

37—Industrial Hygiene

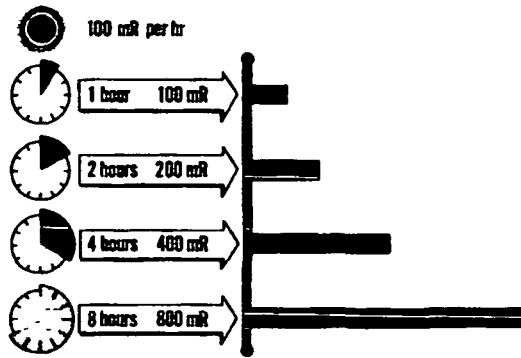


FIG 37-12 —The effect of time on radiation exposure is easy to understand. If we are in an area when the radiation level from penetrating external radiation is 100 mR/hr, then in 1 hr we would get 100 mr (millirems). If we stayed 2 hr, we would get 200 mr, and so on.

From U.S. Atomic Energy Commission, "Living With Radiation—Fundamentals."

will be reduced by a factor of $(\frac{1}{3})^2$ or $\frac{1}{9}$. Fig 37-14 shows how the effect of distance on radiation exposure follows the inverse square law. Thus, by simply putting 3 ft of space between a worker and the source, the radiation level has been reduced by a factor of almost ten.

Shielding is commonly used to protect against radiation from radioactive sources. The more mass placed between a source and a person, the less radiation the person will receive. If the mass is concentrated, as in lead, the barrier thickness required for the same degree of protection will be less than it would be for a less dense material such as packed earth.

This introduces another important term—half value layers (HVL). Tables of HVL are given in radiation handbooks and typical values for two radioactive materials, cobalt-60 and cesium-137, are given in this table.

	Cobalt-60	Cesium-137
Lead	0.49 in	0.25 in
Copper	0.83	0.65
Iron	0.87	0.68
Zinc	1.05	0.81
Concrete	2.6	2.1

Using concrete as an example, the table states that a 2.6-inch layer or thickness of concrete will reduce the gamma radiation coming from any cobalt-60 source by a factor of $\frac{1}{2}$. If the gamma emitter is cesium-137, then the half-value layer for concrete becomes 2.1 in.

Why?

Because the gamma radiation from cesium-137 is lower in energy (not as many Mev's) than the gamma radiation from cobalt-60.

A mental tool of considerable value that can be used for gamma emitters only is the formula

$$R/\text{hr}/1 \text{ ft} \cong 6 \text{ CE}$$

This rule of thumb states that the number of roentgen per hour measured at a distance of one foot from a source is approximately equal to six times the curie strength (C) of the source, times the energy (E) of the source. It cannot be used for estimating beta radiation levels.

If the name of the radioactive source is known and its quantity (or activity) in curies is known, as is usually the case, the value for its energy in Mev can be obtained from handbooks.

Two words of warning are required when this formula is used:

- Some radioactive materials, such as cobalt-60, emit more than one gamma, each with different energies. The sum of the energy of the total emissions must be used. This kind of information is given in handbooks.

- Terms must be consistent. If the source activity is given in millicuries or microcuries, it must be converted to curies. If millicuries are used to work the problem, then the answer is in milliroentgens.

Available guides

The fifth basic concept is that guides setting forth Maximum Permissible Doses (MPD) of ionizing radiation are available. It will not be possible to discuss these guidelines in detail. References that should be studied are *Permissible Dose from External Sources of Ionizing Radiation* (NBS Handbook 59) and *Maximum Permissible Body Burdens and Max-*