

RS 320 X – ray research system

Technical Description

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1. Equipment overview

The RS320 research system has been designed to integrate seamlessly into the modern research facility; it enables the safe irradiation of samples within a laboratory environment.

The radiation leakage from the cabinet is ¹less than 20mSv in any calendar year. At this level of output Radiation monitoring procedures are kept to the legislated minimum, eliminating the regulatory burden and heavy cost associated with the use of radioactive substances.

The RS320 cabinet has been designed to be built in two separate enclosures, thereby reducing overall weight and space required to give a more compact answer to in house irradiation issues.

The motorised vertical shielded door means that the problems of bulky hinges topple factor and opening heavy lead shielded doors have all been eliminated.

Touch screen technology structured on Moeller HMI® multifunctional platform products provides world renowned design and reliability combined with simple to use processes.

Research programs can easily be formulated by the user and programmed into the system via the easy to follow, helpful touch screen interface.

The system can be Ethernet enabled, giving easy access to professional diagnostic and programming assistance.

¹ Based on 40 hours per week over a calendar year

2. X-ray Beam Specifications

The RS320 research system uses a metal ceramic 300kV X-ray tube. The assembly consists of an end grounded metal ceramic X-ray tube of advanced design with an integral high voltage receptacle and cooling system. It is enclosed in a ray-proof housing with fittings for water hose connections.

The MXR 321 tube provides increased homogeneity and a reduction in the “heel effect” of the tube.

X-ray Tube Output Limits:

Voltage	30 - 310 kV
Current	1.0 mA - 30mA
Power	3000W broad focus for designated stability

X-ray Tube Specification:

Focal spot size	8mm in the largest dimension
Target material	Tungsten
Inherent filtration	3.0 ± 0.1 mm Be
Tube power continuous max	3000W
Rating continuous max	62kV/16.0mA
Radiation coverage total	40°
Target angle	30°
Weight	40.0 kg

The system is supplied with a single filter holder. Up to 3mm of filter material can be inserted, to achieve the required half value layer for the research.

Dose Rate Stability

The system continuously monitors the kV and mA actual values. If these deviate by more than ±3% the system will automatically turn off.

- Reproducibility (as IEC 601-2-8)

The reproducibility of the time system for each energy is less than or equal to 1%.

- Linearity (as IEC 601-2-8)

The linearity of time system is better than ± 1% or 1cGy whichever is greater.

3. The Touch Panel Operator Console

The RS320 X-ray control console is a Moeller range HMI Panels. The configuration is touch operated and is provided with a 5.7" LCD or TFT monochrome display.

The processor architecture, driving the panel is a 64 bit RISC CPU operating on Microsoft Windows CE software.

Beam Start up Characteristics

The RS320 control console deals with all the routine elements of beam start up and beam warm up requirements. These characteristics are pre-programmed by Gulmay Medical Engineers to provide ease of use solutions for non technical operators, whilst maintaining secure and safe integrity over the operation of the x-ray dynamics of the equipment allowing reliable operation of the research system

Automatic Run up procedure

In order to maximise the X-ray tube life two run up procedures are programmed within the control system. The controller automatically displays the required run up procedure when the system is powered on.

Short (Daily) run-up 130kV to 315kV in 13minutes, with max kV running for 2 minutes
Long (Monthly) run-up 130kV to 315kV in 65 minutes, with max kV running for 5 minutes

If required, the daily run up procedure can be bypassed, the controller will continue to prompt the operator for the daily warm up before the start of each exposure. The bypass mode is password protected to avoid frequently switch off of the warm up procedure.

Operating Menus

The control console incorporates several menu screens. The screen can be password protected to prevent unauthorised access.

The standard screens provided are:-

- Start screen
- Help screen
- X-ray control screen
- Program screen
- Settings screen

Customer specific parameters can be programmed into the controller software, allowing repeatability of important experiments over lengthy periods, without the fear of operator error.

Data Format

All operations of the research control software are monitored and logged by the system. Error messages are constantly updated and may be downloaded via either the Ethernet (optional) connection or via Profibus/MPI to a remote PC.

4. Radiation Safety

Leakage Radiation

Leakage from the X-ray Cabinet assembly complies with DIN 54113

<1 μ S/h on surface of cabinet

Safety Interlocks

Hardware Interlocks

Safety key switch

Emergency Stop button

Irradiation chamber door interlock (two door switches)

Visual Interlocks

The following interlocks are visible on the Moeller Touch Panel.

Interlock	Comment
Irradiation Time	Stops irradiation at the defined time
Tube Voltage	Stops irradiation
Tube Current	Stops Irradiation
X-rays Off	Interrupt the exposure
X-rays Ready	Interlock circuit (Rack doors, cooler, key switch)
X-ray Warning lights	If this warning light fails, the exposure will be terminated.

Other Interlocks

Interlock	Comment
Key Interlock	Prevents unauthorised use of system
Low Tube Coolant Flow	Protects life of the tube
Excess Tube Coolant Temperature	Protects life of the tube

5. Filters & Applicators.

The flexible combination of adding filtration to the beam, collimation of the beam through the use of optional applicators or variable leaf collimators, provides a wide range of techniques to suit all research applications.

Filters

The RS320 research system is supplied with a single filter carrier, as standard.

A filter wheel can be supplied with the unit, as an optional extra; the filter wheel contains 6 filter holders. This enables the user to have a variety of filters / half value layers, for use on the system.

The filter wheel is encoded, preventing the operator from selecting the incorrect filter for a pre programmed exposure.

Applicators

The applicator assembly and additional applicators can be ordered with the research system. This option must be specified before production commences.

Applicators and collimators are manufactured from stainless steel.

6. Cabinet and Irradiation Chamber

The RS320 x-ray research system has been designed as a self contained, self supporting structure, which can be shipped and assembled on site in two connecting cabinets constructed from a rigid aluminium frame clad with easy clean side and front and rear panels

The electronics cabinet houses all the electronic equipment including the High Tension generator, cooler and uninterrupted power supply.

The irradiation cabinet houses the lead shielded irradiation chamber, x-ray tube, sample table and supports the Touch screen controller or TFT/LCD screen

Cabinet Dimensions:

Electronics Cabinet:	80cm W x 80cm D x 200cm H
Irradiation Cabinet:	89cm W x 85cm D x 1900cm H
Weight:	1,500kg Irradiation Cabinet 650kg Electronics Cabinet
Floor loading (per foot)	297Newtons per sq cm (Irradiation Cabinet)
Floor Loading Summary	1.8 Newton's per sq cm

Lead Shielded Irradiation Chamber

Internal chamber dimensions 60cm W x 65cm D x 68cm H (useable)

The irradiation chamber is accessed through a motor driven lead lined door. The door movements are vertical from floor (open) to eye level (closed). This means of access to the irradiation chamber enables considerable saving in space constraints.

The interior of the chamber is clad in Polypropylene, allowing for easy primary level disinfection and cleaning.

Specimen table

The specimen table is a Perspex plate which can be height adjusted by hand in 100mm steps.

Specimen Table Dimensions	50cm x 50cm
Minimum Distance Focal Spot to table central axis	20cm
Maximum Distance Focal Spot to table central Axis	70cm
Maximum Field Size at 70cm FSD	45cm Circle

7. The X-Ray Generator & Heat Exchange Equipment

The X-ray Generator

The RS320 system includes a CP 160 (Anode tank & Cathode tank), 3kW high voltage generator.

Specifications

Output Power	3200W maximum
Ripple	High frequency and line frequency total ripple envelope is 300 V peak to peak at full rated output
Voltage & Current Stability	short term – 0.05% / hour of set value long term – 0.1% / hour of set value
Voltage & Current Reproducibility	0.1%
Voltage & Current Accuracy	2% & 1%

Reproducibility and Linearity of the generator is assured by a direct output measurement with independent mA and kV control circuitry.

Heat Exchange Equipment

A closed circuit oil cooler is supplied with the RS320 system. The Oil is cooled through a heat exchanger by a thermostatically controlled 'lost water' system. Suitable drainage system must be available close to the site of the power control cabinet.

Noise level	47dBA (50hz)
External Water supply	Temperature 10-15degree Celsius, Difference Pressure 1-5bar

Equipment is mounted within the chamber, below the X-ray box. Great care is taken to ensure the integrity of the coolant system within the heat exchange equipment given the proximity of the High Tension Generator

Electrical Specifications

Voltage supply:	230/400V 50/60Hz, three phase +/-10%
Power Consumption:	40A phase to phase

Additional power regulator (+/-25%) can be supplied. Surge protection is recommended.

8. Optional Features

The following options are available with the RS320 systems:

Dosimetry Control.

The operator can switch between dose and time mode for the exposures. The ion chamber is mounted next to the tube, underneath the filter carriage. The system compensates for temperature and pressure changes.

Filter Wheel.

The wheel contains 6 filter holders. Each holder will take 4mm of filter materials.

The material can be changed by easily due to the threaded ring holders.

Each filter is interlocked in the control system. The wheel is rotated manually by the operator.

Applicators

Applicators are manufactured to customer requirements, field size and FSD. The applicators are not interlocked on the control system.

Laser System

Two red line lasers are mounted inside the irradiation cabinet and point to the central axis of the beam, between 30cm FSD and 50cm FSD. The lasers have a timer which helps extend the lifetime of the lasers.

CCTV system

The system consists of a 6 inch colour screen, built into the door panel of the irradiation cabinet. The camera is mounted in the top corner of the irradiation chamber. The screen automatically switches off when the cabinet door is opened.

Ethernet Enabled

Please contact Gulmay Medical for details on the modules available.