Formline – Form metrology

Innovative measuring systems

for unequivocal measurement of form and positional tolerances

HOMMEL ETAMIC

A member of the JENOPTIK Group

www.hommel-etamic.com

Precise metrology for efficient quality control

As a leading manufacturer of metrology systems, HOMMEL ETAMIC offers a broad portfolio of measurement solutions for industrial manufacturing processes. Our high-precision technologies include pneumatic, tactile or optical measurement of roughness, contour, form and dimensions, as well as optical inspection of machined surfaces. Comprehensive services such as consulting, training, DAkkS-DKD calibration and service, including long-term maintenance contracts, round off our worldwide range of metrology services for quality assurance in industrial manufacturing.

Our measuring systems ensure the quality of the workpiece throughout the entire production process and provide precise measurement data in the shortest possible time. Automatic measuring technologies enhance overall productivity during production through efficiently designed inspection solutions – whether inline or offline, or using spot checks through 100 % inspection of all manufactured workpieces.

We provide you with solutions for a wide range of tasks in form measurement – from the fully automatic CNC measuring station for all form and positional tolerances to combined form and roughness measuring systems to solutions for large and heavy shafts.

Typical applications
- Bearing rings
- Gear shafts
- Rotor shafts
- Brake disks
- Spindles
- Screws
- Prostheses
- Hydraulic and pneumatic components
- Pistons
- Crankshafts
- Camshafts
- And many more

Form tolerances
- Roundness
- Straightness
- Flatness
- Cylinder form

Run-out tolerances
- Radial run-out
- Axial run-out
- Total radial run-out
- Total axial run-out

Position tolerances
- Parallelism
- Perpendicularity
- Angularity
- Coaxiality, concentricity

Specific parameters
- Conicity
- Position deviation
- Length
- Thickness and thickness deviation
- Stroke radius
- Crowning
- Angle deviation
- FFT analysis and synthesis
- Twist
- Roughness (linear and polar)
- Dominant roundness waviness
- Polar and line form
- Cam form
- Vibration velocity
- Angular sector evaluation
- Laminar jump
- Piston evaluation

To the information on our website

Formline F900. Highly efficient solution for form, roughness and twist measurements

Formline F900 with 550 mm column and vibration-damped instrument table

Motorized tilt and rotation module

Magnetic coupling

Double-tipped probe system

Highlights

- Time saving thanks to very fast, fully automatic centering and leveling and CNC controlled measuring axes
- Flexible use with free probe system in C, Z and R direction for form, roughness, waviness and twist measurement in a single clamping operation
- Heights of vertical measuring axis: 350, 550 or 900 mm
- Vibration-damped instrument table with container for PC and system electronics
- Magnetic probe arm coupling for fast changing of the probe arm and protection in case of collisions
- Flexible access to external/internal measurement positions:
  + fully automatic probe positioning by CNC controlled tilt and rotation module
  + fully automatic, freely adjustable probe force and reversible scanning direction

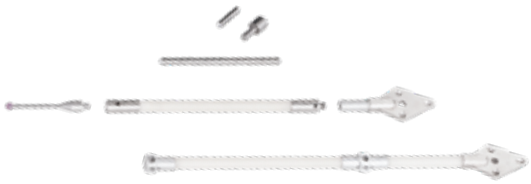
System features

- Highly accurate air bearing rotary table with outstanding rigidity for consistently high precision
- High resolution with 0.1 µm in the R/Z axis and 360,000 points in the C axis
- Integrated linear scale and active level control
- CNC controlled motorized tilt and rotation module for fully automatic measurements
- Double-tipped probe system can be switched from form to roughness during the CNC run
- For roughness measurement, the probing force can be programmed in any position of the probe arm in accordance with standards
- Axes with high resolution and very low interference
- Automatic zenith alignment of the probe arm through 3-ball system

Formline F900. Accessories for a variety of measuring tasks

We offer you a wide range of accessories to adjust the system to different workpieces and measuring tasks.
We can also provide you with specially manufactured accessories for specific tasks.

Probe arm set FTM



With the flexible probe arm set for the configuration of probe arms, you can cover the most common measuring tasks. Other probe arms and probes are available on request.
Art. 1002 9224

Chucks

With three, six or eight hardened clamping jaws for secure clamping of the workpieces on the rotary table. Other chucks are available on request.

Chuck FX70
Chuck range
Internal 18–62 mm
External 2–68 mm
Art. 232 036

Chuck FX100
Chuck range
Internal 28–95 mm
External 2–95 mm
Art. 232 357

Chuck FX150
Chuck range
Internal 46–140 mm
External 2–140 mm
Art. 232 359

Roundness standard FN111

Made of ceramic. For inspecting the radial roundness deviation of the rotational axis.
With factory calibration certificate
Art. 521 799
With DAkkS-DKD calibration certificate
Art. 532 529

Magnification standard FN101

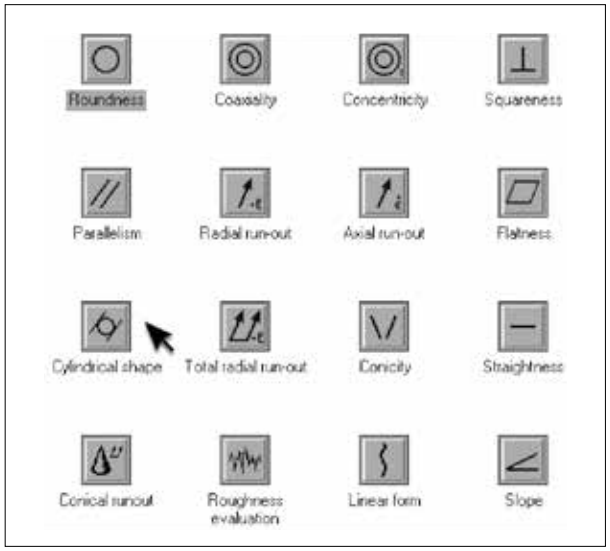
For inspecting the amplification of the probing system.
With factory calibration certificate
Art. 521 809
With DAkkS-DKD calibration certificate
Art. 532 528

Roughness standard RNDX2 with standard holder

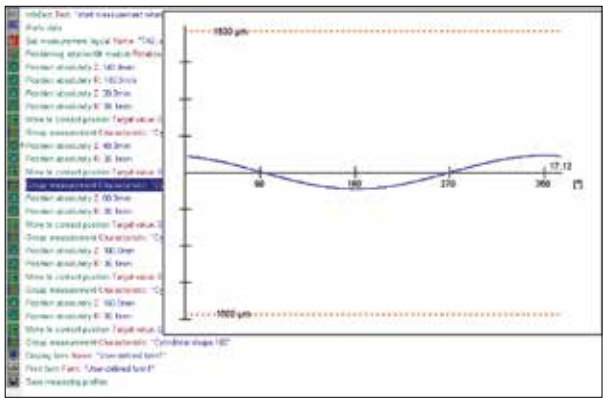
For inspecting the roughness measurement with the Z and R axis. In the FNR standard holder for one or two geometry standards of type RNDH or RNDX.
Scope of delivery:
- Standard holder
- RNDX2 standards
- Factory calibration certificate

Art. 1003 4205

Turbo Form. Software with clear user guidance for reliable measurement evaluation



Test plan creation



Automated alignment and measuring run

Results report for form and roughness measurement

The graphical, function-oriented user interface of Turbo Form ensures simple operation, even when performing complex measurement tasks.

System features

- User-friendly interface with clear icons
- Simple definition of measurement positions/axis references
- Direct transfer of positions via teach-in
- Simple CNC programming using pictograms
- Fully automatic alignment and measurement
- Comprehensive profile analysis and complete documentation of the measurement results
- Clear program flow
- Evaluation in accordance with standards
- Convenient test plan management
- Fast evaluation algorithms for prompt results
- Fourier analysis for detection of recurring profile parts
- Results display in 3D diagrams
- User-defined presentation of measuring reports
- Automatic saving of PDF reports

Automatic measurement runs: CNC

- User-independent, reproducible results
- Aligned workpiece is automatically measured at the measuring positions defined in the test plan
- Created in the teach-in mode or via offline license

Software options

- Line form
- Angular sector
- Fourier synthesis
- Cone
- qs-STAT® interface
- ASCII export interface
- Piston measurement
- Brake disk measurements
- Dominant roundness waviness
- PDF export component
- Profile operations
- Evaluation of common roughness, waviness and profile parameters in accordance with standards
- Twist measurement according to MBN 31007-07 standard with TwistLive® quick analysis method

Formline F900. Twist measurement according to MBN 31007-07

Twist refers to periodic structures which are comparable with the course of a thread. Magnified many times, it is visible as a micro-grinding structure. Twist structures at the sealing surfaces of shafts occur during grinding and impair the sealing function between the shaft and the sealing ring.

The most important properties of these structures can be determined with a 3D evaluation of the surface. The contact zone of the shaft is measured as a 3D area with a roughness stylus tip over a series of envelope line profiles. This allows a graphic representation of the twist structure as well as calculation of the twist parameters according to MBN 31007-07.

Twist parameters

- Number of threads DG
- Twist depth Dt [µm]
- Period length DP [mm]
- Feed cross section DF [µm²]
- Feed cross section per revolution DFu [µm²/U]
- Contact length in percent DLu [%]
- Twist angle DW [°]

Twist standards

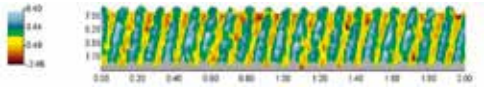
For inspecting the accuracy of the measuring system. Calibrated parameters: Dt, DP, DG and DW. Set consisting of two standards with 10 threads and 30 threads. With factory calibration certificate.
Art. 521 799

Patented TwistLive® analysis method

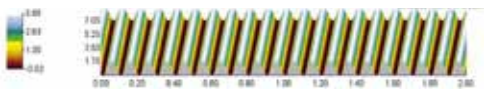
Wit this standard-compliant analysis method for all Formline F900 systems, the normal measurement time may be reduced by 75 %. During the measuring progress, a results forecast of the twist parameters is already possible – live!

The measured value recording for the twist measurement requires 72 profiles. The TwistLive® fast analysis method, which is based on the 36° and 360° profile principle, includes a specially developed evaluation method to shorten the measuring time.

The resulting twist structure is updated after each structure is updated and the twist parameters are calculated. The required measuring time is thus typically reduced from 15 - 20 minutes to approx. 5 minutes per topography.

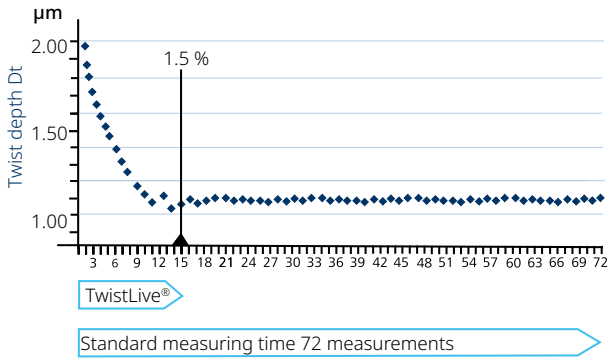


Display of unfiltered primary surface structure



Display of twist structure in detailed scaling

Display of original profile (green) and twist profile (blue)



Example measurement of the twist depth Dt. After 12 measurements, the final value is stable within 1.5 % and the measurement is ended after only approx. 5 minutes.

Formline F900. Application examples and technical data

Application examples Formline F900

Thanks to the extensive range of accessories, the F900 systems are suitable for a wide variety of measuring tasks. If required, we can develop a system that is specially tailored to your requirements.

Combined form and roughness measurement

Form measurement in small, deep bores

Measurement on a gear shaft

Technical data

Model	F900-350	F900-550	F900-900
Measuring range			
Distance C/Z axis, max. interfering edge radius	370 (420[1]) mm	370 (420[1]) mm	370 (420[1]) mm
Max. test diameter	430 (530[1]) mm	430 (530[1]) mm	430 (530[1]) mm
Max. measuring height	350 mm	550 mm	900 mm
Rotation axis (C axis)			
Table diameter	330 mm		
Workpiece alignment	automatic		
Roundness deviation (radial) µm+µm/mm measuring height[2]	0.02 µm + H*0.0005 µm		
Run-out deviation (axial) µm+µm/mm radius[2]	0.03 µm + R*0.0005 µm		
Centering range	±5 mm		
Leveling range	±1°		
Measuring and positioning speed	0.2 – 15 1/min.		
Bearing	air		
Max. charge	1000 N		
Vertical axis (Z axis)			
Measuring distance	350 mm	550 mm	900 mm
Straightness deviation/100 mm	0.15 µm	0.15 µm	0.25 µm
Straightness deviation/measuring distance	0.3 µm	0.45 µm	1.5 µm
Parallel C-Z/measuring distance	0.5 µm	0.8 µm	2.5 µm
Measuring and positioning speed	0.2 – 50 mm/s	0.2 – 50 mm/s	0.2 – 50 mm/s
Collision protection	yes	yes	yes
Horizontal axis (R axis)			
Measuring distance	240 mm		
Straightness deviation/100 mm	0.25 µm		
Straightness deviation/measuring distance	0.5 µm		
Squareness C-R	0.8 µm		
Measuring and positioning speed	0.2 – 50 mm/s		
Dimensions			
Length	1425 mm	1425 mm	1425 mm
Width	800 mm	800 mm	800 mm
Height	1620 mm	1820 mm	2170 mm
Weight			
Measuring system	685 kg	700 kg	720 kg

All data according to ISO 5463. [1] On request. | [2] Filtering with 0 – 15 W/R.

Formline CFM3010. Comprehensive competence for large and heavy shafts

Formline CFM3010 with evaluation unit

Flat measuring follower for crankshafts

Round measuring follower for camshafts

Highlights

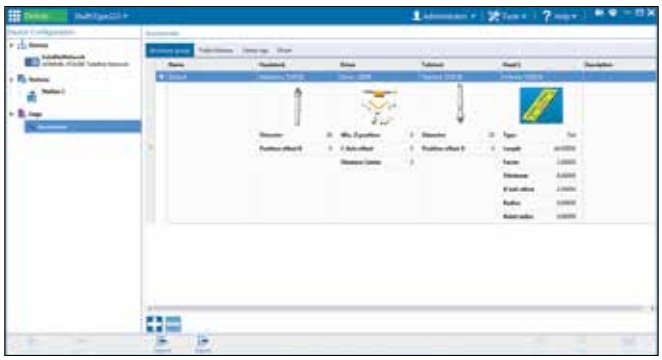
- Secure measurement results thanks to air-bearing, lateral force-stable measuring head, including precise FFT analysis
- Excellent basic accuracy thanks to high-resolution measurement systems
- Robust construction with vibration decoupling for use in the measuring room or in production
- Optimized CNC runs in conjunction with high measurement and travel speeds
- Fast measurement value recording
- Can be used flexibly for a variety of workpieces
- **Typical applications:** crankshafts, camshafts, transmission shafts, rotor shafts, and many more

System features

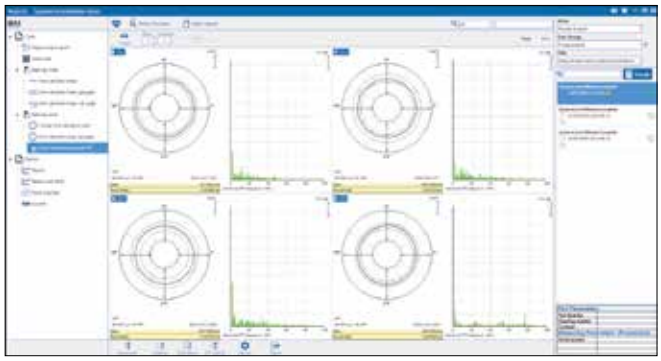
- Gaging component capability: measuring accuracy with repeatability of up to 0.3 µm
- Distance between tips: 1250 (1500) mm
- Wear-free air bearing measuring slides
- Interpolated axis positioning
- Capable evaluation software Tolaris Shaft for camshafts and crankshafts
- Element-oriented programming concept
- Offline programming license
- PTB-certified cam form evaluation algorithms
- Extensive range of accessories such as followers and drivers for different measuring tasks

Tolaris Shaft. Modern evaluation software for reliable process control

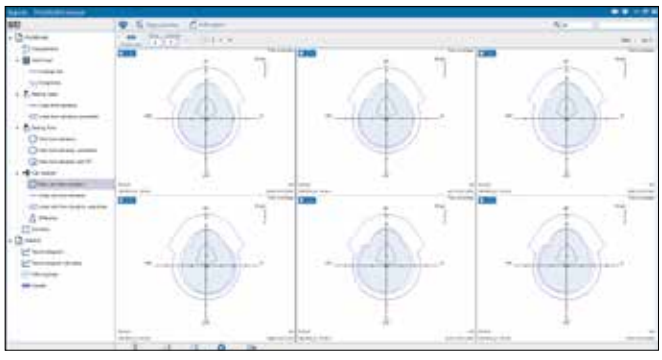
Workpiece displays together with characteristics



Management of workpiece-specific accessories



Polar diagram bearing with FFT



Polar diagram cam form

The Tolaris Shaft evaluation software for the CFM3010 crankshaft and camshaft measuring machine is easy to use and takes all key aspects for controlling and optimizing modern production processes for crankshafts and camshafts into account.

System features

- Optimized for the measurement and evaluation of crankshafts and camshafts
- Standardized displays to make it easy to familiarize yourself with the software and use it reliably
- Extensive toleration functions
- Clear profile graphics
- Simple print form creation
- Control charts
- Extensive data exports to correct machine tools
- Measuring process and accessories management
- User management
- FFT tolerance zone management
- Offline programming
- Scope for expansion to include specific evaluation functions

Simple and comfortable use

- Self-explanatory dialogues to support recurring tasks
- Feature-oriented programming with schematic representation of the workpiece with measuring positions
- Simple machine control and CNC programming for automated measuring sequences
- Accessories management for easy organization of clamping equipment and measuring elements for specific workpieces

Options for specific measuring tasks

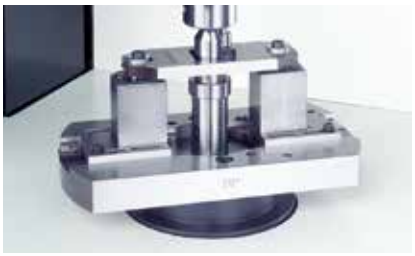
- qs-STAT® interface
- Wavinesses such as chatter marks or dominant roundness waviness
- Cam form
- Classification (for final inspection systems)

Formline CFM3010. Application-related accessories & technical data

Workpiece drivers for Formline CFM3010

Universal standard workpiece drivers for the measurement of all common workpiece types.
Application-specific drivers are also available.

Universal driver for cam shafts, gear shafts and crank shafts



Workpiece-specific axial driver for cam shafts and crank shafts for angle indexing in axial bores

Workpiece-specific radial driver for cam shafts for angle indexing in grooves

Technical data

Model	**CFM3010**
Measuring range	
Distance C/Z axis, max. interfering edge radius[2)]	162 mm
Max. test diameter	300 mm
Max. measuring height	1250 (1500[1)]) mm
Max. traverse distance radial	210 mm
Rotation axis (C axis)	
Face plate	196 mm
Workpiece alignment	tips
Measuring and positioning speed	0.5 – 50 1/min.
Bearing	mechanical
Max. charge	1500 N
Traversing speed	0.5 – 50 1/min.
Resolution	0.00005°
Positioning accuracy	0.1°
Accuracy	±0.00028
Run-out accuracy of the roller bearing	0.25 µm
Measuring point distance	0.1 / 0.2 / 0.5 / 1
Vertical axis (Z axis)	
Travel distance	1290 (1590[1)]) mm
Measuring distance	1250 (1500[1)]) mm
Collision protection	yes
Positioning error/measuring distance	0.02 mm
Measuring and positioning speed	1 – 200 mm/s
Resolution of the Z scale	0.1 µm
Accuracy	±3 µm
Straightness axis (X axis)	
Measuring distance	210 mm
Resolution	0.02 µm
Accuracy	±0.2 µm
Setting range of the measurement force	1, 2, 3 and 4 N
Travel in X direction (resolution probing system)	
Measuring and positioning speed	1 – 80 mm/s
Resolution radial	0.02 µm
Resolution axial	0.1 µm
Dimensions [L x W x H]	1240 x 1360 x 2450 (2700[1)]) mm
Weight measuring system	3100 (3500[1)]) kg

[1)] On request. | [2)] Standard flat measuring follower, length 43 mm.

All-round support. Ensuring your productivity thanks to a comprehensive range of services

We not only provide you with innovative and high-precision measuring systems, but also the appropriate services – from the initial inquiry to the individual customer service package. From our wide range of services, we will put together an individual package for you that is perfectly tailored to your requirements.

Service | Preventive & reactive services

- **Application consulting:** Start-up support, measuring program generation, application studies
- **Maintenance & repairs:** Remote service (teleservice), maintenance & repairs of measuring systems, repairs (technical service)
- **Upgrades & retrofit:** Optimization, retrofitting & extension, software updates & upgrades
- **Spare parts:** Probe replacement and spare parts service
- **Other services:** Relocation service, financing

Training | Good training & safe operation

- Training courses on the basics, operation and programming
- At our premises or at your site
- Standard or individual training courses
- Small groups for optimal learning success
- Qualified instructors with practical experience
- **Webinars:** Practice-oriented and location-independent training on specific topics

DAkkS-accredited DKD calibration laboratory

Due to the constant use of measuring equipment and the associated wear and tear, the measuring accuracy can change unnoticed. Regular calibration of the device with the help of traceable standards is required, because only calibrated measuring devices ensure that meaningful and correct results are generated.

DKD calibration laboratory

Our vibration-insulated and air-conditioned calibration laboratory (D-K-15030-01-00) is accredited by the Deutsche Akkreditierungsstelle GmbH (DAkkS) according to ISO / IEC 17025. Here we calibrate your standards. This ensures direct tracing of the measuring equipment to the Physikalisch-Technische Bundesanstalt (PTB) and guarantees measurements and calibrations at the highest metrological level. If a standard cannot be calibrated, a new one can be obtained from any of our facilities.

For non-accredited parameters, we deliver simple factory calibration certificates (e.g. for cam standards) or factory test reports. We also carry out capability tests for demanding measurement tasks.

Our range of calibration services

Our DAkkS accreditation includes the measurement of variables such as roughness, form deviation, contour, contact stylus instruments and shaft measuring systems. Within this scope we issue DAkkS-DKD calibration certificates for e.g.:

- form standards
- contour standards
- roughness standards

DAkkS-DKD calibration certificate for form standards

Calibration is carried out on our DKD measuring station in an air-conditioned, vibration-insulated measuring room with a rotating spindle system with measuring Z axis.

HOMMEL ETAMIC

Worldwide availability

Our expert teams are available to assist you wherever you are located. We have subsidiaries and distribution partners in key national nations, in order to assist our customers as a reliable production partner.

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