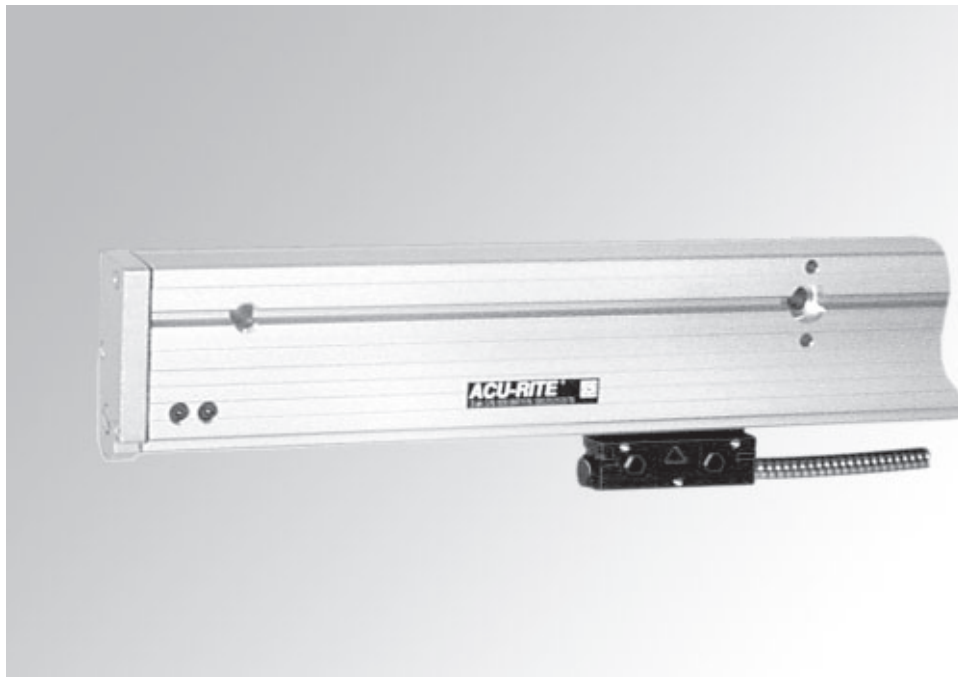


# ENC 250™

## MULTI-SECTION



REFERENCE MANUAL

**ACU-RITE®**

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ACU-RITE readouts and precision 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 circumstances, 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 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.

The ENC 250 linear encoder provides the accuracy and reliability of an ACU-RITE measuring system with digital output. Features and options include:

- Resolution of 5 $\mu$ m (.0002in.)
- Accuracy grade of +/-15 $\mu$ m/M (0.00018in/ft)
- .61m (2 ft.) armor cable and extension cables up to a maximum of 22.9M (75 ft) for a VRO; 10.7M (35 ft) for a DRO
- Mounting hardware
- Brackets and accessories

Contact your Authorized ACU-RITE Distributor for a complete list of other products and accessories.

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The catalog and serial numbers are located on the scale assembly label.

Copy the warranty information here for your own records:

Catalog No.                      Serial No.  
Axis:                      \_\_\_\_\_  
Tape tension value:                      \_\_\_\_\_  
Date of purchase:                      \_\_\_\_\_  
Distributor:                      \_\_\_\_\_  
Address:                      \_\_\_\_\_  
Telephone:                      \_\_\_\_\_

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## Components

Each unit should consist of the following boxes:

*Scale Section Boxes:*

- Right End Section
- Left End Section
- Center Sections (One or more boxes depending on length)

*Common Components Box:*

- Scale Measuring Tape (Coiled On Spool)
- Lipseals (Coiled On Spool)
- Reading Head
- Mounting Hardware with RTV and Silicone Grease
- Reference Manual

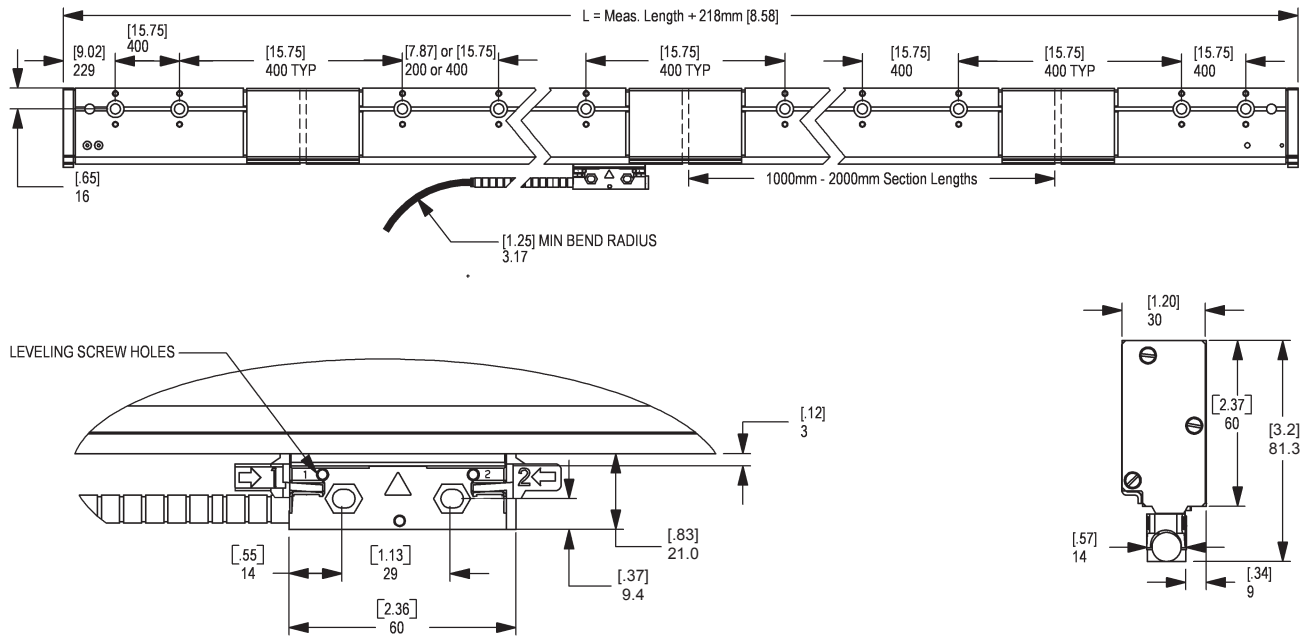
**Tools**

You will need the following tools to complete the installation:

- 0.001" Dial Indicator with Magnetic Base
- English Hex Wrench Set
- Metric Hex Wrench Set
- Dial Calipers
- Feeler Gage
- Hand Drill
- Hand Tap
- Taps(English): 1/4-20 UNC & #8-32 UNC
- Taps(Metric): M6, M4
- Drills(English): #7 (.201"), #29 (.136"), N (.302")
- Drills(Metric): 5mm, 3.3mm, 7.7mm
- Reamer(English): .312"
- Reamer(Metric): 8mm
- Transfer Punch Set
- Hammer
- Center Punch
- Phillips Screw Driver
- Flat-tip Screw Driver
- Torque Wrench

\* NOTE: Both metric and English mounting hardware have been supplied. The mounting instructions reference only to the metric components, but the English components can be substituted if desired. Therefore, not all of these tools are required for all installations.

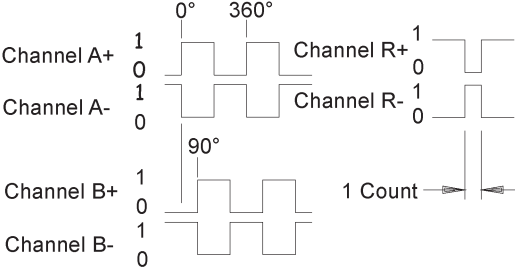
**Scale Dimensions**



**Mechanical Specifications**

Mechanical Specifications	Digital
Resolution	5 $\mu\text{m}$ (0.0002 in.)
Grating Pitch	100 $\mu\text{m}$ (0.00393 in.)
Scale Medium	Reflective Metal Tape
Accuracy	$\pm 15 \mu\text{m}/\text{M}$ (0.00018in/ft.)
Maximum Slew Speed	1 M/sec. (40 in/sec.)
Force to Move Reading Head	$\pm 3.3$ Newtons (0.75 lbs.)
Operating Environment Temperature / Relative Humidity	0° to 40°C (32° to 104°F) 20% to 95% (Non-condensing)
Storage Environment Temperature / Relative Humidity	-40° to 60°C (-40° to 140°F) 20% to 95% (Non-condensing)
Weight with Cable	1 kg + 3.2 kg/M (2.2 lbs. +0.18 lbs/in.)
Connecting Cable Armored	Length = .61M (2 ft.) Connector: DE-9P
Maximum Cable Length	22.9 M (75 ft.) VRO / 10.7 M (35 ft.) DRO
Measuring Length	3240 mm (127 in.) — 19,640 mm (773 in.)
Reference Pulse Intervals	100 mm (3.937 in.) Distance encrypted

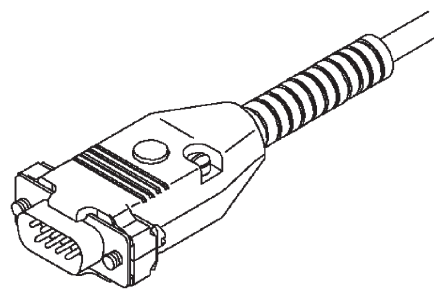
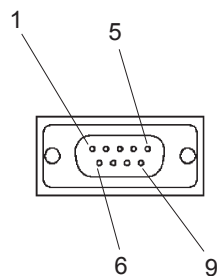
**Electrical Specifications**

Parameter	Digital
Output Signals	$I_{OH}$ - (High level output current) = 20mA $V_{OH}$ - (High level output voltage) >2.5Vdc  $I_{OL}$ - (Low level output current) = -20mA $V_{OL}$ - (Low level output voltage) < 0.5Vdc
Incremental signals	Square-wave voltage signals. Channels A and B, in 90° quadrature relationship
Signal levels	TTL-level
Reference Mark signals	Square-wave pulse
Signal level	TTL-level
Power Supply	5.1 ± 0.1 VDC @ 140 mA max.

**Output Signals and Pin-Outs**

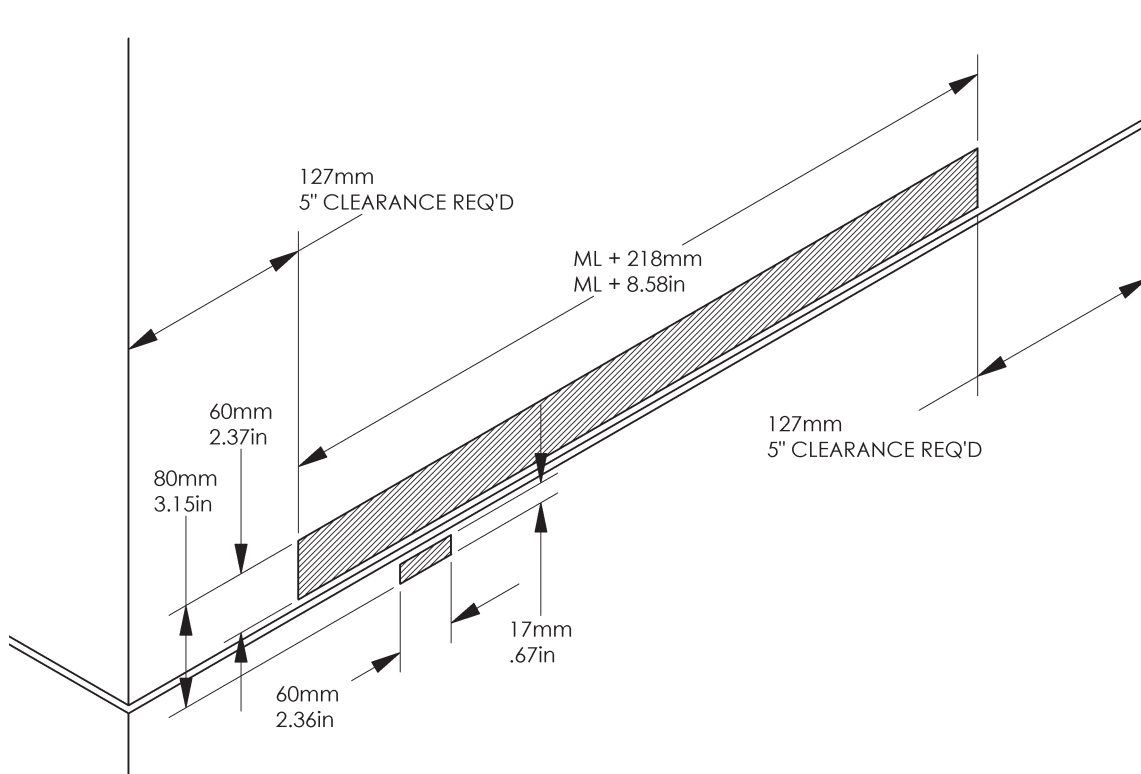
**Digital Differential**

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
N/C	Green	Yellow	Blue	Red	White	Brown	Pink	Gray
N/C	Channel A+	Channel A-	Channel B+	Channel B-	Ground	Vcc, + 5.1 ± 0.1 VDC @ 140mA max.	Channel R+	Channel R-



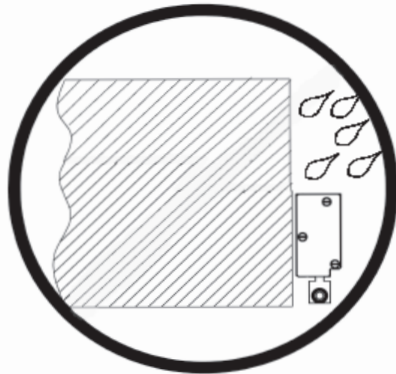
**General**

- Check that the machine's travel does not exceed the scale's measuring length. If the scale is too short, limit the table movement or contact ACU-RITE for a longer scale.
- Remove the paint from all mounting surfaces. Clean each area before beginning the installation.
- Mount with the lipseals down or away from the work area.

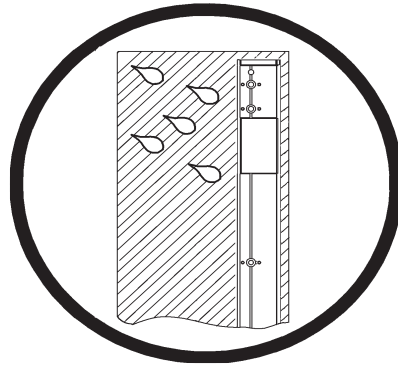




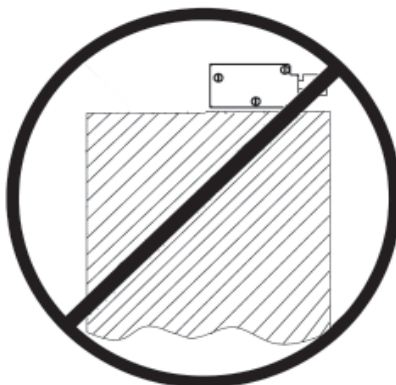
Mounting Examples



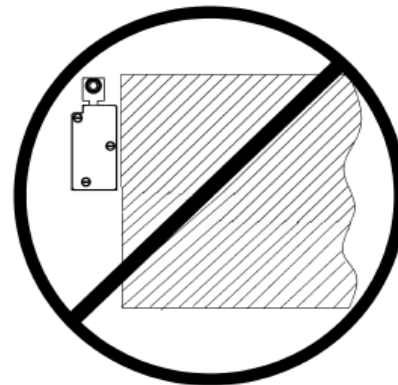
Horizontal application lip seals must face downward



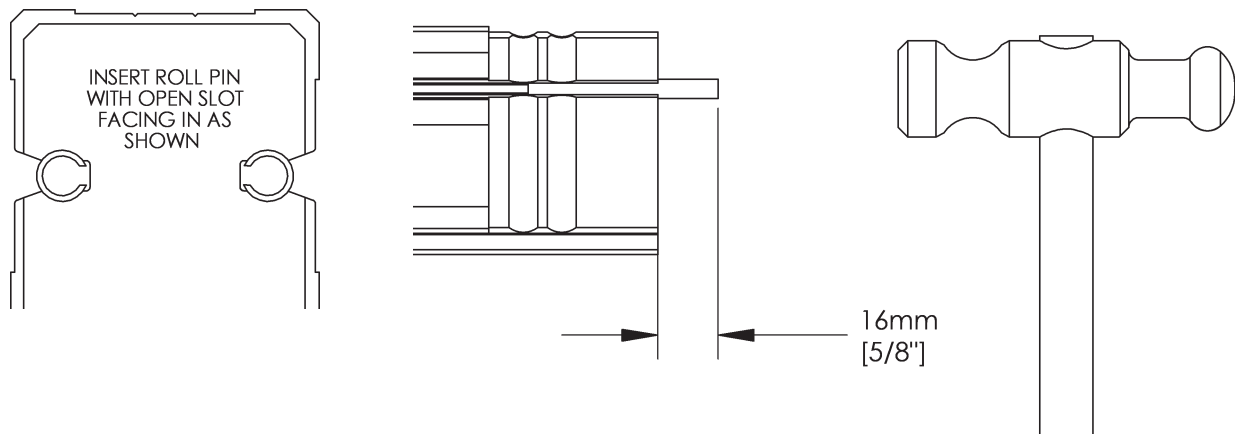
Vertical application lip seals must face away from coolant spray



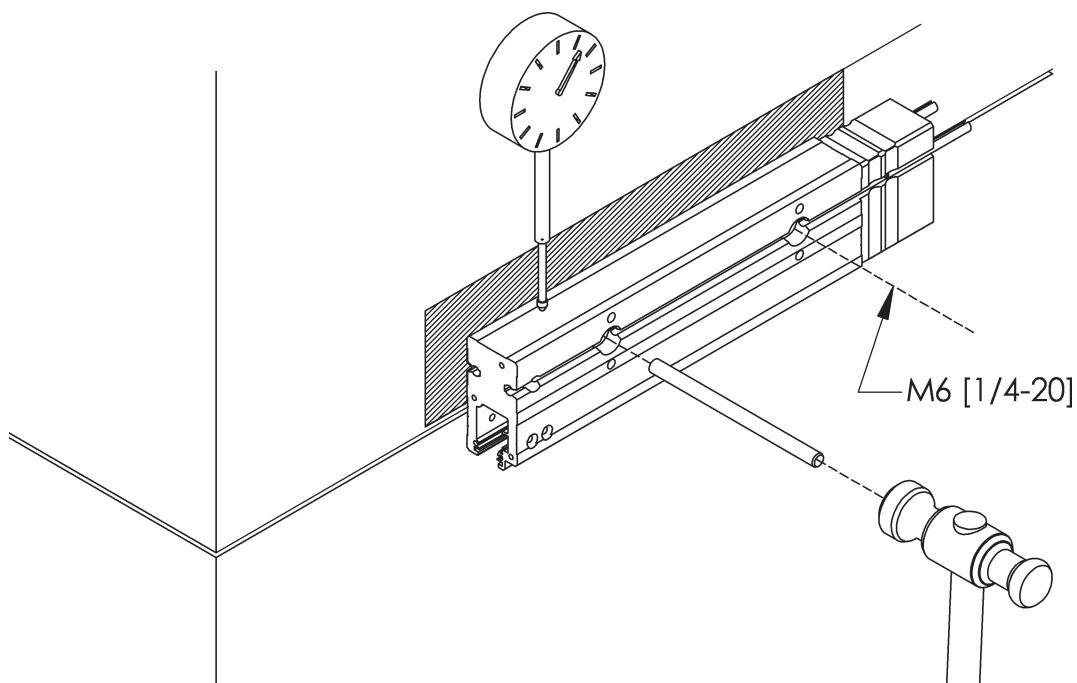
Scale should not be mounted horizontally. Damage to the Reading Head and Tape will result.



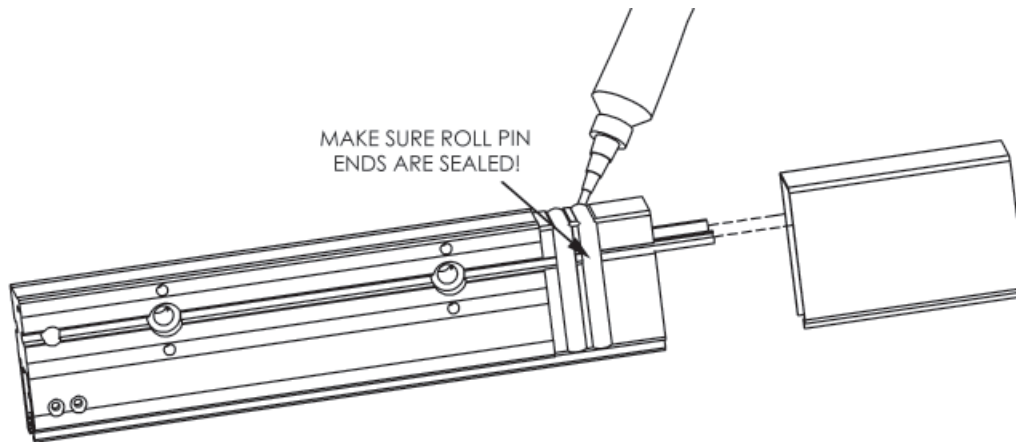
Scale should not be mounted upside down. Damage to the Reading Head and Tape will result.



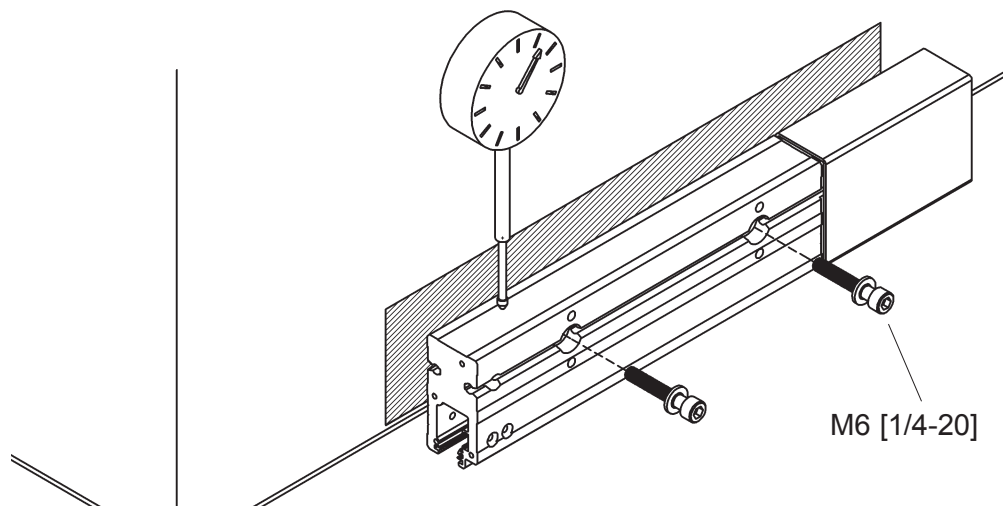
- Gently tap two roll pins into the extruded slots in the left end section as shown. Pins should protrude approximately 16mm (5/8"). **The seams on the roll pins must face towards the inside of the scale case.** This step will be repeated for each section installed.



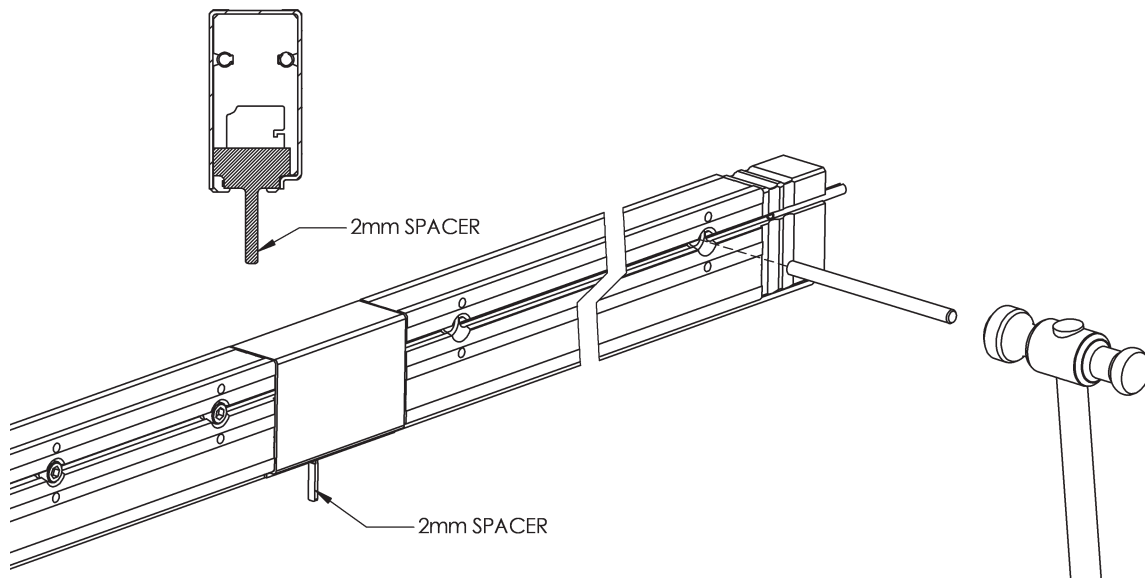
- Hold the left end section against the selected mounting surface and transfer punch one mounting hole.
- Drill and tap the spotted location M6 x 12 mm deep (1/4 - 20 x 1/2" deep) minimum. Keep drill perpendicular to surface when drilling.
- Attach the section to the machine, and align the top surface to within 0.3 mm (.012") of the axis travel. Measure directly over each mounting hole location. Transfer punch the second mounting hole. Remove the section; drill and tap second hole location for a M6 x 12mm deep (1/4 - 20 x 1/2" deep.)



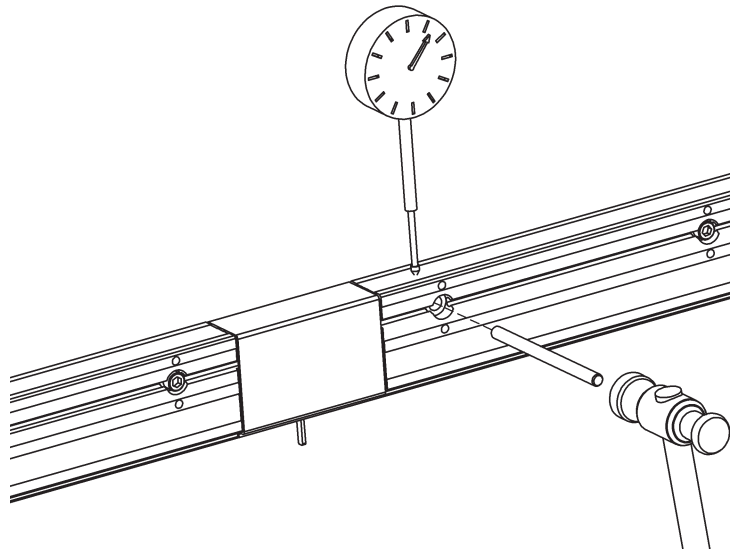
- Apply RTV Silicone Rubber to the sealant grooves in the left end section. The sealant must be applied on all three sides of the case and over the spring pins as shown. **Thoroughly seal the seated ends of the spring pins. Keep the end of the section free of sealant.**
- Slide the scale clip over the end of the scale section. There should be sufficient spring in the clip to clamp it securely around the case.
- Thoroughly clean off the excess RTV on the outside of the case.



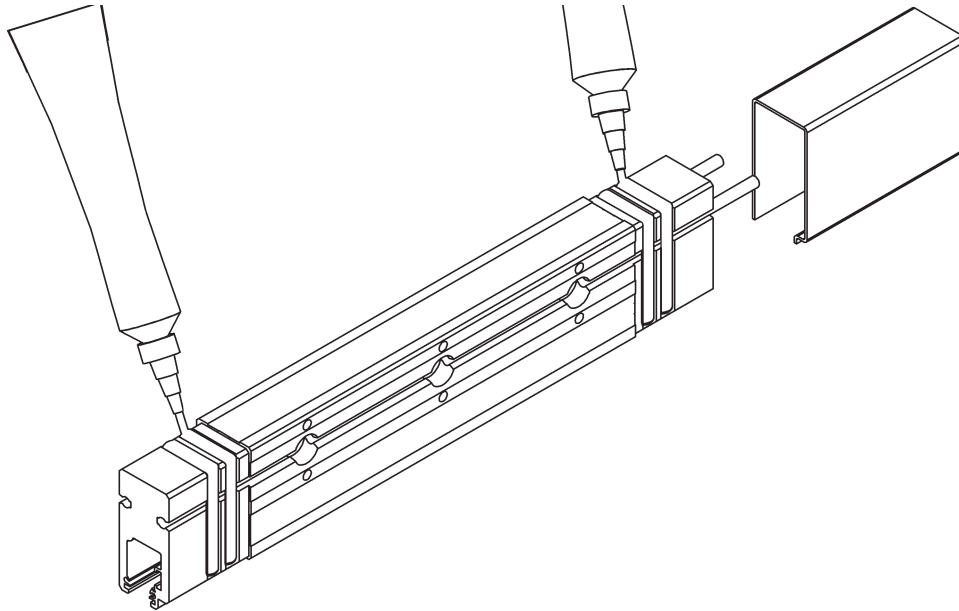
- Bolt the left end section to machine using a M6 x 30 (1/4 - 20 x 1 1/4") SHCS and the scale bolt washers provided in the hardware kit.
- Align the top of the end section parallel to the axis travel within 0.3 mm (.012") and tighten the scale bolts.



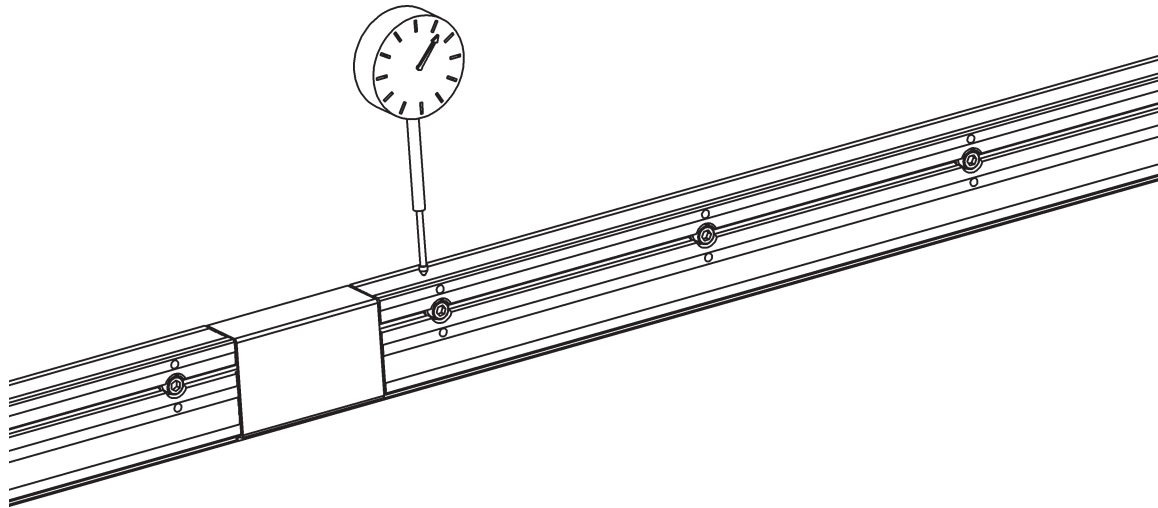
- Place the 2 mm spacer provided in the hardware kit into the scale clip as shown.
- Select a center section for installation. The center sections can be mounted in random order.
- Gently tap two roll pins into the extruded slots in the right end of the section. Pins should protrude approximately 16 mm (5/8").
- Insert the left end of the center section into the scale clip and butt it to the mounted end section. Lightly tap the end of the center section with a soft hammer to seat it against the 2 mm spacer.
- Align the right end of the center section parallel to the mounted end section and transfer- punch the mounting hole closest to the right end onto the mounting surface.
- Remove the center section.
- Drill and tap the spotted location M6 x 12 mm deep (¼ - 20 x ½ " deep) minimum.



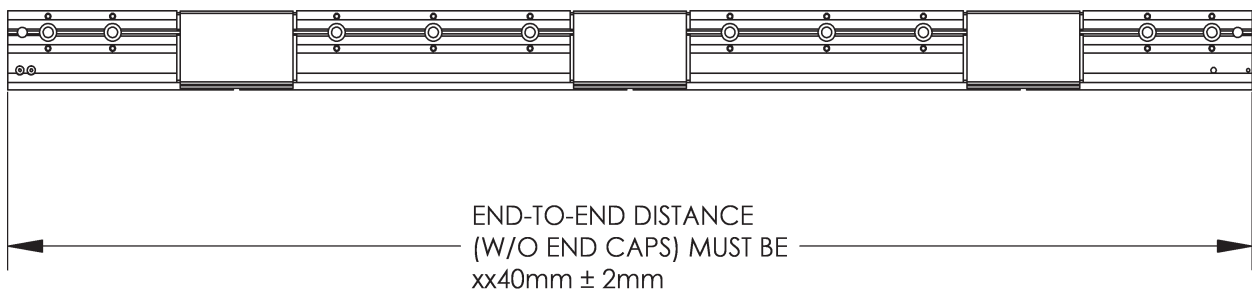
- Insert the left end of the center section back into the scale clip and butt it to the mounted end section. Lightly tap the end of the center section with a soft hammer to seat it against the 2 mm spacer.
- Bolt the right end of the center section to machine using a M6 x 30 (1/4 - 20 x 1 1/4") SHCS and one of the scale bolt washers provided in the hardware kit.
- Align the top of the center section parallel to the mounted end section and the axis travel and transfer-punch each remaining mounting hole onto the mounting surface. Measure directly over each mounting hole as you transfer-punch.
- Remove the center section.
- Drill and tap the spotted locations M6 x 12 mm deep (1/4 - 20 x 1/2 " deep) minimum.



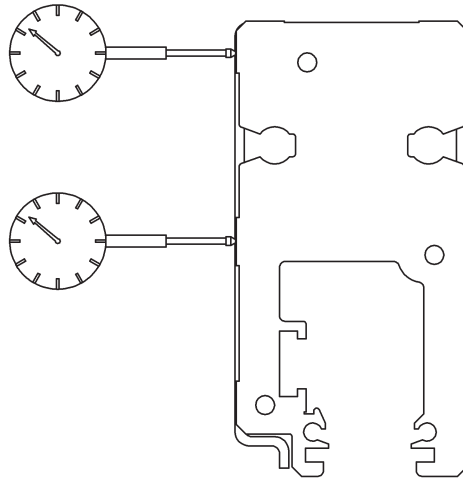
- Apply RTV Silicone Rubber to the sealant grooves in the left and right ends of the center section. The sealant must be applied on all three sides of the case and over the roll pins as shown. **Thoroughly seal the seated ends of the roll pins. Keep the ends of the section free of sealant.**
- Insert scale clip over right end of center section.
- Thoroughly clean off the excess RTV on the outside of the case.



- Insert the left end of the center section back into the scale clip and butt it to the mounted end section. Lightly tap the end of the center section with a soft hammer to seat it against the 2 mm spacer.
- Bolt the center section to machine using a M6 x 30 (¼ - 20 x 1 ¼”) SHCS and one of the scale bolt washers provided in the hardware kit.
- Clean off excessive sealant.
- Measure directly over each mounting hole and align the top of the center section parallel to the machine within 0.3 mm (.012”) as you tighten the mounting bolts.
- Turn the handle of the spacer forward and remove it through the bottom of the scale clip.
- Proceed similarly to mount the remaining center sections and the right end section to the machine. Use the spacer to set the required 2 mm gap between each section. Make sure the top of the case sections are parallel to the axis travel within 0.3 mm (.012”).

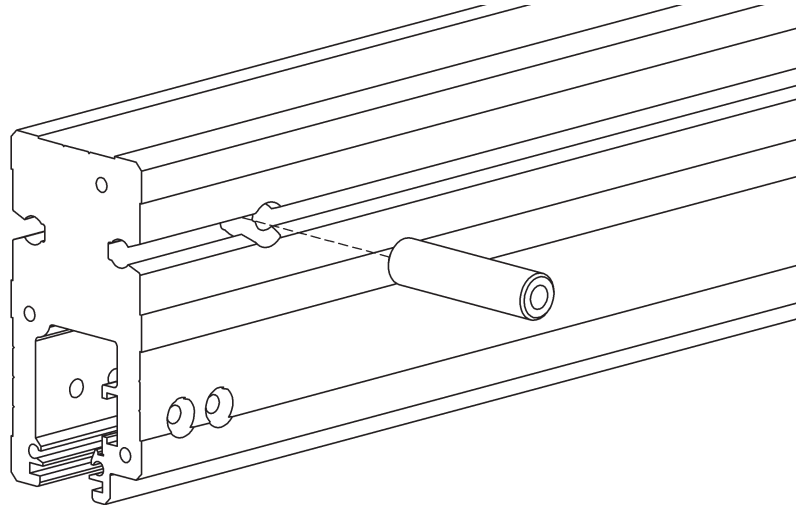


- To check for proper spacing between sections, use a tape measure and measure distance between the two ends of the mounted scale sections (without end caps.) If you are measuring in inches you must convert the distance to millimeters (multiply by 25.4). If the sections are mounted correctly, the last two digits of your measurement should be very close to 40 mm; e.g. 6640 mm, 8040 mm, 10840 mm etc. If this distance is off by more than two millimeters from nominal (e.g. 6637 mm, 6643 mm) shift the location of the right end section to bring it within nominal distance.

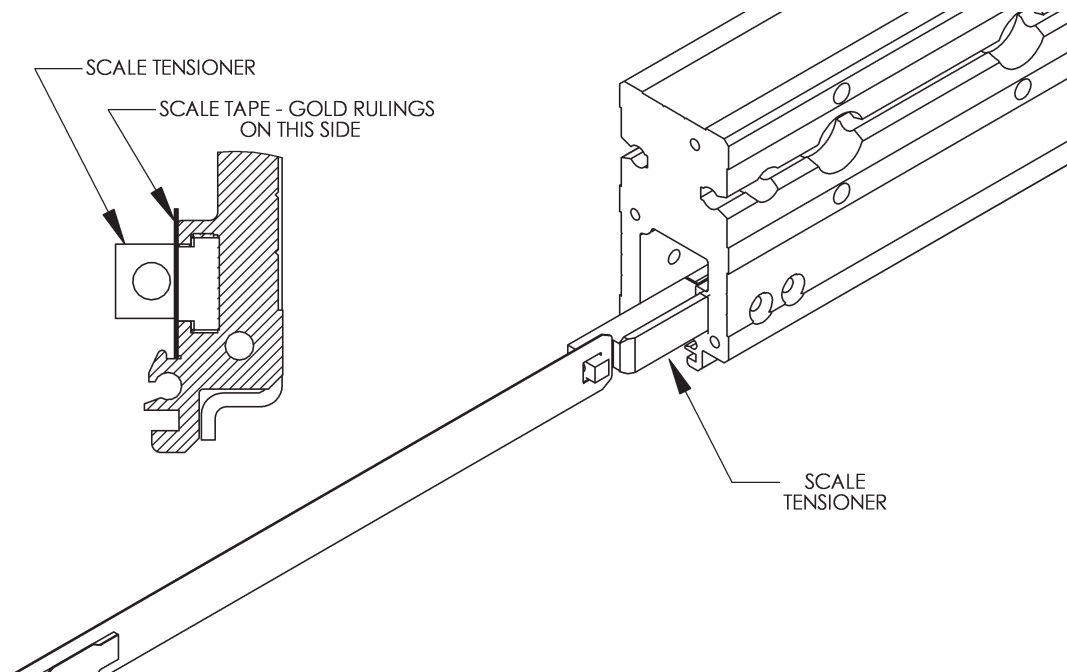


- Check the front surface of the mounted scale sections for parallelism to the table travel. Run a dial indicator along the length of the scale at the two surfaces shown above. If the front surface is not parallel within .03 mm (.012") to the axis travel proceed as follows:
  - Insert the leveling screws (M4 x 25 mm socket head set screws) into the tapped holes in the scale case – two for each mounting hole. Insert these screws until they are flush with the front of the case. Do not tighten these screws at this time!
  - Indicate the front surface of the mounted scale over its whole length to locate the high point. Mark this point and set the indicator to zero at this point.
  - Move the dial indicator to an adjacent mounting bolt. Loosen this mounting bolt. Using the leveling screws, push the scale case away from its mounting surface until the indicator reads zero and retighten the scale mounting bolt.
  - Move the dial indicator to the other remaining mounting holes and proceed similarly until the front of the scale case assembly is parallel within 0.3 mm (.012") to the axis travel.
  - Recheck the top surface with the indicator to make sure it is still parallel to the axis travel within 0.3 mm (.012").

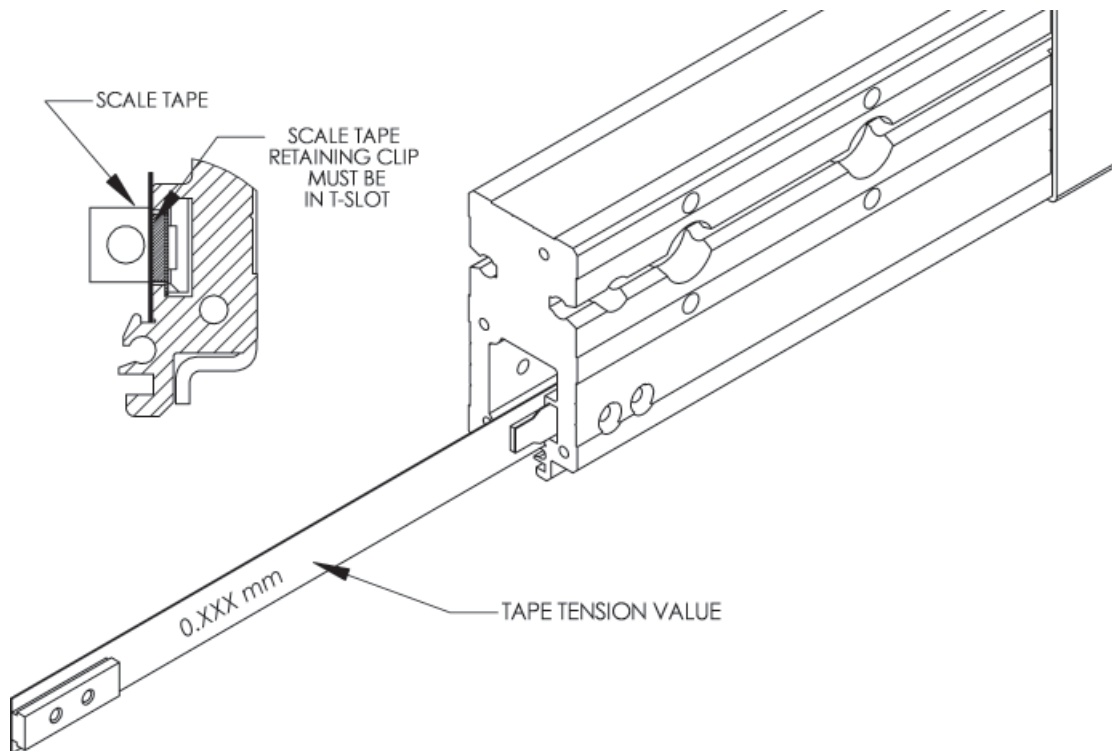




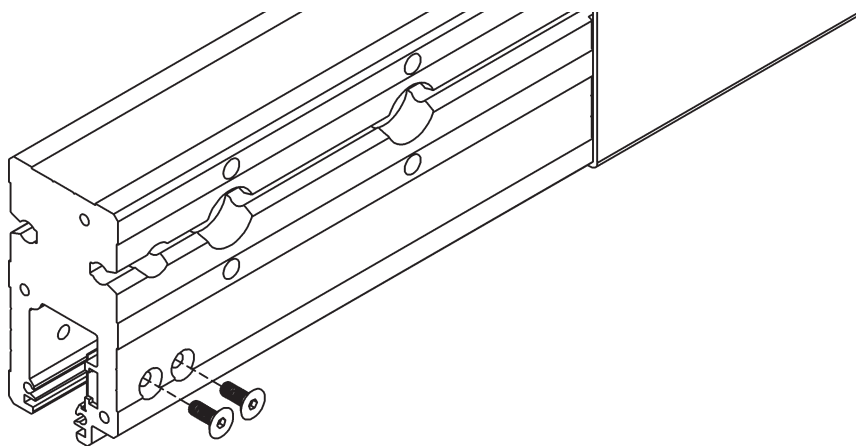
- **The ends of the scale case must be dowelled to the machine to maintain scale accuracy.** Drill 7.7 mm (.302") diameter holes through the dowel pin holes at both ends of the scale case. The holes must be drilled 9.5 mm (3/8") deep into the machine's surface. Use a 8 mm (.312") reamer to provide a press fit hole for each of the 8 mm (5/16") pull dowels in the hardware kit. Insert the dowel pins into these two holes. Make sure that the threaded holes in the dowel pins face outward.



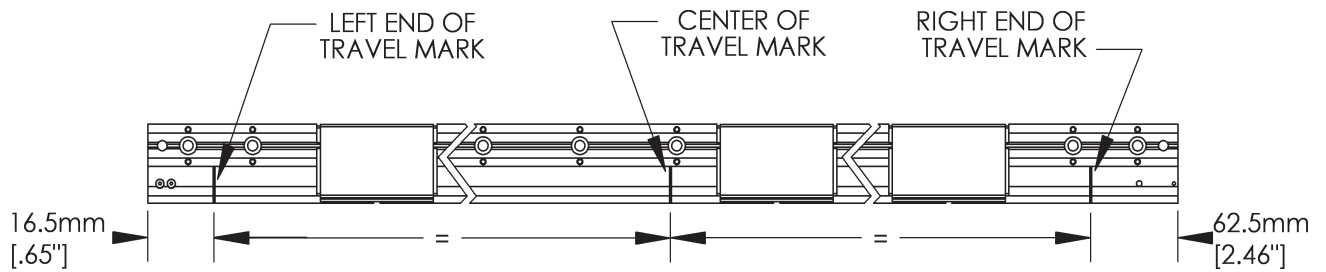
- Place the scale tensioner into the tee slot on the left end of the scale case.
- Retrieve the scale tape from the carton. The scale tape is shipped in a protective plastic coil. Do not uncoil the tape. It should be uncoiled as it is inserted into the case. The tape must be kept free of fingerprints and contaminants. It is best to wear clean cotton gloves when handling it. If necessary, the scale tape may be cleaned with cotton cloth soaked in alcohol or acetone.
- Hook the boss on the scale tensioner through the square hole in the scale tape to capture the tape and slide the scale tensioner into the scale case. **Note – the gold rulings on the scale tape must face into the scale cavity.**



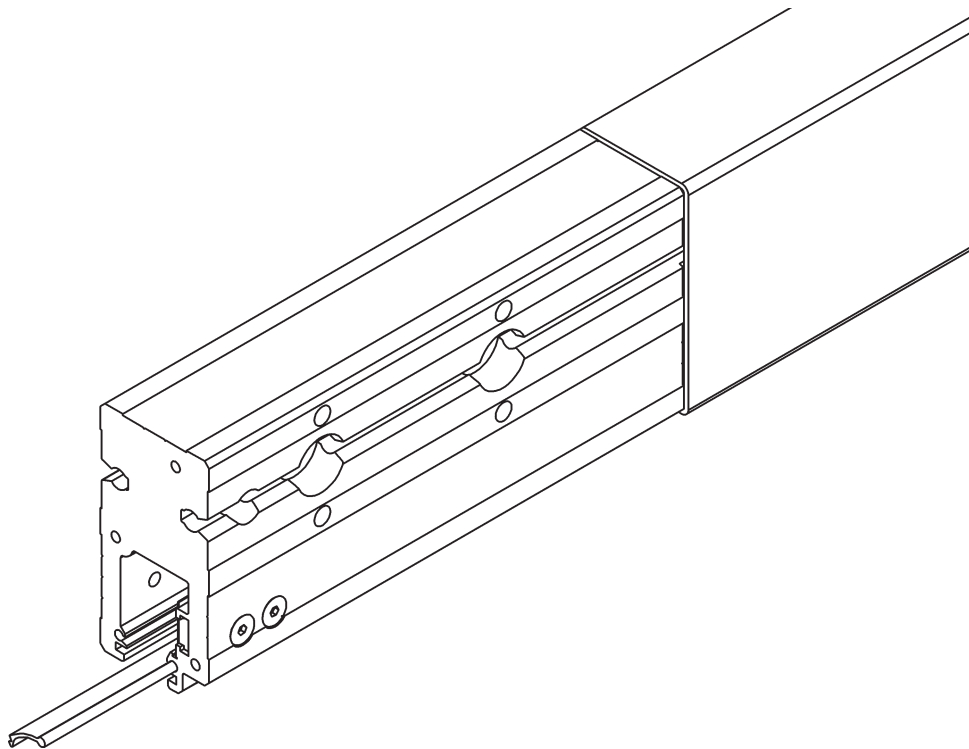
- Before inserting tape completely in to the case, check the tension value on the backside of the scale tape at the anchor end. Check the value on the label attached to the right end section, and verify that it is correct.
- The two M3 x 8 mm Flat Head Socket Screws must be removed from the scale anchor block. Continue pushing the scale tape into the case until the anchor end is flush with the left side of the case. **Make sure that all the scale tape retainer clips go into the T-slot.** If the scale tape cannot be inserted completely by pushing at one end, the scale tensioner may be pulled along the case with a small steel ruler from the bottom of the scale case.



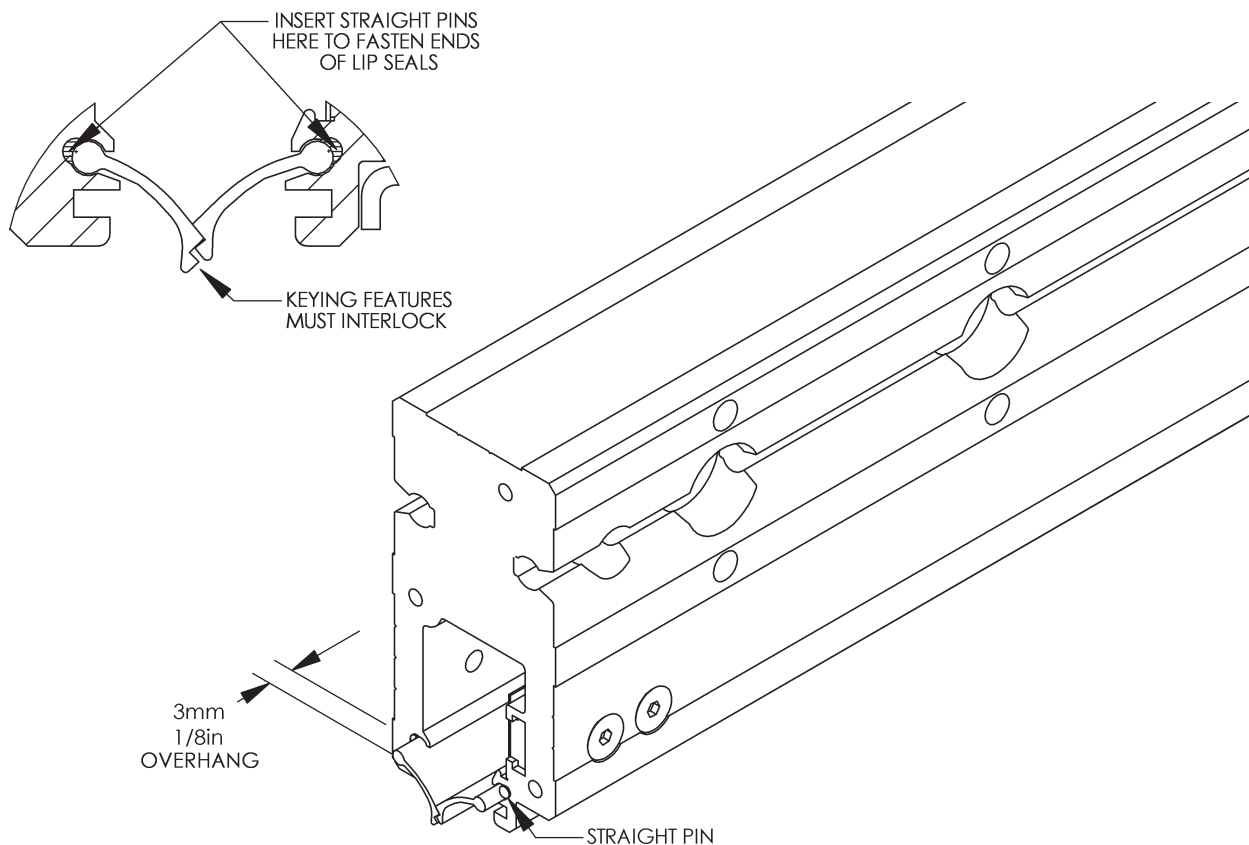
- Apply a small amount of silicone grease – as a sealant - to the two M3 x 8 mm Flat Head Socket Screws. Insert these screws into the countersunk holes in the left end of the case and tighten them securely to fasten the scale anchor block to the scale case.



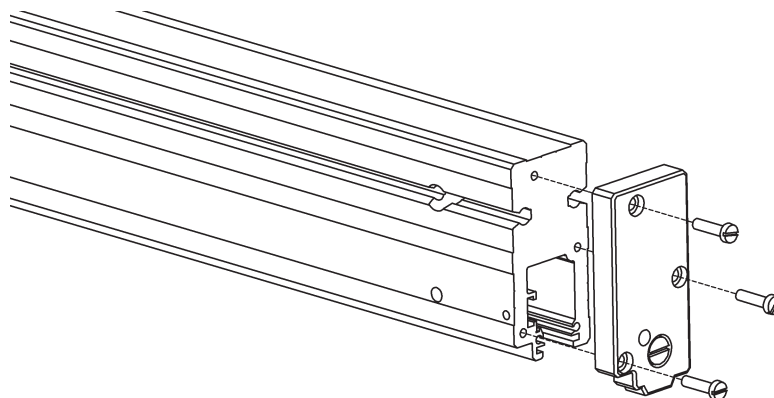
- Draw a line onto the front of the scale case at a distance of 16.5 mm (0.65") from the left end. Similarly draw a line onto the front of the scale case at a distance of 62.5 mm (2.46") from the right end. These are the end-of-travel marks. The ends of the reading head must not travel beyond those lines.
- Find the center distance between the two lines and draw another line onto the front of the scale case. This line represents the center of travel. The reading head must be mounted so that it is centered under this line when the machine carriage is located at the center of its axis travel.



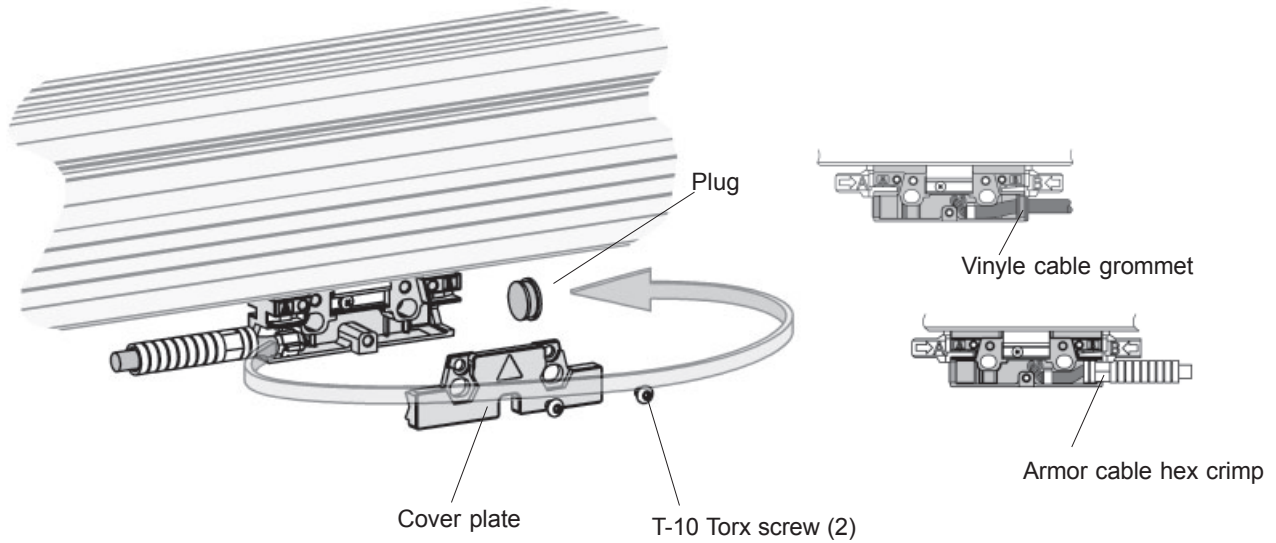
- Insert a lip seal into the front keyhole slot (the one closest to the scale tape) until it protrudes at least 12 mm (1/2") from the far side. Lip seals must be installed with the keying features opposing each other – see drawing.



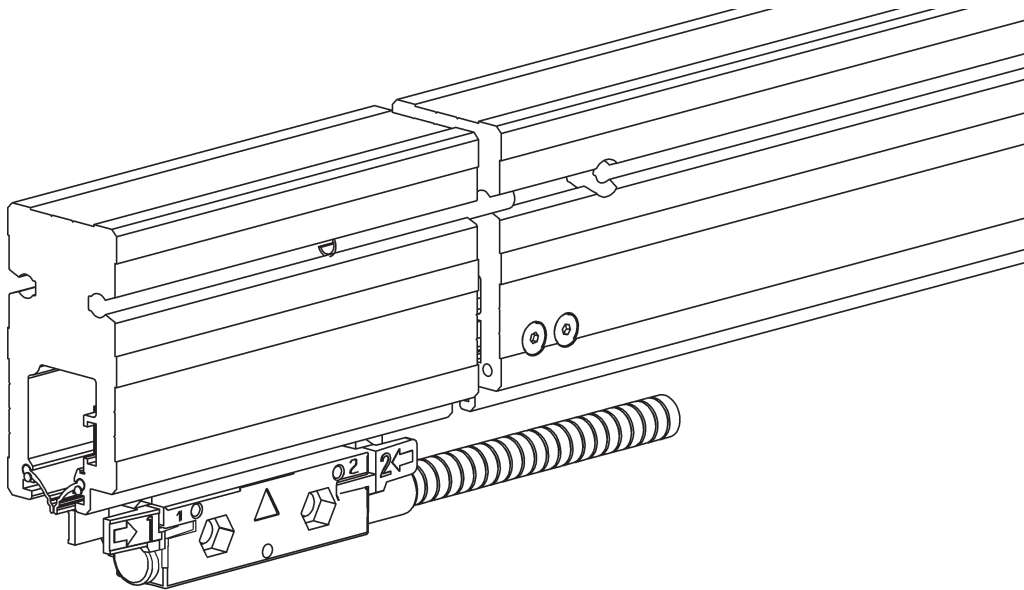
- Similarly, insert the rear lip seal. Make sure that the lip seals are not under excessive tension in the case. Normally, the lip seal can be pulled through completely with a pair of needle-nose pliers. If necessary pull the lip seal along at different points along the inserted length. Insert the 4 straight pins – from the hardware kit – into the ends of the lip seal grooves to keep the lip seals from pulling away from the ends of the scale case. Trim the lip seals ends with a pair of scissors so that there is an overhang of approximately 3 mm (1/8") at each end.



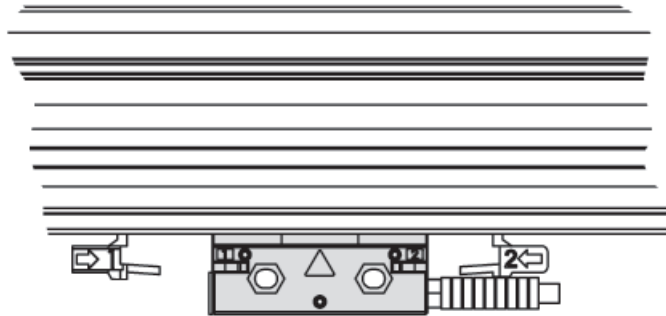
- Attach right end cap with M3 x 12 CHM screws provided in the hardware kit. Tighten these screws securely to compress the end cap gasket.



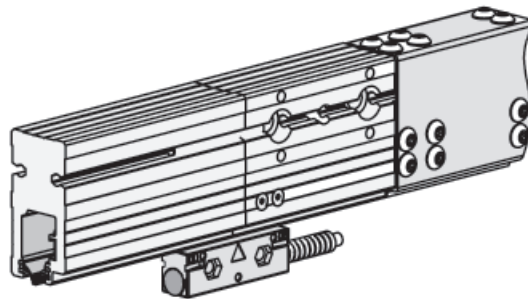
- To change the cable exit direction of the reading head, remove the reading head cover plate and rotate the cable 180°.



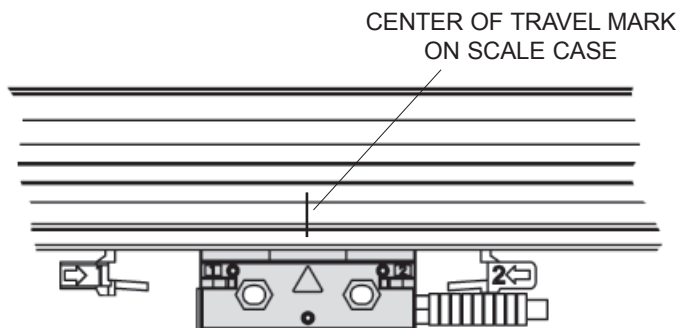
- The Reading Head is shipped attached to the installation tool. Push the protruding roll pins of reading head installation tool assembly into the left end of the scale case. Push on securely to close the gap between the scale sections. **The number indicators of the Reading Head are always facing out.**



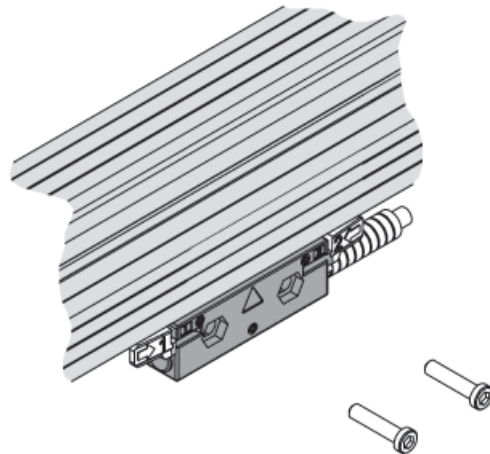
- Remove the alignment brackets by sliding them away from the reading head and twisting them 45° to remove them from the scale case. They may have to be pried away from the reading head with a small screw driver.



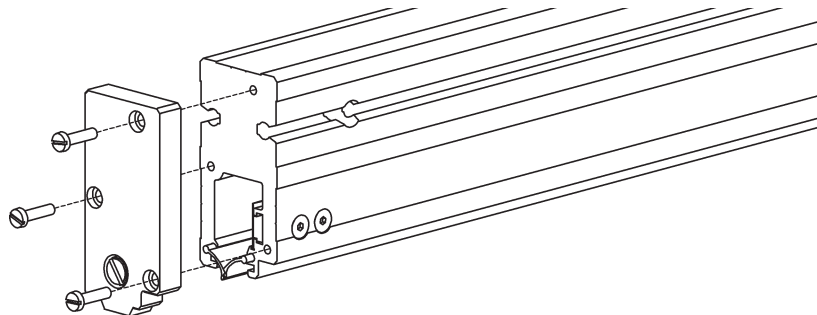
- Slide the reading head onto the scale case to the center of travel mark on the case.



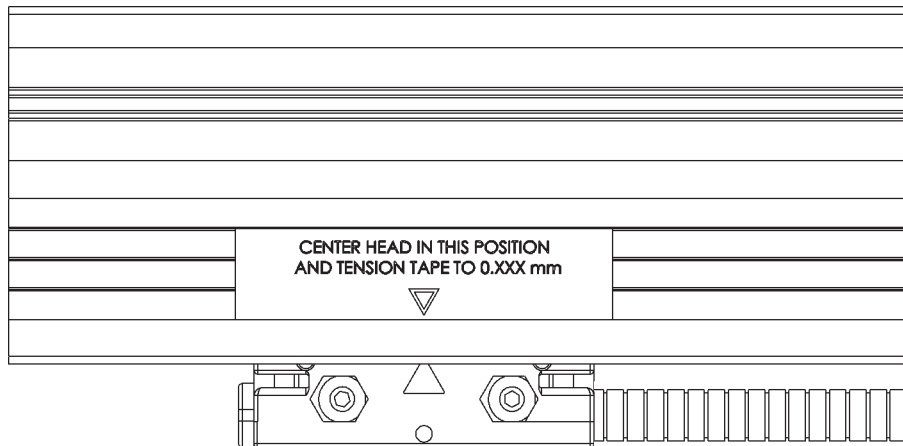
- Install alignment brackets. Insert brackets at 45° and twist to insert them into grooves on the bottom of scale case. Slide brackets against reading head and snap into place. Numbers and letters on reading head casting and alignment brackets must correspond.
- Align the triangle on the reading head with the center-of-travel mark on the scale.
- Locate the machine's encoder mounted axis center of travel. Move the axis to the center of travel, and lock in place. Mark a reference line on the axis so that it can easily be returned to the center of travel.



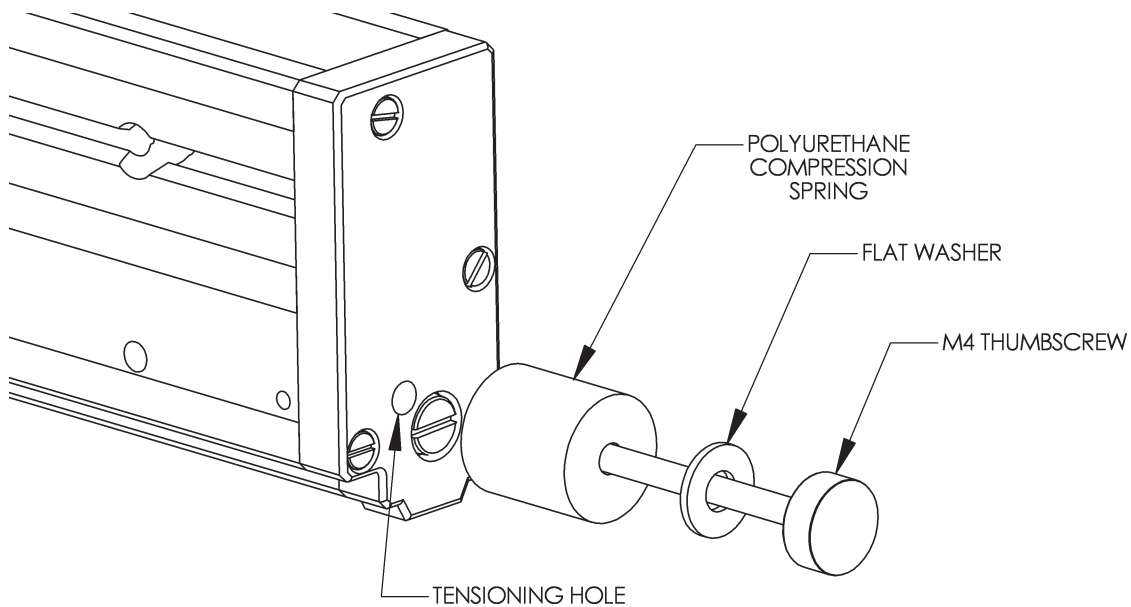
- The reading head must be mounted in the same location as it is held by the alignment brackets. To attach the reading head to the mounting surface, follow these steps...
- Brackets required for assembling the reading head to the machine may use ACU-RITE universal brackets. Custom designed brackets by the installer should be solid, and rigidly assembled. Attach brackets to the machine with 1/4 - 20 fasteners minimum. Allow clearance for removing alignment brackets once the reading head has been installed. Also, allow a small amount of clearance between the reading head and its mounting surface for setting the leveling screws. For custom brackets, spot the two head mounting holes on your brackets and tap these holes for M4 (#8-32) mounting bolts. To mount the reading head proceed as follows:
- Insert, but do not tighten the M4 (#8-32) reading head screws.
- Place a .025-.076 mm (.001 -.003") shim between the leveling set screws and mounting bracket.
- Adjust each screw until a slight drag is felt on the shim.
- Evenly tighten the M4 (#8-32) reading head mounting screws so that the head does not shift or twist. Remove the alignment brackets from the scale case by sliding them away from the reading head and twisting 45°. A small screw driver may be needed to detach the brackets from the reading head.
- Verify the reading head is able to move through the entire length of machine travel without interference.



- Remove the Reading Head shipping tool from the end of the scale case. Attach left end cap with M3 x 12 CHM screws provided in the hardware kit. Tighten these screws securely to compress the end cap gasket.

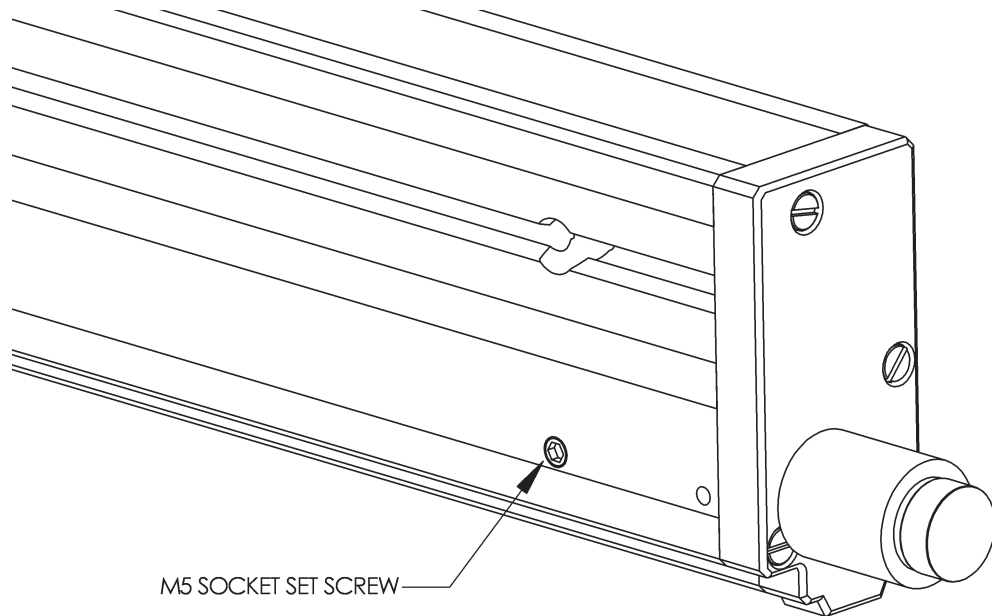


- Position the machine slide to center the reading head at the tape tensoning position indicated by the tension label on the right side of the scale.
- Set the readout's display and encoder resolution to .005 mm. See readout reference manual for setting resolution.

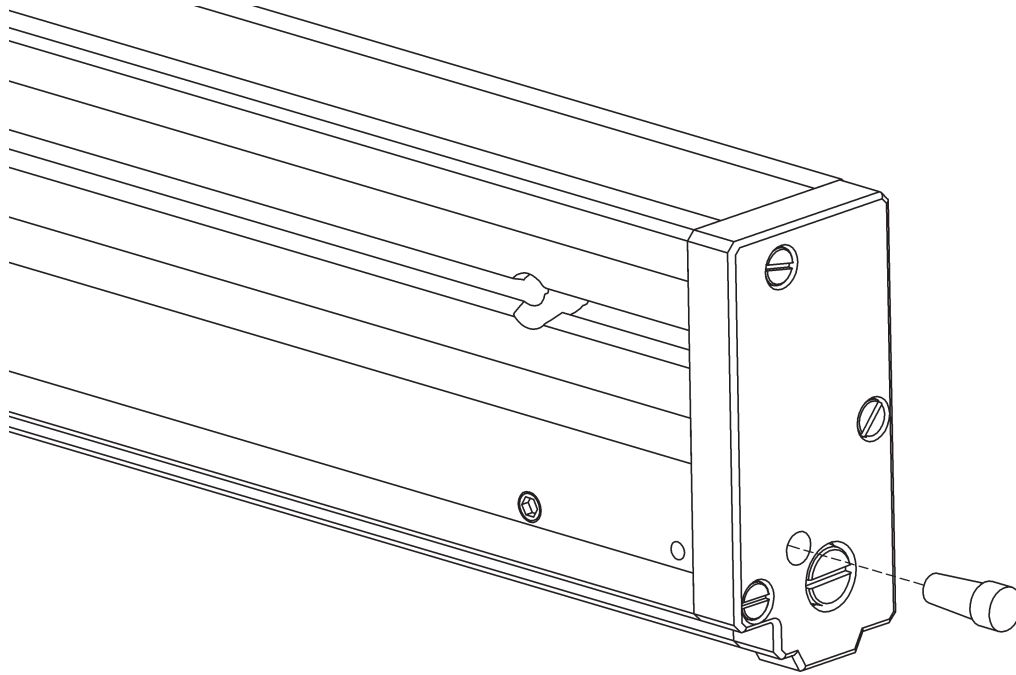


- Remove tensioning hole plug from the right end cap.
- Insert the M4 thumbscrew from the hardware kit through the washer and polyurethane compression spring into the tensioning hole. Turn the thumbscrew until it engages the scale tensioner inside the scale case.

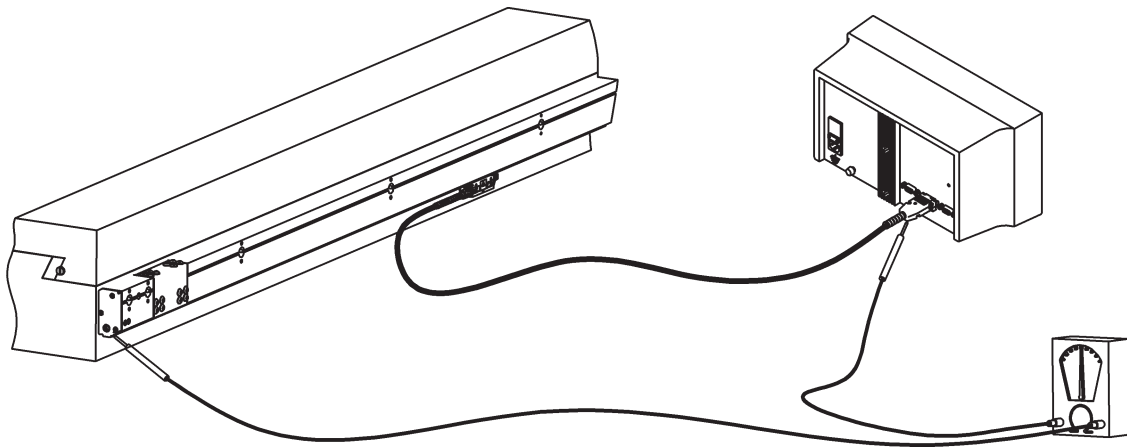




- Turn the thumbscrew clockwise to tension the tape until the display has changed approximately .050 mm. Carefully back off the thumbscrew until the display stops changing. Reset the display to zero.
- Repeat this procedure two to three times to put the tape in a relaxed, slack-free position.
- Slowly tighten the thumbscrew until the display reaches the tensioning value shown on the scale label.
- Tighten the M5 socket set screw on the right side of the case to 3.4 Nm (30 in-lb).
- **THE M5 SOCKET SET SCREW MUST BE TIGHTENED SECURELY AFTER TENSIONING TO PREVENT TAPE SLIPPAGE.**
- Unscrew and remove the knurled tensioning screw assembly from the scale case.



- Coat the plastic plug with silicone grease and install it into the tensioning hole.
- Securely route and fasten the encoder cable to the machine to avoid damage or breakage.
- This completes the installation of the ENC 250.



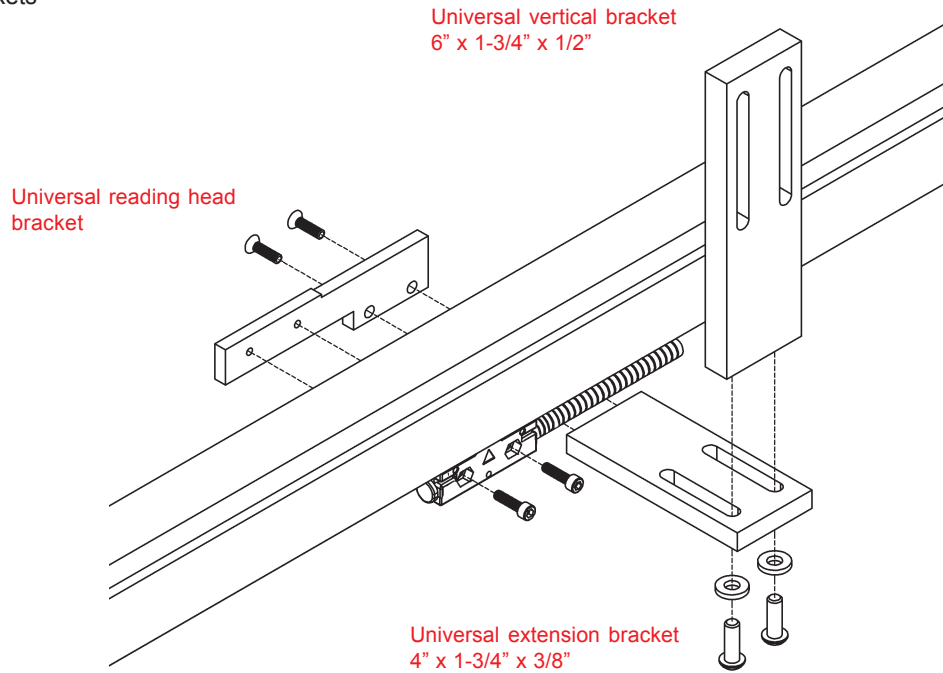
### Grounding the Readout

Connect a ground wire from the terminal on the back of the readout to the machine or earth ground. Attach a ground wire from the machine to a solid earth ground.

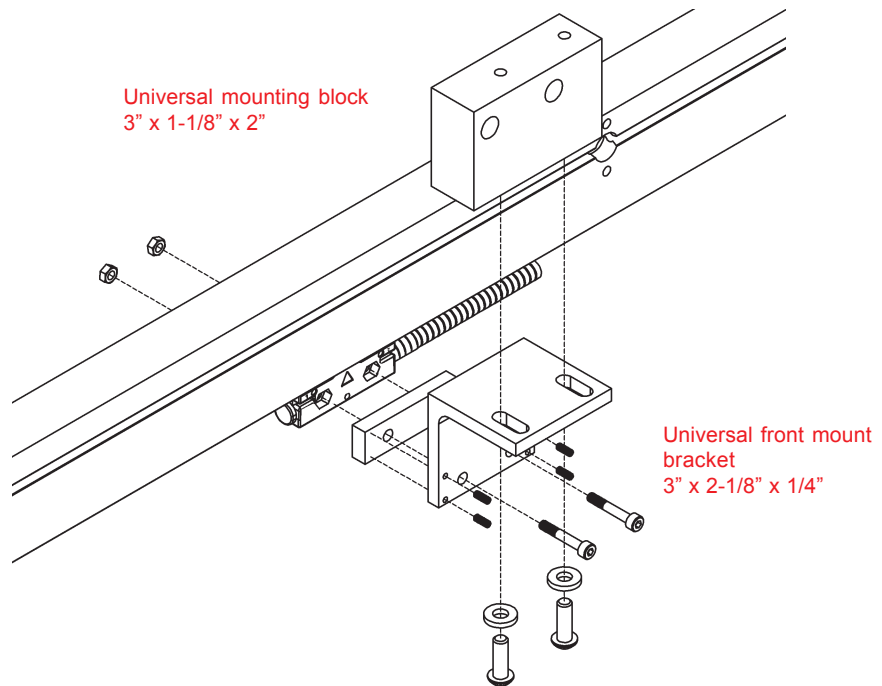
With the encoder attached to the machine and the cable connected to the readout, check shielding by measuring resistance between connector housing and scale unit. **Desired value: 1 ohm max.**

Brackets available from ACU-RITE ...

Rear mounting brackets



Front mount brackets



**Note:** Refer to your authorized ACU-RITE distributor for information on part numbers. Other universal mounting brackets available from ACU-RITE may also apply.

If you experience difficulties with your installation, do the following to determine the problem.

#### **Checking the Readout**

Difficulties on more than one axis are usually associated with the readout. Follow these steps to determine if your difficulties are associated with the readout:

- Ensure that the linear encoder connectors are correctly seated.
- Swap linear encoder cables at the readout to see if the problem is still shown in the same display.
- If the problem remains in the same display, the readout may be in error. To determine if that is the problem, repeat above steps with both encoders, but with only one encoder connected at a time. This should allow you to determine if the problem is with the readout or the encoder.
- If the problem follows the connection change, the linear encoder may be in error.

If the readout is at fault, refer to “**What to do**” to arrange for the parts necessary to repair your system. If a linear encoder appears to be at fault, proceed with “**Checking the Linear Encoders**”.

#### **Checking the Linear Encoders**

Problems on a single axis are usually associated with the linear encoder or its installation. Difficulties can be caused by improper installation, loose or misaligned bracketry, or a damaged or inoperable encoder.

Follow these steps to determine the cause of your system difficulties:

- Confirm that your bracketry and installation does not interfere with other machine structures through the entire length of the linear encoder travel.
- Check for loose fasteners. If you find loose fasteners, first confirm that the linear encoder is installed to the tolerances specified and then retighten the fasteners as required.
- Confirm that the linear encoder is installed to the specified alignment tolerances. If the installation does not meet the tolerances, reinstall the encoder according to the “**Installation Procedure**”.
- Do not attempt to repair the reading head or scale assembly. The ENC 250 is field serviceable by assembly replacement only. Attempts to repair the encoder can permanently damage it and void the warranty.

#### **What to do**

If an ACU-RITE linear encoder or readout is found to be at fault, please contact your Authorized ACU-RITE Distributor for instructions prior to removing the encoders or readout.

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