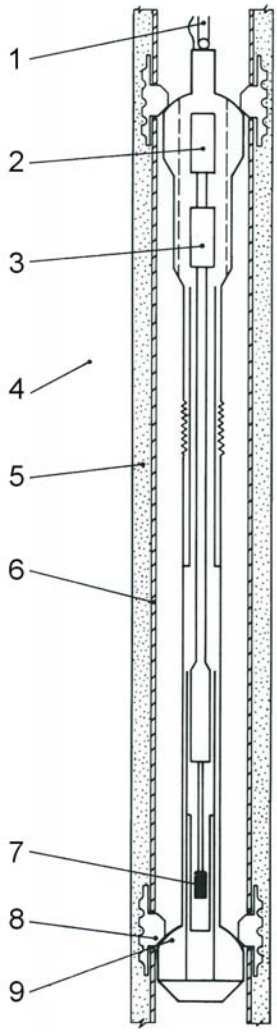
The Trivec probe allows to carry out inclinometer and probe extensometer measurements at the same time. It is a high-precision instrument for determining the three orthogonal components (x, y and z) of the displacement vector of vertical until subvertical measuring axes. The Trivec is a continued development of the sliding micrometer ISETH, which is additionally equipped with two inclinometer sensors (s. Fig. 1). This technology has been developed at the institute for road, railway and rock construction of the Technical University of Zurich, Switzerland. The high-precision measurements are achieved by means of bracing the probe with its spherical heads in the conical measuring marks.



1 Guide rods
2 Inclinometer sensor (x-component)
3 Inclinometer sensor (y-component)
4 Soil, rock or concrete
5 Cementation
6 Measuring tube
7 Displacement sensor (z-component)
8 Measuring mark (conical)
9 Sensor head (spherical)

Fig. 1 Longitudinal section through borehole, measuring tube and probe

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The measuring marks are installed in boreholes of a diameter of at least 100 mm in intervals of 1 m with the help of a plastic protective casing.

The measuring tube is positioned in the borehole, that the x and y axis of the instrument in measuring position is adapted to the measuring aim. Then the annular gap between borehole wall and casing is filled with cement mortar to connect rock and measuring marks.

The probe, weighing only 3 kg, is inserted into the casing and moved in a step-by-step fashion between the measuring marks which are at 1.0 m intervals. Both the spherically shaped probe heads and the measuring marks are provided with recesses which enable the probe to slide along the casing from one measuring mark to the next (sliding position). By rotating the probe 45 ° and pulling back on the guide rods, the probe's two heads are tensioned between two adjacent measuring marks (measuring position). Then rotate the probe 180 ° with the help of the guide rods and measure again.

High precision measurements can be achieved due to the excellent reproducibility of placing the probe. In the calibration frame an accuracy of $\pm$ 1 μm in z-direction and under field conditions $\pm$ 3 μm are attained. The high precision is due to the cone-sphere principle which defines the exact position of the sensor heads with respect to the measuring marks. The sensitivity of the instrument in terms of extension amounts to $1 \cdot 10^{-6}$ for the z-component, the measuring range is 20 mm. Probe and calibration device are provided with a temperature sensor to compensate length changes of the measured distance influenced by temperature.

The precise placing of the probe allows also an extremely high accuracy when measuring the x- and y-component with the aid of the two installed inclinometers. In case of careful measurement the accuracy is $\pm$ 0.05 mm / m at a service temperature between 0 and 40° C.

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Sales Information

2.6.3.1 Trivec measuring tube,
base length 1.0 m made of HPVC
outer diameter 60 mm,
inner diameter 50 mm
with telescopic coupling and conic
accurate stop

2.6.3.2 Cover made of HPVC for measuring tube, below,
with telescopic coupling and 0.5 m
measuring tube

2.6.3.3 Cover made of HPVC for measuring tube, above,
with flange d = 150 mm to fix the cable winch
and 0.5 m measuring tube

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