Technical Notes

UTILCELL
CELULAS DE CARGA - LOAD CELLS
Valor en tecnología de pesaje
Value in Weigh Tech

LOAD CELL SELECTION GUIDE FOR TANKS AND SILOS

This is a practical guide for the selection of a load cell in applications of tanks, vessels and silos. Keep in mind that there are other conditions or technical requirements to consider. It should be taken as an orientation that may be valid for most cases. This guide is only suitable in systems totally supported on load cells and systems with uniformly distributed loads, without major asymmetries. It is not suitable for systems where the force is transmitted to the cells through levers, systems with large asymmetries on the load distribution or systems with rolling loads.

Capacity of the load cell

The objective is to estimate the real load on each supporting point, in all the operating circumstances and life of the weighing system, including extreme situations, and to choose a load cell of a suitable Nominal Capacity with an adequate safety margins.

The Nominal Capacity of a load cell is determined as follows:

- **Dead Load**: It is the weight of the empty structure, including all its elements: tank, pipes, vales, engines, agitators, heating fluids and accessories. It should be calculated or estimated.
- **Product Weight or Net Weight**: It is the maximum quantity of product that can be entered into the tank. It is normally which define the maximum product range of the weighing instrument.
- **Gross Weight**: It is the sum of the **Dead Load** and the **Product Weight** or **Net Weight**.
- **Number of Supports N**: It is the number of supports on which the weighing structure, tank or silo is supported, usually 3 to 6 supports.
- The theoretical static load per support is the result of dividing the Gross Weight by the Number of Supports.
- Select the rated Nominal Capacity of the load cell higher than the theoretical static load per support multiplied by a safety factor k, according to:

$$\text{Cell Nominal Capacity} \geq k \times \text{Gross Weight} / N$$

Where **k** is a safety factor value between 1,25 and 2,2, to increase the necessary capacity of the cells from 25% to 120% of the theoretical static value. It's selection will depend on the presence of static or dynamic loads, vibrations, non-uniform distribution of loads, other asymmetries, impacts or rolling loads.

A practical choice for an apparently static loads is to use:

- Three supports tank (**N=3**) **k = 1,3**
- Four supports tank **(N=4)** **k= 1,5**
- Over four 4 supports tank (**N= 6, 8, …**) **k= 1,7**

and round up to a rated Nominal Capacity of a commercial cell.

Note: When the Dead Weight is over 50% of the Gross Weight, it is recommended to increase the safety margin to **k=2**, as it is usually due to large motors, accessories or heating systems and

very probably, and there could exist non-centred or not uniform loads on the supporting points as well as potential errors on the estimation of the Dead Weight.

Note: After the installation it is important to check the load distribution for each bearing point by visual inspection and measuring the individual mV output of each load cell.

Usually, you can oversize the load cells in more than 2 times the weight of the product without any loss of accuracy. It is very common in scales and you just have to consider the sensitivity of the electronic indicator used or the micro-volts per division are sufficient. Very common with most of the modern electronic specific for load cells.

Continuing by checking the following questions and correct the Nominal Capacity of the cell if necessary:

- Is the value of the Dead Weight correctly calculated?
- May the load be distributed in a non-uniform manner?
- Are there agitations or impacts?
- Is it possible that the tank has a higher capacity and it may overflow exceeding thus the maximum Product Weight?
- Does the possibility of earthquakes or strong wind in the area exist?
- Can a vehicle impact on or overload the system?
- Can you assure a good levelling for obtaining a good load distribution for each bearing point after the installation?

Environmental considerations

It is very common that there exist various models of load cells with the same Nominal Capacity, and so, the most suitable for the environmental working conditions should be chosen:

- For corrosive environments or in presence of permanent humidity, it is recommended the use of stainless steel load cells, instead of those made of aluminium or nickel plated steel.
- The degree of environmental protection increases with the choice of tight joint cells with a welded capsule, hermetically sealed load cells.
- For potentially explosive environments, there exist also specific load cells including ATEX certification.
- Verify the need of any additional safety elements for example in areas with special requirements against earthquakes, strong winds or if there is risk of any injury to persons or damage of goods.

From Utilcell, we hope this technical note has been of your help. It is only a guideline and it is not a contractual specification. We reserve the right to change the content of this technical note at any time without notice. We remaining at your disposal for any further information.