Tunnel Profile Monitoring System

MEMS TILT & INCLINATION SERIES

The RST Tunnel Profile Monitoring System is a series of linked rods, fixed to the tunnel wall, to monitor deformation. A data logging system and related software is available to provide near real time displacement and generate a graphical representation of tunnel performance.

A system of linked arms is affixed to the tunnel wall. Each arm is fitted with a high accuracy displacement sensor and precision tilt meter. Spatial displacement of the pins and arms results in changed tilt and displacement readings. The data logger system automatically collects the data and transmits it to a computer. The computer then analyzes the data, and calculates the displacement profile for presentation.

The system is available in either open or closed loop configurations. The closed loop method is analogous to conventional closed end survey techniques, while the open loop must be referenced to a known location.

Typical installation of the RST Tunnel Profile System, with the inset photo showing a close-up of the final setup.

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applications

- Monitor underground openings during construction for control and safety.
- Monitor tunnel deformation due to nearby construction activities.
- Monitoring long term deformation and performance of existing tunnels.

features

- Low profile design, with multiple arms that fit close to the tunnel wall and may be bent in the field to accommodate obstructions on the tunnel wall.
- No tunnel traffic interference.
- High system accuracy of up to 0.06 mm of deformation.
- Custom engineered by RST to suit each individual application.
- Built in connectors for manual tape extensometer connection to verify operation, and aid in initial installation and commissioning.
- Integral multi stage transient lightning protection.
- Immune to the air density related problems inherent in optical systems.
- On board electronics to minimize electrical noise problems, and permit tilt sensor calibration independent of cable length effects. Cable length may be changed without affecting sensor calibration.
- GeoViewer near-real time software with full graphic and alarm capability.
- Direct measurement of displacement, rather than calculating displacement from a tilt measurement.
- Digital Bussed System: single cable per arm to simplify installation and reduce cost.

specifications + ordering info

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ordering info

ITEM	PART #
Tunnel Profile Monitoring Sensor Arm 1.0 m	ICTPMS010
Tunnel Profile Monitoring Sensor Arm 1.5 m	ICTPMS015
Tunnel Profile Monitoring Sensor Arm 2.0 m	ICTPMS020
4 conductor, 22 gauge polyurethane jacketed cable	EL380004
Detailed cross sectional drawing of each instrumented segment.	
Plan layout of instrumented segments, and readout location.	
Open or closed loop system.	
READOUTS & DATALOGGER	
Ultra-Rugged Field PC^2	IC32000-AR2-RSTS
flexDAQ Dataloggers	

system components

- Tilt/displacement sensor assembly.
- Extension tube.
- Electrical cable sensor to logger.
- Reference pin comes with tape extensometer connector.
- Data Logger system.
- GeoViewer software.
- Manual.

sensor specifications

TYPE	PARAMETER	SPECIFICATION
DISPLACEMENT SENSOR	Total Mechanical Travel	25 mm
	Shock	50 g 11 ms half sine
	Vibration	20 g rms 5 Hz to 2 KHz
	Life	One billion dither operations
	Independent Linearity	0.25%
	Operating Temperature	-40 to 80°C
	Resolution	Infinite
	Accuracy	0.06 mm
TILT SENSOR PARAMETER	**SPECIFICATIONS**	
Range	±15° (other ranges upon request)	
Resolution	±2 arc sec. (±0.0006°) (0.01 mm/m)	
Non-linearity	±0.0125% F.S. (±0.002°) (0.03 mm/m)	
Repeatability	±0.0125% F.S. (±0.002°) (0.03 mm/m)	
Sensor	MEMS (Micro-Electro-Mechanical Systems) Accelerometer, Uniaxial	
Operating Temp.	-40 to 85°C (-40 to 185°F)	

geoviewer software

The RST GeoViewer program is custom written in both English and the user's language for each site-specific application. GeoViewer will allow the user to retrieve data from the logger in near-real time and process the data.

The XY coordinates and displacement data for each reference pin is calculated and displayed in a variety of different charts and graphs, displayed graphically, or presented as an image of the tunnel in 3D. Deformation may be animated, time sliced, or rotated as required. An original image of the tunnel may be superimposed with post deformation data to show displacement with time. GeoViewer will automatically collect and process the data to update the screen in near-real time. Alarm functions with user programmable rate/magnitude thresholds are provided. The program format allows data to be imported into outside software programs for further analysis, or will export JPEG images to the Internet. Windows™ XP and Vista operating systems are supported. (Free demonstration software is available on CD. Please contact RST for details).

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