

(b) Any other Type A packaging that also meets the applicable standards for fissile materials in 10 CFR part 71 and is used in accordance with § 173.471.

(c) Any Type B, B(U) or B(M) packaging authorized pursuant to § 173.416.

(d) Any foreign-made packaging that meets the standards in IAEA "Safety Series No. 6" (incorporated by reference, *see* § 171.7 of this subchapter) and bears the marking "Type A" and was used for the import of Class 7 (radioactive) materials. Such packagings may be subsequently used for domestic and export shipments of Class 7 (radioactive) materials provided the offeror obtains the applicable documentation of tests and engineering evaluations and maintains the documentation on file in accordance with paragraph (a) of this section. These packagings must conform with requirements of the country of origin (as indicated by the packaging marking) and the IAEA regulations applicable to Type A packagings.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended at 67 FR 61014, Sept. 27, 2002]

§ 173.416 Authorized Type B packages.

Each of the following packages is authorized for shipment of quantities exceeding A₁ or A₂, as appropriate:

(a) Any Type B, Type B(U) or Type B(M) packaging that meets the applicable requirements of 10 CFR part 71 and that has been approved by the U.S. Nuclear Regulatory Commission may be shipped pursuant to § 173.471.

(b) Any Type B, B(U) or B(M) packaging that meets the applicable requirements of the regulations of the International Atomic Energy Agency (IAEA) in its "Regulations for the Safe Transport of Radioactive Material, Safety Series No. 6" (incorporated by reference, *see* § 171.7 of this subchapter) and for which the foreign competent authority certificate has been revalidated by DOT pursuant to § 173.473. These packagings are authorized only for export and import shipments.

(c) DOT Specification 6M (§ 173.354 of this subchapter) metal packaging, only for solid or gaseous Class 7 (radioactive) materials that will not undergo pressure-generating decomposition at temperatures up to 121 °C (250 °F) and

that do not generate more than 10 watts of radioactive decay heat.

(d) For contents in other than special form; DOT Specification 20WC (§ 173.362 of this subchapter), wooden protective jacket, when used with a single, snug-fitting inner DOT Specification 2R (§ 173.360 of this subchapter). For liquid contents, the inner packaging must conform to § 173.412(j) and (k).

(e) For contents in special form only; DOT Specification 20WC (§ 173.362 of this subchapter), wooden protective jacket, with a single snug-fitting inner Type A packaging that has a metal outer wall and conforms to § 173.350 of this subchapter. Radioactive decay heat may not exceed 100 watts.

(f) For contents in special form only; DOT Specification 21WC (§ 173.364 of this subchapter), wooden protective overpack, with a single inner DOT Specification 2R (§ 173.360 of this subchapter). Contents must be loaded within the inner packaging in such a manner as to prevent loose movement during transportation. The inner packaging must be securely positioned and centered within the overpack so that there will be no significant displacement of the inner packaging if the overpack containing it is subjected to the 9 m (30 feet) drop test described in 10 CFR part 71.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by 63 FR 52849, Oct. 1, 1998; 66 FR 45380, Aug. 28, 2001; 67 FR 61014, Sept. 27, 2002]

§ 173.417 Authorized fissile materials packages.

(a) Except as provided in § 173.453, fissile materials containing not more than A₁ or A₂ as appropriate, must be packaged in one of the following packagings:

(1) DOT Specification 6L (§ 173.352 of this subchapter), metal packaging, for materials prescribed in paragraph (b)(1) of this section.

(2) DOT Specification 6M (§ 173.354 of this subchapter), metal packaging, for materials prescribed in paragraph (b)(2) of this section.

(3) Any packaging listed in § 173.415, limited to the Class 7 (radioactive) materials specified in 10 CFR part 71, subpart C.

(4) Any other Type A or Type B, Type B(U), or Type B(M) packaging for

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fissile Class 7 (radioactive) materials that also meets the applicable standards for fissile materials in 10 CFR part 71.

(5) Any other Type A or Type B, Type B(U), or Type B(M) packaging that also meets the applicable requirements for fissile material packaging in Section V of the International Atomic Energy Agency “Regulations for the Safe Transport of Radioactive Material, Safety Series No. 6,” (incorporated by reference, *see* §171.7 of this subchapter), and for which the foreign competent authority certificate has been revalidated by the U.S. Competent Authority, in accordance with §173.473. These packages are authorized only for export and import shipments.

(6) A 55-gallon 1A2 steel drum, meeting the applicable packaging testing requirements of subpart M of part 178 of this subchapter at the packing group I performance level, subject to the following conditions:

(i) The quantity may not exceed 350 grams of uranium-235 in any non-pyrophoric form, enriched to any degree in the uranium-235 isotope;

(ii) Each drum must have a minimum 18 gauge body and bottom head and 16

gauge removable top head with one or more corrugations in the cover near the periphery;

(iii) Closure must conform to §178.352 of this subchapter;

(iv) At least four equally spaced 12 mm (0.5 inch) diameter vent holes must be provided on the sides of the drum near the top, each covered with weatherproof tape; or equivalent device;

(v) Appropriate primary, inner containment of the contents and sufficient packaging material, such as plastic or metal jars or cans, must be provided such that Specification 7A (§178.350 of this subchapter) provisions are satisfied by the inner packaging;

(vi) Each inner container must be capable of venting if subjected to the thermal test described in 10 CFR part 71;

(vii) Liquid contents must be packaged in accordance with §173.412 (j) and (k); and

(viii) The maximum weight of contents, including internal packaging, may not exceed 91 kg (200 pounds) with fissile material content limited as shown in table 2:

TABLE 2—FISSILE MATERIAL CONTENT AND TRANSPORT INDEX FOR UN1A2 PACKAGE

Maximum quantity and minimum transport index		Maximum No. of packages transported as a fissile material controlled shipment
U-235 per package (grams)	Minimum transport index per package	
350	1.8	72
300	1.0	129
250	0.5	256
200	0.3	500
150	0.1	500
100	0.1	500
50	(¹)	(²)

¹ Transport index is limited by the external radiation levels.

² Maximum number is limited by the total transport index.

(7) Any metal cylinder that meets the requirements of §173.415 and §178.350 of this subchapter for Specification 7A Type A packaging may be used for the transport of residual

“heels” of enriched solid uranium hexafluoride without a protective overpack in accordance with table 3, as follows:

TABLE 3—ALLOWABLE CONTENT OF URANIUM HEXAFLUORIDE (UF₆) “HEELS” IN A SPECIFICATION 7A CYLINDER

Maximum cylinder diameter		Cylinder volume		Maximum uranium-235 enrichment (weight percent)	Maximum “Heel” weight per cylinder			
Cm	Inches	Liters	Cubic feet		UF ₆		Uranium-235	
					kg	lb	kg	lb
12.7	5	8.8	0.311	100.0	0.045	0.1	0.031	0.07
20.3	8	39.0	1.359	12.5	0.227	0.5	0.019	0.04
30.5	12	68.0	2.410	5.0	0.454	1.0	0.015	0.03
76.0	30	725.0	25.64	5.0	11.3	25.0	0.383	0.84
122.0	48	3,084.0	¹ 108.9	4.5	22.7	50.0	0.690	1.52
122.0	48	4,041.0	² 142.7	4.5	22.7	50.0	0.690	1.52

¹ 10 ton.
² 14 ton.

(8) DOT Specification 20PF-1, 20PF-2, or 20PF-3 (§178.356 of this subchapter), or Specification 21PF-1A, 21PF-1B, or 21PF-2 (§178.358 of this subchapter) phenolic-foam insulated overpack with snug fitting inner metal cylinders, meeting all requirements of §§173.24, 173.410, 173.412, and 173.420 and the following:

(i) Handling procedures and packaging criteria must be in accordance with DOE Report ORO-651 or ANSI N14.1 (incorporated by reference, see §171.7 of this subchapter).

(ii) Quantities of uranium hexafluoride are authorized as shown in table 6 of this section, with each package assigned a minimum transport index as also shown.

(b) Fissile Class 7 (radioactive) materials with radioactive content exceeding A₁ or A₂ must be packaged in one of the following packagings:

(1) DOT Specification 6L (§178.352 of this subchapter), metal packaging. These packages may contain only uranium-235, plutonium-239, or plutonium-241, as metal, oxide, or compounds that do not decompose at temperatures up to 149 °C (300 °F). Radioactive decay heat output may not exceed 5 watts. Class 7 (radioactive) materials in normal form must be packaged in one or more tightly sealed metal or polyethylene bottles within a DOT Specification 2R (§178.360 of this subchapter) containment vessel. Authorized contents are limited in accordance with table 4, as follows:

TABLE 4—AUTHORIZED CONTENTS IN KILOGRAMS (KG) AND CONDITIONS FOR SPECIFICATION 6L PACKAGES

	Uranium-235		Plutonium (Plutonium solutions are not authorized)		Minimum fissile transport index	Maximum No. of packages transported as a fissile material control shipment
	H/X≤3 ¹	3 H/X≤10	H/X≤10	10 ≤ H/X ≤ 20		
14		² 3.6	1.3	80
		2.5	2.4	1.8	50

¹ H/X is the ratio of hydrogen to fissile atoms in their inner containment with all sources of hydrogen in the containment considered.
² Volume not to exceed 3.6 L.

(2) DOT Specification 6M (§178.354 of this subchapter), metal packaging. These packages must contain only solid Class 7 (radioactive) materials that will not decompose at temperatures up to 121 °C (250 °F). Radioactive

decay heat output may not exceed 10 watts. Class 7 (radioactive) materials in other than special form must be packaged in one or more tightly sealed metal cans or polyethylene bottles

within a DOT Specification 2R (§178.360 of this subchapter) containment vessel.

(i) For fissile material with a criticality TI equal to 0.0, packages are limited to the following amounts of fissile Class 7 (radioactive) materials: 1.6 kg of uranium-235; 0.9 kg of plutonium (except that due to the 10-watt thermal decay heat limitation, the limit for plutonium-238 is 0.02 kg); and 0.5 kg of uranium-233. The maximum ratio of hydrogen to fissile material may not exceed three, including all of the sources of hydrogen within the DOT Specification 2R containment vessel.

(ii) Maximum quantities of fissile material and other restrictions for materials with a criticality TI of greater than 0.0 are given in table 5. The min-

imum transport index to be assigned per package and, for fissile material, controlled shipments, the allowable number of similar packages per conveyance and per transport vehicle are shown in table 5. Where a maximum ratio of hydrogen to fissile material is specified in table 5, only the hydrogen interspersed with the fissile material must be considered. For a uranium-233 shipment, the maximum inside diameter of the inner containment vessel may not exceed 12.1 cm (4.75 inches). Where necessary, a tight-fitting steel insert must be used to reduce a larger diameter inner containment vessel specified in §178.354 of this subchapter to the 12.1 cm (4.75 inch) limit. Table 5 is as follows:

TABLE 5—AUTHORIZED CONTENTS FOR SPECIFICATION 6M PACKAGES¹

Uranium-233 ⁵			Uranium-235 ^{4,7}			Plutonium ^{2,3,4}			Minimum transport index	Maximum no. pkgs. transported as a fissile material control shipment
Metal or alloy	Compounds		Metal or alloy	Compounds		Metal or alloy	Compounds			
H/X=0 ⁸	H/X=0	H/X≤3	H/X=0	H/X=0	H/X≤3	H/X=0	H/X=0	H/X≤3		
0.5	0.5	0.5	1.6	1.6	1.6	90.9	90.9	90.9	0	N/A
3.6	4.4	2.9	7.2	7.6	5.3	3.1	4.1	3.4	0.1	1,250
⁶ 4.2	5.2	3.5	8.7	9.6	6.4	3.4	4.5	4.1	0.2	625
⁶ 5.2	6.8	4.5	11.2	13.9	8.3	4.2		4.5	0.5	250
			13.5	16.0	10.1	4.5			1.0	125
				26.0	16.1				5.0	25
				32.0	19.5				10.0	12

¹ Quantity in kg.
² Minimum percentage of plutonium-240 is 5 weight percent.
³ 4.5 kg limitation of plutonium due to watt decay heat limitation.
⁴ For a mixture of uranium-235 and plutonium an equal amount of uranium-235 may be substituted for any portion of the plutonium authorized.
⁵ Maximum inside diameter of specification 2R containment vessel not to exceed 12.1 cm (4.75 inches) (see paragraph (b)(2)(ii) of this section).
⁶ Granulated or powdered metal with any particle less than 6.4 mm (0.25 inch) in the smallest dimension is not authorized.
⁷ Except for material with a criticality TI of 0.0, the maximum permitted uranium-235 enrichment is 93.5 percent.
⁸ H/X is the ratio of hydrogen to fissile atoms in the inner containment.
⁹ For Pu-238, the limit is 0.02 kg because of the 10 watt thermal decay heat limitation.

(3) Type B, or Type B(U), or B(M) packaging that meets the standards for packaging of fissile materials in 10 CFR part 71, and is approved by the U.S. Nuclear Regulatory Commission and used in accordance with §173.471.

(4) Type B, B(U), or B(M) packaging that meets the applicable requirements for fissile Class 7 (radioactive) materials in Section V of the IAEA ‘‘Regulations for the Safe Transport of Radioactive Material, Safety Series No. 6’’ (incorporated by reference, see §171.7 of this subchapter), and for which the foreign competent authority certificate

has been revalidated by the U.S. Competent Authority in accordance with §173.473. These packagings are authorized only for import and export shipments.

(5) DOT Specifications 20PF-1, 20PF-2, or 20PF-3 (§178.356 of this subchapter), or DOT Specifications 21PF-1A or 21PF-1B (§178.358 of this subchapter) phenolic-foam insulated overpack with snug fitting inner metal cylinders, meeting all requirements of §§173.24, 173.410, and 173.412, and the following:

(i) Handling procedures and packaging criteria must be in accordance with DOE Report ORO-651 or ANSI N14.1; and

(ii) Quantities of uranium hexafluoride are authorized as shown in table 6, with each package assigned a minimum transport index as also shown:

TABLE 6—AUTHORIZED QUANTITIES OF URANIUM HEXAFLUORIDE

Protective overpack specification number	Maximum inner cylinder diameter		Maximum weight of UF6 contents		Maximum U-235 enrichment (weight/percent)	Minimum transport index
	Cm	Inches	Kilograms	Pounds		
20PF-1	12.7	5	25	55	100.0	0.1
20PF-2	20.3	8	116	255	12.5	0.4
20PF-3	30.5	12	209	460	5.0	1.1
21PF-1A ¹ or 21PF-1B ¹	² 76.0	² 30	2,250	4,950	5.0	5.0
21PF-1A ¹ or 21PF-1B ¹	³ 76.0	³ 30	2,282	5,020	5.0	5.0
21PF-2 ¹	² 76.0	² 30	2,250	4,950	5.0	5.0
21PF-2 ¹	³ 76.0	³ 30	2,282	5,020	5.0	5.0

¹ For 76 cm (30 in) cylinders, the maximum H/U atomic ratio is 0.088.
² Model 30A inner cylinder (reference ORO-651).
³ Model 30B inner cylinder (reference ORO-651).

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20750, May 8, 1996; 65 FR 58630, Sept. 29, 2000; 66 FR 45380, Aug. 28, 2001; 67 FR 61014, Sept. 27, 2002]

§ 173.418 Authorized packages—pyrophoric Class 7 (radioactive) materials.

Pyrophoric Class 7 (radioactive) materials, as referenced in the §172.101 table of this subchapter, in quantities not exceeding A₂ per package must be transported in DOT Specification 7A packagings constructed of materials that will not react with, nor be decomposed by, the contents. Contents of the package must be—

- (a) In solid form and must not be fissile unless excepted by §173.453;
- (b) Contained in sealed and corrosion resistant receptacles with positive closures (friction or slip-fit covers or stoppers are not authorized);
- (c) Free of water and contaminants that would increase the reactivity of the material; and
- (d) Inerted to prevent self-ignition during transport by either—
 - (1) Mixing with large volumes of inerting materials, such as graphite, dry sand, or other suitable inerting material, or blended into a matrix of hardened concrete; or
 - (2) Filling the innermost receptacle with an appropriate inert gas or liquid.

§ 173.419 Authorized packages—oxidizing Class 7 (radioactive) materials.

(a) An oxidizing Class 7 (radioactive) material, as referenced in the §172.101 table of this subchapter, is authorized in quantities not exceeding an A₂ per package, in a DOT Specification 7A package provided that—

- (1) The contents are:
 - (i) Not fissile;
 - (ii) Packed in inside packagings of glass, metal or compatible plastic; and
 - (iii) Cushioned with a material that will not react with the contents; and
- (2) The outside packaging is made of wood, metal, or plastic.
- (b) The package must be capable of meeting the applicable test requirements of §173.465 without leakage of contents.
- (c) For shipment by air, the maximum quantity in any package may not exceed 11.3 kg (25 pounds).

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended at 66 FR 45380, Aug. 28, 2001]

§ 173.420 Uranium hexafluoride (fissile, fissile excepted and non-fissile).

(a) In addition to any other applicable requirements of this subchapter, uranium hexafluoride, fissile, fissile excepted or non-fissile, must be offered for transportation as follows: