Insight into the Inside
Industrial X-ray and CT
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.

A legacy of more than 30 years in X-ray and CT

With an experience of more than 30 years, Nikon Metrology has an extensive installation base of thousands of X-ray and CT inspection systems worldwide. CT specialists in Tring, UK, design, develop and manufacture complete systems, incorporating proprietary microfocus X-ray sources, high-precision 5-axis fully programmable manipulators and fast acquisition and reconstruction software.

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

**Automotive**
- Electrical connectors
- Injection nozzles
- Sensors (e.g. Lambda sensor)
- LED light pipes
- Small high-pressure die cast parts
- DPF (Diesel Particulate Filters)

**Aerospace**
- Wax turbine blades
- Cast turbine blades
- Crack analysis in components
- Weld analysis

**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 medical devices (instruments, stents, pacemaker, etc)
- Small plastic or composite parts
- Bone structures
- Implants (dental, hip, knee, skull)

**Research**
- Material verification and analysis (e.g. structure, porosity, defects)
- Paleontology (e.g. bones, skulls, fossils)
- Geology and soil science
- Archeology
- Renewable energy (batteries, solar cells, etc.)
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 30 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 low cost of ownership and range from low (180) to medium (225) to high (450) kV, all with micron resolution.

### 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 30 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 low cost of ownership and range from low (180) to medium (225) to high (450) kV, all with micron resolution.

### 180 kV transmission target

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

### 225 kV reflection target

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

### 225 kV rotating target option

Nikon Metrology is the only company to produce an industrial 225 kV rotating target option. 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 using a conventional static 225 kV.

### 450 kV static and high brilliance source

The unique 450 kV microfocus source gives industry leading performance for small high density or small to medium castings with unrivalled power and resolution.

Nikon’s 450 kV high-brilliance source delivers 450 W 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 450 kV.

### 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 320 cabinet.

### Multi-metal target

Often, using a lower energy X-ray emission is beneficial in material analysis and that can be achieved with the multi-metal target. Beside the standard tungsten (W) target, the operator can easily select from three other target materials: silver (Ag), molybdenum (Mo) and copper (Cu).
XT H 225

Detailed capture and measurement of internal component and assembly features is often vital for quality control, failure analysis and material research. The entry-level versatile XT H 225 system offers a microfocus X-ray source, an inspection volume to accommodate small to medium sized parts and high image resolution. Ready for ultrafast CT reconstruction, the XT H 225 covers 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.

**Flexibility in CT**

Specific applications require more detailed images or higher accuracy. The XT H 225 can be configured with different flat panels or source configuration (reflection/ transmission target) to adapt resolution to the specimen’s 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.

**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
The XT H 225 ST is a Computed Tomography (CT) system ideally suited to a wide range of materials and sample sizes. The system has three interchangeable sources; the 225 kV reflection target, 180 kV transmission target and 225 kV 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 225 ST system is an extended version of the XT H 225 system. The large inspection envelope, tilt axis and choice of X-ray source from transmission target 180 kV to high flux rotating target 225 kV 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 4000 x 4000 pixel flat panels, offering a multiple of the resolution of the smaller XT H 160 and 225 systems.

**Motorized FID**

As an option, the ST cabinet can have a motorized FID that allows to move the detector closer to the source. As the X-ray intensity drops with the distance, a shorter FID (Focal spot to Imager Distance) prevents that the X-ray flux decreases. This allows shorter imager exposure and results in faster scan times. Alternatively a shorter FID can give brighter images when using low energy X-rays. Both phenomena are advantageous when high magnification is not a limiting factor.

**MCT225: Absolute accuracy for Metrology CT**

Dimensional inspection using industrial CT has many advantages as all internal dimensions are measured without destroying the part. Metrology CT is possible by - either calibrating scans by performing time consuming reference measurements - or by using a metrology grade system.

The MCT225 is pre-calibrated using accuracy standards by VDI/VDE 2630 guidelines for Computed Tomography in dimensional measurement. Several key metrology features provide enable an impressive absolute accuracy specification of 9+L/50 µm combined with a long term stability.
The XT H 320 is a large cabinet system for the X-ray CT scanning and metrology of large components. The system consists of a 320 kV microfocus source delivering up to 320 W 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.

**Powerful 320 kV microfocus**

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

---

**Features**

- Temperature controlled enclosure
- Liquid cooled X-ray source
- Finite element Analysis (FeA) optimized manipulator
- High precision linear guideways
- High resolution optical encoders

Extended information and specifications can be found in the MCT225 brochure or datasheet.

**All analysis in one go**

- Void analysis
- CAD comparison
- Dimensioning / GD&T

---

7
The proprietary 450 kV source is the world’s only microfocus X-ray source at this energy, enabling the XT H 450 system to deliver 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 450 kV can now be collected up to 5x faster, or with higher accuracy in a similar scan duration, compared to the default 450 kV source.

Unique CLDA technology
When X-rays hit an object, they are absorbed but also scattered, an undesired phenomenon that increases as the density of the object increases. Scatter coming from all points of the part reduces image contrast sensitivity, as is visible on flat panel images. Nikon Metrology has 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, the 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 and reduce the scan time.

450 kV Microfocus
The proprietary 450 kV source is the world’s only microfocus X-ray source at this energy, enabling the XT H 450 system to deliver 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 450 kV can now be collected up to 5x faster, or with higher accuracy in a similar scan duration, compared to the default 450 kV source.

Casting inspection
Microfocus sources at this energy are needed to run highly accurate inspection of 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, e.g. large low density castings. For higher density castings which exhibit scatter, the XT H 450 can build a 3D volume by combining CLDA 2D CT slices.

Turbine blade inspection
A 450 kV 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 system runs automatic data acquisition, high-speed CT reconstruction and inspection, 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.
CT versatility with configurable systems

When there is no standard X-ray and CT system available that suits your organization’s specific requirements, Nikon Metrology can provide a configurable CT system that can be built into (existing) cabinets or walk-in rooms. These modular systems support multiple sources, multiple detectors, specific manipulators and can be custom-configured to fit a variety of applications.
Intuitive and user-friendly software is essential to simplify the process of CT scanning complex samples for accurate inspection. Developed in-house, Inspect-X is designed to streamline the process of acquiring and reconstructing CT data, for both advanced and beginner users. The focus of Inspect-X is on intelligence, offering users only the information they need at any moment, therefore simplifying the task at hand.

Flexible solutions
Inspect-X has multiple scanning techniques to meet the most demanding of applications. From conventional circular CT scanning to X.Tend, which extends the vertical scan height of the X-ray system and Limited Angle, a method for improving the resolution of smaller regions of interest on a sample.

CT wizard
Intuitive guide through the steps to acquiring CT data.

Fast reconstruction
Industry leading reconstruction, developed and controlled in-house.

Simple interface
With a large radiograph image and clear icons, the simple user interface reduces the operators learning curve.
**FOCUSING ON PRODUCTIVITY**

---

**Fully programmable software**
Inspect-X is unique in the X-ray CT market, offering unparalleled control through the use of its programmable interface. The possibilities are infinite, allowing custom experimentation, for example time-lapse CT or complete integration of the system within your production line.

---

**Nikon CT Automation**
A major step closer to zero-defect production

**Batch inspection is standard with Inspect-X software**
Batch inspection allows automation of multiple scans with manual part handling.

---

**Time-lapse CT**
The IPC (Inter-Process Communication) capability allows users to program inspection sequences over time. This enables monitoring internal processes over time such as strain analysis, crack growth, organic seed growth, material distribution behavior, and many more.

---

**Semi-automated is possible with IPC programming**
Semi-automated inspection allows automation of all tasks with multiple part loading.

---

**In-line automation with robot integration**
In-line automation allows full integration to your production line.

---

**One touch**
After selecting the part type from the scan library, only one button has to be pressed to start the scan, reconstruct the data, perform the analysis and output a results file.
### SPECIFICATIONS

#### Microfocus source

<table>
<thead>
<tr>
<th>Transmission target</th>
<th>Max. kV</th>
<th>Max. power</th>
<th>Focal spot size</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 kV</td>
<td>180 kV</td>
<td>20 W</td>
<td>1 µm up to 3 W</td>
</tr>
<tr>
<td>225 kV Reflection</td>
<td>225 kV</td>
<td>25 W</td>
<td>3 µm up to 7 W</td>
</tr>
<tr>
<td>320 kV Reflection</td>
<td>320 kV</td>
<td>30 W</td>
<td>30 µm up to 30 W</td>
</tr>
<tr>
<td>450 kV Reflection</td>
<td>450 kV</td>
<td>45 W</td>
<td>80 µm up to 50 W</td>
</tr>
<tr>
<td>450 kV High brilliance source</td>
<td>450 kV</td>
<td>45 W</td>
<td>80 µm up to 100 W</td>
</tr>
</tbody>
</table>

#### Detectors

<table>
<thead>
<tr>
<th>Detectors</th>
<th># Bits</th>
<th>Active pixels</th>
<th>Pixel Size</th>
<th>Max. frame rate at 1x1 binning</th>
<th>Max. frame rate at 2x2 binning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varex 2520DX</td>
<td>16-bit</td>
<td>1,900 x 1,500</td>
<td>127 µm</td>
<td>12.5 fps</td>
<td>30 fps</td>
</tr>
<tr>
<td>Varex 1611</td>
<td>16-bit</td>
<td>4,000 x 4,000</td>
<td>100 µm</td>
<td>3.75 fps</td>
<td>7.5 fps</td>
</tr>
<tr>
<td>Varex 1620</td>
<td>16-bit</td>
<td>2,000 x 2,000</td>
<td>200 µm</td>
<td>7.5 fps</td>
<td></td>
</tr>
<tr>
<td>Varex 1621 EHS</td>
<td>16-bit</td>
<td>2,000 x 2,000</td>
<td>200 µm</td>
<td>15 fps</td>
<td>30 fps</td>
</tr>
<tr>
<td>Varex 4343</td>
<td>16-bit</td>
<td>2,880 x 2,880</td>
<td>150 µm</td>
<td>15 fps</td>
<td>30 fps</td>
</tr>
<tr>
<td>Nikon Metrology CLDA</td>
<td>16-bit</td>
<td>2,000</td>
<td>415 µm</td>
<td>50 fps</td>
<td></td>
</tr>
</tbody>
</table>

#### Manipulator

<table>
<thead>
<tr>
<th>XT H 225</th>
<th>XT H 225 ST</th>
<th>MCT 225</th>
<th>XT H 320</th>
<th>XT H 450</th>
</tr>
</thead>
<tbody>
<tr>
<td># Axes</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Axes travel</td>
<td>(Typical values - Exact values depend on system configuration)</td>
<td>(X) 185 mm</td>
<td>(Y) 250 mm</td>
<td>(Z) 625 mm</td>
</tr>
<tr>
<td>Max. sample weight</td>
<td>15 kg</td>
<td>50 kg</td>
<td>50 kg (for metrology)</td>
<td>100 kg</td>
</tr>
</tbody>
</table>

#### General specifications

| Cabinet dimensions (L x W x H) | 1,830 mm x 875 mm x 1,987 mm | 2,414 mm x 1,275 mm x 2,202 mm | 2,414 mm x 1,275 mm x 2,202 mm | 2,695 mm x 1,828 mm x 2,249 mm | 3,613 mm x 1,828 mm x 2,249 mm |
| Weight (approx.) | 2,400 kg | 4,200 kg | 4,200 kg | 8,500 kg | 14,000 kg |

#### Safety

All systems are manufactured to IRR99

#### Control software

All systems are controlled by Nikon Metrology’s in-house Inspect-X software

---

**Interested in using X-ray CT inspection contract services?**

Nikon Metrology X-ray & CT inspection services help you to focus on what matters, delivering high quality products in the shortest time possible. Whether you are a manufacturer of components or assemblies incorporating plastics, metals, ceramics, electronic components or any combination of these, Nikon Metrology has in-house Inspection centers to perform X-ray and CT contract inspection services for new or existing clients.

For more information visit [www.nikonmetrology.com/CT_services](http://www.nikonmetrology.com/CT_services).

---

**NIKON METROLOGY NV**
Geldenaaksebaan 329
B-3001 Leuven, Belgium
Tel: +32 16 74 01 00 Fax: +32 16 74 01 03
Sales.NM@nikon.com

**NIKON CORPORATION**
Shinagawa Intercity Tower C, 2-15-3, Konan,
Minato-ku, Tokyo 108-6290 Japan
Tel: +81 3 6433 3701 Fax: +81-3-6433-3784
www.nikon.com/products/industrial-metrology/

**NIKON INSTRUMENTS (SHANGHAI) CO. LTD.**
Tel: +86 21 6841 2050 (Shanghai branch)
Tel: +86 10 5831 2028 (Beijing branch)
Tel: +86 20 3882 0551 (Guangzhou branch)

**NIKON SINGAPORE PTE. LTD.**
Tel: +65 6559 3651

**NIKON MALAYSIA SDN. BHD.**
Tel: +60 3 7809 3688

**NIKON INSTRUMENTS KOREA CO. LTD.**
Tel: +82 2 2186 8400

**NIKON SALES (THAILAND) CO., LTD.**
Tel: +66-2633-5100

**NIKON INDIA PRIVATE LIMITED**
Tel: +91-124-4868500

ISO 14001 Certified for NIKON CORPORATION

ISO 9001 Certified for NIKON CORPORATION

Industrial Metrology Business Unit

More offices and resellers at [www.nikonmetrology.com](http://www.nikonmetrology.com)