ULTRANET "SM"
Service Manual - sm Y00W21L.04
- Revision 18

OLD MODEL VERSION

NO HHS
ULTRANET "SM" Models 45296017 - 45296046 - 45296490 - 45296671

HHS
ULTRANET "SM" Models 45296193 - 45296307 - 45296948 - 45296950 - 45296960

NEW MODEL VERSION
ULTRANET "SM" Models 2204643 - 2204646 - 2204649 - 2204652
ULTRANET "SM" for "OLD & NEW XT suspension"
Model 45296017 from Ser No 1601 yy to Ser No 1640 yy
from Ser No 1801 yy to Ser No 30740 yy 5

ULTRANET "SM" for "COMPAX 400/400T & L/IT table"
Model 45296046 from Ser No 1641 yy to Ser No 1700 yy
from Ser No 1851 yy to Ser No 16027 yy 5

ULTRANET "SM" for "RS-85 tubestand"
Model 45296490 from Ser No 13762 yy 0 to Ser No 18121 yy 4

ULTRANET "SM" for "SOLARIX"
Model 45296671 from Ser No 6086 yy to Ser No 18038 yy 0
ULTRANET “SM”
Service Manual

Validity

HHS VERSION

OLD MODEL VERSION

ULTRANET “SM” for “OLD & NEW XT suspension”
Model 45296193 from Ser No 1941 yy to Ser No 22823 yy 9

ULTRANET “SM” for “EXAFOCUS”
Model 45296307 from Ser No

ULTRANET “SM” for “COMPAX 400/400T & I/IT table”
Model 45296948 from Ser No 15542 yy 4 to Ser No 15557 yy 2

ULTRANET “SM” for “RS-85 tubestand”
Model 45296950 from Ser No to Ser No 15592 yy 9

ULTRANET “SM” for “SOLARIX”
Model 45296960 from Ser No 15518 yy 7

NEW MODEL VERSION

ULTRANET “SM” for “OLD & NEW XT suspension”
Model 2204643 from Ser No 52800 yy 0

ULTRANET “SM” for “COMPAX 400/400T & I/IT table”
Model 2204646 from Ser No 52750 yy 7

ULTRANET “SM” for “RS 85 Tubestand”
Model 2204649 from Ser No 52900 yy 8

ULTRANET “SM” for “SOLARIX”
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ULTRANET “SM”
Service Manual

1 OPERATOR MANUAL (*separate document*)
2 PREINSTALLATION
3 INSTALLATION
4 FUNCTIONAL CHECK
5 THEORY (*not intended*)
6 SERVICE
7 SCHEMATICS
8 DIAGNOSTICS (*not intended*)
9 RENEWAL PARTS
10 PERIODIC MAINTENANCE
11 DIRECTION 13894 (HHS) (*Abstract*)
2 PREINSTALLATION

2.1 MODEL NUMBERS

2.2 DIMENSIONS AND WEIGHTS
   2.2.1 Equipment
   2.2.2 Packing
   2.2.3 Center of gravity

2.3 POWER REQUIREMENTS

2.4 ENVIRONMENTAL REQUIREMENTS
NOTE
The figures mentioned here are found at the end of this section

21 MODEL NUMBERS

NO HHS VERSION
(OLD MODEL VERSION)

ULTRANET SM™ for 'OLD & NEW XT Suspension
ULTRANET SM™ for "COMPAX 400/400T & I/IT Table"
ULTRANET SM™ for RS85 Tubestand
ULTRANET SM™ for SOLARIX™

HHS VERSION
(OLD MODEL VERSION)

ULTRANET SM™ for OLD & NEW XT Suspension
ULTRANET SM™ for 'EXAFOCUS"
ULTRANET SM™ for COMPAX 400/400T & I/IT Table
ULTRANET SM™ for RS85 Tubestand
ULTRANET SM™ for SOLARIX™

HHS VERSION
(NEW MODEL VERSION)

ULTRANET SM™ for "OLD & NEW XT Suspension
ULTRANET SM™ for "COMPAX 400/400T & I/IT Table"
ULTRANET SM™ for "RS85 Tubestand"
ULTRANET SM™ for SOLARIX™

ULTRANET SM™
GB 2-2
2.2 DIMENSIONS AND WEIGHTS

2.2.1 Equipment

Collimator
- Dimensions: see Figure A (found at the end of this section)
- Weights: 15 kg (33 lbs)

Interface plate to tube unit
- Weight: 0.450 kg (1 lbs)

2.2.2 Packing

The collimator is packed in a polystyrene foam container + cardboard box

- Dimensions (w x l x h): 50 x 40 x 40 cm (19.7" x 15.7" x 15.7")
- Weight: 16.7 kg (36.8 lbs)

2.2.3 Center of Gravity

see Figure A (found at the end of this section)

2.3 POWER REQUIREMENTS

Lamp
- Voltage: 24VAC
- Maximum current input: 8A
- Frequency: 50Hz / 60Hz

2.4 ENVIRONMENTAL REQUIREMENTS

All ratings and duty cycles apply at altitudes to 2,500 meters, average relative humidity to 95% and ambient temperatures to 40°C
All dimensions are in millimeters

Fig A

ULTRANET "SM"
GB 2-4
3 INSTALLATION

3 1 SPECIAL EQUIPMENT REQUIRED

3 2 UNPACKING

3 3 CONSIDERATIONS ON TUBE UNIT INSTALLATION
3 3 1 GEMS Tube Unit
3 3 2 GEMS-E Tube Unit

3 4 ATTACHING THE INTERFACE PLATE TO THE TUBE UNIT
3 4 1 GEMS Tube Unit
3 4 2 GEMS-E Tube Unit

3 5 TUBE UNIT - COLLIMATOR INTERFACE PLATE ALIGNMENT

3 6 MOUNTING THE COLLIMATOR

3 7 MOUNTING THE ANODE CUTOFF MASKS

3 8 MOUNTING A FRONT PANEL OVERLAY OTHER THAN THE STANDARD ONE

3 9 LIGHT DEVIATION DEVICE FUNCTIONALITY

3 10 KNOB POSITION TOOL

3 11 COLLIMATOR ELECTRICAL CONNECTION
3 11 1 Connection to OLD & NEW XT Suspension
3 11 2 Connection to COMPAX 400/400T & I/I Table
3 11 3 Connection to RS85 Tubestand
3 11 4 Connection to SOLARIX

3 12 FINAL TASK
31 SPECIAL EQUIPMENT REQUIRED

- Colimator alignment fixture (46-16639061)

- Light meter DIGAPHOT 330013303 or equivalent (accuracy 5% or better)

- Digital multimeter BECKMAN 3030 RMS or FLUKE Model 8030A, or equivalent

- HHS Field Test Kit (RAT Kit) 46-177372G1, with new RAT pattern set 46-216074P1

- Radiation meter

- Standard Absorber 46-173632G1

- Radiographic cassettes 18x24cm, 24x30cm, 35x35cm, 35x43cm or 7"x10", 10"x12", 14"x14", 14"x17"

- A metric scale

- Size pattern (dwg Y702670 - attached)

- 4 brass plates (40 x 40 x 1mm) (PM 45296219) (not required if RAT set is used)

- Set of wrenches (furnished with the collimator and to be left in site)
  - Hook wrench for collimator mounting nng (Part No 2231032)
  - Hex adapter (Part No 2223141)
  - 1/4” Hex square adapter (Part No 2223142)
  - Two wrenches for 10/32” and 9/16” screws (Part No 45298477)
  - Two hook wrenches for 25mm castle nuts (Part No 45298476)
  - One knob position tool (Part No 2188963)

- Set of wrenches (not furnished)
  - Torque wrench (for torquing the mounting nng) 3/8” square drive torque of 20 to 30 Nm (180 to 270 in lbs)
  - Torque screwdriver (for torquing the set screws) torque of 1.4Nm (12 in lbs)
UNPACKING

Do not discard packing material, envelopes, boxes, etc until all parts are accounted for.
Should damaged or missing parts be noticed, refer to the following *Damage in Transportation* statement for instructions regarding transit damage or shortages.

**Damage in Transportation**

All packages should be closely examined at time of delivery.
If damage is apparent, have notation of *bud order* placed by the delivering driver on all copies of the freight or express bill.
If damage is of a concealed nature, notify transportation agent as soon as possible to make an *inspection report on damage* no later than 15 days after delivery.
A transportation company usually will not pay a claim for concealed damage if an inspection is not requested within this 15 day period.
Complete instructions regarding claim procedure are found in Section 'S' of the *Policy and Procedures Bulletins*.

If shipment was handed by moving van service - uncrated - call *Traffic* - Milwaukee immediately when any damage is found.
Do not attempt to call any local agent.
At this time, be ready to describe type of damage, type of equipment, serial numbers, and if possible the order number.

The above paragraph is in regard to equipment requiring installation only, and does not apply to supply items.
The FOB point for these items is as shown in the *Price Book*.

ULTRANET 'SM'
GB 3-3
3.3 CONSIDERATIONS ON TUBE UNIT INSTALLATION

3.3.1 GEMS Tube Unit
GEMS tube units are mounted on the suspension or tubestand as directed in the manuals of the suspension or tubestand.

3.3.2 GEMS-E Tube Unit
GEMS-E tube units are mounted on the suspension or tubestand as directed in the manuals of the suspension or tubestand.
GEMS-E tube units are to be installed by means of a C-support (already mounted on STATORIX 240 S - see Figure 27)

CAUTION
IN CASE OF REMOVAL

Before removing the tube unit from the tube support, relieve tension on the column cables by unwinding the counterpoise springs until the cables are slack.
Do not backwind the springs.
Rest the tube unit on the tabletop or other suitable support.

3.4 ATTACHING THE INTERFACE PLATE TO THE TUBE UNIT

3.4.1 GEMS Tube Unit
Fasten the furnished interface plate (1) Figure 28 directly to the tube unit with the 9/16" hex eccentrics and the 10-32x3/4" hex screws (for MX 75 use 10-32x1/2" hex screws) Do not tighten the screws at this time.

3.4.2 GEMS-E Tube Unit
Secure the interface plate (1) Figure 28 on the supporting plate (see Figure 27) with 9/16" hexagonal eccentrics and 10-32x3/4" hex screws. Do not tighten the screws at this time.
TUBE UNIT - COLLIMATOR INTERFACE PLATE ALIGNMENT

The following procedure will result in alignment of the x-ray beam axis and the center of the collimator. It requires use of the collimator alignment fixture (part No. 46-16639061).

**WARNING**

Incorrect alignment could result in lack of uniform x-ray field density.

1. Rotate the tube unit 180° from the normal over-the-table position.

2. Remove the protective plastic cap from the collimator alignment fixture. Attach the alignment fixture to the interface plate with three 10-24x3/4" hex socket screws. See Figure 29.

(There may be a ring supplied eventually with the fixture to hold the fixture to the plate.)

**WARNING**

For proper application during alignment, use the following x-ray techniques:

- **Small Focal Spot** - 60 kVp • 25 mAs • 4 sec
- **Large Focal Spot** - 60 kVp • 200 mAs • 2 sec

The alignment fixture is designed to provide sufficient radiation protection when the tube unit is operated at or below these techniques. A piece of lead glass (minimum lead content 23 mm lead equivalent at 150 kVp) already mounted at the bottom of the fixture makes it safe to look into the fixture with the naked eye. However, as with any x-ray exposure, a lead protective screen, lead apron, and x-ray glasses or other protective medium should be used to avoid unnecessary radiation exposure.
3  Darken the room and have an assistant make exposure with

   Small Focal Spot - 60 kVp - 25 mA - 4 sec
   Large Focal Spot - 60 kVp - 200 mA - 2 sec

Looking into the bottom of the alignment fixtures, observe correlation of the x-ray pattern with the crosshairs on the screen
Observe the image of both the large and small focal spots
(Because of tube alignment tolerances, the focal spots will not coincide)
When properly aligned, relationship of the crosshairs and focal spot images should be as shown in Figure 30

4  Using the 9/16" hex eccentrics, shift the interface plate in the direction needed for correct alignment (Using the open-end wrenches furnished with the collimator rotate the opposite eccentrics in opposite directions to shift the interface plate position)
Repeat Steps 3 and 4 until alignment is satisfactory, then tighten the four 10-32 hex screws
Make tightening the screws, recheck the alignment to make certain it has not changed

5  Remove the alignment fixture and replace the protective cap
Rotate the tube unit back to the over-the-table position
3.6 MOUNTING THE COLLIMATOR

For an easy installation if possible temporarily upset the suspension or tubestand when mounting the collimator, in order to have the collimator bottom up.

Remove lid (1) Figure 26

Verify the mounting parts (ring and interface plate) are clean and free of steel chips.

Rest the collimator on the interface plate.

Orient the collimator in order to make the pin (3) Figure 28 go into the slot in the interface plate.

Using the service wrench supplied, tighten the collimator-locking ring until

DO NOT OVERTIGHTEN

The locking ring will be torqued at a later step.

Using the GEMS torque wrench (e.g. 46-315668P1, Sturtevant Richmond 3SDR-2001), 40-200 in lbs, set the torque wrench to 200 in lb (22.5 Nm) and connect it to the collimator service wrench using the square in the wrench.

Note: To apply the proper torque to the locking ring ensure that the long axis of the torque wrench is aligned with the long axis of the wrench handle when applying torque. Refer to Illustration 1. Also, make sure that you hold the torque wrench at the handle ONLY. Holding it in other places will cause the applied torque to be wrong.

Note: If the torque wrench specified in the equipment needed section is not available or not used, use the procedure in Para 3.6.2 to determine the proper torque that should be applied using a non-standard torque wrench. The applied torque is based on the length between the center of the square drive and the center point of the handle on the wrench.

Tighten the collimator-locking ring until the torque wrench clicks. Be careful not to jam the torque wrench against the screws that hold the mounting plate.

STOP TIGHTENING WHEN THE TORQUE WRENCH CLICKS

DO NOT OVERTIGHTEN. IF YOU OVERTIGHTEN, YOU WILL APPLY A LARGER TORQUE THAN REQUIRED.
ILLUSTRATION 1
LONG AXIS OF TORQUE WRENCH
ALIGNED WITH LONG AXIS OF HANDLE

Remove the locking nng service wrench and torque wrench.

**WARNING**
BE CAREFUL NOT TO CROSS THREAD THE SETSCREWS
PROPER TORQUE CANNOT BE ACHIEVED IF THE SETSCREWS ARE CROSS-THREADED

Apply the supplied Loctite 243 (or Loctite 222 P/N 46-170683P1) to the supplied set screws (P/N 0418751) and install at least 2 set screws in the 3 holes in the collimator locking nng using the supplied hex socket wrench.

**Note** Use enough Loctite to coat the threads when the setscrews are installed. **DO NOT** use an excessive amount of Loctite that could seep into the interior of the collimator and cause damage to the collimator.

Using the GEMS torque wrench (e.g. 46-282782P1, Sturtevant Richmond CAL-36/4, 2 - 36 in lbs), and the supplied hex socket wrench and adapter, set the torque wrench to 12 in lb (14 Nm) and tighten the set screws until the torque wrench clicks. Refer to Illustration 2.

**CAUTION**
STOP TIGHTENING WHEN THE TORQUE WRENCH CLICKS
DO NOT OVERTIGHTEN IF YOU OVERTIGHTEN, YOU MAY STRIP THE SET SCREW THREADS OR BREAK THE TORQUE WRENCH

Store the spanner wrench on site for future service of the collimator.

ILLUSTRATION 2
ADJUSTING THE TORQUE WRENCH

ULTRANET "SM"
GB 3-8
CHECKLIST

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<td>Try to insert the collimator spanner wrench between the lock ring and the collimator mounting plate. Refer to Illustrations 3 and 4. Does the space between the ring and the mounting plate prevent the wrench from being inserted? (indicates full thread engagement)</td>
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<td>2</td>
<td>Is the collimator roughly parallel to the x-ray tube? (if not, it could indicate a potential cross threaded condition)</td>
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<td>3</td>
<td>Are the threads of the mounting plate on the x-ray tube covered up by the locking ring or not visible? (indicates full thread engagement)</td>
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<tr>
<td>4</td>
<td>Has the proper torque been applied to the collimator-locking ring?</td>
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<td>5</td>
<td>Have the 2 or 3 set screws been installed with Loctite?</td>
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ILLUSTRATION 3
CHECKING THE LOCKING RING AND COLLIMATOR MOUNTING PLATE SPACING

WARNING

VERIFY THAT THERE IS NO PLAY BETWEEN COLLIMATOR AND HOUSING TIPICALLY, YOU SHOULD NOT BE ABLE TO INSERT THE QUEUE OF THE WRENCH OR EXTENSION BETWEEN THE RING AND THE INTERFACE PLATE
362 ULTRANET TORQUE CALCULATION

Use the following procedure to calculate the torque that needs to be applied at the torque wrench if you are not using the GEMS torque wrench, (e.g. 46-315668P1, Sturtevant Richmond 3SDR-2001) 40-200 inch lbs

Note: The torque that is applied to the collimator lock ring is 50 Newton Meters. This is NOT the amount of torque that is applied to the torque wrench. The torque setting or amount of torque that is measured at the torque wrench must be de-rated based on the length of extension of the spanner wrench and adapter to the torque wrench.

Determine the torque that needs to be applied to the torque wrench by using the equation or looking up the value in Table 2.

Measure the distance “D’ from the center of the torque wrench 3/8” square drive to the center of the torque wrench handle.

This measurement “D” must be in millimeters (mm) if using the equation. Refer to Illustration 5.

Insert the measured distance into the following equation or look up the distance “D’” in the table that follows.

If using the table round the actual measured distance “D” up or down to the nearest 5 millimeters.

- Torque at Wrench = [D/(D+275)]*50N*M
- To convert from N*M, Newton Meters, into inch pounds multiply Newton Meters by 8851 (Inch Pounds of Torque) = (Newton Meters of Torque) * 8851
Note: If using a torque wrench with coarse settings, set the torque wrench to the nearest setting.

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**TORQUE LOOK UP TABLE**

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ULTRANET "SM"

GB 3-11
Adjust then the tube hanger counterpoise system or tubestand counterweight system per the appropriate direction.

3.7 MOUNTING THE ANODE CUTOFF MASKS

When the x-ray tube associated to the collimator has a target angle of 11" or 12.5°, the covered field is smaller than the one determined by x-ray tubes with a 15" target angle.

In order to have an actual projection of the covered field already when centering the light field, two anode cutoff masks to be applied on the collimator bottom window are furnished.

Stick the mask directly on the outer surface of the plexiglas plate, in contact with the edge of the window as shown in Figure 25.

- **GEMS** x-ray tubes on the left (area 1 in the figure)
- **GEMS-E** x-ray tubes on the right (area 2 in the figure)
38 MOUNTING A FRONT PANEL OVERLAY OTHER THAN THE STANDARD ONE

Two additional self-adhesive front panel overlays (scaled for different inch or metric SIDs) are furnished with each collimator. According to the radiologist's requirements, one of these overlays can be stuck on the collimator front panel to cover the standard overlay.

Recommended procedure

- Remove the collimator knobs by simply pulling them
- Verify that the old overlay is clean and smooth
- Remove the protective paper from the central area of the new overlay (the area where there are two holes) but leave the other two strips of paper in place
- Apply the overlay on the panel centering the two holes on the bosses of the plate
- Wipe the overlay in order not to catch air bubbles
- Remove the paper from the other areas of the overlay

Wipe thoroughly the overlay
- Replace the knobs

39 LIGHT DEVIATION DEVICE FUNCTIONALITY (see Figure 60)

The light deviation device is used to center the bucky with the X-ray beam for both Table and Wallstand applications and to protect the patient in case of lamp implosion.

Moving the cursor on the right, we obtain longitudinal centering of the table bucky. Moving the cursor on the left, we obtain longitudinal centering of the wallstand.

The position and the configuration of the light deviation device are shown in Figure 60:

- The left window (read 40 in 100 cm) contains a piece of plexiglas used to close the window (see 1 Figure 60)
- The right window (read 72 in 180 cm) contains a prism to deviate the light beam (see 2 Figure 60)
3 10 **KNOB POSITION TOOL** (see Figure 61)

The knob position tool is used for setting the correct angular position of the two front knobs (manual X-ray field limitation) vs the opening angle of the collimator blades, every time it is necessary, when some mechanical adjustment or replacement have been carried through inside the Collimator assembly.

The configuration of the tool is given in Figure 61.

**Adjustment procedure**
See Para 6 5 23

3 11 **COLLIMATOR ELECTRICAL CONNECTION**

3 11 1 **Connection to OLD & NEW XT Suspension**

See schematic 45296017-030

3 11 2 **Connection to COMPAX 400/400T & I/IT Table**

See schematic 45296046-030

3 11 3 **Connection to RS85 Tubestand**

See schematic 45296671-030

3 11 4 **Connection to SOLARIX**

See schematic 45296950-030

3 12 **FINAL TASK**

Perform a *Functional Check* on the equipment as per Section 4.
4 FUNCTIONAL CHECK

4 1 APPLICATION

4 2 EQUIPMENT

4 3 Only for RAFL 'S Control Electronics

4 4 LIGHT FIELD BRIGHTNESS

4 5 LIGHT FIELD CONTRAST RATIO

4 6 Only for RAFL 'S Control Electronics

4 7 X-RAY FIELD VS LIGHT FIELD

4 8 FIELD SIZE INDICATION VS ACTUAL FIELD SIZE

4 9 EXTENSION CYLINDER ALIGNMENT CHECK

4 10 BEAM QUALITY DETERMINATION

4 11 Only for RAFL 'S Control Electronics

4 12 Dedicated to ULTRANET “SA”

4 13 PRESENCE OF LABELS AND DOCUMENTATION

4 13 1 Labels on collimator

4 13 2 Documentation
4.1 APPLICATION

These checks should be performed
- As the final task at installation
- After periodic maintenance has been completed
- After any repair which would affect collimator function described herein

4.2 EQUIPMENT

- Light meter, DIGAPHOT 330013303 or equivalent (accuracy 5% or better)
- Digital multimeter BECKMAN 3030 RMS or FLUKE Model 8030A, or equivalent
- HHS Field Test Kit (RAT' Kit) 46-177372G1, with new RAT pattern set 46-216074P1
- Radiation meter
- Standard Absorber 46-173632G1
- Radiographic cassettes 18x24cm, 24x30cm, 35x35cm, 35x43cm or 7"x10", 10"x12", 14"x14" 14"x17"
- A metric scale
- Size pattern (dwg Y702670 • attached)
- 4 brass plates (40x40x1mm) (P/N 45296219) (not required if RAT set is used)
4.3 Only for RAFL “S” Control Electronics

4.4 LIGHT FIELD BRIGHTNESS

**Check**
Perform the Collimator Light Field Intensity Test described in Section 6-3 of Direction 13894 “System Field Test for HHS”, provided in this manual as Section 11. The average illumination at a distance of 100 cm (39.37”) from the focal spot shall be less than 16 foot-candles (170 lux).

**Adjustment**
See Section 6, Para 6.5.5

4.5 LIGHT FIELD CONTRAST RATIO

**Check**
Perform the Collimator Light Field Contrast Ratio Test described in Section 6-4 of Direction 13894, “System Field Test for HHS”, provided in this manual as Section 11.

**Adjustment**
See Section 6, Para 6.5.6

4.6 Only for RAFL “S” Control Electronics
X-RAY FIELD VS LIGHT FIELD (see Figure 24)

**Check**

*Before performing this test, make sure the collimator axis is thoroughly aligned with the x-ray beam axis*

Place a 35x35cm (14"x14") cassette on the measuring plane. Center it with the light beam.

Move the x-ray assembly to 100cm (40") from the film plane. Considering that for a 14mm thick cassette the film plane is 12mm from the bottom. Delimit a 300x300mm light field. Put the four brass plates (40x40x1mm) at each of the four comers of the light field as shown in Figure 24 and a metal object to determine the direction of reading of the film.

Make the x-ray exposure and develop the film. Measure misalignment values R, R, X, X on the film, and verify that each is lower than or equal to 0.5% of the SID.

Turn the x-ray assembly and the measuring plane through 90° and repeat the test by projecting the beam in the horizontal axis.

**Adjustment**

Position of the lamp see Section 6 Para 6.5.2
FIELD SIZE INDICATION VS ACTUAL FIELD SIZE

Check

Before performing this test, make sure the collimator axis is thoroughly aligned with the x-ray beam axis.

Place a cassette larger than the field size to be tested (for instance 24x30cm for a 13x18cm x-ray field or a 10"x12" cassette for a 5"x8" x-ray field) on the measuring plane, and center it with the light beam.

Move the x-ray assembly to 100cm (or 40" or 44", according to your SID indication) from the film plane; considering that for a 14mm thick cassette the film plane is 12mm from the bottom.

Line up the index of one knob with the point indicating 13cm (or 5") on the curve of 100cm SID (or 40" or 44", according to your SID indication).

Line up the index of the other knob with the point indicating 18cm (or 8") on the curve of 100cm SID (or 40" or 44", according to your SID indication).

Make the x-ray exposure and develop the film.

Measure the dimension of the irradiated field on the film.

The difference with respect to the nominal field size shall be lower than or equal to 1% of the SID.

The same for the following sizes:
- 24x30cm at 120cm SID (or 10"x12" at 60" SID)
- 35x43cm at 180cm SID (or 14"x17" at 72" SID)

Adjustment

See Section 6 Para 6.5.23
4 9  EXTENSION CYLINDER ALIGNMENT CHECK (optional accessory)

Slide the extension cylinder onto the collimator tracks
With the beam vertical project the light field onto a white matte surface
The circle of light should be symmetrical about the crosshairs

If required, verify crosshair centenng with respect to the collimator axis as directed in Section 6, Para 6 5 3

Should the circle of light be still out of center with respect to the crosshair, shift the tracks in order to center them with respect to the collimator axis (see Section 6, Para 6 5 20)

4 10  BEAM QUALITY DETERMINATION

Perform the Half Value Layer Test described in Section 4 of Direction 13894, "System Field Test for HHS", provided in this manual as Section 11

All operator removable filters are to be removed

NOTE
For ULTRANET "S" in association with MAXIRAY 75, the ratio as measured as directed above, is often less than 0.5. In this case you have to mount a special finger cone [0.3 mm (+0.2 mm) thick], available as an option.

This check must be performed at installation and whenever any part of the Diagnostic Source Assembly involving absorption between the source and the patient has been repaired or replaced
Only for RAFL “S” Control Electronics

Dedicated to ULTRANET “SA”

PRESENCE OF LABELS AND DOCUMENTATION

Labels on the collimator

Verify the collimator is equipped with labels as per Figure 11b

Documentation

Verify the presence of the following documentation

sm = Service Manual
om = Operator Manual
6 SERVICE

61 PRELIMINARY

62 SPECIAL EQUIPMENT REQUIRED

63 REMOVING THE COVERS FROM THE COLLIMATOR

64 CONDITION FOR CHECKING

65 ADJUSTMENTS ON THE COLLIMATOR HEAD
   651 Dimensions of the x-ray field at maximum blade opening
   652 Centering the light beam with respect to the collimator axis
   653 Centering the cross-shaped light beam with respect to the collimator axis
   654 Blade parallelism and perpendicular
   655 Light field brightness
   656 Light field contrast ratio
   657 Projection of the reference beam for centering the bucky
   658 Testing the timer
   659 Dedicated to ULTRANET "SA"
   6510 Checking the adjustment of the blade braking clutches
   6511 Dedicated to ULTRANET "SA"
   6512 Dedicated to ULTRANET "SA"
   6513 Dedicated to ULTRANET "SA"
   6514 Pressure-sensitive handle
   6515 Dedicated to ULTRANET "SA"
   6516 Deleted
   6517 Testing the control buttons
   6518 Dedicated to ULTRANET "SA"
   6519 Dedicated to ULTRANET "SA"
   6520 Position of the accessory mounting tracks
   6521 Verifying the force required for collimator rotation and detent
   6522 Dedicated to ULTRANET "SA"
   6523 Position of the knobs with respect to the blade shafts
CHECKING the PRESENCE of **LABELS** and DOCUMENTATION

- Labels on the collimator
- Documentation

**REPAIR PROCEDURE**

- Replacing the lamp
- *Dedicated to ULTRANET ‘SA*
- *Dedicated to ULTRANET ‘SA*
- *Dedicated to ULTRANET “SA”*
- Replacing the detent and pawl springs
- Replacing the plexiglas plate
- Replacing the knobs
- Replacing the accessory mounting tracks
- Replacing the tape measure
- Replacing the mirror
- *Dedicated to ULTRANET ‘SA*
- Replacing the Belleville washer (3) Figure 52
- Replacing the blade antibacklash springs
- Replacing the “Angular Sensor, **LED** and Lamp Button” PWB
- *Dedicated to ULTRANET “SA”*
- Replacing the handle
- *Dedicated to ULTRANET ‘SA*
- Replacing the keyboard + PWB assembly
- Replacing the collimator light lens assembly
6.1 PRELIMINARY

This section describes the checks and the relevant adjustments to be performed to make sure the equipment complies with the performances declared.

6.2 SPECIAL EQUIPMENT REQUIRED

- Light meter DIGAPHOT 3300/3303 or equivalent (accuracy 5% or better)
- Digital multimeter, BECKMAN 3030 RMS or FLUKE Model 8030A, or equivalent
- Oscilloscope TEKTRONTX 564 or equivalent, memory type
- HHS Field Test Kit (RAT Kit) 46-1773726 I with new RAT pattern set 46-216074P1
- Radiation meter
- Standard Absorber 46-173632G
- Radiographic cassettes 18x24cm, 24x30cm, 35x35cm, 35x43cm or 7"x10", 10"x12", 14"x14", 14"x17"
- A metric scale
- Size pattern (dwg Y702670 - attached)
- 4 brass plates (40 x 40 x 1 mm) (P/N 45296219) (not required if RAT set is used)
- Set of wrenches (furnished with the collimator and to be left in site)
  - Hook wrench for collimator mounting ring (Part No 2231032)
  - Hex adapter (Part No 2223141)
  - ¼ Hex square adapter (Part No 2223142)
  - Two wrenches for 10/32" and 9/16" screws (Part No 45298477)
  - Two hook wrenches for 25mm castle nuts (Part No 45298476)
  - One knob position tool (Part No 2188963)
  - Hex square adapter (Part No 2223142)
- Set of wrenches (not furnished)
  - Torque wrench (for torquing the mounting ring) 3/8" square drive torque of 20 to 30 Nm (180 to 270 in lbs)
  - Torque screwdriver (for torquing the set screws) torque of 1.4Nm (12 in lbs)
63 REMOVING THE COVERS FROM THE COLLIMATOR

We identify below the covers of the collimator and list the steps required for disassembling.

A) Main cover (A) Figure 12
   - Remove the rear lid (1)
   - Disconnect the ground cable
   - Remove the six securing screws (2) and remove the main cover

B) Internal cover (B) Figure 13
   - Remove the five screws (1) Figure 13 and remove the internal cover

C) Front panel (C) Figure 9
   - Remove the knobs (by pulling them)
   - Loosen the two screws (1) Figure 9 and open the front panel
   - Disconnect the ground cable
   - Disconnect connector PR 1A
   - Remove the front panel

64 CONDITION FOR CHECKING

When checking as directed in this section, the collimator shall be mounted on a support (tubestand or suspension) with the following feature:

- SID ranges within 600mm and 1800mm, with a straight-line movement perpendicular to the measuring plane
- Possibility of projecting the x-ray beam in both vertical and horizontal axes
- The x-ray tube focal spot shall be 71.1mm from the upper plane of the collimator (see Figure 6) and the collimator axis shall be thoroughly aligned with the x-ray beam axis
6.5 ADJUSTMENTS ON THE COLLIMATOR HEAD

6.5.1 Dimensions of the x-ray field at maximum blade opening

**Check**
Move the collimator (turned downwards) to 600mm SID
Switch the light-beam centering device ON
Fully open the blades and verify the light field is 300x300mm (-0/+8mm)

**Adjustment**
Remove the collimator main cover
Set the collimator downwards
Fully open the blades and measure the distance between them (refer to Figure 31)
- distance A = 124mm (+/- 1mm)
- distance B = 134mm (+/- 1mm)
If required loosen the screws that secure stops (1) Figure 14 and adjust the field

6.5.2 Centering the light beam with respect to the collimator axis

**Check** (see Figure 18)
Move the collimator to 600mm SID
Set a 110x110mm field
Put the size pattern on the measuring plane and center it with respect to the light beam
Move the collimator to 1400mm SID
The new field (256x256mm) shall be centered with respect to the former (110x110mm)
Maximum misalignment allowed (x-x') and (y-y') less than 5mm

**Adjustment** (see Figure 32)
Remove the collimator front panel
- To adjust in direction C-D loosen the two screws (1) Figure 15
- To adjust in direction A-B loosen the two screws (2) Figure 15
Centering the cross-shaped light beam with respect to the collimator axis

Check (see Figure 19)
Move the collimator to 600mm SID
Switch the light-beam centring device ON and open the blades
Center the cross-shaped light beam with respect to the cross-lines of the size pattern
Move the collimator to 1400mm SID
Mark the position of the crosshair projection on the size pattern
The deviation (P and P’) of the crosshair from the cross-lines of the site pattern shall not exceed 2.5mm

Adjustment (GEMS tracks see Figure 25 - GEMS-E tracks see Figure 25a)
Loosen the screws (5) and (6) in the bottom of the collimator (screws (5) also secure the accessory mounting tracks and screws (6) secure the plexiglas plate only) Center the plexiglas plate and tighten screws (6) Before tightening screws (5) center the tracks as directed in Para 6.5.20

Blade parallelism and perpendicularity (see Figure 20)

Check
Move the collimator to 1000mm SID
Set a 300x300mm light field
Measure distances B and B’, C and C’, D and D’
Verify that |B - B’| = |C - C’| = |D - D’| do not exceed 1.5mm

Adjustment
Remove the collimator main cover
While maintaining the height of the blades on their arms unchanged, slightly loosen the screws that secure each blade to be adjusted and turn the blade about the axis of the screws to adjust the position when opening or closing
Light field brightness (see Figure 23)

**Check**
See Section 4, Para 44

**Adjustment**
An average illumination of 170 lux is required (*plus the value of the ambient lighting and the error in the test meter*).

Should illumination be out of the allowance, first inspect the lamp, the mirror and the plexiglas plate, as dust may be the cause of the fault.

Remove the collimator main cover and fully open the blades.

Clean the above parts with antistatic fluid and a non-fluffy cloth, taking care not to scratch the surfaces.

Should illumination be still unsuitable after cleaning, measure the voltage across the lamp.

**IMPORTANT**
*Voltage (under load) shall not be less than 23 Vrms (plus the error in the meter) for GE lamp or 21 Vrms (plus the error in the meter) for other types of lamps.*

Should illumination be still unsuitable after the above steps, replace the lamp as directed in Para 681.

Light field contrast ratio (see Figures 21 and 22)

**Check**
See Section 4, Para 45

**Adjustment**
Should contrast be out of the allowance, first inspect the lamp, the mirror and the plexiglas plate as dust may be the cause of the fault.

Remove the collimator main cover and fully open the blades.

Clean the above parts with antistatic fluid and a non-fluffy cloth, taking care not to scratch the surfaces.
Projection of the reference beam for centering the bucky

**Check**

**Alignment (longitudinal alignment)**
- Move the collimator at 1000mm SID
- **Switch** the light-beam centering device ON and align the light field with the size pattern.
- Lengthen the transverse cross-line of the size pattern.
- Verify that the bucky centering beam coincides with the mentioned cross-line (maximum misalignment allowed +/−5mm) (“+” means a misalignment on the right and “−” means a misalignment on the left).

**Focusing**
- Move the collimator to 1000mm SID and **verify** the reference beam is in focus.

**Adjustment** (see Figure 17)
- Remove the collimator main cove, the internal cover and the front panel.

**Alignment (longitudinal alignment)**
- Loosen the screws (1).
- Move the centering device longitudinally and tighten the screws.

**Focusing**
- Loosen the knurled screw (2) and move the lens assembly.

**Testing the timer**
- **30 seconds**
  - Verify that J1 (Keyboard PWB) is closed.
  - Switch the lamp ON and verify that the illumination time is 30s (+/−3s).

- **60 seconds**
  - Open J1 (Keyboard PWB) or make sure it is open.
  - Switch the lamp ON and verify that the illumination time is 60s (+/−6s).
6.5.10 Checking the adjustment of blade braking clutches

**Check**

Verify that the torque required for rotating the knobs that actuate the blades, is within **0.125 Nm** and **0.375 Nm**

(This is equivalent to a force within **50 g** and **150 g** applied to a **250 mm** lever arm articulated on the rotation axis of the knobs)

**Adjustment**

Longitudinal blades

Remove the collimator main cover

Loosen the counter ring nut (3) Figure 14 and tighten or loosen the ring nut (2) in order to obtain the required value

Should a spring gauge and a lever arm be unavailable, proper adjustment will be obtained as follows:

- Loosen the counter ring
- Loosen the ring nut
- Tighten the ring nut until it comes into contact with the Belleville washers
- Now continue tightening the ring nut by about **135°** (1 notch and 1/2)
- Tighten the counter ring nut definitively

Transversal blades

Remove the collimator main cover

Loosen the counter ring nut (6) Figure 13 and tighten or loosen the ring nut (7) in order to obtain the required value

Should a spring gauge and a lever arm be unavailable, refer to the above description
Pressure-sensitive handle (see Figure 34)
see schematics 45296017-030 (OLD, NEW XT) or
45296046-030 (COMPAX400/400T & YTT) or
45296650-030 (RS-85) or
45296671-030 (SOLARIX)

Check
Connect an ohmmeter to terminals 1 and 5 of PR4
Squeeze the actuators located on the handle and verify the contact closes
Release the actuators and verify the contact opens
Measure the force required for actuating the contact at the center and at the ends
of the actuators
The force shall be within 0 8kg and 3kg
Testing the control buttons
see schematics 45296017-030 and 45296623-040 (OLD & NEW XT) or
45296046-030 and 45296622-040 (COMPAX 400/400T & I/IT) or
45296950-030 and 45296623-040 (RS85) or
45296671-030 and 45296672-040 (SOLARIX)

Lock the collimator rotation by actuating the relevant knob
Press the following keys one by one and check

**XT Suspension (OLD NEW & RS85)**
- BP1 contact open E and F of J/P2
- BP2 contact open J and F of J/P2
- BP3 contact closed D and F of J/P2
- BP4 contact closed A and F of J/P2
  contact open 1-PR4 and 1-PR5
- BP5 contact closed H and F of J/P2
  contact closed N and F of J/P2
- BP6 contact closed B and F of J/P2
  (also squeeze the handle and press BP3)

**COMPAX (400/400T & I/IT)**
- BP1 contact open E and F of J/P2
  (also squeeze the handle)
- BP2 contact open J and F of J/P2
  (also squeeze the handle)
- BP3 contact open C and F of J/P2
  (also squeeze the handle)
- BP4 contact closed A and F of J/P2
  contact open 1-PR4 and 1-PR5
- BP5 contact closed H and F of J/P2
  contact closed N and F of J/P2
  (also squeeze handle and press BP3)
- BP6 contact closed B and F of J/P2

**SOLARIX**
- BP1 contact open E and F of J/P2
  (also squeeze the handle)
- BP3 contact open C and F of J/P2
  (also squeeze the handle)
- BP4 contact closed A and F of J/P2
  contact open 1-PR4 and 1-PR5

**6 5 18 Dedicated to ULTRANET “SA”**

**6 5 19 Dedicated to ULTRANET “SA”**
6 5 20  Position of the accessory mounting tracks

Check (GEMS tracks see Figure 25 • GEMS-E tracks see Figure 25a)
Verify that the tracks are positioned as specified below

- Distance between tracks (end of the groove), symmetrical vs the crosshair
  - GEMS tracks 164mm
  - GEMS-E tracks 178mm

- Transverse centering
  (from the travel-limit pin located in the tracks to the center of the crosshair)
  - GEMS tracks 79mm
  - GEMS-E tracks 88mm

Adjustment (GEMS tracks see Figure 25 • GEMS-E tracks see Figure 25a)

Loosen the six screws (5) and position the tracks as required
Do not handle the four screws (6) which secure the crosshair plate’

6 5 21  Verifying the force required for collimator rotation and detent

Check
Place the collimator as for a vertical projection
Release the rotation lock (C) Figure 49
Verify that the force (applied to the handle) required for rotating the collimator be within 1.5kg and 3.5kg in any position
Verify that the force (applied to the handle) required for moving the collimator out of the detent areas be within 6kg and 9.5kg in any position

Adjustment (see Figure 49)
This adjustment is factory-made
Should both the above values be low replace the springs (A) Figure 49 as directed in Para 6 8 5

6 5 22  Dedicated to ULTRANET “SA”
65 23  Position of the knobs with respect to the blade shafts (see Figure 61)

*Check*
See Section 4, Para 4 8

*Adjustment*
Should all the values measured be out of the allowances, switch OFF the collimator and with the front panel removed and knobs in place, fully close the longitudinal and lateral blades (x, y)

Remove the two knobs with caution and loosen the two M4 screws that secure each knob hub holder (3) Figure 61 on collimator blade shafts

Loosen also the dowel M₄ₓ₆ (1) Figure 61 with a CH₂ Allen wrench in each shaft placed, to permit an easy insertion of the Tool

Insert the Tool on the two free knob hub holders, using the Inch or Cm setting according to the type of collimator front panel in place

(The unused part will appear reversed and above the one used)

Push the Tool so that it is engaged on about 10mm

Tighten the two most accessible M₄ screw (2) Figure 61 for both shaft when pushing on the Tool to make sure the knob hub holders are fully engaged on both collimator blade shafts

Remove the Tool tighten the second set of screws to completely secure both shafts, and reinstall all remaining parts that belong to the collimator like covers, front panel, knobs etc

Perform functional checks of the mechanism for fully close and fully open blade position and compare the field size indicators and index printed on the knobs

66  Only for RAFL "S" Control Electronics

67  PRESENCE OF LABELS AND DOCUMENTATION

671  Labels on the collimator

Verify the collimator is equipped with labels as per Figure 11b

672  Documentation

Verify the presence of the following documentation

- om = Operator Manual
- sm = Service Manual
Replacing the lamp (see Figures 7, 9 10 10b and 11)

**WARNING**

**HIGH-INTENSITY LAMP**

**DO NOT REMOVE THE LID WHEN THE LAMP IS ON**

**LAMP OR HOUSING MAY BE HOT**

**ALLOW COOLING BEFORE HANDLING**

Turn the power **OFF**

Remove the knobs (1) Figure 7 by simply pulling them

Loosen the two screws (1) Figure 9 and open the front panel

Loosen the screw (1) Figure 10 and remove the black lid

Pry the lamp out with a screwdriver as shown in Figure 11

Insert the screwdriver between the lamp socket and the socket in the lamp holder and **prize**

Replace the lamp taking care not to touch the bulb with your fingers as finger grease or perspiration may damage the quartz in the lamp

Push the new lamp **fully** into the socket

Reassemble the parts

**WARNING**

**BEFORE MOUNTING THE FRONT PANEL AGAIN,**

**MAKE SURE THE GROUND CABLE (YELLOW-GREEN) IS CONNECTED TO THE FRONT PANEL ITSELF**

**Check**

After replacement of the lamp if there is not uniformity of the light field in the four (4) quadrants as described in the norm “Direction 13894” (SM Service Manual Section 4 and 6) adjust the mask as below

**Adjustment**

Remove the black lid loosening the screw (1) Figure 10

Making sure that the lamp is **fully** into the socket

Loosen the two screws (1) Figure 10b, and adjust the mask (2) Figure 10b by shifting it in any possible position to obtain a proper illumination uniformity as required in the four (4) quadrants

Do reference Para 655 to perform the light measurements
682 Dedicated to ULTRANET "SA"

683 Dedicated to ULTRANET "SA"

684 Dedicated to ULTRANET "SA"

685 Replacing the detent and pawl springs (see Figure 49)

Remove the collimator from the suspension or column
Place the collimator on a plane, resting on the accessory mounting tracks
Remove the eight M4x8 screws (1)
Remove the disc (2)
Replace the springs, detail (A) and (B)
- Detent detail A (Part No 45296267 - Set of three springs)
- Pawl detail B (Part No 45298475 - One spring)

686 Replacing the plexiglas plate

Replacement procedure
- GEMS Tracks (see Figure 25)
  Remove the collimator main cover
  Remove the two screws (9) and slide off the guard frame (7)
  Remove the six screws (5) and remove the two accessory mounting tracks (4)
  Remove the four screws (6) and remove the plexiglas plate (3)
  Mount the new plexiglas plate
  Temporarily secure it with the four screws (6)

- GEMS-E Tracks (see Figure 25a)
  Remove the collimator main cover
  Remove the two screws (9) and slide off the guard frame (7)
  Remove the six screws (5) and remove the two accessory mounting tracks (4)
  and spacers (8)
  Remove the four screws (6) and remove the plexiglas plate (3)
  Mount the new plexiglas plate
  Temporarily secure it with the four screws (6)

Adjusting the position of the plexiglas plate
Adjust the position of the plate as directed in Para 6 5 3

Mounting and adjusting the accessory mounting tracks
After centering the plexiglas plate, mount the accessory mounting tracks
Adjust their position as directed in Para 6 5 20
Replacing the knobs

Firmly grip the knob (1) Figure 7 and pull
Approach the new knob to the hub, rotate it so that the outline of the hub aligns
with the notch in the knob

Push the knob until it clamps on the hub

Replacing the accessory mounting tracks

Replacement procedure

- **GEMS Tracks** (see Figure 25)
  Remove the collimator main cover
  Remove the two screws (9) and slide off the guard frame (7)
  Remove the six screws (5) and remove the two accessory mounting tracks (4)
  Do not handle the four screws (6) that secure the plexiglas plate!
  Mount the new tracks and the guard frame (7)

- **GEMS-E Tracks** (see Figure 25a)
  Remove the collimator main cover
  Remove the two screws (9) and slide off the guard frame (7)
  Remove the six screws (5) and remove the two accessory mounting tracks (4)
  and spacers (8)
  Do not handle the four screws (6) that secure the plexiglas plate!
  Mount the new tracks and the guard frame (7)

Adjustment procedure

Adjust the position of the tracks as directed in Para 6 5 20
Replacing the tape measure (see Figures 7, 9, 10 and 10a)

Turn the power OFF
Remove the knobs (1) Figure 7 by simply pulling them
Loosen the two screws (1) Figure 9 and open the front panel
Move the flat spring (2) Figure 10 and remove the tape measure from its seat
Cut the terminal portion of the tape measure and slide the steel tape off the collimator
Mount the new tape measure into its seat
Slide the end of the tape measure through the slot in the collimator bottom and mount the rubber bumper (2) Figure 10a (if required wrap some adhesive tape around the end of the tape measure) as directed below

- Slide the end of the tape measure (or the adhesive tape) through the bumper (2) as directed in Figure 10a
- (If required remove the adhesive tape)
- Mount the tab (4) and set the bumper (2) in position (see Figure 10a)

Reassemble the parts

WARNING
Before mounting the front panel again, make sure the ground cable (yellow-green) is connected to the front panel itself

Replacing the mirror (see Figure 48)

Removal procedure

Remove the collimator main cover
Fully open the blades
Remove the screw (2) and plate (1)
Slide the mirror off the two clamps and remove it

Mounting procedure

WARNING
The new mirror shall be accurately mounted.

Slide the new mirror into the two clamps until it stops
Mount the plate (1) with the 45° round-off towards the mirror
Position the plate so that once the screw is tightened it is tangent to the mirror without overlapping
Tighten the screw (2) and mount the main cover
6811 Dedicated to ULTRANET “SA”

6812 Replacing the Belleville washers (3) Figure 52

*Replacement procedure* (see Figure 52)

Remove the collimator main cover
Remove the counter ring (1) and the ring nut (2) using the wrenches furnished with the collimator
Remove the *old* Belleville washers (3) and replace them
Reassemble the parts

*Adjusting the load of the Belleville washers (clutch)*

Adjust the thrust exerted by the Belleville washers as directed in Para 6510

6813 Replacing the blade antibacklash springs (see Figures 50 and 51)

Longitudinal blades antibacklash spring (1) Figure 50
Remove the collimator main cover
Fully open the longitudinal blades
By means of tweezers, seize an end of the spring and unhook it
Unhook the other end of the spring
Mount the new spring

Transverse blades antibacklash spring (1) Figure 51
Fully open the transverse blades
Same steps as above

6814 Replacing the “Angular Sensor, LED and Lamp Button” PWB
(detail (4) Figure 15)

Remove the collimator knobs (by pulling them)
Loosen the *two* screws (1) Figure 9 and open the front panel
Disconnect connector PRI A
Loosen the two nuts and remove the PWB
Mount the new PWB and connect connector PRI A
Close the front panel and mount the knobs
6 8 15  *Dedicated to ULTRANET “SA”*

6 8 16  **Replacing the handle**

Remove the collimator main cover and the internal cover  
Remove the four M4 hexagonal socket screws (1) Figure 53  
Disconnect the ground wire  
Disconnect connector PR4  
Remove the handle sliding off the cables from their paths  
Mount the new handle (invert the procedure described above)

6 8 17  *Dedicated to ULTRANET “SA”*

6 8 18  **Replacing the keyboard + PWB assembly** (see Figure 15 and 55)

Remove the rear cover (3 screws)  
Remove the rear main cover (6 screws) (See Figure 12)  
Remove the internal cover (5 screws) (See Figure 13)  
Remove the two knobs by pulling them straight out  
Remove the front panel by loosening the two screws at the top (See Figure 9)  
Remove the connectors and remove the front panel  
Remove the connectors to the keyboard assembly  
Mount the new keyboard assembly and replace the front handle assembly  
Replace the other connectors  
Replace the internal cover, main cover and rear cover
Replacing the collimator light lens assembly (see Figure 59) (for Bucky tray alignment)

Removal procedure

Remove the knobs by gripping them firmly and pull (1 Figure 7)
Remove the Front Panel (C Figure 9) by loosening the two screws (1) Figure 9 and open the front panel
Disconnect the ground cable and the connector PRIA
Remove the front panel

WARNING

High-intensity lamp' Do not remove the lid when the lamp is ON
Lamp or housing may be hot Allow cooling before handling

Do not touch the lamp with the fingers.

Loosen the screw (1) Figure 10 and remove the black lid
Loosen the two screws (1) Figure 15 and remove the lamp heatsink
Loosen the screw (1) Figure 59 and replace the collimator light lens assembly

Mounting procedure

Mount the new one with the regulation screw in the front side of the collimator and keep the top of the collimator light lens assembly 3mm out of the support plane
Tighten the screw (1) Figure 59
Mount the lamp heatsink and tighten the two screws (1) Figure 15
Reassemble the parts

WARNING

Before mounting the front panel again, make sure the connector PRIA and the ground cable (yellow-green) are connected to the front panel itself

Mount the knobs by pushing them until they clamp on the hub

Adjusting procedure

For new adjustments operate as directed in Para 652 and in Para 657
# ULTRANET “SM”

**LEGEND**

| ES | = Electrical Schematic |
| LD | = Layout Drawing |

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Y702670 Size Pattern

**VALIDITY**

From SNo 6086 YY

**UNIT**

ULTRANET “SM”

Y709130/F

Date JUL/30/96  Author CERVINI  Verified by VARISCO
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RENEWAL PARTS
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<td>Plexiglas plate</td>
<td>1</td>
<td>1</td>
<td>45298002</td>
</tr>
<tr>
<td>1 Fig 7</td>
<td>Knob</td>
<td>2</td>
<td>1</td>
<td>2205271</td>
</tr>
<tr>
<td>5 Fig 10a</td>
<td>Tape measure</td>
<td>1</td>
<td>1</td>
<td>45296021</td>
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<td>4 Fig 10a</td>
<td>Tab</td>
<td>1</td>
<td>1</td>
<td>45298258</td>
</tr>
<tr>
<td>2 Fig 10a</td>
<td>Bumper</td>
<td>1</td>
<td>1</td>
<td>45298242</td>
</tr>
<tr>
<td>3 Fig 48</td>
<td>Mirror</td>
<td>1</td>
<td>1</td>
<td>45298006</td>
</tr>
<tr>
<td>4 Fig 15</td>
<td>Lamp Push Button PWB</td>
<td>1</td>
<td>1</td>
<td>45296192</td>
</tr>
<tr>
<td>13 Fig 7</td>
<td>Push button cap</td>
<td>1</td>
<td>1</td>
<td>0630268</td>
</tr>
<tr>
<td>Fig 34</td>
<td>Pressure sensitive handle assembly</td>
<td>1</td>
<td>1</td>
<td>2205272</td>
</tr>
<tr>
<td>1 Fig 34</td>
<td>Contact for pressure sensitive handle</td>
<td>2</td>
<td>1</td>
<td>45298222</td>
</tr>
<tr>
<td>3 Fig 17</td>
<td>Keyboard assembly (ULTRANET XT)</td>
<td>1</td>
<td>1</td>
<td>45296648</td>
</tr>
<tr>
<td>3 Fig 17</td>
<td>Keyboard assembly (ULTRANET COMPAX)</td>
<td>1</td>
<td>1</td>
<td>45296650</td>
</tr>
<tr>
<td>3 Fig 17</td>
<td>Keyboard assembly (ULTRANET SOLARIX)</td>
<td>1</td>
<td>1</td>
<td>45296673</td>
</tr>
<tr>
<td>3 Fig 17</td>
<td>Keyboard assembly (ULTRANET RS85)</td>
<td>1</td>
<td>1</td>
<td>45296648</td>
</tr>
<tr>
<td>2 Fig 58</td>
<td>Hook wrench for 25mm castle nuts</td>
<td>2</td>
<td>1</td>
<td>45298476</td>
</tr>
<tr>
<td>1 Fig 58</td>
<td>Wrench for 10 - 32&quot; and 9 - 16&quot; screws</td>
<td>2</td>
<td>1</td>
<td>45298477</td>
</tr>
<tr>
<td>4 Fig 58</td>
<td>Hook wrench for collimator mounting nng</td>
<td>1</td>
<td>1</td>
<td>2231032</td>
</tr>
<tr>
<td>5 Fig 58</td>
<td>Hex.adapter (2 5mm x 100 mm)</td>
<td>1</td>
<td>1</td>
<td>2223141</td>
</tr>
<tr>
<td>6 Fig 58</td>
<td>¼&quot; Hex to ¼&quot; square drive adapter</td>
<td>1</td>
<td>1</td>
<td>2223142</td>
</tr>
<tr>
<td>7 Fig 58</td>
<td>Dowels M5x8 (for locking ring)</td>
<td>3</td>
<td>1</td>
<td>0418751</td>
</tr>
<tr>
<td>Fig 59</td>
<td>Collimator light lens assembly (for bucky alignment)</td>
<td>1</td>
<td>1</td>
<td>0634400</td>
</tr>
<tr>
<td>Fig 60</td>
<td>Light Deviation Device</td>
<td>1</td>
<td>2</td>
<td>2205270</td>
</tr>
<tr>
<td></td>
<td>Installation kit</td>
<td>1</td>
<td>N</td>
<td>45296996</td>
</tr>
<tr>
<td></td>
<td>Mounting tools and first-need kit</td>
<td>1</td>
<td>1</td>
<td>45296614</td>
</tr>
</tbody>
</table>
10 PERIODIC MAINTENANCE

10.1 GENERAL,

10.2 EQUIPMENT REQUIRED

10.3 REMOVING THE COVERS FROM THE COLLIMATOR

10.4 LUBRICATION

10.5 COLLIMATOR GENERAL INSPECTION

10.6 CHECKING THE TIGHTNESS OF THE COLLIMATOR MOUNTING RING

10.7 CHECKING ELECTRICAL CABLES, ELECTRICAL CONNECTIONS AND CABLE CONNECTION POINTS

10.8 REASSEMBLING THE PARTS
10.1 GENERAL

The maintenance procedures given can be performed at the site with relative ease.

**WARNING**

*Do not change factory adjustment*

10.2 EQUIPMENT REQUIRED

- Standard tools
- LUBRIPLATE 630-AA Grease (or equivalent)
- Loctite 243 (or Loctite 222 P/N 46-170683P1)
- Set of wrenches *(furnished with the collimator and left in site)*
  - Hook wrench for collimator mounting ring (Part No 2231032)
  - Hex adapter (Part No 2223141)
    - ½" Hex square adapter (Part No 2223142)
  - Two wrenches for 10/32" and 9/16" screws (Part No 45298477)
  - Two hook wrenches for 25mm castle nuts (Part No 45298476)
  - One knob position tool (Part No 2188963)
- Set of wrenches *(not furnished)*
  - Torque wrench (for torquing the mounting ring) 3/8" square drive torque of 20 to 30 Nm (180 to 270 in lbs)
  - Torque screwdriver (for torquing the set screws) torque of 1,4Nm (12 in lbs)

10.3 REMOVING THE COVERS FROM THE COLLIMATOR

We identify below the covers of the collimator, and list the steps required for disassembling.

A **Main cover** (A) Figure 12

- Remove the rear lid (1)
- Disconnect the ground cable
- Remove the six securing screws (2) and remove the main cover

B **Internal cover** (B) Figure 13

- Remove the five screws (1) Figure 13 and remove the internal cover

C **Front panel** (C) Figure 9

- Remove the knobs (by pulling them)
- Loosen the two screws (1) Figure 9 and open the front panel
- Disconnect the ground cable
- Disconnect connectors PR1A and PR2
- Remove the front panel
LUBRICATION (every 12 months)

Apply a light coating of LUBRIPLATE 630-AA or equivalent to the following parts

Worm screw (Figure 13 - item 4)
The figure shows the worm screw coupled to motor M2
Also lubricate the worm screw coupled to motor M1

Clutch (Figure 13 - item 5)
Do not loosen the clutch. Grease is to be applied to its outer surface
The figure shows the clutch for motor M2
Also lubricate the clutch for motor M1

Blade pivot points (Figure 13 - item 3)
The figure shows only two of the eight points to be lubricated
Also lubricate the other six points

Open and close the blades several times to distribute the lubricant

COLLIMATOR GENERAL INSPECTION (every 12 months)

Light field quality is affected by dust build-up or smudges on the window or mirror

Check for any grime on the inner and outer surfaces of the window
Clean with x-ray screen cleaner

Check for any grime on the mirror surface
Carefully clean the mirror with a soft cloth moistened in a mild soap and water solution
Wipe dry using another soft, dry cloth
(A commercial glass cleaner could also be used to clean the mirror)

EXTRA CARE IS NECESSARY SINCE THE REFLECTIVE SURFACE CAN BE EASILY SCRATCHED
10 6  

CHECKING THE TIGHTNESS OF THE COLLIMATOR MOUNTING RING (every 12 months)

1061  

If the collimator has play, you must remount it correctly

Locate the installation procedure 3 6 of Chapter 3
Rotate tube/collimator assembly to bring the collimator bottom up
Disconnect the cables at the back of the collimator
Remove the blocking screws (dowels) and unscrew the mounting ring
Remove the collimator from the interface plate
Put it on the table top taking care of not scratching the top surface
Reassemble all parts following the installation procedure 3 6 of Chapter 3
Pay particular attention to foreign particles or chips that could prevent the ring or dowels being correctly tightened

1062  

If the collimator has no play, you must only check it is safely mounted

Locate the wrench or extension tools provided with all collimators
Check that it is not possible to slide the queue of one of these tools into the space between the ring top surface and the bottom of the interface plate
If the tool can be inserted it means the ring is not fully tighten, in this case you must perform procedure given in 10 6 1
If the tool can not be inserted simply check visually the dowels are present

WARNING

ANY TIME YOU SCREW OR UNSCREW THE BLOCKING SCREWS (DOWELS), YOU HAVE TO LOCTITE THEM AGAIN WITH LOCTITE 243 (OR LOCTITE 222) TO ENSURE THE GLUE EFFECTIVENESS INSIDE THE DOWELS THREADED HOLES
10.7 CHECKING ELECTRICAL CABLES, ELECTRICAL CONNECTIONS AND CABLE CONNECTION POINTS (every 12 months)

Verify that
- The electrical cables are not scratched
- The connectors are secure on their sockets
- The cable fasteners are secure

10.8 REASSEMBLING THE PARTS

Stick to the following sequence
1. Internal cover (B) Figure 13
2. Main cover (A) Figure 12
3. Front panel (C) Figure 9

WARNING

BEFORE MOUNTING THE COVERS, BE SURE THAT ALL THE GROUND CABLES ARE CONNECTED
This is an abstract of Direction 13894 (Sections 4 and 6)

"System Field Test for HHS"

This section is furnished for information
No responsibility is taken on future updating or modification
SECTION 4
X RAY BEAM TESTS

4-1  Beam Quality (Half Value Layer)

Application

All diagnostic source assemblies except MMX but including MBN at installation and whenever replacing tube unit insert mylar window collimator mirror table top or other absorption between source and patient

Note  See Section 7 for Mammographic units

Requirement

The half-value layer of the useful beam at a given kVp shall not be less than that shown in Table 4-1. These requirements are from 21CFR part 1020.30 (m). Specific test point is at 80 kVp thus the minimum half-value layer requirement is 2.3 mm of aluminum.

Since the standard test absorber is 2.5 mm, the procedure described below allows for radiation measurement tolerance with respect to rejection limits kVp must have been previously calibrated.

### TABLE 4-1
**MINIMUM HALF-VALUE LAYER**

<table>
<thead>
<tr>
<th>Design Operating Range (Kilovolts Peak)</th>
<th>Selected kVp</th>
<th>Minimum Half-Value Layer (Millimeters of Aluminum)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 50</td>
<td>30</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0.5</td>
</tr>
<tr>
<td>50 to 70</td>
<td>50</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>1.5</td>
</tr>
<tr>
<td>Above 70</td>
<td>71</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>80*</td>
<td>2.3*</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>130</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>4.1</td>
</tr>
</tbody>
</table>

* Specific test point.
** Type 1 100 aluminum
Summary

1. Measure radiation level at prescribed exposure technic.
2. Add the standard absorber and measure reduced radiation level. This measurement must indicate 50% or more of initial reading.
3. If less than 50% remove standard absorber and add fixed absorber to the beam.
4. It will be found generally that radiographic x-ray sources with collimators already include sufficient filtration (due to mirror in collimator) but that under table and other x-ray sources without light beams may require additional fixed filtration.

Procedure

Note

Familiarity with Section 2 Instrumentation is assumed in the following procedure. This procedure is described at 80 kVp using the standard test absorber. In case the equipment cannot operate at 80 kVp, the regulation prescribes other voltages and corresponding minimum thickness of absorber as given in Table 4-1. If test is to be made below 70 kVp, contact Region Support Engineer for special radiation instrument considerations.

Note

For alternate method refer also to "Beam Quality (Half Value Layer) Measurements Graphical Method" at the end of Section 4-1.

1. Position radiation probe as shown in Illustration 4-1 “Good Geometry”. For fluoroscopic tests use an exposure rate or exposure measuring instrument and for radiographic tests use an exposure measuring instrument. See Illustration 4-2 for a typical LU configuration.

2. The optimum position for the standard absorber is midway between the focal spot and the radiation probe. Other positions will introduce reading errors. For example, if the absorber is placed close to the probe then the probe will receive excess scatter and the absorber will appear to have absorbed less.

3. Position image intensifiers or other equipment at least 4” away from probe to prevent radiation scatter errors.
4. Set technical factors as follows

Fluoroscopic: 80 kVp, 2 mA (use Spot Film mode if possible)

Radiographic: 80 kVp 50 to 100 mA 1/2 to 1 second mA and tune should be adjusted so that reading in Step 6 contains three significant digits.

5. Remove all filters that are removable by the operator and collimate slightly larger than active volume of probe using usage system or light field.

6. Make an exposure and measure exposure or exposure rate with no added filters. Record readings. This represents 100% transmission level.

7. Place standard absorber 46 17363261 in beam. Absorber must be on table top or in collimator accessory rails. Repeat exposure and record reading.


<table>
<thead>
<tr>
<th>Std. Absorber Reading</th>
<th>Fixed Filtration Must Be</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Ratio Is</td>
<td>Fixed Filtration Must Be</td>
</tr>
<tr>
<td></td>
<td>Left as is</td>
</tr>
<tr>
<td>0.5 or greater</td>
<td>Added (mandatory)</td>
</tr>
<tr>
<td>Less than 0.5</td>
<td></td>
</tr>
</tbody>
</table>

**Note**

The 0.5 minimum ratio is mandatory. However, above 0.57, there will be a noticeable reduction in radiation and loss of radiographic contrast.

---

**Mini-Troubleshooting Guide**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLV too high [&gt;0.57]</td>
<td>• kVp incorrect (high)</td>
</tr>
<tr>
<td></td>
<td>• Meter error → probe saturation see Section 2</td>
</tr>
<tr>
<td></td>
<td>• Excessive anode wear</td>
</tr>
<tr>
<td>HVL too low</td>
<td>• kVp incorrect (low)</td>
</tr>
<tr>
<td></td>
<td>• Not enough filtration</td>
</tr>
</tbody>
</table>
Recording Data

Record in F3382 for each diagnostic x-ray source

1. The ratio of two readings using the standard absorber (after all fixed absorbers have been installed)
2. The amount of fixed absorber added or removed from each source

COMMON PROBLEMS TO AVOID

- USEFUL BEAM SMALLER THAN ACTIVE AREA OF PROBE
- USEFUL BEAM SIGNIFICANTLY LARGER THAN ACTIVE AREA OF PROBE
- PROBE NOT 12" FROM ABSORBER
- INTENSIFIER (OR ANYTHING ELSE) WITHIN 4' OF PROBE

ILLUSTRATION 4-1
HALF VALUE LAYER

GOOD GEOMETRY (NOTE BEAM WIDTH)
ILLUSTRATION 4-2
HALF VALUE_LAYER

TEST SET UP " OVERTABLE LATERAL SOURCE OR C-ARM OR LU ARM 

LATERAL INTENSIFIER

SUPPORT OUTSIDE BEAM

4" MIN

12-
(30 cm)

USEFUL BEAM

STANDARD ABSORBER

DIAGNOSTIC SOURCE ASSEMBLY

CATH TABLE
Beam Quality (Half Value Layer) Measurements  Graphical Method

Note
Not applicable for Mammography  (For Mammography see instead Section 7-5)

Many Field Engineers have inquired about the graphical method of determining half value layer used by the FDA and so we are presenting that method here  The graphical method will provide the actual value of the half value layer as opposed to the pass/fail result of the test shown earlier in this section  Either method is acceptable for our purposes

Theory
The exposure rate at any given point is approximately a logarithmic function of the thickness of filtration in the x-ray beam Therefore if exposure readings are taken with various thicknesses of added filtration in the beam including zero added filtration and the results are plotted on semi-log paper as a function of the added filtration then the result will be a straight line  The point where this line crosses the 50% relative exposure level corresponds to the half value layer  In practice the exposure readings are normalized (each reading is divided by the exposure with zero added filtration), before being plotted  In this way we plot relative exposure vs filter thickness

Procedure

1  Follow the standard set up procedure as described earlier in this section and take exposure readings with zero, 1 mm 2 mm 3 mm and 4 mm of added filtration  Take several exposures at each filter thickness and obtain an average exposure for each filter

2  Divide each reading by the exposure value obtained with zero added filtration  Express the results as percentages  The reading with zero added filtration then becomes 100%

3  Plot the data on semi-log paper with the filter thickness being the standard axis and the relative exposure values being the logarithmic axis  (Refer to Illustration 4-3 for example of a graph for half value layer)  You should be able to draw a straight line through the points

Note
If you cannot draw a straight line that goes through the 100% point and comes within 2% or 3% of each of the other data points then something changed during the course of the test  Check for stable kVp mA meter or probe saturation  good reproducibility or a change in position of the probe

4  Mark the point where the line of step 3 crosses the 50% relative exposure line  Read the filter thickness corresponding to this line  This is your half value layer

Note
You must have at least one data point on each side of the 50% relative exposure
ILLUSTRATION 4-3
EXAMPLE OF A GRAPH FOR HALF-VALUE LAYER (N/A FOR MAMMO)

Example

<table>
<thead>
<tr>
<th>Added Filter</th>
<th>Exposure</th>
<th>Relative Exp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mm</td>
<td>1640 mR</td>
<td>div by 1640</td>
</tr>
<tr>
<td>1 mm</td>
<td>1345 mR</td>
<td>div by 1640</td>
</tr>
<tr>
<td>2 mm</td>
<td>1082 mR</td>
<td>div by 1640</td>
</tr>
<tr>
<td>3 mm</td>
<td>935 mR</td>
<td>div by 1640</td>
</tr>
<tr>
<td>4 mm</td>
<td>738 mR</td>
<td>div by 1640</td>
</tr>
</tbody>
</table>

Straight line crosses 50% relative exposure line at corresponding filter value of 3.50 mm aluminum. Half Value Layer = 3.50 mm aluminum.
SECTION 6
COLLIMATOR TESTS

6–1 Collimator Function

This test is divided into four versions to suit different types of collimators

Auto Rad Collimator Version

Undeniable Ruoro Collimator Version

Vascular Collimator Version

Manual Collimator Version

Certain collimators which are part of specialized equipment may have functional requirements in addition to the generalized requirements of this section. Refer to the applicable service manual.

- Changex II
- LU Arm
- Maxitome III
- Exatome
- Polanx
- Telegem 90
- Televix
- Prestux
- VTX
- Stenoscop

Note: Functional tests of a collimator must be complete before performing alignment and SID tests (Section 6–2 of this direction).

Note: There is an HHS requirement for a minimum distance of 30 cm between the focal spot and the patient. Most collimators accommodate this requirement in the design of the collimator. However, in some cases a skin spacer or handle extension is used. Make sure that such features, if provided, are indeed attached to the collimator.
6-1-1 Functional Test - Auto Rad Collimator Version

Application

This set applies to any radiographic adjustable collimator with positive beam limiting capability. Perform at installation and after any repair which might affect this function.

Requirements

Requirements are defined in Collimator service manual.

SID scale and/or SID indication must be present.

Procedure

Check each mode of operation. Verify that collimator enters correct mode when all conditions are met. Also, verify that collimator does not enter above mode if any of the required conditions are not met (change SID, remove cassette, etc.). Check both table and wall receptors. Blades must move to new position in less than 5 seconds.

Refer to appropriate service manual for step by step procedure.

Sentry III - Direction 46-001414 (SMD5303C) Chapter 4
ULTRANET SA - CG Y00W20L 04 Chapter 4

Note

The requirement that the collimator go into manual mode below 36" and return to auto mode between 35" and 35.5" is peculiar to the Sentry and Ultranet collimators and is not an HHS requirement.

Note that collimator shall go into manual below 36" and come back to automatic between 35" and 35.5".

Record Data

In F3382 record that collimator requirements are met for each receptor. Record presence of SID scale.
6-1-2  Functional Test - In Table Fluoro Collimator Version

Application

This set applies to collimators housed in a table. Examples include RX, SFX, and Monotrol. Perform at installation and after any repair which might affect this function.

Requirements

Requirements are defined in Table 6-1 Requirements for Table Fluoro Collimator Vernon.

Procedure

Check conditions for mode and functions provided by mode as described in Table 6-1.

Record Data

In F3382 record that collimator requirements are met.

### TABLE 6-1
**REQUIREMENTS IN-TABLE FLUORO COLLIMATOR VERSION**

<table>
<thead>
<tr>
<th>MODE</th>
<th>CONDITIONS REQUIRED FOR MODE</th>
<th>FUNCTION REWIRED FOR MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTOMATIC</td>
<td>1 SFO SWITCH IN*AUTO</td>
<td>• SHUTTERS LIMIT BEAM TO VISUAL AREA IN FLUORO</td>
</tr>
<tr>
<td></td>
<td>2 CASSETTE IN PLACE</td>
<td>• SHUTTERS CHANGE AUTOMATICALLY TO FULL SIZE OF SELECTED FILM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• WHEN CASSETTE TRANSFERS (IF APPLICABLE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• COLLIMATOR BLADES MUST MOVE TO ANY NEW POSITION WITHIN 5 SECONDS</td>
</tr>
<tr>
<td>MANUAL</td>
<td>1 SFD SWITCH IN MANUAL</td>
<td>• SHUTTERS MAY BE CONTROLLED MANUALLY BUT MAXIMUM BEAM IS ALWAYS LIMITED TO RECEPTOR SIZE (FLUORO OR FILM SIZE)</td>
</tr>
<tr>
<td></td>
<td>2 CASSETTE IN PLACE</td>
<td>• MAXIMUM FIELD SIZE CHANGES AUTOMATICALLY WHEN CASSETTE TRANSFERS BUT SHUTTERS WILL NOT INCREASE OPENING BEYOND FORMAT SIZE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• COLLIMATOR BLADES MUST MOVE TO ANY NEW POSITION WITHIN 5 SECONDS</td>
</tr>
</tbody>
</table>

---

6-3
6–1–3 Functional Test  —  Vascular Collimator  — Vernon

Application

This set applies to all vascular systems. Perform at installation and after any repair which might affect this function.

Requirements

X-ray exposure must not be possible except at proper SID or SID range. Collimator blades must move to any new position in 5 seconds or less.

Procedure

Check that exposure is prevented at incorrect SID and permitted at correct SID (or range). Check collimator shutters for response in 5 seconds or less.

Record Data

In F3382 record SID or range of SID at which exposure is permitted.

6–1–4 Functional Test  —  Manual Rad Collimator  —  Version

Application

This set applies to any adjustable collimator without positive beam limiting capability. Perform at installation and after any repair which might affect this function.

Requirements

Manual collimators which bear an HHS certification label may be installed in the systems described in Table 6.2. If in doubt contact your supervisor. This Table also includes any additional system requirements that apply.

Procedure

Verify that radiographic system using manual collimator is one of the types described in Table 6.2 and verify additional requirements noted if any.

Record Data

In F3382 record that requirements are met.

### TABLE 6.2

**Requirements Manual Rad Collimator Version**

<table>
<thead>
<tr>
<th>SYSTEM DESCRIPTION</th>
<th>ADDITIONAL REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILE</td>
<td>NONE</td>
</tr>
<tr>
<td>RAPID FILM CHANGER (ONLY)</td>
<td>COLL NOT USED WITH TABLE OR WALL BUCKY</td>
</tr>
<tr>
<td>SINGLE SIZE CASSETTE &amp; FIXED SID</td>
<td>* MEANS PROVIDED TO LIMIT BEAM TO CASSETTE SIZE</td>
</tr>
<tr>
<td></td>
<td>* COLL INTERLOCKED TO PREVENT OPERATION AT OTHER SID’S</td>
</tr>
<tr>
<td></td>
<td>* COLL NOT USED WITH TABLE OR WALL BUCKY</td>
</tr>
<tr>
<td>ROOM W/O PERMANENT BUCKY (E.G. TABLE TOP ONLY)</td>
<td>NONE</td>
</tr>
<tr>
<td>SINGLE PURPOSE SYSTEMS (E.G. HYDRADEUTILEX FRANKLIN HEAD UNIT) ACS 1000</td>
<td>NONE</td>
</tr>
</tbody>
</table>

64
6–2 Collimator Alignment And SID

Before continuing with this test, know which type of Receptor Alignment Tool (RAT) you will be using and learn how to use it. (RAT is a tool required for all versions of this test.) Refer to Secuon 2–2–3 and 2–2–4 or 2–2–6 for instructions on using your type of RAT. If you don’t have a GE or GE CGR collimator, refer to Secuon 2–2–5 for instructions on using Type 2 RAT on non-GE collimators.

Also refer to Secuon 2–2–2, Test Film Exposure Techniques, to establish proper exposure.

This test is divided into six versions to suit different types of collimators and applications:

- Auto RAD Collimator Vernon
- Fluoro to SFD Vernon
- Fluoro to Image Intensifier Version
- Manual Collimator Version
- Cone to Cassette Version
- Extension Cylinder Version

See Table 6–3 to determine which test version is appropriate for your system.

Tables 6–4 and 6–5 define the requirements for each type of system.

Note:

For accurate measurements with the Sentry collimator measuring tape, the tab on the end of the tape must be extended.
### TABLE 6-3
APPLICATIONS FOR COLLIMATOR ALIGNMENT AND SID TESTS

**EXCEPTIONS** For MMX Polarx VTX LU Arm and Therasm see applicable service manual for additional requirement/procedures

<table>
<thead>
<tr>
<th>X-RAY SOURCE MOUNTING</th>
<th>X-RAY BEAM LIMITER</th>
<th>IMAGE RECEPTOR</th>
<th>RECEPTOR MOUNTING</th>
<th>SYSTEM EXAMPLES</th>
<th>TEST SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanger Stand or Table</td>
<td>Auto coll</td>
<td>Bucky or Cassette Holder</td>
<td>All except SFD</td>
<td>Auto Coll to RFX Table Bucky V-Bucky</td>
<td>62-1</td>
</tr>
<tr>
<td>AMX</td>
<td>Manual Coll</td>
<td>Any</td>
<td>Any</td>
<td></td>
<td>62-4</td>
</tr>
<tr>
<td>Hanger/Stand</td>
<td>Auto Coll (NOTE 1)</td>
<td>Film Changer</td>
<td>Floor</td>
<td>XT to Puck</td>
<td>62-4</td>
</tr>
<tr>
<td>Hanger/Stand</td>
<td>Lat. Auto Coll</td>
<td>Intensifier</td>
<td>Hanger</td>
<td></td>
<td>62-4</td>
</tr>
<tr>
<td>Hanger/Stand</td>
<td>Manual Coll</td>
<td>Any</td>
<td>Any</td>
<td>Manual Coll on Hanger or Stand</td>
<td>62-4</td>
</tr>
<tr>
<td>Hanger/Stand</td>
<td>Cone</td>
<td>Long-Filmchanger</td>
<td>Floor</td>
<td>Cone to long Film Table</td>
<td>62-5</td>
</tr>
<tr>
<td>Hanger/Stand</td>
<td>Cone</td>
<td>Cassette or Chest Film Changer</td>
<td>Wall</td>
<td>Chest Unit, VCH</td>
<td>62-5</td>
</tr>
<tr>
<td>Undertable</td>
<td>Auto Coll</td>
<td>Intensifier</td>
<td>SFD or Pedestal</td>
<td>RFX, SFX Monotrol</td>
<td>62-3</td>
</tr>
<tr>
<td>Undertable</td>
<td>Auto coll</td>
<td>Intensifier</td>
<td>Bilateral Susp</td>
<td></td>
<td>62-3</td>
</tr>
<tr>
<td>Undertable</td>
<td>Auto coll</td>
<td>SFD</td>
<td>Tower</td>
<td>RFX SFX Monotrol</td>
<td>62-2</td>
</tr>
<tr>
<td>Televix Prestix</td>
<td>Auto coll</td>
<td>Intensifier</td>
<td>Under Table</td>
<td></td>
<td>62-2</td>
</tr>
<tr>
<td>Televix Prestix</td>
<td>Auto Coll</td>
<td>SFD</td>
<td>Table</td>
<td></td>
<td>62-2 &amp; 4</td>
</tr>
<tr>
<td>Telogem 90</td>
<td>Auto coll</td>
<td>Intensifier</td>
<td>Under Table</td>
<td></td>
<td>62-2</td>
</tr>
<tr>
<td>Telegem 90</td>
<td>Auto Coll</td>
<td>SFD</td>
<td>Table</td>
<td></td>
<td>62-2 &amp; 4</td>
</tr>
<tr>
<td>Exatome</td>
<td>Auto coll</td>
<td>SFD</td>
<td>Table</td>
<td></td>
<td>62-2 &amp; 4</td>
</tr>
<tr>
<td>Exatome</td>
<td>Auto Coll</td>
<td>Intensifier</td>
<td>Under Table</td>
<td></td>
<td>62-3</td>
</tr>
<tr>
<td>Hydraljust Table</td>
<td>Manual Coll</td>
<td>Cassette</td>
<td>Table</td>
<td></td>
<td>62-4</td>
</tr>
<tr>
<td>Hydraljust Table</td>
<td>Auto Coll</td>
<td>Intensifier</td>
<td>Table</td>
<td></td>
<td>62-3</td>
</tr>
<tr>
<td>Hydraljust Table</td>
<td>Auto Coll</td>
<td>SFD</td>
<td>Table</td>
<td></td>
<td>62-3</td>
</tr>
<tr>
<td>Utlax Table</td>
<td>Manual Coll</td>
<td>Cassette</td>
<td>Table</td>
<td></td>
<td>62-4</td>
</tr>
<tr>
<td>Franklin Head Unit</td>
<td>Manual Coll</td>
<td>Cassette</td>
<td>Head Unit</td>
<td></td>
<td>62-4</td>
</tr>
</tbody>
</table>

**NOTE 1** Collimator is used in Manual Mode for this application
| 6-21 | 6-22 | 6-23 | 6-24 | 6-25 | 6-26 | RECEPTOR | MEASUREMENT OF MISALIGNMENT | SIMPLIFIED MEASUREMENT EXAMPLE | HHS MAXIMUM MISALIGNMENT % SID | GE REJECTION LIMITS (ALLOWANCE FOR MEASUREMENT ERROR) % SID | GE REJECTION LIMITS (EXAMPLE AT 40 INCH SID) |
|------|------|------|------|------|------|----------|-----------------------------|-----------------------------|-----------------------------|---------------------------------|
| X    | X    | X    | X    | X    |      | Bucky    | Size-to-Size                | Size-to-Size (for one dimension) = A-B | 3.34% (Length Width Sum) | 28.28.38%                        | 112 112 152 inches               |
| X    |      |      |      |      |      | Bucky or Spot Film Device or Cassette or Chest Adapter | Center-to-Center            | Center-to-Center = C         | 2%                              | 18%                             | 72 72 inches                     |
|      | X    |      |      |      |      | Spot Film Device | Edge-to-Edge               | Edge-to-Edge (for one dimension) = D + E | 3.34% (Length Width Sum) | 28.28.38%                        | 112 112 152 inches               |
|      |      |      |      |      |      | Image Intensifier Visible Area on TV Monitor | X-ray Field Size must be less than receptor size | X-ray Field Size must be contained within receptor except on chest wall side where overlap is permitted to 18% SID | 64° (30° SID) | 30° (30° SID) |
|      | X    |      |      |      |      | Cassette or Chest Changer | Size-to-Size               | Size-to-Size (for either dimension) = A-B | X-ray Field may not overlap receptor except on chest wall side where overlap may not exceed 2% of SID | 54° (30° SID) | 30° (30° SID) |
|      |      |      |      |      |      | Mammo Film | Edge-to-Edge             | Chest Wall | X-ray Field | X-ray Field must be contained within receptor except on chest wall side where overlap is permitted to 18% SID | 64° (30° SID) | 30° (30° SID) |

NOTE 1: Applies only to systems with mammography.
<table>
<thead>
<tr>
<th>TEST SET</th>
<th>INDICATION</th>
<th>ACCURACY MEASUREMENT</th>
<th>MEASUREMENT EXAMPLE</th>
<th>HHS REQUIRED ACCURACY % SID</th>
<th>GE REJECTION LIMITS (ALLOWANCE FOR MEASUREMENT ERROR) % SID</th>
<th>GE REJECTION LIMITS (EXAMPLE AT 40-INCH SID)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-2-1</td>
<td>NONE</td>
<td>SID Scale or Detent</td>
<td>Calculated from Magnification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inaccuracy = Indicated SID Minus Calculated SID See Section 2 2 4</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2%</td>
<td>17%</td>
<td>68 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>Collimator Field Size Pointers</td>
<td>Size-to-Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inaccuracy = F Minus Pointer Reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2% (Length Width)</td>
<td>17%</td>
<td>68 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>68 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>Collimator Light Field Alignment</td>
<td>Edge-to-Edge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Edge-to-Edge (for one dimension) = D + E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2% (Length Width)</td>
<td>18%</td>
<td>72 inches</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72 inches</td>
<td></td>
</tr>
</tbody>
</table>
6-2-1 Collimator Alignment and SID Test - Auto Rad Collimator Version

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6.3 to determine if this version applies to your equipment.

Requirements

See Table 6-4, Requirements - X Ray Field Alignment To Receptor for the alignment requirements that apply to your system.

See Table 6-5, Requirements - Operator Indicator Accuracies for the indicator requirements that apply to your system.

Procedure

See appropriate collimator service manual.

Sentry III - Direction 46-001414 (SM D5303C) Chapter 4
Ultramet SA - CG Y00W20L 04 Chapter 4, Section 4-12

Note

Do a final check on SID indication by measuring from focal spot decal perpendicularly to receptor. If error is not within 1.8% then repeat enure 6-2-1 procedure.

Record Data

Record results on F3882. See example in Illustration 6-1.
ALIGNMENT TESTING OF COLLIMATOR

TEST SET 6-2-1 - AUTO RAD COLLIMATOR-TO-BUCKY OR CASSETTE

Requirements of Test Set 6-2-1 have been met for each receptor as substantiated by the following data

YES ☑ NO ☐

ALIGNMENT DATA - AUTO RAD COLLIMATOR-TO-TABLE BUCKY

<table>
<thead>
<tr>
<th>SOURCE - RECEPTOR CONFIGURATION</th>
<th>OVERHEAD MOUNTED TUBE UNIT &amp; TABLE IMAGE RECEPTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vert</td>
</tr>
<tr>
<td>Beam Angulation</td>
<td></td>
</tr>
<tr>
<td>S/ID</td>
<td>Indicated</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td>Inches/cm</td>
<td></td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Center TO Error CENTER Inches/cm</td>
<td></td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Light TO X-RAY</td>
<td>Total Lat, Inches/cm</td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Total Long Inches/cm</td>
<td></td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Field Size Indicator</td>
<td>Indicated</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Long Inches/cm</td>
<td></td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Size TO Size</td>
<td>Film Size</td>
</tr>
<tr>
<td>Measured Field Size</td>
<td>8.5&quot; x 9.7&quot;</td>
</tr>
<tr>
<td>Error %SID</td>
<td>Lat Inches/cm</td>
</tr>
<tr>
<td>Lat %SID</td>
<td></td>
</tr>
<tr>
<td>Long Inches/cm</td>
<td>Long %SID</td>
</tr>
<tr>
<td>Error %SID</td>
<td></td>
</tr>
<tr>
<td>Total %SID</td>
<td></td>
</tr>
</tbody>
</table>

Test on both SS and LS document worst case

When calculating S/ID on a non-GE collimator you must use the Rat on non-GE collimator procedure (2-2-5) Direction 46-013894

All calculations must be in inches or cm

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### Illustration 6-1 (Continued)

**Test Set 6-2-1 - Alignment Data - Auto Rad Collimator to Chest Unit or VBS**

#### Source - Receptor Configuration

<table>
<thead>
<tr>
<th>Beam Angulation</th>
<th>OVERHEAD MOUNTED TUBE UNIT &amp; TABLE IMAGE RECEPTOR OR VBS</th>
<th>Horiz</th>
<th>Vert</th>
</tr>
</thead>
<tbody>
<tr>
<td>SID</td>
<td></td>
<td>SID 1</td>
<td>SID 2</td>
</tr>
<tr>
<td>Indicated</td>
<td>60'</td>
<td>40'</td>
<td>40'</td>
</tr>
<tr>
<td>Actual</td>
<td>59'</td>
<td>40'</td>
<td>40'</td>
</tr>
</tbody>
</table>

#### Center to Center Error

<table>
<thead>
<tr>
<th>Inches/cm</th>
<th>%SID</th>
<th>Inches/cm</th>
<th>%SID</th>
<th>Inches/cm</th>
<th>%SID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SID</td>
<td>(17% max.)</td>
<td>Actual</td>
<td>7</td>
<td>12%</td>
<td>5%</td>
</tr>
<tr>
<td>Error</td>
<td></td>
<td></td>
<td>7</td>
<td>13%</td>
<td>7%</td>
</tr>
</tbody>
</table>

#### Light to X-Ray Error

<table>
<thead>
<tr>
<th>Total Lat Inches/cm</th>
<th>1'</th>
<th>Light Field SID</th>
<th>N 739</th>
<th>N 140</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Lat %SID</td>
<td>(16% max.)</td>
<td>X-Ray Field SID</td>
<td>S 40</td>
<td>S 39</td>
<td>1</td>
</tr>
<tr>
<td>Total Long Inches/cm</td>
<td>2'</td>
<td>Difference</td>
<td>E 120</td>
<td>E 120</td>
<td>0</td>
</tr>
<tr>
<td>Total Long %SID</td>
<td>(16% max.)</td>
<td></td>
<td>W 19</td>
<td>W 20</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Field Size Indicator

<table>
<thead>
<tr>
<th>Indicated Field Size</th>
<th>10' x 10'</th>
<th>12' x 12'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>70' x 70'</td>
<td>10' x 10'</td>
</tr>
</tbody>
</table>

#### Size to Size

<table>
<thead>
<tr>
<th>Film Size</th>
<th>Measured Field Size</th>
<th>8' x 10'</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 x 24 cm</td>
<td>103 x 123 cm</td>
<td>85 x 98</td>
</tr>
<tr>
<td>24 x 30 cm</td>
<td>136 x 168 cm</td>
<td>84 x 104</td>
</tr>
<tr>
<td>35 x 43 cm</td>
<td>14 x 17</td>
<td>84 x 104</td>
</tr>
</tbody>
</table>

#### Error

<table>
<thead>
<tr>
<th>Inches/cm</th>
<th>%SID</th>
<th>Inches/cm</th>
<th>%SID</th>
<th>Inches/cm</th>
<th>%SID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lat.</td>
<td>8%</td>
<td>Lat.</td>
<td>5%</td>
<td>Lat. %SID</td>
<td>10%</td>
</tr>
<tr>
<td>(17% max.)</td>
<td></td>
<td></td>
<td>(2.8% max.)</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Long</td>
<td>2%</td>
<td>Long</td>
<td>3%</td>
<td>Long %SID</td>
<td>7%</td>
</tr>
<tr>
<td>%SID</td>
<td>(2.8% max.)</td>
<td></td>
<td>(2.8% max.)</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

#### Notes

- Do not repeat if already performed on previous page

When calculating SID on a non-GE collimator you must use the Rat on non-GE collimator procedure (2-2-5) Direction 46-013894

All calculations must be in inches of cm
6-2-2 Collimator Alignment and SID Test - Fluoro Collimator to SFD Version

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6-3 to determine if this version applies to your equipment.

Note  
To check center-to-center alignment when the x-ray field cannot be adjusted smaller than the film format see Section 6-2-7. This situation arises for example on a Presutilx 1690 table with pre-version 3.3 firmware.

Note  
Beginning with revision 13 of this direction the edge to edge test has been replaced with a site to size test. The FDA is in the process of rewriting this portion of the requirements.

Requirements

See Table 6-4 Requirements - X Ray Field Alignment To Receptor for the alignment requirements that apply to your system. Be sure to check both focal spots

Procedure

1. The procedure described here covers only the basics. Refer to product service manual Functional Check for the particulars.

Note  
Beginning with revision 13 of this direction the edge to edge error is evaluated by measuring center to center and size to size error. This is a simpler procedure than in the past.

2. The basic approach to this test set. First check the center to center requirement on a number of spot-film formats (using the focal spot with the worst alignment). Of those formats just tested check the edge to edge requirement only for those exposures with the largest center misalignments. Then recheck the worst cases with the table angulated.

3. Check center to center misalignment Repeat the following steps as required:
   a. Install RAT (see Illustration 6-2) Do not install a table top film yet.
   b. Go to minimum SID.
   c. Load SFD.
   d. Select spot film format.
   e. Collimate manually to less than format site.
   f. Expose each format area.
   g. Develop film.

<table>
<thead>
<tr>
<th>TABLE TOP</th>
<th>TYPE OF TOP</th>
<th>FOCAL SPOT TO TOP DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONITROL</td>
<td>4 WAY FLAT TOP</td>
<td>19-3/4</td>
</tr>
<tr>
<td></td>
<td>4 WAY CURVED TOP</td>
<td>18-3/4</td>
</tr>
<tr>
<td></td>
<td>2 WAY FLAT TOP</td>
<td>18-3/4</td>
</tr>
<tr>
<td>SFX WITH 55 SFD OR RFX WITH 88 SFD</td>
<td>4 WAY FLAT TOP</td>
<td>19-3/4</td>
</tr>
<tr>
<td></td>
<td>4 WAY CURVED TOP</td>
<td>18-3/4</td>
</tr>
<tr>
<td></td>
<td>2 WAY FLAT TOP</td>
<td>18-3/4</td>
</tr>
<tr>
<td>SFX WITH 55S SFD OR RFX WITH 88S5 OR 87S5 SFD</td>
<td>4 WAY FLAT TOP</td>
<td>20</td>
</tr>
<tr>
<td>IBIS</td>
<td>4 WAY FLAT TOP</td>
<td>19</td>
</tr>
</tbody>
</table>

6-12
ILLUSTRATION 6-2
TEST SET UP FLUORO TO SFD VERSION

OVERTABLE TELEGEM 90 TELEVIX PRESTILIX

Focal Spot

RAT FIXTURE (TYPE 2 SHOWN)

Cassette

Spot-Film Device

Undertable RFX/SFX

Spot-Film Device

*RAT Pattern

Film not in place for step 3

SFF Table 6-6 for typical focal spot to table top distance

Centered and taped face up on table top

Focal Spot
h  Draw lines on film dividing it into the format areas (see Illustration 6-3)

i  For each format area determine center to center misalignment by making diagonals

j  For each format mark area with largest center to center misalignment.

4  Check edge to edge misalignment. Repeat the following procedure for each format selected in Step 3. Be sure to note or mark on each RAT film the format selected in order to avoid confusion.

a  Select automatic collimation

b  Unit should be at minimum SID

c  Load SFD and select 60 kVp AEC mode

d  Select spot film format

e  Load a paper cassette into RAT fixture (or place on top of RAT pattern)

f  Place copper sheet over RAT film (unless paper cassette has lead backing) and make one exposure only

g  Develop both films

ILLUSTRATION 6-3
MULTIPLE-ONe SPOT-FILMS COLLIMATOR ALIGNMENT TEST - FLUORO TO SFD VERSION
You will now evaluate the edge to edge misalignment by calculating the size to size error for several of the films which show the greatest center to center misalignment. The procedure represents a change from pre REV 13 methods but is consistent with new FDA philosophy. The following relationships are true:

- If \((\text{size} - \text{size error}) / 2 > (\text{center} - \text{center error})\) then \((\text{edge} - \text{edge error}) = (\text{size} - \text{size error})\)
- If \((\text{size} - \text{size error}) / 2 < (\text{center} - \text{center error})\) then \((\text{edge} - \text{edge error}) = 2 \times (\text{center} - \text{center error})\)

In the above formulas the center to center error must be evaluated in both the lateral and longitudinal directions.

**Note**

The above relationships may seem complex but they really describe very simple geometry and can be restated as follows for lateral or longitudinal dimensions:

- If the field overlaps one format edge but not the opposite edge, then the sizing is irrelevant and the edge to edge error is equal to the center to center error times 2.
- For any other situation, (both edges within format or both edges outside format) then the centering is irrelevant and the edge to edge error is equal to the size to size error.

It is clear from the formulas that if the center to center error exceeds 1.5% of SID (1.4% rejection limit) in either direction then the system will fail the test.

Apply the formulas as directed in the next steps. See Example 1.

Enter data for lines 1, 2, and 3. Measure the lateral and longitudinal components of the center to center misalignment. If either component exceeds the rejection limit of 1.4% of SID then the system has failed the test. Enter data on lines 4 and 5. If the system passes this initial test then proceed.

Determine the dimensions of the spot film exposure. Enter data on lines 11 and 12. If the field edges are contained on the film (field undersized) you can simply measure these on the film. If the edges are not contained on the film then use magnification to calculate the field size as described in step k.

The FDA does not consider the effects of a mask. Misalignment is the difference between the collimated field size and the format size where format size is simply a function of film size and number of exposures on the film. If the film shows edges that are created by a mask then you must use magnification to determine where the field edge actually lies.

Note

The ratio of the size of a segment of the scale imprinted on the spot film to the size of that segment as measured on the top film (if you used a vinyl cassette then the RAT pattern and its image have virtually identical dimensions). Enter data on lines 6 thru 10. Using this magnification ratio calculate the size of the field at the spot film by multiplying the dimensions of the field at the top film by the magnification ratio. Enter data on lines 11 and 12.
1. Tabulate the size error for each dimension and the center to center errors for each of the formats you have selected. It is a good idea to convert all data to percent of SID at this time. Enter data on lines 13 and 14 (lines 4 and 5 were entered previously). Evaluate the data using the formulas of step b.

Enter data on lines 15 thru 19 noting that either the a or b hnes should be used for 17 and 18. See both examples. Record the results on Form 3382 under Test 6.2.2.

Example 1: Edge to edge misalignment calculations

<table>
<thead>
<tr>
<th>SID (mm) minimum</th>
<th>29 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lat. format dimension</td>
<td>4.67 in/cm</td>
</tr>
<tr>
<td>Long format dimension</td>
<td>14.00 in/cm</td>
</tr>
<tr>
<td>Lat. center-center error</td>
<td>0.52 in/cm, 0.75 % SID</td>
</tr>
<tr>
<td>Long center-center error</td>
<td>0.33 in/cm, 1.13 % SID</td>
</tr>
</tbody>
</table>

Rejection Limit: 1.4%

| RAT pattern segment measures | 0.05 in/cm |
| Spot-film image segment measures | 0.07 in/cm |
| Magnification ratio (line 7/line 6) | 1.49 |
| Lat. table top image measures | 0.36 in/cm |
| Long table top image measures | 0.86 in/cm |
| Lat. Spot film field (line 8 * line 9) | 0.47 in/cm |
| Long Spot film field (line 8 * line 10) | 0.40 in/cm |
| Lat. size-size error (line 11 - line 2) | 0.08 in/cm, 0.28 % SID |
| Long size-size error (line 12 - line 3) | 0.14 in/cm, 1.38 % SID |

Enter absolute values for 13 & 14, no negatives.

| (UNE 13) - 2 | 0.14 % SID |
| (LINE 14) - 2 | 0.69 % SID |

From lines 15 and 16 we see that for both the lateral and longitudinal directions the (size - size error)/2 is less than the center to center error. Therefore, according to the relationships of step h, the edge to edge errors are each equal to 2 x the center to center error (and are independent of the sue to sue errors). Therefore, we will use lines 17b and 18b. The rest of the calculation is as follows:

```
if line 15 > = line 4 then use line 17a
if line 15 < line 4 then use line 17b
17a Lat. edgeedgeerror = line 13
17b Lat. edgeedgeerror = 2 x line 4
Rejection Limit: 2.8% 7.5 % SID
```

```
if line 16 > = line 5 then use line 18a.
if line 16 < line 5 then use line 18b
18a Long edgemeerror = line 14
18b Long edgemeerror = 2 x line 5
Rejection Limit: 2.8% 2.26 % SID
```

19 Total edgemeerror = line 17 + line 18
Rejection Limit: 3.8% 3.76 % SID

The system passes the test but just barely. If either Lat. or Long. center to center errors have been greater than 1.4% then the rest of the calculation would have been unnecessary as the system would have failed.
In example 2, centenng is unproved and the size to size error become important.

Example 2 Edge to edge misalignment calculations

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SID (set at minimum)</td>
<td>79 in/cm</td>
</tr>
<tr>
<td>2</td>
<td>Lat. format dimension</td>
<td>6.67 in/cm</td>
</tr>
<tr>
<td>3</td>
<td>Long format dimension</td>
<td>14.00 in/cm</td>
</tr>
<tr>
<td>4</td>
<td>Lat. center-center error</td>
<td>0.18 in/cm</td>
</tr>
<tr>
<td>5</td>
<td>Long center-center error</td>
<td>0.11 in/cm</td>
</tr>
<tr>
<td></td>
<td>Rejection Limit</td>
<td>1.4%</td>
</tr>
<tr>
<td>6</td>
<td>RAT pattern segment measures</td>
<td>5.00 in/cm</td>
</tr>
<tr>
<td>7</td>
<td>Spot-film image segment measures</td>
<td>7.45 in/cm</td>
</tr>
<tr>
<td>8</td>
<td>Magnification ratio (line7/line6)</td>
<td>2.10</td>
</tr>
<tr>
<td>9</td>
<td>Lat. table top image measures</td>
<td>3.79 in/cm</td>
</tr>
<tr>
<td>10</td>
<td>Long table top image measures</td>
<td>9.68 in/cm</td>
</tr>
<tr>
<td>11</td>
<td>Lat. Spot-film field (line 8 * line 9)</td>
<td>4.75 in/cm</td>
</tr>
<tr>
<td>12</td>
<td>Long Spot-film field (line 8 * line 10)</td>
<td>14.40 in/cm</td>
</tr>
<tr>
<td>13</td>
<td>Lat. size-size error (line 11 - line 2)</td>
<td>0.08 in/cm</td>
</tr>
<tr>
<td>14</td>
<td>Long size-size error (line 12 - line 3)</td>
<td>0.40 in/cm</td>
</tr>
<tr>
<td></td>
<td>enter absolute values for 13 &amp; 14, no negatives</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>(UNE 13) = 2</td>
<td>14 % SID</td>
</tr>
<tr>
<td>16</td>
<td>(UNE 14) = 2</td>
<td>69 % SID</td>
</tr>
</tbody>
</table>

17a Lat. edge-edge error = line 13
17b Lat. edge-edge error = 2 x line 4

Rejection Limit 2.8% /

18a Long edge-edge error = line 14
18b Long edge-edge error = 2 x line 5

Rejection Limit 2.8%

19 Total edge-edge error = line 17 + line 18

Rejection Limit 3.8%
Record Data

For systems listed below that do not use an 8835, 8735, or 8355 spot film device, record results on F3382 Form 1 for Tea Set 6-2-2. See example in Illustration 6-4.

<table>
<thead>
<tr>
<th>TABLE</th>
<th>MIN SID</th>
<th>MAX SID</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFX</td>
<td>29&quot;</td>
<td>40&quot;</td>
</tr>
<tr>
<td>SFX</td>
<td>29&quot;</td>
<td>40&quot;</td>
</tr>
<tr>
<td>Monrol 90</td>
<td>27.5&quot;</td>
<td>38.5&quot;</td>
</tr>
<tr>
<td>Monrol 15</td>
<td>27.5&quot;</td>
<td>38.5&quot;</td>
</tr>
<tr>
<td>Televix</td>
<td>43.3&quot;</td>
<td></td>
</tr>
<tr>
<td>Prestix</td>
<td>41.3&quot;</td>
<td>59&quot;</td>
</tr>
<tr>
<td>IBIS</td>
<td>30&quot;</td>
<td>40&quot;</td>
</tr>
</tbody>
</table>

**ILLUSTRATION 6-4**

**EXAMPLE OF ALIGNMENT CALCULATIONS**

- 88/85 SPOT FILM DEVICE
- RFX/SFX TABLE

**MISALIGNMENT (% SID)**

**FORM 1** Use this form for all SFD's EXCEPT the 8835, 8735 and 8535 SFD's. For these exceptions use Forms 2, 3, or 4 as appropriate to the cassette sizes available at the hospital.

**NOTE 1** Use format exposure # and SID from horizontal section with worst case center-to-center misalignment.

**NOTE 2** Use format exposure # and SID from horizontal section with worst case edge-to-edge misalignment.

**NOTE 3** Multiple-on-one formats require edge-to-edge calculation only for the exposure with greatest center-to-center misalignment.

<table>
<thead>
<tr>
<th>SID</th>
<th>TABLE ANGULATION</th>
<th>CASSETTE SIZE</th>
<th>FORMAT SELECTED</th>
<th>EXP</th>
<th>CENTER-TO-CENTER (1% % MAX)</th>
<th>LAT (2% MAX)</th>
<th>LONG (2% MAX)</th>
<th>SUM (3% MAX)</th>
<th>EDGE TO-EDGE (NOTE 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MIN)</td>
<td>HORIZONTAL</td>
<td>95&quot; x 95&quot;</td>
<td>1 ON 1</td>
<td>1</td>
<td>11</td>
<td>1.3</td>
<td>1.3</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>95&quot; x 95&quot;</td>
<td>4 ON 1</td>
<td>1</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>95&quot; x 95&quot;</td>
<td>4 ON 1</td>
<td>2</td>
<td>07</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>95&quot; x 95&quot;</td>
<td>4 ON 1</td>
<td>3</td>
<td>16</td>
<td>14</td>
<td>15</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>95&quot; x 95&quot;</td>
<td>4 ON 1</td>
<td>4</td>
<td>72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MAX)</td>
<td>HORIZONTAL</td>
<td>95 x 95</td>
<td>4 ON 1</td>
<td>3</td>
<td>13</td>
<td>2.0</td>
<td>11</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>(NOTE 1)</td>
<td>VERTICAL</td>
<td>95 x 95</td>
<td>4 ON 1</td>
<td>3</td>
<td>11</td>
<td>12</td>
<td>06</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>(NOTE 2)</td>
<td>TABLE TRENDELENBERG</td>
<td>95 x 95</td>
<td>4 ON 1</td>
<td>3</td>
<td>10</td>
<td>17</td>
<td>07</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
For RFX/SFX tables using the 8835/8735/8535 spot film device you must test with a 14" x 14" (35 cm x 35 cm) cassette if available at the hospital. Record the test results on Form 3382 for Test Set 6-2-2, Form 2 (see Illustration 6-5).

If a 14" x 14" (35 cm x 35 cm) is not available test with the largest spot film cassette that is available. If 10" x 12" (24 cm x 30 cm) is the largest size available use 10" x 12" (24 cm x 30 cm) 1 long exposure for all 1 exposures. Substitute 12" x 10" (30 cm x 24 cm) 2 longitudinal for the 14" x 14" 2 exposures and substitute 10" x 12" (24 cm x 30 cm) 2 longitudinal for the 14" x 14" 3 exposures. Record test results on Form 3382 Test Set 6-2-2 Form 3.

If 9-1/2" x 9-1/2" is the largest size available, then do as follows. Use 9-1/2" x 9-1/2" 1 long exposure for all 1 exposures. Substitute 9-1/2" x 9-1/2" 2 longitudinal for the 14" x 14" 2 exposures. There is no test corresponding to the 14" x 14" 3 exposures. Record test results on Form 3382 Test Set 6-2-2, Form 4.

ILLUSTRATION 6-5
EXAMPLE OF ALIGNMENT CALCULATIONS

8835/8735/8535 SPOT-FILM DEVICE
RFX/SFX TABLE
MISALIGNMENT (% SID)

FORM 2 -- 14 x 14 (35 cm x 35 cm) You must use Form 2 if 14 x 14" cassette is available at the hospital.

<table>
<thead>
<tr>
<th>SID</th>
<th>TABLE ANGULATION</th>
<th>CASSETTE SIZE</th>
<th>FORMAT SELECTED</th>
<th>EXP</th>
<th>CENTER-TO-CENTER (18% MAX)</th>
<th>LAT (2% MAX)</th>
<th>LONG (2% MAX)</th>
<th>SUM (38% MAX)</th>
<th>EDGE-TO-EDGE (NOTE 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MIN)</td>
<td>HORIZONTAL</td>
<td>14&quot; x 14</td>
<td>1 ON 1</td>
<td>1</td>
<td>73</td>
<td>735</td>
<td>265</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 x 14</td>
<td>2 ON 1</td>
<td>2</td>
<td>72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14&quot; x 14</td>
<td>3 ON 1</td>
<td>3</td>
<td>72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(MAX)</td>
<td>HORIZONTAL</td>
<td>14&quot; x 14&quot;</td>
<td>1 ON 1</td>
<td>1</td>
<td>13</td>
<td>138</td>
<td>132</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>(NOTE 1)</td>
<td>VERTICAL</td>
<td>14&quot; x 14&quot;</td>
<td>3 ON 1</td>
<td>2</td>
<td>17</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(NOTE 1)</td>
<td>TABLE TRENDELENBERG</td>
<td>14&quot; x 14</td>
<td>3 ON 1</td>
<td>2</td>
<td>76</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(NOTE 2)</td>
<td>VERTICAL</td>
<td>14&quot; x 14&quot;</td>
<td>3 ON 1</td>
<td>2</td>
<td>15</td>
<td>76</td>
<td>37</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(NOTE 2)</td>
<td>TABLE TRENDELENBERG</td>
<td>14&quot; x 14</td>
<td>3 ON 1</td>
<td>2</td>
<td>74</td>
<td>15</td>
<td>29</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

NOTE 1 Use format, exposure # and SID from horizontal section with worst center-to-center misalignment.
NOTE 2 Use format, exposure # and SID from horizontal section with worst edge-to-edge misalignment.
NOTE 3 Multiple-on-one formats require edge-to-edge calculation only for the exposure with greatest center-to-center misalignment.
6–2–3  C o h a t o r  A l i g n m e n t  a n d  S I D  T e a -  F l u o r o  C o h a t o r  t o  I m a g e  I n t e n s i f i e r  V e r s i o n

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6.3 to determine if this version applies to your equipment.

Requirements

See Table 6.4 requirements — X Ray Field Alignment To Receptor for the alignment requirements that apply to your system.

Procedure

Note: For elevating tubes or tables, the test is performed with the tube and table in the lowest position.

1. The requirements of the test set can be met by adjusting the collimator so that when in the Auto mode with maximum opening, 4 blades are present in the visible area of the monitor at all times (16 12 9 6 4 5 inch unage tube field sizes maximum SID minimum SID table horizontal and vertical). The visible area of monitor is that inside the circular blanking (inside monitor circular mask or output phosphor with certain systems).

2. If the collimator has been adjusted as described in Step 1, the only remaining task is to check minimum field size.

   Position for maximum SID.

3. Verify that the collimator meets the 5 x 5 cm minimum size requirement as MEASURED AT THE PLANE OF THE IMAGE RECEPTOR AT MAXIMUM SID WITH COLLIMATOR COMPLETELY CLOSED. (This requirement actually refers to the maximum size of the beam when the collimator is at its minimum.)

4. If the collimator cannot be adjusted as described in Step 1, an inductive test must be made to measure misalignment between any blade not visible and the edge of the visible area of the monitor.

   a. Place RAT pattern/fixture as shown in Illustration 6.2. If RAT pattern is at table top center it in fluoror field and tape in place.

   b. Make fluoror exposure and make a note of the RAT pattern increments that are visible on monitor.

   Example (A) 7 0  (B) 7 0  (C) 7 7  (D) 6 2

   c. Place a loaded cassette in RAT fixture or on RAT pattern as applicable and make a fluoror exposure of about 1 second (terminate exposure as soon as image appears on monitor) and develop film.

   d. Mark on the film the edges of the visible image noted in Step (b)
ILLUSTRATION 6-6
EXAMPLE OF ALIGNMENT CALCULATIONS FLUORO TO IMAGE INTENSIFIER VERSION

- FLUORO EXPOSURE 9" FIELD
- AUTO MODE MAXIMUM FIELD SIZE
- SOURCE TO FILM DISTANCE 18.5"  

<table>
<thead>
<tr>
<th>Longitudinal</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Inches

EDGE TO-EDGE MISALIGNMENT

TOTAL

% SID

0 Inches

0 % SID

2.2 % SID

MONITOR VISIBLE AREA MARKED ON FILM

Record Data

Record results on F3382. See example in Illustration 6-7

ILLUSTRATION 6-7
EXAMPLE DATA RECORD FLUORO TO IMAGE INTENSIFIER VERSION

- TRIPLE FIELD FLUORICON 300 ON SPOT-FILM DEVICE
- RFX TABLE

<table>
<thead>
<tr>
<th>SID</th>
<th>29' (MIN)</th>
<th>40 (MAX)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VERT</td>
<td>HOR</td>
</tr>
<tr>
<td>BEAM ANGULATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensifier Field Size</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Lat Edge-to-Edge (% SID)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Long Edge-to-Edge (% SID)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sum Edge-to-Edge (% SID)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MINIMUM FIELD SIZE (Inches) (AT MAX SID)</td>
<td>1 x 1 (approximately)</td>
<td></td>
</tr>
</tbody>
</table>

(2.8% max)

(2.8% max)

(3.8% max)
6-2-4 Collimator Alignment and SID Test - Manual Collimator Version

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6.3 to determine if this version applies to your equipment.

Requirements

See Table 6.4 Requirements - X-Ray Field Alignment To Receiver for the alignment requirements that apply to your system.

See Table 6.5 Requirements - Operator Indicator Accuracies for the indicator requirements that apply to your system.

Procedure

Complete procedure is found in Cohnator Service Manual. Also refer to Chapter 2 of Direction 46-013894 on the use of the RAT panel.

Note

Do a final check on SID indication by measuring from focal spot decal perpendicularly to receptor at minimum SID. If error is not within 2%, then repeat the entire 6.2.4 procedure.

Record Data

Record results on F3382
6-2-5  Cone/Extension Cylnder to Cassette Version

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6-3 to determine if this version applies to your equipment.

Requirements

See Table 6-4. Center-to-Center applies and also the image must be fully contained within the image receptor.

Procedure

**Note** Cones and extension cylinders may only be used for single size cassette and operate at single fixed SID.

1. If applicable align x-ray source to receptor using normal operator's procedure.
2. Insert loaded cassette (or advance a film) make exposure and develop.
3. If image lies inside all four edges of film (meets part 1 of requirement)
   - Mark on the film one set of diagonal lines joining opposite corners of the x-ray image and one set of diagonal lines joining opposite corners of the film.
   - Distance between intersections must be less than 1.8% SID.
4. If image is not fully contained on film exposed in Step 2 do as follows:
   - As an option, you may do the procedure of Section 2-2-5 if you prefer.

   **Note** Support RAT approximately 24 inches from the focal spot in line with the image receptor measure the distance between the RAT pattern and the focal spot.

   - Make two exposures Number 1 with a loaded cassette (or film) in the image receptor and number 2 with a loaded 10 x 12 cassette at the RAT pattern.

   Calculate the size of the x-ray field at the image receptor. It must be less than the image receptor.

   1. Calculate magnification (X is measured on RAT film).

   2. Measure the field size on the RAT film and multiply it by the magnification. Result is field size at receptor.

   Calculate the center-to-center misalignment. It must be less than 1.8% SID.

   a. Locate the center of the x-ray field on the RAT film and transfer it to the image receptor film.
   b. Mark on the image receptor film diagonals joining opposite corners of the film.
   c. Measure the center to center misalignment directly off the image receptor film.

**Record Data**

Record results on F3382.
Note If you have a dedicated mammography unit such as a Senogaph see Section 7.

Application

Perform this procedure at equipment installation and after any repair which might affect alignment requirements. See Table 6.3 to determine if this version applies to your equipment.

Requirements

See Table 6.4 Requirements - X Ray Field Alignment To Receptor for the alignment requirements that apply to your system.

See Table 6.5 Requirements - Operator Indicator Accuracies for the indicator requirements that apply to your system.

Procedure

1. Arrange equipment for mammography at a common SID and with largest field size.
2. Use RAT pattern to verify that x-ray and light fields are aligned to within 18% SID.
3. Examine film. X ray field may not overlap edges of film except on chest wall side where overlap is permitted to 18% SID.

Record Data

Record results on E3382.
Center-to-Center Alignment When the X-Ray Field Cannot Be Adjusted Smaller than the Film Format Size

Note

This situation arises, for example, on the Premilux 1690 Table with pre-version 3.3 firmware.

There are two alternatives for measuring center-to-center alignment for any system where the x-ray field cannot be adjusted smaller than the film format size. These are as follows:

A. Using the light field cross-hairs to define the x-ray field center

You must first verify that the light field cross-hairs coincide with the x-ray field center.

1. Place an empty medium size cassette in the Bucky and a larger loaded cassette on the table top.
2. Center the table top cassette to the light field and then place a solder marker or washer on the cross-hair shadow. Expose the film.
3. Determine the center of the x-ray field by marking the edges of the field on the film and then drawing diagonals across the image. The image center must coincide with the solder or washer. If it does not coincide, then reposition the mylar window of the collimator and repeat the test.

Once you have verified that the cross-hairs coincide with the x-ray field center, you may proceed.

4. Place a loaded cassette in the Bucky. Align the x-ray tube to the Bucky using the normal operator's technique. (Bucky centering light or auto centering control)
5. Place the solder marker or washer on the cross-hair shadow on the table top and expose the Bucky film.
6. Determine the center of the image receptor by drawing diagonals across the Bucky film corners. The marker must be centered to the film center to within 2% (1.8% rejection limit) of the SID.

Note

We recognize that the center of the film is not necessarily the center of the cassette. If the film has much freedom to move within the cassette, it would be better to mark the center of the cassette with a washer or solder marker. Then measure the distance between the images of the marker on the cassette and the marker on the table top.

6-25
B  Transposing the x-ray field center from a table top film to a Bucky film

Note

Refer to Illustrations 6-8 and 6-9 The newest light field to x-ray field ten pattern (46-303843P1) is shown in these illustrations but any of the patterns in the HHS Field Ten Kit can be used.

1. Place a loaded medium cassette in the Bucky and a loaded large cassette on the table top. Center the x-ray tube to the Bucky and center the table top cassette to the light field.

2. Place the x-ray to light field test pattern (or any of the other test patterns from an HHS Field Ten Kit) on the table top cassette and offset the pattern so that the x-ray beam center will be in a relatively clear area of the pattern.

3. Expose both films simultaneously.

4. Determine the center of the x-ray field on the table top film by drawing diagonals across the image. See Illustration 6-8. Now note the lateral and longitudinal coordinates of the center point using the scales on the image.

5. Since this point will be at the same coordinates on the Bucky film you can transpose the x-ray beam center to the Bucky film. Do this now. See Illustration 6-9.

6. Determine the center of the image receptor by drawing diagonals across the Bucky film corners. Now measure the distance between the center of the film and the transposed center of the x-ray field. The misalignment must be less than 2% (1.8% rejection limit) of the SID.

Note

We recognize that the center of the film is not necessarily the center of the cassette. If the film has much freedom to move within the cassette it would be better to mark the center of the cassette with a washer or solder marker. Then measure the distance between the image of the marker and the transposed x-ray beam center.
ILLUSTRATION 6-8
TABLE TOP FILM

ILLUSTRATION 6-9
BUCKY FILM
6-3 Collimator Light Field Intensity

Application

Installation periodic maintenance repair and bulb replacement

Note For AMX s refer to AMX Manual for test

Requirements

- The average illumination at a distance of 100 cm (39 37") from the focal spot shall be no less than 16 foot candles (170 lux) rejection limit (HHS spec is 15 foot candles)

Note

- GE Model 214 light meter must not be used
- Light meter used for this test (Digaphot 330013303 or equivalent) must have an accuracy of 5% or better
- Fluke 8030A or Beckman 3030 RMS on the 200V scale or equivalent

Procedure

1. Verify that the compensator on the generator is properly adjusted before any light field tests are started
2. Place Light Meter on table top with sensor directed toward Light Source
3. Adjust Focal Spot to Light Meter Sensor distance of 100 cm (not SID of 100 cm) or to maximum if maximum is less than 100 cm (See Illustration 6-10)
4. Turn on collimator lamp and adjust field Size to approximately 10" x 10" (25.4 x 25.4 cm)
5. Place Light Meter in center of one quadrant of the light field
6. With collimator lamp off measure and record Ambient light level
7. Do not move the light meter With collimator lamp on measure and record light level of that quadrant
8. Determine the fluminance of that quadrant by subtracing Ambient light level from the corresponding light level
9. Repeat measurements at the approximate center of remaining three quadrants of light field
10. Average illumination must be no less than rejection limit shown in Table 6-7

Note

For General Electric Sentry and Ultranet Collimators

If Digaphot light meter is not available set the lamp base voltage to read at least the voltage called for in Table 6-7. But to avoid excessive heating and degraded component life do not adjust lamp voltage any higher than necessary

Record Data

Record results of this test in F3382
TABLE 6-7
REJECTIOY LIMITS * LIGHT LEVELS

MINIMUM READING
(Above Ambient)
16.0 FC (170 lux) or
Sentry + 20% VAC + meter tolerance
Ultramat + 21% VAC + meter tolerance

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
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</thead>
<tbody>
<tr>
<td>Low output</td>
<td>• Lamp, Mirror, Mylar window dirty or discolored</td>
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<td></td>
<td>• Lamp voltage low. See Table 6-7</td>
</tr>
<tr>
<td></td>
<td>• Mirror in backwards</td>
</tr>
<tr>
<td></td>
<td>• Supply cable too long</td>
</tr>
<tr>
<td></td>
<td>• Faulty collimator bulb</td>
</tr>
<tr>
<td></td>
<td>• Faulty lamp socket</td>
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</tbody>
</table>

ILLUSTRATION 6-10
TEST SET-UP * COLLIMATOR LIGHT FIELD INTENSITY

CORRECT
FOCAL SPOTS

INCORRECT
SID OF 100 CM

FOCAL SPOT TO LIGHT METER SURFACE

NOTE: FOCAL SPOT TO METER SENSOR SURFACE SHOULD BE 100 CM (NOT A SID OF 100 CM)
6-4 Collimator Light Field Contrast Ratio

Application

At malfunction periodic maintenance and repair

Note

This test should be considered in the event of collimator alignment or light intensity problems

Requirements

The contrast ratio shall be no less than 4 for stationary equipment and no less than 3 for mobile equipment

Equipment

Incident light meter with scale reading in foot candles or lux. Meter must have color and cosine corrected output and must be equipped with a 1 mm aperture

Procedure

1. Place the meter on the table top with the sensor directed toward the light source. Adjust the focal spot to light meter sensor surface distance (not SID) to 100 cm or to maximum if maximum is less than 100 cm. See Illustration 6-10

2. Minimize room lighting. With the 1 mm aperture in place, measure and record the ambient light level

3. Turn on the collimator lamp and adjust the field size to approximately 10" x 10" (25 x 25 cm)

4. Measure the maximum illumination; this should occur near the field center. Shade the meter along the table top and locate the point where the illumination drops to 25% of maximum. This point is defined by BRH as lying on the edge of the light field. All subsequent measurements will be referenced to this point and to this definition of "edge"

5. Measure the illumination at a point 3 mm from the edge of the field toward the center of the field. Record this as I1

6. Measure the illumination at a point 3 mm from the edge of the field away from the center of the field. Record the new reading as I2

7. Correct the values of I1 and I2 by subtracting from each value the ambient light level measured in Step 2. Now divide the corrected value of I1 by I2. This ratio should be 4 or more for stationary equipment and 3 or more for mobile equipment

<table>
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<th>Problem</th>
<th>Possible Cause</th>
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<tr>
<td>Contrast low</td>
<td>Dirty optics</td>
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<td></td>
<td>Low light level (less than 15 FC)</td>
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<tr>
<td></td>
<td>High ambient light level (affects accuracy of measurement)</td>
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</table>
Fig 1
Space reserved to the power transformer
Spazio riservato al trasformatore d'alimentazione

Fig 2

Fig 3

ULTRANET SM
Focal spot

**20 mm for Ultranet SM EXAFOCUS

(*) 26 mm with GEMS tracks
23 mm with GE-CGR tracks
21 mm without tracks

All dimensions are in millimeters

Fig 6

ULTRANET "SM"
OLD MODEL VERSION

45296017 ULTRANET SM for XT Suspension
45296046 ULTRANET SM for COMPAx table
45296490 ULTRANET SM for RS85 tubestand
45296671 ULTRANET SM for SOLARIX

NEW MODEL VERSION

2204643 ULTRANET SM for XT Suspension
2204646 ULTRANET SM for COMPAx table
2204649 ULTRANET SM for RS85 tubestand
2204652 ULTRANET SM for SOLARIX
## ULTRANET S Compatibility

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<tr>
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<th>PRODUCTS</th>
<th>COMPATIBILITY</th>
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<td>Head</td>
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<td>Positioner</td>
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<td>GEMS</td>
<td>S 19001 N</td>
<td>MONITROL COMPAX 40</td>
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<tr>
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<td>RAFL S</td>
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<td>MPG</td>
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</table>

Fig 11c
Fig 16

Fig 17

ULTRANET SM
Fig 18
Fig 19

ULTRANET SM
\[ a' = a'' = \frac{a}{4} \]
\[ b' = b'' = \frac{b}{4} \]
\[ c' = c'' = \frac{c}{4} \]
\[ d' = d'' = \frac{d}{d} \]

Fig 21

ULTRANET SM
Teleradiografo in verticale
Potter mural en verticale
Wet bucky in vertical position

Tavolo in orizzontale visto dall'alto
Table en horizontale vu d'en haut
Table in horizontal position (plan view)

Fig. 33
Figures 35 through 46

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