

71-9073



June 12, 1985

File: OH-142

Ref: 4108

Mr. Charles E. MacDonald, Chief
Nuclear Regulatory Commission
Transportation Certification Branch
Washington, D.C. 20555

PDR
Return
to 396SS

Dear Mr. MacDonald:

Enclosed please find eight copies of the revised pages to convert Revision 10 of the OH-142 Safety Analysis Report to Revision 11 of that report. Also enclosed is the required check for \$150 to initiate the minor revision process.

The changes made to the Safety Analysis Report are of three types. First, the polyurethane stress-strain upper bound curve has been revised to include the response noted from recently fabricated overpacks. The new upper bound has been analyzed in Appendix 1.10.2, with margins of safety being affected only very slightly. Second, a customer has requested the option to mount the primary lid seals on the cask body rather than on the cask lid. The drawings have been changed to allow this option. Finally, the maintenance section has been changed to allow the user to apply any halogen leak test that meets the same technical requirements as our NuPac-specific test.

This revision, including the revised drawings, has been copyrighted. This entire submittal contains proprietary information per the notice on the flyleaf of this report. We are aware of your requirements to place this submittal in the Public Documents Room. This may be done with our permission; however, this permission should not be construed as a waiver of or in any way prejudicial to our lawful proprietary rights to this material. It is done only to facilitate the issuance of a Certificate of Compliance.



June 85-3

Applicant	12428
Check No.	4150-00
Amount / Fee Date	6/18/85
Type of Fee	Amendment
Date Check	6/18/85
Received By	Jackson

8507050374 850627
PDR ADDOCK 07109073
C PDR

10:ED 31 NIP 58.

85 JUN 18 P4:05

RECEIVED

25415

Adv. Copy to FCTC 06/14/85



June 12, 1985

Mr. Charles E. MacDonald, Chief
Nuclear Regulatory Commission

Page 2

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If you have any questions, please do not hesitate to call either myself or Stephen Goetsch. Thank you very much.

Very truly yours,

NUCLEAR PACKAGING, INC.

Charles J. Temus
Technical Director

Enclosure: As stated

cc: Francis Dewberry, Westinghouse Hittman

DOCKET NO. 71-9073
CONTROL NO. ~~06/25/85~~ 20
DATE OF DOC. 06/13/85
DATE RCVD. 06/13/85
FCUF _____ PDR ✓
PCAF _____ LPDR _____
WM _____ I&E REF. ✓
WMUR _____ SAFEGUARDS _____
FCTC ✓ OTHER _____

DESCRIPTION:

Revised pages for
Revision 10 to
The Safety Analysis
Report

06/21/85 INITIAL CEC

71-9073



June 12, 1985

File: OH-142
Ref: 4108

Mr. Charles E. MacDonald, Chief
Nuclear Regulatory Commission
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June 12, 1985

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Nuclear Regulatory Commission

Page 2

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Very truly yours,

NUCLEAR PACKAGING, INC.

Charles J. Temus
Technical Director

Enclosure: As stated

cc: Francis Dewberry, Westinghouse Hittman

MODEL OH-142 SHIPPING CONTAINER

REVISION 11

DELETION AND INSERTION INSTRUCTIONS

<u>Delete</u>	<u>Insert</u>
1-3	1-3
1-7	1-7
Dwg. No. Y-20-201D Rev. N Sheets 1 thru 2	Dwg. No. Y-20-201D Rev. M Sheets 1 thru 2
Dwg. No. Y-20-202D Rev. K Sheets 1 thru 2	Dwg. No. Y-20-202D Rev. L Sheets 1 thru 2
Dwg. No. A1-20-202 Rev. H Sheets 1 thru 3	Dwg. No. AL-20-202 Rev. J Sheets 1 thru 3
Dwg. No. A1-20-203 Rev. G Sheets 1 thru 2	Dwg. No. AL-20-203 Rev. H Sheets 1 thru 2
	1-147 thru 1-159
7-3	7-3
	7-3-a
7-16	7-16

package is located at the approximate geometric center of gravity. A reference point for locating the center of gravity is shown on Drawing Y-20-200D.

1.3 Mechanical Properties of Materials

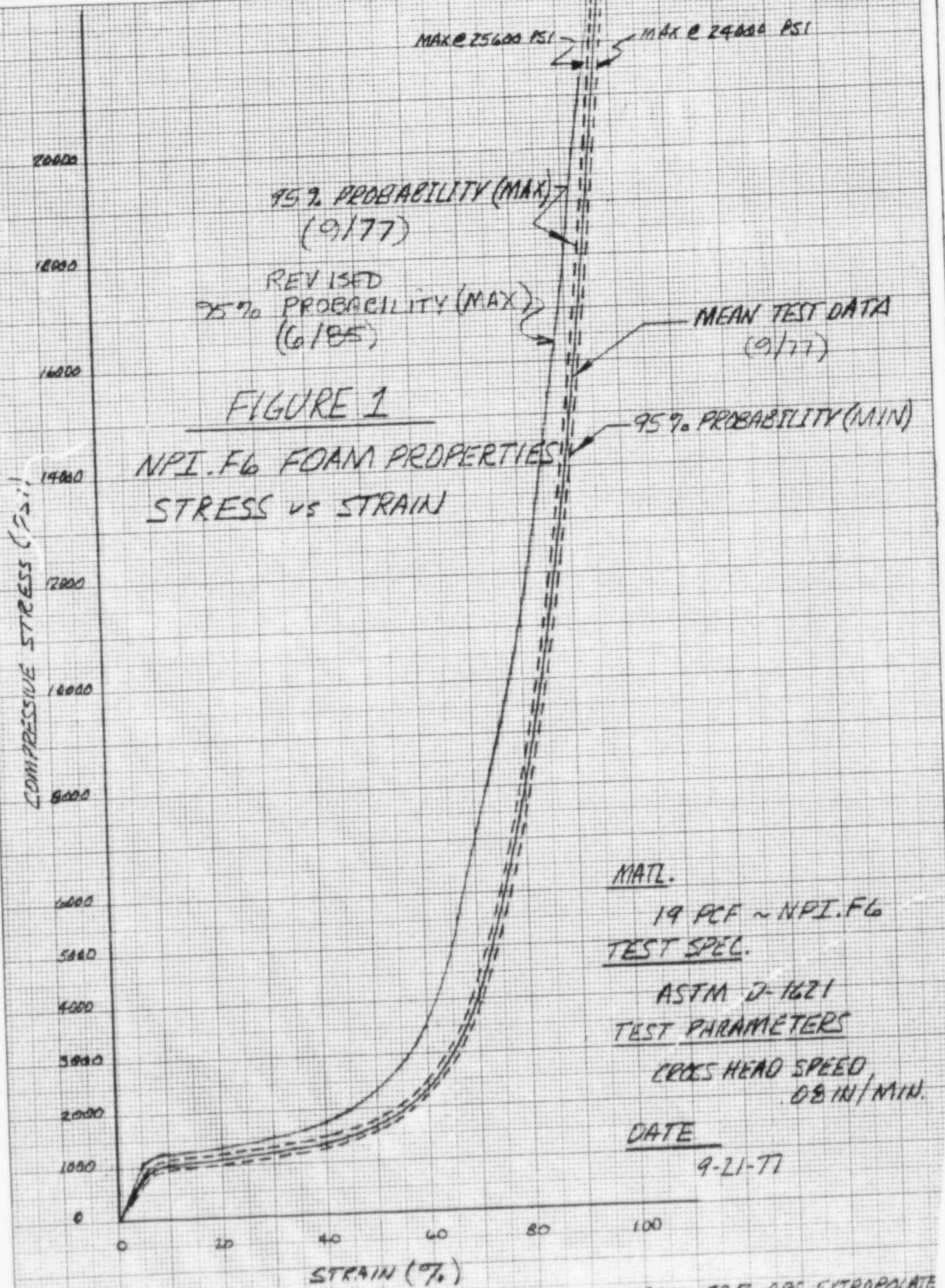
The Model OH-142 packaging uses an outer and inner shell fabricated of various thicknesses of low carbon hot rolled steel. Material properties of the steel are as follows:

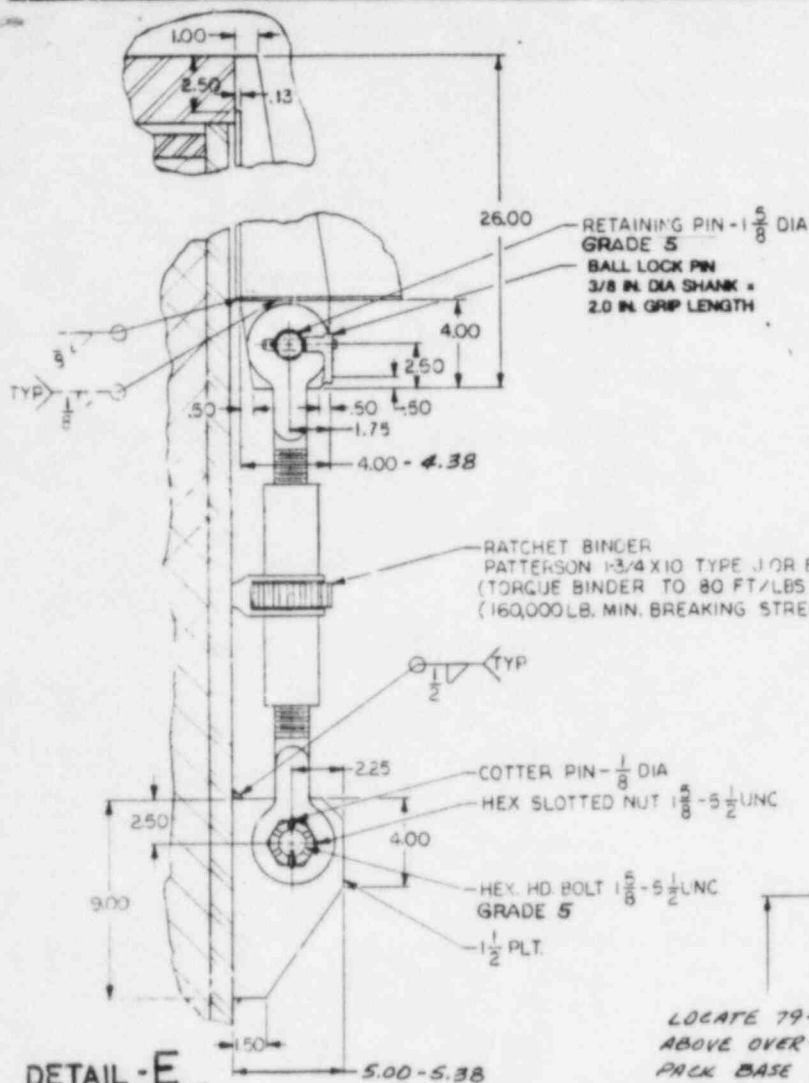
Per		A-36	A-516 (Grade 60)	A-516 (Grade 70)
		MIL-HDBK-V	ASME	ASME
F_{tu}	=	55,000 psi	60,000 psi	70,000 psi
F_{ty}	=	36,000 psi	32,000 psi	38,000 psi
F_{su}	=	35,000 psi	36,000 psi	42,000 psi
F_{brg}	=	90,000 psi	90,000 psi	90,000 psi

Rigid polyurethane foam fills the cavity between the steel shells of the overpack. This material will have a density of approximately 20 pcf and be of a self-extinguishing variety.

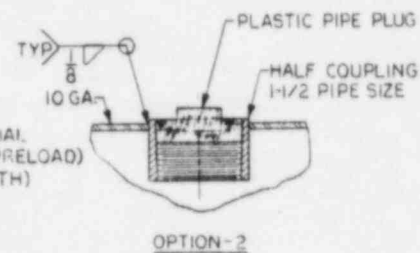
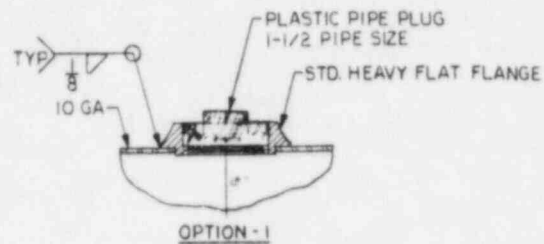
Figure 1 represents the stress-strain curve for the NuPac NPI.F6 foam used for this package. The curve provides both minimum and maximum compressive properties derived from over 8 years of testing. A 95% probability factor was applied to the standard deviation to establish the spread shown.

Foam Specification NPI.F6 defines the detail foaming testing procedure. It specifies that foam samples will be taken during the actual foaming process and tested to verify that they are within the two curves at 10%, 30% and 60% strains. Typically one sample is tested per batch of foam, and one overpack may include as many as 6 or more batches. Occasionally, a data point from the test of one sample may fall outside the range specified. In such a case, several more samples are prepared to verify that 95% of the foam tests do fall within the curves at 10%, 30% and 60% strain.



**DETAIL-E**

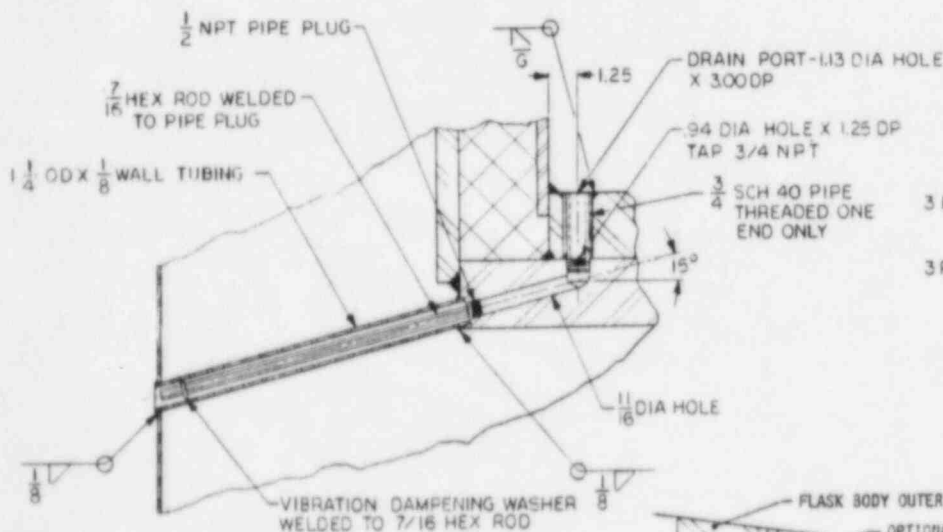
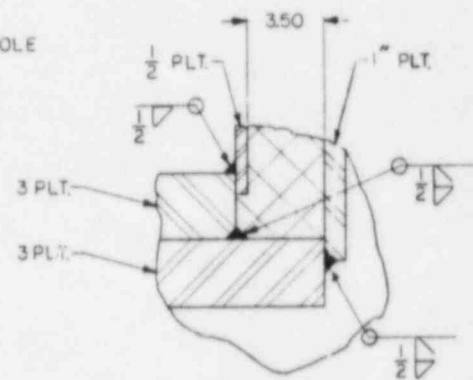
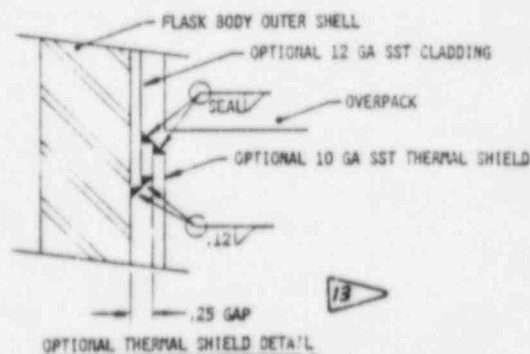
FOR TYPICAL THERMAL SHIELD CONFIGURATION ABOUT RATCHET BINDER LOWER LUG, SEE DWG. NO. Y-20-202D, DETAIL K & VIEW M-M

**DETAIL-H**
SCALE: 1/2

42° FOR REAR LUGS
24° FOR FRONT LUGS

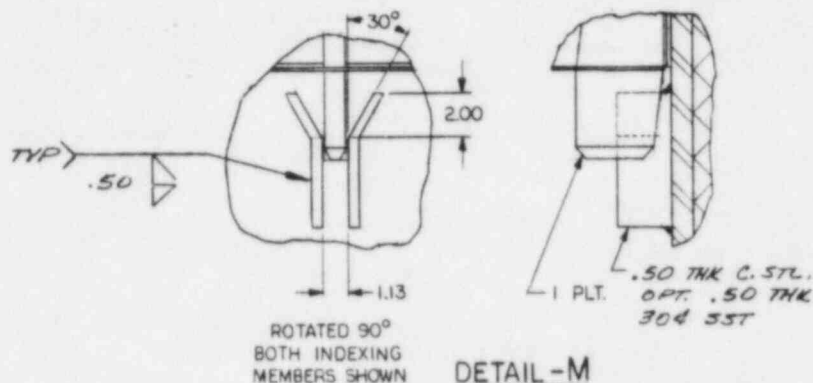
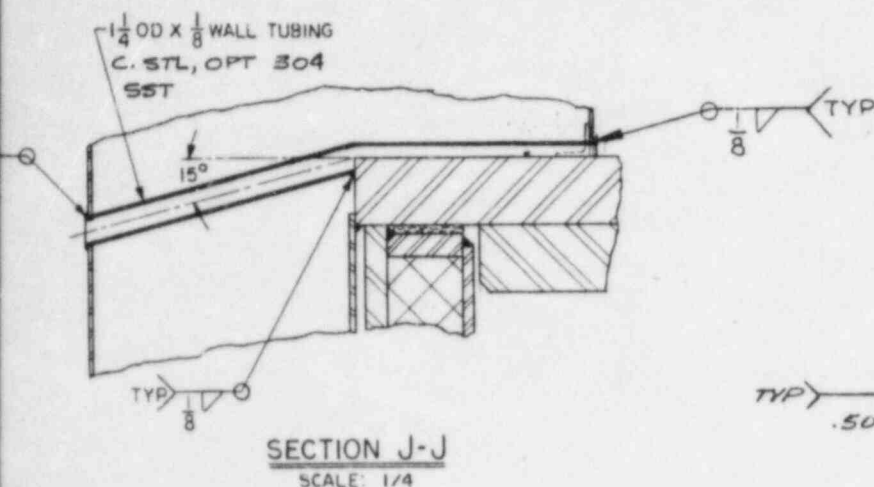
VIEW P-P
SCALE: 1/4

FOR THERMAL SHIELD
ABOUT TIE DOWN
NO. Y-20-202D, VIEW

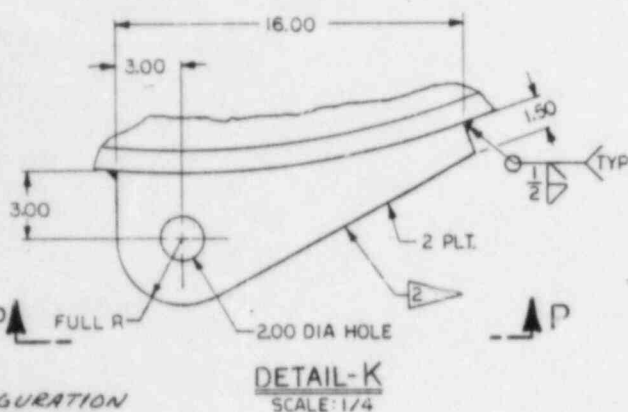
**DETAIL-F**
SCALE: 1/4**DETAIL-G**
SCALE: 1/4

NOTES: UNLESS OTHERWISE SPECIFIED

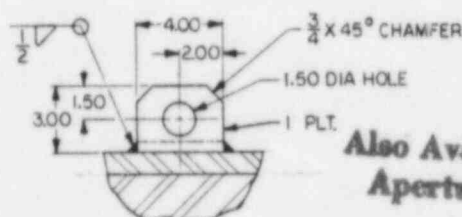
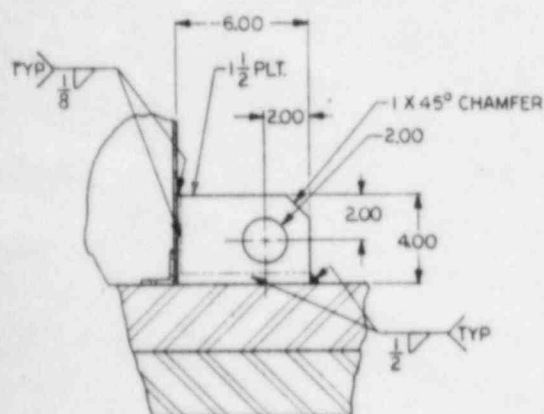
REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
M	SEE DCN		



FOR THERMAL SHIELD CONFIGURATION
ABOUT GUIDE TABS, SEE DWG. NO.
Y-20-202D, DETAIL K.



CONFIGURATION
VUS, SEE DWG.
W M-M.



Also Available On
Aperture Card

TI
APERTURE
CARD

ITEM		PART NO.	DESCRIPTION	MATERIAL
<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS ANGLES 3 PLACES DECIMALS 2 PLACES DECIMALS 1 PLACE DECIMALS</p> <p>DO NOT SCALE THIS DRAWING</p>				
<p>NUCLEAR PACKAGING, INC. TACOMA, WASHINGTON</p> <p>BULK RESIN SHIPPING FLASK MODEL OH142</p> <p>Unpublished - All rights reserved</p>				
<p>DRAWN D. KENT 9-29-76</p> <p>CHECK 1/23/85</p> <p>ENG 1/24/85</p>	<p>1/23/85</p> <p>1/23/85</p> <p>1/24/85</p>	<p>1/23/85</p> <p>1/23/85</p> <p>1/24/85</p>	<p>1/23/85</p> <p>1/23/85</p> <p>1/24/85</p>	<p>1/23/85</p> <p>1/23/85</p> <p>1/24/85</p>
<p>SCALE: 1/16 (NOMINAL) WT. 1/2</p> <p>REV M SHEET 2 OF 2</p> <p>DWG NO. Y-20-201D</p>				

SECTION A-A

UNC, ASTM-
A36 (1-B UNC,
D, GR L7 WITH
29° LID).

NUT, 3/8-9 UNC
WITH OPTION-
(D.)
E TO 200±10 FT-LBS
WASHER, 3/8,
WITH OPTIONAL
(LID).

BOUNDARY LID

NEOPRENE SEAL
BONDED TO LID

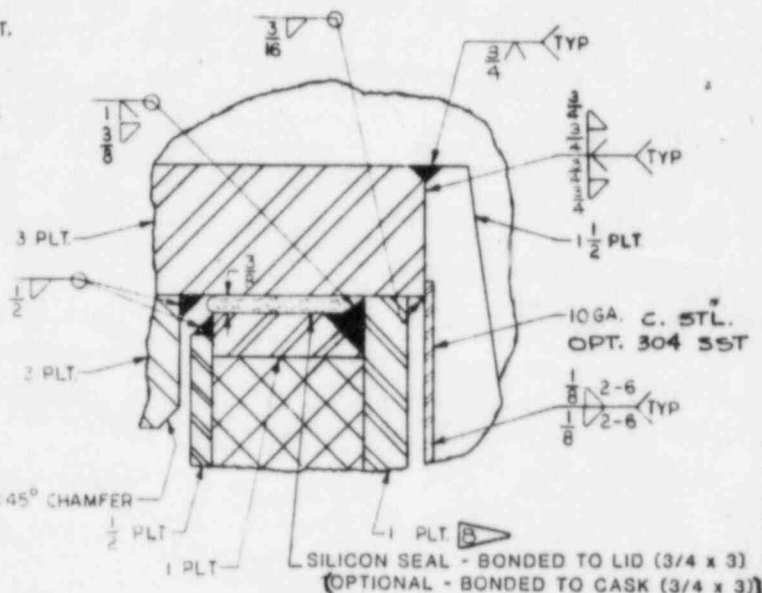
1/8" SPACER
SILICONE SEAL
BONDED TO PLUG
(1/4 X 100)

PLUG

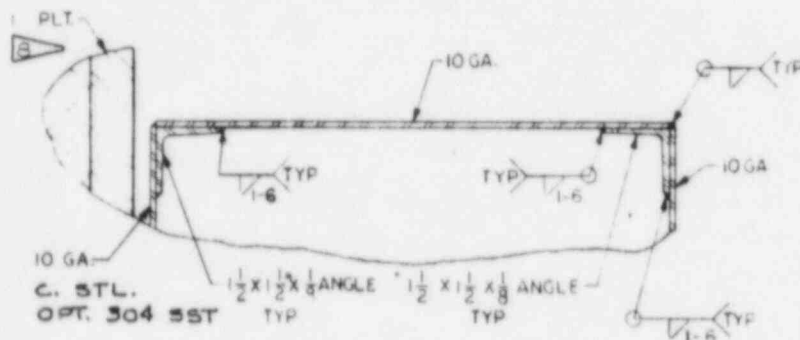
1/4 X 45° CHAMFER-TYP

1/2 X 45° CHAMFER

DETAIL-B
SCALE: 1/2



DETAIL-C
SCALE: 1/2



DETAIL-D
SCALE: 1/2

(BINDER LUG OMITTED FOR CLARITY)

Also Available On
Aperture Card

TI
APERTURE
CARD

8507050374-03

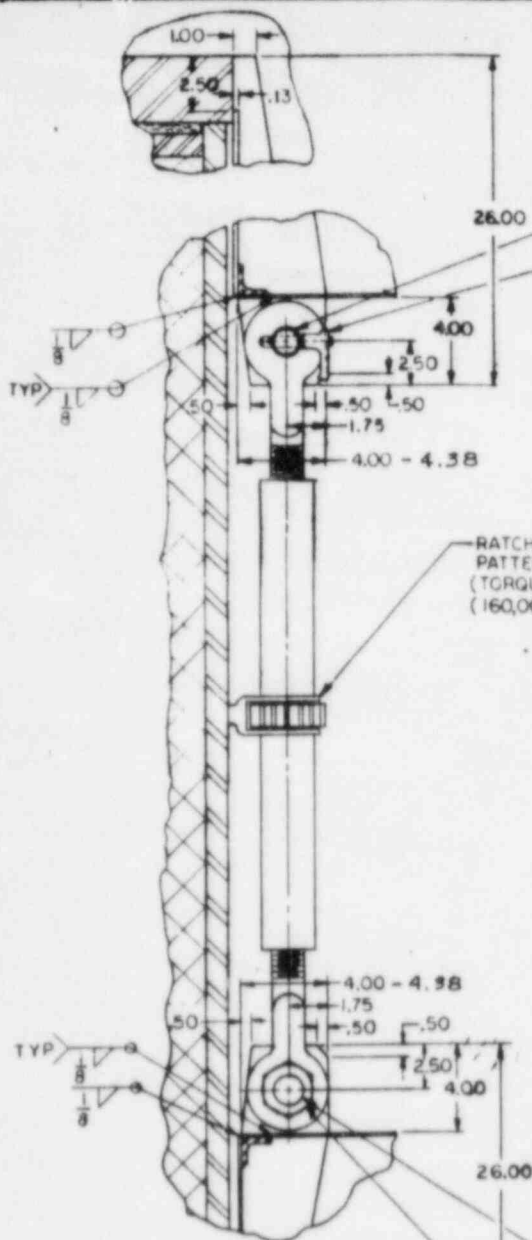
MARKED & IDENTIFIED IN ACCORDANCE WITH THE
10 CFR 71.85(c)

ARY LIDS & DRAIN SHALL BE EQUIPPED WITH TAMPER
IN ACCORDANCE WITH 10 CFR 71.43(b)

erved under copyright law.

ASSEMBLY & QUANTITY		ITEM	PART NO.	DESCRIPTION	MATERIAL
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES FRACTIONS ANGLES 3 PLACE DECIMALS 2 PLACE DECIMALS 1 PLACE DECIMALS DO NOT SCALE THIS DRAWING		<p>NUCLEAR PACKAGING, INC. TACOMA, WASHINGTON</p> <p>BULK RESIN SHIPPING FLASK MODEL OHI42-MK2</p> <p>Unpublished - All rights reserved</p>			
<p>PROPRIETARY DATA: This drawing and the design it covers are the property of NUCLEAR PACKAGING, INC. and shall not be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of NUCLEAR PACKAGING, INC.</p>	<p>DRAWN CULTUM</p> <p>CHECKED C. HENT</p> <p>DESIGNED C. HENT</p> <p>APPROVED C. HENT</p>	<p>12-9-77</p> <p>12-28-77</p> <p>1-18-77</p>	<p>7-12-77</p> <p>1-18-77</p> <p>1-18-77</p>	<p>SCALE: 1/2</p> <p>REV: 1</p> <p>DATE: 1-18-77</p>	<p>WT: 1.0</p> <p>SHEET: 1 OF 1</p> <p>Y-20-2020</p>

D

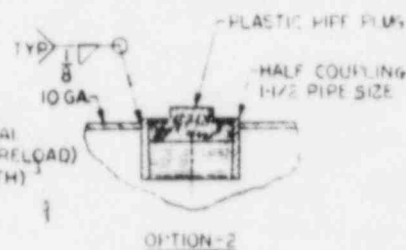
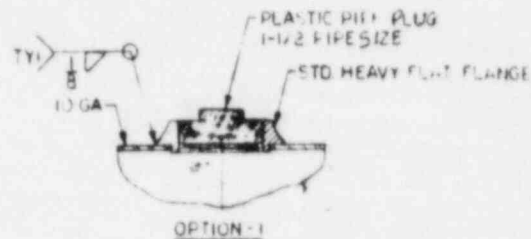
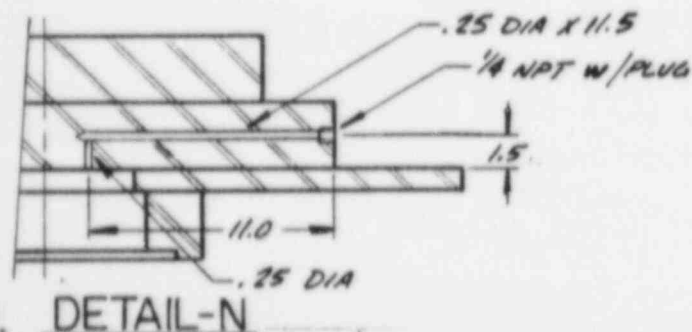


C

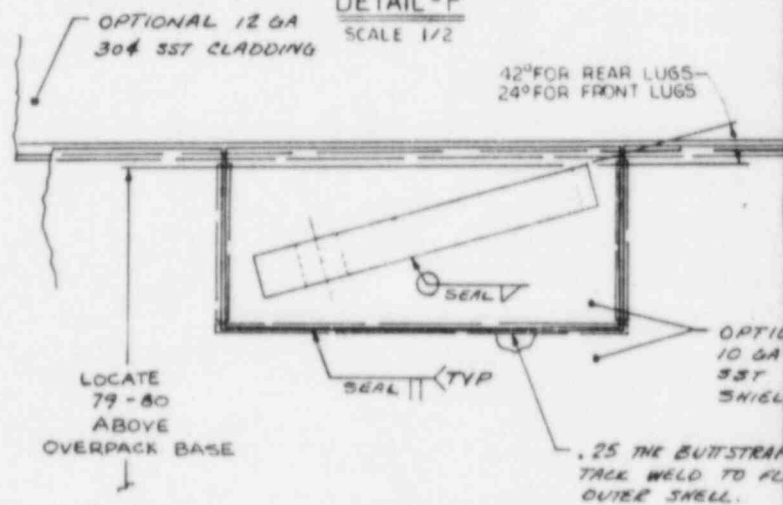
B

DETAIL - E
SCALE: 1/4

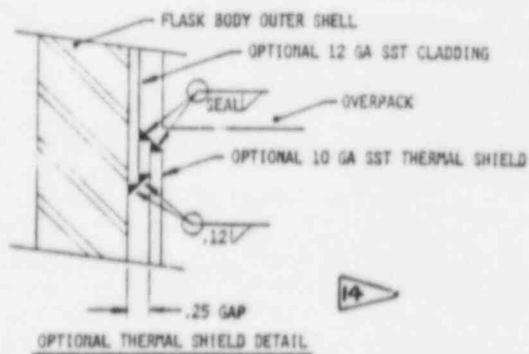
A



DETAIL - F
SCALE 1/2



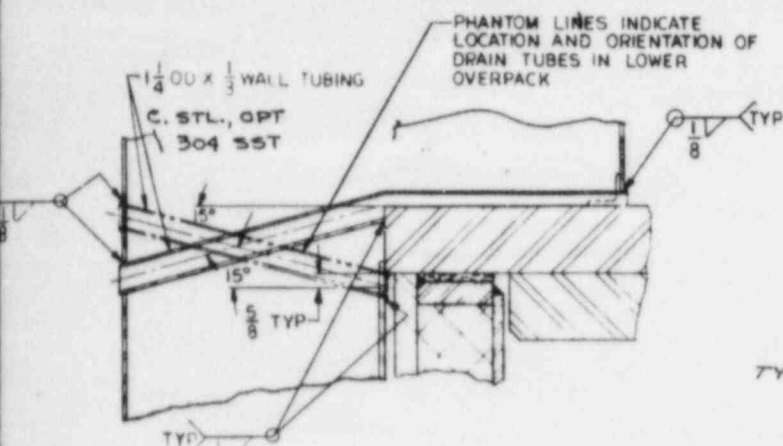
VIEW M-M
(WITH OPTIONAL CLAD & THERMAL SHIELD)



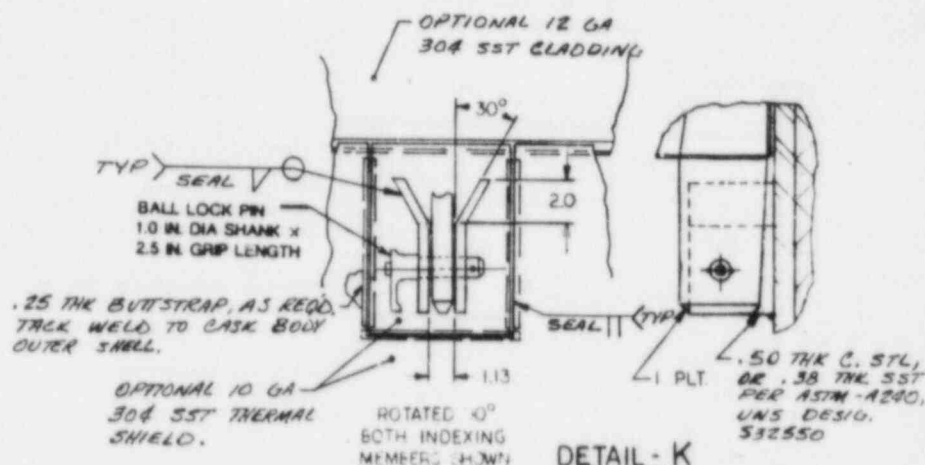
Also A
Apex

AV

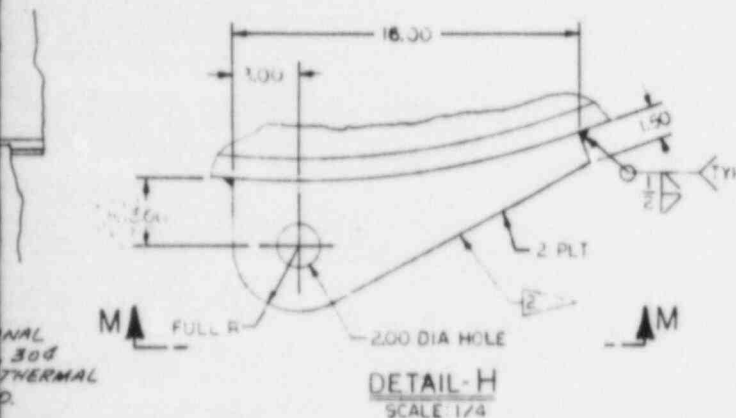
REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
L	SEE DCN		7/87



SECTION G-G
SCALE: 1/4

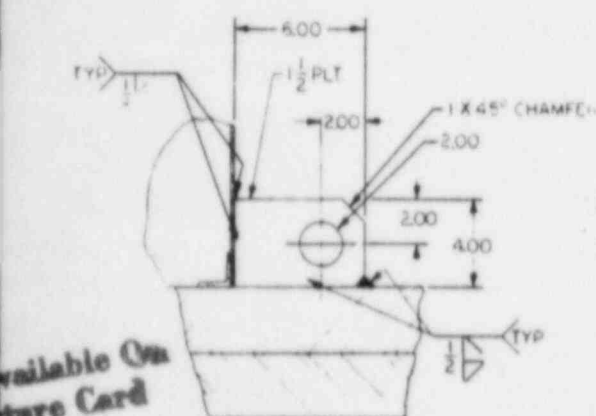


DETAIL - K
SCALE: 1/4

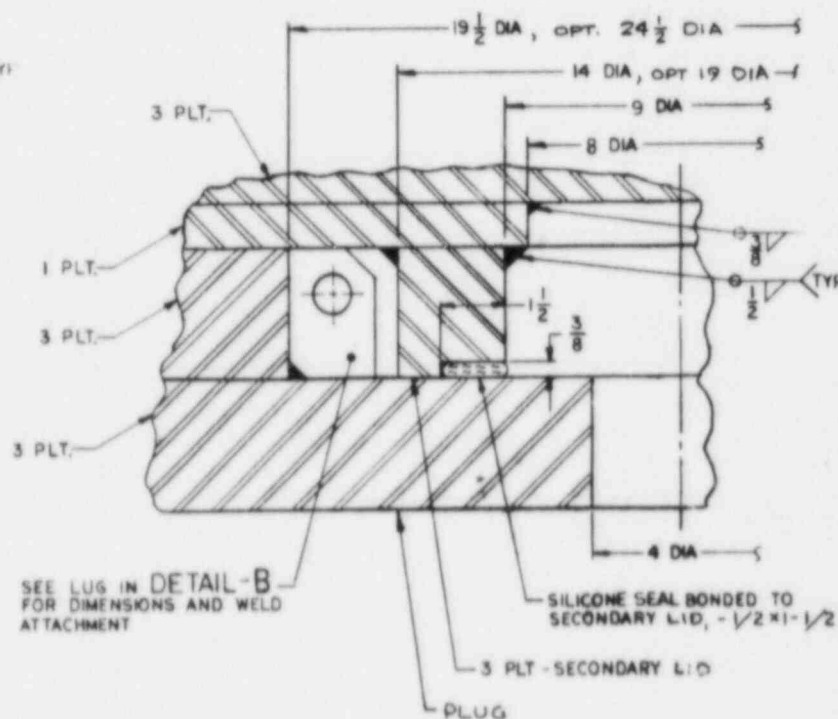


DETAIL - H
SCALE: 1/4

AS REQD.
CASK BODY



DETAIL J
SCALE: 1/4



DETAIL - L
SCALE: NONE

Available On
Feature Card

TI
PERTURE
CARD

ITEM		PART NO		DESCRIPTION		MATERIAL	
<p>ASSEMBLY & QUANTITY</p> <p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONS ANGLES 3 PLACES DECIMALS 2 PLACES DECIMALS 1 PLACE DECIMALS DO NOT SCALE THIS DRAWING</p>							
<p>LIST OF MATERIAL</p> <p>NUCLEAR PACKAGING, INC. TACOMA, WASHINGTON</p> <p>BULK RESIN SHIPPING FLASK MODEL OHI42-MK2</p> <p>Unpublished - All rights reserved</p>							
<p>DRAWN CULTUM</p> <p>CHECK D. KENT</p> <p>ENGR J. H. HARRIS</p>	<p>12-9-77</p> <p>12-28-77</p> <p>1-18-77</p>	<p>QA JHO</p> <p>TRD REL</p> <p>PROD REL</p>	<p>7-12-77</p>	<p>SCALE 1/4" = 1"</p> <p>REV</p> <p>REV</p>	<p>1</p> <p>2</p>	<p>1</p> <p>2</p>	<p>1</p> <p>2</p>
<p>APPLICATION</p> <p>Y-20-202D</p>							

2 8507 050374-04

NOTES: UNLESS OTHERWISE SPECIFIED

1. MATERIAL: LOW CARBON HOT ROLLED STEEL:
: PLATE & SHAPES CONFORM TO ASTM-A516, GR70
: SHEETS CONFORM TO ASTM-A36 or 304 SST PER ASTM-A240 WHERE NOTED.

2. MATERIAL : ASTM-A514 or A517

3. FOAM: 1,000 PSI CRUSH STRENGTH RIGID POLYURETHANE. PER NUPAC FOAM SPECIFICATION NPI-F6.

4. LEAD: PER FEDERAL SPECIFICATION QQ-L-171E, GRADE A OR C.

5. REMOVED

6. REFERENCE DATA: CASK WT: 54,000Lbs.
PAY LOAD: 10,000Lbs.
GROSS WT: 64,000Lbs.

7. REMOVED

8. ALL WELDING PROCEDURES AND PERSONNEL SHALL BE QUALIFIED IN ACCORDANCE WITH ASME CODE, SECTION IX.

9. ALL WELDS SHALL BE INSPECTED VIA NDT METHODS AS FOLLOWS:

LIFTING LUG AND CIRCUMFERENTIAL CONTINUOUS

WELDS: MAGNETIC PARTICLE PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 7.

LONGITUDINAL SHELL WELD: RADIOGRAPHIC PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 2.

10. AS AN OPTION, 12 GA. NO. 304 STAINLESS STEEL CLADDING MAY BE INSTALLED ON THE INTERIOR & EXTERIOR SURFACES OF THE FLASK BODY & INTERIOR SURFACES OF THE UPPER LID, & SEAL WELDED ALONG ALL EDGES & SEAMS.

11. PAINT ALL EXPOSED CARBON STEEL SURFACES WITH ONE COAT CARBROZINC II & ONE COAT PHENOLINE 305, OR ONE PRIMER COAT (5 MILS) MOBIL CHEM EPOXY NO. 89W9 & ONE FINISH COAT (5 MILS) MOBIL CHEM EPOXY NO. 89W9.

12. COAT ALL EXPOSED EXTERIOR SURFACES OF FLASK BETWEEN UPPER AND LOWER OVERPACKS WITH ONE (1) COAT (MIN 3/16 THK) "ALBI-CLAD" NO. 89. AS AN OPTION, A 10 GA. NO. 304 STAINLESS STEEL THERMAL SHIELD MAY BE INSTALLED BETWEEN THE OVERPACKS.

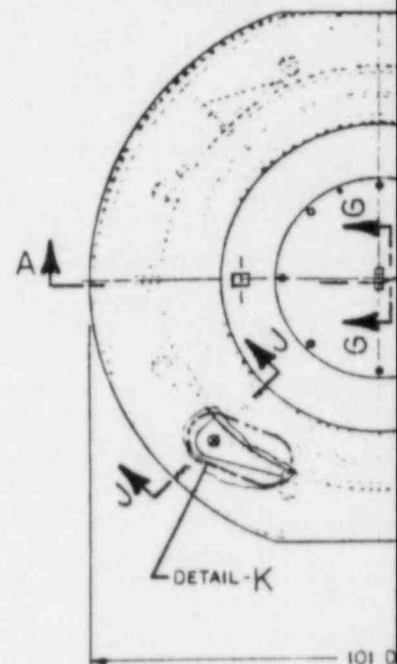
13. FLASKS FABRICATED PRIOR TO 3/84 MAY BE MADE USING ASTM-A36 MATERIAL. (FLASK BODY OUTER SHELL SHALL BE 1 1/8 IN. THICK, WITH FULL PENETRATION DOUBLE SIDED V GROOVE WELD FOR VERTICAL SEAM.)

14. NOMINAL AIR GAP (MINIMUM .05, MAXIMUM .42 in.)

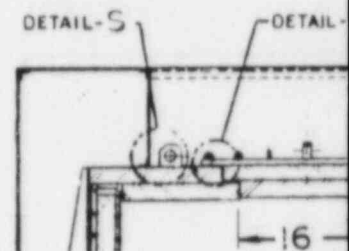
15. PACKAGE SHALL BE MARKED & IDENTIFIED IN ACCORDANCE WITH THE REQUIREMENTS OF 10 CFR 71.85(c)

16. PRIMARY & SECONDARY LIDS & DRAIN SHALL BE EQUIPPED WITH TAMPER INDICATING DEVICES IN ACCORDANCE WITH 10 CFR 71.43(b)

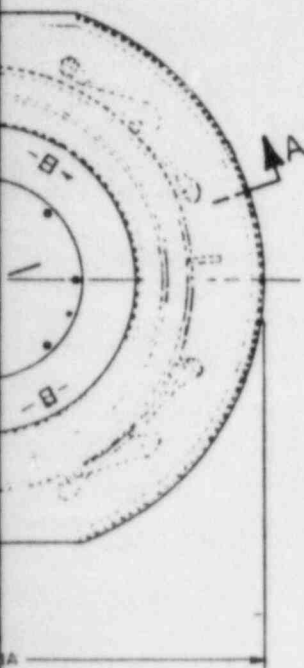
17. Unpublished - All rights reserved under copyright law.



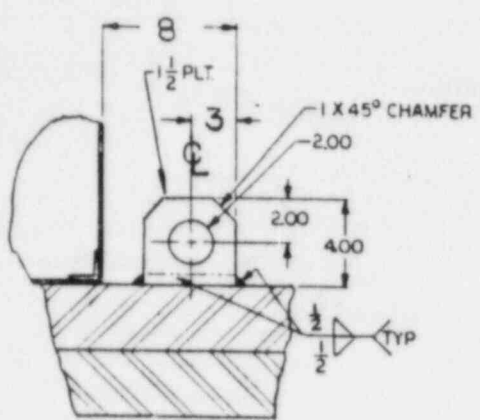
TOP VIEW SHOWING OPTIONA



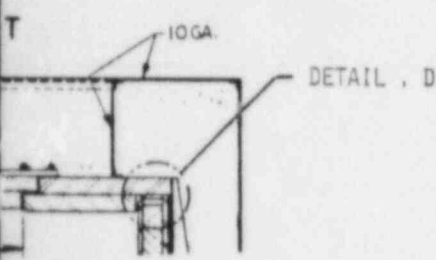
PARTIAL SECT A-A SHOWING OPTIO



16" DIA SECONDARY LID

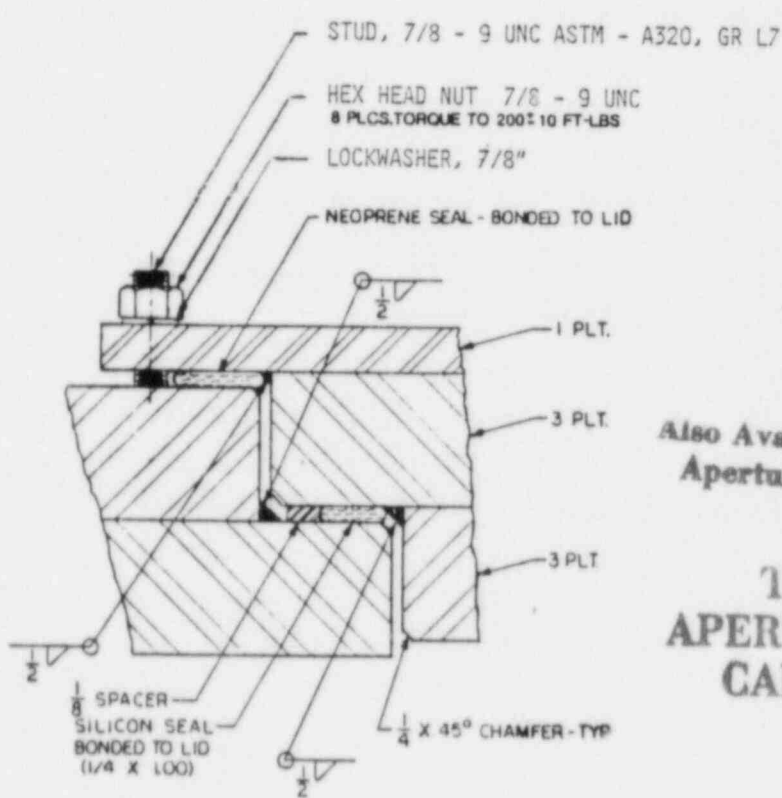


DETAIL - S



DETAIL - D

INAL 16" DIA SECONDARY LID




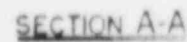
DETAIL - T

Also Available On
Aperture Card

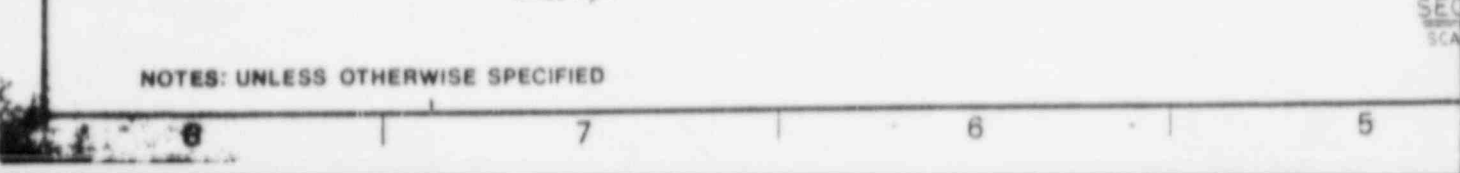
T1
APERTURE
CARD

8507 050374 - 05

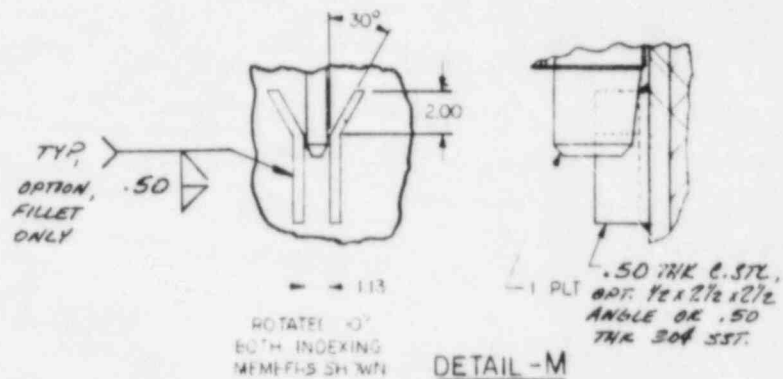
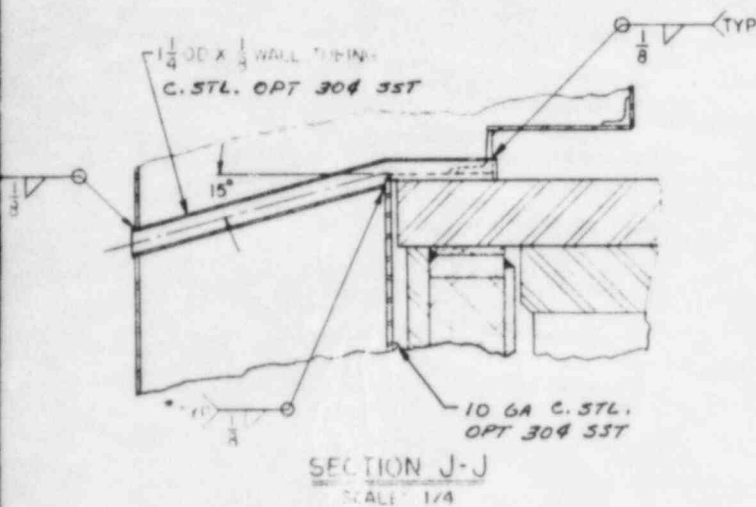
ITEM	PART NO	DESCRIPTION
ASSEMBLY & QUANTITY		LIST OF MATERIAL
REL	REL	 NUCLEAR PACKAGING A FINE LINE NUCLEAR COMPANY FEDERAL WAY, WA
APPO	APPO	
APPO	APPO	
APPO	APPO	
APPO	APPO	
APPO	APPO	
QA	QA	BULK RESIN SHIPPING FLASK MODEL OHI42 MK-I
CHECK	CHECK	
DRAWN	DRAWN	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONS ANGLES 3 PLACE DECIMALS 2 PLACE DECIMALS 1 PLACE DECIMALS		
IT 80TH NEXT ASSY		PROPRIETARY DATA: This drawing and the design it covers are the property of NUCLEAR PACKAGING, INCORPORATED. It is loaned to you in confidence and must be returned upon request. Its contents may not be disclosed in whole or in part to others or used for other than the purposes for which transmitted without prior written permission of NUCLEAR PACKAGING, INCORPORATED. SCALE: _____ WT: _____ REV: _____ SHEET: _____ OF: _____ DWG NO: _____ SIZE: B AL-20-202



8507050374-06



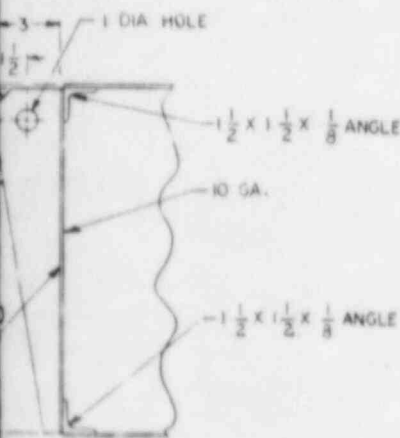
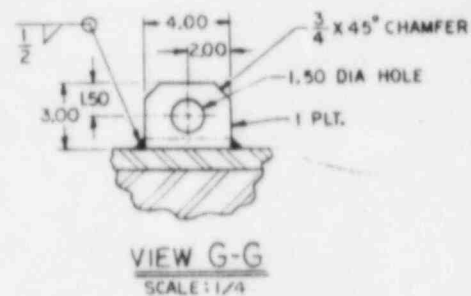
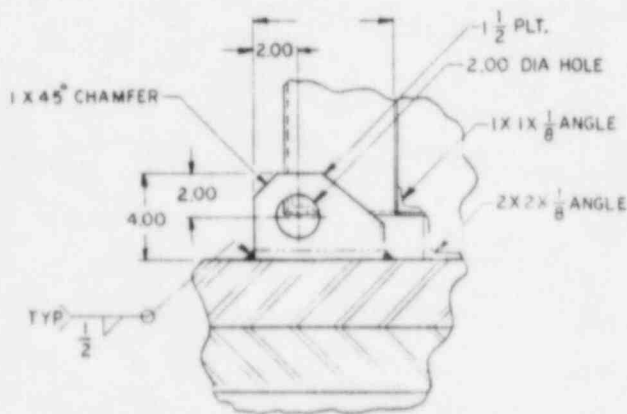
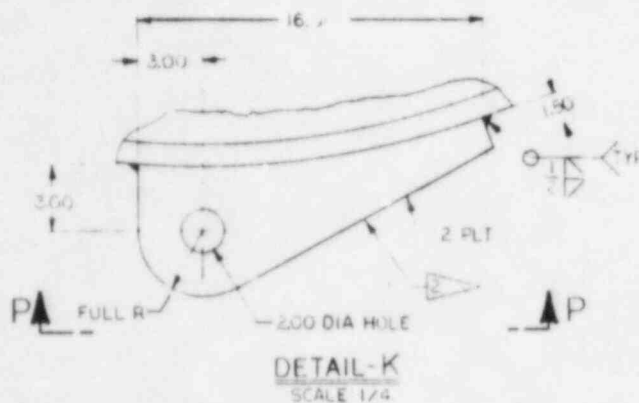
REVISIONS		
ZONE	LTR	DESCRIPTION
J	SEE DCN	
		DATE 6-85



FOR THERMAL SHIELD CONFIGURATION
ABOUT THE GUIDE TABS, SEE DWG. NO.
Y-20-2020, DETAIL-K.

Also Available On
Aperture Card

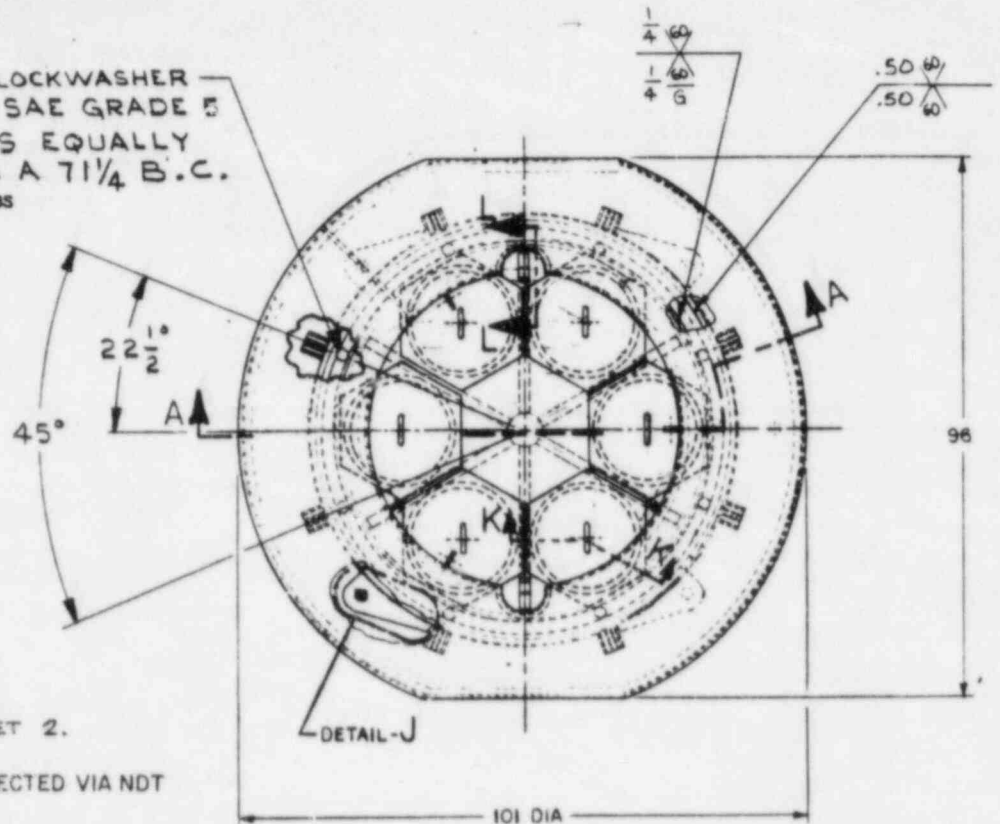
TI
APERTURE
CARD



ASSEMBLY & QUANTITY		ITEM	PART NO	DESCRIPTION	MATERIAL
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONS ANGLES 3 PLACE DECIMALS 2 PLACE DECIMALS 1 PLACE DECIMALS DO NOT SCALE THIS DRAWING		LIST OF MATERIAL			
		NUCLEAR PACKAGING, INC. TACOMA, WASHINGTON BULK RESIN SHIPPING FLASK MODEL OHI42 MK-I Unpublished - All rights reserved			
DRAWN		CULTUM	12-21-77	1/4	SCALE 1/16 (NOT TO SCALE)
CHECKED		1-15-78	1-15-78	1-15-78	REV
ENG'G		1-15-78	1-15-78	1-15-78	DWG NO.
APPLICATION		1-15-78	1-15-78	1-15-78	D
		AL-20-202			

28507050374-107

STUD, NUT & LOCKWASHER
 $1\frac{3}{8}$ -6UNC, SAE GRADE 5
 TYP 8 PLCS EQUALLY
 SPACED ON A $7\frac{1}{4}$ B.C.
 TORQUE 300 ± 25 FT-LBS



NOTES CONTINUE ON SHEET 2.

9. ALL WELDS SHALL BE INSPECTED VIA NDT METHODS AS FOLLOWS:

LIFTING LUGS AND CIRCUMFERENTIAL CONTINUOUS WELDS: MAGNETIC PARTICLE PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 7.

LONGITUDINAL SHELL WELDS: RADIOGRAPHIC PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 2.

8. ALL WELDING PROCEDURES AND PERSONNEL SHALL BE QUALIFIED IN ACCORDANCE WITH ASME CODE, SECTION IX.

7. REMOVED

6. REFERENCE DATA:
 CASK WT: 54,000 LBS.
 PAY LOAD: 10,000 LBS.
 GROSS WT: 64,000 LBS.

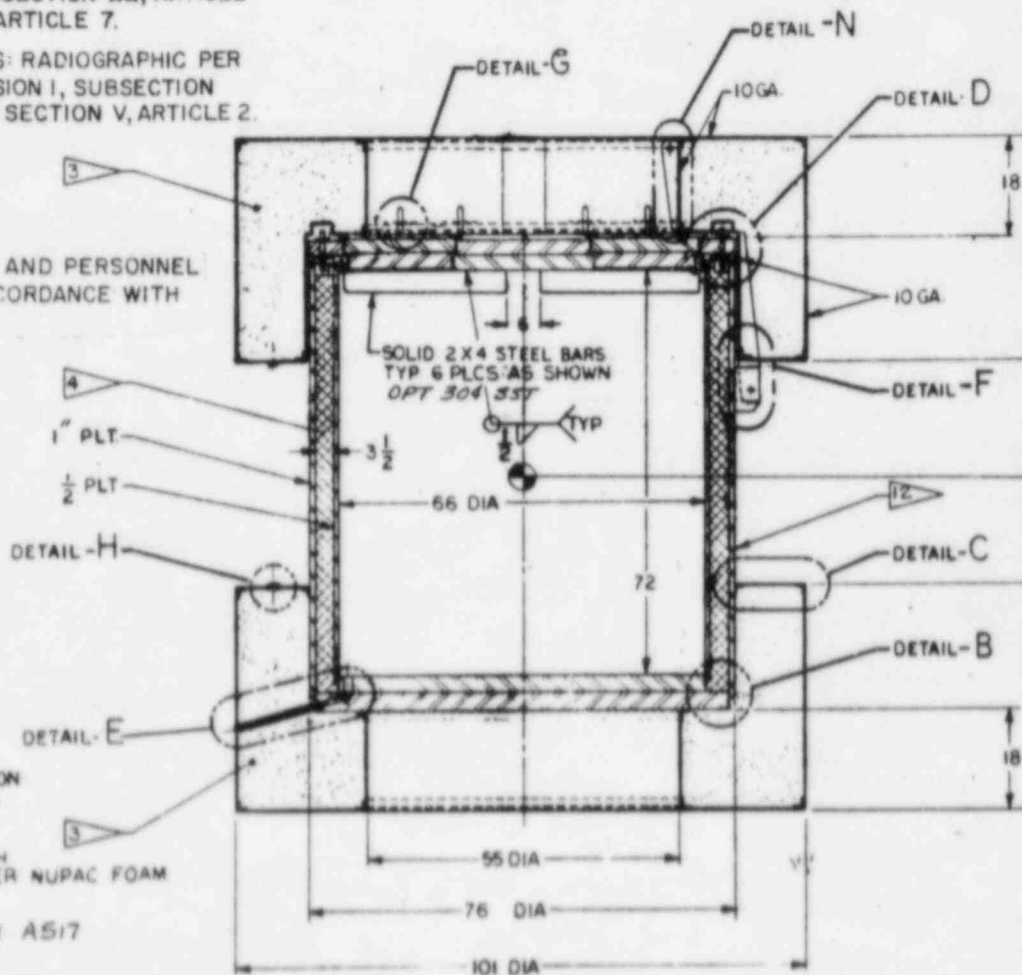
5. REMOVED

4. LEAD PER FEDERAL SPECIFICATION QQ-L-171A, GRADE A OR C.

3. FOAM: 1000 PSI CRUSH STRENGTH RIGID POLYURETHANE, PER NUPAC FOAM SPECIFICATION NPI-F6.

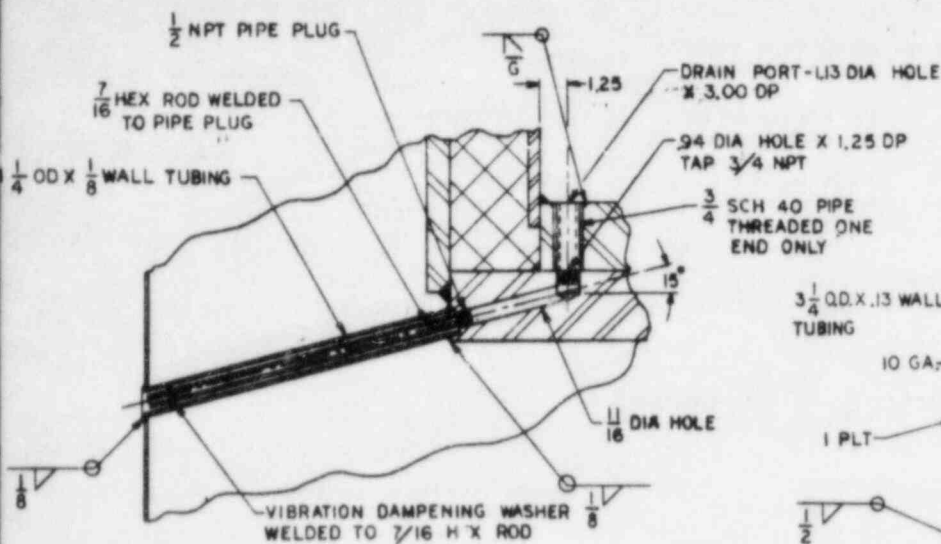
2. MATERIAL: ASTM-A514 OR A517

1. MATERIAL: LOW CARBON HOT ROLLED STEEL PLATE & SHAPES CONFORM TO ASTM-A516, GR 70 SHEETS CONFORM TO ASTM-A515, A36 OR 304 SST PER ASTM-A240 WHERE NOTED.

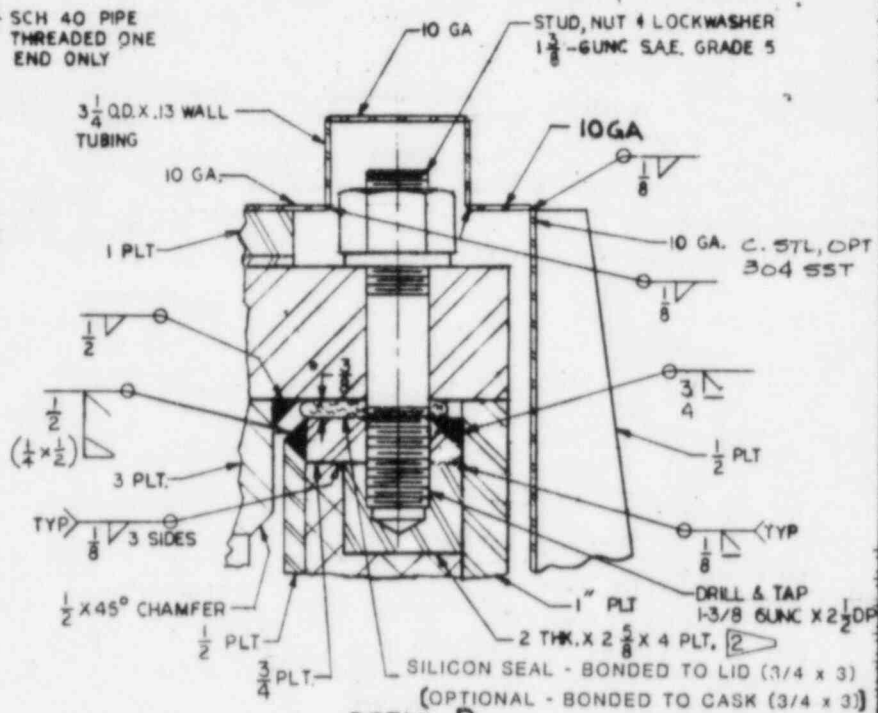


SECTION A-A

NOTES: UNLESS OTHERWISE SPECIFIED

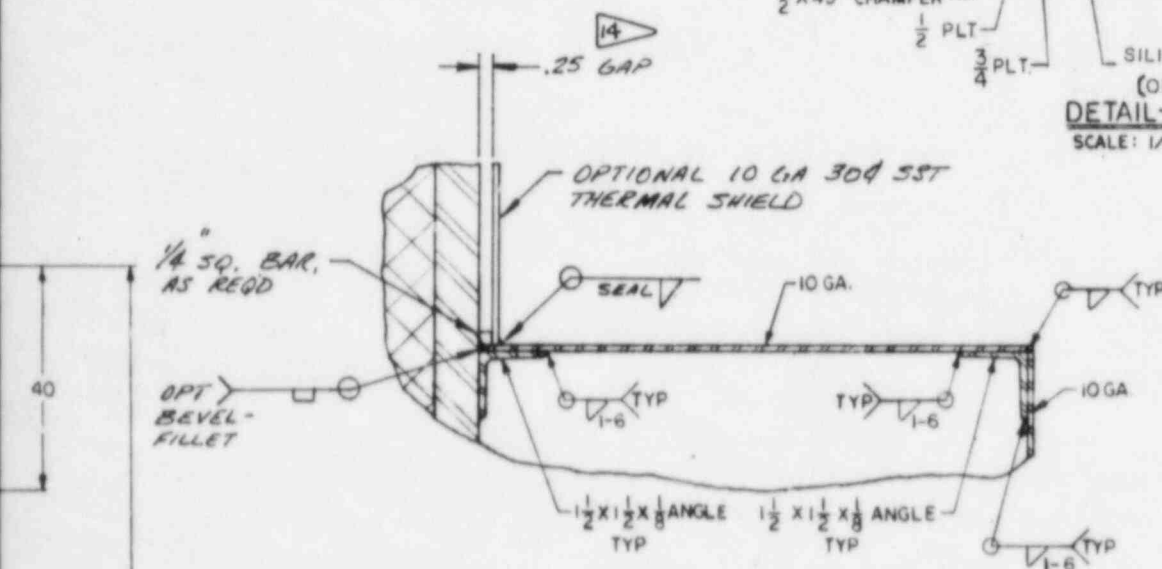


DETAIL-E
SCALE: 1/4



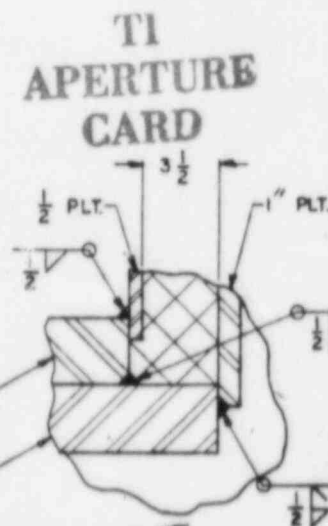
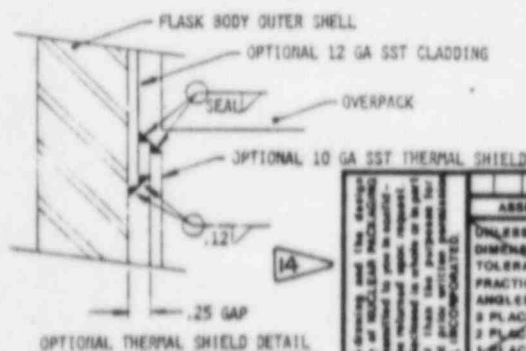
DETAIL-D
SCALE: 1/2

Also Available On
Aperture Card




DETAIL-C
SCALE: 1/2"

(WITH OPTIONAL THERMAL SHIELD)



8507 050374 ⁷³⁸DETAIL-B
SCALE 1/4

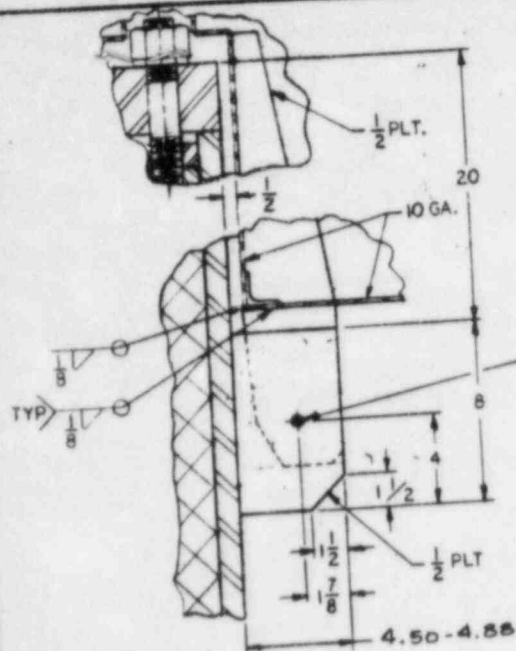
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	ASSEMBLY & QUANTITY		LIST OF MATERIAL				
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS: ANGLES: 3 PLACE DECIMALS 2 PLACE DECIMALS 1 PLACE DECIMAL DO NOT SCALE THIS DRAWING		 NUCLEAR PACKAGING, INC. TACOMA, WASHINGTON				
	(X)		BULK RESIN SHIPPING FLASK MODEL OHI42 MK-1 BOLT ON LID CONFIGURATION				
(X)		DRAWN CULTUM		12-30-77	GA	SCALE: 1/2" = 1'-0"	
CHECK [Signature]		1-13-78		[Signature]	1-12-78	REV: H	
NEXT ASSY USED ON:		ENGR [Signature]		1-15-78	[Signature]	Dwg No. AL-20-203	
APPLICATION		SHEET 1 OF 1					

8

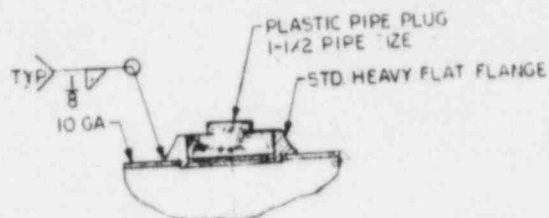
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6

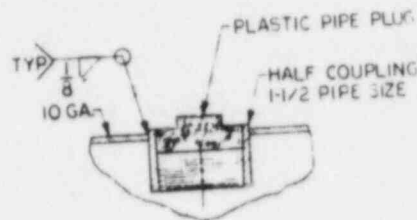
5



DETAIL-F
SCALE: 1/4



OPTION-1



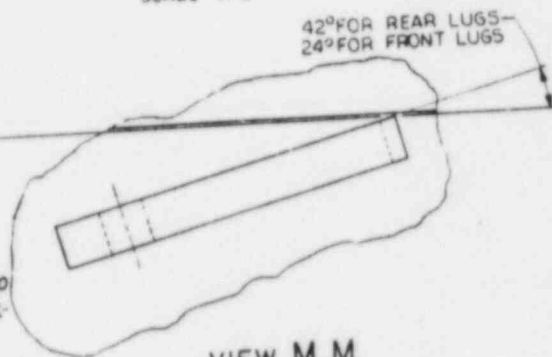
OPTION-2

DETAIL-H
SCALE: 1/2

17. PACKAGE SHALL BE MARKED & IDENTIFIED IN ACCORDANCE WITH THE REQUIREMENTS OF 10 CFR 71.85(c)
16. PRIMARY & SECONDARY LIDS & DRAIN SHALL BE EQUIPPED WITH TAMPER INDICATING DEVICES IN ACCORDANCE WITH 10 CFR 71.43(d)
15. Unpublished - All rights reserved under copyright law.

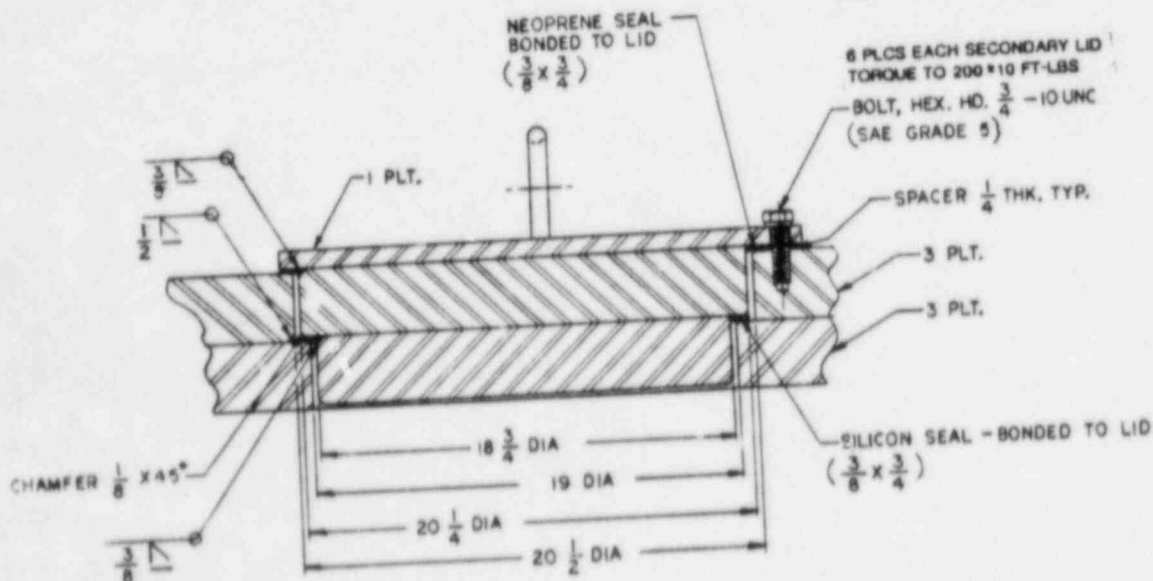
NOTES: CONTINUED

LOCATE 79-80
ABOVE OVER-
PACK BASE



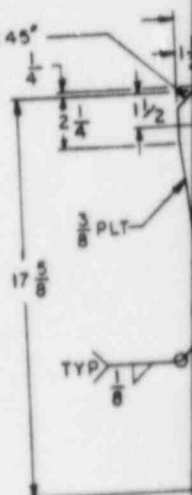
VIEW M-M
SCALE: 1/4

FOR THERMAL SHIELD CONFIGURATION
ABOUT THE TIE DOWN LUGS, SEE DWG.
NO. V-20-202D, VIEW M-M.



SECTION K-K
SCALE: 1/4

CHAMFER $\frac{3}{4} \times 45^\circ$



DETAIL
SCALE

NOTES: UNLESS OTHERWISE SPECIFIED

ZONE	LTR	DESCRIPTION	DATE
	H	SEE DCN	6/85

L AIR GAP (MINIMUM .05, MAXIMUM .42 in.)

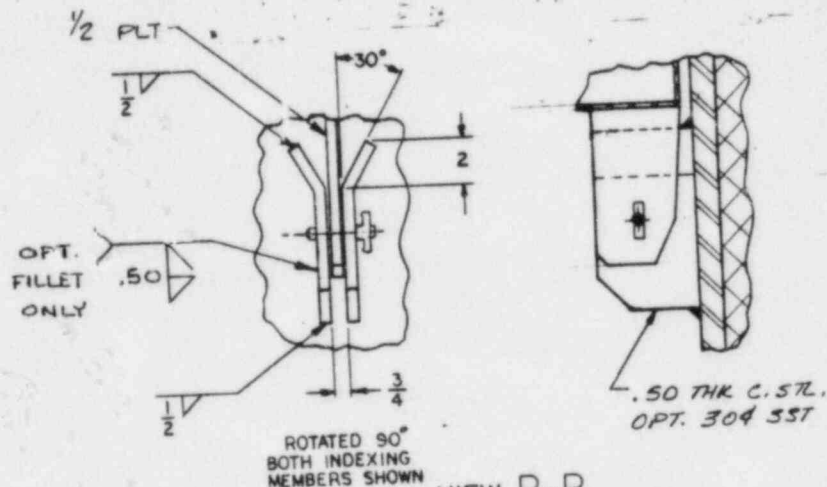
FABRICATED PRIOR TO 5-84 MAY BE MADE USING
A36 MATERIAL. (FLASK BODY OUTER SHELL SHALL
BE 1/2 IN. THICK, WITH FULL PENETRATION DOUBLE
V GROOVE WELD FOR VERTICAL SEAM.)

EXPOSED EXTERIOR SURFACES OF FLASK BETWEEN UPPER AND LOWER
WITH ONE (1) COAT (MIN 3/16 THK) "ALBI-CLAD" NO. 89, AS
ON, A 10 GA. NO. 304 STAINLESS STEEL THERMAL SHIELD MAY BE
ED BETWEEN THE OVERPACKS.

ALL EXPOSED CARBON STEEL SURFACES WITH ONE COAT CARBOZING LI
COAT PHENOLINE 305, COLOR 727 M. GRAY, OR ONE PRIMER COAT
(5) MOBIL CHEM EPOXY NO. 99W9 & ONE FINISH COAT (5 MILS) MOBIL
POXY NO. 99W9, COLOR: WHITE.

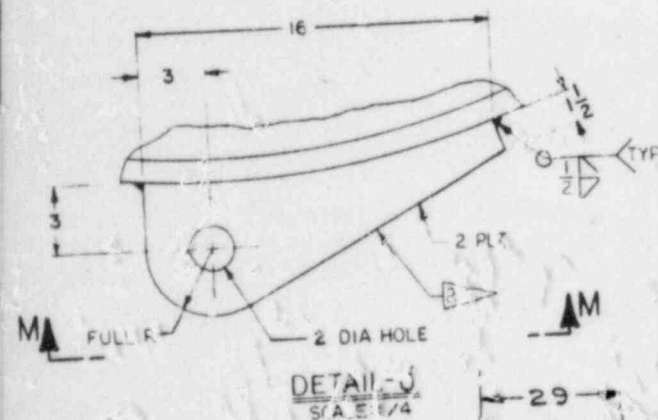
OPTION, 12 GA NO. 304 STAINLESS STEEL CLADDING MAY BE INSTALLED
INTERIOR & EXTERIOR SURFACES OF THE FLASK BODY & INTERIOR
OF THE UPPER LID, & SEAL WELDED ALONG ALL EDGES & SEAMS.

: CONTINUED

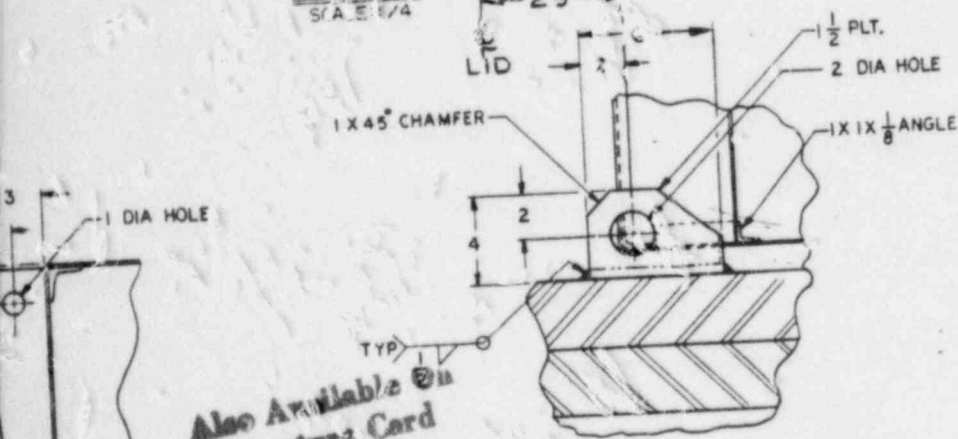


VIEW P-P
SCALE: 1/4

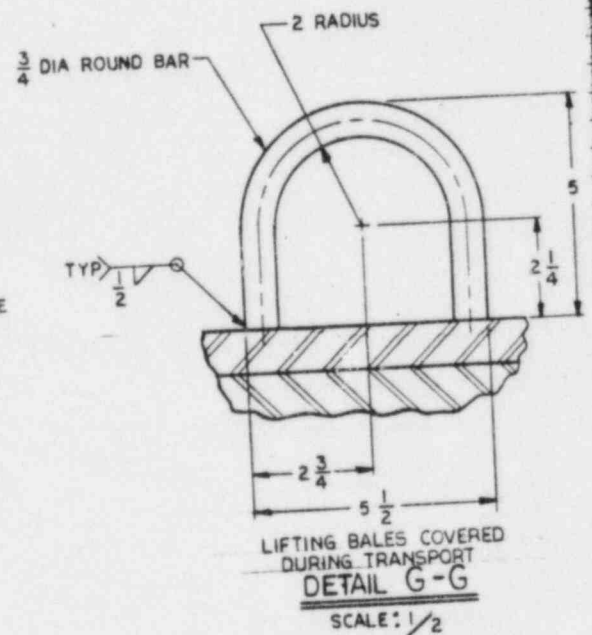
FOR THERMAL SHIELD CONFIGURATION
ABOUT THE GUIDE TABS, SEE DWG. NO.
Y-20-2020, DETAIL K.



DETAIL - J
SCALE 1/4



Also Available on
Aperture Card



LIFTING BALES COVERED
DURING TRANSPORT
DETAIL G-G

SCALE: 1/2

DETAIL L-L
SCALE: 1/4"

TI
APERTURE
CARD

SCALE: 1/4		ITEM		PART NO.		DESCRIPTION		MATERIAL	
<p>UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.</p> <p>TOLERANCES:</p> <p>FRACTIONS: ANGLES:</p> <p>3 PLACE DECIMALS:</p> <p>2 PLACE DECIMALS:</p> <p>1 PLACE DECIMALS:</p>		<p>NUCLEAR PACKAGING, INC.</p> <p>TACOMA, WASHINGTON</p>							
		<p>BULK RESIN SHIPPING FLASK</p> <p>MODEL OH142 MK-1</p> <p>BOLT ON LID CONFIGURATION</p>							
DO NOT SCALE THIS DRAWING		DRAWN		12-21-77		QA		SCALE: 1/16" MAX TH WT. 5	
<p>DO NOT SCALE THIS DRAWING</p> <p>NEXT ASSY USED ON</p> <p>APPLICATION</p>		CULTUM				REV		REV H	
		CHECK		1-13-78		DWG REL		1-13-78	
		ENGR		1-13-78		PROG REL		DWG NO. D	
								AL-20-203	

2 8507050874109

APPENDIX 1.10.2

EXPANSION OF ACCEPTABLE STRESS-STRAIN RANGE FOR IMPACT LIMITERS

1.10.2.1 Introduction

Due to minor changes in the formulation of the NPI.F6 polyurethane foam used in the OH-142 overpacks, it has become apparent that some foam placed in accordance with it may not exhibit stress-strain properties as shown in Figure 1 of Section 1.3 above. Some samples of foam taken during fabrication activities indicate that the upper bound of the stress-strain curve in Figure 1 should be raised. The revised limits of the stress-strain curve are shown in Figure 1.10.2-1. An analysis of the effect of this revised upper bound on the package margins of safety is presented below.

1.10.2.2 End Impact

The end impact drop orientation is the drop orientation most seriously affected by the revised foam properties. NuPac's EYDROP program is used to evaluate the force generated from a 31 foot drop onto an unyielding surface. EYDROP, like its sister programs CYDROP and SYDROP, has been used to demonstrate compliance of several other packages (such as the T-3 Spent Fuel Shipping Cask, Certificate of Compliance No. 9132, and the NuPac PAS-1 package, Certificate of Compliance No. 9184) to the 10 CFR 71 drop events. Table 1.10.2-1 presents output from EYDROP for the OH-142 using the revised upper bound of the stress-strain curve as shown in Figure 1.10.2-1. The table was generated using the equivalent outside diameter of the package. This equivalent diameter is calculated by determining the actual end area of the overpack and finding that diameter of a circle which has the same end area as the actual overpack. Also, the analysis assumes the entire overpack area is effective, corresponding to both the most conservative assumption presented in the body of this report as well as the results of numerous test programs.

FIGURE 1.10.2-1

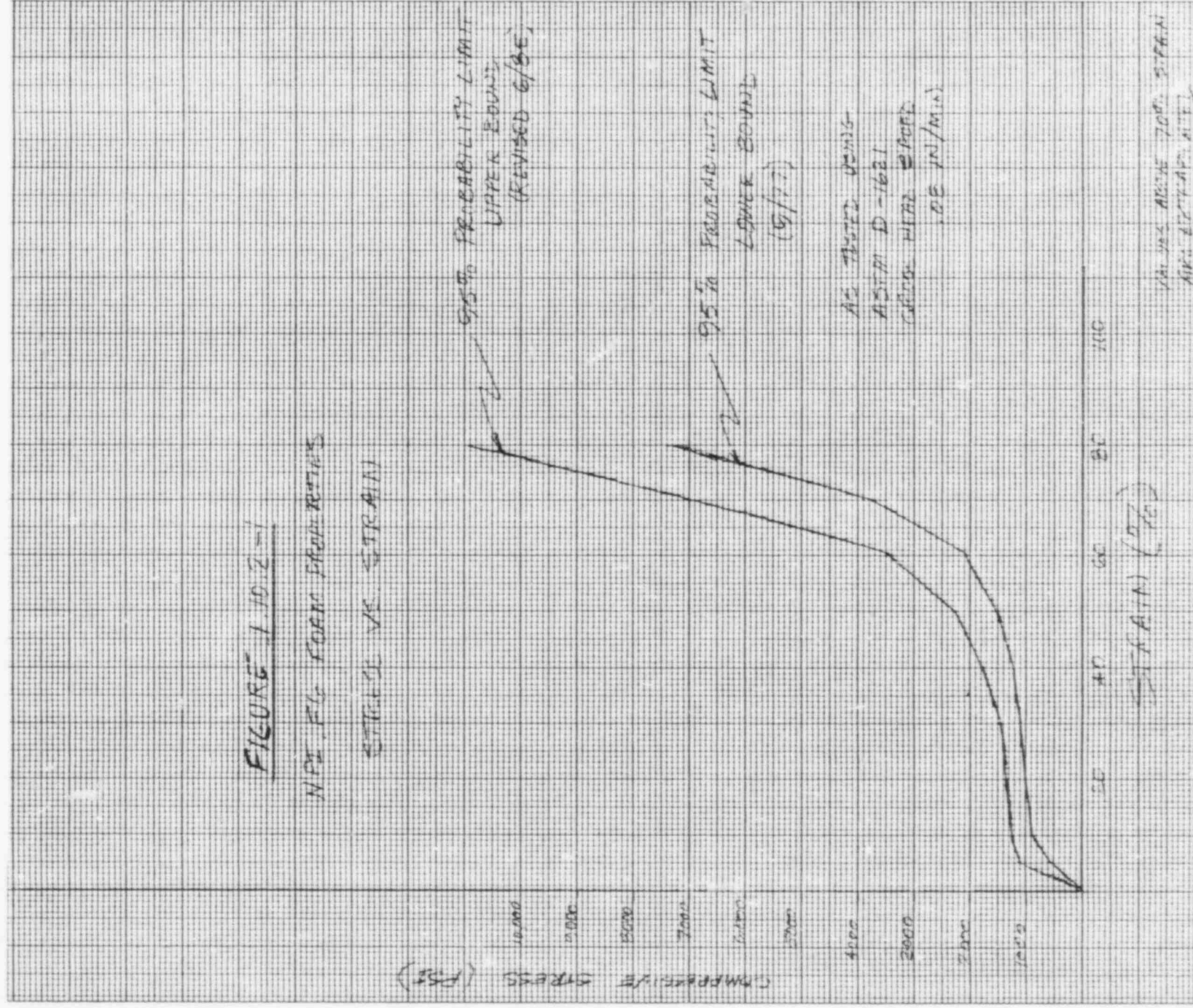


TABLE 1.10.2-1

EYDROP(END)

*

PACKAGE WEIGHT = 64000. (LBS)
 PACKAGE DIAMETER = 100.34 (IN)
 HOLE DIAMETER = 55.00 (IN)
 OVERPACK DEPTH = 18.00 (IN)
 DROP HEIGHT = 31.00 (FT)

CRUSH DEPTH (IN)	STRAIN	**** IMPACT ****		***** ENERGY *****		
		FORCE (LBS)	ACCEL. (G)	KINETIC (IN-LB)	STRAIN (IN-LB)	RATIO (SE/KE)
.25	.014	1690226.	26.4	23824000.	211278.	.009
.50	.028	3380453.	52.8	23840000.	845113.	.035
.75	.042	5070679.	79.2	23856000.	1901505.	.080
1.00	.056	6197042.	96.8	23872000.	3309970.	.139
1.25	.069	6455697.	100.9	23888000.	4891562.	.205
1.50	.083	6683053.	104.4	23904000.	6533906.	.273
1.75	.097	6879108.	107.5	23920000.	8229176.	.344
2.00	.111	7018933.	109.7	23936000.	9966431.	.416
2.25	.125	7119234.	111.2	23952000.	11753702.	.490
2.50	.139	7192218.	112.4	23968000.	13522633.	.564
2.75	.153	7244524.	113.2	23984000.	15327226.	.639
3.00	.167	7282793.	113.8	24000000.	17143141.	.714
3.25	.181	7313663.	114.3	24016000.	18967698.	.790
3.50	.194	7343775.	114.7	24032000.	20799877.	.866
3.75	.208	7413948.	117.3	24048000.	22644595.	.942
4.00	.222	7515532.	117.4	24064000.	24510778.	1.019
4.25	.236	7625653.	119.2	24080000.	26403426.	1.096
4.50	.250	7744310.	121.0	24096000.	28324671.	1.175
4.75	.264	7871504.	123.0	24112000.	30276648.	1.256
5.00	.278	8007234.	125.1	24128000.	32261490.	1.337

The table predicts that for the revised stress-strain limits, the acceleration experienced by the package would be 117 g's, slightly higher than previous analysis had predicted. The predicted deflection, 3.94 inches, is slightly less than previously predicted.

As a result of this analysis, the margins of safety predicted for the secondary lid closure bolts are affected slightly. For the 24 inch opening, the bolt force would be:

$$P = (3098 \text{ lbs.})(117 \text{ g}) / 8 \text{ bolts} = 45308 \text{ lbs./bolt}$$

The associated margin of safety is then:

$$M. S. = (56000/45308) - 1 = +0.24$$

For the optional 29 inch opening, the force in the bolts may be calculated as follows:

$$P = (4186 \text{ lbs.})(117 \text{ g}) / 8 \text{ bolts} = 61220 \text{ lbs./bolt}$$

The margin of safety for the 29 inch opening would be:

$$M. S. = (75750/61220) - 1 = +0.24$$

Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of a 31 foot end impact onto an unyielding surface.

1.10.2.3 Corner Impact

The change in the upper bound of the stress-strain curve causes Cases 3 and 4 discussed in the body of this report to be obsolete. Tables 1.10.2-2 and 1.10.2-3 present the same drop orientation (approximately 40 degrees from vertical) as previously analyzed. From the tables, it can be seen that the maximum acceleration experienced by the package is 77.2 g's, slightly higher than previously used for design. This slight increase in the package acceleration (77.2 g's versus 76.4 g's used previously) will have an affect on the package primary closure device design loads. Using the method shown in the Safety Analysis Report to be very conservative, the loads in the ratchet binders can be calculated:

$$(19900)(77.2)(38.125)\cos 40^{\circ} = (1011660)(15.83)\cos 40^{\circ} + \\ + 2(38.125)P_b(3.5)$$

$$P_b = 122,195 \text{ lbs. per binder}$$

The margin of Safety for the binder is then:

$$M. S. = (160,000/122,195) - 1 = +0.31$$

TABLE 1.10.2-2

CYDROP(CORNER)

NUCLEAR PACKAGING PROPRIETARY

07.19.11

85/06/08

OH-142 FULL 55 INCH HOLE

PACKAGE WEIGHT * 64000. (LBS)
 PACKAGE EXTERNAL LENGTH * 120.00 (IN)
 PACKAGE EXTERNAL DIAMETER * 101.00 (IN)
 PACKAGE EXTERNAL HOLE DIA * 55.00 (IN)
 PAYLOAD ENVELOPE LENGTH * 84.50 (IN)
 PAYLOAD ENVELOPE DIAMETER * 76.00 (IN)
 OVERPACK LENGTH * 40.00 (IN)

DROP HEIGHT * 31.00 (FT)
 ORIENTATION ANGLE * 40.090 (DEGREES WRT TO VERTICAL)

PLATEAU CRUSH STRESS * .00 (PSI)
 (DEFAULT TAKEN AT 10 PCT STRAIN)

STRESS/STRAIN EVALUATED IN 1/2 CRUSH PLANE ELLIPSE AT:
 NX * 25 POINTS PARALLEL TO SEMI-MINOR ELLIPSE AXIS
 NY * 25 POINTS PARALLEL TO SEMI-MAJOR ELLIPSE AXIS

EXPERIMENTAL STRAIN VS. STRESS VALUES

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1330.00
5	.30	1490.00
6	.40	1730.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00
10	.80	11000.00

CYDROP(CORNER)

NUCLEAR PACKAGING PROPRIETARY

07.19.11

85/06/08

OH-142 FULL 55 INCH HOLE

CRUSH DEPTH (IN)	** CRUSH PLANE **		**** IMPACT ****		***** ENERGY *****			DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA					
	AREA (IN2)	VOLUME (IN3)	FORCE (LBS)	ACCEL. (G)	KINETIC (IN-LB)	STRAIN (IN-LB)	RATIO (SE/KE)	LE.70	GT.70 LE.80	GT.80 LE.90	GT.90 LE.95	GT.95	
.50	11.9	3.	2281.	.0	23840000.	570.	.000	100.00	0.00	0.00	0.00	0.00	
1.00	33.6	14.	12940.	.2	23872000.	4375.	.000	100.00	0.00	0.00	0.00	0.00	
1.50	61.5	38.	35004.	.5	23904000.	16361.	.001	100.00	0.00	0.00	0.00	0.00	
2.00	94.4	77.	66309.	1.0	23936000.	41689.	.002	100.00	0.00	0.00	0.00	0.00	
2.50	131.4	134.	105174.	1.6	23968000.	84961.	.004	100.00	0.00	0.00	0.00	0.00	
3.00	172.0	209.	150633.	2.4	24000000.	148513.	.006	100.00	0.00	0.00	0.00	0.00	
3.50	215.9	306.	201562.	3.1	24032000.	236561.	.010	100.00	0.00	0.00	0.00	0.00	
4.00	262.7	426.	257436.	4.0	24064000.	351361.	.015	100.00	0.00	0.00	0.00	0.00	
4.50	312.1	570.	318012.	5.0	24096000.	495273.	.021	100.00	0.00	0.00	0.00	0.00	
5.00	364.1	739.	382597.	6.0	24128000.	670423.	.028	100.00	0.00	0.00	0.00	0.00	
5.50	418.3	934.	450759.	7.0	24160000.	878763.	.036	100.00	0.00	0.00	0.00	0.00	
6.00	474.6	1158.	520553.	8.1	24192000.	1121590.	.046	100.00	0.00	0.00	0.00	0.00	
6.50	532.9	1409.	590333.	9.2	24224000.	1399311.	.058	100.00	0.00	0.00	0.00	0.00	
7.00	593.0	1691.	660629.	10.3	24256000.	1712052.	.071	100.00	0.00	0.00	0.00	0.00	
7.50	654.8	2003.	737012.	11.5	24288000.	2061462.	.085	100.00	0.00	0.00	0.00	0.00	
8.00	718.2	2346.	805876.	12.6	24320000.	2447184.	.101	100.00	0.00	0.00	0.00	0.00	
8.50	783.1	2721.	880539.	13.8	24352000.	2868788.	.118	100.00	0.00	0.00	0.00	0.00	
9.00	849.4	3130.	958841.	15.0	24384000.	3328633.	.137	100.00	0.00	0.00	0.00	0.00	
9.50	917.1	3571.	1037370.	16.2	24416000.	3827685.	.157	100.00	0.00	0.00	0.00	0.00	
10.00	985.9	4047.	1124280.	17.4	24448000.	4368098.	.179	100.00	0.00	0.00	0.00	0.00	
10.50	1056.0	4557.	1213475.	19.0	24480000.	4952537.	.202	100.00	0.00	0.00	0.00	0.00	
11.00	1127.1	5103.	1299980.	20.3	24512000.	5580900.	.228	100.00	0.00	0.00	0.00	0.00	
11.50	1199.2	5655.	1406802.	22.0	24544000.	6257596.	.255	100.00	0.00	0.00	0.00	0.00	
12.00	1272.3	6303.	1510291.	23.6	24576000.	6956869.	.284	100.00	0.00	0.00	0.00	0.00	
12.50	1346.2	6957.	1627652.	25.4	24608000.	7771354.	.316	100.00	0.00	0.00	0.00	0.00	
13.00	1421.0	7649.	1753947.	27.4	24640000.	8616754.	.350	100.00	0.00	0.00	0.00	0.00	
13.50	1496.5	8378.	1876399.	29.3	24672000.	9524339.	.386	100.00	0.00	0.00	0.00	0.00	
14.00	1572.8	9146.	2038818.	31.9	24704000.	10503163.	.425	100.00	0.00	0.00	0.00	0.00	
14.50	1649.6	9951.	2229688.	34.8	24736000.	11570269.	.468	100.00	0.00	0.00	0.00	0.00	
15.00	1727.1	10795.	2412030.	37.7	24768000.	12730699.	.514	100.00	0.00	0.00	0.00	0.00	
15.50	1805.0	11679.	2600944.	41.4	24800000.	13996442.	.564	100.00	0.00	0.00	0.00	0.00	
16.00	1883.5	12601.	2793205.	45.3	24832000.	15392479.	.620	99.77	.23	0.00	0.00	0.00	
16.50	1962.4	13562.	2986992.	50.7	24864000.	16937528.	.681	98.41	1.59	0.00	0.00	0.00	
17.00	2041.7	14561.	3176305.	55.9	24896000.	18643353.	.749	96.36	3.64	0.00	0.00	0.00	
17.50	2121.3	15604.	3385844.	62.3	24928000.	20533890.	.824	95.27	4.73	0.00	0.00	0.00	
18.00	2201.2	16685.	361614.	69.3	24960000.	22639505.	.907	93.67	6.33	0.00	0.00	0.00	
18.50	2281.3	17805.	3809119.	76.7	24992000.	24975939.	1.000	92.53	8.31	1.16	0.00	0.00	
19.00	2361.6	18966.	4017038.	84.6	25024000.	27557478.	1.101	91.00	6.23	2.76	0.00	0.00	
19.50	2442.1	20167.	3960785.	93.1	25056000.	30401934.	1.213	88.71	7.14	4.14	0.00	0.00	
20.00	2522.7	21408.	4548473.	102.3	25088000.	33529248.	1.336	87.49	7.66	4.62	.24	0.00	

TABLE 1.10.2-3

CYDROP(CORNER)

NUCLEAR PACKAGING PROPRIETARY

07.18.39

85/06/08

OH-142 CENTRAL HOLE FILLED

PACKAGE WEIGHT = 64000. (LBS)
 PACKAGE EXTERNAL LENGTH = 120.00 (IN)
 PACKAGE EXTERNAL DIAMETER = 101.00 (IN)
 PACKAGE EXTERNAL HOLE DIA = .00 (IN)
 PAYLOAD ENVELOPE LENGTH = 84.50 (IN)
 PAYLOAD ENVELOPE DIAMETER = 76.00 (IN)
 OVERPACK LENGTH = 40.00 (IN)

DROP HEIGHT = 31.00 (FT)
 ORIENTATION ANGLE = 40.090 (DEGREES WRT TO VERTICAL)

PLATEAU CRUSH STRESS = .00 (PSI)
 (DEFAULT TAKEN AT 10 PCT STRAIN)

STRESS/STRAIN EVALUATED IN 1/2 CRUSH PLANE ELLIPSE AT:
 NX = 25 POINTS PARALLEL TO SEMI-MINOR ELLIPSE AXIS
 NY = 25 POINTS PARALLEL TO SEMI-MAJOR ELLIPSE AXIS

EXPERIMENTAL STRAIN VS. STRESS VALUES

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1350.00
5	.30	1490.00
6	.40	1750.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00
10	.80	11000.00

CYDROP(CORNER)

NUCLEAR PACKAGING PROPRIETARY

07.18.39

85/06/08

OH-142 CENTRAL HOLE FILLED

CRUSH DEPTH (IN)	** CRUSH PLANE **		**** IMPACT ****		***** ENERGY *****		DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA					
	AREA (IN ²)	VOLUME (IN ³)	FORCE (LBS)	ACCEL. (G)	KINETIC (IN-LB)	STRAIN (IN-LB)	RATIO (SE/KE)	LE.70	GT.70	GT.80	GT.90	GT.95
.50	11.9	5.	2281.	.0	23840000.	570.	.000	100.00	0.00	0.00	0.00	0.00
1.00	33.6	14.	12940.	.2	23872000.	4375.	.000	100.00	0.00	0.00	0.00	0.00
1.50	61.5	38.	35004.	.5	23904000.	16361.	.001	100.00	0.00	0.00	0.00	0.00
2.00	94.4	77.	66309.	1.0	23936000.	41689.	.002	100.00	0.00	0.00	0.00	0.00
2.50	131.4	134.	105176.	1.6	23968000.	84561.	.004	100.00	0.00	0.00	0.00	0.00
3.00	172.0	209.	150633.	2.4	24000000.	148513.	.006	100.00	0.00	0.00	0.00	0.00
3.50	215.9	306.	201562.	3.1	24032000.	236561.	.010	100.00	0.00	0.00	0.00	0.00
4.00	262.7	426.	257436.	4.0	24064000.	351561.	.015	100.00	0.00	0.00	0.00	0.00
4.50	312.1	570.	318012.	5.0	24096000.	495275.	.021	100.00	0.00	0.00	0.00	0.00
5.00	364.1	759.	382597.	6.0	24128000.	670425.	.028	100.00	0.00	0.00	0.00	0.00
5.50	418.3	954.	451287.	7.1	24160000.	878896.	.036	100.00	0.00	0.00	0.00	0.00
6.00	474.6	1158.	524453.	8.2	24192000.	1122831.	.046	100.00	0.00	0.00	0.00	0.00
6.50	532.9	1409.	602348.	9.4	24224000.	1404531.	.058	100.00	0.00	0.00	0.00	0.00
7.00	593.0	1691.	684834.	10.7	24256000.	1726127.	.071	100.00	0.00	0.00	0.00	0.00
7.50	654.8	2003.	771236.	12.1	24288000.	2090344.	.086	100.00	0.00	0.00	0.00	0.00
8.00	718.2	2346.	862002.	13.5	24320000.	2498654.	.103	100.00	0.00	0.00	0.00	0.00
8.50	783.1	2721.	957312.	15.0	24352000.	2953482.	.121	100.00	0.00	0.00	0.00	0.00
9.00	849.4	3130.	1057466.	16.5	24384000.	3457177.	.142	100.00	0.00	0.00	0.00	0.00
9.50	917.1	3571.	1162937.	18.2	24416000.	4012277.	.164	100.00	0.00	0.00	0.00	0.00
10.00	985.9	4047.	1274011.	19.9	24448000.	4621514.	.189	100.00	0.00	0.00	0.00	0.00
10.50	1056.0	4557.	1391037.	21.7	24480000.	5287776.	.216	100.00	0.00	0.00	0.00	0.00
11.00	1127.1	5103.	1515086.	23.7	24512000.	6014299.	.249	100.00	0.00	0.00	0.00	0.00
11.50	1199.2	5685.	1646783.	25.7	24544000.	6804759.	.277	100.00	0.00	0.00	0.00	0.00
12.00	1272.3	6303.	1786586.	27.9	24576000.	7663101.	.312	100.00	0.00	0.00	0.00	0.00
12.50	1346.2	6957.	1935879.	30.2	24608000.	8593716.	.349	100.00	0.00	0.00	0.00	0.00
13.00	1421.0	7649.	2096669.	32.3	24640000.	9601852.	.390	100.00	0.00	0.00	0.00	0.00
13.50	1496.5	8378.	2267353.	35.4	24672000.	10692858.	.433	100.00	0.00	0.00	0.00	0.00
14.00	1572.8	9186.	2442304.	38.5	24704000.	11875272.	.481	100.00	0.00	0.00	0.00	0.00
14.50	1649.6	9951.	2624340.	41.9	24736000.	13161934.	.532	100.00	0.00	0.00	0.00	0.00
15.00	1727.1	10795.	2819512.	45.6	24768000.	14562896.	.588	100.00	0.00	0.00	0.00	0.00
15.50	1805.0	11679.	3029064.	50.1	24800000.	16095041.	.649	100.00	0.00	0.00	0.00	0.00
16.00	1883.3	12601.	3257549.	55.3	24832000.	17781694.	.716	99.77	.23	0.00	0.00	0.00
16.50	1962.4	13562.	3504530.	61.0	24864000.	19642214.	.790	98.43	1.57	0.00	0.00	0.00
17.00	2041.7	14563.	3778481.	66.9	24896000.	21687966.	.871	96.45	3.55	0.00	0.00	0.00
17.50	2121.2	15604.	4073638.	72.2	24928000.	23940996.	1.023	95.40	4.60	0.00	0.00	0.00
18.00	2201.2	16685.	4381174.	81.3	24960000.	26433444.	1.059	95.89	6.11	0.00	0.00	0.00
18.50	2281.3	17805.	4786982.	90.4	24992000.	29189239.	1.168	92.86	6.04	1.10	0.00	0.00
19.00	2361.6	18946.	5284137.	99.8	25024000.	32232919.	1.288	91.42	5.95	2.64	0.00	0.00
19.50	2442.1	20167.	5822691.	109.7	25056000.	35583726.	1.420	89.30	6.77	3.95	0.00	0.00
20.00	2522.7	21408.	6475759.	119.9	25088000.	39258338.	1.565	88.27	7.18	4.33	.22	0.00

The effect of losing the capability of one of the ratchet binders prior to the drop event is analyzed in a more realistic manner, which results in a ratchet binder load approximately one third of that used for design. It is inconceivable that the slight change in the foam stress-strain curve would affect that analysis such that the resulting margin of safety would be less than that calculated conservatively above.

The binder retaining pins are calculated to have a capacity of 261,316 lbs. The resulting margin of safety is therefore:

$$M. S. = (261,316/122,195) - 1 = +1.14$$

The Mark I overpack retainer pins have a capacity of 32,800 lbs. in double shear. The body of the report demonstrates that shear of the pin is the controlling condition rather than shear out. The pin load is calculated as below:

$$P_o = (122195 \text{ lbs.})(3000 \text{ lbs.})/(19900 \text{ lbs.}) = 18421 \text{ lbs.}$$

The margin of safety is then:

$$M. S. = 32,800 \text{ lbs.}/18,421 \text{ lbs.} - 1 = +0.78$$

The load carried by the closure bolts in the Mark I bolt-on lid design can be calculated as below:

$$(16900)(77.2)(38.125)\cos 40^\circ = 12267878 + (266.7)(P_b)(71.25/76.25)$$

$$P_b = 103,670 \text{ lbs./bolt}$$

Since the capacity of each stud is calculated to be 120750 lbs./stud, the margin of safety is as below:

$$M. S. = (120,750/103670) - 1 = +0.16$$

The capacity of the cask body closure ring is calculated to be 210,000 lbs. at each stud location. The margin of safety for the closure ring is then:

$$M. S. = (210,000/103,670) - 1 = +1.03$$

Bearing stresses in the overpack attachment lugs can be calculated as follows:

$$f_{brg} = 122,195 / ((1.50)(1.625)) = 50,131 \text{ psi}$$

The margin of safety is then:

$$M. S. = (90,000/50,131) - 1 = +0.80$$

The weld capability of the Mark I hold-down lug weld is 157,500 lbs. The margin of safety is then:

$$M. S. = (157,500/122,195) - 1 = +0.29$$

The shear-out capacity of the binder attachment lugs is calculated to be 197,350 lbs. Therefore, the margin of safety is:

$$M. S. = (197,350/122,195) - 1 = +0.62$$

All of the margins of safety calculated in Section 1.7.1.2 of the report that are affected by the revised stress-strain limit on the foam have been presented above. None of the margins have been affected significantly, and all remain positive, even with very conservative analysis techniques. Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of a 31 foot corner drop onto an unyielding surface.

1.10.2.4 Side Impact

NuPac's SYDROP program was used to evaluate the effects of a 31 foot drop onto the package side. Analyses were performed assuming the the entire length of the overpack is effective in resisting the impact and assuming that only that portion of the overpack between the cask shield and the impact surface is effective in resisting the impact. The latter assumption was made to develop a very conservative prediction of acceleration. Tests have shown that this assumption does not accurately model the actual response of an overpack to impact loads.

The results of the analyses are presented in Tables 1.10.2-4 and 1.10.2-5. The tables show that the more rigorous integration techniques employed by the SYDROP program result in predicted accelerations less than those used for design. As a result, the margins of safety presented in the body of this report under predict the actual margins of safety, even with the revised foam data. Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of 31 foot side drop onto an unyielding surface.

TABLE 1.10.2-4

SYDROP(SIDE)

NUCLEAR PACKAGING PROPRIETARY

10.16.12

85/06/08

OH-142 UNBACKED FOAM EFFECTIVE

PACKAGE WEIGHT * 44000. (LBS)
 PACKAGE EXTERNAL LENGTH * 80.00 (IN)
 PACKAGE EXTERNAL DIAMETER * 101.00 (IN)
 PAYLOAD DIAMETER * 76.00 (IN)
 DROP HEIGHT * 31.00 (FT)

STRAIN VS STRESS TABLE

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1330.00
5	.30	1490.00
6	.40	1730.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00

SYDROP(SIDE)

NUCLEAR PACKAGING PROPRIETARY

10.16.12

85/06/08

OH-142 UNBACKED FOAM EFFECTIVE

CRUSH DEPTH (IN)	** CRUSH PLANE **		**** IMPACT ****		***** ENERGY *****		RATIO (SE/PE)	DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA				
	AREA (IN ²)	VOLUME (IN ³)	FORCE (LBS)	ACCEL. (G)	POTENTIAL (IN-LB)	STRAIN (IN-LB)		LE.70	GT.70	LE.80	GT.80	GT.95
.25	803.0	154.	233553.	3.7	21824000.	29419.	.001	100.00	0.00	0.00	0.00	0.00
.50	1134.2	378.	464309.	10.4	23840000.	141877.	.006	100.00	0.00	0.00	0.00	0.00
.75	1387.4	695.	1148857.	18.0	25856000.	368523.	.015	100.00	0.00	0.00	0.00	0.00
1.00	1600.0	1069.	1508648.	25.6	25872000.	700711.	.029	100.00	0.00	0.00	0.00	0.00
1.25	1786.6	1493.	1821409.	28.3	25888000.	1116967.	.047	100.00	0.00	0.00	0.00	0.00
1.50	1954.7	1961.	2099767.	32.8	25904000.	1607114.	.067	100.00	0.00	0.00	0.00	0.00
1.75	2108.6	2469.	2349958.	36.7	25920000.	2165329.	.090	100.00	0.00	0.00	0.00	0.00
2.00	2251.4	3014.	2577243.	40.3	25936000.	2779229.	.114	100.00	0.00	0.00	0.00	0.00
2.25	2385.0	3594.	2786091.	43.3	25952000.	3449646.	.144	100.00	0.00	0.00	0.00	0.00
2.50	2510.8	4206.	2981005.	46.6	25968000.	4170533.	.174	100.00	0.00	0.00	0.00	0.00
2.75	2630.0	4849.	3174291.	49.6	25984000.	4939945.	.206	100.00	0.00	0.00	0.00	0.00
3.00	2743.4	5520.	3368066.	52.6	26000000.	5757740.	.240	100.00	0.00	0.00	0.00	0.00
3.25	2851.8	6220.	3562299.	55.7	26016000.	6624035.	.274	100.00	0.00	0.00	0.00	0.00
3.50	2955.7	6946.	3758032.	58.7	26032000.	7539076.	.314	100.00	0.00	0.00	0.00	0.00
3.75	3055.5	7697.	3956139.	61.8	26048000.	8503348.	.354	100.00	0.00	0.00	0.00	0.00
4.00	3151.6	8473.	4154666.	64.9	26064000.	9517198.	.395	100.00	0.00	0.00	0.00	0.00
4.25	3244.4	9273.	4355626.	68.1	26080000.	10580945.	.439	100.00	0.00	0.00	0.00	0.00
4.50	3334.2	10095.	4561782.	71.3	26096000.	11695661.	.485	100.00	0.00	0.00	0.00	0.00
4.75	3421.1	10940.	4775360.	74.6	26112000.	12862804.	.533	100.00	0.00	0.00	0.00	0.00
5.00	3505.4	11806.	4999613.	78.1	26128000.	14084679.	.584	100.00	0.00	0.00	0.00	0.00
5.25	3587.3	12692.	5230884.	81.7	26144000.	15365467.	.636	100.00	0.00	0.00	0.00	0.00
5.50	3666.9	13599.	5475269.	85.6	26160000.	16701757.	.691	100.00	0.00	0.00	0.00	0.00
5.75	3744.4	14526.	5739196.	89.7	26176000.	18103563.	.749	100.00	0.00	0.00	0.00	0.00
6.00	3819.9	15471.	6029476.	94.2	26192000.	19574711.	.809	100.00	0.00	0.00	0.00	0.00
6.25	3893.6	16435.	6358156.	99.3	26208000.	21122853.	.873	100.00	0.00	0.00	0.00	0.00
6.50	3965.3	17418.	6705586.	104.8	26224000.	22755446.	.939	100.00	0.00	0.00	0.00	0.00
6.75	4025.8	18277.	7041749.	110.0	26237748.	24237884.	1.000	100.00	0.00	0.00	0.00	0.00
7.00	4085.6	18418.	7396821.	110.9	26248000.	24480747.	1.010	100.00	0.00	0.00	0.00	0.00
7.25	4104.2	19435.	7949775.	118.0	26256000.	26111571.	1.085	100.00	0.00	0.00	0.00	0.00
7.50	4171.3	20470.	8084584.	126.3	26272000.	28265866.	1.165	100.00	0.00	0.00	0.00	0.00
7.75	4237.0	21521.	8721938.	136.3	26288000.	30566681.	1.250	100.00	0.00	0.00	0.00	0.00
7.95	4301.3	22588.	9509482.	148.4	26304000.	32645609.	1.345	100.00	0.00	0.00	0.00	0.00
8.00	4364.2	23671.	10461472.	163.5	26320000.	35141978.	1.445	100.00	0.00	0.00	0.00	0.00

TABLE 1.10.2-5

SYDROP(SIDE)

NUCLEAR PACKAGING PROPRIETARY

17.58.29

85/06/11

OH-142 ONLY BACKED FOAM EFFECTIVE

PACKAGE HEIGHT * 64000. (LBS)
 PACKAGE EXTERNAL LENGTH * 44.00 (IN)
 PACKAGE EXTERNAL DIAMETER * 101.00 (IN)
 PAYLOAD DIAMETER * 76.00 (IN)
 DROP HEIGHT * 31.00 (FT)

STRAIN VS STRESS TABLE

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1330.00
5	.30	1490.00
6	.40	1730.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00

SYDROP(SIDE)

NUCLEAR PACKAGING PROPRIETARY

17.58.29

85/06/11

OH-142 ONLY BACKED FOAM EFFECTIVE

CRUSH DEPTH (IN)	** CRUSH PLANE **		**** IMPACT ****		***** ENERGY *****		RATIO (SE/PE)	DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA				
	AREA (IN ²)	VOLUME (IN ³)	FORCE (LBS)	ACCEL. (G)	POTENTIAL (IN-LB)	STRAIN (IN-LB)		LE.70	GT.70	GT.80	GT.90	GT.95
.25	941.6	79.	129444.	2.0	25824000.	16181.	.001	100.00	0.00	0.00	0.00	0.00
.50	823.8	208.	365370.	5.7	25840000.	78052.	.003	100.00	0.00	0.00	0.00	0.00
.75	763.1	382.	631871.	9.9	25856000.	202687.	.008	100.00	0.00	0.00	0.00	0.00
1.00	880.0	588.	829757.	13.0	25872000.	385391.	.016	100.00	0.00	0.00	0.00	0.00
1.25	982.6	821.	1001772.	15.7	25888000.	619332.	.026	100.00	0.00	0.00	0.00	0.00
1.50	1075.1	1078.	1154872.	18.0	25904000.	885913.	.037	100.00	0.00	0.00	0.00	0.00
1.75	1159.8	1358.	1292477.	20.2	25920000.	1189851.	.050	100.00	0.00	0.00	0.00	0.00
2.00	1258.3	1658.	1417484.	22.1	25936000.	1528576.	.064	100.00	0.00	0.00	0.00	0.00
2.25	1311.7	1977.	1532350.	23.9	25952000.	1897305.	.079	100.00	0.00	0.00	0.00	0.00
2.50	1380.9	2315.	1659553.	25.6	25968000.	2295793.	.094	100.00	0.00	0.00	0.00	0.00
2.75	1446.5	2667.	1745860.	27.3	25984000.	2716970.	.113	100.00	0.00	0.00	0.00	0.00
3.00	1508.9	3036.	1852436.	28.9	26000000.	3166757.	.132	100.00	0.00	0.00	0.00	0.00
3.25	1568.5	3421.	1959264.	30.6	26016000.	3643219.	.152	100.00	0.00	0.00	0.00	0.00
3.50	1625.6	3820.	2066917.	32.3	26032000.	4146492.	.173	100.00	0.00	0.00	0.00	0.00
3.75	1680.5	4234.	2175876.	34.0	26048000.	4676841.	.194	100.00	0.00	0.00	0.00	0.00
4.00	1733.4	4660.	2285066.	35.7	26064000.	5234459.	.218	100.00	0.00	0.00	0.00	0.00
4.25	1784.4	5100.	2395595.	37.4	26080000.	5819542.	.242	100.00	0.00	0.00	0.00	0.00
4.50	1833.8	5552.	2508980.	39.2	26096000.	6432613.	.267	100.00	0.00	0.00	0.00	0.00
4.75	1881.6	6017.	2626448.	41.0	26112000.	7074542.	.293	100.00	0.00	0.00	0.00	0.00
5.00	1928.0	6495.	2749787.	43.0	26128000.	7746571.	.321	100.00	0.00	0.00	0.00	0.00
5.25	1973.0	6981.	2876986.	45.0	26144000.	8449918.	.350	100.00	0.00	0.00	0.00	0.00
5.50	2016.8	7479.	3011398.	47.1	26160000.	9185966.	.380	100.00	0.00	0.00	0.00	0.00
5.75	2059.4	7989.	3156558.	49.3	26176000.	9956961.	.412	100.00	0.00	0.00	0.00	0.00
6.00	2101.0	8509.	3316487.	51.8	26192000.	10746091.	.445	100.00	0.00	0.00	0.00	0.00
6.25	2141.5	9039.	3495336.	54.6	26208000.	11617569.	.480	100.00	0.00	0.00	0.00	0.00
6.50	2181.0	9580.	3688072.	57.6	26224000.	12518699.	.517	100.00	0.00	0.00	0.00	0.00
6.75	2219.6	10130.	3895292.	61.0	26240000.	13464411.	.555	100.00	0.00	0.00	0.00	0.00
7.00	2257.3	10689.	4112176.	64.9	26256000.	14471364.	.597	100.00	0.00	0.00	0.00	0.00
7.25	2294.2	11258.	4346521.	69.3	26272000.	15546228.	.641	100.00	0.00	0.00	0.00	0.00
7.50	2330.2	11837.	4797066.	75.0	26288000.	16701675.	.688	100.00	0.00	0.00	0.00	0.00
7.75	2365.7	12424.	5250213.	81.7	26304000.	17955083.	.739	100.00	0.00	0.00	0.00	0.00
8.00	2400.3	13019.	5715810.	89.9	26320000.	19328088.	.795	100.00	0.00	0.00	0.00	0.00
8.25	2434.3	13624.	6272049.	99.4	26336000.	20845820.	.857	100.00	0.00	0.00	0.00	0.00
8.50	2467.5	14236.	7090515.	110.8	26352000.	22526641.	.925	100.00	0.00	0.00	0.00	0.00
8.75	2499.6	14846.	7899366.	123.4	26367705.	24367727.	1.008	100.00	0.00	0.00	0.00	0.00
8.95	2500.2	14887.	7914543.	123.7	26368000.	24492273.	1.001	100.00	0.00	0.00	0.00	0.00
9.00	2532.2	15486.	8779249.	137.2	26384000.	26488997.	1.088	84.00	16.00	0.00	0.00	0.00

1.10.2.5 Conclusions

The analyses presented above demonstrate that the revised upper bound on the stress-strain properties of the foam has no effect on the package's ability to meet the requirements of 10 CFR 71.

7.2.5.1

The package should be leak tested utilizing a halogen detector type test similar to the one presented in Appendix 7.3.2. The halogen gases shall be introduced to the fully assembled package through appropriate fittings in the drain port area or a vent port, if so equipped. (See Dwg Y-20-201D, Detail F; Y-20-202D, Detail N; Dwg. AL-20-202, Detail E; or AL-20-203, Detail E).

7.2.5.2

The leak test described in Section 7.2.5.1 shall be performed at the Primary and Secondary lid seals and at all ports as appropriate for the particular OH-142 cask configuration. The required elements of this leak test are as follows:

1. A halogen gas leak detector capable of detecting a leak rate of 0.5 oz./yr. shall be used. Its calibration, adjustment, and use shall be in accordance with the manufacturer's requirements.
2. Dichlorodifluoromethane (Freon R-12) shall be used as the halogen and pressurizing gas.
3. The packaging or package (as appropriate) shall be assembled for the test in accordance with Section 6.0. The cask shall be pressurized through the drain or vent port, as applicable.
4. The temperature of the cask shall be measured before the test. The pressurization of the cask shall be based on this temperature as follows:

Cask Body Temperature Range (°F)	Cask Pressurization (Nominal PSIG)
10-40	3.3
41-70	3.4
71-100	3.5
101-120	3.6

5. The sensitivity of the test shall be approximately 5×10^{-6} std. cc/sec/. The acceptance criterion shall be no leak in excess of 10^{-5} std. cc/sec.
6. Each seal area shall be tested.
7. If acceptance criterion is not met, a retest shall be conducted following an assembly recheck, maintenance, and/ or reassembly.



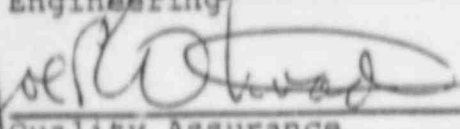
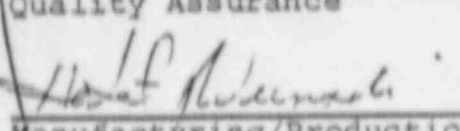
APPENDIX 7.3. 2

PROCEDURE FOR
SEAL INTEGRITY LEAK TEST
OF THE
OH-142 TYPE B SHIPPING CONTAINER

LT-23


REV. 0

MAY 31, 1985


Prepared By6/4/85
Date
Engineering6/4/85
Date
Quality Assurance6/4/85
Date
Manufacturing/Production6/4/85
Date

N/A

Other

Date
Document Control/Release

7-16

6.4.85
Date