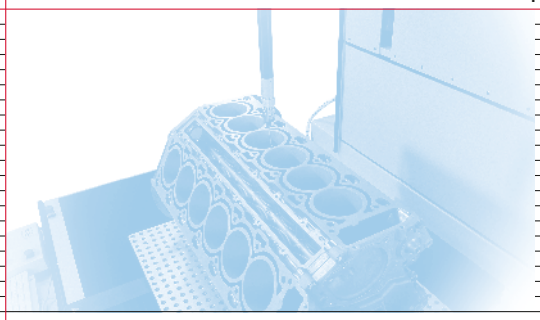
MARFORM | MFK FORM MEASURING CENTER



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Mahr

EXACTLY

WE BELIEVE THAT FORM DEVIATIONS ARE NOT A MATTER OF PERCEPTION. **THAT IS WHY WE HAVE MARFORM.**

The latest information about MARFORM products is available on our website:

www.mahr.de, WebCode 20580

► I The error-free functioning and durability of a workpiece is determined not only by its dimensions but above all by its shape. The roundness, flatness, straightness, coaxiality or run-out are decisive factors when it comes to ensuring that a combustion engine functions fuel-efficiently and with a low level of wear, for example. You can only measure the key characteristics reliably using high-precision, specially optimized form testers, such as the MarForm MFK.

The fact is that the key functional parts are becoming increasingly accurate. The measurement uncertainty must be kept as low as possible to ensure that manufacturing processes can still abide by the specified tolerances. MarForm helps you to cut process costs, without driving up testing costs – by means of stable, innovative instruments offering a high degree of automation, flexibility and accuracy. MarForm has the perfect combination for every requirement. I ◄

MarForm MFK

MarForm MFK

FORM MEASURING CENTERS FOR LABORATORIES AND MEASURING ROOMS

► I With its individually coordinated components, the **MarForm MFK** series offers a high level of flexibility and can be adapted to various measuring tasks. This form tester is based on a non-warping granite base that is isolated from vibrations. The **MarForm MFK** stands out for its unique capabilities where even high-precision coordinate measuring instruments reach their limits. I ◄

MarForm MFK form measuring centers are ideal for testing engine blocks, cylinder heads, cylinder liners, gear cases, hydraulic elements, crankshafts and camshafts. Long measuring and travel paths make it easy and safe to change workpieces. Testing is completed in machine and workpiece coordinates in line with production requirements.

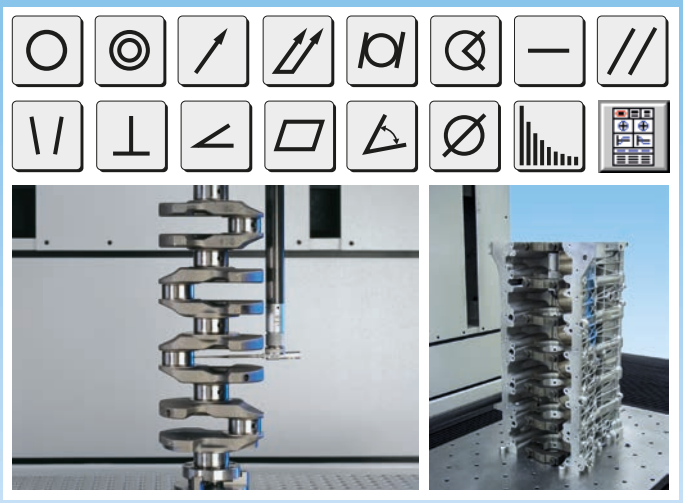
MarForm MFK takes over the full evaluation of form and position features as well as angles and diameters.
Special evaluations such as the Fourier analysis, dominant roundness waviness or lead evaluation are also available.

Extensive accessories such as the optional, CNC-controlled swiveling unit and choice of measuring probes for optimized performance of all measuring tasks.

You can simply program and execute your own measuring tasks with the help of the **user-friendly range of programs** that are parameterized using clearly structured screens.

MarForm MFK 500 Form Measuring Center

Features



Generously sized, optimized design for high measuring accuracy throughout the machine, seven motorized axes of which three (optionally five) are designed as measuring axes.

- Universal form measuring station with a large measuring volume for workpieces of up to 400 kg
- Optional automatic rotating/swiveling unit
- Easy to use and quick to set up thanks to rotating measuring probes and automatic workpiece positioning
- Low maintenance and non-wearing air bearings
- Collision-protected probe systems for diverse measuring tasks
- Large workpiece holder surface for large individual workpieces or workpiece pallets, such as during connecting rod testing
- Roundness measuring device with automatic adjustment to the workpiece diameter, even with eccentric positioning
- Workpiece assessment as per ISO 1101
- Straightness measurements in Z-direction and X-direction
- Optional: Special calibration of the tables axes T_x and T_y for optional straightness measurement

MarForm MFK 500

MarForm MFK 500 Form Measuring Center — Order no. 5440135

Roundness measuring device, C-axis

Measuring principle	Rotating probe
Measuring spindle bearing	Air
Process speeds	0.1 – 10 rpm, variable
Measurement speed	0.1 – 10 rpm, variable
Roundness deviation (µm+µm/mm tracing arm length)	0.1 at 90 mm tracing arm length +0.001 µm/mm additional length
Run-out deviation	0.05 µm + 0.0026 µm/mm measuring radius
Resolution	0.00005° (interpolated)
Positioning accuracy	0.05 °
Distance from spindle axis / vertical column	600 mm
Testing diameter can be extended with accessories up to	700 mm

Vertical straightness measuring device, Z-axis

Measuring path	1200 mm
Measuring path limit	Limit switch at 1180 mm, software limit switch
Straightness deviation / 100 mm (µm)	0.3 µm / 100 mm
Straightness deviation / 1180 mm (µm)	2 µm
Linear resolution (scale)	0.001 µm (interpolated)
Measuring spindle bearing	Air
Measuring speed	0.1 – 50 mm/s
Positioning speed	0.1 – 50 mm/s
Position uncertainty P (VDI 3441)	15 µm
Position deviation Pa (VDI 3441)	8 µm

Horizontal roundness measuring device, R (X)-axis

Measuring path (mm)	120 mm
Measuring path limit	Limit switch at 108 mm, software limit switch
Straightness deviation	2 µm / 108 mm,
Measuring speed	0.1 – 20 mm / s.
Linear resolution (scale)	0.001 µm (interpolated)
Measuring spindle bearing	Air
Positioning speed	0.1 – 20 mm / s.
Position uncertainty P (VDI 3441)	5 µm
Position deviation Pa (VDI 3441)	4 µm
Scanning function during C-movement	Yes

MarForm MFK 500

MarForm MFK 500 Form Measuring Center — Order no. 5440135

Automatic centering and tilting table	
Table surface	800 x 400 mm
Table load capacity	4000 N
Workpiece alignment	Motorized, automatic
Centering area (Tx, Ty axes)	Motorized within the X/Y traverse path of +/- 400 mm (Tx) or +/- 200 mm (Ty)
Tilting range (Ta, Tb axes)	Motorized, +/- 0.6° (max. 10 mm at height of 700 mm)
Motorized and automatic positioning of centering and tilting table in X and Y	Yes
Automatic axis X (Tx)	
Measuring path	800 mm
Measuring path limit	Limit switch
Straightness deviation/800 mm Filter 2 undulations/mm, LSS, 5 mm/s.	20 µm
Measuring speed	0.1 – 50 mm/s
Positioning path	800 (+/- 400) mm
Positioning speed	0.1 – 50 mm/s
Positioning accuracy	2 µm
Automatic axis Y (Ty)	
Measuring path	400 mm
Measuring path limit	Limit switch
Straightness deviation/400 mm Filter 2 undulations/mm, LSS, 5 mm/s.	20 µm
Measuring speed	0.1 – 50 mm/s
Positioning path	400 (+/- 200) mm
Positioning speed	0.1 – 50 mm/s
Positioning accuracy	2 µm
T2W, T6W, T20L, T25L, MFW probe system	
Measuring range ± 1000 µm	30 nm resolution
Measuring range ± 200 µm	6 nm resolution
Measuring range ± 25 µm	0.8 nm resolution

MarForm MFK 500

MarForm MFK 500 Form Measuring Center — Order no. 5440135

Connection data

Mains connection	230 V +6% -10%, 50/60 Hz
Max. power consumption	2700 VA
Power supply filter	according to IEC 950
Input air pressure	6.0 – 10 bar
Air filter	1 pre-filter (AO)
	1 micro filter (AA)
	1 activated carbon filter (APC)
Max. air consumption	300 l/min, in normal state

Dimensions and weight

Length	1900 mm
Width	2012 mm
Height	3380 mm + intermediate piece 200 – 800 mm
Approx. weight	10000 kg + weight of intermediate piece

All values in accordance with ISO 1101 at 20°C +/-1°C in a vibration-neutral environment, filter 15 undulations/revolution LSC or 2.8 undulations/mm LSS, 5 rpm or 5 mm/s and standard probe arm with ball Ø 3 mm. Proof based on the standard using error separation techniques. Subject to change without notice.

MarForm MFK 550 Form Measuring Center

Features

Generously sized, optimized design for high measuring accuracy throughout the machine, seven motorized axes of which three (optionally five) are designed as measuring axes.

- Universal form measuring station with a large measuring volume for workpieces of up to 800 kg
- Three measuring and four set-up axes for measuring form elements
- Optional automatic rotating/swiveling unit
- Easy to use and quick to set up thanks to rotating measuring probes and automatic workpiece positioning
- Low maintenance and non-wearing air bearings
- Collision-protected probe systems for diverse measuring tasks
- Large workpiece holder surface for large individual workpieces or workpiece pallets, such as during connecting rod testing
- Roundness measuring device with automatic adjustment to the workpiece diameter, even with eccentric positioning
- Workpiece assessment as per ISO 1101
- Straightness measurements in Z-direction and X-direction
- Optional: Special calibration of the tables axes T_X and T_Y for optional straightness measurement

MarForm MFK 550

MarForm MFK 550 Form Measuring Center — Order no. 9045385

The technical data is the same as that for MarForm MFK 500. The decisive difference is that it has a larger measuring volume and increased table load capacity. The high load capacity of the table enables the MarForm MFK 550 to even hold particularly heavy workpieces with the optional swiveling unit and to measure them safely.

Automatic centering and tilting table

Table surface	1100 x 590 mm
Table load capacity	8000 N
Workpiece alignment	Motorized, automatic
Centering area (Tx, Ty axes)	Motorized within the X/Y traverse path of +/- 600 or +/- 300 mm
Tilting range (Ta, Tb axes)	Motorized, +/- 0.4°
Motorized and automatic positioning of centering and tilting table in X and Y and A and B	Yes
Workpiece support	Workpiece clamping with M8 thread hole matrix

Automatic axis X (Tx)

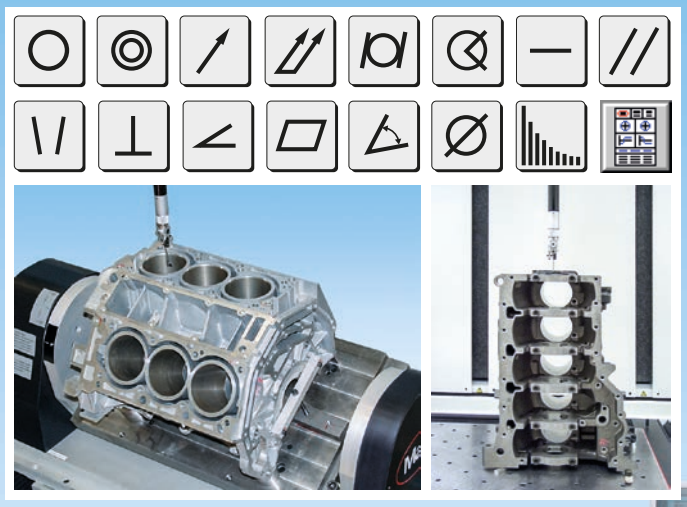
Measuring path	1200 mm, limit switch at 1188 mm
Straightness deviation / 800 mm filter 2 undulations/mm, LSS, 5 mm/s.	20 µm
Positioning speed	0.1 – 50 mm/s
Positioning accuracy	2 µm

Automatic axis Y (Ty)

Measuring path	600 mm, limit switch at 588 mm
Straightness deviation / 400 mm filter 2 undulations/mm, LSS, 5 mm/s.	20 µm
Positioning speed	0.1 – 50 mm/s
Positioning accuracy	2 µm

MarForm MFK 600 Form Measuring Center

Features



Generously sized, optimized design for high measuring accuracy throughout the machine, seven motorized axes of which five are designed as measuring axes.

- Universal form measuring station with a large measuring volume for workpieces of up to 600 kg
- Optional automatic rotating/swiveling unit
- Easy to use and quick to set up thanks to rotating measuring probes and automatic workpiece positioning
- Low maintenance and non-wearing air bearings
- Collision-protected probe systems for diverse measuring tasks
- Large workpiece holder surface for large individual workpieces or workpiece pallets, such as during connecting rod testing
- Roundness measuring device with automatic adjustment to the workpiece diameter, even with eccentric positioning
- Straightness measurements in Z-direction and X-direction
- Straightness measurements with centering and tilting table axes Tx and Ty
- Workpiece assessment as per ISO 1101 including position deviation (distance)

MarForm MFK 600

MarForm MFK 600 Form Measuring Center — Order no. 5440130

Roundness measuring device, C-axis

Measuring principle	Rotating probe
Measuring spindle bearing	Air
Process speeds	0.1 – 10 rpm, variable
Measurement speed	0.1 – 10 rpm, variable
Roundness deviation (µm + µm/mm tracing arm length)	0.1 at 90 mm tracing arm length +0.001 µm/mm additional length
Run-out deviation	0.05 µm + 0.0026 µm/mm measuring radius
Resolution	0.00005° (interpolated)
Positioning accuracy	0.05 °
Distance from spindle axis / vertical column	600 mm
Testing diameter can be extended with accessories up to	700 mm

Vertical straightness measuring device, Z-axis

Measuring path	1180 mm
Measuring path limit	Limit switch at 1170 mm
Straightness deviation / 100 mm (µm)	0.3 µm / 100 mm,
Straightness deviation / 1180 mm (µm)	2 µm
Linear resolution (scale)	0.001 µm (interpolated)
Measuring axes bearing	Air
Measuring speed	0.1 – 50 mm/s
Positioning speed	0.1 – 50 mm/s
Position deviation Pa (VDI / DGQ 3441)	8 µm

Horizontal roundness measuring device, R (X)-axis

Measuring path (mm)	120 mm
Measuring path limit	Limit switch at 108 mm, software limit switch
Straightness deviation	2 µm / 108 mm,
Measuring speed	0.1 – 20 mm / s.
Linear resolution (scale)	0.001 µm (interpolated)
Measuring axes bearing	Air
Positioning speed	0.1 – 20 mm / s.
Position deviation Pa (VDI / DGQ 3441)	4 µm
Scanning function during C-movement	Yes

MarForm MFK 600

MarForm MFK 600 Form Measuring Center — Order no. 5440130

Automatic centering and tilting table	
Table surface	1100 x 590 mm
Table load capacity	6000 N, 10,000 N optional
Workpiece alignment	Motorized, automatic
Centering area (Tx, Ty axes)	Motorized within the X/Y traverse path of +/- 600 or +/- 300 mm
Tilting range (Ta, Tb axes)	Motorized, +/- 0.4°
Motorized and automatic positioning of centering and tilting table in X and Y and A and B	Yes
Workpiece support	Workpiece clamping with M8 thread hole matrix with positioning accuracy +/-30 µm
Automatic measuring axis X (Tx)	
Positioning path	1200 mm, limit switch at 1188 mm
Motorized drive	Yes
Measuring axes bearing	Air
Positioning speed	1 – 50 mm/s
Straightness deviation per 100 mm	1.0 µm
Straightness deviation per 1000 mm	3.0 µm
Linear resolution (scale)	0.001 µm (interpolated)
Position deviation Pa (VDI/DGQ 3441)	15 µm
Automatic measuring axis Y (Ty)	
Positioning path	600 mm, limit switch at 588 mm
Motorized drive	Yes
Measuring axes bearing	Air
Positioning speed	1 – 50 mm/s
Straightness deviation per 100 mm	1.0 µm
Straightness deviation per 500 mm	3.0 µm
Linear resolution (scale)	0.001 µm (interpolated)
Position deviation Pa (VDI/DGQ 3441)	8 µm
T2W, T6W, T20L, T25L probe system	
Measuring range ± 1000 µm	30 nm resolution
Measuring range ± 200 µm	6 nm resolution
Measuring range ± 25 µm	0.8 nm resolution

MarForm MFK 600

MarForm MFK 600 Form Measuring Center — Order no. 5440135

Connection data

Mains connection	220 V – 240 V 50/60 Hz
Max. power consumption	3200 VA
Power supply filter	according to IEC 950
Input air pressure	6.0 – 10 bar
Air filter	1 pre-filter (AO)
	1 micro filter (AA)
	1 activated carbon filter (APC)
Max. air consumption	300 l/min, in normal state

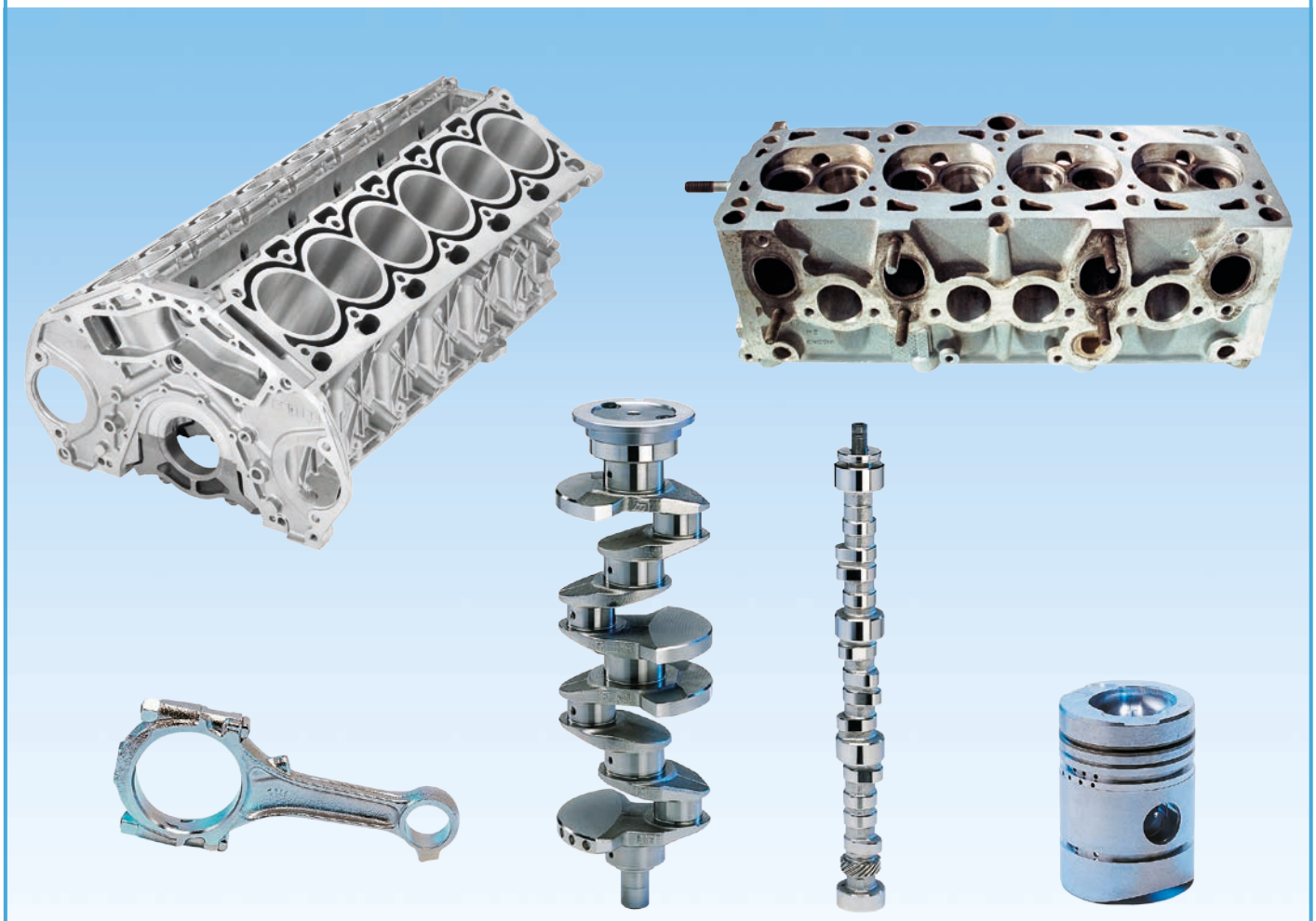
Dimensions and weight

Length	2850 mm
Width	2235 mm
Height	3380 mm + intermediate piece 200 – 800 mm
Approx. weight	Approx. 13350 kg + weight of intermediate piece

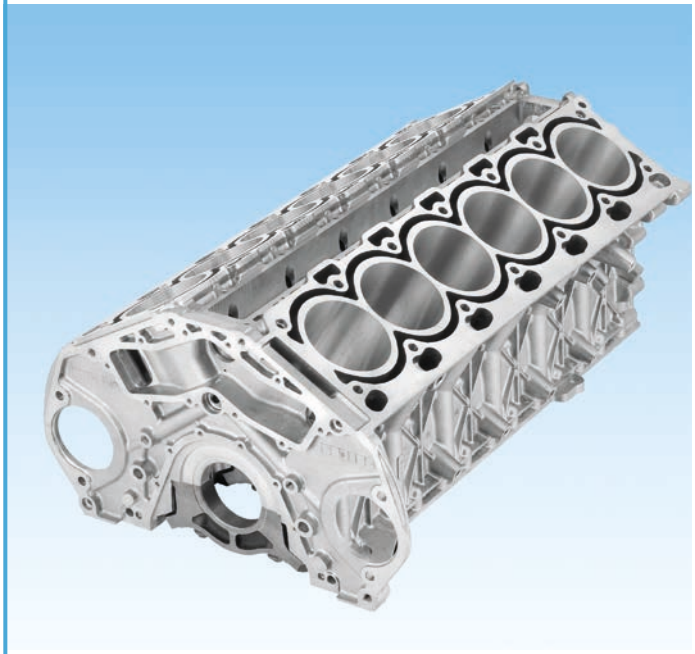
All values in accordance with ISO 1101 at 20°C +/-1°C in a vibration-neutral environment, filter 15 undulations/revolution LSC or 2.5 mm LSS, 5 rpm or 5 mm/s and standard probe arm with ball Ø 3 mm. Proof based on the standard using error separation techniques. Subject to change without notice.

MarForm MFK – Applications

MarForm MFK Range Of Programs



MarForm MFK – Engine Block Application



Crankshaft Channel Measurement

- Any number of bearing positions can be measured with or without radial shaft sealing ring position
- Measure individual bearing points
- Bearing point for measurements and evaluations can be disabled as required
- Measurement depth specified in relation to the edging
- Various tolerances for radial shaft sealing ring position and bearing
- Diameter differences of radial shaft sealing ring position to the bearing
- Reference can be freely defined
- Polar measurements in several freely selectable measuring planes
- Linear measurements in several freely selectable generated lines
- Searching for an edge by setting to zero with the length probe
- Acceptance of table position and Z position of workpiece

Cylinder Bore Measurement

- Cylinder sequence along table axes TX or TY
- Measurement of any number of cylinder bores
- Automatic measurement of V-type engine with optional swiveling unit
- Measurement of individual or all cylinder bores
- All cylinder bores can be selected and deselected for the measurement and evaluation
- Polar measurements in several freely selectable measuring planes
- Linear measurements in several freely selectable generated lines
- Searching for an edge at any point via linear measurement
- Saving the table position of Z position of the workpiece

Evaluation Options

- Diameter measurement at every measuring plane (accuracy <1 µm)
- Roundness at every measuring plane
- Cylindricity
- Segment diameter measurement of freely selectable angular segments in various angular positions
- Straightness of the generated lines
- Parallelism of opposing generated lines
- Distance between the cylinder bore axis and most important bearing axes
- Distance between the cylinder bore in a longitudinal direction
- Conicity of opposing generated lines
- Waviness by means of FFT analysis

Evaluation Options

- Diameter at every measuring plane
- Roundness at every measuring plane
- Radial run-out at every measuring plane
- Cylindricity
- Span width measurements via freely selectable angular segments in various angular positions
- Calculate mean value of the span widths
- Average span width of a bearing
- Straightness of the generated lines
- Parallelism to the opposing generated lines
- Parallelism; axis - axis
- Coaxiality
- Position evaluation to the reference axis
- Parallelism; plane - plane on the thrust bearing
- Perpendicularity; plane - axis
- Radial run-out of the plane from the thrust bearing

MarForm MFK – Crankshaft Application

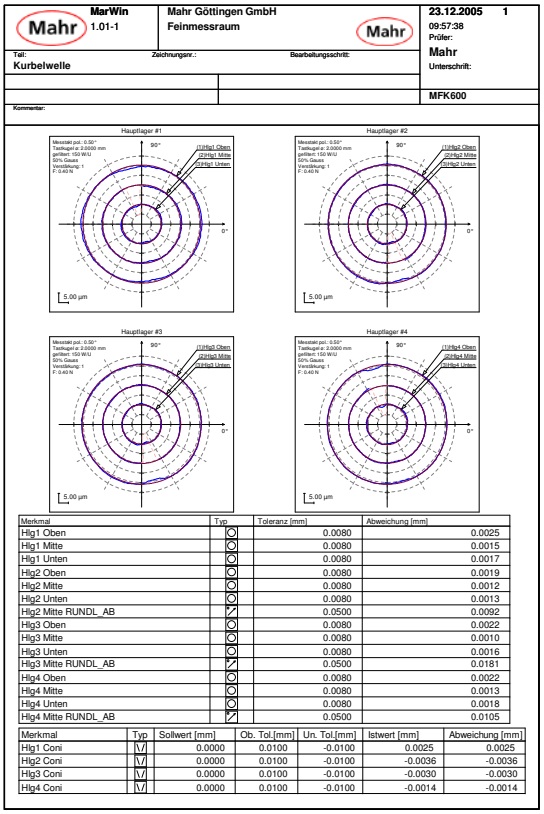
Crankshaft Measurement

- Any number of main bearings and pin bearings can be measured
- Double stroke can also be measured
- Stroke index is freely definable
- Measurements on pins and flange possible
- Measure bearing, flange and pins individually
- Bearing for measurements and evaluations can be disabled as required
- Polar measurements in several freely selectable measuring planes

- Max. four linear measurements on each bearing
- Entering geometric data according to the drawing
- Searching for an edge on the pins, flange or base
- Acceptance of table position and Z position of workpiece

Evaluation Options

- Diameter at every measuring plane
- Roundness at every measuring plane
- Radial run-out, also with the neighboring main bearings as a reference
- Sector roundness
- Crowning during double stroke can be selected via single stroke or 2 double strokes
- Cylindricity
- Span width measurements via freely selectable angular segments in various angular positions
- Straightness of the generated lines
- Parallelism to the opposing generated lines
- Parallelism axis to axis
- Stroke and lifting angle
- Conicity of opposing generated lines or with two circuits
- Waviness by means of FFT analysis



MarWin 1.01-1 | Mahr Göttingen GmbH Feinmessraum | 23.12.2005 09:57:38 | 1

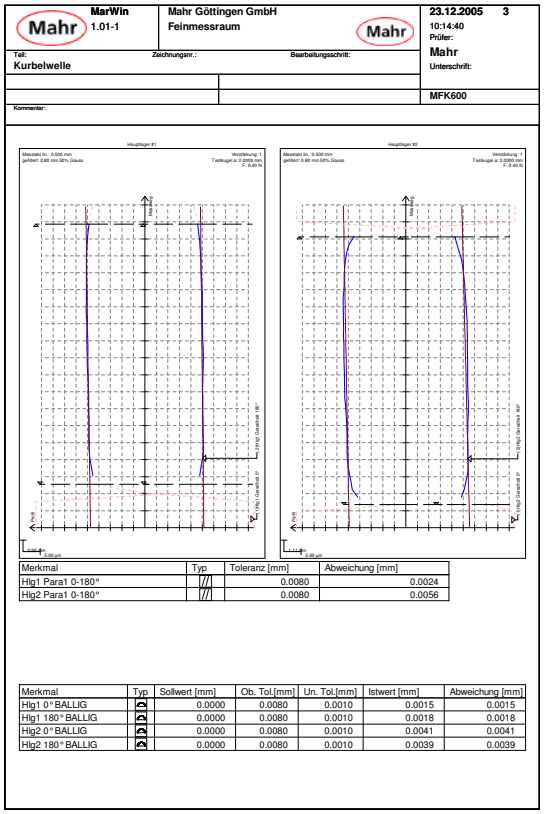
Teil: Kurbelwelle | Zeichnungsnr.: | Bearbeitungsschritt: | Prüfer: Mahr | Unterschrift:

Kommentar: | MFK600

Hauptlager #1 | Hauptlager #2 | Hauptlager #3 | Hauptlager #4

Merkmal	Typ	Toleranz [mm]	Abweichung [mm]
Hlg1 Oben	○	0.0080	0.0025
Hlg1 Mitte	○	0.0080	0.0015
Hlg1 Unten	○	0.0080	0.0017
Hlg2 Oben	○	0.0080	0.0019
Hlg2 Mitte	○	0.0080	0.0012
Hlg2 Unten	○	0.0080	0.0013
Hlg2 Mitte RUNDL_AB	⟋	0.0500	0.0092
Hlg3 Oben	○	0.0080	0.0022
Hlg3 Mitte	○	0.0080	0.0010
Hlg3 Unten	○	0.0080	0.0016
Hlg3 Mitte RUNDL_AB	⟋	0.0500	0.0181
Hlg4 Oben	○	0.0080	0.0022
Hlg4 Mitte	○	0.0080	0.0013
Hlg4 Unten	○	0.0080	0.0018
Hlg4 Mitte RUNDL_AB	⟋	0.0500	0.0105

Merkmal	Typ	Sollwert [mm]	Ob. Tol.[mm]	Un. Tol.[mm]	Istwert [mm]	Abweichung [mm]
Hlg1 Coni	⧸	0.0000	0.0100	-0.0100	0.0025	0.0025
Hlg2 Coni	⧸	0.0000	0.0100	-0.0100	-0.0036	-0.0036
Hlg3 Coni	⧸	0.0000	0.0100	-0.0100	-0.0030	-0.0030
Hlg4 Coni	⧸	0.0000	0.0100	-0.0100	-0.0014	-0.0014



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Teil: Kurbelwelle | Zeichnungsnr.: | Bearbeitungsschritt: | Prüfer: Mahr | Unterschrift:

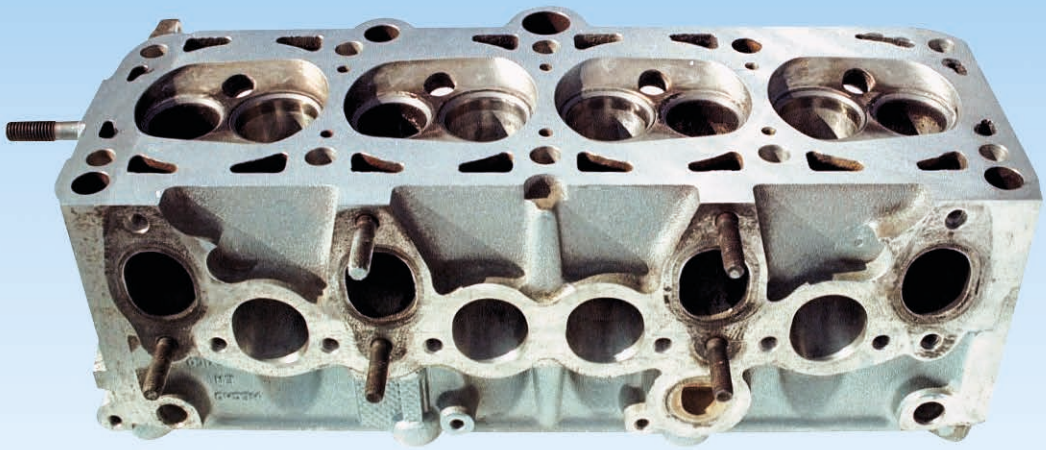
Kommentar: | MFK600

Hauptlager #1 | Hauptlager #2

Merkmal	Typ	Toleranz [mm]	Abweichung [mm]
Hlg1 Para1 0-180°	//	0.0080	0.0024
Hlg2 Para1 0-180°	//	0.0080	0.0056

Merkmal	Typ	Sollwert [mm]	Ob. Tol.[mm]	Un. Tol.[mm]	Istwert [mm]	Abweichung [mm]
Hlg1 0° BALLIG	⌭	0.0000	0.0080	0.0010	0.0015	0.0015
Hlg1 180° BALLIG	⌭	0.0000	0.0080	0.0010	0.0018	0.0018
Hlg2 0° BALLIG	⌭	0.0000	0.0080	0.0010	0.0041	0.0041
Hlg2 180° BALLIG	⌭	0.0000	0.0080	0.0010	0.0039	0.0039

MarForm MFK – Cylinder Head Application



Cylinder Head Measurement

- Valve series along T_x or T_y
- Any number of cylinders that can each be measured with two valves
- Offset valve series permitted
- Measure individual valves
- Valve for measurements and evaluations can be disabled as required
- Measurement depth specified in relation to the edging
- Polar measurements in several freely selectable measuring planes in the guide
- Linear measurements in several freely selectable generated lines in the guide
- One polar measurement and up to four linear measurements on the valve seat
- Three polar measurement and up to four linear measurements on the valve seat blind bore
- Two coordinate systems, one for the guide and another for the valve seat
- Acceptance of table position and Z position of workpiece

Evaluation Options

In the guide

- Roundness at every measuring plane
- Cylindricity
- Parallelism to the opposing generated lines
- Span width measurements via freely selectable angular segments in various angular positions
- Valve seat distance
- Diameter

On the valve seat

- Concentricity of valve seat to guide axis
- Roundness
- Radial run-out of valve seat to guide axis
- Valve seat angle
- Angle to the opposing generated lines
- Straightness of valve seat generated lines
- Valve seat width

In the valve seat blind bore

- Coaxiality of valve seat blind bore to guide axis

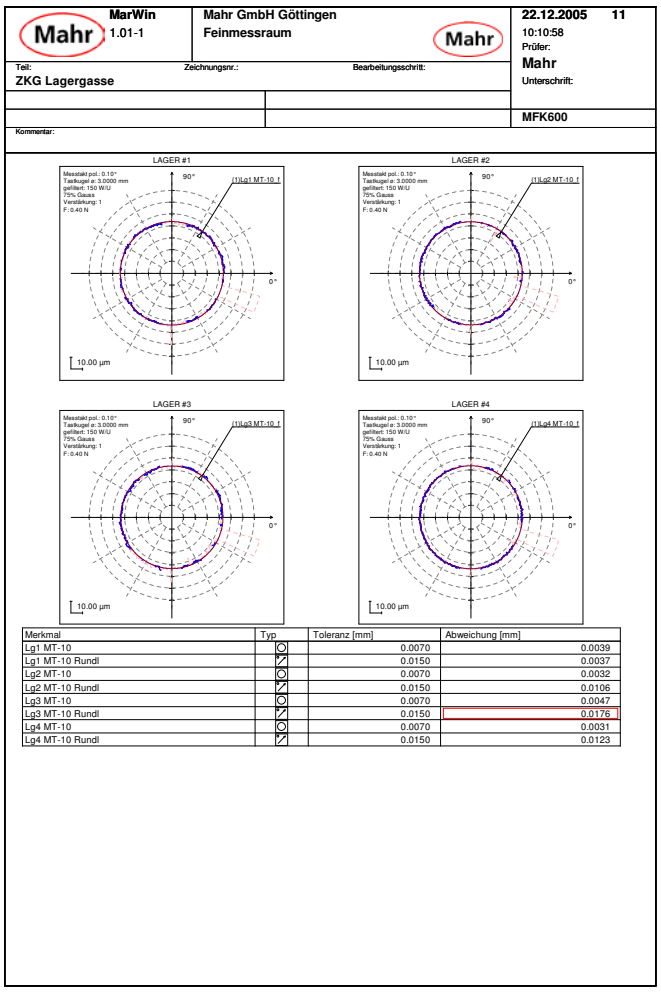
MarForm MFK – Cylinder Head Application

Cylinder Head Measurement (Camshaft Bearing Channel)

- Any number of bearing positions can be measured with or without radial shaft sealing ring position
- Measure individual bearings
- Bearing for measurements and evaluations can be disabled as required
- Measurement depth specified in relation to the edging
- Reference can be defined freely
- Polar measurements in several freely selectable measuring planes
- Linear measurements in several freely selectable generated lines
- Searching for an edge by setting to zero with the length probe
- Acceptance of table position and Z position of workpiece

Evaluation Options

- Diameter of each hole
- Roundness of each hole
- Radial run-out of each hole
- Cylindricity
- Segment diameter measurement freely selectable in each angle position
- Average diameter of the holes
- Straightness of the generated lines
- Parallelism to the opposing generated lines
- Parallelism of the individual bearing axes
- Coaxiality
- Evaluation of the position to the reference axis
- Parallelism of the end faces to one another
- Perpendicularity of the end faces to axis
- Radial run-out of the individual bearing positions to the reference axis



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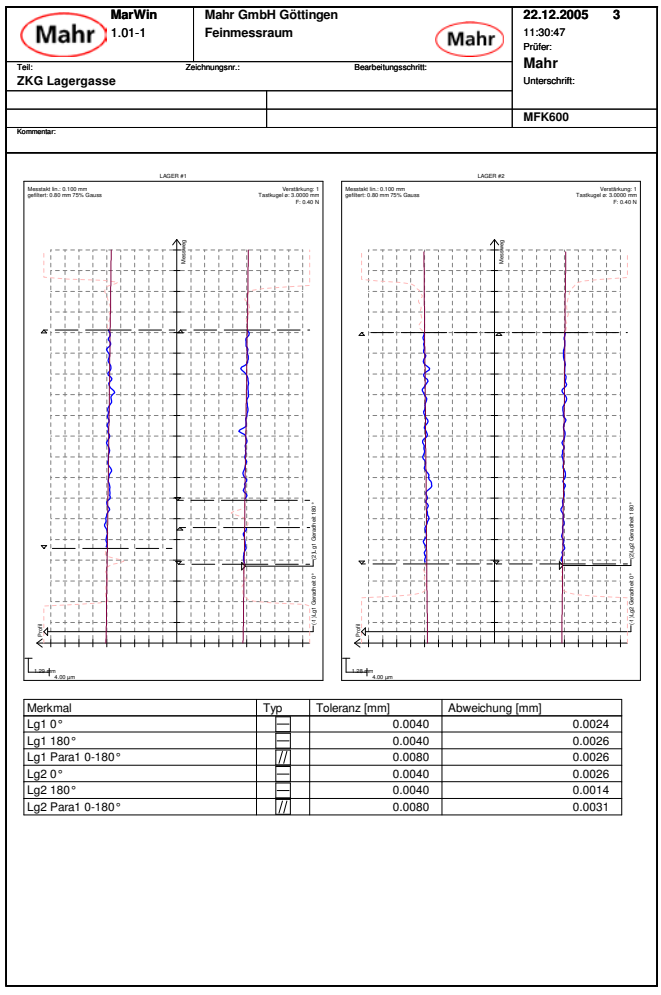
Teil: ZKG Lagergasse | Zeichnungsnr.: | Bearbeitungsschritt: | MFK600

Kommentar:

LAGER #1 | LAGER #2 | LAGER #3 | LAGER #4

Merkmal	Typ	Toleranz [mm]	Abweichung [mm]
Lg1 MT-10	○	0.0070	0.0039
Lg1 MT-10 Rundl	⟋	0.0150	0.0037
Lg2 MT-10	○	0.0070	0.0032
Lg2 MT-10 Rundl	⟋	0.0150	0.0106
Lg3 MT-10	○	0.0070	0.0047
Lg3 MT-10 Rundl	⟋	0.0150	0.0176
Lg4 MT-10	○	0.0070	0.0031
Lg4 MT-10 Rundl	⟋	0.0150	0.0123

RUNDHEITEN Durchlauf 1 / 1



MarWin 1.01-1 | Mahr GmbH Göttingen, Feinmessraum | 22.12.2005 3, 11:30:47 | Prüfer: Mahr | Unterschrift:

Teil: ZKG Lagergasse | Zeichnungsnr.: | Bearbeitungsschritt: | MFK600

Kommentar:

LAGER #1 | LAGER #2

Merkmal	Typ	Toleranz [mm]	Abweichung [mm]
Lg1 0°	⏥	0.0040	0.0024
Lg1 180°	⏥	0.0040	0.0026
Lg1 Para1 0-180°	//	0.0080	0.0026
Lg2 0°	⏥	0.0040	0.0026
Lg2 180°	⏥	0.0040	0.0014
Lg2 Para1 0-180°	//	0.0080	0.0031

GERADHEITEN Durchlauf 1 / 1

MarForm MFK – Piston Application

Piston-specific Measurements

- Measurement of piston oval
- Measurement of piston meridian
- Measurement of piston grooves
- Measurement of piston pin bore

Special Evaluation on the Piston

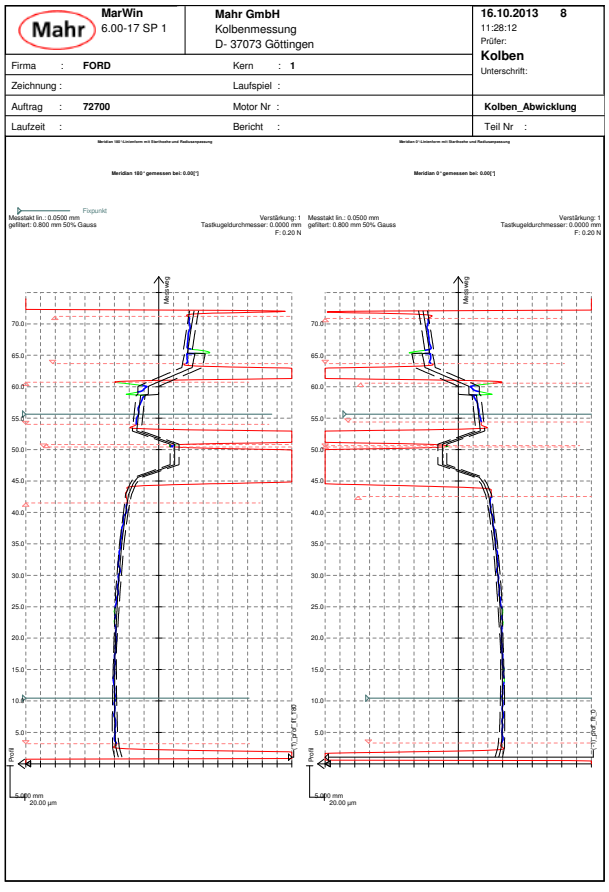
- Partition of piston oval profile in two subprofiles
- Determination of the most important piston oval axis via the extreme points
- Tolerance monitoring of the piston oval profiles by means of plotted tolerance lines
- Calculation of the piston axis
- Tolerance monitoring of the meridian profiles by means of plotted tolerance lines

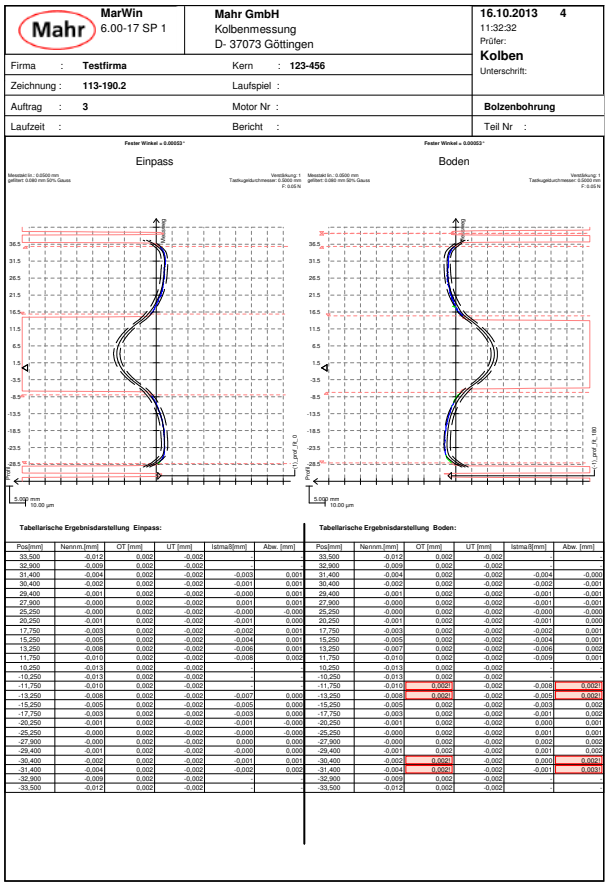
Importing Tolerance Bands

- Importing tolerance bands of the piston oval and meridian

Piston-specific Evaluations

- Evaluation and recording of the piston oval measurement
- Evaluation and recording of the meridian measurement
- Evaluation and recording of the groove measurement
- Evaluation and recording of the long-wave and short-wave components of the meridian profiles





MarForm MFK – Camshaft Bearing Application

Camshaft Bearing Measurement

- Any number of camshaft bearings can be measured
- Position of the radial shaft seal can be measured
- Measure individual bearings
- Bearing for measurements and evaluations can be disabled as required
- Polar measurements in several freely selectable measuring planes
- Max. four linear measurements on each bearing
- Entering geometric data according to the drawing
- Searching for an edge on the pins, radial shaft seal or base
- Acceptance of table position and Z position of workpiece

Evaluation Options

- Diameter at every measuring plane
- Roundness at every measuring plane
- Radial run-out
- Sector roundness
- Crowning
- Cylindricity
- Span width measurements via freely selectable angular segments in various angular positions
- Straightness of the generated lines
- Parallelism to the opposing generated lines
- Conicity of opposing generated lines or with two circuits
- Waviness by means of FFT analysis

MarForm MFK – Connecting Rod Application

Connecting Rod Measurement

- Measure the small and large eye individually or jointly
- Measuring depth over predefined depth
- Polar measurements in several freely selectable measuring planes
- Linear measurements in several freely selectable generated lines
- Acceptance of table position and Z position of workpiece

Evaluation Options

- Diameter of each hole
- Roundness of each hole
- Radial run-out of each hole
- Cylindricity
- Segment diameter measurement freely selectable in each angle position
- Average diameter of the holes
- Straightness of the generated lines
- Parallelism of the generated lines

- Evaluation of the distance from small to large eye
- Parallelism of upper plane to lower plane on large eye
- Perpendicularity of plane to axis of large eye
- Rotational deviation of the small eye to large eye on a basic length of 100 mm

MarForm MFK – Other MarForm MFK Applications

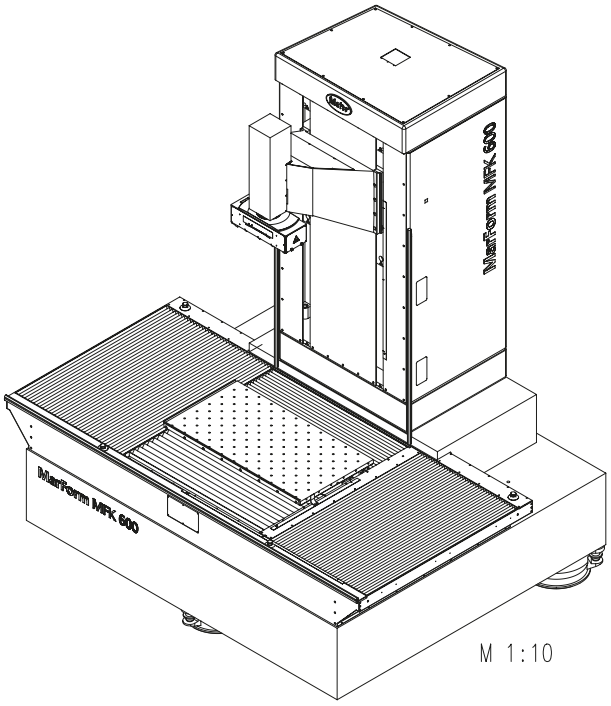
Pallet Measurement

Manufacturers of production machines such as lathe, milling, grinding or honing machines are aware of the challenges. Customers who come to accept their new machine expect proof that the workpieces can be produced in the required quality by the machine tool.

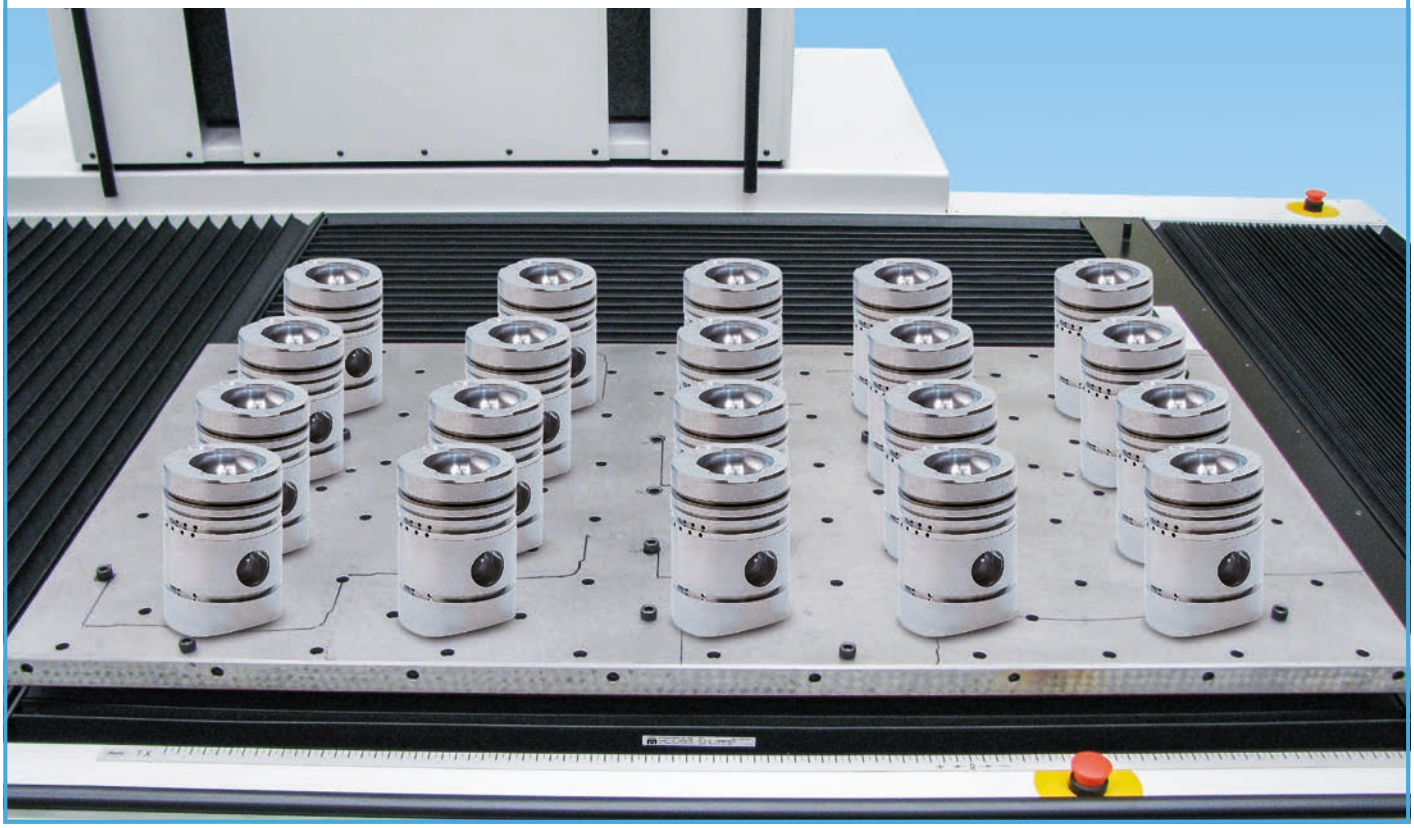
Generally, twenty or more workpieces are produced as a sample. Proof, that the required quality has been achieved, is generally determined by measuring the diameter, form and position features. On standard measuring machines, only one workpiece can generally be checked at a time. This means that it takes a considerable amount of time to check all of the workpieces and to conclude whether a production machine has achieved the required quality.

In this case, the MarForm MFU 500 and 600 measuring centers offer a solution. Pallet measurements can be completed on these machines.

The workpieces that are to be measured are clamped on the generously dimensioned centering and tilting tables. A screen-controlled measuring program is then used to measure, evaluate and then document the results for all of the workpieces in succession. If one workpiece deviates disproportionately, it can be selected in the measuring results and measured again. It is also possible to view the results of the affected workpiece and to evaluate it again using another filter, if necessary.



The pallet measurements ultimately save a considerable amount of measuring time and thus also reduce costs. For example, produce your workpieces on the first day of acceptance, then leave the workpieces over night to initially temper, then measure them and evaluate the results on the next day with your customer.



MarForm MFK – Accessories

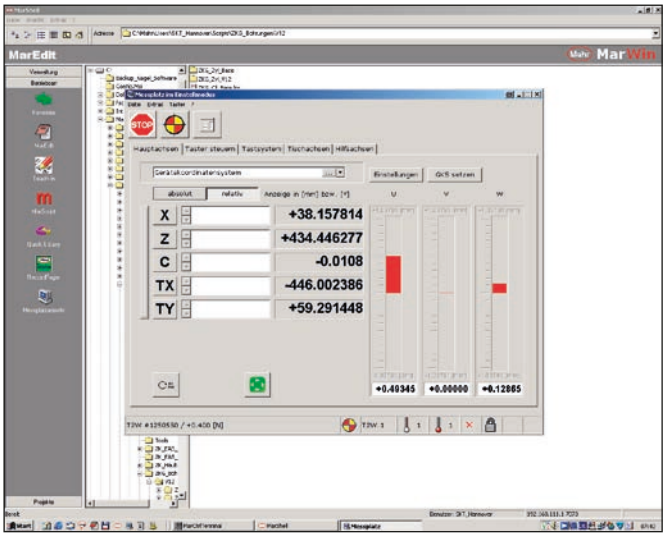
Included in the scope of supply of the MarForm MFK measuring station

MarWin PC with ProfessionalForm and AdvancedForm

Controlling measurement and evaluation unit to evaluate MarForm MFK measurements

Consisting of:

- Pentium PC in accordance with current Mahr standard
- Windows 7 operating system
- "ProfessionalForm" MarWin software incl. "AdvancedForm" teach-in programming. The software makes it easy to create high-performance programs. The measured values are measured, filtered and documented.



MarWinLib Measuring Program Library
Order no. 5480155

High-performance program library with predefined and highly optimized program components.

Printer
Order no. 8165073

Color laser printer in accordance with current Mahr standard.

Optionally available.

24" TFT Monitor
Order no. 3027221

In accordance with the current Mahr standard.

MarForm MFK – Accessories and Options

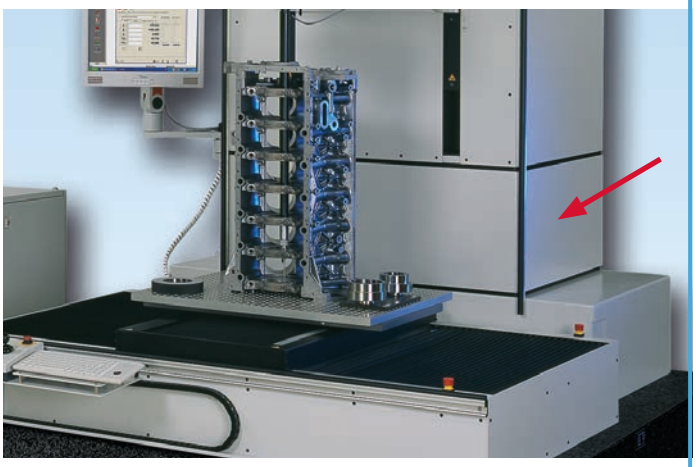
Workpiece-specific and not included in the scope of supply of the MarForm MFK measuring stations.

Intermediate Pieces to Extend the Machine Volume

Intermediate pieces to extend the machine volume in the Z direction.

Intermediate piece 200 mm	Order no. 5440023
Intermediate piece 300 mm	Order no. 5440024
Intermediate piece 400 mm	Order no. 5440025

Intermediate pieces to extend the machine volume in the Z direction. The intermediate pieces are mounted between the vertical Z component and base of the MFK X00 machine. Several intermediate pieces can also be combined without any problems.

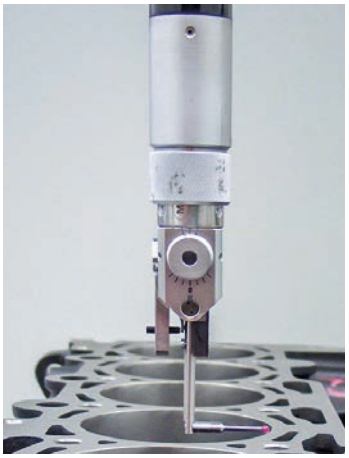


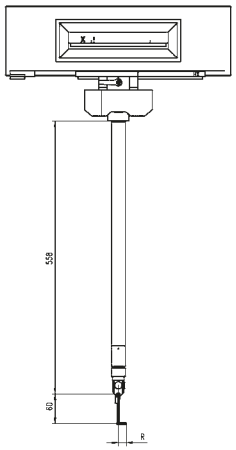
Length Measuring Probe T2W, Plug-in

Order no. 9027633

Attachment tubes of up to 1050 mm can be used

Measuring path	± 1000 µm
Adjustable measuring force	0.25 N to 0.45 N
Free stroke setting	1000 µm to 0 µm
incl. probe bolt extension	15mm (radius setting range 40 – 55), 30 mm (radius setting range 55 – 70) and measuring anvil (steel)



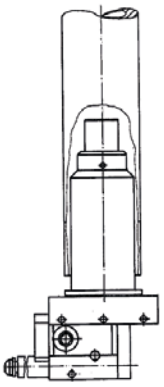


Length Measuring probe T20L, Plug-in

Order no. 5400077

Attachment tubes of up to 1080 mm can be used

Measuring path	± 1000 µm
Adjustable measuring force	0.25 N to 0.45 N
Free stroke setting	1000 µm to 0 µm
Probe protection	in all directions
incl. probe bolt extension	15mm (radius setting range 40 – 55), 30 mm (radius setting range 55 – 70) and measuring anvil (steel)



MarForm MFK – Accessories and Options

Workpiece-specific and not included in the scope of supply of the MFK measuring station.

Length Measuring Probe T25L, Plug-in

Order no. 5400190

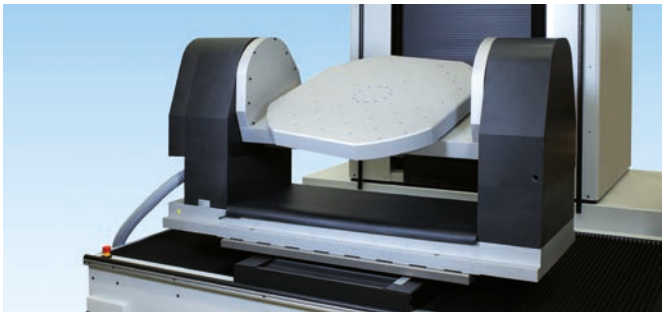
T25L probe for measuring crankshafts including the angle of the pin bearing and stokes, attachment tubes of up to 1050 mm can be used (see below)

Rotating/Swiveling Unit for MarForm MFK 500/550/600

Order no. 9054534

The rotating/swiveling unit is designed to automatically position workpieces on the MarForm MFK 500/600. The measuring object is mounted on the unit using the hole matrix.

Permissible interference contour diameter of the
Workpiece: max. 750 mm
Base plate: 650 mm x 650 mm



Attachment Tubes for T2W/T20L-T25L

Attachment tube 350 mm	**Order no. 5400073**
Attachment tube 550 mm	**Order no. 5400075**
Attachment tube 750 mm	**Order no. 5400082**
Attachment tube 1080 mm	**Order no. 9014122**

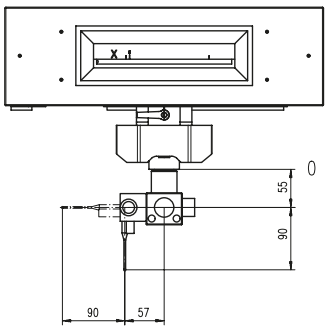
Special tubes for attaching plug-in measuring probe T2W, T20L and T25L. CFK material, therefore extremely insensitive to temperature influences.

The attachment tubes are not included in the scope of supply of the probe systems.

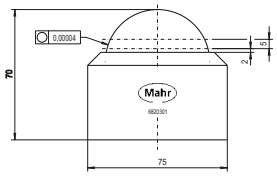
Length Measuring Probe T6W

Order no. 9040490

Mounting shaft	∅28
Probe arm units	length of up to 600 mm available
Measuring path	± 1000 µm
Adjustable measuring force	0.05 N to 0.6 N



MarForm Testing and Calibration Standards

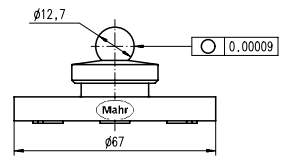


Roundness standard
incl. DAkkS / DKD calibration certificate
incl. Mahr calibration certificate

Roundness Standard – high-precision glass hemisphere

Testing the measuring spindle radial run-out accuracy
Calibrating the sensitivity of the signal transfer chain to test the radial spindle deviation (C-axis)

Diameter	Ø approx. 55 mm
Roundness deviation	~ 0.04 µm
Mass	approx. 1.8 kg

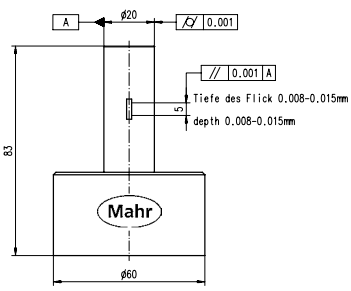


Metal roundness standard
without calibration certificate — **Order no. 5400145**
DAkkS / DKD calibration certificate for 5400145 — **Order no. 9964115**
Mahr calibration certificate for 5400145 — **Order no. 9964307**

Metal Roundness Standard – high-precision measuring ball

Testing the measuring spindle radial run-out accuracy
Calibrating the sensitivity of the signal transfer chain to test the radial spindle deviation (C-axis)

Diameter	Ø approx. 13 mm
Roundness deviation	~ 0.09 µm
Mass	approx. 0.3 kg



Magnification standard
without calibration certificate — **Order no. 5400147**
DAkkS / DKD calibration certificate for 5400147 — **Order no. 9964148**
Mahr calibration certificate for 5400147 — **Order no. 9964311**

Magnification Standard

With a magnification standard
To test the signal amplification on a cylinder with a flattened surface

Diameter	Ø 20 mm
Length	50 mm
Flat area	approx. 10 µm
Cylindricity deviation	~ 1 µm
Mass	approx. 0.4 kg

Optical flat
incl. Mahr calibration certificate

Flatness Standard – optical flat

Checking and adjusting the horizontal measuring device
Testing the axial spindle deviation
Testing the straightness of the linear guide

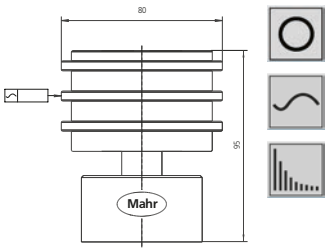
Diameter	Ø 150 mm
Flatness deviation	0.2 µm
Mass	approx. 2 kg

MarForm Testing and Calibration Standards

Multi-shaft Standard

Dynamic testing of the signal amplification
Calibrating the sensitivity of the signal transfer chain
Calibrating the vertical and horizontal profile components
Testing filters / Fourier analysis

Diameter	Ø 80 mm
Sinusoidal shafts on outer diameter	15, 50, 150, 500 upr
Mass	approx. 2.3 kg

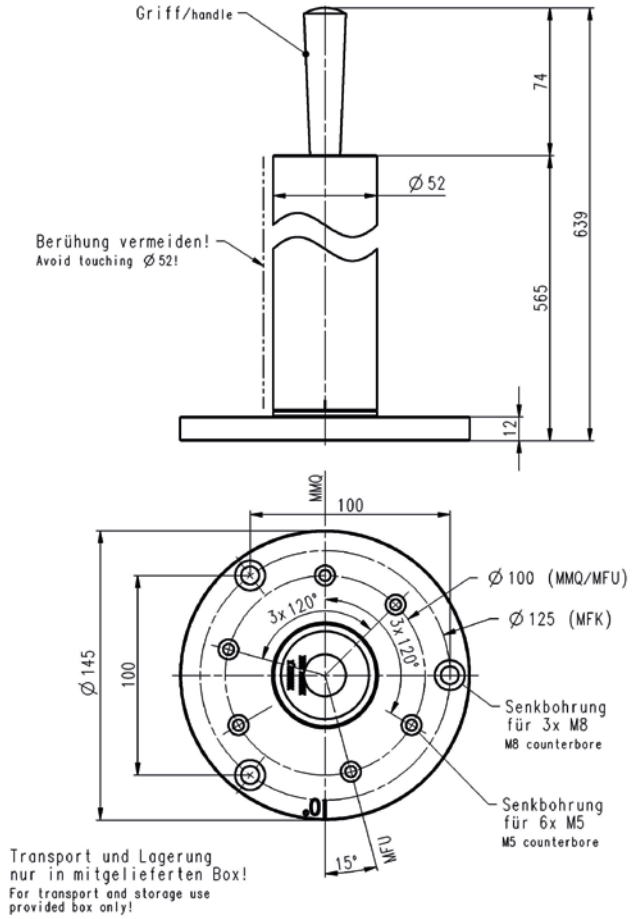


Multi-shaft standard
without calibration certificate **Order no. 5400142**
DAkkS / DKD calibration certificate for 5400142 **Order no. 9964149**
Mahr calibration certificate for 5400142 **Order no. 9964312**

Straightness Standard – Control Column

Checking and adjusting the vertical guide to the measuring spindle axis
To test the straightness of the linear guides
To test the parallelism

Evaluation length: 550 mm



Straightness standard – control column **Order no. 9015106**
To test the straightness of the linear guides
To test the parallelism

Customer Master

To test, adjust and calibrate the measuring device.
Without completing any conversion work, some measuring objects/workpieces, that have been provided with a calibration certificate by the Mahr calibration laboratory, can be used as a master/standard.

Customer master
DAkkS / DKD calibration certificate for customer master **Order no. 9964313**
Mahr calibration certificate for customer master **Order no. 9964314**

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