



Magnetic Settlement Systems



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applications

Monitor settlement or heave associated with construction, mining, and tunneling.

When used around inclinometer casing, deformation in the third axis can be monitored.

Subsidence monitoring.

Displacement of retaining walls, piers, and abutments.

Bottom heave of excavations.

Relaxations of rock around tunnel openings.

Foundation settlement monitoring.

Embankments and fills.

features

Simple, yet accurate principle of operation.

Low cost.

High performance ceramic magnets.

Flush OD, O-ring sealed telescopic sections for access tube or inclinometer casing.

High accuracy, non-stretch tape.

Simple, mechanically released spider magnets without the necessity for pneumatic cutters.

Compatible with RST inclinometer casing.

Integral electrical cable and survey chain.



Close-up of RST's Reed Switch Probe.

RST Instruments Magnetic Settlement Systems are available in 3 main configurations which monitor either heave or settlement in soil and rock. All are designed to be simple, accurate, and provide long term reliability at a low cost.

All 3 configurations listed below use an RST Reed Switch Probe to provide a reading in the magnetic zones allocated along the length of the borehole. Installations are typically vertical, however, horizontal applications may be accommodated utilizing installation rods to insert the probe.

1) MAGNETIC SETTLEMENT SYSTEM WITH FLUSH THREADED PVC PIPE

Installation as a single purpose device to monitor settlement/heave only.

2) MAGNETIC SETTLEMENT SYSTEM WITH INCLINOMETER CASING

Installed in conjunction with RST Flush-coupled Inclinometer Casing to obtain both vertical and horizontal deformation data from a single installation. If larger amounts of settlement/heave are anticipated, this configuration may also incorporate a Corrugated Sleeving with Settlement Magnetic Rings which will accommodate RST's Inclinometer Casing of 70 mm (2.75") and 85 mm (3.34") OD sizes.

3) MAGNETIC SETTLEMENT SYSTEM WITH 1.5" CORRUGATED PIPE

A more inclusive system which contains pre-installed magnets along a 1.5" ID corrugated pipe. This corrugated configuration is also more ideal for situations where larger amounts of settlement/heave are anticipated.



Reed Switch Probe

All 3 types of Magnetic Settlement System configurations employ the use of an RST Reed Switch Probe to provide a reading in the magnetic zones allocated along the length of the borehole.

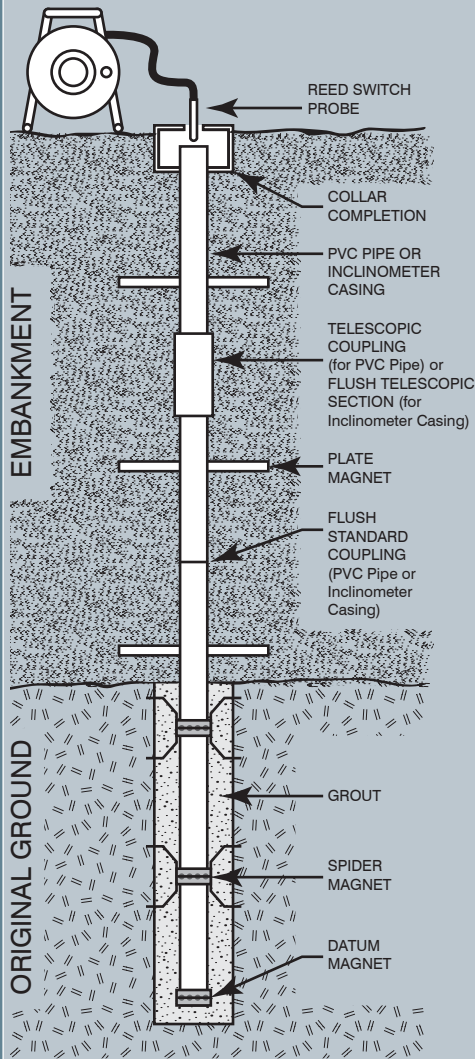


specifications + ordering info

Magnetic Settlement Systems

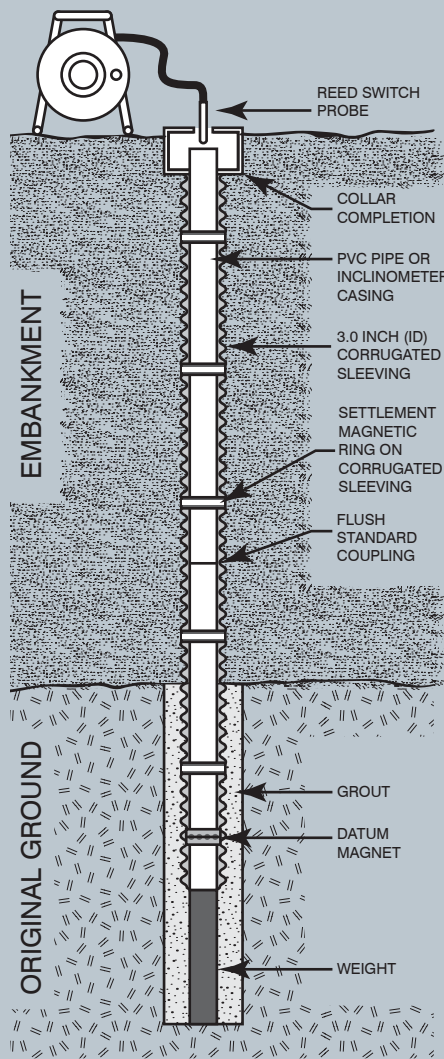
SYSTEM 1

MAGNETIC SETTLEMENT SYSTEM WITH FLUSH THREADED PVC PIPE OR INCLINOMETER CASING



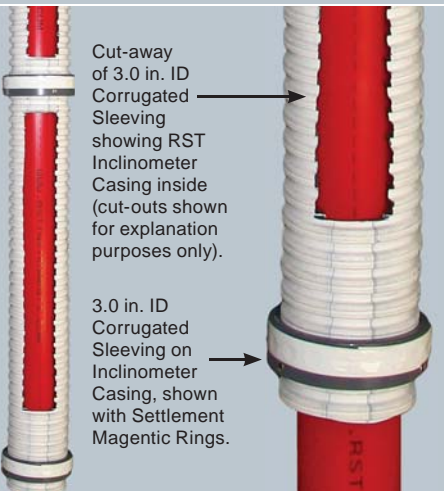
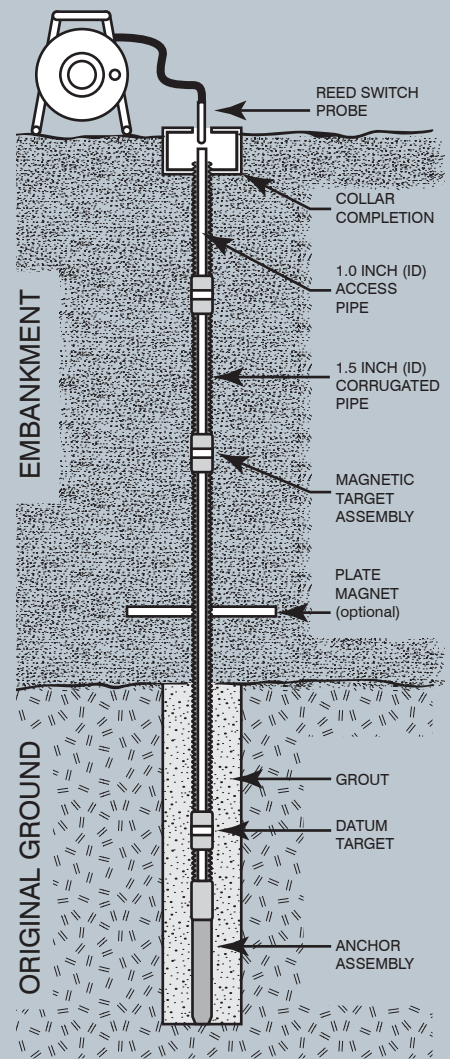
SYSTEM 2

MAGNETIC SETTLEMENT SYSTEM WITH FLUSH THREADED PVC PIPE OR INCLINOMETER CASING AND 3.0 INCH CORRUGATED SLEEVING



SYSTEM 3

MAGNETIC SETTLEMENT SYSTEM WITH 1.5 INCH CORRUGATED PIPE



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Magnetic Settlement Systems



operating principle

Magnetic targets are anchored to the ground around either a PVC pipe, Standpipe Piezometer, Inclinometer Casing, or the corrugated pipe of the 1.5" Corrugated Pipe Magnetic Settlement System. The anchors are not coupled to the access pipe, and are free to move with the soil. Magnets are available for attachment to inclinometer casing to monitor closure of casing telescopic sections

The probe is a normally open, simple reed switch that closes upon entering the magnetic field of the target anchor. Operation is analogous to a water level meter in that when the switch closes, the electrical circuit is completed, causing a buzzer/light in the readout to operate. A two-conductor tape serves to both lower the probe to the bottom of the access tube and connect the probe to the circuit board. To conduct the survey, the probe is lifted from the bottom and the switch in the probe closes upon entering the magnetic field, the signal amplified, and fed to the light/buzzer. Anchor elevation is then read directly from the tape. An optional micrometer head is available for utmost accuracy. A combination Reed Switch/Water Level Meter is also available.

The probe incorporates two reed switches to avoid difficulty in manufacturing a ring magnet with uniform polarity, preclude false closure when passing through the three magnetic fields of the magnet, and negate the end effects on the magnetic field when spring steel spider magnets are employed.

Surveys are always done from bottom to top, not the contrary.

Magnets are arranged within the anchor to yield a uniform, axial magnetic field with a well-defined null zone.

Ceramic magnets, rather than ferrous magnets, are used because of their consistent magnetic properties:

- There is no significant change in field strength with time.
- The magnets are unaffected by most groundwater regimes.
- There is no appreciable difference in field strength with temperature.
- Field strength is unaffected by impact.

Like an inclinometer installation, Reed Switch Settlement Systems utilize the bottom of the borehole as a reference datum. Typically, the borehole is drilled to stable ground and a datum reference magnet installed. If site conditions preclude the use of the bottom of the borehole as a datum, optical survey methods must be used at the borehole collar.

Settlement or heave is determined by comparing subsequent readings to the initial datum readings.

telescopic sections

When vertical compression exceeds 1-2%, telescopic sections must be used to allow axial movement of the access pipe/casing while minimizing distortion due to vertical strain. Telescopic sections, O-ring sealed and flush coupled to permit slipping anchors over the pre-installed access tube, are available to suit either PVC pipe or inclinometer casing.

corrugated sleeving

In replacement of telescopic sections, or in applications where anticipated settlement exceeds the range of telescopic sections, the corrugated sleeving (or the 1.5" Corrugated Pipe Magnetic Settlement System) may be employed to accommodate axial compression up to 35%.

readout

Supplied on a sturdy winding reel, complete with brake and carry handle. A polyethylene or Teflon® coated, non-stretch, flat tape with stainless steel conductors serves to lower the twin reed switch probe. Tapes are dual scale in feet and meters, or single scale in either ft/m, as preferred with a 1/100 ft. or 1 mm resolution. The moisture resistant electronics and standard 9V battery are housed in the reel hub for ease of access. Depth to anchor is indicated by both a light and buzzer with sensitivity control as standard.

access pipe

Access pipes may be either inclinometer casing to monitor both horizontal and vertical deformation, or PVC pipe for settlement/heave measurement only.

RST inclinometer casing is precision manufactured in 70mm (2.75 in.) OD and 85mm (3.34 in.) OD sizes. Two flush coupling methods are available to permit spider anchor installation in cased boreholes. The standard coupling method utilizes ABS cement with the RST Snap Seal Coupling System providing and O-ring sealed, self-coupling method.

Telescopic sections are available to accommodate settlement of 15cm per section. Please refer to the RST inclinometer casing literature for complete specifications. PVC access pipes are flush coupled, threaded joints in either 5ft. (1.5m) or 10ft. (3m) lengths, O-ring sealed telescopic sections are available.

optional equipment

Combination Reed Switch/Water Level Meter

anchor magnets



Datum Magnet

Datum magnets are coupled directly to the bottom of the access pipe or casing, and grouted in place, to serve as a non-setting reference datum in stable ground.



Top view of Plate Magnet

Plate magnets are available for use in fill. The magnets are simply slipped over the pipe or casing as the fill progresses. A large surface area serves to couple the anchor to the fill.

Spider magnets are utilized in borehole installations, employing two methods of deployment. The simplest method requires a cased borehole or hollow stem augers, whereby the greased access pipe/casing is installed through the casing or auger and the drill casing is pulled to the first anchor elevation. A 3-legged spider anchor is then pushed down over the access pipe/casing, exiting the drill casing, allowing the spring legs of the spider magnet to bite into the soil. The casing is pulled to the next anchor location and the procedure is repeated until all anchors are placed. RST systems incorporate flush telescopic sections to permit this method of installation.

Alternately, a 6-legged spider anchor can be utilized. In an open borehole, the access pipe/casing is inserted with all the spider magnets pre installed on the pipe, but with the spider legs retracted. Lengths of corrugated pipe may be utilized to link the magnets, and prevent the grout from bonding to the access pipe. A pin is pulled, similar to a snap ring extensometer anchor, thereby releasing the spider legs to anchor in the soil.

Inclinometer casing magnets are available for incorporation into inclinometer casing telescopic sections, to measure closure of the telescopic joint. This performs the same function as the USBM crossarm device, or a hook type settlement probe, while retaining the simplicity of the reed switch system.



specifications + ordering info

Magnetic Settlement Systems



magnets: specifications

FOR USE WITH PVC PIPE OR INCLINOMETER CASING

MODEL	SPECIFICATIONS
DATUM MAGNETS	
SSRS00D1	To fit 1 in. f.ush threaded PVC pipe. Max OD 5.95cm (2.4 in.).
SSRS00D2	To fit RST 70 mm (2.75 in.) Glue & Snap or Snap Seal inclinometer casing.
SSRS00D4	To fit RST 85 mm (3.34 in.) Glue & Snap or Snap Seal inclinometer casing.
SPIDER MAGNETS	
SSMM100	Mechanical release spider target for 1" PVC pipe.
SSMM275	To fit RST 70 mm (2.75 in.) Glue & Snap or Snap Seal inclinometer casing. Max OD 9.92cm (4.0 in.). Borehole size as required.
SSMM334	To fit RST 85 mm (3.34 in.) Glue & Snap or Snap Seal inclinometer casing. Max OD 11.16 cm (4.5 in.). Borehole size as required.
PLATE MAGNETS	
SSRS00P1	To fit 1 in. f.ush threaded PVC pipe. Dimensions: 30 x 30 cm (12 x 12 in.)
SSRS00P2	To fit RST 70 mm (2.75 in.) Glue & Snap or Snap Seal inclinometer casing. Dimensions: 30 x 30 cm (12 x 12 in.)
SSRS00P3	To fit RST 85 mm (3.34 in.) Standard or Snap Seal inclinometer casing. Dimensions: 30 x 30 cm (12 x 12 in.)
INCLINOMETER CASING: TELESCOPIC SECTION MAGNETS	
ICGC2TS01	To fit RST 70 mm (2.75 in.) Glue & Snap casing. Max OD 7.25 cm (2.85 in.)
ICSC2TS01	To fit RST 70 mm (2.75 in.) Snap Seal casing. Max OD 7.25 cm (2.85 in.)
ICGC3TS01	To fit RST 85 mm (3.34 in.) Glue & Snap casing. Max OD 8.89 cm (3.50 in.)
ICSC3TS01	To fit RST 85 mm (3.34 in.) Snap Seal casing. Max OD 8.89 cm (3.50 in.)

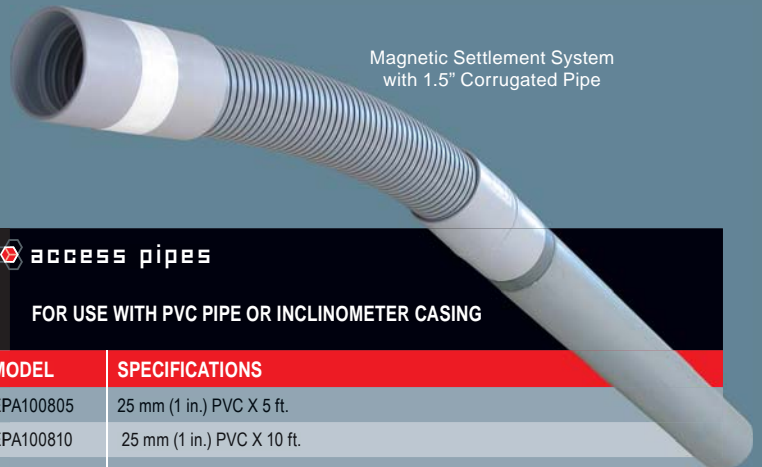


Reed Switch Probe

magnets + access pipes: specifications

FOR USE WITH 1.5 INCH CORRUGATED PIPE SETTLEMENT SYSTEM

MODEL	SPECIFICATIONS
MAGNETS	
SS3210	Anchor Assembly (includes Datum Target)
SS3220	Magnetic Target Assembly
SSRS00P2	Plate Magnet: 30 x 30 cm (12 x 12 in.)
SLEEVING AND ACCESS PIPES	
SS3201	Corrugated pipe/sleeving 38.1 mm (1.5 in) ID
EPA100805	25 mm (1.0 in.) PVC Access Pipe x 5 ft.
EPA100810	25 mm (1.0 in.) PVC Access Pipe x 10 ft.



Magnetic Settlement System with 1.5" Corrugated Pipe

access pipes

FOR USE WITH PVC PIPE OR INCLINOMETER CASING

MODEL	SPECIFICATIONS
EPA100805	25 mm (1 in.) PVC X 5 ft.
EPA100810	25 mm (1 in.) PVC X 10 ft.
SSTS100	1" Telescopic Section - 10' to 7' (3m to 2m) (43mm OD)
ICGC210	2.75 in. Glue & Snap casing X 10 ft.
ICGC205	2.75 in. Glue & Snap casing X 5 ft.
ICTC205	70 mm (2.75 in.) Standard telescopic casing section
ICSC305	3.34 in. Snap Seal casing X 10 ft.
ICSC310	3.34 in. Snap Seal casing X 5 ft.
ICTC310	85 mm (3.34 in.) Snap Seal telescopic casing section
SS3001	Corrugated sleeving 76.2 mm (3.0 in) ID

readout specifications

MODEL	LENGTHS	ITEM	SPECIFICATIONS
SSRS0100	100 ft.	TAPE	Polyethylene coated (Teflon® coated optional) 10mm (0.4 in.) fat style. Stainless steel conductors.
SSRS0150	150 ft.		
SSRS0200	200 ft.		
SSRS0250	250 ft.		
SSRS0300	300 ft.	PROBE	Two reed switches standard. 16 X 200 mm (5/8 in. OD X 8 in. long)
SSRSM015	15 m		
SSRSM030	30 m	REED SWITCH PRECISION	±0.03 to 0.3 mm (±0.001 to 0.01 in.)
SSRSM050	50 m		
SSRSM075	75 m	SYSTEM PRECISION	Vertical installations typically ±3 to 5 mm (±0.1 to 0.2 in.). Vertical installations with micrometer head typically ±0.5 mm (±0.02 in.).
SRSM0100	100 m		
SRSM150	150 m		
Please contact RST for non-standard length requests.		BATTERY	Standard 9 V

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