

MODULE 4.0

Fluoroscopy table**Aim**

Aim is to provide routine maintenance procedures for the fluoroscopy table. These procedures are intended for an under-table tube fluoroscopy table. The under-table Bucky maintenance procedures are described in **module 3.0 page 53**.

Fluoroscopy TV maintenance is provided in **module 4.1 page 60**. Adjustment and repair procedures are provided in **module 9.0 page 130**.

(**Note:** Reference module page numbers refer to the title page.)

Objectives

On completion of this module, the student will be familiar with maintenance and performance checks for the fluoroscopy table. These procedures can be used as a version of quality control, together with the routine maintenance check-sheets provided in the appendix.

Contents

- a. General precautions.
- b. Mechanical and electrical inspection.
- c. Operation test, table body.
- d. Operation test, serial-changer (Spot filmer).
- e. X-ray beam alignment.
- f. Cleaning.

Equipment required

- Basic tool kit.
- Torch.
- Spirit level.
- Cloth, for cleaning.
- Detergent.

a. General precautions

- **Before removing any cover, always switch the generator power off, and ensure the isolation power switch for the room is also switched off.**
- If removing a cover, or dismantling any section, place the screws in a container to avoid loss.

b. Mechanical and electrical inspection

- Make a general inspection of the table body and serial-changer. Tighten any loose screws, or panels and fittings.
- Check the rails holding the tabletop in place. Tighten any loose screws.
- Examine all suspension system cables and chains for any sign of wear, or uneven tension in the case of dual systems.
- Check electrical cables, particularly at the rear of the table. Pay special attention to cables that may be twisted or tangled. It may be necessary to remove existing cable ties, reposition the cables, and then install fresh cable ties. (Use plastic or nylon cable ties only)
- Where electrical cables enter the table, check that the cable clamps properly secure them. The protective outer insulation of the cable should not be pulled back, exposing inner conductors.
- The serial-changer should be able to move smoothly from the 'park' position, and lock firmly into place.
- Check the operation of all switches and operation lights on the serial-changer.
- Additional control switches are sometimes placed on the side of the table body. Patient trolleys can damage these switches.
- Older systems with a demountable image intensifier (II).
 - i. The II should balance vertically when removed from the serial-changer.
 - ii. The II should be held firmly in position when clamped to the serial-changer. Look for loose clamps.
- Is the serial-changer lead-rubber radiation shield in good condition? Can it be easily positioned?

- With the aid of a torch, make a careful examination for lost film markers inside the serial-changer.
- **The footrest requires careful attention. If there is any tendency for the locking mechanism to slip, this will require urgent correction.**

c. Operation test, table body

- Check operation of all locks. The serial-changer vertical lock should operate quickly when operated, and not 'stick on' when released.
- Check all switches and indicator lamps for correct operation. This especially includes those on the table body, which may be damaged by patient trolleys.
- Operate the tabletop in all positions. Listen for any unusual squeaks or bearing rattles.
- On tabletops fitted with a lateral centre stop, the stop position should be checked. Use the procedures described in **module 2.0 page 44**.
- Rotate the table to the vertical and Trendelenburg positions. Listen for unusual bearing or motor noise while the table is rotating. Does the table stop quickly after the rotation control is released, or does it tend to continue or 'coast' for a short while? This could indicate a failure of the motor brake system. Contact the service department for advice.
- The table should stop in the horizontal position, on returning from the vertical position. Use a spirit level to check the horizontal position.
- With the table tilted at maximum position in either direction, check the electrical cables are not pulled tight, or restrict the movement of the serial-changer up and down the table.
- Some tables have power assistance for movements, such as longitudinal movement of the serial-changer; this should be smooth and free from sudden jerks. See **module 9.0 page 130**.
- Some tables have safety anti-crash bars or flaps. Pushing against these safety devices should prevent the table from rotating.
- With the vertical or compression lock 'on', operate the tabletop longitudinal movement. On some tables, movement should not operate, and on others, the vertical lock should release on movement of the tabletop. If not, contact the service department. There may be a safety upgrade available.
- Place a standard 24/30 cm cassette in the serial-changer. With the vertical lock 'off', check for vertical balance when moved up and down.
- Rotate the table into the vertical position. With the serial-changer longitudinal lock 'off', check the

serial-changer and tower assembly for balance, while moving it along the table body.

d. Operation test, serial-changer (Spot filmer)

- Compression cone movement should operate smoothly, and lock into position.
 - i. If the movement is stiff or hesitant, try cleaning the slide tracks, then spray with an aerosol lubricant.
 - ii. Operate several times, and wipe off any excess spray.
- Some serial-changers have manually operated 'close to film' shutters. These are coupled to the film format selection. If stiff or hesitant, clean and lubricate the tracks in the same manner as for the compression cone.
- Manually operated cassette movement.
 - i. Load a 24/30 cm cassette in the tray.
 - ii. Select a low kV and mAs setting at the X-ray control.
 - iii. At the serial-changer, select the four-spot mode.
 - iv. Set the collimator control to 'Automatic'.
 - v. Advance the cassette, and expose all four divisions. Watch the cassette as it moves into the 3rd spot division. If the cassette 'slams' into position, a pneumatic 'damper' may need replacement. Contact the service department for advice.
 - vi. Process the film, and check that the four spots are evenly distributed around the film, are the same size, and without overlap.
 - vii. If incorrect, see **module 9.0 page 130**.
 - viii. Provide a similar test for other split formats.
- Motorized cassette movement.
 - i. Place a 24/30 cm cassette in the cassette carriage.
 - ii. Press the 'load' button. The cassette should be withdrawn and stop smoothly. A 'bang' at the end of travel can indicate an adjustment problem, caused by the cassette carriage overshooting, and hitting the end stop. Contact the service department for advice.
 - iii. Press the 'eject' button. The cassette should move to the 'eject/load' position, and stop smoothly. There should be no 'bang' at the end of travel to indicate travel 'overshoot'. Enough of the cassette should extend to allow easy removal.
 - iv. Reload the 24/30 cm cassette.
 - v. Select a low kV and mAs setting at the X-ray control.

- vi. At the serial-changer, select the four-spot mode.
- vii. Set the collimator control to 'Automatic'.
- viii. Advance the cassette, and expose all four divisions. Watch the cassette as it moves into the 3rd spot division, for possible failure of the movement damper. (Only on some older systems)
- ix. Process the film, and check that the four spots are evenly distributed around the film, are the same size, and without overlap. If incorrect, see **module 9.0 page 130**.
- x. Repeat the above test for other split formats and film sizes.

e. X-ray beam alignment

- Install a 24/30 cm cassette, and select the four-spot mode.
- At the X-ray control, select a low level of fluoroscopy kV and mA. This should be just sufficient to see the position of the X-ray beam shown on the TV monitor. (Or the fluorescent screen)
- With fluoroscopy 'on', manually collimate the beam to the maximum four spot size.
 - i. The edge of the beam should be sharply defined by the four-spot cone or by the 'close to film' shutters.
 - ii. In case one side is less sharp, and shows movement with only a small adjustment of the collimator, then beam alignment is incorrect.
- Observe the beam alignment with the serial-changer at both minimum and maximum height positions above the tabletop.
- Repeat the above test with the table tilted to vertical position.

- **Note.** In most cases, beam alignment will shift a little when the table is moved from horizontal to vertical. The amount of misalignment is usually due to flexing of the table framework. In some cases this may be due to incorrectly adjusted bearings. Contact the service department for advice.
- If beam alignment is incorrect, see **module 9.0 page 130**.

f. Cleaning

- Due to the types of examinations, barium spills can leave deposits under the tabletop, or on the protective cover under the tabletop. Inspect with the tabletop moved to its maximum position in each direction.
- **Hint.** Shine a torch beam between the tabletop and the protective cover.
- Another cause of artefacts is contrast media from an IVP examination. This is sometimes found underneath the serial-changer, as well as the tabletop. The contrast media is not easy to see when it has dried out.
- The contrast residues may be cleaned with a mixture of household detergent and warm water. Use sufficient to just dampen the cleaning cloth.
- Fluoroscopy tables are subject to marks from patient trolleys etc.
 - i. These marks and scratches can be reduced with the aid of car polish.
 - ii. The type to use is one with a mild abrasive, advertized to 'Restore faded or chalky paint'.
 - iii. Silicone furniture polish can help remove scuff-marks, fingerprints etc.

MODULE 4.1

Fluoroscopy TV**Aim**

Aim is to provide routine maintenance procedures for the fluoroscopy TV system. These include checks for image sharpness, and the automatic brightness control. The basic TV imaging system consists of an image intensifier (II), TV camera, and monitor. Systems with greater complexity, such as DSA and electronic radiography, are not included. Adjustment and repair procedures are provided in module 9.1 page 135.

(**Note:** Reference module page numbers refer to the title page.)

Objectives

On completion of this module, the student will be familiar with maintenance and performance checks for the fluoroscopy TV system. These procedures can be used as a version of quality control, together with the routine maintenance check-sheets provided in the appendix.

Contents

- a. General precautions.
- b. Mechanical and electrical inspection, image intensifier.
- c. Mechanical and electrical inspection, TV system.
- d. Image sharpness.
- e. Automatic brightness/kV control.

Equipment required

- Basic tool kit.
- Resolution test piece.*
- Plastic container for water phantom.

* A 'V' pattern test piece is described in appendix 'B' page 169.

a. General precautions

- **Before removing any cover, always switch the generator power off, and ensure the isolation power switch for the room is also switched off.**
- Do not remove the cover of the TV monitor. Dangerous voltages can exist for a considerable time after the monitor is switched off.
- Do not attempt any adjustments to the TV camera, unless under instruction by the service department.
- If removing a cover, or dismantling any section, place the screws in a container to avoid loss.

b. Mechanical and electrical inspection, image intensifier (II)

- On older systems with a ceiling suspension.
 - i. If the unit is dismantled from the serial-changer, the vertical balance should be neutral.
 - ii. When attached to the serial-changer, the clamp or latch system should hold the II securely, with minimum movement.
 - iii. Up and down movement should be free, without binding or unusual noises.
 - iv. The ceiling suspension unit should travel freely. (Some systems may hesitate before moving, this is normal.)
- Electrical cables to the II and TV camera should be securely attached. The cables should not be pulled, or stretched, during table movements.
- Push buttons and selection switches should have their function clearly marked. **Note.** Some knobs or control settings may be for an option only, and not be installed. This should be noted in the logbook.

c. Mechanical and electrical inspection, TV system

- Electrical cables should be securely attached to the monitor trolley. There should be no possibility of pulling against cable connections. This also applies in case of wall mounted plugs and sockets.
- Examine the video cable connection, both at the monitor and TV camera. The cable should be firmly

attached to the plug, including the outer earth shield. Moving the cable at the plug should not cause any 'flicker' or change in the TV image.

- Check the video-input 75 ohm termination-switch. In the case of a single video connection only, this should be 'ON'. If two or more monitors, then the switch on the end monitor should be 'ON', while the middle monitor, with two video connections, should be switched to the 'OFF' position. (In some cases, a termination plug is fitted to the unused video 'out' connection.)
- Ensure the monitor is securely fastened to the monitor trolley. This especially applies to monitor trolleys with a tilting platform.

d. Image sharpness

- An evaluation of image sharpness or focus is best carried out with a 'Line pair' gauge. The industry standard is one made from 0.1mm lead.
- An alternate test piece for testing focus may be constructed from long sewing needles arranged in a 'V' pattern. See appendix 'B' page 169.
- There are several methods used to evaluate performance of an imaging system. The basic method described here is to indicate if resolution has drifted below an acceptable level.
 - i. Tape the gauge onto the centre of the input face of the image intensifier. If access is difficult, then tape the gauge to the under surface of the serial-changer.
 - ii. To avoid interaction with grid lines, attach the gauge so it is rotated approximately 25–45 degrees. (On some CCD TV cameras, this also avoids interaction between pixels.)
 - iii. Lift the serial-changer to maximum height above the tabletop.
 - iv. If the system has automatic kV control, this should be turned off. Set manual fluoroscopy kV to 50–55 kV.
 - v. With fluoroscopy 'on', adjust kV or mA to obtain a normal brightness and contrast image on the monitor.
 - vi. Carefully observe the line-pair patterns. The limiting definition is the line pair group that is reasonably visible, while the next group is completely blurred out. (This can sometimes be a good test of individual eyesight.)
 - vii. If using the 'V' pattern test piece, measure the distance to the apex before blurring occurs.
 - viii. Record the line pair resolution, or 'V' pattern distance obtained, and compare with any earlier tests.

- ix. Repeat this test for other field sizes if a multi-field II is installed.
- x. As a guide, with a 9" image intensifier, resolution should not be less than 1.0 line pairs/mm. (Typical resolutions for current systems are 1.4 line pairs/mm minimum for a standard CCD camera, while some higher performance systems may achieve resolutions of more than 2.0 line pairs/mm.)
- xi. If image sharpness, or image quality, is not good, see module 9.1 page 135.

e. Automatic brightness/kV control

- Automatic brightness adjusts the TV image as different sections of anatomy are examined.
- Automatic brightness normally controls the fluoroscopic output, either by kV or mA, or else a combination of both kV and mA. Older methods operate by direct compensation in the TV camera only. Current systems often use a combination of both methods.
- Systems with automatic control of fluoroscopy kV or mA.
 - i. Place a plastic bucket or container with about 3.0 cm (1.25") of water on the tabletop.
 - ii. Bring the serial-changer down close to the water phantom.
 - iii. With fluoroscopy 'on', the image on the monitor should be a normal brightness level.
 - iv. If automatic control is by kV only, or mA only, this may not provide complete compensation. If the image has excess brightness, it may be necessary to reset the manual adjustment. For example.
 - If automatic control is by kV only, and kV has reached its minimum value of 50 kV, but the mA indicates 3.0 mA, then reduce the fluoroscopic mA setting.
 - If automatic control is by mA only, and the manual kV was set to 120 kV, then of course, reduce kV.
 - v. Increase the height of water in the container to about 18.0 cm (7") of water.
 - vi. With fluoroscopy 'on' kV or mA should automatically adjust to maintain the correct brightness.
 - vii. Close the collimator. Then with fluoroscopy 'on', kV or mA should now reach its maximum value.
 - viii. **Note.** For the above tests, the brightness should stabilize without oscillating up and down in brightness level. (This means the 'settling time' is not stable.)

- Systems with automatic control of brightness by the camera only.
 - i. Place a plastic bucket or container with about 5.0 cm (2.0") of water on the tabletop.
 - ii. Set Fluoroscopy kV to about 60 kV, and the mA control to about 1.0 mA.
 - iii. Bring the serial-changer down close to the water phantom.
 - iv. With fluoroscopy 'on', the image on the monitor should be a normal brightness level.
 - v. If overbright, and it is necessary to reduce kV still further, the camera brightness control is not effective.
 - vi. If brightness appears normal, increase kV in 10 kV steps, till the image becomes over bright, or 'flaring' occurs. A good system should be able to compensate up to about 100 kV. (This is based on a target-controlled vidicon TV camera. CCD types may have reduced control.)