



Glue and Snap Inclinator Casing Installation Instructions

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REVISION HISTORY

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1 INTENDED AUDIENCE

This guide is for the personnel responsible for installing or using Glue and Snap Inclinator Casing. This manual provides steps for installing the Glue and Snap Inclinator Casing.

2 ICONS AND CONVENTIONS USED IN THIS GUIDE

This guide uses the following icons to call attention to important information.



WARNING: This icon appears when an operating procedure or practice, if not correctly followed, could result in personal injury or loss of life.



CAUTION: This icon appears when an operating procedure or practice, if not strictly observed, could result in damage to or destruction of equipment.



NOTE: This icon appears to highlight specific non-safety related information.

3 SAFETY



WARNING: Always follow safety precautions and use proper personal protective equipment (PPE) including safety glasses and high-visibility clothing when working in the field with this equipment.

4 ABBREVIATIONS AND ACRONYMS

This section lists abbreviations and acronyms used in the document.

Abbreviation or acronym	Definition
MEMS	Micro-Electro-Mechanical Systems
ABS	Acrylonitrile Butadiene Styrene
OD	Outer Diameter
ID	Inner Diameter
PSI	Pounds per Square Inch
AWJ	Aqua Water Jet

5 OVERVIEW

RST's Glue and Snap Inclinator Casing is engineered to be assembled quickly and accurately for long and short-term monitoring in the most challenging field conditions. It is suited to be installed in boreholes, embankments, piles, set into concrete or attached to structures.

The casing serves as an access tube to guide a MEMS-based inclinometer probe in the two orthogonal directions of measurement. Changes in the output of the probe caused by the deformation of the casing are proportional to the sine of the angle of inclination of the long sensor axis from vertical. These displacements are incrementally summed to provide profiles of total displacement versus depth.

The inclinometer probe uses grooves in the casing to control the azimuth of the inclinometer probe.

Glue & Snap provides the speed and convenience of a snap-together flush coupling combined with the low cost and high tensile/high torsional strength of a glue joint.

Installation is simply done by applying a thin layer of glue to the male end, snapping casings together, and inserting down hole.

RST casing is manufactured using non-recycled, virgin ABS resin, which imparts increased flexibility stability, and low temperature impact resistance.

5.1 APPLICATIONS

Most common applications for RST's Glue and Snap Inclinator Casing are:

- Pilings
- Subsidence control
- Embankment and dam stability
- Areas next to large excavations
- Landslides and slope stability
- Under large storage tanks
- Bridge pier, abutments deflection

5.2 FEATURES

- High precision, machined guide grooves
- Low spiral ≤ 0.005 Rad/3 m (≤ 0.3 deg./10 ft.)
- Easy assembly minimizes field installation time
- Compatible with all commercial probe types and in-place inclinometer sensors
- Integral coupling reduces assembly induced spiral by 50% over conventional separate coupling methods
- Compatible with inductance, reed switch, magnetic, or mechanical settlement monitoring devices
- Low temperature, impact, and corrosion resistant ABS plastic
- External key provides visual and tactile confirmation of proper installation



Figure 1: RST Glue and Snap Inclinometer Casing

6 INSTALLATION



NOTE: These instructions are for typical field settings and may require modification to meet site-specific applications.

Please consult the site engineer(s) or RST Instruments for further details.



NOTE: The inclinometer casing must be installed, maintained, and operated by technically qualified personnel.

Any errors or omissions in the installation, data, or data interpretation, are not the responsibility of RST Instruments.

6.1 INSTALLATION PRE-REQUISITES

- Inspect casing lengths to ensure that there was no damage in transit.
- Ensure that the inside of the casing is clean.
- To ensure the joint and casing interior remains clean, only remove the protective end caps before installing the casing.
- Store the casing horizontally, fully supported, and away from sunlight.
- Number each length, and assemble numerically to avoid errors, and confirm correct depth.
- Drill the borehole as vertically as possible, preferably within one degree.
- Flush the borehole clean and confirm that the borehole is fully open to the bottom.



CAUTION: Do not assemble the casing prior to insertion in the borehole.

6.2 REQUIRED TOOLS AND COMPONENTS

Before installing an inclinometer casing, ensure the following parts and tools are present:

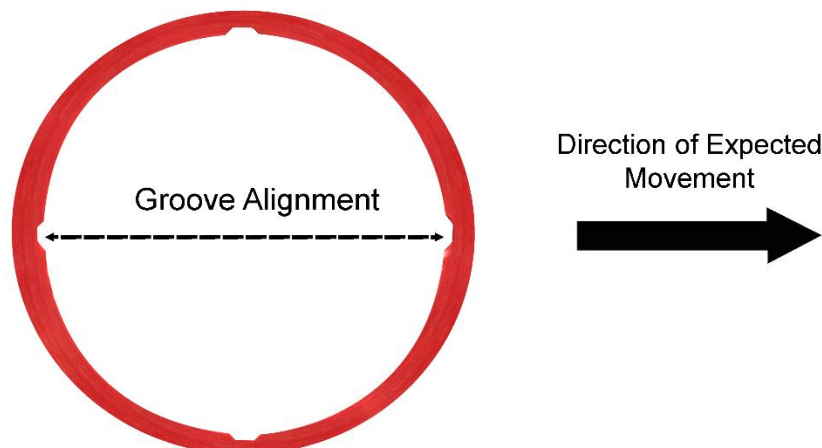
- Duct tape
- Bottom cap and top slip cap
- ABS 771 cement (or equivalent) and associated ABS/PVC cleaner – for use with repair couplings when required
- Pipe cutter/hand saw
- Grout tube (if required)
- Safety line (if required)
- Dummy probe (if required)
- Clean water (if required)

6.2.1 Accessories:

- Casing clamp
- Spare bottom and top caps
- Grout plug, quick-connector
- Female grout adapter
- Grout plug, gasket seal
- Well covers
- Reconnect alignment tool
- Reconnect adapter
- Spare casing lengths

6.3 INSTALLATION NOTES

1. Casing should be stored horizontally and supported evenly so that it does not warp or bend. Whenever possible, casing should be stored in the shade since prolonged exposure to the heat of direct sunlight can cause deformation.
2. Ensure one set of grooves oriented down slope, in the direction of expected movement. If the direction cannot be determined, orient North/South. Alignment must be maintained throughout the installation, to avoid introducing torsion to the casing, thereby causing spiraling of the grooves. Never push the casing from the top or twist the casing during installation.



6.4 GLUE AND SNAP CASING SECTIONS

Each section of casing has a male end with an alignment key, and a lock ring and a female end with a keyway and corresponding lock ring. The casing is installed with the female end facing up.

Please note that the female ends of the casing have three slots in them. These are stress relief cuts which facilitate the insertion of the male end of the subsequent casing section.

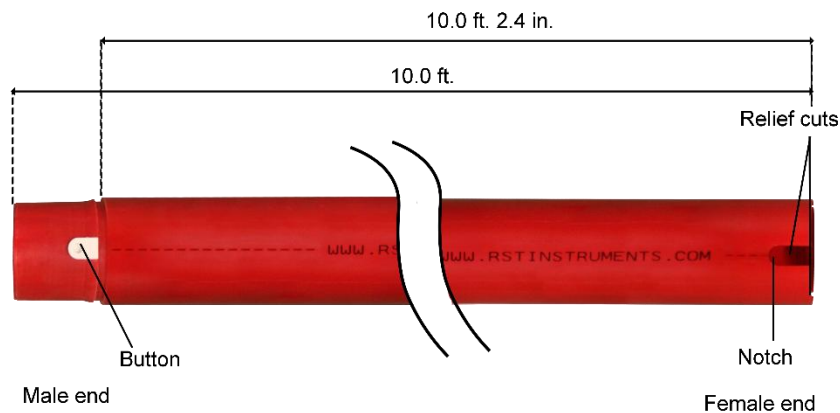


Figure 2: Glue and Snap Inclinometer Casing Overview

6.5 INSTALLATION PROCEDURE

6.5.1 Preparing the Borehole

Drill the borehole as vertical as possible, preferably within 1 degree. Flush the borehole clean and verify that the borehole is fully open to the bottom.

Check the depth of the borehole before the casing is assembled and installed. Also consider that grout valves or external weights may require a deeper borehole.

6.5.2 Pre-Installation Checks

Visually ensure there was no damage to the casings. Number the casings properly to ensure organized and sequential installation, as shown in the figure below.



Figure 3: Visual Inspection and Marking of Casings

6.5.3 Casing Installation

Install an End Cap

Before installing the first section of casing in the borehole, an end cap must be installed as indicated in the figure below:

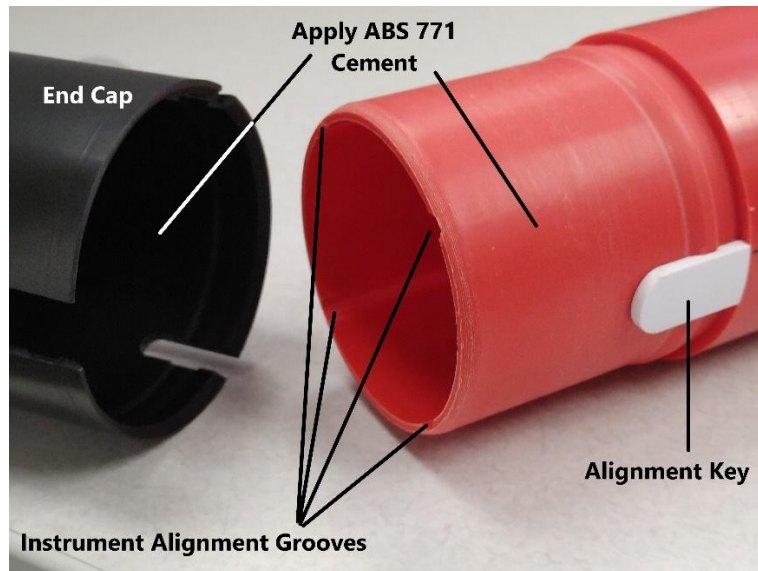


Figure 4: ABS 771 Cement application areas and notch-cap alignment

1. Apply ABS premium cement, in a thin uniform band around the male end of the casing and the inside of the cap. The cement band should cover most of the mating surface.



Figure 5: ABS 771 Cement Application Around the Male End of the Casing



NOTE: The cement will set within a few seconds, so ensure that this step is done quickly.



Figure 6: Attaching and Securing the Bottom Cap to the Casing

2. Align the notch on the cap with the keyway on the casing. Slide the cap on without engaging the notch and then rotate it back and forth 90 degrees to spread the cement. Fully engage the notch and key. The installer will hear a “snap” as the lock ring is seated.
3. Visually ensure proper assembly. If assembly of the joint is difficult, an ABS/PVC cleaner can be used prior to the application of the ABS cement. The cleaner not only cleans the pipe, but also helps to soften the ABS, lessening the force required to complete the joint.
4. Typically, a grout tube can be attached to the bottom casing. More than one grout tube can be added to the casings during installation for multistage grouting. Attach a grout tube with multiple notches cut in the grout line to ensure if one notch is blocked, the grout can flow through other notches.



Figure 7: Attaching a Grout Tube to the Casing

5. The casing, with the attached cap, can then be lowered into the hole. If applicable, attach a safety line (if borehole is dry), otherwise, use the drill rig clamp to hold the casings up until water is reached, but make sure it is set to the correct size so that it does not pinch or crush the casings.
6. Assemble the next casing length using cement.

In each case, ensure the alignment button on the casing is aligned with the notch in the female end. Use duct tape on each joint to ensure the joint is stronger and the joint is sealed.

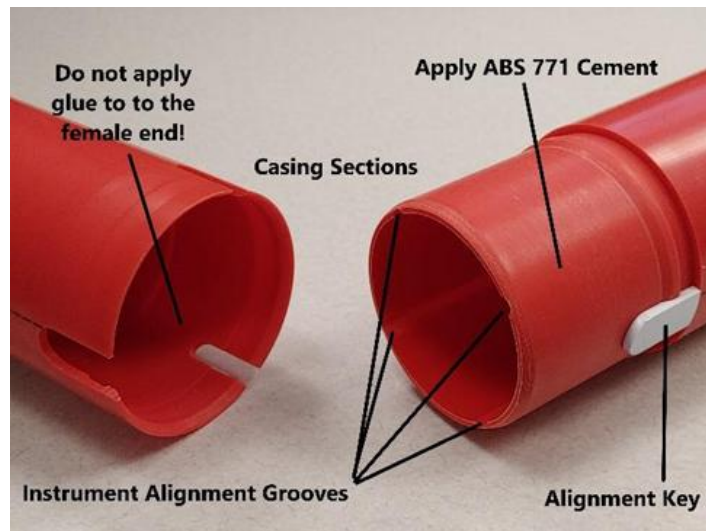


Figure 8: Glue and ABS 771 Cement Application Areas and Casing Section Alignment

Assembling Casing Sections

Subsequent casing sections in a borehole should be assembled using ABS cement on the male end only. DO NOT apply cement to the female end. Applying cement to the female end causes the glue to extrude into the inside of the casing, which can potentially block the grooves. Be sure to apply the glue liberally, ensuring complete coverage of the male end, using ABS cement on the male end only. Do not apply any cement to the lip of the male end and do not apply cement to the female end.



CAUTION: Ensure that the cement is applied to the male end only, being careful of not applying any cement to the lip of the male end or any area of the female end.

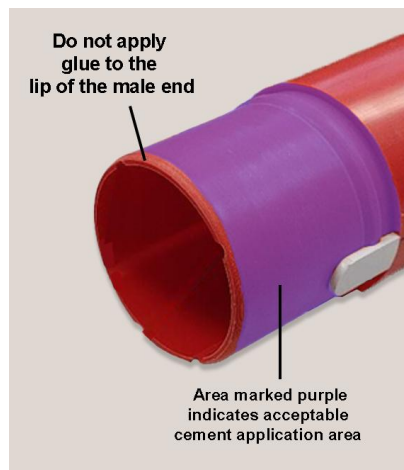


Figure 9: Proper Cement Application to the Male End of the Casing

In each case, the alignment button on the casing should be aligned with the notch in the female end (Figure 1). The installer will hear a “snap” as the lock ring is seated. Wipe off any excess cement that is pushed out of the joint onto the outside of the casing.

Keep in mind that the next piece must be attached within seconds after applying cement due to its fast-drying nature.

If required, the joint can be further sealed by 2” duct tape. If assembly of the joint is difficult, an ABS/PVC cleaner can be used prior to the application of the ABS cement. The cleaner not only cleans the pipe but also helps to soften the ABS lessening the force required to complete the joint.

Assembling Telescopic Sections

Each telescoping section is 2ft. (24”) in length and allows for six inches of compression or extension. Settlement sections may be inserted extended or collapsed, to accommodate the expected settlement/rebound. Typically, sections are shipped in the fully extended condition to accommodate settlement in the borehole. However, sections can be ordered in any configuration, depending on the site-specific requirements. The telescopic section is equipped with Snap Seal ends, thus allowing it to be installed similar to a standard piece of casing.

If the telescoping sections are equipped with settlement rings, then lower the sensor into the casing and record the initial readings for each settlement ring.

Contact RST Instruments Ltd for more information on Settlement Monitoring Systems.

The moving joint of the section is sealed by two O-rings (one at either end). Each telescoping section contains four set screws (two on each side), which are individually sealed with O-rings. These screws are set in tracks which are blocked by a small web of ABS material. When sufficient force, >200lbs, is exerted on the casing (very small in a geotechnical setting), the material will break allowing the casing to compress (or extend). This design allows the telescopic section to bear the weight of the casing above it, and collapse under the force of ground settlement and/or rebound.

To prevent mis-tracking of the inclinometer probe as it passes through the telescoping section, the end of the grooves have a tapered “V-notch”. This notch ensures that the wheels of the probe re-establish themselves in the correct track.

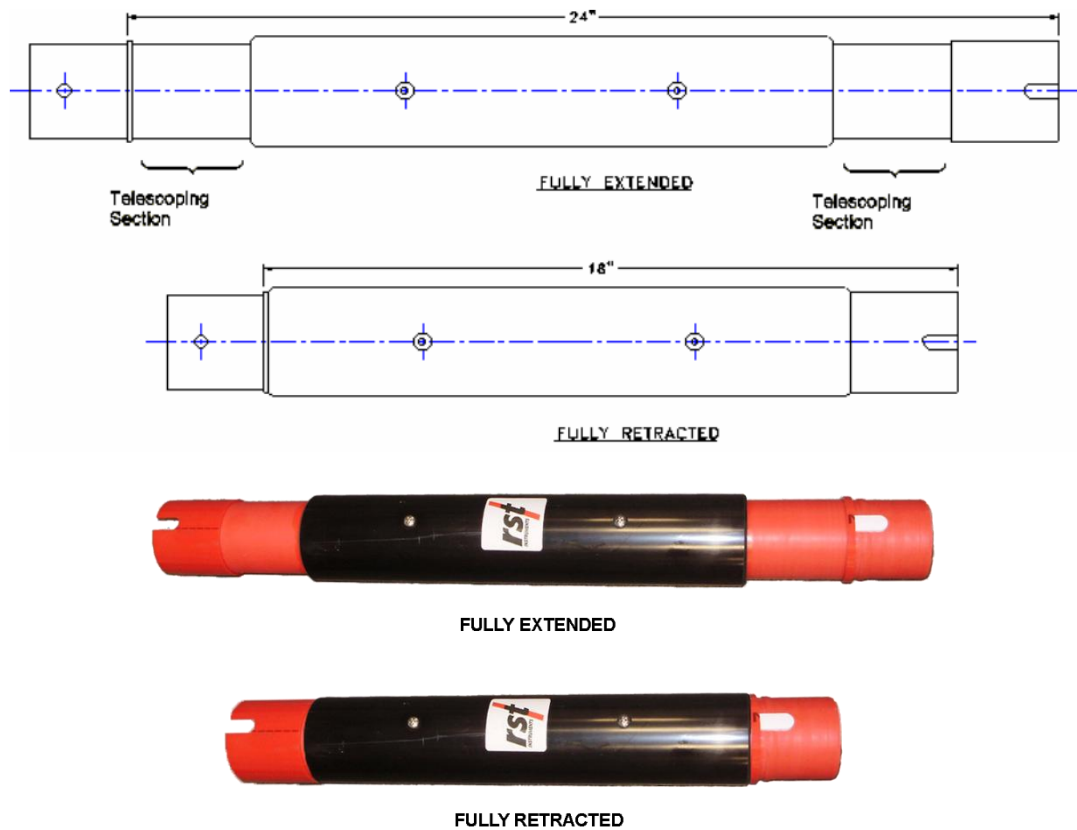


Figure 10: RST Glue and Snap Telescoping Section Overview

7. Install and ballast subsequent lengths of casing or settlement sections as required. Ensure that the alignment key is quickly and properly located before the cement sets up.
8. Insert settlement sections appropriately extended or collapsed to accommodate the expected settlement or rebound.



NOTE: If the borehole is filled with water or mud, neutralize the casing's buoyancy by ballasting the casing with clean water. If the borehole is dry, use a combination of casing clamps and a safety line to restrain the casing during installation. Using the safety line by itself may cause spiralling due to the spiral lay of the rope.

9. Maintain one groove's orientation down slope in the direction of the slide, or parallel to the dam axis. If the direction cannot be determined, orient North/South.



NOTE: Ensure that alignment is maintained throughout the installation to avoid introducing torsion to the casing, which can cause grooves to spiral.

10. When at depth, confirm proper probe tracking with a dummy probe.

- If the probe does not pass, jumps track, or returns in another set of grooves, remove the casing, and troubleshoot.

One of the following common methods can be used to prevent the casing from floating out of the borehole during grouting:

- Insert AWJ drill rods inside the casing to weigh the casings down from the bottom.
- Use a bottom anchor to hold the casings in place.



CAUTION: Do not use the drill rig as a reaction force or wedge the collar, as this will cause the casing to assume a large radius bend. RST does not recommend hanging a weight off the bottom cap during installation as ballast.

11. If the borehole is full of water, fill the casing with enough clean water to neutralize the buoyancy. Be careful with this technique, as in dry boreholes, the differential pressure caused by the head of water may cause casing failure. Grouting using a high shear filtered grouting machine is recommended to avoid problems with lumps obstructing the tube.



Figure 11: Filling the Casing with Clean Water to Neutralize Buoyancy

12. Begin to pump grout as directed by the engineer, usually at a rate of 10–15 liters per minute to avoid over-pressuring the casing or causing bridging and cavities.

Properly mixed grout must be thin enough to pump, but thick enough to set in a reasonable amount of time. Ensure that the grout is free of lumps. If the mixture is too watery, it will shrink excessively, leaving the upper portion of the borehole un-grouted. Also, avoid the use of grouts that cure at high temperature since these may damage the casing.



Figure 12: Pumping Grout through the Grout Pipe to Set the Casing Assembly in Place

13. Observe the water meniscus in the casing as an indication of casing collapse, or grout ingress.

Ensure that differential pressures are kept to a minimum, as the casing will collapse at 220 PSI differential.

→ **NOTE:** Deeper boreholes require a multistage grouting procedure with appropriate stages that depend on the borehole's water level, grout density, grout pump type, etc.

→ **NOTE:** Proper grouting of inclinometer casing is crucial to a successful inclinometer installation. The onsite engineer is required to have experience and can work with the drill crew on the proper mixture for the grout. Grout consistency is very important to ensure proper curing and to avoid separation of the solids and water. Grout must also have the proper viscosity which will enable it to be pumped easily.

14. Place a top slip cap over the last piece of casing when finished and/or not in use. **Do not cement into place.** The cap is provided as a removable protective cover.

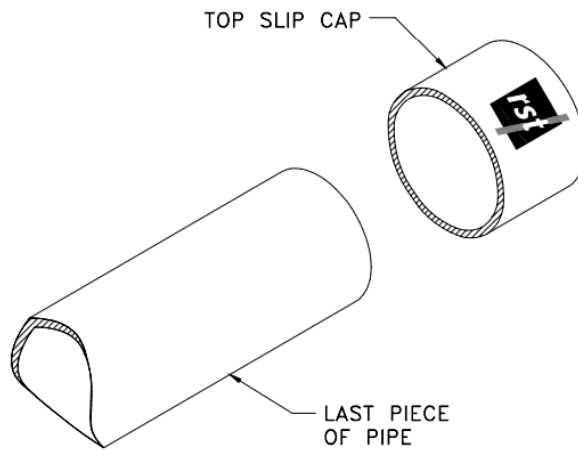


Figure 13: Top Cap Assembly



Figure 14: RST Top Caps

7 REPAIRING DAMAGED CASING

Damaged Glue & Snap Casing can be repaired using RST repair couplings. Most of the time, casing becomes damaged near the top of the borehole due to movement of heavy equipment etc. In any case, the damaged portion of the casing needs to be removed.

1. Cut off the damaged portion of the casing using a hacksaw. Be sure to make this cut as square as possible. Remove all burrs.
2. Apply ABS 771 Cement to the inclinometer casing. The repair coupler will slide over top, and the alignment tool will be used.

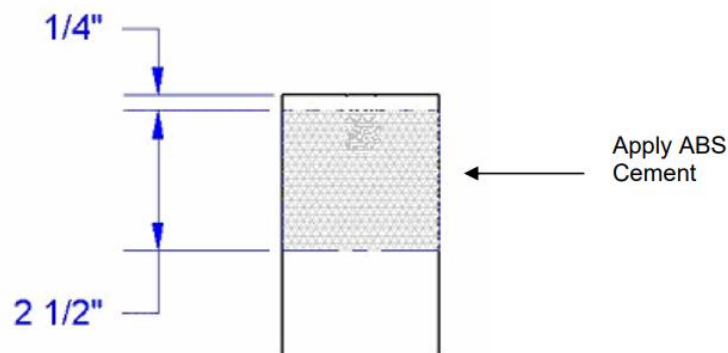


Figure 15: Casing Preparation for Repair



Figure 16: Repaired Casing Example

3. Slide the RST repair coupling onto the casing and align the grooves using the Casing Alignment Tool. Allow the cement to cure, according to the directions on the label of the selected ABS cement.



NOTE: The RST Casing Alignment Tool is available in two different options for the two casing sizes:

- Part number "IC1002" for the 2.75" (70 mm) casing size
 - Part number "IC1003" for the 3.34" (85 mm) casing size
-



Figure 17: Casing Alignment Tool

4. Attach subsequent casing sections as described in Section 6.5.3.

8 INSTALLING CORRUGATED SETTLEMENT SHEATH PIPE

Another alternative is the use of Corrugated Settlement Sheath Pipe. This allows the inclinometer casing to remain in a static position while the ground moves around it. Settlement can thus be observed at the collar of the borehole. For example, if the ground settles, the casing will be observed to extend farther out of the ground than previously.

1. Insert a weight into the bottom of the sheath with the groove side down, leaving room for the installation of the end cap.
2. Slide 2 band clamps over the sheath and tighten so that the clamps squeeze the sheath into the grooves locking the weight into place.
3. Install the End Cap onto bottom of the sheath.
4. Seal with Denso tape and Duct tape.
5. Lower Corrugated Settlement Sheath Pipe into the borehole.



NOTE: Ballasting the pipe with clean water may be necessary to counter the buoyancy encountered with wet bore holes.

6. Install Inclinometer casing inside the Corrugated Settlement Sheath Pipe.
7. Eliminate any slack by pulling on it by hand (hold it in place while performing step 8).
8. Fill the void between the sheath and borehole with grout, ensuring that no grout gets into the sheath or casing.
9. If Corrugated Settlement Sheath is equipped with settlement rings, then lower the sensor into the casing and record the initial readings of each Settlement Ring. Refer to the RST Instruments manual for "Settlement Monitoring System".

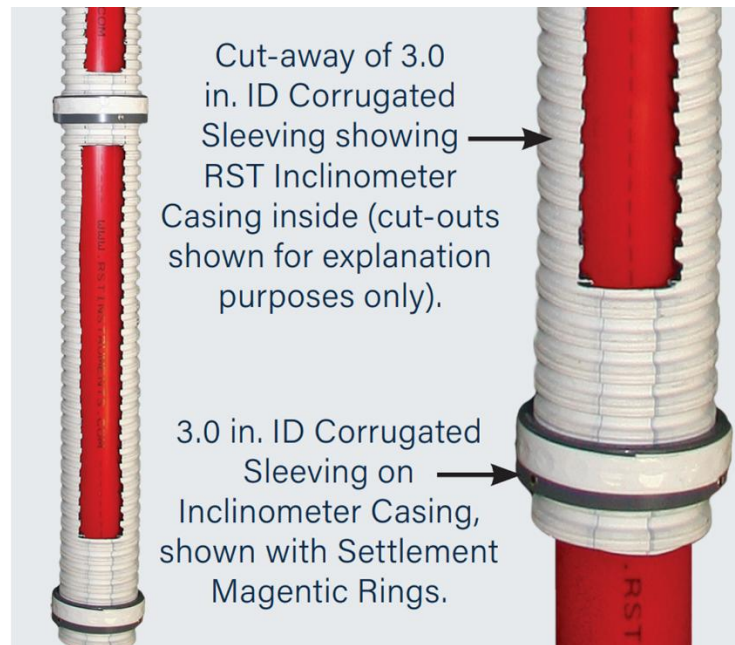


Figure 18: Inclinometer Casing Installed Inside Corrugated Sleeving with Settlement Magnetic Rings

9 PRODUCT AND TECHNICAL SPECIFICATIONS

Item	Specification	
Casing Specifications		
Description	70 mm (2.75 in.) OD	85 mm (3.34 in.) OD
Casing OD (including coupling)	70 mm (2.75 in.)	85 mm (3.34 in.)
Casing ID	59 mm (2.32 in.)	73 mm (2.87 in.)
Casing Length	1.5 or 3 m (5 or 10 ft.)	1.5 or 3 m (5 or 10 ft.)
Casing Weight	1.27 kg/m (0.85 lbs/ft.)	1.49 kg/m (1.0 lbs/ft.)
Material	ABS Plastic	
Groove Spiral	≤ 0.3 deg./10 ft.	
Glue and Snap Specifications – 70 mm		
Load Test	738 kg (1630 lbs.)	
Collapse Test	17.2 bar (250 psi)	



NOTE: For a complete list of specifications and ordering information:

- Navigate to [RST's Inclinometer Casing product page](#)
- Scroll down and click on the Specifications and Ordering Info tabs for more information

10 SERVICE, REPAIR, AND CONTACT INFORMATION

This product does not contain any user-serviceable parts. Contact RST for product services or repairs.

- For sales information: sales@rstinstruments.com
- For technical support: support@rstinstruments.com
- Support portal: <https://support.rstinstruments.com/support/tickets/new>
- Website: www.rstinstruments.com
- Toll-free: 1-800-665-5599

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