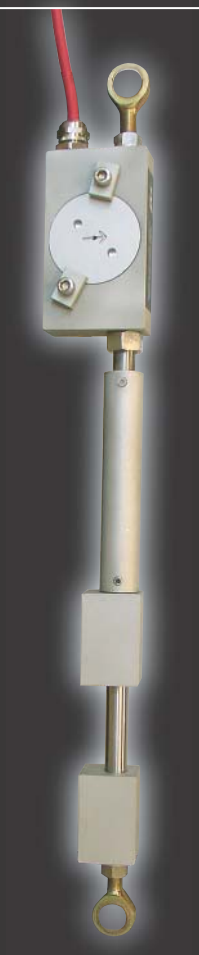
Tunnel Profile Monitoring System

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.



FEATURES

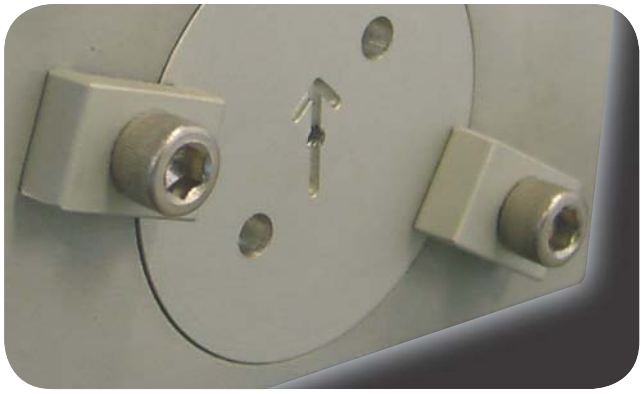
- Low profile design with multiple arms to fit close to the tunnel wall. The arms may be bent in the field to accommodate obstructions on the tunnel wall.
- Does not interfere with tunnel traffic.
- High system accuracy of up to 0.02 mm of deformation.
- Custom engineered by RST to suit each individual 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.
- Integral temperature sensor.
- GeoViewer near-real time software with full graphic and alarm capability.
- Several languages are supported.
- Single cable per arm to simplify installation and reduce cost.
- Direct measurement of displacement, rather than calculating displacement from a tilt measurement.
- DC sensors minimize noise problems.

FUNCTIONS

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

ORDERING INFORMATION

Tunnel Profile Sensor 1.5 m	ICTPMS015
Tunnel Profile Monitoring Sensor Arm 2.0 m	ICTPMS020



Specifications may change without notice. EXB0009B

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The RST Instruments Management System is certified to ISO 9001:2000

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™ 95 – 2000 and NT™ operating systems are supported. (Free demonstration software is available on CD. Please contact RST for details.)

ORDERING INFORMATION (Specify when ordering)

- Detailed cross sectional drawing of each instrumented segment
- Plan layout of instrumented segments, and readout location
- Open or closed loop system
- GeoViewer language option (English is standard)

DATA LOGGER

A Campbell CR-10X based system is integrated with RST hardware and proprietary GeoViewer software to complete the system. System design is site specific, however a logger unit is typically located at each instrumented ring. Each logger is connected to the central readout location by either a single core cable, multi core cable, landline modem, hand phone modem, or radio. All logger components are protected in a NEMA 4X (IP-65) enclosure.

Fully isolated mechanical relays on the RST multiplexer, limit scan speed to approximately 1 channel per second. A complete tunnel profile therefore is performed in near-real time, i.e. delayed by the time required to scan each sensor in the ring.

Loggers are battery powered, with line power backup, for reliable 24-hour operation. Multistage transient lightning protection is provided.

SYSTEM COMPONENTS

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

SENSOR SPECIFICATIONS

DISPLACEMENT SENSOR	PARAMETER	SPECIFICATION
Mechanical	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
Electrical	Independent Linearity	0.1%
	Operating Temperature	-40 to 80°C
	Resolution	Infinite
	Accuracy	0.02 mm

TILT SENSOR

Sensor Type	Electrolevel (standard)
Calibrated Angle Range	±1.5°
Maximum Range	±3°
Resolution (arc degrees)	<.0003
Null Repeatability (arc degrees)	<.0008
Calibrated Accuracy	0.005°
Operating Temperature	-40 to 80°C

TEMPERATURE SENSOR

Interchangeability Tolerance	±0.2°C
Interchangeability Temperature Range	0 to 75°C
Operating Temp. Range	-80° to 75°C
Stability	0.01°C or better / 100 months at 0°C
Resistance at 25°C	2252k Ω

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