THE XCELL® 160/225/320
X-ray Irradiator Systems



INSTRUCTIONS FOR USE

KUBTEC® SCIENTIFIC

The XCELL® 160/225/320 X-ray Irradiator Systems
Instructions for Use IFU-53 Rev A September 2026

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Read this manual thoroughly before using this device. Follow all safety procedures and guidelines when operating radiographic systems. The information in this document has been carefully checked and is believed to be accurate. However, KUBTEC assumes no responsibility for inaccuracies. All specifications are subject to change.

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PREFACE

Intended Use

The XCELL® 160/225/320 X-ray Irradiator Systems are standalone X-ray cabinets used to irradiate organic and inorganic samples and components. This system is intended for use by qualified/trained personnel. This system is not intended for use on humans. Optionally, this system can be equipped with a radiographic detector to capture images of samples (Instructions For Use (IFU) in a separate manual).

The purpose of the Instructions for Use is to provide guidance for the proper use and care of the system. Keep this manual with the system for easy reference.

The Instructions for Use do not cover detailed electronic functions or major system troubleshooting and repair. For assistance in these areas, contact KUBTEC® Customer Care Center.

KUBTEC Customer Care Center

KUBTEC offers customer support through the KUBTEC Customer Care Center at any time for problems not resolved through online help or product documentation. If the Customer Care Center is closed, leave a voicemail message. Make sure to have the following information available when calling:

- Site name
- Hardware system type
- System serial number
- Software version number

Phone: USA: +1.203.364.8544, option 3
International: +1.203.364.8544, option 3

Email: service@kubtec.com

Web: www.kubtecscientific.com

Mail: KUBTEC®
111 Research Drive
Stratford, CT 06615 USA

NOTE: Any serious incident that occurs in relation to the device should be reported to the manufacturer, and the competent authority of the Member State in which the user is established.

User Responsibility

When the system is assembled, operated, maintained, and repaired in accordance with the instructions provided, the system conforms to the description in the Instructions for Use and with accompanying labels and/or inserts.

- It is the responsibility of the user to ensure this product is checked periodically.
- Do NOT use a defective product.
- Replace broken, missing, worn, distorted, or contaminated parts immediately.
- If repair or replacement is required, call 203-364-8544, option 3, or submit a written service request by emailing service@kubtec.com.
- Do NOT use this product or any of its parts other than in accordance with the written instructions provided by KUBTEC and KUBTEC-trained personnel.
- Do NOT alter this product without the prior written approval from KUBTEC.
- The user of this product has the sole responsibility for any malfunction that results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than KUBTEC.

Training

Users must receive adequate training on the safe and effective use of the system before operating it. Training requirements may vary by country. It is the user's responsibility to ensure that training is completed in accordance with applicable local laws or regulations. Information regarding training is available from your local KUBTEC representative..

Safety Information

Observe and heed all warnings, cautions, and notes in the manual and on the system.



WARNING: Warnings are directions that, if not followed, can cause fatal or serious injury, and/or can lead to damage to the system. Warnings in this manual are emphasized with a yellow triangle safety icon.



CAUTION: Cautions are directions that, if not followed, can cause damage to the system and/or cause environmental pollution. Cautions in this manual are indicated with a blue circle surrounding an exclamation point.

NOTE: Notes provide tips and important information to guide the use of the system. Notes in this manual are emphasized with the word "**NOTE**" in capital and bold letters.

Terms and Definitions

Click - Throughout the manual, the instruction for “click” means to left-click the mouse. When a right-click is needed, it will be stated as such.

Qualified engineer is a person who has completed training conducted by KUBTEC and has been certified by KUBTEC on this system.

Qualified technician is a person who has completed training conducted by KUBTEC and has been certified by KUBTEC on this system.

CE Mark

This product carries the CE Mark.

CE

Class 1

The CE Declaration of Conformity becomes invalid if the product is changed without explicit consent of the manufacturer. This applies to all parts, not only to safety elements.

Name of Product

The XCELL® 160/225/320 X-ray Irradiator Systems

Manufacturer



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CHAPTER 1: GENERAL INFORMATION

Introduction

The XCELL® 160/225/320 Systems are a standalone X-ray system typically used for X-ray irradiation of organic and inorganic samples and material components. The system uses a high-energy X-ray source and The DIGISOURCE® Irradiation Software.

NOTE: The appearance of some system components may vary from those shown.



Figure 1-1: The XCELL® 160 System

Safety Information

The following warnings and cautions appear at appropriate places in this manual and on the system. Contact KUBTEC® Customer Care Center if any of these statements are unclear.



WARNING: Do not remove covers. Potentially lethal voltages are present inside the system.



WARNING: Never operate this system with the grounding conductor disconnected.



WARNING: This is a heavy system. If the system needs to be moved, use assistance. If access underneath is required, make sure it is securely supported first.



CAUTION: This system is sensitive and needs to be handled with care. Dropping it from a height or banging it against a hard surface can damage interior components.



CAUTION: When transporting this system, do not drag the cables along the floor.



CAUTION: No operator serviceable parts inside. Refer servicing to qualified personnel.

Additional Considerations

To minimize possible risks that undetected radiation might create, follow these guidelines:

- Transport or relocation of the system is prohibited unless performed or approved by KUBTEC or its authorized representative.
- Keep the exposure chamber door closed at all times except during loading and unloading periods.
- Turn the power switch to the OFF position when the system will not be used for an extended period.
- Continuously monitor the X-ray ON indicator lights to be sure they are off after each exposure.
- At least once a year, and whenever the unit is moved or serviced by authorized personnel, a radiation survey should be performed with a properly calibrated radiation survey instrument.

To preserve the life of the X-ray tube, do not bypass the tube warm-up procedure within the KUBTEC DIGISOURCE Software.

System Handling

Transporting

- Use the utmost care when transporting this system. Any drop or bump can lead to extensive damage and the inability to produce X-rays.
- Disconnect cables using the cable connector that attaches to the source.
- DO NOT pull on the electric or data cable line, as this can result in an electric shock or fire.
- DO NOT drag the cables along the floor.
- When the system reaches its final destination, ensure that it rests on a flat surface.

Environmental conditions

- To ensure consistent irradiation, operate the system at normal room temperature within the guided operating levels stated in Table 1-3: Performance Specifications.
- Drastic and sudden changes in temperature can cause condensation to form on the surfaces. It is strongly recommended to wait until the condensation dissipates and the system temperature acclimates to the surrounding environmental conditions before operating the system.

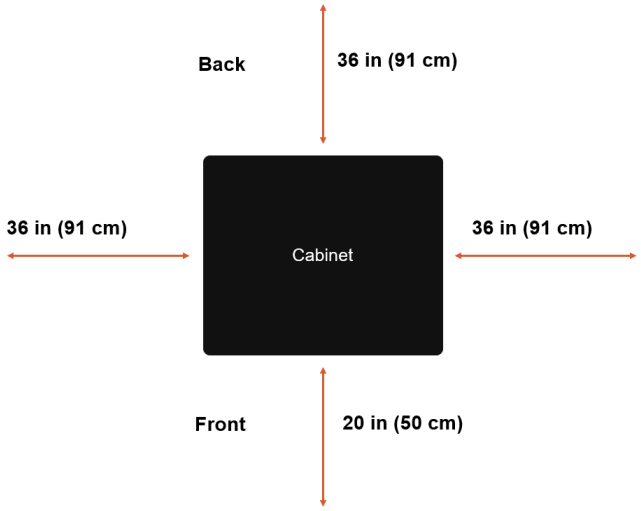
System storage

Store the system in a safe, dry location with particular caution to minimize any chance of damage from falling objects or tipping.

System Handling (continued)

Clearance Requirements

- Allow at least 36 in (91 cm) of space between the rear of the system and the wall for air circulation and unit servicing.
- Allow at least 20 in (50 cm) in front of the cabinet for system operation.
- The cabinet should be placed in an area to facilitate easy access to the rear panel during installation and servicing.



System Maintenance

The Maintenance Chapter contains specific instructions for the care of the system. To ensure safe and consistent use of the system, make sure to read, understand, and follow the stated instructions.

CAUTION: For safety reasons, be sure to inspect the system before every use. Additionally, a regular inspection should be performed at least once per year.

CAUTION: Changes, additions, or maintenance to the system performed by persons without appropriate qualifications and training and/or using unapproved spare parts can lead to serious risk of injury and damage to the system, as well as voiding the warranty.

CAUTION: Use ONLY a soft cloth, neutral detergent, or cleaning liquids to wipe system parts and accessories that come into contact with samples during use. Harsh liquids or rough surface cleaners will damage the system surfaces.

System Inspection

Inspect the system daily before use by following the daily inspection checklist in the Maintenance Chapter. Have a KUBTEC engineer or KUBTEC-trained engineer perform annual inspections. This ensures the system is kept compliant with performance and regulatory guidelines.



WARNING: If necessary, the dosimetry of this equipment must be performed by a qualified technician only.



WARNING: The system must be repaired only by a qualified engineer. If it is not repaired correctly, it can cause a fire, electric shock, or an accident.

Inspection Procedures

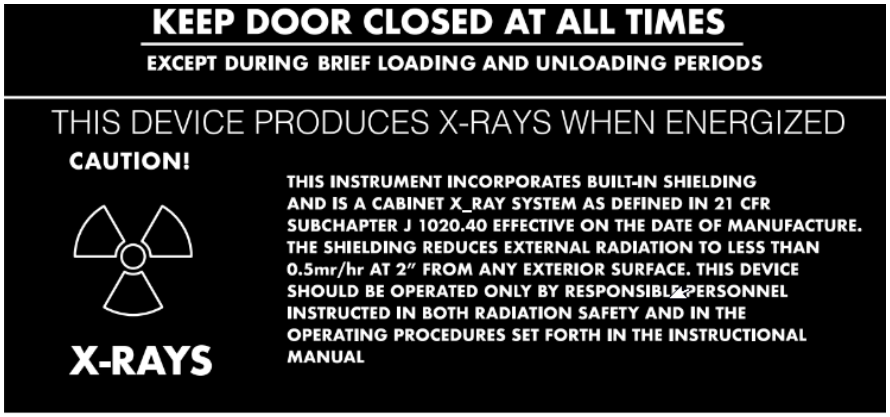
Details for the performance of each inspection are found in the Maintenance Chapter. If any problem is found during the inspection, take the indicated measures. If the problem persists, contact the KUBTEC representative or distributor.

It is recommended to maintain a record of these inspections. Either copies of the checklists can be used, or those provided by the facility or administrator can be used.

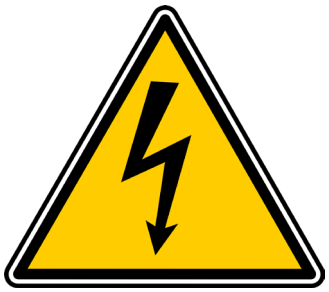
Labels

Warning labels, safety labels, and a certification label are attached at various locations on the unit. These labels must remain permanently attached and in good condition. Tampering with labels is against federal law. Under NO circumstances should the labels be removed or re-affixed.





Labels (continued)



Shock hazard.

Disconnect power before servicing.



X-rays are produced when energized.



CAUTION: To ensure safe system operation, read the Instructions for Use before operating this system.

Recommended Separation Distances

The system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of this system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and this system as recommended below, according to the maximum output power of the communications equipment.

Table 1-1: Recommended separation distances between portable and mobile RF communications equipment and The XCELL® 160/225/320 Systems

Rated maximum output power (W) of the transmitter	**Separation distance (m) according to the frequency of the transmitter**		
	150 kHz to 80 MHz $d = 1,2 \sqrt{P}$	80 MHz to 800 MHz $d = 1,2 \sqrt{P}$	800 MHz to 2.5 GHz $d = 2,3 \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance (d) in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. **NOTE:** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. **NOTE:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

Compliance

The XCELL® 160/225/320 Systems comply with US Federal guidelines that require radiation leakage of not more than 0.5 mR/hr (5 µSv/hr) at a distance of 5 cm from the external machine surface.

These systems are designed, manufactured, and registered in accordance with strict criteria established by the US Department of Health and Human Services (DHHS), the Food and Drug Administration (FDA), and the Center for Devices and Radiological Health (CDRH). This system meets or exceeds all certification requirements for a cabinet X-ray system used in an industrial/laboratory environment.

These systems are manufactured, tested, and certified to comply with the US Federal Performance Standards for Cabinet X-ray Systems, Title 21, Sub-chapter J of the Code of Federal Regulations, Section 1020.40. Modification or damage to the equipment could result in an X-ray exposure hazard.

KUBTEC recommends that all users review and comply with work-site safety requirements regarding radiation safety.

These systems are designed and tested for compliance when used per this IFU. This system is intended for use in the electromagnetic environment specified in the next table. The customer or user of this system shall ensure that it is used in a Guidance and Manufacturer Declaration environment.

Table 1-2: Guidance and Manufacturer declaration for electromagnetic immunity

Immunity test	**IEC 61010-1 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines	±2 kV for power supply lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) and neutral	±1 kV line(s) and neutral	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5s	<5 % U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5s	Mains power quality should be that of a typical commercial or hospital environment. If a dip or an interruption of mains power occurs, the current of the system may drop off from the normal level, and it may be necessary to use an uninterrupted power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	Not applicable	Not applicable
NOTE: U_T is the AC mains voltage prior to application of the test level.			

Table 1-2: Guidance and Manufacturer declaration for electromagnetic immunity (continued)

Immunity test	IEC 61010-1 test level	Compliance level	Electromagnetic environment – guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of this system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: d = 1,2 √P d = 1,2 √P 80 MHz to 800 MHz d = 2,3 √P 800 MHz to 2.5 GHz • P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation. • Distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be below the compliance level at each frequency range. Interference may occur in the vicinity of equipment marked with the following symbol: 
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	
NOTE: At 80 MHz and 800 MHz, the higher frequency range applies. **NOTE**: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcasts, and TV broadcasts, cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, conduct an electromagnetic site survey. If the measured field strength at the location where the system is used exceeds the applicable RF compliance level, observe the system to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the system.

Over the frequency range of 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

These system are designed to meet the following requirements:

Table 1-3: Performance specifications

Degree of protection against penetration of water	No protection provided
Radiation leakage	Certified to US FDA 21 CFR 1020.40 standards
Classification in accordance with 61010-1 degree of protection against electric shock	This system has no applied parts
Methods of sterilization or disinfection	See Cleaning and Disinfection section in the System Maintenance Chapter
Where the system is not suitable for use	In the presence of flammable mixtures
Mode of operation	Up to 100% duty cycle
Temperature range (user operation)	0–40°C (32–104°F)
Pollution degree rating	Pollution degree 2 (normal atmosphere)
Electromagnetic compatibility (EMC) in accordance with 61010-1 • Noise suppression • Immunity to interference	This system conforms to the requirements of IEC 61010-1 (EMC)
Product Life	Service life of the product is 7 to 10 years

Table 1-4: Wireless adapter specifications

Hardware	
Interface	USB 3.0
Button	WPS button
Dimensions (W x D x H)	1.59 × 0.78 × 0.41 in. (40.50 × 19.72 × 10.29 mm)
Antenna type	Internal
Wireless	
Wireless standards	IEEE 802.11ac, IEEE 802.11a, IEEE 802.11n, IEEE 802.11g, IEEE 802.11b
Frequency	5 GHz 2.4 GHz
Signal rate	**5 GHz** 11ac: Up to 867 Mbps (dynamic) 11n: Up to 300 Mbps (dynamic) 11a: Up to 54 Mbps (dynamic) **2.4 GHz** 11n: Up to 400 Mbps (dynamic) 11g: Up to 54 Mbps (dynamic) 11b: Up to 11 Mbps (dynamic)
Transmit power	<23 dBm (EIRP)
Wireless modes	Ad-hoc/Infrastructure mode
Wireless security	Supports 64/128-bit WEP, WPA/WPA2, WPA-PSK/WPA2-PSK
Modulation technology	DBPSK, DQPSK, CCK, OFDM, 16-QAM, 64-QAM, 256-QAM
Certification	CE, FCC, RoHS



For cybersecurity, ensure your network is secure.

WARNING:

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CHAPTER 2: COMPONENTS AND CONTROLS

System Overview

The XCELL® System consists of an upper and a lower section. The upper section houses the specimen cabinet, the user interface, and the X-ray tube. The lower section houses the generator and power supply. The lower section components should be accessed only by service personnel.

NOTE: The appearance of some system components may vary from those shown.

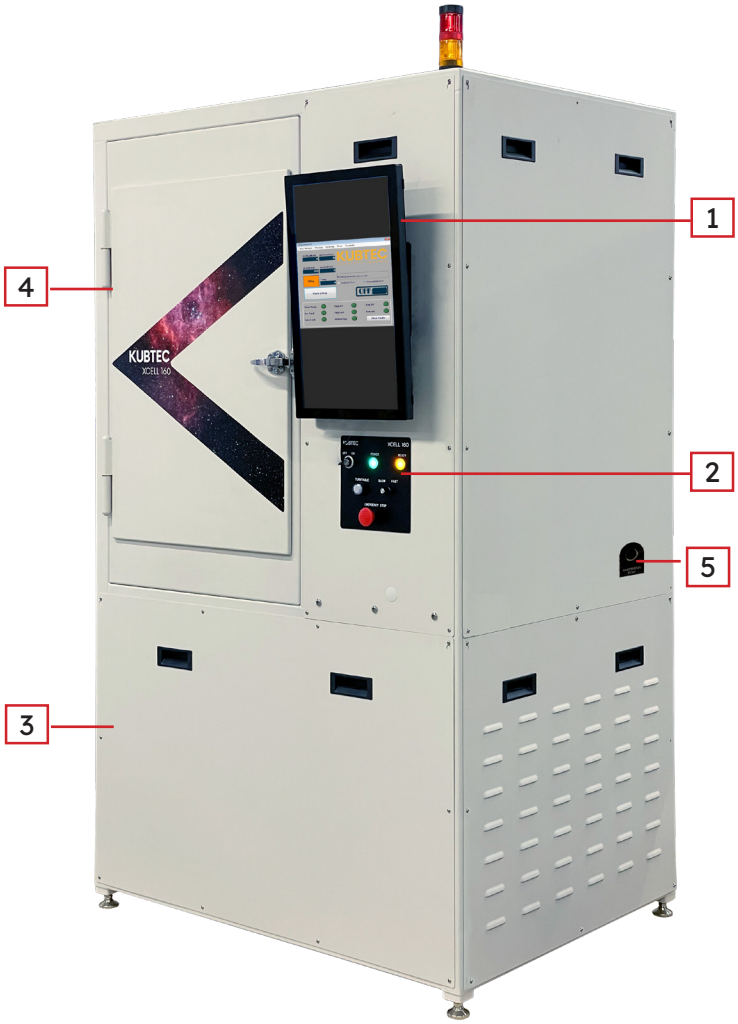


Figure 2-1: System Components

Figure Legend

1 Computer Monitor
2 Control Panel
3 Lower Section
4 Upper Section
5 Access Port

Specimen Cabinet

The specimen cabinet houses an exposure chamber door with safety interlocks, turntable, and a user interface consisting of a touchscreen and a control panel. An X-ray warning light on top of the cabinet is activated when the system is initially powering up or generating X-rays.

CAUTION: Users of the system should never attempt to access the X-ray generation components.



Figure 2-2 Specimen Cabinet

Figure Legend

1 X-ray Warning Light

2 Touch Screen Monitor

3 Control Panel

4 Exposure Chamber Door

NOTE: System components are subject to change and may not be the same as those shown.

Exposure Chamber

The exposure chamber consists of an inner chamber and an outer door. The inner chamber has tray rails at varying heights to allow irradiation at different intensities (i.e. different distances from the X-ray source). A light inside the chamber illuminates when the key switch on the control panel is in the ON position.

The exposure chamber door has electrically independent interlocks. Disengaging either of these interlocks causes X-ray generation to stop.

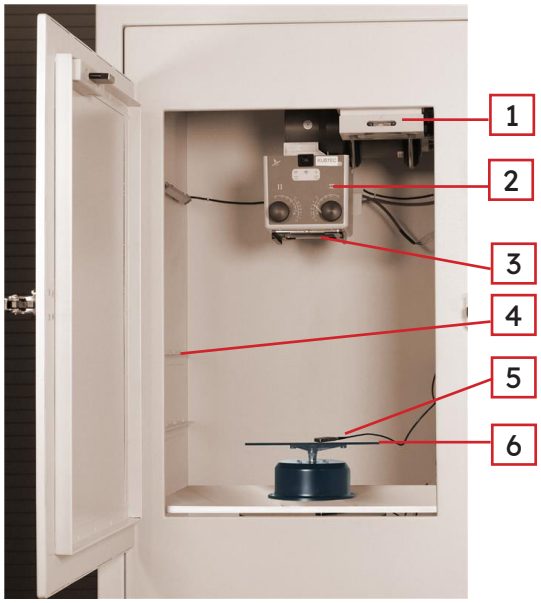


Figure 2-3: Cabinet Chamber

Figure Legend

1 Interlock Switch
2 Collimator
3 Filter Bracket
4 Tray Rails
5 Dosimeter Probe
6 Turntable

Control Panel

The control panel has functions for locking and unlocking the system, turning the system power on and off, using the turntable inside the chamber, and warning when X-rays are being generated.



Figure 2-4: Control Panel

Figure Legend

1	Power light	Power ON = LED is green Power OFF = LED is clear
2	Ready light	Illuminates when door interlocks are engaged, indicating that the system is ready to generate X-rays.
3	Turntable speed switch	Turn left or right to select slow or fast speed for the turntable.
4	Emergency stop button	Push to have the system stop generating X-rays immediately. Pull out to reset.
5	Turntable button	Press to turn the turntable ON (button lights) or OFF (button is not lit). **NOTE:** The turntable can be unplugged and removed from the chamber to adjust the shelf height.
6	Key switch	**OFF** position: The key is turned to the left. The system is locked. X-rays cannot be generated. **ON** position: The key is turned to the right. The system is unlocked and ready to be powered up. X-rays can be generated. **NOTE:** The key is removable when it is in the OFF position. To prevent unauthorized use of the system, KUBTEC® recommends the removal of the key when the system is not in use.

User Interface

The user interface consists of a touchscreen monitor and the control panel.

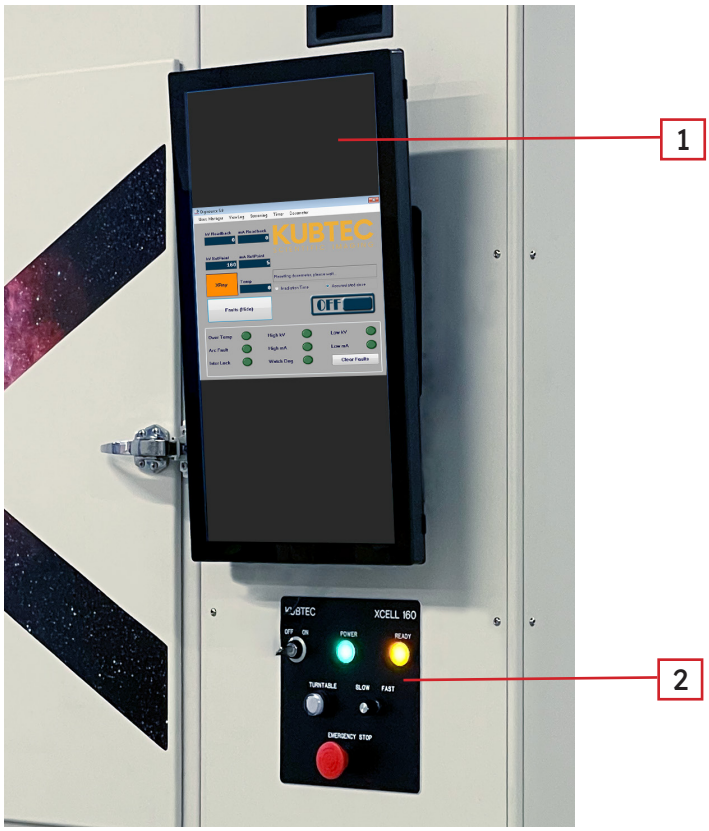


Figure 2-5: User Interface

Figure Legend

1 Touchscreen Monitor

2 Control Panel

Collimator

The collimator's power functionality includes:

- The collimator receives power from the X-ray system.
- The collimator does not include a separate power switch.



Figure 2-6: Collimator

The irradiator has two separate lighting systems:

Cabinet lights — Illuminate the interior when the door is open, so the user can see inside the cabinet.

Collimator LED light field — Because X-rays are invisible, this light field indicates where the X-ray field will be. Pressing the lamp ON button on the collimator turns on the LED, projecting light to show the X-ray field location.

NOTE: The collimator LED light field operates independently of the irradiation function. If the LED overheats and shuts off, the irradiator can continue to operate while the LED cools. Only the light field is temporarily unavailable; irradiation is not affected.

Light Field and Laser controls

- LED and crosshair lasers ON - Press the lamp ON button once to turn ON the LED and the crosshair lasers.
- LED and crosshair lasers OFF - Press the lamp ON button again to turn them OFF.
- LED only (lasers OFF) - Press and hold the lamp ON button for 1 second to turn ON only the LED.
- Crosshair lasers only - Press and hold the lamp ON button until only the crosshair lasers activate.
- **NOTE:** The crosshair lasers Only mode is intended for service personnel during collimator pre-alignment and should not be used during routine operation.

Collimator (continued)

Thermal Safety Limit

- If the LED remains ON for more than 7–8 minutes, the thermal protection sensor will automatically turn the LED OFF.
- The lasers will flash once per second to indicate LED overheating.
- Turn off the light on the collimator and allow it to cool for 10–15 minutes before reuse.

CAUTION: Do not operate the LED continuously for extended periods. Prolonged operation may cause overheating and automatic shutdown of the light on the collimator.

NOTE: If the lasers flash continuously, this indicates an LED over-temperature condition. Allow sufficient cooling time before operating the collimator again.

Filters

The collimator includes a filter bracket used for sliding filters into position.

A filter bracket is included with the collimator, allowing filters to be slid into position. The light field must be used to confirm alignment before any filter is inserted.



Figure 2-7: Filter Bracket and Filters

NOTE: Increasing the filter's thickness or density removes low-energy X-rays, enhancing penetration and hardening the beam's energy spectrum towards monoenergetic.

Purpose

Filters are used to remove low-energy photons, improve beam quality, and reduce unnecessary deposited dose. Only approved filters should be used with the system.

CAUTION: Do not perform exposures with a partially inserted filter. Improper seating can affect beam alignment and image quality for systems that have optional X-ray imaging.

Filters (continued)

The XCELL® 160 System

Available Filters

Standard filters included with the system:

- 1 mm Al
- 2 mm Al
- 0.2 mm Cu
- 1 mm Al + 0.2 mm Cu
- 2 mm Al + 0.2 mm Cu
- 1 mm Al + 0.4 mm Cu

The XCELL® 225 System

Available Filters

Standard filters included with the system:

- 1 mm Al
- 2 mm Al
- 1.5 mm Cu
- 1 mm Al + 0.2 mm Cu
- 2 mm Al + 0.4 mm Cu
- 0.2 mm Cu + 0.8 mm Sn

The XCELL® 320 System

Available Filters

Standard filters included with the system:

- 1 mm Al
- 2 mm Al
- 1 mm Al + 0.2 mm Cu
- 2 mm Al + 0.6 mm Cu
- 1 mm Al + 0.8 mm Sn
- 2 mm Al + 0.6 mm Cu + 0.8 mm Sn

Filters (continued)

TIPS

- Aluminum filters (1–2 mm): Basic filtration to remove low-energy photons.
- Copper filters (0.2–0.4 mm): Additional beam hardening for high-density sample.
- Combination filters (Al + Cu): Provide improved beam quality.
- Ensure the filter is fully seated in the bracket before exposure.
- Do not use the system with a partially inserted filter.
- When using combination filters, position the metal with the highest atomic number closest to the X-ray tube (order: tin, then copper, then aluminum). If the combination includes aluminum, place aluminum at the bottom; if the combination includes tin, place tin at the top.

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CHAPTER 3: SYSTEM USE

Introduction

Before The XCELL® System is turned on for the first time each day, perform the daily inspection as stated in the checklist in the Maintenance Chapter.

NOTE: To obtain consistent results, the system should be operated at normal room temperature and within the guided operating levels stated in the levels stated in Table 1-3. Drastic and sudden changes in temperature cause condensation to form on the surfaces. It is strongly recommended to wait until condensation dissipates and the system acclimates to the surrounding environmental conditions before operating it.

How to Start the System

To power up the system and start the software program, follow these steps:

1. Confirm the power cord is fully inserted into the wall outlet.
2. Turn the key switch to the **ON** position. The power LED on the control panel illuminates.
3. If the monitor is not ON, press the monitor power button.
4. Confirm the Cobia dosimeter screen is on and displaying the dose measurement.
5. Press the down arrow button on the Cobia dosimeter to switch between the Accumulated Dose (Gy), Dose Rate (mGy/s), and Time (s) displays.

NOTE: Calibrate the dosimeter every two years to ensure accuracy of dose measurements.



Figure 3-1: Dosimeter Screen

How to Start the System (continued)

6. Double-click the  icon.
7. When the **Login** screen displays, do the following:

   - Enter the User Name and Password assigned to the user by the System Admin.
   - Click **Login**.

   NOTE: KUBTEC is the default User Name. kubtec is the default Password. Both are case-sensitive, and both can be changed by the system Admin.

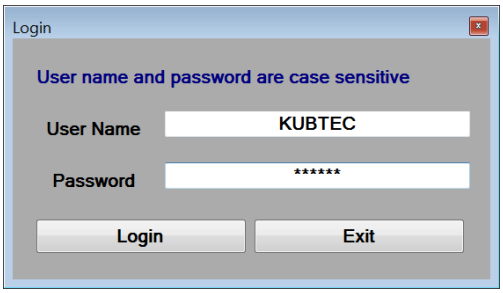


Figure 3-2: Login Screen

User Name	Password	User Type	Permissions
KUBTEC	kubtec	Administrator	• Operate X-ray. • Create/modify regular users' profiles.
USER	aaa	Regular user	Operate X-ray.

When the software finishes loading, the Main Screen displays. All functions of the irradiator system are controlled from this screen.

System Dose Calibration

Dose calibration is recommended before performing any experiment. Refer to **APPENDIX** for detailed Work Instructions on Dose Calibration.

Main Screen Components

The Main Screen provides the means to enter exposure factors, start and stop X-ray generation, view usage logs, add and delete users, and view system messages. Readback indicators on the screen provide feedback during the exposure sequence.

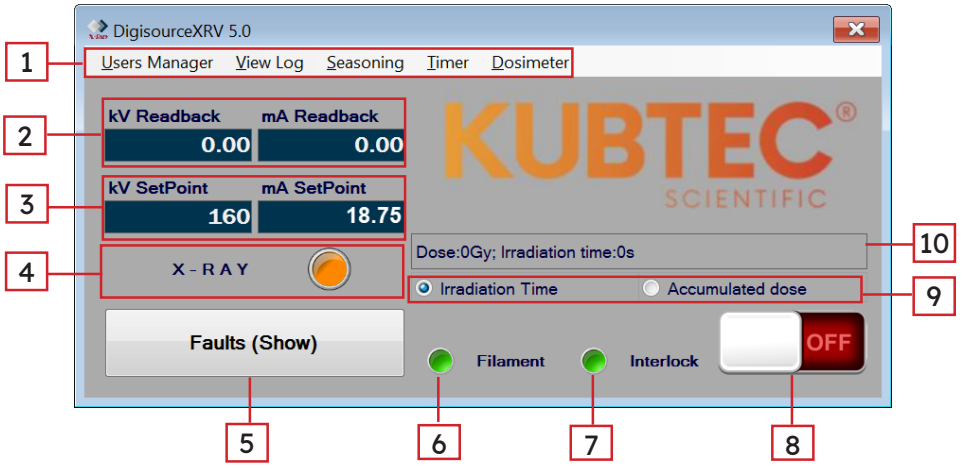


Figure 3-3: The XCELL® 160 System Main Screen

Main Screen Description

Figure Legend

No.	Function
1	**Menu Bar**: Provides access to Admin functions, user logs, seasoning options for the X-ray source, and settings for the timer and dosimeter. Use of each of these options is described in the next section.
2	**kV and mA Readback** fields: Dynamically displays actual kV and mA values while the X-ray is in progress.
3	**kV and mA SetPoint** fields: Allows manual entry of values for kV (up to 160 or 225 or 320) and mA (up to 30.0).
4	**X-RAY** indicator: • Solid unlit or clear: X-rays are not being generated. • Solid amber: System is ready to generate X-rays. • Blinking amber: Pre-warning for X-ray generation. • Blinking bright red: X-rays are being generated.
5	**Faults** field: Displays system faults. When a fault is corrected, system function remains locked until the **Clear Faults** button is pressed.
6	**Filament** LED: • **Green**: The filament in the X-ray source is ready to generate X-rays. • **Red**: The filament has not reached the required temperature for X-ray generation.
7	**Interlock** LED: • **Green**: The chamber door is closed properly. • **Red**: The chamber door is in the open position.
8	**X-RAY (ON/OFF)** button: Starts or stops X-ray generation. It can also be used to stop X-ray generation before the set time reaches zero.
9	**Irradiation Time** and **Accumulated dose** options: Allow selection of the mode of operation: • **Irradiation Time** - X-ray generation stops when set time is reached. • **Dose Accumulation** - X-ray generation stops when the designated dose has been reached.
10	Display: Shows the dose parameters.

Menu Bar: Users Manager

The Users Manager options provide the system Admin with the ability to view and export user logs, clear logs, create and delete users, and change user passwords. To access these functions, click **Users Manager** in the menu bar at the top of the Main Screen.
The **ADMIN(Super Administrator)** screen displays.

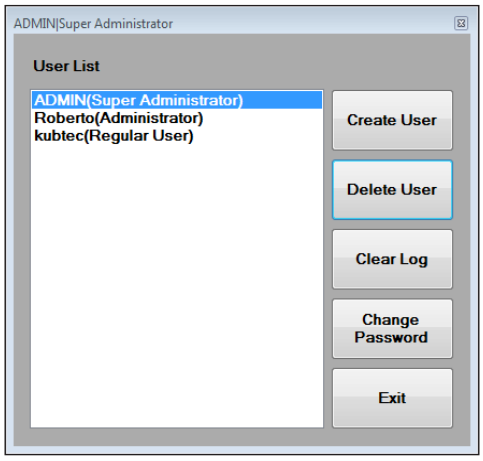


Figure 3-4: ADMIN (Super Administrator) Screen

- To create a new user, click the **Create User** button to access the Create a New User screen. Enter the Username and Password details. Then, select the **User Type**, and then click **Create**.

- To delete a user, click the user name in the **User List**, and click the **Delete User** button. Click **Yes** to the prompt about the selected user's log being deleted, then click **OK** to the User Deleted prompt.

- To clear a log, click the name of the user whose log needs to be cleared, then click **Clear Log**. The Clear Log screen offers two options: **Delete log for this user** OR, **Delete Log before a Date**. Select an option, then respond to the prompts that display.



Figure 3-5: Clear Log Screen

- To change a password, click the name of the user whose password needs to be changed, then click **Change Password**. In the **Change Password** screen, enter the new password in both fields, then click **Change**. Click **OK** to the Password Updated prompt.

Menu Bar: View Logs

The system stores logs of irradiation usage for each user of the system. These user logs contain information about the date, time, and dose for each irradiated sample.

To export a user log, select the desired user log. Click **Export** in the top menu bar. Navigate to the desired export location and click **OK**.

To view a log, click **View Logs** in the top menu bar of the Main Screen. For a Regular user, only the log for that the user who is logged in displays.

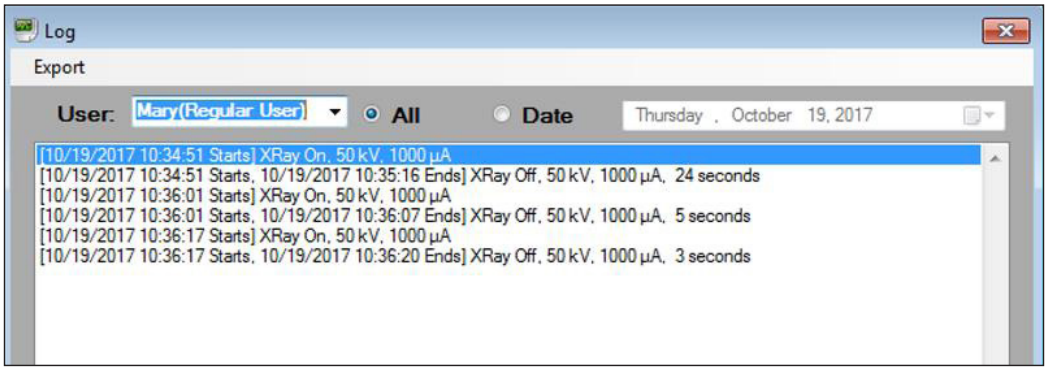


Figure 3-6: Regular User Log

The system admin has access to the logs for all users through the **User** dropdown menu.

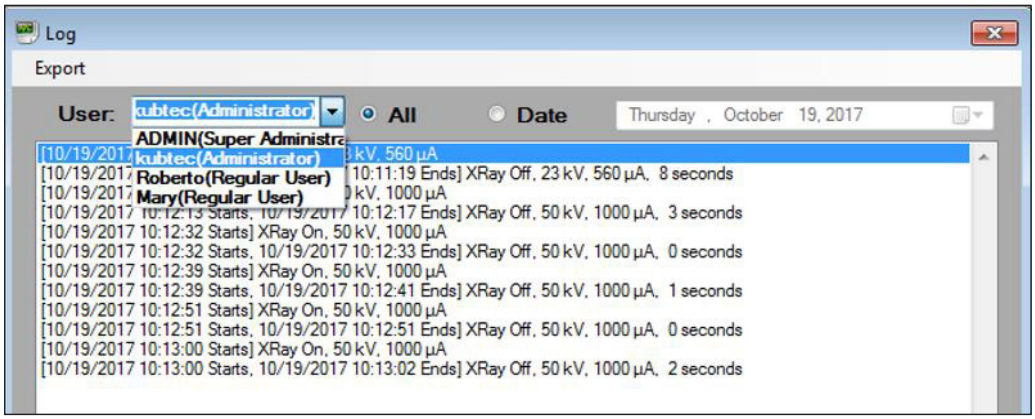


Figure 3-7: Admin Log

Menu Bar: Seasoning

Intelligent tube conditioning (also called seasoning) is a procedure that warms up the X-ray tube/source. The warm-up time varies with the number of hours that have passed since the system was last used. To run the correct system warm-up, follow these steps:

1. From the menu at the top of the screen, select **Seasoning**.
2. In the displayed menu, the system automatically selects the required warm-up time based on how long the system has been idle.

Warm-up mode	System Idle Time	Seasoning Time
Daily	> 8hr < 1 week	20.5 min
Weekly	More than a week	60 min
Monthly	More than a month	2 hrs 22 min
Test	For technician use only	

3. When the screen displays with the settings needed to perform the selected warm-up, click **ON** to start the warm-up.
4. Wait for the warm-up process to finish.

Menu Bar: Timer and Dosimeter

When the system is ready for use, follow these steps to enter the exposure parameters (kV and mA values, and either the time the sample needs to be irradiated, or the accumulated dose to be delivered to the sample):

1. On the Main Screen, enter kV and mA values:
   - In the **kV SetPoint** field, enter a kV value between 100 and the maximum kV of the unit (160/225/320).
   - In the **mA SetPoint** field, enter an mA value between 1.0 and 30.0, limited by the power (1.6 kW, 3.0 or 40 kW, depending on the model).

   NOTE: kV and mA settings must be configured according to system specifications. Refer to the **APPENDIX** for detailed information on setting kV and mA.

   NOTE: A red warning message will appear on the screen if the user selects kV and mA values that exceed the power limit. The user will not be able to start the X-ray until valid values are selected.

Menu Bar: Timer and Dosimeter (continued)

2. On the Main Screen, enter time or dose:

To enter the exposure time:

- Click the **Irradiation Time** button.
- Enter a value up to 60 minutes and 60 seconds.
- Click **OK**.

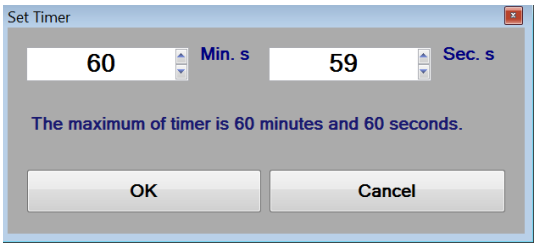


Figure 3-8: Set Timer Screen

To enter the irradiation dose:

- Click the **Accumulated dose** button.
- Enter a value up to 200 Gy.
- Click **OK**.

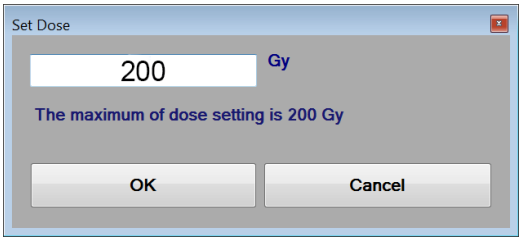


Figure 3-9: Set Dose Screen

Live Feed Software

This feature is used in parallel with The DIGISOURCE® Irradiator Software to preview the interior of the cabinet (chamber):

1. Double-click on the live feed  icon on the desktop to open the Live feed software.

   NOTE: Make sure to turn on the light switch inside the chamber on the upper right before beginning a live feed.



Figure 3-10: Chamber Light Switch

2. Click **Enable AE**.

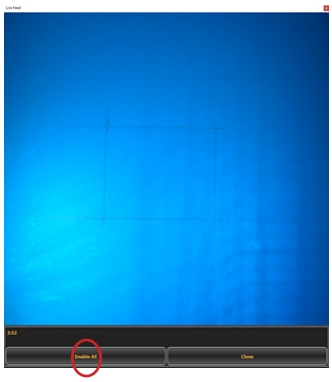


Figure 3-11: Enable Auto Exposure (AE)

NOTE: The live feed will continue for 20 seconds after which time the user must restart the application.

Irradiate the Sample

After the exposure parameters are set, follow these steps:

1. Center the sample on the tray (or rotation device if used).
2. Close the chamber door gently and tightly to ensure interlocks engage.
3. Ensure the **READY** LED is lit. This happens automatically when the door is closed correctly.
4. Click **ON** in the lower right corner of the screen to start X-ray generation. The **X-RAY** button glows during X-ray generation. The kV and mA ReadBack fields provide feedback during the exposure sequence.

   NOTE: To stop X-ray generation before the set time, click **OFF** in the lower right corner of the Main Screen. The system remains powered up, but the X-rays will be stopped.

   NOTE: When a quick and immediate shutdown of the system is needed, push the **Emergency Stop** button.



CAUTION:

Monitor the **X-RAY** indicator to ensure it lights during an exposure and turns off when the exposure finishes.



CAUTION:

Keep the chamber door closed and latched except during the loading periods.

Cool Down Period

It is recommended that the cooling system be allowed to run for 30 minutes after the last X-ray ON cycle. This allows coolant to circulate through the system before the key switch is turned to the OFF position.

System Shutdown

Follow these steps to do a normal system shutdown:

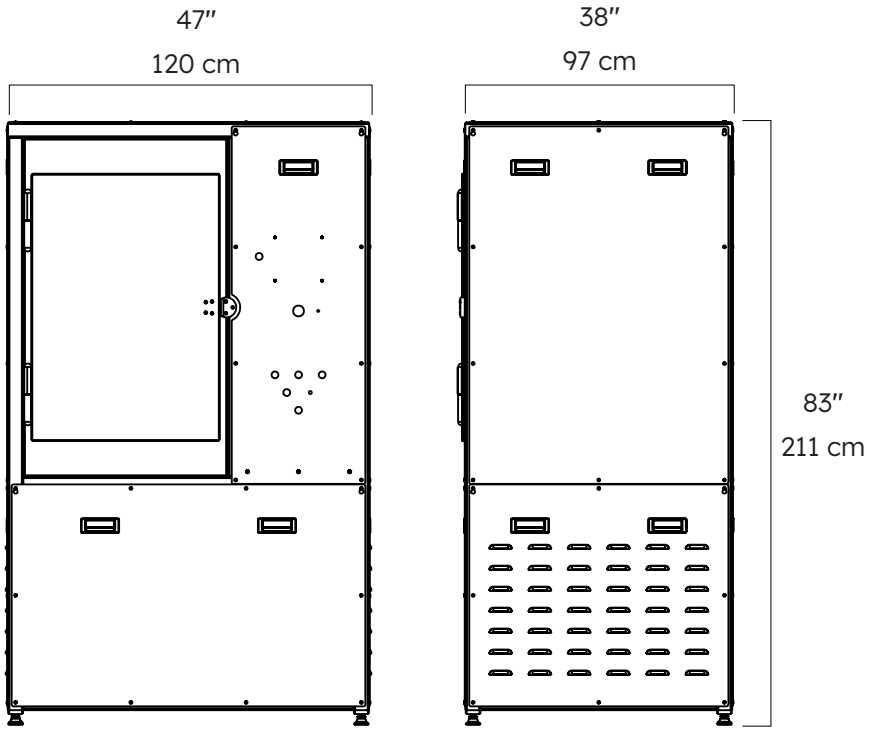
1. Ensure the chamber is empty, then close the door tightly.
2. Click the X in the upper right corner of the screen to close the Main Screen.
3. Click in the lower left area of the screen.
4. Click the power icon, and then click **Shut down** to turn off the computer. The power button light will turn off.
5. Turn the key switch to the **OFF** position.

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CHAPTER 4: SYSTEM SPECIFICATIONS

This section contains tables that list specifications for components of The XCELL® 160 System.

XCELL 160 System Diagram



XCELL 160 System Specifications

This section contains tables that list specifications for components of The XCELL® 160 System.

Machine

Table 4-1: Machine Specifications

Maximum potential	160 kV
Focal spot	7.5 mm
Maximum current	30 mA
Inherent filtration	0.8 mm Be
Recommended breaker rating	30 A
X-Ray Power (maximum)	3000 W
Frequency	47/63 Hz
Beam angle	40 degree
Irradiation chamber dimensions	24″ W x 24″ D x 42″ H (61 cm x 61 cm x 107 cm)
System dimensions	47″ W x 38″ D x 83″ H (120 cm x 97 cm x 211 cm)

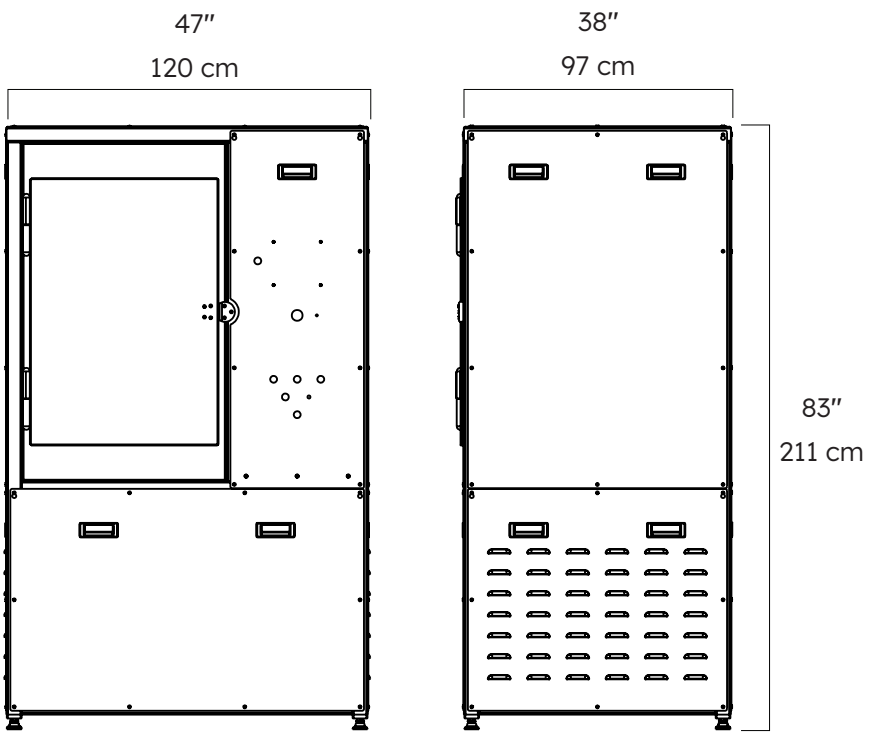
Machine (continued)

Source-to-Sample Distance (SSD)	See **Table 4-5: SSD in each Irradiator**
Weight	1650 lbs (748 kg)
Maximum beam coverage	Collimated 14″ x 14″ (36 cm x 36 cm)
Warmup	Automatic
Software	The DIGISOURCE® Software

Accessories, Monitor, and Computer: These specifications are the same for all XCELL systems. See **Table 4-4: Common Specifications.**

XCELL 225 System Diagram

This section contains tables that list specifications for components of The XCELL® 225 System.



XCELL 225 System Specifications

This section contains tables that list specifications for components of The XCELL® 225 System.

Machine

Table 4-2: Machine Specifications

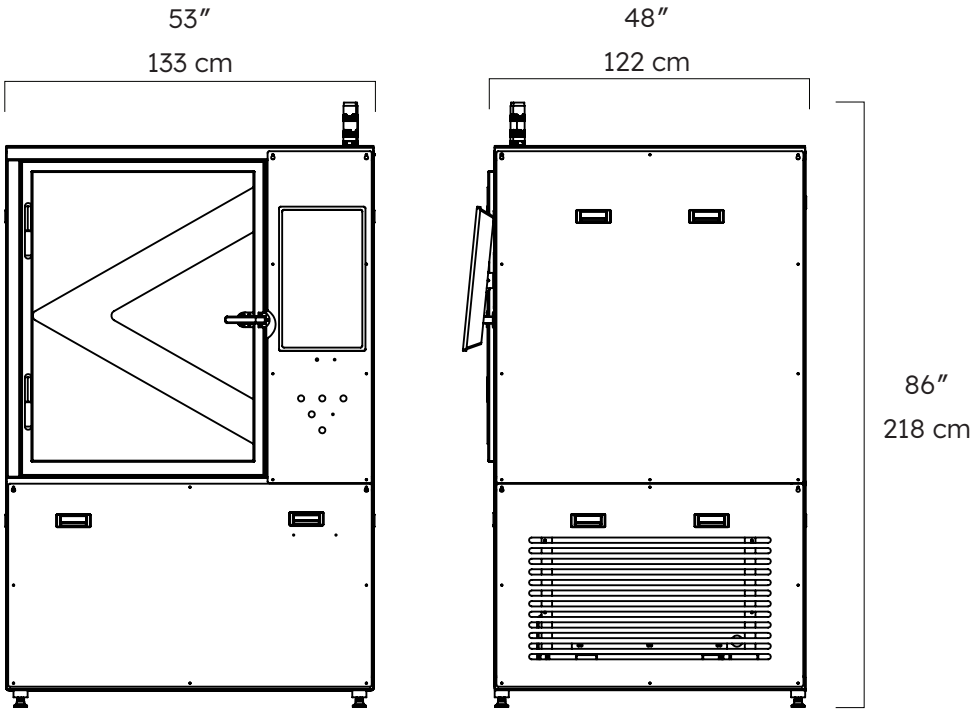
Maximum potential	225 kV
Focal spot	7.5 mm
Maximum current	30 mA
Inherent filtration	0.8 mm Be
Recommended breaker rating	30 A
X-Ray Power (maximum)	3000 W
Frequency	47/63 Hz
Beam Angle	40 degree
Irradiation chamber dimensions	24″ W x 24″ D x 42″ H (61 cm x 61 cm x 107 cm)
System dimensions	47″ W x 51″ D x 83″ H (120 cm x 97 cm x 211 cm)

Machine (continued)

Source-to-Sample Distance (SSD)	See **Table 4-5: SSD in each Irradiator**
Weight	2150 lbs (975 kg)
Maximum beam coverage	Collimated 14″ x 14″ (36 cm x 36 cm)
Warmup	Automatic
Software	The DIGISOURCE® System

XCELL 320 System Diagram

This section contains tables that list specifications for components of The XCELL® 320 System.



XCELL 320 System Specifications

This section contains tables that list specifications for components of The XCELL® 320 System.

Machine

Table 4-3: Machine Specifications

Maximum potential	320 kV
Focal spot	8.0 mm
Maximum current	30 mA
Inherent Filtration	3.0 mm Be
Recommended breaker rating	30 A
X-Ray Power (maximum)	4000 W
Frequency	47/63 Hz
Beam angle	40 degree
Irradiation chamber dimensions	32″ W x 32″ D x 42″ H (81 cm x 81 cm x 106 cm)
System dimensions	53″ W x 48″ D x 86″ H (135 cm x 122 cm x 219 cm)

Machine (continued)

Source-to-Sample Distance (SSD)	See **Table 4-5: SSD in each Irradiator**
Weight	5000 lbs (2268 kg)
Maximum beam coverage	Collimated 14″ x 14″ (36 cm x 36 cm)
Warmup	Automatic
Software	The DIGISOURCE® Software

Common Specifications

Table 4-4: Common Specifications (160/225/320 XCELL Systems)

Accessories

Accessories Specifications	
Standard	• Entry port for anesthesia/monitoring lines • Optical (RGB) camera
Optional	• Mouse irradiation kit. Includes six components as follows: 1. Pie cage 2. Partial body irradiation L Restrainer 3. Partial body irradiation R Restrainer 4. Partial body irradiation L Shield 5. Partial body irradiation S Shield 6. Gas anesthetizing box • Integrated digital X-ray imaging (DIGICOM Software)

Touchscreen

Touchscreen Monitor Specifications	
Screen size	21.5″ (546 mm) (diagonal) 10.5″ x 18.7″ (H x V) (267 mm x 480 mm)
Resolution	HD full screen (1920 x 1080)

Computer

Computer Specifications	
Hard drive	500 GB
RAM	8 GB
Processor	i5
Operating system	Windows® 11
Serial port	Yes

Source-to-Sample distances (SSD)

Table 4-5: SSD in each Irradiator*

Shelf Level	160 kV (1.8 kW)	225 kV (3.0 kW)	320 kV (4.0 kW)
1 (Contact)	37.25″	36.06″	36.56″
2	30.75″	29.75″	23.88″
3	24.75″	23.75″	16.04″
4	18.75″	17.75″	NA

*Using turntable adds an additional 5″ to shelf level (i.e. subtracts 5″ from SSD)

CHAPTER 5: SYSTEM MAINTENANCE

Introduction

This chapter provides information on actions that users must perform to maintain the safe and consistent performance of the system. The first section in this chapter provides information about cleaning and disinfection. There are recommendations for products to use and procedures to follow.

The second section of this chapter contains checklists for routine system inspections. These lists detail the steps for each procedure in the inspection.

Cleaning and Disinfecting

Cleaning

At the completion of each irradiation session, clean and disinfect the interior components of the upper cabinet and all system controls and components were touched by the user during the irradiation. This practice is both for user protection and to avoid cross-contamination of samples.

For purposes of this manual, cleaning means wiping off dust, fingerprints, and other substances that do not contain biological or contaminating fluids. Solutions for this purpose are over-the-counter, neutral detergents and/or liquids. Be sure to use a soft cloth with these cleaners.



CAUTION: Harsh liquids or rough surfaces will damage the system surfaces.

Disinfecting

For purposes of this manual, disinfecting means using approved solutions to wipe areas that have come in contact with biological or contaminating fluids. The following list shows cleaning solutions (and their main ingredients) that KUBTEC® approves for use in cleaning/disinfecting the system.

KUBTEC Approved Item	Ingredients
CaviWipes-XL	Quaternary ammonium + alcohol disinfectant
Accel-TB wipes	Stabilized hydrogen peroxide wipe
PDI and Clorox Disinfectant Bleach wipes	1:10 hypochlorite:water
PDI SaniCloth-HB wipes	Quaternary ammonium and isopropyl alcohol (IPA) disinfectant

Cleaning and Disinfecting (continued)

Areas to Clean/Disinfect

WARNING:

To disinfect trays, use a soft cloth that is dampened with an approved solution to wipe the tray surface. DO NOT spray or spill solutions directly onto the tray surface.

In addition to cleaning/disinfecting surfaces that come in contact and/or and hold the samples, surfaces touched by the user(s) also need to be cleaned/disinfected at the end of each session. These surfaces include:

- Interior and exterior walls of the chamber
- Control panel buttons and indicators
- Touch screen monitor

Recycling and Disposal



At the end of the service life, KUBTEC® requests that the system be returned for proper disposal and recycling. Responsible recycling helps reduce waste and ensures that hazardous materials do not pose a risk to public health.
The hazardous materials present in the system include:

- Lead is used to line the cabinet.
- Oil is contained in the X-ray components.
- Beryllium (Be) in the X-ray tube.

Additionally, the system contains electronic components that must be recycled appropriately.

Daily Inspection

Perform the following inspection daily, before using the system. Contact a KUBTEC representative or distributor if there is any problem.

Inspection	Review	Remedy
Visual	Are there any anomalies with the system?	If there are any visual anomalies during this procedure, contact KUBTEC or distributor.

Yearly Inspection

Preventive Maintenance services are to be performed annually by a KUBTEC engineer or a KUBTEC-trained engineer. This ensures the system is kept compliant with performance and regulatory guidelines.

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FREQUENTLY ASKED QUESTIONS

This section provides answers to questions that users typically ask about The XCELL® 160/225/320 System.

Q: How is the computer turned on?

If the computer does not automatically start when the key switch is turned to the ON position, wait a few seconds. If it still doesn't start, ensure the monitor is ON, then press and hold the black button on the back of the monitor for a few seconds.

Q: Does the unit need to be kept plugged in?

If the Uninterrptible Power Supply (UPS) option is available, KUBTEC® recommends leaving the system plugged in so that the UPS is always charged.

Q: Should the key be removed at night?

Follow institutional policy regarding X-ray equipment. To prevent unauthorized use of the system, KUBTEC recommends the removal of the key when the system is not in use.

Q: Is the unit equipped with Wi-Fi?

The unit has an optional Wi-Fi wireless adapter.

Q: Does it matter how the sample is positioned in the unit?

Position the sample so it is centered with the laser crosshairs on the tray (or turntable).

Q: Is the user being exposed to radiation? Is a lead apron required for shielding?

X-rays are controlled and sealed inside the unit. A lead apron is not required.

Q: How can the unit be cleaned?

Wipe the tray of the sample chamber with a soft cloth dampened with an approved disinfectant solution to prevent contamination. Do not spray or spill solutions directly onto surfaces. Refer to the Maintenance Chapter in the Instruction for Use for more details about cleaning and disinfection.

Q: How often does the system need to be serviced?

Manufacturer's recommendation is that the system get serviced once a year by a KUBTEC trained/certified technician.

Troubleshooting

Problem	Cause	Solution
The AC power key switch is set to ON but the system is not powered up. AC Power indicator is out.	Multiple possibilities.	• Ensure the key switch is in the ON position. • Ensure the red Emergency Stop switch is ON (pulled out). • Ensure the power cord is fully plugged into the outlet. • Check that the circuit into which the system is plugged is live.
The system is powered but X-rays cannot be generated. The **READY** light on the front panel is not lit.	The system is still warming up, or the **X-RAY** interlock switch is not engaged.	• Make sure the door to the system is tightly shut. • If the X-RAY light does not turn on, ensure that the settings in the software are within the proper range.

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APPENDIX

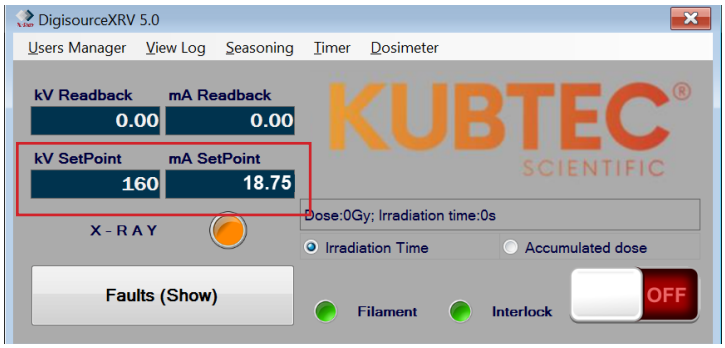
Work Instruction on Dose Calibration

Scope

These work instructions pertain to the dose calibration calculation required to establish accumulated dose time for The XCELL® Systems.

Instructions

1. Place the Cobia probe at the shelf level and height where the sample will be positioned.
2. Ensure that the Cobia probe is positioned at the center of the light field, as indicated by the laser crosshair.
3. Adjust the collimator jaws to the required opening, or leave them fully open.
4. Place the desired filter in the collimator filter holder.
5. Open The DIGISOURCE® Irradiator Software and type the desired irradiation parameters (kV and mA) in the corresponding fields, as shown in the figure.



6. Turn the X-ray on and give the unit a few seconds to reach the commanded values and stabilize.
7. From the Cobia display, record the dose rate in mGy/s.
8. Determine the total dose required (in Gy).
9. From the Correction Factor tables included with the unit, find the correction factor that corresponds to the filter and energy used for the irradiation.

10. Insert the values in the formula below:

$$\text{Time (min)} = \frac{\text{Total Dose Required (Gy)}}{\left(\text{Cobia Dose Rate}\left(\frac{\text{mGy}}{\text{s}}\right) \times \frac{1}{1000}\left(\frac{\text{Gy}}{\text{mGy}}\right) \times 60\left(\frac{\text{s}}{\text{min}}\right) \times \text{Correction Factor}\right)}$$

Convert the decimals to seconds by multiplying the decimal part by 60.

For example:
Total Dose Required = 15 Gy
Cobia Dose Rate = 7.18 mGy/s
Correction Factor = 1.40755

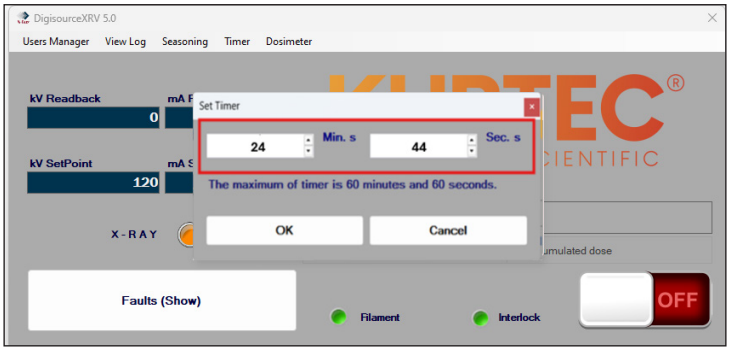
$$\text{Time (min)} = \frac{15(\text{Gy})}{\left(7.18\left(\frac{\text{mGy}}{\text{s}}\right) \times \frac{1}{1000}\left(\frac{\text{Gy}}{\text{mGy}}\right) \times 60\left(\frac{\text{s}}{\text{min}}\right) \times 1.40755\right)} = 24.73 \text{ min}$$

Convert decimals to seconds by multiplying the decimal part by 60:

$$\text{s} = 0.73\left(\text{min}\right) \times 60\left(\frac{\text{s}}{\text{min}}\right) = 43.8 \text{ s} \approx 44 \text{ s}$$

24.73 min = 24 min 44 s

11. Go to the **Timer** tab and input the time calculated above. Click **OK**.



12. Remove the Cobia probe from the center of the cabinet, and place the sample to be irradiated.
13. Ensure The DIGISOURCE® Software is set to Irradiation Time, and start the X-ray.
14. The X-ray will stop once it reaches the commanded irradiation time.

Instructions to Set kV and mA

KUBTEC® floor-standing irradiator systems are designed to operate at maximum power. For operation at settings below the maximum, it is important to understand the relationship between kV and mA.



KUBTEC systems use X-ray tubes with varying power ratings (for example, 4000 W, 4100 W, 4200 W). Users must ensure that the selected energy (kV) and current (mA) values comply with the isowatting rules that define the maximum allowable load for each configuration.

CAUTION: Operating the system outside the recommended kV and mA combinations may result in excessive tube loading and potential tube damage.

Rules for kV and mA Setpoints

The kV and mA peak setpoints are determined by the combination of peak energy (kV), current (mA) limits, and isowatting rules, as described below:

Maximum Energy (kV):

The highest possible energy (kV) is defined by the X-ray tube and generator used in the system. KUBTEC offers three configurations: 160 kV, 225 kV, and 320 kV.

Minimum Energy (kV):

The lowest possible energy (kV) is limited by the value required to protect the X-ray tube. Operating near the highest available kV is recommended, as it helps extend tube life. Although a 320 kV system can theoretically operate at 160 kV, doing so will significantly reduce the tube's lifetime

Table 3-1: kV Settings

System	Lowest possible kV	Recommended lowest kV	Recommended kV
160 kV systems	30 kV	100 kV	160 kV
225 kV systems	30 kV	160 kV	225 kV
320 kV systems	30 kV	240 kV	320 kV

Maximum Current (mA):

The maximum allowable current is the same for all systems: 30.0 mA.

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Isowatting Rules:
The range of values between the peak and minimum kV and mA settings is governed by isowatting rules, as described below.

Isowatting:

Isowatting is a functionality that allows the X-ray system to maintain a constant output power as the energy (kV) and current (mA) values are adjusted. When the energy (kV) changes, the current (mA) compensates to produce the same output power, and vice versa. Therefore, although the system is capable of reaching a current of 30.0 mA, it may not always be permitted to do so, depending on the selected energy (kV) setting.

Isowatting Formula: Current (mA) = Power (W) / Energy (kV)

- **3000 W 160 kV System:**
  at 160 kV the mA limit is: 3000 W / 160 kV → 18.7 mA
- **3000 W 160 kV System:**
  at 120 kV the mA limit is: 3000 W / 120 kV → 25.0 mA
- **3000 W 225 kV System:**
  at 160 kV the mA limit is: 3000 W / 160 kV → 18.7 mA
- **3000 W 225 kV System:**
  at 100 kV the mA limit is: 3000 W / 100 kV → 30.0 mA
- **4000 W 225 kV System:**
  at 225 kV the mA limit is: 4000 W / 225 kV → 17.8 mA
- **3000 W 225 kV System:**
  at 200 kV the mA limit is: 3000 W / 200 kV → 20.0 mA
- **4000 W 320 kV System:**
  at 320 kV the mA limit is: 4000 W / 320 kV → 12.5 mA
- **4000 W 320 kV System:**
  at 280 kV the mA limit is: 4000 W / 280 kV → 14.3 mA

Common Settings and Configurations

A summary of the most common settings and configurations is provided below:

Table 3-2: Common Settings and Configurations

System	Max Power	mA at Max kV	Recommended Default Irradiation	Max kV	Recommend Min kV to protect the tube
XCELL 160 160 kV, 1.8 kW	1800 W	11.2 mA	160 kV at 11.2 mA	160 kV	100 kV
XCELL 160 160 kV, 3.0 kW	3000 W	18.7 mA	160 kV at 18.7 mA	160 kV	100 kV
XCELL 225 225 kV, 3.0 kW	3000 W	13.3 mA	225 kV at 13.3 mA	225 kV	160 kV
XCELL 225 225 kV, 4.0 kW	4000 W	17.7 mA	225 kV at 17.7 mA	225 kV	160 kV
XCELL 320 320 kV, 4.0 kW	4000 W	12.5 mA	320 kV at 12.5 mA	320 kV	240 kV
XCELL 320 320 kV, 4.2 kW	4200 W	13.1 mA	320 kV at 13.1 mA	320 kV	240 kV

Table 3-3: Common Settings and Configurations (continued)

System	Absolute min kV	Max mA	Start of kV Isowatt Range	kV Isowatting Range	mA in IsoWatt Range
XCELL 160 160 kV, 1.8 kW	30 kV	30.0 mA	1800 W/30.0 mA → 60 kV	60–160 kV	mA=Power/kV
XCELL 160 160 kV, 3.0 kW	30 kV	30.0 mA	3000 W/30.0 mA → 100 kV	60–160 kV	mA=Power/kV
XCELL 225 225 kV, 3.0 kW	30 kV	30.0 mA	3000 W/30.0 mA → 100 kV	100–225 kV	mA=Power/kV
XCELL 225 225 kV, 4.0 kW	30 kV	30.0 mA	4000 W/30.0 mA → 133 kV	133–225 kV	mA=Power/kV
XCELL 320 320 kV, 4.0 kW	50 kV	30.0 mA	4000 W/30.0 mA → 133 kV	133–320 kV	mA=Power/kV
XCELL 320 320 kV, 4.2 kW	50 kV	30.0 mA	4200 W/30.0 mA → 140 kV	140–320 kV	mA=Power/kV

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