

Inflow Control Devices with ultrasound

(IBJ deep sea drilling mud flow meter)

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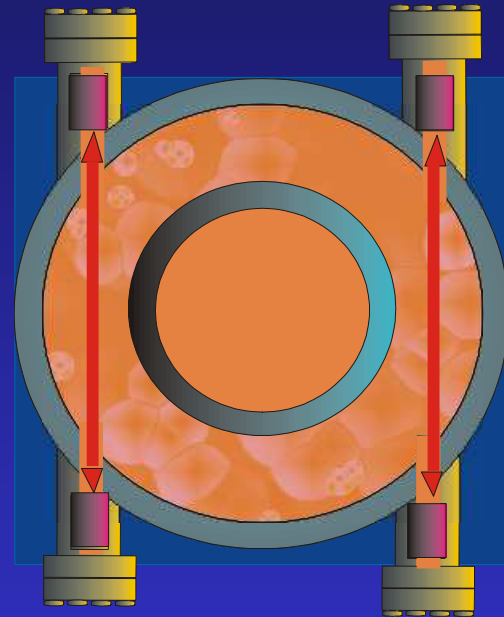
Inflow measurement of marine riser

Measurement of the transit time
with and against the flow of mud

Powerful Ultrasonic Sensors

Burst Booster

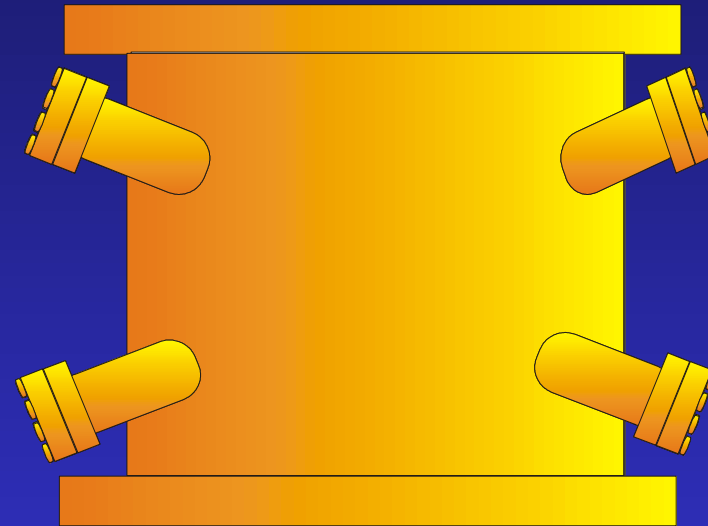
Resolution of Picoseconds



Sound path without reflection on the drill pipe

Inflow measurement of marine riser

The signal range (depth of penetration) at a density of 15.6 lb / gal is 10 times greater than the sensor spacing



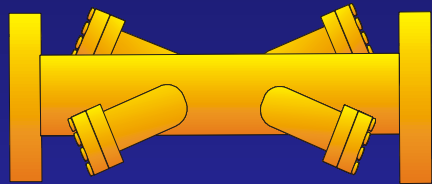
2 or 4 floors with sound paths turned 90 °

More information on the measurement of mud:

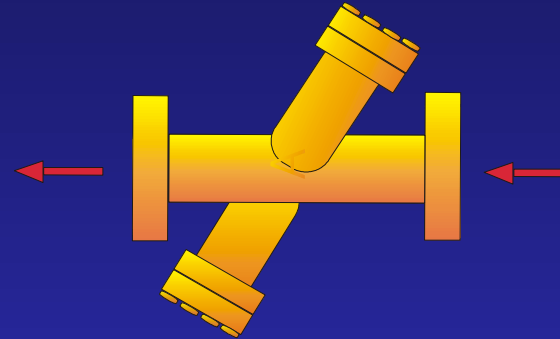
<http://de.slideshare.net/fmj2/experimentalstudy-measurement-of-sonic-speed-of-drilling-muds-under-shear-stress>

<http://de.slideshare.net/fmj2/early-kick-detection-and-nonlinear-behavior-of-drilling-mu>

Inflow measurement riserless



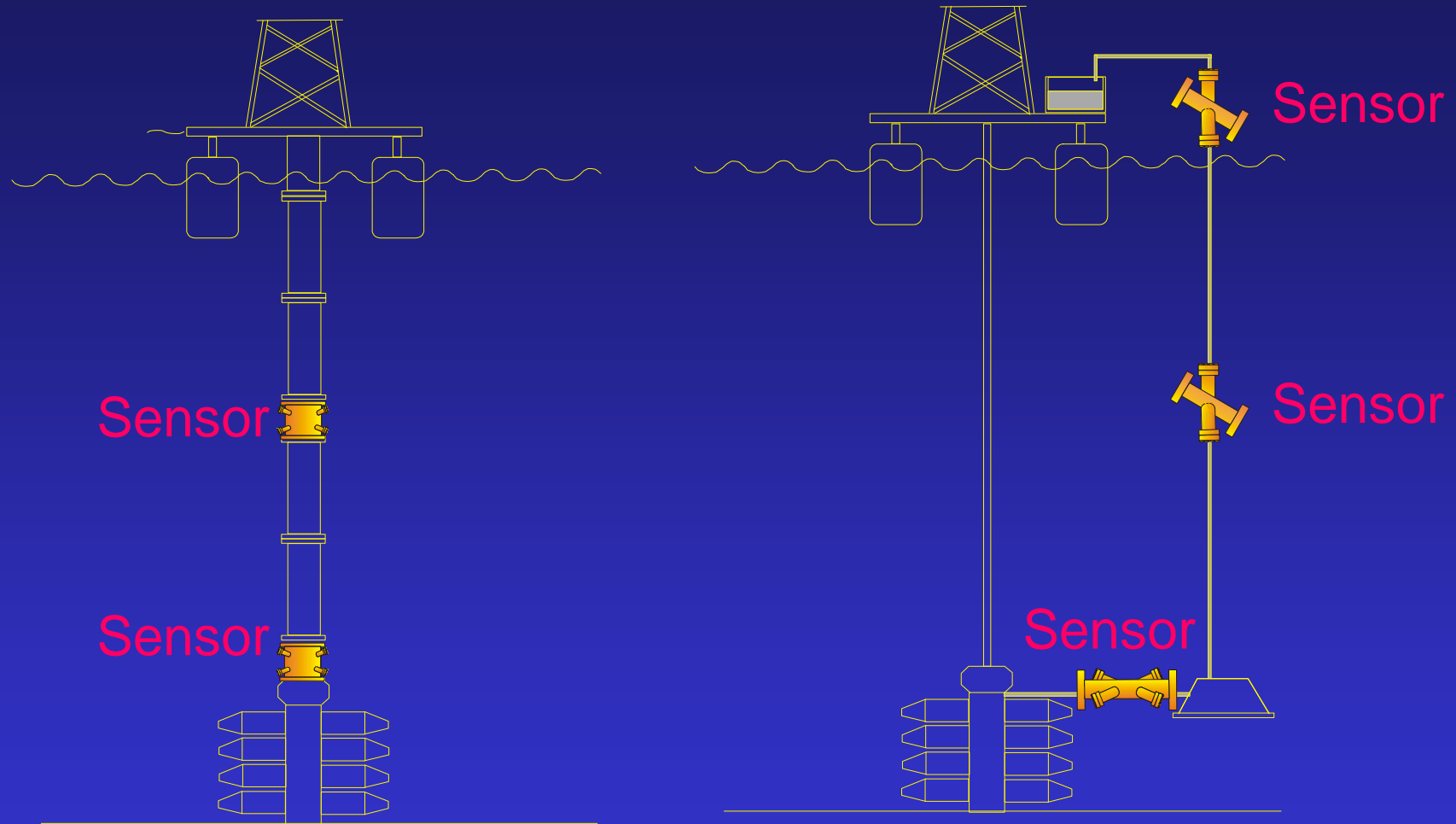
Sound path in the mud line



Same sensors for all applications



Inflow measurement for the deep sea



Same sensors for all applications

Inflow measurement – physical effects

Hydrocarbons and
Liquified gases

Sound speed is becomes smaller

Gas bubbles
Expansion

Flow speed is greater

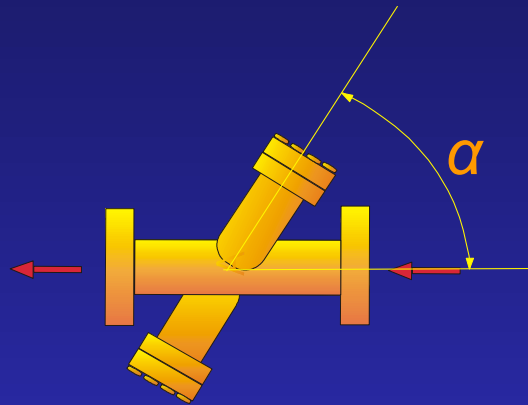
Gas bubbles

Amplitude becomes smaller

Sound speed can change
something

Inflow Measurement Basics

velocity of drilling mud

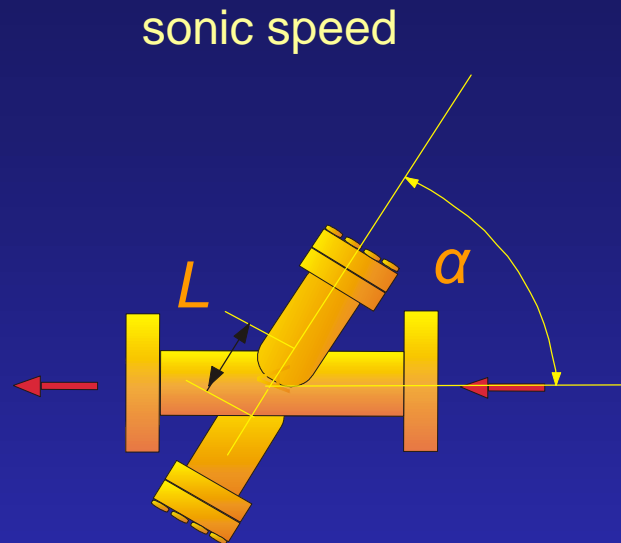


$$v = \left(\frac{T_2 - T_1}{T_1 * T_2} \right) * (L / 2 \cos \alpha)$$

Verily in this are:

- V – mean flow velocity of drilling mud
- T_1 – runtime of the ultrasonic signals with the flow direction
- T_2 – runtime of the ultrasonic signals against the direction of flow
- L – length of the ultrasound path
- α – angle of the ultrasonic signal to the direction of the flow

Inflow Measurement Basics



$$c = L / \sin(2 \alpha) * (T_2 - T_1) / T_1 * T_2$$

Verily in this are:

- c – mean speed of the ultra sound of drilling mud
- T_1 – runtime of the ultrasonic signals with the flow direction
- T_2 – runtime of the ultrasonic signals against the direction of flow
- L – length of the ultrasound path
- α – angle of the ultrasonic signal to the direction of the flow