International Tables for Crystallography (2006). Vol. C, Section 10.1.3, pp. 960–961.

Table 10.1.2. *Maximum primary-dose limit per quarter [based on National Health and Medical Research Council (1977), as amended]*

Note: The annual MPD is typically twice the quarterly MPD

Part of body	MPD (i) (workers)	MPD (ii) (public)
Gonads, bone marrow, whole body	**30 mSv** (3 rem)	**2.5 mSv** (2.5 rem)
Skin, bone, thyroid	**150 mSv** (15 rem)	**15 mSv** (1.5 rem)
Hands, forearms, feet, ankles	**400 mSv** (40 rem)	**35 mSv** (3.5 rem)
Organs (including eye lens)	**80 mSv** (8 rem)	**7.5 mSv** (0.75 rem)
Abdomen of female of reproductive age	**13 mSv** (1.3 rem)	**1 mSv** (0.1 rem)
Foetus between diagnosis of and completion of a pregnancy	**10 mSv** (1 rem)	

Note: The maximum primary dose limits as set here are advisory only, and ultimately one should strive to achieve an MPD limit as low as reasonably achievable (often referred to by the acronym ALARA), economic and social factors being taken into account.

Table 10.1.3. *Quality factors (QF)*

Type of radiation	QF
X-rays, γ-rays, and electrons	1
Neutrons, protons, singly charged particles of rest mass not greater than one atomic mass unit of unknown energy	10
α particles and multiply charged particules	20

1 Sv = (dose in grays) $\times$ QF.

10.1.1.37. *Useful beam*

That part of the primary and secondary radiation that passes through the aperture, cone, or other device for collimating a beam of ionizing radiation.

10.1.2. Objectives of radiation protection

Radiation protection is concerned with the protection of individuals, their offspring, and society as a whole, at the same time allowing for the participation in activities for which radiation exposure might take place. There are two aspects of these deleterious effects: the somatic effects which become manifest in the individuals themselves, and the hereditary effects which become manifest in their descendants.

For the dose range involved in radiation protection, hereditary processes are regarded as being stochastic (thresholdless) processes. Some somatic effects are stochastic, and carcinogenesis is considered to be the chief risk at low doses and therefore a significant problem in radiation protection.

Non-stochastic processes are specific to particular tissues, *e.g.* damage to the cataract of the eye lens, non-malignant damage to the skin, damage to the bone marrow causing depletion of the red-cell count, and gonadal cell damage which impairs fertility. For these changes, the severity of the effect depends on the dose received and a clear threshold exists below which no detrimental effect has been found to occur.

A balance has to be achieved between the risk of damage to individuals and the benefits to society in the use of the ionizing radiation in experiments. Bearing this in mind:

(i) no practice ought to be adopted unless its introduction produces a positive net benefit;
(ii) all exposures should be kept as low as reasonably achievable under the existing economic and social circumstances;
(iii) the dose equivalent to individuals should not exceed the limits indicated in Table 10.1.2.

10.1.3. Responsibilities

10.1.3.1. *General*

In laboratories using ionizing radiations, a clearly defined chain of responsibility has to be established with the employer accepting the responsibility for the provision of services and equipment for the implementation of radiation-protection procedures under whatever legal or administrative procedures are valid for the country in question.

10.1.3.2. *The radiation safety officer*

The radiation safety officer (RSO) is responsible for the controlled areas within a given establishment. He (or she) is responsible to his employer for the implementation of a radiation-protection programme. His duties will vary according to the legislation and administrative arrangements applicable to his institution but will include, *inter alia*:
(i) giving advice on working practices to management and employees;
(ii) monitoring and surveying all controlled areas;
(iii) maintaining all equipment for monitoring radiation levels, including personal radiation monitoring devices;
(iv) keeping records of radiation levels in controlled areas, dosages to employees, stocks and locations of all radioactive materials and irradiating apparatus;
(v) keeping in safe custody all radioactive materials;
(vi) arranging the safe disposal of all radioactive waste;
(vii) preparing the local rules concerning accident safety and emergencies;
(viii) recording and reporting to the appropriate authorities all breaches of the radiation-protection rules.

10.1.3.3. *The worker*

In English common law, the employer is responsible for the actions of his employees but this does not absolve personnel from a duty of care to their fellows. Ultimately, the responsibility for radiation protection lies with the worker concerned. He (or she) should:
(i) ensure that he has an appropriate radiation dosimetry device and wears it;

(ii) inform the RSO whenever he is to work with radioactive materials or irradiating devices;

(iii) report to the RSO all known or suspected unsafe situations;

(iv) be aware of the directionality of scattered beams, particularly in the case of X-rays scattered from extended single crystals;

(v) be familiar with the relevant codes of practice as laid down in legislation and local instructions.

10.1.3.4. *Primary-dose limits*

Two classes of people are envisaged

(i) persons exposed to ionizing radiation in the course of the pursuance of their duties,

(ii) members of the general public.

In Table 10.1.2, the *maximum primary dose* (MPD) for those in class (i) and class (ii) is tabulated. SI units are shown in bold type, and the earlier units are shown in parentheses in light type.

Planned special exposures are permissible in emergency circumstances provided that in any single exposure twice the annual dose limit is not exceeded, and in a lifetime five times the limit.

Also, to allow for the different biological effectiveness of different types of radiation, the *quality factor* listed in Table 10.1.3 is applied to determine the dose.

references