MODEL
R 503 MLP/A

MOTORISED
X-RAY COLLIMATOR WITH LIGHT AND
POTENTIOMETERS

INSTRUCTIONS MANUAL - MTR503MLP/A-ING.

Translated from the original document MTR503MLP/A

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## DOCUMENT EFFECTIVITY

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FRONT MATTER

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS AND CAUTIONS CONTAINED HEREIN EVEN IF THE PERSON IS PERFECTLY CONVERSANT WITH THE INSTALLATION OF X-RAY COLLIMATOR.

COLLIMATOR INSTALLATION AND SERVICE IS TO BE PERFORMED BY PERSONNEL AUTHORISED BY THE MANUFACTURE OF THE X-RAY EQUIPMENT OR BY RALCO srl.

PERSONNEL MUST BE FAMILIAR WITH THE SAFETY STANDARDS COVERING ELECTROMEDICAL EQUIPMENT.

THIS DOCUMENT WAS TRANSLATED FROM THE ORIGINAL ITALIAN VERSION MTR503MLP-A, ISSUED AND DISTRIBUTED BY RALCO srl MANUFACTURER OF THE X-RAY COLLIMATOR DESCRIBED. ADDRESS ENQUIRIES TO:

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20046 BIASSONO (MI) - ITALIA
FAX: ++39-039-2497.799
EMAIL: RALCO@RALCO.ITAL

WARNING:

X-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THOSE AUTHORISED TO OPERATE OR SERVICE THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR WITH THE PROCEDURES REGARDING RADIATION PROTECTION.

WARNING

THE COLLIMATOR DESCRIBED HEREIN CONFORMS TO THE REQUISITES DESCRIBED IN ATTACHMENT 1 OF CEE 93/42/CEE DIRECTIVE AND IS CLASSIFIED CLASS IIb ACCORDING TO ATTACHMENT IV OF THE SAME DIRECTIVE.

THE COLLIMATOR CONFORMS TO STANDARDS IEC 60601-1, IEC 60601-1-2, IEC 60601-1-3.

CONFORMITY IS ENSURED ONLY IF THE COLLIMATOR IS INSTALLED AND USED AS INDICATED IN THIS MANUAL.

THE COLLIMATOR IS TO BE INSTALLED ON A GENERAL PURPOSE RADIOLOGY UNIT CONFORMING TO DIRECTIVE CEE 93/42.

PROPER INSTALLATION, OPERATION AND MAINTENANCE OF THE COLLIMATOR SHOULD EXCLUDE OPERATION PROBLEMS OF THE COLLIMATOR AND OF THE SURROUND EQUIPMENT SINCE RALCO HAS SUCCESSFULLY PASSED EMC TESTING.

TEST THE GENERAL SYSTEM SAFETY IMMEDIATELY AFTER ITS INSTALLATION.

WHENEVER THE COVERS REQUIRE TO BE REMOVED CARE MUST BE TAKEN TO REMOUNT THEM CORRECTLY - SEE CHAPTER G) MAINTENANCE.

THE INSTRUCTIONS MANUAL SUPPLIES INDICATIONS ON STANDARD OPTIONAL MATERIAL. SPECIFIC DATA REGARDING THE VERSION PURCHASED IS PROVIDED BY THE LABEL OR BY ANNEXED DOCUMENTATION.

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A) DESCRIPTION

With a view to improving the appearance of the collimator, modification "A" entails the substitution of the metal cover with an ABS fire-retardant plastic cover.

Radiation leakage is controlled by lead-plating the collimator and, in part, the cover.
Multilayer, square field X-ray collimator.

Round and square-field X-Ray collimator for use in connection with an Image Intensifier, a Spot Film Device and a Potter Bucky. The square field is multilayered while the round field is single-layered.
The round field is defined by 12 lead shutters and is located between the two sets of square shutters positioned approximately half-way within the collimator casing. The square field is defined by six pairs of lead-lined shutters. Two pairs of shutters are positioned near the focus, two near the entrance window of the collimator and two pairs near the exit window of the collimator.

SPECIFICATIONS:

- Maximum X-Ray rating is 150 k V p;
- Minimum inherent filtration 2 mm. Aluminium equivalent. (1mm on request)
- High luminosity provided by a quartz iodide lamp.
- Timer limiting protection lamp exposure time to 30 seconds thus extending lamp life and preventing overheating.
- Mirror regulation is effected externally.
- Movement of shutters is motorised and shutter positioning is controlled by potentiometers.
- Continuous film coverage: square field from 0x0 to 43x43 cm at 100 cm FFD; round 10 cm (4") to 43cm(16") at 100 cm FFD.
B) SPECIFICATIONS

Square and round field X-ray collimator, designed for installation on rotating or fixed anode X-ray tubes (EN 60601-1-3 par. 29.202.3), provides the motorised stepless adjustment of the x-ray field dimension to the size of the image receptor or to that of the anatomical area of interest. Adjustment is also possible from the collimator itself if the version is provided with a remote control.

Six pairs of lead-lined shutters, moved into the beam at right angles to each other, collimate the square field. Two pairs of lead-lined shutters are positioned near the X-ray and limit secondary radiation; two pairs are located at the X-ray beam inlet port and the other two pairs of shutters are positioned at the X-ray beam outlet port of the collimator and accurately limit the X-ray field.

The round field is defined by Twelve lead shutters, iris-arranged, move within the X-ray beam in a circle to collimate the circular field. All twelve shutters are positioned between the two sets of square shutters approximately midway in the collimator housing.

The direct visualisation of the X-Ray field is given by a light beam which correspond to the X-Ray beam, within a tolerance of two percent of the selected distance. The light-field centre is provided by the intersection of two perpendicular silk-screened lines into the Lexan window and projected on the light field by the light beam.

Field illumination is provided by a quartz iodide lamp (150W-24V) switched on by an electronic timer of through a remote control is this is available. Illumination time is limited to 30 seconds.

Average illumination is not less than 160 lux (16 foot-candles); edge contrast ratio is four to one.

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<td>edge contrast setting 350x250 mm at 1000 mm</td>
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<tr>
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<td>EN 60601-1-3 par. 29.202.8</td>
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- **Light field indicator precision:**
  - Light field/x-ray field correspondence: EN 60601-1-3 par. 29.202.9 < 1 % D.F.F.

- **FDD (SID):** (optional)
  - Precision of measurement with retractable tape: EN 60601-1-3 par. 29.203.2 < 2 % D.F.F.

- **Leakage radiation:**
  - x-ray beam = 150 kVp / 4 mA
  - EN 60601-1-3 par. 29.204.3 < 40 mR/h

- **Lamp power supply:**
  - Standard lamp 24V 100 W OSRAM HLX 64638
  - 24V DC/AC
  - 50/60 Hz
  - 6.5A

- **Fuse, lamp:**
  - 4 Amp
  - delayed certified

- **Power supply for standard motor:**
  - 24VDC - 0.5A

- **Fuse, motor:**
  - 315 mA
  - Delayed certified

- **Potentiometers:**
  - 1 turn 5Kohm long/cross
  - 3 turns 5Kohm iris

- **Weight:**
  - 11 kg

- **Guides for accessories:**
  - Maximum load:
    - Static load 70N (about 7.1Kg)
    - Dynamic load 15Nm (about 3.06Kg)

**Validation of specification data:**

- Validation of **minimum filtration** of the radiation unit (x-ray tube, collimator and possible filters) must be performed on a completely installed system by the person responsible for the installation.

- Validation of **light field luminosity** is to be performed by determining average luminosity at four points in the field centre. Measurement of contrast ratio is obtained starting from the field edge by measuring 3mm inside the field and 3mm outside the field at a 1mm aperture.

- Validation of **system x-ray leakage** is to be performed following the installation of the system components.

Ralco is available to provide any information required regarding the validation methods described above.

**WARNING**

**GUIDES FOR ACCESSORIES**

Prior to inserting accessories in the guides check on the perfect fit of the support with the mounting slot on the collimator (tolerance max. ± 0.2 MM). A faulty fit could be dangerous and it could cause the fall of accessories.
Classification: EN 60601-1 par. 5
- Protection against electric hazards: “Class I” equipment
- Protection against direct and indirect contacts: Type B equipment with applied parts.
- Protection against water seepage: “Common equipment”
- Safety of operation in the presence of inflammable anaesthetics with air or oxygen or nitrous oxide: Equipment not suited to application in the presence of inflammable anaesthetic mixtures containing air or oxygen of nitrous oxide.
- Operation conditions: Equipment for continuous operation at intermittent loads. See Operation Instructions on page F-1.

Should label data on the collimator not correspond to the specifications herein, please inform Ralco of the non-conformity.
Verifications of the specifications are to be performed according to the indicated equipment standards.

Operation environment:
- Ambient temperature = from 10°C to 40°C
- Relative Humidity = from 30% to 75%
- Atm. Press. = from 700 to 1060 hPa.

Accessories Included with the collimator
- Two guides to accommodate accessories
- Instructions Manual

Optional Items:
- RO 001 - Mounting flange, 20mm thickness
- RO 002 - Spacers for mounting flange, 1,5mm thickness
- RO 126 - Mylar mirror for 0,3mm Al, inherent filtration.
- RO 161 - Guide spacers for ionisation chamber.
- RO 175 - Glass mirror, 0,8mm thickness (2mm AL inherent filtration)

Symbols:

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<td>Dispositivo sensibile all’energia elettrostatica/ Electrostatic sensitive device</td>
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COMPATIBILITY WITH X-RAY TUBE HOUSING ASSEMBLIES:
Compatibility is determined by the possibility of complying mechanically with the dimensional drawing of Figure 1 - page 0-1.

The tube housing assembly must have a minimum inherent filtration of 1 mm. Al. equivalent and a maximum radiation leakage of 30 mR/hour measured at one meter from the source when operating at its leakage technique factors (150 kVp at 4 mA).

Source values (tube housing-collimator) must not be less than 3mm Al for filtration and must never exceed 100 mR/hr for radiation leakage.
Warning: Whenever the outer covers and the inner partitions require to be removed, re-mount with utmost care making sure they fit perfectly.

C) MOUNTING THE COLLIMATOR TO THE X-RAY TUBE:

**WARNING**
CAREFULLY FOLLOW THE MOUNTING INSTRUCTIONS AND MAKE SURE THAT THE COLLIMATOR IS CORRECTLY ASSEMBLED. INCORRECT MOUNTING COULD BE DANGEROUS: IT COULD CAUSE THE COLLIMATOR TO FALL OR TO OPERATE INACCURATELY

1. Determine the distance from the focal spot to the tube port face from the X-ray tube housing literature.

2. Subtract the resulting distance from 80 mm. (3.15") and determine how many 1.5 mm spacers combined with the 20 mm thickness of the mounting flange will be required to make up the difference. The outer face of the collimator mounting flange must be at 80 mm. (3.15") from the focal spot. Allowable tolerance is 1 mm. (0.009").

3. Select four bolts of suitable thread (M6) and of such a length that they protrude through the flange and spacers far enough to engage at least 5 threads into the tube port face. Securely bolt the flange to the tube port face.

4. Make sure that the flange is a Ralco item or that it is perfectly compatible. Figure 6 page O-6

**IMPORTANT:** to safeguard the operator and patient against the hazard of a falling collimator, the following indications are to be respected.

5. Unscrew the four mounting and centering adjustment Allen screws until the four tongues are withdrawn from the collimator top opening.

**Note:** when unscrewing the Allen screws that control the tabs do not use force exceeding 0,55 Nm. Unscrew with care so as not to damage the fixing tabs

6. Manually adjust the collimator shutters to their widest setting. Carefully couple the collimator with the tube to ascertain that the primary shutters have clearance to move in the port opening.

Place the collimator on the flange. Tighten the four mounting screws equally until the collimator is held firmly on the tube housing, see Figure 1 - page O-1. The fixing tabs must conform to EN 60601-1 par. 28.4. Ralco recommends an appropriate force which ensures safe locking of the tabs (± 5 cNm)
IMPORTANT: make sure to tighten the M6 Allen screws securing the control tabs. Appropriate tightening of the 4 Allen screws ensures secure mounting of the collimator. Tightening force used must not exceed 0.50 Nm.

Note: if the collimator is to be mounted on a ROTATING flange, use a tightening force between min. 0.50 Nm and max. 0.75 Nm.

7. Check to see that the distance from the collimator housing to the mounting flange is equal in all directions and that the collimator face is parallel to the axis of the table.

8. Should it be necessary, repeat the procedure.
D) POWER CONNECTION
THE VERSION SUPPLIED IS INDICATED ON THE LABEL.

WARNING
COLLIMATOR SUPPLY IS NOT PROTECTED BY A FUSE. CHECK THAT THE
COLLIMATOR IS PROTECTED BY AN EXTERNAL FUSE PRIOR TO CONNECTION.
FUSE REQUIREMENTS: 8A DELAYED FOR THE 12V VERSION
4A DELAYED FOR THE 24V VERSION

CABLES AND TERMINALS USED FOR THE INTERNAL CONNECTION OF THE COLLIMATOR MUST BE
SUITE FOR OPERATION AT TEMPERATURES OF 70° C AND COLLIMATOR CURRENT
ABSORPTION.

Collimator supply must conform to MDD 93/42

Collimator supply connection:

- Unscrew the three screws on the back cover and remove the cover.
- Loosen the free part of the cable clamp.
- Connect The AMP connector to the connector on the collimator.
- Tighten the cable clamp and screws to immobilise the cable.
- Reassemble the back cover.

WARNING
INCORRECT POWER SUPPLY COULD DAMAGE THE ELECTRONIC TIMER AND/OR THE LAMP.
SUPPLY TO THE QUARTZ IODIDE LAMP AND TIMER MAY BE EITHER IN ALTERNATE CURRENT OR
DIRECT CURRENT - IN THE LATTER CASE MAKE CERTAIN THE POLARITY IS RESPECTED.
E) COLLIMATOR CALIBRATION

**WARNING:**
THE FOLLOWING PROCEDURES REQUIRE THAT X-RADIATION BE PRODUCED. TAKE ADEQUATE PRECAUTIONS TO SEE THAT NO PART OF THE HUMAN BODY IS EXPOSED TO X-RADIATION, DIRECT OR INDIRECT.

Centering of the X-ray beam
Place a 35x43 cm. (14x17") cassette on the table top or other flat, horizontal surface and position the x-ray tube/collimator assembly with the focal spot at 1 meter (40") above and with the x-ray beam perpendicular to the cassette surface. Do not use equipment scales for reference, but measure the distance from focal spot to cassette surface.

**Note:** if one meter FFD (SID) cannot be obtained, use the obtainable FFD that is closest to one meter and calculate the measurement tolerances as the appropriate percentages of the distance.

If the X-Ray beam cannot be oriented vertically, then make provision by using clamps, masking tape, etc. as required to place the test objects and image receptor at the specified FFD (SID) and perpendicular relative to the X-Ray beam as described in the following procedures.
- Use the collimator light to centre the cassette in the field.
- Mark the location of the cassette with masking tape or other means so that it may be removed and replaced in the same position.
- Place white paper on top of the cassette to provide maximum contrast for the light field.
- Set the collimator to provide a field size of 35x35 cm. (14x14") at one meter (40")
- Activate the light field and use it to position 20 coins as shown in the diagram.
- Position each pair of coins touching one another so that the inner coin is lighted as much as possible and the outer coin is lighted as little as possible.
- The points of tangency will define the edges of the light field. The extra four coins in the lower left corner will provide the means for orienting the film.
- Set the technique factors at the X-Ray generators to produce a density of about 1 (about 50 kVp, 5 mAs).
- Make an exposure. Remove the cassette and process the film. Use the test film to check the alignments: described in the following paragraphs.

Collimator to Focal Spot Alignment (Primary shutter Cut-off).
Inspect the four images of the four collimator shutters which form the edges of the X-Ray field. A definitely ill-defined edge indicates that the primary shutter, close to the focal spot, is the one forming the line, rather than the outermost shutter.
To correct the condition, use the four mounting/centering adjustment screws to shift the collimator in the direction of the ill-defined line. Repeat the test film exposure after making the adjustment.

**NOTE:** The heel effect will cause the field toward the cathode to be slightly less sharp than on the other three sides. This is normal and cannot be corrected by adjustment. In addition, an X-Ray tube of 12 ° or less target angle will produce an asymmetrically shaped field when a large field size is used at short FFD (SID), because of anode cut-off effect. This is normal and may not be corrected by adjustment.

**Cover removal**

1. **TIGHTEN THE FOUR ALLEN SCREWS TO FREE THE OPENING AND FACILITATE COVER REMOVAL.**

2. **UNSCREW THE TWO SCREWS ON THE FRONT PANEL.**
3

REMOVE THE SNAP-FIT FRONT PANEL BY PRISING IT OFF AS SHOW IN THE PHOTOGRAPH.

4

UNSOLED THE TWO WIRES INDICATE IN THE PHOTO.
TURN THE COLLIMATOR OVER AND UNSCREW THE FOUR SCREWS.

REMOVE THE REAR COVER BY UNSCREWSING THE 3 SCREWS.
Light field to X-Ray Field Alignment.
EN60601-1-3 par 29.202.9
Regulations state that the total misalignment of the light field to the x-ray field in either the X (cross table) or Y (long table) direction must be less than 2% of the FFD. In this case, that is less than 20 mm (0.80"). If the test film shows that the light field, shown by the coin shadows, is congruent with the X-Ray field, shown by the shadow of the collimator shutters,
to within one coin diameter, if the diameter is less than 20 mm., then the alignment complies with the regulations.

However, the degree of precision required by Regulations is of a low order. A far greater precision of congruency can be obtained. The recommended maximum deviation is one fourth. You are urged to adjust for the greatest obtainable degree of congruency.

If misalignment is detected in both X and Y directions, check that the spacing from the focal spot to the collimator mounting surface is 80 mm. +/- 1 mm. (3.15" +/- .039"). If the spacing requires adjustment, repeat the test film exposure after the adjustment.

If the collimator mount spacing is correct, but adjustment is still necessary, do not move the collimator relative to the x-ray tube, but proceed as follows:

- Place the test film on the face of the cassette over the white paper and place the cassette in the position originally marked.
- Check the correct orientation of the film by the coin shadows.
- Using the images of the collimator shutters as the reference for the shape and size of the x-ray field, adjust the light field to be congruent to it.
- To move the light field in the cross table direction, first remove the plate from the right side of the collimator. Loosen the locking screws sufficiently to permit turning of the adjuster cam and allow mirror positioning, (Figures. 1 and 2 pages O-1 and O-2 respectively).
- Lock mirror screws and fixing cam into position after adjusting the mirror position. Remount the plate.
- To move the light field in the long table direction, remove the collimator rear and dissipator.

**WARNING: DO NOT TOUCH THE LAMP, THE SOCKET, OR THE LAMP BRACKET WITH YOUR FINGER. THEY CAN BE VERY HOT AND CAUSE SEVERE BURNS.**

- Loosen the four lamp-support fixing screws and using the hexagonal screw on the side of the lamp, adjust the lamp to make the two fields coincide (Figure 3 – page O-3). The X-ray tube focus is not always in the same position; standard tolerance is ± 1mm.
- Use the countersink screw to correct this error – by loosening and tightening this screw the lamp filament travels toward or away from the mirror (see Figure 3 – page O-3)

**WARNING:**

DO NOT TOUCH THE LAMP, THE SOCKET, OR THE LAMP BRACKET WITH YOUR FINGER. THEY CAN BE VERY HOT AND CAUSE SEVERE BURNS.

Do not touch the lamp with your fingers, even when it is cold. Oil from your skin will cause the lamp to crack and possibly explode. If you have touched the lamp, wash off the surface with alcohol, then handle the lamp with a piece of paper.

1. Round- to-square field alignment
- Use fluoroscopy to align the round to square field alignment.
- Open the iris about 6” and close the square field until the shutter touch the round field.
• If the square is not centered on the circle, remove the cover from the adjustment screws; loosen the four screws and shift the iris assembly as required to centre it over the square.
• See Figure 4 - page O-4.

2. Crosshair alignment
• Activate the light field.
• Close the shutters to obtain a narrow strip of light. See that the crosshair line is centered in the narrow light-line in each direction.
• If adjustment is required, remove the lower cover to gain access to the adjustment screws.
• Loosen the four screws and position the plastic panel to centre the crosshair lines in the light-lines. Tighten the screws.

3. Friction brake adjustment
• If the shutters fail to hold their position or are to difficult to move, clutch adjustment is required to obtain adequate friction – Figure 3 on page O-3.
• Remove the front plate to gain access to the adjustment point (Figure 3 - page O-3).
• Tighten, or loosen, alternatively by an equal number of turns, the two screws placed on the disk holding the spring. Remount the front panel.

4. Mechanical Motion Stop Adjustment of shutters
• The purpose of these stops is to prevent excessively stressing the shutters control linkage at the two extremes of travel, by positively limiting the rotation of the control shafts.
• Adjustment of these stops will not be required unless:
  a) The shutters cannot be completely closed or opened to the largest size.
  b) A resilience is felt at one or both extremes of the travel.
  c) The shutters themselves appear to limit the motion rather than the stops.

Setting of the CLOSED stop:
• Loosen the Allen screw placed on the side of the stop - see Fig. 3 page O-3.
• Temporarily remount the knob and use it to bring the shutters to the closed position. Take care to use just enough pressure and no more than is needed to see that the shutters are touching each other.
• Use the field light to ascertain that shutters are closed.
• Rotate the stop to a standstill.
• Tighten the Allen screw.
• Open and close the shutters several times and check the shutters close fully just as the cam can be felt to strike the stop.

5. Adjustment of potentiometers
Potentiometers are located on the rear ad right sides. To gain access to potentiometers:
• Remove the rear lid and lower cover (See figures 2 and 3 pages O-2 and O-3 respectively)
• Adjustment is possible through the two potentiometers support fixing screws.
• Potentiometer calibration is possible by loosening the gear pin and turning to potentiometer shaft – see figures 2 and 3 on pages O-2 and O-3 respectively)
F) OPERATION INSTRUCTIONS

**WARNING**

PROLONGED LIGHTING WITHOUT ALLOWING THE LAMP TO COOL CAUSES THE COLLIMATOR TO OVERHEAT IN THE AREA NEAR THE LAMP –

FOR EMERGENCIES: MAXIMUM LIMIT ADVISED IS 5 SUCCESSIVE LAMP OPERATIONS. ALLOW THE COLLIMATOR TO COOL (ABOUT 10 MIN.)

THE OPERATE MUST AVOID OVERHEATING THE COLLIMATOR AND CARE MUST BE TAKEN NOT TO SCORCH HIMSELF OR THE PATIENT

The collimator is normally operated by activating the pushbutton on the front panel to switch the light field ON

The collimators has been designed to operate as follows:

- Supply constantly connected during operation of the equipment.
- Light ON time is adjustable from 15 to 45 seconds via the trimmer on the electronic board. The factory setting is 30s (tol.20%)
- A normal cycle of lamp ON / OFF of is established at 2 followed by 4 minutes to allow for cooling (i.e. 1 minute ON / 4 minutes OFF)
- A normal on/off cycle which includes the cooling period is set at 10 cycles.
- Rays are permitted by the external electronics that control the collimator.
G) ROUTINE MAINTENANCE

To ensure constantly safe performance of the collimator and its compliance with applicable regulations, a maintenance program is indispensable.

It is the Owner’s responsibility to supply or arrange for this service.

Cleaning recommendations

- The collimator housing must be cleaned as prescribed by the Sanitary Regulations followed by the operator.
- Disconnect supply
- Use non abrasive cleaning products. Care must be taken to prevent liquid from entering the collimator. N.B. the collimator cover is not watertight.
- Do not re-apply power if liquids of any nature, inflammable or otherwise, have entered the collimator. See the following Maintenance instructions

Recommended maintenance programme:

Ralco suggests a yearly servicing programme. However shorter intervals are advisable when the collimator is subject to heavy workloads.

Re-calibration of the collimator will be necessary whenever the x-ray tube is changed or at each substitution of the lamp used to simulate the light field. Calibration procedures must be performed as described in this manual.

1. Check that the screws and tabs which serve to secure the collimator to the flange/tube adapter are correctly tightened.
2. Remove the covers and panels from collimator. Inspect the moving parts for signs of wear or damage.
3. Check the electric system and substitute parts that show wear.
4. Check the Lexan panel and substitute if necessary.
5. Clean the collimator with a soft cloth paying particular attention to the Lexan window. Do not use abrasive or inflammable cleaning products.
6. Sparingly lubricate the moving parts using graphite oil.
7. Wipe away all excess oil.
8. Remount the cover.
9. Check that the screws fixing the covers and guides are properly tightened.

IMPORTANT: make sure to tighten the M6 Allen screws securing the control tabs. Appropriate tightening of the 4 Allen screws ensures secure mounting of the collimator. Tightening force used must not exceed 0.50 Nm.

Note: if the collimator is to be mounted on a ROTATING flange, use a tightening force between min. 0.50 Nm and max. 0.75 Nm.
H) TROUBLESHOOTING
Should the Collimator become faulty do not use it until completely repaired. The use of a faulty collimator might impair the safety of the operator and patient. Before returning the collimator to Ralco for repair, please make sure that it isn’t one of the following problems to cause the fault.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The lamp fails to switch on</td>
<td>The collimator is not supplied correctly</td>
<td>Check supply/ Tension/current/polarity/ Fuses</td>
</tr>
<tr>
<td></td>
<td>The lamp is faulty</td>
<td>Check filaments - substitute if necessary. See Substitution Of The Lamp On Page I-1</td>
</tr>
<tr>
<td></td>
<td>Timer is faulty</td>
<td>Check supply to the timer. If there is no output tension, substitute the timer. See Substitution Of The Electronic Timer on page I-1</td>
</tr>
<tr>
<td></td>
<td>ON-Off button is faulty</td>
<td>Check contacts - substitute if necessary</td>
</tr>
<tr>
<td>The lamp fails to switch OFF</td>
<td>The timer is faulty.</td>
<td>Substitute the timer – see Substitutions on page I-1</td>
</tr>
<tr>
<td></td>
<td>The pushbutton is faulty:</td>
<td>Substitute the pushbutton.</td>
</tr>
<tr>
<td>The collimator is not centred:</td>
<td>Mirror is not positioned correctly</td>
<td>See Chapter Collimator Calibration page E-1</td>
</tr>
<tr>
<td>Shutters fail to move</td>
<td>The motor is faulty</td>
<td>Check: Supplier/ voltage/ current/ fuses.</td>
</tr>
<tr>
<td></td>
<td>Clutch is loose</td>
<td>See Friction brake adjustment page E-7</td>
</tr>
<tr>
<td>Shutters fail to position correctly</td>
<td>External electronics faulty</td>
<td>Consult Manual supplied with unit that controls the collimator.</td>
</tr>
<tr>
<td></td>
<td>Potentiometers are faulty or incorrectly calibrated</td>
<td>See potentiometer adjustment procedures on page E-7 or substitute the potentiometers as required – page I-1</td>
</tr>
<tr>
<td>The external housing is damaged:</td>
<td>X-ray leakage hazard.</td>
<td>Substitute housings</td>
</tr>
<tr>
<td>Light definition is not good.</td>
<td>Light screens not aligned correctly</td>
<td>Adjust the screens – Figure 3 page O-3</td>
</tr>
</tbody>
</table>
I) SUBSTITUTIONS, DISASSEMBLY, TRANSPORT

Substitutions:
The following operations must be performed by technically prepared and authorised personnel.
See Figure 5 – Illustrated parts breakdown - page O-5

Substitution of the lamp:

WARNING: DO NOT IMMEDIATELY TOUCH THE DISSIPATOR WITH YOUR FINGURES IT COULD BE HOT AND CAUSE SEVERE BURNS.

WARNING: DO NOT TOUCH THE LAMP, THE SOCKET, OR THE LAMP BRACKET WITH YOUR FINGER. THEY CAN BE VERY HOT AND CAUSE SEVERE BURNS.

- Disconnect supply
- Remove the back panel
- Remove the lamp protection dissipator
- Carefully remove the faulty lamp.
- Substitute the lamp with an identical lamp
- Make sure that the lamp pins are completely inserted in the lampholder
- Check on light field/x-ray field correspondence
- If necessary remove the lamp, rotate it 180° axially and re-insert.

Substitution of the motors
- Disconnect supply
- Remove the knobs and front panel
- Unsolder the connecting wire on the motor tabs; identify the cables and their position
- Unscrew the motor support from the front side
- Substitute the support with an identical part
- Remount the support with a new motor – do not tighten the screws.
- The plastic gears are not always uniform: a possible deformation could block or stiffen the movement. Check that shutters move from completely open to completely closed uniformly. Allow minimum play between gears.

Substitution of the electronic timer:
- Disconnect Supply
- Remove the knobs
- Remove the front panel.
- Remove the two screws holding the electronic timer.
- Identify the cables and their position on the terminal board.
- Disconnect the cables from the terminal board.
- Install the new timer by proceeding in a reverse order and pay particular attention to the connection of the cables to the 6-way terminal board.
Substitution of the potentiometers
- Disconnect supply to the collimator
- Remove the rear panel
- Remove the lower cover
- Unscrew the two potentiometer support fixing screws
- Unsolder the wires connecting the potentiometer pins; identify the cables and their position.
- Unscrew the two potentiometers stops and remove the gear on the potentiometer shaft.
- Substitute with an identical potentiometers and mount the fear on the shaft without tightening the screw.
- Solder the wires; remount the potentiometer support
- Calibrate the potentiometers – page E-5
- Prior to remounting the front panel and knobs, close both shutters. Adjust the indicator to read correctly.

Disassembly
- Disconnect supply to the collimator.
- Remove the rear panel and disconnect the supply cables.
- Loosen the 4 fixing screws on the upper part of the collimator - care must be taken not to let the collimator fall.

Transport and storage:
- Suitable packing must be provided for the collimator.
- Place the collimator in a plastic bag to avoid packing material from entering the collimator.
- Use an appropriate box for transport, shipment or storage taking care to protect the collimator from rough handling. This will avoid damage to the collimator during transport shipment or storage.
- Limit Storage conditions:
  Ambient Temperature = from -40°C to +70°C
  Relative Humidity = from 10% to 95%
  Atm. Pressure = from 500 a 1060 hPa.
J) RECOMMENDED SPARE PARTS

NOTE: When ordering spare parts, the Client is requested to specify the model and Serial Number of the collimator concerned.

RO 001  Mounting flange, fixed
RO 002  Spacer, metal, 1.5mm thick.
RO 051  Mounting flange, rotating
RS 393  Antidust panel with cross.
RS 006  Lamp. 100 W 24V
RS 022  Motor "Minimotor" 12V r. 548:1 square fied
RS 023  Motor "Minimotor" 24V r. 548:1 square field
RS 033  Ceramic lamp-holder.
RS 036  Potentiometer, iris - SP Electronic 533 1 Kohm
RS 045  Plastic pinion, round, for square field shutters.
RS 046  Clutch for square field shutters.
RS 047  Pushbutton
RS 061  Motor "Minimotor" 24V r. 308:1 for iris
RS 063  Electronic timer FM 338 24V
RS 092  Lamp100 W 12V
RS 098  Motor "Minimotor" 12V r. 308:1 for iris
RS 100  Potentiometer for iris - SP Electronic 533 5 Kohm
RS 101  Potentiometer for iris - SP Electronic 533 10 Kohm
RS 139  Clutch for iris shutters.
RS 204  Electronic timer FM 338 12V
RS 282  Potentiometer, servo, square field 1Kohm
RS 283  Potentiometer, servo, square field 5Kohm
RS 284  Potentiometer, servo, square field 10Kohm
RS 390  Cover
RS 394  Right guide for accessories
RS 395  Left guide for accessories
RS 402  Lateral panel, leaded
RS 403  Upper cover, semicircular
RS 404  Cover screws T.S. m3x22
RS 424  Plastic frame
RS 430  Rear cover, leaded
RS 431  Glass mirror, 1.5mm, with filter.
RS 432  Front panel, leaded, with light pushbutton.
RS 433  Front panel, leaded without light pushbutton.

Label:
K) REPAIRS

- Return the collimator to Ralco at the customer's expense if the unit is out of warranty.
- Provide the collimator with a detailed description (in Italian or English) of the functional problems and/or faults. It is important to indicate whether a repair or a complete overhaul is required.
- Our Quality Control will test the collimator.
- If the repair involved is extensive, Ralco will contact the customer to advise on the repair or possible substitution.

L) END OF LIFE DISPOSAL

Your collimator contains materials which can be recycled and reused. Specialised companies can recycle your product to increase the amount of reusable materials and to minimise the amount of materials to be disposed of.

It is recommended that you observe Local Laws regulating the disposal of your old set. Should this prove impossible, return the collimator to Ralco at the purchaser's expense and Ralco will take care of its correct disposal.

The product requires correct disposal at the end of its life-cycle and according to the current standards; it cannot be considered as normal waste. The unit must be disposed of through certified environmental management concerns or, should you need to replace the unit with new equipment, returned to Ralco. Please contact us if you require further information. The product contains lead which, if dispersed can be highly contaminating. The symbol:

![Symbol]

signifies that the products conforms to the environmental requirements of directives 202/95/EC, 2002/96/EC, 2003/108/EC; it must be disposed of correctly at the end of its life-cycle. Ask you local authorities for disposal information. Failure to disposal of this product correctly is a breach of these provisions.

M) WARRANTY:

Ralco undertakes to replace and repair any collimator part during a period of 24 months from the date of invoice and cover the labour costs involved. The warranty applies provided the product has been handled properly in accordance with its operating instructions; presentation is required of the original invoice indicating the date of purchase, the model and serial number as well as other documents originally supplied with the set.

The warranty does not apply if:
- The documents have been altered in any way or made illegible;
- The model or production number on the product has been altered, deleted, removed or made illegible;
- Repairs or product modifications and alterations have been performed by unauthorised persons;
- Damage is caused by misuse or neglect, incorrect installation or accidental damage including but not limited to lighting, water or fire.
- Use of unoriginal spare parts and accessories.

In-warranty spares will be available only upon return to Ralco, at the customer's expense, of the parts considered to be faulty to allow assess the cause of the fault.

Components not covered by this warranty:
- Consumable items such as lamps.
- Items not produced by Ralco; these items will be accorded to warranty granted by the constructor:
  - Motors - 1 year
  - Potentiometers: 1 year
  - Electronic boards: 1 year
  - Laser 12 months

Ralco reserves the right to decide if the collimator is to be repaired or substituted.
Defective material is to be sent to:

RALCO SRL
VIA DEI TIGLI 13/G
20046 BIASSONO (MI) - ITALIA
FAX: ++39-039-2497.799
EMAIL: RALCO@RALCO.IT

N) SAFETY/RESPONSIBILITY

Ralco adheres to the directives governing manufacturers of electro-medical equipment:
Directive 93/42 CEE para.10
Legislative Decree n° 46 para.10

Ralco shall not be held responsible when instructions provided in the present manual are not complied with.

Ralco shall not be held responsible if the collimator relates to one or several of the following instances:

- The unit is of Ralco construction to client specifications (no CE marking)
- The unit has been modified by the OEM or end user.
- The unit has been installed without respecting the instructions provided in this manual.
- The unit is used without respecting the instructions provided in this manual.
- The unit has not been subject to routine functional inspection.
- The unit has not been subject to routine maintenance.
- The unit has been repaired with unoriginal spare parts.
- Ralco shall decline all responsibility for any damage, direct or indirect, caused to persons or things by inappropriate accessories.

INFORMATION REGARDING ACCIDENTS THAT HAVE OCCURED WHILE USING THE RADIOLOGICAL COLLIMATOR MUST BE REPORTED IMMEDIATELY TO RALCO SRL.
O) FIGURES, DIAGRAMS, TABLES

NOTE: SHOULD THE ELECTRIC DIAGRAM REQUESTED BY YOU DIFFER FROM THE STANDARD UNIT SUPPLIED — PLEASE SEE THE ATTACHMENTS.

Figure 1

CONDIZIONE CON LAMELLE LIMITATRICE COMPLETAMENTE APERTE
NEAR PORT SHUTTERS WITH SHUTTERS FULLY OPEN

PUNTO FOCALE/FOCAL SPOT

ACCESSO REGOLAZIONE INCLINAZIONE SPEZZO
ACCESS TO MIRROR POSITION ADJUSTMENT

4 VITI REGOLAZIONE E FISSAGGIO
4 MOUNTING AND CENTERING ADJUSTMENT SCREWS

INSTRUCTIONS MANUAL MTR503MLP/A - ING. - page O-1
Figure 4

SQUARE TO ROUND FIELDS ALIGNMENT
ALLINEAMENTO DEI CAMPI TONDO E QUADRO
Figure 5 - Illustrated Parts Breakdown
Diagram 2 - Timer FM 338 12 V – Electric
Diagram 3 - Timer FM 338 12 V - Layout
Diagram 5 Timer FM338 24V - Electric
<table>
<thead>
<tr>
<th>POSIZ.</th>
<th>DENOMINAZIONE</th>
<th>PEZZI</th>
<th>N° DISEGNO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø</td>
<td>Ø1.5 mm² ELECTRIC WIRING</td>
<td>2</td>
<td>MP11130</td>
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<tr>
<td>Ø</td>
<td>Ø0.35 mm² ELECTRIC WIRING</td>
<td>20</td>
<td>MP11090</td>
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<tr>
<td>L</td>
<td>ALGREN LAMP 24 V 100 W</td>
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<td>MP11737</td>
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<td>LH</td>
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<td>CON.1</td>
<td>AMP MICROCONTACT FEMALE 182206</td>
<td>5</td>
<td>MP11401</td>
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<tr>
<td>CON.2</td>
<td>AMP CONNECTOR FEMALE 10 WAYS</td>
<td>1</td>
<td>MP11536</td>
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<td>PROTECTION EARTH</td>
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<td>MP11772</td>
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<td>E</td>
<td>MERCURY PLUS PUSH BUTTON PANEL</td>
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<td>POTENZIOMETER SP 533-0-103 10 Kohm</td>
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<tr>
<td>PI</td>
<td>POTENZIOMETER SP 157 SERVO 10 Kohm</td>
<td>1</td>
<td>MP11814</td>
</tr>
<tr>
<td>PI</td>
<td>POTENZIOMETER SP 157 SERVO 10 Kohm</td>
<td>1</td>
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</tr>
<tr>
<td>MI</td>
<td>MOTOR C/C 2225 24V 308.1</td>
<td>1</td>
<td>MP11854</td>
</tr>
<tr>
<td>MI</td>
<td>MOTOR C/C 2233 24V 548.1</td>
<td>1</td>
<td>MP11854</td>
</tr>
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</table>

**DISEGNATO:** Paolo Morelli

**CONTROLLATO:** Pagani Giovanni

**PROGETTO:** [RALCO](#)

**QUALITA':** [RALCO](#)

**DATA:** 06.10.98

**PAG.** 2 di 2

**FORMATO:** A4

**DENOMINAZIONE**: ELECTRICAL WIRING

**R 503 MLP/134**

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*Oggetto: Denominazione e tipografia del progetto. Tutto il contenuto e' esclusiva della RALCO S.R.L.*
INFORMATION FOR THE MANUFACTURER

THE FOLLOWING FORM IS PROVIDED FOR YOUR COMMENTS AND SUGGESTIONS WITH REGARDS TO THE COLLIMATOR SO THAT WE MAY ENSURE AND IMPROVE THE QUALITY OF OUR PRODUCTION.

SHOULD YOU HAVE ANY COMMENTS AND/OR SUGGESTIONS, PLEASE MAIL THE FORM, POST-FREE, TO Raico - VIA DEI TIGLI 13/G, 20046 BISSONO (MI) - ITALIA

DATA:

CUSTOMER:
ADDRESS:

INFORMATION REGARDING POSSIBLE ACCIDENTS THAT MAY HAVE OCCURRED WHILE USING THE COLLIMATOR.

DIRECTIVE 93/42/CEE STATES THAT ACCIDENTS (SUCH AS DEATH OR GRIEVIOUS INJURY) THAT INVOLVE THE COLLIMATOR DESCRIBED HEREIN, MUST BE REPORTED TO THE MINISTRY OF HEALTH AND TO THE MANUFACTURER.

THE PRESENT FORM IS PROVIDED TO REPORT TO Raico - POST-FREE, ACCIDENTS OF THE TYPE STATED IN THE DIRECTIVE.

DATE:
CUSTOMER:
ADDRESS