



Xradia Versa User's Guide

Xradia Versa[®]
High-Resolution 3D X-ray Imaging Systems

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Original Instructions

Can be translated to another language upon request

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Safety

This section provides guidelines and information for safely using and operating the ZEISS® Xradia Versa®:

- [Safety Guidelines](#)
- [EMO Shutdown](#)
- [Enclosure Covers and Access Doors](#)
- [Potential Hazards and Safety Precautions – Personnel](#)
- [Potential Hazards and Safety Precautions – Equipment](#)
- [Safety Labels](#)
- [Safety Lockout](#)
- [Decommissioning and Disposal](#)

Safety Guidelines

Observe and follow these safety guidelines when using the Xradia Versa:



WARNING Electrical and X-ray hazard present. Use the Xradia Versa as cautioned herein, to avoid personal injury and/or damage to the Xradia Versa.



WARNING Failure to observe and follow these guidelines is in violation of product use and warranty, and puts you at risk of serious injury. ZEISS is not liable for personal injury or damage to the Xradia Versa caused by misuse.



WARNING In the rare event that you or someone working with the Xradia Versa is injured as a result of using the Xradia Versa, and the injury requires immediate medical attention, follow the emergency procedures established by your work site.

- Use the Xradia Versa only for applications and uses for which it is designed.
- Use only the components and/or machine accessories prescribed or provided by ZEISS.
- Use the Xradia Versa within environmental conditions specified in [Appendix G, “Specifications.”](#)
- Do **not** use the Xradia Versa with objects or raw materials other than those for which it is intended.
- If the Xradia Versa is covered by a ZEISS field service contract, do not attempt to maintain, service, repair, or modify the Xradia Versa, because these tasks must be performed only by trained ZEISS service personnel.
- Turn OFF the X-ray source before opening the access doors. Do **not** open the access doors while X-rays are being generated.

NOTICE If the access doors do not completely close or are damaged, turn OFF the Xradia Versa and contact the ZEISS Support Team. (Refer to [“ZEISS Support Team \(Technical Support\),”](#) on page 308, in [Appendix K.](#))

- Do **not** intentionally defeat the access door safety interlocks. Keep the access doors closed when the X-ray source is turned ON.
- In the event of a personal safety or Xradia Versa emergency, press an **EMO** button to turn OFF power to the Xradia Versa.

NOTICE The EMO shutdown process (pressing of an **EMO** button) leaves the Xradia Versa stage positions and other system components in undefined states and can adversely affect the computer workstation and/or optional storage server, potentially causing data loss – use only in the event of a personal safety or equipment emergency. Refer to [“Loss of Data Due to EMO Shutdown,”](#) for how to recover lost data.



NOTE Use of the non-emergency shutdown procedure is recommended in non-emergency events. (Refer to [“Shutting Down the Xradia Versa in a Non-Emergency Event,”](#) on page 188, in Appendix C.)

- Connect the Xradia Versa to a properly rated and grounded AC power outlet, on an electrical circuit that is not shared by any other equipment, as specified in [Appendix H, “Electrical Documentation.”](#)
- All users should be sufficiently trained regarding how to use the Xradia Versa, by ZEISS service personnel.
- Keep hands and other body parts, as well as other objects, away from hardware mechanisms (such as the sample stage, detector, and X-ray source) when moving any motorized component(s) within the Xradia Versa.
- Keep the operating temperature range at an ambient room temperature, between 10 to 25°C, with a variation of less than 2°C, for optimum image quality.
- Avoid operating the Xradia Versa in areas where spray or liquids can enter or adhere to it.

EMO Shutdown

NOTICE The EMO shutdown process (pressing of an **EMO** button) leaves the Xradia Versa stage positions and other system components in undefined states and can adversely affect the computer workstation and/or optional storage server, potentially causing data loss – use only in the event of a personal safety or equipment emergency. Refer to [“Loss of Data Due to EMO Shutdown,”](#) for how to recover lost data.

Pressing the Emergency Off (**EMO**) button turns OFF:

- All energy sources, including the X-ray source and high-voltage power supply
- All moving parts within the Xradia Versa, such as the motor control modules
- The ergonomic station
- The computer workstation, and if included, the optional storage server

One **EMO** button is located on the front panel of the enclosure, within easy reach. A second **EMO** button is located on the back of the Xradia Versa enclosure, below the rear access doors. The **EMO** button used, as well as its locations on the Xradia Versa, are shown in the figures that follow.

EMO Button

**EMO** Button – Front of Xradia Versa (Xradia 520 Versa Shown)

***To shut down the Xradia Versa in an emergency event***

1. Firmly press an **EMO** button, to immediately turn OFF power to the Xradia Versa.

After the emergency event has passed, proceed to “[Turning ON the Xradia Versa,](#)” on page 190, in Appendix C.

Enclosure Covers and Access Doors

 **WARNING** Do **not** remove any covers or baffles, or intentionally defeat the access door safety interlocks. Doing so will expose personnel to harmful X-ray radiation, which can result in serious injury.

 **WARNING** If the access doors do not completely close or are damaged, or if any part of the enclosure is damaged, turn OFF the Xradia Versa and contact the ZEISS Support Team. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.) Failure to do so can result in fatal injuries.

 **WARNING** Do **not** modify any part of the enclosure. Doing so can result in fatal injuries.

The Xradia Versa is fully enclosed within a steel enclosure, which includes access doors and protective covers that provide a safety and environmental barrier. The steel and lead-lined enclosure covers and access doors:

- Provide protection from X-ray beams and high voltage generated by the X-ray source
- Maintain the Xradia Versa at operating temperature

The access doors include a fail-safe (safety) interlock. The X-ray source will turn ON only if the access doors are CLOSED. Turn OFF the X-ray source before opening the access doors. Do **not** open the access doors while X-rays are being generated.

 **NOTE** Do **not** open the access doors while X-rays are being generated. Doing so automatically terminates X-ray generation and causes a fault condition, thereby preventing further operation until the fault is reset. Refer to “[Interlock Sequence of Operation](#),” on page 288, in Appendix H for further explanation and method of recovery. Method of recovery is also provided in [Table A-8, “Troubleshooting Light Tower Electrical Issues,”](#) on page 180, in Appendix A.

For personal and equipment safety:

- Do **not** remove any bolted-down covers or doors.
- Ensure that the access doors are completely closed and not damaged nor blocked in any way.
- Do **not** intentionally defeat the access door safety interlocks. Keep the access doors closed when the X-ray source is turned ON.

Potential Hazards and Safety Precautions – Personnel

The Xradia Versa is designed to be safe for standard operator use. However, potential hazards do exist. This section describes the potential hazards to personnel, such as radiation and high voltage, and methods to isolate and control the hazards.

Read and understand all the safety information and follow the procedures when using the Xradia Versa. Severe or catastrophic injury to personnel, or damage to the equipment or facility can result if the prescribed procedures are not followed.

The Xradia Versa uses a broad energy range of X-rays for imaging. A high-voltage power supply is required to generate the high-energy radiation, and a shielding enclosure is required to contain the radiation. The potential hazards to personnel include:

- High Voltage
- Ionizing Hazard
- Electrical Shock Hazard
- Pinch Hazards
- Magnetic Field
- Hazardous Materials

High Voltage

NOTICE Press an **EMO** button to shut down the Xradia Versa in a personal safety or equipment emergency. Refer to “[EMO Shutdown](#),” for further details.

The X-ray source generates dangerous high voltages that can be present if the safety interlocks are defeated and/or cabling is disconnected, cut, or damaged.

The risk level is low for standard use, due to safety interlocks, protective cable insulation, and tool-to-remove cable connection.

The X-ray source and some motion components require high voltage of up to 160 kV. The high-voltage power is located within the High Voltage Power supply located within the enclosure.

Observe the following safety guidelines:

- Do **not** attempt to defeat the access door safety interlocks. Keep the access doors closed when the X-ray source is turned ON.
- Do **not** remove the enclosure panels.
- Do **not** touch any parts inside the enclosure, unless instructed to do so by this guide or by ZEISS service personnel.
- Do **not** remove any GROUND connections.

Potential Damage Severe to catastrophic injuries can result from electric shock by the high-voltage source. Minor to moderate injuries can result from electric shock by hazardous voltage sources.

Hazard Control All high-voltage sources are sealed. Electrical faults are shorted to ground. **Do not touch anything within the Xradia Versa unless instructed to do so otherwise within this guide or by ZEISS service personnel. Firmly press an **EMO** button in an emergency, to shut down the Xradia Versa.**

Ionizing Hazard



WARNING Do **not** modify any part of the enclosure. Doing so can result in fatal injury.

NOTICE Press an **EMO** button to shut down the Xradia Versa in a personal safety or equipment emergency. Refer to “[EMO Shutdown](#),” for further details.

The X-ray source generates X-rays within the enclosure that can expose personnel to dangerous X-rays if the safety interlocks are defeated and the access doors are OPENED, protective covers are removed, or the enclosure is damaged.

The risk level is low for standard use, due to safety interlocks and the protective enclosure.

The Xradia Versa uses a broad energy range of X-rays to image samples and reference images.

Observe the following safety guidelines:

- Do **not** intentionally defeat the access door safety interlocks. Keep the access doors closed when the X-ray source is turned ON.
- Do **not** remove the enclosure panels or any protective covers.
- Do **not** operate the X-ray source if the access doors do not close, any portion of the enclosure appears damaged, or the interlock switches appear to be damaged. Turn OFF the X-ray source and contact the ZEISS Support Team. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.)

Potential Damage Exposure to X-ray radiation causes moderate to severe illness to personnel, mostly in the form of soft tissue damage, or cancer in severe cases, or death due to radiation poisoning.

Hazard Control The Xradia Versa is fully enclosed by a steel and lead-lined enclosure that incorporates safety interlocks, which together protect personnel from harmful X-ray radiation. To ensure the enclosure’s integrity, ZEISS service personnel perform a radiation survey upon installation and during regularly scheduled service every six months, for Xradia Versa units under warranty or service packages.

For questions concerning radiation safety, contact the ZEISS Support Team. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in [Appendix K](#).)

Electrical Shock Hazard



WARNING The Xradia Versa must remain properly grounded and connected to a grounded AC power source, as installed by ZEISS service personnel. Failure to do so can cause electric shock, which can result in fatal or near-fatal injuries.

NOTICE Press an **EMO** button to shut down the Xradia Versa in a personal safety or equipment emergency. Refer to “[EMO Shutdown](#),” for further details.

If the Xradia Versa is not connected to a grounded AC power source, there is a high risk of electrical shock.

There should be no problem with improper grounding when the Xradia Versa is properly connected to a grounded power source, per specifications. Refer to [Appendix H, “Electrical Documentation,”](#) for proper grounding.

Observe the following safety guideline:

- Ensure that the power cord from the Xradia Versa (located on the back of the instrument) is connected to a grounded power outlet.

Pinch Hazards

The radiation-shielding enclosure, which includes the access doors, is made of steel and lead plates that are extremely heavy. Placing body parts in the path of a closing access door can cause bodily injury. Minor injuries can occur in rare occasions, and serious injuries are extremely unlikely; therefore, the risk level is low.

There is also a pinch hazard associated with movement of stages within the enclosure. The risk is low due to the slow speed of motion.

Although unlikely, it is also possible to be pinched by the screw or spring clamp sample holder provided with the Xradia Versa.

Potential Damage Physical pain or minor injuries can result from the pinch.

Hazard Control Pay attention when opening or closing the access doors.

Keep your hands clear of the stages when a stage is in motion.

Keep your fingers free of the part of the screw or spring clamp sample holder, that closes onto the sample, to avoid being pinched.

If a body part is caught in a closing access door

1. Reverse the motion of the access door, to free the body part(s).

If a hand is caught in a stage

1. Reverse the motion that moved the stage onto the hand.

If a finger is caught in a sample holder

1. Reverse the motion that closed the sample holder onto the finger.

Magnetic Field

The Xradia Versa includes several motors that generate low levels of magnetic field. The Xradia Versa might also include power supplies that can incorporate transformers and/or inductors that generate low-level magnetic fields.

The risk level is low for standard use, due to the protective enclosure.

Potential Damage The magnetic field strength is extremely low. Personal injury or damage to equipment is extremely unlikely.

Hazard Control Be aware of the presence of the magnetic field around the motors.

Exercise caution if a person near the motors

- Uses a pacemaker
- Is holding objects sensitive to magnetic fields, such as a floppy disk, external hard disk drive, credit card, hotel key card

Hazardous Materials

 **CAUTION** The materials listed here are not customer-accessible, and should only be accessed by trained ZEISS service personnel. Exposure to these materials, if handled improperly, can cause physical harm.

 **CAUTION** Should you need to decommission and dispose of the Xradia Versa, refer to [“Decommissioning and Disposal.”](#)

 **NOTE** Recent copies of each material’s Material Safety Data Sheet (MSDS) are provided in [Appendix I, “Material Safety Data Sheets,”](#) for reference.

The Xradia Versa contains the following hazardous materials:

- **Thallium-doped Cesium Iodide** – This material is used as the [scintillator](#) and is integrated into the detector, and is therefore not readily user-accessible. The quantity of thallium is approximately 2.5 mg. The thallium content is approximately 1% of the weight of the cesium iodide.
- **Lead** – This material prevents X-rays from escaping the enclosure and exposing personnel to X-ray radiation. The interior of the steel enclosure contains 6-mm-thick lead sheets on all sides, top, and bottom. The right side contains an additional 3 mm of lead sheet, for a total of 9 mm. The lead sheets are covered by steel sheets or paint.

Potential Hazards and Safety Precautions – Equipment

The Xradia Versa is designed to be safe for customer use. However, potential hazards do exist.

Read and understand all the safety information and follow the procedures when using the Xradia Versa. Severe or catastrophic injury to personnel, or damage to the equipment or facility can result if the prescribed procedures are not followed.

Potential hazards to equipment include:

- Loss of Data Due to EMO Shutdown
- Collision of Moving Parts
- Improper Grounding

Loss of Data Due to EMO Shutdown

NOTICE The EMO shutdown process (pressing of the **EMO** button) leaves the Xradia Versa stage positions and other system components in undefined states and can adversely affect the computer workstation and/or optional storage server, potentially causing data loss – use only in the event of a personal safety or equipment emergency.

Potential Damage If you used the **EMO Shutdown** process, it is possible that there will be data loss on the hard disk drives.

Hazard Control Use the EMO shutdown process only in the event of a personal safety or equipment emergency. If possible, use the process described in “**Shutting Down the Xradia Versa in a Non-Emergency Event**,” on page 188, in Appendix C, instead.

To recover lost data

- If a backup copy of the data files that were lost is available, copy or restore the files back onto the affected hard disk drive
- Contact your Information Technology (IT) department for assistance
- Contact the ZEISS Support Team for assistance (refer to “**ZEISS Support Team (Technical Support)**,” on page 308, in Appendix K)



NOTE To help protect data files created by the Xradia Versa, it is recommended that you install a backup program, or other backup process that is required by your IT department, on the Xradia Versa.

Collision of Moving Parts



NOTE Tips for troubleshooting collision and imminent collision are described more fully in “Troubleshooting Scout-and-Scan Control System Sample Issues,” on page 152, in Appendix A.

The risk level is low for standard use.

Collision Detection Xradia Versa Version 10.6 software has a collision detection feature that protects against collision of motorized components. However, it does not protect the sample from colliding with other components when the sample, detector, and/or X-ray source are moved. Collisions, should they occur, are likely due to moving the sample, detector, and/or X-ray source too close to one another. In most cases, equipment damage would be minor.

Potential Damage Collisions can cause misalignment and, in more severe cases, damage to subcomponents. Should the Xradia Versa require realignment, contact the ZEISS Support Team. (Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.)

STOP ALL MOTORS Buttons The Xradia Versa is equipped with two **STOP ALL MOTORS** buttons that immediately stop movement of all moving motors:

- Outside the enclosure, top right of the ergonomic station’s keyboard
- Inside the enclosure, at the base of the sample stage

Both are shown in the figure on the next page. Press a **STOP ALL MOTORS** button to immediately stop all moving motors. Press the button again to release the button before starting any moves.

Observe the following safety guideline:

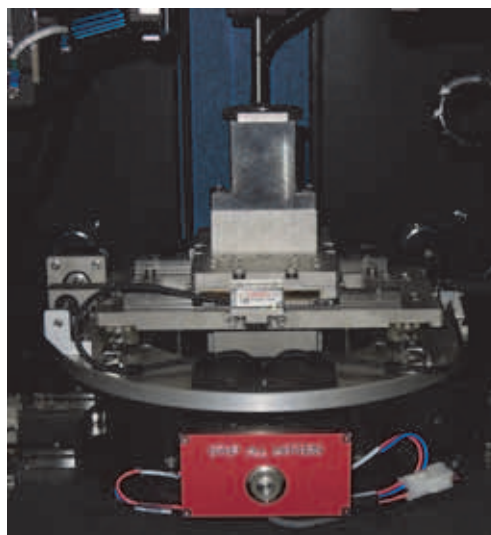
- Ensure that the sample holder assembly is correctly loaded onto the sample stage (flat edge facing front, tungsten balls on the stage aligned with the sample holder base)

STOP ALL MOTORS Buttons

Outside the enclosure,
top right of the ergonomic
station's keyboard



Inside the enclosure,
at the base of the
sample stage



Improper Grounding



WARNING The Xradia Versa must remain properly grounded and connected to a grounded AC power source, as installed by ZEISS service personnel. Failure to do so can cause electric shock, which can result in fatal or near-fatal injuries.

NOTICE Press an **EMO** button to shut down the Xradia Versa in a personal safety or equipment emergency. Refer to “[EMO Shutdown](#),” for further details.

There should be no problem with improper grounding when the Xradia Versa is properly connected to a grounded power source, per specifications. Refer to [Appendix H, “Electrical Documentation,”](#) for proper grounding.

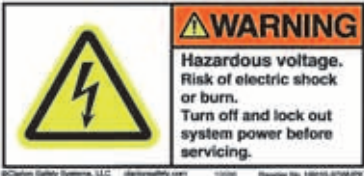
Observe the following safety guideline:

- Ensure that the three-prong power connector (located at the back of the Xradia Versa) is connected to a grounded 230V AC Nominal (160 to 286V AC range, Single Phase, 50/60 Hz, 15A) power source

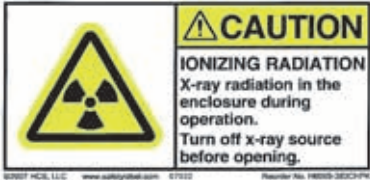
Safety Labels

The following table lists and describes a sampling of the **WARNING** and **CAUTION** safety labels located inside and/or outside the Xradia Versa enclosure.

Safety Labels

Label	Description and Location in/on Xradia Versa
	<p>Warns ZEISS service personnel to turn OFF and lock out Xradia Versa power prior to attempting to service the Xradia Versa. Adhered to the top of the Power Distribution Unit (PDU). Visible when the PDU is pulled out by ZEISS service personnel, for servicing.</p>
	<p>Warns you that moving parts can cut or crush, keep hands clear of moving parts to avoid being pinched. Adhered near the sample stage, visible inside the front and back of the Xradia Versa.</p>
	<p>Warns you that the access doors can cut or crush, keep hands clear when closing the access doors to avoid being pinched. Adhered on the front and back access doors, on the lip of the doors.</p>
	<p>Warns ZEISS service personnel to follow lockout procedures before servicing the Xradia Versa. Adhered under the front left access panel, on the high-voltage power supply.</p>
	<p>Warns you to read and understand this guide and other documentation before operating the Xradia Versa. Adhered under the front left access panel, on the high-voltage power supply.</p>
	<p>Warns you not to lift or move the Xradia Versa without assistance. Adhered under the front left access panel, on the high-voltage power supply.</p>

Safety Labels (Continued)

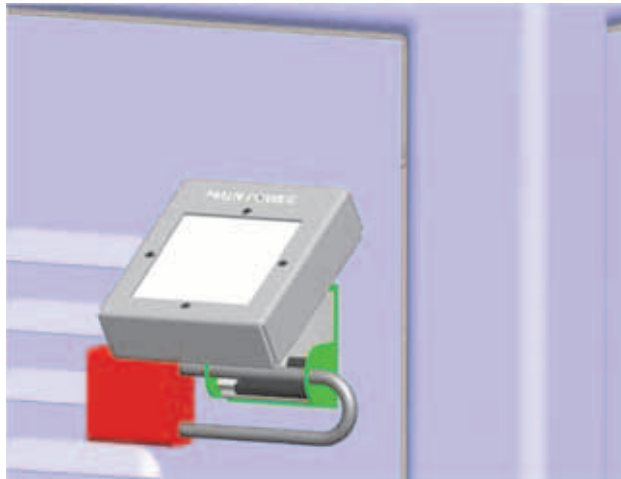
Label	Description and Location in/on Xradia Versa
 <p>CAUTION Heavy object. Can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when removing or replacing.</p>	<p>Cautions you that the Xradia Versa is a heavy object, and to use lifting aides and proper lifting techniques to avoid muscle strain and/or back injury.</p> <p>Adhered under the front left access panel, on the high-voltage power supply.</p>
 <p>CAUTION Do NOT remove this cover. This equipment produces high intensity X-ray beams when energized.</p>	<p>Cautions you to not remove any parts of the enclosure, to protect yourself and others from harmful X-ray radiation.</p> <p>Adhered to the baffles or covers bolted onto the Xradia Versa.</p>
 <p>CAUTION IONIZING RADIATION X-ray radiation in the enclosure during operation. Turn off x-ray source before opening.</p>	<p>Cautions you to turn OFF the X-ray source before opening the access doors, to protect yourself and others from harmful X-ray radiation.</p> <p>Adhered to the front of the Xradia Versa, on an access door.</p>
 <p>CAUTION Heavy object. Can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when removing or replacing.</p>	<p>Cautions you that the Xradia Versa is a heavy object, and to use lifting aides and proper lifting techniques to avoid muscle strain and/or back injury.</p> <p>Adhered under the front left access panel, under the PDU.</p>
 <p>CAUTION Hot surface. Do not touch. To avoid possible skin burns, disconnect and lockout power and allow surface to cool before servicing.</p>	<p>Cautions you to not touch the hot surface of the X-ray source. To avoid possible skin burns, disconnect and lockout power to the Xradia Versa and allow the X-ray source's surface to cool before servicing.</p> <p>Adhered to the X-ray source.</p>

Safety Lockout

! WARNING This safety lockout method described here is the only approved method to use for the Xradia Versa. Use of a lockable cover on the power cord does **not** put the Xradia Versa in a safe power-down state. The Xradia Versa's internal Uninterruptible Power Supply (UPS) continues to generate hazardous voltage, even when power to the Xradia Versa is disconnected. The main power disconnect terminates input power to the Xradia Versa and disables output of the UPS.

Safety Lockout can be accomplished using a padlock with approximately a 7.62-cm shackle (American Lock #A1107KAREG or equivalent). The padlock can be applied to the main power disconnect circuit breaker, located on the back of the Xradia Versa enclosure, as shown in the following figure.

Safety Lockout Using a Padlock



Decommissioning and Disposal

Should you need to decommission and dispose of the Xradia Versa, contact the ZEISS Support Team. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.)

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Preface

The guide covers use of the Scout-and-Scan™ Control System on all ZEISS® Xradia Versa® instruments. In addition, any references to the instruments encompass the current **Xradia Versa** family comprised of the Xradia 520 Versa, Xradia 510 Versa, and Xradia 410 Versa.

Some features are optional and not included with every system. Your particular system might not include optional components if these were not purchased. No differentiation is made in the user's guide about which features and components are optional or standard. ZEISS reserves the right to redefine the standard product configuration and available options.

Document Organization

The process tasks described in each chapter follow a typical workflow. Additional information is provided in the appendices.

This guide is organized as follows:

- [Safety](#) provides guidelines and information for safely using and operating the Xradia Versa.
- [Chapter 1, “Overview,”](#) provides an overview of the technology used by the Xradia Versa, as well as the main components, programs, and processes used to generate and view tomographic data.
- [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System,”](#) provides step-by-step instructions to acquire tomographies using the Scout-and-Scan Control System. Also includes instructions for setting up and using a recipe with variable angle tomography (Xradia 520 Versa only) and a secondary reference.
- [Chapter 3, “Manually Reconstructing a Tomography Dataset,”](#) describes how to use XMReconstructor to manually reconstruct tomography datasets when a dataset is manually acquired, the center shift is incorrect, or the automatic reconstruction had problems.
- [Chapter 4, “Viewing and Editing Tomographies,”](#) describes how to use XM3DViewer to view and edit 2D reconstructed slices and 3D reconstructed volume datasets for use in reports and movies.
- [Appendix A, “Troubleshooting,”](#) describes how to resolve common issues that might be encountered when using the Xradia Versa.
- [Appendix B, “Files and File Storage,”](#) describes the file types unique to the Xradia Versa programs, recommended file handling, and file storage.
- [Appendix C, “Shutting Down and Restarting the Xradia Versa,”](#) describes how to shut down and restart the Xradia Versa, and then home all motorized axes to pre-defined initialization positions.
- [Appendix D, “User Interface and Software Control Features,”](#) describes the Scout-and-Scan Control System, XMReconstructor, and XM3DViewer user interfaces, as well as XMReconstructor software control features.
- [Appendix E, “Mounting, Loading, and Removing Samples,”](#) describes how to mount a sample, load the sample holder assembly onto the sample stage, and remove the sample from the Xradia Versa after use.

- [Appendix F, “Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa,”](#) describes how to manually install an X-ray filter onto the X-ray source (Xradia 510 Versa and Xradia 410 Versa only), as well as how to remove a filter that is already installed.
- [Appendix G, “Specifications,”](#) lists the Xradia Versa component and facility requirement specifications.
- [Appendix H, “Electrical Documentation,”](#) provides electrical documentation specific to the Emergency Off (EMO) system and safety interlocks.
- [Appendix I, “Material Safety Data Sheets,”](#) provides recent copies of the Material Safety Data Sheets (MSDS) for hazardous materials used in the Xradia Versa.
- [Appendix J, “CE Declaration of Conformity,”](#) provides a copy of the ZEISS CE Declaration of Conformity.
- [Appendix K, “License, Warranty, and Service Information,”](#) provides the software license agreement, limited warranties, service and maintenance information, and ZEISS Support Team information.
- [Appendix L, “Glossary,”](#) describes terms used within this guide.

Document Conventions

The following sections contain descriptions of the document conventions applied in this guide.

Instructions and Information

Instructions and information are conveyed as follows:

- Numbered steps denote tasks performed in the order listed
- Bulleted lists denote information that does not need to be processed in sequence

Special Text Formats

Special text formats use the following conventions:

- Critical information, menu names, and text displayed on-screen appear in **bold**. For example:

Click **OK**.

- Settings to be typed or selected (if more than one selection is available) are in *italics*. For example:

Type *130* in the **Source Z** text box.

- Generic references to a specific item or task are in *italics* or to highlight a term by which something is also referred. For example:

Select the appropriate *save option*.

Also referred to as a *Volume Viewer file*.

- File name extensions and partial file names are in *italics*. For example:

Each *.*txrm* file contains multiple images.

- The following colors, when used to reference an item that is that color, appear in bold and the specified color:

blue, gray, **green**, **orange**, **red**, **yellow/gold**

- First capping is used in some cases for OPEN, CLOSED, ON, OFF, CLOCKWISE, and COUNTERCLOCKWISE.

Cross-References

Cross-references (chapters, appendices, headings, step numbers, and so forth) appear in [blue](#). This information is hyperlinked, and if you use the pointer tool in a PDF, you can “jump” to the referenced text.

Page numbers are included with the referenced subheadings, if the text appears outside the current main section, and in some cases, subsection. For example, if you are reading text in Chapter 1, and the referenced text is in Chapter 3, the reference mentions the Chapter number and includes a page number.

GUI Terminology

Graphical user interface (GUI) terms, select and click, are used as follows:

– Select

Move the mouse cursor to select/highlight an item for use. For example:

- Select a *high resolution objective* (whichever best matches the sample size) from the **Objective** drop-down list box.
- Select **File > Open...** from the menu bar

– Click

Click the LEFT (default) or RIGHT mouse button (as instructed) to select a button, box, or other item that incurs an action that issues a command or sets an option. For example:

- Click **OK**
- Click  to proceed to the next tabbed view

Warnings, Cautions, Notices, and Notes

Warnings, Cautions, Notices, and Notes appear throughout the guide. Examples of format and content are provided below. For Warnings, Cautions, and Notices, it is particularly important to read and understand each, so that you are sufficiently aware of the possible hazards that can be encountered when using the Xradia Versa.

If the Warning, Caution, or Notice indicates “contact the ZEISS Support Team,” stop using the Xradia Versa, then contact ZEISS at the number provided in [“ZEISS Support Team \(Technical Support\),” on page 308, in Appendix K.](#)



WARNING Used when information is critical to avoid personal injury.



CAUTION Used when information is important to personal safety.

NOTICE

Used when information is critical to avoid device or equipment damage, or to avoid severely impacting processing.



NOTE Used when information is sufficiently important to require attention.

Assumptions

This guide assumes that you have:

- Been sufficiently trained by ZEISS service personnel in basic use of the Xradia Versa
- Experience using Microsoft Windows 7 (or previous versions of Windows) and a basic working knowledge of how to use its user interface, including browsing for data paths and files, using the mouse pointer to click and drag, and closing open windows and dialog boxes, opening, saving, and closing files, and so forth

1 Overview

This chapter provides an overview of the technology, main components, and programs used by the ZEISS® Xradia Versa® to generate and view tomographic data. A definition of the axes is included as well.

- [Technology Overview](#)
- [Xradia Versa Hardware and Software](#)
- [Axis Definitions](#)

Technology Overview

The following provides a brief overview of how the Xradia Versa is used as an analytical tool, how the Xradia Versa works, and the current **Xradia Versa** family.

X-ray Microscopy

When used together, microscopy enables observation of features smaller than those visible to the naked eye, and X-rays enables observation of features internal to structures.

While medicine and dentistry remain the most common usages of X-rays, it is also widely used in other applications, from airport security to industrial inspection and quality control systems. CAT scanning, or X-ray tomography, has made it possible to use X-rays to create three-dimensional (3D) representations of structures as complex as the internals of the human body.

How X-ray Microscopy Works

X-ray microscopes form images based upon the X-rays transmitted by the sample. Where the sample absorbs more X-rays, the image is darker; where it transmits more X-rays, the image is brighter. Absorption increases with density and thickness, and is also generally higher for elements with a higher atomic number in the periodic table.

Magnification in X-ray microscopes is typically achieved either by using a projection geometry with a point source (as in the ZEISS Xradia Versa), or by using optical elements similar to a regular visible light microscope (as in the ZEISS Xradia Ultra[®]).

In most X-ray microscopes (unlike electron microscopes), the sample is generally at normal atmospheric pressure. Environmental conditions such as temperature, pressure, humidity, or gas atmosphere can be adjusted, as necessary, within certain limits. Wet samples are mounted between X-ray transparent windows or in thin-walled capillaries. X-rays are not affected by factors such as electric or magnetic fields; therefore, samples, including semiconductor packages and various other materials, can be imaged under real operating conditions, or while subject to mechanical forces.

How Computed Tomography Works

In X-ray Computed Tomography (XCT), the sample is imaged from different directions, ideally across an angular range of at least 180°. A single image at one particular angle is called a projection. Computer algorithms can be used to reconstruct the internal, 3-dimensional (3D) structure of the sample from a series of projections. The reconstructed volume can be visualized in different ways; for example *slice by slice* (also referred to as *virtual cross-sectioning*), or by rendering a 3D view of individual internal features.

What the Xradia Versa Does

ZEISS advanced X-ray computed tomography (CT) products help promote innovation in science and industry. ZEISS CT technology has been used by scientists and engineers to provide insight in 3D, into the internal structure of samples in a large variety of applications. For the following applications, the Xradia Versa offers:

- In Life Science Research

The Xradia Versa enables imaging of hard and soft tissue with an unmatched combination of resolution and sample size. ZEISS proprietary detector technology, as well as phase contrast imaging, provides the unique ability to image soft tissue with good contrast, even in combination with calcified tissue and bone structures.

- In Advanced Material Research and Development

The ZEISS multi-length scale solution enables the development of a full model of the material, from millimeter down to nanometer scale. Material defects, such as cracks and voids, can be visualized at these length scales.

- In Semiconductor Package Development and Failure Analysis

Engineers use the **Xradia Versa** family to verify micron-sized defects, without the need for physical de-layering or cross-sectioning, thus maintaining the integrity of the samples.

- In Geomaterials Physics Modeling and Oil and Gas Exploration

Digital rock analysis combines 3D images of reservoir rock pore networks with fluid flow simulation, to estimate and optimize well performance. ZEISS 3D X-ray microscopes provide high-resolution images of pore structures that enable accurate and statistically meaningful simulation models. They also provide a unique, high-resolution imaging platform for *in situ* multi-phase fluid flow experiments to confirm those models. Solutions are available for sandstone, carbonate, tight gas sand, and oil shale.

Key to effective imaging is the ability to use a succession of increasing resolutions, combined with smaller and smaller fields of view that allow “zooming” into the particular [region of interest](#). As product and sample complexity increases, 3D-imaging modalities are required to fully understand the 3D intricacies of structures.

ZEISS Xradia Versa Family

This guide describes the use of CT technology for the **Xradia Versa** family. The Xradia Versa is the latest generation in a leading class of 3D X-ray microscopy (XRM) solutions optimized for non-destructive micro tomography. The Xradia Versa’s new X-ray source technology and high-resolution detector provide unmatched submicron resolution for large and small samples.

Xradia Versa Hardware and Software

The Xradia Versa includes the hardware and software needed to create and view tomography images.

Hardware Description

This section describes the Xradia Versa major hardware components.

Major External and Internal Hardware Components

[Figure 1-1](#) provides visual internal and external views of a typical Xradia Versa (Xradia 520 Versa shown) with the access doors OPEN and CLOSED. [Table 1-1](#) lists the major internal and external hardware components, as they relate to [Figure 1-1](#).

NOTICE The Xradia Versa includes extremely sensitive mechanical, optical, and electronic components. Do not touch anything within the enclosure, except for the following components, unless instructed otherwise by ZEISS service personnel:

- Sample stage, while loading the sample holder assembly
- X-ray source, when installing an X-ray filter

Figure 1-1 External and Internal Views (Xradia 510 Versa Shown)

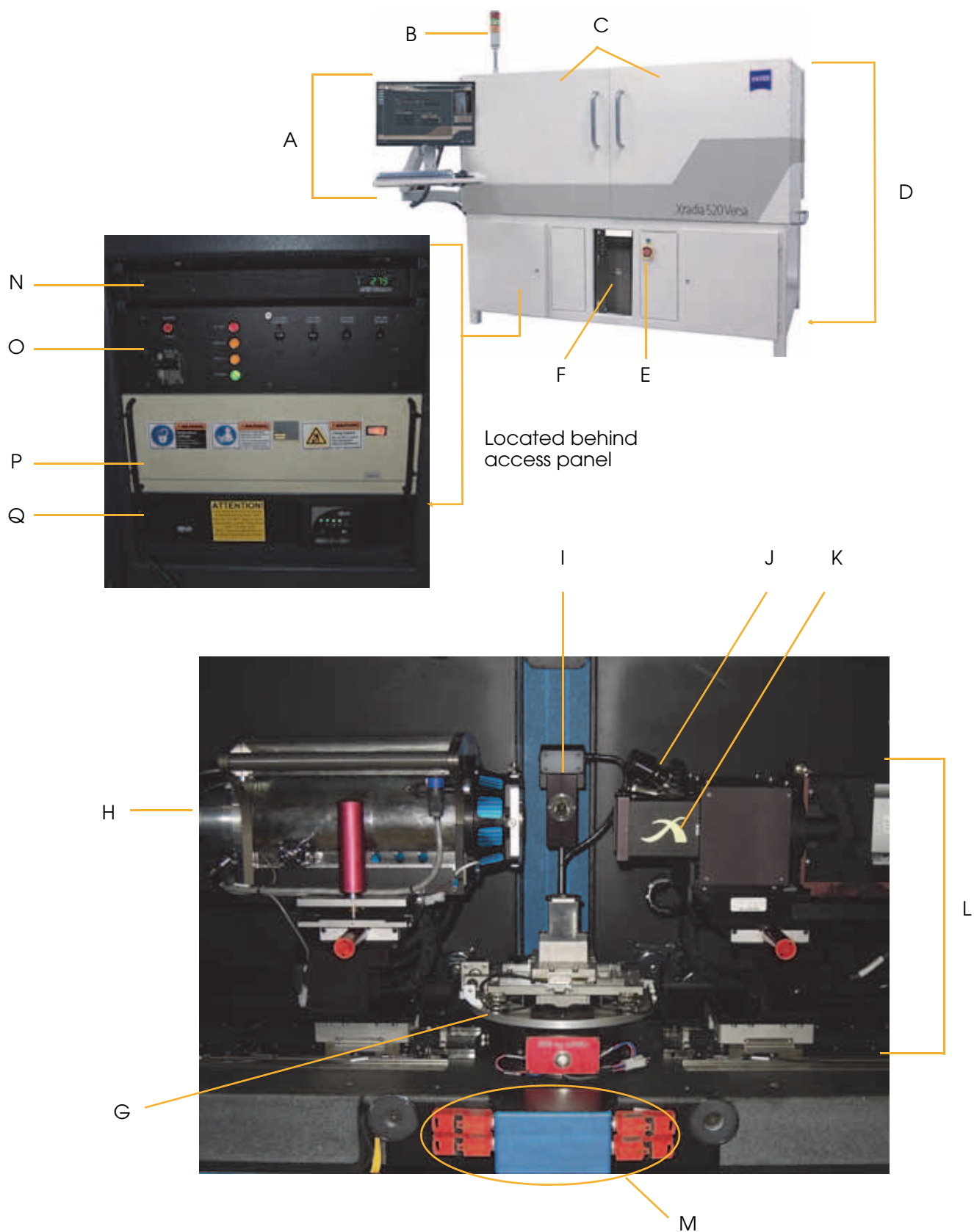


Table 1-1 Major Components Shown in [Figure 1-1](#)

Reference Designator	Part	Description
A	Ergonomic Station	User console for controlling the Xradia Versa for data acquisition and analysis. Refer to “Ergonomic Station,” for further details.
B	Light Tower	Indicator located on top of the Xradia Versa that visually reports the following status conditions: <ul style="list-style-type: none"> – All lights OFF – Power to the Xradia Versa is turned OFF – Red light ON (top) – X-ray source is turned ON and X-rays are present within the enclosure – Red light OFF (top) – X-ray source is turned OFF and X-rays are not present within the enclosure – Yellow light ON (center) – Access doors are CLOSED – Yellow light OFF (center) – Access doors are OPEN – Green light ON (bottom) – Power to the Xradia Versa is turned ON – Green light OFF (bottom) – Power to the Xradia Versa is turned OFF
C	Access Doors	Part of the enclosure. Closes off the X-ray source, providing protection from harmful X-ray radiation. The Xradia Versa has four access doors – two on the front (shown in the figure), and two on the back (not shown), of the enclosure. Typically, only the front access doors need to be opened to access the Xradia Versa interior. Using the door handles, pull an access door toward you to OPEN, or push an access door toward the Xradia Versa to CLOSE.
D	Enclosure	Insulated steel and lead-lined framework that covers the Xradia Versa exterior, providing protection from harmful X-ray radiation.
E	EMO Buttons	Emergency OFF. Used to shut down (power OFF) the Xradia Versa in a personal safety or equipment emergency. To restore power, release the EMO button by twisting it CLOCKWISE, move the PDU's (reference designator O in Figure 1-1) power breaker switches to their OFF (DOWN) position, press the UPS' (reference designator Q in Figure 1-1) Power button, then move the PDU's power breaker switches to their ON (UP) position. A second EMO button is located on the back of the Xradia Versa enclosure, below the rear access doors (not shown).
F	Computer Workstation	Windows 7-based computer included with the Xradia Versa. Must be powered ON, by pressing its Power button.
G	Sample Stage	Platform upon which the sample holder assembly (with a mounted sample) is secured and positioned for microscopy.. Includes a STOP ALL MOTORS button. Refer to “Sample Stage” for further details. Information related to use of its STOP ALL MOTORS button is provided in “Collision of Moving Parts,” on page xxiv, in Safety .

Table 1-1 Major Components Shown in [Figure 1-1](#) (Continued)

Reference Designator	Part	Description
H	X-ray Source	<p>Mechanism that generates X-rays, used by the Xradia Versa to image samples and create reference images. Includes an X-ray filter holder. The following details the voltage levels available with the Xradia Versa, by model number:</p> <ul style="list-style-type: none"> – Xradia 520 Versa and Xradia 510 Versa – 30 to 160 kV (10W maximum) – Xradia 410 Versa <ul style="list-style-type: none"> – 20 to 90 kV (8W maximum) – 40 to 150 kV (10W maximum) – 40 to 150 kV (30W maximum) <p>Refer to “X-ray Source,” and Appendix H, “Electrical Documentation,” for further details.</p>
I	Visual Light Camera	<p>Supplies images to the Visual Light Camera image display (right side of the Scout-and-Scan Control System). Located behind the sample stage, at the rear of the enclosure. Used for positioning the sample, detector, and X-ray source.</p> <p>Located above and behind the sample stage, along the back wall of the enclosure.</p>
J	Turret and Lenses	<p>Part of the detector assembly. Holds up to five lenses. The lens located at the lowest point on the turret is used to focus on the sample. Located between the Macro Lens and the back wall of the enclosure. The following details the lens magnification levels included with the Xradia Versa, by model number:</p> <ul style="list-style-type: none"> – Xradia 520 Versa and Xradia 510 Versa <ul style="list-style-type: none"> – Standard lenses – Macro (0.4X), 4X, 20X – Optional lens (available upon request) – 40X – Xradia 410 Versa <ul style="list-style-type: none"> – Standard lenses – Macro (0.4X), 4X, 10X, 20X – Optional lens (available upon request) – 40X <p>Refer to “Detector Assembly,” for further details.</p>
K	Macro Lens	<p>Part of the detector assembly. Square Macro (0.4X) lens that provides a second beam line for imaging with a larger field of view (FOV) than the other lenses, at a lower magnification.</p> <p>The Macro lens is mounted beside the turret.</p> <p>Refer to “Detector Assembly,” for further details.</p>

Table 1-1 Major Components Shown in [Figure 1-1](#) (Continued)

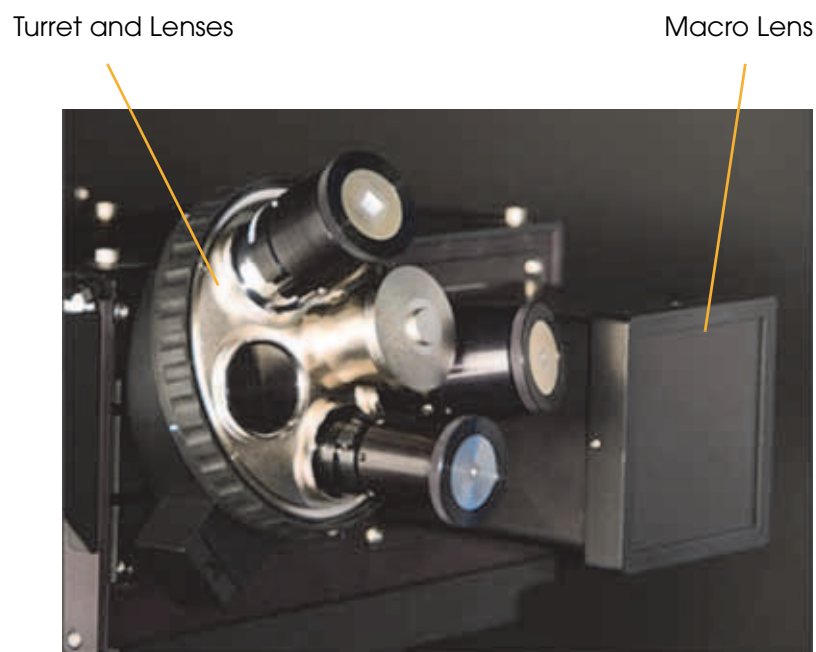
Reference Designator	Part	Description
L	Detector Assembly (Detector)	Assembly that collects X-rays, to present images of the sample. Includes the turret and Macro (0.4X) lens. Refer to “Detector Assembly,” for further details.
M	Safety Interlocks	Turn OFF the X-ray source when the access doors are OPENED. WARNING If any of the safety interlocks are damaged, DO NOT OPERATE THE XRADIA VERSA. Turn OFF the X-ray source, then contact the ZEISS Support Team for assistance. DO NOT TAMPER WITH THE SAFETY INTERLOCKS. Refer to Appendix H, “Electrical Documentation,” for further details. Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K if you need to contact the ZEISS Support Team.
N	Enclosure Temperature Control Unit	Regulates input temperature of air entering the enclosure.
O	Power Distribution Unit (PDU)	Distributes and controls power to the electrical Xradia Versa components.
P	High-Voltage Power Supply	Provides high-voltage power to the X-ray source and battery-supplied power, to allow a soft shutdown of the Xradia Versa in case of a power outage.
Q	Uninterruptible Power Supply (UPS)	Regulates the incoming AC voltage and provides battery-supplied power to the Xradia Versa for approximately 15 minutes in case of a power outage.

Detector Assembly

The detector assembly (“detector”) picks up X-ray images of the sample. The non-macro magnification objectives (lenses) look similar to one another, and are all mounted on a motorized turret (in a manner similar to how an optical microscope has different objectives (lenses)). The turret can hold up to five lenses. The Macro (0.4X) lens is mounted next to the turret.

Figure 1-2 provides a view of how the lenses are mounted on the detector assembly.

Figure 1-2 Lenses Mounted on Detector Assembly



X-ray Source

The Xradia Versa is available with either a 160 kV (Xradia 520 Versa and Xradia 510 Versa) or 90 or 150 kV (Xradia 410 Versa) X-ray source. [Figure 1-3](#) provides a view of the 160 kV X-ray source. [Table 1-2](#) lists the minimum and maximum voltage and power settings, by X-ray source.

The X-ray source includes a holder for installing a filter – material that improves reconstructed image quality, by removing low-energy X-rays that do not provide useful information through the sample. The process of installing the X-ray filter is described in [Appendix F, “Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa.”](#)

-  **NOTE** The filter is referred to as an *X-ray filter* within this guide. X-ray filters are available in a filter kit from ZEISS.
-  **NOTE** If Xradia Versa power or the X-ray source has been turned OFF for more than 23 hours, the X-ray source must go through an initial warm-up process, called **X-ray source aging**. This process takes 3 minutes.
-  **NOTE** If the X-ray source has been turned OFF for more than 15 minutes, it must be warmed up for a minimum of 6 minutes for optimal X-ray source stability during scans.

Figure 1-3 160 kV X-ray Source – Xradia 520 Versa and Xradia 510 Versa

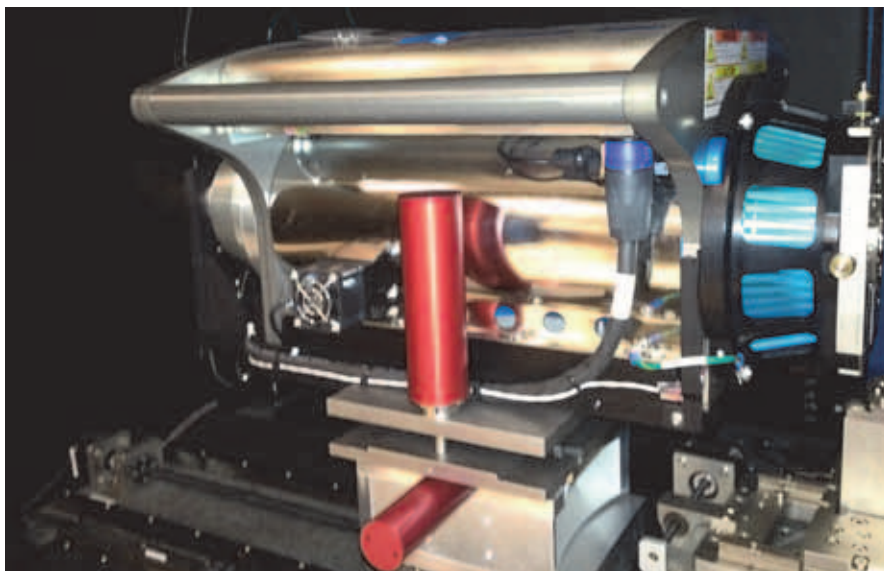


Table 1-2 X-ray Source Voltage and Power Settings

Model	X-ray Source	Voltage (kV)	Power (W)	
		Maximum	Minimum	Maximum
Xradia 520 Versa Xradia 510 Versa	160 kV (10W maximum)	110 to 160	1	10
		100	1	9
		90	1	8
		80	1	7
		70	1	6
		60	1	5
		50	1	4
		40	1	3
		30	1	2
Xradia 410 Versa	90 kV (8W maximum)	40 to 90	1	8
		30	1	4.5
		20	1	2
	150 kV (10W maximum)	40 to 150	1	10
	150 kV (30W maximum)	60 to 150	1	30
		50	1	25
		40	1	20

Sample Stage

The sample stage ([Figure 1-4](#)) is the platform upon which the sample holder assembly (with a mounted sample) is secured and positioned for microscopy.

When loading the sample holder assembly on the sample stage, you must align the flat edges of the assembly and stage (facing the front of the Xradia Versa; refer to [Figure 1-6](#)), and match the slotted grooves on the underside of the assembly with the three tungsten alignment balls (circled in [Figure 1-5](#)) on the sample stage.

NOTICE Use extreme caution when loading the sample holder assembly onto the sample stage.

 **NOTE** Information related to use of the **STOP ALL MOTORS** button shown in [Figure 1-4](#) is provided in “Collision of Moving Parts,” on page xxiv, in *Safety*.

Figure 1-4 Sample Stage and **STOP ALL MOTORS** Button

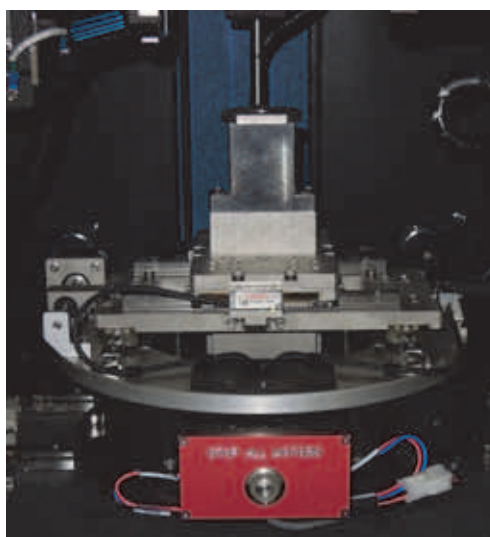
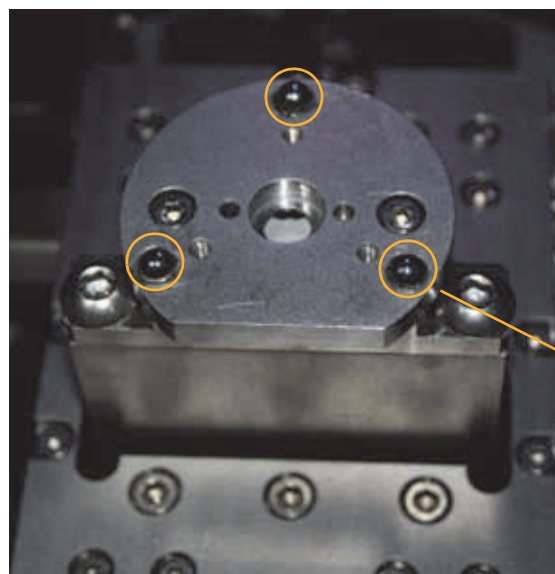
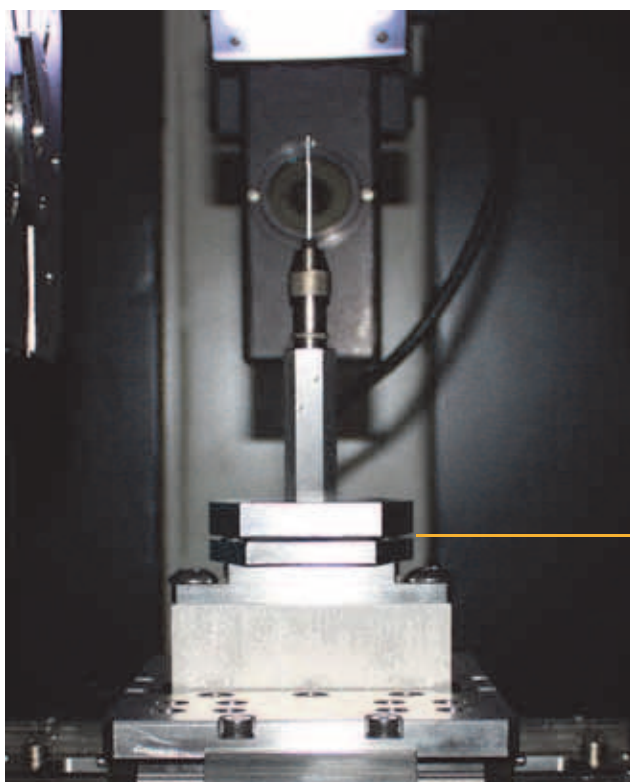


Figure 1-5 Sample Stage, with Tungsten Alignment Balls Highlighted



Tungsten Alignment
Balls (3 pl)

Figure 1-6 Sample Holder Assembly Loaded onto Sample Stage, with Flat Edges Aligned, Facing Front of Xradia Versa)



Align the Sample
Holder Assembly
and Sample Stage
Flat Edges

(Pin Vise sample
holder shown)

Ergonomic Station

The ergonomic station is the console used for controlling the Xradia Versa.

[Table 1-3](#) lists the station's major components.

Table 1-3 Ergonomic Station Components

Component	Description
Monitor (Display)	Used to interface with the Xradia Versa programs. Must be powered ON, by pressing its Power button.
Mouse	Three-button pointing device used to interface with programs used on the Xradia Versa. The device's position is visible on the monitor. The mouse button functions are dependent upon the program and function in which the mouse is being used. Unless stated otherwise in this guide, all references to mouse clicks are to the left-mouse button.
Wrist Pad	Ergonomic wrist rest.
Keyboard	Standard QWERTY computer keyboard. Includes a STOP ALL MOTORS button. ^a

- a. Information related to use of the **STOP ALL MOTORS** button is provided in [“Collision of Moving Parts,”](#) on page xxiv, in *Safety*.

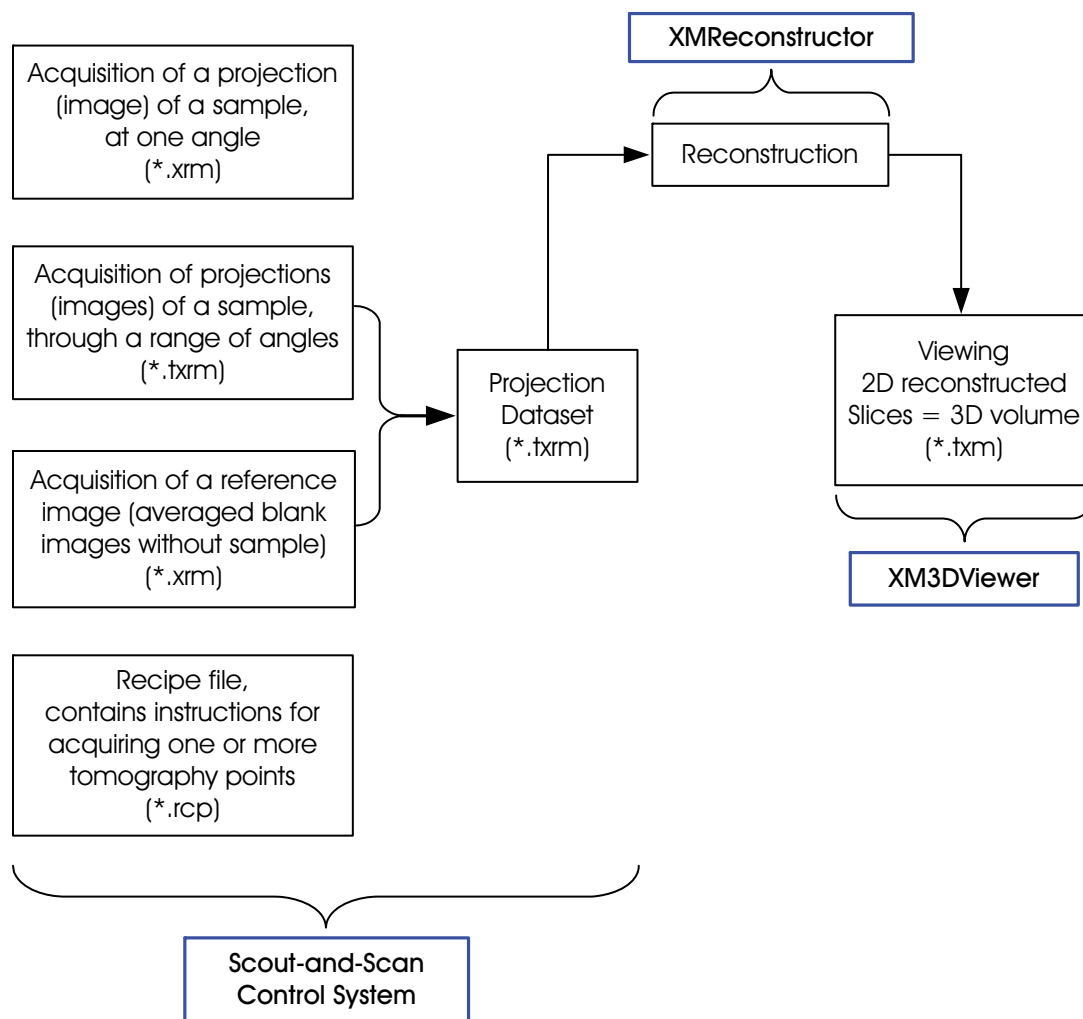
Software Control

The following three programs are used to control the Xradia Versa:

- [Scout-and-Scan Control System](#)
- [XMReconstructor](#)
- [XM3DViewer](#)

[Figure 1-7](#) shows the relationship between the three programs, and the data, processes, and files created by each. Each program is briefly described in the sections that follow. For further details, refer to [Appendix D, “User Interface and Software Control Features.”](#)

Figure 1-7 Data, Processes, and Files

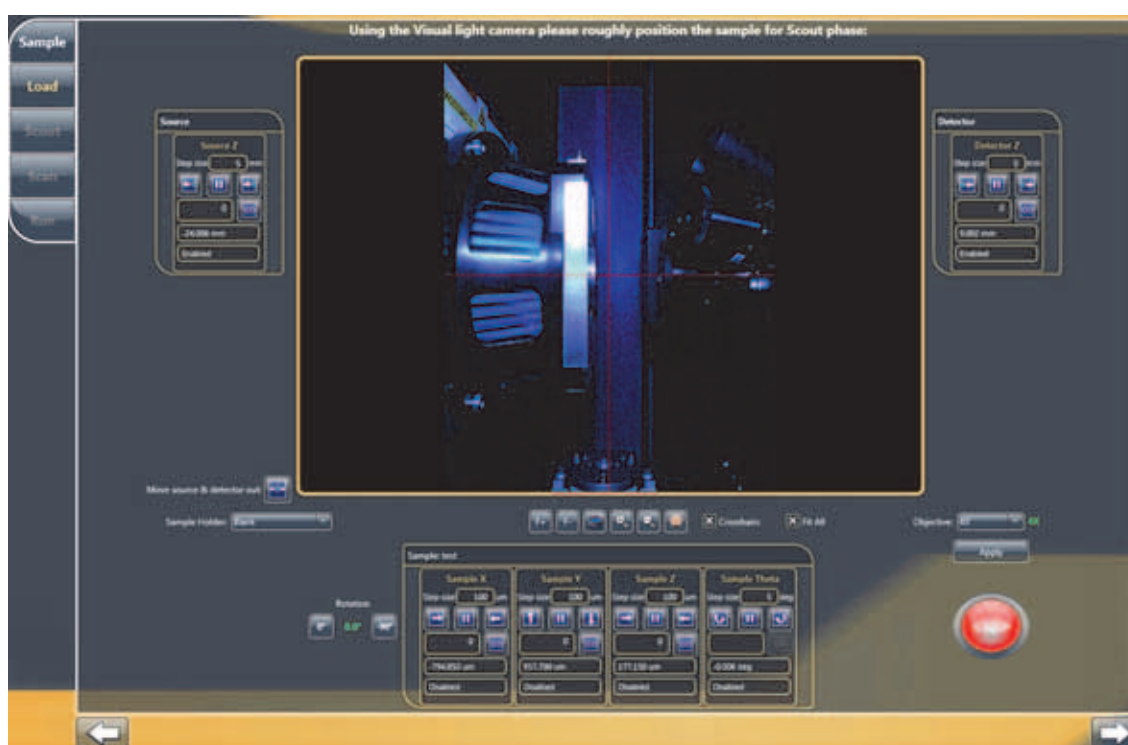


Scout-and-Scan Control System

The Scout-and-Scan Control System ([Figure 1-8](#)) is the program used to manage the data acquisition process, from setting up the sample to the acquisition of data, using a Recipe. Use of the Scout-and-Scan Control System is described in [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System.”](#)

NOTE For in-depth information that describes each user interface control and feature, refer to “Scout-and-Scan Control System User Interface,” on page 198, in [Appendix D](#).

Figure 1-8 Scout-and-Scan Control System Main Window – Typical Load View



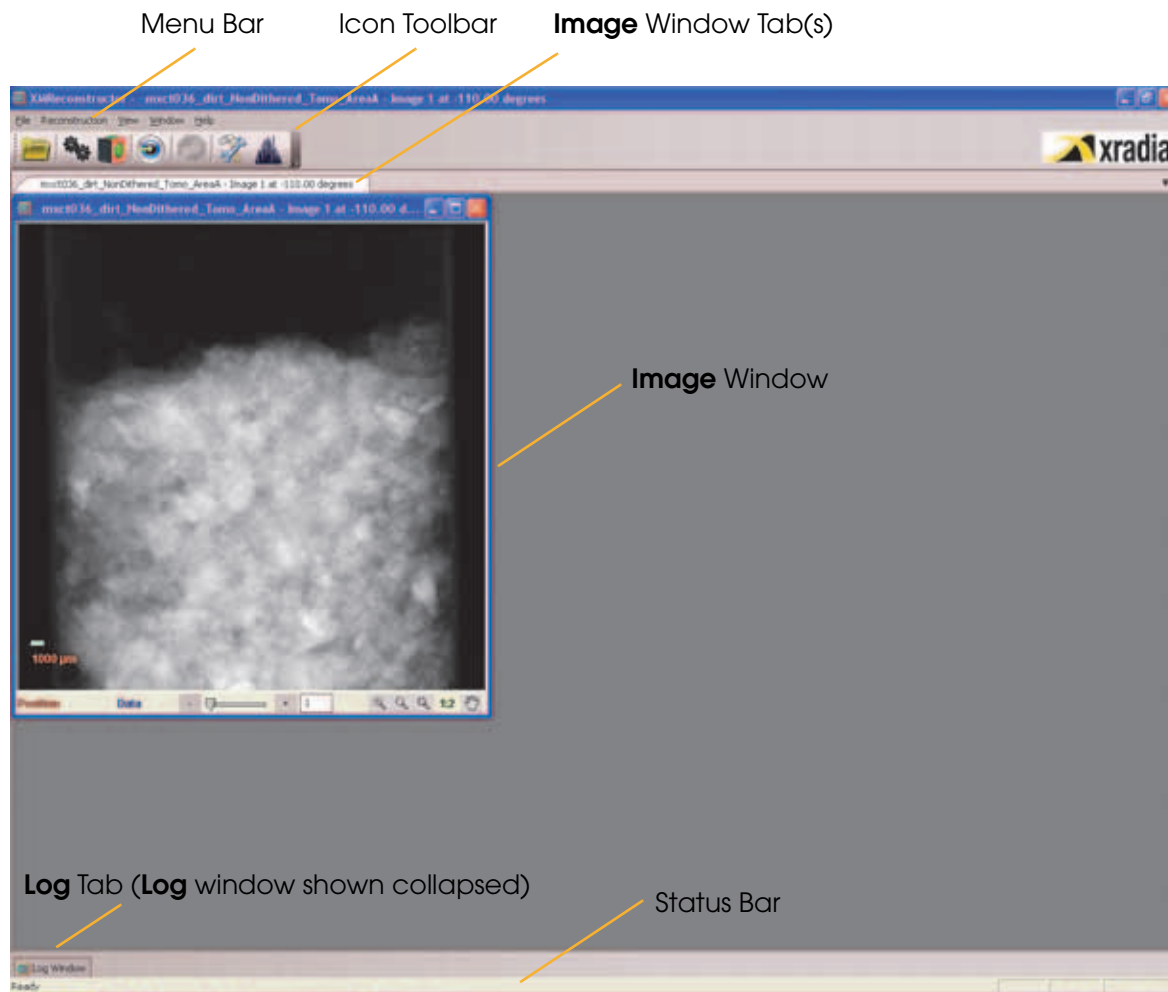
XMReconstructor

XMReconstructor (Figure 1-9) is used to reconstruct the 2D images (projections) acquired during data acquisition/tomography, to create a 3D reconstructed volume. Use of XMReconstructor is described in Chapter 3, “Manually Reconstructing a Tomography Dataset.”



NOTE For in-depth information that describes each user interface control and feature, refer to “XMReconstructor User Interface,” on page 243, in Appendix D.

Figure 1-9 Default XMReconstructor Main Window (Opened File Shown for Reference Only)



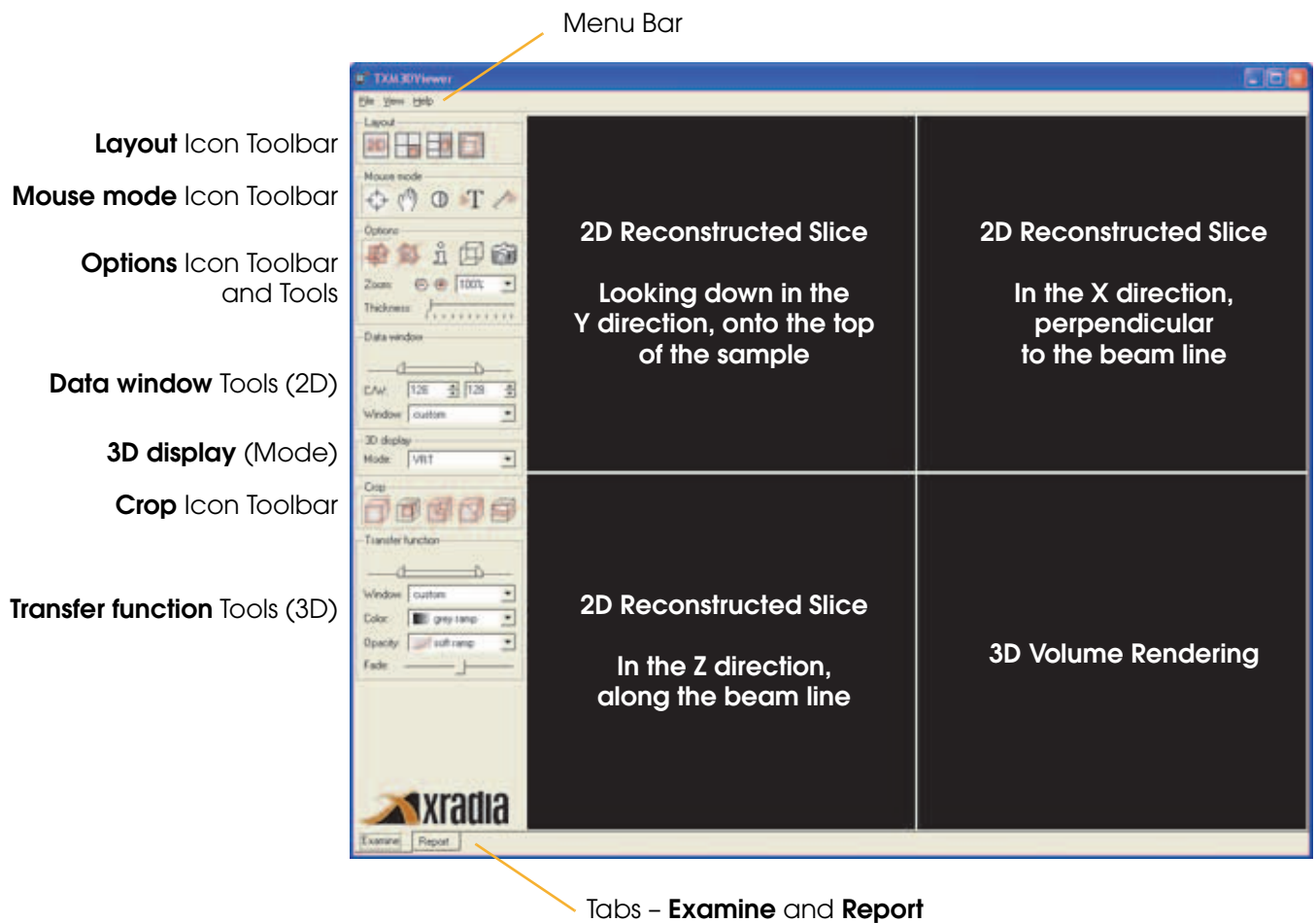
XM3DViewer

After acquiring, referencing, and reconstructing the tomography dataset, the end result is a ready-to-load 3D reconstruction of the region of interest that can be viewed in XM3DViewer ([Figure 1-10](#)). Use of XM3DViewer is described in [Chapter 4, “Viewing and Editing Tomographies.”](#)

NOTE In its main window title bar, XM3DViewer appears as “TXM3DViewer,” rather than as “XM3DViewer”. Additionally, the main window bars and tools change, depending upon which **Layout** icon is selected.

NOTE This guide provides basic information for using XM3DViewer to view tomographic data after reconstruction. For further details regarding the program’s use, refer to “[XM3DViewer User Interface,](#)” on page 261, in [Appendix D](#), as well as the *Xradia ExamineRT Workstation 1.1 User’s Manual*, available under XM3DViewer’s **Help** menu.

Figure 1-10 Default XM3DViewer Main Window – **Examine** Tab, with Descriptions of Each View



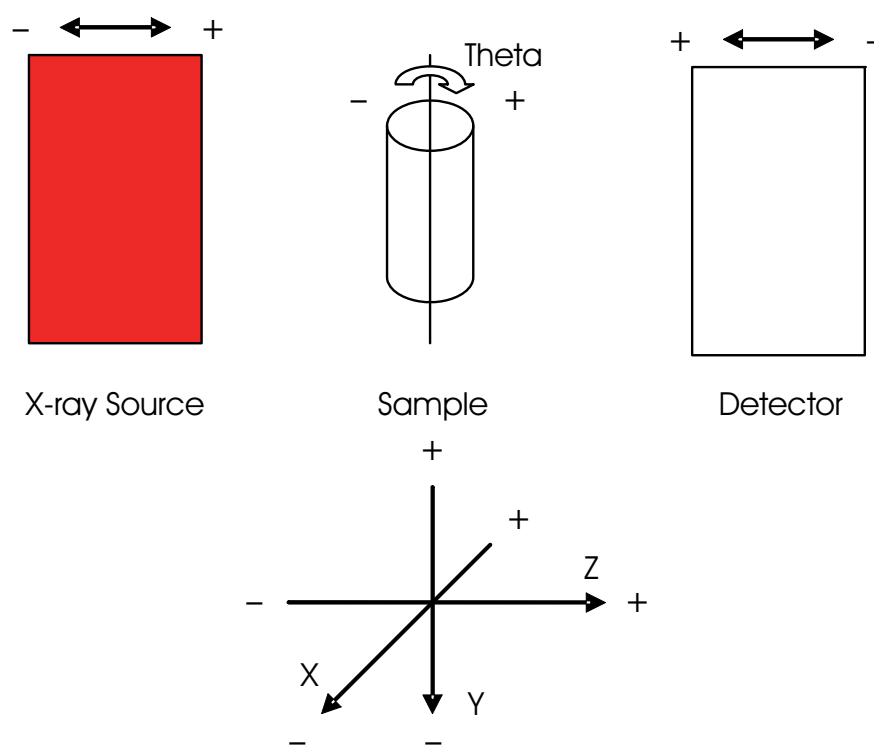
Axis Definitions

Throughout this guide, directions X, Y, Z, and Theta are mentioned. [Table 1-4](#) describes, and [Figure 1-11](#) shows, the directions used when moving the sample, detector, and X-ray source in relation to the visual light camera (located behind the sample stage).

Table 1-4 Sample, Detector, and X-ray Source Movement Directions

Direction (Axis)	Movement	Movement From User's Perspective
X	Toward and away from visual light camera	IN and OUT
Y	From top to bottom of the enclosure	UP and DOWN
Z	Beam line from X-ray source to detector	LEFT and RIGHT
Theta	Circular angle	CLOCKWISE and COUNTERCLOCKWISE

Figure 1-11 Axis Definitions of X-ray Source, Sample, and Detector



2 Acquiring Tomographies with the Scout-and-Scan Control System

This chapter provides step-by-step instructions to acquire tomographies using the Scout-and-Scan™ Control System. It contains instructions for the following use cases:

- [Creating and Running a New Recipe](#)
- [Optional – Setting up and Using a Recipe with High Aspect Ratio Tomography \(HART\)– Xradia 520 Versa](#)
- [Optional – Setting up and Using a Filtered Secondary Reference for Ring Artifact Reduction](#)
- [Loading and Running an Existing Recipe or Recipe Template](#)

 **NOTE** For in-depth information that describes each user interface control and feature, refer to [“Scout-and-Scan Control System User Interface,” on page 198, in Appendix D.](#)

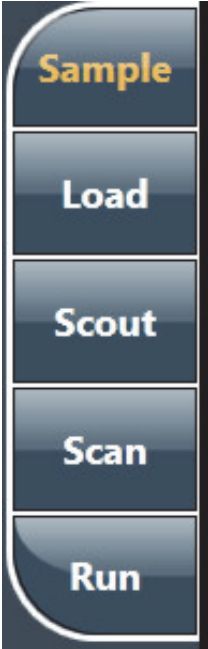
 **NOTE** From this point on, the processes assume that the Xradia Versa is already powered ON and warmed up. If the Xradia Versa is turned OFF, use the processes described in [Appendix C, “Shutting Down and Restarting the Xradia Versa,”](#) to restart the Xradia Versa and home all motorized axes to their pre-defined initialization positions.

 **NOTE** Do **not** open the access doors while X-rays are being generated. Doing so automatically terminates X-ray generation and causes a fault condition, thereby preventing further operation until the fault is reset. Refer to [“Interlock Sequence of Operation,” on page 288, in Appendix H](#) for further explanation and method of recovery. Method of recovery is also provided in [Table A-8, “Troubleshooting Light Tower Electrical Issues,” on page 180, in Appendix A.](#)

Creating and Running a New Recipe

The process of creating and running a new recipe is comprised of five steps, each of which is represented in one of the five **Scout-and-Scan Control System** tabbed views, as listed in [Table 2-1](#). Each view provides the tools to complete the required operations for each step.

Table 2-1 Five Steps to Creating and Running a New Recipe

Scout-and-Scan Control System View Tabs ^a	Step	Operation
	Step 1 – Sample	Set the Sample 's data folder. Initiate the creation of a new recipe.
	Step 2 – Load	Load the sample and roughly position it using the Visual Light Camera.
	Step 3 – Scout	Scout the sample to locate the desired region of interest (ROI), field of view (FOV), and imaging parameters, using X-ray images.
	Step 4 – Scan	Set up 3D Scan parameters for the recipe.
	Step 5 – Run	Run the recipe and acquire the tomographies.

- a. After  is clicked to access the next view, you can click the tabbed item to move between the active views.

Step 1 – Sample

This process describes how to use **Sample** view to set the sample's data folder and initiate creation of a new recipe.

NOTE For in-depth information that describes **Sample** view, refer to “[Sample View](#),” on page 210, in Appendix D.

To set the sample's data folder and initiate a recipe

1. Select **Start > All Programs > Xradia > VersaXRM 10.x > Scout-and-Scan Control System 10.x** from the Windows **Start** menu. The Scout-and-Scan Control System opens to the first tabbed view – **Sample** view.

NOTE “x” is the program's current version number.

NOTE The screen capture provided below is partially filled in. Although a generic name is being used for the sample name, it is recommended that you use a name that better identifies the sample in use.

Figure 2-1 Typical **Sample** View

Please fill in the following details about the recipe:

Sample Details

Output Directory: C:\Users\Trish\Desktop\Scout and Scan

Sample Name: test

Comment:

Create Recipe Point List

Select Recipe Template:

Current Recipe Points

Name	Source	Sample	Mode	Bin	Exp	Filter
Iono-A	0.00 (kV), 0.00 (W)	0.00, 0.00, 0.00	Normal	Bin 2	Exp: 1	

2. Click **Browse**, then browse to and select the *output directory* in which to store the sample's data.
3. Type a *name* in the **Sample Name** text box (new sample) –or– click **Browse** (existing folder), then browse for and select the *sample name* to be used.

A subfolder is automatically created under the selected *output directory*, in which all acquired data will be stored.

4. **Optional** – Type a *comment* in the **Comment** text box.

5. Click  in the **Create Recipe Point List** panel, to add a tomography point and initiate a new recipe.

 **NOTE** Multiple recipe points can be added if you want to acquire multiple tomographies for the sample. Simply click  again, to create another tomography point.

6. Click  to proceed to the next tabbed view (**Load**).

Proceed to “[Step 2 – Load.](#)”

Step 2 – Load

This process describes how to use **Load** view to load and roughly position the sample on the axis of rotation and position the detector and X-ray source, using the visual light camera.

NOTICE



If collision is imminent at any time during this process,

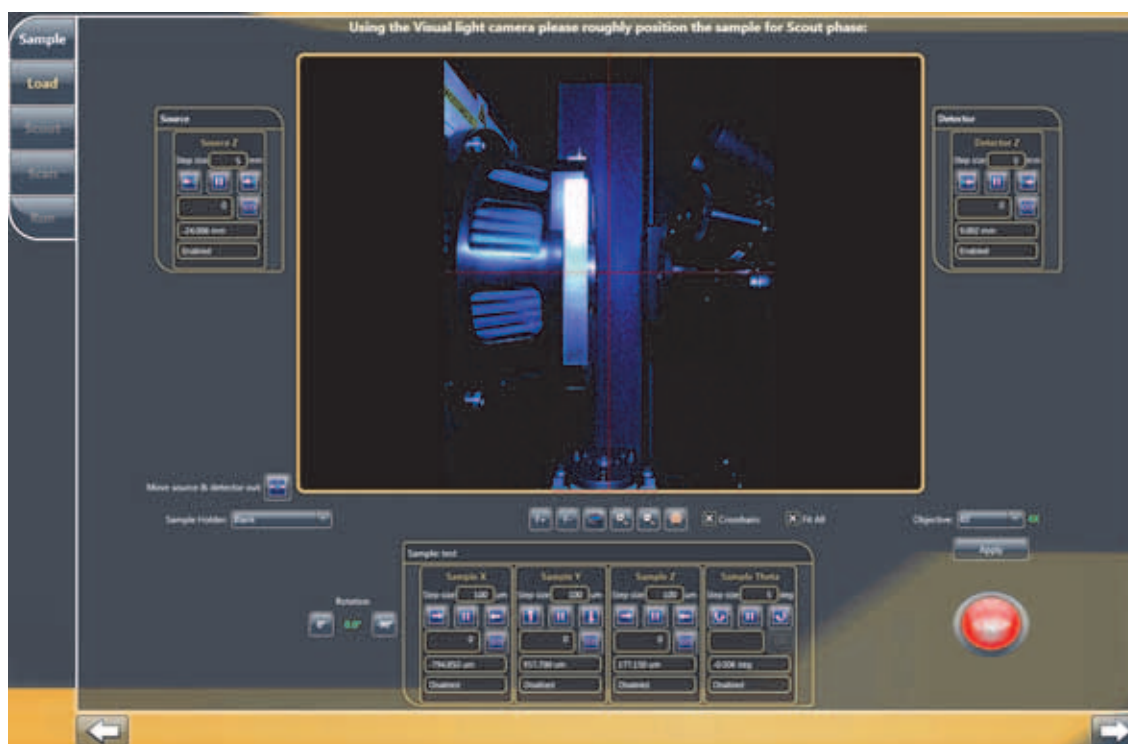


click  to immediately stop all motors, or  within a *motion control*, to halt movement for the axis associated with that motion control.



NOTE For in-depth information that describes **Load** view, refer to “Load View,” on page 215, in Appendix D.

Figure 2-2 Typical **Load** View



To load and roughly position the sample

1. If needed, click  to move the X-ray source and detector away from the sample stage. This should provide sufficient room in which to load the sample holder assembly onto the sample stage.

 **NOTE** If there is insufficient room in which to load the sample holder, click  again. In the **Sample** panel, change the **Sample X**, **Y**, **Z**, and **Theta** axes to 0.

2. Load the sample holder assembly onto the sample stage.

 **NOTE** Instructions for mounting the sample onto the sample holder are provided in [“Mounting a Sample in or on a Sample Holder,” on page 266, in Appendix E](#). Instructions for loading the sample holder assembly (sample mounted on sample holder) onto the sample stage are provided in [“Loading a Sample Holder Assembly onto the Sample Stage,” on page 273, in Appendix E](#).

3. Select *base* from the **Sample Holder** drop-down list box.

 **NOTE** The Xradia Versa’s collision avoidance system is designed to protect against collisions between the sample holder base and X-ray source or detector.

4. Click  to completely zoom out of the *image*.
5. Click  to rotate the sample (**Sample Theta** axis) to 0°. Ensure that the detector and X-ray source are a sufficient distance from the sample, to avoid collision when the sample is rotated.
6. At 0°, under the **Sample** panel, use the **Sample Y** and **Sample Z** tabs to align the *sample or feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display:
 - Click  and/or  (**Sample Y**) to align the sample vertically
 - Click  and/or  (**Sample Z**) to align the sample horizontally

Figure 2-3 Sample Aligned with **Red** Crosshairs, after Adjusting **Sample Y** and **Sample Z**



7. Click  to rotate the sample (**Sample Theta** axis) to -90° . Ensure that the detector and X-ray source are a sufficient distance from the sample, to avoid collision when the sample is rotated.
8. At -90° , under the **Sample** panel, use the **Sample X** tab to align the *sample or feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display. Click  and/or  to align the sample horizontally.
9. Click  to zoom in. Repeat steps 5 through 8 to fine align the *sample or feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display, at both 0° and -90° .
10. Click  to proceed to the next tabbed view (**Scout**).

Proceed to “[Step 3 – Scout](#).”

Step 3 – Scout

This process describes how to use **Scout** view to scout the sample – locate the sample’s ROI and FOV, and set imaging parameters, using X-ray images.

The Scout phase consists of the following processes:

- Scout – Find and Center the ROI at Low Magnification**
- Scout – Fine-Tune the ROI at High Magnification**
- Scout – Set Detector and X-ray Source Positions**
- Scout – Select Proper X-ray Filter and kV**
- Scout – Determine Acquisition Time**

NOTICE

If collision is imminent at any time during this process,

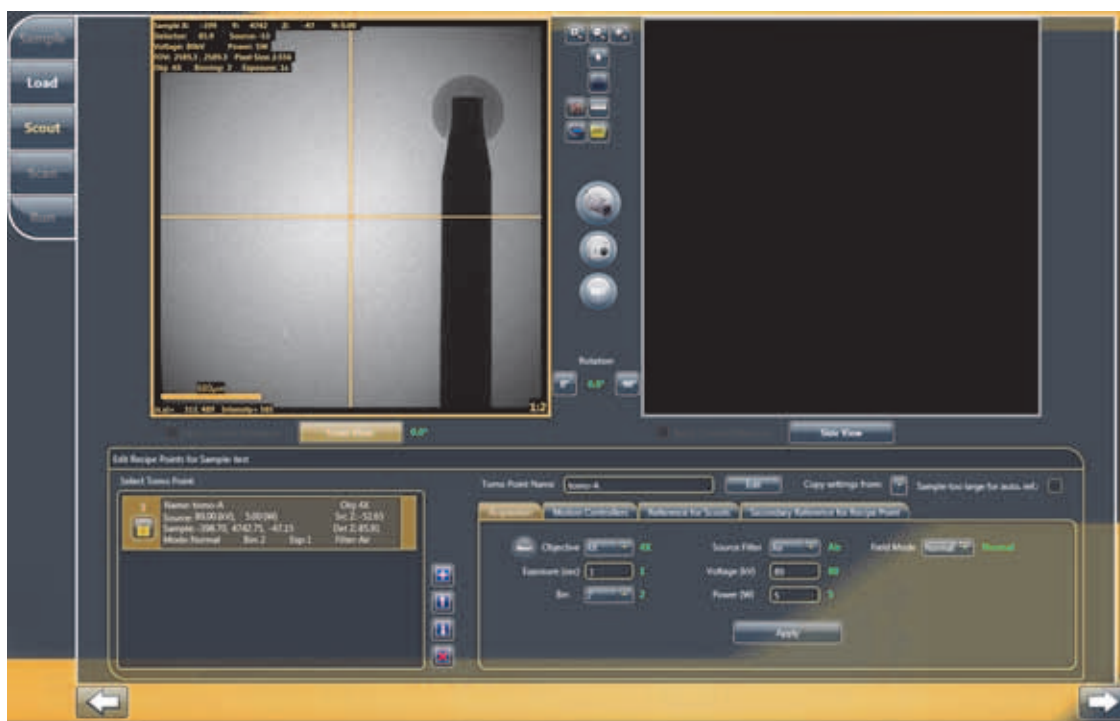


click to immediately stop all motors, or within a *motion control*, to halt movement for the axis associated with that motion control.



NOTE For in-depth information that describes **Scout** view, refer to “**Scout View**,” on page 218, in Appendix D.

Figure 2-4 Typical **Scout** View



Scout – Find and Center the ROI at Low Magnification

This process helps you to locate and roughly center the Sample's ROI, using X-rays. The Sample X, Y, and Z axes are adjusted, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

 **NOTE** For details regarding axes directional movement, refer to "Axis Definitions," on page 20, in Chapter 1.

To find and center the ROI at low magnification

1. Select the **Acquisition** tab within the **Edit Recipe Points for Sample** panel.

Figure 2-5 Typical **Acquisition** Tab within **Scout** View's **Edit Recipe Points for Sample** Panel



2. Select *Macro* or *4X* for samples smaller than 4 mm from the **Objective** drop-down list box.
3. Follow steps **a** through **d** below, to specify the *acquisition settings*:

 **NOTE** For details regarding X-ray source voltage and power, refer to Table 1-2, "X-ray Source Voltage and Power Settings," on page 12, in Chapter 1.

- a. Type the X-ray source *voltage* and *power* in the **Voltage (kV)** and **Power (W)** text boxes, using the following guidelines:
 - 80 kV/7W for thin or low-density samples
 - 140 kV/10W for thick or high-density samples
- b. Type *1* in the **Exposure (sec)** text box.
- c. Select *2* from the **Bin** drop-down list box.
- d. Click **Apply** to set the Xradia Versa to the specified settings.

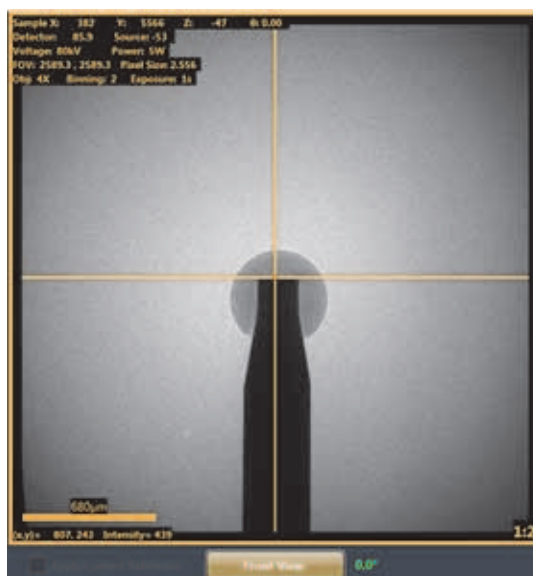
4. Click  to rotate the sample (**Sample Theta** axis) to 0° and activate the **Front View** image display.
5. Click  to start continuous imaging.

 **NOTE** If necessary, move the detector (**Detector Z**) closer to the sample, to increase the FOV. You can start moving the Source (**Source Z**) away from the sample, to continue increasing the FOV.

6. Double-click the *center of the sample or feature of interest on the sample* within the **Front View image**, to automatically position the ROI to the center of the **Front View** image display.

The ROI is now roughly centered for the Sample X and Y axes.

Figure 2-6 ROI Roughly Centered for Sample X and Y Axes

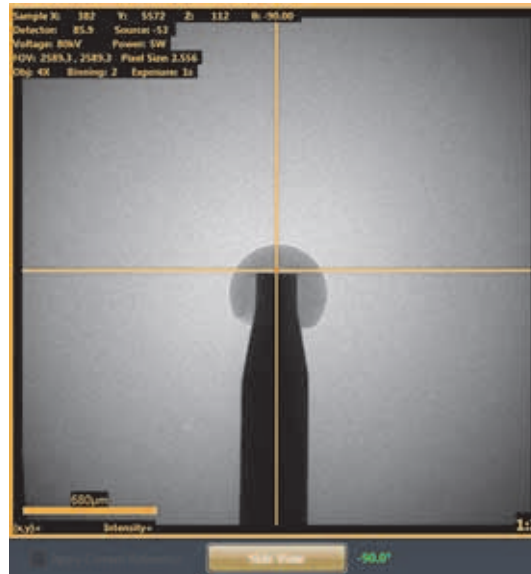


7. Click  to halt continuous imaging.
8. Click  to rotate the sample (**Sample Theta** axis) to -90° and activate the **Side View** image display.
9. Click  to start continuous imaging.

10. Double-click the horizontal **red** line of the crosshair within the **Side View image** to automatically position the ROI to the center of the screen without changing the Y axis position.

The ROI is now roughly centered for the Sample Z axis.

Figure 2-7 ROI Roughly Centered for Sample Z Axis



NOTE The message **Image different from recipe point** might appear on the **Side View** image display. This is okay. It simply indicates that the stage has been repositioned and is different than it is for the **Front View** image display.

11. Click  to halt continuous imaging.

Proceed to “Scout – Fine-Tune the ROI at High Magnification.”

Scout – Fine-Tune the ROI at High Magnification

This process helps you to fine-tune the ROI position at a higher required magnification, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

To fine-tune the ROI at high magnification

1. Select a *high resolution objective* (whichever best matches the sample voxel size) from the **Objective** drop-down list box.

 **NOTE** Voxel (sometimes referred to as *nominal resolution* or *detail detectability*) is a geometric term that contributes to, but does not determine, resolution, and is provided here only for comparison. ZEISS specifies on spatial resolution, the true overall measurement of instrument resolution.

Table 2-2 Objective Selection, by Voxel Size

Objective (Lens)	Voxel Size (μm) with Camera Binning = 2 ^a	
	Xradia 520 Versa Xradia 510 Versa	Xradia 410 Versa
Macro (0.4X)	55 to 5	55 to 6
4X	5 to 0.7	6 to 3
10X ^b	–	2.4 to 1.8
20X ^a	0.9 to 0.5	1.2 to 0.9
40X ^{a, c}	0.5 to 0.3	0.6 to 0.5

- a. **20X and 40X Lenses** – Change binning to 4 to acquire a clearer image.
- b. **10X Lens** – Xradia 410 Versa only.
- c. **40X Lens** – Optional, available upon request.

2. Click **Apply** to set the Xradia Versa to the new settings.
3. Perform steps 3 through 11 of “[Scout – Find and Center the ROI at Low Magnification](#),” on page 29 to fine-tune the sample position at the higher magnification selected in step 1.

 **NOTE** If necessary, move the detector closer to the sample, or the X-ray source away from the sample, to increase the FOV.

Proceed to “[Scout – Set Detector and X-ray Source Positions](#).”

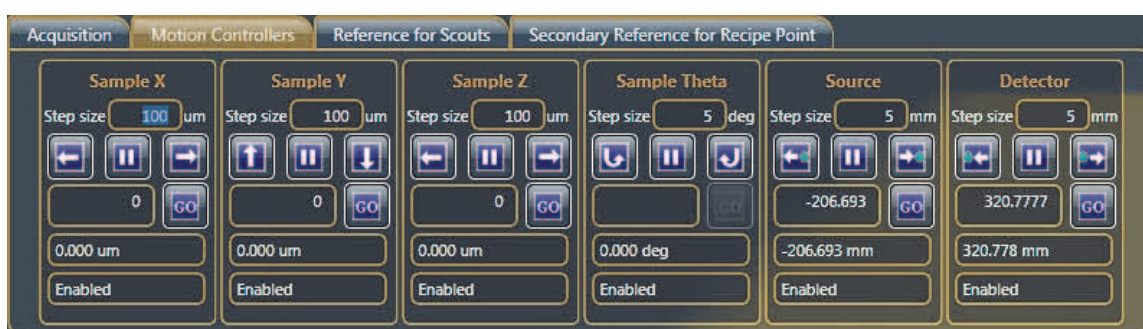
Scout – Set Detector and X-ray Source Positions

This process helps you set the detector and X-ray source positions, using the **Motion Controllers** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

To set the detector and X-ray source positions

1. Select the **Motion Controllers** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

Figure 2-8 Typical **Motion Controllers** Tab within **Scout** View's **Edit Recipe Points for Sample** Panel



 **NOTE** If necessary, click  to halt motion for the selected *controller* (**Detector** or **Source** for Detector Z and Source Z, respectively, or **Sample Theta**).

2. Using the **Sample Theta** motion control and **Visual Light Camera**

image display, click  and  to rotate the sample between -180° and $+180^\circ$ (using the *step size*, such as that indicated in [Figure 2-8](#)), to determine the angle at which the sample is closest to the X-ray source.

 **NOTE** You can also type the *angle* in the text box below those buttons, then click .

3. Using the **Source** motion control and **Visual Light Camera** image

display, click  and  to position the X-ray source as close as possible to the sample, at the angle determined in step 2.

 **NOTE** While moving the X-ray source closer to the sample, start with small step sizes (such as 5 mm) to be safe. If the distance between the X-ray source and sample is large, you can use larger step sizes (such as 10 mm). The **blue** dot in the button icons represents the sample.

4. Using the **Sample Theta** motion control and **Visual Light Camera**

image display, click  and  to rotate the sample between -180° and $+180^{\circ}$ (using the *step size*, such as that indicated in [Figure 2-8](#)), to determine the angle at which the sample is closest to the detector.

 **NOTE** You can also type the *angle* in the text box below those buttons, then click .

5. Using the **Detector** motion control and **Visual Light Camera** image

display, click  and  to position the detector as close as possible to the sample (for fastest scan), at the angle determined in step 4.

 **NOTE** While moving the detector closer to the sample, start with small step sizes (such as 5 mm) to be safe. If the distance between the detector and sample is large, you can use larger step sizes (such as 10 mm). The **blue** dot in the button icons represents the sample.

 **NOTE** Use geometrical magnification (keeping the X-ray source close to the sample, while moving the detector away from the sample) to acquire the resolution, as listed in [Table 2-2 on page 32](#).

6. Using the **Sample Theta** motion control and **Visual Light Camera**

image display, click  and  to rotate the sample between -180° and $+180^{\circ}$, to verify that the sample does not collide with the detector or X-ray source.

Proceed to “[Scout – Select Proper X-ray Filter and kV.](#)”

Scout – Select Proper X-ray Filter and kV

This process selects the proper X-ray filter and voltage to use for the sample, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

To select the proper X-ray filter and kV

1. Select the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

2. Click  to rotate the sample (**Sample Theta** axis) to 0°.

3. Type *10* in the **Exposure (sec)** text box, then click **Apply** to set the Xradia Versa to the new settings.

4. Click  to collect a single image.

 **NOTE** If the *intensity* indicated within the **Front** or **Side View** image display is greater than 60000, reduce the *X-ray source power* (such as to 6W for thin or low-density samples, or 8W for thick or high-density samples), click **Apply**, then repeat step 4. If the image intensity is still too bright, decrease the *exposure time*, then select a higher *binning value* (**Binning** = 1) and repeat step 4 until the intensity indicated is less than 60000.

5. Follow steps **a** and **b** below, to collect and apply a *reference image*:

- a. Click  to collect a reference image.
- b. Select the **Apply current reference** check box, located under the **Front View** image display.

6. Follow steps **a** and **b** below, to determine which X-ray filter to use:

- a. Move the cursor onto the **Front View image**, to view the *transmission value*, identified as a number between 1 and 100.
- b. Use an approximate average *Transmission* value determined in step **a** and Table 2-3, “Macro (0.4X) and 4X X-ray Filter Selection,” on page 36, –or– Table 2-4, “10X, 20X, and 40X X-Ray Filter Selection,” on page 37, to determine which *X-ray filter* to use.

 **NOTE** If step 6 indicates that an X-ray filter is not needed, proceed directly to “Scout – Determine Acquisition Time,” on page 40.

Table 2-3 Macro (0.4X) and 4X X-ray Filter Selection

Transmission at 80 kV (For Thin Samples and/or Low Z Materials)^a	Transmission at 140 kV (For Thick Samples and/or High Z Materials)^b	Filter
> 0.74	Recheck at 80 kV	No Filter (Air)
0.74 – 0.58		LE1
0.58 – 0.46		LE2
0.46 – 0.36		LE3
0.36 – 0.28		LE4
0.28 – 0.20		LE5
0.20 – 0.12		LE6
Recheck at 140 kV	0.32 – 0.20	HE1
	0.20 – 0.12	HE2
	0.12 – 0.08	HE3
	0.08 – 0.05	HE4
	0.05 – 0.03	HE5
	< 0.03	HE6

a. Low Z materials are typically biological or polymeric.

b. High Z materials are typically metallic or contain metallic structures (such as semiconductor samples).

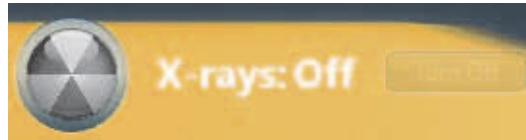
Table 2-4 10X^a, 20X, and 40X^b X-Ray Filter Selection

Transmission at 80 kV (For Thin Samples and/or Low Z Materials) ^c	Transmission at 140 kV (For Thick Samples and/or High Z Materials) ^d	Filter
> 0.63	Recheck at 80 kV	No Filter (Air)
0.63 – 0.44		LE1
0.44 – 0.34		LE2
0.34 – 0.28		LE3
0.28 – 0.21		LE4 ^b
0.21 – 0.14		LE5
0.14 – 0.12		LE6
Recheck at 140 kV	0.30 – 0.18	HE1
	0.18 – 0.08	HE2
	0.08 – 0.06	HE3
	0.06 – 0.04	HE4
	0.04 – 0.03	HE5
	< 0.03	HE6

- a. **10X Lens** – Xradia 410 Versa only.
- b. **Optional 40X Lens** – If the required filter is identified as LE #4 or higher (such as LE #5 or any HE filters), scan the sample with 20X instead. This indicates a relatively high absorption for the sample, and it is not likely that 40X will provide better resolution than 20X.
- c. Low Z materials are typically biological or polymeric.
- d. High Z materials are typically metallic or contain metallic structures (such as semiconductor samples).

7. Click **Turn Off** to turn OFF the X-ray source. The X-ray status changes to **X-rays: Off**.

Figure 2-9 X-rays Are Turned **OFF**



8. Manually install the *X-ray filter* (determined in step 6) onto the X-ray source.

 **NOTE** The process of installing the X-ray filter is described in [Appendix F, “Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa.”](#)

9. Click **Apply** in the **Acquisition** tab to turn ON the X-ray source.

10. Follow steps **a** through **e** below, to adjust the *X-ray source kV* value until the *transmission value* is within the range of 22 to 35:

- a. Select the correct *filter option* in the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

 **NOTE** For the Xradia 520 Versa, step **a** is used to change the filter on the automated filter changer. For the Xradia 510 Versa and Xradia 410 Versa, step **a** logs the correct filter into the recipe, for future reference.

- b. Click  to collect a single image.
- c. Click  to collect and apply the new reference image to the **Front View** image display.
- d. Move the cursor onto the **Front View image**, to view the updated *transmission value*.
- e. Adjust the *X-ray source kV* value in the **Voltage (kV)** text box, then click **Apply**.

If transmissions are higher than the required range, decrease the *voltage* by 20 kV; otherwise, increase the *voltage* by 20 kV. Repeat steps **a** through **e** until the transmission range is within the range of 22 to 35.

 **NOTE** For low-density materials, decreasing the voltage might not bring the transmission values within the required range. In this case, you can decrease the voltage by 40 kV.

Proceed to “**Scout – Determine Acquisition Time.**”

Scout – Determine Acquisition Time

This process helps you determine the acquisition time, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

To determine the acquisition time

1. Type *1* in the **Exposure (sec)** text box, then click **Apply**.
2. Click  to collect a single image.
3. Locate the *intensity* value, located within the **Front** or **Side View** image display. Repeat this step until the *intensity* is greater than 5000. The exposure time that resulted in increasing the intensity above 5000 is the *acquisition time*.



NOTE Exposure time scales linearly with the intensity value.

4. Click  to proceed to the next tabbed view (**Scan**).

Proceed to “[Step 4 – Scan.](#)”

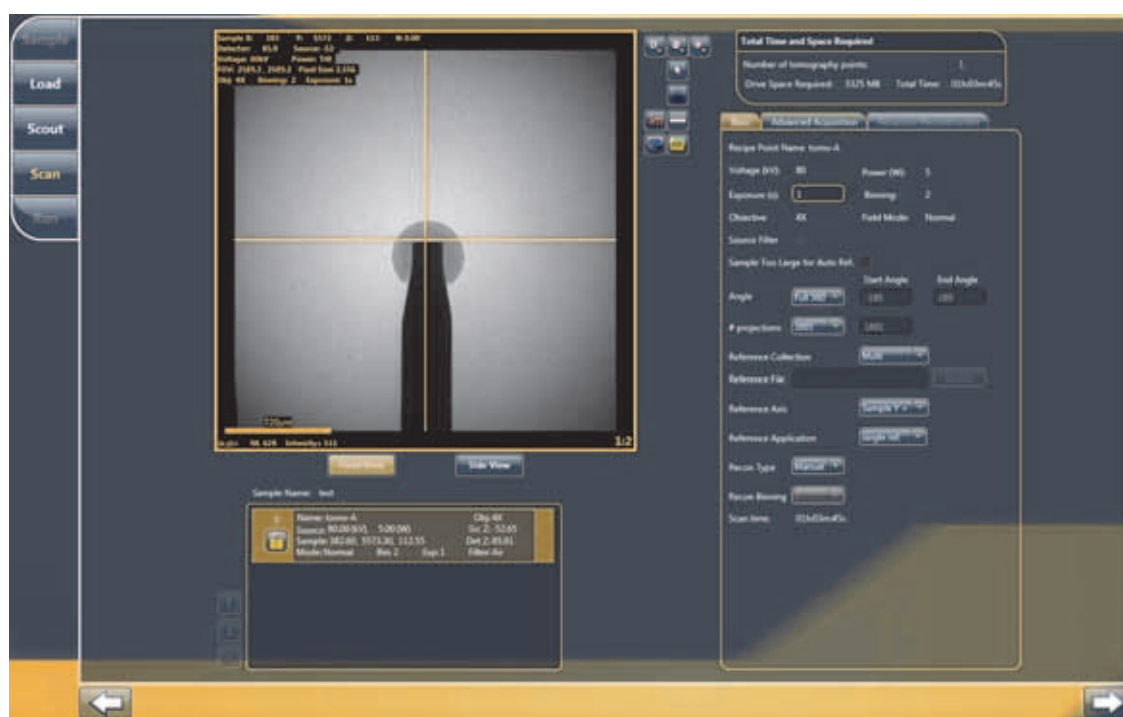
Step 4 – Scan

This process describes how to use **Scan** view to set up the recipe's 3D scan parameters:

- **Xradia 520 Versa** – Basic and Advanced (HART) 3D scan parameters
- **Xradia 510 Versa and Xradia 410 Versa** – Basic 3D scan parameters

 **NOTE** For in-depth information that describes **Scan** view, refer to “[Scan View](#),” on page 231, in Appendix D.

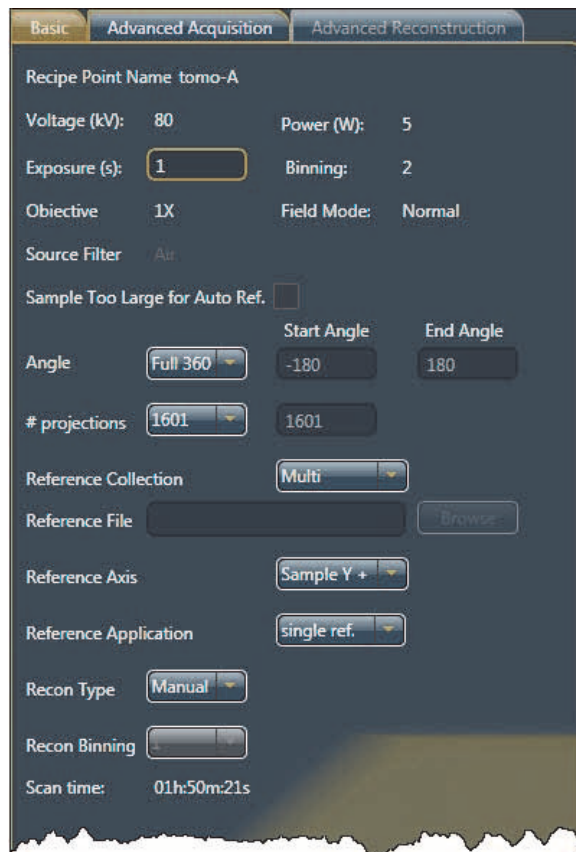
Figure 2-10 Typical **Scan** View



To set up the basic 3D scan parameters

1. Select the **Basic** tab within **Scan** view.

Figure 2-11 Basic Tab within Scan View



2. Select *1601* from the **# projections** drop-down list box for samples that fit within the FOV, for high image quality. For interior tomographies, select *2001*. Use default values for all other parameters.
3. Select *Multi* from the **Reference Collection** drop-down list box.
4. Leave all other options at their default selections.
5. Click  to proceed to the next tabbed view (**Run**).

Proceed to:

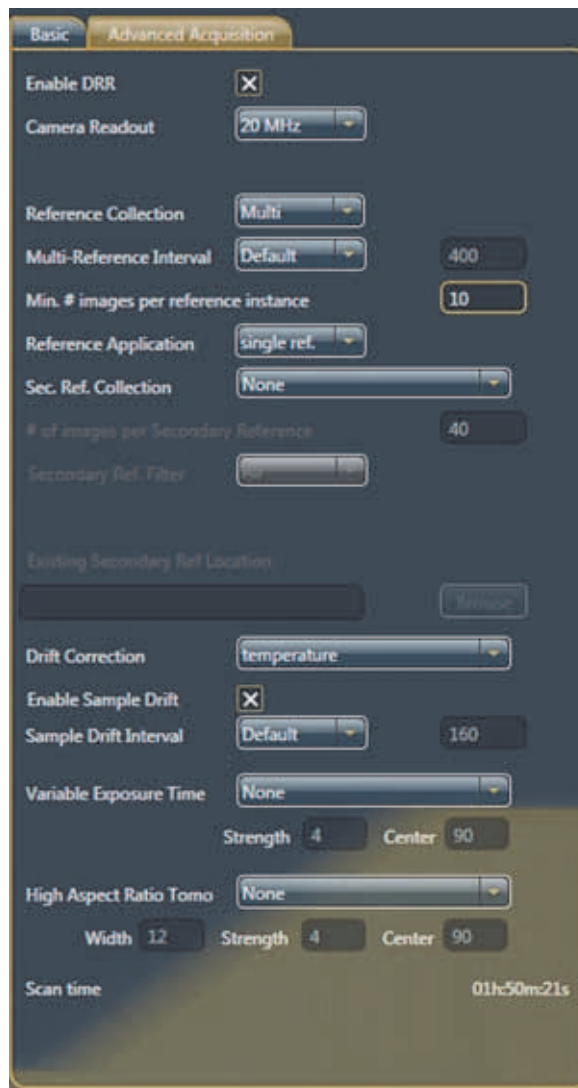
- **Xradia 520 Versa** – “To set up the advanced (HART) 3D scan parameters”
- **Xradia 510 Versa and Xradia 410 Versa** – “Step 5 – Run”

To set up the advanced (HART) 3D scan parameters

1. Select the **Advanced Acquisition** tab within **Scan** view.

 **NOTE** HART is disabled (turned OFF) if *None* is selected for **High Aspect Ratio Tomo**.

Figure 2-12 **Advanced Acquisition** Tab within **Scan** View



2. Follow step [a](#) or [b](#), to enable (turn ON) the *HART acquisition settings*:

- a. **Default HART settings** – Select *Default* from the **High Aspect Ratio Tomo** drop-down list box. The following table lists the *default settings*.

Option	Setting
Width	<i>12 degrees</i>
Strength	<i>4</i> Angular density is 4x normal.
Center	<i>90</i> HART is centered on 90°.

- b. **Custom HART settings** – Select *Custom* from the **High Aspect Ratio Tomo** drop-down list box to enable the **Width**, **Strength**, and **Center** text boxes, then type *values* in then *text box*.

3. Leave all other options at their default selections.

4. Click  to proceed to the next tabbed view (**Run**).

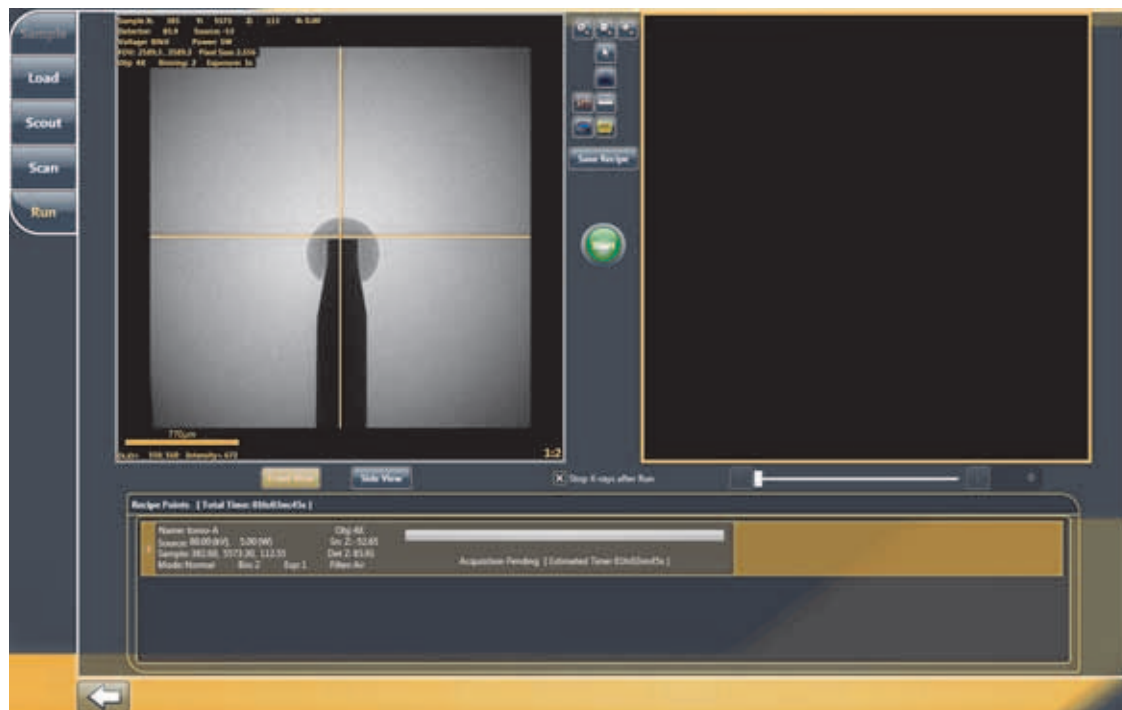
Proceed to “[Step 5 – Run.](#)”

Step 5 – Run

This process describes how to run the recipe and acquire tomographies, using **Run** view.

 **NOTE** For in-depth information that describes **Run** view, refer to “Run View,” on page 240, in Appendix D.

Figure 2-13 Typical **Run** View



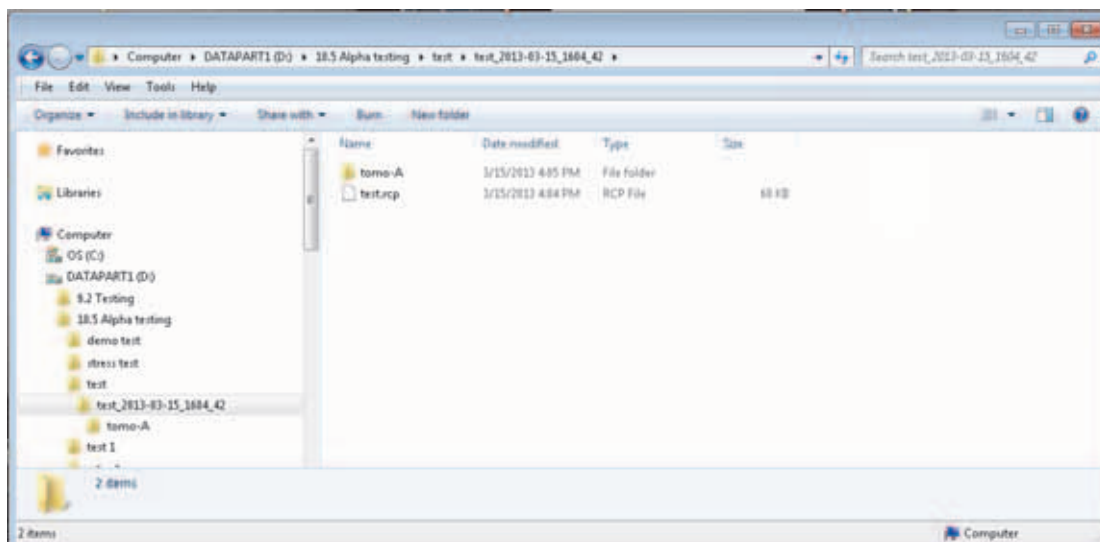
To run the recipe and acquire tomographies

Click  to start acquiring tomographies. The recipe automatically stops running after it finishes data acquisition.

A date- and time-stamped folder is created in the **Sample** folder specified in step 2 of “Step 1 – Sample,” on page 23. In this example, the sample name is **test**. A folder named **tomo-A-Date_Time** is created, and **tomo-A** is the tomography point name created within the **Sample** folder. A copy of the recipe, **Sample Name.rcp**, is also created in the **Sample** folder.

At this point, you can repeat the recipe creation process. Click **New Sample** to begin.

Figure 2-14 Sample Folder Contents after Running a Recipe



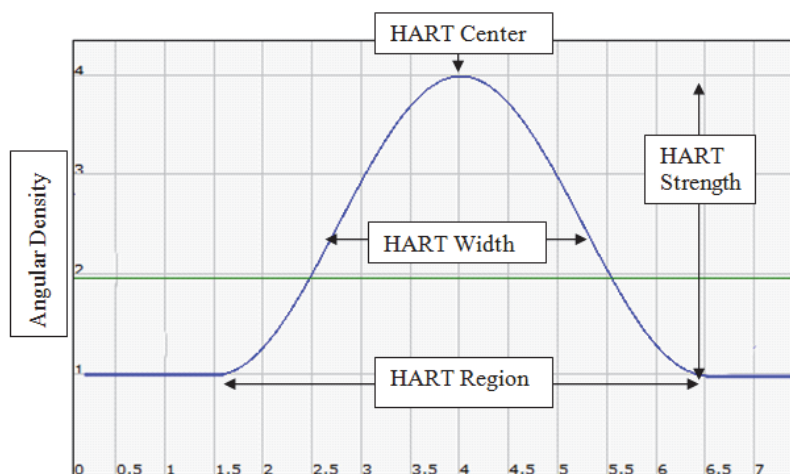
Setting up and Using a Recipe with High Aspect Ratio Tomography (HART)– Xradia 520 Versa

High Aspect Ratio Tomography (HART), available for use with the Xradia 520 Versa, is designed for better imaging of samples that are thin and wide, such as semiconductor packages. Normal tomography uses evenly distributed projections along the rotation direction. However, on high aspect ratio samples, many features can be obscured due to a low signal-to-noise ratio and possible streak artifacts along long views. HART allows users to acquire more projections for long views than short views, so that the features oriented primarily along long views, such as bump cracks, are better visualized. In addition, various artifacts (primarily streaks) are reduced because of the decreased angular step along the long views. The main advantages of using the HART technique are:

- Improved image quality for the same scan time, –or–,
- Equal or better results within a shorter scan time

Figure 2-15 shows how HART is implemented, by adjusting the tomography's angular density at different points. In a Gaussian-shaped curve, the HART region is comprised of projections with a smaller angular step size than the curve's flat regions. The angular density increases within the HART region, and reaches a maximum at the curve's peak (HART center), ideally aligning with the longest view. Single and double HART regions within a tomography are supported.

Figure 2-15 Angular Density Increases (Step Size is Smaller) within HART Region and Reaches Maximum Density, Defined by HART Strength, at HART Center Angle



Setting up HART Parameters – Xradia 520 Versa

To set up HART parameters

1. Complete steps 1 through 3, as described in “[Creating and Running a New Recipe](#)”:
 - a. “[Step 1 – Sample](#),” on page 23.
 - b. “[Step 2 – Load](#),” on page 25.
 - c. “[Step 3 – Scout](#),” on page 28.
2. Complete step 4, as described in “[Step 4 – Scan](#),” on page 41.
Be sure to set up both *basic* and *advanced 3D scan parameters*.
Enabling of HART is included in the advanced 3D scan parameters.



NOTE Advanced 3D scan parameters are new to the Xradia 520 Versa, and specifically described in “[To set up the advanced \(HART\) 3D scan parameters](#),” on page 43.

Setting up and Using a Wide Field Mode Recipe

Wide Field mode allows users to image samples that are larger than 50 mm.

Wide Field mode can also be used to collect a tomography with a smaller voxel size and at a higher resolution for the same field of view.

A set of two tomographies are collected for each tomography point. Two datasets are stitched together at the end of data collection, to form a single tomography:

- Approximately 2K x 1K voxels for a dataset with a binning value of 2, –or–
- Approximately 4K x 2K voxels for a dataset with a binning value of 1

The reconstruction process (such as setting center shift and beam hardening correction) is the same as that used for Normal Field mode datasets. The sample stage is moved and also slightly rotated at each angle during acquisition, however, to calculate angles from the X-ray source for each image acquisition.

To set up and use a Wide Field mode recipe



NOTE The process described here references the steps described in “[Creating and Running a New Recipe](#).”

1. **Sample** – Complete “[Step 1 – Sample](#),” on [page 23](#).
2. **Load** – Follow steps [a](#) and [b](#) below, to load and roughly position the sample with the Visual Light Camera. Refer also to “[Step 2 – Load](#),” on [page 25](#).
 - a. Move the X-ray source and detector distances to *-100 mm* and *100 mm*, respectively, for a large sample, to ensure that the X-ray source and/or detector do not collide with the sample.
 - b. Ensure that the *sample* is roughly positioned within the center of the *field of view (FOV)*, at both 0° and -90°.

3. **Scout** – Follow steps [a](#) through [f](#) below, to set the *pixel size*, *FOV*, *X-ray filter*, and other *imaging parameters*. Refer also to “[Step 3 – Scout](#),” on page 28.
 - a. In Normal Field mode, center the *sample* with both 0 and -90°. Adjust the X-ray source and detector distances so that the Scout image at 0° covers approximately 50% of FOV (for example, if the FOV is 40 x 20 mm in Wide Field mode, ensure that the FOV is 20 x 20 mm, which makes the pixel size approximately 20 μ m). The X-ray Source and detector should be at least 120 to 130 mm apart, to avoid seeing the X-ray source aperture within the FOV.

Figure 2-16 Typical **Scout** View – Normal Field Mode (Before Changing to Wide Field Mode)



- b. Select the *X-ray filter*, *energy/power*, and *camera binning*. The process for determining which *X-ray filter* to use is described in “[Scout – Select Proper X-ray Filter and kV](#),” step 6, on page 35. A binning value of 2 is always recommended for a better signal-to-noise ratio and faster total imaging time.

- c. In the **Acquisition** tab within the **Edit Recipe Points for Sample** panel, select *Wide* from the **Field Mode** drop-down list box, then click **Apply**.
- d. Click  to collect a single image (Continuous mode is not supported by Wide Field mode). The *Wide Field Mode image* appears in a single **View** display.
- e. If you wish to view the original FOV with a smaller voxel size and at a higher resolution, move the detector away from the sample until the FOV in Wide Field Mode is the same as it was in Normal Field Mode.

 **NOTE** In Normal Field mode, the image appears in two displays (**Front** and **Side View**); however, in Wide Field mode, the image appears in only one display.

Figure 2-17 Typical **Scout** View – Wide Field Mode

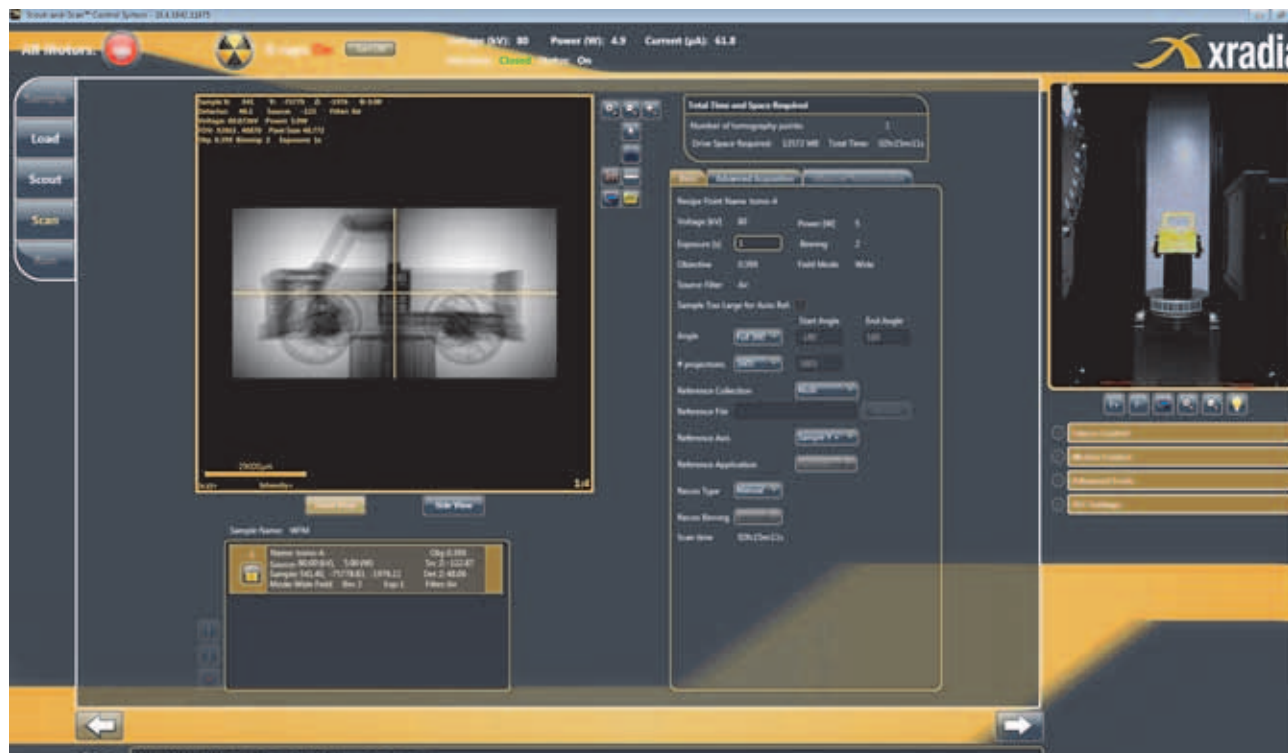


- f. Select an appropriate *exposure time* to acquire sufficient light intensity (less than 60000) within the image, for tomography data collection.

 **NOTE** Ensure that the sample can be moved completely out of the FOV to collect a reference image. If not, select the **Sample too large for auto ref.** check box.

4. **Scan** – Follow steps **a** through **c** below, to set the *scanning* and *reconstruction* parameters. Refer also to “Step 4 – Scan,” on page 41.

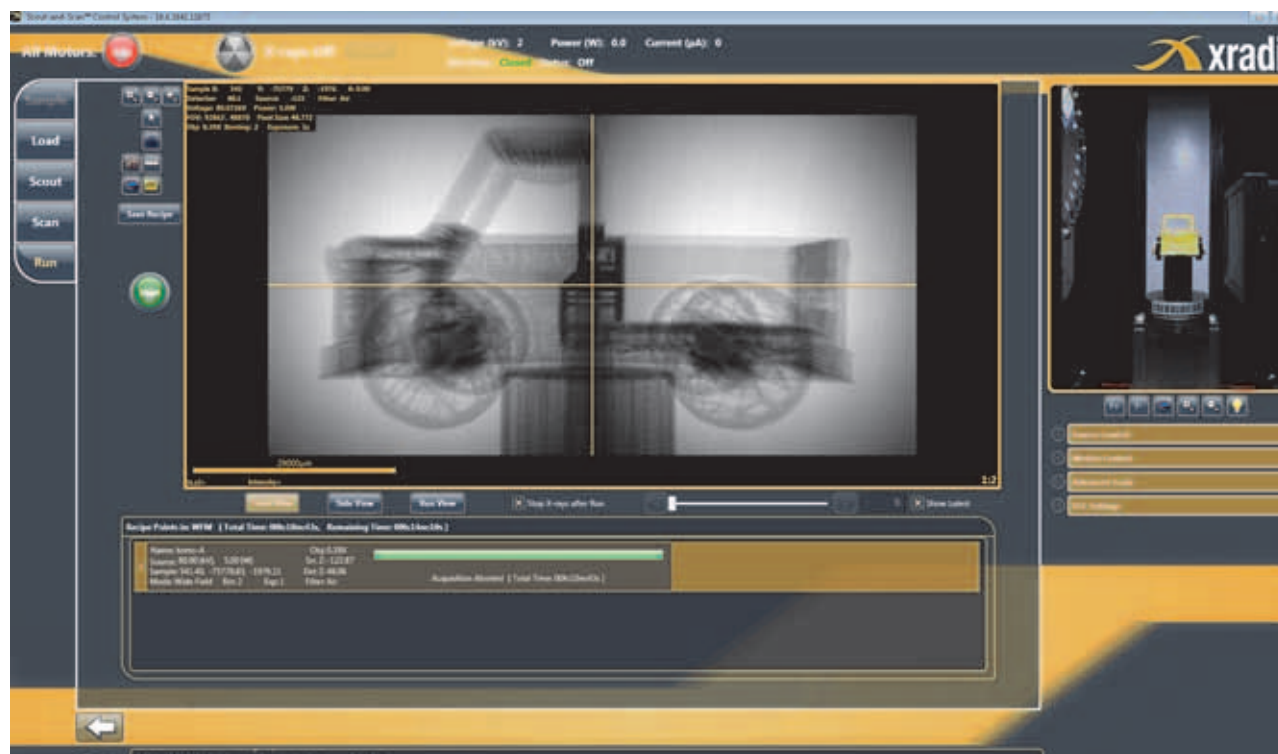
Figure 2-18 Typical **Scan** View – Wide Field Mode



- a. Select *single ref.* from the **Reference Application** drop-down list box.
- b. Select *Y Axis +* from the **Reference Axis** drop-down list box, to help prevent sample drift/motion.
- c. Select *temperature* from the **Drift Correction** drop-down list box.

5. **Run** – Start the recipe. Refer to “Step 5 – Run,” on page 45.

Figure 2-19 Typical **Run** View – Wide Field Mode

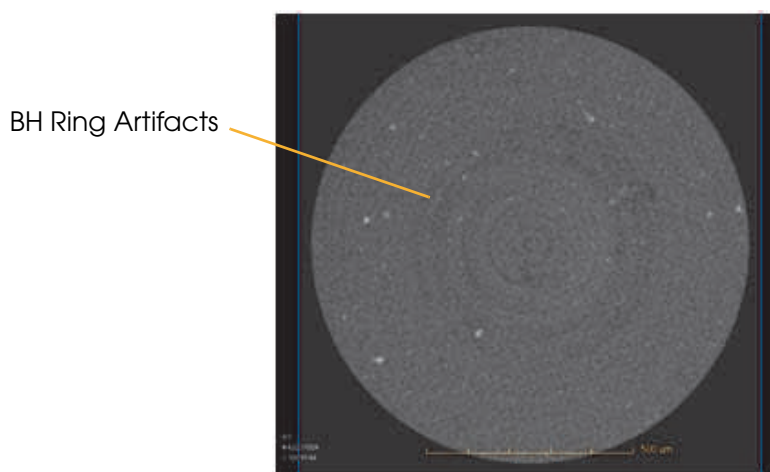


Setting up and Using a Filtered Secondary Reference for Ring Artifact Reduction

X-rays passing through different materials have different attenuations. While this can provide high imaging contrast in a wide variety of materials, it can also contribute to unwanted artifacts when the reference image does not match well with the scanned sample image. This type of artifact can be considered one type of beam hardening (BH) effect. When a reference image contains BH effects that differ from the scanned sample image, the result can appear as diffuse ring artifacts within the reconstructed data. This phenomenon is most prominent when no filter is used for the original tomography or in low-attenuating, uniform materials. [Figure 2-20](#) is an example of a reconstructed slice that shows this type of ring artifact.

Physical filtering is recommended during the original scan, to modify the beam for both the reference and tomography. Images acquired using physical filters are less susceptible to diffuse ring artifacts than images acquired without using a filter. However, in some cases, it is necessary to minimize physical filtering to maximize overall image contrast. Therefore, additional filtering of the reference might be needed to reduce BH ring artifacts within an image. BH ring artifacts can be significantly reduced by collecting a correctly filtered secondary reference, and then applying that reference to the data.

Figure 2-20 BH Ring Artifacts Visible in Reconstructed Image



The process for setting up and using a secondary reference varies, depending on the Xradia Versa model:

- [Setting up and Using a Filtered Secondary Reference – Xradia 520 Versa](#)
- [Setting up and Using a Filtered Secondary Reference – Xradia 510 Versa and Xradia 410 Versa](#)



NOTE The processes described within this section use the Scout-and-Scan Control System and XMReconstructor program, as well as the legacy XMController program. Most are performed using the Scout-and-Scan Control System, unless indicated otherwise.

Setting up and Using a Filtered Secondary Reference – Xradia 520 Versa

Proper collection and application of a filtered secondary reference follows these basic steps:

1. **Determine the correct X-ray filter** – Select a physical filter that matches the sample's average attenuation, then collect the secondary reference using this filter in the **Scout** tabbed view of the Scout-and-Scan Control System. **The quantity of light intensity counts with the secondary filter in place should be within approximately 20% of the counts of the sample image.**
2. **Collect the secondary reference** – Set up the secondary reference's parameters in the **Advanced Acquisition** tab, located in the **Scan** tabbed view of the Scout-and-Scan Control System.
3. **Apply the secondary reference** – Use XMReconstructor, during reconstruction, to apply the filtered secondary reference collected while using the Scout-and-Scan Control System.

To determine the correct X-ray filter to use for the secondary reference



NOTE It is best to collect the secondary reference immediately after collecting the original tomography, **without moving the X-ray source or detector**, to maximize the secondary reference's effectiveness. The Scout-and-Scan Control System allows selecting of the X-ray filter during tomography setup, and automatically acquires the secondary reference after each scan. It is recommended that a secondary reference be automatically collected after acquiring each tomography point, using that same filter, in case the reference is needed later.

1. Use the processes described in [“Creating and Running a New Recipe,” on page 22](#) to set up a *tomography point*, using the Scout-and-Scan Control System. Make note of the *acquisition parameters* and *X-ray filter used during data acquisition*.
2. Follow steps **a** through **c** below, to determine the sample's average *light intensity counts*:
 - a. In the Scout-and-Scan Control System, click the **Scout** tab to return to **Scout** view.
 - b. Using the same parameters as determined for acquisition of the tomography, click  to collect a single image.
 - c. Within the **Front** or **Side View** image display, position the cursor over the center of the *image* to display the average intensity counts (AIC) in that area. The value for this appears in **blue**, at the lower left of the image. **This number is the value you are aiming to match, within approximately 20%, with the secondary filter in place.**



NOTE For samples with high aspect ratios (samples that are much wider than thick), select a projection that is at least 45 degrees to the normal in order to obtain values that will better represent the entire tomography.

3. Select the **Acquisition** tab within the **Edit Recipe Points for Sample** panel, to identify the X-ray filter used in the original tomography's data acquisition.

Figure 2-21 Acquisition Tab within Scout View's Edit Recipe Points for Sample Panel Identifies the X-ray Filter Used during Acquisition

In step 3, identify the X-ray filter used in the original tomography's data acquisition.

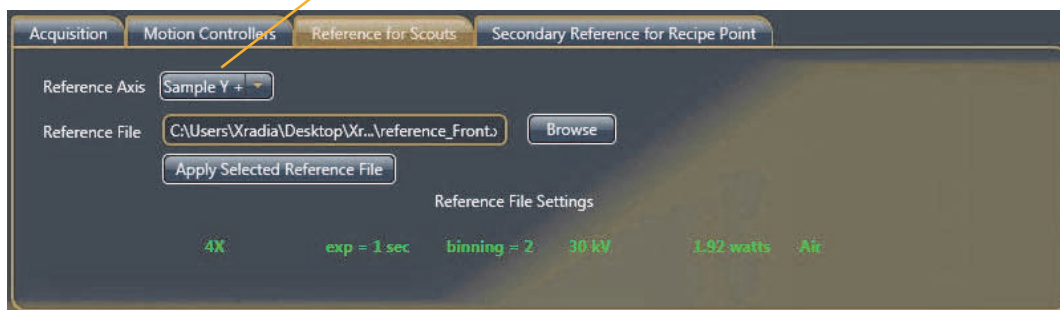


4. Select the **Reference for Scouts** tab within the **Edit Recipe Points for Sample** panel, then select the *reference axis upon which to position the sample during reference acquisition* from the **Reference Axis** drop-down list box.

NOTE By default, *Sample Y+* is chosen to move the sample below the beam line to acquire the reference. If the sample is too tall for the default settings, use *Sample X-* or *Sample X+*.

Figure 2-22 Use Reference for Scouts Tab within Scout View's Edit Recipe Points for Sample Panel to Indicate Reference Axis

In step 4, select the *reference axis upon which to position the sample during reference acquisition*.



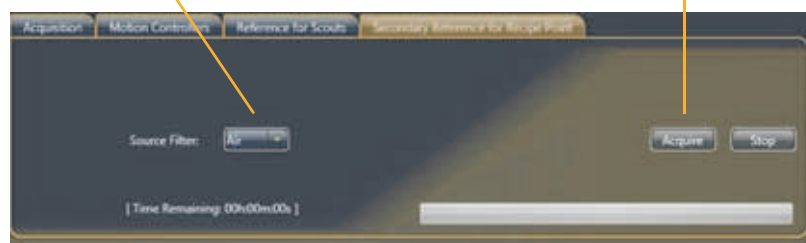
5. Select the **Secondary Reference for Recipe Point** tab within **Scout** view's **Edit Recipe Points for Sample** panel, then select a *filter* from the **Source Filter** drop-down list box that is *N+2 higher* than the *filter used to acquire the original tomography*. For example:
 - If a filter was not used during acquisition, select the LE2 filter
 - If the LE2 filter was used during acquisition, select the LE4 filter

 **NOTE** The process for selecting an X-ray filter during data acquisition is provided in “[Scout – Select Proper X-ray Filter and kV](#),” step 6, on page 35.

Figure 2-23 **Secondary Reference for Recipe Point Tab within Scout View's Edit Recipe Points for Sample Panel**

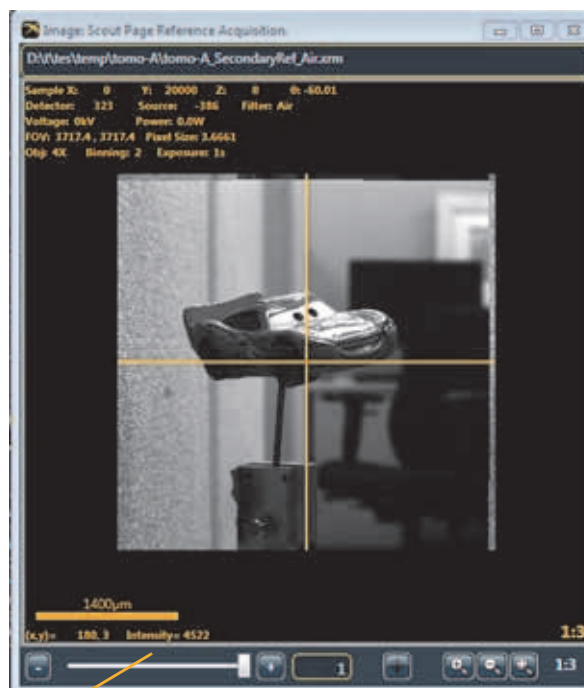
In step 5, select a *filter* that is *N+2 higher* than the *filter used to acquire the original tomography*.

In step 6, click **Acquire** to collect a secondary reference.



6. Click **Acquire** to collect a secondary reference. An **Image: Scout Page Reference Acquisition** window opens, displaying the filtered secondary reference images.

Figure 2-24 Typical **Image: Scout Page Reference Acquisition** Window, Displaying the Filtered Secondary Reference Images



In step 7, compare the **Intensity** value (light intensity counts) against the original tomography's light intensity counts.

✓ NOTE To collect a correct secondary reference, the image acquisition and secondary reference acquisition parameters must be the same to work properly.

7. Position the cursor over the center of the *newly filtered image* to display the **Intensity** (light intensity counts) value, located at the lower left of the image. **This number should be within approximately 20% of the counts from the sample image collected in step 2.** If the counts are too high or low:
 - **Secondary reference's *light intensity counts* are too high** –
Select a *stronger X-ray filter* (for example, if you used LE2 in step 5, try using LE3 instead), then repeat steps 5 through 7
 - **Secondary reference's *light intensity counts* are too low** –
Select a *weaker X-ray filter* (for example, if you used LE2 in step 5, try using LE1 instead), then repeat steps 5 through 7

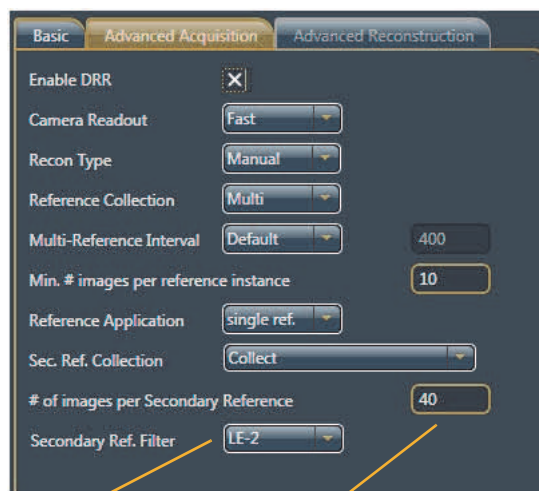
When finished, proceed to “[To collect a secondary reference.](#)”

To collect a secondary reference

1. In the Scout-and-Scan Control System, click the **Scan** tab to return to **Scan** view.
2. Select the **Advanced Acquisition** tab, then follow steps **a** and **b** below, to review the secondary reference's *settings*:
 - a. The X-ray filter to use for collecting the secondary reference should be selected by default. Ensure that the **Secondary Ref. Filter** drop-down list box correctly indicates the X-ray filter selected in “To determine the correct X-ray filter to use for the secondary reference,” step 7, on page 61.
 - b. Verify that the secondary reference is comprised of an average of at least *40 images* (default).

Proceed to “To apply the secondary reference.”

Figure 2-25 Secondary Reference Settings Indicated in **Advanced Acquisition** Tab within **Scan** View



In step 2a, verify that the correct X-ray filter is listed for the secondary reference.

In step 2b, verify that the # of images listed is at least 40.

To apply the secondary reference

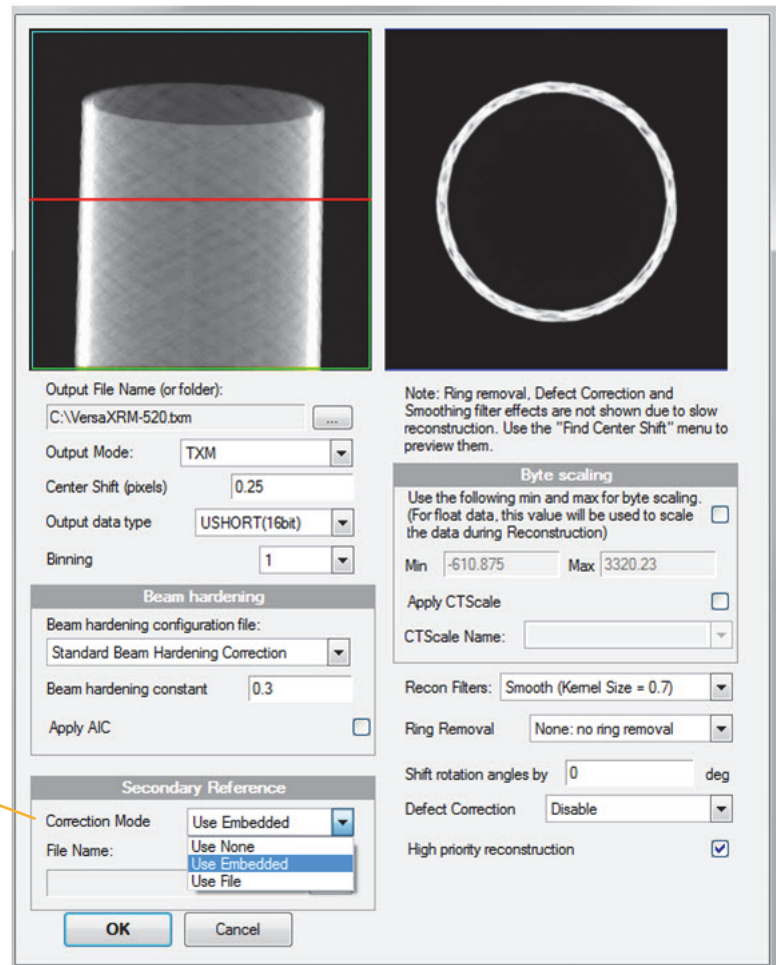
1. Start **XMReconstructor**, then open the *tomography file (*.txrm)* to be reconstructed, for which you have previously collected a secondary reference.

 **NOTE** Instructions for starting **XMReconstructor** and opening a tomography file are provided in “Preparing for Reconstruction,” on page 97, in Chapter 3.

2. Click  in the icon toolbar. The **Reconstruction Setting** dialog box opens, defaulted to the file’s *reconstruction settings*.

Figure 2-26 XMReconstructor **Reconstruction Setting** Dialog Box

In step 3, verify that *Use Embedded* is selected in the **Correction Mode** drop-down list box (default).



3. In the **Secondary Reference** area, *Use Embedded* (default) should already be selected if the secondary reference was included in the tomography recipe. Alternatively:
 - **If a different secondary reference file exists that you want to use** – Select *Use File* from the **Correction Mode** drop-down list box, then navigate to and open that *file*.



NOTE Instructions for using the **Use File** option are provided in the “To apply the secondary reference,” step 3, on page 77 (Xradia 510 Versa and Xradia 410 Versa instructions).

- **If a secondary reference is not required for reconstruction** – Select *Use None* from the **Correction Mode** drop-down list box.
4. Proceed with the standard steps to reconstruct the tomography file, as described in “Reconstructing the Tomography Data,” on page 110, in Chapter 3.
 5. Upon completing the reconstruction process, the results should show a significant decrease in the presence of diffuse rings. Figure 2-27 through Figure 2-29 show three examples of 2D reconstructed slices, before and after a secondary reference is correctly applied.

Figure 2-27 2D Reconstructed Slices of a Bubble in Wax, before and after a Secondary Reference Is Correctly Applied

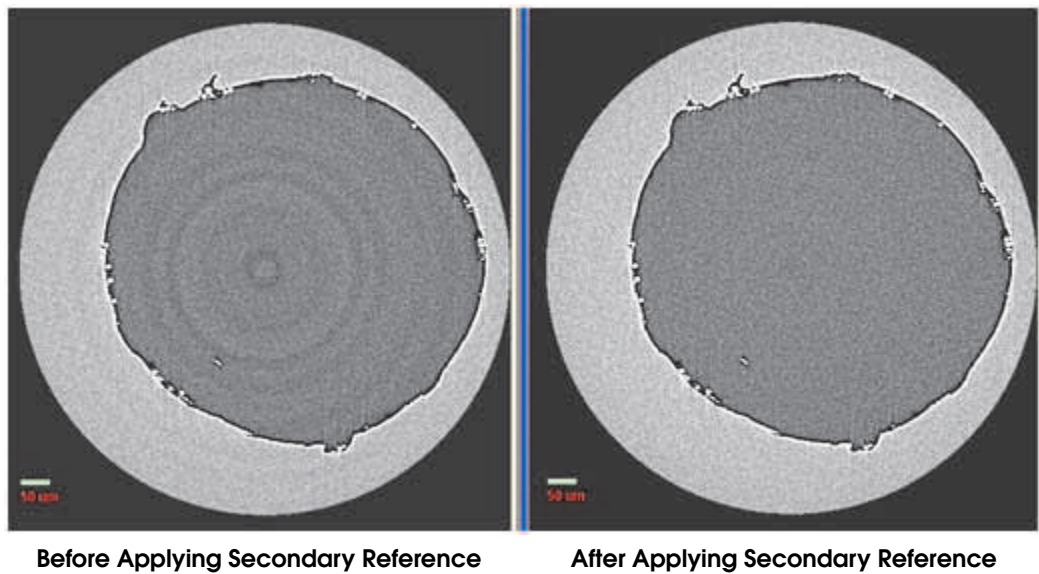


Figure 2-28 2D Reconstructed Slice of a High Aspect Ratio Composite Material, before and after a Secondary Reference Is Correctly Applied

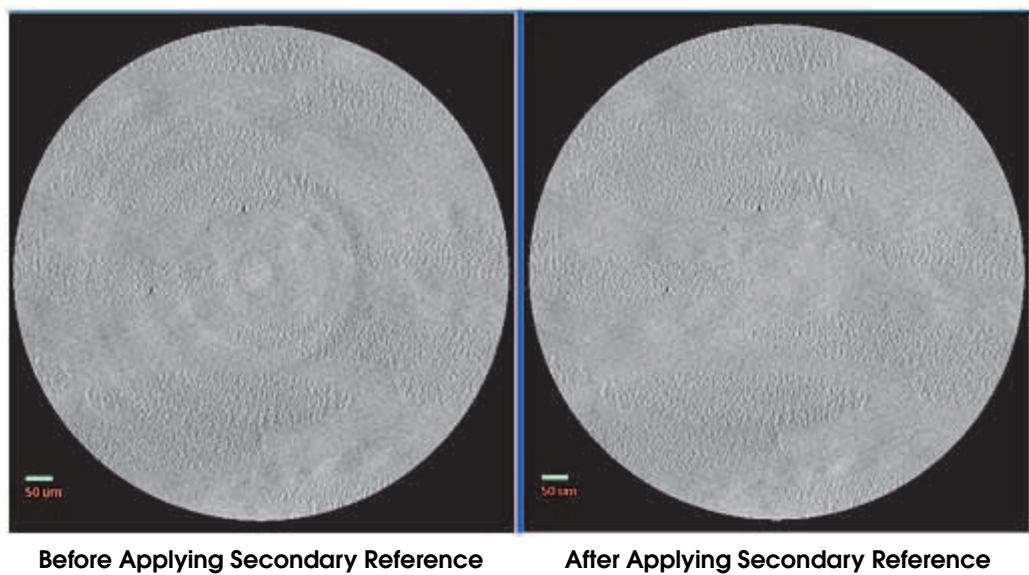
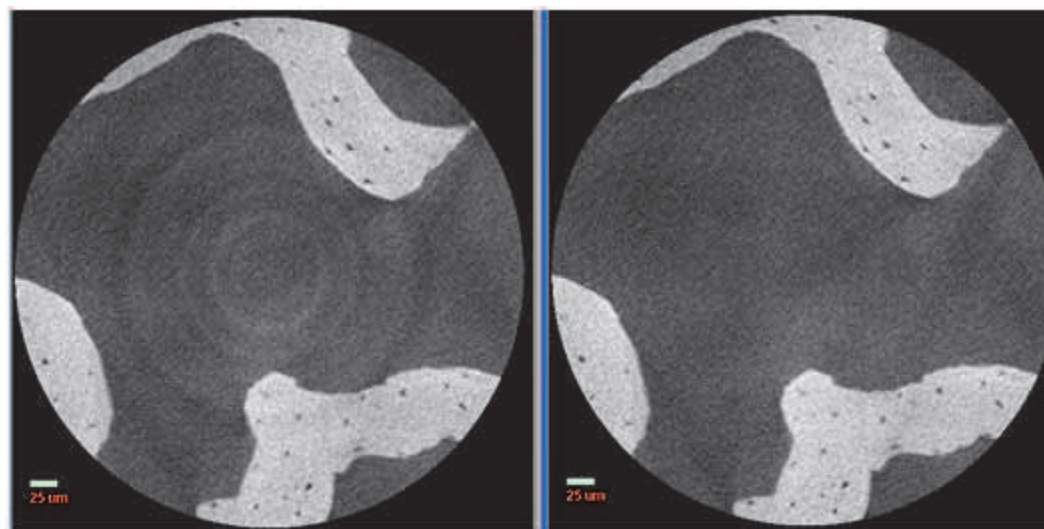


Figure 2-29 2D Reconstructed Slice of a High Resolution Bone, before and after a Secondary Reference Is Correctly Applied



Before Applying Secondary Reference

After Applying Secondary Reference

Setting up and Using a Filtered Secondary Reference – Xradia 510 Versa and Xradia 410 Versa

Proper collection and application of a filtered secondary reference follows these basic steps:

1. **Determine the correct X-ray filter** – Select a physical filter that matches the sample's average attenuation. **The quantity of light intensity counts with the secondary filter in place should be within approximately 20% of the counts of the sample image.** It is best to collect the secondary reference immediately after collecting the original tomography, **without moving the X-ray source or detector**, to maximize the secondary reference's effectiveness.
2. **Collect the secondary reference** – Determine the secondary reference parameters, and then collect the secondary reference, in the **Secondary Reference for Recipe Point** tab, located in **Scout** view of the Scout-and-Scan Control System.
3. **Apply the secondary reference** – Use XMReconstructor, during reconstruction, to apply the filtered secondary reference collected while using the Scout-and-Scan Control System.

To determine the correct X-ray filter to use for the secondary reference

1. Use the processes described in “[Creating and Running a New Recipe](#),” on [page 22](#) to set up a *tomography point*, using the Scout-and-Scan Control System. Make note of the *acquisition parameters* and *X-ray filter used during data acquisition*.
2. After completing tomography collection in **Run** view, click the **Scout** tab to return to **Scout** view.
3. Select the **Acquisition** tab within the **Edit Recipe Points for Sample** panel, then click **Apply** to apply the *current acquisition settings* from the recipe point.

Figure 2-30 Typical **Acquisition** Tab within **Scout** View’s **Edit Recipe Points for Sample** Panel



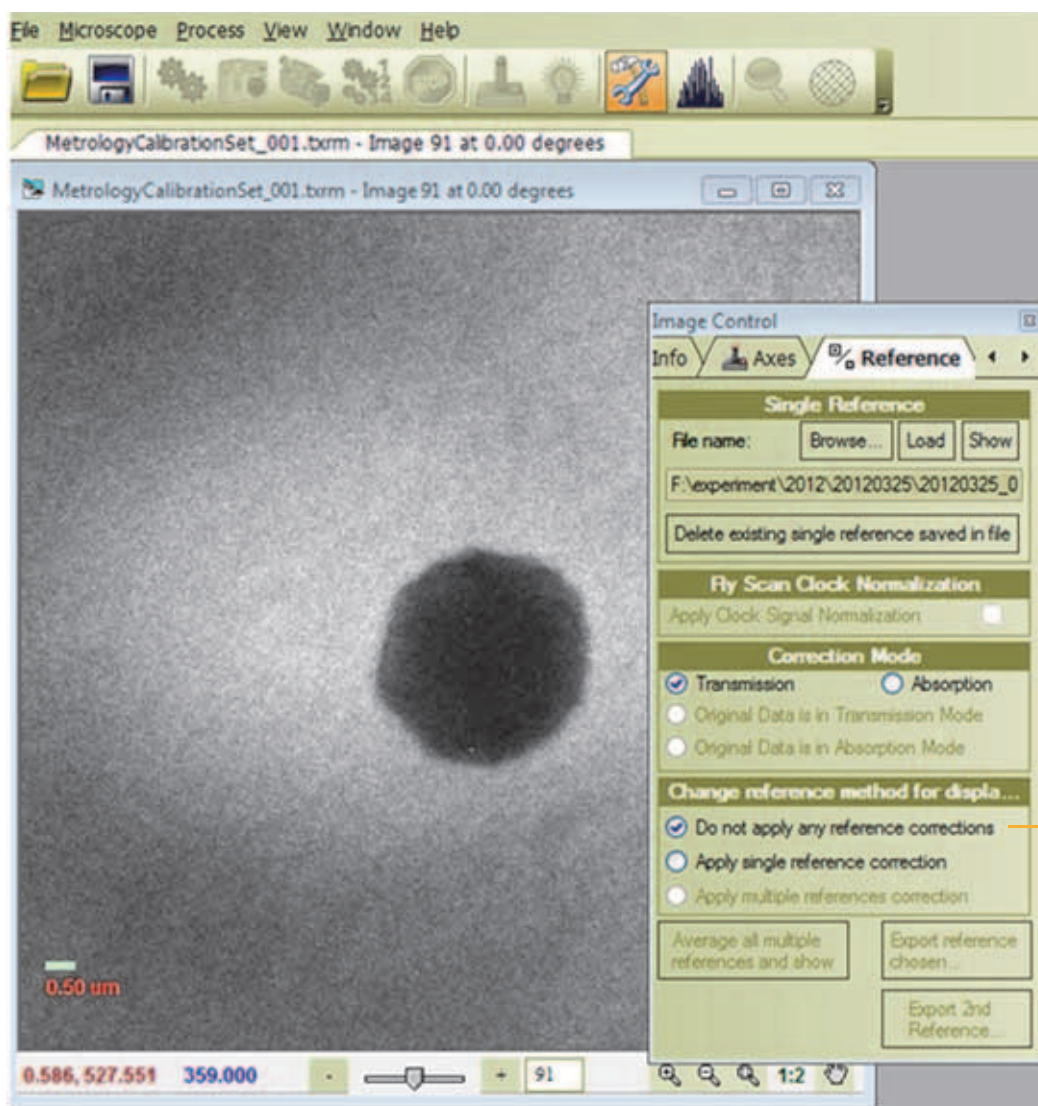
4. If the average light intensity counts of the original tomography are unknown, follow steps [a](#) through [e](#), to determine the *light intensity counts*:
 - a. Click the **Run** tab to return to **Run** view.
 - b. Right-click the *original tomography*, then select **Export to XMController** to open the tomography in the legacy XMController program.
 - c. In XMController, use the **Image** window to scan to the 0° image. If **Variable Exposure Time** was selected in **Scan** view's **Advanced Acquisition** tab when the tomography was acquired, select an *image that has the same Exposure setting previously used in Scout view's Advanced Acquisition tab*.

 **NOTE** For samples with high aspect ratios (samples that are much wider than thick), select a *projection* that is at least 45° relative to the wide and thin view of the sample, to obtain values that better represent the entire tomography.

 **NOTE** XMController **Image** window controls are described in “Image Window Controls – XMController and XMReconstructor” on page 256 in Appendix D of the legacy *VersaXRM-500 User's Guide*.

- d. Select *Do not apply any reference corrections* in the **Reference** tab within the **Image Control** dialog box, to remove any associated *reference image* from the tomography file.

Figure 2-31 Typical **Reference** Tab within Legacy XMController Program's **Image Control** Dialog Box



In step 4d,
select
this option.

- e. Position the cursor over the center of the image, then estimate the *average number of light intensity counts* within this area. The **blue** number at the bottom left of the image corresponds to the quantity of counts. **This is the number you are aiming to match, within approximately 20%, with the secondary filter in place.**

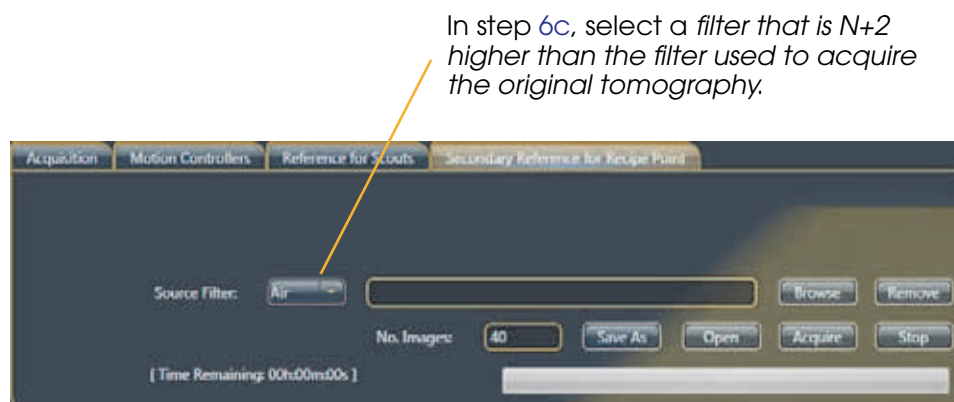
5. Remove the *sample* and *X-ray filter* from the Xradia Versa, without moving any scanning parameters.

 **NOTE** Instructions for removing the sample are provided in “[Removing a Sample after Use](#),” on page 275, in Appendix E. Instructions for removing an X-ray filter are provided in Appendix F, “[Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa](#),” step 4a, on page 278.

6. Follow steps **a** through **d** below, to select and install the *X-ray filter* to use for the *secondary reference*:
 - a. In the Scout-and-Scan Control System, click the **Scout** tab to return to **Scout** view.
 - b. Select the **Secondary Reference for Recipe Point** tab within **Scout** view’s **Edit Recipe Points for Sample** panel.
 - c. Select a *filter* from the **Source Filter** drop-down list box that is *N+2 higher* than the *filter used to acquire the original tomography*. For example:
 - If a filter was not used during acquisition, select the LE2 filter
 - If the LE2 filter was used during acquisition, select the LE4 filter

 **NOTE** The process for selecting an X-ray filter during data acquisition is provided in “[Scout – Select Proper X-ray Filter and kV](#),” step 6, on page 35.

Figure 2-32 **Secondary Reference for Recipe Point** Tab within **Scout** View’s **Edit Recipe Points for Sample** Panel



- d. Manually install the *filter* (determined in step [c](#)) onto the X-ray source.



NOTE Instructions for installing an X-ray filter are provided in [Appendix F](#), “Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa.”

When finished, proceed to “[To collect a secondary reference.](#)”

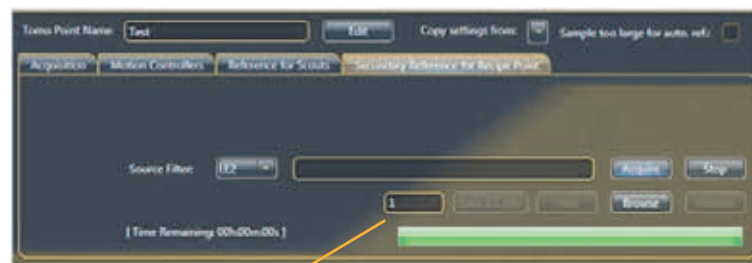
To collect a secondary reference

 **NOTE** If each recipe tomography point has a different objective, the secondary reference collection sequence changes. **Do not change the objective between the tomography and secondary reference acquisition.**

- **Recipe has two tomography points, and both use a different objective** – Collect and save the first secondary reference before the start of the tomography, following the process described below. Finalize the acquisition parameters, then run the tomography from the **Run** tab. After the tomography is complete, follow the process described below to collect and save the secondary reference for the second tomography point.
- **Recipe has three tomography points, and each uses a different objective** – Collect and save the secondary reference for the first tomography point. Next, run the tomography from the **Run** tab. Then, follow the process described below to collect and save the secondary reference for the third tomography point. After the tomography is complete, apply the parameters used during the second tomography point in the **Acquisition** tab within the **Edit Recipe Points for Sample** panel in Scout view. Finally, follow the process described below to collect and save the secondary reference for the second tomography point.

1. Select the **Secondary Reference for Recipe Point** tab within Scout view's **Edit Recipe Points for Sample** panel.
2. Type **1** in the text box, then click **Acquire** to collect a secondary reference. An **Image: Scout Page Reference Acquisition** window opens, displaying the filtered secondary reference.

Figure 2-33 Secondary Reference for Recipe Point Tab within Scout View's Edit Recipe Points for Sample Panel



In step 2, type **1** in the text box, then click **Acquire**.

Figure 2-34 Typical **Image: Scout Page Reference Acquisition** Window, Displaying the Filtered Secondary Reference



In step 3, compare the **Intensity** value (light intensity counts) against the original tomography's light intensity counts.

3. Compare the Intensity value (*light intensity counts*) indicated in the lower left of the **Image: Scout Page Reference Acquisition** window to the original tomography. Aim to match the original counts within approximately 20% of the counts with the filtered secondary reference. If the counts are too high or low:
 - **Secondary reference's *light intensity counts* are too high** – Select a *stronger X-ray filter* (for example, if you used LE2 in “To determine the correct X-ray filter to use for the secondary reference,” step 6, on page 71, try using LE3 instead), then repeat steps 1 through 3
 - **Secondary reference's *light intensity counts* are too low** – Select a *weaker X-ray filter* (for example, if you used LE2 in “To determine the correct X-ray filter to use for the secondary reference,” step 6, on page 71, try using LE1 instead), then repeat steps 1 through 3

4. Type *40* in the text box, then click **Acquire** to collect a additional reference images. Another **Image: Scout Page Reference Acquisition** window opens, displaying the filtered secondary reference images.
5. Click **Save** to save the *filtered secondary reference* (for example, *LE2_secondary_ref.xrm*). Save the *file* to a *folder that you can easily access later*.

Proceed to [“To apply the secondary reference.”](#)

To apply the secondary reference

 **NOTE** Repeat this process for each secondary reference and tomography point pair.

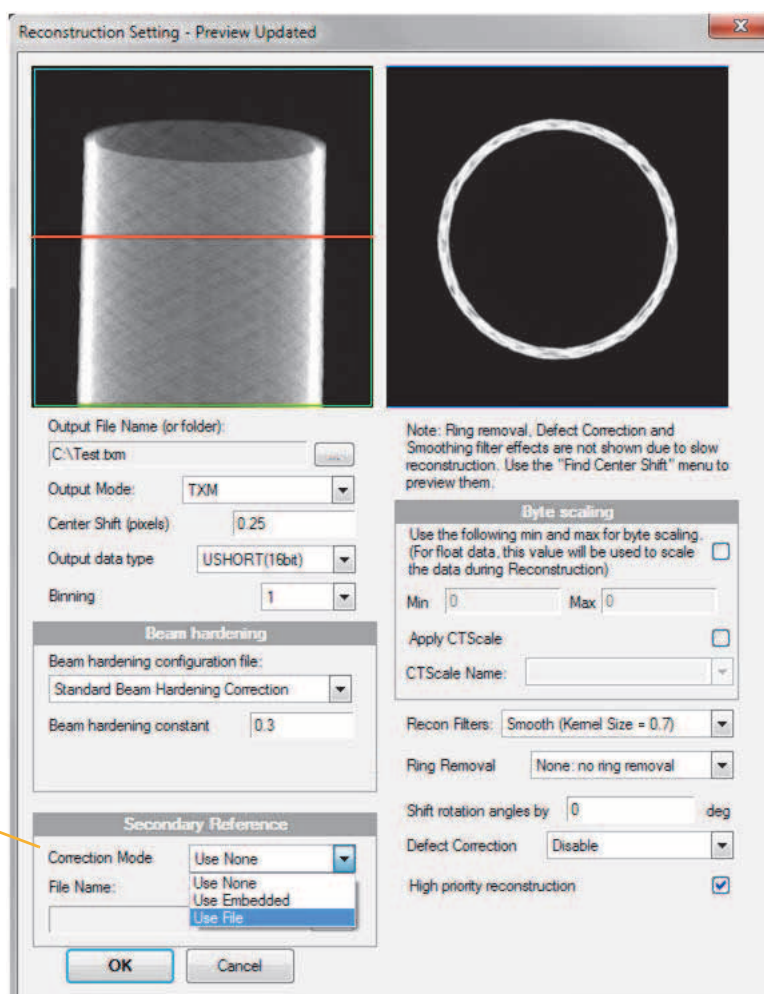
1. Start **XMReconstructor**, then open the *tomography file (*.txrm) to be reconstructed, for which you have previously collected a secondary reference*.

 **NOTE** Instructions for starting **XMReconstructor** and opening a tomography file are provided in “[Preparing for Reconstruction](#),” on page 97, in Chapter 3.

2. Click  in the icon toolbar. The **Reconstruction Setting** dialog box opens, defaulted to the file’s *reconstruction settings*.

Figure 2-35 XMReconstructor **Reconstruction Setting** Dialog Box

In step 3a, select *Use File* from the **Correction Mode** drop-down list box.



3. Follow steps [a](#) through [d](#) below, to open the *filtered secondary reference* previously collected for this tomography file:
 - a. In the **Secondary Reference** area, select *Use File* from the **Correction Mode** drop-down list box.
 - b. Click ... (directly below the drop-down list box).
 - c. Browse to the *destination file path* of the *filtered secondary reference* (*.xrm file) saved in “[To collect a secondary reference,](#)” step [5](#), on page [75](#).
 - d. Select the *file*, then click **Open**. The selected file’s *name* appears in the **File Name** text box.
4. Proceed with the standard steps to reconstruct the tomography file, as described in “[Reconstructing the Tomography Data,](#)” on page [110](#), in [Chapter 3](#).
5. Upon completing the reconstruction process, the results should show a significant decrease in the presence of diffuse rings. [Figure 2-36](#) through [Figure 2-38](#) show three examples of 2D reconstructed slices, before and after a secondary reference is correctly applied.

Figure 2-36 2D Reconstructed Slices of a Bubble in Wax, before and after a Secondary Reference Is Correctly Applied

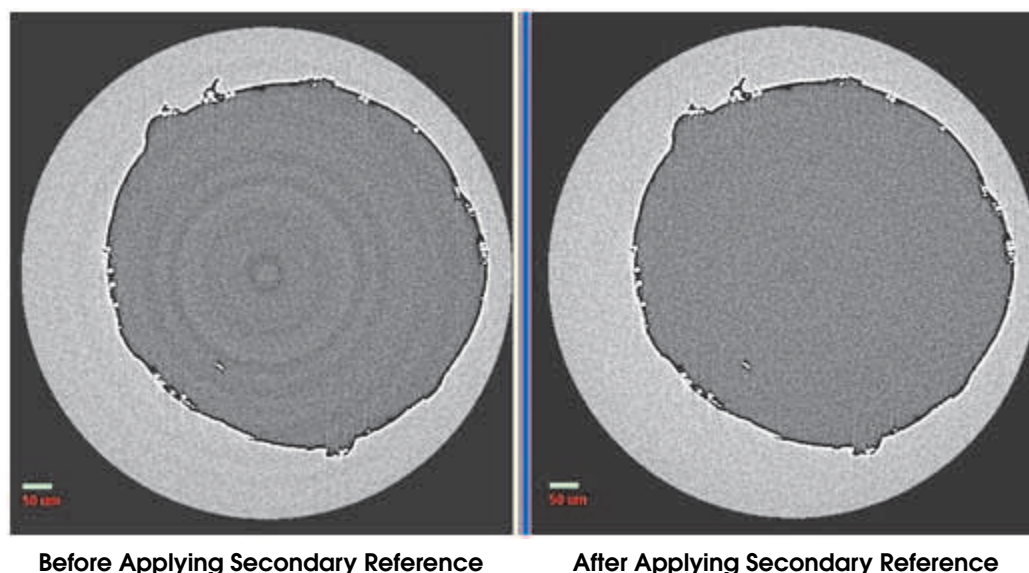


Figure 2-37 2D Reconstructed Slice of a High Aspect Ratio Composite Material, before and after a Secondary Reference Is Correctly Applied

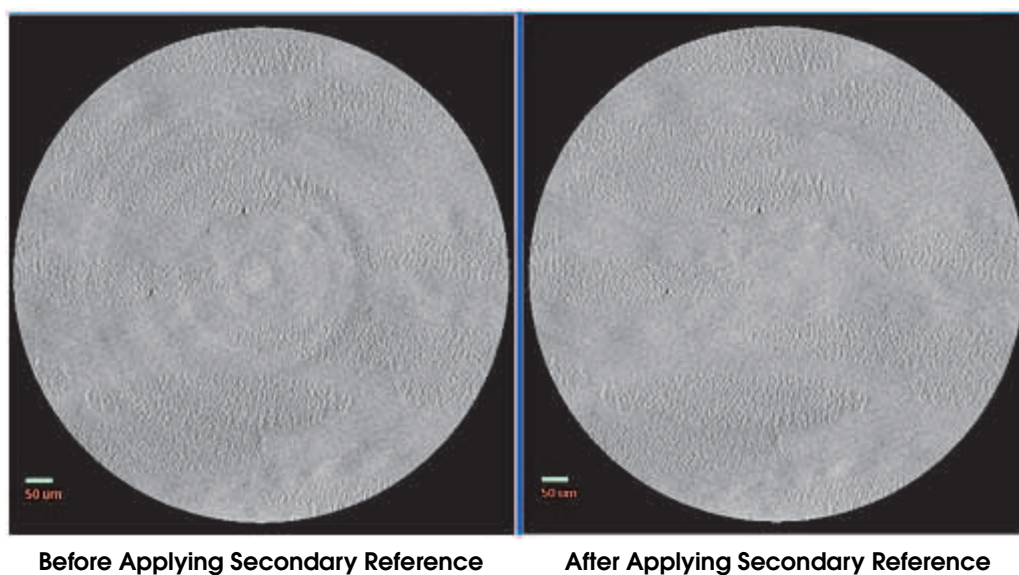
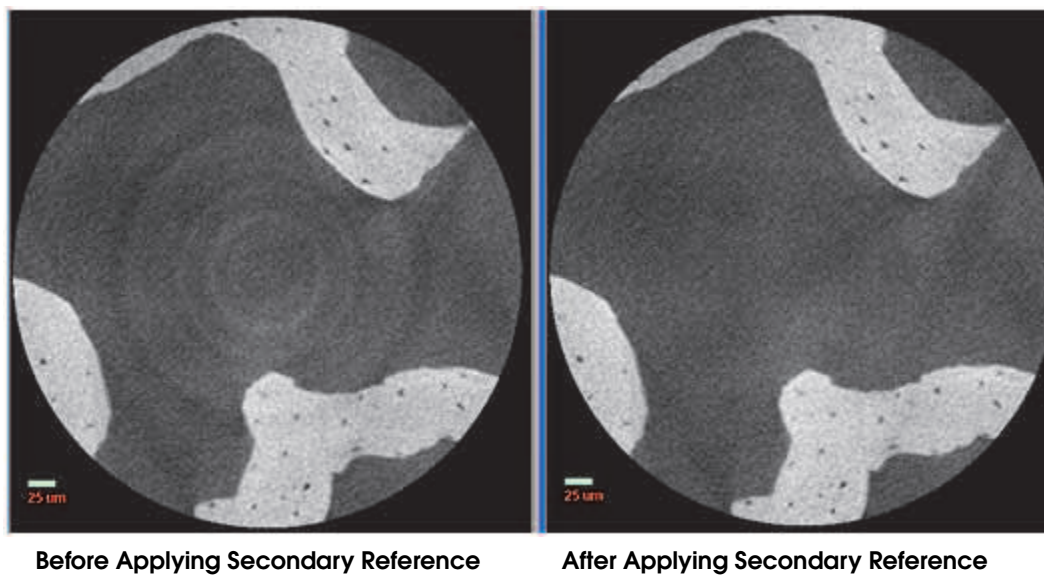


Figure 2-38 2D Reconstructed Slice of a High Resolution Bone, before and after a Secondary Reference Is Correctly Applied



Loading and Running an Existing Recipe or Recipe Template

An existing recipe or recipe template can be re-used if the imaging and scan parameters are suitable for the selected sample. In this case, only the sample position needs to be adjusted to set up the recipe.



NOTE Take care when using existing recipes. Sample size and material dictate the source and detector positions, voltage, filter, and exposure time. Be sure to use the correct recipe to avoid collisions or poor quality of images due to insufficient transmissions or intensity values.

Creating and running an existing recipe or recipe template requires four steps that are represented by four of the five **Scout-and-Scan Control System** tabbed views, as listed in [Table 2-5](#). Each view provides the tools needed to complete the required operations for each step.

Table 2-5 Four Steps to Loading and Running an Existing Recipe or Recipe Template

Scout-and-Scan Control System View Tabs ^a	Step	Operation
	Step 1 – Sample	Set the Sample 's data folder. Load an existing recipe or recipe template.
	Step 2 – Load	Load the sample and roughly position it using the Visual Light Camera.
	Step 3 – Scout	Scout the sample to locate the desired ROI and FOV. The setup of imaging parameters is skipped, because parameters are loaded from the existing recipe or recipe template.
	–	Not used. The Scan step is skipped, because scan parameters are loaded from the existing recipe or recipe template.
	Step 4 – Run	Run the recipe and acquire the tomographies.

- a. After is clicked to access the next view, you can click the tabbed item to move between the active views.

Step 1 – Sample

This process describes how to use **Sample** view to set the sample's data folder and load an existing recipe.

NOTE For in-depth information that describes **Sample** view, refer to “[Sample View](#),” on page 210, in Appendix D.

To set the sample's data folder and load an existing recipe or recipe template

1. Start the Scout-and-Scan Control System, if it is not already running. The program opens, defaulted to **Sample** view.

NOTE The screen capture provided below is partially filled in. Although a generic name is being used for the sample name, it is recommended that you use a name that better identifies the sample in use.

Figure 2-39 Typical **Sample** View

2. Click **Browse**, then browse to and select the *output directory* in which to store the sample's data.
3. Type a *name* in the **Sample Name** text box (new sample) –or– click **Browse** (existing sample), then browse for the *sample* to be used.

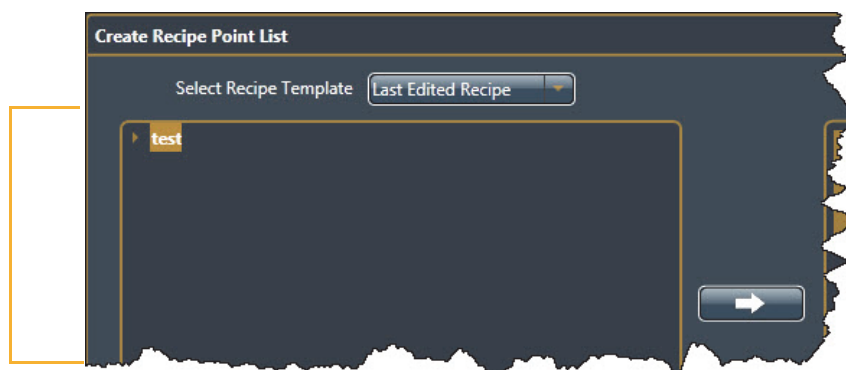
A subfolder is automatically created under the selected *output directory*, in which all acquired data will be stored.

4. **Optional** – Type a *comment* in the **Comment** text box.
5. Select **Existing Recipe...** from the **Select Recipe Template** drop-down list box. An **Open** dialog box opens.
6. Select the *recipe* or *recipe template to load* from the **Open** dialog box.
7. Select the *recipe*, *recipe template*, or *specific tomography points* to be run:
 - **Select the recipe or recipe template** – From the recipe(s) or recipe templates displayed, select the *recipe* or *recipe template* to be run, then click  to add the recipe to the **Current Recipe Points** list.

Figure 2-40 Select Recipe, Recipe Template, or Tomography Points to Be Run

Recipe – Select the *recipe* or *recipe template* to be run, then click the **white arrow button** to add the recipe to the **Current Recipe Points** list

Tomography Points – Click the **gold triangle** (left of recipe), select the *tomography point to add*, then click the **white arrow button** to add the tomography point to the **Current Recipe Points** list



- **Select tomography point(s) within a recipe** – Click  to the left of the *recipe*, select the *tomography point* to be run, then click  to add the tomography point to the **Current Recipe Points** list. Select and add as many tomography points as needed.
8. Click  to proceed to the next tabbed view (**Load**).

Proceed to “[Step 2 – Load.](#)”

Step 2 – Load

This process describes how to use **Load** view to load and roughly position the sample on the axis of rotation and position the detector and X-ray source, using the visual light camera.

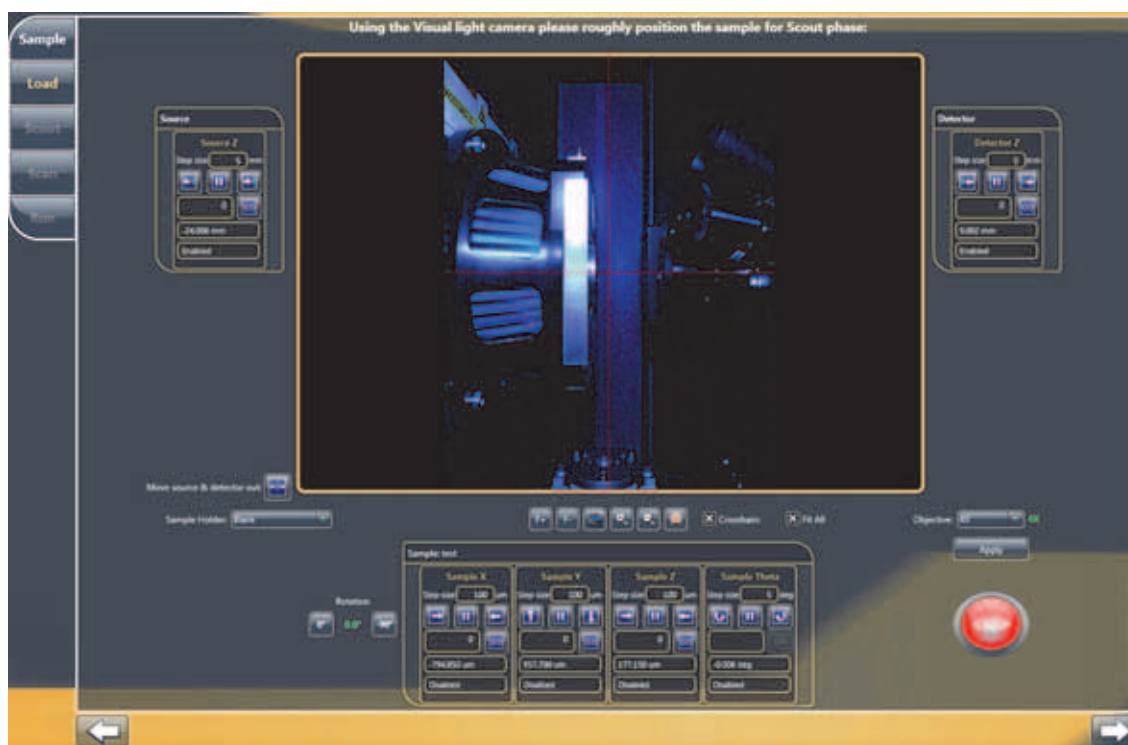
NOTICE If collision is imminent at any time during this process,

click  to immediately stop all motors, or  within a *motion control*, to halt movement for the axis associated with that motion control.

 **NOTE** For in-depth information that describes **Load** view, refer to “Load View,” on page 215, in Appendix D.

 **NOTE** This process is identical to the Load process discussed earlier in this chapter, in “Creating and Running a New Recipe,” on page 22. The process is repeated here for your convenience.

Figure 2-41 Typical **Load** View



To load and roughly position the sample

1. If needed, click  to move the X-ray source and detector away from the sample stage. This should provide sufficient room in which to load the sample holder assembly onto the sample stage.

 **NOTE** If there is insufficient room in which to load the sample holder, click  again. In the **Sample** panel, change the **Sample X**, **Y**, **Z**, and **Theta** axes to 0.

2. Load the sample holder assembly onto the sample stage.

 **NOTE** Instructions for mounting the sample onto the sample holder are provided in [“Mounting a Sample in or on a Sample Holder,” on page 266, in Appendix E](#). Instructions for loading the sample holder assembly (sample mounted on sample holder) onto the sample stage are provided in [“Loading a Sample Holder Assembly onto the Sample Stage,” on page 273, in Appendix E](#).

3. Select *base* from the **Sample Holder** drop-down list box.

 **NOTE** The Xradia Versa’s collision avoidance system is designed to protect against collisions between the sample holder base and X-ray source or detector.

4. Click  to completely zoom out of the *image*.
5. Click  to rotate the sample (**Sample Theta** axis) to 0°. Ensure that the detector and X-ray source are a sufficient distance from the sample, to avoid collision when the sample is rotated.
6. At 0°, under the **Sample** panel, use the **Sample Y** and **Sample Z** tabs to align the *sample* or *feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display:

- Click  and/or  (**Sample Y**) to align the sample vertically
- Click  and/or  (**Sample Z**) to align the sample horizontally

Figure 2-42 Sample Aligned with **Red** Crosshairs, after Adjusting **Sample Y** and **Sample Z**



7. Click  to rotate the sample (**Sample Theta** axis) to -90° . Ensure that the detector and X-ray source are a sufficient distance from the sample, to avoid collision when the sample is rotated.
8. At -90° , under the **Sample** panel, use the **Sample X** tab to align the *sample or feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display. Click  and/or  to align the sample horizontally.
9. Click  to zoom in. Repeat steps 5 through 8 to fine align the *sample or feature of interest on the sample* with the **red** crosshairs on the **Visual Light Camera** image display, at both 0° and -90° .
10. Click  to proceed to the next tabbed view (**Scout**).

Proceed to “[Step 3 – Scout](#).”

Step 3 – Scout

This process describes how to use **Scout** view to scout the sample – locate the sample's ROI and FOV, using X-ray images. It is not necessary to determine new imaging parameters, because the parameters are loaded from the existing recipe or recipe template.

The Scout phase, after loading an existing recipe or recipe template, consists of the following processes:

- a. Scout – Lock Recipe
- b. Scout – Find and Center the ROI at Low Magnification
- c. Scout – Fine-Tune the ROI at High Magnification
- d. Scout – Save Positions to Recipe

NOTICE

If collision is imminent at any time during this process,

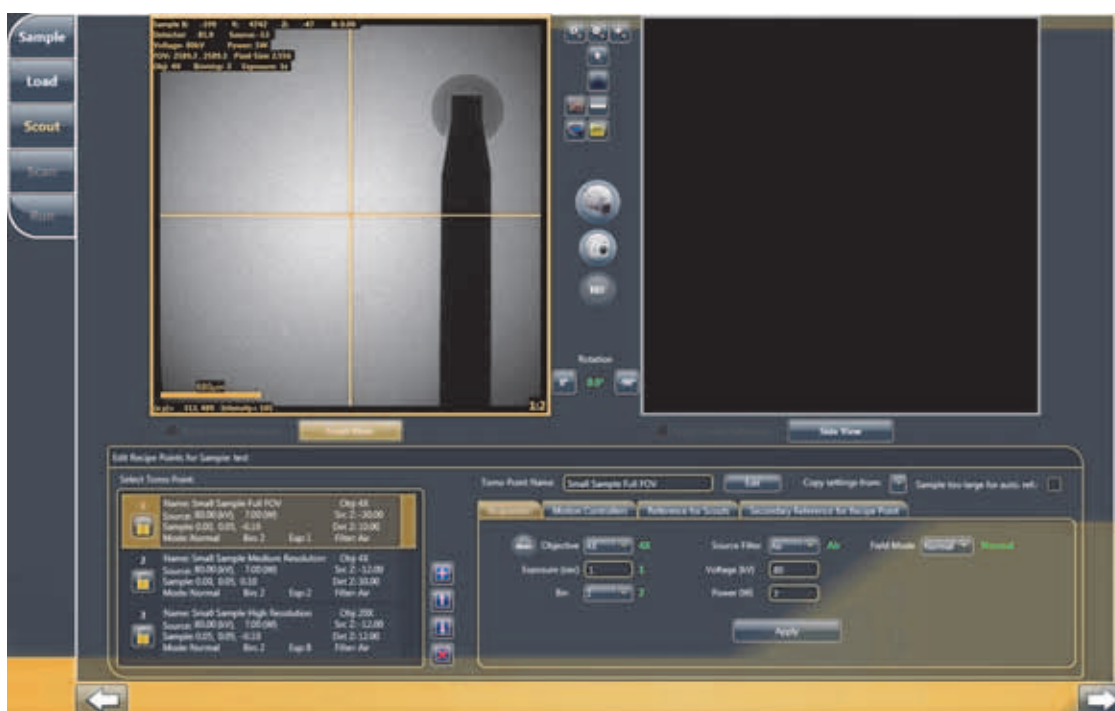


click  to immediately stop all motors, or  within a *motion control*, to halt movement for the axis associated with that motion control.



NOTE For in-depth information that describes **Scout** view, refer to “**Scout View**,” on page 218, in Appendix D.

Figure 2-43 Typical **Scout** View



Scout – Lock Recipe

This process locks the recipe so that it cannot be changed.

To lock the recipe

1. Click  within the *recipe* listed in **Select Tomo Point** area, to lock the recipe that was loaded in “[Step 2 – Load](#),” on page 83.

 **NOTE** Locking prevents the recipe from being changed. The recipe should remain locked until the sample positions are set.

Proceed to “[Scout – Find and Center the ROI at Low Magnification](#).”

Scout – Find and Center the ROI at Low Magnification

This process helps you to locate and roughly center the Sample's ROI, using X-rays. The Sample X, Y, and Z axes are adjusted, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

 **NOTE** For details regarding axes directional movement, refer to “[Axis Definitions](#),” on page 20, in Chapter 1.

To find and center the ROI at low magnification

1. Select the **Acquisition** tab within the **Edit Recipe Points for Sample** panel.

The values displayed are those for the current recipe.

Figure 2-44 Typical **Acquisition** Tab within **Scout** View's **Edit Recipe Points for Sample** Panel



2. Type **1** in the **Exposure (sec)** text box.

 **NOTE** Changing the exposure time speeds up sample positioning, but does not affect the locked recipe's exposure time.

3. Select **Macro** or **4X** for samples smaller than 4 mm from the **Objective** drop-down list box, then click **Apply** to set the Xradia Versa to the new settings.

4. Click  to rotate the sample (**Sample Theta** axis) to 0° and activate the **Front View** image display.

5. Click  to start continuous imaging.

 **NOTE** If necessary, move the detector (**Detector Z**) closer to the sample, to increase the FOV. You can start moving the Source (**Source Z**) away from the sample, to continue increasing the FOV.

6. Double-click the *center of the sample or feature of interest on the sample* within the **Front View image**, to automatically position the ROI to the center of the **Front View** image display.

The ROI is now roughly centered for the Sample X and Y axes. The message **Image different from recipe point** appears on the image. This is expected because the recipe is locked.

Figure 2-45 ROI Roughly Centered for Sample X and Y Axes, with **Image different from recipe point** Message



7. Click  to halt continuous imaging.
8. Click  to rotate the sample (**Sample Theta** axis) to -90° and activate the **Side View** image display.
9. Click  to start continuous imaging.

10. Double-click the horizontal **red** line of the crosshair within the **Side View image** to automatically position the ROI to the center of the screen without changing the Y axis position.

The ROI is now roughly centered for the Sample Z axis. The message **Image different from recipe point** appears on the image. This is expected because the recipe is locked.

Figure 2-46 ROI Roughly Centered for Sample Z Axis, with **Image different from recipe point** Message



11. Click  to halt continuous imaging.

Proceed to “**Scout – Fine-Tune the ROI at High Magnification.**”

Scout – Fine-Tune the ROI at High Magnification

This process helps you to fine-tune the ROI position at a higher required magnification, using the **Acquisition** tab within **Scout** view's **Edit Recipe Points for Sample** panel.

To fine-tune the ROI at high magnification

1. Select the *same high resolution objective that is used in the recipe* from the **Objective** drop-down list box, then click **Apply** to set the Xradia Versa to the new settings.

 **NOTE** The *objective* used by the recipe is listed in the recipe details within the **Select Tomo Point** area.

2. Perform steps 4 through 11 of “[Scout – Find and Center the ROI at Low Magnification](#),” on page 88 to fine-tune the sample position at the higher magnification selected in step 1.

 **NOTE** If necessary, move the detector closer to the sample, or the X-ray source away from the sample, to increase the FOV.

Proceed to “[Scout – Save Positions to Recipe](#).”

Scout – Save Positions to Recipe

This process unlocks the recipe, then saves the new detector and X-ray source positions to the recipe.

To unlock the recipe and save the new detector, X-ray source, and sample positions

1. Click  within the *recipe* listed in **Select Tomo Point** area, to unlock the recipe that was loaded in “[Step 2 – Load,](#)” on page 83.

 **NOTE** Prior to unlocking the recipe, the sample positions and exposure time are listed in **red** because they do not match the scout images. The new values are saved in the next step.

2. Click **Apply** to set the Xradia Versa to the new settings.

3. Click  to collect a single image. The new sample positions are updated in the recipe when image collection is complete.

 **NOTE** The Exposure value is listed in **red** because it does not match the scout **Side View** image.

4. Click  to rotate the sample (**Sample Theta** axis) to -90° and activate the **Side View** image display.

5. Click  to collect a single image.

All recipe parameters should now match the scout images, and are no longer listed in **red**.

6. Click  within the *recipe* listed in **Select Tomo Point** area, to lock the recipe.

All the recipe parameters are identical to the original recipe. Only the sample positions have been updated. The Recipe is now ready to run.

7. Click  twice to proceed to the next view for this process (**Run**).

 **NOTE** **Scan** view is skipped because the scan parameters are already loaded from the existing recipe.

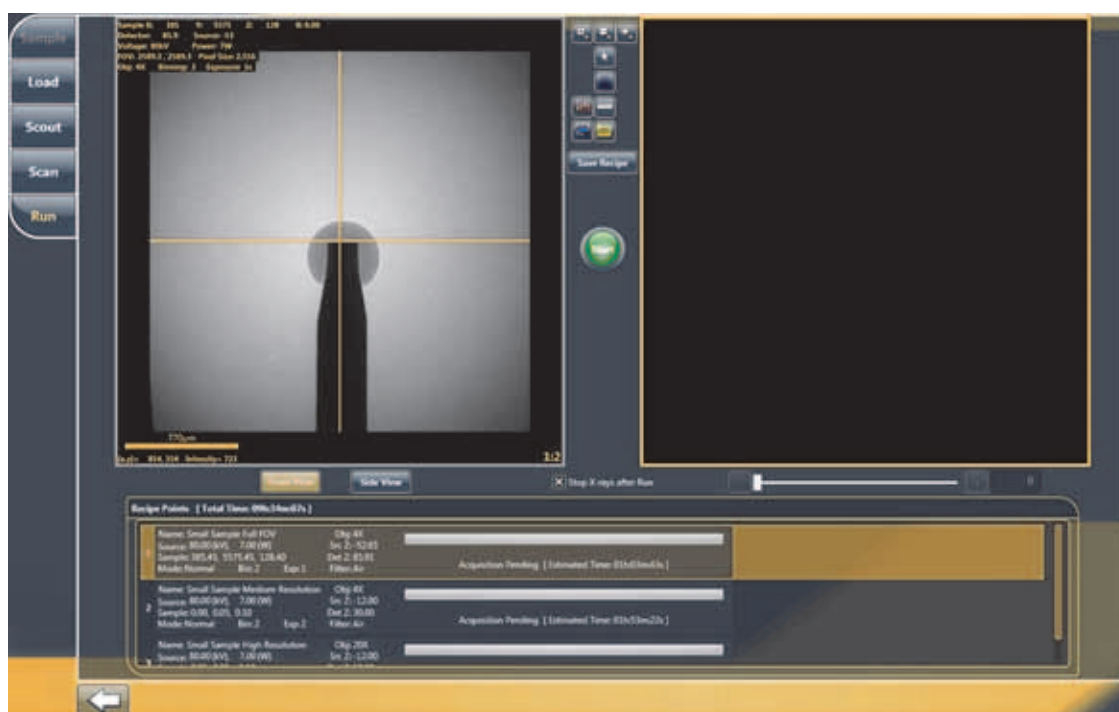
Proceed to “[Step 4 – Run.](#)”

Step 4 – Run

This process describes how to run the recipe and acquire tomographies, using **Run** view.

- ✓ **NOTE** For in-depth information that describes **Run** view, refer to “[Run View](#),” on page 240, in Appendix D.
- ✓ **NOTE** This process is identical to the Run process discussed earlier in this chapter, in “[Step 5 – Run](#),” on page 45. The process is repeated here for your convenience.

Figure 2-47 Typical **Run** View



To run the recipe and acquire tomographies



Click  to start acquiring tomographies. The recipe automatically stops running after it finishes data acquisition.

A date- and time-stamped folder is created in the *Sample* folder specified in “[Step 1 – Sample](#),” step [2](#), on [page 81](#). In this example, the sample name is *test*. A folder named *tomo-A-Date_Time* is created, and *tomo-A* is the tomography point name created within the *Sample* folder. A copy of the recipe, *Sample Name.rcp*, is also created in the *Sample* folder.

At this point, you can repeat the recipe creation process. Click **New Sample** to begin.

3

Manually Reconstructing a Tomography Dataset

This chapter describes how to use XMReconstructor to manually reconstruct a tomography dataset when any of the following conditions exist:

- Recipe was run with **Recon** type set to *Manual* on the **Advanced Acquisition** tab within **Scan** view
- Center shift is incorrect
- Automatic reconstruction had problems

Reconstruction is the process of using all the projections acquired during a tomography data acquisition, to create a 3D volume.

 **NOTE** For in-depth information that describes each user interface control and feature, refer to [“XMReconstructor User Interface,” on page 243, in Appendix D.](#)

 **NOTE** XMReconstructor can only be used to reconstruct images that are reference corrected.

 **NOTE** During reconstruction, the amount of free space required on the hard disk drive must be at least 1 GB more than the file size of the tomography (projection) dataset.

Process Overview

The process of manually reconstructing a tomography dataset is comprised of the following subprocesses:

1. [Preparing for Reconstruction.](#)
2. [Finding Center Shift.](#)
3. [Finding a Constant for Beam Hardening Correction.](#)
4. [Reconstructing the Tomography Data.](#)

Preparing for Reconstruction

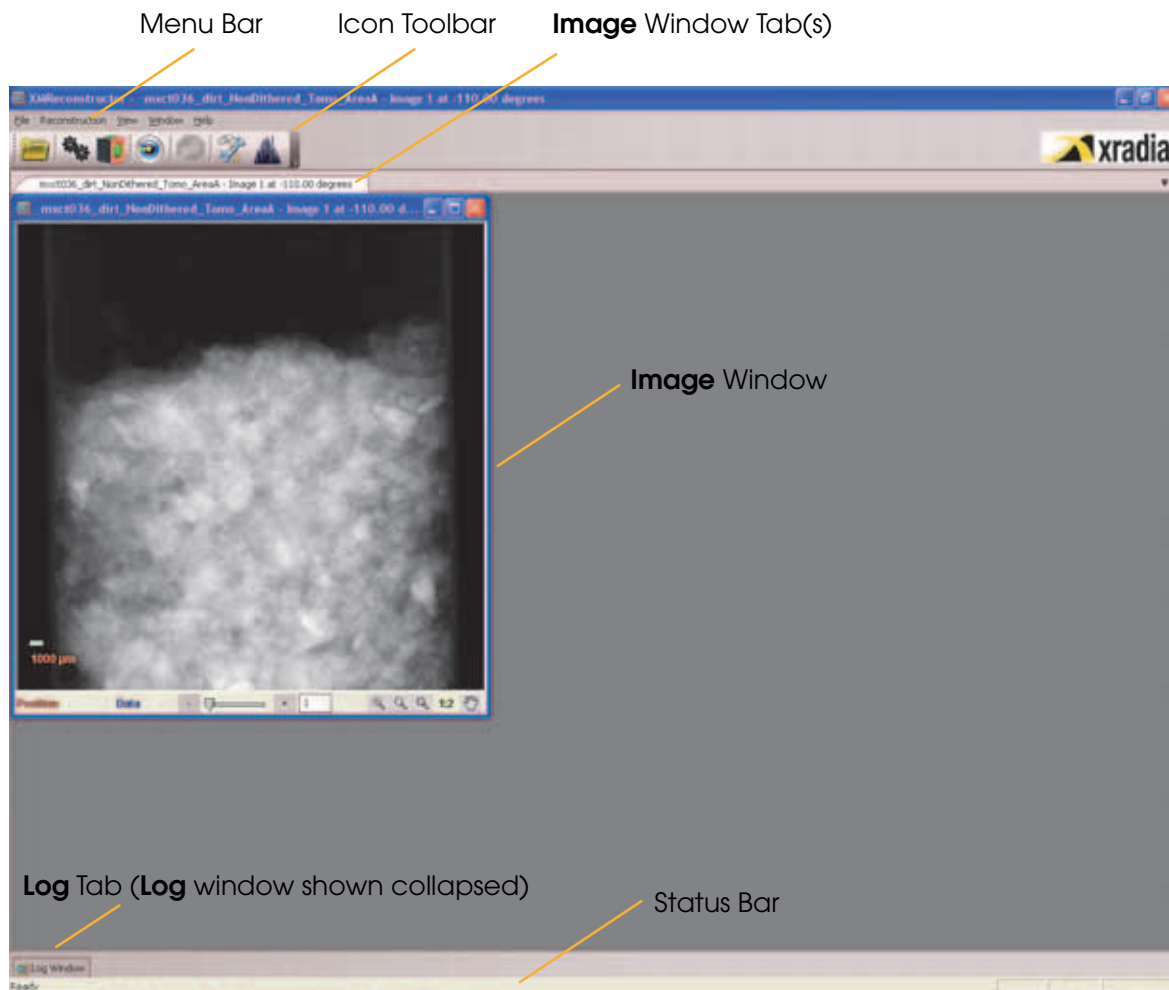
This process describes how to start XMReconstructor and ensure that the tomography dataset to be reconstructed is not in use by another program.

To prepare for reconstruction

1. Select **Start > All Programs > Xradia > VersaXRM 10.x > XMReconstructor 10.x** from the Windows **Start** menu.
The **XMReconstructor** main window opens.

 **NOTE** “x” is the program’s current version number.

Figure 3-1 Default **XMReconstructor** Main Window (Opened File Shown for Reference Only)



2. Open an **Open File** dialog box, using one of the following methods:
 - Select **File > Open...** from the menu bar
 - Click  in the icon toolbar
3. Browse to the *destination file path* of the tomography dataset (*.txrm file) to be opened.
4. Select the *file*, then click **Open**.

Proceed to “[Finding Center Shift](#).”

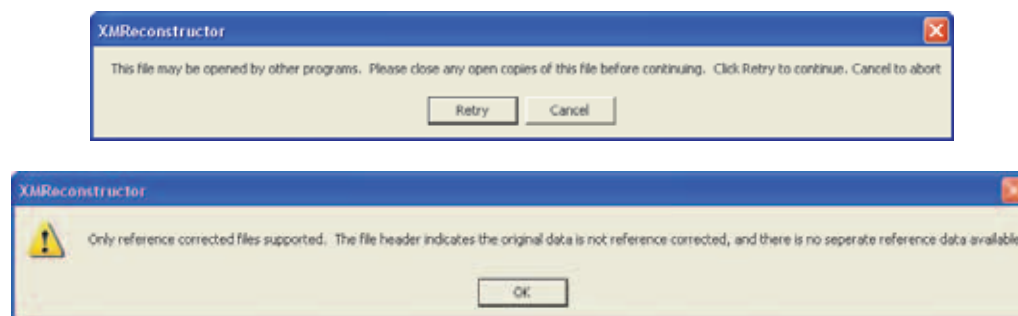
 **NOTE** If the “This file may be opened by other programs” dialog box opens (refer to [Figure 3-2](#)), click **Cancel**, close the file in the other program, then repeat steps 2 through 4.

 **NOTE** If the “Only reference corrected file supported...” **Warning** dialog box opens (refer to [Figure 3-2](#)), the tomography file has not been reference corrected yet. Click **OK**, then apply a reference image to the file, according to the process described in “Applying the Reference Image” on page 147 in Chapter 7 of the legacy *VersaXRM-500 User’s Guide*.

If you have not acquired a reference image yet, collect one, according to the process described in “Acquiring the Reference Image” on page 143 in Chapter 5 of the legacy *VersaXRM-500 User’s Guide*, then apply it to the tomography file.

Upon completing either or both tasks, repeat steps 2 through 4.

Figure 3-2 XMReconstructor Warning Dialog Boxes –
This file may be opened by other programs and
Only reference corrected files supported

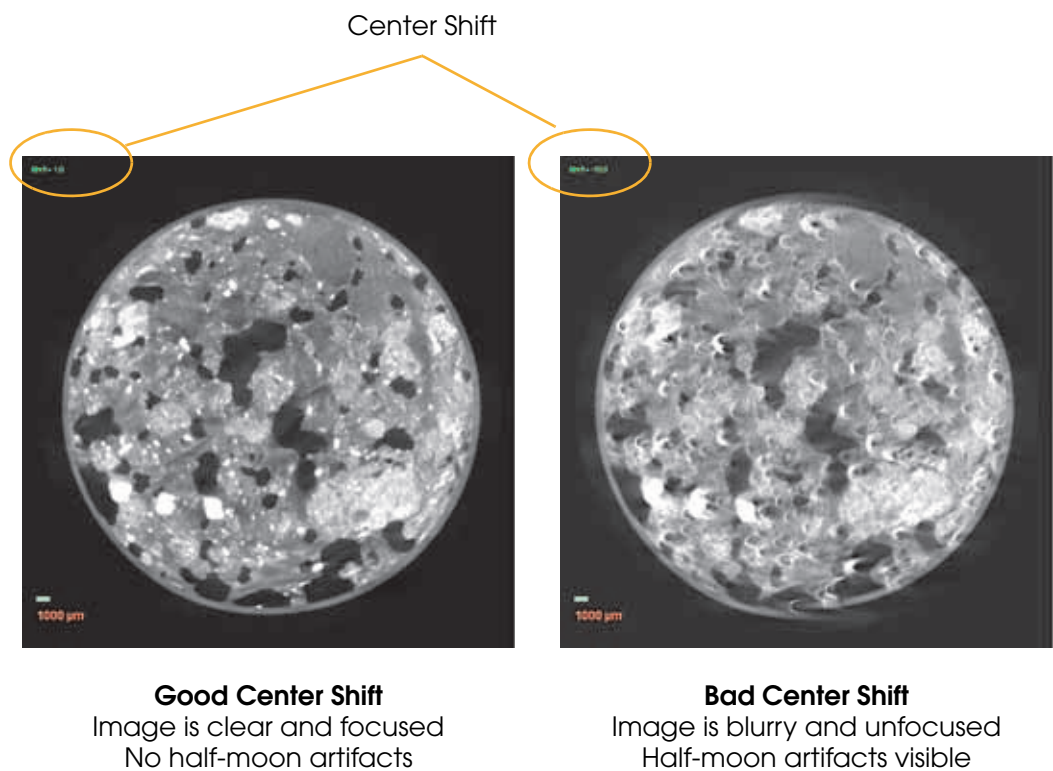


Finding Center Shift

This process describes how to find the center shift. *Center shift* is the amount, in pixels, that the axis of rotation is offset from the center column of the detector. The center shift is used later, when finding the beam hardening correction and when reconstructing the data.

Images with good center shift are focused and clear, while images with bad center shift are unfocused and blurry, often exhibiting half-moon (arc) artifacts. The center shift value appears in **green**. (Refer to [Figure 3-3](#).)

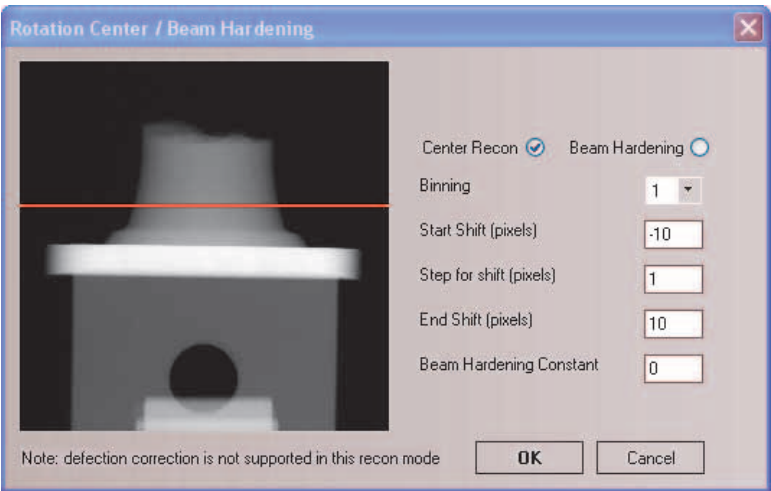
Figure 3-3 Comparison between Good and Bad Center Shift Results



*To find center shift in the open *.txrm file*

1. Click  in the icon toolbar. The **Rotation Center / Beam Hardening** dialog box opens.

Figure 3-4 **Rotation Center/Beam Hardening** Dialog Box – **Center Recon** Option Selected



2. Click and drag the **red** line to cross a high-contrast feature, to select the slice.
3. Select and/or type the *center shift settings* (refer to [Figure 3-4](#)).

Option	Setting
Center Recon	<i>Selected</i>
Binning	<i>1</i>

Leave all other settings at their defaults on the first attempt to find center shift.

4. Click **OK**. A **Reconstruction Status** message box opens, indicating real-time reconstruction status, and a **Reconstructed Slice Image** window opens.

 **NOTE** If you need to abort the Center Shift Find process before it completes, click  in the icon toolbar.

The **Reconstructed Slice Image** window shows a series of 2D reconstructed slices with increasing center shift being created, starting from the shift range specified in the **Rotation Center / Beam Hardening** dialog box **Start Shift (pixels)** text box, increasing in intervals, according to **Step to shift**, and ending in the shift specified in the **End Shift (pixels)** text box. The amount that each image is shifted is indicated as “**Shift = xxx**” (upper left corner).

Wait while the image finishes center-shifting through the range. The **Reconstruction Status** message box closes at the end of the process.

Figure 3-5 **Reconstructed Slice Image** Window



NOTE **Image** window controls are discussed in “[XMReconstructor Image Window Controls](#),” on page 245, in Appendix D.

5. In cases where there are areas on the image that are all white or black, use the Histogram tool to adjust image contrast and brightness, such that detailed features within the all white/black areas can be observed.

 **NOTE** A complete description of how to use the Histogram tool is provided in “XMReconstructor Histogram Tool,” on page 255, in Appendix D.

Follow steps **a** and **b** below, to adjust contrast and brightness:

- a. Click  in the icon toolbar. The **Histogram** panel opens and pins itself in the **XMReconstructor** main window (upper right corner).

Figure 3-6 Histogram Panel

In step 5b, to adjust contrast and brightness of the image in the **Reconstructed Slice Image** window, use the mouse pointer to click and drag to the RIGHT and/or LEFT within the **gray** area of the **Histogram** panel



- b. Use the following instructions to *maintain or adjust image contrast and brightness*.

Contrast and Brightness	Process
Maintain for all images	Select Lock .
Adjust for all images	<p>Click Reset. Next, use the mouse pointer to click and drag to the RIGHT and/or LEFT within the gray area of the Histogram panel, to adjust image contrast and brightness. (The panel is light gray until the mouse is dragged on it. The area in which the mouse is dragged turns dark gray.)</p> <p>After you have sufficiently adjusted the image contrast and brightness in the Reconstructed Slice Image window, select Lock.</p>

 **NOTE** The **Auto-Scaling** option can be selected to automatically estimate the best contrast and brightness for the image; however, the results might not provide the results you want; therefore, manual adjustment is recommended.

6. Scroll through the multiple images in the **Reconstructed Slice Image** window, using the slider in the scroll bar or the image number control (click the – or + symbols) at the bottom of the window, to locate and identify the image with the crispest features (sharpest focus).
7. Note the *center shift* (indicated as **Shift**, upper left corner of the **Reconstructed Slice Image** window) of the image with the sharpest focus or where the selected half-moon artifact is minimized (the curves of the artifact smooth out into a circle). This value is used later, in “[Finding a Constant for Beam Hardening Correction](#),” step 2.



NOTE If a good center shift is not found within the specified Start and End Shift range, repeat steps 1 through 7, but in step 3, change the *Start and/or End Shift setting*, to search over a different range. The step 3 *settings* can also be changed, to look at finer or coarser center shift intervals. Continue to change values until either the image is at its sharpest or a selected half-moon artifact disappears.

Proceed to “[Finding a Constant for Beam Hardening Correction](#).”

Finding a Constant for Beam Hardening Correction

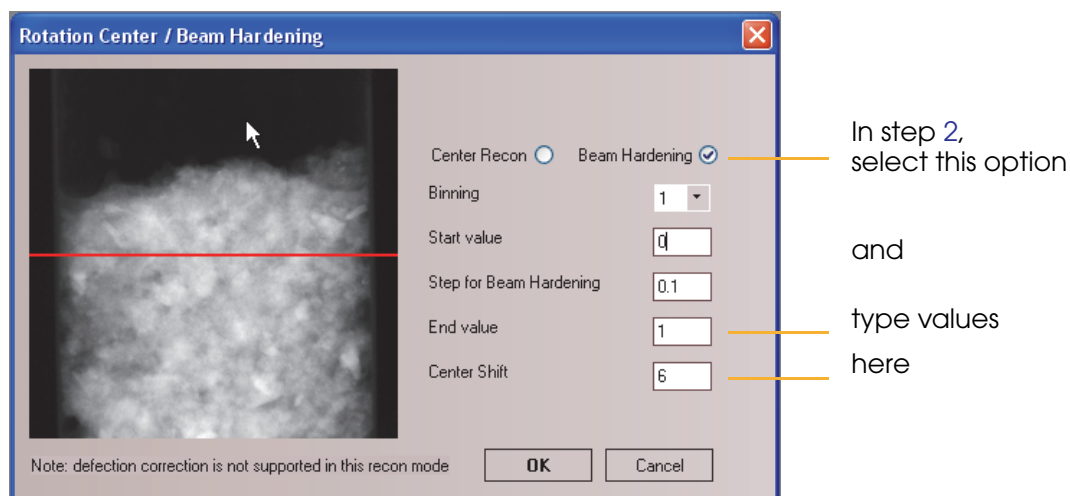
This process describes how to find the beam hardening correction. This value is used later, along with the center shift, when reconstructing data.

Beam hardening is the result of the change in spectrum characteristic as the X-rays pass through the sample, where the sample density remains the same, but the light changes – one area of the same material is darker than another.

To identify beam hardening correction in the open *.txrm file

1. Click  in the icon toolbar. The **Rotation Center / Beam Hardening** dialog box opens.

Figure 3-7 **Rotation Center / Beam Hardening** Dialog Box – **Beam Hardening** Option Selected



2. Select and/or type the *beam hardening settings* (refer to [Figure 3-7](#)).

Option	Setting
Beam Hardening	<i>Selected</i>
Binning	<i>1</i>
Start value	<i>0 (default)</i>
Step for Beam Hardening	<i>01 (default)</i>
End value	<i>1.5</i>
Center Shift	<i>Center shift noted in “Finding Center Shift,” step 7</i>

3. Click **OK**. A **Reconstruction Status** message box opens, indicating real-time reconstruction status, and a **Reconstructed Slice Image** window opens.



NOTE If you need to abort the Beam Hardening Correction Find process

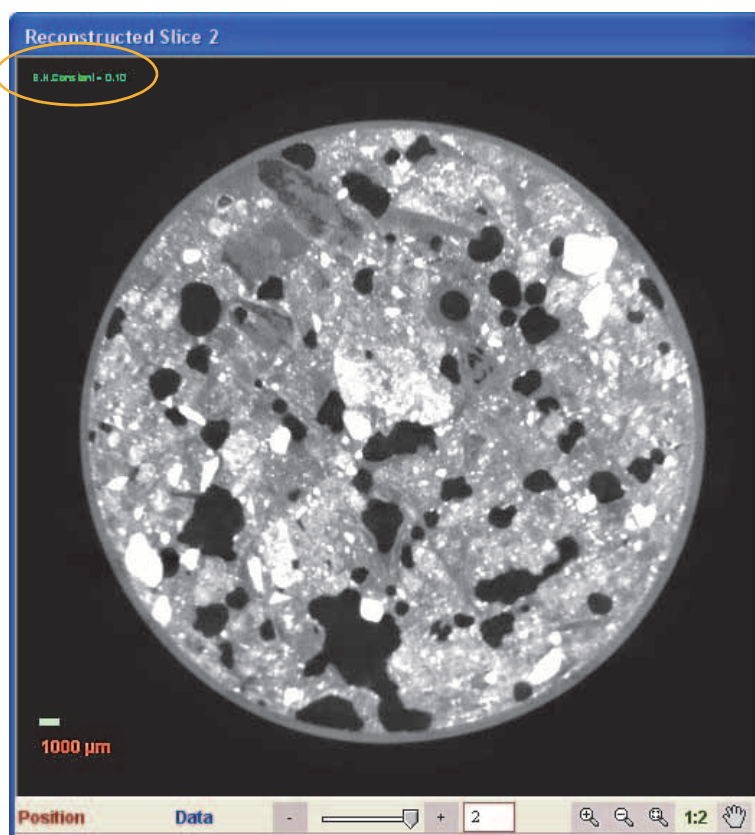
before it completes, click  in the icon toolbar.

The **Reconstructed Slice Image** window shows a series of 2D reconstructed slices with increasing beam hardening correction constants being created, starting from the setting specified in the **Rotation Center / Beam Hardening** dialog box **Start value** text box, increasing in intervals, according to **Step for Beam Hardening**, and ending in the setting specified in the **End value** text box. The amount that each slice is corrected (Beam Hardening Constant) is indicated as **B.H. Constant** (upper left corner).

Wait while the image finishes correcting for beam hardening through the range. The **Reconstruction Status** message box closes at the end of the process.

Figure 3-8 **Reconstructed Slice Image** Window

Beam Hardening
Constant



Scroll Bar and Image Number Indicator –
Use these controls to scroll through the images

4. Adjust *image contrast and brightness* using the **Histogram** tool, if necessary, as described in “[Finding Center Shift](#),” step 5.

 **NOTE** A complete description of how to use the Histogram tool is provided in “[XMReconstructor Histogram Tool](#),” on page 255, in Appendix D.

5. Click  in the icon toolbar. The **Image Control** dialog box opens.

Figure 3-9 Image Control Dialog Box, Defaulted to **Annotation** Tab



6. Click  to enable the Line Plot annotation tool.
7. Draw a line across the 2D reconstructed slice, by using the mouse pointer to click and drag within the **Reconstructed Slice Image** window. The line should span materials of similar density. The **Reconstructed Slice x-Line Plot** dialog box opens.

Figure 3-10 Reconstructed Slice Image Window with Annotation Line

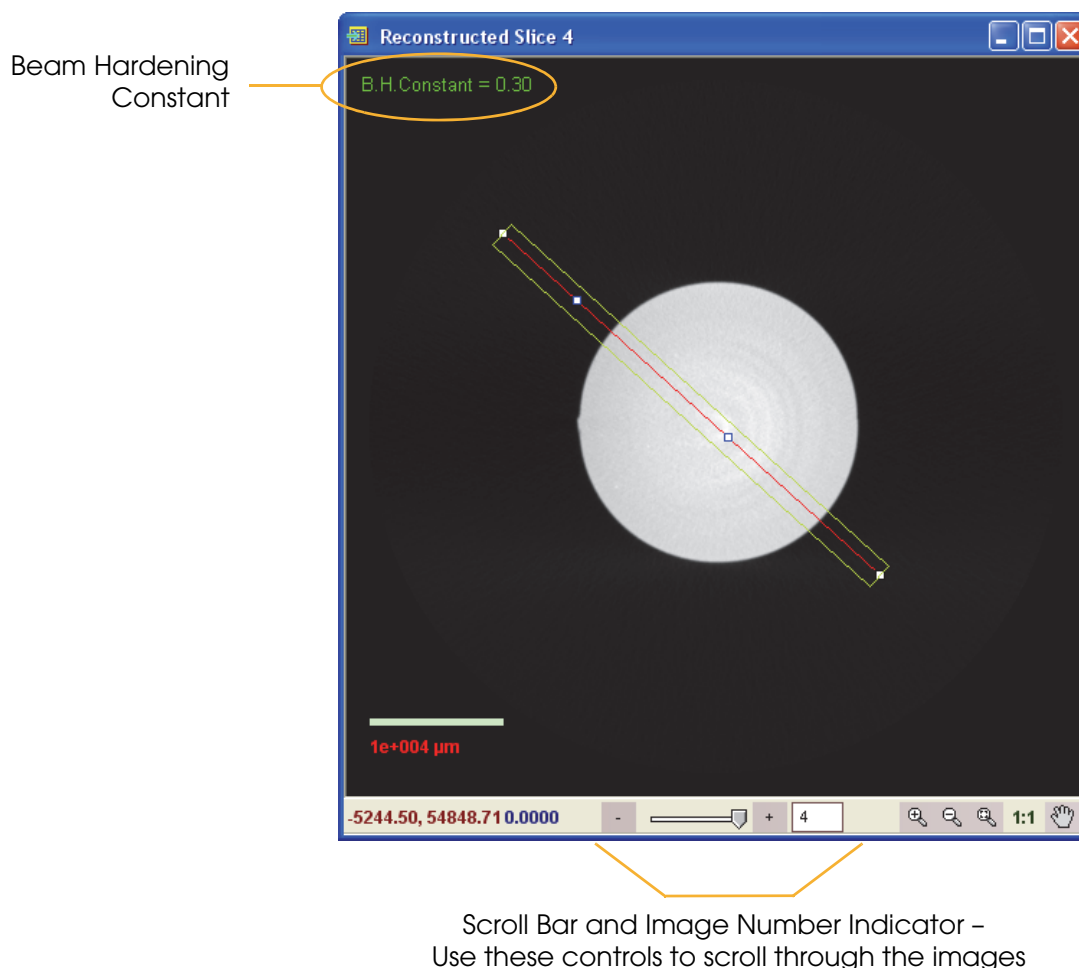
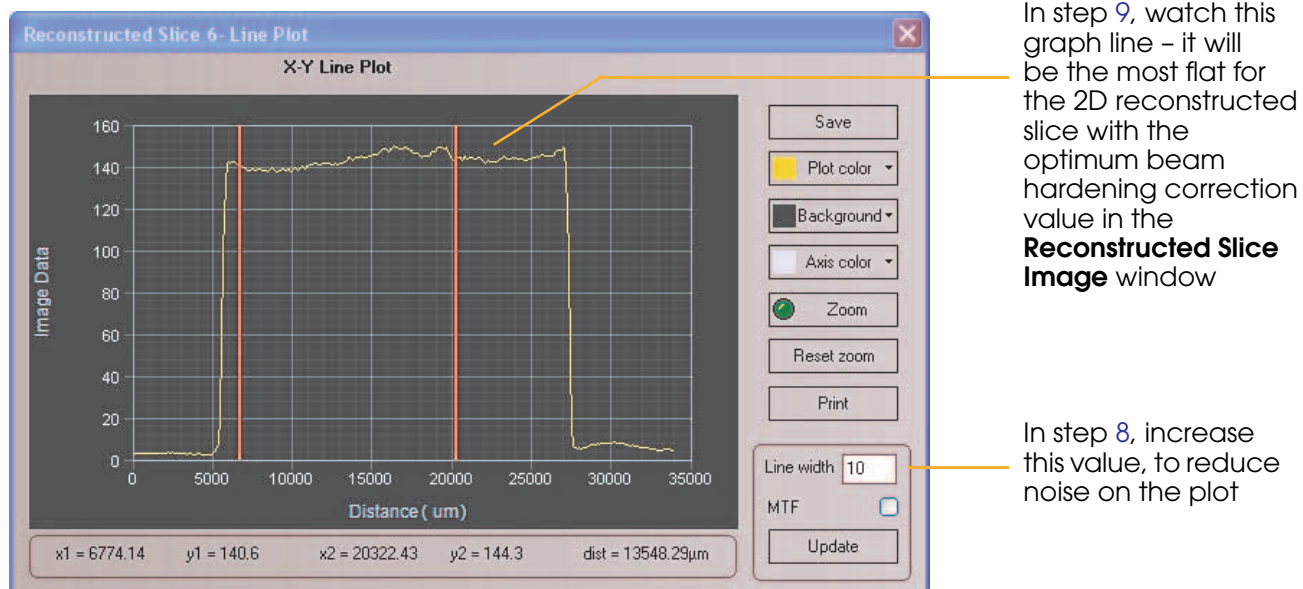


Figure 3-11 Reconstructed Slice x-Line Plot Dialog Box



8. To reduce noise on the plot (by averaging more lines, and thereby smoothing out the graph), type a *value between 10 and 64* (maximum) in the **Line Width** text box, then click **Update**, to widen the graph line width. (Refer to [Figure 3-11](#).)
9. In the **Reconstructed Slice Image** window, use the slider to scroll through the 2D reconstructed slices. As you scroll, watch the graph in the **Reconstructed Slice x-Line Plot** dialog box. The slice with the optimum beam hardening correction value in the **Reconstructed Slice Image** window will have the flattest graph in the **Reconstructed Slice x-Line Plot** dialog box. (Refer to [Figure 3-11](#).)
10. Note the *beam hardening correction* (indicated as **B.H. Constant**, upper left corner of the **Reconstructed Slice Image** window). This value is used later, in “[Reconstructing the Tomography Data](#),” step 3.
11. Close the **Reconstructed Slice Image** window and **Reconstructed Slice x-Line Plot** dialog box (click , upper right corner).
Proceed to “[Reconstructing the Tomography Data](#).”

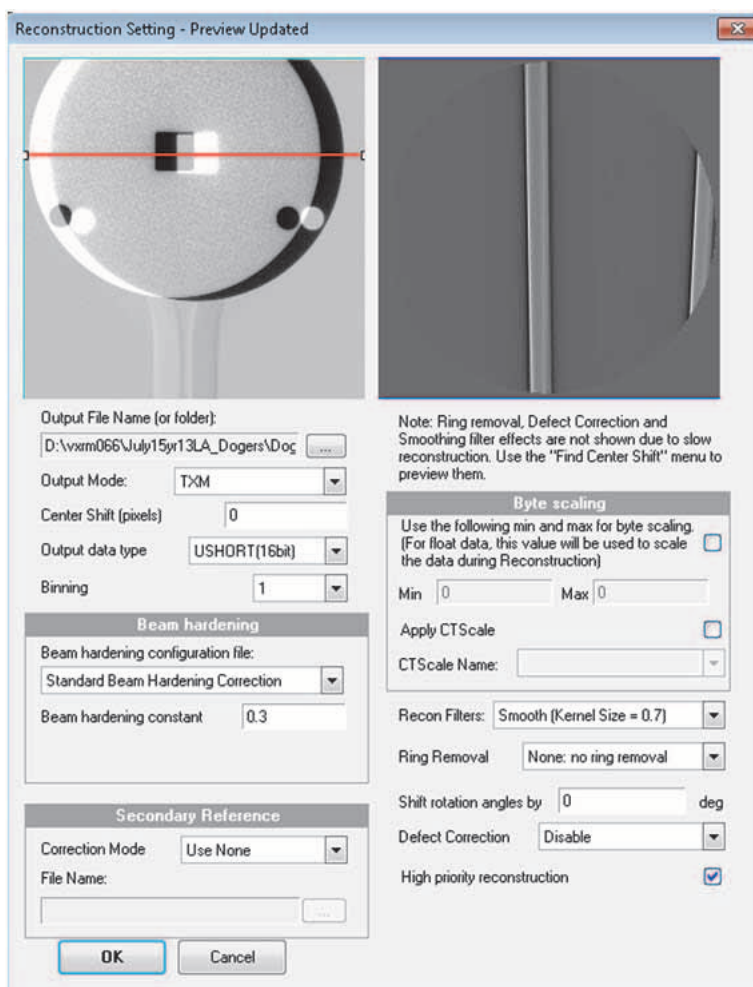
Reconstructing the Tomography Data

This process describes how to reconstruct the tomography data, after finding the center shift and constant for beam hardening correction.

*To reconstruct the open *.txrm file*

1. Open the **Reconstruction Setting** dialog box, using one of the following methods:
 - Select **Reconstruction > Reconstruction Setting...** from the menu bar
 - Click  in the icon toolbar

Figure 3-12 **Reconstruction Setting** Dialog Box – Settings Applied in Subsequent Steps



2. Follow steps **a** through **c** below, to assign the output reconstruction file name:
 - a. Click ... (to the right of the **Output File Name (or folder)** text box), then browse for the *destination file path*.
 - b. Type the *output reconstruction file name* in the **File name** text box.
-  **NOTE** A suggested file name is to use the same name as the tomography dataset, but append an "r" suffix at the end of the file name.
 - c. Click **Save**. The *file path* and *file name* appear in the **Output File Name (or folder)** text box.
3. Select and/or type the following *reconstruction settings*.

Option	Setting
Output Mode	<i>TXM</i> (default)
Center Shift (pixels)	<i>Center shift value</i> identified in " Finding Center Shift ," step 7
Output data type	<i>USHORT(16bit)</i> (default)
Binning	<i>1</i> (refer to Note)
Beam hardening configuration file	<i>Standard Beam Hardening Correction</i> (default)
Beam hardening constant	<i>Beam hardening correction value</i> identified in " Finding a Constant for Beam Hardening Correction ," step 9
Shift rotation angles by	<i>0 deg</i> (default; refer to Note)
Defect correction	<i>Disable</i> (default; should always be selected)

 **NOTE** **Binning** – Because tomography acquisition binning value is usually 2, the reconstruction binning value is 1.

 **NOTE** **Shift rotation angles by** – The selected *value* can be varied to rotate the 3D reconstructed volume, as needed. This can be done to increase 2D slice orthogonality, after which an updated *preview image* is shown in the upper right image within the dialog box. This value is identified as *Rotation Offset* in the **Image Control** dialog box **Info** tab. (Refer to "[Information \(Info\) Tab](#)," on page 252, in Appendix D.)

4. Select one of the following *options* from the **Ring Removal** drop-down list box.

Option	Usage
None: No Ring Removal	Use this option if DRR is enabled.
Low contrast – 8-section RR	Use this option if DRR is disabled, for bone, rock, plastic, carbon composite, or composite material samples.
High contrast – 3-section RR	Use this option if DRR is disabled, for high-contrast samples, such as semiconductors, or if the other two options do not apply.

 **NOTE** 3-section RR is known to sometimes add rings when there are regularly repeating high-contrast features.

5. Select a *software filter* from the **Recon Filters** drop-down list box. The minimum filter available is Smooth (Kernel Size = 0.5); if unsure, start with *Smooth* (Kernel Size = 0.7).

 **NOTE** The **Recon Filters** value is magnification lens- and sample-dependent.

 **NOTE** Determine which *software filter* provides the most satisfactory balance between image resolution and noise (through your own experience); using the correct software filter provides for significant noise reduction, but has a minimal impact on resolution.

 **NOTE** Do **not** use **None** nor **Sharp (Shepp-Logan)**.

6. **High priority reconstruction** is selected, by default.

 **NOTE** The Reconstruction processes are queued, such that only one file is reconstructed at a time. You can open multiple files in multiple instances of XMReconstructor and set up multiple reconstructions; however, the reconstructions occur sequentially, with those from a recipe taking the highest priority, unless **High priority reconstruction** is selected. The high priority reconstruction will be processed immediately after the current reconstruction is complete.

Each reconstruction joins the queue only **after** its temporary file is created (during reconstruction, a temporary file that is the same size as the projection file, is created before the actual Reconstruction process occurs).

7. Use the **Byte scaling** option only if either of the following conditions is true.

Apply Byte Scaling When True	Process
<i>Global minimum and maximum byte scaling values</i> are known from a prior similar sample (scan acquired at the same settings (X-ray source power, detector and X-ray source distances, number of projections, exposure times, binning, and magnification)).	Select Use the following min and max for byte scaling , then type the <i>global minimum and maximum byte scaling values</i> in their respective text boxes.
Dataset is to be CT-scaled and CT scaling calibration is complete.	Select Apply CT Scale , then select the correct <i>software filter</i> from the CTScale Name drop-down list box.

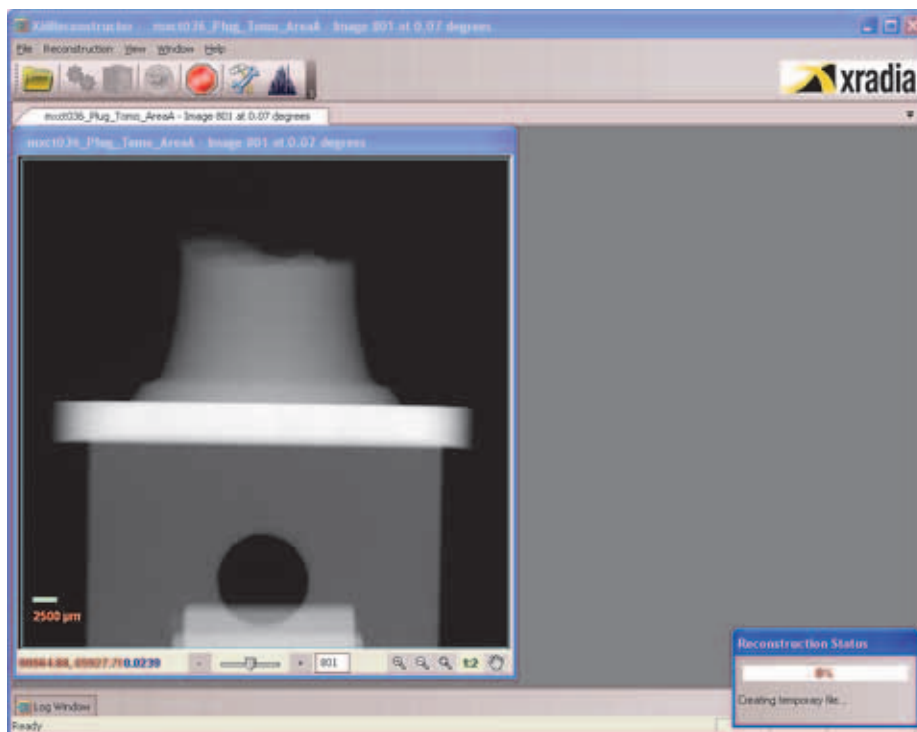
 **NOTE** Refer to *CT Scaling Instructions* (G000135), included with the Xradia Versa product documentation, for details related to CT scaling.

8. **Optional** – If a secondary reference was previously collected, select the secondary reference:
- **Xradia 520 Versa** – Select *Use Embedded* from the **Correction Mode** drop-down list box
 - **Xradia 510 Versa** and **Xradia 410 Versa** – Select *Use File* from the **Correction Mode** drop-down list box, then click ... (to the right of the **File Name** text box) to browse for and select the *secondary reference file*
9. Click **OK** to close the **Reconstruction** dialog box.
10. Reconstruct the tomography data, using one of the following methods:
- Select **Reconstruction > Start Reconstruction** from the menu bar
 - Click  in the icon toolbar

The **Reconstruction Status** window opens, indicating real-time reconstruction progress (lower right corner of the **XMReconstructor** main window).

 **NOTE** If you need to abort the Reconstruction process before it completes, click  in the icon toolbar.

Figure 3-13 XMReconstructor Main Window with **Reconstructed Slice Image** Window and **Reconstruction Status** Window



11. When reconstruction is complete, the **Reconstruction Status** window closes and a **Message** dialog box opens, indicating the total reconstruction time. Click **OK** to close the dialog box.

The tomography is now reconstructed, and ready for viewing with XM3DViewer. The resulting file is a *.*txm* file, also referred to as a *Volume Viewer file*.

Proceed to [Chapter 4, “Viewing and Editing Tomographies.”](#)

4

Viewing and Editing Tomographies

This chapter describes how to use XM3DViewer to view and edit 2D reconstructed slices and 3D reconstructed volume datasets, for use in reports and movies. This is typically done after acquiring and reconstructing the tomography dataset, as described in [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System,”](#) and [Chapter 3, “Manually Reconstructing a Tomography Dataset,”](#) respectively.



NOTE This chapter provides basic information for using XM3DViewer to view tomographic data after reconstruction. For further details regarding the program’s use, refer to [“XM3DViewer User Interface,” on page 261, in Appendix D,](#) as well as the *Xradia ExamineRT Workstation 1.1 User’s Manual*, available under XM3DViewer’s **Help** menu.

Process Overview

The process of viewing tomographies is comprised of the following subprocesses:

1. [Starting XM3DViewer.](#)
2. [Using XM3DViewer:](#)
 - [Adjusting and Navigating 2D Reconstructed Slices](#)
 - [Creating 3D Volume Renderings](#)
 - [Collecting Images \(or Pictures\) for a Report](#)
 - [Generating a Report](#)
 - [Creating Movies of Cross-Sectional 2D Reconstructed Slices and 3D Reconstructed Volumes](#)
 - [Correcting Problems with the Reconstructed File](#)



NOTE Unlike earlier chapters of this guide, most processes described within this chapter can be performed out of sequence, unless indicated otherwise.

Starting XM3DViewer

This process describes how to start XM3DViewer and open a reconstructed file for viewing.

To start XM3DViewer

1. Select **Start > All Programs > Xradia > VersaXRM 10.x > XM3DViewer 1.x** from the Windows **Start** menu. The **XM3DViewer** main window opens.

✓ **NOTE** “x” is the program’s current version number.

✓ **NOTE** In its main window title bar, XM3DViewer appears as “**TXM3DViewer**,” rather than as “**XM3DViewer**”. Additionally, the main window bars and tools change, depending upon which **Layout** icon is selected.

✓ **NOTE** Figure 4-1 provides a sample default view **XM3DViewer** main window. Figure 4-2 provides an explanation of the window’s features and default views.

Figure 4-1 Default **XM3DViewer** Main Window – **Examine** Tab

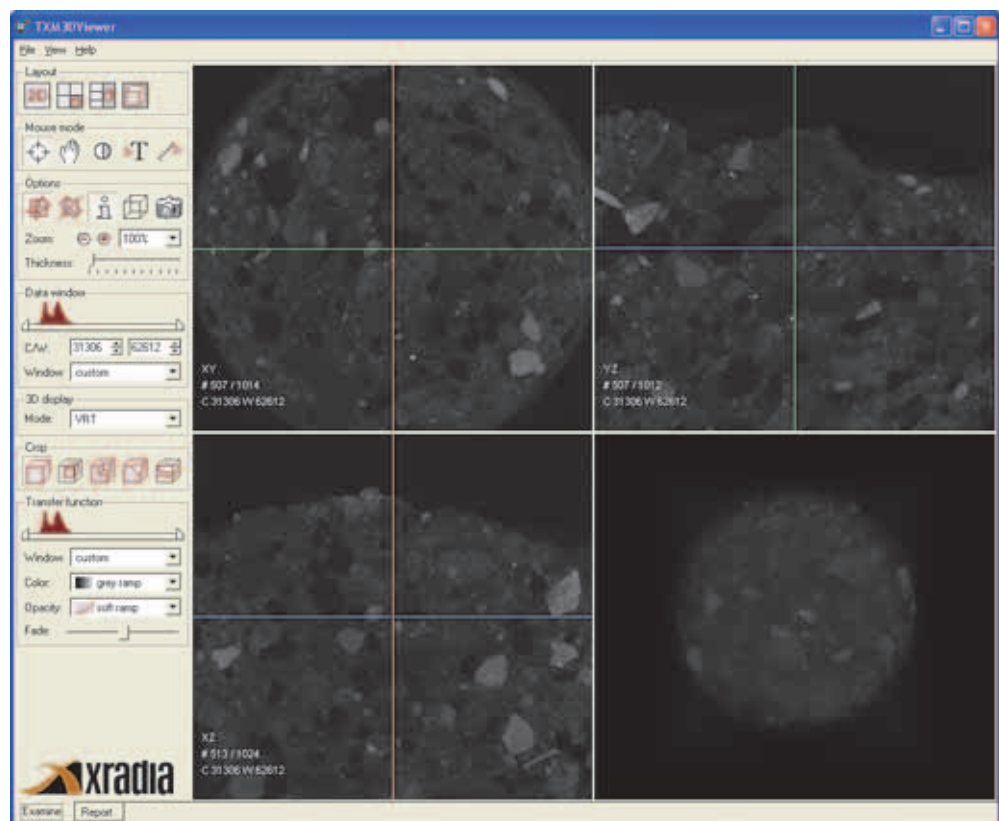
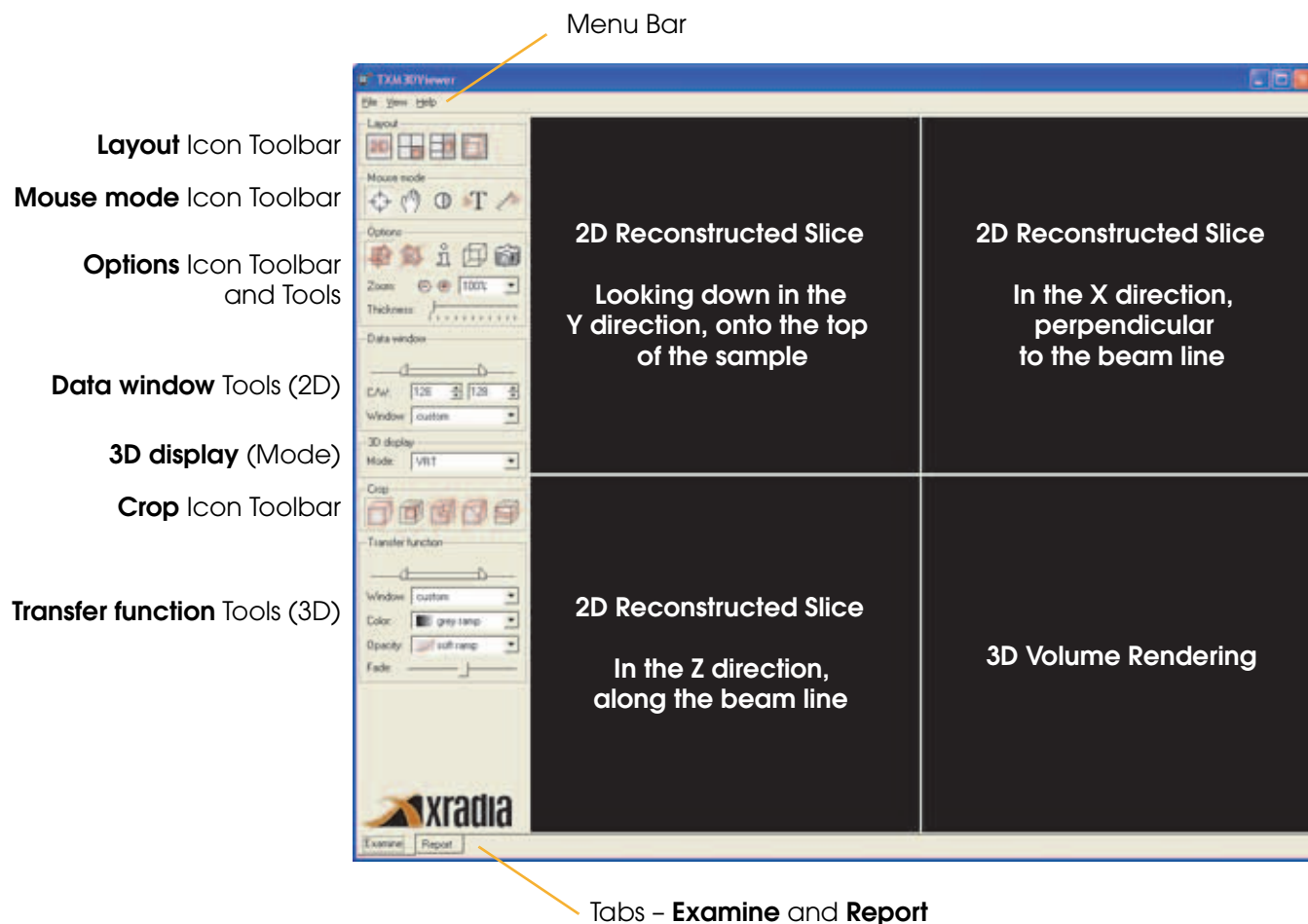


Figure 4-2 Default **XM3DViewer** Main Window – **Examine** Tab, with Descriptions of Each View



2. Select **File > Open...** from the menu bar. An **Open File** dialog box opens.
3. Browse to the *destination file path*, then locate the *reconstructed file that you want to open* (*_Recon* is appended to the original **.txm* root file name).

 **NOTE** If you saved the reconstructed file to the desktop, the file is located in the **C:\Documents and Settings\(*Your Windows User Login Name*)\Desktop** path. In this file path, you will see only the files created with that Login Name.

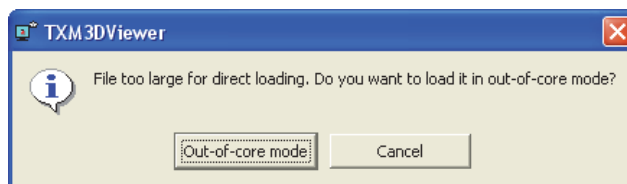
 **NOTE** If you saved the reconstructed file to another hard disk drive, click the **Look in** drop-down list box, then browse to and select the *correct drive* and *destination file path*.

4. Select the *file name*, then click **Load** to open the file. A status window opens, displays the file upload status, then closes when the upload is complete.

 **NOTE** If the file is too large for the graphics adapter memory (larger than the computer workstation's available memory (RAM) capacity), a dialog box opens, asking whether you want to load the file in Out-of-core mode. If this occurs, click **Out-of-core mode** to continue loading the file. A status window opens, indicating out-of-core mode's progress.

During Out-of-core mode, XM3DViewer creates two files – **.txm-exm* and **.txm-exm-ooc*. These files are accessed during viewing of reconstructed results in XM3DViewer. These files can be quite large (on the order of a few gigabytes), and should be deleted after generating reports and creating movies.

Figure 4-3 "Out-of-core mode" Dialog Box



Adjusting and Navigating 2D Reconstructed Slices

After the processing is complete, images appear in each of the four views within the default **XM3DViewer** main window. (Refer to [Figure 4-1.](#))

The processes described in this section provide general guidelines for gaining familiarity with XM3DViewer:

- [Adjusting Contrast and Brightness in the 2D Reconstructed Slice Views](#)
- [Navigating the XM3DViewer Main Window](#)

-  **NOTE** If it is obvious that something is not right, proceed directly to “[Correcting Problems with the Reconstructed File.](#)”
-  **NOTE** The guidelines provided in this section relate to the default layout of the main window – three equally sized 2D reconstructed slice views and one 3D volume view. (Refer to [Figure 4-1.](#)) The layouts are described in [Table 4-1.](#) All **four** layouts are located in the **Layout** icon toolbar.
-  **NOTE** The main window bars and tools change, depending upon which **Layout** icon is selected.

Table 4-1 XM3DViewer Main Window Layout Options

Icon	Description
	Click to display three equally sized 2D reconstructed slice views and one 3D volume view. This is the default window layout.
	Click to display a single 2D reconstructed slice view. Click multiple times to cycle through the orientation of the slice in the 2D reconstructed slice view. When clicked, adds Cine controls to the main window (left side, below the other icon toolbars and tools).
	Click to display three equally sized 2D reconstructed slice views, plus one larger 3D volume view. Displays the same four images as  .
	Click to display a single 3D volume view (not used for 2D reconstructed slices).

Adjusting Contrast and Brightness in the 2D Reconstructed Slice Views

This process describes how to adjust contrast and brightness in the 2D reconstructed slice views, using the **Data window** slider or  **Mouse mode** icon.

To adjust contrast and brightness in the 2D reconstructed slice views

1. Click  in the **Layout** icon toolbar.
2. Select **2D bilinear filter** from the **View** drop-down menu, to turn ON the 2D bilinear filter. This provides for less pixelated 2D reconstructed slices.
3. Use the **Data window** slider to adjust the contrast and brightness of the 2D reconstructed slices (top and bottom left and top right views), using the following *processes*.

Adjustment Needed	Process
Contrast	Use the mouse pointer to click and drag the endpoints of the bar to the LEFT or RIGHT, to change the <i>minimum</i> and <i>maximum contrast values</i> of the <i>Data window</i> range.
Brightness	Use the mouse pointer to click and drag the center bar to the LEFT or RIGHT, to change the <i>Data window</i> position along the <i>histogram values</i> , and thereby change the brightness.

Figure 4-4 Using the **Data window** Slider

Drag the endpoints to change the **contrast**

Drag toward the RIGHT

Drag toward the LEFT



Drag the center bar LEFT/RIGHT to change the **brightness**

Changes in contrast and brightness can also be achieved within any of the three 2D reconstructed slice views, using the following *processes*.

Adjustment Needed	Process
Contrast	Click  in the Mouse mode icon toolbar, then use the mouse pointer to click and drag UP or DOWN within any of the 2D reconstructed slice views, to change the contrast (window width).
Brightness	Click  in the Mouse mode icon toolbar, then use the mouse pointer to click and drag LEFT or RIGHT within any of the 2D reconstructed slice views, to change the brightness (window center).

 **NOTE** In the **Data window** Tools, leave the **Window** option selected as *custom*, to avoid potential problems. For example, if you changed the **Window** option to *CT Default*, all the 2D reconstructed slices will turn white, and you will not be able to see the slices. If this occurs, use the mouse pointer to click and drag the right endpoint on the **Data window** slider to the RIGHT, to improve the contrast and brightness of the 2D reconstructed slice. The **Window** option will change back to *custom*.

Navigating the XM3DViewer Main Window

This process describes how to navigate the **XM3DViewer** main window, by walking you through common tasks.

To navigate the XM3DViewer main window

1. Use the navigation crosshairs (colored lines) in the 2D reconstructed slice views to change position in all the 2D reconstructed slice views. (Refer to [Figure 4-1 on page 117](#).)

For example, move the **green** line in the upper left view to locate the region of interest in the bottom left view (**green** frame). Do the same with the **blue** line and corresponding **blue** frame, and then the **red** line and corresponding **red** frame, to identify the layers in which the region of interest lies.



NOTE **Green** = X/Z, **blue** = X/Y, and **red** = Y/Z.

2. Use the **Zoom** and **Pan** controls,  and  to make the complete slice visible within the 2D reconstructed slice views.

Zoom Control	Description
	Click to zoom OUT.
	Click to zoom IN.
	Select a <i>zoom percentage</i> from the drop-down list box.
	Click this icon in the Mouse mode icon toolbar, then, with the center-mouse button pressed, use the mouse pointer to click and drag UP and DOWN, within any 2D reconstructed slice view, to zoom IN and OUT, respectively. You can also click and hold the left mouse button, then drag LEFT and RIGHT to pan.

3. Orthogonal Slicing mode ( in the **Options** icon toolbar) orthogonally positions the crosshairs – this is the default slicing mode.

If the region of interest is not on the orthogonal plane, click  in the **Options** icon toolbar to use *Oblique Slicing mode*. This places the region of interest on one plane, allowing you to rotate the **green**, **blue**, or **red** crosshairs to line the planes up with the region of interest. Use the left mouse button to click the vertical or horizontal line, then drag to rotate the plane.

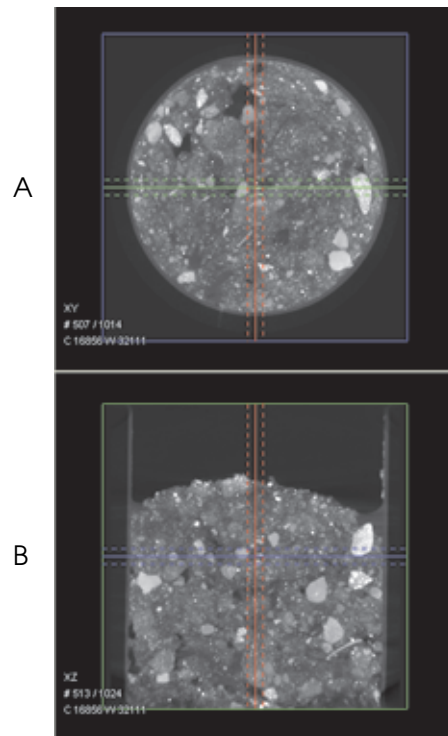
 **NOTE** Use of Oblique Slicing mode reduces image resolution.

4. Select *MPR* (Multi-Planar Rendering) from the **3D display** mode drop-down list box to display the 2D reconstructed slices as planes in 3D space within the 3D volume view (lower right view). This can help you to better observe the spatial interrelations of the three planes (**green**, **blue**, and **red**).
5. Under **Options**, use the mouse pointer to click and drag the **Thickness** slider to the RIGHT to sum the slices between the dashed lines and produce a virtual slice with larger “pixel” thickness.

The slice’s thickness is indicated by dashed lines in the 2D reconstructed slice views. Use the mouse pointer to click and drag the **Thickness** slider to the LEFT, to reduce the thickness.

Figure 4-5 Increasing the Thickness of 2D Reconstructed Slices

The slices between the two dashed, horizontal **blue** lines (**B**, center of image) are summed to create the image shown on the **blue** plane (**A**, entire image)



6. If you need to adjust the contrast and/or brightness, follow the processes described in [“Adjusting Contrast and Brightness in the 2D Reconstructed Slice Views,”](#) step 3.

When the 2D reconstructed slices look as they should, proceed to the next process:

- If you have already located the region(s) of interest, proceed to [“Collecting Images \(or Pictures\) for a Report”](#)
- If you want to work with 3D rendering, proceed to [“Creating 3D Volume Renderings”](#)

Creating 3D Volume Renderings

This process describes how to create a 3D volume rendering that can be used in reports or movies. In the default view, after a reconstructed file (*.txm) is loaded, images appear in each of the four views within the **XM3DViewer** main window. In this view, the 3D volume view is the lower right view of the main window. (Refer to [Figure 4-1](#).)

 **NOTE** Resolution on the 3D volume rendering is reduced, compared to the 2D reconstructed slices, because it is loaded into memory that is not sufficiently sized to contain the full resolution in 3D.

To create a 3D volume rendering

1. Click  in the **Layout** icon toolbar, to open the single 3D volume view.
2. The **3D display** mode should be defaulted to **VRT** (volume rendering technique). If another mode is selected, select **VRT** from the **Mode** drop-down list box.

 **NOTE** VRT is the only 3D display mode that is described in this guide. For information regarding the other 3D display modes, refer to the *Xradia ExamineRT Workstation 1.1 User's Manual*, available under XM3DViewer's **Help** menu.

3. Click  or  in the **Mouse mode** icon toolbar, to enable and use the following *mouse functions*.

Mouse Function	Process
Rotate the image	With the left-mouse button pressed, use the mouse pointer to click and drag within the 3D volume view.
Zoom IN and OUT	With the left- and center-mouse buttons simultaneously pressed, use the mouse pointer to click and drag UP and DOWN, respectively, within the 3D volume view.
Pan	With the center-mouse button pressed, use the mouse pointer to click and drag within the 3D volume view.

4. Use the **Transfer function** slider to adjust the contrast and brightness of the 3D volume, using the processes described in the following table. Use of these processes changes the mapping from actual input data values to display output values.

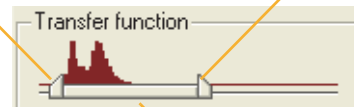
Adjustment Needed	Process
Contrast	With the left-mouse button pressed, use the mouse pointer to click and drag the endpoints of the bar to the LEFT or RIGHT, to change the contrast.
Brightness	With the center-mouse button pressed, use the mouse pointer to click and drag the center bar to the LEFT or RIGHT, to change the <i>Transfer function</i> along the <i>histogram values</i> , and thereby change the brightness.

Figure 4-6 Using the **Transfer function** Slider

Drag the endpoints to change the **contrast**

Drag toward the RIGHT

Drag toward the LEFT



Drag the center bar LEFT/RIGHT
to change the **brightness**

Changes in contrast and brightness can also be achieved in the 3D volume view, using the following *processes*.

Adjustment Needed	Process
Contrast	Click  in the Mouse mode icon toolbar, then use the mouse pointer to click and drag UP or DOWN within the 3D volume view, to change the contrast (window width).
Brightness	Click  in the Mouse mode icon toolbar, then use the mouse pointer to click and drag LEFT or RIGHT within the 3D volume view, to change the brightness (window center).

 **NOTE** Steps 5 through 7 reference tasks that use additional **Transfer function** controls.

 **NOTE** In the **Transfer function** Tools, leave the **Window** option selected as *custom*, to avoid potential problems. For example, if you changed the **Window** option to *CT Default*, the 3D volume becomes a white cube, and you will not be able to see the 3D volume data. If this occurs, use the mouse pointer to click and drag the right endpoint on the **Transfer function** slider to the RIGHT, to improve the contrast and brightness of the 3D volume. The **Window** option will change back to *custom*.

5. Use the mouse pointer to click and drag the **Fade** slider LEFT or RIGHT, to adjust the *fade level*, to make internal features visible.

 **NOTE** Using the **Fade** slider can cause low-contrast features to disappear; use care not to inadvertently hide details in the dataset; otherwise, avoid adjusting the fade level.

 **NOTE** A recommended approach to using the **Fade** slider is to start with a hard fade (all the way to the left), then bring up the left **Transfer function** threshold until the noise disappears. Once the outside air noise *just* vanishes, bring up the right **Transfer function** slider until the material is sufficiently bright, making the surface features visible. Fade can now be slid slightly to the right, to reveal internal structure. Cropping (refer to step 8) can also be used in conjunction with fade control, to provide best viewing of internal structures.

6. Alternate using the mouse pointer to click and drag the **Transfer function** (contrast and brightness) and **Fade** sliders, to obtain a desirable 3D rendering.

7. Select different **Opacity** and **Color** drop-down list box *options*, then repeat step 6 to obtain the optimum effect with the newly selected options.

 **NOTE** **Opacity** mainly affects **Fade** slider behavior. Two of the available false **Color** palettes are **Organic** and **Hue ramp**. **Organic** provides good viewing results for many samples. **Hue ramp** is useful for highlighting density differences within the sample.

 **NOTE** Use colors other than black and white to better view dark features against the black background.

8. Isolate the region of interest within the 3D reconstructed volume,

by clicking  in the **Crop** icon toolbar to isolate a region smaller than the complete volume. Use the remaining **Crop** icons, as needed, to obtain the effect that you want.

Icon	Description
	Click to enable cropping a corner within the 3D reconstructed volume.
	Click to enable creating a diagonal cropped area within the 3D reconstructed volume.
	Click to enable creating a parallel cropped slice within the 3D reconstructed volume.
	No crop (default). Click to omit any previously applied cropping.

 **NOTE** To adjust the crop volume, click  in the **Layout** icon toolbar, then click and drag the **orange** lines to obtain the effect that you want.

If you want to return to the single 3D volume view, click  in the **Layout** icon toolbar.

 **NOTE** For further details regarding these cropping functions, refer to the *Xradia ExamineRT Workstation 1.1 User's Manual*, available under XM3DViewer's **Help** menu.

Collecting Images (or Pictures) for a Report

This process describes how to collect images (or pictures) of the sample, to be used in “[Generating a Report](#).” The information that you will collect depends upon what is needed to be known/reported.

If you are not the owner of the sample, ask the owner to identify what information is needed for the report. For example, if the purpose of imaging is to identify a crack in a particular area of the sample, the images that you collect for the report should highlight the presence and location of the crack.

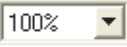
The collection process differs, depending upon whether you are processing cross-sectional 2D reconstructed slices and/or 3D reconstructed volumes:

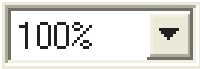
- [Visualize, Measure, and Capture Internal Structure on 2D Reconstructed Slices](#)
- [Visualize, Measure, and Capture Internal Structure on 3D Reconstructed Volumes](#)

Visualize, Measure, and Capture Internal Structure on 2D Reconstructed Slices

This process describes how to create images from 2D reconstructed slices, to indicate the region of interest within a sample, for use in a report.

To visualize, measure, and capture the internal structure on 2D reconstructed slices

1. Click  in the **Layout** icon toolbar, to display the single 2D reconstructed slice view.
2. Click  again, once per plane, to scroll through the **green**, **blue**, and **red** 2D planes, to see different views of each slice.
3. Use the **Zoom** and **Pan** controls,    and , to zoom and pan within the 2D reconstructed slice views.

Zoom Control	Description
	Click to zoom OUT.
	Click to zoom IN.
	Select a <i>zoom percentage</i> from the drop-down list box.
	Click this icon in the Mouse mode icon toolbar, then, with the center-mouse button pressed, use the mouse pointer to click and drag UP and DOWN, within any 2D reconstructed slice view, to zoom IN and OUT, respectively. You can also click and hold the left mouse button, then drag LEFT and RIGHT to pan.

4. Select **View > Scale bar** from the menu bar. This inserts a scale at the bottom of the view, which provides a reference for the size of the region shown.
5. Use the keyboard's **UP** and **DOWN** arrow keys, to scroll through the different slices and identify a 2D reconstructed slice of interest.

6. If you want to add a measurement line, click  in the **Mouse mode** icon toolbar, to enable Measurement mode. In the 2D reconstructed slice view, at the slice's region of interest, click once to define the start point for measuring, then again to define the endpoint for measuring.

 **NOTE** To remove an erroneous measurement line, click the *line* to select it (line color changes from **blue** to **yellow**), then press the **Delete** key on the ergonomic station's keyboard.

If Measurement mode is not the active mode, click  to enable it, then proceed with the removal process described above.

7. If you want to apply arrow and text annotations, click  in the **Mouse mode** icon toolbar, to enable Annotation mode and apply the *annotations*.

Annotation	Process
Arrow	Click within the 2D reconstructed slice view at the point you want to start the arrow, then click again at the point you want to end the arrow. The arrowhead is drawn on the second end point.
Text associated with the arrow	Double-click the arrow, then type the text you want to add.

NOTICE Switching to a new slice automatically removes all annotations. To save the current slice, refer to step 8, below.

 **NOTE** To remove an erroneous annotation, click the *annotation* to select it (annotation color changes from **blue** to **yellow**), then press the **Delete** key on the ergonomic station's keyboard.

If Annotation mode is not the active mode, click  to enable it, then proceed with the removal process described above.

8. After isolating and marking the region(s) of interest in the selected

slice, click  in the **Options** icon toolbar, move the mouse onto the 2D reconstructed slice view, then left-click to take a picture (snapshot) of the slice. This saves a picture of the 2D reconstructed slice on the **Snapshots** panel of the **Report** tab. (Refer to [Figure 4-7](#), lower left corner of the **XM3DViewer** main window.)



NOTE The screen captures are automatically captured at screen resolution and then scaled to fit on the page. This can result in difficult-to-read scale bars, measurements, and annotations when the window is very large during capture. To make the text more readable, resize the **XM3DViewer** main window to a smaller size before taking a picture of the 2D reconstructed slice.

9. Repeat steps [1](#) through [8](#) for all 2D reconstructed slices that are of interest.

When finished, proceed to the next process:

- If you want to take pictures of 3D reconstructed volume data before generating a report, proceed to “[Visualize, Measure, and Capture Internal Structure on 3D Reconstructed Volumes](#)”
- If you want to generate a report with only 2D reconstructed slice data, proceed to “[Generating a Report](#)”

Visualize, Measure, and Capture Internal Structure on 3D Reconstructed Volumes

This process describes how to create images from a 3D volume, to indicate the region of interest within a sample, for use in a report.

To visualize, measure, and capture the internal structure on 3D reconstructed volumes

1. Click  in the **Layout** icon toolbar, to display the single 3D volume view.
2. Click  or  in the **Mouse mode** icon toolbar, to enable and use the following *mouse functions*.

Mouse Function	Process
Rotate the image	Use the mouse pointer to left-click and drag within the 3D volume view.
Zoom IN and OUT	With the left- and center-mouse buttons simultaneously pressed, use the mouse pointer to click and drag UP and DOWN, respectively, within the 3D volume view.
Pan	With the center-mouse button pressed, use the mouse pointer to click and drag within the 3D volume view.

3. Follow steps **a** and **b** below, if you want to include a distance reference:
 - a. Cancel the **3D perspective** selection under the **View** menu. This causes the image in the 3D volume view to appear with a linear distance scaling, which is necessary when including a distance reference or scale bar.
 - b. Select **View > Scale bar** from the menu bar, to insert a scale bar at the bottom of the 3D volume view, which provides a size reference. Ensure that **3D perspective** is not selected.

4. Follow steps **a** through **c** below, if you want to add a measurement line:

- a. Cancel the **3D perspective** selection under the **View** menu (if you did not already cancel it in step **3a**). This causes the image in the 3D volume view to appear out of perspective, which is necessary when adding a measurement line.
- b. Click  in the **Mouse mode** icon toolbar, to enable Measurement mode.
- c. In the 3D volume view, at the region of interest, left-click once to define the start point for measuring, then again to define the endpoint for measuring.

 **NOTE** To remove an erroneous measurement line, click the *line* to select it (line color changes from **blue** to **yellow**), then press the **Delete** key on the ergonomic station's keyboard.

If Measurement mode is not the active mode, click  to enable it, then proceed with the removal process described above.

5. If you want to apply arrow and text annotations, click  in the **Mouse mode** icon toolbar, to enable Annotation mode and apply the *annotations*.

Annotation	Process
Arrow	Left-click within the 3D volume view at the point you want to start the arrow, then click again at the point you want to end the arrow. The arrowhead is drawn on the second end point.
Text associated with the arrow	Double-click the arrow, then type the text you want to add.

 **CAUTION** Switching to a new slice automatically removes all annotations. To save the current slice, refer to step **6**, below.

 **NOTE** To remove an erroneous annotation, click the *annotation* to select it (annotation color changes from **blue** to **yellow**), then press the **Delete** key on the ergonomic station's keyboard.

If Annotation mode is not the active mode, click  to enable it, then proceed with the removal process described above.

6. After isolating and marking the region(s) of interest, left-click  in the **Options** icon toolbar, move the mouse onto the 3D volume view, then left-click to take a picture (snapshot) of the 3D volume. This saves a picture of the 3D volume on the **Snapshots** panel of the **Report** tab. (Refer to [Figure 4-7](#).)

 **NOTE** The screen captures are automatically captured at screen resolution and then scaled to fit on the page. This can result in difficult-to-read scale bars, measurements, and annotations when the window is very large during capture. To make the text more readable, resize the **XM3DViewer** window to a smaller size before taking a picture of the 3D volume.

7. Repeat steps [1](#) through [6](#) for all 3D reconstructed volumes that are of interest.

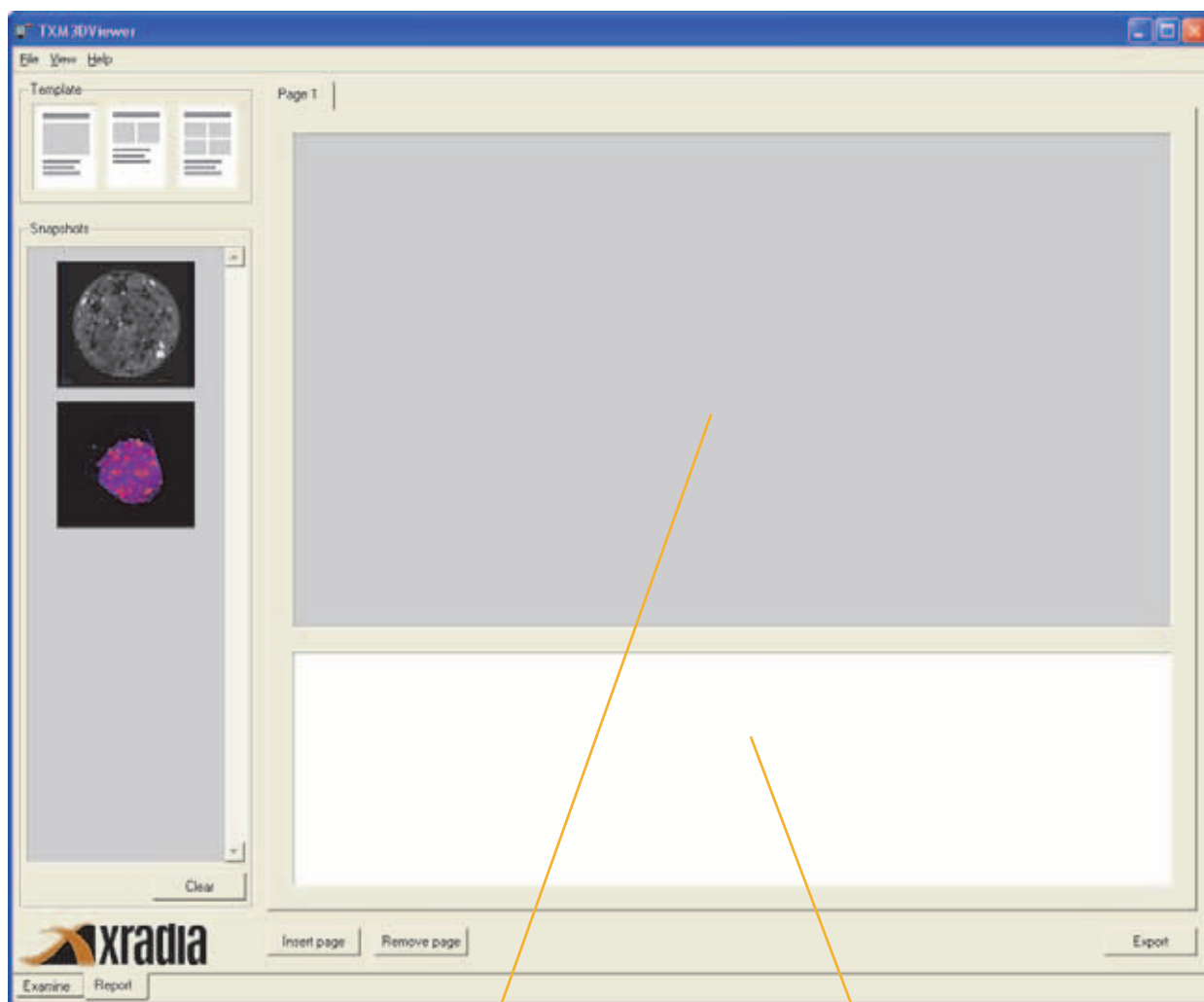
When finished, proceed to one of the next processes:

- [“Visualize, Measure, and Capture Internal Structure on 2D Reconstructed Slices”](#)
- [“Generating a Report”](#)

Generating a Report

This process describes how to generate a report, using the images that you created and modified in “[Collecting Images \(or Pictures\) for a Report.](#)”

Figure 4-7 XM3DViewer Main Window – **Report** Tab



Report tab

Drag snapshots here

Add comments here

To generate a report

1. Click the **Report** tab (lower left corner of **XM3DViewer** main window).
2. In the **Template** panel, click the *report layout that you want to use*. That layout opens in the selected **Page x** tab.
3. Use the mouse pointer to click and drag *snapshots* onto the **Page x** tab, according to the selected layout.
4. To add comments, type the *comment text* in the bottom panel (white space) of the page.

 **NOTE** To add a page, click **Insert page**. Repeat steps 3 and 4, as needed.

 **NOTE** To remove a page that is not needed in the report, select the page's **Page x** tab, then click **Remove page**.

5. When you are finished creating the report data, click **Export** to export and save the report as a formatted Microsoft Word *.doc document.

 **NOTE** Report files are automatically saved in **C:\Program Files\Xradia\VersaXRM\10.6.x\3DViewer\share\examine_report**. To save the report file to a different location, use the Microsoft Word "File > Save As..." menu bar option.

 **NOTE** The report file includes a title page, the exported information, and closes the report with "Sincerely, RADIOLOGIST".

 **NOTE** The images exported in the report file can be copied at full screen resolution into other types of documents, such as a Microsoft PowerPoint presentation or Excel spreadsheet.

 **NOTE** Screenshots are automatically captured at screen resolution, then scaled to fit on the page. This can result in difficult-to-read scale bars, measurements, and annotations when the window image is large. To make the text more readable, resize the **XM3DViewer** main window to a smaller size before performing a screen capture.

 **NOTE** After all required movies and reports are generated, delete the *.txm-exm and *.txm-exm-ooc files created by XM3DViewer if Out-of-core mode was used when XM3DViewer first opened the reconstructed file.

Creating Movies of Cross-Sectional 2D Reconstructed Slices and 3D Reconstructed Volumes

This process describes how to create an animation (movie) of captured data, using the **Cine controls**. The instructions differ, depending upon whether you are processing 2D reconstructed slices or 3D reconstructed volumes:

- [Creating Movies of 2D Reconstructed Slices](#)
- [Creating Movies of 3D Reconstructed Volumes](#)

Creating Movies of 2D Reconstructed Slices

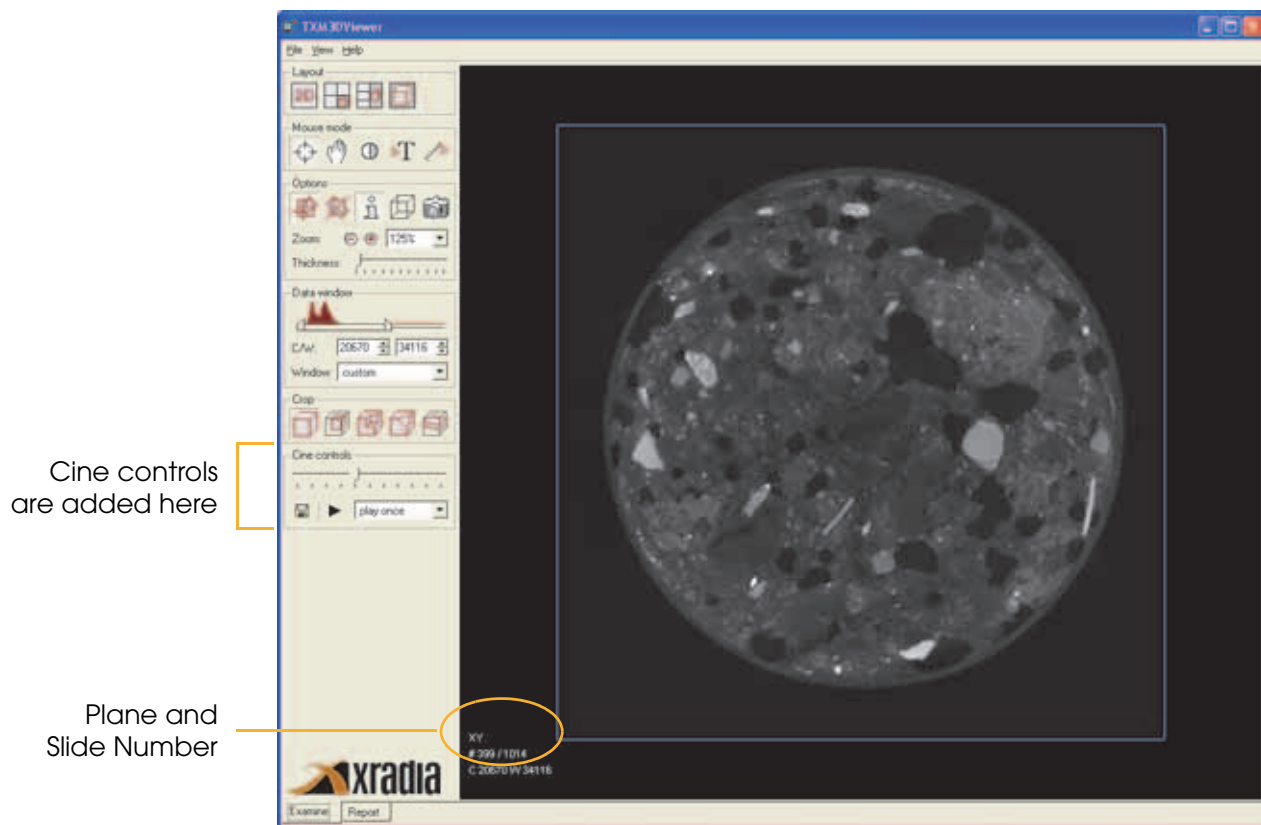
This process describes how to create a movie of 2D reconstructed slices, using the **Cine controls**.

To create a movie of 2D reconstructed slices

1. Click  in the **Layout** icon toolbar. **Cine controls** appears below the **Crop** icon toolbar area.

 **NOTE** If the **Cine controls** are not visible, it is possible that the window size is too small. If this occurs, maximize the window size. **Cine controls** should now be visible.

Figure 4-8 Cine controls (Added to XM3DViewer Main Window)



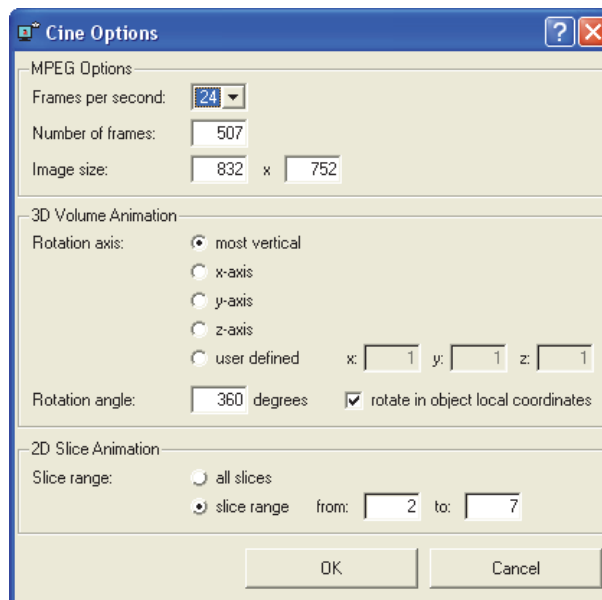
2. Use the following *cine controls* to identify slices of interest, and specify how often to play them in the movie.

Option	Description
	Use the slider to scroll through the 2D reconstructed slices, to identify slices of interest (the slice numbers appear in the bottom left of the screen, indicated in white; if the slice numbers are not visible, click  in the Options icon toolbar to display them). Note the <i>beginning</i> and <i>ending slice numbers</i> to be saved as the movie. These values are used later, in step 4.
	From the drop-down list box, select whether to scroll through the 2D reconstructed slices once (<i>play once</i> ; default) or <i>continuously</i> , in a loop.

3. Click  under **Cine controls**. The **Cine Options** dialog box opens.

 **NOTE** Image size changes with the size of the viewing window. To make a movie that naturally occupies a specific screen size, resize the window, as needed, then click  under **Cine controls**, to generate a movie with that screen size.

Figure 4-9 Cine Options Dialog Box



4. Select and/or type the *cine option settings*.

Option	Setting
Frames per second	24 is a good value to use. The number (quantity) of frames * frames per second = the movie time length.
Number of frames	<i>Use default.</i>
Image size	<i>Use default.</i> This changes with the size of the viewing window. To make a movie that naturally occupies a specific screen size, the window can first be sized, as desired, then click  under Cine controls , to generate a movie with that screen size.
3D Volume Animation	N/A
2D Slice Animation Slice range	Select slice range , then type the <i>beginning</i> and <i>ending slice numbers</i> noted in step 2, in the from and to text boxes, respectively.

5. Click **OK**. A **Choose filename for movie file** dialog box opens, defaulted to the *MPEG movie (.mpg)* file type.

6. Browse to the *destination file path*; type the *new file name* in the **File name** text box, then click **Save**.

 **NOTE** XM3DViewer automatically scrolls through the included 2D reconstructed slices and generates the movie. The window cannot be minimized, and you cannot open any other windows (from within XM3DViewer or another program), until the movie completes rendering.

7. When the movie completes, an **Info** dialog box opens with the message “MPEG file successfully written”. Click **OK** to close the dialog box.

 **NOTE** After all required movies and reports are generated, delete the *.txm-exm and *.txm-exm-ooc files created by XM3DViewer if Out-of-core mode was used when XM3DViewer first opened the reconstructed file.

Creating Movies of 3D Reconstructed Volumes

This process describes how to create a movie of a 3D reconstructed volume, using the **Cine controls**.

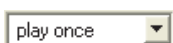
To create a movie of a 3D reconstructed volume

1. Click  in the **Layout** icon toolbar. **Cine controls** appears below **Transfer function** area.

Figure 4-10 Cine controls



2. Use the following *cine controls* to preview a 360° view, and specify how often to play the 3D volume in the movie.

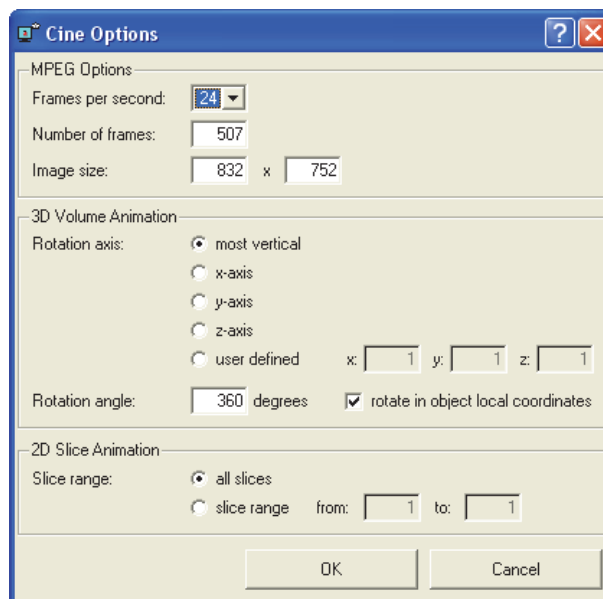
Option	Description
	Use the slider to preview a 360° view. If the sample is not centered about the rotation axis, use the Pan control to center the sample within the view, by clicking  or  in the Mouse mode icon toolbar, then, with the center-mouse button pressed, use the mouse pointer to click and drag within the 3D volume view.
	From the drop-down list box, select whether to play the 3D volume movie once (<i>play once</i> ; default) or <i>continuously</i> , in a loop.

 **NOTE** Check the center of rotation before saving the movie, by playing the movie from the window first. This minimizes any undesirable wobble in the final movie.

To do this, play a small portion of the movie, then use the **Pan** control to re-center the volume when it starts to rotate off-axis (orbit about a point). Continue doing this until the movie rotates about the desired axis location.

3. Click  under **Cine controls**. The **Cine Options** dialog box opens.

Figure 4-11 Cine Options Dialog Box



4. Select and/or type the *cine option settings*.

Option	Setting
Frames per second	24 is a good value to use. The number (quantity) of frames * frames per second = the movie time length.
Number of frames	Use default.
Image size	Use default. This changes with the size of the viewing window. To make a movie that naturally occupies a specific screen size, the window can first be sized, as desired, then click  under Cine controls , to generate a movie with that screen size.
3D Volume Animation Rotation axis	Can be changed, as needed. If allowed to default (most vertical), the movie is taken with the sample rotated about the vertical axis.
3D Volume Animation Rotation angle	Use default.
2D Slice Animation	N/A

5. Click **OK**. A **Choose filename for movie file** dialog box opens, defaulted to the *MPEG movie (.mpg)* file type.
6. Browse to the *destination file path*; type the *new file name* in the **File name** text box, then click **Save**.

 **NOTE** XM3DViewer automatically scrolls through the 3D volume and generates the movie. The window cannot be minimized, and you cannot open any other windows (from within XM3DViewer or another program), until the movie completes rendering.

7. When the movie completes, an **Info** dialog box opens with the message “MPEG file successfully written”. Click **OK** to close the dialog box.

 **NOTE** After all required movies and reports are generated, delete the *.txm-exm and *.txm-exm-ooc files created by XM3DViewer if Out-of-core mode was used when XM3DViewer first opened the reconstructed file.

Correcting Problems with the Reconstructed File



NOTE Troubleshooting tips specific to contrast and brightness is described in “Troubleshooting Contrast, Brightness, and Light Intensity Count Issues,” on page 161, in Appendix A.

This section provides troubleshooting information for how to handle specific problems with reconstructed data:

- [Table 4-2](#) lists “show stopper” problems, with probable cause and solutions
- [Table 4-3](#) lists solutions to problems that require manual reconstruction
- [Table 4-4](#) lists solutions to problems that require re-imaging

Table 4-2 Show Stoppers

Problem	Probable Cause	Solution
Reconstruction failed (no reconstructed file)	Insufficient hard disk drive memory (depends upon the size of the acquired file before reconstruction).	Clean up the available space on the hard disk drive, then reconstruct the file again. The amount of free space required on the hard disk drive must be at least 1 GB more than the file size of the tomography (slice) dataset.
Blank file	Sample fell off the sample stage due to incorrect positioning or motor failure (check for errors in the Scout-and-Scan Control System Status bar).	Reposition sample, detector, and X-ray source, then re-acquire the data. If the problem is due to motor failure, contact the ZEISS Support Team. ^a

a. Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.

Table 4-3 Solutions to Problems that Require Manual Reconstruction

Problem	Solution
There are streaks or blurring in the image.	Correct the center shift (refer to “Finding Center Shift,” on page 99, in Chapter 3), then reconstruct the file.
The outer part of the sample looks more dense than the inside, and the sample is all the same material.	Correct Beam Hardening (refer to “Finding a Constant for Beam Hardening Correction,” on page 104, in Chapter 3), then reconstruct the file.
Regions of the image are blurred. Reconstruction filter kernel is too large.	Repeat “Reconstructing the Tomography Data,” on page 110, in Chapter 3, but in step 5, select a <i>recon filter with a smaller kernel size</i> .
Image is too noisy. Areas that should be smooth contain large intensity variations over short length scales, on the order of the pixel size. Reconstruction filter kernel is too small.	Repeat “Reconstructing the Tomography Data,” on page 110, in Chapter 3, but in step 5, select a <i>recon filter with a larger kernel size</i> .
Too many rings are obscuring the region of interest.	Repeat “Reconstructing the Tomography Data,” on page 110, in Chapter 3, but in step 5, select a <i>different ring removal option</i> .

Table 4-4 Solutions to Problems that Require Reimaging

Problem	Solution
Magnification is insufficient – cannot see fractures or other flaws down to a sufficiently fine detail.	Repeat scan at a higher magnification, if it has not already been done.
Too many rings are obscuring the region of interest and DRR (dynamic ring removal) was not enabled.	Select Enable DRR (Dynamic Ring Removal) (default) for the <i>recipe</i> in the Advanced Acquisition tab within the Scout-and-Scan Control System's Scan view, then repeat the scan. ^a
Region of interest has streaks (sample might have moved during imaging).	Securely mount the sample on the sample holder ^b and/or reposition the detector and X-ray source so that they do not collide with the sample ^c , then repeat the scan.
	Sample drift can occur with any amount of temperature drift; however, it does not cause visible artifacts if the drift is sufficiently small. Sample drift correction can be used to correct for this. ^d

a. Refer to “Advanced Acquisition tab,” on page 235, in Appendix D.

b. Refer to “Mounting a Sample in or on a Sample Holder,” on page 266, in Appendix E.

c. Refer to “Step 2 – Load,” on page 25 or “Step 2 – Load,” on page 83 in Chapter 2.

d. Refer to “Thermal and Sample Drift Correction,” on page 237, in Appendix D.

A Troubleshooting

This appendix describes how to resolve common issues that might be encountered when using the Xradia Versa:

- [Issues that Require ZEISS Assistance](#)
- [Troubleshooting Scout-and-Scan Control System Sample Issues](#)
- [Troubleshooting Contrast, Brightness, and Light Intensity Count Issues](#)
- [Troubleshooting XM3DViewer Issues](#)
- [Troubleshooting X-ray Source Issues](#)
- [Troubleshooting Xradia Versa Power-Related Issues](#)
- [Troubleshooting Light Tower Issues](#)

If the suggested solutions do not resolve the problem, refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.

Issues that Require ZEISS Assistance

Table A-1 and Table A-2 list hardware and software issues, respectively, that must be referred to the ZEISS Support Team (refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K) for resolution.



WARNING Do not attempt to troubleshoot these issues on your own, because doing so will violate the product warranty and/or cause potential physical harm.

Table A-1 Hardware Problems that Require ZEISS Support Team Assistance

Symptom(s)	Problem
The Scout-and-Scan Control System indicates that the X-ray source is turned ON; however, the X-ray source turns OFF almost immediately and the PDU's red ALARM/RESET push-button switch is lit.	Light tower is malfunctioning. Refer also to “Troubleshooting Light Tower Issues.”
Light tower's red (top) light does not turn ON.	X-ray source does not turn ON after closing the access doors and clicking the Apply button (Source Control panel or Acquisition tab in Scout view). Refer also to “Troubleshooting Light Tower Issues.”
Light tower's yellow (center) light does not turn ON when the access doors are closed.	Safety interlock is malfunctioning.
Light tower's yellow (center) light is ON; however, the Interlock indicator in the X-ray Source dialog box indicates OPEN .	
Non-Macro magnification lens was selected; however, the turret does not rotate the selected lens into position.	Turret is malfunctioning.
Homing Status dialog box indicates homing errors: <ul style="list-style-type: none"> – “... followed out on coarse home” – “... followed out on fine home” 	One or more of the axes (Sample X, Y, Z , and/or Theta, Detector Z , and/or Source Z) will not move or cannot be changed/homed.
Axis does not move after clicking  within a motion control.	

Table A-1 Hardware Problems that Require ZEISS Support Team Assistance (Continued)

Symptom(s)	Problem
One or more of the axes (Sample X, Y, Z , and/or Theta, Detector Z , and/or Source Z) does not move, moves erratically, or vibrates when moving.	Xradia Versa motion controller(s) or motor(s) are malfunctioning.
Program running on the Xradia Versa issues an “Unable to communicate with the (motion or source) controller” message.	
Red Warning message appears at the bottom of the Scout-and-Scan Control System display.	
X-ray source tube errors	Refer to Table A-5, “X-ray Source Tube Error Messages that Require ZEISS Support Team Assistance,” on page 168.

Table A-2 Software Problems that Require ZEISS Support Team Assistance

Symptom(s)	Problem
Image quality is not the same quality as achieved in prior acquisitions that used the same settings.	Imaging components, such as the detector and/or X-ray source, have malfunctioned.
Errors in a window or dialog box indicate a problem that cannot be easily user-remedied.	System hardware components, such as the motors, have malfunctioned.
X-ray source reports that it is unable to reach the requested voltage or power.	If the requested voltage and power is within the supported range, this indicates that the X-ray source might require calibration by ZEISS service personnel. Contact the ZEISS Support Team for assistance.
Starting the Scout-and-Scan Control System generated the following error message(s). <div> </div>	An instance of the Scout-and-Scan Control System is likely already running. If this is not the case, try shutting down and restarting the Xradia Versa ^a , then restart the Scout-and-Scan Control System. If the error persists, contact the ZEISS Support Team for assistance.

a. Refer to [Appendix C, “Shutting Down and Restarting the Xradia Versa.”](#)

Troubleshooting Scout-and-Scan Control System Sample Issues

This section provides tips for troubleshooting the following sample-related issues that you might experience when using the Scout-and-Scan Control System:

- Sample Is Unstable
- Sample Is Not Visible within the Front or Side View Display
- Sample Region of Interest Is Not Visible
- Sample and Detector Collision Is Imminent
- Sample and Detector Collided
- Sample and X-ray Source Collision Is Imminent
- Sample and X-ray Source Collided

Sample Is Unstable

Symptom	Sample is wobbly (unstable) on the sample stage or in/on the sample holder; acquired images are blurry and unfocused.
Problem	Sample is not properly mounted or loaded.
Solution	<p><i>To stabilize the sample</i></p> <ol style="list-style-type: none"> 1. Ensure that the flat edges of the sample holder and sample stage are aligned. (Refer to Figure E-7, “Sample Holder Assembly Loaded onto Sample Stage, with Flat Edges Aligned, Facing Front of Xradia Versa,” on page 274, in Appendix E.) 2. Ensure that the tungsten balls on the sample stage are fitted into the indentations on the underside of the sample holder. (Refer to Figure E-6, “Sample Stage, with Tungsten Alignment Balls Highlighted,” on page 274, in Appendix E.) 3. Ensure that the sample is securely mounted in/on the sample holder. 4. Ensure that the sample is stable, such that it does not move nor vibrate in response to gently tapping the sample holder. 5. Follow steps a through d below, if the sample must be repositioned in/on the sample holder: <ol style="list-style-type: none"> a. Remove the sample holder from the sample stage, following the processes described in “Removing a Sample after Use,” on page 275, in Appendix E. b. Adjust the sample’s <i>position</i> in/on the sample holder, based upon the criteria identified in steps 3 and 4, following the processes described in “Mounting a Sample in or on a Sample Holder,” on page 266, in Appendix E. c. Load the sample holder assembly back onto the sample stage, following the processes described in “Loading a Sample Holder Assembly onto the Sample Stage,” on page 273, in Appendix E. d. Repeat steps 1 through 4. <p>If you resume the process in which you determined there was an issue, and the issue persists, contact the ZEISS Support Team for assistance. (Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.)</p>

Sample Is Not Visible within the Front or Side View Display

Symptom Sample is not visible within the Scout-and-Scan Control System **Front** or **Side View** display.

Problem Sample is not properly installed; sample is out of the field of view (FOV).

Solution *To make the sample visible within the Scout-and-Scan Control System Front or Side View display*

1. With the access doors closed, use the visual light camera to verify that the:
 - Sample is securely mounted in/on the sample holder, and has not slid from view, and that its region of interest (ROI) is:
 - Located above the top surface of the holder
 - Positioned so that the least amount of material will be penetrated by X-ray

 **NOTE** Refer to “Mounting a Sample in or on a Sample Holder,” on page 266, in [Appendix E](#) for mounting instructions.

- Sample holder assembly is properly loaded onto the sample stage

 **NOTE** Refer to “Loading a Sample Holder Assembly onto the Sample Stage,” on page 273, in [Appendix E](#) for loading instructions.

- Detector and X-ray source are situated as close as possible to the sample, without colliding with the sample
- Sample is visible after clicking /applying continuous X-rays. If not, do one of the following:
 - Ensure that the **Sample X** and **Sample Z** axes are at 0°, –or–
 - Change the *objective* to a lower magnification, to enable seeing a larger FOV. Move the detector closer to the sample. If the image becomes saturated (intensity greater than 60000), lower the *exposure time* or increase the *binning*, then click  again to apply continuous X-rays.

 **NOTE** The sample may not be sufficiently high, so keep moving the sample up until you see it.

2. Repeat [“Step 2 – Load,” on page 25](#) or [“Step 2 – Load,” on page 83](#) in Chapter 2.

If you resume the process in which you determined there was an issue, and the issue persists, contact the ZEISS Support Team for assistance. (Refer to [“ZEISS Support Team \(Technical Support\),” on page 308, in Appendix K.](#))

Sample Region of Interest Is Not Visible

Symptom Region of interest (the focus of the data to be acquired) is not visible.

Problem Sample is not properly mounted nor installed, or is out of the field of view (FOV).

Solution *To make the sample region of interest visible*

1. Repeat “[Step 2 – Load,](#)” on page 25 or “[Step 2 – Load,](#)” on page 83 in Chapter 2.
2. Repeat “[Step 3 – Scout,](#)” on page 28 or “[Step 3 – Scout,](#)” on page 86 in Chapter 2.

If you resume the process in which you determined there was an issue, and the issue persists, contact the ZEISS Support Team for assistance. (Refer to “[ZEISS Support Team \(Technical Support\),](#)” on page 308, in [Appendix K.](#))

Sample and Detector Collision Is Imminent

Symptom	While using the Scout-and-Scan Control System and moving the sample or detector, the sample and detector are coming too close to one another.
Problem	The sample and detector are so close that they might collide with one another.
Solution	<i>To prevent the sample and detector from colliding</i>

1. If you just clicked  within a motion control, click  for that motion control to immediately halt movement.

NOTICE Always position the mouse pointer over  after clicking  (within the same motion control), so you can quickly halt movement if collision with the sample is imminent.

2. Review the safety guidelines provided in “Collision of Moving Parts,” on page xxiv, in Safety.
3. Move the Detector away from the sample. In the **Detector** motion control, type a *value greater than the current Detector position, in increments of 5 mm or less*, in the **Detector** text box, then click . Repeat this step, as necessary, until the detector does not touch the sample, but is still sufficiently close to it.

Sample and Detector Collided

Symptom While using the Scout-and-Scan Control System, the detector and sample are positioned such that they are touching one another, or the sample holder assembly fell off the sample stage when the sample and detector collided.

Problem While moving the sample or detector, the two collided with one another.

Solution *To resolve the problems caused by the collision*

1. Click .
2. **If the detector is damaged** – Contact the ZEISS Support Team for assistance. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.)
3. Review the safety guidelines provided in “[Collision of Moving Parts](#),” on page xxiv, in Safety.
4. **If the sample holder assembly fell off the sample stage** – Load the sample holder assembly back onto the sample stage, following the processes described in “[Loading a Sample Holder Assembly onto the Sample Stage](#),” on page 273, in Appendix E.
5. **If the sample is damaged** – Follow steps **a** through **c** below, to replace the sample:
 - a. Remove and discard the sample, following the processes described in “[Removing a Sample after Use](#),” on page 275, in Appendix E.
 - b. Mount a new sample in/on the sample holder, following the processes described in “[Mounting a Sample in or on a Sample Holder](#),” on page 266, in Appendix E.
 - c. Position and scan the new sample, following the processes described in Chapter 2, “[Acquiring Tomographies with the Scout-and-Scan Control System](#).”

Sample and X-ray Source Collision Is Imminent

Symptom While using the Scout-and-Scan Control System and moving the sample or X-ray source, the sample and X-ray source are coming too close to one another.

Problem The sample and X-ray source are so close that they might collide with one another.

Solution *To prevent the sample and X-ray source from colliding*

1. If you just clicked  within a motion control, click  for that motion control to immediately halt movement.

NOTICE Always position the mouse pointer over  after clicking  (within the same motion control), so you can quickly halt movement if collision with the sample is imminent.

2. Review the safety guidelines provided in [“Collision of Moving Parts,” on page xxiv, in Safety.](#)
3. Move the X-ray source away from the sample. In the **Source** motion control, type a *value more negative than the current Source position, in increments of 5 mm or less*, in the **Source** text box, then click .

Repeat this step, as necessary, until the detector does not touch the sample, but is still sufficiently close to it.

Sample and X-ray Source Collided

Symptom While using the Scout-and-Scan Control System, the X-ray source and sample are positioned such that they are touching one another, or the sample holder assembly fell off the sample stage when the sample and X-ray source collided.

Problem While moving the sample or X-ray source, the two collided with one another.

Solution *To resolve the problems caused by the collision*

1. Click .
2. **If the X-ray source is damaged** – Contact the ZEISS Support Team for assistance. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.)
3. Review the safety guidelines provided in “[Collision of Moving Parts](#),” on page xxiv, in Safety.
4. **If the sample holder assembly fell off the sample stage** – Load the sample holder assembly back onto the sample stage, following the processes described in “[Loading a Sample Holder Assembly onto the Sample Stage](#),” on page 273, in Appendix E.
5. **If the sample is damaged** – Follow steps **a** through **c** below, to replace the sample:
 - a. Remove and discard the sample, following the processes described in “[Removing a Sample after Use](#),” on page 275, in Appendix E.
 - b. Mount a new sample in/on the sample holder, following the processes described in “[Mounting a Sample in or on a Sample Holder](#),” on page 266, in Appendix E.
 - c. Position and scan the new sample, following the processes described in Chapter 2, “[Acquiring Tomographies with the Scout-and-Scan Control System](#).”

Troubleshooting Contrast, Brightness, and Light Intensity Count Issues

Contrast, brightness, and light intensity count (saturation) adjustments are typically process-specific. [Table A-3](#) lists processes in the guide that describe how to adjust contrast, brightness, and/or light intensity counts, within the context of those processes.

Table A-3 Processes that Apply Contrast, Brightness, and/or Light Intensity Count (Saturation) Adjustments, by Program

Program	Processes that Apply Contrast, Brightness, and/or Light Intensity Count (Saturation) Adjustments
Scout-and-Scan Control System	“Scout – Select Proper X-ray Filter and kV,” steps 3 and 4, on page 35 in Chapter 2
	“Scout – Determine Acquisition Time,” step 1, on page 40 in Chapter 2
	Histogram tool in Table D-5, “Scout View Annotation Controls,” on page 228
XMReconstructor	“Finding Center Shift,” step 5, on page 102 in Chapter 3
	“Finding a Constant for Beam Hardening Correction,” step 4, on page 107 in Chapter 3
	“XMReconstructor Histogram Tool,” on page 255, in Appendix D.
XM3DViewer	“Adjusting Contrast and Brightness in the 2D Reconstructed Slice Views,” on page 121, in Chapter 4
	“Creating 3D Volume Renderings,” step 4, on page 127 in Chapter 4
	“Creating 3D Volume Renderings,” step 6, on page 128 in Chapter 4

Troubleshooting XM3DViewer Issues



NOTE This guide provides basic information for using XM3DViewer to view tomographic data after reconstruction. For further details regarding the program's use, refer to the *Xradia ExamineRT Workstation 1.1 User's Manual*, available under XM3DViewer's **Help** menu.

Because XM3DViewer is a third-party product, its troubleshooting is described separately, in [“Correcting Problems with the Reconstructed File,” on page 146, in Chapter 4.](#)

Additional troubleshooting, with respect to contrast and brightness, is also provided earlier in this appendix, in [“Troubleshooting Contrast, Brightness, and Light Intensity Count Issues.”](#)

Troubleshooting X-ray Source Issues

This section provides tips for troubleshooting the following X-ray source-related issues that you might experience when using the Xradia Versa and/or Scout-and-Scan Control System:

- [X-Ray Source Status](#)
- [Troubleshooting X-ray Source Tube Error Messages](#)
- [Troubleshooting X-ray Source Power Failure](#)
- [Troubleshooting Magnification Lens Too Close to the X-ray Source – Keeping the X-ray Source Aperture out of the Field of View](#)

Tips for troubleshooting X-ray source-related issues with respect to the sample are described earlier in this appendix:

- [“Sample and X-ray Source Collision Is Imminent,” on page 159](#)
- [“Sample and X-ray Source Collided,” on page 160](#)

X-Ray Source Status

The X-ray source goes through the following X-ray source tube state sequence when it receives a voltage or power command:

1. [Stabilizing Voltage and Power.](#)
2. [Centering.](#)
3. [Stabilizing Voltage and Power.](#)
4. [On.](#)

Table A-4 lists and describes the general and error states associated with X-ray source tube. If the state is an error state, the table includes troubleshooting tips.

Table A-4 X-Ray Source Tube States

Status	Troubleshooting Needed/Error ^a	Description
Aging		<p>The X-ray source is undergoing aging, a required initial warm-up process that takes 3 minutes. X-ray source aging is required every 24 hours for optimum tube performance, as well as after the X-ray source has been powered OFF for more than 23 hours. The aging process automatically starts when the X-ray source is powered ON. After aging is complete, the X-ray source tube automatically goes through its standard sequence to achieve the requested voltage and power.</p> <p>The X-ray source voltage and current increase up to their maximum levels in a pre-determined manner during warm-up.</p>
Initializing		Communication with the X-ray source has been initiated. This state is usually not displayed on the user interface because initialization of communication with the tube completes before the Scout-and-Scan Control System user interface is displayed.
Lost Communication with the source	✓	To resolve the error, refer to “ Lost Communication with the source. ” in Table A-6 on page 170 .
Off		The tube is powered OFF.
Off - Arc	✓	<p>The tube high voltage has arced and the high-voltage power supply has automatically been turned OFF. The tube is in an error state. Using the Scout-and-Scan Control System, check the Blank area in the Source Control drop-down panel for an error message, –or– access the Current Log button (not shown) in the Advanced Settings drop-down panel for a description of the error.</p> <p>To reset the error, click the Source Control drop-down list box, then click the Error Reset button. If this does not work, contact the ZEISS Support Team for assistance.^b</p>
On		The tube is powered ON and working normally. It has reached the requested voltage and power.
On - Error	✓	<p>The X-ray source is powered ON and in an error state. The tube might not be at the requested power or voltage. Using the Scout-and-Scan Control System, check the Blank area in the Source Control drop-down panel for an error message, –or– access the Current Log button (not shown) in the Advanced Settings drop-down panel for a description of the error.</p> <p>To reset the error, click the Source Control drop-down list box, then click the Error Reset button. If this does not work, contact the ZEISS Support Team for assistance.^b</p>

Table A-4 X-Ray Source Tube States (Continued)

Status	Troubleshooting Needed/Error ^a	Description
Centering		The tube is centering the electron beam, to optimize tube performance. Whenever the tube is powered ON or the voltage and/or power settings are changed, the tube goes through the Fast Centering process. Fast Centering takes less time than Slow. The tube always attempts to do Fast Centering first. If the tube cannot reach the requested power, only then will it go through the Slow Centering process.
Stabilizing Voltage and Power		The tube is waiting for the requested voltage and power to be reached and stabilized.
Tube Error – Press Error reset	✓	<p>The tube has malfunctioned and is in an error state. Using the Scout-and-Scan Control System, check the Blank area in the Source Control drop-down panel for an error message, –or– access the Current Log button (not shown) in the Advanced Settings drop-down panel for a description of the error.</p> <p>To reset the error, click the Source Control drop-down list box, then click the Error Reset button. If this does not work, contact the ZEISS Support Team for assistance.^b</p>

- a. Specific X-ray source error messages and their resolutions are described in “[Troubleshooting X-ray Source Tube Error Messages](#),” on page 166.
- b. Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.

Troubleshooting X-ray Source Tube Error Messages

This section provides instructions for recovering from X-ray source tube errors. [Table A-5](#) lists X-ray source tube error messages that must be referred to the ZEISS Support Team for resolution. [Table A-6](#) lists X-ray source tube error messages that you can typically troubleshoot and resolve without having to contact the ZEISS Support Team.

If an X-ray source tube error occurs, it must be cleared before troubleshooting can begin. For error messages listed in [Table A-5](#), it is recommended that you wait until after contacting the ZEISS Support Team to perform this action. For error messages listed in [Table A-6](#), you will need to instruct the Xradia Versa to clear the error, before performing the recommended solution.

To clear an X-ray source tube error

1. Click the **Source Control** drop-down list box. The **Source Control** drop-down panel opens.

Figure A-1 **Source Control** Drop-Down Panel



2. Scroll down to the bottom of the panel, then click **Error Reset**. The error message should clear after clicking **Error Reset**.

Figure A-2 Source Control Drop-Down Panel, with Error Message and **Error Reset** Button Shown

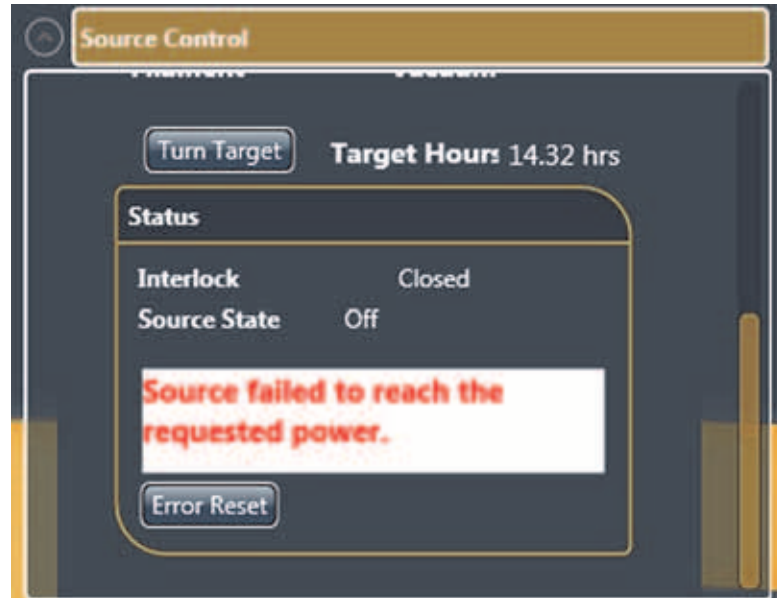


Figure A-3 Source Control Drop-Down Panel, with Error Message Cleared

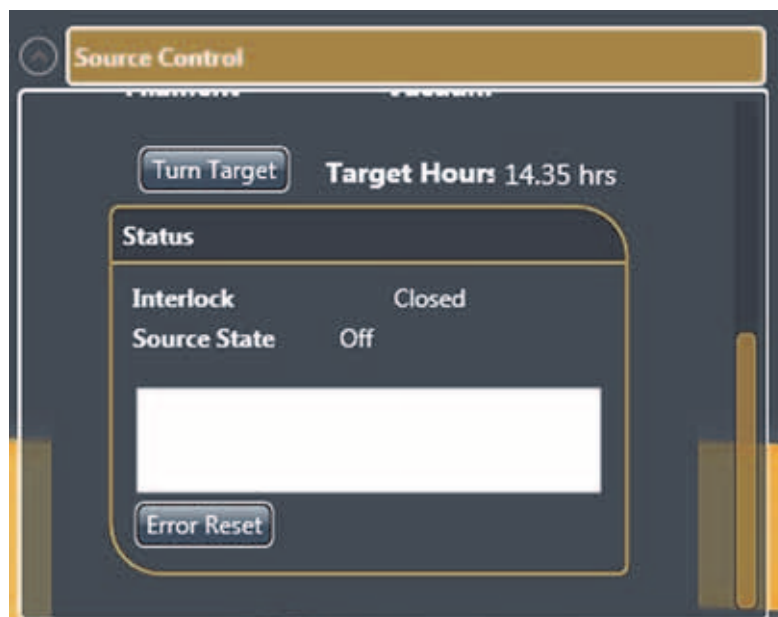


Table A-5 X-ray Source Tube Error Messages that Require ZEISS Support Team Assistance^a

X-Ray Source Tube Error Message	Problem
X-ray 56V fault. Contact ZEISS support.	Internal X-ray source error.
X-ray cache error. Contact ZEISS support.	Internal X-ray source error.
X-ray centering coil ramp failure.	Internal X-ray source error.
X-ray file access error. Contact ZEISS support.	Internal X-ray source error.
X-ray focusing coil ramp failure. Contact ZEISS support.	Internal X-ray source error.
X-ray tube current ramp failure. Contact ZEISS support.	Internal X-ray source error.
X-ray tube error reset failed.	Internal X-ray source error.
X-ray tube filament failed. Contact ZEISS support.	Internal X-ray source error.
X-ray tube unknown fault. Contact ZEISS support.	Internal X-ray source error.
X-ray tube Vacuum is bad. Contact ZEISS support.	The X-ray source tube's vacuum level has degraded and is above the acceptable level. The tube does not turn ON when the vacuum level is outside the supported range.
X-ray tube voltage ramp failure. Contact ZEISS support.	Internal X-ray source error.
X-ray uamp ramp failure. Contact ZEISS support.	Internal X-ray source error.
X-ray uamps lost. Turn tube off and then back on.	Internal X-ray source error.
X-ray undefined PSU. Contact ZEISS support.	Internal X-ray source error.
X-ray vacuum pump fault. Contact ZEISS support.	Internal X-ray source error.
X-ray vacuum sensor failure. Contact ZEISS support.	Internal X-ray source error.
X-ray warmup script failed to load. Contact ZEISS support.	Internal X-ray source error.
Error when changing spot size.	Xradia 410 Versa only This error message only applies if the Xradia 410 Versa has the 150 kV (30W maximum) X-ray source. This occurs if the command to change the source spot size failed to complete.

- a. Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.

Table A-6 X-ray Source Tube Error Message Troubleshooting Tips

X-Ray Source Tube Error Message	Problem	Recommended Solution
Aging failed to complete.	<p>X-ray source aging failed to complete successfully. The X-ray source tube is turned OFF when this occurs.</p> <p>Aging can fail to complete if the tube’s vacuum level is too high.</p>	<ol style="list-style-type: none"> 1. Turn ON the X-ray source. Aging should restart. 2. If aging continues to fail, exit the Scout-and-Scan Control System and start XMController.^a 3. Turn ON the X-ray source. At this point, aging should commence and successfully complete. 4. If aging successfully completed, exit XMController and restart the Scout-and-Scan Control System. The X-ray source should now turn ON without aging. 5. If aging continues to fail, contact the ZEISS Support Team.^b
Cannot set source to requested voltage and power because the source is aging.	X-ray source aging is in-progress and the X-ray source tube cannot be set to the requested voltage and power until aging completes.	<ol style="list-style-type: none"> 1. Wait for aging to complete. 2. Turn ON the X-ray source at the requested voltage and power.
Fast Centering failed. Trying Slow centering.	This occurs if the X-ray source tube was unable to center correctly using fast centering.	The tube should automatically run slow centering. No action is required
High voltage arc occurred in the X-ray tube. Turn the source back on to recover.	A high voltage arc occurred. The high-voltage power supply was automatically turned OFF.	<ol style="list-style-type: none"> 1. Turn ON the X-ray source. 2. If a high-voltage arc continues to occur, contact the ZEISS Support Team.^b
Interlock Open.	The safety interlocks on one or more of the Xradia Versa’s four enclosure access doors are OPEN.	<ol style="list-style-type: none"> 1. Check that all four of the access doors are securely CLOSED. 2. If the error persists, contact the ZEISS Support Team.^b

Table A-6 X-ray Source Tube Error Message Troubleshooting Tips (Continued)

X-Ray Source Tube Error Message	Problem	Recommended Solution
Lost Communication with the source.	The Scout-and-Scan Control System has lost communication with the X-ray source. This can be caused by a disconnected cable, or the Scout-and-Scan Control System simply needs to be restarted.	<ol style="list-style-type: none"> 1. Exit and restart the Scout-and-Scan Control System. 2. If the error persists, contact the ZEISS Support Team.^b
Requested Power value is outside the allowed range.	The requested power is outside the supported range for the requested voltage.	<ol style="list-style-type: none"> 1. Consult Table 1-2, “X-ray Source Voltage and Power Settings,” on page 12, in Chapter 1 for the allowable power for the requested voltage. 2. Change the power to be within the supported range for the requested voltage.
Requested Voltage value is outside the allowed range.	The requested voltage is outside the supported range for the requested power.	<ol style="list-style-type: none"> 1. Consult Table 1-2, “X-ray Source Voltage and Power Settings,” on page 12, in Chapter 1 for the allowable voltage for the requested power. 2. Change the voltage to be within the supported range for the requested power.
Source failed to reach the requested power.	The X-ray source failed to reach the requested power.	<ol style="list-style-type: none"> 1. Turn OFF the X-ray source. 2. Turn ON the X-ray source at the requested voltage and power. 3. If the X-ray source fails to reach the requested power, reduce the power by 1W and retry. 4. If the error persists, contact the ZEISS Support Team.^b
Source failed to reach the requested voltage.	The X-ray source failed to reach the requested voltage.	

Table A-6 X-ray Source Tube Error Message Troubleshooting Tips (Continued)

X-Ray Source Tube Error Message	Problem	Recommended Solution
Source failed to stabilize at the requested power.	The X-ray source failed to stabilize at the requested power.	<ol style="list-style-type: none"> 1. Turn OFF the X-ray source. 2. Turn ON the X-ray source at the requested voltage and power. 3. If the X-ray source fails to stabilize at the requested power, allow the X-ray source to warm up for approximately 15 minutes. 4. If the error persists, contact the ZEISS Support Team.^b
Target Power too high.	The X-ray source power has exceeded its allowable limit. The X-ray source is automatically turned OFF. This can occur during centering.	<ol style="list-style-type: none"> 1. Turn ON the X-ray source at the requested voltage and power. 2. If the error re-occurs, try setting the X-ray source at a lower power. 3. If the error persists, contact the ZEISS Support Team.^b
X-ray tube centering failed. No peak found.	Centering failed to successfully complete.	
X-ray tube current lost during warm up. Turn tube back on.	Internal X-ray source error.	
X-ray kV power supply failed to turn on.	The high-voltage power supply failed to turn ON. This can occur if a high-voltage arc occurred.	Retry turning ON the X-ray source at the requested voltage and power.
X-ray kv ramp error. Contact ZEISS support.	Internal X-ray source error.	
X-ray source failed to turn on.	The X-ray source failed to turn ON.	
X-ray source turned off by user. X-ray source request aborted.	This message is displayed if your turned OFF the X-ray source before it finished stabilizing after submitting a voltage and power request. This is not an error.	No error. Turn ON the X-ray source.

a. Refer to “Starting XMController and Loading the Sample Holder Assembly onto the Sample Stage” on page 35 in Chapter 2 of the legacy *VersaXRM-500 User’s Guide*.

b. Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.

Troubleshooting X-ray Source Power Failure

This section provides tips for troubleshooting an X-ray source power failure.

Symptom X-ray does not turn ON after OPENING and then CLOSING an access door.

Problem X-ray source was turned ON when an access door was OPENED. An access door's safety interlocks turned OFF power to the X-ray source.

Solution *To restore power to the X-ray source*

1. Open the access door on the bottom left front of the Xradia Versa enclosure.
2. Press the PDU's lighted **red ALARM/RESET** push-button switch (located behind the front access panel; refer to [Figure A-4](#)) to restore X-ray source power.

If the X-ray source does not turn ON, contact the ZEISS Support Team for assistance. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on [page 308](#), in [Appendix K](#).)

Figure A-4 Press PDU's Lighted **Red ALARM/RESET** Push-Button Switch to Restore X-ray Source Power (Xradia 520 Versa Shown)

In step 2, press the PDU's lighted **red ALARM/RESET** push-button switch to clear fault conditions



Located behind access panel

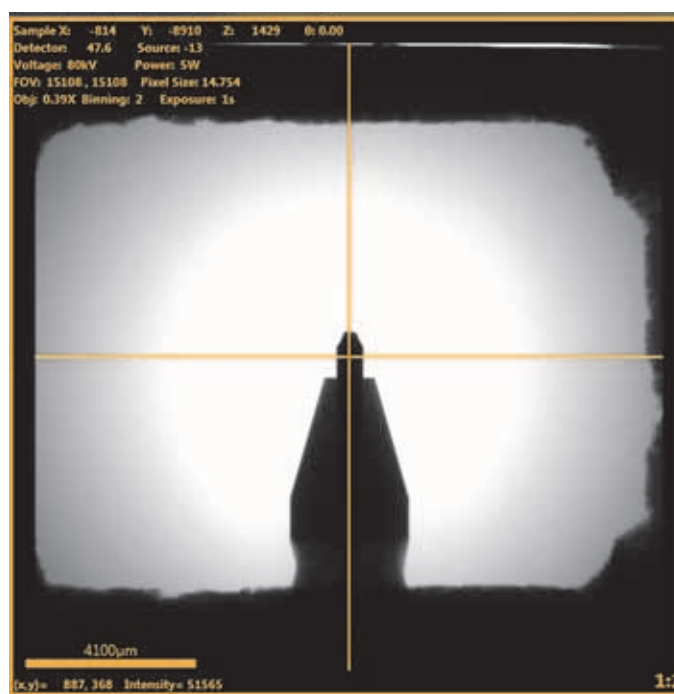
Troubleshooting Magnification Lens Too Close to the X-ray Source – Keeping the X-ray Source Aperture out of the Field of View

It is important to keep the **X-ray source aperture** out of the field of view (FOV) for the Macro (0.4X) lens.

Symptom X-ray source aperture is visible in image scans.

Problem Corner clipping of the images taken with the Macro (0.4X) lens occurs due to the lens being too close to the X-ray source aperture.

Figure A-5 Example of Image with Source Aperture within FOV (Indicated by Jagged Edges) – Image Taken with Macro (0.4X) Lens, with X-ray Source at -13 mm and Detector at 47.6 mm



Solution ***To remove the X-ray source aperture from the image***

 **NOTE** For Macro (0.4X) lens, keep the distance between the detector and X-ray source to at least 140 mm, to avoid the appearance of the X-ray source aperture within the image.

1. Move the X-ray source away from the sample. In the **Source** motion control, type a *value more negative than the current Source position*, in increments of 5 mm or less, in the **Source** text box, then click .

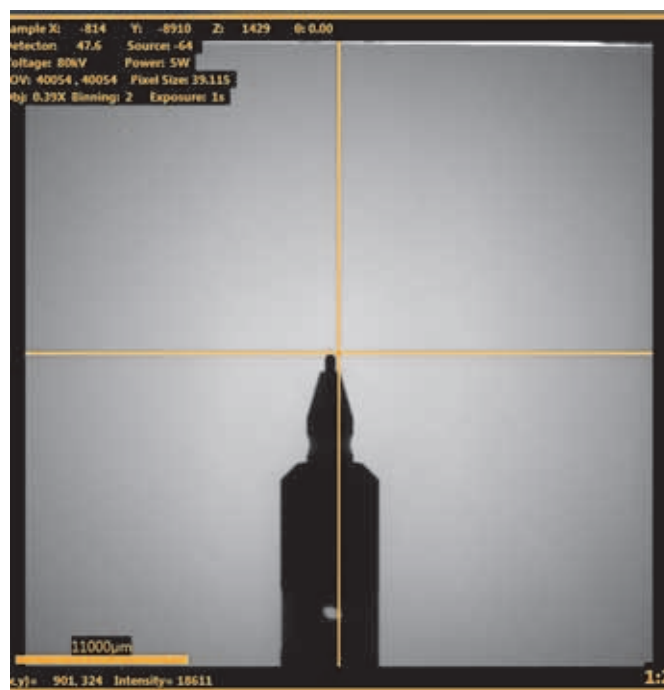
–or–

Move the detector away from the sample. In the **Detector** motion control, type a *value greater than the current Detector position*, in increments of 5 mm or less, in the **Detector** text box, then click .

The end result should resemble [Figure A-6](#).

NOTICE Always position the mouse pointer over  after clicking  (within the same motion control), so you can quickly halt movement if collision with the sample is imminent.

Figure A-6 Example of Image with Source Aperture out of the FOV, after Moving X-Ray Source – Image Taken with Macro (0.4X) Lens, with X-ray Source at -64 mm and Detector at 47.6 mm



Troubleshooting Xradia Versa Power-Related Issues

This section provides tips for troubleshooting the following power-related issues that you might experience when using the Xradia Versa:

- [Troubleshooting PDU Power Breaker Switch in OFF \(DOWN\) Position](#)
- [Troubleshooting Xradia Versa Power-Related Failures](#)

Troubleshooting PDU Power Breaker Switch in OFF (DOWN) Position

Symptom The PDU's power breaker switches are usually in the ON (UP) position, indicating that power is being applied to the Xradia Versa. If there is a power-related malfunction within the Xradia Versa, one or more of the PDU power breaker switches might trip to the OFF (DOWN) position.

Problem A PDU power breaker switch has tripped due to a power-related malfunction within the Xradia Versa.

Solution *To troubleshoot a PDU power breaker switch in the OFF (DOWN) Position*

1. Reset the power breaker switch by moving it to the ON (UP) position, as shown in [Figure A-7](#).

If the power breaker switch trips again, contact the ZEISS Support Team for assistance. (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on [page 308](#), in [Appendix K](#).)

Figure A-7 Resetting PDU Power Breaker Switches (Xradia 520 Versa Shown)

In step 1, move any of the PDU's power breaker switches that are in the OFF (DOWN) position, to the ON (UP) position



Located behind access panel

Troubleshooting Xradia Versa Power-Related Failures

This section provides tips for troubleshooting Xradia Versa power-related failures.

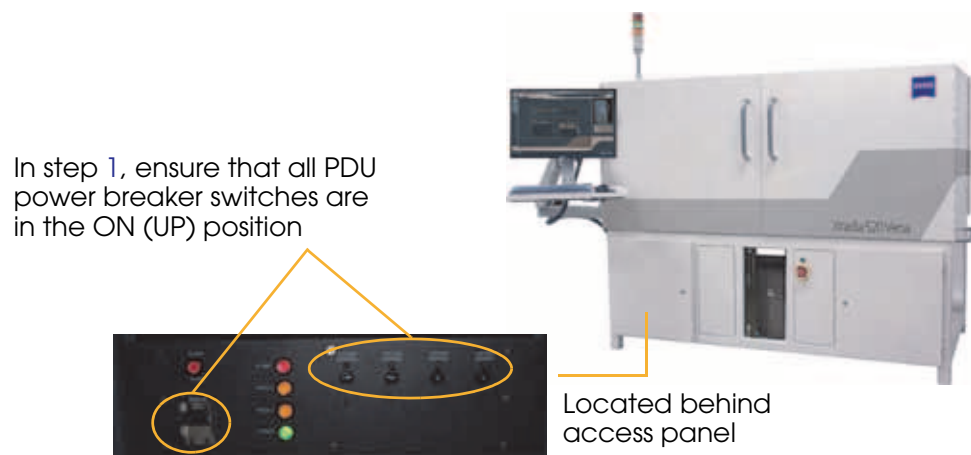
Symptom	Light tower lights do not turn ON; entire Xradia Versa and/or computer workstation does not turn ON; ergonomic station monitor does not turn ON.
Problem	One or more components within the Xradia Versa is not receiving power.
Solution	<i>To troubleshoot Xradia Versa power-related failures</i>

1. Verify that the Xradia Versa's three-prong power connector is connected to a grounded 230V AC Nominal (160 to 286V AC range, Single Phase, 50/60 Hz, 15A) power source. If it is not, plug it in, then proceed to step 6.

However, if using an uninterruptible power source (UPS), line conditioner, surge protector, or similar device, ensure that the Xradia Versa is connected to the device, and that the device's power connector is connected to a grounded 230V AC Nominal (160 to 286V AC range, Single Phase, 50/60 Hz, 15A) power source. If it is not, plug it in, then proceed to step 6.

2. Open the cabinet door on the lower left side of the Xradia Versa. Verify that all PDU power breaker switches are in the ON (UP) position, and that none of the switches are tripped (in the OFF (DOWN) position).

Figure A-8 Resetting PDU Power Breaker Switches (Xradia 520 Versa Shown)



WARNING If a power breaker switch is tripped, refer to “Troubleshooting PDU Power Breaker Switch in OFF (DOWN) Position,” on page 176 to resolve the issue.

3. Verify that the component's (computer workstation and/or ergonomic station monitor) **Power** button is lit. If the component's **Power** button is not lit, press the button again.

If Xradia Versa power is still failing, proceed to step 4. Otherwise, this process is complete.

4. Shut down the Xradia Versa, following the processes described in [“Shutting Down the Xradia Versa in a Non-Emergency Event,” on page 188, in Appendix C.](#)
5. Verify that the power source is working, by plugging another electrical item into it, or testing it with an electrical outlet tester.



NOTE Contact your Facilities or Maintenance Department if another electrical item does not work when plugged into the power source. Either the electrical receptacle must be replaced, or the power source's circuit breaker is tripped.

6. Turn ON the Xradia Versa, following the processes described in [“Turning ON the Xradia Versa,” on page 190, in Appendix C.](#)

If you resume the process in which you determined there was an issue, and the issue persists, contact the ZEISS Support Team for assistance. (Refer to [“ZEISS Support Team \(Technical Support\),” on page 308, in Appendix K.](#))

Troubleshooting Light Tower Issues

Table A-7 describes the behavior of each light (status indicator) in the light tower. Figure A-9 shows a sample light tower status combination. Table A-8 provides tips for troubleshooting light tower electrical issues. If any status indicators are not functioning as described, contact the ZEISS Support Team for assistance. (Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.)

Table A-7 Light Tower Lights (Status Indicators)

Light Tower Indicator Status	Description
All lights OFF	Power to the Xradia Versa is turned OFF.
Red light ON (top)	X-ray source is turned ON and X-rays are present within the enclosure.
Red light OFF (top)	X-ray source is turned OFF and X-rays are not present within the enclosure. Refer also to Table A-8 for troubleshooting electrical issues.
Yellow light ON (center)	Access doors are CLOSED.
Yellow light OFF (center)	Access doors are OPEN.
Green light ON (bottom)	Power to the Xradia Versa is turned ON.
Green light OFF (bottom)	Power to the Xradia Versa is turned OFF.

Figure A-9 Sample Light Tower Status Combination

Red light OFF – X-ray source is turned OFF; X-rays are not present within the enclosure

Yellow light ON – Access doors are CLOSED

Green light ON – Power to the Xradia Versa is turned ON



Table A-8 Troubleshooting Light Tower Electrical Issues^a

Symptom(s)	Problem	Solution
Red (top) light is burned out (OPEN) or shorted	Latching relay LR1 (FAULT) is set in response to X-ray source ON, indicating a fault condition.	Press the PDU's lighted red ALARM/RESET push-button switch (located behind the front access panel; refer to Figure A-10), then contact the ZEISS Support Team ^b to repair the light.
	An access door was OPENED while X-rays were being generated.	CLOSE the access door, then press the PDU's lighted red ALARM/RESET push-button switch. (Refer to Figure A-10 .)

- a. For further details, including the interlock schematic, refer to “[Interlock Sequence of Operation](#),” on page 288, in Appendix H.
- b. Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in Appendix K.

Figure A-10 Press PDU's Lighted **Red ALARM/RESET** Push-Button Switch to Clear Fault Conditions (Xradia 520 Versa Shown)



B Files and File Storage

This appendix describes the file types unique to the Xradia Versa programs, recommended file handling, and file storage:

- [File Types](#)
- [File Storage \(Hard Disk Drives\)](#)

File Types

The Scout-and-Scan Control System controls the Xradia Versa hardware during setup and data acquisition. The control system can also be used for 2D-image viewing for ZEISS-specific images. The Scout-and-Scan Control System is primarily used for acquiring tomography datasets, using user-created **.rcp* files, which are a collection of 2D images (projections) acquired at different angles around the axis of rotation in the Xradia Versa. Datasets that contain a collection of projection images are saved with the file extension *.txrm*. Each **.txrm* file contains multiple images. In contrast, files with the file extension *.xrm* contain only one image.

XMReconstructor reconstructs images stored in each **.txrm* file, to form a set of reconstructed slices. A slice is a 2D section of the 3D reconstructed volume, oriented in the X/Z plane. Slices generated from each **.txrm* file are stored in a file with the file extension *.txm*. A **.txm* file contains a collection of 2D slices that make up the 3D reconstructed volume. If no specific region is selected during reconstruction, the number of slices is equal to the height of each projection image in the original **.txrm* file.

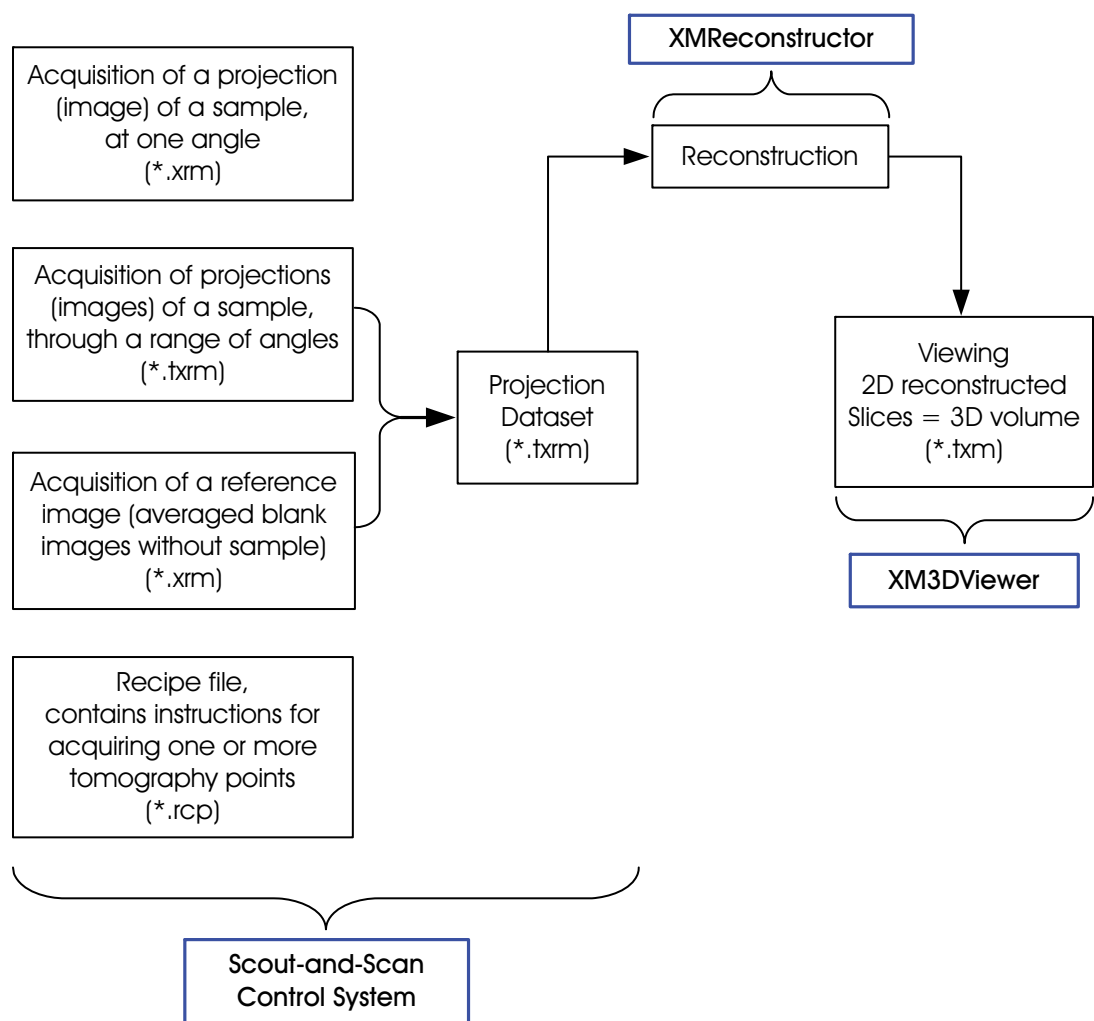
A **.txm* file created by XMReconstructor is also referred to as a *Volume Viewer file*. These files can be viewed with XM3DViewer.

When using XM3DViewer, if the file is too large for the graphics adapter memory, a dialog box opens, asking whether you want to load the file in Out-of-core mode. If selected, XM3DViewer creates two files – **.txm-exm* and **.txm-exm-ooc*. These files can be quite large, and should be deleted after generating reports and creating movies.

Table B-1 summarizes the file name extensions used for files used by the Xradia Versa, and their associated programs. The check mark (✓) indicates that the file type is opened and/or processed by the program. **Figure B-1** shows the relationship between the Scout-and-Scan Control System, XMReconstructor, and XM3DViewer programs, and their data, processes, and file types.

Table B-1 File Name Extensions and Related Programs

File Description	Extension	Scout-and-Scan Control System	XMReconstructor	XM3DViewer
Contains Xradia Versa parameters, to acquire one or more tomography points.	<i>.rcp</i>	✓		
Collection of 2D projection images acquired using the Scout-and-Scan Control System. Also referred to as a <i>tomography dataset</i> .	<i>.txrm</i>	✓	✓	
Image acquired with Single and Continuous acquisition modes and saved, using the Scout-and-Scan Control System.	<i>.xrm</i>	✓		
Collection of 2D reconstructed slices created by XMReconstructor. Also referred to as a <i>Volume Viewer file</i> .	<i>.txm</i>	✓	✓	✓
Created by XM3DViewer if Out-of-core mode was used; should be manually removed after generating reports and creating movies.	<i>.txm-exm</i>			✓
	<i>.txm-exm-ooc</i>			✓

Figure B-1 Data, Processes, and Files

File Storage (Hard Disk Drives)

The Xradia Versa computer workstation has two internal hard disk drives:

- Drive C
- Drive D, which is a RAID-5 array hard disk drive with fast read/write speed

The amount of disk space available on hard disk Drives C and D varies, because it is dependent upon the computer workstation model available at the time of shipment/purchase.

An optional storage server is also available from ZEISS. If included with the Xradia Versa, the server is networked to the computer workstation, as an additional hard disk drive.

 **NOTE** Redundant Array of Independent Disks (RAID) provides redundant (mirrored copies) fail-safe storage for all programs and data stored on hard disk Drives C and D.

 **NOTE** The desktop folder path is typically **C:\Documents and Settings\(*Your Windows User Login Name*)\Desktop**.

 **NOTE** It is recommended that you periodically back up hard disk Drives C and D, and remember to empty the Recycle Bin after deleting files.

 **NOTE** During reconstruction with XMReconstructor, the amount of free space required on the selected hard disk drive must be at least 1 GB more than the file size of the tomography (projection) dataset.

 **NOTE** After all required movies and reports are generated, delete the *.txm-exm and *.txm-exm-ooc files created by XM3DViewer when the reconstructed file (*_Recon.txm) is first opened within XM3DViewer.

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C Shutting Down and Restarting the Xradia Versa

This appendix describes how to shut down and restart the Xradia Versa, and then home all motorized axes to pre-defined initialization positions:

- [Shutting Down the Xradia Versa in a Non-Emergency Event](#)
- [Turning ON the Xradia Versa](#)
- [Homing the Axes](#)



NOTE The EMO shutdown process (pressing of an **EMO** button), used in the event of a personal safety or equipment emergency, is described in [“EMO Shutdown,” on page xii, in Safety](#).

Shutting Down the Xradia Versa in a Non-Emergency Event

This process describes how to shut down the Xradia Versa in a non-emergency event, such as when troubleshooting a problem that requires resetting the Xradia Versa, or if the Xradia Versa is not going to be used for a long period of time (such as during a holiday closure).

To shut down the Xradia Versa in a non-emergency event

1. Close any programs that are running on the Xradia Versa.
2. Select **Start > Shut Down** from the Windows **Shutdown** menu.
3. **If the Xradia Versa has a storage server** – Refer to the provided storage server manufacturer’s product documentation for the server’s shutdown instructions.
4. When prompted, select **Shut Down**, to shut down the Xradia Versa’s computer workstation.

Follow the instructions as they appear on screen.

5. Open the front left access panel, to gain access to the PDU.
(Refer to [Figure C-1.](#))
6. Move the PDU’s **MAIN** power breaker switch to the OFF (DOWN) position. (Refer to [Figure C-1.](#))

 **NOTE** This removes all power from the Xradia Versa, but allows the UPS battery to maintain a charge.

When ready to turn ON the Xradia Versa, proceed to “[Turning ON the Xradia Versa.](#)”

Figure C-1 Move the PDU's **MAIN** Power Breaker Switch to the OFF (DOWN) Position (Xradia 520 Versa Shown)

In step 6, move the PDU's **MAIN** power breaker switch to the OFF (DOWN) position



Turning ON the Xradia Versa

This process describes how to turn ON the Xradia Versa if it has been shut down (turned OFF).

To turn ON the Xradia Versa

1. Ensure that the three-prong power connector (located at the back of the Xradia Versa) is connected to a connected to a grounded 230V AC Nominal (160 to 286V AC range, Single Phase, 50/60 Hz, 15A) power source.

 **NOTE** The Xradia Versa should already be connected to power, at installation.

2. **If restarting the Xradia Versa after an emergency event** – Verify that the emergency has passed, all personnel are safe, and all appropriate safety conditions are satisfied.
3. **If restarting the Xradia Versa after an emergency event** – Twist the **EMO** button (that was previously pressed to shut down the Xradia Versa) **CLOCKWISE**, until the button pops back out. (Refer to [Figure C-2](#).)

Figure C-2 Turning ON the Xradia Versa (Xradia 520 Versa Shown)

In step 4, move all the PDU's power breaker switches to the OFF (DOWN) position, then back to the ON (UP) position in step 6

In step 9, press the ergonomic station monitor's **Power** button



In step 5, press the UPS' **Power** button



Located behind access panel

In step 3, twist the **EMO** button **CLOCKWISE**, until the button pops back out

In step 8, press the computer workstation's **Power** button

4. Move the PDU's power breaker switches to the OFF (DOWN) position. (Refer to [Figure C-2.](#))
5. Press the UPS' **Power** button, to turn ON the Xradia Versa. (Refer to [Figure C-2.](#))
6. Move the PDU's power breaker switches to the ON (UP) position. (Refer to [Figure C-2.](#)). The **green** (bottom) light on the light tower turns ON. If the access doors are closed, satisfying all safety interlocks, the **yellow** (center) light on the light tower also turns ON. (Refer to [Figure C-3.](#))

 **NOTE** At this point in the process, it is okay to have the access doors OPEN. If the **yellow** (center) light does not turn ON, the access doors are not securely CLOSED. To securely close the access doors, OPEN and then RE-CLOSE the doors.

Figure C-3 Light Tower

Red light OFF – X-ray source is turned OFF, X-rays are not present within the enclosure _____

Yellow light ON – Access doors are CLOSED _____

Green light ON – Power to the Xradia Versa is turned ON _____



7. **If the Xradia Versa has a storage server** – Refer to the provided storage server manufacturer's product documentation for the server's power-on instructions.
8. Press the Xradia Versa's computer workstation's **Power** button, to turn ON the workstation. (Refer to [Figure C-2.](#))
9. Press the ergonomic station monitor's **Power** button, to turn ON the monitor. The standard Windows 7 desktop should be (come) visible. (Refer to [Figure C-2.](#))

Proceed to "[Homing the Axes.](#)"

Homing the Axes

This process describes how to use the Scout-and-Scan Control System to home all motorized axes to their pre-defined initialization positions – set the Sample X, Y, Z, and Theta values of the sample stage to 0, and the detector and X-ray source to their positive (**+Limit**) and negative (**-Limit**) limits, respectively – in preparation for acquiring tomographic data.

Typically, the axes are automatically homed, as described in “[Automatically Homing the Axes](#).” However, if it is necessary to manually home the axes, instructions for doing so are provided in “[Manually Homing the Axes](#).”



NOTE The axes must be homed whenever the Xradia Versa is restarted after a shutdown. It is usually not necessary to home the axes at any other time, unless instructed otherwise by the [ZEISS Support Team \(Technical Support\)](#).

Automatically Homing the Axes

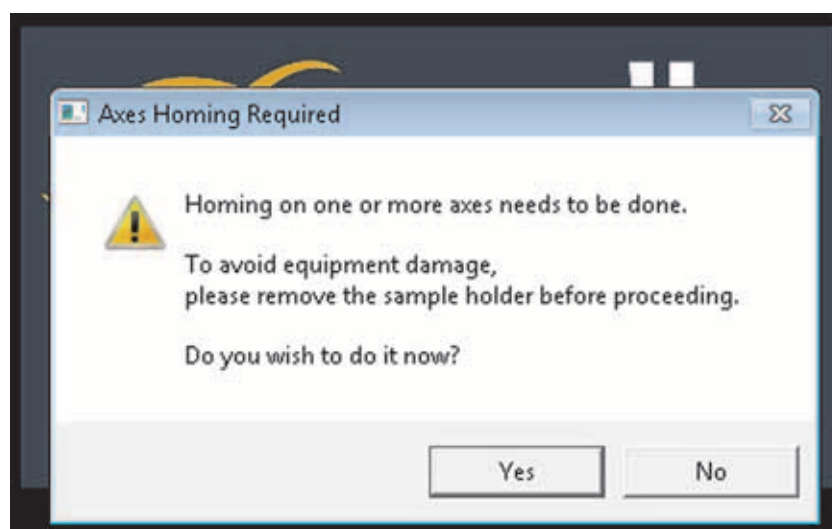
This process describes how to automatically home the motorized sample (**Sample X, Y, Z, and Theta**), detector (**Detector Z**), and X-ray source (**Source Z**) axes to their pre-defined initialization positions.

To automatically home all axes

1. Start the Scout-and-Scan Control System, if it is not already running.
2. If the Xradia Versa has previously been turned OFF, just prior to starting the Scout-and-Scan Control System, the **Axes Homing required** dialog box opens. Click **Yes** to home all motorized axes.

NOTICE If you accidentally clicked **No** in the **Axes Homing Required** dialog box, you must manually home all axes. Proceed directly to [“Manually Homing the Axes.”](#)

Figure C-4 **Axes Homing Required** Dialog Box



During the homing process, the **Homing Status** tab indicates real-time homing status for each axis. This process can take several minutes.

Axes homing is complete and successful when the **Homing operation is complete** message appears at the top of the **Homing Status** tab within the **Motion Control** drop-down panel.

Figure C-5 Final Homing Status – All Axes Successfully Homed



3. **If homing was successful** – Click **Done**, then proceed to [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System,”](#) to prepare the Xradia Versa for acquiring data.

If homing was unsuccessful – The **Homing Status** tab within the **Motion Control** drop-down panel indicates homing errors. Contact the ZEISS Support Team. (Refer to “[ZEISS Support Team \(Technical Support\),](#)” on page 308, in Appendix K.)

Manually Homing the Axes

This process describes how to manually home all motorized axes to their pre-defined initialization positions. Use this process only if you clicked **No** in “To automatically home all axes,” step 2, or if you need to manually home all axes.

To manually home all axes

1. Start the Scout-and-Scan Control System, if it is not already running.
2. Select the **Homing Status** tab from the **Motion Control** drop-down panel.

Figure C-6 Homing Status Tab within the Motion Control Drop-Down Panel



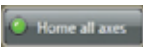
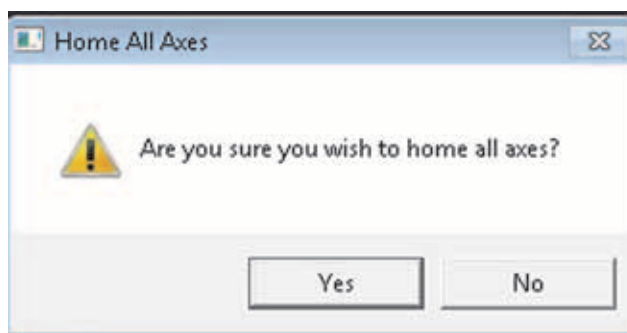
3. Click  to home all axes. The **Home All Axes** dialog box opens.

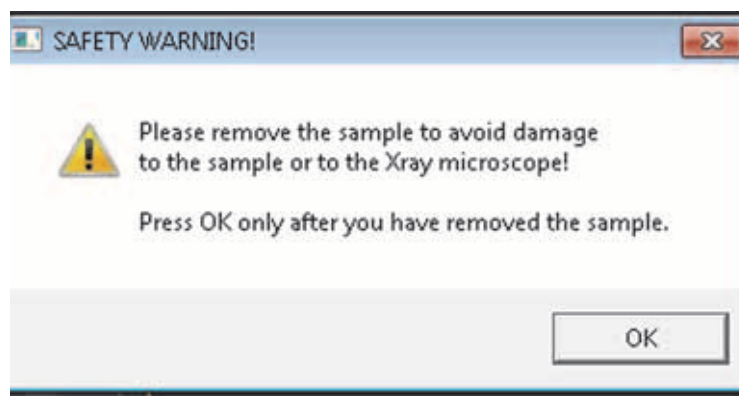
Figure C-7 Home All Axes Dialog Box



4. Click **Yes** to home all axes.

NOTICE If a sample is present, a **SAFETY WARNING!** dialog box also appears, asking you to remove the sample before proceeding. Remove the sample, following the instructions provided in [“Removing a Sample after Use,” on page 275, in Appendix E](#), then click **OK** to continue homing the axes.

Figure C-8 **SAFETY WARNING!** Dialog Box appears If Sample Is Present



During the homing process, the **Homing Status** tab indicates real-time homing status for each axis. This process can take several minutes.

Axes homing is complete and successful when the **Homing operation is complete** message appears at the top of the **Homing Status** tab within the **Motion Control** drop-down panel. (Refer to [Figure C-5](#).)

5. **If homing was successful** – Click **Done**, then proceed to [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System,”](#) to prepare the Xradia Versa for acquiring data.

If homing was unsuccessful – The **Homing Status** tab within the **Motion Control** drop-down panel indicates homing errors. Contact the ZEISS Support Team. (Refer to [“ZEISS Support Team \(Technical Support\),” on page 308, in Appendix K](#).)

D

User Interface and Software Control Features

This appendix describes how to use the following:

- Scout-and-Scan Control System User Interface
 - Controls and Features Common to All Views
 - Tabbed Views
- XMReconstructor User Interface
 - XMReconstructor Image Window Controls
 - XMReconstructor Image Control Dialog Box
 - XMReconstructor Histogram Tool
- XM3DViewer User Interface

Scout-and-Scan Control System User Interface

This section describes the function of each button, icon, and field within the Scout-and-Scan Control System user interface. The user interface consists of five tabbed views that lead the user through the steps required to set up and collect tomographic scans.

Topics within this section are organized as follows:

- Controls and Features Common to All Views
- Tabbed Views
 - Sample View
 - Load View
 - Scout View
 - Scan View
 - Thermal and Sample Drift Correction
 - Run View

 **NOTE** Tasks that use the Scout-and-Scan Control System are discussed in [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System.”](#)

 **NOTE** Throughout this appendix, graphics are used when discussing both graphic- and text-based Scout-and-Scan Control System buttons. Outside this appendix, however, graphics are used only when discussing the graphic-based buttons.

Controls and Features Common to All Views

In addition to the five tabbed views, the Scout-and-Scan Control System's user interface provides a set of common controls and features, located outside the border of each view. [Table D-1](#) lists and describes the function of each.

Table D-1 Controls and Features Common to All Views

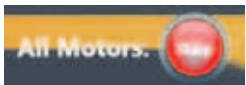
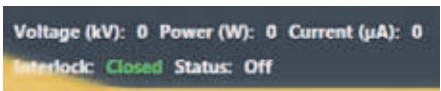
Control	Function
	<p>All Motors Stop button</p> <p>Clicking this button immediately halts all motion of the sample, X-ray source, and detector axes within the Xradia Versa.</p> <p>Use this button when collision between the sample and X-ray source or detector is imminent and you need to immediately halt all motion.</p> <p>Clicking the button does not stop the turret (which holds the lenses) from rotating.</p>
	<p>X-rays Off status</p> <p>When the X-Ray source is turned OFF, its status changes to Off and the radiation symbol and Turn Off button are unavailable.</p>
	<p>X-rays On status</p> <p>When the X-Ray source is turned ON, its status changes to On, the radiation symbol appears, and the Turn Off button is enabled.</p>
	<p>Xradia Versa status</p> <p>Displays current statuses related to the X-ray source:</p> <ul style="list-style-type: none"> – Voltage(kV) status Indicates the X-ray source's voltage, in kiloVolts (kV). Displays 0 when the X-ray source is turned OFF. – Power(W) status Indicates the X-Ray source's power, in Watts (W). Displays 0 when the X-ray source is turned OFF. – Current(μA) status Indicates the X-Ray source's current, in microAmps. Displays 0 when the X-ray source is turned OFF. – Interlock status Indicates the X-ray source's safety interlock status. Displays whether the access doors are Closed or Open. The X-ray source cannot be turned ON when the Interlock status indicates Open. – Status Indicates the X-ray source's status, Off or On. (Refer to X-rays Off status and X-rays On status, described earlier in this table.)

Table D-1 Controls and Features Common to All Views (Continued)

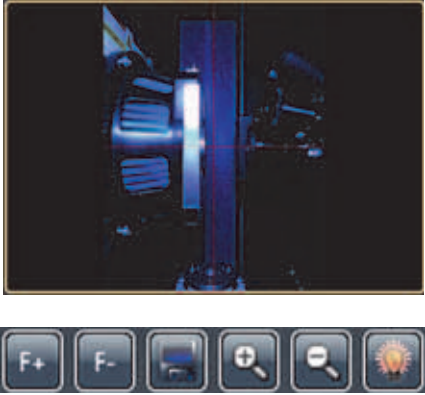
Control	Function
	<p>Visual Light Camera image display and controls</p> <p>Image display with red crosshairs for positioning and aligning the sample on the beam and rotation axes. Includes the following set of controls:</p> <ul style="list-style-type: none"> – Click  to set the focal plane to objects closer to the visual light camera. – Click  to set the focal plane to objects further away from the visual light camera. – Click  to save the visual light camera <i>image</i> to a *.jpg file. – Click  to increase the visual light camera <i>image</i>'s zoom (zoom IN). – Click  to decrease the visual light camera <i>image</i>'s zoom (zoom OUT). – Click  to toggle the visual light camera's light ON/OFF (default is ON).
	<p>Source Control drop-down list box</p> <p>Click to open/close the Source Control drop-down panel.</p>

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Source Control drop-down panel</p> <p>Note Use the vertical scroll bar to access the lower edge of the panel.</p> <p>Used to manually control the X-ray source. Also displays the same X-ray source status as Xradia Versa status, described earlier in this table.</p> <ul style="list-style-type: none"> – X-ray Click On/Off to turn the X-ray source ON (red indicator) or OFF (green indicator). Valid Voltage and Power values, however, must first be typed below, for the X-Ray to turn ON. – Voltage(kV) Indicates the X-ray source's voltage, in kiloVolts. Displays 0.0 when the X-ray source is turned OFF and before the <i>voltage value</i> is typed into the text box. Actual voltage appears in place of 0.0 when the X-ray source is turned ON. – Power(W) Indicates the X-Ray source's power, in Watts. Displays 0.0 when the X-ray source is turned OFF and before the <i>power value</i> is typed into the text box. Actual power appears in place of 0.0 when the X-ray source is turned ON. – Current(μA) status Indicates the X-Ray source's current, in microAmps. Displays 0.0 when the X-ray source is turned OFF. – Apply button Click to apply the <i>voltage</i> and <i>power values</i> typed in their respective text boxes. – Filament X-ray tube's filament level since the target (sample) was last turned. – Vacuum X-ray tube's vacuum level since the target was last turned. – Turn Target button Click to turn the target (sample). The X-ray source is temporarily turned OFF while the target is turned. – Target Hours Quantity of hours since the target was last turned. – Status Current status of the X-ray source, including the Interlock and Source State status. – Blank area Displays any X-Ray source error messages, in red. A complete list of error messages and how to resolve them is provided in “Troubleshooting X-ray Source Tube Error Messages,” on page 166, in Appendix A. – Error Reset button Click to clear any error messages that appear within the blank area, to resume using the X-ray source.

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Motion Control drop-down list box</p> <p>Click to open/close the Motion Control drop-down panel, which includes tabs for the Homing Status, Source, Sample, and Detector motion controls.</p>
	<p>Homing Status tab in the Motion Control drop-down panel</p> <p>Provides the ability to automatically home the motorized X-ray source (Source Z), sample (Sample X, Y, Z, and Theta), and detector (Detector Z) axes to their pre-defined initialization positions.</p> <ul style="list-style-type: none"> – Home all axes Click to home the axes. – Status area Displays status messages for each homed axis. Success messages appear in green. Error messages appear in red.

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Source tab in the Motion Control drop-down panel Controls positioning of the X-ray source (Source Z) axis. Same function as the Source motion control that appears within the Load and Scout views, with the addition of the Stop all motors button.</p> <p>Note The blue dot in the button icons represents the sample.</p> <ul style="list-style-type: none"> – Stop all motors button Click to stop all axis motors, such as when a collision between the sample and X-ray source is imminent. Same function as  within the Load and Scout views. – Step size Incremental value, in millimeters, used to adjust the X-ray source position when using the jog/move buttons. –  button Click once and release to jog the X-ray source to the LEFT (away from the sample) by the value indicated in Step size. Click and hold to continuously move the X-ray source to the LEFT, then release the hold to stop X-ray source movement. –  button Click to halt X-ray source movement. –  button Click once and release to jog the X-ray source to the RIGHT (toward the sample) by the value indicated in Step size. Click and hold to continuously move the X-ray source to the RIGHT, then release the hold to stop X-ray source movement. –  button Click after typing a value in the text box to its left, to move the X-ray source to that position. Unavailable when its text box is blank. – X-ray Source Position status The text box located directly under the GO feature indicates the X-ray source's current position. – X-ray Source Stage status The last text box indicates the X-ray source's stage status: <ul style="list-style-type: none"> – Disabled – Stage is stationary – Enabled – Stage is in motion – +/-Limit Hit – Stage has moved to its maximum position – Smpl T Moving – Indicates that the Sample Theta axis is moving and the collision avoidance system has blocked motion for this axis

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Sample tab in the Motion Control drop-down panel</p> <p>Controls positioning of the sample (Sample X, Y, Z, and Theta) axes. Same function as the Sample motion controls that appear within the Load and Scout views.</p> <p>Note Use the vertical scroll bar to access the lower edge of the panel.</p> <p>Note When Sample Theta is 0°, the Sample X motion control is disabled because you cannot determine the Sample X position from the Visual Light Camera image display.</p> <p>When Sample Theta is -90°, the Sample X motion control is enabled and the Sample Z motion control is disabled.</p>
	<ul style="list-style-type: none"> – Stop all motors button Click to stop all axis motors, such as when a collision between the sample and detector or X-ray source is imminent. Same function as  within the Load and Scout views. – Step size Incremental value, in millimeters, used to adjust the sample stage position when using the jog/move buttons. –  button Click to halt sample stage movement. –  button Click after typing a value in the text box to its left, to move the sample stage to that position. Unavailable when its text box is blank. – Sample Position status The text box located directly under the GO feature indicates the sample stage's current position. – Sample Stage status The last text box indicates the sample's stage status: <ul style="list-style-type: none"> – Disabled – Stage is stationary – Enabled – Stage is in motion – +/-Limit Hit – Stage has moved to its maximum position – Smpl T Moving – Indicates that the Sample Theta axis is moving and the collision avoidance system has blocked motion for this axis <p>Button controls specific to each Sample tab motion control are described on the next two pages.</p>

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Sample tab in the Motion Control drop-down panel (Continued)</p> <p>Controls Unique to Sample X</p> <p>–  button</p> <p>Click once and release to jog the sample stage BACKWARD (toward the visual light camera) by the value indicated in Step size. Click and hold to continuously move the sample stage to the BACK, then release the hold to stop sample stage movement.</p> <p>–  button</p> <p>Click once and release to jog the sample stage to the FORWARD (away from the visual light camera) by the value indicated in Step size. Click and hold to continuously move the sample stage to the FRONT, then release the hold to stop sample stage movement.</p> <p>Controls Unique to Sample Y</p> <p>–  button</p> <p>Click once and release to jog the sample stage UP (toward the top of the enclosure) by the value indicated in Step size. Click and hold to continuously move the sample stage UP, then release the hold to stop sample stage movement.</p> <p>–  button</p> <p>Click once and release to jog the sample stage DOWN (toward the bottom of the enclosure) by the value indicated in Step size. Click and hold to continuously move the sample stage DOWN, then release the hold to stop sample stage movement.</p> <p>Controls Unique to Sample Z</p> <p>–  button</p> <p>Click once and release to jog the sample stage to the LEFT (toward the X-ray source) by the value indicated in Step size. Click and hold to continuously move the sample stage to the LEFT, then release the hold to stop sample stage movement.</p> <p>–  button</p> <p>Click once and release to jog the sample stage to the RIGHT (toward the detector) by the value indicated in Step size. Click and hold to continuously move the sample stage to the RIGHT, then release the hold to stop sample stage movement.</p>

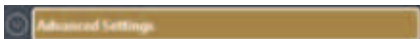
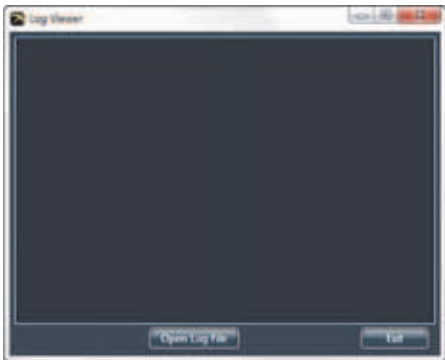
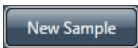
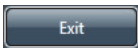
Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Sample tab in the Motion Control drop-down panel (Continued)</p> <p>Controls Unique to Sample Theta</p> <ul style="list-style-type: none"> button Click once and release to jog the sample stage COUNTERCLOCKWISE by the value indicated in Step size. Click and hold to continuously move the sample stage COUNTERCLOCKWISE, then release the hold to stop sample stage movement. button Click once and release to jog the sample stage CLOCKWISE by the value indicated in Step size. Click and hold to continuously move the sample stage CLOCKWISE, then release the hold to stop sample stage movement.

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	<p>Detector tab in the Motion Control drop-down panel Controls positioning of the detector (Detector Z) axes. Detector Z's function is the same as the Detector motion control that appears within the Load and Scout views.</p> <p>Note The blue dot in the button icons represents the sample.</p> <ul style="list-style-type: none"> – Stop all motors button Click to stop all axis motors, such as when a collision between the sample and detector is imminent. Same function as  within the Load and Scout views. – Step size Incremental value, in millimeters, used to adjust the detector position when using its motion control jog/move buttons. –  button Click once and release to jog the detector to the LEFT (toward the sample) by the value indicated in Step size. Click and hold to continuously move the detector to the LEFT, then release the hold to stop detector movement. –  button Click to halt detector movement. –  button Click once and release to jog the detector to the RIGHT (away from the sample) by the value indicated in Step size. Click and hold to continuously move the detector to the RIGHT, then release the hold to stop detector movement. –  button Click after typing a value in the text box to its left, to move the detector to that position. Unavailable when its text box is blank. – Detector Position status The text box located directly under the GO feature indicates the detector's current position. – Detector Stage status The last text box indicates the detector's stage status: <ul style="list-style-type: none"> – Disabled – Stage is stationary – Enabled – Stage is in motion – +/-Limit Hit – Stage has moved to its maximum position – Smpl T Moving – Indicates that the Sample Theta axis is moving and the collision avoidance system has blocked motion for this axis

Table D-1 Controls and Features Common to All Views (Continued)

Control	Function
	Advanced Settings drop-down list box Click to open/close the Advanced Settings drop-down panel.
	Advanced Settings drop-down panel <ul style="list-style-type: none"> – Current Log button (not shown) Click to display the Log Viewer dialog box, which lists the last 100 log entries and updates in real-time, as new log entries are issued. – Log Viewer dialog box Opens after clicking the Current Log button. Includes two buttons, Open Log File and Exit: <ul style="list-style-type: none"> – Click Open Log File to open a copy of the log file, which includes all log entries, in a Windows text editor (Notepad or Wordpad, depending on the file size). The file can be edited and saved to the hard disk drive for later use. – Click Exit to close the Log Viewer dialog box.
	Previous Tabbed View button Click to return to the previous tabbed view. Note If you use this button and apply changes to a previous view, then return to a subsequent view, those changes are carried forward to the subsequent view(s). For example, if you return to Sample view and change the sample name, then proceed to another view, the sample name is updated in all subsequent views.
	Next Tabbed View button Click to proceed to the next tabbed view. Unavailable if all required parameters for the current view are not set. Note After  is clicked to access the next view, you can click the View tabs, to move between the <i>active (enabled)</i> views.
	Status area Scrollable message area that indicates current Scout-and-Scan Control System status. (Actual message area is wider than shown.)
	New Sample button Click to clear all currently listed sample-related data, to start a new sample. Note If clicked after you have already started defining a recipe, you will be prompted with a dialog box to confirm that you want to start a new sample.
	Exit button Click to exit (close) the Scout-and-Scan Control System. Anything created for the recipe up to the point that you clicked the button is saved to the path specified in Sample view's Output Directory text box.

Tabbed Views

The Scout-and-Scan Control System includes five tabbed views that are used for acquiring tomographies:

- Sample View
- Load View
- Scout View
- Scan View
- Run View

Sample View

Sample view (Figure D-1) is the first tabbed view that is displayed when the Scout-and-Scan Control System is started. Use **Sample** view to:

- Create a label for the data to be collected,
- Identify where to store the collected data on the computer workstation's hard disk drive, and
- Select an existing recipe or recipe template, or create a new recipe

A recipe is comprised of one or more tomography points. Each tomography point contains all the parameters needed to command the Xradia Versa for a single tomography.

Tabs for the other four tabbed views, as well as the button for accessing the next tabbed view, , are unavailable until the following *processes* are completed on this view:

- Select the *output directory* in which to store the sample's *data*
- Type a *name* in the **Sample Name** text box (new sample) –or– browse for and load an existing *recipe* or *recipe template*
- One or more *tomography points* are added to the **Current Recipe Points** list

Table D-2 lists and describes each **Sample** view control. Use of **Sample** view in the tomography collection process is described in “Step 1 – Sample,” on page 23 (new recipes) and “Step 1 – Sample,” on page 81 (existing recipes or recipe templates) in Chapter 2.

Figure D-1 Typical **Sample** View

Please fill in the following details about the recipe:

Sample Details

Output Directory: C:\Users\Trish\Desktop\Scout and Scan

Sample Name: test

Comment:

Create Recipe Point List

Select Recipe Template:

Current Recipe Points

Name	Source	Sample	Mode	Bin	Exp	Filter
Tomo-A	0.00 (kV), 0.00 (W)	0.00, 0.00, 0.00	Normal	2	1	

Table D-2 Sample View Controls

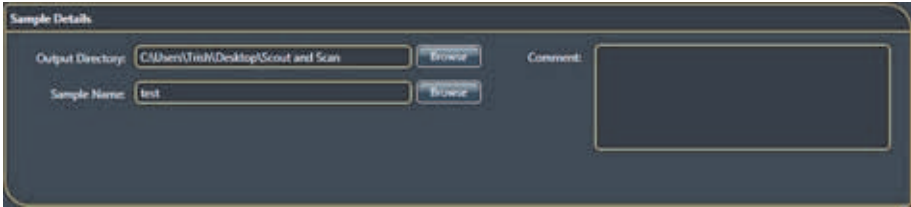
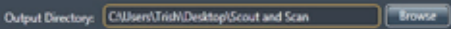
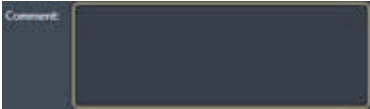
Control	Function
<div>Sample Details panel Use to specify information about the sample, and where to store the recipe’s tomography data output.</div> <div></div>	
<div></div>	<div>Output Directory text box and Browse button The root directory for storing all data collected for this sample. Click  when you need to browse for and select a specific <i>folder location</i>.</div>
<div></div>	<div>Sample Name text box and Browse button The name used to label data associated with this sample and recipe. A subfolder under the output directory is automatically created for each recipe run. For the name shown in Figure D-1, the subfolder created is named <i>Test</i>. Click  when you need to browse for and select an existing <i>sample folder</i>.</div>
<div></div>	<div>Comment text box Type optional general <i>comments</i> related to the sample in the text box.</div>

Table D-2 Sample View Controls (Continued)

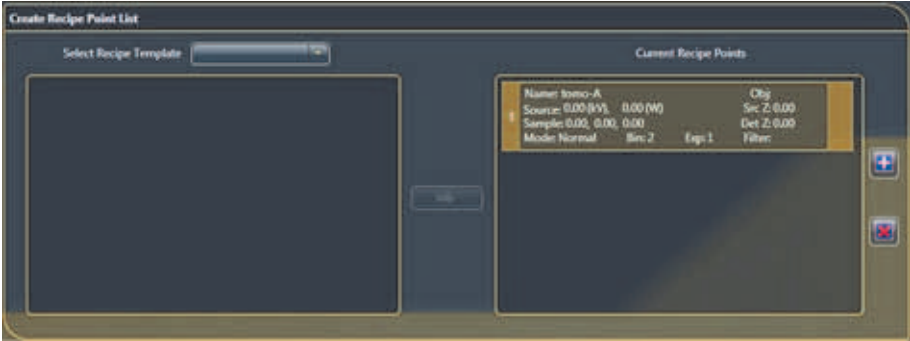
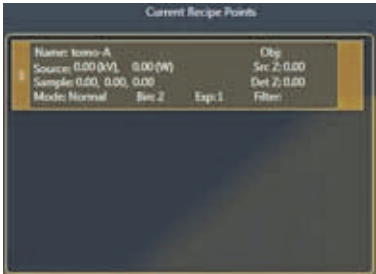
Control	Function
<p>Create Recipe Point List panel</p> <p>Use to construct the starting point for the recipe to be run for this sample. A new recipe can be created, or an existing recipe or recipe template can be selected.</p> 	
	<p>Select Recipe Template drop-down list box</p> <p>Click  to browse for and load an existing <i>recipe</i> or <i>recipe template</i>:</p> <ul style="list-style-type: none"> – Xradia Select to load the recipe templates located in C:\Program Files\Xradia\VersaXRM\10.6.x\Templates: <ul style="list-style-type: none"> – All Objectives – High Res 20x – High Res 4x – Large Sample Mcro – Low res 4x – Existing Recipe... Select to browse for and load an existing <i>recipe</i>. – Last Edited Recipe Select to browse for and load the same <i>recipe</i> that was used the last time you loaded a recipe. <p>Note The Templates folder can contain subfolders, which can also contain recipes. The folder can be modified and tailored, as needed.</p>
	<p>Click to expand and display the loaded <i>recipe</i> or <i>recipe template's tomography points</i>.</p>
	<p>Click after selecting the <i>recipe</i>, <i>recipe template</i>, or <i>individual tomography point</i> that you want to use, to add it to the Current Recipe Points list.</p>

Table D-2 **Sample View Controls (Continued)**

Control	Function
	<p>Current Recipe Points list</p> <p>Lists the <i>tomography points</i> that have been copied over from the left side of the Create Recipe Point List panel.</p>
	<p>Add Tomography Point button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to add and append a copy of that tomography point.</p>
	<p>Remove Tomography Point button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to remove the selected tomography point.</p>

Load View

Load view (Figure D-2) is the second tabbed view within the Scout-and-Scan Control System. This view is available only after completing the required settings in **Sample View**. Many of the view's controls are duplicates of those already documented in “Controls and Features Common to All Views,” on page 199.

Using the visual light camera as a guide, **Load** view is used to load and roughly position the sample's feature of interest on the axis of rotation, and position the detector and X-ray source, in preparation for **Scout View**. The sample can be rotated to verify that it does not collide with the detector and X-ray source during rotation.

Table D-3 lists and describes each **Load** view control. Use of **Load** view in the tomography collection process is described in “Step 2 – Load,” on page 25 (new recipes) and “Step 2 – Load,” on page 83 (existing recipes or recipe templates) in Chapter 2.

Figure D-2 Typical **Load** View

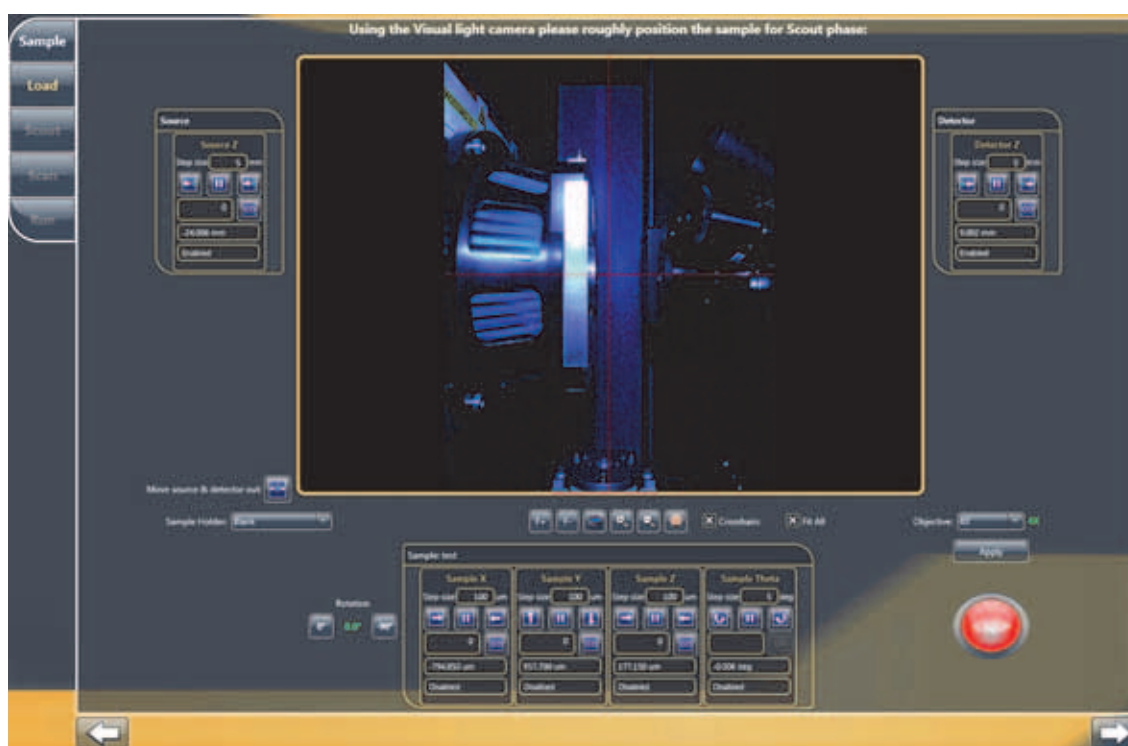


Table D-3 Load View Controls

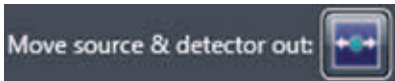
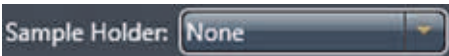
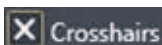
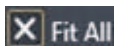
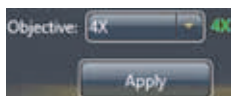
Control	Function
	<p>Source motion control</p> <p>Used for positioning the X-ray source (Source Z axis). Same function as the Source motion control described in “Source tab in the Motion Control drop-down panel,” on page 203, minus the Stop all motors button.</p>
	<p>Visual Light Camera image display and controls</p> <p>Image display with red crosshairs for positioning and aligning the sample on the beam and rotation axes. Includes its own set of controls, located below the image display. Same functions as described in “Visual Light Camera image display and controls,” on page 200.</p>
	<p>Detector motion control</p> <p>Used for positioning the detector (Detector Z axis). Same function as the Detector motion control described in “Detector tab in the Motion Control drop-down panel,” on page 207, minus the Stop all motors button.</p>
	<p>Move X-ray Source and Detector Out button</p> <p>Note The blue dot in the button icon represents the sample.</p> <p>Click  to move the X-ray source and detector away from the sample stage to their -Limit and +Limits, respectively. Useful when loading/removing the sample holder assembly on to/from the sample stage.</p>
	<p>Sample Holder drop-down list box</p> <p>Click to select the type of <i>sample holder</i> being used.</p> <p>NOTICE The Xradia Versa’s collision avoidance system needs this information to protect against collisions with the sample holder assembly.</p>

Table D-3 Load View Controls (Continued)

Control	Function
	<p>Rotation buttons</p> <ul style="list-style-type: none"> Click  to rotate the sample to 0° Click  to rotate the sample to -90° <p>The number displayed in green between the two buttons is the current Sample Theta angle. The number blinks red when the Sample Theta stage is rotating.</p> <p>NOTICE Ensure that the detector and X-ray source are a sufficient distance from the sample, so they are not struck when the sample is rotated.</p>
	<p>Sample panel motion controls</p> <p>Includes the <i>sample name</i>. Controls positioning of the sample (Sample X, Y, Z, and Theta axes). Same function as the Sample motion controls described in “Sample tab in the Motion Control drop-down panel,” on page 204, minus the Stop all motors buttons.</p>
	<p>Crosshairs check box</p> <ul style="list-style-type: none"> Select the check box to toggle ON the red crosshairs within the Visual Light Camera image display (default) Clear the check box to toggle OFF the red crosshairs within the Visual Light Camera image display
	<p>Fit All check box</p> <ul style="list-style-type: none"> Select the check box to adjust the Visual Light Camera <i>image</i> to show the maximum vertical area (default). Useful during sample positioning, because the sample base is visible within the display. Clear the check box adjust the Visual Light Camera <i>image</i> to show a zoomed view of the X-ray source, sample FOV, and detector.
	<p>Objective drop-down list box and Apply button</p> <p>Click to select the <i>objective (lens) magnification</i> to focus on the sample. Click Apply to rotate the selected lens to the lowest point on the turret.</p> <p>The currently selected objective appears in green. Blinks red when the selected objective is being moved into position.</p>
	<p>Stop button</p> <p>Click to stop all axis motors, such as when a collision between the sample and detector or X-ray source is imminent. Same function as described in “All Motors Stop button,” on page 199.</p>

Scout View

Scout view ([Figure D-3](#)) is the third tabbed view within the Scout-and-Scan Control System. This view is available only after completing the required settings in the previous views.

Using X-ray images, **Scout** view is used to precisely position the sample on the axis of rotation and along the beam axis. It is also used to scout the sample to locate the ROI, FOV, and resolution. Additionally, this view is used to optimize the X-ray source settings (kV and Power), exposure, and binning. X-ray images can be acquired and viewed in **Scout** view to assist in these operations.

[Table D-4](#) lists and describes each **Scout** view standard control. [Table D-5](#) lists and describes each **Scout** view annotation control. Use of **Scout** view in the tomography collection process is described in “[Step 3 – Scout,](#)” on [page 28](#) (new recipes) and “[Step 3 – Scout,](#)” on [page 86](#) (existing recipes or recipe templates) in Chapter 2.

Figure D-3 Typical **Scout** View

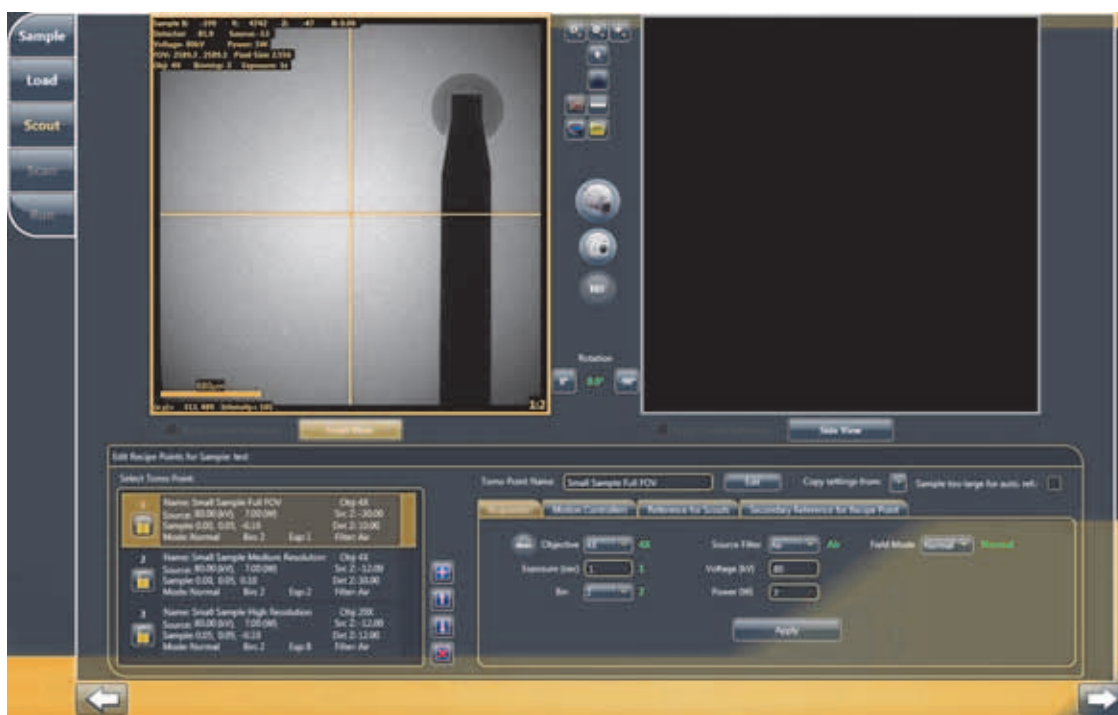


Table D-4 Scout View Standard Controls

Control	Function
	<p>Front View image display</p> <p>Collects and displays scouted sample image data after clicking , , or  when Sample Theta is 0° (latter enables Apply current reference check box). Used when centering the sample's ROI and FOV on the Sample X and Y axes.</p> <p>Click  to make this the active image view when Side view is active.</p> <p>Border colors:</p> <ul style="list-style-type: none"> – Red – Image is actively being acquired and displayed – Yellow – Active (current) image view – Orange – Reference image has been applied (refer to Reference Image Acquisition and Reference for Scouts tab for details) <p>Displays the Image different from recipe point message when settings are changed on-the-fly to a locked tomography point within an existing recipe or recipe template. The settings that do not match appear in red within the tomography point (in the Select Tomo Point area).</p> <p>Annotations can be applied to the <i>image</i> and saved to a file. (Refer to Table D-5.)</p>
	<p>Side View image display</p> <p>Collects and displays scouted sample image data after clicking , , or  when Sample Theta is -90° (latter enables the Apply current reference check box). Used when centering the sample's ROI and FOV on the Sample Z axis.</p> <p>Click  to make this the <i>active image view</i> when Front view is active.</p> <p>Border colors:</p> <ul style="list-style-type: none"> – Red – Image is actively being acquired and displayed – Yellow – Active (current) image view – Orange – Reference image has been applied (refer to Reference Image Acquisition and Reference for Scouts tab for details) <p>Displays the Image different from recipe point message when settings are changed on-the-fly to a locked tomography point within an existing recipe or recipe template. The settings that do not match appear in red within the tomography point (in the Select Tomo Point area).</p> <p>Annotations can be applied to the <i>image</i> and saved to a file. (Refer to Table D-5.)</p>

Table D-4 Scout View Standard Controls (Continued)

Control	Function
	<p>Apply current reference check box</p> <p>Note The reference is not saved with the image, nor does it apply reference correction. It simply collects measurements, and lets you see the effect of a reference image.</p> <p>Activated after collecting a <i>reference image</i> at the current Sample Theta position (0° for Front View, -90° for Side View).</p> <p>Select to apply the <i>current reference image</i> to the appropriate <i>active image view</i> on-the-fly. The selected <i>active image view</i>'s border color changes to orange.</p> <p>If the check box is cleared, the reference image is not applied.</p> <p>Useful to see the effect of a reference image, by selecting and clearing the Apply Current Reference check box.</p>
	<p>Zoom IN</p> <p>Click to zoom into the <i>active image view</i>. Can be clicked until the <i>image</i> reaches maximum zoom.</p>
	<p>Zoom OUT</p> <p>Click to zoom out of the <i>active image view</i>. Can be clicked until the <i>image</i> reaches minimum zoom.</p>
	<p>Zoom All</p> <p>Click to completely zoom out of the <i>active image view</i>.</p>
	<p>Continuous Acquisition</p> <p>Click to start continuous imaging in the <i>active image view</i>.</p> <p>Click again to stop continuous imaging in the <i>active image view</i>.</p>
	<p>Single Image Acquisition</p> <p>Click to acquire a single image in the <i>active image view</i>.</p>

Table D-4 Scout View Standard Controls (Continued)

Control	Function
	<p>Reference Image Acquisition</p> <p>Click to acquire a reference image at the current Sample Theta position (0° for Front View, -90° for Side View). Collecting a reference image activates the Apply current reference check box (located below the Front View image display or Side View image display), which can be selected to apply the <i>current reference image</i> to the <i>active image view</i>.</p> <p>Select the Sample too large for auto ref. check box if the sample is too large to be moved out of the FOV when collecting a reference image. (When selected, you will be prompted to remove the sample, and a reference image will be collected before starting a tomography.)</p> <p>Unavailable if no image is displayed in the <i>active image view</i>.</p> <p>After acquiring a reference image, the Reference for Scouts tab displays the image's <i>file name</i>, and the image's <i>acquisition settings</i> in green.</p> <p>Note Reference images taken at 0° should only be applied to the Front View image display. Reference images taken at -90° should only be applied to the Side View image display.</p>
	<p>Rotation buttons</p> <p>Used to rotate Sample Theta to 0° and -90° in the Front View and Side View image displays, respectively. Same function as the Rotation buttons described in “Rotation buttons,” on page 217.</p>
<p>Edit Recipe Points for Sample panel</p> <p>Provides the ability to add and remove tomography points. Also provides four tabs – Acquisition, Motion Controllers, Reference for Scouts, and Secondary Reference for Recipe Point – which allow you to set the acquisition parameters, motion controller positions, and reference settings for the recipe, respectively. Includes the sample name (in this example, <i>test</i>).</p> <p>Note Changing the settings in this panel only modifies an unlocked tomography point's recipe settings, not the Xradia Versa's physical settings. To set the Xradia Versa to the recipe settings (permanent for an unlocked tomography point, or temporary for a locked tomography point), click  in the Acquisition tab, select the Motion Controllers tab, then click  within each <i>motion control that was changed</i>.</p> 	

Table D-4 Scout View Standard Controls (Continued)

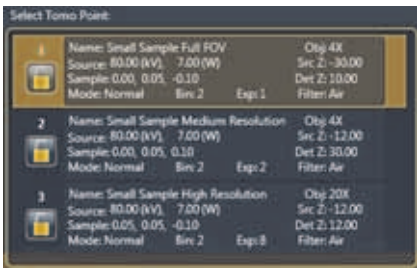
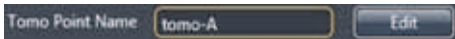
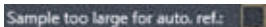
Control	Function
	<p>Select Tomo Point area</p> <p>Click to select and highlight a <i>tomography point</i> (in this example, the first tomography point is selected, and three tomography points are shown). The selected point's name appears to the right in the Tomo Point Name text box and Edit button.</p> <p>If the Front View image display or Side View image display displays the Image different from recipe point message (when settings are changed on-the-fly to a locked tomography point within an existing recipe or recipe template) the settings that do not match appear in red within the tomography point.</p> <p>Refer also to Lock/Unlock tomography points.</p>
	<p>Tomo Point Name text box and Edit button</p> <p>Displays the name of the currently selected <i>tomography point</i>. Each point must have a unique name. Typically, each point already has a unique name.</p> <p>If the point's name is not unique (name appears in red), or if you want to change its name, click . The button label changes to . Type a new <i>name</i> in the text box, then click  to change the name. The new <i>tomography point name</i> appears in the text box, as well as in the Select Tomo Point area.</p>
	<p>Copy settings from drop-down list box</p> <p>Select a <i>tomography point</i>, then click the drop-down list box to select the <i>sequence number of the tomography point whose settings you want to copy</i>. All settings are copied, including the copied tomography point's Scan view settings.</p>
	<p>Sample too large for auto ref. check box</p> <p>Note All tomography points within the recipe must use the same objective (lens) when this check box is selected.</p> <p>Select the check box if the sample is too large to be moved out of the FOV when collecting a reference image. When selected, you will be prompted to remove the sample, and a reference image will be collected before starting a tomography.</p>

Table D-4 Scout View Standard Controls (Continued)

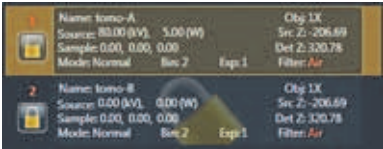
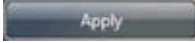
Control	Function
	<p>Lock/Unlock tomography points</p> <p>A tomography point can be locked to protect its <i>settings</i> from being changed. After the point is locked, any changes made within the Edit Recipe Points for Sample panel can be applied to the Xradia Versa (by clicking  in the Acquisition tab or  within the Motion Controller tab's motion controls), but does not change the recipe values. Useful for experimenting with Xradia Versa settings without changing the current recipe settings.</p> <p>Click  to lock the selected <i>tomography point</i>. The point indicates that it is locked, by changing the button to  and displaying a lock watermark (refer to the lower image on the left).</p> <p>If needed, click  to unlock the <i>tomography point</i>.</p>
	<p>Add Tomography Point button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to add and append a copy of that tomography point.</p>
	<p>Move Tomography Point UP button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to move that tomography point UP within the list, to change the sequence in which it will run within the recipe.</p> <p>Unavailable if only one tomography point is listed.</p>
	<p>Move Tomography Point DOWN button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to move that tomography point DOWN within the list, to change the sequence in which it will run within the recipe.</p> <p>Unavailable if only one tomography point is listed.</p>
	<p>Remove Tomography Point button</p> <p>Click after selecting a <i>tomography point</i> in the Current Recipe Points list, to remove the selected tomography point.</p> <p>Unavailable if only one tomography point is listed.</p>

Table D-4 Scout View Standard Controls (Continued)

Control	Function
<p>Acquisition tab</p> <p>Provides the ability to change the tomography point's objective (lens), exposure time, binning, X-ray source's filter type, voltage, and power, and whether the aperture is normal or wide.</p> <p> Note Changing the settings in this panel only modifies an unlocked tomography point's recipe settings, not the Xradia Versa's physical settings. To set the Xradia Versa to the recipe settings (permanent for an unlocked tomography point, or temporary for a locked tomography point), click .</p> 	
	<p>Objective drop-down list box and Abort button</p> <p>Select the <i>objective (lens)</i> for the selected tomography point. The current objective setting appears in green (for example, 4X), and blinks red while the turret rotates the objective into place. The Abort button is usually unavailable, but is enabled and turns red when the objective is being changed. Click to immediately halt the turret from rotating, if the turret and/or one of its objectives looks like it is about to collide with another object.</p>
	<p>Exposure (sec) text box</p> <p>Type a <i>length of time</i> (typically 10 or less, in units of seconds) to expose the selected tomography point to light. The current exposure setting appears in green (for example, 1).</p>
	<p>Bin drop-down list box</p> <p>Select the <i>binning value</i> (1, 2, 4, or 8) for the visual light camera to apply to the selected tomography point. For example, when binning is set to 2, the visual light camera averages 2 pixels in the horizontal and vertical directions, together. The image number of pixels in the acquired image will then be reduced by a factor of 4. The current binning value appears in green (for example, 2).</p>
	<p>Source Filter drop-down list box</p> <p>Note The process for determining which X-ray filter to use is described in "Scout – Select Proper X-ray Filter and kV," step 6, on page 35 in Chapter 2.</p> <p>Optional, because filter selection and installation is done manually. Click to select (indicate) the <i>filter</i> that you manually installed onto the X-ray source (<i>Air</i> (no filter), <i>LE#</i>, or <i>HE#</i>). The current filter setting appears in green (for example, Air).</p>

Table D-4 Scout View Standard Controls (Continued)

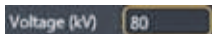
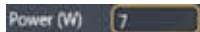
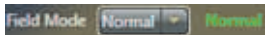
Control	Function
	<p>Voltage (kV) text box</p> <p>Type the X-ray source <i>voltage</i> to use for the selected tomography point, using the following guidelines:</p> <ul style="list-style-type: none"> – 80 kV for thin or low-density samples – 140 kV for thick or high-density samples <p>The current X-ray source voltage setting appears in green (not shown), and blinks red when it is being changed on the X-ray source.</p>
	<p>Power (W) text box</p> <p>Type the X-ray source <i>power</i> to use for the selected tomography point, using the following guidelines:</p> <ul style="list-style-type: none"> – 7W for thin or low-density samples – 10W for thick or high-density samples <p>The current X-ray source power setting appears in green (not shown), and blinks red when it is being changed on the X-ray source.</p>
	<p>Field Mode drop-down list box</p> <p>Select the <i>field mode</i>:</p> <ul style="list-style-type: none"> – <i>Normal</i> for Normal Field mode – <i>Wide</i> for Wide Field mode <p>The current field mode setting appears in green.</p> <p>Wide Field mode allows users to image samples that are larger than 50 mm. A set of two tomographies are collected for each tomography point.</p> <p>Two datasets are stitched together at the end of data collection, to form a single tomography.</p>
	<p>Source Filter drop-down list box</p> <p>Select the filter to be used/in use.</p> <ul style="list-style-type: none"> – Xradia 520 Versa – Filter selection changes the <i>filter</i> on the automated filter changer (after clicking Apply; refer to Apply button), when the recipe is run. – Xradia 510 Versa and Xradia 410 Versa – Filter selection logs the correct filter into the recipe, for future reference/informational purposes only. You must manually place the <i>filter</i> in front of the X-ray source, to use the correct filter.

Table D-4 Scout View Standard Controls (Continued)

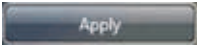
Control	Function
<div></div>	<p>Apply button</p> <p>Note This button must be clicked to be able to proceed to Scan view.</p> <p>The button’s function varies, depending on the task:</p> <ul style="list-style-type: none">– After updating unlocked tomography points – Click to apply the acquisition settings to the recipe and Xradia Versa– After updating locked tomography points – Click to apply the acquisition settings to the Xradia Versa; the recipe is not updated– After clicking  to turn off the X-ray source – Click to turn ON the X-ray source
<p>Motion Controllers tab</p> <p>Used to set the Sample X, Y, Z, and Theta, Source (Source Z), and Detector (Detector Z) axis positions. The sample, X-ray source, and detector axis positions are not stored in the recipe until you complete an acquisition. When you select a tomography point using the Edit Recipe Points for Sample panel, the Go values are updated with the positions indicated in the tomography point. To move the sample, X-ray source, and detector to these positions, click  for each <i>axis</i>. The motion controls function the same as described in “Load View,” on page 215.</p> <p>Note Changing the settings in this panel only modifies an unlocked tomography point’s recipe settings, not the Xradia Versa’s physical settings. To set the Xradia Versa to the recipe settings (permanent for an unlocked tomography point, or temporary for a locked tomography point), apply changed acquisition settings, then click  within each <i>motion control that was changed</i>.</p> <div></div>	
<p>Reference for Scouts tab</p> <p>Used to select the Reference Axis. This is the axis along which the sample is moved to place it out of the detector FOV when collecting a reference. A previously collected reference file can also be selected and applied to a scouted image.</p> <div></div>	

Table D-4 Scout View Standard Controls (Continued)

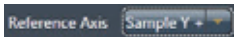
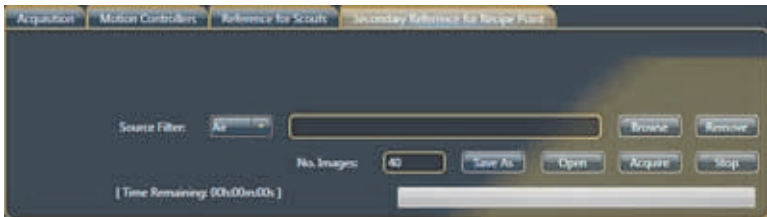
Control	Function
	<p>Reference Axis drop-down list box</p> <p>Click to select the <i>axis</i> and <i>direction</i> in which to move the sample before collecting the reference image. Use this option to help ensure that the sample is moved completely out of the FOV.</p> <p>Note Axis directions are defined in “Axis Definitions,” on page 20, in Chapter 1.</p>
	<p>Reference file and Browse button</p> <p>Click  to browse for and load a specific <i>reference image</i>. This action activates the Apply Selected Reference File button (previously unavailable). Click the button to apply the <i>loaded reference image</i> to the appropriate <i>active image view</i> (Front or Side View image display). The selected <i>active image view</i>’s border color changes to orange.</p>
	<p>Reference File Settings</p> <p>Note For a reference image to have the desired effect, its acquisition settings should match those of the image currently displayed in the <i>active image view</i> (Front or Side View image display). If the acquisition settings do not match, load a <i>reference image</i> whose settings match, –or– collect a <i>new reference image</i> whose settings match.</p> <p>The values indicate the <i>reference image’s acquisition settings</i>:</p> <ul style="list-style-type: none"> – Green values match the acquisition settings for the image in the <i>active image view</i> – Red values (if shown) do not match the acquisition settings for the image in the <i>active image view</i>
<p>Secondary Reference for Recipe Point tab</p> <p><u>Reviewer’s Note: Juan 4/26/13: Will review more later.</u></p> <p>Use to acquire and/or select a <i>reference image</i> to use for a tomography point when running the recipe. You can acquire and/or select a primary or secondary reference image.</p> <p>If necessary, click  to remove the <i>file</i> displayed from use within the recipe.</p> 	

Table D-5 Scout View Annotation Controls

Control	Function
	<p>Select annotation tool</p> <p>Click to activate using the mouse pointer as a selecting tool, such as to control panning, or move or edit any <i>annotations</i> within the <i>active image view</i>.</p>
	<p>Histogram tool</p> <p>Click to open the Histogram Control dialog box.</p> <p>Option is also available by right-clicking the <i>active image view</i>, and selecting Histogram.</p>
	<p>Histogram Control dialog box</p> <p>Use to adjust the <i>active image view</i>'s contrast and brightness. Click Apply to apply changes made.</p> <p>Select the Global Lock check box to lock the Front and Side View image displays to the adjusted histogram limits.</p>
	<p>Measure annotation tool</p> <p>Click to annotate the <i>active image view</i> with a line of measured tick marks. Click a line <i>start point</i> and <i>endpoint</i> within the <i>active image view</i>, while holding down the mouse button. Hold down SHIFT and the mouse button, to draw a vertical or horizontal line.</p> <p>Option is also available by right-clicking the <i>active image view</i>, and selecting Measurement.</p>
	<p>Line Graph annotation tool</p> <p>Click to draw a line on the <i>image</i> and display a graph that compares intensity versus position. Click a graph <i>start point</i> and <i>endpoint</i> within the <i>active image view</i>, while holding down the mouse button.</p> <p>Option is also available by right-clicking the <i>active image view</i>, and selecting Line Plot.</p>
	<p>Save Image tool</p> <p>Click to save the <i>active image view</i> to a *.bmp, *.gif, *.jpg, *.png, or *.xrm file.</p> <p>Option is also available by right-clicking the <i>active image view</i>, and selecting Save.</p>
	<p>Load Image tool</p> <p>Click to load a *.bmp, *.gif, *.jpg, *.png, or *.xrm file. The image loads into a separate <i>image window</i>. It does not load into the Front or Side View image display.</p>

Table D-5 Scout View Annotation Controls (Continued)

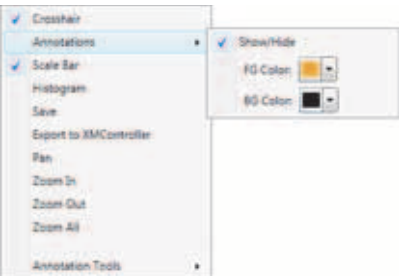
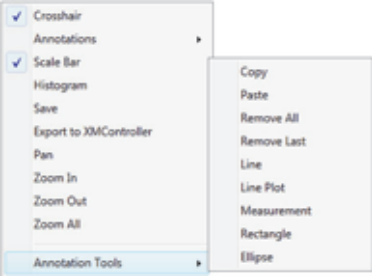
Control	Function
–	<p>Pan annotation tool</p> <p>Right click the <i>active image view</i>, then select Pan. Click to activate panning of the <i>active image view</i>.</p> <p>Next, click  to activate the mouse pointer. Within the <i>active image view</i>, click and drag in the direction you want to pan the <i>image</i>.</p> <p>Option is also available by right-clicking the <i>active image view</i>, and selecting Pan.</p>
	<p>Right-Click Shortcut Menu</p> <p>Right-click the Front or Side View image display to open the shortcut menu:</p> <ul style="list-style-type: none"> – Crosshair – Select to display the red crosshair, clear to hide the red crosshair. – Annotations – Click to display a secondary shortcut menu: <ul style="list-style-type: none"> – Show/Hide – Select to display <i>annotations</i>, clear to hide <i>annotations</i>. – FG Color – Click the drop-down list and select a <i>foreground color</i> to use for annotations. – BG Color – Click the drop-down list and select a <i>background color</i> to use for annotations. – Histogram – Refer to Histogram tool. – Save – Refer to Save Image tool. – Export to XMController <ul style="list-style-type: none"> – Scout images – Automatically makes a copy of the Scout image and opens it in the legacy XMController program. The copied image is named <i>Scout_xxW_xxKV_expNsec_binx_obj_date-Time.xrm</i>. The settings at which the image was acquired are included in the file name for easy identification. – Tomographies – Opens the file in the legacy XMController program – Pan – Refer to Pan annotation tool. – Zoom In – Refer to Zoom IN. – Zoom Out – Refer to Zoom OUT. – Zoom All – Refer to Zoom All. – Annotation Tools – Refer to Right-Click Shortcut Menu – Annotation Tools.

Table D-5 Scout View Annotation Controls (Continued)

Control	Function
	<p>Right-Click Shortcut Menu – Annotation Tools</p> <p>Right-click the Front or Side View image display to open the shortcut menu, then select Annotation Tools to display a secondary shortcut menu:</p> <ul style="list-style-type: none">– Copy – Select, click , then select the <i>annotation on the active image view</i> that you want to copy.– Paste – Select to paste a copied annotation onto the <i>active image view</i>.– Remove All – Select to remove all <i>annotations</i> from the <i>active image view</i>.– Remove Last – Select to remove the most recently created <i>annotation</i> from the <i>active image view</i>.– Line – Select, then click a <i>start point</i> and <i>endpoint</i> within the <i>active image view</i>, while holding down the mouse button. Hold down SHIFT and the mouse button, to draw a vertical or horizontal line.– Line Plot – Refer to Line Graph annotation tool.– Measurement – Refer to Measure annotation tool.– Rectangle – Select, then click within the <i>active image view</i> at the rectangle's <i>upper left corner</i> and drag to the rectangle's <i>lower right corner</i>, to form the rectangle.– Ellipse – Select, then click a <i>start</i> and <i>end side</i> (diameter width) within the <i>active image view</i>, to form the ellipse. <p>Note If you need to move an <i>annotation</i> after it has been created, click , then drag the <i>annotation</i> to the desired location within the <i>active image view</i>.</p>

Scan View

Scan view (Figure D-4) is the fourth tabbed view within the Scout-and-Scan Control System. This view is available only after completing the required settings in each of the previous views. **Scan** view is used to set up the 3D scanning parameters for each tomography point within a recipe.

Table D-6 lists and describes most **Scan** view controls. The zoom- and annotation-related controls work the same as those previously described in “Scout View,” on page 218. Use of **Scan** view in the tomography collection process is described in “Step 4 – Scan,” on page 41, in Chapter 2 (new recipes only).

Figure D-4 Typical **Scan** View

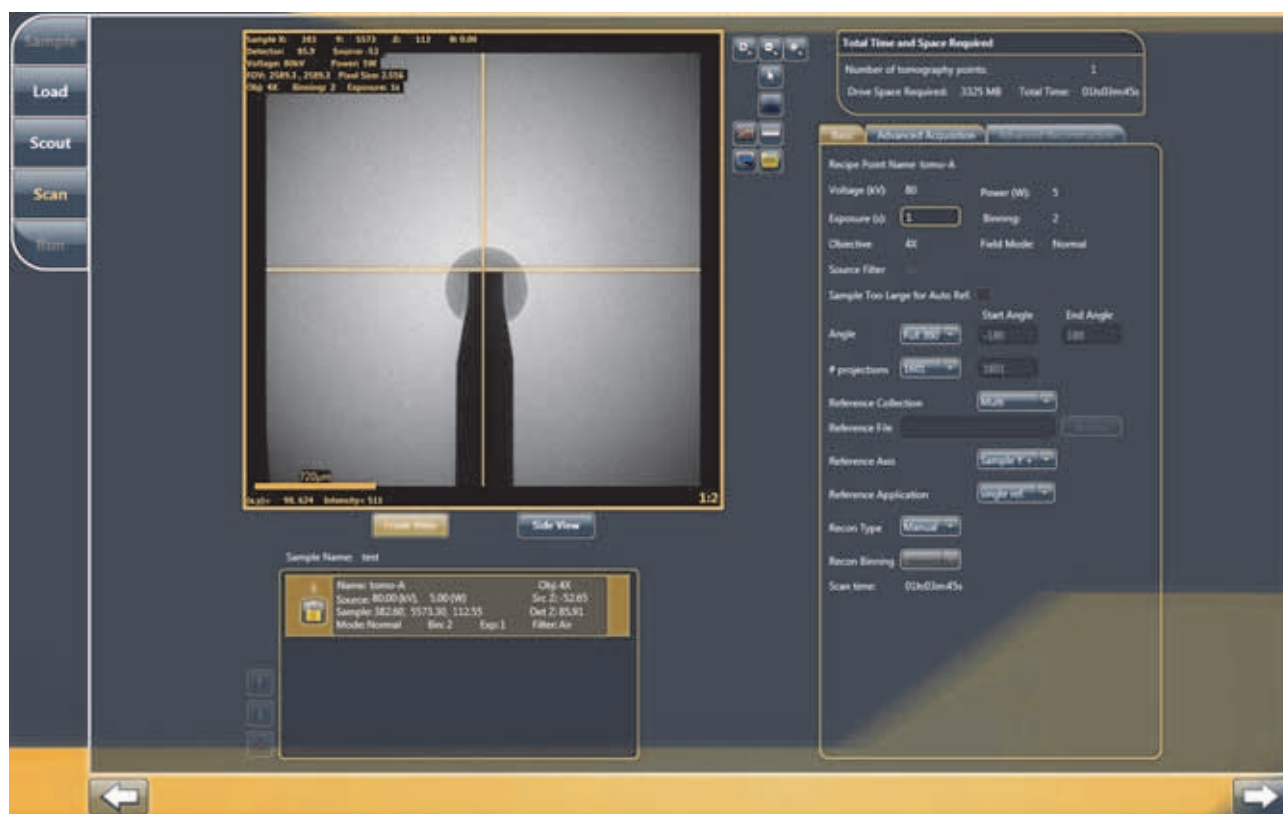


Table D-6 Scan View Controls

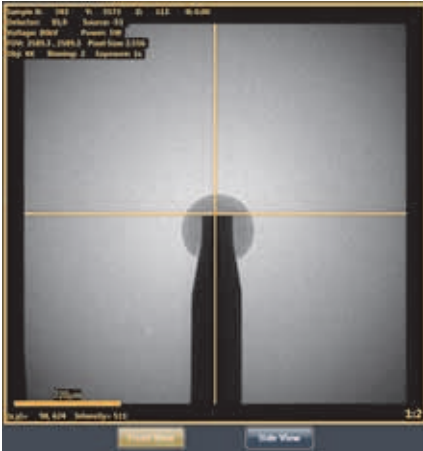
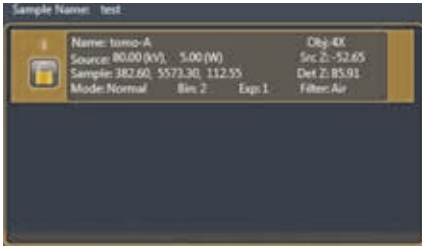
Control	Function
	<p>Tomography Point Front or Side View Scout Images</p> <p>Displays the Front or Side View image display for the selected scouted tomography point:</p> <ul style="list-style-type: none"> Click  to display Front View Click  to display Side View <p>Note An orange-colored border indicates that a reference image has been applied.</p>
	<p>Zoom IN, Zoom OUT, Zoom All</p> <p>Zoom-related controls work the same as those previously described in Table D-4 on page 219.</p>
	<p>Miscellaneous Annotation tools</p> <p>Annotation-related controls (buttons, as well as tools that are available by right-clicking the <i>image</i>) work the same as those previously described in Table D-5 on page 228.</p>
	<p>Tomography Point selection panel</p> <p>Use this panel to select the <i>tomography point</i> that is being scanned. The icon button indicates whether the tomography point is unlocked, , or locked . If needed, click  to unlock the <i>tomography point</i>.</p> <p>Note For further details regarding the lock/unlock feature, refer to “Lock/Unlock tomography points,” on page 223.</p>

Table D-6 **Scan View Controls (Continued)**

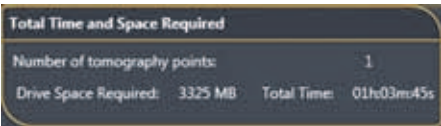
Control	Function
	<p>Move Tomography Point UP button</p> <p>Click after selecting a <i>tomography point</i> in the Tomography Point selection panel, to move that tomography point UP within the list, to change the sequence in which it will run within the recipe.</p> <p>Unavailable if only one tomography point is listed.</p>
	<p>Move Tomography Point DOWN button</p> <p>Click after selecting a <i>tomography point</i> in the Tomography Point selection panel, to move that tomography point DOWN within the list, to change the sequence in which it will run within the recipe.</p> <p>Unavailable if only one tomography point is listed.</p>
	<p>Remove Tomography Point button</p> <p>Click after selecting a <i>tomography point</i> in the Tomography Point selection panel, to remove the selected tomography point.</p> <p>Unavailable if only one tomography point is listed.</p>
	<p>Total Time and Space Required</p> <p>Displays the total <i>time</i> and <i>hard disk drive space</i> required to complete data acquisition for all tomography points within the recipe.</p> <p>Note The time and space values do not include Reconstruction time if Recon Type – <i>Auto</i> is selected in the Basic tab.</p>



Table D-6 Scan View Controls (Continued)

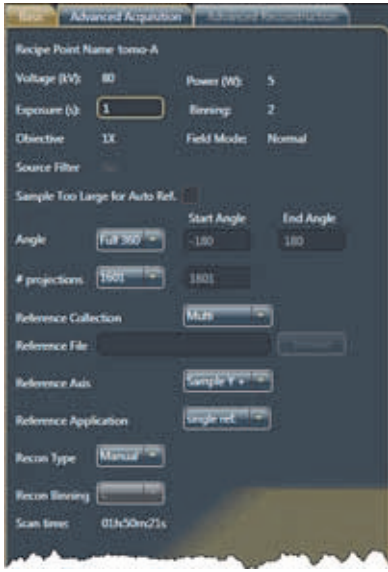
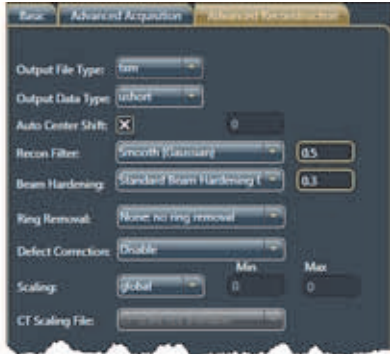
Control	Function
	<p>Basic tab</p> <p>Basic scan parameters that can be applied to unlocked tomography points. Those with text boxes or drop-down list boxes are editable. Type or select the necessary <i>parameters</i>.</p> <p>Note The Voltage (kV), Power (W), Binning, Objective, Field Mode, Source Filter, and Sample too Large for Auto Ref. parameters are informational only. If these <i>parameters</i> need adjustment, adjust them in Scout View.</p> <ul style="list-style-type: none"> – Exposure (s) text box – Exposure <i>time</i>, in seconds. Use the <i>time</i> previously specified in Scout view, or type a new <i>time</i>. – Angle drop-down list box – Select the <i>start</i> and <i>end</i> angles: <ul style="list-style-type: none"> – Full 360 – Sets the start angle to <i>-180</i> and end angle to <i>180</i> – 180 + fan – Sets the start angle to <i>-92</i> and end angle to <i>92</i> – Custom – Type the <i>start</i> and <i>end</i> angles in their respective text boxes – # projections drop-down list box – Select <i>201</i>, <i>401</i>, <i>801</i>, <i>1601</i>, <i>3201</i>, or <i>Custom</i>. If you select <i>Custom</i>, type a <i>quantity</i> in the text box. – Reference Collection drop-down list box – Select <i>None</i>, <i>Use File</i>, <i>Single</i>, or <i>Multi</i>. If you select <i>Use File</i>, an Open dialog box opens, from which you can select an <i>*.xrm</i> file. – Reference file and Browse button – Same function as the Source motion control described in “Reference file and Browse button,” on page 227. – Reference Axis drop-down list box – Same function as the Source motion control described in “Reference Axis drop-down list box,” on page 227. – Reference Application drop-down list box – Select <i>no ref.</i>, <i>single ref.</i>, or <i>multi-ref.</i> to indicate the Reference Application mode. – Recon Type drop-down list box – Select <i>Auto</i> or <i>Manual</i>. If you select <i>Auto</i>, reconstruction is automatically run on the tomography point after data collection is complete. Select <i>Manual</i> if you want to manually reconstruct the tomography dataset later, using XMReconstructor. – Recon Binning – Enabled when Recon Type – <i>Auto</i> is selected. <i>Binning value</i> used during reconstruction. Select <i>1</i> (recommended), <i>2</i>, or <i>4</i>. – Scan time – Estimated <i>time</i> needed to scan the tomography point, based on the selected parameters.

Table D-6 Scan View Controls (Continued)

Control	Function
	<p>Advanced Acquisition tab</p> <p>Optional. Advanced scan parameters that can be applied to unlocked tomography points. Those with text boxes or drop-down list boxes are editable. Type or select the necessary <i>parameters</i>:</p> <ul style="list-style-type: none"> – Enable DRR check box – Select to enable Dynamic Ring Removal, which reduces the quantity of rings around the image ROI. Useful when too many rings obscure the image ROI. – Camera Readout drop-down list box – Select <i>20 MHz</i> (recommended), <i>10 MHz</i>, or <i>5 MHz</i>. – Recon Type drop-down list box – Select <i>Auto</i> or <i>Manual</i>. Same function as in Basic tab. – Reference Collection drop-down list box – Select <i>None</i>, <i>Use File</i>, <i>Single</i>, or <i>Multi</i>. Same function as in Basic tab. – Multi-Reference Interval drop-down list box and text box – Sets the quantity of scans between reference collections. Select <i>Default</i> or <i>Custom</i>. If you select <i>Custom</i>, type a <i>quantity</i> in the text box. – Min. # images per reference instance text box – Type a <i>quantity of references to average</i> in the text box. – Reference Application drop-down list box – Select <i>no ref.</i>, <i>single ref.</i>, or <i>multi-ref.</i> – Sec. Ref. Collection – Enable application of a <i>secondary reference</i> using a file. Future use. Associated <i>features</i> that appear below this option are unavailable. – Drift Correction drop-down list box – Set the Drift Correction mode. Select <i>none</i>, <i>sample</i>, <i>source</i>, or <i>temperature</i>.^a – Enable Sample Drift check box – Automatically selected when any <i>Drift Correction mode</i> is selected; automatically cleared when <i>none</i> is selected. Use in tandem with the selected Drift Correction mode, to correct for various factors that can cause sample drift.^a – Sample Drift Interval drop-down list box and text box – Enabled when the Enable Sample Drift check box is selected. Select <i>Default</i> or <i>Custom</i>. If you select <i>Custom</i>, type an <i>interval</i> in the text box.^a – Variable Exposure Time drop-down list box and Strength and Center text boxes – Select <i>None</i>, <i>Default</i>, <i>Custom</i>, or <i>Browse...</i>. If you select <i>Custom</i>, type <i>strength</i> and <i>center values</i> in their respective text boxes. – High Aspect Ratio Tomo drop-down list box and Width, Strength, and Center text boxes, Xradia 520 Versa only – Select <i>None</i>, <i>Default</i>, or <i>Custom</i>. If you select <i>Custom</i>, type <i>width</i>, <i>strength</i>, and <i>center values</i> in their respective text boxes. – Scan time – Estimated <i>time</i> needed to scan the tomography point, based on the selected parameters.

Table D-6 Scan View Controls (Continued)

Control	Function
	<p>Advanced Reconstruction tab</p> <p>Enabled when Recon Type – Auto is selected in the Basic tab. Type or select the necessary <i>parameters</i>:</p> <ul style="list-style-type: none"> – Output File Type drop-down list box – Select <i>tcm</i>, <i>dicom</i>, <i>16-bit tif</i>, or <i>bin</i>. – Output Data Type drop-down list box – Select <i>uchar</i> (8-bit), <i>ushort</i> (16-bit), or <i>float</i> (32-bit). – Auto Center Shift check box and text box – Select to enable automatic center shift, –or– clear the check box and type a <i>center shift value</i> in the text box. – Recon Filter drop-down list box and text box – Select <i>Smooth (Gaussian)</i>.^b <p>Note Do not use the <i>None-Filter Applied Externally</i> or <i>Sharp (Shepp-Logan)</i> recon filter options.</p> <ul style="list-style-type: none"> – Beam Hardening drop-down list box and text box – Select <i>Legacy</i>, <i>9.x Standard</i>, or <i>Standard Beam Hardening Correction</i>. – Ring Removal drop-down list box – Select <i>None: no ring removal</i>, <i>High contrast: 3-section RR</i>, or <i>Low contrast: 8-section RR</i>.^c – Defect Correction drop-down list box – Select <i>Disable</i>, <i>Bright spots only</i>, or <i>Bright and dark spots</i>.^d – Scaling drop-down list box and Min and Max text boxes – Select <i>global</i> or <i>custom</i>. If you select <i>custom</i>, type <i>min</i> and <i>max values</i> in their respective text boxes. – CT Scaling File drop-down list box – Unavailable.

- a. **Drift-related features** – Refer to “[Thermal and Sample Drift Correction](#),” on [page 237](#) for further details.
- b. **Recon Filter drop-down list box and text box** – The Gaussian Smooth filter reduces high-frequency image noise, by convolving the image with a 3D Gaussian function. There is typically a corresponding reduction in image detail or resolution; however, most high-resolution images acquired using the 20X or optional 40X magnification lens have more than one pixel per spatial resolution element. Therefore, the reduction in resolution is minimal, with significant improvements in noise when the image is Gaussian smoothed with a standard deviation between 0.5 and 1.
- c. **Ring Removal drop-down list box** – If DRR is enabled in the [Advanced Acquisition tab](#), select *None: no ring removal*.

If DRR is disabled in the [Advanced Acquisition tab](#), select *High contrast – 3-section RR* for high-contrast samples such as semiconductors, –or– *Low contrast – 8-section RR* for bone, rock, plastic, carbon composite, or composite material samples.

- d. **Defect Correction drop-down list box** – Select *Disable* to disable defect correction.

Select *Bright spots only* if the *Bright and dark spots* option seems to add more artifacts than are desirable to the reconstruction.

Select *Bright and dark spots* to remove both bright and dark defects on the projections. If these defects are not removed, intense rings might be observed in the reconstruction.

Thermal and Sample Drift Correction



NOTE Thermal drift correction is available only on the Xradia 520 Versa and Xradia 510 Versa.

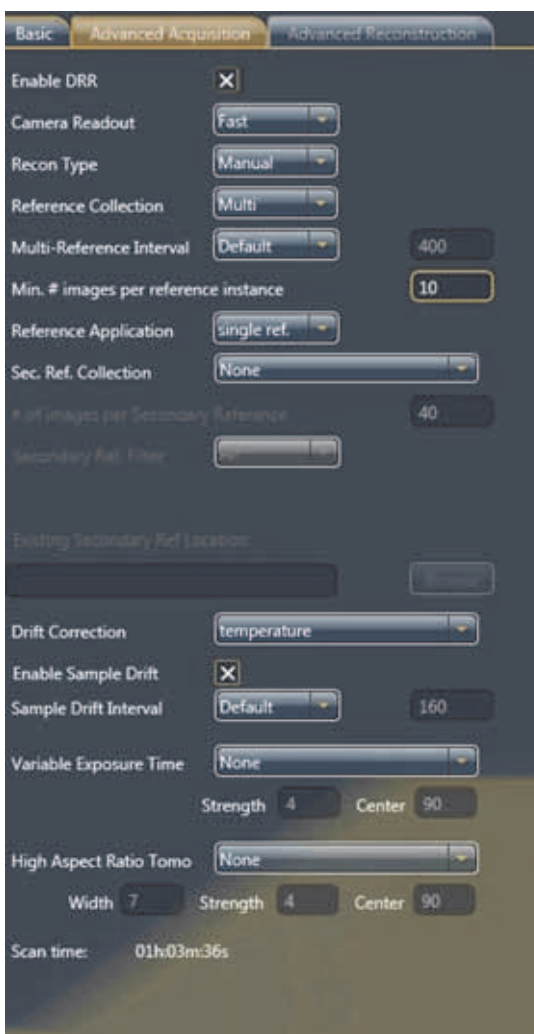
This section provides an overview of the Scout-and-Scan Control System's Thermal and Sample Drift Correction feature.

Thermal drift correction reduces image artifacts due to thermal fluctuation during tomography acquisition. If the temperature surrounding the Xradia Versa changes during data acquisition, the sample stage moves, resulting in streak or arc artifacts that emanate from features within the imaged region. These artifacts are pronounced if the temperature fluctuates more than 1 to 2°C, and larger changes can render the Center Shift Find and Reconstruction processes impossible.

The Xradia Versa automatically compensates for sample movement due to temperature variations.

By default, thermal compensation is enabled in the **Advanced Acquisition** tab within **Scan** view, as shown in [Figure D-5](#). Thermal compensation does not, however, correct for sample movement due to factors other than temperature variations. In cases where thermal compensation is insufficient, sample drift correction should also be used, as shown in [Figure D-5](#).

Figure D-5 **Advanced Acquisition** Tab within **Scan** View, with Temperature Shifts and Sample Drift Enabled



When sample drift correction is used during tomography acquisition, the sample (Sample Theta) is rotated back to 0°, at the *sample drift interval* specified within the **Advanced Acquisition** tab (refer to [Figure D-5](#)), and an image is acquired.

Image acquisition continues, with a series of 0° images acquired and correlated, which are then used to identify the amount that the sample shifted throughout the acquisition period. Image shifts between these images are interpolated and applied to all projection images within the tomography dataset, before reconstruction. This set of images is saved as a separate *.txrm file, with *_SourceDriftorVDT* appended to the same root file name as the sample tomography dataset.

The “sample drift” correction is valid only if the position remains constant. All standard X-ray sources supplied with the Xradia Versa stabilize after having been turned ON for more than 15 minutes. Thus, it is important that the X-ray source be turned ON for at least 15 minutes before starting tomography data acquisition. If the setup time for the tomography location or recipe exceeds 15 minutes, it is unnecessary to wait an additional 15 minutes.

Drifts are more pronounced with higher-resolution scans over long periods of time. Thus, sample drift correction is more critical to datasets acquired with magnifications of 10X or higher. Using this feature with a tomography data acquisition lengthens the total scan time by approximately 2%.

Run View

Run view (Figure D-6) is the fifth tabbed view within the Scout-and-Scan Control System. This view is available only after completing the required settings in the previous four (new recipes) or first three (existing recipes or recipe templates) views. **Run** view is used to run the recipe and acquire tomographies.

Table D-7 lists and describes most **Run** view controls. The zoom- and annotation-related controls work the same as those previously described in “Scout View,” on page 218. Use of **Run** view in the tomography collection process is described in “Step 5 – Run,” on page 45 (new recipes) and “Step 4 – Run,” on page 93 (existing recipes or recipe templates) in Chapter 2.

Figure D-6 Typical **Run** View

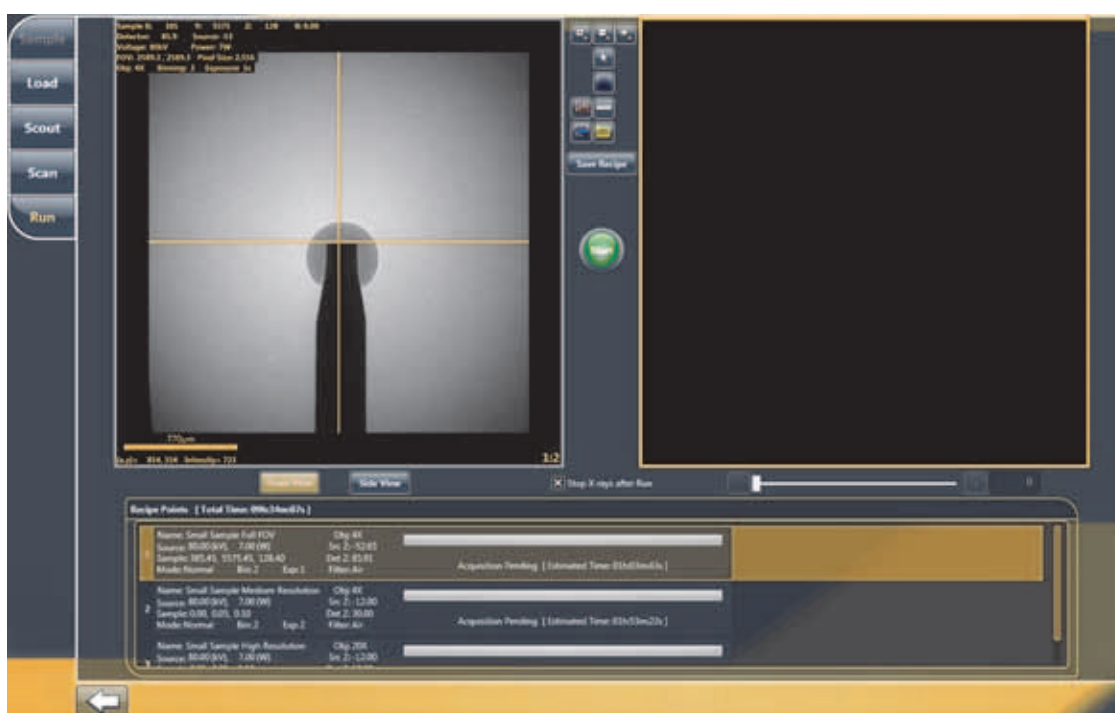


Table D-7 Run View Controls

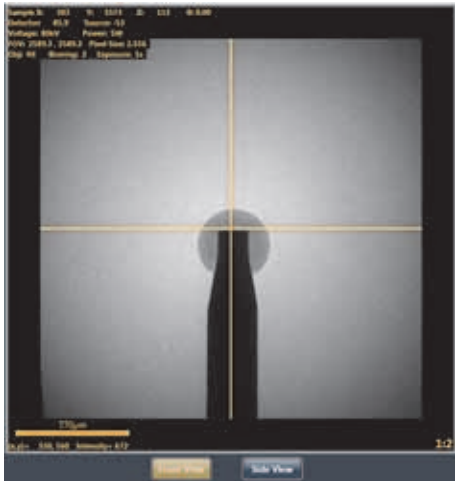
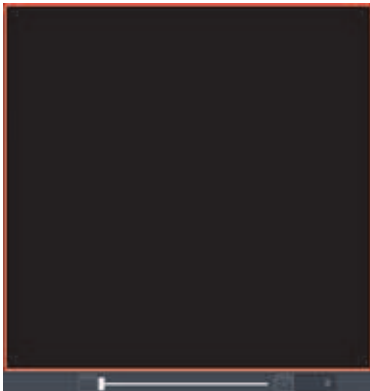
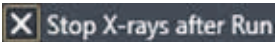
Control	Function
	<p>Tomography Point Front or Side View Scout Images Displays the Front or Side View image display for the selected scouted tomography point:</p> <ul style="list-style-type: none"> Click  to display Front View Click  to display Side View
	<p>Zoom IN, Zoom OUT, Zoom All Zoom-related controls work the same as those previously described in Table D-4 on page 219.</p>
	<p>Miscellaneous Annotation tools Annotation-related controls (buttons, as well as tools that are available by right-clicking the <i>image</i>) work the same as those previously described in Table D-5 on page 228.</p>
	<p>Start button Click to start running the recipe. Activates the Acquired Projections Image Display. Changes to the Stop button while a recipe is running.</p>
	<p>Stop button Click if you need to stop running the recipe before the recipe completes.</p>
	<p>Acquired Projections Image Display Activates after  is clicked. While the recipe is running, its border is red, indicating that projection images are actively being acquired and displayed.</p>
	<p>Scroll Bar and Image Number Indicator Click and drag the slider to scroll through and view the acquired projection images, –or– type the <i>image number</i> you want to view, in the Acquired Projections Image Display. The number indicates the <i>current projection image</i> displayed.</p>

Table D-7 Run View Controls (Continued)

Control	Function
	<p>Recipe Point selection panel</p> <p>Select a <i>tomography point</i> to view its scouted and acquired projection images. If the recipe is currently running, each projection can be viewed as it is acquired, in the Acquired Projections Image Display (border is red). Previously acquired projections can also be viewed after the recipe finishes running, using the Scroll Bar and Image Number Indicator.</p> <p>Prior to clicking , the [Total Time] for the entire recipe is listed in brackets at the top of the panel. The Acquisition Pending [Estimated Time] is listed for each tomography point, under a status bar that will indicate the tomography point's acquisition progress.</p> <p>After  is clicked, [Total Time, Remaining Time] for the entire recipe is listed in brackets at the top of the panel. Projection <i>x</i> of <i>y</i> and [Time Remaining] are listed for each tomography point, under a status bar that indicate the tomography point's acquisition progress.</p>
	<p>Stop X-rays after Run check box</p> <p>Select to automatically turn OFF the X-ray source after the recipe finishes running.</p> <p>Useful to help extend the life of the X-ray source, or conserve power if the X-ray source is not needed for an extended period of time after running the recipe.</p>

XMReconstructor User Interface

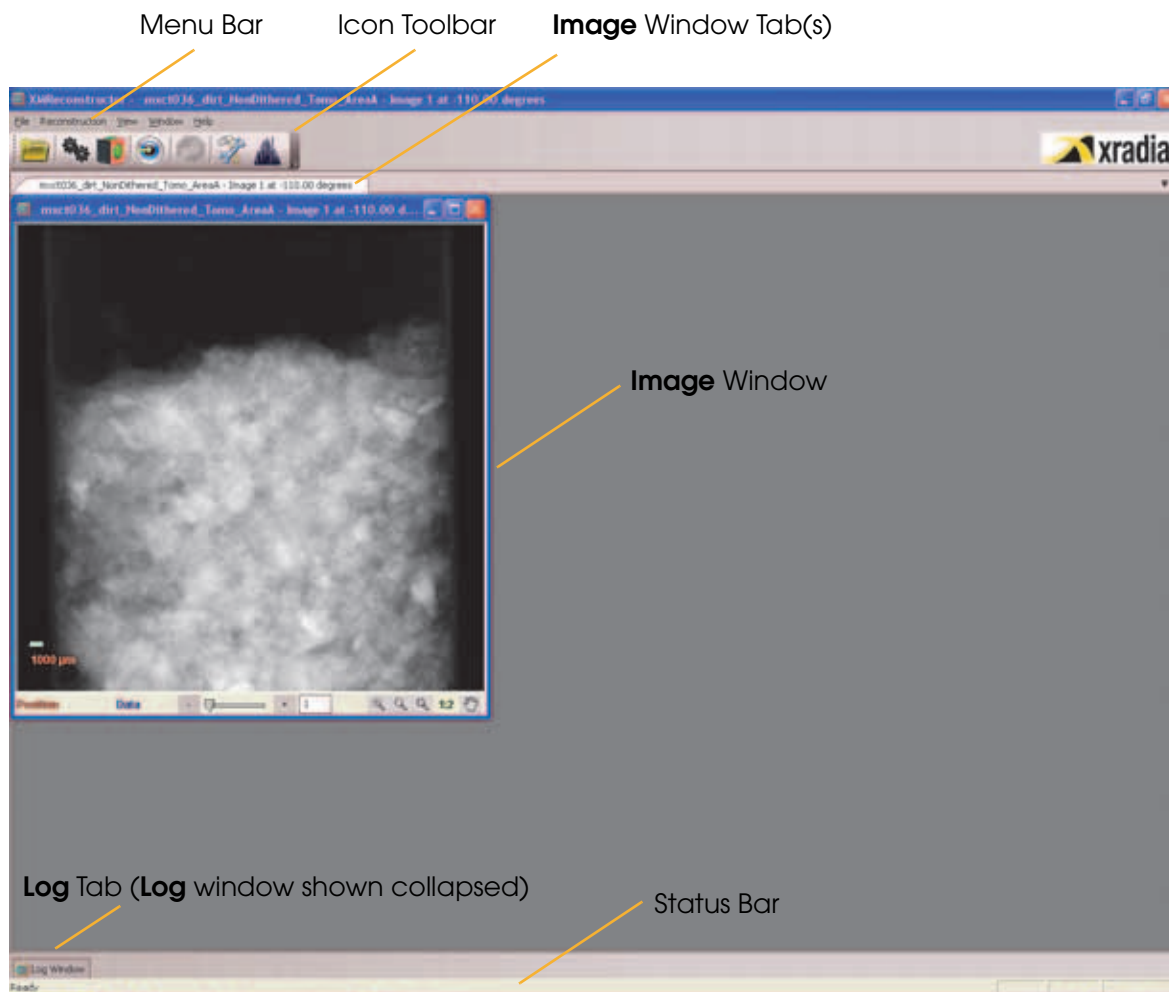
This section provides instructions for using the **XMReconstructor** main window's (Figure D-7) user interface icons (Table D-8), as well as tips for using the following software control features:

- [XMReconstructor Image Window Controls](#)
- [XMReconstructor Image Control Dialog Box](#)
- [XMReconstructor Histogram Tool](#)



NOTE Tasks that use XMReconstructor are discussed in [Chapter 3, "Manually Reconstructing a Tomography Dataset."](#)

Figure D-7 Default **XMReconstructor** Main Window
(Opened File Shown for Reference Only)



 **NOTE** If an icon is highlighted **orange** in the icon toolbar, its associated dialog box is already open, and clicking the icon closes, rather than opens, the dialog box.

Table D-8 XMReconstructor User Interface Icons

Icon	Description
	Click to select the file to be opened/used. Opens an Open File dialog box. Same as selecting File > Open... from the menu bar.
	Click to set the <i>reconstruction settings</i> and start the Reconstruction process. Opens the Reconstruction Setting dialog box. Same as selecting Reconstruction > Reconstruction Setting... from the menu bar.
	Click to reconstruct the tomography data. Opens the Reconstruction Status window. Same as selecting Reconstruction > Start Reconstruction from the menu bar.
	Click to identify and correct center shift and beam hardening. Opens the Rotation Center / Beam Hardening dialog box. Same as selecting Reconstruction > Find Center Shift from the menu bar.
	Click to abort the Center Shift Find, Beam Hardening Correction Find, and Reconstruction processes. Same as selecting Reconstruction > Abort from the menu bar.
	Click to access tools for manipulating the projection images or reconstructed image while finding the center shift or beam hardening correction constant. Opens the Image Control dialog box, which has Annotation , Info , Navigator , and Shifts tabs. A complete description of each tab is provided in “ XMReconstructor Image Control Dialog Box ,” on page 247. Same as selecting View > Image Controls from the menu bar.
	Click to control and adjust image contrast and brightness, using the Histogram tool. A complete description of how to use the tool is provided in “ XMReconstructor Histogram Tool ,” on page 255. Same as selecting View > Histogram tool from the menu bar.

XMReconstructor Image Window Controls

A typical **Image** window is shown in [Figure D-8](#), and described in [Table D-9](#).

Figure D-8 XMReconstructor **Image** Window for *.txrm Files, Including Tomography

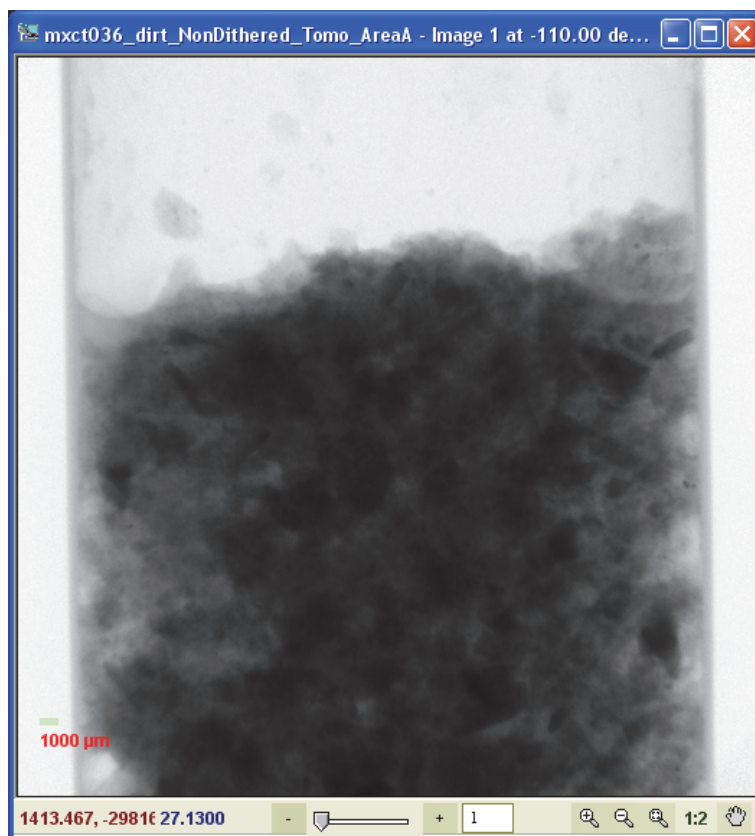


Table D-9 XMReconstructor **Image** Window Controls

Control	Description
	Indicates the X and Y coordinates of the mouse pointer's current location on the image. If Microns is selected in View > Measurements , the measurement is in <i>microns</i> . If Pixels is selected in View > Measurements , the measurement is in <i>pixels</i> .
	Indicates the light intensity of the pixel at the mouse pointer's current location. If the image is not reference-corrected, the number is in counts ranging from 1 through 65,535. If the image is reference-corrected in Transmission mode, the numbers indicate the transmission percentage.
	Click the – and + buttons, to scroll BACKWARD and FORWARD through the images, respectively, one image per click. Click and drag the slider to the LEFT and RIGHT, to navigate BACKWARD and FORWARD, respectively, through the images. The current image number is shown in the text box to the right of the + button.
	Click to zoom IN on the image.
	Click to zoom OUT from the image.
	Click to fit the entire image within the display area.
	Indicates the ratio of the display image to the actual image. For example, in Figure D-8 , the display area is 512 x 512 pixels, but the actual image is 1,024 x 1,024.
	Click to move (pan) the zoomed-in image around within the display area.

XMReconstructor Image Control Dialog Box

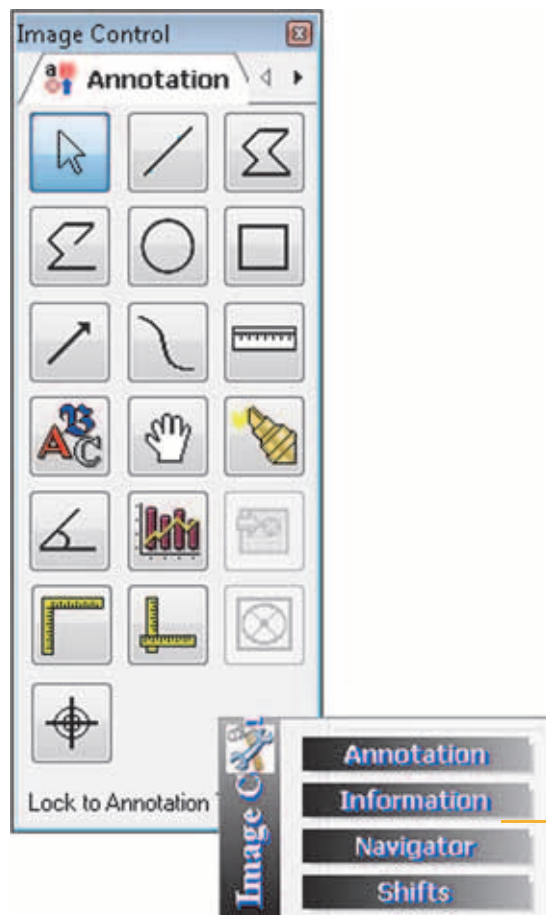
XMReconstructor uses an **Image Control** dialog box within the following tabs, for use with *.*txrm* files:

- [Annotation Tab](#)
- [Information \(Info\) Tab](#)
- [Navigator Tab](#)
- [Shifts Tab](#)

To access the **Image Control** dialog box, click  in the icon toolbar or select **View > Image Controls**. The dialog box opens, defaulted to the **Annotation** tab. To navigate to the other tabs, right-click within the main body of the dialog box, then select the *tab* you want from the shortcut menu. (Refer to [Figure D-9](#).)

 **NOTE** If  is highlighted **orange** in the icon toolbar, the **Image Control** dialog box is already open, and clicking the icon closes, rather than opens, the dialog box. If the dialog box is hidden behind other windows or dialog boxes, click the highlighted **orange** icon, then click the non-highlighted icon, as described above.

Figure D-9 XMReconstructor **Image Control** Dialog Box **Annotation** Tab – Selecting a Different Tab



Right-click within the main body of the **Image Control** dialog box, then select the *tab* you want, from the shortcut menu

Annotation Tab

The **Image Control** dialog box **Annotation** tab is shown in [Figure D-10](#) and described in [Table D-10](#).

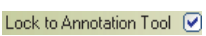
Figure D-10 XMReconstructor **Image Control** Dialog Box **Annotation** Tab



Table D-10 XMReconstructor **Image Control** Dialog Box – **Annotation** Tab Options

Icon	Function	Description
	Pointer	Click the icon, and use it to move or edit any <i>annotations</i> within the Image window.
	Line	Draws a line on the image. Click the icon, then click a <i>start point</i> and <i>endpoint</i> within the Image window, while holding down the mouse button. Hold down SHIFT and the mouse button, to draw a vertical or horizontal line.
	Polygon	Draw a closed polygon on the image. Click the icon, then click <i>multiple points</i> within the Image window. Double click to end the polygon.
	Polyline	Draw connected straight lines that do not close to form a polygon. Click the icon, then click <i>multiple points</i> within the Image window. Double click to end the polyline.
	Circle	Draw a circle on the image. Click the icon, then click a <i>start</i> and <i>end side</i> (diameter width) within the Image window, to form the circle.
	Square	Draw a square or rectangle on the image. Click the icon, then click within the Image window at the shape's <i>upper left corner</i> and drag to its <i>lower right corner</i> , to form the square or rectangle.
	Arrow	Draw an arrow on the image. Click the icon, then click a <i>start point</i> and drag to an <i>endpoint</i> within the Image window. The start point will have an arrowhead applied to it.
	Polyspline	Draw a curve line on the image. Click the icon, then click <i>multiple points</i> within the Image window. Double click to end the polyspline.
	Ruler	Measure distances on the image. Click the icon, then click a <i>start point</i> and drag to an <i>endpoint</i> within the Image window. The distance between the two points is added to the window.
	Note	Annotate the image at specific areas. Click the icon, then type <i>text</i> at locations of interest, within the Image window.
	Pan	Move image within window when zoomed IN. Click the icon, then move the mouse pointer around within the Image window, to pan the image.
	Highlighter	Highlight areas on the image. Click the icon, then click and drag over <i>areas you want to highlight</i> within the Image window.

Table D-10 XMReconstructor **Image Control** Dialog Box –
Annotation Tab Options (Continued)

Icon	Function	Description
	Angle	Measure angles on the image.
	Line Plot	Plot an intensity graph across the image specified by a drawn line.
	Move to Position	Move the clicked point to the center of the FOV. Works only when Sample Theta = 0°.
	Multi-Line Scale	Draw consecutive adjoining lines with distance measurements.
	Ortho Rule2	Draw two orthogonal rulers on the image.
	–	<i>Unavailable. Disabled/not used.</i>
	Crosshair	Draw a crosshair at the selected location on the image.
	Lock Tool	Selected, by default. If not selected, any selected annotation tool is no longer selected, after a single use on the image. If you plan to use the same tool multiple times, select this option.

Information (Info) Tab

The **Image Control** dialog box **Info** tab is shown in [Figure D-11](#). [Table D-11](#) describes the tab's options.

Figure D-11 XMReconstructor **Image Control** Dialog Box – **Info** Tab



Table D-11 XMReconstructor **Image Control** Dialog Box – **Info** Tab Options (All Images)

Item	Description
Imaging Mode	Describes the imaging mode used for the active Image window.
Angle	Angle of the projection.
Exposure Time	Exposure time used for image acquisition, in seconds.
Sample X, Y, Z Positions	Sample X, Y, and Z positions of the projection.
Camera Binning	Camera binning used during image acquisition.
Camera Temperature	Camera temperature during image acquisition.
Pixel Size	Size of each pixel within the image, in microns.
File Data Type	Data type in which the image is stored. Available types are UCHAR (8-bit), USHORT (16-bit), and FLOAT (32-bit).
Image Size	Image width and height, in pixels.
File Size	Image file size.
Date and Time	Date and time that the file was last saved to the hard disk drive.

Navigator Tab

The **Image Control** dialog box **Navigator** tab, shown in [Figure D-12](#) and described in [Table D-12](#), is used to automatically scroll through the multiple images in a tomography projection file (*.txrm).

Figure D-12 XMReconstructor **Image Control** Dialog Box – **Navigator** Tab

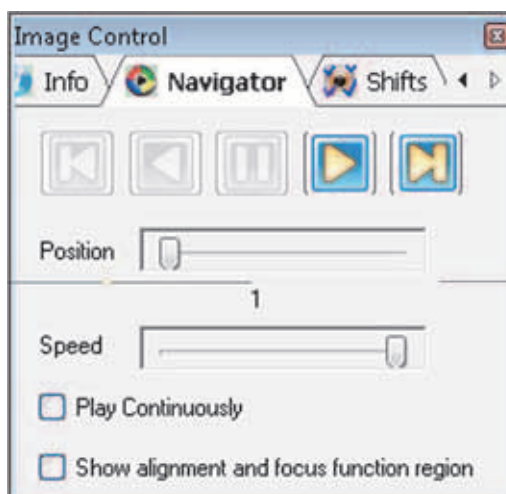


Table D-12 XMReconstructor **Image Control** Dialog Box – **Navigator** Tab Controls

Control	Description
	Step One Image in Reverse, Reverse, Pause, Forward, and Step One Image Forward buttons, respectively. Use to navigate to different projection images within a tomography file or slices within a reconstructed file.
	Navigate to different projection images within a tomography file or slices within a reconstructed file. To move backward, drag the slider to the LEFT. To move forward, drag the slider to the RIGHT.
	Controls the speed at which the images or slices are scrolled. To reduce speed, drag the slider to the LEFT. To increase speed, drag the slider to the RIGHT.
Play Continuously	Select to continuously loop the images.
Show alignment and focus function region	Select to show the alignment and focus function region, if applicable.

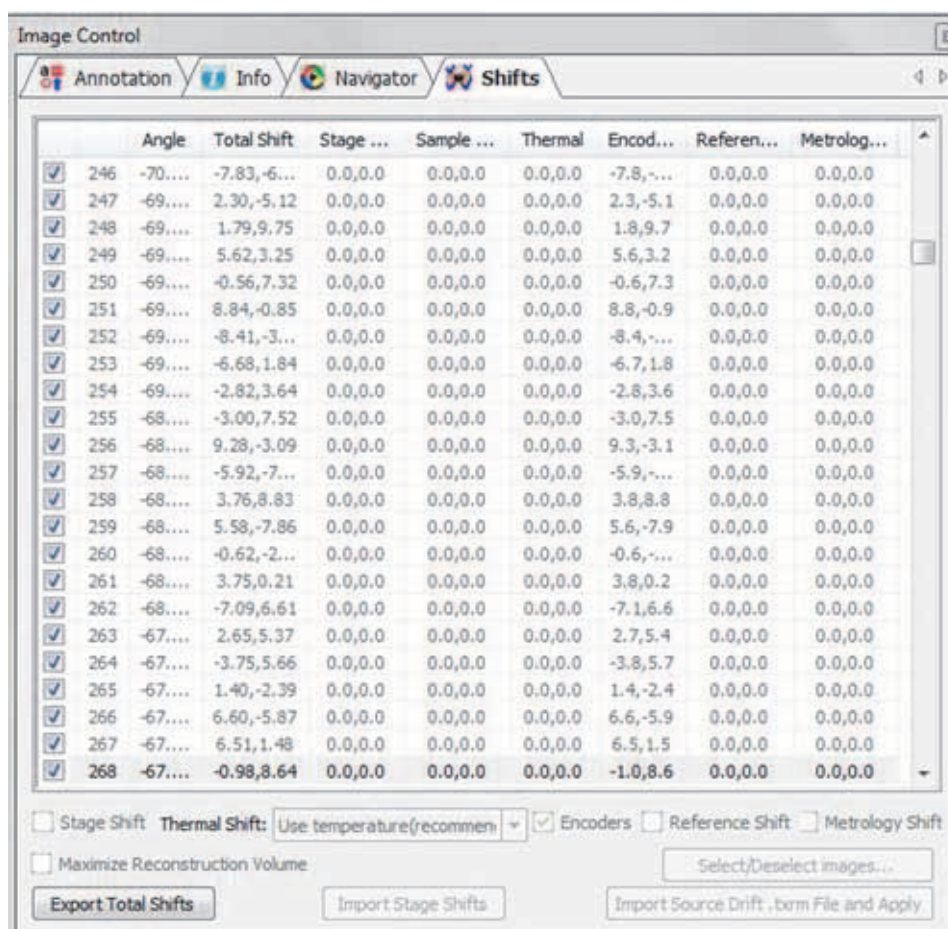
Shifts Tab

 **NOTE** The **Shifts** tab is available only for *.txrm files.

The **Image Control** dialog box **Shifts** tab, shown in [Figure D-13](#), displays and applies shifts to images on the dataset shown in the active **Image** window. Encoder shifts should be checked, to ensure that actual encoder counts are used to align the images to one another. Reference shifts are copied from the **Alignment** tab, and are typically 0 for a tomography dataset.

Refer to the relevant Applications Notes for the usage of the other functions within the **Shifts** tab. Information related to this tab's use for the Sample Drift Correction feature is discussed in [“Thermal and Sample Drift Correction,”](#) on [page 237](#).

Figure D-13 XMRConstructor **Image Control** Dialog Box – **Shifts** Tab



XMReconstructor Histogram Tool

The Histogram tool is used to adjust contrast and brightness. This is required, for example, if there are large regions within the image that are all black or all white, or to highlight features within a narrow part of the dynamic range of the image. The Histogram tool also allows applying color tables to images.

Open the Histogram tool, using one of the following methods:

- Select **View > Histogram tool** from the menu bar

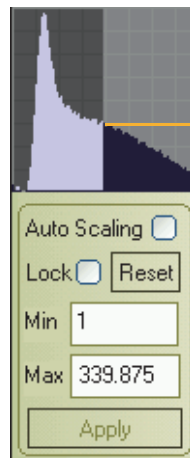


- Click  in the icon toolbar

The Histogram tool opens ([Figure D-14](#)), and the toolbar icon changes to **orange** highlight. When finished using the Histogram tool, click the icon again to close the tool.

[Table D-13](#) describes the Histogram tool features.

Figure D-14 Histogram Tool



Double-click the histogram curve to toggle to **Color Table Mode**

To return to Grayscale Histogram mode, double-click that area of the Histogram tool again

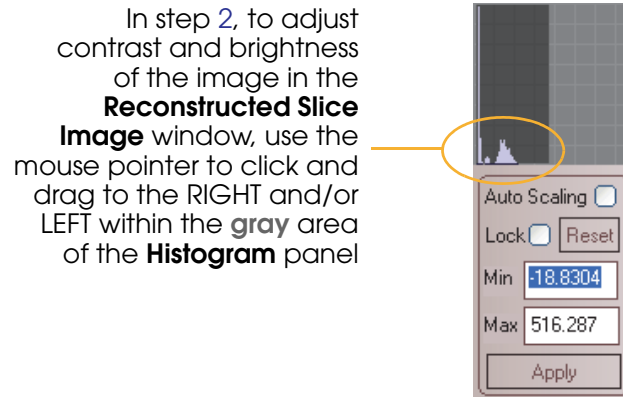
Table D-13 Histogram Tool Features

Feature	Explanation
Histogram Display	<p>Displays the histogram of the image within the currently used range of pixel values. Every pixel at or below the minimum pixel value (at the left of the curve) is displayed in black. Every pixel at or above the maximum pixel value (at the right of the curve) is displayed in white.</p> <p>Drag the mouse pointer across the histogram to narrow the data window (to widen the window, click Reset and adjust again).</p> <p>Double-click the histogram curve to toggle to Color Table Mode. To return to Grayscale Histogram mode, double-click that area of the Histogram tool again.</p>
Auto Scaling	<p>When this check box is selected, the contrast is scaled such that the brightest and darkest 10% of pixels are excluded. This can be useful if image contrast is dominated by a few extremely bright or dark pixels.</p>
Lock	<p>When this check box is selected, the current contrast scaling is preserved, even if the image changes, and it is applied to every image that receives the mouse focus. This is useful, for example, to compare images of the same feature under varying conditions.</p>
Reset	<p>Clicking Reset resets the contrast scaling, using the minimum and maximum pixel values within the image.</p>
Min Max	<p>These two text boxes allow direct typing of the desired minimum and maximum pixel values. Click Apply to apply the changes.</p>

To adjust contrast and brightness

1. Open the Histogram tool. The **Histogram** panel opens and pins itself in the **XMReconstructor** main window (upper right corner).

Figure D-15 Histogram Panel



2. Use the following instructions to *maintain or adjust image contrast and brightness*.

Contrast and Brightness	Process
Maintain for all images	Select Lock .
Adjust for all images	<p>Click Reset. Next, use the mouse pointer to click and drag to the RIGHT and/or LEFT within the gray area of the Histogram panel, to adjust image contrast and brightness. (The panel is light gray until the mouse is dragged on it. The area in which the mouse is dragged turns dark gray.)</p> <p>After you have sufficiently adjusted the image contrast and brightness in the Reconstructed Slice Image window, select Lock.</p>

 **NOTE** The **Auto-Scaling** option can be selected to automatically estimate the best contrast and brightness for the image; however, the results might not provide the results you want; therefore, manual adjustment is recommended.

Color Table Mode

This section provides a brief description of how to use Color Table mode. A detailed description of its use, however, is beyond the scope of this guide.

To toggle to Color Table mode from Grayscale Histogram mode, double-click the histogram curve (refer to [Figure D-14](#)). In Color Table mode, various *false color tables* (color palette options) can be selected from its drop-down color list box (refer to [Figure D-16](#)), and applied to the image. Standard grayscale can be restored to the image, by selecting *Grey* from the drop-down color list box.

The transfer function can also be modified beyond a simple linear curve, sometimes known as *gamma correction*. To modify the Grayscale Transfer function, click the line within the graph to generate a point (refer to [Figure D-16](#) and [Figure D-17](#)), then click the *point* and drag UP or DOWN, to change the light intensity at that point.

[Figure D-18](#) shows samples of both a typical grayscale image and false-colored image.

Figure D-16 Histogram Color Table Mode – Drop-Down Color List Box

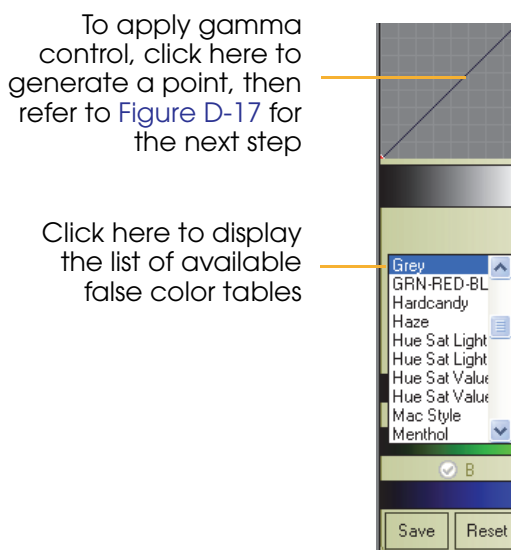
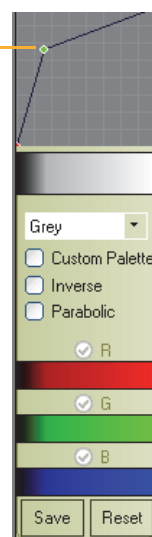
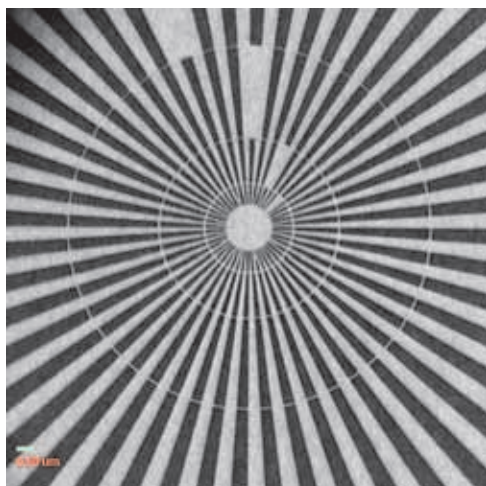
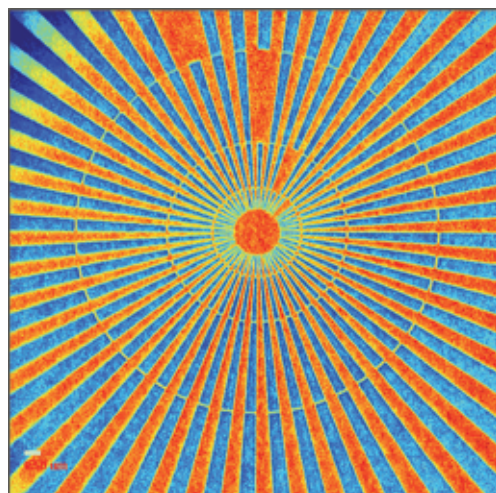


Figure D-17 Histogram False Color Mode – Gamma Control

After generating a point (by clicking the line), click the point and drag UP or DOWN, to change the light intensity at that point.

**Figure D-18** Sample Grayscale and False-Colored Images

Example of a typical grayscale image



Example of a false-colored image

Pixel Values Graph

A Histogram measures the quantity of pixels in the image within a certain range of pixel values, from lower values (dark) on the left to higher values (bright) on the right, and plots the data on a relative scale. In [Figure D-14](#), the Histogram is peaked toward the left, meaning there are more dark than bright regions within the image. [Table D-14](#) describes how to interpret the image pixel values.

Table D-14 Interpreting Pixel Values for Various Reference Correction Modes

Image Condition	What the Pixel Value Represents
If the image is not reference corrected	The pixel value is related to the quantity of X-rays collected, with larger values indicating more X-rays (brighter). The maximum value is 65,535.
If the image was reference corrected in Transmission mode	The pixel value represents the percentage of incident X-rays that have been transmitted through the sample, ranging from 0% (dark) to 100% (bright).
If the image was reference corrected in Absorption mode	<p>The pixel value represents the absorption coefficient $\times$ the thickness of the sample (also known as <i>optical density</i> μt), where zero (dark) means no material and large positive numbers (bright) represent dense or thick sample regions.</p> <p>Mathematically, $\mu t = -\log(I/I_0)$, where:</p> <ul style="list-style-type: none"> – μ is the material's absorption coefficient – t is the sample thickness – I is the transmitted intensity – I_0 is the incident intensity

XM3DViewer User Interface

This section provides instructions for using the **XM3DViewer** main window's (Figure D-19) user interface icons (Table D-15).

NOTE Tasks that use XM3DViewer are discussed in Chapter 4, "Viewing and Editing Tomographies." This guide provides basic information for using XM3DViewer to view tomographic data after reconstruction. For further details regarding the program's use (beyond what is provided in Chapter 4 and this appendix), refer to the *Xradia ExamineRT Workstation 1.1 User's Manual*, available under XM3DViewer's **Help** menu.

NOTE In its main window title bar, XM3DViewer appears as "TXM3DViewer," rather than as "XM3DViewer". Additionally, the main window bars and tools change, depending upon which **Layout** icon is selected.

Figure D-19 Default **XM3DViewer** Main Window – **Examine** Tab, with Descriptions of Each View

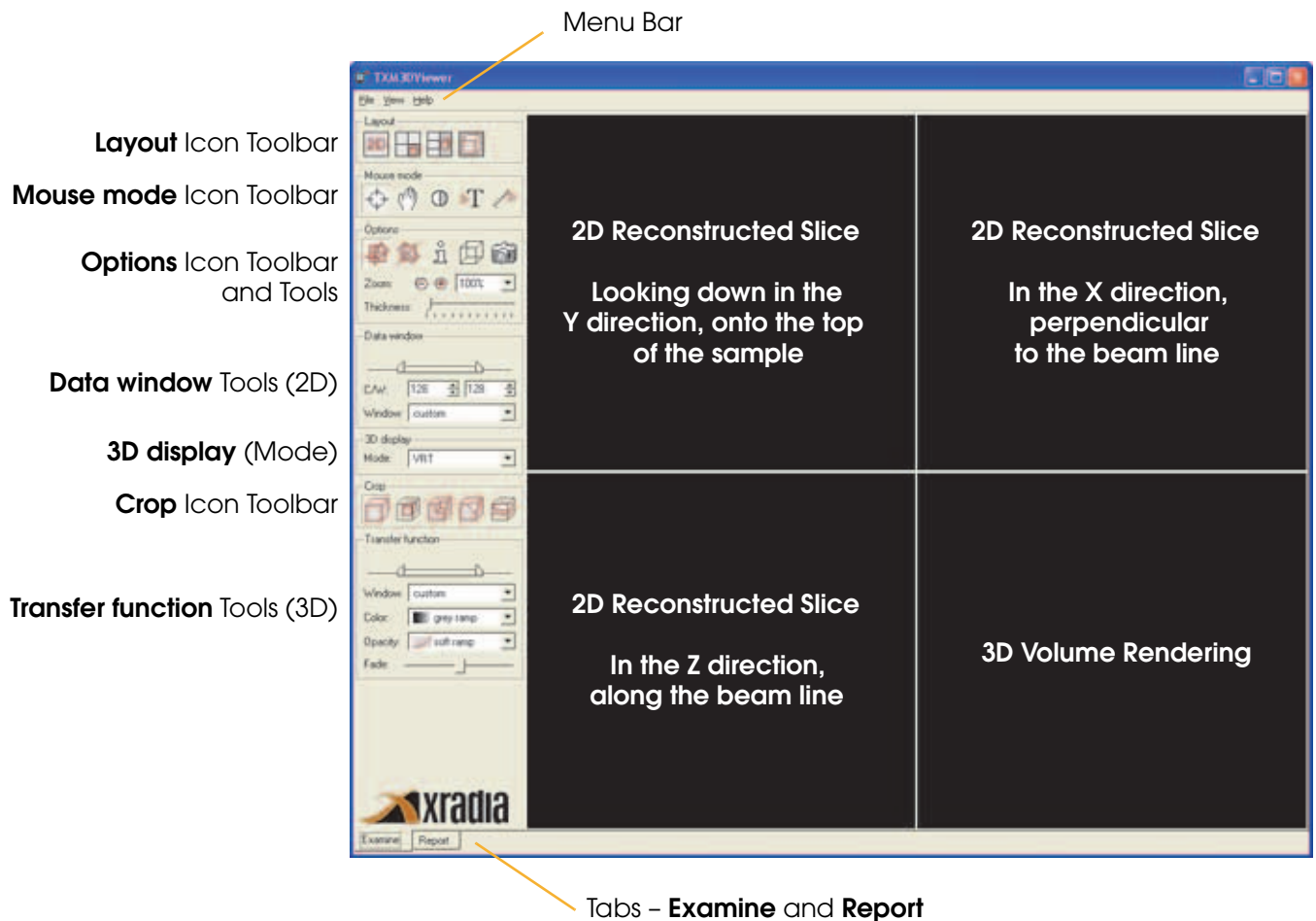


Table D-15 XM3DViewer User Interface Icons^a

Type	Icon	Description
Layout		Click to display a single 2D reconstructed slice view. Click multiple times to cycle through the orientation of the slice in the 2D reconstructed slice view. When clicked, adds Cine controls to the main window (left side, below the other icon toolbars and tools).
		Click to display four equally sized views (default) – three 2D reconstructed slice views plus one 3D volume view. Displays the same four images as  . In Figure D-19 , the white text in each view identifies the type of image shown in that view.
		Click to display three equally sized 2D reconstructed slice views, plus one larger 3D volume view. Displays the same four images as  .
		Click to display a single 3D volume view (not used for 2D reconstructed slices).
Mouse mode		Standard navigation mode (default). Enables selecting and moving navigation lines (crosshairs) in the 2D reconstructed slice and 3D volume views. If it is not the current mode, click to enable. Navigation line (plane) colors – green = X/Z, blue = X/Y, and red = Y/Z.
		Click to enable Zoom/Translate mode. Behaves differently, depending upon whether it is used in a 2D reconstructed slice or 3D volume view, as follows: – 2D reconstructed slice view – Enables panning and zooming – 3D volume view – Enables image rotation, panning, and zooming
		Click to enable Window/Level mode. Behaves differently, depending upon whether it is used in a 2D reconstructed slice or 3D volume view, as follows: – 2D reconstructed slice view – Enables interactive adjustment of image contrast and brightness, by changing the width and center, respectively, of the Data window. – 3D volume view – Enables interactive adjustment of image contrast and brightness, by changing the width and center, respectively, of the Transfer function.
		Click to enable Annotation mode. You can add arrows and text annotations: – Arrow – Click within a 2D reconstructed slice or 3D volume view at the point you want to start the arrow, then click again at the point you want to end the arrow. – Text associated with an arrow – Double-click the arrow, then type the text you want to add.
		Click to enable Measurement mode. In the 2D reconstructed slice or 3D volume view, at the region of interest , click once to define the start point for measuring, then again to define the endpoint for measuring.

Table D-15 XM3DViewer User Interface Icons^a (Continued)

Type	Icon	Description
Options		Click to enable Orthogonal Slicing mode (default). Restricts the slice orientation in 2D reconstructed slice views to the reconstruction plane (X/Z plane of the Xradia Versa).
		Click to enable Oblique Slicing mode. All three planes are orthogonal to one another; however, they are not orthogonal to the reconstruction plane.
		Click to enable Dataset information mode. Toggles the display of dataset information text in the 2D reconstructed slice and 3D volume views.
		Click to enable Bounding box mode. Toggles the display of a wire frame of the bounding box in the 3D volume views.
		Click to enable Snapshot mode. Changes the mouse cursor to a camera. Click the icon, move the mouse onto the image, then click to take a picture (snapshot) of the image. This saves the entire image in the Snapshots panel.
Crop		No crop (default). Click to omit any previously applied cropping.
		Click to focus on the region of interest within the 3D reconstructed volume view, by isolating a region smaller than the complete image.
		Click to enable cropping a corner within the 3D reconstructed volume view.
		Click to enable creating a diagonal cropped area within the 3D reconstructed volume view.
		Click to enable creating a parallel cropped slice within the 3D reconstructed volume view.

- a. Complete details regarding mouse use for these functions is included in the process steps in which they are used, in [Chapter 4, “Viewing and Editing Tomographies.”](#)

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E Mounting, Loading, and Removing Samples

This appendix describes the following processes:

- Mounting a Sample in or on a Sample Holder
- Loading a Sample Holder Assembly onto the Sample Stage
- Removing a Sample after Use

Mounting a Sample in or on a Sample Holder

This process describes how to mount samples on the sample holders used with the Xradia Versa:

- [Mounting Using a Screw Clamp](#)
- [Mounting Using a Spring Clamp](#)
- [Mounting Using a Pin Vise](#)
- [Mounting Using a Sample Base](#)

The processes that use these instructions appear in [“Step 2 – Load,” on page 25](#) and [“Step 2 – Load,” on page 83](#) in Chapter 2.

In general, samples should be mounted onto their sample holders in such a manner that the region of interest in the sample (the focus of the data acquisition) is:

- Located above the top surface of the holder
- Positioned so that the least amount of material is penetrated by X-ray

Additionally, the sample must be:

- Securely mounted in/on the holder
- Stable, such that it does not move nor vibrate in response to gentle tapping on the holder

Table E-1 lists the various types of samples that the Xradia Versa can image, and their corresponding holders. Use and mounting procedures for each holder type are described in the sections that follow. **Table E-2** lists the recommended maximum solid sample thickness, by magnification lens.

For specific sample applications, contact the ZEISS Support Team. (Refer to “ZEISS Support Team (Technical Support),” on page 308, in Appendix K.)



CAUTION Follow the safe sample handling procedures established by your work site.



NOTE A properly mounted sample should not move during data acquisition. Any movement, however small, will compromise image resolution and create streak artifacts in reconstructed 2D slices and 3D volume data.

Table E-1 Sample Types and Corresponding Sample Holders

Sample Holder ^a	Sample Type
Screw Clamp	Semiconductor; flat. Sample should be no thicker than 10 mm.
Spring Clamp	Semiconductor; flat; rigid material. Sample should be thin and flat, no thicker than 5 mm.
Pin Vise	Solid material (such as rock core samples, or thin, long pieces of material). Sample (or toothpick or rod) should be 3 mm or less in diameter.
Sample Base	Soft biological samples.

- a. The screw clamp, spring clamp, and pin vise sample holders are permanently mounted onto a sample base, which is the rounded base with a flat edge that lines up with the sample stage when the sample holder assembly (sample plus sample holder) is loaded onto the sample stage. The stand-alone sample base is also used as a sample holder.

Table E-2 Recommended Maximum Solid Sample Thickness, by Objective (Lens)

Objective	Recommended Maximum Thickness of Solid Material
Macro (0.4X)	100 mm
4X	50 mm
10X ^a	30 mm
20X	10 mm
40X ^b	5 mm

a. **10X Lens** – Xradia 410 Versa only.

b. **40X Lens** – Optional, available upon request.

Mounting Using a Screw Clamp

This process describes how to mount a sample, using the screw clamp sample holder. The screw clamp is primarily used for semiconductor or flat samples.

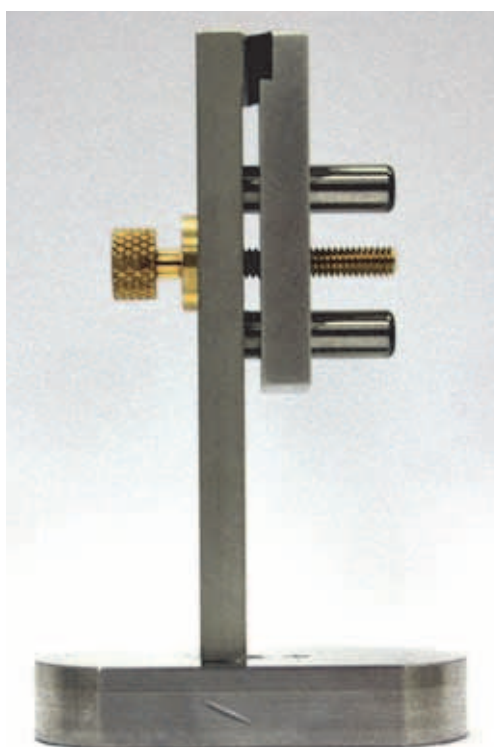
To mount a semiconductor or flat sample in a screw clamp

1. Turn the thumbscrew COUNTERCLOCKWISE on the clamp lever, to OPEN the clamp region.
2. Position the sample in the clamp. Ensure that the region of interest is clearly visible, and not covered by the edges of the clamp.

CAUTION Keep your fingers free of the part of the clamp that closes onto the sample, to avoid being pinched.

3. Gently tighten the clamp thumbscrew CLOCKWISE, to hold the sample in place.

Figure E-1 Sample Holder – Screw Clamp



Mounting Using a Spring Clamp

This process describes how to mount a sample, using the spring clamp sample holder. The spring clamp is used for semiconductor or flat samples, as well as for rigid material, such as a tooth.

To mount a semiconductor, flat, or rigid material sample in a spring clamp

1. Push down on the clamp to OPEN it.
2. Position the sample between the clamp's pincers. Ensure that the region of interest is clearly visible, and not covered by the edges of the clamp.

CAUTION Keep your fingers free of the part of the clamp's pincers, to avoid being pinched.

3. Release the spring clamp to close.

Figure E-2 Sample Holder – Spring Clamp



Mounting Using a Pin Vise

This process describes how to mount a sample, using the pin vise sample holder. The pin vise is used for solid material, such as rock core samples, or thin, long pieces of material. The pin vise can hold an Al rod with the sample epoxied on top of thin rod.

To mount a solid or thin, long material sample in a pin vise

1. Rotate the outer section of the vise to sufficiently narrow (CLOCKWISE) or widen (COUNTERCLOCKWISE) the pin opening, for inserting the rod holding the sample into the vise.
2. Position the sample in the vise.

Place the end opposite from the sample, into the vise.

3. Rotate the outer section of the vise CLOCKWISE, to gently tighten the gripping section.

Figure E-3 Sample Holder – Pin Vise



Mounting Using a Sample Base

This process describes how to mount a sample directly onto a sample base sample holder. The sample base is used for soft biological samples. The sample is loaded into a plastic tube, then epoxied onto the sample base, using 5-minute epoxy.

 **NOTE** The sample must be securely packed within the tube.

To mount a soft biological sample onto a sample base

1. So that the sample base can be reused, apply cellophane tape to its top surface, prior to applying the epoxy.
2. Load the biological sample into a plastic tube, packing firmly so that the sample does not move within the tube.
3. Epoxy the tube onto the base, as per the epoxy manufacturer's instructions.

 **CAUTION** Follow the epoxy manufacturer's safety guidelines.

Figure E-4 Sample Holder – Sample Base with Sample in Plastic Tube



Loading a Sample Holder Assembly onto the Sample Stage

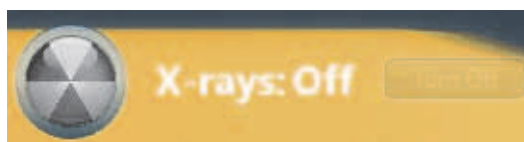
This process describes how to load the sample holder assembly. To do this, the detector and X-ray source must be moved away from the sample stage, to allow access to the sample stage. After the detector and X-ray source are moved, the sample holder assembly (sample plus sample holder) can be loaded onto the sample stage.

The processes that use these instructions appear in “[Step 2 – Load,](#)” on [page 25](#) and “[Step 2 – Load,](#)” on [page 83](#) in Chapter 2.

To load the sample holder assembly onto the sample stage

1. Click  to move the X-ray source and detector away from the sample stage to their **-Limit** and **+Limits**, respectively.
2. Click **Turn Off** to turn OFF the X-ray source. The X-ray status changes to **X-rays: Off**.

Figure E-5 X-rays Are Turned OFF



3. Open the access doors.

NOTICE Use extreme caution when loading the sample holder assembly onto the sample stage.

4. Load the sample holder assembly onto the sample stage, with the flat edges of the assembly and sample stage aligned, facing the front of the Xradia Versa. (Refer to [Figure E-7](#).) The slotted grooves on the assembly should match and help seat the assembly onto the three tungsten alignment balls (circled in [Figure E-6](#)) on the sample stage.
5. Close the access doors. The **Interlock** indicator in the **X-ray Source** dialog box indicates **CLOSED**. The **yellow** (center) light on the light tower turns ON.
6. Click **Apply** in the **Acquisition** tab to turn ON the X-ray source.

Figure E-6 Sample Stage, with Tungsten Alignment Balls Highlighted

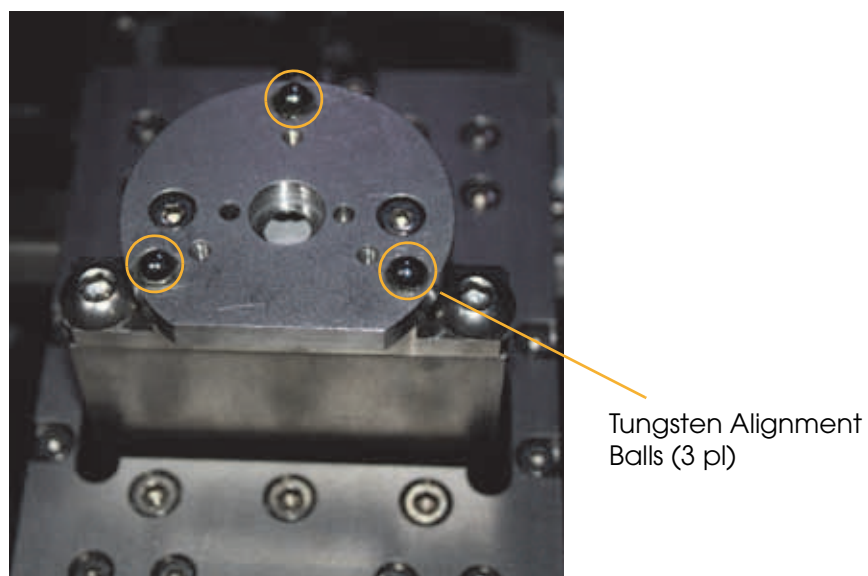
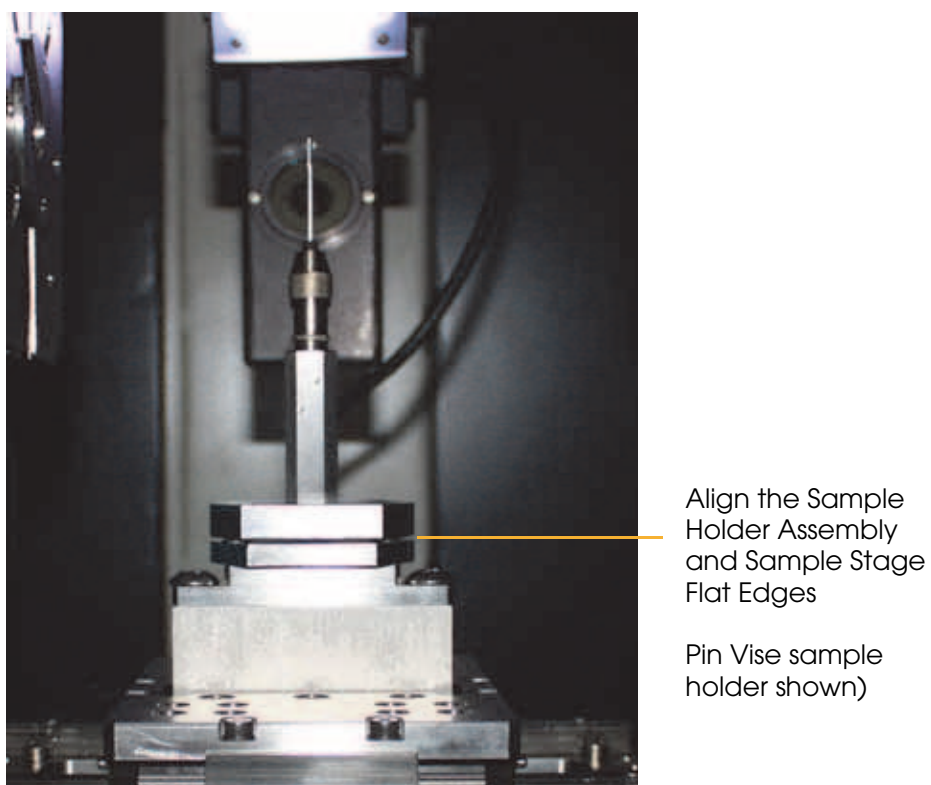


Figure E-7 Sample Holder Assembly Loaded onto Sample Stage, with Flat Edges Aligned, Facing Front of Xradia Versa)



Removing a Sample after Use

This process describes how to remove the sample from the Xradia Versa, after you have finished imaging the sample.

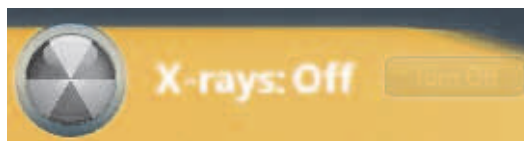


CAUTION Follow the safe sample handling procedures established by your work site.

To remove the sample after use

1. Click  to move the X-ray source and detector away from the sample stage to their **-Limit** and **+Limits**, respectively.
2. Click **Turn Off** to turn OFF the X-ray source. The X-ray status changes to **X-rays: Off**.

Figure E-8 X-rays Are Turned **OFF**



3. Open the access doors.

NOTICE Use extreme caution when removing the sample holder assembly from the sample stage.

4. Remove the sample holder assembly from the sample stage.
5. Remove the *sample* from the sample holder assembly, using one of the following *processes*.

Sample Holder Type	Process
Screw Clamp	While holding the sample, loosen the clamp thumbscrew COUNTERCLOCKWISE, then remove the sample from the clamp.
Spring Clamp	While holding the sample, push down on the clip to OPEN the clamp, then remove the sample from the clamp.
Pin Vise	Rotate the outer section of the vise COUNTERCLOCKWISE, then remove the sample (or toothpick or rod) from the vise.
Sample Base	While holding the sample, remove the cellophane tape from the sample base surface.

6. Store the sample in a safe place that is free from contaminants, for future use, or dispose of properly, per site-specific requirements.
7. Close the access doors. The **Interlock** indicator in the **X-ray Source** dialog box indicates **CLOSED**. The **yellow** (center) light on the light tower turns ON.

F

Installing an X-ray Filter – Xradia 510 Versa and Xradia 410 Versa

This appendix describes how to manually install an X-ray filter onto the X-ray source used by the Xradia 510 Versa and Xradia 410 Versa. The instructions also include how to remove a filter that is already installed.

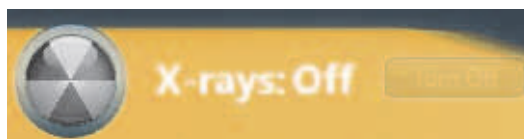
 **NOTE** The Xradia 520 Versa includes an automatic filter changer, and therefore does not require manual installation nor removal of X-ray filters.

 **NOTE** A typical process for determining which X-ray filter to use is described in “Scout – Select Proper X-ray Filter and kV,” step 6, on page 35 in Chapter 2.

To install an X-ray filter onto the X-ray source

1. Click  to move the X-ray source and detector away from the sample stage to their **-Limit** and **+Limits**, respectively.
2. Click **Turn Off** to turn OFF the X-ray source. The X-ray status changes to **X-rays: Off**.

Figure F-1 X-rays Are Turned **OFF**



3. Open the access doors.
4. Follow steps **a** through **c** below, to install the X-ray filter selected with the Scout-and-Scan Control System.
 - a. **If a filter is already installed** – Holding the metal tab at the top of the *filter* and taking care not to touch the filter, gently slide the *filter* out of the X-ray filter holder. (Refer to [Figure F-2](#) for handling.) Keep the filter in a safe location (such as its storage box).
 - b. **New filter** – Holding the metal tab at the top of the *filter* and taking care not to touch the filter, gently slide the *filter* into the X-ray filter holder, at the front of the X-ray source, with the thickest part of the filter facing toward the sample. (Refer to [Figure F-2](#) for handling and placement.)
 - c. Ensure that the lower edge of the filter is firmly seated in the X-ray filter holder.

NOTICE At this point in the process, the sample stage might be close to the X-ray source. Take care not to scratch the X-ray filter during its installation.

Figure F-2 X-ray Filter Installation (160 kV X-ray Source Shown)



5. Click **Apply** in the **Acquisition** tab to turn ON the X-ray source.

G Specifications

This appendix lists the Xradia Versa specifications.



NOTE Contact the ZEISS Support Team for specific questions related to maintenance, or for any specifications that might not be included in this guide at the time of publication. (Refer to [“ZEISS Support Team \(Technical Support\),”](#) on page 308, in Appendix K.)



NOTE All data presented is subject to change. Consult ZEISS for the most current information. (Refer to [“ZEISS Support Team \(Technical Support\),”](#) on page 308, in Appendix K.)

Table G-1 Imaging

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Spatial Resolution (ZEISS resolution target) ^a	0.7 μm	0.7 μm	0.9 μm
Resolution at a Distance (RaaD TM) (at 50 mm working distance) ^b	1.0 μm	1.0 μm	1.5 μm
Minimum Achievable Voxel (voxel size at sample at maximum magnification) ^c	70 nm	70 nm	100 nm

- a. Spatial resolution measured with ZEISS 2D resolution target, Normal Field mode, with optional 40X objective.
- b. RaaD working distance is defined as clearance about the axis of rotation.
- c. Voxel (sometimes referred to as *nominal resolution* or *detail detectability*) is a geometric term that contributes to, but does not determine, resolution, and is provided here only for comparison. ZEISS specifies on spatial resolution, the true overall measurement of instrument resolution.

Table G-2 Contrast-Optimized Detectors

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Macro (0.4X) Objective	Standard	Standard	Standard
Spatial Resolution	20 μm	20 μm	20 μm
Maximum 3D FOV	50 mm	50 mm	50 mm
Wide Field Mode, Maximum 3D FOV	90 mm	90 mm	90 mm
Recommended Maximum Solid Sample Thickness	100 mm	100 mm	100 mm
4X Objective	Standard	Standard	Standard
Spatial Resolution	1.9 μm	1.9 μm	5 μm
Maximum 3D FOV	6.5 mm	6.5 mm	6.5 mm
Wide Field Mode, Maximum 3D FOV	11 mm	–	–
Recommended Maximum Solid Sample Thickness	50 mm	50 mm	50 mm
10X Objective	–	–	Standard
Spatial Resolution	–	–	2.5 μm
Maximum 3D FOV	–	–	2.6 mm
Recommended Maximum Solid Sample Thickness	30 mm	30 mm	30 mm
20X Objective	Standard	Standard	Standard
Spatial Resolution	0.9 μm	0.9 μm	1.5 μm
Maximum 3D FOV	1.3 mm	1.3 mm	1.3 mm
Recommended Maximum Solid Sample Thickness	10 mm	10 mm	10 mm
40X Objective	Optional	Optional	Optional
Spatial Resolution	0.7 μm	0.7 μm	0.9 μm
Maximum 3D FOV	0.7 mm	0.7 mm	0.7 mm
Recommended Maximum Solid Sample Thickness	5 mm	5 mm	5 mm

Table G-3 X-ray Source

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Architecture	Sealed	Sealed	Sealed
Target Mechanism	Transmission	Transmission	Reflection
Target Material	Tungsten (W)	Tungsten (W)	Tungsten (W)
Minimum Aging Time, Prior to Warm-Up	3 minutes	3 minutes	3 minutes
Minimum Warm-Up Time Prior to Use	6 minutes	6 minutes	6 minutes
Tube Voltage Range, Standard	30 to 160 kV	30 to 160 kV	20 to 90 kV
Maximum Output, Standard	10W	10W	8W
Maximum Tube Current, Standard	90 μ A	90 μ A	200 μ A
Tube Voltage Range, High-Energy Option	–	–	40 to 150 kV
Maximum Output, High-Energy Option	–	–	10W
Maximum Tube Current, High-Energy Option	–	–	250 μ A
Tube Voltage Range, High-Power Option	–	–	40 to 150 kV
Maximum Output, High-Power Option	–	–	30W
Maximum Tube Current, High-Power Option	–	–	500 μ A

Table G-4 X-ray Filters

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Automated Filter Changer	Standard	–	–
Filter Capacity	24	Single	Single
Filters, Standard	Range of 12	Range of 12	Range of 12
Filters, Custom	Available ^a	Available ^a	Available ^a

a. Available by special order.

Table G-5 X-ray Source Voltage and Power Settings

Model	X-ray Source	Voltage (kV)	Power (W)	
		Maximum	Minimum	Maximum
Xradia 520 Versa Xradia 510 Versa	160 kV (10W maximum)	110 to 160	1	10
		100	1	9
		90	1	8
		80	1	7
		70	1	6
		60	1	5
		50	1	4
		40	1	3
		30	1	2
Xradia 410 Versa	90 kV (8W maximum)	40 to 90	1	8
		30	1	4.5
		20	1	2
	150 kV (10W maximum)	40 to 150	1	10
	150 kV (30W maximum)	60 to 150	1	30
		50	1	25
		40	1	20

Table G-6 Charge-Coupled Device

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Pixel Array	2,048 x 2,048	2,048 x 2,048	2,048 x 2,048
Pixel Size	13.5 μm	13.5 μm	13.5 μm
Temperature	< -50°C	< -50°C	< -50°C

Table G-7 Control Workstation

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Operating System	Microsoft Windows 7 Pro	Microsoft Windows 7 Pro	Microsoft Windows 7 Pro
Central Processing Unit (CPU)	Dual Eight Core	Dual Eight Core	Dual Eight Core
Graphics Processing Unit (GPU)	Dual CUDA-enabled 3D GPU	Single CUDA-enabled 3D GPU	Single CUDA-enabled 3D GPU
Hard Disk Physical Capacity	8 TB (4 x 2 TB)	8 TB (4 x 2 TB)	8 TB (4 x 2 TB)
Hard Drive Configuration (Drive D)	RAID-5	RAID-5	RAID-5
Memory	32 GB	32 GB	32 GB
Display Monitor	24-inch LCD	24-inch LCD	24-inch LCD

Table G-8 Instrument Software

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
System Control and Tomography Acquisition	Scout-and-Scan Control System	Scout-and-Scan Control System	Scout-and-Scan Control System
	XMController	XMController	XMController
Reconstruction	XMReconstructor	XMReconstructor	XMReconstructor
3DViewer	XM3DViewer	XM3DViewer	XM3DViewer

Table G-9 GPU-Accelerated Reconstruction Performance

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Reconstruction Time (972 slices from 2000 projections, 2k x 2k)	< 2.5 min	< 4 min	< 4 min

Table G-10 Stage Motions

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Sample Stage, Load Capacity	15 kg	15 kg	15 kg
Sample Stage Travel, X Direction	45 mm	45 mm	45 mm
Sample Stage Travel, Y Direction	100 mm	100 mm	100 mm
Sample Stage Travel, Z Direction ^a	50 mm	50 mm	50 mm
Sample Stage Travel, Rotation	360°	360°	360°
X-ray Source Travel, Z Direction ^a	190 mm	190 mm	350 mm
Detector Travel, Z Direction ^a	290 mm	290 mm	290 mm

a. Z direction is defined along the X-ray beam path.

Table G-11 Advanced Modes

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
High Aspect Ratio Tomography	Standard	–	–
Wide Field Mode	Macro (0.4X) 4X	Macro (0.4X)	Macro (0.4X)
Vertical Stitching	XMController	XMController	XMController

Table G-12 Advanced Analysis Tools

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Dual-Scan Contrast Visualizer with Single Scan Optimizer	Standard	–	–

Table G-13 *In Situ* Compatibility

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
<i>In Situ</i> Interface Kit	Optional	Optional	Optional
Integrated <i>in situ</i> recipe control for Deben	Standard	Standard	Standard

Table G-14 X-ray Radiation Safety

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Safety Standards Compliance	UL/CSA 61010-1 SEMI S2-0712 SEMI S8-0712 CE Mark ^a	UL/CSA 61010-1 SEMI S2-0712 SEMI S8-0712 CE Mark ^a	UL/CSA 61010-1 SEMI S2-0712 SEMI S8-0712 CE Mark ^a
Radiation Safety, measured 25 mm above surface of enclosure	<< 1 µS/hr	<< 1 µS/hr	<< 1 µS/hr

a. A copy of the CE Declaration of Conformity is provided in [Appendix J](#).

Table G-15 Facilities^a

Category	Xradia 520 Versa	Xradia 510 Versa	Xradia 410 Versa
Standard Dimensions, including handles and ergonomic arm bracket (L x W x H)	217 x 119 x 209 cm	217 x 119 x 209 cm	217 x 119 x 209 cm
Standard Weight	2,468 kg	2,461 kg	2,430 kg
Electrical Requirements	230V AC Nominal 160 to 286V AC range, Single Phase, 50/60 Hz, 15A SCCR: 10K Amps	230V AC Nominal 160 to 286V AC range, Single Phase, 50/60 Hz, 15A SCCR: 10K Amps	230V AC Nominal 160 to 286V AC range, Single Phase, 50/60 Hz, 15A SCCR: 10K Amps
Climate Requirements	10 to 25°C < 2°C variation RH < 70%	10 to 25°C < 2°C variation RH < 70%	10 to 25°C < 2°C variation RH < 70%

a. Consult the latest *Xradia Versa Facilities Guide* for the most up-to-date information.

H Electrical Documentation

This appendix provides electrical documentation specific to the Emergency Off (EMO) system and safety interlocks.

EMO

The Xradia Versa's EMO circuit consists of two mushroom-style push-button switches (**EMO** button) and an auxiliary switch attached to the main power disconnect circuit breaker. All three switches have normally CLOSED contacts and are connected in a serial manner to the EMO circuit in the Uninterruptible Power Supply (UPS). If either **EMO** button is pressed, –or– if the main disconnect circuit breaker is tripped or switched OFF, the contacts OPEN, and in response, the UPS immediately terminates output power to the entire Xradia Versa.



CAUTION The two **EMO** buttons should be used only to shut down (power OFF) the Xradia Versa in a personal safety or equipment emergency.



NOTE Use of the non-emergency shutdown procedure is recommended in non-emergency events. (Refer to ["Shutting Down the Xradia Versa in a Non-Emergency Event,"](#) on page 188, in Appendix C.)

Interlock Sequence of Operation

The interlock electronics are contained within the Power Distribution Unit (PDU) and is intended to serve as a safety circuit that protects the operator from exposure to X-rays. Because there are two different manufacturers of X-ray sources used within the **Xradia Versa** family, the PDU produces interlock signals for both. Each X-ray source has input for two independent interlock signals – Interlock-1 and Interlock-2. Either interlock prevents X-ray generation.

The light tower located on top of the Xradia Versa provides equipment status to the operator:

- **All lights OFF** – Power to the Xradia Versa is turned OFF
- **Red light ON (top)** – X-ray source is turned ON and X-rays are present within the enclosure
- **Red light OFF (top)** – X-ray source is turned OFF and X-rays are not present within the enclosure
- **Yellow light ON (center)** – Access doors are CLOSED
- **Yellow light OFF (center)** – Access doors are OPEN
- **Green light ON (bottom)** – Power to the Xradia Versa is turned ON
- **Green light OFF (bottom)** – Power to the Xradia Versa is turned OFF

There are four access doors located on the Xradia Versa's enclosure. Each door has two normally closed dual-contact switches. Contacts from one switch on each door are connected in series and serve Interlock Circuit 1, and the other four switches are likewise connected in series and serve Interlock Circuit 2. If any of the four access doors are OPENED, both interlock circuits OPEN.

In [Figure H-2](#), door interlocks are represented as a single switch, one representing the serial circuit for Interlock-1 and the other for Interlock-2. The switches are shown in the OPEN state, representing any of the four access doors being OPEN. When all four access doors are CLOSED, interlock relays K1 (INT-1) and K2 (INT-2) are both energized, provided that latching relay LR1 (FAULT) is not active. If interlock relays INT-1 and INT-2 are both energized, the **yellow** indicator on the light tower is turned ON and relay K4 (INTLK OK) is energized.

Contacts from K2 and K4 produce the two interlock signals for both types of X-ray sources.

When both Interlocks are energized, the X-ray source is capable of producing X-rays in response to software requests from the operator, by way of the Scout-and-Scan Control System. If the X-ray source is generating X-rays, it sends a signal that energizes K3 (X-RAY ON). X-RAY ON relay contacts are used to power the light tower's **red** indicator.

Additional components monitor current to the light tower's **red** X-RAY ON indicator. Therefore, if the **red** indicator is burned out (OPEN) or shorted, latching relay LR1 (FAULT) is set in response to X-RAY ON, indicating a fault condition. This fault condition can be cleared only by pressing the PDU's lighted **red** ALARM/RESET push-button switch (located behind the front access panel; refer to [Figure H-1](#)) and then repairing the X-RAY ON light (contact the ZEISS Support Team to repair the light). (Refer to “[ZEISS Support Team \(Technical Support\)](#),” on page 308, in [Appendix K](#).) A fault condition (LR1) is also set if an access door is OPENED while X-rays are being generated. This can be cleared by CLOSING the access door and then pressing the PDU's lighted **red** ALARM/RESET push-button switch (refer to [Figure H-1](#)).

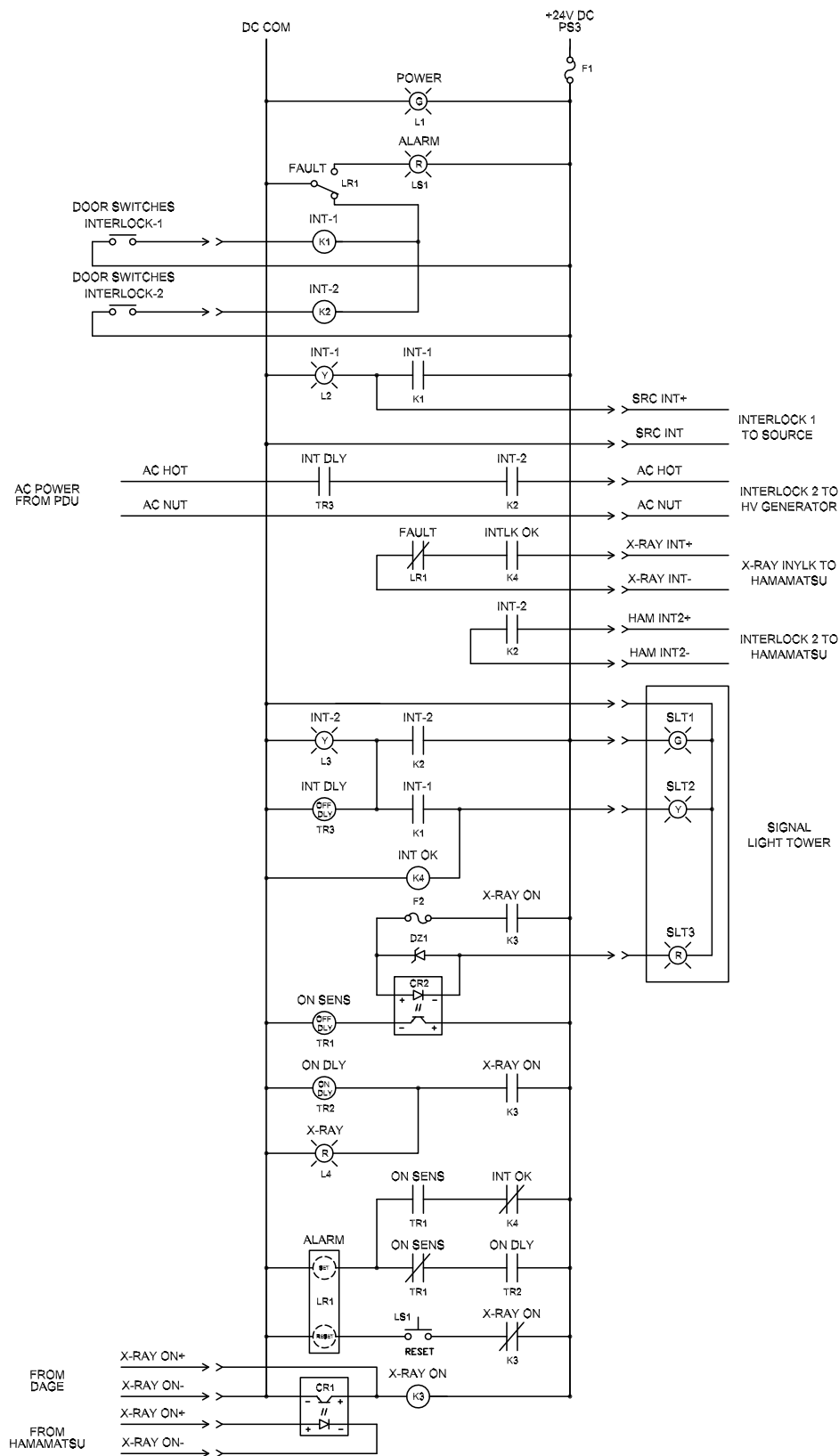
Figure H-1 Press PDU's Lighted **Red** ALARM/RESET Push-Button Switch to Clear Fault Conditions (Xradia 520 Versa Shown)

Press the PDU's lighted **red** ALARM/RESET push-button switch to clear fault conditions



Located behind access panel

Figure H-2 Safety Interlock Electrical Diagram

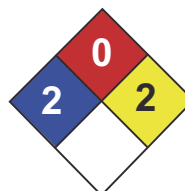


I Material Safety Data Sheets

This appendix provides recent copies of the Material Safety Data Sheets (MSDS) for hazardous materials used in the Xradia Versa, for your reference:

- [Cesium Iodide MSDS](#)
- [Lead MSDS](#)

Cesium Iodide MSDS



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet Cesium Iodide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Cesium Iodide

Catalog Codes: SLC3250

CAS#: 7789-17-5

RTECS: FL0350000

TSCA: TSCA 8(b) inventory: Cesium Iodide

CI#: Not available.

Synonym: Cesium Monoiodide, Dicesium Diiodide, Tricesium Triiodide

Chemical Name: Cesium Iodide

Chemical Formula: CsI

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Cesium Iodide	7789-17-5	100

Toxicological Data on Ingredients: Cesium Iodide: ORAL (LD50): Acute: 2386 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. The substance may be toxic to the reproductive system, thyroid. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 259.8 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 1280°C (2336°F)

Melting Point: 626°C (1158.8°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, moisture.

Corrosivity: Not available.

Special Remarks on Reactivity:

Caution: Hygroscopic Keep container closed when not in use. Store in a tightly closed container. Store in a cool, dry, well-ventilated area from incompatible substances.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 2386 mg/kg [Rat].

Chronic Effects on Humans:

DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. May cause damage to the following organs: the reproductive system, thyroid.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation (lung irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Cesium Iodide

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R36/37/38- Irritating to eyes, respiratory system and skin. S24/25- Avoid contact with skin and eyes. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 2

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 04:37 PM

Last Updated: 06/09/2012 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

Lead MSDS



Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet Lead MSDS

Section 1: Chemical Product and Company Identification

Product Name: Lead

Catalog Codes: SLL1291, SLL1669, SLL1081, SLL1459, SLL1834

CAS#: 7439-92-1

RTECS: OF7525000

TSCA: TSCA 8(b) inventory: Lead

CI#: Not available.

Synonym: Lead Metal, granular; Lead Metal, foil; Lead Metal, sheet; Lead Metal, shot

Chemical Name: Lead

Chemical Formula: Pb

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Lead	7439-92-1	100

Toxicological Data on Ingredients: Lead LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (permeator). CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Non-flammable in presence of open flames and sparks, of shocks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes of lead.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable

protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 0.05 (mg/m³) from ACGIH (TLV) [United States] TWA: 0.05 (mg/m³) from OSHA (PEL) [United States] TWA: 0.03 (mg/m³) from NIOSH [United States] TWA: 0.05 (mg/m³) [Canada] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 207.21 g/mole

Color: Bluish-white. Silvery. Gray

pH (1% soln/water): Not applicable.

Boiling Point: 1740°C (3164°F)

Melting Point: 327.43°C (621.4°F)

Critical Temperature: Not available.

Specific Gravity: 11.3 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, excess heat

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Can react vigorously with oxidizing materials. Incompatible with sodium carbide, chlorine trifluoride, trioxane + hydrogen peroxide, ammonium nitrate, sodium azide, disodium acetylide, sodium acetylide, hot concentrated nitric acid, hot concentrated hydrochloric acid, hot concentrated sulfuric acid, zirconium.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. May cause damage to the following organs: blood, kidneys, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:

Acute Potential: Skin: Lead metal granules or dust: May cause skin irritation by mechanical action. Lead metal foil, shot or sheets: Not likely to cause skin irritation Eyes: Lead metal granules or dust: Can irritate eyes by mechanical action. Lead metal foil, shot or sheets: No hazard. Will not cause eye irritation. Inhalation: In an industrial setting, exposure to lead mainly occurs from inhalation of dust or fumes. Lead dust or fumes: Can irritate the upper respiratory tract (nose, throat) as well as the bronchi and lungs by mechanical action. Lead dust can be absorbed through the respiratory system. However, inhaled lead does not accumulate in the lungs. All of an inhaled dose is eventually absorbed or transferred to the gastrointestinal tract. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include metallic taste, chest pain, decreased physical fitness, fatigue, sleep disturbance, headache, irritability, reduces memory, mood and personality changes, aching bones and muscles, constipation, abdominal pains, decreasing appetite. Inhalation of large amounts may lead to ataxia, delirium, convulsions/seizures, coma, and death. Lead metal foil, shot, or sheets: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count. Ingestion: Lead metal granules or dust: The symptoms of lead poisoning include abdominal pain or cramps (lead cholic), spasms, nausea, vomiting, headache, muscle weakness, hallucinations, distorted perceptions, "lead line" on the gums, metallic taste, loss of appetite, insomnia, dizziness and other symptoms similar to that of inhalation. Acute poisoning may result in high lead levels in the blood and urine, shock, coma and death in extreme cases. Lead metal foil, shot or sheets: Not an ingestion hazard for usual industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Lead California prop. 65 (no significant risk level): Lead: 0.0005 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Lead Connecticut hazardous material survey.: Lead Illinois toxic substances disclosure to employee act: Lead Illinois chemical safety act: Lead New York release reporting list: Lead Rhode Island RTK hazardous substances: Lead Pennsylvania RTK: Lead

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R20/22- Harmful by inhalation and if swallowed. R33- Danger of cumulative effects. R61- May cause harm to the unborn child. R62- Possible risk of impaired fertility. S36/37- Wear suitable protective clothing and gloves. S44- If you feel unwell, seek medical advice (show the label when possible). S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:21 PM

Last Updated: 06/09/2012 12:00 PM

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J CE Declaration of Conformity

This appendix provides a copy of the ZEISS CE Declaration of Conformity.



DECLARATION OF CONFORMITY

According to EN ISO/IEC 17050-1:2010

Manufacturer's Name and Address:

Xradia, Inc.
4385 Hopyard Road
Suite 100
Pleasanton, CA 94588
USA

Phone: +1.925.701.3600
Fax: +1.925.730.4952
Web: www.xradia.com

TYPE OF EQUIPMENT: High Resolution X-ray 3D Computed
Tomography Microscope
REGULATORY MODEL: VersaXRM
TRADE/BRAND NAME: Xradia



2013

Year CE Mark was
first affixed to
declared product

Xradia, Inc., as the responsible party for regulatory compliance, declare under our sole responsibility that as delivered the described product is in compliance with applicable harmonized European standard EN 61010-1+A11, listed under EC directive 2006/95/EC (Low Voltage Directive) and EMC directive 2004/108/CE, and carries the EC-marking.

The described product has been assessed and determined compliant with the following standards:

SAFETY: EN 61010-1+A11
EN ISO13849-1
Annex I of 2006/42/EC
SEMI S2-0712 including X-ray

EMC: EN 61326-1:2006
EN 55011/A2:2007
EN 61000-4-2, -3, -4, -5, -6, -8, -11

SUPPLEMENTARY INFORMATION: This product has been tested and found to comply with the electromagnetic compatibility (EMC) limits for a **Class A** digital device pursuant to the listed directives, regulations and standards. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a business environment. The equipment was tested in a typical configuration.

Person located in the EU authorized to compile technical file: Pete Lander, c/o Blue Skies Scientific Ltd, 4 The Penns, Barkway SG88DH, UK; plander@xradia.com.

Pleasanton, California, USA

Place of Issuance

May 2013

Date of Issuance

G000993

Document Control Tracking Number

Signature

Thomas Murman

Full Printed Name

Director, Manufacturing Operations

Position/Title

K License, Warranty, and Service Information

This appendix provides the software license agreement, limited warranties, service and maintenance information, and ZEISS Support Team information.

Software License Agreement

All Software obtained by Purchaser from ZEISS is proprietary to ZEISS and its licensors and is subject to copyrights, other intellectual property rights and moral rights owned by ZEISS and its licensors. Any references to “purchases” of Software signify only the purchase of a license to use the Software in question pursuant to the terms of the following software license. ZEISS grants to Purchaser a non-exclusive license to use, according to its intended use, any software or firmware incorporated in or provided to operate with the Products, together with any modifications or enhancements to such software or firmware supplied to Purchaser by ZEISS. Except as expressly set forth herein, no other rights are granted to or acquired by Purchaser with respect to Software. Purchaser may not sublicense, assign, or otherwise transfer its rights to use Software, except upon a transfer of any Product(s) with the Software or for which the Software was supplied, and then, only if these same licensing terms and limitations are agreed and adhered to by the sublicensee, assignee, or transferee. Purchaser acknowledges that the Software incorporates valuable trade secrets of ZEISS and agrees not to copy, decompile, disassemble, reverse engineer, or modify any Software provided by ZEISS or its suppliers. This license granted herein is effective upon delivery of the Software to Purchaser.

Other terms and conditions regarding licensing might also be defined in the formal sales contract between the user and ZEISS. If any terms or conditions described here are deemed to be in conflict with the sales contract, then the sales contract takes precedence.

Limited Warranties

a) **Hardware Warranty** – ZEISS warrants to Purchaser that the hardware component of the Products will be free from defects in material and workmanship and will conform to applicable specifications or documentation for a period of twelve (12) months from the date of delivery to Purchaser (the “Warranty Period”) when given normal, proper and intended usage and care. If, during the Warranty Period, the hardware component of any Product fails to conform to the foregoing warranty, ZEISS shall, in its sole discretion, either repair or replace such Product, without charge to Purchaser, provided that: i) ZEISS is promptly notified in writing by Purchaser (not later than thirty (30) days after discovery of the nonconformity or thirty (30) days after expiration of the Warranty Period, whichever occurs first) that the Product does not conform to the foregoing warranty, and ii) Purchaser obtains a Return Material Authorization (“RMA”) and a RMA number from ZEISS prior to returning the nonconforming Product to ZEISS at the Ex Works point, freight prepaid. ZEISS cannot warrant the product if: (i) Customer modifies the hardware component, (ii) improper use of the hardware component, or (iii) the hardware operating environment is outside of the ZEISS stated operating environment.

b) **Software Warranty** – ZEISS warrants to Purchaser that during the Warranty Period the Software will perform substantially in accordance with its user documentation and specifications. ZEISS does not warrant that the Software will operate in combination with other software or firmware which may be selected for use by Purchaser. If, during the Warranty Period, the Software fails to conform to the foregoing warranty, ZEISS shall correct the nonconforming Software so that it performs as warranted at no charge to Purchaser, provided that: i) ZEISS is promptly notified in writing by Purchaser (not later than thirty (30) days after discovery of the nonconformity or thirty (30) days after expiration of the Warranty Period, whichever occurs first) that the Product does not conform to the foregoing warranty. Customer modifications to this Software will void the warranty.

c) ZEISS shall have no responsibility with respect to defects in the Products or performance problems occurring in whole or part by reason of i) accident, misuse, neglect, alteration, unauthorized or improper installation, unauthorized repair, improper testing, unusual physical or electrical stress, or environmental conditions outside the operating parameters specified by ZEISS, ii) software or firmware not supplied by ZEISS, or iii) Purchaser’s failure to follow operating or corrective instructions provided by ZEISS.

d) ZEISS shall have a reasonable time to repair or replace nonconforming Product(s) or correct nonconforming Software. ZEISS will pay standard freight for shipment of the repaired or replacement Product to Purchaser. Each repaired or replacement Product will be warranted for a period equal to the remainder of the original warranty period for the returned Product or ninety (90) days from the date of shipment of the repaired or replacement Product to Purchaser, whichever is longer.

e) ZEISS warrants to Purchaser that, at the time title to the Products passes to Purchaser, ZEISS has good and marketable title to the Products and that they are free and clear of all liens and encumbrances.

f) THE WARRANTIES STATED HERE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES STATED HERE ARE EXCLUSIVE WITH RESPECT TO ANY DEFECTS OR DEFICIENCIES IN THE PRODUCTS.

Service and Maintenance

All service and maintenance is to be performed by ZEISS service personnel, for customers with field service contracts. Should the Xradia Versa require service outside the contracted maintenance schedule, contact the ZEISS Support Team to schedule a service visit.

ZEISS Support Team (Technical Support)

If you need assistance with the Xradia Versa, contact the ZEISS Support Team, using one of the following methods:

Email: xrmservice@zeiss.com

Website: microscopy.zeiss.com/microscopy/en_de/products/x-ray-microscopy.html

Telephone: 1 (888) 497-2342

Fax: 1 (925) 730-4952

Mail: Carl Zeiss X-ray Microscopy, Inc.
4385 Hopyard Rd, Ste 100
Pleasanton, CA 94588 USA

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Glossary

access doors Part of the [enclosure](#). Close(s) off the X-ray source, providing protection from harmful X-ray radiation. The Xradia Versa [enclosure](#) has four safety-interlocked access doors – two on the front and two on the back. Typically, the front access doors are used to access the Xradia Versa's interior. Keep all four access doors closed, whenever possible, to maintain temperature stability.

artifacts Features that exist in an image that are not part of the sample, but are introduced by the imaging system.

baffle Part of the interior shielding within the [enclosure](#), designed to deflect and/or absorb X-rays.

beam hardening Result of the change in spectrum characteristic as the X-rays pass through the sample, where the sample density remains the same, but the light changes – one area is darker than another.

beam line Imaging X-ray/light path consisting of the X-ray source, sample, and detector.

binning Process of combining charges from adjacent pixels in a [CCD](#) during readout. The two primary benefits of binning are improved signal-to-noise ratio ([SNR](#)) and the ability to increase frame rate, albeit at the expense of reduced spatial resolution. A binned pixel can be referred to as a *super pixel*, because charges of the binned pixels are combined into one. To ensure that dark current noise does not lower SNR during binning, it is essential that the CCD be sufficiently cooled, to reduce the dark current noise to a negligible level relative to the read noise.

CCD Charge-Coupled Device. A device for the movement of electrical charge, usually from within the device to an area where the charge can be manipulated. Technically, CCDs are implemented as shift registers. Often the device is integrated with a sensor, such as a photoelectric device to produce the charge that is being read, used where the conversion of images into a digital signal is required. CCDs are widely used in professional, medical, and scientific applications where high-quality image data is required.

centering Procedure that adjusts the centering currents of the X-ray tube's electron beam, to optimize tube performance.

center shift Amount, in pixels, that the axis of rotation is offset from the center column of the detector.

computer workstation Windows 7-based computer included with the Xradia Versa.

CT Computed Tomography.

CT scale, CT scaling Process by which the tomography images produced have the appropriate **Hounsfield Units (HU)**, in which air and water have values of -1,000 and 0, respectively. ZEISS uses the unsigned short data format; therefore, ZEISS CT scaling scales air to 0 and water to 1,000.

detector assembly Assembly that collects X-rays, to present images of the sample. Includes the **turret** and Macro (0.4X) lens.

Dynamic Ring Removal Refer to **DRR**.

DRR Dynamic Ring Removal. ZEISS proprietary method to remove ring artifacts in reconstructed slices and volumes (available in the Scout-and-Scan Control System's **Advanced Acquisition** tab within **Scan** view).

EMO button Emergency Off button. Used to turn OFF power to the entire Xradia Versa in a personal safety or equipment emergency. The Xradia Versa has two – one button is located on the front panel, the other button is located on the back of the Xradia Versa enclosure, below the rear access panels. Use the proper shutdown procedure in non-emergencies.

enclosure Insulated steel and lead-lined framework that covers the Xradia Versa exterior, providing protection from harmful X-ray radiation.

enclosure temperature control unit Regulates input temperature of air entering the **enclosure**.

ergonomic station User console for controlling the Xradia Versa for data acquisition and analysis.

exposure time Amount of time that the **CCD** is exposed to light when acquiring an image. Typically expressed in seconds.

field of view Refer to **FOV**.

FOV Field of View. Size of the area imaged by the Xradia Versa.

HART High Aspect Ratio Tomography. **Xradia 520 Versa Only**. Provides better imaging of samples that are thin and wide, such as semiconductor packages. Allows users to acquire more projections for long views than short views, so that the features oriented primarily along long views, such as bump cracks, are better visualized. In addition, various artifacts (primarily streaks) are reduced because of the decreased angular step along the long views.

hazardous material Dangerous or toxic substance that is a biological, chemical, or physical agent (or a combination of agents), whose presence or use in the workplace can endanger the health and/or safety of personnel.

High Aspect Ratio Tomography Refer to **HART**.

high-voltage power supply Provides high-voltage power to the X-ray source and battery-supplied power, to allow a soft shutdown of the Xradia Versa in case of a power outage.

Hounsfield Units (HU) Scale in which the radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero HU, while the radiodensity of air at STP is defined as -1,000 HU. These standards are universally available references and are suited to the imaging of the internal anatomy of living creatures, based upon organized water structures and mostly living in air. The scale was established by Sir Godfrey Newbold Hounsfield, one of the principal engineers and developers of computed axial tomography (CAT, or CT scans).

ionizing hazard Hazard caused by exposure to X-ray radiation.

kernel size Number of pixels sampled as a unit during image manipulation.

light intensity counts Pixel intensity values, indicated as **Intensity** in the lower left status area of a **Front** or **Side View** image display (Scout-and-Scan Control System) or as a **blue** number in an **Image** window (XMReconstructor).

light tower Indicator located on top of the Xradia Versa that visually reports status conditions. For further details, refer to [Table A-7, “Light Tower Lights \(Status Indicators\),” on page 179, in Appendix A.](#)

Modulation Transfer Function Refer to [MTF](#).

motion controller hardware Embedded microprocessor-based system that drives and controls all Xradia Versa motors and other Xradia Versa features. The Motion Controllers communicate to the computer workstation over a dedicated network cable, and interface with the Scout-and-Scan Control System.

MTF Modulation Transfer Function. In imaging systems, describes the response of an optical system to an image decomposed into sine waves. MTF represents the Bode plot of an imaging system (such as a microscope or the human eye), and thus depicts the filtering characteristic of the imaging system.

noise Random variation in intensity, in images produced by the different components of the imaging system.

PDU Power Distribution Unit. Distributes and controls power to the electrical Xradia Versa components.

Power Distribution Unit Refer to [PDU](#).

power supply Refer to [high-voltage power supply](#).

projection 2D images acquired during data acquisition/tomography using the Scout-and-Scan Control System.

reconstruction Process of using all the [projections](#) acquired during data acquisition/tomography, to create a 3D volume. This process requires the use of [XMReconstructor](#).

reference image Blank image acquired with the sample out of the [FOV](#).

region of interest Refer to [ROI](#).

ROI Region Of Interest. Data acquisition area of focus.

safety interlocks Devices that prevent operation of the X-ray source when the access doors are open.

sample base The rounded base with a flat edge that lines up with the sample stage when the sample holder assembly is loaded onto the sample stage.

sample holder Device used to hold the sample in place. Sample holders used with Xradia Versa are screw clamps, spring clamps, pin vises, and [sample bases](#). Sample holders are described in “[Mounting a Sample in or on a Sample Holder,](#)” on page 266, in [Appendix E](#).

sample holder assembly Sample mounted on a [sample holder](#).

sample stage Platform upon which the [sample holder assembly](#) (with a mounted sample) is secured and positioned for microscopy.

SCCR Short Circuit Current Rating.

scintillator Device used for detecting and counting scintillations produced by ionizing radiation.

scout the sample Locate the sample’s [ROI](#) and [FOV](#), and set imaging parameters (new recipes only), using X-ray images.

Scout-and-Scan Control System Program used for controlling the Xradia Versa and acquiring tomographies. Use of this program is featured in [Chapter 2, “Acquiring Tomographies with the Scout-and-Scan Control System.”](#)

Signal-to-Noise Ratio Refer to [SNR](#).

slice XMReconstructor reconstructs images stored in each **.txrm* file to form a set of reconstructed slices. A slice is a 2D section of the 3D reconstructed volume. Slices generated from each **.txrm* file are stored in a file with the file extension *.txm*. A **.txm* file contains a collection of 2D slices that make up the 3D reconstructed volume. If no specific region is selected during reconstruction, the number of slices is equal to the height of each [projection](#) image in the original **.txrm* file.

SNR Signal-to-Noise Ratio. Describes the quality of a measurement. In [CCD](#) imaging, SNR refers to the relative magnitude of the signal compared to the uncertainty in that signal on a per-pixel basis. Specifically, it is the ratio of the measured signal to the overall measured noise (frame-to-frame) at that pixel. High SNR is particularly important in applications that require precise light measurement.

stitching Process in which two volumes are merged at a common plane, to become a single volume. The two volumes must be reconstructed at the same byte scaling, to provide identical grayscale levels for both volumes. Stitching increases the scan volumes vertically, allowing users to image and analyze larger volumes.

tomography Technique that allows virtual cross-sectioning or de-layering, which enables you to look at the interior of the sample, without destroying the sample.

transmission value Ratio of X-rays through the sample versus the X-rays without the sample present.

turret Part of the [detector assembly](#). Holds up to five lenses. The lens located at the lowest point on the turret is used to focus on the sample.

uninterruptible power supply Refer to [UPS](#).

UPS Uninterruptible Power Supply. Regulates the incoming AC voltage and provides battery-supplied power to the Xradia Versa for approximately 15 minutes in case of a power outage.

visual light camera Supplies images to the **Visual Light Camera** image display (right side of the Scout-and-Scan Control System). Located behind the sample stage, at the rear of the enclosure. Used for positioning the sample, detector, and X-ray source.

Volume Rendering Technique Refer to [VRT](#).

voxel Geometric term that contributes to, but does not determine, resolution. (Also referred to as *nominal resolution* or *detail detectability*.) Basic unit of computed tomography reconstruction, represented as a pixel in the **Front** and **Side View** image displays. ZEISS specifies on spatial resolution, the true overall measurement of instrument resolution.

VRT Volume Rendering Technique. Default XM3DViewer **3D display** mode that is used to compute a color and transparency mapping of a 3D reconstructed volume.

XM3DViewer Program used to view regions of interest in reconstructed tomographic data as a 3D volume. Use of this program is featured in [Chapter 4, “Viewing and Editing Tomographies.”](#)

XCT X-ray Computed Tomography.

XMReconstructor Program used to reconstruct 2D projections into 3D reconstructed volumes. Use of this program is featured in [Chapter 3, “Manually Reconstructing a Tomography Dataset.”](#) Refer also to [reconstruction](#).

X-ray source Mechanism that generates X-rays, from 30 to 160 kV. Used by the Xradia Versa to image samples and generate reference images.

X-ray source aging Required initial warm-up process that takes 3 minutes. Aging is required every 24 hours for optimum tube performance, as well as after the X-ray source has been powered OFF for more than 23 hours. The aging process automatically starts when the X-ray source is powered ON. After aging is complete, the X-ray source tube automatically goes through its standard sequence to achieve the requested voltage and power.

X-ray source aperture Piece of tungsten with a hole in the center of it, that is bolted onto the front of the X-ray source. Blocks X-rays that do not contribute to imaging.

X-ray filter Material (available in a filter kit from ZEISS) that improves reconstructed image quality, by removing low-energy X-rays that do not provide useful information through the sample.

XRM X-Ray Microscope.

Z material, Low or High Low Z materials are typically biological or polymeric. High Z materials are typically metallic or contain metallic structures (such as semiconductor samples).

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