XT H Series

X-ray and CT technology
for industrial applications

NIKON METROLOGY | VISION BEYOND PRECISION

Get the inside picture of complex industrial parts, by looking into the internal structure. Then use CT capability to qualify and quantify any inner or outer dimension in a smooth, non-destructive process.

Industrial X-ray and CT systems bring high accuracy and the ability to measure internal and external dimensions simultaneously without destroying the part. Furthermore, they provide additional insight through the fourth dimension of material density and structure, rapidly making X-ray technology a must-have tool in the production toolbox.

Exhibiting a broad application reach

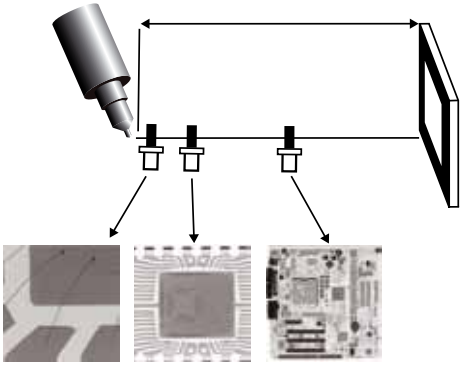
Microfocus X-ray and CT technology has evolved over the last ten years to the extent that it is a mainstream metrology technology used for a diversity of applications. The range of applications is growing constantly across the automotive, aerospace, energy, medical and consumer sectors, dealing with plastics, metals and exotic materials.

A legacy of more than 25 years in X-ray and CT

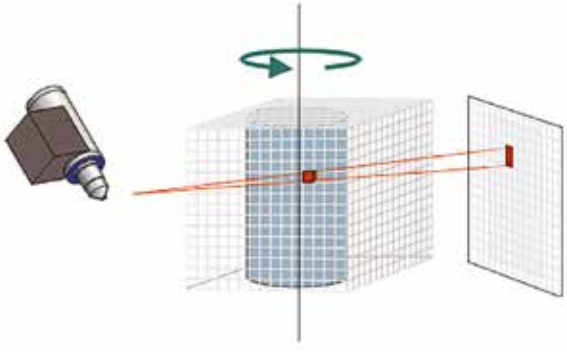
Nikon Metrology is dedicated to industrial microfocus X-ray and CT, as the company built up an installed base of several hundreds of inspection systems. CT specialists in Tring, UK, develop complete systems, incorporating proprietary microfocus X-ray sources, high-precision 5-axis fully programmable manipulators and fast reconstruction software that runs on industrial grade PCs.

Commercial firms and research organizations purchase X-ray and CT systems that vary in size from the smallest cabinet system up to a customized 50-ton 450kV walk-in inspection room. More than 2,500 systems in service are used today to create X-ray sections and 3D volumes ranging from the smallest of features within micro components to the contents of large soil samples.

Introducing industrial microfocus X-ray and CT



Moving the sample closer to the X-ray source increases the magnification of the resulting image



As the component is rotated around its axis while taking X-ray images, a full 3D CT volume is generated.

X-ray technology

X-ray technology (or radiography), is essentially a straightforward process. An object is placed on a rotary stage between the X-ray source and a detector. The proprietary high precision microfocus source generates an X-ray beam that is transmitted through the sample. The digital flat panel detector then receives an image consisting of multiple shades of grey based on a shadow, caused by the absorption of X-rays when passing through the object – influenced by material and geometry. Thicker or denser material such as iron, copper and lead, result in darker areas than thin or light materials such as plastics, paper or air.

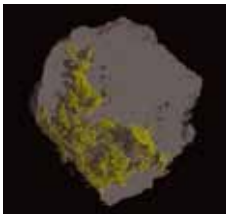
Computed Tomography (CT)

To generate a 3D CT volume, a series of sequential 2D X-ray images are captured as the object is rotated through 360 degrees. These images are then reconstructed using a complex software algorithm generating a 3D volumetric representation of the object. In addition to the outer surfaces, the reconstructed volume contains all information relating to the interior surfaces and structure - as well as including information relating to the fourth dimension: material density. It is therefore possible to navigate through the CT volume at any given point, through any plane. As a result even interior measurements can be easily obtained, as well as the added benefit of localising structural material imperfections and identifying assembly errors not usually visible through traditional methods of NDT.

Serving multiple purposes

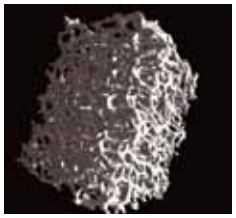
Real-time X-ray imaging is typically used for quick manual or automated visual inspection, CT scanning for in-depth analysis supporting research and troubleshooting:

- Defect checks
- Porosity analyses
- Assembly inspection
- Damage analysis
- Inspection of materials
- Dimensional metrology
- Input for rapid prototyping
- Comparison of geometries

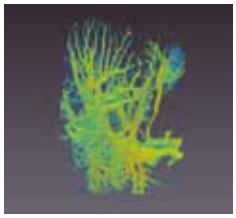


Gold spurs

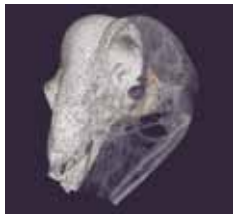
Composites



Foam



Vascular casts - Liver

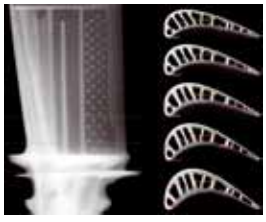


Fossils

Shaving foam can

Connector

Piston



Turbine blade

X-ray sources

In-house design and build

Nikon Metrology X-ray sources are at the heart of our technology and have been designed and manufactured in-house from 1987 to this day; offering over 25 years of knowledge. Being at the heart of the image, control over the X-ray source technology allows Nikon Metrology to quickly move with the market and develop complete and innovative solutions to the application demand. All sources are open-tube giving a lost cost of ownership and the collection ranges from low (160) to medium (225) to high (450) kV, all with micron resolution.

225 kV ultrafocus and rotating targets

With up to 225 kV and a minimum spot size of 3um, the 225kV microfocus source is the core of Nikon's XTH 225 range, devising flexibility to cope with a range of sample sizes and densities.

Nikon Metrology is the only company to produce an industrial 225kV microfocus rotating target. Using a rotating target, the electron beam falls on a moving instead of a fixed surface, which yields much more effective cooling. This offers the opportunity to measure objects faster, or denser objects with higher accuracy than can be measured using the default 225kV.

450 kV static and high-brilliance source

The worlds only 450 kV microfocus source gives industry leading performance for small high density or small to medium castings with unrivalled accuracy and resolution, delivering 25 micron repeatability and accuracy.

Nikon's 450kV high-brilliance source delivers 450W continuous power, without any measurement time restriction, whilst maintaining a smaller spot size for faster CT scanning.; collecting data up to 5x faster or with higher accuracy in a similar scan duration of the default 450kV.

180 kV transmission target

Applicable for samples smaller than 10mm, such as small rock cores or bone samples, the Transmission Target operates up to 180kV to achieving a minimum spot size of 1µm leading to high resolution CT.

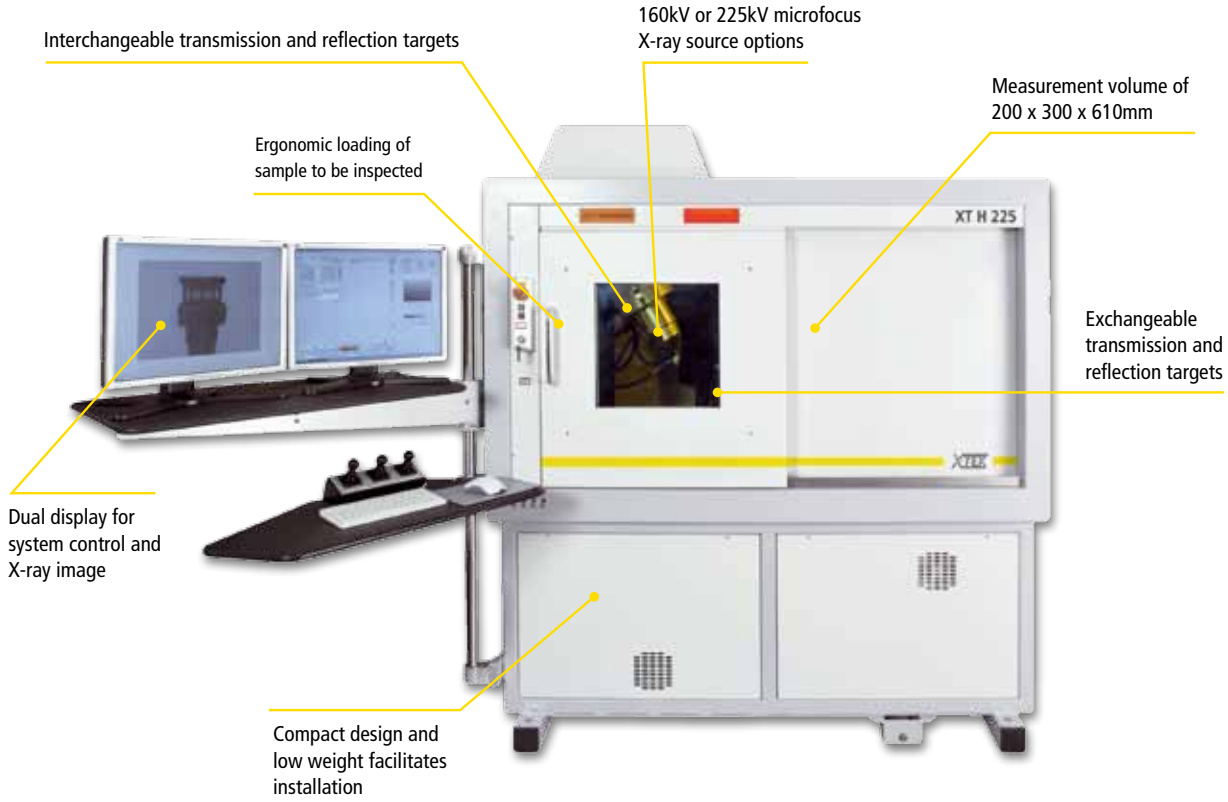
320 kV source

The 320 kV source is a unique microfocus source for samples too large or dense for 225 kV whilst still maintaining a small spot size. Ideal for rock cores and small castings the source is an option in the XT H 225/320 LC cabinet.

XT H 225

All-round X-ray and CT inspection

Detailed capture and measurement of internal component and assembly features is often vital for quality control, failure analysis and material research. The entry-level XT H 160 and the versatile XT H 225 systems offer a microfocus X-ray source, a large inspection volume, high image resolution and is ready for ultrafast CT reconstruction. They cover a wide range of applications, including the inspection of plastic parts, small castings and complex mechanisms as well as researching materials and natural specimens.



Easy Operation

Users are operational with the system within a few days of training. A CT wizard guides operators through the data acquisition process. Customizable macros automate the measurement workflow, and tight integration with industry-standard post-processing applications streamline the decision making process. Customizable macros automate the measurement workflow, and tight integration with industry-standard post-processing applications streamline the decision making process.

Flexibility in CT

Specific applications require more detailed images or higher accuracy. XT H 225 can be configured with different flat panels (Varian, Perkin Elmer) or source configuration (reflection/ transmission target) to adapt resolution to the specimens needs: full part in coarse resolution and high resolution in a desired region of interest. A small spot size and a high-resolution flat panel create sharp images.

Low Cost of Ownership

Regardless of the target of choice, the XT H 225 system uses an open-tube X-ray source that guarantees a lower cost-of-ownership. The open X-ray tube allows for local maintenance of internal tube components rather than whole tube replacements. The XT H 225 system is self-contained and quick to install. No special floor treatments are required.

XT H 225 ST

The XT H 225 ST is a Computed Tomography (CT) system ideally suited to a wide range of materials and sample sizes especially those that are too large or heavy for other systems in the range. The system has three interchangeable sources; the 225kV reflection target, 180kV transmission target and 225kV rotating target. Combined with the wide range of flat panel detectors to choose from the ST system provides a flexible tool for quality laboratories, production facilities and research departments.

Inspection Volume

XT H 225ST system is an extended version of the XT H 225 system, capable of housing a variety of samples especially those that are too large or heavy for other systems in the range. The large inspection envelope, tilt axis and choice of X-ray source from transmission target 180kV to high flux 225kV make the system a versatile tool for small and light to large and heavy samples in any industry.

Stunning Images

Multi material or lower attenuating samples are better scanned with the Perkin Elmer flat panels due to the higher dynamic range offered by the panels. High resolution voxel data is achieved in CT scans by having high resolution flat panels with many pixels in the radiograph. The ST cabinet is configurable with higher resolution 2000 x 2000 pixel Perkin panels, offering twice the resolution of the smaller XT H 160 and 225 systems.

Motorised FID

The ability to move the detector closer to the source can be under computer control with the ST cabinet. X-ray attenuation drops as the X-ray beam travels from the focal spot to the imager. A shorter FID (Focal spot to Imager Distance) means that the X-ray flux is increased and with a shorter imager exposure the scan time can be reduced. Alternatively a shorter FID can giver brighter images when using low energy X-rays. Both phenomena are advantageous when high magnification is not a limiting factor.

Research

The first step in high voltage microfocus

XT H 225/320 LC

The XT H 225/320 LC is a large cabinet system for the X-ray CT scanning and metrology of large components. The system consists of a 225kV, 225kV rotating or 320kV microfocus source delivering up to 320W of power.

A high resolution flat panel is used to collect high quality images of the sample. The system is controlled by Inspect-X software which makes the collection of CT data and setting up of measurements simple and easy. The system can output volume data to Industry standard volume viewing software

First 320kV microfocus

Nikon Metrology breaks new ground in micro-CT by adding more powerful microfocus X-ray sources to its solutions portfolio. The XT H 225/320 LC features a more powerful microfocus X-ray source that is able to run highly accurate inspection on dense industrial objects. The large walk-in cabinet, accessible through a big access door, can accommodate much larger samples than smaller XT H 225 cabinets with a sample weight of up to 100kg

Larger and Denser Specimens

Most system suppliers only offer microfocus sources up to 225kV, while more powerful sources in their offerings are mini-focus. With larger samples, one often needs more penetration power and therefore Nikon Metrology offers a unique 320kV microfocus X-ray source. As the X-ray spot size of these sources is orders of magnitude smaller compared to mini-focus sources, end users benefit from superior resolution, accuracy and a wider array of measurable parts.

With all NIKON Metrology CT systems you can

- Verify complex internal structures
- Isolate and inspect included components
- Measure internal dimensions without sectioning the sample
- Automatically detect and measure internal voids/volumes
- Reveal internal and external surfaces with ease
- Reduce total inspection time
- Reduce number of iterations to fine-tune (pre-) production parameters

XT H 450

Large capacity manipulator
Samples weights up to 100kg

Low cost of ownership
Serviceable open-tube source

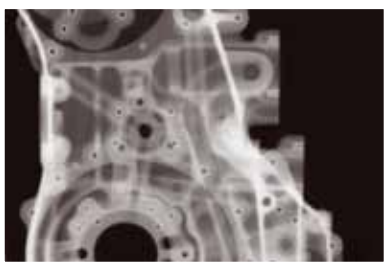
The XT H 450 system offers the necessary source power to penetrate through high density parts and generate a scatter-free CT volume with micron accuracy. At the core of this powerful equipment is a 450kV microfocus source, providing superior resolution and accuracy up to 450W power whilst offering sufficient X-ray power to penetrate dense specimens. The system is available with a flat panel (referred to as 3D) or a proprietary Curved Linear Diode Array (CLDA) (referred to 2D) detector that optimizes the collection of the X-rays without capturing the undesired scattered X-rays.

450kV Microfocus

The proprietary 450kV source is the world's only microfocus X-ray source at this energy, and delivers 25 micron repeatability and accuracy! As this microfocus spot size is considerably smaller than existing mini-focus sources, the level of detail that it captures is beyond comparison. With the high-brilliance source the level of detail possible with 450kV can now be collected up to 5x faster or with higher accuracy in a similar scan duration of the default 450kV.

Unique CLDA Technology

When X-rays hit an object, they are absorbed but also scattered, an undesired phenomena that aggravates with the density of the part. Scatter coming from all points of the part reduces image contrast sensitivity, as is visible on flat panel images. Nikon Metrology developed a proprietary CLDA that optimizes the collection of the X-rays travelling through the part, without capturing the undesired scattered X-rays. By avoiding image pollution and associated contrast reduction, CLDA realizes stunning image sharpness and contrast. The linear array of diodes is curved to further enhance image quality by keeping the X-ray path length to diode receptors constant compared to straight arrays. This allows longer crystals to be used to enhance the X-ray sensitivity and hence boost the signal-to-noise ratio.



Casting Inspection

Microfocus sources at this energy are needed to run highly accurate inspection on dense industrial objects, such as large castings. The XT H 450 3D is a system designed to give industry leading performance in the scanning of large objects where scattering is not a limiting factor i.e. large low density castings etc. The system consists of a 450kV microfocus source delivering up to 450W of power, an amorphous silicon flat panel to collect high quality radiographic images and a precision CT manipulator. For higher density casting which exhibit scatter, the XT H 450 can build a 3D volume by combining CLDA 2D CT slices.

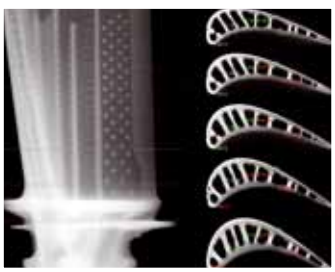
Protective enclosure
No risk of radiation exposure

Flat panel & CLDA
Choice of flat panel or CLDA, or both, to suit the application

Dual monitors
Full screen image
and software controls

Large access door
Walk-in cabinet accessible via large
pneumatic controlled door

Nikon Metrology 450kV
Worlds only 450kV microfocus X-ray source, now
available in high-brilliance



Turbine Blade Inspection

The XT H 450 sets a new reference for turbine blade measurement. A 450kV source in combination with a CLDA is ideal for Radiographic and CT inspection as well as metrology of small to medium metal alloy turbine blades. Such an X-ray system offers sufficient source power to penetrate through the part and generate a scatter-free CT volume. In a production environment, the shop floor friendly system runs automatic data acquisition, high-speed CT reconstruction and inspection based on blade type, generating pass/fail status for each inspected part. Blade manufacturers can run detailed CT metrology inspection of turbine blades (e.g. wall thickness) to optimize the fuel economy of jet engines.
When taking radiographs and CT inspection of turbine blades, raw images and specific information items, such as blade profiles and inner and outer wall thicknesses, are stored for traceability and further analysis

High-performance processing

Intuitive visualization and analysis

Interactive and user-friendly software is essential in evaluating the complex internal structure of samples and performing accurate inspection. The software tools guides you in retrieving the required information, using the most advanced visualization and analysis capabilities. Developed to streamline the process of inspection and measurement, Nikon Metrology X-ray and CT inspection software runs first-article inspection in minutes, instead of hours or days.

The core of the processing power is situated in the XT software suite that builds on Nikon Metrology's track record of improving sample throughput and simplifying operation to take the systems out of the hands of experts and into the hands of users. XT Software also brings the fastest reconstruction of CT data currently available on a single PC. This PC is built from standard components to aid serviceability. The sample throughput can be improved further by the use of additional PCs. The complete system is also ready for any market leading CT visualization and processing software, such as Volume Graphics VGStudioMAX.

Real-time X-ray inspection

- Interactive joystick control for intuitive part positioning
- Ultra-fast acquisition of X-ray scans
- Integrated display and analysis tools
- Capability to measure on screen
- Support of annotation and dimensional data
- Programmable macros for automated repetition

CT reconstruction

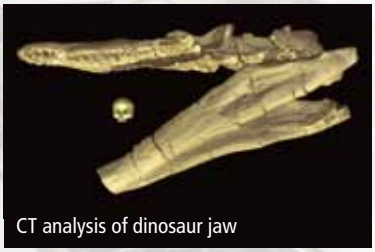
- Precise reconstruction into 3D volume dataset using off-the-shelf PC hardware
- Fast full part reconstruction for general analysis
- Detailed reconstruction for analysis of specific regions of interest
- On-the spot creation of CT slices

Offline CT analysis

- Off-line analysis on dedicated visualization station
- Movie capture of complex internal structure
- CAD-comparison of external and internal surfaces (optional)
- Geometric shape fitting in internal 3D features (optional)

Custom built system configurations

When there is no standard X-ray and CT system available that suits your organization's specific requirements, Nikon Metrology can develop a purpose-built system. CT specialists from Nikon Metrology build complete systems, configured with customer-specific inspection cabinet, manipulator, detectors, software features, etc.



CT analysis of dinosaur jaw

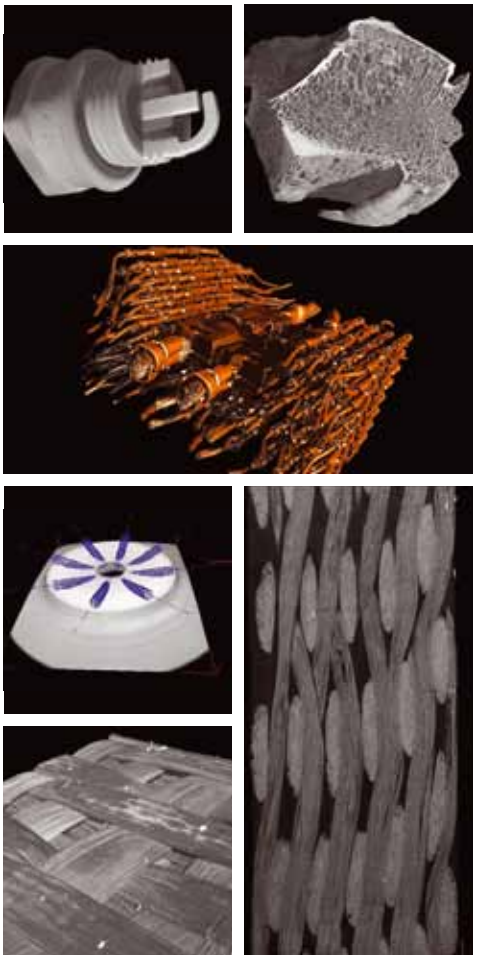
Wide range of applications

Quality control, failure analysis and material research

Anywhere the internal structure matters, X-ray and CT technology serves as an efficient tool to provide valuable information. Detailed capture and measurement of internal features is often vital for quality control, failure analysis and material research across various industries.

- Fault detection and failure analysis
- Assembly inspection of complex mechanisms
- Dimensional measurement of internal components
- Part to CAD comparison
- Advanced material research
- Analysis of the biological structures
- Digital archiving of models

Application domains



Automotive
- Electrical connectors
- Injection nozzles
- Sensors (e.g. Lambda sensor)
- Translucent dashboard LED light pipes
- Small high-pressure die casting parts e.g. turbo compressor

Aerospace
- Positioning of cores in wax for turbine blades
- Crack analysis in components
- Blade inspection

Plastic injection molding
- Complex plastic components (e.g. fan)
- Soft, translucent materials where tactile or optical is no option
- Ultrasonic welding of plastic parts

Pharmaceutical/medical
- Medicine dispensers
- Small instruments
- Small plastic or composite parts
- Bone structures

Research
- Material verification and analysis (e.g. structure, porosity, defects)
- Palaeontology (e.g. bones, sculls, fossils)
- Geology and Soil science
- Archaeology

Specifications

	XT H 160	XT H 225	XT H 225 ST	XT H 225/320 LC	XT H 450
X-Ray Source (Standard)	Xi 160kV Microfocus Reflection Target	225kV Microfocus Reflection Target	225kV Microfocus Reflection Target	225kV Microfocus Reflection Target	450kV Microfocus Reflection Target
X-Ray Source (Option)	High power upgrade to 225W	180kV Microfocus Transmission Target 225kV Rotating Target	180kV Microfocus Transmission Target 225kV Rotating Target	320kV Module 225kV Rotating Target	High-brilliance 450kV source
Maximum kV	160kV	180kV / 225kV	180kV / 225kV	225kV / 320kV	450kV
Power Rating	60W / 225W (Optional high power upgrade)	225W	225W	225W / 320W (320kV Module)	450W (450W continuous for high-brilliance source)
X-Ray Spot Size	3µm	180kV Transmission Target: 1µm 225kV Reflection Target: 3µm	180kV Transmission Target: 1µm 225kV Reflection Target: 3µm	225kV Reflection Target: 3µm 320kV Module: 20µm	80µm
Geometric Magnification	> 150x	> 150x	> 150x	> 150x	> 17x (3D) 24x (2D)
Imaging System (Standard)	Varian 1313 Flat Panel Detector	Varian 2520 Flat Panel Detector	Varian 2520 Flat Panel Detector	Varian 2520 Flat Panel Detector	
Imaging System (Option)	Varian 2520 Flat Panel Detector Perkin Elmer 0820 Flat Panel Detector	Perkin Elmer 0820 Flat Panel Detector Varian 4030 Flat Panel Detector	Varian 4030 Flat Panel Detector Perkin Elmer 1620 Flat Panel Detector Perkin Elmer 1621 EHS Flat Panel Detector	Varian 4030 Flat Panel Detector Perkin Elmer 1620 Flat Panel Detector Perkin Elmer 1621 EHS Flat Panel Detector	Perkin Elmer 162x Flat Panel Detector Curved Linear Diode Array (CLDA) Combined 2D/3D both flat panel and CLDA
Manipulator (Standard)	5 Axes	5 Axes	5 Axes	4 Axes	4 Axes
Axes Travel	(X) 185mm (Y) 280mm (Z) 730mm (Tilt) +/- 30° (Rotate) n*360°	(X) 185mm (Y) 280mm (Z) 730mm (Tilt) +/- 30° (Rotate) n*360°	(X) 300mm (Y) 350mm (Z) 750mm (Tilt) +/- 30 (Rotate) n*360°	(X) 500mm (Y) 600mm (Z) 780mm (Rotate) n*360	(X) 400mm (Y) 600mm (Z) 600mm (Rotate) n*360
Manipulator (Option)	None	None	None	Additional Tilt Axis	n.a.
Max. Sample Weight	15kg	15kg	50kg	100kg	100kg
Cabinet Dimensions (LxWxH)	1,830mm x 875mm x 1,987mm	1,830mm x 875mm x 1,987mm	2,330mm x 1,285mm x 2,230mm	2,695mm x 2,366mm x 1,834mm	3,613mm x 2,366mm x 1,834mm
Weight	2,200kg	2,400kg	4,200kg	8,000kg	14,000kg
Safety	All Nikon Metrology X-ray systems are manufactured to IRR99				
Control	All Nikon Metrology X-Ray systems are controlled by Nikon Metrology's in-house Inspect-X software				
Common System Options	Advanced High Speed Reconstruction Workstation				
	Multi Metal Target (UltraFocus Reflecton Target Only) Advanced Filter Kit (UltraFocus Reflection Target Only)				

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