24Fluoroscopes (X-ray Equipment)

Scope

1. Non-medical X-ray fluoroscopes are widely used for the examination of postal packages, luggage and other baggage. The fluoroscopes may be installed or portable. They may be of a compartment type allowing continuous viewing of the X-ray image of a package, or a conveyor type where images are converted to digital form and viewed on a computer monitor. Although very high radiation dose rates may exist within the equipment, design is such as to minimise exposure to operators and others. Operation of such equipment is subject to the Ionising Radiations Regulations 2017 (IRR17). This chapter describes the radiation safety arrangements that employers must put in place to ensure compliance with the regulations.

2. This Chapter does not cover the radiation safety requirements for maintenance and testing of such fluoroscopes. Nor does the scope of this chapter extend to the operation of X-ray generators for purposes other than postal and baggage security scanning by fluoroscopy. Separate Chapters cover high voltage equipment (Chapter 23), industrial radiography, pulse and flash X-ray equipment (Chapter 28), medical diagnostic X-ray (Chapter 26), Dental X-ray (Chapter 25) and Veterinary X-ray (Chapter 27).

Statutory requirements and parallel arrangements

3. In addition to the general requirements of the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, the following specific legislation applies directly:

   a. Ionising Radiations Regulations 2017 (IRR17).

Duties

4. Duties as detailed in Chapter 39 apply. In addition, the following duties also apply.

Radiation Protection Supervisor (RPS)

5. An RPS must be appointed in respect of any area designated as controlled or supervised. However, area designation is not normally necessary where the only work with ionising radiation in the area is the operation of postal and baggage fluoroscopes. Where an RPS is appointed, they are to ensure that work is carried out in accordance with the local orders for radiation safety which are to include the requirements of this chapter. Further information on the requirements for designated areas is given in Chapter 4.

Workplace Supervisor (WPS) (X-ray)

6. In units operating postal or baggage fluoroscopes but where it is unnecessary to appoint an RPS, a WPS (X-ray) is to be appointed with duties to ensure that work is carried out in accordance with the local orders which are to include the requirements of this chapter.

Hazards

7. X-ray generators used in postal and baggage fluoroscopes generate high in-beam dose rates capable of delivering up to a few mSv per minute. However, design of such equipment is to ensure that dose rates to operators are normally restricted to no more than 1 μSv/h. Faults or other occurrences, which may be reasonably foreseeable, could reduce the effectiveness of shielding and lead to higher dose rates – such X-ray leakage may give a general increase in exposure levels or may be confined to narrow beams (streaming pathways).

8. During maintenance work, involving access (by a suitably qualified engineer) to internal components, higher dose rates may be encountered.

Risk assessments for postal and baggage fluoroscopes

Risk assessment at procurement

9. In the acquisition of equipment which may emit ionising radiation, safety and environmental management is to begin at the requirements definition stage of procurement and is to be carried forward through service to disposal in accordance with the requirements in Chapter 1 and Chapter 2. All aspects of maintenance and operation (including military service) are to be taken into account. Those managing the procurement process and specification development of the equipment which may emit ionising radiation are to assess the risk areas and recommend solutions to reduce the risks to as low as reasonably practicable. Where possible, those managing the procurement are to produce a generic risk assessment, which is to be made available to users.

Risk assessment for users

10. A risk assessment is to be carried out by the unit or establishment in consultation with the Radiation Protection Adviser (RPA) prior to any new activity involving X-ray fluoroscopes. This risk assessment is to take into account information from the manufacturer, the generic risk assessment carried out at the procurement stage (if available) and take into account the recommended solutions to reduce risk provided by the acquisition process and the local conditions of use. Details of the form of the risk assessment and the actions to be taken arising from it are described in Chapter 2. Risk assessments are to be reviewed as detailed in Chapter 2.

11. The following are key inputs into the risk assessment:

a. advice from the manufacturer or supplier and information from the PT if applicable;

b. RPA information and advice – the Dstl RPA may be able to provide detailed hazard and risk assessment information on the equipment;

c. radiation survey information – estimated dose rates when operating and during maintenance (if carried out);

d. planned systems of work and routine operation profile e.g. hours per day, per shift etc.;

e. personnel access and occupancy of areas subject to levels of ionising radiation;

f. assessment of reasonably foreseeable fault conditions and resultant dose rates; and

g. assessment of the impact of reasonably foreseeable accidents / incidents.

Design of postal and baggage fluoroscopes

12. Non-medical fluoroscopes are normally to be designed such that the dose-rate on the external surface of the equipment or at any routinely accessible opening does not exceed 2.5 µSv/hr so that the dose to any person does not exceed 1 mSv in a year. Where the equipment is used in a public place, this value is not to exceed 1 µSv/hr.

13. Automatic equipment, such as a conveyor belt security X-ray machine, where the production of X-rays is triggered by the presence of a parcel, are to be designed so that cutting the power to the conveyor belt will prevent X-ray production. An emergency stop button to isolate the power to the conveyor is also to be located at the entry and exit ports to the X-ray chamber and where appropriate, also at the control panel.

14. The fluoroscope should include design features or safety devices that prevent anyone reaching inside it to an area where the dose-rate exceeds 7.5 µSv/hr.

Warning signals

15. A warning light is to be provided on the equipment to indicate when X-rays are being generated. For non-medical fluoroscopes in which the control panel is not within sight of the fluoroscope, an additional warning light is to be provided on the control panel. Notices are to be displayed to indicate the purpose of the warning lights.

16. All warning lights are to be tested on an annual basis and following any maintenance or repair. Records are to be kept of the tests to indicate the type of test carried out and when the next test is due.

Installation

17. The installer of the equipment has a number of duties imposed by IRR17, in particular:

a. they must carry out a critical examination of the way in which the equipment has been installed ensuring that safety features and warning devices operate correctly and that there is sufficient protection for persons from exposure to ionising radiation;

b. they must consult with their RPA or with the operator's RPA with regard to the extent of the critical examination and in regard to the results of that examination; and

c. they must provide the employer (the employer being the operator of the fluoroscope e.g. the CO, Head of Establishment) with adequate information about proper use, testing and maintenance of the equipment.

18. The employer must consult their RPA regarding the plans for installing the equipment in relation to engineering controls, design features, safety features and warning devices. They are also to consult the RPA regarding the acceptability of the test results of the critical examination and the requirements and results of any further commissioning tests or radiation surveys.

19. The employer is to ensure that they understand the information provided by the manufacturer and installer and that a radiation survey is carried out prior to first use.

20. The fluoroscope is not to be operated until any deficiencies identified in the initial inspection have been repaired by a suitably qualified person, and the fluoroscope has been re-inspected and monitored.

Maintenance

21. The employer must ensure that engineering controls, design features, safety features and warning devices are properly maintained, examined and tested at suitable intervals (typically annually). The employer is to arrange maintenance and testing in accordance with the manufacturer's information, Chapter 8 (Radiation Monitoring Instruments) and the advice of the RPA.

22. Records must be kept of the examinations and tests to identify if any faults were found, how they were rectified and when the next examination or test is due.

23. In many cases, it is permissible for employers to hand-over the area in which the equipment is housed to maintenance staff. In this case, the employer is to ensure that suitably competent staff will undertake the maintenance / repair and that it is clear that the maintenance employer has control of the area – the maintainer is to then operate to their own local orders. If this arrangement is inappropriate, then the employer retains all safety responsibilities and must ensure that local orders are adequate to cover the maintenance task and that appropriate training of their own supervisory staff has been carried out. If the maintenance requires area designation, then an RPA must be consulted.

Operating instructions

24. A set of operating instructions is to be drawn up by the unit or establishment for each fluoroscope. Each operator is to comply with the operating instructions.

Local Orders for Radiation Safety

25. The requirements for radiation safety are to be drawn up in accordance with Chapter 16. The local orders are to include the requirements for periodic radiation surveys, as advised by the manufacturer or RPA, and are also to specify dose rate action levels. RPA advice is to be sought regarding the action levels and the action to be taken if they are exceeded.

Security

26. The equipment is to be kept locked and secured when not in use. If key controlled, the key is to be kept in safe custody; the names of persons authorised to draw the key are to be recorded.

General Safety Requirements

27. Where reasonably practicable, fluoroscopes are to be fitted with interlocks to prevent access to the examination compartment during X-ray emission.

28. The condition of lead impregnated rubber curtains is to be checked regularly. Any damaged curtains are to be repaired or replaced immediately.

29. Fluoroscopes are to have viewing facilities which do not permit direct viewing of the fluoroscopy screen.

30. No alterations or additions are to be made to fluoroscopes after installation except by qualified, authorised staff.