Load cell Guide

EXCELLENCE IN LOAD CELLS

LOAD CELL SELECTION

Selecting the correct type and size of load cells has a major impact on the performance and long term reliability of any weighing system or scale.

This bulletin is intended to guide the user through the selection process.

The first task is to understand fundamental weighing principles which are outlined at the end of this document.

For a particular application the user has to make an informed choice about which load cell to use, taking into account:

- Method of supporting the weighing structure or platform.
- Operating environment.
- Required performance.
- Cost.

After preliminary consideration has been given to these points, decisions then need to be made regarding:

- Number of load cells.
- Capacity for each load cell.
- Accuracy level required.
- Necessary approvals (legal for trade, hazardous areas etc).
- Mounting method.
- Protection against overload, side load and impact shocks.

A particular type of application will often determine which basic type of load cell is best suited. Although there appear to be many different types of load cells, essentially they work on four main principles:

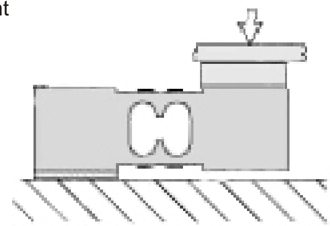
- Bending
- Shear
- Column Compression (or tension)
- Torsion bending ring

The main families of load cells are:

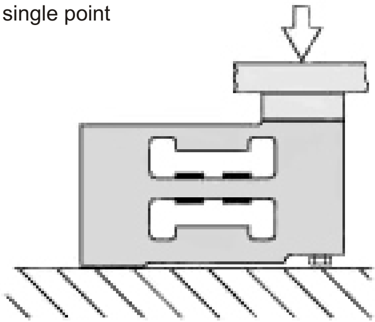
TYPE		OPERATION
Single points(low capacity)	–	Bending
(high capacity)	–	Bending and shear
Single ended beams	–	Bending and shear
S beams	–	Bending and shear
Double ended beams	–	Shear
Canisters	–	Compression
	–	Bending
	–	Torsion

Load cells operate in one of two ways -loads either sit on or hang from them. The load cell either operates as a cantilever where the applied load is at some defined distance from the main mounting point or in tension/compression where the load is applied axially through the load cell.

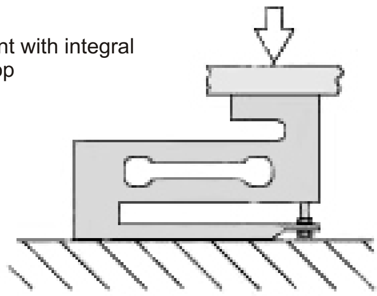
Dual cantilever single point



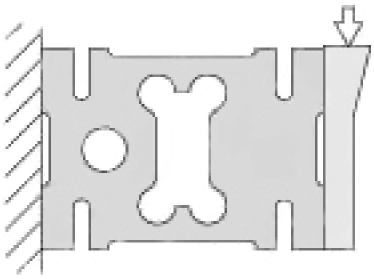
Triple cantilever beam single point



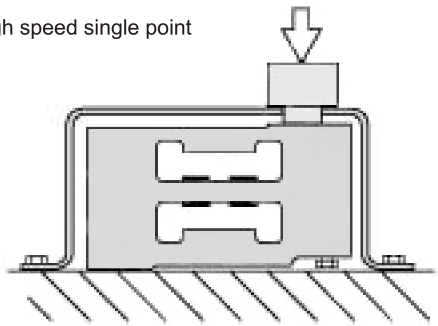
Dual cantilever single point with integral bi-directional overload stop



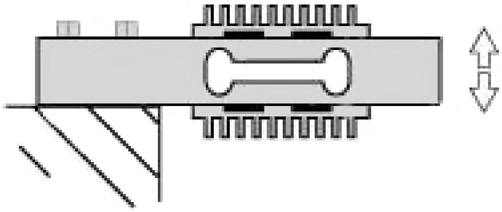
High capacity end fixing single point



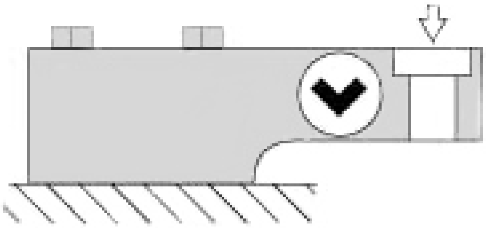
Viscous damped high speed single point



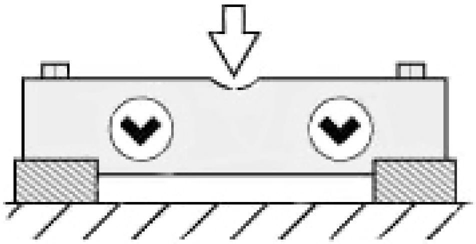
Dual cantilever bending beam



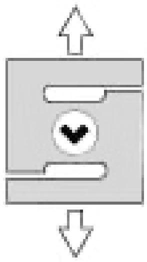
Single ended shear beam



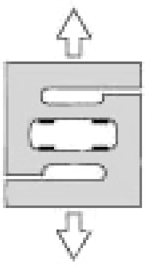
Double ended shear beamDouble ended shear beam



Tension/Compression

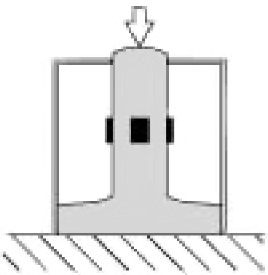


S Type shear beam

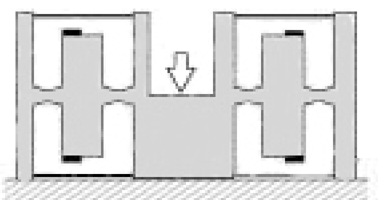


S Type bending beam

Compression canister



Bending ring cell



Load cell types can be generalised as follows:

CAPACITY RANGE	MODE OF OPERATION
Low-medium capacity (up to 500 kg)	- Bending
Medium capacity (500-5000 kg)	- Shear
Medium-high capacity (5000-100,000 kg)	- Double ended shear
	- Compression
	- Bending ring
Very high capacity >100,000 kg	- Compression

SINGLE POINT

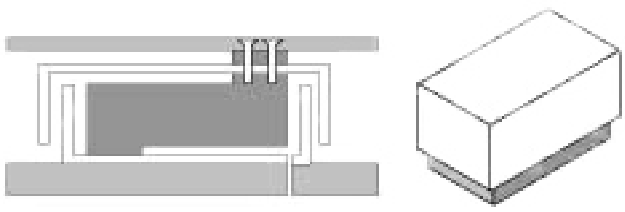
The single point centre cell or moment insensitive load cell has now become well established in a wide range of commercial and industrial applications. This type of load cell, which is typically constructed from high grade aluminium, has revolutionised the small platform and retail scale market. Advances in design, capacity range and enhanced sealing have allowed the product to become increasingly used in industrial environments. Such products offer simplicity in design, high performance and low cost.

Most single point load cells work on the bending beam principle. The sensor body is designed to resist torsion caused by loads applied away from the centre line. During manufacture each individual single point load cell is mechanically compensated by file-adjusting the integral flexures.

As a result, platforms and weighing structures can be fixed directly to a single load cell and accurate weighing can be maintained wherever the load is placed within the platform limits This unique design concept removes the need for cumbersome levers and flexures thus dramatically simplifying the mechanical design criteria.

ENVIRONMENTAL PROTECTION

Certain Tedea-Huntleigh single point load cells can be supplied with additional protection up to IP67. However, if diverse conditions such as wash down or spillage are possible then additional protection should be provided by the user as shown below. Such labyrinth seals can be highly effective but it is important that adequate drainage is incorporated to prevent build up of liquids around the load cell.
The model 1510, which is available in capacities of 100, 250 and 500 kg, offers sealing to IP68. This stainless steel load cell is fully welded, making it ideal for use in the harshest of environments.

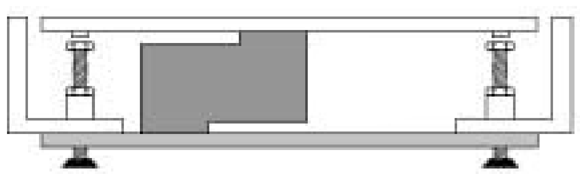


OVERLOAD PROTECTION

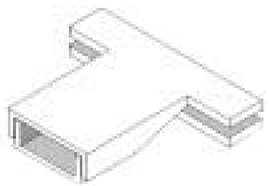
Although single point load cells provide a simple solution for many applications, it is important to incorporate adequate protection against overload or misuse. Many single points incorporate a built-in overload stop on the front end of the load cell but as a general guideline this should be used in conjunction with additional external overload protection. The typical deflection of single point load cells at rated capacity is <0.4mm. The overload stops should be set so that they come into operation around 10% above the maximum normal operating capacity of the scale or weighing system. Note that this may be considerably lower than the load cell capacity.

In addition to these positive overload stops, it is also important to provide lift-off underload protection especially in cases where the scale may be lifted by its top platform or in machines where hoppers or buckets are removed for cleaning or maintenance. Remember that lift-off stops can normally be set at about 20% scale capacity or less. For high shock applications, it is possible to design in a spring protection system using either conventional springs or Belville type disc springs. Here the loading platform is effectively isolated from the load cell, allowing a relative motion system to operate under conditions of abrupt overload or shock. Further advice on the design of such systems is available on request.

When setting overload stops, care should be exercised so that they do not become traps for small debris or process material. Fine thread form bolts are ideal The user should avoid using tapered end stops which can either readily squash or push into the top part of the scale. Lock nuts should be used to secure the overload stops and provide a firm load path. Each overload system should, ideally, be set on a individual scale basis.
In addition to overload or shock load, side loads can cause significant damage to single point load cells. Where necessary or applicable, side protection should be designed into the scale. Remember that you should not rely on the displacement of the load cell in the design of such protection. This can be achieved in the method shown below.



The side of the base acts as the side load buffer or an additional impact bar can be added.

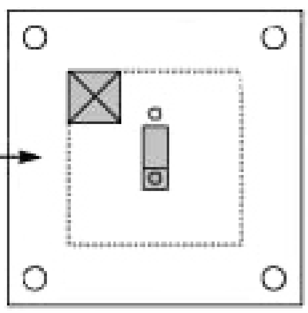


The scale construction, shown left, can provide both mechanical and environmental protection for the oad cell.

PLATFORM SIZE

The individual load cell data sheets provide information on the recommended platform size for each model. Under certain circumstances it may be possible to use larger platform sizes if the product or material to be weighed is light (relative to the capacity of the load cell) yet bulky, eg; long rolls.
In such circumstances the overload stops must be set with the requisite test load placed at the recommended maximum distance from the load cell (as shown below). It is also important to ensure that the platform or similar structure can be adequately and safely secured to the load cell.

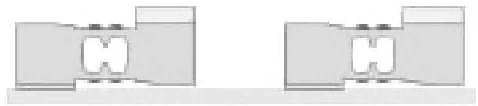
Recommended platform size



INDUSTRIAL APPLICATIONS

Single point load cells can provide useful solutions for industrial weighing systems both used singly and in multiples. The additional use of flexures can provide greater versatility in design.

When using more than one single point load cell, the user must remember to allow any structure above the load cells to move un-hindered to accommodate changes due to temperature or other fluctuations. The use of flexible mounts or one or more sliding surfaces can facilitate this, while still maintaining sufficient system integrity. Under no circumstances should more than one single point load cell be mounted rigidly (at both ends) in a weighing system.



Ensure that load cells face the same direction to avoid opposed reaction forces during loading.

BENDING BEAM LOAD CELL

Bending beam load cells provide a versatile and cost effective solution to many low capacity weighing applications ranging from lever base work scales through to hopper weighing.

The Tedea-Huntleigh 355 welded stainless steel beam load cell sets the industry standard and is available in OIML approved grades as well as hazardous area certified versions.

Based on the dual cantilever principle, the 355 critical areas are weld sealed with a stainless steel bellows which give full protection in the harshest of environments as experienced by equipment such as marine scales, chemical batching scales and food processing systems. To obtain optimum performance it is important that the 355 is mounted correctly and a variety of mounting arrangements and options are available. It is also critical that the bellows do not become damaged during use and additional mechanical protection should be considered where necessary.

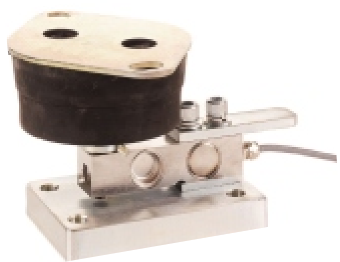
Tedea Huntleigh offer three proprietary mounting assemblies which are designed to facilitate the application of the 355 beam.

CELLMATE

This mounting configuration provides a self-levelling assembly with built-in jacking bolts and limited lift-off protection.
Note that cable entry protection and additional flexible conduit protection is also advisable.

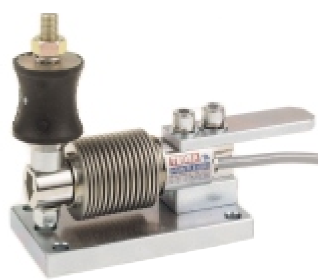
ANTI-VIBRATION MOUNT

This is a useful arrangement for low capacity hoppers and vessels. The deflection of the mount allows external overload stops to be incorporated into the system. The assembly also reduces interference from external vibrations.



BALL AND CUP

This mounting arrangement provides a self levelling facility and limited movement to accommodate thermal expansion.



S BEAM

The S beam load cell provides a very compact and cost effective solution to certain weighing and force measuring applications. Tedea-Huntleigh offers three main products,

Model 601 aluminium s beam
Model 616 stainless steel s beam
Model 620 fully welded stainless steel s beam

The S beam load cell can be used in both tension and compression but is primarily applied to in-line tension applications. It provides a convenient method for weighing small to medium hoppers and tanks up to 5000 kg where three or four load cells are used in the suspension mechanism. When using S beams in such applications, it is important to incorporate additional safety restraints and not rely solely on the integrity of the load cell.

The S beam is also used to convert mechanical scales, where typically, a single load cell is fitted into the final link arm. Such hybrid scale conversions can be carried out quickly and easily, providing a cost effective solution. For legal for trade scale conversions, users should check the relevant requirements. The model 620 meets OIML R60 approval standards as well as being certified for use in hazardous areas.

S beams can be used in compression provided that suitable mounting arrangements are utilised to minimise non-axial loading.

It is possible to use S beams in tension applications where the load cell itself is actually loaded in compression. This arrangement ensures efficient load introduction while giving a high level of system integrity. This method is particularly useful for lifting applications such as crane scales or cable tension monitoring.
The S beam load cell is also used extensively in a wide range of measuring applications which include material testing machines. dynamometers and research. Tedea-Huntleigh are pleased to offer advice and assistance for such applications.

SINGLE ENDED SHEAR BEAM

The single ended shear beam is arguably the most versatile of modern industrial load cells. Tedea-Huntleigh offers three main products;

Model 3410 potted tool steel shear beam
Model 3510 low profile fully welded steel shear beam
Model 343 fully welded stainless steel shear beam

The robust construction of such products makes them ideal for both stand alone scales and vessel weighing. The shear technology provides a very stiff load cell which is not adversely affected by unwanted side forces, end forces and bending moments. The simple rectangular design of shear beams allows critical strain gauge areas to be easily sealed with welded cups. This makes these products ideally suited to weighing applications in harsh environments.

FLOOR SCALES

The single ended shear beam has revolutionised floor scale design. The load cells can be mounted directly to the scale and self levelling feet secured to the other end. To ensure optimum performance, the scale deck must be as rigid as possible to avoid the introduction of unwanted forces.

PROCESS WEIGHING

Welded shear beam load cells are ideal for low to medium capacity vessel weighing especially when used with proprietary mounting hardware. The Tedea-Huntleigh Cellmate mount arrangement provides a complete self contained loading unit. The upper plate is designed to accommodate misalignment in weighing structures and changes due to thermal expansion and contraction.

To prevent installation damage of the load cells the high performance bolts can be used the system allowing the Cellmate to be fitted without the load cell and once any structural adjustments have been made, (welding etc), then the load cells can be fitted just prior to commissioning.

Limited overload protection is also provided with the Cellmate mount.

Our single ended shear beams have CENELEC and FM approval for use in hazardous areas

SUSPENDED VESSEL WEIGHING

Shear beams can readily be used to weigh suspended vessels. The load cells must be securely mounted to the support structure and the vessel suspended by adjustable steel rods. It is important to ensure that these rods are free to self-align and accommodate vessel movement introduced by temperature changes. The use of spherical washers or rod end bearings will facilitate this.

Relative motion overload stops can be incorporated into such mounting methods if that structure allows.

As with any suspended weighing systems, additional safety chains or systems should be incorporated in the design.

OVERHEAD TRACK SCALES

The robust design and high sealing integrity makes the shear beam an ideal choice for overhead track scales where typically two such devices are used to support the live section of the track.

DOUBLE ENDED SHEAR BEAM

Single ended shear beams are ideal up to 5000 kg capacity. However above this, the cantilever forces exerted on the fixing bolts and mounting plate require a substantial increase in load cell size and strength. A more efficient and compact solution is the double ended shear beam. Typically the load cell is mounted at each end and then loaded through the centre using a specially designed mounting plate. Such load cells are now well established as a practical solution for tank and silo weighing.

The 4158 load cell comes as a complete self contained loading assembly which provides a simple mechanical link between the vessel and the ground or support structure. Such designs accommodate structure misalignment and allow sufficient movement for thermal expansion.

BENDING RING COMPRESSION CELL

The 220 bending ring load cell represents a new concept in load cell design which provides an extremely compact and cost effective solution for high capacity vessel weighing and weighbridges (truck scales).

These cells are low profile and easy to mount, thus providing a low cost answer to high capacity weighing applications. The fully welded stainless steel construction provides optimum protection for the harshest environments. To minimise time consuming corner correction procedures the 220 has current matched outputs. The high output impedance and CENELEC intrinsic safety certification mean that the 220 can be used in all hazardous areas.

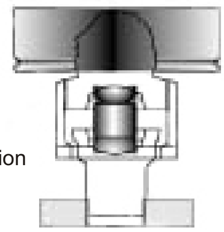
Tedea-Huntleigh provides complete loading assemblies for the 220 for a variety of applications. These self-aligning assemblies ensure optimum load introduction whilst also providing complete system integrity.

The SiloMount is the ideal choice for vessel weighing. The unit provides some protection against side loads and prevents lift-off for outdoor vessels. The assembly has built-in bolts which can be used to support the assembly allowing fitting without the load cell prior to commissioning. Once all levelling procedures and final welding welding has been carried out,

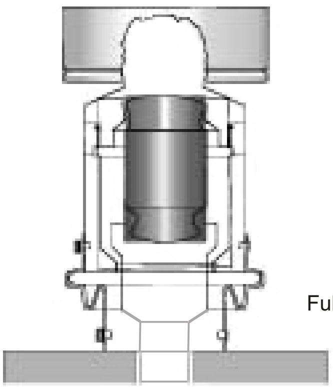
the load cell can be fitted and the bolts released.

The 220 stainless steel scale foot mounting assemblies are available in 5 and 10 tonne capacities and have been specifically designed for heavy duty industrial platforms, especially those that operate in harsh wash down environments. Two models are available, a standard, adjustable version and a fully sealed version which is ideal for slaughter house scales and pit mounted axle weighers.

Full details of their application are available on request.



Standard version



Fully sealed version

Details of 220 mounting assemblies for weighbridge applications are available on request.

CHOOSING THE RIGHT CAPACITY LOAD CELL

This is often a confusing issue for many users but common sense and simple mechanical understanding can greatly simplify matters.

A number of factors should be taken into consideration. The final choice will often be a trade-off between any necessary overload protection, performance and available standard capacities.

First and foremost, the load cells in a particular system must be capable of supporting the total load that can be applied under both normal and adverse conditions. (Overload, shock, wind etc.)

Secondly, the individual load cell assemblies should be capable of withstanding the maximum load that can be applied individually to them under abnormal conditions, especially if no overload stops are provided.

Thirdly, the load cells must provide sufficient electrical output to ensure a workable system.

TOTAL APPLIED LOAD

This is the sum of the weight of the weighing structure itself (dead load) and the maximum live load.

The maximum live load may be higher than the normal operating capacity of the system and takes into account the situation where overload may occur (over filling etc).

The required capacity for each load cell can be derived from the following equation:

$$\text{load cell capacity } C = \frac{1}{k} \times \frac{(\text{dead load + maximum live load})}{(\text{number of load cells})}$$

K is a loading constant which takes into account such factors as load distribution, overload, wind load, and seismic load. It has typical values lying between 0.1 and 0.7.

APPLICATION		NUMBER OF LOAD CELLS	TYPICAL K VALUE
BENCH SCALE		1	0.5-0.7
FLOOR SCALE	light duty	4	0.5-0.7
	heavy duty	4	0.3-0.4
WEIGHBRIDGE		4-8	0.2-0.4
SILO / TANK INDOORS		3-4	0.7-0.9
OUTDOORS		3-4	0.4-0.6
FILLING MACHINE		1	0.1-0.3

Once C has been calculated then the actual capacity is chosen from the nearest available capacities for the particular load cell. (Choose the next highest available capacity). All the load cells in a system should be of the same type and capacity.

After this preliminary calculation, consideration must be given to the output per unit load change that occurs in the given system.

OUTPUT PER UNIT LOAD

Output per unit load is a vital factor in any weighing system and is defined as the change in electrical output from the load cells for the minimum weight change that is to be measured. This output must be large enough to be measured accurately by the instrument and sufficiently larger than any back ground interference or other source of error.

UTILIZATION FACTOR AND V MIN

Load cells are rarely used to their full capacity, especially in multiple cell applications.

This is due in part to the availability of specific capacities and the requirements to build in safety factors for uneven load distribution, overload and misuse.

Typically a 5000 kg scale may be designed to use 4 x 5000 kg load cells or 4 x 2000 kg cells. If 4 x 5000 kg cells are used then it is easy to see that when the scale is evenly loaded with 5000 kg then each load cell only supports:

$$\frac{5000\text{ kg}}{4} \quad \text{or} \quad 1250\text{ kg}$$

Another way of interpreting this is that each load cell is being used or utilized to 25% of its rated capacity. If this is the case, then any performance characteristics for the individual load cells must apply for this 25% working range. Note that this 25% may, for example, be from 15-40% or 25-50% of the actual working range depending on the dead load.

Although certain load cell parameters improve when a smaller range is used, zero temperature coefficient (zero Tc) is a fixed error and therefore becomes relatively larger as less of the full range of the load cell is used.

Therefore there must be tighter tolerances set on this parameter for load cells with low utilization factors.

Approved load cells for use in legal for trade applications are tested and certified with this in mind. Approval is given in terms of a maximum number of verification intervals nmax and a minimum verification interval Vmin (usually stated in kg).

The minimum permitted utilization factor is calculated from:

$$U(\%) = n_{max} \times \frac{v_{min}}{\text{load cell capacity}} \times 100$$

or

$$U(\%) = \frac{n_{max}\text{ scale}}{n_{max}\text{ load cell}} \times 100$$

The relationship between Vmin for the individual load cells and the allowable scale interval d is given by:

$$v_{min} \quad \frac{\text{scale division d}}{\sqrt{\text{number of load cells N}}}$$

Example 1

Consider a 10000 kg batching vessel with a dead load of 4000 kg indoors supported on four load cells.

$$\text{load cell capacity C} = \frac{1}{k} \times \frac{(4000+10000)}{4}$$

if k = 0.7

$$C = \frac{14000}{2.8} = 5000\text{kg}$$

Therefore if the vessel is supported on 4 x 5000 kg load cells each with an output of 2mV/V, the total change in electrical output from empty to full (assuming 10V excitation) is given by:

$$\text{Output E} = \frac{14000}{4 \times 5000} \times 2 \times 10$$

$$= 14\text{mV or } 14000\ \mu\text{v}$$

This is the total change in electrical output which is generated from an empty to full vessel and equates to a change of 1µv per kg change in load. In other words, if we wanted to resolve our system to 5 kg (1 part in 2000) we would get an output per unit load change of 5 µv or for 2 kg resolution (1 part in 5000), 2 µv change.

2µv resolution is typically sufficient for modern instrumentation but in order to assess the overall performance the user may need to take other factors into consideration.

Example 2

Consider an industrial duty 3000 kg x 1 kg floor scale with a dead load of 300 kg utilizing 4 load cells (2mV/V):

$$\text{Individual capacity C} = \frac{1}{k} \times \frac{(300+3000)}{4}$$

when k = 0.4

C = 2000kg

$$\text{Output E} = \frac{3000}{4 \times 2000} \times 2 \times 10$$

$$= 7.5\text{mV or } 7500\ \mu\text{v}$$

For the required resolution of 1 kg (3000 divisions), our output per unit load change :

$$= \frac{7500}{3000} = 2.5\ \mu\text{v.}$$

In this case, the instrument needs to be capable of accurately resolving a minimum of 2.5 µv.

NUMBER OF LOAD CELLS

The three main considerations in deciding the number of load cells for an application are :

- Mechanical configuration
- System integrity
- Required performance
- Cost

In many cases the number of support points for a system will determine how many load cells are used. A four legged silo will usually be mounted on four load cells.

Number of Load Cells		
1	• Single point platforms • Crane scales • Electromechanical conversion • In-line check weigher • Belt scale	• Dynamometer • Lever base works scale • Loss in weight feeder • Force measurement • Small hopper scale
2	• Sack filler • Overhead track scale	• Check weigher
3	• Belt scale • Silo weighing • Hopper scale	• Small hopper scale • Batching scale • Reactor vessel
4	• Loss in weight feeder • Silo weighing • Batching scale • Hopper scale •Conveyor scale	• Axle weigher • On board truck weighing • Rail scale • Truck scale • Floor scale
6+	• Truck scale • Conveyor scale	• Multi-head filler • Rotary filling machines

3 OR 4 LOAD CELLS ?

If the structure can accommodate either combination then the requirements and location of the weighing system must also be considered. From a mechanical point of view, it is advantageous to support the vessel on three load cells. Load distribution will always be divided between the three cells and no 'rocking' will occur. If four support points are used then great care must be exercised to ensure that the load is distributed evenly on all four load cells. One load cell will tend not to see as much load and levelling shims must be fitted between the vessel support and the top of the loading assembly. This is achieved by measuring the individual mV readings for each cell when the vessel is empty and shimming to equalise the readings-(typically within 0.5-1mV is sufficient). Ideally this should be carried out after the vessel has been fully loaded and then emptied although in many cases this may not be practical.

Three load cells are ideal for applications where the vessel is not likely to be subjected to external tipping forces, (as experienced by outdoor tall vessels where the C of G of the loaded vessel is significantly above the loading points). A four support system is more secure for such applications and approximately 30% more stable.

Note; for certain applications (such as tall skirted silos) it may be possible to use more than four load cells for added stability. Additional attention should be given to the levelling procedure as described above.

USING LOAD CELLS AND PIVOTS

Under certain circumstances, it can be cost effective to use a combination of live load cells and pivot points (or flexures). In this situation, the live load cells see part of the full load, proportional to the distance of the C of G of the weighing system from the live load cells. However, caution must be exercised. This method is only reliable if the material being weighed is sufficiently free flowing so that the C of G of the system does not change during operation. This typically applies to liquids and free flowing powders and pellets.
Normal combinations are two pivots and one live load cell or two pivots and two live load cells. The pivots must be designed so that they allow the vessel to apply load to the live load cells freely and un-hindered over the full weighing range. Significant errors can occur if weighing is carried out under changing conditions ie; the load distribution can vary as the vessel being weighed is subjected to side forces caused by wind.

PLATFORM SCALES

For platform scales, the size and capacity will usually determine how many load cells are used. Single point load cells are cost effective for scales up to 300 kg with platform sizes of 600 x 600 mm. Above this, scales are usually based on four load cells or a single load cell in combination with flexures or levers.
However, the model 1320 single point has been specifically designed for scales up to 1500kg with platform sizes up to 1200 x 1200 mm.

Advice on using this load cell is available from our Engineering Department.

WEIGHING PRINCIPLES

However sophisticated or simple a weighing system may be in terms of electronics and functionality, the overall performance of the system relies totally on the reliability and repeatability of the weight data received from the load cells. Although certain corrective compensation procedures can be carried out by the electronics, this can only be effective if the signal received is highly repeatable and stable.

As a result, good design considerations are of paramount importance to achieve and maintain accurate weighing. The way in which systems are used can have a significant effect on weighing performance. Therefore, before selecting load cells for a particular application it is useful to understand and appreciate the different weighing operations.

SIMPLE PRODUCT WEIGHING

This is usually carried out on a stand alone scale and may involve weighing products from bank notes to bananas, from tinned fruit to trucks.

Typically, in such applications, the product to be weighed spends a short time on the scale which starts at 'zero' and returns to 'zero' within no more than a few minutes or less.

The weighing purpose may be simply to establish how much product there is, or to use the weighing data to compute price or quantity, as With retail or counting scales.

A zero tracking facility will usually ensure the scale returns to zero after the weighment has been made.

INVENTORY WEIGHING

This is usually carried out in storage vessels, tanks or silos. Although the overall required accuracy may be relatively low (typically 0.1-0.25%) such systems require load cells which offer very good long term stability.

Once such vessels are commissioned and calibrated, they may not go back to a reference 'zero' or empty condition until the next routine calibration.
Any unwanted change in load cells output will manifest itself as an apparent weight change which will not necessarily be detected.

BATCH WEIGHING

This can be divided into two main types:

a) **ADDITIVE WEIGHING**

This usually takes place in a mixing vessel supported on load cells. Batch ingredients are fed individually into the vessel via pipes, screw feeders or conveyors. The overall control system meters the amount of each material based on weight data from the mixing vessel. It is usual to zero out or tare the weighing system after each ingredient has been added. This method provides a high accuracy system because weighing is actually carried out over a relatively short period under steady state conditions from a known starting point. Individual batch ingredients can usually be weighed out to a higher accuracy than the overall system accuracy, but such batch sizes are ultimately governed by the overall vessel capacity. Note that it is difficult to add individual ingredients with a weight of less than 1 or 2% of the overall system capacity with sufficient accuracy. In this situation, small amounts of ingredients have to be weighed out separately and 'hand' added.

b) **LOSS IN WEIGHT**

In this type of batching, individual ingredients are weighed out into a mixing vessel from a number of individual weighers. This method allows for simultaneous addition of materials and ingredient weights are governed by the individual capacities of the weigh feeders, not the overall capacity of the mixing vessel, thus allowing addition of very small amounts.

The accuracy with which product is added to a vessel will depend on the precision and sophistication of the pump or feed system as well as the accuracy of the weighing system.

Once the feed mechanism has been switched off there will be a certain amount of material in free space which up until now has not been weighed. This 'material in flight' will manifest itself as an increase in the displayed weight.

In repetitive filling, a closed loop feed back system compensates for this by re-adjusting the next fill based on the previous result.

DYNAMIC WEIGHING

This covers applications such as belt weighing, high speed check weighing, in motion axle weighing, filling and packing. In these applications, the actual mass being weighed may spend only fractions of a second on or in the weighing system. As a result, such a system must have extremely fast response and settling times. Using the correct load cell, mechanical design and electronic filtering can ensure accurate results for speeds up to 500 weighments per minute (a response time of approximately 120 milliseconds).

Rotary filling machines require special consideration to compensate for centrifugal forces and vibration.
Tedea-Huntleigh specialises in load cells which have been specifically developed for a diverse range of dynamic weighing applications.

Further information is given in Technical Bulletin No 005 which is available on request.

SHIFT OR DRIFT

These two terms are often mixed up. Output drift is normally associated with slow changes in load cell output over time, caused by factors such as temperature changes and physical changes within the load cell.

Shift refers to rapid step changes in load cell output caused by factors which include shock load and other mechanical damage. Such changes may be progressive and therefore misinterpreted as drift.

Good mechanical design and controlled operational conditions can usually eliminate the problems of shift, whereas drift problems are a function of the load cell.

Note: Drift may also be a function of any associated electronics within the weighing systems.

CERTIFICATION

LEGAL FOR TRADE

Tedea-Huntleigh provide load cells which meet both national and international requirements for legal metrology.

Most countries now adopt OIML (Organisation Internationale de Métrologie Légale) requirements for load cells and weighing equipment. (Load cells are covered under International Recommendation R60)

In the USA load cells are certified under the National Type Evaluation Program (NTEP) which is a cooperation between the National Conference on Weights and Measures (NCWM), the National Institute for Standards and Technology (NIST), State Weights and Measures officials and private industry.

HAZARDOUS AREA CERTIFICATION

Load cells for use in designated hazardous areas are required to meet stringent legislation.

In Europe, such requirements are clearly laid down by CENELEC (European Committee for Electrotechnical Standardisation) in the EC is directive 94/9/EC. It is commonly known as Atex Directive.

In the USA, products must meet standards laid down by the National Fire Protection Agency (NFPA) and tested by Factory Mutual Research Corporation (FM) or Underwriters Laboratories Inc. (UL).

Note; Although there is growing cooperation between bodies such as NIST and OIML; FM and CENELEC, no direct harmonisation of standards currently exists.

SEALING LEVELS

There are no formal accepted environmental protection standards for load cells and in the absence of these, the majority of load cell manufacturers have adopted either the IP (International Protection) or, in the US, NEMA (National Electrical Manufacturers Association) classifications for their products. Although these standards are well defined, they are intended to define the sealing of electrical enclosures and load cells can only be loosely defined as such. However, the ratings given by the standards do help to differentiate between different products.

At Tedea-Huntleigh, we carry out extensive long term humidity cycling tests at elevated temperatures to ensure that our products exceed these sealing standard classifications.

IP System is defined in BSEN 60529: 1992

Essentially, the IP system uses two numbers to classify products, The first number defines the sealing integrity related to the penetration of solid objects, ranging from 0 no protection up to 6 for dust particles. The second number, ranging form 0-8, relates to the ingress of water.

Industrial load cells are usually classified as IP66, IP67 or IP68. IP66 denotes protection against direct hosing, IP67 allows for immersion while IP68 allows submersion.

NEMA

Classifications in the NEMA system run from NEMA1 to NEMA13 and load cells are usually classified as NEMA4 or NEMA6.
Unlike the IP system NEMA does deal with environmental conditions such as corrosion, rust, icing, oil and coolants
.
NEMA4 products are intended for indoor and outdoor use and provide protection against wind blown dust and rain as well as washdown.
NEMA6 products are used where there is chance of temporary immersion.

Full details of our approvals are available on request.

The information in this bulletin is intended as a guide only and, where appropriate, expert engineering advice should be sought when designing weighing systems.

This technical bulletin is one of a series of publications designed to help ensure that you obtain optimum performance and integrity from our extensive range of products.

For further information on available documents please contact your nearest sales department.

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