Single point load cells: With only one load cell for precise weighing

Single points are among the most widely used load cells worldwide. In contrast to other force sensors, these products allow force to be applied at different points without falsifying the measurement result – this is ensured by the integrated parallelogram. High-precision weighing applications can thus be realised with only one load cell.

Single point load cells are suitable for a wide range of applications and are primarily used by plant engineers for manufacturing industries and for installation in industrial scales. The user benefits from the simple design of weighing applications due to the use of only one load cell. But how did the product actually become so popular? The history of the single point load cell began with the invention of the strain gauge.

Strain gauges: The basis of every load cell

As early as 1856, Lord Kelvin discovered that the electrical resistance of copper and iron wires increases when they are subjected to tensile stress. He thus laid the foundation for strain gauge technology, which is the basis for today's single point load cells. However, Edward E. Simmons and Arthur C. Ruge are considered the fathers of the strain gauge. Interesting fact: Ruge filed the patent for a strain gauge in 1938 with MIT, where he worked. Their verdict: Since this development was deemed "commercially unprofitable", he was allowed to claim the patent and revenue from it for himself alone. Today, strain gauges are considered an indispensable component worldwide for everything that has to do with industrial weighing. As such, strain gauges are one of the most widely used technologies in industrial weighing worldwide.

What sets the Single Points apart from other load cells, such as those used in the weighing of containers and silos, is the special design with integrated parallelogram and the associated possibility of eccentric loading. "Although single points have been around for decades, they are still indispensable in today's industry." Product Manager Yannick Salzmann said. "With parallelogram links and the resulting ability to precisely weigh loads off the centre of the platform, Single Point load cells offer great added value for a wide range of applications and industries, for both non-verifiable and verifiable requirements." Salzmann explains.

Eccentric load: How Single Points ensure highly precise weighing results

The structure of a single point load cell is characterised by two „parallelogram links", which are fixed to both sides of the base body. Two strain gauges are typically glued onto each of the parallelogram links. Due to the thin spots, the parallelogram links are deformed in an S-shape when force is applied – the rectangular basic shape becomes a parallelogram. This parallelogram link structure ensures that off-centre loads are compensated and that the load is always applied vertically. Thus, platform scales up to a certain size can be realised with only one load cell. Before

investing, however, fundamental questions must be clarified in order to find the right weighing solution.

The basic body material: aluminium or stainless steel?

For use in various applications with different environmental influences, the materials of the base body must be selected to match. There are basically two materials that are used here: Aluminium or stainless steel.

Aluminium exhibits high strength combined with low "creep effects" (the time and temperature-dependent viscoelastic or plastic deformation) under load. In combination with the low ageing properties at typical operating temperatures of -20° to 65° C, it is thus best suited for use as a base body material and offers higher measuring accuracy compared to stainless steel. Further advantages lie in the rapid compensation of temperature gradients, as aluminium has a significantly better thermal conductivity than stainless steel and can therefore compensate for temperature differences more quickly, especially at the thin points of the parallelogram link.

Aluminium, on the other hand, is not very corrosion resistant to chemicals. Therefore, basic bodies are anodised (controlled to create a thick, protective and extremely hard layer over an aluminium workpiece by means of anodic oxidation) to improve the properties against environmental influences. The area of the thin spots is cast after application to protect the film, usually with a silicone, so that corrosion protection is guaranteed in this area.

Stainless steel: When the going gets tough

If the corrosion protection must be further increased due to the environment, such as the chemical or pharmaceutical industry, stainless steel is used as the base body material. The corrosion resistance is significantly increased by these materials. If the sensor is protected by a housing, as is the case with a bench scale, for example, an aluminium load cell is sufficient in the vast majority of cases. Regardless of the choice of base body material, however, it is also important that the strain gauges are protected to ensure accurate measurement results.
"Protection of the strain gauges is essential: at Minebea Intec we ensure with a wide portfolio that there is the right load cell for every application."

Protection of strain gauges: silicone encapsulation or metal encapsulation

The choice between silicone encapsulation and metal encapsulation depends primarily on the environment in which the load cell will be used. If the aluminium or stainless steel load cell is to be used primarily in dry applications encapsulated by a housing, or if the influence of moisture plays a subordinate role, silicone encapsulation is sufficient.

However, silicone has the disadvantage of being permeable to water vapour. Most carrier foils (such as those made of acrylic resin, epoxy resin, phenolic resin, polyamide) are hygroscopic, as are some adhesives used. The carrier film swells when it absorbs water, which results in stretching and thus causes a measurement error.

One way to improve this is therefore to encapsulate the strain gauges metallically. This can be implemented in the area of the parallelogram links or with an additional deformation body. Encapsulated stainless steel cells are predestined for environmental conditions with high demands on the degree of protection up to IP69 and aggressive media. The foil of the strain gauges is completely encapsulated in metal, which means that humidity has no influence on the measurement result. The connection cables are usually connected by means of a glass feed-through in order to meet the requirement for hermetic sealing.

Application areas of single point load cells

Single point load cells are used in a variety of devices. The most common applications are in dynamic or static checkweighers, which are used in the food industry for classic tasks such as checkweighing.

Single point load cells, for example, are the basis for platform scales of all kinds, from smaller table scales to floor scales with a size of up to 800 x 800 mm. They consist of a base plate on which the load cell is screwed and a load plate with which the load cell is mounted on the load side. Advantageously, the load cell is centrally located, ideally the centre of the load plate is in the centre of the load cell to keep the occurring moments symmetrical. Together with the right weighing electronics, platform scales offer highly accurate results for manual and automatic weighing processes.

A dynamic checkweigher, also called a checkweigher or in-line checkweigher, unlike the scales described above, has no load plate but a conveyor belt. The product is weighed as it passes over this conveyor belt. In the production of piece goods, it is used, for example, to monitor, sort (classify) or even influence (weight-wise) the goods according to weight criteria, such as calibration requirements, e.g. by corrective control (tendency controller) of filling machines. Dynamic checkweighers are used, among other things, for 100% control of a product flow to check these products against legal requirements, to create production reports and, if necessary, to eliminate products with incorrect weights. The load cell scans the weight values at a high measuring frequency and takes the measured values of the product shortly before it is transferred to the outgoing conveyor belt to determine the weight.

Multi-talented: Single point load cells in use

Furthermore, single point load cells are used in almost every form of industrial weighing, as the load cells can be easily integrated. Two machines that are particularly used in the food and building materials industries are rotary fillers and belt weighers: With a weigh filler, filling takes place directly into the packaging / container. In other words, it is dosed into the final packaging. The package is placed on a weighing platform, each of which is connected to a load cell. Several of these platforms are arranged in a circle and rotate around the centre of the circle. The filled package is then transported further or the package is placed on a conveyor belt, similar to a checkweigher, and is transported over this conveyor belt in a start/stop cycle. It is also possible that the load cells are arranged in a circle and rotate during filling with the filling heads assigned to each load cell. In this case, the empty packages are introduced below the respective filling head in a circular segment, the filling head is filled above a circular segment and then, for example, after a 270° rotation, the filling head contents are ejected into the package (for example, by opening flaps) so that the package is fed out filled at the end.

Instead of a conveyor belt, belt scales have one or more non-actively driven rollers mounted on a load cell, which are installed in a belt conveyor. The goods, usually bulk material, are conveyed via this belt, which allows the mass flow to be recorded continuously.

In addition to these two applications, there are countless other use cases, such as multihead weighers, differential dosing weighers or in-process weighing, which proves the versatility of the Single Point load cells. "Single Point load cells are the ideal all-rounder: with our portfolio we cover all load levels between 300 grams and 750 kilograms. All load cells are available in protection classes between IP65 and IP69 and are therefore also suitable for use in challenging environmental conditions. We are constantly working on expanding our portfolio in order to live up to our claim of "the true measure" in single point load cells as well," says Product Manager Salzmann, giving a glimpse into the future.

For more information, please visit the manufacturer's website: www.minebea-intec.com.

Images

The central parallelogram ensures that the force on a spatial surface can come from different sides.

Single point load cells are also often used in checkweighers.

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