KR06-100: Instructions for checking absolute measuring caliper gauges of the series E100 (digital-analog)

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1 Generalities

This instruction follows the checking instructions for caliper gauges according to VDI/VDE/DGQ 2618, page 12.1 and 13.1.
The gauges are referred to as gauges with absolute measurement and adjustable zero point.

2 Terms

Terms of length testing techniques see DIN 2257, part 1 and 2 (see also fig. 1) and International Vocabulary of Basic and General Terms in Metrology.

2.1 Range of indication Azb

The range of indication is the range between the highest and the lowest indication.

2.2 Measuring range Meb

The measuring range is defined as the range of values of the measurable variable, in which given or stipulated margins of error will not be exœeded.

2.3 Total motion Gh

The total motion of the movable caliper arm consists of the range of indication and the free motion.

2.4 Scale interval (Graduation) Skw = Zw numerical interval

The scale interval represents the modification of the value of the measurable variable, which causes the indication to change by one scale part. The scale interval is indicated in the unit of the measurable variable. The scale interval was also called graduation. The numerical interval of a numerical scale is the change of the value of the measured variable, which causes a change of the reading by a number step. The numerical interval, which corresponds to the scale interval of a mark-scale, is indicated in the unit of the measured variable.

2.5 Deviation in the measuring range f_M

The deviation in the measuring range (range of deviation) f_M represents the distance of ordinates between the highest and the lowest position in the deviation diagram, when the movable caliper arm closes. The tolerance field G_M for f_M is symmetrically positioned to the zero line.

2.6 Repeat precision f_W

The repeat precision f_W is a characteristic value for deviations of the measured quantity within the measuring range of the movable caliper arm (usually n is 5). This margin of error is designated as repeat limit r.

2.7 Measuring force F_{min} , F_{max}

When the caliper arm closes, the measuring force F_{min}/F_{max} is determined at the top of the movable caliper arm.
The gauge must be held in vertical position.

3 Characteristics for checking

The values of table 1 and 2 must not be exceeded within the measuring range. These values are valid for the vertical measuring position of the instruments for internal measurement (F…) and for the instruments for external measurement (B…).

Attention:
The above mentioned error parameters imply the correct handling of the gauge. Errors, which are due to incorrect handling such as extreme motion of the caliper arms, application in temperatures below 10°C and above 30°C are excluded.
Gauges used out of the reference temperature the zero point have to be adjusted. Extremely loadings are fast and jerky actuating of the arms, as well as tight hitting against the limit stop in the case

3.1 Reading

Division scales (scale ring, scale)
The division scale is to be arranged by lines with marginal sharpness. These lines should clearly contrast with the ground. All lines should be straight, directed to the rotation of the pointer pivot and arranged centrically. Accentuated lines should be longer than the others.
The distance of the centers of adjacent lines (scale spacing) should not be smaller than 0.75 mm, measured from a circle described by the tip of the pointer. The width of the lines should be 0,3mm of the scale spacing width. The deviation of the medium width of one line within one scale must not exceed ± 0.03 scale spacing. The scale interval has to be indicated with value and unity in mm using the following symbol: ⇒¦ ⇐ 0.01mm.

Cleanness and quality of the scale print, bezel
The field of the scale lines applies as an operating field. Visible breaks of the lines, colour specks or dust particles more than 0,1mm are not admissible. The rest of the LCD-Display applies as a design field. Max. 2 visible colour specks not more than 0,2mm are admissible. The colour specks on the LCD-Display must not exceed 0,1mm.
If colour specks and dust particles in the operation field, design field and on the LCD-Display are in tolerance are only allowed one time per gauge in the different fields and not together (plural pieces are not allowed).

Total lift
Against the figures indicated in the table 1, the gauges are allowed to deviate from the following values:

Gauge	Max-value (mm)	Min-value (mm)
F…	±0,5	±0,5
B…	±0,5	

3.2 Adjustment and measuring force

Identification
Similarly to the standard for dial gauges VDI/VDE/DGQ 2618 page 12.1 and 13.1 the checking is done in steps, which correspond to the decuple of the scale interval (up to 200 times). Block gauges and ring gauges are used to determine f_M and f_W. A fully automatically checking device is also used to determine

these values.
Its calibration is annually revised. Being checked through the DKD (German calibration service), all gauges and devices correspond to the national length standard.
The repeatability f_W is checked by means of 5 measurements of the same measure in the first third of the measuring range.

Attention: Usually all gauges are electronically adjusted with error limits. For manual calibration the tolerance limits of the certificate are valid. Variations due to the operator are considered. In case of failure of the electronic adjustment a B1 certificate based on manual inspection is provided. The following test points are considered for B1 certificates:

Measuring range ≤ 20 mm	5 test points
Measuring range = 25 mm	6 test points
Measuring range ≥ 50 mm	11 test points

The certificate of calibration applies as quality statement.

Pointer position at the beginning of the measuring range
A deviation of the pointer at the beginning of the measuring range or „0“ is admissible.
A deviation of ± 3 test points should not be exceeded. The caliper gauge should have a specific key for the now necessary zero point adjustment.

Measuring force
The measuring force for the B... and F... is made by means of a tensile spring.
The force is defined by the spring inset point and the spring. A force-sending device can determine the measuring force.
Pre-stressing the spring makes the given measuring force.
The measuring force values are presented in the table 1. The Fmin and Fmax-value includes the given tolerance of the spring-manufacturer.

Reference temperature
The reference temperature is 20 ± 3 °C.

Sight and function-control

- Function-control with a battery
- Figures and scale should be readable and show good contrast allover.
- Check the initial value
- Check the MM/INCH-Selection (not actively with Mitutoyo-Japan)
- Check the absolute/relative/Measuring mode-Selection
- Check the numerical division
- Check the Mode-selection
- Check the measuring contacts (the measuring surface should be clean and uncoated
- Check the complete measuring range, if there is no slipping sound during actuation
- Check the measuring force in random samples
- **Protection IP 63 must be ensured**.
  Check the seal for correct fit, the case must be sealed and firmly bolt
- For checking the tightness use the CETA 810 (Overpressure-Check)

- **Interface**
  Check the interface with the Mitutoyoprinter.

3.3 Measuring arms and contacts

Measuring arms
Measuring arms made of stainless steel are usually not coated.
Concerning surface irregularities a visual check is made.

Measuring contacts
All ball-measuring contacts made of stainless steel are provided with a carbide ball, which are fixed by inductive soldering.
The quality is visual checked.
All chisel measuring contacts are made of stainless steel and are tempered.
Flat measuring contacts made of stainless steel or aluminum are coated with hart-coat.

Interchangeability
If there is a possibility the gauges have interchangeable measuring contacts.
When changing the measuring contacts insignificant deviations in the display are possible because of the process tolerance and will be compensated by the function-key.

Positions tolerance of the measuring contacts
The gauges with ball contacts or chisel contacts have an admissible position tolerance deviation of max. +/- 0,2mm due to the axle.
A parallelism deviation of max. 0,01mm for chisel contact is admissible.
The check is made with a test piece 1-2mm. The test piece is touched with both outer chisel points. The deviation must be max. 0,01mm.

Documentation
The checking values can be memorized in a diagram or a computer (table). After the final test and acceptance, the gauges must be correctly marked with the identification number of the testing record.
It may be given to the customer as:

- Manufacturer certificate M according to DIN 55350 (Type B1 and C).

Table 1: 4 Allowed Deviation

Lfd. Nr.	Gauge	Measuring range [mm]	Indicating range [mm]	Total lift [mm]	Numerical interval [mm]	G_M [mm]	r [mm]	F_{min} [N]	F_{max} [N]	Measuring unsafeness [mm] B1	Measuring unsafeness [mm] C	certificate Type	Remarks
1	F1-02	2.5 - 12.5	2.3 – 13,0	2.2-13.5	0.005	0.01	0.01	0.7	1.2	0.003	0.002	C (B1)	
2	F2-05	5 -25	4.7 – 25.5	4.5-27.0	0.01	0.02	0.02	0.9	1.4	0.003	0.002	C (B1)	
3	F2-10	10 - 30	9.7 – 30.5	9.3-32.0	0.01	0.02	0.01	0.9	1.4	0.004	0.002	C (B1)	
4	F2-20	20 - 40	19.7 - 40.5	19.3-42.0	0.01	0.02	0.01	0.9	1.4	0.004	0.002	C (B1)	
5	F2-30	30 - 50	29.7 - 50.5	29.0-52.0	0.01	0.02	0.01	1.1	1.7	0.004	0.002	C (B1)	
6	F2-40	40 - 60	39.7 - 60.5	39.0-62.0	0.01	0.02	0.01	1.1	1.7	0.004	0.002	C (B1)	
7	F2-50	50 - 70	49.7 - 70.5	49.0-72.0	0.01	0.02	0.01	1.1	1.7	0.004	0.002	C (B1)	
8	F2-60	60 - 80	59.7 - 80.5	59.0-72.0	0.01	0.02	0.01	1.1	1.7	0.005	0.002	C (B1)	
9	F2-70	70 - 90	69.7 - 90.5	69.0-82.0	0.01	0.02	0.01	1.1	1.7	0.004	0.002	C (B1)	
10	F4-15	15 - 55	14.7-56.0	14.5-60.0	0.02	0.04	0.02	1.2	1.7	0.004	0.002	C (B1)	
11	F4-35	35 -75	34.7-76.0	33.5-77.0	0.02	0.04	0.02	1.3	1.87	0.004	0.002	C (B1)	
12	F4-55	55 -95	54.7-96.0	53.5-97.0	0.02	0.04	0.02	1.3	1.87	0.004	0.002	C (B1)	
13	F4-75	75 -115	74.7-116.0	73.5-117.0	0.02	0.04	0.02	1.3	1.87	0.004	0.002	C (B1)	
14	F4-95	95 -135	94.7-136.0	93.5-137.0	0.02	0.04	0.02	1.3	1.87	0.004	0.002	C (B1)	
15	B1-10	0 – 10	0 - 10.5	0 – 11.0	0.005	0.01	0.01	0.6	1.2	0.003	0.002	C (B1)	
16	B1-10T	0 – 10	0 - 10.5	0 – 11.0	0.005	0.01	0.01	0.6	1.2	0.003	0.002	C (B1)	
17	B2-20	0 – 20	0 - 20.5	0 – 22.0	0.01	0.02	0.01	0.7	1.3	0.003	0.002	C (B1)	
18	B2-20R	0 – 20	0 - 20.5	0 – 22.0	0.01	0.02	0.01	0.7	1.3	0.003	0.002	C (B1)	
19	B4-40	0 – 40	0 – 41.0	0 – 44.0	0.02	0.04	0.02	1.0	1.5	0.004	0.002	C (B1)	
20	B4-40R	0 – 40	0 – 41.0	0 – 44.0	0.02	0.04	0.02	1.0	1.5	0.004	0.002	C (B1)	
21	B4-40T	0 – 40	0 – 41.0	0 – 44.0	0.02	0.04	0.02	1.0	1.5	0.004	0.002	C (B1)	

Picture 1:

Picture 2 **Measuring force for closing caliper arm**