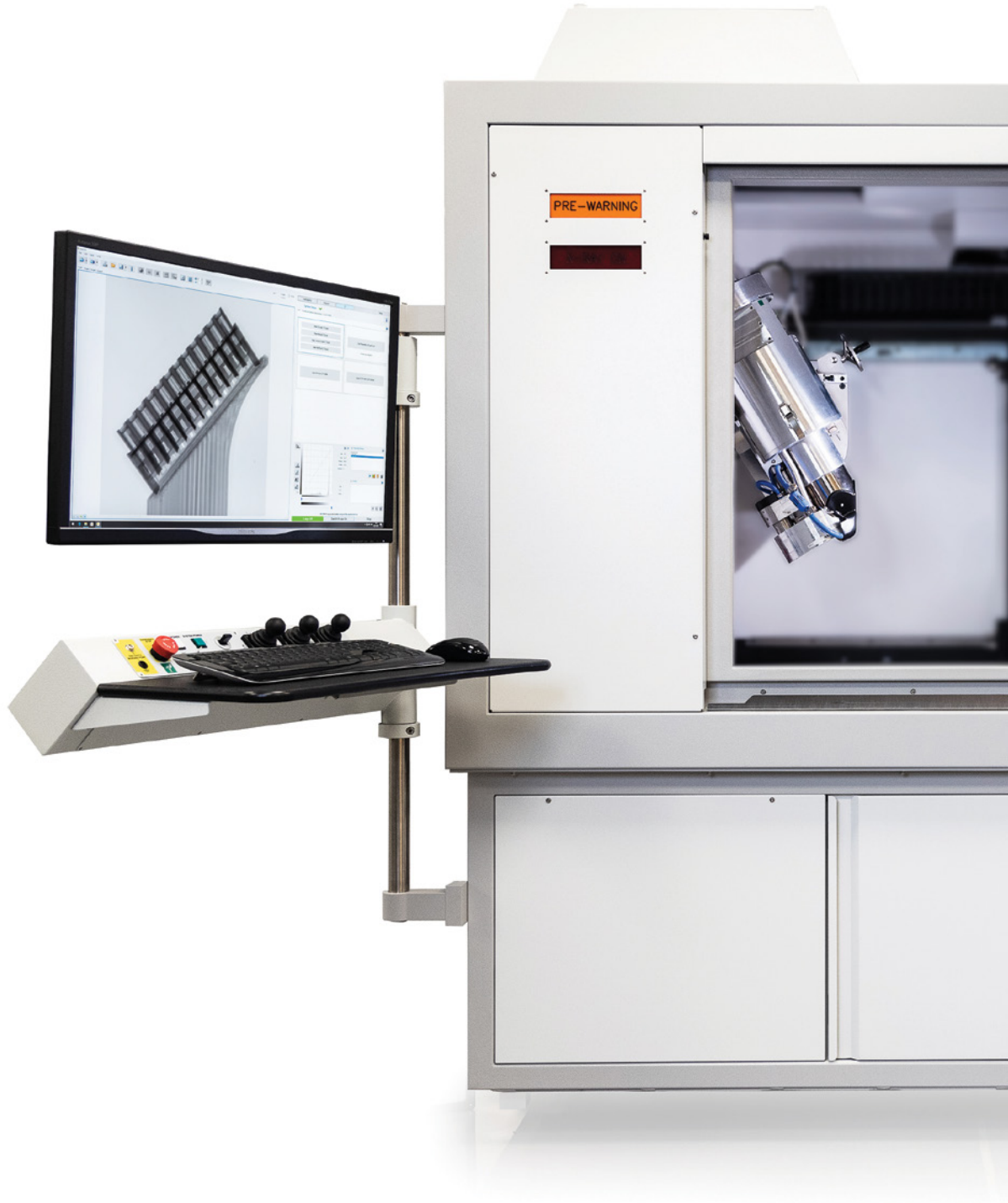




Rethink shop floor  
processes with  
Quality 4.0

Industrial  
X-ray and CT

XT H 225 ST 2X



Productivity without  
compromise

# Functionality for the shop floor

For many years, X-ray CT (computed tomography) has been used in laboratories for inspecting the interior of samples such as fossils and artefacts. More recently, this valuable technology has been finding its way into the manufacturing environment for quality control applications.

It is able to non-destructively detect voids, burrs, cracks and other imperfections inside components and assemblies, including those that have been additively manufactured. It also serves as a metrology tool to ensure dimensional compliance, both internally and externally, to a high degree of accuracy.

However, manufacturers are no longer only finding failures in a manufacturing process. The usefulness of CT goes even further on the factory floor by allowing a production line to be adjusted continuously in real-time to prevent components falling out of tolerance.

By combining unique hardware with innovative software, the XT H 225 ST 2x delivers the efficiency, reliability and accuracy required for these production applications. Throughout the entire time to market of a user's new product, all steps from R&D through production line set-up and pre-series trial runs to full production are supported.



## **AUTO.FILAMENT CONTROL**

Extended filament lifetime

## **HALF.TURN CT**

Faster CT acquisition

## **DETECTOR TECHNOLOGY**

Industry leading data quality

## **QUICK.CHANGE**

Faster filament exchange

## **ROTATING.TARGET 2.0**

High X-ray power with small focal spot

## **LOCAL.CALIBRATION**

High accuracy CT measurements

PRODUCTIVITY | DATA QUALITY | ACCURACY

# 2x productivity without compromise

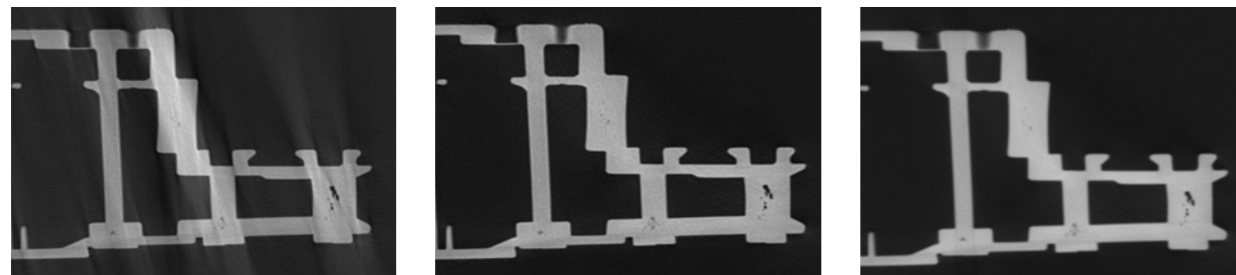
The integration of industry-leading features into the XT H 225 ST 2x microfocus X-ray CT system allows a doubling of data acquisition speed and hence of inspection productivity. It is a result of using advanced detector technology combined with new functionality including Half.Turn CT and Rotating.Target 2.0.



## HALF.TURN CT, FASTER CT ACQUISITION

Instead of rotating the sample under investigation through 360 degrees while the X-rays directed at it are either absorbed or pass through to the detector, Nikon Metrology has devised a method that allows sufficient data to be obtained by rotating the sample through just over 180 degrees.

Complete in-house control over the development of world-leading reconstruction software has facilitated the Half.Turn CT breakthrough, as it enabled the introduction of novel automatic centre of rotation calculation coupled with optimisation of the reconstruction algorithm. Together they eliminate artefacts introduced by rotating a sample through less than 360 degrees. As a consequence, an image is produced automatically without loss of quality or accuracy from about half of the data usually acquired with conventional CT.



Without Half.Turn CT

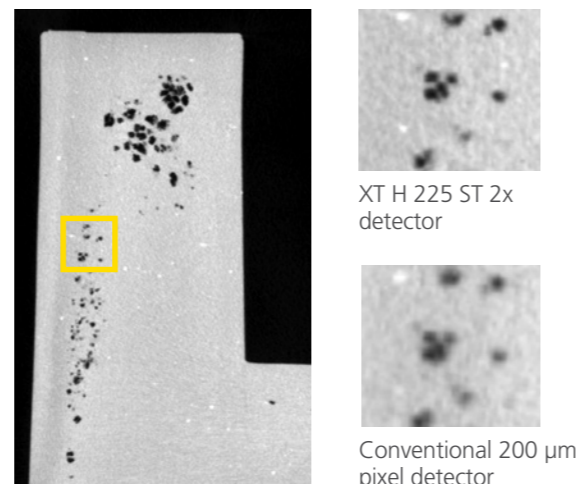
With Half.Turn CT

Traditional 360° CT

## INDUSTRY LEADING DETECTOR TECHNOLOGY

Nikon Metrology uses an industry-leading flat panel detector, which offers small pixel sizes and fast exposures. However, the advanced features of the panel technology can only be leveraged when matched with a compatible microfocus X-ray source.

The XT H 225 ST 2x delivers that compatibility, resulting in ultra-fast data acquisition due to the high power generated from the Rotating.Target 2.0, which allows the detector to operate at its fastest exposure times. Datasets are of high quality and resolution due to the small focal spot size at high X-ray powers in combination with the detector's small pixel size and large area.



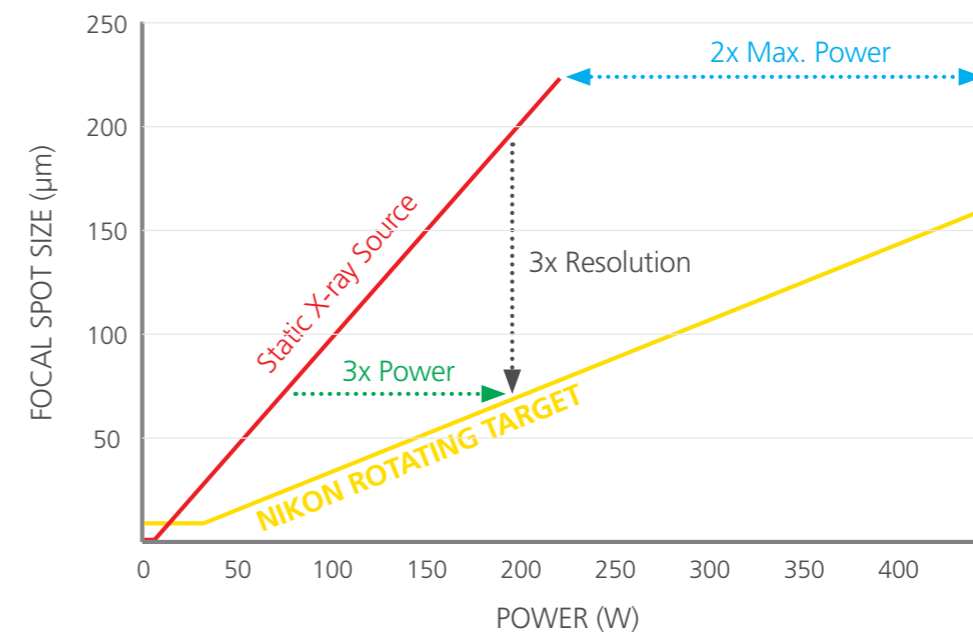
XT H 225 ST 2x detector

Conventional 200 µm pixel detector

## ROTATING.TARGET 2.0

Nikon Metrology industrial CT systems uniquely offer the benefit of using rotating target technology to increase scanning speed and signal-to-noise ratio dramatically. It is due to the target's ability to generate high power X-rays while maintaining a small focal spot. Optimisation of the design of the latest version, Rotating.Target 2.0, has enabled a doubling of the guaranteed operating time.

Spinning the tungsten target at 8,000 rpm combined with liquid cooling increases dissipation efficiency of the heat generated by the small spot size of the incident electron beam. Compared with a static, high-power target that relies for cooling solely on its material properties such as the thermal conductivity, the rotating target offers significant advantages. They include continuous operation and consecutive scanning without the need for cool down periods and a maximum power of 450W without having to switch to another target.



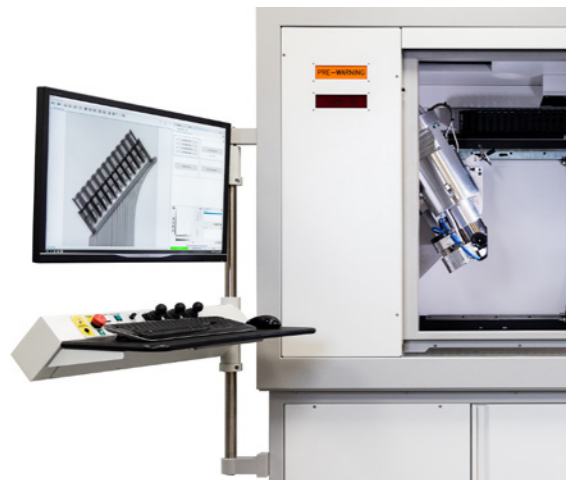
# Maximum availability for high inspection productivity

Nikon Metrology understands that there are two essential facets to achieving high inspection productivity: first, high speed data acquisition and reconstruction; and secondly, maximum uptime of the X-ray system. Equipment availability is a function not only of overall reliability but also of long intervals between, and short downtimes for, maintenance jobs such as periodic replacement of the filament.

## **AUTO.FILAMENT CONTROL, DOUBLES FILAMENT LIFETIME**

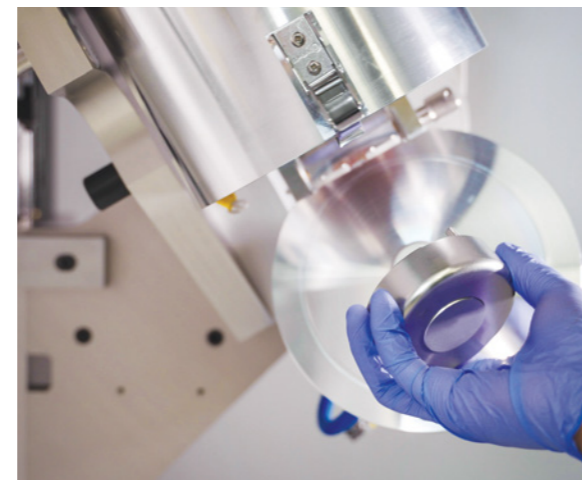
High-resolution microfocus X-rays start with electrons emitted from a thin filament that has to be replaced periodically. Less frequent changing of the filament is desirable, as it means that system availability is higher. Long-life filaments are available but they are thicker, so the high resolution nature of the microfocus X-rays is lost.

With the XT H 225 ST 2x, the user no longer has to choose between high-resolution and long-life filaments. Auto.Filament Control intelligently controls the X-ray source to double the lifetime of the filament and increase system availability. Nikon Metrology is able to implement these algorithms as its sources are designed and manufactured in-house, providing the ability and expertise to control the source in such a way that operational life is increased.



## **QUICK.CHANGE, FASTER FILAMENT EXCHANGE**

When the filament does have to be replaced, downtime is considerably lowered by the introduction of Quick.Change plug-and-play filament cups. This convenient, highly repeatable procedure eliminates human error. In addition, the filaments themselves have been aligned and conditioned by Nikon Metrology's X-ray engineers to deliver optimal performance.



# Results that you can trust

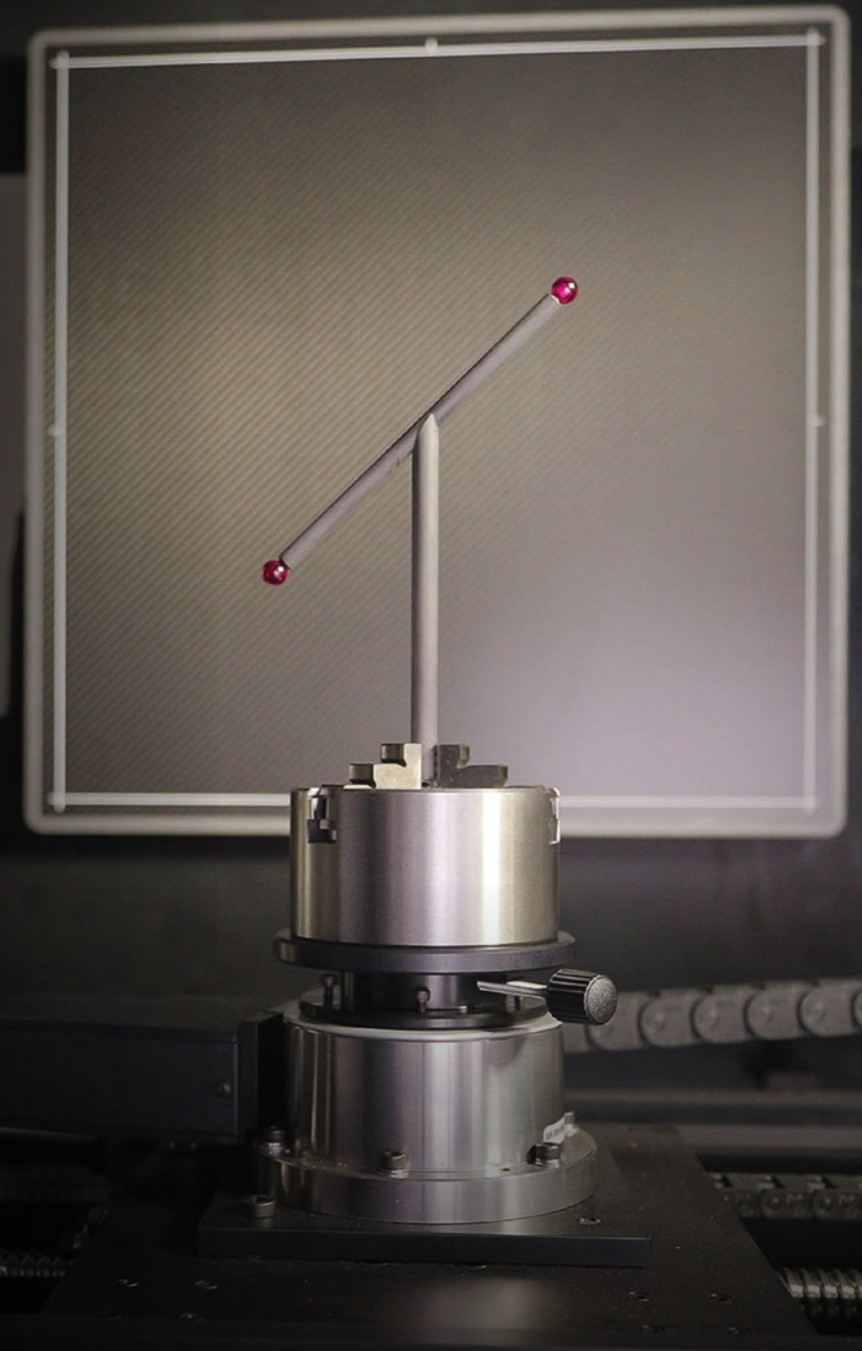
## **AUTOMATED DETECTOR EVALUATION**

The condition of the digital X-ray detector has a considerable influence on the efficiency and accuracy with which features are revealed and measured, so being able to evaluate and track its performance over time is crucial.

Flat panel detectors at Nikon Metrology are qualified to ASTM E2597 and users are able to evaluate and track the performance of the detector in accordance with ASTM E2737. Dedicated software performs all necessary functions, including artefact manipulation, image collection and data analysis, creating a detailed report automatically and rapidly with unique performance tracking and trend analysis.

## **LOCAL.CALIBRATION, HIGH ACCURACY CT MEASUREMENTS**

Local.Calibration allows fast, automated calibration of voxel size at any CT scan position, rather than the user having to perform the function manually. It leads to a radical improvement in measurement accuracy for metrology applications. Further benefits are that the procedure is deskilled and dimensional accuracy is traceable. As the CT scan position is calibrated with reference to a known artefact, measurements can be made with a high level of confidence.



# Quality 4.0

The goal of Industry 4.0 is to enable manufacturers to produce better products at a lower cost, speed up the response to changes in demand, and shorten time to market, everything together resulting in greater competitiveness. In this context, quality control can no longer be a pure qualifier of good or bad products. Going forward, inspection needs to provide the information to proactively control the manufacturing process, resulting in zero defect production. This paradigm shift in quality control is referred to as Quality 4.0. It requires more frequent and more detailed inspection, as close to real-time as possible. Computed Tomography is the ideal tool for this as it enables fast and fully automated inspection of internal and external dimensions as well as defects in a single process.

## Automation benefits



Increased productivity



Reduced costs



Improved quality



Closed-loop manufacturing



Centralised data



Complex tasks deskilled

# Automation-ready CT for production

## BATCH CT INSPECTION

As standard, Nikon Metrology's Inspect-X software allows users to save profiles to be recalled later. The profile defines all acquisition and analysis parameters, ensuring repeatability of the complete CT process.

- No programming skills required
- Simple operator interface
- Eliminates manual parameter selection
- Operator is free to carry out other tasks

## SEMI-AUTOMATED CT INSPECTION

Loading of the sample holder with multiple parts is the only manual operation. Identification of the part, program selection, data acquisition, analysis and reporting are completely automated.

- Automated part identification
- Integration with manufacturing database
- Statistical process control (SPC)

## IN-LINE CT INSPECTION

In-line CT is a solution for fully autonomous production environments where critical parts with complex geometries need to be inspected.

- Integration with robot and conveyor systems
- Rapid detection and feedback of process variation
- Controlled and optimised production in real-time



# Flexibility when you need it

The XT H 225 ST 2x can be configured with industry-leading flat panel detectors up to 2,880 x 2,880 pixels (150  $\mu\text{m}$ ). Together with the ability to exchange the X-ray targets, motorised moveable FID and choice of measurement modes, the system is a very flexible tool that can cope with a wide range of samples and inspection challenges.

This means that the XT H 225 ST 2x is not only suited for fast series inspection, but also fits well with the needs of R&D work, pre-series support, quality control and failure analysis.



180 kV  
TRANSMISSION TARGET



225 kV  
REFLECTION TARGET



225 kV  
ROTATING TARGET



MULTI-METAL  
TARGET

## FOUR TARGET OPTIONS, ONE SOURCE

With a choice of four X-ray target heads, unique flexibility is achieved from a single 225 kV microfocus source. All targets are interchangeable by the user, quickly and effortlessly, to optimise system performance. The additional cost of buying and maintaining a second source tube and accessories is therefore avoided.

The reflection target is our standard source with a focal spot size down to 3  $\mu\text{m}$ , providing the resolution and power for a wide range of applications. The rotating target on the other hand features a 3x smaller spot size starting from 30 W, allowing very crisp images to be maintained at high powers and reducing the time needed to scan objects. Alternatively, the transmission target gives a spot size down to 1  $\mu\text{m}$  for even greater clarity.

Often in material analysis, using lower energy X-ray emission is beneficial and can be achieved with a multi-metal target. Besides the standard tungsten (W) target, the operator can select from three other target materials: silver (Ag), molybdenum (Mo) and copper (Cu).

## ADVANCED CONTROL SOFTWARE

Inspect-X software is unrivalled in the X-ray CT market. Intuitive and user-friendly, it simplifies the process of CT scanning complex samples for accurate inspection. Developed by Nikon Metrology in-house, the software is designed to streamline the process of acquiring and reconstructing CT data.

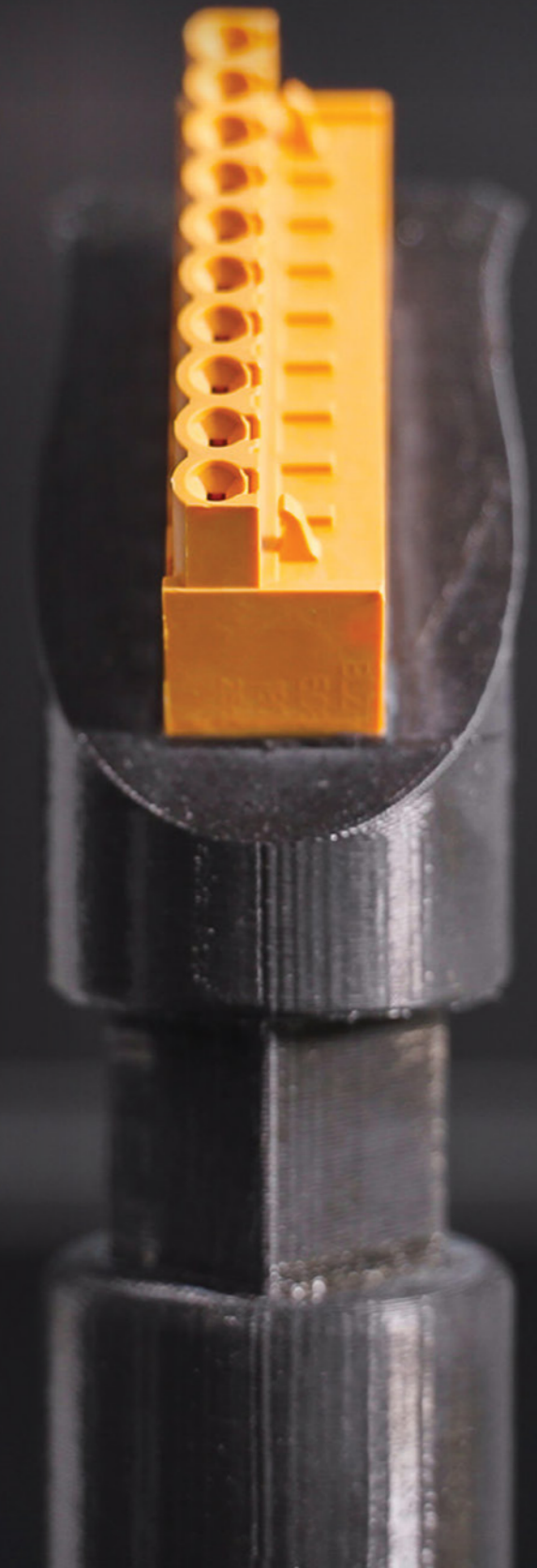
For novice users the focus is on intelligence, operators being offered only the information they need at any moment, thereby simplifying the task at hand. Advanced users can take advantage of full control over all settings of the source and flat panel detector, as well as acquisition techniques and settings, to tailor the system to the sample being scanned.

The user is offered unparalleled control and opportunities for custom experimentation, for example time-lapse CT or complete integration of an inspection system within a production line.

## MOTORISED FID

Since X-ray intensity falls as the distance increases between the source and the flat panel detector, to compensate for any loss of flux users typically have to either increase the X-ray source power, which makes the focal spot larger, or use longer detector exposures, which lengthens the scan times.

The XT H 225 ST 2x has motorised FID (Focal spot to Imager Distance) adjustment, so the user does not have to increase either X-ray power or detector exposure time. Instead a shorter FID may be selected, giving faster scan times for a given resolution or alternatively a higher signal-to-noise ratio when using low energy X-ray power.



# Specifications

X-ray Source	
Type	Open Tube Microfocus
Target Options	Reflection Target Rotating Target 2.0 Transmission Target Multimetal Target
Maximum Energy	225 kV
Maximum Power	450 W
Minimum Focal Spot	1 $\mu$ m

System	
Maximum CT Swept Diameter	265 mm
Maximum FID (Focus-Imager-Distance)	1,110 mm nominal
FID Type	Motorised moveable
Maximum Sample Weight	50 kg

Detector	
Maximum Active Area	432 mm x 432 mm
Maximum Pixel Matrix	2,880 x 2,880
Minimum Pixel Size	150 $\mu$ m
Maximum Frame Rate	30 fps
Type	ASTM E 2597

Cabinet	
Length	2,414 mm
Width	1,275 mm
Height	2,202 mm
Weight	4,200 kg

Not all specifications are available simultaneously, contact us to configure a system to meet your requirements.

With more than 3,000 systems installed globally, Nikon Metrology has designed and manufactured X-ray CT equipment in-house for over 30 years. We are committed to continue to serve our customers in the future and innovate by pushing the boundaries for world-leading inspection and metrology solutions.



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