

**The Swedish Radiation Protection Authority's Regulations
on Equipment for Industrial Radiography;**

issued on August 23, 1989.

On the basis of section 7 of the Radiation Protection Ordinance (1988:293) the Swedish Radiation Protection Authority has issued the following regulations.

Definitions

In these regulations the following terms and concepts are used with the meanings specified here.

<i>Tube unit: (x-ray tube unit)</i>	tube housing with mounted filter and x-ray tube; it may include a high voltage transformer and other details mounted in the housing, the whole unit in everyday speech often referred to as the "x-ray tube",
<i>x-ray equipment:</i>	a unit consisting of a tube unit, a high voltage transformer, a filament current transformer, an operating panel, operating and high voltage cables as well as accessories such as diaphragm, filters, support etc.,
<i>container:</i>	a radiation shielded box used for storage and transport of a radioactive source,
<i>gamma equipment:</i>	a unit consisting of an exposure container, a projection sheath with a radioactive source, a device for remote control, remote control cable and sheath, as well as accessories such as collimator etc.,
<i>equipment:</i>	x-ray equipment or gamma equipment,
<i>x-ray leakage radiation:</i>	radiation through the housing including accessories such as cap, diaphragm etc. outside the used primary beam,
<i>gamma leakage radiation:</i>	radiation from the container with the radioactive source in its storage position,
<i>operating panel:</i>	a unit containing controls for setting and instruments showing data for operation as well as a device to release and stop the exposure, key controlled switch etc.,
<i>sheath:</i>	a unit where the source is mounted, connected to the operating cable affording the source to be moved between the position of exposure and the secured position.

Applicability

1 § These regulations apply to equipment for industrial radiography or fluoroscopy that has been manufactured after the coming into force of these regulations.

For the use of the equipment conditions connected to licences for practice are given.¹

2 § The equipment shall, when it is delivered to be used or is exposed for marketing, meet the requirements in the sections 3 - 39, if not otherwise in special cases is stated by the Swedish Radiation Protection Authority.

X-ray equipment

3 § The x-ray tube unit shall be shielded in such a way that the dose equivalent rate due to leakage radiation at a distance of 1 metre from the focus of the x-ray tube at maximum power, does not exceed what is given by Table 1 for the voltages specified.

Table 1

Voltage setting	Dose equivalent rate
up to 150 kV	1 mSv/h
above 150 kV up to 200 kV	2.5 mSv/h
above 200 kV	5 mSv/h

If the equipment gives pulsed radiation, with dose equivalent rate shall be meant the dose equivalent in an hour at the largest pulse frequency for which the x-ray tube is designed.

4 § The x-ray tube unit shall normally be provided with a permanently mounted filter. The total filtering shall at least correspond to the values given in Table 2 at specified maximum voltages as inherent in the design of the x-ray tube.

Table 2

Maximum voltage	Total filtering
up to 50 kV	No requirement
above 50 kV up to 100 kV	2 mm Al
above 100 kV up to 200 kV	3 mm Al
above 200 kV up to 300 kV	4 mm Al
above 300 kV	0.5 mm Cu

5 § For special purposes, lower total filtering than specified in section 4 may be acceptable. In such cases additional filters shall be delivered together with the tube unit, intended to be used when low filtering is not needed. The additional filter shall be of a kind that affords compliance with section 4 when used. It shall be easy to mount and dismount.

If the equipment is provided with an additional filter, the permanently mounted filter shall be marked in a way that makes it clearly distinguishable from the additional filter.

¹ The conditions are replaced by the regulations and general advice (SSI FS 2000:8) on Radiography.

6 § A cap shall be delivered, together with the tube unit, intended to be used during test runs and warming up. The cap shall afford shielding to meet the requirements in section 3. It shall be easy to use.

There is no need to deliver a cap if the x-ray unit is to be used in an enclosed installation.

7 § Different diaphragms with various slit sizes shall be available to the tube unit. The diaphragms shall be used to limit the radiation field. The diaphragms shall afford shielding in accordance with section 3. They shall be easy to use.

8 § If the x-ray tube is radiating omni directionally, the radiation exit shall be clearly marked.

9 § Together with an x-ray tube unit of an omni directional type, devices shall be delivered able to limit the field of radiation into certain lobes. These devices shall meet the requirements on shielding as mentioned in section 3. The devices shall be easy to use.

10 § An x-ray equipment shall be designed in such a way that unintentionally grounding of an electric conductor does not imply emission of x-rays.

11 § An x-ray equipment shall be designed to afford remote control of the exposure release. This remote control shall only be operable via the manoeuvre cable.

12 § An x-ray equipment shall be designed in a way that exposure release is possible by ordinary means only. The exposure shall be able to interrupt.

13 § The manoeuvre cable shall normally have a length of at least 20 metres. However, for use of an x-ray tube unit in an enclosed installation, the manoeuvre cable may be shorter.

14 § The control panel shall be provided with a key-switch, having an effect on the exposure function only.

15 § The control panel shall be provided with two devices, that independently of each other, indicate when x-rays are emitted. One of these shall be a lamp with red light connected in such a way that no x-rays can be emitted in case of lamp failure.

A single fault should not imply that both devices become out of order.

16 § The control panel shall be provided with a lamp that indicates when the equipment is ready to emit x-rays.

17 § The control panel shall be provided with a device that allows the connection of a safety switch. This connector shall be arranged in such a way that restart is only possible with the aid of the remote control according to section 11, if the exposure has been interrupted by the safety switch.

18 § The control panel shall be provided with a device that allows the connection of an additional warning lamp. This connector shall be arranged in such a way that no x-rays can be emitted in case of lamp failure.

19 § The tube unit shall be marked, clearly and permanently, with

1. the maximum tube voltage and power,
2. the divergence angle of the beam without the slit diaphragm and
3. the filtering without additional filters.

20 § A tube unit provided with a beryllium filter or equivalent only, thus affording a low degree of filtering, shall be provided with a warning text in Swedish giving the information that this tube unit gives an extremely large dose-rate.

21 § At delivery, a summarised manual, in Swedish, shall be included, telling in what way the equipment normally shall be used. This manual shall be permanently affixed at, or in the proximity of the control panel. The manual shall clearly state that an x-ray equipment is of concern and it may be used only by authorised persons having an adequate education in radiation protection regarding the practice.

22 § At delivery, a comprehensive manual shall be supplied, giving information on the design of the equipment and making service and maintenance possible from a radiation protection point of view.

Gamma-equipment

23 § Gamma-equipments shall meet the requirements in Swedish Standard SS-ISO 3999, issue 1, 15th of February 1979.

24 § A portable or mobile container shall meet the requirements for containers of type B(U) according to the regulations on transports that apply when these regulations enter into force. At delivery, such a container shall be provided with a certificate issued by an organisation that can be approved by the Radiation Protection Authority.

25 § A gamma-equipment shall be provided with a device that affords remote control of the radioactive source. Use of the remote control shall be the only way to bring the source out of and into the storage position.

26 § The remote control shall have affixed, clearly visible and permanently, an instruction for the use in order to start and stop exposure.

27 § If there are no special circumstances, the equipment shall at delivery be provided with a remote control system not shorter than 15 metres.

28 § It shall not be possible to detach the remote control cable unintentionally from the remote control system.

29 § It shall be possible to mount the remote control cable mechanically to the remote control system. It shall not be possible to detach this assembly unintentionally.

30 § The container must only contain one radioactive source.

31 § The container shall

1. be provided with a lock that ensures that the radioactive source remains in the storage position,
2. be possible to unlock only with a unique key,
3. be possible to lock without a key and
4. be possible to lock only when the source is in the storage position.

32 § The container shall be shielded so the dose equivalent rate does not exceed what is stated in table 3. The values in table 3 apply on the specified positions when the container is locked and contains a source of the nuclide and maximum activity for which the container is designed.

Table 3

Position	Dose equivalent rate
Surface of the container	2000 $\mu\text{Sv/h}$
At a distance 1 metre from the surface	20 $\mu\text{Sv/h}$

33 § Remote control sheaths of different lengths, from 0.5 metre and longer, shall be deliverable.

34 § A remote control sheath must not be joint and must not be designed to allow joining.

35 § It shall only be possible to bring out the radioactive source from the storage position when the remote control cable is correctly attached to the remote control system and the exposure hose is correctly attached to the container.

36 § A collimator shall be deliverable to every equipment. The collimator shall limit the field of radiation and reduce the dose equivalent rate so it is no more than 1 percent in directions that are not used.

37 § The collimator shall be provided with a device that ensures that it can easily and safely be affixed to the object of radiography.

38 § The equipment shall be provided with caps that prevent water or dust to enter the container or the exposure hose. The caps shall be affixed at the proximity of the openings with chains or similar.

39 § The equipment shall be provided with a manual in Swedish that describes the normal use. The manual shall clearly state that the equipment must only be used by persons with adequate education.

These regulations enter into force on January 1st 1990.