LOAD CELL MOUNTING AND INSTALLATION BEST PRACTICES

While selecting the appropriate load cell model for an application is important, if the load cell is not properly mounted and installed, its output measurements could be useless. Properly installing a load cell is critical to obtaining high-quality, accurate readings. Proper installation also guarantees ease of use, and safe operations.

This article will give helpful load cell installation tips but is not intended to be an installation guide. For best results always follow the manufacturer's installation instructions, ensure that installers are properly trained prior to any installation attempts, and if questions or concerns arise, contact Tacuna Systems immediately.

THE RIGHT FRAME AND FIXTURE

Every load cell is designed for a different environment, set of conditions, and mechanical orientation. Setting up the proper fixture and frame is critical to maximize load cell performance and maintain safe operating conditions.

The fixture should be designed to minimize unintended inputs from the surrounding environment. Vibrations, thermal expansion, mechanical deformation, and stray electrical current can cause false readings and damage to or failure of the load cell.

An optimal frame design should maximize stiffness but minimize weight and costs. The frame is required to be sturdy enough to support the maximum weight capacity and rigid enough to withstand deformation and flexing. This also means the supporting features to the structure should be rigid, ultimately mitigating vibration issues.

THE RIGHT FRAME AND FIXTURE

Vibrations affecting the fixture can be introduced by a variety of sources, including compressors, pumps, actuators, and engines. Any of these can lead to inaccuracies in the load cell measurements. Additionally, ground vibrations from seismic activity can skew measurement results.

Securing the frame to a hard flat surface will reduce vibrations from passing vehicles and local equipment. This will also prevent component and hardware failure that could cause personal injury or damage to surrounding equipment.

If possible, turn off vibrating or rotating equipment during measurement taking and calibration of load cells. If equipment cannot be turned off, select load cells that compensate for dynamic loading.

ALIGNING LOADS IN THE PROPER DIRECTION

Ideally, all of the load, or weight, will be transmitted through the load cell. Failure to set up the fixture in this way will cause inaccurate "force shunts" that interfere with measurements.

A force shunt is any device or path in which a portion of the force or load flows through. While this term is typically used in electrical systems, the concept remains true for the "flow" of force. The force being considered is mechanical, and can be created by a physical load, weight, or pressure.

If the force is not shunted through the load cell, it cannot capture the correct measurement. Avoiding erroneous force shunts is especially useful for weighed objects such as tanks, platforms, or scales.

For a more in-depth explanation of force shunts, see the article on force shunts.

Load cells should be placed at all corners of the supporting structure to maintain the full weight or load. While some manufacturers recommend placing "dummy" cells on supports and deriving the total load, dummy cells can prevent proper calibration. When using load cells under structural supports, always arrange in symmetrical, level orientations.

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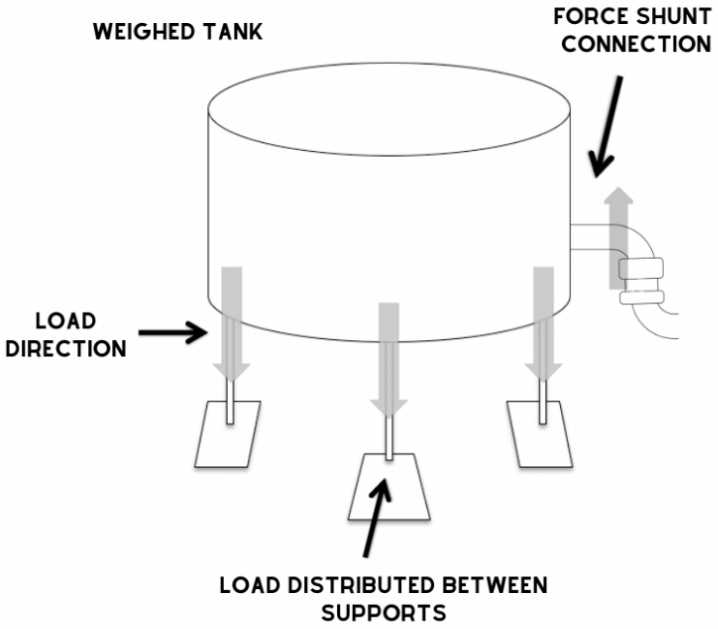
If there are attachments to the measured fixture due to process connections, (i.e., piping, hosing, ducts) they should remain flexible to reduce force shunting. Small diameter piping, or long segments without significant supporting structures, can also cause significant force shunting. If possible, use larger diameter connections at all times. Connect piping with hoses or accordion tubing for best results.



ALIGNING LOADS IN THE PROPER DIRECTION

Ladders, pipes, rods, and catwalks can all improperly load, or shunt, a portion of the measured structure. These should either be removed when measuring, or should otherwise be compensated for.

Safety features that create force shunts should still be utilized. Flexible structures such as cables or chains will help reduce force shunts and guarantee high levels of safety for operators.

ENVIRONMENTAL FACTORS AFFECTING LOAD CELLS FIXTURES

Every load cell will perform differently depending on the environment. It is important to know what factors a load cell and fixture will be subjected to before installation. The load cell application should be kept in a controlled environment, and, when possible, devices should be operated indoors to reduce these environmental effects.

However, operating load cells fixtures indoors is not always feasible, so keep in mind how temperature, wind, precipitation, sunlight, humidity, electrical systems, and ground conditions will affect load cell devices and their measurements.

TEMPERATURE

If ambient temperatures where devices will operate fluctuate, use load cells that are temperature compensated. This information is found on the model datasheet. Uncompensated devices will behave poorly at extreme temperatures, so it is important to cover them from radiant heat and cooling systems. Implementing a shield or insulation can provide protection from extreme temperatures.

MOISTURE

If the operating environment will be exposed to moisture or precipitation, discuss how well the load cell performs and compensates for moisture with the manufacturer. Moisture can lead to shorting in the electrical current, causing errors in measurements and often damage the load cell.

Take precautions to avoid corrosion of both the load cell device and the mount, and inspect them frequently. Some steps include using non-corrosive metals such as aluminum and stainless steel when the device will be exposed to moisture, and keeping the load cell and surrounding surfaces dry. Also check for cracks caused by corrosion pitting that could lead to damage to the load cell and equipment failure.

ELECTRICAL

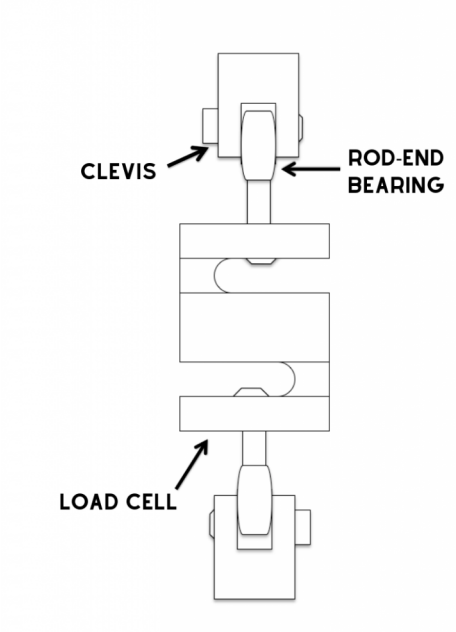
Stray electrical currents could interfere with load cell readings and are another possible source of damage to the device. Properly cover and secure all wiring and lighting, and ground the load cell fixture to the specifications outlined by the manufacturer. Avoid welding the frame, fixture, or mounts while the load cell device is connected. Stray currents from welding can significantly damage components.

PROPERLY PREPARING THE MOUNTING FRAME

The surface and structure that the load cell will be mounted to is critical to in delivering accurate results. A clean, even, and level surface should always be maintained when installing mounts. This will allow the total load to be transferred through the bottom mount of the load cell and to the supporting structure.

The load cell should be mounted so that it acts as the intermediate point between a fixed surface and the introduced load path. The load direction relative to the load cell body's orientation should always be in accordance with the installation manual provided by the manufacturer. These are often clearly marked or labeled on the device. The loading direction will ideally be vertical or perpendicular to the loading surface.

For load cells designed for axial loading, avoid significant side loads and bending moments. Suitable mounting kits can be utilized to overcome misalignments. If side loading or torsion cannot be avoided, use the appropriate load cells to capture these inputs. Rod ends or clevises can also help reduce the bending moments experienced by load cells.



The load cell should be mounted to heavy plates attached to the fixture. The surface should be level and machined. As mentioned before, these plates should be rigid and non-deformable relative to the load cell. Mounting kits for different models can be purchased or designed for the necessary application.

Drill and tap holes in the mounting plates based on the dimensions in the load cell's installation drawing or data sheet. Maintain tight tolerances when drilling. Loose tolerances will prevent the ability to install, or cause unnecessary residual stress in the device and hardware.

The size and capacity of the load cell should be selected specifically based on the application without significant oversizing. The dimensions of the load cell will affect clearances of the fixture when it is loaded to capacity.

Single point load cells are rated for a specific loading area, and the load or weight should be kept within these margins. Top plates and scales should be designed these capacities and limitations in mind. While load cells are rated for some margin beyond their capacity, it is best practice to keep the max load and location of the load safely within margins.

HARDWARE

Properly securing the load cell to the support plates will prevent motion of the device. Limiting unintended movement will keep the device aligned with the load path, maximize accuracy, and prevent damage to the component.

Always use the provided device hardware or other standard hardware approved by the manufacturer. Install all hardware to the specifications outlined in the installation manual. Engage the full threaded section of bolts and apply the proper preload before supporting the total weight of the measured system.

If bolts are not preloaded or preload is not maintained, the hardware could experience joint-separation or a fatigue failure. It can also lead to self-loosening. This can ultimately cause a failure in the bolted joints. The hardware should also be torqued to the proper specifications. Utilize jam nuts and other locking hardware to prevent connections becoming undone. Lastly, do not allow suspended systems to rotate, as this might loosen hardware.

Standard hardware should not be the weak point in the load path. Yielding, shearing, or fatigue failures could cause damage to the load cell device. If standard hardware might be a failure point, upgrade hardware before beginning installation.

The attachment plate that the load cell will be mounted to should be thick enough to have a significant thread engagement with attaching hardware. If the plate is thin, it will prevent the component from being properly secured.

BEST PRACTICES FOR INSTALLING VARIOUS TYPES OF LOAD CELLS

Load cells are designed for different applications and, therefore, require different mounting and installation.

When installing shear beams, single-point, platform, canister, and disk load cells, keep the lower mount plate level and flat. The top plate that will translate the load should always maintain a parallel position to the bottom plate, and the load path should be vertical to the plates. This will keep a predominately axial loading.

A failure to maintain axial loading could result in bending moments. As mentioned before, rod-end bearings and clevis mounts can be installed to prevent these bending moments. Misalignments of the mounting plates and the load path can also cause inaccuracies, especially in devices that are sensitive to non-axial loadings.

When operating double-end shear beams, the load should be aligned vertically through the center, and should not cause twisting or torsion. The load should be kept fixed relative to the cell body. Double-ended shear beams are rated for higher load capacities than single-end, so when supporting greater loads with size constraints, implement double-end beams. Canister or disk load cells are typically rated for higher capacities, but are larger and bulkier.

TENSION AND SUSPENSION APPLICATIONS

Load cells that measure in tension are good for lifting, suspending, and hanging applications. This can be accomplished by permanently fixing the measured system to a frame above or by hoisting the system at the time of measurement. Typical hanging applications that will utilize tension load cells are pulleys, hoists or cranes, and fork lifts.

S-beam load cells can be used in both tension and compression. They are susceptible to large bending moments, so install with rod-end bearings to prevent this. Usually a strain gage is located on a specific end of s-beam load cells, so always verify it is oriented correctly. If oriented incorrectly the device cable can interfere with the accuracy of measurements.

Load pins can be used in suspended systems where a pin supports the structure. Load pins can be utilized in shackles with clevis pins, sprockets, or pulleys. If a load is reacted by a pin, it can be replaced directly by a load pin load cell to begin measuring the relevant loading.

If there are installation questions, or questions about load cell applications, always contact Tacuna Systems.

If load cell component failure will result in injury, always have the proper structural backup to prevent system failure. Secure the fixture with cables or stops to prevent harm to operators and equipment.

As with structures supported on top of load cells, fewer suspended supports will deliver results that are more accurate. Install suspension systems with adjustable linkages to maintain the ability to evenly distribute loads among load cells. Additionally, limit the amount of rotation suspended systems see, as this could loosen hardware over time.

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