Application Note
for Defense Industry

Automated Barrel Inspection and 3D Measurement

with NOVACAM™
Non-Contact 3D Metrology Systems

Recent Evolution of Barrel Measurement Requirements

The inner surface quality of barrels highly contributes to firearm safety and accuracy. This is why barrel manufacture processes must be controlled through rigorous inspection and measurement of barrel IDs. Until recently, gauging of firearm barrels has been carried out manually with pin gauges, star gauges, ball gauges, and air gauges. Video borescopes have assisted in defect detection. However, data provided by these methods are minimal and not adequate for a thorough evaluation of all ID parameters.

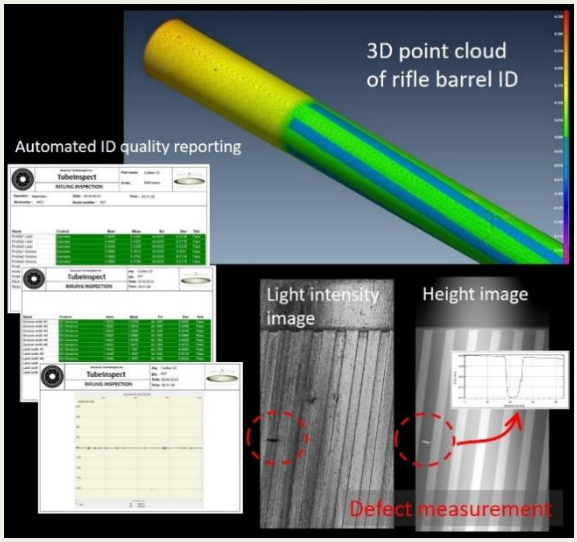
To best control the barrel manufacture process, firearm manufacturers increasingly look for more comprehensive and automated barrel ID (inside diameter) measurements. The first reason is the growing need for 3D inspection and quantitative evaluation of a wider range of ID parameters. Secondly, as automation of barrel machining and finishing processes increases, automating inspection is crucial to speeding up and improving quality control of both intermediate and final products.

Superior Barrel Measurements with NOVACAM™ 3D Metrology Systems

In answer to these needs, NOVACAM non-contact 3D metrology systems increase the range and precision of barrel ID measurements and facilitate automation. As a result, manufacturers improve their process control and product quality, decrease scrap, and increase savings.

SYSTEM PARAMETERS for NON-CONTACT BARREL MEASUREMENT

- Measured barrel IDs from 1 mm to 155 mm
- Micron (micrometer) precision of measurements
- Up to 100,000 measurements (3D points) per second
- Ability to measure
  - ✓ Rifling parameters - widths and IDs of lands and grooves, flank angles, polygonal rifling measurements, etc.
  - ✓ Straightness, twist rate(pitch), roundness, taper, runout, etc.
  - ✓ Surface defects
  - ✓ Roughness
  - ✓ Chatter
  - ✓ Chambers, cross-holes, grooves, steps, undercuts, and slots
- User-configurable automated inspection sequences within the barrel ID along linear, circular, or spiral paths
- With NOVACAM™ Barrel Analysis PolyWorks® Package, the systems are preconfigured for automated barrel and chamber inspection reports.



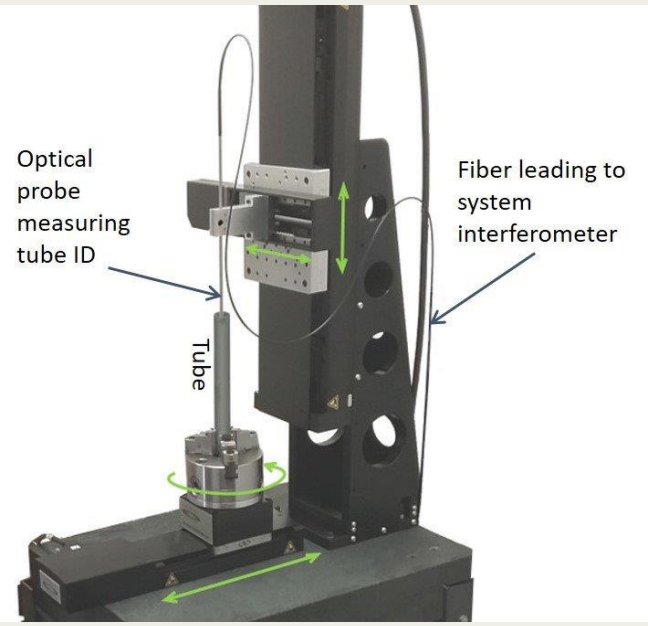
TUBEINSPECT™ and BOREINSPECT™ Systems for Barrel ID Measurement

Novacam offers two non-contact 3D metrology systems for barrel inspection – the **TUBEINSPECT** and the **BOREINSPECT system**. Both are based on low-coherence interferometry technology. Also, both:

- Measure barrels and chambers of **rifles, shotguns, handguns** as well as **large caliber firearms**
- Measure **GD&T parameters (straightness, roundness, etc.) and roughness** with a **single probe**
- Are **easily integrated** in firearm manufacturer's lab or automated industrial inspection setups
- **Produce 3D data used for automated user-configurable reports, for SPC** (statistical process control) monitoring of production, **and for gaining manufacture process insight** that leads to process improvement.

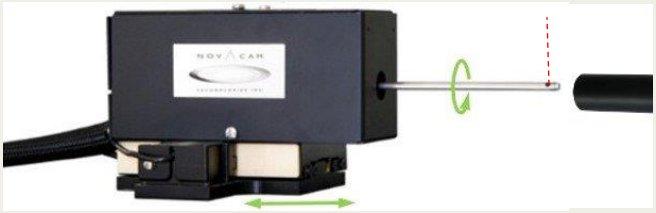
The main difference between the two systems is how they scan the barrel ID:

The TUBEINSPECT system rotates the measured barrel around the optical probe.



- Watch the TUBEINSPECT system in action: https://www.novacam.com/resources/novacam-metrology-videos/3d-tube-id-measurement-video/

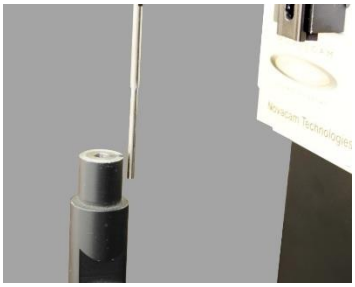
The BOREINSPECT system rotates the optical probe within the fixed barrel.



Watch the BOREINSPECT system in action:

- BOREINSPECT system being "fed" hollow shafts by a robot: https://www.novacam.com/resources/novacam-metrology-videos/chatter-measurement-video/
- BOREINSPECT system displaced between fixed bores: https://www.novacam.com/resources/novacam-metrology-videos/valve-body-bore-id-measurement-video/

The TUBEINSPECT System Also Measures ODs of Barrels, Reamers, and Mandrels



Many manufacturers appreciate the capability of the TUBEINSPECT system to **also** measure – down to the micron:

- **The outside diameter (OD) of barrels.** In most cases, there is no need to change probes. The same instrument and probe on the same inspection station can measure barrel ID and OD, with the same datum.

- **The OD of reamers, mandrels and other machining tools**. For mandrels, the TUBEINSPECT system can measure the same parameters as for barrel IDs - lands and grooves, pitch, straightness, etc. Periodic high-precision inspection of such tools helps avoid scrap that occurs when tools are out of spec. No matter which rifling process is employed – cut rifling, broach rifling, button rifling or hammer forging - manufacturers gain superior control on the machining & finishing processes.

More on the selection of the system for your barrel inspection application is available further below.

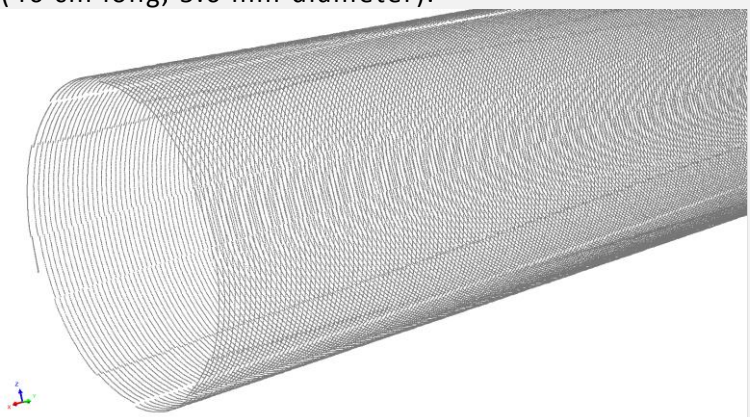
First, let's look at the barrel ID data obtained by both systems.

Format of Raw Measurement Data

From scanning the barrel ID, NOVACAM 3D metrology systems generate 3 types of raw data simultaneously:

- 3D point cloud,
- light intensity map, and
- height map.

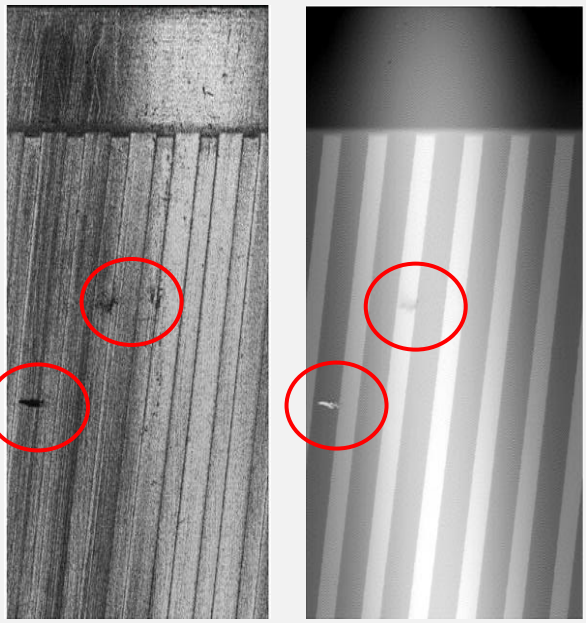
Example: ID data acquired by TUBEINSPECT system from a scan of an 18", .22 caliber rifle barrel (46 cm long, 5.6 mm diameter).



3D point cloud. This data is used for both interactive and automated analysis of a 3D model of the bore and for calculating 3D parameters.

This particular high-resolution scan comprises ~4.7 million 3D points. The user selected:

- Sampling step in axial direction: 0.1 mm
- Sampling step along rotational path: ~ 0.017 mm (1,050 points/ rotation)



The **light intensity map** (above left) and the **height map** (above right) of the unfolded bore ID surface are automatically generated at the same time as the 3D point cloud file. These data sets greatly facilitate defect detection and measurement.

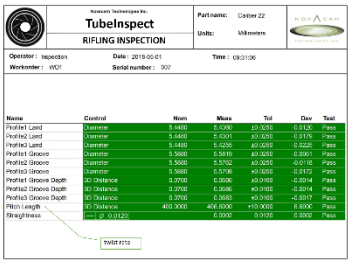
Options for Data Analysis

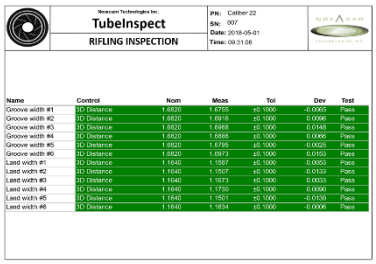
Data acquired with NOVACAM 3D metrology systems may be analyzed as follows:

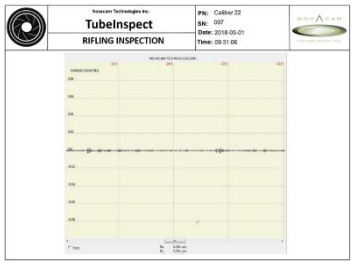
- **The generated 3D point cloud** may be viewed and analyzed with third-party CAD/GD&T software in conjunction with Novacam barrel measurement analysis tools. Standard software options offered with NOVACAM 3D metrology systems to barrel and chamber manufacturers include:
    - InnovMetric PolyWorks® Inspector: an industry-standard third-party CAD/GD&T software that offers full capabilities for GD&T analysis and viewing of the acquired 3D point cloud.
    - NOVACAM™ Barrel Analysis PolyWorks® Package: a domain-specific extension for the PolyWorks Inspector software. This package is geared towards speeding up and fully automating the repetitive tasks of processing barrel (and/or chamber) measurements and go-no-go reporting.

  With the above two software options, NOVACAM 3D metrology systems are preconfigured to:

    - Let users easily define and edit scan locations, nominals, and tolerances for standard inspections and
    - Produce automated barrel and/or chamber inspection reports.







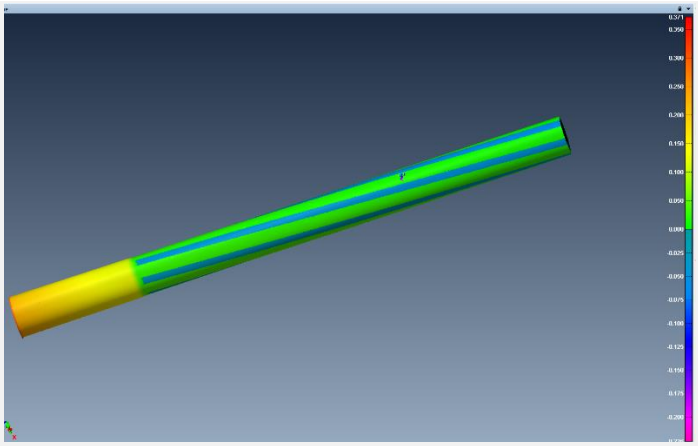
Sample rifling and chamber reports are presented in more detail further below.

- **The generated height and light intensity maps (images)** may be viewed from within NOVACAM data acquisition software for analysis of defects such as burrs, erosion, pitting, corrosion, or wear. More on this below.

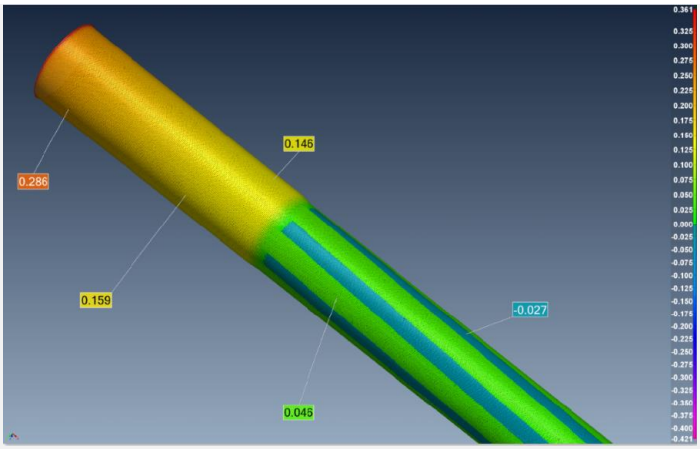
- **For clients who prefer to process the barrel and/or chamber ID data themselves using their own or third-party CAD/GD&T software** (e.g., Geomagic), a range of output data options are available: 3D point cloud, height image, intensity image, roughness, diameter, STL file, and more.

Interactive Data Visualization of Barrels and Chambers

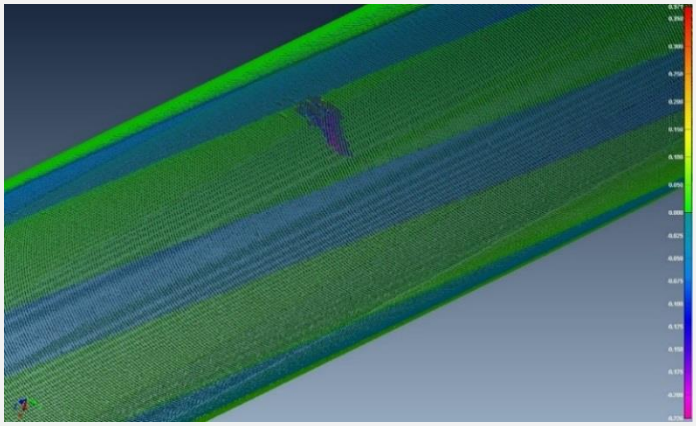
Third-party CAD/GD&T software (PolyWorks® Inspector) provided as an option with NOVACAM metrology systems enables full viewing and analysis of the acquired point cloud as a 3D interactive map. As shown in the images below, views such as deviation maps (deviation from a perfect cylinder or from a CAD) help provide key insight into bore machining processes - including gundrilling, reaming, rifling, stress relieving, contouring, chambering, or finishing – as well as into the effect of wear.



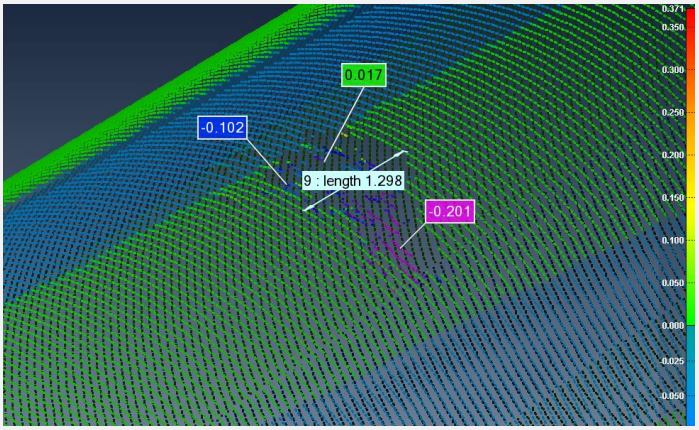
Fully mapped ID surface (high-density scan) of the first 9 cm of an 18", .22 caliber rifle barrel (46 cm long, 5.6 mm diameter) shown as 3D deviation map.



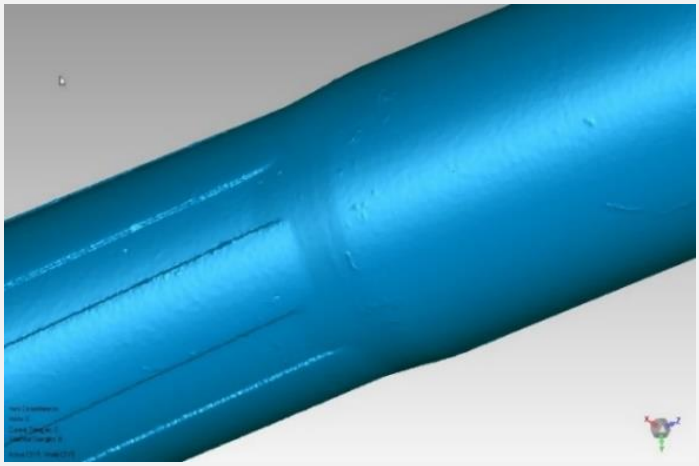
Zooming into the 3D point cloud, users can query surface measurements.



Progressive zooming in reveals surface defects.

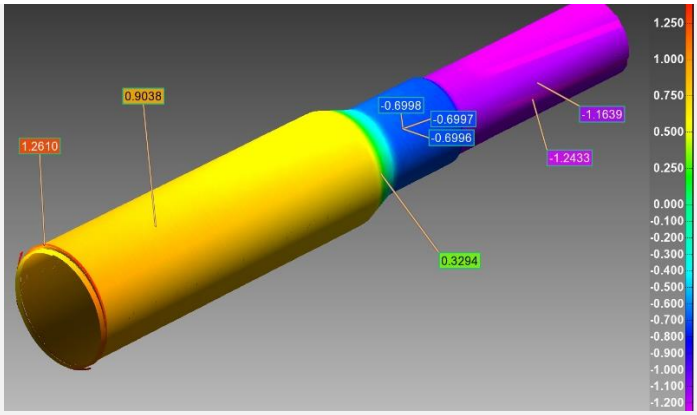


Interactive measurement of a discovered defect.

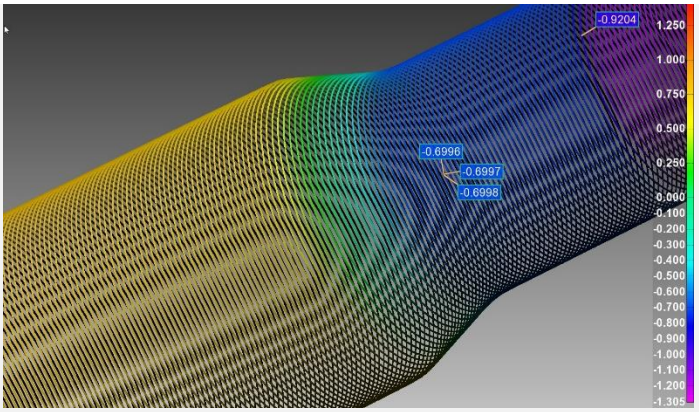


View of the barrel in STL (instead of 3D point cloud) format.

Zooming into the STL view of the acquired data to examine barrel ID surface details.

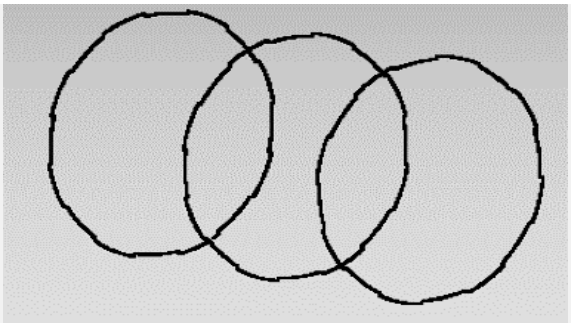


Fully mapped ID of.308 Winchester chamber.

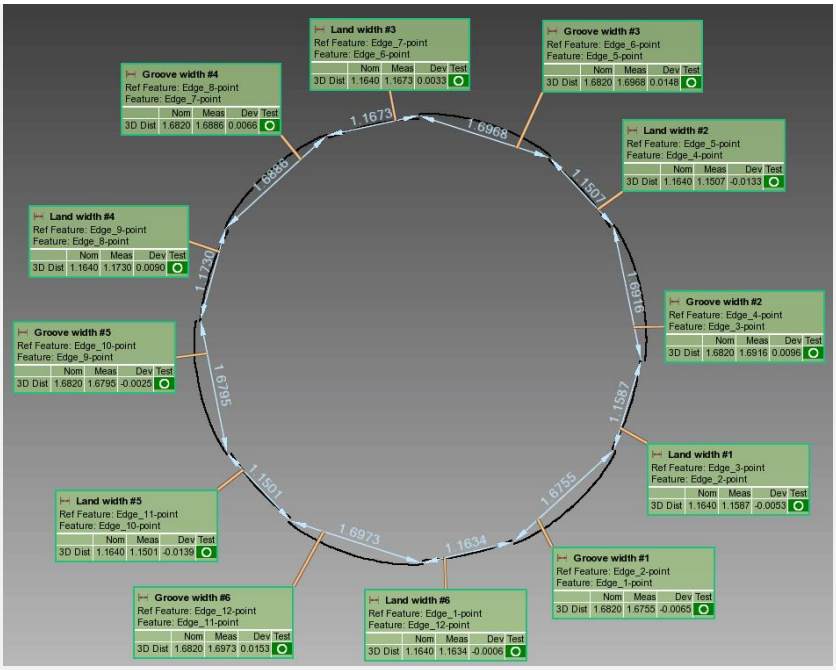


Zooming into the 3D point cloud to examine the first shoulder of the .308 Winchester chamber.

The images above show high-density point cloud data. Such a high level of detail is not always necessary; when inspection time is of the essence, several profiles inside a barrel provide an excellent basis for fast quality control assessment. As shown below, users can run an inspection sequence consisting of linear, circular, or spiral barrel profiles and use NOVACAM barrel measurement analysis tools to analyze key barrel measurement parameters.



Example of 3D point cloud with three rifling profiles.



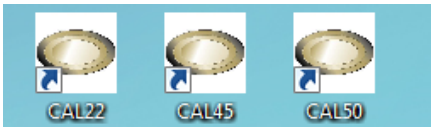
Lands and grooves measurements and go-no-go reporting for a rifling profile. Each land and groove is marked with the measured width, the nominal width, the value of deviation from nominal, and the pass-fail status based on user-set tolerances.

The next pages present more details on NOVACAM barrel and chamber measurement analysis tools.

Measurement Analysis Tools for Barrels and Chambers

Barrel and chamber ID measurements acquired with NOVACAM 3D metrology systems may be evaluated with respect to user-defined criteria (GD&T, inner feature specifications, roughness, and defect inspection) or with respect to a reference CAD model.

The inspection, analysis, and reporting may be done both interactively and in a fully automated mode. To automate repetitive tasks, users configure **Scan Definitions** that comprise measurement sequences and subsequent reporting. Once a Scan Definition is built, it can be named and saved for later reuse.



Saved Scan Definitions may be recalled from a drop-down menu list or by clicking inspection shortcuts on the desktop.

The above-mentioned NOVACAM Barrel Analysis PolyWorks Package further simplifies the entire definition, analysis, and reporting process and facilitates user onboarding. It provides domain-specific dialog forms, powerful 3D data processing capabilities, and report templates specific to barrel and chamber inspection.

1) AUTOMATED RIFLING ANALYSIS – *lands, grooves, twist rate, straightness*

As an example of a user-configured barrel inspection sequence, a **Scan Definition** called CAL22 was configured to **measure, analyze, and report on three circular profiles** at specified depths within a 22-caliber barrel. Nominal and tolerance values for each parameter were included in the definition.

This particular Scan Definition generates a multi-page report. The report summary page is as follows:

TUBEINSPECT system

RIFLING INSPECTION

Part name: Caliber 22

Units: Millimeters

NOVACAM

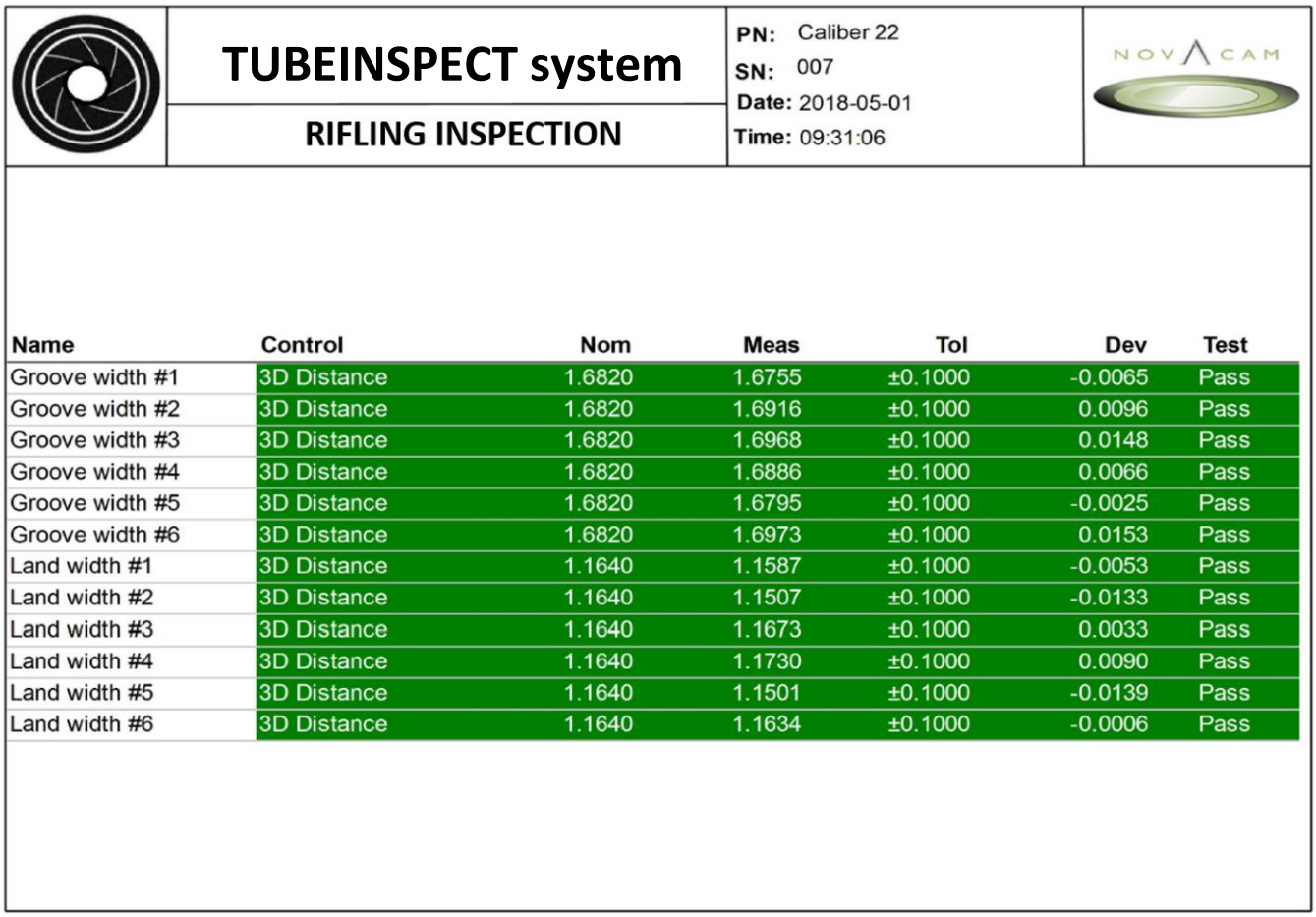
Operator : Inspection **Date :** 2018-05-01 **Time :** 09:31:06

Workorder : WO1 **Serial number :** 007

Name	Control	Nom	Meas	Tol	Dev	Test
Profile1 Land	Diameter	5.4480	5.4360	±0.0250	-0.0120	Pass
Profile2 Land	Diameter	5.4480	5.4301	±0.0250	-0.0179	Pass
Profile3 Land	Diameter	5.4480	5.4255	±0.0250	-0.0225	Pass
Profile1 Groove	Diameter	5.5880	5.5819	±0.0250	-0.0061	Pass
Profile2 Groove	Diameter	5.5880	5.5762	±0.0250	-0.0118	Pass
Profile3 Groove	Diameter	5.5880	5.5708	±0.0250	-0.0172	Pass
Profile1 Groove Depth	3D Distance	0.0700	0.0686	±0.0100	-0.0014	Pass
Profile2 Groove Depth	3D Distance	0.0700	0.0686	±0.0100	-0.0014	Pass
Profile3 Groove Depth	3D Distance	0.0700	0.0683	±0.0100	-0.0017	Pass
Pitch Length	3D Distance	400.0000	406.6000	±10.0000	6.6000	Pass
Straightness	— Ø 0.0120		0.0002	0.0120	0.0002	Pass

twist rate

More detailed calculated parameters for each circular scan profile are also available and included in the report.



TUBEINSPECT system

RIFLING INSPECTION

PN: Caliber 22
SN: 007
Date: 2018-05-01
Time: 09:31:06

NOVACAM

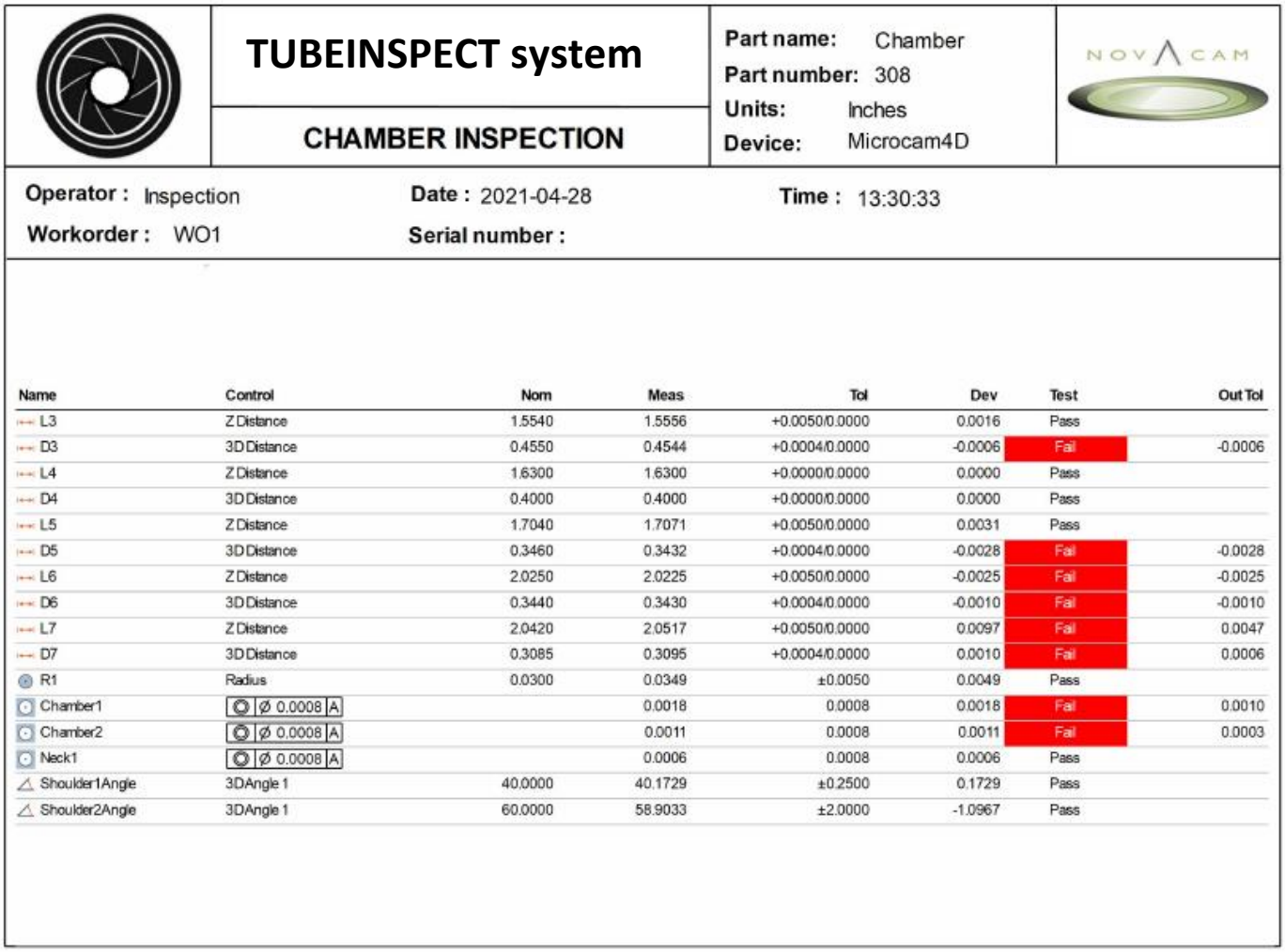
Name	Control	Nom	Meas	Tol	Dev	Test
Groove width #1	3D Distance	1.6820	1.6755	±0.1000	-0.0065	Pass
Groove width #2	3D Distance	1.6820	1.6916	±0.1000	0.0096	Pass
Groove width #3	3D Distance	1.6820	1.6968	±0.1000	0.0148	Pass
Groove width #4	3D Distance	1.6820	1.6886	±0.1000	0.0066	Pass
Groove width #5	3D Distance	1.6820	1.6795	±0.1000	-0.0025	Pass
Groove width #6	3D Distance	1.6820	1.6973	±0.1000	0.0153	Pass
Land width #1	3D Distance	1.1640	1.1587	±0.1000	-0.0053	Pass
Land width #2	3D Distance	1.1640	1.1507	±0.1000	-0.0133	Pass
Land width #3	3D Distance	1.1640	1.1673	±0.1000	0.0033	Pass
Land width #4	3D Distance	1.1640	1.1730	±0.1000	0.0090	Pass
Land width #5	3D Distance	1.1640	1.1501	±0.1000	-0.0139	Pass
Land width #6	3D Distance	1.1640	1.1634	±0.1000	-0.0006	Pass

With barrel inspection reports such as those above, the operator is quickly informed of the barrel's conformity to specified tolerances.

2) AUTOMATED CHAMBER ANALYSIS – *body, shoulder(s), neck, freebore, leade, etc.*

As an example of a user-configured chamber inspection sequence, a Scan Definition called WIN308 was configured to measure, analyze, and report on 7 circular and 2 linear scan profiles through a .308 Winchester chamber. Nominal and tolerance values for each parameter were included in the definition.

The scan definition generates a 3-page report shown below:



TUBEINSPECT system

CHAMBER INSPECTION

Part name: Chamber
Part number: 308
Units: Inches
Device: Microcam4D

NOVACAM

Operator : Inspection **Date :** 2021-04-28 **Time :** 13:30:33
Workorder : WO1 **Serial number :**

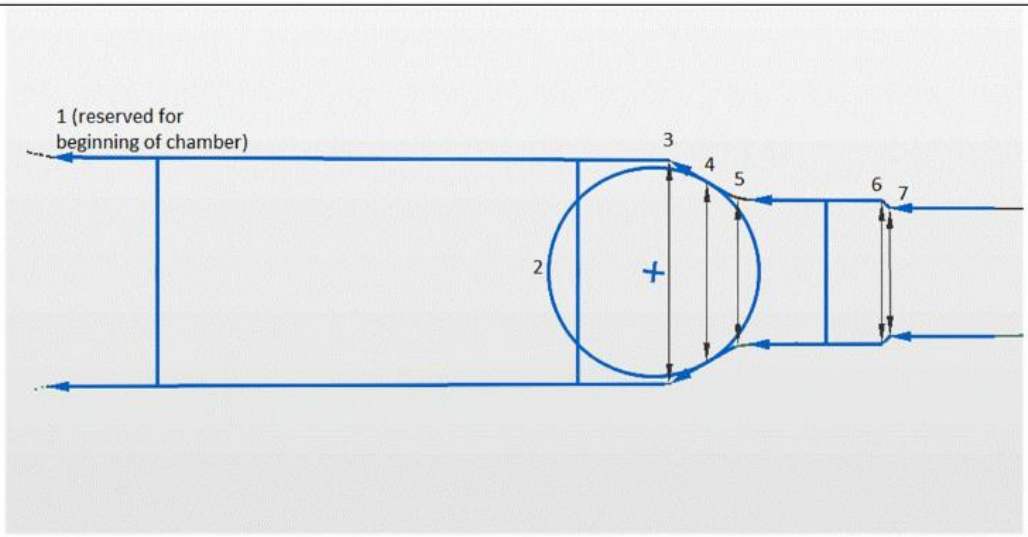
Name	Control	Nom	Meas	Tol	Dev	Test	Out Tol
L3	Z Distance	1.5540	1.5556	+0.0050/0.0000	0.0016	Pass	
D3	3D Distance	0.4550	0.4544	+0.0004/0.0000	-0.0006	Fail	-0.0006
L4	Z Distance	1.6300	1.6300	+0.0000/0.0000	0.0000	Pass	
D4	3D Distance	0.4000	0.4000	+0.0000/0.0000	0.0000	Pass	
L5	Z Distance	1.7040	1.7071	+0.0050/0.0000	0.0031	Pass	
D5	3D Distance	0.3460	0.3432	+0.0004/0.0000	-0.0028	Fail	-0.0028
L6	Z Distance	2.0250	2.0225	+0.0050/0.0000	-0.0025	Fail	-0.0025
D6	3D Distance	0.3440	0.3430	+0.0004/0.0000	-0.0010	Fail	-0.0010
L7	Z Distance	2.0420	2.0517	+0.0050/0.0000	0.0097	Fail	0.0047
D7	3D Distance	0.3085	0.3095	+0.0004/0.0000	0.0010	Fail	0.0006
R1	Radius	0.0300	0.0349	±0.0050	0.0049	Pass	
Chamber1	⌀ 0.0008 A		0.0018	0.0008	0.0018	Fail	0.0010
Chamber2	⌀ 0.0008 A		0.0011	0.0008	0.0011	Fail	0.0003
Neck1	⌀ 0.0008 A		0.0006	0.0008	0.0006	Pass	
Shoulder1Angle	3D Angle 1	40.0000	40.1729	±0.2500	0.1729	Pass	
Shoulder2Angle	3D Angle 1	60.0000	58.9033	±2.0000	-1.0967	Pass	

TUBEINSPECT system

CHAMBER INSPECTION

Part number: 308
Units: Inches
Device: Microcam4D

Operator : Inspection **Date :** 2021-04-28 **Time :** 13:30:33
Workorder : WO1 **Serial number :**

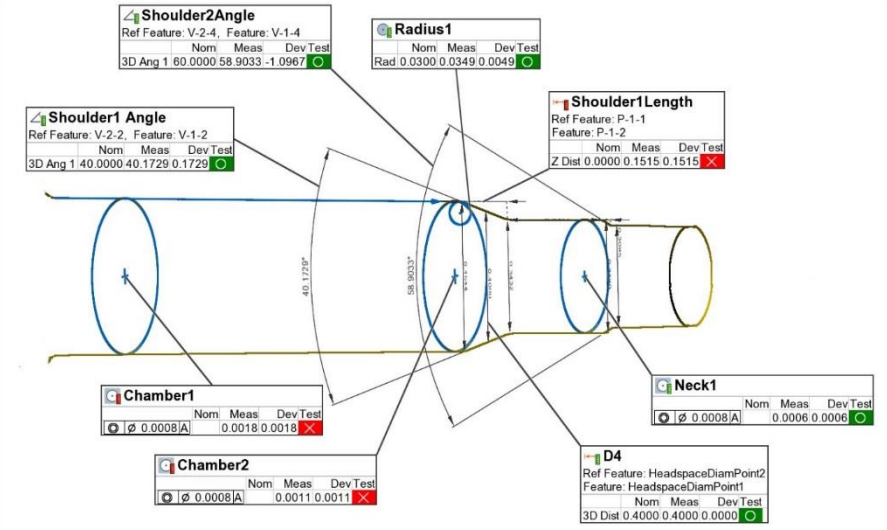


TUBEINSPECT system

CHAMBER INSPECTION

Part number: 308
Units: Inches
Device: Microcam4D

Operator : Inspection **Date :** 2021-04-28 **Time :** 13:30:33
Workorder : WO1 **Serial number :**

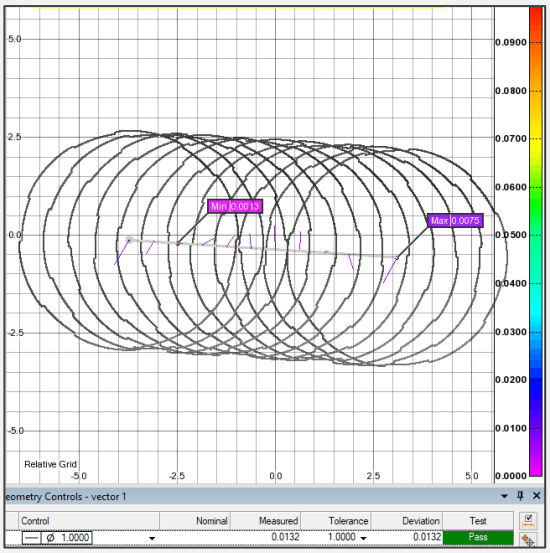


3) OTHER GD&T PROCESSING OPTIONS

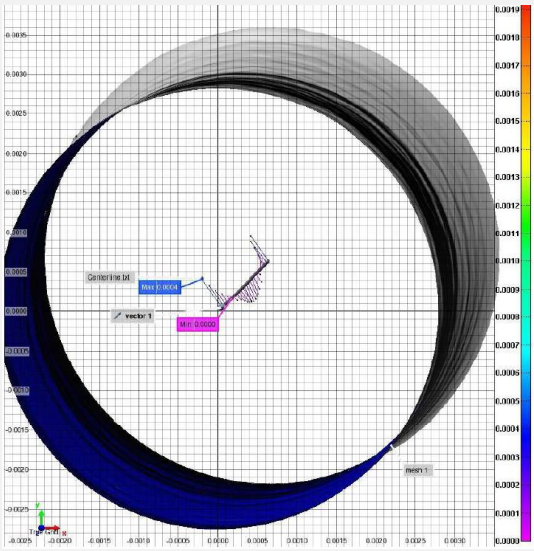
The following types of GD& measurements can be obtained with NOVACAM 3D metrology systems and included in barrel inspection and chamber inspection reports.

Straightness measurement

Axial barrel straightness may be calculated from 3 or more circular profiles (see below left) or from a high-density scan of the bore ID (see below right).



Straightness from 10 profiles.



Straightness from a high-density scan.

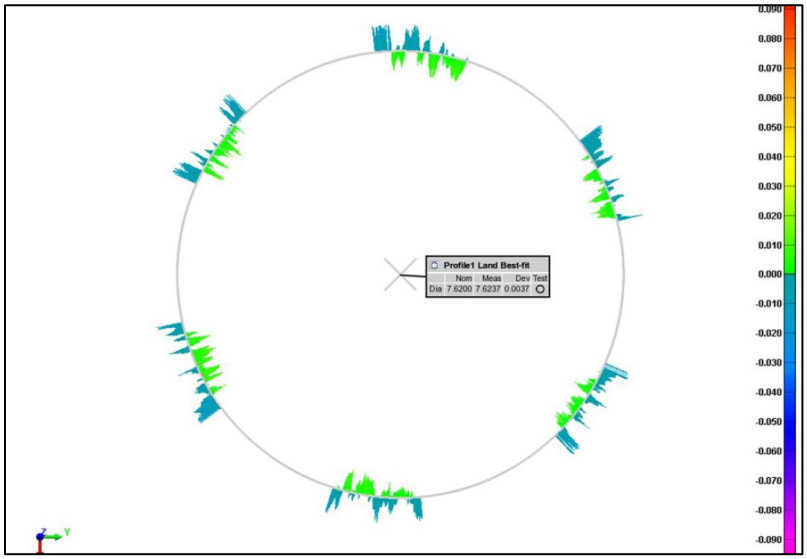
Notably, the accuracy and precision (i.e., repeatability, or standard deviation) of straightness measurements acquired with NOVACAM systems are better than 0.5 µm (0.00002”).

- Example: GD&T straightness was measured for 2 bores. For each bore, the measurements were repeated 10 times. PolyWorks Inspector™ software was used for straightness calculation and reporting to obtain the following results:

Measurement #	Tube 1 straightness (inches)	Tube 2 straightness (inches)
1	0.001271	0.000863
2	0.001272	0.000862
3	0.001263	0.000853
4	0.001256	0.000859
5	0.001262	0.000841
6	0.001261	0.000841
7	0.001271	0.000857
8	0.001273	0.000844
9	0.001269	0.000843
10	0.001262	0.000846
Standard deviation	**0.000006” (0.15 µm)**	**0.000009” (0.23 µm)**

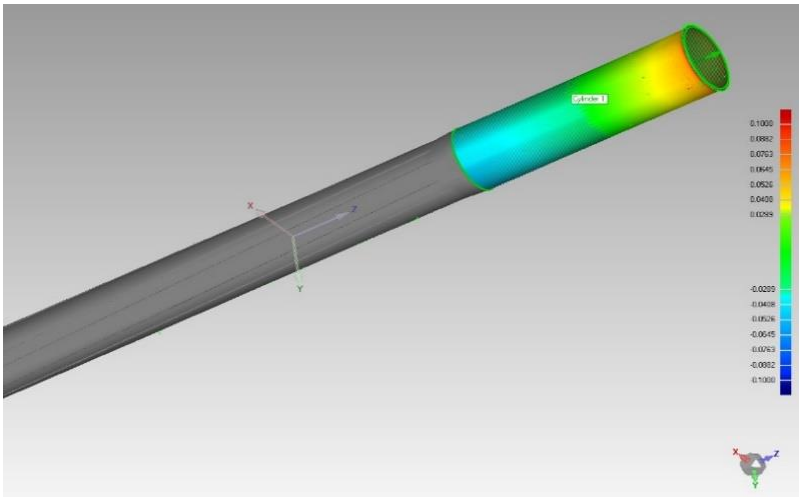
Roundness (Circularity) measurement

Roundness may be measured for both smoothbores and rifled bores. The graph below shows the measured roundness of lands within a rifled bore.



Surface profile measurement – cylindricity, conicity, taper, etc.

Cylinder, cone and taper tolerancing, as well as any other profile tolerancing, is supported by Novacam through powerful GD&T software like PolyWorks Inspector. The cylinder deviation map below shows the cylindricity of the rifle chamber.

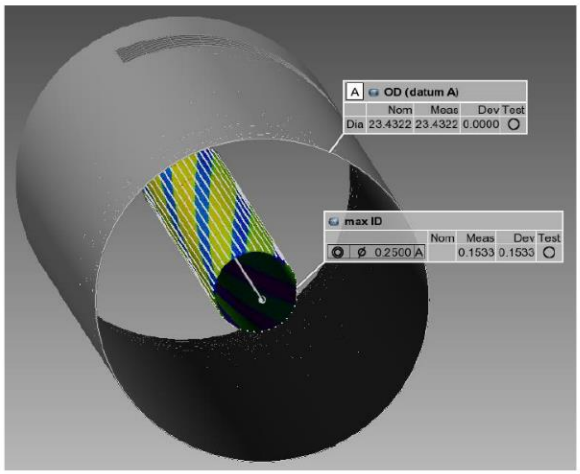


Runout measurement

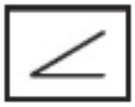
All runouts may be measured, including:

- Runout between the chamber and the lands
- Runout between grooves and lands
- Runout between OD and lands (see below).

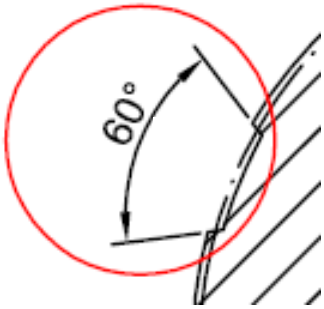
The graph below shows the ID and OD surfaces of a rifle barrel scanned with the TUBEINSPECT system and subsequently combined into one data set. The ID and OD axes may be compared to each other and runout calculated.

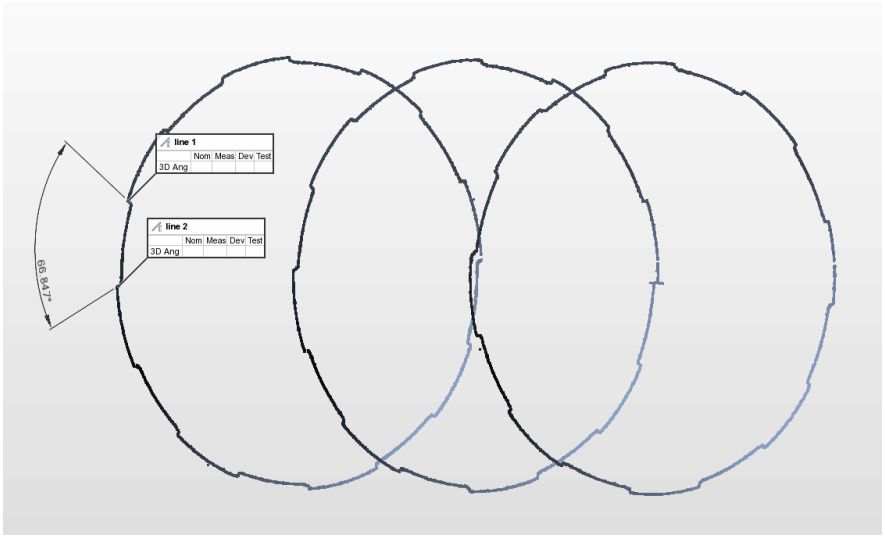


Flank angle measurement



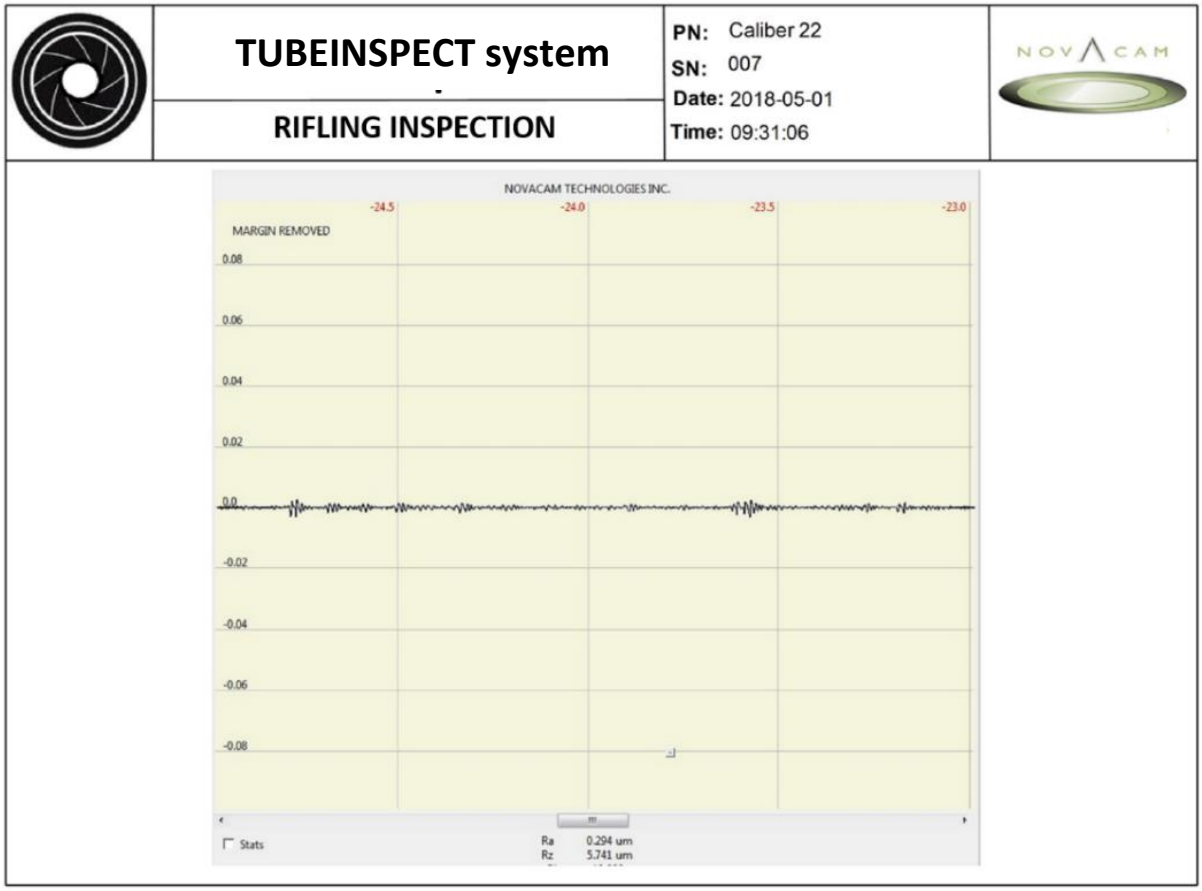
Angles of groove edges (flank angles) can also be measured and displayed in a report format.





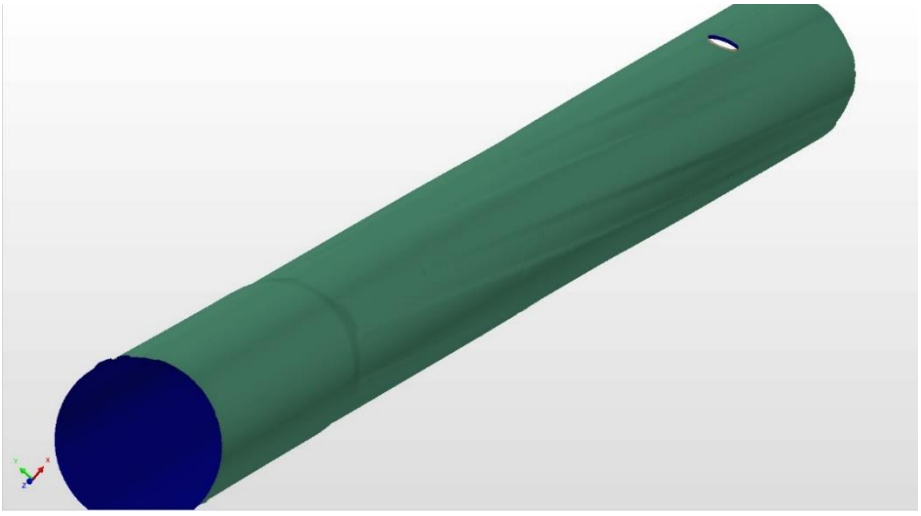
4) ROUGHNESS MEASUREMENT AND ANALYSIS

A roughness profile of a selected section of the barrel is available directly from NOVACAM acquisition software and may also be included as part of an automatically generated barrel inspection report.



5) CROSS-HOLES MEASUREMENT

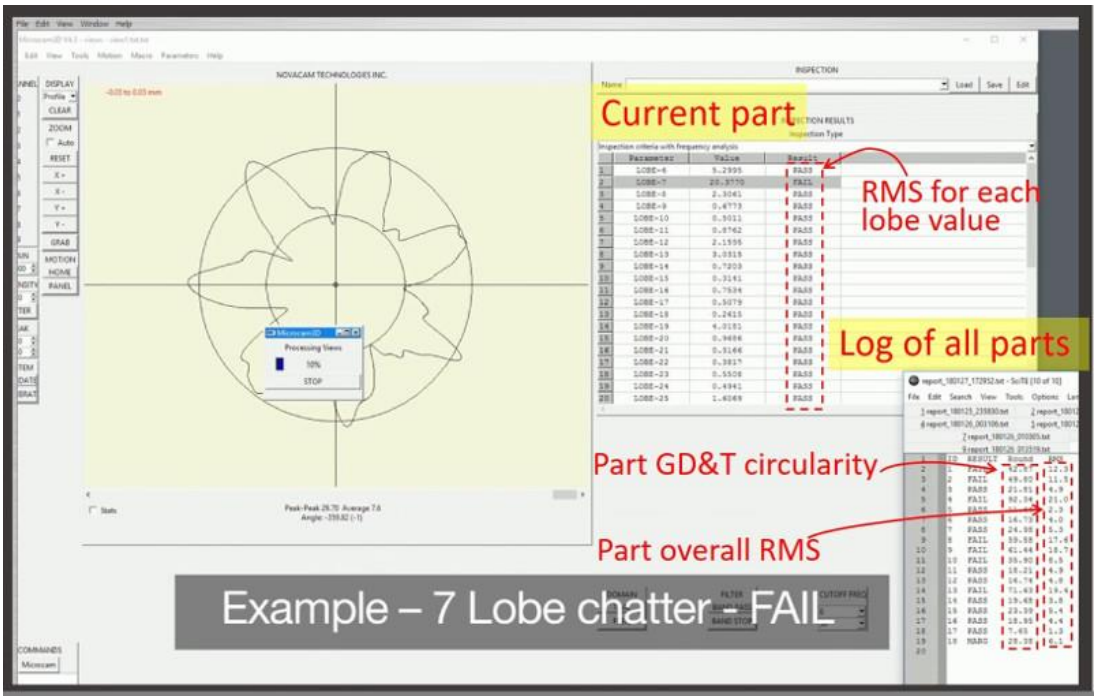
Gas-port holes drilled in automated rifles can be measured and visualized.

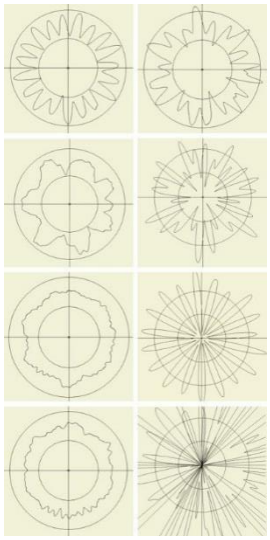


6) CHATTER MEASUREMENT AND ANALYSIS

NOVACAM 3D metrology systems provide fast and reliable non-contact chatter measurements on IDs of barrels. The TUBEINSPECT system will also measure chatter on barrel ODs or on the ODs of barrel machining tools.

NOVACAM Chatter Analysis Software mathematically analyzes the pattern of chatter and characterizes it by parameters such as the amplitude or RMS (root mean square) value for each lobe value. Parts may be categorized as PASS or FAIL as per user criteria.



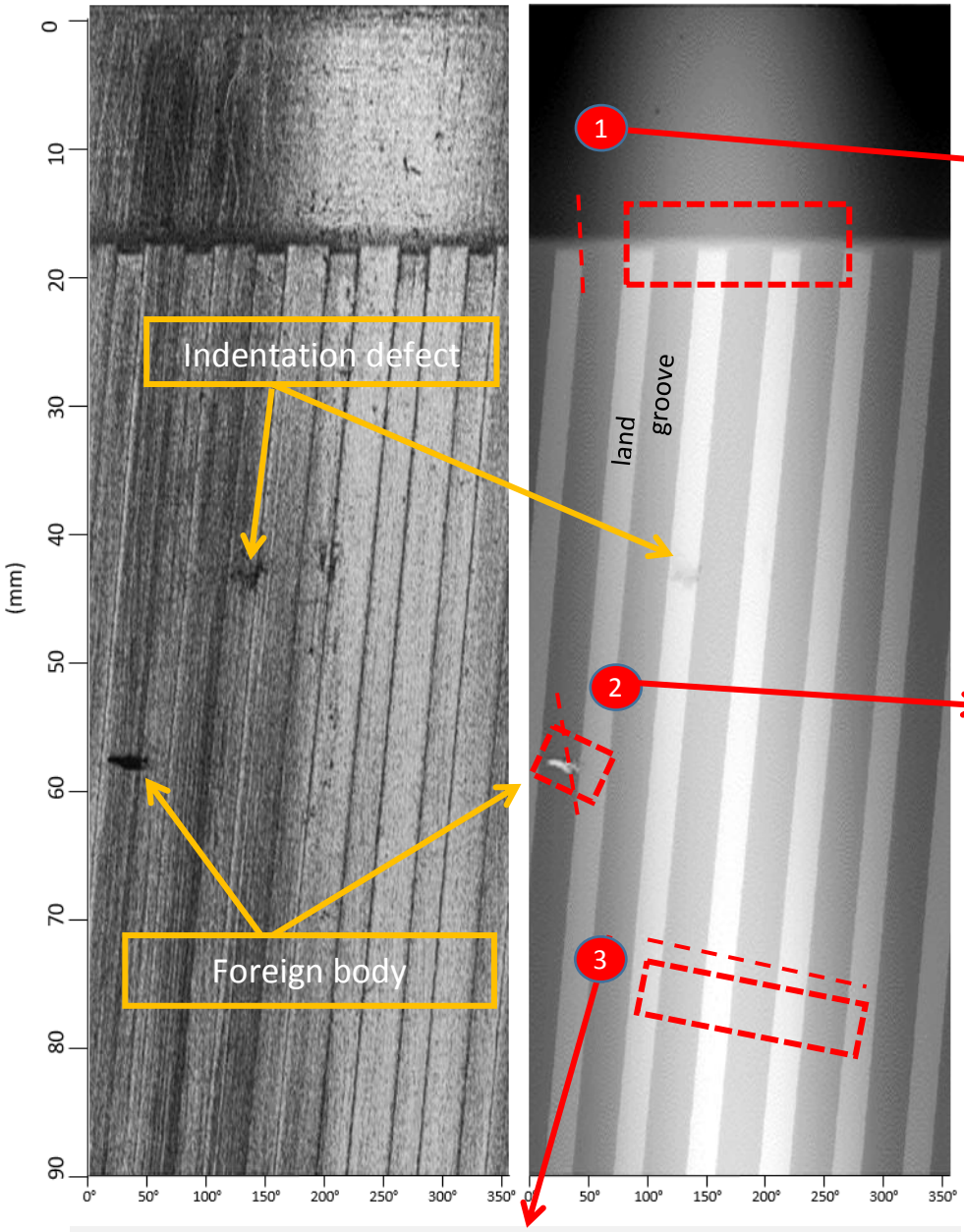


7) DEFECT INSPECTION

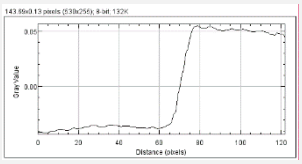
With NOVACAM 3D metrology systems, defect detection and reporting can be completely automated. Nevertheless, for clients who want to also look for defects interactively, the height and light intensity maps generated in addition to 3D point clouds are excellent tools for fast bore ID defect detection and analysis. The following maps represent the ID of the first 9 cm of a .22 caliber (5.6 mm diameter) rifle barrel.

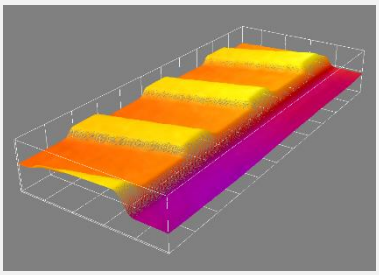
Equivalent to a borescope image or a photo obtained by a vision system, **the light intensity map** is a useful visual reference, but does not contain height data

The height map provides micron-precision height values of the surface

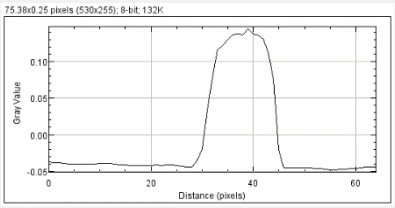


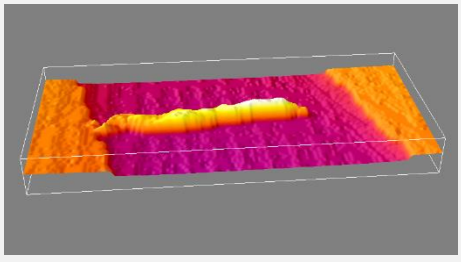
Inspecting chamber-to-barrel transition



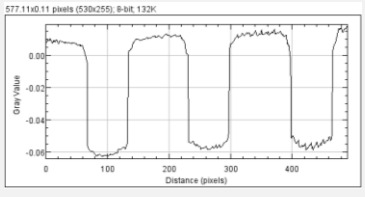


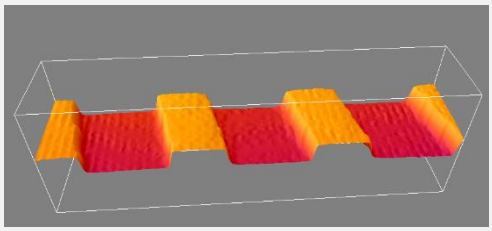
Inspecting defect area height profile





Inspecting rifling profile





Which System Should I Select - BOREINSPECT or TUBEINSPECT?

Both the TUBEINSPECT system and the BOREINSPECT system include the following components:

1. **MICROCAM™-3D/4D interferometer** (19" rack-mountable component) that provides a light source to the optical probe and carries out optical and electronic processing of the measurements
2. **Fiber-based side-looking optical probe** whose length, diameter, and optical properties (spot size, standoff distance) are selected according to client needs. Several probes may be multiplexed to one interferometer for additional return on investment (ROI).
3. **Motion controller** (19" rack-mountable component)
4. **PC workstation** (mini desktop size PC or laptop) that hosts NOVACAM data acquisition software and, typically, data analysis software
5. **Inspection station with motion components** (linear and rotation) that are standard for standard supported barrel calibers or customized to client requirements
6. **Calibration rings.**

To see which system would best suit your barrel metrology application, please consult the following comparison of the BOREINSPECT and TUBEINSPECT systems.

	TUBEINSPECT™ system	**BOREINSPECT™ system**
Common characteristics		
Technology	Low-coherence interferometry (LCI)	
Type of measurement	Non-contact, optical, collinear measurements (enabling even the measurement of high-aspect-ratio features such as cross-holes, undercuts, etc.)	
Light wavelength	1,310 nm, infrared	
Light bandwidth	Broadband light	
Pointer for alignment purposes	In-probe red laser @ 650 nm	
Instrument safety[1]	Class 1M laser product: < 20 mW of infrared, < 5 mW of in-probe laser pointer	
Acquisition speed	2,100 or 100,000 3D point measurements per second, depending on the interferometer model selected (MICROCAM-3D or MICROCAM-4D)	
Sampling step along the rotational path	User-configurable	
Sampling step in axial direction	User-configurable	
Light spot size	Variable, typically 13 to 22 µm (512 to 870 µin.)	
Key differences		
Key differentiator	Rotates the measured barrel. The side-looking probe advances along the inside (or outside) wall of the rotating barrel to acquire the ID (or OD).	Rotates and advances the side-looking probe into the measured barrel, which remains fixed.
Rotational speed for spiral acquisition	Up to 2 rotations (circular profiles) per second with an upgrade to 6 rotations per second	Up to 30 rotations (circular profiles) per second
Probe positioning	The probe does not need to be positioned at the center of the bore; it only needs to remain at a fixed distance from the side wall.	The probe should be positioned close to the bore centerline (+/- 0.25 mm) to capture the entirety of ID features. For irregularly shaped objects or slots or crevices, the probe can acquire the entire surface by scanning from several positions.

	TUBEINSPECT™ system	BOREINSPECT™ system
Benefits		
Standard barrel diameter sizes supported	**Small caliber:** ✓ .172 caliber (4 mm) ✓ .20 caliber (5 mm) ✓ .22 caliber (5.6 mm) ✓ .243 caliber (6mm) ✓ .26 caliber (6.5 mm) ✓ .284 caliber (7 mm) ✓ .308 caliber (7.62 mm) ✓ .323 caliber (8 mm) ✓ .357 caliber (9 mm) ✓ .40 caliber (10mm) ✓ .44 caliber (10.9 mm) ✓ .45 caliber (11.43 mm) ✓ .50 caliber (12.7 mm) **Medium and large caliber** ✓ 20 mm - 90 mm	The same system standard barrel IDs are supported, but depending on the application, different caliber ranges may require a change of probe. *NOVACAM **extended range** rotational probes (4.6-mm diameter) are capable of scanning barrel IDs from 6 mm to 30 mm – wider range than any other rotational probe currently on the market.
Barrel length[2]	Standard up to 40 in. (1,000 mm)	Standard up to 12 in. (300 mm)
Barrel weight	Up to 250 kg is standard. Heavier barrels may require custom rotational stages.	Not applicable since the barrel remains stationary
Unique advantages	✓ Ability to scan IDs of various diameters with the same instrument ✓ Ability to scan IDs and ODs with the same system	✓ Ideal for barrels that cannot be rotated ✓ Maximum rotation speed is higher, at up to 30 rotations per second
Bonus measurements	✓ IDs of chambers, chokes, and gas tubes ✓ Barrel ODs – including o Flatness, perpendicularity, and concentricity of OD datum surfaces o Features such as fluting or rifle muzzle threads ✓ ODs of gas tubes, gas pistons, bolt bodies, and bolt carrier bodies ✓ ODs of machining tools such as reamers and mandrels ✓ ODs of related components such as cutting tools for ammunition die blocks	✓ IDs of chambers, chokes, and gas tubes ✓ IDs of rifle receivers ✓ IDs of ammunition die blocks

[1] Class 1M laser product: Visible and invisible laser radiation. Do not stare into the beam or view directly with optical instruments.

[2] Non-standard barrel IDs and lengths can be accommodated with custom setups.

- With longer custom probes, bores as long as 6’ (1.8 m) have been scanned.
- A trade-off exists between probe diameter (which affects rigidity) and probe length. For longer probes, centralizers may be required.
- Longer barrels with a small ID can often be measured in two scan sequences – one from each end – with the two data sets subsequently merged into one if required.

Conclusion

When it comes to firearm accuracy and safety, barrel ID quality is key. NOVACAM TUBEINSPECT and BOREINSPECT systems bring significant inspection capabilities to barrel manufacturers. These **capabilities include high-precision barrel ID measurements**, an **option for complete automation** of the inspection process, and a **high level of versatility** for inspection station setup. For manufacturers, the wide variety of measurements obtainable automatically with either the TUBEINSPECT system or the BOREINSPECT system expands the range of quantifiable parameters while decreasing the inspection effort**. More data and more efficient inspection mean better process control. And cost savings**.

Outside diameter (OD) measurements, which are additionally available with the TUBEINSPECT system, increase the return on investment for barrel manufacturers on two fronts. First, barrel OD surface parameters may be measured to the same level of detail and precision as the barrel ID, ensuring better control on the final product. Second, using the TUBEINSPECT system to measure the OD of machining tools (mandrels, reamers, etc.) ensures that only to-spec tools are used. **With tool verification capability, product quality improves, scrap decreases, and savings increase.**

Novacam encourages technicians and engineers in charge of barrel inspection to contact us to discuss your applications and particular challenges.

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