Dos and Don'ts

For Custom Scale Design and Weigh Module Installation

METTLER TOLEDO

Disclaimer

This booklet illustrates the most important design rules for custom scales and best practices for the installation of Weigh Modules.

The simplified pictograms herein cannot serve as a comprehensive engineering guide. Please refer to METTLER TOLEDO's Weigh Module Systems Handbook for guidelines on scale design, calibration, and environmental considerations.

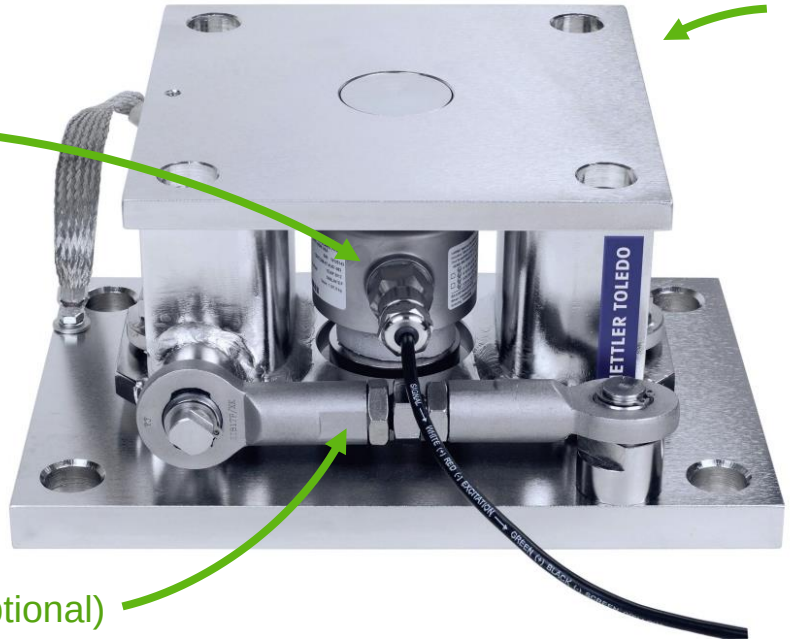
Review the manuals specific to the product for detailed instructions and safety precautions before installing, operating or servicing any METTLER TOLEDO product.

Weigh Module = Load Cell + Mounting Hardware

- Shall provide accurate weight data
- Shall support the object safely

Top plate: Interface to tank, hopper, silo, vessel, etc.

Load Cell: Measuring Device



Base plate: Interface to support or foundation

Stabilizer (optional)

Exemplary image: Compression Weigh Module SWC515 PinMount™

Content

Calculation of Weigh Module Size

Weight of empty scale, including mixers, heating jackets, fluids, etc.

Maximum load scale is designed to weigh

1.25 recommended, higher for special situations

$$\frac{(\text{Total dead load} + \text{Scale capacity}) \times \text{Safety factor}}{\text{Number of Weigh Modules}} =$$

Consider worst case for an uneven load distribution, e.g. full end loading of conveyor and floor scales

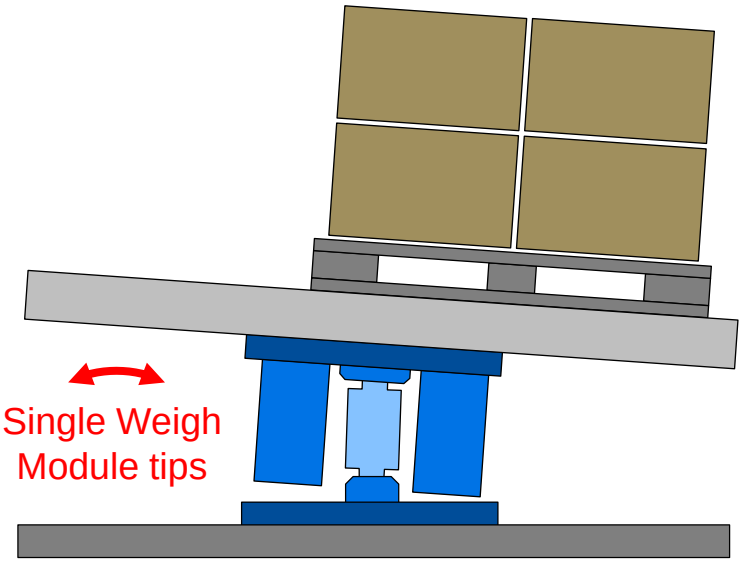
= Weight per Weigh Module

Choose Weigh Module with the next available larger size

Further considerations (e.g. wind, seismic, shock forces) may apply.
Consult METTLER TOLEDO to choose the right device that meets your requirements.

Number of Weigh Modules

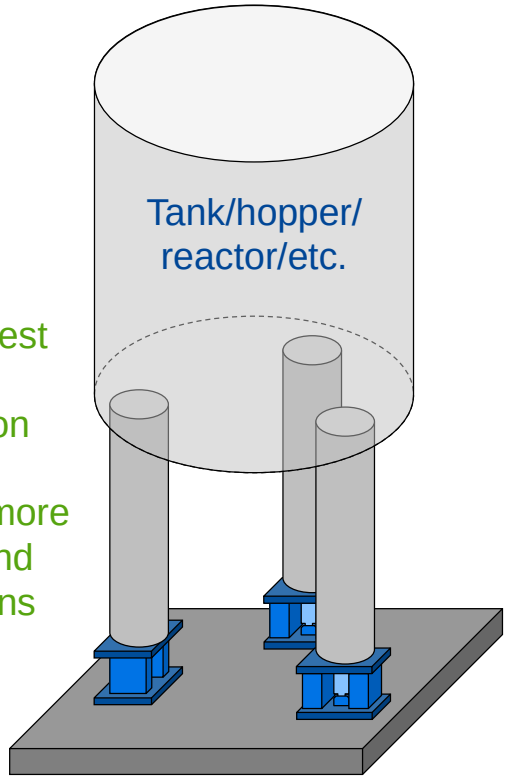
A single Weigh Module cannot take any bending moment



Design scale with minimum 3 supports and Weigh Modules

3 supports are best for an optimal weight distribution

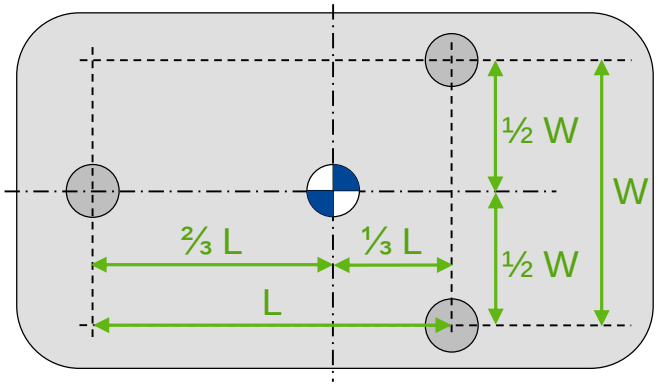
≥4 supports are more stable in wind and seismic conditions



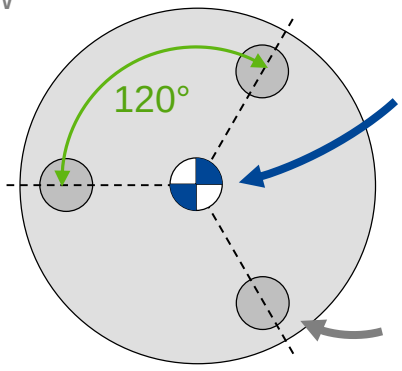
Support Position

Ensure good weight distribution by proper positioning of the supports

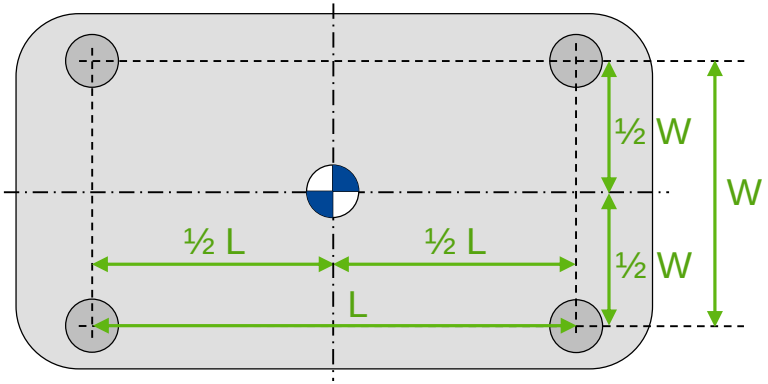
3 supports:

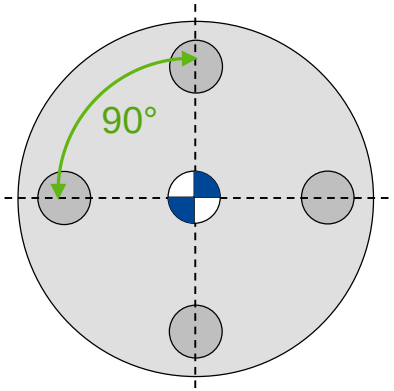


Top view



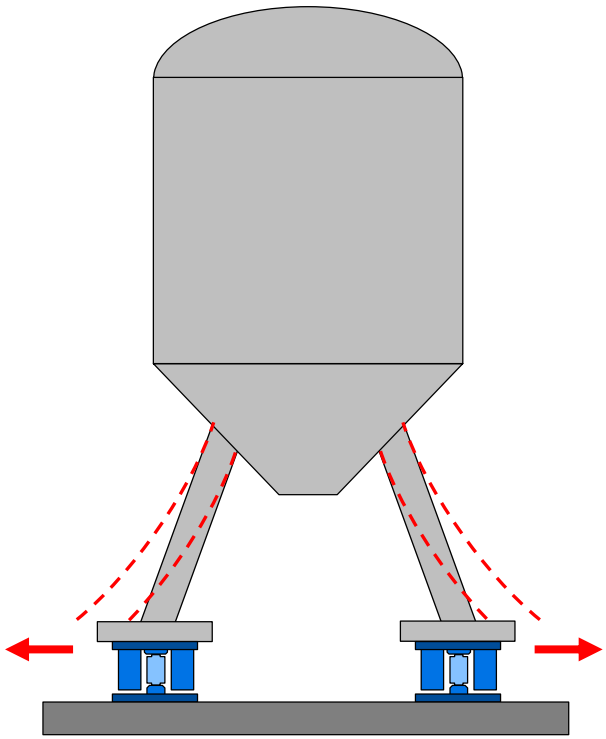
4 supports:



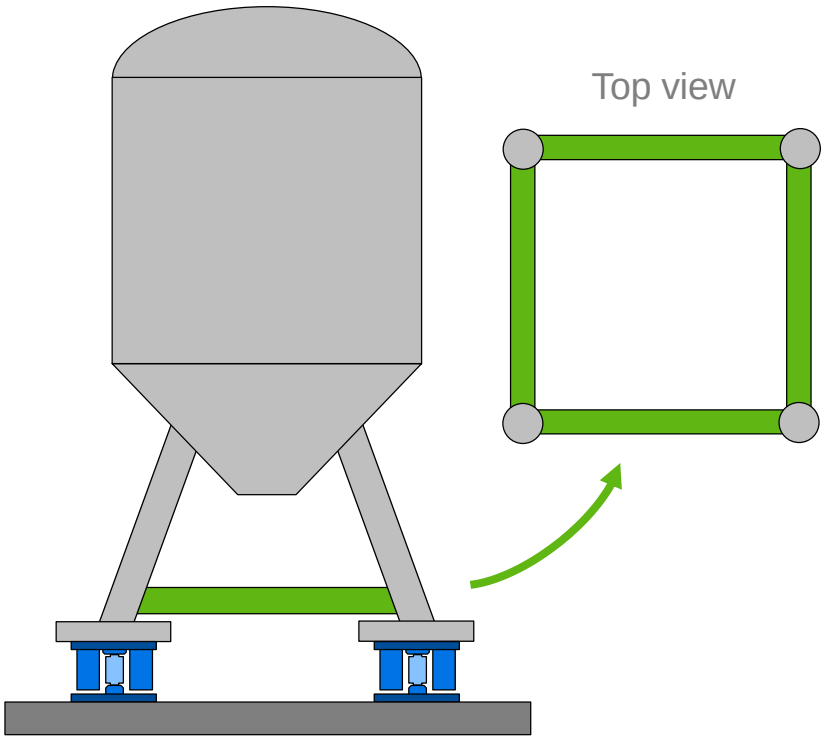


Rigid Legs

Inclined legs splay under load

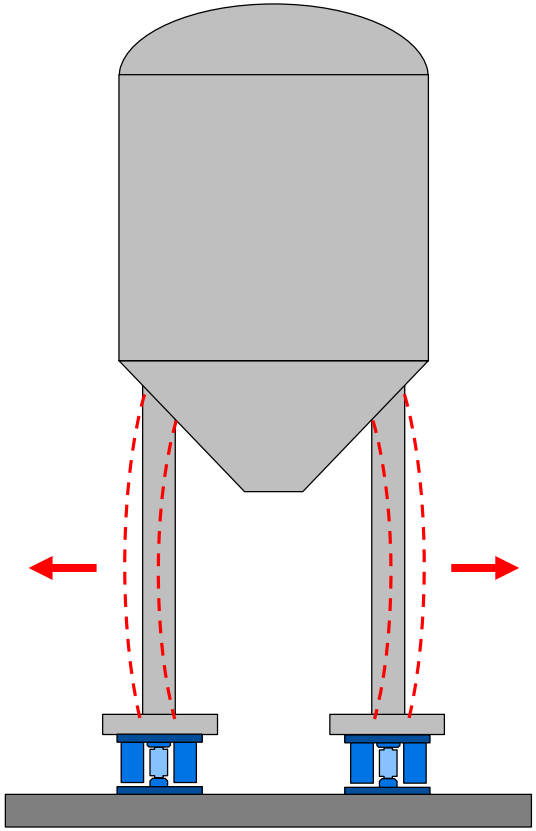


Stiffen legs with braces



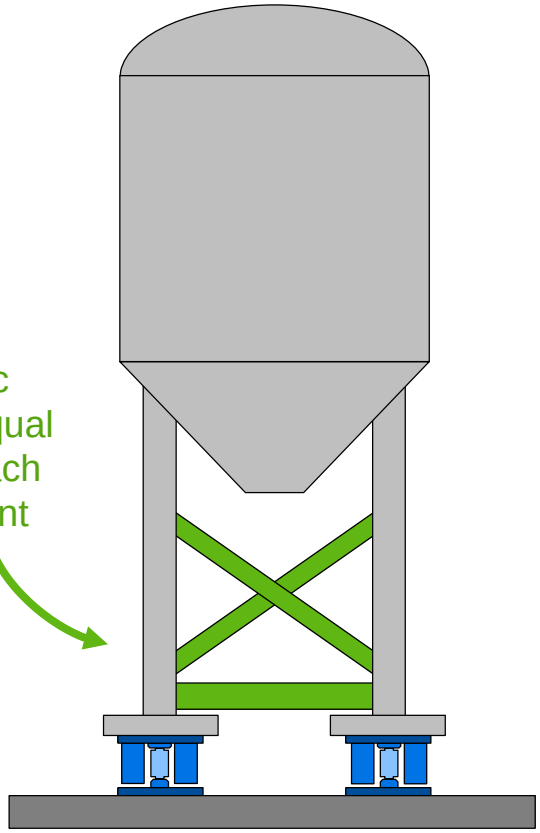
Rigid Legs

Long legs deflect under load



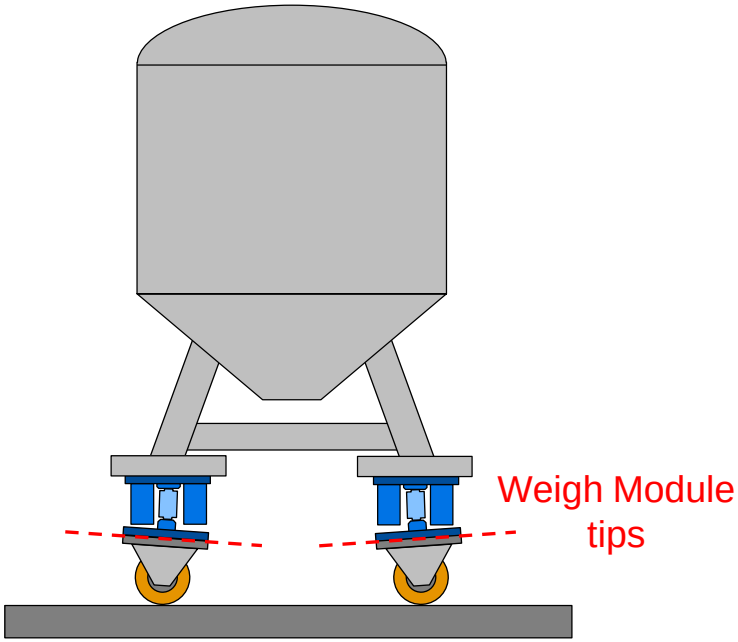
Strengthen legs with cross-bracing

Symmetric design for equal rigidity at each support point

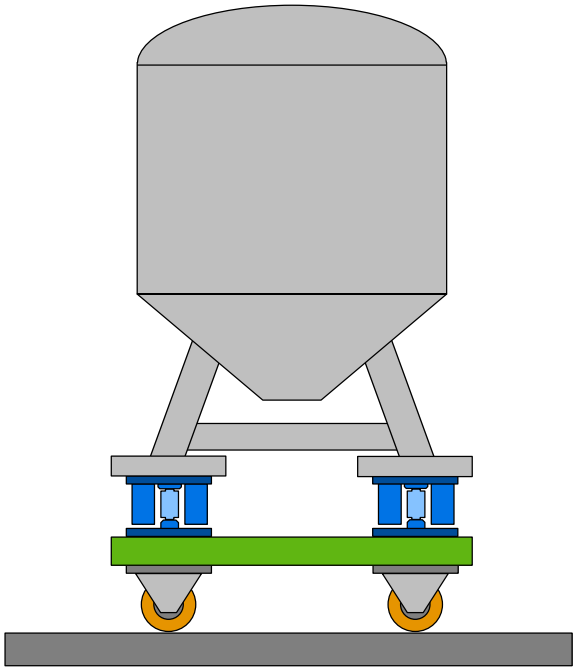


Portable Tank

Weigh Modules on individual wheels or casters

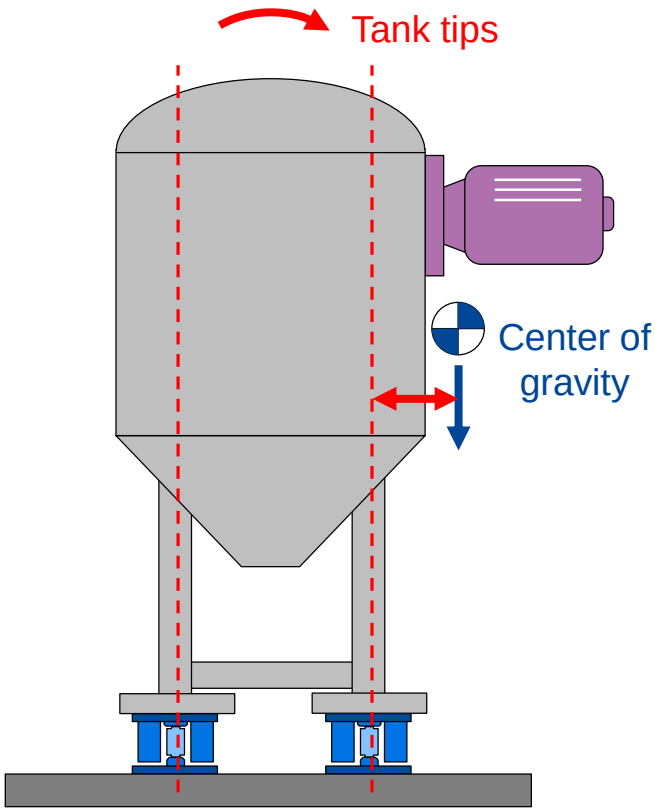


Trolley with rigid sub-frame

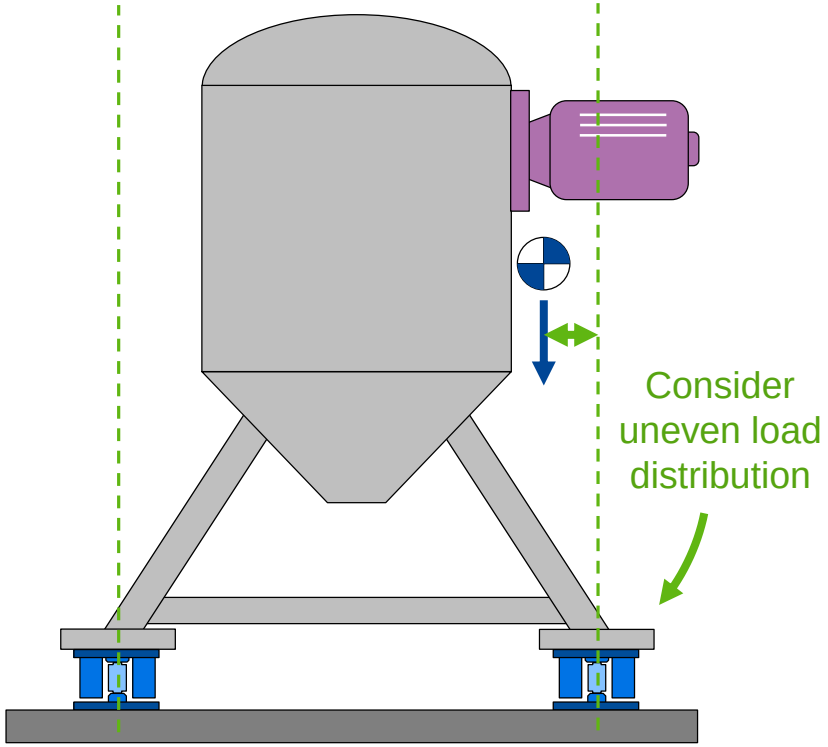


Center of Gravity

Tank tips due to off-centered load (e.g. motor, electrical cabinet)

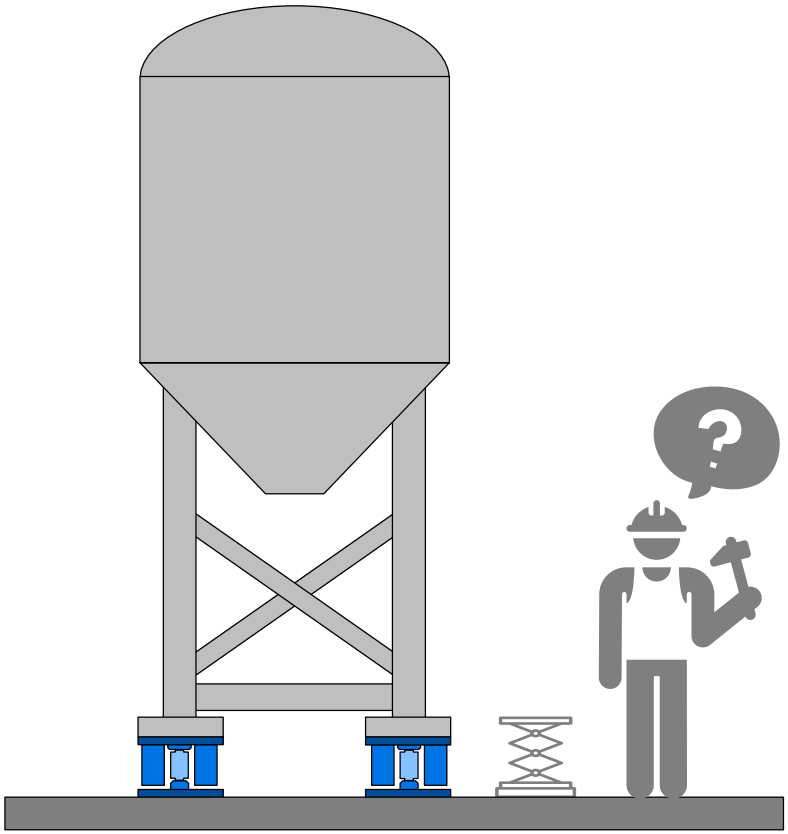


Consider the center of gravity for leg design and support positioning

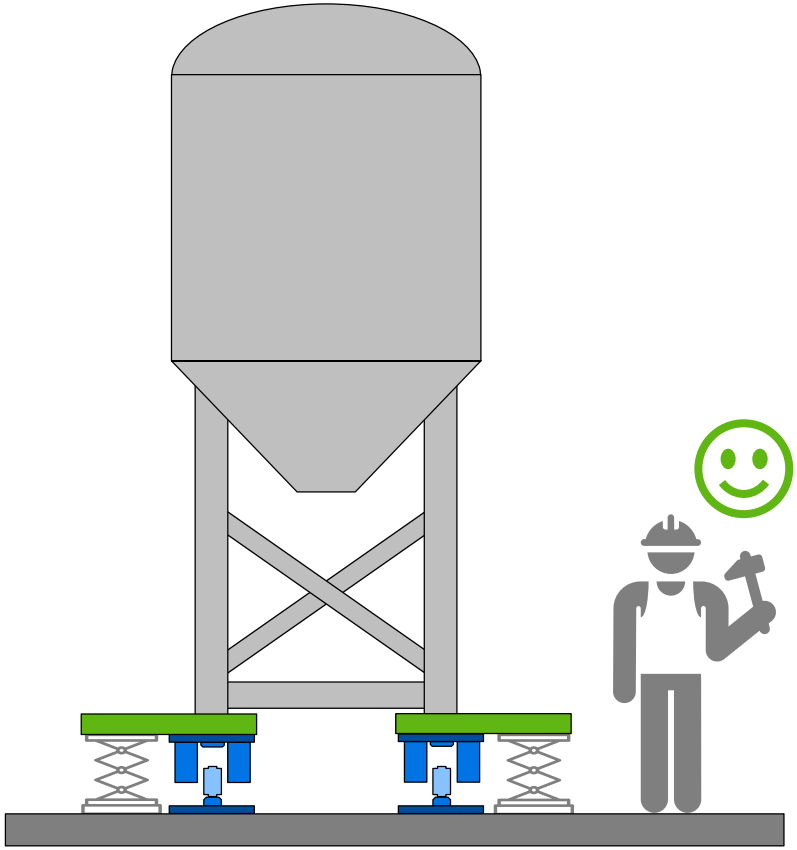


Jacking Points

No jacking points for installation and service

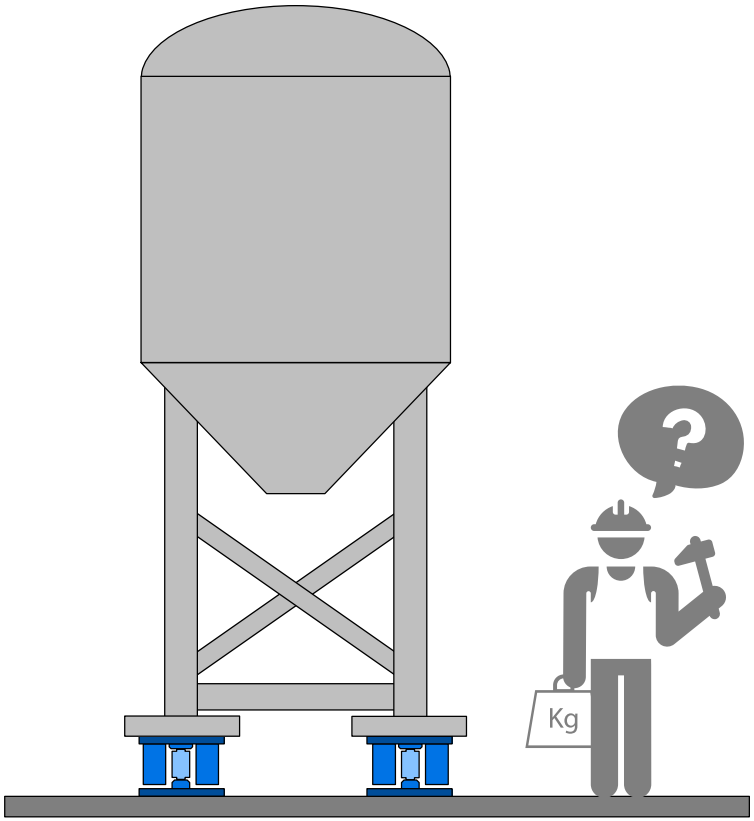


Design with jacking points

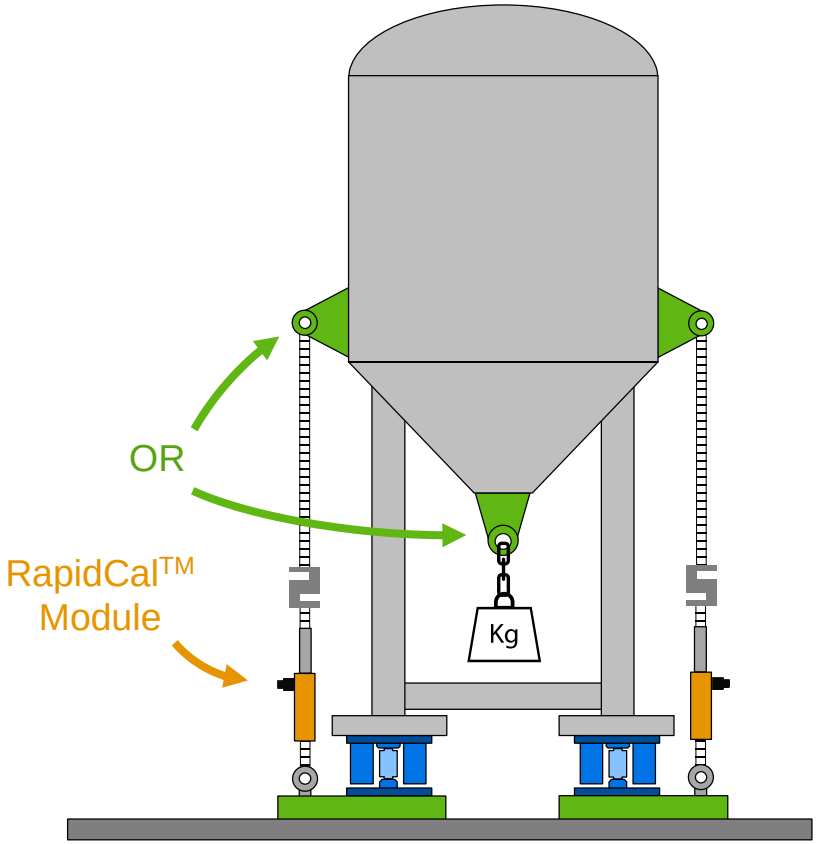


Provision for Calibration

No provision for calibration

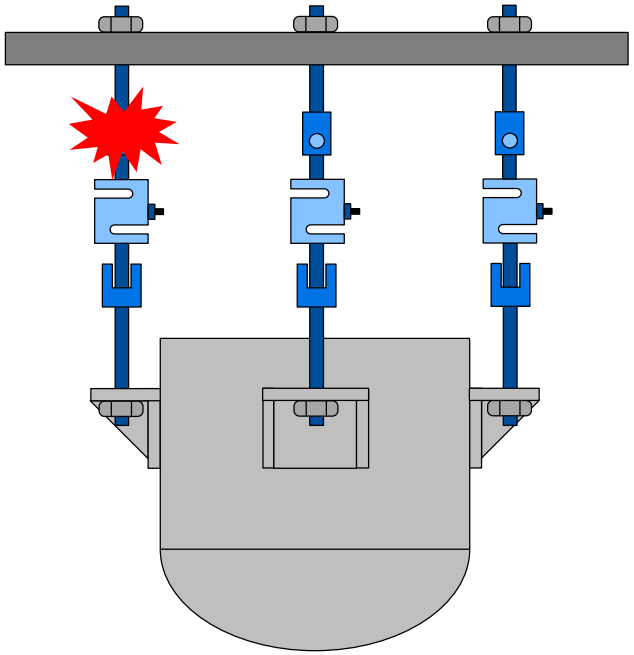


Anchor points for calibration, e.g. with test weights or RapidCal™

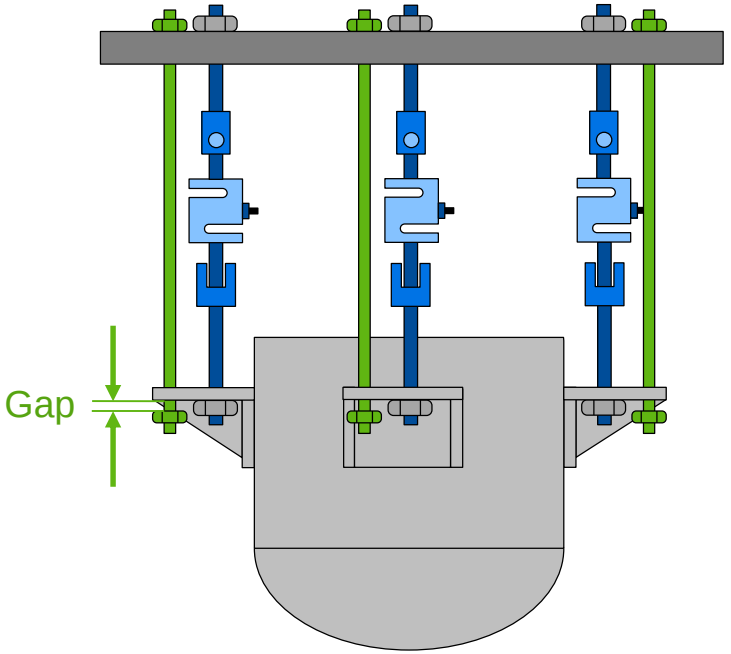


Safety Rods for Tension Weigh Modules

Suspended hopper without safety measures

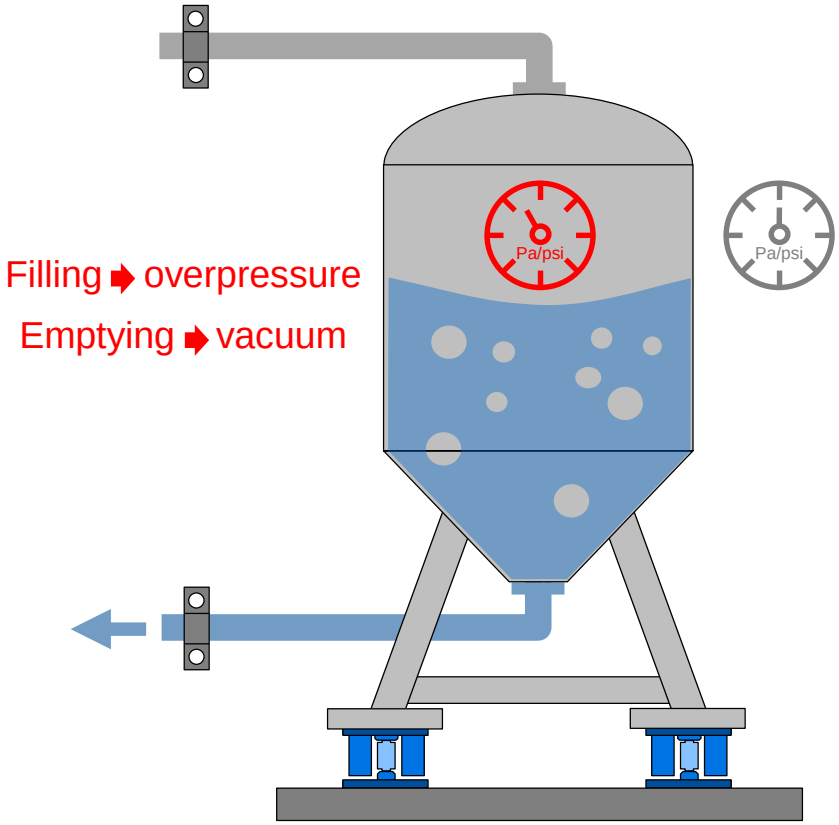


Safety chains or rods prevent hopper from falling if component fails

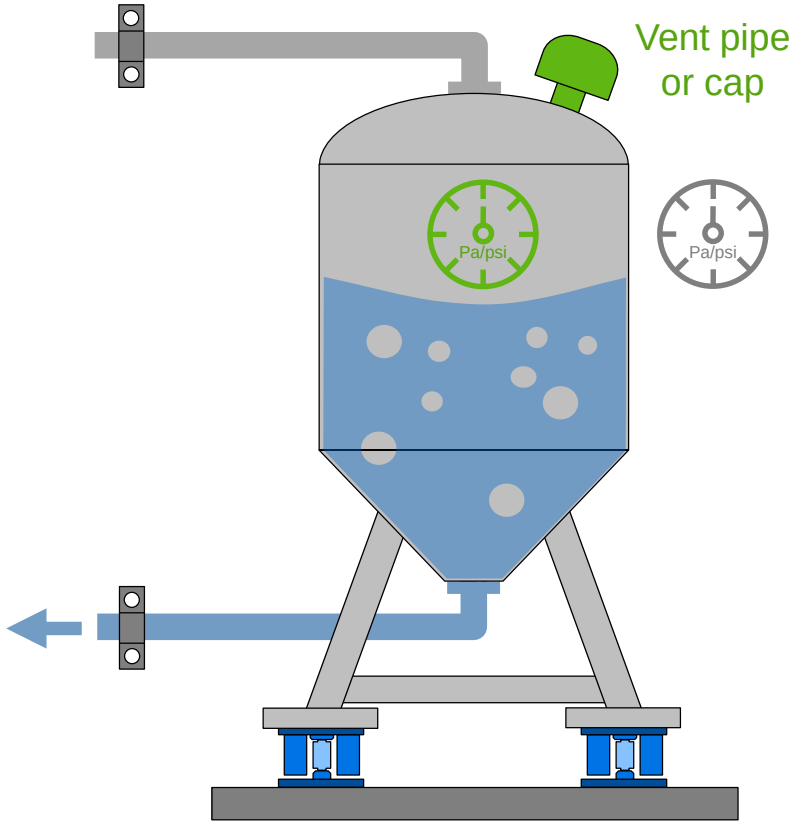


Constant Pressure

Pressure imbalances cause weighing errors

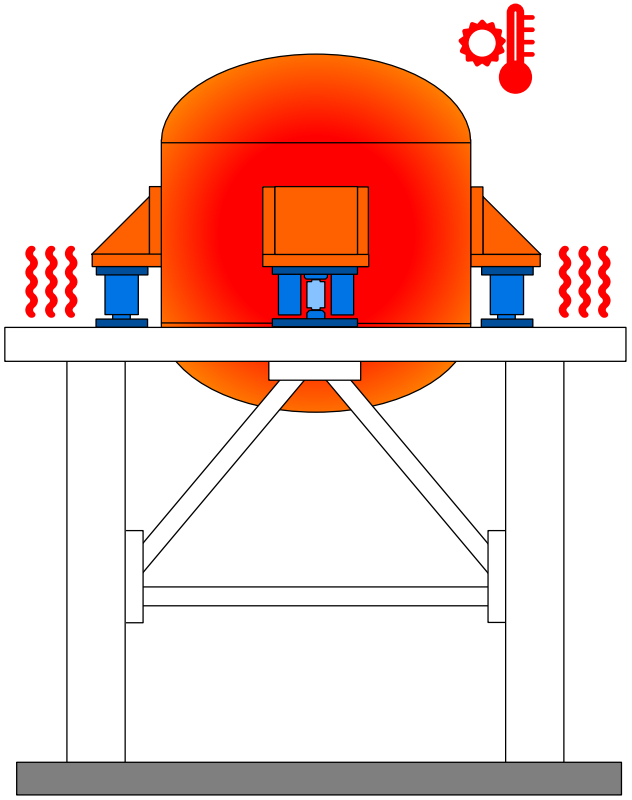


Ensure a constant or controlled pressure, e.g. by a vent pipe

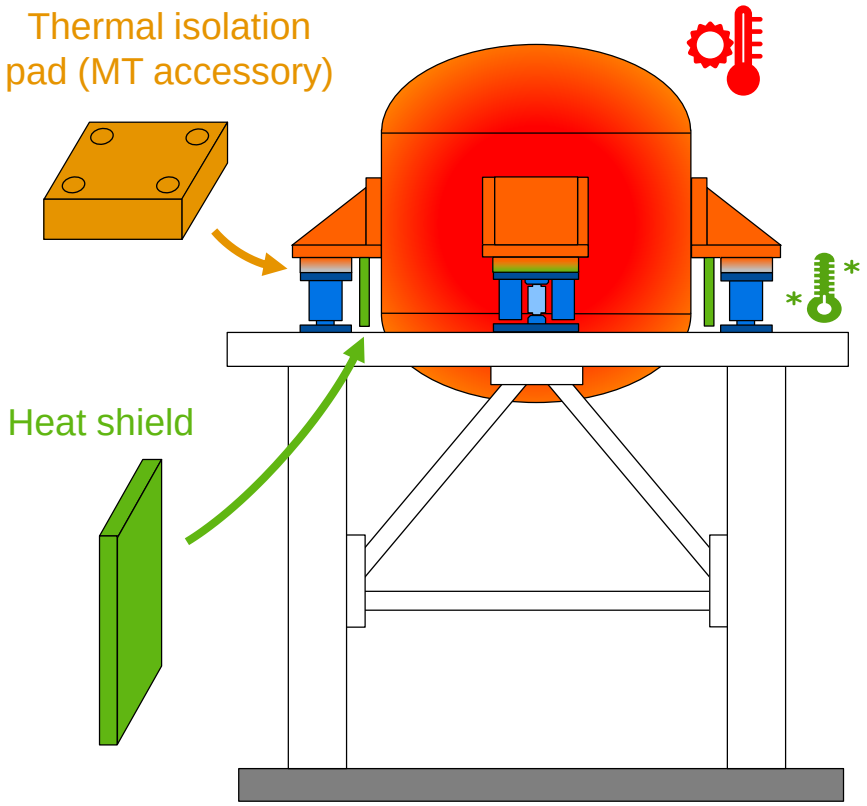


Thermal Isolation Pads

Hot tank heats up Load Cells

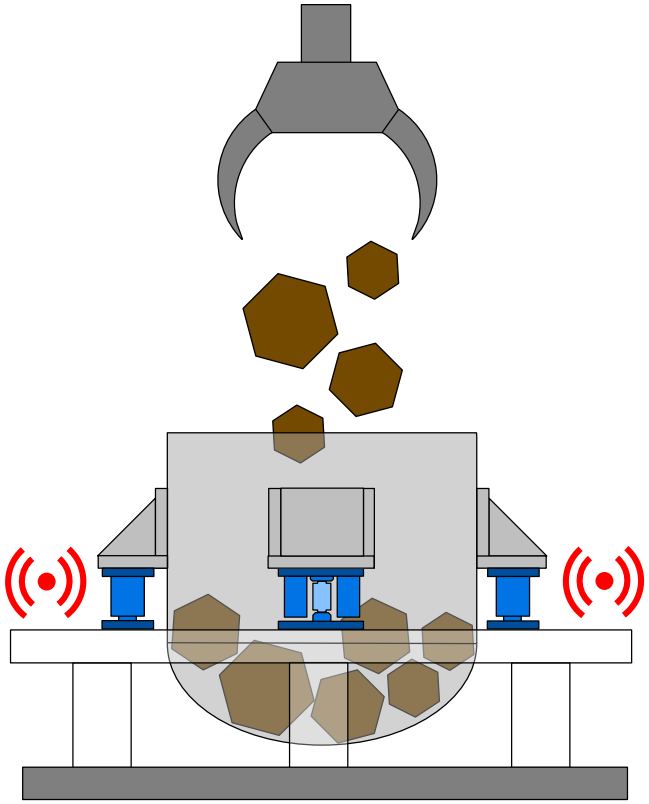


Heat transfer is reduced by thermal isolation pads and heat shields

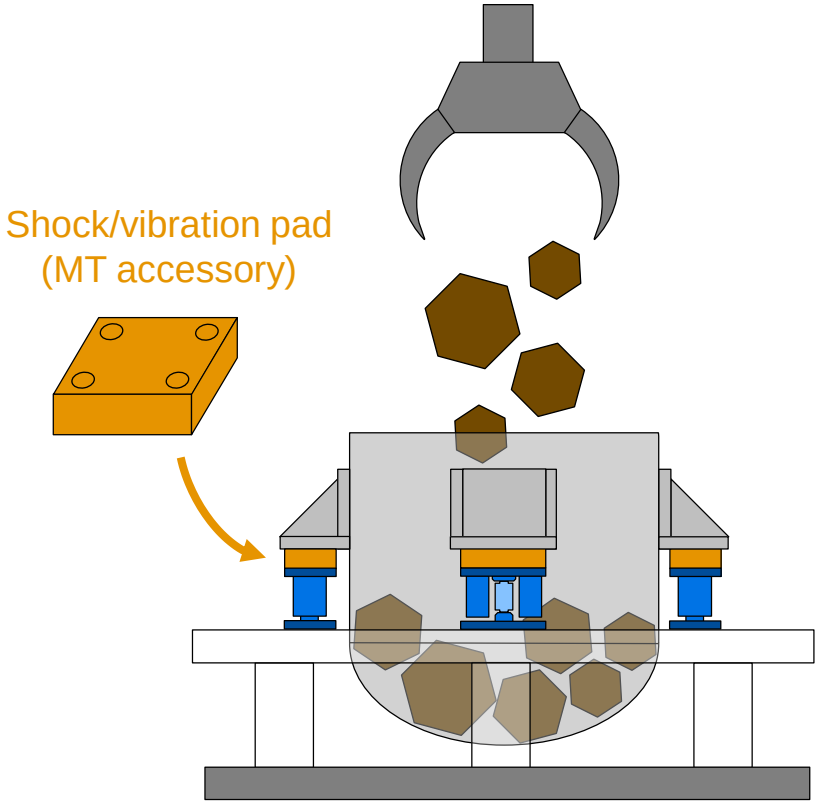


Shock/Vibration Pads

Shock loads can damage the Load Cells



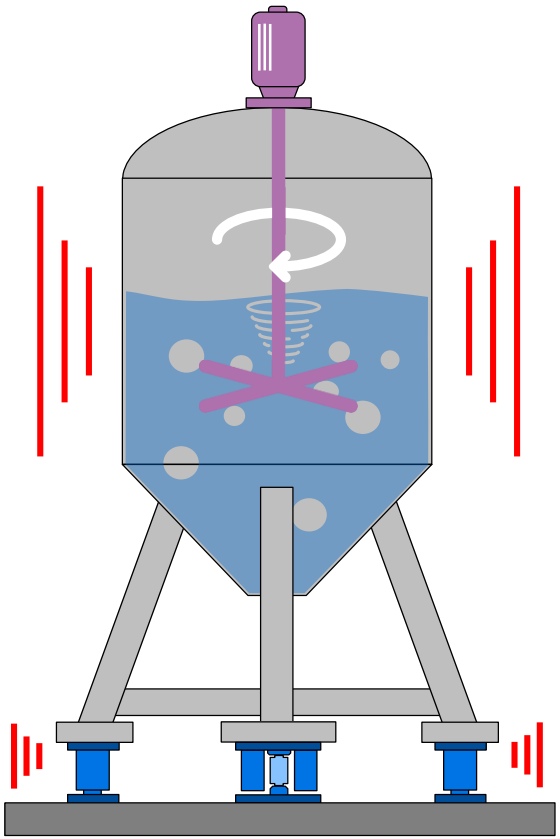
Oversize the Load Cells and protect them with shock/vibration pads



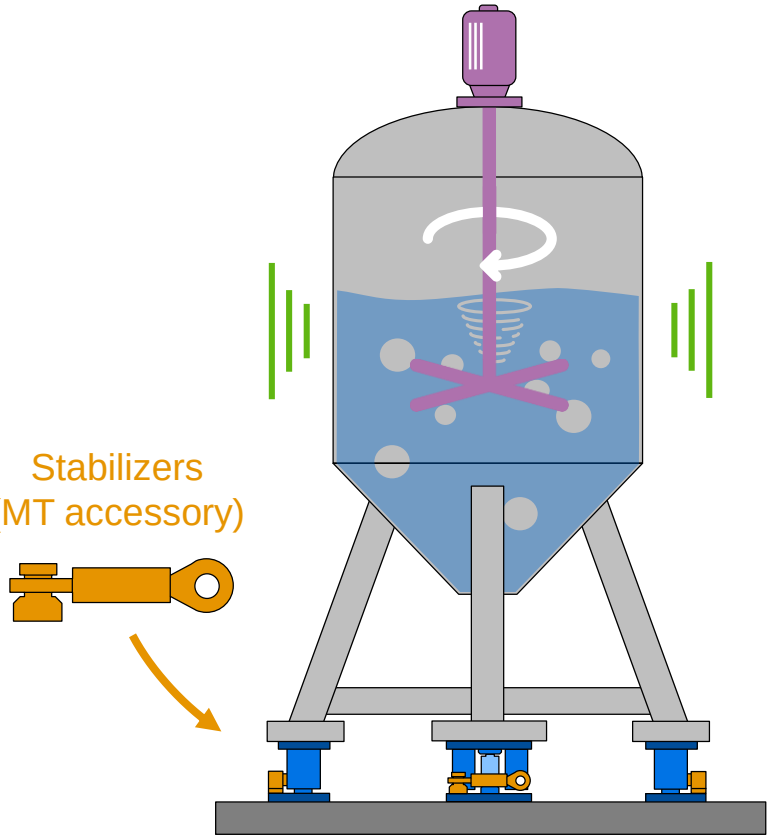
Content

Weigh Modules with Stabilizer Option

High power mixer or blender create vibrations and large horizontal forces



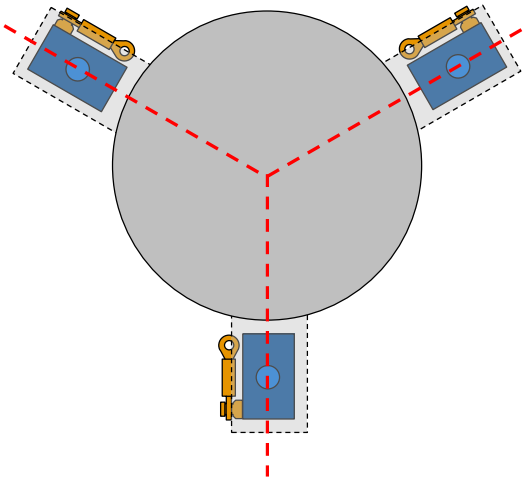
Stabilizers dampen vibrations and horizontal forces



Stabilizer Orientation for 3 legs

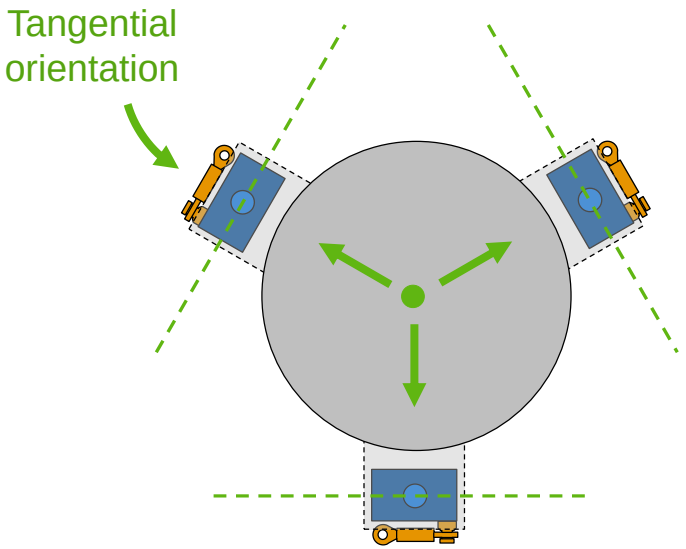
Stabilizers point to each other, prohibiting thermal expansion

Top view



Stabilizers do not interfere with thermal expansion

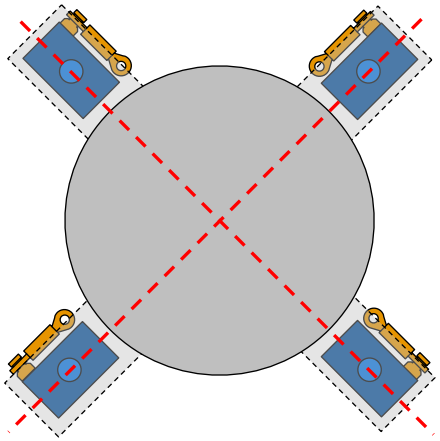
Top view



Stabilizer Orientation for 4 legs

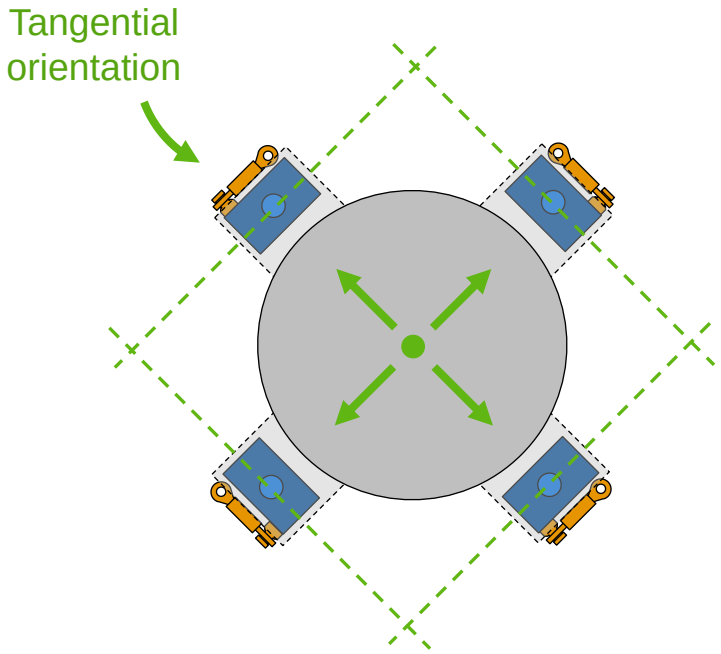
Stabilizers point to each other, prohibiting thermal expansion

Top view



Stabilizers do not interfere with thermal expansion

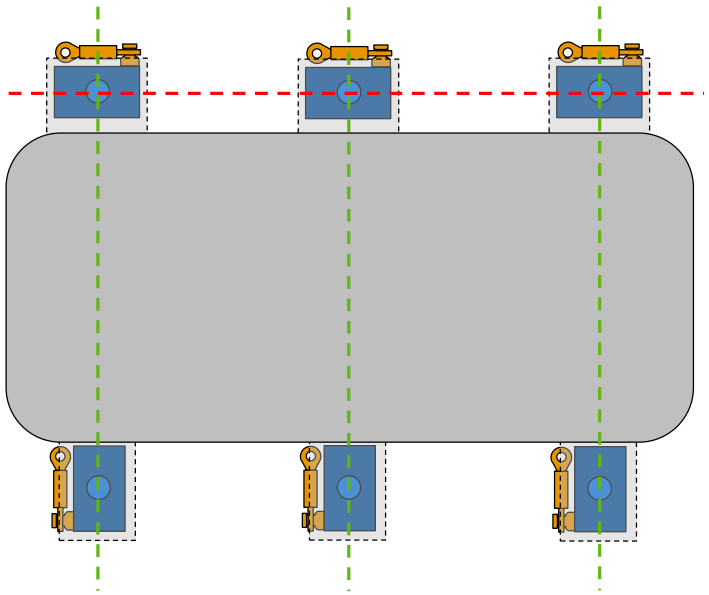
Top view



Stabilizer Orientation for 6 legs

Too many stabilizers, prohibiting thermal expansion

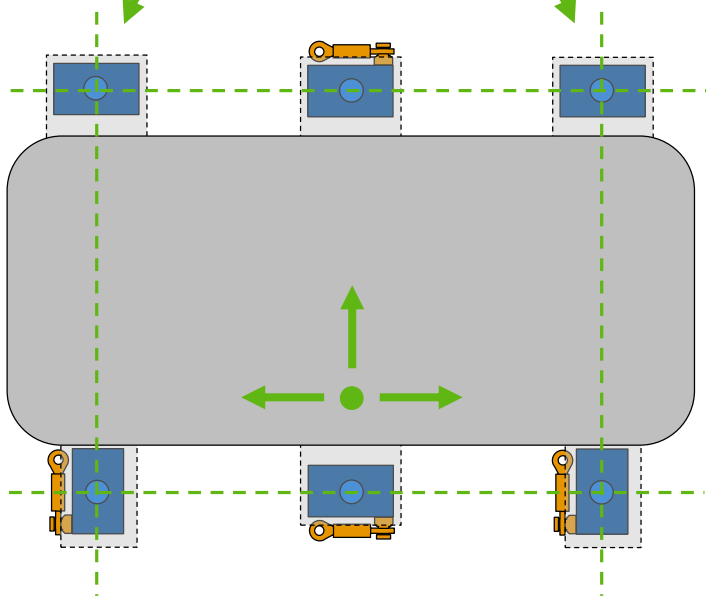
Top view



Stabilizers do not interfere with thermal expansion

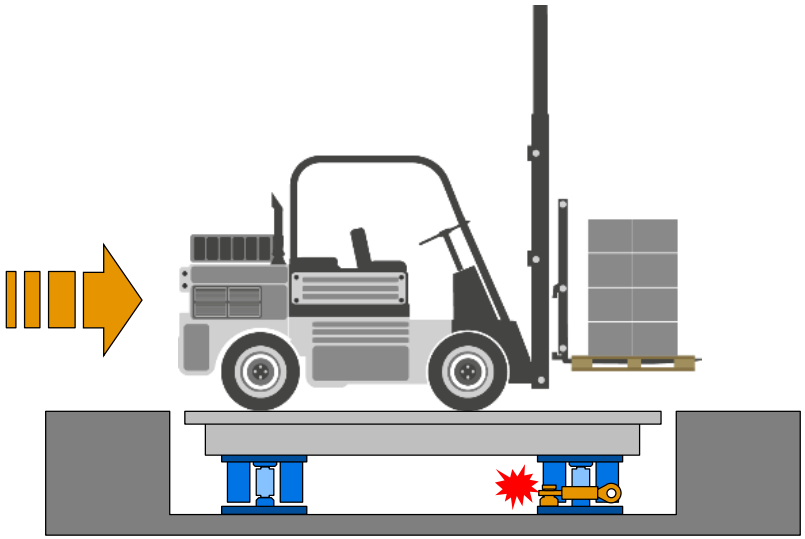
Top view

No stabilizers for these Weigh Modules



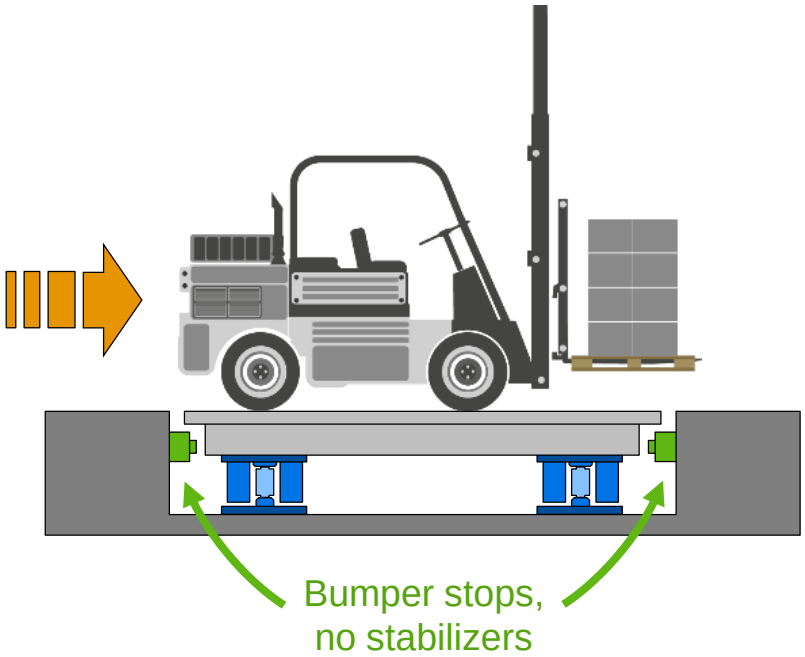
Bumper Stops Instead of Stabilizers

Very large horizontal forces can overload stabilizers



Stabilizer overload

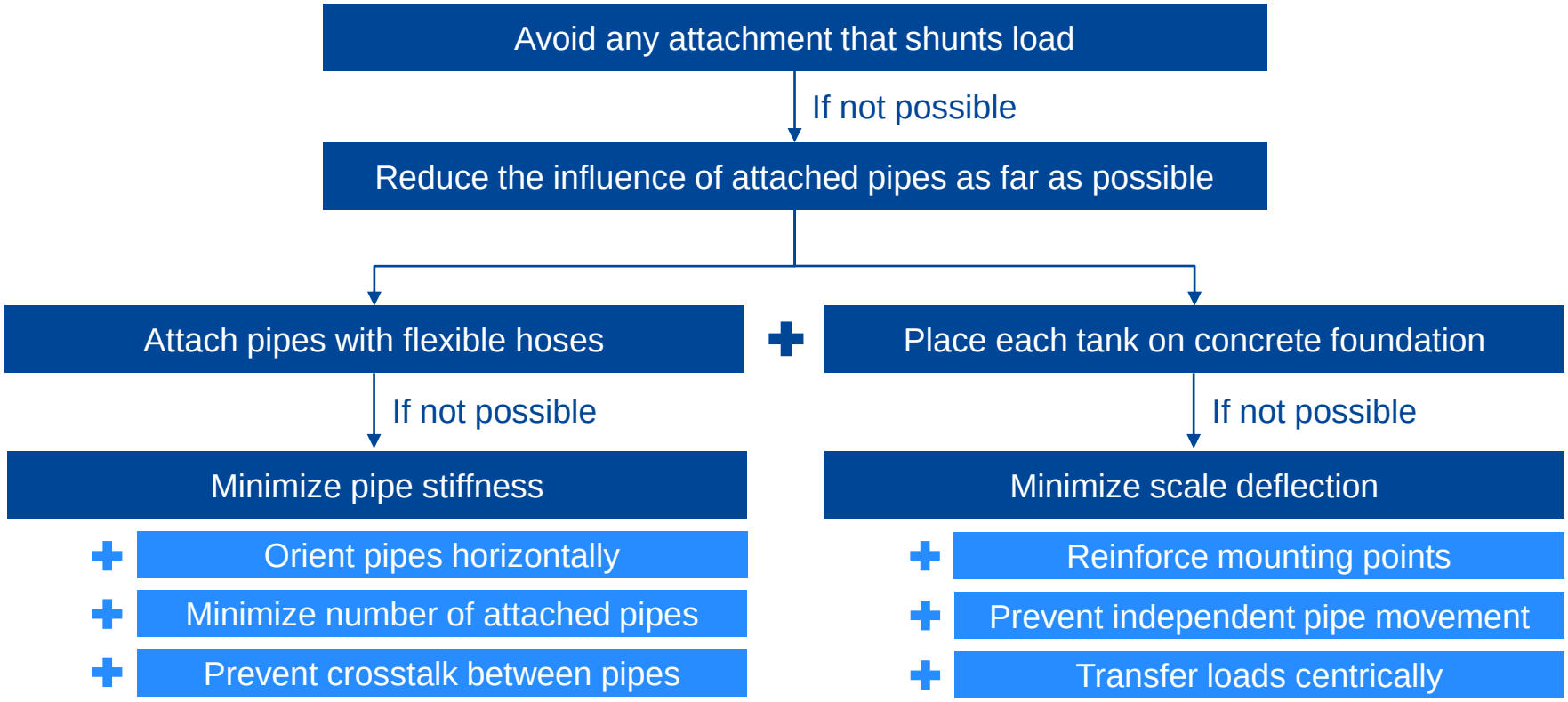
Equip drive-on platform scales with bumper stops instead of stabilizers



Content

Good Piping Design: Overview

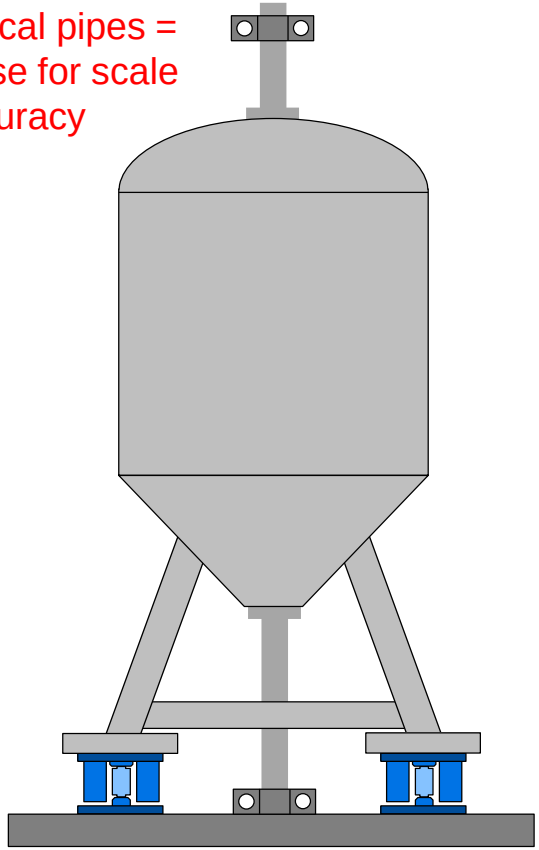
Lower pipe forces ➡ Higher scale accuracy



Unattached Pipes

Rigidly attached pipes

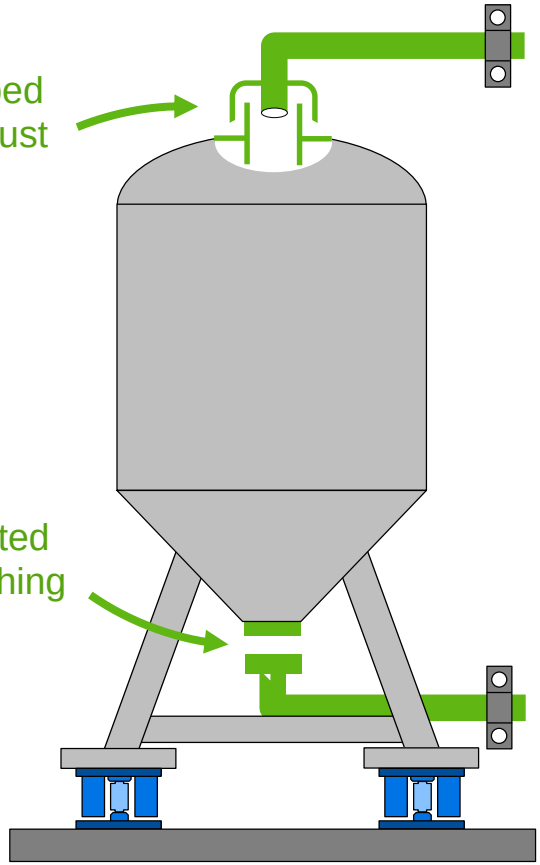
Stiff, vertical pipes = Worst case for scale accuracy



Avoid attached pipes entirely during weighing

Open-topped tank with dust boot

Disconnected during weighing cycle



Good Piping Design: Overview

Lower pipe forces ➡ Higher scale accuracy

Avoid any attachment that shunts load

If not possible

Reduce the influence of attached pipes as far as possible

Attach pipes with flexible hoses

If not possible

Minimize pipe stiffness

- Orient pipes horizontally
- Minimize number of attached pipes
- Prevent crosstalk between pipes

+

Place each tank on concrete foundation

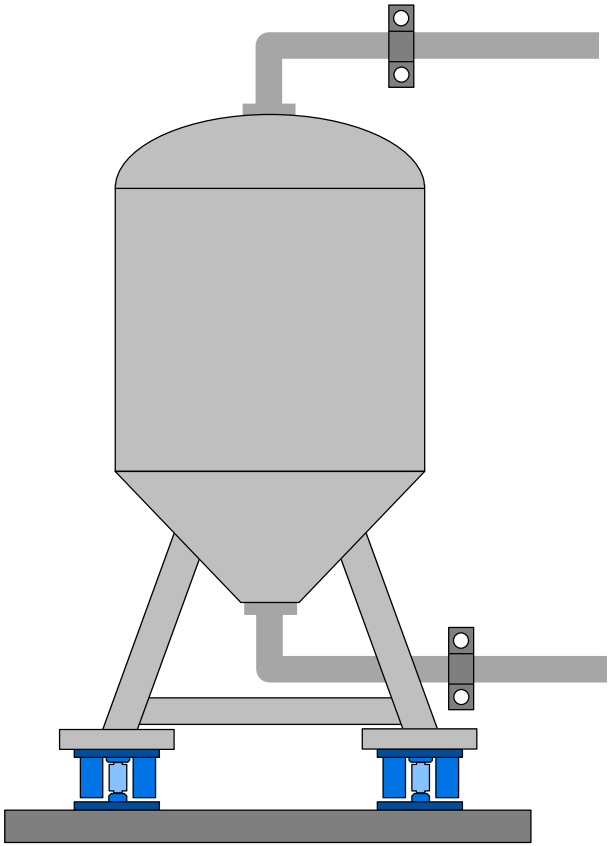
If not possible

Minimize scale deflection

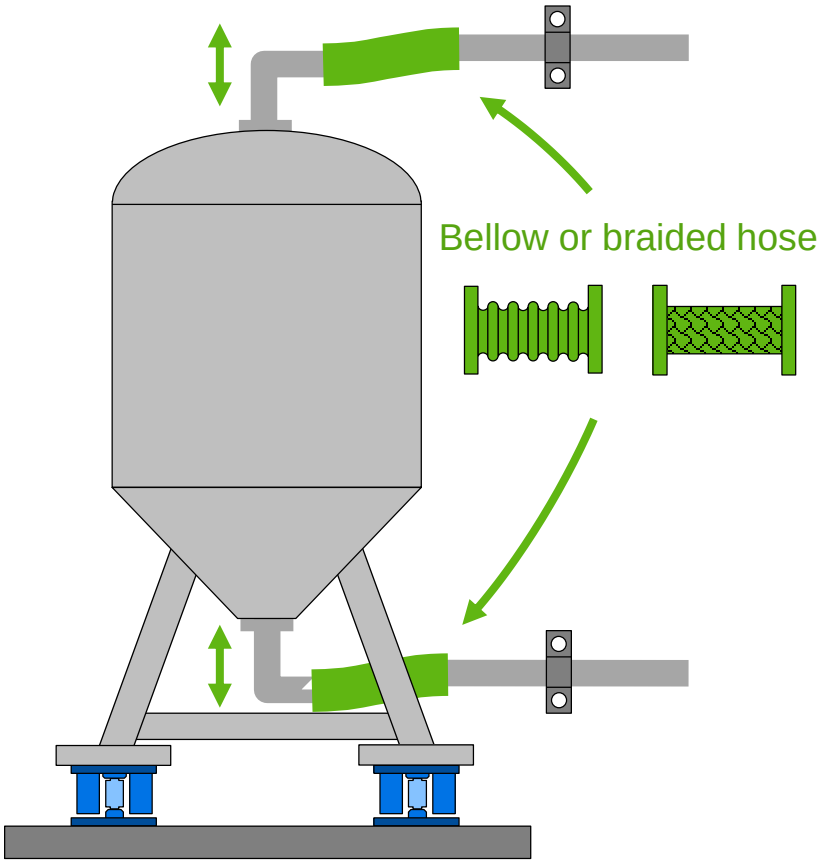
- Reinforce mounting points
- Prevent independent pipe movement
- Transfer loads centrically

Flexible Hoses

Rigidly attached pipes

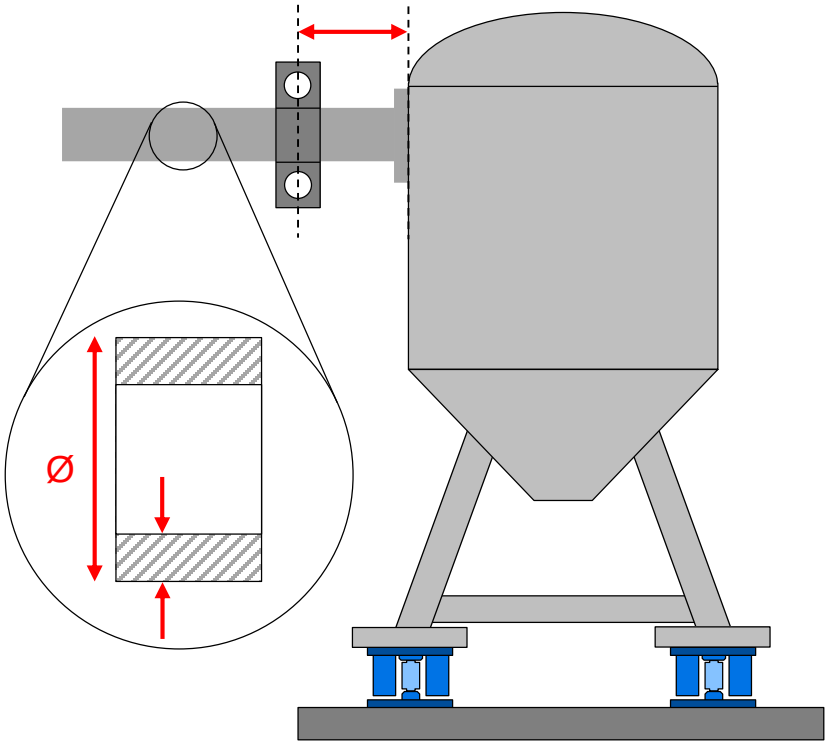


Use flexible horizontal hoses

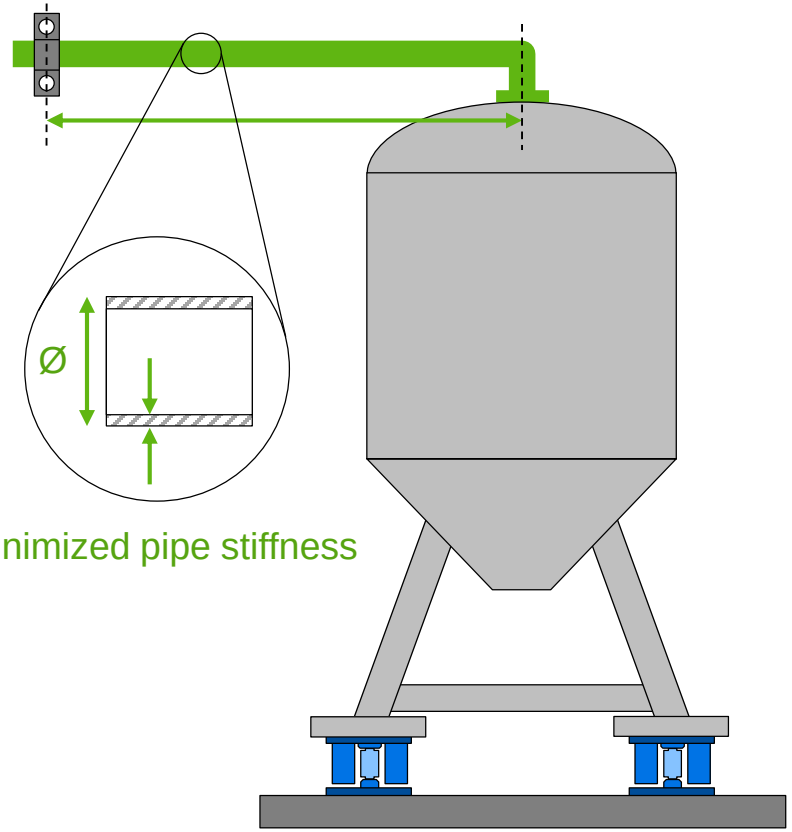


Minimized Pipe Stiffness

Short pipes with a large diameter and thick walls



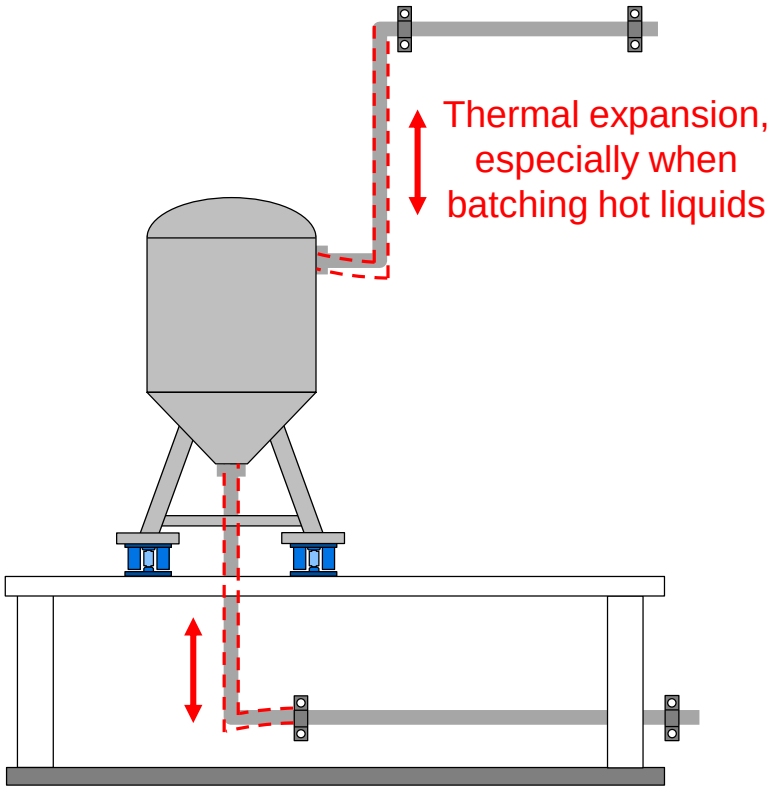
Long, small, thin-walled pipes



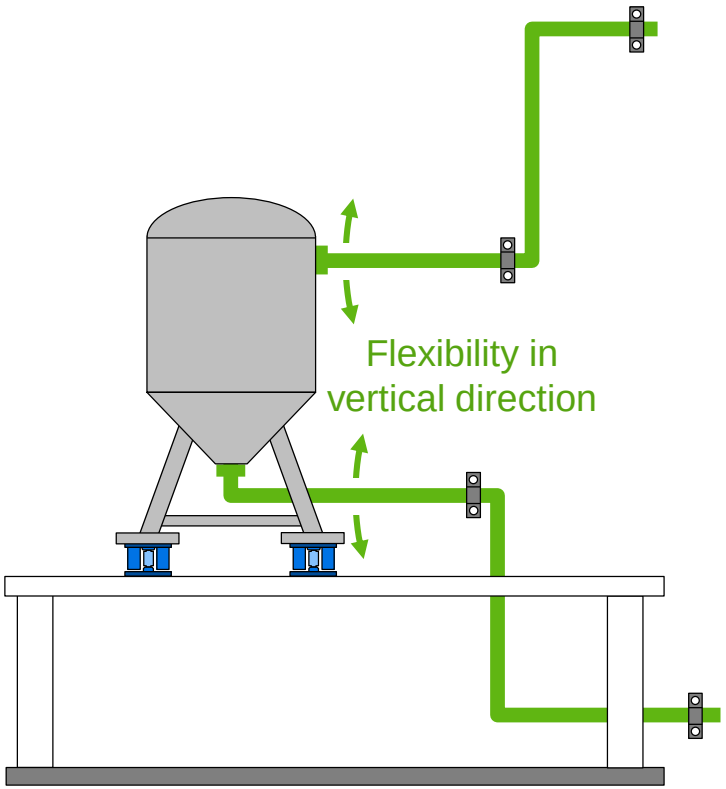
Minimized pipe stiffness

Horizontal Pipes

Vertical pipes create forces due to thermal expansion

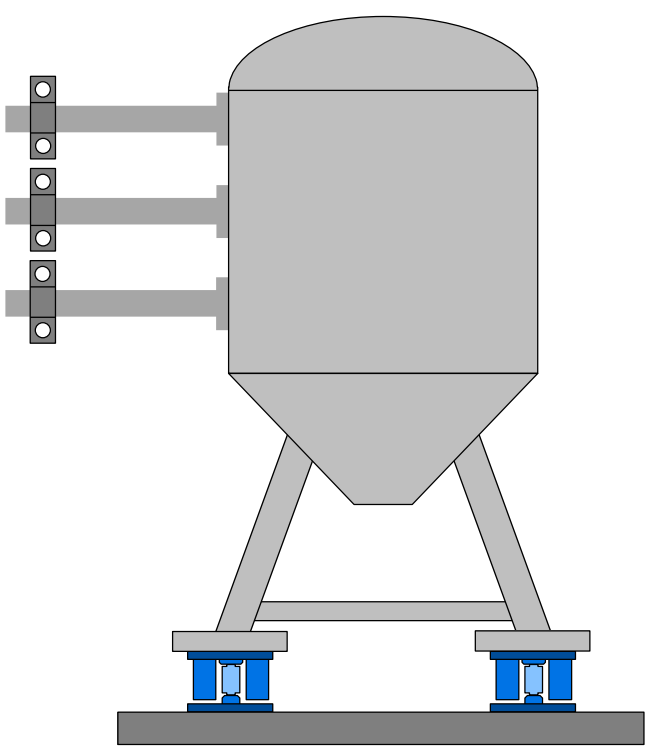


Long horizontal pipes between tank and first clamp

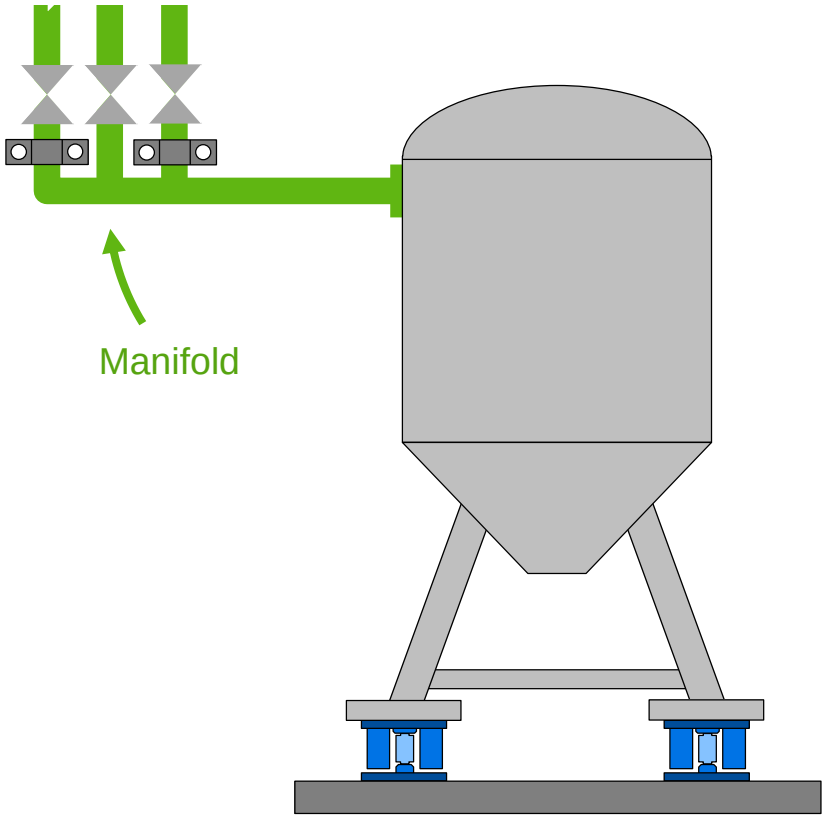


Number of Attached Pipes

Multiple inlet pipe attachments

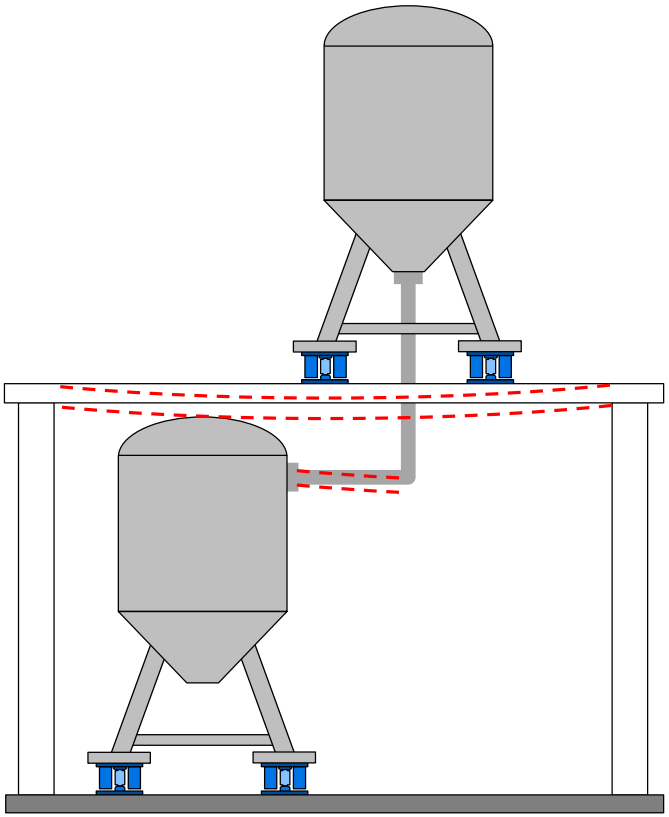


Minimize number of attached pipes

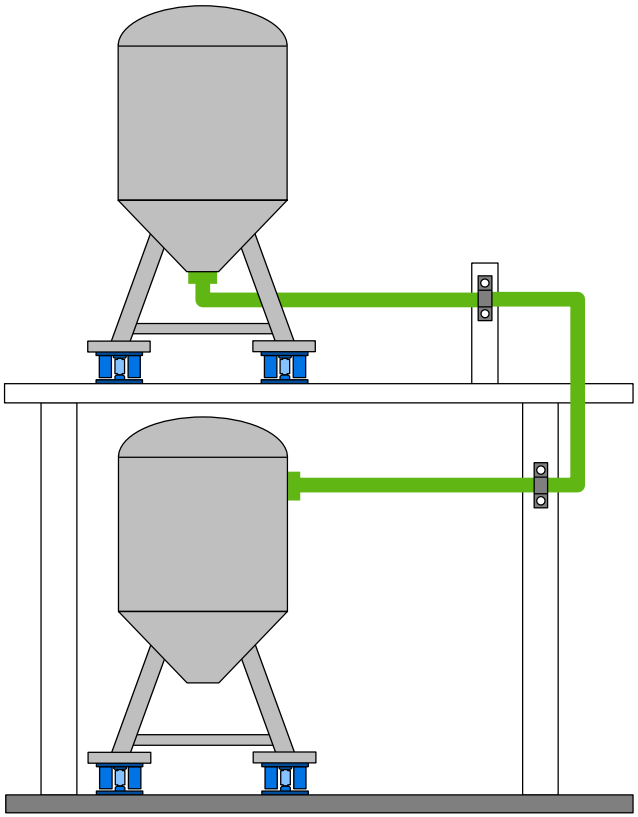


Prevent Crosstalk Between Pipes

Pipe forces due to deflection of another tank (crosstalk)



Decoupling of tanks, independent pipe clamps



Good Piping Design: Overview

Lower pipe forces ➡ Higher scale accuracy

Avoid any attachment that shunts load

If not possible

Reduce the influence of attached pipes as far as possible

Attach pipes with flexible hoses

If not possible

Minimize pipe stiffness

- Orient pipes horizontally
- Minimize number of attached pipes
- Prevent crosstalk between pipes

+

Place each tank on concrete foundation

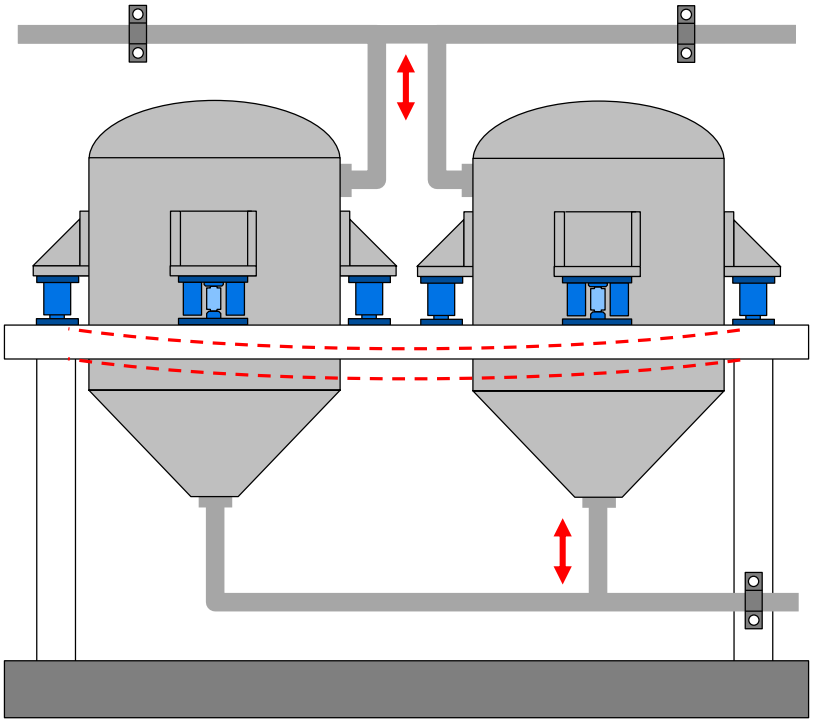
If not possible

Minimize scale deflection

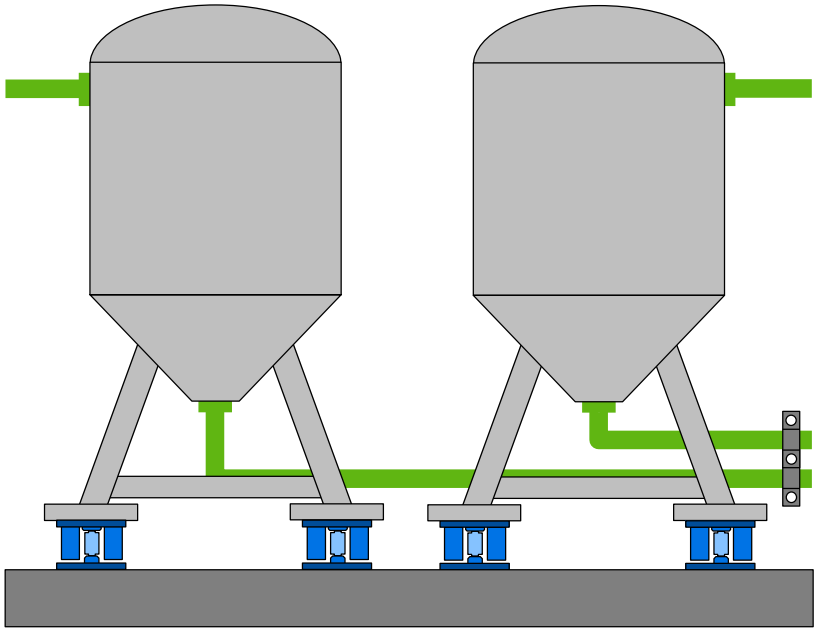
- Reinforce mounting points
- Prevent independent pipe movement
- Transfer loads centrically

Individual Tanks on Foundation

Multiple tanks on a mezzanine with interconnected pipes

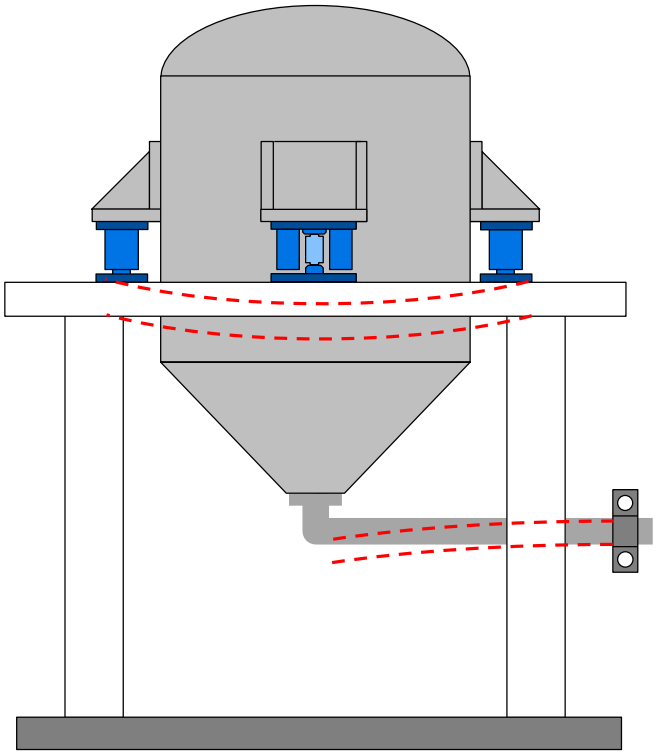


Place each tank on concrete foundation with separate pipes

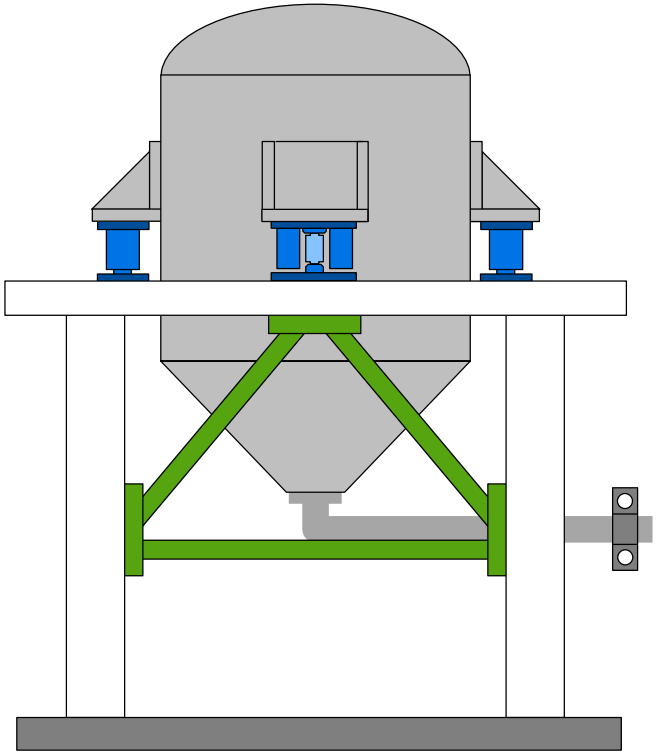


Reinforced Mounting Points

Large deflection of Weigh Module mounting points



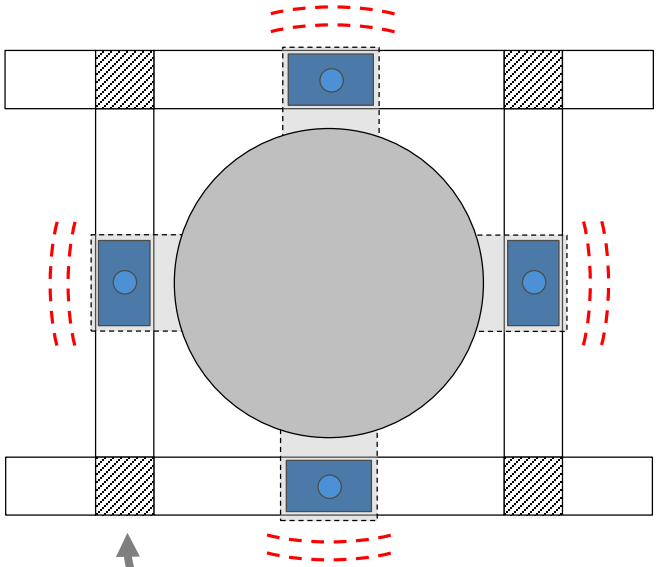
Reinforce Weigh Module mounting points



Reinforced Mounting Points

Large deflection of Weigh Module mounting points

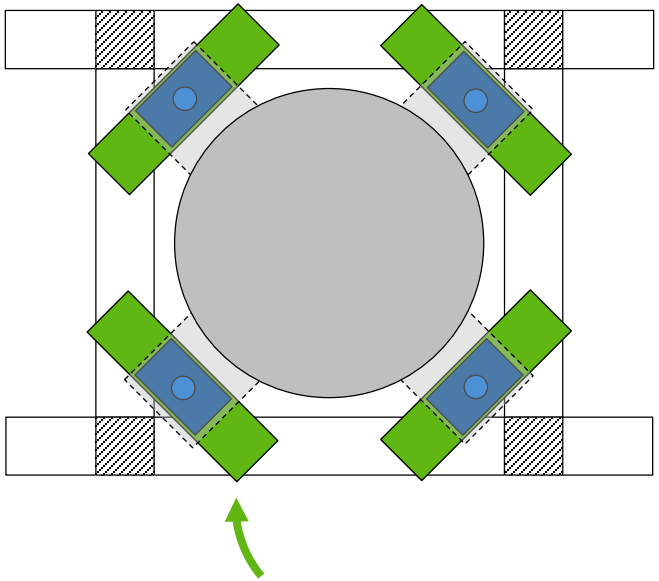
Top view



Vertical column

Weigh Modules on crossbars near vertical columns

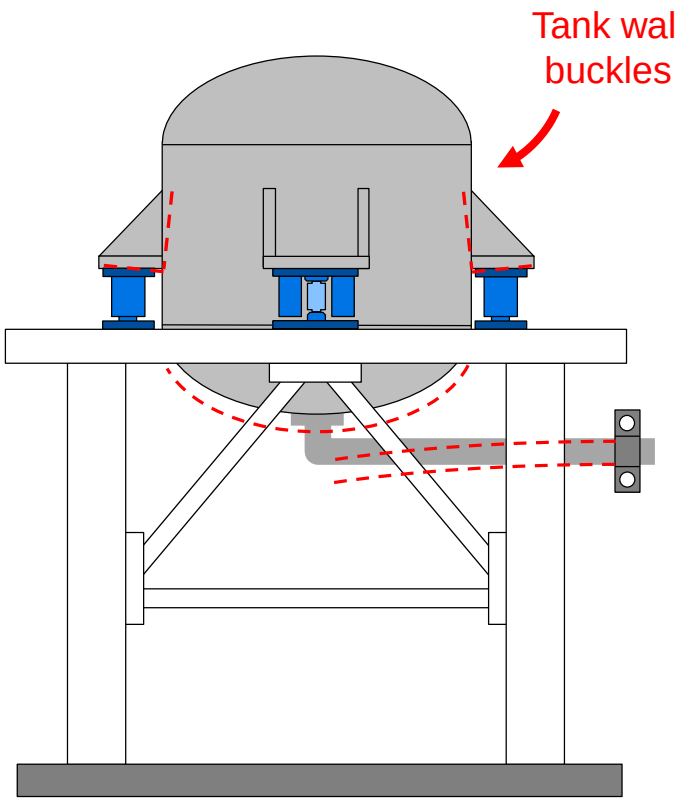
Top view



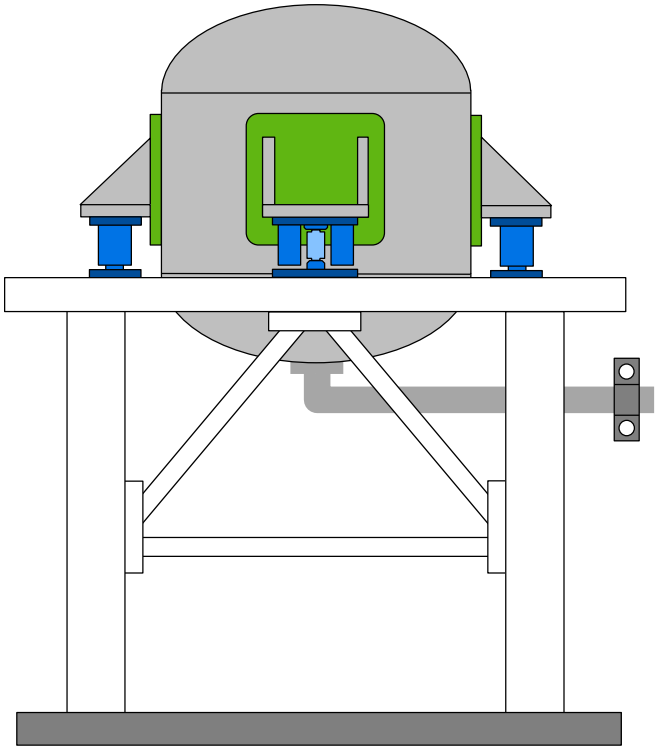
Crossbar

Reinforced Mounting Points

Large deflection due to weak tank walls

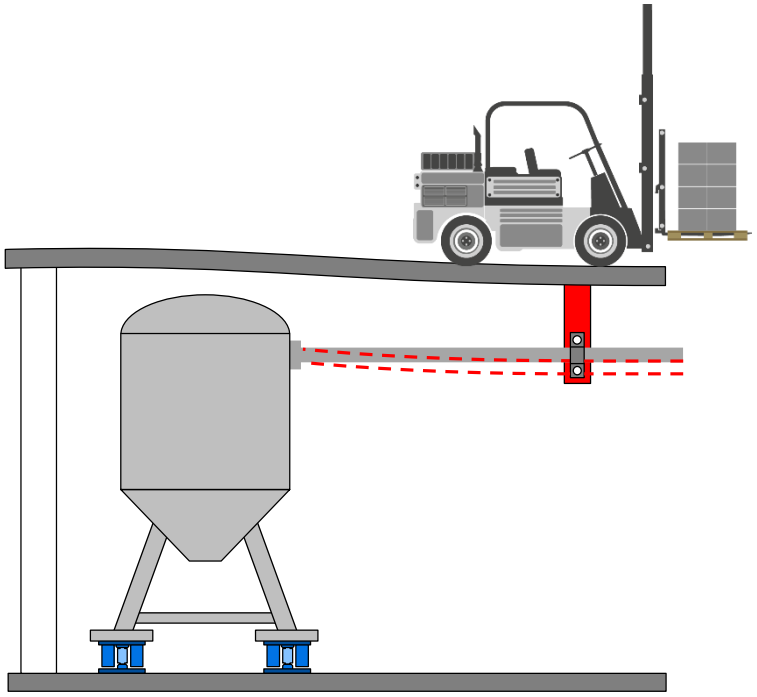


Reinforce tank wall behind support bracket

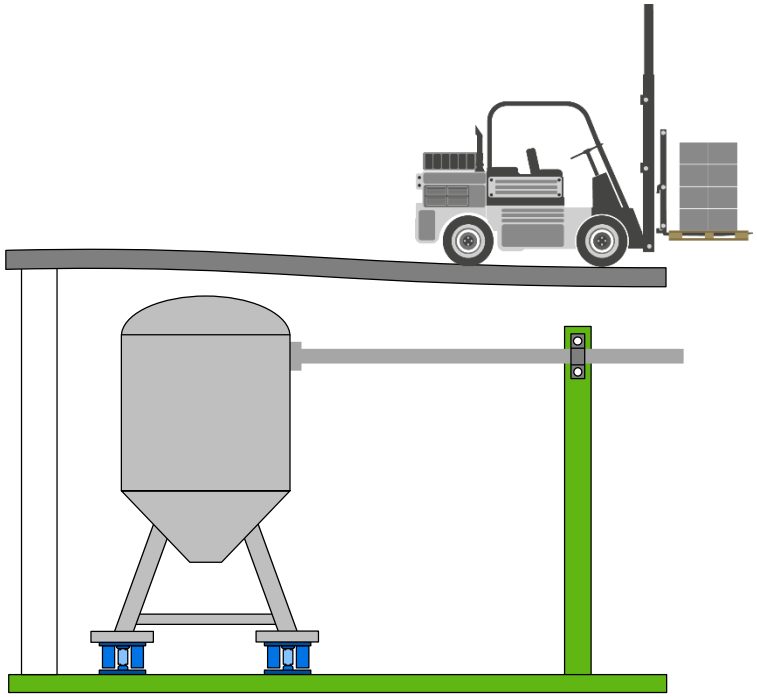


Prevent Independent Pipe Movement

Pipe is clamped to a structure that moves independently

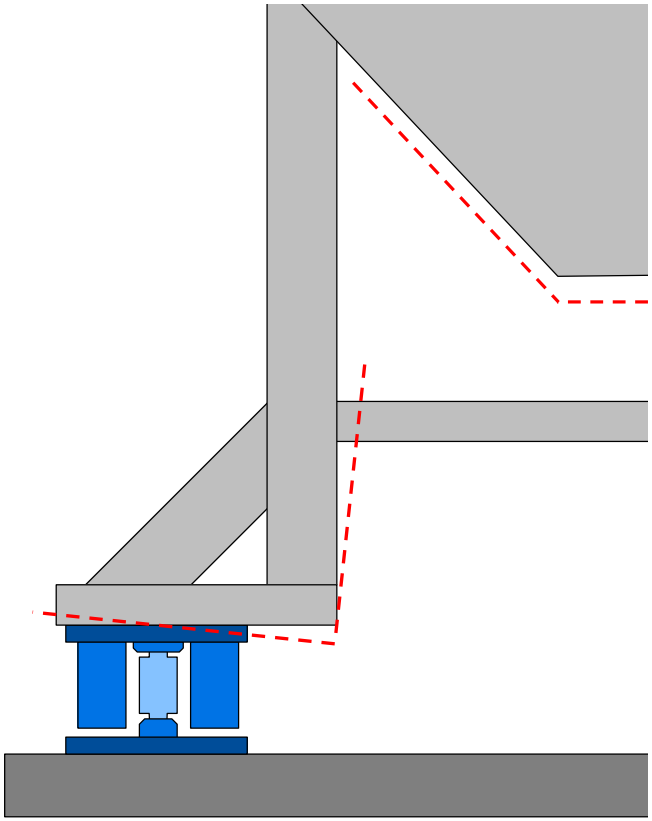


Tank and pipe are attached to the same structure

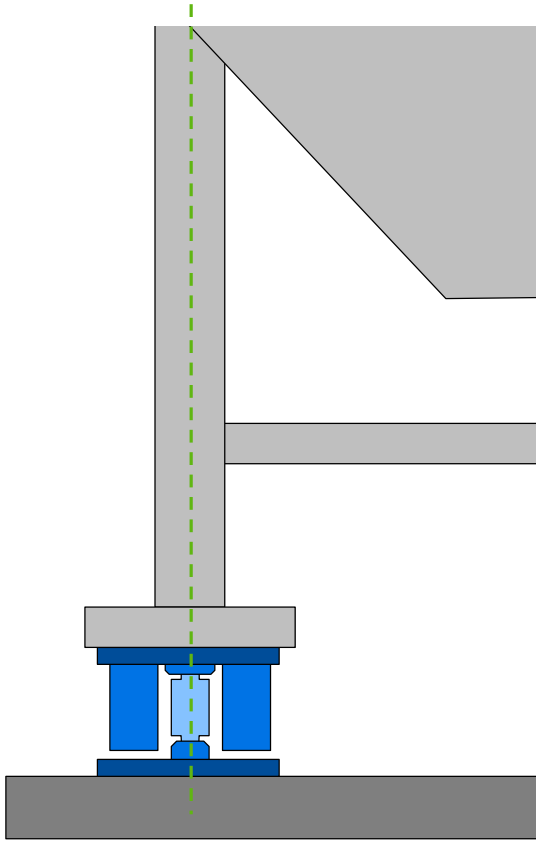


Centric Load Transfer

Localized deflection at Weigh Module mounting point



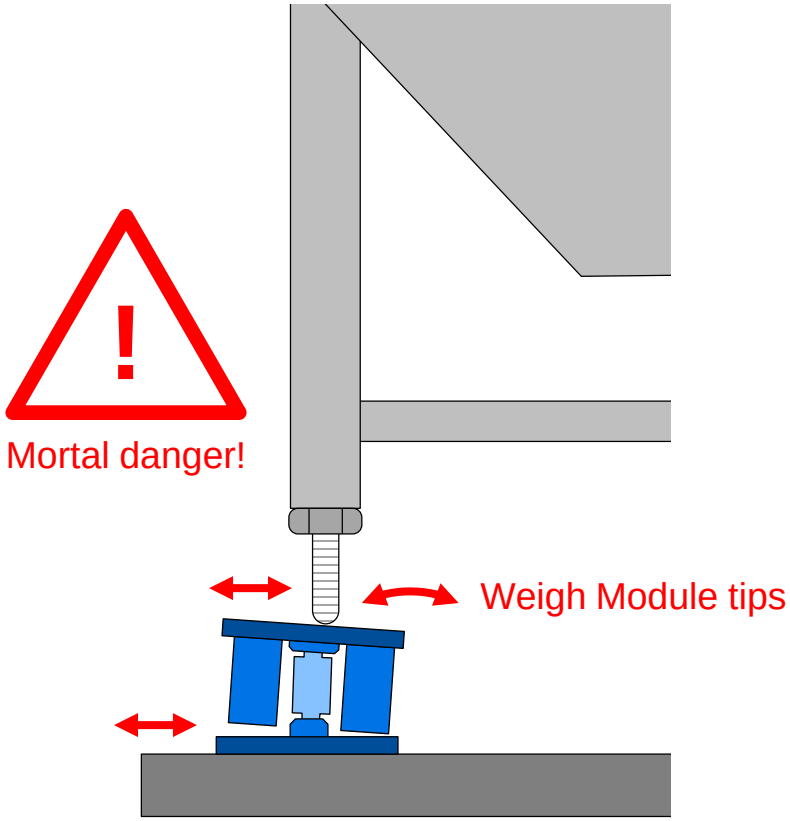
Support tank legs at their center line



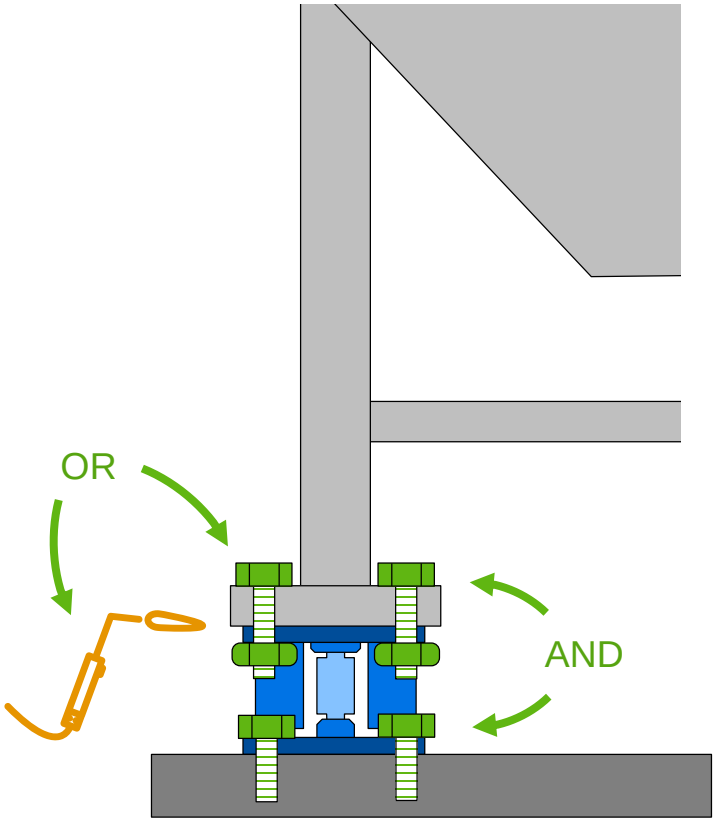
Content

Weigh Module Fastening

Weigh Module not fastened to tank leg or ground

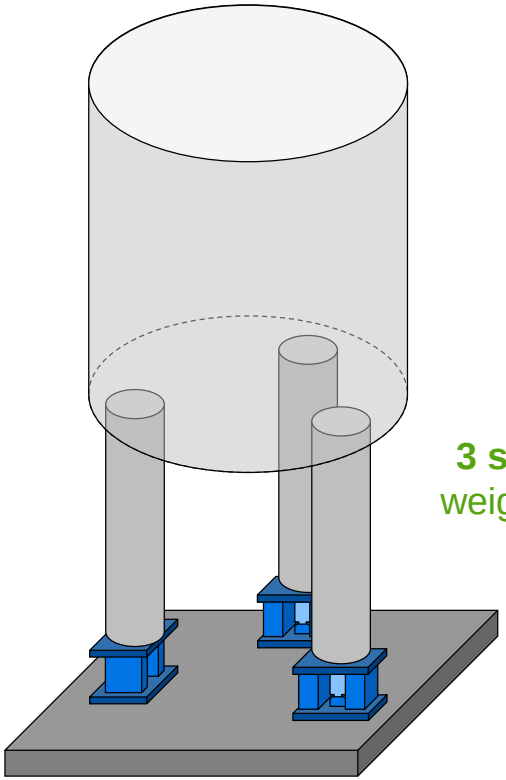


Weigh Module welded or bolted safely to leg and foundation

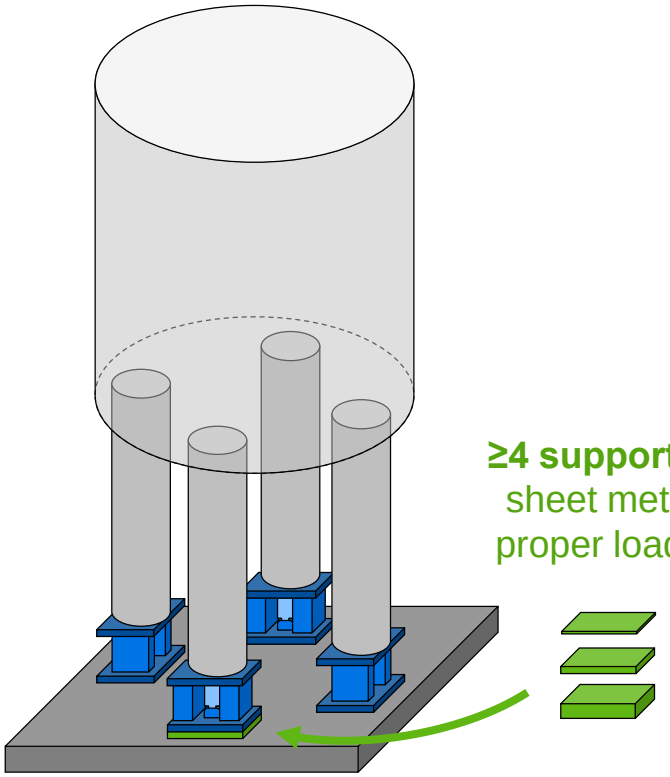


Shimming for 4 Legs and More

A 3-support system does not require shimming, 4 and more supports may require shimming for a proper load distribution



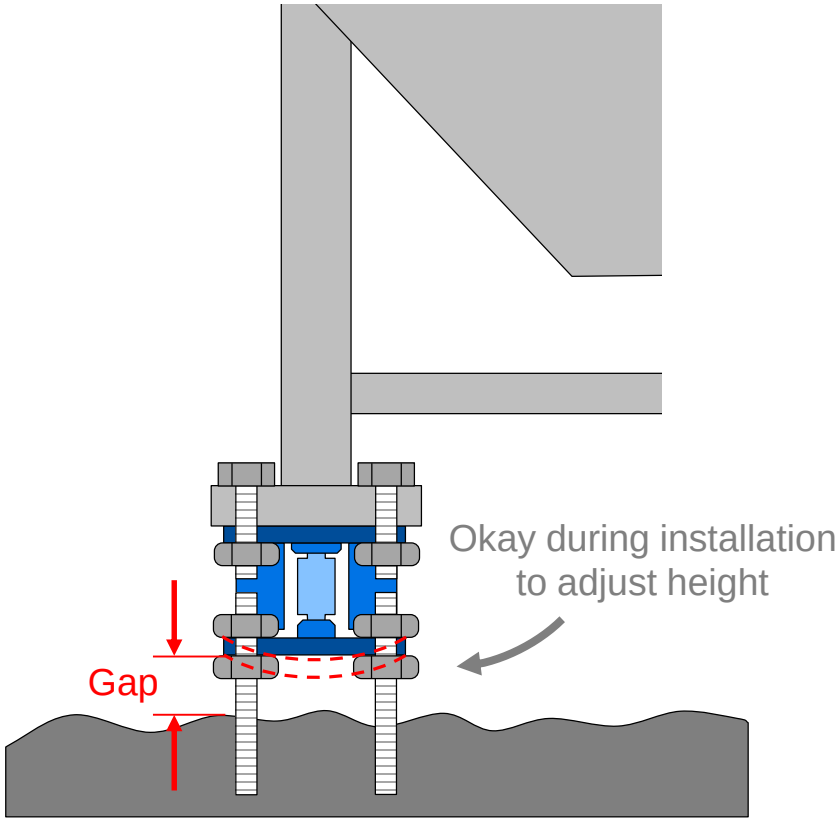
3 supports: Good weight distribution is inherent



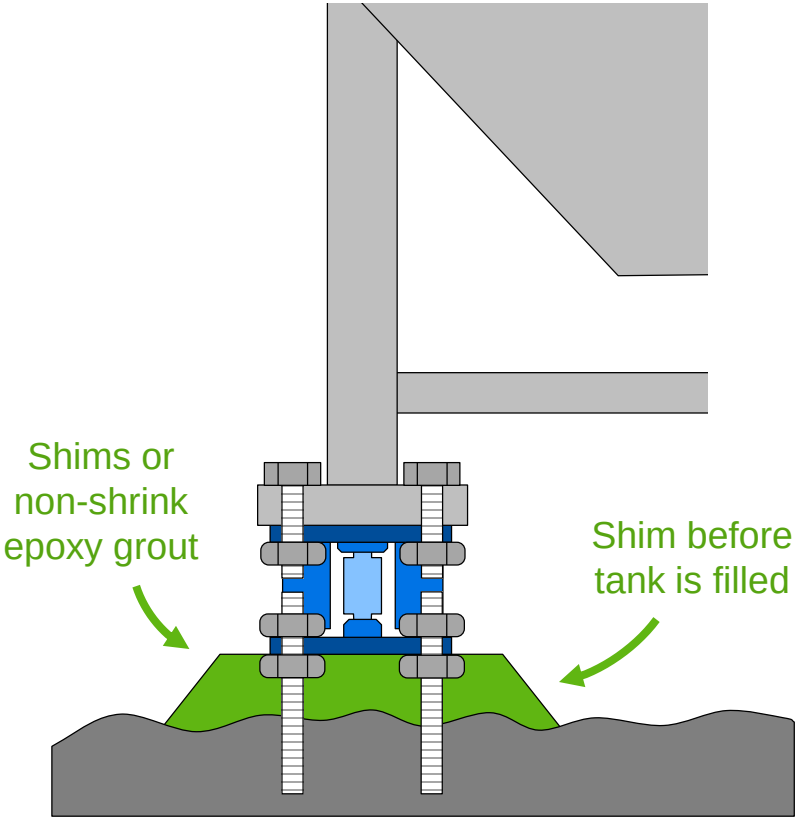
≥4 supports: Shim with sheet metal to ensure proper load distribution

Base Plate Support

Weigh Module base plate bends due to lack of support

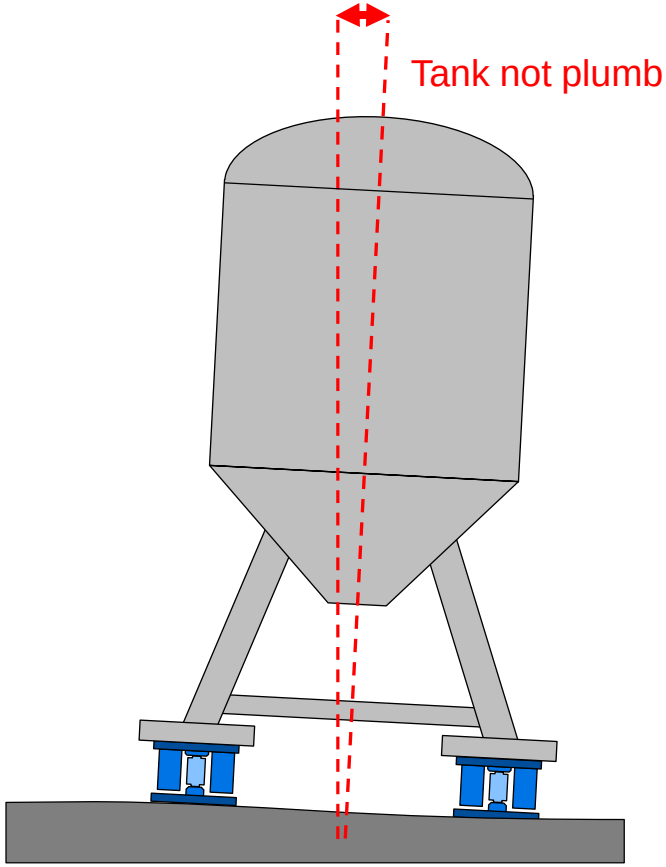


Full support of Weigh Module base plate, e.g. by shims or injectable grout

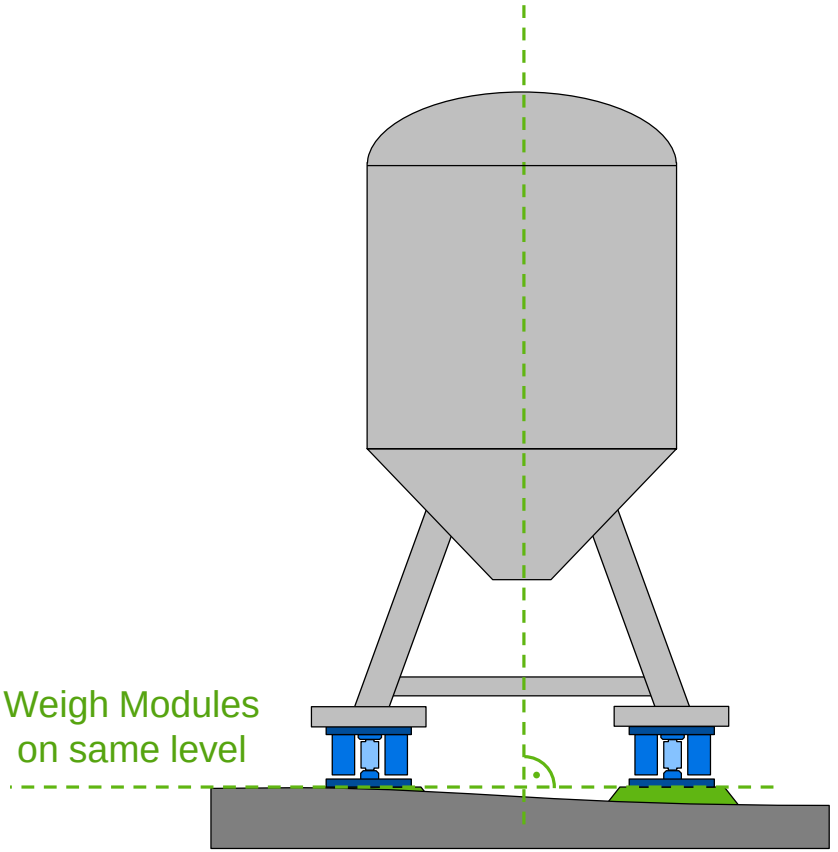


Levelling of Tank

A tilted scale leads to an uneven load distribution

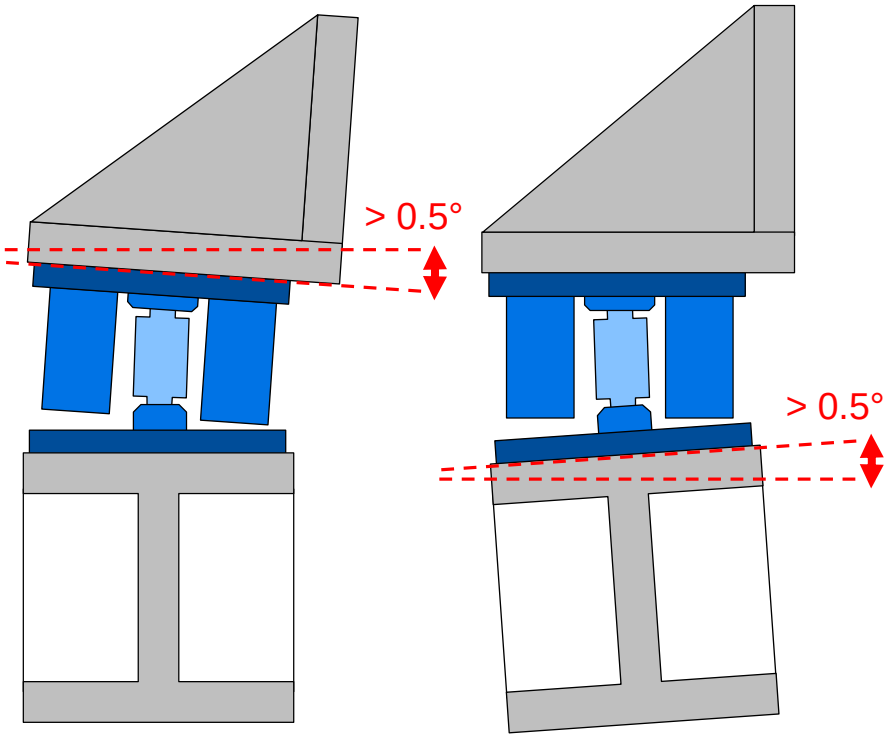


Shim Weigh Modules to ensure a plumb and levelled installation

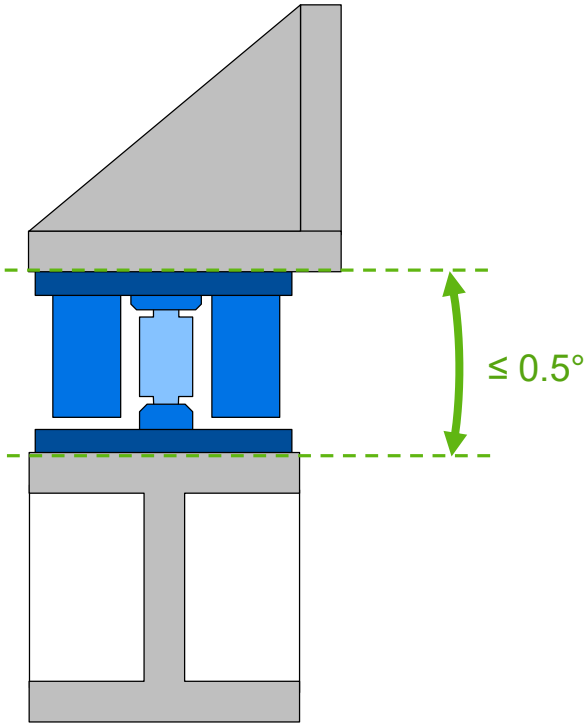


Levelling of Weigh Modules

Weigh Module top plate or base plate tilted by more than ±0.5°

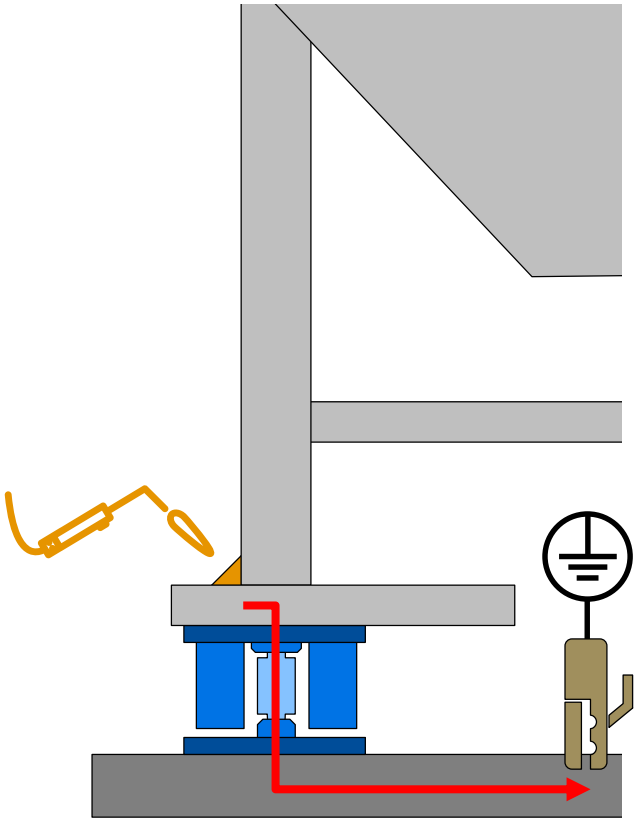


Support bracket and support structure are aligned properly

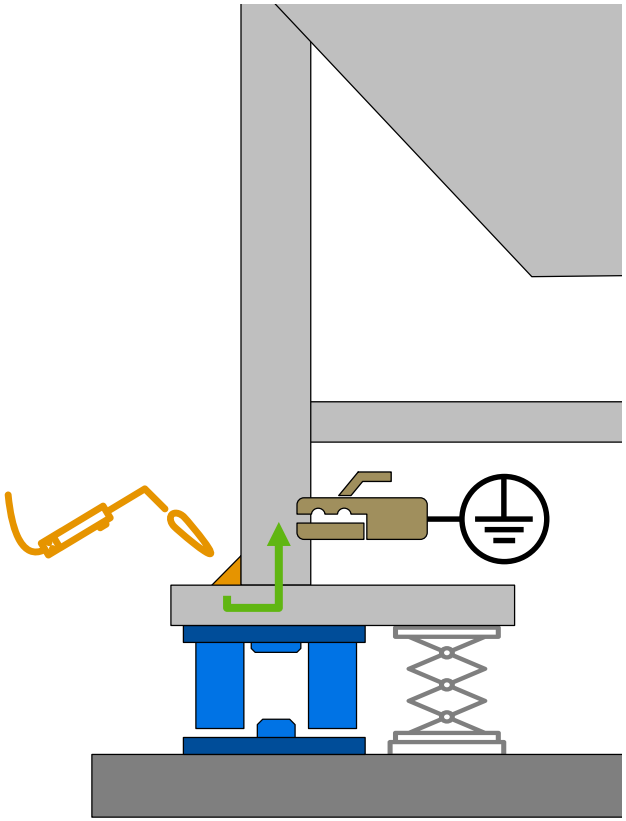


Welding Work on Tank

Welding current flows through Load Cell

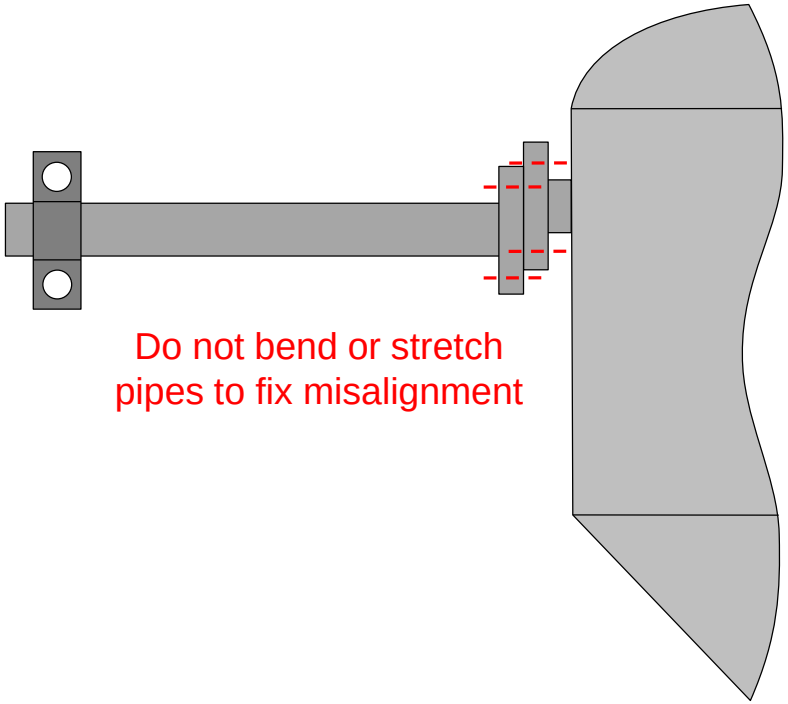


Grounding near welding zone, remove Load Cell when closer than 1.2 m (4 ft)



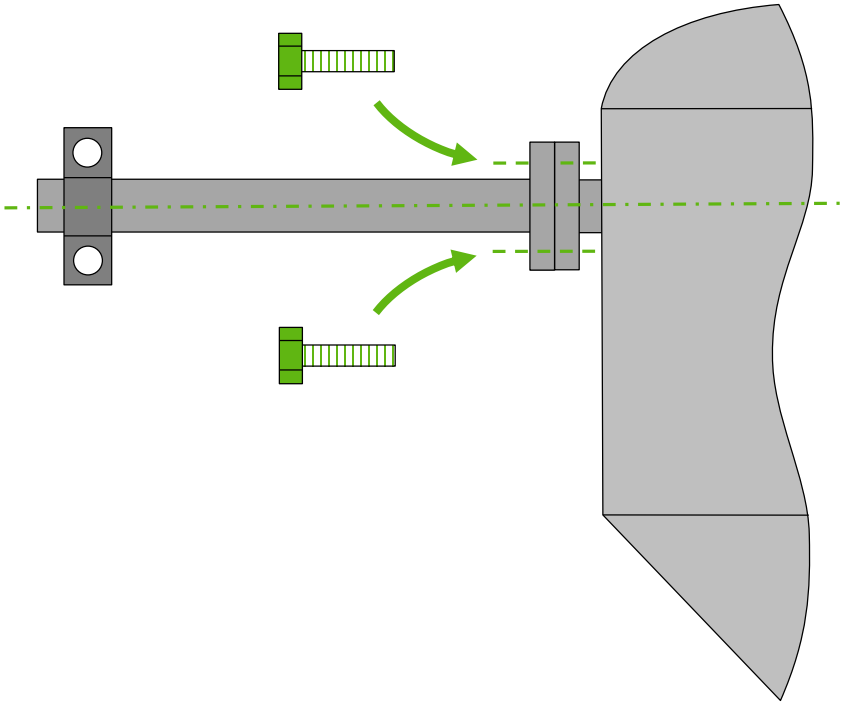
Precise Pipe Alignment

Pipe and tank flanges not aligned before bolting



Do not bend or stretch pipes to fix misalignment

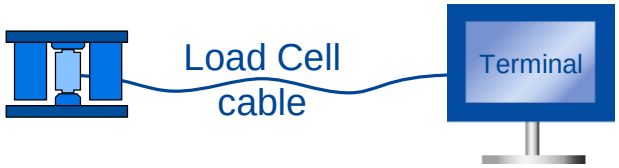
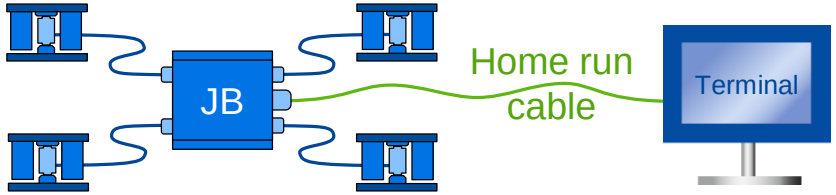
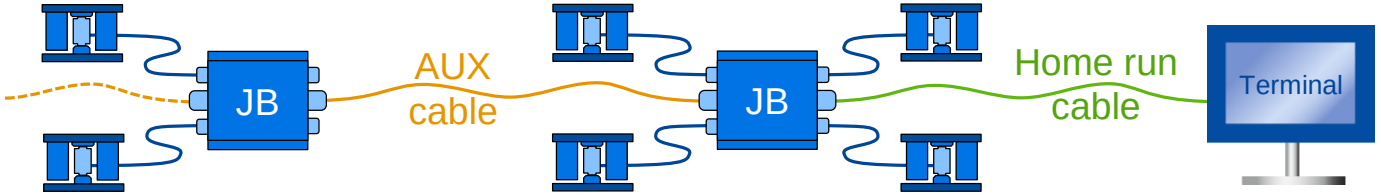
Precise pipe alignment avoids pre-stress



Content

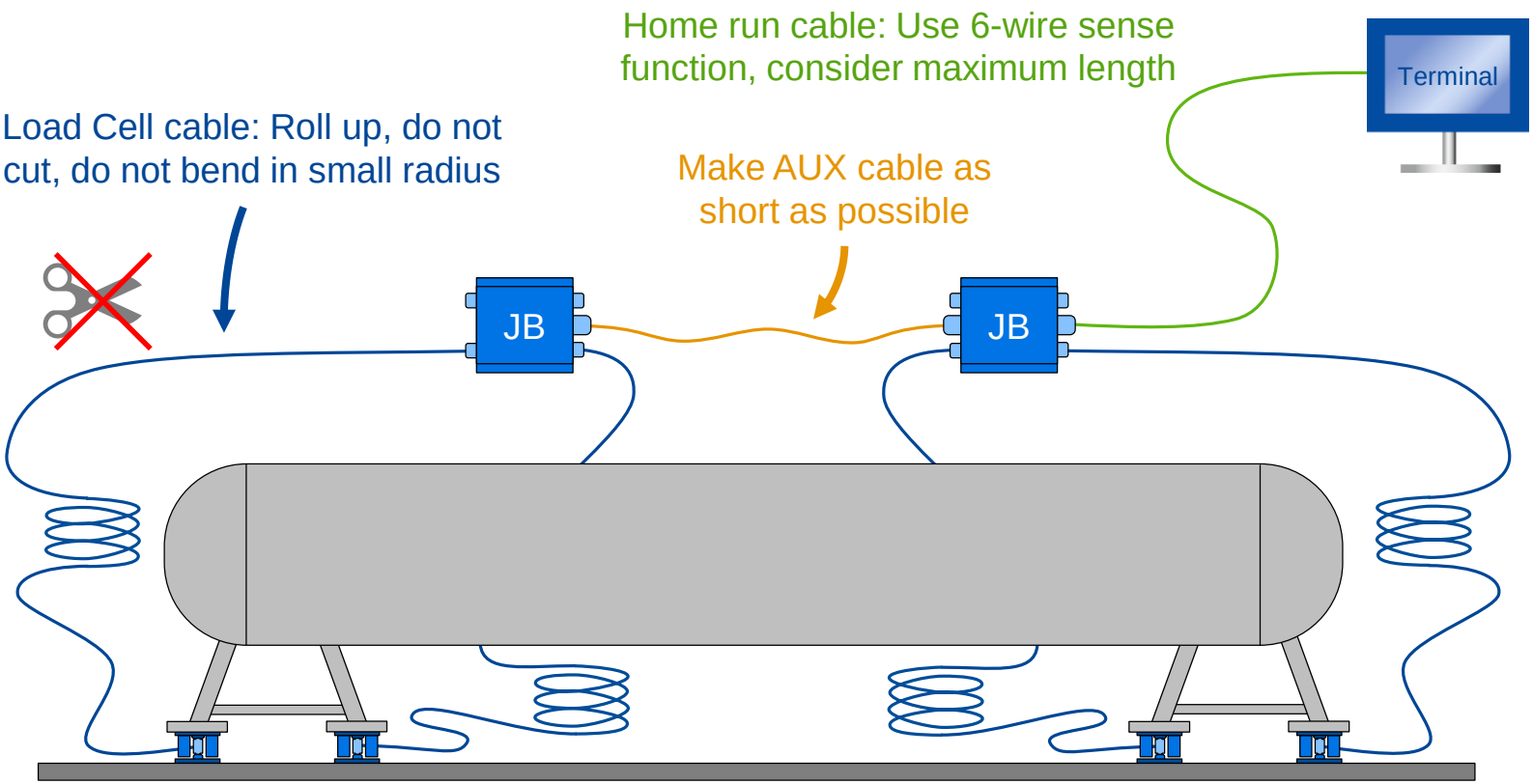
Junction Box Connection (Analog Only)

Multiple analog Load Cells are connected by a Junction Box.
Multiple Junction Boxes are connected in series by auxiliary (AUX) cables

1 Load Cell	
>1 Load Cells, 1 Junction Box	
>1 Load Cells, >1 Junction Boxes	

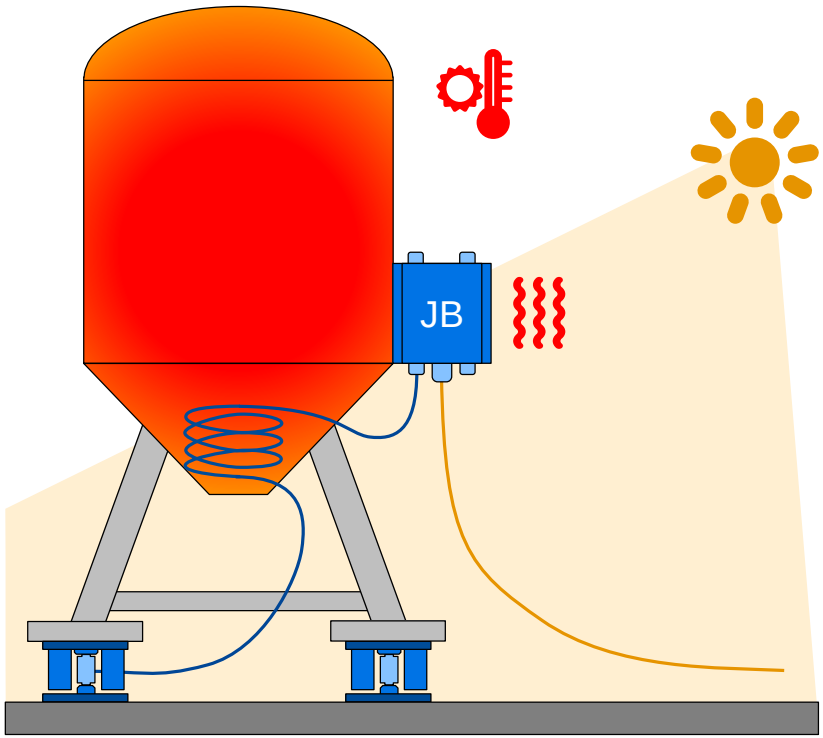
Cable Handling for Load Cells (Analog Only)

Do not cut Load Cell cables. Make Junction Box auxiliary (AUX) cables as short as possible (analog devices)

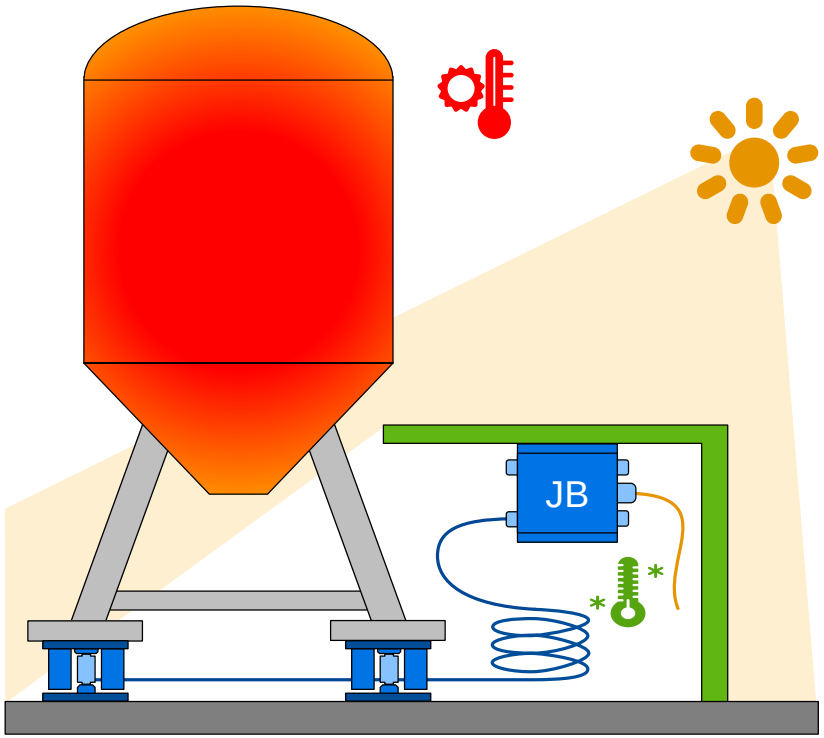


Protection from the Elements

Load Cells, Junction Box and cables exposed to sun, heat, or water

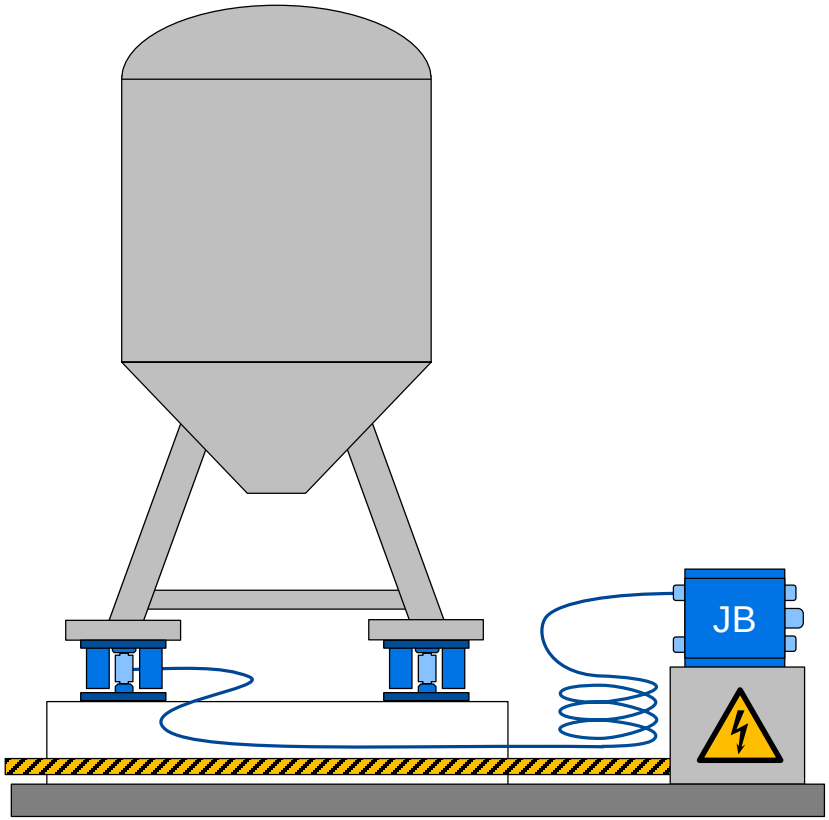


Protection of all devices and cables from environmental influences

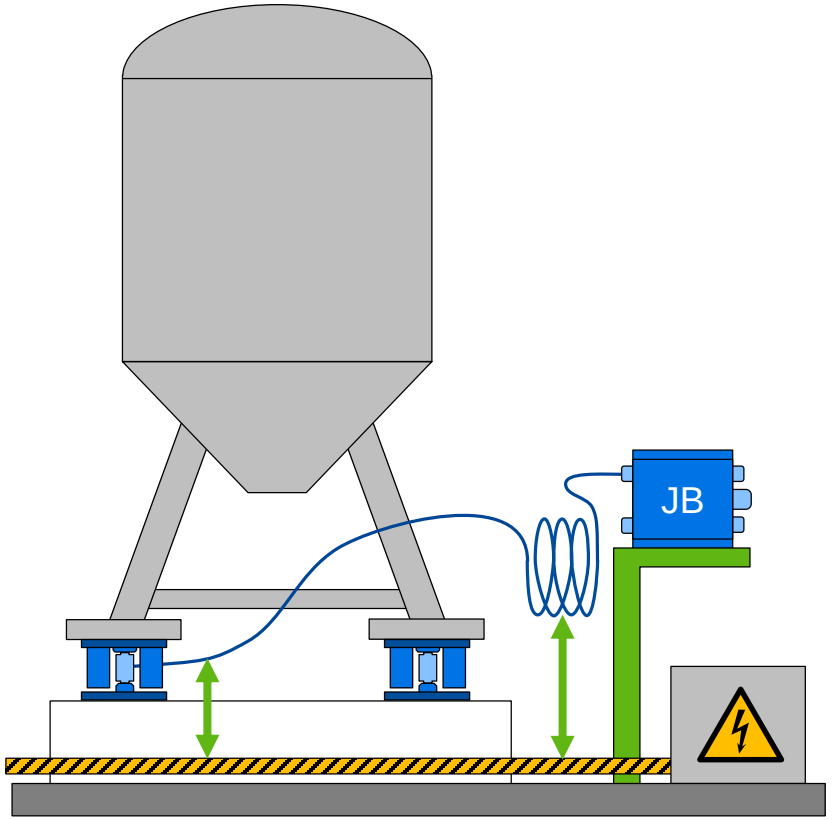


Protection from Electromagnetic Interference

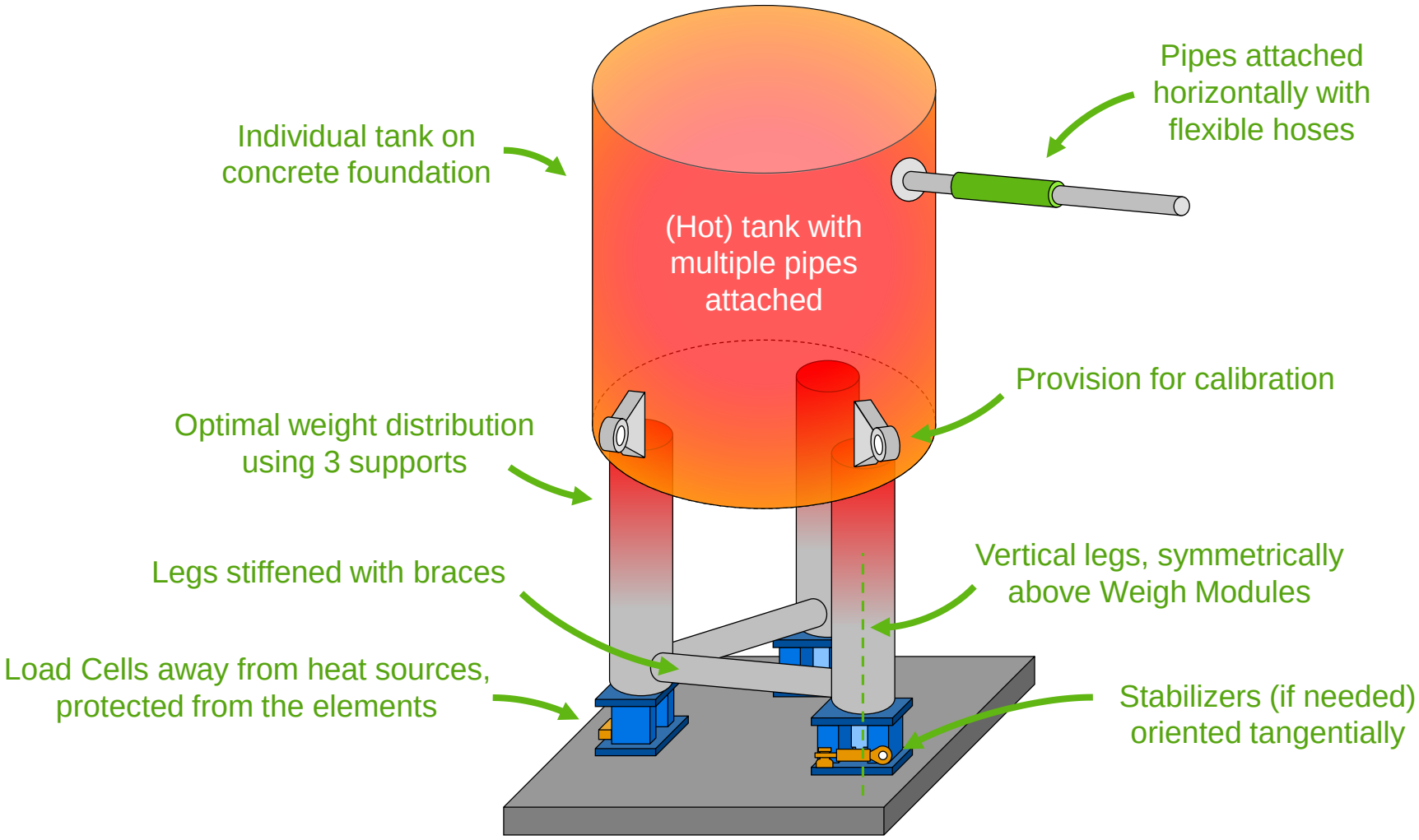
Junction Box and cables near power lines



Junction Box and cables away from power lines



Summary: Scale Design for High Accuracy



Checklist

Scale design and piping considerations

- ❑ Weigh Module capacity calculation: Consider worst case and special situations
- ❑ Design scale with ideally 3 supports
- ❑ Stiffen legs with braces
- ❑ Ensure a rigid support structure and foundation
- ❑ Consider the center of gravity of the scale for leg design and support positioning
- ❑ Include jacking points and provision for calibration
- ❑ Apply safety rods for tension Weigh Modules
- ❑ Ensure a constant or controlled pressure
- ❑ Keep Load Cells away from heat sources, apply thermal isolation or shock/vibration pads if necessary
- ❑ Use stabilizers to dampen vibrations
- ❑ Orient stabilizers in order that they do not interfere with thermal expansion of the scale
- ❑ If possible, avoid any attachment that shunts load
- ❑ Reduce the influence of attached pipes as far as possible:
  - Minimize the pipe stiffness, e.g. by flexible hoses
  - Place scales individually on a concrete foundation

Mechanical and electrical installation

- ❑ Weld or bolt Weigh Modules to legs and foundation
- ❑ Shim Weigh Modules to ensure a proper load distribution (applies for 4 and more supports)
- ❑ Ensure a full support of the Weigh Module base plate, e.g. by shims or injectable grout
- ❑ Ensure a plumb and levelled installation
- ❑ Welding current must not pass through the Load Cell
- ❑ Align pipes precisely, do not pre-stress them during installation
- ❑ Do not cut Load Cell cables (applies to analog devices)
- ❑ Protect all devices and cables from the elements
- ❑ Do not lay devices and cables near power lines

Consult METTLER TOLEDO's Weigh Module Systems Handbook and your local point of contact for further guidance!