EUREKA

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LINEAR™ MC150-C

Installation
Operation
and Maintenance

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PROGENY, INC.

Manufacturers of Eureka Collimators and Cables

INSTALLATION ADVISORY

TO: INSTALLERS, SERVICE PERSONNEL, AND USERS OF X-RAY SYSTEMS

COLLIMATOR MOUNTING INFORMATION

In order to ensure a safe and secure mounting of this collimator to the x-ray tube housing, the following installation guidelines must be followed:

1. Two different length screws are provided in the cloth bag containing the spacers. Determine the correct length of screw to use, taking into account the collimator spacing requirements and/or peculiarities of the tube housing port boss.
2. Clean the screws and housing port boss with alcohol and, if necessary, remove any debris which may be present in the tube housing mounting holes.
3. Securely fasten the upper mounting ring and spacers to the mounting surface located on the tube housing port. As a precaution, a medium strength thread locking compound such as Loctite #242, should be applied to the screws before fastening the collimator mounting ring to the tube housing. The screws provided have a Nylok patch, as vibration resistant mounting screws are strongly recommended.
   Verify that the collimator mounting screws engage the housing by at least five (5) threads when used with the any required collimator spacer plate(s).
4. In order to fasten the Collimator to the Tube Housing, it is necessary that the four (4) collimator detent ball plungers (located on the top of the collimator) are aligned with the detent holes located on the collimator tube mounting plate (i.e. collimator is mounted in either the 0, -90, or +90 degree swivel position).
   NOTE: It is much easier to mount the collimator when the tube is inverted (upside-down) or if the collimator is placed on the table top and the tube is lowered onto it.
5. Carefully support the collimator in place and attach the clamping ring. The hinge of the clamping ring must line up with the pin in the lower mounting ring. Securely fasten the #6-32 socket head cap screw locking the collar halves in place. **Use only the provided Collar Locking Screw (26-00752), do not replace with other hardware. In addition install two (2) Collar Locks (70-10038), which provides a fail-safe for the Collar/Screw Assembly.**
6. After mounting the collimator and/or performing any service to it or the tube housing, inspect the fit of the collimator and the tube housing. Grasp and attempt to move the collimator and then the tube housing assembly while inspecting for loose joints or gaps between the tube/collimator assembly, as well as other tube mounting areas. If a problem is found, consult factory personnel.
7. It is strongly recommended that a periodic inspection (at least every 12 months) should be made to ensure mounting integrity.

WARNING

Failure to adhere to the above guidelines may result in loosening, damaged screws or mount failure which could result in heavy components falling during use. Incidents of loose system components should be reported immediately to x-ray service personnel for repair.

TABLE OF CONTENTS

SECTION		PAGE
1.0	**INTRODUCTION**	**1-1**
1.1	You have Legal Obligations	1-4
1.2	Background	1-4
1.3	Collimator Features	1-5
1.4	General Specifications	1-5
1.5	Advanced Features	1-6
1.6	Radiation and Mechanical / Electrical Warning	1-6
1.7	Compatibility	1-7
1.8	Maintenance	1-8
2.0	**INSTALLATION**	**2.0**
2.1	Unpacking	2-3
2.2	Equipment Supplied	2-3
2.3	Collimator Mounting	2-3
2.4	Interconnect Wiring 24 Volt AC Source	2.5
2.5	Power Chassis Mounting	2-5
2.6	Interconnect Wiring WHEN USING EUREKA POWER SUPPLY	2-5
3.0	**OPERATIONAL CHECKOUT PROCEDURE**	**3.0**
4.0	**ADJUSTMENT PROCEDURES**	**4-1**
4.1	Field Projection Lamp and Mirror Adjustment	4-3
4.2	Cross-Hair Window Adjustment	4-4
4.3	Bucky Centering Light-line Adjustment	4-4
4.4	Long and Cross SID Indicator Adjustment	4-5
5.0	**COMPLIANCE VERIFICATION**	**5.1**
5.1	Verification Test to be Performed	5-3
XR8/2.09	Determination of Half-Value Layer	5-4
XR8/2.14	Visual Definition of X-Ray Light-Field	5-9
XR8/2.15	Intensity of Light Field Illumination	5-14
XR8/2.17	X-Ray Field Receptor Center Alignment	5-16
XR8/2.18	Indication of Field Size	5-17
XR8/2.20	X-Ray Field Limitation and Alignment	5-18

TABLE OF CONTENTS (Continued)

SECTION		PAGE
	Record Sheet.....	5-21
6.0	**THEORY OF OPERATION.....**	**6-1**
6.1	Mechanical Operation.....	6-3
6.2	Electrical Operation.....	6-3
7.0	**RENEWAL PARTS LIST.....**	**7-1**
8.0	**APPENDIX.....**	**8-1**

LIST OF ILLUSTRATIONS

SECTION	FIGURE		PAGE
1.0	1-1	Front Panel Indicators and Collimator Operations.....	1-3
2.0	2-1	Component Identification.....	2-2
	2-2	Skin Guard Installation.....	2-6
	2-3	Collimator Mounting Dimensions.....	2-7
	2-4	Interconnect Wiring 24 Volt AC Source.....	2-8
	2-5	Power Chassis Outline.....	2-8
	2-6	Interconnect Wiring WHEN USING EUREKA POWER SUPPLY.....	2-9
3.0	3-1	Light Field/ X-Ray Fild Congruency Test Measurement.....	3-5
4.0	4-1	Lower Case Removal.....	4-2
	4-2	Lamp and Buck Light Line Adjustments.....	4-6
5.0	5-1	BRN/FDA Compliance Test Stand.....	5-2
	5-2	Compliance Stand Detail.....	5-2
	5-3	Light Field vs. X-Ray Field Error Measurements.....	5-7
	5-4	Calculation Example.....	5-11
	5-5	Metal Marker Method.....	5-11
	5-6	Half-Value Layer Determination Graphs.....	5-8

LIST OF TABLES

SECTION	TABLE		PAGE
5.0	5-1	Minimum Beam Quality Requirements.....	5-4
	5-2	Aluminum Equivalentof Primary Beam Total Filtration.	5-5
	5-3	Highest Design Operating Range.....	5-7
	5-4	Half Value Layers as a Function of Filtration and Tube Potential for Diagnostic Units.....	5-8

SECTION 1.0

INTRODUCTION

This product has been tested by Underwriter's Laboratories in conformance with standards set forth by UL 2601-1, CAN/CSA-C22.2 No. 601.1-M-90, and IEC 601-2-32. It has been found to comply with these standards and, therefore, bears the above "Recognized Component" symbol for UL and UL-C.

UL File No. E181750

FRONT PANEL INDICATORS & COLLIMATOR OPERATION

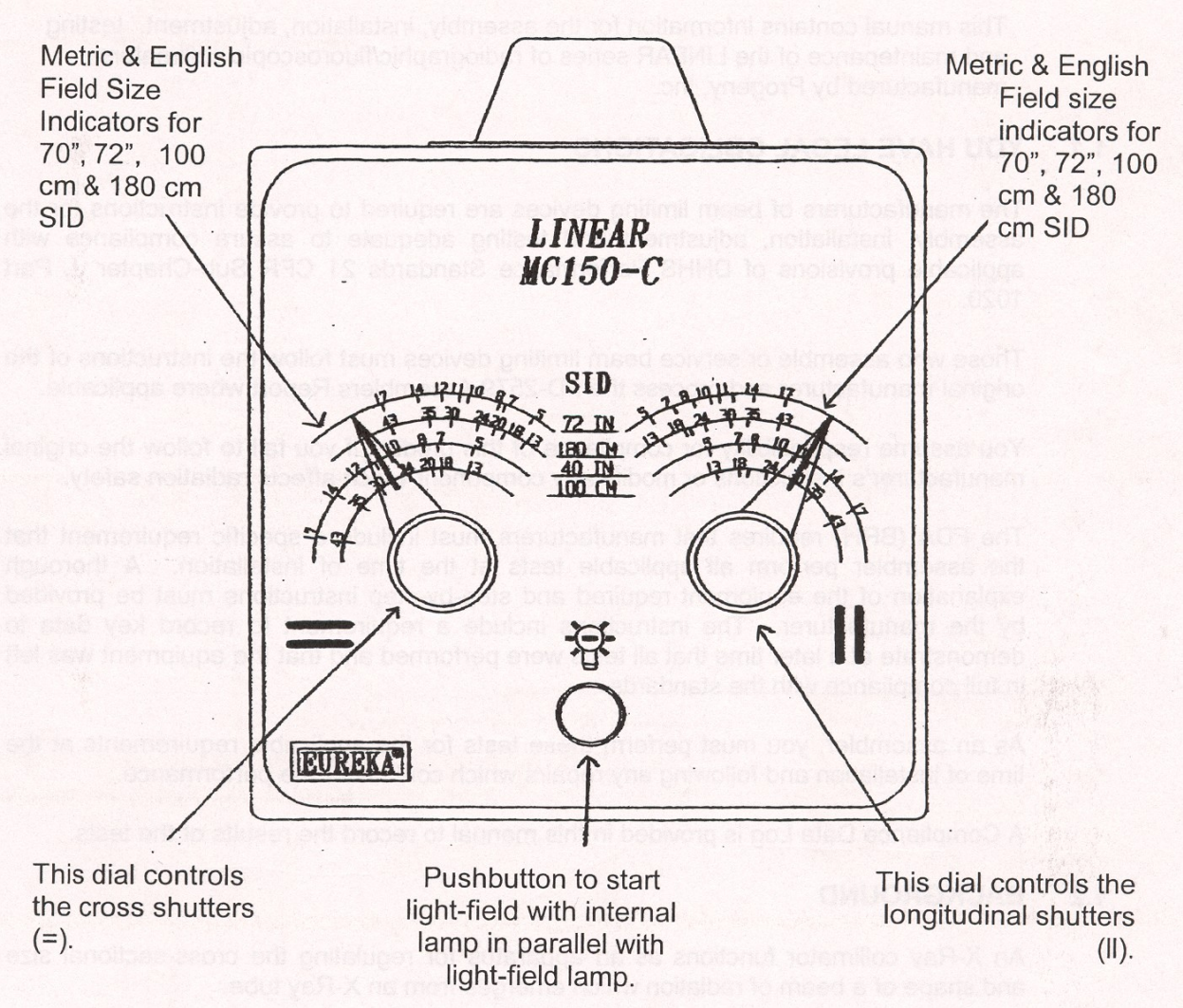


Figure 1.1

MANUAL OPERATION

- Press the "lamp" pushbutton to activate the light-field.
- Adjust the shutters (both longitudinal and cross) to a size not larger than the film to be used.
- Center light-field over cassette or anatomical area to be exposed.

1.0 INTRODUCTION

This manual contains information for the assembly, installation, adjustment, testing and maintenance of the LINEAR series of radiographic/fluoroscopic collimators manufactured by Progeny, Inc.

1.1 YOU HAVE LEGAL OBLIGATIONS

The manufacturers of beam limiting devices are required to provide instructions for the assembly, installation, adjustment and testing adequate to assure compliance with applicable provisions of DHHS Performance Standards 21 CFR Sub-Chapter J, Part 1020.

Those who assemble or service beam limiting devices must follow the instructions of the original manufacturer and process the FD-2579 Assemblers Report where applicable.

You assume responsibility for compliance of this product if you fail to follow the original manufacturer's instructions or modify any component which affects radiation safety.

The FDA (BRH) requires that manufacturers must include a specific requirement that the assembler perform all applicable tests at the time of installation. A thorough explanation of the equipment required and step-by-step instructions must be provided by the manufacturer. The instructions include a requirement to record key data to demonstrate at a later time that all tests were performed and that the equipment was left in full compliance with the standards.

As an assembler, you must perform these tests for the applicable requirements at the time of installation and following any repairs which could alter the performance.

A Compliance Data Log is provided in this manual to record the results of the tests.

1.2 BACKGROUND

An X-Ray collimator functions as an apparatus for regulating the cross-sectional size and shape of a beam of radiation which emerges from an X-Ray tube.

The source of radiation is virtually a point-source and, due to the tube housing design, emerges from the port as a solid diverging cone of radiation. The finite angle of the anode surface limits the X-Ray beam on the anode side (heel-effect) forming a 'D" shaped X-Ray field, limiting the useful coverage.

In "collimating" a beam to a given size and shape, a geared pair of lead shutters are moved symmetrically into the beam to absorb the unwanted portion of the emerging beam. A second geared pair of shutters are positioned at right angles to the first pair, and again are moved symmetrically into the beam. In this manner, a continuously variable square/rectangular beam is formed.

The landing area of the beam will contain a radiographic image receptor located in a plane perpendicular to the beam at pre-determined distances from the radiation source (focal spot).

The size and shape of the image receptor will determine the maximum useful cross-sectional size and shape of the beam in the plane of the image receptor. The source-to-image receptor distance (SID) determines the actual shutter opening required to regulate the beam size and shape in the plane of the image receptor.

1.3 LINEAR SERIES COLLIMATOR FEATURES

1.3.1 SERVICEABILITY

The Linear™ series collimator logic provides a third objective not included with other similar products - serviceability. This new dimension is incorporated in a manner which allows a single positioning of the collimator above a table top for the diagnostic troubleshooting of the logic and collimator functions. All calibrations are then done by observing the light-field projected onto a test pattern provided with each collimator.

1.4 GENERAL SPECIFICATIONS - Model LINEAR MC150

The Linear MC150-Ccollimation system from EUREKA includes all features required for diagnostic excellence...

APPLICATIONS.....	For general purpose mobile X-Ray units and special purpose radiographic units.
MAXIMUM kVp.....	150 kVp.
OUTER DIMENSIONS.....	10.12” x 6.75” x 6.5” (25.70 cm x 17.15 cm x 16.51 cm
NET WEIGHT.....	17 lbs (10.2 kg) - approximately
PROJECTION LAMP.....	Quick change, pre-aligned quartz halogen lamp. Light output more than 160 Lux at 100 cm.
LAMP TIMER.....	Push button type, 25 seconds approximately.
POWER SUPPLY.....	24 VAC +/- 10% at 8 Amps
PROJECTED FIELD SIZE..	Square or rectangular pattern continuously variable from closed to 43cm by 43cm at 86cm SID (17” x 17” at 34” SID)
CONE TRACK.....	Optional
SWIVEL MOUNT.....	Standard
BUCKY LIGHT LINE.....	Optional
SKIN GUARDS.....	Optional, to be attached for Mobile operation
FILTRATION.....	2.0 mm (Min.) Aluminum equivalent at 100kVp.
INDICATIONS.....	English and Metric cassette sizes at 40”(100 cm) and 72” (180 cm) SIDs.

1.5 ADVANCED FEATURES

The Linear MC150-C Collimator system also incorporates features required for diagnostic convenience...

… Swivel mount standard for angulated positioning.

… All electronic components are standardized types available at major electronic suppliers. Use of standardized, straight-forward logic allows troubleshooting and repair with general electronic experience.

… A spare lamp is provided inside the lamp housing and is easily replaced by the owner/operator.

1.6 RADIATION AND MECHANICAL/ELECTRICAL WARNING (from NEMA Standards Publication/No. XR8-1979)

Radiation Warning for Diagnostic X-Ray Systems

X-rays are dangerous to both operator and others in the vicinity unless established, safe, exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar, and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, *"Diagnostic X-Ray Systems and their Major Components,"* and the National Council on Radiation Protection (NCRP) No. 33, *"Medical X-Ray and Gamma-Ray Protection for Energies up to 10 MeV-Equipment Design and Use,"* as revised or replaced in the future.

Failure to observe these warnings may cause serious, genetic or potentially fatal bodily injuries to the operator or those in the area

Mechanical-Electrical Warning for Diagnostic X-Ray Systems

All of the moveable assemblies and parts of X-Ray equipment should be operated with care.

Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are deadly; be sure line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories.

Do not remove the flexible high tension cables from the X-Ray tube housing, or high tension generator, or the access covers from the generator until the main and auxiliary power supplies have been disconnected.

When disconnecting high voltage cables, they must be grounded immediately in order to dissipate any electrical charge that may remain on the cables or the tube.

Failure to comply with the foregoing may result in serious or potentially fatal bodily injuries to the operator or those in the area.

1.7 COMPATIBILITY

The Linear MC150-C collimator is compatible and can be adapted for use with X-Ray tube/housing assemblies that meet all of the following factors:

1. Focal Distance of X-Ray Tube:

   The focal spot to collimator mounting flange distance must be 6.0 cm, +/- .080 cm. Four (4) spacers are supplied for adaptation:

   1 - .25” (0.635 cm) spacer

   3 - .60” (0.152 cm) spacer

   Use any of the above combination to achieve the requirements.

2. Leakage Radiation:

   Maximum leakage radiation from the X-Ray tube/housing assembly must not exceed 50 mR/hr at 100 cm (40 inches) at specified leakage technical factors. This collimator is compatible with all x-ray tube housing assemblies having leakage technique factors of 150 kV and 4 mA.

3. Inherent Filtration and Half-Value Layer:

   The Eureka Linear™ collimator has a minimum value of 2.0 mm aluminum equivalence at 100 kV. This value plus any tube inherent filtration plus any added filtration must meet the minimum requirements of 21 CFR Sub-Chapter J, Part 1020.30 (m)(1) Table 1 on beam quality (e.g. minimum HVL at 100 kV must be 2.7 mm Al.

4. Application:

   The intended application is for general purpose radiographic equipment, including tomographic and chest applications. Maximum tube rating must be 150 kV or less.

5. Installation:

   Must be made with supplied hardware, including mounting flange, spacers (as required), four (4) M6 x 16 bolts, and four (4) 1/4 – 20 screws equally spaced on a 9 cm diameter bolt center.

1.8 MAINTENANCE

The Collimator system must be properly maintained to assure both compliance with BRH regulations and useful life.

Preventive maintenance is to be performed once every twelve months. This includes inspection and lubrication of both the cassette tray(s) and collimator mechanism. The collimator mounting ring and locking screw (70-10036 and 26-00752) should be examined to ensure secure mounting of the collimator. **ONLY PROGENY P/N 26-00752 COLLAR LOCKING SCREW SHOULD BE USED.**

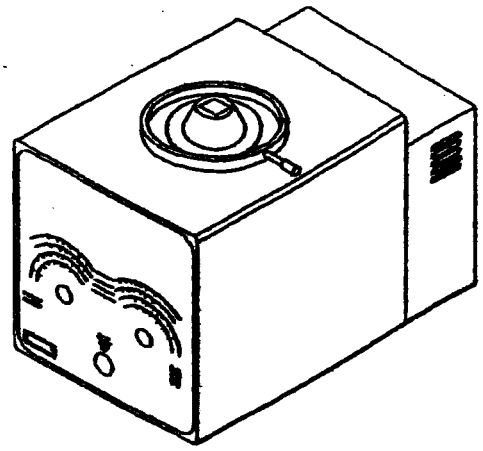
Checkout should also occur if any of the following conditions occur:

- Lamp replacement
- Premature electronic component failure
- When collimator is removed from tube/housing assembly
- When collimator and/or cassette tray have been subjected to external damage

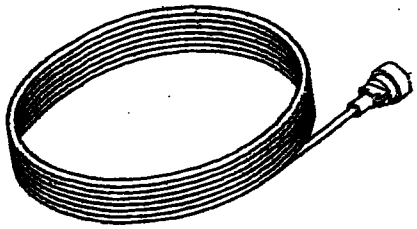
Refer to Section 5.0 for collimator CHECK-OUT procedure, and refer to the cassette tray manual for tray maintenance.

SECTION 2.0

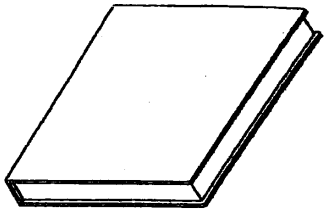
INSTALLATION



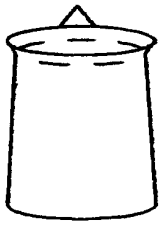
MC150-C COLLIMATOR



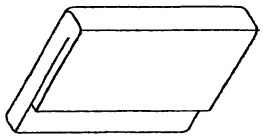
INTERCONNECT CABLE



MC150-C MANUAL



SPACER KIT



SKIN GUARD KIT (OPTIONAL)

COMPONENT IDENTIFICATION
FIGURE 2.1

2.0 INSTALLATION

2.1 UNPACKING

Carefully unpack the equipment and check for damage incurred during shipment. Any damage should be referred to the agency that delivered the product.

2.2 EQUIPMENT SUPPLIED

Refer to Figure 2-1 for component identification

- Linear MC150-C Collimator
- Spacers and mounting hardware
- Interconnect cable
- Packet containing Instruction Manual, Assembler's Report FD -2579, Returned Goods Authorization/Service Report
- Skin Guard Kit (Optional)

2.3 COLLIMATOR MOUNTING

2.3.1 SKIN GUARD INSTALLATION

NOTE: Refer to Figure 2.2

1. Remove the Front and back covers, then the outer cover by removing the twelve (12) 6-32 screws which keep them in place.
2. Mount the two (2) Skin Guard Rails to the outer cover using the four (4) screws provided in the Skin Guard Kit.
3. Reattach the outer cover, then the front and back covers. After assembly, test the field lamp timer for proper operation.

2.3.2 Determine the collimator mounting surface to focal spot distance from the data supplied with the X-Ray tube (do not rely on an inscribed mark on the tube housing).

Note: The collimator will not perform properly unless the focal spot to upper swivel ring distance is 2-7/16" (2.44 inches, 62 mm) +/- 1/32" (.031 inches, 1 mm). Be sure to include any permanent mounting plates in the focal spot to port boss distance stated in the tube manufacturer's data.

Note: The Linear MC150-C is designed to be used <u>with</u> a lead diaphragm or cone in the plastic port of the X-Ray tube.

If it is found that lead diaphragms or cones require removal or modification, consult the factory.

Determine the total thickness of the supplied spacer(s) that must be added to the collimator mounting surface to obtain a focal spot to collimator mounting flange distance of 2-7/16" (2.44 inches, 62 mm) +/- 1/32" (.031 inches, 1 mm). Refer to Figure 2-3.

Remove the upper swivel ring from the collimator by removing the 6-32 socket head cap screw and opening the clamp ring.

In order to insure a safe and secure mounting of this collimator to the X-Ray tube housing, the following installation guidelines should be followed.

1. Two different lengths of screws are provided in the cloth bag containing the spacers. Determine the correct length of screw to use, taking into account the collimator spacing requirements and/or peculiarities of the tube housing port boss.

2. Clean the screws and housing port boss with alcohol and if necessary, remove any debris which may be present in the tube housing mounting holes.

3. SECURELY fasten the upper mounting flange and spacers to the collimator mounting surface. As a precaution, a medium strength thread locking compound, such as Loctite #242, should be applied to the screws before fastening the collimator mounting ring to the tube housing.

   Verify that the collimator mounting screws engage the housing by at least five (5) threads when used with any required collimator spacer plate(s).

4. Carefully support the collimator in place and re-attach the clamping ring. The hinge of the clamping ring must line up with the pin in the lower mounting ring. Apply Loctite to the 6-32 socket head screw holding the clamping ring and securely fasten together.

5. After mounting the collimator and/or performing any service to it or the tube housing, inspect the fit of the collimator and tube housing. Grasp and attempt to move the collimator and then the tube housing assembly while inspecting for loose joints or gaps between the tube/collimator assembly as well as other tube mounting areas.

WARNING! FAILURE TO ADHERE TO THE ABOVE GUIDELINES MAY RESULT IN LOOSENING, DAMAGED SCREWS, OR MOUNT FAILURE WHICH CAN RESULT IN HEAVY COMPONENTS FALLING DURING USE. INCIDENTS OF LOOSE SYSTEM COMPONENTS SHOULD BE REPORTED IMMEDIATELY TO X-RAY SERVICE FOR REPAIR.

2.4 INTERCONNECT WIRING
24 VOLT AC SOURCE ONLY

(Refer to Cabling Outline Figure 2.4)

Connect the unterminated end of the supplied three wire cable and plug to a suitable 24 VAC source with a capacity of 8 Amps minimum. Make the connections as per the following:

BLACK - HOT (fused at 8 AMPS min.)
WHITE - Neutral
GREEN - Ground (Earth)

Connect the plug end of the cable to the receptacle provided in the rear of the collimator head.

NOTE: It is the responsibility of the installer to insure that the collimator has been connected to a source which has been fused for no more than 8 Amps.

2.5 POWER CHASSIS MOUNTING

The power chassis is intended to be mounted on the wall or in an equipment cabinet. There are holes in the bottom of the enclosure to allow mounting. Follow all local wiring codes and locate the enclosure in an area that will permit:

- Cable Bend Radius
- Convection Cooling
- Access to Fuses F1 and F2

External connections to the system are made to the free ends of the two cables permanently attached to the Power Chassis. They include:

- 120 VAC or 220 VAC Power Connection (Depends on Power Supply purchased)
- Power Chassis to Collimator (Plug Connection).

Refer to the Power Chassis drawing (Figure 2.5) for mounting dimensions.

2.6 INTERCONNECT WIRING
(Refer to Cabling Outline Figure 2.6)

All connections are made external to the Power Chassis (refer to Figures 2.5 and 2.6)

2.6.1 120 VAC or 220 VAC INPUT

Connect the three wire cable supplied to the VAC source as follows:

Black	-	Hot
Wire	-	Neutral
Green	-	Ground

Progeny offers two different power supplies to match incoming power of either 120 VAC or 220 VAC depending on power source available. The power supply part numbers are:

120 VAC transformer: P/N 70-20254
220 VAC transformer, P/N 70-20288

Remove the protective sheet metal cover.

Measure AC power source with a RMS type voltmeter and record reading.

Connect the power source to the transformer tap closest to the power source voltage read. The taps are numbered as follows for:

120 VAC Transformer, (Power Supply 70-20254)
Primary: 0V, 105, 115, 125 VRMS 47-63 Hz
Secondary: Full load 19, 27 VRMS @ 6-25 Amps

220 VAC Transormer, (Power Supply 70-20288)
Primary: 0V, 210, 230, 250 VRMS 47-63 Hz
Secondary: Full load 19, 27 VRMS @ 6-25 Amps

2.6.2 Route the 8-conductor Collimator cable and plug between the Power Chassis and Collimator Head as desired. Connect plug B4 inserting it into receptacle and turning clockwise until it is secure.

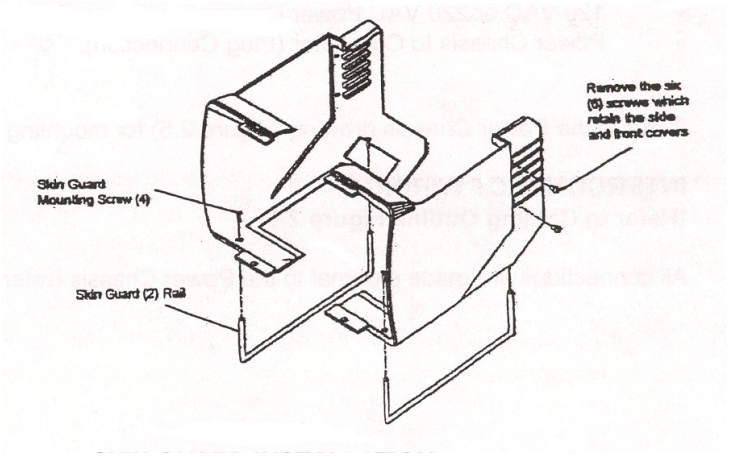


FIGURE 2.2
SKIN GUARD INSTALLATION

DIMENSIONS

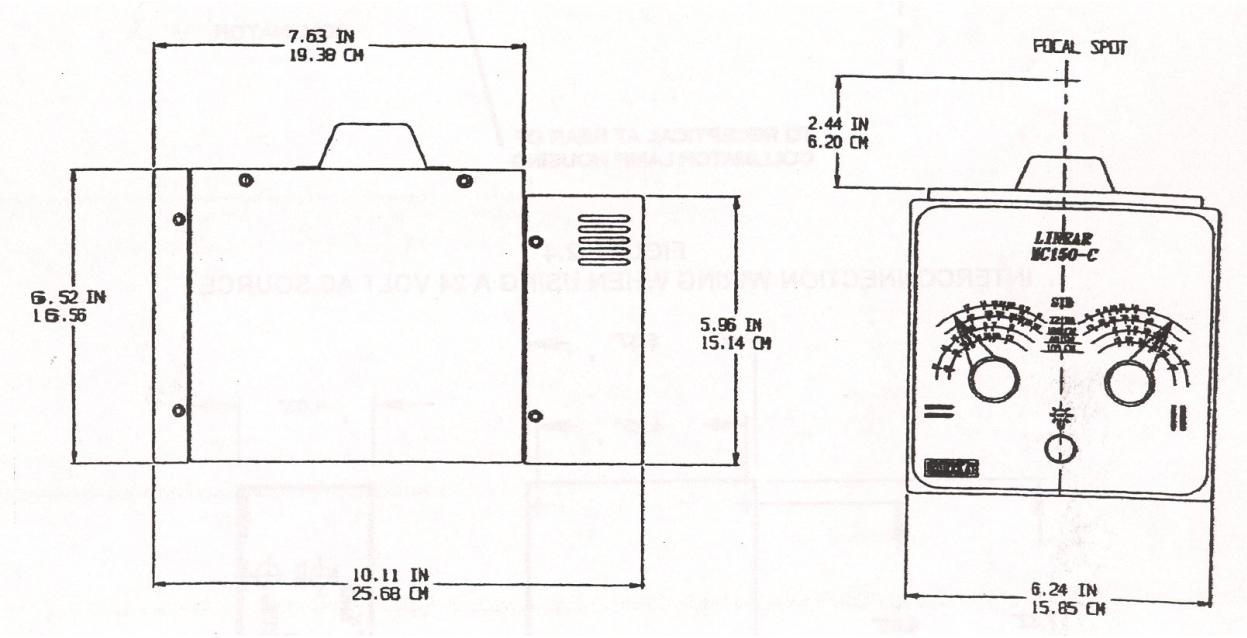


FIGURE 2.3
COLLIMATOR MOUNTING DIMENSIONS

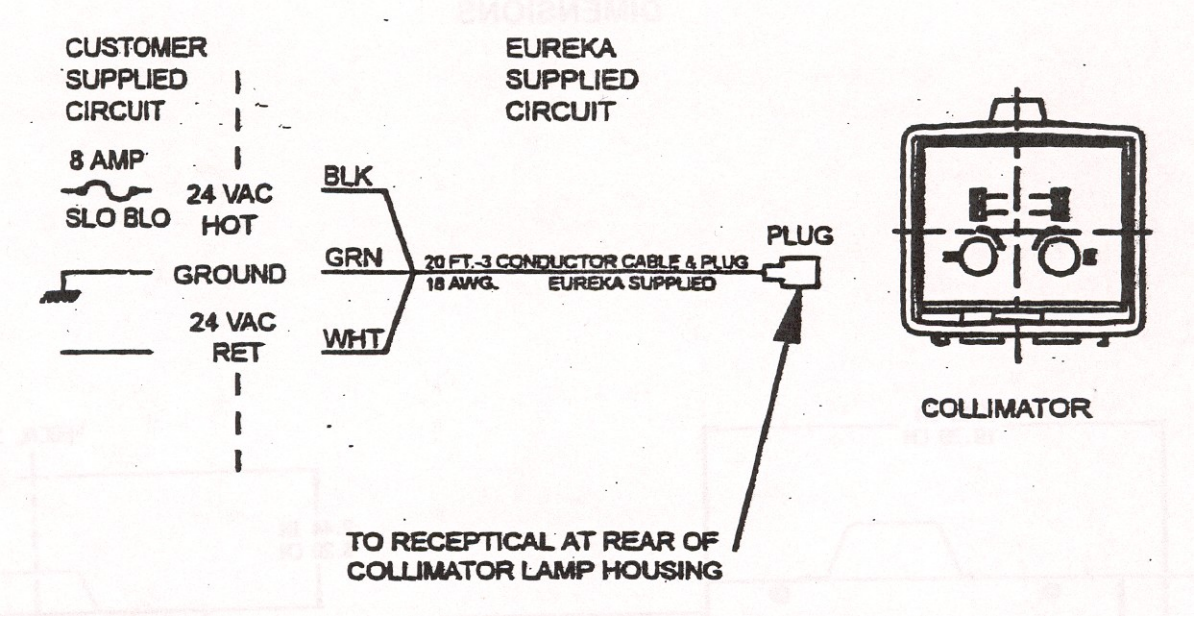


FIGURE 2.4
INTERCONNECTION WIRING WHEN USING A 24 VOLT AC SOURCE

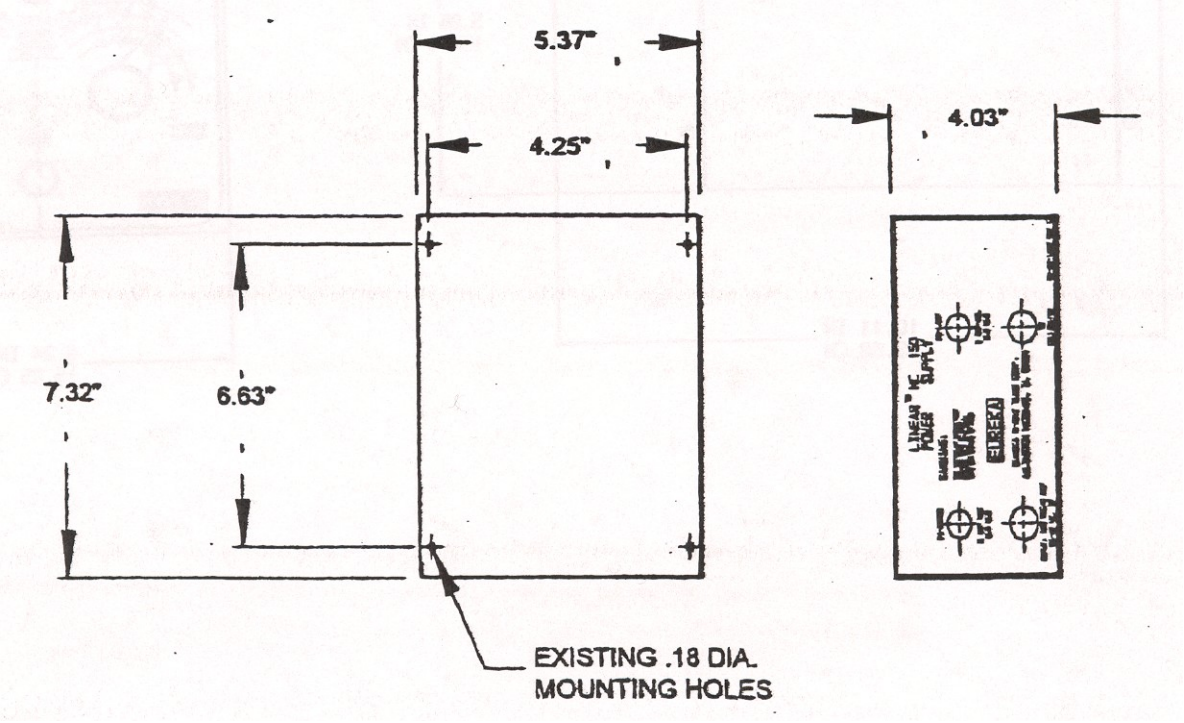
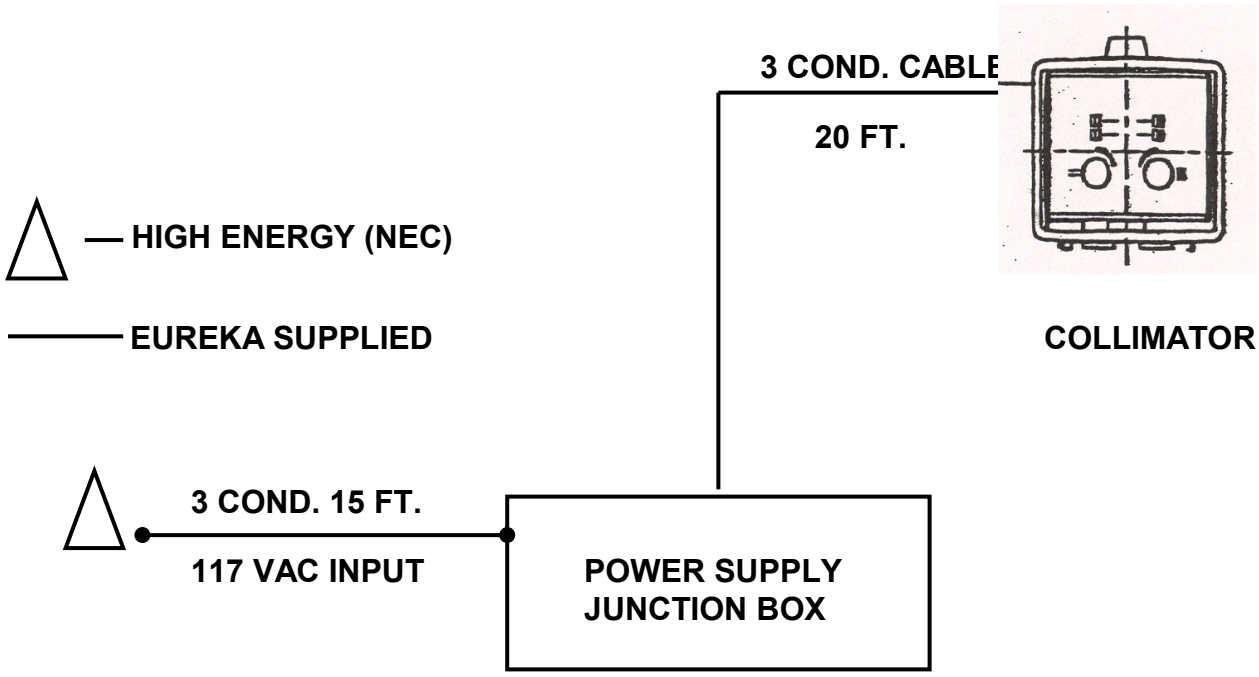


FIGURE 2.5
POWER CHASSIS OUTLINE



CABLE CONFIGURATION FOR 70-63000 LINEAR MC 150
WHEN USING EUREKA POWER SUPPLY 70-20254

FIGURE 2.6
INTERCONNECT WIRING

(NO TEXT)

SECTION 3.0

OPERATIONAL CHECK-OUT PROCEDURE

(NO TEXT)

3.0 OPERATIONAL CHECK-OUT PROCEDURE

3.1 Operational Check - After the Collimator, Power Chassis and cabling have been installed, apply 24 VAC power and observe the collimator.

3.1.1 Push the LAMP button and check that the light field lamp remains on for approximately 25 seconds.

3.1.2 While the field lamp is on, be sure the light field can be collimated to required size with the control knobs.

3.2 LIGHT FIELD/X-RAY FIELD CONGRUENCE TEST

The following operational check is performed with the collimator located in a single fixed position above a test pattern located on the table top.

Any required adjustments are made while observing the light-field edges, therefore it is necessary to confirm that the light-field is representing the X-Ray field. By establishing a defined light-field and exposing a film to a density of 1.0, the X-Ray field (image) can be compared to the light-field.

The Performance Standards 1020.30 (b)(22) and (45) define the edges of the light-field as the locus of points at which the illumination is one-fourth of the maximum and the edges of the X-Ray field as the locus of points at which the exposure rate is one- fourth of the maximum.

The X-Ray field should be determined by exposing film to a density of 1.0 on the developed image, and observing the point at which the density is just visibly increased above the fog background of the film.

In a similar manner, the light-field edges should be determined by observing the lightfield on a white background. By observing the point at which the light-field is just visibly in increased over the background illumination, and comparing this to the X-Ray field (and to the tolerance marks on the pattern), comparisons may be made.

EQUIPMENT REQUIRED:

A. LINEAR collimator test pattern (contained in this manual)
B. Measuring tape (ruler)
C. 14” X 17” (35.5 cm x 43 cm) X-Ray film cassette
D. Densitometer (or a 1.0 density neutral density filter for a density comparison).

3.2.1 Remove the LINEAR collimator table-top TEST PATTERN #1 from this manual and position it on the table-top with the edges parallel to the table-top edges. Flatten the creases and tap it into position at the corners in a manner that will not damage it upon removal.

3.2.2 Angulate the collimator to 0° horizontal. Position the collimator at a focal spot to TEST PATTERN distance of 100 cm ± 0.2 cm by measuring from the center of the exit window to the center of the light-field; this distance should be 77 cm ± .02 cm".

LIGHT FIELD/X-RAY CONGRUENCE TEST

3.2.3 Place the X-Ray source to table distance at 100 cm SID.

3.2.4 Locate a cassette on the table-top and accurately center the cassette to the light-field.

3.2.5 Manually reduce the size of the X-Ray field to the next smaller film size.

3.2.6 Identify the light-field edges and carefully mark the edges by placing the metal markers as illustrated in Figure 3.1.

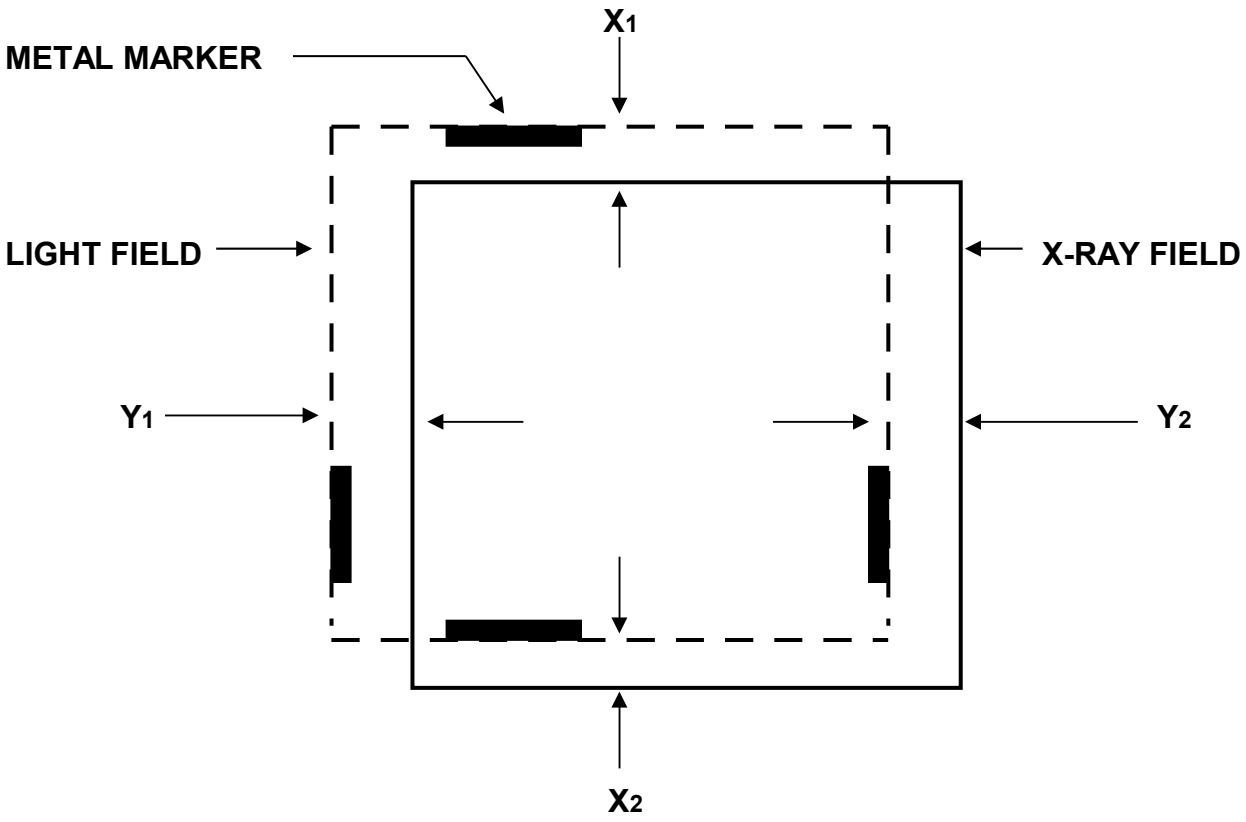
3.2.7 Expose the film to a density of 1.0 and develop.

3.2.8 Carefully identify the X-Ray field edges and measure the difference between the X-Ray field edges and light-field edges.

3.2.9 The sum of the long axis difference (X1 + X2) shall not exceed 2% of the SID, and the sum of the cross axis difference shall not exceed 2% of the SID.

3.2.10 If errors exceed those shown in Figure 3.1 below, refer to Section 4.0, ADJUSTMENT AND ALIGNMENT PROCEDURES.

LIGHT FIELD / X-RAY FIELD CONGRUENCE TEST



$X_1 + X_2$ must be less than 2% of the SID
$Y_1 + Y_2$ must be less than 2% of the SID

FIGURE 3.1

(NO TEXT)

SECTION 4.0

ADJUSTMENT and ALIGNMENT PROCEDURES

CROSS-HAIR WINDOW ADJUSTMENT

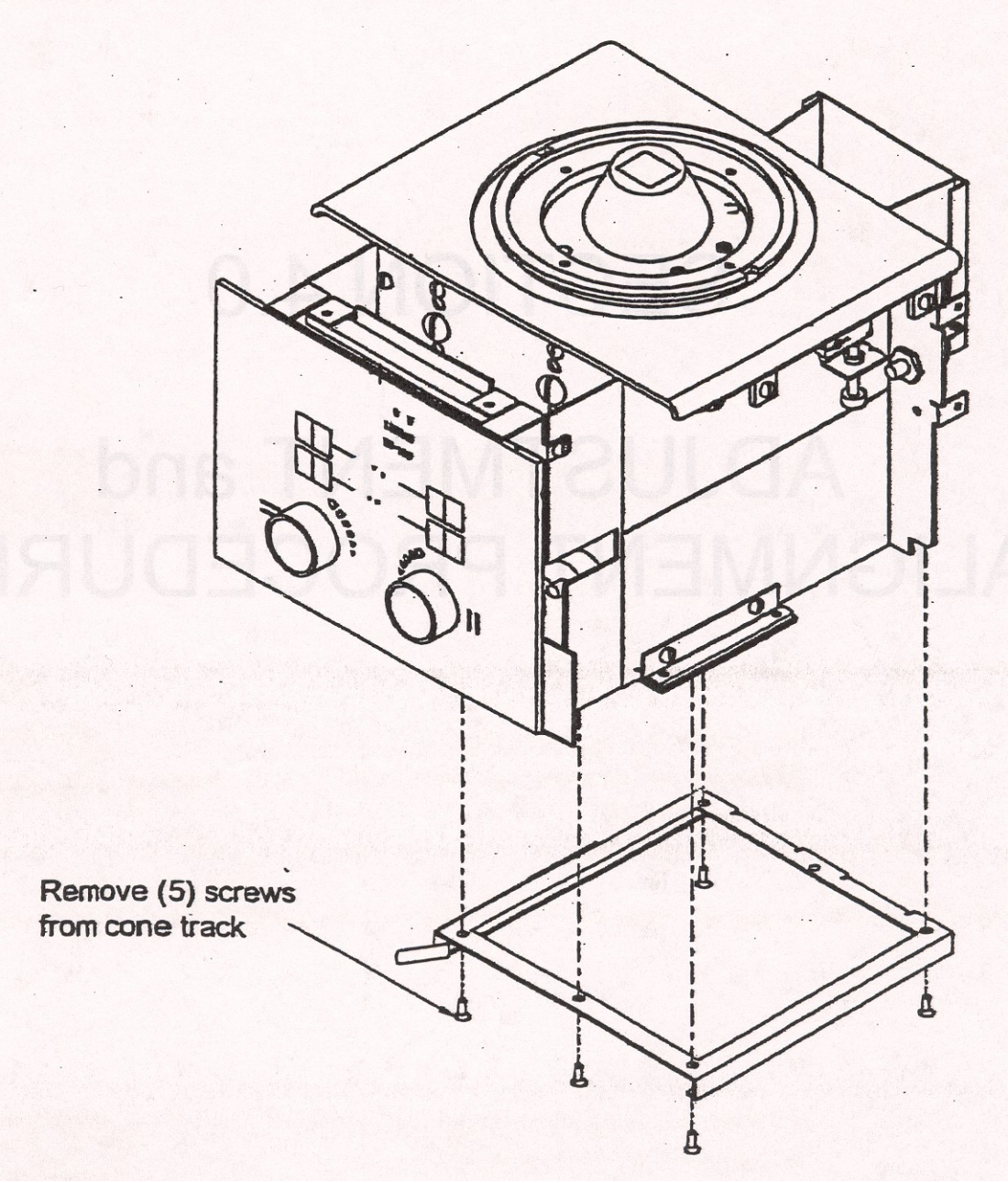


FIGURE 4.1

4.0 ADJUSTMENT AND ALIGNMENT PROCEDURES

4.1 FIELD PROJECTION LAMP AND MIRROR ADJUSTMENT

These tests must be performed when the field projection lamp is altered from it's original position or replaced. These tests must also be performed if the original mirror angle has been altered and if any edge of the developed X-Ray image is outside of the 30.5 cm x 30.5 cm @ 100 cm tolerance marks as defined in Step 3.2.

4.1.1 Steps 3.1 through 3.2 should be carefully reviewed or repeated prior to a lamp or mirror adjustment attempt. This is particularly important if only a single testing indicates a failure to meet the requirements defined in Step 3.2.

4.1.2 The collimator position, and the developed X-Ray film must remain undisturbed from the position defined in Steps 3.1 through 3.2.

4.1.3 Remove the rear cover and the lamp housing heat shield.

WARNING! THE LAMP AND HEAT DEFLECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING! THE INTENSITY OF THE LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENT WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

4.1.4 If the developed X-Ray image (steps 1 through 9 in section 3.2) is off-center in the longitudinal direction, loosen the two screws securing the lamp housing.

4.1.5 Use a pair of long nose pliers to move the lamp housing slightly until ***the light field has shifted*** to a position that is centered to the developed X-Ray image in the longitudinal direction. Tighten the two screws securing the lamp bracket.

4.1.6 If the developed X-Ray image (steps 1 through 9 in section 3.2) is in error in the cross-table direction, adjust the angle of the mirror (using the knurled knobs as shown in Figure 4.2) until ***the light field has shifted*** to a position that is centered to the developed X-Ray image.

4.1.7 Repeat steps 1 through 9 in section 3.2 to confirm the results of the above adjustment.

4.1.8 Tighten the lamp bracket screws and replace the rear cover.

4.2 CROSS HAIR WINDOW ADJUSTMENT

These procedures are to be performed if the cross hair shadows are not centered to the light field (Reference Figure 4.1).

4.2.1 Loosen the screws securing the plastic window.

4.2.2 Move the plastic window to align and center the cross hair pattern to the light field (center lines on the test pattern).

4.2.3 Tighten the screws and reassemble the collimator covers.

4.3 BUCKY CENTERING LIGHT-LINE ADJUSTMENT

4.3.1 These procedures are to be performed if the centering light-line is not centered to the ***correctly adjusted light-field***.

4.3.2 Remove the rear cover.

WARNING: THE LAMP AND HEAT DEFLECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING: THE INTENSITY OF THE LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENT WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

4.3.3 If the centering light-line is off-center to the correctly centered light-field or exhibits a rainbow of colors along one edge, loosen the two screws securing the prism/slit bracket See Figure 4.2.

4.3.4 Use a pair of long-nose pliers to move the bracket as required to center the light-line to the correctly adjusted light-field.

NOTE: IN ORDER TO AVOID THE RAINBOW OF COLORS ALONG THE EDGES, MAINTAIN THE PRISM IN A POSITION THAT IS CENTERED TO THE BRIGHT LIGHT-LINE THAT IS OBSERVED ON THE BRACKET AT THE BASE OF THE PRISM WHILE ADJUSTING THE BRACKET.

4.3.5 Tighten the screws and replace the collimator covers.

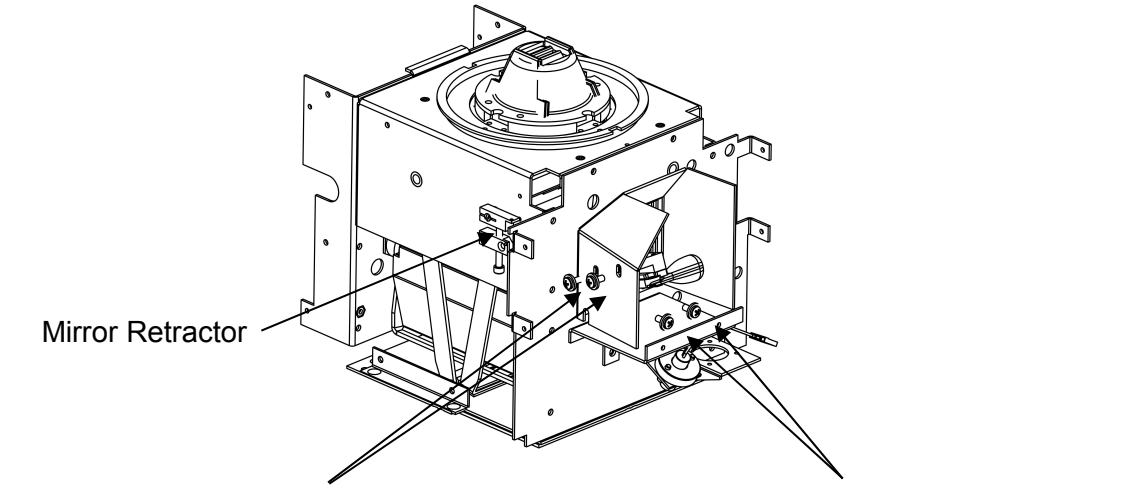
4.4 LONG AND CROSS SIZE INDICATOR ADJUSTMENT

4.4.1 Using a long allen wrench, loosen the #4-40 set screws securing the indicators to the axles.

4.4.2 Same as above.

4.4.3 Set the indicators to 17" x 17" @ 40" SID then tighten the indicator set screws.

COVER REMOVED



CROSS ALIGNMENT

1. Adjust two #6-32 screws for light-field alignment
2. (Option) Add Loctite to set in postion

LONGITUDINAL ALIGNMENT

1. Slightly loosen the two #6-32 screws
2. Position lamp bracket laterally for light-field alignment, left to right
3. Tighten the two #6-32 screws

FIGURE 4.2 - LIGHT-FIELD ADJUSTMENT

WARNING! THE LAMP AND HEAT DEFLECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING! THE INTENSITY OF LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENT WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

CAUTION: BOTH CROSS AND LONG SHUTTERS MUST BE FULLY OPEN FOR ANY MIRROR RETRACTION - FORCING THE MIRROR WILL MISCALIBRATE THE LIGHT-FIELD!

SECTION 5.0

COMPLIANCE VERIFICATION

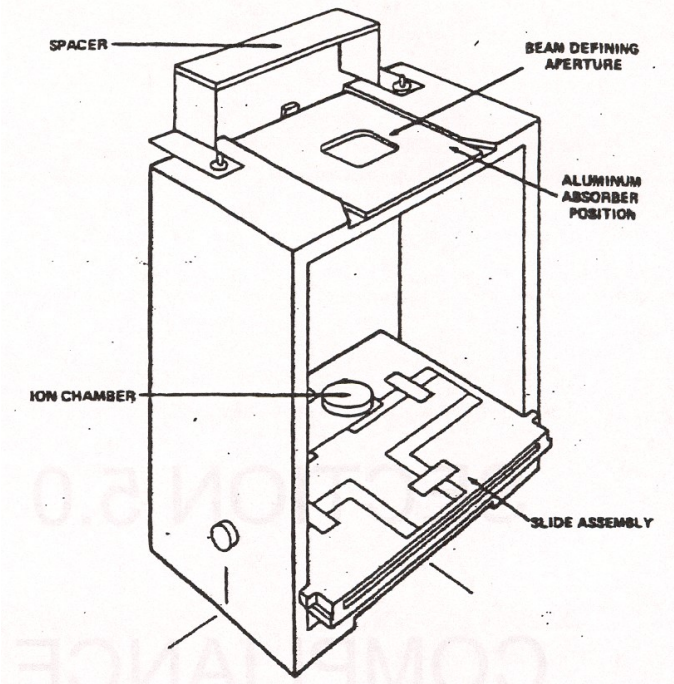


FIGURE 5.1 BRN/FDA COMPLIANCE TEST STAND

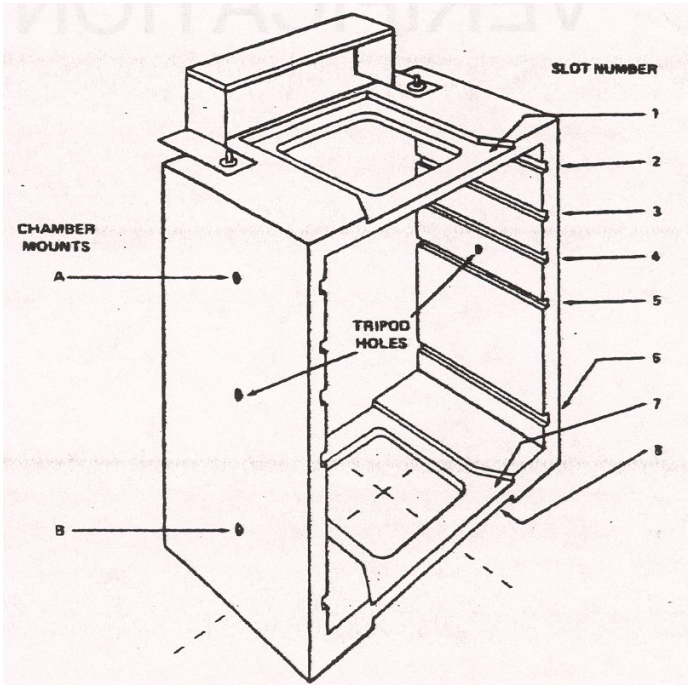


FIGURE 5.2 COMPLIANCE STAND DETAIL

5.0 COMPLIANCE VERIFICATION

It is necessary for the assembler to verify compliance. A series of tests, when performed at the time of installation, will indicate compliance with 21 CFR, Sub-Chapter J, Part 1020, Performance Standards.

The following tests are from NEMA Standards Publication, No. XR-8-1979 (Test Methods for Diagnostic X-Ray Machines for Use During Initial Installation).

For each compliance item, there may be a variety of test methods described. Which method is used will depend on the tester's experience, availability of equipment, time, or special requirements of the Eureka Linear Collimator. Any reference to tolerances on compliance items are referenced directly from 21 CFR, Sub-Chapter J, Regulations. They do not take into account inaccuracies brought about by the test equipment, instrumentation, or the human element. These factors must be considered when these tests are performed and the compliance of the equipment is being determined.

5.1 VERIFICATION OF TESTS TO BE PERFORMED

	Test Procedure or Requirement	Applicable Paragraph
1.	Determination of Half Value Layer	XR8/2.09
2.	Visual Definition of X-Ray Light Field	XR8/2.14
3.	Intensity of Light Field Illumination	XR8/2.15
4.	X-Ray Field/Receptor Center Alignment	XR8/2.17
5.	Indication of Field Size	XR8/2.18
6.	X-Ray Field Limitation and Alignment	XR8/2.20

RECORD THE RESULTS ON THE *RECORD SHEET* SUPPLIED AT THE END OF THIS SECTION

Radiation Warning for Diagnostic X-Ray Systems

X-rays are dangerous for both the operator and others in the vicinity unless established safe exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, *"Diagnostic X-Ray Systems and their Major Components,"* and the National Council on Radiation Protection (NCRP) No. 33, *"Medical X-Ray and Gamma-Ray Protection for Energies up to 10 Me V-Equipment Design and Use,"* as revised or replaced in the future.

Failure to observe these warnings may cause serious, genetic or potentially fatal bodily injuries to the operator or those in the area.

XR 8-2.09 BEAM QUALITY (HALF-VALUE LAYER [HVL])

REQUIREMENT- The minimum beam quality requirements listed in Table 5-1 shall be met. [See 21 CFR 1020.30 (m).]

.01 METHOD I - VISUAL DETERMINATION OF HALF-VALUE LAYER (HVL)

A. General

The above HVL requirement will be considered to have been met if it can be demonstrated that the aluminum equivalent of the total filtration in the primary beam is not less than that shown in Table 5-2.

B. Equipment

None is required.

Table 5-1 MINIMUM BEAM QUALITY REQUIREMENTS

Kvp Range	Measured kVp	HVL (mmAl*)
Below 50.....	30	0.3
	40	0.4
	49	0.5
50 to 70.....	50	1.2
	60	1.3
	70	1.5
Above 70.....	71	2.1
	80	2.3
	90	2.5
	100	2.7
	110	3.0
	120	3.2
	130	3.5
	140	3.8
	150	4.1

*Type 1100 aluminum alloy as given in Aluminum Association Publication No. ASD-1, Aluminum Standards and Data.

Table 5-2 ALUMINUM EQUIVALENT OF PRIMARY BEAM TOTAL FILTRATION

Operating Voltage (kVp)	Total Filtration (mm Al Equivalent)
Below 50.....	0.5
50-70.....	1.5
Above 70.....	2.5

C. PROCEDURE

Visually inspect the system and determine the aluminum equivalence of the total filtration in the primary beam. This includes the inherent filtration of the X-Ray tube, X-Ray tube housing, beam-limiting device, and any additional filtration that may have been added in the useful beam (in fluoroscopic systems the tabletop is included as part of the added filtration).

D. VERIFICATION OF COMPLIANCE

The aluminum equivalence of the total filtration must be equal to or greater than the amount specified in Table 5-1.

NEMA Standard 5-15-1979

.02 METHOD II - STANDARD ABSORBER METHOD

A. GENERAL

This test is to be used when the surveyor cannot remove or see the total filtration equivalence.

The HVL determinations obtained from the following procedures are to be compared with those illustrated in Table 5-1. The HVL in millimeters of aluminum of the system being tested must be greater than or equal to the values shown in Table 5-1.

B. EQUIPMENT

1. Radiation detector
2. Standard absorber with equivalent filtration of 2.5 millimeters of aluminum.

C. PROCEDURE

1. With the detection device positioned horizontally, an exposure is made at a preselected technique factor of 80 kVp and appropriate mA and time. The reading of the radiation output is recorded.

2. Position a total of 2.5 millimeters of aluminum at the port of the beam-limiting device and repeat the exposure using the same technique factors. Record the radiation output.

   For X-Ray units operating at low kVp (less than 50) and for mammography units, it will be necessary to use an aluminum absorber of 0.6 millimeters at 49 kVp.

D. VERIFICATION OF COMPLIANCE

Verify that the radiation output in step 2 is greater than or equal to 50 percent of the radiation output in step 1.

.03 METHOD III - BRH/FDA COMPLIANCE TEST

A. GENERAL

The HVL determinations obtained from the following procedures are to be compared with those illustrated in Table 5-1. The HVL in millimeters of aluminum of the system being tested must be greater than or equal to the values shown in Table 5-1.

B. EQUIPMENT

1. BRH/FDA compliance test standard with accessories.
2. Survey meter adapted for use with stand with an ion chamber.
3. Several sheets of aluminum, each having a thickness of 0.5 or 1.0 millimeter.

C. PROCEDURE

1. Attach the spacer, positioned out of the primary beam, to the test stand. Center the stand on the table. Center the source over the stand and bring the beam-limiting device down into firm contact with the spacer. Select the MANUAL mode of operation (there must not be a cassette in the cassette tray). Insert the beam-defining assembly in slot 1 of the stand with the leaded side up (See Figure 5-1). Adjust the beam-limiting device so that the X-Ray field slightly exceeds the aperture of the beam-defining assembly. Mount the ion chamber at position B with the chamber facing upward. Connect the chamber and meter with the cable provided. Select a tube potential that is commonly used and is in the highest kVp range of the X-Ray system.

2. With no added filtration in the beam, make an exposure and record the reading. For all diagnostic X-Ray equipment, use Table 5-3 to determine increments of filtration required to perform the half-value layer procedure. Make an exposure and record the reading for each total thickness.

TABLE 5-3 HIGHEST DESIGN OPERATING RANGE

Total Added Filtration, mm Al		
Below 50 kVp	50 - 70 kVp	Above 70 kVp
0.5	1.0	1.5
1.0	1.5	2.5
1.5	2.5	3.5
2.0	3.5	4.5

The recorded data is plotted on semi-log graph paper (Examples A and B, Fig. 5-6) and the half-value is read directly from the graph.

D. VERIFICATION OF COMPLIANCE

Verify that the half-value layer of the useful beam for a given X-Ray tube potential is not less than the values shown in table 5-1.

NEMA Standard 5-15-1979

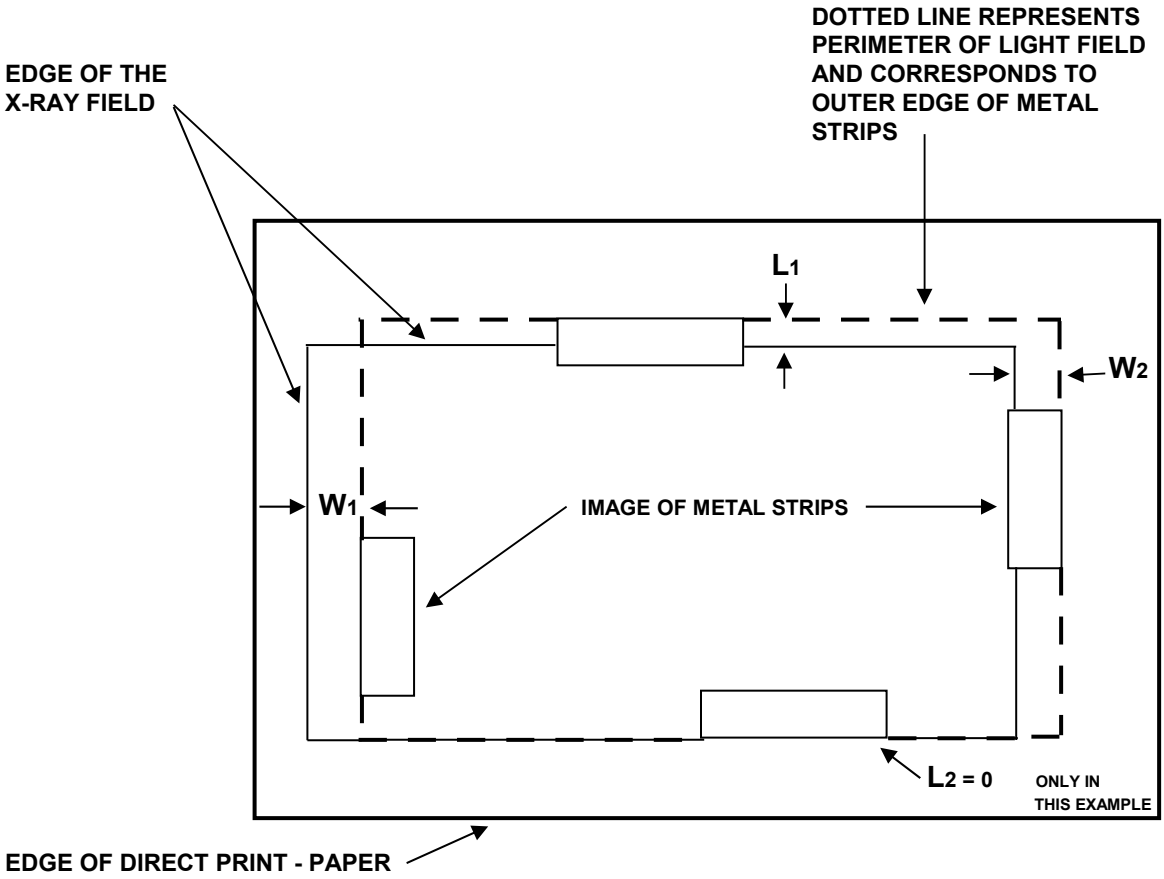


FIGURE 5.3 LIGHT FIELD vs. X-RAY FIELD ERROR MEASUREMENTS

TABLE 5-4 HALF VALUE LAYERS AS A FUNCTION OF FILTRATION AND TUBE POTENTIAL FOR DIAGNOSTIC UNITS*

Total Filtration mm Al	Peak Potential (kVp)									
	30	40	50	60	70	80	90	100	110	120
	Typical Half-Value Layers (mm Al)									
0.5	0.36†	0.47†	0.58	0.67	0.76	0.84	0.92	1.00	1.08	1.16
1.0	0.55	0.78	0.95	1.08	1.21	1.33	1.46	1.58	1.70	1.82
1.5	0.78	1.04	1.25†	1.42†	1.59†	1.75	1.90	2.08	2.25	2.42
2.0	0.92	1.22	1.49	1.70	1.90	2.10	2.28	2.48	2.70	2.90
2.5	1.02	1.38	1.69	1.95	2.16	2.37†‡	2.58†‡	2.82†‡	3.06†‡	3.30†‡
3.0	...	1.49	1.87	2.16	2.40	2.62	2.86	3.12	3.38	3.65
3.5	...	1.58	2.00	2.34	2.60	2.86	3.12	3.40	3.68	3.95

*For full-wave rectified potential
† Recommended minimum HVL for radiographic units.
‡ Recommended minimum HVL for fluoroscopes

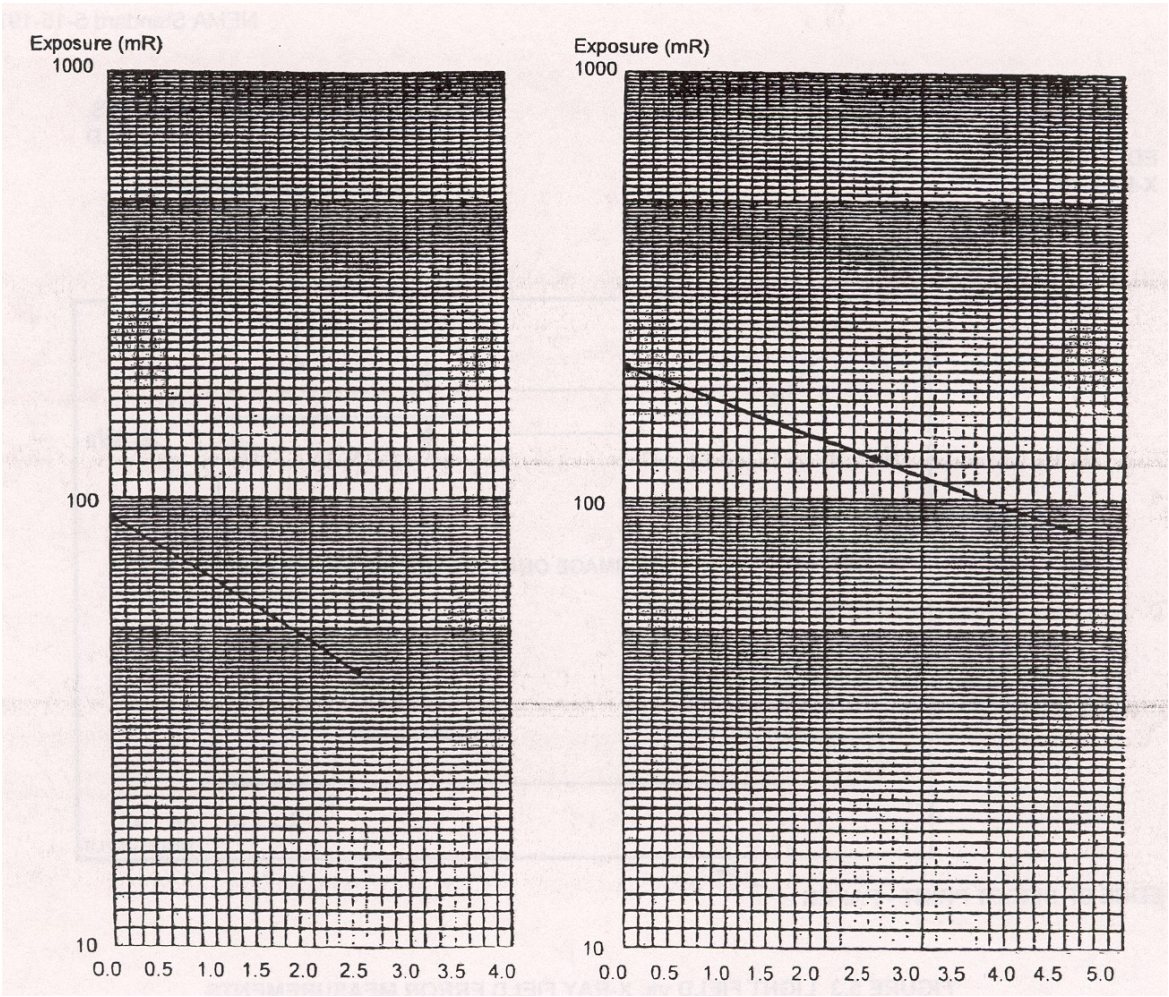


FIGURE 5-6
HALF-VALUE LAYER DETERMINATION GRAPHS

XR 8-2.14 VISUAL DEFINITION (RADIOGRAPHIC) OF X-RAY LIGHT FIELD

REQUIREMENT - Means shall be provided for visually defining the perimeter of the X-Ray field. The total misalignment of the edges of the visually defined field with the respective edges of the X-Ray field along either the length or width of the visually defined field shall not exceed 2 percent of the distance from the source to the center of the visually defined field when the surface upon which it appears is perpendicular to the axis of the X-Ray beam (see 21 CFR 1020.31 (d) (2)).

.01 METHOD 1 - BRH-FDA COMPLIANCE TEST METHOD

A. EQUIPMENT REQUIRED

1. BRH/FDA compliance test stand (including slide assembly)
2. Four metal marker strips
3. Plastic cassette, loaded with direct print paper or film

B. PROCEDURE

1. Attach the spacer, positioned out of the primary beam to the test stand. Center the stand on the table. Center the source over the stand, assure by the means provided that the axis of the X-Ray beam is perpendicular to the plane of the image receptor, and bring the beam-limiting device down into firm contact with the spacer. Select the MANUAL mode of operation (there must not be a cassette in the cassette holder).

2. Insert the slide assembly, grid side up, into slot 6 of the test stand and the focal spot assembly into slot 1 (Figure 5-2). Place a cassette loaded with direct print paper or film into the slide assembly.

3. Adjust the collimator so that no part of the light-field intersects any portion of the top of the test stand. (Further collimation to a light field of less than 15 by 20 centimeters (6 by 8 in) on the side assembly grid may be desirable to assure that the X-Ray field will be fully contained on the direct print paper for film in the slide assembly).

4. Position the outer edge of each metal strip to correspond with each side of the light-field. One end of the metal strip shall extend to the center line of the respective grid arm.

5. Select proper technique factors and make an exposure (may require several exposures to obtain 1 R to the direct print paper).

6. Develop the direct print paper or film.

C. VERIFICATION OF COMPLIANCE

For determination of misalignment, compare the edges of the X-Ray field to the edges of the light-field as defined by the outer edges of the metal strips. On each side of the rectangular fields, measure the separation between the X-Ray field and the outside edge on the image of the respective metal strip. Sum these measured separations for opposite sides of the X-Ray field to yield a total misalignment in the length and width dimensions. Record the length misalignment and width misalignment, both without regard to sign (see Paragraph D and Figure 5.3).

D. CALCULATIONS

Calculate the source to image distance (SID) per the following formula (to slot 6) as the indicated source-to-table top distance minus 4.7 centimeters (1.85 in) and record. Calculate 2 percent of this SID and record. Both the length and width misalignment must be less than 2 percent of SID (to slot 6).

$$\frac{2.5}{S} = \frac{X}{X + 13.95}$$

$$2.5X + (2.5)\ 13.95 = XS$$

$$(2.5)\ 13.95 = XS - 2.5X$$

$$34.875 = X\ (S - 2.5)$$

$$X = \frac{34.875}{S - 2.5}$$

The misalignments are calculated as follows:

Length misalignment = $L_1 + L_2 \leq 2\%$ SID
Width misalignment = $W_1 + W2 \leq 2\%$ SID

Calculate 2% of the measured SID. Each of the misalignments, length or width, must be less than or equal to 2% of the measured SID for compliance.

NEMA Standards 5-15-79

.02 METHOD II - METAL MARKER METHOD

A. GENERAL

The actual versus indicated source-to-image receptor distance (SID) test must be performed prior to attempting this test.

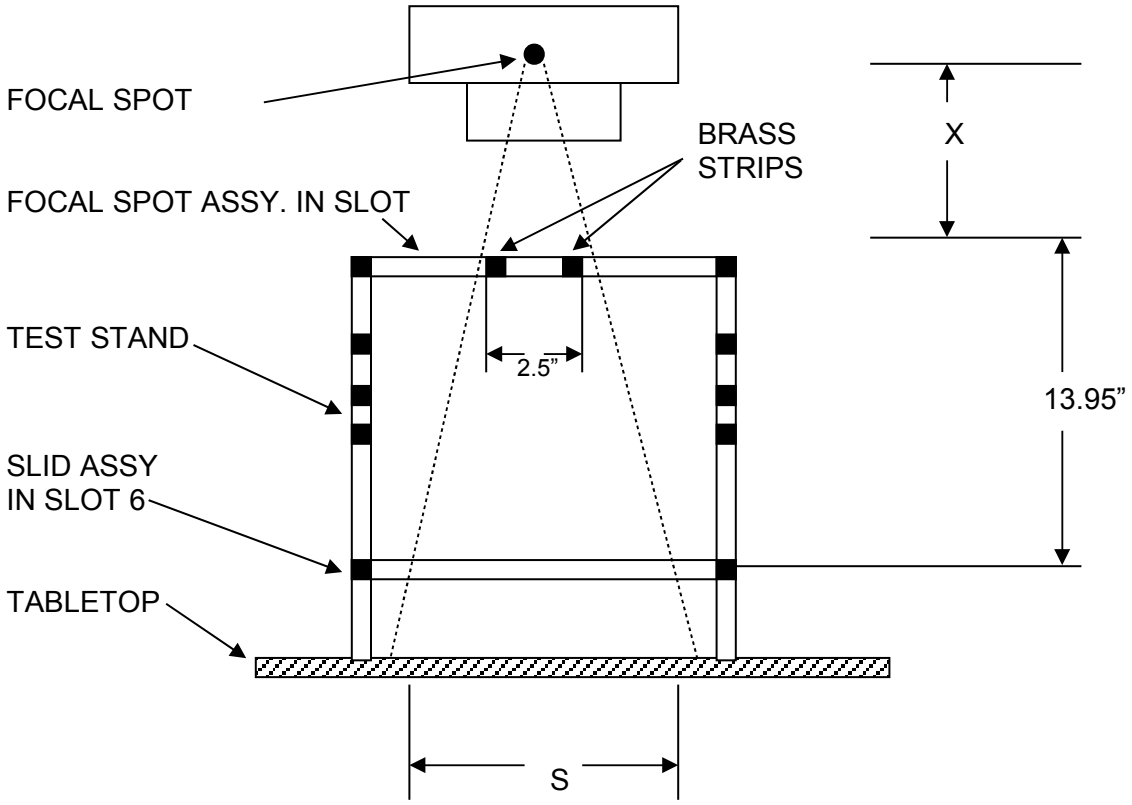


FIGURE 5-4 CALCULATION EXAMPLE

DOTTED LINE COINCIDES WITH THE OUTER EDGE OF THE MEATAL STRIPS AND IS THE PERIMETER OF THE LIGHT FIELD.

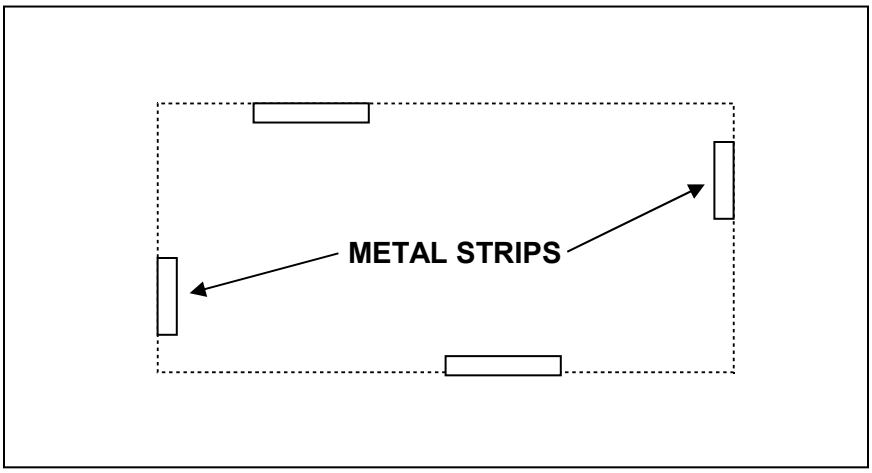


FIGURE 5-5 METAL MARKER METHOD

B. EQUIPMENT

1. Plastic cassette with direct printer paper or film.
2. Radio-opaque markers*

* Each marker is approximately .080 cm galvanized sheet metal having the dimensions of 4 by 4 cm.

C. PROCEDURE

1. Adjust the source assembly and the beam-limiting device so that they are approximately centered over the table and perpendicular to the table top. Then position the beam-limiting device to the SID previously determined and record the indicated value.

2. Insert the cassette and turn on the light-field.** Adjust the beam-limiting device to the next size smaller than the cassette size being used.

** Make a note to record the field size indicated on the dial of the beam-limiting device for the SID being used.

3. Position the outer edge of each metal marker on the table top to correspond with each side of the light-field (Figure 5-5).

4. Select the appropriate technique factors and make an exposure.

5. Develop film or direct-print paper.

D. VERIFICATION OF COMPLIANCE

For determination of misalignment, compare the edges of the X-Ray field to the edges of the light field as defined by the outer edges of the metal strips. On each side of the rectangular fields, measure the separation between the X-Ray field and the outside edge of the image of the respective metal strip. Sum these measured separations for opposite sides of the X-Ray field to yield a total misalignment in the length and width dimensions. Record the length misalignment and width misalignment, both without regard to sign (see Par. E and Figure 5-3).

E. CALCULATIONS

$$\frac{2.5}{S} = \frac{X}{X + 13.95}$$

$$2.5X + (2.5)\ 13.95 = XS$$

$$(2.5)\ 13.95 = XS - 2.5X$$

$$34.875 = X\ (S - 2.5)$$

$$\frac{X}{} = \frac{34.875}{S - 2.5}$$

The misalignments are calculated as follows:

Length misalignment = $L_1 + L_2 \leq 2\%$ SID
Width misalignment = $W_1 + W2 \leq 2\%$ SID

Calculate 2% of the measured SID. Each of the misalignments, length or width, must be less than or equal to 2% of the measured SID for compliance.

NEMA Standards 5-15-79

.03 METHOD III - ALTERNATE TEST STAND METHOD

A. GENERAL

1. The image of the radiation field on the film must be of uniform density with sharply defined edges.

2. The graduated template is utilized to minimize the amount of error introduced into the measurement of the X-Ray field size.

3. The actual versus indicated SID must be determined prior to performing this test.

B. EQUIPMENT

1. Manufacturer's recommended test stand.

2. Cassettes and film.

3. Graduated template.

C. PROCEDURE

1. Align the tube unit and image receptor and set the SID with the normal operating aids (detents, scales, lights, etc.)

2. Load cassette and insert into image receptor.

3. Close shutters to a size smaller than that of the cassette placed into the image receptor.

4. Position the test stand in accordance with the manufacturer's instructions.

5. Energize the field light and record or define the position of the four light field edges as shown on the graduated template or position four metal markers so that the outer edge of each metal marker corresponds to an edge on each side of the light-field or both.

6. Select proper technique factors, make an exposure, and develop film.

D. VERIFICATION OF COMPLIANCE

1. Calculate 2 percent of the actual SID and record.

2. Compare the edges of the X-Ray field to the edges of the light field as defined by the outer edges of the metal markers or by the graduated scale.

3. Measure the distance between the edges of the two fields for each side of the rectangular fields (see Figure 5-3).

4. Arithmetically sum the misalignment of opposite sides, regardless of sign, of the rectangles, to yield misalignment in each of the two directions.

$$\text{Length misalignment} = L_1 + L_2 \leq 2\% \text{ SID}$$
$$\text{Width misalignment} = W_1 + W2 \leq 2\% \text{ SID}$$

Both the length and width misalignment must be less than 2 percent SID as calculated in Step 1.

NEMA Standards 5-15-79 1/3

XR 8-2.15 INTENSITY OF LIGHT FIELD ILLUMINATION

.01 REQUIREMENT

A. GENERAL

1. The image of the radiation field on the film must be of uniform density with sharply defined edges.

2. The graduated template is utilized to minimize the amount of error introduced into the measurement of the X-Ray field size.
3. The actual versus indicated source-to-image distance (SID) must be determined prior to performing this test.

B. EQUIPMENT

1. Manufacturer's recommended test stand.
2. Cassettes and film.
3. Graduated template.

C. PROCEDURE

1. Align the tube unit and image receptor and set the SID with the normal operating aids (detents, scales, lights, etc.)

2. Load cassette and insert into image receptor.

3. Close shutters to a size smaller than that of the cassette placed into the image receptor.

4. Turn on the light localizer.

5. At or near the center of a light field quadrant, determine the illuminance by subtracting the ambient light level from the corresponding light level as measured when the light localizer is energized. Do not move the photometer between measurements.

6. Repeat the procedure for the remaining three quadrants.

7. Determine the average illuminance of the four light field quadrants.

8. Record the model number, serial number, and the date of calibration of test instrument.

D. VERIFICATION OF COMPLIANCE

Verify that the average illumination is not less than 160 lux (15 footcandles).
NEMA Standards 5-15-79

.02 METHOD II - INDIRECT TEST

A. GENERAL

1. This indirect test is feasible after the correlation between light output and voltage is made; the manufacturer then specifies a voltage to be measured or adjusted, or both.

2. Make certain that all surfaces in the light path are clean and unobstructed.

B. EQUIPMENT

Digital voltmeter

C. PROCEDURE

1. Remove trim covers to gain access to the lamp socket.

2. Verify that the specified lamp is in the socket.

3. With the light-field energized, measure the voltage across the lamp socket terminals.

4. Record the voltage measured.

5. Record the model number, serial number and calibration date of the digital voltmeter.

D. VERIFICATION OF COMPLIANCE

The voltage recorded shall be within the tolerances specified by the manufacturer.
NEMA Standard 5-15-1979

NOTE: THE AC VOLTAGE AT THE LAMP SOCKET MUST NOT BE LESS THAN 19.5 VAC RMS

XR 8-2.17 X-RAY FIELD/RECEPTOR CENTER ALIGNMENT

REQUIREMENT - Means shall be provided to align the center of the X-Ray field with respect to the image receptor to within 2 percent of the SID (See 21 CFR 1020.31 (e) (1)).

A. GENERAL

1. All exposures taken during this test must have a uniform film density of approximately 1.0.

2. Actual versus indicated SID must be determined prior to performing this test.

B. EQUIPMENT

Radiographic cassette loaded with film (20 by 25 cm).

C. PROCEDURE

1. Load cassette with film and place into the bucky tray.

2. Assure the X-Ray beam is perpendicular to the image receptor and centered over the bucky tray.

3. Set the SID to the value determined in the actual versus indicated SID test.

4. Reduce the X-Ray field to approximately 15 by 20 cm.

5. Make an exposure and develop the film.

6. To determine as accurately as possible the corners of the image recorded on the film, locate two points on each of the four sides of the image. Through the two points on each side draw a straight line. These four lines, when extended, intersect making a rectangle which is a close approximation of the actual X-Ray field. Draw a diagonal across the image to determine the center of the X-Ray image.

    7. To determine the center of the X-Ray film draw diagonals across the film (the point where these two lines cross is the center of the film), or fold the film into quarters (the point where the two folds cross is the center of the film).

    8. The distance from the film center mark to the image center mark is measured and recorded as the linear displacement or misalignment of the centers of the X-Ray field and the image receptor.

D. VERIFICATION OF COMPLIANCE

Verify that this distance is less than or equal to 2 percent of the SID.

NEMA Standards 5-15-79

XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT - Means shall be provided on the beam-limiting device to indicate field size in the image receptor plane to within 2 percent of the SID (see 21 CFR 1020.31 (e) (1)).

A. GENERAL

The actual versus indicated SID test must be performed prior to beginning this test.

B. EQUIPMENT

A 24 by 30 centimeter or a 20 by 25 cm cassette with film.

C. PROCEDURE

1. Set the SID to the value determined in the actual versus indicated SID test.

2. Center the film cassette in the cassette tray and insert into position.

3. Adjust the field size to 15 by 15 centimeters or 8 by 8 inches by means of the numerical indicators on the beam-limiting device.

4. Make an exposure and develop film.

5. Measure and record the length and width dimensions of the image.

D. VERIFICATION OF COMPLIANCE

The deviation of any of the recorded dimensions must not exceed 2 percent of the SID in Step 1.

NEMA Standards 5-15-79

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT

The X-Ray field size in the plane of the image receptor, whether automatically or manually adjusted, shall be such that neither the length nor the width of the X-Ray field differs from that of the image receptor by greater than 3 percent of the SID and that the sum of the length and width differences without regard to sign be no greater than 4 percent of the SID, when the equipment indicates that the beam axis is perpendicular to the plane of the image receptor (see 21 CFR 1020.31 (e) (2) (ii)).

.01 METHOD 1 - BRH/FDA TEST STAND METHOD

A. EQUIPMENT

1. BRH/FDA compliance test stand with accessories

2. Slide assembly

3. Plastic cassette containing a sheet of direct print paper or X-Ray film

4. Ruler

5. Cassette (preferably 20 to 25 cm or smaller).

B. PROCEDURE

1. Using the means provided, align the source assembly so that the beam axis is perpendicular to the image receptor.

2. Place the test stand on the table.

3. Position the spacer so that it does not intersect the primary beam and secure with the pushbutton connectors.

4. Center the source assembly over the test stand using the means provided, e.g. bucky light.

5. Bring the source assembly down into firm contact with the spacer.

6. Center the cassette tray with the source assembly using the means provided, e.g. bucky light.

7. Insert the plastic cassette into the slide assembly. Then insert the slide assembly into slot 5 (see Figure 5-2).

8. Center the film cassette in the cassette tray and insert into position. If the positive beam limitation will not operate at this SID, raise the source assembly and lock in position at the first operable SID.

9. Make an exposure. Develop the image. Measure and record and length and with dimensions of the image.

10. Calculate the field size correction factor as the SID/A where:

    a. SID is the indicated source-to-image receptor distance, and

    b. A is the indicated source-to-tabletop distance less 19.5 cm. Multiply each of the measured dimensions by the correction factor.

$$\text{X-Ray field length at undertable image receptor} = \frac{SID}{A} \times (\text{X-Ray field length at slot 5})$$

$$\text{X-Ray field width at undertable image receptor} = \frac{SID}{A} \times (\text{X-Ray field width at slot 5})$$

Determine the difference without regard to sign between the corrected length and width dimensions and the corresponding cassette film size dimensions (20 by 25, 13 by 18, etc.). Each of these differences must be less than 3 percent of the SID, and the sum of these differences must be less than 4 percent of the SID.

NEMA Standards 5-15-79

.02 METHOD II - ALTERNATE TEST STAND METHOD

A. GENERAL

Prior to performing this test, the magnification factor must be determined in accordance with the X-ray/light field alignment test - Method III.

B. EQUIPMENT

1. Manufacturer's recommended test stand
2. Cassette with film

C. PROCEDURE

1. Align the tube unit and image receptor and set SID to the value determined in the actual versus indicated SID test.

2. Insert empty 20 by 25 cm cassette into bucky tray.

3. Position test stand in accordance with manufacturer's instructions.

4. Load a second cassette and place in the designated position.

5. Select the proper technique factors, make an exposure, and develop film.

6. Measure the length and width of the X-Ray image on the film.

7. Multiply each measurement by the magnification factor previously determined.

D. VERIFICATION OF COMPLIANCE

Verify that the X-Ray field size in the plane of the image receptor does not differ from that of the image receptor by greater than 3 percent of the SID and that the sum of the length and width differences without regard to sign is not greater than 4 percent of the SID.

NEMA Standards 5-15-79

RECORD SHEET

This sheet is to be used by the assembler to assure that all points of compliance are covered. It will also serve as a maintenance log.

HOSPITAL _____ ROOM # _____

DATE OF INSTALLATION _____ ASSEMBLER _____

_____ _____

Requirement	Applicable Paragraph	Installation Date	Date	Date	Date	Date

1. Determination of Half-Value Layer	XR8/2.09
2. Visual definition of X-Ray light field	XR8/2.14
3. Intensity of light-field	XR8/2.15
4. X-Ray field/receptor center alignment	XR8/2.17
5. Indication of field size	XR8/2.18
6. X-Ray field Limitation & Alignment	XR8/2.20
7. Cassette Tray/ Inspection Cleaning	
8. Electrical Cable Inspection	
INITIALS:	

NOTES:

(NO TEXT)

SECTION 6.0

THEORY OF OPERATION

(NO TEXT)

6.0 THEORY OF OPERATION

6.1 MECHANICAL OPERATION

The EUREKA LINEAR™ MC150-C Collimator contains two major sets of shutters, long and cross, which define the absolute X-Ray field size. There is also a fixed aperture cone which protrudes into the port of the X-Ray tube that helps reduce the effects of off-focus radiation.

Both shutter mechanisms are geared with anti-backlash mechanisms coupled though shafts to indicators and knobs on the front panel. The shutters are positioned manually

with these knobs. Scales provided on a deadfront panel indicate all conventional film sizes for both 40", 72", 100 cm and 180 cm SID's.

All Eureka Linear Series collimators have a swivel mount configuration. Detents are located at 90 degree increments. The collimator may be oriented to any position for achieving proper X-Ray field to cassette alignment for table-top or non-bucky operation.

The shutter mechanism has been precisely aligned with respect to the mounting flange at the factory. Therefore, the necessity for field alignment of the central ray has been virtually eliminated.

6.2 ELECTRONIC OPERATION

The collimator electronics reside on a number of printed circuit boards:

- Power Supplies
- Lamp Timer Circuit

NOTE: Refer to Schematics 70-08358 and 70-08359

6.2.1 POWER SUPPLIES

The Linear MC150-C is designed to accept power from either a fused customer supplied 24 VAC source or by means of an optional Eureka power supply P/N 70-20254.

In the case of a 24 VAC supply, power is supplied to the timer PCB 70-08359 where it is rectified, filtered and regulated by bridge B1, capacitor C1, and regulator VR1 respectively.

When the MC150-C is supplied with the Linear MC150-C power supply (70-20254, 120 VAC power source or 70-20288, 230 VAC) is fused through F1 and stepped down by means of transformer T1. A 24 VAC tap on the secondary of T1 is fused through F2 and applied directly to the collimator projection lamp circuit.

6.2.2 LIGHT-FIELD LAMP CIRCUIT Ref. 70-08358 & 70-08359

The light field lamp voltage is switched on and off by the 15 Amp Triac located on the lamp bracket. The gate signal is controlled by the output of U1 with an ON time of 25 seconds determined by R15 and C6. The timer is triggered by the front panel "LAMP" push button switch. The surge resistor in series with the lamp filaments offers high resistance at turn-on which reduces the in-rush current thereby greatly extending the bulb life.

SECTION 7.0

RENEWAL PARTS LIST

LINEAR™ MC150

RENEWAL PARTS LIST

EUREKA P/N	DESCRIPTION
	COLLIMATOR
70-11201	Swivel Mounting Ring - Tube Side
70-10008	Swivel Mounting Ring - Collimator Side
70-10036	Swivel Ring
26-00849	Thumbscrew

70-11236	Window - Cross Hair
70-04752	Knob - Front Panel
70-11246	Cover – Outer Wrap
70-11250	Cover - Front
70-11248	Cover - Top
70-11253	Cover - Rear
70-04571	Lamp - Light Field - DZE 24 Vac, 150W *(mfg. before December 2003)*
70-04300	Lamp – Light Field – FCS 24 Vac, 150W *(mfg. after November 2003)*
70-04572	Socket – Lamp *(mfg. before December 2003)*
70-04299	Socket – Lamp *(mfg. after November 2003)*
70-01901	Current Limit Resistor
70-03051	Triac, 15 Amp, Lamp Timer
70-20024	Mirror/Bracket Assembly
70-10049	Spacer - 1/4”
70-10050	Spacer - 1/16”
70-08359	Linear MC150-C Lamp Timer PCB Assembly
70-10122	Tape Measure
70-10282	Skin Guard
70-11251	Display Overlay
70-08177	MC150 Interconnect Cable
70-10810	Thumbscrew - Rear Cover

POWER SUPPLY UNIT 70-20254

70-06016	Transformer - Power 27/19 VAC
70-04782	Fuse Holder
70-04603	Fuse – 2 Amp SloBlo - Power
70-04607	Fuse - 8 Amp SloBlo - Lamp
70-04651	Strain Relief bushing (SR-6N3-4)

POWER SUPPLY UNIT 70-20288 (220 V INPUT)

70-06017	Transformer – Power 27/19 VAC
70-04782	Fuse Holder
70-04602	Fuse – 1 Amp Slo-Blo Power
70-04607	Fuse – 8 Amp Slo-Blo - Lamp
70-04651	Strain Relief bushing (SR-6N3-4)

SECTION 8.0

APPENDIX

DEFINITIONS

SID	**S**ource to **I**mage receptor **D**istance
VSID	**V**oltage representing **SID**
VCSID	**V**oltage representing **C**ontinuous **SID**
SID TRUE	Signal representing the Operating SID Range
XF	**X**-ray **F**ield
VXFC	**V**oltage at the Collimator Feedback Potentiometer Wiper repesenting the **X**-Ray **F**ield in the **C**ross Dimension
VXFL	**V**oltage at the Collimator Feedback Potentiometer Wiper representing the

	X-Ray **F**ield in the **L**ong Dimension
IR	**I**mage **R**eceptor (Cassette Tray)
VIRC	**V**oltage from the Cassette Sensing Element representing the **I**mage **R**eceptor size in the **C**ross Dimension
VIRL	**V**oltage from the Cassette Sensing Element representing the **I**mage **R**eceptor size in the **L**ong **D**imension
IR TRUE	Voltage representing the Presence of a Cassette
VCPC	**V**oltage applied to the **C**ollimator **P**otentiometers in the **C**ross Position
VCPL	**V**oltage applied to the **C**ollimator **P**otentiometers in the **L**ong **P**osition

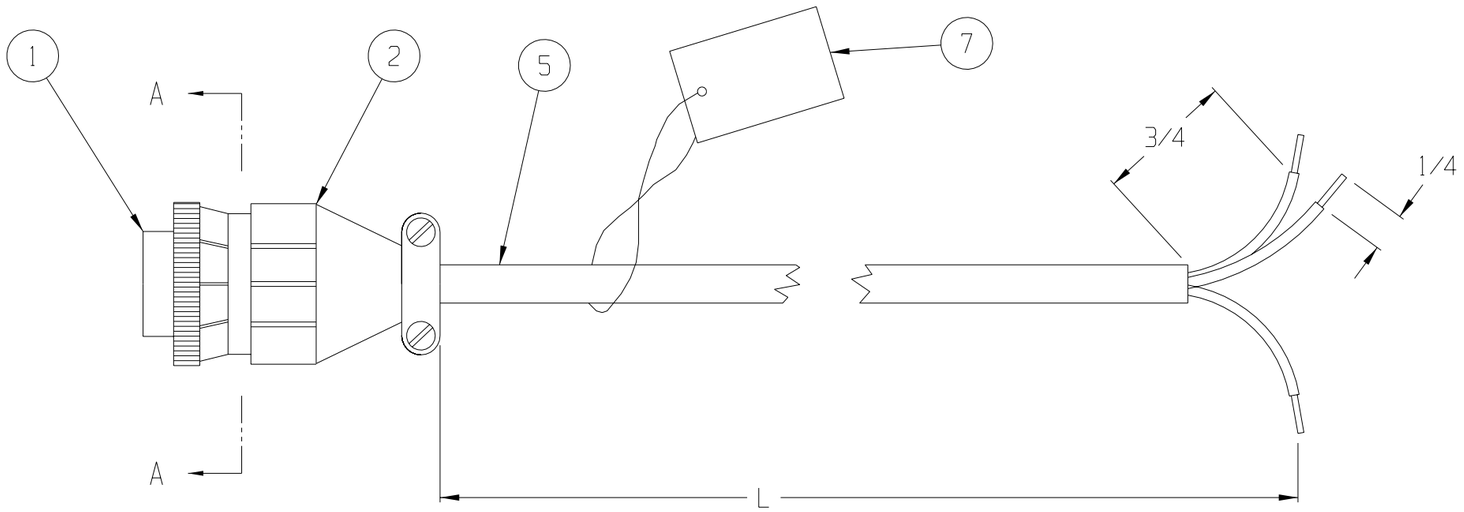
TABLE 1.

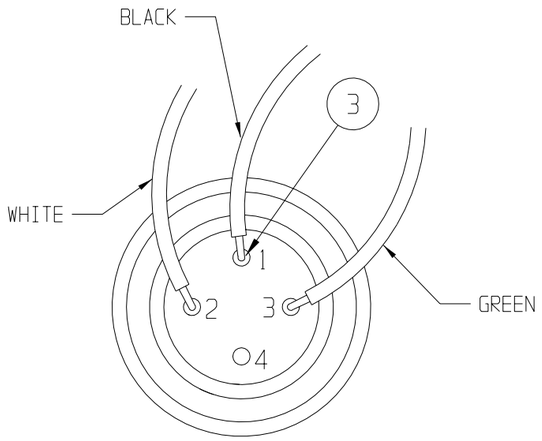
The following list is intended to help the installer determine mounting information only, and does not imply compatibility. See Section 1-0 for compatability information.

MANUFACTURER	TUBE HOUSING	FOCAL SPOT TO PORT MOUNTING	DISTANCE TO COLLIMATOR MOUNTING FLANGE
Eureka	Emerald Series	2 - 1/16”	3/8” (.95 cm)
	Diamond Series	2 - 1/16”	3/8” (.95 cm)
	Sapphire Series	2 - 1/16”	1/4” (.635 cm)
Varian/Eimac	B100	2 - 17/64”	11/64” (.434 cm)

	B150	2 - 11/64”	17/64”	(.637 cm)
	B160	2 - 1/4”	3/16”	(.477 cm)
	B180	2 - 1/4”	3/16”	(.477 cm)
General Electric	Maxiray 100	2 - 5/16”	1/8”	(.125)
	HRT, MX75	2 - 1/16”	3/8”	(.375)
Picker/Dunlee	DU - 140	2 - 1/16”	3/8”	(.375)
	DU - 200	2 - 1/16”	3/8”	(.375)
	DU - 300	2 - 9/32”	5/32”	(.156)
	PX - 400	2 - 5/16”	1/8”	(.125)
	PX - 1300	2 - 3/16”	1/4”	(.250)
	PX - 1400	2 - 5/16”	1/8”	(.125)
Machlett	DX40 Series	2 - 1/16”	3/8”	(.375)
	DX50 Series	2 - 3/16”	1/4”	(.250)
	DX60 Series	2 - 5/16”	1/8”	(.125)
	DX70 Series	2 - 5/16”	1/8”	(.125)

(NO TEXT)





VIEW A-A: CONNECTIONS
ENLARGED

PARTS LIST

ITEM	PART NUMBER	DESCRIPTION	QTY	NOTE
1	70-04773	PLUG,4 PIN,CPC CONNECTOR SERIES 1	1	
2	70-04776	CPC CABLE CLAMP	1	
3	70-04555	PIN,SOCKET 18-16AWG	3	
5	24-10061	CORD,STATOR 3 CONDUCTOR	SEE TABLE " L1"	
6	26-30063	LONG TIES, CABLE	2	2
7	00-02-1546	TAG, POWER SUPPLY CONNECTOR	1	

PART NO.	NOMINAL LENGTH L +0.5 - FEET	CUTTING LENGTH L1- FEET	REV
70-08177-20	20	20.5	A
70-08177-30	30	30.5	A
70-08177-35	35	35.5	A
70-08177-40	40	40.5	A
70-08177-65	65	65.5	A

NOTES:
1. TIGHTEN SCREWS ON CABLE CLAMP (ITEM #2) AFTER SCREWING IT COMPLETELY TO ITEM #1.
2. COIL ASSEMBLED CABLE & SECURE USING ITEM #6 (NOT SHOWN).
3. ITEM #7 TO BE TIED APPROXIMATELY 10" FROM ITEM #2.

A	P0520	RELEASED	04-28-00	A.ZVEREV
REV	ECN	DESCRIPTION	DATE	INITIAL

PROGENY, INC.

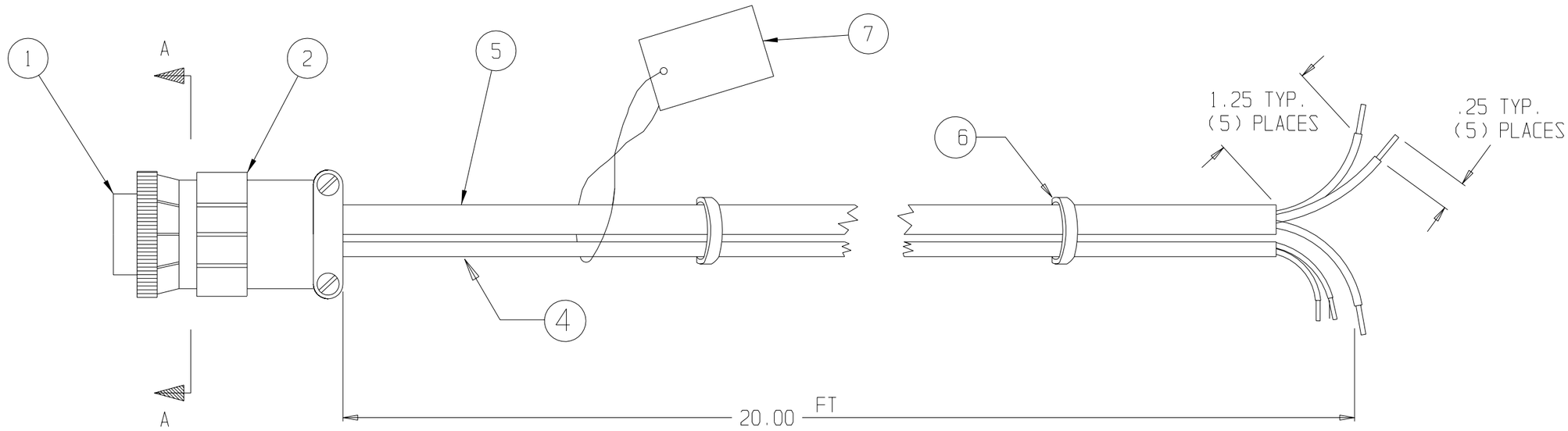
APPROVALS	DATE
DRN. A. ZVEREV	04-28-00
CHK.	
APP.	

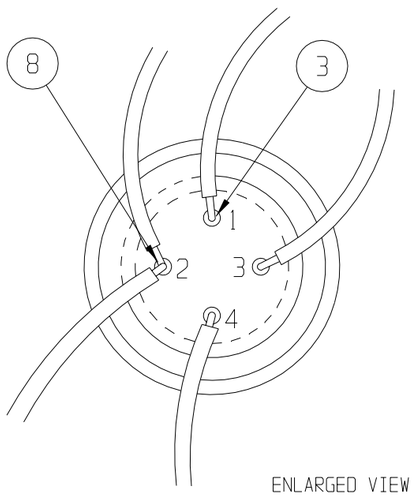
ORIGINAL PRODUCT
COLLIMATORS MC150 & MC150-C

CABLE,INTERCONNECT,ASSEMBLY

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
B	70-63XXX SERIES	20-09-082	70-08177	A

REL.ECN	SCALE	FILENAME	SHEET
P0520	NONE	70-08177	1 OF 1





ENLARGED VIEW A-A
(FOR REFERENCE ONLY)

ITEM	WIRING CONNECTIONS
5	BLACK TO 1
5	WHITE TO 2
5	GREEN TO 3
4	BLACK TO 2
4	RED TO 4

NOTES:
1. TIGHTEN SCREWS ON CLAMP COVER (ITEM 2) AFTER SCREWING COMPLETELY ON TO ITEM 1.
2. COIL CABLE & HOLD USING ITEM 6.
3. ITEM 7 TO BE TIED APPROXIMATELY 10" FROM ITEM 2.

ZONE	REV	DESCRIPTION	DATE	APP'D
	A	ORIGINATE & RELEASE PER ECN P0200		

REVISIONS

PACKAGE:
VENDOR SHALL SUPPLY THE PARTS SUFFICIENTLY PACKAGED TO PROTECT THE FINISH AND INTEGRITY DURING SHIPMENT AND STORAGE. THE OUTSIDE OF THE PACKAGE SHALL BE PROMINENTLY MARKED WITH PART NUMBER AND REVISION.

REMOVE ALL BURRS AND SHARP EDGES

DECIMALS	(MM)	ANGLES	MACHINE FINISH
XX = ±.01	(± 0.25)	1°	32
XXX= ±.005	(± 0.127)		

UNLESS OTHERWISE SPECIFIED

MATERIAL:
SEE SEPARATE B/M

FINISH:

DO NOT SCALE DRAWING

ORIGINAL PRODUCT
MC 150 COLLIMATOR

APPROVALS	DATE
DRN. K A Roberson	10-6-94
CHK.	
ENG.	
APP.	
APP.	

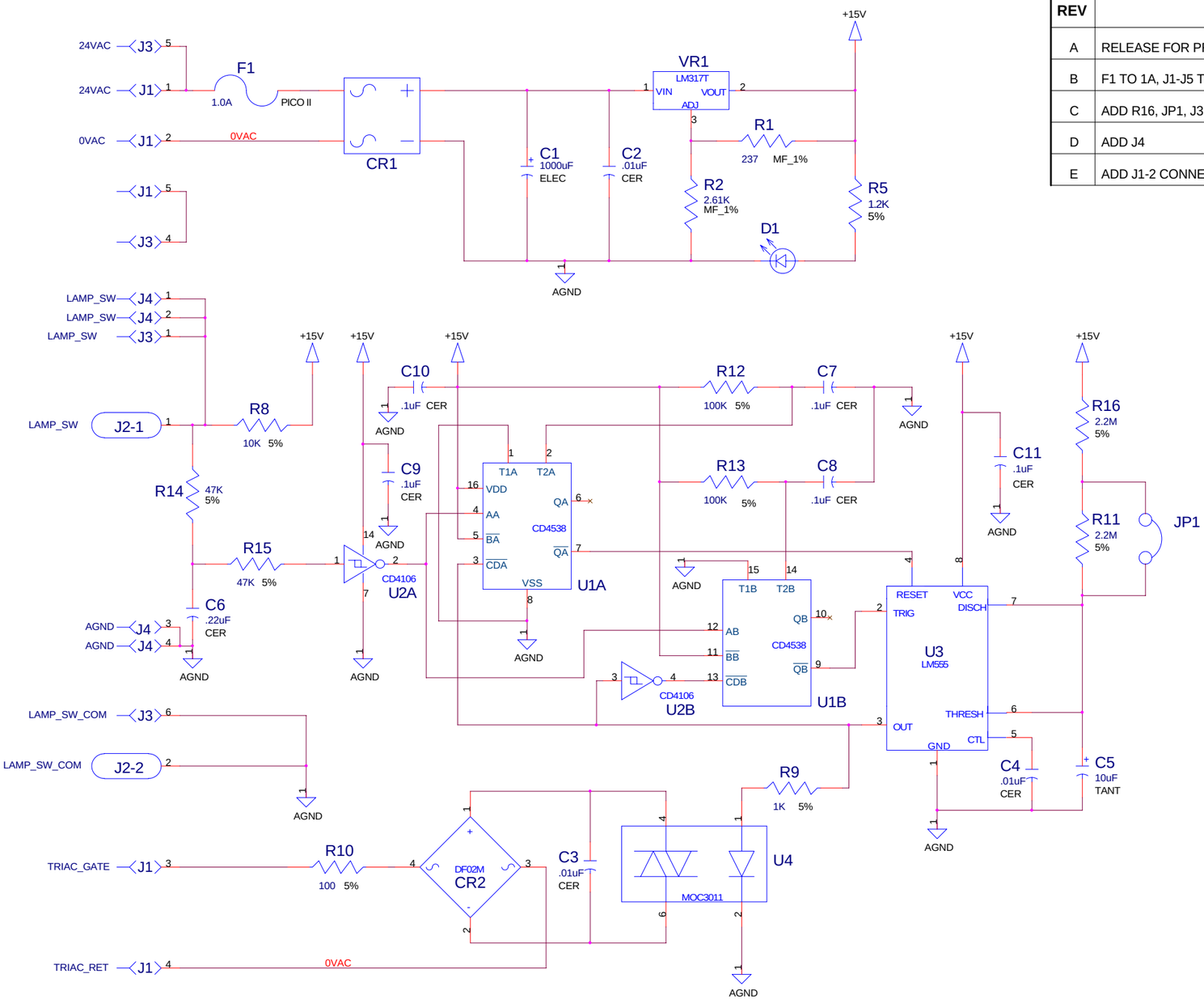
PROGENY, INC.

MC-150 W/REMOTE FIELD LAMP INTERCONNECT CABLE

SIZE	ITEM CLASS	DRAWING NO.
B		70-08177X

SCALE NONE | FILENAME 7008177X | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION (SAME AS REV 1)	7/14/98	A. KREMA
B	F1 TO 1A, J1-J5 TO J1, J3 TO J2, R5 TO 1.2K, C6 TO .22	9/25/98	A. KREMA
C	ADD R16, JP1, J3	7/8/99	A. KREMA
D	ADD J4	5/3/01	A. KREMA
E	ADD J1-2 CONNECTION TO J1-4	10/14/01	A. KREMA



NOTES

ASSEMBLY DRAWINGS 70-08359, 70-08369
FABRICATION DRAWING 70-06318

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	6/29/98
CHK	AK	7/6/98
APP	CH	7/6/98

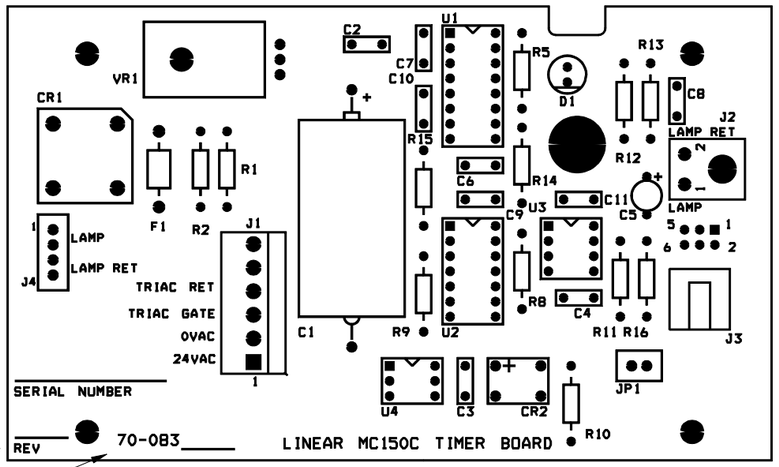
PROGENY INCORPORATED

LINEAR MC150C
TIMER PCB SCHEMATIC

SIZE	ITEM CLASS	DRAWING NO.
B		70-08358

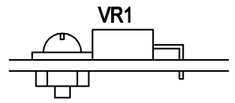
SCALE | FILENAME: MC150C.DSN | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	7/13/98	A. KREMA
B	J1-J5 CHANGE	9/25/98	A. KREMA
C	ADD J3	7/8/99	A. KREMA
D	ADD NOTE 6	8/24/99	A. KREMA
E	ADD CLEARANCE FEATURES	10/18/00	A. KREMA
F	ADD J4	5/3/01	A. KREMA



MANUFACTURER TO ADD
SERIAL NUMBER,
CURRENT REVISION,
AND ASSY NUMBER.

SEE NOTE 4, SECURE VR1 WITH SCREW AND NUT ITEMS 23 AND 24



NOTES:

1. ALL COLOR CODED RESISTORS TO BE INSERTED WITH TOLERANCE BAND TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
2. ALL PRINTED RESISTORS TO BE INSERTED WITH THE RESISTANCE VALUE VISIBLE AND ORIENTED SUCH THAT THE BOTTOM OF THE TEXT IS TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
3. ALL CAPACITORS, DIODES, ETC. TO BE INSERTED WITH THE VALUE AND/OR TYPE VISIBLE AND ORIENTED AS DESCRIBED IN NOTE 2.
4. SECURE VR1 PER DETAIL ON THIS DRAWING.
5. SCHEMATIC 70-08358
   FABRICATION 70-06318
6. JP1 NOT INSTALLED FOR 60 SECOND TIMER OPERATION.

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	7/2/98
CHK	AK	7/6/98
APP	CH	7/6/98

PROGENY INCORPORATED

LINEAR MC150C
60 SECOND TIMER PCB ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08359

SCALE | FILENAME:7006318.MAX | SHEET 1 OF 1

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08359
Rev. F ECN: P0690

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0001	1	B	70-06318		Linear MC150C Display PCB		
0002	1	A	70-02515		Capacitor, Elec 50V	1000UF	C1
0003	3	A	70-02012		Capacitor, Cer 50V	.01 UF	C2, C3, C4
0004	1	A	70-02511		Capacitor, Tantalum 35V	10 UF	C5
0005	5	A	70-02010		Capacitor, Cer 50V	.1 UF	C7, C8, C9, C10, C11
0006	1	A	70-03032		Bridge Rectifier		CR1
0007	1	A	70-03030		Bridge Rectifier	DF02	CR2
0008	1	A	70-03302		Adjustable Voltage Reg	LM317	VR1
0009	1	A	70-03115		IC Dual Timer, Dip 16	CD4538	U1
0010	1	B	70-03161		IC INV Schmit Trigger, Dip 14	CD40106	U2
0011	1	A	70-03353		IC Timer, Dip 8	LM555	U3
0012	1	A	70-03043		IC Opto Triac, Dip 6	M0C3011	U4
0013	1	B	70-00700-11		Resistor Metal Film 1%	237	R1
0014	1	B	70-00700-12		Resistor, Metal Film 1%	2.61 K	R2
0015	1	D	70-00038		Resistor, Carbon Film 5%	680	R5
0016	1	D	70-00064		Resistor, Carbon Film 5%	10K	R8
0017	1	D	70-00042		Resistor, Carbon Film 5%	1K	R9
0018	1	D	70-00018		Resistor, Carbon Film 5%	100	R10
0019	2	D	70-00110		Resistor, Carbon Film 5%	2.2 M	R11, R16
0020	2	D	70-00086		Resistor, Carbon Film 5%	100K	R12, R13

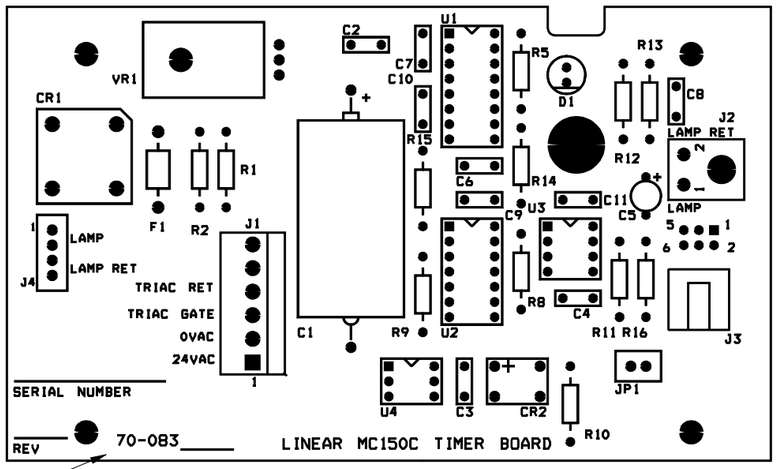
Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08359
Rev. F ECN: P0690

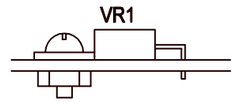
ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0021	2	D	70-00078		Resistor, Carbon Film 5%	47K	R14, R15
0022	1	A	70-02021		Cap., Cer., .22MF, 50 VDC		C6
0023	1	B	70-03061		LED (Red)		D1
0024	1	A	70-04608		Fuse, 1A, Little Fuse 473.001		F1
0025	1	A	70-04748		Header, 6 Pin, Straight – Sq. Lock		J1
0026	1	A	70-04291		Pushbutton R18-21A-1		Switch
0027	.5	B	20-46223-2		Wire, 24 GA, Red		
0028	.5	A	70-06544-0		Wire, Hook-Up, Black, 24 AWG		
0029	1	A	70-04701		Tie Wrap		
0030	1	A	70-04506		Socket, Dip 6		U4
0031	1	A	70-04222		Socket, Dip 8		U3
0032	1	A	70-04216		Socket, Dip 14		U2
0033	1	A	70-04217		Socket, Dip 16		U1
0034	1	A	10-04002		Header, 4 x 1 Pin		J4
	REF	B	70-08358		Linear MC150 Display SCH		
	REF	B	70-08359		Linear MC150 Display Assy		

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	5/16/99	A. KREMA
B	ADD NOTE 6	8/24/99	A. KREMA
C	ADD CLEARANCE FEATURES	10/18/00	A. KREMA
D	ADD J4	5/3/01	A. KREMA



MANUFACTURER TO ADD
SERIAL NUMBER,
CURRENT REVISION,
AND ASSY NUMBER.

SEE NOTE 4, SECURE VR1 WITH SCREW AND NUT ITEMS 23 AND 24



NOTES:

1. ALL COLOR CODED RESISTORS TO BE INSERTED WITH TOLERANCE BAND TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
2. ALL PRINTED RESISTORS TO BE INSERTED WITH THE RESISTANCE VALUE VISIBLE AND ORIENTED SUCH THAT THE BOTTOM OF THE TEXT IS TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
3. ALL CAPACITORS, DIODES, ETC. TO BE INSERTED WITH THE VALUE AND/OR TYPE VISIBLE AND ORIENTED AS DESCRIBED IN NOTE 2.
4. SECURE VR1 PER DETAIL ON THIS DRAWING.
5. SCHEMATIC 70-08358
   FABRICATION 70-06318
6. INSTALL JP1 FOR 30 SECOND TIMER OPERATION.

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	5/15/99
CHK	AK	5/16/99
APP	CH	5/16/99

PROGENY INCORPORATED

LINEAR MC150C
30 SECOND TIMER PCB ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08369

SCALE | FILENAME:7006318.MAX | SHEET 1 OF 1

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08369
Rev. D ECN: P0690

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0001	1	B	70-06318		Linear MC150C Display PCB		
0002	1	A	70-02515		Capacitor, Elec 50V	1000UF	C1
0003	3	A	70-02012		Capacitor, Cer 50V	.01 UF	C2, C3, C4
0004	1	A	70-02511		Capacitor, Tantalum 35V	10 UF	C5
0005	5	A	70-02010		Capacitor, Cer 50V	.1 UF	C7, C8, C9, C10, C11
0006	1	A	70-03032		Bridge Rectifier		CR1
0007	1	A	70-03030		Bridge Rectifier	DF02	CR2
0008	1	A	70-03302		Adjustable Voltage Reg	LM317	VR1
0009	1	A	70-03115		IC Dual Timer, Dip 16	CD4538	U1
0010	1	B	70-03161		IC INV Schmit Trigger, Dip 14	CD40106	U2
0011	1	A	70-03353		IC Timer, Dip 8	LM555	U3
0012	1	A	70-03043		IC Opto Triac, Dip 6	M0C3011	U4
0013	1	B	70-00700-11		Resistor Metal Film 1%	237	R1
0014	1	B	70-00700-12		Resistor, Metal Film 1%	2.61 K	R2
0015	1	D	70-00038		Resistor, Carbon Film 5%	680	R5
0016	1	D	70-00064		Resistor, Carbon Film 5%	10K	R8
0017	1	D	70-00042		Resistor, Carbon Film 5%	1K	R9
0018	1	D	70-00018		Resistor, Carbon Film 5%	100	R10
0019	2	D	70-00110		Resistor, Carbon Film 5%	2.2 M	R11, R16
0020	2	D	70-00086		Resistor, Carbon Film 5%	100K	R12, R13

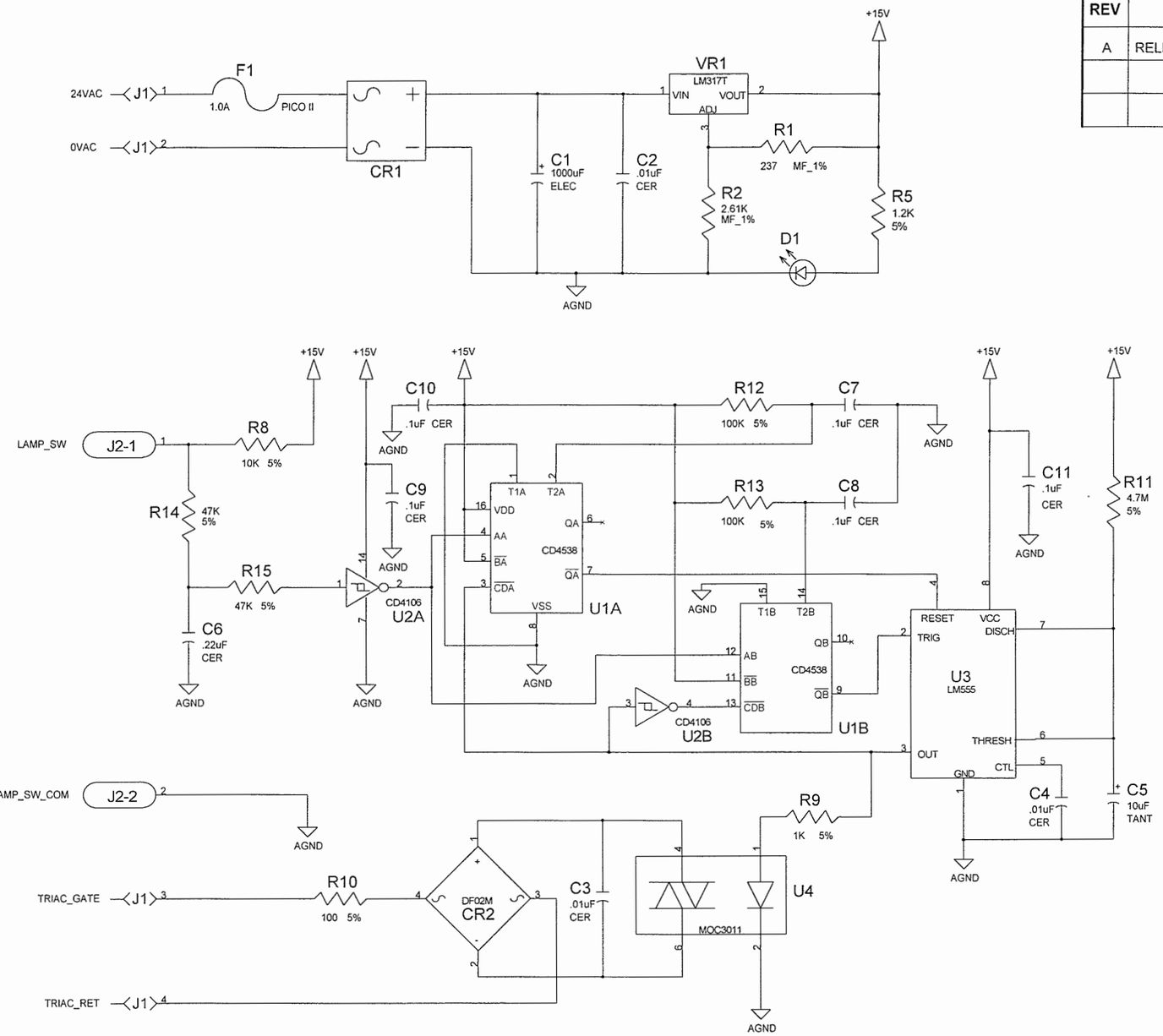
Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08369
Rev. D ECN: P0690

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0021	2	D	70-00078		Resistor, Carbon Film 5%	47K	R14, R15
0022	1	A	70-02021		Cap., Cer., .22MF, 50 VDC		C6
0023	1	B	70-03061		LED (Red)		D1
0024	1	A	70-04608		Fuse, 1A, Little Fuse 473.001		F1
0025	1	A	70-04748		Header, 6 Pin, Straight – Sq. Lock		J1
0026	1	A	70-04291		Pushbutton R18-21A-1		Switch
0027	.5	B	20-46223-2		Wire, 24 GA, Red		
0028	.5	A	70-06544-0		Wire, Hook-Up, Black, 24 AWG		
0029	1	A	70-04701		Tie Wrap		
0030	1	A	70-04506		Socket, Dip 6		U4
0031	1	A	70-04222		Socket, Dip 8		U3
0032	1	A	70-04216		Socket, Dip 14		U2
0033	1	A	70-04217		Socket, Dip 16		U1
0034	1	A	70-04758		Header, 2 Pin		JP1
0035	1	A	70-04806		2 Pin Shunt		JP1
36	1	A	10-04002		Header, 4 x 1 Pin		J4
	REF	B	70-08358		Linear MC150 Display SCH		
	REF	B	70-08359		Linear MC150 Display Assy		

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	5/16/99	A. KREMA



NOTES

ASSEMBLY DRAWING 70-08369
FABRICATION DRAWING 70-06318

ORIGINAL PRODUCT

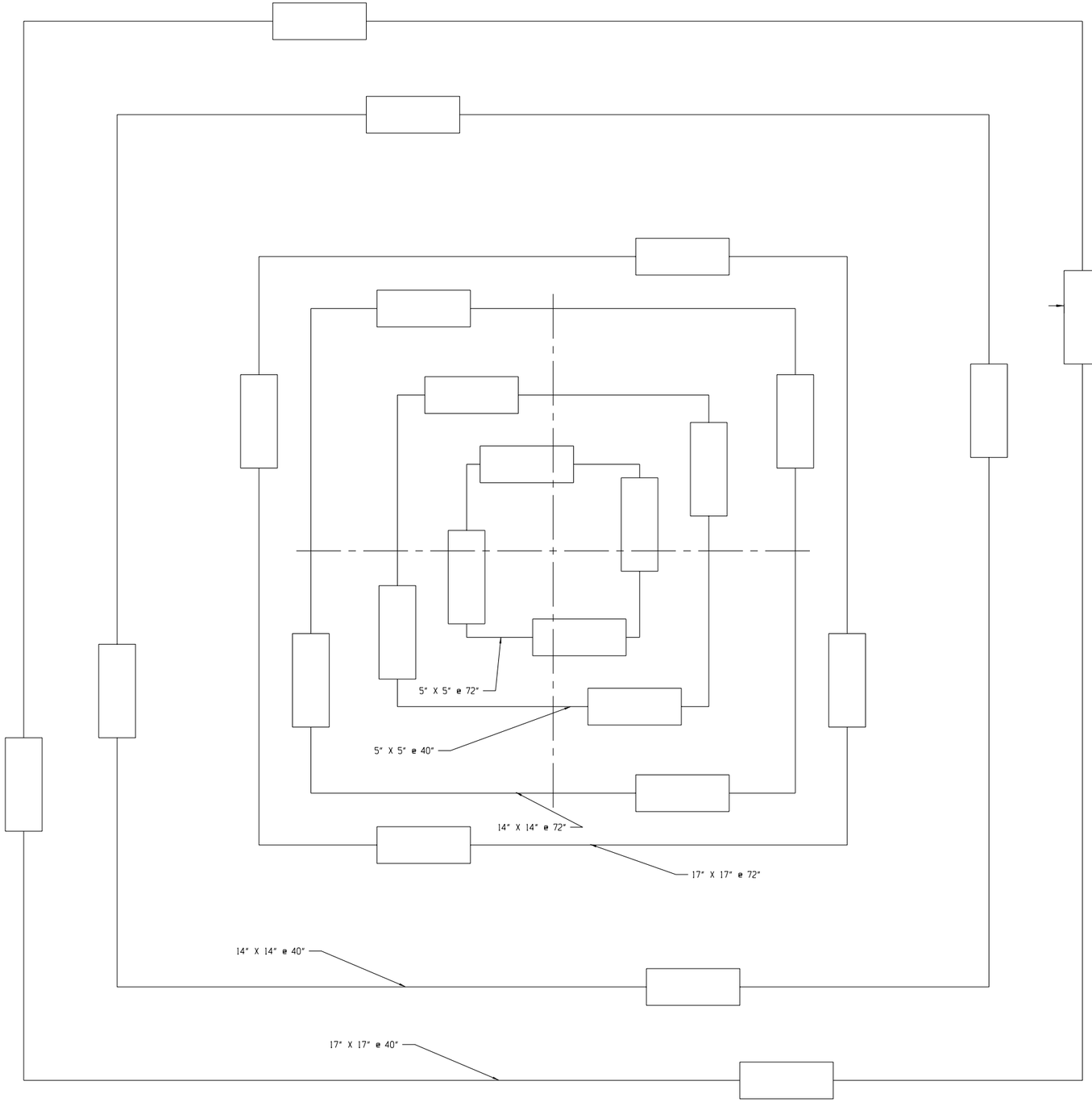
APPROVALS		DATE
DRN	KT	5/15/99
CHK	AK	5/16/99
APP	CH	5/16/99

PROGENY INCORPORATED

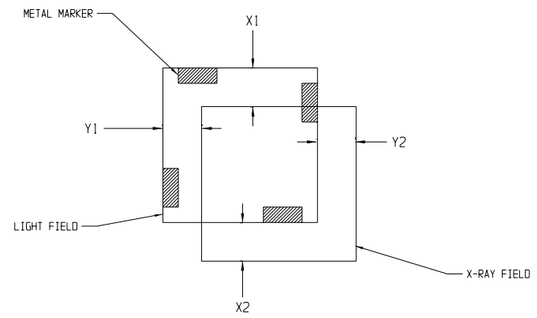
LINEAR MC150C
TIMER PCB SCHEMATIC

SIZE	ITEM CLASS	DRAWING NO.
B		70-08370

SCALE	FILENAME: MC150C.DSN	SHEET 1 OF 1



THIS DIMENSION REPRESENTS 1.5 % OF 40" SID.
THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE. AND X-RAY FIELD SIZE
VS IMAGE RECEPTOR SIZE IS LIMITED
(SEE XR8-2.18 AND XR8-2.20 REQUIREMETS)



X1 + X2 MUST BE LESS THAN 2 % OF THE SID
Y1 + Y2 MUST BE LESS THAN 2% OF THE SID

XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT- MEANS SHALL BE PROVIDED ON THE BEAM-LIMITING DEVICE TO INDICATE FIELD SIZE IN THE IMAGE RECEPTOR PLANE TO WITHIN 2% OF THE SOURCE TO IMAGE DISTANCE (SID). (SEE 21 CFR 1020.31(e)(1))

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT - THE X-RAY FIELD SIZE IN THE PLANE OF THE IMAGE RECEPTOR, WHETHER AUTOMATICALLY OR MANUALLY ADJUSTED, SHALL BE SUCH THAT NEITHER THE LENGTH NOR THE WIDH OF THE X-RAY FIELD DIFFERS FROM THAT OF THE IMAGE RECEPTOR BY GREATER THAT 3% OF THE SOURCE TO IMAGE DISTANCE (SID) AND THE SUM OF THE LENGTH AND WIDTH DIFFERENCES WITHOUT REGARD TO SIGN BE NO GREATER THAN 4% OF THE SID, WHEN THE EQUIPMENT INDICATES THAT THE BEAM AXIS IS PERPENDICULAR TO THE PLANE OF THE IMAGE RECEPTOR. (SEE 21 CFR 1020.31 (e)(2)(ii))

NOTE:
PATTERN FOR REFERENCE ONLY
NOT TO SCALE

NOTE: USE THIS TEST PATTERN AT 40" SID

THE MAGNIFICATION FACTOR FOR 72" SID AT 40" SID = 40/72 = .556

THEREFORE: 5" X 5" @ 72" SID IS 2.778" X 2.778"
14" X 14" @ 72" SID IS 7.778" X 7.778"
17" X 17" @ 72" SID IS 9.444" X 9.444"

REV.	ECN	DESCRIPTION	CHG.	DATE
C	P1033	ADDED NOTE, FOR REFERENCE ONLY	DD	07-14-04
B	P0473	ADDED 17"X17" PATTERN & REDRAWN	AZ	02-21-00

REVISIONS

PROGENY, INC.

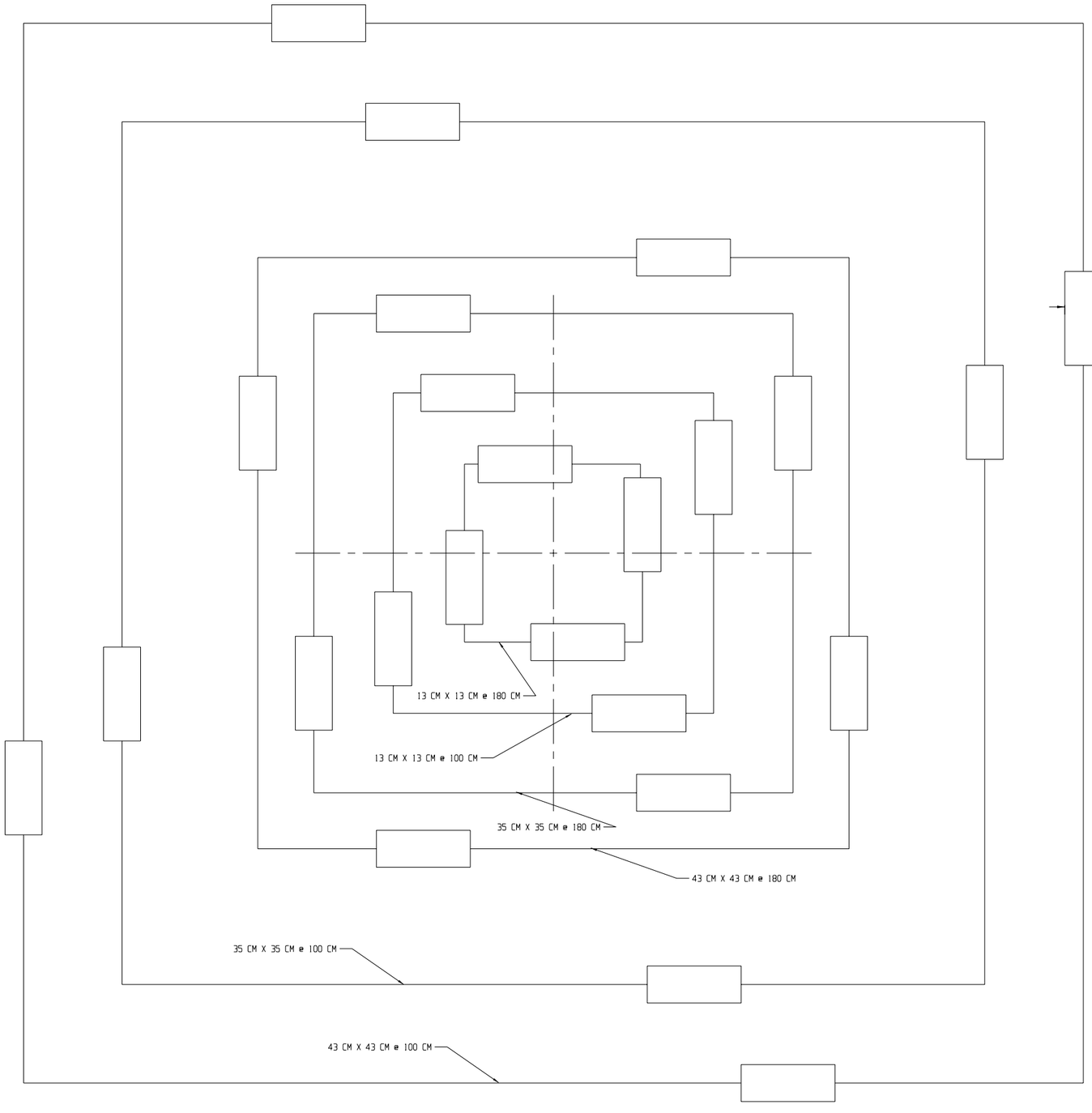
APPROVALS	DATE
DRN. A. ZVEREV	02-21-00
CHK.	
APP.	

ORIGINAL PRODUCT
LINEARS

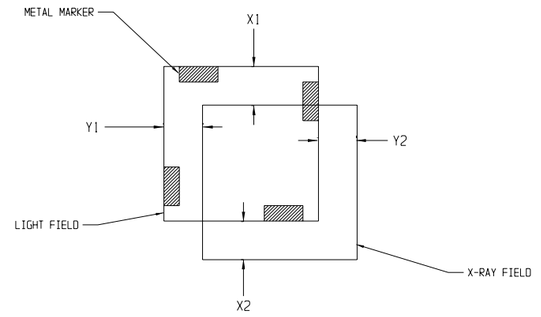
TEST PATTERN #1
FOR 40" AND 72" SID ADJUSTMENTS

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE	20-34-003	70-09021	C

REL.ECN 1-31-90 | SCALE 1:1 | FILENAME 70-09021 | SHEET 1 OF 1



THIS DIMENSION REPRESENTS 1.5 % OF 100 CM SID.
THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE. AND X-RAY FIELD SIZE
VS IMAGE RECEPTOR SIZE IS LIMITED.
(SEE XR8-2.18 AND XR8-2.20 REQUIREMETS)



X1 + X2 MUST BE LESS THAN 2 % OF THE SID
Y1 + Y2 MUST BE LESS THAN 2% OF THE SID

XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT- MEANS SHALL BE PROVIDED ON THE BEAM-LIMITING DEVICE TO INDICATE FIELD SIZE IN THE IMAGE RECEPTOR PLANE TO WITHIN 2% OF THE SOURCE TO IMAGE DISTANCE (SID). (SEE 21 CFR 1020.31(e)(1))

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT - THE X-RAY FIELD SIZE IN THE PLANE OF THE IMAGE RECEPTOR, WHETHER AUTOMATICALLY OR MANUALLY ADJUSTED, SHALL BE SUCH THAT NEITHER THE LENGTH NOR THE WIDH OF THE X-RAY FIELD DIFFERS FROM THAT OF THE IMAGE RECEPTOR BY GREATER THAT 3% OF THE SOURCE TO IMAGE DISTANCE (SID) AND THE SUM OF THE LENGTH AND WIDTH DIFFERENCES WITHOUT REGARD TO SIGN BE NO GREATER THAN 4% OF THE SID, WHEN THE EQUIPMENT INDICATES THAT THE BEAM AXIS IS PERPENDICULAR TO THE PLANE OF THE IMAGE RECEPTOR. (SEE 21 CFR 1020.31 (e)(2)(ii))

NOTE:
PATTERN FOR REFERENCE ONLY
NOT TO SCALE

NOTE: USE THIS TEST PATTERN AT 100 CM SID

THE MAGNIFICATION FACTOR FOR 180 CM SID AT 100 CM SID = 100/180 = .556

THEREFORE: 13 CM X 13 CM @ 180 CM SID IS 7.222 CM X 7.222 CM
35 CM X 35 CM @ 180 CM SID IS 19.444 CM X 19.444 CM
43 CM X 43 CM @ 180 CM SID IS 23.889 CM X 23.889 CM

REV.	ECN	DESCRIPTION	CHG.	DATE
C	P1033	ADDED NOTE, FOR REFERENCE ONLY	DD	07-14-04
B	P0492	ADDED 43 CM X 43 CM PATTERN & REDRAWN	AZ	03-20-00

REVISIONS

PROGENY, INC.

APPROVALS	DATE
DRN. A. ZVEREV	03-20-00
CHK.	
APP.	

ORIGINAL PRODUCT: LINEARS

METRIC TEST PATTERN
FOR 100CM AND 180CM SID ADJUSTMENTS

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE		70-09025	C

REL. ECN P0280 | SCALE 1:1 | FILENAME 70-09025 | SHEET 1 OF 1