Glue and Snap Inclinometer Casing Installation Instructions

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TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

REVISION HISTORY

Rev.	Revision History	Date	Prepared By	Approved By
A				
B	Updates	June 27, 2023	CA	
C	Edits to Section 2.3 Assembling the Casing – Step 4: replaced twisting step with forceful engagement. Step 5: added “Attach a grout tube with multiple notches cut in the grout line to ensure if one is blocked, the grout can flow through other holes.” Step 6: added “(if borehole is dry), otherwise, use the drill rig clamp to hold the casings up till you reach water but make sure it is set to the correct size so that it doesn’t pinch or crush the casings.” Removed “and a grout tremie line with multiple notches cut in the grout line to ensure if one is blocked, the grout can flow through other holes”. Added note: “remember you have seconds after applying the cement to attach the next piece.” Step 11: inserted drill rod type. Removed “anchor the bottom of the casing in grout, then grout the balance of the borehole”.	Sep 15, 2023	S. Malik	A. Ahrabi

	Added “Use a bottom anchor to hold the casings in place”. Step 12: added filling the casing “with enough clean water to neutralize the buoyancy”. Step 13: added “to avoid over pressuring the casing or causing bridging and cavities”. Added Section 4: Product and Technical Specifications Added figure captions			

1 OVERVIEW

RST's Inclinometer Casing is engineered to be assembled quickly and accurately for long- and short-term monitoring in the most adverse 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, is 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.

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

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.

1.1 INTENDED AUDIENCE

This guide is for the personnel responsible for installing or using an RST Inclinometer Casing.

1.2 ICONS AND CONVENTIONS USED IN THIS GUIDE

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

⚠	**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.

2 INSTALLATION

2.1 REQUIRED TOOLS AND COMPONENTS

Before installing an inclinometer casing, make sure to have the following components and tools:

- ABS 771 cement (or equivalent)
- Duct tape
- Grout tube (if required)
- Safety line (if required)
- Dummy probe (if required)
- Clean water (if required)

2.2 BEFORE ASSEMBLING THE CASING

- Inspect casing lengths to ensure that it wasn't damaged 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 vertical as possible, preferably within 1 degree.
- Flush the borehole clean and verify that the borehole is fully open to the bottom.

2.3 ASSEMBLE THE CASING

To assemble the casing, complete the following steps:

1. Install the casing with the female end facing up.

2. Apply ABS 771 cement (**not PVC cement**) in a thin uniform band, around the whole male end of the casing and the inside of the cap. Make sure the cement band covers most of the mating surface.

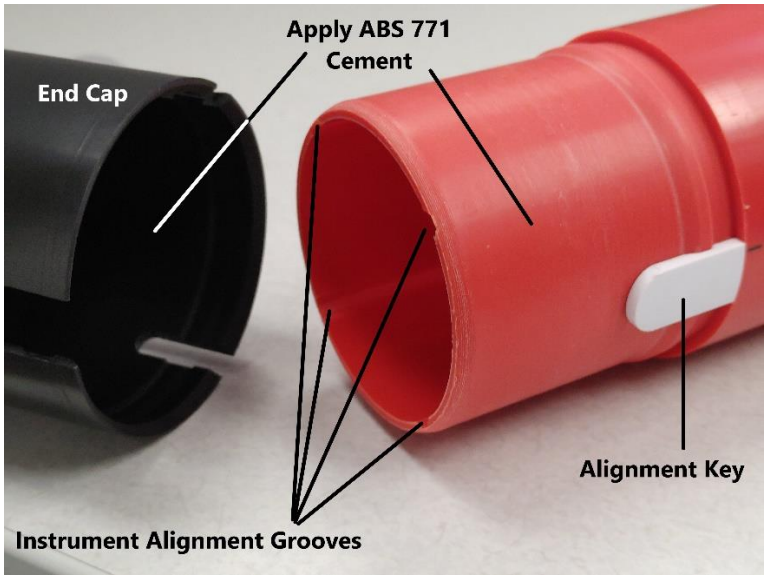

Figure 1: ABS 771 Cement application areas and notch-cap alignment

3. Align the notch on the cap with the key on the casing.

4. Align the end cap with the key and slide it on forcefully to engage the notch, being mindful of the fact that the cement hardens very quickly

→ **NOTE**: The cement will set within a few seconds, so you must do this quickly.

5. Visually ensure proper assembly.

Typically, you can attach a grout tube to the bottom casing. You may add more than one grout tube to the casings during installation for multistage grouting. Attach a grout tube with multiple notches cut in the grout line to ensure if one is blocked, the grout can flow through other holes.

6. Lower the casing with the attached cap into the hole.

If applicable, attach a safety line (if borehole is dry), otherwise, use the drill rig clamp to hold the casings up till you reach water but make sure it is set to the correct size so that it doesn't pinch or crush the casings.

Figure 2: Joint securement using duct tape

7. Assemble the next casing length using cement.

In each case, make sure 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.

NOTE: Do not apply glue on the inside of the female end as the excess glue could be pushed into the grooves and prevent proper inclinometer probe movement in the inclinometer casing. Again, remember you have seconds after applying the cement to attach the next piece.

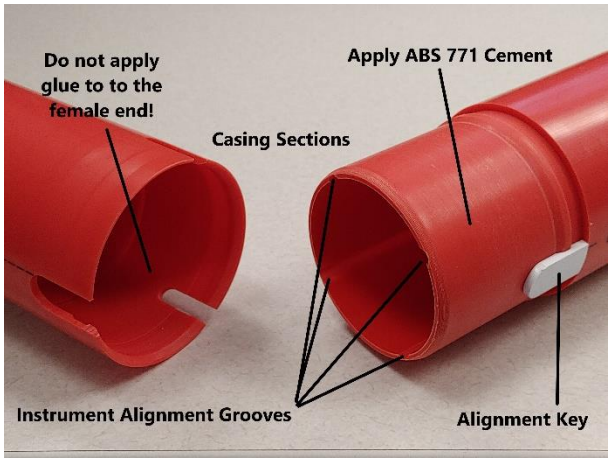

Figure 3: Glue and ABS 771 Cement application areas and casing section alignment

8. 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.

9. 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 spiraling due to the spiral lay of the rope.

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

NOTE: You must maintain alignment throughout the installation to avoid introducing torsion to the casing which can cause to grooves to spiral.

11. When at depth, verify 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 rectify the problem.

You can use one of the following common methods 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.

12. If the borehole is full of water, fill the casing with enough clean water to neutralize the buoyancy. Exercise caution 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.

13. 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.

14. 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: In deeper boreholes, this will require a multistage grouting procedure with appropriate stages dependent on borehole water level, grout density, grout pump type, etc.

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15. 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.

3 PRODUCT AND TECHNICAL SPECIFICATIONS

Table 1: 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	5 or 10 ft. (1.5 or 3 m)	5 or 10 ft. (1.5 or 3 m)
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)	

4 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
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