

MSI3700

MAGNUM PLUS
ELECTRONIC LIFT
TRUCK SCALE
WITH DIGITAL WEIGHT
INDICATOR

User Guide

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Industrial
Weighing
and Force
Measurement
Equipment*



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TABLE OF CONTENTS

Introduction4
 Specifications4
 Options and Accessories5
 Unpacking6
 Installation Procedure6
 Figure 1: Removing the forks6
 Figure 2: Loading the scale on the carriage7
 Figure 3a: Adjusting the scale assembly7
 Figure 3b: Adjusting the jam nuts8
 Figure 4: Attaching the safety plates8
 Figure 5: Assembling the load cell cable9
 Figure 6a: Placing the mounting bracket9
 Figure 6b: Mounting the indicator 10
 Figure 6c: Connecting the load cell cable 10
 Figure 7: Connections to the lift truck battery 11
 Figure 8a: Installing forks onto the Magnum Plus 11
 Figure 8b: Installing the stop bolts 12
 Flexure Replacement & Adjustment 12
 Figure 9: Magnum Plus flexures 12
 Lower Suspension Bolt Adjustment Procedure 13
 Figure 10: Bolt Adjustments 14
 Indicator Calibration and Operation 15
 Optional Indicator 15
 Effects on Lifting Capacity 15

NTEP Option only:
 MSI-3700 NTEP Angle Verification 16
 Figure 11: Definition of X and Y for Angle Calibration 16
 MSI-3700 NTEP Angle Calibration Procedure 17
 MSI-3650 Menu Structure for Angle Verification/Calibration 19
 NTEP Initial Calibration20
 NTEP Standard Calibration21
 Wiring Notes22
 NTEP Meter Operational Notes22
 Troubleshooting23

The MSI Limited Warranty 24

INTRODUCTION

Congratulations for choosing the MSI-3700 Magnum Plus lift truck scale. It ensures accurate weight readings and dependable operation. Unlike other lift truck scales, your Magnum Plus is designed upon a concept that minimizes the scale's weight while maintaining its strength. A unique single load cell, multi-flexure design safeguards the load cell from excessive shock and vibration. The combination of light weight and advanced design provides you with an optimal set of benefits.

SPECIFICATIONS

MSI-3700 Magnum Plus Lift Truck Scale

Accuracy: 0.1% of rated capacity

Operating Temperature Range:

14° to 140° F (-10° to 60° C)

Safe Overload:

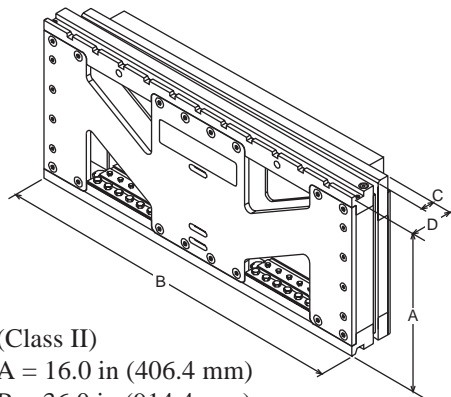
200% of rated scale capacity

Ultimate Overload:

500% of rated scale capacity

Capacity: 5,000 lb x 2 lb / 2,500 kg x 1 kg (Class II)

Dimensions:



(Class II)

A = 16.0 in (406.4 mm)

B = 36.0 in (914.4 mm)

C = 1.465 in (37.211 mm)

D = 4.35 in (110.49 mm)

Center of Gravity = (0.5A) x (0.5B) x (0.5D)

Scale Unit Weight:

163 lb (74 kg)

Shipping Weight:

186 lb (84 kg)

MSI-3650-M Digital Weight Indicator

Power: DC operated from 12 to 56 V

Display:

- 6 digit 0.9" (23 mm) numeric LCD (weight display)
- 8 digit 0.45" (11 mm) alphanumeric LCD (message display)
- 21 segment analog bar graph used for level indication with NTEP option
- Annunciators for measurement modes
- LED indicator for totalizing and setpoint indication
- Photocell to activate backlighting

Enclosure:

NEMA IV, IP65 Alodined and powder coated cast aluminum

Operating Temperature:

14° to 140°F (-10° to 60°C)

Functions:

- Power: On/Off
- Zero: zero out residual weight
- Net/Gross: switch between Net (tared) and Gross weight
- Tare: tare out container weight and indicate Net weight
- Print: digital output to external printer
- Setup: for selection of programmable functions and features
- Total: accumulate weighments in register (automatically or manually)
- View Σ : display accumulated weighments in registers
- User: program user-defined functions
- Test: display and function test

Programmable Features:

- Automatic or Manual Tare entry
- Automatic or Manual Totalizing with weighments counter
- 12 programmable ID Codes (expanded memory option available)
- Lock mode to prevent unauthorized program changes
- Digital calibration

Warranty: One Year

OPTIONS AND ACCESSORIES

- NTEP approved for legal for trade installations (MSI-3650-M indicator and 5000 lb x 5 lb capacity only)
- Class III (20" x 42") 8,000 lb x 2 lb / 4000 kg x 2 kg
Class III (20" x 48") 10,000 lb x 5 lb / 5000 kg x 2 kg
- Substitute standard indicator with an MSI-3750 indicator (please see respective indicator manual for Product Specifications and Options)

- Tape printer with truck-mounting bracket (requires RS232 option)
- Cable retracting and storage assembly kit with 200" maximum lifting height (contact factory for specifications)

MSI-3650-M Digital Weight Indicator Options

- RS232 Input/Output with Real Time Clock, Eight Setpoints, and full output formatting
- Second Isolated RS232 or RS485 with Eight Setpoint Relays
- Expanded ID Memory up to 240 Product Codes
- Internal Battery power (2 D-cell alkaline batteries)

UNPACKING

The Magnum Plus lift truck scale is shipped on a wooden skid. Upon receipt of the system, be sure all parts are included. A standard system will include the following:

- 1) 1 ea. Scale assembly with safety plates
- 2) 1 ea. MSI-3650 Digital Weight Indicator with mounting bracket and hardware
- 3) 1 ea. Load cell cable assembly
- 4) 1 ea. Power cable

INSTALLATION PROCEDURE

- 1) Remove forks from lift truck. They will be easier to remove if you grease the track.



Figure 1: Removing the forks.

- 2) Remove shipping straps from the scale assembly. Place the scale vertically on the edge of the shipping skid and align it so it can be lifted into

position by raising the truck carriage. Position the scale assembly onto truck carriage so it is centered, and make sure the center pin seats in center notch on the truck carriage.



Figure 2: Loading the scale on the carriage.

- 3) Scale adjustment procedure. Raise the scale to provide access to the underside. There are adjustment bolts on each lower back corner of the rear plate. They can be identified by their conical-shaped heads. They are threaded through the lower back rail and secured by jam nuts on the inside of the rear plate.

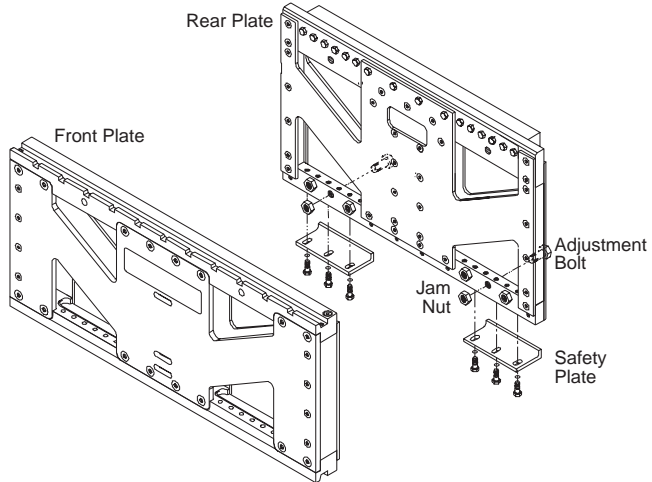


Figure 3a: Adjusting the scale assembly.



WARNING: Jam nuts are located under the flexure plates. When adjusting jam nuts, be careful not to roll end wrench too far. It may severely damage the flexure.

Using a 15/16" open end wrench, loosen both jam nuts. Adjust the bolts until the scale assembly is supported equally by each bolt and the scale assembly is approximately parallel to the truck carriage. Secure the adjustment bolts by tightening the jam nuts. It will be necessary to use two wrenches so the bolts do not move when the nuts are tightened. Again, be careful not to damage the flexures while adjusting the jam nuts.



Figure 3b: Adjusting the jam nuts.

- 4) Attach safety plates to bottom of scale assembly with vertical angle of safety plate behind bottom edge of the truck carriage (see Figure 3a for proper orientation). Use a 9/16" socket or closed-end wrench.



Figure 4: Attaching the safety plates.

- 5) Load cell cable assembly. After attaching the cable to the scale, route the cable so it will not snag while the forklift is moving. Also make sure that the routing will allow full movement of the truck carriage and mast.



Figure 5: Assembling the load cell cable.

- 6) Install indicator. Location of indicator is a matter of operator preference.
a) The mounting bracket is attachable to either the safety cage or the truck dash board. This example is the top of a safety cage.

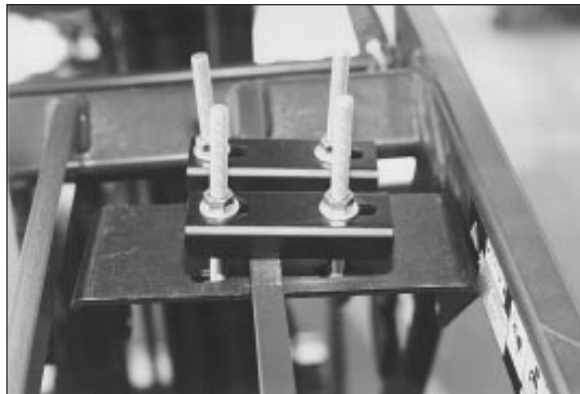


Figure 6a: Placing the mounting bracket.

- b) Unscrew the side knobs to fit the indicator to the bracket, then tighten the screws to secure the indicator.



Figure 6b: Mounting the indicator.

- c) Connect the load cell cable to the indicator.



Figure 6c: Connecting the load cell cable.

- 7) **Power Hook-Up.** Connect one end of the power cable to the indicator. Route the cable to the battery of the forklift, and make sure the cable is secured tightly with tie wraps. Run the two-conductor power cable from the indicator to the 12-56 VDC power at the truck battery or fuse block. (Ensure all electrical connections, other than those directly to the battery posts, are equivalent in polarity and voltage of the battery posts.) Power cable inputs are Red (+) and Black (-).

Note: Do not use instrument gages for hookup. Due to internal impedance, this can cause indicator problem or failure. It also may be necessary to install noise suppression on some lift trucks. If the cable is not connected directly to the battery, check its resistance from the point of

hookup back to the battery terminal. It should read less than 0.5 ohm.



WARNING: Not all electric lift trucks have a chassis ground. A connection using chassis as ground may affect the truck's electrical system.



Figure 7: Connections to the lift truck battery.

- 8) Install forks onto the Magnum Plus scale assembly by sliding the forks in from the ends. Install stop bolts (four total) to the top and bottom of the scale assembly on both sides (see Figure 8b).

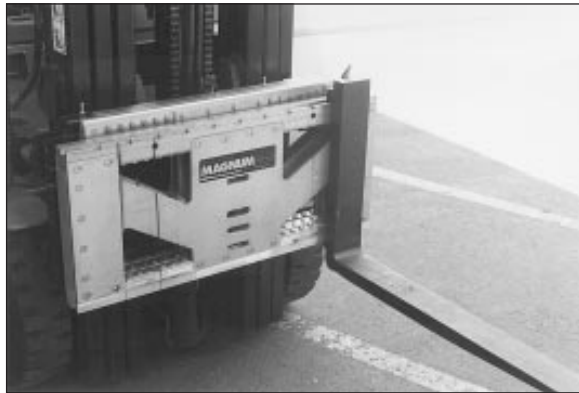


Figure 8a: Installing forks onto the Magnum Plus.

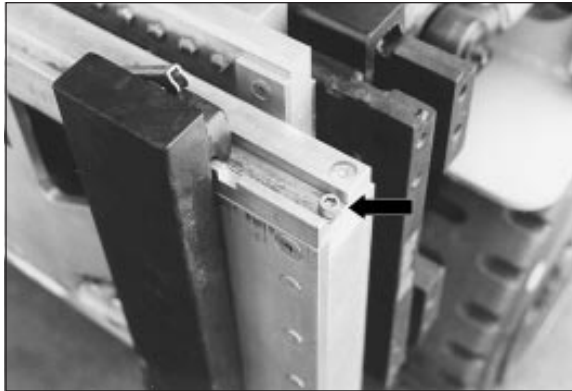


Figure 8b: Installing the stop bolts.

- 9) On level ground with forks raised, push the Zero button on the indicator (a bubble-level indicator is built in to the scale top). Indicator should read zero and be ready for use. The scale must be vertical to ensure accurate readings. The optional NTEP configuration provides level correction.

FLEXURE REPLACEMENT & ADJUSTMENT

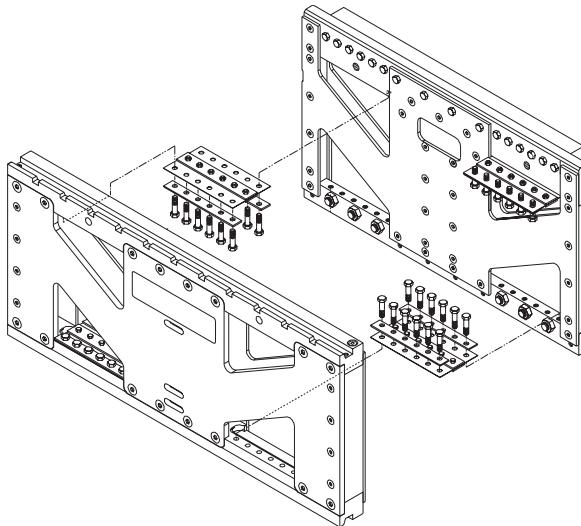


Figure 9: Magnum Plus flexures.

The Magnum Plus is designed with four steel flexures that absorb excessive shock and vibration in order to protect the scale's load cell. In extreme cases, such as collisions, the flexures may give way much like a fuse with electrical circuitry. Flexures can be repaired quickly and easily in the field. Follow these

instructions:

A. Remove scale assembly from lift truck.

- 1) Remove forks from scale assembly.
- 2) Disconnect load cell cable from the indicator.
- 3) Remove safety plate from bottom of scale assembly and truck carriage.
- 4) Lift scale assembly off truck carriage and place in vertical position on a sturdy work platform.

B. Removal and Replacement of Flexures.

1) Top Flexure Replacement:

If it is necessary to repair more than one flexure, remove and replace only one flexure at a time. Replace all flexure retainer clamps back in to the scale assembly in the original position. Apply removable liquid threadlocker adhesive to the flexure retainer bolts and torque to 20 ft/lb (27 N/m).

2) Bottom Flexure Replacement:

Replacement of bottom flexures is more complex than replacing the top flexures. All shims used for achieving heel to toe balancing will be located in the bottom row of the flexures. As flexures are removed from the bottom row, do so carefully and look for shims beneath. Shims must be returned to the same position that they originated. After all lower flexures are replaced and shims are in proper locations, tighten all lower bolts on retainer clamps. Apply removable liquid threadlocker adhesive to the flexure retainer bolts and torque to 20 ft/lb (27 N/m).

C. Scale Balancing.

Heel-to-toe shift in weighing may be adjusted by adding or removing shims between the lower flexures and the scale assembly. If weight on the heel of the fork is higher than the toe or tip of the fork, remove shims (if any) from the lower flexure on the front plate or add shims to the lower flexure on the rear plate. If weight on the toe is higher than the heel, add shims to the lower flexure on the front plate (or remove shims from the rear plate). A 2 lb or 1 kg error can be corrected by 1 each .002" shim (MSI part #501203). When performing a heel-to-toe adjustment, always check both sides of the scale and adjust if necessary. When the heel-to-toe adjustment is complete, a span calibration must be performed.

MSI-3700 LOWER SUSPENSION BOLT ADJUSTMENT PROCEDURE

Tools Required:

- 2 each 0.75" Open End Wrenches
- 1 each 0.75" Socket Wrench
- Loctite 242 (Blue)

Procedure:

- 1) Remove forks from carriage.
- 2) Loosen Load Cell Jam Nut and both Lower Jam Nuts. Loosen Lower Suspension Bolt enough for it to clear the load cell.
- 3) With the Lower Suspension Bolt clear of the load cell, turn the meter on, wait for it to complete the power up sequence, then press the ZERO button. Meter should indicate 0 lb or kg.
- 4) Apply Loctite 242 to end of bolt. Thread the bolt into Load Cell. Using 0.75" socket, turn bolt until displayed reading of 80 lb or 35 kg is showing on the meter.
- 5) Apply a little more Loctite to the threads of the bolt just below the Load Cell. While holding the bolt with the socket wrench, tighten the Load Cell Jam Nut against the Load Cell. Tighten the Load Cell Jam Nut as tight as possible. MSI recommends 60 ft/lb (81 N/m).



Caution: While securing the nut, be extremely careful to not rotate the Load Cell. You may need to hold the Load Cell in place while setting the Load Cell Jam Nut.

- 6) Reset the Lower Jam Nuts by turning the bottom nut down until it makes contact with the washer. Back the bottom nut 1/4 turn up from the washer so the washer can turn freely. Hold the bottom nut in place with a 0.75" open end wrench and secure by jamming the upper nut onto the lower nut.
- 7) Place forks back on carriage assembly and then press the "ZERO" button on the meter.
- 8) Performing this procedure should not have an adverse effect on the calibration of the scale. It is recommended that you verify the calibration and make adjustments, if necessary, as described in the Users Guide.

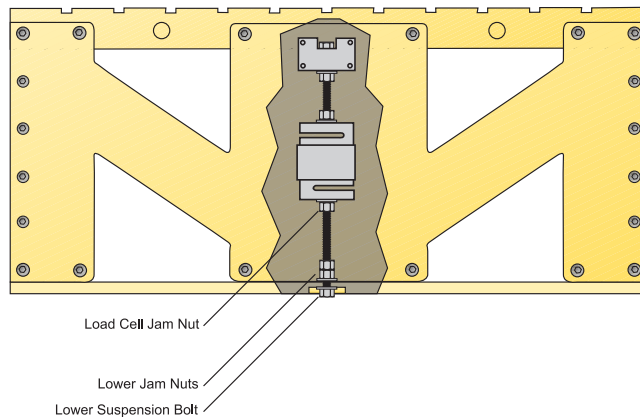


Figure 10: Bolt adjustments.

INDICATOR CALIBRATION AND OPERATION

Your MSI indicator will arrive calibrated and ready for use. If it requires recalibration, please refer to its User Guide for complete instructions. The User Guide also contains comprehensive operational information regarding the features and functions of your MSI digital weight indicator.

Note: Users of the NTEP configuration should also refer to NTEP instructions at the back of this manual.

OPTIONAL INDICATOR

MSI-3750 Digital Weight Indicator:



All the features of the MSI-3650 indicator, plus the following:
Complete alphanumeric keypad.
Standard RS232, real-time clock, and eight setpoints.
Optional statistics package for inventory and quality control applications.

EFFECTS ON LIFTING CAPACITY

As with any lift truck carriage attachment, installing your lift truck scale will reduce the lifting capacity of your lift truck. MSI designed the Magnum Plus to minimize the lost capacity. You should expect a reduction of approximately 450-600 lb (200-275 kg) for a 5,000 lb capacity truck. For an accurate calculation of the new lifting capacity, contact your lift truck manufacturer and provide them with weight and dimension specifications for Magnum Plus

MSI-3700 NTEP ANGLE VERIFICATION

Angle calibration is to be performed after the scale has been installed and calibrated to the carriage assembly on a level surface.

Equipment Needed:

- 1) Digital Protractor
- 2) Truck Ramp, 4.5 degree minimum tilt side to side on truck.

Procedure:

- 1) Position the truck so that the carriage is level both side to side and front to back.
- 2) Turn meter on and then press the SETUP button, display will read "SETUP" for two seconds and then "UNITS".
- 3) Using the SETUP and /or VIEW TOTAL buttons to scroll through the menu, press the ENTER button when the display reads "ANGL CHK".
- 4) Display will show "X . X Y . Y" on the main display and "X CHEK Y" on the alphanumeric display. "X . X" indicates the $\pm X$ angle at which the carriage is positioned, and "Y . Y" indicates the $\pm Y$ angle. Refer to Figure 10 below for X and Y references in relation to the carriage assembly.
- 5) Verify calibration accuracy by positioning the carriage at several different angles between 0.0 and 4.5 degrees, comparing the indicated angle on the display to the actual angle indicated on the digital protractor. All indicated angles should be within 0.1 degrees of the actual angles. Press the EXIT button twice to exit out of the angle check mode and into the normal weighing mode. If indicated angles are not within tolerance, then angle calibration must be performed.

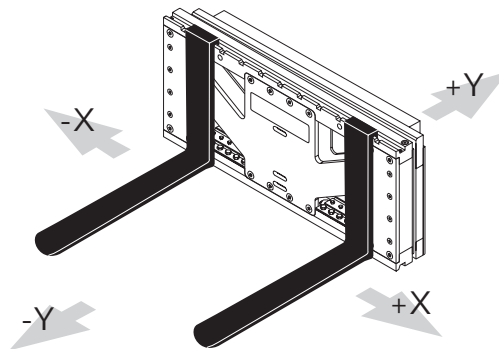


Figure 11: Definition of X and Y for Angle Calibration.

MSI-3700 NTEP ANGLE CALIBRATION PROCEDURE

Angle calibration is to be performed when either:

- a) the scale fails Angle Verification even though it has been installed and calibrated to the carriage assembly on a level surface,
- b) or if the meter PCB or angle sensor PCB has been serviced or replaced.

Equipment Needed:

- 1) Digital Protractor
- 2) Phillips Screwdriver
- 3) Truck Ramp, 4.5 degree minimum tilt side to side on truck.

Procedure:

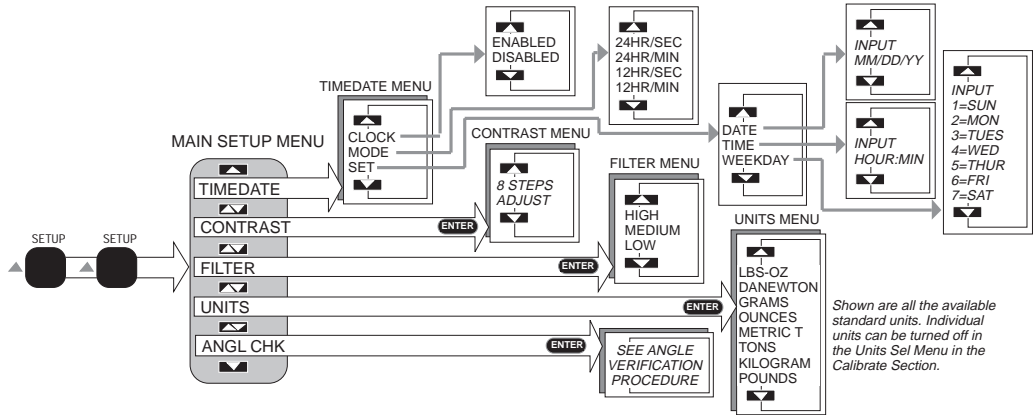
- 1) Position the truck so that the carriage is level both side to side and front to back.
- 2) Remove the calibration seal port screw on lower left side of meter. Insert small nonconductive screwdriver or wooden stem of “Q-Tip” in the calibration access hole and press switch. Display will read “CALSETUP” for two seconds and then “STD CAL”.
- 3) Using the SETUP or VIEW TOTAL buttons to scroll through the menu, press the ENTER button when “ANGLE” is shown on the display. The meter will then show “ANGL CAL”, press ENTER and “R U SURE” will be displayed, press ENTER.
- 4) Display will read, “XX - YY” on the main display and “X ZERO Y” on the alphanumeric display. Verify again that the carriage is level, both side to side and front to back. Press ENTER. Display will show “CAL ‘ ING” for one second.

In steps 5 - 8, the exact angle of the truck carriage must be entered manually. The digital protractor must be placed squarely on the MSI-3700 to register the exact angle of the truck carriage. When the display shows “4.50” use the SETUP button for scrolling up, the VIEW TOTAL button for scrolling down, the POWER button for entering the decimal point, and the ENTER button to enter each individual number. Do not press the ENTER button after entering the decimal point, the cursor will automatically move to the next position.

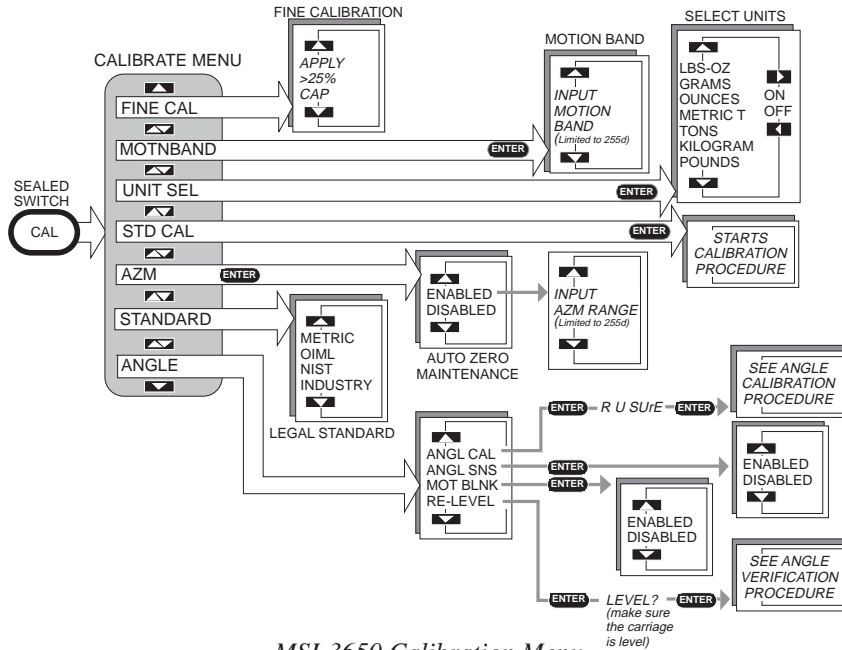
- 5) Display will read “4.50” on the main display and “- ANGL X ” on the alphanumeric display. Referring to Figure 1, raise the - X side of the carriage until the digital protractor reads approximately 4.50 degrees. Manually enter the exact angle into the MSI-

- 3650 indicator. Display will show “CAL ‘ ING” for one second.
- 6) Display will read “4.50” on the main display and “ + ANGL X “ on the alphanumeric section. Referring to Figure 1, raise the + X side of the carriage until the digital protractor reads approximately 4.50 degrees. Manually enter the exact angle into the MSI-3650 indicator. Display will show “CAL ‘ ING” for one second.
 - 7) Display will read “4.50” on the main display and “ - ANGL Y ” on the alphanumeric display. Referring to Figure 1, raise the - Y side of the carriage until the digital protractor reads approximately 4.50 degrees. Manually enter the exact angle into the MSI-3650 indicator. Display will show “CAL ‘ ING” for one second.
 - 8) Display will read “4.50” on the main display and “ + ANGL Y ” on the alphanumeric display. Referring to Figure 1, raise the + Y side of the carriage until the digital protractor reads approximately 4.50 degrees. Manually enter the exact angle into the MSI-3650 indicator. Display will show “CAL ‘ ING” for one second.
 - 9) Display will show “ X . X Y . Y ” on the main display and “ X CHEK Y” on the alphanumeric portion. “X . X” indicates the $\pm X$ angle at which the carriage is positioned, and “Y . Y” indicates the $\pm Y$ angle.
 - 10) Verify calibration accuracy by positioning carriage at several different angles and comparing the indicated angle on the display to the actual angle indicated on the digital protractor. All indicated angles should be within 0.1 degrees of the actual angles. Press the EXIT button three times to exit out of the calibration menu and into the normal weighing mode.

MSI-3650 MENU STRUCTURE FOR ANGLE VERIFICATION/CALIBRATION



MSI-3650 Main Setup Menu



MSI-3650 Calibration Menu

NTEP INITIAL CALIBRATION

Additional information found in the 3650 owner's manual.
(Performed only after a "Reset Calibration" or "Reset All")

NOTE: The following procedure is for use only when changing the load cell or the electronics package. Use the "NTEP STANDARD CALIBRATION" procedure for routine calibration of the NTEP 3700 & 3650.

* Before starting the following procedure, make sure that the carriage has been properly installed. Additionally, make sure that the lift truck is level and that the lift truck remains level throughout the calibration procedure.

1. Enable Calibration as described in the 3650 User Guide.
2. Set the STANDARD to NIST as described in the 3650 User Guide.
3. Scroll to the "Std Cal" menu option using the up and down arrow keys. Press "Enter" to begin calibration.
4. The meter will prompt you to select the type of power that is being used (AC, Battery, or Vehicle). Scroll to the appropriate power source and press enter.
5. The next prompt will be to select the default units that the system will be calibrated with (units can be changed after calibration is completed). Select the appropriate units and press enter.
6. The next prompt will be to enter the full scale capacity. The indicator will default to 5000 lb or 2500 kg. Press enter to accept.
7. The next prompt will be to enter the count by, or resolution. For pound units, the highest resolution allowed is 5 lb. For kilogram units, the highest resolution allowed is 2 kg. Press enter to accept.
8. The next prompt will ask you to set the analog Gain that the indicator will use for calibration. The indicator will default to a gain of 3. This gain setting should not need to be changed. Press enter to accept.
9. The next prompt, "MGM ONLY" asks you to enter the weight of the Magnum carriage without the forks. To enter this weight, leave the carriage on the lift truck with no forks, lifting accessories, or any other additional weight hanging from the "live" carriage. When the motion light is out, press enter.
10. The next prompt, "MGM + FRKS" asks you to enter the weight of the Magnum carriage with the forks and / or other standard lifting accessories attached. When the motion light is out, press enter.

11. The next prompt “Weight 1” will ask you to enter the value of the first known test weight.

Note: Five test weights will be used to set the linearity. These test weights should cover the full capacity of the scale (For example 1000lb, 2000lb, 3000lb, 4000lb, 5000lb) Place the first test weight on the forks. Enter the value into the indicator as described in the 3650 User Guide. When the motion light goes out, press enter.

12. Repeat step 11 for “Weight 2”, “Weight 3”, “Weight 4”, and “Weight 5”. When complete, remove the test weights from the lift truck.
13. The next prompt “MGNM WT?” will ask you to enter the weight of the live carriage assembly and other miscellaneous hardware. The indicator will default to 90 lb or 40 kg. When the motion light goes out, press enter.
14. If everything was completed successfully the indicator will say “Cal OK”, then return to the main calibration menu. The next step will be to perform the angle calibration procedure as described in this manual.
15. After completing the angle calibration and the scale returns to normal weighing mode, use varying known test weights to confirm the scale is operating properly.

NTEP STANDARD CALIBRATION

Use this procedure for routine calibration of the NTEP 3700 & 3650. Before starting the following procedure, make sure that the carriage is properly installed. Also make sure that the angle sensor is calibrated and that the lift truck is level.

1. Enable Calibration as described in the 3650 User Guide.
2. Scroll to the “Std Cal” menu option and press enter.
3. The next prompt, “MGM ONLY” asks you to enter the weight of the Magnum carriage without the forks. To enter this weight, leave the carriage on the lift truck with no forks, lifting accessories, or any other additional weight hanging from the “live” carriage. When the motion light is out, press enter.
4. The next prompt, “MGM + FRKS” asks you to enter the weight of the Magnum carriage with the forks and / or other standard lifting accessories attached. When the motion light is out, press enter.
5. The next prompt “Weight 1” will ask you to enter the value of the

first known test weight.

Note: Five test weights will be used to set the linearity. These test weights should cover the full capacity of the scale (For example 1000lb, 2000lb, 3000lb, 4000lb, 5000lb). Place the first test weight on the forks. Enter the value into the indicator as described in the 3650 User Guide. When the motion light goes out, press enter.

6. Repeat step 11 for “Weight 2”, “Weight 3”, “Weight 4”, and “Weight 5”. When complete, remove the test weights from the lift truck.
7. The next prompt “MGNM WT?” will ask you to enter the weight of the live carriage assembly and other miscellaneous hardware. The indicator will default to 90 lb or 40 kg. When the motion light goes out, press enter.
8. If everything was completed successfully the indicator will say “Cal OK”, then return to the main calibration menu. Press exit to return to normal weighing mode and use varying test weights to verify that the scale is operating properly.

WIRING NOTES

<u>Pin label</u>	<u>Connector</u>	<u>L/C cable color</u>	<u>Meter Pigtail color</u>
+ EXC	A	Red	Blue / White
- EXC	D	Black	White / Blue
+ SIG	B	Green	Orange / White
- SIG	C	White	White / Orange
shield	E	Shield	Drain
X Axis	F	Blue	Green / White
Y Axis	G	Yellow	White / Green

NTEP METER OPERATIONAL NOTES

In normal weighing mode. The display will blank out when there is motion being registered. Only stable weights will be displayed.

The bargraph is used to indicate whether the load is level from front to back. During normal operation the indicator will read “Tilt” beyond 4.00 degree tilt in any direction.

TROUBLESHOOTING

Non-linear

1. Verify that the adjustment bolts are supporting the carriage assembly evenly.
2. Verify that the angle sensor is properly calibrated.
3. Verify that the flexures are properly torqued to 20 ft/lb (27 N/m).

Note: See flexure replacement and adjustment.

4. Verify that the load cell is parallel to the carriage.
5. Verify that the lower suspension bolt is properly adjusted.

Note: See lower suspension bolt adjustment procedure.

Un-stable display readings

1. Make sure the load cell cable is securely connected.
2. Check the load cell cable for broken conductors

Non repeating

1. Verify that the adjustment bolts are supporting the carriage assembly evenly.
2. Check carriage for debris that will interfere with carriage movement.

Heel to toe & side to side error

1. See “Scale Balancing” procedure under the Flexure Replacement & Adjustment

See also Indicator manual

THE MSI LIMITED WARRANTY

MEASUREMENT SYSTEMS INTERNATIONAL, INC., WARRANTS load sensing elements and meters against defects in workmanship and materials for a period of one year from date of purchase and warrants electrical cables and batteries against the same defects for a period of ninety (90) days from date of purchase.

Any device which proves defective during the warranty period will be replaced or repaired at no charge; provided that the defective device is returned to the Company freight prepaid.

In no event shall the Company be liable for the cost of any repairs or alterations made by others except those repairs or alterations made with its specific written consent, nor shall the Company be liable for any damages or delays whether caused by defective workmanship, materials or otherwise.

The Company shall not be liable for any personal injury or property damage resulting from the handling, possession or use of the equipment by the customer.

The warranty set forth herein is exclusive and is expressly in lieu of all other warranties, express or implied, including without limitation any implied warranties of merchantability or fitness or of any other obligations or liability on the part of the Company.

The liability of the Company under this warranty is limited solely to repairing or replacing its products during the warranty periods; and the final judgement and disposition of all claims will be made by MEASUREMENT SYSTEMS INTERNATIONAL, INC.



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