
Standard Practice for Installing, Monitoring, and Processing Data of the Traveling Type Slope Inclinometer

AASHTO Designation: R 45-13 (2021)

Technically Revised: 2013

Reviewed but Not Updated: 2021

**Technical Subcommittee: 1b, Geotechnical Exploration,
Instrumentation, Stabilization, and Field Testing**



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1. SCOPE

- 1.1. This practice provides instructions for installation, monitoring, and data reduction for the *traveling type* slope inclinometer for use with guide casing. A slope inclinometer is a precision instrument that measures lateral displacement of a guide casing resulting from the movement of earth, concrete, or other masses. This type of instrument can be used to detect and monitor movements in earth- and rock-fill dams, highway embankments and foundations, excavation slopes, sheet pile bulkheads, concrete retaining walls, and other structures. Because the instrument is waterproof, it can be used on projects where normal measurements would not be feasible, such as the displacement of the lower portion of a pipe pile. The data, which are well suited for computer reduction, can be used to interpret shear zones in landslide areas and as a basis for predicting impending shear failures or structural failures based on the amount and rate of lateral deformation occurring.
- 1.2. *The practice is divided into the following parts:*
 - 1.2.1. Part I, Installing Slope Inclinometer Guide Casing;
 - 1.2.2. Part II, Monitoring Slope Inclinometer Guide Casing; and
 - 1.2.3. Part III, Data Computations and Analysis.
- 1.3. The values stated in SI units are to be regarded as the standard.

PART I—INSTALLING SLOPE INCLINOMETER GUIDE CASING

2. APPARATUS

- 2.1. *Drilling Equipment:*
 - 2.1.1. Drill rig capable of drilling a hole with diameter large enough to accommodate the particular size slope inclinometer casing used and allow for adequate backfilling. The depth of the hole needed varies with the particular installation, locale, and/or discretion of the engineer. Normally, a drill rig capable of drilling a 203-mm (8-in.) diameter hole to the desired installation depth may be used. A smaller drill rig may be used for shallow depth installations.
- 2.2. *Guide Casing:*

- 2.2.1. Guide casing, usually round extruded plastic, with four equally spaced longitudinal grooves on the inside of the casing compatible with the particular torpedo sensor used. However, some casing may not be grooved because the torpedo sensor maintains proper orientation by use of locking metal orientation rods. Some inclinometers may be used in square steel casing with the torpedo sensor guide wheels tracking in opposite corners of the casing. The casing comes in assorted diameters and may come in any convenient length, such as 1.52- or 3.05-m (5- or 10-ft) sections.
- 2.3. *Couplings:*
- 2.3.1. The couplings may be extruded plastic with four equally spaced grooves and usually come in 152-mm (6-in.) lengths. In cases where settlement is expected, longer couplings may be used to join the sections of casing. The resulting gap between casing sections allows the casing to telescope together as compression of the surrounding materials occurs. Alternately, a coupling mechanism may be included as part of the guide casing.
- 2.4. *Installation Tools:*
- 2.4.1. Inclinometer guide casing installation tools specified by the manufacturer, normally consisting of hacksaw, casing clamp, casing anchor (recommended), tape measure, and a device for marking casing grooves such as a felt tip marker or file. A special wheel groove alignment tool, duct or masking tape, and solvent cement may be needed for plastic casing. A vibrator and/or grout pump may be used for backfill compaction and placement if necessary.
- 2.5. *Plugs:*
- 2.5.1. Plugs compatible with the particular guide casing are used for protecting the top and bottom of the casing from mud and debris. A conical plug may be used to ease insertion of the casing into a rough-sided hole.
- 2.6. *Protective Device (Optional):*
- 2.6.1. Hole cover or other protective device to minimize vandalism and large enough [152 mm (6 in.)] to allow the cable clamp-guide wheel assembly to be installed on top of the casing. A metal pipe with either a threaded cap or hinged lid with hasp and lock may be used. For protection from impacts by construction traffic, bollards or barriers may be installed.

3. DRILLING AND HOLE PREPARATION

- 3.1. The size of the drill hole should be large enough to accommodate the particular size casing used and depends on the particular installation, locale, materials encountered, depth of the hole, available backfill materials, or the discretion of the engineer. Larger holes facilitate backfilling. Minimum diameter may be only sufficient to accommodate the casing used. This is applicable in cases where the material may close quickly. Normally, the drill hole may be approximately two times the outside diameter of the casing or a minimum of 127 to 152 mm (5 to 6 in.). The hole should be as vertical as possible (vertical inclination should be less than 3 degrees), and drilled several meters (at least 3 m, or as directed by the engineer) into stable material below or beyond the anticipated zone of movement. Usually, the borehole should extend into rock or soil to achieve sufficient rigidity to provide the fixity of the inclinometer. The bottom 3 m (or as directed by the engineer) of the inclinometer casing should be embedded below the lowest possible failure plane and should extend into hard or very dense material to assure that the future readings do not show any movement at the bottom of the inclinometer casing.
- 3.2. The hole usually should be cleaned by flushing with water or blowing compressed air before attempting to install the inclinometer casing. Depending on the installation, sometimes it is