POST-EXPO 2009
EXHIBITOR

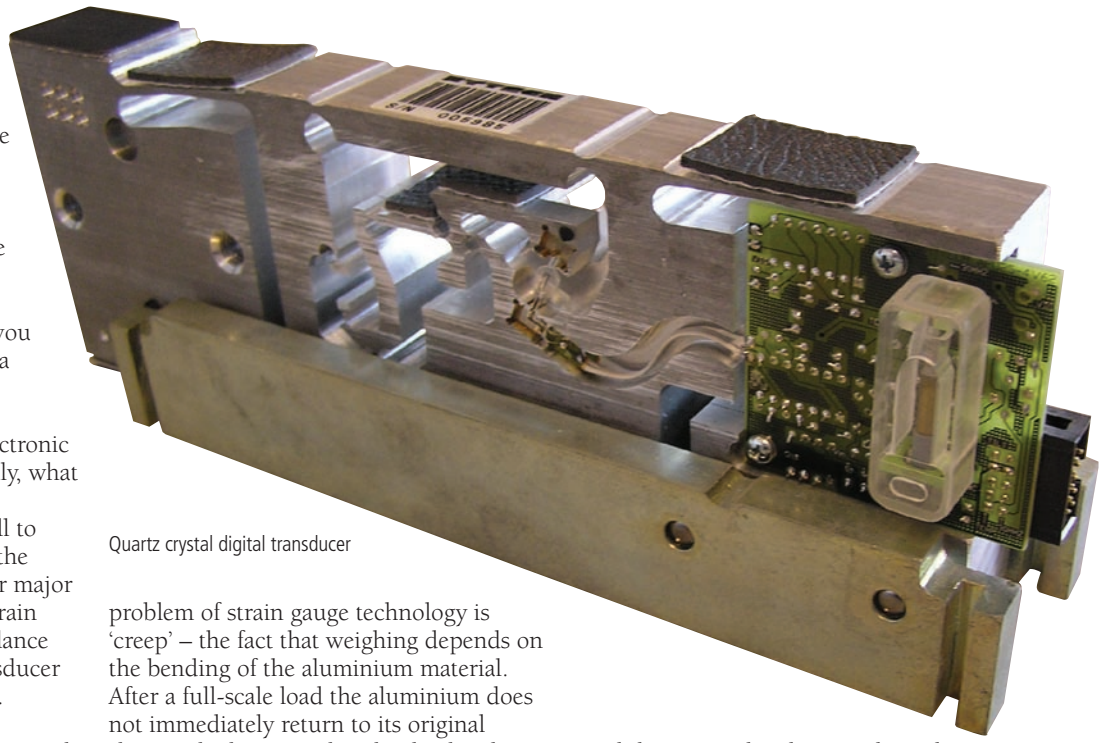
WEIGHTY CONSIDERATIONS

Buying a scale means weighing performance, price, initial installation cost and on-going cost of ownership

The most important price-defining parameter in the postal industry is weight. This has been the case ever since the General Postal Union was created, joining the first 21 signatory states to form a single territory for postal regulation. The Union introduced fixed regulations and uniform fees that are based on the weight of the letter or parcel as well as its destination. Wherever you go, there's one thing you can be sure of: every post office has a weighing scale.

But what's inside a scale? What technologies are in use in today's electronic weighing scales and more importantly, what are the pros and the cons?

All electronic scales use a load cell to accurately measure the weight. It is the heart of a weighing instrument. Four major load cell technologies are in use – strain gauge transducer, magnetic force balance transducer, resonant frequency transducer and quartz crystal digital transducer.



Quartz crystal digital transducer

Strain gauge A strain gauge is a thin metal film that changes its resistance in response to mechanical stretching (strain). In most scales using this technology four strain gauges are glued to an aluminium body, which bends slightly as a load is applied to the scale. Two gauges are arranged on one side of the aluminium so that they are stretched by the applied load while the other two are positioned on the other side of the aluminium and are therefore compressed by the load. The four strain-gauge resistances are connected into a bridge circuit that must be exited by a stable and accurately known voltage source. The bridge in turn outputs a much smaller differential voltage, which is approximately proportional to the ratio of the strain gauge resistances and therefore the applied load.

It is this difference voltage that is first amplified, then converted from an analogue to a digital signal, and finally translated to the weight on the display. The biggest problem of strain gauge technology is 'creep' – the fact that weighing depends on the bending of the aluminium material. After a full-scale load the aluminium does not immediately return to its original shape, which means that the display does not return to zero immediately.

Setting it back to zero via a switch or software is quite often used as a workaround, but in some circumstances this can actually result in a negative weight being displayed. For less accurate demands this problem is generally compensated for by a lower price. A compact design and easy adaptation to quite high maximum capacities are the advantages of strain-gauge technology.

Magnetic force transducer In this system a magnetic field generated by an electrical current is used to compensate for the force on the weighing pan. As a result the pan does not move when weight is applied, and instead the current is increased to keep the pan in its original position, continuously regulated by a position sensor and servo amplifier. An analogue-to-digital converter measures the actual current that is needed, and this is translated to weight and then displayed.

As the magnetic field has to carry the full weight, a high current is needed. This means that a long warm-up time is required and temperature effects can cause inaccurate measuring results. In order to minimise this a lower current is preferred, but that means transmitting the force through a system of levers, guides and mechanical adjustments. Creep is not really an issue with this technique, but mechanical adjustments and temperature sensitivity are significant disadvantages. The fact that it needs regular maintenance, and it's relatively high pricing, does not make this a very popular technology.

Resonance frequency transducer Another technique is to measure the change in resonance frequency of a vibrating material, such as wire or quartz crystal, while a tension or compression is applied.

The resulting resonant frequency change is related to the applied force through an approximately square-law relationship.

There are a few manufactures that use this technique – but to measure the bending of the aluminium body material of the load cell, just as for the standard strain-gauge load cell. Since this technology is still based on the bending of the aluminium it is just as sensitive to creep as the strain-gauge technology it was developed from. Although use of a quartz crystal provides a worthwhile improvement over vibrating wires, it remains a technology that is hardly any better than the plain old strain gauge.

Quartz crystal digital transducer This is the most sophisticated technology and combines high-resolution weighing, a very competitive price and zero cost of ownership. Similar to the resonant frequency transducer, this technique is based on measuring a quartz crystal's frequency change when subjected to a force placing the crystal in tension. However the force is applied directly to the quartz without relying on the bending of other materials such as aluminium. With no moving parts there is no fatigue and need for adjustment or maintenance and no recalibration is needed.

When used under normal circumstances the load cell never changes mechanically. As all compensations are stored in its inbuilt non-volatile memory and calculated by its inbuilt processor, it is prepared for all circumstances without any need for adjustment, and because it does not measure the change in force on the metal body, there is almost no creep in the quartz crystal digital transducer – it is generally less than 0.00015 percent.

Ultra-low creep means fast, exact and repeatable weighing results, making this technology most suitable for postal operators. The weighing scale immediately returns to zero, which means that right after weighing a 30kg parcel an envelope of only 10g can be weighed accurately. The quartz crystal digital transducer also does all its signal processing digitally, so there is no analogue-to-digital converter and none of the adjustments that would entail. The measurement remains digital from quartz to display.

As well as giving excellent performance this also means that the hardware design around the load cell can be very simple, with fewer components and cables, resulting in higher reliability of the entire weighing instrument. The inbuilt processor and firmware support temperature and angular tilt compensation, eliminating the necessity for exact horizontal placement and a stable thermal environment. The very low power consumption also enhances reliability and enables battery operation – making the quartz crystal digital transducer the greenest technology of all.

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