



# **JYOTHISHMATHI INSTITUTE OF TECHNOLOGY & SCIENCE**

Nustulapur, Karimnagar - 505481.  
(Approved by AICTE & Affiliated to JNTUH)

**SUBJECT  
SYSTE~~M~~S**

**:- INSTRUMENTATION AND CONTROL**

**TOPIC  
”**

**:- “BOURDON’S TUBE PRESSURE GAUGE**

**PRESENTED**

**BY**

**:- P. SPANDANA**


**ASSISTANT PROFESSOR**

**MECHANICAL ENGINEERING**

# “BOURDON’S TUBE PRESSURE GAUGE”

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- 2) FUNCTION , IMPORTANCE ,  
SIGNIFICANCE.
- 3) SPECIFICATIONS.
- 4) CONSTRUCTION.
- 5) WORKING.
- 6) DESIGN PROCEDURE



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# *Introduction*

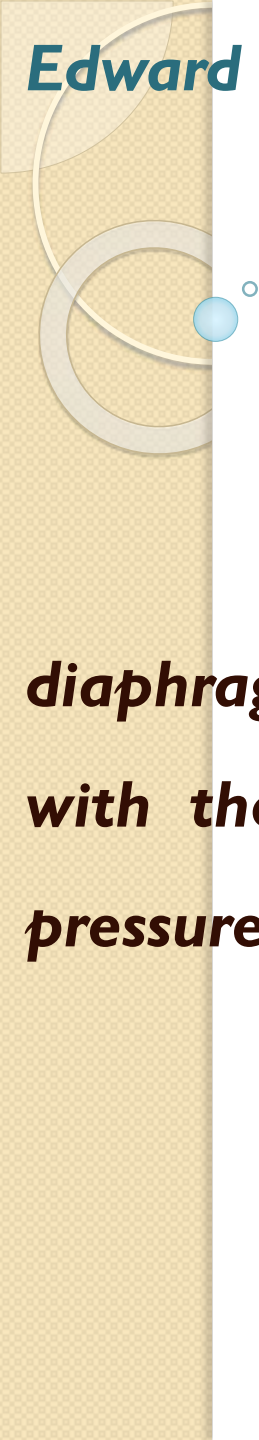
**The Bourdon tube pressure gauge uses the principle that a flattened tube tends to straighten or regain its circular form in cross-section when pressurized.**

**Eugene Bourdon patented his gauge in France in 1849, and it was widely adopted because of its superior sensitivity, linearity, and accuracy.**



1808-1884

***EUGENE  
BOURDON***



**Edward Ashcroft** purchased Bourdon's American patent rights in 1852 and became a major manufacturer of gauges.

**In 1849, Bernard Schaeffer in Magdeburg, Germany** patented a successful diaphragm pressure gauge, which, together with the Bourdon gauge, revolutionized pressure measurement in industry .

**In 1875** after Bourdon's patents expired, his company Schaeffer & Budenberg also manufactured Bourdon tube gauges.

### Basic Principle of Bourdon tube

pressure gauge:

( bourdon tube in this case ) is subjected to a pressure, it deflects.

This deflection is proportional to the applied pressure when calibrated.

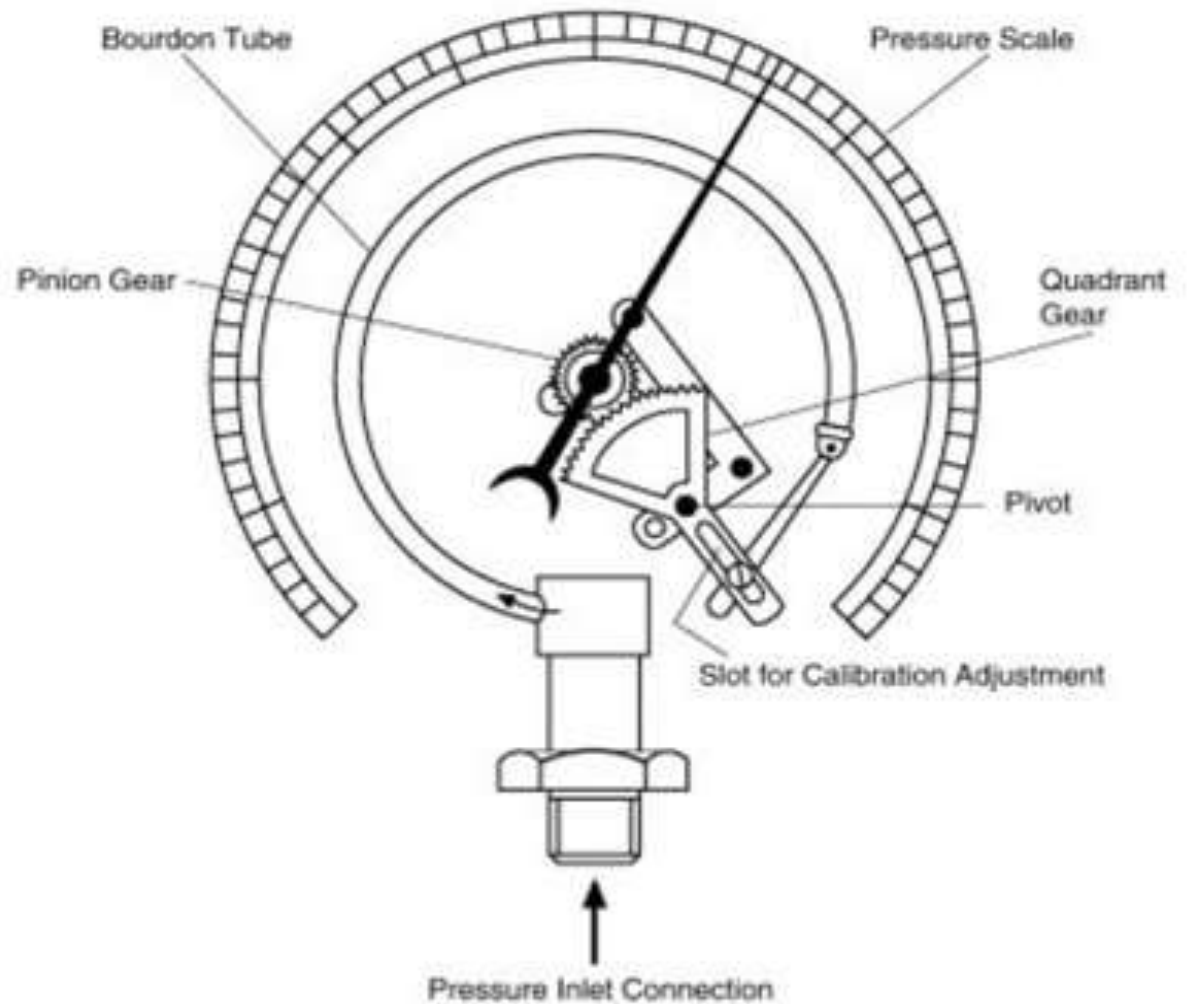


## *Types of bourdon's tube pressure gauge*

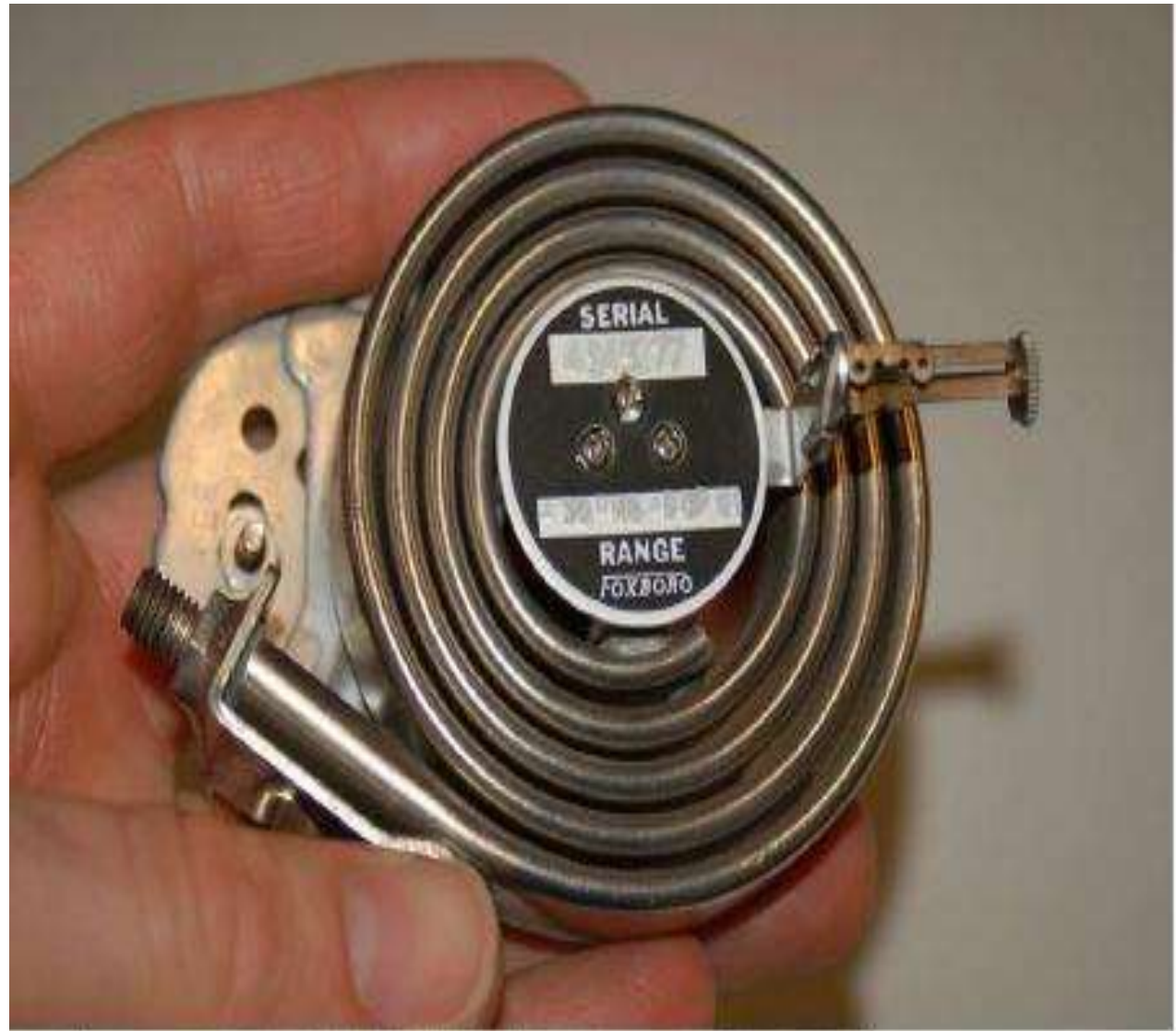


# I) C-TYPE

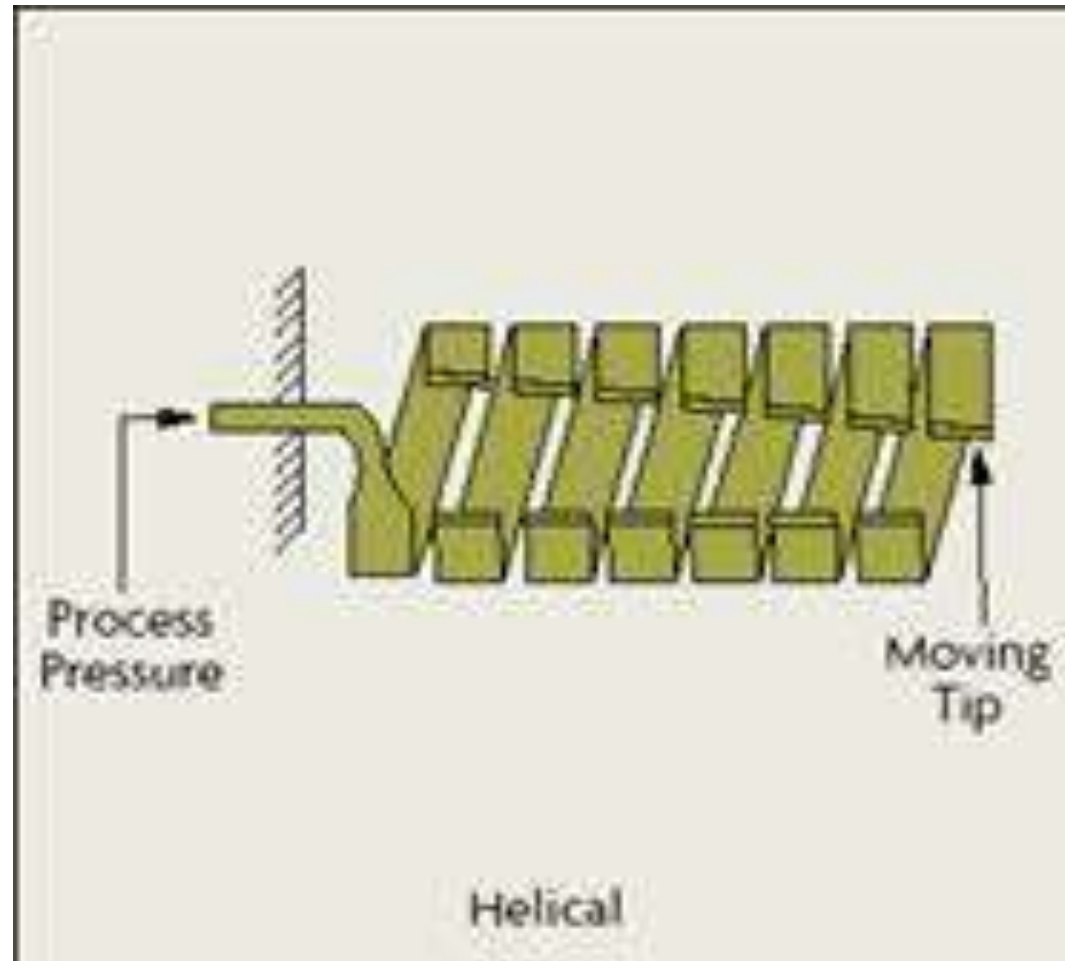
## The C-Type Bourdon-Tube Pressure Gauge



## 2) SPIRAL TYPE



### 3) HELICAL TYPE





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**FUNCTION** ,

**IMPORTANCE** ,

**SIGNIFICANCE**



# **Advantages of Bourdon**

## **tube pressure gauge:**

**1) These Bourdon tube pressure gauges give accurate results.**

**2) Bourdon tube cost low.**

**3) Bourdon tube are simple in**

**construction.**

**4) They can be modified to give electrical outputs.**

**5) They are safe even for high pressure measurement.**

**6) Accuracy is high especially at high**

**pressures.**

## Limitations of bourdon tube



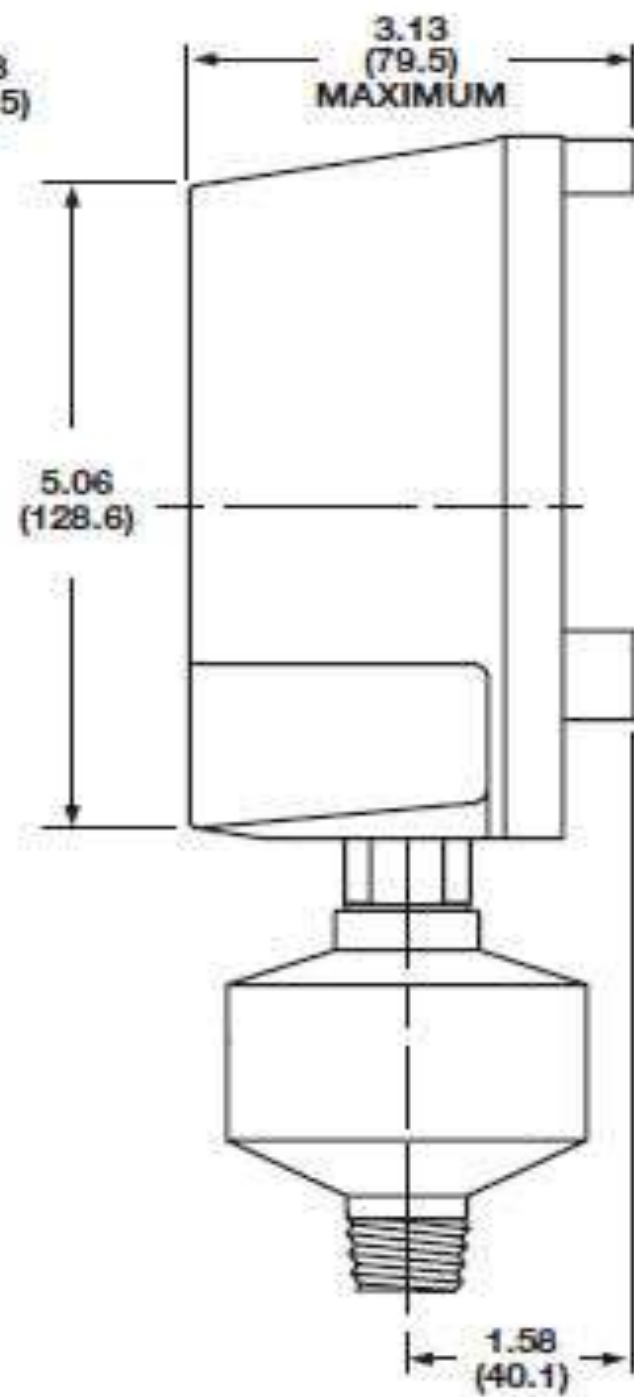
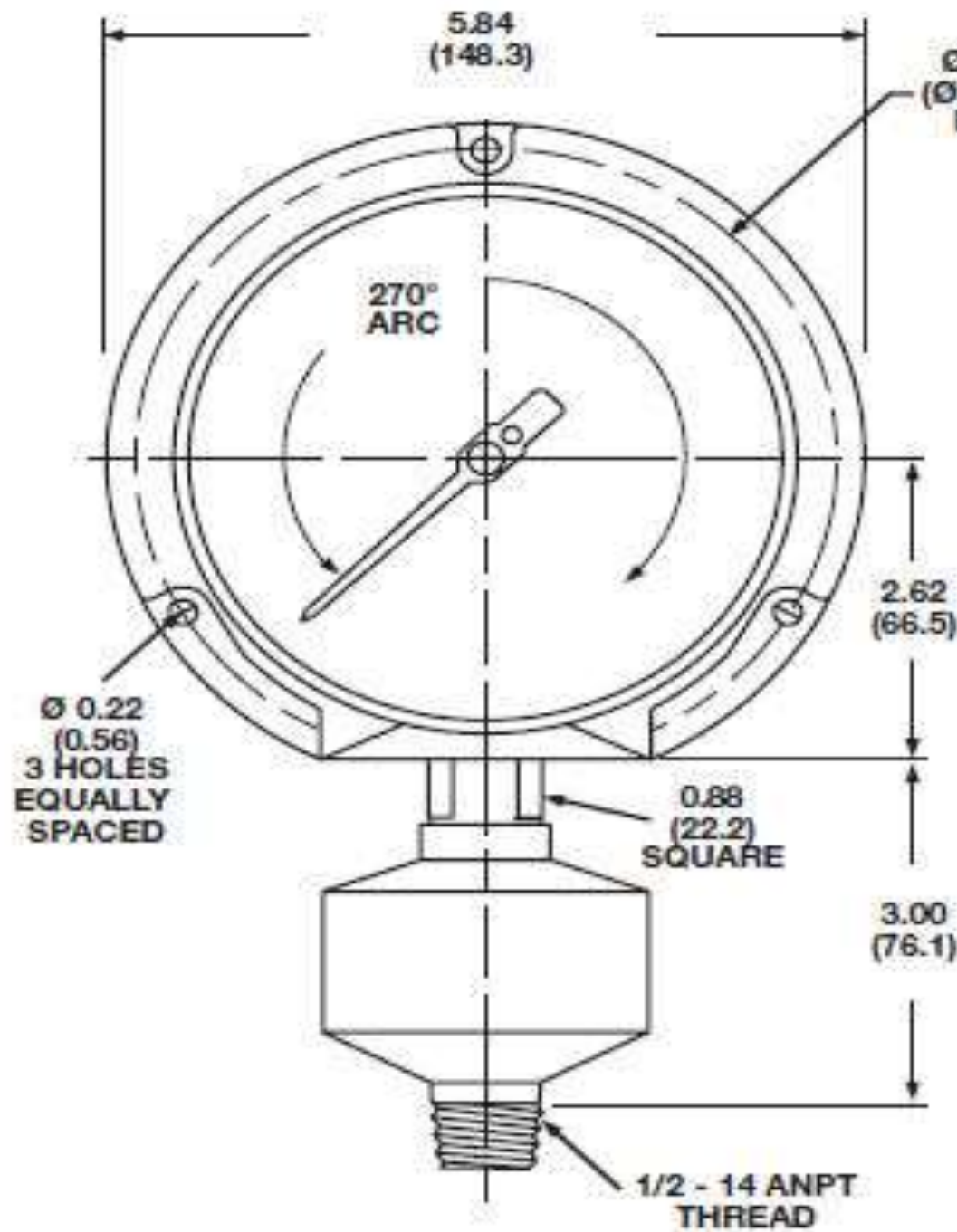
pressure gauge:

- 1) They respond slowly to changes in pressure.
- 2) They are subjected to hysteresis .
- 3) They are sensitive to shocks and vibrations.
- 4) Amplification is a must as the displacement of the free end of the bourdon tube is low.
- 5) It cannot be used for precision measurement.



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# **SPECIFICATION**





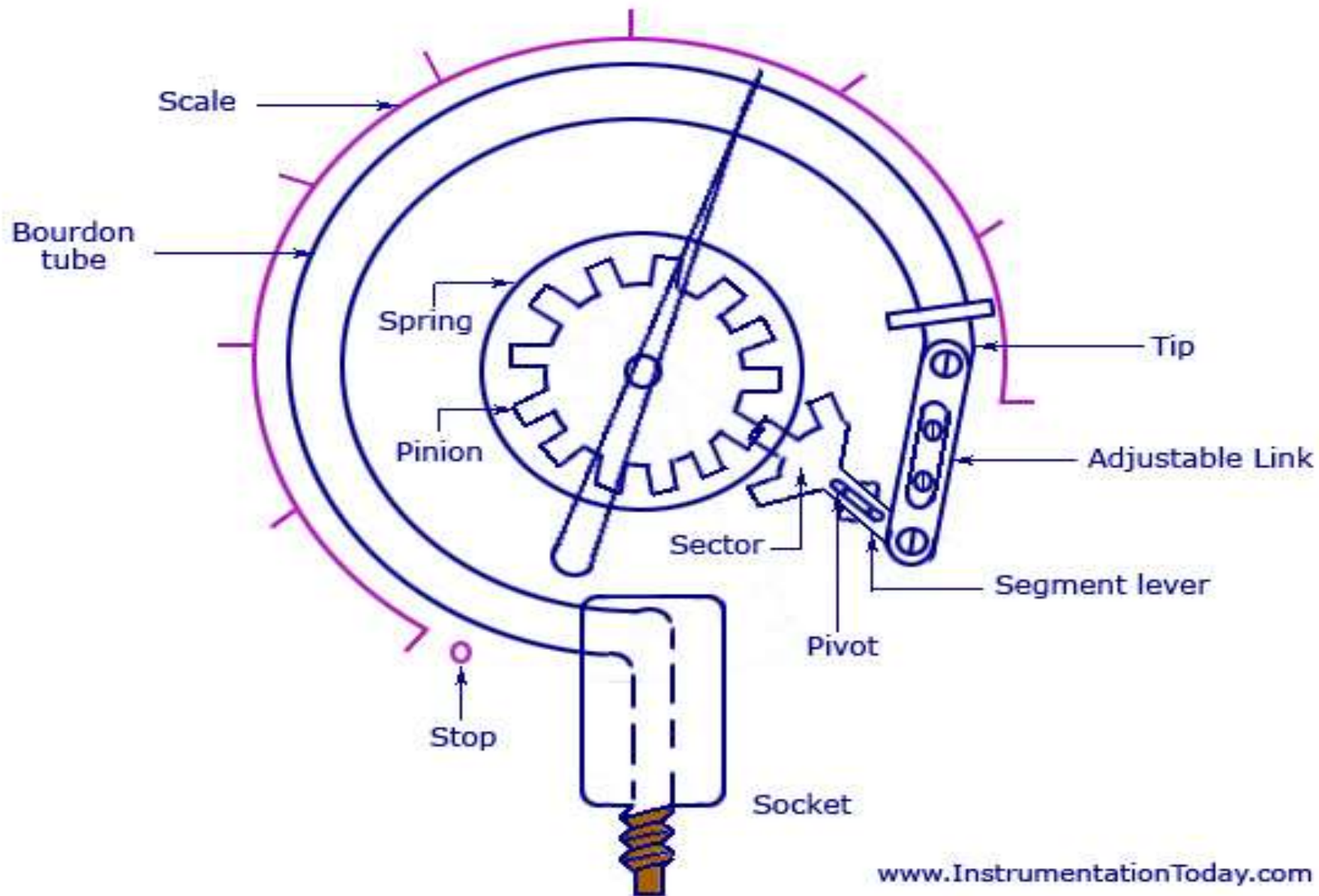


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**CONSTRUCTION**



*The bourdon tube pressure gauges used today have a slight elliptical cross-section and the tube is generally bent into a C-shape or arc length of about 27 degrees. The detailed diagram of the bourdon tube is shown below.*



Bourdon Tube Pressure Gauge

*As seen in the figure, the pressure Input is given to a socket which is soldered to the tube at the base.*

*The other end or free end of the device is sealed by a tip. This tip is connected to a segmental lever through an adjustable length link.*

*The lever length may also be adjustable. The segmental lever is suitably pivoted and the spindle holds the pointer as shown in the figure.*

*A hair spring is sometimes used to fasten the spindle of the frame of the instrument to provide necessary tension for proper meshing of the gear teeth and thereby freeing the system from the backlash.*

*Any error due to friction in the spindle bearings is known as lost motion. The mechanical construction has to be highly accurate in the case of a Bourdon Tube Gauge.*

*If we consider a cross-section of the tube, its outer edge will have a larger surface than the inner portion. The tube walls will have a thickness between 0.01 and 0.05 inches.*



(5)

working

*As the fluid pressure enters the bourdon tube, it tries to be reformed and because of a free tip available, this action causes the tip to travel in free space and the tube unwinds.*

*The simultaneous actions of bending and tension due to the internal pressure make a non-linear movement of the free tip.*

*This travel is suitable guided and amplified for the measurement of the internal pressure. But the main requirement of the device is that whenever the same pressure is applied, the movement of the tip should be the same and on withdrawal of the pressure the tip should return to the initial point.*



*A lot of compound stresses originate in the tube as soon as the pressure is applied.*

*This makes the travel of the tip to be non-linear in nature. If the tip travel is considerably small, the stresses can be considered to produce a linear motion that is parallel to the axis of the link.*

*The small linear tip movement is matched with a rotational pointer movement. This is known as multiplication, which can be adjusted by adjusting the length of the lever.*

*For the same amount of tip travel, a shorter lever gives larger rotation. The approximately linear motion of the tip when converted to a circular motion with the link-lever and pinion attachment, a one-to-one correspondence between them may not occur and distortion results.*

*This is known as angularity which can be minimized by adjusting the length of the link. Other than C-type, bourdon gauges can also be constructed in the form of a helix or a spiral. The types are varied for specific uses and space accommodations, for better linearity and larger sensitivity.*

*For thorough repeatability, the bourdon tubes materials must have good elastic or spring characteristics.*

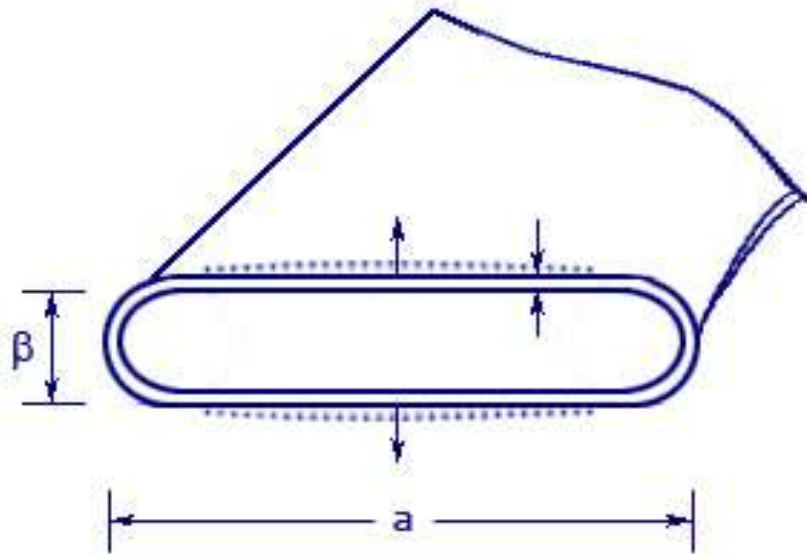
*The surrounding in which the process is carried out is also important as corrosive atmosphere or fluid would require a material which is corrosion proof.*

*The commonly used materials are phosphor-bronze, silicon-bronze, beryllium-copper, inconel , and other C-Cr-Ni-Mo alloys, and so on.*

*In the case of forming processes, empirical relations are known to choose the tube size, shape and thickness and the radius of the C-tube.*

*Because of the internal pressure, the near elliptic or rather the flattened section of the tube tries to expand as shown by the dotted line in the figure below (a). The same expansion lengthwise is shown in figure (b). The arrangement of the tube, however forces an expansion on the outer surface and a compression on the inner surface, thus allowing the tube to unwind. This is shown in figure (c).*

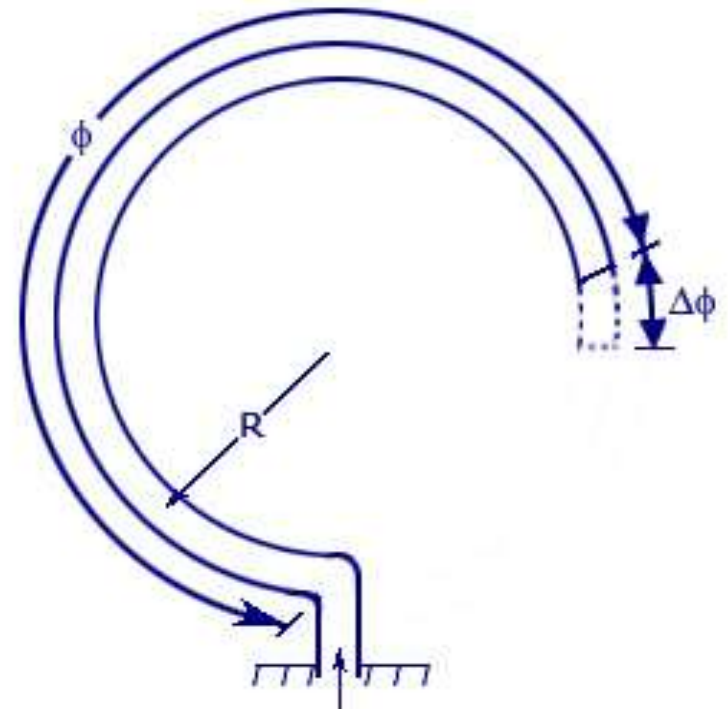
## Expansion of Bourdon Tube Due to Internal Pressure



(a) Expansion cross-sectionwise



(b) Extension length wise



(c) Unwinding

*Expansion of Bourdon Tube Due to Internal Pressure Like all elastic elements a bourdon tube also has some hysteresis in a given pressure cycle.*

*By proper choice of material and its heat treatment, this may be kept to within 0.1 and 0.5 percent of the maximum pressure cycle.*

*Sensitivity of the tip movement of a bourdon element without restraint can be as high as 0.01 percent of full range pressure reducing to 0.1 percent with restraint at the central pivot.*



THANK YOU.