

NPFLEX 3D Surface Metrology

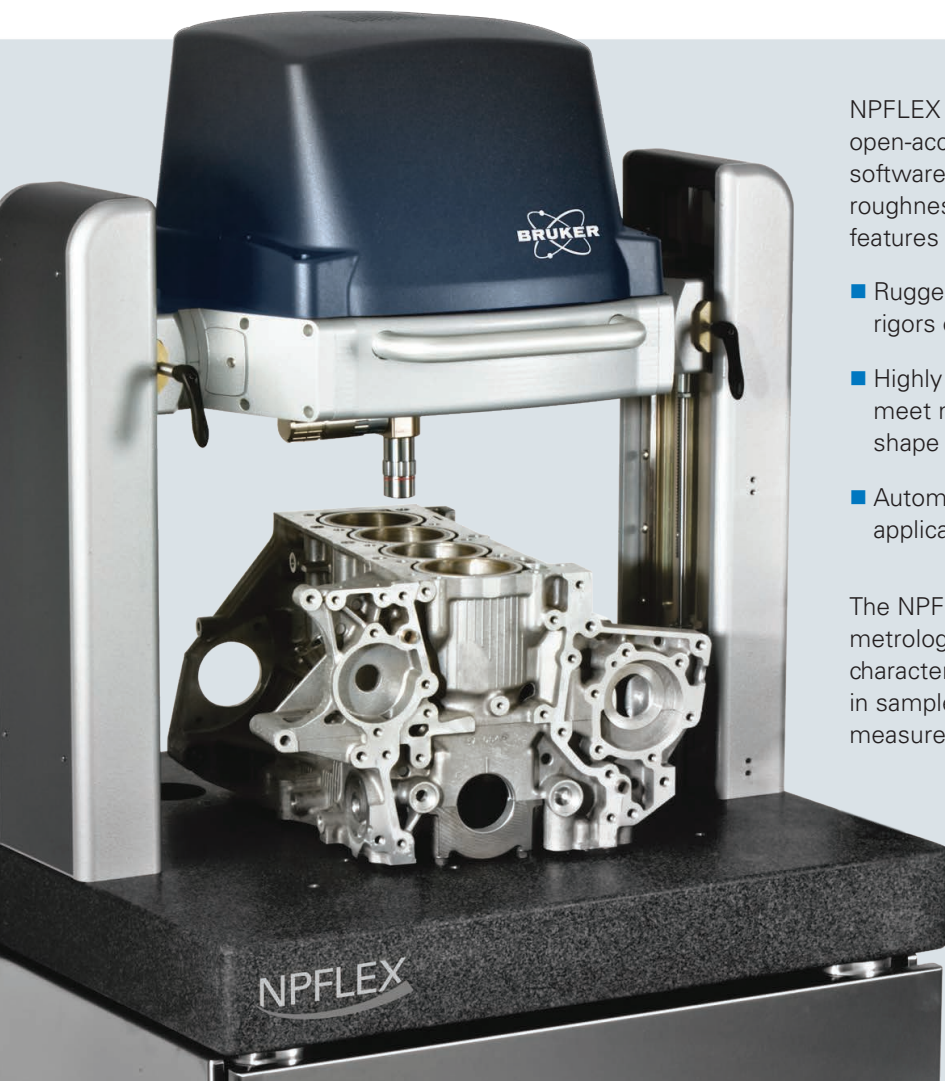
● You Make It, We Measure It — Nano to Macro Features

Innovation with Integrity

Optical & Stylus Microscopy

Delivering New Perspectives on Precision Manufacturing

Bruker's NPFLEX™ 3D Surface Metrology System brings unprecedented flexibility, measurement capabilities, and performance to precision manufacturing industries, enabling faster ramp-up times, improved product quality, and increased productivity. The culmination of decades of expertise in white light interferometric (WLI) technology and large-sample instrument design, the NPFLEX is the first optical metrology system built to handle nano- to macro-features effortlessly on samples of widely varying shapes and sizes. It provides data-rich, three-dimensional (3D) images, superior resolution, and repeatability beyond what is possible with contact instrumentation, all of which ultimately provides much greater insight into part performance and functionality.



NPFLEX features non-contact techniques, open-access sample loading, and intuitive analysis software to characterize surface texture, finish, roughness, curvature, slope, and numerous other features with sub-micron resolution:

- Rugged, high-performance platform built for the rigors of the manufacturing environment
- Highly configurable hardware and software to meet measurement needs for nearly any sample shape or size
- Automated routines and fully customizable applications for speed on the production line

The NPFLEX system offers the most comprehensive metrology platform available for surface characterization, providing the ultimate flexibility in sample sizes, access to sample areas, and measurement environments.

● High-Performance Metrology

Designed for the Rigors of Industry

Precision manufacturing requires gage R&R-capable metrology tools that provide reliable, quantitative statistical data for day-to-day process and quality control. Residing on a square, granite surface floating atop a vibration-eliminating air table, the rugged floor-standing NPFLEX ensures precision measurements. The granite base handles up to 170 pounds, and the bridge gantry is designed to provide extreme resistance to vibration commonly found on manufacturing floors.

The instrument head is mounted on precisely-aligned posts that are secured at the exact center of opposing edges of the granite table. The head can be raised or lowered vertically on the posts to lower the center of gravity for unmatched precision measurement stability. The Piezo-actuated scanner head provides a more linear response and tight control across short distances for stable, repeatable metrology performance.

A robust solution for concept-through-production metrology

NPFLEX provides consistent, high-resolution, 3D images and rich, comprehensive data for greater insight into part performance and functionality, more efficient processes, and better end products. It's a robust surface-measurement solution for the entire lifecycle of a product, from initial design through post-production troubleshooting, to help meet the daily challenge of understanding and controlling manufacturing processes.

Manufacturing Process Improvement Across Diverse Industries

Process Development

- Defining processes
- Designing for performance
- Designing for maximum cost efficiency

Production

- Monitoring processes
- Monitoring specification tolerances
- Monitoring part integrity

Quality Analysis

- Size, shape, surface consistency
- Failure investigation
- Designing for longer product lifetimes

Product Research & Development

- Quantifying textures
- Quantifying wear
- Quantifying acid/alkaline surface exposure

Oil Transport and Refining

- Corrosion monitoring and damage assessments
- Development of corrosion preventive coatings and materials

Automotive & Aerospace

- Rotors
- Camshafts
- Gears
- Turbine blades
- Gaskets and seals

Medical

- Hip, femoral, spine implants
- Aortic stents
- Prostheses and orthoses

The NPFLEX can measure nearly anything—from ink droplets to the crosshatch patterns in automotive engine bores!

Primary Metal Manufacturing

- Steel pipe and tubes
- Aluminum containers
- Coils, foil, sheets, plates
- Extruded parts

Fabricated Metal Products

- Precision hand tools
- Saw blades
- Drill bits
- Fasteners
- Hardware
- Plumbing fixtures

Other Manufacturing

- Musical instruments
- Silverware, plated ware
- Plastic pipes, film
- Laminates
- Electrical connectors, wiring, parts

● Unparalleled Flexibility in a Precision Metrology Solution

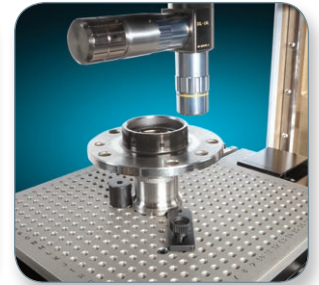
Non-destructive characterization of extremely diverse sample types

In the past, manufacturers have had to destructively dissect products to measure certain areas of interest. NPFLEX is designed specifically for investigating widely varying sample sizes and shapes without damaging the sample. Insensitive to material type, the system's WLI technology provides 3D, non-contact measurements of virtually any surface feature. It's equally adept at imaging in deep trenches, high-aspect ratio holes, and samples with high topographic relief.

A breakthrough open-gantry design affords more than 300 degrees of access to surfaces previously inaccessible or too difficult to analyze due to size or part orientation. With 13 inches (330 millimeters) of space below the objectives, there is easy accessibility to part areas that simply can't be reached with other types of profilometers. The clearance beneath the objectives provides ample room for all types of custom fixtures and mounts. Minimal sample preparation and measurement setup time enable manufacturers to switch out parts quickly and perform measurements on multiple surfaces with ease.

NPFLEX's low-profile, 300-millimeter indexed, automated XY stage offers the largest working area of any automated interferometer on the market. If more room is needed, the stage can be removed with ease. This open architecture works hand-in-hand with the patented tip/tilt optical head, which maintains the ideal line of sight to the surface under inspection with extremely long working distances.

NPFLEX includes a high-resolution CCD camera option for color imaging. LED illumination is optimized for clearer imaging and better data display. The system has an automated focus finder, white balancing that enables RGB color optimization, and 3D color overlays. NPFLEX provides the advantages of vivid color imaging with color data segmentation plus analysis—all with the best Z-height resolution, speed, and automation capabilities available.



The Universal-Part Fixture Kit is designed to reduce the need for traditional fixturing methods, which often take longer to set up than to measure the part. It can adapt to any application through the use of various size components and base plates.



Theta motorized rotation stage (with variable chuck to hold parts) mounted on top of motorized X, Y stage.



Phi motorized rotation stage (with variable chuck to hold parts) mounted on top of motorized X, Y stage.



Bore-Scope objective collecting data 150 mm inside large metal engine cylinder liner.

Many options and configurations for a truly customized solution

The NPFLEX system offers many options to customize its operation for specific applications. The Swivel Head option permits repetitive investigation of sidewalls, beveled edges, and angled surfaces. Additionally, there are several stage options available:

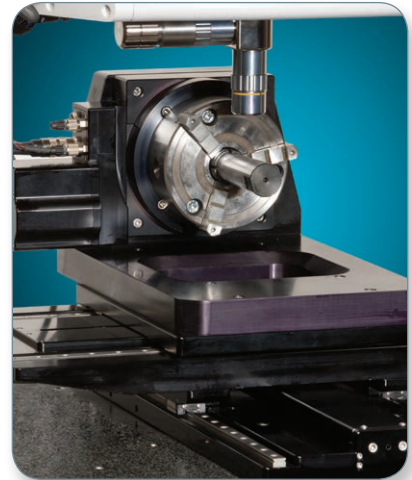
- **Rotational stage** with optional chuck for holding fixtures
- **Theta rotating stage** for sample rotation
- **Phi rotating stage** for vertical sample rotation
- **Phi Roller Stage** for automated positioning and rotation of smaller, cylindrical samples
- **Automated XY Stage** for automated XY positioning

An optional universal-mount **Fixture Kit** is offered that includes the XY stage plus specialized fasteners to securely hold almost any shape to the stage for consistent, repeatable measurements.

The **Lead Angle** option for **quantification of leakage in sealing systems** is the first comprehensive, non-contact, WLI metrology solution that can quantify true lead angle (to industry standard MBN 31007-7) and surface texture of dynamic sealing surfaces. It provides gage-capable, global lead-angle analysis that integrates macro- and micro-features for reliable, repeatable, and more meaningful characterization. It's a complete single-instrument solution for simultaneous measurement of lead and surface texture, independent of part alignment.

The **Bore-Scope Objective** for **quantitative 3D inspection of cylinders and bores** enables NPFLEX to capture 3D data as far down as 150 millimeters on the inner walls of cylinders or bores. This option, combined with the theta rotational 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.

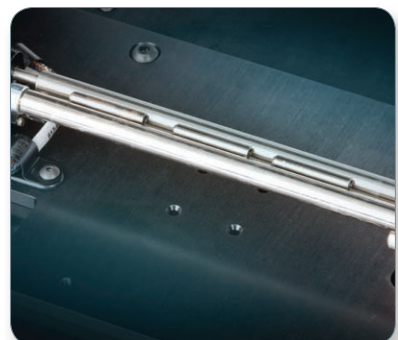
There are additional objective and turret options available. The flexibility built into this system gives you the power to ensure the measurements you get are the ones you need.



NPFLEX performing measurements with Phi sample rotation configuration.



Fold Mirror option being used to measure inside surface of gear.



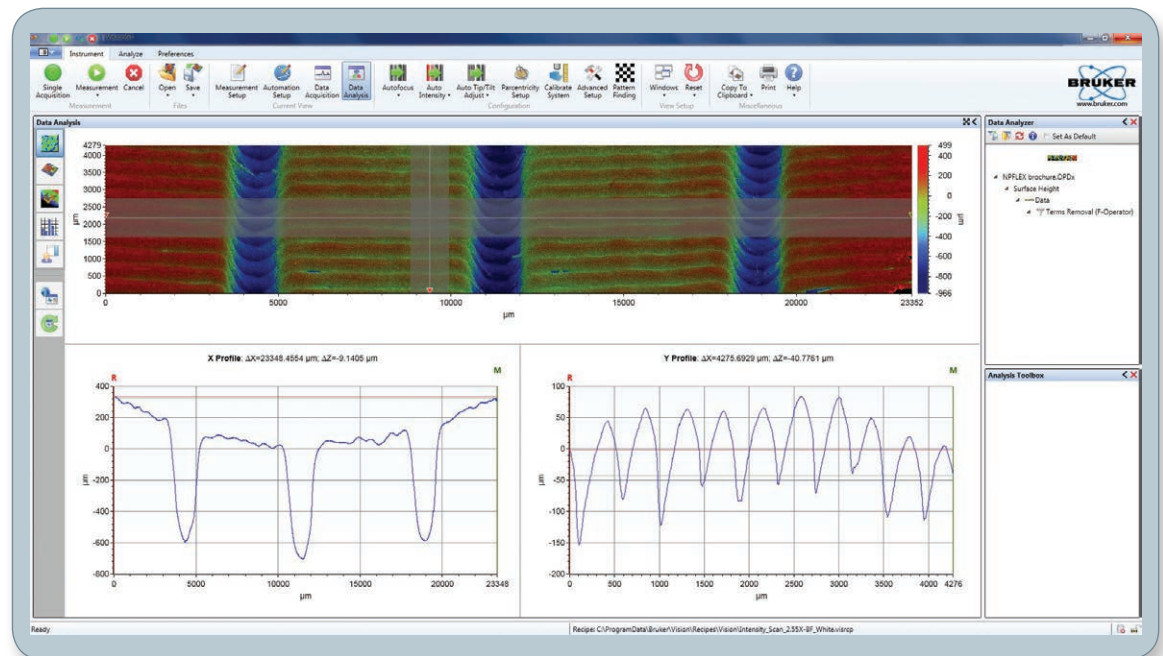
Motorized roller stage.

● Automated Processes for Speed and Ease of Use

Full-featured software for the fastest, easiest results

NPFLEX is powered by **Vision64® software**, the industry's most functional and user-friendly graphical user interface. It incorporates the familiar Windows Ribbon design and a toolbar with Windows 7 functionality and features. Intelligent architecture supports an intuitive, visual workflow and enables extensive user-defined automation capabilities.

A special **Advanced Production Interface (API)**, designed specifically for operator ease-of-use, is also available. Based on a typical manufacturing production flow, the interface provides tools to easily customize process workflows and automate mapping. It delivers unparalleled flexibility and comprehensive, high-density data and analysis without sacrificing throughput.



Results of a 3D-printed part surface-roughness analysis, shown in Vision64 user interface.

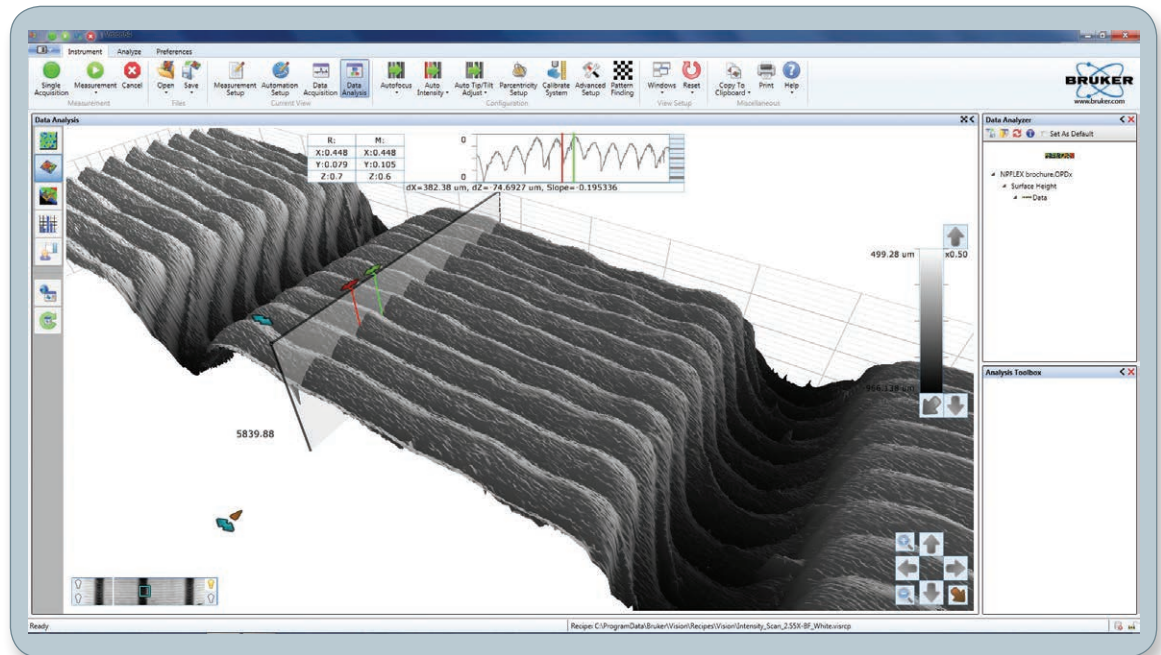
Vision64 provides the ability to create, save, and reuse custom recipes and analysis routines that include user-defined metrology standards, data filters (threshold, Gaussian regression, data flattening, data restore, statistical, etc.), or parameters for custom reports. An operator can also create, save, and reuse custom stage-automation recipes. Software prompts and password-protected entries eliminate human error.

All of Bruker's NPFLEX surface texture analysis is done according to ISO and ASME standards: ASME B46.1-1995 Surface Texture, Surface Roughness, Waviness and Lay (2D); ISO 4287 Standard for Surface Texture Parameters (2D); ISO 25178-2 Standard for the classification of 3D surfaces. Our S-parameters are based on this standard (3D ~1996); ISO 16610-21 (Gaussian profile filter), ISO 16610-61 (Gaussian areal filter), and ISO 16610-71 (Robust Gaussian areal filter).

The combination of NPFLEX's sub-micron resolution, rapid stitching of large areas, and the ability to run multiple analyses from a single scan increases throughput, while providing a complete and detailed performance dataset across many parameters for any area—information so complete it can be used for re-optimization of upstream tools and processes, which in turn will result in far fewer bad parts and much less waste.

Dynamic, customizable tools built in

Vision64's **Data Analyzer** and **Analysis Toolbox** epitomize the power and simplicity of Vision64's design, which incorporates industry-specific analysis routines and ISO standards. Specialized software capabilities support the operator's efforts for a streamlined, efficient workflow.



Results of a 3D-printed part surface analysis, shown in Vision64 user interface.

Vision64 includes **phase-shifting interferometry (PSI)** for testing smooth objects with very high precision with a vertical resolution of 0.1 nanometer; **vertical-scanning interferometry (VSI)** for true 3D measurement of surface areas with the ability to measure non-specular, rough surfaces; and **VXI interferometry**, which combines PSI and VSI for high-resolution characterization of both smooth and rough surfaces in a single measurement.

The **Analysis Toolbox** includes ISO-compliant filters such as robust Gaussian and Gaussian ball filters that combine with masking and shape removal for extraction of roughness, waviness, or form. Vision64 ensures accuracy; repeatable, custom measurements; data keyed to any performance specification (ISO or customer-defined); and high-density 3D areal information at nanometer resolution.

The **Data Visualization** window provides quick access to the most common plot objects, from 2D and 3D analyses to bearing ratio and power spectral-density displays. The **Live Video** window puts X, Y and Z stages, tip/tilt, and intensity controls at the operator's fingertips. The **Measurement Parameters** window keeps commonly used measurement parameters visible, and the **Active Gallery** displays all open datasets.

The unparalleled flexibility built into its hardware and software, plus its non-destructive measurement techniques, make the NPFLEX the premier metrology tool for almost any application. NPFLEX is equally well-suited for research and development metrology or for the rigorous metrology requirements of a high-throughput, production environment.

NPFLEX Specifications

Measurement Capability	Non-contact, 3D, surface roughness, critical dimension, film thickness, tribology
Objectives	Super long working distance objectives: 2X, 5X, 10X, with crash mitigation assembly; Standard working distance objectives: 1.5X, 2.5X, 5X, 10X, 20X, 50X, 100X, 115X; Optional through transmissive media objective kits; Optional four-position turret
Field of View Multipliers	0.55X, 0.75X, 1X, 1.5X, 2X; Auto-sensing motorized selector, discreet zoom
Light Source	Long-lifetime green and white LEDs
Measurable Sample Dimension	350 mm H (249 mm with automated stage); 304 mm D; 304 mm W
Stage Weight Load Capacity	≤50 kg (110 lbs)
Air Table Weight Load Capacity	77 kg (170 lbs)
Optical Assembly	Integrated computer-controlled illuminator; Closed-loop precision vertical scanner
Camera Options	Standard resolution monochrome camera; Standard resolution color camera; High-resolution monochrome camera
Computer Systems	Latest Dell PC with flat panel monitor, mounted on Ergotron mobile workstation; Production mode, built-in databasing with pass/fail for any parameter; Optional HDVSI, MATLAB/TCPIP, Film Analysis, Optical Analysis and SureVision
Vertical Resolution ¹	<0.1 nm
RMS Repeatability ²	0.004 nm
Step Height	0.75% accuracy; <0.12% 1 sigma repeatability
Lateral Spatial Sampling	Camera and optics dependent
Optical Resolution ³	0.33 μm
Field-of-View	7.68 × 5.76 mm max, larger with stitching
Footprint	172 cm H x 77 cm D x 81 cm W (67.6 in. H x 30.4 in. D x 32 in. W)
Certification	CE, NRTL, T-Mark, ROHS compliant, ANSI B46.1 compliant

1. As demonstrated by a Piezo PSI difference measurement on an SiC reference mirror, 10 averages per measurement and computed Sq.

2. As demonstrated by taking the one sigma Sq value of 30 PSI repeatability measurements on an SiC reference mirror.

3. Based on Sparrow Criteria at 535 nm, 115X objective.

Note: Specifications are subject to change without notice.

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Cover application images

Top: 3D image showing wear on a sliding contact sensor.
Middle: 3D image showing cross-hatch honed engine bore with embedded residuals.
Bottom: 3D image showing surface roughness of hip implant.