# BRUKER

3D OPTICAL METROLOGY

NPFLEX-1000 Profilometer

Most Flexible Large-Sample Precision Manufacturing Solution for Fast, Automated Roughness and Surface Texture Measurements

NPFLEX-1000

The floor-standing NPFLEX-1000 white light interferometry (WLI) system brings unprecedented flexibility, measurement capabilities, and performance to precision manufacturing industries aiming to understand and control manufacturing processes. With its open-gantry design and 300-mm distance between the stage and objectives, the system is uniquely capable of handling nano- to macro-features effortlessly on samples of widely varying shapes and sizes. New one-click Advanced Find Surface™ improves user experience and time-to-result by incorporating auto-focus and auto-illumination and eliminating the need to manually register the surface before each measurement. Combined with its self-adapting USI measurement mode and guided, simplified VisionXpress™ interface, the NPFLEX-1000 provides uncompromised metrology for automotive, medical device, and additive manufacturing production facilities.
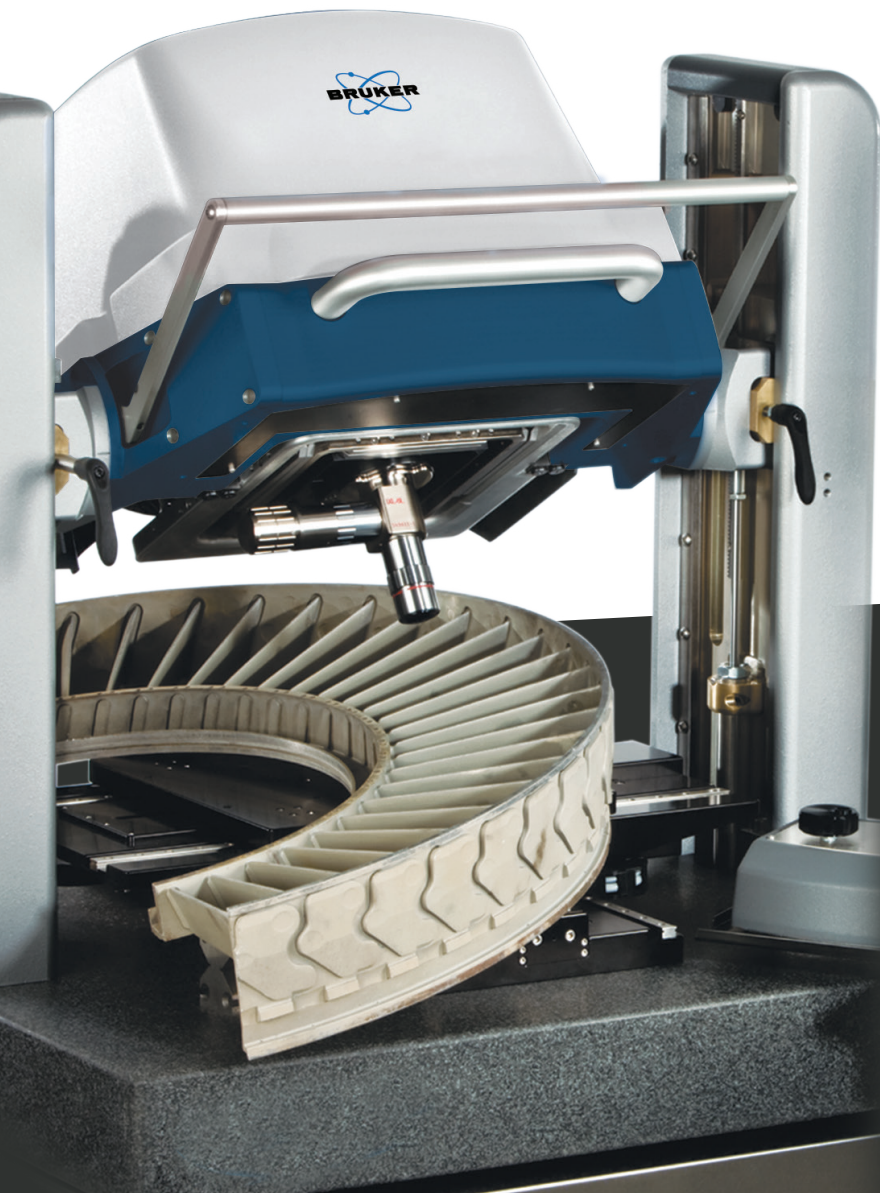
NPFLEX-1000 Features:

- Ultimate large-part and high-slope surface compatibility reduces sample preparation and increases the range of measurement surfaces accessible per part

- Exceptional ease-of-use empowers operators at any experience level to obtain expert results

- Super-fast automated measurement and analysis routines provide decreased time-to-result

- Highly robust bridge architecture and integrated vibration isolation offer long-term accuracy and reliability for production environments

Practical Advantages

Open-access sample loading and intuitive analysis software enable characterization of surface texture, finish, roughness, curvature, slope, and numerous other parameters with sub-micron resolution.

Material-insensitive—reflectivity from 0.05% to 100% and surface textures from flat to rough

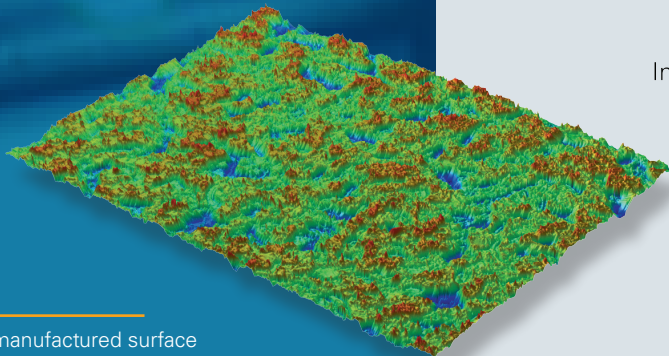**Automation-ready**—fully customizable measurement and analysis routines

Self-calibrating—highest accuracy and reproducibility

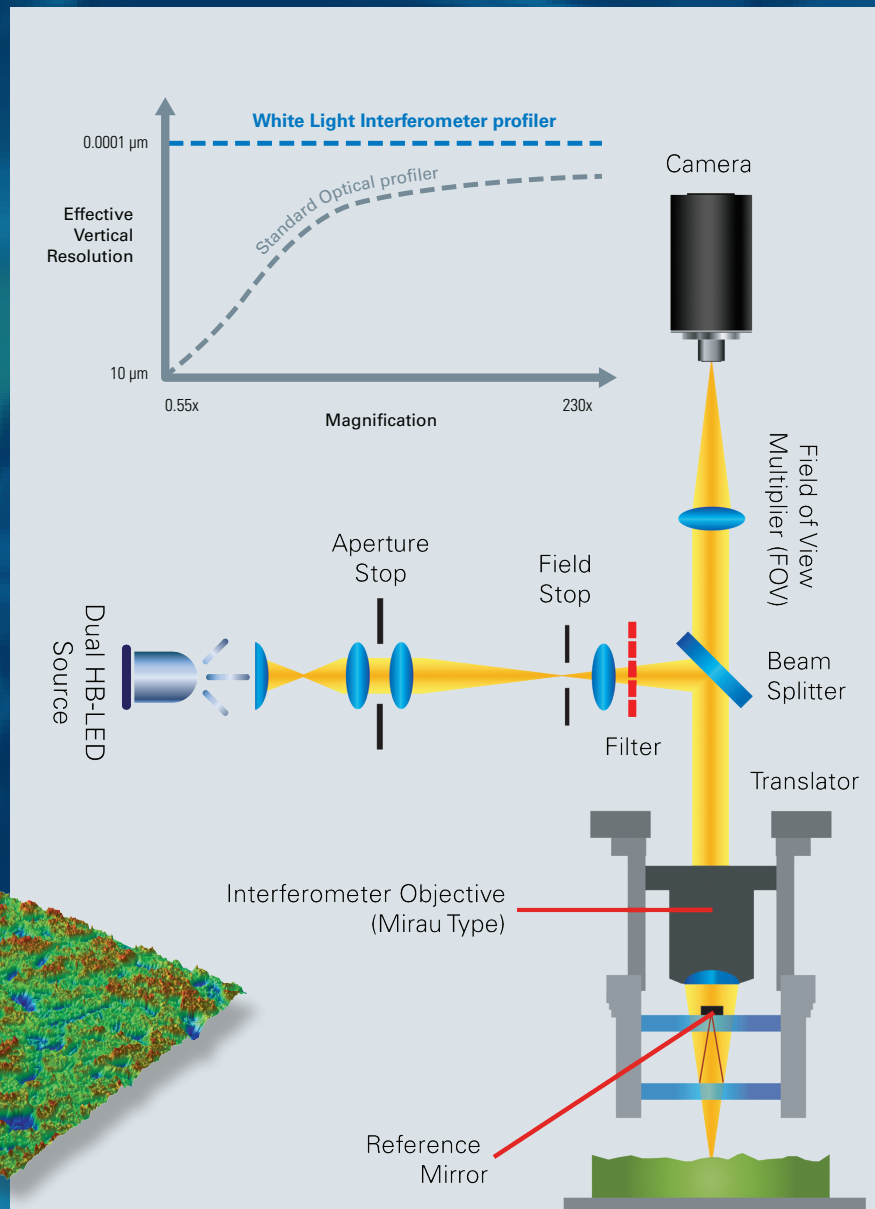# Unparalleled Profilometry for Roughness and Surface Texture

Why White Light Interferometry?

Most non-contact areal profiler techniques are magnification dependent, which has led to the common use of high-resolution objectives with short working distances to achieve the best vertical resolution. White light interferometry (WLI), on the other hand, utilizes interferometric objectives that reveal the sample surface via a moiré pattern only when focus is reached. Due to the limited coherence length of white illumination, the depth of field for the moiré presence does not exceed ±1 µm, and the focal plane can be easily determined within a couple of nanometers. Thus, the technique is independent from the objective, guaranteeing nanometer precision even with low-magnification objectives (e.g., 1X, 2.5X or 5X). This provides significant metrology advantages:

- **Long working distance objectives** can be used without compromising vertical resolution to access recessed or specific locations in complex parts

- **Ease of use** is increased with the extra safety margin between objective and surface, as well with the ability to target challenging locations

- A mirror can be inserted along the focusing beam to deflect the optical path to **measure vertical walls** with a high degree of precision

- A single acquisition at low magnification has a **large field of view** (100 mm²), making rapid detection of defects possible, or permitting high-throughput flatness control

- **Stitching** can be used to combine high lateral resolution over even wider areas

- Metrology assessment and budget allocation become easier since **all objectives have the same vertical precision**

Additive manufactured surface

White Light Interferometer profiler

Standard Optical profiler

Effective Vertical Resolution

0.0001 µm

10 µm

Magnification

0.55x   230x

Camera

Field of View Multiplier (FOV)

Aperture Stop

Field Stop

Dual HB-LED Source

Beam Splitter

Filter

Translator

Interferometer Objective (Mirau Type)

Reference Mirror

Surface-Independent Metrology for Application-Specific Solutions

NPFLEX-1000 combines fast time-to-result and high-quality results from non-expert users with a large form-factor gantry. An open-access robust bridge architecture, swivel head, and versatile objective lens options provide ultimate sample-size freedom and the ability to measure high-slope surfaces.

The flexibility of the NPFLEX-1000 is designed to answer the roughness and surface texture measurement questions that arise in precision machining QA/QC for sectors such as automotive, medical, and large-scale additive manufacturing. Some of these QA/QC studies include:
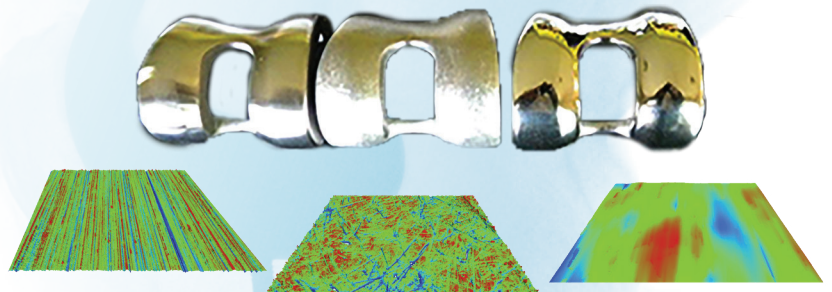
Corrosion Monitoring

- Identify and quantify signs of corrosion

- Measure number of pits, maximum width, depth, and volume directly and automatically

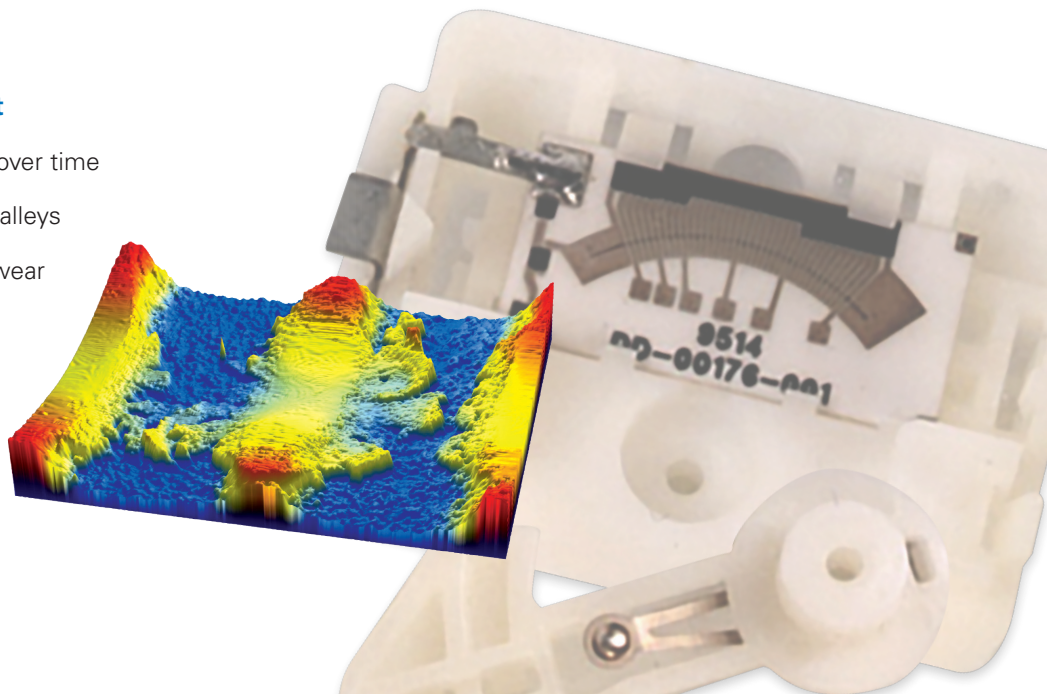- Assess total volume loss for complex alloys
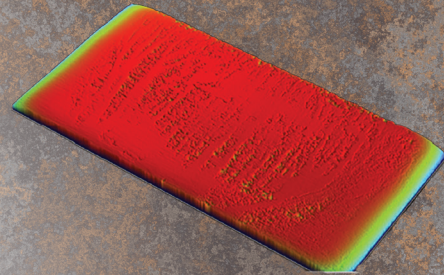
Surface Finish Quality Control

- Measure surface texture

- Correlate results to surface properties

- Support control of the manufacturing process

Wear and Lifetime Assessment

- Quantify volume of material lost over time

- Determine the ratio of peaks to valleys

- Understand the directionality of wear

Bore Cylinder Surface Texture

- Analyze sidewall roughness to understand lubrifaction and sealing performance

- Detect surface defects around inner diameter through rotational stitching

- Determine angular information on cross-hatch pattern
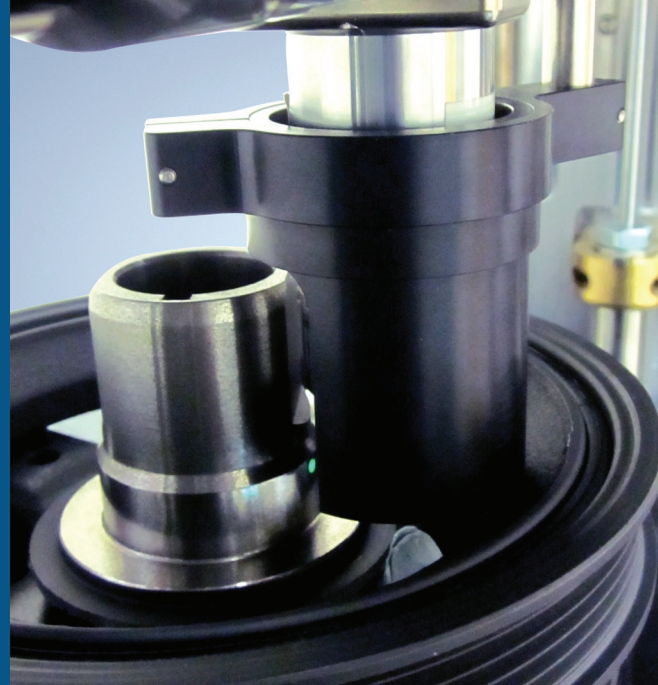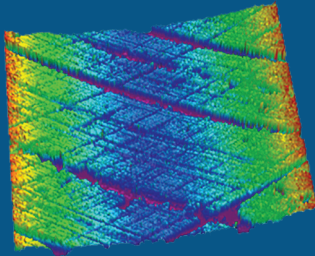
Gear Flank Roughness

- Measure Bearing function to understand real contact area

- Quantify wear on teeth along tribology test non-destructively

- Assess surface morphology and resistance after treatment or coating
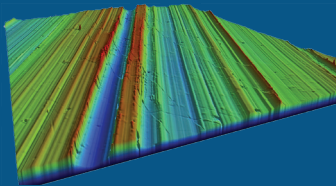
Chatter Marks Analysis

- Examine camshaft lobe for evidence of chatter

- Quantify periodicity of chatter marks

- Understand how textures of interfacing surfaces influence part effectiveness or failure
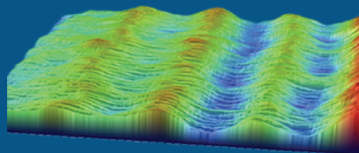
Optimal Performance and Ease of Use

NPFLEX-1000 is equally well-suited for research and development metrology or for the rigorous metrology requirements of a high-throughput, production environment. In any setting, both novice and experienced users can obtain consistent, expert results in a short amount of time by taking advantage of ease-of-use tools for measurement and analysis. For specialized applications, the NPFLEX-1000 enables customized routines created specifically for your requirements.

NPFLEX-1000 is powered by Vision64® software, the industry's most functional and user-friendly graphical user interface. This full-featured software includes:

## Advanced Find Surface for Effortless Setup

The Advanced Find Surface feature enables ultimate ease of use for multi-user environment. It not only enables auto-focus, but also adjusts key illumination parameters such as intensity of the LED ring light for uncompromised metrology on varied material surfaces.

VisionXpress for Fast Routine Analyses

Between the easy-to-use VisionXpress interface with its standard test library for multi-user environments, the award-winning full-featured Vision64 interface for advanced setup and automated analysis, and the Advanced Production interface for ultimate automation with minimal user-intervention, you can select the most suitable solution for your unique metrology needs, without compromise.

Universal Scanning Interferometry for Expert Results Every Time

Bruker's innovative Universal Scanning Interferometry (USI) mode enables superior WLI measurement results across a wider range of surfaces. Where other technologies require switching scanning modes or objectives, the adaptive surface intelligence of USI mode automatically adjusts algorithm parameters for optimum results on different surface textures in the same field of view, even on surfaces with differing contrast, intensity, and heights. This ability to automatically sense the type of surface and provide the most accurate areal metrology makes it one of the easiest and most robust measurement methods for almost any surface, transparent to opaque, with a vertical range up to 120 µm.
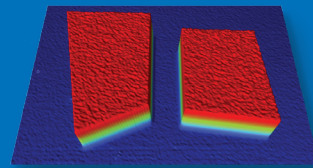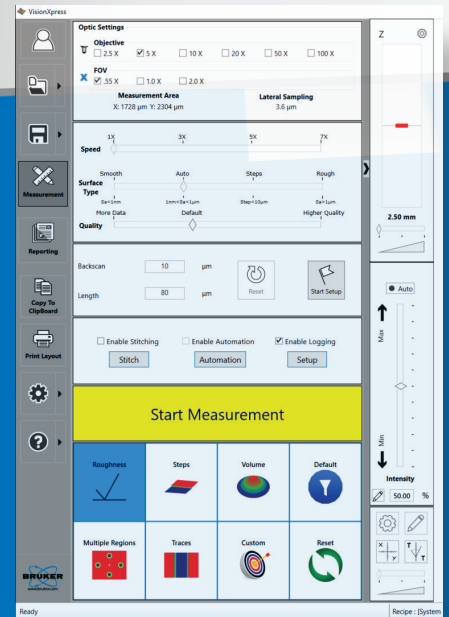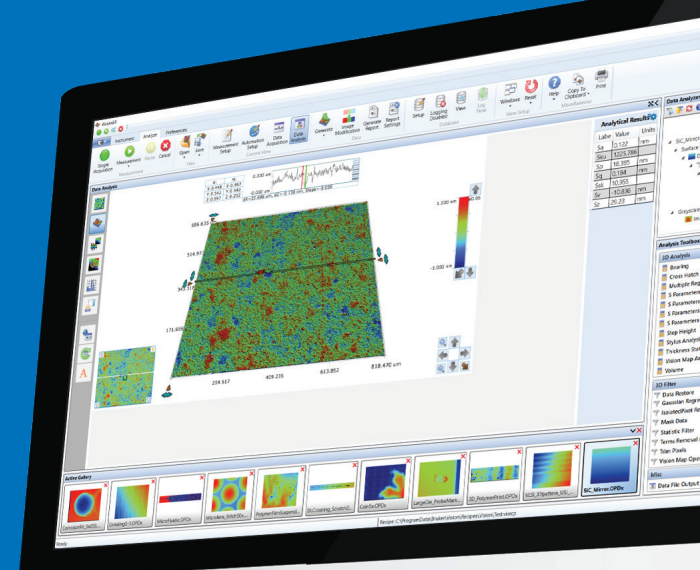
3D Profile Showing µm Step

**Sub-nm Roughness**
Top and Bottom Surface
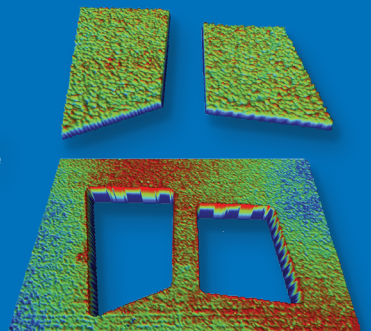
Designed for Extreme Flexibility

The NPFLEX-1000 is optimized for productivity both in the lab and on the factory floor. It delivers a unique ability to access difficult orientations on large parts due to its large gantry and swivel head design. Integrated vibration isolation and a self-calibrating laser reference provide maximum reliability in any setting. Additional accessories adapt the system to fit your unique samples and applications.

Open Gantry and Swivel Head Access Difficult Surfaces

A spacious 300 mm distance between the stage and objectives allows for all types of custom fixtures and mounts, such as a vacuum wafer chuck or universal sample mounting kit. Part size and shape freedom translates to minimal sample preparation and measurement setup time so that manufacturers can switch out parts quickly and perform measurements on multiple surfaces with ease. Access to surfaces of interest is further increased via a swivel head that enables repetitive investigation of sidewalls, beveled edges, and angled surfaces.
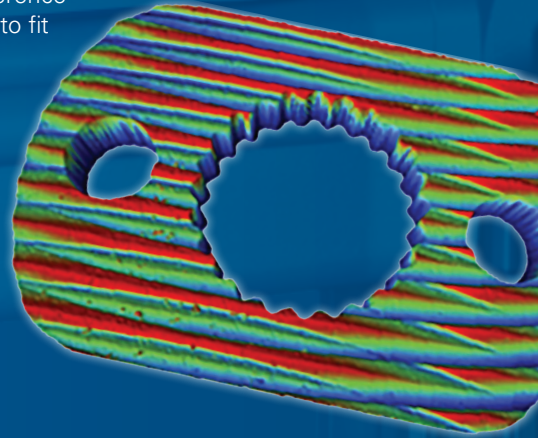
Objective Lens Innovations Extend Viewable Areas

Long focal-length objectives with up to a 34 mm working distance expands the possibilities for sample types by always ensuring a safe distance from sample to lens. The bore-scope objective for quantitative 3D inspection of cylinders and bores enables NPFLEX-1000 to capture 3D data as far down as 150 mm on the inner walls of cylinders or bores. This option, combined with the theta rotating stage, enables automated inner-diameter stitching of 3D surface data. Plus, a fold mirror offers non-destructive analysis of inside diameters of bores and cylinders and along sidewalls of bowl shapes with high slopes up to 70°.

CNC-milled part

Motorized Stages Maximize Maneuverability

The NPFLEX-1000 allows for easy, automated movement to any location on your part without remounting.

- Automated XY stage with 10 mm Z-positioning for batch review of trays
- Rotational stage with optional chuck for holding fixtures
- Theta rotating stage for sample rotation
- Phi rotating stage for vertical sample rotation
- Phi roller stage for automated positioning and rotation of smaller, cylindrical samples

## Self-Calibrating Laser Reference Ensures Stability

Whenever tight control of environmental factors is not possible, the NPFLEX-1000 still maintains excellent reproducibility thanks to its ability to self-calibrate. A built-in reference signal laser interferometer continuously calibrates the temperature to account for environmental influences and to always ensure high accuracy and reproducible measurements, ideal for applications that require absolute long-term stability.

Fold mirror on objective
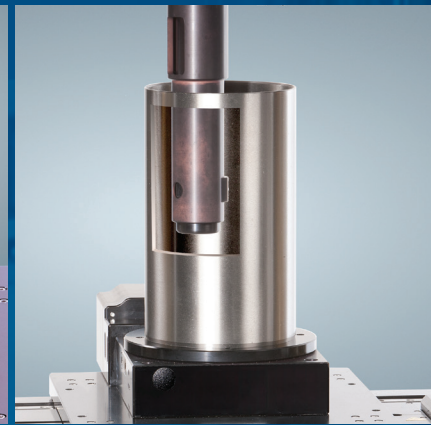
Bore-scope objective
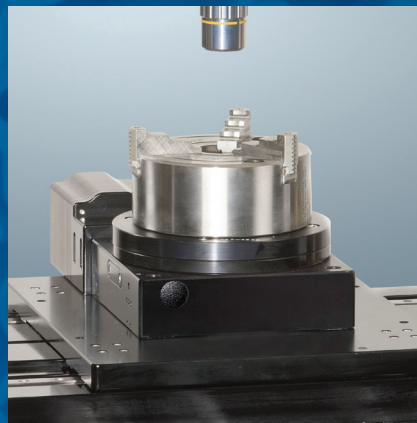
Motorized theta rotating stage

Motorized phi rotating stage

NPFLEX-1000 Specifications

Measurement Modes	PSI, USI, VSI, Optional Film
Max. Scan Range	≤10 mm
Vertical Resolution[1]	<0.01 nm
Lateral Resolution	0.38 µm minimum (Sparrow criterion) 0.13 µm (with AcuityXR®)
Step Height Accuracy[2]	<0.75%
Step Height Repeatability	<0.125% one sigma repeatability
Max. Scan	≤122 µm/sec (with laser references)
Sample Reflectivity	0.05% to 100%
Sample Size	350 mm × 304 mm × 304 mm (H × D × W); 249 mm H with automated stage
Sample Weight	45 kg (77 kg without standard stage)
XY Sample Stage	300 mm automated
Z Focusing	249 (350 mm without automated stage)
Optical Metrology Module	Patented dual-LED illumination
Objectives	Parfocal: 2.5X, 5X, 10X, 20X, 50X, 100X, 115X; LWD: 1X, 2X, 5X, 10X; TTM: 2X, 5X, 10X, 20X; Bright Field: 10X; Single-objective adapter; Optional motorized five-position turret
Available Zoom Lenses	0.55X, 0.75X, 1X 1.5X, 2X auto-sensing modules
Camera	5 MP monochrome with 1200 × 1000 data array; Optional color camera
Software System	Vision64 and VisionXpress on Windows 10 LTS 64-bit OS
Software Packages	AcuityXR; Advanced PSI; Automatic Pattern Alignment; MATLAB; Multiple Region Analysis; Optical Microlens Analysis; Production Mode; SDK; TCP/IP; SureVision; Vision64 Map™
Reporting Languages	English; German; French; Italian; Spanish; Japanese; Chinese; Polish; Korean; Brazilian Portuguese; Russian
Automation	Auto-focus; Auto-intensity; Auto-saving; Auto-stitching; On-fly analysis; Scattered and grid automation; Recording in database
Calibration	Optional auto and continuous internal laser signal
System Footprint	1717 mm × 772 mm × 914 mm (H × D × W)
Weight	478 kg
Warranty	12 months
Certification	CE-Certification

[1] As demonstrated by taking the one sigma Sq value of 30 PSI repeatability measurements on an SiC reference mirror.
[2] Absolute accuracy for step heights 8 µm and higher.

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