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The Wonders of Vacuum or is it Pressure?

By Jeff Rachlin

Presented at the 2025 NOWRA Mega-Conference, October 19-22, 2025

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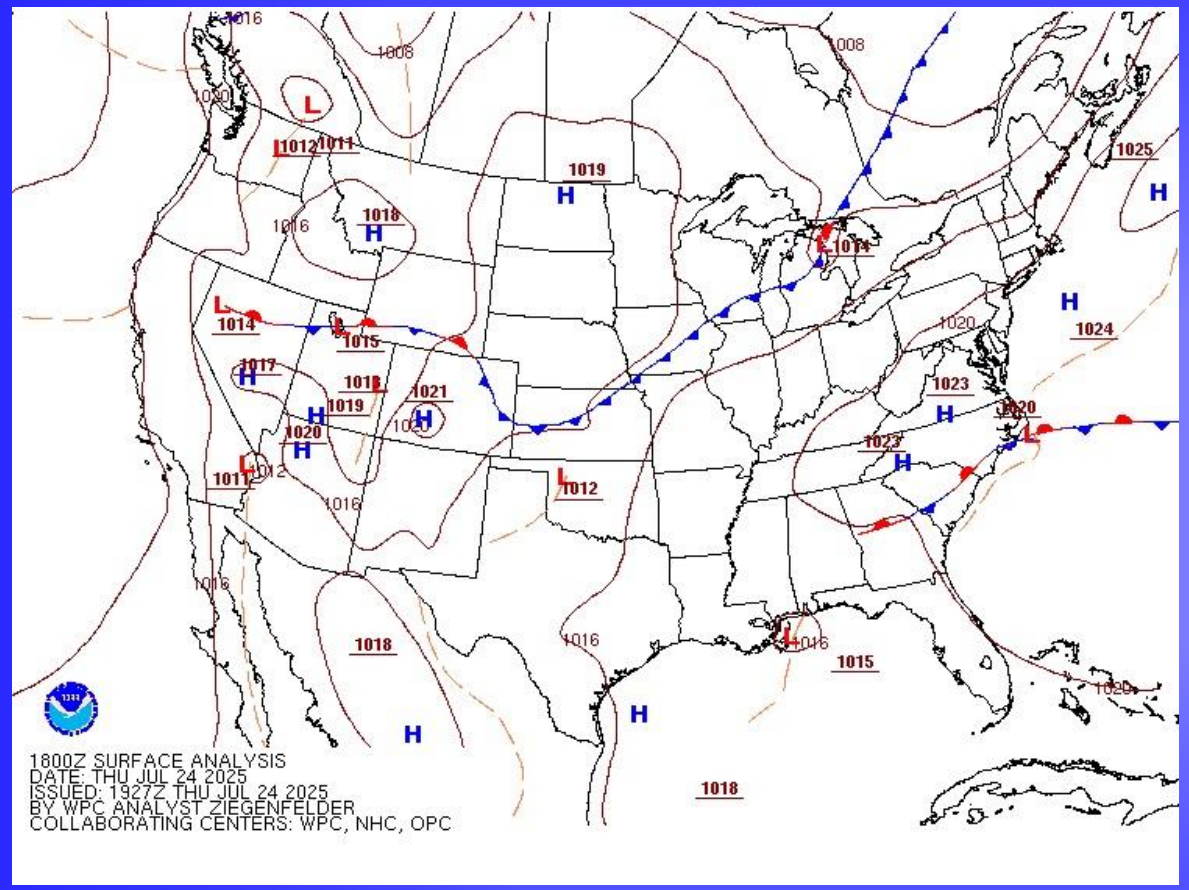
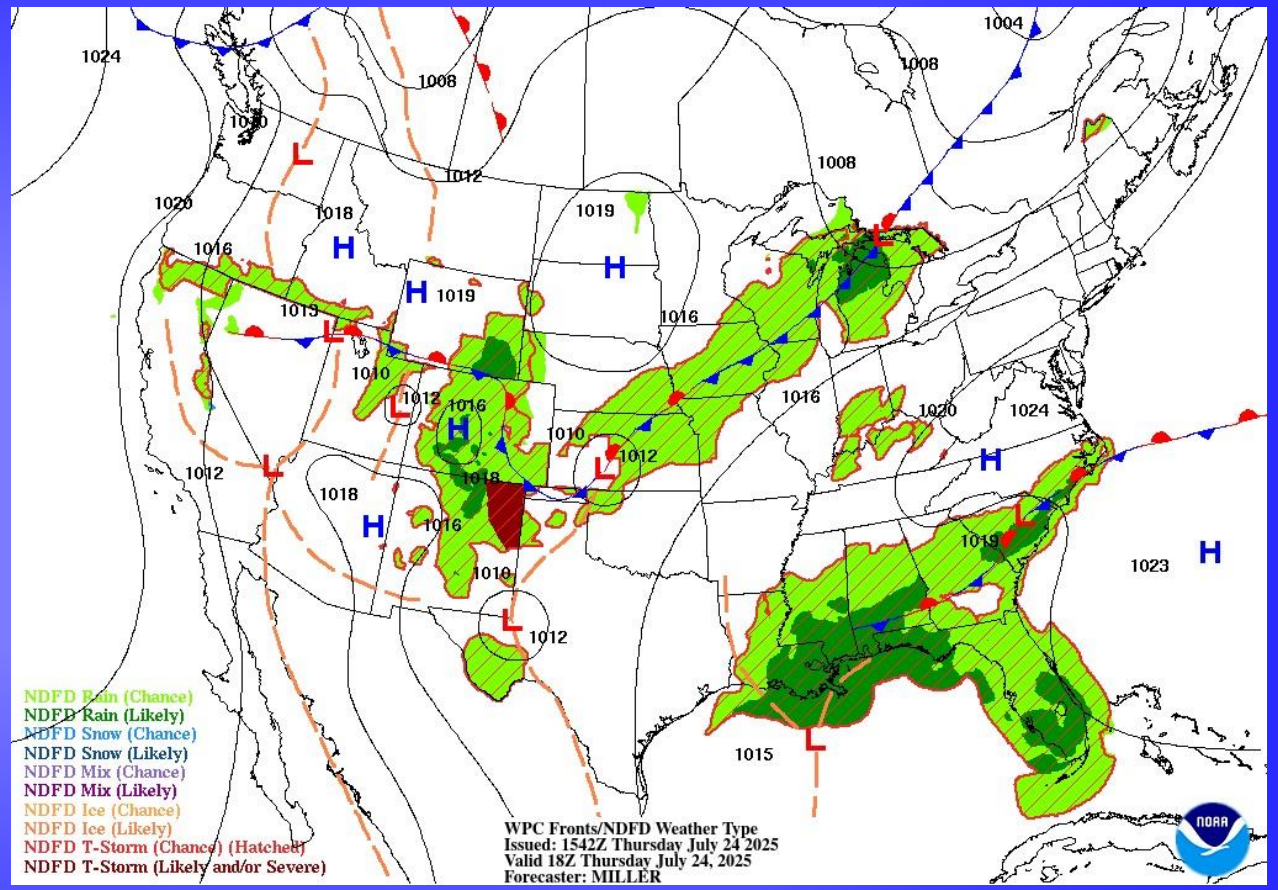
Pressure is always trying to equalize itself


1800Z SURFACE ANALYSIS
DATE: THU JUL 24 2025
ISSUED: 1927Z THU JUL 24 2025
BY WPC ANALYST ZIEGENFELDER
COLLABORATING CENTERS: WPC, NHC, OPC


NDFD Rain (Chance)
NDFD Rain (Likely)
NDFD Snow (Chance)
NDFD Snow (Likely)
NDFD Mix (Chance)
NDFD Mix (Likely)
NDFD Ice (Chance)
NDFD Ice (Likely)
NDFD T-Storm (Chance) (Hatched)
NDFD T-Storm (Likely and/or Severe)
WPC Fronts/NDFD Weather Type
Issued: 1542Z Thursday July 24 2025
Valid 18Z Thursday July 24, 2025
Forecaster: MILLER

Balloon Demo

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How do we measure vacuum?

- In inches of mercury or Hg
- Why mercury
- Standard Temperature and Pressure at sea level
  - 15˚C or 59˚F and 1013.2 millibars or 29.92 In of Hg
  - Standard Atmosphere
  - 1 Atmosphere weighs or exerts 14.7 lb/in^2

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Suction Cup Demo

- 2.18” Diameter Suction Cup
- Area = πr^2
- 3.14 x 1.09 x 1.09 = 3.73
- 3.73 x 14.7 = 54.83 lbs of suction

- 1 cubic foot of Hg weighs 845.47 lbs
- 1 cubic foot of H_2O holds 7.5 gallons
- 8 pint = 1 gallon of H_2O
- “A pint is a pound the world around”
- 1 gallon of H_2O weighs 8 lbs
- 1 cubic foot of H_2O weighs 7.5 x 8 = 60 lbs

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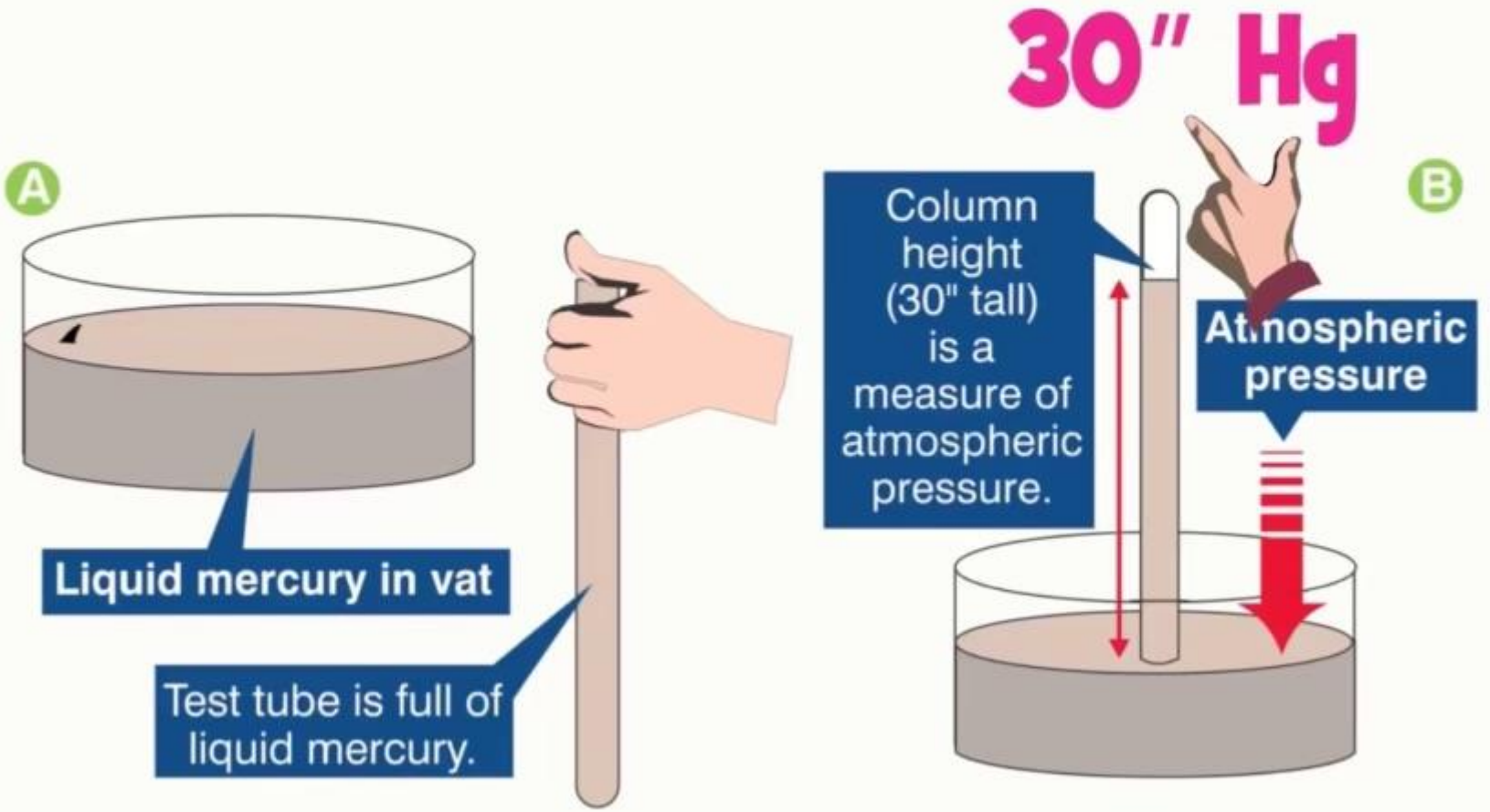
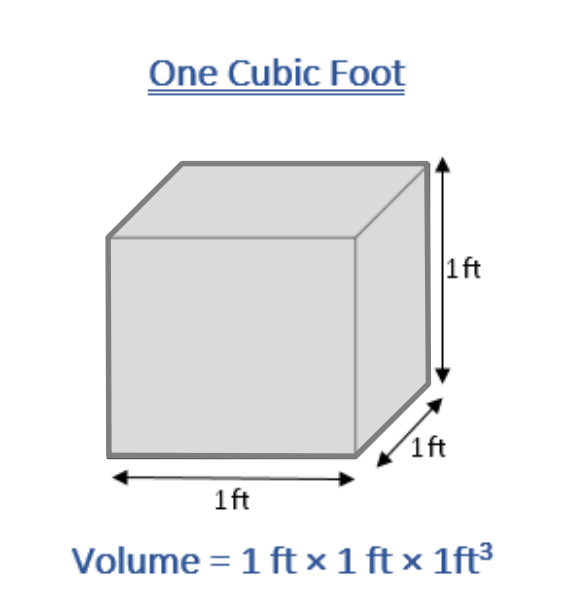
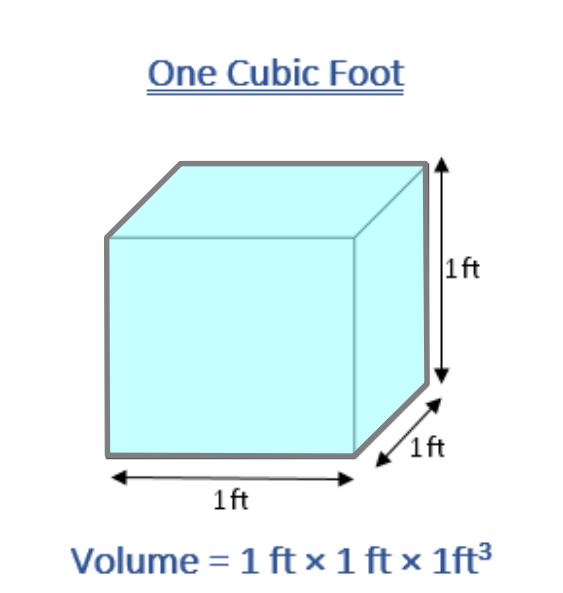
How A Mercurial Barometer Works

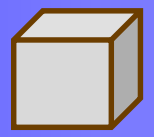


Mercury weights 845.47 pounds per cubic foot



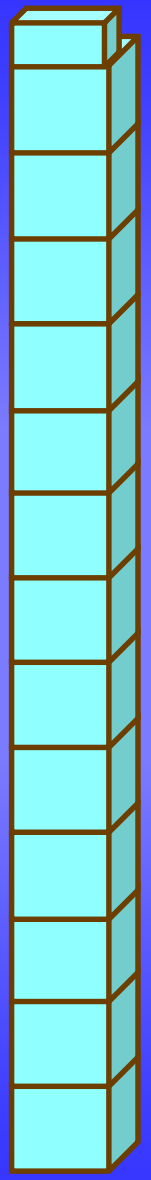
Water weights 62.4 pounds per cubic foot





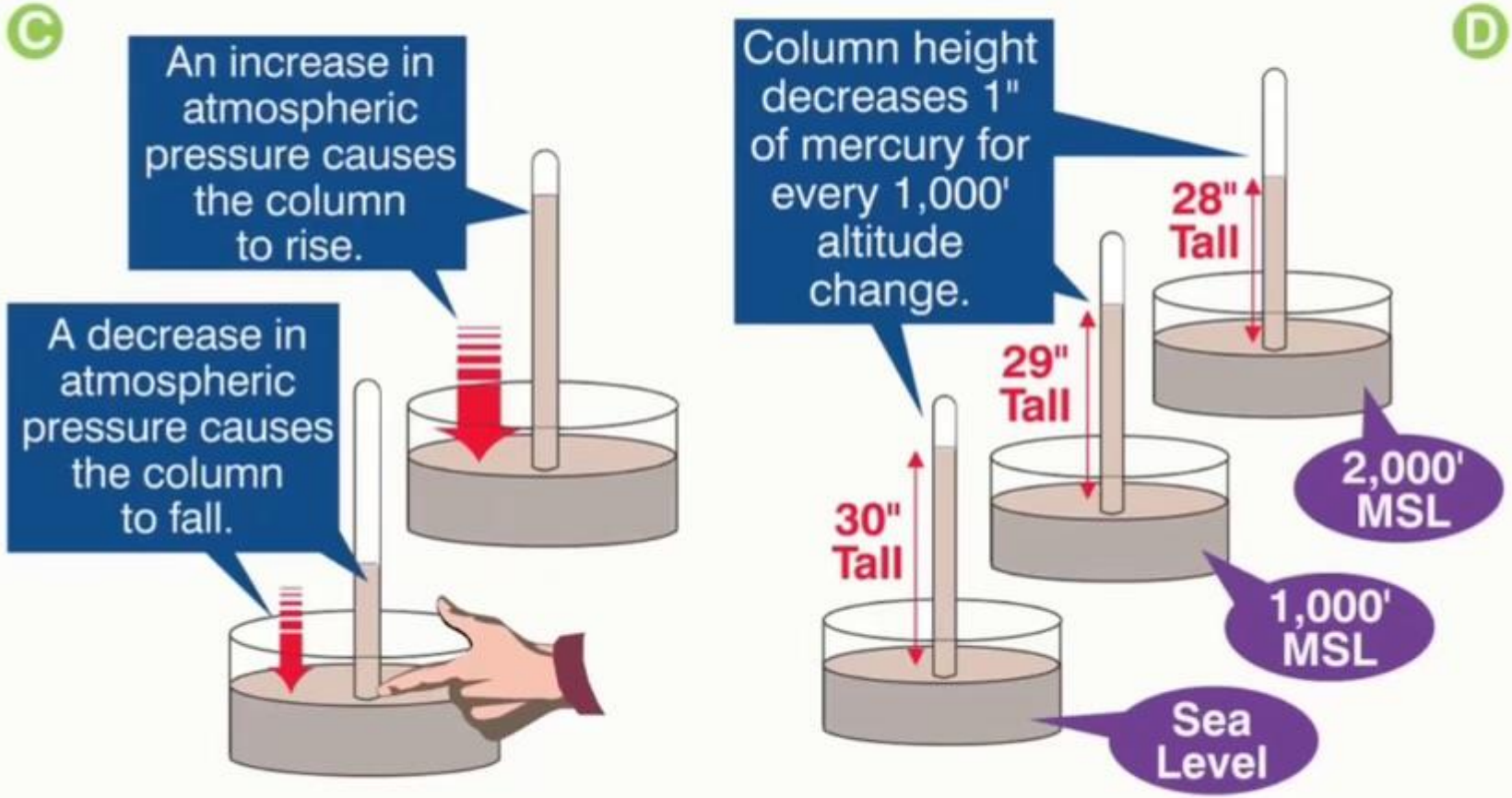
1” of Hg

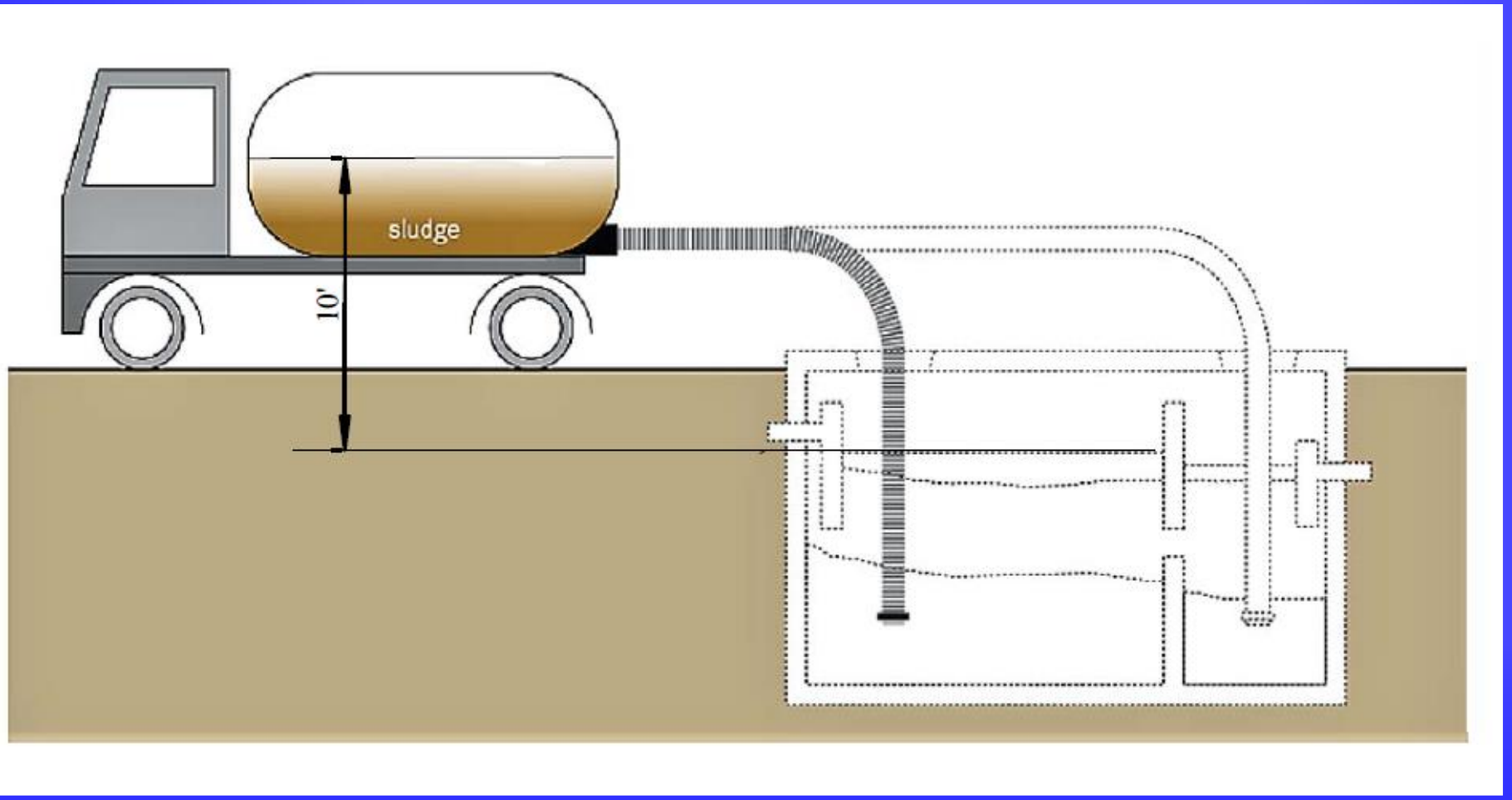
=



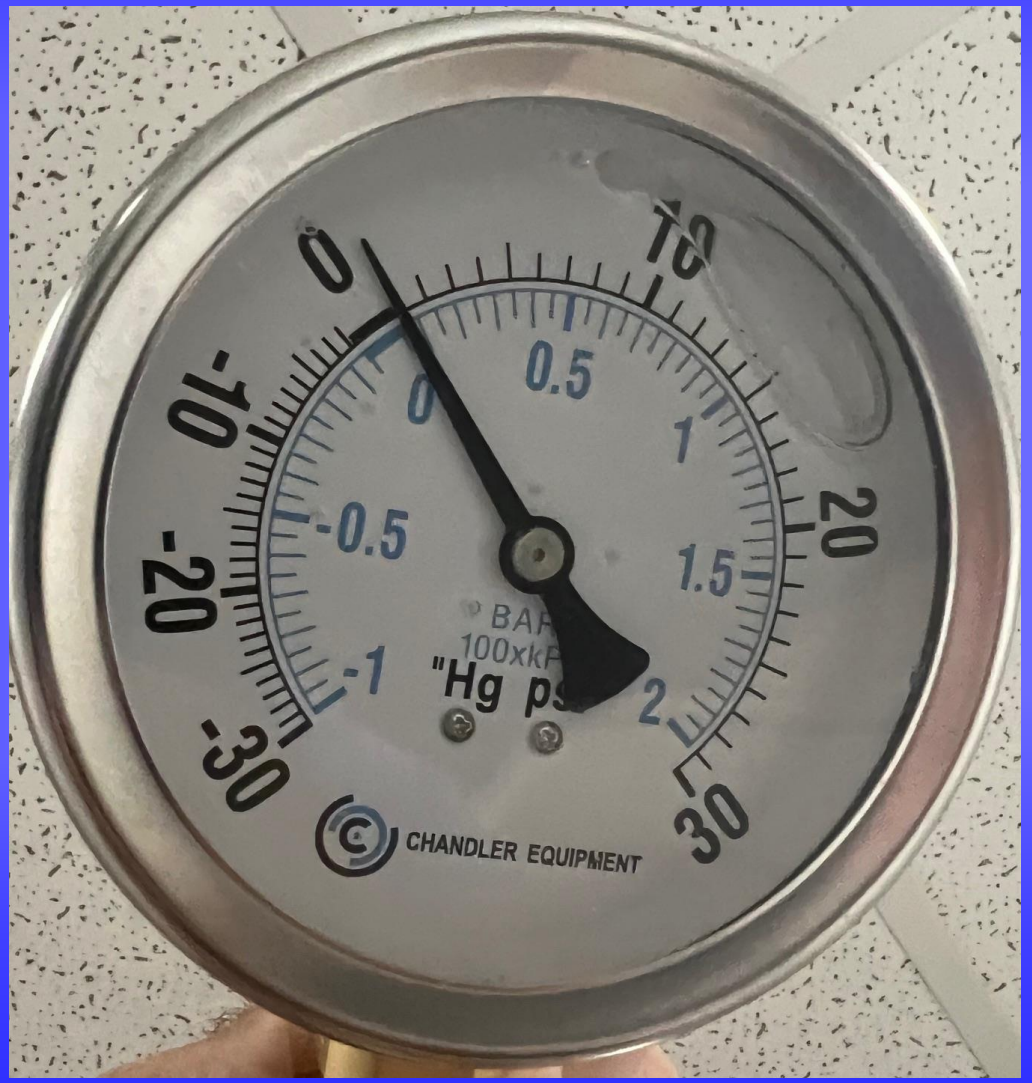
13.6” or 1’ of H_2O

How A Mercurial Barometer Works




sludge
10'

Let’s talk about Pressure



What is 1 psi?

- It’s a unit of force
- 1 pound per square inch
- 1 psi can push water 2.313’ straight up
- Sometimes we talk about pressure as “Head”
- Therefore 3’ of Head = 3 ÷ 2.313 or 1.30 psi

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84” Diameter Barrel

Air is Energy Stored When Compressed

- Force = Area x Pressure
- What is the area of an 84” diameter end head ?
- Area = πr^2
- Area = 3.14159 x 42 x 42
- Area = 5542 square inches

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Air is Energy Stored When Compressed

- At 1 psi there is 5,542 pounds of pressure on the head
- At 5 psi there is 27,710 pounds of pressure on the head
- At 10 psi there is 55,420 pounds of pressure on the head
- At 20 psi there is 110,840 pounds of pressure on the head

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Pressure Drop

Air
Water
Sewage

Moves through a hose there is pressure drop due to friction loss

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Friction Loss Hose Demo

- What did we learn?
- The smaller the diameter of the hose the more pressure drop
- The longer the hose length is the more pressure drop
- The faster the fluid moves the more pressure loss

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Moving Different Materials Demo

- Air
- Water
- Sludge
- Viscosity vs. Weight

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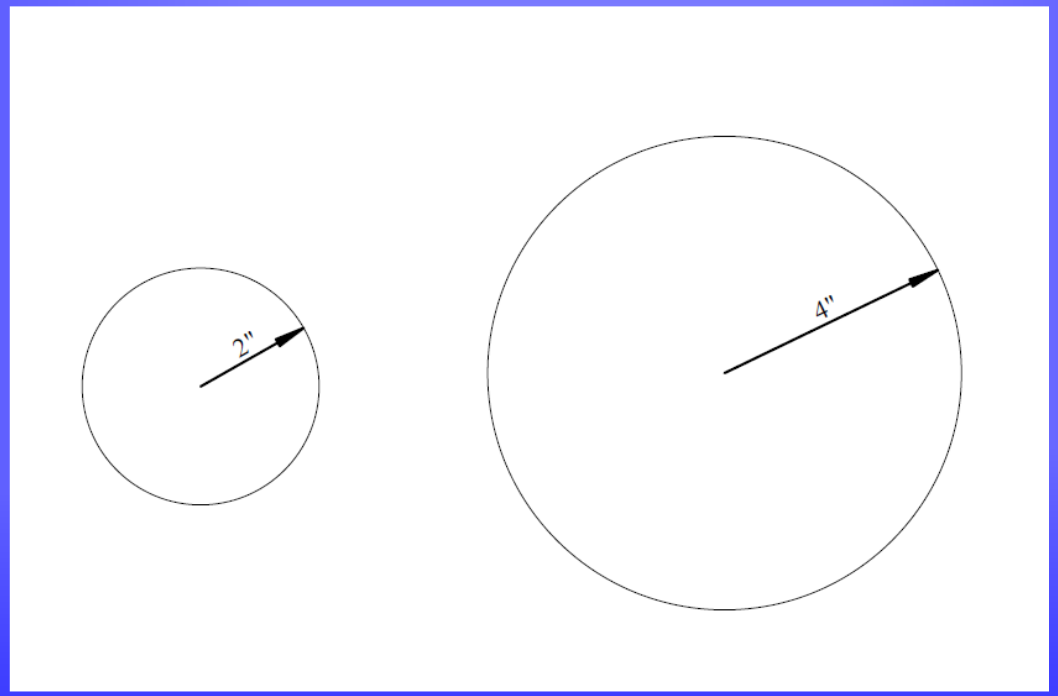
Hose Diameter Demo

Is a 4” diameter half the size of an 8” diameter hose ?

Area = πr^2
3.14 x 2 x 2 = 12.56



Area = πr^2
3.14 x 4 x 4 = 50.24

8” Hose is 4 times as big as 4” Hose

Viscosity vs. Weight

- Oil rises slower than the water did
- When pressure is static the oil column is higher than the water is
- Why?

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Thank You!

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