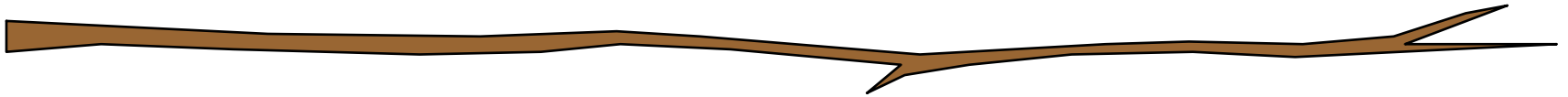


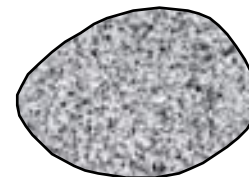
The History Of Level Measurement

In the beginning, the most common measuring device was the....



The stick was great for almost everything except things that were real deep.

So being inventive, man used...



To drop into wells and other deep things. Unfortunately, once dropped, the stone was no longer accessible to the dropper.



Count on us.

TDR

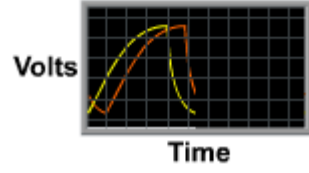
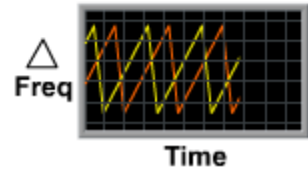
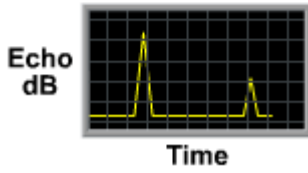
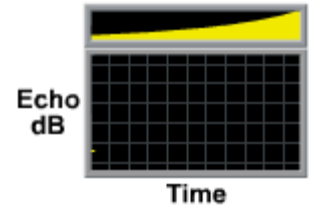
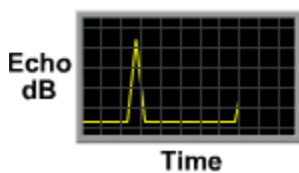
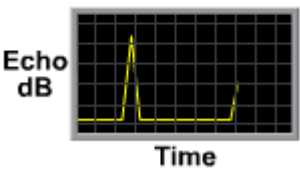
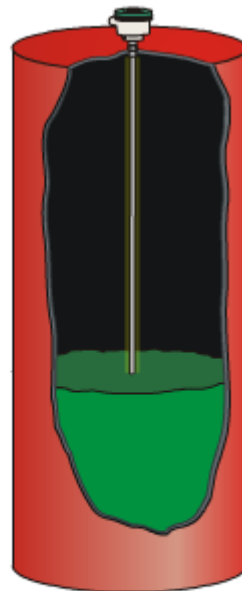
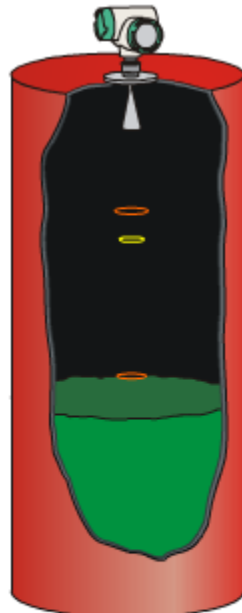
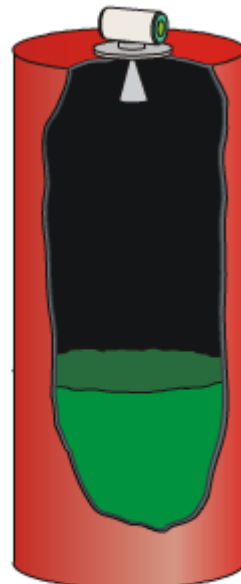
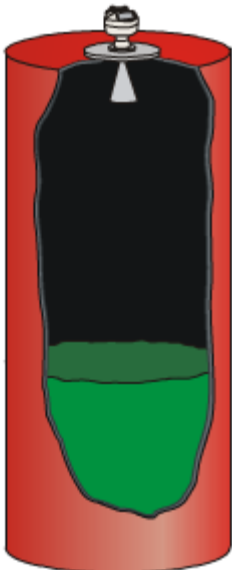
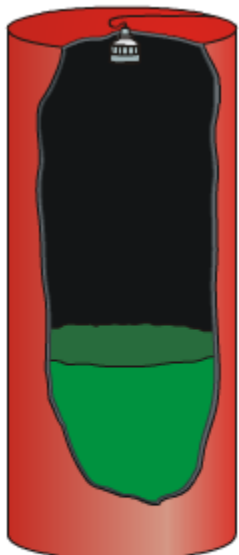
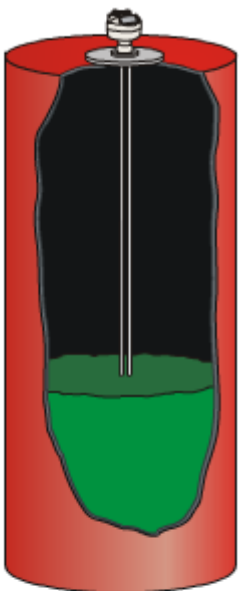
Ultrasonic

2 wire radar

4 wire radar

FMCW

Capacitance



Technology Limitations

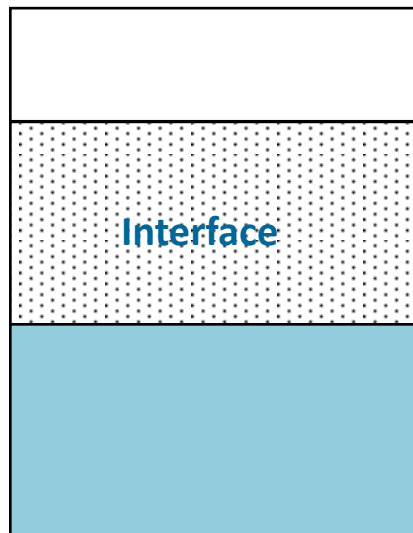
About level measurement technologies:

- ☑ Every technology has certain limitations
- ☑ No technology is good for every application
- ☑ Knowledge is key to success

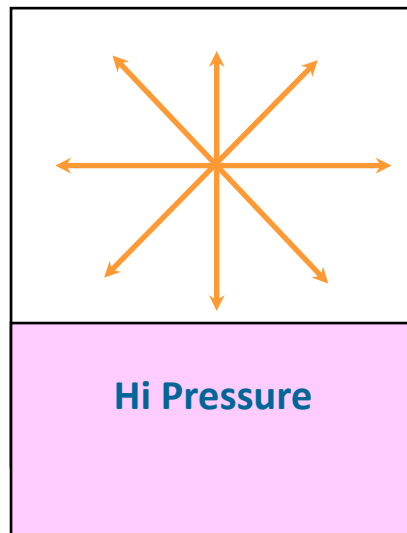
Application Suitability!

How well do other technologies work for...

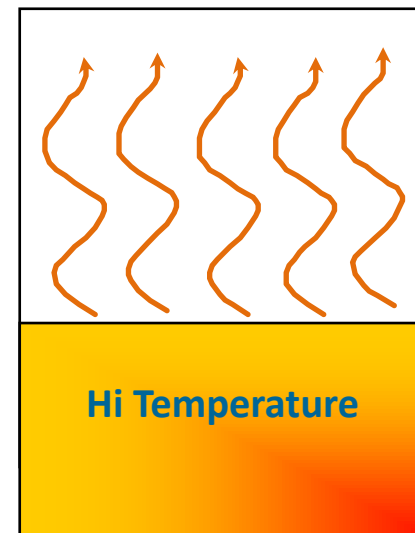
INTERFACE



HI PRESSURE



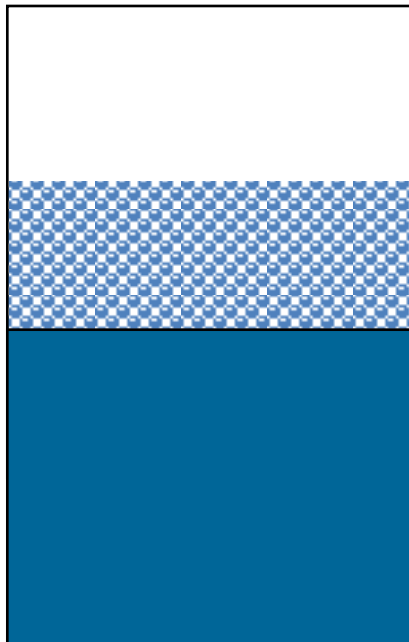
HI TEMPERATURE



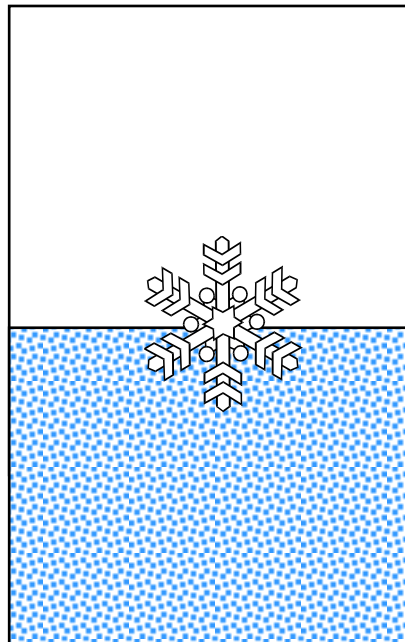
Application Suitability!

Capacitance also works well for...

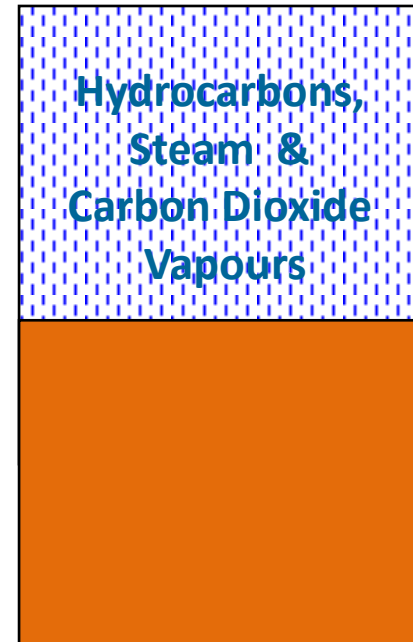
HEAVY FOAM



CRYOGENIC

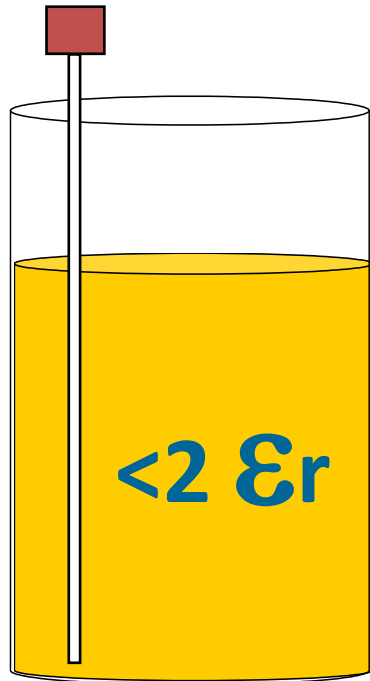


VAPOURS

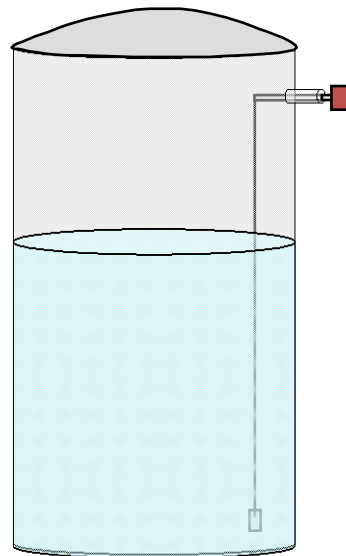


Even More Application Suitability!

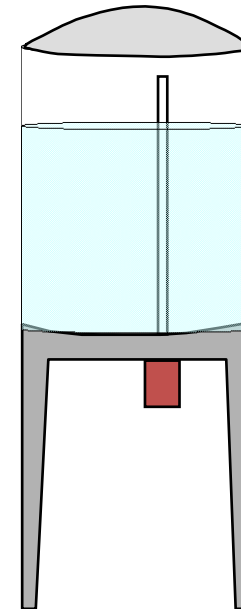
VERY LOW ϵ_r



SIDE MOUNT
REQUIREMENTS



BOTTOM MOUNT
REQUIREMENTS



What is Capacitance?

Michael Faraday Discovered:

- ☑ 2 conductors separated by dielectric hold a charge.
- ☑ Capacitance is affected by 3 variables:
 - ☑ Dielectric
 - ☑ Plate Area
 - ☑ Plate Separation
- ☑ Units of Measure:
 - ☑ Base unit = Farad
 - ☑ Common derivative = PicoFarad (1×10^{-9} Farads)

What Is A Dielectric?

- ☑ Dielectric is the material that fits between the plates of a capacitor, even if it's air.
- ☑ Each dielectric has an associated value.
- ☑ At a given temperature, the value is constant.
- ☑ And strangely enough...
- ☑ ...it's called the Dielectric Constant.

Dielectrics come in 2 categories

INSULATORS

Dielectric Constant: 1 to 20

ELECTROLYTES

Dielectric Constant: 21 to 100

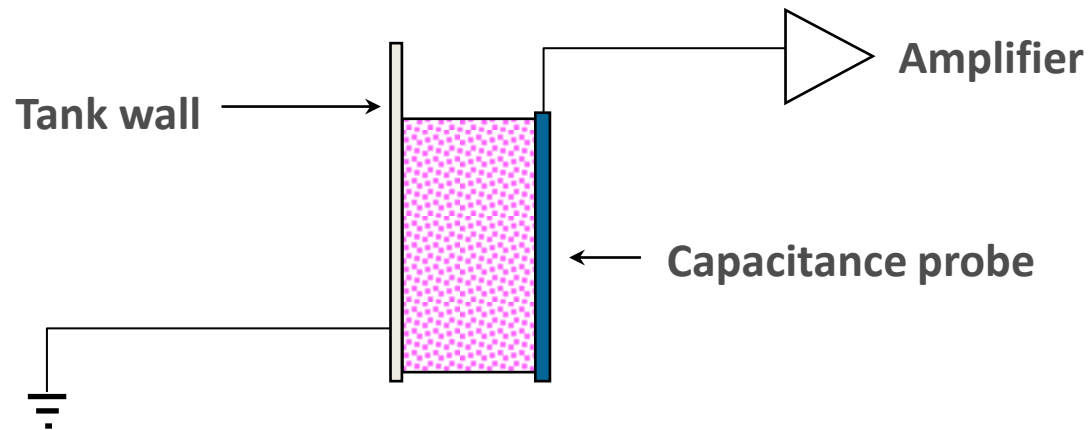
Insulators → **Non-Conductive**

Electrolytes → **Conductive**

Capacitance Level Measurement

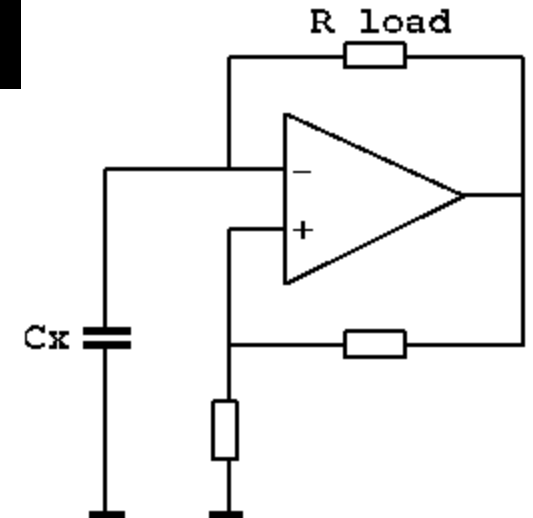
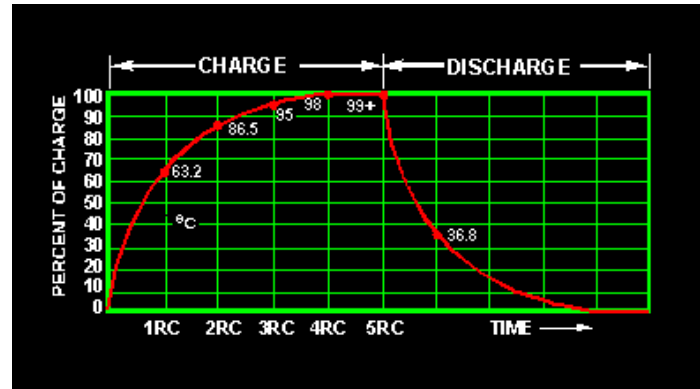
Basics:

- ☑ The probe electrode is one plate of the capacitor
- ☑ The METALLIC tank wall is the reference electrode
- ☑ The REFERENCE ELECTRODE must be grounded



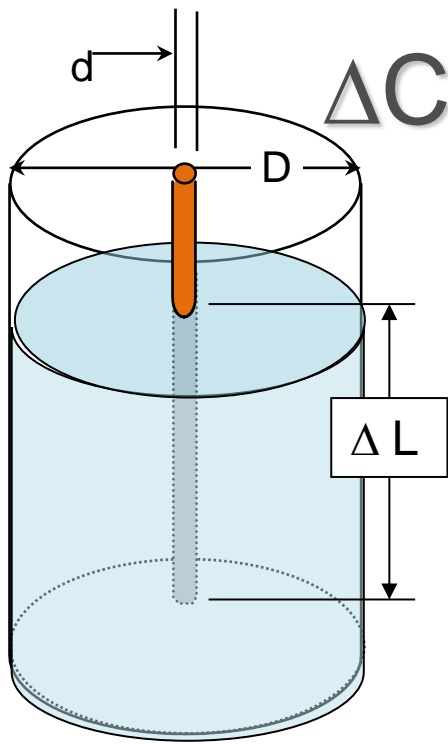
What is the difference ?

- ☑ 2-pole system.
- ☑ 3-pole system.



Capacitance Level Measurement

Basics:



$$\Delta C = \frac{K1 \times \Delta L \times \epsilon_r}{\log(D/d)} \quad (\text{pF})$$

($K1 = 24,3$ with L in meter)

ΔC = Capacitance increase (pF)

ΔL = Covered section of probe (ft)

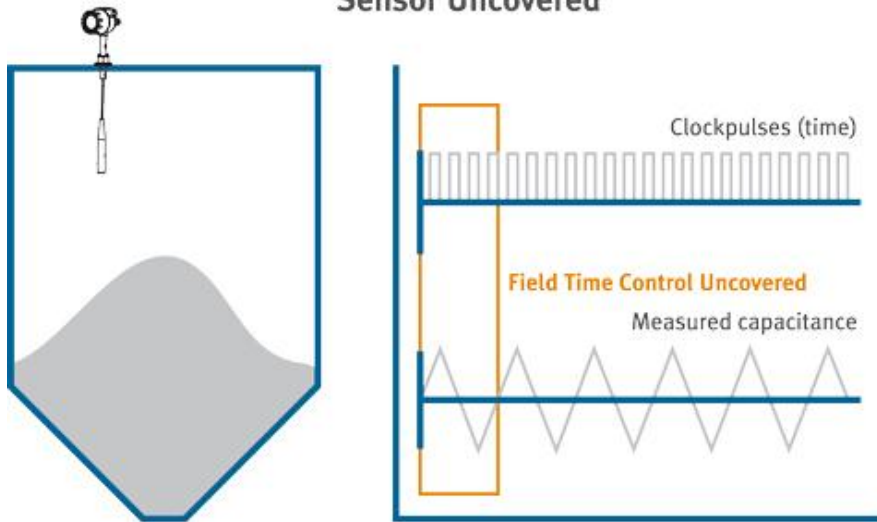
ϵ_r = Dielectric factor of product

D = Diameter vessel (ft)

d = Diameter probe (ft)

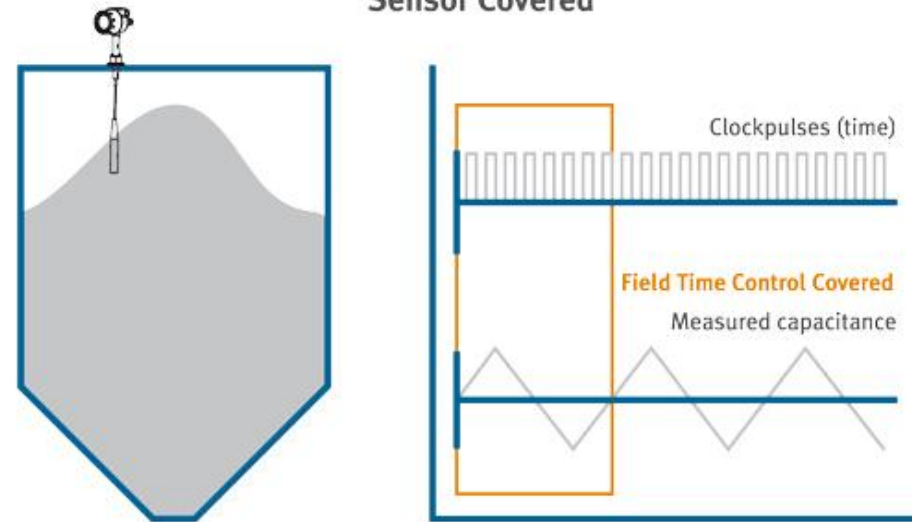
Field Time Control Technology

Sensor Uncovered



- ✔ Output FTC Sensor in air.
- ✔ No interference of focused electric field

Sensor Covered



- ✔ Output FTC sensor with product
- ✔ Product interferes this focused electric field and this results in cycle time increase
- ✔ More product; more time