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## **Before Starting Repair Work**

Please be sure to read this "Service Manual" before starting repair work and fully understand the contents. Some repair works involve risks in adjustment, confirmation, etc. So be very careful about the safety when performing such works. The repair works shall be performed by a qualified personnel or a person who completed the training specialized in repair at our company.

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## **01. INTRODUCTION**

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1. Before starting repair work, be sure to read Operation Manual of the equipment.
2. The operating procedure of panoramic radiography forms the basis of all operations. So become fully familiar with its procedure before taking other radiograph.
3. Be sure to observe the warnings and prohibited matters in the body of this Service Manual strictly.
4. Read this Service Manual from the beginning in the order it is written. If you read from the middle of this manual and do the repair work, it may cause an accident, breakage of this equipment etc. due to an incorrect repair work.
5. If you find any unclear point during a repair work, read this Service Manual again to check about it and restart the repair work.
6. Exemption from Responsibility  
Be sure to observe the contents of Service Manual. The accident and breakage of this equipment due to an incorrect repair work are out of the scope of our responsibilities.
7. Warranty Period for Equipment  
The warranty period is two years from the date of purchase. The charge-free warranty will be applied only to the cases where breakage, failure, etc. of this equipment occurred through normal use.
8. Available Period for Repair Parts and Service Parts  
The repair parts and service parts are available for 10 years after discontinuing this product.
10. The disinstallation and disposal of equipment are within the scope of responsibilities of the customer. In the case to disinstall the equipment, consult with the dealer you purchased from or with us.

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**03**

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**System Requirements**

Temperature : 5 ~ 35°C

Humidity : 30 ~ 85%

Pressure : 700 ~ 1060 hPa

**Storage Environment**

Temperature : -10 ~ 60°C

Humidity : 10 ~ 95%

Pressure : 700 ~ 1060 hPa

**Transportation Environment**

Temperature : -10 ~ 60°C

Humidity : 10 ~ 95%

Pressure : 700 ~ 1060 hPa

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## 05. EQUIPMENT SETTINGS

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### Description of Equipment Settings

#### 1. Basic Operation

- 1) Turn on the power of the device.
- 2) After equipment initialization completed, set the X-ray tube voltage setting to "0kV" as follows:
  - Press SELECT key to blink the X-ray tube voltage setting display.
  - Hold down SELECT DOWN key.
- 2) Enable the equipment setting mode as follows:
  - Hold down SELECT key and press READY key.
- 4) Use TECH UP/DOWN key to select the content of equipment setting.
- 5) Use SELECT key to blink the equipment setting display.
- 6) Use TECH UP/DOWN key to determine the content of equipment setting.
- 7) Cancel the equipment setting mode as follows:
  - Hold down SELECT key and press READY key.

#### 2. Mode-specific Operations

- 1) With or Without CEPHALO Setting Mode: OFF/R/L
  - Without Cephalo: OFF
  - With Cephalo on the right: R
  - With Cephalo on the left: L
- 2) PREHEAT Voltage Setting Mode: 0 ~ 255

The mode for setting the tube current reference voltage.

  - If decreased the value, the rising of tube current becomes slower.
  - If increased the value, the rising of tube current becomes faster.
- 3) EXHIBITION ON/OFF Setting Mode: ON/OFF

Operation mode for exhibition

  - When set to ON, if release the equipment setting and press RESET key, the equipment repeats return-to-origin operation and radiography operation.
- 4) XRAY COUNT Display Mode

Number of irradiations display mode

  - If press SELECT key and hold down SELECT DOWN key, the number of irradiations will be cleared.
- 5) POWER OFF ON/OFF Setting Mode: ON/OFF

Auto power-off function setting mode

  - When set to ON, the power turns off automatically in five minutes after the final key operation.
  - When set to OFF, the power will not turn off until turning POWER switch to OFF.

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## 6. TROUBLESHOOTING

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### 1. Unable to Turn On Power

If the surface of circuit protector is bulging and in a “trip” condition, unplug from outlet, wait for 60 seconds or more, and fully insert the plug into the outlet. The plug can be burning hot. Be careful not to get burned.

After eliminating the cause, turn on power again.



- Blowout of MOTOR CPU BOARD fuse F1 (3.15A)
- Check if electric wire is in contact with body of equipment due to breaking, pinching, etc.
- Breaking of electric wire of rotary shaft
- Defective switching power supply
- Defective INV BOARD
- Blowout of MAIN CPU BOARD fuse F1 (3.15A)

### 2. Arm Doesn't Rotate

- Blowout of MOTOR CPU BOARD fuse F3 (3.15A)
- Defective motor driver
- Defective motor

### 3. Y-axis Doesn't Move

- Blowout of MOTOR CPU BOARD fuse F2 (3.15A)
- Defective motor driver
- Defective motor

### 4. Cassette Doesn't Move

## 7. Body Doesn't Move Up and Down

### 1) When operating on Beam Line Operation Panel

- Defective REST SW BOARD (when pressing switch makes no sound)
- Breaking of curl cord
- Defective sliding unit elevation motor driver

Remove the top cover, turn on power and check the blinking interval of driver's LED.

- ◆ Overload protection function (Number of LED blinks: 2 times)
  1. Eliminate the cause that hinders the vertical motion (obstacle, overload)
  2. Check if pressing operation button makes a sound of brake.  
When it makes no sound, replace BRAKE BOARD.
  3. Replace the driver
- ◆ Open-phase protection function (Number of LED blinks: 3 times)
  1. Replace sliding unit elevation motor
  2. Replace the driver
- ◆ Overvoltage protection function (Number of LED blinks: 4 times)  
Undervoltage protection function (Number of LED blinks: 5 times)
  1. Check if the voltage between MOTOR CPU BOARD check pins CP1 and CP2 is 24Vdc.  
When the deviation is large, replace SW power supply.
  2. Replace the driver
- ◆ Overspeed protection function (Number of LED blinks: 6 times)  
Defective MOTOR CPU BOARD and replacement
  - Defective MOTOR CPU BOARD  
Check that output voltage of CP8 varies while pressing UP/DOWN switch.  
If it does not vary, replace the board.

### 2) When operating on CM switch

- Defective CM SW BOARD (when pressing switch makes no sound)
- Defective sliding unit elevation motor driver  
Remove the top cover, turn on power and check the blinking interval of driver's LED.  
After eliminating the cause, turn on power again.
- Defective MOTOR CPU BOARD  
Check that output voltage of CP8 varies while pressing UP/DOWN switch.
- Defective CNK BOARD

## 8. Primary Slit Doesn't Move

- Blowout of BEAM MOTOR BOARD fuse F1 (3A)
- Defective BEAM MOTOR BOARD
- Defective motor
- Blowout of MAIN CPU BOARD fuse F3 (3.15A)
- Defective MAIN CPU BOARD

## 9. Head Doesn't Rotate

- Blowout of BEAM MOTOR BOARD fuse F1 (3A)
- Defective BEAM MOTOR BOARD
- Defective motor
- Blowout of MAIN CPU BOARD fuse F2 (3.15A)
- Defective MAIN CPU BOARD

## 10.Unable to Irradiate X-rays

- Check if MOTOR CPU BOARD D16 and MAIN CPU BOARD D36 light when READY ON.
- Check which red LED of INV BOARD is lit.

Error contents

DL1: LV Lights when output voltage drops abnormally such as output short-circuit.

DL2: OV Lights when output voltage rises abnormally

DL3: OC Lights when output current rises abnormally.

DL4: TH Lights when INV BOARD temperature rises abnormally.

Response

DL1: Check the wiring from INV BOARD to head

Check the input voltage between 1 and 2 pins of CN1 when READY ON. 120Vac

DL2, DL3: Check between MAIN CPU BOARD check pins CP11 and CP5 (kV), CP14 and CP5 (PREHEAT), and CP15 and CP5 (mA).

DL4: Turn off power and recheck 30 minutes later.

Table 1 Voltage between kV ref CP11 and CP5

	60kV	70kV	80kV	90kV
2mA	2.82	3.27	3.71	4.14
4mA	2.88	3.34	3.78	4.21
6mA	2.94	3.39	3.84	4.31
8mA	3.00	3.45	3.91	4.40
10mA	3.11	3.53	4.00	4.50
12mA	3.19	3.63	4.09	4.60

Table 2 Voltage between mA ref CP15 and CP5 (Tube voltage is optional)

Tube Current	CP15-CP5
2mA	1V
4mA	2V
6mA	3V
8mA	4V
10mA	5V
12mA	6V

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## 07. RESPONSE TO ERROR MESSAGE

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**When an error occurred in the equipment, the error message appears on the indicator of control panel. Take a measure to resolve the error.**

### **1. CASSETTE: Cassette Mounting Error (ANA-BEL/ANA-BEL CM)**

- 1) Film cassette is not mounted on the right position.  
Mount it on the right position.
- 2) Abnormality of film cassette detection sensor  
Adjust the sensor position or replace the sensor.

### **2. CST MT: Cassette Feed Motor Operation Error(ANA-BEL/ANA-BEL CM)**

- 1) Abnormality of cassette feed detection sensor  
Adjust the sensor position or replace the sensor.
- 2) Blowout of MAIN CPU BOARD F4 (3.15A)  
Replace the fuse.
- 3) Defective motor driver  
Replace the driver.
- 4) Defective motor  
Replace the motor.

### **3. 1COL MT: First Collimator Motor Operation Error**

- 1) Abnormality of first collimator detection sensor  
Adjust the sensor position or replace the sensor.
- 2) Blowout of BEAM MOTOR BOARD F1 (3A)  
Replace the fuse or BEAM MOTOR BOARD
- 3) Defective motor  
Replace the motor
- 4) Blowout of MAIN CPU BOARD fuse F3 (3.15A)  
Replace the fuse.  
Replace MAIN CPU BOARD.

### **4. HEAD MT: Head Rotation Motor Operation Error**

- 1) Abnormality of head rotation motor detection sensor  
Adjust the sensor position or replace the sensor.
- 2) Blowout of BEAM MOTOR BOARD F1 (3A)  
Replace the fuse or BEAM MOTOR BOARD.
- 3) Defective motor  
Replace the motor.
- 4) Blowout of MAIN CPU BOARD F3 (3.15A)  
Replace the fuse.  
Replace MAIN CPU BOARD.

### **5. CST POS: Cassette Position Error(ANA-BEL/ANA-BEL CM)**

- 1) Preparatory operation for radiography is stopped as cassette was moved after getting READY ON.
- 2) Replace MAIN CPU BOARD.

**6. INVERTER: Inverter Error**

- 1) Check if MOTOR CPU BOARD D16 and MAIN CPU BOARD D36 light when READY ON.
  1. When D16 doesn't light
    - Breaking of electric wire of rotary shaft
    - Defective MOTOR CPU BOARD
    - Defective MAIN CPU BOARD
  2. When D36 doesn't light
    - Breaking of electric wire of rotary shaft
    - Defective MAIN CPU BOARD
    - Defective MOTOR CPU BOARD
  3. When D16 and D36 light
    - Defective K-L1
    - Defective MOTOR CPU BOARD

- 2) Check which red LED of INV BOARD is lit.

Error contents

DL1: LV Lights when output voltage drops abnormally such as output short-circuit.

DL2: OV Lights when output voltage rises abnormally

DL3: OC Lights when output current rises abnormally.

DL4: TH Lights when INV BOARD temperature rises abnormally.

Response

DL1: Check the wiring from INV BOARD to head

Check the input voltage between 1 and 2 pins of CN1 when READY ON. 120Vac

When the voltage is lower than 120Vac

- Breaking of electric wire of rotary shaft
- Defective K-L1

DL2, DL3: Check between MAIN CPU BOARD check pins CP11 and CP5 (kV), CP14 and CP5 (PREHEAT), and CP15 and CP5 (mA).

DL4: Turn off power and recheck 30 minutes later.

Table 1 Voltage between kV ref CP11 and CP5

	60kV	70kV	80kV	90kV
2mA	2.82	3.27	3.71	4.14
4mA	2.88	3.34	3.78	4.21
6mA	2.94	3.39	3.84	4.31
8mA	3.00	3.45	3.91	4.40
10mA	3.11	3.53	4.00	4.50
12mA	3.19	3.63	4.09	4.60

Table 2 Voltage between mA ref CP15 and CP5 (Tube voltage is optional)

Tube Current	CP15-CP5
2mA	1V
4mA	2V
6mA	3V
8mA	4V
10mA	5V
12mA	6V

**7. THERMAL: Tube Temperature Error**

- 1) As the head temperature is abnormally high, leave the equipment for 30 minutes or more before taking next radiograph.

**8. RS CPU: Communication Error with MOTOR CPU BOARD**

- 1) Check the continuity of rotary shaft harness.  
In the case of breaking, replace the harness, use spare wire as a temporary measure.  
In the case where the continuity exists, replace MOTOR CPU BOARD or MAIN CPU BOARD.

**9. Y MT: Y-axis Motor Operation Error**

- 1) Abnormality of Y-axis detection sensor  
Adjust the sensor position or replace the sensor.
- 2) Blowout of MOTOR CPU BOARD F2 (3.15A)  
Replace the fuse or MOTOR CPU BOARD
- 3) Defective motor driver  
Replace the motor driver.
- 4) Defective motor  
Replace the motor.

**10. ROT MT: Rotation Motor Operation Error**

- 1) Abnormality of rotation detection sensor  
Adjust the sensor position or replace the sensor.
- 2) Blowout of MOTOR CPU BOARD F3 (3.15A)  
Replace the fuse or MOTOR CPU BOARD.
- 3) Defective motor driver  
Replace the motor driver.
- 4) Defective motor  
Replace the motor.

**11. BEAM MT: Indicator Operation Error**

When indicator (beam operation portion) is operating

- 1) Replace the sensor.

When indicator (beam operation portion) is not operating

- 1) Replace the motor.
- 2) Replace MOTOR CPU BOARD.

**12. UNIT MT: Planetary Portion Operation Error**

- 1) When operating Beam Line Operation Panel
  - Defective sliding unit elevation motor driver  
Remove the top cover, turn on power and check the blinking interval of driver's LED.  
After eliminating the cause, turn on power again.
  - ◆ Overload protection function (Number of LED blinks: 2 times)
    3. Eliminate the cause that hinders the elevation motion (obstacle, overload)
    4. Check if pressing operation button makes a sound of brake.  
When it makes no sound, replace BRAKE BOARD.
    3. Replace the driver
  - ◆ Open-phase protection function (Number of LED blinks: 3 times)
    1. Replace sliding unit elevation motor.
    2. Replace the driver.

- ◆ Overvoltage protection function (Number of LED blinks: 4 times)  
Undervoltage protection function (Number of LED blinks: 5 times)
  1. Check if the voltage between MOTOR CPU BOARD check pins CP1 and CP2 is 24Vdc.  
When the deviation is large, replace SW power supply.
  2. Replace the driver.

- ◆ Overspeed protection function (Number of LED blinks: 6 times)
  1. Defective MOTOR CPU BOARD  
Check that output voltage of CP8 varies while pressing UP/DOWN switch.  
If it does not vary, replace the board.

2) When operating CM switch

- Defective CM SW BOARD (when pressing switch makes no sound)
- Defective sliding unit elevation motor driver  
Remove the top cover, turn on power and check the blinking interval of driver's LED.  
After eliminating the cause, turn on power again.
- Defective MOTOR CPU BOARD  
Check that output voltage of CP8 varies while pressing UP/DOWN switch.
- Defective CNK BOARD

### 13. RS PC: Communication Error with PC (ANA-BEL D/ANA-BEL D CM)

Check the continuity of CCD sensor.

When breaking: Replace the harness.

When continuity exists: Replace MAIN CPU BOARD or CCD sensor.

### 14. RS PC: Communication Error with PC (ANA-BEL D/ANA-BEL D CM)

CCD sensor is not initialized: Initialize CCD sensor by personal computer.

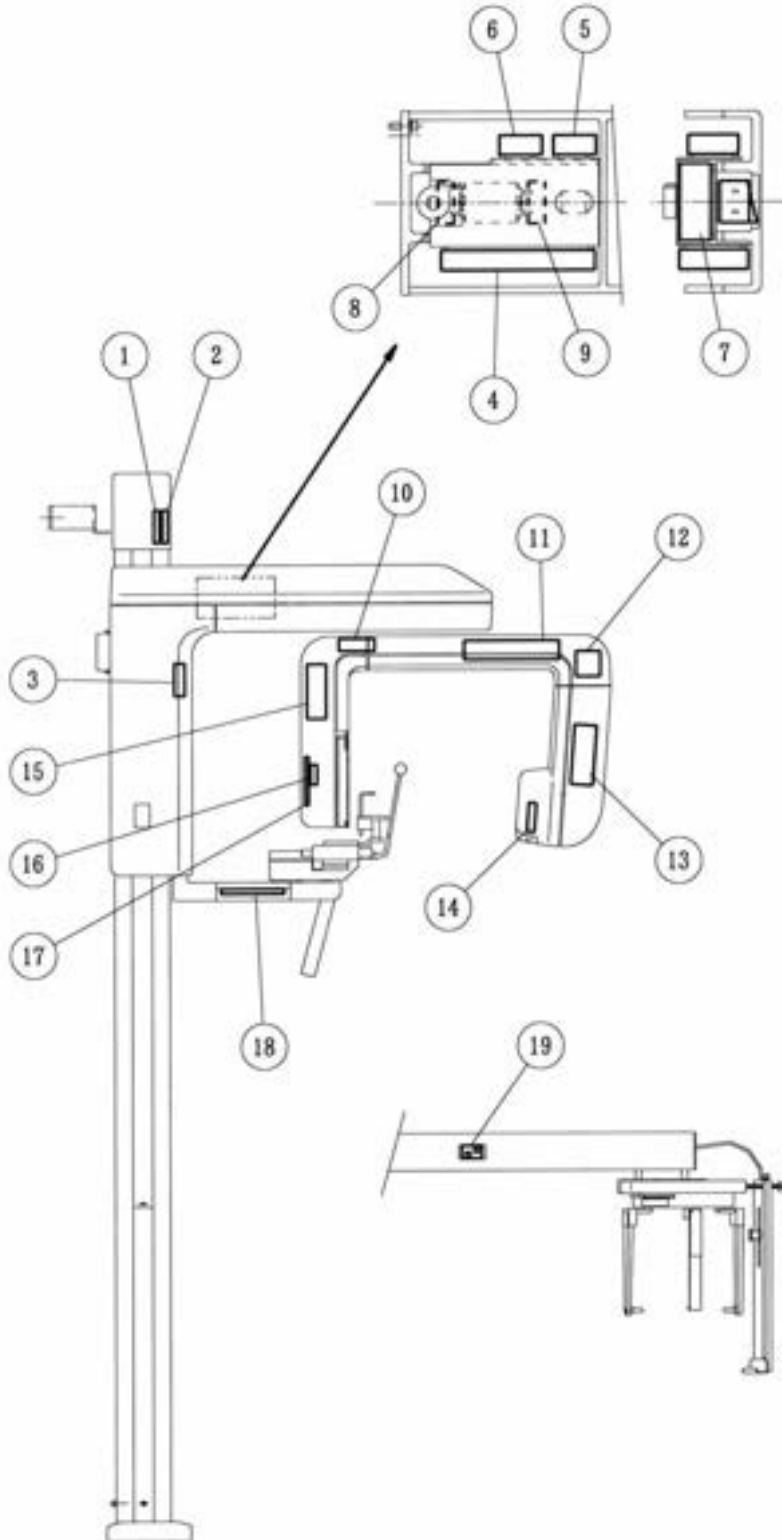
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## 08. PRINTED CIRCUIT BOARD LAYOUT DRAWING

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### 1. Overall View

The printed circuit board assemblies are housed in the portions shown in the drawing.



No.	Board Name
1	DC brushless motor driver
2	Brake board
3	CNK board
4	Motor CPU Board
5	Rotation motor driver
6	Y-axis motor driver
7	Switching power supply
8	NF1 board
9	NF2 board
10	Film motor driver (for X-raying using film)
11	High frequency inverter power supply
12	Head swing motor driver
13	High-voltage generator board
14	Collimator motor board
15	Main CPU board
16	LCD indicator
17	Switch board
18	Beam switch board
19	Vertical motion switch board

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**2. Sliding Unit**

**PART LIST: Sliding Unit**

No.	Drawing No.	Part Name	Quantity		Remarks
			ANA-BEL ANA-BEL D	ANA-BEL CM ANA-BEL D CM	
0201	408-10156	CNK board	1	1	
0202	977-60001-07	DC motor TG-38E-LG66	1	1	
0203	964-30012-13	Microswitch ABJ241441	2	2	
0204	408-10296	Dog	1	1	
0205	962-05006	Laser marking projector LDV167LS	1	1	Horizontal beam
0206	962-05003	Laser marking projector LDV167LA	1	1	Median beam
0207	408-08591	Mirror	1	1	
0208	978-60007-02	Photomicrosensor EE-SY671	3	3	
0209	964-28001-02	POWER switch A8G-107-1G-24	1	1	
0210	108-01181	Sliding unit cover	1	1	
0211	408-10309	Rear cover	1	-	
0212	408-09751	Pulley	2	2	
0213	408-05331	Shaft	4	4	Bundled with 0218
0214	408-09751	Roller (2)	4	4	
0215	408-10253	Membrane sheet	1	1	
0216	965-85012-69	Circuit protector 15A	2	2	For 100V-spec.
0217	965-85012-67	Circuit protector 8A	2	2	For 200V-spec.
0218	030-03000-01	Bearing 6000ZZ	4	4	Bundled with 0213

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## 8. Cephalometric Radiography Unit

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## 10. MAINTENANCE CHECK

### **WARNING**

**High voltage is applied to some parts inside the equipment. Take extra care when removing the case of equipment.**  
**Before beginning repair work, turn OFF the power of equipment and unplug from electrical outlet.**  
**After unplugged the equipment, wait for 10 minutes or more before starting a repair work.**

Specialized knowledge, experience and special measuring instruments are required to check this equipment. To maintain the performance of equipment, please perform daily check (with eyes) and implement periodic maintenance by dealer service personnel.

### Dental X-ray Equipment Maintenance Check List

Maintenance by service personnel: 1 or 2 times/year

Check Item	Purpose of Check	Contents of Check	Method
Electricity Condition	Check power supply voltage range	Check the compatibility between the power supply voltage connected to the equipment and the specified voltage for the equipment.	○
Appearance and Indication	(1) Appearance of equipment	a. Deformation, flaw, nameplate b. Cautions	○
	(2) Inside of equipment	Check defacement and dust.	○
Installation Place	Temperature, humidity, gas	Check the compatibility of environmental ambient of the place where the equipment will be used.	●
	Levelness of equipment	Check the effect on the equipment	●
	Floor and equipment stabilizing condition	Check vibration and movement stability of the equipment.	●
	Check obstacles	Check that there is no obstacle within the movement range of the equipment.	○
	Rust development condition	Check the condition of rust development functional safety.	○
Operation Test	Operation test before check	Check operating condition of the equipment.	⊙
	Operation test after check	Check operating condition of the equipment.	⊙
Safety Test for Electric Shock	Insulation resistance	Check resistance between power line and the earth.	●
	Leaked current from the outer cover	Check the current leaking from the outer cover of the equipment to the earth.	●
	Earthing resistance	Check the resistance between exposed metal portion of the equipment and the earthing point.	●
	Resistance of earthing wire	Check the resistance between the earth terminal of the equipment and earthing point.	●

Check Item	Purpose of Check	Contents of Check	Method
Operation Accuracy of Equipment	Check operation of power supply circuit	Check the voltage of power supply circuit.	●
	Check operation of radiographic circuit	Check the operating waveform and setting values of control circuit.	●
	Check operation of operation circuit	Check operation of operation sequence.	●
	Accuracy of positioning mechanism	Check deterioration of the positioning mechanism.	●
	Check operation of protection circuit	Check the setting values and operating condition of protection circuit.	●
	Check operating condition indicator	Check the circuit function to indicate the operating condition.	●
Indication during X-ray irradiation	Check irradiation of X-ray and the indication are in sync	Check the operation of indicator during X-ray irradiation.	◎
X-ray Generator	X-ray tube housing	Check leakage of insulating oil.	○
	Low voltage cable	Check wear, flaw, tension and twist.	○
	Irradiation cone	Check looseness, deformation and damage.	○
	Filter	Check coming off and damage.	○
	Slit Plate (Collimator)	Check off-alignment of irradiation field and irradiation width.	○
Radiographic Mechanism	Rotation and movement of X-ray generator	Check slip, abnormal sound and stopping accuracy.	◎
	Movement of arm		
	Patient positioning mechanism	Play, looseness, operability and stability.	●
	Light for positioning	Check the brightness and position accuracy.	○
Elevating Mechanism	Wire rope	Check breaking of wire and end portion.	○
	Braking mechanism	Check the movement.	◎
	Electromagnetic lock		
	Upward and downward movement condition	Check smoothness of movement	○
X-ray Output	X-ray tube voltage	Check X-ray tube voltage.	●
	X-ray tube current	Check X-ray tube current.	●
	Exposure time	Check exposure time.	●

Symbol	Checking Method
○	Check with eyes
●	Check by using measuring instruments etc.
◎	Check by operating the equipment.

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## 11. CONTACT INFORMATION

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Please contact our sales office or a distributor near you.

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