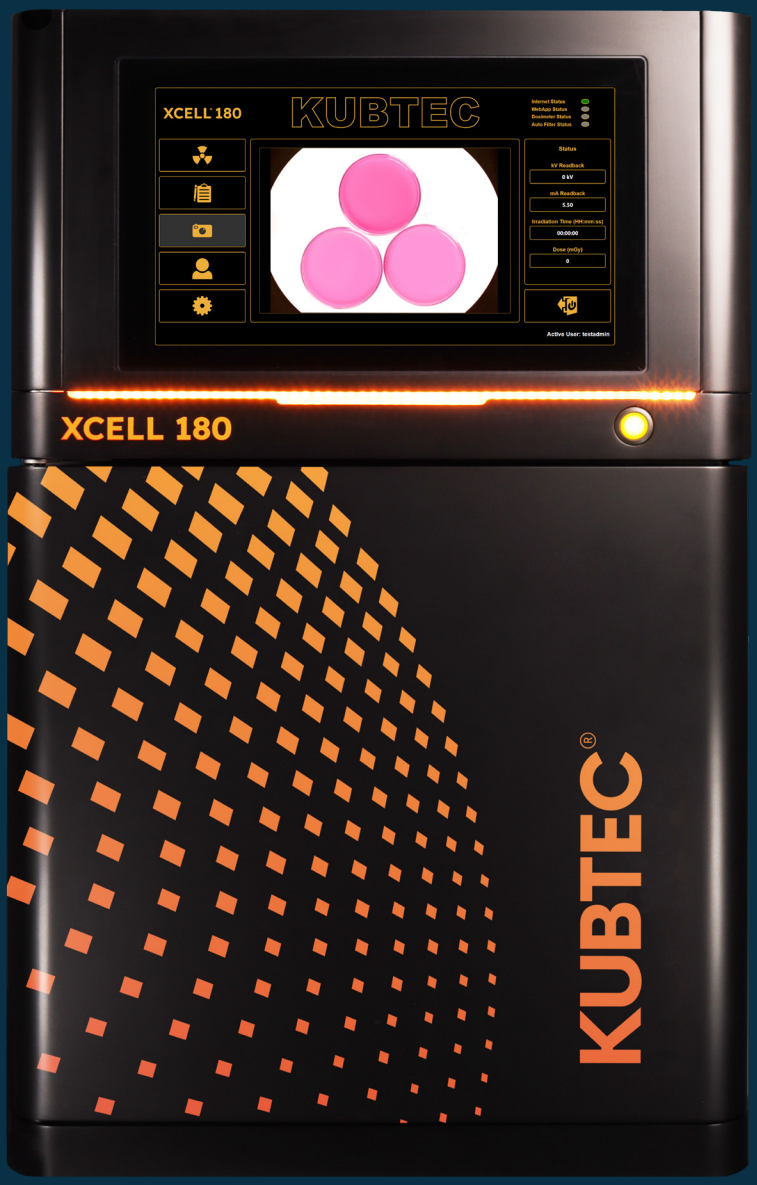
THE **XCELL® 180**

Benchtop X-ray Irradiator System



INSTRUCTIONS FOR USE

KUBTEC® SCIENTIFIC

The XCELL® 180 Benchtop X-ray Irradiator System

Instructions for Use IFU-40 Rev B March 2026

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PREFACE

Intended Use

The XCELL® 180 System is a benchtop cabinet X-ray irradiator designed to deliver radiation to biological and agricultural samples as well as material components. This system is intended for use by qualified and trained personnel and is not intended for use on humans.

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

This manual describes the most extensive system configuration. Every function, option, or accessory described in the manual may not have been purchased or licensed on your system.

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

KUBTEC Customer Care Center

KUBTEC provides customer support through the KUBTEC Customer Care Center for issues 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:

- Your 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, it 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 that this product is inspected periodically.
- Do NOT use a defective product.
- Replace broken, missing, plainly 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 prior written approval from KUBTEC.
- The user assumes sole responsibility for any malfunction resulting from improper use, inadequate maintenance, improper repair, damage, or alteration performed 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 provided in the manual and displayed on the system.



WARNING:

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

Safety Information (continued)

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.

A qualified engineer/technician - A person who has completed training conducted by KUBTEC and has been certified by KUBTEC on this system.

Name of Product

The XCELL® 180 Benchtop X-ray Irradiator System

Manufacturer



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CHAPTER 1: GENERAL INFORMATION

Introduction

The XCELL® 180 Benchtop X-ray Irradiator System is a standalone X-ray system used to deliver radiation to biological and agricultural samples. The system uses an X-ray source and The DIGISOURCE® Irradiator Software.



Figure 1-1: The XCELL® 180 System

Safety Information: Warnings

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



WARNING: Do not remove covers. Potential shock hazards are present inside the system.



WARNING: For cybersecurity, ensure your network is secure.



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



WARNING: **Heat** - The XCELL® 180 System uses 1800 W of input power, all of which is eventually converted to heat. The room must provide adequate cool airflow for the cooler to operate properly. The ambient temperature should be maintained within the limits specified in Table 1-3, and air should not be recirculated around the system. Inadequate airflow may cause malfunction or reduce system service life.



WARNING: **Weight** - The complete system weighs approximately 850 lbs. The end user is responsible for selecting an appropriate table for the system and ensuring the cabinet is moved safely.



WARNING: **Input power** - The system uses a nominal input power level of 1800 W with an initial startup peak of 2000 W.

For use in the USA, it is recommended to connect the system to an appliance outlet rated at 20 A and 120 VAC.

For use in Europe, it is recommended to connect the system to a 10 A, 230 VAC power outlet.



WARNING: **Yanking the power cable** - Do not turn off the system by yanking the power cable from the wall. This can damage the computer and the X-ray tube because the heat exchanger will be unable to remove the latent heat generated by the tube.



WARNING: The XCELL® 180 System is equipped with a detachable power cord. Do not replace the provided power cord unless advised by KUBTEC.

Safety Information: Cautions

The following caution labels appear at relevant places in this manual and on the system. Contact the KUBTEC Customer Care Center if any of these statements are unclear.



CAUTION: This system is sensitive and must to be handled with care.



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



CAUTION: **X-rays present** - The interlock system is designed to restrict X-rays generation to times when the door is closed. Do not attempt to generate X-rays with the door open under any circumstances.



CAUTION: **X-rays present/high-voltage** – Do not attempt to operate The XCELL® 180 System with any side panels removed.

Environmental Conditions

The XCELL® 180 System uses 1800 W of input power, which is ultimately dissipated as heat. Adequate cool airflow must be provided to ensure proper operation of the cooling system. The ambient air temperature must remain within the limits specified in Table 1-3, and airflow must be sufficient to prevent air recirculation around the system. Installation in an area with insufficient airflow may result in system malfunction or reduced service life.

System Handling

Transporting (shipping)

- The XCELL® 180 System should only be shipped in a KUBTEC-approved shipping container supplied by KUBTEC. It is recommended that professional movers (riggers) be used when moving the system within a facility. A Facility Installation Guide is available for reference.

Lifting and carrying

- The XCELL® 180 System weighs approximately 850 lbs and is not designed to be lifted or carried manually.
- Any attempt to move the system must be performed by trained professionals using appropriate equipment.

System Handling (continued)

System storage

- Store the XCELL® 180 System in a safe, dry location. Take precautions to minimize the risk of damage from falling objects or tipping.
- Ensure that the installation location provides a level surface.
- The installation location should provide approximately 39″ (1 m) of clearance on all sides to allow access for service personnel, as the rear and side panels must be removed during servicing. This clearance also ensures adequate airflow around the system.
- If the system is placed on a table or bench, the system weight of approximately 850 lbs must be considered. The end user is responsible for selecting a table or bench that can safely support the system. The selected table or bench should have a weight capacity of at least 1.5 times the system weight.

System Maintenance

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



CAUTION: For safety reasons, inspect the system before each use. In addition, carry out a regular inspection at least once a year.



CAUTION: Changes, additions, or maintenance to the system performed by persons without appropriate qualifications and training and/or the use of unapproved spare parts, may result in serious injury, damage to the system, and voiding of the warranty.

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 to perform annual inspections. These inspections ensures continued compliance with performance and regulatory requirements.



WARNING: If necessary, system dosimetry must be performed only by a qualified technician.



WARNING: The system must be repaired by a qualified engineer to prevent accidental damage to internal components.

Inspection procedures

The recommended inspection instructions are provided in the Maintenance Chapter of this IFU. If any issue is identified during the inspection, perform the corrective action indicated. If the issue cannot be resolved, contact a KUBTEC representative or authorized distributor.

It is recommended that inspection records be maintained. Inspection documentation may consist of completed checklists from this manual or equivalent records provided by the facility or administrator.

Labels

Labels are attached at various locations on the system. 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 reattached. The presence and condition of all labels must be verified as part of the inspection procedure.

Labels (continued)



English	French
X-RAY ON WHEN FLASHING RED	RAYONS X ALLUMÉS LORSQU'ILS CLIGNOTENT EN ROUGE
CAUTION: X-RAYS PRODUCED WHEN ENERGIZED	ATTENTION: RAYONS X PRODUITS LORS DE LA MISE SOUS TENSION
CAUTION: NO OPERATOR SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.	ATTENTION, AUCUNE PIÈCE RÉPARABLE PAR L'OPÉRATEUR À L'INTÉRIEUR. CONFIEZ L'ENTRETIEN À DU PERSONNEL QUALIFIÉ.



Possible 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 XCELL® 180 System is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user 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® 180 System

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 calculated 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

Radiation emitted from the cabinet X-ray system shall not exceed an exposure level of 0.5 mR/hr (0.005 mSv/hr) measured at a distance of 5 cm from the external system surfaces of the system.

The XCELL® 180 System is designed and manufactured in accordance with strict criteria established by the Food and Drug Administration (FDA), the Center for Devices and Radiological Health (CDRH), and the Department of Health and Human Services (DHHS). This system meets or exceeds all certification requirements for a cabinet X-ray system used in an industrial/laboratory environment.

The XCELL® 180 System is 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.

This system has been designed and tested for compliance when used per this IFU document. KUBTEC products comply with IEC Safety Standards.

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 the power supply input lines IEC 61000-4-11	<5 % UT (>95% dip in UT) for 0,5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5s	<5 % UT (>95% dip in UT) for 0,5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) 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 benchtop 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: UT 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 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 Vrms 3 V/m	Portable and mobile RF communications equipment should not be used closer to any part of this benchtop system, including cables, than the recommended separation distance calculated using the equation applicable to the transmitter frequency. 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, and should be less than the compliance level in each frequency range. Interference may occur in the vicinity of equipment marked with the following symbol: 
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 accurately by theoretical analysis. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be conducted. If the measured field strength at the location where the benchtop system is used exceeds the applicable RF compliance level, observe the benchtop system to verify normal operation. If an abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the benchtop system.
Over the frequency range of 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

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 & Disinfection section in the Maintenance Chapter.
Where equipment is not suitable for use	In the presence of flammable mixtures.
Mode of operation	100% duty cycle.
Temperature range (user operation)	0–25°C (32–70°F).
Humidity	The system is safety certified up to operation within specific humidity levels. Specifically, a maximum relative humidity of 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C.
Altitude	The system is safety certified up to 2000 m above sea level.
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).
Variants	Software programmable variants from third party.
Product Life	The 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 in. × 0.78 in. × 0.41 in. (40.5 mm × 19.72 mm × 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	Support 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:

Table 1-5: Hardware Interfaces Features

Features	
USB port	A USB port located on the side of the system for general-purpose use.
Ethernet Jack	An Ethernet jack on the back of the system, intended to provide Internet access in environments where Wi-Fi signals are limited.
Tubing/Access Port	Tubing on the side of the system that can be used for purposes such as inserting a device into the cabinet (for example, a thermocouple).

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CHAPTER 2: COMPONENTS AND CONTROLS

System Overview

The XCELL® 180 Benchtop X-ray Irradiator System consists of the following major components:

- Cabinet
- Power on/off button
- Touchscreen monitor and control interface

Cabinet

The cabinet encloses the exposure chamber door with safety interlocks, a turntable, and the touchscreen monitor for the user interface. An X-ray indicator LED on the cabinet illuminates when the system is powering up or actively generating X-rays.

CAUTION: Users must not attempt to access the upper interior portion of the cabinet where the X-ray source is located.

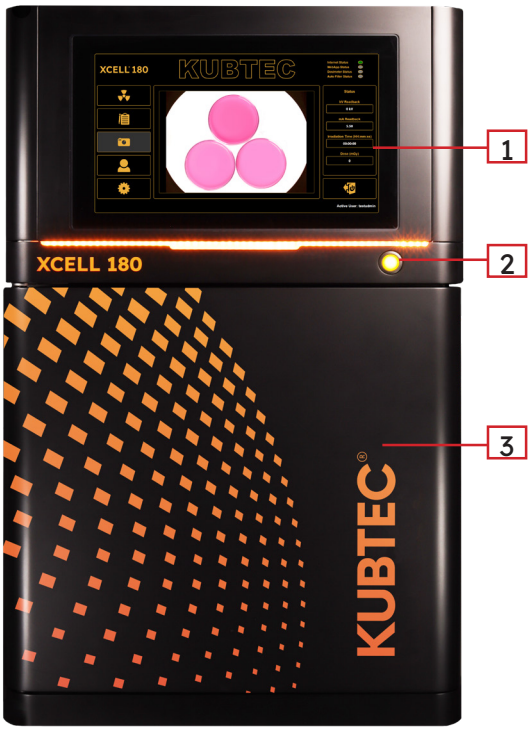


Figure 2-1: The XCELL® 180 System Cabinet

Figure Legend

1 Control interface

2 Power on/off button

3 Cabinet

Exterior Cabinet

The exterior cabinet includes physical controls and indicators for the following system functions:

- Locking and unlocking the system.
- Turning system power on and off.
- Indicating when X-rays are generated.

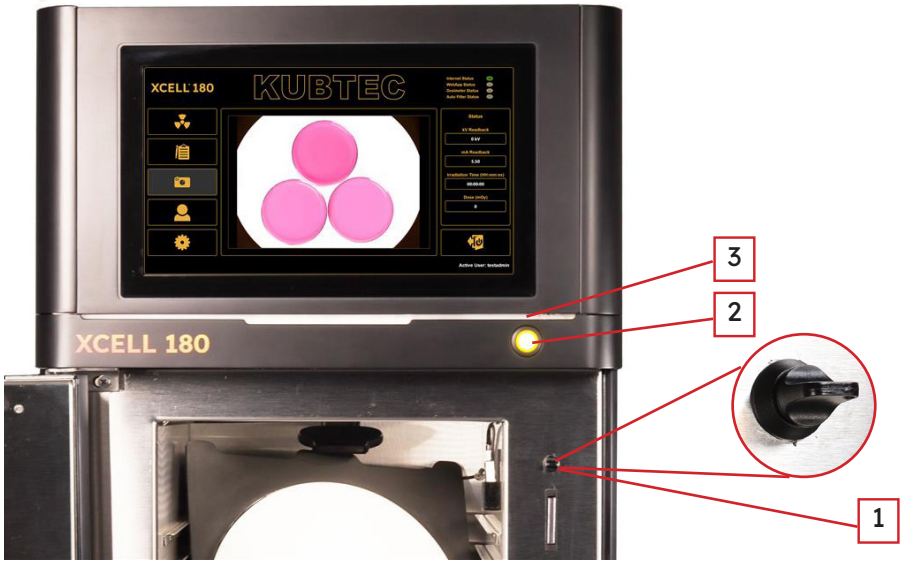


Figure 2-2: The XCELL® 180 System Control Panel

Figure Legend

1	**Key switch**	• **OFF position**: The key is turned to the left to the vertical position. The system (other than computer) remains energized, and X-rays cannot be generated. • **ON position**: The key is turned to the right to the horizontal position. If the computer is powered off, it will power on when the key is turned. As long as the power button is on, X-rays can be activated using the software. **NOTE**: The key is removable in the OFF position. To prevent unauthorized use of the benchtop system, KUBTEC® recommends removing the key when the system is not in use.
2	**Power button**	• **ON position (pushed in):** System power is enabled and the LED is illuminated. • **OFF position (pushed out):** Power is disabled and the LED is not illuminated.
3	**Activity light**	• The Ready LED illuminates yellow when the door is closed, the panel power is ON, and the system is ready to generate X-rays. • The LED flashes red when X-rays are being emitted.

Interior Cabinet

The interior cabinet includes a turntable, an integrated dosimeter, a filter bracket, and an array of sensors that automate the irradiation process. In addition to the contact level (the lowest level within the interior chamber), the cabinet has three additional levels that place the sample closer to the irradiation source. Each of these four positions is dose-calibrated, enabling the system to deliver the appropriate dose output for each position.

The Automatic Magnification Tray Detection Feature identifies the intensity (magnification) level of the turntable and displays it on the Main User Screen (see Figure 3-2).



Figure 2-3: Cabinet Chamber

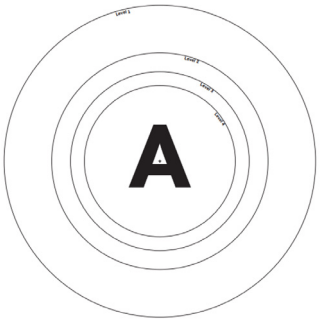
Figure Legend

1	Interior LEDs	**6**	Third-level shelf rail
2	Filter recognition base	**7**	Second-level shelf rail
3	HD camera	**8**	Integrated dosimeter probe
4	Magnification turntable sensor	**9**	Turntable
5	Fourth-level shelf rail		

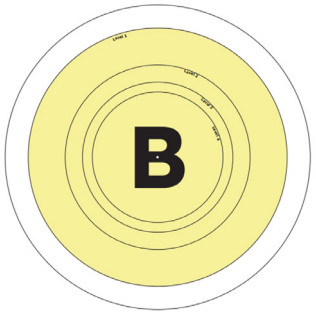
Irradiation Field Size at Mag Level and Uniformity

The usable irradiation field decreases in size as the magnification level increases. To assist users in identifying the usable area at each magnification level, a set of three labels is provided. Each label indicates the achievable dose uniformity for its corresponding usable area. Figure 2-4 shows the dose uniformity for each magnification level.

Rotational dose uniformity: Area A
Base level uniformity diameter: 12.0″ (30.5 cm)
Uniformity: 80% ± 5%.



Rotational dose uniformity: Area B
Base level uniformity diameter: 10.5″ (26.7 cm)
Uniformity: 85% ± 5%.



Rotational dose uniformity: Area C
Base level uniformity diameter: 9.0″ (22.9 cm)
Uniformity: 90% ± 5%.

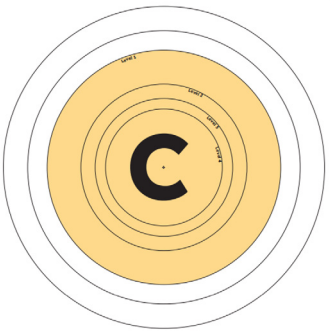


Figure 2-4: The XCELL® 180 System Turntable Uniformity Areas

Turntable Uniformity

The turntable improves dose uniformity by averaging the heel effect. The example below illustrates how The XCELL® 180 System turntable achieves this averaging.

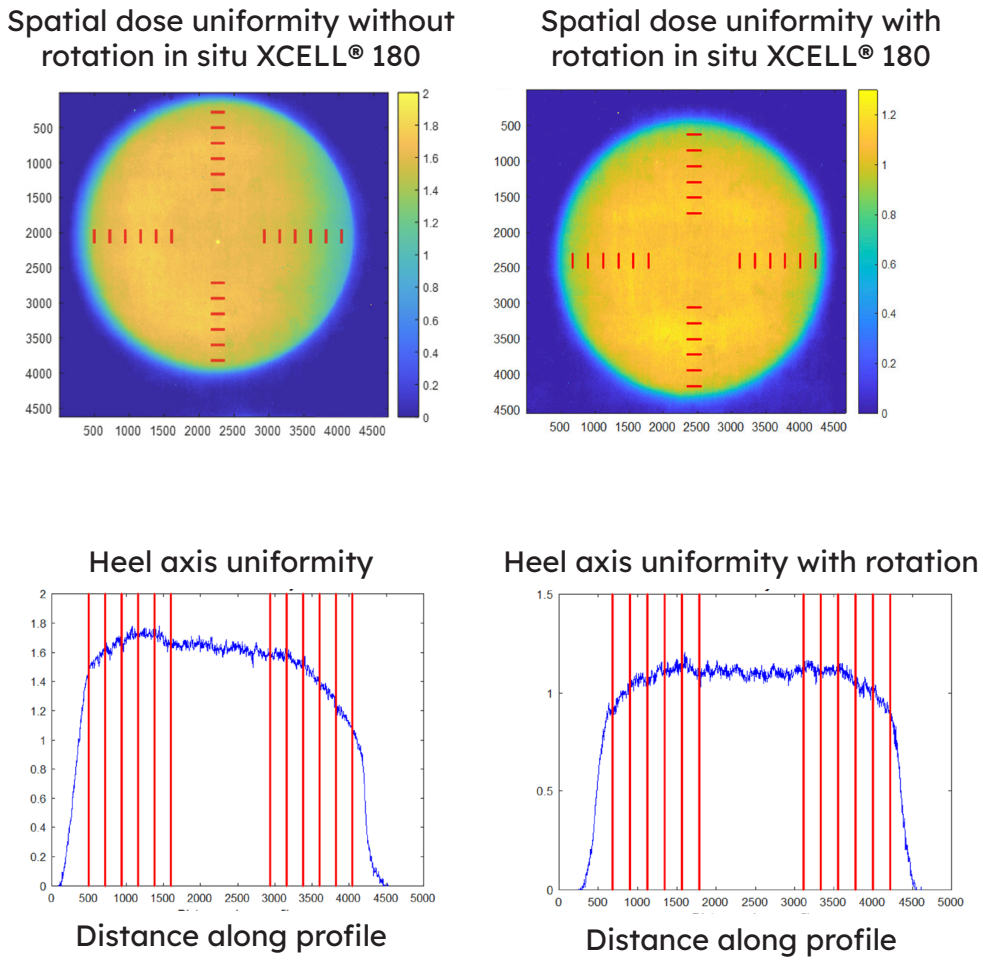


Figure 2-5: Dose Uniformity with and without Rotation

NOTE: When using the turntable, ensure the dosimeter sensor and cord are positioned on the dose probe holder located on the side of the chamber with the cable out of the way.

NOTE: Dose values displayed on the charts of Figure 2-5 are relative values.

Turntable Uniformity (continued)

Each KUBTEC system is supplied with a QA document that includes a radiochromic film scan showing validation of the system's rotational dose uniformity specifications and its simulated dose uniformity. The simulated rotational dose is generated by rotating the same film scan 360 degrees and averaging 100 times. An example of the simulation QA process is shown below.

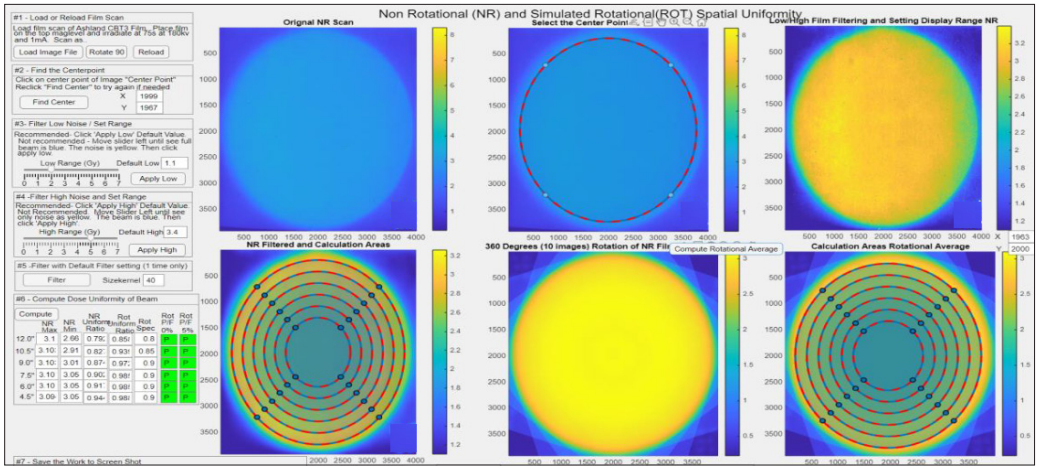


Figure 2-6: Non-Rotational (NR) and Simulated Rotation Spatial Uniformity Scans

Automatic Filter Recognition

The XCELL® 180 system includes two standard selectable filters, and two additional selectable filters available upon request.

An irradiation filter is a material placed in the X-ray beam that preferentially removes low-energy photons while allowing higher-energy photons to pass. This shifts the X-ray spectrum toward higher energies, resulting in higher-quality irradiation. Filters may be made from different materials and may vary in density and thickness, which determines their specific filtering characteristics.

Inherent Filtration vs. Selectable Filtration

Inherent filtration is a filter built into an X-ray system and cannot be removed. Selectable filtration, on the other hand, can be added or removed as needed. Using multiple filters simultaneously is recommended, meaning that selectable filters should be used along with inherent filtration.

NOTE: KUBTEC® does not recommend irradiating samples without selectable filtration.

Standard and By-Request Filters

The system supports a range of filters designed to optimize beam quality and dose control. The filters listed below include both standard filters supplied with the system and additional filters available upon request.

Standard filters included with the system:

- 1.6 mm Al
- 0.25 mm Cu

Available filters upon request:

- 0.50 mm Cu
- Thoreaus (1.6 mm Al + 0.25 mm Cu + 0.8 mm Sn)

When a selectable filter is changed, the corresponding filter type is updated on the Main User Screen. If no selectable filter is attached, the display will show **Inherent Filter.** The user should periodically verify that the filter type shown on the screen matches the filter installed.



Figure 2-7: Standard Filters

System Filters and Magnetic Filter Mount

Filters are attached to the magnetic filter mount on the inside top of the cabinet. The user places the filter close to the filter base. Magnets within the filter are attracted to the corresponding magnets in the base. This magnetic pull draws them together with enough force to snap into place with the necessary alignment.

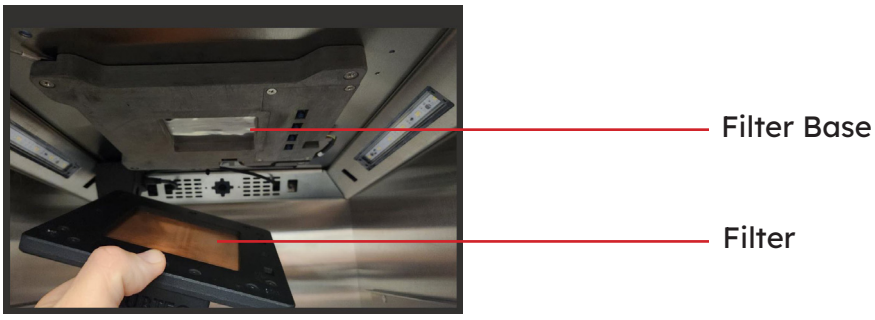


Figure 2-8: System Filters and Magnetic Filter Mount



Figure 2-9: Properly Installed Filter

The system is equipped with Automatic Filter Recognition Software, which indicates to the user which filter is installed and automatically adjusts the calibrated dose rate accordingly.

Low-Energy X-ray Removal by XCELL Filtration Options

The figures below illustrate how inherent and selectable filters remove low-energy X-rays, thereby improving the energy spectrum uniformity of the beam.

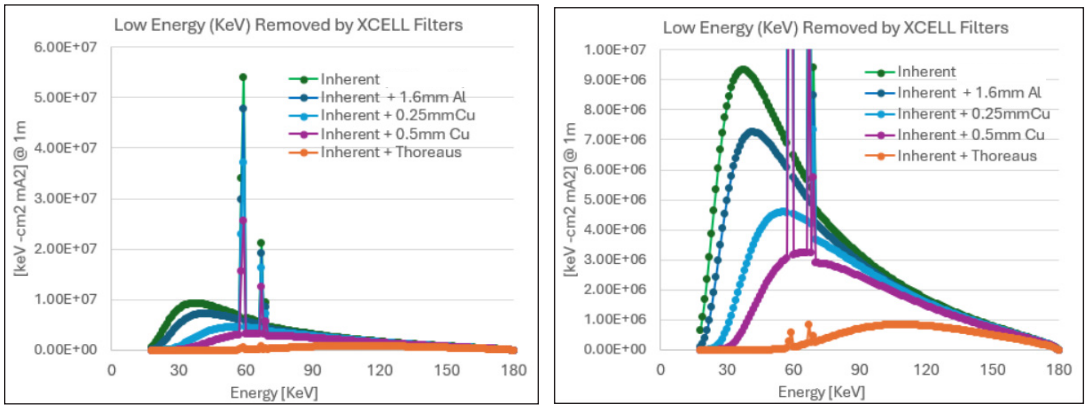


Figure 2-10: Effect of Inherent and Selectable Filtration
The effect of inherent alone and in combination with each of the four selectable filters. As filtration increases, the amount of low-kV X-ray content decreases, resulting in improved depth uniformity. The first two filters (1.6 mm Al and 0.25 mm Cu) are standard; the last two (0.5 mm Cu and the Thoreaus filter) are optional.

Magnification Railings

Magnification railings are used to position the turntable and sample within the X-ray field at four different levels. Positioning the turntable closer to the X-ray source will increase the intensity of the absorbed X-rays. This increase is due to the Inverse Square Law which states how radiation intensity decreases proportionally to the square of the distance from the source.

The cabinet provides four magnification railings. The usable area at each railing level is indicated on the three labels (see Figure 2-4).

These labels correspond to a percentage of rotational dose uniformity as follows:

Label A - Uniformity 80% +5%

Label B - Uniformity 85% +5%

Label C - Uniformity 90% +5%

The magnification turntable is shown (Figure 2-11) at two of the four possible magnification levels. In this example, the usable areas are indicated on label A (uniformity: 80% ± 5%) on the turntable. The usable area falls within the smaller circle when the turntable is positioned closer to the source. When the turntable is moved farther from the source, the usable area expands to the larger circle. Although the same beam uniformity is maintained, irradiation time increases as the sample is positioned farther from the source.



Figure 2-11: Magnification Level 1 (Contact) and Level 3

Magnification Railings (continued)

After selecting the appropriate label (A, B, or C) corresponding to the desired uniformity, the user should choose the magnification railing that allows the sample to fit within the smallest usable area (i.e., the position closest to the X-ray source). This ensures the fastest irradiation rate for the given sample size. An example of duration versus railing selection is shown below.

Table 2-1: Dose Rate and Time Required to Deliver 2 Gy at Each Magnification Level

Magnification Level	Dose Rate - Gy/sec	Time Required to Deliver 2 Gy (min:sec)
4 (top)	0.0414	0:49
3	0.0307	1:05
2	0.0201	1:40
1 (bottom)	0.0099	3:22

Auto Mag Detection – The cabinet is equipped with a time-of-flight (TOF) sensor located in the rear corner, which detects the position of the magnification turntable. The sensor identifies the turntable position by reading a small white label attached to the turntable.

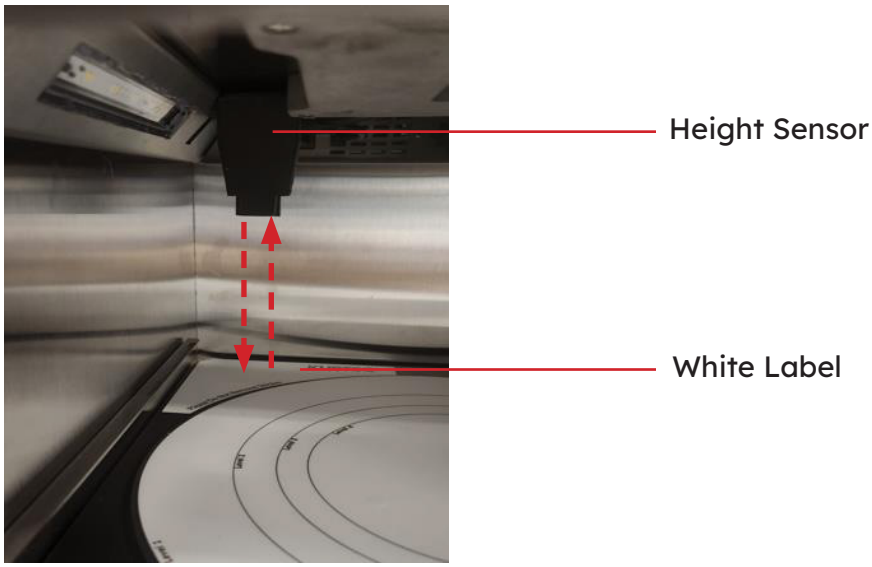


Figure 2-12: Time-of-flight height sensor reading the white identification label to determine the mag turntable position

Magnification Railings (continued)

When the magnification level is changed, the **Intensity Level** will reflect the change accordingly in the Main user screen:



Figure 2-13: Intensity Level

WARNING: Do not tamper with the white label on the back left corner of the magnification turntable. This label is required for accurate detection of the turntable position.

WARNING: The users should periodically verify that the Intensity Level shown on screen matches with the railing position of the magnification turntable.

This is important because the correct Intensity Level is required for the accurate dose calculation.

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CHAPTER 3: SYSTEM USE FOR IRRADIATION

Introduction

Before turning on The XCELL® 180 Benchtop X-ray Irradiator System for the first time each day, perform the daily inspection as stated in the checklist in the Maintenance Chapter.

NOTE: To obtain consistent results, operate the system at normal room temperature and within the operating limits specified in the Specifications Chapter. Drastic and sudden temperature changes may cause condensation to form on the system surfaces. If this happens, it is strongly recommended to wait until the condensation dissipates and the system acclimates to the surrounding environmental conditions before resuming operation.

How to Start the System

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

1. Confirm the following:
   - The system is placed on a flat, stable surface.
   - The power cord is fully inserted into the wall outlet.
2. Open the door and turn the key switch to the ON position.
3. Press the power button on the control panel.
4. When the Login screen displays, do the following:
   - Enter the User Name and Password provided by the System Administrator.

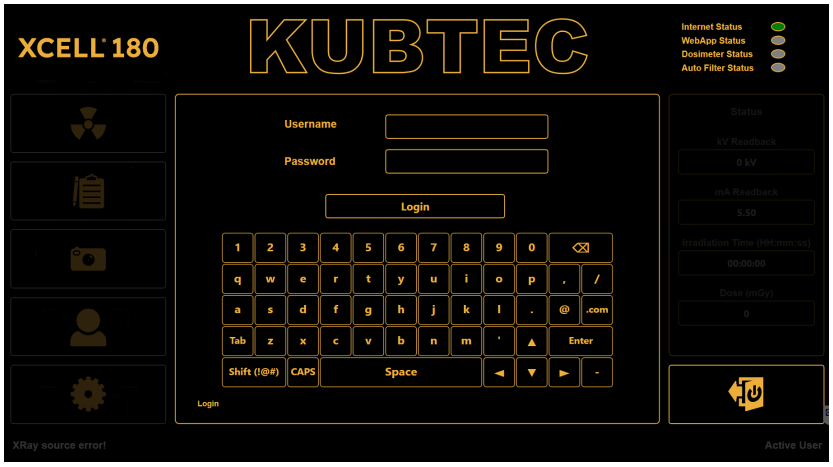


Figure 3-1: Login Screen

5. Click the **Login**.
6. When the software finishes loading, the Main User Screen (described in the next section) is displayed.

Main Screen Components

The Main User Screen allows the user to enter exposure factors, start and stop X-ray generation, view usage logs, check intensity turntable level (magnification level), check filter installation, and add/delete users. Screen indicators provide feedback for the user during the exposure sequence.

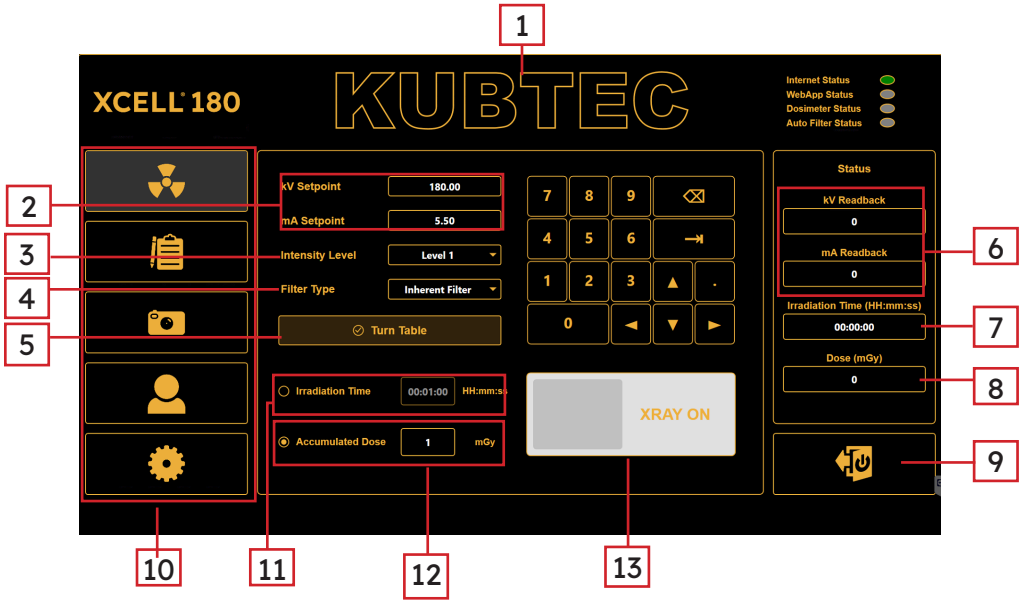


Figure 3-2: The XCELL® 180 System Software Main Screen

Legend for Main Software Screen

Figure Legend

No.	Function
1	**READY Indicator** - Illuminates orange when the benchtop system is ready to generate X-rays. The orange light turns off when the system is not ready to generate X-rays (for example, when the door is open, the interlocks are disengaged) and blinks red when X-rays are being generated.
2	**kV and mA Setpoint** fields - Allows manual entry of values for kV (60 kV to 180 kV) and mA (0.1 mA to 5.5 mA).
3	**Intensity Level** – Automatic Magnification Tray Detection feature indicates the magnification turntable level, ranging from 1 to 4, with level 4 being closest to the X-ray source. Although this value populates automatically, the user should verify that it is correct.
4	**Filter Type** – Automatic Filter Recognition displays the selectable filter currently mounted to the system.
5	**Turntable** – This option enables the turntable to either rotate (to improve dose uniformity) or be stationary. It rotates only when the X-ray is turned on.

Legend for Main Software Screen (continued)

6	**kV and mA Readback** fields - Provides dynamic feedback about these settings while the X-ray is in progress.
7	**Irradiation Time** (display) - Dynamically counts down the remaining time during which X-rays will be generated after the X-ray button is pushed.
8	**Dose (Gy)** (display) – Provides dynamic feedback on the accumulated dose.
9	**Exit button** - Closes the The XCELL® 180 System software.
10	**Main User Screen menu** - Displays the main system function along side of the screen: • **Irradiation** Tab - Controls all radiation parameters. • **Logs** – Allows Admin users to view and export every user logs and allows regular users access to view logs. • **Live Feed** – Allows users to see live video of sample. • **User Manager** – Allows Admin users to create or delete users, clear logs and change passwords.
11	**Irradiation Time** (entry) - Allows manual entry of the exposure time in the format hh:mm:ss.
12	**Irradiation Dose** (entry) - Allows for the entry of target dose at which the system will stop irradiation (in dose mode).
13	**XRAY (ON/OFF)** toggle button - Initiates the generation of X-rays. It also can be used to stop X-ray generation before the set time/dose reaches zero.

Warmup/Seasoning

Warming up (seasoning) the X-ray source is a procedure detemined by the length of time since the system was last used. The system automatically determines the appropriate warmup profile.

After logging in, if a warmup is required, a prompt appears instructing the user to initiate the warmup process. If the warmup is not performed, the system remains non-operational and cannot be used.

Requirement	Duration	System Idle Time
No warmup	0 min	The system was last used 0–24 hours ago.
Short warmup	10 min	The system was last used between 1 and 7 days ago.
Long warmup	50 min	The system was last used over 7 days ago.



Figure 3-3: Warmup Required Screen

Dose QA

Every seven days, the system requires a Dose QA to be performed. Once the calibration is completed, the system returns to the standard user interface.

CAUTION: Dose QA can be disabled if necessary; however, disabling this feature prevents detection of changes in delivered dose. For this reason, it is strongly recommended to keep Dose QA enabled.

CAUTION: Depending on the sample thickness, the absorbed dose may vary. Appropriate dose calculations should be performed to ensure accurate measurement.

Follow these steps to run the dose QA:

- Set the turntable at the lowest level.
- Place the dosimeter in the center of the turntable. Make sure it sits flat so that it remains flush with the turntable.
- Click the **Start Dosimeter Calibration**.

Dose QA (continued)

- When the calibration is complete, click to return to the main window.

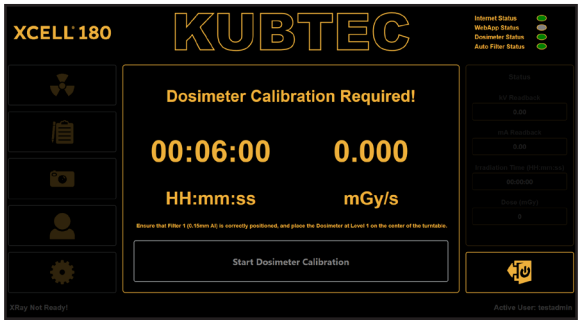


Figure 3-4: Start of Dose QA

How to Irradiate a Sample

To irradiate a sample, follow these steps:

1. Perform the warmup procedure, if required.
2. Perform the dosimeter QA (dose calibration), if required.

   NOTE: Calibrate the dosimeter every two years to ensure accurate dose measurements.
3. Enter the exposure factors:
   - In the **kV Setpoint** field, enter a value between 60 and 180 kV.
   - In the **mA Setpoint** field, enter a value between 0.1 and 5.5 mA.
4. Select an irradiation mode (**Irradiation Time** or A**ccumulated Dose**).



Figure 3-5: Timer and Dosimeter

To enter the Irradiation Time:

- Select the **Irradiation Time** option.
- Enter a value in the format hours:minutes:seconds (for example, 1:00:00 will irradiate for 1 hour).
- The system operates for the specified irradiation time and then automatically turns off.

To enter Accumulated Dose:

- Select the **Accumulated Dose** option.
- Enter a value in Grays (Gy) (for example, 10.00 Gy will irradiate until the system reaches 10 Gy).

How to Irradiate a Sample (continued)

5. Check the **Filter Type** to ensure the desired filter is installed. If a different filter is required, remove the current filter and attach the desired filter to the inside top of the cabinet. The magnets will ensure the proper placement of the filter on the cabinet, and the system will automatically identify and display the new filter in the **Filter Type** field on the Main User Screen.



Figure 3-6: Filter Type

6. Check the **Intensity Level** to ensure that the magnification turntable is set to the desired level. If a different level is desired, move the magnification turntable to the appropriate level. The system will automatically detect the new level and display it in the **Intensity Level** field on the Main User Screen.



Figure 3-7: Intensity Level

7. Position the sample at the center of the turntable and within the marked border lines.
8. Click the **XRAY ON** button to start X-ray generation:
   - Confirm that the KUBTEC logo and LED change from yellow to blinking red.
   - The **XRAY ON** button changes to red and reads **XRAY OFF**.

   NOTE: To stop X-ray generation before the set time (or set dose in dose mode) is reached, click the **XRAY** OFF button.

System Logs and Log Management

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

Once a user log is selected, it can be exported by clicking **Export to CSV** on the bottom at the screen, and navigating to the desired export location and clicking **OK**.

To view a log, click **Logs** on the left-side menu bar. For regular users (not admin), only the log for the currently logged-in user is displayed.

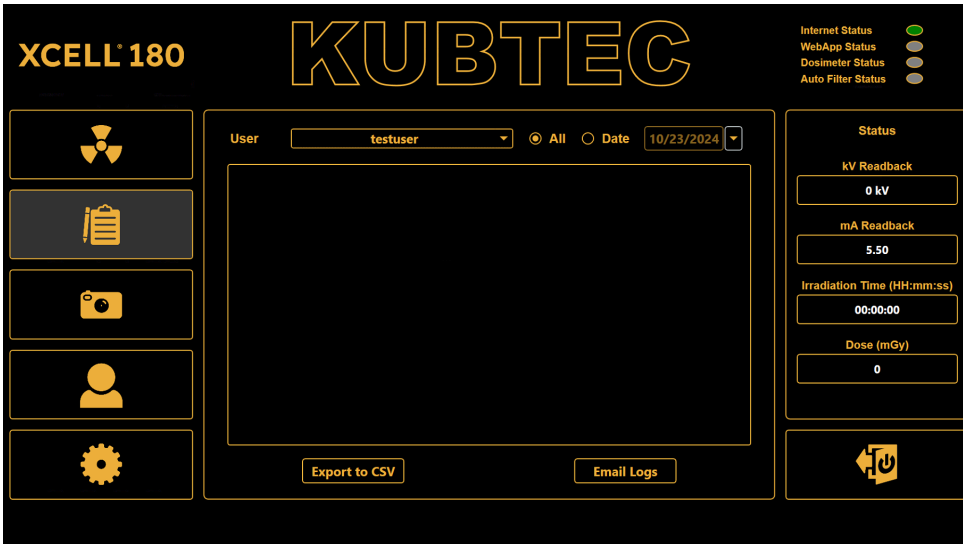


Figure 3-8: User Log Screen

In addition to viewing and exporting user logs, the system admin can clear logs, create and delete users, and change user passwords. To access and use these functions, click the **Users Manager(U)** button on the menu bar on the left-side of the Main User Screen.

Admin Screen - User Manager

The Admin has the following functions available on the Admin screen:

- To create a new user, click the **Create New User** button to access the create a new user screen. Enter the **Username** and **Password** details, select the **User Type**, then click **Create**.
- To delete a user, click the user name in the **User List**, click **Delete User**, and click **Yes** to confirm deletion of the selected user and associated logs. When the **User Deleted** prompt appears, click **OK**.



Figure 3-9: System Admin Functions Screen

- To change a password, click the name of the user whose password needs to be changed, and then click **Change Password**. On the change password screen, enter in the **Current Password**, **Type New Password** in both fields, then click **Submit**.

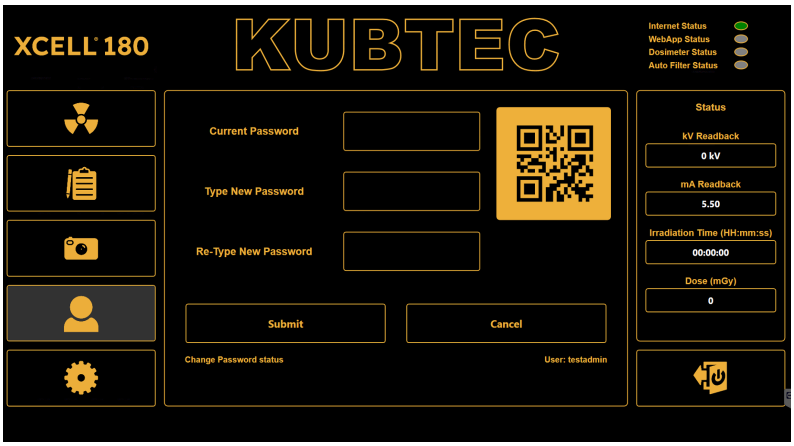


Figure 3-10: Change Password Screen

Mobile Application

The KUBTEC mobile app provides easy access to essential information, support, and features for registered KUBTEC systems.

NOTE: To welcome new customers, KUBTEC provides the first year of mobile app service at no cost. An annual subscription fee applies for subsequent years. Mobile app service will automatically expire after the first year unless the customer chooses to subscribe.

The mobile application has the following functions:

- **System Registration:** The users can register each KUBTEC® system using its unique serial number.
- **System Information:** The users can view system type, serial number, installation date, location, Quick Reference Guides (QRG), and User Manuals (IFU).
- **Service Requests:** The users can submit maintenance requests or report issues directly to the KUBTEC Service team.

Installation

- Visit https://kubtec.netlify.app/ and download the application to your mobile device.
- Once the application opens in the browser, click the three dots in the upper-right corner and select **Create shortcut.**
- The application icon will appear on the device home screen.

Creating Accounts and Signing In

The KUBTEC mobile app provides the following three options for account access:

- **Sign In:** Existing KUBTEC customers with user accounts can sign in by entering their email and password. After signing in, users are directed to the home page, which displays their system information.
- **Sign Up:** New users can create an account by selecting **Sign up**. After entering their name, email, phone number, and creating a password, they need to enter an organization code. The joining request will be pending until approved by the organization admin. Once approved, users are directed to the home page with their system details.
- **Forgot password?:** If an existing user forgets their password, they can reset it by selecting **Forgot password?** Password reset instructions are sent to the registered email address.

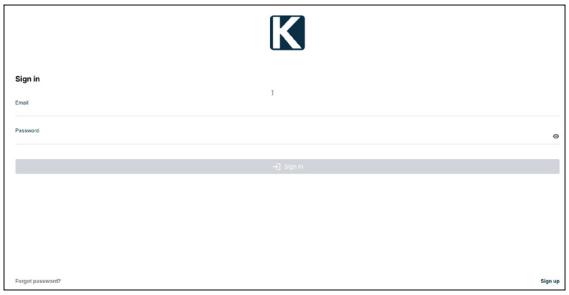


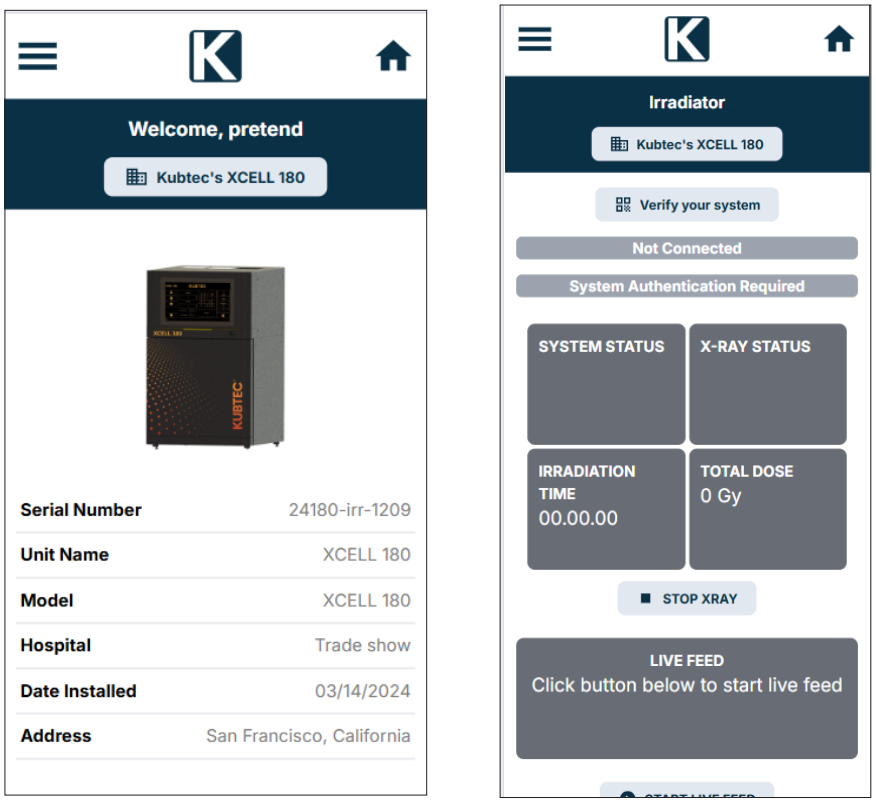
Figure 3-11: Mobile Sign In Screen

Mobile Application (continued)

Navigation Menu

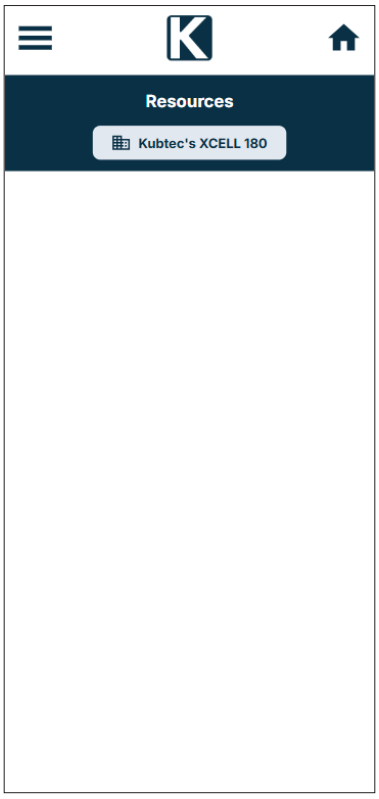
The users can access the navigation menu from the top-left icon (three horizontal lines). The following six options are available:

1. **Home:** Displays the system image, serial number, model, installation date, and location. A banner at the top allows users with multiple systems to select the desired system for detailed information.
2. **Irradiator:** Available if the user owns an irradiator. This option takes the user to the irradiator page, where they may be prompted to verify their system if a significant amount of time has passed between uses. After verification, the user can monitor system status, X-ray status, irradiation time, and total dose. If the irradiator is active, users can choose to stop it or view a live feed. The personal logs can be downloaded here.
3. **Resources:** Provides access to system-related resources and documentation.
4. **Chat with Kubtec**: Allows users to connect with KUBTEC Admin or their authorized dealer for support.
5. **What's new:** Redirects to the KUBTEC website, where the users can explore additional functionalities and access the latest company updates and information.
6. **Logout:** Logs the user out of the KUBTEC app securely.

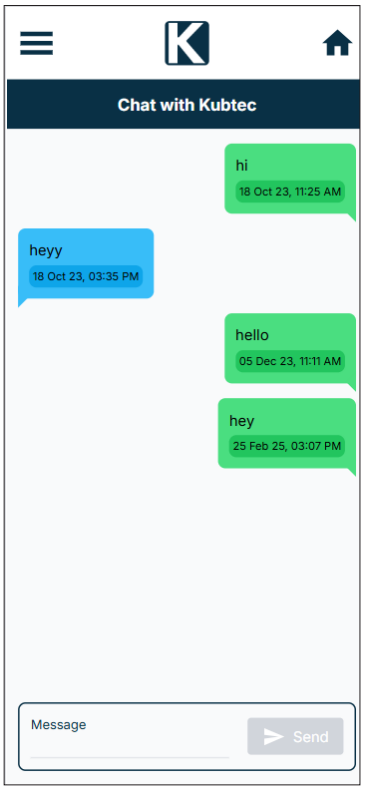


Home Menu **Irradiator Menu**

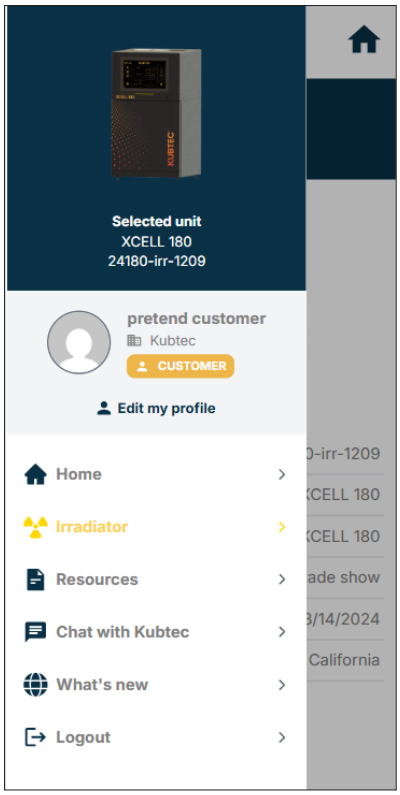
Figure 3-12: Mobile Application Menus



Resources Menu



Chat with Kubtec Menu



Logout Menu

Figure 3-13: Mobile Application Menus (continued)

Mobile Application (continued)

System Monitoring

When the system is connected to the KUBTEC mobile app, the following system parameters can be monitored:

- **SYSTEM STATUS:** Displays whether the system is currently online or offline.
- **IRRADIATION TIME:** Shows the elapsed time of the ongoing irradiation cycle in the format hh:mm:ss.
- **X-RAY STATUS:** Indicates if the X-ray system is currently ON or OFF.
- **TOTAL DOSE:** Displays the total accumulated dose from the current X-ray cycle.
- **LIVE FEED:** Provides a real-time view of the interior of the cabinet.
- **STOP X-RAY:** This allows the user to manually stop the ongoing irradiation cycle.

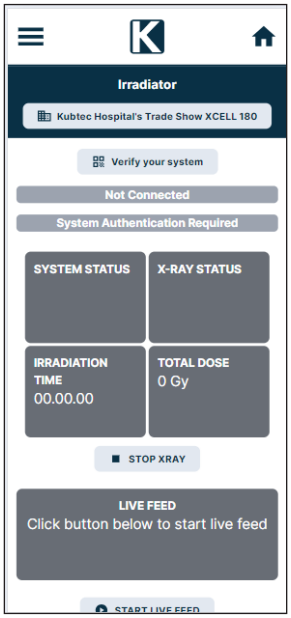


Figure 3-14: Mobile Monitoring

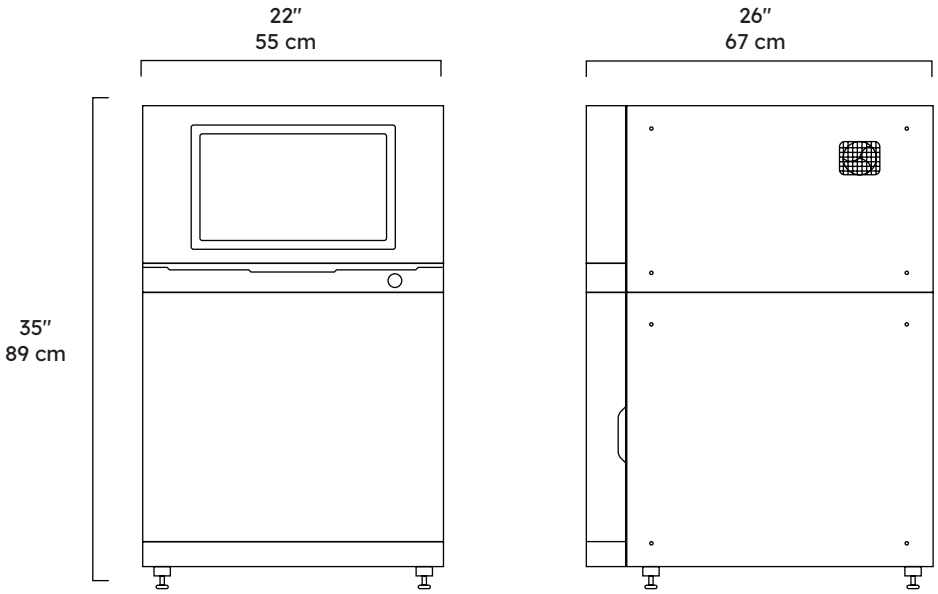
Shut Down the System

To shut the system down:

1. Ensure the cabinet is empty.
2. Click the **EXIT** icon in the software.
3. To shut down the computer, exit The XCELL® 180 Software, then use the Windows shutdown command. The computer will automatically power on the next time the system key switch is turned on.
4. Click the physical power button above the door.
5. Open the door and turn the key to the OFF position.

CHAPTER 4: SYSTEM SPECIFICATIONS

System Diagram



System Specifications

This chapter contains tables that list specifications for components of The XCELL® 180 System.

Electrical Requirements

Table 4-1: Electrical and Mechanical Specifications

Input line voltage	120 VAC ±10%; 230 VAC ±10%
Peak input power	2000 W
Frequency	50/60 Hz
Construction	Fully integrated benchtop system
Dimensions	55 cm W x cm 67 D x 90 cm H (22″ x 26″ x 35″)
Irradiation chamber dimensions	33 cm W x 38 cm D x 42 cm H (13″ x 15″ x 17″)
Weight	385.6 kg (850 lbs)

Tube Specifications

Table 4-2: Tube and Source Specifications

Maximum potential	180 kV
Maximum output power	990 W
Focal spot	3.2 mm
Inherent filtration	2.15 mm Al
Beam angle	40°
Source to sample distance	43 cm (17″) maximum with three additional calibrated distances
Anode type	Tungsten

Computer Specifications

Table 4-3: Computer Specifications

Hard drive	450 GB
RAM	16 GB
Processor	Intel™ I5-10500TE (2.3 GHz, 3.7 GHz)
Operating system	Windows® 11 Enterprise

CHAPTER 5: SYSTEM MAINTENANCE

Introduction

This chapter provides information on actions that users must perform to maintain safe and consistent performance of the system.

The first section of this chapter Cleaning and Disinfection, including recommended products and procedures.

The second section of this chapter contains checklists for the routine system inspections.

Cleaning and Disinfecting

Cleaning

After completing each sample case, clean and disinfect the interior components of the cabinet and all system controls or components that were touched during the operation. This helps protect the user and prevents cross-contamination of samples.

For purposes of this manual, cleaning refers wiping off dust, fingerprints, and other substances that do not contain biological contaminants. Suitable cleaning solutions include over-the-counter neutral detergents or liquids. Always 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 refers using approved solutions to wipe areas that have come in contact with biological contaminants.

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 turntable, use a soft cloth dampened with an approved solution to wipe the turntable surface. DO NOT spray or spill solutions directly onto the internal labeling.

In addition to cleaning/disinfecting surfaces that contact come into contact with samples, all surfaces touched by the user(s) also need to be cleaned and disinfected after each use. 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 XCELL 180 system's 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 and within the monoblock assembly.
- Oil is contained in the monoblock assembly.
- Beryllium (Be) in the X-ray tube.

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

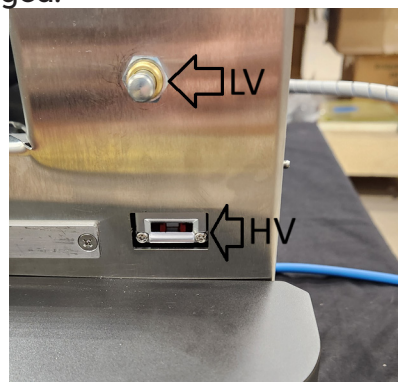
High Voltage Warning

WARNING:

After disconnecting the XCELL® 180 power source, wait **at least three minutes** before touching any high-voltage connections on the generator. The capacitors remain charged with high voltage for up to three minutes.

Daily Inspection Checklist

Perform the following inspection daily, before using the system. Contact a KUBTEC representative or distributor if any issues are observed.

Inspection	Review	Remedy
Visual	Are there any anomalies with the system? Verify that all the exterior panels are securely attached. Verify that the push button and switch-edge interlocks are not damaged. Verify that the low-voltage (LV) and high-voltage (HV) interlocks are not damaged. 	If any visual anomalies are observed during this procedure, contact KUBTEC or the distributor.
Dosimetry calibration	Verify that the system completes dosimeter calibration successfully.	If any issues occur, do not use the system and contact KUBTEC Technical Support.
Red LED	Confirms that the red LED illuminates when the X-ray is active.	If any issues occur, do not use the system and contact KUBTEC Technical Support.
Digital interlock icon	The digital icon of the interlock (KUBTEC logo) should turn **amber** when the door is closed and **gray** when it is open.	If any issues, do not use the system and contact KUBTEC Technical Support.

Daily Inspection Checklist (continued)

Inspection	Review	Remedy
READY LED	The READY LED should turn off when the cabinet door is open.	If any issues occur, do not use the system and contact KUBTEC Technical Support.
Readback kV and mA	Check the Readback kV and mA on the GUI. The displayed values shall match the user-commanded values within ±1% in both the OFF and ON states (180 kV, 5.5 mA).	If any issues occur, do not use the system and contact KUBTEC Technical Support.
Readback kV with door open	The Readback kV should display 0.00 kV (with no fluctuations) when the door is open.	If any issues occur, do not use the system and contact KUBTEC Technical Support.

Weekly/Monthly Inspection Checklist

Inspection	Review	Remedy/Action
kV and mA Accuracy	Verify that the source output kV and mA values displayed on the readback monitor screen are within ±1% of the set values.	If any issues occur, do not use the system and contact KUBTEC Technical Support.
Automatic Magnification Tray Detector	Place the magnification turntable at each of the four magnification levels.	The sensor should automatically detect each position and display it in the **Intensity Level** field on the Main User Screen. If it does not, contact KUBTEC Technical Support.
Turntable Function	Use the internal camera to confirm that the turntable rotates when selected.	If it does not, check the connection.
Fans	Verify the two fans on the side and the two rear fans move when the system is powered on.	If the fans do not turn on, do not use the system, contact KUBTEC Technical Support.
Labeling	Verify that all labels listed in Chapter 1 are present on the system.	All required labels must be present.
Automatic Filter Recognition	Attach each filter one-by-one to the filter bracket.	The sensor should automatically detect and display the filter in the **Filter Type** field on the Main User Screen. When no filter is attached, the display should read **Inherent**. If the displayed filter type does not match the filter in use, contact KUBTEC Technical Support.

Yearly Inspection

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

FREQUENTLY ASKED QUESTIONS

This section provides answers to questions that users typically ask about the functionality of The XCELL® 180 System.

Q: How to turn on the computer?

The computer turns on with the system when the power button is pressed and the key is in the ON position. The black button on the back of the cabinet does not turn the computer on. This is a hard computer shutdown only (Do not use this button unless approved by KUBTEC® FSE).

Q: Why does the computer power function independently of the cabinet?

The computer power is different from the cabinet power. This is because a computer can be damaged by abruptly removing the power from it. Thus, the system is designed so that the computer will stay on when the cabinet's power is turned off. The computer can still be turned off using Windows commands. To turn the computer back on, use the key switch and the push button on the front panel of the cabinet.

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

KUBTEC recommends leaving the system plugged in to prevent damage to the computer caused by unexpected power disruptions. Do not yank the power cord from the wall to shutdown the system, since this can damage the computer.

Q: Should the key be removed at night?

Follow the institution's 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 connectivity?

Yes, the unit has a built-in Wi-Fi wireless adapter. The system also has an external Ethernet jack from which a router can be added.

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

Position the sample within the border lines on the turntable. Note that changing the intensity (magnification) level affects the usable area; use the provided area labels to determine the usable area and desired uniformity. As the sample is placed closer to the X-ray source, the dose rate increases while the irradiation field size decreases.

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 turntable with a soft cloth dampened with an approved solution to disinfect and prevent infection. Do not spray or spill solutions directly onto surfaces. Refer to the Maintenance Chapter in this **Instructions 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 be serviced once a year by a KUBTEC trained/certified technician.

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