Installation and Service Manual

Precision Junction Boxes

AJB540S AJB540L
AJB641S AJB641SX
AJB841S AJB841SX
AJB541M AJB941M

METTLER TOLEDO

Precision Junction Boxes

METTLER TOLEDO Service

Essential Services for Dependable Performance of Your Precision Junction Box

Congratulations on choosing the quality and precision of METTLER TOLEDO. Proper use of your new equipment according to this Manual and regular calibration and maintenance by our factory-trained service team ensures dependable and accurate operation, protecting your investment. Contact us about a service agreement tailored to your needs and budget. Further information is available at www.mt.com/service.

There are several important ways to ensure you maximize the performance of your investment:

1. **Register your product**: We invite you to register your product at www.mt.com/productregistration so we can contact you about enhancements, updates and important notifications concerning your product.

2. **Contact METTLER TOLEDO for service**: The value of a measurement is proportional to its accuracy – an out of specification scale can diminish quality, reduce profits and increase liability. Timely service from METTLER TOLEDO will ensure accuracy and optimize uptime and equipment life.

   a. **Installation, Configuration, Integration and Training**: Our service representatives are factory-trained, weighing equipment experts. We make certain that your weighing equipment is ready for production in a cost effective and timely fashion and that personnel are trained for success.

   b. **Initial Calibration Documentation**: The installation environment and application requirements are unique for every industrial scale so performance must be tested and certified. Our calibration services and certificates document accuracy to ensure production quality and provide a quality system record of performance.

   c. **Periodic Calibration Maintenance**: A Calibration Service Agreement provides on-going confidence in your weighing process and documentation of compliance with requirements. We offer a variety of service plans that are scheduled to meet your needs and designed to fit your budget.

   d. **GWP® Verification**: A risk-based approach for managing weighing equipment allows for control and improvement of the entire measuring process, which ensures reproducible product quality and minimizes process costs. GWP (Good Weighing Practice), the science-based standard for efficient life-cycle management of weighing equipment, gives clear answers about how to specify, calibrate and ensure accuracy of weighing equipment, independent of make or brand.

Standard Warranty

METTLER TOLEDO warrants that the equipment covered by this warranty will be free from defects in workmanship and materials for a period of one year from date of installation or eighteen (18) months from date of shipment to the buyer, whichever comes first.

Should any such defects be found and reported during the first thirty (30) days after installation (if installation occurs during the warranty period), METTLER TOLEDO (herein referred to as the "Company"), will, at its option, refund the purchase price or correct such defects furnishing replacement parts and service free of charge to the buyer. For the remainder of the warranty term, the Company will furnish necessary replacement parts and on-site technician's service free of charge, provided the Buyer agrees to pay reasonable technician's travel time, vehicle mileage, and associated travel expenses to and from the nearest authorized Company service location. The following are NOT covered under any of these warranties:

1) Initial installation and ongoing scale calibration.

2) Damage to scale components by gross abuse, fire, flooding, explosion, water, voltage surges, or civil disturbance.

3) Normal maintenance or consumable items.

This warranty covers only Model Analog Junction Box. Refer to METTLER TOLEDO Standard Product Warranty for coverage of other scale system components including scale instrument, printer, and/or other accessories.

THE COMPANY EXPRESSLY WARRANTS THE EQUIPMENT MANUFACTURED BY IT AS SET FORTH HEREIN. THE COMPANY MAKES NO OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED (INCLUDING WITHOUT LIMITATION WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). IN ADDITION, THIS DOCUMENT SHALL CONSTITUTE THE SOLE AND EXCLUSIVE REMEDIES OF THE BUYER FOR ANY BREACH BY THE COMPANY OF ITS WARRANTIES HEREIN.

COMPANY LIABILITY UNDER THIS WARRANTY OR ANOTHER WARRANTY WHETHER EXPRESSED OR IMPLIED IN LAW OR FACT SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE MATERIAL AND WORKMANSHIP, AND IN NO EVENT SHALL IT BE LIABLE FOR CONSEQUENTIAL OR INDIRECT DAMAGES.

This warranty coverage is only applicable to the United States of America. Consult METTLER TOLEDO for Export Warranty Terms and Conditions.

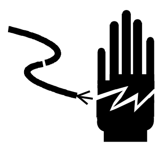
Application Guides

The only warranty of METTLER TOLEDO is for the product it supplies under the Product Warranty Statement listed above. Weighing application guidelines pertain to METTLER TOLEDO products.

- Declaration of Conformity is available at http://glo.mt.com/global/en/home/search/compliance.html/compliance/.

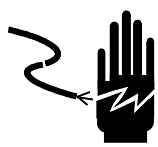
Warnings and Cautions

- READ this manual BEFORE operating or servicing this equipment and FOLLOW these instructions carefully.
- SAVE this manual for future reference.
- DO NOT allow untrained personnel to operate, clean, inspect, maintain, service, or tamper with this equipment.
- ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance.
- Call METTLER TOLEDO for parts, information and service



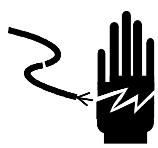
⚠ WARNING

PERMIT ONLY QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS, AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.



⚠ WARNING

FOR CONTINUED PROTECTION AGAINST SHOCK HAZARD, CONNECT TO PROPERLY GROUNDED OUTLET ONLY. DO NOT REMOVE THE GROUND PRONG.

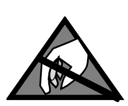


⚠ WARNING

DISCONNECT ALL POWER TO THIS UNIT BEFORE INSTALLING, SERVICING, CLEANING, OR REMOVING THE FUSE. FAILURE TO DO SO COULD RESULT IN BODILY HARM AND/OR PROPERTY DAMAGE.

⚠ CAUTION

BEFORE CONNECTING/DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT, ALWAYS REMOVE POWER AND WAIT AT LEAST 30 SECONDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY HARM OR DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.



NOTICE

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES.

Disposal of Electrical and Electronic Equipment

In conformance with the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) this device may not be disposed of in domestic waste. This also applies to countries outside the EU, per their specific requirements.

Please dispose of this product in accordance with local regulations at the collecting point specified for electrical and electronic equipment.

If you have any questions, please contact the responsible authority or the distributor from which you purchased this device.

Should this device be passed on to other parties (for private or professional use), the content of this regulation must also be related.

Thank you for your contribution to environmental protection.

Contents

Contents

1 Specifications

1.1. Precision Junction Boxes

Precision junction boxes are used to connect multiple analog load cells (typically, with 2mV/V or 3mV/V output). The junction boxes also provide a convenient method to shift adjust each load cell to eliminate corner error. Although METTLER TOLEDO takes all necessary care to balance load cells electronically in production, the system may need to be further adjusted by means of shift adjustment, to obtain the desired system accuracy.

MT junction boxes also support "weightless" calibration using CalFree™, for occasions when other calibration methods are inconvenient or impossible.

1.2. Junction Box PCBA Functions

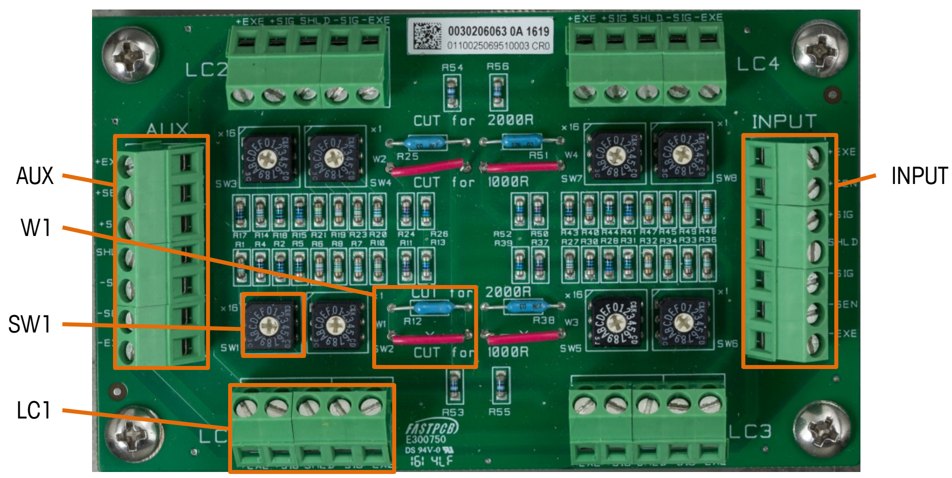


Figure 1-1: Junction Box Printed Circuit Board Assembly

Table 1-1 explains the use of each of the PCB elements. One of each kind of element is indicated in Figure 1-1.

Table 1-1: Junction Box PCB Elements and Functions

<table>
<tr><th></th><th>Element</th><th colspan="2">Function</th></tr>
<tr><td rowspan="3">Termination</td><td>LC1 – LCn</td><td colspan="2">Load Cell Connection – 4/6 wire + shield</td></tr>
<tr><td>Input</td><td colspan="2">Home Run cable connection to terminal – must be 6 wire + shield in all cases</td></tr>
<tr><td>AUX</td><td colspan="2">Connection to another junction box for systems with more than 4 load cells shall be 6 wire + shield in all cases. For more details, refer to Chapter 2, section 2.5.</td></tr>
<tr><td rowspan="4">Others</td><td>W1 – W4
Cut for 1000R</td><td colspan="2">To set the box for a load cell system of ≥1000 Ohm, cut all wires 1000R</td></tr>
<tr><td rowspan="2">SW1 – SWn</td><td>x16</td><td>Coarse shift adjustment, ca. 1/1250 per step</td></tr>
<tr><td>x1</td><td>Fine shift adjustment, ca. 1/19.000 per step</td></tr>
<tr><td>W1 – W4
Cut for 2000R</td><td colspan="2">To set the box for a load cell system of ≥2000 Ohm, cut open all (blue) through hole resistors 2000R.
Note: W1-Wn must be cut as well. Only available for AJB541M, AJB540L</td></tr>
</table>

1.3. Suitable Load Cells

The junction boxes can be used with all analog load cells providing 1-3 mV/V output signals with 120 – 4000 Ohm resistance. Preferred load cell resistance values are 350, 1,000 and 2,000 Ohm nominal output resistance. The typical adjustment range is 1.3%, which is sufficient for single box systems. In the case of multiple box systems connected via AUX, the adjustment range can be extended to 3.4% for up to 1,000 Ohm load cells.

- Note: Single point load cells are not designed for parallel connection. A parallel arrangement might lead to a shift error beyond the adjustment range of these boxes.

1.4. Suitable Terminals and Power Supply Requirements

The junction boxes can be connected to all METTLER TOLEDO terminals with analog load cell input. The Analog Junction box is a passive device which receives power from a METTLER TOLEDO terminal. Please make sure the terminal can supply suitable power for the required number of load cells (refer to the terminal's technical manual for details).

1.5. Junction Box Item Numbers

Refer to the Precision Junction Box datasheet for a complete listing of item numbers.

1.6. Accuracy

Scale accuracy depends on:

- Correct **shimming or height adjustment** of the load cells. This ensures that dead load is distributed in a proper manner and avoids changes in dead load distribution due to loading. Height adjustment is done by mechanical means such a thin metal shims or height adjustment using feet. Height adjustment is recommended if four or more load cells are used.
- Precise **shift adjustment**. A scale that is properly shift adjusted remains within tolerances in the event of eccentric loading. Shift adjustment is performed electronically using the load cell switches SW1-SW*n* in the junction boxes. Shift adjustment is always recommended when load distribution changes during operation – for instance, in the case of floor scales and vehicle scales. Shift adjustment is recommended if multiple junction boxes are connected via AUX.
- Proper **sealing** of junction box to prevent humidity from entering the junction box.
- Proper system **grounding** to avoid stray currents through the measurement cable.

2 Installation

2.1. Inspection

On receiving the junction box, visually inspect the packing containers and modules for freight damage. In case of damage such as loose components on the circuit board, a damaged enclosure or broken cable glands, contact your freight carrier immediately, and inform METTLER TOLEDO. Generally speaking, load cell cables should not be repaired as they are integral to the cell's temperature performance. If a broken or damaged cable is discovered, replace the cell.

2.2. Installation

- Note: Do not reduce the length of the load cell cables. Excess cable should be coiled and placed so that it does not interfere with the scale's operation or pose a safety risk.

1. Mount the junction box in a location where the load cell cables can be properly terminated inside the box. It is preferable to mount the junction box on the dead side – wall, cabinet etc. – to avoid crossing dead to live load cell cables.
2. Do not mount the junction box on a hot surface. When possible, mount in a dry area and avoid placing the box in direct sunlight, to reduce rapid temperature influence.
3. For AJB941M ONLY: Once a suitable location is determined, use one of the methods shown in sections 2.2.1 and 2.2.2 below to secure the junction box in place.
4. After ensuring that the cables are free from dirt and oil, thread the cable through the junction box's cable glands (grommet), ensuring that the gland's inside bushing securely engages the cable; this will ensure that water does not penetrate the connection (see Figure 2-2).
5. Terminate wires according to the color code marked on each load cell and its corresponding position in the junction box. Ensure that no stray wire threads cross the terminal, and remove remaining wire threads from inside the box.
6. Connect the home-run cable from the scale terminal to the junction box.
7. Confirm that all live-to-dead connections (pipes, conduit, etc.) are flexible and securely anchored at both the scale and the dead connection point.

2.2.1. Mounting Option 1: Welding

- This procedure applies to the AJB941M Hygienic Junction Box ONLY.

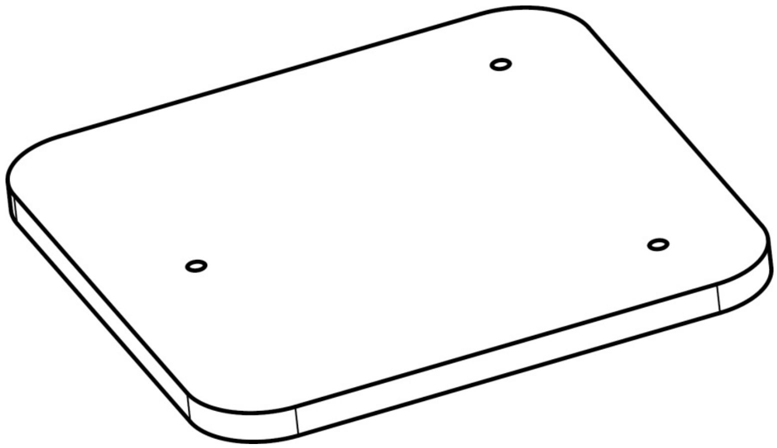


Figure 2-1: Optional Mounting Plate

1. Use optional plate item 30431230. Use a continuous seal weld to attach the plate to a wall or suitable location
2. Attach the three standoffs to the plate, making sure the rubberized washers are placed between the standoffs and the mounting plate.

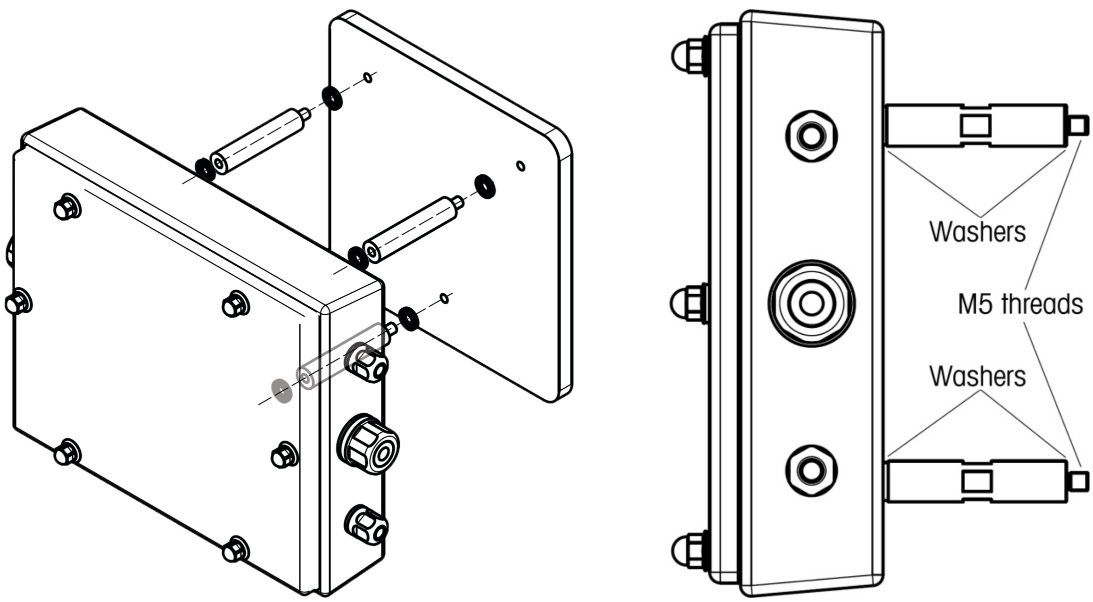


Figure 2-2: Standoff Installation

3. Secure the junction box to the stand-offs using the provided screws, placing washers between the junction box and the standoffs. This step is critical to ensure the IP rating of the junction box.

2.2.2. Mounting Option 2: Bolting

Using a customer supplied interface, attach the junction box using the supplied standoffs.

1. The interface should have a pattern of three M5 threaded holes, as shown in Figure 2-3.

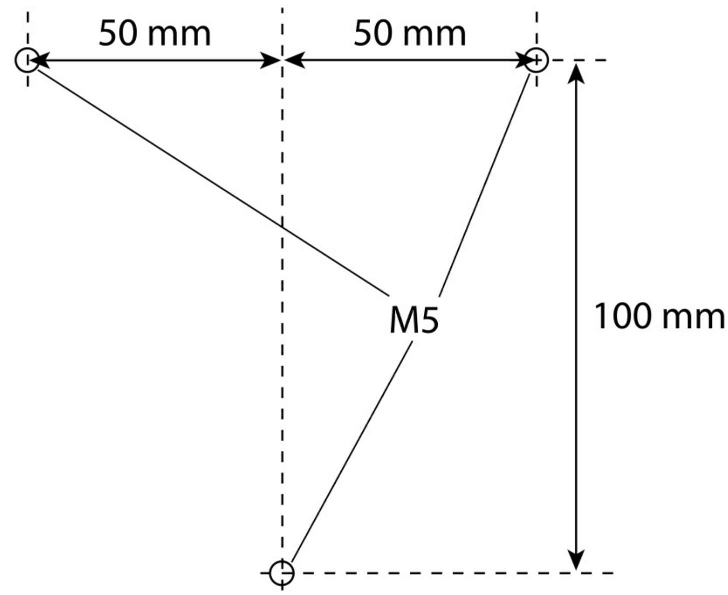


Figure 2-3: Customer Interface Mounting Hole Pattern

2. Thread the standoffs into the customer interface, placing the rubberized washers in between the standoffs and the interface.
3. Next, attach the junction box to the standoffs, being careful to place the rubberized washers in between the box and the standoffs. Secure the box to the standoffs using the supplied screws.

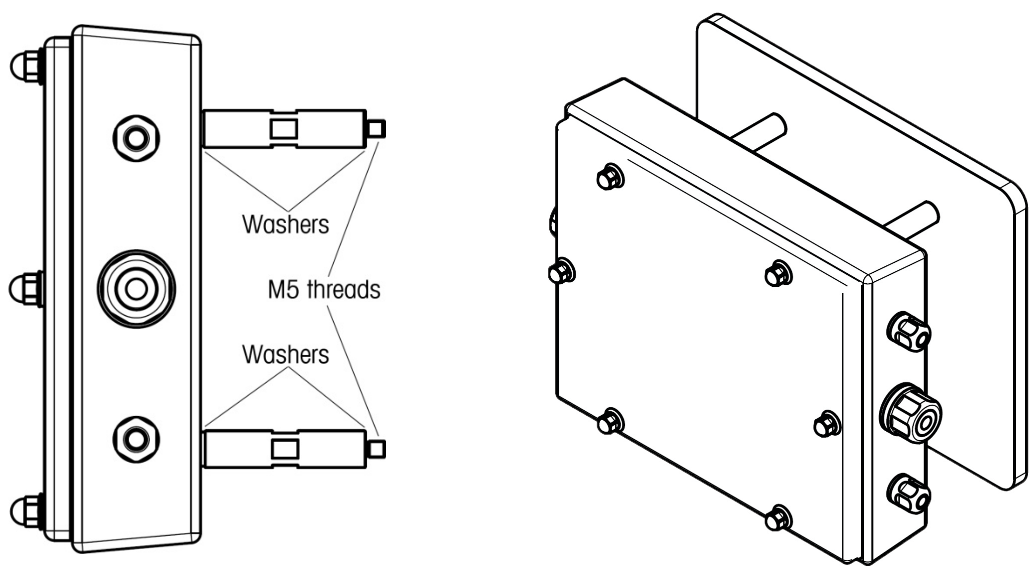


Figure 2-4: Junction Box Installed

4. Secure the wires through the cable glands. Tighten the cable glands until the rubberized seal of the cord grip sits firmly against the face of the junction box.

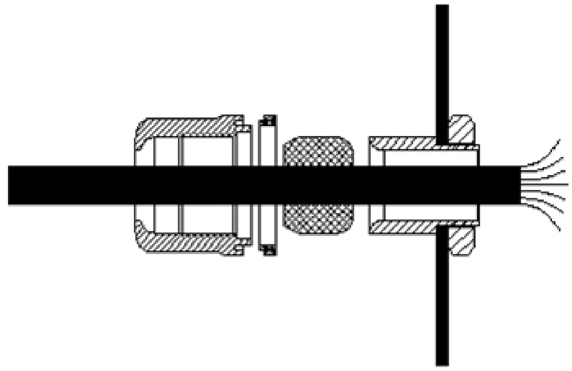


Figure 2-5: Exploded Cable Gland

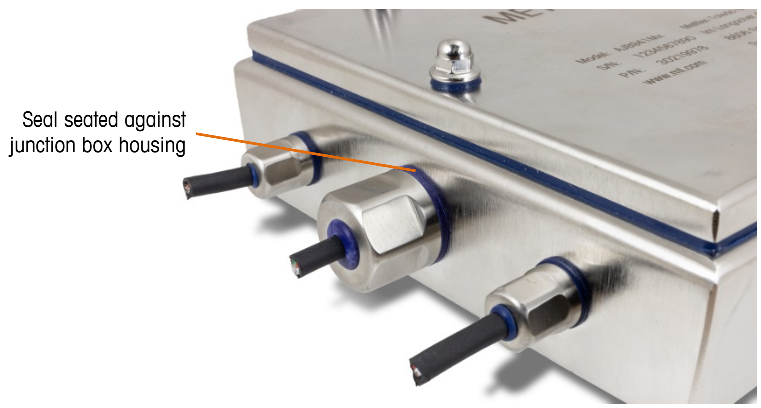


Figure 2-6: Cable Gland, Installed

5. All junction box cover bolts should be tightened to 16 in-lb (1.8 Nm).

- Junction box seals should be monitored and replaced as needed or every three years, whichever comes first. Replacement seals can be ordered using item number 30489548, which is a kit containing all seals for the AJB941M junction box.

2.3. Home Run Cable Connection

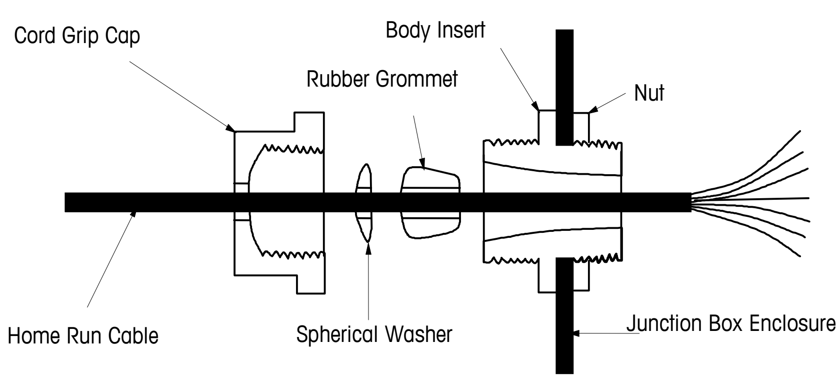


Figure 2-7: Standard Cord Grip Connection Details

To connect the home run cable:

1. Thread the home run cable through the junction box cable gland, ensuring that the diameter of the grommet securely engages the cable.
2. Connect the home run cable from the scale terminal to the junction box.
3. Wire the home run cable to the PCB.
4. Remove any loose wire threads from the junction box.
5. Place the desiccant bag inside the junction box.
6. Reinstall the junction box lid. Ensure that the rubber gasket is clean and correctly positioned so that it contacts the enclosure edges to prevent water ingress.
7. Hand-tighten all screws and cord grip caps.

2.4. Load Cell Connection

Load cell connections are similar to the home run cable connection described in section 2.3. To achieve best accuracy, the junction box should be set according to the load cell connection scheme in Table 2-1.

2.4.1. Connection of 6-Wire Load Cell to 4-Wire Terminal Junction Boxes

Connect load cell cables as follows. For two-wire connections to a screw terminal (excitation/sense for 4-wire load cells), use a ferrule.

Table 2-1: Connection of 6-Wire Load Cells to 4-Wire Terminal Boxes

6-Wire Cell Load cell cable	4-Wire Load cell terminal junction box
Excitation + (Sleeve)	Excitation +
Sense + (Sleeve)	
Excitation – (Sleeve)	Excitation -
Sense – (Sleeve)	
Signal +	Signal +
Signal -	Signal -
Shield	Shield

2.5. Connection of Multiple Jboxes via AUX

The connection of several junction boxes via the AUX extension port is critical mainly in terms of the connection cable influence. The resistance and temperature behavior of those cables cannot be compensated for by the terminal as they can for the home run cable. Special care is therefore required to achieve a well performing scale when multiple boxes are connected:

- Keep the connection cables as short as possible, ideally below 1 m (5 ft). Otherwise, refer to Table 2-3 for cable requirements. Make sure the cross section (AWG or mm^2) of the Connection Cable is appropriate for the cable length. Choosing the wrong cable will result in significant out of spec temperature behavior. Always use 6-wire cable.
- As a rule of thumb, 1 Ohm wire resistance (equals 7 m cable @ 0.14mm^2 / AWG 24) results in 1% initial shift error with a 1000 Ohm system, and 3% with a 350 Ohm system. This is significant, especially when considering the typical legal-for-trade scale tolerance of 0.03%. The effort to shift adjust will be increased by such large initial errors.
- Beyond 2 m cable length, an Initial Shift Adjustment is recommended before starting the shift adjustment. Refer to Chapter 5, section 5.6 for more details.
- When CalFree calibration is planned, keep the total connection cable length below 1m at 0.5mm^2 (AWG 20 or smaller) for 350 Ohm systems, and below 4m for 1000 Ohm systems, in order to keep the influence below 0.1%.

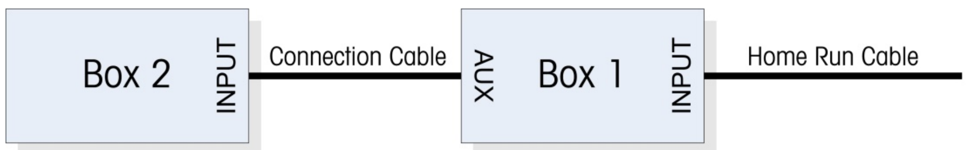


Figure 2-8: Daisy Chain Connection of Junction Boxes

Table 2-2: Cable Wire Resistance

Wire cross section	AWG	Resistance/m	Resistance/ft
0.14 mm^2	24	0.14 Ohm/m	0.042 Ohm/ft
0.25 mm^2	23	0.08 Ohm/m	0.024 Ohm/ft
0.34 mm^2	22	0.06 Ohm/m	0.018 Ohm/ft
0.5 mm^2	20	0.04 Ohm/m	0.012 Ohm/ft
0.75 mm^2	18	0.03 Ohm/m	0.009 Ohm/ft

Table 2-3: Connection Cable Length in m and (ft)

		Connection cable diameter mm^2 (6 wire cable – Exc and Sens connected)		
	Load Cell Resistance	20 AWG 0.5 mm^2	23 AWG 0.25 mm^2	24 AWG 0.14 mm^2
Test weight calibration – keep temperature effects under 3.000e. Shift adjustment recommended.	350 Ohm	<8 m (33 ft.)	<4 m (16 ft.)	<2 m (8 ft.)
	1000 Ohm	<16 m (100 ft.)	<8 m (50 ft.)	<4 m (26 ft.)
CalFree Calibration – keep signal drop below 0.1%. Shift adjustment obsolete	350 Ohm	1 m (5 ft.)	Not recommended	Not recommended
	1000 Ohm	<4 m (13 ft.)	<2 m (6.5 ft.)	<1 m (3.3 ft.)

3 Shimming or Height Adjustment: Four or More Load Cells

3.1. General

When scales with 4 or more load cells are first installed, inevitably they will "rock", so the load cell assemblies must be shimmed or adjusted in height until all carry a portion of the dead load. Otherwise, the scale's measurements may be non-repeatable, it may be impossible to get a proper calibration and, in the worst case, load cell(s) may be damaged.

3.2. Manual Height Adjustment

Floor Scales typically have adjustable feet. Find the rocking corner and adjust the height until motion is eliminated. Lift up on each corner (using a bar if necessary) to roughly gauge the load distribution, and if necessary adjust foot height again.

Tank and hopper scales are usually constructed using weigh modules and height adjustment is typically done by adding stainless steel shims. Proceed as described for floor scales above, adding shims as required above or below the weigh module.

3.3. Terminal Supported Height Adjustment

For larger systems, the dead load on each load cell must be measured to adjust the load cells' heights. This can be done using a volt meter to measure the voltage signal of each load cell separately. Note that the signal strength is low, which may cause practical problems. For instance, with 10V terminal excitation, a 10% load on load cell typically yields of a signal of 0.002 V.

As an alternative, the terminal can be used to make the measurement. The terminal can easily cope with such low signals and display them in a usable resolution. Once a cell is isolated, the terminal can show a variety of positive and negative values not easily related to the scale settings, unless calculations are performed. Provided the scale has been calibrated, the relationship between terminal display and actual load on the individual load cell is given by the equation shown in Figure 3-1.

$$\text{Actual Load on LC [kg]} = \frac{\text{Scale DL [kg] + Terminal Signal [kg]}}{\text{Number of LC}}$$

Figure 3-1: Terminal Display to Load Cell Load Equation

Figure 3-2 shows the results of this equation in relation to fractions of dead load. This makes it possible to determine quickly how much of the total dead load is on the load cell being tested. For clarity, percentages relate to the terminal display, numbers given in fractions of 1 relate to the actual load on the load cell. For example, 20% means the display shows 20% of the total dead load (note that negative values are possible), and 0.2 means 20% of the total dead load is on the measured load cell.

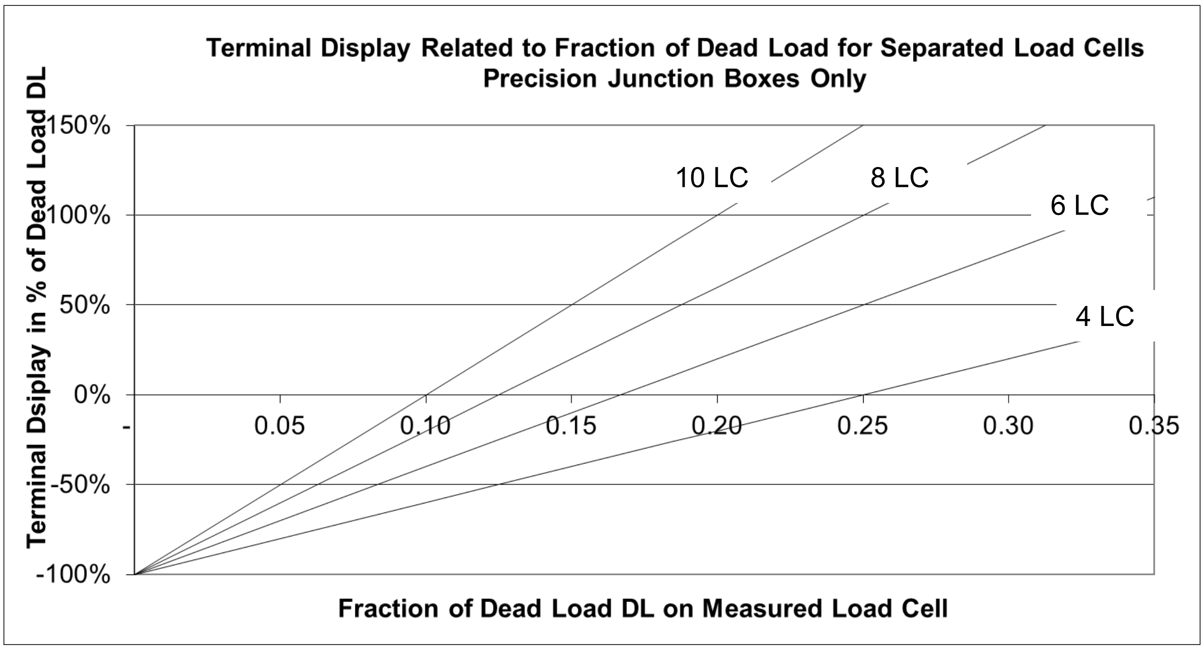


Figure 3-2: Terminal Display related to Actual Load on Separated Load Cell

The following example is offered to clarify this diagram:

With a dead load of 20.000 kg:

4 load cells	terminal displays 0 kg	=	0% of dead load:	actual load on cell is 0.25 of dead load, or 5,000 kg
6 load cells	terminal displays -7.000 kg	=	-35% of dead load:	actual load on cell is 0.1 of dead load, or 2,000 kg
8 load cells	terminal displays 12.000 kg	=	60% of dead load:	actual load on cell is 0.2 of dead load, or 4,000 kg

3.3.1. Terminal Supported Height Adjustment Procedure

This is a recommended step, **before** electronic shift adjustment, for heavy capacity scales with four or more load cells. The result of proper height adjustment is a repeatable and well performing scale.

3.3.1.1. Procedure

1. Empty the scale
2. Initially calibrate the fully connected scale with a simulator or with CalFree. Once calibration is complete, ensure that the zero value for the terminal is set or adjusted.
3. Know the approximate dead load dead load (bridge weight, tare weight) of the scale.
4. Configure the terminal to allow unlimited negative display, for example in setup at **Scale > Zero > Under Zero Blanking = Disable**.
5. Load cell separation can be made by disconnecting one signal wire for each load cell in the junction box except for the target cell. Cells with a dead load below average will provide negative weight level, those above average, positive. If the load on the load cell is close to average the signal will be close to 0%.
6. It is practical to bring all load cells into a display band of **-50% to +50% of dead load**. Table 3-1 shows the ideal dead load fraction and the related display value.

Table 3-1: Deal Load Fractions and Display Values

No of Load Cells	Ideal DL Fraction on Each Load Cell	Ideal Terminal Display for each Load Cell, in % of DL
4	0.25	0%
6 Tank Scale	0.166	0%
6 Truck Scale*	0.125 corner LC 0.25 mid LC	-25% corner LC +50% middle LC
8 Truck Scale*	0.08 corner LC 0.16 mid LC	-25% corner LC +25% middle LC

* Middle load cells typically carry a larger dead load

3.3.1.2. Example

In a system with four load cells, and a dead load of 20.000kg:

Displayed weight with separated load cells:

LC1: 10.000kg (50% DL)

LC2: -5.000kg (-25%DL)

LC3: 10.000kg (50% DL)

LC4: -15.000kg (-75% DL)

(Remember that the display is not directly related to the real load. The diagram in Figure 3-2 shows how to determine the real dead load on each load cell).

From the diagram, get the fraction of dead load for each load cell:

LC1: >0.35

LC2: 0.17

LC3: >0.35

LC4: 0.02

In this case, LC4 is bearing the least dead weight and should be adjusted.

Best practice would be to connect LC4 and apply shims till the signal is larger than -50% DL – in this case, greater than -10.000kg. This will increase the dead load of LC4 to 0.125, and at the same time automatically remove dead load from the other load cells.

Check the result by connecting each load cell separately again. No load cell should be below -50% DL or above +50% of DL.

Configure terminal to the requested display function, for example in setup at **Scale > Zero > Under Zero Blanking = Enable**.

- Note that single load cell signals are typically less stable than fully connected systems.

4 Single Load Cell Check

It may be necessary to check the actual load on a single load cell. This requires the load cells to be separated, and their signals measured individually. An alternative method to using a voltmeter is to use the terminal display for checking. As described in Chapter 3, once the load cells are separated the terminal display must be interpreted, as it is not directly related to the actual load on the load cell, but it follows strict rules (provided the scale has been calibrated):

$$\text{Actual Load on LC [kg]} = \frac{\text{Scale DL [kg] + Terminal Signal [kg]}}{\text{Number of LC}}$$

Figure 4-1: Terminal Display to Load Cell Load Equation

The load cells can be separated by disconnecting one signal wire for each load cell in the junction box, except the target cell. To determine the actual load on the cell, add the scale dead load to the terminal display and divide by the number of load cells in the system.

For example, if the Dead Load DL is 15.000kg and the number of load cells is 4:

Load Cell	Terminal display	Calculation	Actual load on load cell
1	30.000 kg	(15.000 + 30.000) / 4	11.250 kg
2	20.000 kg	(15.000 + 20.000) / 4	8.750 kg
3	25.000 kg	(15.000 + 25.000) / 4	10.000 kg
4	18.000 kg	(15.000 + 18.000) / 4	8.250 kg

- Note that single load cell signals are typically less stable than fully connected systems.

5 Shift Adjustment

5.1. General

Shift adjustments should be made only after checking all mechanical parts and after proving that the scale activity is repeatable. To check repeatability, repeatedly place a test weight in the same position on the scale to make sure that the scale gives the same weight reading each time. If the scale doesn't give the same reading every time, check for mechanical binding. The scale should also be plumb level and square. Once it is confirmed that there is no binding, re-perform the height adjustment described in chapter 3.

Once these checks are complete, perform a shift adjustment to set the weight reading for each load cell at or near the same for the same test weight. The procedure is described in the following sections.

Many technicians perform both the height adjustment and shift adjustments with the terminal in expanded mode. This is generally listed in each of the terminal's service manuals either as "x10" or as "expanded". A normal weighing terminal displays the smallest increment which is called e, and this value is affected by the zero indication. Setting the terminal to 10x expands this value to d (1/10 e), or to the lowest observable displayed increment. In the service and maintenance section it is also possible to expand the display to read the smallest available "d" calculated by the terminal's Analog to Digital converter.

The amount of test weight used for the shift test should be equal to at least 10 percent of the rated scale capacity.

5.2. Test Weight Positioning

Correct positioning of test weights is very important for a reliable shift adjustment procedure. First try to repeat the positioning as closely as possible between cycles. Good practice is to mark corner positions on the scale deck. Second, avoid undefined loading of any load cell in the system which might occur if platform is loaded to the very edge. Best practice is to stay well within the distance between the load cells.

5.3. Shift Adjustment with SW Switches

Shift adjustment changes the contribution of the single load cell to the sum signal by changing the resistance in the individual load cell branch. Two rotary switches per load cell, labeled SW, allow for coarse and fine adjustment. Turning the switches from 0 to F increases, and F to 0 decreases, the load cell signal by typical values. Use a 2-3mm flat-bladed screw driver to turn the switches.

The adjustment range is about 1.35% of the scale capacity. In case the required adjustment is out of range, refer to section 5.9.

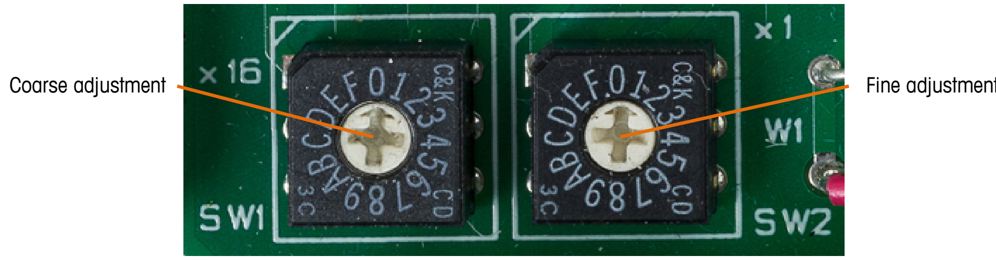


Figure 5-1: Load Cell Shift Adjust Switches (SW) – Position 00 shown

In total, 256 steps per load cell are possible. Initially the switches should be set to 80, allowing for both 128 positive and 128 negative adjustment steps for each load cell. The initial setting of 80 is in the middle of the adjustable range.

- Note: Switching one step past position FF to 00 goes back to the lowest load cell signal, and quite a large change will be observed. If 00 or FF is exceeded in you adjustment, review the Range Extension possibilities in section 5.9.

5.4. Three Procedures for Shift Adjustment

Three different procedures may be used for electrical shift adjustment:

1. Optional initial adjustment when multiple boxes are used. The pre-adjustment compensates for the shift error introduced by the connection cable, and helps to make final adjustment with test weights more rapid.
2. "On-load" procedures, in which SW switches are operated while the test weight is on the tested load cell. This is the simplest procedure. First load for reference, then load and adjust to reference cell by cell until no further adjustment is necessary in the course of a full cycle of all cells. After each cycle, zero the scale and perform a new reference loading. This procedure is recommended when shift adjustment is not a familiar procedure.
3. An "Off-load" procedure, in which a full test cycle is performed without changing the SW switches. Then new switch settings are calculated off-load, and SW switches set accordingly. Off-load procedures require knowledge about the scale system, but are fast and can be semi-automated – the testing can be done by machines. No reference loading is necessary for these procedures. The optimal switch setting can be determined by means of InSite™ software. (Refer to chapter 6, Software Supported Shift Adjustment.)

Table 5-1: Characteristics of Three Types of Shift Adjustment Procedure

Type	Description	When to Use	Test Weight, 2 – 4 Load Cells	Test Weight, 6 or More Load Cells	Advantages and Disadvantages
Initial (optional)	Pre-adjustment to compensate AUX cable impact	Multiple Jboxes	-	-	+ Speeds up the following shift adjustment procedure. + Calculates the AUX connection cable impact

Type	Description	When to Use	Test Weight, 2 – 4 Load Cells	Test Weight, 6 or More Load Cells	Advantages and Disadvantages
On-load	While test weight is on corner turn SW to reference. Typically several test cycles needed. No calculations needed.	In field PC not available	No precise knowledge about the test weight is necessary. Shall be above 10% of nominal scale load.	Precisely split test weight into 3 parts for 6 load cells, 4 parts for 8 load cells, etc. Alternative if no split test weights are available, refer to section 5.7.3	+ No calculation + Any test weight >10% up to 4 load cells + Not critical, always works - Takes more time - Split test weight required beyond 4 load cells
Off-load	Perform full test cycle. Calculate shift adjustment Set SW respectively	Frequently repeated test Box not accessible while loading Semi automation possible	Any known test weight above 10% nominal scale weight	Any known test weight above 10% nominal test weight	+ Fast + Any known test weight >10% + No reference loading - Calculations needed - Parameter set required, thus preparation needed

- **Note**: The test weight requirements apply to shift adjustment only. Calibration needs known test weight in any case.

5.5. Set Adjustment Range to 350R, 1000R, 2000R

The load cell output resistance is relevant for the box setup. To set the adjustment ranges proceed as following:

350 Ohm to 999 Ohm load cells	No action – the box is set to 350R initially.
≥ 1,000 Ohm load cells	Set box to 1000R by cutting all wires W1-W*n* and bending the ends apart. Make sure **all** red wires are cut; otherwise a very large shift error will occur.
≥ 2,000Ohm load cell	AJB541M and AJB540L only: Cut through all red wires and one wire of each blue resistor

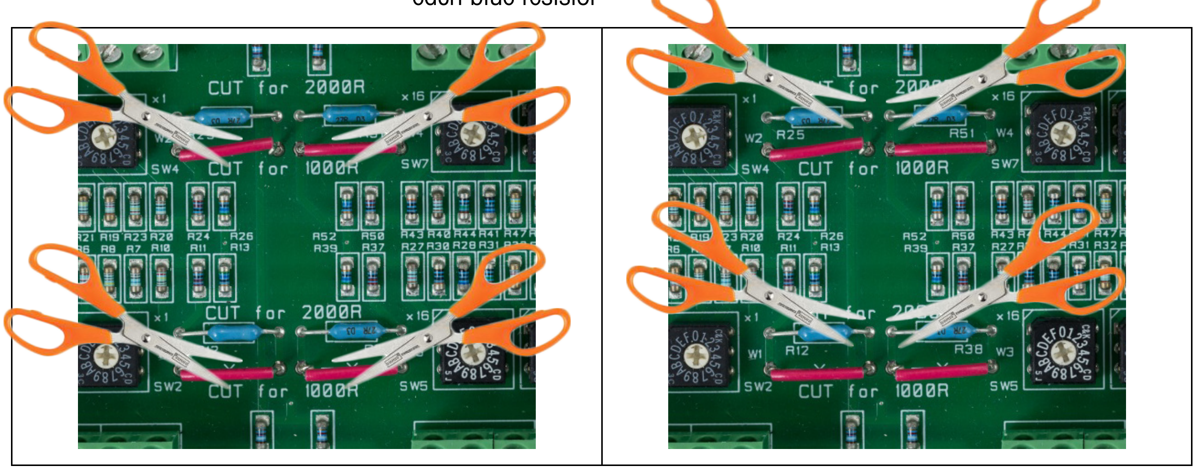


Figure 5-2: Adjusting for 1,000 Ohm (left) and 2,000 Ohm (right) Load Cells

5.6. Initial Shift Adjustment

When multiple boxes are connected via an AUX cable, it is recommended that an Initial Shift Adjustment be performed. This will equalize the different sensitivities between the boxes caused by the AUX connection cable. Use the table from section 5.6.1, or use InSite software in case you cannot find your box arrangement. (Refer to chapter 6, **Software Supported Shift Adjustment**.) and enter the required data, found on the load cell Calibration Certificates supplied with the load cells.

An Initial Shift Adjustment should not be performed in conjunction with CalFree Calibration. Refer to the connection cable requirements in chapter 2, section 2.5.

An Initial Shift Adjustment is not a replacement for real corner testing, since mechanical influences are not taken into account.

5.6.1. Initial Shift Adjustment – Compensation for AUX cable

Based on the load cell resistance and arrangement of boxes, load cell switches shall be set according to Table 5-2.

- Note: This procedure is not to be used when CalFree calibration is used.

Table 5-2: Switch Settings for Initial Shift Adjustment

Load Cell Resistance	Total Number of Load Cells	Connection Cable Wire Resistance, Ohms	Switch Set, 1st Box [Same value for each switch]	Switch Set, 2nd Box
350 Ohm (Boxes set to 350R)	6 (4 in 1st box, 2 in 2nd box)	0.1	6E	A4
		0.2	5D	CC
		0.3	Not recommended	
	6 (3 in 1st box, 3 in 2nd box)	0.1	68	98
		0.2	51	B3
		0.3	Not recommended	
	6 (2 in 1st box, 4 in 2nd box)	0.1	63	8E
		0.2	48	9E
		0.3	Not recommended	
	8 (4 in 1st box, 4 in 2nd box)	0.1	60	A1
		0.2	43	C5
		0.3	27	EB
		0.4	Not recommended	

Load Cell Resistance	Total Number of Load Cells	Connection Cable Wire Resistance, Ohms	Switch Set, 1st Box [Same value for each switch]	Switch Set, 2nd Box [Same value for each switch]
1000 Ohm (Boxes set to 1000R)	6 (4 in 1st box, 2 in 2nd box) 6 (3 in 1st box, 3 in 2nd box)	0.1	79	8D
		0.2	73	9A
		0.3	6D	A9
		0.4	67	B8
		0.5	61	C7
		0.6	5B	D8
		0.7	Not recommended	
	6 (4 in 1st box, 2 in 2nd box)	0.1	77	88
		0.2	6F	91
		0.3	66	9B
		0.4	5E	A5
		0.5	57	AF
		0.6	4F	B9
		0.7	Not recommended	
	6 (2 in 1st box, 4 in 2nd box)	0.1	75	85
		0.2	6B	8A
		0.3	62	90
		0.4	58	95
		0.5	4F	9B
		0.6	Not recommended	
	8 (4 in 1st box, 4 in 2nd box)	0.1	74	8B
		0.2	69	98
		0.3	5E	A5
		0.4	54	B2
		0.5	4A	C0
		0.6	41	CE
		0.7	Not recommended	

5.7. On-Load Shift Adjustment

Corners are adjusted based on the actual weight display while the test weight is on scale, and thus require manual operation. This procedure does not need any calculations, and typically two to four test cycles and one verification cycle are needed to achieve an acceptable result. For scales with more than 4 load cells, equally split test weights are needed. Refer to section 5.7.3 in case split test weights are not available. This is easiest and least critical procedure, but it is more time-consuming.

- Shift Adjustment is **not** recommended for CalFree Calibration.

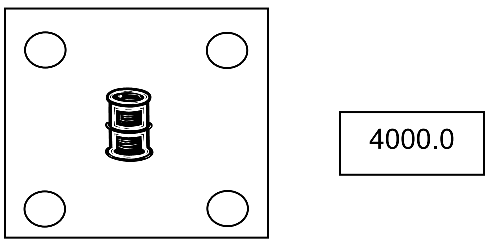
5.7.1. On-Load, Single Corner Test, 2…*n* Load Cells

1. Set the box to 350R, 1.000R or 2.000R as shown in section 5.5.
2. Perform an Initial Shift Adjustment (refer to section 5.6) when multiple junction boxes are used.
3. Perform test as follows:

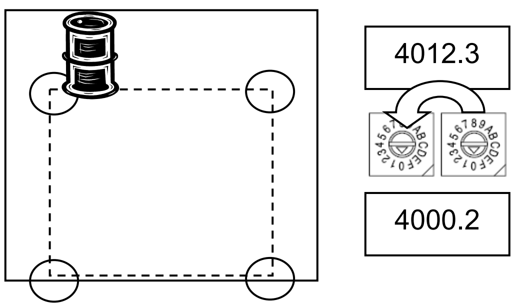
2, 3 or 4 Load Cells

Any test weight >10% of scale capacity

Reference loading – exactly in middle of scale



Corner test

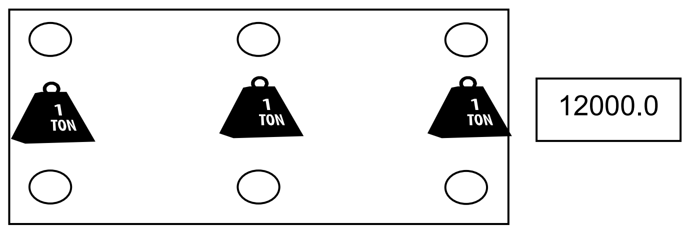


1. Unload and zero the scale.
2. Apply test weight to the middle first. Note the terminal's indication as a reference.
3. Load first corner .Adjust respective SW switches to match the display as closely as possible to the reference signal from step 2.
4. Load/adjust the next corner and so on until the last corner has been adjusted.
5. Repeat steps 1 to 4 until no further adjustments are necessary.
6. Continue with span calibration.

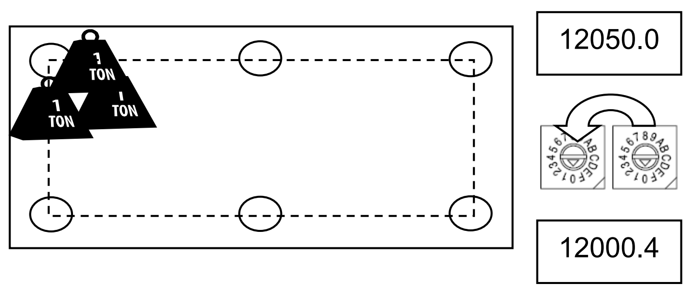
6 or More Load Cells

The test weight needs to be 3 equal parts for a 6 load cell; four equal parts for 8 load cells and so on.

Reference loading with three identically sized weights



Corner test



1. Unload and zero the scale
2. Apply split test weights to the middle section so that all load cells carry the same load. Note the terminal's indication as a reference.
3. Load first corner with all parts of the split test weight. Adjust respective load cell SW switches to match the display as closely as possible to the reference signal from step 2.
4. Load/adjust next corner and so on, until the last location has been adjusted.
5. Repeat steps 1 to 4 till no corrections are necessary.
6. Continue with span calibration.

5.7.2. On-Load – Pair/Section Test – 4…n Load Cells

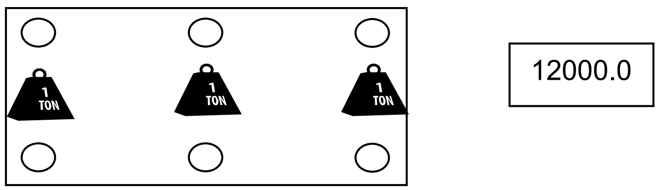
For this situation build load cell pairs LC1 + LC2, LC3 + LC4, etc.

1. Set the box to 350R, 1.000R or 2.000R as shown in chapter 5.5
2. Perform an Initial Shift Adjustment (refer to section 5.6) when multiple junction boxes are used.
3. Perform the test as follows

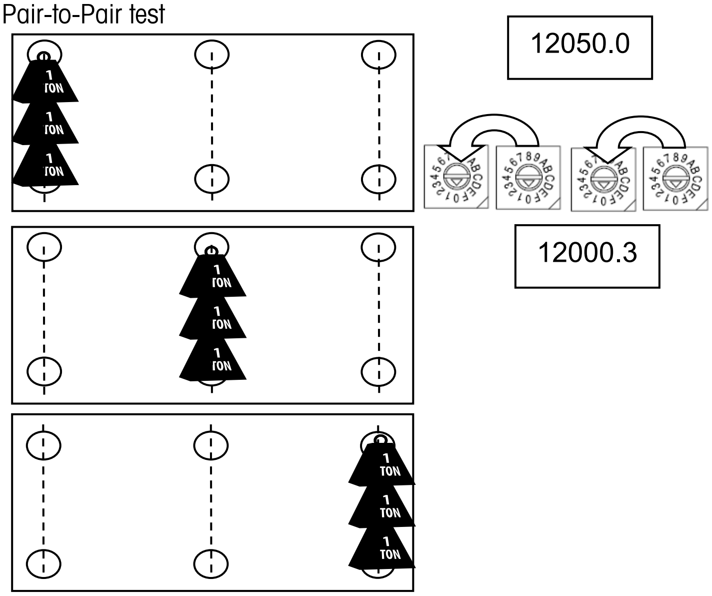
Pair-to-Pair

The test weights must be three equal values for a six load cell, four equal parts for eight load cells, and so on.

Reference loading with numerous identical weights



Pair-to-Pair test



1. Unload and zero the scale.
2. Apply split test weights over the load cells in the middle so that all load cells carry the same load. Note the terminal's indication as a reference.
3. Load each pair with all the test weights. Adjust the respective load cell switches pair-wise to match the noted reference as closely as possible.
4. Load/adjust next pair until last pair has been adjusted.
5. Repeat steps 1 to 4 until no further corrections are needed.
6. Verify the result by placing a test load on all corners.
7. Continue with span calibration.

5.7.3. On-Load – Alternative Reference Determination

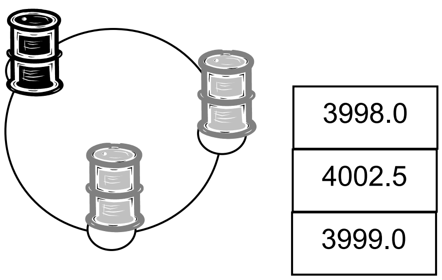
The nature of reference loading is to equally spread the test weight to all load all load cells. For instance, using a 10t test weight in a 4-load cell system, the ideal reference loading for each cell is 2.5t.

When split test weights are not available, or when it is not possible to load scale in the middle, the reference can be determined by averaging the results of several single loadings.

2, 3 or 4 load cells

Alternative Reference Determination

Reference loading – three corner tests

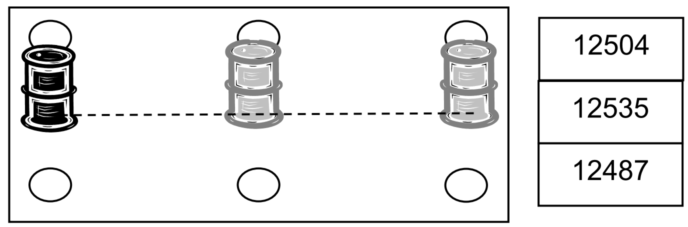


1. Unload and zero the scale.
2. Apply test weight corner by corner and record the terminal's indication as a reference.
3. Average the single signals to determine the reference signal, e.g. 3999,83
4. Continue with On-Load shift adjustment

6 or more load cells

Alternative Reference Determination

Reference loading – three pair tests



1. Unload and zero the scale
2. Apply test weight pair by pair and record signal
3. Average the single signals to determine the reference signal, ex. 12508
4. Continue with On-Load shift adjustment

5.8. Off-Load Shift Adjustment

Off-load shift adjustment uses calculations to achieve the required adjustment. A full test cycle is performed first, followed by off-load calculations. There are no special requirements for the test weight – any known test weight of least 10% of scale nominal capacity can be used for the procedure. This procedure is recommended for frequently repeated processes, since it typically requires only one test cycle and one verification cycle. This procedure can also be helpful when the box is not accessible when the scale is loaded, and it also allows for automated, un-manned testing.

The procedure is fast but requires preparation. The key for rapid results is to keep loading conditions constant. Extreme differences in load cell sensitivity may force iteration.

Perform an Initial Shift Adjustment (refer to chapter 5.6) when multiple junction boxes are used.

- Shift Adjustment is not recommended for CalFree Calibration.

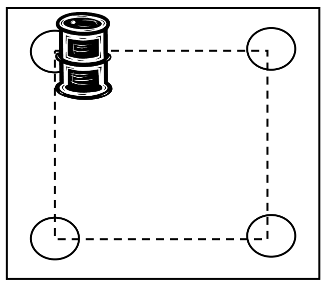
5.8.1. Off-Load - Single Corner Test – 2…n Load Cells

2…n load cells

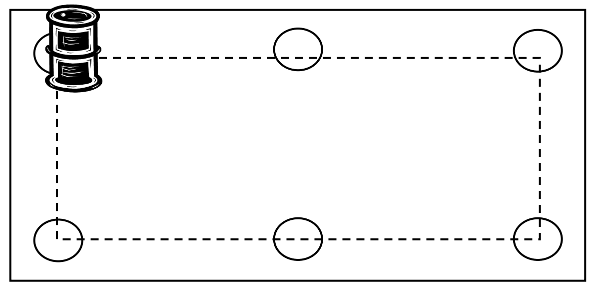
Known test weight >10% of scale capacity

InSite software is required. Refer to chapter 6, Software Supported Shift Adjustment.

Corner test



Corner test



1. Unload and zero the scale.
2. Load the first corner. Record the terminal's indication as a reference.
3. Load the next corner and record the signal; repeat until the last corner has been tested.
4. Enter the recorded values in InSite.
5. Set the switches accordingly.
6. Verify the result by performing another test cycle. Repeat steps 1 to 6 if necessary.
7. Continue with span calibration.

5.8.2. Off-Load – Pair/Section Test – 4…n Load Cells

In a load cell system of this type, load cell pairs are LC1 + LC2, LC3 + LC4, etc.

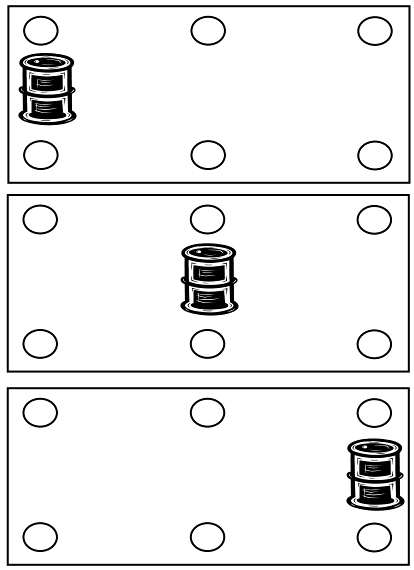
1. Set the box to 350R, 1.000R or 2000R as shown in section 5.5
2. Perform an Initial Shift Adjustment (refer to section 5.6) when multiple junction boxes are used.

Pair Corner Test

Known test weight >10% of scale capacity

InSite™ software is required. Refer to chapter 6, **Software Supported Shift Adjustment**.

Pair test



1. Unload and zero the scale.
2. Load pair with test weight. Record the terminal's indication as a reference.
3. Load second pair and record the terminal signal; repeat until all pairs are complete
4. Use InSite to calculate new switch settings.
5. Set the switches accordingly.
6. Verify the result by performing another test cycle. Repeat steps 1 to 5 if necessary.
7. Continue with span calibration.

5.8.3. Off-Load - Geometry Factor

The shift adjustment result depends on the actual load spread while testing. The calculation formulae assume full load on one load cell while testing, which is not the case in practice due to scale geometry and the mechanical linkage between corners. Typically the shift result is too small, and will require iterative steps to achieve an acceptable result. In order to speed up the procedure it is recommended to apply the suitable Geometry Factor to the required shift results. Values given in Table 5-3 are typical only.

Table 5-3: Geometry Shift Adjustment Factors

Geometry factor (Applied to required signal shift)	Value	Remark
No mechanical link between the load cells	1	Valid for all numbers of load cells
2 Load Cell System		
Overhead rail scale	1,25	Load point 80% within load cell distance

Geometry factor (Applied to required signal shift)	Value	Remark
3 Load Cell System		
Tank scale	1,25	
4 Load cell System		
Floor scale, Tank scale, Pallet scale	1,3	
Truck scale	1,3	
6 Load Cell System		
Truck Scale	1,25	
8+ Load Cell System		
Truck scale	1,15	

5.9. Shift Adjustment out of Range

An Out of Range event typically only occurs with multiple box systems in which the connection cable resistance is significant. If a single box system is out of range, this indicates a mechanically incorrect installation.

1. In the case of **350 Ohm load cells,** set the box to 1.000R by cutting open **all** wires W1-W*n*. This increases the adjustment range by a factor of approximately 2.6, making adjustment steps coarser. Set all SW back to 80 and restart the adjustment procedure from the beginning.

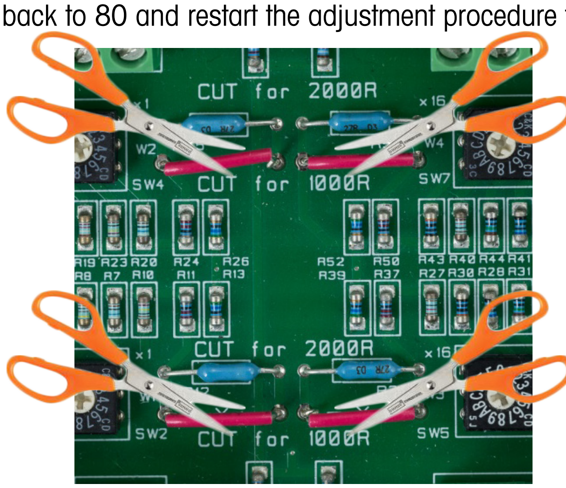


Figure 5-3: Extending Shift Adjustment from 350 Ohms to 1000 Ohms

2. If the box is already in 1000 Ohm mode and further adjustment range is required, cut one wire of **each** blue through-hole resistor (only available for AJB541M and AJB540L). This increases the adjustment range by a factor of approximately 2.6, making adjustment steps still coarser. Set all SW back to 80 and restart the adjustment procedure from the beginning.

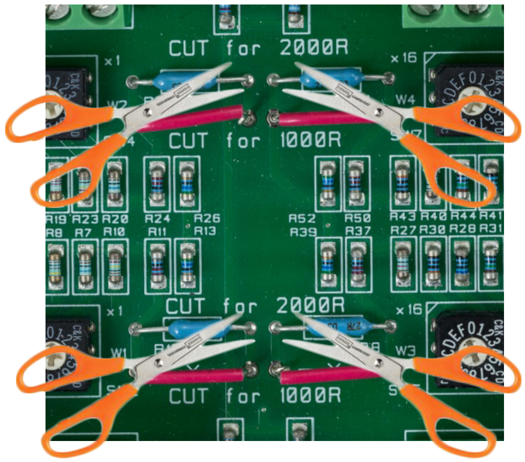


Figure 5-4: Extending Shift Adjustment from 1000 Ohms to 2000 Ohms

6 Software-Supported Shift Adjustment

METTLER TOLEDO InSite™ software supports Initial and Off-Load shift adjustment.

6.1. InSite Screen General

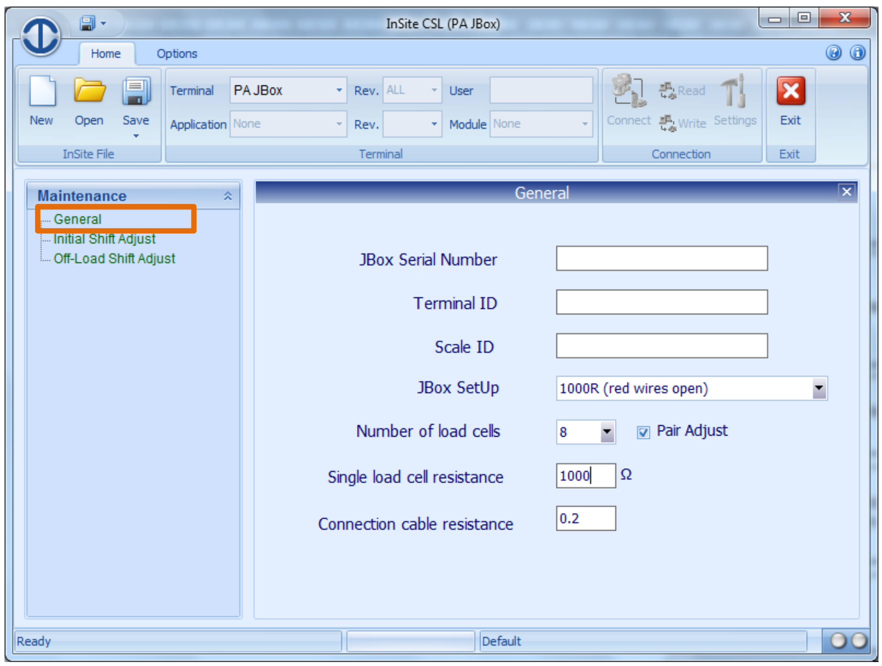


Figure 6-1: InSite General Screen

JBox SetUp	Select from 350R, 1000R, 2000R – refer to section 5.5 in chapter 5.
Pair Adjustment	Check when a pair/section adjustment is planned.
Single load cell resistance	Typically 350 or 1000 Ohm.
Connection Cable resistance	Resistance of one single wire of the Jbox connection cable. This is only relevant when multiple Jboxes are used, and is used for Initial Shift Adjustment

6.2. InSite Screen Initial Shift Adjustment

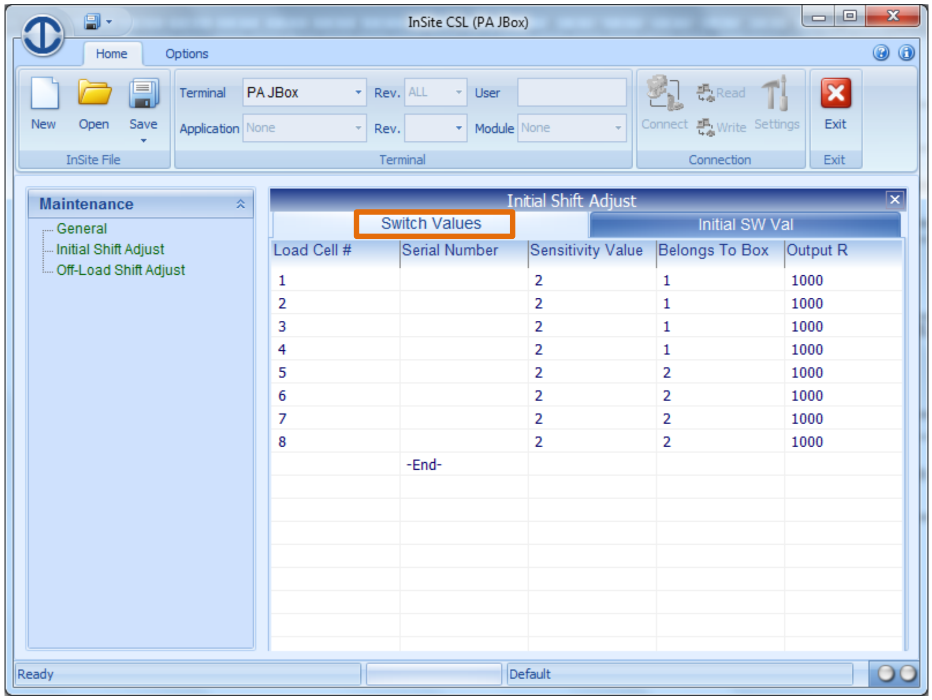


Figure 6-2: InSite Initial Shift Adjust Screen, Switch Values Tab

Enter the load cell output resistance **Output R** for each load cell. Ideally, measure the single load cell's resistance between Sig+/Sig- lines and enter here. This is also relevant for Off-Load adjustment.

Output R	Typically 350 or 1000 Ohm for matched load cells. This is also relevant for Off-Load calculation.

Enter a **Sensitivity Value** – ideally taken from the Calibration Certificate – for each load cell.

Sensitivity Value	Typically 2 or 3 mV/V
Belongs to Box	1 or 2

Click to access the **Initial SW Val** tab.

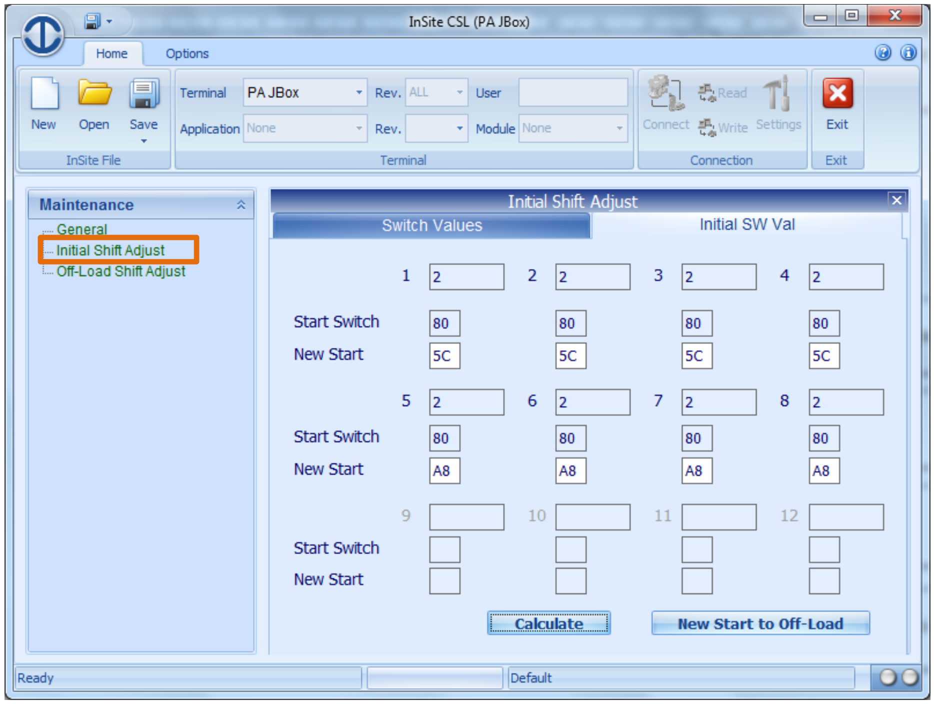


Figure 6-3: InSite Shift Adjust Screen, Initial Switch Values Tab

Start Switch:	Initial setup of boxes – always 80.
Calculate:	Press for Initial Shift Adjustment.
New Start	Set the switches in the box to the values displayed here.
New Start to Off-Load	Copies the new switch levels to the Off-Load Adjustment.

6.3. InSite Screen Off-Load Shift Adjustment

- **Important**: Make sure that the Output R values on Initial Shift Adjustment are correct.

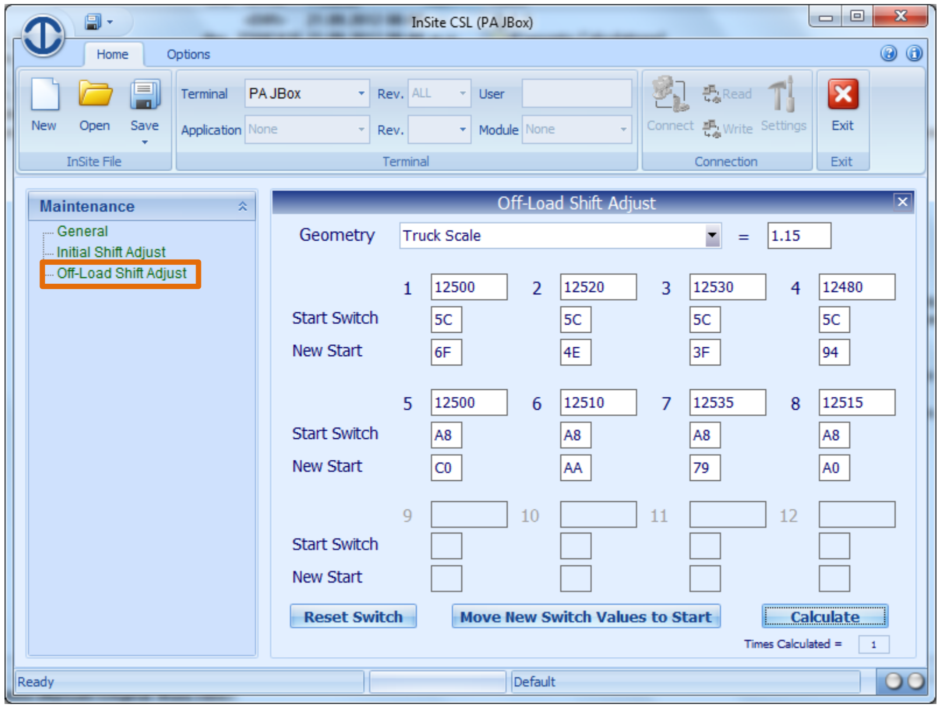
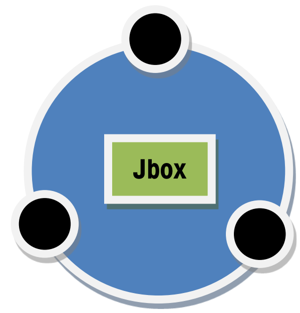


Figure 6-4: InSite Off-Load Shift Adjust Screen

Geometry	Select the scale type.
1 – n	Enter the corner test results. For pair adjustment, only enter values for odd numbered cells – 1,3,5, etc.
New Start	Set the switches in the box to the values displayed here.
Start Switch	Start position of switches while corner test was performed
Move New Switch Values to Start	Copies the **new** switch levels to the Initial Shift Adjust fields for the next test cycle
Calculate	Press to calculate new switch positions.

7 Best Practice Scale Adjustment

7.1. Tank Scale with 3 Load Cells



7.1.1. CalFree™ Calibration Decision

If the scale is to be calibrated by CalFree set all switches to 80 and continue with calibration.

7.1.2. Shift Adjustment – Not Relevant for Liquid Weighing

1. If load cell resistance is ≥1.000 Ohm, cut all W1-W*n* wires.
2. Set all switches to 80.
3. Zero the scale.
4. Check the corner error by applying at least 10% test weight on each corner and recording readings. If in tolerance, continue with scale calibration.
5. If shift error is out of tolerance preferably use On-Load shift adjustment.

7.1.2.1. On-Load Shift Adjustment

1. As a reference, calculate the average reading from previous test results. Never use the lowest or highest reading for reference. as the procedure might not meet target in this case.
2. Load the first corner and adjust the associated SW switches till the terminal's display equals the reference value. Do the same for the other corners.
3. Unload and zero the scale
4. Check theshift error by applying test weight again on each corner and recording the results.
5. If the results are not in tolerance, calculate the average of the latest test result to use as a reference, and repeat the shift adjustment till the measurements are in tolerance

7.1.2.2. Alternative Off-Load Shift Adjustment

1. Run InSite™.
2. Select Off-Load Shift Adjustment.
3. Enter Geometry Factor 1.25.
4. Enter the switch settings.

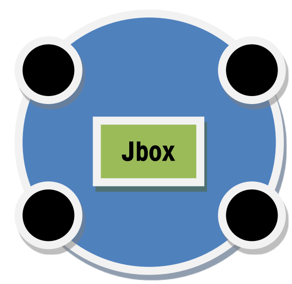
5. Enter the shift test results.
6. Calculate the new switch settings and set the SW switches in the box accordingly.
7. Unload and zero the scale.
8. Check the shift error, and repeat the adjustment if necessary.

7.1.3. Scale Calibration

Perform scale calibration, refer to terminal manual

7.2. Tank Scale with 4 Load Cells and one Junction Box

7.2.1. Height Adjustment



7.2.1.1. Manual Height

For small tanks, perform a manual height adjustment while tank is empty.

7.2.1.2. Terminal Supported Height Adjustment

For larger tank systems, perform a terminal supported height adjustment:

1. Know the approximate dead weight of the scale.
2. Roughly calibrate the scale either with test weight or with CalFree™.
3. Set the terminal so that it can display negative weights – typically in setup at **Scale** > **Zero** > **Under Zero Blanking** > **Disable**.
4. Unhook all the load cells from the signal by disconnecting all Sig+ wires.
5. Record each load cell's reading by connecting Sig+ one at a time. Ideally, all signals will be close to zero. If readings are lower than -50% of dead weight, shim the affected load cells or weigh modules.
6. Repeat the height adjustment process till the condition noted in step 5 is fulfilled.

7.2.2. CalFree™ Calibration Decision

If the scale is to be calibrated using CalFree™, set all switches to 80 and continue with calibration.

7.2.3. Shift Adjustment – Not relevant for Liquid Weighing

1. If the load cells' resistance is ≥1.000 Ohm, cut all W1-W*n* wires
2. Set all switches to 80.
3. Zero the scale.
4. Check the corner error by applying at least 10% test weight on each corner and recording readings. If the resulting value is within tolerance, continue with scale calibration.

5. If the shift error is out of tolerance, preferably use On-Load shift adjustment.

7.2.3.1. On-Load Shift Adjustment

1. Calculate the average reading of former test results for reference. Never use the lowest or highest reading for reference as the procedure might not meet target in this case.
2. Load the first corner and turn switches up or down until the reading equals the reference value. Repeat for each other corner.
3. Unload and zero the scale.
4. Check the shift error by applying the test weight again on each corner and recording readings.
5. If the value is not in tolerance, calculate the average reading of latest test result as a reference, and repeat the shift adjustment till the values are within tolerance.

7.2.3.2. Alternative Off-Load Shift Adjustment

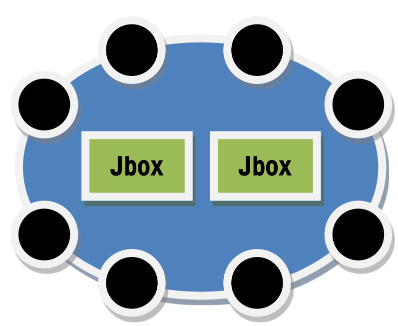
1. Run InSite.
2. Select **Off-Load Shift Adjustment**.
3. Enter a Geometry Factor of 1.3.
4. Enter the switch settings.
5. Enter the shift test results.
6. Calculate the new switch settings and set the SW switches in the box accordingly.
7. Unload and zero the scale.
8. Check the shift error and repeat the adjustment if necessary.

7.2.4. 4. Scale Calibration

To perform scale calibration, refer to the terminal's manual.

7.3. Tank Scale with 5 –12 Load Cells and Multiple Junction Boxes

7.3.1. Junction Box Connection Cable



1. If the scale is to be calibrated by CalFree™ make sure the total length of all connection cables is no gerater than 2m and the wires are at least 0,5 mm^2 (AWG20).
2. For all other calibration methods make sure that the connection cables fit the requirements.
3. Know the connection cable wire resistance.

7.3.2. 2. Height Adjustment

For larger tanks systems perform a terminal supported height adjustment:

1. Know the approximate dead weight of the scale.

2. Roughly calibrate the scale either with test weight or with CalFree™.
3. Set the terminal so that it can display negative weights – typically in setup at **Scale > Zero > Under Zero Blanking > Disable**.
4. Unhook all the load cells from the signal by disconnecting all Sig+ wires.
5. Record each load cell's reading by connecting Sig+ one at a time. Ideally all signals are close to zero.
6. If readings are lower than -50% of dead weight, shim the affected load cells or weigh modules.
7. Repeat the height adjustment process till condition note in step 6 is fulfilled.

7.3.3. CalFree™ Calibration Decision

If scale is to be calibrated by CalFree™ set all switches to 80 and continue with calibration.

7.3.4. Initial Shift Adjustment

- It is strongly recommended to perform Initial Shift Adjustment to compensate for the effect of the connection cable.
- If load cells resistance is ≥ 1.000 Ohm, cut all W1-Wn wires.
- Measure the junction box connection wire resistance, or determine it from the table in chapter 2, section 2.5.
- Pre-adjust the junction boxes using the values from Table 5-2 in chapter 5, section 5.6.1.

7.3.5. Shift Adjustment

1. Zero the scale
2. Check the corner error by applying at least 10% test weight on each corner and record readings. If the values are in tolerance, continue with scale calibration.
3. If the shift error is out of tolerance, preferably perform Off-Load Shift Adjustment.

7.3.5.1. Off-Load Shift Adjustment

1. Run InSite.
2. Select Off-Load Shift Adjustment.
3. Enter a Geometry Factor of 1.15.
4. Enter the switch setting for each load cell and shift test results.
5. Calculate the new switch settings and set the SW switches in the boxes accordingly.
6. Unload and zero the scale.
7. Check shift error and repeat adjustment if necessary.

7.3.5.2. Alternative - On-Load Shift Adjustment

1. Calculate the average of the previous test results as a reference. Never use the lowest or highest reading for reference as the procedure might not meet target in this case.

2. Load first corner and adjust that cell's switches until the reading equals the reference value. Repeat for each remaining corner. If the shift range is exceeded, set the box to the next range and restart the shift adjustment procedure.
3. Unload and zero the scale.
4. Check the shift error by applying the test weight again on each corner and recording readings.
5. If the values are not in tolerance, calculate the average of the latest test result as a reference and repeat the shift adjustment until the values are in tolerance.

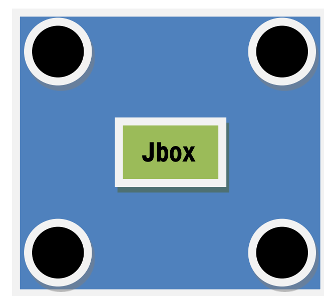
7.3.6. Scale Calibration

To perform a scale calibration, refer to the terminal's manual.

7.4. Floor Scale with 4 Load Cells

7.4.1. Height Adjustment

Perform a manual height adjustment while scale is empty.



7.4.2. Shift Adjustment

1. If the load cells' resistance is ≥ 1.000 Ohm, cut all W1-Wn wires.
2. Set all switches to 80.
3. Zero the scale.
4. Load the scale with the test weight in the center so that all load cells are loaded the same, and record the reading.
5. Check the corner error by applying the test weight on each corner and recording the readings. If the readings are in tolerance, continue with scale calibration.
6. If the shift error is out of tolerance, preferably use On-Load shift adjustment.

7.4.2.1. On-Load Shift Adjustment

1. Use the center load reading as reference. Never use the lowest or highest reading for reference as the procedure might not meet target in this case.
2. Load the first corner and adjust the SW switches until the reading equals the reference value. Repeat for each remaining corner.
3. Unload and zero the scale.
4. Check the shift error by applying the test weight again at each corner and recording the readings.
5. If the values are not in tolerance, load the scale in center and use the reading as a reference for the next cycle. Repeat shift adjustment until the values are in tolerance.

7.4.2.2. Alternative Off-Load Sift Adjustment

1. Run InSite.

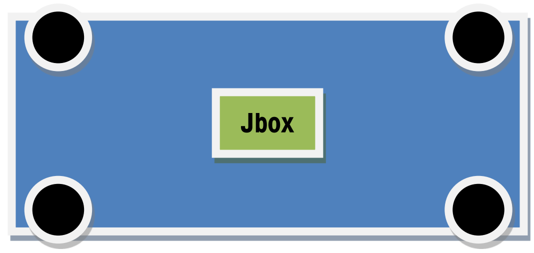
2. Select Off-Load Shift Adjustment
3. Enter a Geometry Factor of 1.3.
4. Enter the switch settings.
5. Enter the shift test results
6. Calculate the new switch settings and set the SW switches in the box accordingly.
7. Unload and zero the scale.
8. Check the shift error and repeat the adjustment if necessary.

7.4.3. Scale Calibration

To perform a scale calibration, refer to the terminal's manual.

7.5. Vehicle Scale with 4 Load Cells and one Junction Box

7.5.1. Height Adjustment



Perform a terminal supported height adjustment:

1. Know the approximate dead weight of the bridge.
2. Roughly calibrate the scale either with test weight or with CalFree™.
3. Set the terminal so that it can display negative weights – typically in setup at **Scale > Zero > Under Zero Blanking > Disable**.
4. Unhook all load cells from the signal by disconnecting all Sig+ wires.
5. Record each load cell's reading by connecting each Sig+ one at a time.
6. Ideally, all signals are close to zero. If the readings are lower than -50% of dead weight, shim the affected load cells or weigh modules.
7. Repeat the height adjustment process until the condition mentioned in step 6 is fulfilled.

7.5.2. Shift Adjustment

1. If the load cells' resistance is ≥ 1.000 Ohm, cut all W1-Wn wires.
2. Set all switches to 80.
3. Zero the scale.
4. Load the scale with the test weight in the center so that all load cells are loaded the same, and record reading.
5. Check the corner error by applying the test weight at each corner and recording readings. If the values are in tolerance, continue with scale calibration.
6. If the shift error is out of tolerance, preferably use On-Load shift adjustment.

7.5.2.1. On-Load Shift Adjustment

1. Use the center load reading as reference. Never use the lowest or highest reading for reference as the procedure might not meet target in this case.
2. Load the first corner or pair and adjust the switches until the reading equals the reference value. In pair adjustment, treat both load cell switches the same. Repeat for the other corners or pairs.
3. Unload and zero the scale.
4. Check the shift error by applying the test weight again at each corner or pair, and recording the readings.
5. If the values are not in tolerance, load the scale in the center and use this reading as a reference for the next cycle. Repeat the shift adjustment until the values are in tolerance.

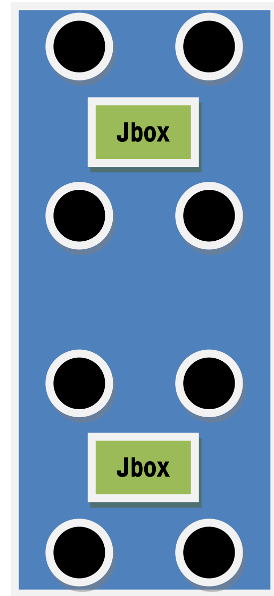
7.5.2.2. Alternative Off-Load Shift Adjustment

1. Run InSite.
2. Select Off-Load Shift Adjustment
3. Enter a Geometry Factor of 1.3.
4. Check Pair Adjustment if appropriate.
5. Enter the switch settings for each cell.
6. Enter the test results for each load cell or pair.
7. Calculate the new switch settings and set the SW switches in the box accordingly.
8. Unload and zero the scale.
9. Check the shift error and repeat the adjustment if necessary.

7.5.3. Scale Calibration

To perform a scale calibration, refer to the terminal's manual.

7.6. Vehicle Scales with 6 – 12 Load Cells and Multiple Junction Boxes



7.6.1. Junction Box Connection Cable

Make sure the connection cables fit the requirements. Failure to do so will result in bad temperature behavior and large initial shift error beyond the range of the boxes.

Know the connection cable wire resistance.

7.6.2. Height Adjustment

Perform a terminal supported height adjustment:

1. Know the approximate dead weight of the bridge.
2. Roughly calibrate the scale either with test weight or with CalFree™.
3. Set the terminal so that it can display negative weights – typically in setup at **Scale** > **Zero** > **Under Zero Blanking** > **Disable**.
4. Unhook all load cells from the signal by disconnecting all Sig+ wires.
5. Record each load cell's reading by connecting each Sig+ one at a time.
6. Ideally the mid load cell signals are positive, and edge load cells all signals are negative. If the readings are lower than -50% of dead weight, shim the affected load cells or weigh modules.
7. Repeat the height adjustment process until the condition noted in step 6 is fulfilled.

7.6.3. Initial Shift Adjustment

- It is strongly recommended to perform Initial Shift Adjustment to compensate for the effect of the connection cable.
- If load cells resistance is ≥ 1.000 Ohm, cut all W1-Wn wires.
- Measure the junction box connection wire resistance, or determine it from the table in chapter 2, section 2.5.
- Pre-adjust the junction boxes using the values from Table 5-2 in chapter 5, section 5.6.1.

7.6.4. Shift Adjustment

Zero the scale.

Check the corner error by applying the test weight on each corner or pair and recording the readings. If the values are in tolerance, continue with scale calibration.

If the shift error is out of tolerance, preferably perform Off-Load Shift Adjustment.

7.6.4.1. Off-Load Shift Adjustment

1. Run InSite.
2. Select Off-Load Shift Adjustment.
3. Enter a Geometry Factor of 1.15.
4. Check Pair Adjustment when appropriate.
5. Enter the switch settings for each load cell.
6. Enter the test results of each corner test or pair test.
7. Calculate new switch settings and set box switches accordingly.
8. Unload and zero the scale.
9. Check shift error and repeat adjustment if necessary.

7.6.4.2. Alternative On-Load Shift Adjustment

1. Determine the reference reading by using similar test weights and applying one on each pair. Make sure all load cells get the same share of the full test weight. It is not appropriate to use fewer test weights than there are pairs, since this it will not allow the cells to be loaded equally.
2. Load first corner or pair with full test weights and adjust the SW switches until the reading equals the reference value. In pair adjustments, treat both load cell switches the same. Do the same for each remaining corner or pair. If the range is exceeded, set the box to the next range and restart the shift adjustment procedure.
3. Unload and zero the scale.
4. Check the shift error by applying the test weight again on each corner or pair and recording the readings.
5. If the values are not in tolerance, load the scale for reference again as described above and use this reading as a reference for the next cycle. Repeat the shift adjustment until the values are in tolerance

7.6.5. Scale Calibration

To perform a scale calibration, refer to the terminal's manual.

7.7. Mono Rail Scale with 2 Load Cells

7.7.1. Shift Adjustment

1. If the load cells' resistance is ≥1.000 Ohm, cut all W1-Wn wires
2. Set all switches to 80.
3. Zero the scale.
4. Load the test weight on the center and calibrate scale.
5. Check the corner error by applying the test weight near each end. Record these readings.

6. If the values are in tolerance, continue with scale calibration.
7. If the values are out of tolerance take a center reading as a reference. Never use one corner reading for reference as the procedure might not meet target in this case.
8. Load the first corner and adjust the cell's switches until the terminal's displayed value equals the reference value. Repeat for each remaining corner, keeping the load within the inner load cell distance.
9. Unload and Zero the scale
10. Check shift error by applying test weight again on each corner and record results.
11. If not in tolerance repeat center loading for reference and shift adjustment till in tolerance

7.7.2. 2. Scale Calibration

To perform a scale calibration, refer to the terminal's manual.

8 Scale Calibration (Span)

8.1. Calibration with Test Weights

The most accurate and reliable way to calibrate a scale is to do so using test weights equal to the scale capacity. Follow the calibration procedure given in the terminal's manual.

8.2. Options for Calibration

8.2.1. Calibration with Test Weights and Material Substitution

The substitution method is recommended for larger installations such as tanks, where it is physically impossible to add test weights equal to the tank's maximum capacity. When performed correctly, this method provides weight readings that plot a reliable performance graph.

An example of this procedure is as follows:

1. Add 1,000 kg of test weights, take a weight reading, and then remove the test weights.
2. Add enough material to the tank to match the weight reading obtained with the test weights.
3. Leaving the material in the tank, add the same test weights again, take a second weight reading, and then remove the test weights.
4. Add enough additional material to the tank to equal the second test weight reading.
5. Repeat this procedure until the tank is full.

8.2.2. Calibration with Material Transfer

When calibrating with material transfer, weigh a material (usually water) on an existing scale and transfer it to the tank scale being calibrated. Do this either in a single transfer or in stages until the tank's maximum capacity is reached.

This method provides only a rough calibration. It is only as accurate as the existing scale and the precision of the transfer process. Even under the best circumstances, it is not possible to tell if allowable errors are cumulative or compensating.

8.2.3. Electronic Calibration

When using the electronic calibration method, replace the load cell cables with leads from a load cell simulator. The simulator sends out a signal equal to the signal the load cells should produce. Electronic calibration is noted for its speed and simplicity; however, it calibrates only the electronics. It does not verify the scale performance because it assumes that the tank and all mechanical connections are in perfect working order.

The procedure is as follows:

1. With the simulator adjusted to zero output, set the terminal to zero.
2. Adjust the simulator to full output, the signal that all the load cells should produce at their rated capacity.
3. Adjust the terminal to show the total capacity of all load cells in the system.
4. Attach the load cell input to the terminal.
5. "Zero off" the empty weight of the tank.

8.2.4. CalFree™ – Calibration without Test Weights

CalFree™ allows for calibration without the use of test weights, by using load cell sensitivity data and METTLER TOLEDO terminals. CalFree calibration accuracy is limited and cannot be used in legal for trade applications. As no test weights are available shift adjustment with test weights cannot be performed. For CalFREE™, adjust the box/s as follows:

8.2.4.1. When Using a Single Box

1. Set box to 350R, regardless of load cell resistance. (If the box has been set to 1000R or 2000R, CalFree is still possible with slightly reduced accuracy.)
2. Set all SW switches to 80 (coarse 8, fine 0). Do not perform a shift adjustment.
3. Follow the instructions for CalFree given in the weighing terminal's manual.

8.2.4.2. When Using Two or More Boxes Connected via AUX (Daisy Chaining)

1. Keep the total length of all junction box connection cables below 2 m at $0.5 mm^2$ (AWG20) not to exceed 0.1% sensitivity drop. This limitation is not valid for the home run cable from the first junction box to the terminal.
2. Set box to 350R regardless of load cell resistance. (If the box has been set to 1000R or 2000R, CalFree is still possible with slightly reduced accuracy.)
3. Set all SW switches to 80 (coarse 8, fine 0). Do not perform a shift adjustment.
4. Follow the instructions for CalFree given in the weighing terminal's manual.

9 Routine Care and Maintenance

9.1. General

Once the weighing equipment is installed, an authorized METTLER TOLEDO representative should inspect and calibrate it periodically. If the scale is used for legal-for-trade purposes, consult the local weights and measures authorities for minimum inspection requirements. Contact your local authorized METTLER TOLEDO service representative for information on periodic inspection and calibration services. The calibration interval should be based on the importance of the scale in the system and the criticality of the weight value to customer's overall operation. More frequent calibrations and adjustments ensure that the weighing results remain accurate, and improve confidence in the weighing results.

9.2. Site Inspection

Make sure that the scale site remains in good condition. Check for:

- Alterations in the dead-to-live connections
- Alterations in support for the load cells
- Overloading and excessive vibration
- Debris or material build-up on, under or around the scale that could inhibit freedom of movement.

If a load cell or its cable is damaged, it should be replaced with a new cell. Mounting bolts should be inspected to insure that there are no loose mechanical connections.

9.3. Junction Box Inspection

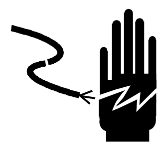
During periodic inspections of the system, check:

- Is the junction box lid properly sealed? Are all cord grips tight?
- Is moisture or foreign material present around or inside the junction box assembly
- Periodically replace the desiccant bags inside the junction box with new ones.
- Is the instrument cable damaged? Does it bind the scale?

- Is there any physical damage to the scale, load cells or junction box/es?
- The repeatability and shift of the scale.

10 Troubleshooting

10.1. General



⚠ WARNING

PERMIT ONLY QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS, AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.

If a scale is not working properly, find out as much about the problem as possible. Try to determine whether the problem is constant or intermittent. Both mechanical and electrical influences can cause malfunctions.

When troubleshooting, start by checking the instrument cable for damage and checking all connections for any loose/incorrect wiring. Examine the physical location of the scale, checking for the following:

- Proper clearance between live and dead portions of scale base or weigh module
- Water
- Corrosive materials
- Uneven floors
- High vibrations
- Air currents
- Physical damage to the scale platform or frame

⚠ CAUTION

BEFORE CONNECTING/DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT, ALWAYS REMOVE POWER AND WAIT AT LEAST 30 SECONDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY HARM OR DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

10.2. Isolate the Problem

To determine whether the problem is in the scale or the digital terminal:

1. Remove power from the system.
2. Disconnect the weighing terminal from the scale, and connect it to a load cell simulator (analog load cell simulators are available from METTLER TOLEDO).
3. Reapply power. If the problem persists, consult the terminal;s manual for further troubleshooting assistance.
4. If the problem is **not** present with the load cell simulator attached to the terminal, remove power. Disconnect the simulator and reconnect the scale. If the problem persists, continue troubleshooting the scale.

10.3. Check Wiring

To check the wiring:

1. Remove power from the system.
2. Remove the lid from the junction box and check the interior for moisture and foreign material.
3. Make sure that all wiring connections are tight and that no insulation material is touching the terminal contacts.
4. Check all cable connections for correct wiring. Check all cable connectors and cord grip caps on the junction box. Tighten any loose connectors.

10.4. Check Load Cells

Remove load cell leads from the terminal strip and check each load cell for proper bridge resistances. If bridge resistances are within specification, perform a shorted-signal symmetry check:

1. Short the signal leads together and place one multi-meter lead on the shorted signal and one lead on the +Excitation wire, and record the resistance value.
2. Remove the lead from the +Excitation wire and place it on the –Excitation wire, and record the resistance. The two values should be approximately equal.

If the cells pass the above test:

1. Reapply power to the scale platform.
2. Confirm that proper excitation voltage is reaching the load cells by placing multi-meter leads on the excitation positions of each load cell terminal. Excitation voltage can vary from 6 VDC to 15 VDC, depending on the application and weighing terminal, so check the terminal's manual for the expected value.
3. If the proper excitation voltage is reaching the load cells, check the output signal from each cell.

4. If one cell has a particularly high or low dead-load output, it is suspect. The maximum output from any cell is 30 mV at 15 VDC excitation when loaded to gross capacity.
5. If any cell has an unusual signal, remove all load from that cell by raising the platform.
6. With the power still on, measure the output from the suspect load cell. The "no-load" zero output should be ±1.5% of the full scale output. For example, if the excitation voltage is 15 VDC, then the full scale output is 30 mV and the load zero output should be within ±0.45 mV.
7. If the load cell is out of specification, replace it.
8. If a load cell fails any of the above tests, replace it.

10.5. Load Cell Replacement Procedure

1. Remove power from the digital terminal and disconnect the instrument cable.
2. Remove the junction box cover and locate the defective load cell terminal.
3. Disconnect the defective load cell cable from its terminal on the JBox PCB.
4. Loosen the watertight cable connector on the junction box and remove the cable from the enclosure.
5. If the load cell cable runs through a conduit, attach a string to the end of the defective load cell cable. The string should be both strong enough and long enough to pull the new load cell cable through the conduit.

⚠ CAUTION
BE SURE TO BLOCK THE SCALE WHEN IT IS IN THE RAISED POSITION. OBSERVE ALL APPROPRIATE SAFEY PRECAUTIONS WHEN INSTALLING AND SERVICING THE WEIGH MODULES.

6. Carefully pull the defective load cell cable through the conduit while feeding the string through the junction box opening. Once the string is at the load cell location, detach it from the load cell cable. Attach the new load cell cable to the pulling string and carefully thread it through the conduit into the junction box opening.
7. Reattach the instrument cable and power-up the terminal. Perform a shift adjust if required, and recalibrate the scale.

10.6. PCBA Replacement

10.6.1. Replacement Parts

Spare PCBAs are compatible with housings as shown in Table 10-1. For systems with multiple boxes, always exchange all PCBAs at the same time. Mixing a trim pot PCBA with a Precision Junction Box PCB would result in very poor scale performance.

Table 10-1: Replacement PCBs for Precision Junction Boxes

Precision Junction Box	Spare PCBA – Item No.
AJB540S	30206062
AJB641S	30206064
AJB541M	30206063
AJB540L	30206063
AJB641SX	30093314 (Ex Version)
AJB841SX	30093314 (Ex Version)
AJB941M	30206064
Former Junction Boxes	**Suitable PCBA**
AJB015	30206062 (exchange all PCBAs in the scale)
TB100458 – Large 5 Hole	30206063 using Precision Technology (exchange all PCBAs in the scale) or 71210772 – based on old technology
TB100481 – Standard 6- Hole	30206063 using Precision Technology (exchange all PCBAs in the scale) or 71210772 – based on old technology
Former ATEX Junction Boxes	**Suitable PCBA**
TB100772-5	71210772
TB100771-5	71210772
Other Parts	**Item No.**
AJB941M Seal Kit	30489548

10.6.2. Replacement Procedure

The following procedure describes the replacement of a single PCBA. In multiple-box systems, follow the same sequence for each Junction Box:

1. Remove power from the weighing terminal and disconnect the instrument cable.
2. Remove the junction box cover.
3. Disconnect all cables from the PCBA.
4. Inspect the existing PCBA for the cause of failure. In case of moisture and corrosion damage, check the box for leakage.
5. Remove the existing PCBA and install the new one.
6. Set box's range to match the existing PCBA; for instance, if the 1000 Ohm wires are cut on the existing PCBA, cut them on the replacement board.
7. Adjust the new SW switches to match the existing values.
8. Reconnect all cables, and close the box.

Once all PCBs are replaced, re-check the scale performance.

METTLER TOLEDO Service

To protect your product's future:

Congratulations on choosing the quality and precision of METTLER TOLEDO. Proper use according to these instructions and regular calibration and maintenance by our factory-trained service team ensure dependable and accurate operation, protecting your investment. Contact us about a service agreement tailored to your needs and budget.

We invite you to register your product at www.mt.com/productregistration so we can contact you about enhancements, updates and important notifications concerning your product.

www.mt.com/junctionbox

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