X-RAD Biological Irradiator

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User Manual

This document is to provide a complete operational description of the X-RAD Biological Irradiator. This document is intended for use by system Users and Super-Users.

Contents

1   Radiation Protection Information

> **Caution: This equipment produces dangerous levels of X-Ray radiation that can cause serious injury or death if used improperly. The X-RAD Biological Irradiator should be used by qualified personnel only.**

A key is required to operate the system. We strongly recommend that the key be removed when the system is not being used.

Although the equipment is delivered with safety functions required by federal regulations, we require that the following additional measures be taken to assure safe operation and continued protection for users of this equipment:

1. Carefully read all user manuals provided for this equipment before operating the equipment.
2. Never defeat the protection mechanisms installed with your unit. This includes safety door switches, warning lights, lead shielding, and equipment connections.
3. Never open any of the covers or side panels on this unit unless unit contains a User-Access panel. Failure to comply could result in elevated radiation leakage and personal injury
4. Warning: there are no user serviceable parts in this unit. Service and maintenance of the equipment must be performed at regular intervals by qualified service technicians.

2   Introduction/System Overview

2.1   Irradiation Cabinet

The Irradiation Cabinet is a once-piece radiation enclosure that is manufactured to comply with Federal Regulations CFR1020.40. It provides radiation protection with a leakage of less than 0.2mRem/hr. at any point on the outside surface. The Cabinet features safety interlocks located on the cabinet door and the baffle to ensure that users cannot be exposed to radiation under recommended operating conditions.

2.2   TouchRAD Panel

The TouchRAD Panel features all of the controls for the X-RAD Biological Irradiator including all analog controls/indicators and a touchscreen computer that hosts the TouchRAD User Interface. Analog controls include a System Key-Switch to change the system state between OFF, STANDBY and ON, Motor Key-Switch to raise/lower the specimen shelf and an Emergency Stop that will instantly stop X-Rays when activated. Also, there is a steady analog indicator for X-Rays on warning lamp while X-Rays are   being   produced.

Touchscreen Computer

Emergency Stop

Warning Lamp

...elf Key-Switch

USB Port

Key-Switch
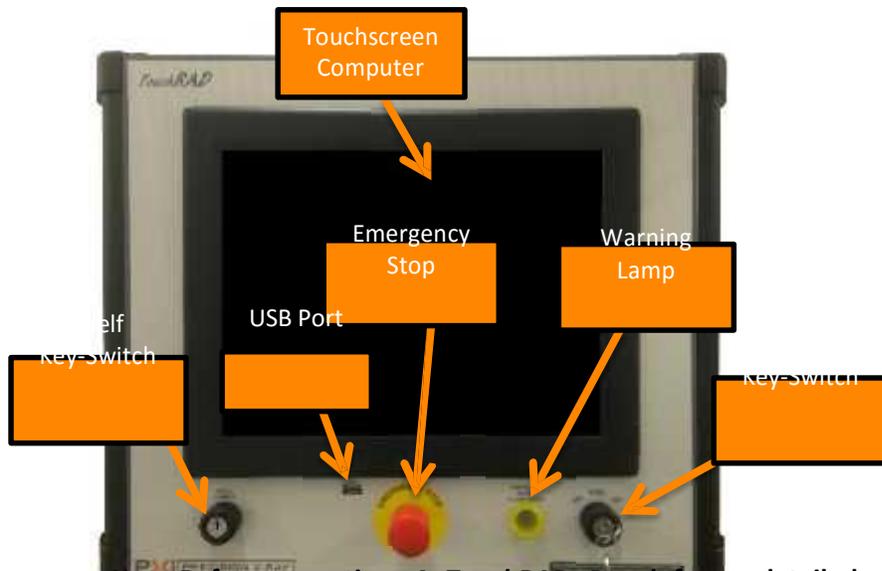
Note-Refer to section *4 TouchRAD Panel* for a detailed description of TouchRAD Panel Components

2.3 TouchRAD User Interface

The TouchRAD User Interface is a touchscreen interface that allows the user to operate all features of the X-RAD Biological Irradiator. The TouchRAD User Interface allows a user to manipulate kV and mA, run time dependent or dose dependent programs and review exposure histories as well as many other features.

2.4 Available Accessories

To enhance capabilities, there are several options available designed for specific usage with the X-RAD Biological Irradiator. All options can be retro fitted on existing installed unit.

3 Irradiation Cabinet

3.1 Safety Interlocks

All X-RAD Biological Irradiators feature safety interlocks to prevent accidental radiation exposure to the user(s). If one or more of the interlocks are disabled, X-Rays will not be permitted. If X-Rays are on and an interlock is disabled, i.e. emergency stop, X-Rays will immediately shut off. Each X-RAD Biological Irradiator is equipped with an CDRH Switch, Center for Devices and Radiological Health Switch, located on the cabinet door which physically inhibits X-Rays from being produced while the door   is   open.

X-RAD Model	Cabinet Door	CDRH Switch	Emergency Stop	Baffle(s)	Access Panel(s)	Warning Lamp
160	✓	✓	✓		✓	✓
iR160	✓	✓	✓	✓	N/A	✓
225	✓	✓	✓		✓	✓
iR225	✓	✓	✓	✓	N/A	✓
320	✓	✓	✓	✓	N/A	✓
320iX	✓	✓	✓		✓	✓

3.2 Warning Lamp

All X-RAD Biological Irradiators feature an "X-Ray On" warning lamp to give the users and bystanders a visual notification that X-Rays are being produced.

> Note-If the warning lamp fails, X-Rays will shut off, a "Warning Lamp" error will be displayed to the User Interface and X-Rays will be disabled until the Warning Lamp is replaced.

3.3 Baffle

The baffle is a lead shielding around the port hole(s) of each X-RAD Biological Irradiator to stop/limit irradiation leakage outside of the cabinet. Cabinets containing baffle safety interlocks feature redundant interlocks ensuring the baffle cannot be open and X-Rays produced. Some X-RAD models feature dedicated user accessible baffles to allow the user to run wires, cables, hoses and equipment into the cabinet without any radiation leakage. If an X-RAD model does not have a dedicated user accessible baffle, the user can run wires, cable, hoses and equipment through the main baffle.

X-RAD Model	User Baffle
160	✓
iR160	
225	✓
iR225	
320	
320iX	✓

4 TouchRAD Panel

4.1 System Key-Switch

4.1.1 Overview

The System Key-Switch puts the X-RAD Biological Irradiator in one of three modes: Off, Standby and On.

4.1.2 OFF

When the System is in the OFF state, X-Rays cannot be produced and the TouchRAD User Interface is inoperable. When the System is initially turned to the OFF state from the STANDBY state, the TouchRAD User Interface will take about 30 seconds to shut down.

> **Note-Once System is in OFF state, it must remain OFF for at least 30 seconds to ensure the computer will start normally when System goes to STANDBY state.**

4.1.3 STANDBY

When the system is in STANDBY mode, the TouchRAD User Interface is operable but X-Rays cannot be produced. In order to produce X-Rays, the system must be put in ON mode.

> **Note-If user tries to produce X-Rays, a "Safety Circuit Error" will be displayed to the User Interface.**

4.1.4 ON

When the System is in the ON state, the whole system is operable and X-Rays can be produced. By switching the System Key Switch to the ON position, the safety circuit for the X-Ray system is closed allowing X-Rays to be produced.

4.2 Warning Lamp

The Warning Lamp is a steady yellow light that is on while X-Rays are being produced.

> **Note-The TouchRAD warning lamp is not included in the safety circuit as it is a secondary indicator. If the TouchRAD warning lamp bulb fails, X-Rays <u>CAN</u> be produced.**

4.3 Emergency Stop

The Emergency Stop is hardwired into the X-Ray Power Supply via the safety circuit and will instantly stop X-Rays when activated. To activate the Emergency Stop, simply push the button inward toward the panel. To deactivate the Emergency Stop, twist the button counterclockwise and it will pop out to its inactivated state.

> **Note-When the Emergency Stop is activated a "Safety Circuit Error" will be returned to the User Interface.**

4.4 Shelf-Switch

> **Note-This section only applies if Motorized Shelf or Programmable Shelf option is installed. Refer to section *7.6 Motorized Shelf* and *7.7 Programmable Shelf* for more details**

The Shelf-Switch will move the Motorized/Programmable Shelf within the cabinet up and down to adjust the source to specimen distance (SSD). Turning the switch counterclockwise will lower the shelf while clockwise will raise the shelf.

> **Note-If Programmable Shelf option is installed, the Shelf-Switch will only work while the TouchRAD User Interface is in *Program Mode* or *Manual Mode***

4.5 Touchscreen Computer

The touchscreen computer hosts the TouchRAD User Interface. This computer can only be turned on and off via the System Key-Switch. When the System is initially put in STANDBY mode, the computer will turn on and take about 30 seconds before the TouchRAD User Interface starts up. When the System is initially put in OFF mode, the computer will immediately start to shut down and take about 30 seconds before it is completely off. In order for proper ON/OFF cycles of the computer to occur, the System must remain in OFF state for at least 30 seconds before it can be put back in STANDBY state.

4.6 USB Port

The USB Port is to be used by the User for downloading the System Database and plugging in an external WIFI adaptor for use with PXi's Remote Access feature.

5 TouchRAD User Interface

5.1 Overview

The TouchRAD User Interface is a touchscreen based application from which all functionality of the X-RAD system is controlled. It enables users to run exposures, set exposure routines, administer user accounts and much more.

5.2 System Startup

> **Note-Precision X-Ray highly recommends that the system be warmed-up weekly, regardless of system usage.**

To start the TouchRAD User Interface, simply position the System Key-Switch key to the STANDBY or ON position. The touchscreen computer will automatically start and the TouchRAD User Interface will automatically load once the computer is ready for operation. During start-up, the TouchRAD User Interface will perform an initialization which takes approximately 10 seconds. Once this initialization is complete, the User Login Screen will be displayed.

5.3 Logging In

When the TouchRAD User Interface is ready for operation, the Login Screen will be displayed. In order to use any functionality of the X-RAD Biological Irradiator, a user must be logged in. To login, select the "USERNAME" text box or select the dropdown button to the right of the text box to input a username. Selecting the text box will open the keyboard where the username can be manually entered. Selecting the dropdown button will pull down a list of active usernames from which one can be selected. Once a username is entered, select the "PASSWORD" text box and manually enter password using the onscreen keyboard. Select the "CONTINUE" button to complete the log in process; the Main Menu will be displayed.

5.4 Manual Mode (Program 0)

5.4.1 Overview

"Manual Mode" or Program 0 gives the ability to run an exposure without a predefined program. In this mode the kV, mA and exposure time can be manipulated to suite the user's needs.

5.4.2 Producing X-Rays

In order to produce X-Rays the user must:

1. If Programmable Shelf option installed – kV, mA, exposure time, source to specimen distance (SSD) and specimen offset have to be set.

2. If Motorized Shelf option or fixed shelf installed – kV, mA and exposure time have to be set.

Once all necessary fields have been entered a "Continue" button will appear in the lower-middle of the screen. This button must be selected in order to prepare the X-Ray system for operation. Once this button has been selected and no errors are returned, the user may turn X-Rays on by selecting the "X-RAYS START" button. At any point during the exposure X-Rays can be turned off by selecting the "X-RAYS STOP" button.

> Note: If the X-Ray unit requires a warm-up, a notification will be displayed. Exposures cannot be performed until the warm-up process is completed. Please refer to section *5.8 Warm-up/Conditioning* for more details.

5.5 Programs Types

5.5.1 Overview

A program is a pre-defined exposure routine used for accurate, consistent exposures. "Set Program" gives the ability to define a new program or modify an existing program. There are four types of programs that can be created; Time, Dose, Variable Dose and Cycle Modes. Time and Cycle Modes come standard with the X-RAD Biological Irradiators while Dose, Variable Dose and Dose based Cycle Modes are available with systems that include the Dose Measurement Control option.

5.5.2 Time Mode

A Time Program produces X-Rays at a specific kV and mA and ends the exposure when the pre-defined time (in seconds) has been reached. A Time Program must be set from a minimum of 5 seconds to a maximum of 99,999 seconds.

> Note: If an exposure needs to be longer than 99,999 seconds, PXi will increase the maximum exposure time.

5.5.3 Dose Mode

A Dose Program produces X-Rays at a specific kV and mA and ends the exposure when the pre-defined dose (in cGy) has been reached.

5.5.4 Variable Dose Mode

A Variable Dose Program produces X-Rays at a specific kV and mA and ends the exposure when the user-defined dose (in cGy) has been reached. A User/Super-User defines the dose in this mode upon program start-up.

5.5.5 Cycle Mode

A Cycle Program is a program that repeats an On-Off X-Ray cycle for a user-defined amount of cycles at a specific kV and mA. The On cycle can be based upon time or dose while the Off cycle is only based upon time.

5.6 Program Recall

5.6.1 Overview

Program recall is the ability to run a pre-defined exposure program for accurate, consistent exposures. Selecting "Recall Program" from the Main Menu shows a user selectable list of program profiles that the individual user has access to. From here, the user can select a program to recall and make an exposure.

5.6.2 Recalling a Program

There are two ways to recall a program; select the "ITEM" box of the row containing the program of interest or select the empty RECALL PROGRAM entry box and a keypad screen will pull down to enter the program of interest. Once selected, the line will be highlighted. Select the CONTINUE button to select the highlighted program and the following screen will be displayed:

Note-If the X-Ray unit requires a warm-up, a notification will be displayed. Exposures cannot be performed until the warm-up process is completed. Please refer to section *5.8 Warm-up/Conditioning* for more details.

5.7 Warm-up/Conditioning

A Warm-up is used to put the X-Ray tube (emitter) in a mechanically ready state to produce X-Rays at maximum kV and mA. If a tube is not properly warmed up it can become damaged resulting in lost performance and downtime for repair. A Warm-up occurs when the system has not produced X-Rays within 8 hours. This is determined automatically by the system. The user will be prompted that a Warm-up is required and X-Rays will not be able to be produced until the system has been warmed up. A typical Warm-up with a system downtime of 8-96 hours will take 20 minutes.

5.8 Filter Recognition

5.8.1 Overview

Filter Recognition is automatic software detection of which Filter is inserted into the Collimator/Filter Holder to ensure that proper Program procedures are followed.

Note-There is no indicator stating the correct filter is inserted

5.8.2 Incorrect Filter

If the wrong filter is inserted into the Collimator/Filter Holder, an onscreen error will be displayed to the user indicating the wrong filter is being used. This error also states the current filter inserted via a four bit binary number.

5.9 Motorized Shelf

> **Note-This section only applies if Motorized Shelf option is installed. Refer to section _7.6 Motorized Shelf_ for more details.**

5.9.1 Overview

The Motorized Shelf allows the user to set the source to specimen distance (SSD) manually via the Shelf Key-Switch located on the TouchRAD Panel; turning the key-switch counterclockwise will lower the shelf and clockwise will raise the shelf. To position the shelf accurately, the user must use the scale located behind the shelf and line the shelf or specimen to the desired SSD.

5.10 Programmable Shelf

> **Note-This section only applies if Programmable Shelf option is installed. Refer to section _7.7 Programmable Shelf_ for more details.**

5.10.1 Overview

The Programmable Shelf allows the user to set the source to specimen distance (SSD) and specimen offset automatically through the User Interface. This distance is specified for each program in the Set Program mode "SSD" box or set by the user in Manual Mode by entering the desired shelf location in the "SSD" box.

> **Note-"SSD" values are in centimeters and must be whole numbers**
>
> **Note-The SSD value does not take the specimen height into consideration. The user must enter the offset in the respective input box.**

The shelf can also be positioned manually via the Shelf Key-Switch on the left side of the TouchRAD panel; turning the key-switch counterclockwise will lower the shelf and clockwise will raise the shelf. There is a scale located behind the shelf to give the user accurate measurement of the shelf.

5.11 Specimen Observation System

> **Note-This section only applies if Specimen Observation System option is installed.**

The Specimen Observation System is a closed circuit live feed camera located inside the cabinet to allow the user to quickly and easily monitor a specimen located in the cabinet before, during and after an exposure.

The Specimen Observation System can be viewed in full screen by simply selecting the thumbnail. All crucial X-Ray data is displayed on the lower edge of the screen and includes a "X-RAYS STOP" button incase the user needs to immediately stop X-Rays.

To return to the main operation screen, simply select anywhere on the image.

5.12 Errors

5.12.1 Overview

During normal operation of X-RAD, the user may occasionally encounter an error message indicating that a safety circuit has not been satisfied or there is an error with the X-Ray system itself. Typically, the user will only come across safety circuit errors. Errors will be displayed to the user as follows:

Note-If an error is present, the User must fix the error and then clear error before producing X-Rays. To clear the error simply select the "CLEAR" button as indicated in the above figure

5.12.2 Error Codes

Error Message	Cause	Action
Safety Circuit Open	Door Open; Baffle Open; Emergency Stop Button Activated; System Key-Switch in STANDBY Position	-Check Door and/or Baffle are closed -Check Emergency stop to see if switch is depressed, twist counterclockwise to release -Ensure Key is in On Position
Door Contact Open	High Voltage Door switch Open	-Close Door
Filament Current	Excessive or Insufficient Filament Current	-Contact Precision X-Ray For Repair
Undervoltage Primary	Insufficient System Input Voltage; Faulty Warning Lamp	-Contact Precision X-Ray For Repair
Overvoltage	Tube Arcing	Wait 5 minutes and start X-Rays again, If problem continues to occur after several attempts Contact Precision X-Ray For Repair
Diamentor Error	Faulty Dose Measurement Control	-Contact Precision X-Ray For Repair

> Note-To contact Precision X-Ray for repair, please refer to section *9 Support* for more details

6 Maintenance

6.1 Overview

Normal scheduled maintenance of the X-RAD Biological Irradiator is required to assure long term product reliability. In addition, operators should inspect the unit every time it is used, and report any faults or performance anomalies to Precision X-Ray immediately.

6.2 Daily Inspection

Each day before use, the operator should perform these quick visual inspections to verify system integrity:

1) Inspect the cabinet and all visible components and cables for signs of recent damage or misuse.
2) Verify that there are no gross cooling system leaks or fluids on the floor.
3) Verify that the cabinet door closes properly and that there are no loose screws or hardware on the latching mechanism.

4) Verify that all Indicator and Warning Lights are illuminated when X-Rays are turned on.

Report any system function that is not working properly to Precision X-Ray immediately.

6.3 Annual Maintenance

6.3.1 Overview

The X-RAD Biological Irradiator requires system maintenance be performed by an authorized Precision X-Ray Engineer on an annual basis to assure proper system performance and longevity. The TouchRAD console will display the following message when annual maintenance is due:

Tapping CONTINUE allows the user to continue to operate the unit, however it will again be displayed every time the unit is powered up until maintenance is performed.

The following services are performed during annual maintenance:

6.3.1.1 High Voltage Interface Maintenance

High voltage interfaces located at both the X-Ray tube and X-Ray generator are cleaned, greased and properly compressed. Failure to perform (properly) this task will certainly cause serious damage to the X-Ray system which will lead to expensive system repair and downtime.

6.3.1.2 Cooling System Inspection

The cooling system is inspected for leaks, improper fluid levels, coolant discoloration, and safety system functionality.

6.3.1.3 Cabinet Radiation Survey

The cabinet is surveyed to ensure that there are no radiation leaks above factory specifications.

6.3.1.4 Safety Systems Verification

All cabinet safety interlocks are fully inspected for wear and tested for functionality.

6.3.1.5 Operational Performance Testing

System is operated at full operating levels to determine operating performance. Equipment operating history logs are downloaded and analyzed. Adjustments will be made if necessary.

7 Troubleshooting

7.1 User Interface/X-Ray System Out-of-Sync

It is possible for the TouchRAD User Interface to become out-of-sync with the X-Ray system which will prevent X-Rays from being produced.

7.1.1 Diagnosis

- TouchRAD User Interface is on and the System-Key-Switch is in the **OFF** position
    - o TouchRAD User Interface will display an error during startup
    - o X-RAD Biological Irradiator is very quiet because the cooler is off
- TouchRAD User Interface is off and the System-Key-Switch is in the **STANDBY** or **ON** position

7.1.2 Fix

1. Set System-Key-Switch to **OFF** position
2. Wait for TouchRAD User Interface to fully start up
3. Using a small cylindrical object, such as a screw driver, press the reset button located on the back of the TouchRAD User Interface panel or lower right corner of TouchRAD Panel
4. Wait for TouchRAD User Interface to fully shut down

5. TouchRAD User Interface and X-Ray System are now synced. The system can be used normally by setting the System-Key-Switch to the **STANDBY** or **ON** position

7.2   Safety Circuit Errors

Safety circuit errors are the most common errors a user will encounter when using the X-RAD Biological Irradiator and are caused by a safety interlock switch being "open" which prevents X-Rays from being produced.

7.2.1   Causes

1. System-Key-Switch not in **ON** position
2. Emergency Switch is activated
3. Cabinet Door is open
4. Cooler has low flow
5. Tube/Cooler are operating too high of a temperature
6. Baffle is opened/off

7.2.2   Fix

1. Set the System-Key-Switch to the on position. If error not fixed continue to next item
2. Deactivate Emergency Switch by twisting switch counterclockwise. Switch will automatically retract to its inactivated state. If error not fixed continue to next item
3. Open the Cabinet Door and re-close it. If error not fixed continue to next item
4. Check the cooler hoses for any kinks. If a kink is found, unkink it.

If none of these steps fix the safety circuit error, please contact Precision X-Ray by referring to section *9 Support* for there is no way for the user to correct the errors without the guidance of Precision X-Ray. Possible causes are: cooler may be too low on coolant, tube/cooler may be operating at too high of a temperature, baffle is opened/off or a safety switch may have failed.

8 Available Accessories

8.1 Overview

To enhance capabilities, there are several options available designed for specific usage with the X-RAD BLANK. All options can be retro fitted on existing installed unit.

8.2 Dose Measurement Control (PN 150010)

The Dose Measurement and Control option allows users to specify the actual dose (in Gy) to be delivered at a known distance, and terminate the exposure when the dose has been reached. Measurement of relative dose is accomplished using a PTW 7862 parallel plate transmission chamber positioned so it can measure both an unfiltered beam, or filtered, if a beam hardening filter has been inserted into the filter holder.

Standard	Available
X-RAD 320iX	X-RAD 160
	X-RAD iR160
	X-RAD 225
	X-RAD iR225
	X-RAD 320

## 8.3 X-Ray Beam Conditioning/Hardening Filters with Filter Recognition

In biological irradiation, undesired low energy photons are produced which do not penetrate specimens deep enough to be of any practical use. In addition, these undesired photons add to the dose delivered to the specimens superficial layers such as the skin. This can lead to the specimens' skin being irritated/burned. With X-Ray beam conditioning/hardening filters, these low energy photons are filtered out delivering only desired photons to the specimen.

Filter Recognition is automatic software that recognizes which filter is inserted into the applicator holder. The software will compare this to the specified filter in the program. If the wrong filter is inserted into the applicator holder, an error will appear on screen and not allow X-Rays to be produced.

8.4 Fixed Collimators

Standard or customized fixed aperture collimators can be supplied that precisely define the irradiation field. Standard sizes range from 0.5cm to 10cm diameter, and specialized shapes are available for spinal or cranial irradiation. Please contact Precision X-Ray for more information.
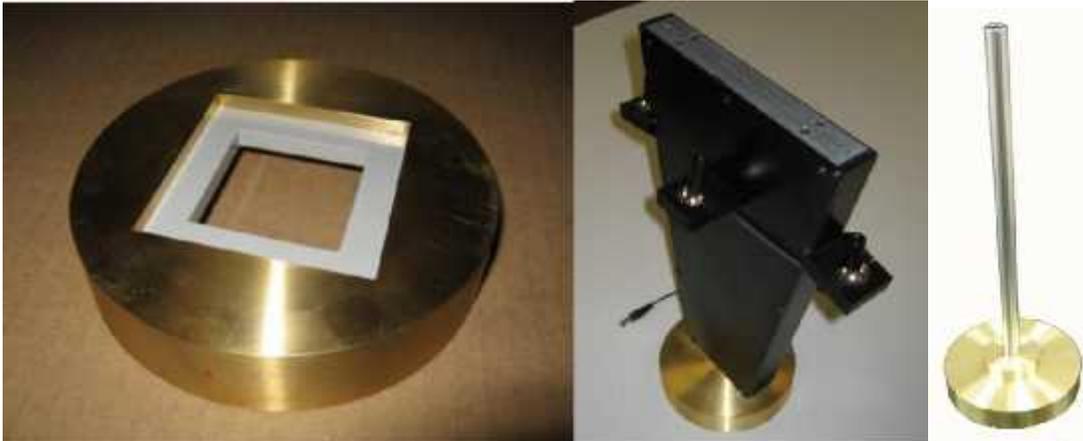
Standard	Available
X-RAD 320iX	X-RAD iR160
	X-RAD iR225
	X-RAD 320

8.5 Adjustable Collimator

The Adjustable Collimator is a motorized 4-leaf X-ray field diaphragm that allows users to quickly define a rectangular or square exposure field from less than 1x1 cm to 20x20 cm at 50 cm FSD. A coincident

light field illuminates the irradiation field for precise sample placement.

Standard	Available
X-RAD 320iX	X-RAD iR160
	X-RAD iR225
	X-RAD 320

8.6 Motorized Shelf (PN XD1602001)

The key operated stainless steel specimen shelf allows the operator to quickly set up exposures without the need to manually move a shelf, or place build up structures under the specimen. This fixture replaces the manually moved shelf inside the X-RAD cabinet. A source to shelf height indicator clearly and accurately identifies the shelf height for exact treatment distances.

Standard	Available
X-RAD 320iX	X-RAD iR160
	X-RAD iR225
	X-RAD 320

8.7 Programmable Shelf (PN XD1602201)

The programmable specimen shelf is similar in configuration to the key operated motorized specimen shelf but with the additional feature of being able to program height through the *Touch*RAD control.

When the height is programmed with the irradiation parameters, recalling

them will set the SSD together with either kV, mA and time, or dose if the

Dose measurement & Control has been added to the *Touch*RAD operator

Interface

Available
X-RAD iR160
X-RAD iR225
X-RAD 320
X-RAD 320iX

8.8 Turntable

Available
X-RAD 160
X-RAD iR160
X-RAD 225
X-RAD iR225

X-RAD 320
X-RAD 320iX

8.9 Remote Access

Remote access allows Precision X-Ray to remotely connect to the X-RAD BLANK for system diagnostics and updates. There are many cases where software, database and computer issues can be resolved remotely saving the customer the expense of having to schedule a service call. Precision X-Ray Service Engineers can gain a better understanding of system errors by exploring/diagnosing the system prior to a service call giving time to develop a plan and put together any equipment needed for the repair. Finally, Remote Access allows the TouchRAD User Interface to be updated as soon as a new software version is released keeping the customer up-to-date with software.

Standard	Available
X-RAD 320iX	X-RAD 160
	X-RAD iR160
	X-RAD 225
	X-RAD iR225
	X-RAD 320

8.10 Cabinet Heater (PN XD1608401)

The irradiation chamber of the X-RAD can be heated with a compact, wall mounted, thermostatically controlled ceramic heating unit. With this system temperatures up to 35°C can be maintained.

Available
X-RAD iR160
X-RAD iR225
X-RAD 320
X-RAD 320iX

8.11 Environmental Chamber (PN XD1608101)

The Environmental Chamber is designed to be used with the X-RAD irradiator when it is required to introduce and control gases in an environmental chamber.

- CO_2 Controller and Sensor
- Pressure relief valve
- Two sensors with three sensor access ports
- Circulation fan
- Two gas inlets
- Pullout sliding shelves

- Humidification tray

Available
X-RAD iR160
X-RAD iR225
X-RAD 320
X-RAD 320iX

8.12 Environmental Chamber Temperature Control (PN XD1608101)

As an additional option to the environmental chamber, the chamber temperature can be controlled by thermostatic adjustment of electrically heated floor/base.

Available
X-RAD 160
X-RAD iR160
X-RAD 225
X-RAD iR225
X-RAD 320
X-RAD 320iX

8.13 Pie Cage (PN XD1905005)

The circular mouse pie cage can hold 11mice and is designed for whole body irradiation. The notched ventilated lid can be dialed to any pie shaped chamber for insertion or removal of mice.

Available
X-RAD iR160
X-RAD 225
X-RAD iR225
X-RAD 320
X-RAD 320iX

8.14 Mouse Fixtures/Shields

Mouse restraining fixtures with lead shields are designed for numerous partial body irradiation applications including, flank, spine, abdomen, or head exposure.

Available
X-RAD iR160
X-RAD 225
X-RAD iR225
X-RAD 320
X-RAD 320iX

9 Support

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