

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
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2. PREAMBLE

- a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."
- b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

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| a. ISSUED TO (<i>Name and Address</i>)
Alpha-Omega Services, Inc.
9156 Rose Street
P.O. Box 789
Bellflower, CA 90706 | b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION
AOS application, Revision H-7, dated January 25, 2019. |
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4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

- (1) Model Nos.: AOS-025A, AOS-050A, AOS-100A, AOS-100B, and AOS-100A-S

- (2) Description

A cylindrical stainless steel packaging, designed to transport Type B quantities of encapsulated solid materials or solid metals meeting Normal or Special Form criteria. The packaging is available in three model sizes – AOS-025, AOS-050, and AOS-100. Tungsten alloy is used as shielding material in model numbers with the suffix A, while carbon steel is the shielding material for model numbers with the suffix B. The Model No. AOS-100A-S has a double-ended opening configuration to be either loaded or unloaded from either end of the package. All models use a double O-ring arrangement seal in the lid joint.

The packaging includes an outer shell, a cavity, a shielding cylinder and shielding plugs, a bottom plate, a lid and lid plug. The outer shell and the cavity cylinder interlock to encase the shielding cylinder, made of either tungsten or carbon steel. A weldment attaches the upper portion of the cavity to its lower portion encasing the shielding. At the cavity's closed end, the shielding plug is encased between the cavity bottom wall and the packaging bottom plate. The shielding plug encased in the lid plug is of the same size and material (tungsten or carbon steel) as the one encased at the bottom of the packaging. The lid consists of a flat disk, with recessed areas concentric with the bolt holes on the top surface, to protect the bolts from impact loads.

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5.(a)(2) Description (Continued)

The packaging may use either elastomeric or metallic lid seals: the Model Nos. AOS-025A and AOS-050A elastomeric seal has two O-rings and one flat metal retainer ring, while the Model No. AOS-100 has two O-rings and two SS300 series flat retainer rings. The metallic seal for all models is a double "C" cross section seal.

The packaging may require the use of a liner, axial shielding plates, and/or cavity spacer plates, depending on the model, for shipment of some contents, as stated in Tables 3, 4, and 5 of this certificate. Additional packaging components include lid bolts and port plugs with their threaded pipe plugs, O-ring seals, port plug covers, and a pair of trunnions with their attachment bolts.

The impact limiters consist of a thin-walled stainless steel cylindrical shell, filled with polyurethane foam, with a dish head at one end and a flat disk at the other end. At the dish-head end, another recess is provided to reduce the area available for impact during a head-on drop event. Twelve (12) squared ribs are attached to the inner wall of the cylindrical recess section of the flat disk end. Eight (8) of these ribs extend beyond the flat disk plate and are used as turnbuckle attachment points. The turnbuckles join the impact limiters and partially enclose the packaging. For the Model No. AOS-025 package, the turnbuckles are replaced with "J" hooks. The package is transported in the upright position, using a shipping cage and a pallet. The Model Nos. AOS-50 and AOS-100 may include a lifting bar with the shipping cage; the lifting points are disabled during transport when the shipping cage lifting bar is included.

The maximum weights of the package shall not exceed the values listed in Table 1 below:

Table 1: Package Dimensions and Weights

Model	Width in a transport configuration (in.)	Height ^(a) in a transport configuration (in.)	Packaging OD (in.)	Packaging Height (in.)	Cavity OD (in.)	Cavity Height (in.)	Maximum Package Weight (lbs.)
AOS-025A	18.00	21.38	7.00	9.00	1.62	5.00	220
AOS-050A	35.75	38.63 ^a	14.00	18.00	3.25	10.00	1,500
AOS-100A	61.02	75.40 ^a	28.00	36.00	6.50	20.00	12,500
AOS-100B	61.02	75.40 ^a	28.00	36.00	6.50	20.00	11,000
AOS-100A-S	61.02	75.40 ^a	28.00	36.00	6.50	20.00	12,500

(a): the height specified in a transport configuration includes the optional lifting bar on the shipping cage.

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5(a)(3) Drawings

The packaging is constructed and assembled in accordance with the following drawings:

Table 2: Packaging Drawings

Model	Assembly	Rev	Impact Limiter	Rev	Packaging	Rev	Liner/Axial Shielding Plates	Rev	Cavity Spacer Plates	Rev
AOS-025A	166D8142	J	105E9722	I	166D8143	I	183C8485	H	-	-
AOS-050A	105E9718	J	166D8138	I	166D8137	I	183C8519	A	-	-
AOS-100A	105E9711	K	105E9713	J	105E9712 G001	L	183C8491	I	183C8518	B
AOS-100B	105E9711	K	105E9713	J	105E9712 G002	L	-	-	-	-
AOS-100A-S	105E9711	K	105E9713	J	105E9719	L	183C8491	I	183C8518	B

5.(b) Contents

(1) Type and form of material

Activation product radioactive materials as Normal or Special Form. Special Form materials shall have a current certificate. Dispersible Normal Form materials shall be enclosed in an inner container. The inner container is considered to be a "shoring device."

Any material with a melting point less than 900°F shall be in Special Form.

(2) Maximum quantity of material per package

- Maximum decay heat: 10 watts for Model No. AOS-025A; 100 watts for Model No. AOS-050A; 400 watts for Model Nos. AOS-100A, AOS-100A-S, and AOS-100B.
- Maximum weight of contents: 10 lbs for Model No. AOS-025A; 60 lbs. for Model No. AOS-050A; 500 lbs. for Model Nos. AOS-100A, AOS-100A-S, and AOS-100B. Maximum weight includes any shoring devices and any additional shielding plates.
- Neutron emitting nuclides, fissile materials, and irradiated fissile materials containing fission products are prohibited. Free-standing liquid is not authorized.
- Maximum activities are listed in Tables 3 and 4, with the following exceptions:

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- (1) When transported by exclusive use, the increased maximum activities listed in Table 5 are applicable for the Model Nos. AOS-100A and AOS-100A-S.
- (2) When transporting mixtures of isotopes including low energy gamma and/or beta emitters (i.e., any isotope with all gamma and/or beta emissions, including those from their progeny, ≤ 0.3 MeV), compliance with package dose rate and decay heat limits is determined per the procedure provided in Appendix 7.5.1.

Table 3- Activity Limits All Isotopes except Ir-192 and Ir-194 (TBq)

Isotope	Decay Heat Watt/Ci	AOS-025	AOS-050	AOS-100A AOS-100A-S	AOS-100B
Co-60	$1.55 \cdot 10^{-2}$	$4.92 \cdot 10^{-3}$	$2.76 \cdot 10^{-2}$	10.1	0.366
Co-60-B	$1.55 \cdot 10^{-2}$	-	-	30.5	-
Co-60-C	$1.55 \cdot 10^{-2}$	-	-	356	-
Cs-137	$4.99 \cdot 10^{-3}$	0.370	0.636	1300	19.6
Hf-181	$4.33 \cdot 10^{-3}$	-	2.83	3410	146
Zr/Nb-95 ⁽¹⁾	$1.62 \cdot 10^{-2}$	-	$9.84 \cdot 10^{-2}$	130	2.43
Yb-169	$2.55 \cdot 10^{-3}$	145	287	-	-
Shipping Configuration		Use of Liner Required. Drawing 183C8485	No additional shielding required	Co-60-B quantities require axial shielding plates per drawing 183C8491 Co-60-C quantities require both axial shielding plates and cavity spacer plates per drawing Nos. 183C8491 and 183C8518.	No additional shielding required

(1): Only Nb-95 resulting from the decay of Zr-95 is allowed.

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Table 4 – Activity Limits for Ir-192 and Ir-194 (TBq)

Model	Decay Heat Watt ⁽¹⁾	Ir-192 limit (TBq)	Ir-194 impurity limit (TBq)	Shipping Configuration
AOS-025A	0.44	2.62	0.0185	Use of Liner Required. Drawing 183C8485
	0.40	2.33	0.0740	
	0.37	2.10	0.1110	
AOS-050A	6.24	37.33	0.37	Use of Axial Shielding Plates Required. Drawing 183C8519
	5.87	34.78	0.74	
	5.13	29.67	1.48	
	4.39	24.60	2.22	
	3.66	19.49	2.96	
	2.92	14.39	3.70	
AOS-100A	400	2,286.37	148.00	No Additional Shielding Required
AOS-100A-S	400	2,094.42	370.00	
AOS-100B	13.87	80.51	3.70	No Additional Shielding Required.
	12.39	67.37	8.51	

(1) Ir-192 and Ir-194 generate 6.13×10^{-3} Watt/Ci and 5.30×10^{-3} Watt/Ci, respectively.

Table 5 - AOS-100A/A-S Activity Limits When Shipped As Exclusive Use (TBq)

Isotope	Decay Heat Watt/Ci	AOS-100A/A-S
Co-60	1.55×10^{-2}	17.0
Co-60-B	1.55×10^{-2}	58.5
Co-60-C ⁽¹⁾	1.55×10^{-2}	954
Cs-137	4.99×10^{-3}	2090
Hf-181	4.33×10^{-3}	3410
Ir-192	6.13×10^{-3}	2410
Ir-194	5.30×10^{-3}	1480
Zr/Nb-95 ⁽²⁾	1.62×10^{-2}	215
Shipping Configuration	Co-60B quantities require axial shielding plates per drawing 183C8491. Co-60-C quantities require both axial shielding plates and cavity spacer plates per drawing Nos. 183C8491 and 183C8518	

(1): For Co-60-C quantities, the maximum allowable specific activity is 350 Ci/g

(2) Only Nb-95 resulting from the decay of Zr-95 is allowed

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6. In addition to the requirements of Subpart G of 10 CFR Part 71:
- (a) The package must be prepared for shipment and operated in accordance with the Operating Procedures of Chapter No. 7 of the application, and
 - (b) Each packaging must meet the Acceptance Tests and Maintenance Program of Chapter No. 8 of the application.
7. For transport by air, quantities are limited to the lesser of Tables 3, 4, or 5 of this certificate or 3,000 A₂.
8. For contents meeting Normal Form requirements, the package must be leak-tested to 10⁻⁷ std cm³/sec prior to the first use of the package, and prior to each subsequent use.
9. When contents are loaded under water, or if water is introduced in the cavity of the package, the package must be vacuum dried prior to shipment and the cavity of the package filled with helium for such shipments.
10. The sealing surfaces of the package must be inspected. The metallic seal shall be replaced prior to each shipment. The elastomeric seal can be used only for shipment of Special Form material.
11. The inner container, by design or with additional shoring, shall be immobilized to prevent both radial and axial movements during normal conditions of transport. Shoring devices must be comprised of materials compatible with the radioactive contents and the cask cavity material. All shoring materials within the cavity must have a melting point greater than (i) 600°F for Co-60 in metallic form and Cs-137 in the form of cesium chloride and (ii) 900°F for all other contents.
12. Torque values for the lid bolts and the connectors of the impact limiters must be as follows:

Model	Lid Bolt (ft-lb), lubricated	Impact limiter connector (ft-lb), lubricated
AOS-025A	35	10
AOS-050A	62.5	3
AOS-100A	500	70
AOS-100B	500	70
AOS-100A-S	500	70

13. The weight of the foam in each impact limiter must be measured and its average density calculated based on the known volume of foam fill.
14. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
15. Revision No. 8 may be used until February 28, 2020.
16. Expiration date: July 31, 2021.

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REFERENCES

Radioactive Material Transport Packaging System Safety Analysis Report for Model AOS-025, AOS-050, and AOS-100 Transport Packages, Rev. H-7, dated January 25, 2019.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

John McKirgan, Chief
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: February 19, 2019

