GLÖTZL Baumeßtechnik

THREE-AXIAL BOREHOLE DEFORMATION PROBE

for determination of compressive stress transpositions in elastic range

Type: DBS . . .
Art. No: 95.10

Figure 1 P095.10FO01_engl.cdr

The instrument is used for measurement of borehole deformations in three orthogonal directions (2 x radial and axial) and enables the determination of stress transpositions in elastic range (system Herget [1], s. fig.1).

By the mechanical precision wedge and the vibrating wire principle, long-term measurements can be carried out and the instrument can be recovered for the application in new measuring sections.

Application:

- Stress transpositions in hard rock, in concrete structures and salt formations
- Control of construction behaviour
- Long-term deformations in 0.001 mm range with automatic data recording

Measuring Principle:

In the borehole, the three-axial probe is a soft inclusion consisting of two measuring rings (figure 3) which are connected to each other by a telescopic tube.

The deformation of the telescopic tube and the measuring rings is recorded by vibrating wires with an accuracy of up to 0.0002 mm/Hz.

Connection to the borehole wall is done by hydraulically placed keys which are running on precision-refined contact areas.

The installation is uncomplicated for boreholes with any inclination.

Recovery is possible for an application in further measuring sections.

Figure 2 P095.10FO02_engl.cdr

[1] Manufactured under CANMET-licence, Ottawa, Canada, US patent: 4858472, 5113707, 5463907

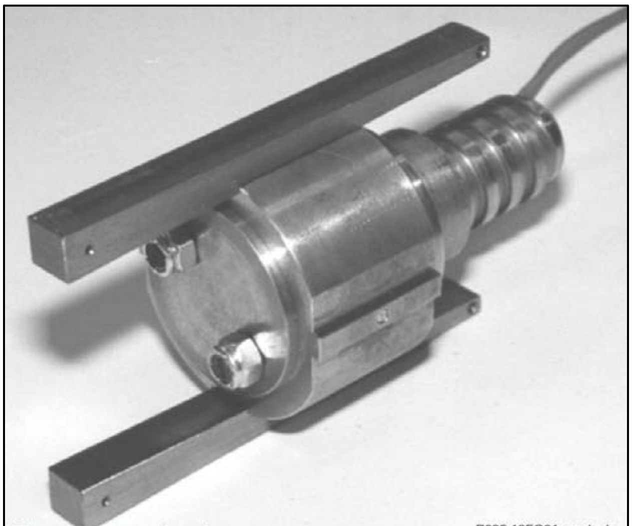
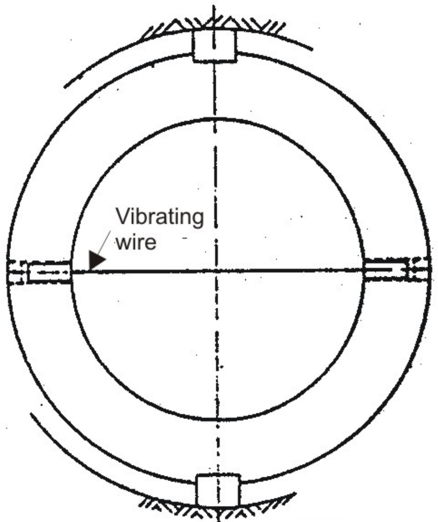


Figure 3: Measuring ring P095.10FO01_engl.cdr



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The measuring rings are availabe in two rigidities to enable a correct application in hard rock, in concrete of hard salt.

Corrosion protection and temperature coefficients can be selected according to the in-situ conditions. The instrument is robust in regard to blasting and construction works.

By means of calibration curves (figures 4 and 5) and the corresponding material laws, stress transpositions and energy accumulations are determined by upsetting deformations in three orthogonal directions.

Data recording by automatic collector is recom-mended.

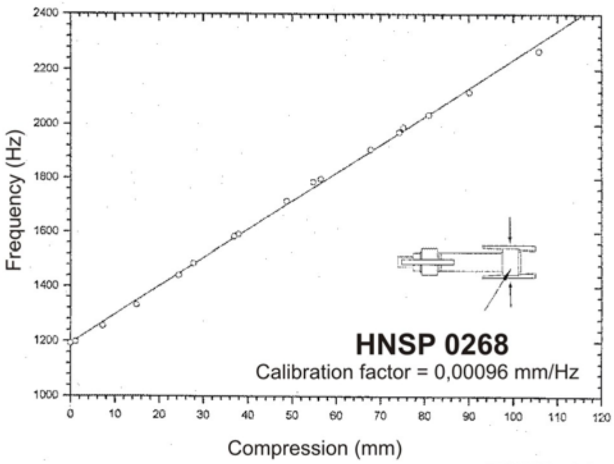


Figure 4 '095.10SB02_engl.cdr

Calibration curve for measuring ring

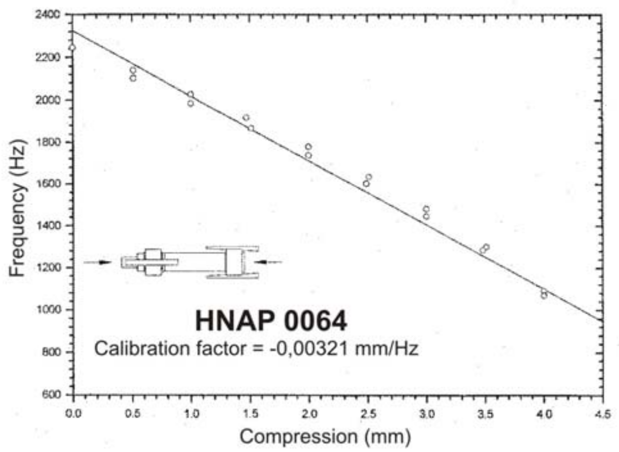


Figure 5 P095.10SB03_engl.cdr

Calibration curve for axial displacem. transducer

Examples:

In a horizontal borehole with a dia. of 118 mm four measuring rings are installed so that four diameters permanently displaced by 45° are recorded.

After a blasting for a nearby cavern, the following measuring values have been recorded on 04.12.88 (figure 6):

Angle of diameter to the

Horizontal	0°	45°	90°	135°
Frequency change	+22	0	-11	12
Calibration factor (10^{-5} mm/Hz)	25	18	28	18
Diameter change (mm)	0.0055	0	-0.0031	0.0022
Upsetting 10^{-6}	46.5	0	-26	18.2

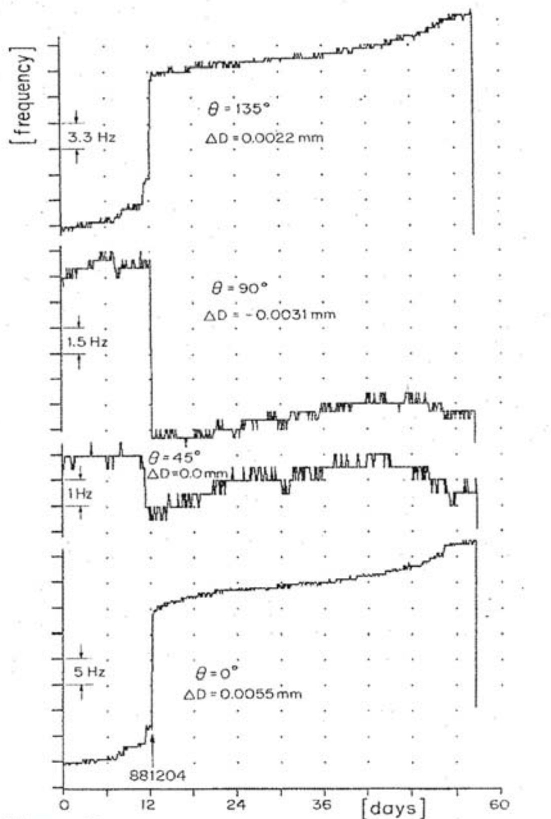


Figure 6 P095.10SB04_engl.cdr

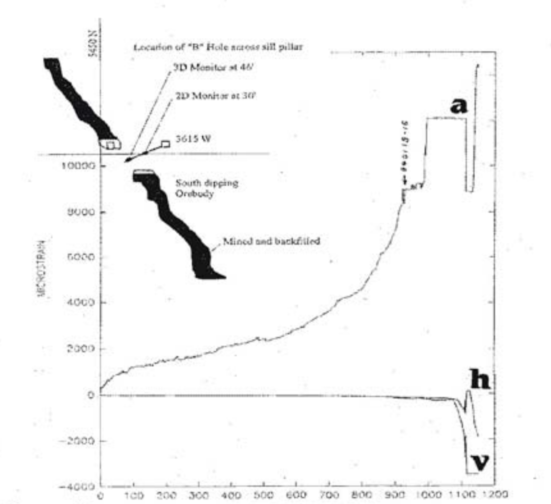


Figure 7 P095.10SB05_engl.cdr

The fourth measuring direction allows a quality control and the stress ellipse could be calculated four times.
With an elasticity modulus of 58 GPa and a Poisson's condition of 0.3 the following stress changes could be recorded:

Meas. direction	Max. pressure (MPa)	Min. pressure (MPa)	Angle of max. stress to horizont. position
0°, 90°, 135°	2.5	-0.81	-6.2°
45°, 90°, 135°	2.38	-0.86	-7.2°
45°, 90°, 135°	2.52	-0.83	-7.8°
135°, 0°, 45°	2.47	-0.95	-6.8°
Average	2.46 ± 0.06	-0.86 ± 0.06	-7.0° ± 0.7°

The above list shows the repeatability of the measured values. For the advice if the rock is in the elastic range or the advice to what extent the compressive stresses have changed by mining or cavity, a two-dimensional measuring arrangement is sufficent in many cases. However, if quantitative or half-quantitative values are required for planning or calibration of numerical models, it will be necessary to measure the reaction of rock in three dimensions.

For this purpose, the probe will be delivered with three orthogonally oriented displacement determinations. This is required as minimum for the three-dimensional measurement.

An example is given in figure 7 where a measurement of the diameter in vertical (V) or horizontal direction (H) would not have given any hint to the great stress change parallel to the borehole (A).

Technical Data (instrument for boreholes with Ø 86 mm)

Type	Steel	Radial stiffness	Calibr. factor	Deformation range	Temperature coefficient
standard	normal	160 MN/m	0.0002 mm/Hz	0.2 mm	0.2 Hz/°C
standard	stainless	125 MN/m	0.0002 mm/Hz	0.2 mm	4.8 Hz/°C
thin wall	normal	17 MN/m	0.0001 mm/Hz	0.2 mm	0.2 Hz/°C
thin wall	stainless	13 MN/m	0.0001 mm/Hz	0.2 mm	4.8 Hz/°C
Axial telescopic tube:			0.003 mm/Hz	6.3 mm	-0.2 Hz/°C

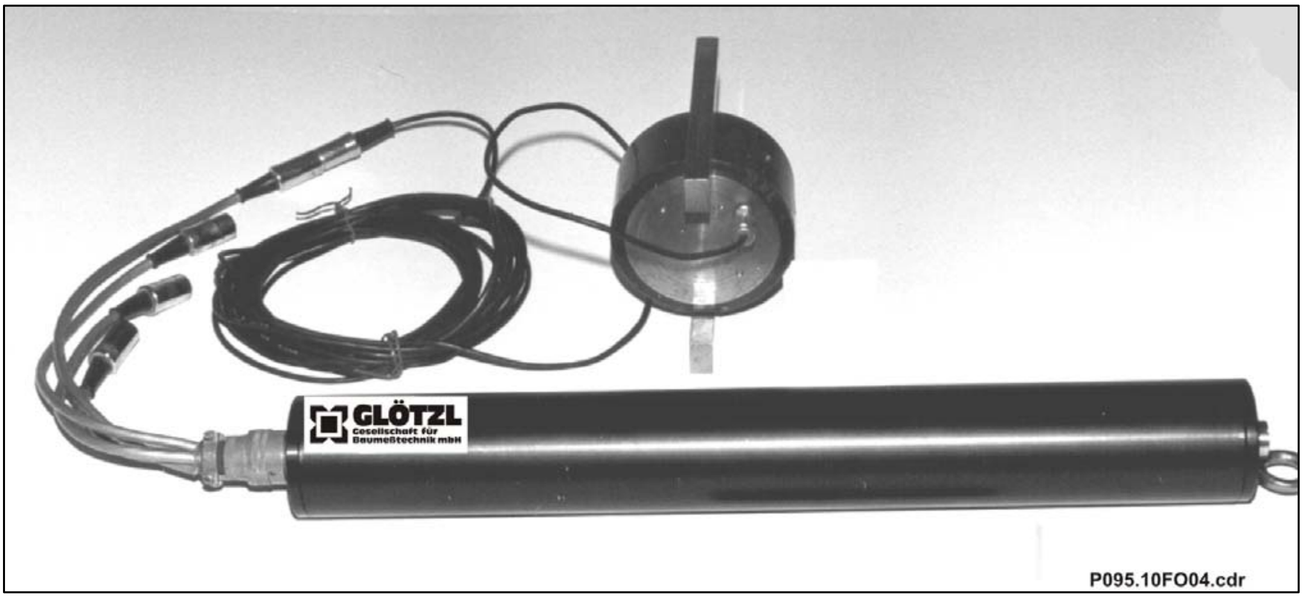
Operating frequency: 1000 - 2500 Hz
Vibrating wire holding device: stainless steel clamp
Temperature range: -20° up to +80° (higher values on request)
Watertight up to 2 bars.

Data Recording Devices:

Multimeter with data memory and allocation of measuring points, type VMG11-1; see detailed single description

Portable readout unit with simple ring memory for battery operation, type KMG 06-D

Automatic measuring station MFA 6E as standard or Exx-model



Watertight tube data collector