

INSTRUMENT

INSTRUMENT FOR OPERATION





What are the four parameter ?

Pressure

Level

Flow

Temperature



pressure

What is pressure?

▮ The force acting unit area .

▮ How calculate the pressure?

▮
$$P = \frac{F}{A} = \frac{N}{M^2} = Pa$$

▮ Example : if the $f = 50n$ & $A = 2.5m^2$ find the $p = ?$



pressure

▮ Units of pressure

- ▮ Kpa
- ▮ KG/CM2
- ▮ BAR
- ▮ PSI (pound per square inch)
- ▮ mmH2O
- ▮ mmHg
- ▮ inH2O
- ▮ inHg

▮ **Use the convert table**

pressure

Units	kPa	Pa	Bar	Std. Atm.	psi	Kg/cm ²	mmH ₂ O	mmHg	inHg	inH ₂ O
kPa	=1=	1000	0.01	0.0098692	0.145	0.0101972	101.9716	7.50062	0.2953	4.0146
Pa	0.001	=1=	0.00001	0.0000098	0.000145	0.0000101 97	0.1019716	0.007501	0.0002953	0.0040146
Bar	100	100,000	=1=	0.98692	14.5	1,019716	10,197.16	750.062	29.53	401.46
Std. Atm .	101.325	101,325	1.01325	=1=	14.696	1.033228	10,332.28	760	29.92	406.78
psi	6.89476	6,894.76	0.06895	0.068046	=1=	0.070307	703.072	51.715	2.036	27.68
Kg/cm ²	98.0665	98,066.5	0.980665	0.967841	14.22	=1=	10,000	735.559	28.96	393.70
mmH ₂ O	0.0098067	9.80665	0.0000981	0.0000967	0.001422	0.0001	=1=	0.0735559	0.002896	0.03937
mmHg	0.1333224	133.3224	0.0013332	0.0013158	0.0193	0.0013595	13.5951	=1=	0.03937	0.53524
inHg	3.3864	3,3864	0.033864	0.03342	0.491	0.03453	345.3155	25.4	=1=	13.5951
inH ₂ O	0.24909	249.09	0.002491	0.00246	0.0361	0.00254	25.4	1.8683	0.0735559	=1=



pressure

▮ Type of pressure

- ▮ Atmospheric pressure
- ▮ Absolute pressure
- ▮ Vacuum pressure
- ▮ Pressure Gauge
- ▮ Differential pressure



pressure

▮ To calculate absolute pressure

▮ $Abs = Atm + Pg$ when $Pg < 14.7 \text{ psi}$

▮ $Abs = Atm - Pg$ when $Pg > 14.7 \text{ psi}$



pressure

▮ **Sensor & Device**

- ▮ Manometer
- ▮ Pressure gauge
- ▮ Differential pressure transmitter

pressure

▮ Manometer



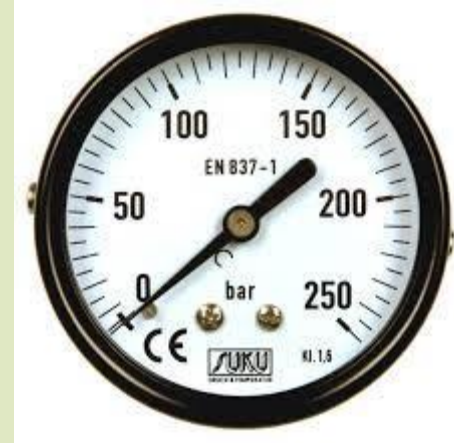
pressure

▮ Digital Pressure gauge



pressure

▮ Pressure gauge



Pressure

▮ Differential pressure transmitter





FLOW

▮ What is flow?

▮ The amount of liquid passes through a system

▮ How calculate the flow?

▮ $Q = V * A$

▮ Where flow rate (Q) = flow velocity (V) × pipe area (A)

▮ $Q = K * \sqrt{h}$



FLOW

▮ Units of flow

▮ Liter/min

▮ m³/hr

▮ cut/sec

▮ Kg/sec

▮ tans/hr

▮ gallon/min



FLOW

- ▮ **Flow Measurement**
 - ▮ **a- Primary element**
 - ▮ **b- Secondary**



FLOW

- ▮ **a- Primary element**

- ▮ **Venturi**

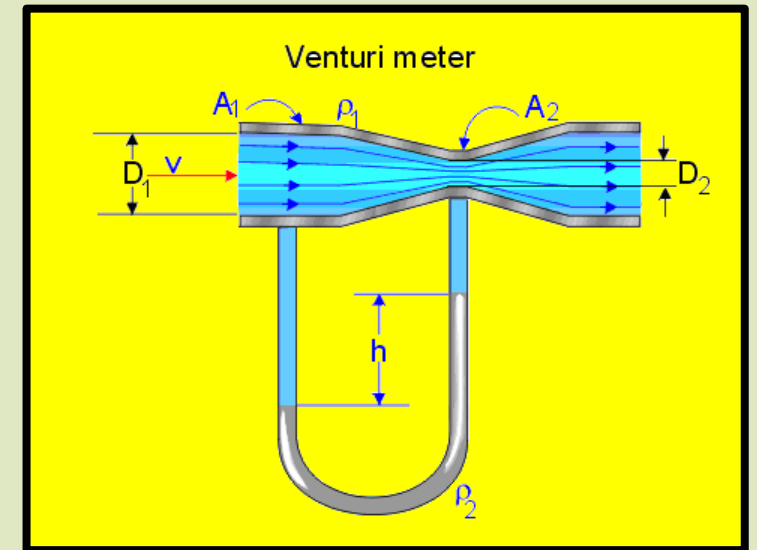
- ▮ **Orifice**

- ▮ **Flow nozzle**

FLOW

▮ Venturi:

- ▮ **The Venturi tube has particular advantages:**
- ▮ Efficiency – they have very low pressure losses
- ▮ High accuracy
- ▮ Suitability for fluids with suspended solids
- ▮ **The disadvantages of the Venturi tube are:**
- ▮ Cost
- ▮ Size (length)
- ▮ Difficulty of installation



FLOW

❑ **Orifice:** The most common element used to create a differential pressure is the orifice plate

❑ **The Orifice Plate has particular advantages:**

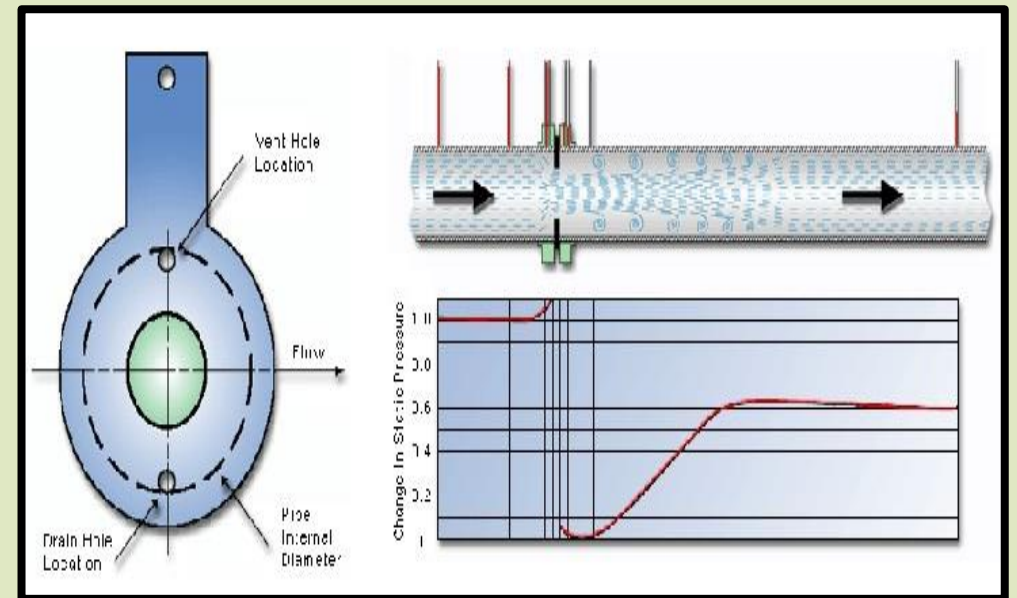
❑ Low cost

❑ Small size

❑ Easy of installation

❑ **The disadvantages of the Orifice Plate are:**

❑ Low pressure



FLOW

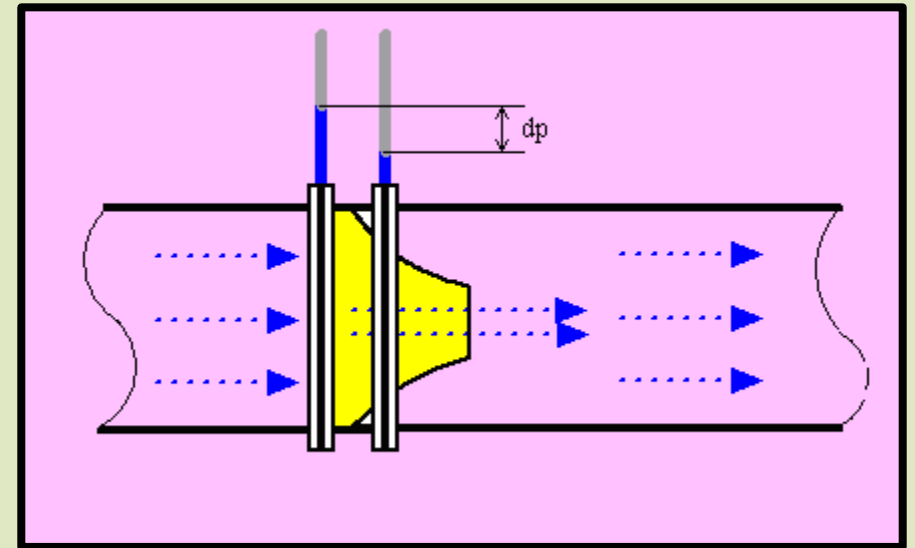
▮ **Flow nozzle:** The flow nozzle is more rigid than an orifice plate and will not deform at high temperatures and flow rates.

▮ **The advantages are:**

- ▮ Inexpensive
- ▮ Easily manufactured
- ▮ Simple to install or change because they fit between flanges

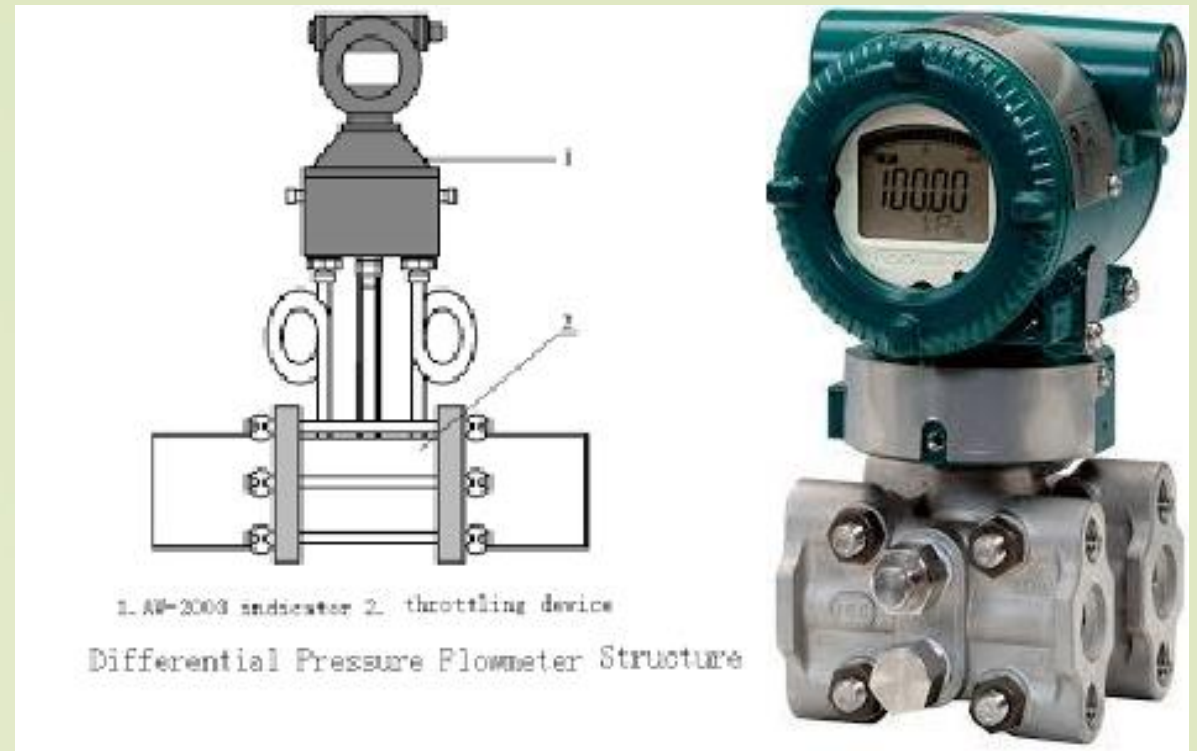
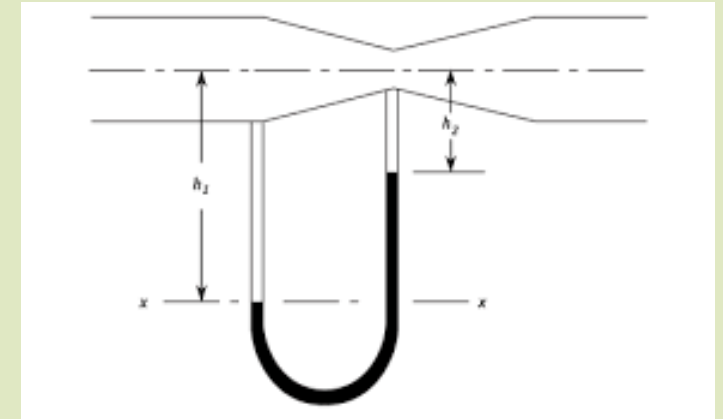
▮ **The disadvantages are:**

- ▮ Unsuitable for flows with suspended solids
- ▮ Not as accurate as Venturi tubes
- ▮ Have higher pressure losses than Venturi tubes



FLOW

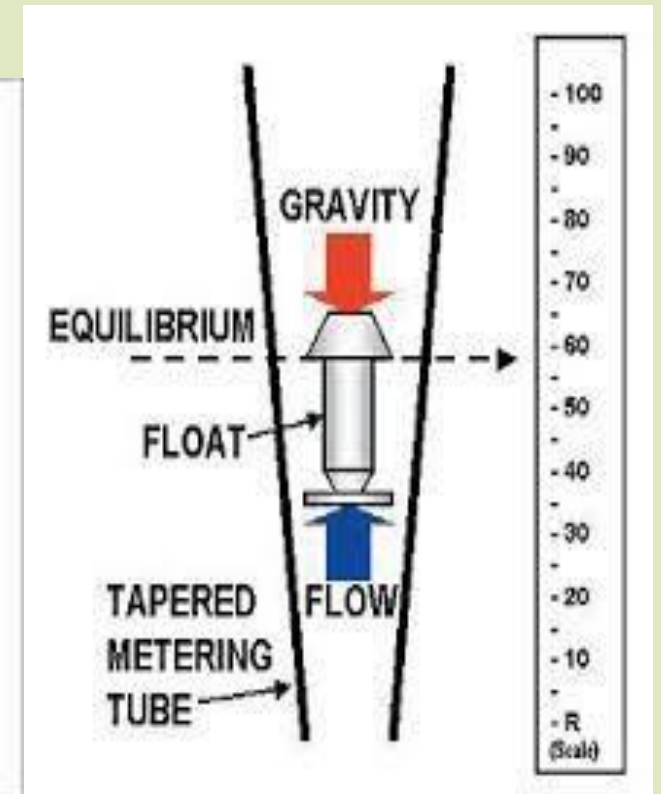
- ▮ **b- Secondary**
- ▮ **U-tube monometer**
- ▮ **Differential pressure**



FLOW

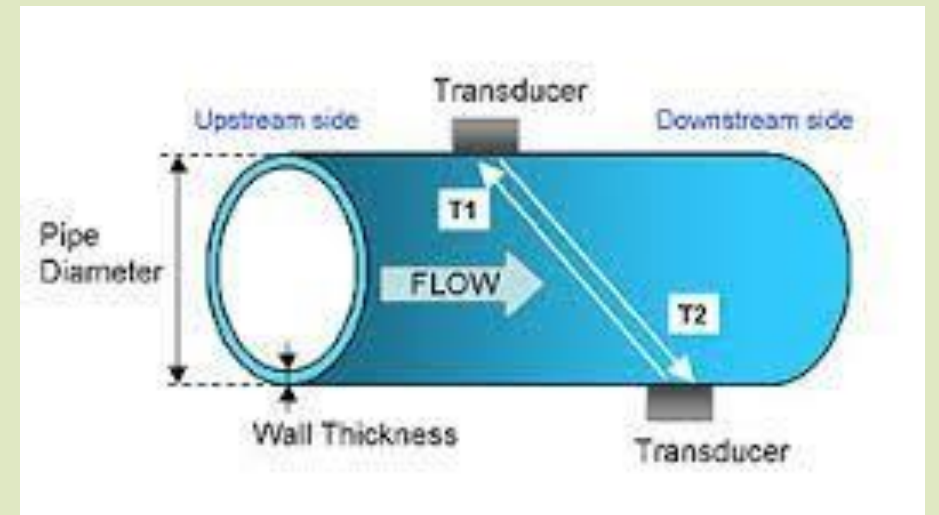
Flow devices:

Rota meter



FLOW

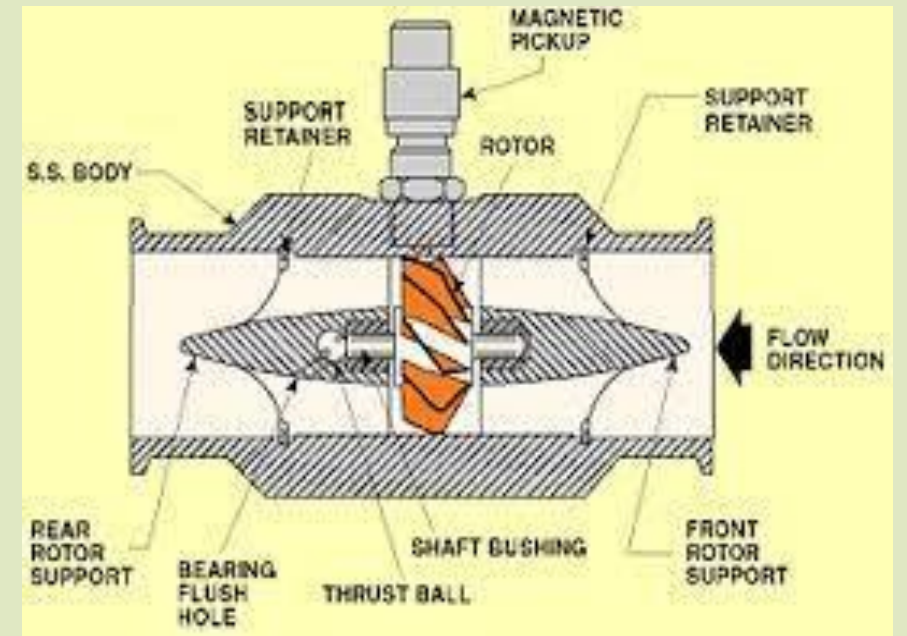
- ▮ **Flow devices:**
- ▮ **Ultrasonic flow meter**



FLOW

Flow devices:

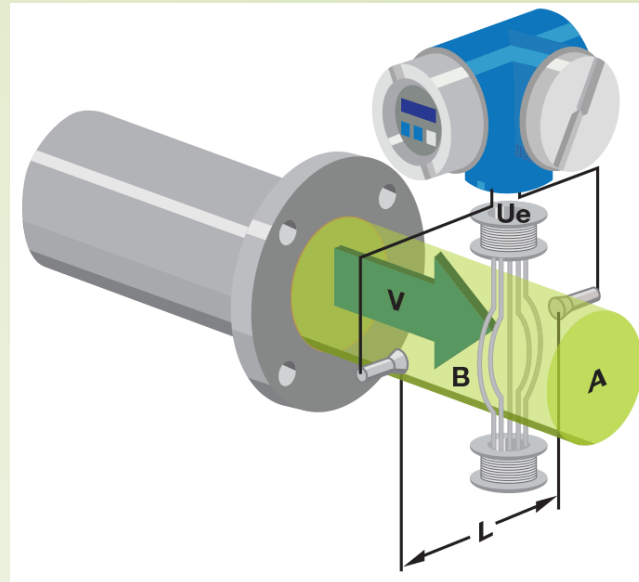
Turbine flow meter



FLOW

- Flow devices:

- magnetic flow meter





LEVEL

▮ What is the level?

▮ Height of the liquid is called level

▮ How calculate the level?

▮
$$h = \frac{\Delta P}{\rho g}$$

h = high of liquid & ΔP = pressure & ρ = Density of liquid
 g = Gravity



LEVEL

▮ Units of level

- ▮ mm
- ▮ Cm
- ▮ Feet
- ▮ meter



LEVEL

▮ Level types:

▮ Liquid

▮ Solid

▮ Level measurement:

▮ 1-Direct method

▮ 2-indirect method

LEVEL

1-Direct method

A-Dip stick



LEVEL

▮ B-Gauge glasses

▮ Type 1-Tubular glass.

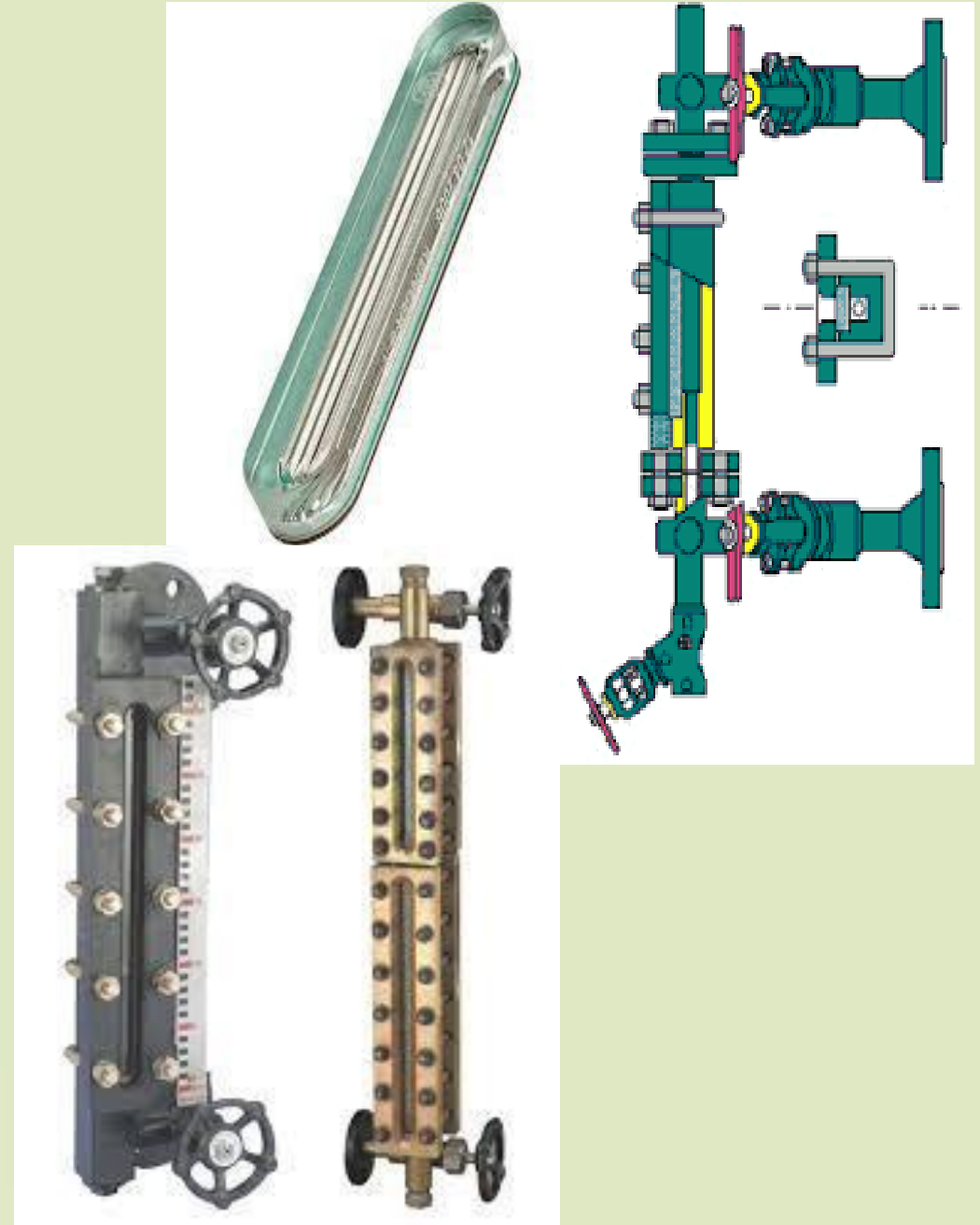
- ▮ Using in the low pressure
- ▮ Easy maintenance
- ▮ Easy to broken
- ▮ Open tank
- ▮ Closed tank
- ▮ No severe operation



LEVEL

▮ Type 2-Reflex gauge glass.

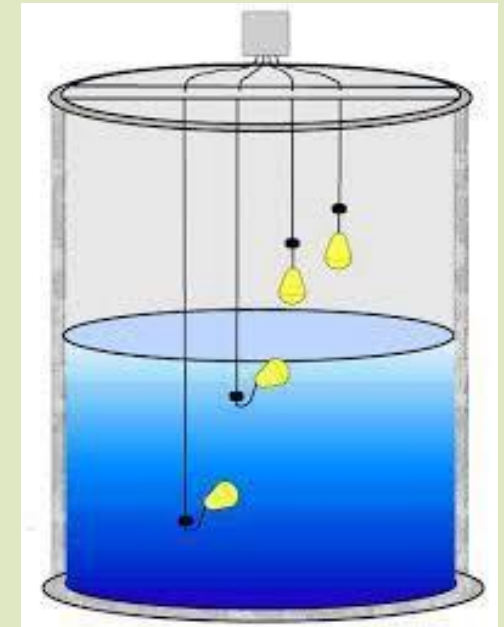
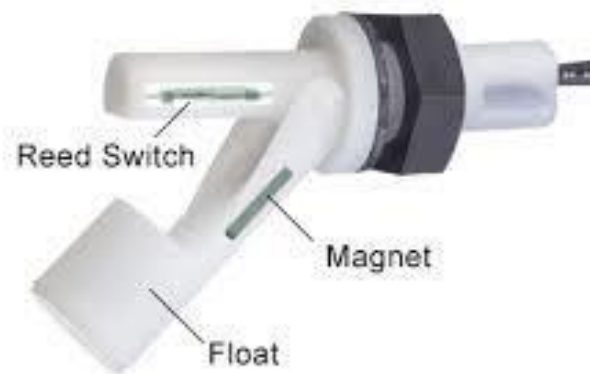
- ▮ Using in the high pressure
- ▮ Usually attached with light
- ▮ Closed tank
- ▮ Severe operation



LEVEL

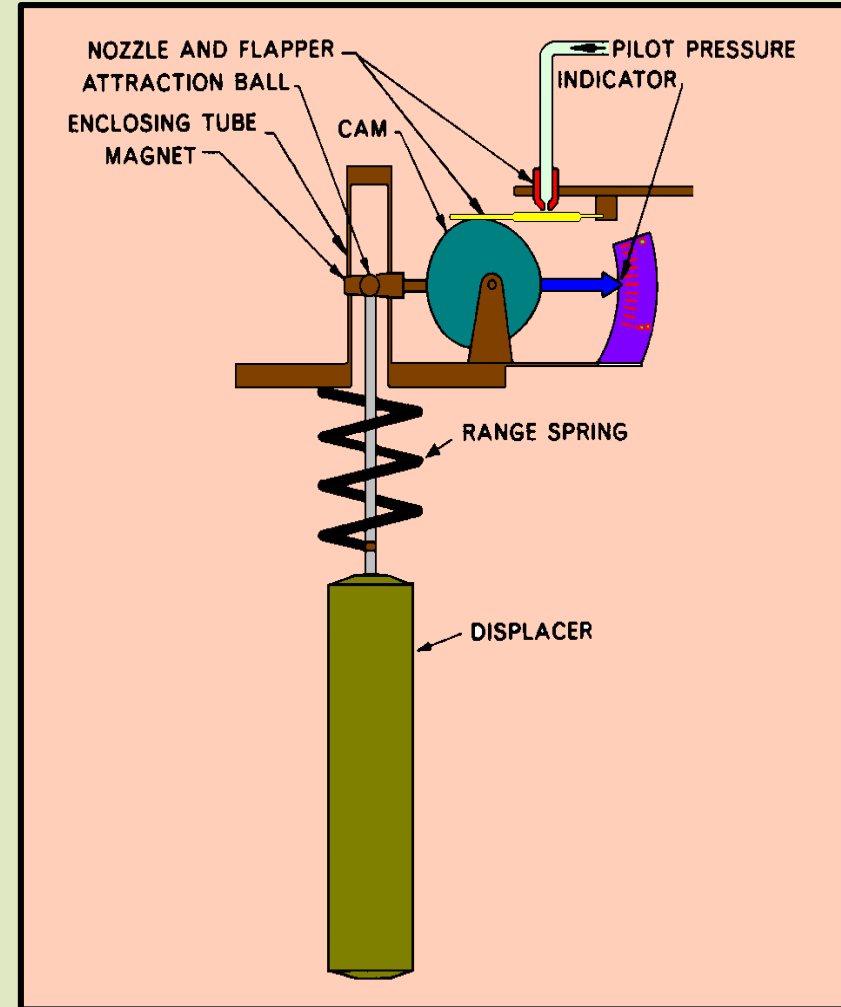
▮ C-Floats

Horizontal Type:



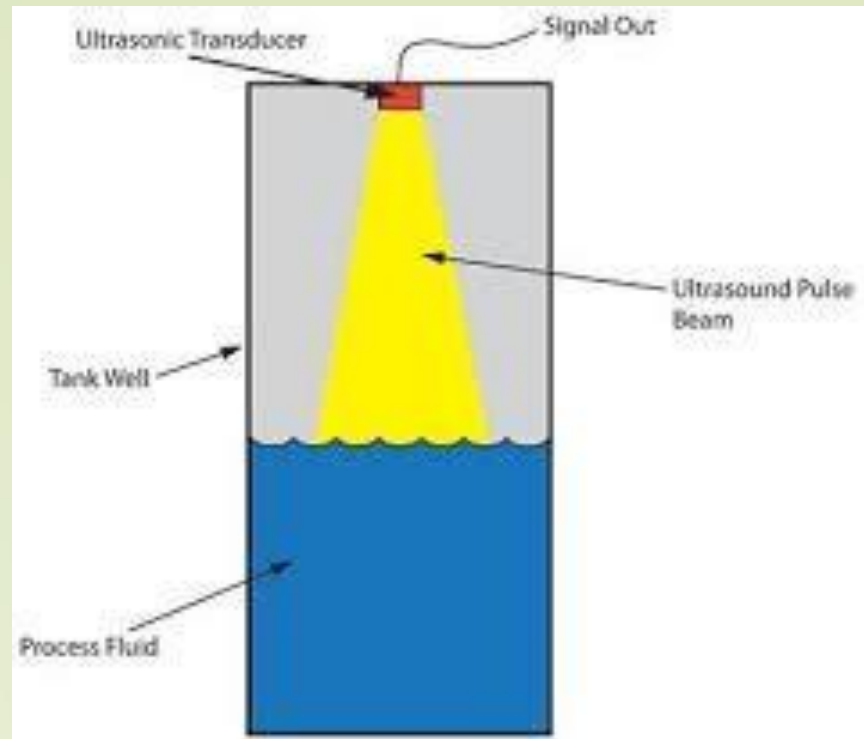
LEVEL

2-indirect method A-Displacer type



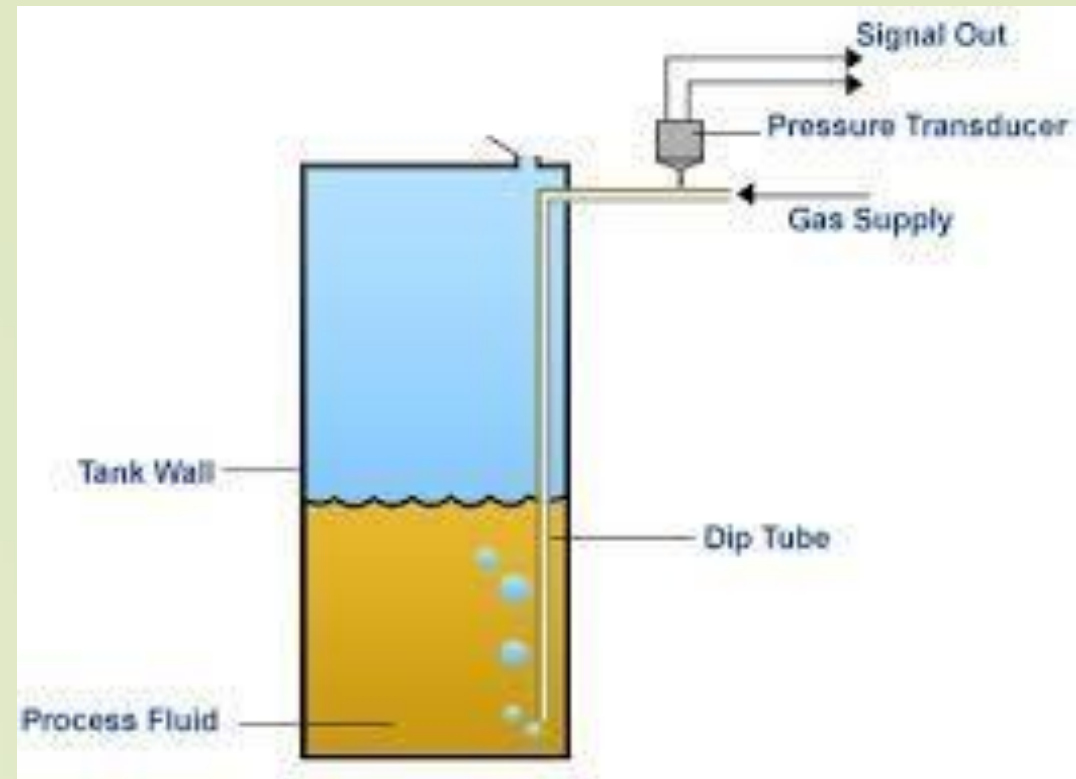
LEVEL

■ B- Ultra sonic



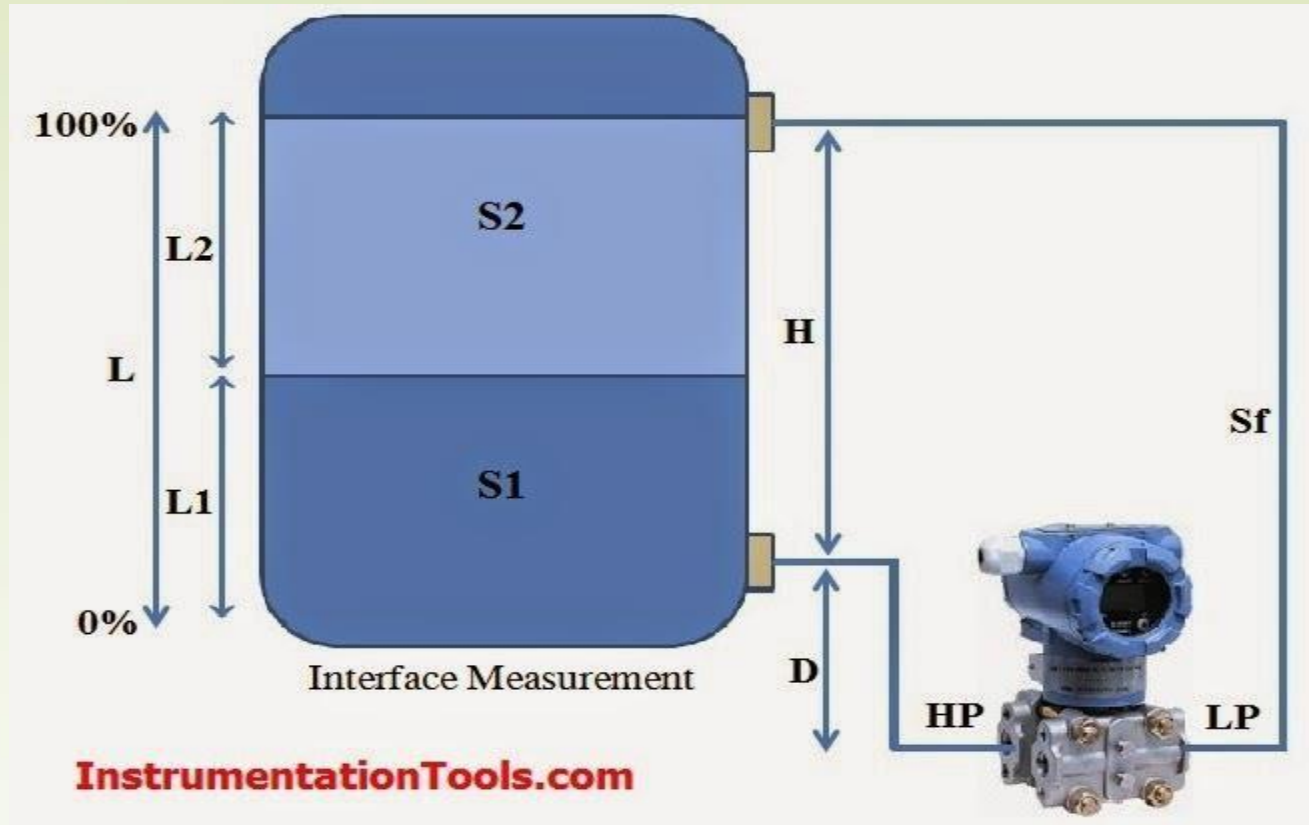
LEVEL

▮ C-Bubble system



LEVEL

□ D-Differential Pressure



TEMPERATURE

What is the Temperature?

It is measurement of hotness or coldness

Unit of Temperature:

- 1-Celsius scale $(C = \{F - 32\} / 1.8)$
Ex: $F = 63.5$ $C = ?$ $C = (63.5 - 32) / 1.8 = 17.5$ C
- 2-Kelvin scale $(K = C + 273)$
Ex: $C = 32$ $K = ?$ $K = 32 + 273 = 305$ K
- 3-The Fahrenheit scale $(F = 1.8 * C \{+32\})$
Ex: $C = 17.5$ $F = ?$ $F = (1.8 * 17.5) + 32 = 63.5$ F
- 4-Rankine $(R = F + 460)$
Ex: $F = 120$ $R = ?$ $R = 120 + 460 = 580$ R

TEMPERATURE

TEMPERATURE Device:

1-Glass thermometers



TEMPERATURE

2-Bimetallic thermometers

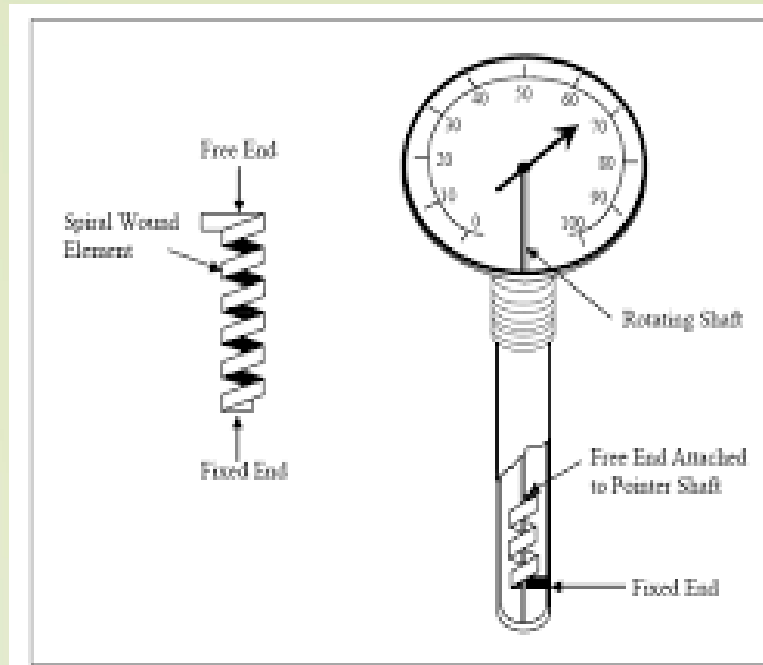


Figure 7-3. Bimetallic dial thermometer



TEMPERATURE

3-Filled system thermometer



TEMPERATURE

4-Thermocouple Thermometer

Type:

A-Copper-Constantan

B-Iron- Constantan

C-Nickel-Nickel chromium

D-Chrome- Aluminum

E-Platinum- Platinum Rhodium

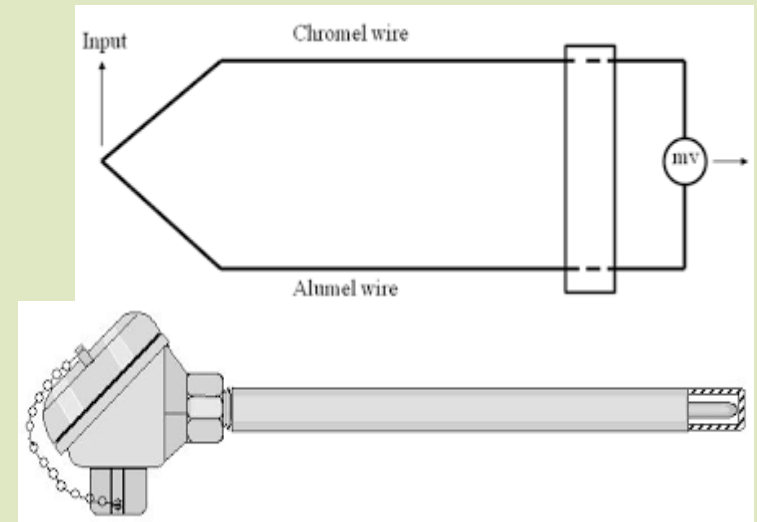
type T

type J

type E

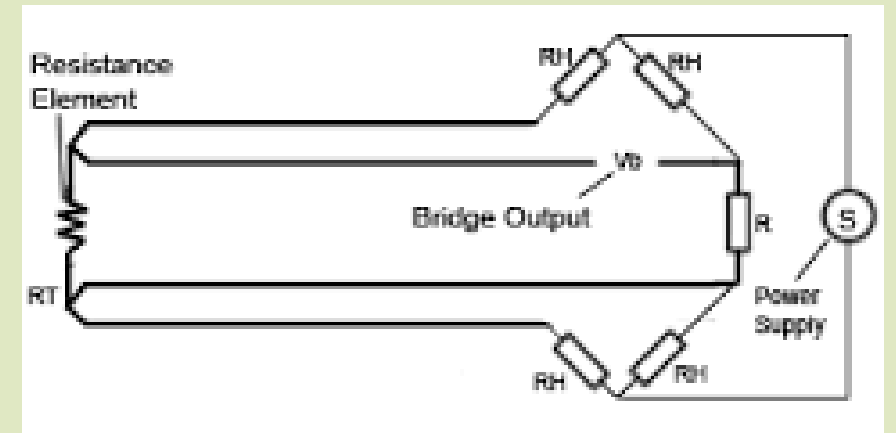
type K

types R-S



TEMPERATURE

5-Electrical resistance thermometer





Thank you