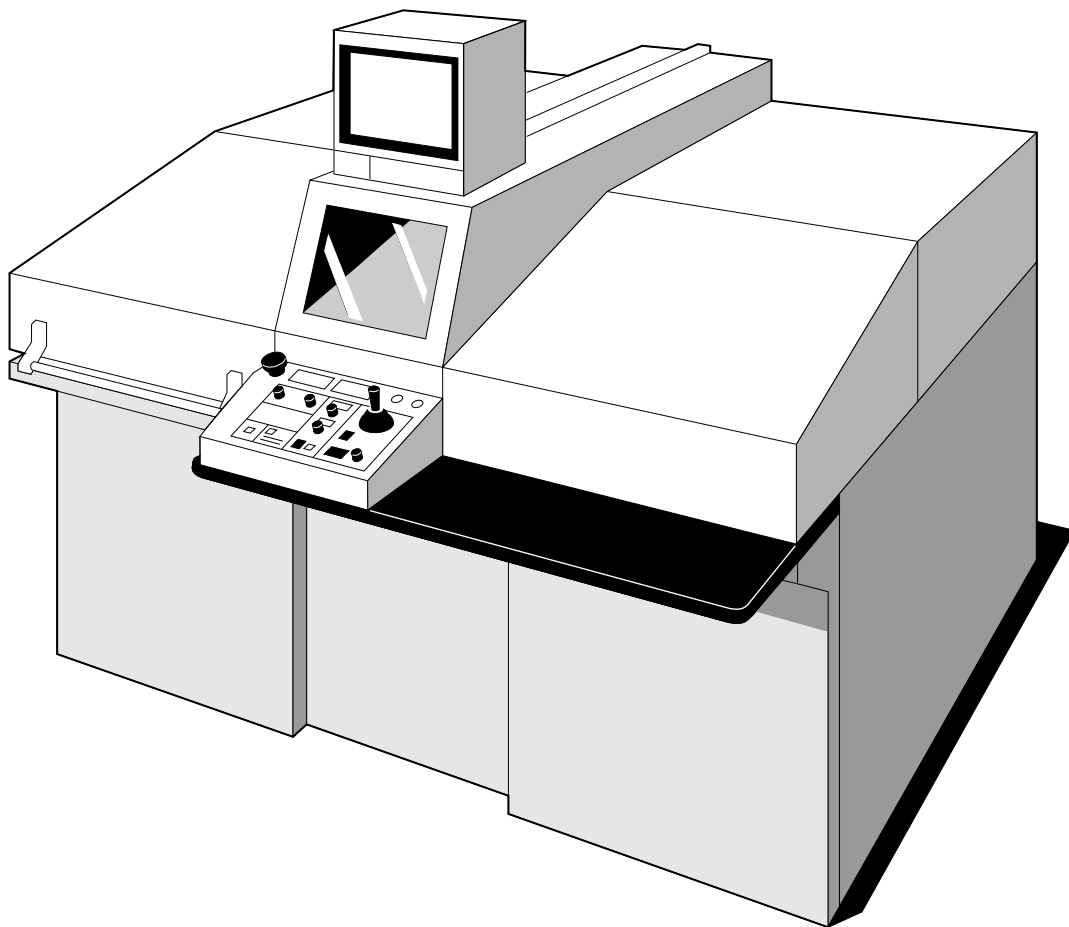


NXR 1400

Nicolet X-Ray System

Operation Manual



**Nicolet
Imaging
Systems**

A ThermoSpectra Company

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NXR-1400

Operator Manual

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Section 1

INTRODUCTION

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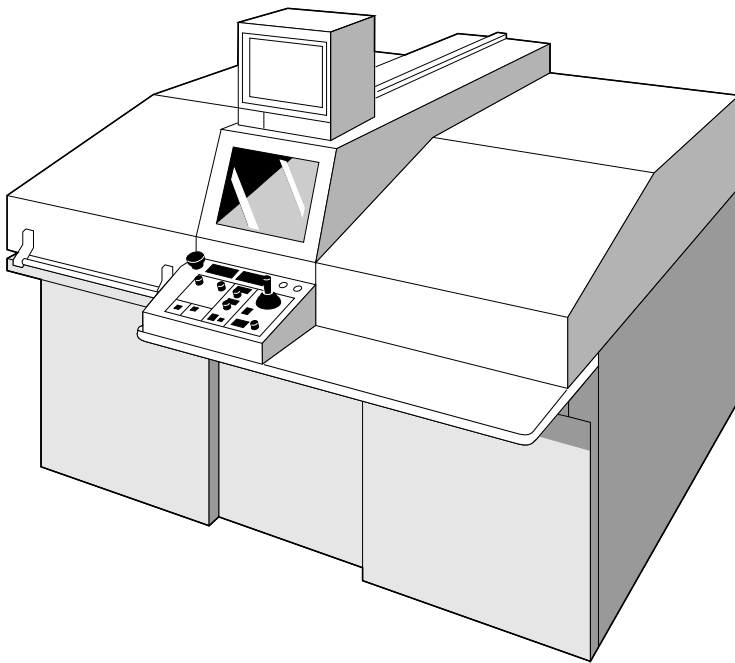


Figure 1 - NXR 1400 System

Your Nicolet Imaging Systems NXR 1400 x-ray system is typically used for real-time, non-destructive inspection of electronic components, hybrid circuitry, multilayer circuit boards, sealed components and electronic assemblies.

You can remotely manipulate the sample during inspection by using a joystick and optimize the system for the best possible image by adjusting the x-ray and camera control settings.

The basic system consists of a lead-lined cabinet which houses an x-ray source, x-ray camera, control panel, and sample tray. A display monitor is also part of the basic NXR system.

The System Options and **Accessories Include:**

- video hard copy printer
- video image processor
- sample rotation fixture
- UPS Line Conditioner

USER RESPONSIBILITY

This Product will perform in conformity with the description thereof contained in this operating manual and accompanying labels and/or inserts when assembled, operated, maintained, and repaired in accordance with the instructions provided.

This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated should be replaced immediately. Should such repair or replacement become necessary, Nicolet Imaging Systems recommends that a telephonic or written request for service advice be made to the nearest NIS Regional Office.

This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Nicolet Imaging Systems and NIS trained personnel.

The Product must not be altered without the prior written approval of Nicolet Imaging Systems. The user of this Product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Nicolet Imaging Systems.

You are required to register the use of this Product with the state in which the product is installed. See the Appendix towards the end of this manual.

RECEIVING & INSPECTION

The NXR system is carefully inspected both mechanically and electrically before shipment and should be free from damage.

When the system is delivered by commercial carrier, check it for damage with the carrier. Contact the carrier's office and NIS office if any damage is found.

When unloading from a commercial carrier, do **not** use any hooks. If your system is shipped crated, follow the uncrating instructions attached to the shipping crate. Contact NIS if you have any questions regarding the uncrating instructions.

Compare the packing list with your order invoice and contact your regional NIS office if you find any discrepancies.

Save all packing material for the system in case it should ever have to be moved or shipped again.

The following equipment is supplied **with the basic NXR system:**

QTY	DESCRIPTION
1	X-ray Cabinet and Internal Electronics
1	Video Monitor
1	Image Camera
1	Operators Manual
1	Shipping Kit (spare parts)
1	Control Panel Shelf
1	Control Panel Assembly

POTENTIAL, CURRENT, AND DUTY CYCLE RATINGS

Your Nicolet Imaging Systems NXR 1400 is designed such that -

The x-ray source potential does not exceed 120 kv.

The x-ray source beam current does not exceed 500 microamps.

No combination of the x-ray source voltage and current exceeds 60 watts.

The NXR 1400 has a 100% duty cycle when the x-rays are on.



SAFETY PRECAUTIONS

Specific notations are used in this manual to call attention to conditions which could result in injury, damage to the equipment, or require special attention.

**WARNING:**

A Warning notation is used to describe an operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in injury or loss of life.

**CAUTION:**

A Caution notation is used to describe an operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in damage to or destruction of equipment.

Note: A Note is used to describe an essential operating or maintenance procedure, condition, or statement which requires special attention.

DEFINITIONS

The terms *operation*, *maintenance*, and *service* have specific and important meanings throughout this manual. They are defined as follows:

Operation means the use of the NXR system over the full range of its functions.

Maintenance means the performance of those adjustments or procedures specified in this manual which are to be performed by you.

Service means the performance of those adjustments or procedures which are to be performed only by individuals certified by Nicolet Imaging Systems, Inc.

ABOUT YOUR MANUALS

The NXR system is shipped with a number of manuals depending on the options and accessories you ordered.

Read this NXR OPERATOR MANUAL first. It describes the basic installation, setup, and operation of the NXR 1400 system. Please read and refer to all other manuals before operating your NXR system.

Note: The installation procedures described in Section 2 of this manual are provided for informational purposes only. Your system must be installed by a qualified NIS Service Representative.

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Section 2

THEORY OF OPERATION

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The object to be inspected is placed on the sample tray. The x-ray tube generates x-rays, some of which pass through the object and strike the target area of the image camera. This image is then processed and sent to a video monitor which allows you to view the internal features of an object in real-time.

The following pages provide a brief description of the different elements used to produce the image.

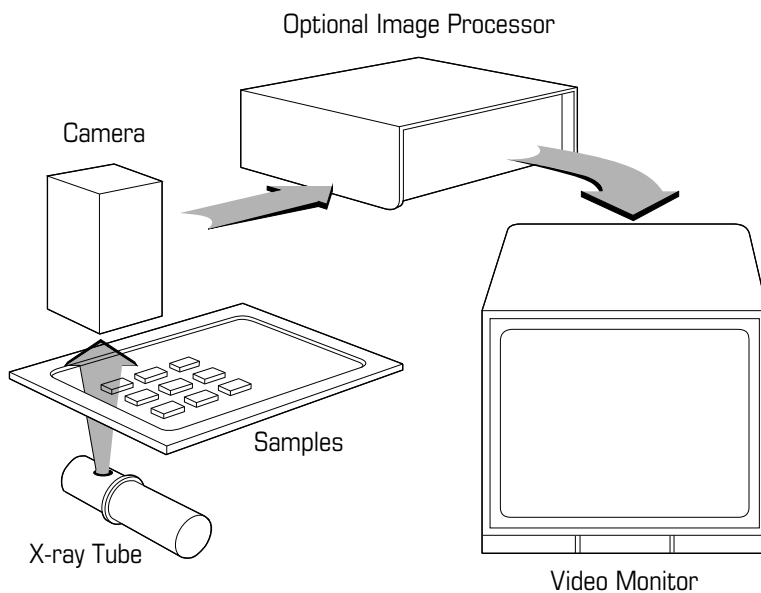


Figure 1 - Typical NXR System

X-RAYS

Using the highly penetrating, non-destructive properties of x-rays, the NXR creates an image on the video monitor for viewing the internal construction of an object. You can examine the image on the monitor to determine if there are hidden defects or internal irregularities in the object.

X-rays are a form of electromagnetic radiation. They exhibit properties similar to visible light rays but have shorter wavelengths.

X-rays have wavelengths less than 100 angstroms as compared to wavelengths of 10,000 angstroms in visible light. Because of their shorter wavelengths, x-rays are capable of penetrating solid objects in their path. Light rays are absorbed or reflected by the objects.

THE X-RAY TUBE

Caution: Leave the system in the Standby mode with power on when it is not in use to help prolong the life of the x-ray tube. On/Off cycling of power

accelerates the stress factors of any x-ray tube.

The Filament

The tube filament emits electrons when a current is passed through the filament. The greater the current passing through the filament, the greater the number of electrons emitted. These electrons are gated and accelerated by high voltage applied to the anode. This electron emission is called the tube current. X-ray output is proportional to the tube current.

Focusing Grid

The electron optics of the x-ray tube in the NXR system are designed to focus the emitted electrons down to a very small

beam. This beam is then focused onto the tungsten anode.

The Anode

A high voltage applied to the anode of the x-ray tube attracts the electrons emitted by the filament. X-rays are generated when the emitted electrons, which travel at high speed, either collide with the anode or abruptly change direction.

The anode is comprised of a tungsten target because of tungsten's high melting point. Large numbers of electrons strike the anode and transform to heat at the target.

Tungsten is also an efficient material for generating x-rays because it has a high atomic number. The efficiency of a material to generate x-rays depends on its atomic number — the higher the number, the more efficient the material.

Cooling the Tube

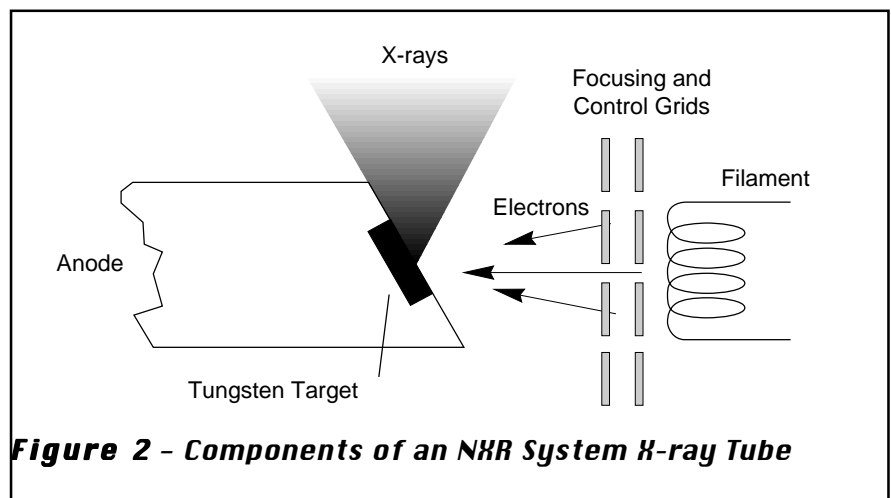


Figure 2 - Components of an NXR System X-ray Tube

When electrons strike the tungsten target, most of the energy is transformed into heat. This heat must be dissipated to prolong the life of the tungsten. NXR 1400 systems circulate air through the inside of the x-ray tube enclosure to reduce the temperature to a suitable operating level.

SHADOW FORMATION

To understand how an x-ray image is produced, it is important to understand the principles of shadow formation.

The shadow formation principles (**enlargement, sharpness, and distortion**) discussed in this section are explained using light rays as examples. X-rays and light rays have similar characteristics. However, x-rays have other properties, such as scattered radiation, which also affect the image. See "Image Quality," later in this section.

Enlargement

The displayed image can be enlarged by moving the image camera away from the sample and x-ray source (Figure 3). The image diameter is calculated using the equation shown.

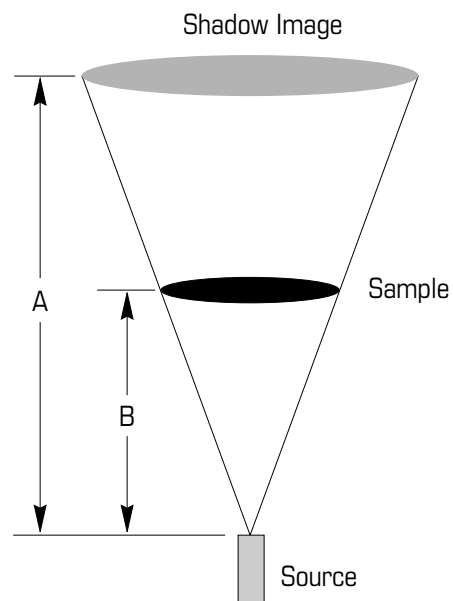


Figure 3 - Shadow Enlargements

$$\text{Image Diameter} = \text{Sample Diameter} \times \frac{A}{B}$$

Where:

A = Distance from source to the shadow
(see Figure 3)

B = Distance from source to the sample
(see Figure 3)

$$\frac{A}{B}$$

= **Magnification**

Equation 1 - Calculating the image diameter

Sharpness

Another characteristic of shadow formation is the sharpness of the image. As illustrated in Figure 4, the size of the light source (or effective focal spot on the target) affects image sharpness. If the source is more than a single point, multiple shadows are cast which will be slightly displaced. This creates an image area which appears unfocused, called the **penumbra** (Figure 5). The larger the effective focal spot, the greater the penumbra area.

Image sharpness is also affected by the distance between the source and the object. The larger the area of the light source (or effective focal spot), the further the source must be from the object to minimize the penumbra effect. This is illustrated in Figure 6.

Distortion

It is also important in the formation of shadow images that the object and the surface upon which the shadow is projected be as parallel as possible. The center of the light source or x-ray beam should be perpendicular to the object and collector surface. This reduces distortion, and ensures that the shadow image is a true representation of the object.

IMAGE QUALITY

X-rays can penetrate solid objects because they have short wavelengths. Some are absorbed by the object while others pass through the object. X-rays that pass through the object are projected onto an x-ray sensitive surface, which produces a shadow image of the object's material mass.

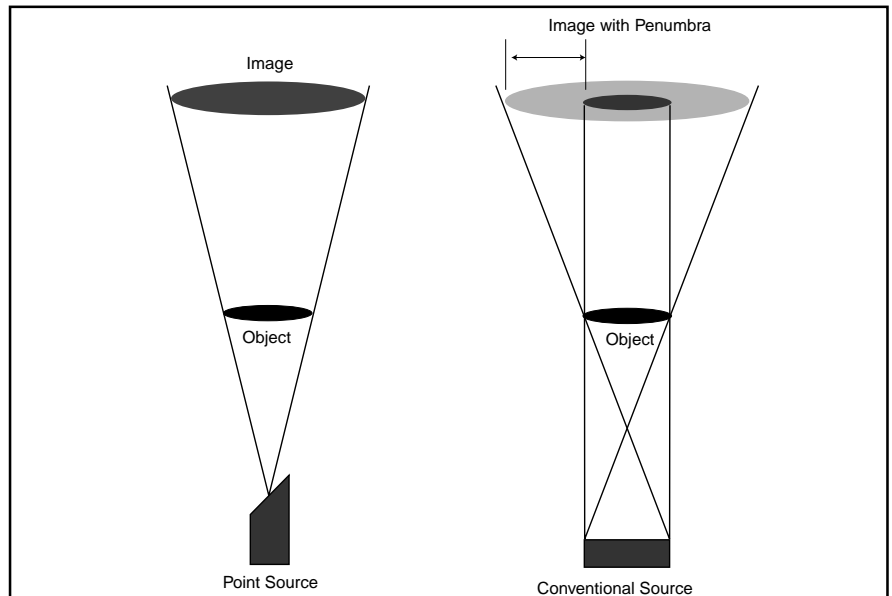


Figure 4 - Source Size

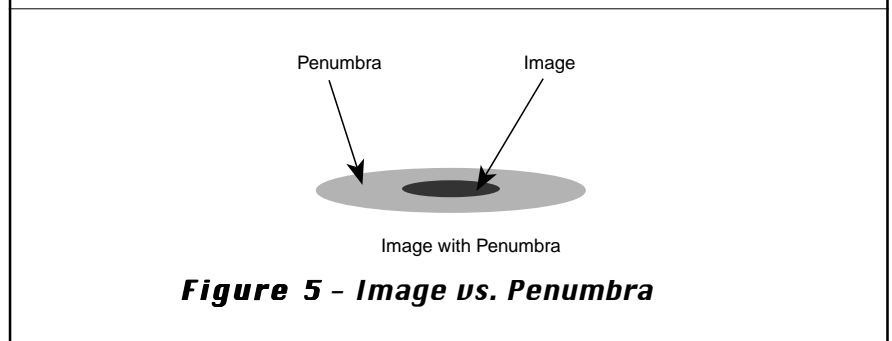


Figure 5 - Image vs. Penumbra

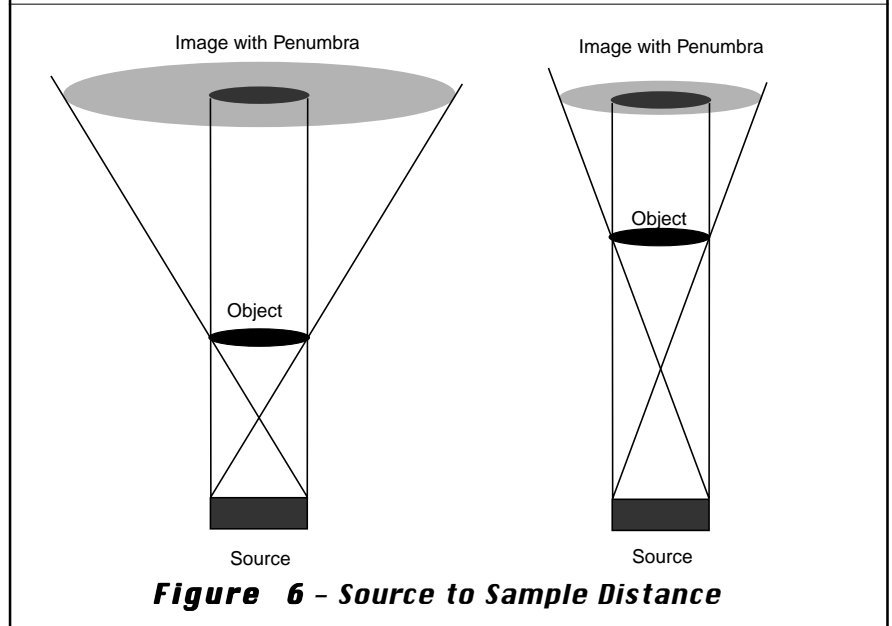


Figure 6 - Source to Sample Distance

The quality of the image is affected by a number of factors. These include:

- x-ray intensity,
- x-ray penetration,
- the size of the effective focal spot,
- the mass of the object,
- and the properties of the collector surface.

X-ray Intensity

The amount (intensity) of radiation emitted by the x-ray tube's filament is proportional to the current flowing through the x-ray tube. Adjusting the **Power** knob on the control panel clockwise increases the intensity.

X-ray Penetration

The speed of the electrons as they travel to the tungsten target is proportional to voltage applied to the x-ray tube's anode. Increasing the **Kilovolts** setting on the control panel increases the x-ray beam's penetration capabilities.

Focal Spot

NXR systems use a microfocus x-ray source (point-source) x-ray tube. Microfocus refers to the size of the area onto which the electron stream is focused and the size of the effective focal spot. The target of the x-ray tube is placed at an angle of 20° to the electron beam as shown in Figure 7. This creates an effective focal spot much smaller than the actual area on the target.

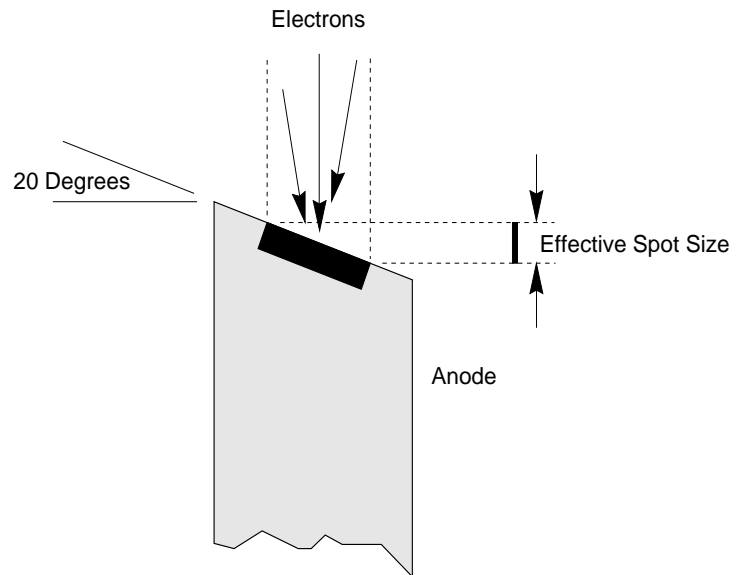


Figure 7 - Effective Focal Spot

Object's Mass

The density, thickness, and atomic number of an object determine the rate at which x-rays pass through the object to illuminate the collector surface of the camera. When no or few x-rays pass through an object, the displayed image is black. The image becomes lighter and lighter as more x-rays reach the camera. If an object has mass variations, such as the circuit board in Figure 8, the variations are displayed with different gray levels.

To adjust the contrast of the image, you need to lower or raise the voltage.

For example, at lower kilovolts settings, fewer x-rays pass through the chip on the circuit board in Figure 8. In this example, the contrast ratio between the chip and the board is 1:4.

Higher kilovolts settings add x-rays of shorter wavelengths that more readily pass through the chip. The higher voltage causes the ratio of x-rays passing through the chip and board to decrease which, in turn, decreases the contrast of the variations on the image. See Figure 9.

Sensitivity

When an object has minute density variations, use a lower kilovolt setting to increase the contrast between the different densities.

When inspecting extremely dense objects, use a higher kilovolt setting to increase the penetration capabilities of the x-rays.

Collector

The x-rays are projected onto a thin layer of florescing material that converts invisible x-ray photons into visible light photons to be collected by the camera. The image of the object's mass is then displayed on the monitor.

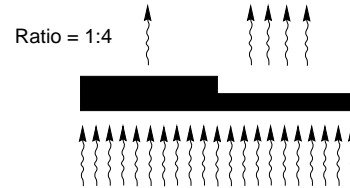
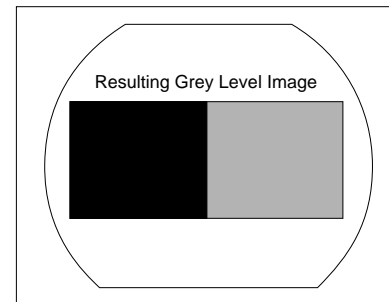


Figure 8 - Contrast at Lower Voltage

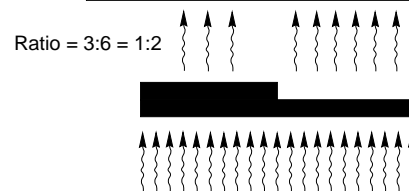
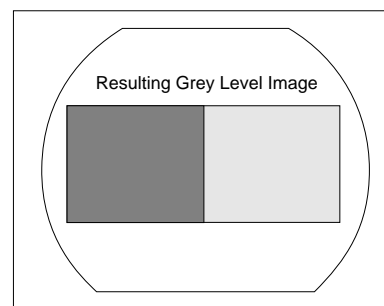


Figure 9 - Contrast at Higher Voltage

Section 3

SYSTEM

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The installation procedures described in this chapter are provided for informational purposes. A Nicolet Imaging Systems Service Representative must install your NXR system.

System Requirements

AC Power

Your NXR system is equipped with a three conductor power cord in accordance with NEMA recommendations. When plugged into the appropriate receptacle, the power cord is designed to ground the equipment cabinet.

NXR systems can be ordered for any of these four AC power sources:

- 105-125 VAC, 20 Amp, 50 Hz
- 105-125 VAC, 20 Amp, 60 Hz
- 200-240 VAC, 10 Amp, 50 Hz
- 200-240 VAC, 10 Amp, 60 Hz

Clearance

- Allow at least 76 cm (30 inches) in front of the cabinet for operating the system.
- Allow at least 15 cm (4 inches) between the rear of the system and wall for air circulation.
- Locate the cabinet where it can be rolled out to access the rear panels during installation and service.

Note: NXR systems are caster-mounted and easy to move.

Environment

The environment for your NXR system should be free from excess dust and dirt, and the floor should not vibrate. The your system is designed to tolerate the following temperature and humidity ranges:

Temperature: 0° to +35°C (32° to 95°F).

Humidity: 70% max. to 20% min. at 35°C with no condensation.

Safety

This system is designed to conform to Federal Regulation (CFR) 21, subchapter J, paragraph 1020.40, "Cabinet X-ray Systems." Various localities may have different rules and regulations, that must be complied with prior to installation. Make an inquiry as to these rules and regulations with the installation facility's Safety Department and with the local Department of Health. Notify them that the installation is taking place and inquire about any special plant requirements that may apply. Requirements may involve wiring, notices, or special safety procedures unique to that particular company. Take whatever steps necessary to comply with these requirements.

See the Appendix later in this manual for a listing of each state's agency with which your NXR X-ray system must be registered.

Inspection

1. Carefully inspect the NXR for any physical damage. Look for:
 - dislodged components,
 - loose cables, and
 - any other apparent damage.

Note: Do not discard the packing material. If you find damage, the carrier may want to examine the material. Also, in the event the system needs to be returned to Nicolet, it should be shipped in the original containers.

2. Record the system serial number on the Service Installation form. The serial number appears on the back of the cabinet.
3. Compare the shipped items to those listed on the packing slip.
4. Report any discrepancies to the regional NIS Service office.

Line Conditioner

The line conditioner supplied with the system is designed to provide constant and accurate power for the system. Nicolet Imaging Systems offers these SOLA Constant Voltage Sinusoidal (CVS) Transformers, Table 1.

Model	Part Number
1 KVA 60 Hz	113- 713300
1 KVA 50 Hz	113- 712600

Installing the Control Panel Shelf

Have someone help you install the shelf for the control panel.

1. Locate the eight bolts provided for the shelf.
2. Position the shelf and spacer under the right front of the sample compartment.
3. Start one bolt on each end and only finger-tighten each bolt.
4. Start the remaining six bolts.
5. Securely tighten all eight bolts.



CAUTION:
Do not use
bolts in excess
of 1-1/2 inches.
Longer bolts may
damage the
table top.

Cabling

These instructions tell you how to route and connect all the cables for the system and its components. Before you begin, locate all the cables.

Monitor

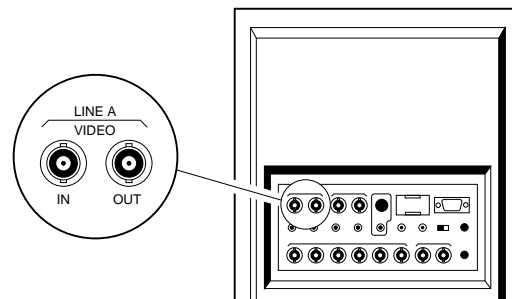
1. Set the monitor on top of the NXR; directly above the control panel.
2. Pry loose one side of the cable channel's top and pull it off.
3. Route the monitor's power cord along one side and through the cable channel.
4. Route the power plug through the hole in the top rear of the cabinet.
5. Adjust the cord so there is no excess at the rear of the monitor or where it exits the channel. The extra cord length should be inside the lower cabinet.
6. Connect the BNC cable to the **Video In** connector on the back of the monitor (Figure 1).
7. Align the BNC cable and the power cord in the cable channel.
8. Snap on the top of the cable channel.
9. If any other peripheral is to be connected to the monitor's Video out connector (printer, etc.), set the 75Ω switch on the peripheral to ON.
10. Locate the monitor's power plug by removing the right rear door of the cabinet.
11. Plug the monitor's power cord into the utility power strip mounted on the inside right rear of the cabinet.

Electronics Chassis

1. Check that the ribbon cable connector (from the control panel to the electronics chassis) is properly seated.
2. Check all other connectors on the electronics chassis and ensure proper electrical connections.
3. Untie the AC power cord at the rear center of the cabinet.
4. Verify that the power source is correct for the system.
5. Plug the cord into the power source.
6. Run the ribbon cable and the other cables through the large hole in the control panel shelf.
7. Use cable ties to secure these cables to the cable anchors on the bottom of the shelf.

Control Panel

1. Connect the cables you put through the hole in the shelf to the connectors on the underside of the control panel housing.
2. Ensure that all the cables are fully seated.
3. Align the control panel housing holes with the holes in the shelf.
4. From the underside of the shelf, secure the control panel housing to the shelf with four bolts. Use the longest bolt at the left/front corner for the ground strap connection.
5. Securely tighten all bolts.



Color Monitor

Figure 1 - Video In Connection

Installing the Camera

1. Locate the camera's 25-pin DB connector cable inside the sample compartment.
2. Connect the cable to the top of the camera as shown in Figure 2.
3. Tighten the two locking screws on the connector.
4. Mount the camera on its bracket inside the sample compartment (Figure 2). You may need to tighten the bolts on the back of the camera to ensure that it is securely mounted.

CAUTION:

Do not attempt to tighten or loosen the four screws on the camera's rear mounting plate. These have been carefully adjusted for proper camera alignment.

Initial Setup

If you have not already done so, familiarize yourself with the control panel. See Section 3. Then perform the following steps **before** turning on the system.

1. Set the kilovolts to the lowest voltage by turning the **Kilovolts** control knob all the way to the left.
2. Set the power to its lowest setting by turning the **Power** control knob all the way to the left.
3. Turn on the video monitor.
4. Locate and remove the keys taped inside the sample compartment.
5. Insert the keys into the **AC Power** and **X-ray** key switches on the control panel (Figure 3).

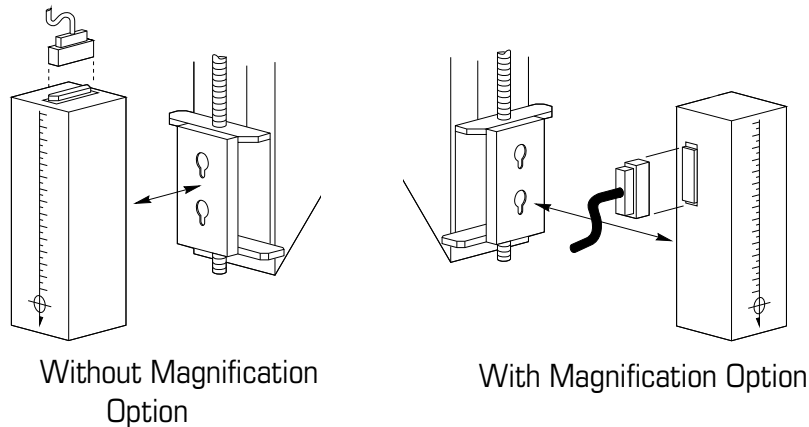


Figure 2 - Installing the Camera

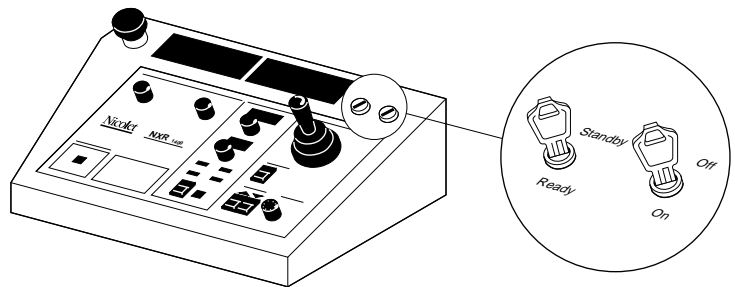


Figure 3 - Key switches

Starting the System

1. Start the system by turning the **AC Power** key switch to *on*.

Warning:
The fans and line conditioner are energized when the power is turned on.

2. Ensure the high voltage power supply located inside the right cabinet is on. Also check if the camera control box is on.
3. Turn the **X-ray** key switch to *ready*.

It takes approximately ten minutes for the NXR to warm up. The **Ready** light appears when the system is ready to generate x-rays. While you are waiting for the system to warm up, check the indicators and joystick operation as described in the next two sections: "Indicators" and "Joystick Operation."

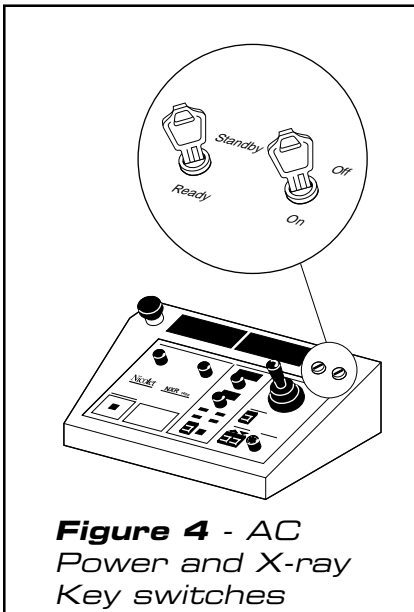


Figure 4 - AC Power and X-ray Key switches

Indicators

While you are waiting for the system to warm up, check for the following indicators:

- a. The red **Power** light is on.

POWER
[Red LED]
- b. Zeroes appear in the **Kilovolts** display.

Kilovolts
000
- c. The number 10 appears in the **Power** display.

10
Power
- d. The **Interlock 1** light is on. This light blinks when the sample compartment door is open. If the light is blinking, close the door.

Interlock 1
[Blinking LED]
- e. The **Interlock 2** light is on. This LED indicates the Service Access Panel is closed and the x-ray source is properly secured.

Interlock 2
[On LED]
- f. The **Standby** light is on.

Standby
[On LED]
- g. The green **X-ray Off** light is on.

X-RAY OFF
[On LED]
- h. No other indicator is on.

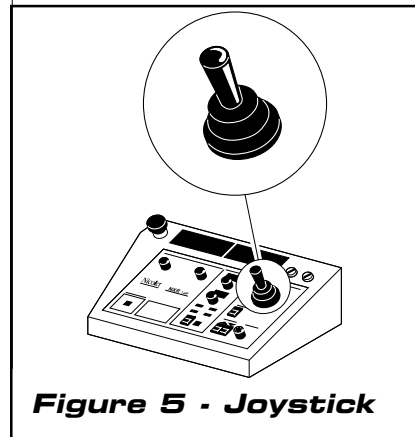


Figure 5 - Joystick

Joystick Operation

To test the joystick (Figure 5):

1. Move the joystick in all directions and ensure the sample tray moves in the same direction as the joystick. Vary the speed at which you move it — from very quickly to very slowly.
2. Using the joystick, move the tray to all its extreme positions. Ensure the tray reaches its full limit of travel and stops when it contacts its limit switch.
3. Stop the sample tray somewhere in the middle of its travel and press the **Load** button. Ensure the sample tray moves to the extreme left front position and stops.

Camera Control

To check the camera movement:

1. Press the **Camera Up** button and ensure that the camera moves up.
2. Press the **Camera Down** button and ensure that the camera moves down.

Cold Start Procedures

All System Operators Should Read This Section for Operational Information Affecting the X-ray Source Life.

The life of the x-ray tube is affected by how well you adhere to specified operating procedures. All operators of your system must be informed of these procedures and the importance of following the procedures exactly. There are some general concepts regarding high voltage and high vacuum systems that must be considered.

Do not change the high voltage setting abruptly. An abrupt change results in a high degree of stress on all insulators within the high voltage system. These include high voltage cables, connector dry well, high voltage power supply and components inside the vacuum tube. Abruptly switching high voltage will contribute to insulator breakdown over time resulting in failure of components.

A high vacuum system that does not have voltage applied internally can essentially lose vacuum over a period of time. Due to outgassing of the internal elements, free atoms become

loose within the vacuum creating a current path for high voltage. The more free atoms, the lower the resistance. Consequently, the longer the vacuum exists without voltage applied to the internal elements of the tube, the more free atoms that will exist, and the greater the probability of discharge through the now compromised vacuum.

When high voltage is once again applied to the internal elements of the tube and current flows to the anode, the free atoms tend to be attracted to the internal elements and are absorbed. The atoms are no longer free within the vacuum, and cannot create a current path for high voltage. This is the rationale for the cold start procedure for x-ray systems

that have been idle for a period of time. The longer the idle time, the longer the cold start time required to eliminate free atoms within the x-ray tube.

X-ray Source Burn-in

A burn-in period must always be implemented when making a cold start (power up of the machine after the power has been removed). This burn in time is proportional to the time the system has been shut off. The following table has recommended burn-in times versus idle times.

1 day or less	10 min.	15 min.
1 day to less than 1 week	20 min.	25 min.
1 week to less than 1 month	60 min.	70 min.
1 month to less than 2 months	90 min.	100 min.
2 months to less than 6 months	2 hours	3 hours
6 months and over	3 hours	4 hours

Conditioning the X-ray Tube

When you first install the NXR, or after it has been off or left in Standby for a long time with no KV applied to the tube, you must condition the x-ray tube so it can withstand high voltage. To condition the tube always follow the burn-in procedure exactly.

1. Ensure that the **Ready** light is on.
2. Close the sample compartment door if it is not already closed.
3. Ensure that the voltage is set at its lowest kilovolt level. Turn the **Kilovolt** knob all the way to the left.
4. Ensure that the **Power** control is set to 10.
5. Press the **X-ray** button.
6. Check for the following indicators:
 - The system beeps.
 - The high voltage power supply fan starts.
 - The **Ready** light is on.
 - The **X-ray On** light by the **X-**

ray On button is on.

- The red **X-ray On Warning** light is on and the green **X-ray Off** light is off.
- The voltage increases on the **Kilovolts** display. The voltage should stop at 20 KV. If it continues to increase, turn the **Kilovolts** knob all the way to the left to set the voltage to the minimum amount.



CAUTION:

Do **not** increase the kilovolts at this time.

7. Divide the required time determined from the chart by 4. After this amount of time has passed, the KV can be increased to an amount equal to 25% of full KV.

CAUTION

DO NOT INCREASE KV BY MORE THAN THE SPECIFIED AMOUNT AT EACH STEP.

EXAMPLE:

100 KV X-ray source has been inactive for 1 month. The reference chart indicates a burn-in time of 90 minutes is required. 90 minutes divided by 4 equals approximately 23 min-

utes. This is the time period for each of the burn-in KV increments.

8. After the required time has elapsed, increase the KV by 25% again, bringing it to 50% of full KV. Listen carefully while the KV is increased. If arcing is heard, (an audible ticking or snapping sound), immediately reduce the KV setting to a level where the arcing stops. Let the source operate at that level for one complete time period.
9. Once the time period has elapsed, again increase the KV setting to an additional 25% of full KV.
10. After the time period at this level has elapsed, slowly increase the KV to 75% of full KV. Once again, listen very carefully for any sign of arcing.
11. Again, after the required time has elapsed, slowly increase the KV by 25%. The system should now be operating at maximum KV. Assuming no arcing, the system should now be operational. You can now adjust the **Power** or **Kilovolts** settings as desired for your application.

Because of the burn-in period required when power has been turned off, NIS recommends that the system always be left with the power applied except when the system is not going to be used for an extended period of time.

For short periods of not being used, (overnight or weekends), reduce the KV to approximately 50% of maximum and turn on x-rays. Allow the system to idle in this state.

If it is impractical or installation procedures dictate the system be locked in Standby when not in use, a burn-in procedure should be implemented before use after one or two days of no use even though power has been applied to the system.

Turning X-rays On

Always turn the KV control fully counterclockwise (minimum setting) before turning on x-rays. Never turn on x-rays with the KV control set at maximum.

After the X-ray On has been started, slowly rotate the KV control to increase high voltage.

Turning X-rays Off

Rotate the KV control fully counter-clockwise at a slow rate before turning x-rays off.

Never turn off the X-ray mode with high KV applied to the source. Doing so will result in instantaneous reduction of high voltage.

Never open the sample compartment door while the system is in the X-ray On mode. Set the KV control to minimum, then open the sample compartment door.

Installing Accessories

Refer to your NIS Service Manual and the option or accessory's manual before installing them. Figure 6 illustrates the order in which to connect the accessories. As a general rule, always terminate the last item in the string using the 75 ohm termination switch.

Note: Any other configuration may affect the signal impedance and image quality.

$75\Omega = 75$ ohms input termination

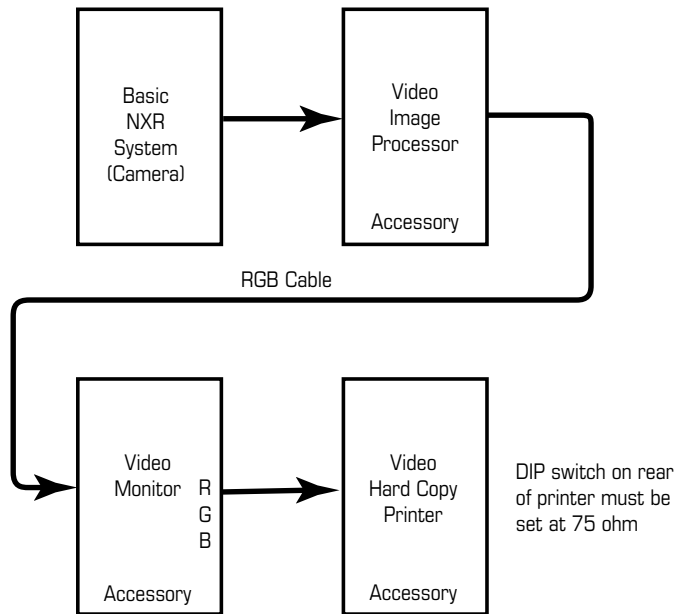


Figure 6 - System Configuration with Accessories

Section 4

BEFORE YOU START

The Keys	4-3
Emergency Off	4-3
The Control Panel	4-4
The Camera	4-6
• Adjusting the Camera's Lower Limit	4-6

Take the time to become familiar with the NXR system, its components, and any options and accessories on your system. Be aware of and heed all the safety precautions set by your operating site.

 **WARNING:**

Never operate the system if any of these conditions exist:
The viewing glass is cracked or broken.
The lead lining is separating from the inside of the sample compartment.



WARNING:

This equipment produces X-RAYS when energized. Follow all safety procedures set by your place of employment.

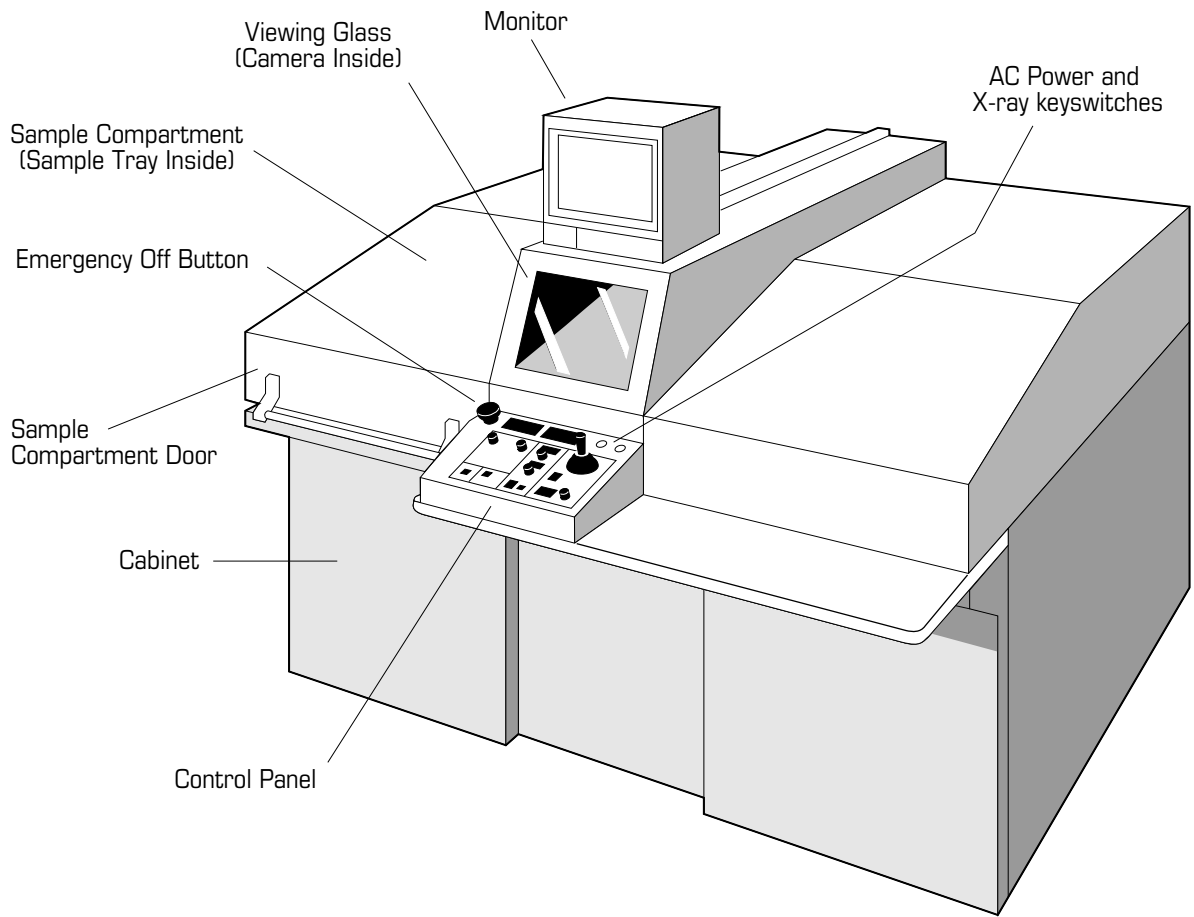


Figure 1 - NXR 1400

The Keys

Four keys were shipped with the NXR. Even though all the keys are identical, you need two of them to operate the system. Store two keys in a safe place as a master set and use the other two in your day-to-day operation of the system. You can duplicate these keys if necessary.

You cannot remove the key from the **X-ray** keyswitch while the NXR is in the *ready* mode. To remove the key, turn the keyswitch to *standby* (Figure 2).

You cannot remove the key from the **AC Power** keyswitch while the NXR is on. To remove the key, turn the keyswitch to *off* (Figure 2).



WARNING:
This equipment produces **X-RAYS** when energized. Follow all safety procedures set by your place of employment.

Emergency Off

The NXR is equipped with an **Emergency Off** button (Figure 3). Press this large, red button whenever you want to immediately shut down the system. This button turns off the AC power.

Restarting the System After an Emergency Off

To restart the system after pressing the **Emergency Off** button:

1. Set the voltage to its lowest amount by turning the **Kilovolts** control all the way to the left.
2. Turn the **AC Power** keyswitch to *off*.
3. Turn the **AC Power** keyswitch back to *on*.

The NXR needs approximately 10 minutes to warm up. After turning on the system, the yellow **Standby** LED comes on and remains on until the NXR is ready to generate x-rays. Be sure the X-ray keyswitch is set to *ready*.

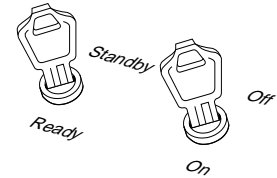


Figure 2 - Positions required to remove the keys

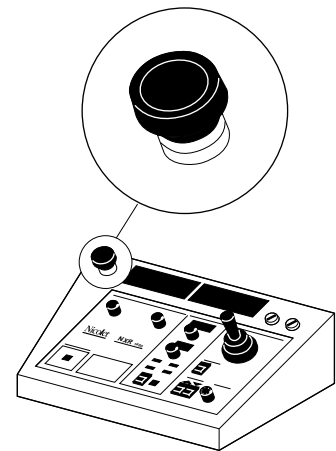


Figure 3 - Emergency Off Button

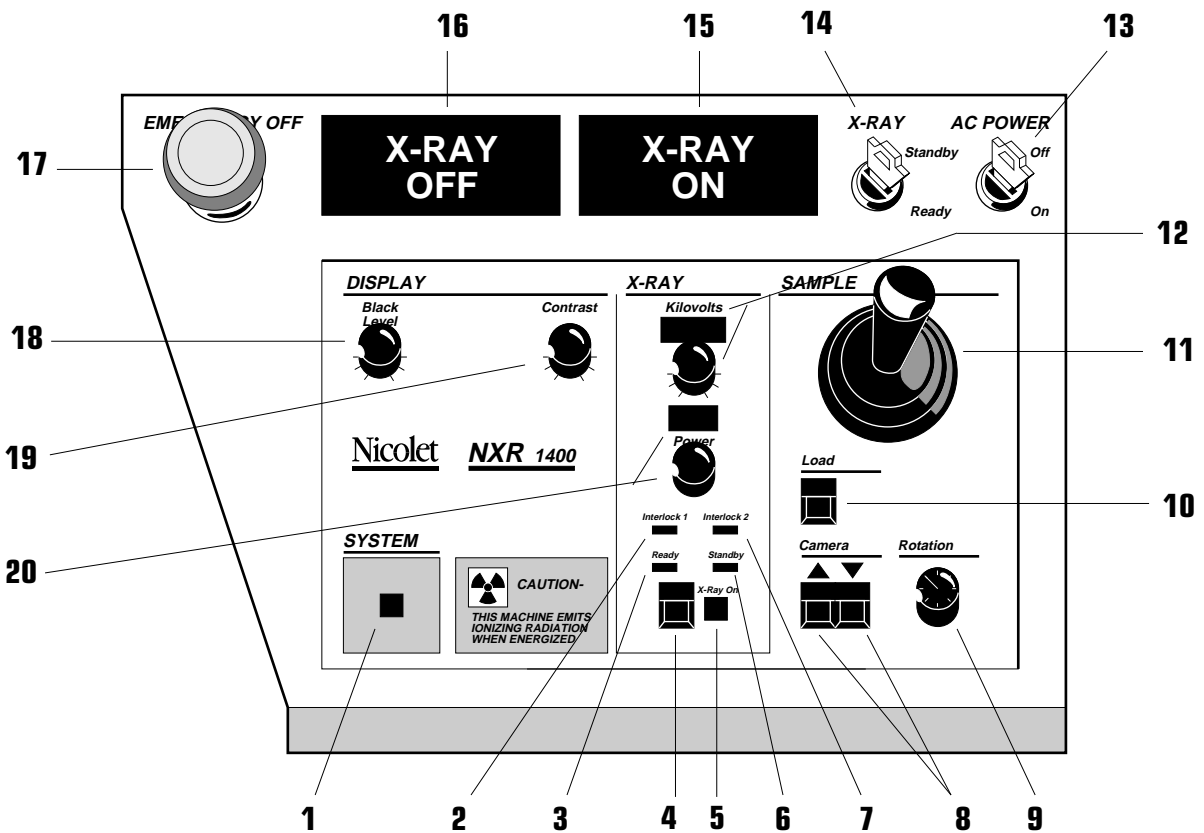


Figure 4 - NXR 1400 Control Panel

1. Power

A red light appears here when the AC power is on.

2. Interlock 1 LED

This green LED lights when you turn the **X-ray** keyswitch **(14)** to *ready*. You cannot turn on the x-rays when either of these conditions cause the LED to blink on and off:

- sample compartment door is open, or
- x-ray tube enclosure is removed.

3. Ready LED

This green LED lights when the NXR is ready to generate x-rays. The AC power must be on and the **X-ray** keyswitch set to *ready*. You cannot turn on the x-rays until this LED lights.

4. X-ray On Button

Turns the x-rays on or off. When you turn on the x-rays, the red **X-ray On Warning** light **(15)** at the top of the control panel comes on, a long "beep" sounds, and then the red **X-ray On LED (5)** turns on. When you turn off the x-rays, a short "beep" sounds, and the **X-ray On Warning** light and **X-ray On LED** turn off.

5. X-ray On LED

This red LED comes on when you press the **X-ray On** button **(4)** to turn on the x-rays.

6. Standby LED

This yellow LED lights whenever the system needs to warm up or the **X-ray** keyswitch **(14)** is set to *standby*.

7. Interlock 2 LED

This green LED lights when you turn the **X-ray** keyswitch **(14)** to *ready*. You cannot turn on the x-rays when either of these conditions cause the LED to blink on and off:

- x-ray tube is over heated, or
- x-ray tube enclosure is removed.

8. Camera

Press the **Up** button to raise the camera, thus increasing the magnification and reducing the intensity of the displayed image. Press the **Down** button to lower the camera, thus decreasing the magnification and increasing the intensity of the displayed image.

9. Rotation

Rotates an object 360° around the x axis. Your NXR must be equipped with the sample rotation accessory described in Chapter 5.

10. Load

Moves the sample tray to its load position, which is the front left of the sample compartment.

11. Joystick

Move the joystick in the direction you want the sample tray to move. Speed of movement is proportional to the deflection of the joystick.

12. Kilovolts

Increases or decreases the voltage applied to the x-ray tube. The voltage in kilovolts appears in the display directly above this control. There is a delay between the time you turn the control to increase the voltage and the displayed voltage to guard against sudden increases.

13. AC Power Keyswitch

Turns the system *on* or *off*. This is the master switch and controls the power for the entire system.

14. X-ray Keyswitch

Sets the system to *ready* or *standby*. Set the system to *standby* and remove the key to guard against unauthorized use of the system.

15. X-ray On Warning Light

This red, warning light comes on when the x-rays are turned on.

16. X-ray Off Light

This green light stays on when the x-rays are turned off.

17. Emergency Off

Press to immediately turn off the system. You then must restart the system by turning the **AC Power** keyswitch **(13)** to *off* and then back to *on*. Expect a 10 minute delay for System warm-up.

18. Black Level

Adjust clockwise to **brighten the screen image**.

19. Contrast

Adjusts the gain of the camera which affects the contrast of the image displayed on the monitor.

20. Power (Option)

Adjust clockwise to increase the power, thus increasing the x-ray intensity. Power levels of 10W, 20W, 35W and 60W are selectable.

The Camera

When you press the **Camera Up** or **Down** button, the Camera Position Indicator (Figure 5) points to a number indicating the height of the camera. Use the camera position indicator to position the camera to a predetermined height, or return the camera to its previous setting after vertically moving the camera.

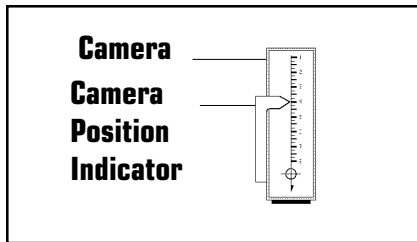


Figure 5 - Camera Position Indicator

The numbers on the camera do not represent precise magnification factors. They are only intended to indicate the relative vertical position of the camera. The precise magnification factor which these positions represent is impossible to predict because other variables influence the actual factor. These variables include:

- the size of the monitor's screen,
- distance between the object and x-ray source, and
- thickness of the sample.

Keep a record of camera positions used for your samples. This will speed up future inspections by giving you a starting position for the camera. For example, when inspecting sample A, record the camera's position. Likewise, record the camera's position when you inspect sample B. Then, the next time you inspect sample A or B, you can quickly set the camera to its proper position.

Adjusting the Camera's Lower Limit

The lowest position to which the camera can be set is determined by the dimension of the sample under the camera. To gain the maximum field of view, position the camera as close as possible to the sample without touching it.

Because damage can occur if the camera makes contact with the sample, adjust the lower limit of the camera. See Figure 6.

You need a 7/16" wrench to adjust the lower limit.

1. Turn the **X-ray** keyswitch to *standby*.
2. Open the sample compartment door and place a representative sample on the sample tray directly below the lowest part of the camera.
3. Carefully lower the camera by pressing the **Camera Down** button. Stop the camera just before it contacts the sample.
4. Loosen the limit adjust locknut.
5. Unscrew the limit adjust screw until it releases the limit switch.
6. Tighten the limit adjust locknut.
7. Raise the camera by pressing the **Camera Up** button.
8. Carefully lower the camera again. It should automatically stop at the new lower limit.
9. Ensure that there is sufficient clearance between the camera and sample. You may need to make fine adjustments.
10. Carefully lower the camera from its fully raised position to test for over-travel. If the camera contacts the sample, make further adjustments.

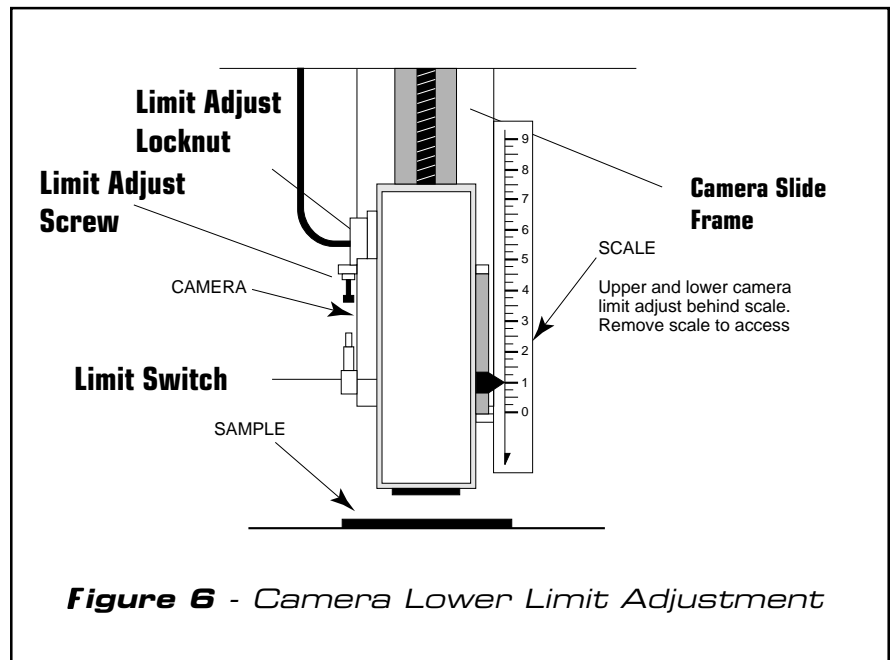


Figure 6 - Camera Lower Limit Adjustment

Section 5

OPERATING THE NXR SYSTEM

Turning on the Power	5-2
Enabling the X-rays	5-3
Loading the Sample	5-4
Inspecting a Sample	5-5
Disabling the System	5-6



WARNING: This equipment produces X-RAYS when energized. Follow all safety procedures set by your place of employment.

Before you can use the NXR, it must be installed by a NIS representative. The instructions in this section assume the system is installed and operating normally. The instructions are arranged sequentially — in the order you should follow to properly operate the NXR.



CAUTIONS

1. Follow all safety rules set by your place of employment.
2. If the system has been turned off for any period, perform the "Starting the System" procedure in Section 3.
3. If the system has been off for any period, you must condition the x-ray tube. See Section 3, "Conditioning the X-ray Tube."
4. The NXR automatically moves the sample tray to the load position whenever you turn on the power. You must remove the sample rotation's tailstock from the sample compartment **before** you turn on the power to avoid damaging the camera.
5. Always adjust the camera's lower limit to guard against damage which may occur if the camera makes contact with the sample. See Section 4, "Adjusting the Camera's Lower Limit."

Turning On the Power

The NXR is usually left in the *standby* mode when it is not being used for short lengths of time. Never turn the systems completely off except for service or maintenance.

CAUTION: If the system is off for any period, perform the "Starting the System" procedure described in Section 3 of this manual. Failure to complete each step of the procedure could severely damage the x-ray tube.

These instructions tell you how to start the NXR when the AC power is off. If the NXR is in the *standby* mode, skip to the next page "Enabling the X-rays."

To Turn on the System:

1. If the sample rotation's tailstock is mounted to the sample tray, remove it.
2. Set the voltage to its lowest setting by turning the **Kilovolts** control all the way to the left (Figure 1-A).

Important: Always set the kilovolts to its lowest setting before turning on the system.

3. Set the power to its lowest setting by turning the **Power** control all the way to the left (Figure 1-B).

Important: Always set the power to its lowest setting before turning on the system.

4. Insert the key in the **AC Power** key switch and turn it to *on* (Figure 1-C). The light flickers and then comes on in the camera area. The sample tray moves to the front left of the sample compartment.

The NXR needs approximately 10 minutes to warm up. After turning on the system, the **Standby** LED (Figure 1-D) comes on and remains on until the NXR is ready to generate x-rays.

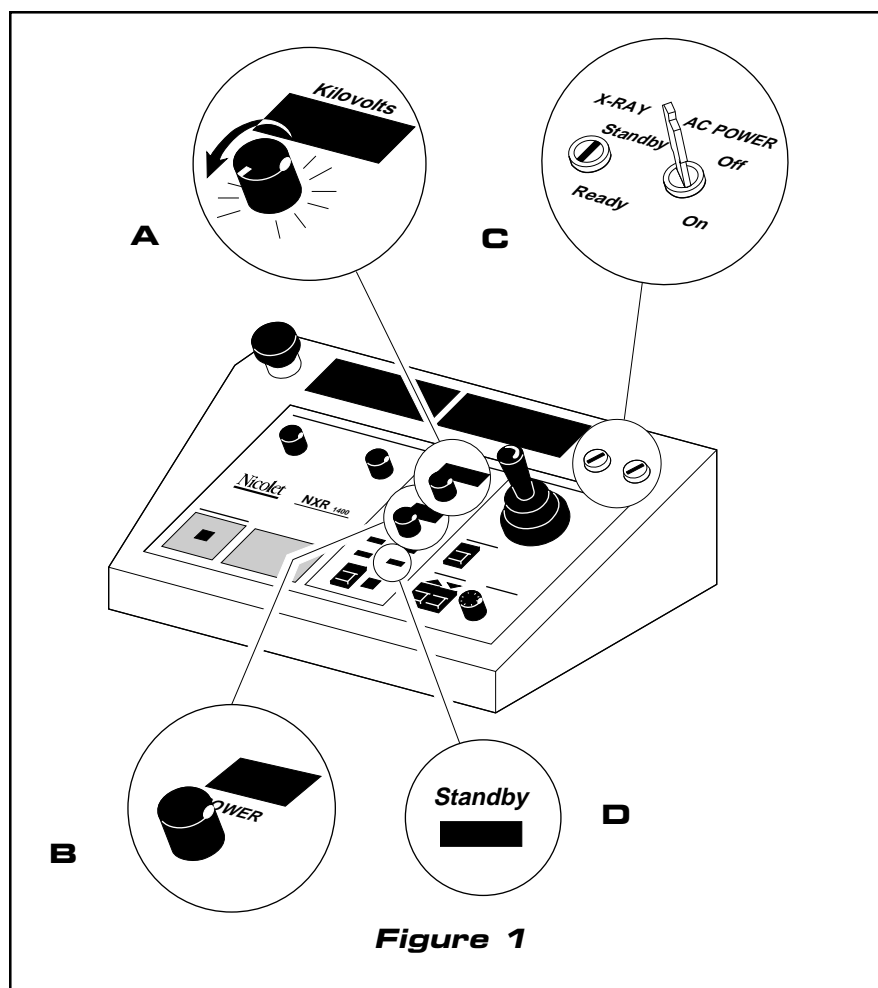


Figure 1

Enabling the X-rays

In order to generate x-rays, the NXR must be in the *Ready* mode. When the NXR is in the *Ready* mode, the system is designed to only generate x-rays when you press the **X-ray On** button. The *Ready* mode does **not** turn on the x-rays — it only enables them to be turned on.

Important: Refer to the Cold Start procedures in Section 3 of this manual if the system has been turned off.

To Enable the X-rays:

1. Set the voltage to its lowest amount by turning the **Kilovolts** control all the way to the left (Figure 2-A).
Important: Always set the kilovolts to its lowest setting before enabling the x-rays.
2. Set the power to its lowest setting by turning the **Power** control all the way to the left (Figure 2-B).
Important: Always set the power to its lowest setting before turning on the system.
3. Insert the key in the **X-ray** key switch and turn it to *ready* (Figure 2-C). The **Standby** LED (Figure 2-D) goes out and the **Ready** LED (Figure 2-E) comes on.

The NXR is now ready to generate x-rays.

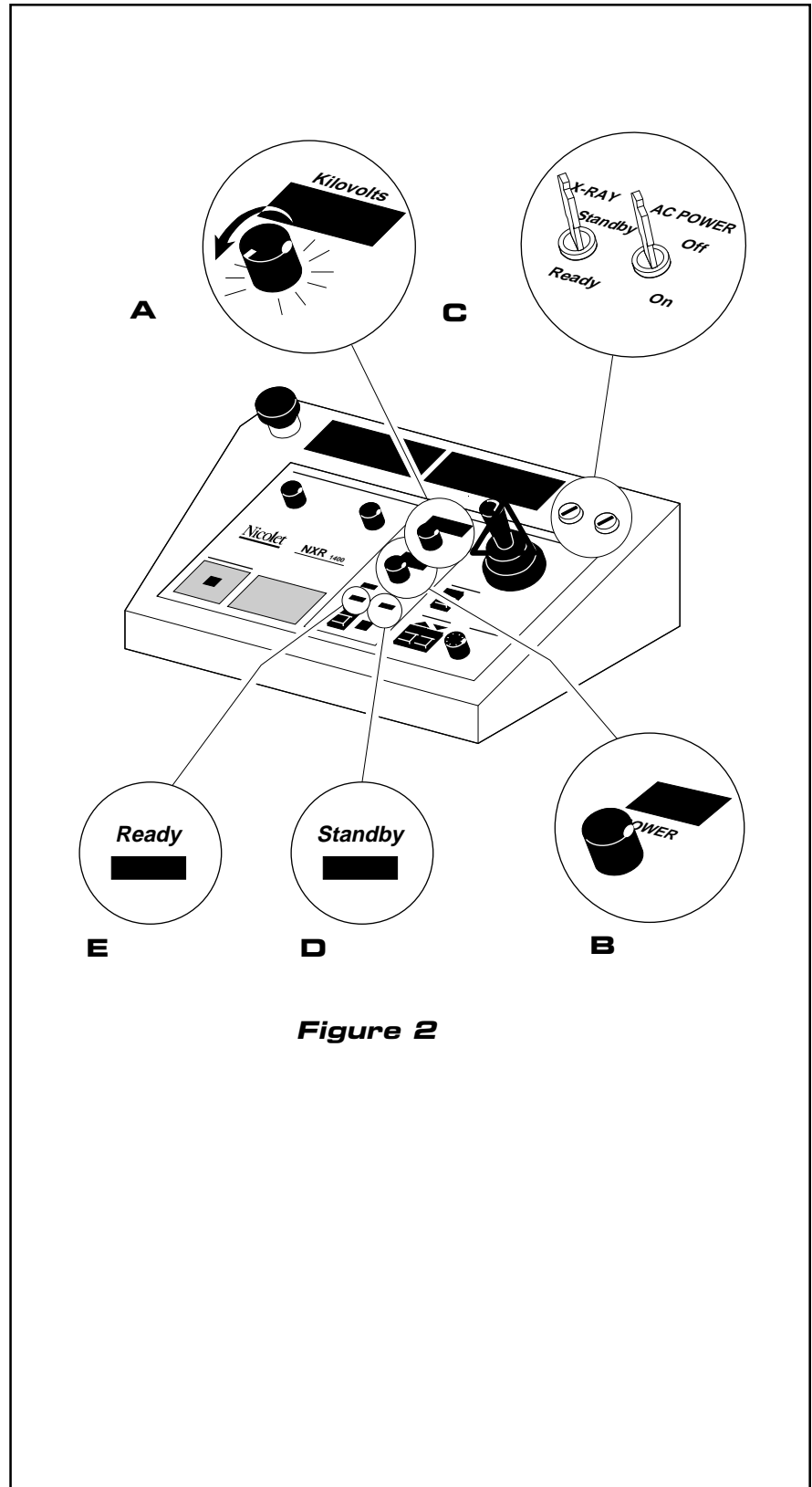


Figure 2

Loading the Sample

You can load the first sample while you are waiting for the system to warm up.

To Load a Sample:

1. If necessary, press the **Load** button (Figure 3-A) to automatically move the sample tray to the front left of the sample compartment.
2. Open the sample compartment's door and place the sample on the sample tray. The **Interlock 1** LED (Figure 3-B) blinks whenever the compartment door is open.
3. Close the compartment door. The **Interlock 1** LED (Figure 3-B) should now be on, but not blinking. If it is blinking, the door is not securely closed.

Note: A necessary safety feature of the NXR is designed to guard against you turning on the x-rays when the sample compartment door is open. The x-rays cannot be turned on until the sample door is closed.

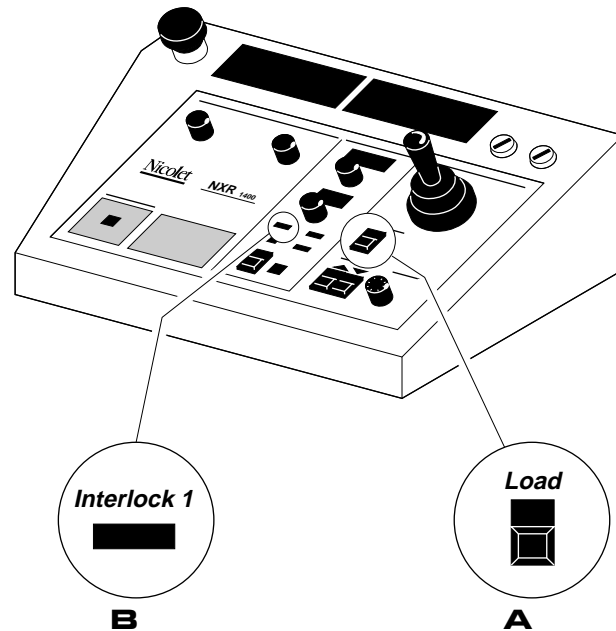


Figure 3

Inspecting the Sample

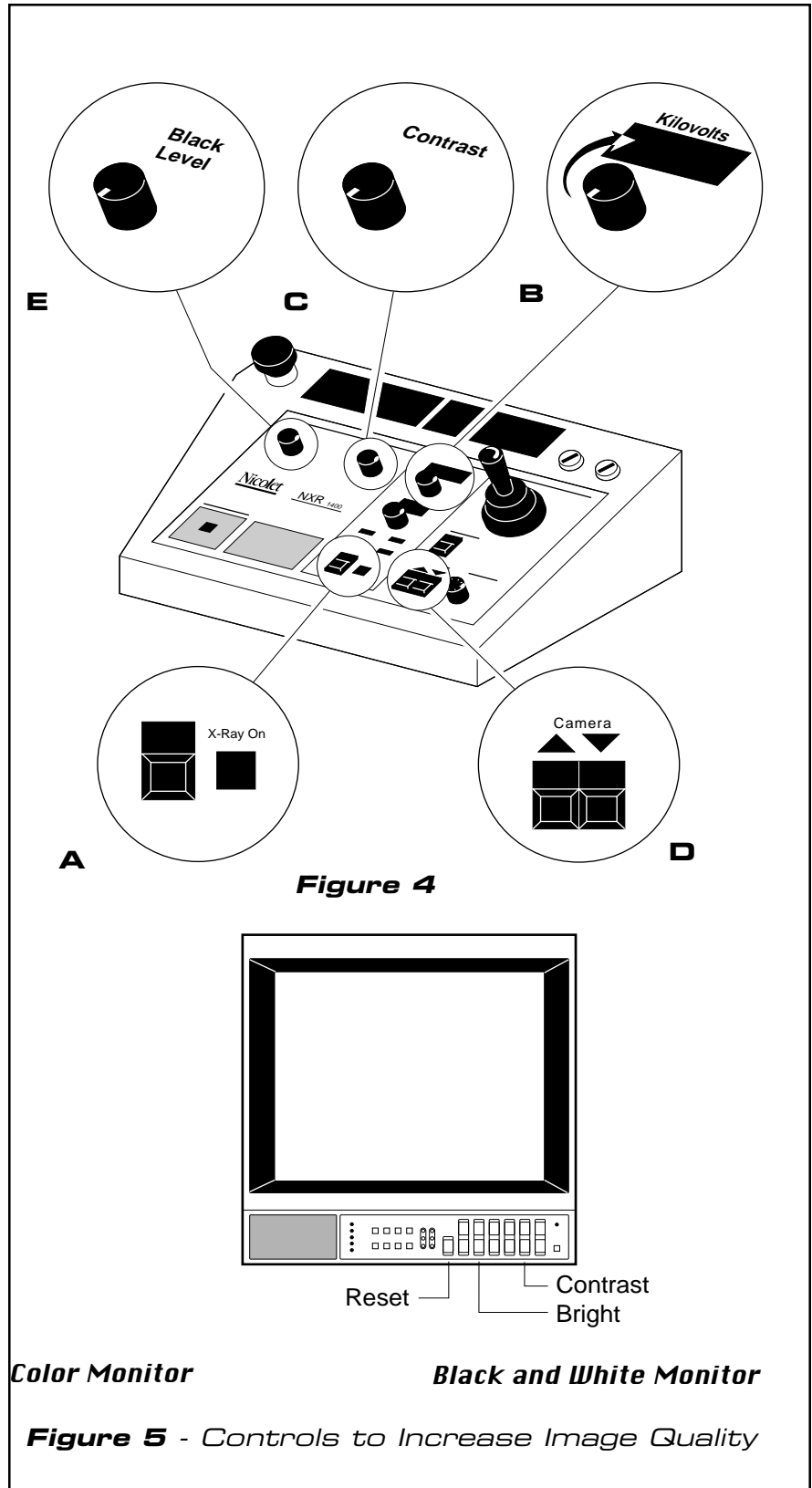
The NXR must be in the ready mode before you can turn on the x-rays. The **Ready** LED comes on when the system is ready to generate x-rays.

1. Use the joystick to move the sample under the camera. If not already done, adjust the lower limit of the camera to avoid contact with the sample. See "Adjusting the Camera's Lower Limit," page 4-6.
2. Press the **X-ray On** button (Figure 4-A). The system beeps and the **X-ray On** LED and **Warning** light come on.



Caution: If the NXR has been turned off for approximately four or more days, perform "Starting the System" in Section 3. Failure to do so can cause severe damage to the x-ray tube.

3. Increase the voltage by slowly turning the **Kilovolts** control (Figure 4-B) to the right. This increases the kilovolts readout value (Figure 4-B) and brightens the monitor.



Color Monitor

Black and White Monitor

Figure 5 - Controls to Increase Image Quality

4. Turn the **Contrast** (Figure 4-C) and **Kilovolts** (Figure 4-B) controls until the displayed image is clear and distinguishable. You may need to use the **Camera** buttons (Figure 4-D) to adjust the camera position. If you still cannot achieve a quality image, adjust the **Bright** and **Contrast** controls on the monitor (Figure 5). Pressing **Reset** on the color monitor returns the monitor's front panel adjustments to mid range. If no picture appears, try adjusting the **Black Level** control (Figure 4-E).

Loading the Sample

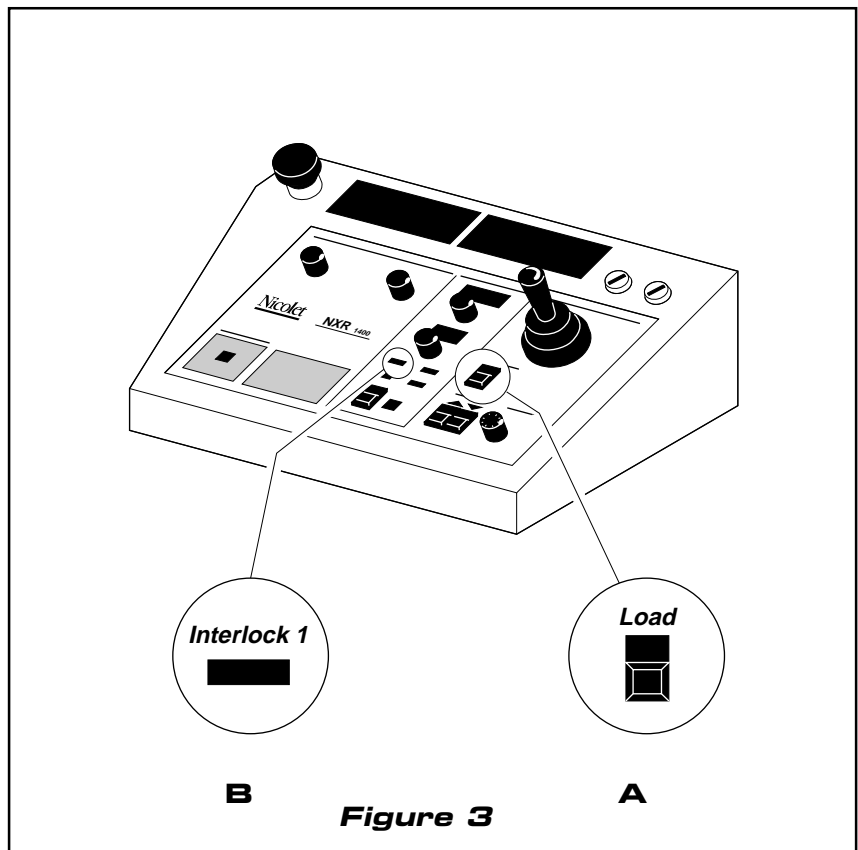
You can load the first sample while you are waiting for the system to warm up.

To Load a Sample:

1. If necessary, press the **Load** button (Figure 3-A) to automatically move the sample tray to the front left of the sample compartment.
2. Open the sample compartment's door and place the sample on the sample tray. The **Interlock 1** LED (Figure 3-B) blinks whenever the compartment door is open.

3. Close the compartment door. The **Interlock 1** LED (Figure 3-B) should now be on, but not blinking. If it is blinking, the door is not securely closed.

Note: A necessary safety feature of the NXR is designed to guard against you turning on the x-rays when the sample compartment door is open. The x-rays cannot be turned on until the sample door is closed.



Inspecting the Sample

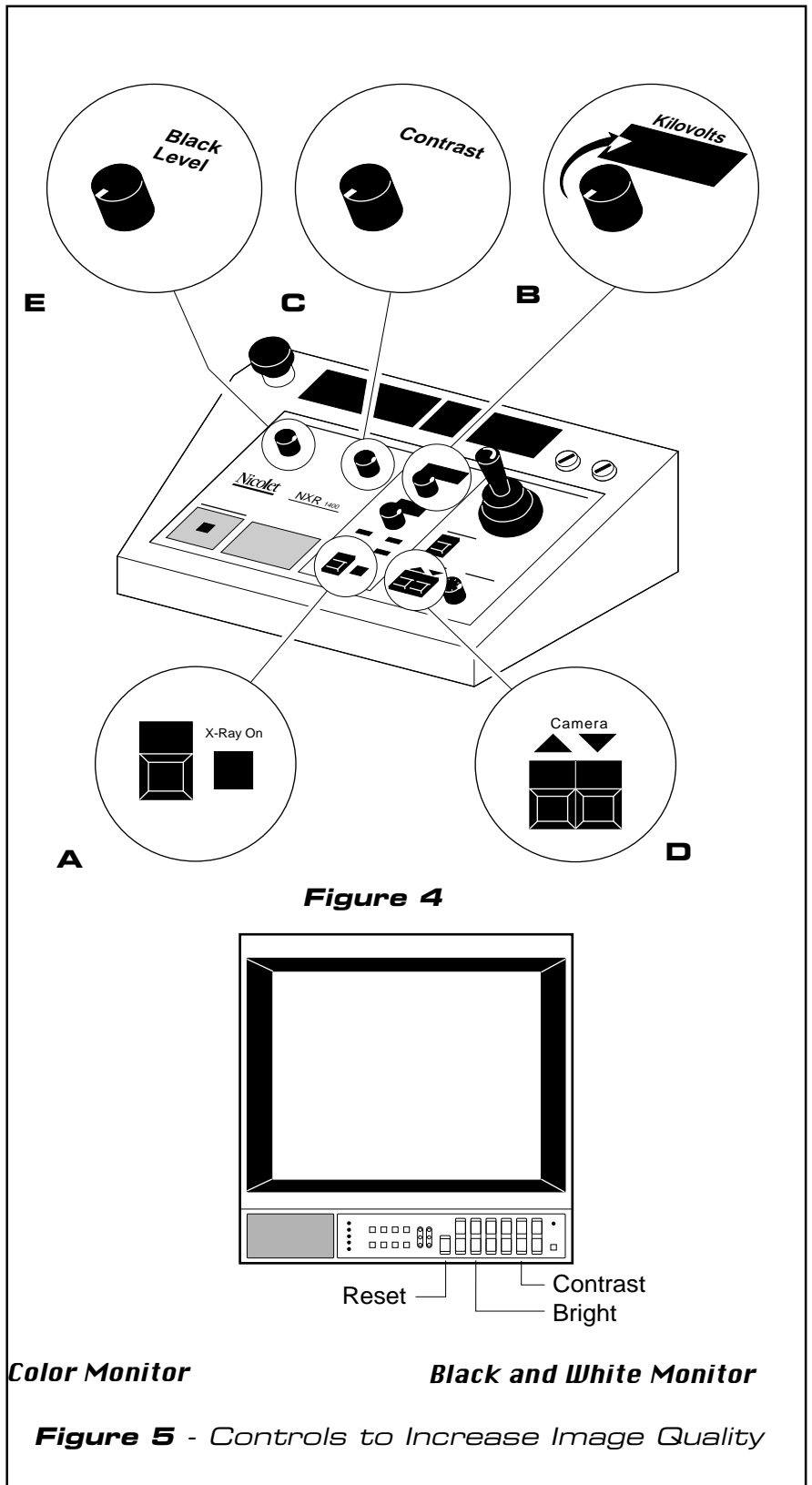
The NXR must be in the ready mode before you can turn on the x-rays. The **Ready** LED comes on when the system is ready to generate x-rays.

1. Use the joystick to move the sample under the camera. If not already done, adjust the lower limit of the camera to avoid contact with the sample. See "Adjusting the Camera's Lower Limit," page 4-6.
2. Press the **X-ray On** button (Figure 4-A). The system beeps and the **X-ray On** LED and **Warning** light come on.



Caution: If the NXR has been turned off for approximately four or more days, perform "Starting the System" in Section 3. Failure to do so can cause severe damage to the x-ray tube.

3. Increase the voltage by slowly turning the **Kilovolts** control (Figure 4-B) to the right. This increases the kilovolts readout value (Figure 4-B) and brightens the monitor.



4. Turn the **Contrast** (Figure 4-C) and **Kilovolts** (Figure 4-B) controls until the displayed image is clear and distinguishable. You may need to use the **Camera** buttons (Figure 4-D) to adjust the camera position. If you still cannot achieve a quality image, adjust the **Bright** and **Contrast** controls on the monitor (Figure 5). Pressing **Reset** on the color monitor returns the monitor's front panel adjustments to mid range. If no picture appears, try adjusting the **Black Level** control (Figure 4-E).

Disabling the System

Any time you leave the NXR system or will not be using it for a while, set the system to the *standby* mode (Figure 6) and then remove the **X-ray** key. The *standby* mode disables the x-rays and helps guard against unauthorized use of the system.

To Disable the System:

1. Turn the key in the **X-ray** key switch to *standby* (Figure 6).
2. Remove the key and put it in a safe place.

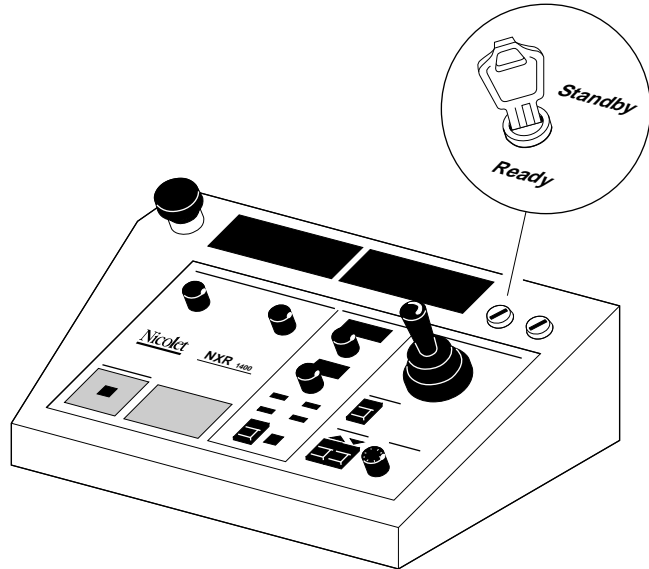


Figure 6 - NXR in the Standby mode

Section 6

Options & Accessories

Sample Rotation 6-3

This section contains general information about the accessories that can be ordered for your NXR system. Please refer to the appropriate manufacturer's manual for specific information.

Contact your NIS sales representative if you are interested in upgrading or adding accessories to your system.



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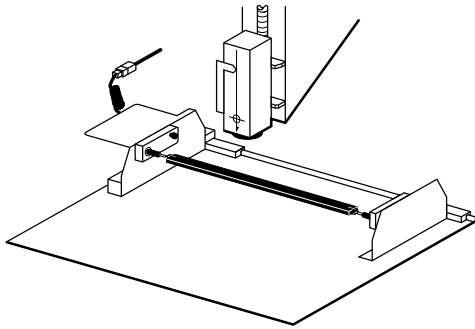


Figure 1 - Sample Rotation

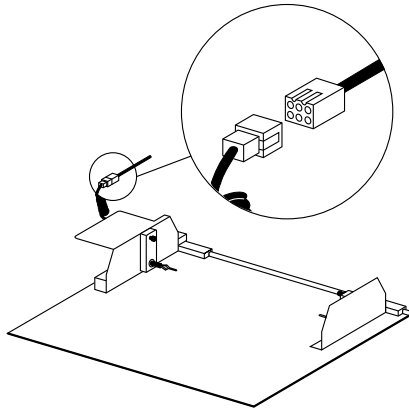


Figure 2 - Installing the Sample Rotation

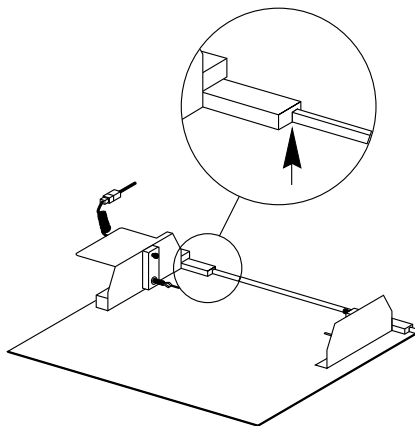


Figure 3 - Mounting the Sample Rotation

Sample Rotation

The Sample Rotation accessory lets you rotate samples a full 360° while they are in the x-ray beam. This helps you:

- Inspect samples such as tube ICs for bond wire height, wire sweep, molding voids, or die attach voids without manually repositioning the samples.
- View samples such as pin grid arrays and plated-through-hole boards at an angle to obtain additional information about their internal characteristics.

Installing the Sample Rotation

The Sample Rotation accessory has a motor assembly and tailstock (Figure 1) which mount on the small rail at the back of the sample tray.

1. Turn the **X-ray** key switch to *Standby*.
2. Open the sample compartment door and locate the socket at the top left (Figure 2).
3. Plug the motor assembly's 6 pin connector into the socket. The ridges on the connector must match the grooves on the socket.
4. Mount the motor assembly onto the small rail at the back of the sample tray. The rail fits into the groove on the block at the bottom of the assembly (Figure 3).
5. Mount the tailstock onto the small rail at the back of the sample tray in the same manner as the motor assembly. You may need to move the sample tray so the tailstock isn't touching the camera.



CAUTION: When the sample rotation is in the sample compartment, be extremely careful when you move the sample tray. Avoid striking the camera with the motor assembly or tailstock. **Do NOT press the Load button or turn on the power with the tailstock in the sample compartment.** The sample tray automatically moves to the load position when you turn on the AC power.

Sample Rotation

Adjusting the Swivel Arms

Before using the Sample Rotation, raise or lower the swivel arms on the motor assembly and tailstock so the sample just clears the sample tray. When the swivel arm is in its lowest position, there is approximately 0.5 inch clearance between the rotation shaft and the sample tray. When the arm is in the highest position, there is approximately 5.5 inches of clearance. You can position the arms at any height between these two extremes.

Adjust the swivel arms so the sample is as close as possible to the sample tray, but far enough away so the sample does not strike the tray when it rotates.

1. Loosen the swivel brake at the top of the swivel arm (Figure 1).
2. Rotate the arm toward the front of the sample compartment until there is sufficient clearance for the sample to rotate freely.

Note: Always keep the distance between the sample and the tray to a minimum to take advantage of the denser x-ray field.

3. Tighten the swivel brake to lock the arm in position.
4. If you are using the tailstock, adjust its swivel arm to the same height as the swivel arm on the motor assembly (Figure 2).
5. Test to ensure that the sample freely rotates by turning the **Rotation** knob. The rotating sample must not touch the tray or camera.



CAUTION: You may also need to adjust the camera's lower limit to avoid striking the sample with the camera. See Section 4, "Adjusting the Camera's Lower Limit."

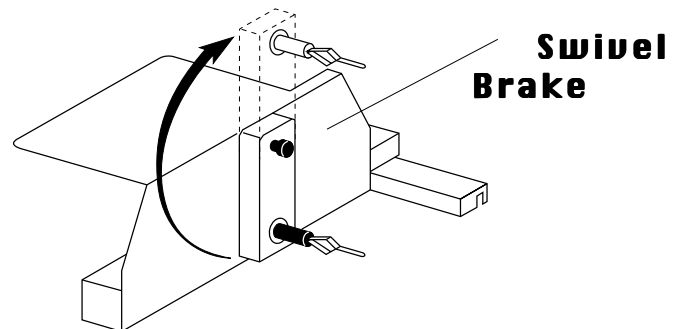


Figure 1 - Adjusting the Swivel Arm on the Motor Assembly

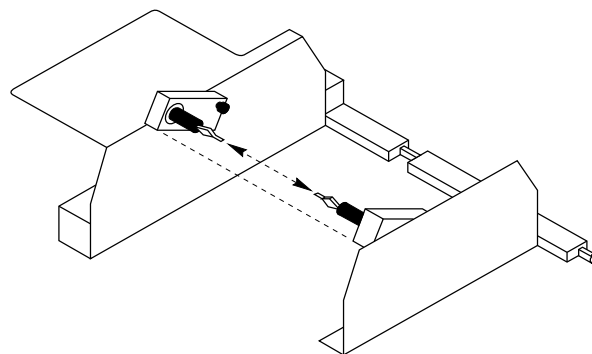


Figure 2 - Adjusting the Swivel Arm on the Tailstock

Sample Rotation Using the Sample Rotation

In some cases, the weight of the sample may cause the clips to slip which makes it difficult to fully rotate the sample. There are a number of methods to prevent the slippage. If this occurs in your application, please contact your NIS representative for an application-specific solution.

To use the sample rotation:

1. When you are inspecting small samples, simply clip them to the motor assembly (Figure 1). Use the tailstock to support large samples (Figure 2).
2. Turn the **Rotation** knob (Figure 3) on the control panel to rotate the sample. Turning the knob all the way to the right rotates the sample slightly more than 360°.



CAUTION:

When the sample rotation is in the sample compartment, be extremely careful when you move the sample tray. Avoid striking the camera with the motor assembly or tailstock. **Do NOT press the Load button or turn on the power with the tailstock in the sample compartment.** The sample tray automatically moves to the load position when you turn on the AC power.

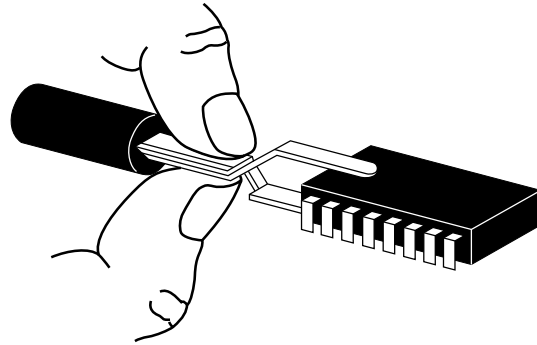


Figure 1 - Mounting Small Samples

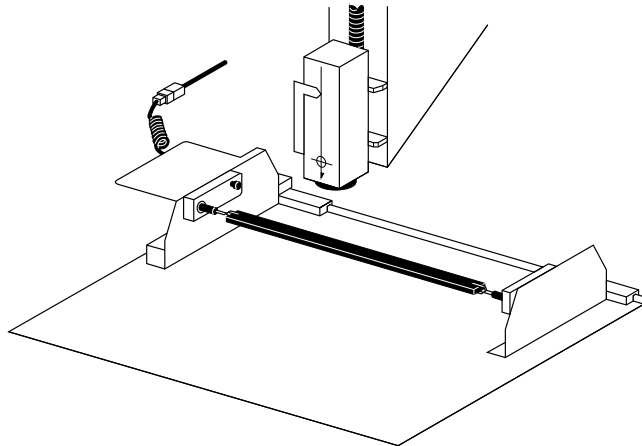


Figure 2 - Mounting Large Samples

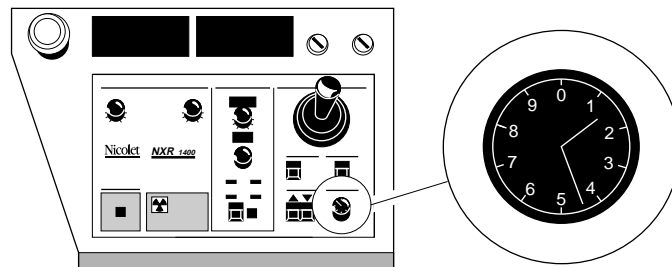


Figure 3 - Rotation Knob

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Maintenance, Service & Troubleshooting

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This section contains basic maintenance procedures you must follow to keep your NXR performing at its optimum capabilities. It also includes how to obtain service information and a list of problems and their solutions.

If you have questions, please call NIS Customer Service Center (CS).

CS: 800-228-1147

FAX: 619-693-0815

Local: 619-635-8621

Maintenance

Cleaning - General

To avoid damage and unnecessary cleaning, protect the equipment from dust, dirt, and any other environmental hazards that damage surfaces or impair operation.

Do not use rough, abrasive cloths to clean the equipment, or solvents such as acetone, carbon tetrachloride, or trichloroethylene. These solvents may damage the painted surfaces.

- Clean controls and other machine surfaces with a no-rinse liquid cleaner.
- Clean the acrylic plastic surfaces with an acrylic plastic cleaner and a soft cloth.
- Clean glass surfaces with a glass cleaner and a soft cloth.



CAUTION:

Use only glass cleaner and a soft cloth to clean the viewing glass. The leaded glass is especially designed for protection against x-ray radiation exposure. Abrasives may damage its protection capabilities.



WARNING:

Do NOT operate the system if the viewing glass is damaged in any way. Immediately contact NIS Customer Care Center for repairs.

Cleaning - Sample Tray and Sample Table

To keep the sample tray moving smoothly and the displayed images distinct, regularly clean the tray and table. Remove the sample tray by unscrewing the four screws along the right edge, and thoroughly clean the table top and bottom of the tray.

Inspection

As with any other equipment or system, periodically inspect the NXR for signs of wear and damage.

- Examine the interior of the sample compartment and ensure that the lead lining is intact.
- Examine the viewing glass for any cracks, chips, or scratches.

Shipping Kit (Spare Parts)

The shipping kit packaged with your system contains additional lamps and fuses. Keep this kit in a safe place. If you suspect that a lamp or fuse has burned out, please contact -

Nicolet Imaging Systems' Customer Service Center at:

CS: 800-228-1147

FAX: 619-693-0815

Local: 619-635-8621

A NIS service representative may need to inspect your system and, depending on its location, replace the lamp or fuse.

SERVICE

If you have questions, please call NIS Customer Service Center. If you need service, please call your regional office.

CS: 800-228-1147

FAX: 619-693-0815

Local: 619-635-8621

Return Authorization

Before returning an NXR or any component, please contact the Customer Service Center for a Return Authorization Number. Nicolet cannot accept unauthorized returns.

Repackaging

After you obtain a Return Authorization Number, attach a tag to the NXR or component that includes your name, place of business, and type of service or repair required. Also include the Return Authorization, model, and full serial numbers.

Returning the X-Ray Cabinet

If you are returning the x-ray cabinet, contact the Customer Service Center for packaging and shipping instructions.

Returning the Monitor

Follow these procedures when returning the monitor. If you have questions about returning any other system component, please contact NIS Customer Service Center for packaging and shipping instructions.

1. Place the monitor in its original container and insert the foam end mounts.
2. Seal the container with strong tape or metal bands.
3. Appropriately mark the container with "Delicate Instrument," "Fragile," and "This End Up."

If you are unable to locate the original shipping container for the monitor, follow these precautions:

1. Place packing material around all sides of the monitor.
2. Protect the screen with cardboard.
3. Wrap the monitor in heavy paper or plastic.
4. Place the wrapped monitor in a wooden box and seal it with strong tape or metal bands.
5. Appropriately mark the container with "Delicate Instrument," "Fragile," and "This End Up."

Troubleshooting

This section describes solutions to common problems that you may encounter as you use the NXR system. Check your system with any indicators that may be listed and see that the same conditions exist before trying the solution.

Before Calling for Help

In order to help us better serve you and determine whether a service call is necessary, please complete the following procedures before you call:

- Determine the general problem.
- Follow the appropriate troubleshooting procedure described in this section.
- If the problem cannot be solved with a troubleshooting procedure, turn off the AC power. Let the system cool down and then turn on the power again. Determine if the problem still exists.
- Make a visual inspection of all controls and cables. Note any unusual circumstances, or correct improper settings and connections.
- Determine if the **Kilovolts** display appears normal.
- Make a note of any other control panel indicators and all non-normal conditions you observed.

Calling for Help

If you cannot solve your problem, please call the NIS Customer Service Center at:

CS: 800-228-1147
FAX: 619-693-0815
Local: 619-635-8621

POWER



- Problem:** The AC Power key switch is set to on, but the system is not on.
- Indicator:** AC Power LED is out.
- Solution:** Ensure that the system is plugged into an active AC power source and the fuse has not been blown. Also, someone may have pressed the Emergency Off button and did not restart the system. To restart the system, turn the AC Power key switch to off and then back to on.
-

X-RAYS

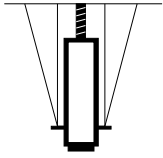


- Problem:** The power is on, but you cannot turn on the x-rays.
- Indicators:** Standby LED is on.
Ready LED is out.
- Solution:** The system either needs to warm up, or the X-ray key switch is set to standby. The NXR needs approximately ten minutes to warm up after you turn on the power. If the X-ray key switch is set to standby, turn it to ready. The Ready LED comes on when the system is ready to generate x-rays.
-

- Problem:** The power is on, but you cannot turn on the x-rays.
- Indicator:** Interlock 1 LED is blinking.
- Solution:** Ensure that the sample compartment door is securely closed.
-

- Problem:** The power is on, but you cannot turn on the x-rays.
- Indicator:** Interlock 2 LED is blinking.
- Solution:** Immediately contact Nicolet's Service Center.

CAMERA



Problem: The camera does not move up when you press the Camera Up button.

Indicators: AC Power key switch is on.
AC Power LED is on.

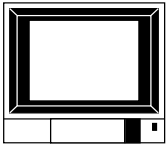
Solution: The camera is already at its maximum height. You can only lower the camera by pressing the Camera Down button.

Problem: The camera does not move down when you press the Camera Down button.

Indicators: AC Power key switch is on.
AC Power LED is on.

Solution: The camera may be impacting the sample or already at its lowest position. Raise the camera by pressing the Camera Up button. If you want to position the camera lower than its present lowest position, try adjusting the camera's lower limit. See Section 4.

MONITOR



Problem: No image appears in the monitor.

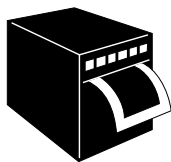
Indicators: X-ray On LED and X-ray On Warning light are on.
Sample is below camera.
Coaxial cable is connected to the back of the monitor.
Monitor is on.

Solution: Try adjusting the following controls on the control panel:

- Kilovolts
- Contrast
- Power
- Black Level
- Camera.

If an image still does not appear, try adjusting the Brightness and Contrast controls on the monitor. Pressing the Reset button on the Color Monitor's front panel resets all variable control settings on the monitor to their mid range settings. Also ensure the camera power is on and the high voltage supply is on. Bypass all other options/accessories between the NXR and monitor. For example, if the video micrometer accessory is being used, disconnect it from the string and connect the monitor directly to the NXR.

PRINTER

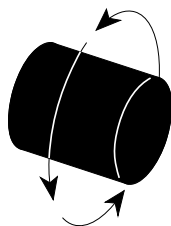


Refer to the printer's manual for additional troubleshooting and information.

- Problem:** Printer does not respond when you press the Print button.
- Solution:** Press the power switch on the front of the printer to turn on the printer's power. If that does not work, ensure that the cable is properly connected between the monitor and printer, and there is paper in the printer. Ensure the "Head Set" lever is ON (inside front panel of the printer). The Alarm lamp on the front of the printer lights when the printer is out of paper.

- Problem:** You cannot preview the printer's output on your color monitor.
- Solution:** Press either the Line A or Line B button on the front of the color monitor. You must turn on the line to which the printer's Mon Out cable is connected in order to preview the printer's output.

SAMPLE ROTATION



- Problem:** The sample hits the tray when you try to rotate it.
- Solution:** Adjust the swivel arms on the sample rotation. See Section 6.

- Problem:** The sample hits the camera when you try to rotate it.
- Solution:** Move the camera up by pressing the Camera Up button. You may want to adjust the camera's lower limit if this is a reoccurring problem. See Section 6.

- Problem:** The sample does not rotate or slips when you turn the Rotation knob.
- Solution:** The weight of the sample may be causing the clips to slip. Try using the tailstock to help support the sample. If that does not work, please contact your NIS representative for an application-specific solution.

Section 8

APPENDIX FOR THE NXR 1400

Registration of X-ray Equipment 8-3

This chapter contains additional information pertaining to your NXR Real-Time X-ray Imaging System.

REGISTRATION OF X-RAY EQUIPMENT

Each state requires you to register your NXR Real-Time X-ray Imaging System. The following is a list of agencies for each of the states in which your X-ray equipment is located.

Alabama (AL)	Director of X-ray Compliance, Division of Radiological Health, State Department of Public Health, State Office Bldg, Montgomery, AL 36130 Tel. (205) 261-5315
Alaska (AK)	Radiological Health Program, Department of Health & Social Services, Box H, Juneau, Alaska 99811-0613 Tel. (907) 465-3019
Arizona (AZ)	X-ray Compliance, Arizona Radiation Regulatory Agency, 4814 South 40th St., Phoenix, Arizona 85040 Tel. (602) 255-4845
Arkansas (AR)	Division of Radiation Control and Emergency Management, Department of Health, 4815 West Markham Street, Little Rock Arkansas 72205-3867 Tel. (501) 661-2301
California (CA)	Radiological Health Branch, State Department of Health Service, 714 P Street, Office Bldg #18, Sacramento, California 95814 Tel. (916) 322-2040
Colorado (CO)	Radiation Control Division, Department of Health, 4210 East 11th Avenue, Denver, Colorado 80220 Tel. (303) 331-8480
Connecticut (CT)	Radiation Control Unit, Dept. of Environmental Protection, 165 Capitol Avenue, Hartford, Connecticut 06106 Tel. (203) 566-5668
Delaware (DE)	Office of Radiation Control, Division of Public Health, Robbins Bldg., Silver Lake Plaza, Box 637, Dover Delaware 19903 Tel. (302) 736-4731
District of Columbia (D.C.)	Department of Consumer and Regulatory Affairs, Service Facility Regulation Administration, 614 H Street, N.W., Room 1014, Washington D.C. 20001 Tel. (202) 727-7190
Florida (FL)	Office of Radiation Control, Department of Health and Rehabilitative Services, 1317 Winewood Boulevard, Tallahassee, Florida 32399-0700 Tel. (904) 487-1004

REGISTRATION OF X-RAY EQUIPMENT

Indiana (IN)	Radiological Health Section, State Board of Health, 1330 West Michigan Street, Box 1964, Indianapolis, Indiana 46206 Tel. (317) 633-0152
Iowa (IA)	Bureau of Environmental Health, Iowa Department of Public Health, Lucas State Office Building, Des Moines, Iowa 50319 Tel. (515) 281-4928
Kansas (KS)	Bureau of Air Quality and Radiation Control, Department of Health and Environment, Forbes Field, Bldg. 321, Topeka, Kansas 66620 Tel. (913) 296-1542
Kentucky (KY)	Radiation Control Branch, Cabinet for Human Resources, 275 East Main Street, Frankfort, Kentucky 40621 Tel. (502) 564-3700
Louisiana (LA)	Department of Environmental Quality, Box 44066, Baton Rouge, Louisiana 70804 Tel. (504) 342-9103
Maine (ME)	Division of Health Engineering, 157 Capitol Street, State House, Station 10, Augusta, Maine 04333 Tel. (207) 289-3826
Maryland (MD)	Center for Radiological Health, Environmental Science and Health, Maryland Dept. of the Environment, 201 W. Preston St., Baltimore, Maryland 21201 Tel. (301) 333-3130
Massachusetts (MA)	Radiation Control Program, Department of Health, 150 Tremont Street, Second Floor, Boston, Massachusetts 02111 Tel. (617) 727-6214
Michigan (MI)	Div. of Radiological Health, Bureau of Environmental & Occupational Health, Dept. of Public Health, 3500 N. Logan St., Box 30035, Lansing, MI 48909 Tel. (517) 335-8200
Minnesota (MN)	Section of Radiation Control, Minnesota Dept. of Health, 717 Delaware St, S.E., Box 9441, Minneapolis, Minnesota 55440 Tel. (612) 623-5351
Mississippi (MS)	Division of Radiological Health, State Department of Health, 3150 Lawson Street, Box 1700, Jackson, Mississippi 39215-1700 Tel. (601) 354-6657
Missouri (MO)	Bureau of Radiological Health, 1730 East Elm Street, Box 570, Jefferson City, Missouri 65102 Tel. (314)-751-6083
Montana (MT)	Environmental Sciences Division, Department of Health and Environmental Sciences, Cogswell Building, Helena, Montana 59620 Tel. (406) 444-3948

REGISTRATION OF X-RAY EQUIPMENT

Nebraska (NE)	Division of Radiological Health, Department of Health, 301 Centennial Mall, South, Box 95007, Lincoln, Nebraska 68509 Tel. (402) 471-2168
Nevada (NV)	Radiological Health Section, Health Division, Department of Human Resources, 505 East King Street, Carson City, Nevada 89710 Tel. (702) 885-5394
New Hampshire (NH)	Radiological Health Program, Box 148, Concord, New Hampshire 03302 Tel. (603) 271-4588
New Jersey (NJ)	Division of Environmental Quality, Department of Environmental Protection, 380 Scotch Road, CN411, Trenton, New Jersey 08625 Tel. (609) 530-4002
New Mexico (NM)	Radiation Protection Bureau, Environmental Improvement Division, Dept. of Health and Environment, Box 968, Santa Fe, New Mexico 87504-0968 Tel. (505) 827-2959
New York (NY)	Bureau of Environmental Radiation Protection, New York State Health Department, Two University Place, Albany, New York 12203 Tel. (518) 458-6461
North Carolina (NC)	Radiation Protection Section, Division of Facility Services, Department of Human Resources, 701 Barbour Drive, Raleigh, North Carolina 27603 Tel. (919) 733-4283
North Dakota (ND)	Division of Environmental Engineering, Department of Health, 1200 Missouri Avenue, Box 5520, Bismark, North Dakota 58502-5520 Tel. (701) 224-2348
Ohio (OH)	Radiological Health Program, Department of Health, 122 Kinnear Road, Columbus, Ohio 43212 Tel. (614) 481-5800
Oklahoma (OK)	Radiation and Special Hazards Service, State Department of Health, Box 53551, Oklahoma City, Oklahoma 73152 Tel. (405) 271-5221
Oregon (OR)	Radiation Control Section, State Health Division, Department of Human Resources, 1400 Southwest Fifth Avenue, Portland, Oregon 97201 Tel. (503) 229-5797

REGISTRATION OF X-RAY EQUIPMENT

Washington (WA)	Office of Radiation Protection, Dept. of Social and Health Services, Mail Stop LF-13, Olympia, Washington 98504 Tel. (206) 753-3468
West Virginia (WV)	Industrial Hygiene Division, 151 11th Avenue, South Charleston, West Virginia 25303 Tel. (304) 348-3526
Wisconsin (WI)	Radiation Protection Section, Division of Health, Dept. of Health and Social Services, Box 309, Madison, Wisconsin 53701 Tel. (608) 273-5181
Wyoming (WY)	Radiological Health Services, Division of Health and Medical Services, Hathaway Bldg., Cheyenne, Wyoming 82002-0710 Tel. (307) 777-6015

Section 9

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