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How they work

Load Cell design in Process Engineering

The latest developments in technology being used to extend the use of load cells in process engineering applications.



The use of strain gauge based load cells in a wide range of process applications has grown steadily in recent years. Indeed, non-contact load cells are rapidly becoming the preferred choice of sensor in many areas, including weight monitoring, batch control, mixing, dosing and blending of liquids or solids.

Although the fundamental strain gauge principle has remained largely unaltered since this type of product was first used for aircraft weight and balance measurement in the 1930s, the technology employed in the development and volume manufacture of load cells is now extremely advanced. As a result, the latest generation of load cells are easy to install and calibrate, are robust, stable and reliable, even in particularly aggressive or hazardous environments, and are typically accurate to 0.1 per cent or better.

The quality, accuracy and stability of the load cell is, however, only part of the equation. Of perhaps equal significance is the design and installation of the loading assembly, which transfers the load from the vessel being monitored to the sensor itself. This is especially important with larger silos, hoppers and mixing vessels, where greater volume and weight have to be considered.

Made to measure

To date, process, plant and maintenance engineers have either had to produce their own loading assemblies, or source them direct from the load cell supplier, and accept that the loading assembly will probably not have been developed specifically for process weighing.

There are a number of factors that need to be considered when specifying load cells and loading assemblies. In particular, the load cell must be capable of supporting the total load that can be applied, even under adverse conditions caused, for example, by shock, high winds or vibration. Additionally, the loading assembly must provide both lift-off protection - especially in machines where hoppers or buckets are removed for cleaning - and side load protection, to compensate for the expansion and contraction of the vessel being monitored. It must be easy to install, calibrate and replace; and it must be as compact and lightweight as possible, while being sufficiently robust to withstand often lengthy periods of harsh operating conditions where vessels are in exposed sites or being used for aggressive materials.

With most process vessels, it is normal procedure to install a number of load cells. For example, smaller equipment such as sack scales will typically use two load cells, while multi-head fillers or rotary filling machines will utilise six or more cells. It is therefore essential to calibrate and balance the output of each cell correctly.

Developing load cells and loading assemblies that address all of these factors is challenging, both technically and commercially. Nevertheless, we are now seeing the introduction of a new generation of load cells, capable of achieving new and higher levels of accuracy, stability and reliability in many process applications.



Process applications require special properties from weighing systems. These load cells are designed to cope with overloading and side loads.

One of the first of this new generation of products to be introduced is the 220 SiloMount, manufactured by Tedeo Huntleigh. This is based on an hermetically sealed, bending ring load cell, which is constructed from an annular measuring ring to which specially designed strain gauges are bonded. The load is then transmitted to the measuring ring by a central floating load adapter.

This arrangement has a number of advantages, including the elimination of the problems of off-axis loading and side load damage, often found with traditional compression load cells.

Unlike other loading assemblies, the new system is designed to be installed without the load cell, but with the jacking screws locked in place. The cell is only installed once vessel alignments and fabrication work are completed, with the top mount plate being free to move in two planes and then simply lowered 3mm onto the cell once it is correctly positioned.

The loading assembly, with its freely moving top plate, allows thermal expansion and contraction of the vessel to be compensated, while the floating load adapter, with a roller pin and saddle arrangement, enables the load cell easily to be oriented to match any rotation of the vessel. To simplify calibration, especially where multiple cells are used on large silos with unevenly distributed contents, the system has matched current outputs, ensuring that the output per unit load remains consistent, regardless of load distribution. Compared with traditional trimmed resistors, this is a more effective and reliable method of calibration.

Although the latest load cells require a degree of care, they are far more robust and capable of dealing with the rigours of most process applications than has previously been the case. For example, overload capacities are now up to three times the rated load. The design of low profile cell and loading assemblies help to overcome operating stresses, with factors such as off-axis loading of up to four degrees from the vertical being acceptable without affecting overall performance or accuracy.

From an article by John Goodson of Tedeo Huntleigh Europe

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