INSTRUCTIONS FOR INCORPORATING REVISION III AMENDMENTS
TO MODEL NP-50xxL APPLICATION, DATED JUNE 6, 1980

Insert new page 0-3	Remove old page 0-3
Insert new page 0-4	Remove old page 0-4
Insert new page 1-19	Remove old page 1-19
Insert new page 1-34	
Insert new page 1-35	
Insert new page 1-36	
Insert drawing X-20-200D Rev C	Remove old page X-20-200D Rev B
Insert new page 1-37	
Insert new page 1-38	

The cask body consists of 3/8 inch external and internal steel shells separated by a lead shield between these two shells. The top and bottom ends of the cylindrical cask are constructed of a pair of stacked steel plates. Reference dimensions of the cylindrical lead shield and steel ends are:

	Thicknesses (in)	
Version	Lead Shield(1)	Steel Ends(2)
50-1.5L	1-1/4	2-1/4
50-2.5L	2-1/4	4
50-3.0L	2-3/4	4-1/2
50-4.0L	3-3/4	6

Notes:

(1) Does not include the 3/8" internal and external steel shells.

(2) Comprised of two stepped plates.

The top serves as a removable cask lid and is secured to the cylindrical cask body by eight high strength 1 inch ratchet binders. A 23 1/2 inch secondary cask lid is located in the center of the primary lid and is secured to the primary lid by eight 3/4 inch studs. Lifting lugs and tiedowns are a structural part of the package.

0.2.1.3 Containment Vessel

The NuPac 50-xxL Cask serves as the containment vessel and its mechanical configuration is described in the foregoing paragraph.

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A neoprene gasket is employed in the primary and secondary lid interfaces. The secondary lid also uses a redundant neoprene seal.

Waste products will be contained in 55 gallon drums or with heavy gauge disposable steel liners.

0.2.1.4 Neutron Absorbers

There are no materials used as neutron absorbers or moderators in the NuPac 50-xxL packaging.

0.2.1.5 Package Weight

The gross, net and payload weights of the NuPac 50-xxL packaging are:

	50-1.5L	50-2.5L	50-3.0L	50-4.0L
Lids				
Primary	940	1755	2030	2865
Secondary	340	610	685	910
Cask Body				
Steel Shells	1840	1940	1975	2065
End	1280	2365	2715	3775
Lead	4305	8160	10160	14490
Lugs/Binders	130	130	130	130
Net Cask Wt:	8835	14960	17695	24235
Payload Wt:	4200	4200	4200	4200
Gross Wt:	13035	19160	21895	28435
(Use for Analysis:	13100	19200	22000	28500)

Three drop orientations are possible: flat end drop, side drop and corner drop. For the flat end drop, the most critical condition will be settlement of the unbonded lead shield at the end opposite the point of impact. For the side drop, local flattening will be evaluated. For the corner drop, the most critical condition will be the lid closure. In addition to the analysis presented, a full scale drop test was also conducted (Reference Section 1.6.6.3 and Appendix 1.10.3)

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1.6.6.1 Flat End Drop

The evaluation of flat end impact upon settlement of lead shielding closely follows Shappert's approach for a cylindrical load shield, outlined in Section 2.7.3 of his Cask Designer's Guide, ORNL-NSIC-68, February 1970. The lead settlement distance is given by:

$$\Delta H = \frac{RWH}{\pi (R^2 - r^2)(t_s \sigma_s + R \sigma_{pb})}$$

Where: ΔH = Settlement depth (in)

H = Drop height (in)

R = Outer lead radius (in)

W = Weight of Lead (lbs)

r = Inner lead radius (in)

t_s = Thickness of external steel shell (in)

σ_s = Steel dynamic flow stress (psi)

σ_{pb} = Lead dynamic flow stress (psi)

Appendix 1.10.2

Test Report, Corner Drop

1.0 Purpose

The purpose of the drop test was to evaluate the effects of a 46" corner drop on the lid.

2.0 Test Set-up

The test artical was a NuPac-50 2.5L cask manufactured from A-5 material. New gaskets were installed and the cask was pressure tested to 7.2 psig for 4 hours. No loss of pressure was recorded. A standard NuPac 50 cubic foot, snap-on lid liner, was filled with 4000 lbs.of wet sand. The liner plus the sand payload totaled 4200 lbs. The liner was also pressure tested, with no loss of pressure noted. Upon completion of the pressure test the liner was placed in the cask and transported to the drop site. The drop pad was constructed in 1973 for Type "B" testing of the 37,500 lb. Paducah Tiger (C of C No. 6553). It consists of a 2" thick steel plate grouted onto a massive reinforced concrete pad. The pad closely approximates the "unyielding surface".

3.0 Drop Test

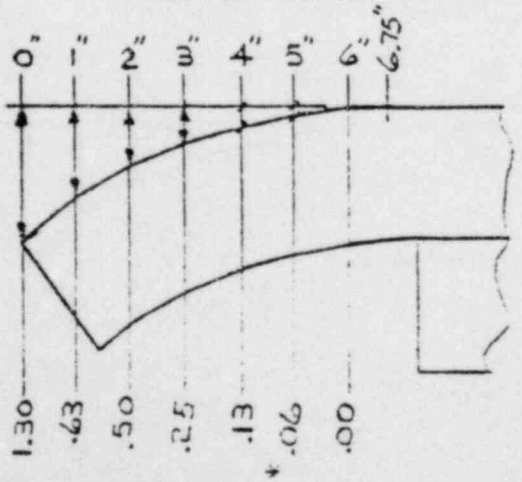
A heavy steel lug was welded to the bottom corner of the cask such that the c.g. will be directly above a corner tab on the cask lid. In order to provide an era of conservatism the N.R.C. suggested that the regulation height of 36" be increased by 25%. Therefore the cask was raised to a height of 45" and released.

4.0 Test Results

The analysis conducted in Section 1.6.6.3 (Pg 9-22a) predicted local corner deformation of 1.25 to 1.40". From the attached photo's it can be seen that the actual deformation was 1.30". There was no indication of brittle fracture or cracking of any kind. Temperature of the cask was 51°F. Damage was restricted ed to the cask lid corner. After the drop, the cask was subjected to the same differental and freon test. No leakage was detected. On removal of the lid the gasket and spacer ring were uneffected. Local deformations of the lid in the area of the spacer ring were matched by local deformations in the cask lip. Using a straight edge these deformations were limited to less than .06 over 8" of length.* See attached figure. Since this deformation matched the lid configuration the seal remained unaffected. The liner was removed and tested. No leakage was noted. From the photos it can be seen that liner suffered minimal damage. Deformations were only slightly larger than those allowed by normal manufacturing tolerances.

Figure 1.10.3.1

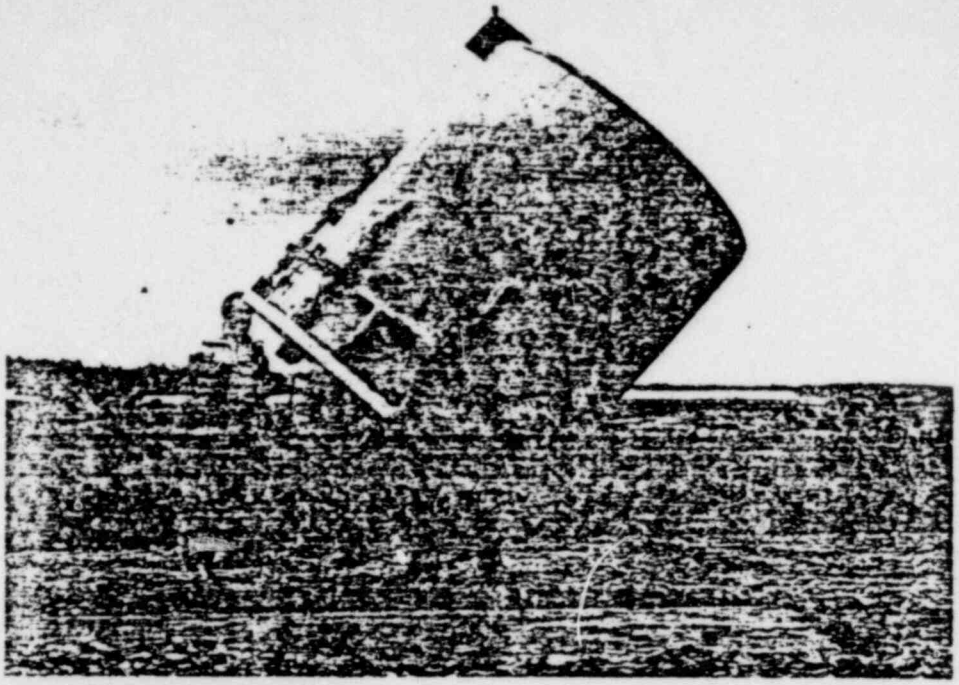
Corner Deformation



5.0 Conclusion

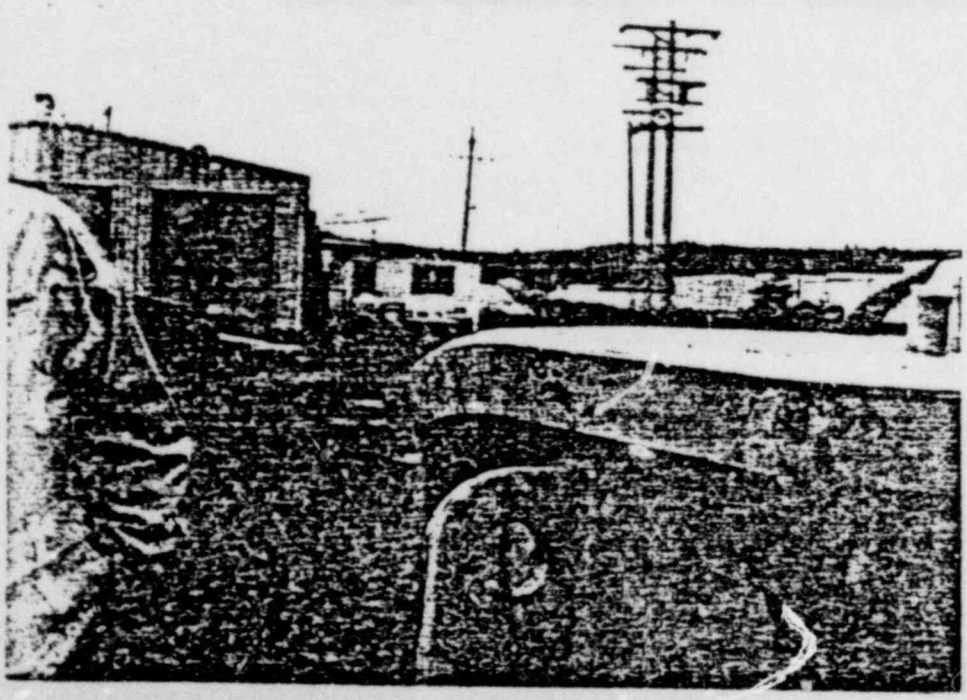
The NP50-2.5L, manufactured from A-36, was dropped from a h ight 1.25 times higher than required by 10 CFR 71. Damage sustained was limited to local deformation and had no impact on the packages ability to retain its contents. Therefore, the package successfully demonstrated it's ability in meeting the requirement of 10 CFR 71 Appendix A, Paragraph 6.

NP50-2.5L
DROP TEST

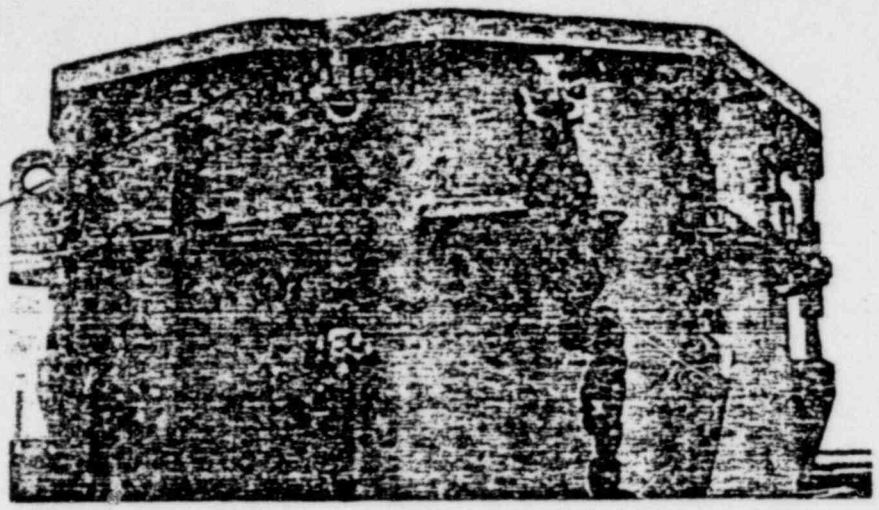


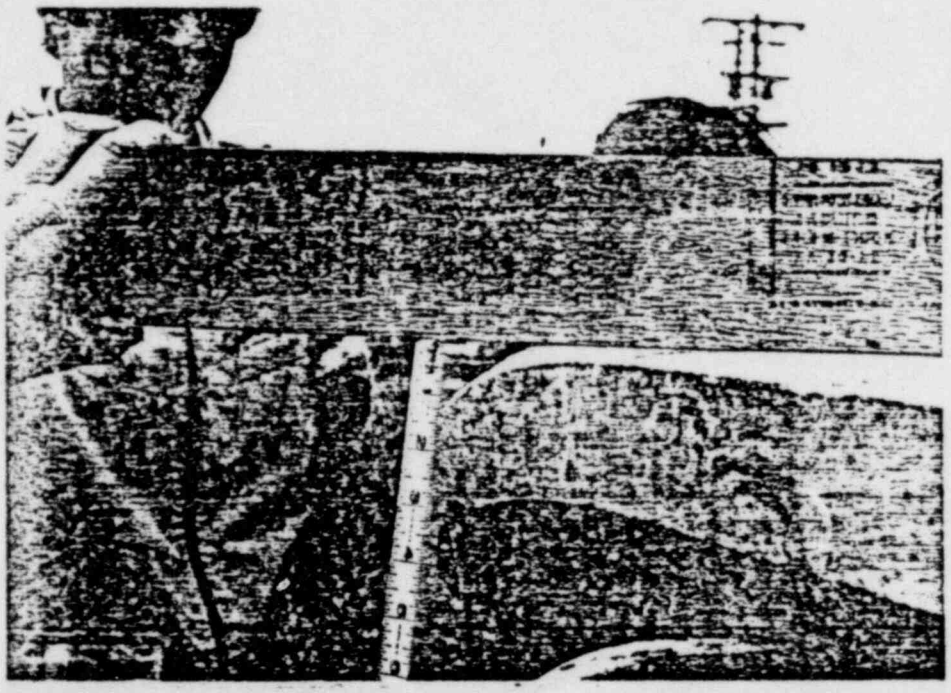
DROP ANGLE 42°

DROP HEIGHT 46"

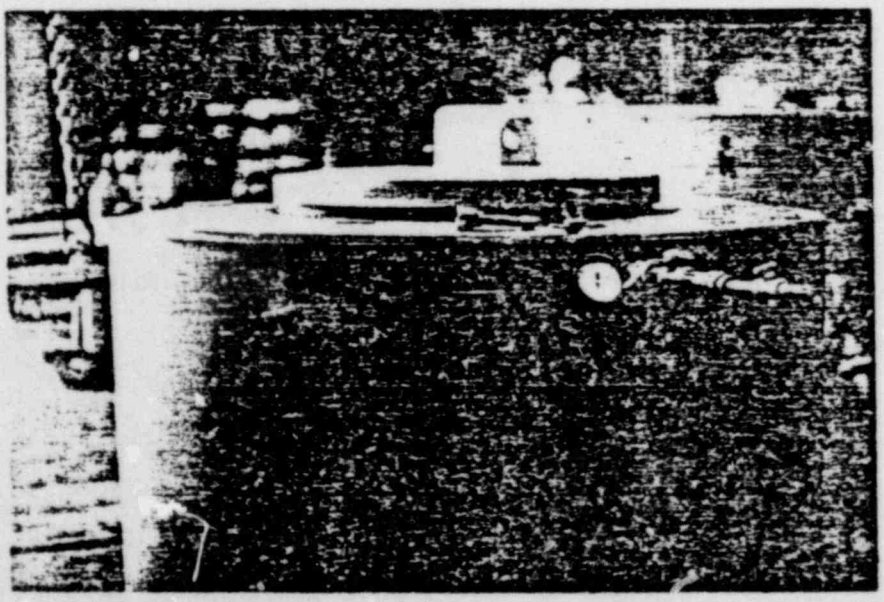


LOCAL CORNER DEFORMATION

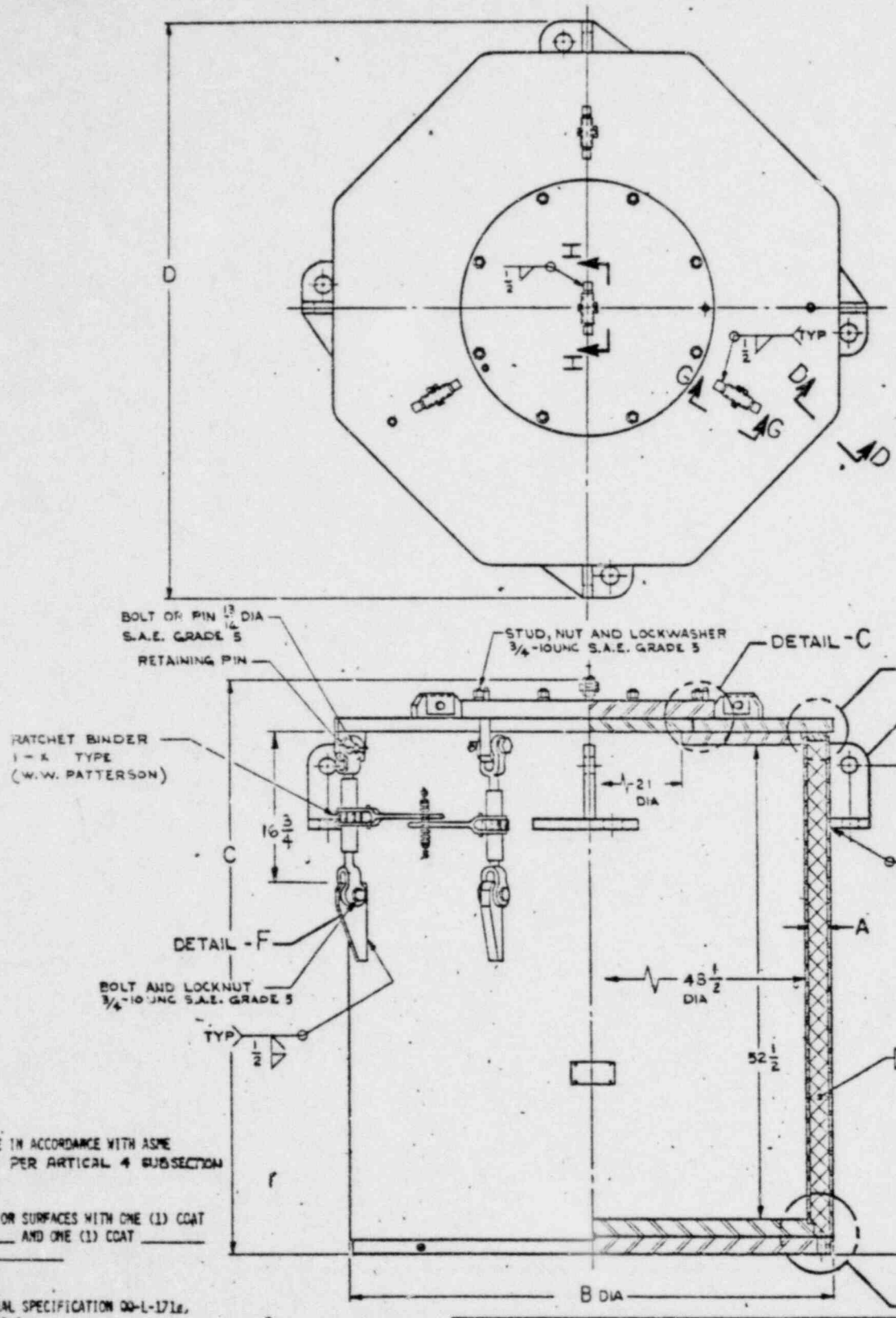




DEFLECTION = 1.3"



POST DROP LINER PRESSURE TEST



5. WELDING SHALL BE IN ACCORDANCE WITH ASME CODE-SECTION IX. PER ARTICAL 4 SUBSECTION QW-400.

4 PAINT ALL EXTERIOR SURFACES WITH ONE (1) COAT _____ AND ONE (1) COAT _____
COLOR: _____

3 LEAD: PER FEDERAL SPECIFICATION QQ-L-171a, GRADE A OR C

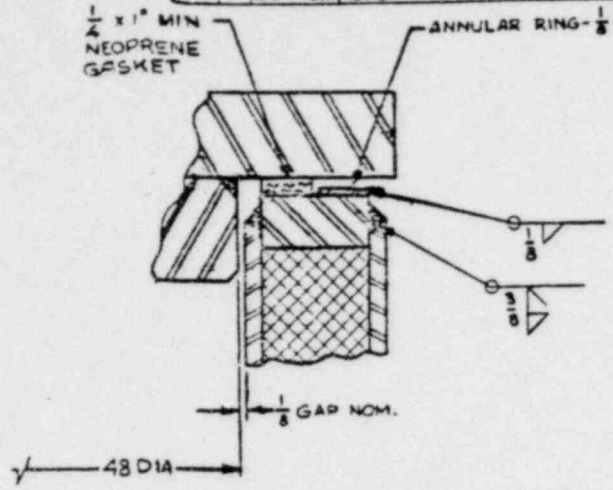
2 MATERIAL: U.S. T-1 STEEL (ASTM-A517)

1 MATERIAL: LOW CARBON HOT ROLLED (REF NOTE 6) STEEL: PLATE & SHAPES CONFORM TO ASTM-A36

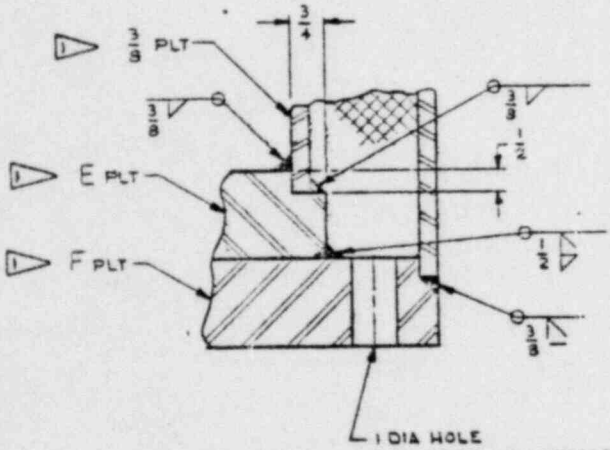
NOTES: UNLESS OTHERWISE SPECIFIED

CASK MODEL	DIMENSIONAL DATA						REFERENCE DAT	
	A	B	C	D	E	F	CASK WT.	PAY LOAD
50-2.5L	1.25	52.50	61.13	67.63	1.00	1.25	8835	4200
50-2.5L	2.25	54.50	65.38	69.63	2.00	2.00	14960	
50-3.0L	2.75	55.50	66.88	70.63	2.00	2.50	17695	
50-4.0L	3.75	57.50	70.38	72.63	3.00	3.00	24235	4200

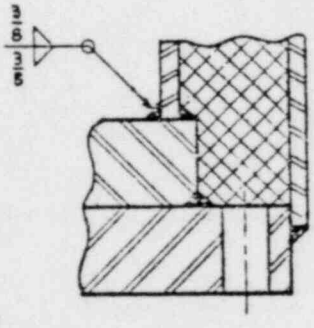
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED "B" DIMENSION, ADDED RADIAL ADDED GASKET CALLOUT, REVISED OPT 2 DETAIL, REVISE MAT'L DETAIL 3.	10-77	



DETAIL A
SCALE: 1/2



OPTION - 1



OPTION - 2

DETAIL B
SCALE: 1/2

ITEM	PART NO.	DESCRIPTION	MATERIAL
		LIST OF MATERIAL	

NUCLEAR PACKAGING, INC.
TACOMA, WASHINGTON

TRANSPORTATION SHIELD
TYPE A
MODELS 50-1.5L, 50-2.5L, 50-3.0L, 50-4.0L

41535

DRAWN CULTUM	3-21-78	PA	8-9-78	SCALE: 1/2 & NOT TO WT. SEE CHART
CHECK	8-9-78	ENG'L	8-9-78	REV C SHEET 1 OF 2
APPD	8-9-78	PROG. MGR.		SIZE D DWG NO. X-20-200D

ASSEMBLY & QUANTITY

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONS ±
ANGLES ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
1 PLACE DECIMALS ±
DO NOT SCALE THIS DRAWING

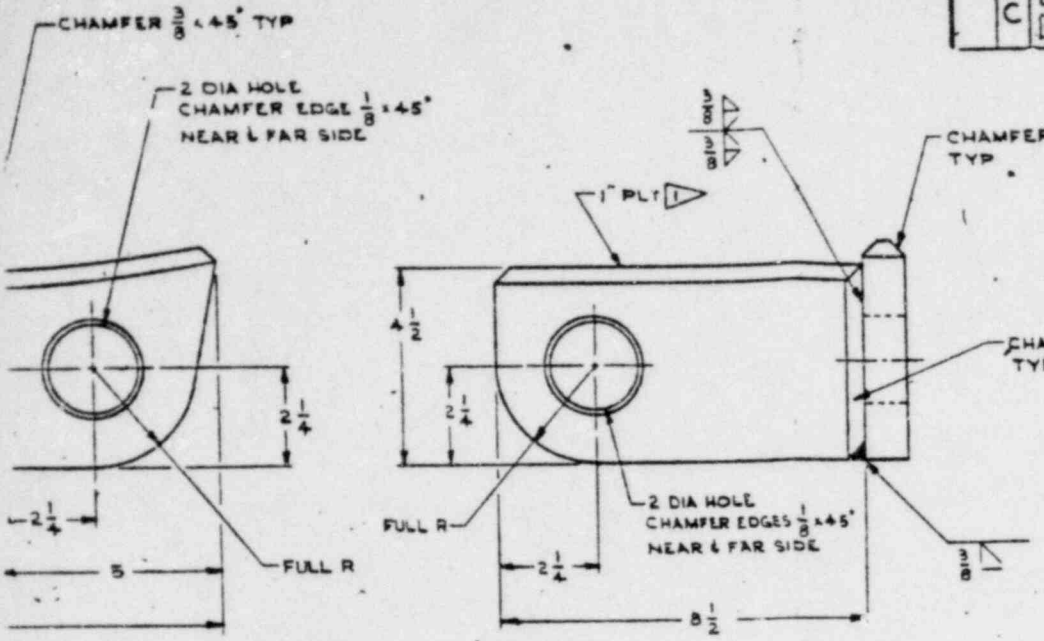
NEXT ASSY | USED ON | APPLICATION

SS WT.
3035
3160
3325
3435

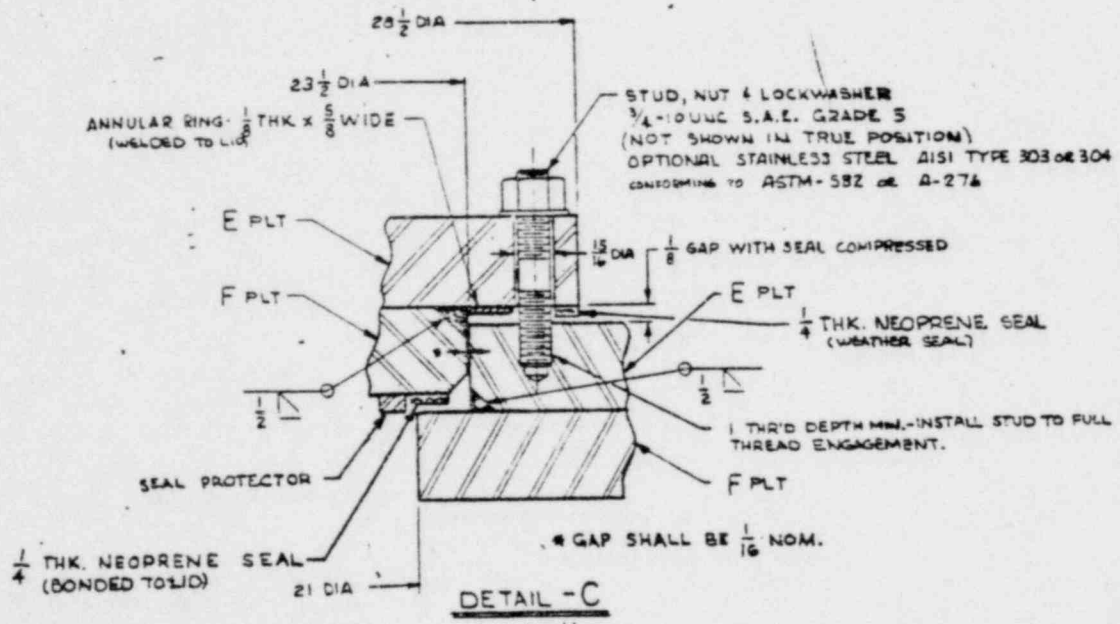
X-20-200D

4 3 2 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REVISED TO AGREE WITH S.A.E. REQUIREMENTS	[illegible]	[illegible]
	C	DELETED 12 GA. S. STL. LINER, NOTES 6, 7 & REVISED NOTE 1	6/6/80	[illegible]



DETAIL -E
SCALE: 1/2



DETAIL -C
SCALE: 1/2
(GASKET SHOWN UNCOMPRESSED)

HOLE

2 3/4

ITEM	PART NO.	DESCRIPTION	MATERIAL
		LIST OF MATERIAL	

NUCLEAR PACKAGING, INC.
TACOMA, WASHINGTON

TRANSPORTATION SHIELD
TYPE A
MODELS 50-1.5L, 50-2.5L, 50-3.0L, 50-4.0L

DRAWN CULTUM	3-21-78	[illegible]	RADS	SCALE: 1/8 & NOTED	WT. SEE CHART
CHECK [illegible]	3-21-78	[illegible]	3-9-78	SIZE C	SHEET 2 OF 2
ENGR. [illegible]	3-8-78	PROG. REL.		SIZE D	DWG NO. X-20-200D

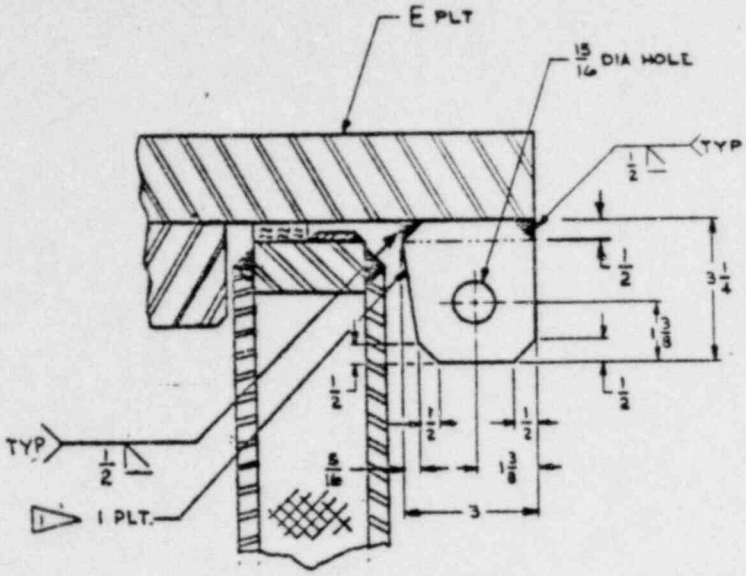
ASSEMBLY & QUANTITY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS ± ANGLES ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± 1 PLACE DECIMALS ±

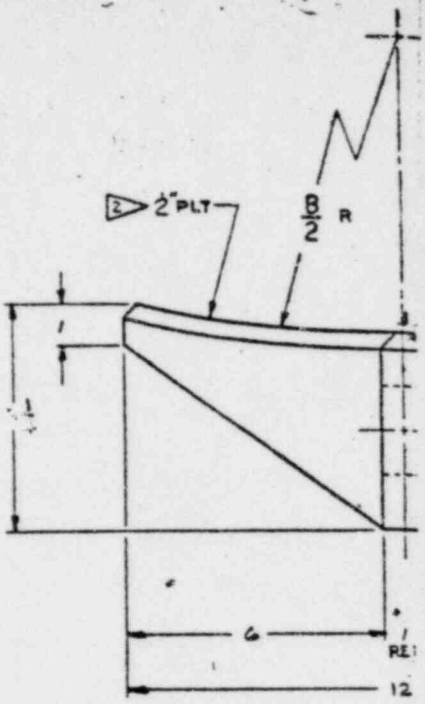
DO NOT SCALE THIS DRAWING

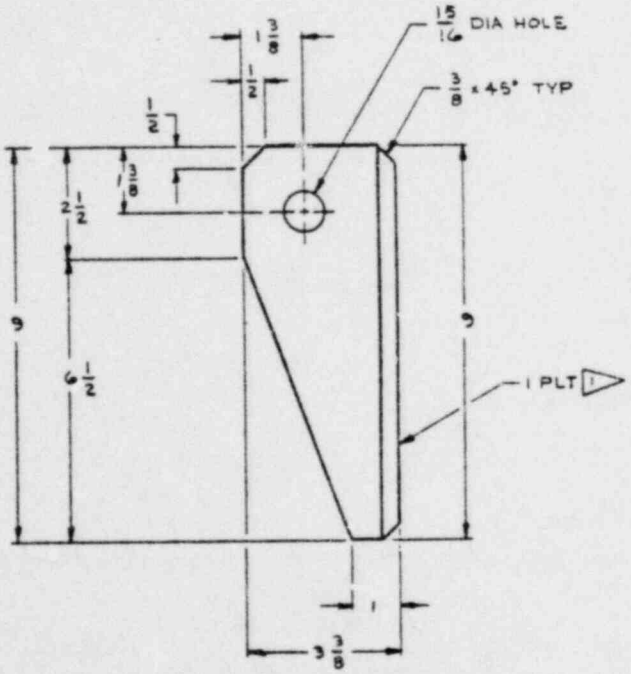
NEXT ASSY | USED ON APPLICATION

X-20-200D

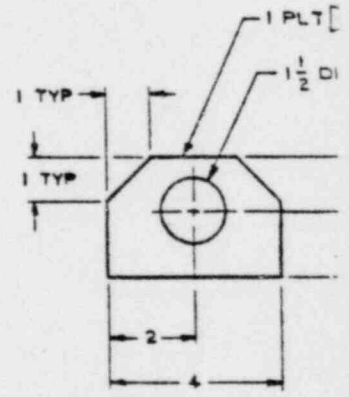


SECTION D-D
SCALE: 1/2





DETAIL - F
SCALE: 1/2



VIEW G-C
SCALE: 1/2

VIEW H-H
SCALE: 1/2

NOTES: UNLESS OTHERWISE SPECIFIED