



HOMMEL-ETAMIC F1000 – F4004

Fast and easy determination of form and positional tolerances



Precision is our business.

Your partner for industrial metrology

Hommel-Etamic, the Industrial Metrology Division of the Jenoptik Group is a leading manufacturer and system provider of high-precision, tactile and non-tactile production metrology. The range of products provided include total solutions for a wide range of measurement tasks such as testing surfaces, form, and determining dimensional tolerances – throughout all phases of the production process, for final inspection or in a metrology lab. Our product portfolio is rounded off by a wide range of services in consulting, training and service, including long-term maintenance contracts.

Flexible form measurement

The modular design of our measuring systems guarantees maximum flexibility for a wide range of applications. Our product line of form measuring systems includes compact roundness measuring devices as well as standard and custom fully automated measuring systems for the determination of all form and positional tolerances. The roundscan offers combined form and surface roughness measurement and our spindle measuring machines are the ideal solution for very large, heavy workpieces.

Hommel-Etamic – precision is our business!



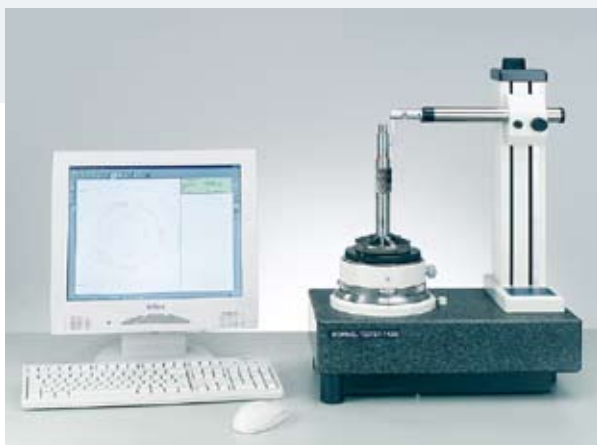
Form measurement – what for?

Every workpiece is machined with a more or less strong deviation from the ideal geometrical shape. The slightest deviation from the nominal form may already have a considerable influence on the functionality of a component. The form and positional deviations of all parts are therefore very important, especially for the trouble-free interaction of several workpieces with common functions.

Measurements of form deviations tell us something about the quality of the finished parts, allow us to draw conclusions about the overall quality of the production process and thus help to reduce costs.

Hommel-Etamic form measuring instruments allow you to check the functions of your components easily, quickly and economically. Form and positional deviations are evaluated and displayed clearly by the TURBO FORM software.

Our form measurement instruments offer the suitable solution from simple roundness measurement right up to CNC-capable determination of all common form and positional tolerances.



HOMMEL-ETAMIC F1000



HOMMEL-ETAMIC F4004

Form measuring system	Workpiece weight	Measuring axes	Vertical axis	Horizontal axis	Centering/Leveling
F1000	25 kg		motorized	manual	manual
F1003	25 kg		measuring	motorized	manual
F1004	25 kg		measuring	measuring	manual
F4004	40 kg		measuring	measuring	automated

Compact and cost-effective form measuring systems

The form measuring systems of the F1000 series have an air-bearing rotary table with a diameter of 150 mm, suitable for workpieces up to 25 kg. Its high quality air bearing operates wear-free and guarantees constantly high precision.

As an alternative to the desktop version, the F1003 and F1004 can also be installed in an ergonomically designed table GTF1 where they offer an ideally adapted workstation.

The measuring instruments are easy to operate thanks to the Windows-based TURBO FORM evaluation software. Measuring programs can be programmed quickly and easily with the test plan wizard.

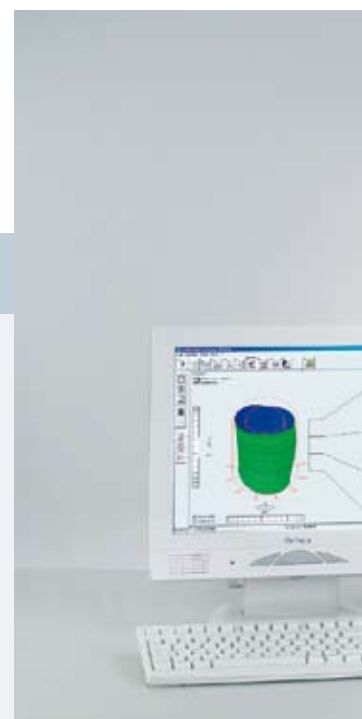
HOMMEL-ETAMIC F1000 for roundness measurement

The menu-guided, manual centering and leveling of the workpiece, the continuously adjustable measurement speed and the motorized, vertical adjustment axis with a range of 300 mm ensure maximum flexibility and easy operation.

The F1000 is designed for a workpiece volume with a diameter of up to 320 mm. As a compact desktop device it is ideally suitable for form measurement in a production environment.



HOMMEL-ETAMIC F1000



HOMMEL-ETAMIC F1003



HOMMEL-ETAMIC F1003 for measurement of cylindrical form

The F1003 is ideal for measuring precision parts where the cylindrical form needs to be measured in addition to the roundness. It has a high-precision vertical measuring axis (Z axis) with a measurement distance of 350 mm (550 mm as an option). With the motor-driven, positionable horizontal axis (R axis) the device offers a wide performance scope and enables automatic measurement runs.

The probe is protected against collisions and the design of the instrument allows probe movement past the centre of the table to measure parallelism and conicity without rotating the table.

The optional manual probe tilt arm FS1 simplifies the measurement process on complex workpieces. It can be moved easily and quickly into the optimum operating position.

HOMMEL-ETAMIC F1004 for determination of cylinder form and flatness

With three motorized measuring axes (C, Z and R axis) the F1004 is a compact, desktop device for the measurement of all common form and position parameters including the determination of multi-track flatness. The vertical traverse length is 350 mm (optional 550 mm).

In connection with the optional motorized tilt and rotation module MDS, axial and radial measurement are performed fully automatically without the CNC run being interrupted.

The F1004 is therefore very suitable for the low-cost, automatic measurement of workpieces.



HOMMEL-ETAMIC F1004



Fully automated measurement of form and positional tolerances

The F4004 features a precise automatic centering and leveling of the workpiece. With three motorized measuring axes it is suitable for measuring all form and position parameters. The software is optimally adapted and offers extensive analysis facilities as well as a great flexibility in the set-up of workpiece-specific measuring programs.

The traverse length of the motorized vertical axis (Z axis) is 350 mm (optional 550 mm). The rotary table with a diameter of 250 mm is designed for measuring workpieces weighing up to 40 kg and with a diameter of up to 430 mm.

The probe is protected against collisions and the design of the instrument allows probe movement past the centre of the table to measure parallelism and conicity without rotating the table.

With its fully automatic CNC measuring run the F4004 is ideally equipped for measuring complex workpieces. The wear-free air bearing of the rotary table ensures the reproducibility of the smallest tolerances over a long period. It is therefore ideally suitable for demanding measuring tasks in series production as well as for use in the measuring room with frequently changing measuring tasks.

The GTF2 table offers the ideal ergonomic platform for the F4004. With the integrated, vibration-damped granite plate it offers a strong workbase – free from external influences.



HOMMEL-ETAMIC F4004



Motorized tilt and rotation module

The optional motorized tilt and rotation module MDS allows fully automated axial and radial measurements without interrupting the CNC run. It has one motorized axis for both tilting (90°) and rotating (270°) the probe, allowing access to even the most difficult to reach positions. The autostop function has an intelligent, computer-aided approach with automatic detection of the probing direction.

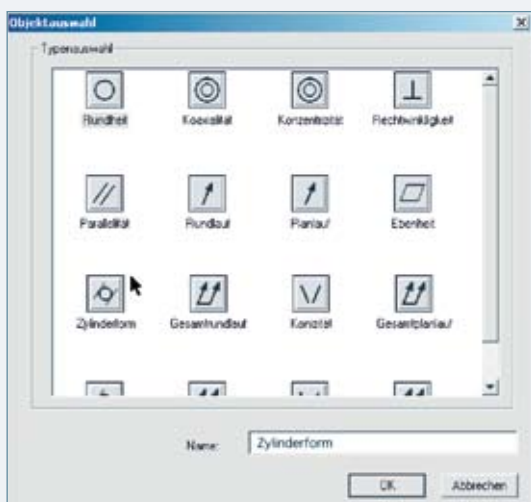


TURBO FORM – evaluation software with parameter-oriented user guidance

The graphical, function-oriented user interface of the TURBO FORM evaluation software guarantees you simple operation even for complex measuring tasks. Starting with the simple definition of measurement positions and axis references, through the fully automatic alignment and measurement of the workpieces right up to extensive profile analysis and continuous documentation of the test results.

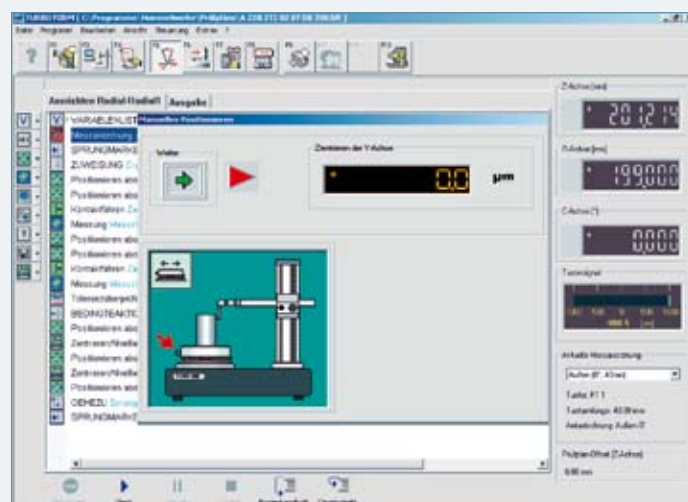
The graphical user interface can be configured flexibly and individually for every measuring program. All common form and positional parameters are calculated with TURBO FORM according to current standards. The toolbar, which can be operated with the mouse or keyboard, ensures maximum operating comfort. The software is open for an unlimited number of measuring programs and measurement protocols.

The user-friendly navigation through the whole measurement is clearly shown here using the cylindrical form measurement as an example:



Testplan creation

You select the desired parameter via a mouse. The wizard then guides you simply and safely through all necessary steps.



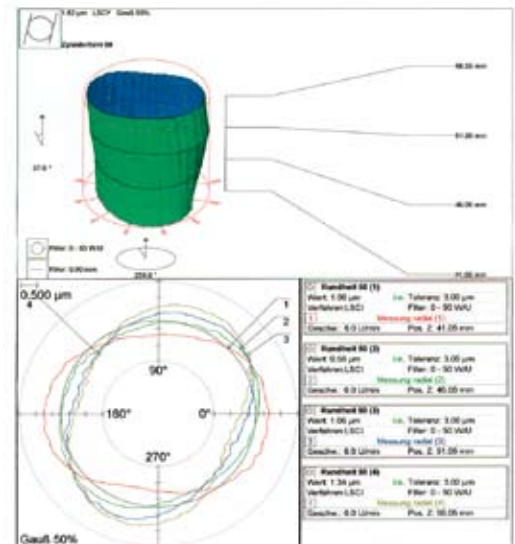
Automatic alignment

Alignment is semi-automatic or fully automatic (depending on the form measuring instrument) and is optimally supported by the software.

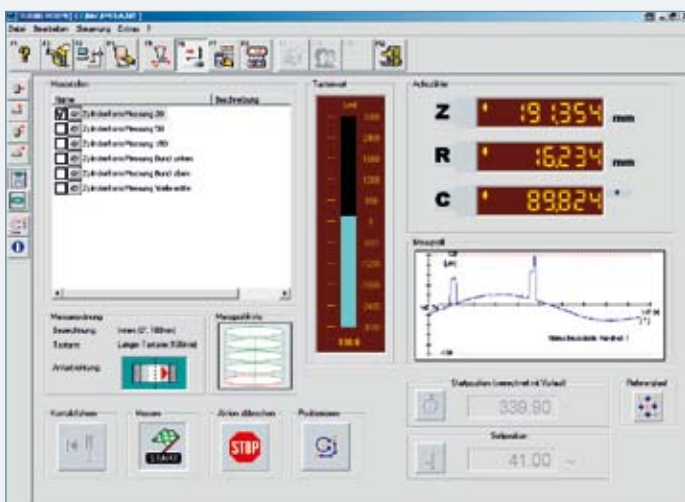
The performance characteristics of TURBO FORM at a glance

- Clear program sequence
- Positions can be entered by simple teach-in functions
- User-friendly interface with distinct symbols
- Easy CNC programming by pictograms
- Evaluation compliant with standard
- Comfortable measuring program management
- Numerous options for special applications
- Fast evaluation algorithms supply prompt results even in complex measuring tasks
- CNC modules, Fourier analysis and informative 3D analysis are already part of the standard scope
- User-defined representation of measurement protocols, screen and printout forms

Lieferant/Kunde: Ernst Mester	Prüfplan: EM KA	
Prüfteilbezeichnung: Welle KF-43	Meßmechanik: F4003	
Zeichnungsnummer: 12034-567	Prüfnummer: V6547-856	
Auftragsnummer: 123-545-567	Prüfmann: Karl Mayer	20h-Wochen V 5.00 Datum
Kommentar:		15.04.2003 Uhrzeit
Kundenmessung		09:27:40

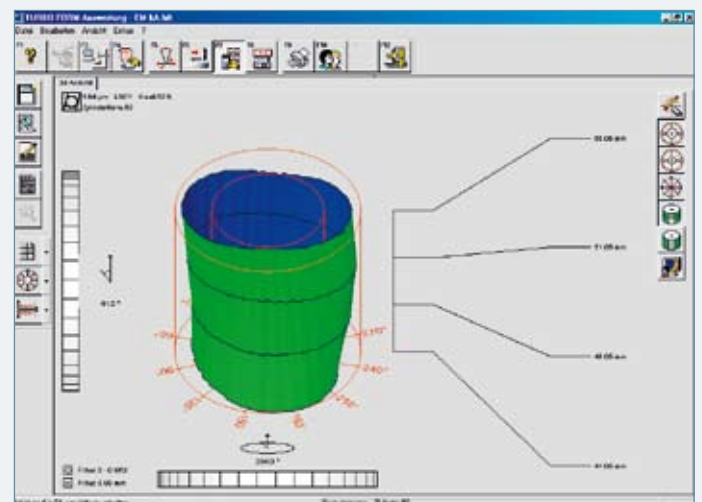


Printout form



Measurement

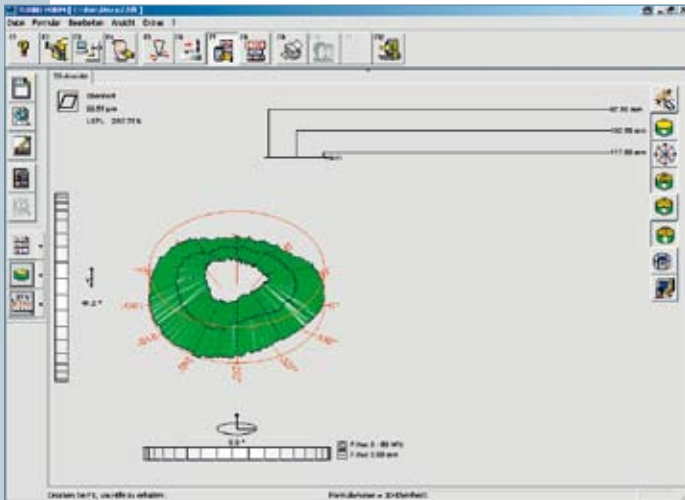
The aligned workpiece is measured at the measurement positions defined in the test plan. Help functions and displays in the measuring program make it easier for you to find and scan the individual measurement positions. Visualization of the measuring profile allows an evaluation to be made during the measurement.



Analysis

The measuring profiles are shown clearly in (3D) diagrams after scanning the workpiece.

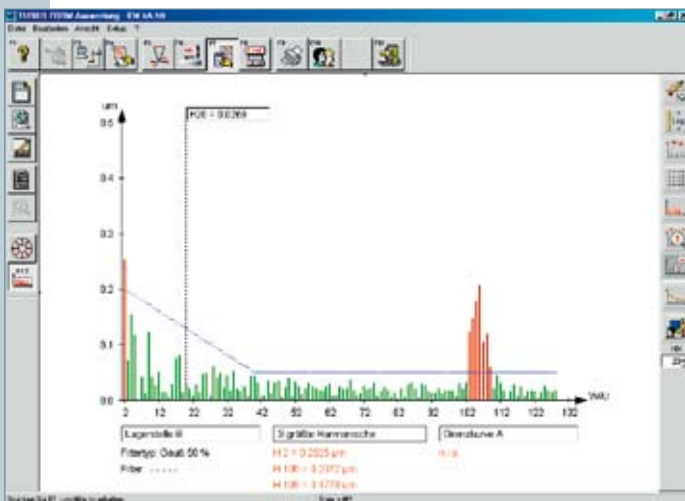
Functional variety in the standard software package



3D evaluation

3D evaluations

Detailed 3D representations of the measurement such as flatness, simplify evaluation of the measurement results as shown in the diagram.

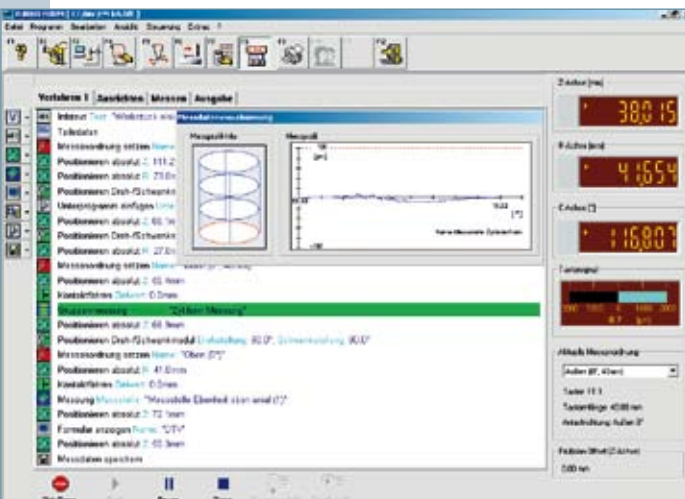


Fourier analysis

Fourier analysis

The measured profile is broken down into its spectral components and displayed graphically in the Fourier analysis. A limit curve and a warning limit can be defined for tolerancing.

This makes recurrent, high frequency profile segments recognizable. An example of a typical application is the detection of chatter marks on the workpiece.



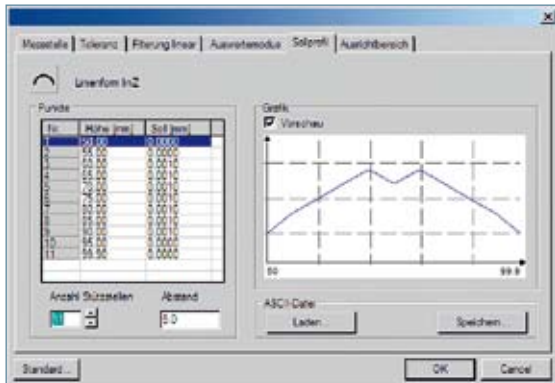
Automatic measuring run: CNC

Automatic measuring runs: CNC

A CNC run requires far less time than a manual measuring sequence and supplies operator-independent reproducible results. The automatic run leaves the operator free to perform other tasks.

CNC programs are created by a teach-in process and can be changed Step by Step afterwards – either as a total measuring run or in individual steps.

Software options for the evaluation of special measuring tasks



Line form

Line form

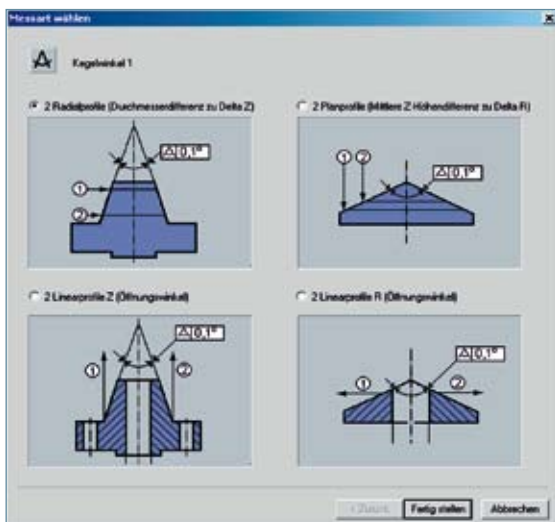
Evaluation of the line form by a nominal curve with even tolerance band.

Angular sector

Determination of the greatest roundness error within a defined angle segment.

Fourier synthesis

Extraction of individual frequency ranges. Characteristics, which are then formed no longer, contain these waves.



Cone

Cone

Calculation of the cone angle from two polar or two linear profiles. Determination and clear 3D display of conical form and run.

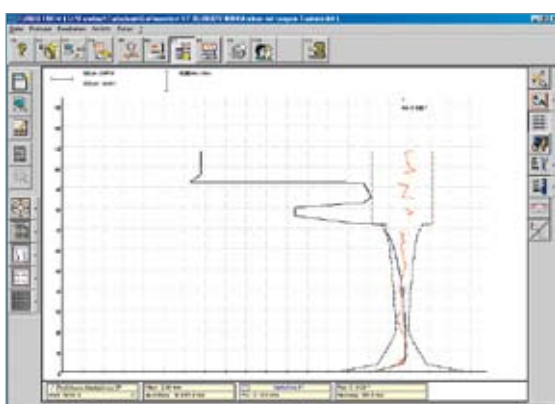
qs-STAT® interface

Certified according to AQDEF.

Transfer of the measuring data to the statistics package qs-STAT® for process data analysis.

ASCII export interface

Export of calculated characteristics and their measured values in ASCII format for further processing in other software programs such as Excel.



Linear form piston

Piston measurement

Evaluation of non-standardized characteristic types on pistons, e.g. evaluation of the ovality, reference bolt axis or linear form.

Brake disc measurement

Evaluation of certain important properties of brake discs such as wobble, thickness difference, waviness and wear measurement.

pdf output

Saving of forms in a pdf file (by CNC step or manually).

Twist measurement according to Daimler standard MBN 31 007-07

Twist refers to periodically running structures, which are comparable with the course of a thread. It is recognizable as a micro grinding structure under multiple magnification.

Twist structures are caused on the sealing surfaces of shafts during grinding and impair the sealing function between the shaft and the sealing ring.

The most important properties of these structures can be determined by a 3D evaluation of the surface.

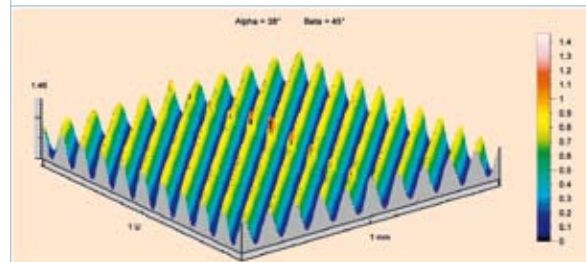
The contact zone of the shaft is scanned with a roughness stylus tip over a series of envelope line profiles as a 3D surface. This allows graphic representation of the twist structure as well as the calculation of the twist parameters twist pitch, period length, direction of twist, mean valley depth and mean conveyor cross section.

A twist standard with a cylindrical measuring surface with a 10 or 20-turn left twist is used to check the accuracy of the measuring systems.

The F1003/F1004/F4004 form measuring systems can be equipped optionally for the twist measurement. The equipment contains a high-resolution glass scale, a roughness stylus tip as well as the software for evaluating the parameters and 3D display of the surface structures.

Twist parameters:

Pitch	= -1 mm	angle	= 0° 14'
Lambda	= 0,1 mm	turns	= -10
Depth	= 0,669 µm	FQ	= 33 µm ²



3D display of the twist evaluation



Twist standards



Twist measurement with a roughness stylus tip

Workpiece-specific special measuring stations

Our standard form measurement systems are suitable for various measuring tasks thanks to their wide range of accessories. Our aim is to find the optimum solution for you – either with one of our standard systems or with a system specially tailored to meet your needs. You will benefit from our years of experience and extensive know-how in the development of special solutions.

Application examples in the automobile industry

- Break discs
- Pistons
- Valves
- Conrods
- Injection parts

Break discs

Wobble, axial runout, waviness, and thickness variation are determined with a special probe holder to which 2 probes are fixed. Special measuring reports are used for evaluation.



HOMMEL-ETAMIC F4004 for conrods

Pistons

Measurement of the external piston form, the bolt axis in the grooves and on the piston cover. Informative measuring reports allow a simple evaluation of the measurement results.

Valves

Measurement of all form and position tolerances on the valve. The workpiece is fixed by a vacuum holder. All the relevant characteristics are determined in one measuring run.

Conrods

For measuring the roundness and parallelism of the small and large eye.

Injection parts

Hommel-Etamic offers specially adapted clamping devices for the CNC measurement of different injection molded parts.



HOMMEL-ETAMIC F4004 for break discs

Probe arms – basis for high-precision measurement

Probe arm set FTS 1

The FTS 1 probe arm set covers most common measurement tasks.

Art. 230 580



The components of the probe arm set may also be ordered separately:

Extension L030

L = 30 mm (2x); M2 thread Art. 051 210

Stylus tip M2 KU500/R L20

L = 20 mm; 1 mm ruby ball; M2 thread Art. 051 209

Stylus tip FO KE300/90H L10 D2/10

L = 10 mm; 2 conical tips Art. 519 520

Stylus tip FO KU1500/R L20 D2/18,5

L = 18,5 mm; 3 mm ruby ball Art. 243 877

Stylus tip FO KE300/90H L35 D2/35

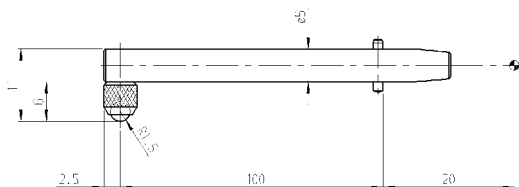
L = 35 mm; 2 conical tips Art. 241 712

Stylus tip FO TO250-8000/60H L40 D2/40

L = 40 mm; axe stylus tip with 0.25 mm and 8 mm radius Art. 243 681

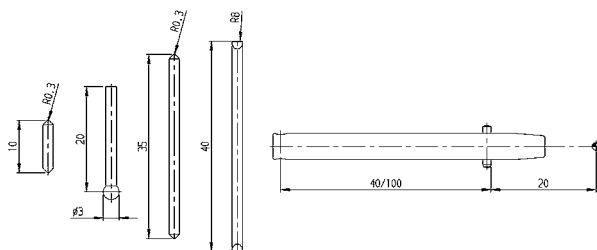
Key for changing the stylus tip M2

Art. 051 215



Probe arm FT-R-L100-KU 1,5

L = 100 mm, 3 mm probe ball Art. 230 615

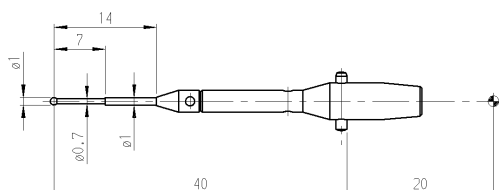


Probe arm FT-HR-L040/L100-D2

2 mm bore for inserting stylus tips

L = 40 mm Art. 230 630

L = 100 mm Art. 230 634



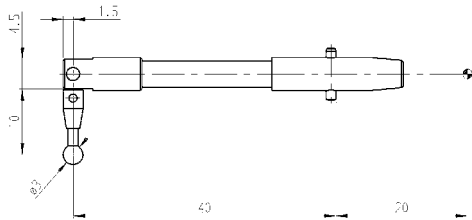
Probe arm FT-HA-L020-M2

M2 thread for screwing on stylus tips

L = 20 mm Art. 230 561

Carbon fiber probe arms

State of the art carbon fiber probe arms deliver excellent stability and maximize measurement flexibility. Available in standard and custom sizes, which can be quickly and easily adapted to a variety of measurement situations. Below are examples of different types of probe arms.



Probe arm FT-HR-L040/L100-M2

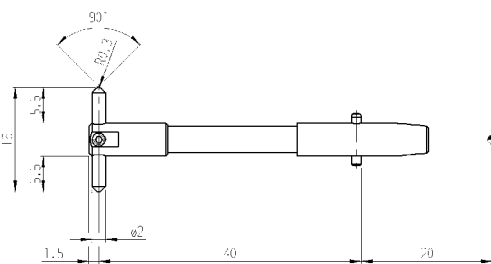
2 mm thread for screwing on stylus tips

L = 40 mm Art. 244 940

L = 100 mm Art. 244 941

Stylus tip with 3 mm ruby ball

Art. 063 935



Probe arm FT-HR-L404/L100-D2

for inserting 2 mm stylus tips

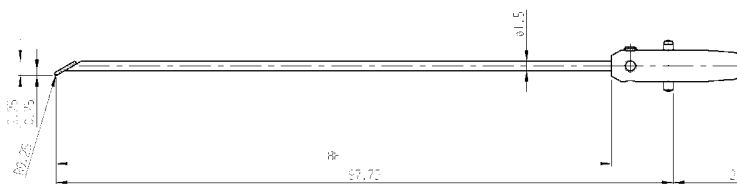
L = 40 mm Art. 256 720

L = 100 mm Art. 1000 1880

Stylus tip with 2 conical tips

Art. 243 938

For measurements on ground and slightly soiled measurement positions

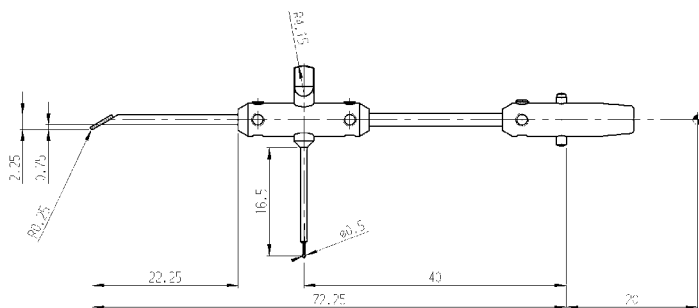


Probe arm FT-R-L097,75-KU0,15

with tip contacting at an angle

Art. 241 561

For measurements on envelope lines

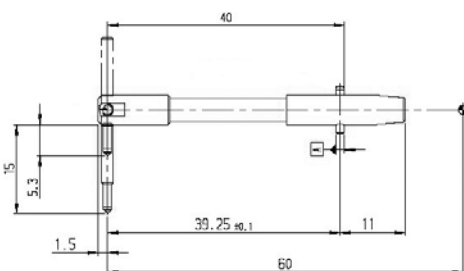


Probe arm FT-AR-L040/072,25

Special version

With cross pin Art. 256 729

For measurements on end surfaces, in bores above 3 mm and on the bottom surfaces of bores



Probe arm FT-A-L040-KE5

L = 40 mm, diamond Tipp with 90°, 5 µm

Art. 513 140

For twist measurement

Accessories for different measuring tasks

Hommel-Etamic offers a wide range of standard and custom accessories for handling even the most complex workpieces.

Probe FT1

The individual lever probe FT1 has an interchangeable, 180° rotatable probe arm with reversible probing direction, adjustable gauging force and a variable free stroke limit in both directions.

Art. 231 410



Tables

Dimensions 2000 x 800 x 780 mm (L x W x H)

GTS for F100x Art. 232 900

GTF1 for F1003/F1004 Art. 232 953

GTF2 for F4004 Art. 232 902

Dimensions 1600 x 800 x 780 mm (L x W x H)

GTS-K Art. 232 901

Cover

For use in production

Art. 1003 9020



Chucks

with three, six or eight hardened clamping jaws for secure clamping of the workpieces on the rotary table.

Chuck FX 70

Chuck range

Internal 18-62 mm

External 2-68 mm

Art. 232 036



Chuck FX 100

Chuck range

Internal 28-95 mm

External 2-95 mm

Art. 232 357



Chuck FX 150

For 150 mm rotary table

Chuck range

Internal 46-140 mm

External 2-140 mm

Art. 507 001



Chuck FX 150

For 250 mm rotary table

Chuck range

Internal 46-140 mm

External 2-140 mm

Art. 232 359



Probe tilting modules

Manual probe tilt arm FS1

(See page 5 in HOMMEL-ETAMIC F1003 picture)

Art. 513 277

Motorized tilt and rotation module MDS

(See page 7)

Art. 513 253

Permanent accuracy

Calibration and adjustment

Our measuring systems as well as single components are delivered completely aligned, tested and in perfect condition. All individual parts can easily be changed as a result without impairing the measuring accuracy.

In most cases the perfect function of the measuring device cannot be detected directly. In general the calibration of the system has to be carried out with the help of a feedback standard.

Hommel-Etamic is a DKD calibration laboratory

One particularly important aspect is the continuous monitoring of our products for optimum accuracy. In the DKD calibration laboratory (German calibration service) we calibrate your standards. If a standard proves impossible to calibrate you can order new standards from us. A simple in-house calibration certificate or test certificate is issued for variables which are not accredited, and as a low-cost alternative to the DKD calibration certificate.

Our calibration services:

- DKD calibration certificates for form standards
- DKD calibration certificate for roughness standards
- DKD calibration certificate for roughness measuring systems
- DKD calibration laboratory for the variable length: including roughness, profile depth, roughness measuring systems as well as roundness, straightness, parallelism and magnification standards

DKD calibration certificates for form standards

Calibration is performed in a temperature controlled, vibration isolated laboratory, using a Z-axis rotary spindle DKD measuring station. All common form parameters can be calibrated.

Magnification standard FN 101

For checking the scanning system

With in-house calibration certificate Art. 521 809

With DKD calibration certificate Art. 532 528



Roundness standard FN 111

Ceramic, for checking the radial roundness deviation of the rotational axis.

With in-house calibration certificate Art. 521 799

With DKD calibration certificate Art. 532 529



The right form measuring system for every measuring task

HOMMEL-ETAMIC roundscan

Ergonomically designed measuring station for fast, high-precision form measuring. Optionally upgradeable for the combined, automated form and roughness measurement with one scanning system.



HOMMEL-ETAMIC FMS

Spindle form measuring machines with rotating scanning head for large, heavy workpieces.



HOMMEL-ETAMIC shaftscan

Form measuring machine for crankshafts and camshafts with a robust design for use in production.

Technical data

	HOMMEL-ETAMIC F1000 Art. 999 600	HOMMEL-ETAMIC F1003 / F1003L Art. 999 603 / 999 613	HOMMEL-ETAMIC F1004 / F1004L Art. 999 604 / 999 614	HOMMEL-ETAMIC F4004 / F4004L Art. 999 644 / 999 654
Measuring range				
Distance C/Z axis	220 mm	270 mm	270 mm	350 mm
Max. test diameter	320 mm	340 mm	340 mm	430 mm
Max. measuring height	300 mm	350/550 mm	350/550 mm	350/550 mm
Rotation axis (C axis)				
Table diameter	150 mm	150 mm	150 mm	250 mm
Workpiece alignment	manual	manual	manual	automatic
Roundness error $\mu\text{m}+\mu\text{m}/\text{mm}$ measuring height	0.05 + 0.0005	0.05 + 0.0005	0.05 + 0.0005	0.04 + 0.0005
Roundness error $\mu\text{m}+\mu\text{m}/\text{mm}$ measuring height*	0.025 + 0.00025	0.025 + 0.00025	0.025 + 0.00025	0.02 + 0.00025
Axial run-out error $\mu\text{m}+\mu\text{m}/\text{mm}$ radius	0.05 + 0.0005	0.05 + 0.0005	0.05 + 0.0005	0.04 + 0.0005
Axial run-out error $\mu\text{m}+\mu\text{m}/\text{mm}$ radius*	0.025 + 0.00025	0.025 + 0.00025	0.025 + 0.00025	0.02 + 0.00025
Centering range	± 2 mm	± 2 mm	± 2 mm	± 2 mm
Leveling range	$\pm 0.6^\circ$	$\pm 0.6^\circ$	$\pm 0.6^\circ$	$\pm 0.6^\circ$
Measuring speed	1–10 1/min.	1–10 1/min.	1–10 1/min.	1–12 1/min.
Bearing	Air	Air	Air	Air
Max. charge	250 N	250 N	250 N	400 N
Vertical axis (Z axis)				
Traverse distance	300 mm	–	–	–
Measuring distance	–	350/550 mm	350/550 mm	350/550 mm
Straightness error / 100 mm	–	0.2 μm	0.2 μm	0.2 μm
Straightness error / measuring distance	–	0.5/0.7 μm	0.5/0.7 μm	0.5/0.7 μm
Parallel C-Z / measuring distance	–	1.0/1.5 μm	1.0/1.5 μm	1.0/1.5 μm
Collision protection	–	yes	yes	yes
Horizontal axis (R axis)				
Traverse distance	170 mm	170 mm	–	–
Measuring distance	–	–	170 mm	220 mm
Straightness error / 100 mm	–	–	0.5 μm	0.5 μm
Straightness error / measuring distance	–	–	0.8 μm	0.8 μm
Squareness C-R	–	–	2 μm	2 μm
Dimensions / Weight				
Length	475 mm	630 mm	630 mm	780 mm
Width	285 mm	400 mm	400 mm	500 mm
Height	600 mm	845/1045 mm	845/1045 mm	865/1065 mm
Weight	80 kg	170 kg	176 kg	311 kg

L = systems with greater vertical measurement length

All accuracy data according to DIN 1101. Roundness deviations measured with filter 0-15 W/U; 6 rpm.; LSC.

Straightness deviations measured with cut-off wavelength 2.5 mm; 100 mm/min.; LSS.

All data relate to 20°C \pm 1°C.

* Values as maximum deviation from the reference circle LSCI, filter 0-15 W/r LSC, 6 rpm.



Our global presence.

- | | | |
|-------------|----------------|-------------|
| Germany | Spain | Mexico |
| France | Czech Republic | China |
| Switzerland | United States | South Korea |
| | | India |

Group companies, affiliates and representation worldwide

www.hommel-etamic.com