



Silo Weigh IIoT

(Industrial Internet of Things)

User's Manual

Ver: 1.9

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Errors in documentation:

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Should you have any difficulty in installation, operation, or maintenance of your SiloWeigh IIoT system, our staff are available to help you during normal business hours and at any other time by special arrangement.

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1.0 Introduction

This manual contains complete instructions for the setup and calibration of the SiloWeigh IIoT systems.

Software Installation

Your SiloWeigh IIoT system has all the software pre-loaded and depending on what information was supplied at the time of ordering, it may also be pre-configured.

SiloWeigh IIoT can record weights of up to 32 Vessels per location with information being pushed to your local network and or the cloud. Optional touchscreens are also available as a local display

Throughout the manual, warnings, cautions, and special notes are added to indicate a potentially hazardous condition or to identify a potentially hazardous situation if not corrected.



Describes a condition that may prove to be harmful or fatal to either personnel, equipment or both.

NOTE:

Describes a condition which requires special attention.

2.0 Before you start

Please read, understand, and follow all steps in this manual. Failure to do so can result in a faulty installation, and erroneous readings.

Installation of your system requires the use of a few basic tools. Ensure the installer understands how to use the tools, and that they are used in a safe manner. Certain tools are provided with the installation kit. Below is a list of the tools needed to perform an installation of the system, although in practice you may choose to use other tools if they make the job easier.

- Emery cloth (variety of grits)
- Drill
- 3mm, 5mm, and step drill (included)
- Center punch (included)
- M6 and M10 tap set (included where necessary)
- Digital Multimeter (must read millivolts, ohms, and megohms)
- 10mm & 17mm wrenches for M6 & M10 bolts & nuts
- Torque Wrench to fit 17mm nuts & bolts, with long socket if using weld tabs
- Small slot blade screwdriver
- Wire cutter and stripper (for #22AWG wire)

2.1 Grounding

To avoid damage due to lightning or static build-up on the vessel, both the vessel and the display cabinet should be at the same electrical potential. Run #10 wire or thicker from a convenient location on the Vessel structure to the Ground stud inside the SiloWeigh IIoT cabinet. If this is not done, the system could be damaged during a lightning storm; this is not covered by the warranty.



DANGER – DO NOT APPROACH OR TOUCH THE CABINET DURING A LIGHTNING STORM. The internal components are connected to the Vessel and can become charged with high voltages during these events. Flashover to your body can occur, with possibly fatal results. Lightning is dangerous – keep away from all electrical devices.

2.2 Installations of 10 vessels or more

When the total number of vessels exceeds 10, the total number of sensors exceeds 50 or the total cable run from the DAQ to the furthest vessel DJB exceeds 150 feet, the cable run has to be evaluated to ensure that the voltage drop in the power lines is not excessive. In cases where many vessels and many sensors per vessel are all connected in the same system, it may be necessary to devise separate power and data wiring runs, using cable appropriate to the task. Consult Scale-Tron for the best solution.

Some information for use in this task:

The data cable provided is 4 conductor, 22 AWG per conductor, shielded.

22 AWG cable has a resistance of 1.65 ohm per 100 ft. Allow for twice the length used since there are 2 conductors involved (black and red).

The resistance of 18 AWG drops to 0.651 ohm per 100 ft and may be better for long runs.

The power supply inside your SiloWeigh IIoT cabinet is 24 volts DC. The absolute minimum at the DJB power terminals must be kept to 7.0 volts or higher, which should not be a problem for most systems.

Use of this type of shielded cable for long runs (1000 ft or more) with RS485 is not recommended. Use CAT5E low capacitance twisted pair instead and use only one pair for the RS485. Do not ‘fan out’ from a central point – this cable **MUST** be run as a daisy-chain or multi-drop connection. This length of CAT5E cable may have too great a drop for use as power cable. After calculating the drop, consider a separate 18-gauge cable or larger for power as shown above.

2.3 Installation and wiring of the Cabinet

Prior to starting this process, it is assumed that the sensors, junction boxes, and DJBs have been installed, and wired to one another. (Please see the separate manual supplied with your system)

This step will see the cabinet installed, and connected to the sensors, to your network, and to power.

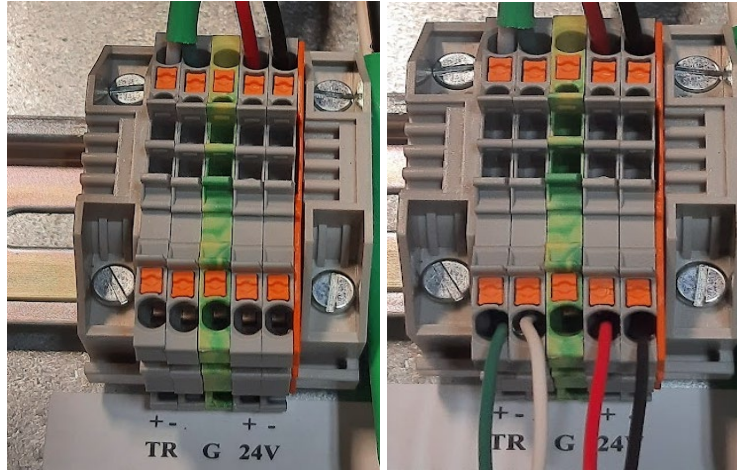
2.4 Mounting the Cabinet

Affix the metal mounting clips to the back of the cabinet with the supplied hardware. Mount the cabinet on a convenient wall. Any additional mounting components are not supplied by Scale-Tron and depend on the specific installation location.

2.5 Connecting cables from DJB(s) to the main cabinet

Feed the cables coming from the DJB(s) through the strain relief into the cabinet interior. Cut the cable and strip 3 inches of insulation from the outer insulation. Remove the aluminum shield and use the cable jacket to insulate the shield wire. To connect the wires into the quick connect terminals use a small screwdriver to push the orange tab in, then insert the wire and release the tab to lock in the wire.

Wire Insulation Color	Terminal titles
Red	24V+
Black	24V-
Green	TR+
White	TR-



2.6 Connecting the Power

Ensure the circuit breaker inside the enclosure has the tab pointing down and a green bar. Connect the power cable to an AC outlet or to a dedicated junction box if permanent connection is preferred. Push the circuit breaker tab up and confirm the red bar is showing.

 **WARNING CAUTION** CAUTION – THE SYSTEM IS NOW LIVE, CLOSE THE CABINET DOOR.

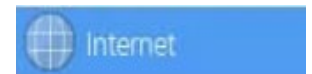
2.7 Connecting to your Network

Locate the nearest network router or hub. Install a new network cable (not supplied) at your router or hub and connect it to the ethernet port located on the underside of the cabinet. Type <http://swn.local> in a browser to access SiloWeigh IIoT.

The router where the DAQ board is connected will assign an IP automatically. If this IP is required, it can be obtained by opening a Command prompt and typing **ping -4 swn.local** This IP can also be used to access the SiloWeigh IIoT system by typing [http:insert Ip address/SiloWeigh IIoT](http://insert Ip address/SiloWeigh IIoT)



If you purchased a panel mount screen with your SiloWeigh IIoT system, click on the internet icon on the home screen to launch the software.

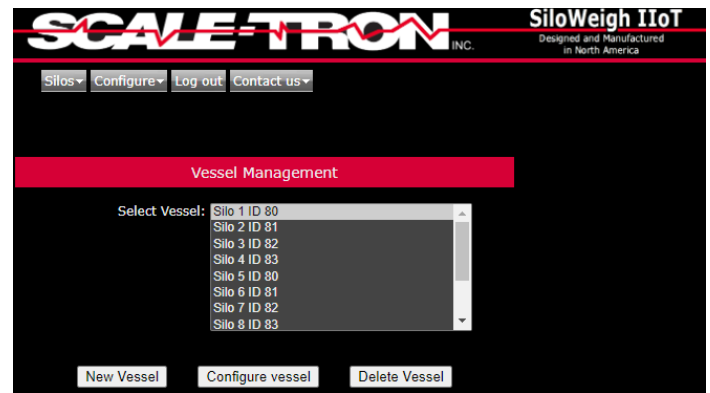


Click the ‘swn.local’ tab this will launch the local browser where you can enter the defaults parameters.
 Username: **admin** Password: **admin**



2.7.0 Adding new vessels and configuring alarms and weather filters.

Use your mouse to hover over the ‘Configure’ tab and move your cursor to the right, clicking on ‘DAQ’ tab then click ‘Manage vessels On This DAQ’ then click ‘New Vessel’



Fill out the grey boxes as shown below with the appropriate information. The ‘Transmitter Address’ should correspond to the number on the light grey digital junction box located on the corresponding vessel. Certain fields are prefilled namely, ‘Data Capture Interval’ and ‘DAQ ID’. ‘Current Weight Value Unfiltered’ and ‘Filtered’ will be generated during the calibration process.

‘Capacity’ indicates the maximum storage weight of the vessel. The specified vessel capacity is normally calculated to conservatively hold the stated amount when density is at its lowest (volume is highest). Under normal conditions, it is usually possible to add more material than this calculated amount. To prevent your display going over-scale and not reading, you should always enter a capacity value at least 10% higher than the design capacity. Example: Vessel rated at 100-ton capacity; set capacity to 110 or 120 ton for a cement Vessel where the material fluffs during filling but settles later and reduce your Overfill limit to 100 ton or less.

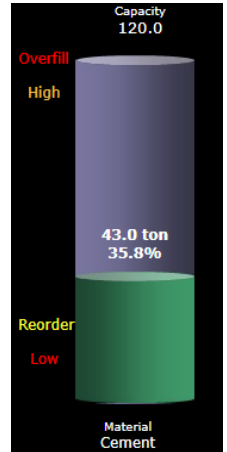
NOTE:

In the ‘Measurement units’ select Tonne, Ton or Kilopound, as required.



‘Overfill’ and ‘High’ are alarm conditions that will be visually triggered should the contents of the vessel exceed the entered values (as a percentage of capacity).

‘Reorder’ and ‘Low’ are alarm conditions that will be visually triggered should the contents of the vessel drop below the specified values (as percentages of capacity).



Local Alarms: Setpoints and I/O Configuration				
	Set Point	Visual Alarm I/O Port	Audible Alarm I/O Port	Discrete Alarm I/O Port
Overfill:	100.0 %	Off	Off	Off
High:	90.0 %	Off	Off	Off
Reorder:	20.0 %	Off	Off	Off
Low:	10.0 %	Off	Off	Off
High Use:	0.0 %	Off	Off	Off

NOTE: Local Set Point alarms are visual alarms only, denoted by the Vessel display changing color and details being recorded in the alarm log. Visual, Audible and Discrete Alarm I/O should be set to ‘Off’ unless you have purchased the relay option to connect to external alarms.

‘Number of sensors per input’

For each input of the DJB, enter the number of sensors connected. Typically, a separate sensor should be connected to each input for vessels of 4 legs. If more than 4 sensors are used, it is acceptable to connect a maximum of 2 sensors to each input.

NOTE: If a sensor is damaged, it can be disabled by entering 0 instead of 1 in the ‘Number of Sensors per Input’. The example to the right shows sensor 1 has been disabled. The span or slope should remain accurate within 10% in most cases, allowing you to continue using the system until the problem is rectified.

‘Filter coefficients And Covariances’ determine how the readings and graph are derived from the raw values. Since fast temperature changes caused by the sun can affect the readings and cause temporary errors, the advanced filter in the SiloWeigh IIoT software has been developed to hold the readings steady during these fluctuations. SiloWeigh IIoT is the only system to have this type of advanced reading correction. When a real change occurs, the filter recognizes it and responds with very little delay. How it responds can be altered by the settings of the parameters.

NOTE: The R parameters are dependent on the Data Capture Interval and defaults shown in Red are based on the default filter sampling time of 300 seconds (5 min.). If the reporting time is made shorter, R+ and R- should be increased in proportion, and vice versa. Example: If ‘Data Capture Interval’ is set to 150 seconds in place of 300, default for R+ should increase to 60. L+ and L- are not affected except for L+ relationship to fill rate.

‘L+’ is the filling threshold value, above which the filter response is made much faster. Check that the filtered value follows the raw value. Use the default value as a starting point and watch the result over a few days.

Value = 6	Fill rate of 2 to 10 % of capacity per minute
Value = 2	Fill rate of 0.5 to 1 % of capacity per min.
Value = 1	Fill rate of 0.1 to 0.5 % of capacity per minute
Value = 20	Parameter disabled (full filtering)

Always use the most negative value, consistent with the error that you find acceptable. Values are recommendations only. Contact us for a full no-cost analysis. *These values are thresholds and are not dependent on the Data Capture Interval.*

‘L-’ is the discharge threshold value, below which the filter response is also made faster. Use the default value as a starting point and watch the result over a few days. Always use the minimum value, consistent with the error that you find acceptable. Recommended values are for a 100 ton capacity cement Vessel which receives deliveries of 25 to 30 tons over a 40 to 60 minute period. *These values are thresholds and are not dependent on the Data Capture interval.*

Value = -0.7	Discharge rate of 5 to 10 % of capacity/hour.
Value = -0.3	Discharge rate of 0.5 to 2 % of capacity/hour.
Value = -0.1	Discharge rate of 0.02 to 0.2 % of capacity/hour.
Value = -20	Parameter disabled (full filtering)

‘R+’ determines how closely the readings follow the raw value during stable periods, slow increase or decrease. Smaller values will allow it to follow more closely with less time delay but will increase the possibility of response to temperature fluctuations. Always use the maximum value, consistent with the reading delay that you find acceptable. *Values are dependent on the Data Capture interval and weather.*

Value = 100	Rise/fall time of 100 hours
Value = 30	Rise/fall time of 30 hours
Value = 1	Filter disabled

‘R-’ is the controls how closely the readings follow the raw value when a discharge is detected. A value of 10 is acceptable for discharges of less than 2% per hour. For discharge rates of 5 – 10% per hour, values of 2 to 3 will give delays of ½ to 1 hour. Results are somewhat related to the R+ and L- values.

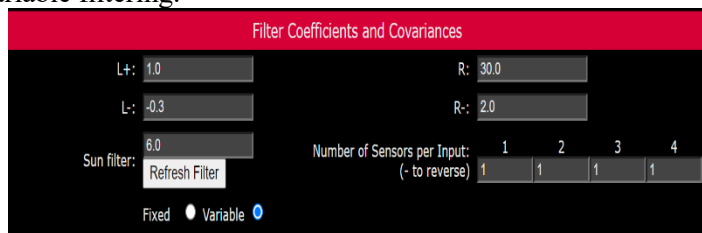
Value = 10	Delay of 2 hours
Value = 2	Delay of 1/2 hour
Value = 1	Delay of 15 min.

To disable all filtering (filtered = raw values), leave L+ and L- at their default values and set both R+ and R- to 1.

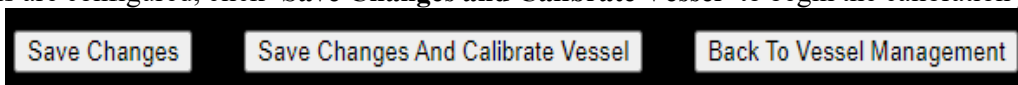
‘Sun filter’ fixed/variable – for outdoor Vessels, you should always use the variable setting to allow the filter parameters to provide more filtering during the highly variable effects of the weather, sunlight in particular. For indoor use or with load cells, choose the fixed setting for non-variable filtering.

‘Refresh Filter’ Instantly sets the filtered value to match the raw (unfiltered) value.

When complete, click ‘Save Changes’. Repeat the process for each additional installed vessel.



Once all vessels are configured, click ‘Save Changes and Calibrate Vessel’ to begin the calibration process.

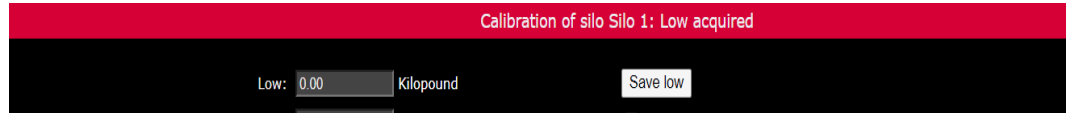


2.8 Calibration of Single Vessels

NOTE:

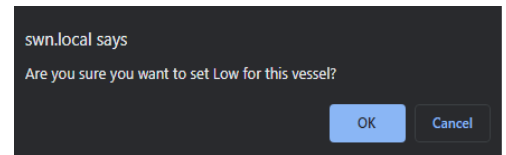
If you are calibrating a large silo which is likely to take many hours or days to complete, please read section 2.10.2 before commencing any calibration.

Click on the ‘**Low**’ box and enter your best estimate of the contents of the vessel, in the units



you already selected (e.g., ton), at its current low level. The more accurate the estimate, the more precise the calibration, although the calibration parameters can at a later time be tweaked to adjust the level if it shows an error.

Click ‘**Save Low**’ and click ‘**OK**’ in the pop-up box to confirm. Note that clicking ‘**OK**’ replaces any previous value with your new value. The banner will confirm ‘**Low acquired**’.



Wait until a known quantity of material has been deposited in the vessel. It is critical that the quantity being deposited is known accurately. The larger the quantity of material deposited, the more precise the calibration will be, but filling should always be done over a period of 2 hours or less if possible.

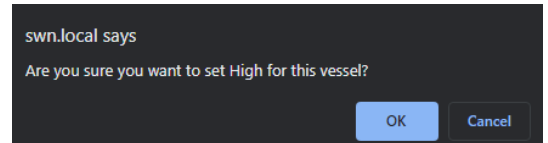
NOTE:

If your low value was not 0, you need to add your current low value to your high value before entering and clicking ‘**Save high**’. Example, low value 5.2 tons, delivered amount 36.0 tons, high value to be entered would be 41.2 tons. Remember to deduct any estimated usage taken out during the filling process.

Click on the ‘**High**’ box and enter the amount of material added to the vessel, in the units you already selected (e.g., ton, Kilopound).



Click ‘**Save High**’ and click ‘**OK**’ in the pop-up box to confirm. Note that clicking ‘**OK**’ replaces any previous value with your new value. The banner will confirm ‘**Calibrated**’.

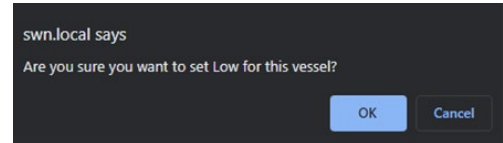


Repeat this process for each additional single Vessel to be calibrated.

The calibration can be done in any order at any time. If the vessel is part or completely full and you know the contents accurately you can enter the ‘**High**’ value first, then empty the vessel and complete the ‘**Low**’ value. If material is used from the Vessel as it is being filled, note the quantity accurately and deduct this from the total when entering the ‘**High**’ value.

NOTE:

The SiloWeigh Network Pop Up may vary in color and text depending on what browser you are using. For example, it may display your IP address instead of **swن.local says**

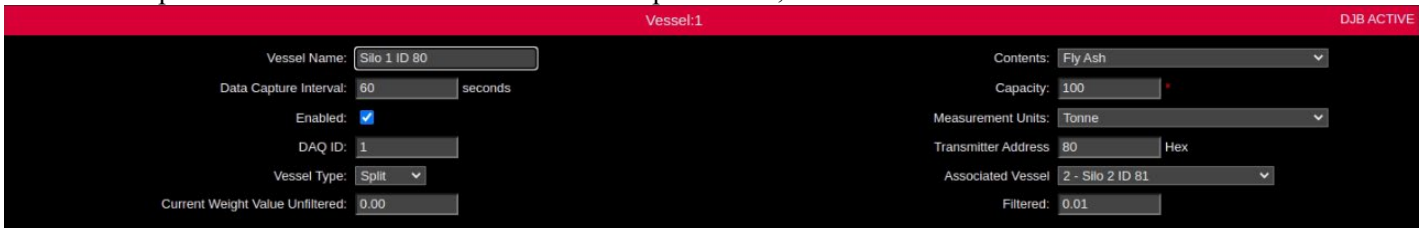


2.9 Calibration of divided Vessels

Divided Vessels can be measured; however, since the four legs are now divided between two compartments, the accuracy will be reduced, typically +/-5% of the vessel capacity.

Before calibration can begin, you need to identify the divided vessel, this is done by firstly selecting the 'Vessel type' and clicking 'Split' You then need to confirm the 'Associated Vessel'

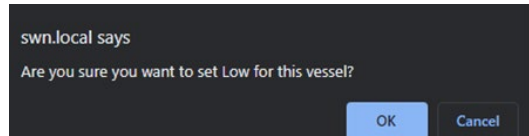
The example shown below identifies Vessel 1 as a split Vessel, associated with Vessel 2.



NOTE:

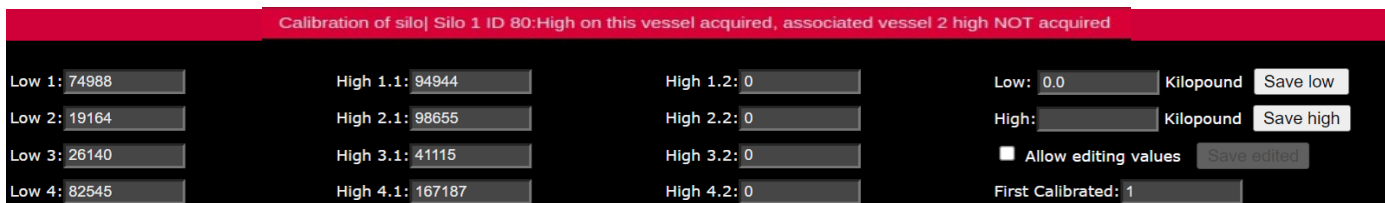
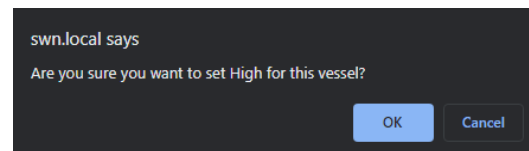
Calibration of a divided Vessel is more critical than for regular Vessels. For this reason, you need to start with both compartments empty and have a delivery ready for each compartment in turn.

Click on the 'Low' box and enter 0.0 Click 'Save Low' and click the 'OK' prompt to confirm. Note that clicking 'OK' for a single side of a split Vessel will automatically save the low value for the associated Vessel. The banner will confirm 'Low acquired'.

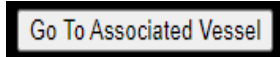


Wait until a known quantity of material has been transferred into the first compartment. It is critical that the quantity being transferred is known accurately. The larger the quantity of material transferred, the more precise the calibration will be.

Click on the 'High' box. Enter the contents of the vessel, in the units you already selected. Click 'Save High' and click the 'OK' prompt to confirm. The banner message will confirm 'High on this vessel acquired, associated vessel # high NOT acquired.' High values will appear for each leg on the 1st side of the vessel.

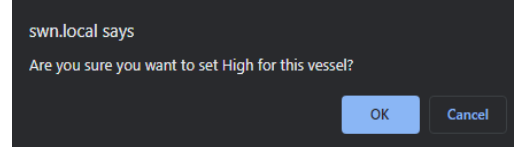


To calibrate the High value for the associated Vessel press ‘Go to Associated Vessel’



Wait until a known quantity of material has been transferred into the second compartment. It is critical that the quantity being transferred is known accurately. The larger the quantity of material transferred, the more precise the calibration will be.

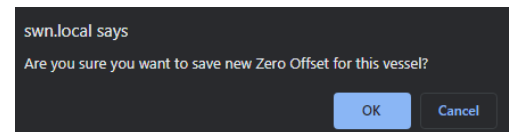
Click on the ‘High’ box. Enter the contents of the vessel, in the units you already selected. Click ‘Save High’ and click the ‘OK’ prompt to confirm. The banner message will confirm ‘Calibration of Silo # Calibrated.’ High values will appear for each leg.



2.10 Calibration adjustments

2.10.0 Adjust zero Offset

This will adjust the reading when the Vessel is empty. If you know that the reading is in error by a fixed amount across the whole range, an offset adjustment is necessary. The adjustment should be equal and opposite to the error; for example, if readings are known to be consistently high by 5 tons, the correction amount should be -5. In the ‘Adjust zero offset’ box, enter the adjustment value as a number and press ‘Save’ and press the ‘OK’ prompt to confirm. The word **Saved** will appear.

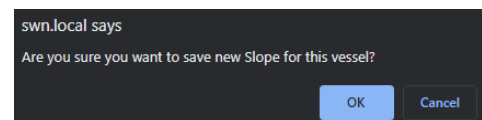
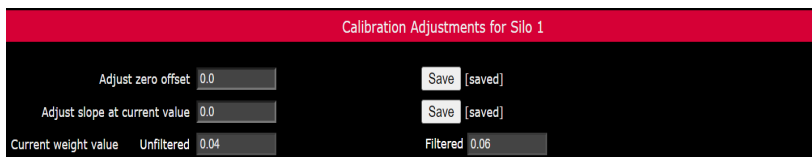


2.10.1 Adjust slope at current value

This will adjust the reading when the Vessel is part full, holding the empty reading steady; it alters the slope of the calibration line, giving a correction that increases as the reading increases. Since this correction is dependent on the reading, it is based on the reading at the current value and the correction at other weights will be different in proportion.

Example: If reading is 10 tons low at a reading of 75 ton, make the adjustment value +10. The reading at 100 ton will change by $100/75 \times 10 = 13.33$ ton.

In the ‘Adjust slope at current value’ box, enter the adjustment value as a number and press ‘Save’ and press ‘OK’ in the pop up box to confirm. The word **saved** will appear.



If both zero and current value are to be adjusted, they can both be entered at the same time. However, the full-scale adjustment assumes that the zero offset has already been corrected. When calculating the current value adjustment, make sure your zero adjustment is done first.

2.10.2 Temperature Correction

SiloWeigh IIoT automatically captures the temperature at the beginning and end of the calibration process, along with displaying real time temperature. This information can be very useful when calibrating large or split silos, when filling them can take days to complete. For this function to work the system requires internet access. Celsius or Fahrenheit is automatically configured by the system dependent on the measurement units selected. For example Tonne or Klb.

3.0 Troubleshooting

Troubleshooting guide:

Issue / problem	Probable Cause	Solution
Display not showing any readings	Sensors not connected correctly	Check wire connections to DJB and sensors. Check voltages at DJB sensor connectors. Volts between blk-red should be 4.6 to 5.2 V. blk-grn and blk-wht should be half of this. V wht-grn should be -5 to +5 millivolts
	No power	Check power voltage, power fuse, power at DJB box and SiloWeigh IIoT cabinet
Voltage between white & green is too high and cannot be brought within range	Disconnected or damaged sensor	If mV signal is greater than -10 to +10 mV, disconnect sensor connector at DJB and check resistance between blk-red and between wht-grn. Each should be equal and should be 350Ω (Ohms) divided by number of sensors, i.e. 87Ω to 88Ω for 4 sensors. If not, disconnect and check each sensor.
Weight reading decreases or does not change when weight added.	Calibration done incorrectly	Check Low weight and High weight values. High value must be greater than Low value. Raw readings should show enough difference to be stable. Difference of 50,000 or more is adequate but 100,000 is necessary for stability.
	Wires crossed at DJB or in sensor junction boxes	Check wiring of sensors
	No power at sensors	Check for 4.0 to 5.2 volts between blk-red at sensor, recheck connections at DJB
Weight reading decreases or does not change when weight added	Shorted signal wires	Disconnect sensor. Resistance between blk-red and between wht-grn should be 350Ω (Ohms) divided by number of sensors, i.e., 87Ω to 88Ω for 4 sensors
	Lost connection or incorrect sensor output	Check wiring and mV signal between wht-grn wires. Remove J-box and DJB covers to check for water. May need to replace sensor if this is cause
Readings erratic and drifting with time	One or more sensors installed incorrectly	Disconnect sensors one leg at a time until readings stabilize
	Water in sensor, connection box or damaged cable	Remove sensor wires from DJB connector. Check insulation resistance between any sensor wire and shield

		or Vessel leg. Must exceed 20 Megohms. Remove J-box and DJB covers and check for water.
Readings still erratic and drifting with time after checking and eliminating causes above	Sensors installed in wrong part of structure	Must be on main load bearing members – send picture and get advice
	Structure too sturdy for application	When calculated loading is 1500 psi (per leg) or less, these errors increase proportionally.
	Structures interconnected	Check possible impediments and ask for advice Try to separate structures – free welded catwalks at one end
Reads correctly after calibration but jumps suddenly to an incorrect value	Faulty installation of sensor	Remove, check and eliminate paint or rust layers, ensure mounting surface is bare and flat, reinstall with correct torque and bonding if indicated in installation manual
	Strong local RF field may cause temporary jumps	Check for walkie-talkie or mobile radios, local radio station etc. May need metal cabinets to shield electronics
Reading follows true weight over some, but not all, of the ‘empty to full’ range	Incorrect installation and verification of sensor output in millivolts	Estimate % filling of Vessel and make offset adjustment or recalibrate
When not every leg of Vessel is gauged, readings are erratic	Load not shared by all legs equally, foundations not equal	Leg sizes are different or more of the available legs should be gauged. Ideally all legs should be gauged
DJB or power supply destroyed	Electrical storm damage	Ensure DAQ cabinet is grounded to Vessel structure with thick, direct copper ground cable
Reading jumps when sun rises	Local heating of sensors	Some variation is normal and is minimized by sun shield. Oversized legs make problem worse. Use larger shield for sunlight. Mount sensors on north or west facing sides of legs
Voltage at blk-red DJB 0V - V+ wires is less than 12 volts and varies	Power supply cannot supply enough power or is faulty	Too many sensors (capacity is 40 legs) or AC power is low in voltage. Power voltage must be in the range 100 – 260 volts.

3.1 Replacing the DJB

Remove incoming power and then disconnect the connectors and the shields from the two screws on the backplate. Remove the complete light gray box and replace it with the new box containing the new board. Re-connect all connectors and the shield. Restore power and test as above.

DJB boards are normally preset with the correct address prominently marked on a label, e.g., ‘80’. This address must match the one being removed. If different, the DAQ setting for ‘**Transmitter Address**’ must be changed to this new address before communication can be re-established.



Take precautions against static electricity. Electronic devices are sensitive to static charges and can be destroyed by careless handling. Only remove items from the protective package at a static workstation. If this is impossible, eliminate any static charge by grasping the metal Vessel leg, conduit, building column or concrete wall. Do not touch the module unless these steps have been followed first. Ensure that the equipment cabinet is securely grounded to earth ground or power ground. Always connect the shield, power, or communication wires before connecting signal or load cell wires. Static damage is not covered by the warranty.