



YieldPoint's unique 1 to 6-Point Multiple Rod Extensometer (*d-Exto*) combines a traditional Multi-rod design and digital signal processing to result in dramatically improved accuracy reliability compared to similar priced existing technology. This high precision digital instrument comprises up to six (6) Variable Induction Displacement Sensors and an on-board digital temperature sensor.

Design features of the *d_Exto* include a Lexan™ body sheath much stiffer, stronger and durable than polyethylene commonly used; a compact central core which will not be damaged by shear movements of up to 10mm; hermetically sealed electronics that operate indefinitely when submerged in water and robust torsionally straightened stainless steel rods.

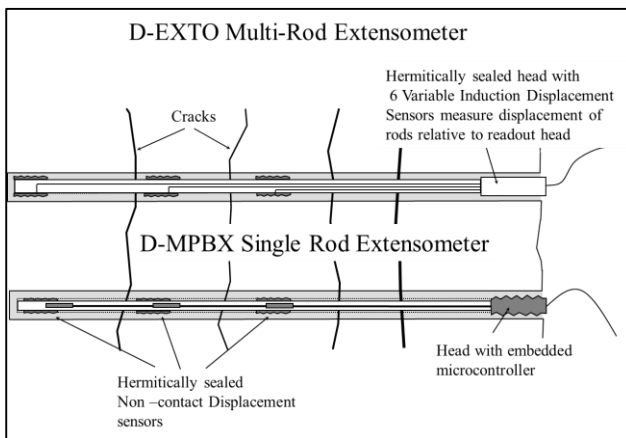
The inherently digital nature of the signals eliminates the necessity for expensive analog-to-digital conversion and results in low cost readout unit that reads data directly in real world units (*mm* and °C). The sensor output is an ASCII (9600,8,N,1) digital signal which can be read by a low cost readout unit (*d-Reader*), dataloggers (*d-Logger*), and wirelessly networked (*dMesh*) for transmission to cloud based servers. The signals themselves are robust and can be transmitted over 1000ft of lead-wire. If broken the lead-wire can be twisted and taped together.

Features:

- ▲ `Super-Tough` design with high strength Lexan™ outer sheath
- ▲ Multiple Stainless Steel rods maintained straight in multi-lumen extruded tube for maximum accuracy.
- ▲ 1-6 anchor points
- ▲ 125, 150mm, 250mm stroke length
- ▲ High individual sensor accuracy (0.5%FS) and resolution (0.01mm)
- ▲ Output in real world units
- ▲ Unique instrument ID
- ▲ Calibration Coeffs. in Flash memory
- ▲ Smallest electronics head (25mm diameter 150mm long)
- ▲ On-board digital temperature compensation
- ▲ High survivability following blasts and vibration even if toe is damaged
- ▲ Easy to install and maintain— Arrives on site fully assembled.

Technology

The *d-Exto* design is based on a traditional multi-rod design (see below) which includes 1 to 6 Variable Inductive Displacement Sensors. The 6 stainless steel rods are housed individually in a central multi-lumen tube to maintain them perfectly straight and eliminate friction between rods. The individual rods are completely independent of one another and therefore if damaged by blasting the proximal sensors will continue to operate.



Each displacement sensor is individually calibrated and the calibration coefficients written to microcontroller memory. The *d-Exto* can easily detect and resolve sub-mm displacements of with $10\mu\text{m}$ resolution. Accuracy is enhanced by an on-board temperature sensor which provides compensation. The displacement sensors use non-contact sensing the design is inherently waterproof; therefore it is especially suited for monitoring the displacement of backfill.

The diameter of the instrument is only 25mm. this includes the electronics head that can be recessed into the borehole for protection.

Telemetry

The RS485 output signal can be transmitted over 1000ft without amplification. Readings are directly in mm allowing immediate interpretation of rock mass deformation without having to enter the raw voltage data in a spreadsheet.

Manual Readout

YieldPoint's low cost *d-Reader* readout unit provides the temperature and displacement data directly in $^{\circ}\text{C}$ and mm.



Data logging

Data from the *d-Exto* can be collected using YieldPoint's *d-Logger* dataloggers (*d¹Logger* and *d⁴Logger*). The data-loggers require no configuration and are fully interchangeable with any other type of YieldPoint instrument (*d-Cable* borehole extensometers, *d-GMM*, *d-Tilt*, *d-Plucker* etc). Therefore arrays of instruments to monitor cable load and ground movement can easily be combined.

Automated Data Retrieval

Clusters of instruments (4 per Logger) that are monitored using YieldPoint's *d⁴Logger* can be wireless networked using *dMesh* - a 900MHz low cost Zigbee wireless mesh solution. Each low-cost wireless mesh (up to 20 modems) can be interfaced to a TCP/IP or WiFi network.

Core Sensor Technology

- ▲ **Core Technology:** Up to 6 temperature compensated Variable Inductance Displacement Sensors: 0-150mm range. 1-wire Digital Temperature sensor
- ▲ **Resolution:** 0.01mm for 125 and 150mm range. 0.2mm for 250mm range.
- ▲ **Linearity:** 0.1%FS typical better than 0.15% based on 10 point digital linearization.
- ▲ **Displacement Temp. Sensitivity:** Typically 0.01%FS. Can be reduced by recessing instrument head into borehole
- ▲ **Repeatability:** Better than 0.25%
- ▲ **Overall Accuracy:** The lesser of 0.5%FS or 0.5mm.
- ▲ **Temp. range:** Temp: -40 to 125°C
- ▲ **Temp resolution:** 0.1C

Overall Instrument Performance

- ▲ **Key Feature:** Fully integrated and preassembled borehole extensometer
- ▲ **Dimensions:** Up to 6 Anchor points over lengths up to 30m
- ▲ **Disp.Accuracy.** - typically 0.5% F.S(<10m) with individual sensors calibrated to 0.1% linearity(>10m). Overall accuracy depends on distance between anchor point and head.
- ▲ **Temp. range:** Temp: -40 to 125°C
- ▲ **Output Signal** -RS485 with transmission up to 500m over 2 x tp.
- ▲ **Output Signal:** A synchronous serial signal: 9600,8,N,1. ASCII encoded. Values and units transmitted.
- ▲ **Leadwire:** 4 conductor. Blk Gnd, Red 5-15VDC, White RS485A, Green RS485B.