

DIGITAL INCLINOMETER

DATASHEET

MODEL EAN-26M



OVERVIEW

The Encardio Rite model EAN-26M Digital Inclinerometer is a MEMS-based system designed to precisely measure lateral movement and deformation in earthworks and structures. It is the first inclinometer in the world to utilize an Android OS-based mobile phone for data readout and storage. The system leverages the high computational power and high-resolution color display of modern mobile phones for accurate readings and effective data visualization.

Applications include measuring lateral movement and deformation in earthworks, assessing inclination or tilt in structures such as retaining walls and piles, and monitoring geotechnical and structural changes over time. It is particularly effective for monitoring deformation in tunnels, underground cavities, slopes, and embankments and for structural health monitoring during and after construction activities.

The inclinometer system comprises of a series of access tubes installed in a borehole or embedded in earth/rock fill or concrete structures. The EAN-26M includes a digital tilt-sensing probe connected to a cable reel positioned at the gage well top. Data is transmitted via signal cable to the mobile phone that communicates with the cable reel unit via Bluetooth.

When ground displacement occurs, the inclinometer casing deforms along with the surrounding soil. The inclinometer probe monitors this deformation by measuring the angle of inclination from the vertical. This angle is converted to lateral displacement using the formula " $L \sin \theta$ ", where L is gage length (500 mm) and θ is the angle of tilt from vertical. By summing the readings taken at 500 mm intervals, a complete profile of the gage well can be obtained. Comparing these profiles over time allows for the determination of horizontal displacement at different depths.

FEATURES

- **Advanced MEMS technology:** Delivers high accuracy and reliability.
- **Mobile phone as readout/datalogger:** Android OS-based mobile phone is used as readout unit, with the Digital Inclinometer application. for data collection, configuration, and real-time analysis.
- **Easy maintenance:** Mobile phones allow for easy replacement or local servicing, reducing downtime.
- **Wireless connectivity:** Bluetooth connection between reel and mobile phone eliminates traditional cable issues.
- **High data storage:** Mobile phone memory allows storage of over 1 million data points, ensuring extensive data logging capability.
- **Multi-functional capability:** The mobile phone can also serve as a camera, GPS device, and tutorial viewer, enhancing its utility on-site.
- **Immediate data verification:** Operators can compare logged data with previous readings directly on-site, via tables or graphs on mobile phone, enabling quick identification and investigation of any anomalies.
- **Durable cable:** Features a high-strength, stretch-proof cable with Kevlar core.
- **Ease of use:** Lightweight, shock-resistant design preferred by field personnel for ease of transport and operation.
- **Instant data transmission:** Data can be sent instantly to a central server via a cellular connection, facilitating real-time monitoring.
- **Optional settlement measurement:** Can be equipped with magnetic targets (fixed to the inclinometer casing at different depths) and a magnetic sensor probe (Model EDS-91/2.1) for settlement monitoring.

SYSTEM COMPONENTS

Inclinometer casing and fittings

The ABS access tubes (casings) feature longitudinal keyways produced to precise tolerances, allowing the wheels of the tilt-sensing probe to run smoothly inside. Standard casings have an outer diameter (o.d.) of 70 mm (~2.75 in), an inner diameter (i.d.) of 58 mm, and a length of 3 meters (~9.85 ft). Casings with an outer diameter of 85 mm (~3.35 in) and an inner diameter of 77 mm, also in 3-meter lengths, are available upon request.

Fixed and telescopic couplings are available to quickly join access tubes, ensuring the correct alignment of keyways throughout the depth of the borehole. Additional accessories include end caps, top caps, pop rivets, self-tapping screws, mastic tape, BOPP tape, protective manhole covers, a pop rivet gun, a power drill, and more. Refer to our technical datasheet on ABS casing for further details. Inclinometer probe and accessories.

Inclinometer probe and accessories

EAN-26MV Inclinometer probe

The digital probe, constructed from stainless steel, is equipped with two pairs of pivoted, spring-loaded wheels that can rotate freely. The standard gage length between the wheels is 500 mm, with an optional 2-foot (Imperial unit) gage length available. The spring-loaded wheel arms help position the probe centrally inside the access casing at any desired depth. It is compatible with ABS access tubing of both 70 mm and 85 mm outer diameters.

The probe contains two precision MEMS accelerometers: one aligned with the plane of the wheels and the other positioned at 90° to it. It uses a 24-bit ADC to measure the MEMS sensor output with a resolution exceeding 1 million counts. The probe detects horizontal deviations from the vertical plane along both orthogonal axes. A four-pin connector is provided for attaching the signal cable.



SPECIFICATIONS

EAN-26DP Dummy probe

It has the same dimension and cord length as the actual probe and is used for checking the gage well integrity.

EAN-26CCJ Calibration check jig

It allows for verification of the inclinometer probe's calibration at known tilt angles.

EAN-26R Operating cable and cable reel

The signal cable consisting of tensile straining member, and marked at every 0.5 m (or 2 ft Imperial), is available in different lengths, with suitable portable reel. A four pin connector is provided for connecting it to the probe.

The reel unit includes a winding reel holding the cable and a wireless Bluetooth relay unit that transmits the digital probe data to the mobile phone. A rechargeable battery within the reel unit powers the entire system.



EAN-26CB Cable suspension bracket

It is placed at the top of the installed ABS casing (gage well) and holds the signal cable at the graduated marks during data collection.

Readout unit - Mobile phone

An Android mobile phone with the Digital Inclinometer application software serves as a handheld readout. The application software is included in the supply. A phone can be supplied upon request or sourced locally. Data transfer requires a SIM card (client's scope).

Probe specification

Measuring range	± 30° of vertical
Resolution (Metric)	± 0.008 mm/500 mm
Resolution (Imperial)	± 0.0004 in/2 ft
Distance between wheels	500 mm Metric (standard) 2 ft Imperial (on request)
Operating temperature	-20°C to 80°C
Probe weight	1.4 kg (~3.1 lb)
Probe casing	AISI 316L Stainless steel
Total system accuracy ¹ (Metric)	± 2 mm/30 m (readings at every 500 mm)
Total system accuracy ¹ (Imperial)	± 0.1 in/100 ft (readings at every 2 ft)

Cable specification

Details	Two core abrasion resistant polyurethane sheathed, weather proof, with high tensile straining member, graduated at every 0.5 m (or 2 ft Imperial).
Diameter	6 mm (~ 0.24 in)
Weight	1.9 kg/50 m (3.8 lb/150 ft); including ferrules

Cable reel specifications

Upto 100 m (330 ft) cable reel	300 mm (~ 12 in) diameter (flange)
100 - 200 m (330-650 ft) cable reel	380 mm (~ 15 in) diameter (flange)
For 50 m (150 ft) cable length	4.5 kg (9.5 lb) weight

¹ Difference between cumulated displacements while taking readings in similar conditions repeatedly

*All specifications are subject to change without prior notice

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