Linatron® - M9 & M9A

Modular high-energy X-ray source

The Linatron®-M™ is a modular system. The control console, modulator, and RF unit are common to all model configurations. Only the X-ray head changes to match the application. The Linatron - M is designed to fit mobile, gantry, and fixed installations.

1.0 Standard Equipment and Services

1.1 Control Console
The standard control console is a touch screen display system. An optional desktop PC control console is available (see section 4.6).

Touchscreen Control Console

1.2 X-ray Head Low Leakage (0.1%)

1.3 Modulator/Power Distribution Cabinet
External signal interface

1.4 Temperature Control Unit (TCU)
The TCU is used to keep the system components at a nominal 30°C (86°F). It is available in high voltage and low voltage configurations for environments ranging from -40/+55°C (-40/131°F), condensing.

1.5 Standard Spare Parts Kit
The standard spare parts kit includes over 40 items such as PC boards and individual components.

1.6 Interconnecting Cables (X-ray Head to Modulator. Modulator to Console) and Hoses (TCU to X-ray Head) Included. Lengths up to 100 meters.

1.7 Manuals and Data Books
Two sets of operator and maintenance manuals and data books are included in English.

1.8 Installation Supervision and Start-up Assistance

1.9 Varex's Standard Warranty

2.0 Performance

X-ray Head and RF Unit

2.1 X-ray Beam Quality
The X-ray beam quality is specified using Half Value Layer (HVL) steel. This corresponds to the nominal X-ray energy shown in Table 1. These HVL numbers are derived from a compilation of broad beam data measurements.

Table 1

Model	Nominal Energy (MeV)	HVL (in)	Flatness (% @ ±7.5°)	Max. Dose Rate (Gy/min)
M9	5.0	1.06	≥65.5	6.0
	6.0	1.10	≥62.0	8.0
	9.0	1.18	≥55.0	30.0

2.2 X-ray Beam Dose Rate* (10 cm x 10 cm field)
The maximum continuous dose rate at 1 meter is listed in Table 1 (without flattening filter).
*Dose rate is reduced with flattening filter

2.3 X-ray Field Size
A 30° cone or 22.5° square defines the field. Also see section 4.1.

2.4 X-ray Beam Focal Spot Size
The focal spot size does not exceed 2.0 mm in diameter.

2.5 X-ray Beam Symmetry
The beam asymmetry does not exceed 5% at +/-7.5° off the central axis for all energies.

2.6 Radiographic Quality
The Linatron-M system will demonstrate at least ASTM E 94 1-2T, or equivalent, sensitivity over the ranges given in Table 2 using film detection.

Table 2

Model	Nominal Energy (MeV)	Range (mm)
M9	5.0	45-230
	6.0	51-254
	9.0	76-381

2.7 Standard Leakage Radiation
The leakage radiation is specified along the horizontal axis at 1 meter from the beam centerline at angles 60° and greater, outside the primary beam. The values in Table 3 are a fraction of the primary beam central axis dose rate measured with a 10 cm x 10 cm collimator. Leakage is taken with the primary beam completely blocked. See section 4.2 for lower leakage options.

Table 3

Model	Leakage (fraction)
M9	$1x10^{-3}$

3.0 Customer Facility Requirements

3.1 Electrical Requirements

3.1.1 The Linatron-M operates from a single 15 kVA 50/60 Hz power source. Two voltage ranges are available.

3.1.1.1 Low Voltage Option
208 VAC, 3 phase, 3 or 4 wire plus ground, 60 Amp minimum surge per leg. +/-10% voltage regulation is required.

3.1.1.2 High Voltage Option
400 VAC, 3 phase, 4 wire plus ground, 40 Amp minimum surge per leg. +/-10% voltage regulation is required.

3.1.2 The TCU is connected to a separate 13-kVA power source. Models are available that can operate on a line voltage of 220 VAC and 400 VAC, at 50Hz; or 220 VAC and 480 VAC, at 60Hz. A separate 10-kVA power source may be required for the in-line heater package.

3.2 Operating Environment

3.2.1 Indoor Requirement
The operating environment for control console and modulator must be between 4°C (39°F) and 35°C (95°F), with 90% maximum relative humidity (non-condensing).

Modulator

3.2.2 Outdoor Requirement
The available temperature range for X-ray head/RF unit is dependent on the TCU and thermal insulation blanket. The range can be absorbed as -40/+55°C (-40/131°F), condensing.

3.2.3 Ventilation
The appropriate heat given to room air from each component with system operating at full power is given below:
X-ray Head/RF Unit: 1.0kW
Modulator Cabinet: 2.0 kW
Temperature Control Unit: 6.0-12.0 kW
Touchscreen Control Console: Negligible

4.0 Optional Equipment

4.1 Custom Beam Collimation
Nonstandard field sizes are available per customer's requirements. A motorized collimator is also available to quickly change the beam collimation.

4.2 Lower Leakage Options are listed in Table 4.

Table 4

Model	Leakage (fraction)		RF Unit/Head Wt. (lbs)	
	Super Low	Ultra Low	Super Low	Ultra Low
M9	2×10^{-5}	N/A	2,100	N/A

4.3 Voltage Regulator
Recommended for installations where line power short-term fluctuations are greater than +/-5%. A step-up or step-down transformer can also be ordered to adapt a non-standard voltage source for use with the Linatron or TCU. The regulator is CE and UL approved.

4.4 Beam Flattener

This option provides a more uniform beam intensity over the exposed region at 5, 6, and 9 MeV. Use of a flattening filter will reduce dose. See table below.

Flatness Specification

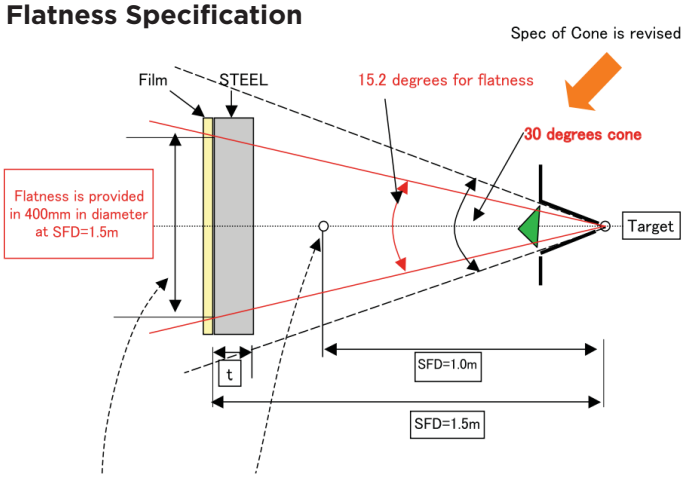


Table 5

Energy (MV)	Flatness	Dose rate (Gy/min-m)	Coverage steel thickness range t (mm)
5	better than 80%	3 or more	50-250
6	better than 80%	3.5 or more	50-250
9	better than 80%	12 or more	50-380

Remarks: Effective field size of flatness specified is 400 mm in diameter at SFD=1.5 m. Flatness is measured by density of film exposed.

4.5 Dual Energy

The dual energy specifications are given in Table 6. Select two operating energies:

Table 6

Model	Nominal Energy (MeV)	HVL (in)	Flatness (% @ ±7.5°)	Max. Dose Rate (Gy/min)
M9A	5.0	1.06	≥65.5	6.00
	6.0	1.10	≥62.0	10.0
	9.0	1.20	≥55.0	30.0

4.6 Desktop PC Control Console

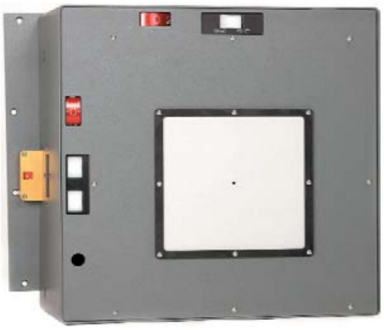
The desktop PC control console provides the same system control as the touch screen console but has a

4.7 Laser Alignment System

An internally mounted single spot laser is available to align the X-ray beam to an object being radiographed.

4.8 Variable External Collimator

The dependent jaw variable external collimator mounts to the front of the X-ray head. The field size varies between 1° and 24°. A rotating version is available that rotates over a range from -50° to +50°.



External Collimator with Rotation

4.9 Remote Customer Interface

A 37-pin Amphenol socket is provided on the modulator for interface to customers equipment. Signals include:

- External Trigger
- Emergency Off
- Remote Interlock
- Warning Lights
- Warning Alarm
- X-ray on Request
- Warm Up and Power On Status
- Fault Information and Reset

For a complete description of these signals, request document #100015302.

4.10 Small Focal Spot

1.0 to 1.5 mm available

**Maximum dose rate may be reduced*

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CE Marking

All Linatron-M models are designed and manufactured in accordance with the Electromagnetic Compatibility Directive 89/336/EEC and Low Voltage Directive 73/23/EEC.

ETL Marking

All Linatron-M models conform to UL STD 61010A-1 and are certified to CSA 1010.1.

Quality Standard

Varex Imaging Corporation, Las Vegas Facility, Quality Management Systems is registered to ISO 9001:2008.

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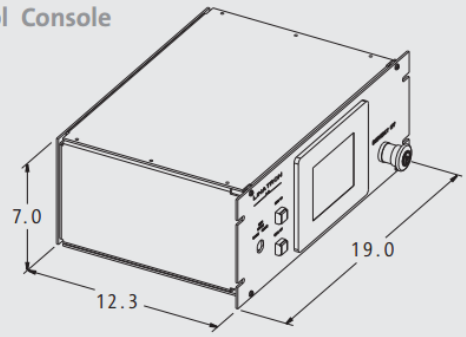
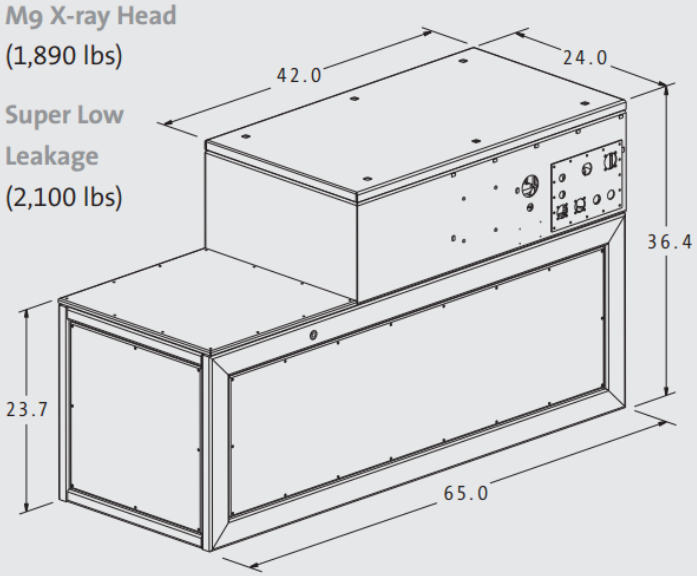
5.0 Physical Description

Control Console
(9 lbs)

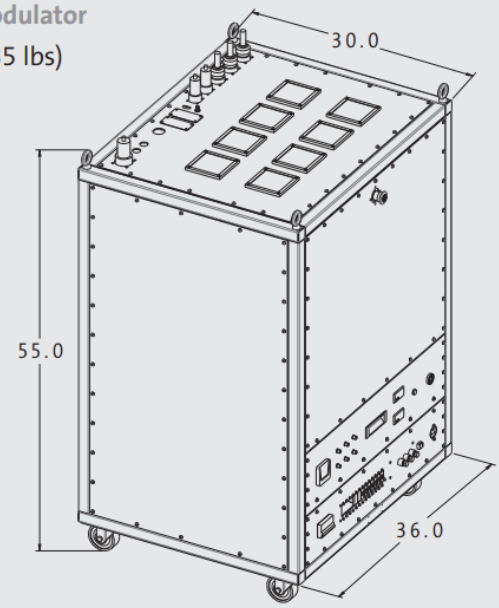


M9 X-ray Head
(1,890 lbs)

Super Low Leakage
(2,100 lbs)



Modulator
(735 lbs)



** Dimensions are in inches.*

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