DENTAL X-RAY

BELRAY II 097

INSTALLATION INSTRUCTIONS

- *Floor Mount Type.....FK1/FK2*
- *Mobile Type.....FM*
- *Room Mount Type.....RK*
- *Ceiling Mount Type.....CK*

⚠WARNING

This X-ray equipment may be dangerous to patients and operators unless safe exposure factors and operating instructions are observed.

Belmont®

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⚠ CAUTION

This manual provides information and instructions for the installation, assembly calibration and certification procedures for **BELMONT BELRAY II 097** dental x-ray.
The instructions contained in this book should be thoroughly read and understood by dealer service personal before attempting to install the X-ray unit. After installation is completed, owners should file this manual and refer back to it to schedule periodic maintenance.

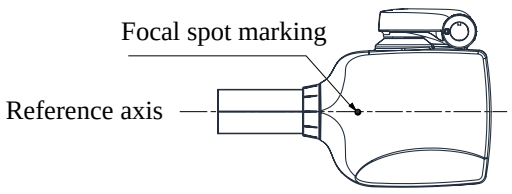
SECTION 1 : TECHNICAL DATA

[1] ELECTRICAL AND RADIATION DATA

1. Nominal focal spot value 0.7 (IEC60336)
2. Rated peak tube potential..... 70 kV
3. Rated tube current..... 4 mA / 7 mA selectable
4. Maximum rated peak tube potential ..... 70 kV
5.

Rated Line Voltage	[Vac]	100	110	120	220	230	240
Minimum Line Voltage	[Vac]	90	99	108	198	207	216
Maximum Line Voltage	[Vac]	110	121	132	242	253	264
Rated Line Power (Momentary rating)	[kVA]	0.8	0.9	0.8	0.8	0.8	0.8
Rated Line Current at 7mA	[Aac]	7.8	7.8	6.5	3.4	3.4	3.4
Maximum Line Current at 7mA	[Aac]	8.6	8.6	7.2	3.7	3.7	3.7
(Internal Resistance	[Ω])	(0.37max)	(0.41max)	(0.54max)	(1.27max)	(1.33max)	(1.38max)
Range of Line Voltage Regulation	[%]	0 ~ 3	0~ 3	0 ~ 3	0 ~ 2	0 ~ 2	0 ~ 2

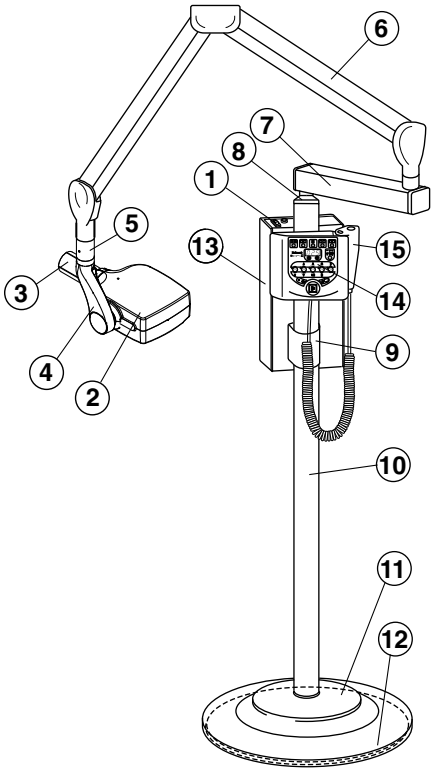
6. Power line frequency ..... 50 / 60 Hz, Single Phase
7. Line power (Long term rating) ..... 12 VA
8. Exposure time ..... 0.02 ~ 3.2 sec. (On and Off are zero crossed.)
9. Timer accuracy..... ±1 pulse (= 1/50 sec. or 1/60 sec.)
10. Inherent filtration ..... 1.7 mmAl Equivalent
11. Added filtration ..... 0.5 mmAl
12. Minimum filtration permanently in useful beam ..... 2.2 mmAl Equivalent at 70 kV(peak)
13. Nominal roentgen output 4 mA 7 mA
    a. Distal end of regular cone ..... 4.2 mGy/sec. 7.1 mGy/sec. ±40 %
    b. Distal end of long cone ..... 1.9 mGy/sec. 3.3 mGy/sec. ±40 %
14. Cone Source to skin distance Field size
    a. Regular cone..... 204 mm 58mm dia., circular
    b. Long cone (Option) ..... 305 mm 58mm dia., circular
15. Leakage technique factor ..... 70 kV(peak), 494 mAs at 1 hour
16. Duty cycle ..... 1 : 50 (0.5 sec. exposure with 25 sec. interval)
17. Source to the base of cone distance ..... 81 mm
18. Reference current time product..... 22.4 mAs (70 kV(peak), 7 mA, 3.2 sec.)
19. Maximum earth leakage current ..... 0.5 mA
20. Tolerance of the focal spot marking..... ±1 mm
21. Target angle and material .....16 ± 1°, Tungsten
22. Maximum anode heat content ..... 4.3 kJ (6 kHU)
23. Maximum x-ray tube assembly heat content ..... 150 kJ (210 kHU)
24. Nominal electrical output of H.V.Generator ..... 0.36 kW at 70 kV, 7 mA
25. Measurement base of technique factors

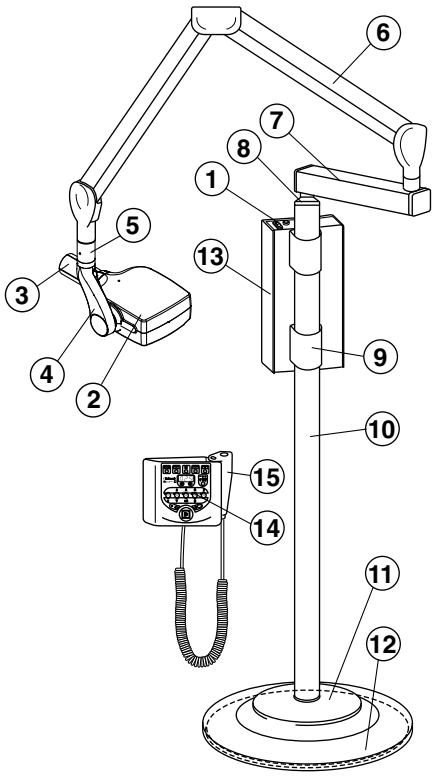


    a. Peak tube potential ..... Peak tube potential of conducting half cycle
    b. Tube current ..... Average of tube current during one cycle of line frequency
    c. Exposure time..... Impulses of power line frequency
26. Environmental condition for storage.....-20 ~ 70℃, 10 ~ 90%, 500 ~ 1060 hPa
27. Environmental condition for operation.....10 ~ 40℃, 30 ~ 75%, 700 ~ 1060 hPa
28. Rotation angle of head ..... Horizontal 0 ~ 600° , Vertical 0 ~ 300°
29. Service Life.....10 Years

[2] OVERALL VIEW AND MAJOR COPMPNENTS

1. FOOR MOUNT TYPE (FK1/FK2)





① Main Power Switch
② X-Ray Head
③ Cone
④ Yoke
⑤ Arm Collar
⑥ Balance Arm
⑦ Horizontal Arm (300mm)
⑧ Pole Bush
⑨ Back Supporter
⑩ Pole
⑪ Base Cover
⑫ Mounting Plate
⑬ Main Controller
⑭ Sub Controller
⑮ Hand Exposure Switch

Fig.1-1 Overrall view and Major Components for FK1/FK2

2. MOBILE TYPE (FM)

① Main Power Switch
② X-Ray Head
③ Cone
④ Yoke
⑤ Arm Collar
⑥ Balance Arm
⑦ Pole Bush
⑧ Pole
⑨ Pole Base
⑩ Leg Bar (long)
⑪ Leg Bar (Short)
⑫ Lock Caster
⑬ Standard Caster
⑭ Main Controller
⑮ Sub Controller
⑯ Hand Exposure Switch

⚠CAUTION

Balance arm should be held closed while moving mobile type (FM) X-ray.

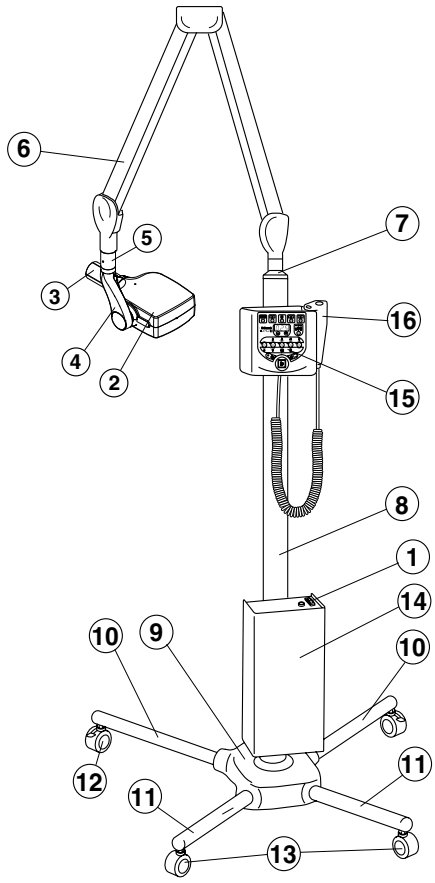
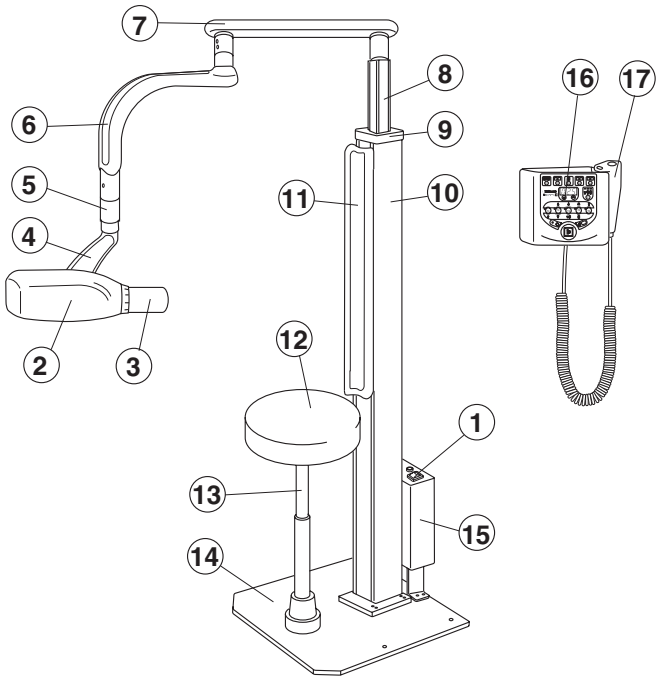


Fig.1-2 Overall view and Major Components for FM

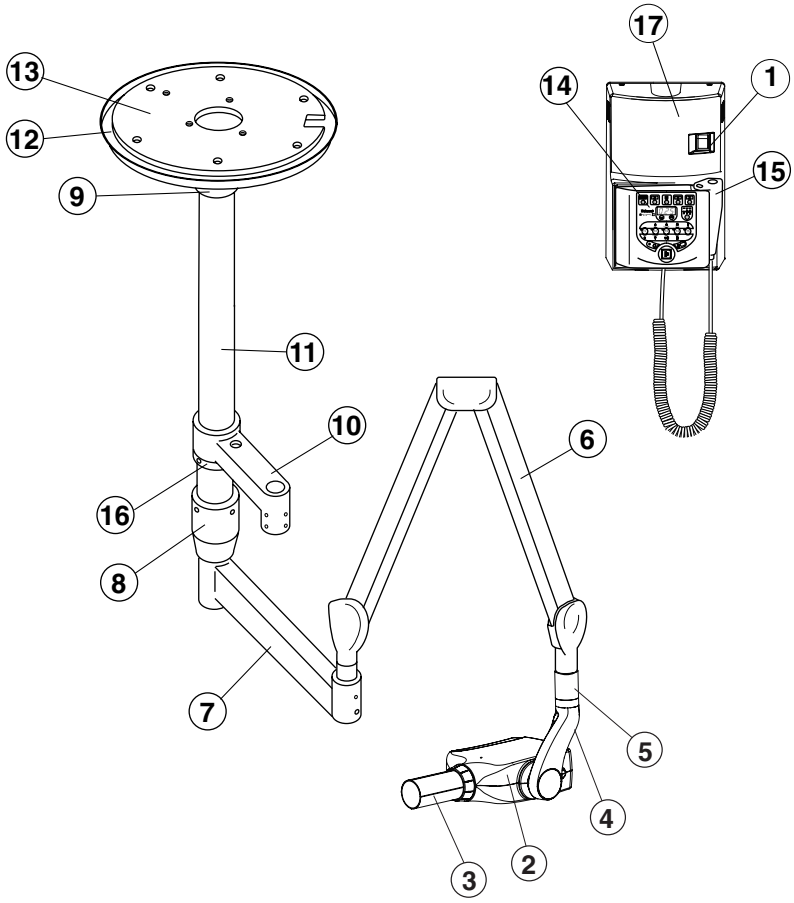
3. ROOM MOUNT TYPE (RK)



① Main Power Switch
② X-Ray Head
③ Cone
④ Yoke
⑤ Arm Collar
⑥ Swing Arm 1
⑦ Swing Arm 2
⑧ Sliding Post
⑨ Column Cover
⑩ Colum
⑪ Backrest Cushion
⑫ Seat
⑬ Gas Pump
⑭ Base Plate
⑮ Main Controller
⑯ Sub Controller
⑰ Hand Exposure Switch (Option)

Fig.1-3 Overall view and Major Components for RK

4. CEILING MOUNT TYPE (CK)



① Main Power Switch
② X-Ray Head
③ Cone
④ Yoke
⑤ Arm Collar
⑥ Balance Arm
⑦ Swing Arm
⑧ Swing Post
⑨ Cover Ring
⑩ Light Arm (Option)
⑪ Ceiling Pole
⑫ Ceiling Cover
⑬ Ceiling Mounting Plate
⑭ Sub Controller
⑮ Hand Exposure Switch(Option)
⑯ Support Ring
⑰ Main Controller

Fig.1-4 Overall view and Major Components for CK

5. SUB CONTROLLER

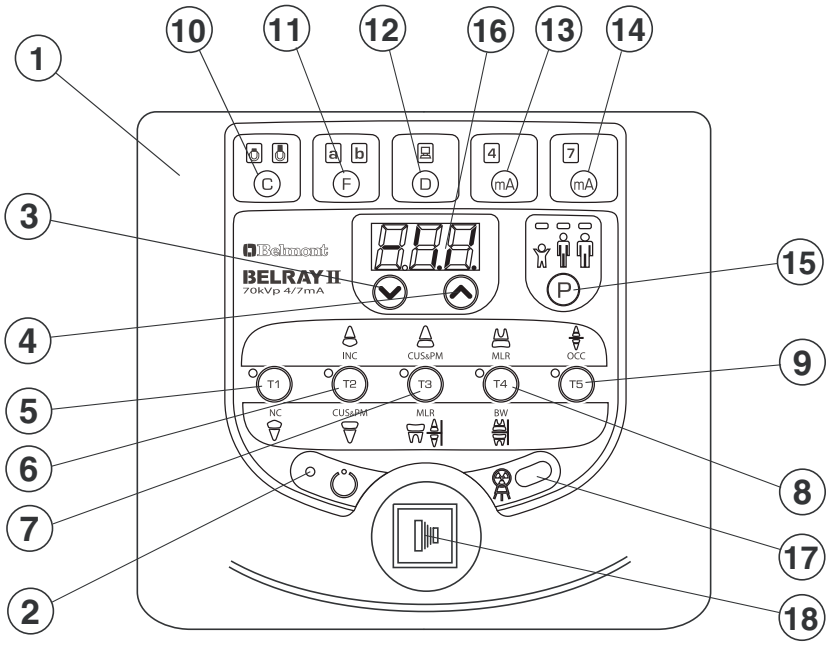


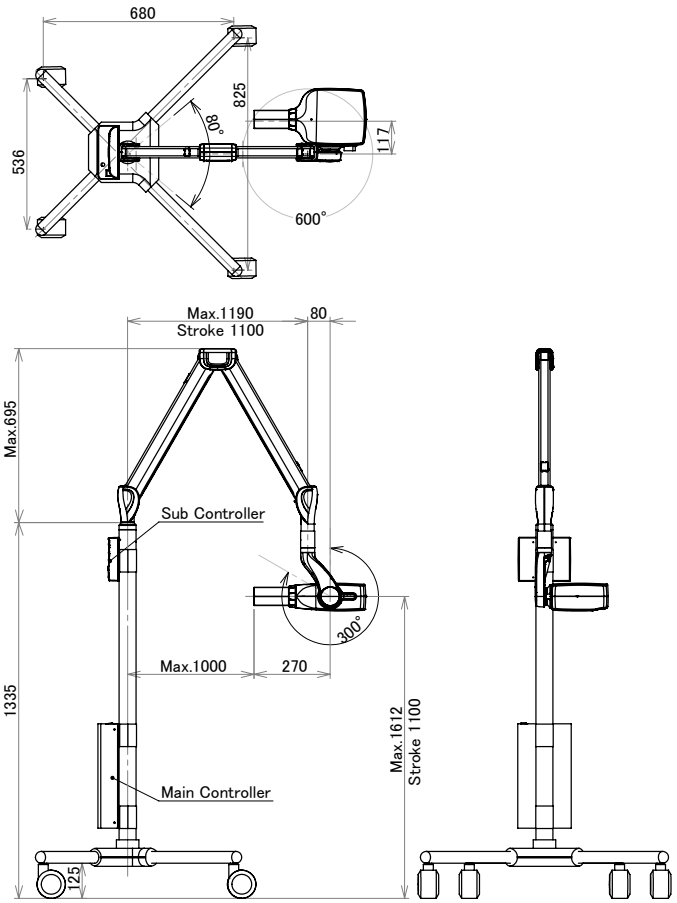
Fig.1-5 Sub Controller Switches

(1) Sub Controller Front Panel
(2) Ready Light
(3) Exposure Time Adjusting Switch (Down)
(4) Exposure Time Adjusting Switch (Up)
(5) Tooth Selection Switch (T1)
(6) Tooth Selection Switch (T2)
(7) Tooth Selection Switch (T3)
(8) Tooth Selection Switch (T4)
(9) Tooth Selection Switch (T5)
(10) Cone Type Selection Switch
(11) Film Speed Selection Switch
(12) Digital Imaging Switch
(13) 4mA Selection Switch
(14) 7mA Selection Switch
(15) Patient Size Selection Switch
(16) Exposure Time Display Window
(17) Exposure Warning Light
(18) Exposure Switch

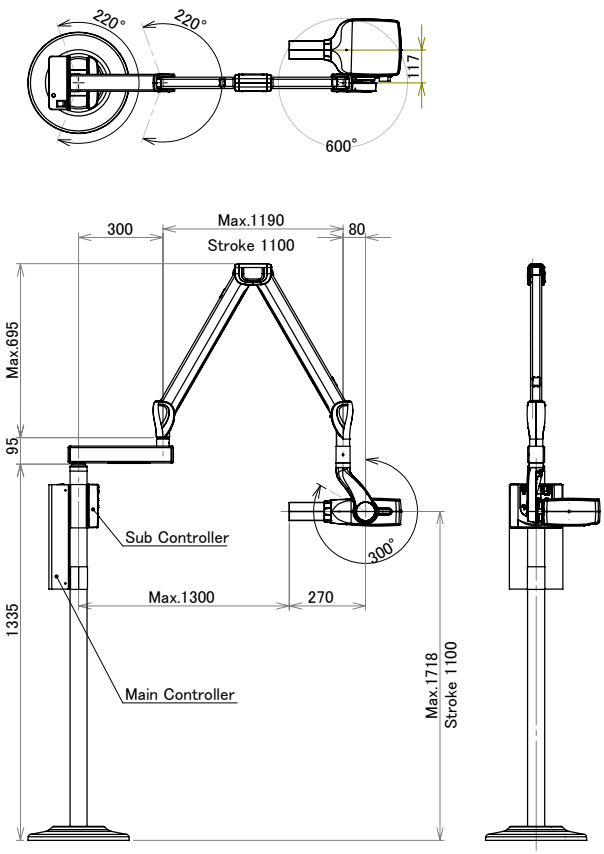
[3] PHYSICAL DIMENSIONS

[UNIT : mm]

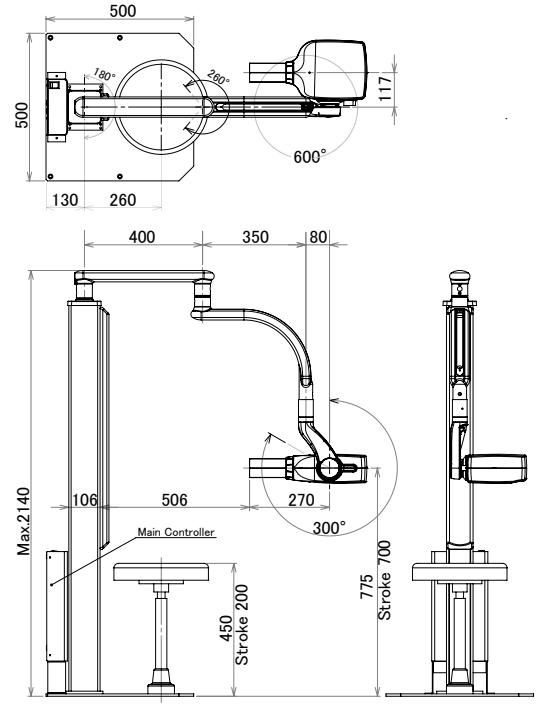
FM Type



FK1/FK2 Type



RK Type



CK Type

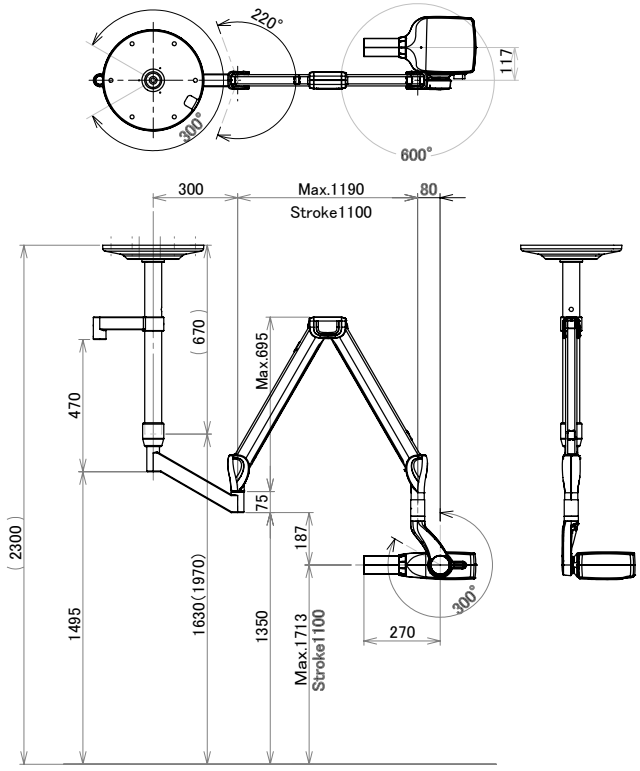


Fig.1-6 Dimensions

[3] TUBE HEAD THERMAL CHARACTERISTICS

A. Interval between each exposure

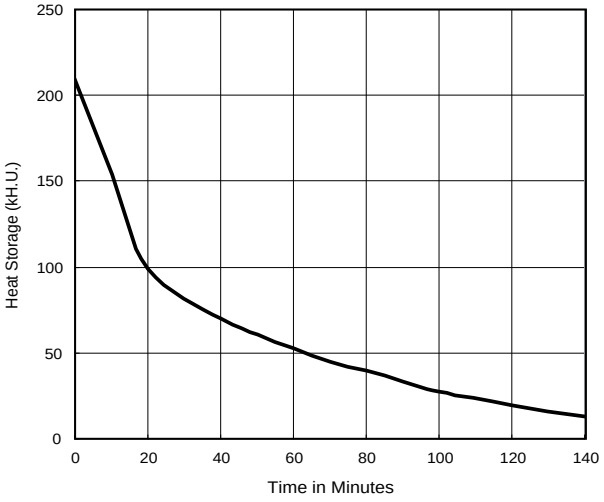
The temperature inside of the tube head rises when an exposure is made. The value of the heat generated is measured in Heat Units (HU), which is the product of tube potential, tube current and exposure time. Excessive heat will accumulate inside of the tube head if the x-ray is used without a proper cool down interval between each exposure. The excessive heat may damage the x-ray tube, high voltage generator or both.

B. Duty cycle

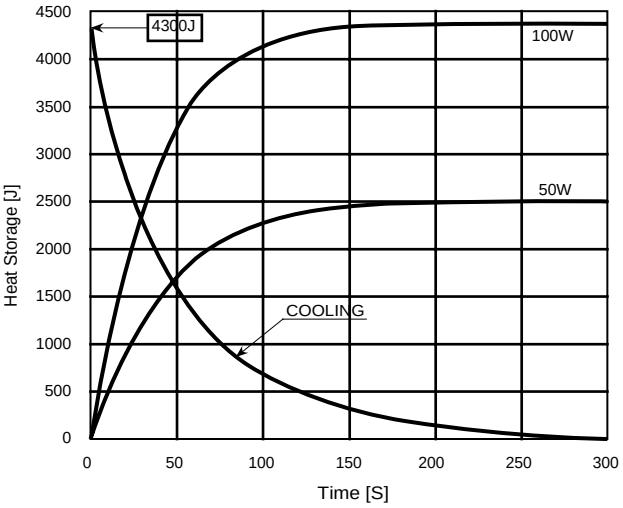
A cool down interval of 50 seconds or more must be allowed between each 1 second exposure. (a 25 second cool down must be allowed between each 0.5 second exposure.) This will avoid the accumulation of excess heat and prolong the tube head life.

C. Tube head cooling curve

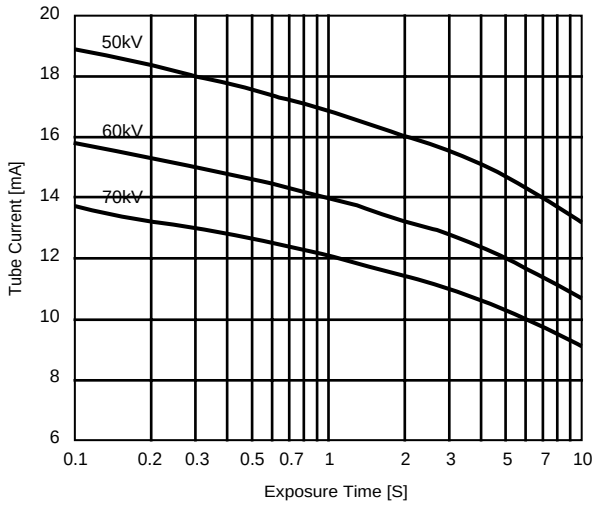
1. Tube housing cooling curve



2. Anode thermal characteristics



3. Maximum rating chart



SECTION 2 : PRE-INSTALLATION INSTRUCTION

[1] SUPPORT REQUIREMENTS

A. Arm and head

(1) Floor mounting type (FK1/FK2)

The floor and mounting hardware for mounting plate must be sufficient to withstand a **100kg** withhdrawal force.

(2) Ceiling mounting type (CK)

The ceiling and mounting hardware for mounting plate must be sufficient to withstand **150kg** withdrawal force.

B. Main Controller (Fig.2-1)

The main controller for CK type is installed on the wall. The wall and monting hardware must be sufficient to withstand a **25kg** shear load.

C. Sub Controller (Fig.2-1)

The sub controller for FK2 is installed on the wall. When mounting the sub controller, the wall and mounting hardware must be sufficient to withstand a **4.5 kg** shear load.

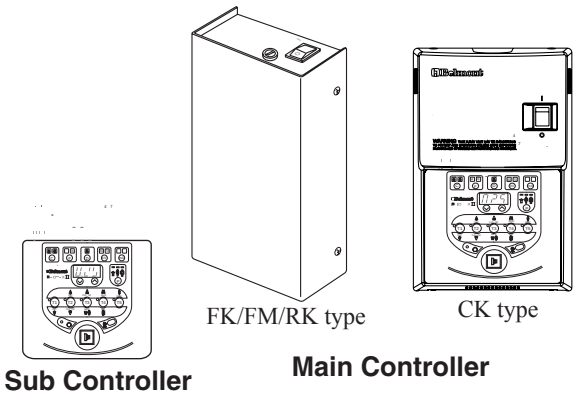


Fig.2-1 Main Controller and Sub Controller

⚠CAUTION

If BELARY II 097 is to be mounted in a manner other than what is specified in this manual or if the hardware to be used is other than what is supplied, the support capability of the wall or ceiling and the strength of the hardware must be checked and verified to be adequate.

[2] ELECTRICAL REQUIREMENTS

A. Power supply

BELRAY II 097 x-ray system is operated on a power supply of rated line voltage ±10% with a three wires (hot, neutral, earth) circuit, separately connected to the central distribution panel with an over current protection device. Use a flexible cable approved by CEE (13) 52 or 53 onsists of 0.75 mm^2 or 1 mm^2 conductors. Diameter of the sheath of cable should be 6 ~ 7.5 mm diameter. Line voltageregulation should be within the range of 2 ~ 5% (for 100V, 110V, 120V type) or 0 ~ 3% (for 220V, 230V, 240V type) at rated current.

B. Concealed wiring for RK,FK2 (Fig.2-2)

Concealed wiring is accomplished by bringing conduit and wires in a flush mounted junction box located behind the sub controller. Recommended height for the flush junction box is 1310 mm. Wiring done in this manner should extend 300mm beyond the wall surface to allow sufficient wire for connections. Interconnecting wires between main controller and sub controller should be 4 conductor, 0.5 mm^2, 300V. Maximum wire run distance is 10 m.

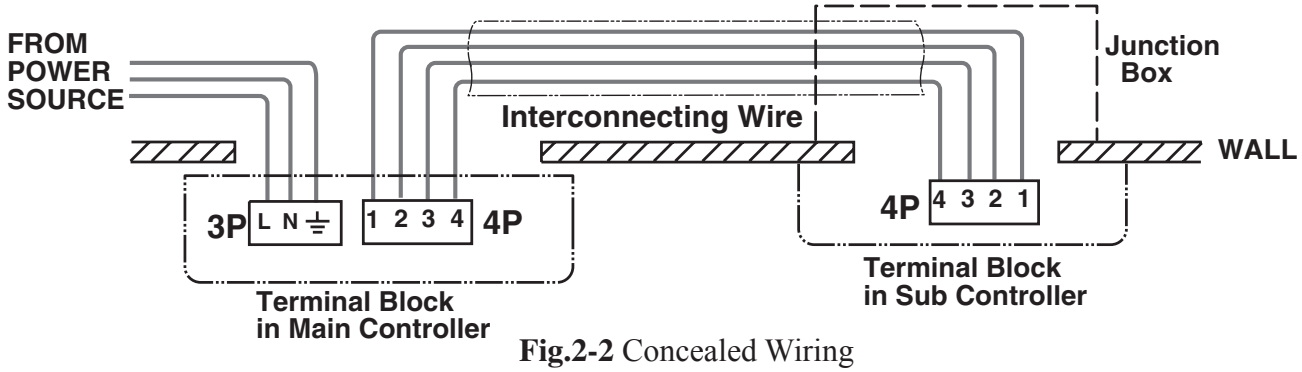


Fig.2-2 Concealed Wiring

Note : All connections, workmanship and materials used must comply with the local codes.

SECTION 3 : INSTALLATION INSTRUCTIONS

⚠CAUTION

This section explains the installation instructions for BELRAY II 097.
After the installation is completed, BELRAY II 097 requires the calibration and inspection. Refer to SECTION 6.

[1] INSTALLATION REQUIREMENTS

Tools :

Standard tool kit including 1.5 mm, 2 mm, 3 mm and 5 mm allen keys.

Instruments :

- Digital multimeter with an accuracy of 1%, capable of measuring 300 V AC and 10 mA DC, and capable of indicating true RMS value within 1 sec.
- Standard calculator.

TEST 1 : POWER SUPPLY

Prior to starting the installation inspect the power supply and confirm that the power supply is within rated line voltage ±10 % and that the supply is a 3 wire earthed circuit, separately connected to the central distribution panel with an overcurrent protection device.

[2] INSTALLATION OF FK1/FK2 TYPE

A. MOUNTING PLATE AND POLE INSTALLATION

1. Pass through the power supply cable in the center hole of floor mounting plate. (FK1 Type)
   Pass through the power supply cable and interconnecting wires in the center hole of floor mounting plate. (FK2 Type)
   Fix the floor mounting plate to the floor. Make sure the mounting plate is firmly fixed and can withstand a 100kg withdrawal force. (Fig.3-1)

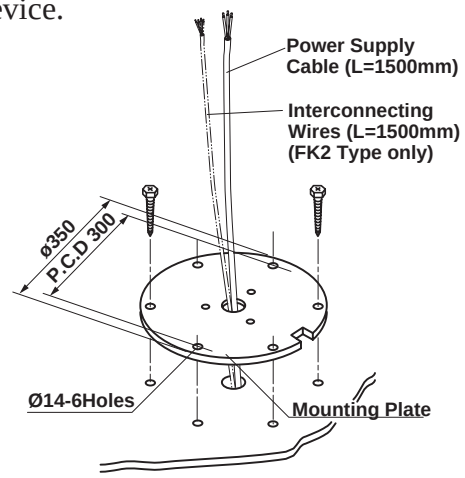


Fig.3-1 Installation of Floor Mounting Plate

2-1. FK1 Type
   After setting the cover to the pole, pass through the power supply cable in the lower hole (for main controller) on the pole. Pass through the interconnecting wire from the upper hole to the lower hole on the pole. Connector side of wire should come out from the lower hole. (Fig.3-2)

2-2. FK2 Type
   After setting the cover to the pole, pass through the power supply cable and interconnecting wire in the lower hole (for main controller) on the pole. (Fig.3-2)

3. Attach the pole to the mounting plate by three mounting bolts. Make the pole vertical by adjusting three adjustment bolts and three mounting bolts. Then set the cover to the pole. (Fig.3-2)

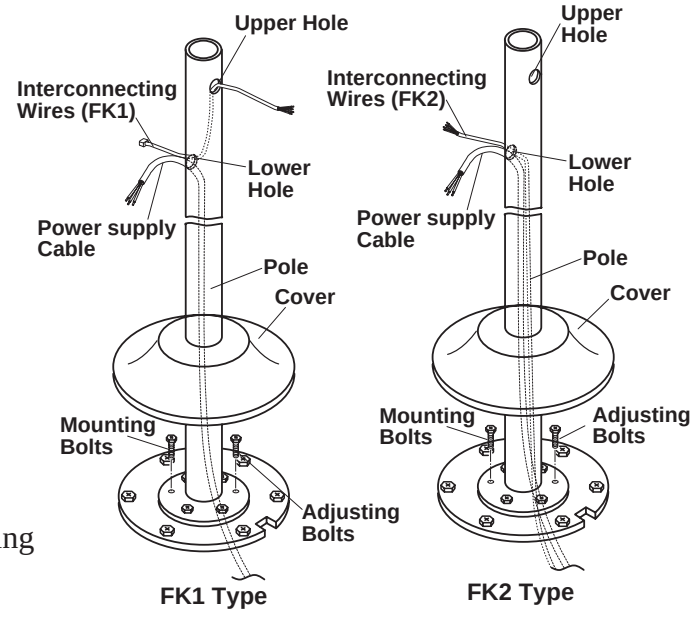


Fig.3-2 Installation of Pole & Cover

B. HORIZONTAL ARM INSTALLATION

1. Remove 2 set screws on the pole and remove the pole bushing. (Fig.3-3)

2. Insert the horizontal arm into the pole bushing then set stopper screw and brake plug, brake spring and brake screw on the pole bushing. (Fig.3-3)

3. After putting the back supporters to the pole, insert the pole bushing and horizontal arm into the pole with passing through the arm cable into the lower hole on the pole then fix the pole bush with 2 set screws. (Fig.3-3)

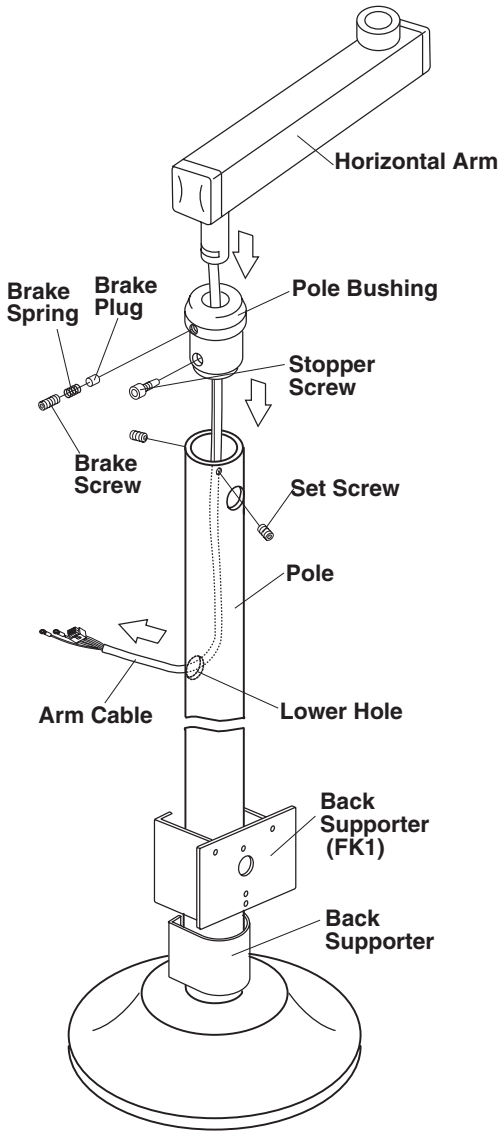


Fig.3-3 Horizontal Arm Installation

C. MAIN CONTROLLER FIXING PLATE INSTALLATION

1-1. FK1 Type

Pass through the interconnecting wire into the FK1 back supporter on the upper hole and fix the FK1 back support on the hole with 2 screws. Pass through the arm cable, power supply cable and interconnecting wire into the lower hole on the main controller fixing plate.
Fix the main controller fixing plate to the back supporters and pole with 8 screws. (Fig.3-4)

1-2. FK2 Type

Pass through the arm cable, power supply cable and interconnecting wire into the lower hole on the main controller fixing plate.
Fix the main controller fixing plate to the back supporters and pole with 6 screws. (Fig.3-4)

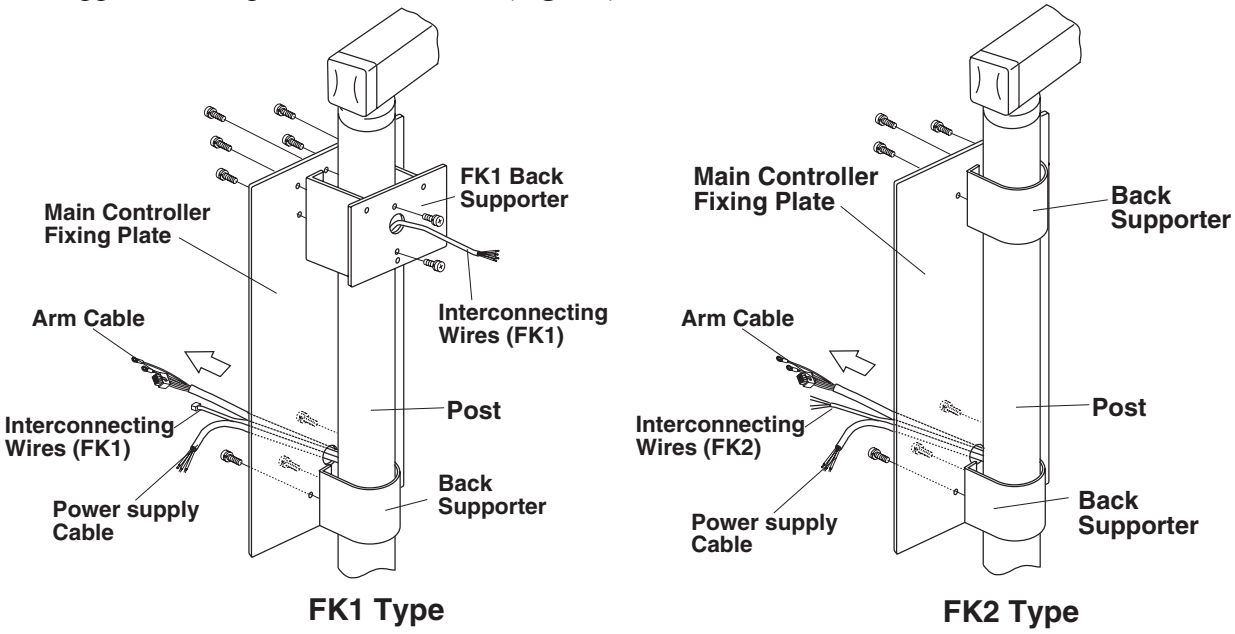


Fig.3-4 Main Controller Fixing Plate Installation

D. MAIN CONTROLLER INSTALLATION

1. Remove 4 cover screws and open the front cover of the main controller. (Fig.3-5)
2. After passing through the arm cable, interconnecting wires and power supply cable into the hole on the chassis of main controller, fix the main controller on the main controller fixing plate with 4 screws. (Fig.3-5)
3. Connect 3P and 2P connectors of horizontal arm cable to the respective connectors on power PC Board. (Fig.3-5)
4. Connect the wire with ring terminal of horizontal arm to the chassis with a M4 screw.
5. Cut the wires to workable length and strip 10mm of insulation for power supoply cable. Connect wires of power supply cable to 3P terminal block. (Fig. 3-6)
6. For FK1 type, connect a 4P connector of interconnecting wires to the 4P connector on power PC Board. (Fig.3-5)
7. For FK2 type, cut the wires to workable length and strip 5mm of insulation for interconnecting wires. Connect interconnecting wires to 4P terminal block. (Fig.3-6)

Note : The front cover for the main controller should not be closed until all installation and the post-installation inspections and confirmation are completed.

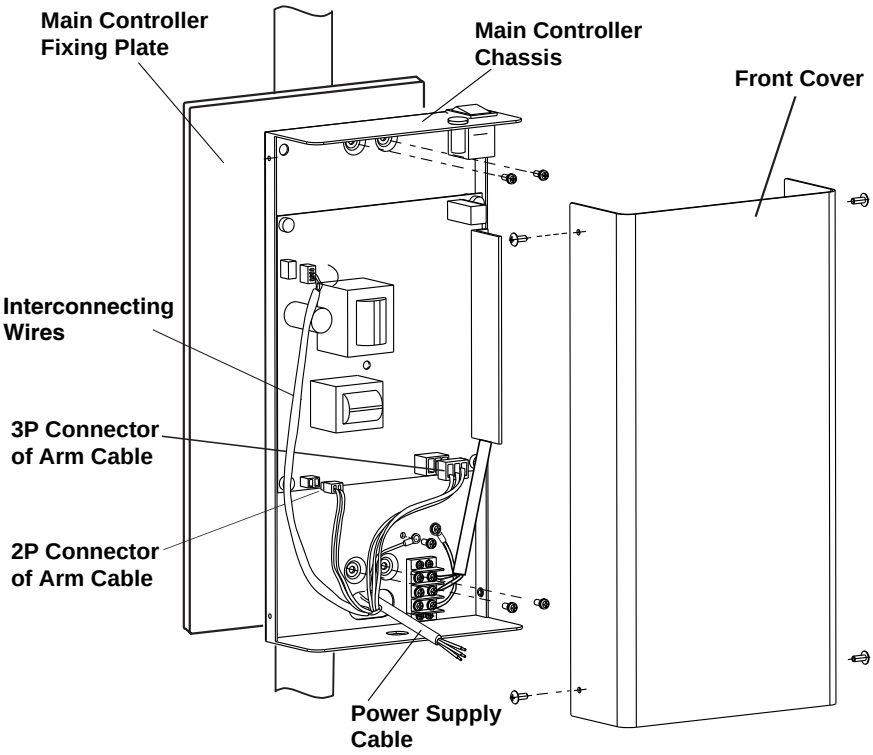


Fig.3-5 Installation of Main Controller (FK1 type)

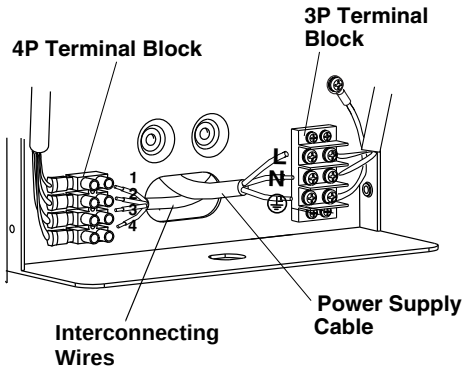


Fig.3-6 Interconnecting Wires (FK2 type)

E. BALANCE ARM ASSEMBLY

⚠WARNING

Do not release Arm holding band until the X-ray head has been installed.
Balance arm assembly is spring loaded and can cause equipment damage and injury if not handled in the proper manner.

1. During this procedure, do not remove Arm holding band.

2. Remove two (M3 x 8mm) screws from the underside of the horizontal arm to open the bottom cover. (Fig.3-7)

3. Route the cable with 8P connector from the balance arm shaft through the horizontal arm. Insert the balance arm into the horizontal arm. The cable should be fed through the bottom cover opening on the bottom of the horizontal arm. (Fig.3-8)

4. Connect 8P connector of the balance arm cable to 8P connector of the horizontal arm cable. Secure the wires from the balance arm to the bottom cover with nylon cable clamp to prevent the damage from twisting. (Fig.3-9)

5. Re-attach the bottom cover to the horizontal arm with two screws.**(Fig.3-8)**

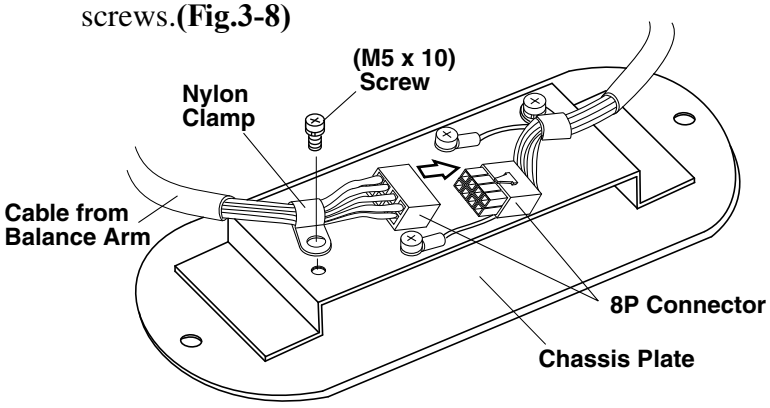


Fig.3-9 Connection of Balance Arm Cable on Bottom Cover

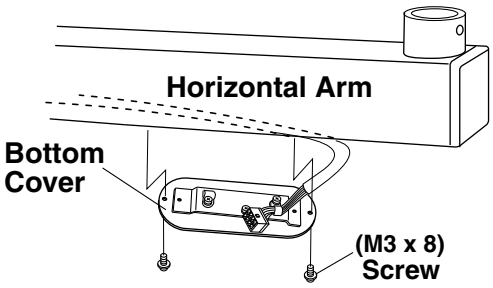


Fig.3-7 Horizontal Arm Bottom Cover

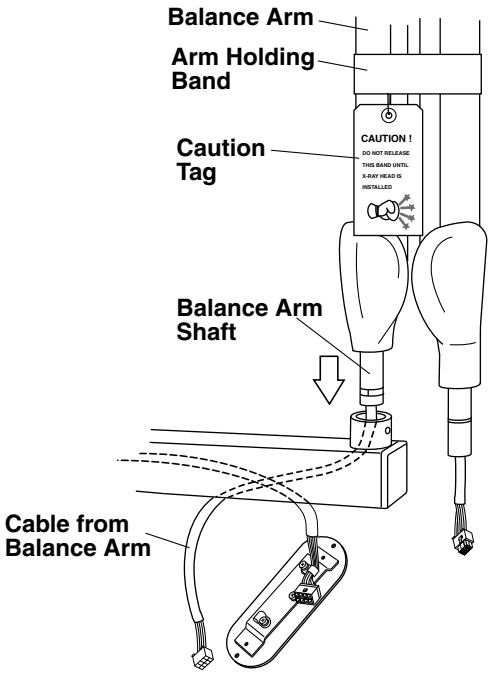


Fig.3-8 Balance Arm Installation

6. Insert the brake plug and brake screw (M6 x 6mm) into the horizontal arm collar. (Fig.3-10)
Do not fully tighten.

7. Remove the end cap screw and open end cap from horizontal arm.
Insert the stopper screw into upper threaded hole inside horizontal arm and tighten securely.
Install the end cap with cap screw and place a screw cover. (Fig.3-10)

⚠CAUTION

If stopper screw is not tightened securely, the Balance Arm can lift out of the horizontal arm.

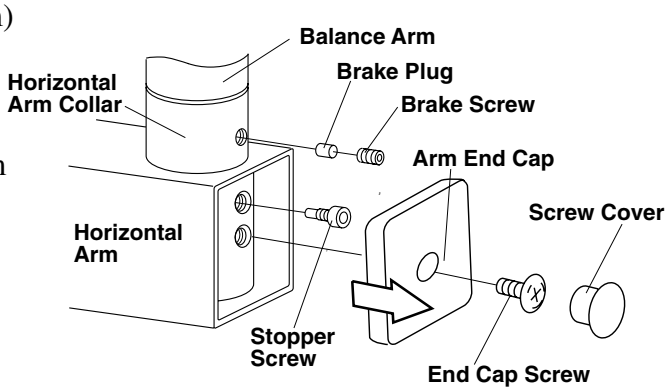


Fig.3-10 Stopper and Brake for Balance Arm

F. HEAD ASSEMBLY INSTALLATION

⚠ WARNING

Do not release Arm holding band until the X-ray head has been installed.
Balance arm assembly is spring loaded and can cause equipment damage and injury if not handled in the proper manner.
Refer to the Caution Tag on the band.

1. Remove the arm collar screw (M4 x 8mm) from the arm collar. Slide the arm collar upward and temporarily hold it in position with adhesive tape. (Fig.3-11)

2. Open the yoke inside cover of x-ray head by removing (M4 x15mm) countersunk screw (Fig.3-12)

3. Making sure the stopper ring is placed on the yoke, insert the wiring from the balance arm assembly through the head shaft and into the yoke. (Fig.3-13)

4. Insert the shaft of the balance arm into the head yoke, and while holding the head in position, insert the head key securely into the retaining groove. (Fig.3-13)

5. Remove adhesive tape and slide the arm collar downward. Fix it in place with the arm collar screw. Remove the UP-mark from the arm collar. (Fig.3-13)

6. Loosen the (M5 x 10mm) screw and remove the nylon cable clamp from the yoke housing. Place cable clamp on the balance arm cable. Connect the 6P connectors, and then attach the balance arm cable to the yoke housing with the nylon cable clamp. (Fig.3-14)

7. Reattach the yoke inside cover with the screw (M4 x15mm). Before closing the cover. (Fig.3-12)

8. Remove arm holding band.

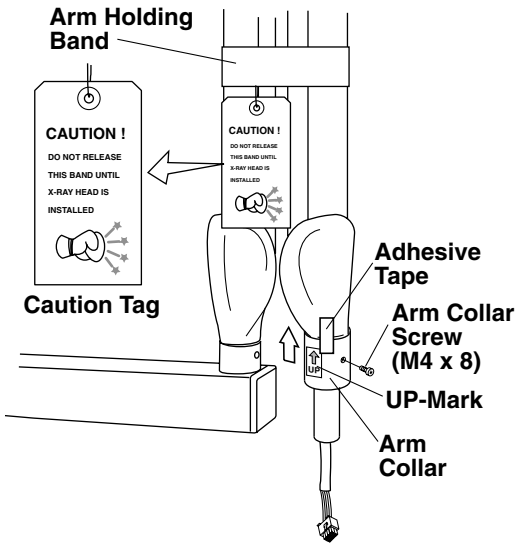


Fig.3-11 Setting Arm Collar on Balance Arm

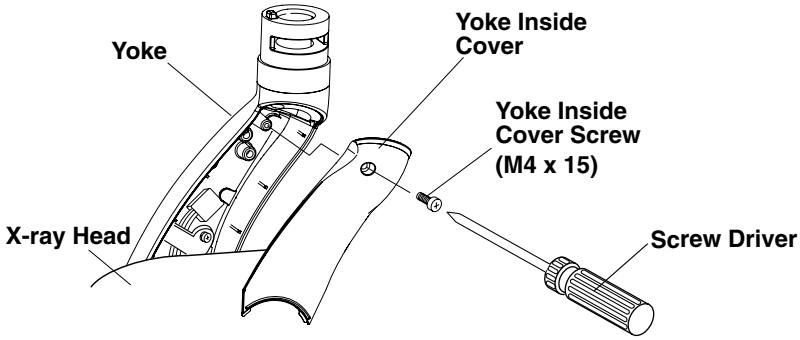


Fig.3-12 Removing Yoke Inside Cover

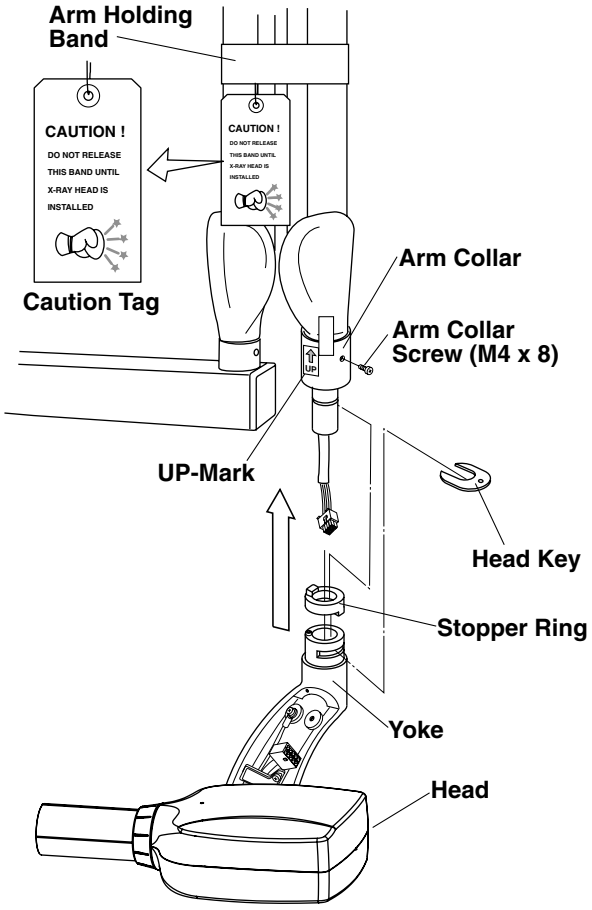


Fig.3-13 X-ray Head Installation

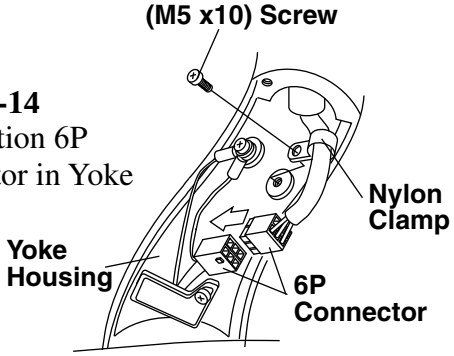


Fig.3-14
Connection 6P Connector in Yoke

G. SUB CONTROLLER INSTALLATION

For FK2 type, the wall and the strength of the hardware used must be checked and verified as being adequate to withstand a 10 pound (4.5kg) shear load. A flush mounted junction box with the necessary conduit and wiring should be pre-installed at 51-5/8" (1310mm) from the floor.

1. Remove two (M3 x8mm) screws from the under side of the controller and open the front panel. (Fig.3-14)

2. Disconnect the 4P connector from the timer PC Board. (Fig.3-15)

3. Route the interconnecting wires from the main controller through access hole of chassis and mount on the subcontroller plate with three (M4 x 10) screws (FK1 type) or on the wall with four (ø4.1 x 20mm) wood screws. (FK2 type)

4. Cut 4 interconnecting wires from main controller to a workable length. Strip 5mm insulation off the wires and connect them to the 4P terminal block.Terminal number for each wire should be matched to the terminal number in the main controller. (Fig.3-16)

⚠CAUTION

Miswiring causes permanent damage to both timer PC board and power PC board.

5. If wire length is too long, push it back into the access hole of the wall. This will prevent mechanical damage to the timer PC Board when replacing the front cover.

6. Reattach the 4P connector to the timer PC Board. (Fig.3-15)

7. Set the pins located on the upper side of the front panel into holes on the top of chassis and attach the front cover to the chassis with two (M3 x 8mm) screws. (Fig.3-14 & Fig.3-17)

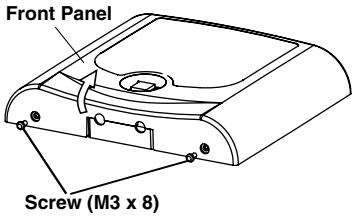


Fig.3-14 Opening Front Panel

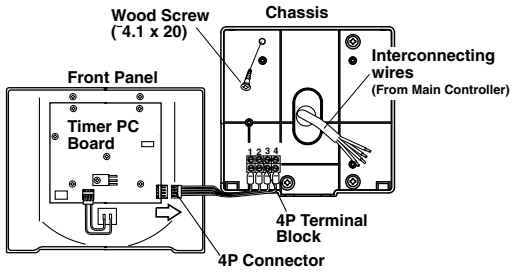


Fig.3-15 Attaching Sub Controller Chassis

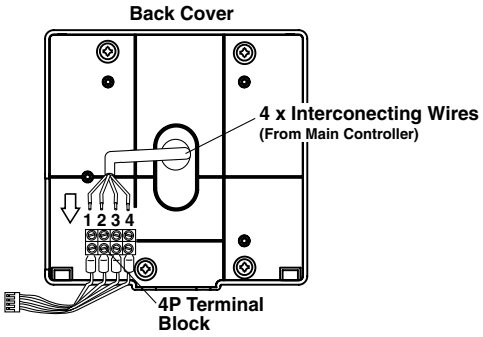


Fig.3-16 Interconnecting Wires Connection in Sub Controller

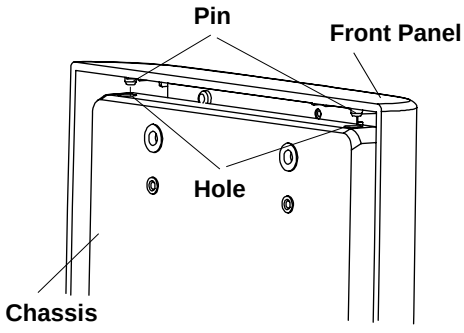


Fig.3-17 Top side of Sub Controller

H. HAND EXPOSURE SWITCH

Hand exposure switch can be connected to the sub controller. Since this exposure switch has a coiled cord, operator can stand the most suitable position for operation.
The exposure switch on the front panel of sub controller and this hand exposure switch can be used. If local code prohibits use of both switches, disconnect the connector of either switch.

1. Confirm the contents of optional hand exposure switch kit. (Fig.3-18)

   Hand exposure switch ---------- 1
   Hook ---------- 1
   Screw for hook (ø3 x 8mm Tapping screw) ----- 1

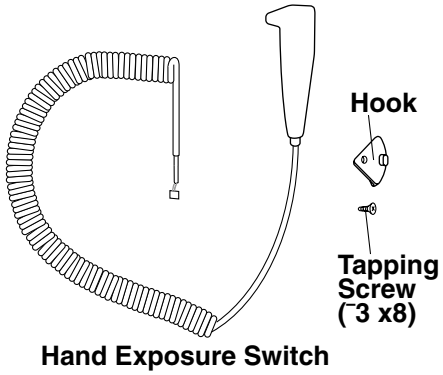


Fig.3-18 Hand Exposure Switch Kit

2. Remove two (M3 x8mm) screws from the under side of the controller and open the front panel.

3. Connect the connector at the end of hand exposure switch coil cord to CN3 connector on the timer PC board. (Fig.3-19)

4. Insert the bushing of coil cord into the slot at the bottom of the chassis, reattach the front cover and secure two (M3 x 8mm) screws again. (Fig.3-19)

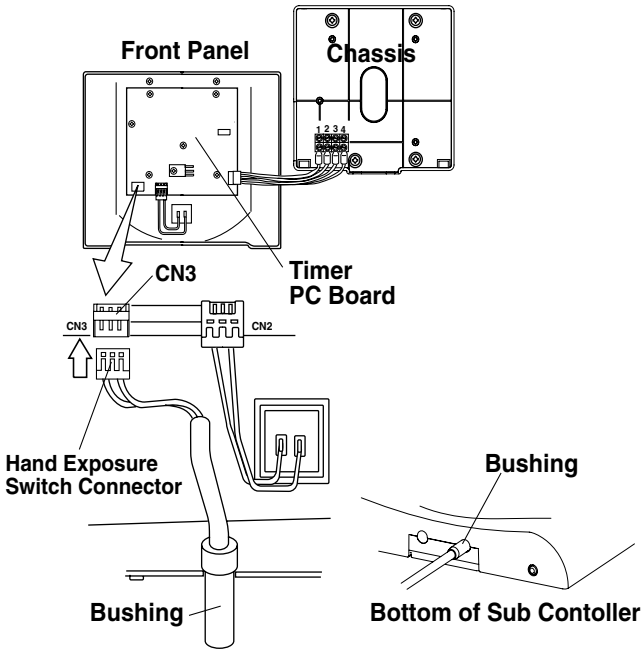


Fig.3-19 Connecting Hand Exposure Switch

5. Place the hook on the top corner (right or left) of controller and attach it with the tapping screw (ø3 x 8mm). (Fig.3-20)

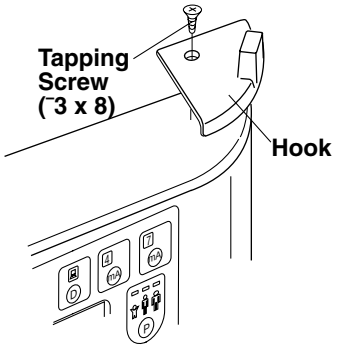


Fig.3-20 Attaching Hand Exposure Switch Hook

[3] INSTALLATION OF FM TYPE

A. POLE ASSEMBLY INSTALLATION (Fig.3-21)

1. Attach four legs bars to the pole base and secure them by hex socket head bolts. (Align the hole on bottom of base with the threaded hole on the leg bar.).

⚠ CAUTION

Two longer leg bars must be attached to the wider ends of the base.

2. Attach the lock casters to the each longer leg bar ends. Attach the standard casters to the shorter leg bar ends.

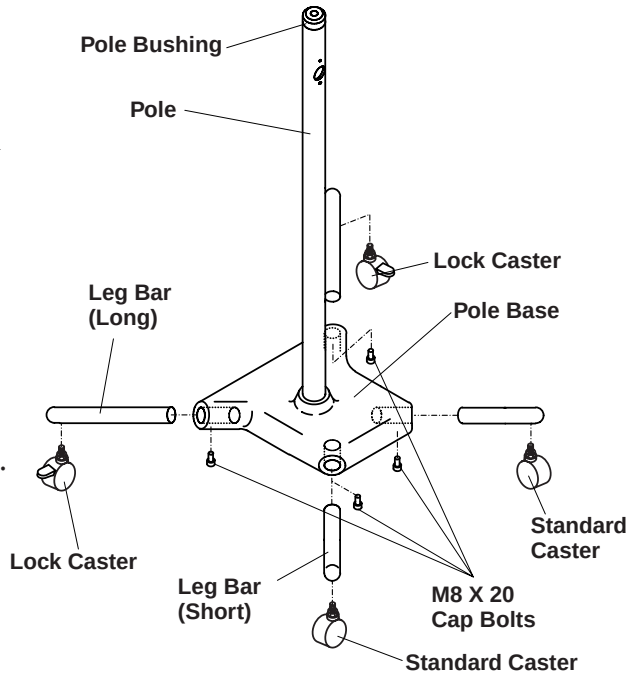


Fig.3-21 Pole Assembly Installation

B. ARM ASSEMBLY INSTALLATION (Fig.3-22)

⚠ WARNING

Do not release arm holding band until the X-ray head has been installed. Balance arm is spring loaded and can cause equipment damage and injury if not handled in the proper manner.

1. Remove 2 mounting screws on the pole and remove the pole bushing.

2. Insert the pole bushing into the shaft of balance arm.

3. Insert brake plug, brake spring and brake screw (M6 x 6mm) into the upper threaded hole of pole bushing. **Do not fully tighten**.

4. Insert the stopper screws into lower threaded hole of pole bushing and tighten securely.

5. After putting 3 back supporters to the pole, insert the pole bushing and balance arm into the pole as the wires go through the lower hole of the pole.

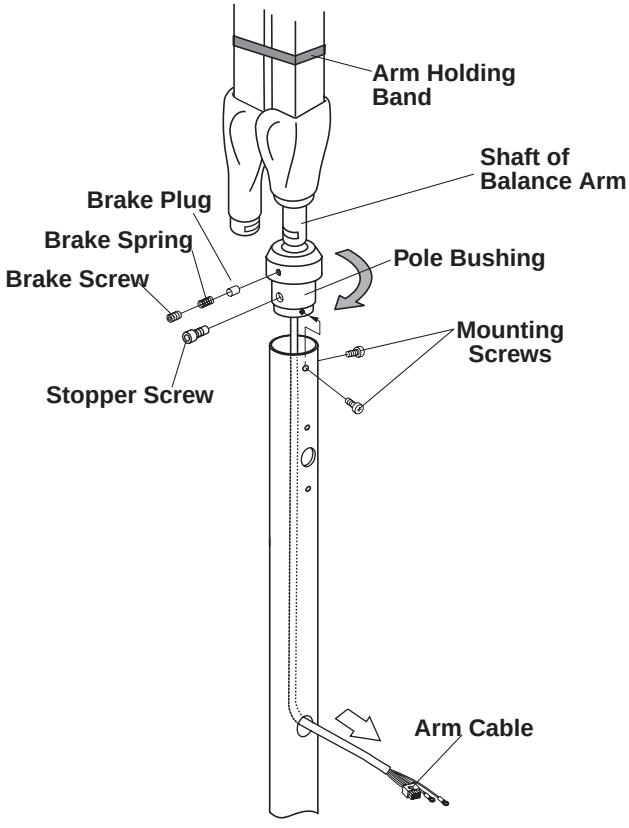


Fig.3-22 Arm Assembly Installation

C. MAIN CONTROLLER FIXING PLATE AND SUB CONTROLLER PLATE INSTALLATION (Fig.3-23)

1. Pass through the interconnecting wire from the upper hole to the lower hole on the pole. Connecter side of wire should come out from the lower hole.

2. Pass through the interconnecting wire and arm cable into the large hole on the main controller fixing plate. Set the main controller fixing plate over the lower hole on the pole at the short leg side. Fix the main controller fixing plate with 6 screws to 2 back supporters and the pole.

3. Screw a cable hook on the main controller fixing plate and fix it up right position with a nut from opposite side.

4. Pass through the interconnecting wire into the large hole on the sub controller fixing plate. Set the sub controller fixing plate over the upper hole of the pole at the short leg side. Fix the sub controller fixing plate with 4 screws to the back supporter and the pole.

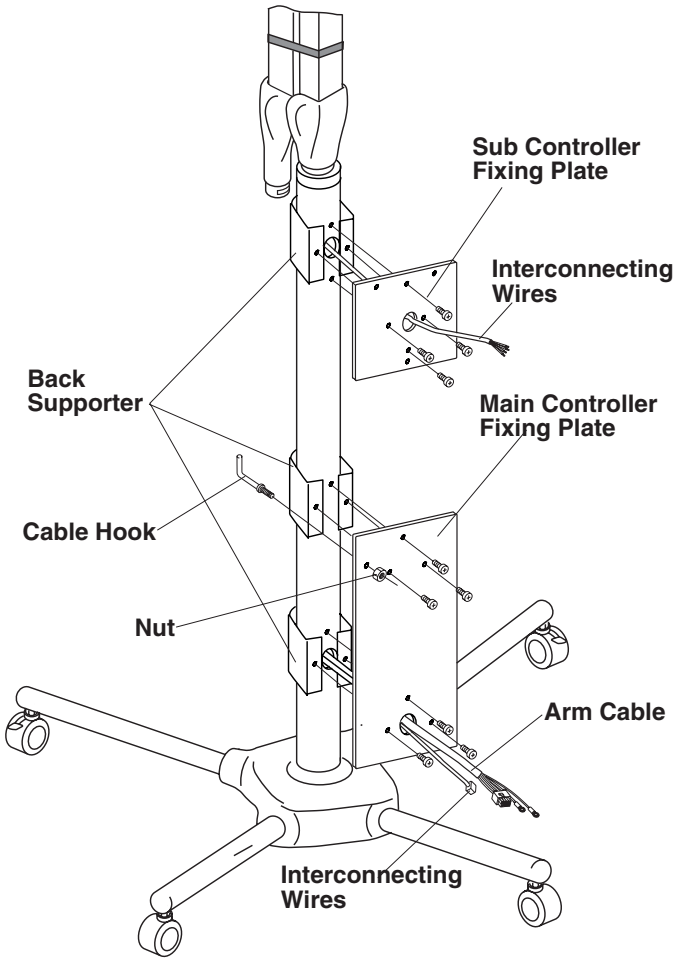


Fig.3-23 Controller Fixing Plates Installation

D. HEAD INSTALLATION

Refer to page 13.

E. MAIN CONTROLLER INSTALLATION

Refer to page 11. Power supply cable is pre-installed on the main controller.

F. SUB CONTROLLER INSTALLATION

Refer to page 14.

G. ADJUSTMENT

1. Tighten the brake screw if arm drifts.
2. Perform the post installation inspection. (page 24 ~ 26).

H. BALANCE ARM SWING ANGLE ADJUSTMENT

After installation of the head, balance arm swing angle should be adjusted following 1 to 3.

1. Keeping the arm at the position (a) of Fig.3-24, rotate the pole bushing to the limit by the direction as the arrow in Fig.3-22 indicates.

2. Fix the pole bushing by two mounting screws on the pole.

3. Confirm the swing angle of the arm is as Fig.3-24.

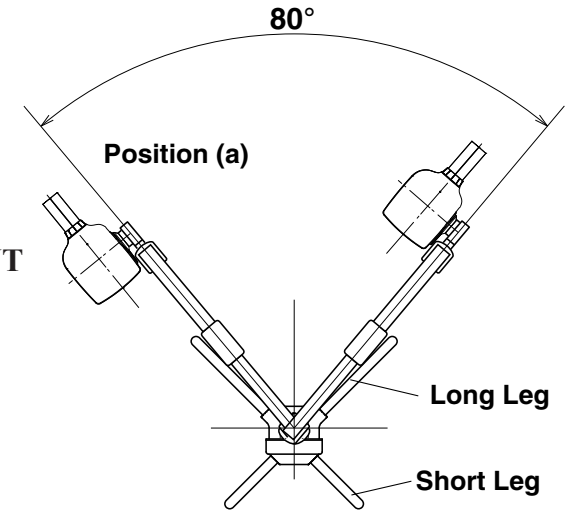


Fig.3-24 Balance Arm Swing Angle Adjustment

[4] INSTALLATION OF RK TYPE

A. BASE AND COLOMN INSTALLATION

1. Fix the base plate on the floor with 5 lag screws (supplied) or with appropriate means. (Fig.3-25)

⚠ CAUTION

Make sure the base plate is fixed on the floor firmly.

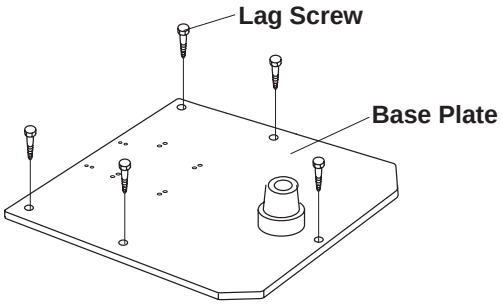


Fig.3-25 Fixing Base Plate to Floor

2. Insert the sliding post with column cover into the column. The direction of sliding post is shown in Fig.3-27.

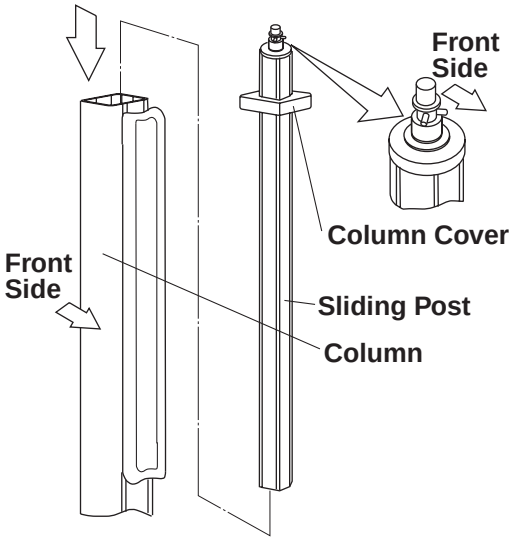


Fig.3-26 Setting Sliding Post

3. Install the column on the baseplate with mounting bolts. Make it vertical with adjusting bolts. (Fig.3-27)

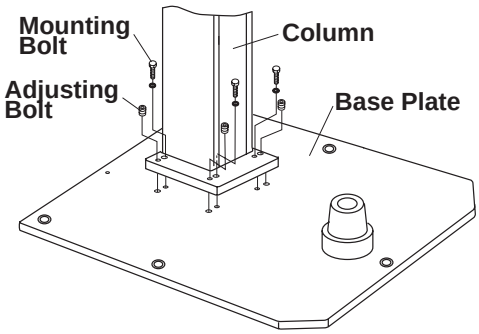


Fig.3-27 Fixing Column on Base Plate

B. SWING ARM INSTALLATION

⚠ CAUTION

When installing the swing arm assembly on the sliding post, keep holding the sliding post.

1. Pull down the sliding post into the column and hold it. Set the thrust washer on the top of sliding post. Keep holding the sliding post and insert the swing arm assembly on the top of sliding post. After setting the swing arm on the sliding post, slowly release the sliding post. (Fig.3-28)
2. Set and fix the cable guide on the rear side of column. (Fig.3-28)

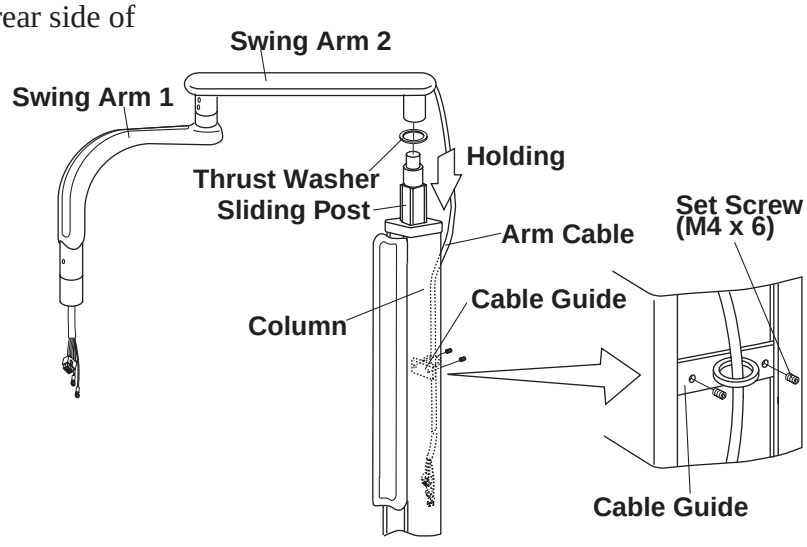


Fig.3-28 Swing Arm Installation

3. Set the stopper screw into lower threaded hole of swing arm 2. (Fig.3-29)

4. Set the brake plug then brake spring and brake screw into the upper hole of swing arm 2. (Fig.3-29) Tighten the brake screw, IF ARM DRIFTS. DO NOT FULLY TIGHTEN.

5. Fix the cable guide on the rear side of colum with 2 screws. (Fig.3-28)

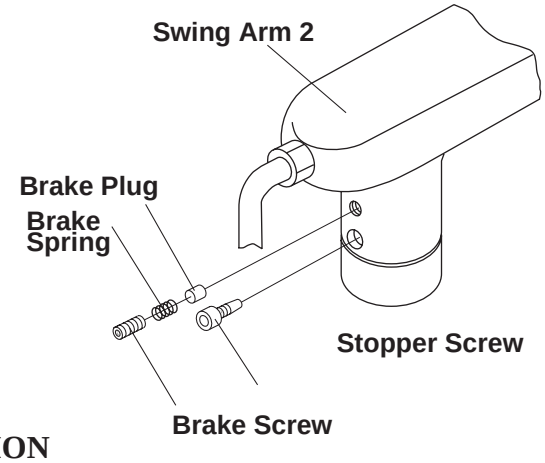


Fig.3-29 Brake Screw and Stopper Screw for Swing Arm 2

C. STOOL AND BACKREST CUSHION INSTALLATION

1. Slide up the backrest cushion to the top of column.

2. Insert the gas pump into the gas pump bracket. Mount the stool seat on the gas pump then press them. (Fig.3-30)

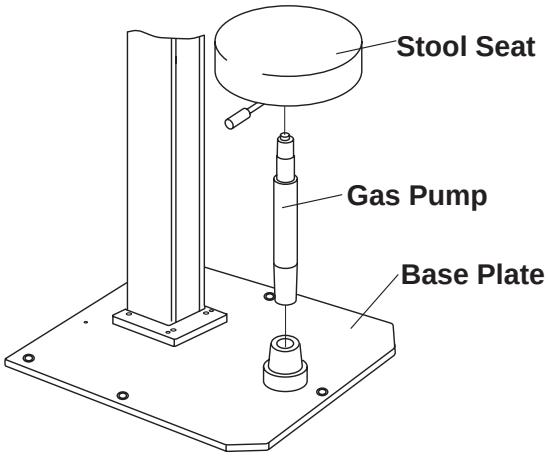


Fig.3-30 Stool Installation

D. HEAD INSTALLATION

Refer to page 13.

E. MAIN CONTROLLER INSTALLATION

1. Remove 4 cover screws and open the front cover of the main controller.
2. Attach the mounting plate to the main controller with 2 screws.
3. Pass through the arm cable, interconnecting wires and power supply cable into the bottom hole on the chassis of main controller.
4. Arm cable should be fixed by 2 clamps, one nylon clamp (insulated type) for holding the arm cable and one plating clamp (conducting type) for shielding wire to be grounded. (Fig.3-31)

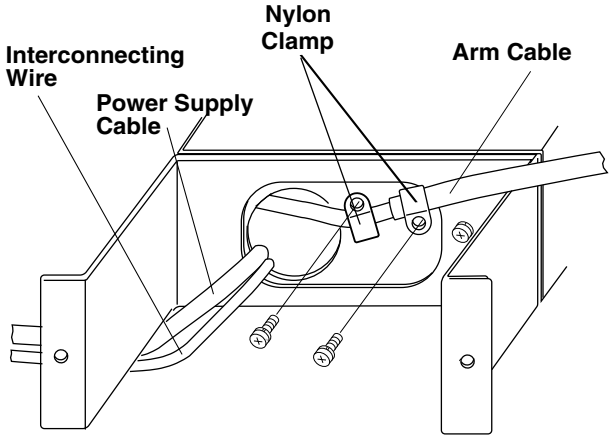


Fig.3-31 Nylon Clamps (View A of Fig.3-32)

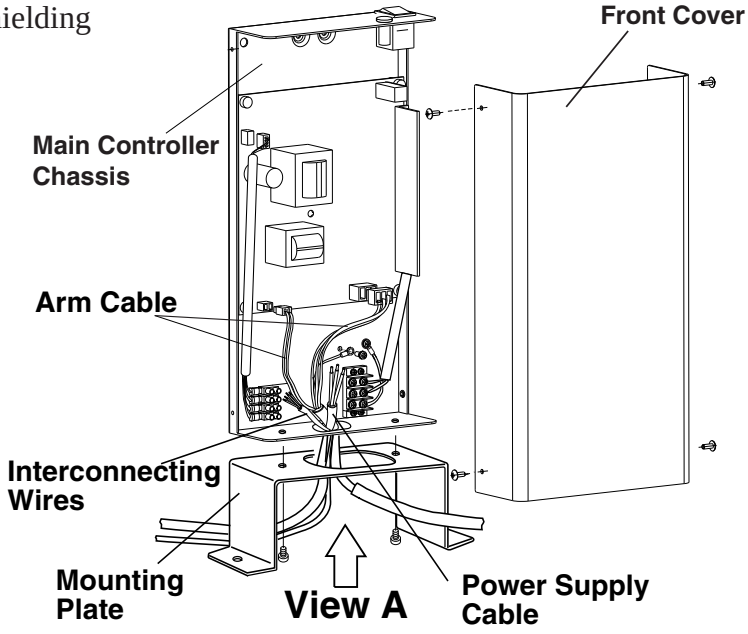


Fig.3-32 Installation of Main Controller

5. Connect 3P and 2P connectors of arm cable to the respective connectors on power PC Board. (Fig.3-32)
6. Connect the wire with ring terminal of arm cable to the chassis with a M4 screw. (Fig.3-32)
7. Cut the wires to workable length and strip 10mm of insulation for power supply cable. Connect wires of power supply cable to 3P terminal block. (Fig.3-33)
8. Connect the gound wire with ring terminal to the column. (Fig.3-34)
9. Cut the wires to workable length and strip 5mm of insulation for interconnecting wires. Connect interconnecting wires to 4P terminal block. (Fig.3-33)
10. Attach the mounting plate on the base plate with two M4 screws.

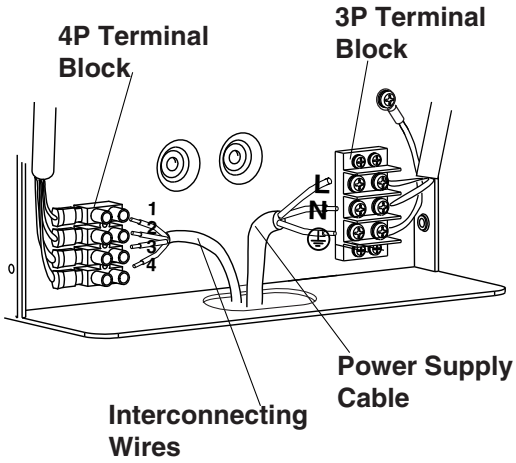


Fig.3-33 Power Supply Cable and Interconnecting Wires Connection

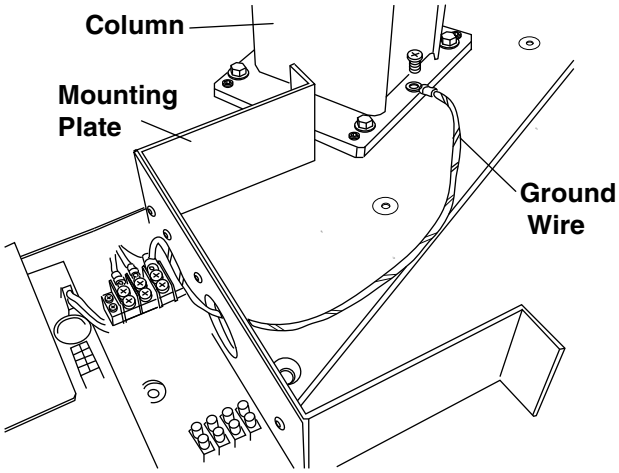


Fig.3-34 Ground Wire Connection

F. Sub Controller Installation

Refer to page 14.

[5] INSTALLATION OF CK TYPE

A. MOUNTING PLATE AND POLE INSTALLATION

1. Pass the power supply cable and inter connecting wire through the centre hole of ceiling mounting plate. (Fig.3-35)

2. Fix the ceiling mounting plate to the ceiling with lag bolts or anchor bolts.
   Make sure the mounting plate is firmly fixed and can withstand a 150kg withdrawal force. (Fig.3-35)

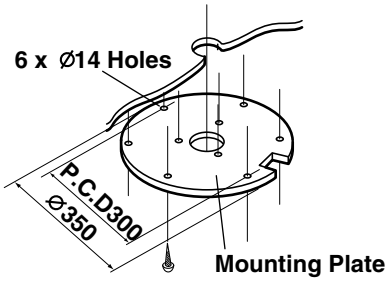


Fig.3-35 Fixing Ceiling Mounting Plate

3. After setting the cover and cover ring to the pole, pass the power supply cable and interconnecting wire through the hole for main controller on the pole.
   Pass power supply cable for light through the hole for light arm. (Option)
   Fix the pole to the ceiling mounting plate with 3 x mounting bolts (M8 x 20).
   Make the pole vertical by adjusting 3 adjusting bolts and 3 mounting bolts. (Fig.3-36)
   Set the cover and cover ring to the pole and tighten the set screws of cover ring as the cover stays at the upper end of the pole. (Fig.3-36)

4. Pass the power supply cable for light through the light arm and fix the light arm to the pole with 3 cap bolts on the support ring. (Option) (Fig.3-36)

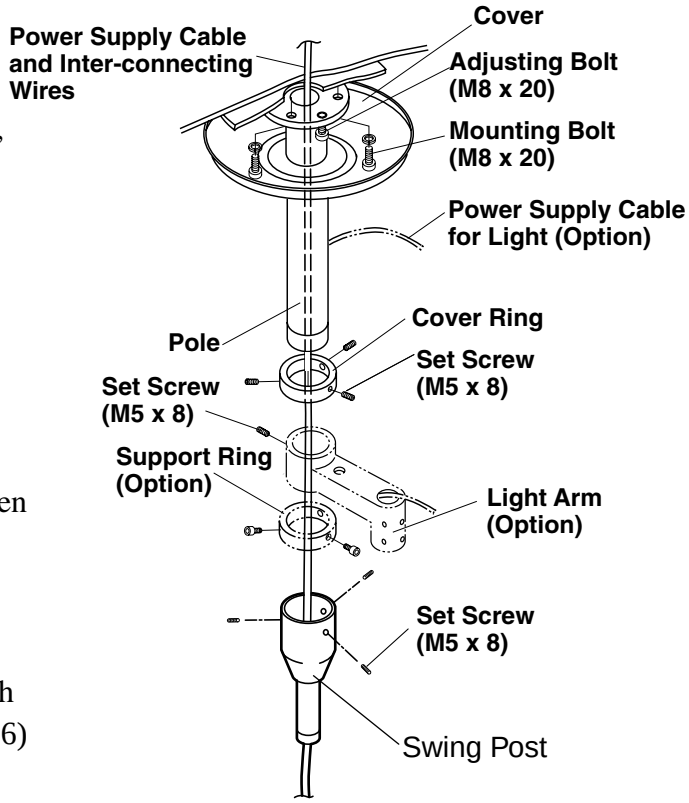


Fig.3-36 Fixing Pole & Cover

B. SWING ARM INSTALLATION

1. According to the desired rotation angle of swing arm, set the stopper screw to the stopper ring.
   9 different angles can be obtained by changing the position of stop screws. Right table shows the relation between the rotation angle of swing arm and the position of stopper screws.

2. Set the stopper ring, swing arm and keys to the swing post. After the swing arm is lowered to the limit, make sure the stopper ring is in contact with the swing arm. (Fig.3-37)

3. Fix the stopper ring to the swing post by the set screws. Start position of the rotation of swing arm is decided by these set screws. (Fig.3-38)

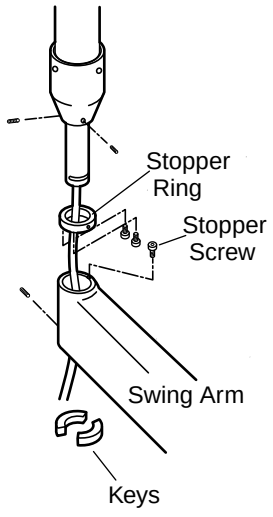


Fig.3-37 Swing Arm

Swing Angle

300û	
90û 270û	
150û 210û	
60û 300û	
120û 240û	

C. BALANCE ARM INSTALLATION

⚠ CAUTION

Do not release Arm holding band until the X-ray head has been installed.
Balance arm assembly is spring loaded and can cause equipment damage and injury if not handled in the proper manner.

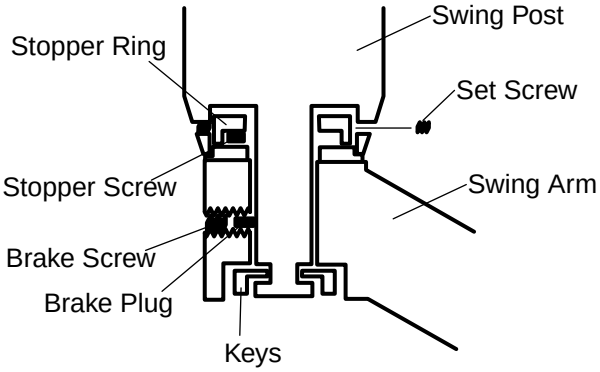


Fig.3-38 Set Screw for Stopper Ring

1. Insert the shaft of balance arm to the swing arm. set a brake plug then brake screw into the top threaded hole of the swing arm. Do not fully tighten. Set a stopper screw into lower threaded hole of swing arm and tighten securely. (Fig.3-39)
2. Connect the cables from the balance arm and the cables from the main controller under the pole, then put the cables into the swing arm.

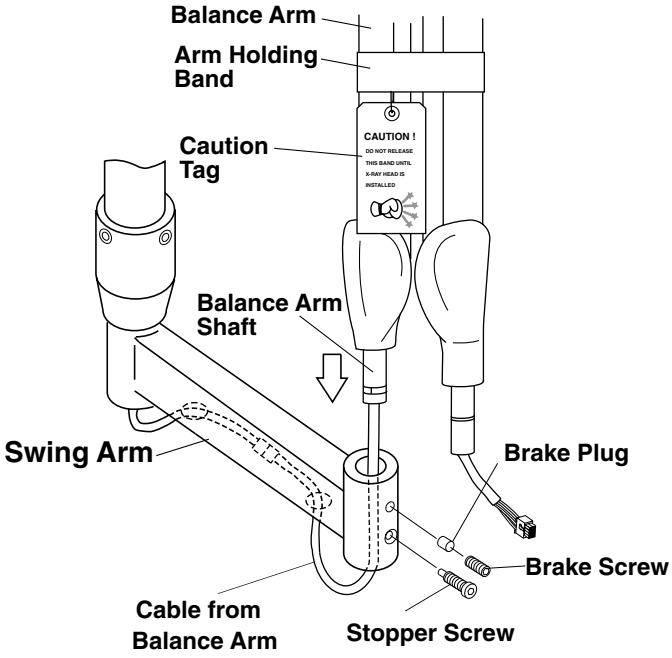


Fig.3-39 Balance Arm Installation

D. Head Installation

Refer to page 13.

E. Chassis of Main Controller

1. Remove two screws (M3 x 8mm) from the top of the main controller and open the front cover.
2. Remove the restricton plate over the 3P terminal block by taking out two screws (Fig. 3-40).
3. Route the power supply wires and arm cable though each access holes of chassis. Install the chassis on the wall with four screws. (Fig.40)

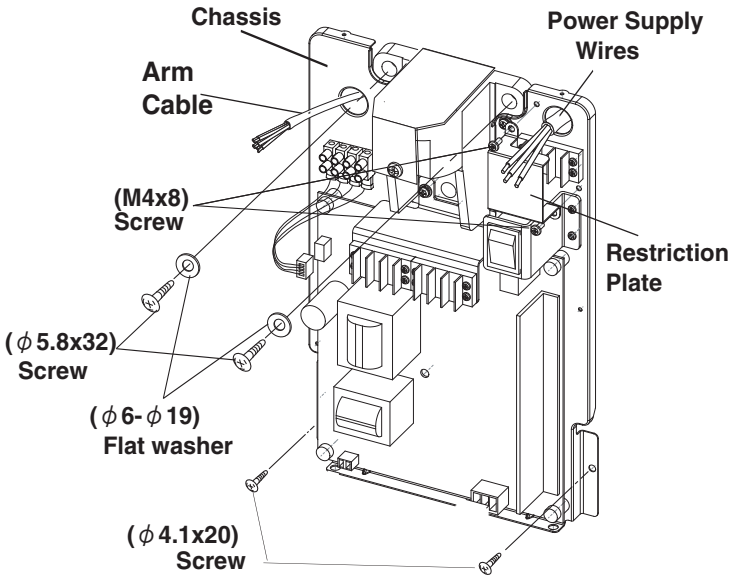


Fig.3-40 Balance Arm Installation

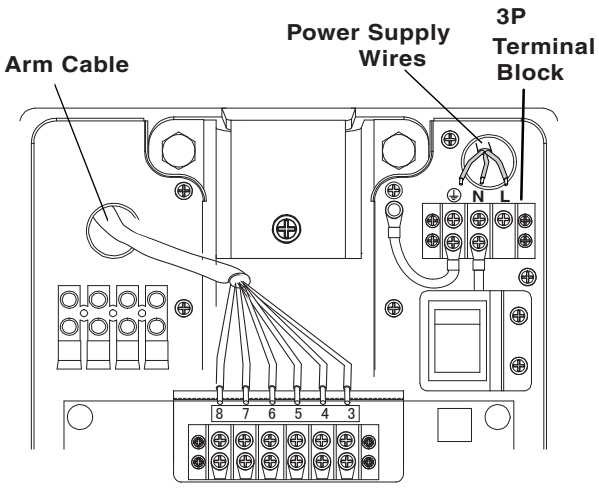


Fig.3-41 Balance Arm Installation

4. Cut the wires to workable length and strip 10 mm of insulation for each wires. Connect the power supply wires to 3P terminal block and connect the arm cable to the 6P terminal block. (Fig.3-41)
5. Reattach the restriction plate over the 3P terminal block.

F. SUB CONTROLLER INSTALLATION

For CK type, an interconnecting cable between the main controller and sub controller is supplied as the sub controller can be mounted on the front cover of the main controller.

1. Remove two (M3 x8mm) screws from the under side of the controller and open the front panel. (Fig.3-42)

2. Disconnect the 4P connector from the timer PC Board. (Fig.3-43)

3. Route the interconnecting wires from the sub controller through access hole of front cover of main controller and attach the chassis on the front cover of the main controller. (Fig.3-44)

4. Connect the 4P connector to the timer PC Board again and close the front panel of sub controller by two screws from bottom side. (Fig.3-43)

5. Connect the 4P connector of interconnecting wires to the 4P connector on the power PC Board. (Fig.3-45)

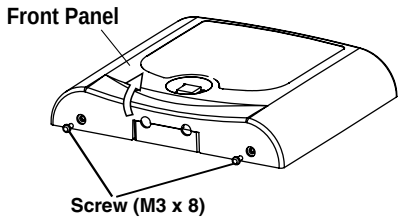


Fig.3-42 Opening Front Panel

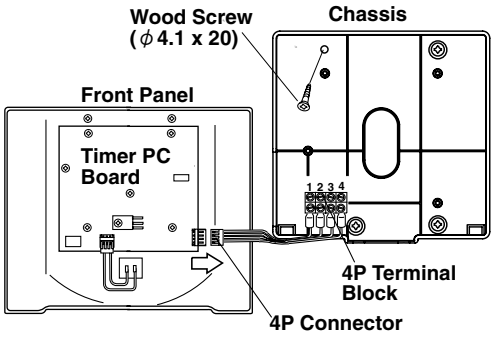


Fig.3-43 4P connector on Timer PC Board

⚠ CAUTION

Miswiring causes permanent damage to both timer PC board and power PC board.

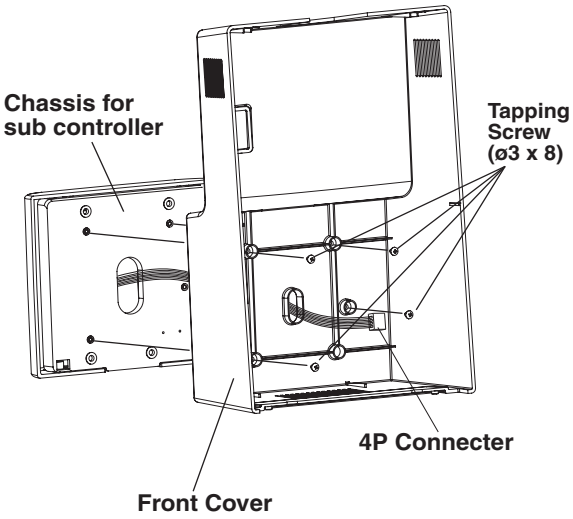


Fig.3-44 Installation of sub controller chassis on the front cover of main controller

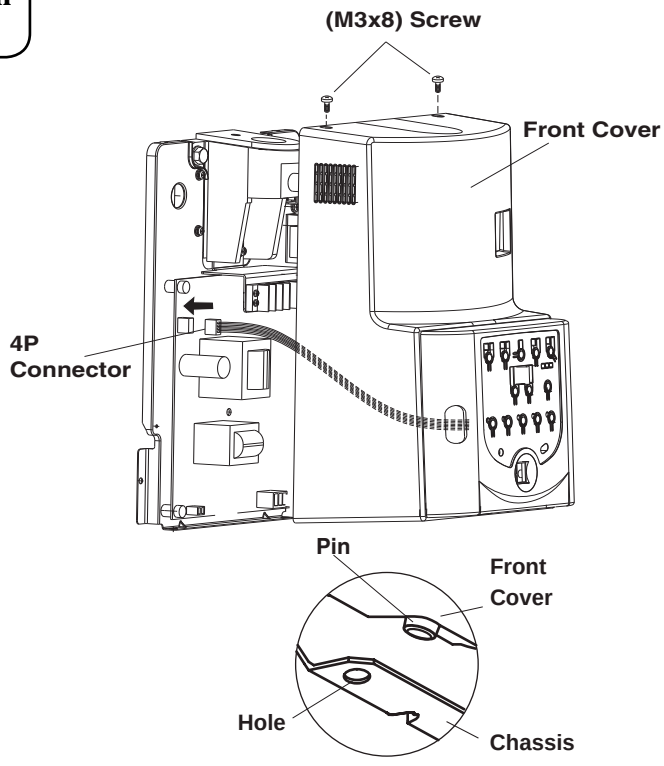


Fig.3-45 4P connector on Power PC Board

SECTION 4 : POST INSTALLATION INSPECTION

[1] FK1/FK2 TYPE

A. LEVEL ADJUSTMENT FOR FK1/FK2 TYPE
(**Fig.4-1**)
Level for FK1/FK2 type can be adjusted by 3 level adjusting bolts located bottom of the pole.

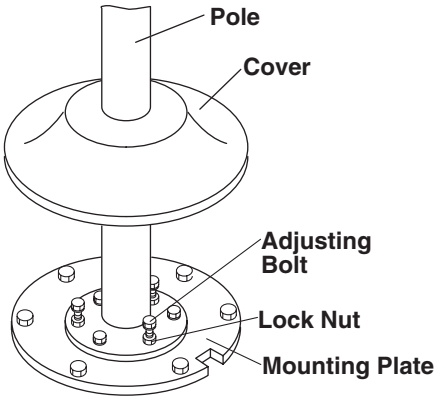


Fig.4-1 Level Adjustment for FK1/FK2

B. SWING FRICTION ADJUSTMENT FOR
B. SWING FRICTION ADJUSTMENT FOR

1. Horizontal Arm Swing Friction Adjustment
The horizontal arm swing friction can be adjusted by the brake screw located on the pole bush.

⚠ CAUTION

When adjusting arm swing friction, set the arm holding band on the balance arm for safety.

2. Balance Arm Swing Friction Adjustment
The Balance arm swing friction can be adjusted by the brake screw located end of the horizontal arm.

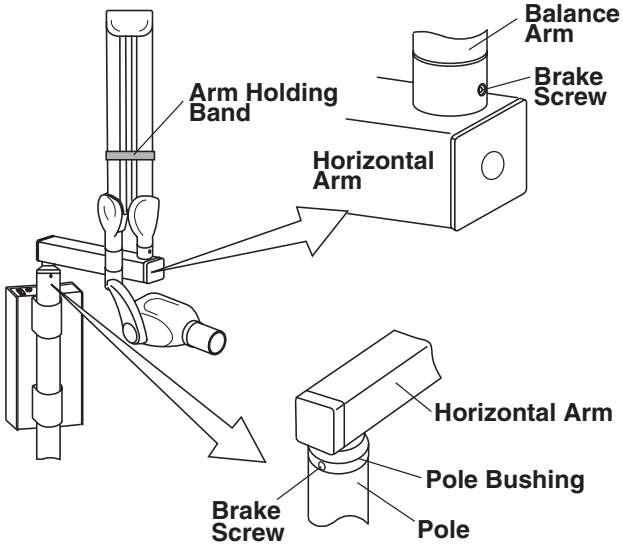


Fig.4-2 Swing Friction Adjustment for FK1/FK2

C. BALANCE
(Fig.4-3)
1. Place the balance arm into position.
2. If either balance arm drift higher or lower from the set position, remove the spring adjuster cover and adjust the balance arm spring tension with the balance arm wrench.

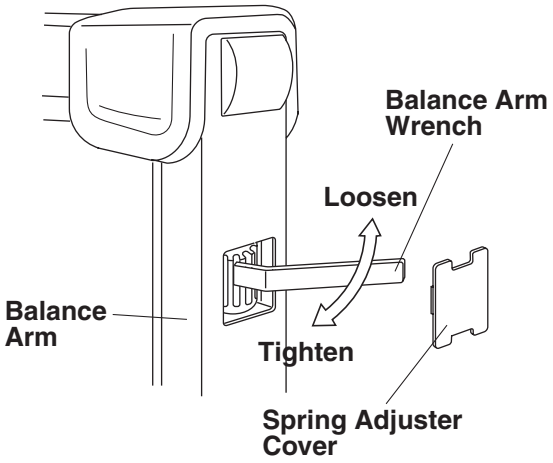


Fig.4-3 Balance Arm Tension Adjustment for FK1/FK2 and FM

[2] FM TYPE

A. LEVEL ADJUSTMENT FOR FM TYPE (Fig.4-4)

Level for FM type can be adjusted by 4 x casters located bottom of the legs

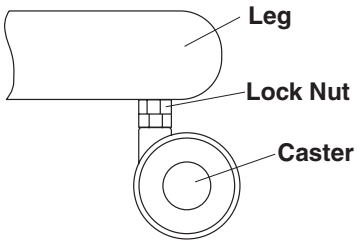


Fig.4-4 Level Adjustment for FM

B. BALNNCE ARM SWING FRICTION ADJUSTMENT FOR FM TYPE (Fig.4-5)

⚠ CAUTION

When adjusting balance arm swing friction, set the arm holding band on the balance arm for safety.

The Balance arm swing friction can be adjusted by the brake screw located on the pole bush.

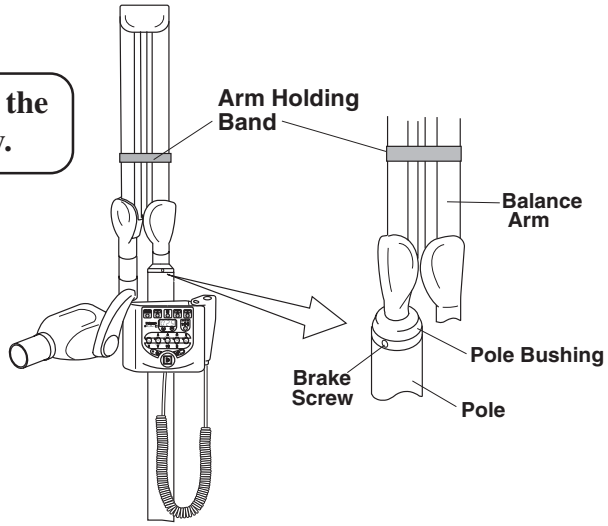


Fig.4-5 Balance Arm Swing Friction Adjustment for FM

C. BALANCE ARM TENSION ADJUSTMENT (Fig.4-3)

1. Place the balance arm into position.
2. If either balance arm drift higher or lower from the set position, remove the spring adjuster cover and adjust the balance arm spring tension with the balance arm wrench.

[3] RK TYPE

A. LEVEL ADJUSTMENT FOR RK TYPE (Fig.4-6)

Level for RK type can be adjusted by 4 level adjuster screws located bottom of the column.

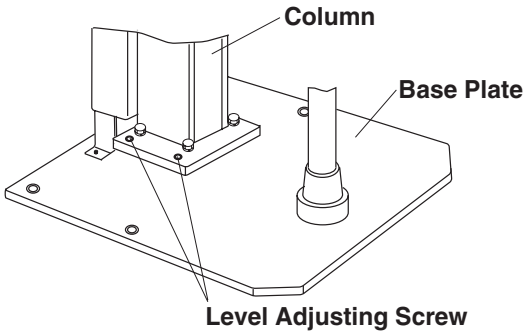


Fig.4-6 Level Adjustment for RK

B. SWING ARM FRICTION ADJUSTMENT FOR RK TYPE (Fig.4-7)

1. Swing Friction Adjustment for Swing Arm 1
   The swing arm 1 friction can be adjusted by the brake screw A on the swing arm 2.

2. Swing Friction Adjustment for Swing Arm 2
   The swing arm 2 friction can be adjusted by the brake screw B on the swing arm 2.

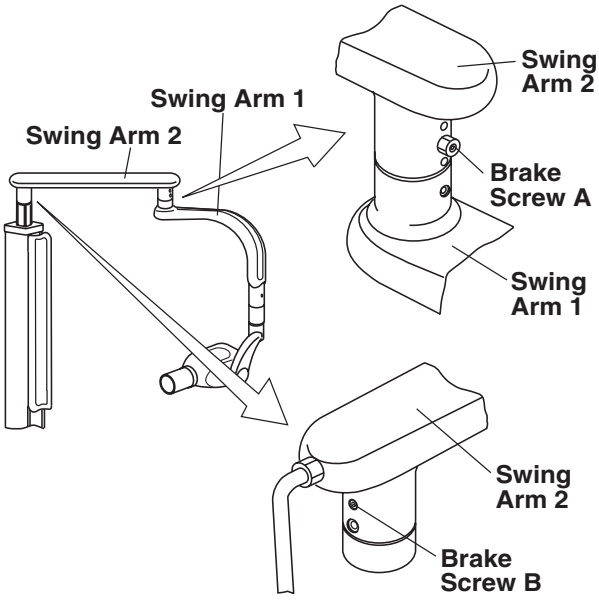


Fig.4-7 Swing Arm Friction Adjustment for RK

[4] HEAD POSITIONING

A. Place head into position.

B. If head drifts from the set position, adjust the brake screws according to the following procedures. (Fig.4-8)

1. Loosen the yoke side cap screw (¿3 x 8mm tapping screw) and remove the yoke side cap.
2. Adjust the six brake screws using a screw driver.
3. After adjustment, reteach the yoke side cap and screw.

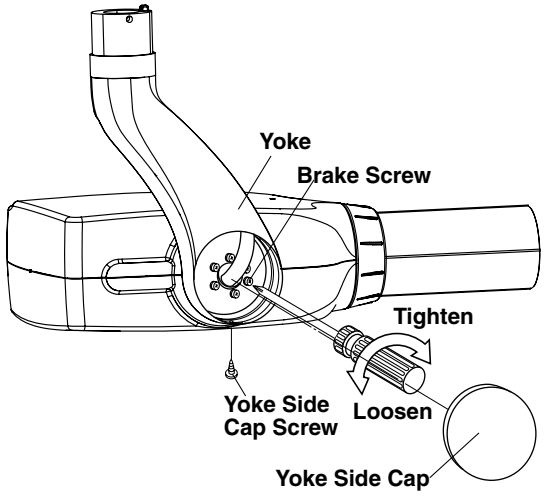


Fig.4-8 Head Positioning

SECTION 5 : CONTROL IDENTIFICATION AND OPERATION

[1] MAJOR COMPONENTS AND CONTROL IDENTIFICATION

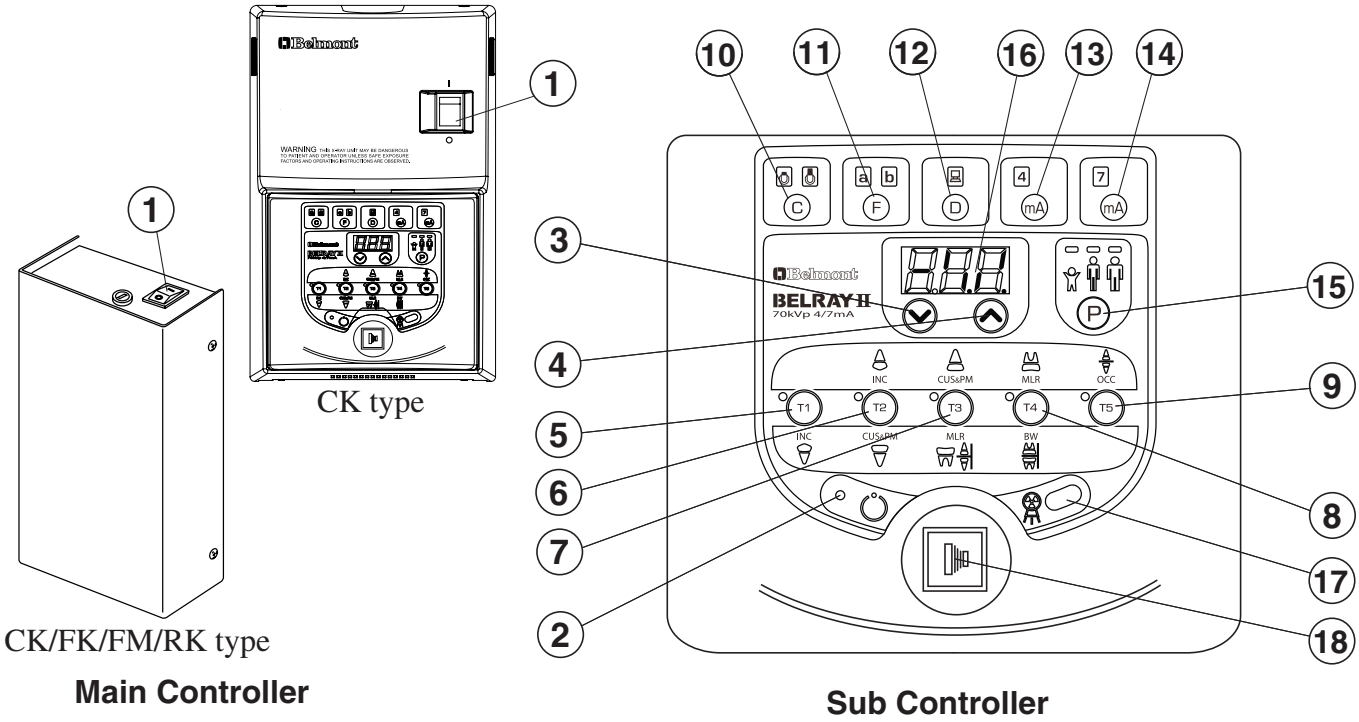


Fig.5-1 Major Components and Control Identification

① Main Power Switch
② Ready Light
③ Exposure Time Adjusting Switch (Down)
④ Exposure Time Adjusting Switch (Up)
⑤ Tooth Selection Switch (T1)
⑥ Tooth Selection Switch (T2)
⑦ Tooth Selection Switch (T3)
⑧ Tooth Selection Switch (T4)
⑨ Tooth Selection Switch (T5)
⑩ Cone Type Selection Switch
⑪ Film Speed Selection Switch
⑫ Digital Imaging Switch
⑬ 4mA Selection Switch
⑭ 7mA Selection Switch
⑮ Patient Size Selection Switch
⑯ Exposure Time Display Window
⑰ Exposure Warning Light
⑱ Exposure Switch

[2] FUNCTION OF CONTROLS

(1) Main Power Switch

Pushing the upper side of this switch to the ON position energizes the x-ray unit. (Ready light and pre-select light for cone type, film or digital, mA, and patient size illuminate.)
It is recommended to keep this switch OFF when the unit is not in use, in order to prevent an accidental exposure.

IMPORTANT : To prevent the risk of an accidental exposure, push the lower side of this switch to the OFF position, when the unit is not in use.

(2) Ready Light

This light illuminates when the line voltage is within operable range .
When this light is not on, exposure can not be made.

(3)(4) Exposure Time Adjusting Switches

By momentarily pushing the (⌃ or ⌄) switch, the exposure time displayed increases (or decreases) by one increment. By keeping the switch depressed more 2 sec., the exposure time displayed increases (or decreases) continuously until the switch is released.
BELRAY II 097 has the following 23 exposure time settings :

0.00, 0.02, 0.03, 0.04, 0.05, 0.06, 0.08, 0.10, 0.13, 0.16, 0.20, 0.25, 0.32, 0.40
0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00, 2.50, 3.20 (sec.)

(5) ~ (9) Tooth Selection Switches (T1 ~ T5)

Pushing one of these switches sets the exposure time automatically for the following (10) ~ (15).

(5) T1 : Incisor of Mandible
(6) T2 : Incisor of Maxilla, Cuspid & Premolar of Mandible
(7) T3 : Cuspid & Premolar of Maxilla, Molars of Mandible, Bite Wing
(8) T4 : Molar of Maxilla, Bite Wing Molars
(9) T5 : Occlusal

If the T1 switch (5) is depressed more than 3 sec., unit goes into " Lock Mode".
In lock mode, the only functional switch is the power switch. To exit from the lock mode, depress the T1 switch more than 3 sec. again.

(10) Cone Type Selection Switch

Depressing this switch for more than 2 sec. selects the cone type : 204 mm standard cone or 305 mm optional long cone.

(11) Film Speed Selection Switch

a. BELRAY II has 16 film speed settings : (F.00 ~ F.15)
Two speed settings are pre-set at the factory (a & b) and can be selected with (11).
a = Film speed No. F.09 (equivalent to ISO speed group " D" or Kodak Ultra-Speed film)
b = Film speed No. F.04 (equivalent to ISO speed group " F/E" or Kodak InSight film)

b. Pushing this switch momentarily displays the selected film speed setting in the **Exposure Time Display Window** (16).
Depressing this switch for more than 2 sec. changes the film type being selected.

c. If the **Digital Imaging Switch** (12) is depressed, both of the film speed indicating light (a & b) are turned off.

(12) Digital Imaging Switch

If a digital imaging system is used, shorter exposure time is often required. BELRAY II has 16 speeds for digital imaging : (d.00 ~ d.15). Pushing this switch momentarily displays the speed being selected in the **Exposure Time Display Window** (16). With the factory speed setting d.06, the exposure time becomes half of F.06 setting.

TABLE 1. Speed Setting and Exposure Time (Regular Cone) [unit : sec.]

Speed Setting	mA	Child					Adult					Obese				
		T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
F.09	4	0.20	0.32	0.40	0.50	0.80	0.32	0.50	0.63	0.80	1.25	0.40	0.63	0.80	1.00	1.60
	7	0.10	0.20	0.20	0.32	0.40	0.20	0.32	0.40	0.50	0.63	0.20	0.40	0.40	0.63	0.80
F.04	4	0.08	0.13	0.16	0.20	0.32	0.13	0.20	0.25	0.32	0.50	0.16	0.25	0.32	0.40	0.63
	7	0.05	0.08	0.10	0.13	0.16	0.08	0.13	0.16	0.20	0.32	0.10	0.16	0.20	0.25	0.32
d.06	4	0.06	0.10	0.10	0.16	0.20	0.10	0.16	0.20	0.25	0.40	0.10	0.20	0.25	0.32	0.40
	7	0.03	0.05	0.06	0.08	0.13	0.05	0.08	0.10	0.13	0.20	0.06	0.10	0.13	0.16	0.25

TABLE 2. Speed Setting and Exposure Time (Long Cone) [unit : sec.]

Speed Setting	mA	Child					Adult					Obese				
		T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
F.09	4	0.40	0.63	0.80	1.00	1.60	0.63	1.25	1.25	2.00	2.50	0.80	1.25	1.60	2.00	3.20
	7	0.25	0.40	0.50	0.63	1.00	0.40	0.63	1.80	1.00	1.60	0.50	0.80	1.00	1.25	2.00
F.04	4	0.16	0.25	0.32	0.50	0.63	0.25	0.50	0.50	0.80	1.00	0.32	0.50	0.63	1.00	1.25
	7	0.10	0.16	0.20	0.25	0.40	0.16	0.25	0.32	0.40	0.63	0.20	0.32	0.40	0.50	0.80
d.06	4	0.13	0.20	0.25	0.32	0.50	0.20	0.32	0.40	0.50	0.80	0.25	0.40	0.50	0.63	1.00
	7	0.06	0.13	0.13	0.20	0.25	0.10	0.20	0.25	0.32	0.40	0.13	0.25	0.25	0.40	0.50

(13) 4mA Selection Switch

By momentarily depressing this switch, the tube current is set at 4mA.
When Film switch is depressed, the tube current setting will be automatically changed to 7mA.

(14) 7mA Selection Switch

By momentarily depressing this switch, the tube current is set at 7mA.
When Digital switch is depressed, the tube current setting will be automatically changed to 4mA.

(15) Patient Size Selection Switch

This switch alters the selection of patient type/size to be radiographed (child→adult→large adult→ child) and sets the exposure time automatically.

NOTE : Setting or adjusting the exposure time manually (with ⌃ or ⌄ switch) supersedes (5) ~ (15) functions.

(16) Exposure Time Display Window

This window displays the selected exposure time. If an abnormal condition exists or a malfunction occurs, an Error Code is displayed. (See Section : **[5] ERROR CODES**)

(17) Exposure Warning Light

Illumination of this light indicates the unit is producing x-radiation.

(18) Exposure Switch

This switch initiates radiographic exposure. When making an exposure, depress and hold this switch unit the **Exposure Warning Light** (17) and the audible warning shut off. Failure to keep this switch depressed will result in the premature termination of the exposure and error code E.00 will be displayed in **Exposure Time Display Window** (16).

[3] OPERATING PROCEDURES

1. Turn ON the Main Power Switch (1).
2. Confirm that Ready Light (2) is illuminated

NOTE : The ready light will not illuminate unless the incoming line voltage is correct and within the x-ray's operable range.

3. Select the appropriate tooth type (5) ~ (9), and confirm the pre-selected conditions (cone type, film or digital, mA and patient size) are suitable for exposure.

NOTE : To manually set the exposure time, depress either of the manual Exposure Time Adjusting Switches (⌃ or ⌄) until the desired exposure time appears in the Exposure Time Display Window (16). While the unit is in manual mode, other selection switches (5) ~ (15) do not affect exposure time. (All of the tooth selection lights are off.) To return to the automatic exposure time selection mode, depress any one of Tooth Selection Switches (5) ~ (15).

4. Depress the Exposure Switch (18). When the Exposure Switch is depressed, the Exposure Warning Light (17) illuminates and the audible warning sounds. Do not release the Exposure Switch until the Exposure Warning Light and audible warning automatically shut off. Failure to keep the switch depressed will result in exposure being terminated prematurely.

5. To continue to radiograph other teeth, just select appropriate Tooth Selection Switches (5) ~ (9).

IMPORTANT : To protect x-ray tubehead from heat accumulation, wait for a time interval that is equal to 50 times the selected exposure time before making additional exposures. (Example : a 25 sec. wait is necessary between exposures that are 0.5 sec. in duration.)

6. Turn OFF the Main Power Switch (1) in order to prevent accidental exposures when the unit is not in use.

NOTE : If the unit left over 8 min. without being operated and the Main Power Switch (1) is kept on, figure " 1" runs thr ough the Exposure Time Display Window (16). This does not mean that malfunction of the unit has occurred ; this is an energy saving feature. The unit returns to ready condition by pressing any one of the switches, except the Exposure Switch (18).

[4] OPTIONAL HAND EXPOSURE SWITCH

Optional hand exposure switch can be connected to the sub controller. Since this exposure switch has a coiled cord, operators can stand in the most suitable position for operation.
As controller has separate connector for this exposure switch, both exposure switch (18) on the front panel of sub controller and this hand exposure switch can be used.
If local code prohibits use of both, ask installer to disconnect the connector of either switch.

[5] ERROR CODES

If an abnormal condition exists in the unit, or a malfunction occurs, an error code is displayed in the Exposure Time Display Window (16). Please refer to the Table below.

<table>
<tr><th>Error Code</th><th>Condition</th><th>Step to be Taken</th><th>Possible Solution</th></tr>
<tr><td>E.00</td><td>Exposure switch was released before exposure termination.</td><td>All the tooth selection lights blink.
Depress one of the tooth switches.</td><td>Release the exposure switch after the exposure light turns off.</td></tr>
<tr><td rowspan="2">E.01</td><td>Exposure switch was depressed within 10 sec. of previous exposure.</td><td rowspan="3">A 10 sec. delay is built in between each exposure.

Release the exposure switch.</td><td>There should be a " wait" interval of 50 times the exposure time between successive exposures.</td></tr>
<tr><td>Exposure time was set and exposure switch was depressed within 3 sec. of the power switch being turned on.</td><td>Wait a minimum 3 sec. after the main power switch is turned on before pressing the exposure switch.</td></tr>
<tr><td>E.02</td><td>Line voltage was less than 90% of rated voltage.</td><td>If line voltage is less than 90% of rated voltage, correct it by using a step-up transformer. (*)</td></tr>
<tr><td>E.03</td><td>Line voltage was more than 110% of rated voltage.</td><td>If line voltage is less than 110% of rated voltage, correct it by using a step-down transformer. (*)</td></tr>
<tr><td>E.04</td><td>Excess current during exposure.</td><td rowspan="5">Turn off the main power switch and wait for approximately 2 min. Turn on the main power switch again.</td><td>Contact customer service</td></tr>
<tr><td>E.05</td><td>Tube current at last portion of exposure was less than 3 mA at 4 mA setting or less than 5.25 mA at 7 mA setting.</td><td rowspan="4">Conduct the confirmation of tube current described in section 6.</td></tr>
<tr><td>E.06</td><td>Tube current at last portion of exposure was more than 5 mA at 4 mA setting or more than 8.75 mA at 7 mA setting.</td></tr>
<tr><td>E.07</td><td>During the exposure, tube current becomes less than 2 mA at 4mA setting or less than 3.5 mA at 7 mA setting.</td></tr>
<tr><td>E.08</td><td>During the exposure, tube current becomes more than 6 mA at 4mA setting or more than 10.5 mA at 7 mA setting.</td></tr>
<tr><td>E.09</td><td>Malfunction of the microcomputer.</td><td>Contact customer service</td></tr>
<tr><td>E.10</td><td>Exposure switch or exposure circuit had been ON, when main power switch is turned on.</td><td>Release all the switches</td><td>Do not turn on the power while other switch is depressed.</td></tr>
<tr><td>E.11</td><td>Tube current is detected during pre-heating period.</td><td rowspan="2">Turn off the main power switch and wait for approximately 2 min. Turn on the main power switch again.</td><td rowspan="2">Contact customer service</td></tr>
<tr><td>E.12</td><td>Tube current is detected when main power switch is turned on.</td></tr>
</table>

Error Code	Condition	Step to be Taken	Possible Solution
E.22	Failure of electrical communication between the power PCB and timer PCB.	Turn off the main power switch and wait for approximately 2 min. Turn on the main power switch again.	Contact customer service
E.23	Any switch on the sub controller is depressed when the main power switch is turned on. (Except the exposure switch)	Release all the switches	Do not turn on the power while other switch is depressed.

(*) Should a step up or down transformer be required to follow local and national electrical code for electrical ratings and installation.

[6] MAINTENANCE

BELRAY II 097 x-ray unit requires post installation confirmation and periodic maintenaqce checks to be performed by dealer service personnel. These procedures ensure that the x-ray unit is functioning within the manufacturer's specifications and remain in compliance with the Standard.

It is the responsibility of the owner of the unit to see that these maintenance checks are done **once a year** and that they are performed by a trained, certified service technician.

The specific instructions to perform these checks are located within this Installation Manual.

A. Line voltage confirmation (page 32)
B. Tube potential and Tube current confirmation (page 32)
C. Inspection of arm and head movement (page 24 ~ 26)
D. Mechanical safety
   1. The floor mounting plate (FK1/FK2) or base plate (RK) should be checked to confirm that it is securely attached to the floor.
   2. The pole (FK1/FK2) or column (RK) should be checked to confirm that it is securely attached to the floor mounting plate (FK1/FK2) or base plate (RK). The pole or column must be level horizontally and vertically.
   3. Check and verify that the horizontal arm and balance arm are not raising up and out of the arm mounting bracket. This should be verified routinely by treatment room personnel.

SECTION 6 : POST INSTALLATION CONFIRMATION

[1] CONFIRMATION OF POWER SUPPLY VOLTAGE

As specified in Electrical Requirements (page 5), power supply voltage must be within the rated line voltage ± 10%. Confirm the power supply voltage again before turning on the unit.

1. Open the front panel of main controller by loosening two screws on top of the controller.
2. Set the range of digital multimeter at 300 VAC, connect probes of multimeter to L and N of the 3P terminal block.

⚠WARNING

Do not touch the restriction plate (refer to Fig.3-3) with the probes of multimeter during measurement, or a short circuit occurs.

3. Confirm that the reading is rated line voltage ± 10%

NOTE : BELRAY II 097 x-ray can not be operated unless the power supply voltage is within this range.

[2] CONFIRMATION OF TUBE CURRENT

BELRAY II 097 x-ray incorporates self diagnose and adjusting system to check if the tube current are within specified ranges at the beginning of exposure.

1. Keep depressing tooth selection switches T1, T4 & T5 together until “h.XX” is appeared on the exposure time display window.
2. Wait until the display changes to be “0.50”.
3. Make exposure by depressing the exposure switch.

⚠WARNING

X-radiation is generated for 0.50 second.

4. Repeat step 2. and 3. until “Fin” is displayed. This self diagnose and adjustment is automatically done for 4mA/7mA.
5. If "Agn" is displayed, turn off the power switch and wait 3 seconds. Turn on the power switch again and repeat steps 1. ~ 4. until "Fin" is displayed.

[3] CONFIRMATION OF EXPOSURE WARNING LIGHT & BUZZER

A. EXPOSURE WARNING BUZZER

1. Make an exposure and confirm that the exposure warning buzzer located within the sub controller is activated during the entire exposure.

B. EXPOSURE WARNING LIGHT

Exposure warning light is located on the front panel of the sub controller.

1. Make an exposure and confirm that the warning light illuminates during the exposure

[4] CONFIRMATION OF LINE VOLTAGE REGULATION

1. Make sure that main power switch is "OFF".
2. Set the range of digital multimeter at 300 VAC, connect probes of multimeter to L and N of the 3P terminal block in the main controller.

⚠WARNING

Do not touch the restriction plate (refer to Fig.3-40) with the probes of multimeter during measurement, or a short circuit occurs.

3. Turn the main power switch on, and set the exposure time at 2.00 sec. with manual switch at 7mA.
4. Record the no-load line voltage (VN) indicated by the multimeter before exposure.
5. Make an exposure and record the load voltage (VL) indicated by the multimeter during exposure.

⚠WARNING

X-Radiation is generated for 2 seconds.

NOTE : Read the multimeter when the value is stabilized (about one second after exposure started).

6. Calculate line voltage regulation R(%) in the formula below :

$$R = \frac{VN - VL}{VL} \times 100$$

NOTE : Line voltage regulation must not exceed the range of 0~3% for 100V~120V, 0~2% for 220V~240V. If it is greater than this range, the size of the power supply wires must be increased.
Refer to the power supply requirements outlined on page 5 to determine the correct wire size necessary. If line voltage regulation is within the range, apparent resistance of supply line can be considered to be less than 0.5 OHM.

SECTION 7 : INITIAL SETTING

[1] SPEED SETTING FOR FILM AND DIGITAL IMAGING

A. FILM SPEED

Prior to shipment of the x-ray from the factory, the following two film speeds are programmed to be selected by the Film Speed Selection Switch.

a = Film speed F.09 (equivalent to ISO speed group "D", or Kodak Ultra-speed Film)
b = Film speed F.04 (equivalent to ISO speed group "F/E", or Kodak InSight Film)

In addition to these two speeds, BELRAY II 097 x-ray can provide 16 different film speeds (F.00 ~ F.15) and any two of them can be programmed for easy selection. If the doctor uses a different film speed, or prefers darker (or lighter) radiographs, the new speed can be programmed as follows. Higher speed settings make films darker. If film speed is increased by 1, exposure time becomes 25 % longer.

1. Keep the 4mA selection switch and 7mA selection switch depressed simultaneously for more than 3 seconds. Release the switches if the ready light starts to flash.

2. Push F switch momentarily until the "a" light above the F switch illuminates. The exposure time display window shows the present film speed for "a" setting. (The factory default setting, F.09 should be displayed.) By depressing ⌃ or ⌄ switch, increase or decrease film speed number until desired number for "a" setting is displayed.

3. To change the "b" setting from the factory default, F.05, push F switch momentarily until the "b" light illuminates. By depressing ⌃ or ⌄ switch, increase or decrease film speed until the desired number for "b" setting is displayed.

4. Press **T1 switch** to store these settings, then turn the main power switch off.

B. SPEED FOR DIGITAL IMAGING

BELRAY II 097 x-ray unit has 16 speeds for digital imaging (d.00 ~ d.15). The factory setting is d.06 and with this setting the exposure time becomes half of F.06 setting.
As the sensitivity is different according to each manufacturer of digital imaging sensors, this setting should be adjusted. To get a darker image, increase the speed setting and to get a lighter image, decrease the speed setting. If the speed setting is increased by 1, exposure time becomes 12 % longer.

1. Keep 4mA selection switch and 7mA selection switch depressed simultaneously for more than 3 seconds. Release the switches if the ready light starts to flash.

2. Push D switch momentarily until the light above the D switch illuminates and the exposure time display window shows the present speed setting. (The factory default setting d.06 should be displayed.)

3. By depressing ⌃ or ⌄ switch, increase or decrease speed until the desired number is displayed.

4. Press **T1 switch** to store these settings, then turn the main power switch off.

TABLE 1. Speed Setting and Exposure Time (Regular Cone) [unit : sec.]

Speed Setting	mA	Child					Adult					Obese				
		T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
F.09	4	0.20	0.32	0.40	0.50	0.80	0.32	0.50	0.63	0.80	1.25	0.40	0.63	0.80	1.00	1.60
	7	0.10	0.20	0.20	0.32	0.40	0.20	0.32	0.40	0.50	0.63	0.20	0.40	0.40	0.63	0.80
F.04	4	0.08	0.13	0.16	0.20	0.32	0.13	0.20	0.25	0.32	0.50	0.16	0.25	0.32	0.40	0.63
	7	0.05	0.08	0.10	0.13	0.16	0.08	0.13	0.16	0.20	0.32	0.10	0.16	0.20	0.25	0.32
d.06	4	0.06	0.10	0.10	0.16	0.20	0.10	0.16	0.20	0.25	0.40	0.10	0.20	0.25	0.32	0.40
	7	0.03	0.05	0.06	0.08	0.13	0.05	0.08	0.10	0.13	0.20	0.06	0.10	0.13	0.16	0.25

TABLE 2. Speed Setting and Exposure Time (Long Cone) [unit : sec.]

Speed Setting	mA	Child					Adult					Obese				
		T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
F.09	4	0.40	0.63	0.80	1.00	1.60	0.63	1.25	1.25	2.00	2.50	0.80	1.25	1.60	2.00	3.20
	7	0.25	0.40	0.50	0.63	1.00	0.40	0.63	0.80	1.00	1.60	0.50	0.80	1.00	1.25	2.00
F.04	4	0.16	0.25	0.32	0.50	0.63	0.25	0.50	0.50	0.80	1.00	0.32	0.50	0.63	1.00	1.25
	7	0.10	0.16	0.20	0.25	0.40	0.16	0.25	0.32	0.40	0.63	0.20	0.32	0.40	0.50	0.80
d.06	4	0.13	0.20	0.25	0.32	0.50	0.20	0.32	0.40	0.50	0.80	0.25	0.40	0.50	0.63	1.00
	7	0.06	0.13	0.13	0.20	0.25	0.10	0.20	0.25	0.32	0.40	0.13	0.25	0.25	0.40	0.50

[2] PRIORITY OF SELECTIONS

Factory default setting :

Cone	: Regular cone
Film Speed	: "a"
Digital Imaging	: off
mA selection	: 7 mA
Patient Type	: Adult

If necessary, these settings can be changed. For example, if digital imaging is used for pedodontistry, digital imaging and "child" (patient type) should be selected.

1. Keep 4mA selection switch and 7mA selection switch depressed simultaneously for more than 3 seconds. Release the switches if the ready light starts to flash

2. Press D switch momentarily. (Light above D switch illuminates and speed setting for digital imaging is displayed on exposure time display window.)

3. Select the patient type "child" by depressing P switch momentarily.

4. Press **T1 switch** to store these settings, then turn the main power switch off.

5. Cone type, mA selection can be changed by same procedures.

NOTE: For digital imaging, 4 mA is recommended to get good contrast and precise exposure time control.

[3] ELECTRONIC CHIME ON/OFF

An electronic chime sounds when switches are depressed. If preferred, this sound can be deactivated as follows :

1. Keep T1 and T2 switches depressed together for more than 3 seconds.
   Release the switches if the ready light starts to flash

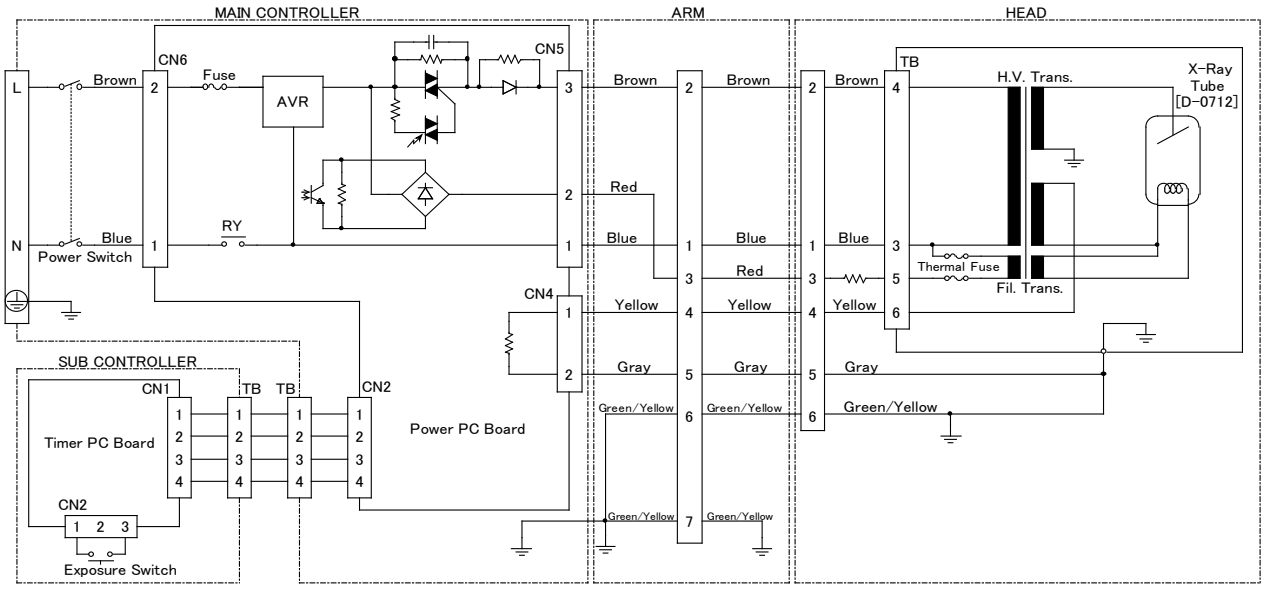
2. "bu. 2" will be displayed in exposure time display window.

3. By depressing either ⌃ or ⌄ switch, display changes to "bu.0".

4. Press **P switch** (Patient type Switch) to store this setting and turn off the main power switch.

NOTE : Exposure Warning Buzzer and alarm sound of error code can not be eliminated.

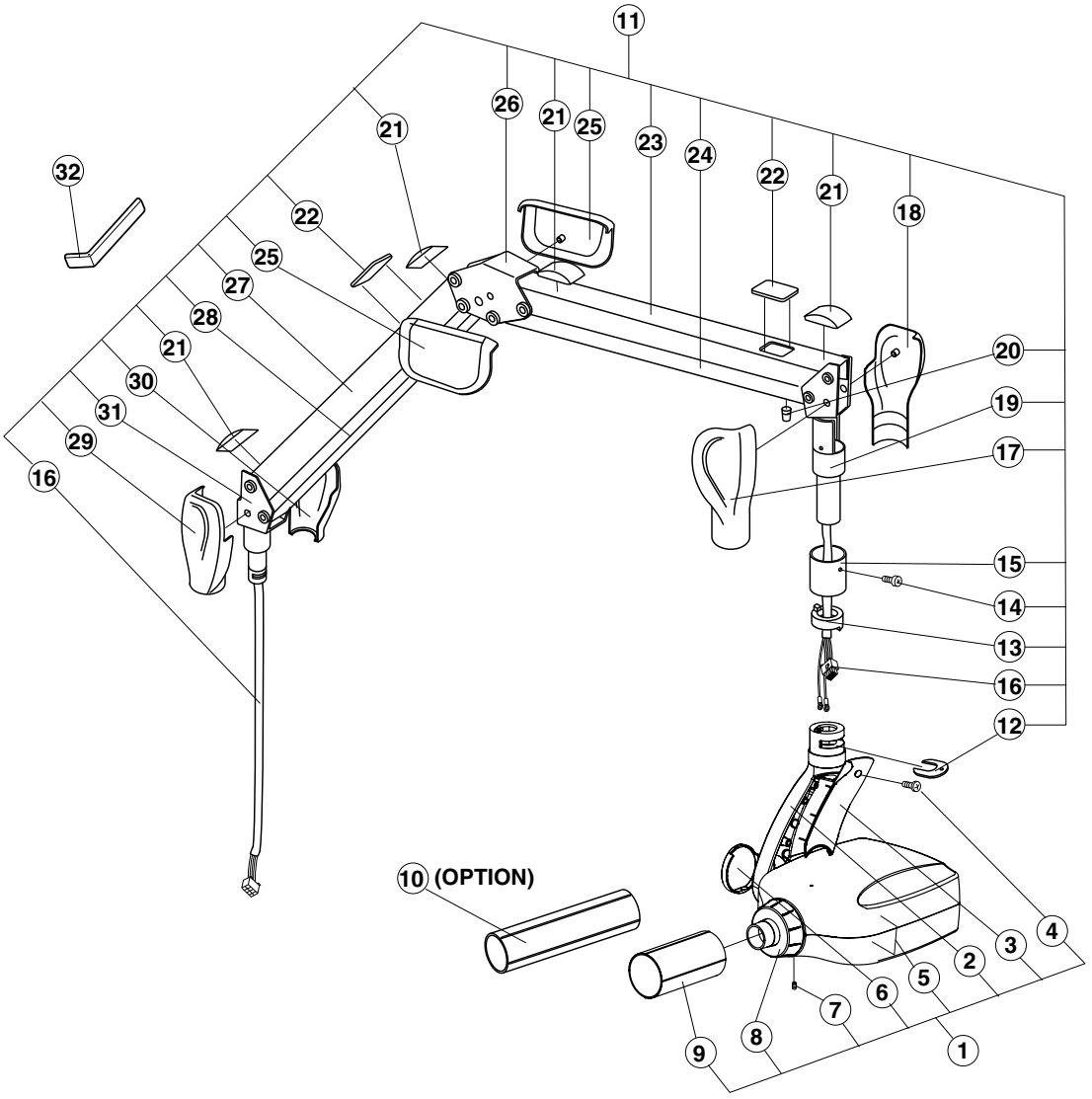
APPENDIX 1 : CIRCUIT DIAGRAM



Note : Fuse FM, FK1/FK2 Type only
Fuse Rating 100, 110, 120V Type : 10A
220, 230, 240V Type : 6.3A

APPENDIX 2 : PARTS IDENTIFICATION

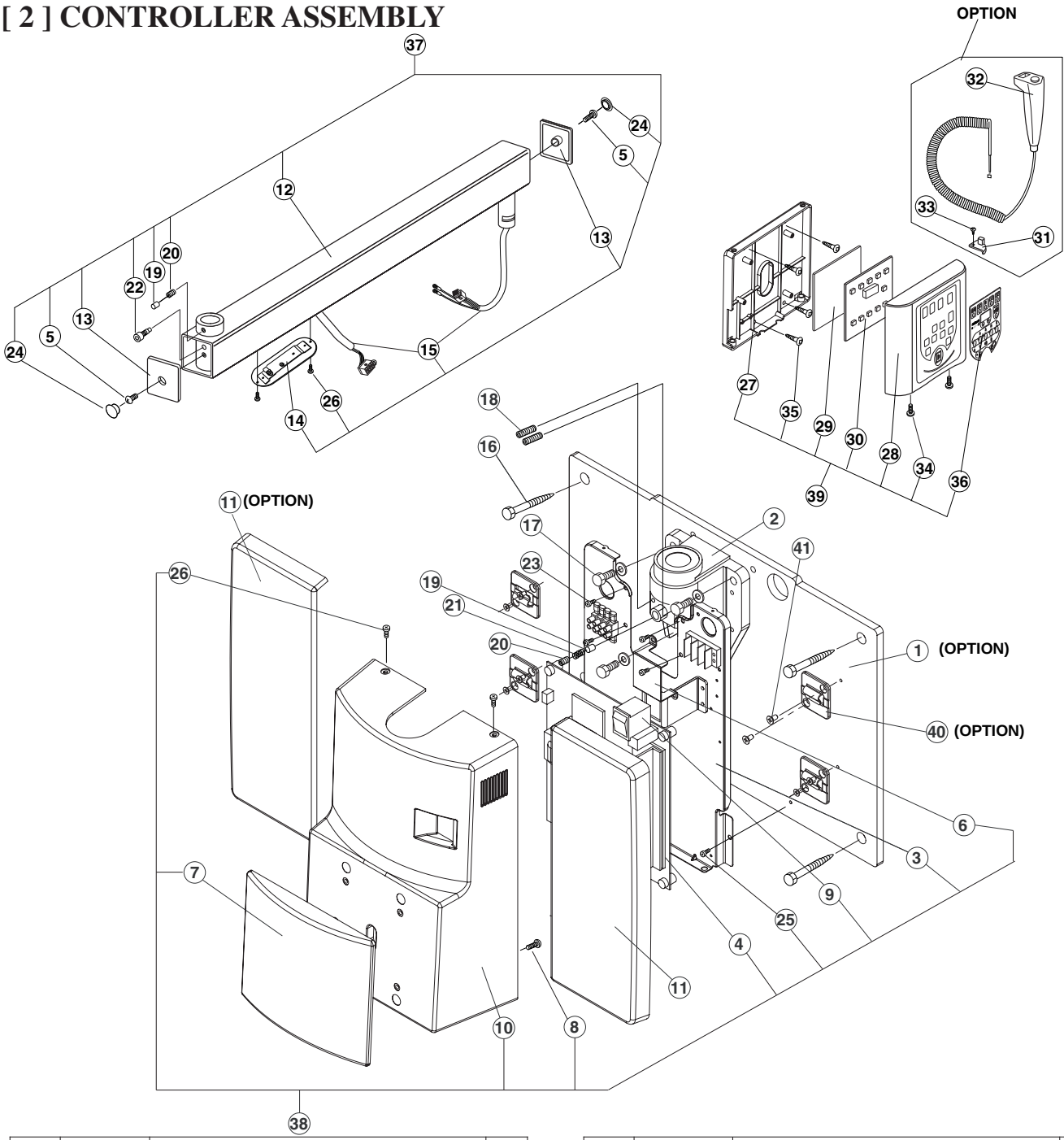
[1] ARM AND HEAD ASSEMBLY



ID.No.	Parts No.	Description	QTY
1	1P01CBA0	X-RAY Head Assembly	1
2	ECPE24C0	Yoke	1
3	1A037UA0	Yoke Inside Cover	1
4	----------	Yoke Inside Cover Screw(M4 × 15)	1
5	----------	Head Housing Cover Set	2
6	1A04JJA0	Yoke Side Cap	1
7	----------	Yoke Side Cop Screw(ϕ 3 × 8)	1
8	1A037RA0	Lock Nut for Cone	1
9	ECPR21D0	Regular Cone	1
10	EHLL13A0	Long Cone(Option)	1
11	1P01CDA0	Balance Arm Assembly	1
12	ECQR62A0	Head Key	1
13	ECQR24A0	Stopper Ring	2
14	----------	Arm Collar Screw(M4 × 8)	2
15	ECQR31A0	Arm Collar	1
16	1A04DZA0	Wire Harness in Balance Arm	4

ID.No.	Parts No.	Description	QTY
17	ECPE19F0	Left Cover for Joint No.3	1
18	ECPE18F0	Right Cover for Joint No.3	1
19	ECPE17B0	Joint No.3	1
20	ECQR33A0	Cushion Absorber	1
21	ECQR27B0	Crevice Cover	2
22	ECQR30C0	Spring Adjuster Cover	1
23	ECPJ60A0	Arm Cover No.2	1
24	ECPE30B0	Balance Arm No.2	1
25	ECPJ64C0	Cover for Joint No.2	1
26	ECPJ58B0	Joint No.2	1
27	ECPJ59A0	Arm Cover No.1	1
28	ECPE31B0	Balance Arm No.1	1
29	ECPJ63F0	Left Cover for Joint No.1	2
30	ECPJ62F0	Right Cover for Joint No.1	2
31	ECPE15B0	Joint No.1	1
32	ECLJ82A0	Balance Arm Wrench	4

[2] CONTROLLER ASSEMBLY



ID.No.	Parts No.	Description	QTY
1	1A04BYA0	Wide Wall Plate (option)	1
2	ECPE34A0	Arm Mounting Bracket	1
3	1A0389A0	Chassis	1
4	1A03Z6A0	Power PC Board	1
5	---------	End Cap Screw(M6×15)	2
6	1A0387A0	Restriction Plate	1
7	1A0386A0	Front Panel	1
8	---------	Screw for Front Panel(ϕ3×6)	1
9	1E01J8A0	Main Power Switch	1
10	1A0385A0	Front Cover	1
11	1A04JFA0	Side Cover (option)	1
12	1A04BXA0	Horizontal Arm Frame	1
13	ECLJ36A0	Arm End Cap	2
14	ECQR70C0	Arm Bottom Cover	2
15	1P01CXA0	Wire Harness in Horizontal Arm (800mm)	(1)
	1P01CZA0	Wire Harness in Horizontal Arm (300mm)	(1)
	1P01D0A0	Wire Harness in Horizontal Arm (500mm)	(1)
	1P01D1A0	Wire Harness in Horizontal Arm (650mm)	(1)
	1P01CYA0	Wire Harness in Horizontal Arm (1000mm)	(1)
16	---------	Lag Screw(ϕ9×75)	4
17	---------	Machine Bolt(M8×20)	3
18	ECPR44B0	Retaining Bolt(M6×35)	2
19	ECLS06B0	Brake Plug	1
20	---------	Brake Screw(M6×6)	1
21	ECLS11B0	Brake Spring	1

ID.No.	Parts No.	Description	QTY
22	---------	Stopper Screw(M6)	1
23	---------	Screw for Chassis(M4×10)	4
24	ECNR24A0	Hole plug for End Cap	2
25	---------	Screw for Chassis(M4×6)	2
26	---------	Screw for Cover(M3×8)	2
27	1A037WA0	Chassis for Sub Controller	1
28	1A037VA0	Front Panel for Sub Controller	1
29	ECQR58A0	Protector for Timer PC Board	1
30	1A03L4A0	Timer PC Board	1
31	ECQR68A0	Hook for Hand Exposure Switch(Option)	1
32	---------	Hand Exposure Switch Assembly(Option)	1
33	---------	Tapping Screw(Option)	1
34	---------	Front Cover screw for Sub Controller(M3×8)	2
35	---------	Wood Screw(ϕ4.1×20)	2
36	1A03CKA0	Switch sheet	1
37	1P01CEA0	Horizontal Arm Assmbly(800mm)	(1)
	1P01B7A0	Horizontal Arm Assmbly(300mm)	(1)
	1P01CGA0	Horizontal Arm Assmbly(500mm)	(1)
	1P01CHA0	Horizontal Arm Assmbly(650mm)	(1)
	1P01CFA0	Horizontal Arm Assmbly(1000mm)	(1)
38	1P01CJA0	Main Controller Assembly	1
39	1P01CLA0	Sub Controller Assembly	1
40	1A04JGA0	Hook for Side Cover	1
41	---------	Screw for Hook(M4×6)	1

NOTE

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