CH0302 Process Instrumentation

Lecture 12 – Level Measurements

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Introduction – Pressure and Level Measurments

- Pressure Definitions and units
- Classification of pressure measuring instruments
- Working principles of pressure measuring instruments
- Measuring elements for gauge, vacuum pressure and absolute pressure
- Indicating elements in pressure measuring instruments

Introduction – Pressure and Level Measurements

- Pressure measurement for corrosive fluids
- Level Measurements
- Classifications of Level measuring instruments

Level Measurements – Classification

There are basically two kinds of measurement made on liquid level (or even for dry material.

- 1st head measurement in which the level or height is directly measured by a float that follows the surface or by a direct contact means.

- 2nd is pressure measurement in which the level or height is determined from the relation $P = \rho g h$ and $h = \mathrm{p}/\rho g$

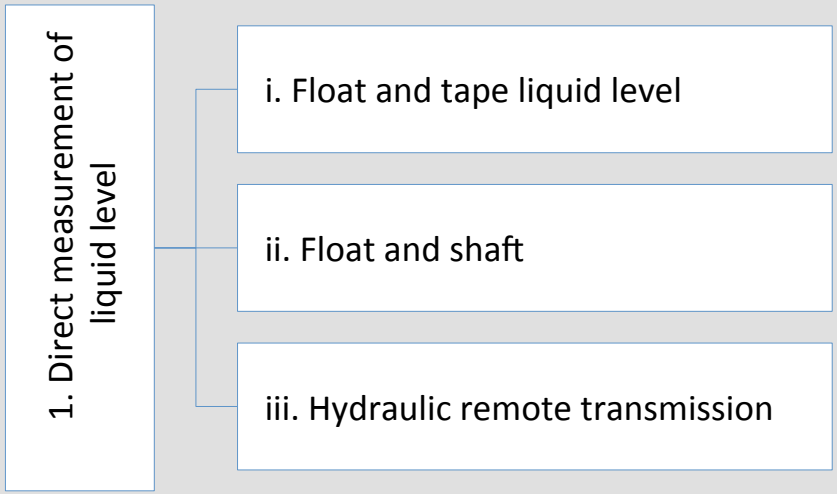
Level Measurements – Classification

Classification based on applications

1. Direct measurement of liquid level
2. Pressure (level) in open vessels for liquids
3. Level measurements in pressure vessels (Manometric)
4. Measurement of interface level
5. Level by weighing solids

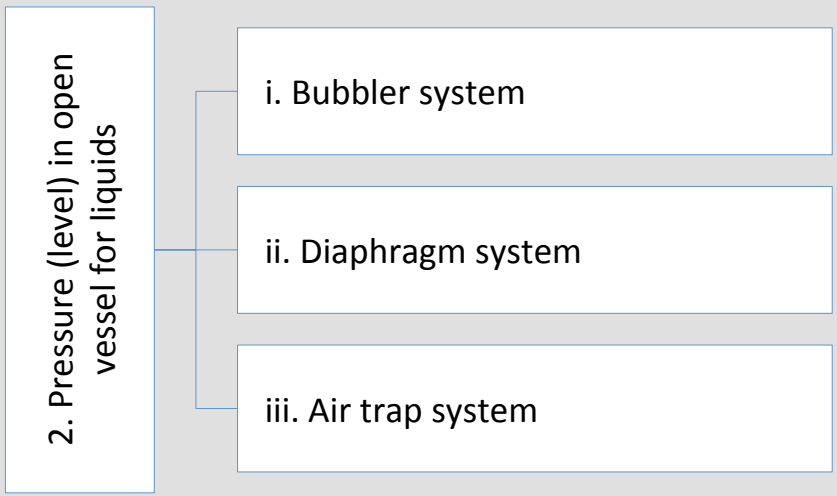
Level Measurements – Classification

Classification based on applications



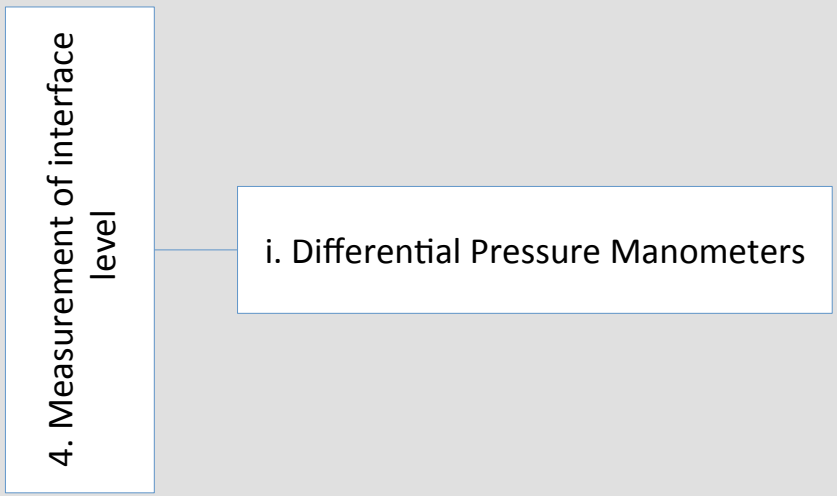
Level Measurements – Classification

Classification based on applications



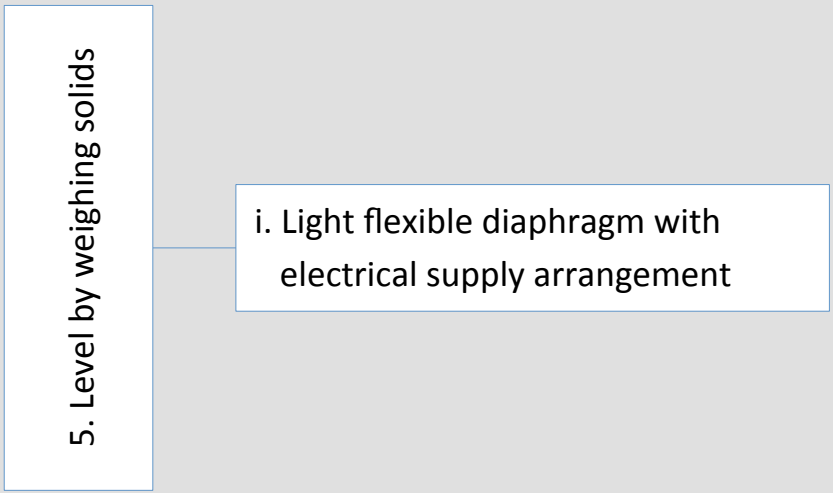
Level Measurements – Classification

Classification based on applications



Level Measurements – Classification

Classification based on applications

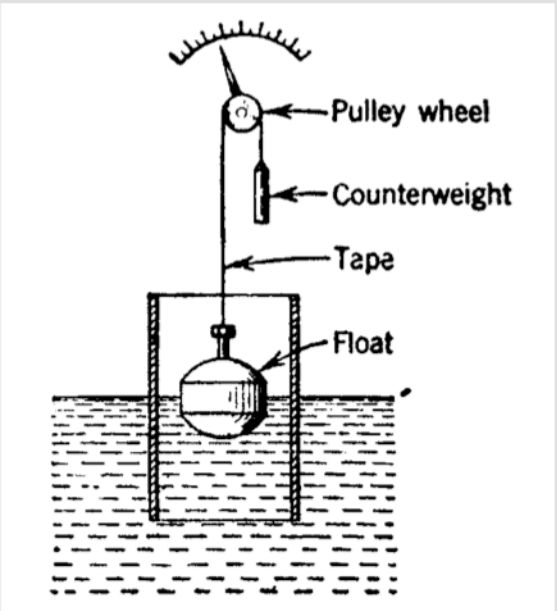


Level Measurements – Classification

Classification based on applications –

Float and tape type

- Widely used method
- It is employed in open vessel level measurement only.
- The float usually rest on the surface of the liquid, supported by buoyant force

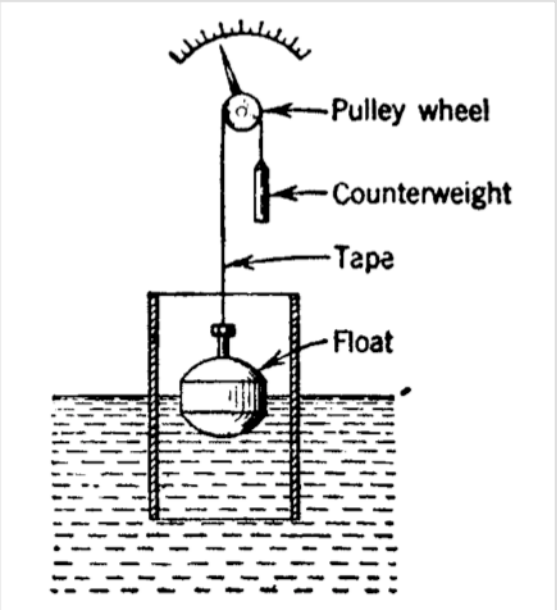


Level Measurements – Classification

Classification based on applications –

Float and tape type

- The float is made with a sloping top in order to avoid building up of solid material on the top of the float, thereby changing its weight.
- The float is connected to the drum by a thin, light weight, flexible tape or cable.

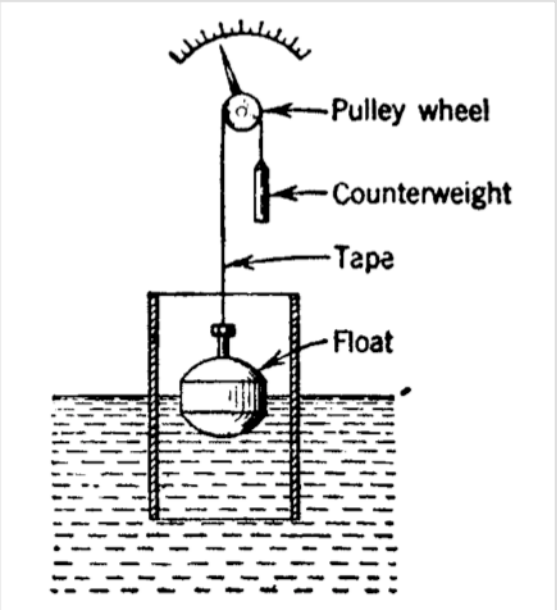


Level Measurements – Classification

Classification based on applications –

Float and tape type

- Slipping of tape on the drum is prevented by a direct connection of the tape drum.
- By a suitable reduction in motion the pointer indicates level on a scale

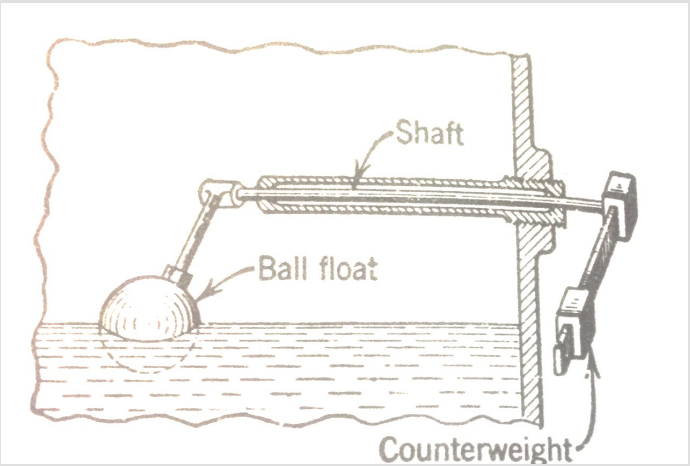


Level Measurements – Classification

Classification based on applications –

Float and shaft type

- It is employed either in open vessel level or in a pressure having pressure upto 1000 psi internal.
- The float rest on the surface of the liquid and the motion of the float is taken through the stuffing box by the shaft

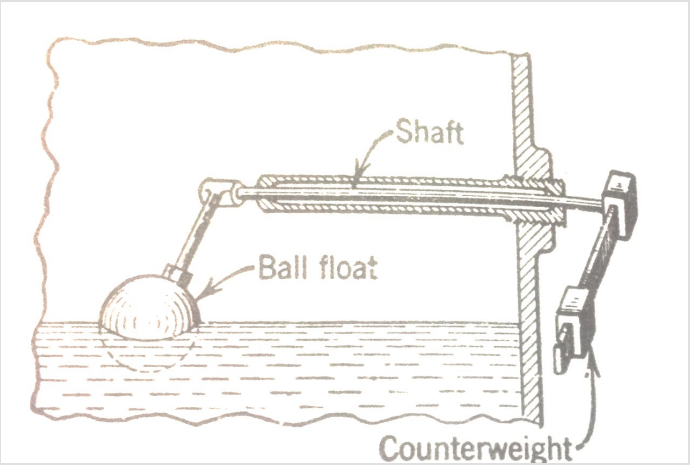


Level Measurements – Classification

Classification based on applications –

Float and shaft type

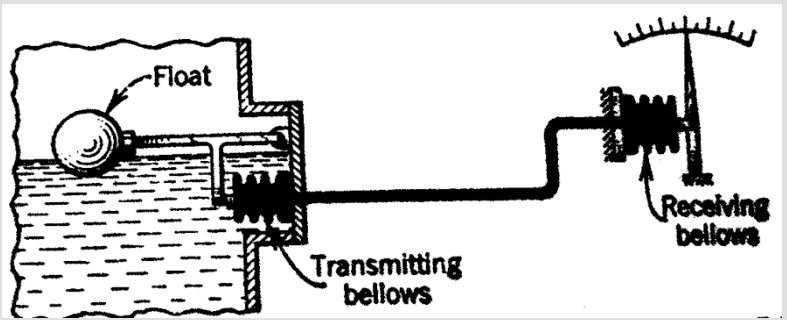
- The counter weight is adjustable, so that the float can be made to ride half submerged.



Level Measurements – Classification

Classification based on applications – Hydraulic remote transmission type

- It works similar to float and shaft but the difference is that the rotation of shaft is converted into change in hydraulic or pneumatic transmission.

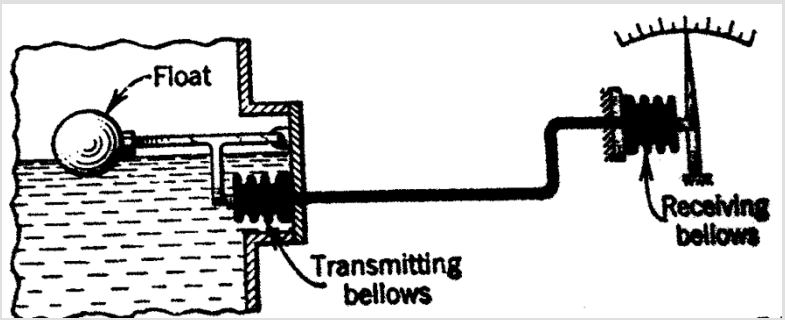


- The movement of float causes a displacement of metallic bellows which is filled with oil.

Level Measurements – Classification

Classification based on applications – Hydraulic remote transmission type

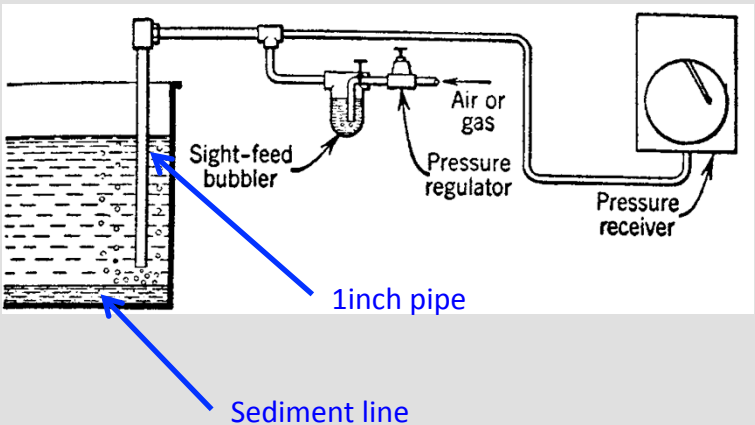
- The receiving-bellows displacement is equal to the transmitting bellows displacement.



Level Measurements – Classification

Classification based on applications – Bubbler System (Open Vessels)

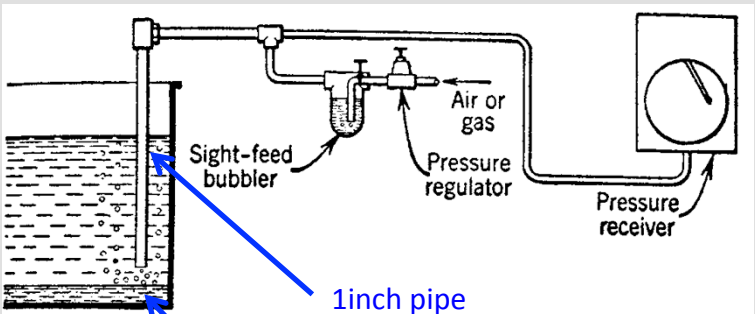
- This system is satisfactory for all liquids, even corrosive and liquids containing suspended solids.
- Air is supplied to the pipe through a valve and sight feed bubbler.



Level Measurements – Classification

Classification based on applications – Bubbler System (Open Vessels)

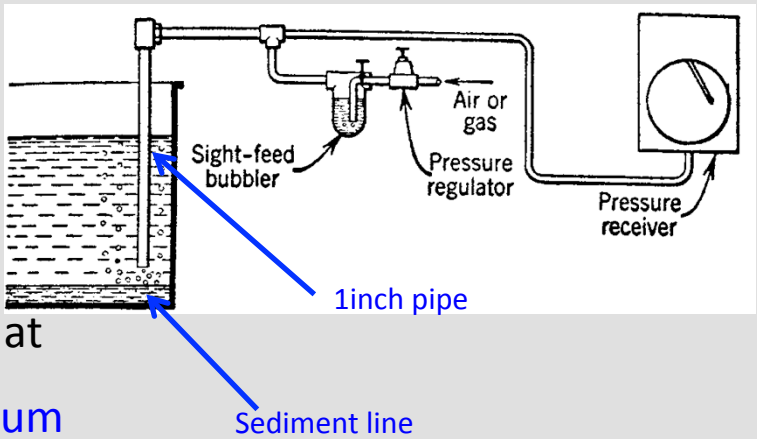
- A pressure gauge of suitable type is connected separately to upper end of the bubbler pipe.
- The system operates by building up a pressure inside the feed line until the air escapes and flow stabilizes at the rate determined by the valve or other regulator in the feed line.



Level Measurements – Classification

Classification based on applications – Bubbler System (Open Vessels)

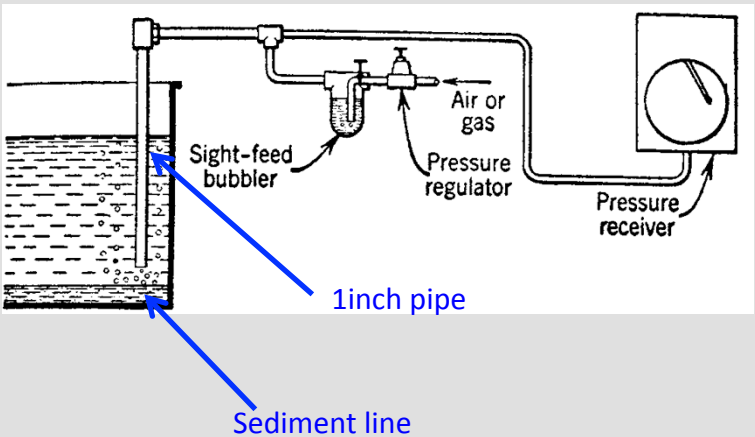
- The pressure in the bubbler pipe necessary to cause flow is slightly higher than the liquid head over the bubbler pipe.
- Therefore, the air feed must be available at a pressure slightly higher than the maximum head to be measured.



Level Measurements – Classification

Classification based on applications – Bubbler System (Open Vessels)

Thus the pressure is measured by the pressure gauge which can be read in terms of head



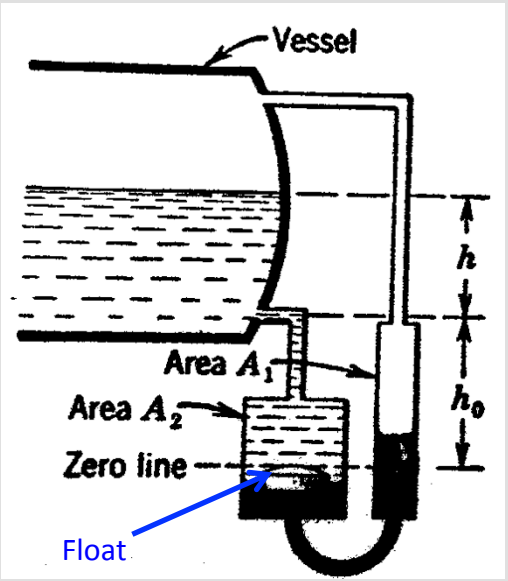
Level Measurements – Classification

Classification based on applications – Closed Pressure vessels

(Differential pressure manometer)

- It measures the variations in liquid level.

- By selecting the value of area A_1, the desired height can be related to any given float displacement.

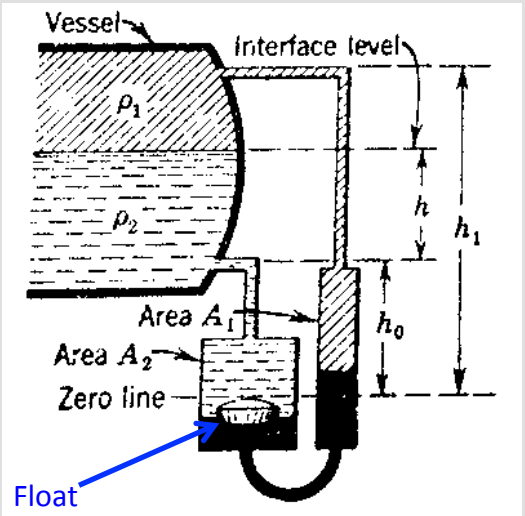


Level Measurements – Classification

Classification based on applications – Interface level

(Differential pressure manometer)

- Surface of the liquid level bounded by a gas or vapor
- The measurement of level is based on the difference between the densities of the fluid.
- It is noted that level gauge will measure an average position of the interface.



Level Measurements – Classification

Classification based on applications – Dry solids

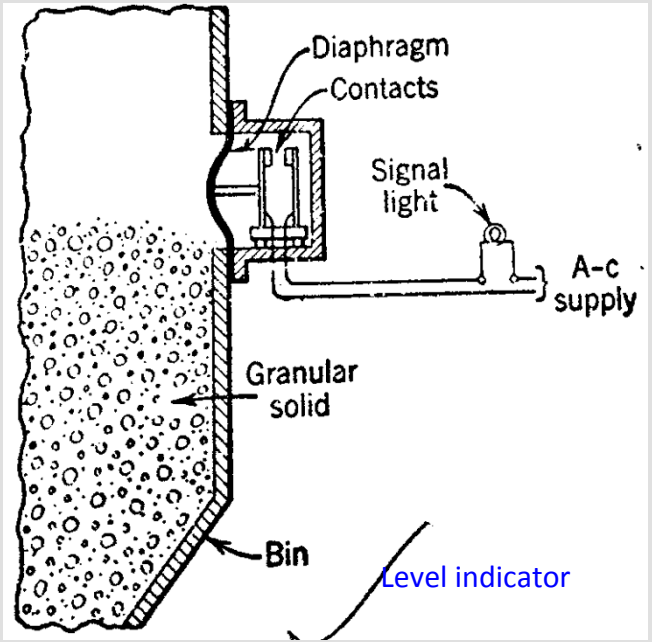
- The simplest and most obvious way to measure the level of a liquid or a dry material is to weigh the contents of the entire vessel.

- When the area of the vessel is known, the level can be determined.

Level Measurements – Classification

Classification based on applications – Dry solids

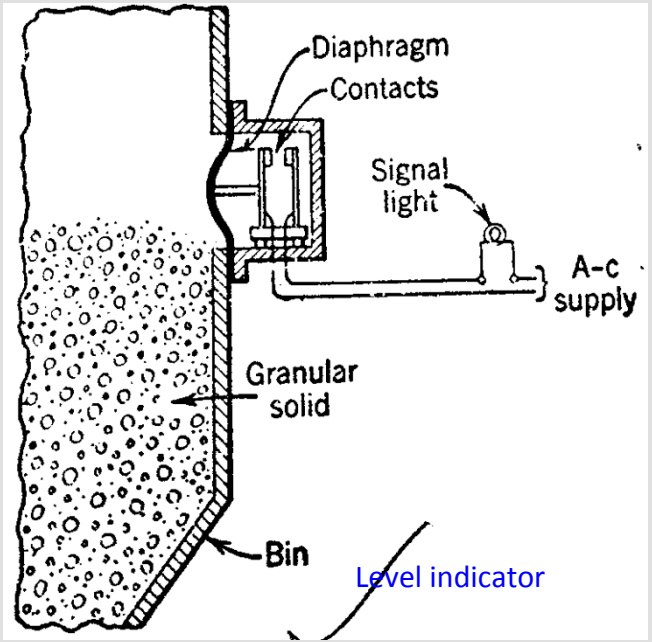
- Signal indicator of M/s. Bin-Dictator company for measuring the weight is shown here.
- This device operates from a light flexible diaphragm which mechanically positions a switch.



Level Measurements – Classification

Classification based on applications – Dry solids

- This device operates from a light flexible diaphragm which mechanically positions a switch.
- The weight of the dry material in the bin acts against the diaphragm when the material in the bin reaches a desired level.



References

1. Donald P. Eckman, (2004) *Industrial Instrumentation*, CBS Publishers, Pp. 1- 27.

Thank You