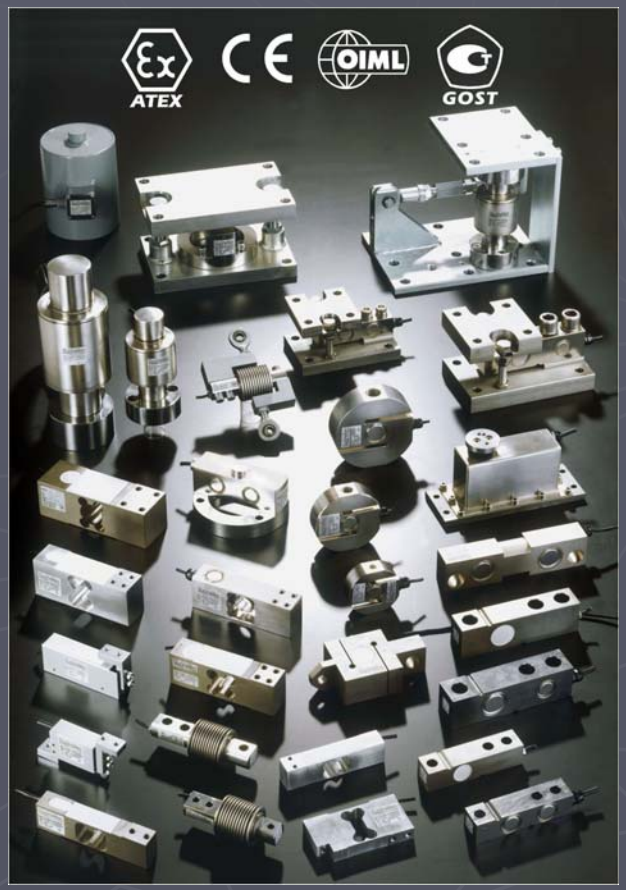
Introduction to Load Cells

- Introduction
- Classification
- Selection



UTILCELL
CELULAS DE CARGA - LOAD CELLS

22/12/2008

Load Cell

- **Concept: Is a Force Transducer. Converts the Force / Weight into an electrical signal which is proportional to the applied Force / Weight.**

- **Applications:**
  - **Scales**
  - **Packaging**
  - **Dosing**
  - **Level Control on Tanks and Silos**
  - **Test Machinery**
  - **Quality Control**

Principle of Measurement

Force / Weight

⇓

Mechanical Deformation

⇓

Strain Gages: Resistance Change

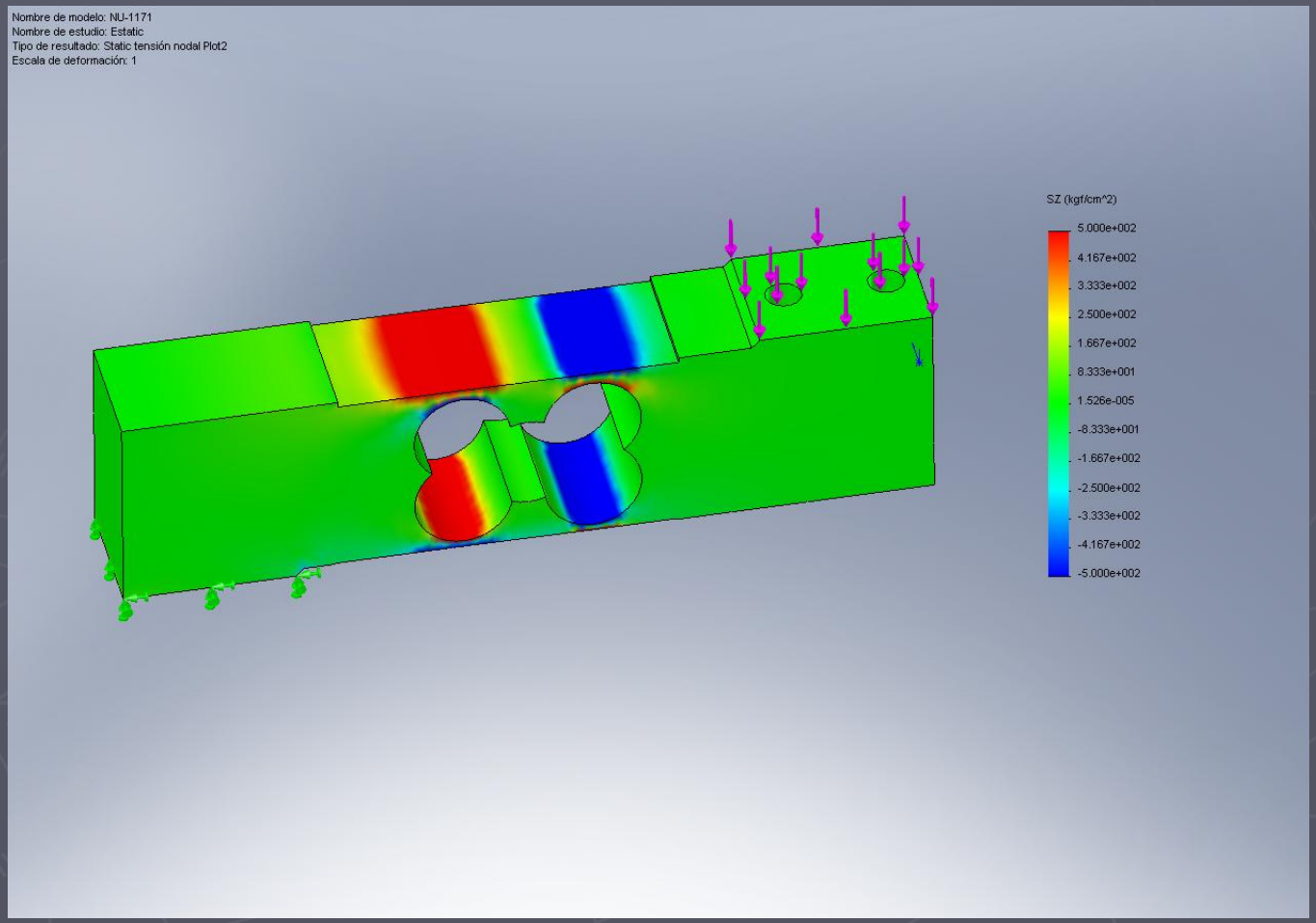
⇓

Wheatstone Bridge Circuit

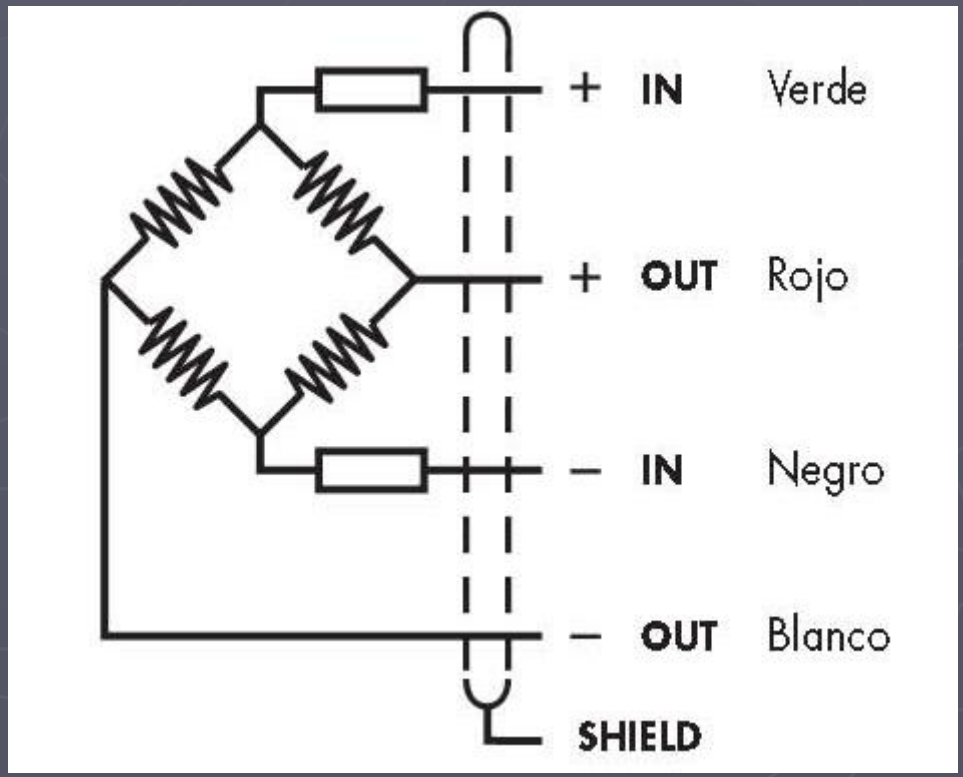
⇓

Electrical Output mV / V

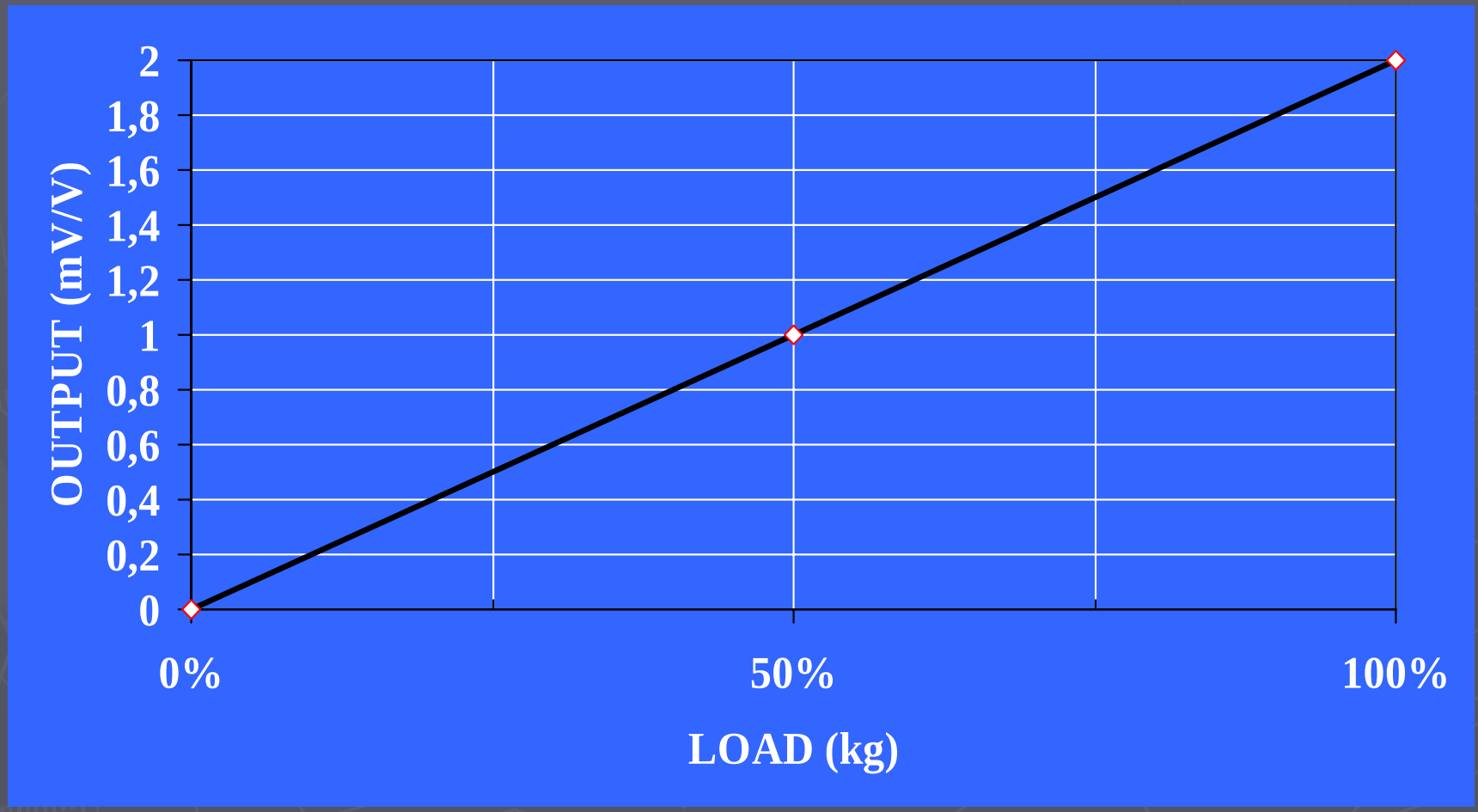
Mechanical Deformation



Wheatstone Bridge



Characteristic Curve



Components

- Elastic Body
- Electrical Circuit
- Housing

Elastic Body

- Any force will produce a deformation on the elastic body of the load cell, concentrated on the strain gages zone, which are sensible to that deformation.
- Materials: Special Alloys
  - High strength
  - High fatigue life
  - High repeatability
  - High linearity and low hysteresis.
  - Steel Alloys, Stainless Steel, Aluminium, Beryllium-Copper, ...

Electrical Circuit

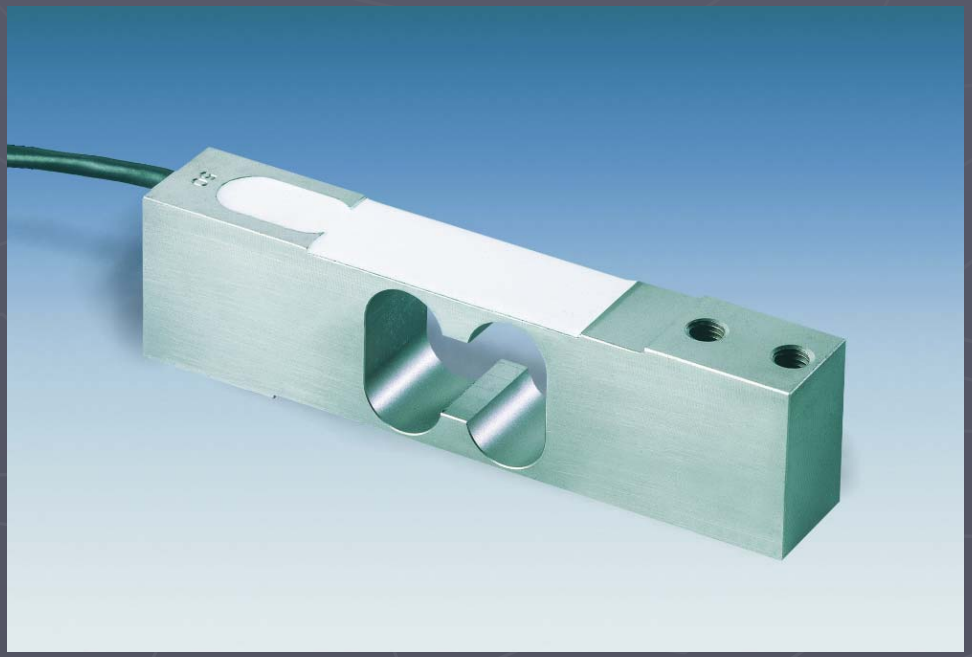
- Strain Gages: Deformation Sensors. They are perfectly bonded to the elastic body to follow the deformation produced by the Force-Weight.
- The resistance value (Ohms) change with the deformation.
- Wheatstone Bridge electrical circuit configuration: Magnify small changes on resistance value of the strain gages, obtaining the signal output in mV per Volt of excitation voltage (mV/V).
- Adjusting Resistors for thermal compensation and calibration.

Housing

- Provided that load cells have the following particularities:
  - Small Deformations
  - Small changes of resistance
  - Small output signal (microvolts)
- Must be protected of:
  - Dust
  - Wet
  - Electromagnetic Interferences
- Protection types: Varnish + Silicones + Flexible covers hermetically sealed (bellows, capsules, etc) + Cable glands + Shielded Cable

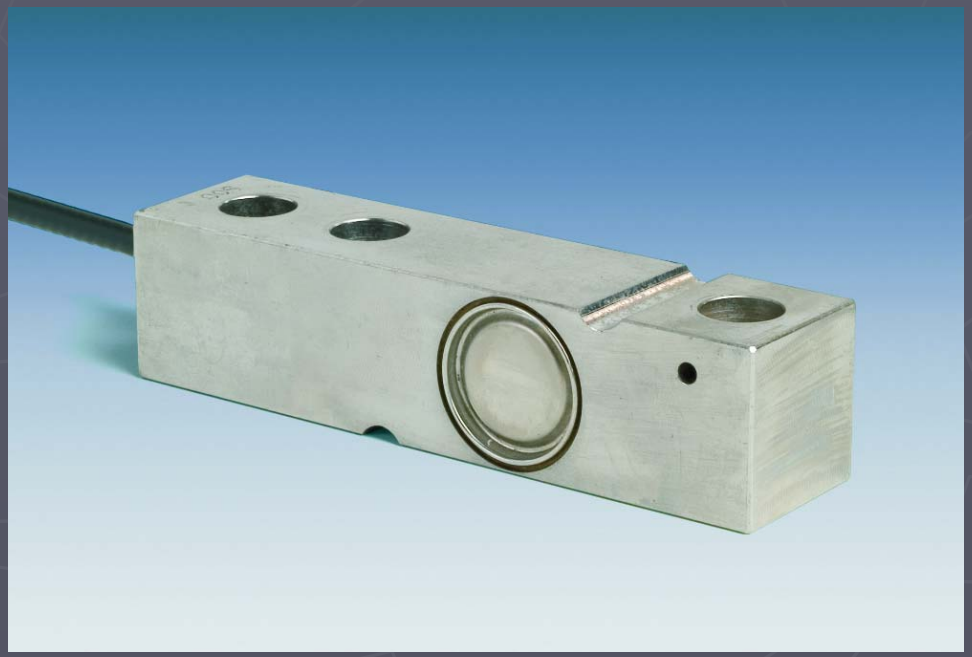
Classification according Geometry:

Double bending beam: 1...500 kg



Classification according Geometry:

Shear Beam: 300...5000 kg



Classification according Geometry:

Double Shear Beam: 5...100 t

Classification according Geometry:

Column: 15...400 t

Classification according the Application of the Force:

- SINGLE POINT:
  - DOUBLE BENDING BEAM: 1...500 kg
- FLEXION:
  - DOUBLE BENDING BEAM: 1...500 kg
  - SHEAR BEAM: 500 ...5.000 kg
- TENSION:
  - DOUBLE BENDING BEAM: 1...500 kg
  - SHEAR BEAM: 500 ... 5.000kg
- COMPRESSION:
  - SHEAR BEAM: 500 ...5.000 kg
  - DOUBLE SHEAR BEAM: 5 t...100 t
  - COLUMN: 10 t...400t

Load Cell Selection

- Determination of the Applied Load
- Environment
- Mounting Assemblies

Determination of the Applied Load

1) Information of the installation:
   - Dead Load: Weight of the structure, vessel, hopper, silo, engines, valves, heaters, etc.
   - Net Weight: Weight of the product.
   - Gross Weight: Dead Load + Net Weight.
   - Number of bearing points N: Total number of bearing points of the structure, with or without load cell.

Determination of the Applied Load

2) Bearing Load:

- Theoretical bearing Load =
= Gross Weight / Number of bearing points N

- Security Factor k:
  - Dynamic loads: hits, vibrations, ...
  - Non centred loads, lack of levelling, misalignments, failed bearing points, ...

- Load Cell Nominal Capacity = k x Gross Weight / N

- k use to have a value between 1,25 and 2,2.
- Example for tanks and silos: k=1,5
- Example for platforms (possible non-centred loads): k=2
- Choose available Nominal Capacity nearest over above calculation.

Determination of the Applied Load

3) Additional Checks:

Try to answer the following questions and correct if necessary the Nominal Capacity of the load cell accordingly:

- Is the value used for Dead Load an exact value?
- Could the load be distributed in a non-uniform way?
- Is it possible than the scale or vessel receive a higher load than calculated, overloaded or overfilled, exceeding the estimated Net Weight?
- Is there the possibility of earthquakes or high speed winds on the location zone?
- Could any vehicle impact or overload the weighing system?
- If you are not sure do not install the system.

Environment

- Once selected the Nominal Capacity of the load cell it is very probable that exist many load cell models with same Nominal Capacity. Choose the load cell model accordingly to the environmental working conditions as:
  - Temperature
  - Wet and water
    - Type of Sealing
    - Stainless Steel
  - Potentially explosive atmospheres: ATEX certified versions.

Mounting Assemblies

- Assemblies designed for weighing instruments: Repeatability and Accuracy.
- Freedom of movement for adapting to deflections and thermal expansions.
- Security: Lift-off prevention.
- Easy to mount.
- Materials: Painted, Zinc Plated, Stainless Steel.
- Junction Box of good quality
- Competitive cost

Examples