EUREKA®

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LINEAR™ MC150 PINNACLE

Installation Operation and Maintenance

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PROGENY, INC.
Suppliers of Eureka Collimators and Cables

INSTALLATION ADVISORY

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

COLLIMATOR MOUNTING INFORMATION
(See following pages if unit includes the "Locking Collar" feature)

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 screw 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.

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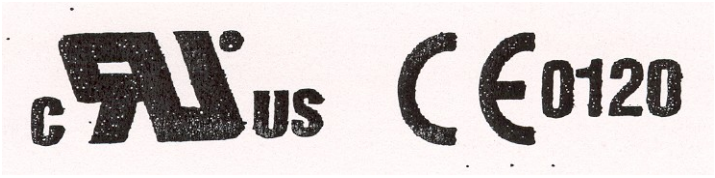
INTRODUCTION



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

Progeny, Inc. is registered to ISO9001, EN46001, and the Medical Device Directive 93/42/EEC Annex II by SGS Yarsley, Ltd.

FRONT PANEL INDICATORS & COLLIMATOR OPERATION

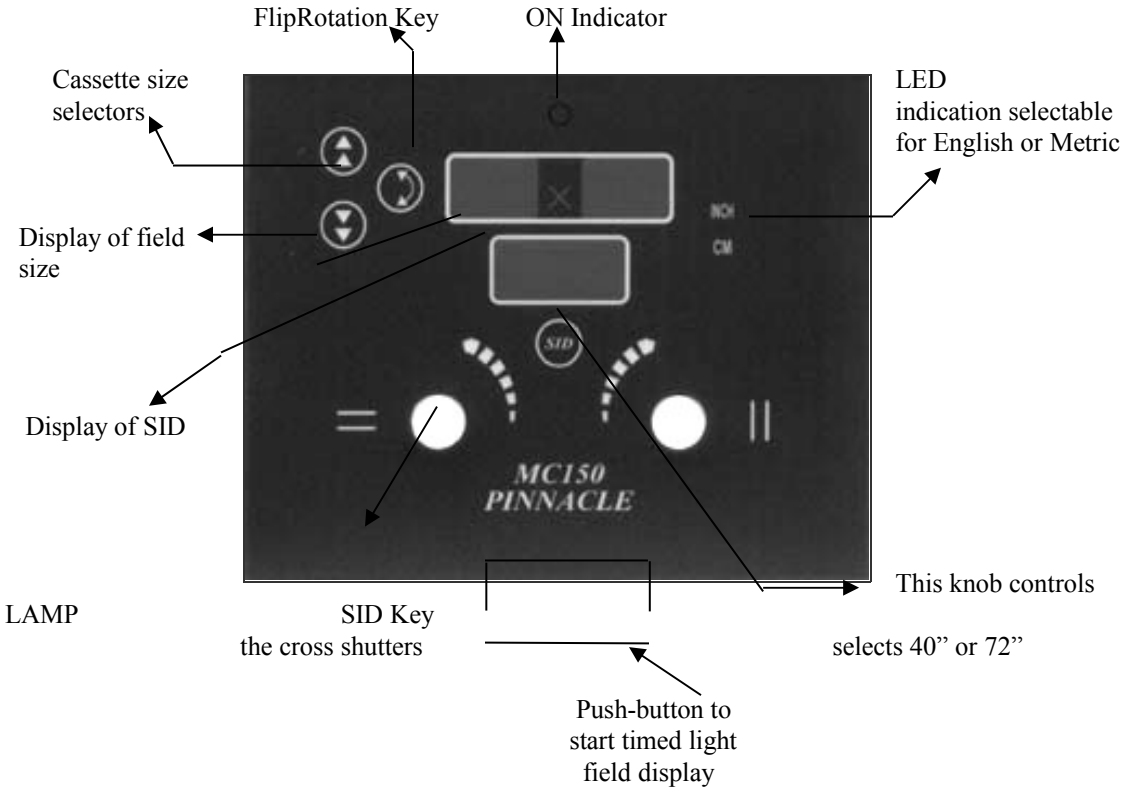


FIGURE 1

Keypad operation

- Press SID key to select 40" SID (100cm) or 72" SID (180cm).
- Press cassette size selectors to recall a cassette size stored in memory.
- Press rotation key to flip cassette 90° degrees. Eg: 14x17 to 17x14.
- Press the "Lamp" push-button to activate light field. Verify light field aperture with cassette size to be used.

Manual operation

- Press the lamp push-button to activate the light field. Adjust the shutters to size not larger than the film to be used.
- Center light field over cassette or anatomical area to be exposed.

SECTION 1.0

OPERATION

The MC150 Pinnacle is a motorized manual collimator. The Pinnacle has motors to move the shutters, buttons to select the field size, a button to select SID, a digital display of field size, and a digital display of SID. Figure 1, shows the front panel of the Pinnacle, which contains these features.

The user operates the unit as a manual collimator. The user opens the collimator shutters to the desired size by rotating the knobs on the front panel. The user will view the field size on the collimator front panel via the digital display. The default SID scale used will be 40 inch SID (100cm). If the user requires a 72 inch SID (180cm) scale, pressing the SID button will cause the display scale to alternate between 40 inches (100cm) and 72 inches (180cm).

In addition, the user may utilize the motors by pressing the arrow keys which will cause the display to change the field size to one of the stored values. The stored field sizes are listed in Table 1. The two arrow keys are referred to as up and down. When the user presses the up key, the next largest field size in memory is displayed. When the user presses the down key, the next smallest field size in memory is displayed.

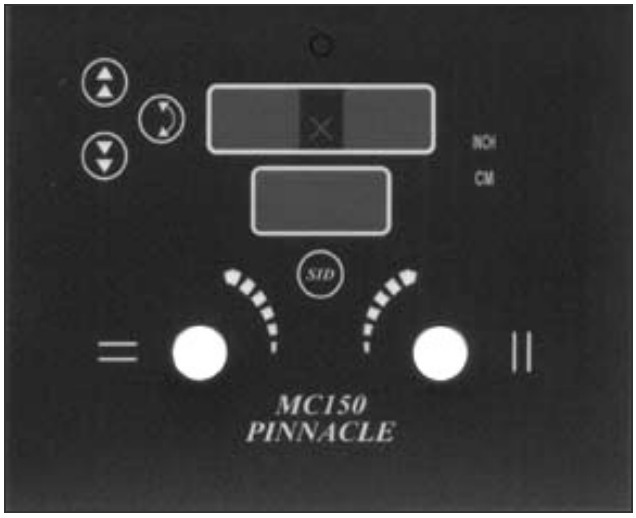
The stored sizes are rectangular in shape. In every case in which the size selected is a rectangle, the longer dimension of the rectangle is displayed in the longitudinal direction and the smaller dimension in the cross table direction. If the user requires the field size to be rotated by 90 degrees, the circular arrow flip key must be pressed.

TABLE 1

FIELD SIZE

Inches	Metric (cm)
14 x 17	35 x 43
14 x 14	35 x 35
11 x 14	30 x 35
10 x 12	24 x 30
8 x 10	18 x 24

The collimator can display either inches or metric (cm's). The default scale is set with an internal switch which determines the display when power is turned on. Metric and English field sites can be stored as valid sizes at the same time in memory (if a location uses both English and metric cassettes). If both inches and metric preset field sizes have been stored, when selecting from an English scale to a size in metric scale, the collimator will automatically switch between English to Metric display. In order for the Pinnacle to change the default condition, the jumper, labeled JP2 on the Pinnacle control PCB must be set with a shunt in the CM position. This can only be done by a technician after removing power, the interconnect cable, and the covers. Then, once reconnected and with the covers in place, with power turned on, the collimator will display field size in metric (cm's). When in metric display, the SID scales used will be 100 and 180 cm.



1.1 KEYPAD OPERATION

When the SID key is pressed, the software will toggle the SID display, i.e., if 40 is displayed before the key press, 72 will be displayed, and vice versa. Following this, the software will compute the size of the field on the new SID scale.

If the ROT key is pressed, the field display will alternate values from cross to long, e.g., 14 x 17 will now display 17 x 14.

If either the UP or DOWN key is pressed, the next stored preset field sizes is displayed.

The keypad delays one second before completing an action to allow the operator to scroll through the preset field sizes without resizing occurs.

1.2 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.

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MANUAL OPERATION

1.2 INTRODUCTION

This manual contains information for the assembly, installation, adjustment, testing and maintenance of the MC150 PINNACLE collimator manufactured by Progeny, Inc.

1.3 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 FDA 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 (CDRH) 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.

1.4 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.

1.5 GENERAL SPECIFICATIONS - Model MC150 PINNACLE

The MC150 PINNACLE collimation system from EUREKA includes all features required for diagnostic excellence.

APPLICATIONS.....	For general purpose radiographic units and special purpose radiographic units.
MAXIMUM kVp.....	150 kVp.
OUTER DIMENSIONS.....	18cm x 20.5cm x 30cm or 7.1 inches x 8.1 inches x 11.8 inches
NET WEIGHT.....	8.2kg or 18.04 lbs. (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 or 17 inches by 17 inches at 36 inches SID
CONE TRACK.....	Optional
SWIVEL MOUNT.....	Standard
BUCKY LIGHT LINE.....	Standard
SKIN GUARDS.....	Optional, to be attached for Mobile operation
FILTRATION.....	2.0 mm (Min.) Aluminum equivalent at 100kVp. Low filtration mirror bracket available from Progeny (1.00 mm minimum aluminum equivalent).
INDICATIONS.....	Cassette size and SID displays for long and cross shutters calibrated for 100cm and 180cm and 40 in and 72 in SID’s.

1.6 ADVANCED FEATURES

The MC150 PINNACLE collimator system incorporates features required for diagnostic convenience...

- Front panel displays to show projected field dimensions at 100cm, 180cm, 40 inches, and 72 inches SIDs.
- Bright centering light-line which extends from the front of the extended cassette tray across the table-top to beyond the center of the patient, completely eliminates the need for mechanical “pointers”.
- Swivel mount standard for angulated positioning.
- Keypad to select and store cassettes sizes.

An indicator lamp in the “light” switch will indicate when the field projector bulb requires replacement. A spare lamp is provided inside the lamp housing and is easily replaced by the owner/operator.

1.7 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.

1.8 COMPATIBILITY

The MC150 PINNACLE 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 2.44" ± .03" (6.0 cm ± . 08 cm).** Four (4) spacers are supplied for adaptation:

1-.25" (0.635 cm) spacer
2- 6" (0.152 cm) spacer

Use any of the above combination to achieve the requirements.
If the large spacer is used, be sure to orient the sides per the labels attached to the spacer.

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 MC150 PINNACLE 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. **A low filtration mirror bracket (1.0 mm Aluminum equivalent) is available from Progeny for use with X-Ray tubes with high inherent filtration.**

Application:

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

Installation:

Must be made with supplied hardware, including mounting flange, spacers (as required), four ¼ - 20 bolts or four M6 x 16 bolts spaced on a 3.625 diameter bolt center.

1.9 MAINTENANCE

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

Preventive maintenance is to be performed once every twelve months. This includes inspection and lubrication of the collimator mechanism.

If collimator does not spin freely and smoothly, remove it from tube. Clean all surfaces of collar and mounting flanges. Apply lubriplate or similar grease. Mount collimator onto tube. **If shutters seem too loose or too tight when turning knobs, remove the front bezel cover and adjust the knob tension bar as required.** This can be done using an allen key to turn screws in bar.

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

- Lamp replacement
- Electronic component failure, replacement or calibration performed
- When collimator is removed from tube/housing assembly
- When collimator has been subjected to external damage

Refer to Section 5.0 for collimator CHECK-OUT procedure.

1.10 EUROPEAN REPRESENTATIVE

Progeny, Inc. has contracted with the following company to act as a European Authorized Representative relative to the requirements of EN46001 and the Medical Device Directive:

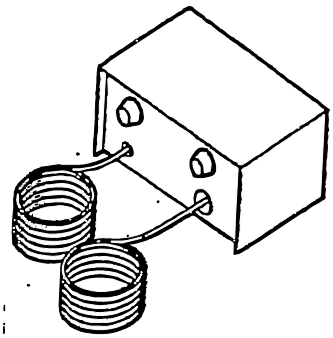
CE Partner 4U
Esdoornlaan 13
3951DB Maarn
The Netherlands

Phone: +31.343.442.524
Fax: +31.343.442.162

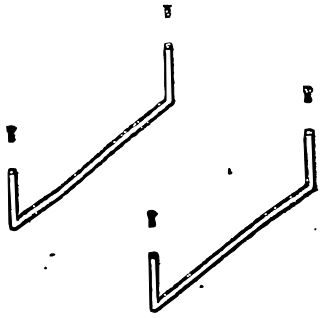
European customers should direct any customer complaints or requests for product technical files to CE Partner 4U.

SECTION 2.0

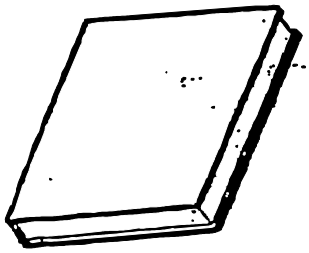
INSTALLATION



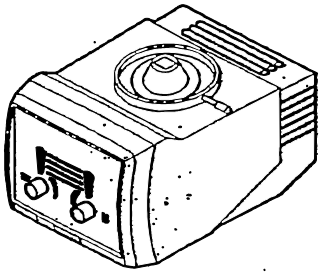
INTERCONNECTING CABLES AND POWER SUPPLY UNIT (OPTIONAL)



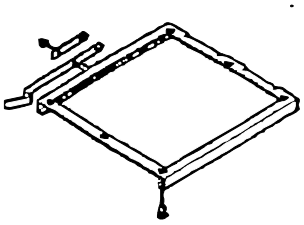
SKIN GUARD AND MOUNTING HARDWARE (OPTIONAL)



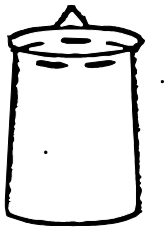
MANUAL



LINEAR MC150 COLLIMATOR



CONE TRACK (OPTIONAL)



SPACERS AND MOUNTING HARDWARE

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

- MC150 PINNACLE Collimator
- Spacers and mounting hardware
- Power supply unit (when supplied) and wiring cables.
- Packet containing Instruction Manual, Assembler's Report FD -2579, Returned Goods Authorization/Service Report

2.3 COLLIMATOR MOUNTING

2.3.1 Determine the collimator mounting surface to focal spot distance from the datas 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 MC150 PINNACLE 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. <u>SECURELY</u> 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.

2.3.2 SKIN GUARD INSTALLATION (OPTIONAL)

NOTE: Refer to Figure 2.2

NOTE: Skin Guard Kits are optional and must be purchased separately from collimator.

1. Remove the Front Cover Bezel, then the Left and Right Side Covers by removing the six (6) 6-32 screws which keep them in place.

2. Mount the two (2) Skin Guard Rails to the Left and Right Side Covers using the four (4) screws provided in the Skin Guard Kit.

3. Reattach the Left and Right Side Covers, then the Front Cover Bezel. After assembly, test the field lamp timer for proper operation.

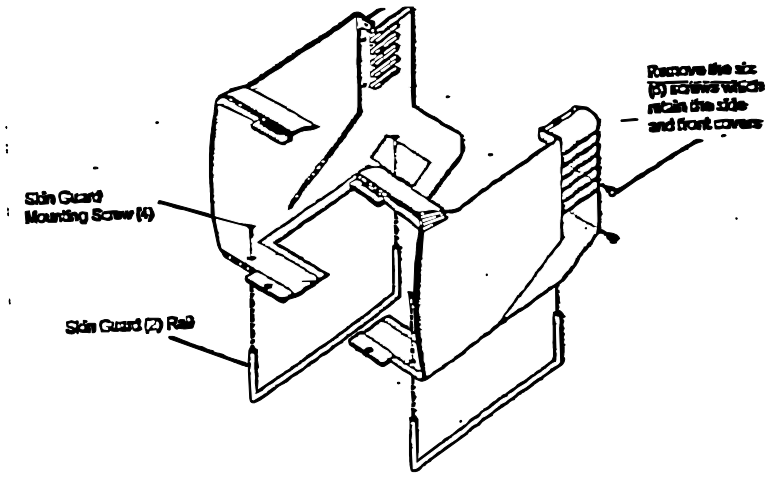


FIGURE 2.2 – SKIN GUARD INSTALLATION DIMENSIONS

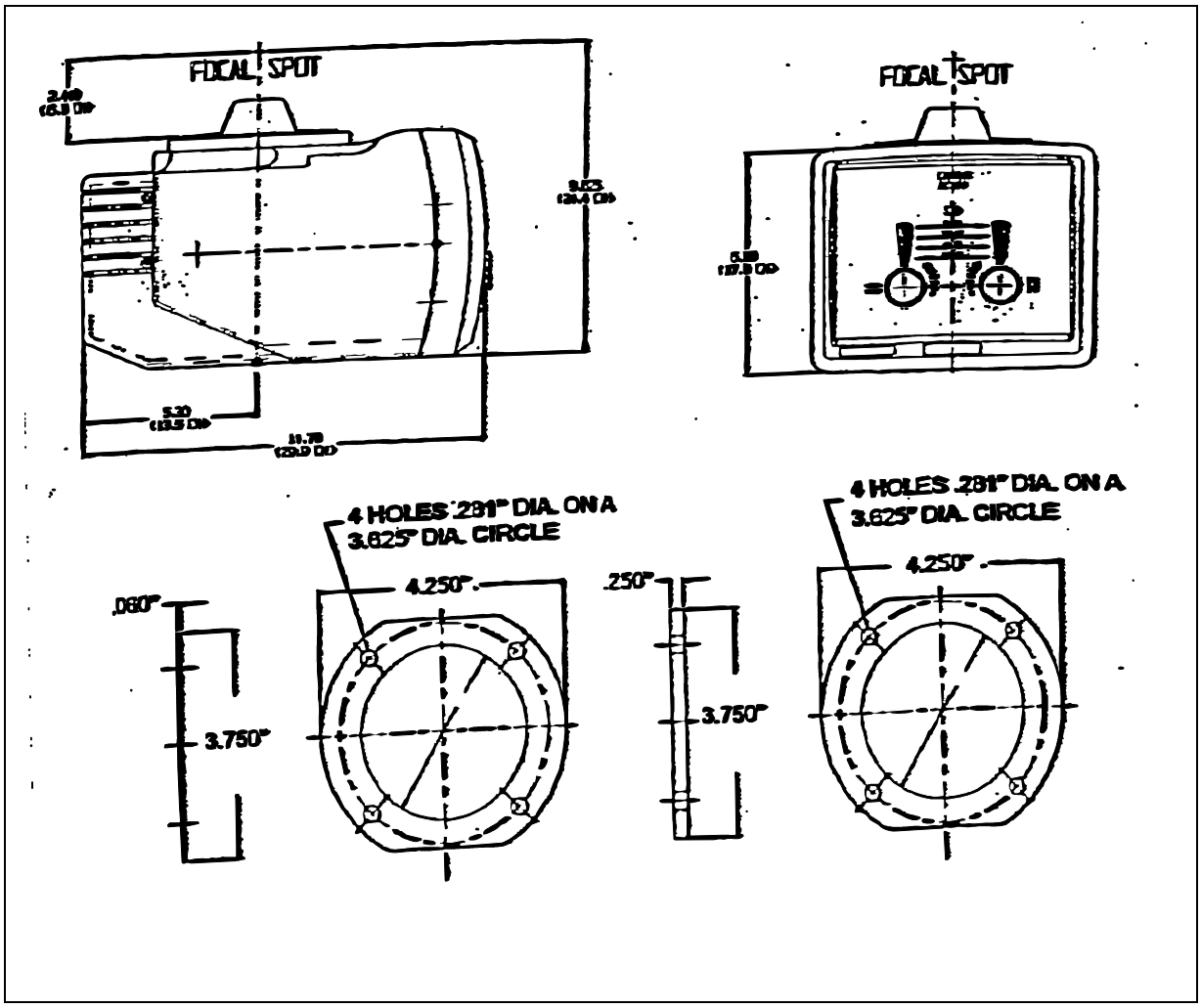


FIGURE 2.3 – COLLIMATOR MOUNTING DIMENSIONS

2.4 WIRING TO SYSTEM (NON-PROGENY) PROVIDED 24 VOLT AC POWER SUPPLY

(Refer to Cabling Outline Figure 2.4)
Follow this procedure if the MC150 PINNACLE will be powered by a power supply other than a Progeny supplied 24 volt supply.
Connect the unterminated end of the supplied three wire cable and plug to a suitable 24 VAC source with a capacity of 8 Amps maximum. 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.

WARNING: VERIFY INPUT POWER WITH LAMP OFF, IS NO GREATER THAN 24 VAC RMS. VERIFY 28 VDC SUPPLY ON PCB IS NO GREATER THAN 30 VDC.

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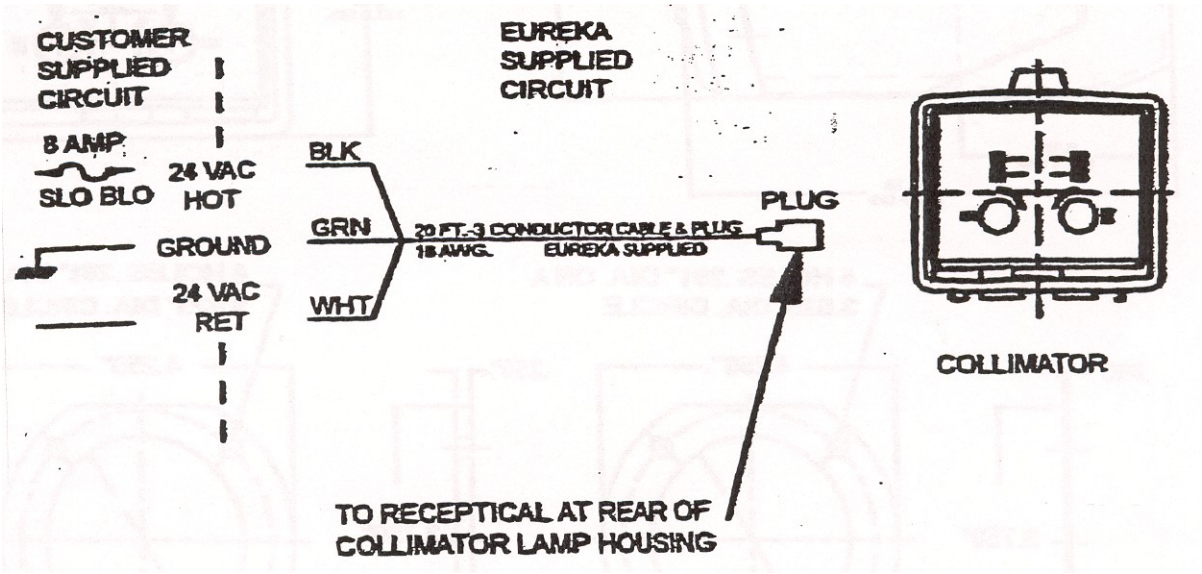


FIGURE 2.4
WIRING WHEN USING A 24 VOLT AC SOURCE
PROVIDED BY X-RAY SYSTEM (NON-PROGENY)

2.5 MOUNTING AND WIRING OF PROGENY POWER SUPPLY (70-20254)

2.5.1 The power chassis is intended to be mounted on a 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:

- 120V or 220 V power connector (input voltage is selectable on power supply chassis)
- Power Chassis to Collimator (Plug Connection).

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

1.5.2 All connections are made external to the Power Chassis (refer to Figure 2.6)

2.5.3 120 VAC or 230 VAC INPUT

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

Black	-	Hot
White	-	Neutral
Green	-	Ground

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

120 VOLT OPERATION

Line VAC	L1 (Black)	L2 (White
125	4 and 8	1 and 5
115	3 and 7	1 and 5
105	2 and 6	1 and 5

220 VOLT OPERATION

Line VAC	L1 (Black)	L2 (White)	Connect
250	8	1	4 and 5
230	7	1	3 and 5
210	6	1	2 and 5

2.5.4 Route the 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.

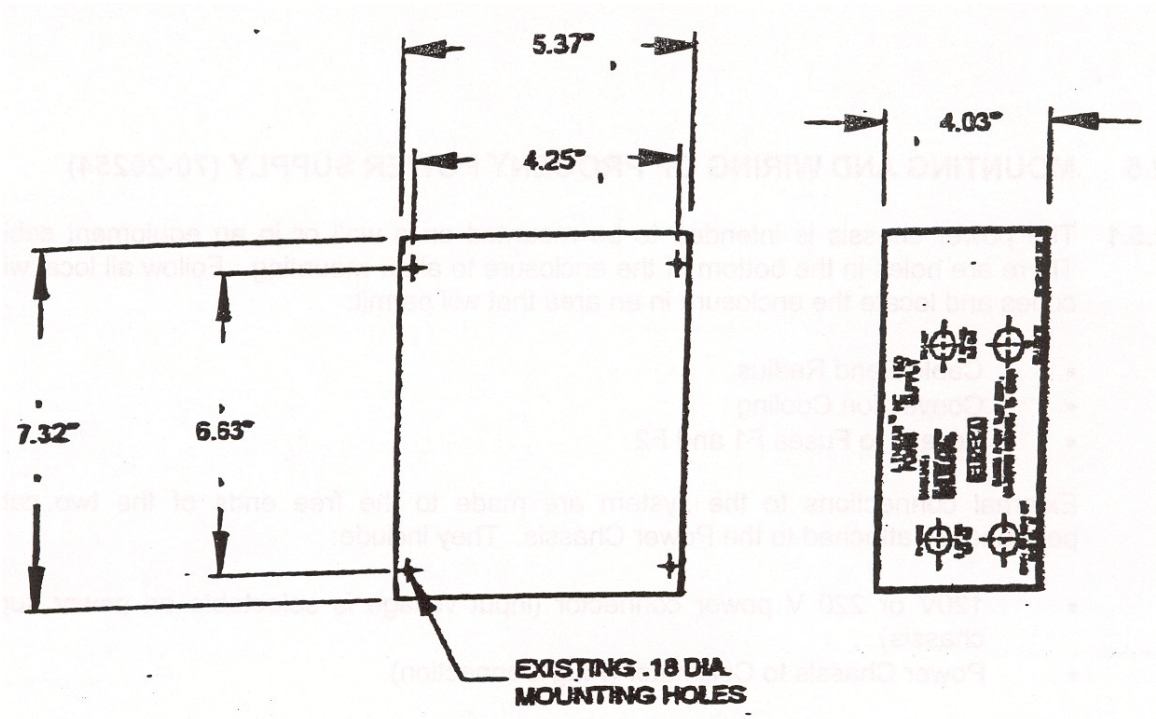
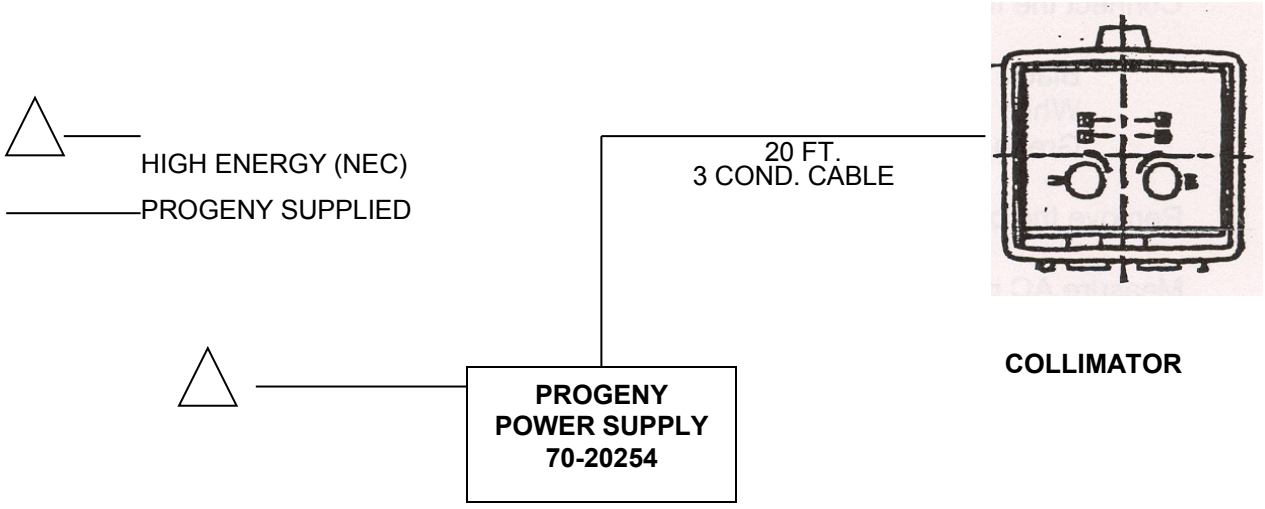


FIGURE 2.5
PROGENY POWER SUPPLY CHASSIS



CABLE CONFIGURATION FOR 70-63000 LINEAR MC150
WHEN USING PROGENY POWER SUPPLY 70-20254

FIGURE 2.6
WIRING TO PROGENY PROVIDED POWER SUPPLY

CALIBRATION

FOR ALL NEW SYSTEMS, THE CALIBRATION PROCEDURE NEED NOT BE PERFORMED IF THE UNIT TESTS SATISFACTORILY FOR X-RAY FIELD TO LIGHT FIELD ALIGNMENT. BEGIN CALIBRATION BY PRESSING THE CAL SWITCH, SW S1, ON THE CONTROL PCB WHILE POWER IS TURNED ON. THEN PROCEED WITH THE FOLLOWING STEPS:

IF CALIBRATION IS TO BE PERFORMED, BOTH INCH CAL AND METRIC CAL WILL BE REQUIRED. FIRST, PLACE A SHUNT IN THE "INCH" POSITION OF JP2, AND PLACE A SHUNT IN POSITION 1 (TOPMOST) OF HEADER JP1. THEN, WHEN SWITCH S1 IS PRESSED THE FIELD SIZE CALIBRATION IN INCHES WILL BE ENTERED. WHEN COMPLETED, MOVE THE SHUNT OF JP2 TO THE "CM" POSITION. THEN PRESS SWITCH S1 TO PERFORM THE FIELD SIZE CALIBRATION FOR CM SIZES.

ACTION TAKEN	FRONT PANEL DISPLAY
1. Press Cal button on Logic PCB.	Flash green Ready Light. Light will continue to blink Throughout the calibration procedure.
2. Close Shutters to minimum opening. Press Cal button on Logic PCB.	**0.0 x 0.0** / **40** **OR** **0.0 x 0.0** / **100**
3. Open Shutters to 17 inch size at 40 inch SID. Or 43 cm size at 100 cm SID. Press Cal button on Logic PCB.	**17 x 17** / **40** **OR** **43 x 43** / **100**
4. Open Shutters to 15 inch (38 cm) size at 40 inch (100 cm) SID. Press Cal button on Logic PCB.	**15 x 15** / **40** **OR** **38 x 38** / **100**
5. Open Shutters to 13 inch size at 40 inch SID. Or 33 cm size at 100 cm SID. Press Cal button on Logic PCB.	**13 x 13** / **40** **OR** **33 x 33** / **100**
6. Open Shutters to 11 inch size at 40 inch SID. Or 28 cm size at 100 cm SID. Press Cal button on Logic PCB.	**11 x 11** / **40** **OR** **28 x 28** / **100**

7. Open Shutters to 9 inch size at 40 inch SID.
   Or 23 cm size at 100 cm SID.
   Press Cal button on Logic PCB. **9 x 9 / 40 OR 23 x 23 / 100**

8. Open Shutters to 7 inch size at 40 inch SID.
   Or 23 cm size at 100 cm SID.
   Press Cal button on Logic PCB. **7 x 7 / 40 OR 18 x 18 / 100**

9. Open Shutters to 5 inch size at 40 inch SID.
   Or 13 cm size at 100 cm SID.
   Press Cal button on Logic PCB. **5 x 5 / 40 OR 13 x 13 / 100**

Now use the template provided with the collimator providing the sizes required at 72 SID. The template is designed to be placed at 40 inch SID and the sizes are the proportional sizes needed to achieve the displayed sizes at 72 inch SID.

10. Open Shutters to 17 inch size at 72 inch SID.
    Or 43 cm size at 180 cm SID.
    Press Cal button on Logic PCB. **17 x 17 / 72 OR 43 x 43 / 180**

11. Open Shutters to 15 inch size at 72 inch SID.
    Or 38 cm size at 180 cm SID.
    Press Cal button on Logic PCB. **15 x 15 / 72 OR 38 x 38 / 180**

12. Open Shutters to 13 inch size at 72 inch SID.
    Or 33 cm size at 180 cm SID.
    Press Cal button on Logic PCB. **13 x 13 / 72 OR 33 x 33 / 180**

13. Open Shutters to 11 inch size at 72 inch SID.
    Or 28 cm size at 180 cm SID.
    Press Cal button on Logic PCB. **11 x 11 / 72 OR 28 x 28 / 180**

14. Open Shutters to 9 inch size at 72 inch SID.
    Or 23 cm size at 180 cm SID.
    Press Cal button on Logic PCB. **9 x 9 / 72 OR 23 x 23 / 180**

Open Shutters to 7 inch size at 72 inch SID.
Or 18 cm size at 180 cm SID.
Press Cal button on Logic PCB. **7 x 7 / 72** **OR** **18 X 18 / 180**

15. Open Shutters to 5 inch size at 72 inch SID.
Or 13 cm size at 180 cm SID.
Press Cal button on Logic PCB. **5 x 5 / 72** **OR** **13 x 13 / 180**

2.6 PRESET FIELD SIZE CALIBRATION

To enable calibration, a shunt must be placed in header JP1 position 2 (second from top position). In addition, there must be no shunt in the topmost position of header JP1. The preset field size calibration begins by pressing the S1 momentary switch on the Pinnacle control PCB.

When pressed, the cross field size will flash indicating it can be changed for memory. The operator uses the UP and DOWN arrow keys to set the size desired. When acceptable, the ROTATE key is pressed to save the cross field size. Then, the long field size will flash and allow modification in the same way. When the long field size is accepted, the SID display will flash. At this time, the operator may set the SID of the size by using the SID button as well as the size in either inches or metric by using the UP and DOWN arrow keys. When the SID scale and inch/metric is acceptable, the preset field size is stored by pressing the ROTATE key.

This procedure is repeated for each of the ten stored field size settings. If it is desired to not use any of the ten saved settings, each setting can be set to 0 and stored. It will then be invisible to use.

As shipped from Progeny, the preset field sizes are as follows:

Inches	Metric (cm)
14 x 17	35 x 43
14 x 14	35 x 35
11 x 14	30 x 35
10 x 12	24 x 30
8 x 10	18 x 24

2.7 VOLTAGE ADJUSTMENT FOR FIELD SIZE FEEDBACK POTENTIOMETERS

The field size feedback potentiometers are set at the factory for 200 ohms when the shutters are fully closed. However, due to mechanical losses, the potentiometer reading is not always exact. In order to achieve a factory standard feedback reading for every collimator, there is an adjustment to be made to the feedback pot voltage. This adjustment is made at the factory and should not be made in the field without first consulting the factory technical service department. The adjustment is achieved as follows:

First, place a voltmeter on TP1, "VREF". This voltage should be 5.00 volts. Adjust potentiometer to set this voltage.

VREF = 5.00 volts

Next, place a voltmeter on TP2 "VXFC. Fully close the cross shutters and record the voltage. The desired voltage is 1.10, however variance of + or – 0.25 is common.

VXFC = _____

To initiate the adjustment procedure, place a shunt in position 7 (bottom most) of header JP1 on the Control PCB. Then press SW1 momentarily. The procedure begins by flashing the field size display for the CROSS shutters. This indicates that the CROSS feedback potentiometer is to be adjusted first. The SID display now shows the output of the trimpot labeled CROSS ADJUSTMENT. The number displayed is a number between 0 and 255, with 0 representing 0 volts and 255 representing VREF, which is 5.00 volts. Adjusting the trimpot will provide a signal to the collimator that an adjustment is required to either increase or decrease the VXFC signal. The 0 adjustment level is 128. First adjust the trimpot so the display reads 128. The number over 128 will add to the VXFC signal and the number below 128 will subtact from the VXFC signal.

Now determine how much adjustment is required. First subtract the desired voltage of 1.10 from the recorded VXFC.

Delta Voltage = 1.10 – VXFC = _____

If delta voltage is positive, we will increase the cross adjustment trimpot over 128. If it is negative, the 128 number will be reduced. Each one increment in the number represents an adjustment of 0.02 volts. Determine the number to change by the following equation:

Delta Voltage / 0.0196 = Result = _____ (round to the nearest integer)

Now adjust the trimpot so the reading is 128 + Result. If result is negative, 128 will be reduced. When the desired number is displayed, the VXFC adjustment is complete. Pressing the ROTATE key on the front panel will proceed with the VXFL adjustment for the long shutter field.

Next, place a voltmeter on TP3 “VXFL. Fully close the cross shutters and record the voltage. The desired voltage is 1.10, however variance of + or – 0.25 is common.

VXFL = _____

The procedure begins by flashing the field size display for the LONG shutters. This indicates that the LONG feedback potentiometer is to be adjusted. The SID display now shows the output of the trimpot labeled LONG ADJUSTMENT. The number displayed is a number between 0 and 255, with 0 representing 0 volts and 255 representing VREF, which is 5.00 volts. Adjusting the trimpot will provide a signal to the collimator that an adjustment is required to either increase or decrease the VXFL signal. The 0 adjustment level is 128. First adjust the trimpot so the display reads 128. The number over 128 will add to the VXFL signal and the number below 128 will subtract from the VXFL signal.

Now determine how much adjustment is required. First subtract the desired voltage of 1.10 from the recorded VXFL.

Delta Voltage = 1.10 – VXFL = _____

If delta voltage is positive, we will increase the long adjustment trimpot over 128. If it is negative, the 128 number will be reduced. Each one increment in the number represents an adjustment of 0.02 volts. Determine the number to change by the following equation:

Delta Voltage / 0.0196 = Result = _____ (round to the nearest integer)

Now adjust the long trimpot so the reading is 128 + Result. If result is negative, 128 will be reduced. When the desired number is displayed, the VXFL adjustment is complete. Pressing the ROTATE key on the front panel will return the collimator to normal operation.

NO TEXT

SECTION 3.0 OPERATIONAL CHECK-OUT PROCEDURE

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 face plate of 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.

3.1.3 While the field lamp is on, select different sizes cassettes stored in memory, be sure the light field can be collimated to selected sizes.

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 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 light-field on a white background. By observing the point at which the light field is just visibly increased over the background illumination, and comparing this to the X-ray field (and to the tolerance marks on the pattern), congruence comparisons may be made.

NOTE: The Performance Standards 1020.30 (b)(22) and (45) define the edges of the light field where the illumination is one-fourth of the maximum and the edges of the X-ray field where the exposure rate is one-fourth of the maximum.

EQUIPMENT REQUIRED:

A. LINEAR collimator test pattern (contained in this manual)
B. Measuring tape (ruler)
C. 14” x 17” (35 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 40" or 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 30.38" or 75.6 cm.

LIGHT FIELD/X-RAY CONGRUENCE TEST

3.2.3 Place the X-ray source to table distance at 40 inches or 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.

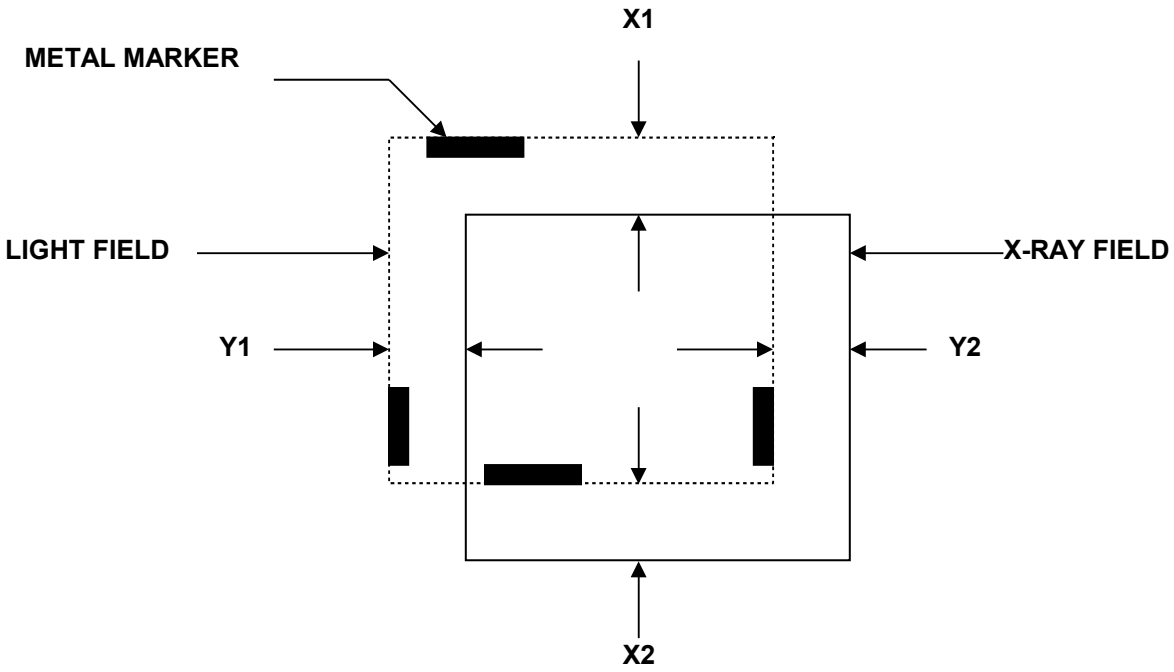
3.2.7 Expose the film to a density of 1.0 and develop.

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.**

LIGHT FIELD/X-RAY FIELD CONGRUENCE TEST



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

FIGURE 3.1

SECTION 4.0
ADJUSTMENT and ALIGNMENT PROCEDURES

CROSS-HAIR WINDOW ADJUSTMENT

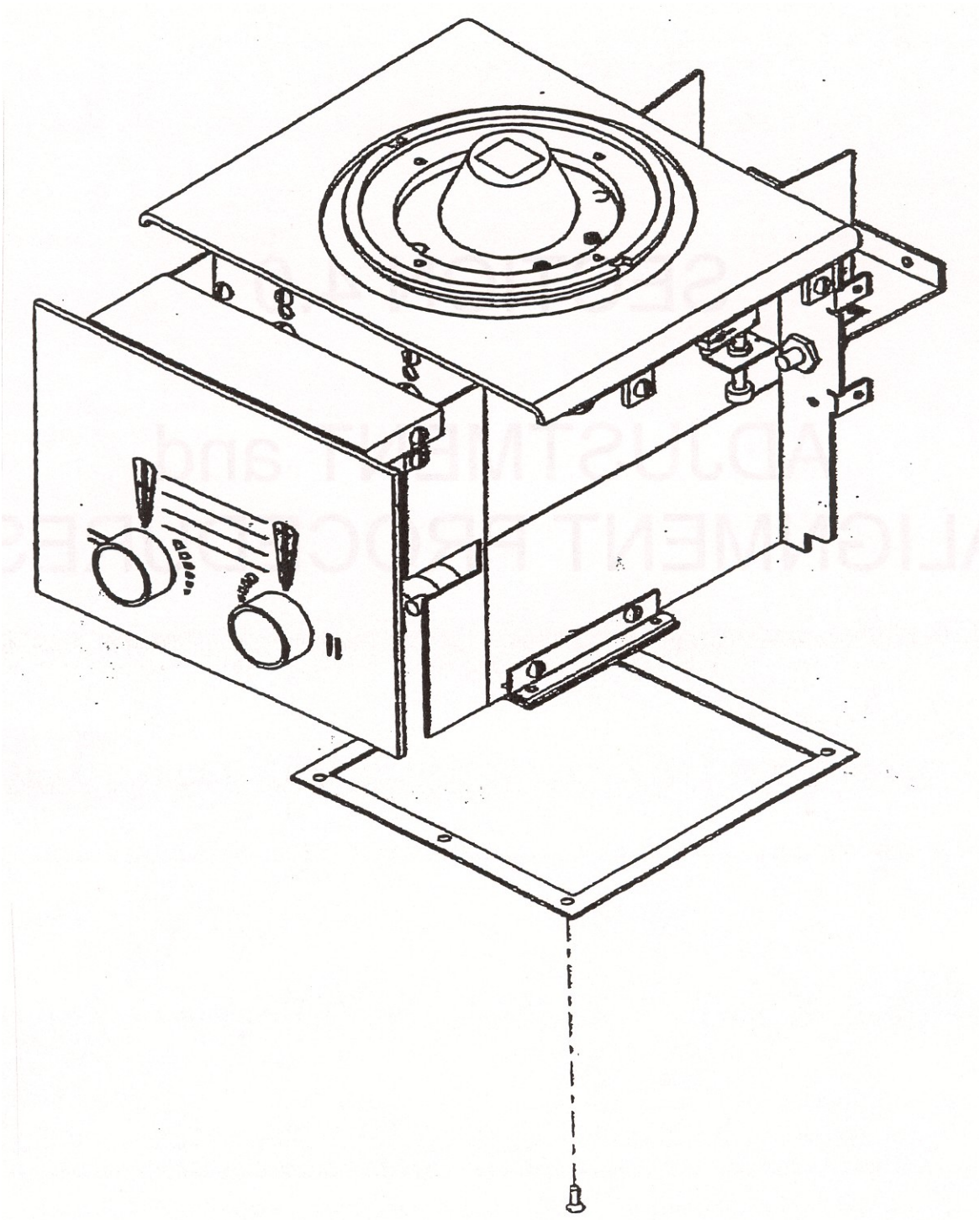


FIGURE 4.1

4.0 ADJUSTMENT AND ALIGNMENT PROCEDURES

4.1 Field Projection Lamp and Mirror Adjustment

This procedure must be performed when the field projection lamp is altered from it's original position or replaced. This test 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.

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 adjustment screw) until ***the light field has shifted*** to a position that is centered to the developed X-ray image.

4.1.7 If the X-ray image is smaller than the light field, loosen the screws securing the lamp socket and use a pair of long nose pliers to move the socket further away from the center of the collimator until light field/x-ray field congruency has been achieved

4.1.8 If the X-ray image is larger than the light field, loosen the screws securing the lamp socket and use a pair of long nose pliers to move the socket closer to the center of the collimator until light field/x-ray field congruency has been achieved.

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

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

4.2 CROSS HAIR WINDOW ADJUSTMENT

This procedure is to be performed if the cross hair shadows are not centered to the light field (Reference Figure 4.1).

4.2.1 Remove the spacer and the entire collimator enclosure.

4.2.2 Loosen the screws securing the plastic window.

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

4.2.4 Tighten the screws and reassemble the collimator covers.

4.3 BUCKY CENTERING LIGHT-LINE ADJUSTMENT

If the collimator is equipped with a Bucky Light-Line Prism:

4.3.1 This procedure is 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 DETECTORS 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.

If the collimator is equipped with a Bucky Light-Line Laser:

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! This unit utilizes a low power (2.5 x 10^{-3} W 650 nm) Class II laser to produce an alignment beam. DO NOT STARE DIRECTLY INTO BEAM OR VIEW WITH OPTICAL INSTRUMENTS.

Laser Adjustment

1.) Verify alignment of the field light to the X-ray beam.

2.) Remove the covers from the collimator.

3.) Open the long shutters to the maximum setting.

4.) Close the long shutter to project a .25 to .50 wide beam onto the work surface.

5.) Use a “rigid projection board” (piece of cardboard ~ 12” x 18”) to sweep the activated laser/field light beam from the work surface up to the bottom of the collimator.

6.) Note the laser line to field light position and alignment at the extremes of the projection board movement.

7.) Axial angular adjustment: Indicated by an angular mis-alignment of the laser line to the field light projection. Loosen the 4-40 rotation stop screw and rotate the laser module until the laser line is parallel and in alignment with the field light projection.

8.) Lateral (side to side) adjustment: Loosen the bracket laser mounting screws and adjust the laser side to side in the slots provided. Tighten the mounting screws.

9.) Longitudinal angular adjustment: Indicated by the laser line projection moving from one side to the other of the field light projection. Loosen the module mount screws. Move laser module to appropriate direction.

10.)Reinstall the covers on the collimator.

Laser Bucky line Projections

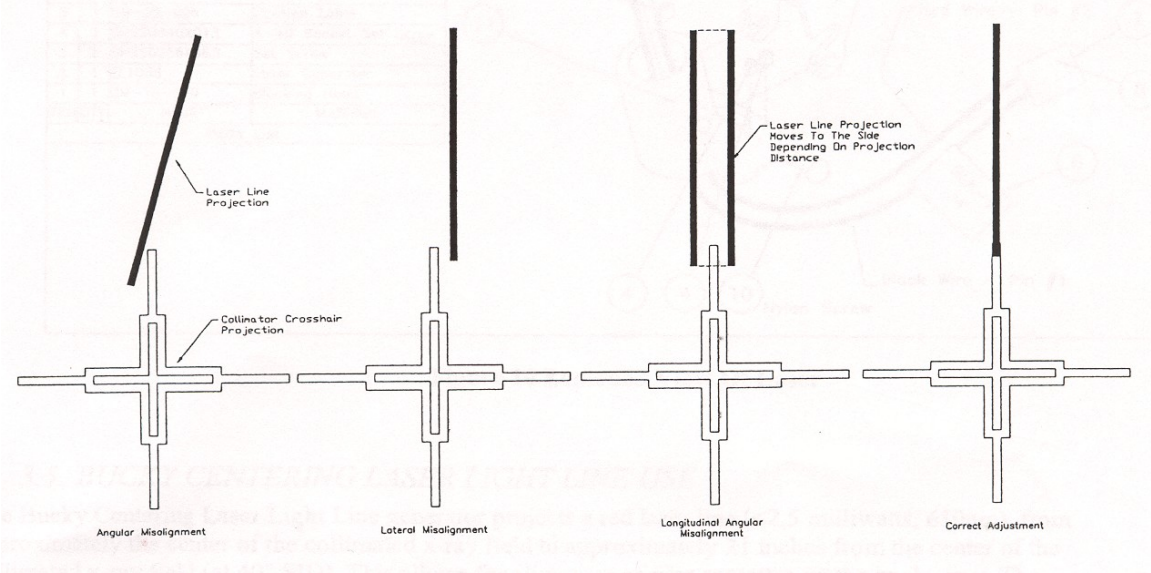
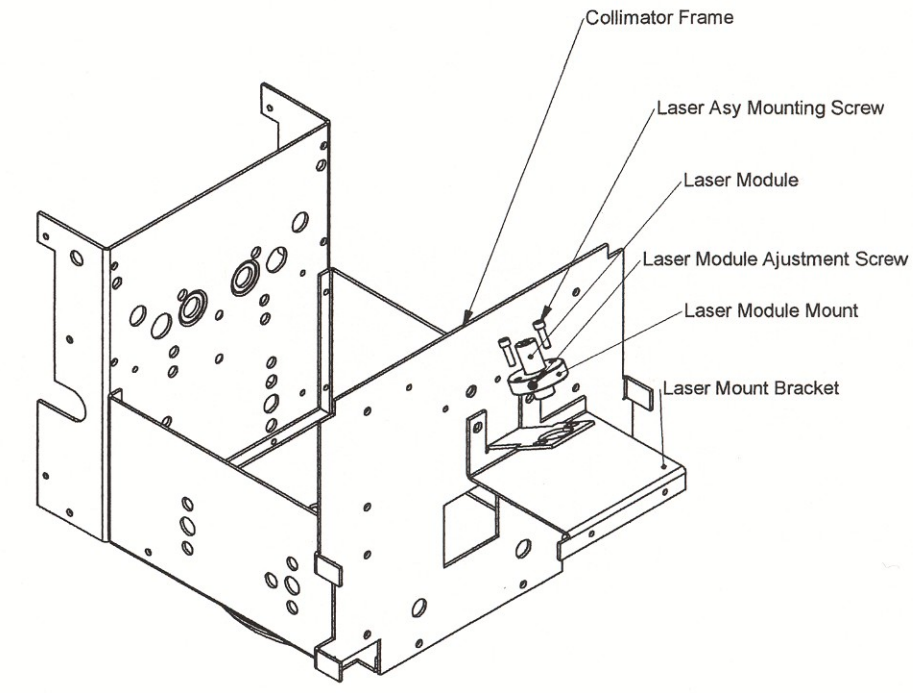
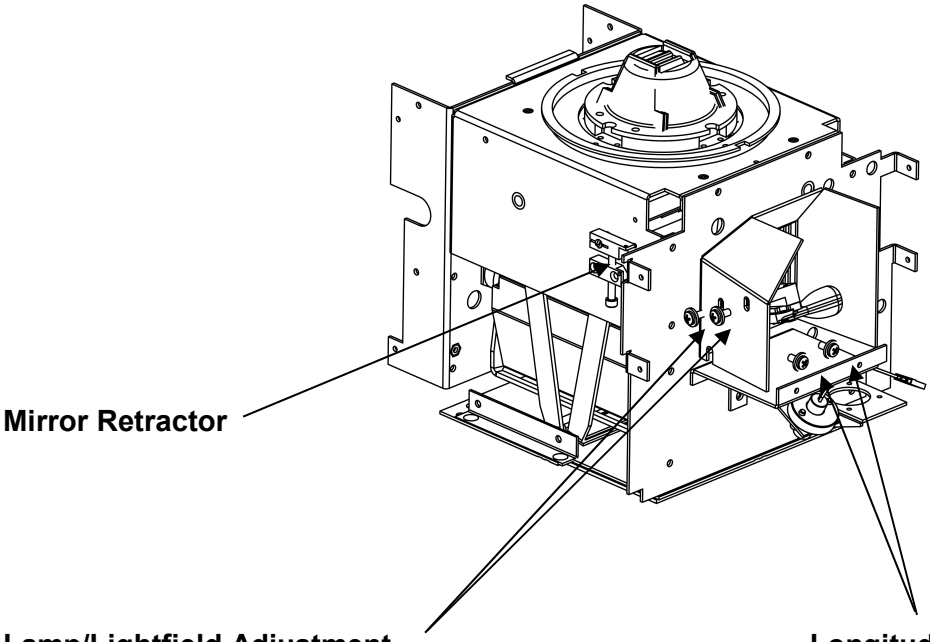


Figure 4.2
Reference View of Laser Parts



Cover Removed



CROSS ALIGNMENT

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

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

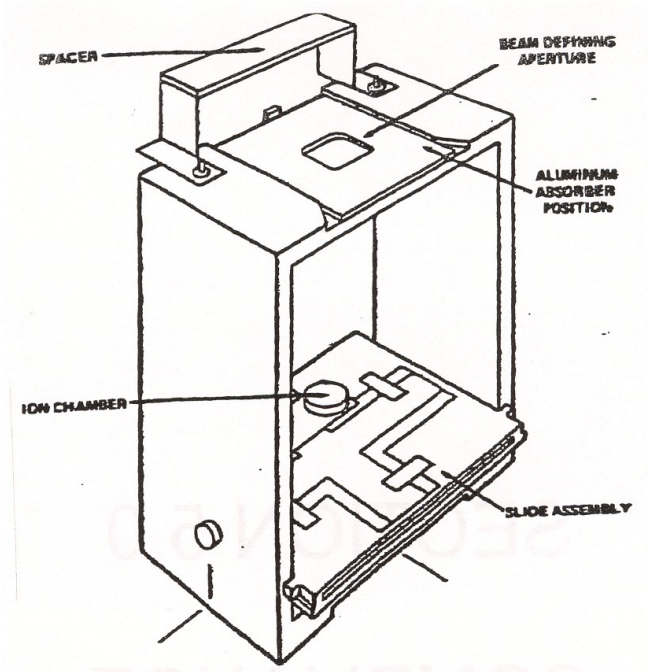


FIGURE 5.1 BRN/FDA COMPLIANCE TEST STAND

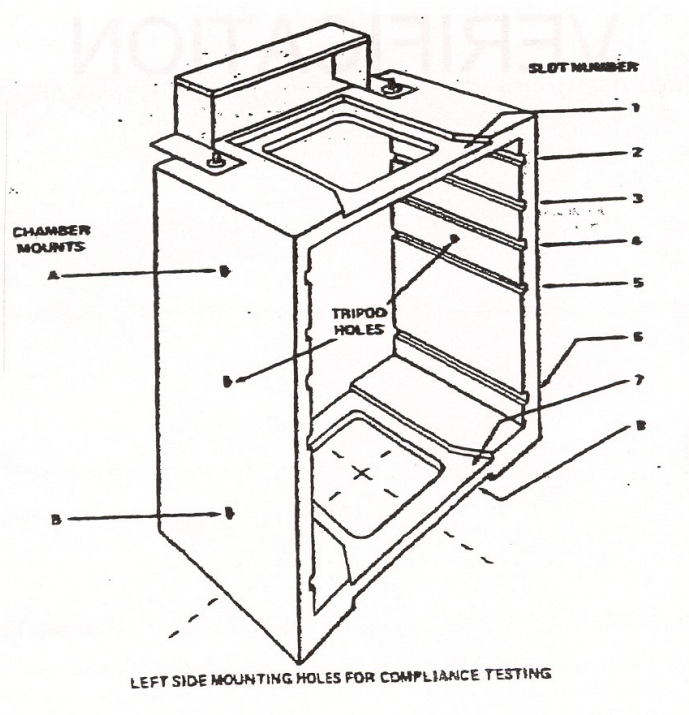


FIGURE 5.2 COMPLIANCE STAND DETAIL

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

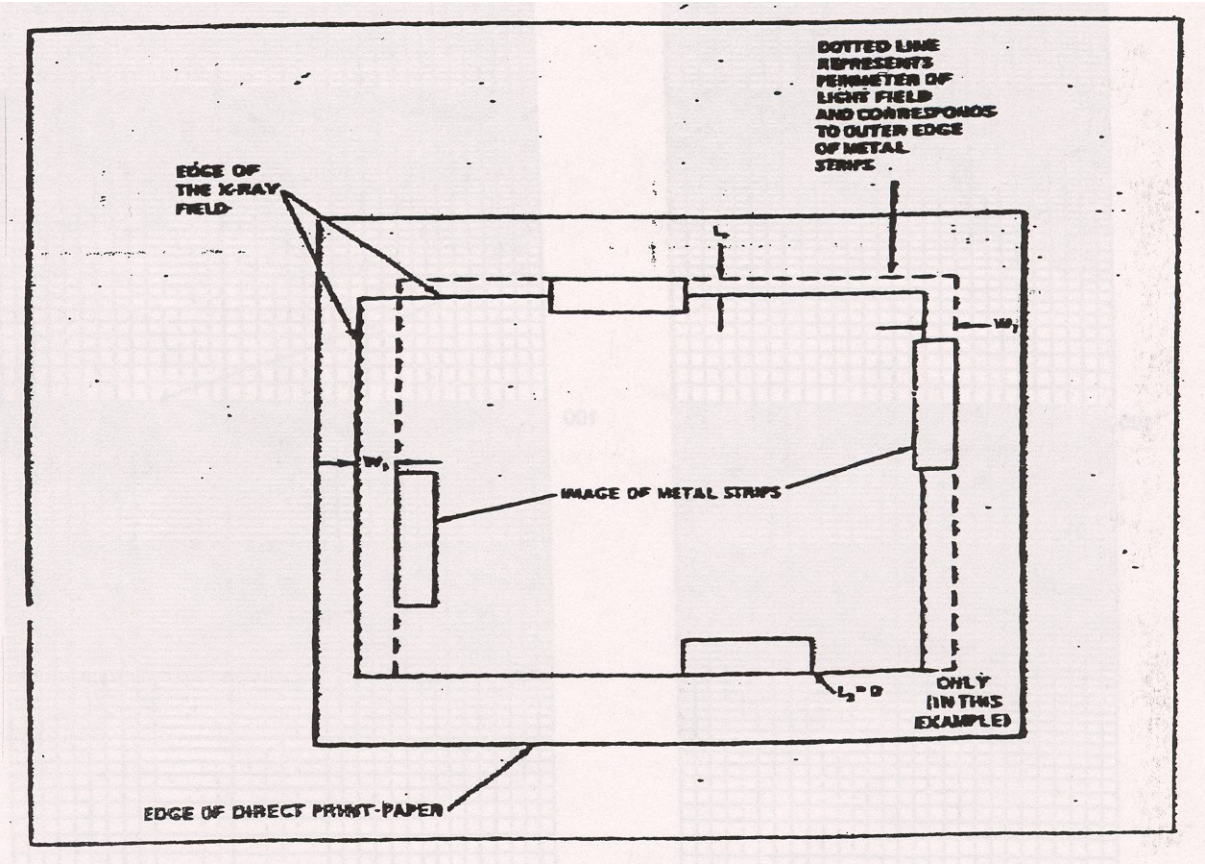


FIGURE 5.3 LIGHT FIELD vs. X-RAY FIELD ERROR MEASUREMENTS

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

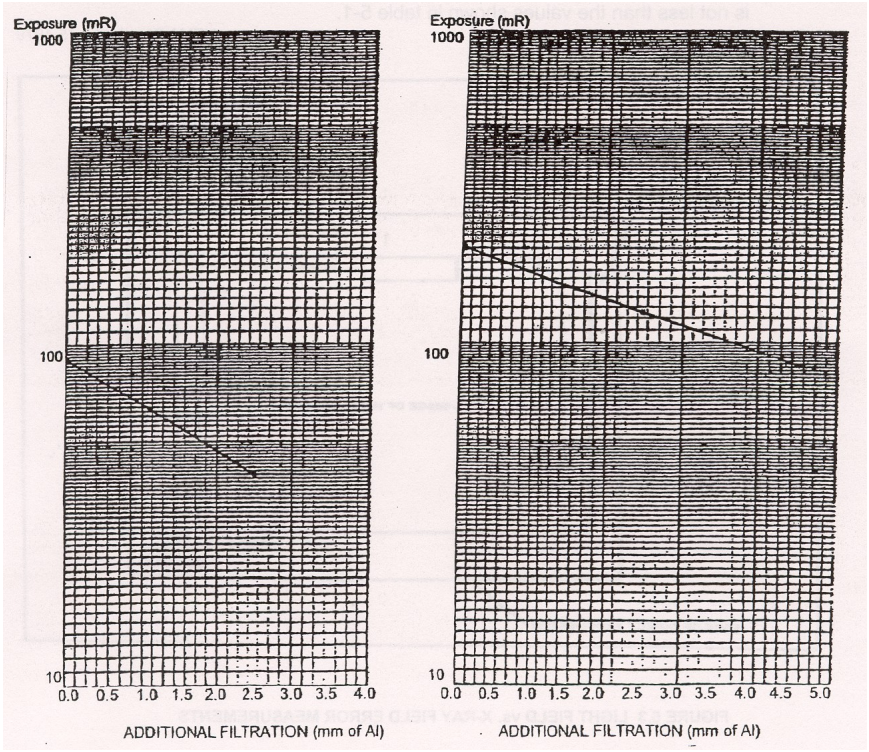


FIGURE 5-6
HALF-VALUE LAYER DETERMINATION GRAPHS

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.

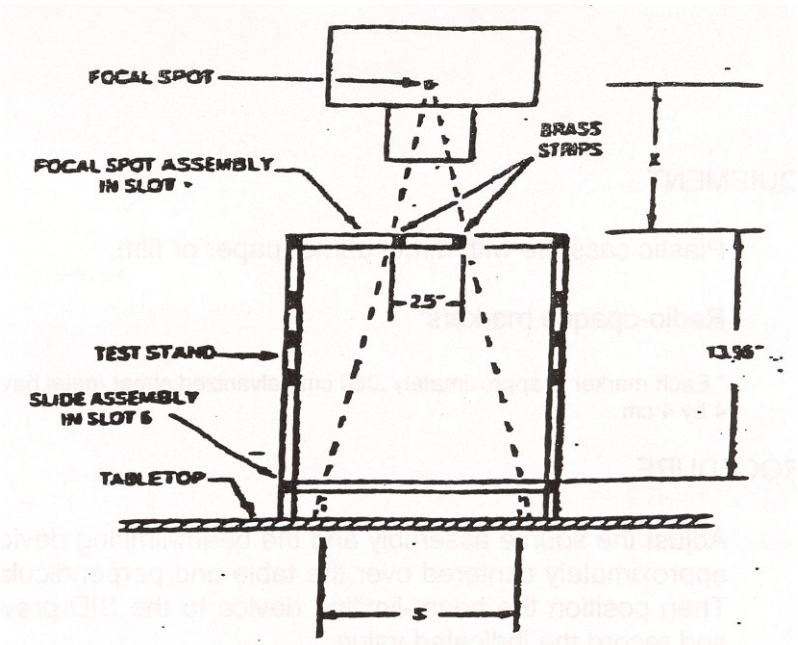


FIGURE 5-4 CALCULATION EXAMPLE

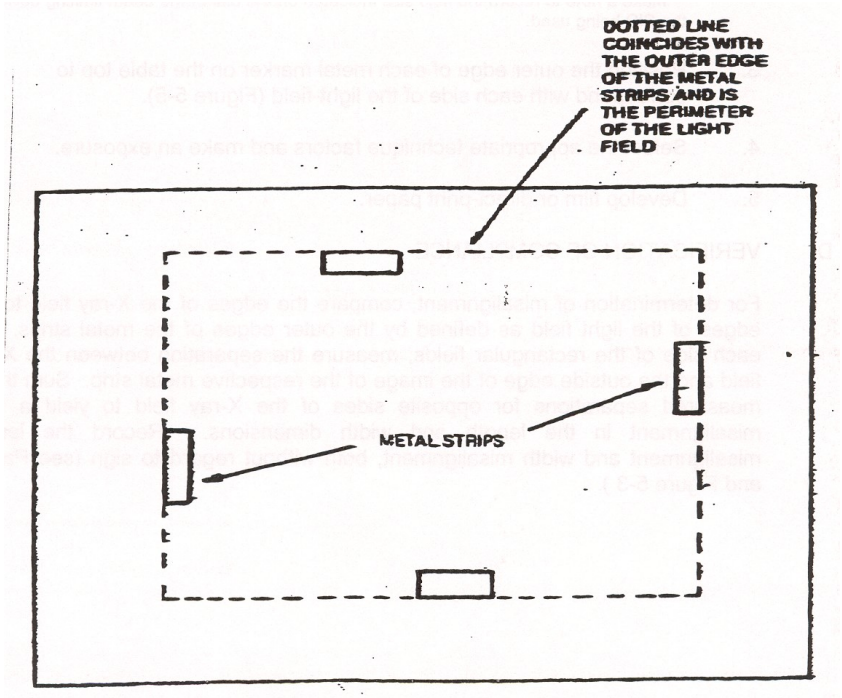


FIGURE 5-5 METAL MARKER METHOD

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).

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

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

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

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

2. 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.
6. 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.

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.

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

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

(5-18)

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 18 by 24 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.

B. VERIFICATION OF COMPLIANCE

Verify that the X-Ray field size in the plane of the image receptor does not differ from hat 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 # _____

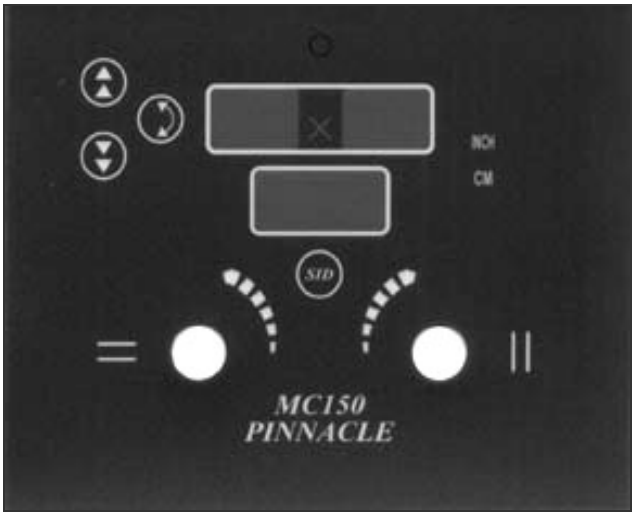
DATE OF INSTALLATION _____ ASSEMBLER _____

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:

SECTION 6.0

THEORY OF OPERATION



User Keypad Input Mode

When this mode is entered, the software has sensed that one of the keys, SID, ROT, UP, or DOWN, has been pressed. The operation is dependant on which of the keys has been pressed.

If the SID key has been pressed, the software will display the SID which is not show, i.e., if 40 is displayed before the key press, 72 will be displayed, and vice versa. Following this, the software will compute the size of the field on the new SID scale. This size will be displayed and the mode will be exited as described below.

If the ROT key ahs been pressed, the field display will alternate values from cross to long, eg., 14 x 17 will now display 17 x 14. The mode will then be exited as described below.

If either the UP of DOWN key has been pressed, the pointer to the array of stored preset field sizes is incremented or decremented appropriately. The new preset preset field size is displayed and the mode is exited as described below.

In all cases after the display is updated, the User Keypad Input mode will monitor the keys for approximately one second. If a key is pressed during this time, the action(s) discribed above will be repeated. If no key is pressed, the mode will conclude and transfer to the Change Field Size Mode.

SECTION 7.0

REPLACEMENT PARTS LIST

MC150 PINNACLE
REPLACEMENT 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 Collar
26-00752	Collar Screw
70-11089	Window - Cross Hair
70-20264	Cross Hair Kit with Brackets
70-04752	Knob - Front Panel
70-08181	Push Button Switch Assembly
70-11126	Lens for Push Button Switch
70-04263	Lamp for Push Button Switch
70-11026	Cover - Front Bezel
70-11127	Cover - Top
70-11028	Cover - Rear
70-11129	Cover, Left Side
70-11130	Cover, Right Side
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
70-10096	Prism, Centering Light-Line
70-20024	Mirror/Bracket Assembly
70-20164	Low Filtration Mirror/Bracket Assembly
70-20265	Cone Track Kit (Optional)
70-11285	Cross Shutter Field Size Dial
70-11286	Long Shutter Field Size Dial
70-11075	Tape Measure
70-10282	Skin Guard (76.2 mm) – Optional
70-20332	Skin Guard (152.4 mm) – Optional
70-08177	MC150 Interconnect Cable
70-10810	Thumbscrew - Rear Cover
70-20319	Axle Clamp Kit
70-11200	Dual Cone Track (for use with dosimeters)

POWER SUPPLY UNIT 70-20254

70-06016	Transformer - Power 27/19 VAC
70-04603	Fuse - 2 Amp SloBlo - Power
70-04607	Fuse – 8 Amp SloBlo – Lamp

POWER SUPPLY UNIT 70-20288 (220V INPUT)

70-06018	Transformer – Power 27/19 VAC
70-04602	Fuse – 1 Amp SloBlo – Power
70-04607	Fuse – 8 Amp SloBlo - Lamp

SECTION 8.0

APPENDIX

(8-1)

DEFINITIONS

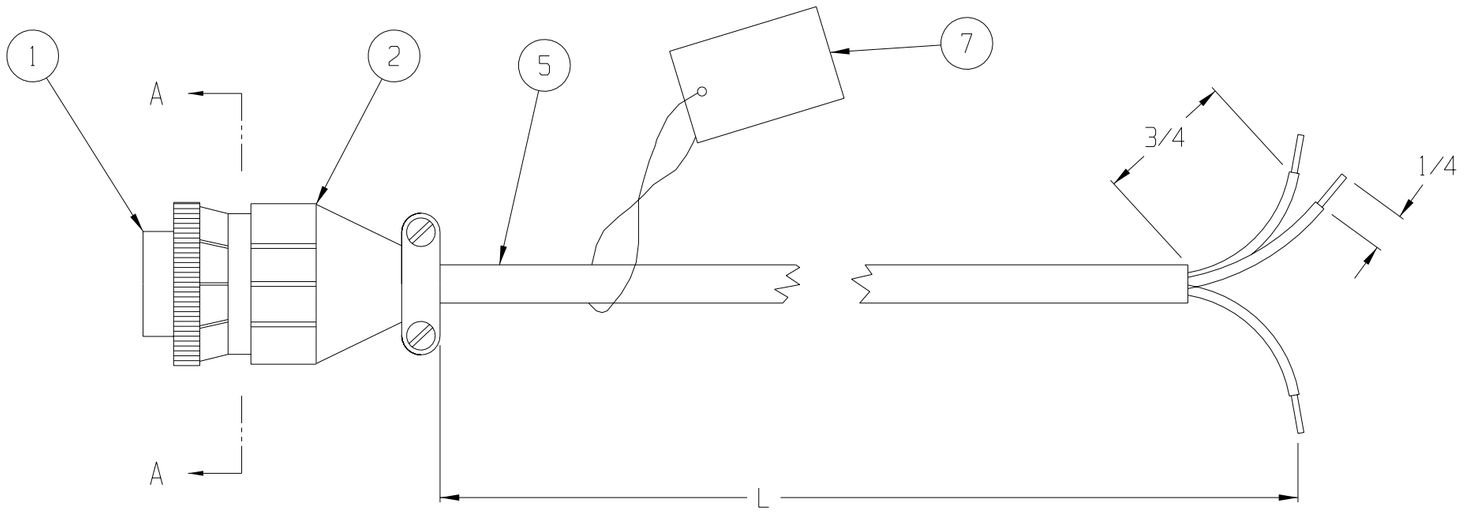
SID **S**ource to **I**mage receptor **D**istance
VSID **V**oltage representing **SID**

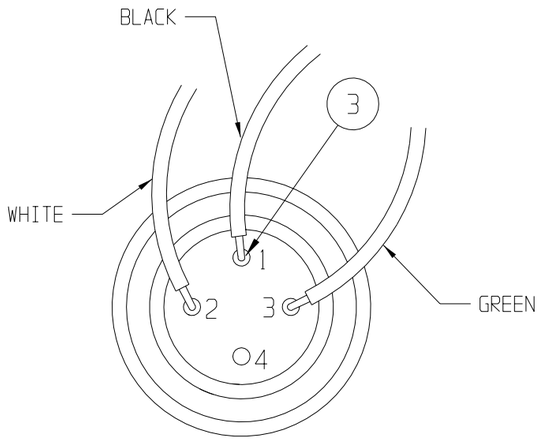
VCSID	**V**oltage representing **C**ontinuous **SID**
SID TRUE	Signal representing the Operating SID Range
XF	**X**-ray **F**ield
VXFC	**V**oltage at the Collimator Feedback Potentiometer Wiper representing The **X**-ray **F**ield in the **L**ong Dimension
VXFL	**V**oltage at the Collimator Feedback 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.

FOCAL SPOT **DISTANCE TO**

MANUFACTURER	TUBE HOUSING	TO PORT MOUNTING	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 - 3/16”	¼” (.635 cm)
Varian/Eimac	B100	2 - 17/64”	11/64” (.434 cm)
	B150	2 - 11/64”	17/64” (.637 cm)
	B160	2 - ¼”	3/16” (.477 cm)
	B180	2 - ¼”	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”	¼” (.250)
	PX - 1400	2 - 5/16”	1/8” (.125)
Machlett	DX40 Series	2 - 1/16”	3/8” (.375)
	DX50 Series	2 - 3/16”	¼” (.250)
	DX60 Series	2 - 5/16”	1/8” (.125)
	DX70 Series	2 - 5/16”	1/8” (.125)





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.	

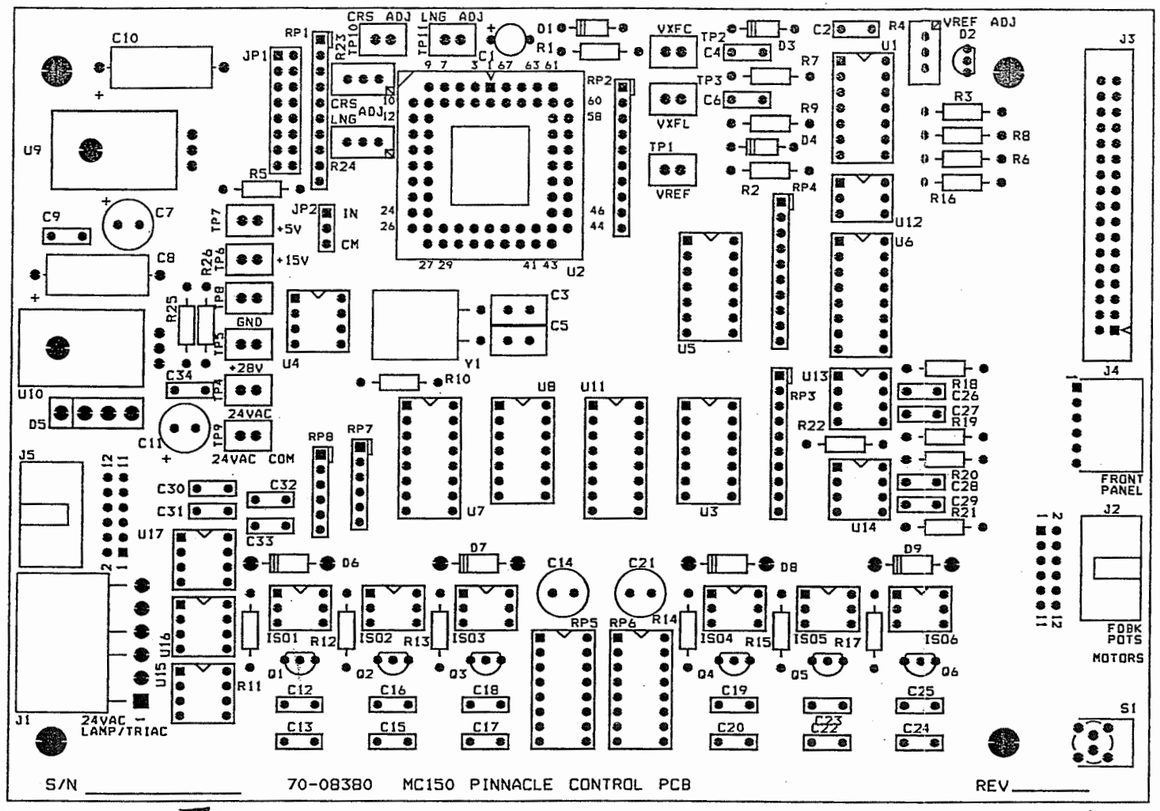
ORIGINAL PRODUCT
COLLIMATORS MC150 & MC150-C

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

REVISIONS				
ECN	REV	DESCRIPTION	DATE	APP'D
	A	RELEASED	09-13-00	A. KREMA
	B	COMBINE J1 - J5	01-04-01	A. KREMA
	C	D3, D4 TO +5V, U1-3 TO U1-7, U10 CKT	03-09-01	A. KREMA
P0661	D	BOM CHANGE	06/12/01	D. DEROSA
P0719	E	BOM CHANGE	08-22-01	D. DEROSA
P0844	F	BOM CHANGE	02-14-03	D. DEROSA
P0890	G	BOM CHANGE	08-13-03	D. DEROSA



MANUFACTURER TO ADD SERIAL NUMBER AND CURRENT REVISION.

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. SCHEMATIC 70-08381
   FABRICATION 70-06324

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	9/12/2000
CHK	AK	9/13/2000
APP	AK	9/13/2000

PROGENY INCORPORATED

MC150 PINNACLE
CONTROL PCB ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08380

SCALE | FILENAME:7006324.MAX | SHEET 1 OF 1

ORIGINAL

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

BILL OF MATERIAL

70-08380 MC150 Pinnacle Microcontroller

Rev. G ECN P0890

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
1	1	B	70-06324		Fabrication, PCB Linear II Microcontroller		
2	2	A	70-04806		Shunt		JP1,JP2
3	1	A	70-02511		Capacitor, Tantalum 10 uF 35V		C1
4	2	A	70-02010		Capacitor, Ceramic .1 uF 50V		C2, C9
5	2	A	70-02030		Cap., Ceramic CK05, .001MFD, 200WVDC		C4, C6
6	2	A	70-02031		Capacitor, Mica, 300 WVDC, 22pF		C3, C5
7	2	B	70-02524		Capacitor, Aluminum 63 WVDC, 100 uF		C7, C11
8	2	A	70-02501		Capacitor, Electrolytic, 1uF, 50v		C8,C10
10	7	A	70-02012		Capacitor, Ceramic .01 uF 100V		C12,C16,C18,C19, C23,C25,C34
11	14	A	70-02021		Capacitor, Ceramic .22 uF 50V		C3,C13,C15,C17, C20,C22,C24,C26, C27,C28,C29,C30, C31, C32, C33
12	2	A	70-02101		Capacitor, 50 WVDC, 10uF		C14, C21
13	3	A	70-03001		Diode, 1N914		D1, D3, D4
15	1	A	70-03358		LM336Z-5.0 Reference Diode		D2
16	4	A	70-03012		IN4002 Diode	IN4002	D6, D7, D8, D9
18	6	A	70-03043		Opti-Triac 6 Pin Dip	MOC3011	ISO1 – ISO6
19	3	A	70-04807		Header, 3 Pin Breakaway, Single Row		JP2, J4
20	2		10-04001		Header, 4 x 2 Pin		JP1
22	1	A	70-04748		Connector, 6 Pin, Molex		J1
23	1	A	70-04526		Connector, Header 34 Pin		J3

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

BILL OF MATERIAL

70-08380 MC150 Pinnacle Microcontroller

Rev. G ECN P0890

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
24	2	A	70-04731		Connector, Header 12 Pin, Right Angle		J2, J5
25	6	A	70-03052		Triac	MAC97A6	Q1 – Q6
27	4	A	70-00510		Resistor Array, 10 Pin Sip, 10K Ohms		RP1, RP2, RP3, RP4
28	1	A	70-00518		Resistor Array, 6 Pin Sip, 1K Ohms	1K	RP8
29	1	A	70-00511		Resistor Array, 8 Pin Sip, 10K Ohms	10K	RP7
30	3	D	70-00064		Resistor – ¼ Watt, 5%	10K	R5,R10,R22
31	1	D	70-00052		Resistor – ¼ Watt, 5%	3.3K	R3
32	1	D	70-00062		Resistor, Carbon Film, 1/4W +/- 1%	8.2 K	R1
33	5	D	70-00042		Resistor, Carbon Film 1/4W +/- 5%	1 K	R2, R18, R19, R20, R21
34	1	A	70-00654-3		Resistor, Var. 5K OHMS Slim Pk Orig.	Var 5K	R4
35	2	D	70-00071		Resistor - ¼ Watt, 5%	24K	R6, R8
36	2	D	70-00028		Resistor, 270 OHMS, ¼ W +/- 5%	270	R7, R9
37	6	A	70-00032		Resistor, 390 OHMS, ¼ W +/- 5%	390	R11 R12, R13, R14, R15, R17
38	2	A	70-00508		Resistor Array 470HM, 16 Pin Dip		RP5, RP6
39	1	D	70-00058		Resistor, Carbon Film ¼ W 5%, 5.6K		R16
40	2	A	70-00654-7		Resistor, Var. 10K Ohms		R23, R24
41	1	A	70-03359		LM324 Quad Op Amp		U1
44	1	A	70-08239		68 Pin Programmed Logic Device Pinnacle		U2
45	3	B	70-03161		I.C., Inv. Schmit Trigger, DIP 14	CD40106	U3, U5, U8

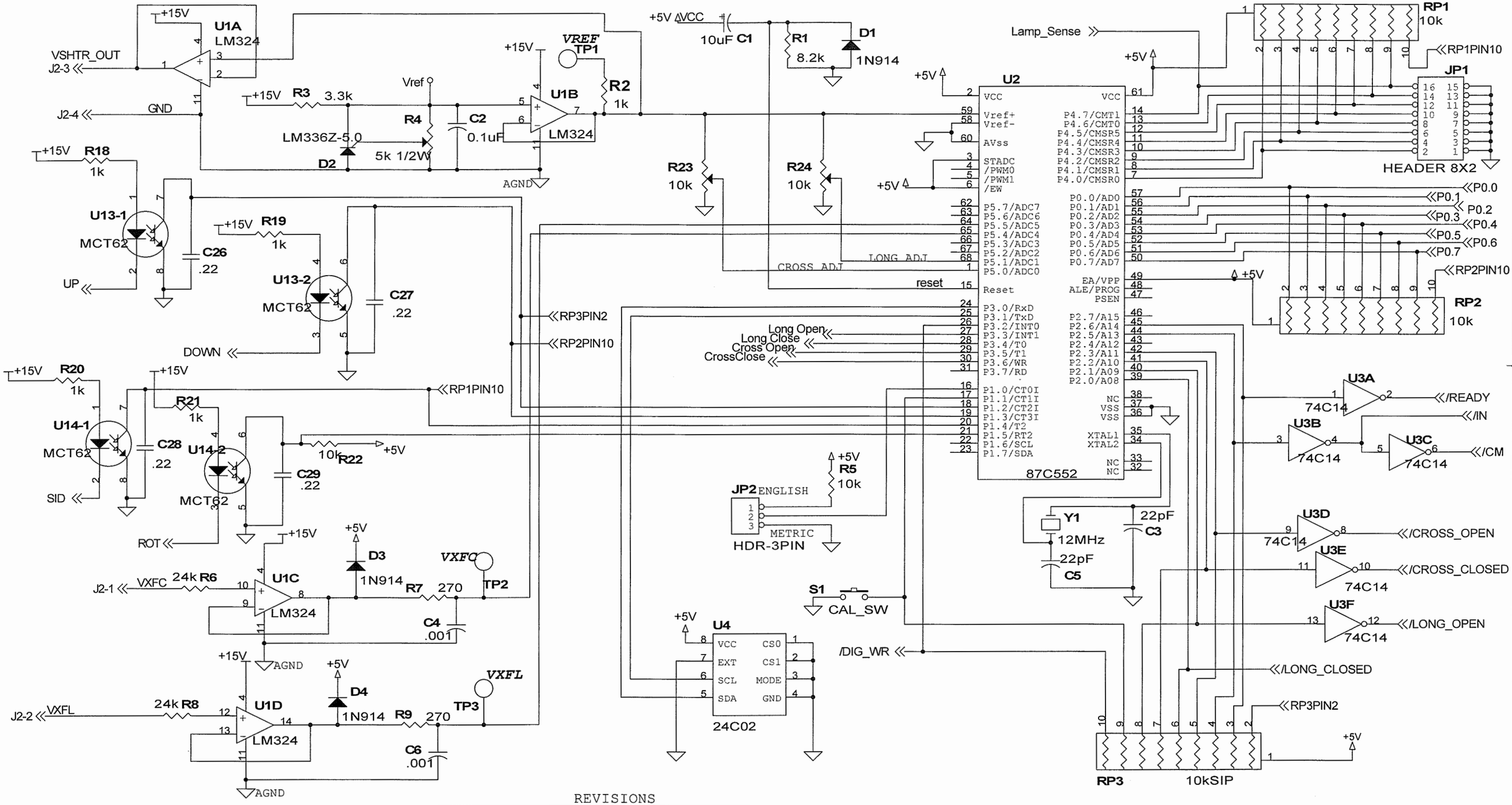
Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

70-08380 MC150 Pinnacle Microcontroller

Rev. G ECN P0890

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
46	1	A	70-03165		2 Wire Serial EEPROM	24C02	U4
48	1	A	70-03303		5 V - 3 Terminal Pos.	7805	U9
49	2	A	70-04778		Heatsink for U9, U10		
50	3	A	70-03146		I.C., 16 Pin DIP	ULN2003	U6, U7, U11
52	5	B	70-03094		Opto-Isolator	MCT62	U13, U14, U15, U16, U17
54	1	A	70-03154		Crystal, 10 MHz		Y1
55	1	A	70-04282		Socket Square for PLCC 68 Pin		
56	3	A	70-04217		Socket, 16 Pin Dip		U6,U7,U11
57	4	A	70-04216		Socket, 14 Pin Dip		U1,U5,U3,U8
58	6	A	70-04222		Socket, 8 Pin Dip		U4,13,14,15,16,17
59	7	A	70-04506		Socket, 6 Pin Dip		ISO1,2,3,4,5,6,12
60	1	A	70-04295		Switch, Pushbutton		S1
61	1	A	26-00830		Screw, 6-32 x ¼ Phillips Pan Hd.		
62	1	A	70-11166		Nut, 6-32		
64	1	A	70-03302		LM317 Voltage Regulator, Adjustable		U10
65	1	A	10-03001		Bridge Rectifier, 100V, 1 AMP		D5
66	1	B	70-00700-11		Resistor, Metal Film 1% 237 Ohms	237	R25
67	1	B	70-00700-12		Resistor, Metal Film 1% 2.61K Ohms	2.61K	R26



REVISIONS

REV	DESCRIPTION	DATE	APP'D
A	Production Release		AlK
B	Combined J1 & J5		AlK
C	Connect D3 & D4 to +5V, U1-3 to U1-7, U10 change ECN#P0662	3/1/01	AlK
D	change R23,R24 to 10K ECN #P0890	8/13/03	AlK

APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

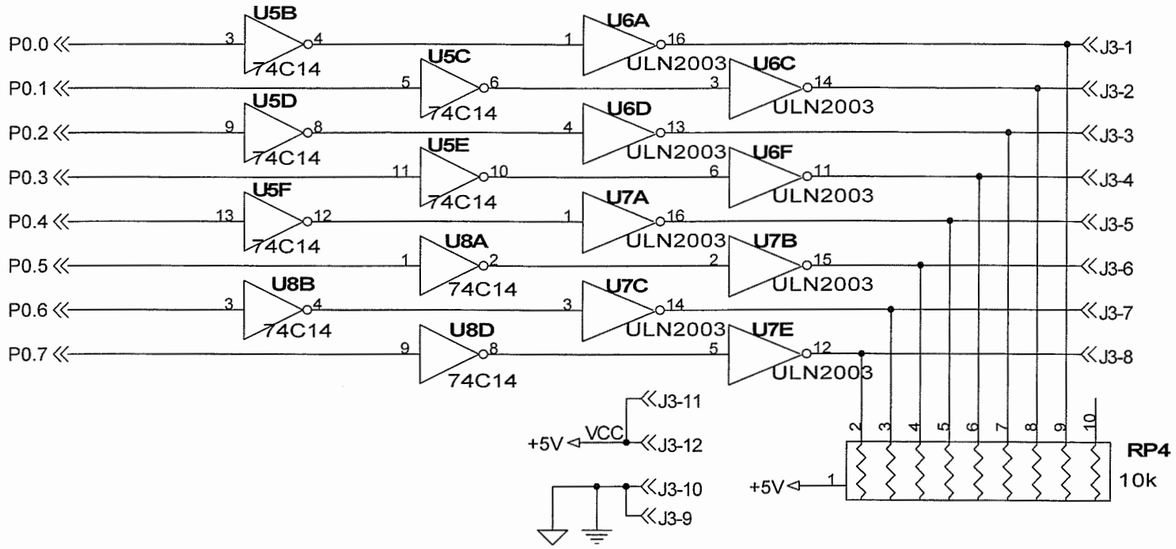
PROGENY, Inc.

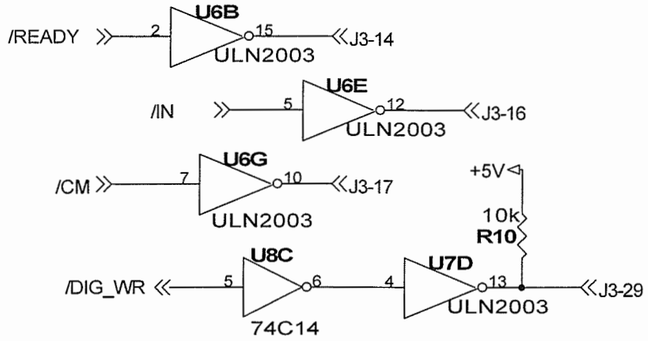
Fab 70-06324
Assembly 70-08380

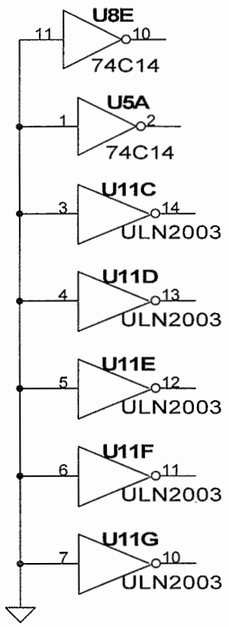
Title: MC150 Pinnacle Control PCB

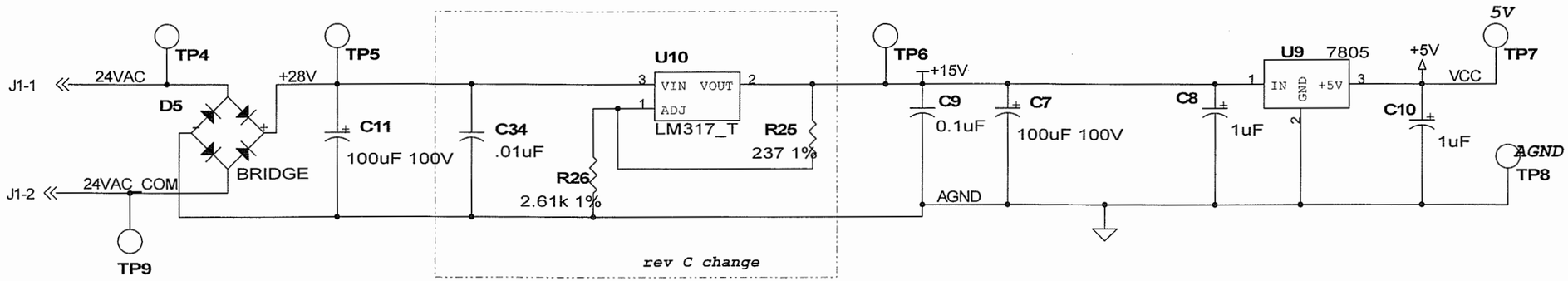
Size | Document Number: 70-08381 file: 70_08381.dsn | Rev: D

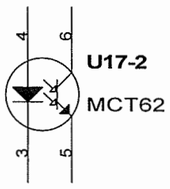
Date: March 14, 2001 Sheet 1 of 3











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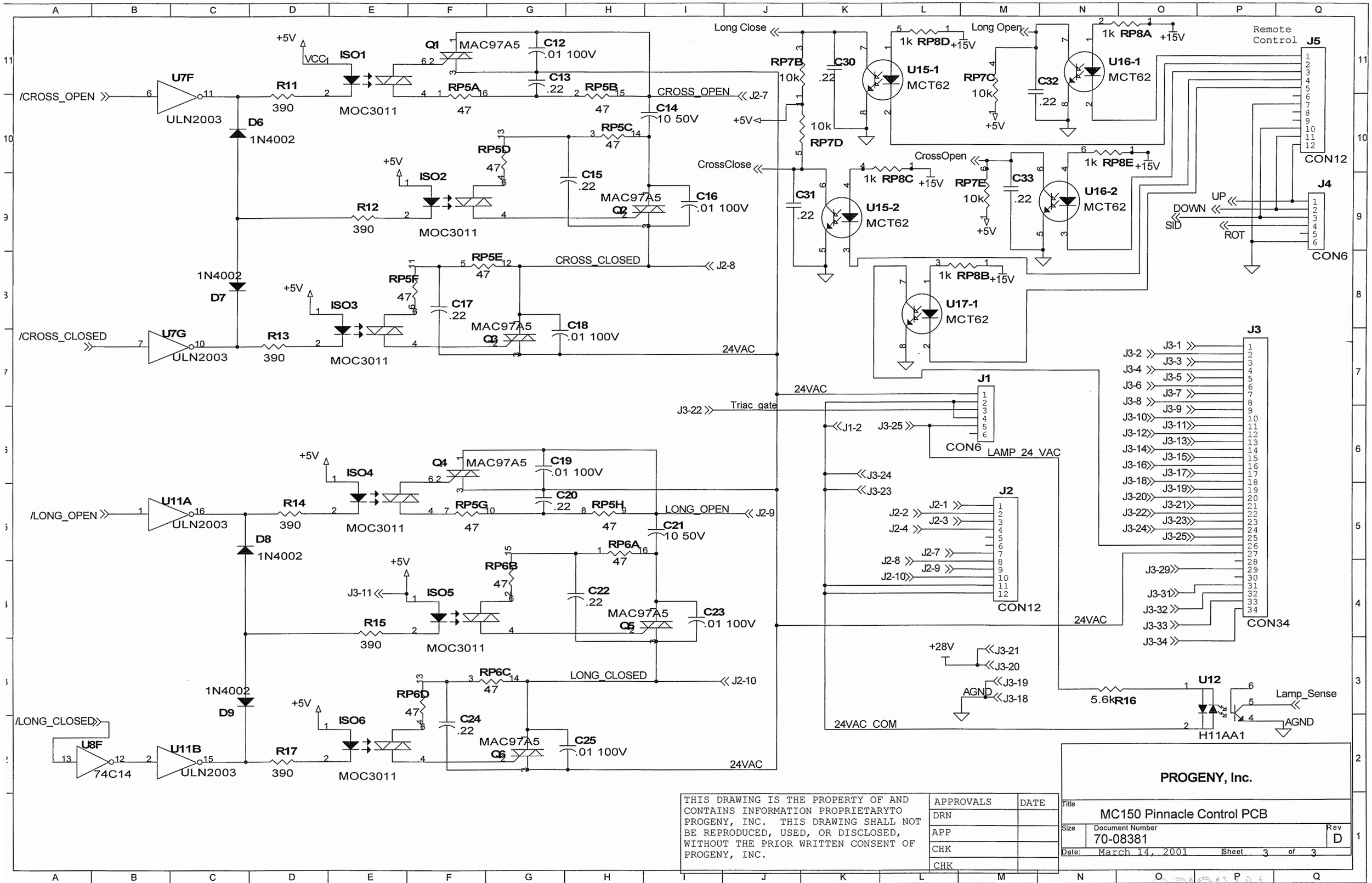
APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

PROGENY, Inc.

Title: MC150 Pinnacle Control PCB

Size | Document Number: 70-08381 | Rev: D

Date: March 14, 2001 Sheet 2 of 3



APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

PROGENY, Inc.

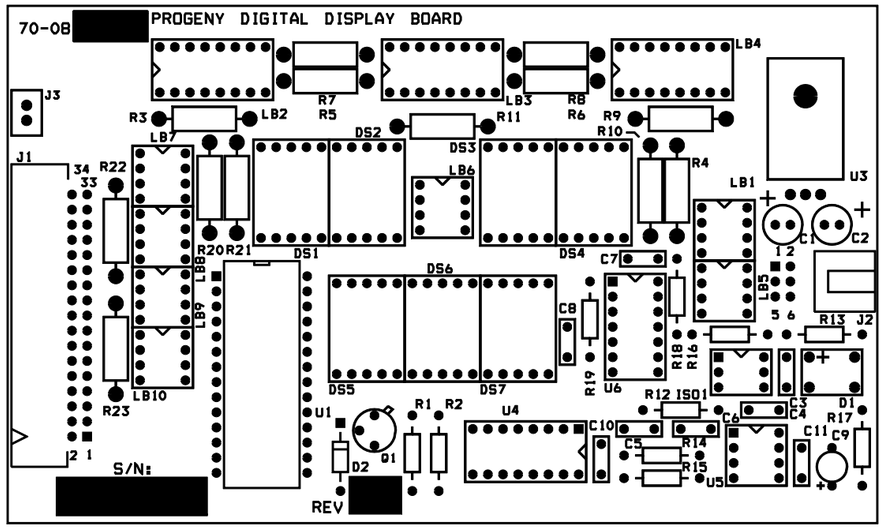
Title: MC150 Pinnacle Control PCB

Size: | Document Number: 70-08381 | Rev: D

Date: March 14, 2001 Sheet 3 of 3

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	1/9/01	A. KREMA
B	ADD LASER CIRCUIT	2/10/02	A. KREMA
C	MOVED ALL COMPONENTS DOWN 1/16"	5/31/02	A. KREMA
D	ECN PO914 Remove IC sockets	9/19/03	A. KREMA

MANUFACTURER TO ADD REMAINDER OF ASSEMBLY NUMBER 382.



MANUFACTURER TO ADD SERIAL NUMBER AND CURRENT REVISION.

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. SCHEMATIC 70-08383
   FABRICATION 70-06323

ORIGINAL PRODUCT

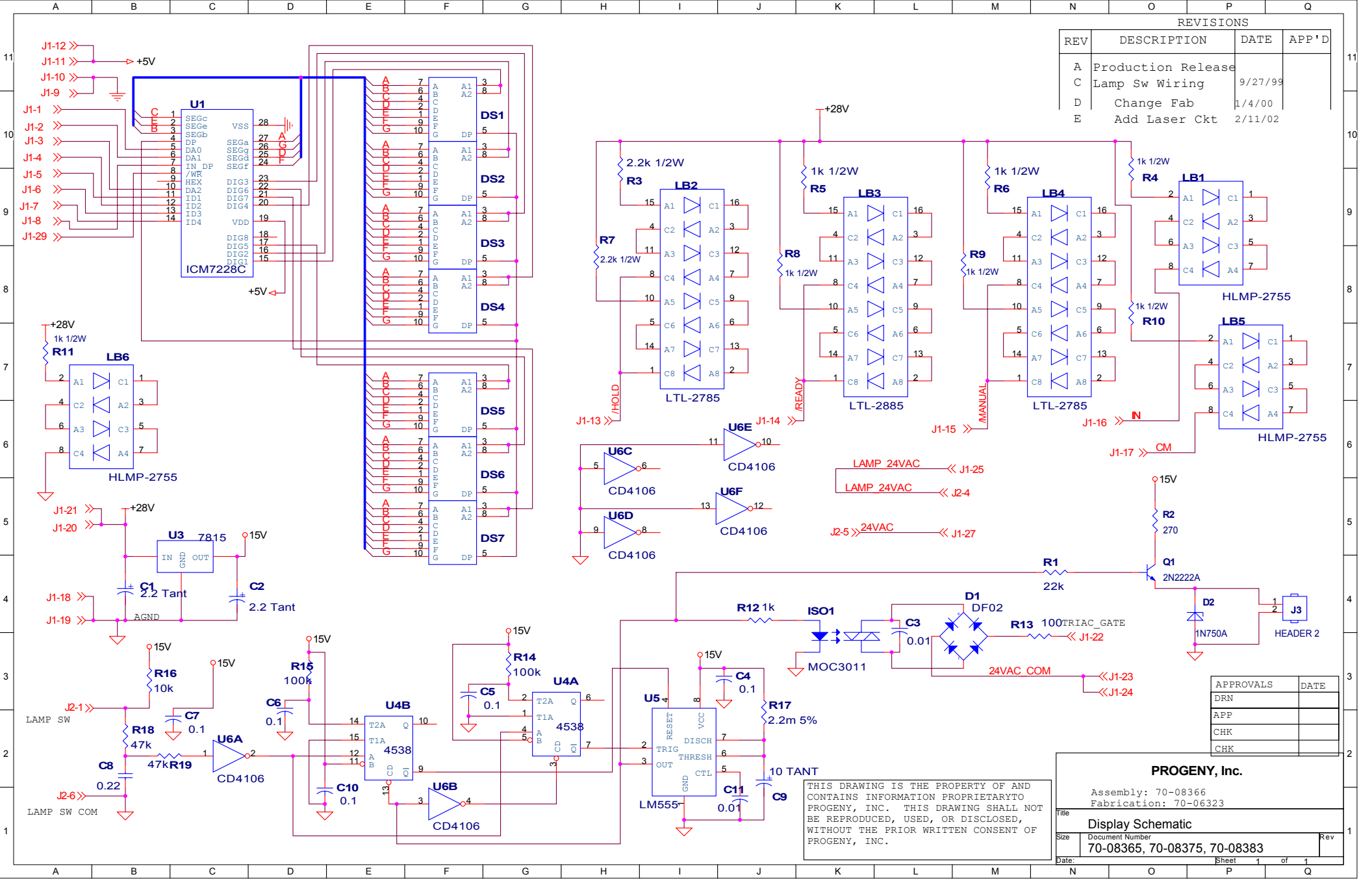
APPROVALS		DATE
DRN	KT	1/8/01
CHK	AK	1/9/01
APP	AK	1/9/01

PROGENY INCORPORATED

MC150 PINNACLE
DIGITAL DISPLAY ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08382

SCALE | FILENAME:7006323.MAX | SHEET 1 OF 1


REVISIONS
REV | DESCRIPTION | DATE | APP'D
A | Production Release
C | Lamp Sw Wiring | 9/27/99
D | Change Fab | 1/4/00
E | Add Laser Ckt | 2/11/02
U1
ICM7228C
DS1
DS2
DS3
DS4
DS5
DS6
DS7
LB1
LB2
LB3
LB4
LB5
LB6
HLMP-2755
LTL-2785
LTL-2885
R3 2.2k 1/2W
R4 1k 1/2W
R5 1k 1/2W
R6 1k 1/2W
R7 2.2k 1/2W
R8 1k 1/2W
R9 1k 1/2W
R10 1k 1/2W
R11 1k 1/2W
+28V
+5V
/HOLD
/READY
MANUAL
IN
CM
U3 7815
C1 2.2 Tant
C2 2.2 Tant
AGND
U6C CD4106
U6D CD4106
U6E CD4106
U6F CD4106
LAMP_24VAC
24VAC
R1 22k
R2 270
Q1 2N2222A
D1 DF02
D2 1N750A
J3 HEADER 2
R12 1k
ISO1 MOC3011
C3 0.01
R13 100
TRIAC_GATE
24VAC_COM
R14 100k
R15 100k
R16 10k
R17 2.2m 5%
R18 47k
R19 47k
C4 0.1
C5 0.1
C6 0.1
C7 0.1
C8 0.22
C9 10 TANT
C10 0.1
C11 0.01
U4A 4538
U4B 4538
U5 LM555
U6A CD4106
U6B CD4106
LAMP SW
LAMP SW COM
APPROVALS | DATE
DRN
APP
CHK
CHK
PROGENY, Inc.
Assembly: 70-08366
Fabrication: 70-06323
Title
Display Schematic
Size
Document Number
70-08365, 70-08375, 70-08383
Rev
Date:
Sheet 1 of 1
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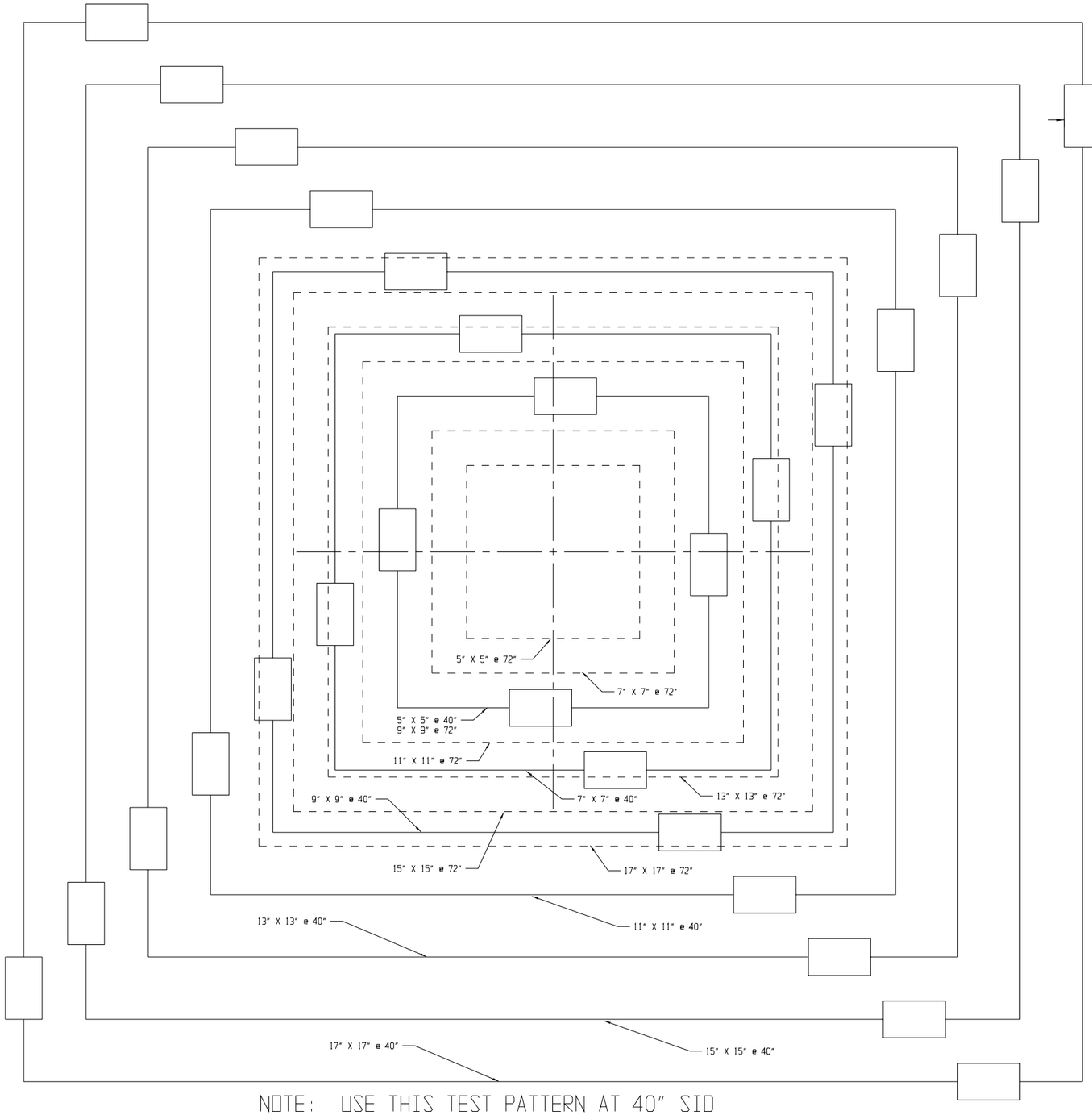
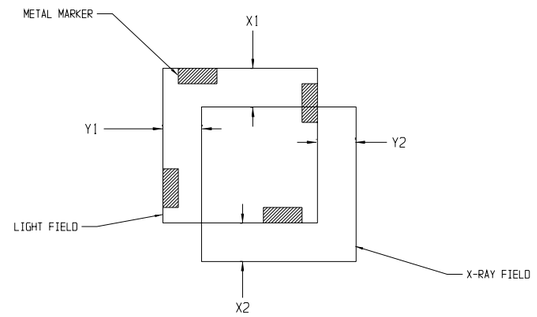


THIS DIMENSION REPRESENTS 1.5 % OF 40" SID.
THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE. AND X-RAY FIELD SIZE
VS IMAGE RECEPTOR SIZE IS LIMITED
(SEE XR8-2.18 AND XR8-2.20 REQUIREMETS)



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: 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"
7" X 7" @ 72" SID IS 3.889" X 3.889"
9" X 9" @ 72" SID IS 5.000" X 5.000"
11" X 11" @ 72" SID IS 6.111" X 6.111"
13" X 13" @ 72" SID IS 7.222" X 7.222"
15" X 15" @ 72" SID IS 8.333" X 8.333"
17" X 17" @ 72" SID IS 9.444" X 9.444"

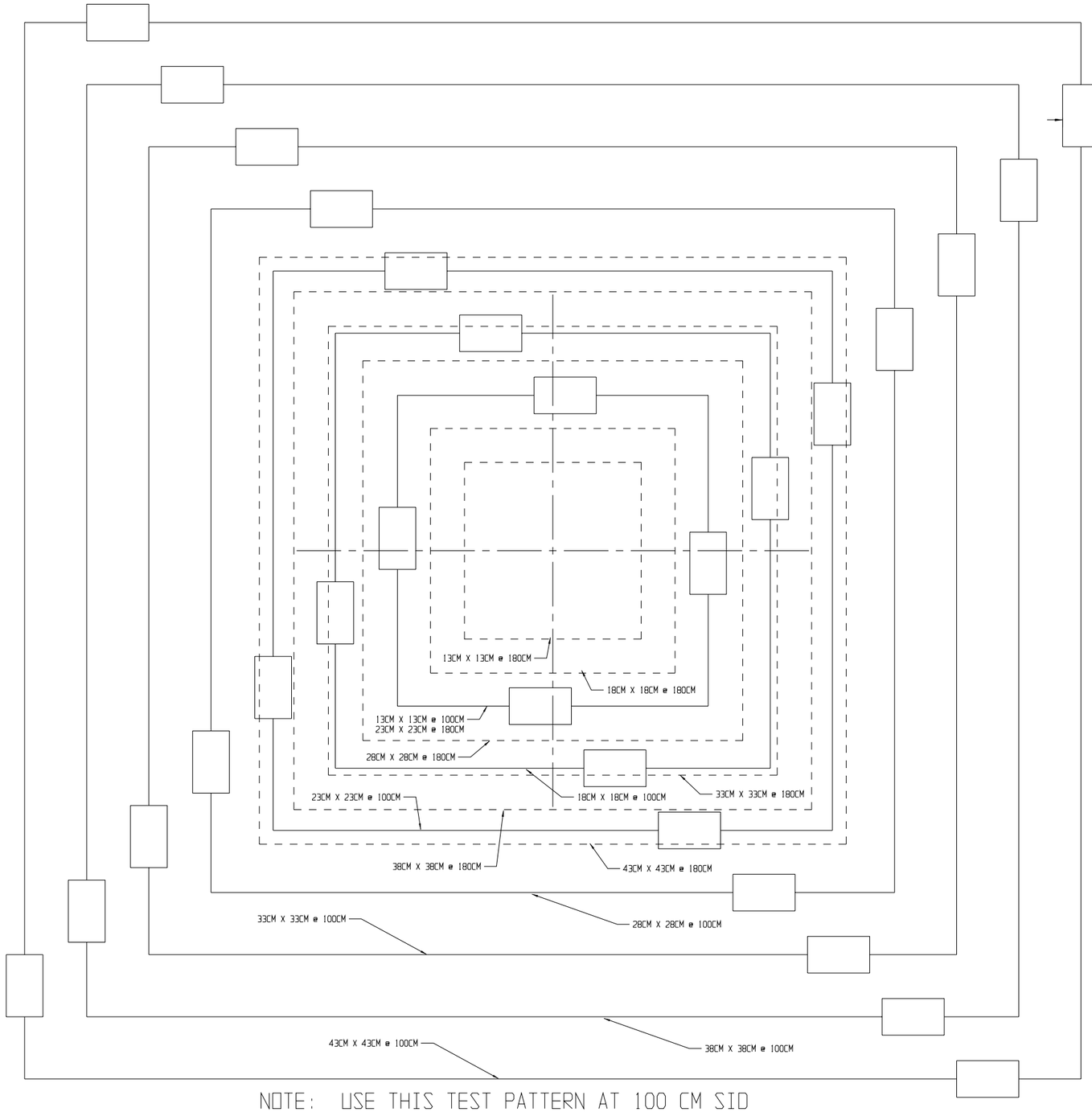
APPROVALS	DATE
DRN. T. ZVEREV	10-26-00
CHK.	
APP.	

ORIGINAL PRODUCT
LINEAR MC-150 PINNACLE

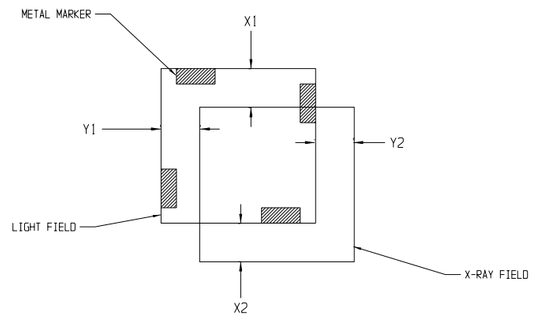
TEST PATTERN #1
FOR 40" AND 72" SID ADJUSTMENTS

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE	20-34-003	70-09023	A

REL. ECN P0606 | SCALE 1:1 | FILENAME 70-09023 | SHEET 1 OF 1



THIS DIMENSION REPRESENTS 1.5 % OF 100CM 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

NOTE: USE THIS TEST PATTERN AT 100 CM SID

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

THEREFORE: 13CM X 13CM @ 180CM SID IS 7.22CM X 7.22CM
18CM X 18CM @ 180CM SID IS 10.00CM X 10.00CM
23CM X 23CM @ 180CM SID IS 12.78CM X 12.78CM
28CM X 28CM @ 180CM SID IS 15.56CM X 15.56CM
33CM X 33CM @ 180CM SID IS 18.33CM X 18.33CM
38CM X 38CM @ 180CM SID IS 21.11CM X 21.11CM
43CM X 43CM @ 180CM SID IS 23.89CM X 23.89CM

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))

PROGENY, INC.

ORIGINAL PRODUCT: LINEAR MC-150 PINNACLE

METRIC TEST PATTERN
FOR 40" AND 72" SID ADJUSTMENTS

APPROVALS	DATE
DRN. T. ZVEREV	10-26-00
CHK.	
APP.	

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE	20-34-003	70-09024	A

REL. ECN P0605 | SCALE 1:1 | FILENAME 70-09024 | SHEET 1 OF 1