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Maintenance

HF Series Generators

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	APR 1, 2001	First edition
1	DEC 20, 2001	Text revision
2	APR 15, 2005	Review of Maintenance procedures
3	DEC 12, 2005	Reference to Calibration Chapter
4	MAR 26, 2008	Calibration of Touch Screen Sensor

This Document is the English original version, edited and supplied by the manufacturer.

The Revision state of this Document is indicated in the code number shown at the bottom of this page.

ADVISORY SYMBOLS

The following advisory symbols will be used throughout this manual. Their application and meaning are described below.

DANGERS ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED WILL CAUSE SERIOUS PERSONAL INJURY OR DEATH.

ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED COULD CAUSE SERIOUS PERSONAL INJURY, OR CATASTROPHIC DAMAGE OF EQUIPMENT OR DATA.

Advise of conditions or situations that if not heeded or avoided could cause personal injury or damage to equipment or data.

Note ☞

Alert readers to pertinent facts and conditions. Notes represent information that is important to know but which do not necessarily relate to possible injury or damage to equipment.

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SECTION 1 INTRODUCTION

The purpose of this Periodic Maintenance is to assure continued safe performance of the X-ray Generator, to increase serviceability, to reduce the costs (down time, repairs, etc.) and to assure the safety (personal risk).

The following checks and maintenance procedures, together with the suggested intervals, are the manufacturer's recommendation for the most effective Periodic Maintenance schedule for this Generator.

Service tasks here described must be performed exclusively by service personnel specifically trained on medical X-ray Generators.

The first Periodic Maintenance Service should be performed six (6) months after installation, and the subsequent services every twelve (12) months. Periodic Maintenance Service depends on the working load of the Generator and X-ray Tube.

Note ☞ *Take note in the Data Book all the periodic maintenance services carried out and the data changes made during any maintenance service.*

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SECTION 2 PERIODIC MAINTENANCE PROCEDURES

When any major component, such as a X-ray Tube, HV Transformer or major circuit board, is replaced in the system, perform the respective Configuration and Calibration procedures.

Update and take note in the Data Book any new data entered in memory.

If the HT Control Board or the ATP Console CPU Board is replaced, check specially that Extended Memory data have not been lost or modified with the Board change. Compare Extended Memory data with the values noted in the Data Book.

Also, make some exposures using different techniques and Focal Spot and check that mA stations are calibrated correctly, if not perform Calibration procedures.

Before starting the periodic maintenance procedures, it is recommended to make a test exposure using the same operating factors and conditions as a typical exposure.

Perform the X-ray tube warm-up procedure if the tube has not been in use for approximately one hour. (*Refer to Operator Manual of the Console).*

2.1 TEST EQUIPMENT

The tools and test equipment required to perform the Periodic Maintenance Service are the same as specified in "*Installation*" document.

2.2 GENERAL CAUTIONS

MAKE SURE THAT THE MAIN CAPACITORS OF THE HIGH VOLTAGE INVERTER DO NOT CONTAIN ANY RESIDUAL CHARGE. WAIT UNTIL THE LIGHT EMITTING DIODES ON THE CHARGE-DISCHARGE MONITOR BOARDS ARE OFF, APPROX. 3 MINUTES AFTER THE UNIT IS TURNED OFF.

ALWAYS HAVE THE "IPM DRIVER BOARD" CONNECTED IN THE GENERATOR PREVIOUS TO MAINS POWER IS ACTIVATED IN IT. IF THE "IPM DRIVER BOARD" IS NOT CONNECTED, PERMANENT DAMAGE WILL OCCUR TO IGBTS.

LINE POWERED GENERATOR:
THIS GENERATOR IS PERMANENTLY CONNECTED TO THE POWER LINE, AND POWERED ON UNLESS THE SAFETY SWITCH INSTALLED IN THE ROOM ELECTRICAL CABINET IS OFF. WHEN THE GENERATOR IS POWERED, THE NEON LAMP (GREEN) LOCATED ON THE TRANSFORMER 6T2 (GENERATOR CABINET) IS ON.

INTERNAL PARTS OF THE GENERATOR (ALL FUSES, LINE CONTACTOR (6K5), INPUT TRANSFORMER (6T2), ON/OFF RELAY (3K3) AND LF-RAC MODULE) ARE PERMANENTLY POWERED ON THROUGH POWER LINE ALTHOUGH THE CONTROL CONSOLE IS OFF. BE SURE THAT THE SAFETY SWITCH IS OFF BEFORE HANDLING ANY INTERNAL PART OF THE EQUIPMENT.

BATTERY POWERED GENERATOR:
THIS GENERATOR IS PERMANENTLY CONNECTED TO THE POWER LINE THROUGH A LINE PLUG.

WHEN IT DOES NOT WORK WITH STAND-ALONE, IT IS POWERED ON UNLESS THE SAFETY SWITCH INSTALLED IN THE ROOM ELECTRICAL CABINET IS OFF. WHEN THE UNIT IS POWERED, THE NEON LAMP (GREEN) LOCATED ON THE TRANSFORMER 6T2 IS ON.

WHEN IT WORKS WITH OPTIONAL STAND-ALONE IT IS POWERED ON IN ALL SITUATIONS. WHEN THE UNIT IS TURNED ON, THE NEON LAMP (GREEN) LOCATED ON THE TRANSFORMER 6T2 IS ON.

KEEP THE PROTECTION COVERS IN PLACE ALL THE TIME, ONLY REMOVE THE COVERS TO PERFORM SERVICE OPERATIONS. INTERNAL PARTS (CONTACTOR 6K5, LINE FUSES, BATTERY CHARGER BOARD, LINE MONITOR BOARD, BATTERY MONITOR BOARD, ENERGY GUARD BOARD AND STAND-ALONE BOARD) ARE PERMANENTLY POWERED ON AND HAVE THE FULL VOLTAGE POTENTIAL OF THE BATTERIES (APPROX. 400 VDC) ALTHOUGH THE UNIT IS DISCONNECTED FROM THE LINE OR THE CONTROL CONSOLE IS OFF. USE CAUTION WHEN WORKING IN THIS AREA.

CAPACITOR ASSISTED GENERATOR:
THIS GENERATOR IS PERMANENTLY CONNECTED TO THE POWER LINE THROUGH A LINE PLUG. IT IS POWERED ON UNLESS THE SAFETY SWITCH INSTALLED IN THE ROOM ELECTRICAL CABINET IS OFF. WHEN THE UNIT IS POWERED, THE NEON (GREEN) LOCATED ON THE TRANSFORMER 6T2 IS ON.

KEEP THE PROTECTION COVERS IN PLACE ALL THE TIME, ONLY REMOVE THE COVERS TO PERFORM SERVICE OPERATIONS. INTERNAL PARTS (CAPACITOR OF HV INVERTER, STORAGE CAPACITORS MODULE, LINE FUSES, DC BUS FUSES, ETC.) ARE PERMANENTLY POWERED ON AND HAVE THE FULL VOLTAGE POTENTIAL OF THE CAPACITORS (APPROX. 800 VDC), ALTHOUGH THE UNIT IS DISCONNECTED FROM THE LINE OR THE CONTROL CONSOLE IS OFF. USE CAUTION WHEN WORKING IN THIS AREA.

2.3 GENERAL CLEANING

NEVER ATTEMPT TO CLEAN OR HANDLE ANY PART OF THE X-RAY GENERATOR WHEN IT IS TURNED ON. SWITCH OFF THE GENERATOR MAIN DISCONNECT BEFORE CLEANING OR INSPECTING.

2.3.1 EXTERNAL SURFACES

Clean external covers and surfaces frequently, particularly if corroding chemicals are present and specially parts in contact with the patient, with a cloth moistened in warm water with mild soap solution. Rinse wipe with a cloth moistened in clean water. Do not use cleaners or solvents of any kind.

Clean Console keyboard and displays with a cloth dampened in warm water. Rinse wipe with a cloth dampened in clean water.

Also check painted surfaces for scratching and touch up as required.

2.3.2 INTERNAL CABINET CLEANING

Remove the external access cover from the Generator Cabinet.

Visually inspect all major components for dust or foreign items. Search carefully to detect objects which might cause short circuits and for loose connections.

If excess dust is present, clean the interior of the Generator Cabinet using a dry brush or vacuum cleaner. Make sure that the fans operate properly and the vent holes of the cabinet are not obstructed.

2.3.3 INTERNAL TOUCH SCREEN CONSOLE CLEANING

MAKE SURE THAT THE TOUCH SCREEN CONSOLE IS POWERED OFF OR UNPLUGGED.

Remove the front cover of the Touch Screen Console.

Visually inspect internally for dust or foreign items. Search carefully to detect objects which might cause short circuits and for loose connections.

If excess dust is present, clean the interior of the Touch Screen Console using a dry brush or vacuum cleaner. Make sure that the fans operate properly and the vent holes are not obstructed.

Clean the Touch Screen sensor with an isopropyl alcohol and water solution ratio of 50:50 , always damp the lint-free cloth and then clean the screen. Spray the cleaning liquid onto the cloth, never spray directly on the screen.

2.4 CABLE CHECKS

CAREFULLY HANDLE ALL INTERNAL PARTS OF THE UNIT.

Check that all electrical connections are firm and secure and that all cable clamps and strain reliefs are in place. Also check that connectors do not have exposed wire-veins and check cable sheaths (cable cover) for wear and fraying.

Check that all cables are correctly routed.

2.4.1 GROUND CABLE CONNECTIONS

The central reference ground of the X-ray System and Generator is located at the Generator Cabinet.

Check the ground lead interconnections continuity using a multimeter at its lowest ohms range.

2.4.2 AC POWER SUPPLY IN X-RAY ROOM

Measure the value of AC power supply between all phases, neutral and ground. Check that these values comply with the tolerances established at the original installation.

2.5 CONTROL CONSOLE CONDITION

Check the proper connection and condition of the cables connected to the Console.

If applicable, check the Handswitch condition. Verify that the Handswitch cable and its connection to the Console are in good condition.

Check correct operation of the buttons, displays and indicators by performing the following test:

1. Turn the Generator / Console ON.

2. If the Console is a Touch Screen Console, touch on different points of the operator application on the Touch Screen to check that the Touch Screen Sensor is properly calibrated. If it is not calibrated, perform the procedure described in *Section 2.5.1 - Touch Screen Sensor Calibration*.

3. If applicable, check the Handswitch condition. Verify that the Handswitch cable and its connection to the Console are in good condition.

4. Select a radiographic technique and observe:

   - Indicators of the selected workstation and Focal Spot.

   - Technique parameters are displayed on the Console. Change technique parameters and observe that changes are correctly displayed.

   - Select the parameters for an usual exposure. Press "*Prep*" and verify that the "*Ready*" indicator is activated. Release "*Prep*" and observe that the "*Ready*" indicator is deactivated.

   - Make the exposure, and verify that radiographic exposure signal sounds and the "*Prep*" and "*X-ray On*" indicators are activated during the exposure.

5. If AEC is installed, select a technique with AEC and observe that the indicators of the selected AEC controls are activated.

6. If APR is installed, select an APR technique and observe:

   - Indicators of the selected Patient Size are activated and the Body Region / Anatomical Views are shown on the APR Display and its corresponding parameters are shown on the RAD Display.

   - Change the APR technique and observe that selection and parameters changes on both Displays.

7. If Fluoro is installed, select a workstation for Fluoro operation and observe:

   - Fluoro parameters are displayed on the Fluoro Display.
   - Change the Fluoro kV and observe that changes are correctly displayed.
   - Check selection of another functions related to Fluoro if they are present (ABC, PPS, etc.).

2.5.1 TOUCH SCREEN SENSOR CALIBRATION

Note ☞ *This calibration procedure only applies to Touch Screen Console.*

If required to calibrate the Sensor of the Touch Screen because the buttons can not be properly selected or because the Compact Flash has been changed, perform the next procedure:

CALIBRATION FOR AN "ELO" TOUCH SCREEN SENSOR

1. Enter in "*Service Mode*" and press the "*Software Upgrade*" button.
2. Press the "*Start-Windows*" button on the keyboard connected to the Touch Screen Console, then select (double-click):
   "*Settings / Control Panel / EloTouchscreen*".
3. Execute the "*Align*" program and follow the process touching on the indicated places. Click on "Yes" and "OK", then close the "Control Panel".
4. Return to the Application through "*Start*" and select: "*Programs / Start up (select the first one) / Console*".

CALIBRATION FOR A "3M" TOUCH SCREEN SENSOR

1. Enter in "*Service Mode*" and press the "*Software Upgrade*" button.
2. On the PC Desktop, press the"*Start-Windows*" button on the keyboard connected to the Touch Screen Console, then select: "*Programs / UPDD / Calibrate*".
3. Execute the "*Calibrate*" program and follow the process clicking on the indicated places.
4. When finish this calibration, come back to the Application by entering again in "*Start*" and select: "*Programs / Start up (select the first one) / Console*".

2.6 HV TRANSFORMER CONDITION

The HV Transformer contains “Shell Diala AX” oil.

Check that there is not oil leakage. If found, remove the oil fill plug from the top of the HV Transformer and verify that the oil level is within 20 mm (3/4”) of the top surface of the HV Transformer. If necessary add oil “Shell Diala AX”.

Note ☞ *This point does not apply to the hermetic HV Transfromers (black aluminium HV Transformers).*

Make sure that:

- HV oil in the HV Cable terminals is clean and shows no evidence of arcing.
- HV Cable terminal rings are tight.

2.7 X-RAY TUBE CONDITION

Make sure that:

- All parts are mechanically secure with no oil leaks.
- HV grease on the HV Cable terminals is clean and shows no evidence of arcing.
- HV Cable terminal rings are tight.

2.8 RADIOGRAPHIC PARAMETERS

With the generator power OFF, connect:

- Non-invasive kV Meter to measure kV.
- mAs Meter to the banana plug connections on the HV Transformer to measure mA or mAs (connect the mAs Meter for Digital mA Loops calibration).

Note ☞ *Test points on the HT Controller PCB can also be used to monitor the kV and mA readings but **should not be used** to calibrate the unit. These test points must be checked with scope. (Refer to Calibration chapter – Section 2 "Calibration Procedures", for test points and scale factors).*

2.8.1 TEST FOR kV LOOP

1. Verify that dip switch 3000SW2-2 on the HT Controller Board is in *"**Off**"* position (enables Filament and Rotor Interlocks).
2. Turn the Generator ON and select the "*Direct*" (*No Bucky*) workstation in one of the X-ray Tubes.
3. Select 80 kV, 200 mA (or the first mA station for Large Focus), 100 ms. Make an exposure and note the kV at the end of the exposure.
4. Check that the kV value read on the kV Meter must be 80 ±1 kV.

   If the kV value does not comply with the above value, perform the respective Calibration procedures.

2.8.2 TEST FOR DIGITAL mA LOOP OPEN

1. Set the dip switch 3000SW2-4 on the HT Controller Board in *"**On**"* position (Digital mA Loop Open / Filament Current Constant).

Note ☞ *Only for Generators with LF-RAC (LSS):*

*- When the mA Loop is open (dip switch 3000SW2-4 in "**On**"), the rotor runs for two minutes after release the handswitch push-button from "Preparation" position.*

*- When the mA Loop is closed (dip switch 3000SW2-4 in "**Off**"), the Tube will brake after release the handswitch push-button from "Preparation" position.*

2. Enter in Manual Calibration selecting the "*Direct*" (*No Bucky*) workstation of the corresponding X-ray Tube.

3. Select 80 kV and the following mA stations. Make an exposure and note the mAs values read on the mAs Meter.

   - Minimum mA for Small Focal Spot.
   - Maximum mA for Small Focal Spot.
   - Minimum mA for Large Focal Spot.
   - Maximum mA for Large Focal Spot.

4. Check that the mAs values read on the mAs Meter must be the same mAs displayed on the Console with a tolerance of ±6% mAs.

   If the mAs values do not comply with the above values, perform the respective Auto-Calibration procedures.

5. Repeat this test for the second X-ray Tube.

6. Turn the Generator OFF and set the dip switch 3000SW2-4 on the HT Controller Board in *"**Off**"* position (Digital mA Loop Closed).

2.8.3 TEST FOR DIGITAL mA LOOP CLOSED

1. Turn the Generator ON and select the "*Direct*" (*No Bucky*) workstation in one of the X-ray Tubes.
2. Select the following parameters, make an exposure and note the mAs values read on the mAs Meter.
   - 80 kV, 100 ms, 50 mA.
   - 80 kV, 100 ms, 200 mA.
3. Check that the mAs values read on the mAs Meter must be the same mAs displayed on the Console with a tolerance of ±4% mAs.
4. If the mAs values do not comply with the above values, perform the respective Auto-Calibration procedures.
5. Turn the Generator OFF.

2.9 AEC CHECKS

Note ☞ *For AEC calibration, use the same Film and Cassettes used by the customer. AEC calibration must be performed using the Medium Film/Screen speed combination. The Medium Film/Screen speed has to be double of the Slow and half of the Fast (a.e. 200-Slow, 400-Medium, 800-Fast).*

Note ☞ *When using CR (Computer Radiography) or DR (Digital Radiography) instead of measuring Optical Density:*

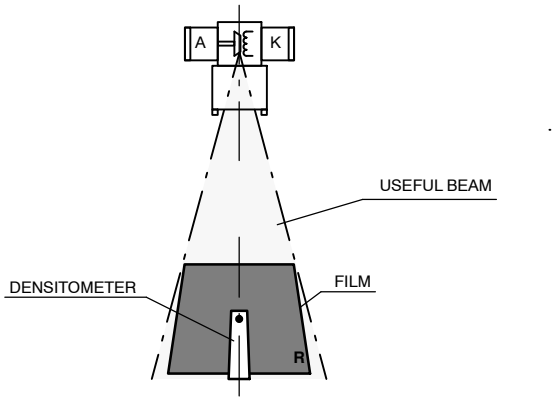
- measure the Image Gray level by using the needed software tools inside each application (refer CR or DR documentation).

- or measure the Dose level:
- For CR, placing the Dosimeter as close as possible to the Cassette and centered with the Central Area of the Ion Chamber.
- For DR, placing the Dosimeter as close as possible to the Panel, centered with the Central Area of the Ion Chamber and with the Grid removed.

2.9.1 OPTICAL DENSITY

Note ☞ *The Film Optical Density must be measured always on the same point for all the X-ray Films developed during this procedure.*

The recommended point is on the central axis of the Film with relation of the Anode and Cathode and as close as possible to center of the Film.



1. Set SID at the Focal Distance of the Grid installed in the Table Bucky (usually 100 cm) or in the Vertical Bucky Stand (usually 150 cm).

2. Collimate the X-ray beam so that it completely covers all three fields but does not extend beyond limits of the phantom.

3. Place Copper plates (or equivalent homogeneous phantom) in the Collimator Filter Holder: 1.5 mm for SID of 100 cm, 1 mm for SID 150 cm. (*1 mm Copper ≃10 cm Plexiglass or Water*).

4. Select a workstation for the Ion Chamber to be tested. Select on the Console:

   - RAD Menu: 70 kV, 200 mA Large Focus (or the first mA station for Large Focus if 200 mA station is set for Small Focus) and 1 second back-up time.
   - AEC Menu: "*Central Area*", "*Density 0*" and "*Medium Film/Screen*".

5. Make an exposure without film in the cassette and note the Exposure Time displayed on the Console, it should be approximately 100 ms. If necessary, change the Copper thickness (or if needed change the mA station) and make the exposure again.

6. Insert a cassette with the Medium Film/Screen combination used by the customer. Make an exposure, develop the film and check the Optical Density, it should be 1.0 (or the customer preference O. Density).

7. If the Optical Density is not as required, perform the respective AEC Calibration procedure.

8. Repeat the above steps for all the Ion Chambers installed with the Generator.

2.9.2 kV COMPENSATION

1. Select a workstation for the Ion Chamber to be tested. Select on the Console:

   - RAD Menu: 55 kV, 200 mA Large Focus (or the first mA station for Large Focus if 200 mA station is set for Small Focus) and 1 second back-up time.
   - AEC Menu: "*Central Area*" , "*Density 0*" and "*Medium Film/Screen*".

2. Make an exposure without film in the cassette and check that the Exposure Time is lower than 1 second. If necessary for that, change the Copper thickness (or if needed change the mA station) and make the exposure again. Take note of the final Copper thickness and mA station selected for 55 kV.

3. Select 90 kV. Make an exposure without film in the cassette and check that the Exposure Time is higher than 20 ms. If necessary for that, change the Copper thickness (or if needed change the mA station) and make the exposure again. Take note of the final Copper thickness and mA station selected for 90 kV.

4. Select 110 kV. Make an exposure without film in the cassette and check that the Exposure Time is higher than 20 ms. If necessary for that, change the Copper thickness (or if needed change the mA station) and make the exposure again. Take note of the final Copper thickness and mA station selected for 110 kV.

5. Insert a cassette with the Medium Film/Screen combination used by the customer. Make an exposure at 55 kV and 90 kV *(use the final Copper thickness and the selected mA station noted before for each kV)*, develop the film and measure the Optical Density obtained with those exposures. Check that the film variation range is the same ±0.2 of the Optical Density (or ±20% of Image Gray Level / Dose Level with CR or DR) obtained before at 70 kV (*Optical Density Adjustment - Section 2.9.1*).

6. If the variation values is not as required, perform the respective AEC Calibration procedure.

7. Repeat the above steps for all the Ion Chambers installed with the Generator.

2.9.3 ATS DIGITAL AEC (RAD) (OPTIONAL)

Note ☞ *If the Generator is interfaced with an "ATS Digital System", Digital AEC test has to be performed as explained in the "ATS Digital System" documentation.*

2.10 FLUORO CHECK

Fluoro functions are calibrated by performing the following steps:

1. Turn the Generator ON.

Make sure that the Small Filament of the X-ray tube is properly warmed-up.

2. Set up a Dosimeter to measure the Maximum Entrance Skin Exposure Dose Rate. Position the Probe at the center of the primary beam with the entire active volume within the primary beam. Place the Tube-Collimator Assembly as close as possible to the Table-Top, fully open the Collimator Blades and align the Image Intensifier with the light beam. Block radiation input to Image Intensifier with a Lead Apron. (*Refer to Illustration in Fluoro Calibration).*

Note ☞ *Note that in practice, the rejection limits for entrance exposure rate must be somewhat less than the maximum specified due to Dosimeter calibration accuracy.*

METER CALIBRATION ACCURACY	REJECTIONS LIMITS	
	FOR 5 R/min (43.5 mGy/min) MAXIMUM	FOR 10 R/min (87 mGy/min) MAXIMUM
±5%	4.75 R/min (41.3 mGy/min)	9.5 R/min (82.7 mGy/min)
±10%	4.50 R/min (39.2 mGy/min)	9.0 R/min (78.3 mGy/min)
±15%	4.25 R/min (37 mGy/min)	8.5 R/min (74 mGy/min)

3. For testing the Dose, make a Fluoro exposure at maximum kV and measure the dose applied, it should not be over the Rejection Limits for 5 R/min (43.5 mGy/min) or 10 R/min (87 mGy/min) (*refer to the above table*).

   In case that the value is not acquired, perform the respective Fluoro calibration process.

4. The Fluoro mA values are obtained by measuring the average mA using a mA meter in Fluoro.

   During Fluoro exposure, mA values are read directly with a mA Meter in DC connected to the mA Test Points (banana plug connections) on the HV Transformer. Only for this purpose, remove the link between the banana plug connections on the HV Transformer.

5. For testing the mA, make a Fluoro exposure at 50 kV, 80 kV and 110 kV.

   Check that the mA values read on the mAs Meter must be the same mA displayed on the Console with a tolerance of ±10 % mA. If the mA value does not comply with the above values, perform the respective Calibration procedures.

6. Remove the Dosimeter and the Lead Apron (Blocker).

2.11 ABC CHECK

Note ☞ *If the Generator is interfaced with an ATS Image System, ABC testing procedure has to be performed as explained in the Image System documentation.*

1. Be sure that the Video System and the Image Intensifier are powered and operating correctly.

2. Set up a Dosimeter as close as possible to the Image Intensifier Radiation Input to measure the Entrance Image Intensifier Exposure Dose Rate. Position the Probe at the center of the primary beam with the entire active volume within the primary beam.

   Place the Tube-Collimator Assembly at the normal SID (1 meter), fully open the Collimator Blades and align the Image Intensifier with the light beam.

3. Adjust TV Camera gain for 1 volt peak-to-peak composite video output.

4. Select ABC mode.

5. Place 2 mm of Copper (or equivalent homogeneous phantom) in the Collimator Filter Holder.

6. Make a Fluoro exposure and check that Fluoro kVp displayed on the Console is between 80 kVp and 60 kVp. If it is more than 80 kV or less than 60 kV modify the Copper thickness in steps of 0.1 mm (or 0.2 mm) and make Fluoro exposures until the kVp is within the range.

7. Calculate the value of the optimum dose rate (that will give optimum brightness) to obtain 2μR/frame at 9" FOV.

   Examples:
   For 25 frame/second optimum dose rate is 3 mR/min.
   2 μR/frame x 25 frame/s = 50 μR/s.
   50 μR/s x 60 s/min = 3000 μR/min = 3 mR/min.
   For 30 frame/second optimum dose rate is 3.6 mR/min.
   2 μR/frame x 30 frame/s = 60 μR/s.
   60 μR/s x 60 s/min = 3600 μR/min = 3.6 mR/min.

   The optimum dose rate (dose rate) value should be measured at Image Intensifier Radiation Input. Intensifier grid should be removed, if it can not be removed, this value should be multiplied by the value specified as Grid Absorption Factor.

8. Make a Fluoro exposure and measure the dose rate. The dose rate read on the Dosimeter must be the same as the previously calculated with the tolerance specified by the Dosimeter accuracy. If the dose rate does not comply, perform the respective Calibration procedures.

9. Stop the Fluoro exposure and select 40 kV. Make a Fluoro exposure and check that the kV value goes to 70 kV (or the kV obtained in step-6.) ±2 kV without System problems.

10. Stop the Fluoro exposure and select 100 kV. Make a Fluoro exposure and check that the kV value goes to 70 kV (or the kV obtained in step-6.) ±2 kV without System problems.

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SECTION 3 SPECIAL MAINTENANCE RELATED TO BATTERY POWERED GENERATORS

Note ☞ *This Section only applies to Battery Powered Generators and must be performed at least once a year.*

3.1 BATTERY STORAGE CONDITIONS

This generator should be stored at a dry environment around 20ºC (68ºF). The recommended operating temperature is 15ºC to 30ºC (59ºF to 86ºF).

During normal storage conditions (dry environment at 20ºC (68ºF) the internal resistance of the batteries will cause a discharge rate of 15% per six month period. Storage above 30ºC (86ºF) should be avoided, since it will cause excessive battery voltage loss.

Within the recommended operating temperature and under optimum float conditions, the batteries service life is expected to exceed 5 years.

The batteries of the Unit are fully charged when delivered from the factory. If the Unit is going to be stored or has been stored for a period longer than six months, batteries must be fully charged during eight hours before operation or service tasks.

If the unit has not been used or it has been stored for six months, it should be installed and/or energized to prevent deep discharge of the batteries. A deep discharge will cause permanent damage to the batteries. Perform the following Maintenance Tests.

3.2 BATTERY CHARGER TEST AND BATTERY CONDITION TEST

Refer to *Section 2.6 "Procedures related to the Battery Powered Generators"* of the Troubleshooting document in the Service Manual and perform all the indicated procedures to carry out a correct maintenance of the Battery Charger Board and Batteries.

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