hydrocyclones
- Gas Flootation
- Media Filtration
- Solids Removal & Cleaning
- Stripping

### Separation Internals

### Heat Exchangers

### Gas Separation

- Demisting
- Scrubbers
- Filters
- SwirlSep

### Heat Exchangers

- Shell & Tube Heat Exchangers

### Air-Cooled Coolers

### Gas Sweetening (H<sub>2</sub>S & CO<sub>2</sub>)

- Amines
- Thiopaq O&G
- Solid Bed Scavenger
- Membrane
- Molecular Sieve

### Gas Dehydration

- Glycol (TEG)
- Molecular Sieve

### Dew Point Control

- Low Temperature Separation (LTS)
- Solid Desiccant

### Hydrate Inhibition

- MEG/DEG Recovery
- Methanol Recovery
- MEG/DEG Desalination

### Light Hydrocarbon Recovery

- Condensate Stabilization
- Fractionation

### Fuel Gas Treatment

### Hydraulic Systems

- Wellhead Control
- Subsea Hydraulic Power Units
- Hydraulic Power Units
- IWOCs (Intervention Workover Control Systems)
- TUTU (Topside Umbilical Termination Unit)
- Cargo Ballasting Systems

### Safety Instrumented Systems

- High Integrity Protection Systems (HIPS)

### Chemical Injection

- Chemical & Methanol Injection Systems
- Chemical Distribution Systems
- Seawater Electrochlorination Systems

### Valve Automation Center

- Actuators and Actuated Valve Packages
- Control Systems

### Automation

- Buoy Control
- Tank Farm Control & Safeguarding

## Services



### Asset Life Cycle Management

### Maintenance & Field Services

### Commissioning

### Spare Parts

### Operator Training

### Engineering Studies

- Conceptual
- FEED and Basic

## Integrated Solutions



### Total Plant Solutions

### Industrial CO<sub>2</sub>

### Modules

### Early Production Facilities

### Wellsite Packages

### Biogas