Appendices to Part 4: Standards for Protection Against Radiation

Effective April 1994

KAR 28-35-133 through KAR 28-35-363

State of Kansas • Department of Health and Environment
Division of Environment • Bureau of Air and Radiation
Radiation Control Program
Topeka, Kansas

APPENDIX A

Appendix A. Protection factors for respirators[1].

Description[2]	Modes[3]	Protection Factors[4] Particulates only	Protection Factors[4] Particulates, gases, vapors[5]	Tested & Certified Equipment: National Institute for Occupational Safety and Health & Mine Safety and Health Administration tests for permissibility
(a) AIR-PURIFYING RESPIRATORS[6]				
Facepiece, half-mask[7]	NP	10		30 CFR 11, Subpart K.
Facepiece, full	NP	50		
Facepiece, half-mask full, or hood	PP	1000		
(b) ATMOSPHERE-SUPPLYING RESPIRATORS				
(1) Air-line respirator				
Facepiece, half-mask	CF		1000	
Facepiece, half-mask	D		5	
Facepiece, full	CF		2000	
Facepiece, full	D		5	30 CFR 11,
Facepiece, full	PD		2000	Subpart J.
Hood	CF		[8]	
Suit	CF		[9]	[10]
(2) Self-contained breathing apparatus (SCBA)				
Facepiece, full	D		50	
Facepiece, full	PD		10,000[11]	30 CFR 11,
Facepiece, full	RD		50	Subpart H.
Facepiece, full	RP		5,000[12]	
(c) COMBINATION RESPIRATORS				
Any combination of air-purifying and atmosphere-supplying respirators	Protection factor for type and mode of operation as listed above			30 CFR 11, Sec. 11.63(b).

(d) FOOTNOTES

(1) For use in the selection of respiratory protective equipment to be used only where the contaminants have been identified and the concentrations, or possible concentrations, are known.

(2) Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. Hoods and suits are excepted.

(3) The mode symbols shall be defined as follows:

CF = continuous flow;

D = demand;

NP = negative pressure, that is, negative phase during inhalation;

PD = pressure demand, that is, always positive pressure;

PP = positive pressure;

RD = demand, recirculating or closed circuit; and

RP = pressure demand, recirculating or closed circuit.

(4)(A) The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment, usually inside the facepiece, under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

(B) The protection factors shall apply:

(i) only for individuals trained in using respirators and wearing properly fitted respirators that are used and maintained under supervision in a well-planned respiratory protective program;

(ii) for air-purifying respirators only when high efficiency particulate filters, above 99.97% removal efficiency by thermally generated 0.3 μm dioctyl

phthalate (DOP) test or equivalent, are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards;

(iii) for atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided the quality and quantity required in accordance with the national institute for occupational safety and health and the mine safety and health administration certification described in 30 CFR 11. Oxygen and air shall not be used in the same apparatus. No adjustment shall be made for the use of sorbents against radioactive material in the form of gases or vapors.

(5) For radioactive contaminants that present an absorption or submersion hazard, the following protective factors shall be used rather than those in (a), (b) and (c) above. For tritium oxide, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of less than 2 shall be used when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for respiratory protective equipment is 5, the effective protection factor for tritium shall be 1.4; with protection factors of 10, the effective factor for tritium oxide shall 1.7; and with protection factors of 100 or more, the effective factor for tritium oxide shall be 1.9. Air-purifying respirators shall not be suitable for protection against tritium oxide. See also footnote 9 concerning supplied-air suits.

(6) Canisters and cartridges shall not be used beyond service-life limitations.

(7) Under-chin type only. This type of respirator shall not be considered satisfactory for use where it might be possible, such as, if an accident or emergency were to occur, for the ambient airborne concentrations to reach instantaneous values greater than 10 times the pertinent values in Appendix B, Table I, Column 3. This type of respirator shall not be considered suitable for

protection against plutonium or other high-toxicity materials. The mask shall be tested for fit prior to use, each time it is donned.

(8)(A) Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained.

(i) A protection factor of not more than 1000 may be utilized for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet per minute (0.17 m^3/min) is maintained and calibrated air line pressure gauges or flow measuring devices are used.

(ii) A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment, this rate is greater than 6 cubic feet per minute (0.17 m^3/min) and calibrated air line pressure gauges or flow measuring devices are used.

(B) The design of the supplied-air hood or helmet, with a minimum flow of 6 cubic feet per minute (0.17 m^3/min) of air, may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres.

(9) Appropriate protection factors shall be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with a respirator or other apparatus appropriate for the potential hazards and communications equipment whenever supplied-air suits are used.

(10) No approval schedules are currently available for this equipment. Equipment shall be evaluated by testing or on the basis of reliable test information.

(11) This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure, such as skin absorption, shall be taken into account in such circumstances.

(12) Quantitative fit testing shall be performed on each individual, and no more than 0.02% leakage shall be allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus shall be considered unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer.

(e) Notes.

(1) Protection factors for respirators approved by the U.S. bureau of mines and the national institute for occupational safety and health, according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances shall take into account applicable approvals of the U.S. bureau of mines and the national institute for occupational safety and health.

(2) Radioactive contaminants, for which the concentration values in Appendix B, Table I, Column 3, are based on internal dose due to inhalation, may present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.