

MICRO-LINE™

For Milling Applications

REFERENCE MANUAL



ACU-RITE®

*Readout Systems
Precision Glass Scales*

TABLE OF CONTENTS

General

Overview	1
Preparation	2
Packing List	2
Warranty Records	2
Installing the Scales	3
Installing the Readout	3
Power Up	4
Display Saver	4

Setup

Parameter Setup.	5
Display Resolution	6
Linear Error Compensation.	7
How to Determine the Linear Error Compensation	8
Scale Resolution	9
Count Direction	10
Testing the Scales.	11
Counting Test.	11
Repeatability Test.	11

Operation

Setting the Datum (Absolute Zero)	12
At Current Position.	13
Using an Offset.	13
Example	14
Incremental Dimensions	15
Example.	16
Presets	17
Example.	18
Centerline.	19
Setting Datum on a Centerline	19
Example.	20
Locating Centerline Using Incremental Dimensions	21

TABLE OF CONTENTS

Bolthole Patterns	22
Creating	22, 23
Running	24, 25

Troubleshooting

Introduction	26
General	27
Error Messages (General)	31
Keypad Test	32

Reference

Electrical Specifications	33
Factory Default Settings	34
Keypad	35, 36
Conventions	37
DRO Mode (2- and 3-axes systems)	37
Count Direction	37
Recalling the Last Datum Setting for International Units	38
Absolute and Incremental Dimensions	39

Scale Installation

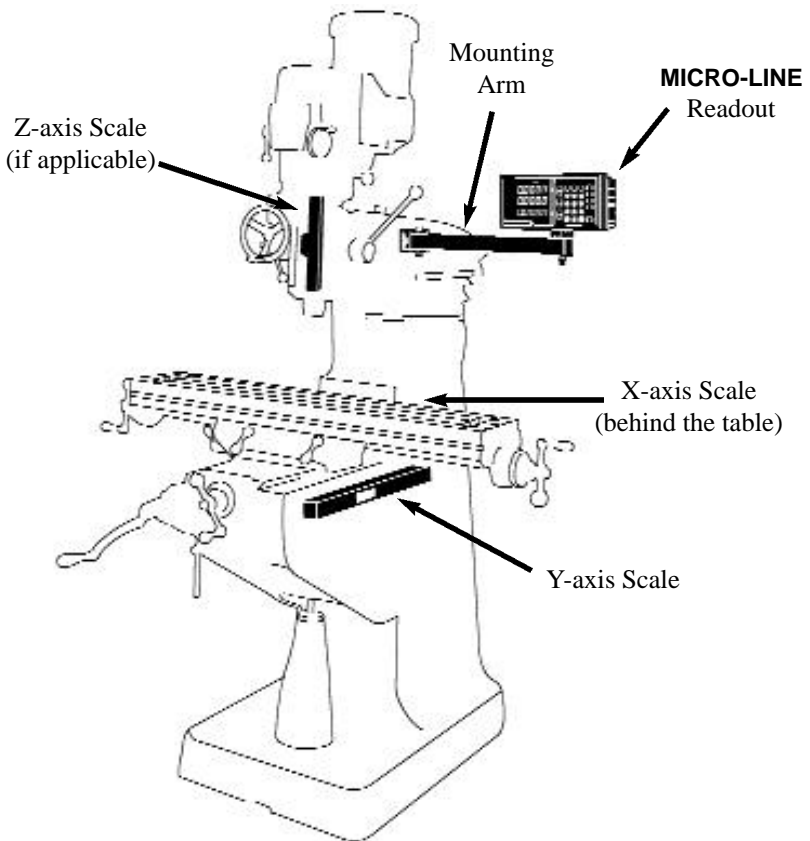
General Installation Instructions for the Scale	40
Installation Brackets	40
Introduction	41
Mounting Preparation	42
Mounting Information	43
Scale Dimensions	44
Mounting Illustrations	45
Installation Procedure	46
Warranty	49

Overview

This manual will guide you through the installation, setup, and operation of the **MICRO-LINE** system. Use it to get your system up and running “out of the box” and as a quick reference guide for your day-to-day operations.

Install the scales first, according to the instructions included in this manual. After the scales are in place, install the readout and then finish setting up the system.

Here’s how a typical machine will look after the installation is complete:



GENERAL

Preparation

Packing List

Verify that you have received all of the components for your system:

- Readout instructions
- Installation instructions
- Mounting arm
- **MICRO-LINE** scale(s)
 - Cable mounting hardware
 - Scale mounting hardware
- Warranty card

If a component is missing, contact your **MICRO-LINE** distributor immediately for replacement.

Warranty Records

Complete the warranty card included with your **MICRO-LINE** system. The readout's catalog and serial numbers are on the back of the display; the scale's catalog number is on the scale assembly label; and the serial number is on the scale case.

Copy the information here for your own records and mail the warranty card as soon as possible.

Distributor:	_____	
Address:	_____	
Telephone:	_____	
	Catalog No.	Serial No.
Readout	_____	_____
Axis #1:	_____	_____
Axis #2:	_____	_____
Axis #3:	_____	_____
Date of Purchase:	_____	

Installing the Scales

Install the scales according to installation instructions found in this manual. These general installation instructions are found on page 40. Please read the instructions completely before beginning. If specific bracket kit instructions are included, they supersede instructions contained within this manual.

Installing the Readout

Follow the readout installation instructions that are included with your mounting arm bracket kit. The electrical specifications for the readout are listed on pg. 33.

After the installation is complete, proceed to “Power Up.”

Power Up

Press the switch on the back of the readout to power up the system. A series of tests will check that the display, keypad, and memory are all working properly.

If a problem is detected, an error code will appear on the screen. (Error messages and solutions are listed on pgs. 31 - 32.) It is important to note that the **E1 message** will appear every time you power up your system and does not indicate a problem. It merely indicates that the system had lost power. To acknowledge the message, press the **CLEAR** key and proceed to the DRO mode.

Note: If the E1 message appears at any other time during normal operation, refer to pg. 31 for possible problems and solutions.

Display Saver

When the system is not used for more than 90 minutes, a decimal point will “scroll” across the X-axis display, indicating that the display saver has been activated. The display saver, like a screen saver on a computer monitor, will help prolong the life of your readout.

If the display saver has been activated, press any key on the readout or move the table to return to the normal DRO view.

Parameter Setup

There are four parameters that you can define on your system:

- Display resolution (diS)
- Linear error compensation (LEC)
- Scale resolutions (rES)
- Scale count directions (Ct dir)

Establish each setting the first time you power up the system. You can change the parameters later by returning to Setup and then using the **ENTER** key to scroll to the appropriate category.

Anytime you change the linear error compensation, or count direction for an axis, the absolute and incremental displays for that axis will be reset to 0. If you change these settings, you will need to re-establish the datum point.

For international units using 5 μ m (0.0002") scales with reference marks, you will need to recall Datum. Refer to pg. 38 for instructions.

When in the Setup mode, use the **CLEAR** key when you want to back-space, restore the previous value or access the previous parameter.

SETUP

Display Resolution

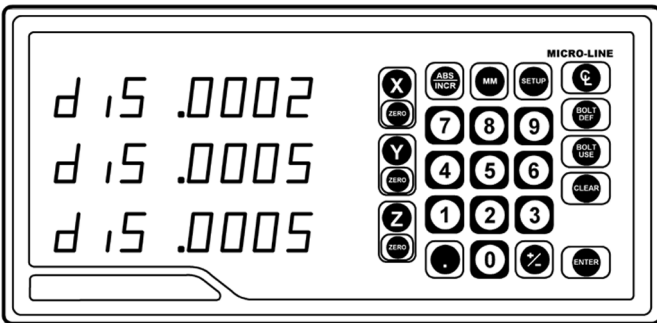
The display resolution determines how detailed each scale's position will be displayed on the readout. Use the setting that best suits each job.

To change the display resolution:

- Press the **SETUP** key. (“diS” will show on the display.)
- Press the **X**, **Y**, or **Z** key for the display you want to change.

For 10 μ m scales, the display resolution will toggle between 0.01 mm (0.0005”) and 0.02 mm (0.001”). For 5 μ m scales, it will toggle between 0.005 mm (0.0002”) and 0.01 mm (0.0005”).

- After you complete setting your display resolution, press **ENTER** to continue with setup or press **ENTER** then **SETUP** to return to the normal DRO display.



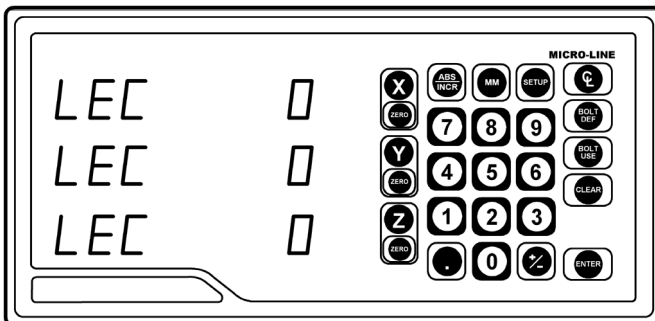
Linear Error Compensation

With **MICRO-LINE**, you can compensate for machine tool wear. If you know the linear error compensation (LEC) value in parts per million (PPM), you can enter it directly.

If you don't know the LEC, use the formula on the next page to determine the value for each axis.

To change the linear error compensation:

- Move to the “Linear Error Compensation” display in the Setup mode. (Press **SETUP** and then the **ENTER** key until the display appears).
- Press the **X**, **Y**, or **Z** key for the axis you want to change. **MICRO-LINE** will display the current LEC value for that axis.
- Using the keypad, enter the linear error compensation factor (in PPM), followed by a **+** or **-** sign. The number must be within -9999 and 9999 (use whole numbers). The formula for calculating the value is on the next page.
- After you complete setting your LEC, press **ENTER** to continue with setup or press **ENTER** then **SETUP** to return to the normal DRO display.



SETUP

How to Determine the Linear Error Compensation

Follow this procedure for each axis:

- In the DRO mode.
- Place a standard of known length on the table. Make sure it's parallel with the table's travel.
- Put the readout in the absolute display mode (**ABS/INCR** key).
- Using an edge finder or dial indicator, locate one end of the standard.
- Press the **ZERO** key twice for the axis you are measuring. "0" should appear on the display.
- Move the table along the axis until the edge finder or dial indicator reaches the opposite end of the standard.
- Write down the length that is shown on the readout display for that axis.
- Use the formula below to calculate the LEC for the axis you just measured. Enter the result in the LEC screen (previous page).

Note: If the measured length is greater than the standard length the LEC value will be negative.

Formula

S = Standard length
M = Measured length

$$LEC = \left(\frac{S - M}{M} \right) \times 1,000,000$$

Example

If the length of the standard you used is 10" and the measured length along the X-axis is 9.995", then the LEC for the X-axis is 500 parts per million (PPM).

$$LEC = \left(\frac{10 - 9.995}{9.995} \right) \times 1,000,000$$

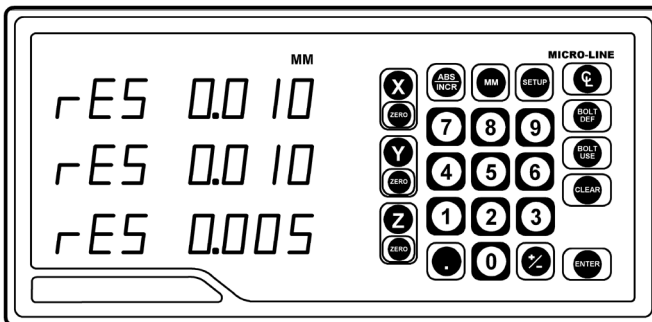
$$LEC = \begin{array}{l} 500 \text{ PPM} \\ \text{(rounded to the nearest} \\ \text{whole number)} \end{array}$$

Scale Resolution

To ensure accurate readings, the scale resolution shown for each axis must correspond with the resolution of the scales on your machine.

To change the scale resolution:

- If necessary, choose “Scale Resolution” from the Setup menu. (Press **SETUP** and then the **ENTER** key until the screen appears).
- Press the X-axis key until the appropriate resolution appears. Choose 0.01 mm for 10 μ m (0.0005”) scales and 0.005 mm for 5 μ m (0.0002”) scales (international units only).
- Repeat the procedure for each axis.
- Press **ENTER** to continue with Setup.



SETUP

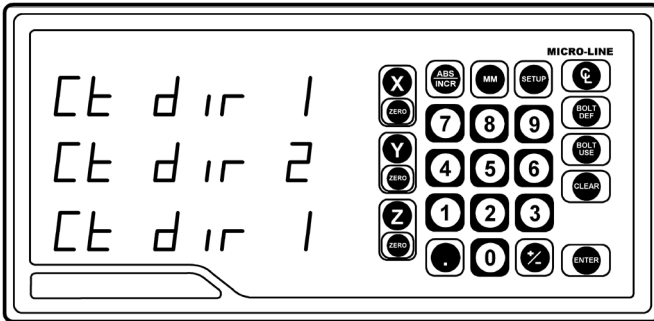
Count Direction

Use the count direction setting to define the positive counting direction for each scale. The direction will be displayed as a “1” or a “2” (the numbers are not assigned to a particular direction). You only need to change the count direction if the scale is counting in the negative direction during a positive table move, or vice versa.

Refer to Conventions on pg. 37 for more guidelines.

To change the count direction:

- Move to the “Count Direction” display in the Setup mode. (Press **SETUP** and then the **ENTER** key until “Ct dir” appears).
- Press the appropriate axis key (**X**, **Y** or **Z**). The current count direction (1 or 2) will appear.
- After you complete setting your count direction, press **ENTER** to continue with setup or press **ENTER** then **SETUP** to return to the normal DRO display.



Testing the Scales

Follow these steps to confirm that the scale has been installed properly. The Counting Test will confirm the scale's electrical operation, and the Repeatability Test will check the installation integrity.

Counting Test

- Move the table along each axis, one at a time. Check that the readout correctly displays the table's movement. If it doesn't, then the scale resolution you selected may not be accurate. Refer to Scale Resolution on pg. 9 for instructions.

Repeatability Test

- Locate a magnetic base and dial indicator on the end of the scale. Zero the readout and the indicator.
- Move the axis through the full travel and return the dial to "0." The readout should also read 0 (± 0.0005 " for 10 μ m scales; ± 0.0002 " for 5 μ m scales). If it doesn't, then the scale cable may be loose, or the scale, mounting bracket, or reading head may need to be tightened or realigned.
- Repeat these steps for each scale.

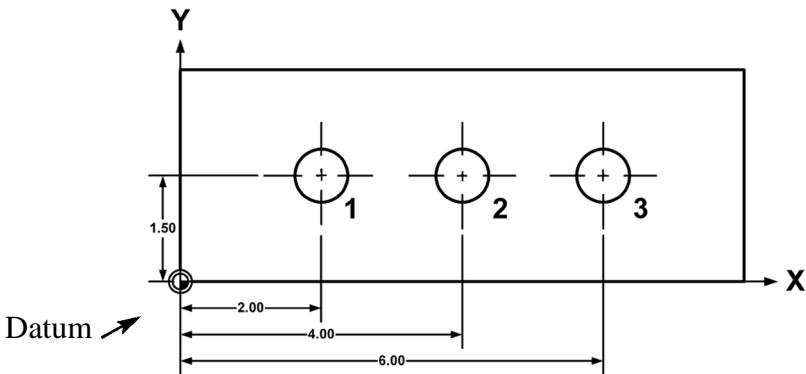
Setting the Datum (Absolute Zero)

MICRO-LINE allows you to measure both absolute and incremental dimensions. A dimension measured from the point you define as the datum is an absolute dimension. A dimension measured from any other point on your print is an incremental dimension.

Datum, also known as absolute zero or workpiece zero, is the reference point from which **MICRO-LINE** will base all of your part's coordinates. When the readout is in the ABS mode, it is actually measuring the distance from the datum to the table's current position.

You will need to establish a datum for every job. Your datum may already be identified on your print; if it isn't, then establish a datum that allows you to enter most of your part's dimensions directly, with the least number of calculations.

All of the dimensions in the drawing below are based from the datum.



If you are using 5 μ m (0.0002") scales (international units only), **MICRO-LINE** can recall your last datum position each time you power up the system. Refer to pg. 38 for the proper procedure.

To set the datum at the tool's current position:

- Position the workpiece on the table. Move the table until the tool is centered on the edge of the workpiece at the location where you would like to establish the datum.
- Using the **ABS/INCR** key, select the absolute (ABS) mode.
- Press the X-axis **ZERO** key twice to establish the current X-axis position as the datum. Repeat for the Y- and Z-axes.

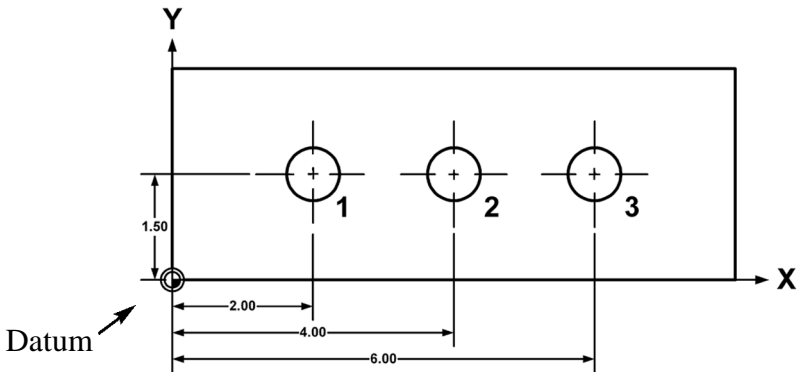
To set the datum using an offset:

- Using the **ABS/INCR** key, select the absolute (ABS) mode. Also check that the proper measurement (inch or mm) is selected.
- Move the tool to a known point, i.e. the outside diameter of the workpiece or the face of the workpiece.
- Press the **ZERO** key for the axis (X, Y or Z) you are entering a dimension for.
- Using the keypad, enter the distance from your tool's current location to the point you want to establish as the datum. Include a decimal point (.) and minus (-) sign when necessary.
- Press the **ZERO** key for another axis, or press **ENTER** to return to the DRO display.

OPERATION

Example: Absolute Dimensions

Let's say that your print looks like this:



Here is how you would drill the holes using absolute dimensions. Notice that all of the dimensions are measured from the point that was established as datum (0, 0, 0).

- Check that “ABS” is selected on the DRO display (press the **ABS/INCR** key, if necessary). By selecting ABS, you’re telling **MICRO-LINE** to measure the machine’s movement on the X-, Y-, and Z-axes from your datum (0, 0, 0).
- Press the **MM** key until “Inches” is selected (the MM display is not lit up).
- For Hole 1, move the table until X = 2.00” and Y = 1.50”. Drill Hole 1.
- Move the table until X = 4.00” and Y = 1.50”. Drill Hole 2.
- Move the table until X = 6.00” and Y = 1.50”. Drill Hole 3.

Incremental Dimensions

As described earlier, incremental dimensions are measured from the current tool position to the next. If the tool is currently at 2" and you want to move an additional 3.125", you would select the incremental mode, zero out the axis, and move the table until the display reads 3.125.

An example of how to measure using incremental dimensions is shown on the next page.

To use an incremental dimension:

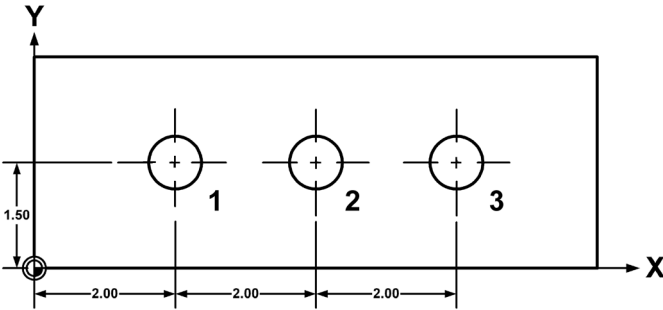
- Move the table to the point where you want to measure an incremental distance from.
- Using the **ABS/INCR** key, select the incremental (INCR) mode on the readout. Also check that the proper measurement (inch or mm) is selected.
- Press the **ZERO** key below the axis(es) from which you are measuring.
- Move the table. **MICRO-LINE** will display the table's position in relation to the "0" point(s) for the axis(es) you chose.

After you have reached the position you want and have milled the part, you can "zero" each axis again and then measure from that location to the next point on the workpiece or press **ABS/INCR** to return to the absolute mode.

OPERATION

Example: Incremental Dimensions

Let's say that your print looks like this:



Hole 1 is an absolute dimension (measured from the datum), while Holes 2 and 3 are measured incrementally. By putting **MICRO-LINE** in the incremental mode for the last two holes, you can measure their distances just as the print specifies, without any calculations.

1. Press the **ABS/INCR** key until “ABS” is selected on the DRO display. Press the **MM** key until “Inches” is selected (the MM display is not lit up).
2. For Hole 1, move the table until $X = 2.00''$ and $Y = 1.5''$. Drill Hole 1.
3. Now press the **ABS/INCR** key so that “INCR” is selected on the DRO display. This tells **MICRO-LINE** that you want to measure the distance from the current position to the next point.
4. Press the **ZERO** keys that are below the X- and Y-axes keys. This resets the X- and Y-axes displays at “0.”
5. Move the table until $X = 2.00''$ and $Y = 0.000''$. Drill Hole 2.

6. Now repeat the process for the third hole. Press the **ZERO** key for the X-axis to measure from your tool's current position.
7. Move the table until $X = 2.00''$ and $Y = 0.000''$. Drill Hole 3.

Using Incremental Presets

In the standard incremental mode, you would reset the display at "0" and move the table until the scale counts up to the point you want to reach. With the *preset* feature, you enter the distance you want to move first, and then count down to 0. For instance, if you enter 3.125" as the preset distance, **MICRO-LINE** will show -3.125 on the display. As you move the table in the positive count direction, the system will start counting. When the axis display reads "0," your tool is in the correct position.

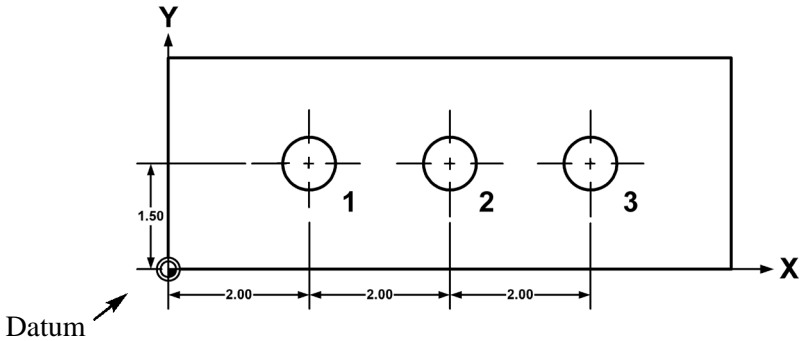
To preset an incremental position:

1. Press the key (**X**, **Y**, or **Z**) for the axis you want to preset. **MICRO-LINE** will automatically switch to the incremental mode.
2. Enter the distance from your tool's current position to the final location. Include a decimal point and minus (-) sign when necessary.
3. Repeat the step above for another axis or press **ENTER** to return to the DRO display.

To reach the preset position, move the table until the display for each preset axis reads "0."

OPERATION

Example: Incremental Presets



Hole 1 is an absolute dimension because it's measured from datum. Holes 2 and 3 are incremental dimensions (measured from one hole to the next) that you can preset.

1. Press the **ABS/INCR** key until "ABS" is selected on the DRO display. Also check that the system is in the "inches" mode (the MM key should not be lit up).
2. For Hole 1, move the table until X = 2.00" and Y = 1.50". Drill Hole 1.
3. Now press the **ABS/INCR** key so that "INCR" is selected on the DRO display. This tells **MICRO-LINE** that you want to measure the distance from your current position to the next point.
4. Press the **X** key, enter **2** as the distance from Hole 1, and then press **ENTER**. Two inches is the incremental preset distance.
5. Move the table until X = 0.000" and Y = 0.000". Drill Hole 2.
6. Press the **X** key (2.00 should already appear as the distance), and then press **ENTER**. Two inches is the incremental preset distance.
7. Move the table until X = 0.000" and Y = 0.000". Drill Hole 3.

Centerline

With **MICRO-LINE**, you can find the centerline (midpoint) between any two positions on your part. You can establish centerline as your datum by using absolute dimensions or you can create a centerline using incremental measurements without affecting your current datum.

Refer to “Setting the Datum (Absolute Zero)” on pg. 12.

Setting the Datum on a Centerline

1. Press the **ABS/INCR** key until ABS is selected.
2. Move the table to the first location.
3. Press the **ZERO** key twice for the axis (X, Y, or Z) you want to find the centerline for.
4. Move the table to the second location along the same axis.
5. Press the **C/L** (centerline) key. Dashes will flash on the screen.
6. Press the appropriate key (**X**, **Y**, or **Z**) for the axis you’re measuring.
7. **MICRO-LINE** will measure the distance between the two points, then divide the sum in half. You can locate the centerline by moving the table until the position for the axis you measured reads “0.”

Repeat the procedure to locate the midpoint for multiple axes. An example appears on the next page.

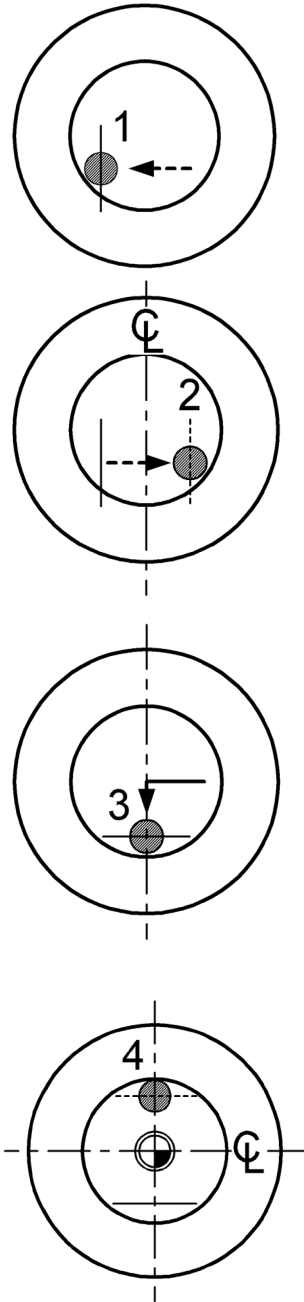
OPERATION

Example: Setting the Datum on a Centerline

Here's how you would establish the datum on the centerline of the part shown:

1. Using the **ABS/INCR** key, select the absolute (ABS) mode. Check that the proper measurement (inch or mm) is selected.
2. Rest the indicator against any point on the left or right side of the circle. (In graphic 1 above, we started on the left side.) Press the **ZERO** key for the X-axis twice.
3. Move the table until the indicator rests against the other side of the circle. Press the **C/L** (centerline) key. Press the **X** key, and **MICRO-LINE** will calculate the centerline between the two points. The display will show the distance from the current position to the centerline.
4. Now follow the same procedure for the Y-axis. Only this time rest the indicator against any point on the top or bottom half of the circle. Press the **ZERO** key twice for the Y-axis.
5. Move the table until the indicator rests against the other side of the circle. Press the **C/L** (centerline) key. Press the **Y** key, and **MICRO-LINE** will calculate the centerline and display the distance from the current position to the centerline.

Your datum is now located at the center of the circle.



Locating Centerline Using Incremental Dimensions

1. Press the **ABS/INCR** key to select the incremental display mode.
2. Move the table to the first location.
3. Press the **ZERO** key for the appropriate axis. Doing so will zero the current position.
4. Move the table to the second location along the same axis.
5. Press the **C/L** (centerline) key. Dashes will flash on the screen.
6. Press the appropriate key (**X**, **Y**, or **Z**) for the axis you're measuring.
7. **MICRO-LINE** will measure the distance between the two points, then divide the sum in half. You can locate the centerline by moving the table until the position for the axis you measured reads "0."
8. Repeat the procedure for each axis.

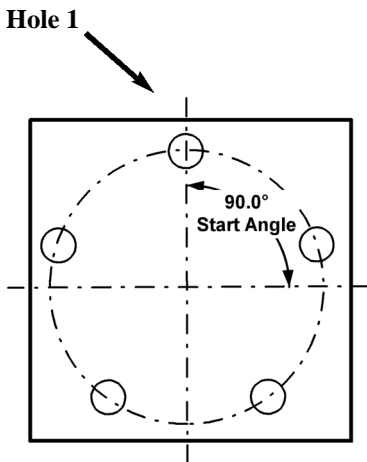
OPERATION

Bolthole Patterns

Creating a Bolthole Pattern

A bolthole pattern is defined by its number of holes (up to 99), center point, radius, and start angle.

MICRO-LINE will automatically position "Hole 1" at the start angle and space the holes equally throughout the pattern.



To create a bolthole pattern:

1. Press the **BOLT DEF** key. "HOLES" will appear on the X-axis display.
2. Enter the number of holes (1-99) in the pattern. Press the **ENTER** key.
3. Press the **ENTER** key again. "Center" will appear, and then a flashing dash will appear on the X- and Y-axes.
4. Press the **X** key. Using the keypad, define the center point of the bolthole pattern on the X-axis. Use a decimal point and minus (-) sign when necessary.
5. Press **ENTER**.

HOLES
5

Center
Center

0.0000=
0.0000=

OPERATION

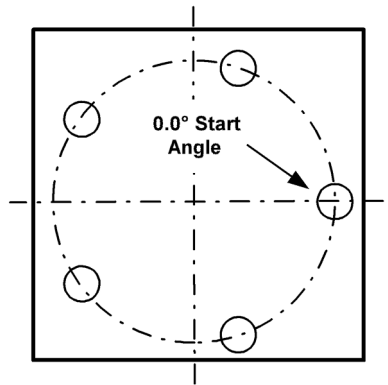
6. Press the **Y** key. Enter the bolthole pattern's center point on the Y-axis. Use a decimal point and minus (-) sign if necessary.
7. Press the **ENTER** key.
8. Press the **ENTER** key again. "Radius" will appear.
9. Enter the radius of the circle pattern. Press **ENTER**.
10. Press **ENTER** again. "START" will appear on the X-axis display.
11. Enter the start angle of the first hole in the bolthole pattern. (0 degrees is at the 3 o'clock position.) Use a decimal point and minus (-) sign if necessary.
12. Press **ENTER** to complete the pattern.



rAd iuS



START



OPERATION


Running a Bolthole Pattern

When you run a bolthole pattern, **MICRO-LINE** always assumes that you want to start with the first hole. It will display "Hole 1," and then the distance to the hole from your tool's current position. Move the table until it reaches 0, 0. After you've drilled the hole, press the **BOLT USE** key again, and "Hole 2" will appear. Move the table to "0," drill the hole and continue with the rest of the pattern. If you want to start at a different place in the pattern, press **BOLT USE** followed by the number of the hole you want to begin with.

Notice that the system automatically switches to the incremental mode whenever you run a pattern. That's because the system is using incremental presets (pg. 17) to measure from one hole to another. As with any preset, you can find the current hole's location by moving the table until the displays for both the X- and Y-axes read "0."

After you've completed the operation, you may either keep the readout in the incremental mode or press the **ABS/INCR** key to switch to absolute measurements.

To run a bolthole pattern:

- Press the **BOLT USE** key. "HOLE" will appear on the X-axis display. The number of the first hole to be milled will appear on the Y-axis display. (To select a different hole, refer to the note on the next page.)
- 
- **MICRO-LINE** will display the distance to the hole you've chosen. Move the table until the X- and Y-axes both read "0." Drill the first hole.
 - Press the **BOLT USE** key again. Move the table until the X- and Y-axes read "0." Drill the second hole. Repeat the procedure for each hole in the pattern.

Note: To select a different hole in the pattern, press the **BOLT USE** key and immediately press the number of the hole you want to mill. Press “2” on the keypad for Hole 2, “3” for Hole 3, etc. The holes are numbered counter-clockwise from the start angle.

You can also scroll through the series of holes by pressing the **BOLT USE** key repeatedly.

Troubleshooting Introduction

Refer to this troubleshooting guide whenever you have questions or concerns about the operation of the **MICRO-LINE** system.

This guide is arranged in three columns entitled Symptom, Probable Cause and Recommended Corrective Action. The symptoms are listed in the order of the most common, easiest to check, and least expensive to correct.

First locate the symptom that best describes the problem you are trying to solve. Then identify the probable cause that most closely matches the problem and implement the recommended corrective action.

If a problem persists or cannot be resolved using this manual, contact your **MICRO-LINE** distributor for further assistance.

TROUBLESHOOTING

Symptom	Probable Cause	Recommended Corrective Action
Screen is blank	No power to the readout	<p>Check that the power switch on the back of the console is “on.”</p> <p>Check that the readout’s power cord is properly connected to the power supply.</p> <p>Check the fuse. (Located above the power switch).</p> <p>Check that the power source meets the specifications required by your system (pg. 33).</p>
	LED failure	Contact your MICRO-LINE distributor for repair/replacement procedures.
Decimal point scrolls across display	System has been idle for approximately 90 minutes and is in “display saver” mode	Press any key or move the table to return to the previous screen.
Dashes appear on screen	Display overflow	<p>The value entered exceeds the display’s 8-character capability. Enter a value with less than 8 characters.</p> <p><i>(cont’d next page)</i></p>

TROUBLESHOOTING

Symptom	Probable Cause	Recommended Corrective Action
Dashes appear on screen <i>(cont'd)</i>	Display overflow	Move the table toward the "0" position. As the scale counts down, the display will show the correct position.
Error message (E1) appears	Power loss occurred	This is a normal message at power up. If the message appears at any other time during operation, a problem may have occurred. Refer to pg. 31 for details.
Error messages (E2-E58) appear	Causes vary	Turn the system "off" and then "on" again, using the switch on the back of the readout. If an error (besides E1) is still detected when the system is powered up, contact your MICRO-LINE distributor for repair/replacement procedures. Refer to pgs. 31 - 32 for a list of error messages.
Keys not working properly	Invalid keypress	Turn the system "off" and then "on" again, using the switch on the back of the readout. If an error (besides E1) is still detected when the system is powered up, contact your MICRO-LINE distributor for repair/replacement procedures. Refer to pg. 31-32 for a list of error messages.

TROUBLESHOOTING

Symptom	Probable Cause	Recommended Corrective Action
Scale won't count	Loose cable	Check that the scale cable is securely connected to the readout.
	Wrong input	Check that the scale cable is connected to the correct input on the back of the readout. Refer to the readout installation instructions.
	Scale not installed properly	Check the scale and reading head for proper installation (refer to scale installation instructions).
	The scale's reading head is not working properly	Unplug the scale from the readout and plug it into an input for another axis. If the scale still does not count, the reading head may need to be replaced. If the scale counts on the other axis then the display may need to be replaced. See LED Failure.
Scale counts, but not correctly	Wrong scale resolution	Check that the correct scale resolution for the correct axis was selected (pg. 9).
	Wrong count direction	Change the count direction (pg. 10).
	Scale not installed properly	Check the scale and reading head for proper installation (refer to scale installation instructions included with your system). Clean the scale, if necessary.

TROUBLESHOOTING

Symptom	Probable Cause	Recommended Corrective Action
Setup does not save values	Improper procedure	Press the ENTER key after each value is entered into a Setup screen. If you press another key instead, the new value will not be saved. Refer to pgs. 5 - 10 for proper procedures.
Numbers don't appear/are faded on the display	LED failure	Turn the system "off" and then "on" again, using the switch on the back of the readout. If this does not correct the problem, contact your MICRO-LINE distributor for repair/replacement procedures.

Error Messages (General)

When **MICRO-LINE** is powered up, it will run a series of tests to ensure that the software is working properly. If an error message appears, refer to the charts on this page and the next for a diagnosis and solution.

E1	A power loss has occurred. This message will appear every time you power up the system and can be cleared by pressing the CLEAR key. If the E1 message appears at any time other than at power up, a power interruption has occurred and your current table position may be lost. Re-establish the datum if necessary. If the problem persists, contact your distributor for repair/replacement procedures.
E2	An EEPROM memory error has occurred. Press the CLEAR key to acknowledge the error. The datum and setup information may be lost. These areas should be checked and reestablished upon power up. If the problem persists, contact your distributor for repair/replacement procedures.
E3	A ROM memory error has occurred. Press the CLEAR key to acknowledge the error. If the system does not operate properly, contact your MICRO-LINE distributor for repair/replacement procedures.
E4	A random access memory (RAM) error has occurred. Press the CLEAR key to acknowledge the error and continue with the next test. If the system does not operate properly, contact your MICRO-LINE distributor for repair/replacement procedures.
E9	A scale miscount error (invalid waveform) error has occurred. The E9 message will appear on the axis that has the error. Press CLEAR to reset the axis(es). Your current position may be lost. Re-establish the datum if necessary. If the system does not operate properly, contact your MICRO-LINE distributor for repair/replacement procedures.

TROUBLESHOOTING

Error Messages (Keypad Test)

The messages below indicate that a problem was found during the keypad test at startup. If an error message appears, turn the system off, press the appropriate key to release it back into position, and then restart the system. (Or you can press the **CLEAR** key to clear the error message.) If the key does not work during normal operation, contact your distributor for repair/replacement procedures.

E11	SETUP key	E35	5 key
E12	C/L key	E36	4 key
E15	MM key	E38	Y key
E16	ABS/INCR key	E41	3 key
E18	X key	E45	2 key
E21	9 key	E46	1 key
E22	BOLT DEF key	E48	ZERO key for the Y-axis
E25	8 key	E51	± key
E26	7 key	E54	ENTER key
E28	ZERO key for the X-axis	E55	0 key
E31	6 key	E56	Decimal point (.) key
E32	BOLT USE key	E57	ZERO key for the Z-axis
E33	CLEAR key	E58	Z key

Electrical Specifications

Follow these specifications when installing your **MICRO-LINE** system.

Characteristic	Specification
Operating conditions	0° to 40°C (32° to 104°F) 25% to 85% relative humidity (non-condensing)
Storage conditions	-40° to 60°C (-40° to 140°F) 25% to 85% relative humidity (non-condensing)
Input requirements: Voltage Frequency Current	115VAC or 230VAC, single phase 47 - 63Hz per channel 300mA @ 115V, 150mA @ 230V
Fuse	115V operation: 1/2A, 250V, 3AG, slo-blo 230V operation: 1/4A, 250V, 3AG, slo-blo
Encoder input	Position signals: channels A & B TTL square wave signal in quadrature (90° nominal phase relationship) Maximum input rate: 70 kHz
Size	9.875" x 4.679" x 4.75"
Weight	4 lbs., 2 oz.
Mounting	Bottom; two 1/4"-20 threaded inserts
FCC compliance	Part 15 of FCC rules for a class A computing device
CE compliance	For Europe
ETL compliance	For United States
ETLc compliance	For Canada

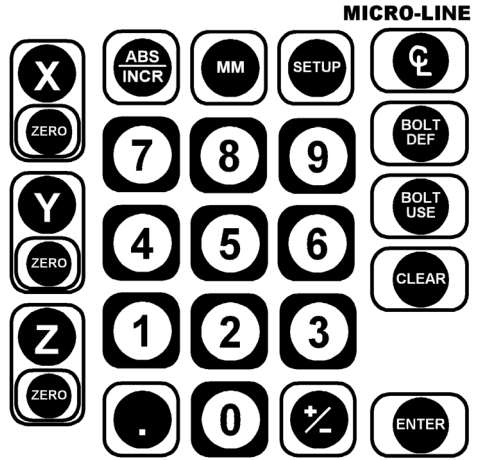
REFERENCE

Factory Default Settings

Display Resolution	High (0.0005"/0.01 mm for 10 μ m scale)
Linear Error Compensation	0 parts per million
Scale Resolution	0.0005"/0.01 mm (10 μ m)
Count Direction	1
Bolt Circle	
Number of Holes	1
Center	(0, 0)
Radius	0
Start Angle	0 degrees
Display Units	Inches
Display Mode	ABS (absolute dimensions)

Keypad

Here's an overview of the **MICRO-LINE** keypad. Each key's function is described below.



X, Y, Z	Correspond with the scales on the X-, Y-, and Z-axes. Used to specify a change to a particular axis.
ZERO	Three keys reset the incremental or absolute display position at "0" for the corresponding axis.
ABS/INCR	Used to switch between absolute (ABS) and incremental (INCR) measurements. The active mode will be displayed at the top of the DRO display.
MM	Press this key to switch X, Y & Z displays between English and metric units.
SETUP	Provides access to the display resolution, linear error compensation, scale resolution, and scale count direction operations.
C/L (CENTERLINE)	Locates the centerline of the workpiece (pg. 19).

REFERENCE

BOLT DEF	Used to create a bolthole pattern.
BOLT USE	Used to run a bolthole pattern.
CLEAR	Acts as backspace key during numeric entry; otherwise, it clears or cancels the last operation.
ENTER	Completes numeric operations; selects next parameter in SETUP or BOLT DEF operations.
±	Changes the sign of the entered value from positive(+) to negative(-) or vice versa. Numbers are positive unless a (-) appears in front of them.
.	Decimal point can be used during numeric entry; also used to access the recall feature for systems with 5µm (0.0002") scales after power up.
0-9	Used to enter a distance, angle, or other number value.

Conventions

This section identifies the standard conventions that apply to your **MICRO-LINE** system.

DRO Mode

The **MICRO-LINE** system is considered to be in the DRO (digital read-out) mode when the X- and Y-axes positions are displayed for a 2-axes system, and the X-, Y-, and Z-axes positions are displayed on a 3-axes system.

Count Direction

MICRO-LINE uses positive and negative numbers to determine the position of the table and tool on each axis. The graphic below shows a typical setup for the positive and negative count directions for the X-, Y-, and Z-axes on a vertical knee mill. All of the examples in this manual are based upon this setup.

X-axis:

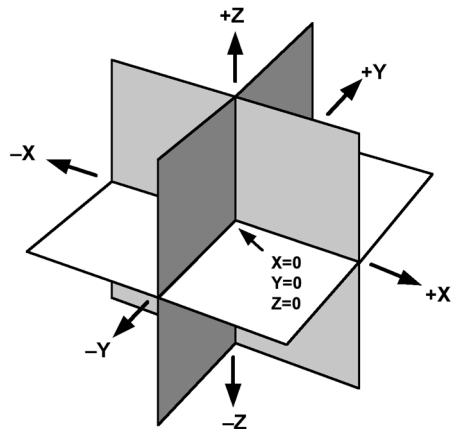
The table will move to the left and the tool will move to the right for a positive count direction.

Y-axis:

The table will move toward you while the tool moves away from you for a positive count direction.

Z-axis:

The quill will move up (away from the table surface) for a positive count direction.



Recalling the Last Datum Setting For International Units

If you are using 5 μ m **MICRO-LINE** scales, **MICRO-LINE** can retrieve your last datum setting when you power up your system. This feature is especially useful when you have to shut down the system in the middle of a job, or if a power interruption occurs. When power is restored, **MICRO-LINE** will use Position-Trac™ technology to read the scales' reference marks and recall the datum within seconds.

The recall feature only works after you have completed the initial system setup and established a datum, so it won't be accessible the very first time you turn the readout on. After you have completed those operations, you can recall the datum for every power up thereafter.

To recall your last datum:

- Power up the system.
- Press the **CLEAR** key to clear the E1 message.
- Press the decimal point (.) on the readout's keypad. Move the table in the *positive* count direction along the X-axis. Keep moving it until the system recalls the datum and "found" flashes on the screen. The system will automatically reset the X-axis value to reflect the distance from the table's current position to the datum.

Repeat this step for the Y- and Z-axes, always moving the machine in the positive count direction.

After you have completed the recall procedure, you can move to the datum by positioning the table, saddle, and quill until the display reads "0" for each axis.

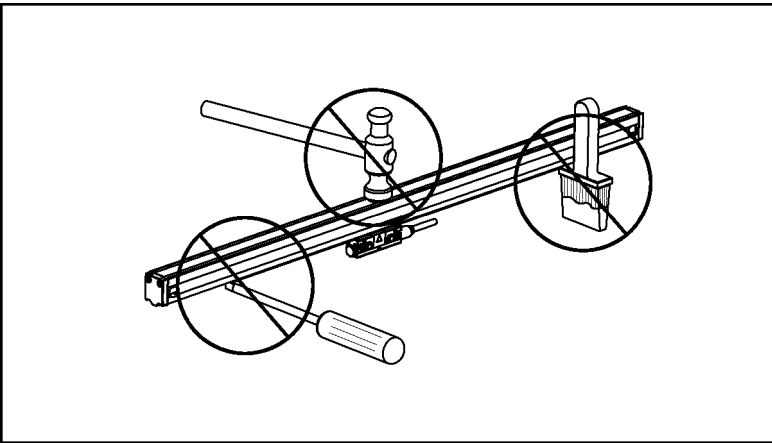
Notes:

SCALE INSTALLATION

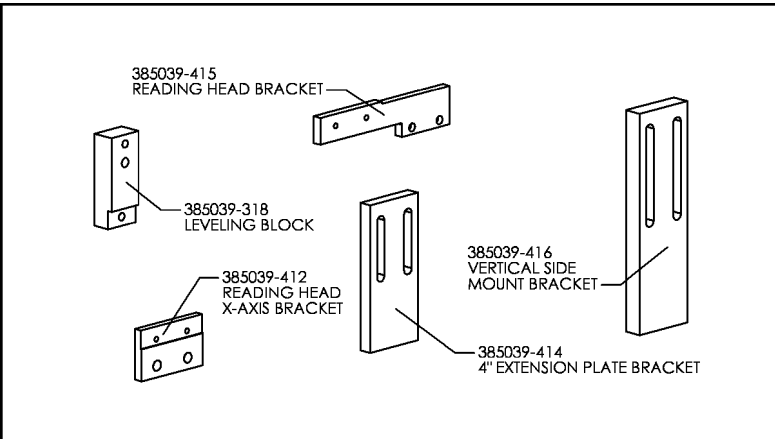
General Installation Instructions for the Scale

Specific instructions may be included that will supersede this section.

Please do not expose the scale to the following:



Installation Brackets



- Installation brackets and tools are already included with each system.
- Your Authorized ACU-RITE Distributor can assist you in selecting brackets and tools for your installation.

Introduction

The **MICRO-LINE** precision glass scale provides the accuracy and reliability of an ACU-RITE measuring system. Features and options include:

- Digital resolutions of 5 or 10 μ m.
- Accuracy Grade of $\pm 10\mu\text{m}/1000\text{mm}$.
- Home reference signals on international units only.
- Braided cables in 10ft., 15ft., or 20ft. lengths.
- Two scale case forms:
 - Top mounting scale available 2 - 120" measuring length
 - End mounting scale available 2 - 22" measuring length
- Mounting Fasteners
- Installation Brackets

See Page 2 to fill out warranty record information.

Scale mounting hardware and cable mounting hardware are provided with each **MICRO-LINE** scale.

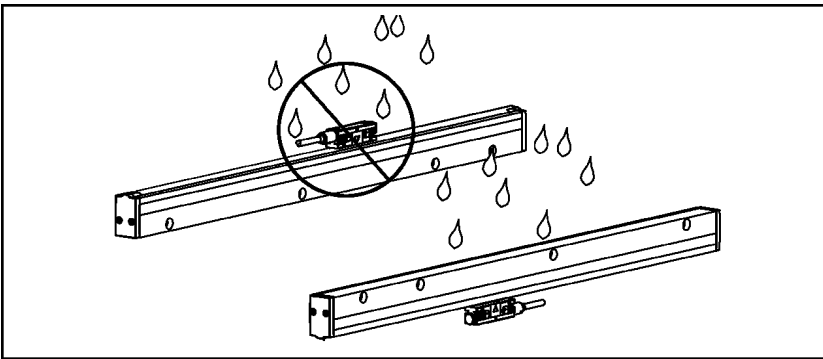
SCALE INSTALLATION

Mounting Preparation

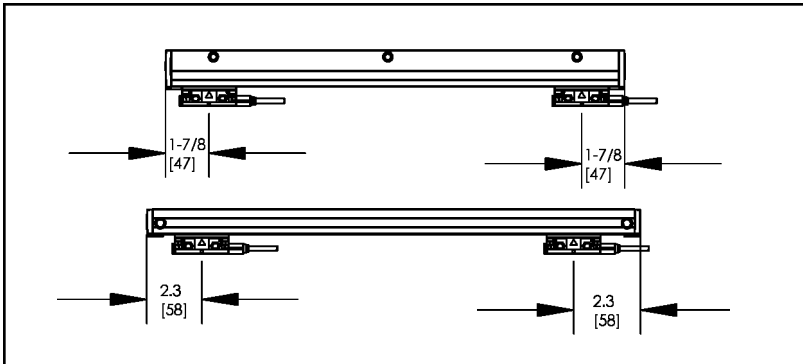
- Understand your mounting requirements.
- Mount with lipseals down and away from the work area.
- Brackets should be kept as short and rigid as possible.
- Clean all mounting surfaces.
- Ensure the correct length scale is being used for the total machine travel.



Do not remove alignment brackets until instructed.



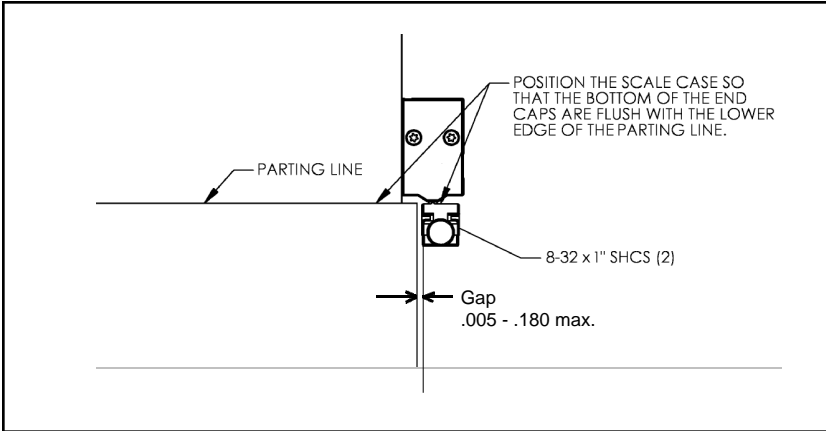
Never mount with lipseals upward or toward work area.



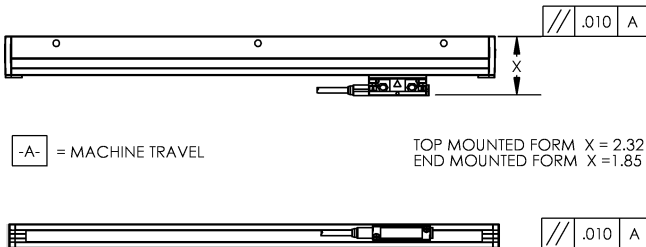
Equipment travel **must not exceed** scale measuring length.

Mounting Information

- Mount the scale close to machine guide ways to ensure system accuracy.
- Follow kit instructions when using an ACU-RITE bracket kit.



- A gap greater than .18" between the reading head and mounting surface requires a spacer or bracket.
- Reading head leveling set screws are provided to adjust the gap between the reading head and mounting surface.

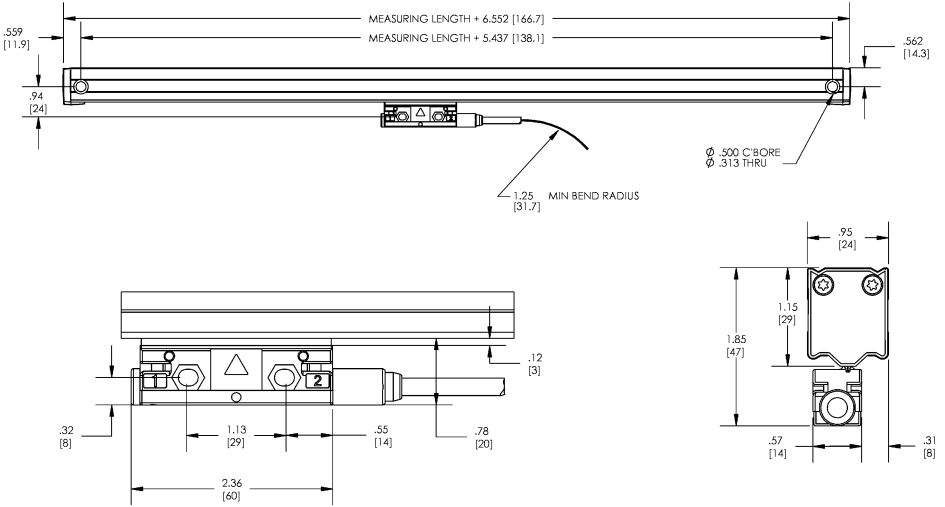


- Tolerances of .010" TIR apply to all mounting dimensions.

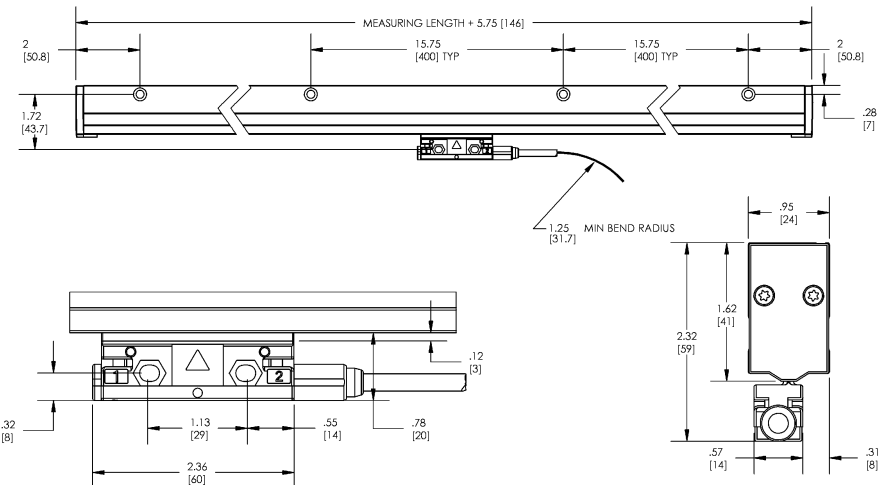
SCALE INSTALLATION

Scale Dimensions

End Mounted Scale Form



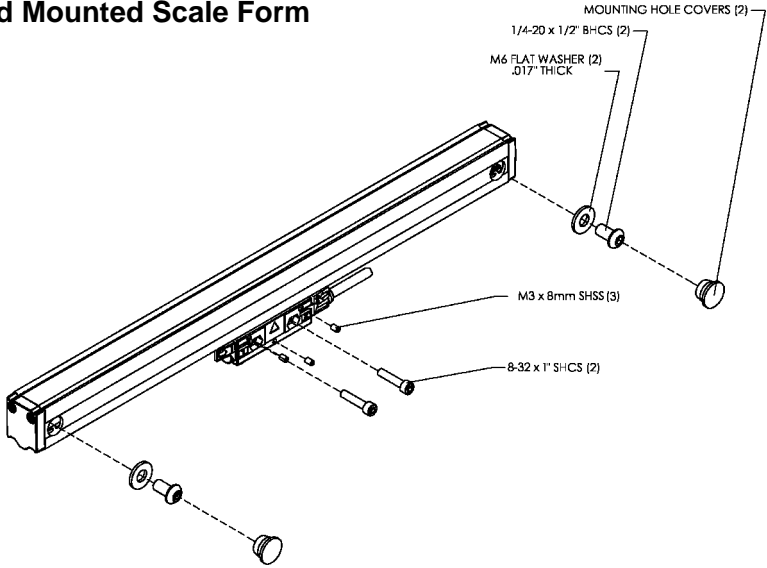
Top Mounted Scale Form



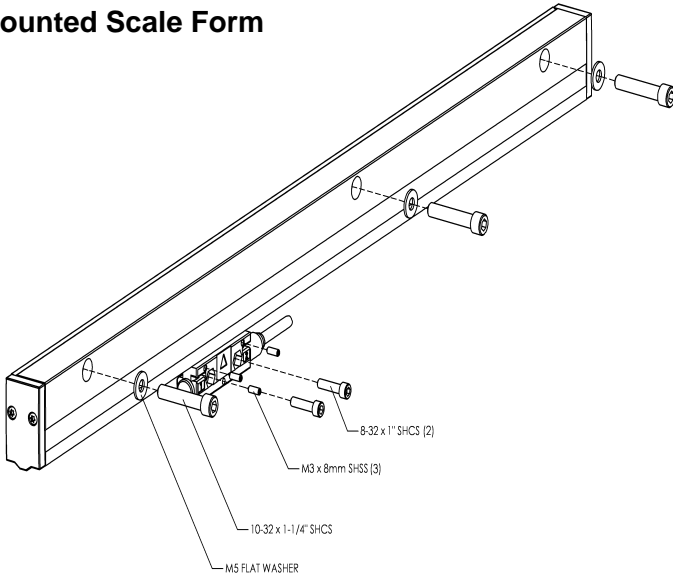
SCALE INSTALLATION

Mounting Illustrations

End Mounted Scale Form



Top Mounted Scale Form



SCALE INSTALLATION

Installation Procedure

These steps apply to typical mounting conditions. Although this may not pictorially represent your application, your installation procedure should follow these steps.

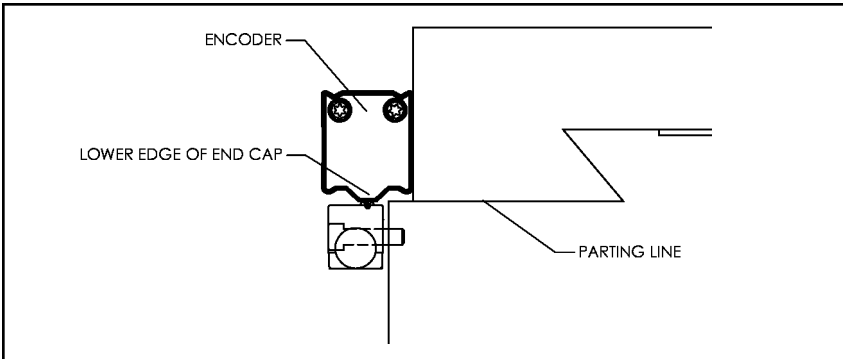


ACU-RITE bracket kit instructions supersede this section.

- Adjust drill depths and fastener lengths as required.
- Contact your Authorized ACU-RITE Distributor if assistance is required.

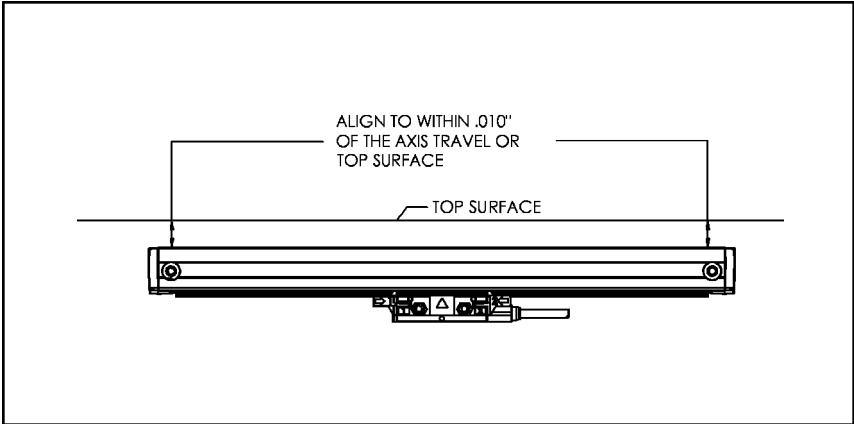
First Steps:

1. Move the axis to its center of travel.
2. Mark the axis location so that it can be re-centered easily.
3. Slide the reading head with the alignment brackets attached, along the scale case to the center of the scale case.



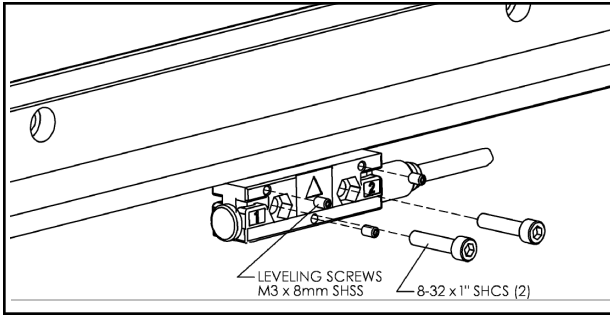
4. Locate the bottom of the end cap flush with the axis parting line.
5. Mark one end mounting hole.
6. Drill and tap the hole location 10-32 x 1/2" deep for the top mounting form and a 1/4-20 x 1/2" deep for the end mounting form. Attach the scale.

SCALE INSTALLATION

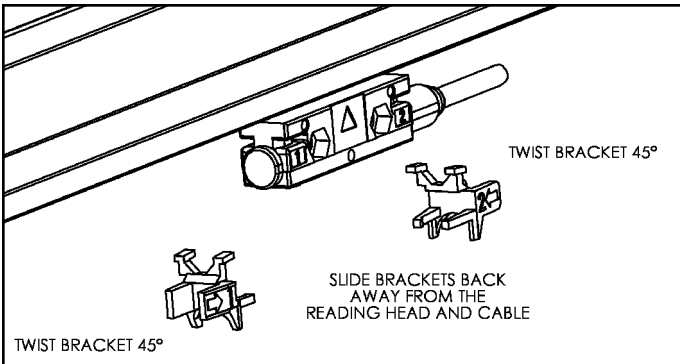


7. Align to within .010" TIR to axis of travel and mark the second end mounting hole. Remove scale, drill and tap correct hole size.
8. Attach the scale and align to within .010" TIR to axis of travel.
9. Top mounting requires the top surface to be indicated to within .010" TIR over each mounting hole. Mark remaining hole locations. Remove scale, drill and tap remaining holes. Attach the scale and align to within .010" TIR to axis of travel.
10. For end mounting form, after scale is attached and aligned, insert mounting hole covers.
11. Ensure the axis is still at its center of travel and the reading head is centered on the scale. Mark the reading head mounting holes.
12. Move the axis and drill and tap for 8-32 (M4).

SCALE INSTALLATION



13. Move the axis to align reading head mounting holes.
14. A gap must exist between the reading head and the mounting surface.
15. Adjust the leveling screws, using a .001" -.003" feeler gage (or shim) between the leveling screw and the mounting surface. Adjust the leveling screw until a slight drag is felt on the feeler gage. Repeat this for each leveling screw, 3 total.
16. Evenly tighten the two 8-32 SHCS to secure the reading head.



17. Use the Allen wrench from the leveling screw adjustment to slide brackets away from the reading head.
18. Remove the alignment brackets and save with this Reference manual.
19. Route cable with slack loops allowing for axis motion.
20. Secure excess cable by fastening with clips and ties.
21. Move the axis through its full travel. Confirm that the assembly does not interfere with the machine movement.

Hassle-Free Warranty

ACU-RITE readouts and precision glass scales are warranted to the end user against defects in material and workmanship and against any damage that occurs to the product within three (3) years from the original purchase date. ACU-RITE will, at its discretion and expense, repair or replace the returned item or any of the item's component(s) as long as ACU-RITE receives notice of the defect or damage within the three (3) year warranty period.

The foregoing warranty obligations are in lieu of all expressed and/or implied warranties of fitness or merchantability or otherwise, and state ACU-RITE's entire liability and the end user's exclusive remedy, under any circumstance, for any claim of damage.

In no event shall ACU-RITE be liable for incidental or consequential damages nor shall ACU-RITE's liability for any claims or damage arising out of or connected with this warranty or the manufacture, sale, delivery, or use of the products with which this warranty is concerned exceed the purchase price of said products.



ACU-RITE IS AN
ISO 9001
CERTIFIED
MANUFACTURER



ACU-RITE®

ACU-RITE INCORPORATED

One Precision Way • Jamestown, NY 14701

