V1.1 May 2017

# INCLINOMETER CASING EXTERNAL COUPLER (XC)

INSTRUCTION MANUAL


GEOSENSE

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## 1.0 INTRODUCTION

This manual is intended for all users of **XC (External Coupler) Inclinometer casing** manufactured by **Geosense®** and provides information on installation, operation and maintenance**.**

**It is VITAL that personnel responsible for the installation and use of XC Casing READ and UNDERSTAND the manual, prior to working with the equipment.**

### 1.1 Applications

**Geosense® XC (External Coupler) Inclinometer Casing** is for use with inclinometer systems for monitoring stability & movement of:-

- Slopes
- Embankments
- Diaphragm & sheet piled walls
- Deep foundations
- Tunnelling operations
- Piles
- Pre-loads
- Deep excavations

Manufactured from high impact virgin ABS material, it has four internal grooves formed at 90 degrees into the internal surface into which inclinometer probes (Portable or In-Place) can be inserted to carry out profile monitoring of the casing which will deform with any ground movement.

It is available in standard 3 & 1.5 metre lengths, each length is connected to the next with an ABS external coupler (XC). The couplers are glued and riveted to the casing to provide a strong and watertight joint. **XC Inclinometer Casing** can be cut to different lengths prior to shipping or on site for added flexibility.

**Geosense® XC (External Coupler) Inclinometer Casing** can be installed vertically, inclined or horizontally in boreholes, embedded in fill material, cast into concrete or attached to structures.

### 1.2 Advantages

**XC Inclinometer Casing** can be cut to any length on site and joined using standard procedure. This eliminates the need for special repair couplings.

**XC Inclinometer Casing** can also be a more cost effective solution if installations are not time critical.

## 2.0 CONFORMITY

This product is NOT covered by any CE directives and therefore CANNOT be CE marked.

## 3.0 MARKINGS

**XC Inclinometer Casing** is labelled with the following information:-

- Manufacturers website address
- Manufacturers telephone number
- Direction of installation arrows
- Batch number

## 4.0 DELIVERY

This section should be carefully read by all users of **Geosense® XC Inclinometer Casing**

### 4.1 Packaging

**XC Inclinometer Casing** is packed in protective cardboard boxes for transportation to site. Packaging is suitably robust to allow normal handling by transportation companies. Inappropriate handling techniques may cause damage to the packaging and the enclosed equipment. The packaging should be carefully inspected upon delivery and any damage MUST be reported to both the transportation company and Geosense.

### 4.2 Handling

Whilst **XC Inclinometer Casing** is tough and durable, care should be taken when handling so as not to damage it by dropping it or dragging the ends on hard surfaces.

### 4.3 Inspection

It is important to check all the equipment in the shipment as soon as possible after taking delivery and well before installation is to be carried out. Check that all the components detailed on the documents are included in the shipment. Check that the equipment has not been physically damaged.

**IF COMPONENTS ARE MISSING OR DAMAGED, CONTACT THE DELIVERY COMPANY, THE SUPPLIER AND GEOSENSE®**

### 4.4 Storage

**XC Inclinometer Casing** should be stored in the protective cardboard boxes in an environment that is protected from weather and direct sunlight.

Boxes may be stacked up to a maximum of six high.

## 5.0 COMPONENTS & ASSEMBLY

This section of the manual is intended for all users **Geosense® XC Inclinometer Casing** and is intended to provide guidance with respect to its installation.

It must be remembered that no two installations will be the same and it is inevitable that some 'fine tuning' of the following procedures will be required to suit specific site conditions.

**It is VITAL that personnel responsible for the installation and use of the XC Casing READ and UNDERSTAND the manual, prior to working with the equipment.**

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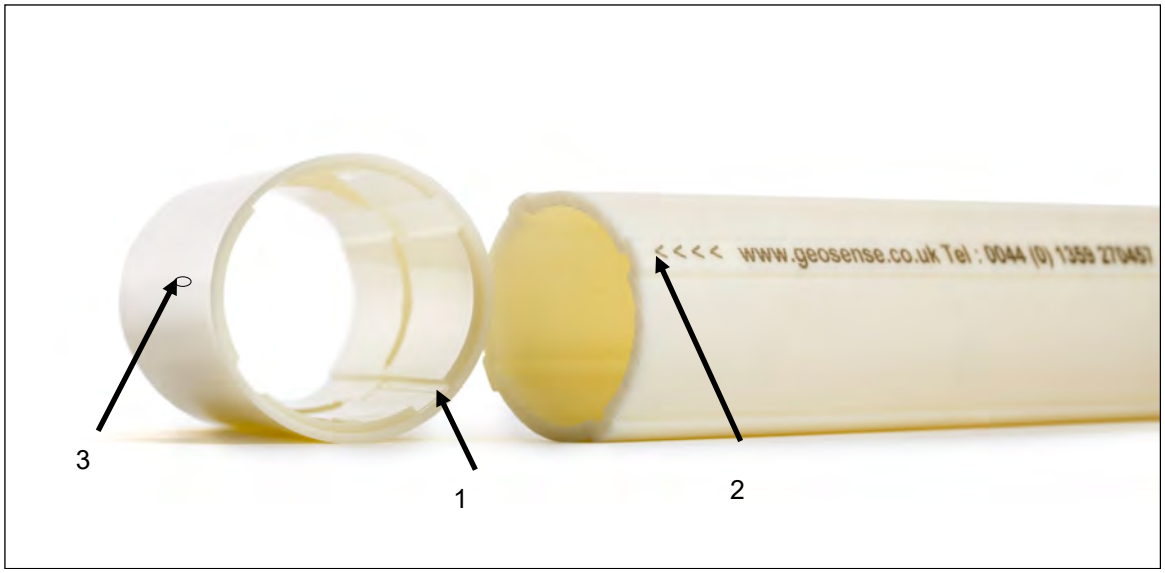
**As stated before, it is vital to check all the equipment in the shipment soon after taking delivery and well before installation is to be carried out. Check that all components that are detailed on the shipping documents are included.**

### 5.1 XC casing sections

Each section of the **XC Inclinometer Casing** has a male end with a locating peg and a locking ring and a female end with a keyway, O-ring and locking groove.




1. Internal locating groove (coupler)
2. External locating groove (casing)
3. Rivet guide hole

## 5.2 End caps

Before installing the **XC Inclinometer Casing** a bottom cap should be fitted. Various options are available as follows:-

### 5.2.1 Standard end cap (A)

To be used where no problems with uplift are expected and a separate external Tremie tube is to be used.

### 5.2.2 Grout valve cap (B)

Used in small boreholes where there is no room for external Tremie pipes.

The cap has a non-return valve and perforated pipe fitted to the end cap (1).

The grout pipe fitted on the bottom with a female Quick-Connect coupling (2) is lowered through the inclinometer casing and couples to a male Quick-Connect coupling (3) in the cap.

Grout is pumped through the pipe into the base of the borehole filling it from the base.

The grout pipe is removed after grouting completed.

## 5.2 End caps contd..

As an option to steel rods or drill casing being installed to the base of the casing to counteract buoyancy anchors can be used.

They can be either a standard anchor which can be used with external grout pipes or a combination anchor/grout valve.

Installation of the casing procedures are the same as previously described.

### 5.2.3 Grout anchor cap (C)

Used to control uplift due to buoyancy of water and grout. The anchor is fitted with sprung loaded arms which grip to the side of the borehole and prevent uplift

### 5.2.4 Anchor cap with grout valve (D)

As 5.2.3 above but fitted with an integral grout valve as in 5.2.2

**THE APPROPRIATE END CAP TYPE SHOULD BE CHOSEN ACCORDING TO THE APPLICATION**

**IF IN DOUBT PLEASE CONTACT GEOSENSE® FOR ADVICE**

### 5.2.5 Top cap

Once all the inclinometer casing sections have been installed it is recommended that a removable push fit top cap be fitted to protect the installation from the ingress of debris.

### 5.2.6 Protection

In order to protect the complete installation from damage it is recommended that a steel protective steel cover be placed over the top and concreted in.

### 5.3 Telescopic joint

Telescopic joints are generally used in situations where man made fills are constructed such as embankments and dams and should be used where settlements of over 2% are expected. Total settlement up to 30% can be accommodated.

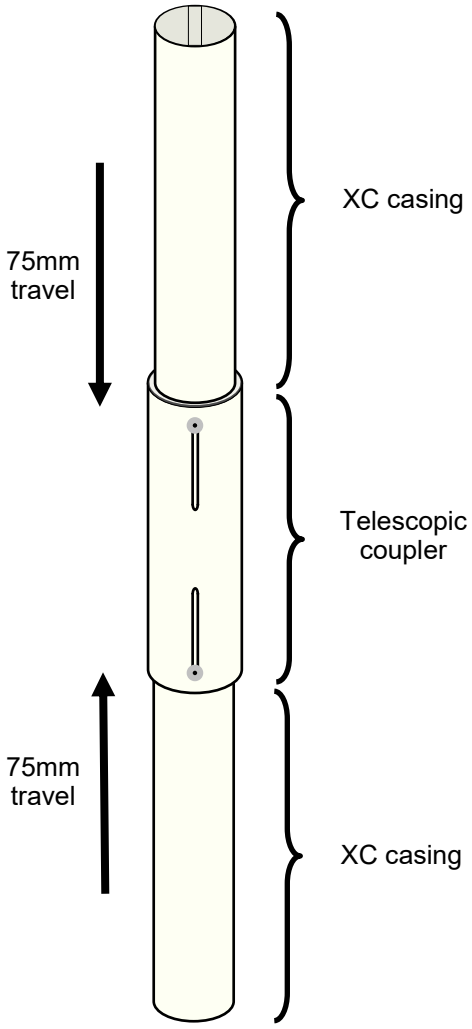
Each telescopic joint allows for 150mm vertical movement thus avoiding any buckling of the casing due to excessive axial loading.

Positions and quantities of telescopic couplers should be calculated in accordance with the ground conditions of each installation.

Telescopic couplers are 700mm long and can accommodate 150mm of compression (settlement) or extension (heave).

The joints are supplied with pre machined grooves to allow for the level of movement in the joint to be altered on site.

See page 24 for installation instructions.



## 5.4 GEO-XM 300l settlement

**Geosense® XC Inclinometer Casing** can also be used as part of the **GEO-XM 300l magnetic settlement system**.

An outer corrugated sleeve is used to isolate the inclinometer casing from any settlement in the surrounding ground so eliminating ay axial loading onto the inclinometer casing (see **GEO-XM 300l** manual for installation details).

## 6.0 INSTALLATION - PLANNING

### 6.1 Installation considerations - all types

Prior to installation of **Geosense® XC Inclinometer Casing** it is essential to establish and confirm details of the installation to be carried out. Some of the main considerations are listed below :-

1. **Intended elevation and depth**
2. **Installation type (borehole, fill, horizontal)**
3. **Grouting method (pre-grout, post grout, internal tremie tube etc.)**
4. **Borehole/location**
5. **Tools**

Obtain any tools necessary to carry out the installation. The following is a brief list of tools typically used during the installation of **XC Inclinometer Casing.**

- Shovel for placing and levelling fill by hand
- Duct tape
- Grease (Denso) tape
- Hand Saw
- Chain or Casing Clamps
- Drill rods
- Grout Tremie Line
- Rivet gun
- High shear grout mixer and pump
- Drill and 4mm drill bit

5. **Equipment Needed**

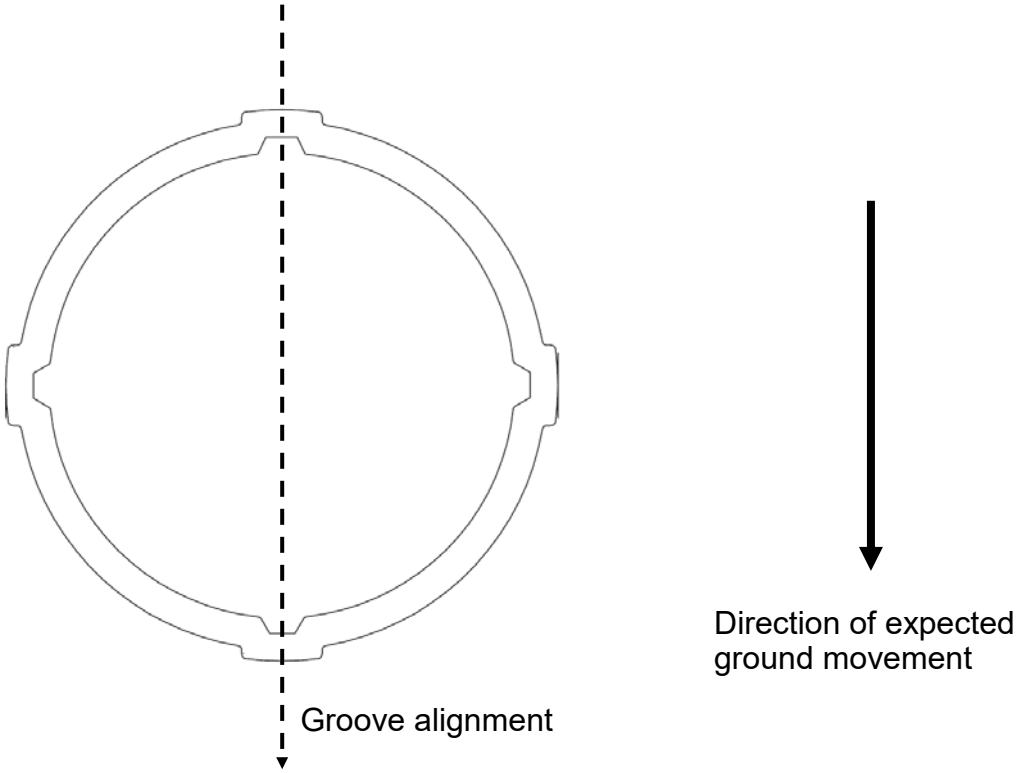
- XC Inclinometer Casing
- XC coupler (telescopic if required)
- Relevant bottom cap
- Push on top cap
- Clean Water Supply (to ballast Casing)
- Casing Collar Protection (if needed)
- Spare Casing/caps
- 4mm x 9mm rivets
- Sealing mastic (silicon)

**BEFORE STARTING THE INSTALLATION CHECK TO ENSURE CASING HAS NOT BEEN DAMAGED DURING TRANSIT OR STORAGE**

**IT IS RECOMMENDED TO ATTACH A COUPLER TO ONE END OF EACH LENGTH OF CASING BEFORE INSTALLING**

### 6.2 Alignment

One set of grooves should be aligned with the expected direction of movement as below.




**NEVER TRY TO TWIST OR PUSH THE CASING FROM THE TOP AS THIS WILL CAUSE TORSION, TWIST AND SPIRALLING OF THE GROOVES**

## 7.0 INSTALLATION - VERTICAL BOREHOLE

### 7.1 Borehole depth & cleanliness

The borehole should be drilled as vertical as possible, preferably within 1 degree.

Once drilled to final depth the borehole should be flushed out with clean water and checked that it is open to the bottom.

**CHECK THE DEPTH BEFORE INSTALLING**

**ENSURE DEPTH ALLOWANCE FOR GROUT VALVES IF USED**

## 7.2 Installation overview

It is recommended when installing into a vertical borehole to use pipe clamps to install **XC Inclinometer Casing** as there may be a risk of loosing the casing down the borehole.

In dry boreholes (particularly deep ones) a safety line should be attached to the base of the casing to provide additional security and a way to retrieve the casing if necessary.

**Install the casing as follows:-**

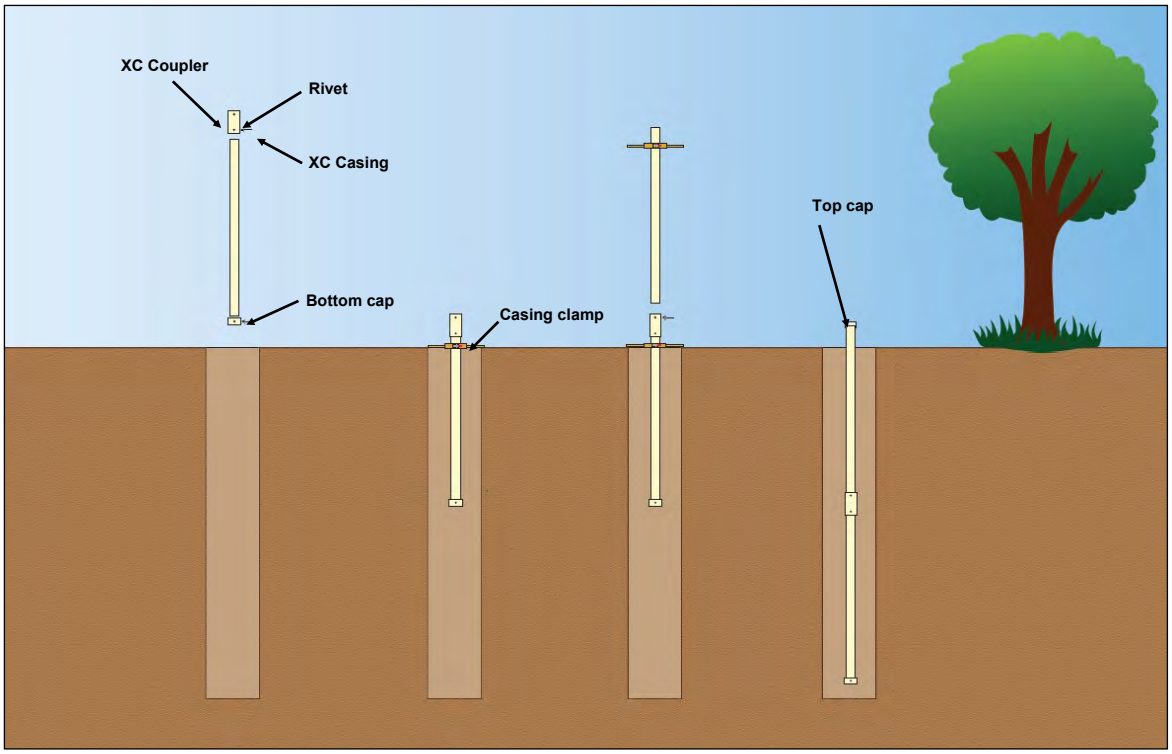
1.) Attach clamp A to the first section of the casing and lower into the borehole until the clamp rests on the top of the borehole, exposing the coupler.

2.) Attach clamp B to a suitable location on the next section of the casing and align the external grooves of the casing with the internal grooves of the coupler and insert the casing into the coupler. Glue and rivet the coupler to the casing. Reposition the clamp to the top of the casing.

3.) Remove clamp A and lower the new section into the borehole until clamp B rests on the top of the borehole.

4.) Remove clamp A and repeat as per step 2. Repeat alternating clamps A & B until installation is complete.

**ONCE THE CASING IS INSTALLED TO DEPTH IT IS SUGGESTED TO USE A DUMMY/INCLINOMETER PROBE TO CONFIRM THE CASING IS FREE FROM OBSTRUCTION.**



### 7.3 Buoyancy

**XC Inclinometer Casing** will be buoyant if the borehole is filled with water or grout and should therefore be filled with water to counteract this. The addition of grout to the borehole will however make the casing become buoyant again as grout is denser than water and becomes worse the denser the grout used.

If buoyancy is expected to be a major problem casing anchors can be used or weight can be applied at the base of the casing by installing a steel pipe or drill rods.

**DO NOT APPLY WEIGHT TO THE TOP OF THE CASING AS THIS WILL PUT THE CASING UNDER COMPRESSION AND DISTORT ITS PROFILE. PLACE ANY WEIGHT INSDE THE CASING AND AT THE BASE.**

### 7.4 Grouting

Grouting is required to connect the surrounding ground to the inclinometer casing and the grout mixture should be mixed to match the strength and deformation properties of the ground. The design of the grout is the responsibility of the Site Engineer.

Grout equipment should comprise of the following:-

- Grout mixer
- Grout pump
- Pipe or hose for Tremie or grout valve method

**DO NOT MIX GROUT MANUALLY**

**USE A PROPER HIGH SHEAR GROUT MIXER AND PUMP**

Correctly mixed grout must be of a “just pump able” consistency but thick enough to set in a reasonable time and be free of lumps. If the mixture is too watery excessive shrinkage will occur leaving the upper part of the borehole un-grouted.

During the grouting process care should be taken to balance the differential pressures between the inside and outside of the casing and it is also important to monitor the water level in the casing.

When mixing the grout add the cement to the water first and then add the Bentonite to the correct consistency. If the grout is too thin the solids and the water will separate. If too thick it will be difficult to pump.

## 6.6 Grouting contd…

Grout strength decreases with water-cement ratio and controlling this ratio is the most important factor for grouting and it is therefore recommended that the water and cement is mixed first. Water and cement ratios greater than 0.7 - 1.0 by weight will segregate without the addition of Bentonite or other filler to keep the cement in suspension and it is recommended that Bentonite normally be used as it is readily available.

The tables below provide guidelines for typical mixes that may be adopted for varying soil types but are only a guideline and the installer should request the project specification from the Engineer.

| | HARD SOILS | | MEDIUM SOILS | | SOFT SOILS | |
|---|---|---|---|---|---|---|
| Materials | Unit | Weight ratio | Unit | Weight ratio | Unit | Weight ratio |
| Cement (OPC) | 50Kg | 1 | 50 Kg | 1 | 50 Kg | 1 |
| Bentonite | 15 Kg | 0.3 | 15 Kg | 0.3 | 20 Kg | 0.4 |
| Water | 125 Lit | 2.5 | 225 Lit | 4.5 | 325 Lit | 6.5 |

Other compounds can be added to the grout mixture to alter its characteristics:-

- Expanding agents are added to introduce small bubbles into a cement and water mix as it cures to prevent it from shrinking.
- Plasticisers can be added to a mixture to allow it to flow more freely through small bore pipe work.
- Fillers are added to provide weight and / or bulk to the mixture for use where grout may have a tendency to flow through the borehole walls.

## 7.5 Grouting methods

### 7.5.1 Pre-grouting with external grout pipe

The following steps should be carried out when pre-grouting the borehole:-

1.) Flush out the borehole with clean water and check the depth.

2.) Lower the grout pipe to the bottom of the borehole.

3.) Pump in the grout to fill the borehole then and remove and flush out the grout pipe.

4.) Attach the relevant bottom cap to the first length of inclinometer casing.

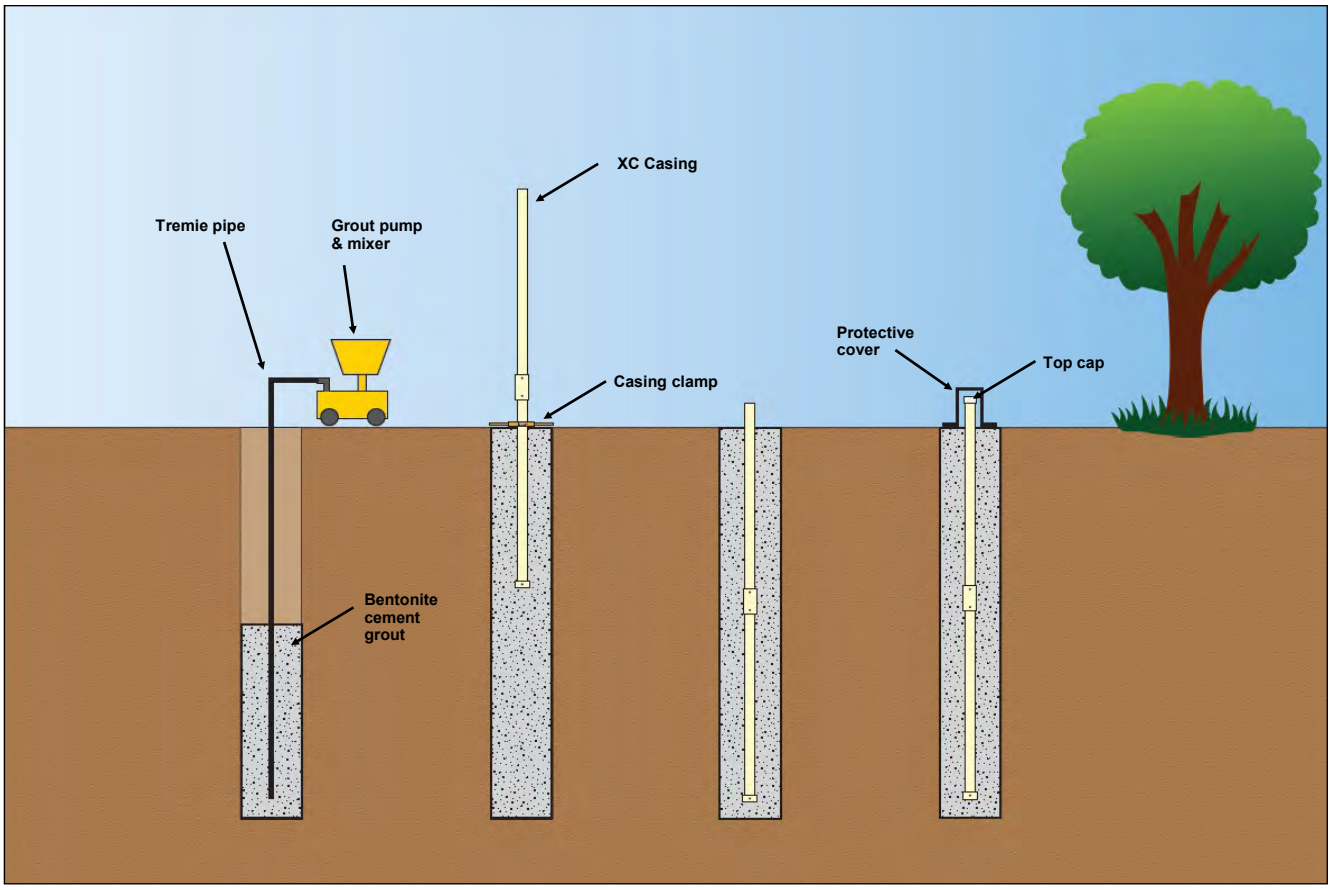
5.) Install the casing into the borehole to the specified depth, ensuring that the casing is filled with water to counteract any buoyancy and grout pressure.

6.) Lower a steel bar or drill rods to the bottom of the casing to further counteract buoyancy if necessary.

7.) Allow the grout to set.

8.) If necessary add grout to the top of the borehole and fit a protective cover.

**IF THE ALIGNMENT OF THE CASING NEEDS CHANGING LIFT THE CASING UP AND DOWN IN THE GROUT WHILST TURNING. DO NOT JUST TWIST AS THIS WLL CAUSE TWISTING OF THE CASING**



### 6.6.2 Post-grouting with external grout pipe

The following steps should be carried out when post-grouting the borehole:-

1.) Flush out the borehole with clean water and check the depth.

2.) Attach the relevant end cap to the bottom of the casing to the required depth.

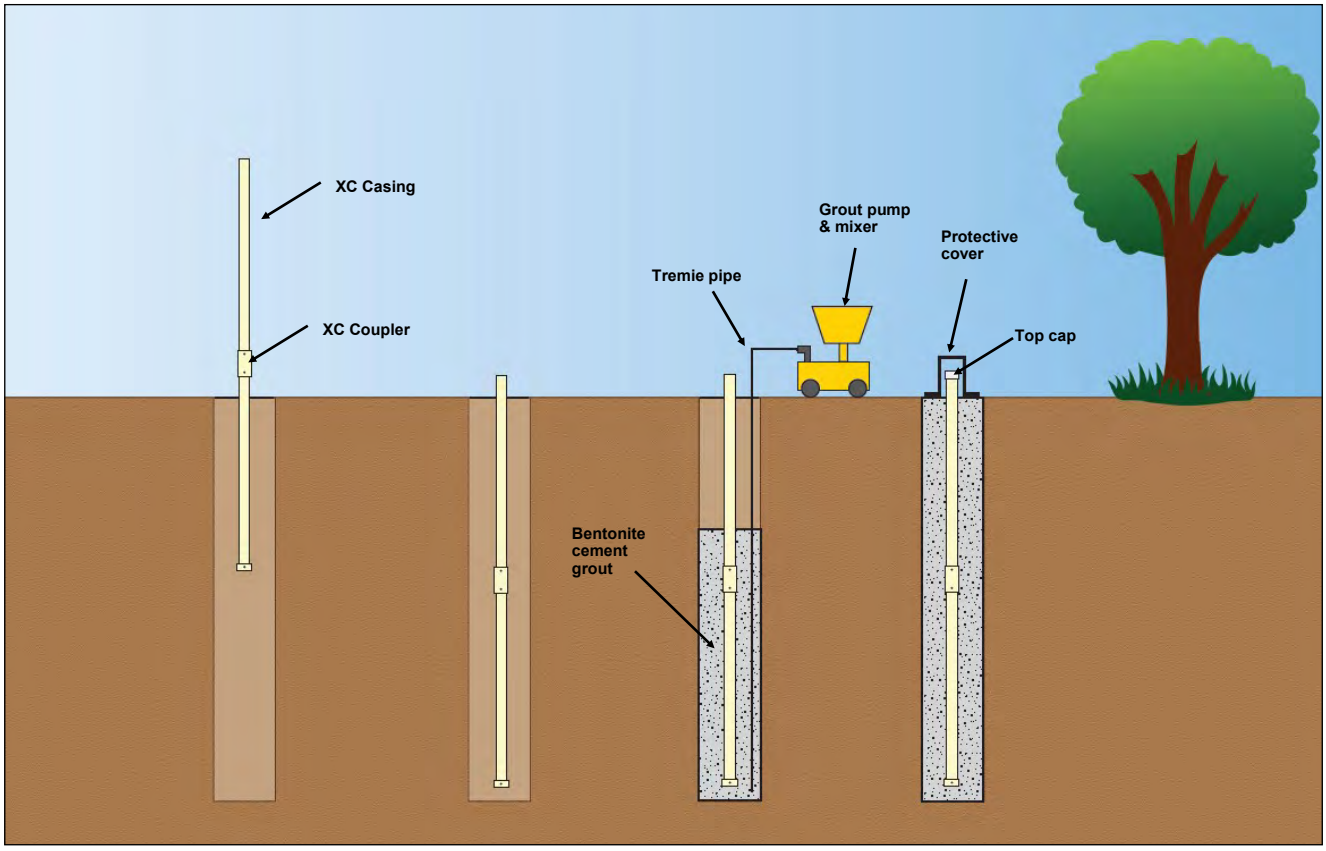
3.) Add water to the casing to counteract buoyancy and/or grout pressure.

4.) Place the grout pipe to the bottom of the borehole and pump in grout.

5.) Lower a steel bar or drill rods to the bottom of the casing to further counteract buoyancy if necessary.

6.) Remove the grout pipe, flush with water and allow the grout to set.

7.) If necessary add grout to the top of the borehole and fit a protective cover.



### 7.5.3 Post-grouting with a grout valve

Grout valves are generally used when casing is installed in small diameter boreholes that do not allow the use of an external grout pipe and is fitted with a non-return valve and a male Quick Release fitting.

A grout pipe is lowered down through the centre of the casing with a female Quick Release fitting which attaches onto the male fitting on the grout valve. Once grouting is complete the grout pipe is then removed.

The following steps should be carried out when post-grouting the borehole:-

1.) Flush out the borehole with clean water and check the depth.

2.) Attach the grout valve end cap to the bottom of the casing and install to the required depth.

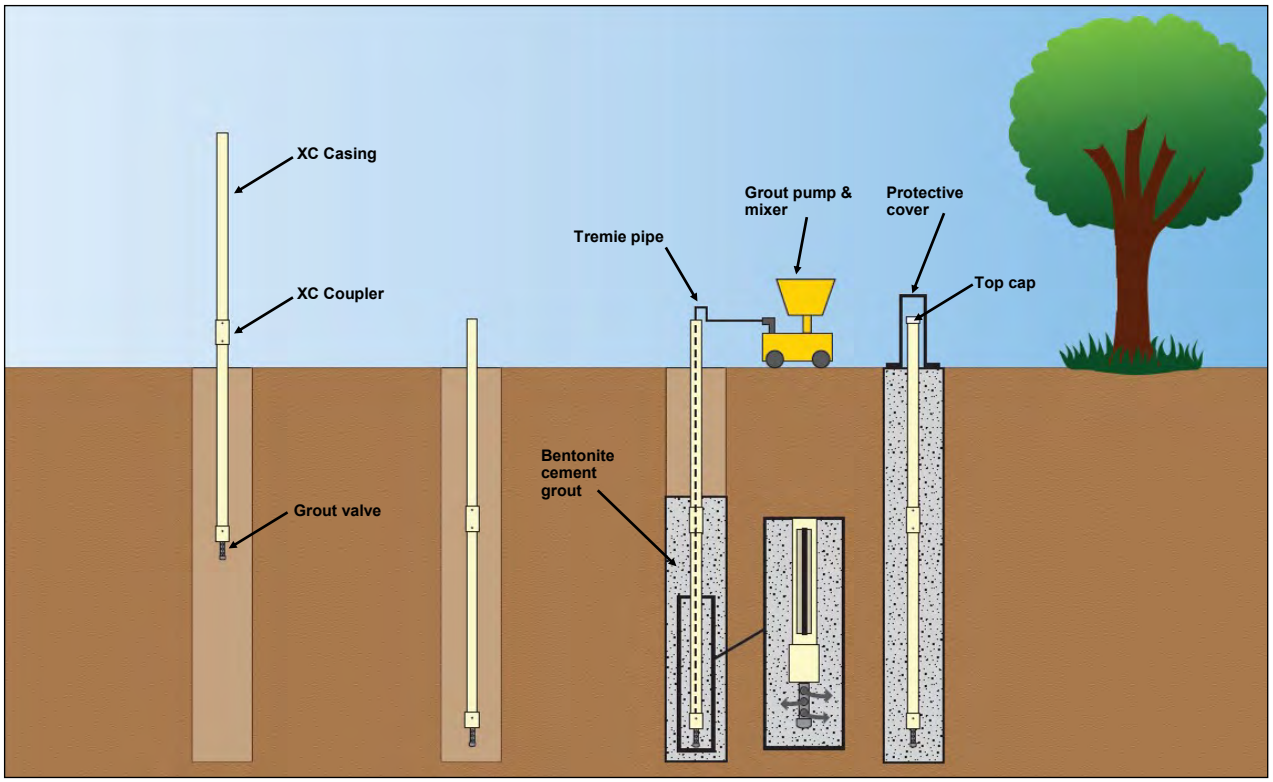
3.) Add water to the casing to counteract buoyancy and/or grout pressure.

4.) Place the grout pipe to the bottom of the borehole onto the Quick Release fitting and pump in grout.

5.) Use the internal grout pipe to further counteract buoyancy if necessary.

6.) Remove the grout pipe, flush with water and allow the grout to set.

7.) If necessary add grout to the top of the borehole and fit a protective cover.



## 7.6 INSTALLATION PROCEDURE

It is important that the first section is installed into ground where no movement is anticipated and thus acts as a datum.

Once prepared install the casing as follows:-

### 7.6.1 Attaching the bottom cap

**STEP 1** - Apply ABS adhesive onto the inside edges of the bottom cap as shown and place the cap onto the end of the first length of casing.

**STEP 2** - Using a 3.2mm drill bit, drill a hole (between the grooves) through the side of the cap and the casing.

**STEP 3** - Rivet the cap to the casing using a 3.2mm rivet.

**STEP 4** - Repeat another 3 times so that there is a rivet between each groove.

### 7.6.1 Attaching the bottom cap

**STEP 5** - Apply a bead of silicon sealant along the top edge of the bottom cap.

**STEP 6 -** Smear the silicon around the top of the cap to ensure a good seal.

**STEP 7 -** Apply cloth tape to the joint to protect the joint from grout intrusion.

### 7.6.2 Attaching standard couplers

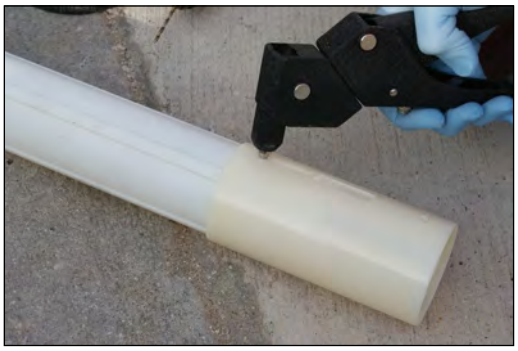
**STEP 8 -** Apply ABS adhesive to the top 25mm of the casing.

**STEP 9 -** Push the coupler onto the end of the first length of casing.

### 7.6.2 Attaching standard couplers contd….

**STEP 10 -** Using a 3.2mm drill bit, drill a hole through the coupler guide hole and the casing.

**STEP 11 -** Rivet the coupler to the casing using a 3mm x 9mm rivet.

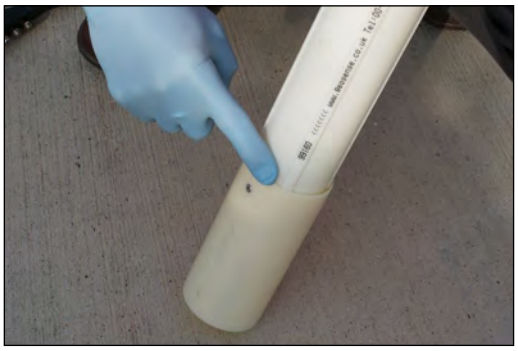


**STEP 12 -** Repeat for the opposite side.

**STEP 13** - Apply a bead of silicon sealant along the bottom edge of the coupler and the casing.

### 7.6.2 Attaching standard couplers contd….

**STEP 14 -** Smear the silicon around the bottom of the coupler to ensure a good seal.



**STEP 15 -** Apply cloth tape to the joint to protect the joint from grout intrusion.

**STEP 16:** Measure 150mm from the end of the casing and mark.

**FOR EASE OF INSTALLATION IT IS RECOMMENDED TO ATTACH THE COUPLERS TO ALL LENGTHS OF CASING BEFORE INSTALLING INTO THE BOREHOLE**

### 7.6.3 Attaching telescopic couplers

**STEP 17:** Slide the telescopic coupler onto the casing until the bottom of the coupler reaches the mark.

**STEP 18 -** Turn the casing/coupler over and drill a hole through the coupler and casing (not using the pre-cut grooves)

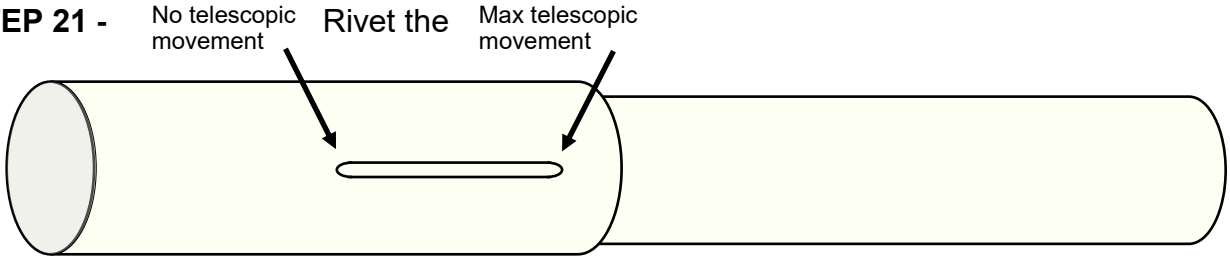
**STEP 19 -** Rivet the coupler to the casing using a 3.2 x 9mm rivet.

**THE PREVIOUS RIVET IS USED TO STOP UNWANTED MOVEMENT OF THE TELESCOPIC JOINT DURING INSTALLATION.**

### 7.6.3 Attaching telescopic couplers contd….

**STEP 20 -** Drill a hole into the casing through the pre cut grooves in the coupler.

**STEP 21 -** Rivet the telescopic coupler to the casing through the pre cut groove using a 3.2 x 9mm pop rivet.




**STEP 22 -** Apply silicone sealant to the groove in the telescopic coupler.

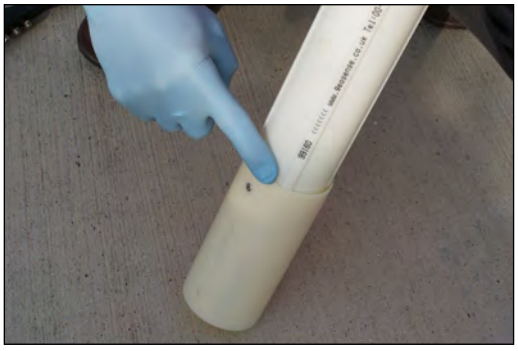
### 7.6.3 Attaching telescopic couplers contd...

**STEP 23 -** Smooth the sealant into the grooves.

**STEP 24 -** Apply silicon sealant between the bottom edge of telescopic coupler and the casing.

**STEP 25 -** Smear the silicon around the bottom of the coupler to ensure a good seal.

**STEP 26 -** Wrap grease (Denso) tape around the joint.



### 7.6.3 Attaching telescopic couplers contd….

**ENSURE THAT THE TAPE COVERS THE GROOVE IN THE COUPLER.**

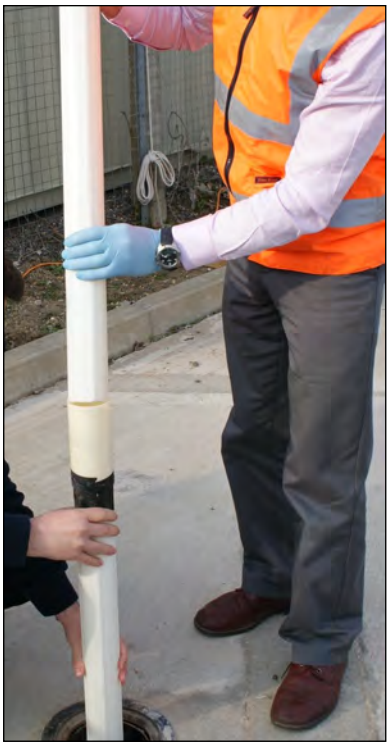
**FOR EASE OF INSTALLATION IT IS RECOMMENDED TO ATTACH THE COUPLERS TO ALL LENGTHS OF CASING BEFORE INSTALLING INTO THE BOREHOLE**

**STEP 27 -** Lower the first section of casing (with bottom cap) into the installation borehole.

### 7.7 First section

**STEP 28 -** While supporting the previous length of casing, insert the next length of the casing into the coupler.

## 7.8 Subsequent sections



**STEP 29 -** Using a 3.2mm drill bit, drill a hole through the coupler guide hole and the casing.

**STEP 30 -** Rivet the coupler to the casing using a 3mm x 9mm rivet.

**STEP 31 -** Repeat for the other guide hole

**STEP 32 -** Apply a bead of silicon sealant between the top end of the coupler and the casing.

## 7.8 Subsequent contd…..

**STEP 33 -** Smear the silicon around the top of the coupler to ensure a good seal.

**STEP 34 -** Apply cloth tape to the joint to protect the joint from grout intrusion.

**STEP 35 -** Repeat steps 27 to 34 for remaining lengths of casing.

**FOR SOME INSTALLATIONS IT MAY BE NECASSARY TO COUNTARACT BOUYANCY BUT FILLING THE CASING WITH CLEAN WATER**

**WHEN ADDING LENGTHS OF CASING TO TELESCOPIC COUPLINGS PLEASE USE STEPS 16 TO 26**

## 7.8 Subsequent sections contd…..

**EXCESS CASING CAN BE CUT DOWN AT THE TOP OF THE BOREHOLE ONE INSTALLED**

**STEP 36 -** Place the top cap onto the top of the casing as shown.

**STEP 37 -** Tape the cap onto the top of the casing using cloth tape to ensure no debris enters the casing.

## 7.9 Installing the top cap

**STEP 38** - Backfill with a suitable grout mix

## 7.9 Installing the top cap contd….

Once the casing is installed ensure a suitable top cap is fitted to prevent debris from entering.

It is recommended that the installation be fully protected and secured if necessary using an appropriate cover and lock.

## 7.10 Orientation

**MAKE SURE THAT THE ORIENTATION OF THE GROOVES IS CORRECT.**

## 7.11 Removing temporary casing

**ALWAYS REMOVE THE TEMORARY CASING USING A STRAIGHT UPWARD LIFT**

**<u>DO NOT TWIST</u> AS THIS COULD CAUSE TWIST IN THE INCLINOMETER CASING**

## 7.12 Protection

## 8.0 INSTALLATION - VERTICAL FILL

**XC Inclinometer Casing** is often installed in vertical fills such by adding lengths of casing as the filling progresses for applications such as embankments and dams.

It is recommended to use 1.5m lengths for this application.

In these applications settlements are expected and the use of telescopic joints or a corrugated external sleeve (**see GXM-300**) should be used.

Joining of the Casing is generally as shown in section 7.0.

A typical installation procedure is as follows:-

8.1 Excavate a small pit or drill a shallow borehole into solid ground.

8.2 Fit the bottom cap to the first length and place into the pit/borehole.

8.3 Check for verticality

8.4 Backfill with grout.

8.5 Once grout has set carefully place finely graded selected fill and compact manually taking care not to damage the Casing or affect its verticality.

8.6 Where necessary place telescopic joints.

8.7 Continue adding lengths of Casing and fill as required.

**ALWAYS PROVIDE PROTECTION TO AVOID DAMAGE OR CHANGE IN VERTICALITY**

## 9.0 INSTALLATION - HORIZONTAL

Typical installations where casing is installed horizontally are:-

- Foundation slabs - within reinforced concrete
- Underneath embankments - within trench

### 9.1 Preparation for installation

Before the installation starts ensure that the following items are available:-

- Casing (Correct amount)
- Dead-end pulley (if required)
- Draw wire
- Cable ties
- Tie wire
- Duck tape or other sticky tape
- Installation Tool (For verticality of grooves)
- Spirit level

### 9.2 Installation horizontally within a Re-bar Cage

Important points to consider when installing inclinometer casing horizontally are:-

- Orientation of grooves
- No twist in casing
- Good fixing of the casing

The first piece of casing is the most important as the more accurately this is installed and with the minimum amount of twist/torsion in the casing the easier the rest of the installation will be.

The ideal situation is to install the casing directly into the rebar cage but another option is to weld angles onto the cage on which the casing can sit (see figure 1).

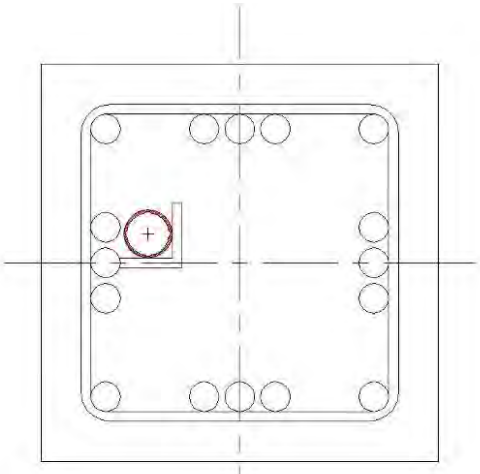


Figure 1

## 9.2 Installation horizontally within a Re-bar Cage contd…

**STEP 1 -** mark the steel at the level the casing needs to be installed. The top of the casing height should be used as it will be easier to see when installing.

If the cage is already in place marks should be made on the re-bars using levelling techniques.

**STEP 2** - the first length of casing can be installed from either end or from the open end if a dead end pulley system is employed. Each casing length should be held at both ends in roughly the correct position and then checked with a spirit level from the top of the casing to the level marks on the rebar cage.

When this is fixed in approximately the correct position then it should be held in place loosely by some tape, making sure that the internal grooves are vertical (by eye is ok at this stage).

The next stage is to fix the casing securely starting at the outside end of the first casing.

**STEP 3** - place the installation tool horizontally into the casing and then place the spirit level on the plate and rotate the casing until absolutely horizontal.

## 7.2 Installation horizontally within a Rebar Cage contd...

**STEP 5** - repeat as steps 3 & 4 at the other end of the first length of casing and then tie wire should be used to fix the casing permanently.

**STEP 6** - add the additional lengths of casing/coupler as per standard installation procedure as required.

**THE FAR END OF THE CASING SHOULD BE SUPPORED AT ALL TIMES**

**STEP 7** - repeat steps 1 to 5 for all lengths of the casing fixing with tie wire at regular intervals.

**STEP 8** - once all casings have been installed place suitable material (rags, paper etc) into the end of the two outer casings and tape plastic caps onto the ends of the casing. This will prevent the ingress of debris or concrete.

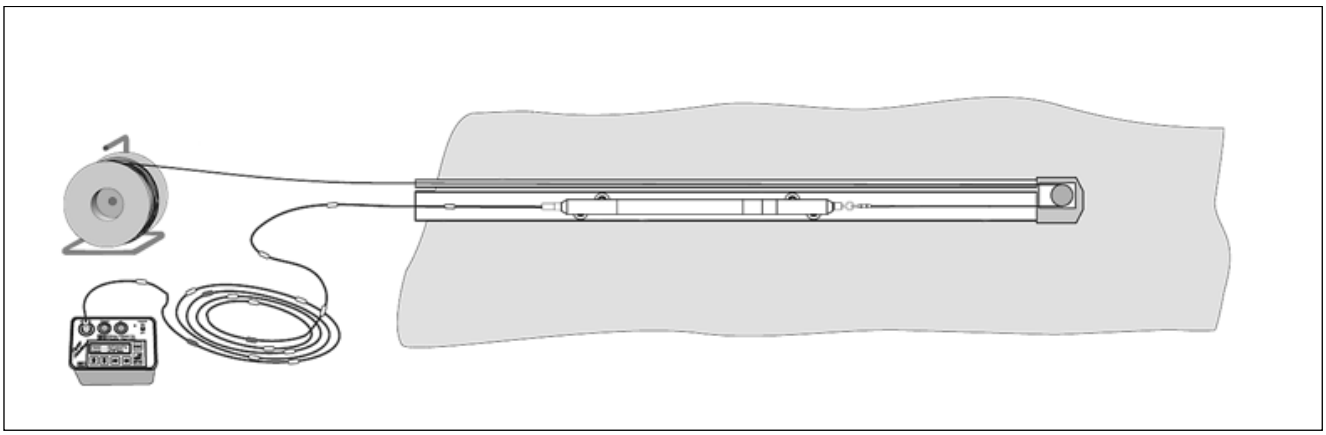
### 9.3 Dead-end pulley

A dead-end pulley is required f one of the ends of the casing is not accessible.

A draw wire twice the length of the casing is used to pull the inclinometer probe back and forth.

The installation of the inclinometer casing will depend on the application and ground Conditions.

Please contact **Geosense**® for advice.



### 9.4 Installation within a trench

The trench should be excavated with a small gradient (~0.5%) to allow drainage and the bottom should be flat. A system of horizontal supports which prevent twist of the casing should be used e.g. sections of channel with pipe clamps.

**STEP 1 -** Place and compact 100mm layer of sand in the trench.

**STEP 2** - Connect together the required amount of inclinometer casings and couplers along the line of the trench ensuring verticality of one set of grooves and fix in place so the casing cannot move during backfilling.

**STEP 3** - Cover casing with 100mm of sand and compact evenly.

**STEP 4** - Backfill remainder of trench with selected fill compacting evenly.

**DO NOT BACKFILL WITH LARGE OR SHARP OBJECTS**

## 10.0 SPECIFICATION

| CASING SPECIFICATION | | |
|---|---|---|
| Material | 100% virgin ABS (Acrylonitrile-butadiene-styrene) | |
| Groove spiral | < 0. degree/3m | |
| Collapse resistance | ~ 2000kPa | |
| Joint strength | 710 Kgf | |
| Torque | 525Nm | |
| Temperature range | -20°C to +70°C | |
| Colour | Natural (other available on request) | |
| | | |
| CASING DIMENSIONS | | |
| Outside diameter | 70mm | 85mm |
| Inside diameter | 62mm | 77mm |
| Length (effective) | 3 & 1.5 metre | 3 & 1.5 metre |
| | | |
| STANDARD COUPLER DIMENSIONS | | |
| Outside diameter | 77mm | 91mm |
| Inside diameter | 70mm | 85mm |
| Length | 160mm | 200mm |
| | | |
| STANDARD COUPLER DIMENSIONS | | |
| Outside diameter | 77mm | 91mm |
| Inside diameter | 70mm | 85mm |
| Length | 400mm | 380mm |
| Telescopic range | ±75mm | ±75mm |
| | | |
| WEIGHTS | | |
| Casing | 2.66kg/m | 3.18kg/m |
| Top cap | 48g | 64g |
| Bottom cap | 70g | 90g |
| Standard coupler | 136g | 236g |
| Telescopic coupler | 380g | 400g |
| | | |
| INSTALLATION ACCESSORIES | | |
| Rivets, sealing tape (1roll per 6 couplings) mastic and solvent cement (1 tin per 20 joints) available. | | |

## 11.0 SPARE PARTS

As inclinometer casing is non-retrievable there are no spare parts as such but additional components of a **Geosense® XC Inclinometer Casing** installation which can be added if required and are as follows:-

- Extra lengths of casing (3m & 1.5m)
- Standard couplers
- Telescopic couplers
- Standard bottom cap
- Bottom cap with anchor
- Bottom cap with anchor & grout valve
- Bottom cap with grout valve
- Bottom cap with dead-end pulley (horizontal installation)
- Top cap
- Support clamps
- ABS cleaner
- ABS solvent cement
- Duct tape
- Grout pipe
- Premixed grout
- Protective/lockable top covers
- Rivets
- Rivet gun
- Grease tape (denso)
- Sealing mastic

## 11.0 RETURN OF GOODS

### 11.1 Returns procedure

If goods are to be returned for either service/repair or warranty, the customer should contact Geosense for a **Returns Authorisation Number,** request a **Returned Equipment Report Form QF034** and, where applicable, a **Returned Goods Health and Safety Clearance Form QF038** prior to shipment. Numbers must be clearly marked on the outside of the shipment.

Complete the **Returned Equipment Report Form QF034**, including as much detail as possible, and enclose it with the returned goods.

All returned goods are also to be accompanied by a completed **Returned Goods Health and Safety Clearance Form QF038** attached to the outside of the package (to be accessible without opening the package) and a copy of both forms should be faxed or emailed in advance to the factory.

### 11.1.2 Warranty Claim

**(See Limited Warranty Conditions)**
This covers defects which arise as a result of a failure in design or manufacturing. It is a condition of the warranty that the **Geosense® XC Inclinometer casing** must be installed and used in accordance with the manufacturer's instructions and has not been subject to misuse.

In order to make a warranty claim, contact **Geosense®** and request a **Returned Equipment Report Form QF034.** Tick the warranty claim box and return the form with the goods as above. You will then be contacted and informed whether your warranty claim is valid.

### 11.2 Packaging and Carriage

All used goods shipped to the factory **must** be sealed inside a clean plastic bag and packed in a suitable carton. If the original packaging is not available, **Geosense®** should be contacted for advice. **Geosense®** will not be responsible for damage resulting from inadequate returns packaging or contamination under any circumstances.

### 11.3 Transport & Storage

All goods should be adequately packaged to prevent damage in transit or intermediate storage.

## 12.0 LIMITED WARRANTY

The manufacturer, **Geosense® Limited** warrants the **Geosense XC Inclinometer Casing** manufactured by it, under normal use and service, to be free from defects in material and workmanship under the following terms and conditions:-

Sufficient site data has been provided to **Geosense®** by the purchaser as regards the nature of the installation to allow **Geosense®** to select the correct type of inclinometer casing and other component parts.

The **XC Inclinometer Casing** shall be stored and installed in accordance with the manufacturer's recommendations.

The equipment is warranted for 1 year from the date of shipment from the manufacturer to the purchaser.

The warranty is limited to replacement of part or parts which, are determined to be defective upon inspection at the factory. Shipment of defective part or parts to the factory shall be at the expense of the Purchaser. Return shipment of repaired/replaced part or parts covered by this warranty shall be at the expense of the Manufacturer.

Unauthorised alteration and/or repair by anyone which, causes failure of the unit or associated components will void this **LIMITED WARRANTY** in its entirety.

**The Purchaser warrants through the purchase of the Geosense® XC Inclinometer Casing equipment that he is familiar with the equipment and its proper use. In no event shall the manufacturer be liable for any injury, loss or damage, direct or consequential, special, incidental, indirect or punitive, arising out of the use of or inability to use the equipment sold to the Purchaser by the Manufacturer.**

The Purchaser assumes all risks and liability whatsoever in connection with the **XC Inclinometer Casing** from the time of delivery to Purchaser.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