



Monitor
with
Confidence

Vibrating Wire 2-3 Point Borehole Extensometer Installation Manual

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1 INTRODUCTION

Multi-Point Borehole Extensometers are used to determine the stability and movement behaviour of soil, rock, and concrete structures. The extensometer is to be installed flush with the borehole collar or ground surface and will measure movement at different depths within the borehole.

1.1 HYDRAULIC BORROS ANCHORS

The Multi-Point Borehole Extensometer system is used in conjunction with Double Acting Hydraulic Borros Anchors. Borros Anchors are used to monitor subsurface settlement or heave of ground.

Each hydraulic borros anchor is connected to the extensometer head assembly by a 3/16" flexible rod. The rods are pliable and the length of the rods will vary with the anchor elevation. Hydraulic borros anchor reference points are located in the middle of the anchor from where the top and bottom prongs extrude.

Provide a detailed technical description of how the product functions, at least to the level of understanding required for the user to properly operate the equipment.

Use clear graphics to illustrate product details. Reference the graphic caption in the corresponding text using a cross-reference field. Include callouts in the illustration to point to the key parts of the product.

2 SAFETY

The use of a hydraulic pump is required for the installation of the extensometer. Ensure the hydraulic pump is in working condition prior to using the tool.

Normal safety precautions should be followed and proper personal protective equipment (PPE) should be worn when working in the field with this equipment, including safety glasses and nitrile gloves.

3 INSTALLATION

Installation of the Multi-Point Borehole Extensometer system will require special installation tools. Refer to Section 3.1 for the list of tools required to install the extensometer into its working environment.

3.1 INSTALLATION TOOLS

The following list of tools are required for installing the Multi-Point Borehole Extensometer.

- Vise Grips® (2 pairs),
- Safety line (for securing the extensometer assembly while lowering into borehole),
- Tape (for securing inflation line),
- Tube Union Wrenches (for use with the hydraulic borros anchors),
- Hydraulic Pump (for use with hydraulic borros anchor only),
- Hydraulic Oil.

3.2 MULTI-POINT BOREHOLE EXTENSOMETER INSTALLATION (EXTENSION ONLY)

The extensometer with borros anchors are pre-assembled in the factory and only require proper placement. Remove any white tape to prepare the extensometer for installation. Do not remove any red tape. Should the red tape be removed, re-tape the tubes in between the anchor prongs. Refer to Figure 3-1 for placement on where to re-tape the tubes.



CAUTION: DO NOT REMOVE ANY RED TAPE ON THE EXTENSOMETER. THE RED TAPE HAS BEEN APPLIED DURING ASSEMBLY IN THE FACTORY AND IS USED TO ENSURE THAT THE TUBES WILL NOT BE IN A POSITION TO BE RUPTURED BY THE PRONGS DURING EXTRUSION.

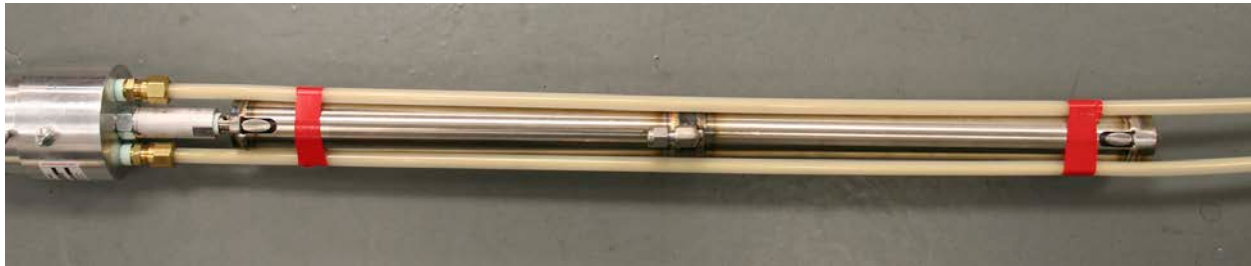


FIGURE 3-1 TAPE THE TUBES AWAY FROM THE PRONGS

The following list describes the procedure to install the Multi-Point Borehole Extensometer. Refer to Appendix B for a diagram of the overall view. Refer to Appendix C for an installation reference diagram.

- 1 Drill a borehole of 8" in diameter (minimum of 4") and at least 13" past the lowest anchor elevation. Refer to Appendix B.
- 2 Unroll the extensometer beside the borehole. Do not remove any red tape. Ensure that the anchor reference position is at a proper distance from the reference surface of the extensometer head.

- 3 Attach a safety line to the extensometer to prevent the extensometer assembly from accidentally dropping into the borehole while lowering into the borehole. Attach a safety line to the grout tube should backfill grout be desired.
- 4 Attach a $\frac{3}{16}$ " high pressure hydraulic inflation line to the elbow fitting on each borros anchor if the inflation line is not already attached. Ensure the inflation line is long enough to reach the pump.
- 5 Tape the hydraulic inflation line along the anchor body. Ensure the line does not rest over the extrusion opening of the prongs.



CAUTION: ENSURE THAT THE HYDRAULIC INFLATION LINE IS TAPED IN BETWEEN THE ANCHOR PRONGS. INFLATION LINES NOT SEPARATED FROM THE PRONGS RISK BEING RUPTURED WHEN THE PRONGS ARE EXTRUDED.

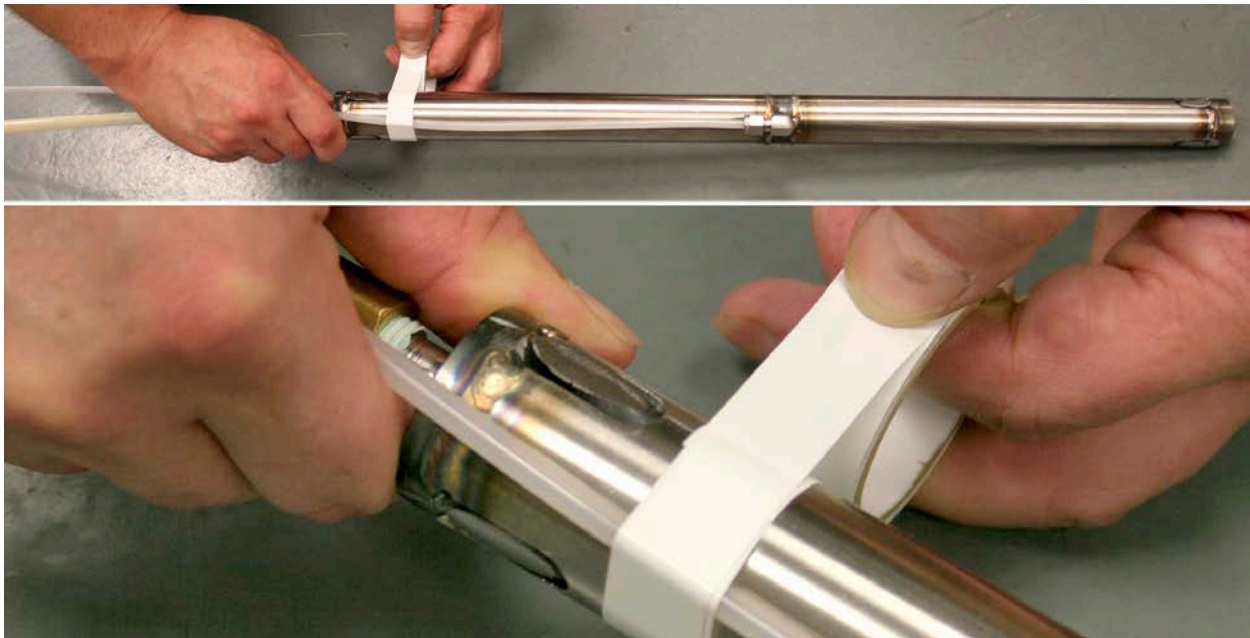


FIGURE 3-2 HYDRAULIC INFLATION LINE TAPED AWAY FROM THE PRONGS

- 6 Lower the entire extensometer assembly into the borehole until the borros anchors reach their elevation inside the borehole and the reference surface of the extensometer head is 45" below the borehole surface. Refer to Appendix C.
 - Optional: Use a cross bar (not provided) and attach to the temporary installation ready rod if necessary to ensure that the extensometer assembly can rest on top of the borehole prior deploying the double acting hydraulic borros anchors.
- 7 Connect a hydraulic pump to the high pressure hydraulic inflation line from the collar anchor.

- 8 Slowly cycle the pump until the hydraulic borros anchor hydraulic line fails (approx. 2500 PSI).



NOTE: THE HYDRAULIC PUMP IS CONNECTED TO A HIGH PRESSURE HYDRAULIC LINE, WITH A WORKING PRESSURE OF 2500PSI (17.24MPa), WHICH CONNECTS TO THE HYDRAULIC BORROS ANCHORS. THE PRESSURE WILL CONTINUE TO BUILD UNTIL THE BORROS HYDRAULIC LINE FAILS WHEN THE HYDRAULIC BORROS ANCHOR IS DEPLOYED. ADDITIONAL HYDRAULIC OIL WILL BE NEEDED FOR EACH ANCHOR.

- 9 Repeat steps 7 – 8 until all hydraulic borros anchors have been installed in descending order down the borehole.
- 10 Unscrew the two 10-32 pan head screws at the top of the extensometer head to unlock the anchor rods to ensure they are free to move as the ground settles.
- 11 Replace the two 10-32 pan head screws with the two provided ¼"-20 pan head sealing screw at the top of the extensometer head to prevent water from leaking into the sensors compartment.
- 12 Unscrew the temporary installation ready rod at the top of the extensometer assembly when the installation is complete. Refer to Figures 3-4 and 3-5.

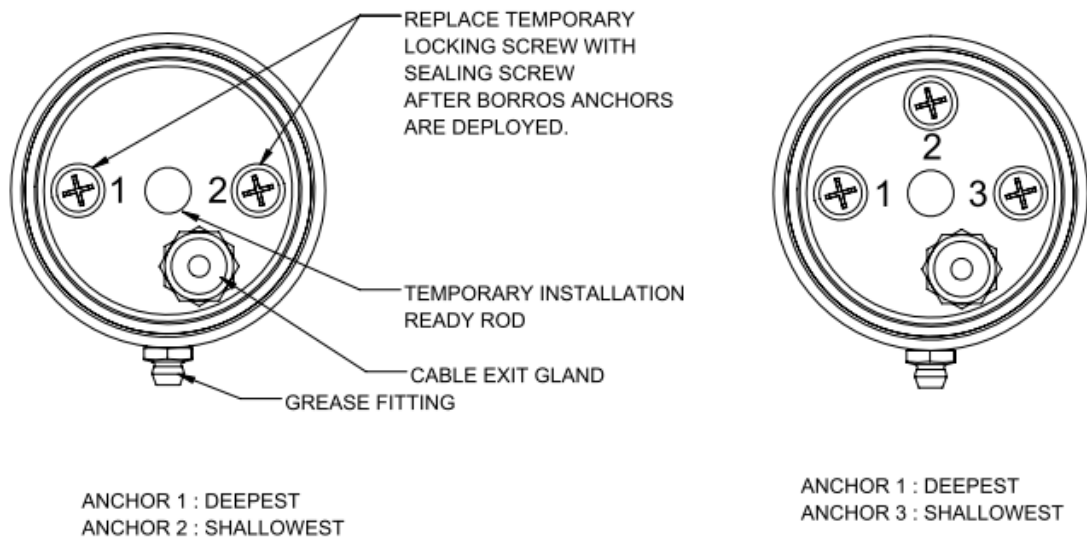


FIGURE 3-3 ANCHOR/SENSOR ORIENTATION - TOP VIEW



FIGURE 3-4 ANCHOR/SENSOR ORIENTATION

3.3 MULTI-POINT BOREHOLE EXTENSOMETER INSTALLATION (EXTENSION & COMPRESSION)

The extensometer with borros anchors are pre-assembled in the factory and only require minimum adjustment during installation. Remove any white tape to prepare the extensometer for installation. Do not remove any red tape. Should the red tape be removed, re-tape the tubes in between the anchor prongs. Refer to Figure 3-1 for placement on where to re-tape the tubes.



CAUTION: DO NOT REMOVE ANY RED TAPE ON THE EXTENSOMETER. THE RED TAPE HAS BEEN APPLIED DURING ASSEMBLY IN THE FACTORY AND IS USED TO ENSURE THAT THE TUBES WILL NOT BE IN A POSITION TO BE RUPTURED BY THE PRONGS DURING EXTRUSION.

The following list describes the procedure to install the Multi-Point Borehole Extensometer. Refer to Appendix B for a diagram of the overall view. Refer to Appendix C for an installation reference diagram.

- 13 Drill a borehole of 8" in diameter (minimum of 4") and at least 13" past the lowest anchor elevation. Refer to Appendix B.
- 14 Unroll the extensometer beside the borehole. Do not remove any red tape. Ensure that the anchor reference position is at a proper distance from the reference surface of the extensometer head.
- 15 Attach a safety line to the extensometer to prevent the extensometer assembly from accidentally dropping into the borehole while lowering into the borehole. Attach a safety line to the grout tube should backfill grout be desired.

- 16 Skip to step 19 for groutable anchors.
- 17 Attach a $\frac{3}{16}$ " high pressure hydraulic inflation line to the elbow fitting on each borros anchor if the inflation line is not already attached. Ensure the inflation line is long enough to reach the pump. Skip this step for groutable anchors installation.
- 18 Tape the hydraulic inflation line along the anchor body. Ensure the line does not rest over the extrusion opening of the prongs. Refer to Figure 3-2.
- 19 For groutable anchor are used, tape the grout tube to the lowest anchor and along the sheaths and anchors until reaching the top of borehole. Ensure the line does not rest over the extrusion opening of the prongs. Refer to Figure 3-2.



CAUTION: ENSURE THAT THE INFLATION LINE OR GROUT TUBE IS TAPED IN BETWEEN THE ANCHOR PRONGS. INFLATION LINES NOT SEPARATED FROM THE PRONGS RISK BEING RUPTURED WHEN THE PRONGS ARE EXTRUDED.

- 20 Lower the entire extensometer assembly into the borehole until the extensometer head is approximate 40" above the borehole surface.
 - Optional: Use a pickle fork to hold the extensometer temporary while setting the sensor stroke.
- 21 Unscrew the two 10-32 pan head screws at the top of the extensometer head to unlock the anchor rods.
- 22 Slide to open the PVC protective cover, unlock the setscrews temporary from the side of rectangular sensor block. Adjust the sensor stroke. For example, if the system is to allow for 25mm extension and 25mm compression, then set the sensor at mid-stroke. Lock the setscrew after the sensor stroke is set.
- 23 Repeat step 22 until all sensors are set.
- 24 If the system is to allow for compression, then trim off the fiberglass rod by the maximum compression movement from the top to allow room for the fiberglass rod to move upward. For example, if the system is to allow for 30mm extension and 20mm compression, then minimum 20mm of fiberglass rod will be trimmed from the top to allow for 20mm movement.
- 25 Replace the two 10-32 pan head screws with the two provided $\frac{1}{4}$ "-20 pan head sealing screw at the top of the extensometer head to prevent water from leaking into the sensors compartment.
- 26 Replace the PVC Protective Cover.
- 27 Lower the unit down into the borehole until the anchors reach their proper depths.
- 28 Skip to step 32 for groutable anchors.

- 29 Connect a hydraulic pump to the high pressure hydraulic inflation line from the collar anchor.
- 30 Slowly cycle the pump until the hydraulic borros anchor hydraulic line fails (approx. 2500 PSI).



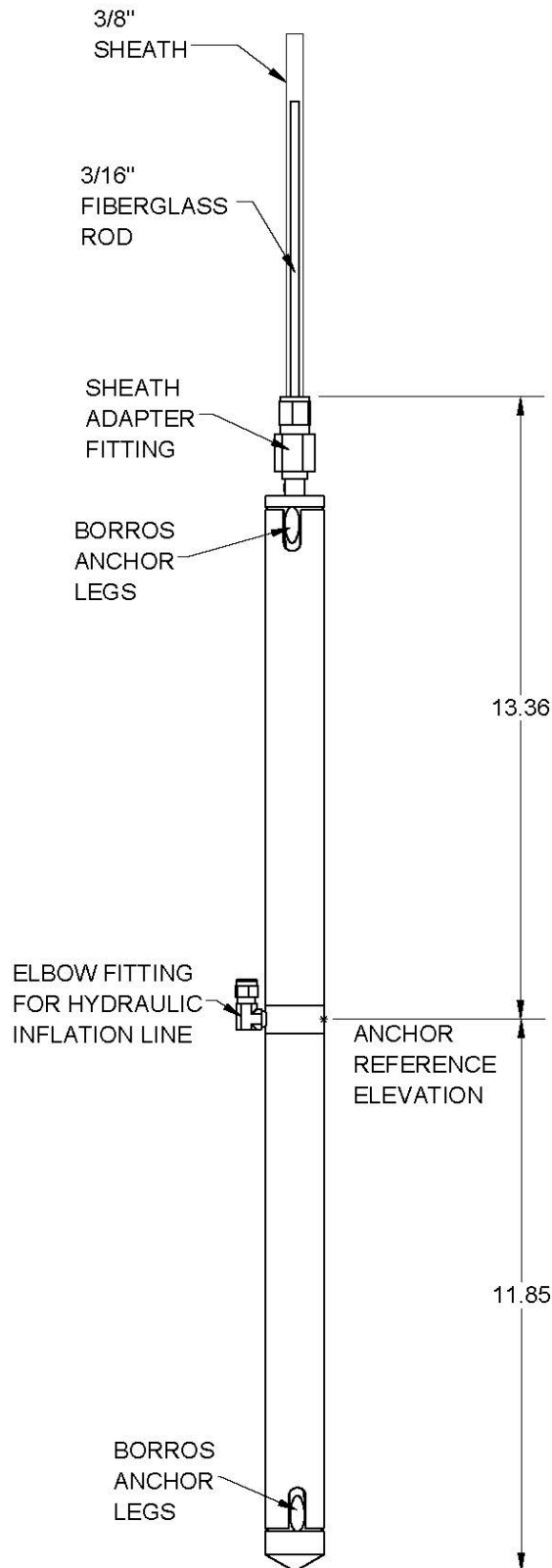
NOTE: THE HYDRAULIC PUMP IS CONNECTED TO A HIGH PRESSURE HYDRAULIC LINE, WITH A WORKING PRESSURE OF 2500PSI (17.24MPA), WHICH CONNECTS TO THE HYDRAULIC BORROS ANCHORS. THE PRESSURE WILL CONTINUE TO BUILD UNTIL THE BORROS HYDRAULIC LINE FAILS WHEN THE HYDRAULIC BORROS ANCHOR IS DEPLOYED. ADDITIONAL HYDRAULIC OIL WILL BE NEEDED FOR EACH ANCHOR.

- 31 Repeat steps 29 – 30 until all hydraulic borros anchors have been installed in descending order down the borehole.
- 32 Grout the borehole.
- 33 Unscrew the temporary installation ready rod at the top of the extensometer assembly when the installation is complete if necessary. Refer to Figures 3-4 and 3-5.

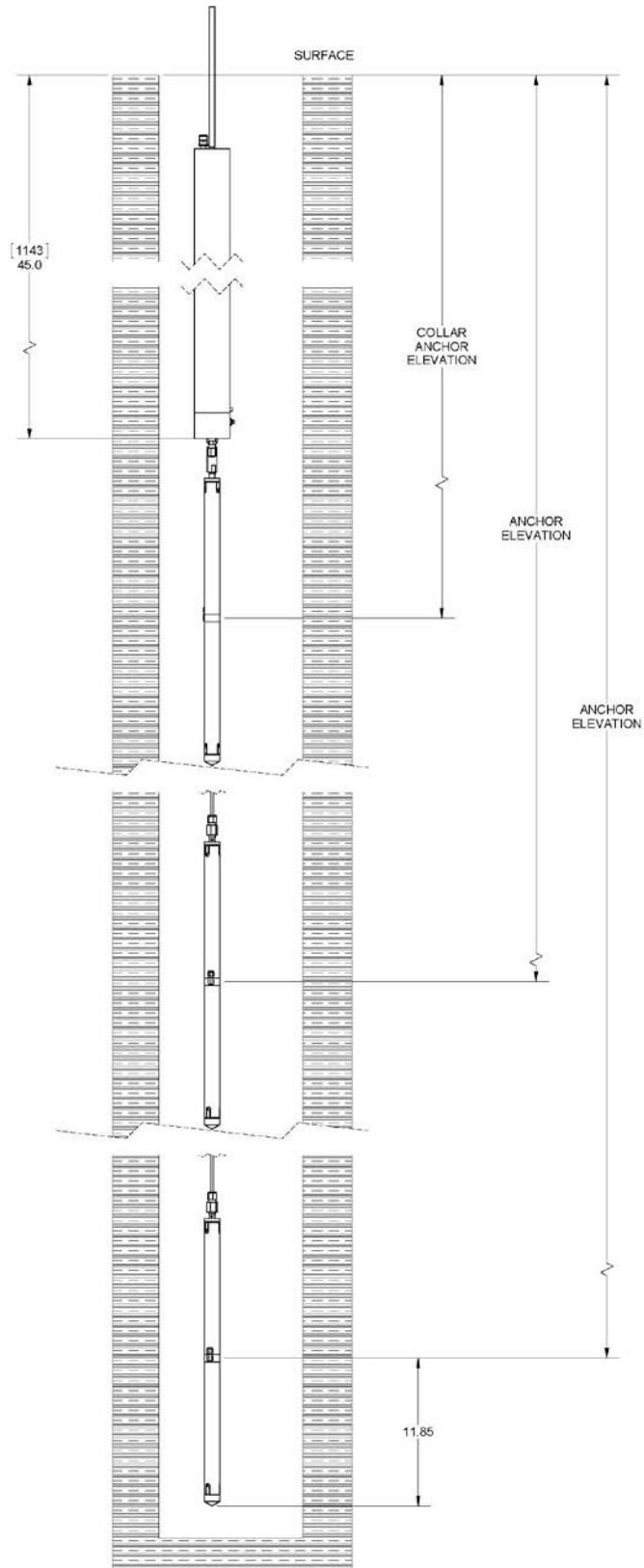
4 SERVICE AND REPAIR

The product contains no user-serviceable parts. Contact RST for product service or repair not covered in this manual.

Appendix A HYDRAULIC BORROS ANCHOR REFERENCE POINT



Appendix B OVERALL VIEW



Appendix C INSTALLATION REFERENCE DIAGRAM

