

## GE AMX 4+ Portable X-Ray



Typical Manufacturer's Picture

- GE Healthcare's AMX-4+ analog X-ray system provides high-performance in a compact, easy-to-maneuver package.
- The rotating arm and tube simplify positioning and facilitate bedside studies, while the maintenance-free battery produces up to 50 high-quality exposures with a single charge.
- Dual drive motors and oversize casters facilitate movement; even in taxing environments.

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### Specifications

#### Accuracy Criteria

Specified accuracies are subject to additional errors for accuracy of instrumentation used during calibration and measurement. To achieve generator accuracies, the following criteria must be met:

- The WAIT message must not appear on the Message Display when taking an exposure.
- The READY FOR EXPOSURE message must appear on the Message Display.

General Electric Healthcare reserves the right to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

#### 1-2 Physical Characteristics

##### 1-2-1 Dimensions (All measures are nominal)

1. Height: 70 inches (1778 mm) for Models 2169360-6, 2236420-6, and 2275938-6, -12, -13, -14, -15; all others 76 inches (1930 mm).
2. Width: 25-3/16 inches (640 mm)
3. Length: 45-3/8 inches (1153 mm)
4. Weight: 1080 pounds (490 kg)

##### 1-2-2 Environmental Limits

1. Operating temperature range: 59 to 100 Degrees Fahrenheit (15 to 38 Degrees Celsius) at 80% non-condensing humidity.
2. Storage temperature range -40 to +140 Degrees Fahrenheit (-40 to +60 Degrees Celsius)
3. Maximum operating altitude: 8,000 feet (2440 meters).

#### 1-3 Battery

##### 1-3-1 Specifications

1. Nine 12.9 volt batteries connected in series provide approximately 116 volts at full charge.
2. Battery charger requires the following:
  - > For Models 2169360-7, 2169360-8, 2169360-9, 2169360-10, 2236420-7 & 2275938-7, 2236420-8 & 2275938-8, 2236420-9 & 2275938-9, 2236420-10 & 2275938-10: 120 Volts AC, 60 Hz at 6 A.
  - > For Models 2169360, 2169360-2, 2169360-3, 2169360-4, 2236420 & 2275938, 2236420-2 &



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2275938-2, 2236420-3 & 2275938-3, 2236420-4 & 2275938-4 and 2275938-12, -13, -14, -15, -16, -17: 220/240 Volts AC, 50 Hz at 3.15 A.

> For Models 2169360-5, 2169360-6, 2236420-5 & 2275938-5, 2236420-6 & 2275938-6: 100 Volts AC, 50/60 Hz at 6 A.

Voltage must be maintained to +/-10% of the nominal value during charging.

### 1-3-2 Battery Capacity

The AMX-4+ battery capacity can be measured by one of the following five methods. All capacities are measured after the AMX-4+ has been charged to the "CHARGE COMPLETE" state. Available capacity as stated applies only to new battery sets free of defective cells. Capacity may decrease as the battery nears the end of its useful life.

#### method 1: exams

The AMX-4+ batteries will provide capacity for more than 20 typical EXAMs. An "EXAM" is defined as:

- Two 70 kVp, 10 mAs X-ray exposures including:
  - > 7 seconds of prep (rotor and filament drive)
  - > 25 seconds of field light
- 5 minutes of drive time
- 9 minutes of idle time

The formula in the "VARIED USAGE" section can be used to determine the number of total EXAMs available for usage regimes different from this typical case.

#### method 2: X-ray Exposures

The AMX-4+ batteries will provide enough capacity for 165 or more 100 kVp, 100 mAs X-ray exposures. Each exposure includes 4 seconds of prep (rotor and filament drive) time and 30 seconds of idle time for battery recovery. This number may be reduced by additional idle time required for X-ray tube cooling.

#### method 3: drive time

The AMX-4+ batteries will provide enough capacity for 140 minutes of continuous drive time. This time is typically independent of driving conditions, however, it may be reduced if a significant portion of the drive is on carpeting or up ramps.

#### method 4: idle time

The AMX-4+ batteries will provide capacity for 23.3 hours of continuous idle time. "Idle" is the time when the AMX-4+ is ON but not being used.

#### method 5: Varied usage

For varied usage, the AMX-4+ batteries will provide capacity according to the following formula:

$$\begin{aligned} & \{ (\text{idle time in minutes}) \_ 3 \} + \\ & \{ (\text{drive time in minutes}) \_ 30 \} + \\ & \{ (\text{field light time in minutes}) \_ 25 \} + \\ & \{ (\text{prep time in minutes}) \_ 30 \} + \\ & \{ (\text{exposure energy}^* ) \_ 2.17 \} = 4200 \end{aligned}$$

\*exposure energy = cumulative { ( kVp \_ mAs ) \_ 1000 }

EXAMPLE: Assume one desires to estimate the number exams available from an AMX-4+ used in a particular pediatric ward. It is determined that a typical exam for this case is comprised of:

- Two 70 kVp, 0.8 mAs X-ray exposures including:
  - > 3 seconds of prep
  - > 15 seconds of field light
- 1 minute of drive



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– 5 minutes of idle

Using the above formula we can estimate the number of exams as follows:

each EXAM uses { (5 idle *minutes* ) \_ 3 } + { (1 drive *minutes* ) \_ 30 } +  
2 x [ { (15 \_ 60 field light *minutes* ) \_ 25 } + { (3 \_ 60 prep *minutes* ) \_ 30 } +  
{ ( (70 kVp \_ 0.8 mAs ) \_ 1000 ) \_ 2.17 } ] = 60.7

therefore the total number of typical EXAMS available is: 4200 \_ 60.7 = 69

#### **1-4 Movements**

1. Tube vertical movement measured at the focal spot (arm extended):

a. Range at least 46.5 inches (1181 mm) for Models 2169360–6, 2236420–6 and 2275938–6, –12, –13, –14, –15; all others at least 52.5 inches (1334 mm).

b. Lowest position 26.1 inches (663 mm) max. from floor.

c. Highest position 72.6 inches (1844 mm) min. from floor for Models 2169360–6, 2236420–6 and 2275938–6, –12, –13, –14, –15; all others 78.6 inches (1996 mm) min. from floor.

2. The horizontal movement measured at the focal spot relative to column face is 24 inches (610 mm) minimum, to 40 inches (1016 mm) maximum.

3. Tube Column rotation measured from horizontal arm latch is +/-270 degrees.

4. Tube and yoke rotation around Horizontal Arm measured from tube port down position:

a. Range 360 degrees;

b. Detent locations 0, +/-90, and +/-180 degrees.

5. Tube Trunnion rotation measured from tube port down position:

a. Range 120 degrees;

b. Forward 110 degrees;

c. Backward 10 degrees;

d. Detent 0 degrees, and 90 degrees.

6. Collimator Rotation measured from the front of the collimator with the tube port facing down:

a. Range 180 degrees;

b. Right 90 degrees;

c. Left 90 degrees;

d. Detent 0 and 90 degrees.

#### **1-5 Moving Efforts**

1. Moving efforts with locks mechanically off (that is, energized electrically):

a. Vertical tube motion: 12 pounds (53 Newtons) maximum, measured going up or down; 15 pounds (67 Newtons), measured over last 4 inches (102 mm) of travel.

b. Horizontal tube motion: 14 pounds (62.3 Newtons) maximum, measured going in or out.

c. Tube Column rotation: 15 pound–feet (20.3 Newton–meters) maximum.

d. Tube and yoke angulation around horizontal Arm: 10 to 20 pound–feet (14 to 27

Newton–meters) to disengage from detent, 6 to 18 pound–feet (8 to 24 Newton–meters) to rotate between detents.

e. Tube rotation in yoke: 7 to 30 pound–feet (9.5 to 41 Newton–meters) to disengage from detent, 4 to 20 pound–feet (5 to 27 Newton–meters) to rotate between detents.

2. Moving efforts with locks mechanically on (that is, not energized electrically):

a. Vertical tube motion: 15 pounds (67 Newtons) minimum, 32 pounds (142 Newtons) maximum; measured going up or down.

b. Horizontal tube motion: 10 pounds (44.5 Newtons) minimum, 28 pounds (125 Newtons) maximum; measured going in or out.

c. Tube Column rotation: 25 to 40 pound–feet (34 to 54 Newton–meters).

#### **1-6 Drive Speed**



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There are two speeds: Drive Speed with the horizontal Tube Arm secured for transport, and Maneuvering Speed with the horizontal Tube Arm removed from the Transport Latch. Drive speed is measured on a smooth, hard and level surface. Speed will be reduced by inclines, carpeted or soft surfaces.

1. Drive Speed is 264 feet (6705 mm) per minute  $\pm$  25%;
2. Maneuvering Speed is 30% to 60% of drive speed.

#### **1-7 Tube Unit Ratings**

Tube Housing and Insert Specifications are given in Direction 46-017226, *Tube Ratings, HRT 50 and 60 Hz.*, or in 2236721-100, *Product Data Sheet Maxiray 75 TH 11 X-ray Tube*. Also, refer to note on maximum allowable kVp and mAs ratings in 2166913-1EN *AMX-4+ Operating Manual*.

#### **1-8 Generator Operator Indicators**

Check for proper operation of tones or buzzers and labels as required by regulations. Reference "Generator Operator Indicators" in Tab 3 of Direction 46-013894, *System Field Test for HHS*.

1. X-ray on indicator lights during an exposure.
2. Audible tone occurs during exposure.
3. Audible tone occurs with safety timed termination of AEC exposures.
4. Safety timed termination of AEC exposures requires resetting before taking another exposure.
5. X-ray warning label is legible.

#### **1-9 kVp Accuracy**

1. Rise time of the kVp wave form from 10% to 90% of the maximum kVp is 1.2 millisecond or less.
2. Fall time of the kVp wave form from 90% of the maximum kV to 20 kV is 2.5 milliseconds or less.
3. Accuracy of the kVp wave form to selected kVp is  $\pm$  8% of the value displayed on the operator panel for the first 20 ms and  $\pm$  5% after 20 ms. Accuracy applies within the range of the bar graph battery charge indicator.

**Note:** These specifications do not apply to switching transients which occur during the first millisecond and the last millisecond of an exposure.

#### **1-9-1 Test Method**

Use a Keithley Non-Invasive kVp Divider (Model 35080A with Deviation 535 or Model 35080B, both using Mobile Filter Pack Plus 37946C and optional Low Range Filter Pack 38237C). A Triad 35050A Dosimeter can also be used to provide digital readout of corrected kVp values. **No other substitutions for non-invasive kVp Dividers are approved!**

The set-up procedure and linear correction curves (non-Triad systems) for using the Keithley divider are covered in Section 3 of Direction 46-017561 *HHS Control and Tube Assembly Tests* and Keithley's Operation and Maintenance manuals.

#### **Alternate**

Use the GE C1515A Invasive Bleeder. If this method is used, the unit should be calibrated and verified with this meter.

**Note:** If an attempt is made to verify a unit calibrated with a C1515A bleeder with either of the above Keithley Non-Invasive dividers, kVp readings will read 5-7 kVp higher than when read with the C1515A. This is due to impedance changes in the high voltage circuit with the bleeder removed from the circuit and due to frequency compensation errors present using the C1515A divider with the AMX-4+ waveform. The procedure for connecting the C1515A High Voltage divider is covered in Direction 46-013288 *Bleeder, High-Voltage Dual Type T8005G and*



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*C1515A Connection ... Applications, and Direction 2196272-100, High Voltage Cable Installation and Troubleshooting Procedures.*

Make exposures and calculations as described in “Technique Accuracy – kV/mA” in Tab 3 of Direction 46-013894 *System Field Test for HHS*.

### **1-10 mAs Metering Accuracy**

Accuracy of mAs is the integral of X-ray tube emission current between the time at which the kV wave form reaches 75% of the indicated peak value at the beginning of an exposure and the time at which it falls to 75% of the indicated peak value when the exposure is terminated. Actual mAs shall match selected mAs within +/-10%.

#### **Preferred**

##### **1-10-1 Test Method**

This is an indirect procedure which verifies accuracy of the mAs metering circuitry and mAs calibration. Measuring mAs Metering Accuracy is done by injecting 100 mA into the mAs integrating circuit and comparing the response with a meter installed in the circuit. Reference Direction 2173223-100, *AMX-4+ Calibration* – familiarity with this direction is assumed. Also reference “Technique Accuracy – mAs” in Tab 3 of Direction 46-013894, *System Field Test for HHS*.

1. Enter mAs calibration and install meter.
2. At the prompt ENTER VALUE compare meter reading with displayed reading.
3. Correct reading to include meter accuracy before comparing with requirements.

**Note:** Accuracy of mA reading at the approximate 100 mA test condition is  $\pm 0.1$  mA. Meter accuracy must be added to the mA reading before making judgment on the final reading.

##### **1-11 Reproducibility**

The coefficient of variation for radiation output is less than 0.045 for successive exposures having constant technique factors. Coefficient of variation is measured and calculated as described in “Reproducibility of Exposure” in Tab 3 of Direction 46-013894, *System Field Test for HHS*. This applies to all units for non-AEC mode – reference the procedure “for exposures made without the use of A.E.C.” For units equipped with Mobil-AID, also reference the procedure “for exposures made with an A.E.C.”

##### **1-12 Beam Quality**

The half-value layer of the useful beam at 80 kVp shall not be less than 2.5 millimeters of aluminum. This requirement differs slightly from and supersedes NCRP 33. The specific test point is at 80 kVp requiring a half value layer of 2.5 millimeters of aluminum. This applies to systems manufactured before June 10th, 2006. For systems manufactured on or after June 10th, 2006 the following new regulation applies; The half-value layer of the useful beam at 80 kVp shall not be less than 2.9 millimeters of aluminum. The specific test point is at 80 kVp requiring a half value layer of 2.9 millimeters of aluminum. Reference the System Rating Plate to determine manufactured date. Note: The rating plate shows month and year only. For systems manufactured during June, 2006 you must verify the manufactured date in the GE GIB database. Contact your local Service Representative for assistance.

##### **1-12-1 Test Method**

The procedure for measuring Beam Quality is presented in “Beam Quality (Half Value Layer)” in Tab 4 of Direction 46-013894 *System Field Test for HHS*. The following noted exceptions to that procedure apply for the AMX-4+:

1. Select initial technique factors of 80 kVp and 20 to 48 mAs.
2. When making an exposure without the absorber, adjust mAs so that the radiation meter reading contains three significant digits.



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3. Use an AMX-4 absorber 46-173632G2 in the collimator rails.
  - > For systems manufactured On or After June 10th, 2006 add additional aluminum filtration from the HVL Attenuator set part # 46-194427P274 found in the HHS Kit part # 46-303879G1 or 46-303879G2. Total test filtration = 3.1 mm of Aluminum. Affix these plates to the AMX-4 absorber with tape. Ensure the tape is not in the usable beam path.
  - > For tube changes there is an additional 1.2 mm Aluminum cup added to the X-Ray Tube. This cup snaps onto the collimator mounting plate and is easily identified since the tube glass port is not visible. This cup must be present and retained for systems manufactured On or After June 10th, 2006. Likewise this cup if provided with the replacement tube it must be removed for systems manufactured before June 10th, 2006. Reference the system rating plate affixed to the AMX unit.

#### **1-13 Collimator Function**

A manual collimator, model 46-270615P2 (Micro Medical Systems) or model 46-270615P3 (Medys), bearing an HHS certification label is installed on the AMX-4+. Reference "Functional Test – Manual Rad Collimator Version" in Tab 6 of Direction 46-013894, *System Field Test for HHS*.

1. Minimum source to skin distance is limited to more than 30 centimeters by the skin spacers at the beam exit of the collimator.
2. Full 17 by 17 inch (43 by 43 centimeters) radiographic coverage at 40 inch (1.02 meter) Source to Image Distance.
3. Minimum inherent filtration of 2.0 mm aluminum equivalent at 100 kVp.

#### **1-14 Collimator Alignment and SID**

Collimator Alignment and SID tests are performed in accordance with Tab 6 of Direction 46-013894, *System Field Test for HHS*, reference:

SID Test

Light to X-ray Field Test

Center to Center Test

Field Indicator (Pointers to Actual Size)

1. The X-ray field size must agree with the indicated field size within 1.8% of SID.
2. Total misalignment of parallel edges of the light field with the edges of its X-ray field must not exceed 1.7% of SID.
3. The difference between the indicated SID and the actual SID must not exceed 1.8% of the indicated SID.

#### **1-15 Collimator Light Field Intensity**

The average illumination at a distance of 100 cm (39.37 inch) from the focal spot shall be 16 foot candles (170 lux) or more. Reference "Collimator Light Field Intensity" in Tab 6 of Direction 46-013894, *System Field Test for HHS*.

#### **1-16 AEC Minimum Exposure Time**

(Applies to units equipped with Mobil-AID)

When the X-ray kVp is equal to or greater than 50 kVp, the minimum exposure time will be equal to or greater than the time interval required to deliver 5 mAs. Reference "AEC Minimum Exposure Time" in Tab 3 of Direction 46-013894, *System Field Test for HHS*.

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