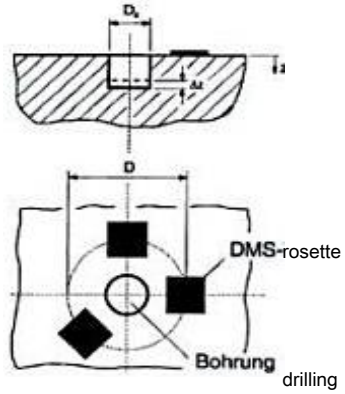
DE =	EN =	PT =	UN =
Method borehole			

Voltage measurement means wellbore method

The hole drilling method is one of the most commonly used mechanical part destructive method with an internationally recognized standard (AST E 837-99). In the borehole method, the determination of the internal stresses of the material by the strain change occurs in the material removal. Through the hole-free surfaces, which leads to the release of the residual stresses and distortion change entstehehen. The deformation is using strain gauges, known as strain gage rosettes registered (Figure 4.13).



drilling

a)

Carbide end mill (drills)

well

DMS rosette

b)

Figure 4.13: Measurement setup, the hole drilling method, diagrammatic representation metallic
Observation of the drilling operation with the video microscope

A gradual introduction of the bore turns at each depth step in the vicinity of the bore, a new state of equilibrium, since the voltages must disappear perpendicular to the generated load bore cylindrical surface. For each depth slice Az the strains are registered on the component surface in the radial direction and plotted as a function of depth z. In order to obtain a correlation between the residual stress caused in the depth R and registered on the surface change in the strain Δε signals, a calibration to a known, mostly homogenous state of tension with the aid of a standard is necessary.

To evaluate the residual stresses Various methods represent the most common is probably the determination of residual stress over a residual stress distribution, since the gradient of the residual stress distribution can be viewed over the depth. In practice this several methods have become established, which is to be further only briefly on the method of Kelsey.

DE =	EN =	PT =	UN =
Method borehole			

Kelsey leads to internal stress calculating a proportionality factor K (Eq. (4.11)) again as the measured strain changes Δε may be converted during the hole-drilling method is not directly over the Hooke's law in voltages. This arises because the voltages in a depth increment Az are only partially triggered when drilling:

$$\Delta\varepsilon_{z_i} = K \cdot \frac{R_{z_i}}{E} \qquad (4.11)$$

With

Δε strain change

K proportionality factor = f (bore diameter D₀ Geometry and arrangement of the strain gauges, hole depth z.

For the calculation of residual stresses after Kelsey for the two-axis case, it follows by considering the case of a drilling Az at a depth zᵢ measured at the surface strain increments Δε following relationship (equation (4.12) and (4.13).):

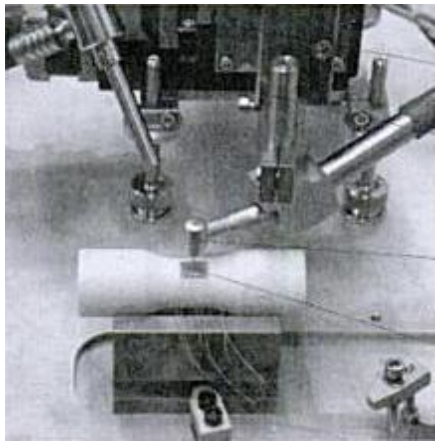
$$R_x = \frac{E}{K_x^2 - \mu^2 \cdot K_y^2} \cdot \left[K_x \cdot (\Delta\varepsilon_x) + \mu \cdot K_y \cdot (\Delta\varepsilon_y)\right] \qquad (4.12)$$

$$R_y = \frac{E}{K_x^2 - \mu^2 \cdot K_y^2} \cdot \left[K_x \cdot (\Delta\varepsilon_y) + \mu \cdot K_y \cdot (\Delta\varepsilon_x)\right] \qquad (4.13)$$

Where:

μ Poisson's ratio of the material K proportionality

In Figure 4.14 the experimental setup is shown a borehole for examination.
Most measurement systems for
Logging ermöglicen it,
to examine parts with very complex geometries and in different sizes.



3-axis translation stage for controlling the drilling operation

Video microscope to center of the drill and observation of measurement process

Dental turbine with precision bearings Sion

DMS rosette

Figure 4.14: Borehole procedure in the laboratory

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Modification:	on	Date:	03/14/2014	WIAP KFKOK	Method borehole	r 1a	datei_wi_8_f_1_19_f200_r
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DE =	EN =	PT =	UN =
Method borehole			

The results of a well logging with a residual stress depth profile of a 300 micron thick hard chromium layer on a copper base body are shown in Figure 4.15. Using this principle must be observed that the optimal penetration depth depends on the diameter of the drill used, and from a depth of about 1 mm no reliable evaluation of the results is possible.

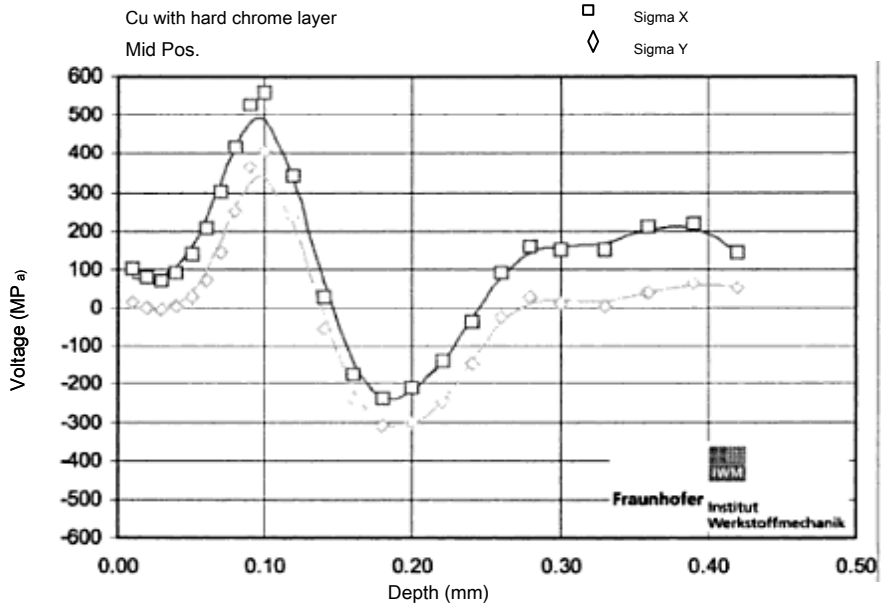

Figure 4.15: residual stress distribution at the example of a hard chrome layer determined by means of incremental hole drilling method

A significant advantage of the hole drilling method is in a relatively simple measurement implementation. The measurements are performed locally with a very high spatial resolution. Using the incremental hole drilling method, it is possible to measure depth distributions of residual stresses.

The disadvantage of this method lies in the partially destructive measuring principle, and this must be considered depending on the use of the component, since it only is very small holes.

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