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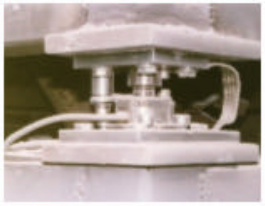
SENSY Presentation

KNOW HOW & FLEXIBILITY

THE WAY TO EXCELLENCE

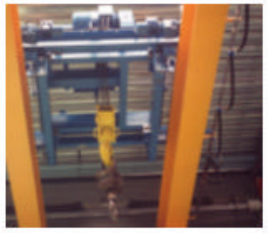
FORCE MEASUREMENT

WEIGHING

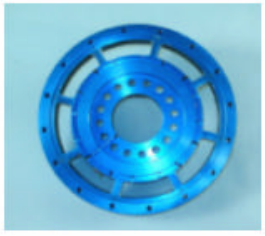


FORCE TESTING MACHINES

LOAD LIMITATION



STATIC TORQUEMETER



CUSTOM MADE LOAD CELLS

INSTRUMENTATION

CALIBRATION SERVICE

SOFTWARE SOLUTIONS

Bringing solution through special force transducers, load cells as well as customized systems is Sensy motto

✓ Points :

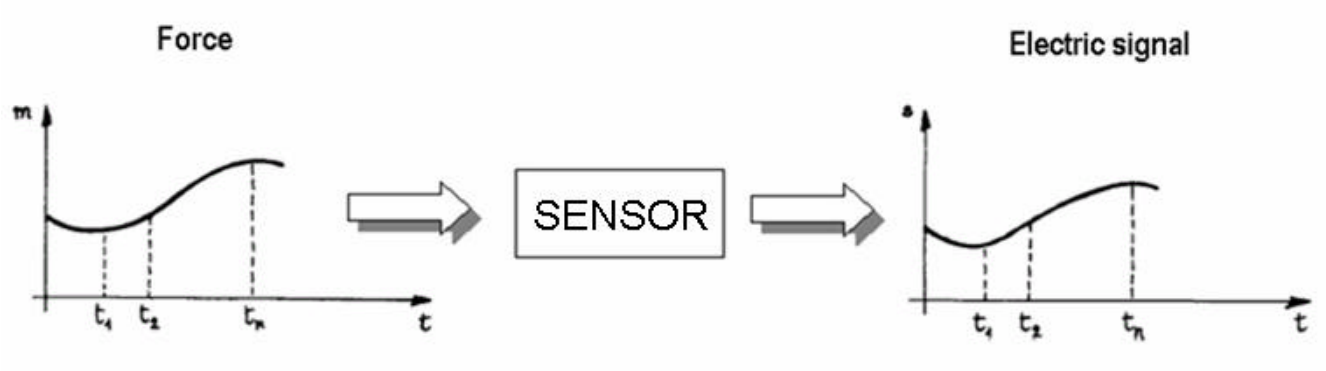
- SENSY company : Presentation
- Load cells and force transducer : definition and applications
- Principle and characteristics
- Communications protocols : SENSY solutions
- Projects
- …

✓ Definition :

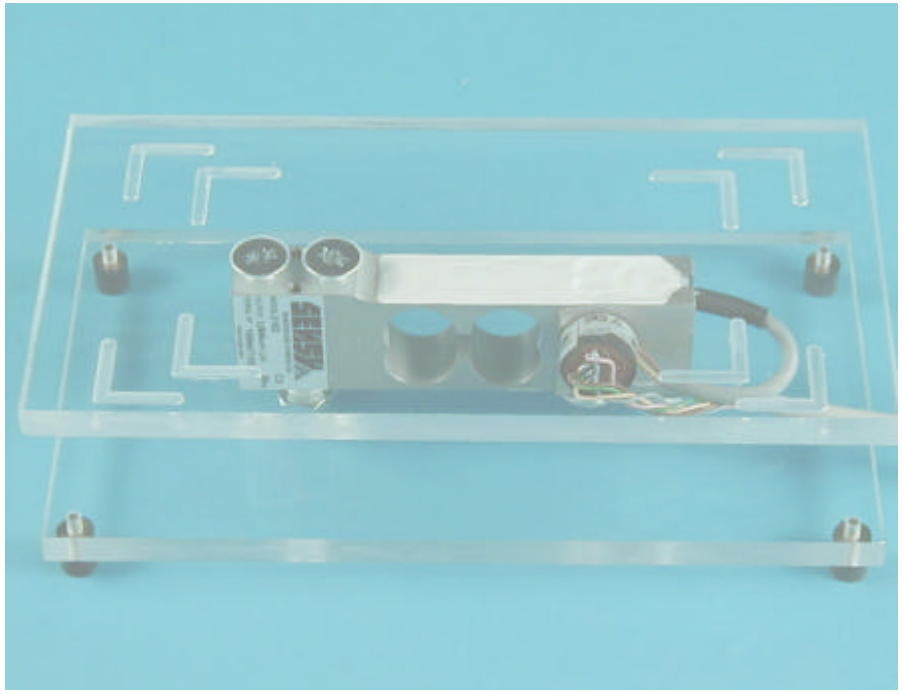
- Element which deliver a electric signal proportional to its applied force.

✓ Technical data :

- Non-Linearity
- Resolution
- Hysteresis
- Sensitivity
- Non-Repeatability

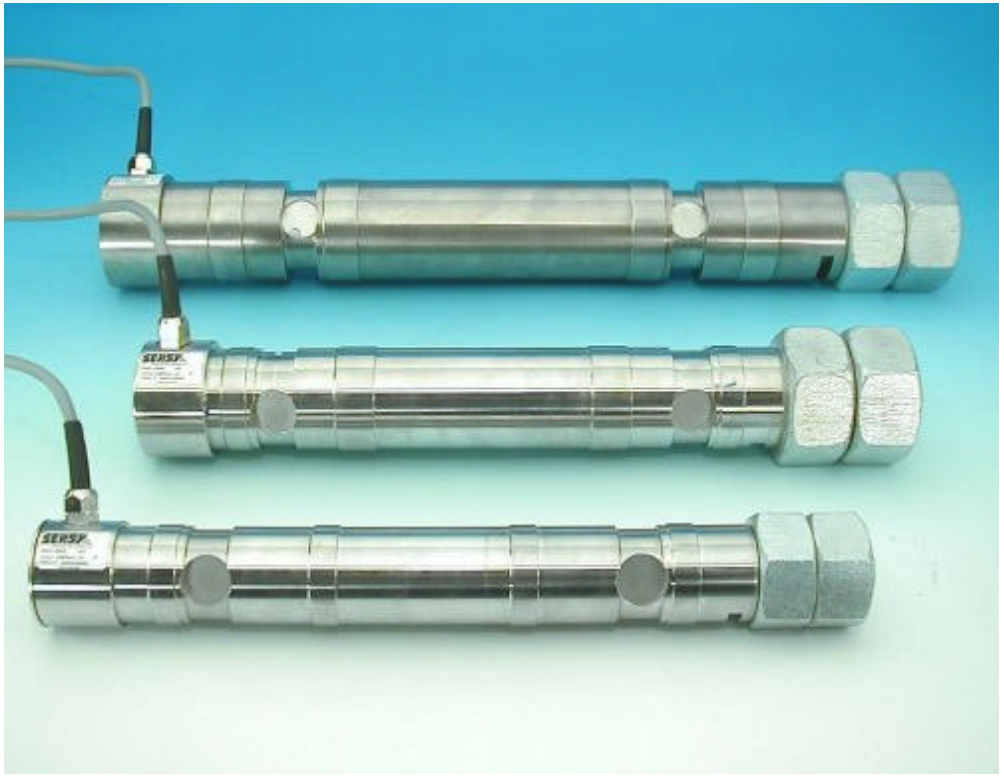


✓ Model 2162 (small hoppers and computing scales)



✓ Model 5000 : redundant solution for safety on Overhead cranes

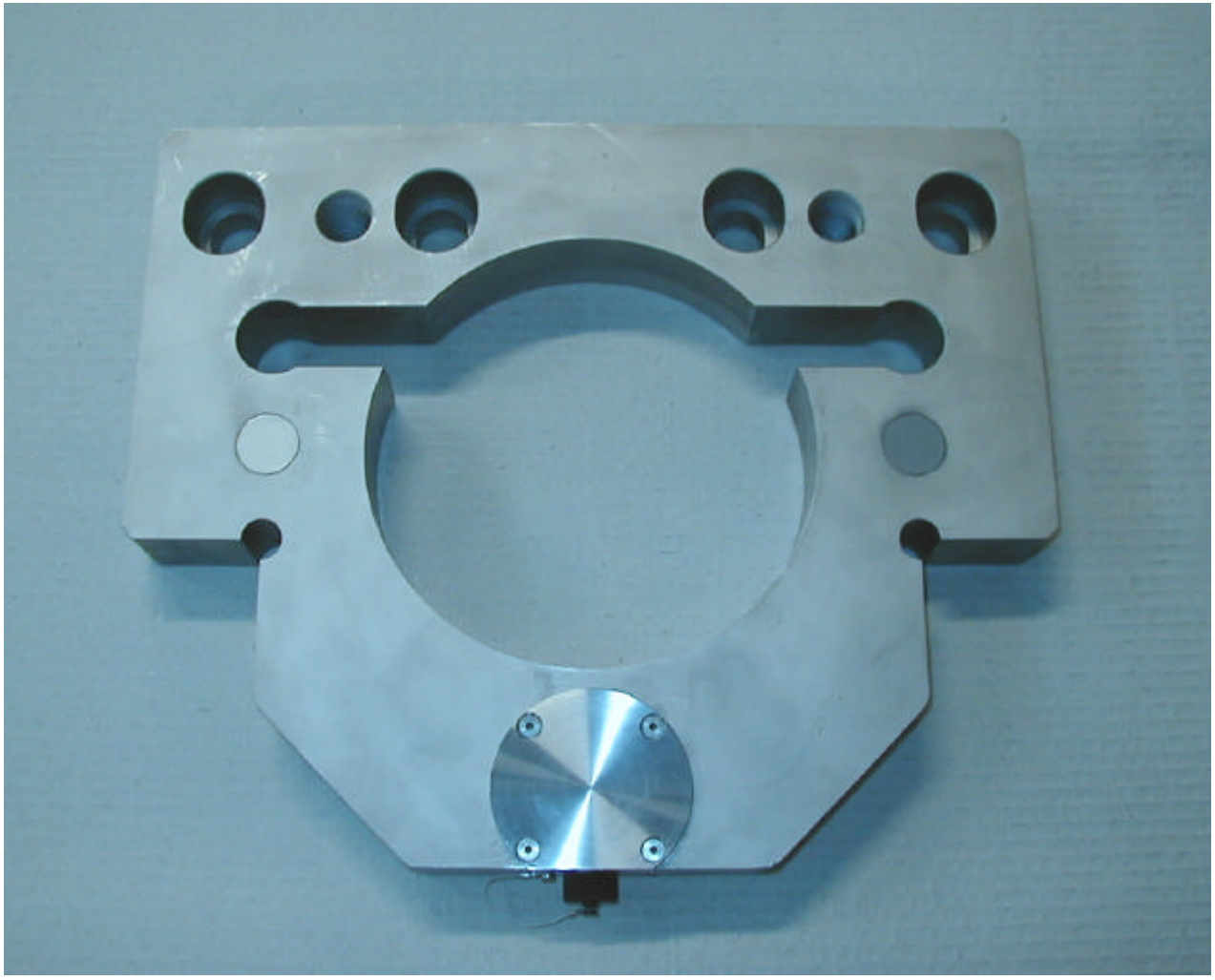
✓ Model 5000 : Custom made load pins



✓ Model 5000 : a wide range of OEM solutions with or without integrated amplifier : 4 – 20 mA and 1 – 5 V

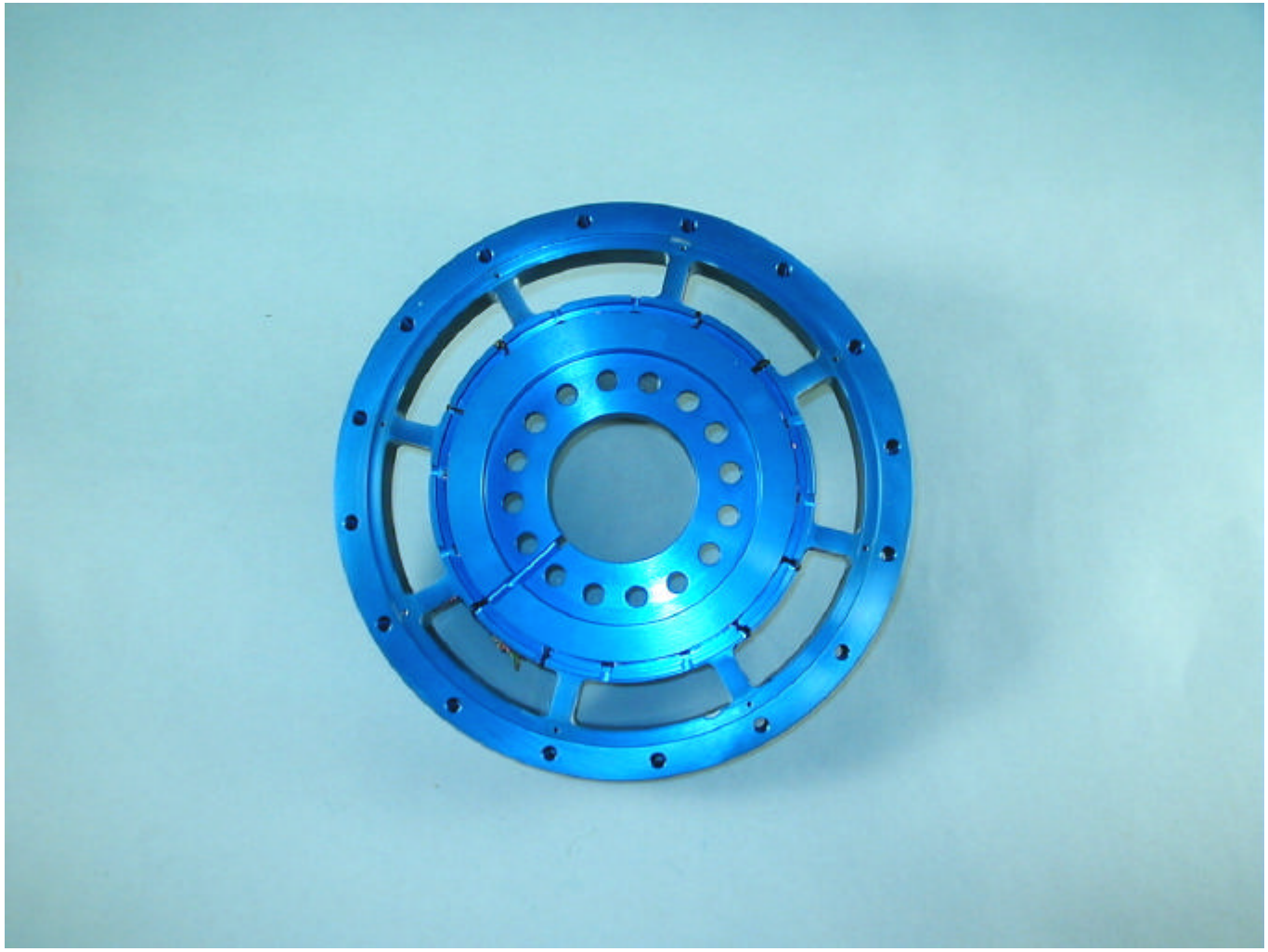
High capacity load pins: 260 t

✓ Special Custom made force transducer for Shaft bearing on cranes



Capacity: 45 t

✓ Custom made torque transducer for automotive gear transmission

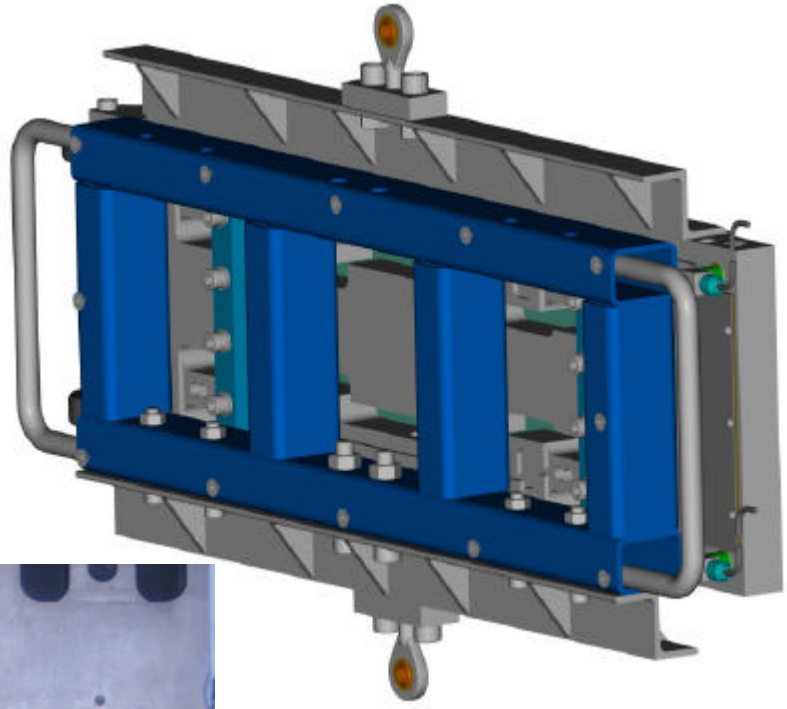


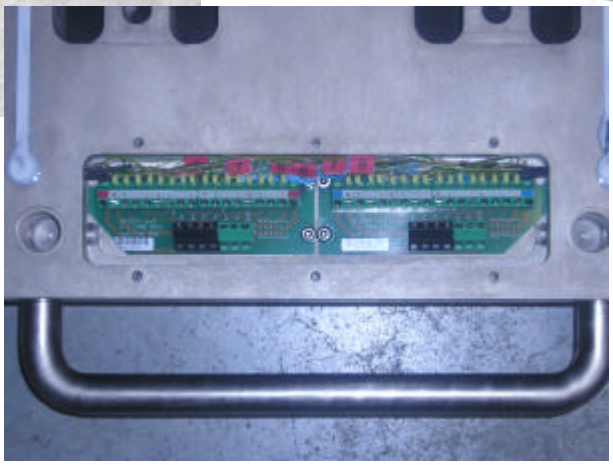
✓ Custom made load cell

3 independent Bridges :

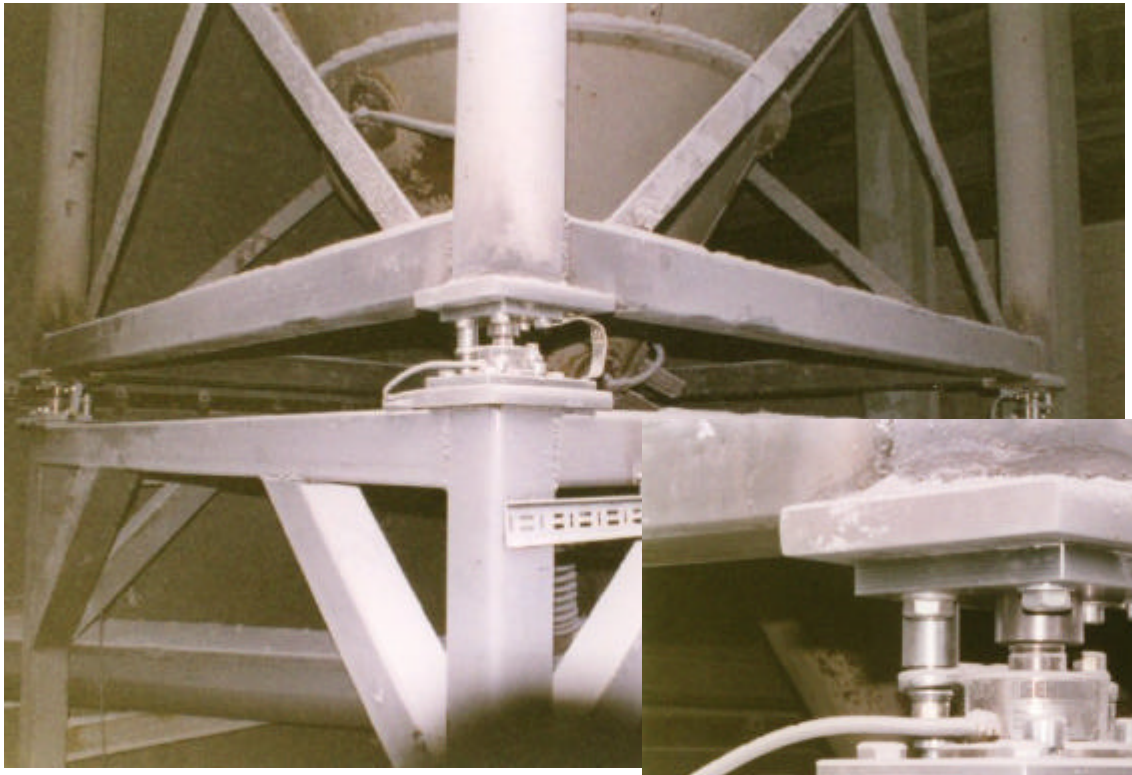
- Tension
- Compression
- Torque

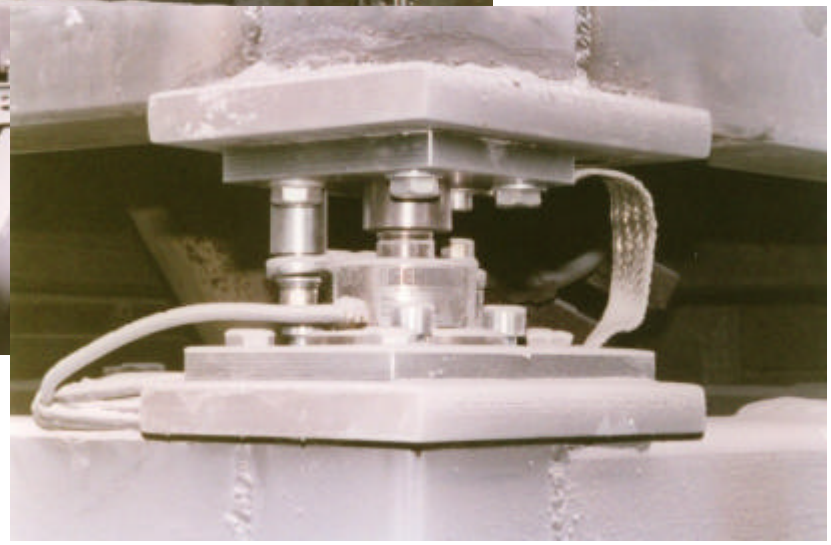
✓ Bidirectional scale : Fz & Fx : Testing of truck's brake

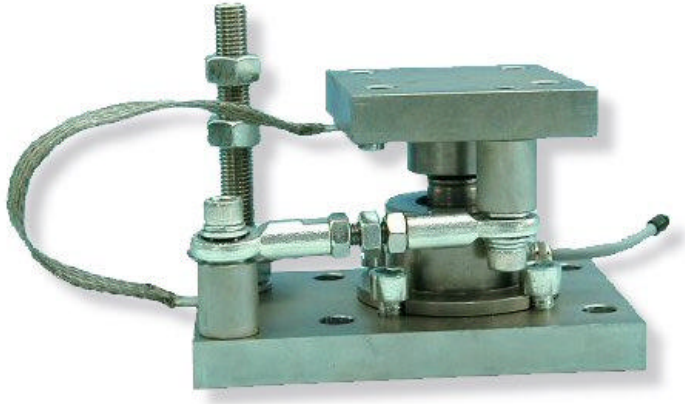




✓Model 5950 (tanks and reactors weighing)

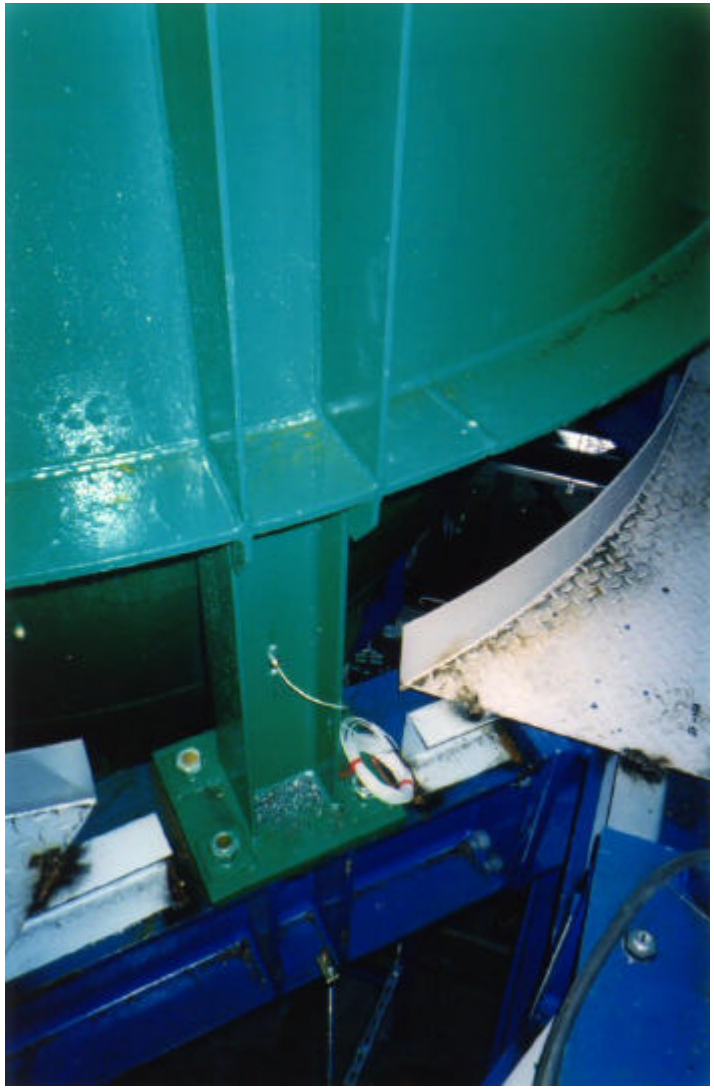






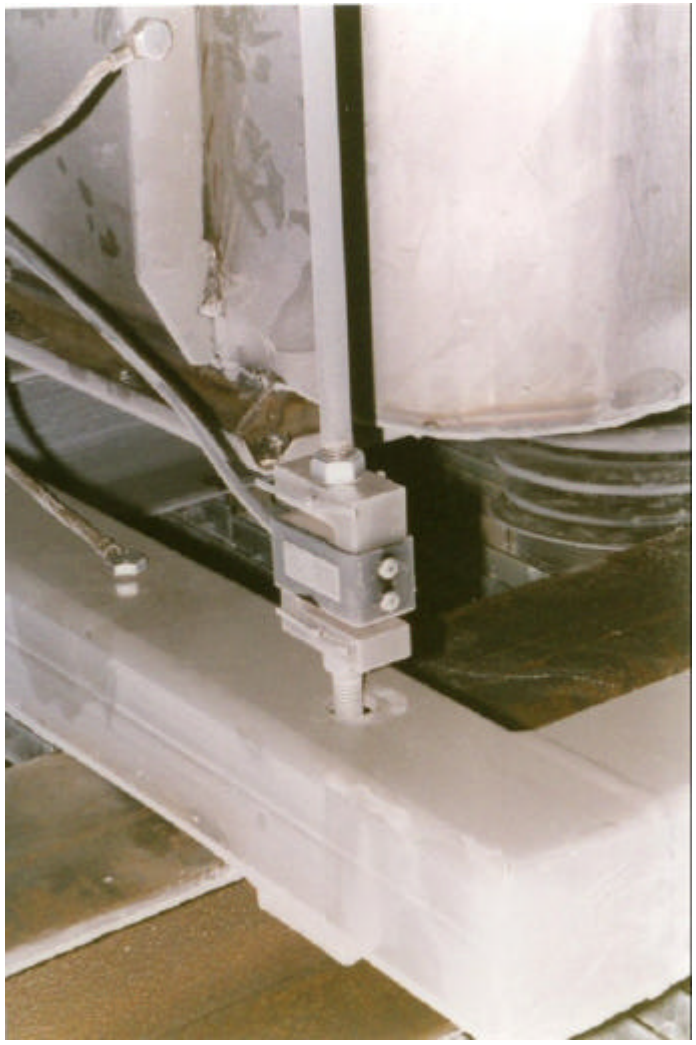
✓INSERT GAGE (Model 3300)

Silos levelling

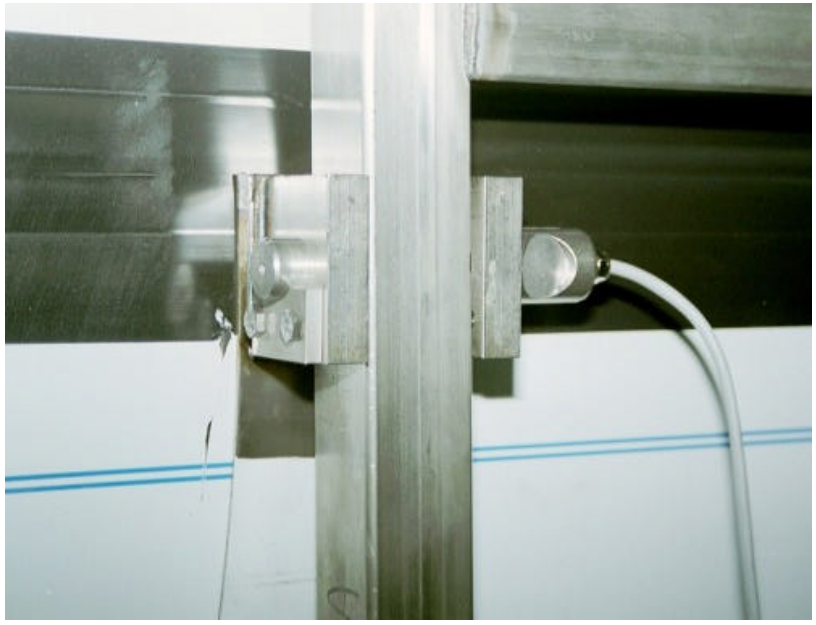


- ✓Model 2712 Tension/Compression

Hoppers & tanks of medium size



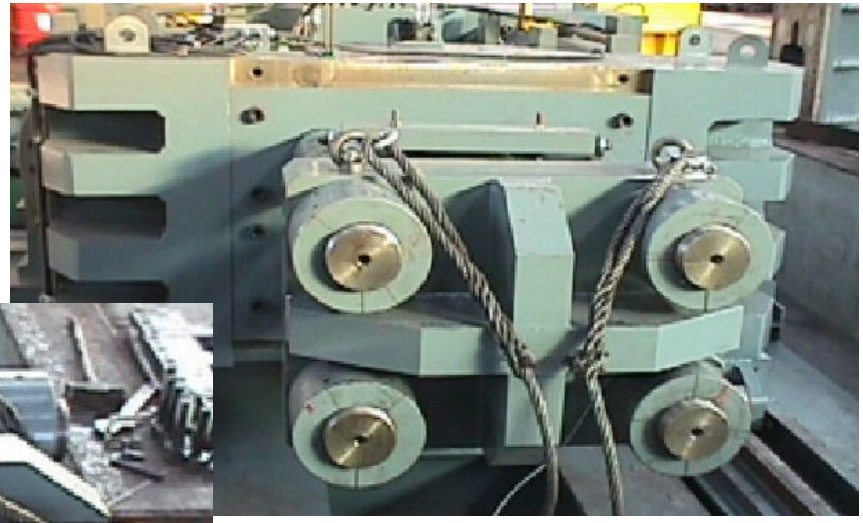
✓Model 5600 (weighing of chemical reactors)

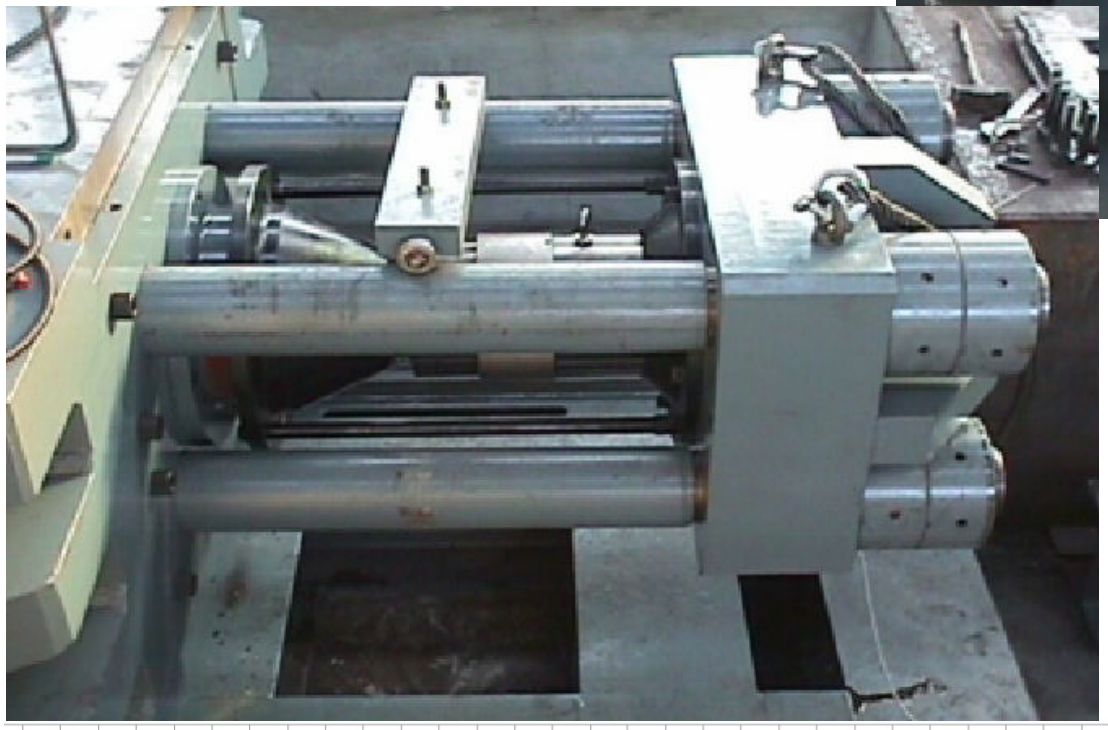


- ✓ Torque measurement on an axle (customers own material made up)

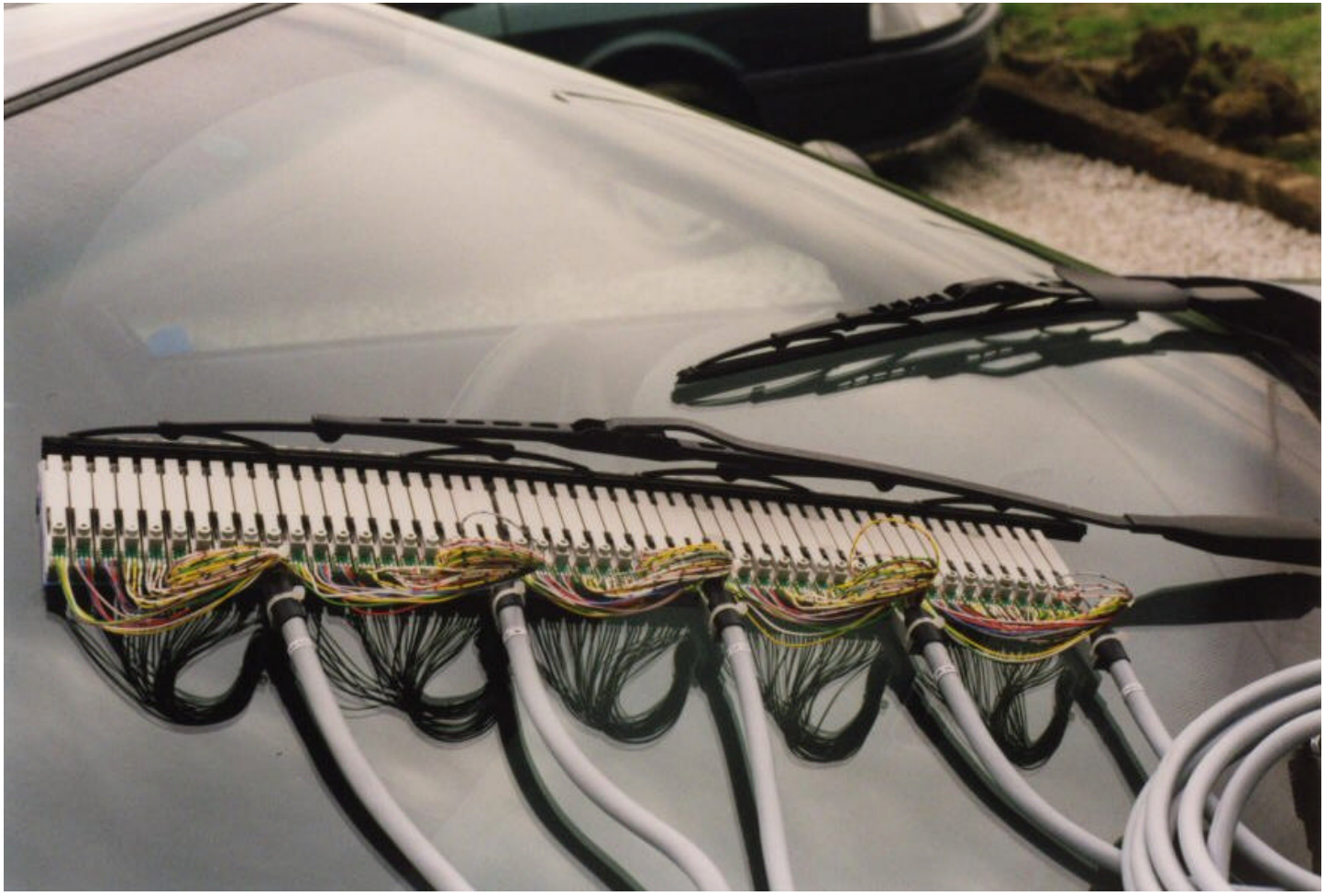
✓Stress measurement on concrete pipe

✓Model 5105 20MN (2000t) – Testing machines

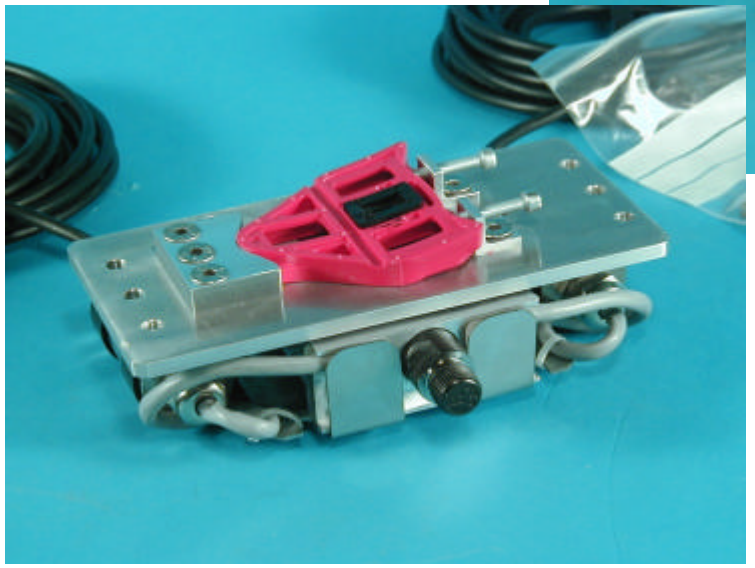




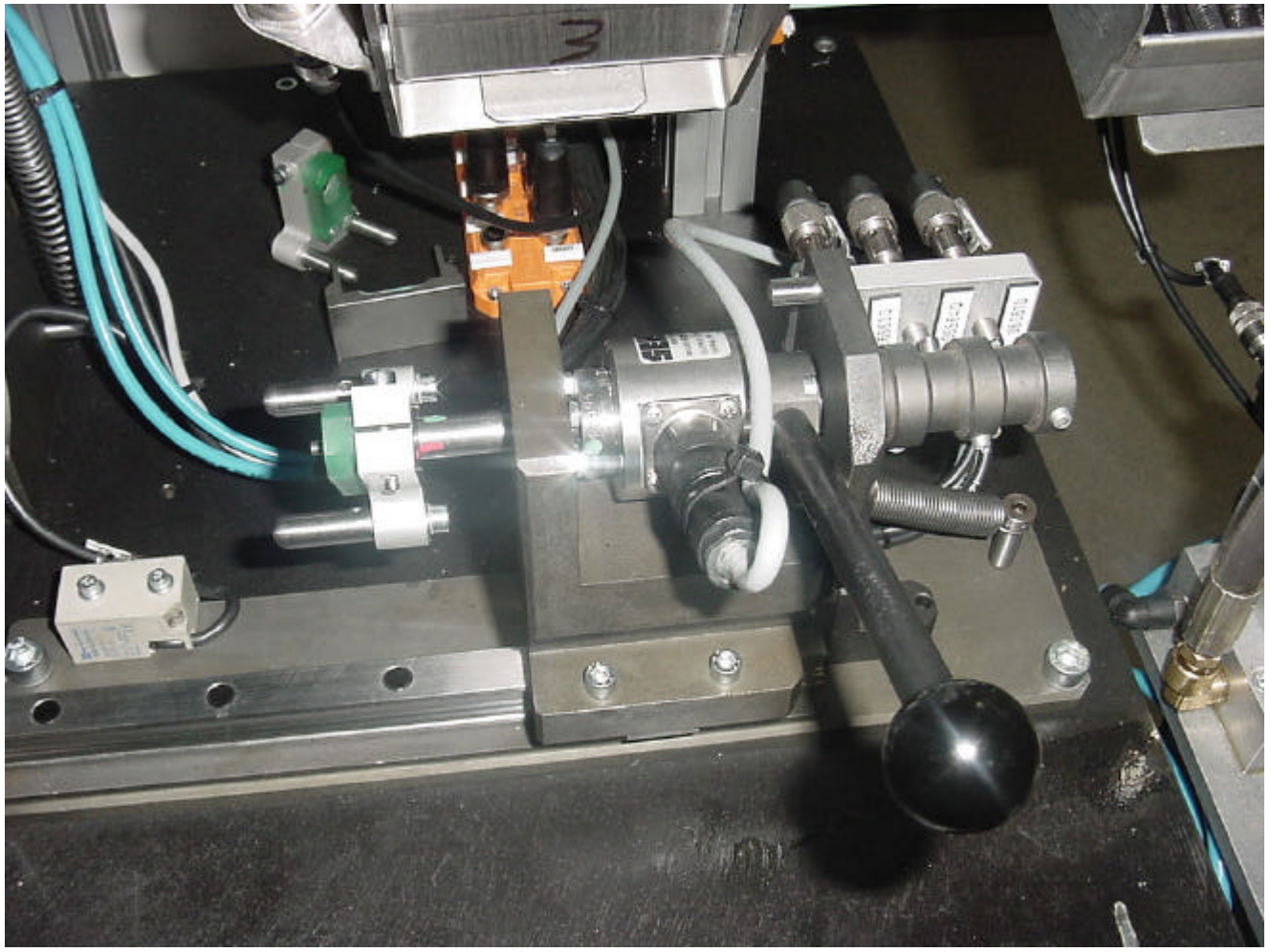
✓Special application : windscreen wiper



✓Model 9PED : bidirectional pedal for bike

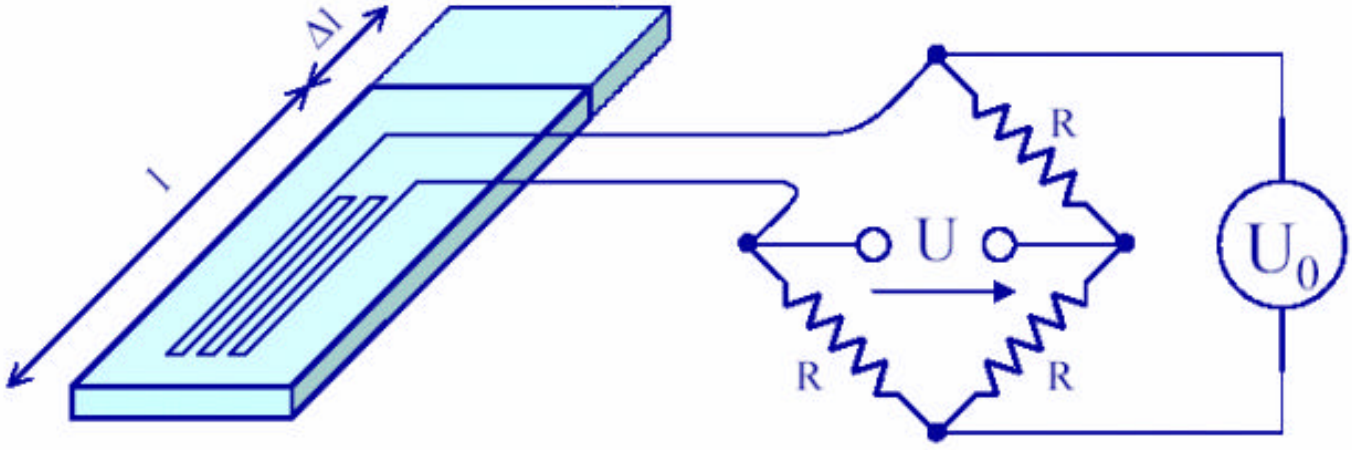


✓Model 6500M : torque measurement

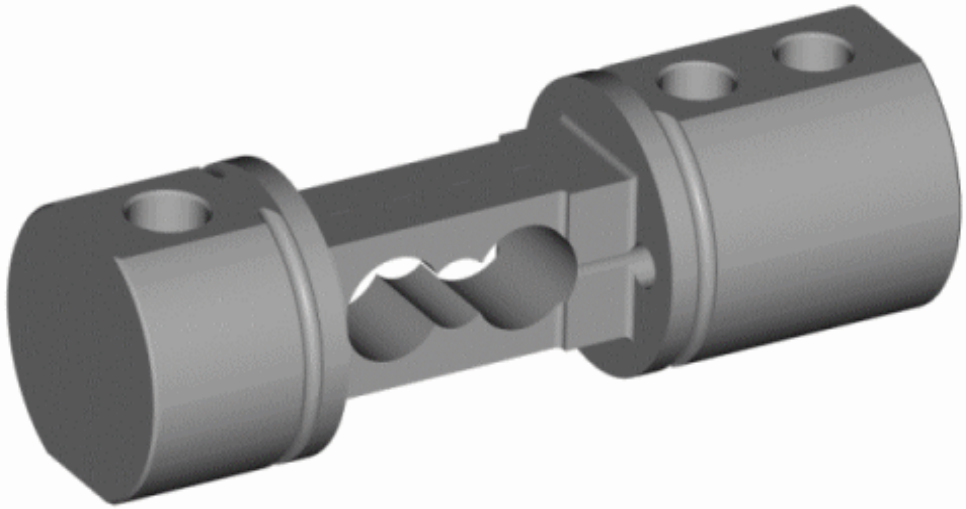


- ✓ SENSY Load cells : used principle :

  - Strain gages of extensiometry : The strain gages are bonded on the mechanical element to have the same deformation.



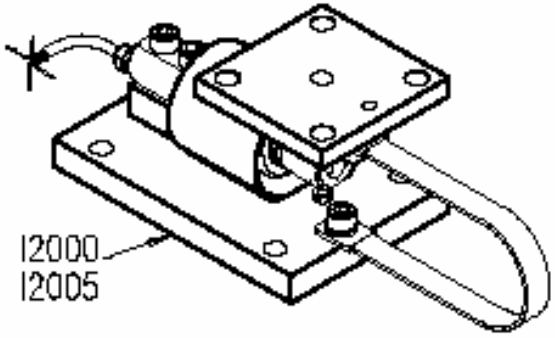
- ✓ Which are the elements of influence of a Force sensor?

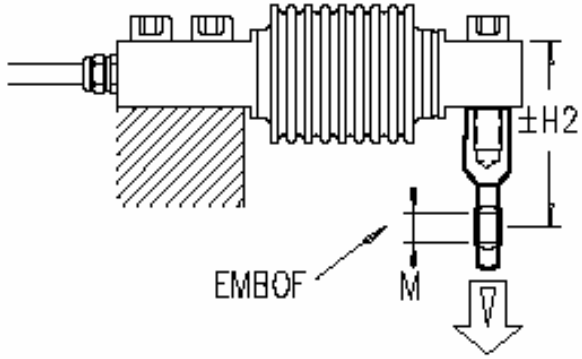


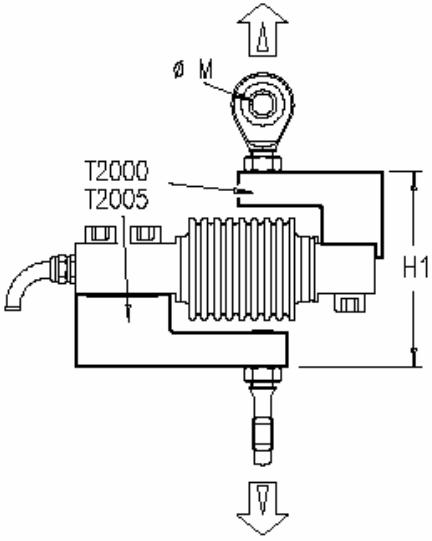
  - Mechanical element
  - Bond
  - Strain gages
  - Corrections of the drifts
  - (Integrated amplification card)

✓Bending load cells used as for:

- Scales
- Pallets scale
- Small to medium range hoppers
- Etc…

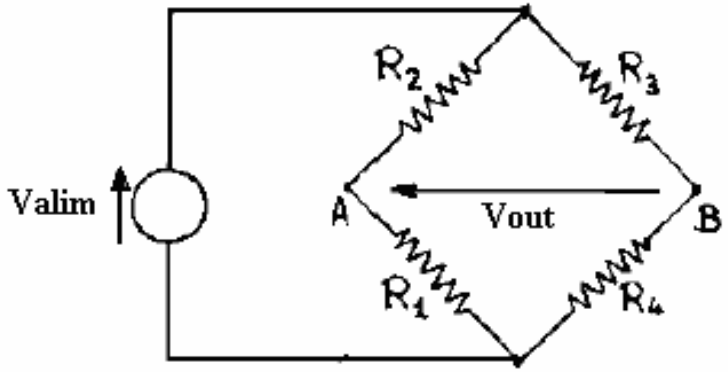






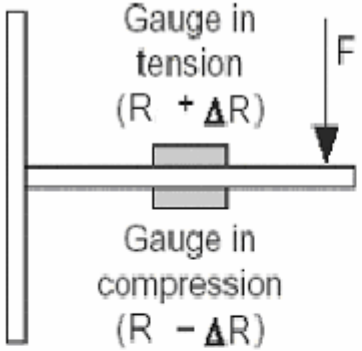
✓ Principle : Wheatstone bridge

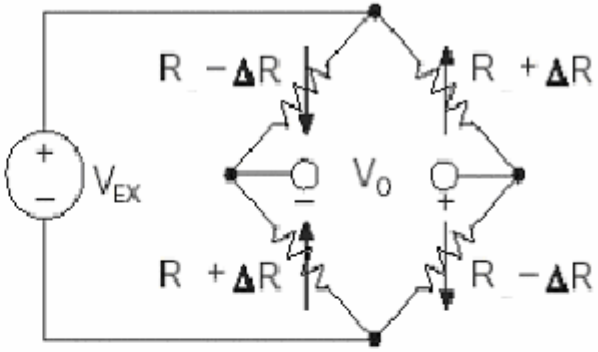
Vout = 0 Volts if charge = 0 N



$$Vout = \frac{R1 \cdot R3 - R2 \cdot R4}{(R1 + R2) \cdot (R3 + R4)} \cdot V_{alim}$$

- Each resistance is a gage which varies according to its deformation.
- Advantage: Output signal = 0 Volt in absence of force combined with differential measures (less disturbance).





$$Vout = \frac{\Delta R}{R} \cdot E$$

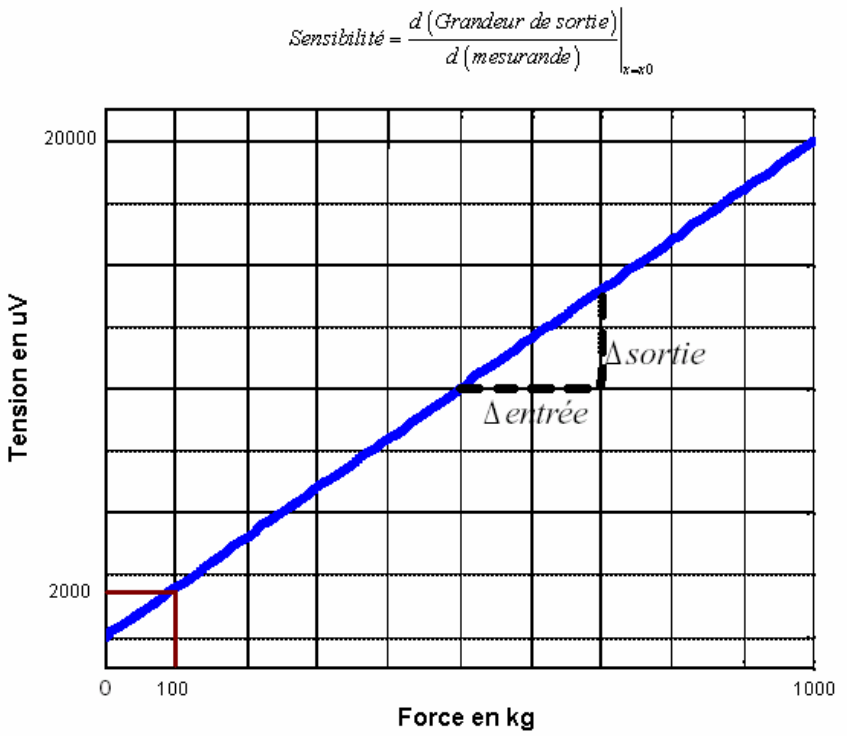
Knowing the relation $\frac{\Delta R}{R} = GF \cdot \frac{\Delta l}{l}$ Defined by the strain gages principle

We may write : $Vout = GF \cdot \varepsilon \cdot E$

✓ Sensitivity definition:

- It determine the evolution of the output variable according to the size of entry in a given point. It is the slope of the tangent to the curve resulting from the sensor's characteristics.

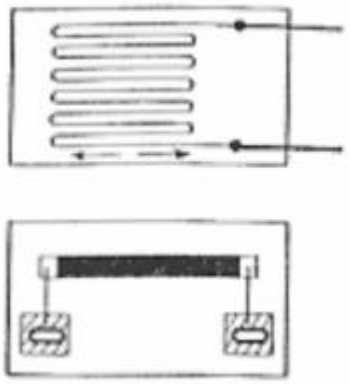
$$\text{sensitivity} = \left(\frac{S - Z}{force}\right) \cdot \frac{\text{Capacity}}{\text{Exc. voltage} * 1000}$$

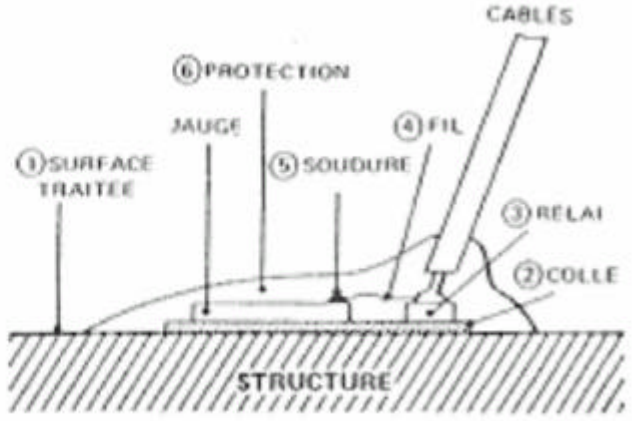


- Used formula:
- Unit: mV/V (from 1 to 2 mV/V)

✓ Strain gauges

- Passive sensor which translates into variation resistance their own deformation.





$$R = \frac{\rho m l}{s}$$

- 2 types of gages which are characterized by the variation from resistivity
  - Metallic strain gages
  - semiconductors

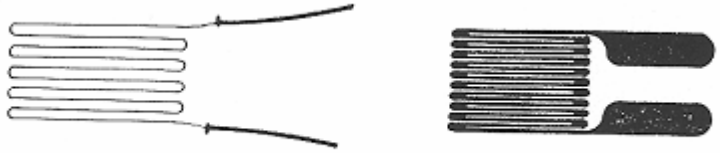
- ✓ **Metal gages:** Using the relation of Bridgman who allows to bind the variation of resistivity to the variation of volume.

$$\frac{\Delta\rho}{\rho} = C \cdot \frac{\Delta V}{V}$$

- ✓ **Semiconductor gages:** Use the piezo-resistivity effect. The variation of resistivity is expressed according to the constraint s and of the piezo-resistive coefficient p by the relation: $\frac{\Delta\rho}{\rho} = \pi \quad \sigma$

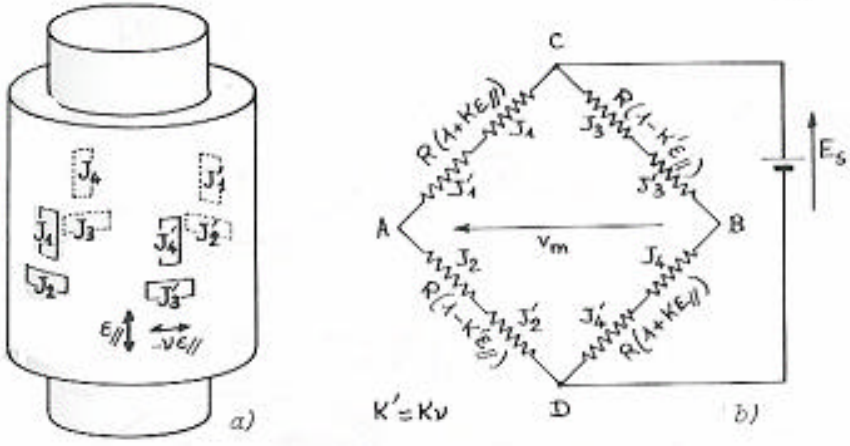
- ✓ After calculations, we obtain: $\frac{\Delta R}{R} = K \cdot \frac{\Delta l}{l}$ With K = factor of gage
- ✓ Rem. : K often oscillates around 2 for the strain gages, and between 100 and 200 for semiconductor gages.

- ✓ SENSY is using metal gages of 120, 350... 5000 Ohms.
  - Advantages:
    - Better positioning
    - Better temperature behavior
    - Less fragile and less expensive
    - Diversity of the gages according to their creep resistance.
    - Better linearity.



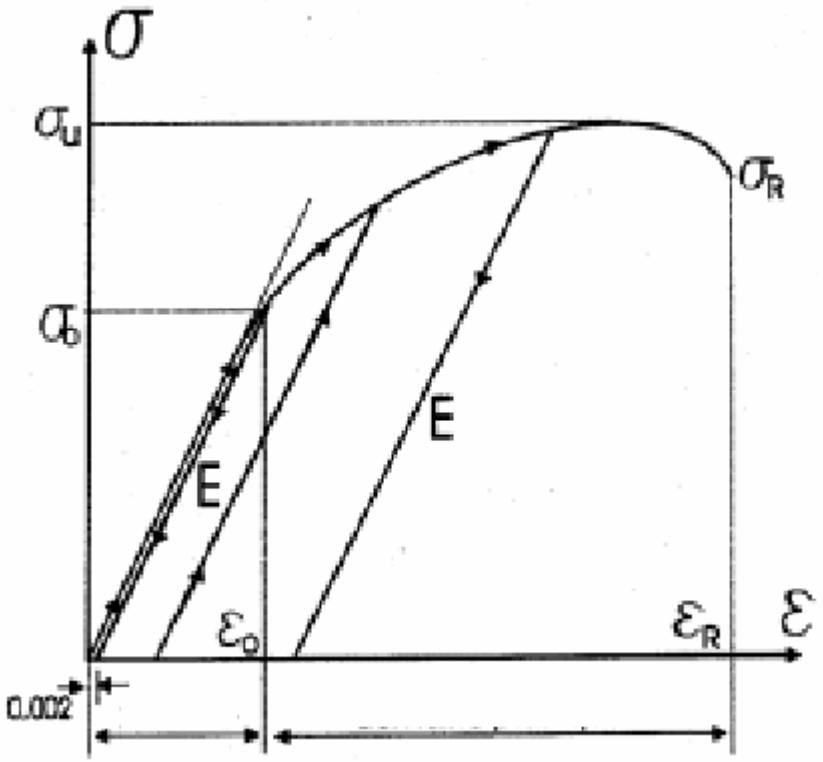
  - Characteristics of the semiconductor gages:
    - Adapted very well to the measurement of very weak deformations
    - Better adapted to dynamic measurements.

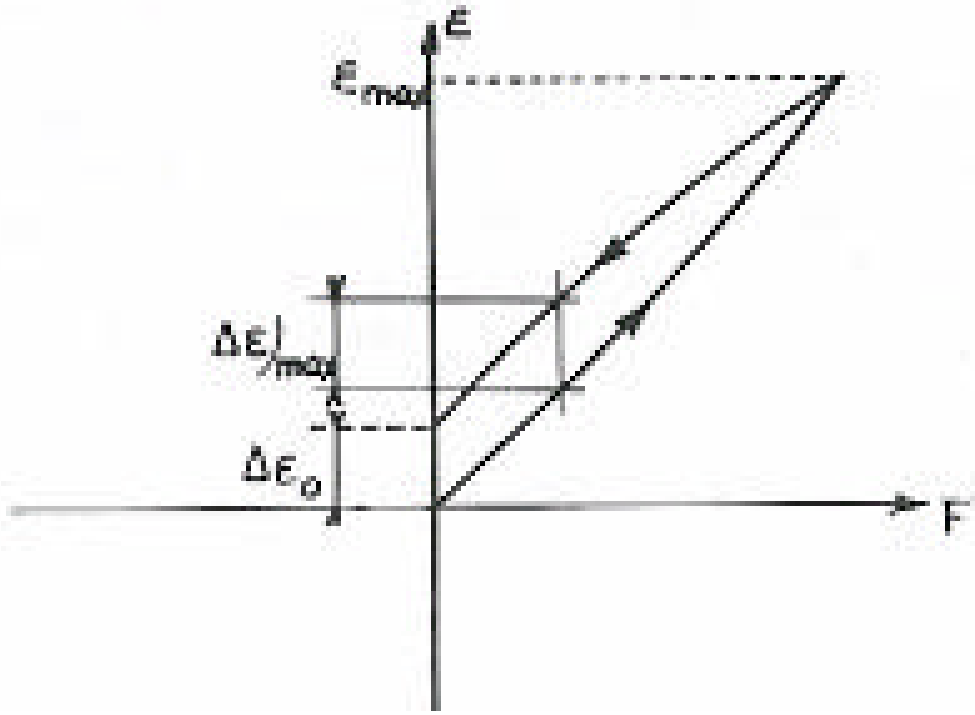
- ✓ Concept of accuracy at SENSY:
  - In the case of a sensor of force, the accuracy represents the whole of the errors on the linearity, Hysteresis, the non-repeatability, creep, sensitivity drift of in temperature, etc...
  - For example:

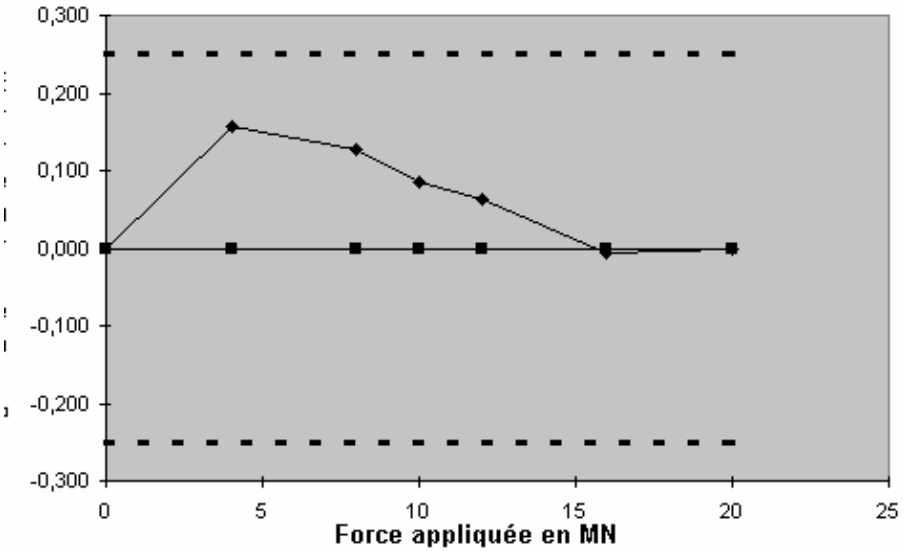


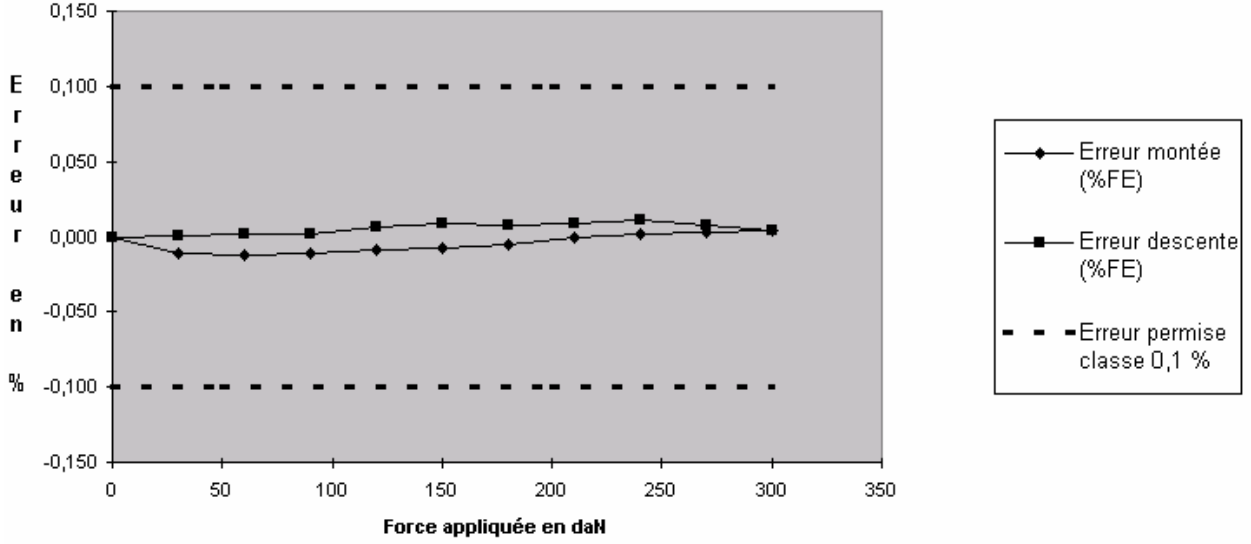
✓ Mechanical characteristics

- Zero and hysteresis





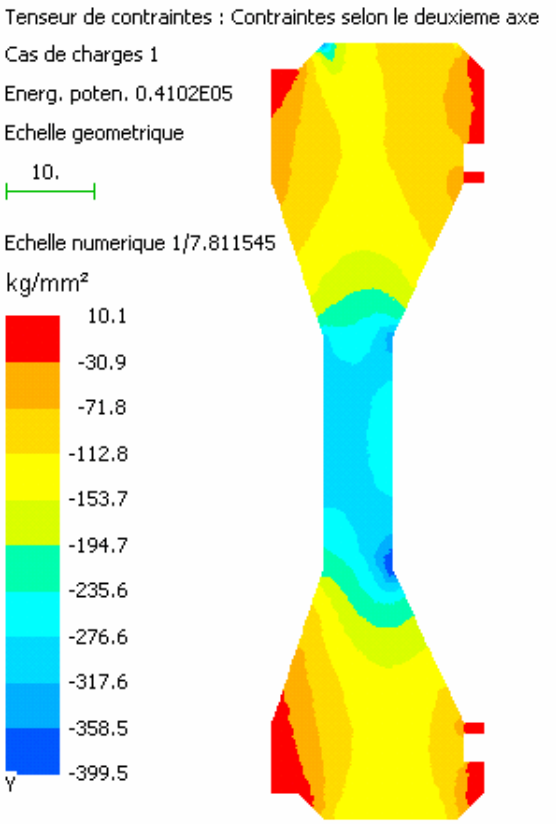

0,300
0,200
0,100
0,000
-0,100
-0,200
-0,300
0
5
10
15
20
25
Force appliquée en MN
Erreur montée (%FS)
Erreur descente (%FS)
Erreur permise classe 0,25 % (échelon)

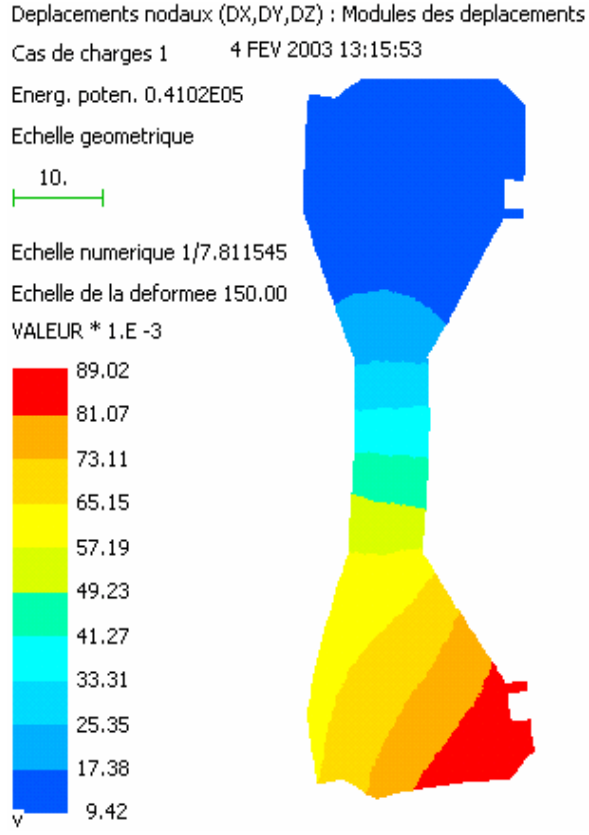

0,150
0,100
0,050
0,000
-0,050
-0,100
-0,150
Erreur en %
0
50
100
150
200
250
300
350
Force appliquée en daN
Erreur montée (%FE)
Erreur descente (%FE)
Erreur permise classe 0,1 %

✓Load cells and force sensor development

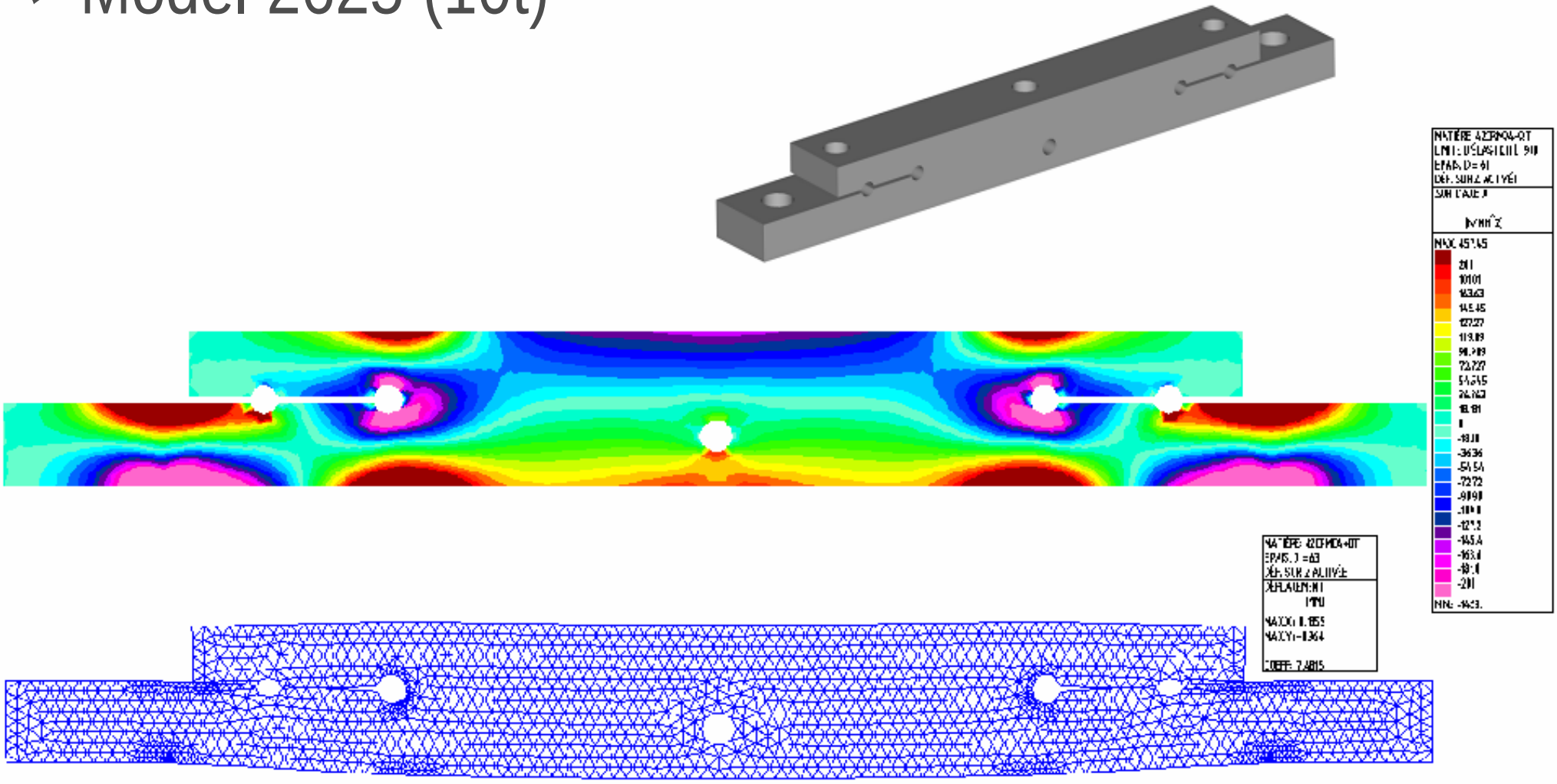
- Data
  - Capacity
  - Dimensions
- Load cell design depends on the type of stress but also on its capacity, temperature range of use , etc…)For the design, we do use a software which allows to calculate the strains gages localization by finite element.
- Examples…

✓Simulation by finite elements on the Model 5190

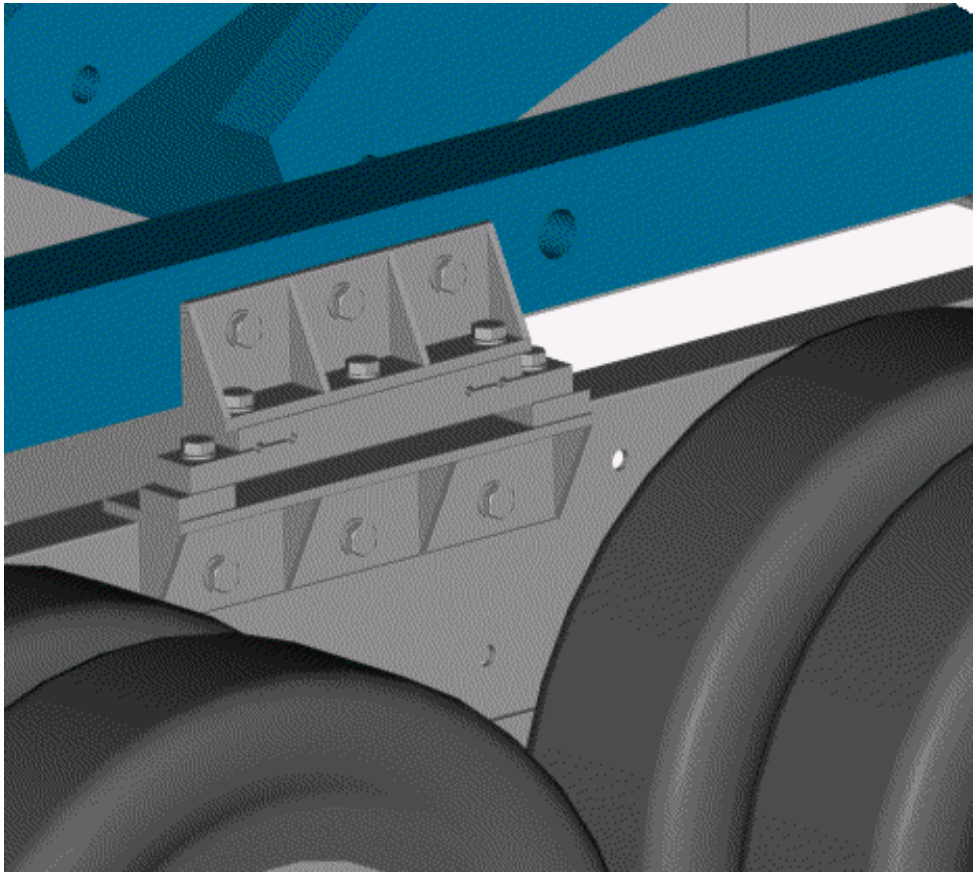


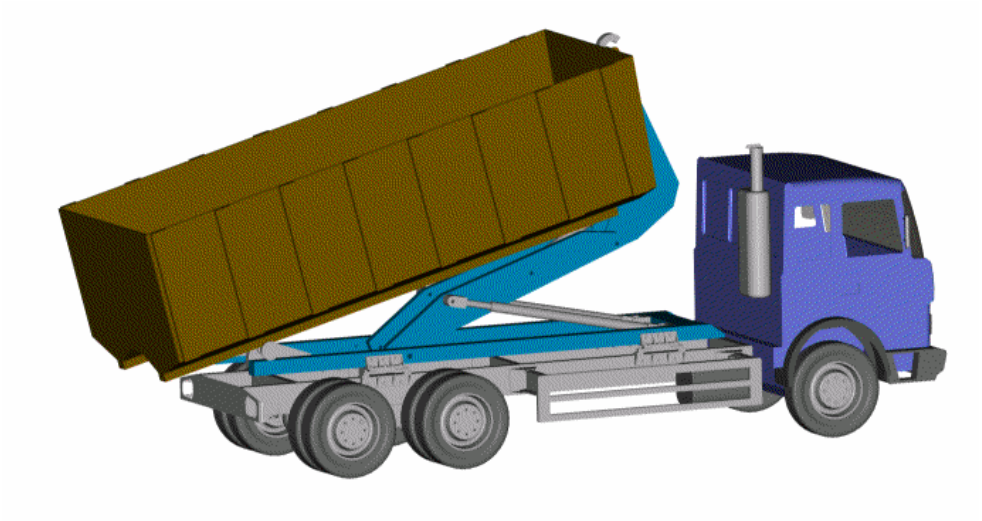


✓Model 2625 (10t)

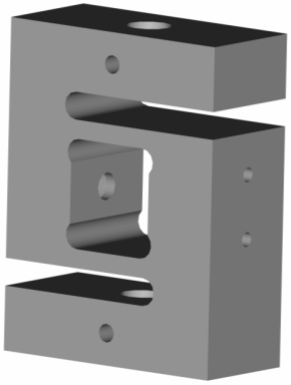


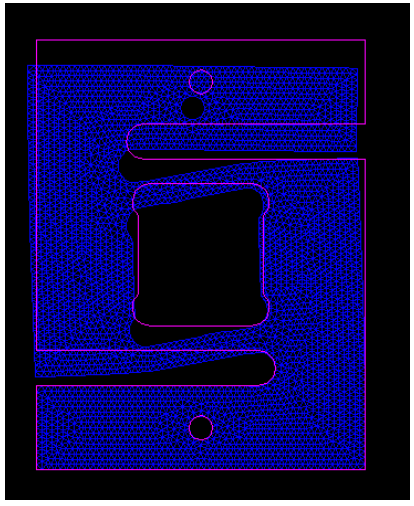
✓Model 2625 «On board » application

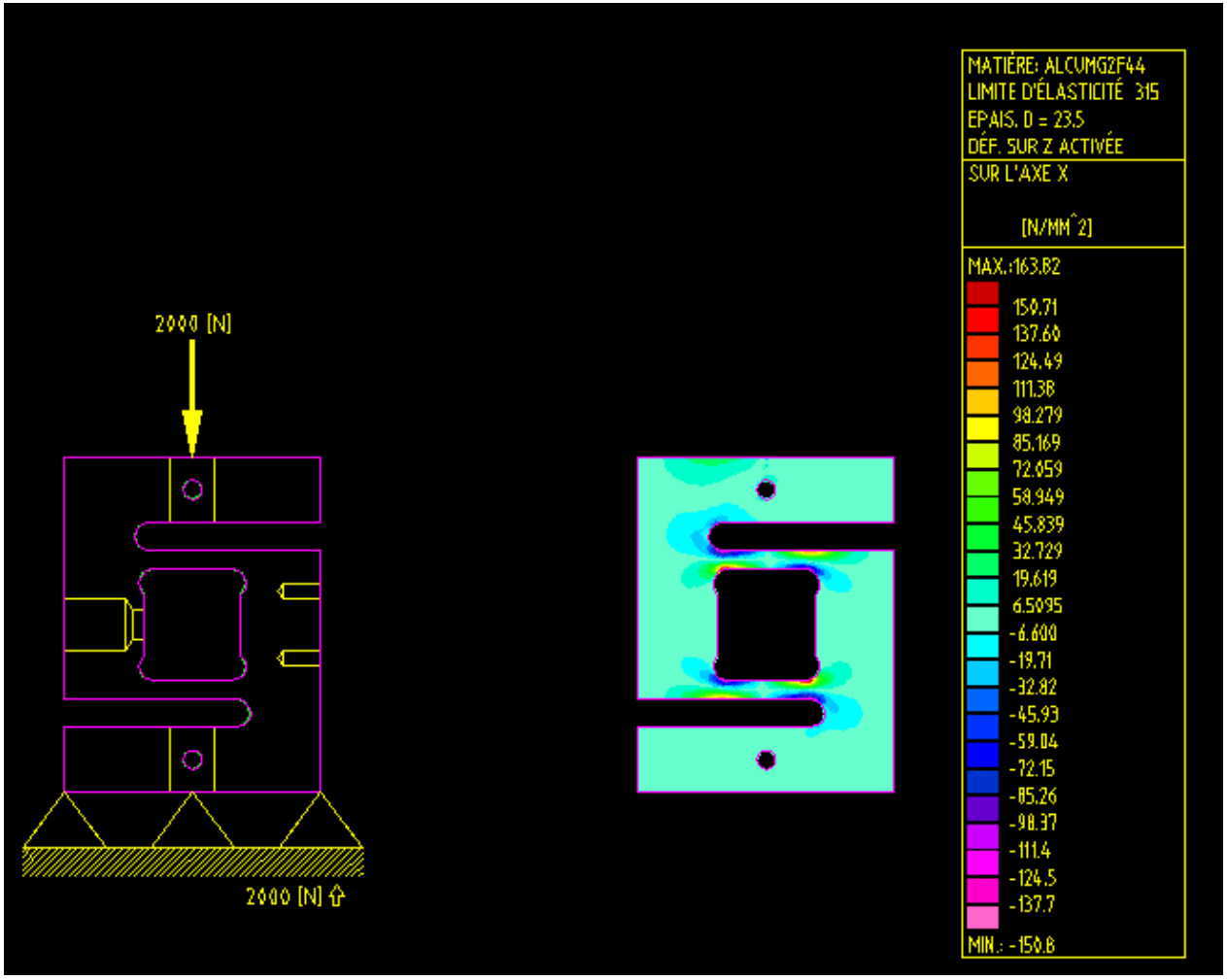




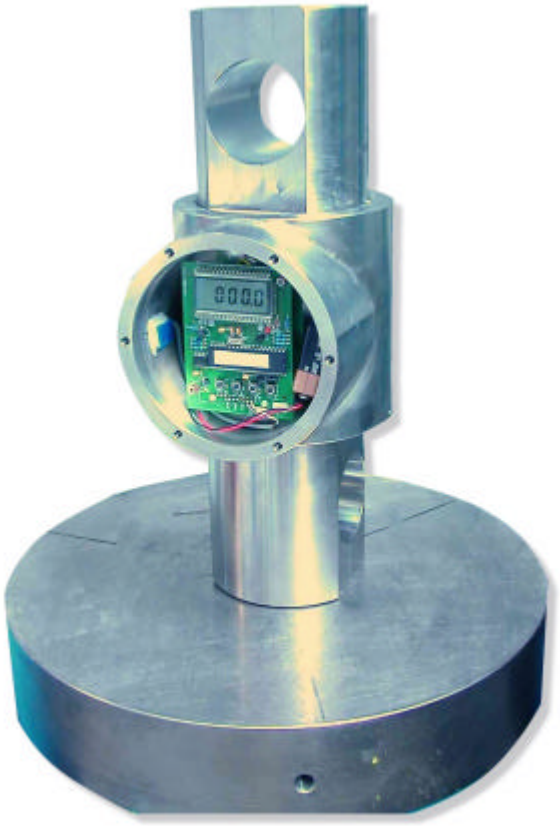
✓Model 2712 (200kg): application

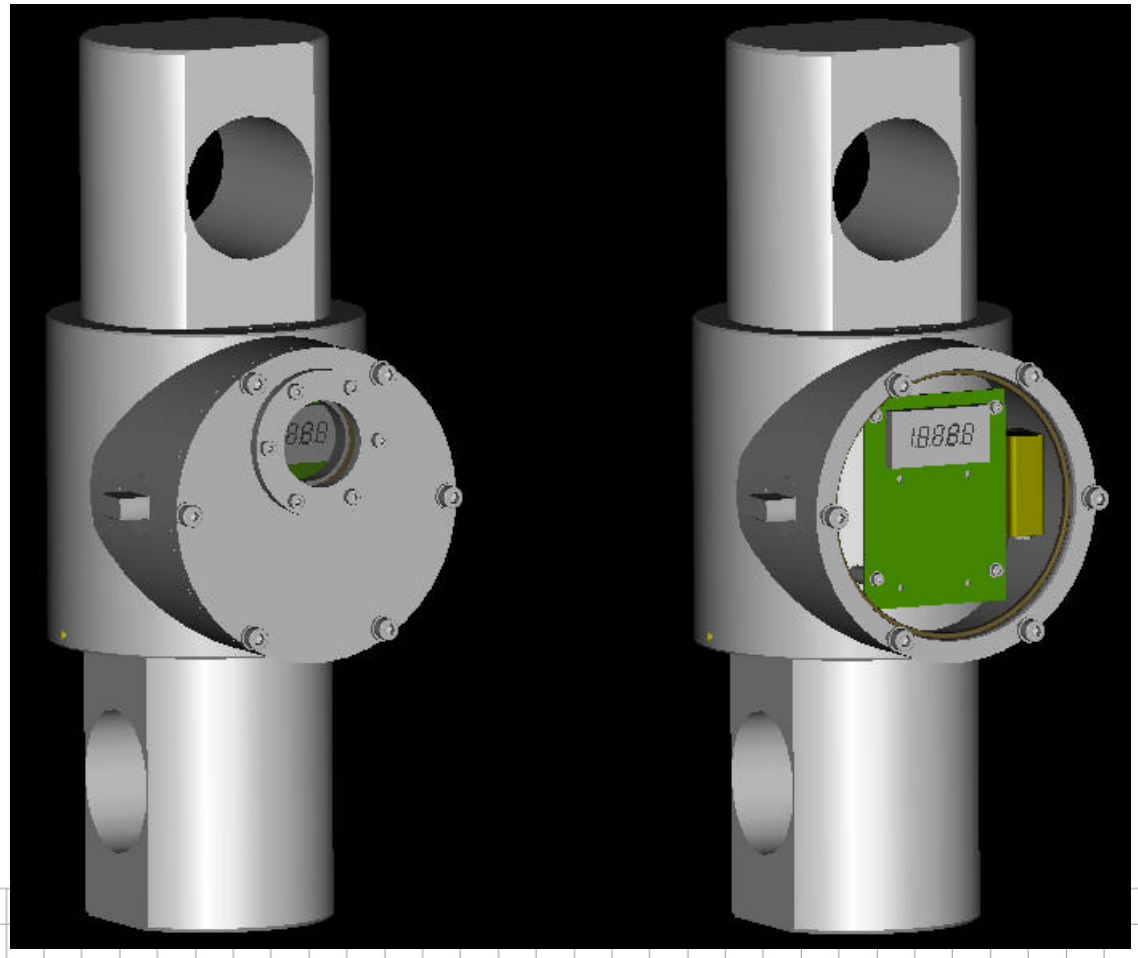




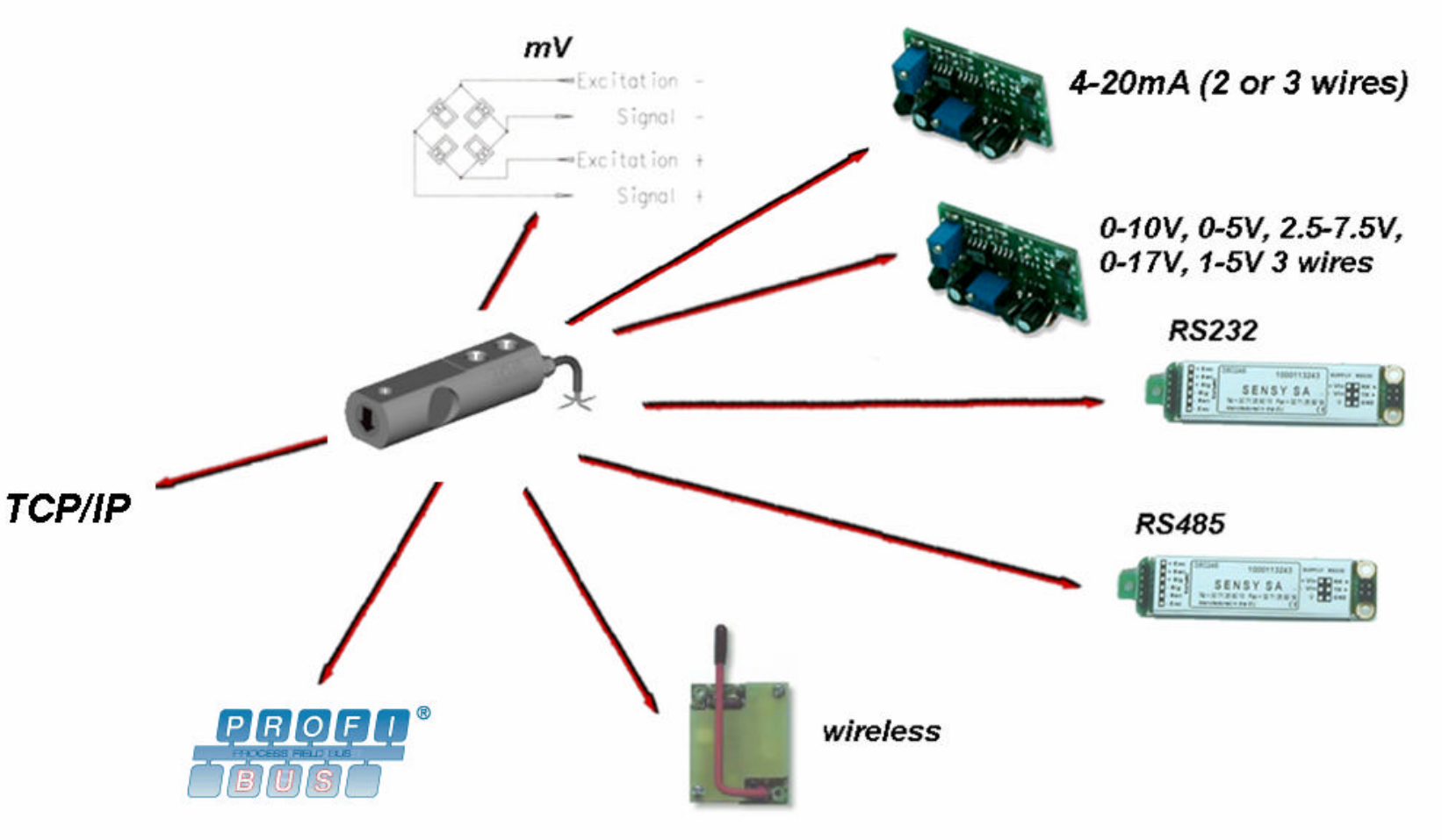


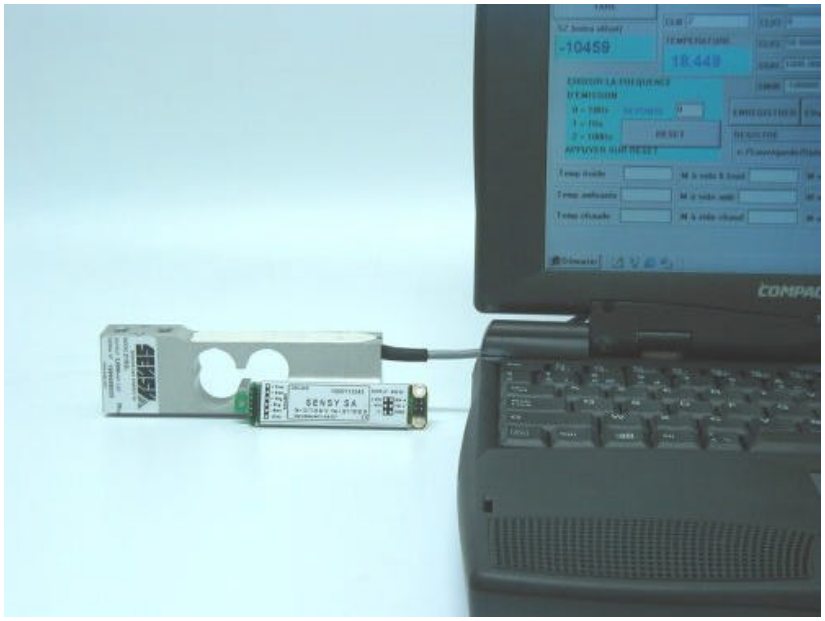
- ✓ Model 5100L (customized) IP68, submerged environment (used under the sea – long term period)





✓ Available output





✓ Digital reference load cell

- Various types of output
  - RS232
  - RS485
- Advantages:
  - Digital correction of the temperature drifts.
  - Signals much less prone to the parasites.
  - Reading by an ordinary PC.
  - Very high resolution.
  - Faster calibration, etc…

✓ Digital sensors project in progress:

- Multiplication of achievements of programs "to measure" For example: evolution of the signal sensor according to time in a graph, tests or calibrations of machines in accordance with standards.

- Digital Standard Reference load cell.