

RISKS ASSOCIATED WITH ELECTRON TUBES



GENERAL

This document draws the attention of equipment makers and users to the possible risks associated with electron tubes, so that necessary personnel protection measures can be taken.

Electron tubes present a certain number of potential risks, by the very nature of the physical principles included in their manufacture or operation, and because of the materials used to make these tubes.

The operation of electron tubes under inappropriate conditions, either due to lack of care or knowledge, can lead to serious risks to life and limb of personnel, independent of the risk of tube destruction and/or equipment damage.

Equipment manufacturers and end users bear the responsibility for informing themselves, for protecting against these risks, and for respecting local safety laws and regulations.

It is the user's responsibility to refer to the specifications and recommendations for electron tube use, as well as to the documents provided by the manufacturers of systems incorporating these tubes,

WARNING

The following list is not exhaustive. The main known risks, which may or may not be associated, are described. The relative importance of each risk depends on the type of tube.

ELECTRICAL RISKS

The high voltage necessary for electron tube operation can be deadly. All operations must be performed solely by qualified personnel, specially trained for these operations.

Interlocks, grounding poles, etc. must prevent access to zones under voltage. Arrangements must also be made for capacitor discharge, e.g. bleeders, automatic grounding etc., after shutdown.

In fact, an electron tube itself constitutes a capacitor, and the appropriate measures must be taken to prevent handling of a tube until it has been completely discharged.

RF-RADIATION

The exposure of personnel to the electromagnetic fields produced by electron tubes, even at low frequencies, must be limited to the minimum possible.

RF- Radiation can also affect the operation of pacemakers.

Avoid all electromagnetic leakage. Special care must be taken with connections, joints, couplings etc.

Never operate a tube without it being connected to a suitable matched load.

X-RAYS

The harmful effects of the X-rays that may be generated by an electron tube increase as the operating voltage reaches 10 kV. The greater the tube current, the more dangerous the X-rays are.

The envelope of certain tubes can act as a screen or shield. In general, however, provision must be made for external X-ray shielding either around the tube only, or around the part of the equipment in which the tube is installed.

In practice, no detectable radiation appears for voltages of less than 20kV. Special operating modes can, however, lead to the appearance of measurable doses. We suggest, in all cases, to take readings so that adequate protective measures can be defined and implemented.

IMPLOSION

The electron tubes are evacuated devices and the force of the atmospheric pressure is applied to their envelope. The insulating parts, made of ceramics, are less mechanically resistant than those parts made out of metal. In the event of blows and strain, whether externally caused or spontaneous, the ceramic parts can break and implode violently, projecting dangerous debris.

Therefore, it is very important not to scratch the ceramic parts of a tube, nor subject them to mechanical or thermal stress.

HIGH TEMPERATURES

High-power electron tubes dissipate very large amounts of heat. The corresponding energy is removed by air or water. The cooling water can reach temperatures higher than 100 °C and several bars of pressure.

Therefore, the untimely opening or the burst of a line can release very hot water or steam, which can cause serious burns.

In case of cooling by circulating air, surface temperatures can reach several hundred degrees centigrade. The same applies also for certain tube parts, not directly cooled.

Temperature rise can sometimes continue even after tube shutdown, due to thermal inertia. Therefore, it may be necessary to continue cooling the tube for a certain time after shutdown.

Precaution and instructions must be established to prevent personnel from coming into contact with insufficiently cooled tubes.