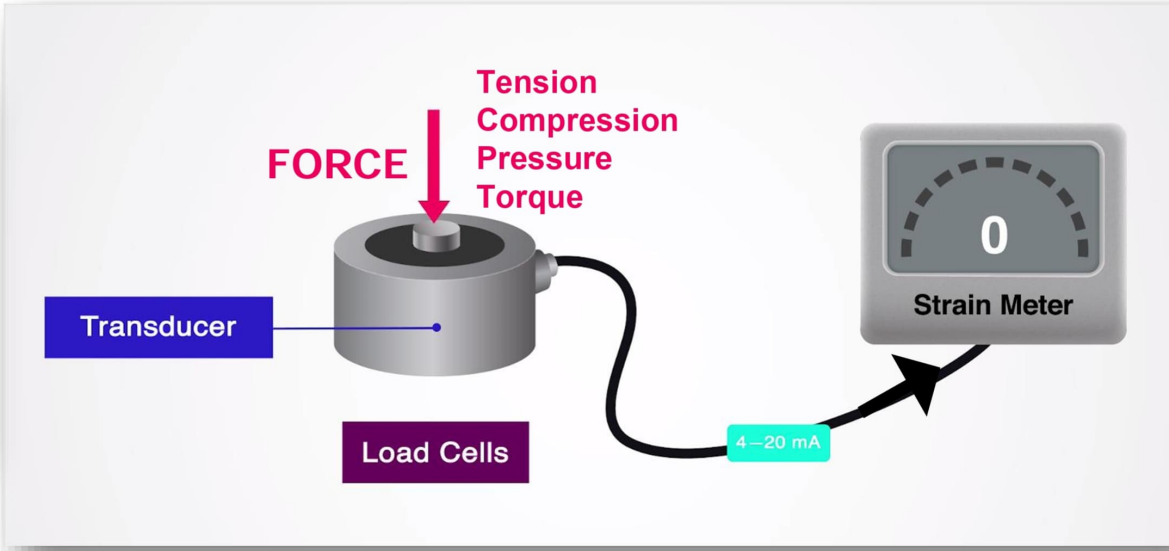
Load cells

Introduction

- A **LOAD CELL** is a force gauge that consists of a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured.



- Produced Electrical output ∝ Force Applied

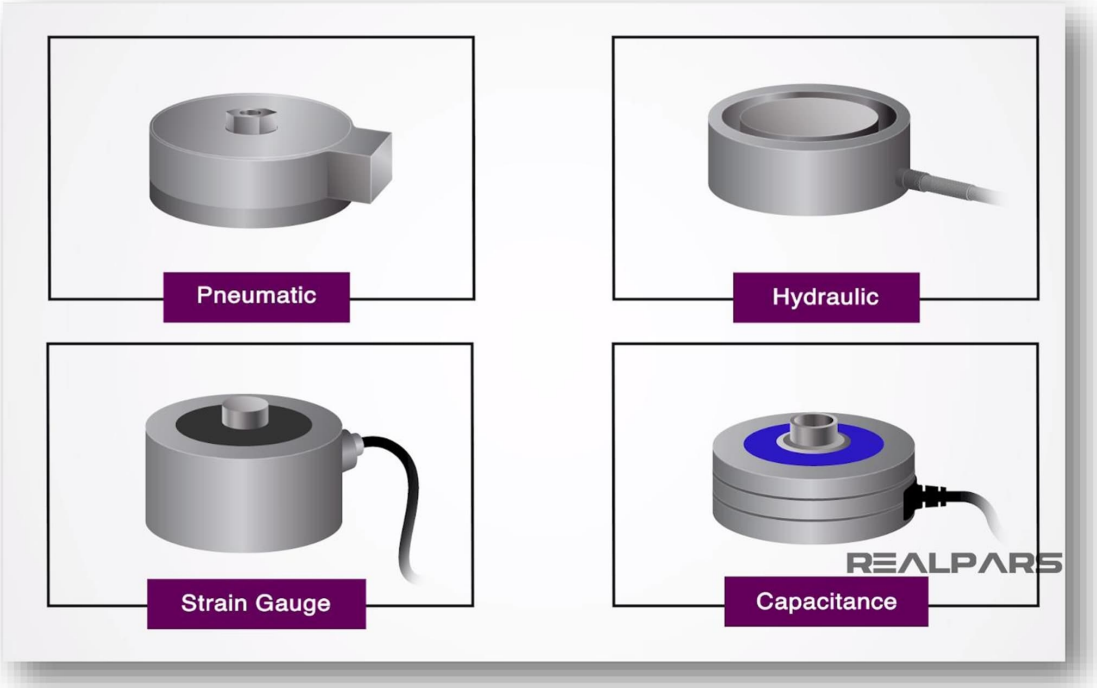
Load cells

What are the Different Types of Load Cells?

There are four common types of these sensors;

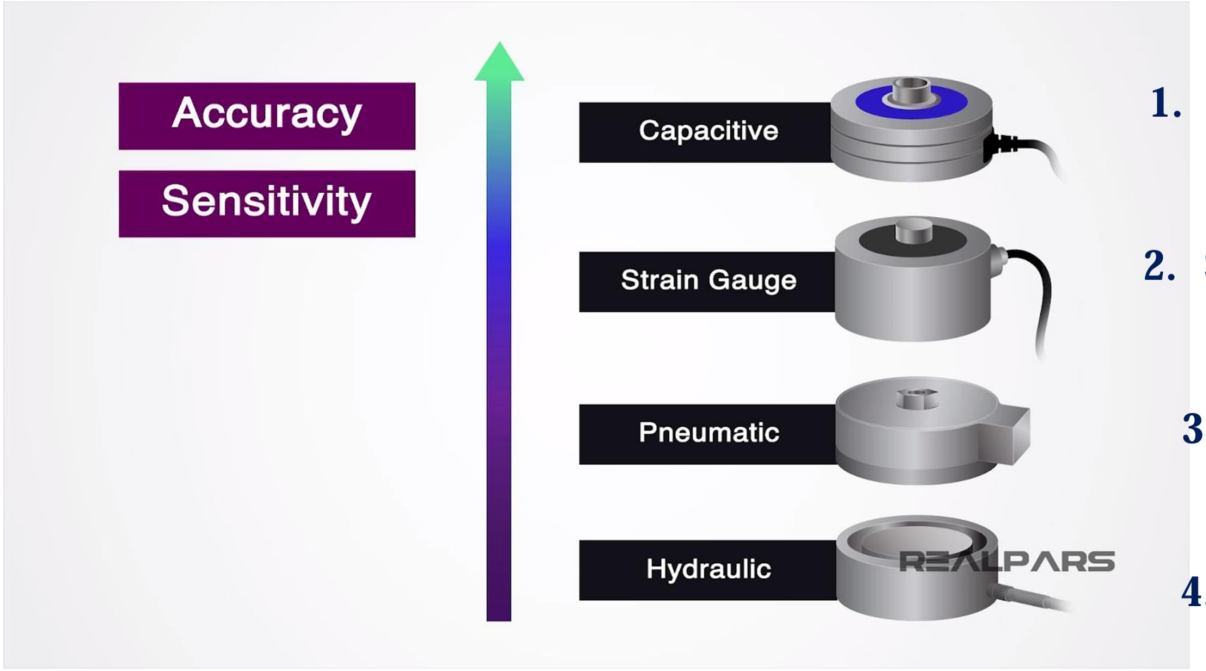
they are:

- ❑ – Pneumatic
- ❑ – Hydraulic
- ❑ – **Strain gauge**
- ❑ – Capacitance



Load cells

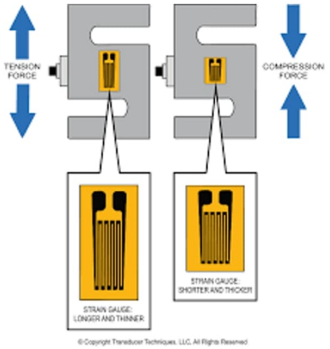
There are four common types of these Load Cells



1. Capacitance
2. Strain gauge
3. Pneumatic
4. Hydraulic

Load cells

Types of Load Cells



(a) Strain Gauge Load Cells

- Most common and precise
- Used in industrial weighing scales, force measurement
- Requires signal conditioning and amplification

(b) Capacitive Load Cells

- Measures changes in capacitance due to mechanical deformation
- Used in precision force measurement applications

(c) Hydraulic & Pneumatic Load Cells

- Use fluid pressure to measure force
- Used in hazardous environments where electrical sensors may not be safe

Load cells

Applications of Load Cells

- **Weighing Systems:** Industrial scales, truck weighbridges
- **Aerospace:** Measuring thrust forces in jet engines
- **Robotics & Automation:** Force feedback in robotic arms
- **Biomedical Applications:** Prosthetics, rehabilitation devices
- **Structural Monitoring:** Measuring stresses in bridges and buildings

Load cells

Working Principle of Load Cells

Load cells operate based on **strain gauge technology** or other sensing principles like piezoelectric, capacitive, or hydraulic effects.

Strain Gauge-Based Load Cells (Most Common)

•When a force is applied, the load cell deforms slightly.
•This deformation changes the resistance of the strain gauge, which is measured using a **Wheatstone bridge circuit**.

•The change in resistance is converted into an electrical signal proportional to the applied force.

Mathematically, strain (ε) in a material is given by:

$$\varepsilon = \Delta L / L$$

where: ΔL = change in length
L = original length

The change in resistance (ΔR/R) is related to strain by: $\frac{\Delta R}{R} = G_f \cdot \varepsilon$