

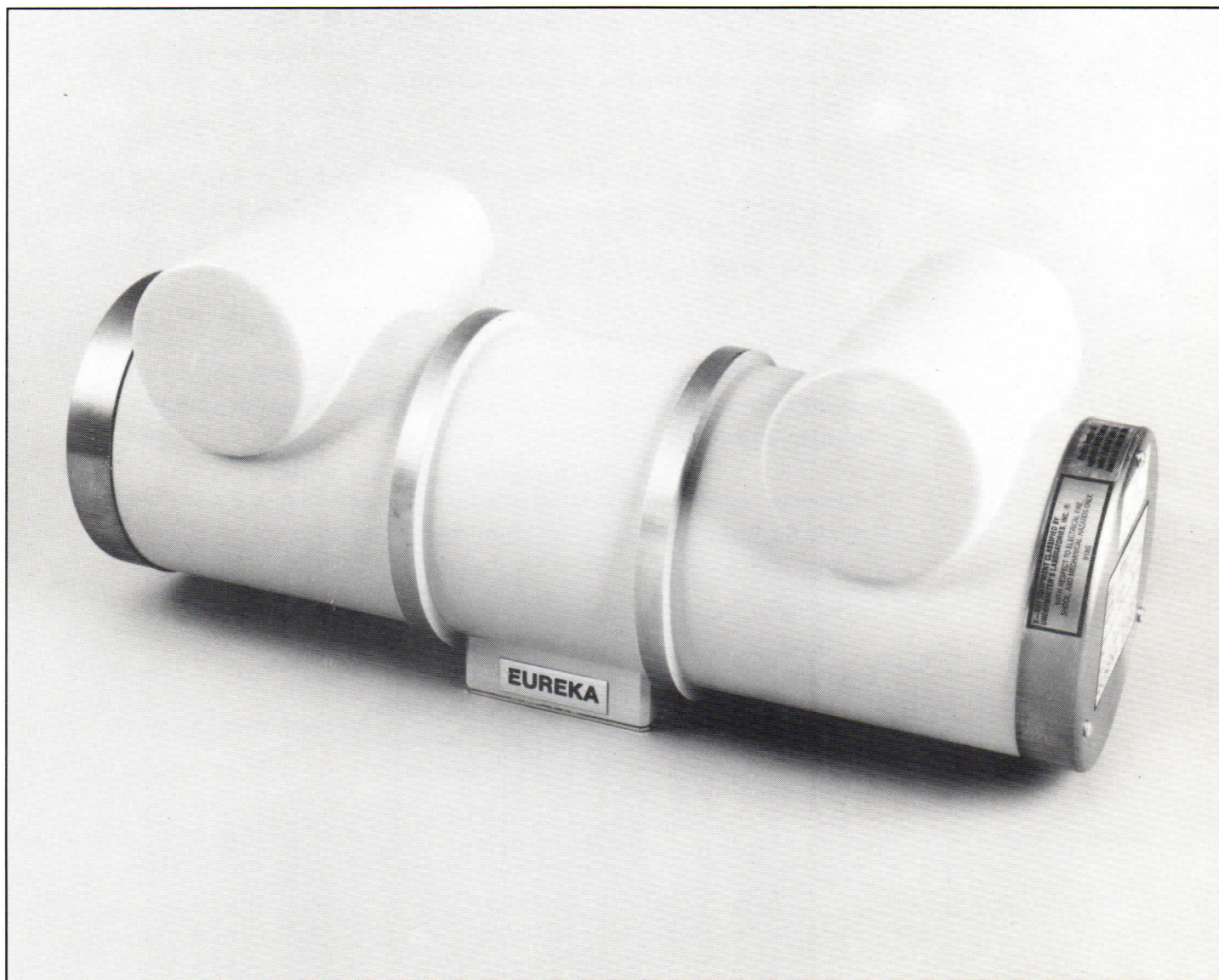
# EUREKA

Eureka X-Ray Tube, Inc.  
600 University Drive  
Arlington Heights, IL 60004  
(708) 394-5800  
(800) 545-3126  
FAX (708) 394-5903

## ROTATING ANODE X-RAY TUBE HOUSINGS

**DIAMOND** . . . for heavy duty procedures up to 150 kVp

**EMERALD** . . . for normal diagnostic technics up to 130 kVp



THE EMERALD AND DIAMOND HOUSINGS ARE DESIGNED FOR THE EUREKA — ROTATING ANODE INSERTS WITH 3 INCH DIAMETER TARGET.



## SPECIFICATIONS

**Shockproof Housing:** Aluminum; Lead-lined; filled under vacuum with high dielectric insulating oil and hermetically sealed. An expansion chamber provides adequate compensation for full temperature range of operation. Contains stator for driving rotor.

**Finish:** Textured Gray with brushed stainless steel trim.

**Cable Receptacles:** Federal Standard Receptacles, conform to NEMA Standard No. 72 and USASI, 86.1 specifications. Cable terminals may be positioned at 90°, 180°, 270°, or 0° from the port.

**Thermostat:** Mounted on anode end of housing and connects to actuate external circuits to protect housing from excessive heat and pressure. Normally closed contact opens when housing temperature is exceeded. (Does not protect insert against overheating.) See Stator and Motor Control Section for connections.

**Stator:** Eureka EMERALD and DIAMOND Rotating Anode X-Ray Tube Units employ a conventional stator requiring a 24-30 mfd phase shifting capacitor for 60 Hertz, 3450 rpm operation. The same stator requires a 6 mfd phase shifting capacitor when used on 180 Hertz for 10,000 rpm anode rotation. A brake circuit is necessary with high-speed rotation.

Both starting and braking requirements are discussed fully in "Instruction for Installing a Eureka Rotating Anode X-Ray Tube" (document #00-02-102) which is supplied with each tube unit shipment. A copy can be obtained on request from the marketing department.

**Stator Cord:** A five-wire shield-grounded stator cord is connected from the stator terminal board to the motor control. Connections are as follows:

<u>Stator Cord Color Code</u>	<u>Function</u>
White	Stator Common
Black	Stator Main
Red	Stator Phase Shift
Orange/Brown	Thermostat
Brown/Orange	Thermostat
Green/Yellow	Ground

**Stator Motor Ratings:**

	<u>Frequency</u>	<u>Volts</u>	<u>White Lead Amperes (Typical)</u>
Emerald & Diamond —	60 Hz	50-60*	1.5 – 2.0
		120	3.5 – 4.2
		220	6.5 – 8.2
Diamond —	180 Hz	100*	1.5 – 2.0
		220	3.8 – 4.0
		290	5.0 – 6.0
		320	6.0 – 7.0

\*Running Voltage

**Operating Temperature:** Minimum ambient temperature for storage and transportation  $-18^{\circ}\text{C}$ . ( $0^{\circ}\text{F}$ ). Normal operating range of housing is  $16^{\circ}\text{C}$ . ( $60^{\circ}\text{F}$ ) to  $75^{\circ}\text{C}$  ( $167^{\circ}\text{F}$ ).

**Inherent Filtration:** 0.6 mm of aluminum minimum.

**Rayproofing:** Stray radiation complies with DHHS standards under Radiation Control for Health and Safety Act 1968.

**X-Ray Coverage:**  $12^{\circ}$  target –  $17'' \times 17''$  at 40" distance.  
 $16^{\circ}$  target –  $17'' \times 17''$  at 30" distance.

**Weight:** 36 lbs. without cables or accessories.

Maximum Voltage:	Diamond 150	Emerald 130	Emerald 125
Anode to Cathode	150 kVp	130 kVp	125 kVp
Anode to Ground	82.5 kVp	71.0 kVp	68.7 kVp
Cathode to Ground	82.5 kVp	71.0 kVp	68.7 kVp

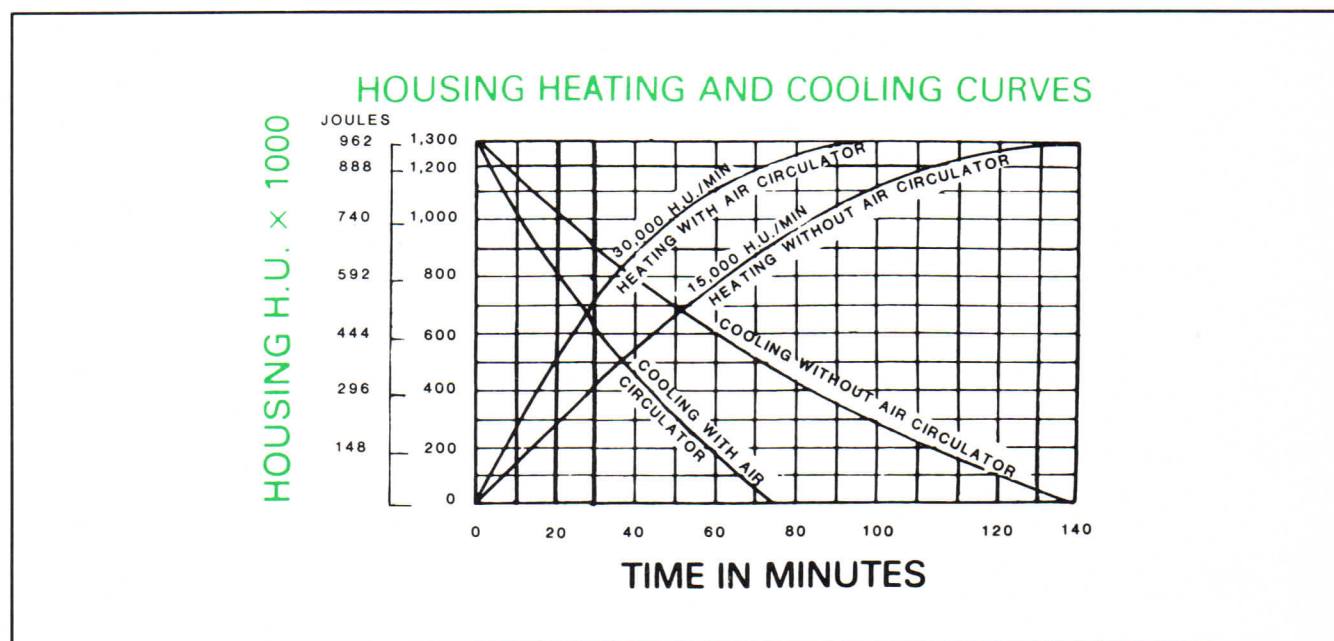
## THERMAL CHARACTERISTICS

Housing Heat Storage Capacity ..... 1,300,000 H.U.\*

Housing Cooling Rate, Max.:

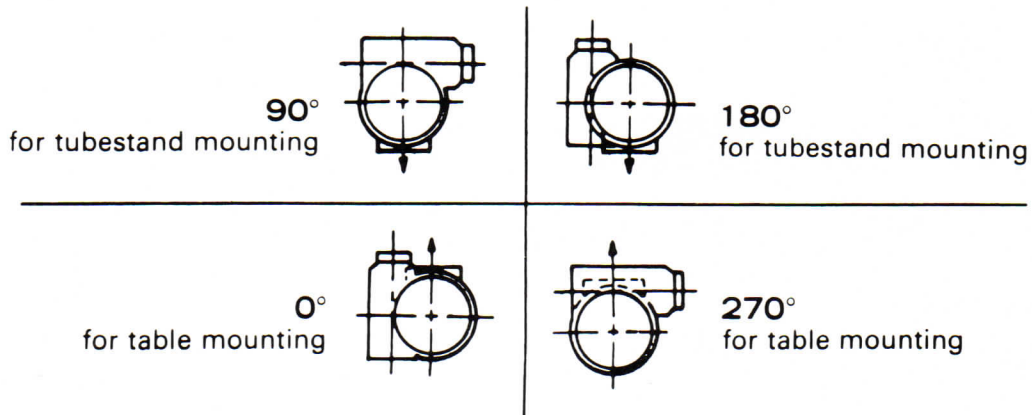
Without Air Circulator ..... 15,000 H.U.\*/Min.  
 With Air Circulator ..... 30,000 H.U.\*/Min.

\*H.U. = kVp  $\times$  mA  $\times$  time in seconds.

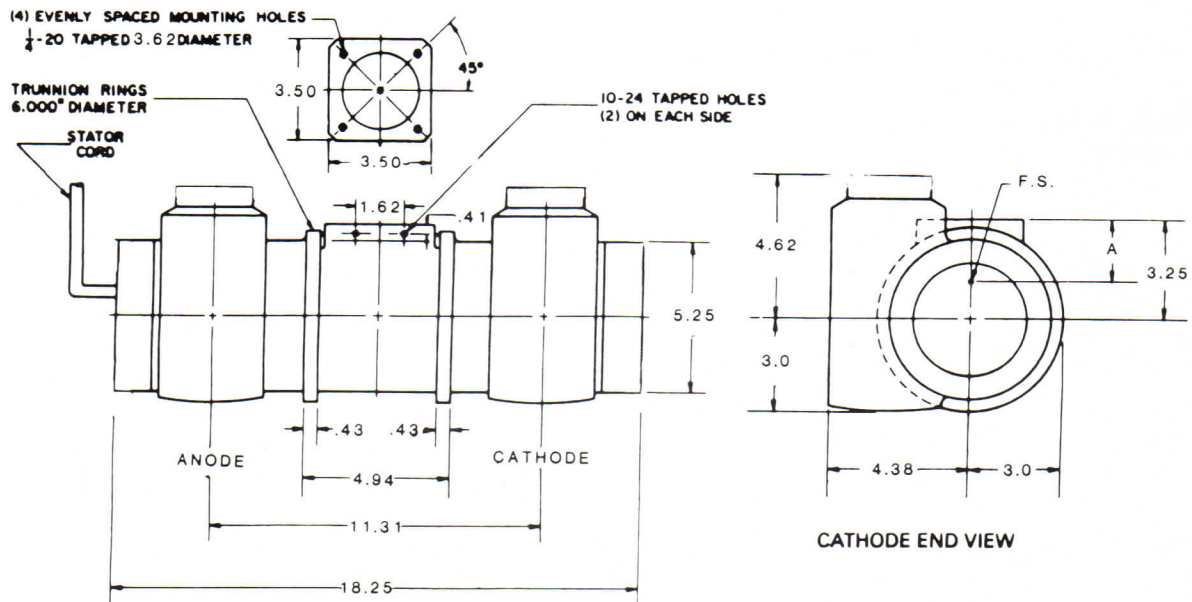


Emerald and Diamond units are U.L. Classified and C.S.A. Certified if labeled.

## SELECT FROM FOUR HOUSING MODELS:



## DIMENSIONAL DATA



**A** FOCAL SPOT TO PORT DISTANCE  
 Emerald 125T, Diamond 150TH - 2.12  
 Emerald 125, Emerald 130 - 2.19



## RAD-8 ROTATING ANODE X-RAY TUBE PRODUCT DATA

### Introduction

The RAD-8 Rotating Anode X-ray Tube is rated to 125 kVp. It features a 16° tungsten molybdenum target having a heat storage capacity of 150,000 H.U., and a heat dissipation rate of 40,000 H.U. Min.

Superimposed focal spots of 1.0 mm and 2.0 mm are standard. The RAD-8 insert is intended for use in (but not limited to) the Eureka Diamond®/Emerald® series housings.

The RAD-8 insert is ideally suited for general radiographic light volume use.

### Physical Characteristics:

Frame:	Borosilicate glass with controlled window thickness
Inherent Filtration:	0.5 mm aluminum equivalent, minimum, at 100 kVp.
Weight:	Insert only: 3.15 lbs (1.43 kg) approx.
Dimensions:	Refer to outline drawing
Focal Spot Combinations:	1.0 mm – 2.0 mm
Effective Target Angle:	16°
Target Diameter:	2.87 inches (73 mm)
Nominal Focal Track Diameter:	2.13 inches (54 mm)
Target Material:	Tungsten track on a molybdenum alloy substrate

X-ray Field Coverage:	41 in <sup>2</sup> (104 cm <sup>2</sup> ) FLD at 72 in. (180 cm) SRD 23 in <sup>2</sup> (58 cm <sup>2</sup> ) FLD at 40 in. (100 cm) SRD
-----------------------	---

### Thermal Characteristics:

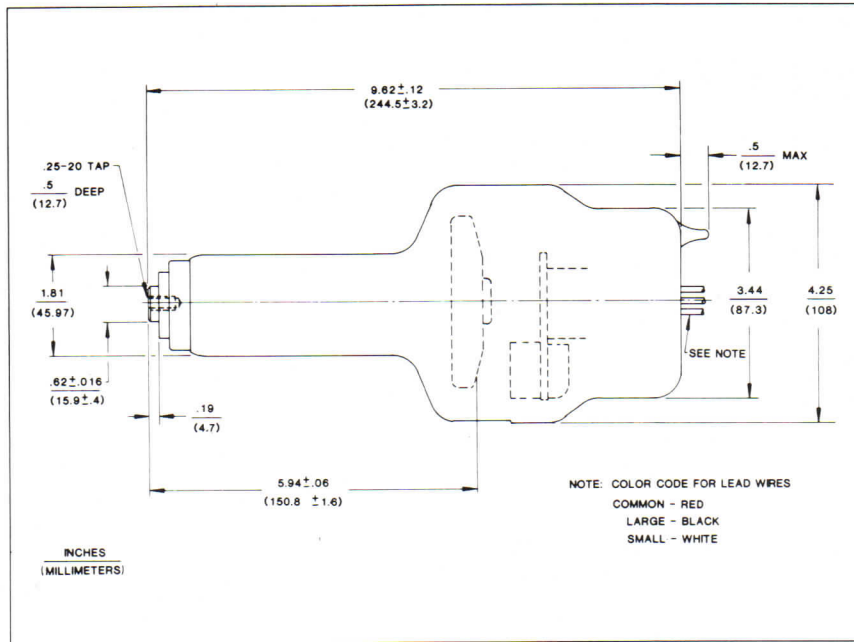
Anode Heat Storage Capacity:	150,000 H.U. (111,000 J.)
Anode Heat Dissipation Rate:	40,000 H.U./Min Max. (500 Ws)

### Electrical Characteristics:

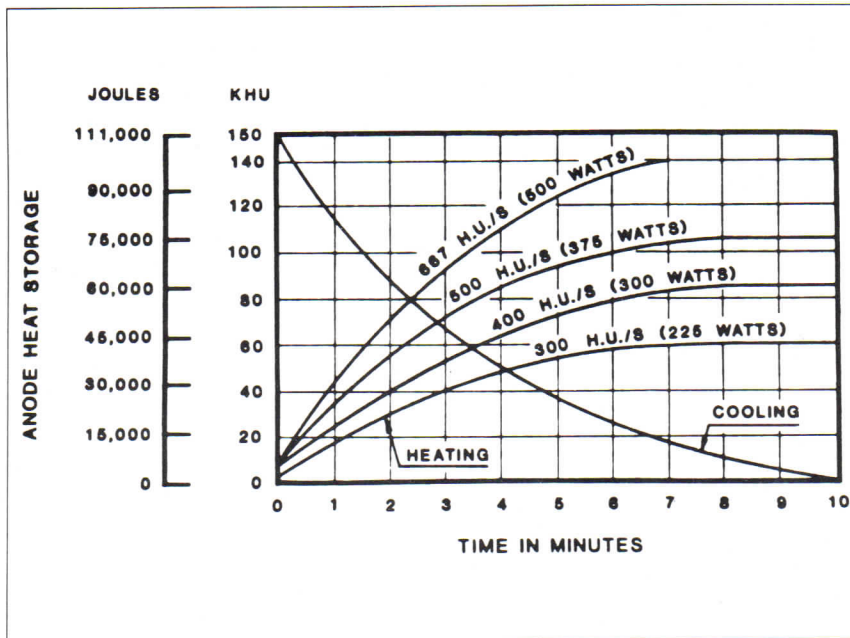
Maximum Peak Voltages:	Anode to cathode 125 kVp Anode to ground 68 kVp Cathode to ground 68 kVp		
Filament Characteristics:	<u>Focal Spot</u>	<u>Voltage (V)</u>	<u>Current (A)</u>
	1.0 mm	3.0 – 7.0	3.0 – 5.30
	2.0 mm	4.0 – 9.0	3.0 – 5.30
Maximum Continuous Filament Current:	3.3 Amperes or to a value which will produce a tube current of 3 mA or less at 80 kVp.		
Maximum Energy:	Refer to rating charts		
Kilowatt Ratings:	Single Exposure Rating at 0.1 seconds		

Focal Spot	Single Phase 60 Hz.	Three Phase 60 Hz.
1.0 mm	20 kW	22 kW
2.0 mm	42 kW	47 kW

## Insert Outline Drawing



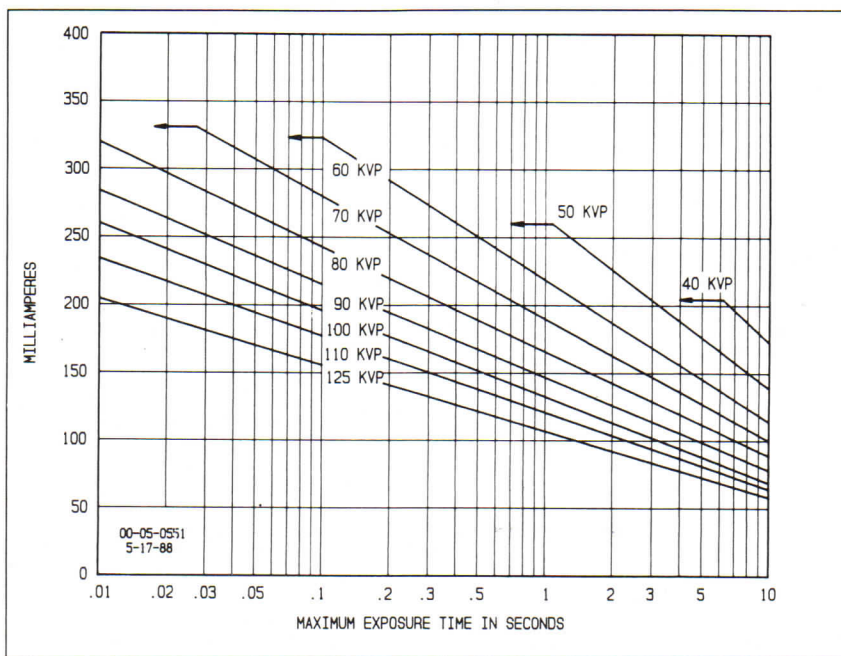
## Anode Heating & Cooling Chart



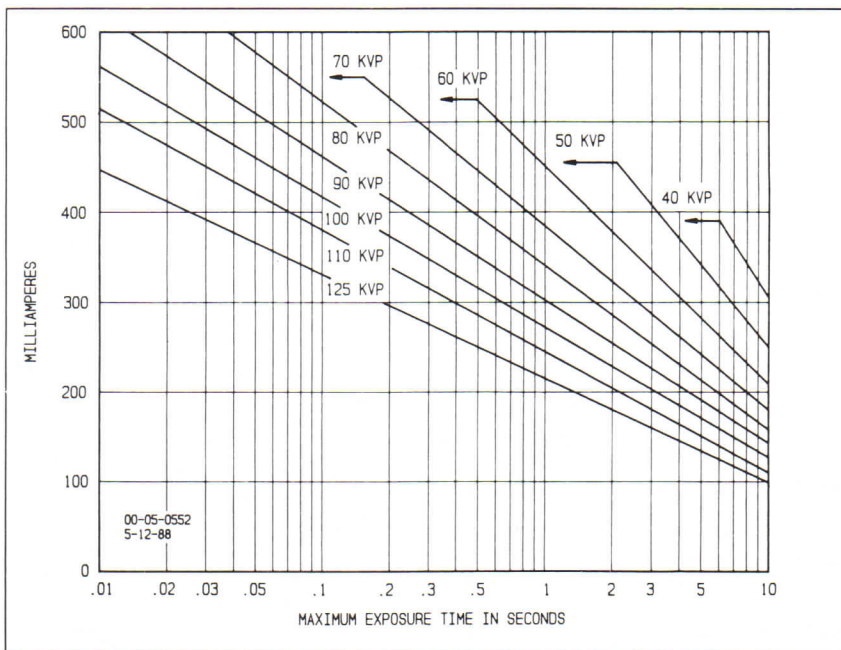


Single Phase — Full Wave  
Target: 2.8" Dia., 16°, 150,000 H.U.  
Stator Frequency: 60 Hz. — 3,450 RPM

1.0 mm Focal Spot

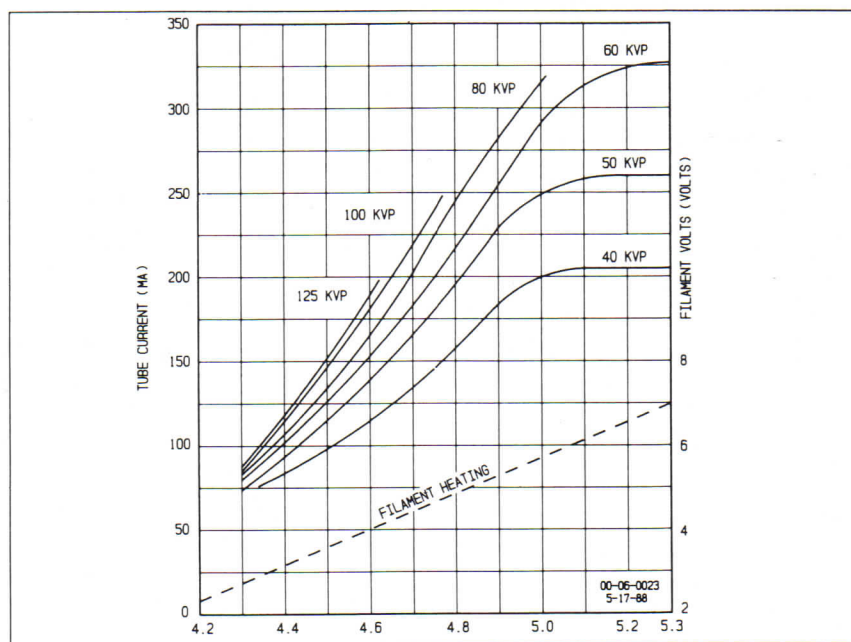


2.0 mm Focal Spot



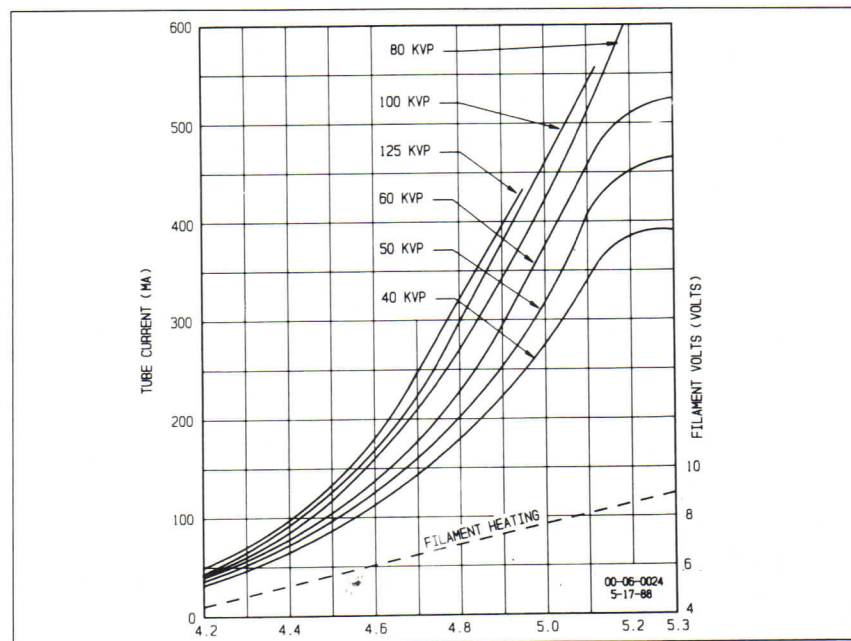
Single Phase — Full Wave

1.0 mm Focal Spot



Filament Current  $\pm 0.15$  amps

2.0 mm Focal Spot



Filament Current  $\pm 0.15$  amps



# EUREKA X-RAY TUBE CO.

## INFORMATION PACKET FOR THE USER

This packet contains technical data and useful information for the user concerning the following tube housing assembly:

Model <i>EMERALD</i>		Serial No. <i>H541</i>
Cat. No. <i>S2-08101</i>	Focal Spots <i>1.0x2.0</i>	Cable Arms <i>F20 180°</i>
Target Angle <i>16°</i>	Remarks:	

Included are the following:

- 00-02-101 Safety Procedures concerning radiation, also Maintenance Procedures for Rotating Anode and Stationary Anode Tube Housing Assemblies. Also includes Exhibit 4.0 giving pertinent data concerning application, maximum rated kVp, leakage radiation technic factors, insert type and manufacturer, minimum aluminum equivalent in the beam and kVp at which it was obtained and additional filtration required for beam quality requirements.
- 00-02-102 General Information for Installing and Operating Eureka X-ray Tube Co. Housing Assemblies in Diagnostic X-Ray Systems.
- 00-02-104 Component Specifications. These include the printed brochure for the above model giving the description of the tube housing assembly, outline drawings, electrical and heat rating data, anode and housing cooling curves and focal spot rating charts.
- 00-02-105 Eureka X-ray Tube Co. Warranty and Tube Housing Assembly Warranty Registration Card, attached to the tube unit in the envelope 00-02-109; also included is the Eureka tube return service report.

Revised April 21, 1979

00-02-100

### IMPORTANT SAFETY NOTICE

Eureka X-Ray Tubes are designed with intricate thermal transfer characteristics in order to provide the capability to handle today's demanding loads. However, with the large amount of energy used in examinations it is possible for the tube to rupture if proper precautionary measures are not followed. Here are a few factors which must be considered to insure safe operation of an X-ray tube unit:

1. All Anode ratings must be considered prior to establishing an exposure or series of exposures. This includes attention to a number of exposures in a series as well as proper cooling interval between exposures. The use of an Eureka Anode Alert infra-red optical pyrometer will assist in monitoring anode temperature, and establishing safe procedures.
2. All thermal input to the housing must be considered when calculating housing loading. This includes the power for breaking and that for starting, stopping and maintaining the anode rotation, as well as the power from the exposures. The thermal switch should be connected according to the instructions provided to reduce the chance of housing overheating. A copy of Eureka's recommendations may be found as a tag attached to the unit.
3. Proper warm up of the anode must be done on a cold unit prior to making exposures. The specific details may be found in "General Information for Installing and Operating Eureka Tubes (00-02-102)" that is shipped with each unit. The warm-up procedure tags are attached to each unit.
4. All equipment that powers the X-ray tube must be calibrated according to the manufacturer's instructions to insure proper tube operational parameters.



5. All connections on the high voltage circuit, both primary and secondary, must be inspected to protect against voltage spikes.
6. All safety procedures and proper maintenance schedules must be followed as outlined in the manufacturer's specifications.
7. An x-ray tube unit that is known to be electrically unstable, MUST NOT BE OPERATED.

Failure to follow proper precautions may result in a catastrophic failure. An overheated housing may develop oil leaks, ruptured diaphragm, melted windows or cause a decomposition of the insulating oil, causing an explosive gas to form. Overheated anodes may cause deposits on the glass envelope of the insert which may lead to a puncture of the glass. Insulating oil striking a superheated anode may also cause an explosive gas to form. Any source of ignition in an explosive atmosphere may cause the housing to explode thus allowing hot oil fragments to be sprayed all over the room. It is incumbent upon the installer, user and service personnel to constantly guard against such a failure. Adherence to techniques within the ratings, proper maintenance, and periodic inspection is mandatory.

EUREKA X-RAY TUBE COMPANY

February 1978

EUREKA X-RAY TUBE CO.

INFORMATION PACKET FOR THE ASSEMBLER

00-02-103

The following information is contained in this packet for the assembler of diagnostic X-ray apparatus relative to the diagnostic source assembly.

Pages	Item
(2) and (2A)	Instructions pertaining to specific mountings for Beam Limiting Devices on Tube Housing Assemblies.
(3) through (9B)	Information and Instructions for the Assembler concerning the Installation of Tube Housing Assemblies.
(10)	Eureka X-Ray Tube Housing port dimensions for collimator mounting.
(11) through (13A)	List of Compatible Eureka Tube Housing Assemblies with Beam Limiting Devices and lists of Mountings and Compatibility Combinations of Eureka Tube Housings by model or part numbers of various manufacturers' equipment.
(14) (14) through (16A)	Exhibit 4.0 Leakage Technic Factors and Inherent Filtration of Tube Housing Assemblies.
Form FD-2579	Report of Assembly of a Diagnostic X-ray System and return envelope.

Revised April 21, 1979

00-02-103 (1)

Radiation Control Group No. 1  
Any changes to be made on this drawing must be approved by the above group.



INSTRUCTIONS FOR MOUNTING MACHLETT AND  
OTHER COLLIMATORS ON EUREKA ROTATING  
ANODE X-RAY TUBE HOUSING ASSEMBLIES

When installing a collimator on a tube housing assembly certain preliminary steps must be considered to permit proper attachment to the X-ray tube port.

The first of these is to determine the thickness of the spacers to be used between the collimator mounting surface and the x-ray tube housing port mounting surface. Collimator instructions give the dimension required between the focal spot and a specified surface on the collimator. By referring this dimension to the sketch and chart on page 10 of 00-002-103, "Eureka X-ray Tube Housing Port Dimensions for Collimator Mounting", the required spacer can be calculated. Spacers are usually supplied with the collimator, and they should consist of a steel plate or plates, large enough to cover the entire area of the tube housing mounting surface and/or the collimator mounting surface whichever is larger. If the spacers used are not of steel, but made of some other lighter metal such as aluminum, the addition of a minimum of 1 mm. lead lining on the inside diameter of the hole is required, and a 2 mm. thick piece of lead against the complete face of the tube housing mounting surface and/or the collimator mounting surface, whichever is larger.

In almost all cases the lead cone will not need to be removed from the x-ray tube port. Collimators with entrance shutters should be checked for interference with the sides of the cone and the x-ray window surface. If it is necessary to remove the cone it can be pried up at the outer edge with a sharp knife and pulled out. The lead cone is cemented in place. Do not remove any screws in the face of the tube housing port surface. Always leave the lead cone in place if possible, as it offers additional shielding from and collimation of, the main x-ray beam.

After considering the above items carefully, install and adjust the collimator in accordance with the instructions supplied with the collimator being used.

# INFORMATION AND INSTRUCTIONS FOR ASSEMBLER CONCERNING THE INSTALLATION OF TUBE HOUSING ASSEMBLY

## A. General:

Each tube housing assembly is shipped with information for the user and one for the assembler equipment. This is in accordance with the Regulation for the Administration and Radiation Control for Health and Safety. A list of items included for the user is given on the title page in the user packet. The information packet will be helpful to the assembler in making connections and time delay adjustments to the motor as well as other items -- for example cable installations. At the completion of the law requires that this information be

of information for the X-ray assembly of the unit of the assembly. A list of the items included for the user is given on the title page in the user packet. The information packet will be helpful to the assembler in making connections and time delay adjustments to the motor as well as other items -- for example cable installations. At the completion of the law requires that this information be

## B. Requirements for Compatibility Concerning

The leakage radiation from the diagnostic source measured at a distance of 1 meter in any direction shall not exceed 100 milliroentgen per hour when the X-ray tube is operated at its leakage

ing.

assembly from the source when the X-ray tube is operated at its leakage

The table in 6-2074-B, Exhibit 4.0, states the technic factors for various Eureka diagnostic assemblies to be used in measuring at 1 meter from the focal spot. This factor is based on operation with an air circulator on the hot end of the HE models. The models with the prefilled circulator with heat exchanger. The increased capability of these models requires the use of greater mA factors listed.

leakage radiation from the diagnostic source measured at a distance of 1 meter in any direction shall not exceed 100 milliroentgen per hour when the X-ray tube is operated at its leakage

If the additional components making up the assembly are measured at the same leakage rate as the tube housing assembly, the total must not exceed 100 mR/hr. as noted above. If the leakage rate for a component is given at the same kVp, but not at the same mA, the leakage specified for the component must be decreased in direct proportion to the mA. If the technic factor for a component is specified at a higher kVp than for the tube housing assembly, the leakage specified may be added to that of the tube housing assembly. Leakage values may NOT be corrected directly to the difference in the kVp.

leakage radiation from the diagnostic source measured at a distance of 1 meter in any direction shall not exceed 100 milliroentgen per hour when the X-ray tube is operated at its leakage



Supporting members used or interposed between the X-ray tube unit and the beam limiting device such as tube mounting plate brackets, cone holders, and filter mounts, should have special consideration for possible X-ray leakage. If the X-ray leakage of such an item is not included in the specifications for the leakage of the beam limiting device, it should be added to the total for the entire diagnostic source assembly. As an example, aluminum support plates or other configurations attached to the tube housing port boss, require a lead lining on the inside of the openings to prevent side radiation from the sandwich. All mating parts must be flat and have smooth surfaces between the X-ray tube port and a collimating device.

If it is necessary to assemble certified components by adding their specified leakage values as above, a survey for total leakage after assembly should be made at the installation to be sure the interfacing has been properly made.

#### Standby Radiation from Capacitor Energy Storage Equipment.

Radiation emitted from the X-ray tube when the exposure switch or timer is not activated shall not exceed a rate of 2 mR/hr. at 5 cm from any accessible surface of the diagnostic source assembly, with the beam-limiting device fully open. This requirement permits the dark current shutters to be closed, but the collimating-beam limiting device must be fully open. The dark current shutters are automatically opened upon initiation of the X-ray exposure switch during the first stage of application. A properly rayproofed tube housing should not have leakage radiation exceeding the above in any direction.

The above requirement applies to equipment in which the grid is used only to control a single exposure. Grid tubes in which the grid controls or pulses the exposures one after the other as in cineradiography, are not subject to this requirement.

#### C. Tube Housing Port Dimensions:

The basic port and window dimensions of the various Eureka tube housing assemblies are given on Drawing 6-2074-L. Certain early housings had smaller dimensions for C and D, the port diameter. Later assemblies use the port with the larger dimensions as shown. Unless specified, all diagnostic source assemblies are compatible with the smaller port diameters. The dimensions shown are with the lead rayproofing cone removed. When a collimator with rayproofing type of shutter which protrudes into the port is used, the cone must be removed, if the shutter does not clear the surfaces of the port by 1/16" minimum at its wide open position. If the collimator does not have a protruding shutter, or when some other type of beam limiting device is attached, the rayproofing cone or diaphragm must be left in place. The bolts holding the collimator or other beam limiting device must engage the threads in the port boss by at least 4 turns, to insure proper holding ability and rayproofing. Steel bolts should be used for maximum strength.



A listing is given below of the spacer thickness required for various Eureka Tube Housing Assemblies when using any of the Machlett collimators shown on the compatibility list 00-02-103 (11).

<u>Eureka Tube Housing Assembly</u>		<u>Space Thickness Inches Nominal</u>
Sapphire 150 Series	)	
Star Sapphire 150 Series	)	3/8
Sapphire MT-300,200	)	
Sapphire M	)	
Diamond 150 Series	)	
Emerald 125-T	)	1/2
Emerald 125	)	
Emerald 125-MT	)	7/16
RA-79, RA-79-L		3/8
RA-59, RA-71, RA-72		9/16

D. Beam Quality and Permanent Filtration.

The beam quality requirement for the diagnostic source assembly is such that enough total permanent filtration must be in the beam to insure the minimum half value layer (HVL) will equal or exceed a specified amount. This amount is listed in the table below for the various voltages with the total filtration recommended to achieve it (NCRP 33).

Design Operating Range (Kilovolts Peak)	Measured Potential (Kilovolts Peak)	Minimum Re- quired Half- Value Layer (Millimeters of Aluminum)	Minimum Total Filtration Re- quired (Milli- meters of Aluminum)
Below 50 .....	30	0.3	.5
	40	0.4	↓
	49	0.5	
50 to 70 .....	50	1.2	1.5
	60	1.3	↓
	70	1.5	
Above 70 .....	71	2.1	2.5
	80	2.3	↓
	90	2.5	
	100	2.7	
	110	3.0	
	120	3.2	
	130	3.5	
	140	3.8	
	150	4.1	↓

The total permanent filtration in the beam consists of that in the tube housing assembly (inherent filtration) and that not removable from the beam limiting device (mirrors in collimators, etc.) plus what must be added to the two mentioned above to equal the minimum required in the beam as stated in the table above.

To check the HVL of the X-ray beam, the following procedure may be used:

- (1) Set the R output measuring probe at a distance equal to two times the distance from the focal spot to the added filter and adjust the beam limiting device shutters so that the X-ray beam just covers the probe.

(3)



- (2) First measure the R output at maximum rated kVp and low mA (3 to 5 mA); then add a pure aluminum filter, or 1100 alloy filter to give a total thickness equal to the minimum required HVL for the same voltage (from table above), and measure the R output a second time. This second R output may be equal to, but not be less than one-half of the first reading. Take several measurements and average the results..
- (3) If the second reading in (2) is less than one-half, there is not enough permanent filtration in the beam, and more should be added until the proper HVL is obtained.
- (4) Minimum inherent filtration of Eureka tube housing assemblies and the filtration which must be added is given in 6-2074-B (Exhibit 4.0).
- (5) If a diagnostic source assembly has a collimator with variable total filtration, this test should be repeated at the maximum permissible voltage for each possible value of total filtrations.

#### E. Use of Multiple X-ray Tubes

When more than one radiographic tube can be energized from the same control, the tube which has been selected shall be clearly indicated both at, or close to the tube, and on the X-ray control. The indicator may take the form of a clearly visible light inter-connected with the generator tube selector switches, and is supplied by the equipment manufacturer as a part of the X-ray control.

#### F. Field Limitation and Alignment on Stationary General Purpose X-ray Equipment.

The manufacturers' procedures for mounting and adjusting the tube housing assembly on the tube mounting structure should be followed carefully. The requirements that should be met are:

- (1) An indication of when the X-ray beam is perpendicular to the image receptor.
- (2) Alignment of the center of the X-ray field with respect to the center of the image receptor to within 2% of the source-image distance.  
See Section J for method of checking.
- (3) An indication of the source-image distance (SID) to within 2%  
See Section K for method of checking.
- (4) The beam limiting device shall numerically indicate the field size in the plane of the image receptor to which it is adjusted and this size shall be aligned to that on the image receptor within 2% of the SID when the beam is perpendicular to the plane of the image receptor.



- (5) For collimation on stationary general purpose equipment, 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 more than 3% of the source-image distance and that the sum of the length and the width differences without regard to sign, be no greater than 4% of the source-image distance when the equipment indicates that the beam axis is perpendicular to the plane of the image receptor.

#### Maintenance.

Periodic maintenance instructions are given in users' information (6-2074-A) pertaining to the tube housing assembly. Collimator and other beam limiting devices should be maintained in accordance with the instructions supplied by the manufacturer. It is conceivable that changes in the insert tube due to long time normal usage, short time heavy use, or overloading could require collimator alignment checking and readjustment.

#### G. Dealer and Distributor Records.

- (a). Dealers and distributors of diagnostic tube housing assemblies shall obtain and preserve for a period of five years from the date of sale, award, or lease of each such product such information as is necessary to permit tracing of specific products to specific purchasers.

- (b). Such information shall include:

1. The name and mailing address of the distributor, dealer, or purchaser to whom the product was transferred.
2. Identification and brand name of the product.
3. Model number and serial, or other identification number of the product.
4. Date of sale, award, or lease.

#### H. Records to be Furnished to Eureka by Dealers and Distributors:

The information required in "G" above shall immediately be forwarded to Eureka unless:

- (a) The dealer or distributor elects to hold and preserve such information, and to immediately furnish it to Eureka X-ray Tube Co. when advised

by Eureka or the Director, Bureau of Radiological Health, that such information is required for purposes of Section 359 of the Radiation Control for Health and Safety Act of 1968, and,

- (b) The dealer or distributor, upon making the election under (a) above of this section, promptly notifies Eureka and the Bureau of Radiological Health of such election. Such notification shall be in writing and shall identify the dealer or distributor and the type of tube housing assemblies for which the information is being accumulated.

I. Assembler's Report.

All assemblers who install certified components shall file a report of such assembly. All assemblers' reports shall be on a form prescribed by and available from the Director, FDA/Bureau of Radiological Health, Division of Compliance, 5600 Fishers Lane, Rockville, Maryland, 20852. The form is FD-2579. The original shall be sent to the Director and copies to the purchaser, State Agency responsible for radiation protection, and one kept by the assembler for a period of at least five years.

J. Beam Alignment and Centering of the X-ray Field.

- (a) Install the tube and mount it on the collimating device, adjusting the thickness of the spacers taking into account the difference, if any, between the focal spot to mounting surface between the original and replacement tube housing.
- (b) Check the tube stand with a level to see that it is truly vertical and adjust if necessary. Align the tube according to the indications on the tube hanger, so that its axis is paralleled to the plane of the image receptor. If indicators are non-existent, they must be added to permit positive alignment.
- (c) Load the cassette with a sheet of X-ray film.
- (d) Place a lead cross marker on the exact center of the cassette face and position the cassette in its tray or receptor.
- (e) Position the X-ray tube unit at a height typical of diagnostic technics using the means of alignment indication provided by the manufacturer.
- (f) Adjust the beam limiting device to provide an X-ray field at the film smaller than the film size.
- (g) Make an exposure with technic factors selected to assure that the net film density is in the range of 0.9 to 1.2.



- (h) Locate the edges of the X ray field by points at which the next film density is 1/10 of that at the nominal center.
- (i) Draw the diagonals of the X-ray image as determined in (h). The lead cross denotes the center of the image receptor. The difference between the point of intersection of these diagonals and the lead cross denotes the mis-alignment that needs to be corrected.
- (j) Carefully measure the source-image distance for the above settings. The mis-alignment must not exceed 2% of this amount.
- (k) The markings on the gage indicating source-image distance must be accurate to within 2% error. This should be checked by actual measurements, or the following method:

K. Checking the Source to Image Distance by Size Comparison of Objects in the Radiation Field.

Equipment:

- 1. Two brass strips, one 2" long (L) and one 4" long (2L). Both strips are 1/2" wide and 1/8" thick.
- 2. Tape measure.
- 3. Aluminum Sheet: 12" x 12" x 1/8".

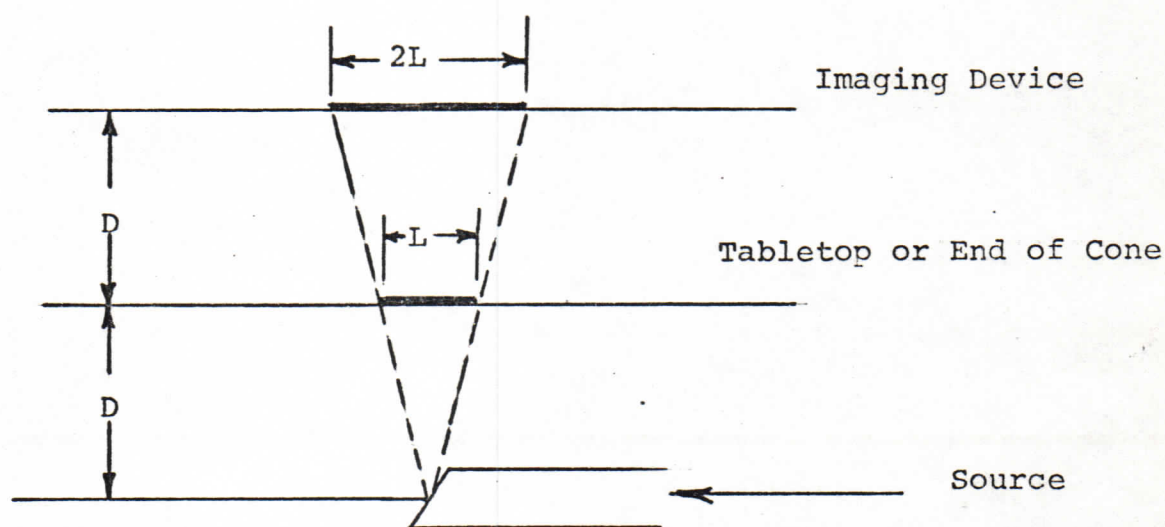
Test Procedure:

- 1. For fixed direct-viewing fluoroscopy units (without image intensification), the source-to-tabletop distance is measured with a brass strip (length L) placed on the table-top, and a second strip (length 2L) on the fluoroscopic screen assembly.
- 2. When a unit employs image amplification, the physical arrangement of the equipment will determine the placement of the two brass strips.
  - (a) If the source is directed upward from under the patient, an aluminum sheet is taped to the underside of the image intensifier, one strip (2L) is attached to it, and the other (L) is placed in the radiation field either on the table-top, or if there is none, on the end of the beam limiting device.
  - (b) If the source is above the tabletop, the aluminum sheet is placed on the table over the intensifier, one brass strip (2L) is placed on it, and the other (L) is taped to the beam limiting device.
  - (c) In a C-arm type of fluoroscope, the arm is positioned above a surface with the beam aligned horizontally to this surface. An aluminum sheet is taped to the underside of the image intensifier and a brass



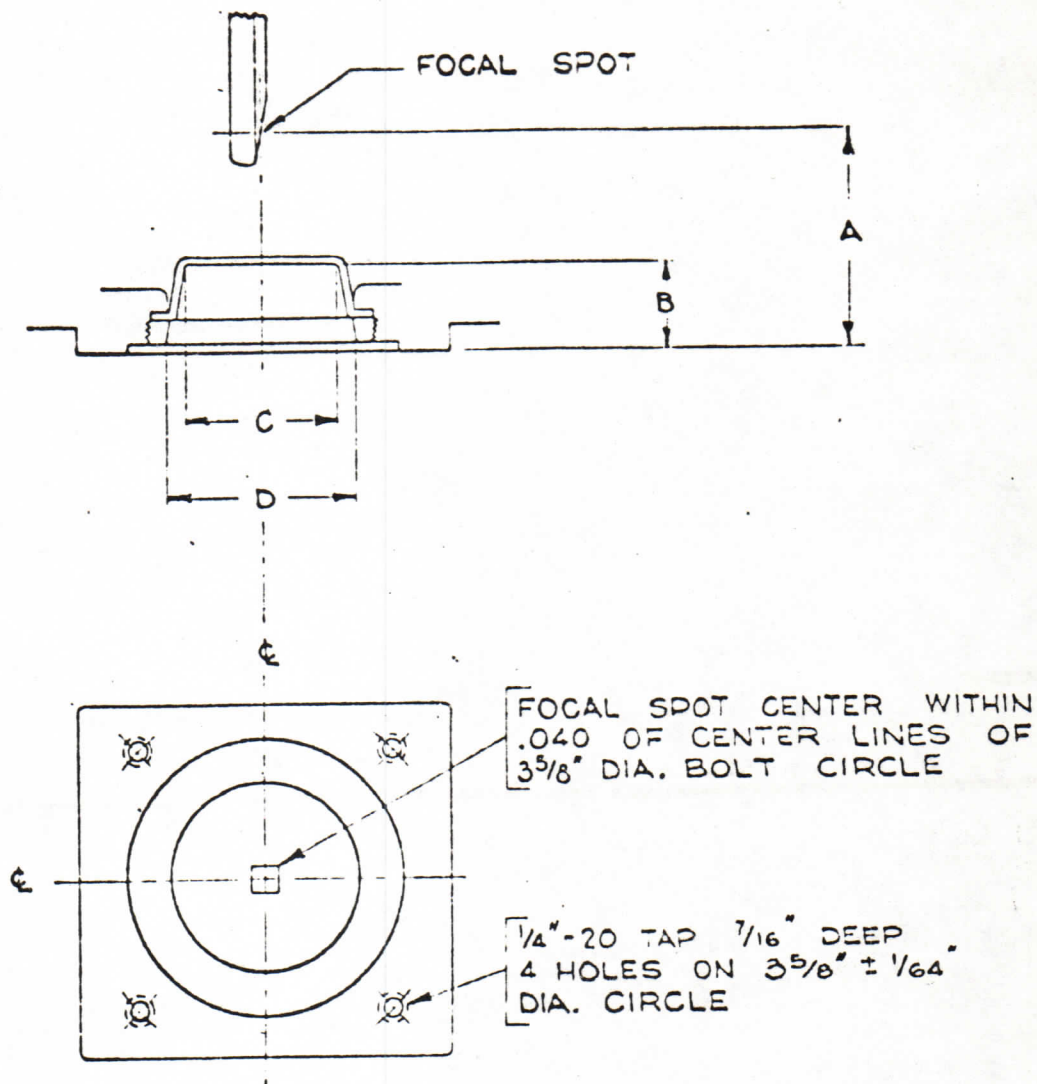
strip ( $2L$ ) is attached to it. The other strip ( $L$ ) is attached to a stand on the surface and positioned between the image intensifier and the source.

3. The fluoroscopy unit is activated and the movable portion of the assembly (the fluoroscopic screen, the image intensifier, brass strip, or the source) is moved up or down, until the images of ( $L$ ) and ( $2L$ ) are equal in length on the image receptor. The vertical distance between the two strips is measured.
4. By similar triangles, the distance between the two brass strips is equal to the source to tabletop (or cone end) distance.



# EUREKA X-RAY TUBE HOUSING PORT DIMENSIONS FOR COLLIMATOR MOUNTING

DWG. NO. 6-2074-L



HOUSING TYPE	A	B	C	D	
Sapphire 150T and Star Sapphire 150T Series	2-3/16	.906"	1-7/16	2-1/8	(A)
Sapphire 150, Sapphire M, Sapphire MT	2-3/16	.906"	1-7/16	2-1/8	(A)
Diamond 150T and Emerald 125T Series	2	.875"	1-7/16	1-13/16	
Emerald 125	2-1/8	.875"	1-7/16	1-13/16	
RA-59, 71, 72	1-15/16	1.000"	1-7/16	1-7/8	
RA-79, 79L	2	.843"	1-7/16	1-13/16	
AR-15	2-3/8	.843"	1-7/16	1-7/8	



Sheet 1		COLLIMATOR MFGR'S NAME & IDENTIFICATION																									
MANUFACTURER AND MODEL NO.		COLLIMATOR																									
		Hodges 5000 Coll.	Machlett Collimaster A	Machlett Collimaster M	Machlett Ducon M	Machlett Collimaster A-FS 150(A)	Machlett Ducon S (C)	Toshiba TF-6TL-4UL with VX-1 Shutter	CGR Medical Corp. X-ACT Models	726B951 G16 and G 03	" G17 " G 04	" G18 " G 05	" G19 " G 06	" G20 " G 07	" G21 " G 11	" G22 " G 12	" G15	" G23	Machlett C-FSR (A-FSR)	" C-50/150 (A-50/150)"	" C-150 (A-150)	" C-UT-150 (A-UT-150)	" M-50/150	Machlett Ducon M-150	" M-50/150	Toshiba TF-7M-5	ITO R-202
(A) 12-17-74 A.B.L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(B) 6-6-75 A.B.L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(C) 7-12-75 A.B.L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(D) 12-19-75 W.W.L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(E) 5-11-77 W.W.L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(F) 8-1-77 W. W. L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(G) 8-15-77 W. W. L.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sapphire 150 Series																											
Star Sapphire Series																											
Sapphire M																											
Diamond 150 Series																											
Emerald 125 Series																											
RA-79																											
RA-79L																											
RA-72																											
RA-71																											
RA-59																											
AR-15																											
Sapphire MT-300, 200 (B)																											
Emerald 125-MT (B)																											
Toshiba DRX-66DUW (D)																											



EXHIBIT 12.3.1.6  
COMPATIBILITY LIST - FOR TEST RESULTS SEE EXHIBIT 12.4.2.1

Sheet 1a

MANUFACTURER  
AND  
MODEL NO.  
(A) 5-11-77 W.W.L.  
(B) 6-23-77 W.W.L.  
(C) 1-15-79 W.W.L.

Sheet 1a		COLLIMATOR										MFGR'S. NAME & IDENTIFICATION																			
MANUFACTURER		Searle 4000 G1, EMI 60000C1 (C) (A)										Siemens 4271 490G 5139										Toshiba TF-6TL-4UL with VX-1 Shutter									
AND																															
MODEL NO.																															
(A)	5-11-77																														
(B)	6-23-77																														
(C)	1-15-79																														
Eureka X-Scan 150																															
Siemens RG 150/100 (B)																															
Toshiba DRX 186 DW (B)																															

## EXHIBIT 12.3.1.6

COLLIMATOR MANUFACTURER'S NAME AND IDENTIFICATION

**TUBE HOUSING ASSEMBLY**  
**Manufacturer and Model**  
**6-6-78 W.W.L.**  
**(A) 3-22-79 WWL**

[illegible]

EUREKA X-RAY TUBE CO.

00-02-103 (11AA)



## COMPATIBILITY LIST - FOR TEST RESULTS SEE EXHIBIT 12.4.2.1

Sheet 2

Sheet 2		MANUFACTURER'S NAME & IDENTIFICATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
MANUFACTURER AND MODEL NUMBER		CONE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
(A)	10-27-74 A.B.L.	X	Continental 3" #9453.311 and .310																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

A X-RAY TUBE UNIT



## COMPATIBILITY LIST - FOR TEST RESULTS SEE EXHIBIT 12.4.2.1

Sheet 3

MANUFACTURER AND MODEL NUMBER		PORT MOUNTING BRACKET		MANUFACTURER'S NAME AND IDENTIFICATION	
(A)	10-27-74	A.B.L.			
(B)	12-17-74	A.B.L.			
(C)	2-21-75	A.B.L.			
(D)	6-5-75	A.B.L.			
(E)	7-12-75	A.B.L.			
(F)	10-7-76	A.B.L.			
(G)	11-24-76	A.B.L.			
(H)	2-24-77	A.B.L.			
(I)	1-15-79	W.W.L.			
(J)	3-20-79	W.W.L.			
EUREKA X-RAY TUBE UNIT					
Sapphire 150 Series	X	L.M.S. A-21862-1			
Star Sapphire Series	X	Katum CM 115			
Sapphire M	X	Amrad C-0122-07-001-0			
Diamond 150 Series	X	Continental #5236.123.03 & .08			
Emerald 125 Series	X	Fischer #38250-G			
RA-79	X	L.M.S. - Zuder Gyrotome 504 619EZA (J)			
RA-79L	X	Liebel-Flarsheim #219930 (A) (E)			
RA-72	X	L.M.S. 7/16" #36952-2 (B)			
RA-71	X	L.M.S. #A-16855-1 & 30044-1 (B)			
RA-59	X	L.M.S. 1/4" #36952-1 (B)			
AR-15	X	L.M.S. #A-16855-1 (B)			
Sapphire MT-300, 200 (D)	X	L.M.S. #B-1057 (C)			
Emerald 125-MT (D)	X	Universal X-Ray #3016 (C)			
Emerald - M (E)	X	Grafax Corp. #102-358 (D) 70 kVp (J)			
		Spectrum 4J-70150 (D)			
		L.M.S. #A-51409-1 (D) 70 kVp (J)			
		Amrad C-0122-07-014 (D)			
		Standard #962576 (F)			
		Standard #962612 (F)			
		Standard #968465 (F)			
		Fischer Enterprises KB-44-A-1B-1 (F)			
		H.L. Lyons #100-3 (G)			
		L.M.S. A-21862-2 (H)			
		EUREKA 55-18200 (11-1066A) (I)			
		Xonics Medical System A 66647-1 (J)			
		Xonics Medical System A-66649-1 (J)			



# PORT MOUNTING BRACKET MANUFACTURER'S NAME AND IDENTIFICATION

EUREKA X-RAY TUBE UNIT	Pausch Corp Model 622T100	Standard Konixx 968550	Konics Medical System A-968550-1	AMRAD D-0122-07-083	ITO C-1005
Sapphire 150 Series	X	X	X		
Star Sapphire Series	X	X	X		
Sapphire M	X	X	X		
Diamond 150 Series	X	X	X		
Emerald 125 Series	X	X	X	X	X
RA-79	X				
RA-79L	X				
RA-71-72	X			X	
RA-59	X			X	
AR-15	X				
Sapphire MT-300,200 (D)	X	X	X		
Emerald 125-MT (D)	X	X	X	X	
Emerald - M (E)	X	X	X	X	

## EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.5, 12.3.1.13.1.2

## RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

Models	A 11-8-79 WWL	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation *** Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
Sapphire 150T, 150TH, 150THG	150THG	MR-F	150	4.0	RAD-16, 16° RAD-21, 12° RAD-19, 10°	0.6 0.6 0.6	1.9 1.9 1.9
HE Sapphire 150T, 150TH, 150THG	150THG	MR-F	150	8.4	3 above inserts + RAD-38, 17° A	0.6	1.9
Sapphire 150		MR-F	150	4.0	RAD-13, 17° RAD-25, 14°	0.6 0.6	1.9 1.9
Star Sapphire 150T, 150TH	150TH	MR-F	150	4.0	RAD-18, 16° RAD-20, 12° RAD-17, 10°	0.6 0.6 0.6	1.9 1.9 1.9
HE Star Sapphire 150T, 150TH	150TH	MR-F	150	8.4	3 above inserts	0.6	1.9
Sapphire M		M	70	8.6	RAD-11, 14°	*	2.0 **
Diamond 150T, 150TH	150TH	MR-F	150	3.3	RAD-13, 16° RAD-14, 12°	0.6 0.6	1.9 1.9
Emerald 125		MR-F	125	4.0	RAD-8, 16° A	0.6	1.9
Emerald 125T		MR-F	125	4.0	RAD-13, 16°	0.6	1.9
RA-72		MR-F	110	3.8	RAD-2, 16° A	0.6	1.9
RA-59		MR-F	100	3.33	RAD-10, 16° A	0.6	1.9
AR-15 Stationary Anode		MR-F	100	4.16	SP-6, 20°	0.7	1.8
REPLACEMENT ONLY							
RA-71		MR-F	110	3.8	RAD-2, 16° A	0.6	1.9
RA-79		MR-F	125	4.0	RAD-8, 16° A	0.6	1.9
RA-79L		MR-F	100	5.0	RAD-8, 16° A	0.6	1.9

## Notes:

4.1 Application

MR= Medical Radiography

M= Mammography

F = Fluoroscopic

F = 35 KvP

July 1975

July 1974

Page 1

\* Sapphire M - Min. Inherent Filtration is equivalent to 0.52 mm of Al. @ 35 KvP

\*\* Sapphire M - No added Filtration required below 50 KvP. 2.0 mm, 50 to 70 KvP

\*\*\* Tube Housing Maximum Leakage 50 mR/hr. unless noted otherwise.

X Added March 20, 1979

00 October 13, 1975

(11-02-02-00)



# EUREKA X-RAY TUBE CO.

6-2074-B

EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.4, 4.5, 12.3.1.13.1.2

## RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

Reloaded Housings of Other Manufacture A 11-8-79 WWL Models	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation *** Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
Profexray A-2500	MR-F	100	3.5	RAD-1, 17°	0.8	1.7
A-2501	MR-F	100	3.5	SPH-6, 20°	0.8	1.7
Pickier X-Ray Corp. PX-17	MR-F	125	4.0	RAD-8, 16°	0.5	2.0
PX-17	MR-F	125	4.0	RAD-13, 16°	0.7	1.8
PX-18	MR-F	125	3.3	RAD-13, 16°	0.7	1.8
Machlett Laboratories Dynamax Types						
HD-25	MR-F	100	4.2	RAD-8, 16°	0.5	2.0
32	MR-F	110	4.6	RAD-8, 16°	0.5	2.0
40	MR-F	125	4.0	RAD-8, 16°	0.5	2.0
42	MR-F	125	4.0	RAD-8, 16°	0.5	2.0
50	MR-F	150	3.3	RAD-13, 16°	0.5	2.0
50-40	MR-F	130	3.9	RAD-8, 16°	0.5	2.0
50-HD-40	MR-F	130	3.9	RAD-13, 16°	0.5	2.0
57	MR-F	150	3.3	XX RAD-13, 16°	0.5	2.0
59	MR-F	150	3.3	XX RAD-14, 12°	0.5	2.0
60	MR-F	150	4.0	RAD-16, 16°	0.6	1.9
61	MR-F	150	4.0	RAD-19, 10°	0.6	1.9
63	MR-F	150	4.0	RAD-19, 10°	0.6	1.9
67	MR-F	150	4.0	RAD-16, 16°	0.6	1.9
68	MR-F	150	4.0	RAD-19, 10°	0.6	1.9
69	MR-F	150	4.0	RAD-21, 12°	0.6	1.9
Toshiba DRX-66 DUW	MR	100	2.0	Toshiba DR-66 RAD-36, 17°	0.9 @ 50 KvP	1.6

July 1974  
Page 2

Notes: Same as Page 1.

December 18, 1975  
November 14, 1977  
March 20, 1979

EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.4, 4.5, 12.3.1.13.1.2  
RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

Reloaded housings of other manufacture - Continued.	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
Models A-1-6-78 B-5-3-78 C-3-20-79 D-11-8-79 WML						
Toshiba DRX-186 DW	MR	125	1.0	Toshiba DR-186 18°	0.7 @ 62.5 kVp	1.8
Siemens RG 150/100	MR-F	150	3.0	RAD-16, 18 RAD-17, 19 RAD-20, 21 RAD-47	1.5 1.5 1.5 1.5	1.0 1.0 1.0 1.0
Eimac B-100	MR-F	150	3.3	RAD-13, RAD-14,	0.5 0.5	2.0 2.0
Eimac B-150	MR-F	150	4.0	RAD-16, 18 RAD-17, 19 RAD-20, 21	0.5 0.5 0.5	2.0 2.0 2.0
Eimac B-150-H	MR-F	150	8.4	6 above inserts	0.5	2.0
Eimac B-100	MR-F	125	4.6	RAD-3 RAD-13	0.5 0.5	2.0 2.0
G.E. Maxiray-100 09 or 18 G.E. Maxiray-100 FL B G.E. Maxiray-75 D	MR-F MR-F MR-F	150 150 150	4.0 5.0 2.0	RAD-40, RAD-44, RAD-13, 14, 16°, 12°	0.7 0.7 0.7	1.8 1.8 1.8



# EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.5, 12.3.1.13.1.2

## RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

Reloaded housings of other manufacture - Continued A 11-8-79 WWL Models	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
AEROMAX 512	CT	140	28 mA	EXR-150-201-C 20°	3.3	---
PHILIPS ROT 350 A	MR-F	150	2.35	RAD-45	0.7	1.9

## EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.5, 12.3.1.13.1.2

## RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

Models	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation *** Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
Sapphire MT-200	MR-F-M	125	4.8	RAD-15 MT, 14°	0.5	2.0
HE Sapphire MT-200	MR-F-M	125	7.2	RAD-15 MT, 14°	0.5	2.0
Sapphire MT-300	MR-F-M	125	4.8	RAD-16 MT, 16° RAD-22 MT, 14°	0.5 0.5	2.0 2.0
HE Sapphire MT-300	MR-F-M	125	10.0	(2 above inserts)	0.5	2.0
Emerald 125 MT	MR-F-M	125	4.0	RAD-13 MT, 16°	0.5	2.0
HE Emerald 125 MT	MR-F-M	125	8.0	RAD-13 MT, 16°	0.5	2.0
Emerald M	M	70	7.2	RAD-12 M, 14°	*	2.0 **
HE Emerald M	M	70	14.3	RAD-12 M, 14°	*	2.0 **
HE Sapphire M	M	70	18.0	RAD-11, 14°	*	2.0 **
HE Diamond 150T, 150TH	MR-F	150	6.7	RAD-13, 16° RAD-14, 12°	0.6 0.6	1.9 1.9
HE Emerald 125T	MR-F	125	8.0	RAD-13, 16° RAD-14, 12°	0.6 0.6	1.9 1.9

NOTES: Same as Page 1

00 October 13, 1975

May 8, 1975

Page 3



EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.5, 12.3.1.13.1.2  
RADIATION LEAKAGE TECHNIC FACTORS      MINIMUM INHERENT FILTRATION

EUREKA MODELS A 5-11-77 WWL B 10-14-77 WWL C 5-3-78 WWL D 9-12-78 WWL E 3-21-79 WWL F 11-8-79 WWL	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
X-SCAN 150 (oil cooled Stationary Anode) A	CT	140	20.0 *	EXR-150-30L 30° EXR-150-30LC 30° E EXR-150-20L 20° E EXR-150-20LC 20° E EXR-150-23L 23° E EXR-150-25L 25° E EXR-150-25LC 25° F	3.3	--
ROTOSCAN B	CT	150	9.3	RAD-38 12° RAD-39 16°	3.0	--
XP-1 C	MR-M	75	5.6	RAD-2 16° RAD-35 10°	0.5 at 50 kvp	2.0
UX-50H/40C (EMERALD 125) D	MR-F	125	4.0	UX-40C 16° (RAD-8, 16°)	0.6	1.9
EMERALD 110 F	MR-F	110	4.6	RAD-3 16° RAD-8 16°	0.6 0.6	1.9 1.9

4.1 Application See page 1 CT - Computerized Axial Tomography

\* Maximum leakage 70 mR/hr. Other Notes: Same as Page 1

May 11, 1977

EXHIBIT 4.0 LISTING DATA 4.1, 4.2, 4.3, 4.5, 12.3.1.13.1.2  
RADIATION LEAKAGE TECHNIC FACTORS MINIMUM INHERENT FILTRATION

<u>EUREKA MODELS</u>	Appli- cation 4.1	Max. Rated KvP 4.2	Radiation Leakage Technic Factors, Ma @ Max. KvP 12.3.1.13.1.2	Eureka Insert Model & Target Angle 4.3	Minimum Inherent Filtration @ 100 KvP mm Al. 4.5	Required Min. Added Filtration Par. (m) 1020.30 mm Al.
EMERALD 125T	MR-F	125	4.0	RAD-13 RAD-14	0.6 0.6	1.9 1.9
XP-2	IND.	50	0.5 *	GR-3-R/2 GR3-W/2 GR3-Au/2	0.12 mm.Beryllium at all kVp	Does not apply - Non medical
PV 9100/20 (Philips Identification - THA is identical to XP-2)	IND.	50	0.5 *	PV9582/00 is a GR3-R/2 35° PV9584/00 is a GR3-W/2 35° PV9581/00 is a GR3-Au/2 35°	Same as above	Same as above

Note: IND. means Industrial Application

\* Maximum Leakage less than 1 mR/hr at 5 CM