



Often questions arise over load cell installations on a tank or silo weighing system. How many load cells should I use and what capacity? Can I save by using fewer load cells than the number of supports on the silo and use hinges or dummy load cells on the other legs or by using a lower capacity load cell?

Frequently tank and silo systems are designed with 4 legs and we'll use this as an example. It is commonly thought that installing only two load cells under 2 legs and 2 dummy load cells is cost saving so let's look at a few examples of a silo with 4 legs and the various weighing scenarios.

Example 1:- A four leg silo, gross weight 80t, 2 load cells on 2 legs and two dummies on the opposite two legs. Each leg has a load of 20 tonne, assume we are using 25t load cells.

Explanation:- When only 2 load cells are used in a silo with 4 legs the distribution of the contents affects how much weight is on each load cell and therefore the accuracy and if the material is not perfectly central there will be more weight on one side than the other and errors will occur. Deviation from vertical or correct shape of the silo can cause these errors also. Any wind or side loading forces will also alter the proportion of the weight of the contents on each leg, and therefore the accuracy of the reading.

Example 2:- Also, same as example 1, but using 4 load cells (one on each leg).

Explanation:- Example 2 will be more accurate than example 1 because 4 load cells compensate for any uneven material distribution. When load redistributes from one leg to another due to uneven contents, wind or side forces, the total load on the load cells and the reading remains the same.

In both the above examples the load cells have reserve capacity above the weighing system total weight.

Example 3:- A four leg silo, with a total maximum weight of 100 Tonnes, using 25T load cells. Each leg has a load of 25T.

Explanation:- If there is some unevenness of the loading the load on a load cell may exceed the capacity, it will be more accurate to use a higher capacity load cell so that the full capacity of the load cell is not exceeded. The load cells have a safe load rating higher than capacity, but the specifications are not guaranteed up to the limit of the safe load and accuracy may diminish. In situations where the load is cyclic, the fatigue life is diminished by the higher operating stresses. The uneven loading may result from side loading, wind forces, vibration or from uneven support. Load cells need very little deflection compared to steel or concrete foundations for the load to change substantially and just a small amount of support flexing can drastically change the load on each load cell. In a worst case with 4 legs a silo may be supported on only 2 diagonally opposite legs in a see-saw effect. It would be better to use 4x50t load cells for the 100t silo, there is little difference in accuracy between 25t load cells and 50t load cells.

Some notes to remember:- The accuracy can be maintained from full load down to less than 30% utilisation of the load cell full capacity when due consideration is given to the zero (empty) condition. That means that weighing 0 - 30t in a silo with 4x25t load cells can be as accurate as using 4x10t as most specifications are a proportion of the weighing range (FS) and not the capacity(FO, FLO). It is good practise to be weighing with a scale full load (silo full load) between 45-50% and 80% of the total load cell capacity. It is also necessary to check that the indicator has the sensitivity ($\mu\text{V}/\text{division}$) to make use of the load cell accuracy. A vessel installed on only 3 supports will not be subjected to the redistribution of load from relaxation of any support (see-saw effect) and prediction of individual load cell loads will be more accurate.

In short, even weight distribution is a vital part of a good weighing system. Using 4 x load cells in a 4 legged system gives the system more weighing stability and improves accuracy, especially if the load is uneven and not self levelling. When using 2 x load cells in a 4 legged system the location of the load cells is important, using 4 x load cells in a 4 legged system also avoids a possible mistake in that respect. When higher accuracies are not required, as for simple level control or silo refilling, a reduced number of load cells and pivoting supports may be appropriate.