

Formline – Form metrology

# Innovative measuring systems for unequivocal measurement of form and positional tolerances



# 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  $\mu\text{m}$  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.

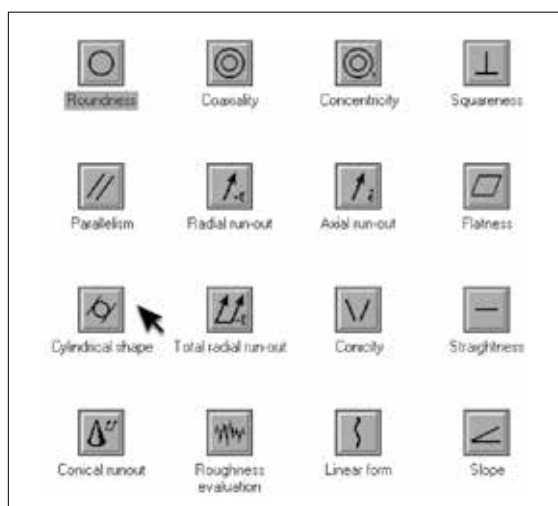
Scope of delivery:

- Standard holder
- RNDX2 standards
- Factory calibration certificate

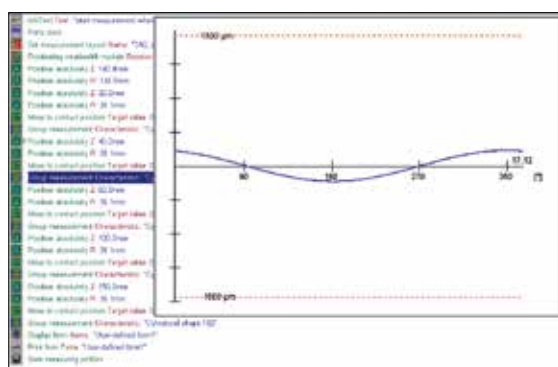
Art. 1003 4205



# 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 [ $\mu\text{m}$ ]
- Period length DP [mm]
- Feed cross section DF [ $\mu\text{m}^2$ ]
- Feed cross section per revolution DFu [ $\mu\text{m}^2/\text{U}$ ]
- 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

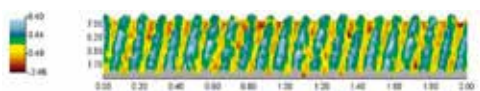


### Patented TwistLive® analysis method

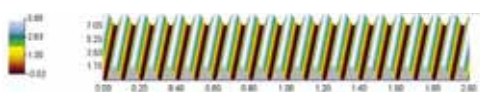
With this standard-compliant analysis method for all Formline F900 systems, the normal measurement time may be reduced by 75 %. During the measuring progress, a results forecast of the twist parameters is already possible – live!

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.



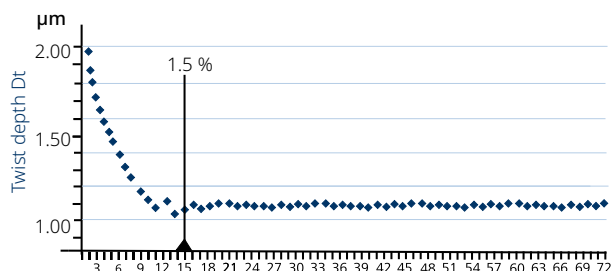
Display of unfiltered primary surface structure



Display of twist structure in detailed scaling



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



TwistLive®

Standard measuring time 72 measurements

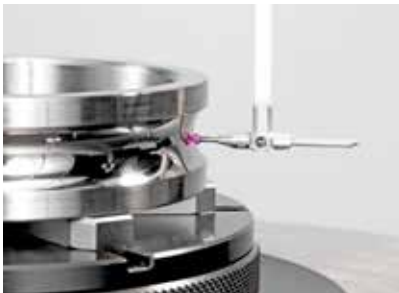
Example measurement of the twist depth Dt. After 12 measurements, the final value is stable within 1.5 % and the measurement is ended after only approx. 5 minutes.



# 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   |
|---|--|---|--|
| <b>Measuring range</b><br>Distance C/Z axis, max. interfering edge radius<br>Max. test diameter<br>Max. measuring height  | 370 (420 <sup>1)</sup> ) mm<br>430 (530 <sup>1)</sup> ) mm<br>350 mm   | 370 (420 <sup>1)</sup> ) mm<br>430 (530 <sup>1)</sup> ) mm<br>550 mm                            | 370 (420 <sup>1)</sup> ) mm<br>430 (530 <sup>1)</sup> ) mm<br>900 mm                           |
| <b>Rotation axis (C axis)</b><br>Table diameter<br>Workpiece alignment<br>Roundness deviation (radial) $\mu\text{m}+\mu\text{m}/\text{mm}$ measuring height <sup>2)</sup><br>Run-out deviation (axial) $\mu\text{m}+\mu\text{m}/\text{mm}$ radius <sup>2)</sup><br>Centering range<br>Leveling range<br>Measuring and positioning speed<br>Bearing<br>Max. charge | 330 mm<br>automatic<br>0.02 $\mu\text{m} + H \cdot 0.0005 \mu\text{m}$<br>0.03 $\mu\text{m} + R \cdot 0.0005 \mu\text{m}$<br>$\pm 5 \text{ mm}$<br>$\pm 1^\circ$<br>0.2 – 15 1/min.<br>air<br>1000 N |   |  |
| <b>Vertical axis (Z axis)</b><br>Measuring distance<br>Straightness deviation/100 mm<br>Straightness deviation/measuring distance<br>Parallel C-Z/measuring distance<br>Measuring and positioning speed<br>Collision protection   | 350 mm<br>0.15 $\mu\text{m}$<br>0.3 $\mu\text{m}$<br>0.5 $\mu\text{m}$<br>0.2 – 50 mm/s<br>yes   | 550 mm<br>0.15 $\mu\text{m}$<br>0.45 $\mu\text{m}$<br>0.8 $\mu\text{m}$<br>0.2 – 50 mm/s<br>yes | 900 mm<br>0.25 $\mu\text{m}$<br>1.5 $\mu\text{m}$<br>2.5 $\mu\text{m}$<br>0.2 – 50 mm/s<br>yes |
| <b>Horizontal axis (R axis)</b><br>Measuring distance<br>Straightness deviation/100 mm<br>Straightness deviation/measuring distance<br>Squareness C-R<br>Measuring and positioning speed  | 240 mm<br>0.25 $\mu\text{m}$<br>0.5 $\mu\text{m}$<br>0.8 $\mu\text{m}$<br>0.2 – 50 mm/s  |   |  |
| <b>Dimensions</b><br>Length<br>Width<br>Height  | 1425 mm<br>800 mm<br>1620 mm   | 1425 mm<br>800 mm<br>1820 mm  | 1425 mm<br>800 mm<br>2170 mm   |
| <b>Weight</b><br>Measuring system   | 685 kg   | 700 kg  | 720 kg   |

All data according to ISO 5463.

<sup>1)</sup> On request. | <sup>2)</sup> 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  $\mu\text{m}$
- 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



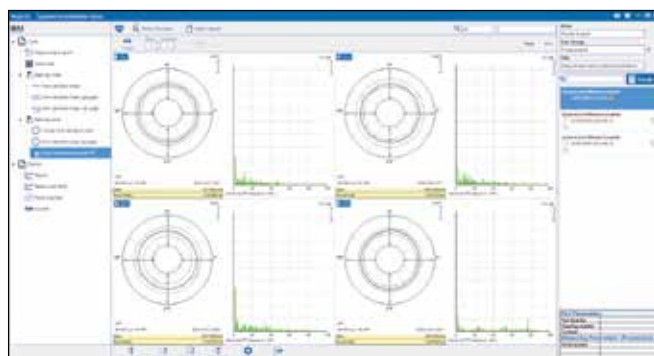
# Tolaris Shaft. Modern evaluation software for reliable process control



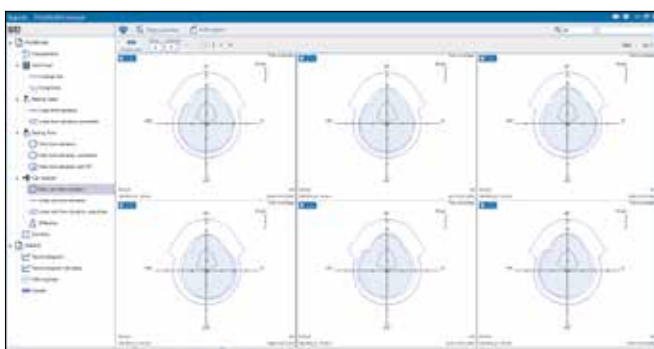
Workpiece displays together with characteristics



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

<sup>1)</sup> On request. | <sup>2)</sup> 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 EN 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.

## 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.

