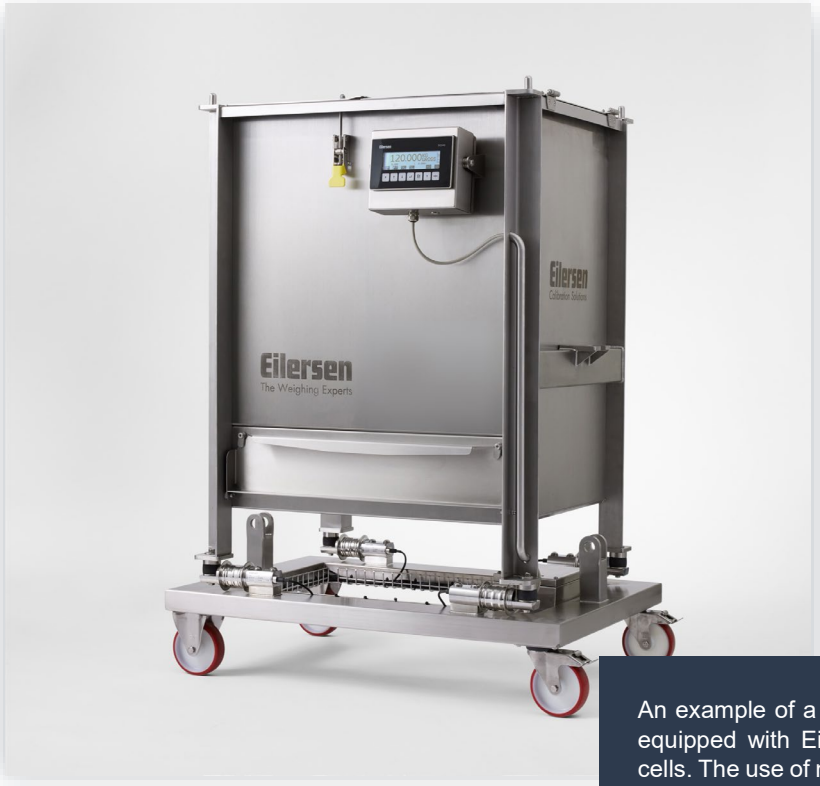
How Using Capacitive Load Cells Increases Uptime for Mobile Totes

A Case Study on Eilersen Beam Load Cells

Eilersen continuously partners with industry leaders to qualify our equipment and concepts in real-world conditions and simulated process environments. In this study, we partnered with a Belgian mechanical and electrotechnical engineering firm to test the performance of capacitive load cells on mobile totes and mixers for biopharma manufacturing.

The biopharma industry has increasingly adopted single-use equipment and mobile totes in recent years. This is due to the flexibility it provides, enabling manufacturers to make changes in manufacturing layout faster than before. Other benefits are also valued, as single-use equipment leads to a lower risk of contamination and reduced time and costs associated with cleaning and validation.

The use of mobile totes can however present a challenge when it comes to other aspects. As load cells using strain gage technology are sensitive to the sideloads they encounter in such an application, accurately measuring the product's weight in the tote or mixer can be a problem. Movements and uneven surfaces can result in strain gage load cells being impacted, losing calibration, and thus leading to inaccurate measurements.



An example of a mobile tote equipped with Eilersen load cells. The use of mobile totes in the biopharma industry has increased significantly as manufacturers require additional flexibility.

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The Limitations of Strain Gage Load Cells

A large international biopharma manufacturer encountered several challenges when pushing around their mobile totes equipped with strain gage load cells. During daily activities, mobile totes are frequently pushed around carrying bags of liquids. To prevent the load cells from being overloaded, many strain gage load cells are installed with some variety of mechanical protection such as brackets or stay rods. During high sideloads the stay rods and brackets protect the load cell. However, after impact, the tension between the load cells and stay rods affects the weight reading and accuracy, causing a need for recalibration of the entire weighing system. Such issues are well documented and caused by simple movements such as technicians turning the tote around corners, pushing, or pulling the tote. Key limitations relating to the use of strain gage load cells include:

- Strain gage load cells can be overloaded by the impact occurring when rolling over bumps and uneven surfaces when moved between locations.
- Strain gage load cells can be overloaded when being pushed around the facility using an electrical mover.
- Strain gage load cells can be overloaded by the sloshing of liquids in the mobile tote during transportation.
- The mechanical elements protecting the strain gage load cells introduce tension that influences weight reading and accuracy.

If the technicians suspect that the load cells on a mobile tote have been overloaded, a recalibration of the weighing system is required. This process will take the tote out of production for several hours and can cost thousands of dollars, due to the use of expensive single-use bags, a large volume of purified water, and time spent on documentation.

To overcome these challenges, the biopharma manufacturer installed a mechanical “transport lock” by each strain gage load cell to protect the load cell from the impact of bumps and sloshing liquids whenever the tote was moved around the facility. For this system to work properly, the daily operators would have to manually engage and disengage the brackets before and after moving the tote. In practice this action was frequently forgotten, causing deviations, and requiring recalibration of the weighing systems. To solve this important issue, the biopharma manufacturer approached the Belgian mechanical and electrotechnical engineering firm, specializing in the design and production of parts for pharmaceutical companies.

Example of strain gage load cells with side- and overload protection.

Example of strain gage load cell mounted with transport lock.

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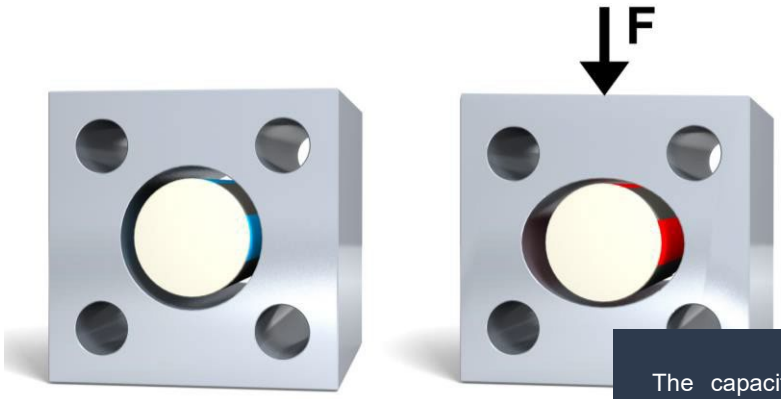
Assessment of Capacitive Load Cells

Being familiar with the capacitive technology of Eilersen load cells, the engineering firm knew that capacitive load cells do not require transport locks, stay rods, or brackets for overload protection due to the capacitive weighing technology. While strain gage load cells measure the change of resistance, the capacitive technology instead measures the change of distance between the load cell body and an internal ceramic sensor. This patented contactless measurement principle makes the capacitive weighing technology resistant to sideload and able to handle up to 1,000% overload.



The capacitive load cells measure the change in distance between a metal body and a ceramic sensor.

Read more

A test system was required to assess the performance of the capacitive technology when subjected to the impacts of daily operations in the biopharma industry. Therefore, a mobile tote was retrofitted using the following products from Eilersen:

- 3 pcs BL 150kg beam-type load cells
- 1 pc 5024G Digital LCD Weighing Indicator

Tests were conducted after retrofitting the tote with Eilersen load cells to measure the influence of movements on both smooth and uneven surfaces while transporting a mobile tote at full capacity.

Eilersen Beam Load Cell BL used in the test setup

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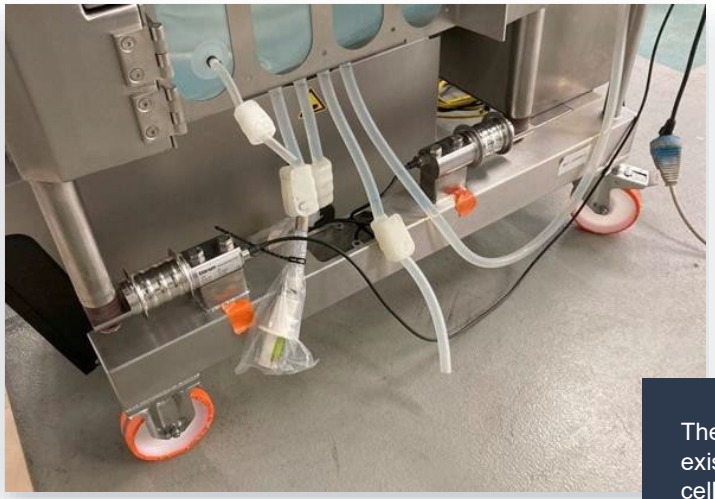
Test on smooth and even surface

For the first test, an empty tote was calibrated and validated. A 200L single use bag was installed and the tote was zeroed. The tote was then filled with water to resemble the approximate full working weight of the tote. Before starting the test, the load indication was noted. During the test, the tote was pushed through a room, stopped, and pushed around a corner and the results were measured with a resolution of 10 grams. The experience of the biopharma manufacturer was that such movements would often result in a measured difference exceeding 5kg when using strain gauge load cells if the transport locks were not engaged.



The mobile tote after existing strain gage load cells were replaced with Eilersen capacitive load cells.

Movement Test	Weight Indication
Difference	**0.02% full scale**

Results

After being pushed around at full capacity without lockout kits, the Eilersen weighing indicator displayed a difference of only 0.020% full scale, which is better than the rated load cell accuracy of 0.025%. The results were well within the MPE (Maximum Permissible Error) requirements of the biopharma manufacturer.

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Case Study 003

Beam Load Cell for mobile totes

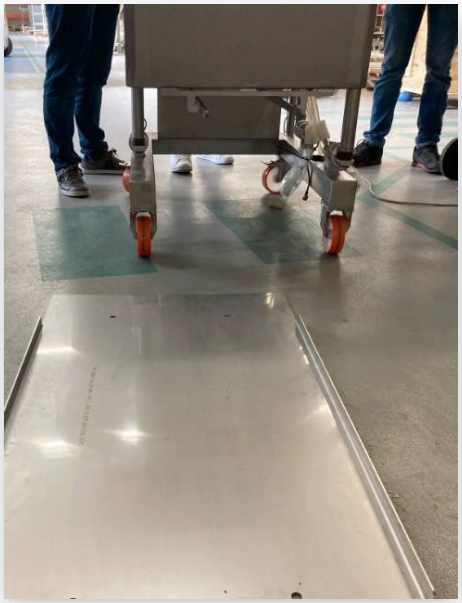
Test on Uneven Surfaces

An aluminum plate and a wooden plate were used as a simulation of obstacles commonly encountered by a mobile tote. The plates were placed on the floor in front of the mobile tote causing an impact force when rolled over. Two tests were conducted – one in which two side wheels encountered the aluminum plate and another in which all four wheels encountered the wooden plate. The biopharma manufacturer had previously experienced a significant variation when strain gage load cells were subjected to similar impacts caused by a full tote rolled over such plates. The results of these tests performed using Eilersen capacitive load cells are displayed below:

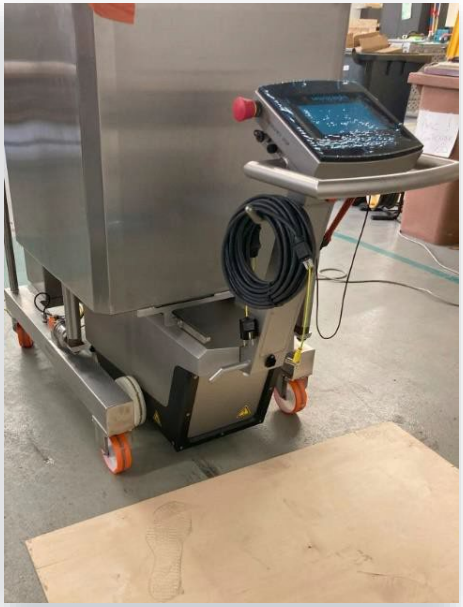
Uneven Surface Test	Two wheels Aluminum plate, 3 mm	Four wheels Wooden plate, 4 mm
Variance (% of full scale)	0.010%	0.020 %

Results

After rolling over the aluminum and wooden plates of 3 and 4 mm, the weighing indicator cells displayed a variation of between 0.010% and 0.020% of full-scale after impact without utilizing lockouts or any protective devices. These results were within the MPE (Maximum Permissible Error) requirements of the biopharma manufacturer.



Aluminum plate
Thickness: ~3 mm



Wooden plate
Thickness: ~4 mm

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Conclusion

The replacement of strain gage load cells with Eilersen capacitive beam-type load cells resulted in a weighing system being able to sustain sideloads due to movements and impacts commonly occurring during daily operation. Following tests conducted at full tote capacity, the weighing system based on Eilersen capacitive load cells exhibited only minor differences that were well within their rated accuracy.

Following these results, the biopharma manufacturer decided to replace their existing strain gage-based weighing systems with Eilersen digital beam load cells for all mobile tanks in their manufacturing process.

Over time, replacing strain gage load cells will lead to a decrease in unforeseen instances of inaccurate weighing data and a reduction in downtime caused by the need for recalibration. After changing load cell technology, the biopharma manufacturer has gained enhanced flexibility, eliminated expenses associated with overload-protection brackets and cleaning, and alleviated concerns regarding deviations in their weighing systems.

Summary

- Strain gage load cells need “overload-protection brackets” and “transport locks” to protect from sideloads and impacts during daily use.
- Capacitive technology can handle up to 1,000% overload due to the contactless measurement principle.
- Capacitive load cells allow reading of individual load cell values and replacement of load cell cables on-site without the need for recalibration.
- The movement tests on uneven surfaces showed satisfying results with a deviation that were will within the MPE of the plant.

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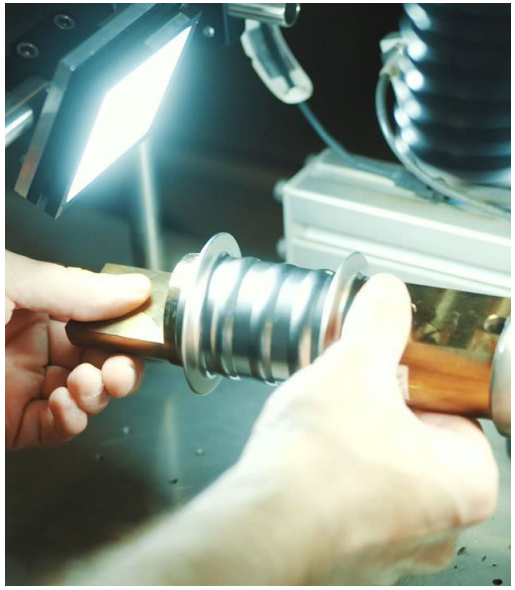
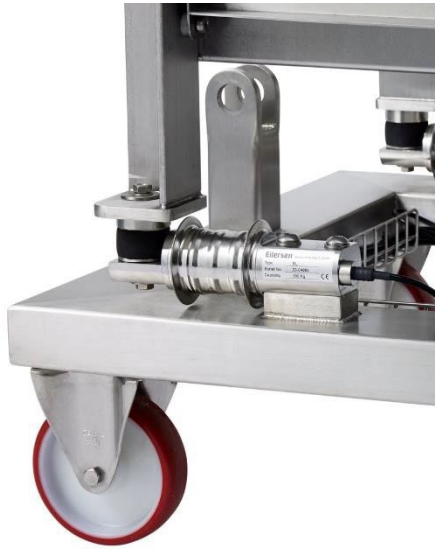
Eilersen Capacitive Load Cells

The capacitive load cells were invented at Eilersen and have been thoroughly tested and proven over more than 50 years. Eilersen load cells are known for being robust, accurate, and reliable. Our load cells are used in a range of industrial applications and industries ranging from offshore, logistics to the biopharma industry. The beam load cells are produced in stainless steel, are laser welded, and are an obvious choice for biopharma industries due to their hygienic design (IP68). Contact Eilersen Electric A/S today to learn about our many capacitive load cell variations, and together we find the optimal weighing solution for your application.





About Eilersen Electric A/S

Since its foundation in 1969, Eilersen Electric A/S has been dedicated to developing, manufacturing, and supplying high-quality, robust load cells based on capacitive technology for measuring force and weight. Eilersen products are developed, manufactured, and individually calibrated in Denmark at the Eilersen ISO 9001:2015 certified manufacturing facilities.

Eilersen – Made in Denmark, Trusted Worldwide

At Eilersen we continuously invest in quality, product development, and unmatched customer support. This is why Eilersen is known worldwide and delivers to leading companies and customers in 90+ countries.

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