



X-Tek X-ray and CT Inspection

XT H 225 X-ray System

Safety Manual

XTM0522-B1

NIKON METROLOGY | VISION BEYOND PRECISION



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About this manual

This manual applies to a typical machine with the model type given on the front cover. Any non-English manual is a translation of the ORIGINAL Instructions for the safe use of this machine.

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Sources of additional information

Contact service.nm-tring@nikon.com to:

- Get technical support (customers and distributors)
- Request quotations and order service parts

Current application software, drivers and manuals can be downloaded from:

<http://extranet.nikonmetrology.com/>

Access is restricted and a user account is required. Send an application for an account to service.nm-tring@nikon.com.

Documentation feedback, suggestions for new or missing content or other comments can be sent to: EngDoc.NM-Derby@nikon.com

The following symbols are used throughout this document. Please familiarise yourself with their meaning:



A red circle with a diagonal line indicates an action that is prohibited. A specific warning will be displayed inside the circle as a black symbol.



A white symbol inside a blue circle indicates a mandatory action that must be taken to avoid a hazard.



A black symbol inside a yellow triangle with a black border indicates a hazard.



A black symbol on a white background with a red diamond border indicates a harmful chemical or irritant.



A white symbol on a green background indicates a safe condition.



The note symbol is used to draw your attention to additional important information.

About this manual

This manual provides important health and safety information which must be read and understood before operating the machine.



This manual may contain additional information about system features that are not applicable to your specific hardware configuration.



It is important to read ALL accompanying safety and installation instructions to avoid damage to the product and potential injury to yourself or others.

This manual is divided into the following sections:

- **Important health and safety information** - It is mandatory to read and understand this section before operating the X-ray system.
- **Safety systems** - Details the safety systems of the machine.
- **Warnings** - It is mandatory to read and understand this section before operating the X-ray system.
- **Introduction to the X-ray system** - Provides an overview of the system and its components.
- **Maintenance** - Covers preventative maintenance which should be carried out to ensure reliable and safe operation.
- **Declaration of conformity** - Provides the declaration of conformity for the named machine.

This manual covers the following model: XT H 225.

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1 Important health and safety information

1.1 Safety notice

It is extremely important to read ALL safety information and instructions and any accompanying documentation before operating the system. The Operator Safety Manual is an integral part of the product and must be kept with the X-ray system at all times.

Heed all cautions and warnings during routine use of the system. All operators must have read and understood the Safety Information and the X-ray system's Operating Instructions and have received relevant training before using the X-ray system for X-ray inspection. Any operator performing Routine Maintenance Tasks as detailed in the X-ray system's Operator Manual must have received appropriate training in these procedures.



Before opening the operator door (or any other access panels), you must switch X-rays off from the X-ray zone of Inspect-X.



Do not attempt to unpack, install or commission the system.
Unpacking and installation must only be performed by a qualified Nikon Metrology service engineer.



Do not move the system. Contact a Nikon Metrology representative if you wish to relocate the X-ray system.

The X-ray system is designed to operate under the following environmental conditions:

- External temperature range to be 10°C to 30°C.
- Relative humidity to be 30-80%.
- Vibration to be less than -200 µm/s RMS (ISO Residential Day).
- Air cleanliness must be ISO 8 (ISO 14644-1) and Pollution Degree 2 or better.
- The system is IP20 rated and not designed to be used in a wet environment.

The system should be sited on flat, suitably rated ground, with sufficient clearance left for service access. Refer to the relevant installation drawing for your system for further details.

Fusing requirements

Supply voltage/tap	Recommended fuse/breaker capacity
100 V	16 A
110 V	15 A
115 V	15 A
200 V	10 A
220 V	10 A
230 V	8 A
240 V	8 A



This system is a Class A product and should not be connected to the domestic electrical supply. In a domestic environment, this product may cause harmonic interference. If the user wishes to connect to a domestic supply they may be required to take adequate measures to prevent interference.



Machines ship configured for a UK style 230 V (50/60 Hz) AC supply to a single live conductor, a neutral conductor referenced to earth, and a separate earth (TN-S). Other supply earth arrangements are not supported.



The user must not configure or modify the electrical supply in any way.



Using domestic electrical fittings or inadequate wiring may lead to fitting/wire overheating, failure, or electrical fire.



This system has high protective conductor currents
 $3.5 \text{ mA} < I_L < 10 \text{ mA}$.

It must be connected via either permanent fixed wiring or a suitable industrial plug and socket.

1.2 Intended use

Nikon Metrology X-ray products are intended for non-destructive inspection of industrial and electronic components using X-rays.



Do not use the system for any purpose other than its intended use.

1.3 In case of emergency



To make the system safe in case of emergency, push the emergency stop button and isolate the system from mains power. The emergency stop button is located on the control console.

1.4 Health and safety information

1. The relevant "Health and Safety at Work" authorities, for your country, may need to be informed that you are in possession of equipment designed for the generation of X-rays. This is a statutory requirement in many countries, including the UK.
2. You must comply with all legislation for X-ray generating equipment existing in your country. In some countries, both national and local government regulations apply. For example, in the USA the use of X-ray equipment is controlled by both Federal and State regulations. In the UK, the applicable regulations are the Ionising Radiation Regulations 1999 (IRR99).
3. It is essential that the personnel engaged in the operation and maintenance, and any repair of this equipment, be competent and experienced in this work, and that they comply with the relevant statutory requirements and regulations.

These include either the provisions of the Health and Safety at Work Act 1974 (UK Regulations), or the Occupational Safety and Health Act (OSHA) as published in the Code of Federal Regulations (USA), title 29, part 1910, and any additions or amendments that may become legal requirements.

The personnel should also comply with the equivalent statutory requirements of their own country.

4. Any operator performing routine maintenance on the X-ray system must be trained to carry out these procedures.
Refer to the Operator Manual provided either physically or electronically with the X-ray system for details of these procedures.
5. Ensure that the control console and monitor support arms are adjusted for comfortable operator use and then firmly locked in position, where applicable.
Take advice on the safe use of computer and monitor equipment as provided by local regulations.
6. Take care when loading and unloading samples from the system. Never overload the manipulator. Repeated opening of the door and sample loading may lead to discomfort. Customers should comply with Provision and Use of Work Equipment Regulations (PUWER).
7. Noise emitted by the X-ray system is minimal. The level of noise will not exceed an A-weighted pressure level of 70 dB (A).
8. The cabinet can be cleaned with a cloth dampened with water. Switch off and isolate mains power before cleaning, and allow to dry before reconnecting. Take care when cleaning as mechanical hazards are present.

1.5 Understanding the hazards

1.5.1 X-ray radiation

X-rays are ionising radiation. High doses of ionising radiation can cause lasting injuries, disfigurement and (in extreme cases) death.

Important health and safety information

The X-ray system has been designed and built to United Kingdom Ionising Radiation Regulation Standards (IRR 1999).

The system is certified by Nikon Metrology to emit less than one microsievert per hour ($1 \mu\text{Sv}/\text{h}$) on all external surfaces. Certification is provided with the system. There is no significant X-ray radiation risk to users under normal operating conditions.



If the system is damaged, it must not be used and Nikon Metrology must be contacted immediately. Nikon Metrology will then arrange for an approved engineer to examine the system for radiation leakage before it can be re-commissioned.

This does not replace the need for statutory radiation safety checks to be carried out at the site in accordance with your regional or national legal requirements.

1.5.2 High voltages



The system contains high voltages. These pose no risk to users under normal operating conditions.

1.6 Hazard warning labels

Hazard warning labels are fixed to the X-ray system for your information and safety.



Labels must not be removed or tampered with.



If you require replacement labels, please contact Nikon Metrology.



Labels are not shown to scale.

Warning label located near the cabinet feet.



WARNING
HAND CRUSH HAZARD
DO NOT OVER EXTEND FEET
MISALIGNMENT OR OVER EXTENSION MAY LEAD TO SERIOUS INJURY

Caution label near the roof on the sides and / or rear of the cabinet.



DO NOT LOAD CABINET ROOF

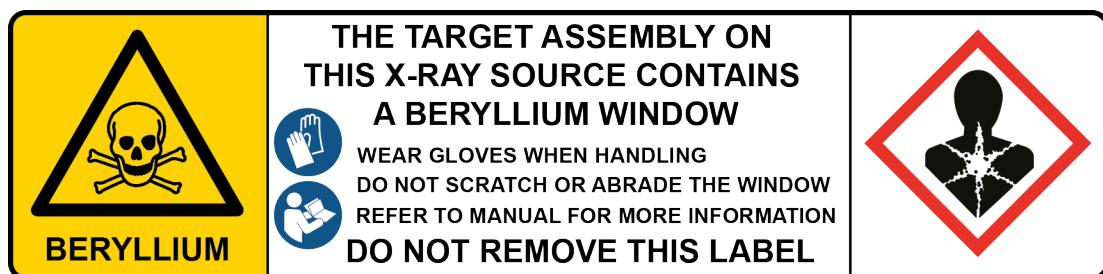
LOADS PLACED ON THE ROOF OF THIS SYSTEM MAY RESULT IN FAILURE OF THE RADIATION SHIELDING

Warning label placed on the radiation protective lead glass window in the operator door.



RADIATION PROTECTIVE GLASS
DO NOT REPLACE
CONTACT X-TEK SYSTEMS LTD.

Warning label fitted to the X-ray source target if a beryllium window is fitted.



Important health and safety information

BERYLLIUM

THE TARGET ASSEMBLY ON THIS X-RAY SOURCE CONTAINS A BERYLLIUM
WINDOW

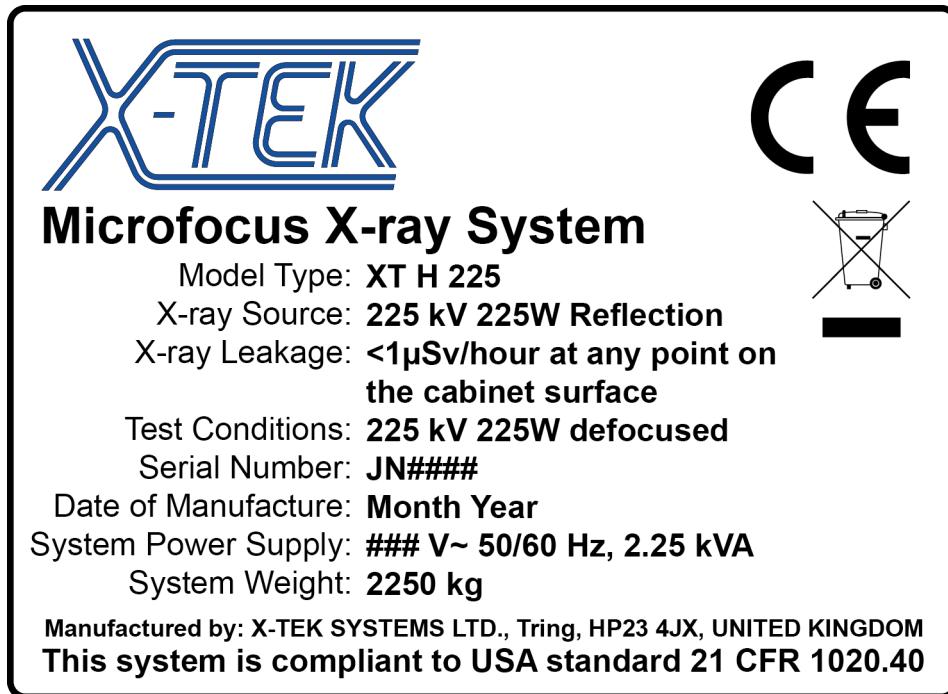
WEAR GLOVES WHEN HANDLING

DO NOT SCRATCH OR ABRADE THE WINDOW

REFER TO MANUAL FOR MORE INFORMATION

DO NOT REMOVE THIS LABEL

Machine identification label fitted to the side of the system.



X-TEK

Microfocus X-ray System

Model Type: XT H 225

X-ray Source: 225kV 225W Reflection

X-ray Leakage: <1µSv/hour at any point on the cabinet surface

Test conditions: 225kV 225W defocused

Serial No: JN####

Year of Manufacture: Month Year

System Supply: ### V~ 50/60 Hz, 2.25 kVA

System Weight: 2250 kg

Manufactured by: X-TEK SYSTEMS LTD., Tring, HP23 4JX, UNITED
KINGDOM

This system is compliant to USA standard 21 CFR 1020.40

Earth warning label located adjacent to the machine identification label.



WARNING
THIS SYSTEM HAS HIGH PROTECTIVE CONDUCTOR CURRENTS
 $3.5\text{ mA} < I_L < 10\text{ mA}$
SYSTEM MUST BE CONNECTED VIA EITHER PERMANENT FIXED
WIRING OR A SUITABLE INDUSTRIAL PLUG AND SOCKET

Weight label fitted to lid of Gulmay HV generator above handle.



Warning label fitted to cover of Gulmay HV generator.



Warning label fitted to the Gulmay generator above the HV cable flange.



Warning label fitted to side of Gulmay HV generator, behind service doors.



WARNING

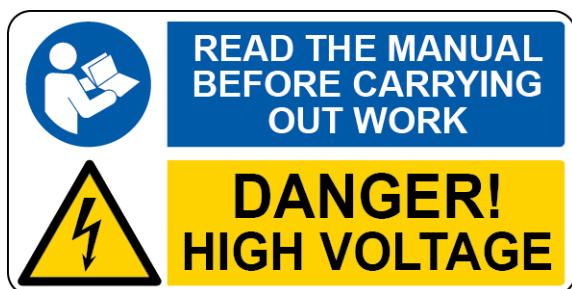
Hazardous voltage inside.

Disconnect power before opening.

Service by trained personnel only.

Consult manual.

Warning on high voltage cable flange.



READ THE MANUAL
BEFORE CARRYING OUT WORK
DANGER!
HIGH VOLTAGE

Warning on X-ray target.



WARNING
DO NOT LIFT X-RAY SOURCE BY TARGET
ASSEMBLY

Mandatory label placed on the rear of the monitor arm.



CONSULT THE USER MANUAL BEFORE
ATTEMPTING TO MOVE THE MONITOR
BRACKET

Radiation warning label affixed to the front of the cabinet adjacent to the operator door.



CAUTION
X-RAYS PRODUCED
WHEN ENERGISED

Warning label fitted on electrical covers.



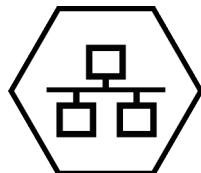
DANGER
DISCONNECT THE
MAINS SUPPLY BEFORE
REMOVING THIS COVER

Caution label placed on the manipulator inside the cabinet, dependent on the load rating of the manipulator platform.



DO NOT OVERLOAD THE MANIPULATOR
MAXIMUM 15 kg
(34 lbs)

Indicator for external Ethernet network port.



Important health and safety information

Safety warning label fitted on removable radiation protection covers.



SAFETY WARNING
THIS IS A RADIATION PROTECTION COVER
X-rays must not be generated with this cover removed
Only trained or qualified personnel to remove
If in doubt contact X-Tek Systems Ltd.

Weight label on removable radiation protection covers.



HEAVY COVER 15 kg
(34 lbs)

Weight label on servo drive amplifier enclosure inside the cabinet.



HEAVY COVER 12 kg
(27 lbs)

Safety warning label fitted above the machine identification label.



WARNING: X-RAY PROTECTION
DO NOT DRILL OR SCREW INTO ANY PART OF THE CABINET
DO NOT REMOVE ANY PART OF THE CABINET
DO NOT MODIFY ANY PART OF THIS EQUIPMENT

Warning labels placed on the warning lamp tower.

PRE-WARNING

PRE-WARNING

X-RAYS ON

X-RAYS ON

Warning label fitted on the external water chiller.



CAUTION

FILL WITH UNDILUTED HEXID A4 ONLY

Hexid A4 Supplied by:

Applied Thermal Control, UK.

Tel: +44 (0) 1530 839 998

COMPOSITION:

Water, Propylene Glycol and Fluorescein
Biocide: 1-2-Benzisothiazol-3(2H)-one
0.002%

Label indicating the return and flow pipes for the external chiller unit.

**COOLANT
RETURN FLOW**

COOLANT

RETURN FLOW

Warning label affixed to the internal cabinet cooler.

**DO NOT OPERATE
WITHOUT COVERS FITTED
ISOLATE POWER BEFORE SERVICING**

**DO NOT OPERATE
WITHOUT COVERS FITTED
ISOLATE POWER BEFORE SERVICING**

Identification labels for cabinet cooler connections.

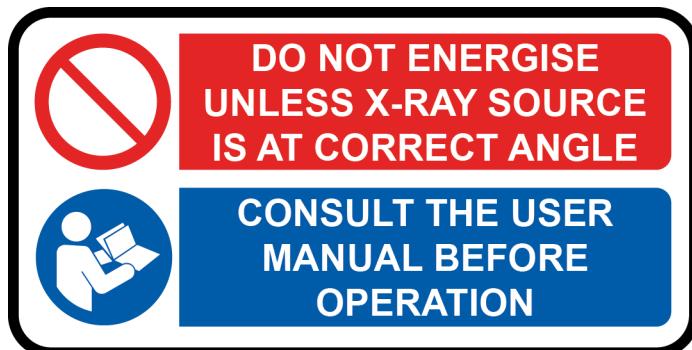
FLOW

FLOW

RETURN

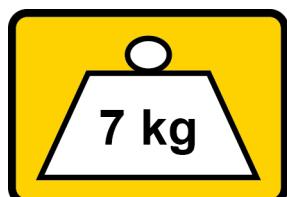
RETURN

Caution label placed on the X-ray source barrel in systems with a moveable source mount.



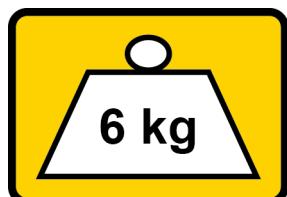
DO NOT ENERGISE
UNLESS X-RAY SOURCE
IS AT CORRECT ANGLE
CONSULT THE USER
MANUAL BEFORE
OPERATION

Weight label on 225 kV reflection target.



7 kg
(16 lbs)

Weight label on 180 kV transmission target.



6 kg
(14 lbs)

1.7 Disposal and recycling – European Union

This product is required to comply with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC.

It is marked with the following symbol:



This symbol indicates that this product is not to be disposed of with household waste, according to the WEEE Directive (2002/96/EC) and your national law. This product should be handed over to a designated collection point or to an authorised collection site for recycling waste Electrical and Electronic Equipment (EEE).

Improper handling of this type of waste could have a possible negative impact on the environment and human health due to potentially hazardous substance that are generally associated with EEE and products of this type. At the same time, your cooperation in the correct disposal of this product will contribute to the effective usage of natural resources.

For more information about recycling this product, please contact Nikon Metrology / X-Tek Systems.

2 Safety systems

The radiation enclosure is fully lined with lead to absorb stray X-rays. The door is lead lined and fitted with double safety interlocks, preventing X-rays from being generated when the door is opened. The X-ray controller has interlock control circuitry to ensure that all interlock switches are made before there can be any generation of X-rays.



Report any safety system failure to Nikon Metrology and under no circumstances override safety interlocks.

The interlocks include:

- X-ray controller key.
- Vacuum sensing circuit to ensure that the vacuum is at an acceptable level.
- Cabinet door interlock switches.
- External and internal warning lamp systems.
- Coolant flow sensing.



Interlocks should under no circumstances be modified, tampered with or bypassed.



The interlock system should only be repaired, replaced or adjusted by qualified personnel.

During manufacture, the cabinet and all associated components undergo a radiation survey to ensure they comply with the stated specification. The system is then issued with a radiation certificate.

Periodical radiation checks must be carried out either by Nikon Metrology during annual service or by your own staff, provided they are competent and appropriately trained and have access to the necessary measuring instruments. In some territories, persons making such measurements are required to be licensed or certified by a national body.



If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

With regards to the X-ray hazard, the performance level of the safety-related parts of the control system (SRP/CS) achieves PL E against EN 13849-1:2008.

2.1 X-ray status indication

X-ray status indicators are mounted on the front of the cabinet or on a signal tower mounted on top, in clear view of the operator and nearby personnel, to indicate the state of the X-ray system.

The warning lamps have failure detection circuitry. If the lamps are damaged, or removed from the system, X-ray generation will be prevented. Lamp failure will be indicated in the system status panel in Inspect-X.

There are two labelled indicators, or warning lamps:

- Amber indicator - PRE-WARNING

PRE-WARNING

- Red indicator - X-RAYS ON

X-RAYS ON



Amber indicator

When the operator turns X-rays on using the controls on the PC, the PRE-WARNING indicator is turned on. No X-rays are generated during this period. At any time during this period, the operator may cancel the X-rays on sequence.

Red indicator

After the 'pre-warning' period, X-ray generation will commence. The PRE-WARNING indicator will turn off and the X-RAYS ON indicator will illuminate. The X-RAYS ON indicator will remain on when X-rays are being generated.

2.2 Emergency stop



To make the system safe in case of emergency, push the emergency stop button and isolate the system from mains power.

The emergency stop system allows all power to the X-ray system to be isolated should a hazardous situation arise.

Power isolation ensures that:

- No X-rays can be generated.
- Movement of all axes of the manipulator is stopped.

The emergency stop button is located on the control console. Operation of this button will result in immediate system power isolation, with the exception of the computer and monitor to prevent data loss.



Releasing the emergency stop button will not automatically result in restoration of power. Activation of the 'Power On' button on the control console is required to manually reset the emergency stop system and restore power.

2.3 Door interlocking

Samples are loaded into the X-ray system through the door in the front of the cabinet. This door is fully interlocked to prevent X-ray generation and movement of the manipulator when the door is not fully closed.

- X-ray generation is prevented by removing mains power to the high voltage supplies for the X-ray sources. With no high voltage present, no X-rays can be generated.
- Manipulator movement is prevented by disabling the motor amplifier drives.



The safety relay is configured for automatic reset operation. Closing the door is sufficient to reset the safety relay. X-ray generation will, however, not automatically restart when the door is closed. The operator must re-initiate X-ray generation using the computer controls.



In normal use, always switch X-ray generation off via the X-ray zone in Inspect-X, never by relying on the door interlocks, prior to opening the operator door.

2.4 Coolant sensing

Coolant flow is sensed by the system. Failure in flow of coolant will prevent the generation of X-rays. Coolant failure is indicated in the status panel in Inspect-X. Certain issues such as low coolant (AL01) will result in the chiller displaying errors. It is necessary to press the **RUN/STOP** button on the chiller to start it after switching on.

3 Warnings

There are hazardous aspects associated with the operation of this equipment. Under normal use, no hazard is presented to the operator. The areas where a potential hazard may occur are listed in the following sections.

3.1 General



The following warnings are identified as hazards:

- Always observe all current safe working practices when working on electrical systems.
- Both X-ray production and manipulator use are interlocked to the door closed switch.
- Ensure the required space set out in the installation drawing is left around the system.
- The system is designed to be used either standing or on a draftsman's chair. Users should perform their own risk assessment for operator comfort.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- If the operator door interlock switches become damaged, the operator must stop using the system at once and report this damage to Nikon Metrology.
- Damage, however small, to the cabinet door glass (where fitted) must not be repaired, as the glass is a special leaded type. If damaged, the system must not be used, and the damage reported to Nikon Metrology.



The following warnings are identified as prohibited actions that must not be performed:

- Do not remove any panels or covers from the machine whilst operating or powered up in any way.
- Do not try to produce X-rays with any safety interlock overridden or with any radiation shielding removed.
- Do not apply power to the machine until all covers or panels have been fitted and secured correctly.
- Never operate the system at full X-ray power without a sample between the X-ray source and the imaging system.
- Do not interfere with or try to override the door interlock switches as this may result in exposure to mechanical or radiation hazards.
- Do not block or restrict any exterior vents.

3.2 Electrical



The following warnings are identified as hazards:

- High voltages are necessary for the production of X-rays. Whilst under normal operating conditions these do not pose a problem, care should always be taken to ensure that equipment is not exposed, damaged or operated in an unsuitable environment, for example, wet or very damp conditions.
- When isolating power from the system, shut down the computer first to prevent data loss.
- Check that the electrical supply is suitable according to the equipment's rating label.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- The X-ray system operates at hazardous voltages and so access to service areas is restricted to suitably skilled technicians. Panels covering high voltage components are clearly labelled; the system must be isolated from the electrical supply before working on these areas.
- All electrical maintenance must be carried out by a qualified Nikon Metrology service engineer.



The following warnings are identified as prohibited actions that must not be performed:

- Never carry out any maintenance work on the X-ray source while X-ray power is on.
- Never disconnect any cables while the system has electrical power.
- Never disconnect any earth connections when the system has electrical power.
- Do not adjust, make or re-make any electrical power connections whilst the system is connected to a live supply.
- Do not attempt to disconnect any of the high voltage connectors. The high voltage connectors should only be worked on by trained service engineers, with system power isolated.

3.3 X-ray source assembly



The following warnings are identified as hazards:

- Take care not to trap fingers when opening and closing the X-ray source assembly to change the filament.
- When the system has been operating at high power, the components of the X-ray source and focus cup may become hot and care must be taken when handling these parts.
- Ozone build-up in the cabinet is possible if the target window is damaged and electrons are allowed to escape through to atmosphere. Auto-defocus should prevent

damage to the target. In case of target damage sufficient for generation of ozone, image brightness/quality degrades significantly.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- In normal use, always switch X-ray generation off via the X-ray zone in Inspect-X prior to opening the operator door, never by relying on the door interlocks.
- When the system has been operating and the source is opened for service operations, the internal source components must be grounded to the source body using an insulated-handled screwdriver prior to any physical handling.



The following warnings are identified as prohibited actions that must not be performed:

- Do not start the turbo pump with the X-ray source open, for example when changing the filament.
- Do not leave the system unattended while conditioning the source.

3.4 Vacuum system

To maintain the quality of vacuum required to ensure that the high voltage inside the X-ray source can be maintained without flashover, and the electron beam is not unduly dissipated before reaching the target, a two-stage pumping system is used. The first vacuum pump is generally known as a 'backing' pump. This pump alone is, however, not adequate to produce the vacuum required for generating X-rays. A second turbomolecular (turbo) vacuum pump is necessary to bring the vacuum down to the required level.



The following warnings are identified as hazards:

- Damage may occur to the turbo pump if its cable is connected or disconnected whilst the system is powered up.
- The backing pump will be hot to the touch during normal operation of the equipment; let the backing pump cool to a suitable temperature before handling.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- Only vent the vacuum system to atmosphere when the **X-ray Power** button (and therefore, the vacuum system) is turned off, and do so very slowly, especially at the start.
- If the backing pump emits visible fumes or smells, power off immediately. This will usually indicate a serious vacuum leak, such as incorrect sealing of the X-ray source lid, an open vent valve, or incorrectly fitted turbo pump or vacuum gauge. Fumes emitted by the pump under these conditions may be harmful, and should be avoided.



The following warnings are identified as prohibited actions that must not be performed:

Warnings

- Do not attempt to operate the vacuum system unless it is fully connected. Ensure that the vent valve is fully closed before powering up the vacuum system.
- Do not start the vacuum system whilst changing the filament. Damage will result if the vacuum pumps are operated whilst open to atmosphere.
- Never try to open the X-ray source when the system is under vacuum.
- Never cover the backing pump exhaust vent.
- Never move the system while the turbo pump is running.

3.5 High voltage generator



The following warnings are identified as hazards:

- There is a risk of electrocution if you tamper with, or open the high voltage generator.
- The high voltage generator is heavy (175 kg, 386 lbs). It should only be removed by authorised Nikon Metrology personnel.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- Always ensure that the generator is operated in a dry environment.
- Always ensure the generator is earthed.
- The high voltage generator is oil filled and therefore must always be kept in an upright position.
- Always allow a few minutes before moving the generator if it has been operating and the system has produced X-rays.



The following warnings are identified as prohibited actions that must not be performed:

- Never allow the cooling vent on the rear of the generator to be covered.

3.6 Mechanical



The following warnings are identified as hazards:

- The user door is heavy and care must be taken when opening and closing to prevent injury to the operator or damage to the cabinet.
- Cabinet labyrinths should only be opened by qualified personnel. The covers are heavy and care should be taken when removing. Systems should be radiation tested after any work is performed on the labyrinths.
- Care should be taken when loading and unloading samples. Samples should be securely fixed to the manipulator as otherwise they present a crushing hazard to both users and the machine. Do not exceed the maximum load rating of the manipulator.
- Take care to ensure that samples do not make contact with the X-ray source, detector or inside of the cabinet, especially when homing the manipulator or performing CT.

- When adjusting the position of the FID, avoid trapping fingers in the gap between release knob and mounting bracket.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- The cabinet is very heavy and should only be moved or lifted using correctly-rated equipment and only by authorised Nikon Metrology personnel. Any movement of the cabinet requires it to undergo a radiation check.
- The X-ray source is heavy and requires two people to lift.
- If for any reason the manipulator becomes jammed, the operator must remove power to the X-ray system before attempting to unjam the manipulator. Contact Nikon Metrology for further advice.
- The system feet should only be adjusted by authorised Nikon Metrology personnel. Incorrect adjustment may lead to the feet becoming detached from the system resulting in a serious crushing hazard.



The following warnings are identified as prohibited actions that must not be performed:

- Never attempt to enter the cabinet, samples should be loaded from outside, using suitable personal protective equipment as necessary. Inspect-X has a sample loading position preset to assist.
- Never modify any part of the system.
- Do not drill or screw into the cabinet.
- Never operate the system without the radiation protection covers in place.
- Do not interfere with the manipulator mechanism when the X-ray system is powered.

3.7 Chemical



The following warnings are identified as hazards:

- Consumables supplied by Nikon Metrology, either with the machine or on an after-sale basis, are not dangerous when used in accordance with reasonable standards of industrial practice and in accordance with instructions provided on or with the goods.
- The backing vacuum pump in this system uses mineral oil. For a brief period following switch on, and in the event of a malfunction, oil mist may be produced. Ensure all suitable precautions are taken when handling and refer to the relevant Material Safety Data Sheet.
- The X-ray cabinet uses lead for shielding. The lead is in solid form and all exposed surfaces are covered or painted so an operator should not come into direct contact. However, ensure all suitable precautions are taken and refer to the relevant Material Safety Data Sheet (MSDS).
- Some X-ray source windows are made from beryllium. Care should be taken to avoid scratching or abrading the window when removing as this may release toxic dust.
- Coolant oil is not classified as flammable but will burn.

Warnings

- Self-sealing connectors on coolant hoses may leak a small quantity of coolant when disconnected. This should be cleaned up using suitable PPE.



The following warnings are identified as mandatory actions which must be followed to prevent a hazard:

- Fluid products must not be allowed to get into the eyes and prolonged or repeated contact with the skin must be avoided. Splashes into the eyes or onto the skin must be washed away immediately with plenty of clean water, and medical advice should be sought immediately.
- Chemicals must be kept away from food and drink.
- Inflammable products such as isopropyl alcohol (IPA, propanol) must only be used in a well-ventilated area and away from any source of ignition.
- Cooling systems contain Hexid A4 heat transfer fluid or mineral oil (Shell Diala). While the coolant itself is not considered hazardous, best practice dictates the use of gloves and goggles while handling. Use only pre-mixed Hexid A4 inhibitor to minimise biological growth and prevent corrosion. Ensure all suitable precautions are taken when handling and refer to the relevant Material Safety Data Sheet.
- When working with coolant or mineral oil clean up any spills to prevent a slipping hazard. Fluids should only be replaced by trained personnel. Comply with local regulations when disposing of used fluids.
- Beryllium is highly toxic in particulate form; always wear gloves when touching the target window assembly.
- Always observe local health and safety regulations relating to the handling and disposal of beryllium and refer to the relevant Material Safety Data Sheet.



The following warnings are identified as prohibited actions that must not be performed:

- Any fumes produced by the system in the event of a failure, or by items in the spares kit, must never be inhaled.
- Do not scratch the target window or try to clean it with an abrasive material since this may produce beryllium dust.
- Do not allow beryllium dust to enter the body through cuts, inhalation or ingestion.
- Never attempt to modify the beryllium window.

4 Introduction to the X-ray system

The XT H 225 has been developed utilising X-Tek's extensive experience in the application and development of microfocus X-ray technology. Designed to deliver high quality results in a quick, straightforward process, it is ideal for a wide range of applications, including the inspection of plastic parts, small castings and complex mechanisms as well as investigating a diverse range of materials and natural specimens.

The system operates at voltages of between 30 and 225 kV, up to a maximum power of 225 W, providing a flexible tool for quality laboratories, production facilities and research departments.

The lead-lined cabinet shields the system to less than 1 $\mu\text{Sv}/\text{hr}$ of leakage making the system safe for operation in any environment. The cabinet and system are fully compliant with international safety regulations and feature dual safety interlocks on the doors as well as visual warnings of X-ray status. A lead glass window in the operator door allows viewing of the sample region; this door also acts as the entry port for samples into the system.

The Inspect-X software makes system set-up straightforward for interactive and automated inspections. It provides interactive visualisation and fully automatic X-ray inspection, with Computed Tomography (CT) for in-depth 3D analysis. Captured images can be analysed interactively both on-line and in post-processing. The optional validation station runs an off-line version of Inspect-X ideal for off-line analysis of stored data and report writing.

4.1 System overview

The XT H 225 comprises a single cabinet that is separated into two sections.

1. The upper section is a lead-lined chamber that houses the X-ray source, X-ray imaging components and a motorised manipulator for moving the sample.
2. The lower section includes the electrical controls, power supplies, manipulator drives, X-ray source cooling pump and vacuum pump.

There is one access door at the front of the machine. This door is used by the operator to load and unload samples onto the manipulator. This door has a special lead glass window so that the operator can safely view the inside of the X-ray chamber.

The X-ray source is mounted inside the lead cabinet. Voltages up to 225 kV DC and power levels up to 225 W are used to generate the X-ray beam.

The standard Ultrafocus 225 kV reflection target has the following specifications:

- Operating voltage: 30 to 225 kV
- Beam current: 0 to 1 mA
- Power rating: 225 W
- Focal spot size: 3 μm below 7 W, rising to 225 μm at 225 W
- Spot position: 6 mm behind output window
- Beam angle: 25° included angle, conical beam

The optional 180 kV transmission target has the following specifications:

- Operating voltage: 30 to 180 kV
- Beam current: 0 to 1 mA
- Power rating: 20 W (Digital Radiography), 10 W (Computed Tomography)

- Focal spot size: 1 µm below 3 W, rising to 10 µm depending on power
- Spot position: 0.25 mm behind output window
- Beam angle: 170° included angle, conical beam

The beam is directed horizontally, through the sample to be inspected, and onto a flat panel detector. The detector transmits the image data to a computer for processing and display.

The system can be supplied with a range of imaging options including:

Detector	Bit depth	Active pixels	Pixel size	Max. frame rate at 1x1 binning	Max. frame rate at 2x2 binning
Varian 2520	14-bit	1900 x 1516	127 µm	7.5 fps	15 fps
Varian 4030	14-bit	2300 x 3200	127 µm	3 fps	7 fps
Perkin Elmer 0820	16-bit	1000 x 1000	200 µm	7.5 fps	15 fps

An external chiller unit provides a circulating cooled water supply to the X-ray source. A vacuum ‘backing’ pump is used in conjunction with a high-speed turbo vacuum pump mounted on the source itself, to produce the high vacuum inside the X-ray source necessary to generate X-rays.

The 5-axis manipulator inside the cabinet allows the sample under inspection to be moved. The sample can be moved in the X and Y directions and the Z direction (magnification). The sample can also be rotated 360° and tilted +/- 30°.

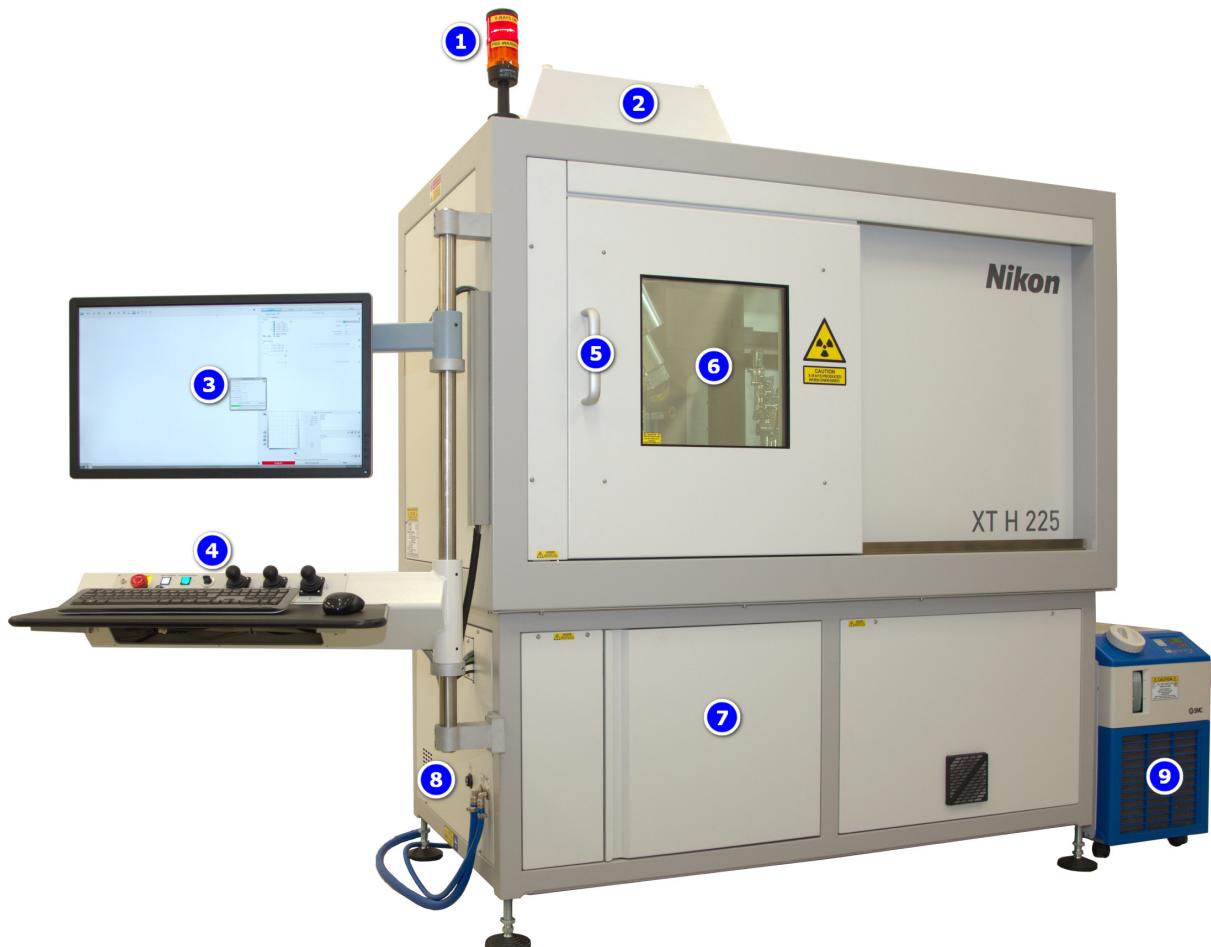
- Axes travel: (X) 200 mm, (Y) 300 mm, (Z) 610 mm.
- Maximum sample weight: 15 kg (33 lbs).

Two adjustable arms are attached to the left-hand side of the cabinet. The upper arm carries the display monitor. A shelf is mounted to the lower arm with a control console mounted to the rear of this shelf. The control console includes the controls used to operate the system and the joysticks used to move the sample manipulator. A computer keyboard and mouse are also located on the shelf. The computer is mounted behind a panel in the bottom left corner of the cabinet. An access door allows access to the CD/DVD writer.

A signal tower mounted on the top of the arm extension indicates when X-ray generation is imminent (amber light) and when X-rays are being generated (red light).

The XT H 225 is supported on four adjustable feet. The loading requirements are specified on the installation drawing. The system will be levelled when installed and should not require adjustment. The system is not portable and is designed for indoor use only in a clean environment.

Cabinet dimensions (LxWxH) are 1,740 mm x 875 mm x 2,017 mm (68.5" x 34.4" x 79.4"). Weight is 2250 kg (4961 lbs).



1. **X-ray status indicators.** When the red 'X-RAY ON' lamp is lit, X-rays are being produced. The orange light warns that X-rays are about to be produced.
2. **Cabinet extension.** Provides more space for the X-ray gun.
3. **Computer monitor.** Shows the Inspect-X software controls and X-ray images.
4. **Control console.** Contains an emergency stop button, system power on/off buttons, X-ray power on/off button and interlock key switch, plus joysticks to control the manipulator X- and Y-axes, magnification, tilt and rotation. It also has a USB3 port for transferring data.
5. **Operator door.** Samples are loaded through this door onto the manipulator. If the door is not closed fully, no X-rays can be produced.
6. **Viewing window (showing X-ray source).** Provides safe viewing of the inspection process.
7. **Door covering X-ray controller and computer.** The computer has a DVD writer and additional USB ports for data transfer.
8. **Network connection point and chiller hoses.** Connection to a network allows data to be transferred automatically to a reconstruction system.
9. **External chiller.** Provides cooling to the X-ray source.

Not shown:

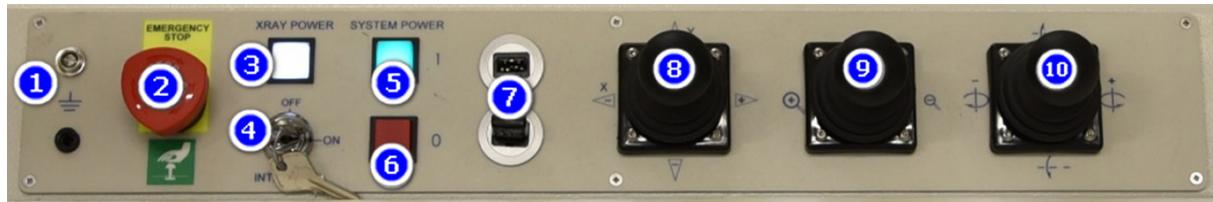
- **Service access panel.** The rear service access panel must not be opened unless the electrical supply is isolated. With suitable training, a supervisor can check the backing pump oil and air filters.

4.2 Operator console

The operator console is a single unit that combines the controls used to operate the system and the joysticks used to move the sample manipulator. It contains the following controls:

- An EMERGENCY STOP button.
- SYSTEM POWER on (green) and off (red) buttons.
- XRAY POWER on/off button (white).
- An INTERLOCK key switch.

When the INTERLOCK key switch is in the OFF position, it is not possible to generate X-rays. Always turn this switch to the OFF position and remove the key when performing any maintenance operations, such as changing the filament in the source.



1. **ESD earthing point.** Allows attachment of E.S.D. wristbands or other equipment to earth to avoid static discharge damaging electronic components.
2. **EMERGENCY STOP.** Activated by pushing the red knob fully inwards, when all electrical power to the machine will be immediately cut (with the exception of the computer to prevent data loss). After the emergency situation has been resolved, the knob can be twisted and lifted to restore power. The system must be powered up again before it can be used.



The emergency stop also forms part of the safety interlock system.

3. **X RAY POWER.** Illuminates white when pressed and applies electrical power to the vacuum pump circuit and X-ray system (SR controller, high voltage generator and, if fitted, rotating target controller). X-rays can be produced as soon as the vacuum reaches a satisfactory level.
4. **INTERLOCK key.** Enables (ON) and disables (OFF) X-ray generation; part of the safety interlock system
5. **SYSTEM POWER On.** Illuminates green when pressed and applies electrical power to the main circuits.
6. **SYSTEM POWER Off.** Cuts electrical power to the main circuits when pressed.
7. **Two USB 3.0 ports.** Provide easy access for USB devices.
8. **X-Y axis manipulator joystick.** Moves the manipulator table in the +/- X/Y direction as indicated.
9. **Image zoom manipulator joystick.** Changes the geometric magnification by moving the sample towards or away from the X-ray source.
10. **Tilt/rotate manipulator joystick.** Tilts the sample stage or rotates the turntable around the axis indicated.

4.3 System options

Multi-metal target

The standard tungsten target gives an X-ray energy spectrum which contains the Bremsstrahlung spectrum and the specific emission lines of tungsten. For some materials, in particular composites, it is often better to have the specific emission at lower energies; this can be achieved by using different materials as a target. Using the multi-metal target, the operator can select one of four materials in the target: tungsten (W), silver (Ag), molybdenum (Mo) and copper (Cu).

Advanced filter kit

The advanced filter kit helps produce the best quality CT metrology conditions using the multi-metal target.

Sample holders

A selection of additional sample holders is available to increase the flexibility of the XT H 225. These include:

- Self-centring chuck
- Self-centring vice

4.4 Monitor and console arm adjustment

Adjust the height of the monitor and console



The monitor and console arms are heavy. It is recommended that two people perform these adjustments, one to support the arm and one to adjust the locking rings.



Ensure that there is enough free cable to the monitor or control console before attempting to move them.

The amount of force needed to move the monitor arm and control console arm can be adjusted by tightening or loosening the resistance grub screws located at each hinge point.



Both the monitor arm and console arm are secured on a bar with lockable clamps. To change the height of either, first slacken the resistance grub screws located in each arm. Next, support the weight of the arm whilst loosening the hexagonal cap head bolt in the retaining clamp until it is moveable. Slide both to the desired position and re-tighten the clamp bolt. Adjust the resistance grub screws to suit.



Adjust the tilt of the monitor

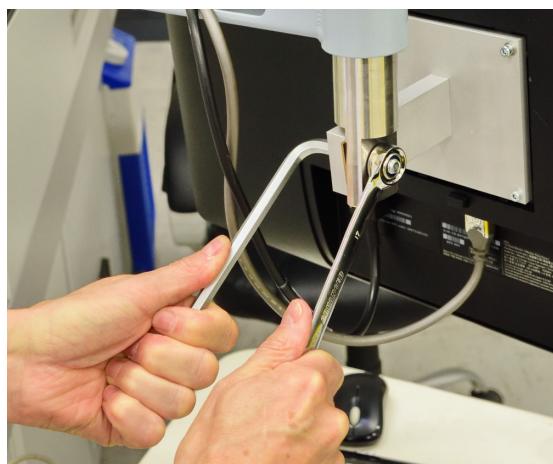


If the monitor is not supported when released it will tip forward, possibly resulting in damage to the monitor and/or cables.



It is recommended for two people to perform this adjustment, one to hold the monitor and one to lock and unlock the bracket.

To adjust the monitor height firmly support the monitor then slacken the locking bolt using a spanner and hex key to release the monitor. Tilt the monitor to suit and re-tighten the locking bolt.



The monitor can be rotated by releasing both grub screws at the top of the mount. These should be re-tightened after adjustment.

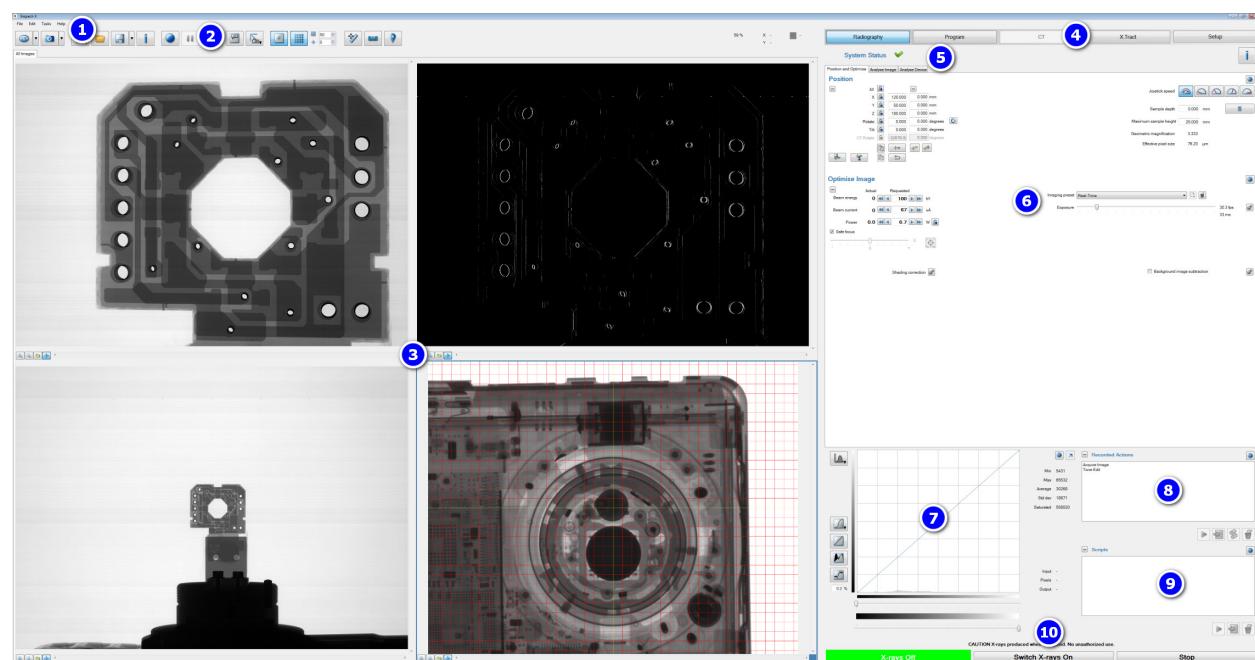


4.5 Inspect-X

Inspect-X is the software that controls Nikon Metrology X-ray inspection systems. Inspect-X is used with a single large screen (3840 x 2160 pixels), the image window displays on the left side of the screen with the toolbar above the image window. The control area is displayed on the right.

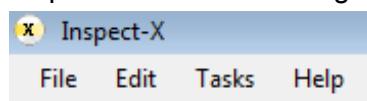
Screen layout

The screen is divided into the following areas:



1. Menu bar

The menu bar is located at the top of the window and provides access to a number of Inspect-X functions through a series of menus.



2. Imaging control toolbar

The imaging control toolbar contains controls for enabling and disabling live imaging, saving images, annotating images and controlling how the images are displayed.



3. X-ray image window

The image window can display four images at once, which can be a mix of captured or previously saved and re-loaded images plus one live image. These are displayed either as four tabs, or if supported and enabled on your system as four images in a split screen configuration.

If your inspection system is configured with either the 2D or 3D Computed Tomography (CT) options, an additional imaging tab is displayed when setting reconstruction options in the CT workflow. This allows the setting of the CT volume (3D) or area (2D) of interest for the reconstruction.

If your system is configured for device analysis (XT V systems only) then an additional device analysis tab is displayed during the set-up procedure.

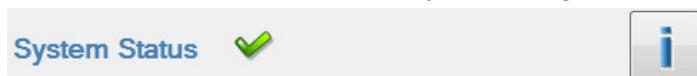
4. Workflow buttons

The workflow buttons provide access to the controls and settings for Radiography, Program, CT, X.T tract and Setup. The buttons shown depend on the capabilities of the inspection system.



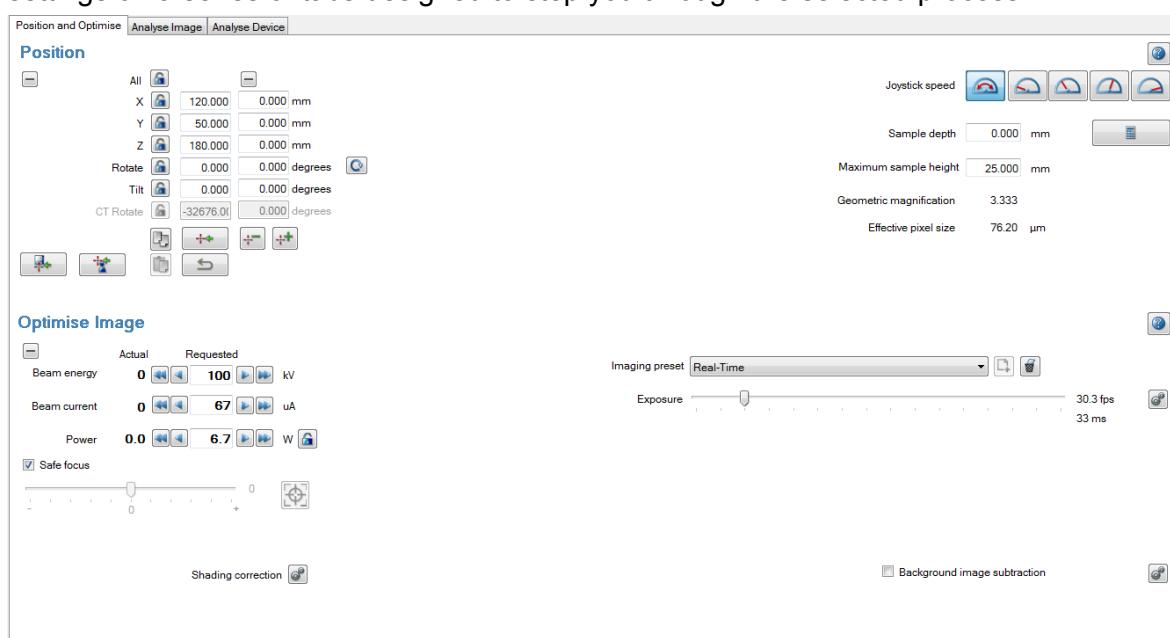
5. System messages

Error, warning and information messages appear here, alerting you to problems in a workflow or successful completion of an operation. A green tick next to System Status shows that interlocks are made and X-rays can be generated. A red cross indicates that interlocks are not made; no X-rays can be generated.



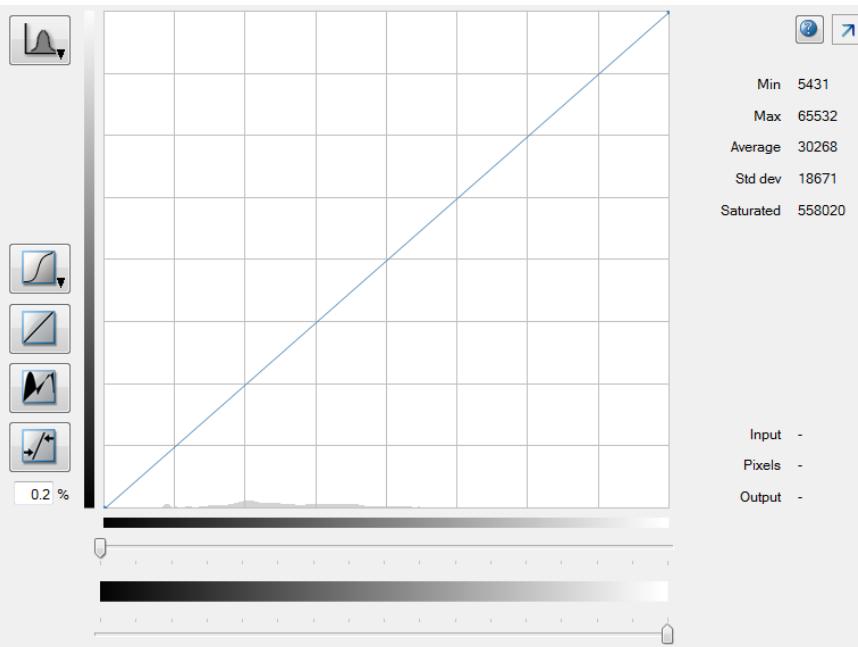
6. Control panel

Once a workflow has been selected, the control panel displays relevant controls and settings on a series of tabs designed to step you through the selected process.



7. Histogram

Shows the grey level distribution within an image and provides access to tools to adjust the tone of an image and to display a black and white binary image or a pseudo-colour image.



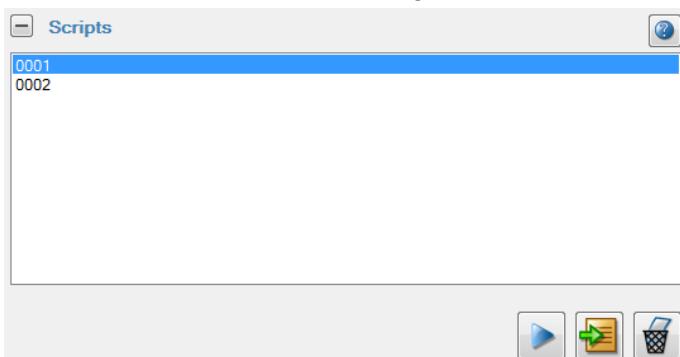
8. Recorded Actions

Shows a list of actions recorded during the acquisition, processing and analysis of an image. Use these actions to create an inspection program.



9. Scripts

Shows a list of scripts (collections of actions) based on recorded actions. You can also add scripts to an inspection program.



10. X-ray zone

The controls for switching X-rays on and off and stopping the manipulator in an emergency are always located in the bottom right corner of the screen.



X-rays should always be turned off before opening the operator door; do not rely on the door interlocks to switch X-rays off.

CAUTION X-rays produced when energized. No unauthorized use.

X-rays Off

Switch X-rays On

Stop

11. Manipulator Map (Not shown on overview)

The **Manipulator Map** floating window can be displayed from the **imaging control toolbar**. It shows an X-ray image-based map (on XT V systems) which can be used to position the manipulator.



The manipulator map may appear next to the image window, depending on the system settings.

4.5.1 The Inspect-X manipulator and imaging controls

The controls that you need to position your sample and adjust the image so that you can see appropriate detail are presented on Inspect-X's **Position and Optimise** tab. This tab is available to you in the **Radiography**, **CT** and **X.T tract** workflows. The following section describes how to:

- **Position the sample** (on page 32)
- **Optimise the image** (on page 33)
- **Switch X-rays on and off** (on page 34)



For more information, refer to the *Inspect-X Online Help* or *User Manuals*.

Position the sample

To inspect a sample, move it into the path of the X-ray beam using the manipulator. Control the manipulator axes using:

- The joysticks on the operator console.
- The **Axes** controls and readouts in the **Position** panel on the **Position and Optimise** tab.
- Saved manipulator position sets.
- The manipulator map (on XT V systems).
- Interactions with the live image window.

When using the joystick controls, the movement speed can be set with the **Joystick speed** controls. The automatic setting scales the movement speed with the movement of the joystick, that is, the movement speed is proportional to the amount the joystick is moved.



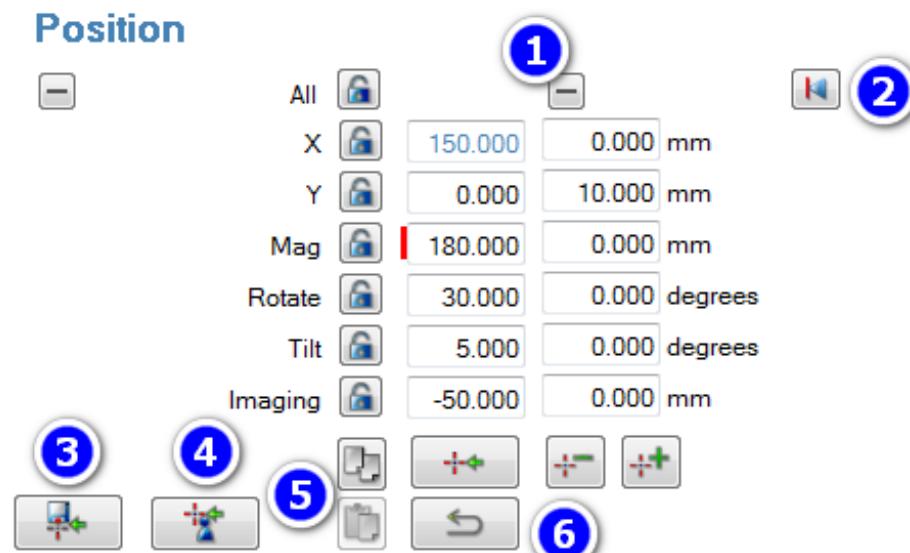
There are some small differences to the **Axes** controls in Inspect-X dependent on the type of manipulator within the X-ray system. In particular, there are different numbers of axes that

may be controlled. Additional controls are displayed if you are using CT or X.T tract workflows, which allow you to centre, rotate or tilt a sample.



Before using the manipulator to position the sample, ensure that the manipulator has been homed. This needs to be performed each time Inspect-X or the computer is re-started. Home the manipulator from the **Setup** workflow.

Position panel



- Shows requested and current positions for each axis in the left column and increment value in the right column.
Requested positions are shown in blue. In the example above, the X-axis position will change to the requested position (150.00) when you click or , and the Y-axis will increment or decrement by 10 mm when you click or .
- Allows you to define limits of travel of axes on horizontal systems. The Mag-axis in the image above has a travel limit applied, shown by a red bar. This is especially useful in preventing collisions. It is recommended to set limits when loading new samples. XT V systems have an anti-collision system built in so the limit controls are not needed.
- Opens the **Saved Positions** window, which allows specific manipulator positions to be saved and recalled.
- Moves the manipulator to the **Load** position. You can then open the operator door and load the sample onto the manipulator.
- If you want to move the manipulator to a position and then move back to the previous position, you can copy the original positions and then paste back these values.
- The button resets the requested values back to the actual positions.

Optimise the image

The X-ray parameters that need to be set to perform an X-ray inspection of a sample are:

- **Beam energy (kV)**, which controls the energy of the X-rays and hence the penetration of the sample.

- **Beam current (μA)**, which controls the brightness of the image by controlling the amount of X-rays generated.
- **Power (W)**, which is the product of the beam energy and current.

The X-ray target can only dissipate a certain amount of power before damage occurs.

The X-rays are automatically defocused whilst **Safe focus** is selected to prevent damage. The power can be locked to optimise the X-ray spot size. Safe focus should **not** be disabled under normal operating conditions.

To adjust the X-ray conditions, use the controls in the **Optimise Image** panel on the **Position and Optimise** tab. You can adjust the conditions with X-rays switched on or off.

Optimise Image

	Actual	Requested	
Beam energy	130	130	kV
Beam current	77	77	μA
Power	10.0	10.0	W 
<input checked="" type="checkbox"/> Safe focus			
		0	



Fine focus controls are by default only enabled below the defocusing threshold of the fitted target. For example, <7 W for the 225 kV reflection target.



Adjusting the X-ray conditions and image settings is an iterative process and requires some knowledge of what to alter. In particular, knowledge of how to reduce the noise in the image is important. There are two major sources of noise: X-ray photon noise and electronic noise within the imaging detector.

Switch X-rays on and off

The X-ray zone always displays in the bottom right of the control window.



It clearly shows the status of the system and whether X-rays are switched on (3) or off (1). When you click **Switch X-rays On**, a pre-warning is displayed (2), corresponding to the physical warning light. After a short delay, the X-rays are switched on (3). There are two buttons in the X-ray zone, which are used to:

- Switch X-rays on or off.
- Stop all movement of the manipulator in an emergency (**Stop**).



X-rays should be switched off using these controls prior to opening the system door.



Do not use the interlocks to switch the X-rays off during normal use.
Doing so shortens the life of the filament.

5 Maintenance

5.1 Preventive maintenance

Checks should be carried out at frequent intervals, dependent on the duty cycle of the machine and the type of environment. Please consult with your company health and safety officer, or local authority to establish a suitable routine inspection procedure. The following should be regarded as a guide to a minimum standard.

If you have any queries about maintenance procedures please contact Nikon Metrology.



Routine maintenance is only to be carried out by trained personnel.
Servicing is only to be performed by trained service engineers.

5.1.1 Maintenance checks



If warning messages appear in the Inspect-X status area, there is a fault with the machine. Report any problems to a trained service engineer.



If in doubt about any faults, do not use the machine.

The X-ray source filament has a lifetime of approximately 200 hours. Only trained personnel should perform filament changes, as correct filament setup is very important in achieving good system performance.

Daily

An operator should perform the following checks on a daily basis:

1. Before switching the machine on, a visual check should be made for signs of any leakage of fluids.



The system uses coolant and mineral oil, either of which could leak under extreme circumstances.



If there is any evidence of leakage from under the machine, or around the water chiller, do not switch the machine on and request a Nikon Metrology-trained engineer to inspect the system.

Deal with any spillage using absorbent granules and alert other users by placing signs in the area to indicate a slipping hazard.

2. Check that the access door operates smoothly and closes correctly with firm pressure.
3. Check all indicator lamps for correct functionality.
4. Check inside the cabinet for any foreign objects. Nothing should be left anywhere inside the cabinet.
5. Run through the power-up sequence and note anything unusual.

Weekly

An operator should perform the following checks on a weekly basis:

1. Operate the manipulator through the whole of its range to check for unusual noises, which might indicate a loose drive or any jamming of the mechanism. Also, check that the end of travel limits operate correctly. Any problems will require the attention of a trained service engineer.
2. Check that all switches and warning lamps operate correctly.
3. Check that the external cooling fans are producing a reasonable flow of air and are not producing any unusual noises.

Monthly

Access to the lower section of the cabinet is required to check the oil level in the backing pump. A Nikon Metrology-trained supervisor should perform the following tasks on a monthly basis:

1. Check all electrical connections for physical security.
2. Check cables for signs of deterioration or damage.
3. Check all connections to accessories fitted to the system and computer.
4. Check all cabinet cooling and air vents and filters, and clean as necessary.
5. Check all vacuum system connections for security.
6. Check the cooling system and coolant level and top up with the specified coolant if required. Turn off the cooling unit and check the cooling interlock is broken.
7. Check chiller dust filters and clean as necessary.
8. Check the oil level in the backing pump. If it is low contact Nikon Metrology for service.
9. Check the emergency stop button(s) function correctly.
10. Unplug one of the coolant hoses from the target and check the coolant flow interlock is broken. Have absorbent material available to clean up any leakage.

Yearly

1. The system should be radiation checked in line with local radiation regulations. Typically, this is once a year.
2. Interlock switches should be fully assessed for wear and damage.



If switches are found to be damaged or worn do not use the machine and contact Nikon Metrology to have them replaced.

3. It is advisable to replace the coolant once a year, or sooner if any sign of contamination is present. Use the coolant specified on the chiller unit.
4. It is advisable to replace the backing pump oil once a year, using only the specified vacuum pump oil. This should be performed by a qualified service engineer.

5.1.2 Interlock testing

The preventive maintenance schedule should include this interlock testing procedure:

Equipment Interlock testing						
Name	Location	Activation method	Verification method	Test frequency	Comment	Pass/Fail
Door	Upper and lower door corner	Open the door	Try to move the manipulator. Should not respond to commands.	Weekly		
Door	Upper and lower door corner	Open the door	Ensure the interlock status is reported to inspect-X properly for the X-ray source interlocks as well as the manipulator	Weekly		
Emergency Switch OFF (EMO)	On the operator table, near joysticks	Push the button down until it locks	All systems apart from computer are powered down - pumps are stopped, manipulator cannot be moved with controls.	Monthly		

6 Declaration of conformity

DECLARATION OF CONFORMITY



Name of manufacturer: X-Tek Systems Ltd.

Address of Manufacturer: Unit 5E, Tring Business Centre
Icknield Way,
TRING
HP23 4JX
UK

Declare under our sole responsibility that the following product:

Industrial X-Ray Inspection Machine

Model: XT H 225 (Mk 4)

Conforms with the relevant Essential Health and Safety Requirements (EHSRs) of the **Machinery Directive 2006/42/EC**, with the relevant requirements of the **Low Voltage Directive 2014/35/EU** and with the essential protection requirements of the **EMC Directive 2014/30/EU and EU Council Directive 96/29/EURATOM**,

and that, where applicable, the following standards and normative documents have been applied:

BS EN 60204-1:2006+A1:2009

Ionising Radiations Regulations 1999

Title 21 CFR 1020.40

BS EN ISO 12100:2010

BS EN ISO 13849-1:2015

BS EN 55011:2009+A1:2010

BS EN 61326-1:2013

BS EN 61000-4[-2:2009,-3:2006+A2:2010,-4:2012,-5:2006,-6:2009,-8:2010,-11:2004]

Date: 02nd November 2016

Name: David John Bate

Function: Vice President of Engineering (X-ray)

Signature:

Doc Ref.
XTF029 V6

The technical documentation for the machinery is available from the above address.

Declaration of conformity

DECLARATION OF CONFORMITY

Name of manufacturer: X-Tek Systems Ltd.

Address of Manufacturer: Unit 5E, Tring Business Centre,
Icknield Way,
TRING
HP23 4JX
UK



Declare under our sole responsibility that the following product:

Industrial X-Ray Inspection Machine

Model: XT H 225 (Mk 4)

Conforms with the relevant Essential Health and Safety Requirements (EHSRs) of the **Machinery Directive (2006/42/EC)**, with the relevant requirements of the **Low Voltage Directive (2014/35/EU)** and with the essential protection requirements of the **EMC Directive (2014/30/EU)** and **EU Council Directive 96/29/EURATOM**,

and that, where applicable, the following standards and normative documents have been applied:

BS EN 60204-1:2006+A1:2009

Ionising Radiations Regulations 1999

Title 21 CFR 1020.40

BS EN ISO 12100:2010

BS EN ISO 13849-1:2015

BS EN 55011:2009+A1:2010

BS EN 61326-1:2013

BS EN 61000-4[-2:2009,-3:2006+A2:2010,-4:2012,-5:2006,-6:2009,-8:2010,-11:2004]

Date: 02nd November 2016

Name: David John Bate

Function: Vice President of Engineering (X-ray)

Signature:

A handwritten signature in blue ink, appearing to read "David John Bate".

Doc Ref. XTF029 V6

The technical documentation for the machinery is available from the above address.

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