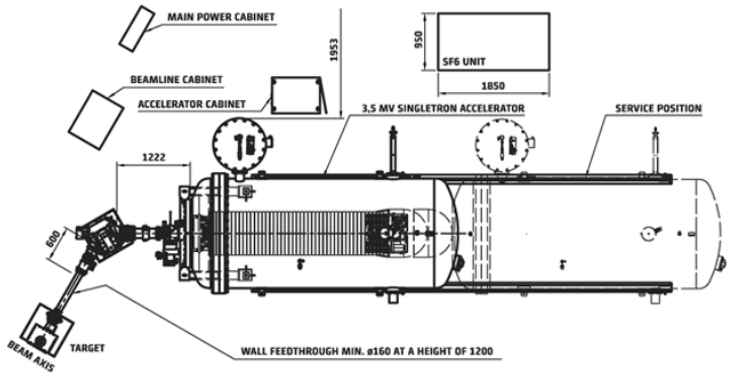
Electron beam X-ray radiation line

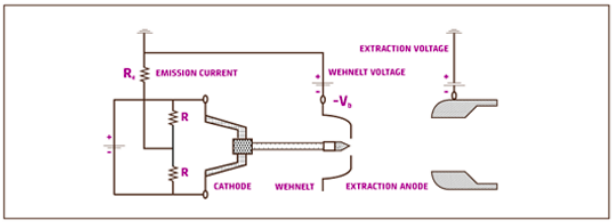
• The electron beam is generated by a 3.5 MV Singletron designed and produced by HVE for ATRON.

• This electrostatic electron accelerator has a floor space requirement of 10.4 x 6.9 m².

• The continuous electron beam, delivered on a removable conversion target, is adjustable in current (from pA to mA) and in voltage (from 0.2 to 3.5 MV) so that a very wide dose-equivalent rate range can be achieved from 0.1 µSv/h to 500 Sv/h at 1 m from the target.



ELECTRON SOURCE

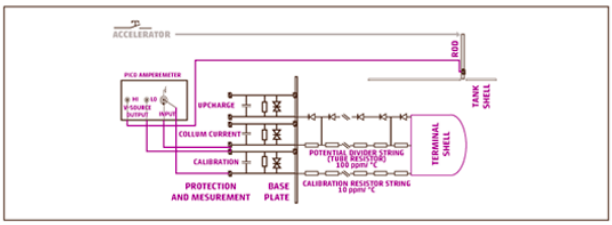


• The electron source consists of a 300 µm LaB6 cathode.

• The emission current is controlled both by the current of the filament and the voltage of a Wehnelt cylinder which surrounds it.

• It has a service life of 4000 hours at 1 mA.

ACCELERATOR ACCURACY

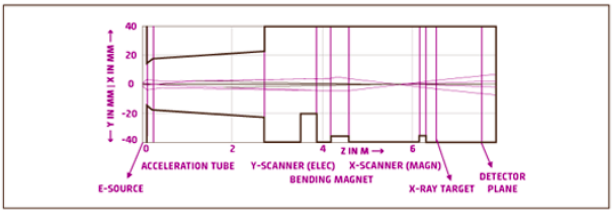


• The stability of the accelerating voltage is ensured by the measurements of a calibrated resistor string and a potential difference (GVM).

• The calibration string presents an accuracy of 0.15% and preliminary studies have shown a drift of less than 0.3% over an eleven-month period.

3.5 MeV Singletron HVEE e⁻-beam & X-rays

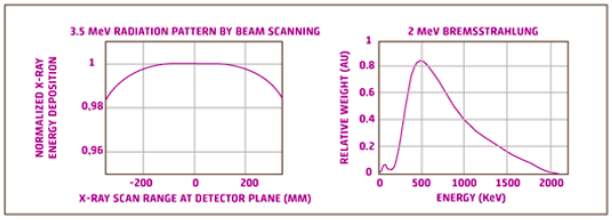
BEAM OPTICS



RADIATION FIELD

• The conversion target, measuring 40 x 220 mm², consists of a 1.5 mm tantalum layer attached to a copper support which facilitates its cooling.

• The 2.5 kW beam power is distributed on the target by a 1 kHz vertical scan. In addition, a triangular-shaped 25 kHz horizontal scan is applied in order to uniformise the radiation field over a range of ±15° with respect to the normal of the incident field.



• For a given beam energy, the energy spectrum of the X-ray radiation field produced by braking radiation (bremsstrahlung) extends from zero up to this energy and the resulting dose-equivalent rate is proportional to the current of the beam.

Geometry of the beam

Horizontal beam, at 120 cm from the floor
Electron window and removable X-ray target

Voltage (U): 0.2 – 3.5 MV

Stability: ± 350 V (short term), ~ 0.1 % (long term)
Accuracy: < 1 %
Reproducibility: ~ 0.1 %

Current (I): 1 pA – 1 mA up to 2 MV, 1 pA – 600 µA beyond

Stability: ~ 1 % + 2 pA
Accuracy: ~ 1 % + 2 pA

Electron beam scanning

1 kHz vertically
25 Hz horizontally with parameterisation

X-ray radiation field: 0.1 µSv/h – 500 Sv/h at 1 m

Uniformity < 2 % at ± 15°