XR200
X-RAY SOURCE

OPERATOR'S MANUAL

CONTENTS

1.0 INTRODUCTION

The XR200 produces high levels of radiation and must be operated by qualified personnel who must read the Warning and Operations section of the manual before operating the device.

The XR200 is a lightweight x-ray generator that operates on its own removable battery pack. The XR200 is a pulsed x-ray device that produces x-ray pulses of very short duration (60 nanoseconds). It produces a relatively low dose rate comparable to a 1 mA constant potential machine. The energy produced by the XR200 is up to 150 KVP, which makes it possible to penetrate up to .4 inches (1 cm) of steel.

The XR200 comes with 2 battery packs, 2 keys, 1 battery charger, 1 tripod adapter, 1 remote operating cable, and a carrying case.

2.0 WARNINGS

2.1 The XR200 is an industrial type x-ray generator that produces hazardous radiation when energized.

2.2 It is unlawful to use this equipment to intentionally expose humans or to use it for medical radiography.

2.3 *The XR200 is subject to state regulation and registration. Contact your state board of health before operating this equipment.*

2.4 The operator must be properly trained to safely operate the XR200 X-ray unit.

2.5 Unauthorized personnel should not have access to the XR200.

2.6 Develop and closely follow a safe operating system for using the XR200.

2.6.1 The safe operating system must ensure that no one is exposed to radiation above the permissible limits as established by your local regulatory agency.

2.6.2 The safe operating system must ensure the XR200 is used within federal and state guidelines.

2.7 All operators and users of the XR200 must wear a personal radiation monitoring device, such as a TLD (thermoluminescent dosimeter), film badge, or a pocket dosimeter, consistent with the appropriate federal, state, territorial, or provincial standards (note: an electronic dosimeter will not detect the XR200 radiation pulses).

2.7.1 Due to the short pulse width of the XR200, survey meters of the Geiger-Mueller and scintillator type do not accurately detect the radiation emitted

from the x-ray source. *Survey meters should be of the ionization gage type and should be used in the integration mode.*

2.7.2 Survey meters must not be used in the rate mode because the XR200 does not produce constant radiation. The XR200 produces very high rates of radiation for very short periods of time resulting in either unrealistically high readings or no readings for a survey meter in rate mode.

2.8 The XR200 has no explosion proof rating and should not be used in an explosive atmosphere. The Spark Gap is vented to the air and could be a source of ignition.

3.0 PHYSICAL DESCRIPTION

3.1 HIGH VOLTAGE PULSER/TUBEHEAD. The front half of the XR200 consists of a 4-inch diameter canister that is rounded at its end.

3.1.1 The canister contains the high voltage generator and the x-ray tube.

3.1.2 A radiation-warning label is located on each side of the canister.

3.1.3 A beam angle label located on the front of the canister indicates the direction and angle the x-ray beam leaves the XR200.

3.2 BASE. The base of the XR200 accomodates the threaded tripod mount. Using the tripod mount release button, the XR200 can be quickly and easily mounted on any standard photographic tripod.

3.2.1 A label identifying the model, manufacturer, and serial number is located on the bottom of the XR200 base.

3.3 CONTROL MODULE/REMOTE CONNECTOR. The control module contains the following indicators and switches.

3.3.1 Green LED: Illuminates when the battery voltage is applied to the control module. (Power on)

3.3.2 Red LED: Blinks when the XR200 is in delay mode and is about to pulse. Stays on continuously when the XR200 is pulsing.

3.3.3 Liquid Crystal Display (LCD): Shows the number of counts selected unless the unit is in delay mode. In delay mode, the LCD displays the number of seconds remaining until the XR200 begins pulsing.

3.3.4 Switches: The key switch for the XR200 is located on top of the control module. Two push button switches just below the LCD are used to select the number

of counts. A switch in front of the control module puts the XR200 in delay mode (60 or 15 seconds).

3.3.5 Connector: Connector for the remote cable is located on the back of the control module.

3.4 BATTERY PACK. The battery is a DeWalt® 14.4 volt nickel-cadmium battery. To attach the battery simply insert it into the back of the control module.

3.4.1 To completely remove power from the XR200 the battery must be removed.

3.4.2 The battery pack loses 1% charge per day when not in use. To keep the XR200 ready for operation the battery should be charged at least once a month.

3.5 BATTERY CHARGER. The battery charger is a DeWalt® charger for 14.4 volt batteries.

3.5.1 To charge battery, insert the battery in the charger and the battery automatically begins charging.

3.5.2 The red light flashes when the battery is charging.

3.5.3 The red light stays on constantly when the battery is completely charged.

4.0 OPERATING INSTRUCTIONS

4.1 OPERATING PRECAUTIONS

4.1.1 The operator should always stand at least 10 feet behind the X-ray unit while it is pulsing. All other personnel should stand at least 50 feet behind the X-ray unit while it is in use.

4.1.2 Closely follow all procedures in the safe operating system.

4.2 OPERATING PROCEDURES (when used with Polaroid® film systems)

4.2.1 Attach fully charged battery pack to XR200.

4.2.2 If using a remote cable, plug cable into XR200.

4.2.3 Place cassette holding the negative as close as possible behind the object to be x-rayed. Make sure silver side of the cassette faces the object.

4.2.4 Place the XR200 2-4 feet in front of the object with the front of the XR200 pointing directly at the object and cassette.

4.2.5 Insert key into key switch located on top of the XR200.

4.2.6 Turn on the XR200 by turning the key clockwise 1/4 turn.

4.2.7 Select the desired number of pulses by the unit's counter and the tens counter just below the LCD. (See chart for approximate pulse settings.)

Option A - Remote cable option

4.2.8A Retreat behind the XR200 the length of the cable.

4.2.9A Clear area of personnel referring to established safe operating procedures.

4.2.10A Fire the XR200 by depressing the button on the remote cable.
-The red light turns on and stays on until the XR200 stops pulsing.
-The XR200 will stop pulsing when the pulse count reaches "00".
-The operator may stop the pulsing immediately by releasing the button on the remote cable (the unit will display original pulse count).

4.2.10A Check the XR200 to see that original pulse count is on LCD.

4.2.11A Turn off the key switch.

Option B - Delay mode option.

4.2.8B Clear area of personnel referring to established safe operating procedures.

4.2.9B Push the delay button and the red light starts to blink.
-The LCD starts at 59 seconds.
-If the operator holds the button down for 1.5 seconds the unit goes to 15 second delay.
-The red light continues to blink and the XR200 beeps until it begins to pulse.

4.2.10B Retreat at least 20 feet behind the XR200.

4.2.11B The red light stays on and the XR200 makes a snapping sound while it is pulsing.

4.2.12B Check the XR200 to see that the original pulse count is on the LCD.

4.2.13B Turn off the key switch.

4.3 SUGGESTED PULSE SETTINGS

The chart below lists approximate counts necessary to penetrate various materials when used with Polaroid® film and a rarex regular intensifying screen. The counts are APPROXIMATE because all XR200 units vary depending on tube output and other

factors. The settings are based on a distance of 24 inches between the front of the XR200 and the front of the film cassette.

MATERIAL	XR200 PULSE SETTINGS
Envelope	1-2
Cardboard box	2-3
Light wood container	2-4
Heavy wood container	5-6
Plastic box	4-6
Light metal container	9-14
Steel Pipe	30-50

When using Polaroid® positive film: If the radiograph is too dark, the film is underdeveloped. If the radiograph is too light or washed out, the film is overexposed.

4.4 DUTY CYCLE WARNING. *Up to 200 pulses may be used without resting the XR200. After every 200 pulses, the operator should allow a rest period of 4 minutes. The XR200 is a light duty machine. It is not made to pulse continuously.*

5.0 SOFTWARE

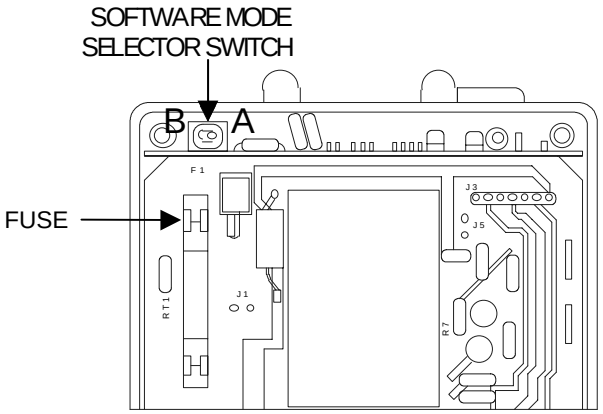
5.1 The software program that controls the microcontroller can be identified by turning the key switch on while both push button switches below the LCD are depressed. The LCD displays the software version “42”. If the operator continues to hold both push button switches down after “42” is displayed the LCD will display the total number of pulses on the unit. The number displayed in the right column of the LCD represents 10,000 pulses. The number in the left column represents 100,000 pulses. A reading of “07” indicates are between 70,000 and 80,000 pulses on the XR200.

5.2 The operator can change the control module defaults for use with film or video imaging systems by changing the position of the software mode selector switch. The selector switch is accessed by removing the cover on the rear of the XR200. Using a T-10 Torx driver, remove the five screws and carefully pull the cover out until you feel resistance. The selector switch is located in the upper left-hand corner (Fig. 1).

5.2.1 In the A position, the XR200 will default to "00" on the LCD when the key is turned on. This position is best for use with film systems.

5.2.2 In the B position, the XR200 will default to "99" on the LCD when the key is turned on. This position is best for use with video imaging systems.

Figure 1



5.3 The software program in the control module is capable of indicating two conditions:

5.3.1 The first condition is detected if there are more than .33 seconds between two consecutive pulses.

5.3.1.1 The XR200 continues the current pulse train to “00”.

5.3.1.2 After the XR200 stops pulsing, the LCD will go back to the original pulse setting, but the left and right digits will blink alternately.

5.3.1.3 The condition indicates a low battery.

5.3.1.4 The XR200 will be inoperable until the key switch is turned off and on, or the battery is replaced.

5.3.2 The second condition is detected if there is more than 1 second between two consecutive pulses.

5.3.2.1 The XR200 stops pulsing immediately and the LCD displays “00”.

5.3.2.2 This function prevents XR200 from pulsing continuously if there is a failure in detecting circuitry.

5.3.2.3 This condition may indicate a low battery, electrical noise, or failure in detecting circuitry.

5.3.2.4 The operator may need to replace the battery pack, turn key switch off and on, or send the XR200 back for repair.

6.0 MAINTENANCE

6.1 X-RAY DOSE MEASUREMENT. Using a dosimeter, the average X-ray dose for each new tube can be established.

6.1.1 With the dosimeter located 1 foot from the front of the case and in line with the center of the beam angle label, the reading for 10 counts should be 31 mR+/- 5 mR.

6.1.2 Figure 2 on page 13 illustrates the X-ray dose and maximum allowable radiation leakage levels for each X-ray unit.

6.1.3 The leakage and dose of the tube should be measured every 30,000 pulses or every 2 years.

6.2 TUBE REPLACEMENT. The X-ray tube may be replaced in the field by closely following the procedures listed below.

6.2.1 Unscrew the collimator from the front of the XR200.

6.2.2 Using your fingers or needle nose pliers remove the tube from the tube cavity.

6.2.3 Lift the new tube by the metal part of the tube. *Do not touch the glass portion of the tube because dirt and oils from your hand may contaminate the tube*.

6.2.4 Insert the new tube in the tube cavity - glass end first.

6.2.5 Screw the collimator back onto the front of the XR200.

7.0 TROUBLESHOOTING

SYMPTOM	TEST	ACTION
No "power on" light	-Check battery voltage -Check connection	-Charge/replace battery -Make sure battery is attached securely
X-ray "ON" lights, but X-ray does not fire	-Check battery voltage -Check fuse (Fig. 1)	-Charge/replace battery -Replace fuse
Black picture, but X-ray operating correctly	-Check if paper envelope removed from negative -In dark place, fire X-ray at opened cassette. Greenish light will show on cassette screen.	-Remove envelope from film -Return for tube replacement if no green light
Oil leaking from unit		-Return for repair
LCD displays “00” after unit fires	-Turn key switch off and on	-If problem occurs often return for repair

7.1 INSTRUCTIONS FOR REPAIR

7.1.1 When returning a unit for repair, include a brief description of problem incurred along with contact name, telephone number, and return address.

7.1.2 Remove battery before shipping the unit. Battery may be returned in same package with XR200.

7.1.3 Be sure the unit is securely packaged for shipment.

7.1.4 Return address: Golden Engineering, Inc., 6364 Means Road, Centerville, IN 47330 U.S.A.

7.2 INSTRUCTIONS FOR BATTERY DISPOSAL

7.2.1 Users disposing of old battery packs should follow all federal, state, and local laws for disposal of nickel-cadmium batteries.

7.2.2 Users may send their old battery packs to Golden Engineering for disposal.

8.0 WARRANTY

Certification of Warranty

XR200 Serial Number	_____
Battery Charger Serial Number	_____
150P Processor Serial Number	_____
4”x5” Cassette/Developer Serial Number	_____
Date Delivered	_____/_____/_____

Unit Warranty

Golden Engineering, Inc. warrants THE INSPECTOR® X-ray Source Model XR200 made and sold by Golden Engineering or its authorized representatives to be free of defects in materials and workmanship for a period of twelve (12) months from the date of shipment to the end user. To make a claim under this limited warranty, customer must ship the entire unit (or the component believed to be defective) to Golden Engineering, post-paid. Golden Engineering, Inc. assumes no liability for units or components shipped until they are actually in the custody of Golden Engineering, Inc. Provided Golden Engineering, Inc. in its sole discretion, is satisfied that the defect is not the result of abuse, misuse, accident, modification or improper disassembly or repair, Golden Engineering, Inc. will repair or replace the defective component(s) at its own expense. Golden Engineering, Inc. reserves the right to use reconditioned and remanufactured components that meet original specifications. The unit or component will be return shipped to customer at customer's expense. THIS EXPRESS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND GUARANTEES, EITHER EXPRESS OR IMPLIED OR CREATED BY OPERATION OF LAW.

9.0 SPECIFICATIONS

9.1 PHYSICAL DIMENSIONS INCLUDING BATTERY PACK:

Length.....12.5 in. (31.75 cm)
Width.....4.5 in. (11.5 cm)
Height.....7.5 in. (19 cm)
Weight..... 12 lbs. (5.5 Kg)

9.2 X-RAY OUTPUT.

X-ray dose per pulse……	3.1 milliroentgens at 12 inches from the front of the unit, +/- 0.5 mR.
Number of pulses per exposure.....…	1 to 99.
Number of pulses per battery charge.	4000.
Number of pulses per second.....…	25 (nominal).
Expected tube life of XR200.....	100,000 pulses
X-ray source size.....….	1/8 in. (3 mm)
Maximum photon energy.....	150 KVP.
X-ray pulse width.....….	60 nanoseconds. (.00000006 seconds)

9.3 ELECTRICAL AND THERMAL CHARACTERISTICS.

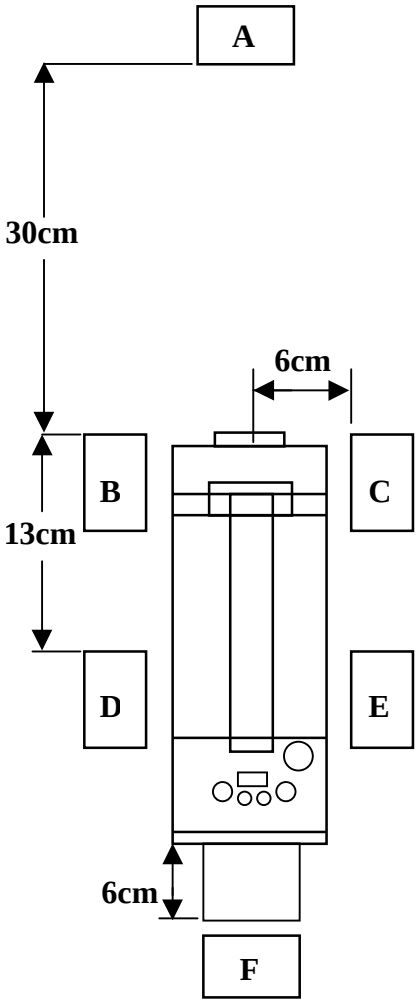
Battery Voltage.....…. 14.4 volts.
Battery Type..... Nickel Cadmium
Battery recharge time..... 1 hour.
Battery Charger..... DeWalt® 14.4 volt 1 hour charger.
Temperature range.....… -10 to 120 degrees F (-23 to 50 degrees C)
Maximum duty cycle..... 200 pulses every 4 minutes (3000 pulses per hr)
Warm-up..... None required.

9.4 X-RAY LEAKAGE

X-ray leakage .....10 mR per 100 pulses maximum on the side of the unit, 3 inches from the center of the unit. 3 mR per 100 pulses 2 inches behind the unit.

X-RAY LEAKAGE TEST
XR200

PROBE	#PULSES	RADIATION MEASURED	RADIATION ALLOWED
A	10		26min 36max
B	10		.400 MAX
C	10		.400 MAX
D	10		.100 MAX
E	10		.100 MAX
F	10		.100 MAX



*****Radiation units in milliroentgens

Radiation Probe: Radcal #20X6-6

DATE TESTED: _____

SERIAL #: _____

MEASURED BY: _____

GOLDEN ENGINEERING, INC.

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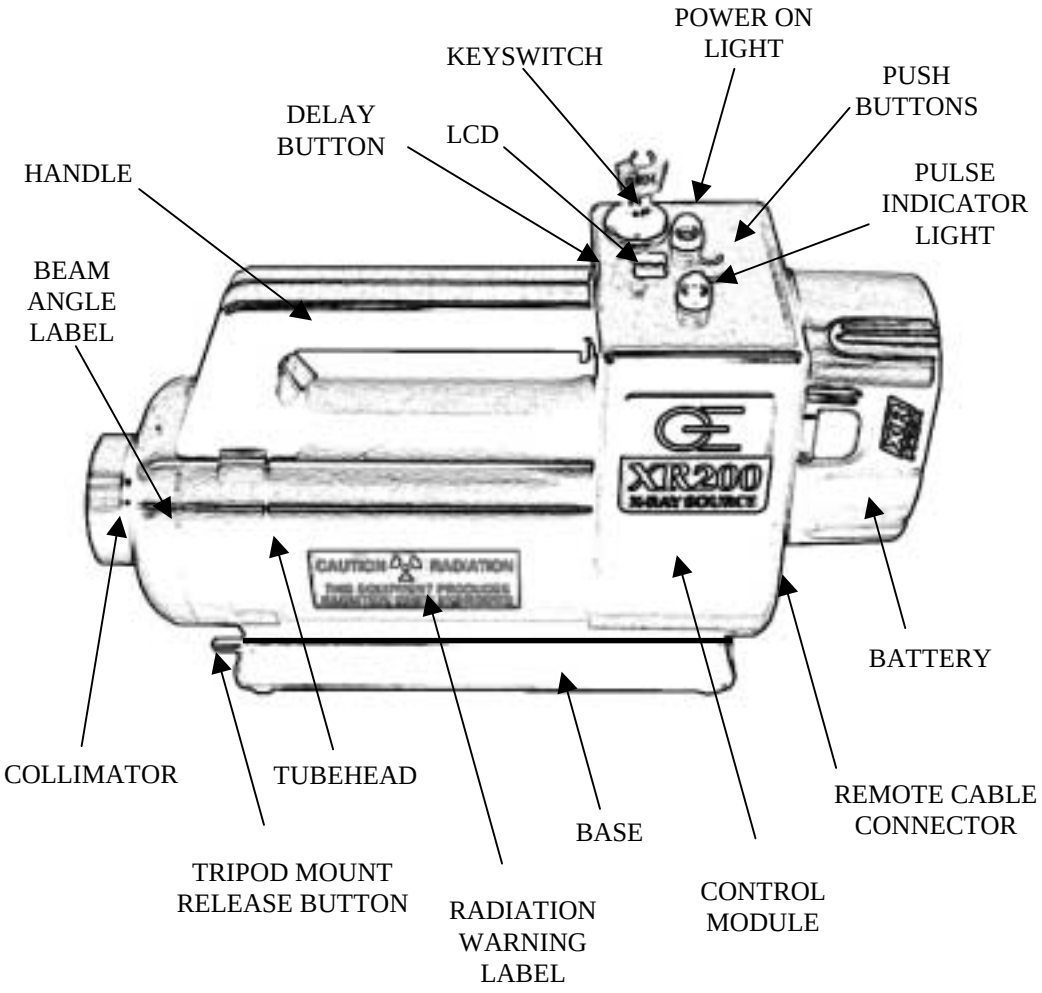
FAX: (765)855-3492


POWER ON LIGHT
KEYSWITCH
PUSH BUTTONS
DELAY BUTTON
LCD
HANDLE
PULSE INDICATOR LIGHT
BEAM ANGLE LABEL
XR200
CAUTION RADIATION
BATTERY
COLLIMATOR
TUBEHEAD
REMOTE CABLE CONNECTOR
BASE
TRIPOD MOUNT RELEASE BUTTON
RADIATION WARNING LABEL
CONTROL MODULE

XR200 PARTS AND ACCESSORIES

ITEM	PART #
Tube ……	2001300
Remote cable ……..	2006050
Tripod mount …….	2008010
Collimator ……...	2002075
Carrying case ……..	1630
Key …….	A126
Battery ……	DW9091
Battery charger ……...	DW9106
……	DW9107
220V battery charger ……..	DE9107
15 minute charger ……...	DW9115
Bogen tripod ……..	3031
Tripod bag for 3031 ……	3280
Bogen tripod (broader range of elevation) …….	3035
Tripod bag for 3035 ……	3281
4"x5" cassette/developer ……	4800
8"x10" manual processor ……	150P
Carrying case for 150P ……...	1620
8"x10" Polaroid® cassette with regular screen ……..	85-7
8"x10" Polaroid® cassette with fine screen ……...	85-6
8"x10" Polaroid® 110V processor …….	85-12
8"x10" Polaroid® 220V processor …….	85-22
8"x10" Polaroid® loading tray ……..	81-9
Carrying case for 85-12 or 85-22 ……	1610
Polaroid® 4"x5" type 553 film ……..	608730
Polaroid® 8"x10" TPX film ……..	604783
Polaroid® 8"x10" 803 film …….	609656

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