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19 July, 2002 *ml*

Mr. Dave Tiktinsky
Package Certification Section
Spent Fuel Project Office
US Nuclear Regulatory Commission
11555 Rockville Pike
One White Flint
Rockville, MD 20852

Dear Mr. Tiktinsky:

Enclosed please find minor revisions to the SAR for the Model 702 Type B transport container. These revisions:

- Adjust the minimum wall/weld thickness for the special form capsules transported in this container.
- Document compliance with IAEA paragraph 619.
- Revised the descriptive assembly drawings to reflect dimensions for copper spacers between uranium and steel interfaces as "minimum" values. This will allow for minor adjustments in shimming by the addition of copper to compensate for minor variations in the depleted uranium shielding dimensions.

Changes are noted in the right hand column of the affected sheets which are enclosed. If you need additional information, please contact me at 781-272-2000 ext. 241.

Sincerely,

Lori Podolak, CHP
Product Licensing Specialist
Regulatory Affairs Department

	<i>16 July 02</i>
RA/QA Approval	Date
	<i>18 July 02</i>
Engineering Approval	Date

Enclosures: Revision 6 to SAR
 List of Affected Pages

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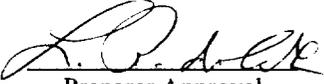
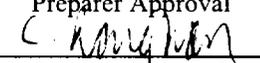
Safety Analysis Report

AEA Technology / QSA Inc.

Model 702 Type B(U) - 85 Transport Package

July 2002

Revision 6

	<u>15 Jul 02</u>
Preparer Approval	Date
	<u>16 July 02</u>
RA/QA Approval	Date
	<u>18.30.02</u>
Engineering Approval	Date

AEA Technology QSA, Inc.
Burlington, MA

Safety Analysis Report

AEA Technology / QSA Inc.

Model 702 Type B(U) Transport Package

July 2002

Revision 6

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Safety Analysis Report for the Model 702 Transport Package

AEAT/QSA Inc.
Burlington, Massachusetts

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This temperature would not adversely affect the transport package during normal transport since the melting temperatures of all safety critical components are well above this temperature. It is therefore concluded that the Model 702 transport package will maintain its structural integrity and shielding effectiveness under the normal transport heat condition.

2.6.2 Cold

Reference:

- *USNRC, 10 CFR 71.71 (c)(2)*
- *IAEA TS-R-1, paragraph 637*

The carbon steel components of the Model 702 transport package are susceptible to brittle fracture at low temperature. The transport package, however, successfully met Type B(U)-85 Transport Tests requirements at temperatures below -40°C (-40°F), the minimum specified in the regulations. Thus, it is concluded that the Model 702 transport package will withstand the normal transport cold condition.

2.6.3 Reduced External Pressure

Reference:

- *USNRC, 10 CFR 71.71 (c)(3)*
- *USDOT, 49 CFR 173.412(f)*
- *IAEA TS-R-1, paragraph 643 & 619*

The Model 702 transport package includes a Neoprene gasket between the cask body and the cask cover. If the gasket remains intact, Section 3.5.2, "Maximum Internal Pressure" demonstrates that the cask cover bolts will withstand an external pressure reduction of at least 54 psi. If the gasket fails under this pressure, the Model 702 will no longer be a sealed unit. Thus, there will be no differential pressure acting on it. Therefore, the reduced external pressure requirements of 3.5 psi in 10 CFR, 3.6 psi in 49 CFR and 8.7 psi (60 kPa) and 0.7 psi (5 kPa) in IAEA are met.

2.6.4 Increased External Pressure

Reference:

- *USNRC, 10 CFR 71.71(c)(4)*

If the Neoprene gasket remains intact, the package would be subjected to a differential pressure between the 2.26 inch (57.4 mm) diameter source cavity and the cask (7.5 inch (191 mm) outer diameter) of 5.3 psig. The cask will withstand this pressure without loss of structural integrity.

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If the gasket fails, the cylindrical special form source (primary containment) will be vulnerable to collapse due to the required assumed pressure increases of 21.7 psig and 290 psi for the respective regulatory references. The source capsules are fabricated from Type 304 or 310 stainless steel. This analysis bounds any special form source capsule with a maximum inside diameter of 0.195 inch (4.95 mm) and a minimum wall thickness and weld penetration of 0.01 inch (0.254 mm). From Reference 1, the external collapsing pressure for a thin walled cylinder is:

$$P_{\text{collapse}} = (t / R)(\sigma_y / (1 + (4\sigma_y / E)(R / t)^2))$$

Where:

t	=	0.01 in (Weld Thickness)
R	=	0.195 in (Inside Radius)
σ_y	=	30,000 psi (Yield Strength) (Reference 1)
E	=	28,000 ksi (Young's Modulus) (Reference 2)

From this relationship, the minimum collapsing pressure of the source capsule is 889.8 psi, which exceeds the required external pressure.

Resource references:

1. Young, Warren C. Roark's Formulas for Stress & Strain, Sixth Edition. McGraw-Hill: New York, 1989, p. 634.
2. Hibbeler, R.C. Mechanics of Materials. 2nd Edition, 1991.

2.7.7 Summary of Damage

Table 5 summarizes the results of the Normal Conditions of Transport and Hypothetical Accident testing performed on the Model 702, in the sequence that the tests were completed.

Table 5: Summary of Damages During Performance of TP81

Specimen	Test Performed	Test Results
TP81(A)	Compression test	No damage
	1 meter (40 inch) penetration bar on top, center of cage	Cage perforated plate dented in and partially broken. No other damage.

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Specimen	Test Performed	Test Results
	Post-Drop Inspection	<ul style="list-style-type: none"> • Cask remained secured to skid via 4 cask-to-skid bolts • Cask cover remained secured
TP81(A)	9 meter (30 foot) drop, vertical, top down	<ul style="list-style-type: none"> • Brittle fracture of skid • Cask and square plate welded to skid tore away from rest of skid • 3 hold down ring brackets failed (4th had broken in 1.2 meter (4 foot) drop test) • Cask struck impact surface, which dented head of 1 cask cover bolt • Cask fin ends dented
	1 meter (40 inch) puncture, cask attached to portion of skid, dropped upside down, 10° to 15° off vertical onto dented cask cover bolt	Bolt was further dented, but remained secure.
	Post-Drop Inspection	<ul style="list-style-type: none"> • Cask remained secured (after 3rd 30 foot drop and 2 puncture tests) • Small change in radiation profile

The same shipping cask was used in all three test specimen. In the course of testing, the single cask was conservatively subjected to all the Normal Conditions of Transport Tests, three 9 meter (30 foot) drop tests, and two puncture tests without loss of structural integrity or shielding effectiveness.

Based on these results, it is concluded that the Model 702 transport package maintains structural integrity and shielding effectiveness during Hypothetical Accident Conditions and Normal Conditions of Transport.

2.8 Special Form

The Model 702 transport package is designed for use with a special form source capsule with an inside radius ≤ 0.195 inches and a wall thickness or weld penetration ≥ 0.01 inches. The source capsule must qualified as Special Form radioactive material.

2.9 Fuel Rods

Not applicable.

FIGURE WITHHELD UNDER 10 CFR 2.390

 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	REV	
B	R70290	M	
	SCALE: 1/4	SHEET 1 OF 10	

5

4

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1

D

D

C

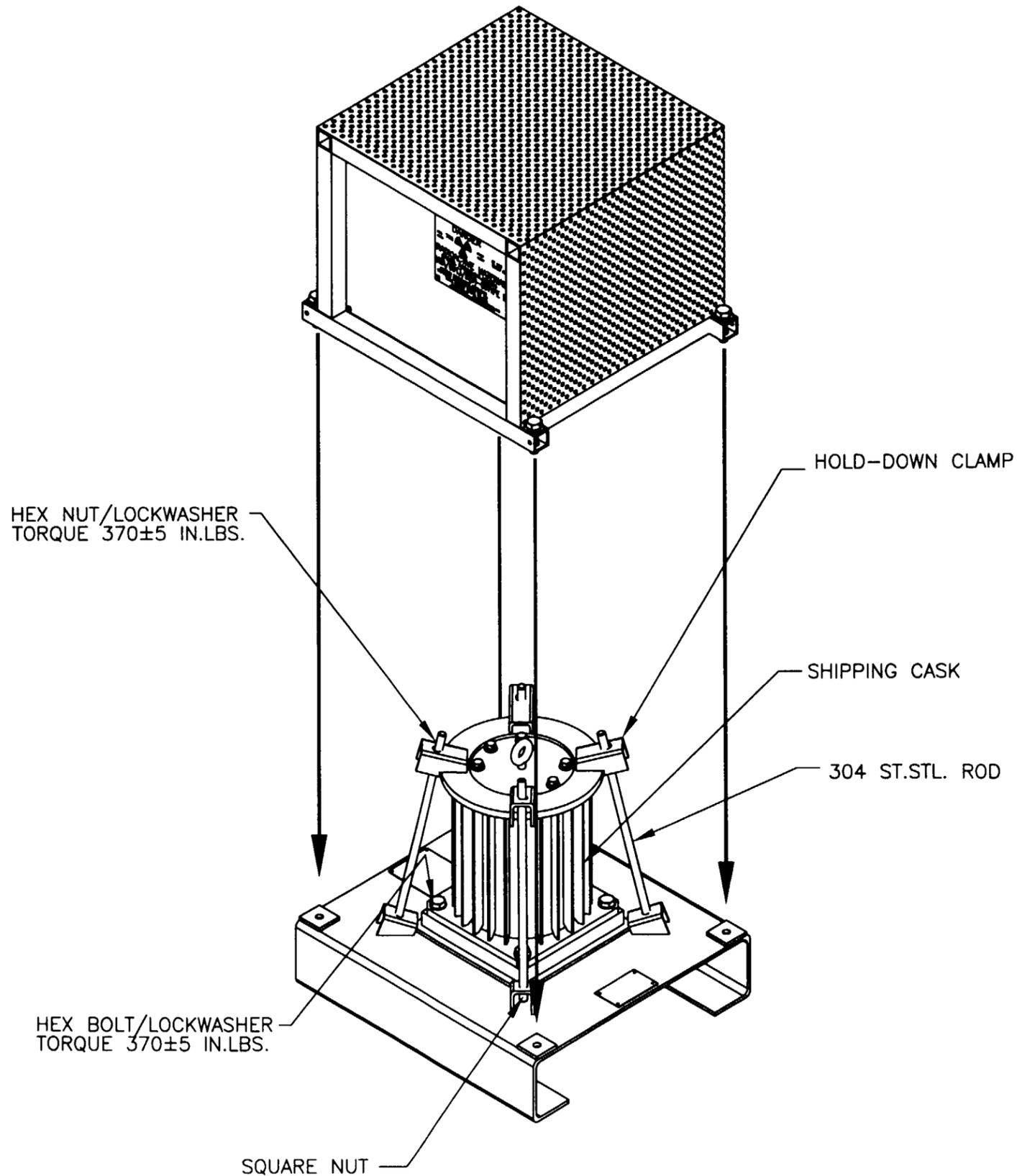
C

B

B

A

A



HEX HEAD BOLT	4	½-13 ST.STL.
SQUARE NUT	4	½-13 ST.STL.
HEX NUT	4	½-13 ST.STL.
LOCKWASHER	8	½ ST.STL.
HOLD-DOWN CLAMP	1	SEE SHEET 5
304 ST.STL. THREADED ROD	4	14¾ ±1/8 LENGTH 1/2-13 THREADED
SHIPPING CASK	1	SEE SHEET 6
PART NAME	QTY.	DESCRIPTION

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE INCHES, TOLERANCE ±1/16



DESCRIPTIVE
DRAWING

TITLE MODEL 702
ISOTOPE SHIELD SHIPPING CONTAINER

SIZE	DWG. NO.	R70290	REV
B	SCALE: 1/8	SHEET 2 OF 10	M

5

4

3

2

1

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	R70290	REV
B	SCALE: 1/8	SHEET 3 OF 10	M

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	R70290	REV
B	SCALE: 1/8	SHEET 4 OF 10	M

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 QSA 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	REV	
B	R70290	M	
SCALE: 1/4		SHEET 5 OF 10	

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	REV	
B	R70290	M	
	SCALE: 1/4	SHEET 6 OF 10	

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 40 NORTH AVE., BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	REV	
B	R70290	M	
SCALE: 1/2		SHEET 7 OF 10	

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	R70290	REV
B	SCALE: 1/2	SHEET 8 OF 10	M

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C

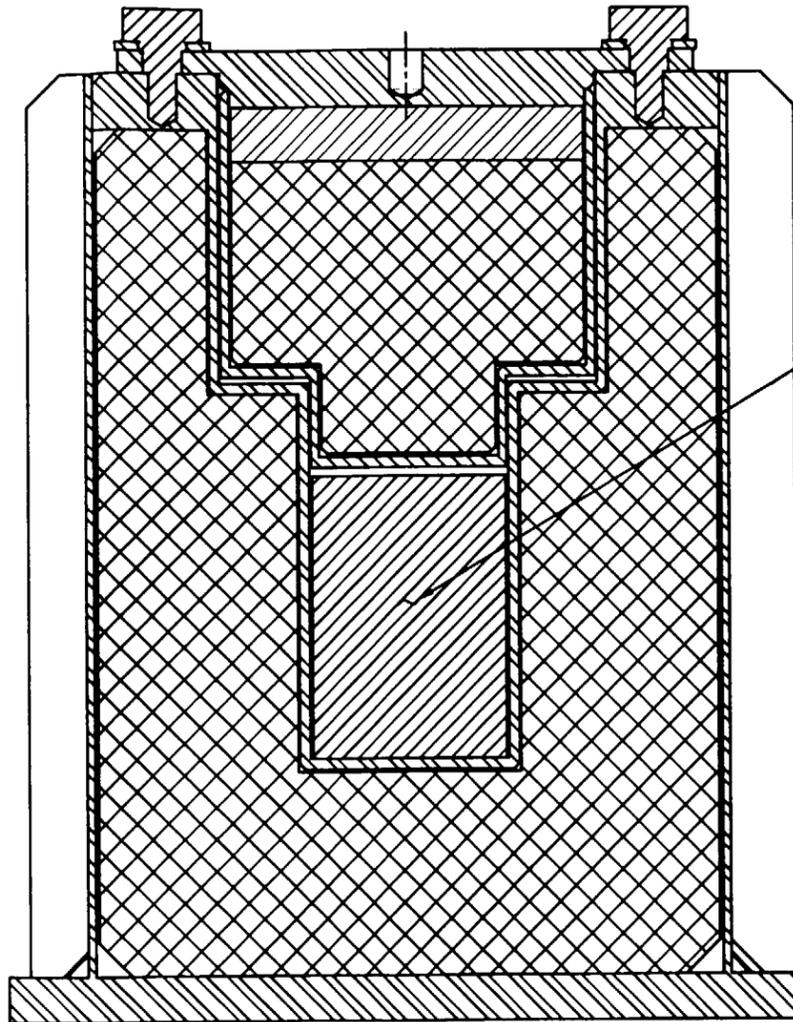
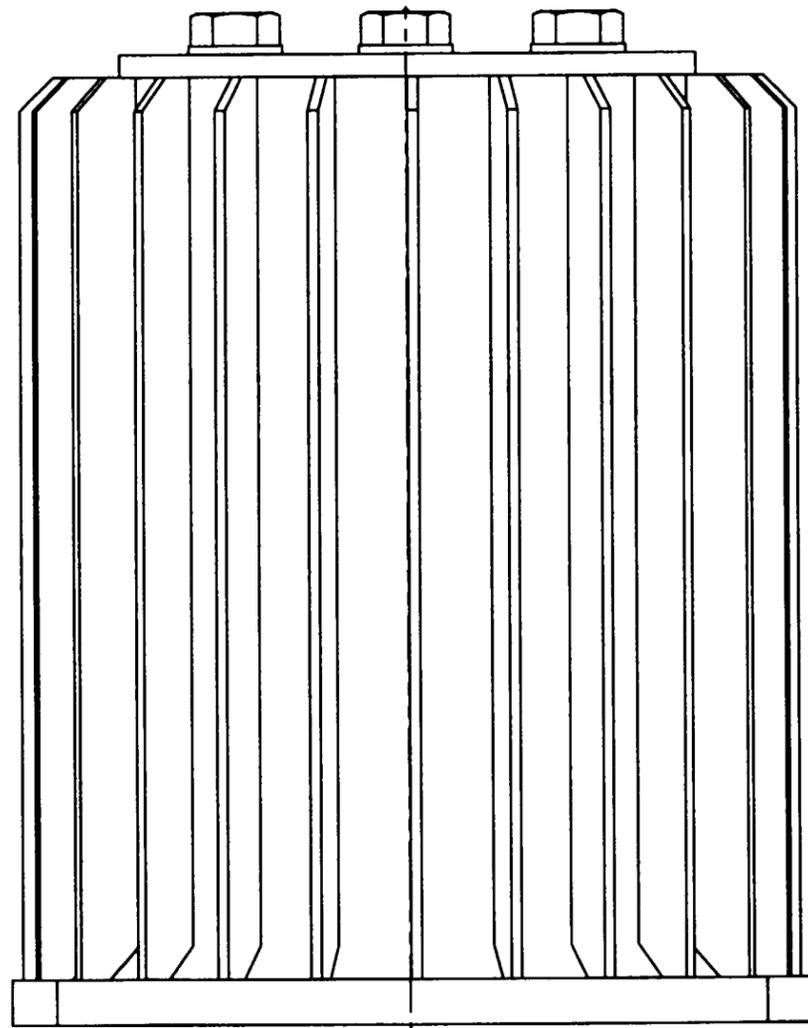
D

C

B

C

A



SEE SHEET 10
FOR SEVEN NEST INSERT

SECTION C-C

- NOTES:
1. INSERT IS USED FOR TRANSPORT OF IRIIDIUM 192 ONLY.
 2. OPTIONAL USE OF METALLIC CANS CAN BE USED TO LIMIT MOVEMENT FOR OTHER ISOTOPE CAPSULES. METALLIC CANS ARE NOT TO EXCEED $\phi 2 \frac{7}{32} \times 3 \frac{1}{8}$ HEIGHT.

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$



DESCRIPTIVE
DRAWING

TITLE MODEL 702
ISOTOPE SHIELD SHIPPING CONTAINER

SIZE B	DWG. NO.	R70290	REV M
	SCALE:	1/2	

5

4

3

2

1

FIGURE WITHHELD UNDER 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE INCHES, TOLERANCE $\pm 1/16$			
 QSA 40 NORTH AVE, BURLINGTON, MA 01803		DESCRIPTIVE DRAWING	
TITLE		MODEL 702 ISOTOPE SHIELD SHIPPING CONTAINER	
SIZE	DWG. NO.	REV	
B	R70290	M	
SCALE: 1/1		SHEET 10 OF 10	