



# Pendulum System



Inverted Pendulum shown with RxTx Telependulum.



RxTx Telependulum shown outside of completed system above.

RST's direct and inverted pendulums are simple, and very reliable and accurate systems used to monitor internal lateral deformations of concrete dams, dam foundations and abutments, tall industrial buildings and bridge piers.

The direct pendulum (plumbline) consists of a stainless steel wire attached to a fix point at a top of structure to be monitored, a weight, and a tank containing damping fluid to damp movements of the weight due to wind and air circulation.

Displacements relative to the wire can be measured by a portable coordinometer or the RxTx Telependulum, which allows remote continuous monitoring of deformations.

The inverted pendulum uses the same readout units, and includes a stainless steel wire anchored in the structure foundation with a float fixed at its upper end. The float, which is free to move in a tank, tensions the wire and keeps it vertical. Once anchored in stable point in foundation it measures absolute deformation of the structure and it's used as a reference for surface geodetic surveying.

RST's pendulums are easy to use and very accurate instruments in long- term use, and are an excellent choice for monitoring of concrete dams. The plumbines are usually installed in shafts or pipes extending vertically from crest of the dam to a bottom monitoring gallery located near the dam foundation. Wherever feasible horizontal movements of the dam, in both the upstream-downstream direction and left-right bank direction, are measured at several elevations to obtain the deflected position of the dam section over the full height of the structure.

The length of the plumbline is limited up to 60 m. Longer configurations are not recommended due to excessive vibration of the wire generated by air circulation and wind in the pendulum shaft. To monitor deflection of a complete profile of a very high concrete dam (>> 60 m) several plumbines can be installed in vertical alignment one above the other starting with an inverted pendulum anchored in borehole in the dam foundation.

## ordering info

ITEM	MODEL
Direct pendulum comes with a wire tensioning weight and damper tank.	IC9201
Inverted pendulum comes with a float unit and anchoring weight.	IC9205
Stainless steel wire for pendulums.	IC9210
Portable coordinometer Measuring range: x=150 mm y=50 mm Accuracy: better than 0.1 mm	IC9215
RxTx telependulum Measuring range: x=50 mm y=50mm z=25mm (call RST for detailed specifications)	IC9220



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## applications

To monitor internal lateral deformations of concrete dams, the dam foundations and abutments.

To monitor movement of tall industrial buildings and bridge piers.

## features

Simple, reliable and accurate systems for long term use.

Available as both direct and inverted pendulum systems.

Inverted pendulum measures absolute deformation of structure and can be used to monitor movement of a structure during its construction.

Inverted pendulum can be successfully used as reference for geodetic surveying.

RxTx Telependulum for remote monitoring and datalogging.



specifications + ordering info

# Pendulum System



## RxTx specifications

ITEM	SPECIFICATION
Data Storage Capacity	370 readings
Local Software	EPROM
Clock	Real-time clock
Communication Ports	RS232C, V.24; RS485
Console Port	9600 bps
Modem Port	HAYES™ Compatible 2400 bps or 9600 bps
Sensor	CCD
Precision	±0.05 mm
Resolution	7.5 µm
Measurement Axes	X, Y, Z
Range	50 x 50 x 25 mm
Drift	Digital
Power	9 Va
Voltage	117 Vac
Frequency	60/50 Hz ±10%
Options	DC power supply / Auxiliary power pack
Dimensions (console only)	360 x 380 x 130 mm
Weight (console only)	10 kg
Console	Weather Resistant
Operating Temperature	-10°C to +40°C
Relative Humidity	Up to 95% non-condensing

## RxTx Telependulum

The RxTx Telependulum is an electronic highly precise detection instrument developed for automated continuous remote recording of an anchored or suspended pendulum wire.

The RST Telependulum accurately senses the position of the pendulum wire by using a network of CCD's setup along the X and Y axes. The instrument can also be equipped with an additional Invar leveling wire allowing it to measure small vertical movements in the Z axis. An integrated micro-processor manages all of the Telependulum's activities. The instrument can be accessed at any time through its serial port, using any type of asynchronous terminal. For communication over longer distances, the unit has an integrated RS-485 port and a Hayes compatible modem port. Several data logging options are available, either through the Telependulum's onboard memory or external data loggers offered by RST.

A number of configuration and diagnostic functions are offered, allowing the user to setup the instrument in the field. The telependulum is an excellent choice for both new and existing structures when continuous remote monitoring of deformations is required.

Inside, uncovered view of Inverted Pendulum tank.



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