PXi PRECISION X-RAY

# X-RAD 225XL
# Technical Specifications & Options


The purpose of this information is to provide details of the features and advantages of the X-RAD 225XL x-ray irradiator.

The X-RAD 225XL is modular in design and can be installed where access and space are limited. The large irradiation chamber allows procedures to be performed on cells, mice, rats and other specimens. Whole body irradiation can be performed with either purpose designed pie cages, or in the animal cages. Targeted irradiation such as cranial or spine can be carried out using one of the optional fixed collimators that can target down to 1mm. Partial body irradiation such as flank or brain can be performed using the fixtures and shields offered as options with the X-RAD 225XL. Using an x-ray tube with a highly homogenic beam designed for clinical orthovoltage radiation therapy and powered by a 225 kV high frequency, ultra-stable x-ray generator, the X-RAD 225XL is capable of precise, repeatable irradiations with any similar system worldwide.

February, 2015

PXi PRECISION X-RAY

The X-RAD 225XL features the *Touch***RAD** password protected multi-user programmable control that allows a supervisor user full access to the system but is capable of limiting students or researchers to certain authorized pre-programmed protocols. The *Touch***RAD** allows the supervisor user to download individual users time and use of the system for billing or review purposes. Over a 1000 individual techniques can be programmed either in KV, mA and time or Dose mode

The X-RAD 225XL with *Touch***RAD** control features built in remote diagnostic support that allows technicians to remotely obtain vital diagnostic information or update software without a site visit. (Requires either Ethernet or Wi-Fi access)

**Other considerations**

- **Proven long term reliability**
  Similar systems over 10 years old are running with their original x-ray tubes.
- **Proven replacement for Source irradiators.**
  Studies by Sandia Labs and papers published by Duke University identify this.
- **No security clearance required**
  The difficulty in obtaining security clearance for overseas visitors and students required for source irradiators is non-existent with x-ray.
- **No Regulatory Licensing Necessary**
  May need registering as an installed x-ray system with some States for a small fee.
- **Self shielded. No additional barrier or security required.**
  No problem with operator being close to cabinet when irradiating.

## TECHNICAL SPECIFICATIONS

**Cabinet Features**

- Fully shielded cabinet provides a large area to place small animals and multiple samples to be irradiated.
- Side entry port baffle allows introduction of cables and hoses for additional equipment to be placed in the irradiation chamber by the user.
- Complies with domestic and international regulations for cabinet radiation safety.

**Cabinet Size and Weight (LxWxH)**

| | | |
|---|---|---|
| Overall Dimensions: | 33x55.5x76 inch | [838x1410x1930 mm] |
| Irradiation chamber: | 26x26x42 inch | [65x65x106 mm] |
| Weight: | 3300 lbs. | [1497 kg] |

PXi PRECISION X-RAY

**Power Requirements**

- Mains Power
  - Voltage: 230VAC ±10% 1Ø
  - Current: 40A
  - Frequency: 50/60 Hz
  - Fuse: 50A (slow blow)

- Earth Ground (PE)
  - Gauge: 7 AWG [10 $mm^2$]
  - Resistance: 0.3 Ω

**High Voltage Generator**

- Maximum Output Voltage: 225kV
- Maximum Output Current: 30mA
- Output Power: 4500W (limited to x-ray tube specification)
- Accuracy: <±1%
- Reproducibility: <0.01% at constant temperature
- Automatic warm-up with intelligent tube conditioning.
- Proven long term reliability and output consistency.

**X-ray Tube**

- Maximum Potential: 225kV
- Maximum Power: 3000W
- Type: Metal Ceramic, Fixed Anode, Water Cooled
- Focal Spot: 7.5mm (per EN12343)
- Inherent Filtration: 0.8mm Be

**TouchRAD Operators Control**

- Large Touch screen Graphical User Interface.
- kV Setting & Display Accuracy: 5 - 225kV in 0.1kV increments.
- mA Setting & Display Accuracy: 0.1 – 45mA in 0.01mA increments.
- Exposure Settings in Time: (0.9999), continuous or optional dose controlled.
- Password protected user accounts (>9,999 users)
- Fully programmable with access assigned to individual irradiation protocols
- Exposure history database via USB flash drive for use with EXCEL®

PXi PRECISION X-RAY

# PERFORMANCE CHARACTERISTICS OF THE X-RAD 225XL

## X-ray Beam Profile

X-rays are emitted from the x-ray source in a cone shaped beam with a beam angle of 40 degrees. The uniformity of the beam changes significantly at its outer perimeter. Therefore, Precision X-Ray limits/collimates the beam angle to 31.4 degrees in order to achieve the best beam homogenity across the field of radiation. The resultant beam can be further collimated for specific usage using either the fixed or adjustable collimators available from Precision X-ray.

The field size at 50 cm SSD is a 28cm diameter with 90% uniformity over the total area. Larger areas of radiation can be achieved by moving the specimen shelf further from the source (up to 90cm) increasing the SSD, but with a reduction in dose.

To determine dose at other distances the inverse square law applies.

For instance at 75cm will be $\left(\frac{50}{75}\right)^2$ or 0.44 times dose at 50cm.

## Maximum Dose Rate

At maximum energy and current for the X-RAD 225XL, dose output is primarily a function of distance and beam filtration (beam hardening). At settings of 225kV, 13.3mA, and a source to specimen shelf distance of 30cm (SSD) the following table indicates the range of dose output as a function of beam filtration. For cell and culture irradiation, very little or no beam filtration may be required, so it is possible to have dose outputs greater than 5 Gy/min. For small animals, such as mice where it is desirable to have uniform dose distribution throughout the animal to a possible depth of >2cm, a filtered (hardened beam is required. The standard currently used is a 2mm Al filter (HVL = 1mm Cu) or a combination of materials yielding a HVL = 3.8 Cu. From the table, a 2mm Al filter results in a dose output of approximately 6.4Gy/min, while using a “harder” beam filter results in a dose output of 1 Gy/min.

**Typical Dose Rates at 225kV, 13.3mA, SSD 30cm**

| | |
|---|---|
| No Filter | >12 Gy/min |
| With Beam Hardening Filter (2mm Al) | >6.4 Gy/min |

# OPTIONS AVAILABLE FOR THE X-RAD 225XL

- **Dose Measurement & Control (Part # 150010)**

  The Dose Measurement and Control option allows users to specify the actual dose (in cGy) 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 the dose rate and cumulative dose in filtered and unfiltered beams.

- **Light Field Adjustable Collimator (XD # 1601001)**

  The Adjustable X-ray Beam Collimator is a motorized 4 leaf X-ray field diaphragm that allows users to quickly define a square or rectangular exposure field from less than 1 x 1cm to 20 x 20cm at a source to specimen distance (SSD) of 50cm and larger as the SSD is increased. A highly accurate coincidental light field illuminates the irradiation field for precise specimen placement.

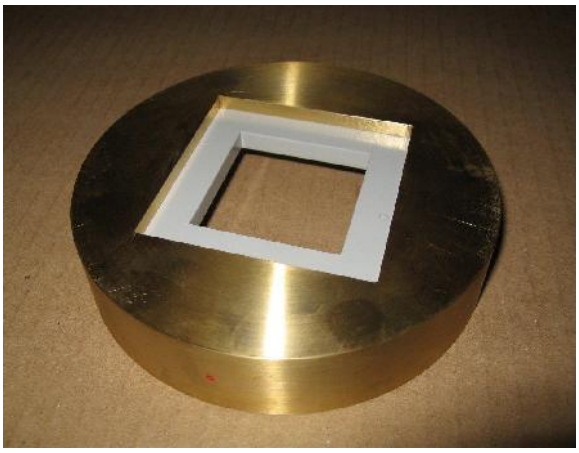
  Features include

  - 2 separate switches for control of XY shutters.
  - ON/OFF light field switch.
  - Dimensions: 11.5cmH x 26.5cmW x 26.5cmD
  - Weight 25lbs (11.4kg).
  - Removable via side mounted lifting handles when not in use.


**Variable light field Collimator**

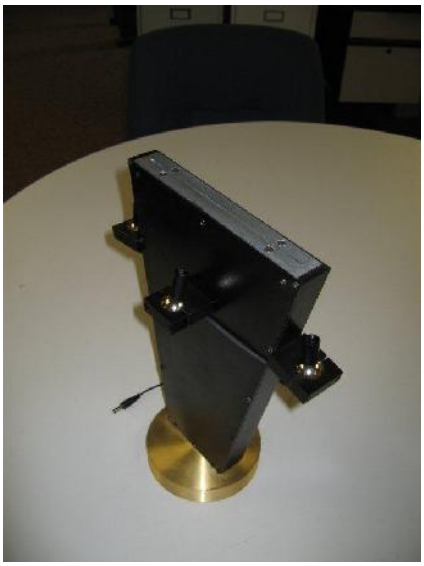
- **Fixed Collimators**

  Standard or customized fixed aperture collimators can be supplied that precisely define the irradiation field. Standard sizes range from 0.5cm to 15cm diameter, and specialized shapes are available for spinal or cranial irradiation.



**Fixed field Collimator**

**Targeting Collimator**



**Spine Collimator**

- **Mouse Fixtures and Shields**

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

- **Motorized shelf (Part # XD1602001)**

  The key operated motorized stainless steel specimen shelf allows rapid, precise, motor controlled specimen exposure set up. . This option replaces the manually moved shelf inside the X-RAD 320/350 cabinet. A source to shelf height indicator clearly and accurately identifies the shelf height for exact treatment distances.

**OR**

- **Programmable shelf (Part # XD 1602201)**

  The programmable specimen shelf is similar in configuration to the key operated motorized specimen shelf but with the additional feature of being height programmed 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

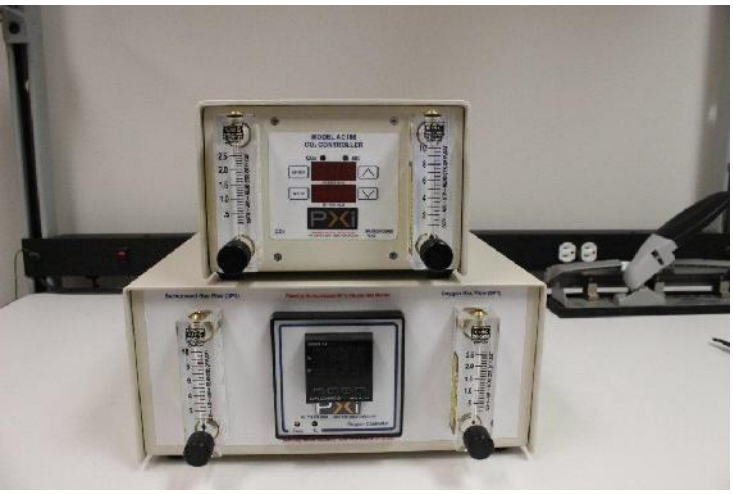
- **Environmental Chamber (Part # XD1608101)**

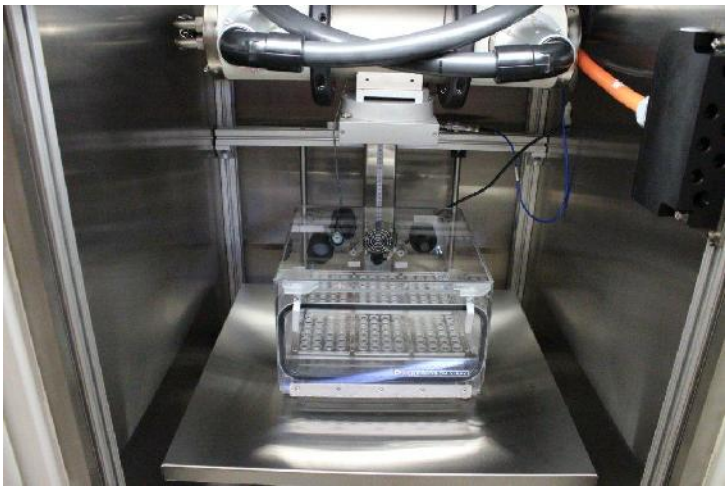
  The ECX 1000 is designed to be used with the X-RAD irradiator when it is required to introduce and control gases in an environmental chamber.

  Features include

  - $O_2$ controller and sensor.
  - Pressure relief valve.
  - Two sensor ports.
  - Circulation fan.
  - Gas inlet.
  - Pullout sliding shelves.
  - Humidification tray.

**Environmental Chamber Control** **Environmental Chamber**





- **Environmental Chamber Temperature Control (Part # XD1608101)**

  As an additional option to the ECX 1000 the environmental chamber temperature can be controlled by thermostatic adjustment of electrically heated floor/base.

- **X-RAD Irradiation Chamber Heating (Part # 1608401)**

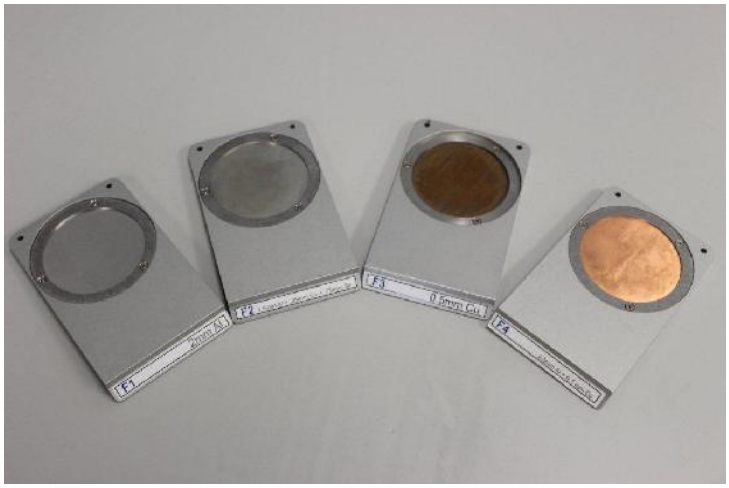
  The irradiation chamber of the X-RAD 320/350 can be heated with a compact, wall mounted, thermostatically controlled ceramic heating unit. With this system temperatures up to 35°C can be maintained.

- **Specimen Turntable**

  The specimen turntable has a sturdy 30cm platter that rotates at up to 4rpm.

- **Beam Conditioning Filters**

  Additional X-ray beam conditioning filters are available that can be configured for specific HVL or Radiation Quality requirements.



- **Mouse Pie Cage (XD1905005)**

  The circular mouse pie cage can hold up to11mice and is designed for whole body irradiation. The notched ventilated lid can be dialed to any chamber for insertion or removal of specimens..


**Mouse Pie Cage**

PXi PRECISION X-RAY

February, 2015