

Electronic Dipstick for Mineral Oil Trucks

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DEZI DATA GmbH

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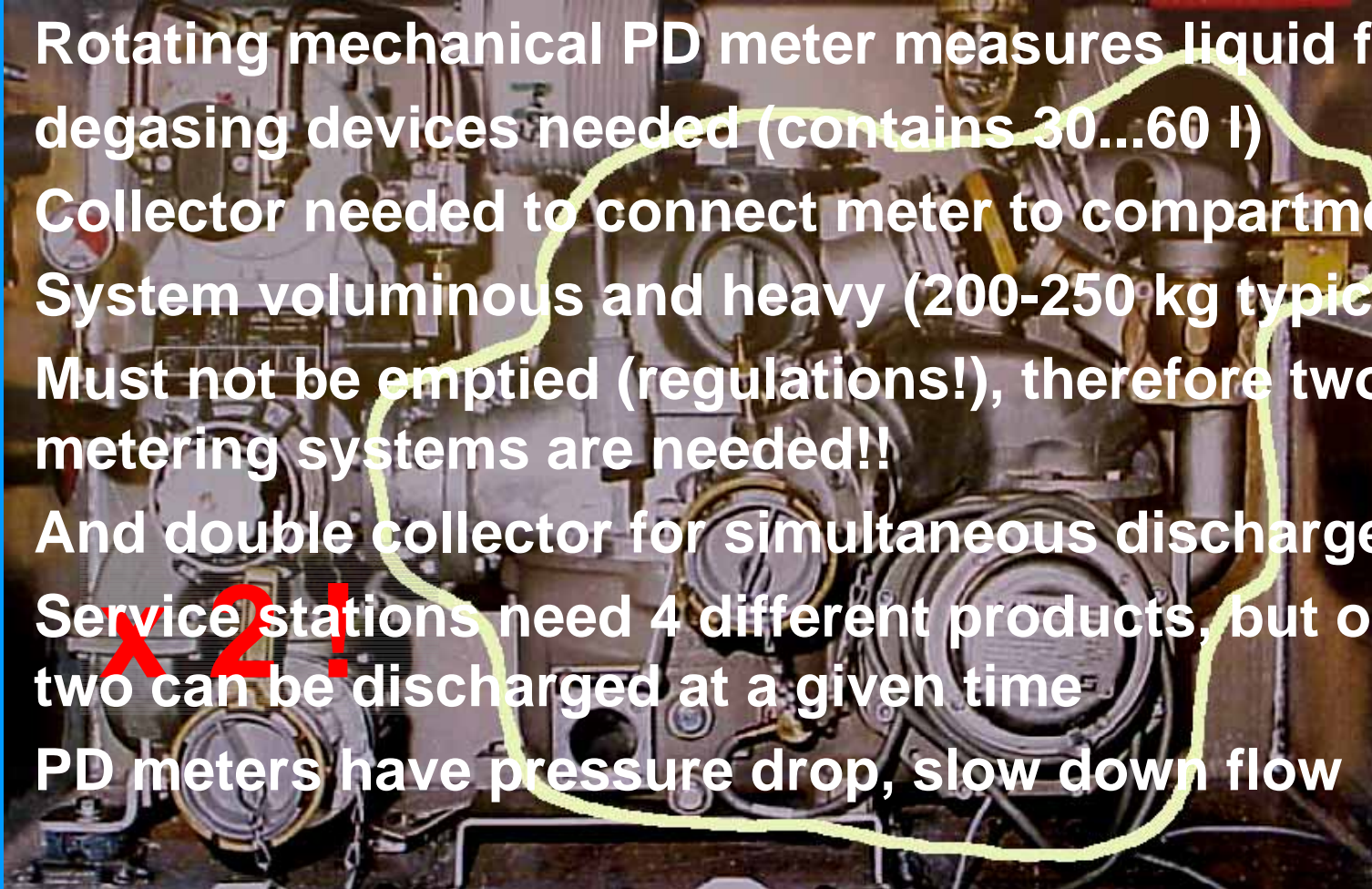
- ★ Why a new measuring method?
- ★ Working principles
- ★ Correction methods
- ★ Optional devices
- ★ P-NET „dipstick controller“
- ★ Future plans



- ★ Founded end of 1998
- ★ Founders: Siegfried Zisler,
Dr. Rainer Decker
- ★ Partner: Wennstrom SA, Sweden
- ★ Main activities
 - ★ electronic dipstick (mobile/ground based)
 - ★ various approved data capture systems
 - ★ mobile computer solutions with TouchPC

Today: conventional flowmeter

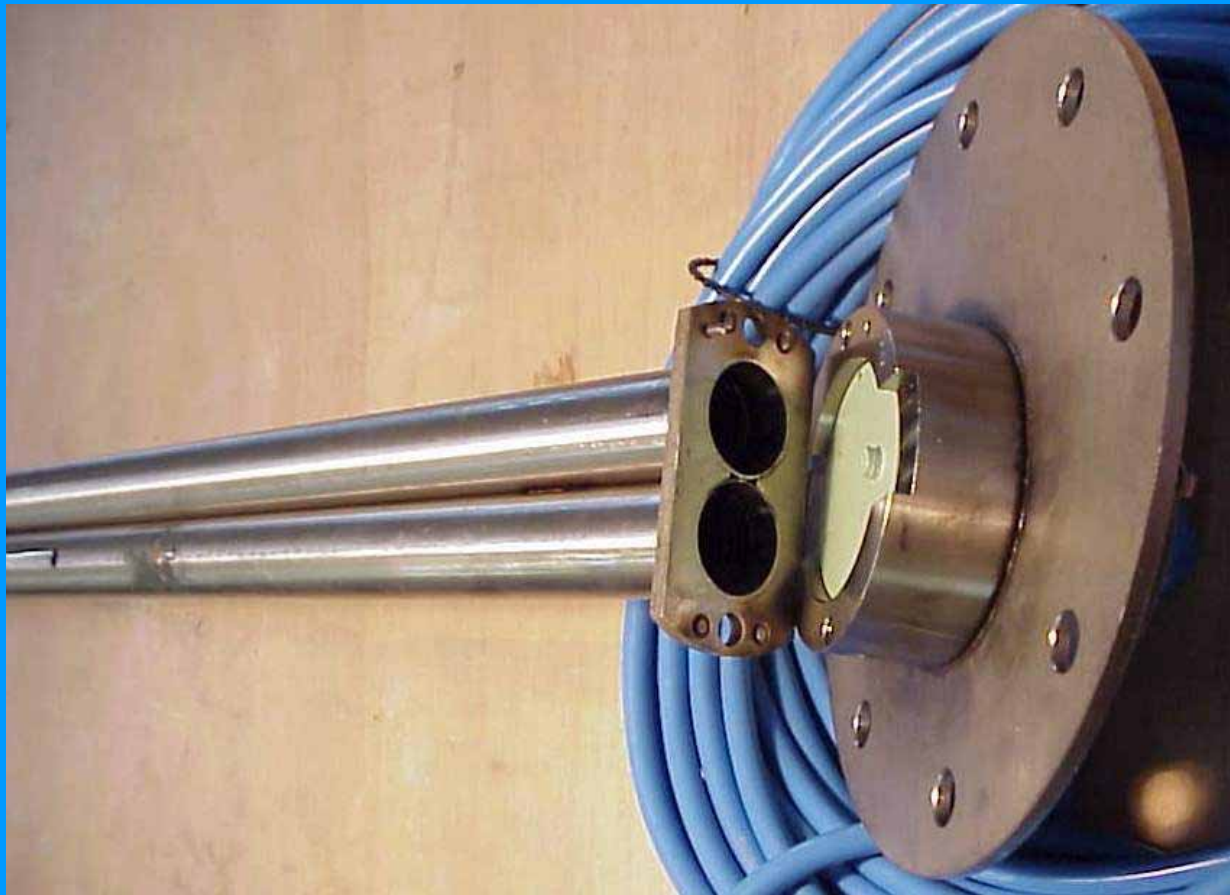
- ★ Rotating mechanical PD meter measures liquid flow
- ★ degassing devices needed (contains 30...60 l)
- ★ Collector needed to connect meter to compartments
- ★ System voluminous and heavy (200-250 kg typical)
- ★ Must not be emptied (regulations!), therefore two metering systems are needed!!
- ★ And double collector for simultaneous discharge
- ★ Service stations need 4 different products, but only two can be discharged at a given time
- ★ PD meters have pressure drop, slow down flow



Replace with electronic dipstick

- ★ Save weight and volume (total weight approx. 50 kg)
- ★ saves time by unlimited parallel delivery
- ★ ... and by avoiding pressure drop in discharge line!
- ★ Avoids contamination by complete emptying
- ★ better control: measures the inventory, not the change of inventory!
- ★ May also be used to check loading transactions!
- ★ Overflow prevention function may be integrated
- ★ May be integrated even into „low tech“ tank trucks

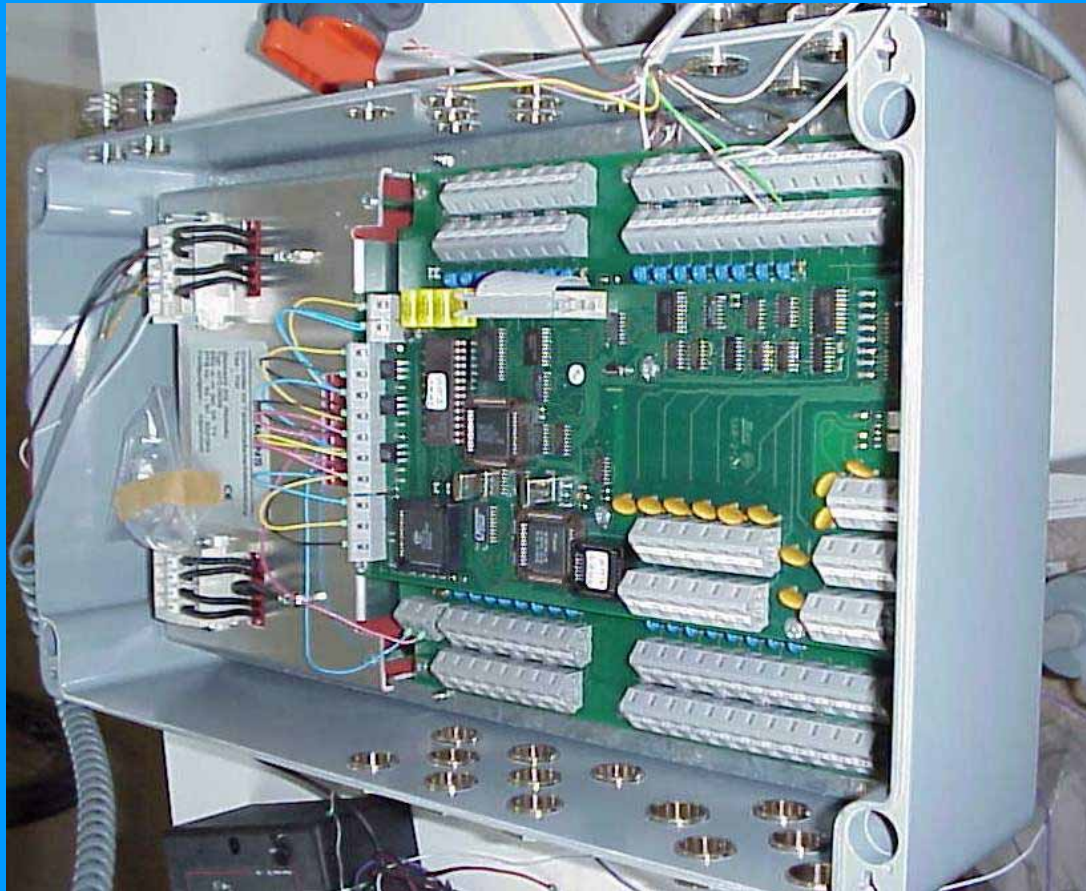
Ultrasonic Sensor



Built into the bottom of every tank truck compartment. Using ultrasonic pulses, it measures

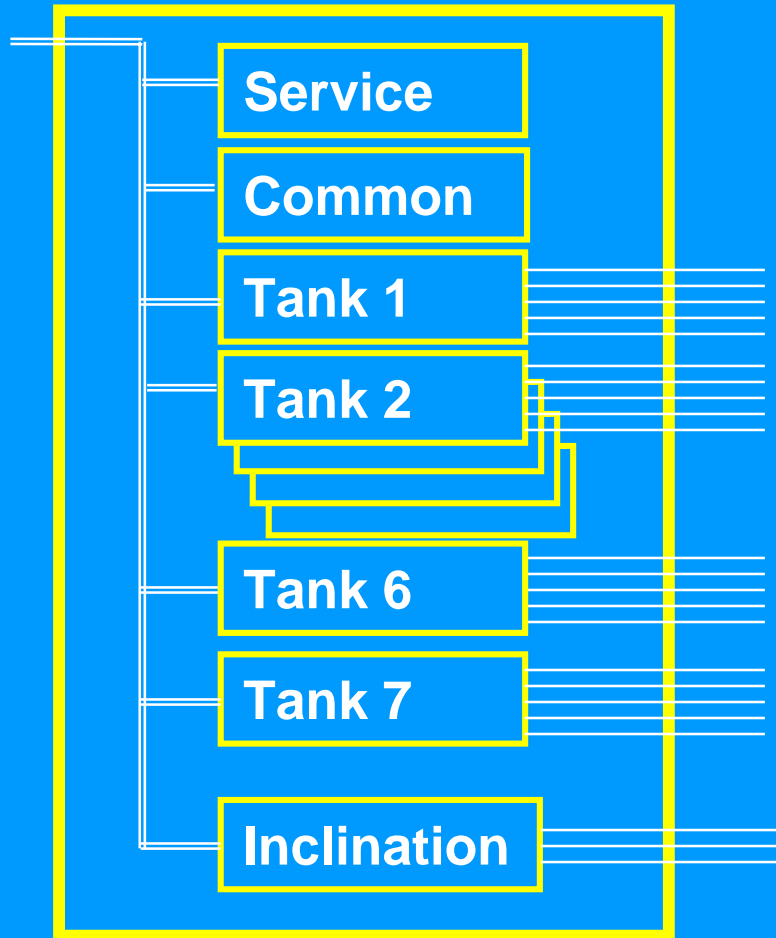
- liquid level
- temperature
- speed of sound

Dipstick Controller



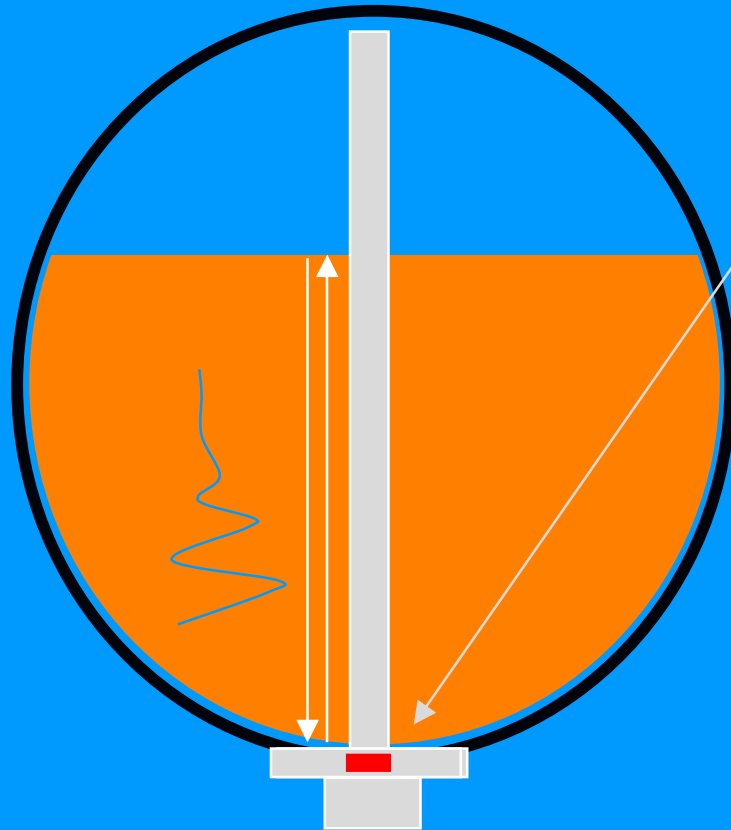
- ★ Connects to up to 7 sensors
- ★ Measures for each compartment:
Reference, Level,
2xProduct detector,
Temperature
- ★ Signal output to
control bottom
valves
- ★ Electronic seal

P-NET Structure of Dipstick Controller



- ★ Standard Service Channel, but with electronic SEAL
- ★ Each Tank connects to
 - ★ level sensor
 - ★ reference sensor
 - ★ two product detectors
 - ★ temperature sensor
 - ★ overfill signal output (EN)
- ★ Inclination channel
 - ★ three simple level sensors

Level Measurement



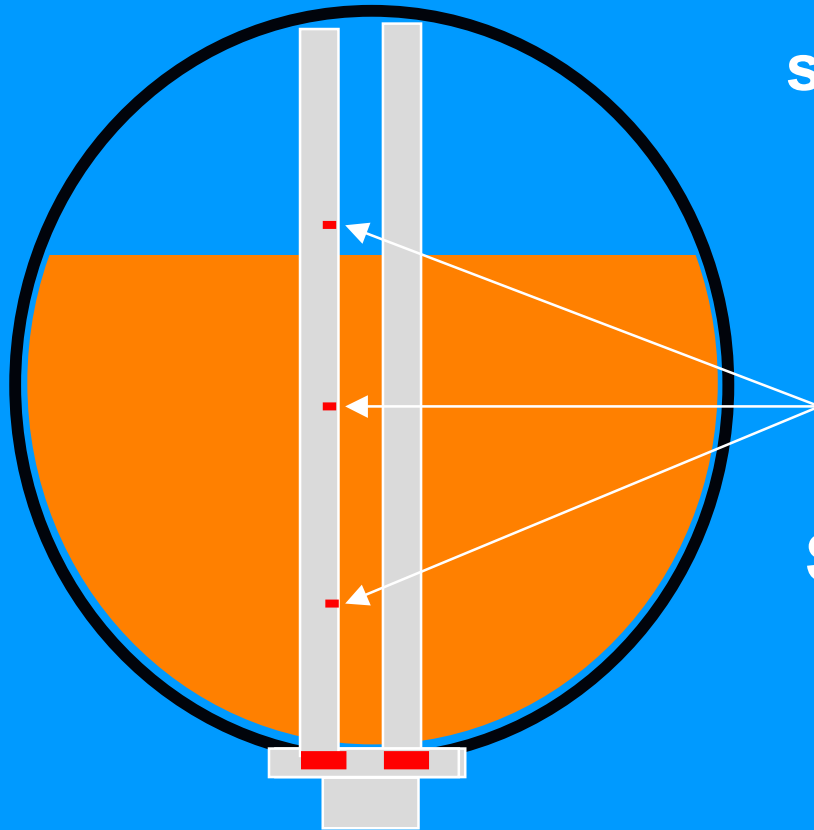
Using a **piezo-ceramic disk** (as e.g. in every wrist watch „beeper“), a „click“ is generated

The ultrasonic sound pulses (1-2 MHz) is conducted by a wave guide tube

reflected at the liquid level

Transmitter now switched to microphone, receives signal

Speed of Sound

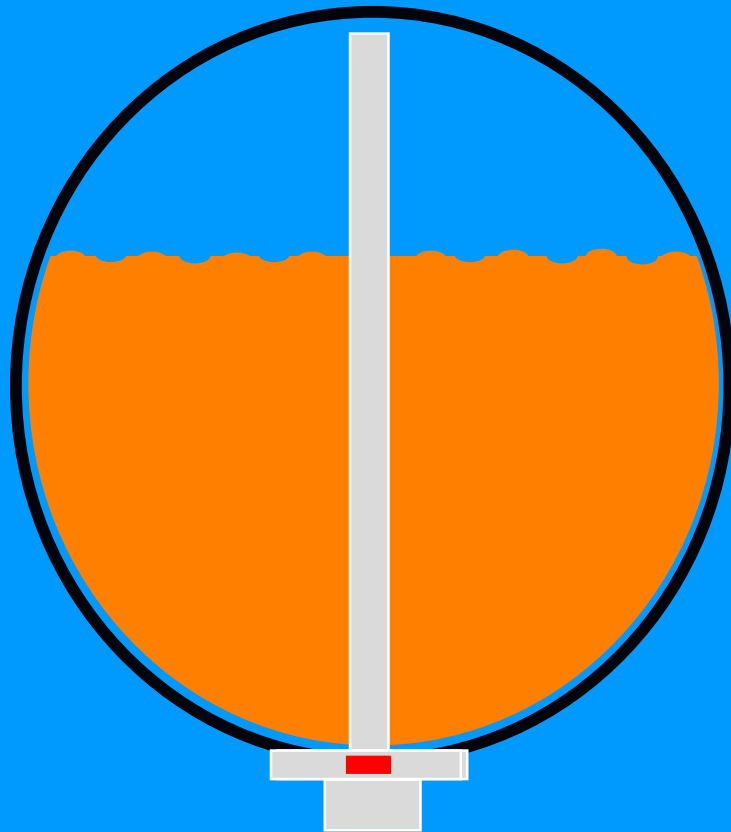


Unfortunately, the speed of sound depends on product and on it's temperature!

Mount reflector plates at precisely known levels, and measure the travel time with second transducer

Side effect: we may determine the specific gravity of the liquid!

Surface Waves

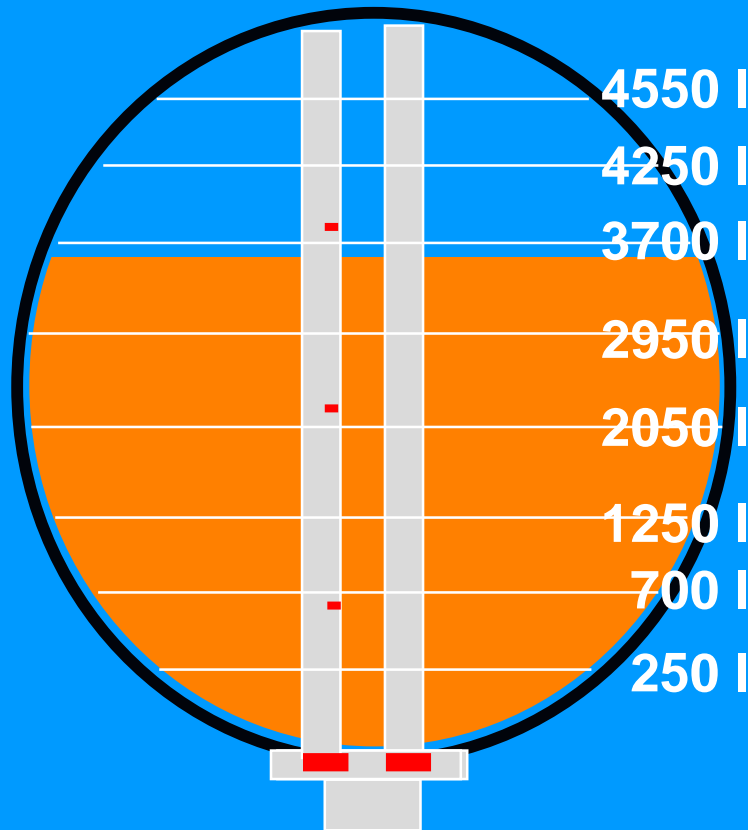


Upon arrival, surface is in violent movement
PTB requires that amplitude is < 3 mm.

Appropriate measures (construction) for damping
Measure amplitude when < 3 mm, start averaging process.

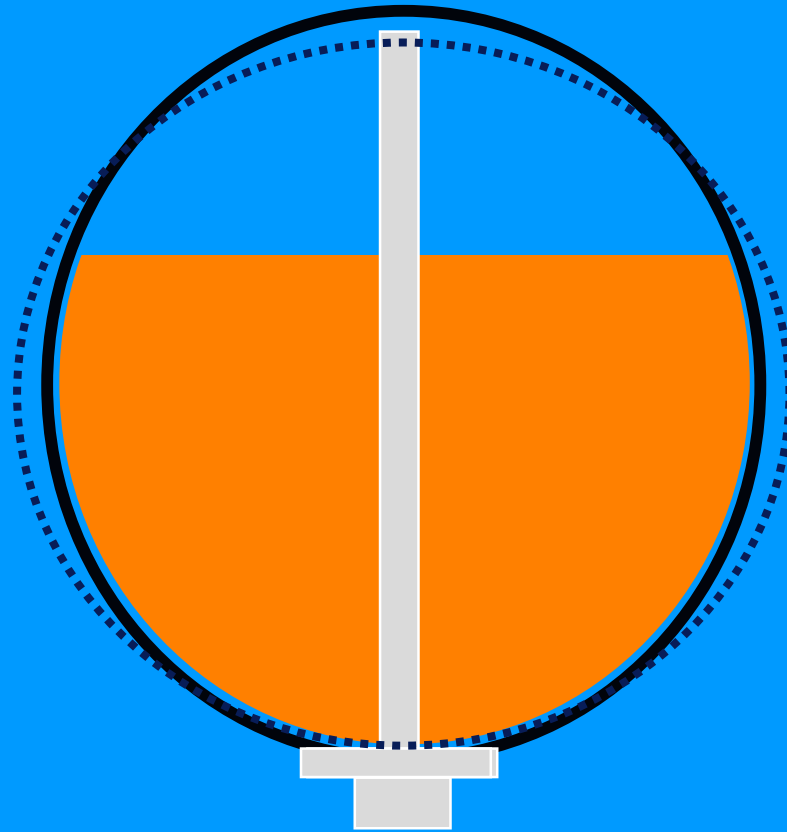
Typical time: 2-8 minutes

Tank Shape



We need volume as result
... But measure the height
Collect a data table while
emptying the compartment
Need 20-40 points
Interpolation by software
Computer simulation not
permitted (manufacturing
cannot be done with the
necessary precision of 0,05%)

Mechanical Stability of Shape



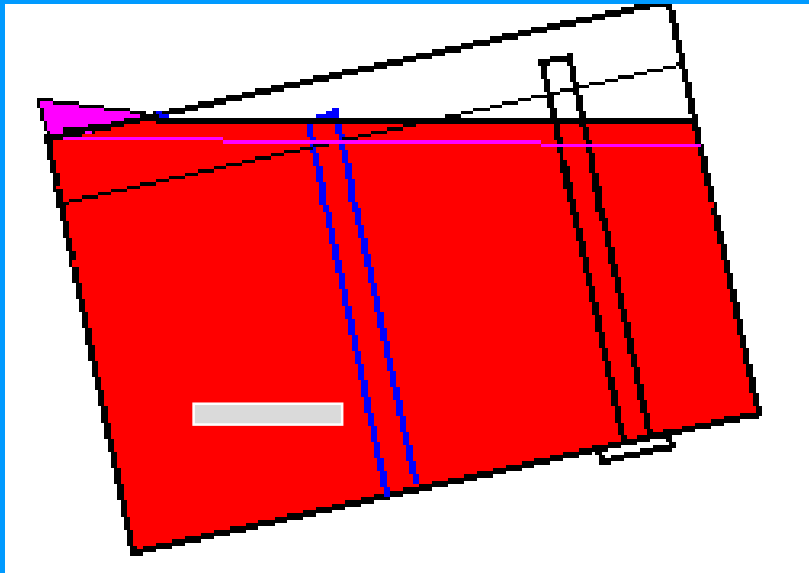
Tank shape must be unaffected
by daily use

Level must be unaffected by
level in adjacent compartments

This can only be achieved by
the truck builder (appropriate
construction)

must be proved in legal type
approval

Inclination

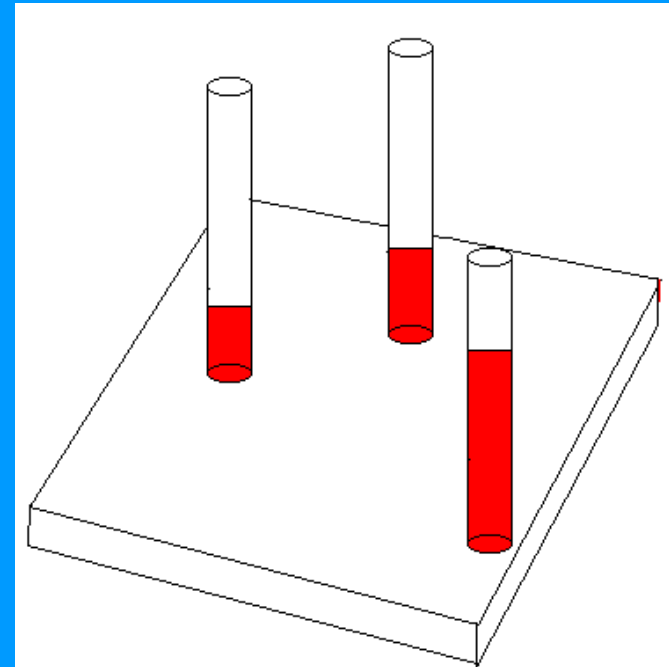
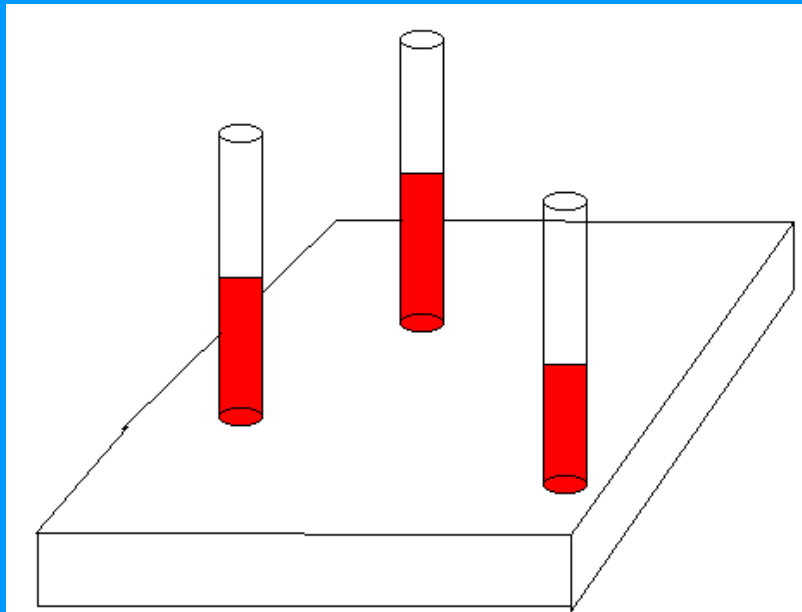


Even when sensors are mounted in the ideal position, level remains inclination dependent.

... And thus must be corrected!

We use a 3-dimensional, CAD-based correction table

Working Principle of Inclination Sensor



Hardware of Inclination Sensor

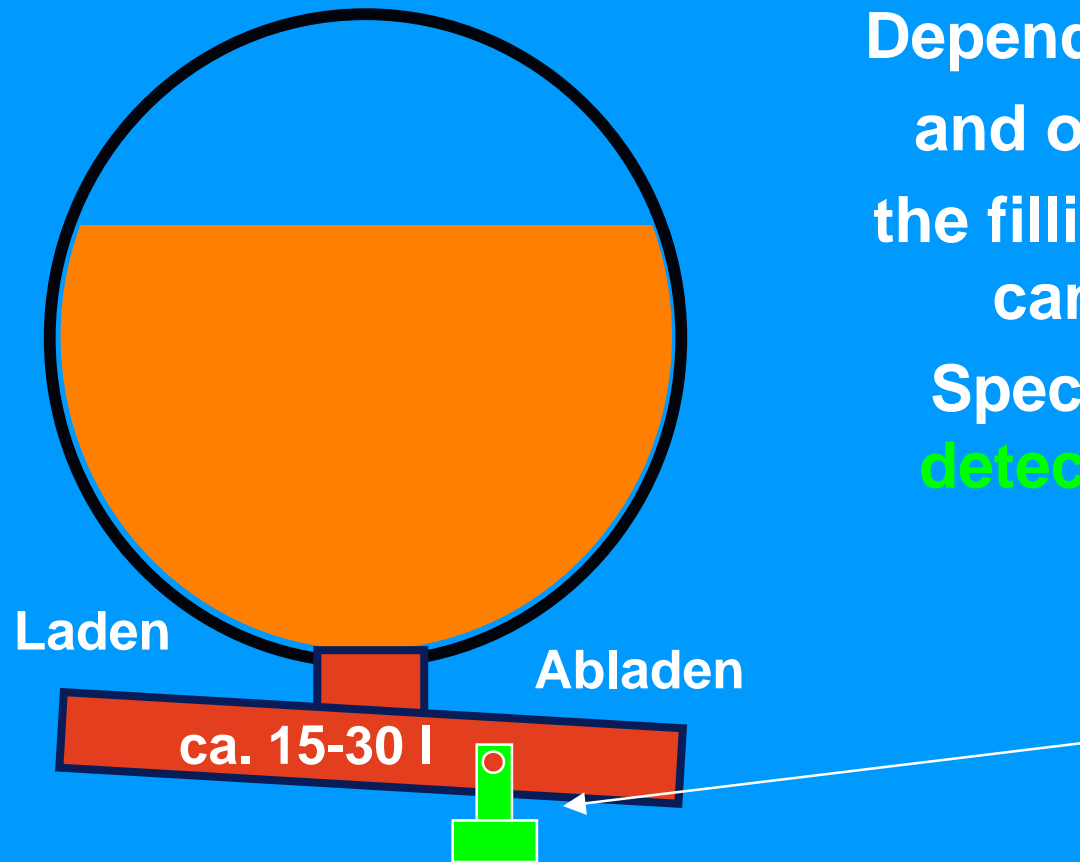


Three connected tubes
Each containing a level sensor (yes, ultrasonic)
Level of liquid in the 3 tubes define a horizontal plane
Precision within range of $\pm 5^\circ : 0,2^\circ$

Volume outside the Tanks

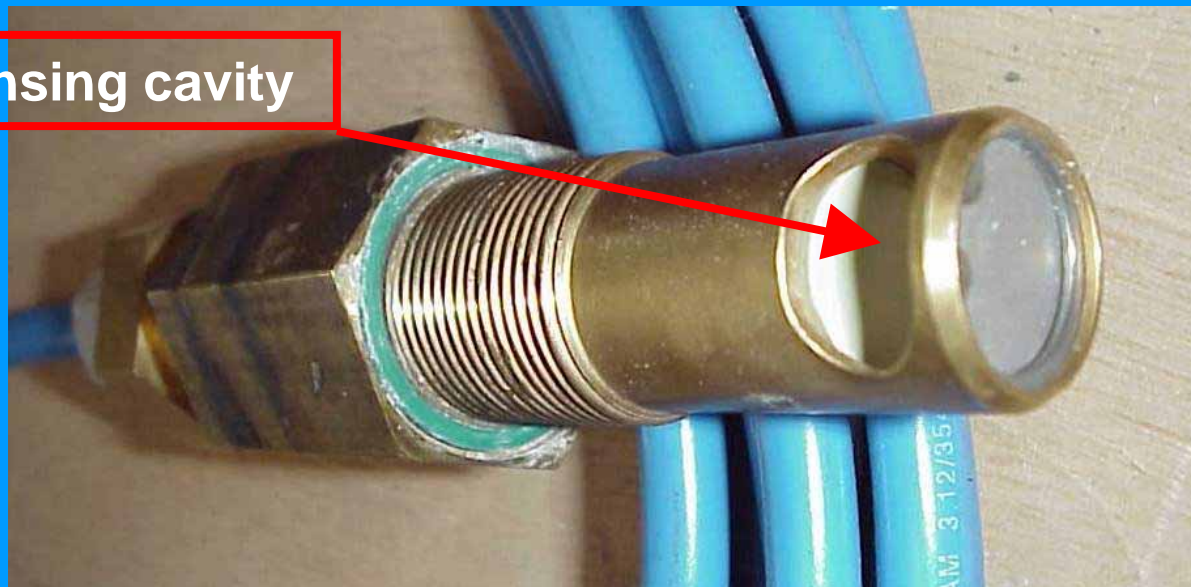
Depends on loading method
and on discharge history
the filling tube (marked **red**)
can be full or empty

Special sensor (**product
detector**) used (yes, also
ultrasonic)



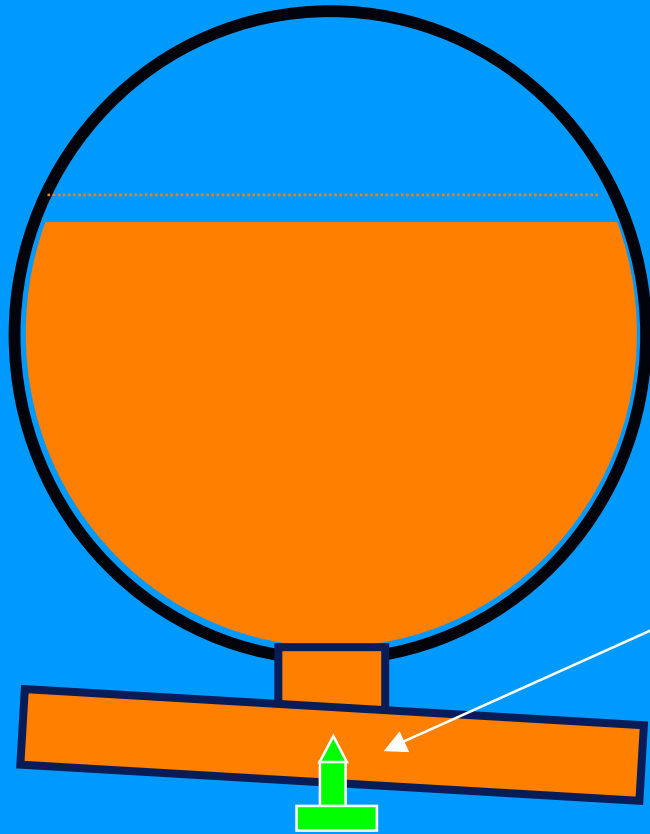
Hardware of Product Detector

Liquid sensing cavity



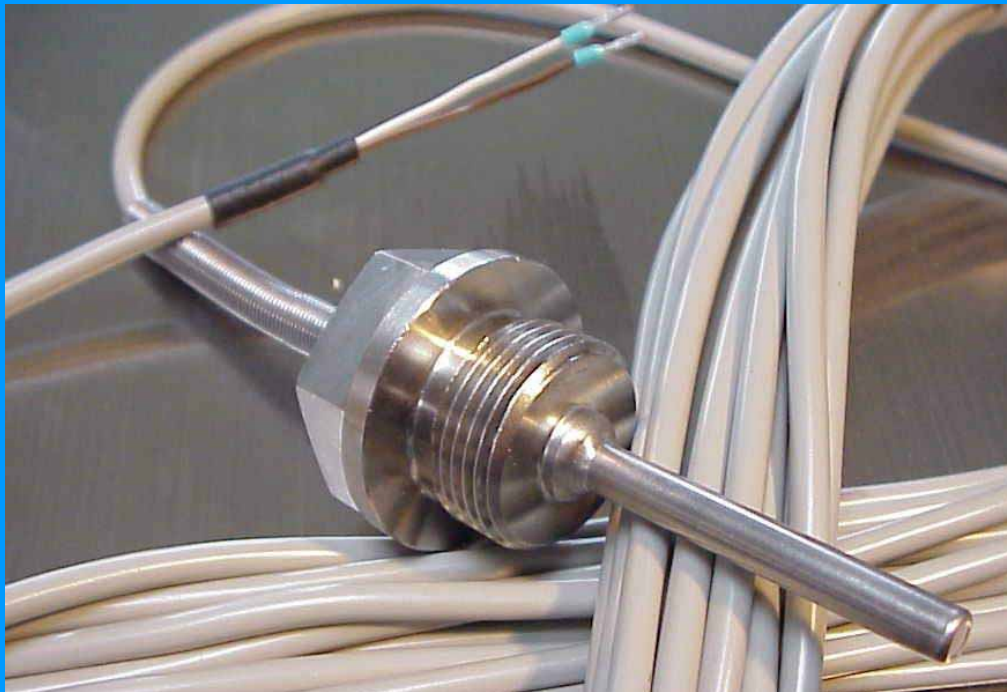
Sound reflected by plate in 2 cm distance measurable „noise“ after 10-15 reflections but only when the space is filled by liquid!

Temperature Compensation



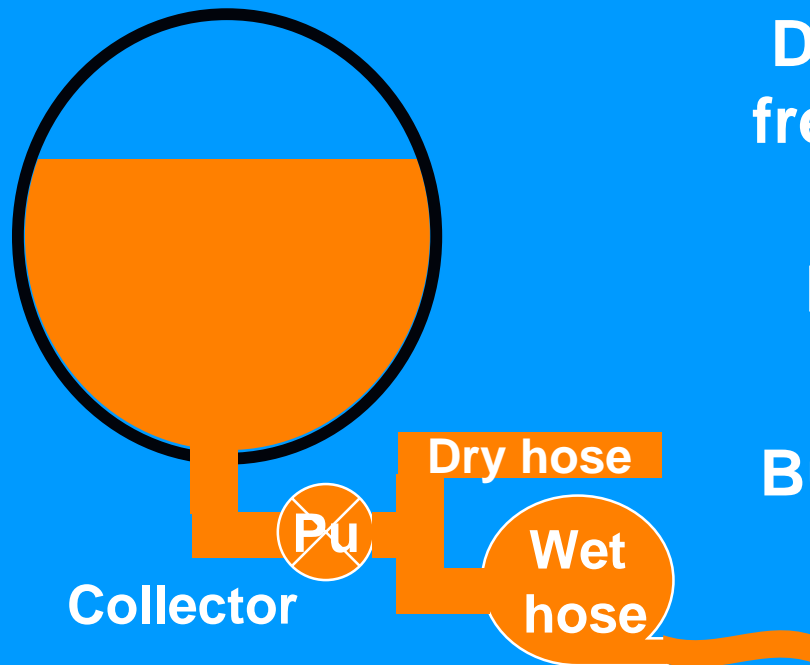
German law requires the calculation of volume @15°C
A **temperature sensor** in the discharge line is monitored during loading and discharge
Compute volume-proportional average temperature of product.

Temperature Sensor Hardware



Mounted in discharge
tube
in contact with liquid
eliminates problem of
internal temperature
sensor (stratification)
integration planned with
product detector

Pumped Wet Hose Delivery



Delivery of heating oil and diesel frequently into surface tanks 👍 no delivery by gravity!

Pump through wet or dry hose

Wet hose must stay wet!

But: pipework must be „as empty as possible“ (product contamination)

PLC used in conjunction with wetleg sensors and valve control

PLC for Wet Hose Delivery



Standard PLC (Siemens S5)

Reads state of wetleg sensors and pneumatic controls

Controls pneumatic valves

Additional Functions

Quantity Preset

Overflow Prevention (approval needed)

Measure also loaded quantity

Shows error message when complete discharge is impossible due to inclination of truck

Tank Truck Manager

- ★ P-NET Controller (derived from standard PD4000) in EEx approved version
- ★ graphic display, background illuminated
- ★ very compact
- ★ can be used also as secondary display, e.g. for trailers or for (left) loading side
- ★ may be sealed by authorities

Tank Truck Manager



W&M approved
for measuring systems (e.g.
milk)
program and parameters
„sealable“
developed for use on trucks...
... and under extreme climatic
conditions

Future Plans of Dezidata

Digital link to existing tank truck control systems (gateways are under development)

Cross Over Prevention System
Connect to Service Station, using „Low Power Radio Device“ (DECT)
same with Loading Gantry

Thank
You
Very
Much!

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