Made in Germany

KOBA-Ball Bar®

Protected by Patent

Monitoring system for periodic supervision of large co-ordinate measuring machines

DELIVERY PROGRAMME AND SERVICE:

- Gauge blocks
- Gauge block accessories
- Step gauge KOBA-step
- Sphere plate KOBA-check
- Thread gauges
- Cylindrical gauges
- Flat gauges
- Precision parts
- Spline gauges
- KOBA-calibration service
- DKD-calibration laboratory

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Special requirements desired of a monitoring process for large Coordinate measuring devices where at least one axis is longer than 2 meters are as follows:

- Assessment possibility for the entire measuring volume with sufficiently fine subdivision
- Recording the effect of all defective components as far as possible as well as of the probing system also in the case of CMM with numeric correction of errors
- Conformity of the characteristic sizes which have been determined to the existing standards and guidelines and thereby easy interpretation
- General good-bad statement
- Connection to the SI-unit meter
- Easy handling and quick setup.

Figure 1: **KOBA-Ball Bar** on a CMM of horizontal arm type

KOBA-Ball Bar with its constructive features represents a suitable monitoring standard for this task. The basic concept of the equipment is based on a patented idea originating in the year 1989 (Patent application P 3930223.7), which was further developed into a dismountable test body by the PTB. The constructive transformation by Kolb & Baumann was carried out in a close collaboration with the PTB and the automobile industry.

The principle of the dismountable test body constitutes that the balls and the distance rods be lined together as such dimension determining elements in a reproducible manner without having to perform the carrying function for the entire structure. This task is taken over by the carrying devices which disengage by application of force. The total length is determined by the one-after-the other lining sequence of balls and rods (1).

The significant features of the KOBA-Ball Bar are:

- High reproductivity of measuring lengths by means of a three-point contact on the joint of the ball-distance tube
- Long-term stability due to the contact points made of hard metal
- Simple calibration
- Short set-up and take-down durations
- Easy handling as a result of maximum element lengths of 1800 mm in the case of lesser weight
- Varying lengths and divisions
- Constant axial force on the joint of the ball-distance tube
- Corrosion resistant due to the ceramic balls and special steel-distance tubes.
- Distance rods alternatively of carbon-fibre with coefficient of thermal expansion close to 0.

Construction features:

The carrying body comprises of a CFC-GFC aluminium box section packed with foam material the most significant features of which are high rigidity and good vibration damping capacity in the case of lesser weight. The number of individual elements depends upon the total length. These are positively tied together by the fastening elements. The fixing elements are ceramic balls which are connected over a spring element with retainers in the base. This spring element provides freedom of movement in axial direction which is essential for a perfect bonding between the ball and the distance tube. Stress is applied to the rods and balls which have been lined up by means of a clamping unit with reproducible force in the axial direction and support themselves upon a fixed skewback (springer) at the opposite end. Thereby changes in the length occurring due to the varied pre-stress forces are avoided.

Figure 2: Ball on the spring element between two distance tubes

The tube elements are designed in a self-centering manner for skewback and for the clamping unit.
The distance tubes are made of stainless steel or CFC at the end of which a carbide three-point contact is provided for the ceramic balls. This form of contact ensures the best reproductivity of measured lengths.

The mounting of KOBA-Ball Bar is carried out by means of a step bearing and a reasonably stable, support adjustable in height (alternatively, in order to be able to achieve a horizontal equipment, two supports can also be used).

Handling:

Owing to a well-planned design, setting-up of the completely dismounted test body can be accomplished within 20 min. by one person.
A change of the position of the test body within the measuring volume can be made within few minutes.

Calibration:

The calibration of individual measuring lengths can be carried out by the user on an exact co-ordinate measuring machine of normal construction size. Thereby, the cost of calibration is greatly reduced. For the purpose of calibration, only the first supporting body element is used. On this element a small number of measuring lengths, corresponding to the size of the measuring machine, are mounted by using the clamping unit.
The respective pairs (for example Ball 1-Rod 1-Ball 2 / Ball 2-Rod 2-Ball 3 etc.) are measured and the values for the distances of center point of ball are noted in a calibration document.

Why are there two types of distance tubes of different material?

The measuring results of distance tubes of stainless steel with coefficient of thermal expansion of $\alpha = 16 \cdot 10^{-6}\ K^{-1}$ reflect environmental influences.
This means that the fluctuations in temperature are reproduced in length deviations and present the actual uncertainty of measurement.
Distance tubes of CFC-material with coefficient of thermal expansion of 0 do not react to fluctuations in temperature and merely show the uncertainty of measurement of the measuring instrument without any influence of the environmental conditions.

Figure 4: CFC-tube with carbide 3-point contact

Application and evaluation:

The ball bar is adjusted and measured in various positions in the measuring volumes according to the respective specific requirements. The arrangement can be carried out in the direction of individual axis, in the direction of diagonals of the measuring planes or in the direction of the space diagonals in the measuring volume of the CMM to be examined. The measuring values which have been recorded can be evaluated with the software GUK-KS. The software is independent of the manufacturer of the measuring machine and can administer up to 100 measuring machines.

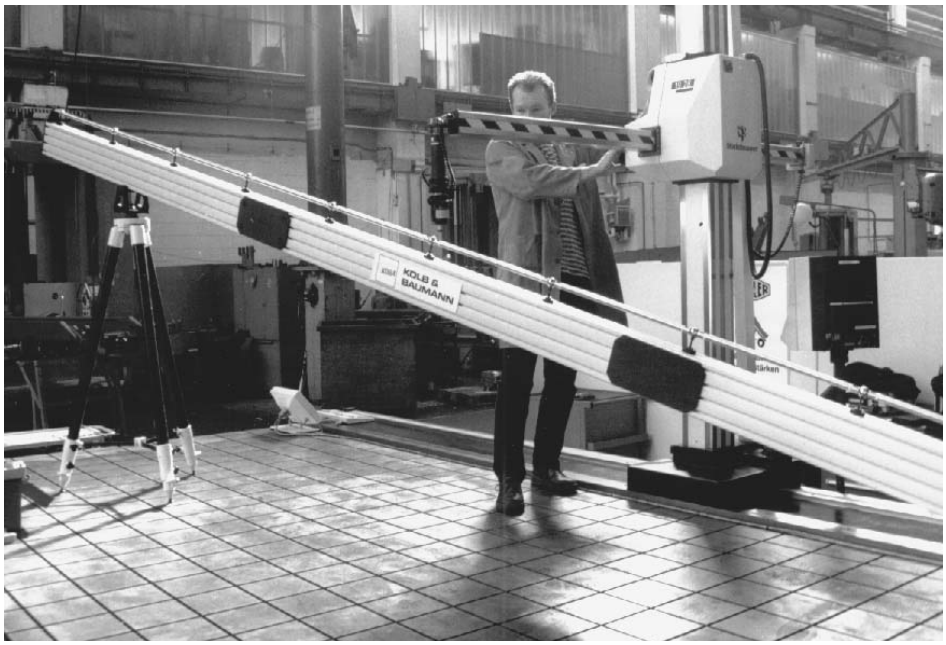

Figure 3: Checking of a CMM with the **KOBA-Ball Bar** of the first generation

Technical data:

Attainable lengths:	2000 mm to 8000 mm
Division (Ball distance):	200 mm, 300 mm, 400 mm, 500 mm (special divisions possible)
Useable vertical range of height:	250 mm to 3000 mm (depending on the length)
Probing elements:	Ceramic balls 30 mm
Distance tubes:	Tube of stainless steel or CFC with three-point contacts made of carbide
Weight:	approx. 8 kg / m
Length of individual elements:	max. 1800 mm

List of sources:

(1) Überwachung großer Koordinatenmeßgeräte mit einem demontierbaren Prüfkörper
Busch, K.; Trapet, E.; Wäldele, F.
Physikalisch-Technische Bundesanstalt, Braunschweig

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