anomalies and discrepancies are detected among what is expected and what is given.

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Administrative Criteria for the "Designation" of Persons working with Unsealed Sources of Radioactive Substances

WORK with radioactive substances in universities and hospitals is subject to codes of practice[1,2] which require the "designation" of a person unless it is most unlikely that they will receive more than three-tenths of the annual maximum permissible dose. This criterion is easier to apply to persons exposed to external radiation only than to those using unsealed radioactive substances where there is the additional requirement of adequate precautions against contamination. I shall set out here criteria for designating individuals working with unsealed sources.

Monitoring has shown that persons working with unsealed sources at the University of Leeds have received much less than three-tenths of the maximum permissible dose from external radiation and this is supported by similar experiences elsewhere[3,4]. In these circumstances, designation has to be related to the hazards of inhalation or ingestion. I shall consider two cases: first, exposure after an accident involving an unsealed source and, second, chronic exposure to small losses during experimental work.

Considering exposure after an accident, assume that there is not more than one accident per month. Designation is necessary unless the quantity handled is limited so that, in an accident, the person will be most unlikely to take in more than three-tenths of the monthly maximum permissible intake (calculated as three-tenths of one-twelfth of the annual intake from the data for continuous exposure[5]).

Franke, Herrmann and Hunzinger[6] have taken as the critical parameter in an accident the inhaled fraction of the total activity handled (IFTAH) and have calculated the values given in Table 1. These range from 1×10^{-8} for an explosion in a glove box to 1×10^{-5} for splashing during distillation. Taking the largest IFTAH, that is, 10^{-5}, with a factor of 10 to represent the phrase "most unlikely", the resulting factor of 10^{-4} has been used to relate three-tenths of the monthly maximum permissible inhalation to the maximum activity which can be handled at any time. Results for some commonly used radionuclides are given in column *B* of Table 2, which therefore represent the maximum activity of each radionuclide which a person may handle at one time so that it is most unlikely that he will take in more than three-tenths of the maximum permissible intake provided that he does not have more than one accident per month.

Table 1. INHALED FRACTION OF TOTAL ACTIVITY HANDLED FOR ACCIDENTS INVOLVING SOME TYPES OF OPERATION

	Glove box	Ventilated area	Non-ventilated area
Solids	1×10^{-7}	3×10^{-8}	
Ambient temperature	1×10^{-3}	2×10^{-7} 4×10^{-7}	7×10^{-7}
Aqueous solution		5×10^{-7}	
Ambient temperature		3×10^{-8} 4×10^{-7}	
Elevated temperature		7×10^{-6} 1×10^{-5} 3×10^{-6} 3×10^{-6}	

This table is taken from ref. 6.

Table 2. MAXIMUM ACTIVITY WHICH MAY BE USED BY A NON-DESIGNATED INDIVIDUAL

A Radionuclide	*B* Maximum activity to be handled at one time (mCi)	*C* Maximum turnover in experiments per quarter (mCi)
^{3}H (water)	$3{\cdot}7 \times 10^{3}$	110
^{14}C (CO_2)	$1{\cdot}8 \times 10^{3}$	48
^{22}Na (soluble)	$1{\cdot}1 \times 10^{2}$	2·4
^{31}Si (soluble)	$3{\cdot}7 \times 10^{3}$	55
^{32}P	$3{\cdot}7 \times 10$	1·1
^{35}S	$1{\cdot}6 \times 10^{2}$	3·6
^{36}Cl (soluble)	$1{\cdot}8 \times 10^{2}$	4·8
^{42}K (soluble)	$1{\cdot}3 \times 10^{3}$	18
^{45}Ca	$1{\cdot}8 \times 10$	0·54
^{47}Ca (soluble)	$1{\cdot}1 \times 10^{2}$	3·0
^{59}Fe (soluble)	$9{\cdot}1 \times 10$	1·2
^{60}Co (soluble)	$1{\cdot}8 \times 10^{2}$	3·0
^{65}Zn (soluble)	$7{\cdot}3 \times 10$	2·2
^{85}Kr (gas)	$5{\cdot}5 \times 10^{3}$	170
^{90}Sr	$1{\cdot}8 \times 10^{-1}$	0·0018
^{125}I	$1{\cdot}3 \times 10$	0·30
^{131}I	5·5	0·12
^{133}Xe (gas)	$5{\cdot}5 \times 10^{3}$	170
^{203}Hg	$3{\cdot}7 \times 10$	1·1
^{204}Tl (soluble)	$3{\cdot}7 \times 10^{2}$	6·0
^{226}Ra	$1{\cdot}8 \times 10^{-2}$	0·00018
$^{nat.}$U (soluble)	$5{\cdot}5 \times 10^{-2}$	0·0016

Considering chronic exposure to small doses during experimental work, assume that it is most unlikely that a person will lose during the course of an experiment more than one-tenth of the activity used and then take in more than a tenth of the tenth lost. The resulting factor of a hundredth has been used to relate three-tenths of the quarterly maximum permissible intake by inhalation or ingestion, whichever is the smaller, to the maximum turnover which a non-designated individual may use in one quarter. (The quarterly maximum permissible intake has been calculated as a quarter of the annual.) The results given in column *C* of Table 2 represent the maximum turnover per quarter which a person may use for experiments so that it is most unlikely that he will take in more than three-tenths of the maximum permissible intake.

Table 2 therefore provides an administrative basis for the designation of persons working with unsealed sources when the limiting factor is internal irradiation. The factors used in arriving at the figures in Table 2 could be refined, but it must be remembered that the object is not to estimate hazardous levels accurately but to provide levels below which it is justifiable not to designate workers with open sources.

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