to the external radiation emitted from the exposed radionuclide and to the often more serious problem of ingestion into the body particularly through inhalation. Since the radiotoxicity hazards of the radionuclides vary by eight orders of magnitude,[2] a realistic set of standards should take into account which isotope is being transported. For this reason each radioisotope is classified, for transport purposes, into one of seven transport groups, labeled by Roman numerals I through VII according to their relative toxicity and potential hazard. A list of the radionuclides and their respective transport groups is found in 10 CFR 71, Appendix C (Appendix D-1, this document), and in 49 CFR 173.390.

Radioisotope quantities in each transport group are classified in order of increasing quantity, as "exempt," "Type A," "Type B," and "large quantity." The reason for this classification will become apparent in the next section. The limits for these quantity groupings are shown in Table II-1.

Certain physical forms of a radioactive material of any of the seven transport groups are classified as "special form" and are subject to the quantity limits shown in Table II-1 under "Special Form." A special form material is essentially non-dispersible in water or in a fire. The complete definition is found in 10 CFR 71.4(o) (See Appendix D-1, this document) and in 49 CFR 173.389.

Any radioactive material which does not qualify as a special form material is considered "normal form" and is categorized according to its transport group. While a special form material could, in the event of a severe

TABLE II-1

QUANTITY LIMITS FOR THE SEVEN TRANSPORT GROUPS AND SPECIAL FORM

Transport Group	Exempt Quantity* (Curies)	Type A Quantity** (Curies)	Type B Quantity (Curies)**	Large Quantity** (Curies)
I	$\leq 10^{-5}$	$>10^{-5}$ to 10^{-3}	$>10^{-3}$ to 20	>20
II	$\leq 10^{-4}$	$>10^{-4}$ to 5×10^{-2}	$>5 \times 10^{-2}$ to 20	>20
III	$\leq 10^{-3}$	$>10^{-3}$ to 3	>3 to 200	>200
IV	$\leq 10^{-3}$	$>10^{-3}$ to 20	>20 to 200	>200
V	$\leq 10^{-3}$	$>10^{-3}$ to 20	>20 to 5000	>5000
VI	$\leq 10^{-3}$	$>10^{-3}$ to 10^{3}	$>10^{3}$ to 5×10^{4}	$>5 \times 10^{4}$
VII	≤25	>25 to 10^{3}	$>10^{3}$ to 5×10^{4}	$>5 \times 10^{4}$
Special Form	$\leq 10^{-3}$	$>10^{-3}$ to 20	>20 to 5×10^{3}	>5000

*49 CFR 173.391.
**10 CFR 71.4 and 49 CFR 173.389.

Note: The regulations actually prescribe only the upper limits for Exempt, Type A, and Type B quantities. The symbol ≤ means "less than or equal to," and > means "greater than."

accident, present an exposure hazard, it is apparent from its definition that the chance of any significant amount of the contents being released into the air, groundwater, etc. and being ingested by a human is extremely remote. Examples of special form materials are radiography sources and unirradiated reactor fuel rods.

1. Type A Package

In order to be qualified for transport, all packaging used to contain radioactive material must meet the general requirements of 49 CFR 173.393. These requirements state, among other things, that the packaging must be adequate to prevent loss or dispersal of the radioactive contents and maintain the radiation shielding properties for the normal conditions encountered during transport. The contents of 49 CFR 173.393 are given in Appendix D-2. Tests to simulate normal transport conditions are outlined in 49 CFR 173.398(b) and in 10 CFR 71, Appendix A (see Appendix D-1).

The seven transport groupings and the Type A quantity limits have their origin in the IAEA regulations. The Type A limits were determined essentially in the following way.[1] It was recognized that the chance of a rail accident of such severity as to cause complete loss of the package contents was very small. Experimental work had indicated that a release of 0.1 percent of the package contents would be a reasonable assumption for the vast majority of possible accidents. Furthermore, on the basis of general handling experience, it was assumed the actual intake of radioactive material into the body by a person coming into contact with air or surfaces contaminated by such a release was unlikely