AOS Radioactive Material Transport Packaging System

Alpha Omega Services Inc (AOS) has developed and licensed a family of radioactive material transport packaging with the following characteristics:

- Licensed to transport “NORMAL” and “SPECIAL” form materials.
- Licensed to transport Type B quantities.
- Licensed to transport fissile and activated materials.
- Simple to use and maintain
- May be wet or dry loaded

International Isotopes Inc. of Idaho Falls, Idaho is the exclusive worldwide distributor of the AOS Radioactive Material Transport Packaging System.

Terms and pricing for sale, lease or rent options are available by contacting:

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Section 1 - Introduction

The family of AOS Radioactive Material Transport Packaging Systems encompasses a group of transport packaging scaled up or down from the Model AOS-100 transport package, a basic design.

Figure 1 presents a typical package assembly and cross-section.

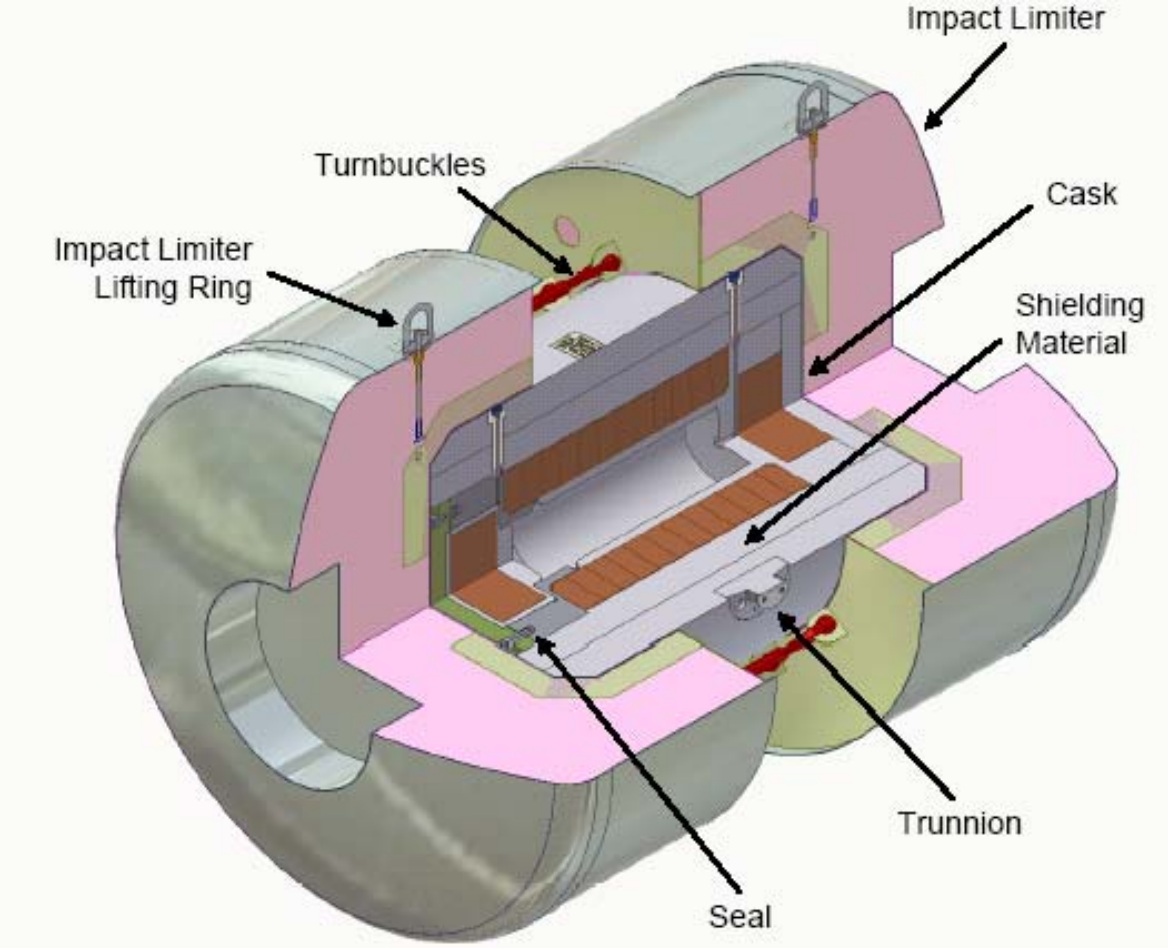

Figure 1 – AOS Transport Packaging System

Table 1 presents a summary of the AOS Transport Packaging System specifications. The model nomenclature is as follows:

AOS-XXXY-Z

Where XXX represents the scaled value from the basic design, Model AOS-100:

• Model AOS-025 is 25% of the size of the Model AOS-100

• Model AOS-050 is 50% of the size of the Model AOS-100

• Model AOS-165 is 65% greater than the Model AOS-100

Y is either “A” for tungsten, or “B” for carbon steel, shielding

Z is either “S” to identify the particular packaging as double-ended and that there is a lid on each end of the cask or left blank to signify a single lid.

Table 1 - AOS Radioactive Material Transport Packaging System Specifications

Model	Packaging Dimensions		Cask Dimensions		Cavity Dimensions		Packaging Weight	Cask Weight	Limiters Weight	Content Weight
	OD	Height	OD	Height	OD	Height				
AOS-025A	28.96 cm	39.62 cm	17.78 cm	22.86 cm	4.14 cm	12.7	128 kg	53 kg	68 kg	7 kg
	11.4 in	15.6 in	7 in	9 in	1.63 in	5 in	282 lb	117 lb	150 lb	15 lb
AOS-050A	57.96 cm	79.25 cm	35.56 cm	45.72 cm	8.26 cm	25.4 cm	590 kg	426 kg	136 kg	27 kg
	22.82 in	31.2 in	14 in	18 in	3.25 in	10 in	1300 lb	940 lb	300 lb	60 lb
AOS-100A	115.93 cm	158.5 cm	71.12 cm	91.44 cm	16.51 cm	50.8 cm	3901 kg	3402 kg	272 kg	227 kg
	45.64 in	62.4 in	28 in	36 in	6.5 in	20 in	8600 lb	7500 lb	600 lb	500 lb
AOS-100B	115.93 cm	158.5 cm	71.12 cm	91.44 cm	16.51 cm	50.8 cm	3232 kg	2733 kg	272 kg	227 kg
	45.64 in	62.4 in	28 in	36 in	6.5 in	20 in	7125 lb	6025 lb	600 lb	500 lb
AOS-100A-S	115.93 cm	158.5 cm	71.12 cm	91.44 cm	16.51 cm	50.8 cm	3901 kg	3402 kg	272 kg	227 kg
	45.64 in	62.4 in	28 in	36 in	6.5 in	20 in	8600 lb	7500 lb	600 lb	500 lb
AOS-165A	191.26 cm	264.16 cm	117.35 cm	150.88 cm	27.23 cm	83.82 cm	18234 kg	14968 kg	2268 kg	998 kg
	75.3 in	104 in	46.2 in	59.4 in	10.72 in	33 in	40200 lb	33000 lb	5000 lb	2200 lb
AOS-165B	191.26 cm	264.16 cm	117.35 cm	150.88 cm	27.23 cm	83.82 cm	15535 kg	12270 kg	2268 kg	998 kg
	75.3 in	104 in	46.2 in	59.4 in	10.72 in	33 in	34250 lb	27050 lb	5000 lb	2200 lb

Section 2 - Package Description

Packaging

Each AOS transport package consists of three (3) main components:

- Cask
- Overpack (Impact Limiter)
- Lid Seals

The cask component is made of 300 series stainless steel (SS300) material. Tungsten or carbon steel materials are embedded within the cask body and lid plug cask components, to enhance the cask assembly's shielding capability.

Aided by the seal, the cask also provides containment to the radioactive material content and assures sub-criticality of fissile material payloads. The impact limiters attach to one another by eight (8) turnbuckles, covering each end of the cask. These packaging components mitigate mechanical and thermo loads generated during Normal and Hypothetical Accident conditions. They are made of SS300 thin shell, filled with polyurethane foam. All transport package models use an elastomeric, double O-ring arrangement seal in the lid joint. However, the Model AOS-165 transport package can utilize a metallic, double "C" cross-section seal for certain payloads, based upon the content's decay heat threshold.

Each component is described in the paragraphs that follow.

Cask

The cask is a cylindrical structure with a cavity to contain its payload. The cask structure is comprised of seven (7) major components:

- Outer shell
- Cavity cylinder
- Shielding cylinder
- Shielding plugs
- Cask bottom plate
- Lid
- Lid plug

The outer shell and cavity cylinder interlock to encase the shielding cylinder, which is a component made of tungsten or carbon steel. A weldment attaches the upper portion of the cavity cylinder with its lower portion encasing the shielding cylinder. The function of the shielding cylinder and plugs is to enhance the shielding characteristics of the cask.

To provide shielding in the axial direction, the "Lid Plug" component is placed in the open end of the cavity. At the cavity's closed end, the shielding plug is encased between the cavity bottom wall and cask bottom plate. The shielding plug encased on the lid plug

is of the same size and material (tungsten or carbon steel) as the one encased at the bottom of the cask.

The lid consists of a flat disk, with recessed areas concentric with the bolt holes on the top surface. This feature is to protect the bolts from impact loads. The groove on the bottom surface of the lid houses the seal, as well as a central recess to accommodate the lid plug component. Additional cask assembly components are lid bolts and port plugs with their threaded pipe plugs, O-ring seals, and port plug covers. Both the lid and the cask bottom plate reside below the surface of the cask's outer shell, for protection during impact events.

Figure 2 presents an isometric depiction of the cask, with its components exploded.

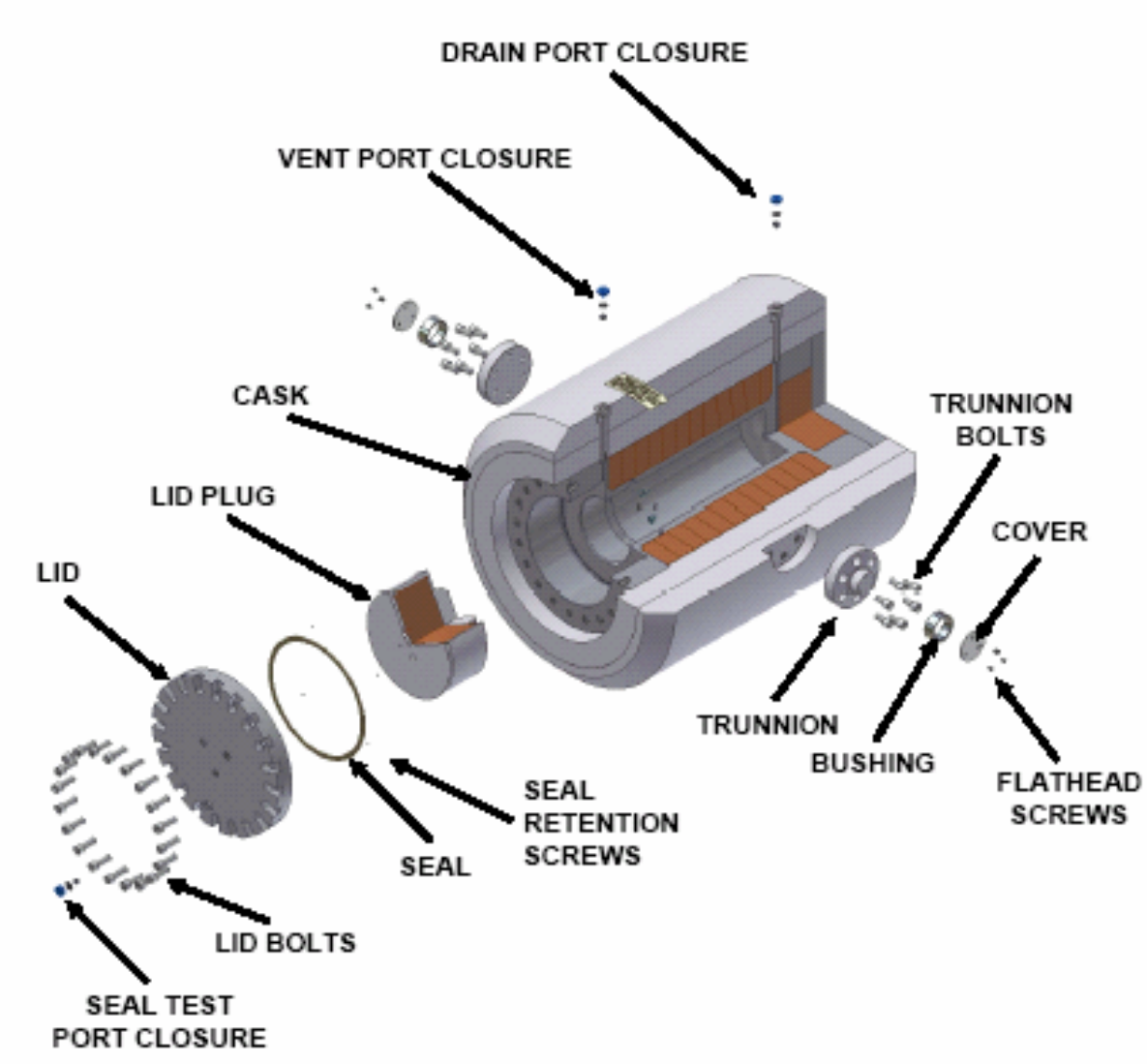

Figure 2 - Cask Component

Impact Limiter

The overpack (impact limiter) is a major component consisting of a thin-walled cylindrical shell, with a dish head at one end and a flat disk at the other end. At the flat-disk end, there is a cylindrical recess, with an internal profile identical to that of the cask end profile.

This cavity accommodates the cask in the transport configuration. Twelve (12) squared ribs are attached to the inner wall of the cylindrical recess section. Eight (8) of these ribs extend beyond the flat disk plate, to be used as turnbuckle attachment points. At the dish-head end, there is another recess, created to reduce the area available for impact during a head-on drop event.

The impact limiter shell is filled with rigid, closed-cell, polyurethane foam material.

Figure 3 presents an isometric view of the impact limiter with its components exploded.

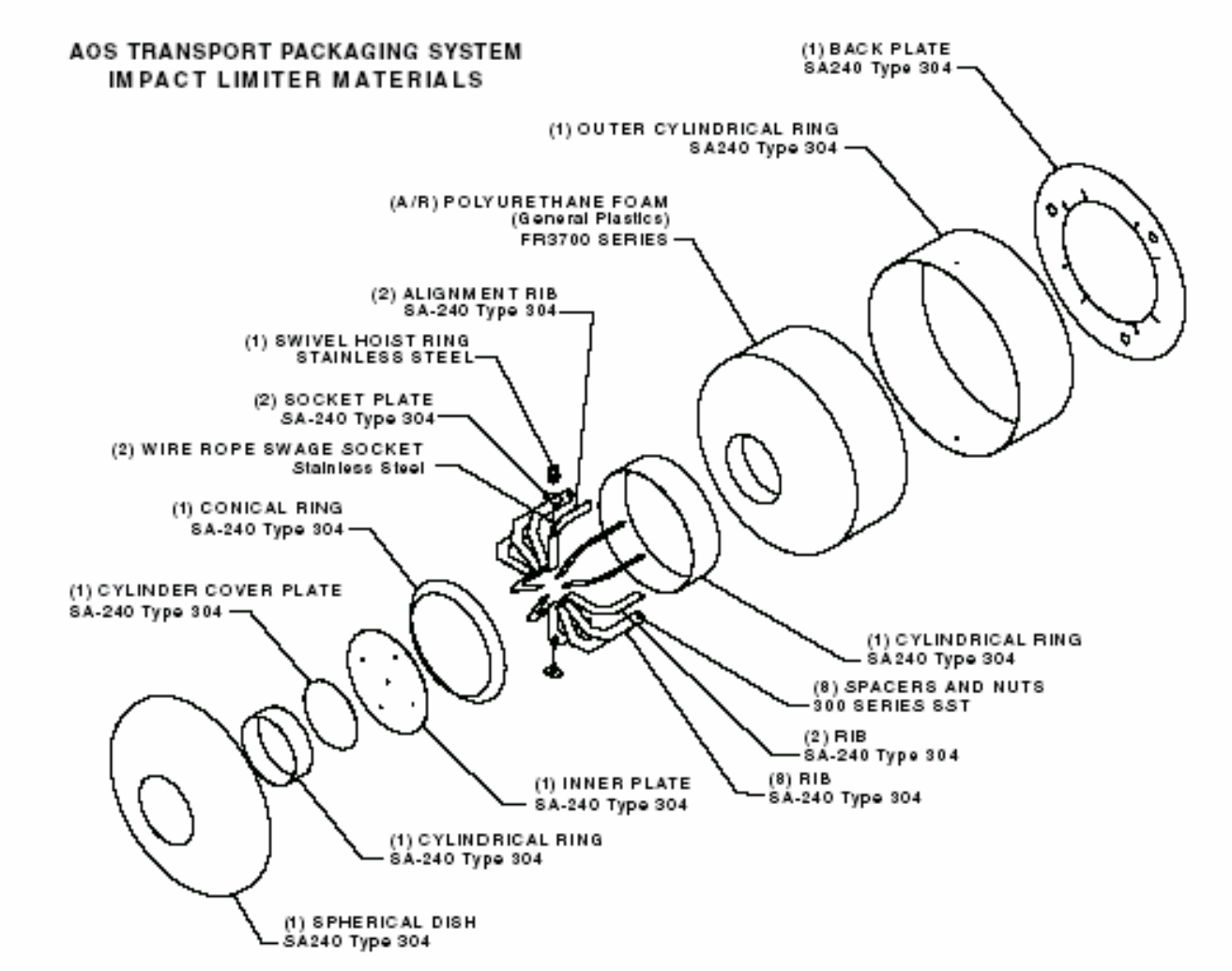

Figure 3 - Overpack (Impact Limiter) Component

Lid Seals

Two (2) types of seals are used in the design.

One consists of two elastomeric O-rings, a cross-section capture between two 300 stainless steel (SS300) metal flat rings to form a unit. The elastomeric seal is used in all packaging configurations, including the AOS-165A up to 2.5 kW of decay heat.

The second type of seal employed in the design is a metallic, double "C" cross-section arrangement and applies only to the Model AOS-165A transport package and may be used with decay heat loads up to 7 kW. Both seal designs provide a means for leak testing between the two seal cross-sections.

Figure 4 illustrates cross-sections of each seal type.

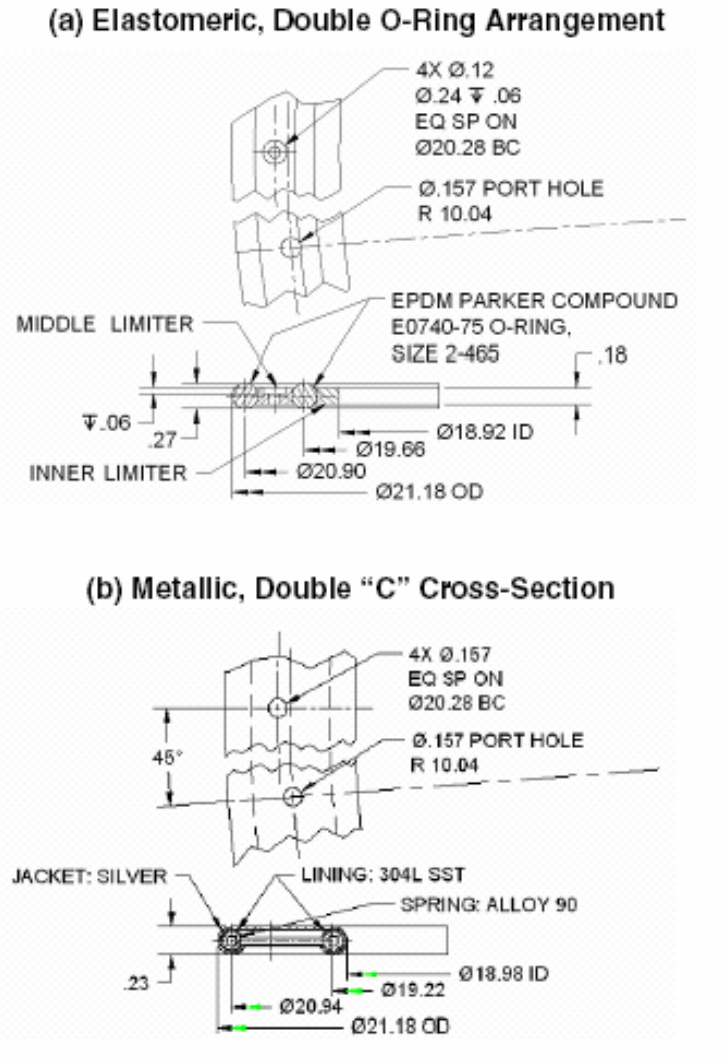

Figure 4 – Lid Seal Component

Section 3 - Loading & Activity Limits

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The AOS Transport Packaging System is intended to be used to transport up to Type B quantities of radioactive material, including fissile materials. These may include, but are not limited to by-product, source, and special nuclear materials. Limits for Special Nuclear Material (SNM) are listed in Table 2.

Table 2 - Material Loading Limits

Isotope or Material	Model					
	AOS-025 Decay Heat= 10 watts	**AOS-050** Decay Heat= 100 watts	**AOS-100** Decay Heat = 400 watts, byproduct and SNM		**AOS-165** Decay Heat = 7000 watts byproduct, 1200 SNM	
	A	A	A	B	A	B
SNM Enrichment $\leq$ 5%	No Analysis	No Analysis	SNM Loading Limits 400 g U-235 equiv Burn up = 100K 120 Cooling Days	No Analysis	SNM Loading Limits 1200 g U-235 equiv Burn up = 100K 120 Cooling Days	No Analysis
SNM Enrichment Between 5 & 94%	No Analysis	No Analysis	300 g U-235 equiv Burn up = 100K 120 Cooling Days	No Analysis	600 g U-235 equiv Burn up = 100K 120 Cooling Days	No Analysis

(The U-235 equivalent mass is determined by U-235 mass plus 1.66 times U-233 mass plus 1.66 times Pu-239 mass.)

Section 5 – Radiation Survey Information

The maximum contact radiation dose rates for each package configuration with the corresponding activities for Cobalt-60, Iridium-192 and Cesium-137 are provided for reference in the tables below.

Model AOS-025A			**Model AOS-050A**		**Model AOS-100A**	
Isotope	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)
Co-60	0.055	188 *	2.08 Ci	196	20,000 Ci	169 *
Ir-192	345	199 *	1500 Ci	101	2.0 E+07	72
Cs-137	5.01	200 *	129.41 Ci	194	2.3 E+06	69.5

Model AOS-100B			**Model AOS-165A**		**Model AOS-165B**	
Isotope	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)	Source Strength (Ci)	Max Surface Dose Rate (mRem/hr)
Co-60	209 Ci	150 *	450,000	22	450,000	112 *
Ir-192	6810	113	1.15 E+06	<1	7.82E+06	161
Cs-137	1290	112	1.45E+06	<1	990,000	155

* - Additional tungsten shield plates were installed in the cask cavity.