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Mahr

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MarForm. Reference Formtester MarForm MFU 100 D / 110 D



A new dimension of innovative and intelligent metrology for components that are optimized down to the last detail

Energy conservation and energy efficiency have increasingly gained importance in recent years. This trend will continue over the next few years as awareness is growing that resources must be conserved.

The energy conservation and the energy efficiency of a machine are associated with precisely manufactured components that are tightly tolerated.

The tighter the tolerances, the more difficult it is to produce the workpieces. Consequently, the manufacturing process must be carefully controlled. After all, the measurement results of these workpieces are the most important feedback in the manufacturing process.

For exactly those crucial measurement tasks, the reference formtester MarForm MFU 100 D / 110 D offers the right technology. They are specially optimized for the capable measurement of the tightest tolerances, thus helping to reduce process costs, but without driving up inspection costs.

Capable processes for even the smallest tolerances

Achieving capability measurement processes primarily means using an instrument that obtains stable and reproducible measurement results. The more reproducible the measuring device should operate, the less the readings may scatter.

Highly precise, yet universal

The MarForm MFU 100 D / 110 D MFU measuring units are accurate, provide exactly reproducible measurements and are yet universal. Both the geometries and diameter can be measured with very small variations in the nanometer range.

Thanks to outstanding engineering and the powerful MarWin software, the systems offer you the chance to also measure and evaluate roughness and contour.

Automated testing – even of standards

The CNC control of the MarForm MFU 100 D / 110 D enables not only an automatic testing of geometric dimensioning and tolerancing. The diameter and shape tolerances of standards such as plug gages are automatically checked within a series of measurements. The MarForm MFU 100D / 110 D attains accuracies otherwise known only from length measuring units.

Thus the traceability of your standards can be performed with only one machine. At the same time, diameter and form are calibrated with unparalleled accuracy.



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The smaller the tolerance the greater the challenge

Mahr has long been a competent partner in precision metrology. Another step in a new dimension of accuracy has been made:

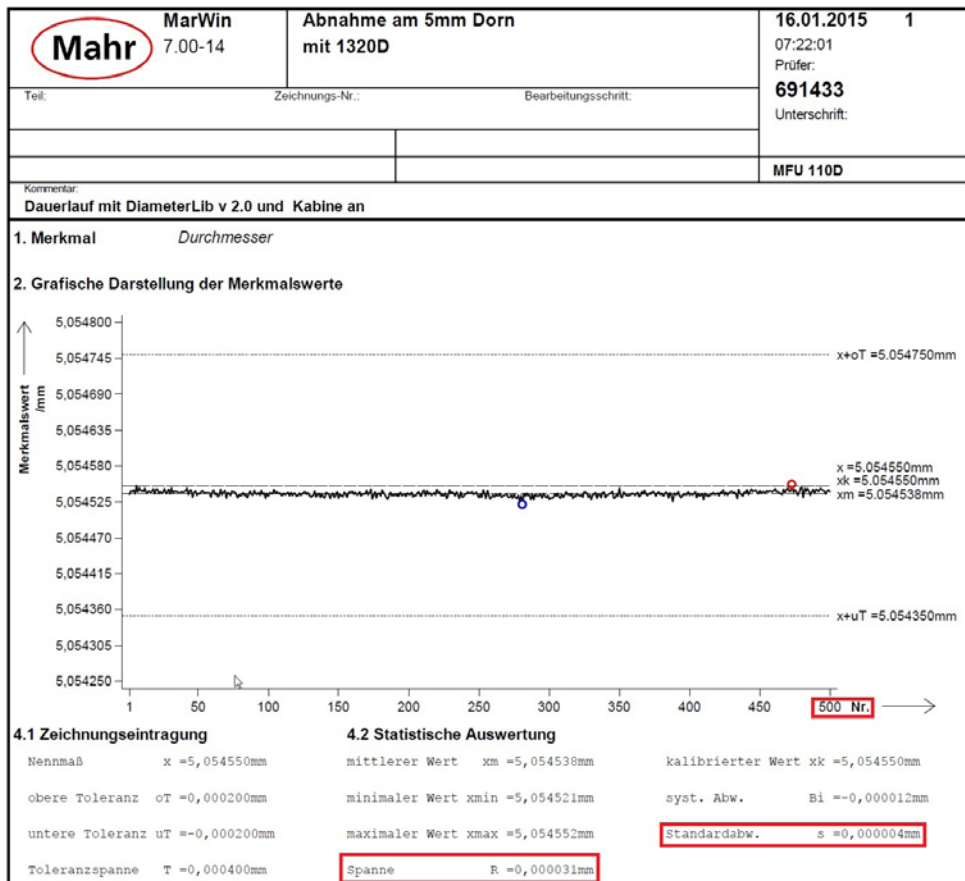
The MarForm MFU 100 D and MarForm 110 D ultraprecise diameter calibration machines are suitable for form measurement in reference quality and for diameter measurement with measuring uncertainties in the nanometer range.

Each machine is integrated into a **machine enclosure** with permanent heat dissipation using **active heat exchanger technology**. Each machine also has active homogeneous temperature turbulence.

These conditions allow highly accurate diameter measurements and bring **increased stability to form and position measurements**.

In addition to the well-known probe T7W, the probe system 1320 D is also included in the standard scope of delivery of the MFU 100D / 110D. It is ideal for high-precision diameter calibration with standard deviations in the single-digit nanometer range.

The following control chart shows an example of the variation of measured values over 500 measurements. The standard deviation here is only 4 nm!



The MarForm MFU 100 D / 110 D can be used universally for comprehensive workpiece evaluation according to DIN ISO 1101. Among others, their strengths lie in close-tolerance features such as roundness, straightness, parallelism, coaxialities, runout tolerances, cylindrical forms, conical forms and diameters.

The MarForm MFU 100 D / 110 D machines are ideally suited for measurements on:

- small, high-precision workpieces
- particularly close tolerance work pieces
- slender workpieces
- standards such as gages or gage rings

MarForm. Reference Formtester MarForm MFU 100 D / 110 D



Scope of measuring station

The reference formtesters MarForm MFU 100 D / 110 D include:

- Roundness measuring device, circular (C)
- Motorized centering and tilting table (X, Y, A, B)
- Straightness measuring axis, vertical (Z)
- Straightness measuring axis, horizontal (X)
- Tangential multifunction axis (Y)
- Motorized length measuring probe T7W with tactile probe arm
- Probe 1320 D
- Evaluation software MarWin for form and location characteristics



The MarForm MFU-D machines are available in two different models:

MarForm MFU 100 D

- "Precision measuring room" model with enclosure and actively controlled temperature compensation elements
- Incl. T7W probe with standard probe arm
- 1320 D probe with 55mm probe arm and 1mm diamond ball

MarForm MFU 110 D

- "Precision measuring room" model with enclosure and actively controlled temperature compensation elements
- Incl. T7W probe with standard probe arm
- 1320 D probe with 55mm probe arm and 1 mm diamond ball
- In addition, fast rotating C-axis



MarForm. Measuring Probe 1320 D

Diameter measurements for the highest demands

The probe 1320 D is a stylus with vertical probe arm arrangement for highly accurate diameter measurement.

Only single-ball probe arms are used in a vertical arrangement for the measurement task. The probe 1320 D in conjunction with a holder for the MarForm MFU 100 D turns the MarForm MFU 100 D into an ultra-precise diameter measuring machine for detecting deviations in the diameter of rings, mandrels and gage blocks as well as in holes and cylindrical workpieces.

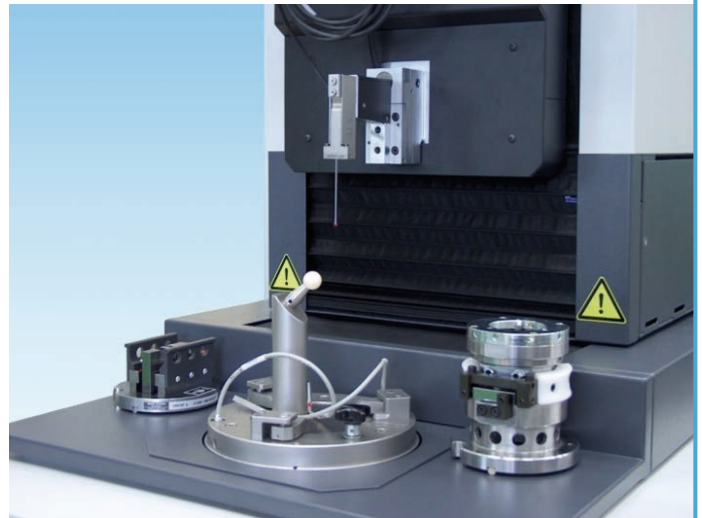
With the measuring probe 1320 D, probing in positive and negative direction is possible, which makes a measurement of the outer and inner diameters possible without operator intervention.

An interface on the Y-axis of the MarForm MFU 100 D allows for easy change from the T7W to the 1320 D.

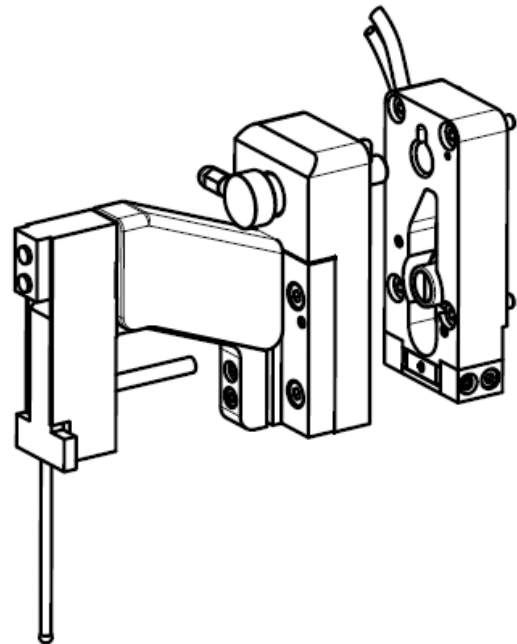
For subsequent calibration, special calibration sequences are available in the form of MarScript programs. Supports for rings, mandrels and gage blocks allow for calibration of the calibration standard that is the most suitable in each case for the next measurement task. Included in the standard scope of delivery is the probe 1320 D with a probe arm length of 55 mm and a diamond ball with diameter 1.0 mm.

Technical data for 1320 D probe:

- Measuring distance from zero position $\pm 100 \mu\text{m}$
- Repeatability: max. $0.01 \mu\text{m}$
- Bilateral measuring direction from zero position
- Measuring force with $10 \mu\text{m}$ deflection: 0.04 N
- Friction-free and hysteresis-free probe arm support
- Easy probe arm change using fastening screws



MarForm MFU 100 D with measuring probe 1320 D



1320 D adapter for Y-axis

MarForm MFU 100 D / MFU 110 D. Technical Data

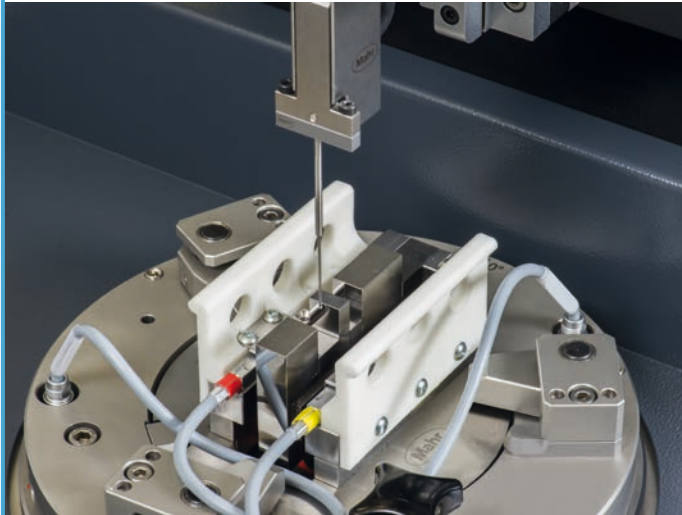
Order no.	MarForm MFU 100 D / MFU 110 D 9999404 / 9999407
Roundness measuring unit, C-axis	
Roundness deviation ($\mu\text{m}+\mu\text{m}/\text{mm}$ measuring height)**	0.02 + 0.0004 (filter 15 W/U); 0.03 + 0.0005 (filter 50 W/U)
Axial runout ($\mu\text{m}+\mu\text{m}/\text{mm}$ measuring radius)**	0.04 + 0.0005 (filter 15 W/U); 0.05 + 0.0005 (filter 50 W/U)
Resolution (interpolated)	0.0001°
Centering and Tilting Table	
Table diameter	180 mm
Table load, centric	200 N
Workpiece alignment	motorized, automatic
RPM 50 Hz / 60 Hz	(0.1 to 15 / 0.1 to 200) 1/min
Straightness measuring unit, vertical, Z-axis	
Measuring path	320 mm
Measuring path limit	Software limit switch
Straightness deviation/100 mm**	0.1 μm
Straightness deviation/200 mm**	0.2 μm
Straightness deviation/320 mm**	0.6 μm
Linear resolution (scale)	0.001 μm (interpolated)
Parallelism deviation Z-/C-axis in tracing direction	0.6 μm
Measuring speed	0.1 mm/s to 50 mm/s
Positioning speed	0.1 mm/s to 50 mm/s
Positioning uncertainty (VDE 3441)*	2 μm
Straightness measuring unit, horizontal, X-axis	
Measuring path	190 mm
Measuring path limit	Software limit switch
Straightness deviation /100 mm**	0.15 μm
Straightness deviation /190 mm**	0.3 μm
Perpendicularity X-/C-axis	0.3 μm
Positioning speed	0.1 mm/s to 50 mm/s
Measuring speed	0.1 mm/s to 50 mm/s
Linear resolution (scale)	0.001 μm (interpolated)
Position uncertainty (VDI 3441)*	2 μm
Automatic axis Y	
Measuring path	6 mm
Measuring path limit	Software limit switch
Straightness deviation over 5 mm Filter 0.25 $\mu\text{m}/\text{mm}$, LSS, 5 mm/s	0.5 μm
Perpendicularity Y-/X-axis	1 μm
Resolution (interpolated)	0.001 μm
Diameter measurement***	
Measuring uncertainty u95 (\varnothing measurement with T7W)	90 nm + $(10^{-7} \times L)$ nm (L = diameter/distance in mm)
Measuring uncertainty u95 for gage blocks (\varnothing measurement with 1320 D)	50 nm + $(10^{-7} \times L)$ nm (L = diameter/distance in mm)
Measuring uncertainty u95 for rings \varnothing measurement with 1320 D)	90 nm + $(10^{-7} \times L)$ nm (L = diameter/distance in mm)
Measuring uncertainty u95 for mandrels (\varnothing measurement with 1320 D)	65 nm + $(10^{-7} \times L)$ nm (L = diameter/distance in mm)

* (Sum error P acc. to VDI 3441)

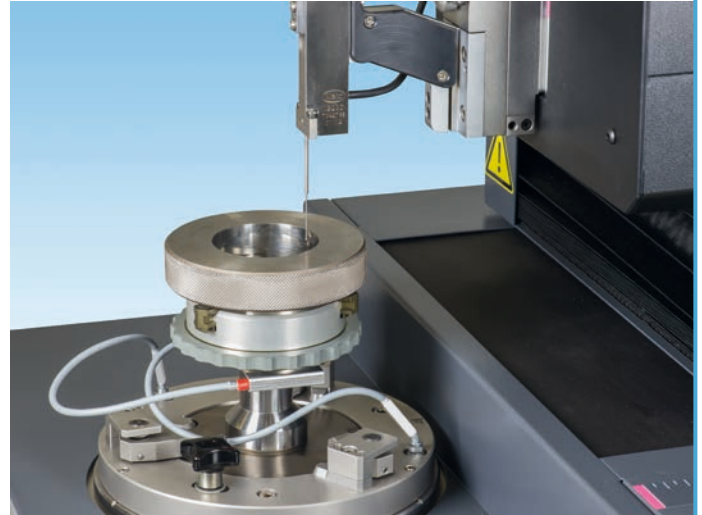
** All values according to DIN ISO 1101 at 20°C \pm 1°C (68°F \pm 33.8°F) in an anti-vibration environment, filter 15 upr or 2.8 $\mu\text{m}/\text{mm}$ LSC or LSS, 5 rpm or 5 mm/sec. (0.197 in/s) and standard probe arm with ball \varnothing 3 mm (0.11811). Evidence is made on a standard by means of error separation techniques*** Measuring and evaluation conditions: T = 20 °C \pm 0.1 K; 5 mm $\leq \varnothing \leq$ 100 mm; measuring height: 20 - 50 mm over table; measurement in direction x-axis: standard probe arm 60 mm; ball probe diameter 1 - 3 mm; without U95 share of \varnothing calibration body; calibration method: with Diameter-Lib 2 and Mahr calibration set (Order No. 5440165)

Subject to change

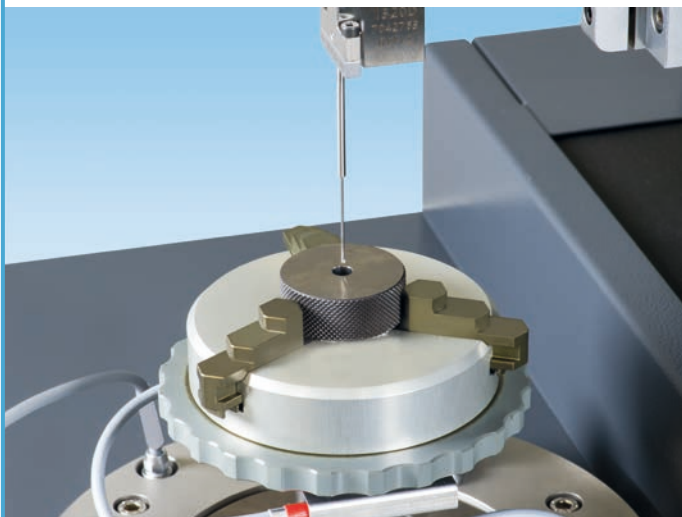
MarForm MFU 100 D / MFU 110 D



Calibration of diameter measuring series on gage block bridge



Calibration of a calibration ring (form and diameter with probe 1320 D)



Diameter measurement in small bore



Testing of machine specifications on test cylinder



Diameter and form measurement with T7W



Camshaft measurement incl. measurement of cam shape

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