# DISTRIBUTION SHEET

| To | From | Page 1 of 1 |
|---|---|---|
| Distribution | Equipment Stress Analysis/8D430 | Date December 22, 1994 |
| Project Title/Work Order | | EDT No. 608387 |
| Analysis of The Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101) (N2B2K) | | ECN No. NA |

| Name | MSIN | Text With All Attach. | Text Only | Attach./ Appendix Only | EDT/ECN Only |
|---|---|---|---|---|---|
| L. D. Blackburn | H5-67 | | | | X |
| R. M. Boger | L4-90 | | X | | |
| J. S. Burgess | H5-53 | | X | | |
| C. E. Hanson | H5-09 | | X | | |
| F. H. Huang | H5-67 | | X | | |
| J. W. Lentsch | S7-15 | | X | | |
| T. C. Mackey | S2-03 | X | | | |
| M. J. Ostrom | H5-68 | X | | | |
| R. B. Pan | H5-53 | | | | X |
| G. A. Ritter | H0-36 | X | | | |
| H. Toffer | H0-38 | | | | X |
| Central Files (2 Copies) | L8-04 | X | | | |
| OSTI (2 Copies) | L8-07 | X | | | |

A-6000-135 (01/93) WEF067

MAR 2 1995 58 **ENGINEERING DATA TRANSMITTAL**

Sta. #3



1. EDT 608387

| | | |
|---|---|---|
| 2. To: (Receiving Organization) Distribution | 3. From: (Originating Organization) Equipment Stress Analysis/8D430 | 4. Related EDT No.: NA |
| 5. Proj./Prog./Dept./Div.: N2B2K | 6. Cog. Engr.: G. A. Ritter | 7. Purchase Order No.: NA |
| 8. Originator Remarks: Aprroval/Release | | 9. Equip./Component No.: NA |
| | | 10. System/Bldg./Facility: NA |
| 11. Receiver Remarks: | | 12. Major Assm. Dwg. No.: H-2-83687, Rev. 1 |
| | | 13. Permit/Permit Application No.: NA |
| | | 14. Required Response Date: NA |

15. DATA TRANSMITTED

| (A) Item No. | (B) Document/Drawing No. | (C) Sheet No. | (D) Rev. No. | (E) Title or Description of Data Transmitted | (F) Impact Level | (G) Reason for Transmittal | (H) Originator Disposition | (I) Receiver Disposition |
|---|---|---|---|---|---|---|---|---|
| 1. | WHC-SD-WM-DA-160 | NA | 0 | Analysis of the Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101) | SQ | 1,4 | 1 | |

16. KEY

| Impact Level (F) | Reason for Transmittal (G) | Disposition (H) & (I) |
|---|---|---|
| 1, 2, 3, or 4 (see MRP 5.43) | 1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required) | 1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged |

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

| (G) Reason | (H) Disp. | (J) Name | (K) Signature | (L) Date | (M) MSIN | (J) Name | (K) Signature | (L) Date | (M) MSIN | (G) Reason | (H) Disp. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | Cog.Eng. G. A. Ritter | G.A. Ritter | 1/6/95 | H0-38 | | | | | | |
| 1 | 1 | Cog. Mgr. ~~H. Toffer~~ C.E. HANSON | C.E. Hanson | 2/24/95 | H0-38 | | | | | | |
| 1 | 1 | QA M. L. McElroy | M.L. McElroy | 2/23/95 | S1-54 | | | | | | |
| 1 | 1 | Safety G. E. McPherson | G.E. McPherson | 2/10/95 | ~~T4-10~~ S2-41 | | | | | | |
| 1 | 1 | T. C. Mackey | T.C. Mackey | 12/23/94 | S2-03 | | | | | | |
| 1 | 1 | Indep. Review J. S. Burgess | J.S. Burgess | 12/22/94 | H5-53 | | | | | | |
| 1 | 1 | ESA Mngr. R.B. Pan | R.B. Pan | 12/23/94 | H5-53 | | | | | | |

| 18. | 19. | 20. | 21. DOE APPROVAL (if required) |
|---|---|---|---|
| F. H. Huang<br>F.H. Huang 12-21-94<br>Signature of EDT Originator / Date | G. A. Ritter<br>G.A. Ritter 1/6/95<br>Authorized Representative for Receiving Organization / Date | C.E. HANSON ~~H. Toffer~~<br>C.E. Hanson 2/24/95<br>Cognizant/Project Engineer's Manager / Date | Ltr. No.<br>[] Approved<br>[] Approved w/comments<br>[] Disapproved w/comments |

# RELEASE AUTHORIZATION

| | |
|---|---|
| **Document Number:** | WHC-SD-WM-DA-160, REV 0 |
| **Document Title:** | Analysis of the Flexible Receiver Lifting Yoke and Blast Sheild Assembly (Tank 241SY101) |
| **Release Date:** | 2/28/95 |

**This document was reviewed following the procedures described in WHC-CM-3-4 and is:**

**APPROVED FOR PUBLIC RELEASE**

**WHC Information Release Administration Specialist:**

Kara M. Broz — February 28, 1995

Mua 3/1/95

# SUPPORTING DOCUMENT

| | |
|---|---|
| 1. Total Pages | ~~22~~ 25 |

| 2. Title | 3. Number | 4. Rev No. |
|---|---|---|
| Analysis of the Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101) | WHC-SD-WM-DA-160 | 0 |


5. Key Words

Analysis, Bending, Lifting Lug, Tear-out Weld, Shear.


APPROVED FOR PUBLIC RELEASE

KMB 2/28/95


6. Author

Name: F. H. Huang

Signature

Organization/Charge Code
8D430/N2B2K



7. Abstract

The analysis of the lifting yoke and blast shield assembly considers the bending stress, weld strength, and resistance of the lug hole to tear out. The bending stress of the lifting lugs is evaluated to ensure that they meet the requirements of the American Institute for Steel Construction (AISC 1989). Also considered in the calculations is the capability of the thick lugs to withstand the weight of the pump together with that of the container and strongback during rotation to the horizontal position.




9. Impact Level SQ

10. RELEASE STAMP

OFFICIAL RELEASE 58
BY WHC
DATE MAR 2 1995
Sta. #3

# Analysis of the Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101)

December 1994

PREPARED BY: [signature] Date 12-21-94
F. H. Huang, Principal Scientist
Materials Engineering

REVIEWED BY: [signature] Date 12/22/94
J. S. Burgess, Engineer
Equipment Stress Analysis

APPROVED BY: [signature] Date 12/23/94
R. B. Pan, Manager
Equipment Stress Analysis

Westinghouse Hanford Company
Hanford Operations and Engineering Contractor
for the
U. S. Department of Energy

DESIGN VERIFICATION METHOD

The need for design verification has been reviewed with the method selected as indicated below:

x Independent Review

___ Alternate Calculations

___ Qualification Testing

___ Formal Design Review

R. B. Pan
Cognizant/Project/Design Manager

SD #WHC-SD-WM-DA-160

ECN # NA

DWG(S) # NA

# TYPICAL CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed WHC-SD-WM-DA-160

Author F. H. Huang

| Yes | No | N/A | |
|---|---|---|---|
| [✓] | [ ] | [ ] | Problem completely defined. |
| [✓] | [ ] | [ ] | Necessary assumptions explicitly stated and supported. |
| [ ] | [ ] | [✓] | Computer codes and data files documented. |
| [✓] | [ ] | [ ] | Data used in calculations explicitly stated in document. |
| [✓] | [ ] | [ ] | Data checked for consistency with original source information as applicable. |
| [ ] | [ ] | [✓] | Mathematical derivations checked including dimensional consistency of results. |
| [ ] | [ ] | [✓] | Models appropriate and used within range of validity or use outside range of established validity justified. |
| [✓] | [ ] | [ ] | Hand calculations checked for errors. |
| [ ] | [ ] | [✓] | Code run streams correct and consistent with analysis documentation. |
| [ ] | [ ] | [✓] | Code output consistent with input and with results reported in analysis documentation. |
| [✓] | [ ] | [ ] | Acceptability limits on analytical results applicable and supported. Limits checked against sources. |
| [✓] | [ ] | [ ] | Safety margins consistent with good engineering practices. |
| [✓] | [ ] | [ ] | Conclusions consistent with analytical results and applicable limits. |
| [✓] | [ ] | [ ] | Results and conclusions address all points required in the problem statement. |

**MANDATORY** Software QA Log Number N/A

J. S. Burgess *J. S. Burgess*
Reviewer

12/22/94
Date

# CONTENTS



APPENDICES

# Analysis of the Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101)

## 1.0 INTRODUCTION

The flexible receiver is used to maintain primary tank confinement and minimize waste spillage during equipment removal from tank risers through pump pits. To remove the mixer pump, a crane is used to lift the lifting yoke (WHC 1994a) that is connected to the mixer pump. Before the pump is lifted, a bag assembly with a blast shield (WHC 1994b) is lowered over the lifting yoke and the mixer pump onto the load distribution frame by the crane. During set up for pump removal, the lifting yoke will be stabilized vertically by a yoke brace (WHC 1994c) while the crane is disconnected from the yoke and connected to the bag assembly. Each of the two components has four handling lugs for lifting. After the mixer pump is pulled from the 241SY101 waste tank, it will be inserted into a vertical container supported by a hydraulic strongback.

The disposal container then is lowered slowly to the horizontal position for transport. During the lowering of the container with the pump, the lifting yoke remains attached to the crane. A safety chain runs under the pump and is attached to two thick lugs of the yoke. The safety chain prevents the yoke from bumping the flange of the container. The analysis is to ensure that the lifting lugs have adequate strength.

This supporting document reports on the structural analysis of the equipment based on requirements for safety class 3 (DOE-RL 1993a), the *Manual of Steel Construction* (AISC 1989), and the *Hanford Hoisting and Rigging Manual* (DOE-RL 1993b).

## 2.0 SUMMARY

The analysis of the lifting yoke and blast shield assembly considers the bending stress, weld strength, and resistance of the lug hole to tear out. The bending stress of the lifting lugs is evaluated to ensure that they meet the requirements of the American Institute for Steel Construction (AISC 1989). Also considered in the calculations is the capability of the thick lugs to withstand the weight of the pump together with that of the container and strongback during rotation to the horizontal position.

## 3.0 DISCUSSION

The structural calculations are based on the following allowable stresses: 12,000 lbf/in$^2$ for bending, tension, and bearing; 7,200 lbf/in$^2$ for shear; 7,200 lbf/in$^2$ on effective area for welds. According to the *Hanford Site Hoisting and Rigging Manual* (DOE-RL 1993b), the allowable stresses except allowable shearing stress are one-third of yield strength.

### 3.1 Lugs for Lifting the Yoke

Four ½-in.-thick lugs are welded on the 1½- by 6-in. flat bar of the yoke. The location of the handling lugs is symmetrical to the center of gravity of the yoke when the yoke is lifted horizontally. The calculations check the bending stress of the lugs when lifting without the use of spreader beams. Also considered in the analysis is the lifting load capacity of the lugs in terms of tension, shear, bearing, and tear-out resistance (see Appendix A).

### 3.2 Lugs for Securing the Yoke

The total weight of the container and the pump is approximately 80,000 lb; the strongback weighs 30,000 lb. The lugs are designed on the basis of the reaction acting on the safety chain and the lugs from the total weight of container, pump, and strongback. The lugs are full-penetration welded to the yoke bar. Because the safety chain will bend the lugs inward, the analysis checks the bending of the lugs. Calculations show that the bending stress of a lug 1½-in thick is acceptable (see Appendix A).

### 3.3 Lug for Lifting the Blast Shield Assembly

The weight of each component of the blast shield assembly is estimated from drawing H-2-821387 (WHC 1994b). Although there are four lifting lugs, the analysis assumes that only two lugs share the total weight of the assembly. The assembly shall be lifted by a 52-in. by 28-in. spreader bar with four 15-ft-long cables. Because the dimensions of the spreader bar is close to those of the assembly, the spreader bar lifts the lug of the assembly nearly vertically. The thickness of the lug and the edge distance of the hole in the lug are checked to ensure adequate strength. The calculations appear in Appendix B.

## 4.0 CONCLUSION

The calculations in Appendices A and B show that the ½-in.-thick lugs are qualified to carry the weight of the lifting yoke or the blast shield assembly. Also, the calculations determine that the 1½-in.-thick lug is structurally adequate to secure the container, pump and strong-back during rotation from 90° to the horizontal position.

## 5.0 REFERENCES

AISC 1989, *Manual of Steel Construction,* Ninth edition, American Institute for Steel Construction, Chicago, Illinois.

DOE-RL 1993a, *Standard Arch-Civil Design Criteria, Design Loads for Facilities*, Hanford Plant Standard SDC-4.1, Rev. 12, U.S. Department of Energy-Richland Field Office, Richland, Washington.

DOE-RL 1993b, *Hanford Site Hoisting and Rigging Manual*, DOE-RL-92-36, U.S. Department of Energy Richland Field Office, Richland, Washington.

WHC 1994a, *Mixer Pump Assembly Lifting Yoke*, drawing H-2-83687, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC 1994b, *HMT-Flexible Receiver Blast Shield Assembly*, drawing H-2-821387, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC 1994c, *Structural Analysis: Flexible Receiver Yoke Brace for the 241SY101 Mixer Pump*, WHC-SD-WM-DA-157, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

# Appendix A

## Calculations for Lifting Yoke

# DESIGN CALCULATION



(1) Drawing H-2-83687, Rev. 1 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________ (6

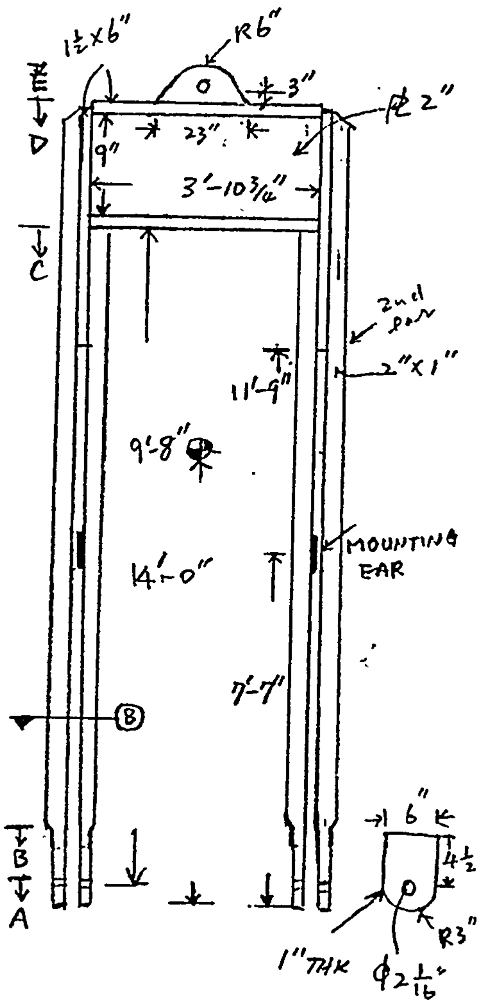
(7) Subject HMT- Flexible Receiver Lifting Yoke Assembly

(8) Originator FH Huang [signature] Date 6-8-94

(9) Checker [signature] Date 7/7/94

(10)

## C.G OF LIFTING YOKE




WEIGHTS.

$$A \doteq \frac{1}{2}\left[\frac{\pi}{4}\left(6^2-(2\tfrac{1}{16})^2\right)\right]\times 1 \times 4 \times 0.284 = 14.2\ \#$$

All Ys from bottom

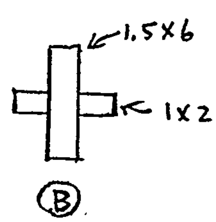
$$Y_A = 3 \times 0.5756 = 1.73''$$

$$B = \left[4.5\times1\times6\times2 - \frac{\pi}{4}(2\tfrac{1}{16})^2\right]\times 2 \times 0.284 = 28.8\ \#$$

$$Y_B = 3.98''$$

$$C = (1.5\times6 + 1\times2\times2)\times(14\times12-4.5)\times2\times0.284 = 1207.3\ \#$$

$$Y_C = (14\times12-4.5)/2 + 4.5 + 3 = 89.25''$$




$$3'\text{-}10\tfrac{3}{4}'' = 46.75''$$

$$D = [2\times9\times46.75 + 1.5\times6\times46.75\times2 + (1.5\times6+1\times2)(9+1.5+1.5)\times2]\times0.284$$

$$= (841.5 + 841.5 + 260)\times0.284 = 552\ \#$$



BD-6400-060 1 (12/87)

# DESIGN CALCULATION



(1) Drawing H-2-83687, Rev. 1 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject HMT- Flexible Receiver Lifting Yoke Assembly

(8) Originator FH Huang FHH Date 6-8-94

(9) Checker J.S. Burgess Date 7/7/94

(10)

$$Y_D = (9 + 1.5 \times 2)/2 + 14 \times 12 + 3$$
$$= 177''$$

$$E = (9 \times 23)/2 \times 2 \times 0.284$$
$$= 59\#$$

$$Y_E = 9 + 1.5 \times 2' + 14 \times 12 + 3 + 4$$
$$= 187''$$

C.G From bottom

$$\bar{Y}(14.2 + 28.8 + 1207.3 + 552 + 59)$$

$$= 14.2 \times 1.73 + 28.8 \times 3.98 + 1207.3 \times 89.25 + 552 \times 177 + 59 \times 187$$

$$= 216627.7$$

$$\bar{Y} = \frac{216627.7}{1861.3} = 116.4'' \quad (9' - 8\tfrac{3}{8}'')$$



BD-6400-060 1 (12/87)

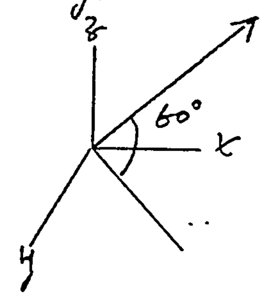
(1) Drawing H-2-83687, Rev. 1 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject LUG of Lifting Yoke Assembly
(8) Originator FH Huang [signature] Date 6-14-94
(9) Checker [signature] Date 7/14/94

(10)

HANDLING LUGS OF LIFTING YOKE ASSEMBLY

Assume the (2000×1.5=) 3000 lb lifting yoke assembly is supported by 2 lugs, 1500 lb per lug.
The cable is 60° tilt.

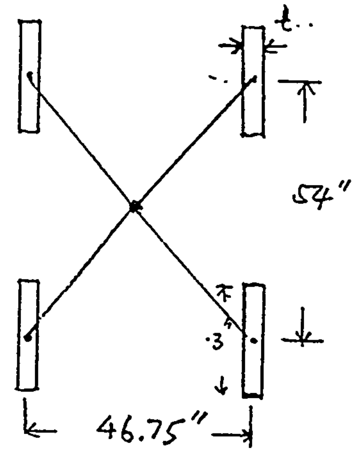
Loads on x, y, z directions




$F_z = 3000/2$
$= 1500$ #

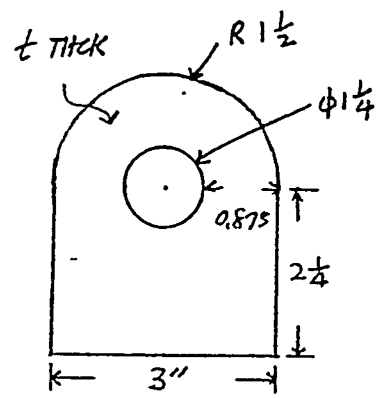
$F_x = 1500/\tan 60° \times \dfrac{46.75}{\sqrt{46.75^2+54^2}}$
$= 866 \times \dfrac{46.75}{71.43}$
$= 566$ #

$F_y = .866 \times \dfrac{54}{71.43} = 655$ #




1. Bending stresses

$\sigma_x = \dfrac{F_x \times 2.25}{3 \times t^2/6}$
$= \dfrac{2547}{t^2}$ psi




$\sigma_y = \dfrac{F_y \times 2.25}{\dfrac{t \times 3^2}{6}}$
$= \dfrac{983}{t}$ psi

$\sigma_z = \dfrac{F_z}{3t} = \dfrac{500}{t}$ psi

(1) Drawing H-2-83687, Rev.1 (2) Doc. No. ________



(4) Building ________ (5) Rev. ________

(7) Subject LUG of Lifting Yoke Assembly

(8) Originator FH Huang Date 6-14-94

(9) Checker [signature] Date 7/7/94

(10)

The bending stress on the lug is

$$\sigma_t = \left[\left(\frac{2547}{t^2}\right)^2 + \left(\frac{983}{t}\right)^2 + \left(\frac{500}{t}\right)^2\right]^{1/2} \text{ psi}$$

For ½" plate,

$$\sigma_t = \left[\left(\frac{2547}{0.5^2}\right)^2 + \left(\frac{983}{0.5}\right)^2 + \left(\frac{500}{0.5}\right)^2\right]^{\frac{1}{2}} \text{ psi}$$

$$= 10,424 \text{ psi} < 12,000 \text{ psi} \quad \text{O.K.}$$

2. Lifting load capacity

Tension Failure

$$f_t = \frac{1500}{2 \times 0.5 \times 0.875} = 1,714 \text{ psi} < 12,000 \text{ psi} \quad \text{o.K.}$$

Shear Failure

$$\tau = \frac{1500}{2 \times 0.5 \times 0.875} = 1,714 \text{ psi} < 7,200 \text{ psi} \quad \text{o.K.}$$

Bearing Failure

$$f_b = \frac{1500}{0.5 \times 1.25} = 2,401 \text{ psi} < 12,000 \text{ psi} \quad \text{o.K.}$$

Tear-out Failure

$$P/A = \frac{1500}{0.5 \times 0.875}$$

$$= 3429 \text{ psi} < 12000 \text{ psi} \quad \text{O.K.}$$

$P_{all}$ Allowable load, based on D.T. Ricker of AISC Eng J. of



BD-6400-060 1 (12/87)

**DESIGN CALCULATION**



(1) Drawing H2-83687, Rev. 1 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject Lifting Yoke Assembly

(8) Originator FH Huang [signature] Date 6-24-94

(9) Checker [signature] Date 7/7/94

(10)

Check allowable load, based on D.T. Ricker of Eng. J of AISC

$$P_{all.} = \frac{1.67((2000)(0.5)(1.5-1.25/2)^2}{1.25}$$

$$= 6{,}137 \text{ lb} > 1{,}500 \text{ lb} \quad \text{O.K.}$$

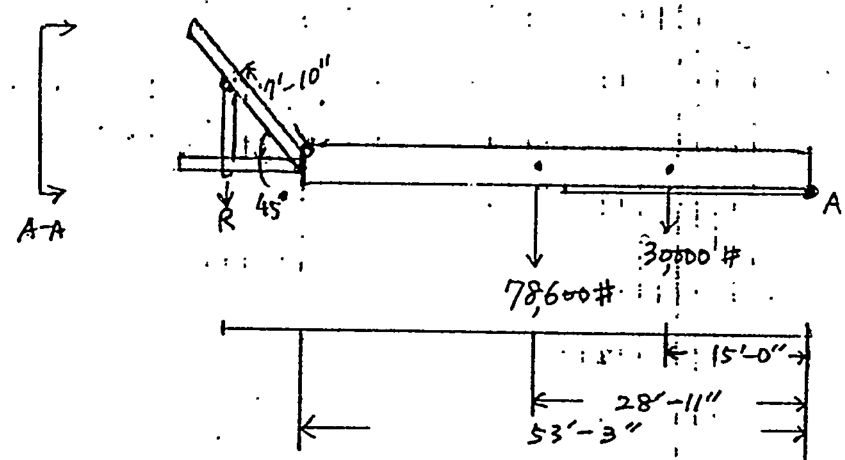


BD-6400-060 1 (12/87)

(1) Drawing ______ (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject ______
(8) Originator FH Huang [signature] Date 6-17-94
(9) Checker B. Burgess Date 7/7/94

(10)

Check Lugs of the lifting Yoke during Lifting




Ears at C.G

$\Sigma M_A$:

$R[53\times12+3+.94/\sqrt{2}]$

$=78600(28\times12+11)+$
$30000(15\times12)$

$R=\dfrac{32674200}{705.5}$

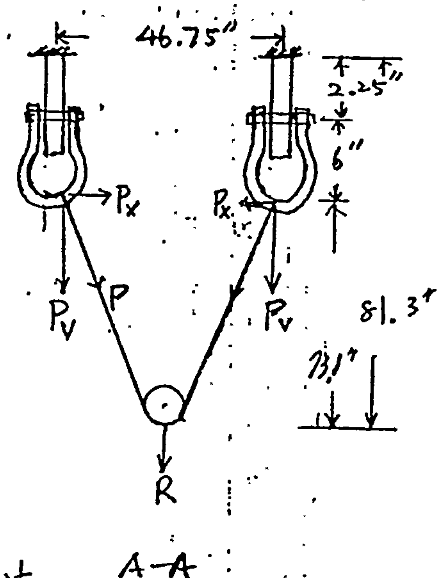
$=46{,}314$ lb

$P_V = 46314/2 = 23{,}157$ lb

Load on the cable

$P = 23157\times\dfrac{(23.375^2+73.05^2)^{\frac{1}{2}}}{73.05}$

$= 24314$ lb




Use 13½ ton shackle (Crosby Forged part # 1018231)

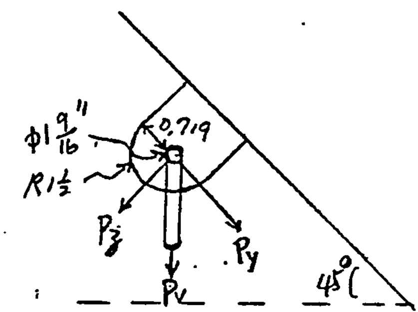
(1) Drawing H-2-83687 Rev. 1 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject Lifting Yoke Assembly
(8) Originator FH Huang [signature] Date 6-17-94
(9) Checker [signature] Date 7/7/94

(10)

$$P_x = 23157 \times \frac{23.375}{73.05} = 7411 \text{ lb}$$

$$P_y = 23157 \times \cos 45^\circ = 16372.6 \text{ lb}$$

$$P_z = 16372.6 \text{ lb.}$$




Bending Stresses on 1½" Lug

$$\sigma_x = \frac{7411 \times (2.25 + 6)}{3 \times (1.5)^2/6} = 54{,}344 \text{ psi}$$

$$\sigma_y = \frac{16372.6 \times 2.25}{\frac{1.5 \times 3^2}{6}} = 16{,}372.6 \text{ psi}$$

$$\sigma_z = \frac{16372.6}{3 \times 1.5} = 3638.4 \text{ psi}$$

Resultant Stress

$$\sigma_r = \sqrt{54344^2 + 16372.6^2 + 3638.4^2} = 56.9 \text{ ksi} < F_u = 58 \text{ ksi}$$

check tear-out stress

$$P/A = \frac{23157}{1.5 \times (1.5 - .25/32)} = 21.4 \text{ ksi}$$



BD-6400-060 1 (12/87)

# Appendix B

## Calculations for Blast Shield Assembly

**DESIGN CALCULATION**

(1) Drawing H-2-821387, Rev.0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject HMT-Flexible Receiver Blast Shield
(8) Originator FH Huang Date 6-21-94
(9) Checker [signature] Date 7/8/94

(10)

WEIGHT OF RECEIVER BLAST SHIELD

BASE ASSEMBLY

C 3 × 5.0 : 5 lb/ft

Angle $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ : 2.34 lb/ft

$[(4'-7/8'')\times 2 + (3'-8\frac{3}{4}'')\times 2 + (1'-4\frac{7}{8}'')\times 4]\times 5/12$

$+ (2'-9\frac{5}{8}'')\times 4 \times 2.34/12 = \underline{116.8\ lb}$

REF (14)

$\frac{68\times 3.1416}{12}\times 2.34 = \underline{41.7\ lb}$

REF (13) Tubing ½" φ 304L (sch. 5) ρ = 0.538#/ft

$\frac{68\pi}{12}(0.538) = 9.6\ lb$

REF (6), (9), (10)

$(1\frac{1}{8}\times 2\times 6\times 8 + \frac{1}{2}\times 3\times 10\times 6 + \frac{1}{2}\times 3\times 7.5\times 4)\,0.284$

$= \underline{69\ lb.}$

REF (19), (11)

$(\frac{1}{2}\times 3\times 10\times 8 + \frac{1}{2}\times 3\times 24\times 4)\times 0.284$

$= \underline{75\ lb}$

REF (7), (8)

$[68\times 3.1416\times 51\times 3/16 + (5\times 12+8.875)(6\times 12+0.875)\,3/16]\times$
$0.284 = \underline{847.5\ lb}$



BD 6400-060 1 (12/87)

# DESIGN CALCULATION



(1) Drawing H-2-821387, Rev. 0 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject HMT-Flexible Receiver Blast Shield Assembly

(8) Originator FH Huang Date ______

(9) Checker [signature] Date 7/8/91

(10)

Latch Assembly and Stop

$1\frac{1}{2} \times 3/4 \times 3\,7/8 = 4.36 \text{ in}^3$

$(1 \times 12 + 5\frac{3}{16}) \frac{\pi}{4} (\frac{3}{4})^2 = 7.6 \text{ in}^2$

$[4\frac{1}{2} \times 1 \times \frac{1}{2} + \frac{\pi}{4}(\frac{9}{16})^2 \times 2]\, 2 = 5.5$

$W_L = (4.36 + 7.6 + 5.5) \times 4 \times 0.284 = \underline{19.8 \text{ lb}}$

Latch Handle

$[(7/8)^2 - (7/8 - 0.095)^2](5 \times 12 + 14.25) \times 4 \times 0.284$

$= \underline{13.3 \text{ lb.}}$

Detector mount Assembly

$\frac{\pi}{4}[(2\frac{3}{8})^2 - (2\frac{3}{8} - 0.24)^2] \times 5 +$

$3/4 \times 3/4 \times 2\,3/16 + 1/16 \times 3/4 \times 4\,3/8$

$= 4.25 + 1.23 + 0.21 = 5.686 \text{ in}^3$

$wt = 4(0.284 \times 5.686) = \underline{6.5 \text{ lb.}}$

Bag w = 250 lb

Total weight

$= 116.8 + 41.7 + 9.6 + 69 + 75 + 847.5$

$+ 19.8 + 13.3 + 6.5 + 250 = 1449 \text{ lb}$

S.F. = 1.5

$W_t = 1445 \text{ lb} \times 1.5 = \underline{2174 \text{ lb.}}$

(1) Drawing H-2-821387, Rev. 0 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) ______

(7) Subject HMT-Flexible Receiver Blast Shield

(8) Originator [signature] Date 12-21-94

(9) Checker [signature] Date 12/22/94

(10)

Because of design change, additional weights include:
(See drawing H-2-821386)

Collimator Assembly:

plates: $10 \times 10 \times 3 \times 4 = 1200\ in^3$

Backing plate: $1/4 \times 8\,1/4 \times 10\,3/8 \times 2 = 42.8\ in^3$

Mounting BRKT: $3/16 \times 8\,1/8 \times 2 \times 8 = 24.4\ in^3$

side plate: $3/16 \times 8\,1/8 \times 10 \times 4 = 60.9\ in^3$

Total weight $W_c = 1328 \times 0.284 = 377$ lb.

Cone:

$$W_n = \frac{\pi}{2}\left(65\tfrac{3}{8} + 60\tfrac{5}{8}\right) \times 11 \times 0.134 \times 0.284$$

$= 82.8$ lb

Ring:

$$W_g = 64.5 \times \pi \times \tfrac{1}{4} \times 4.43 \times 0.284$$

$= 63.7$ lb

Detector, Conduit and junction box:

$W_d = 320$ lb.

Total weight of Receiver Blast Shield

$$W_T = 1445 + 377 + 82.8 + 63.7 + 320$$

$= 2,289$ lb

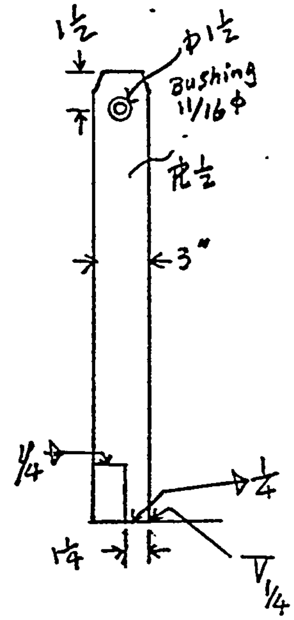
With safety factor $W_T = 2,289 \times 1.5 = 3,433$ lb

(1) Drawing H-2-821387, Rev.0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6)
(7) Subject HMT - Flexible Receiver Blast Shield
(8) Originator Z.H. Huang Date 12-21-94
(9) Checker [signature] Date 12/22/94

(10)

CAPACITY OF LUG

$= 1{,}700$ lb/lug for 4 Lugs




Check Lug - Tensile tearing

$A = (1.5 - \frac{1.5}{2})\frac{1}{2}$

$= 0.375\ in^2$

$\frac{P}{A} = \frac{1700}{0.375}$

$= 4.5 ksi < 12 ksi$ OK

Tear-out allowable load

$P = \frac{1.67(12000)(0.5)(0.75)^2}{1.5}$

$= 3{,}758$ lb

$S.F = \frac{3758}{1700} \doteq 2.21$ OK

The calculations are Conservative with bushing 11/16" φ used in lug hole

Lug weld strength

$A_w = (3+0.5) \times 2 = 7$ in

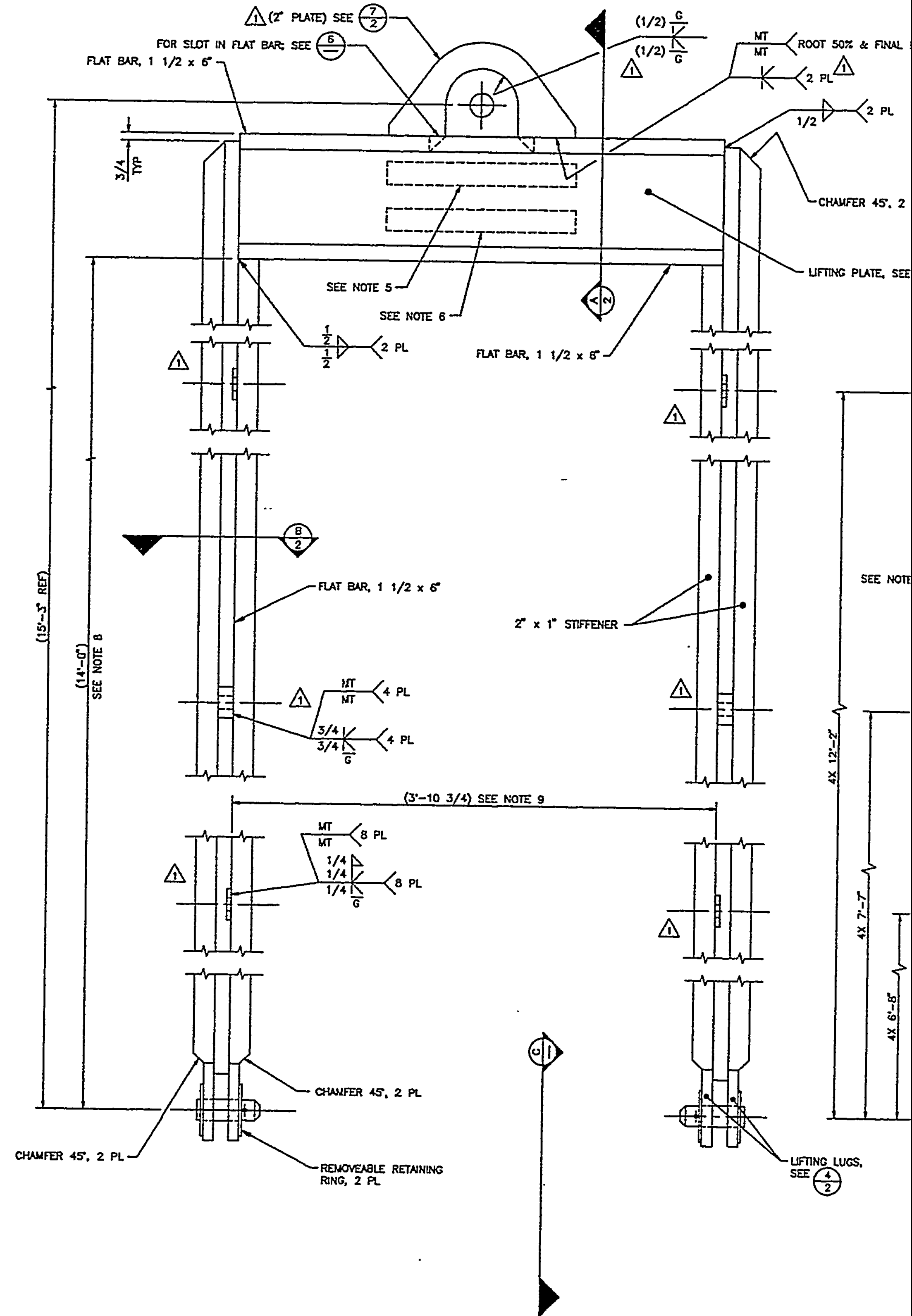
$f_u = \frac{1700}{7 \times 1/4} = 972\ psi < 7{,}200\ psi$ OK



BD-6400-060.1 (12.87)

# Appendix C

## Drawings



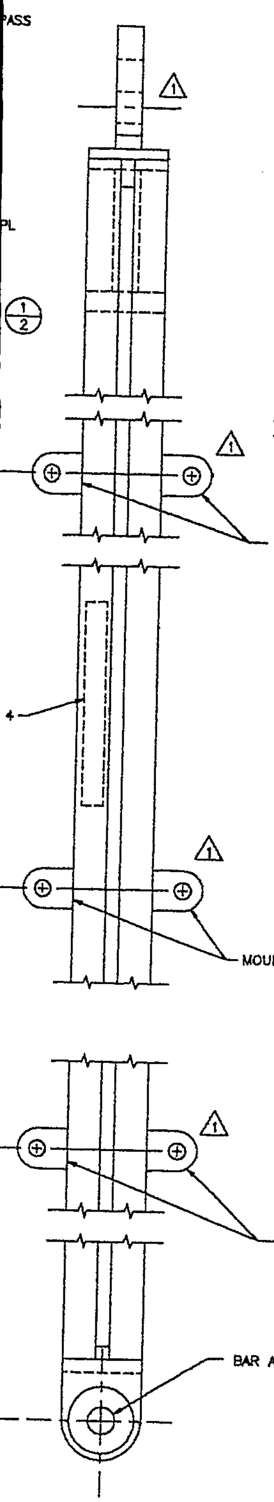

## ASSEMBLY

SCALE: 3/16 SIZE

DWG NO

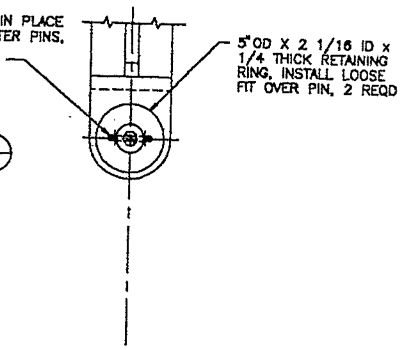
DRAWING

54-6000-027(3/89)

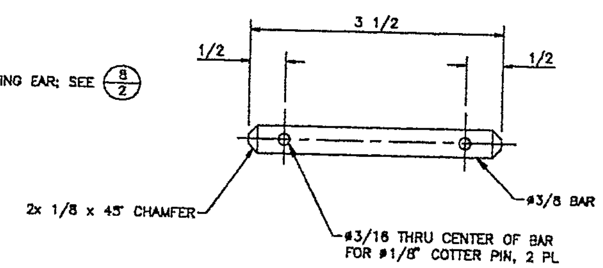



## GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

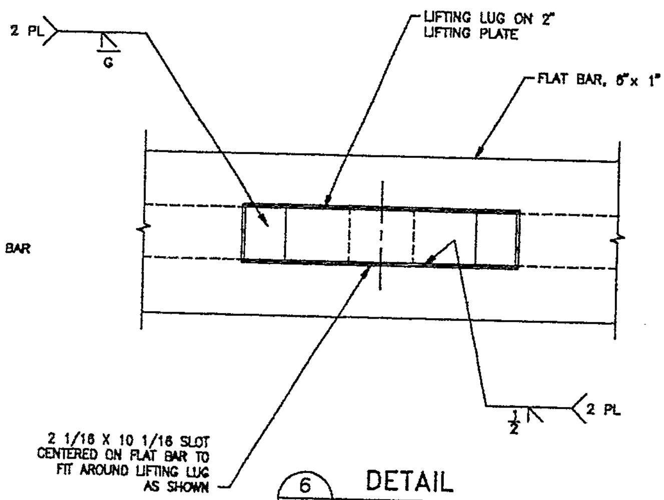
1. REMOVE ALL BURRS AND BREAK SHARP EDGES.
2. WELD AND INSPECT PER AWS D1.1. VT FINAL PASS OF ALL WELDS. MT DESIGNATED WELDS BEFORE AND AFTER LOAD TESTING. WELDS SHALL BE DOCUMENTED ON AN APPROVED INSPECTION DOCUMENT. WELD QUALIFICATIONS PER ASME SECTION IX ARE AN ACCEPTABLE SUBSTITUTION.
3. FLAT BAR, PLATE, AND STRUCTURAL SHAPES SHALL CONFORM TO ASTM A36 CARBON STEEL. ROUND BAR SHALL CONFORM TO ASTM A108 GR 1018.
4. IDENTIFY ASSEMBLY WITH DRAWING NUMBER AND DRAWING REVISION NUMBER IN THE LOCATION INDICATED ON THE DRAWING. CHARACTERS SHALL BE 1" HIGH AND SHALL BE PAINTED WITH BLACK ENAMEL.
5. PAINT "WEIGHT **** LBS" IN THE LOCATION INDICATED ON BOTH SIDES OF THE LIFTING PLATE. THE ASSEMBLY SHALL BE WEIGHED PRIOR TO PAINTING THE ABOVE ON THE LIFTING PLATE AND THE WEIGHT TO THE NEAREST POUND SHALL BE INSERTED WHERE THE **** ARE. CHARACTERS SHALL BE 2" HIGH AND SHALL BE BLACK ENAMEL ON A YELLOW ENAMEL BACKGROUND.
6. PAINT "CAPACITY 20 TONS" IN THE LOCATION INDICATED ON BOTH SIDES OF THE LIFTING PLATE. CHARACTERS SHALL BE 2" HIGH AND SHALL BE BLACK ENAMEL ON A YELLOW ENAMEL BACKGROUND.
7. THE ASSEMBLY SHALL BE LOAD TESTED PER HANFORD HOISTING AND RIGGING MANUAL WHC-CM-6-4. IF THE ASSEMBLY FAILS TO PASS THE LOAD TEST, NECESSARY REPAIRS SHALL BE MADE AND THE LOAD TEST REPEATED. ANY REPAIRS MADE TO THE WELDING WILL REQUIRE RE-INSPECTION OF THE WELDS.
8. THE CONTRACTOR SHALL FIELD VERIFY THE REQUIRED LENGTH OF THE EXTENSION BARS PRIOR TO FABRICATION TO ASSURE THE NECESSARY CLEARANCE FOR THE MIXER PUMP ASSEMBLY.
9. THE CONTRACTOR SHALL VERIFY THE WIDTH BETWEEN THE NEW LIFTING LUGS ON THE EXISTING PUMP FLANGE BEFORE FABRICATION OF THE LIFTING YOKE TO ASSURE PROPER ALIGNMENT AND FIT-UP BETWEEN THE LIFTING LUGS ON THE EXISTING PUMP FLANGE AND THE LIFTING LUGS ON THE LIFTING YOKE.
10. THE FABRICATOR SHALL VERIFY THE WIDTH BETWEEN THE MOUNTING EARS ON THE YOKE BRACE (DWG H-2-821388) BEFORE WELDING THE MOUNTING EARS ON THE LIFTING YOKE TO ASSURE PROPER ALIGNMENT AND FIT-UP BETWEEN THE MOUNTING EARS ON THE YOKE BRACE AND THE MOUNTING EARS ON THE LIFTING YOKE.




VIEW C
SCALE: 3/16 SIZE




DETAIL 5
SCALE: FULL SIZE




DETAIL 6
SCALE: 3/8 SIZE
NOTE: BEFORE ITEM 7 IS INSTALLED

**FOR REFERENCE ONLY**

| | | |
|---|---|---|
| WHC-SD-WM-DA-109 | SUPPORTING DOC | |
| H-2-83686 | LIFTING BEAM | |
| H-2-83684 | TRANSPORT CRADLE | |
| REF NUMBER | TITLE | |
| TITLE | REFERENCES | |
| TRACEABILITY LIST | NEXT USED ON | END ITEM |

REVISIONS: 1 — REVISE PER ECN 611749

CADFILE 8083687A — CADCODE 18:18M:ACD2:11.00:SS

| | | |
|---|---|---|
| DRAWN R.N. KYLE | 7-92 | |
| CHECKED D. HAVENS | 7-92 | |
| OPTE APVD ON FILE | 7-15-92 | |
| T.R. BENEGAS | 7-16-92 | |
| T.C. MACKEY | 7-16-92 | |
| APVD FOR IMPLEMENTATION BY CARL HANSON | 7-15-92 | |

124825

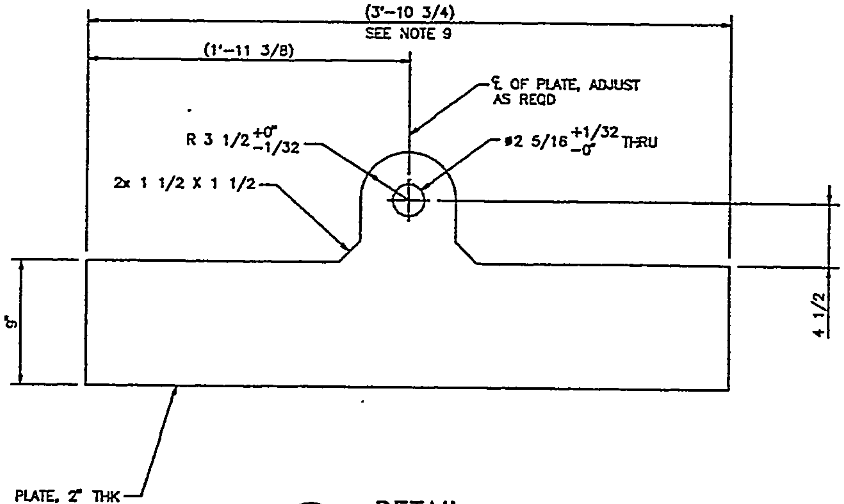
U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Westinghouse Hanford Company

# MIXER PUMP ASSEMBLY LIFTING YOKE

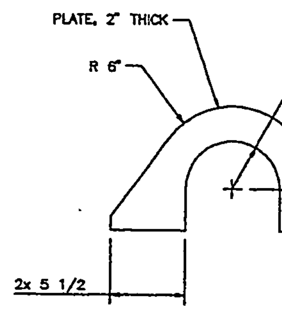
| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| F | 241-SY | 1001 | H-2-83687 | 1 |

SCALE SHOWN — SHEET 1 OF 2 — DATE 29Jul94

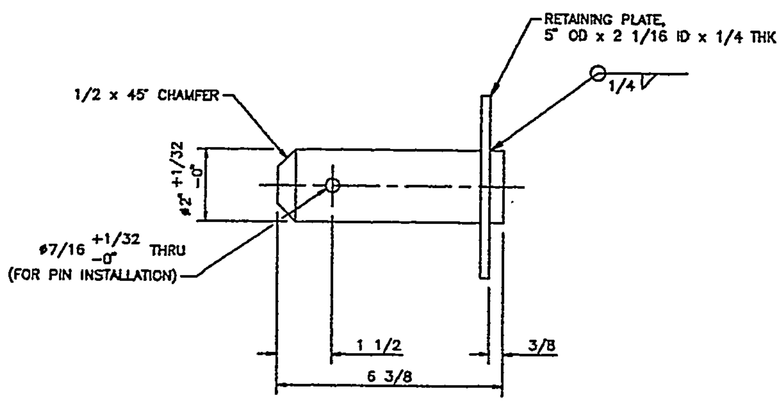
H-2-83687



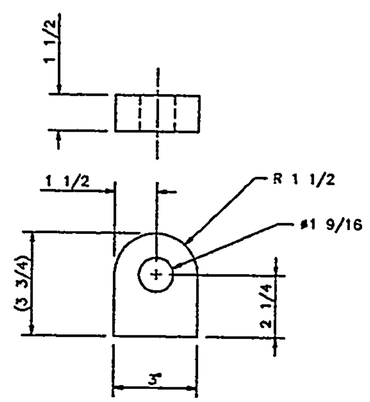

DETAIL 1/1
SCALE: 3/16 SIZE



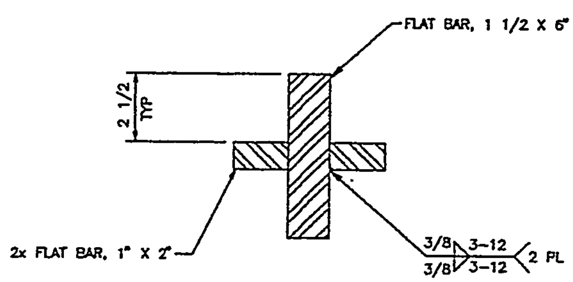

DETAIL 7/1
SCALE: 3/16




DETAIL 2/1
SCALE: 1/2 SIZE

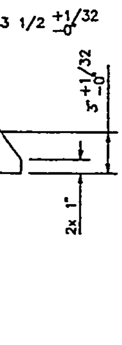


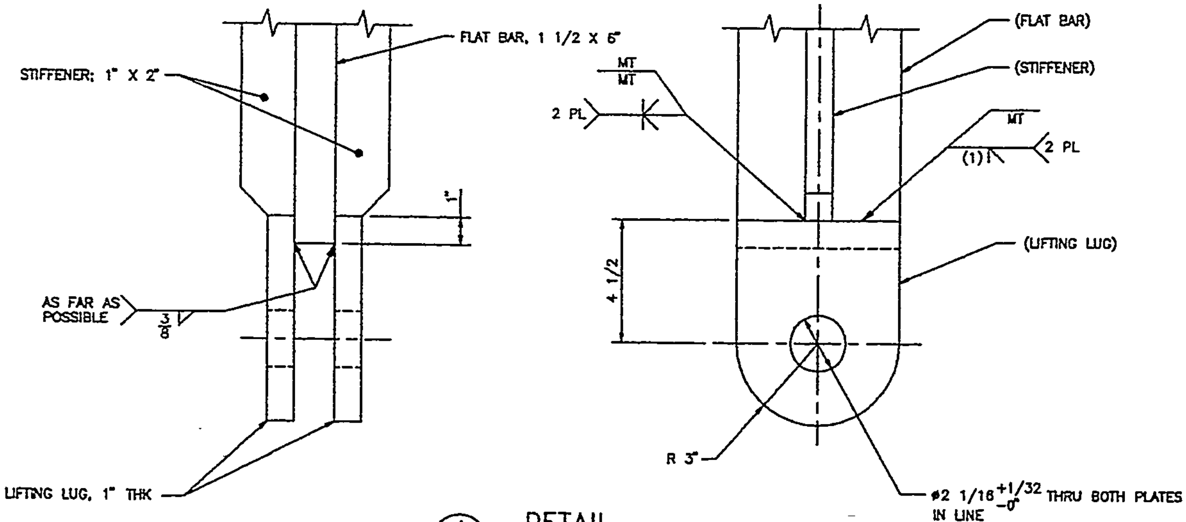

DETAIL 8/1
SCALE: 3/8 SIZE



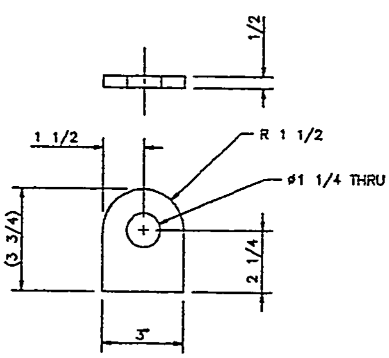

SECTION B/1
SCALE: 3/8 SIZE
TYP EACH LEG

DWG NO
DRAWING

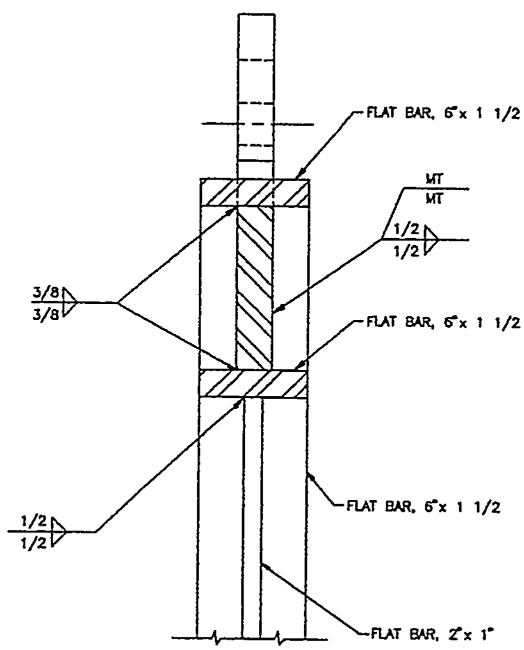



DETAIL 4/1
SCALE: 3/8 SIZE
TYP 2 PLACES




DETAIL 9/1
SCALE: 3/8 SIZE




SECTION A/1
SCALE: 1/4 SIZE

**FOR REFERENCE ONLY**

FOR GENERAL NOTES SEE SHEET 1

| | | |
|---|---|---|
| DRAWN R.N. KYLE | 7-92 | U.S. DEPARTMENT OF ENERGY, Richland Operations Office, Westinghouse Hanford Company |
| CHECKED D. HAVENS | 7-92 | |
| DFTG APVD ON FILE | 7-15-92 | MIXER PUMP ASSEMBLY LIFTING YOKE |
| COG ENGR T.R.BENEGAS | 7-16-92 | |
| OTHER T.C.MACKEY | 7-16-92 | |
| APVD FOR IMPLEMENTATION BY CARL HANSON | 7-16-92 | SIZE F, BLDG NO 241-SY, INDEX NO 1001, DWG NO H-2-83687, REV 1 |
| | | SCALE SHOWN, SHEET 2 OF 2 |

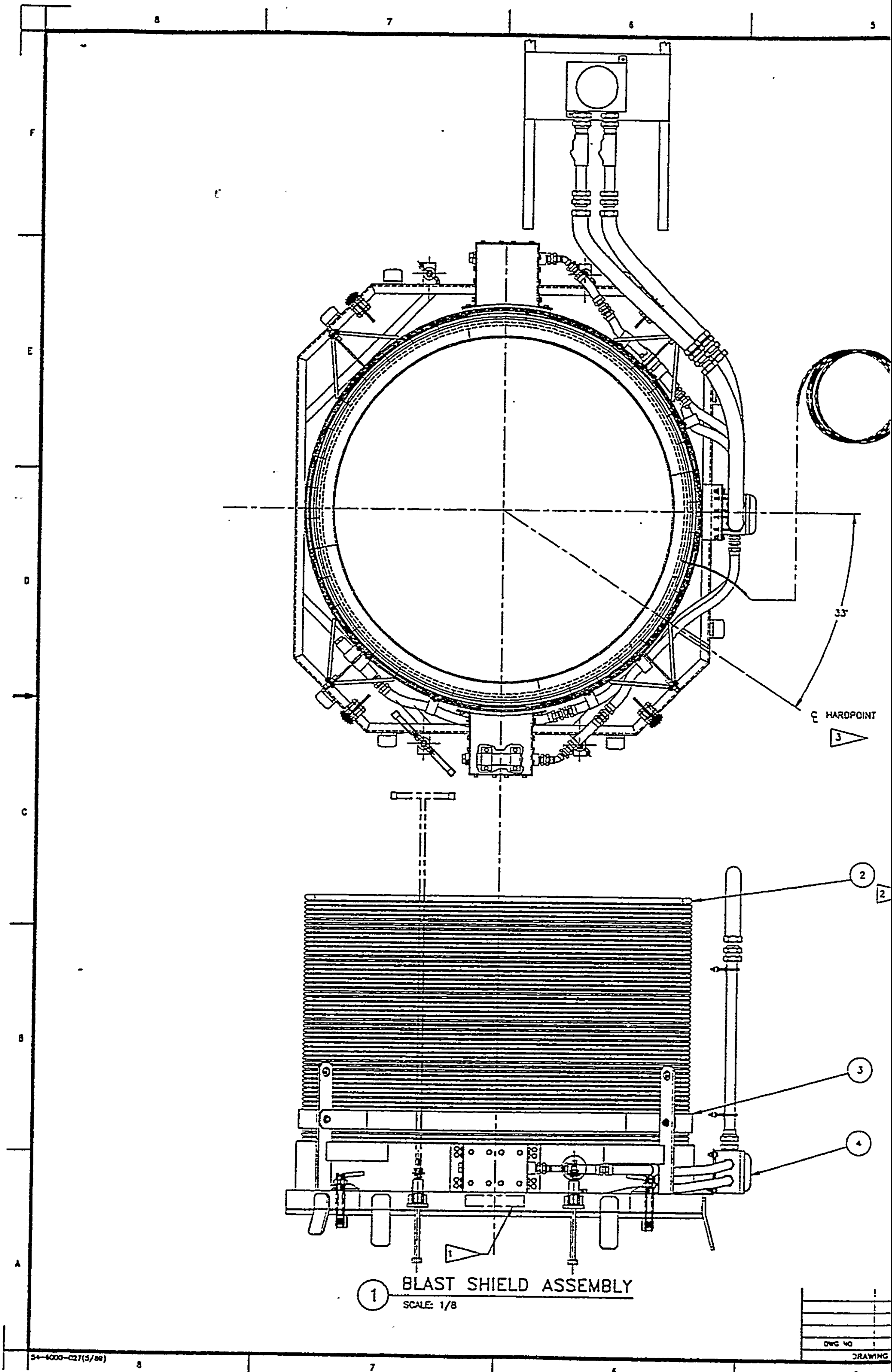
ECN 124825

| REV | DESCRIPTION | |
|---|---|---|
| 1 | REVISE PER ECN 611749 | |

REFERENCES: NEXT USED ON H-2-83687 SH 1

CADFILE 80836878 · CADCODE 1E:18M:ACD2:11.00:SS

DATE 30Jul94



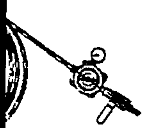
8
7
6
5
F
E
D
C
B
A
33°
℄ HARDPOINT
3
2
2
3
4
1
1
BLAST SHIELD ASSEMBLY
SCALE: 1/8
DWG NO
DRAWING
54-4000-C27(5/89)

| QTY REQD -040 | -030 | -020 | -010 | PART/DASH NUMBER | NOMENCLATURE/DESCRIPTION | MATERIAL/REFERENCE | SHEET | ITEM NO. |
|---|---|---|---|---|---|---|---|---|
| | | | X | -010 | FLEXIBLE RECEIVER ASSEMBLY | | 1 | 1 |
| | | X | | -020 | CONTAINMENT BAG ASSEMBLY | H-2-821391 | | 2 |
| | X | | | -030 | BLAST SHIELD ASSEMBLY | H-2-821387 | | 3 |
| X | | | | -040 | GAMMA DETECTOR ASSEMBLY | H-2-824280 | | 4 |

PARTS/MATERIAL LIST

BAG WEIGHT ≅ 175 lb +0/-10 lb.





GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. IDENTIFY ASSEMBLY WITH DRAWING NUMBER, PART NUMBER AND REVISION NUMBER PER HS-BS-0015 TYPE 2. USE 1/2 INCH HIGH CHARACTERS. LOCATE APPROX. WHERE SHOWN.
2. CONTAINMENT BAG (ITEM 2) FOLDED IN APPROX. 4" FOLDS TO COMPRESS ONTO THE BLAST SHIELD (ITEM 3).
3. ALIGN ITEM 2 AND 3 ALONG HARDPOINT INDICATORS AT ASSEMBLY.

H-2-821386

DRAWN DF HILDERMANN 12/94

U.S. DEPARTMENT OF ENERGY
DOE Field Office, Richland
Westinghouse Hanford Company

FLEXIBLE RECEIVER ASSEMBLY

HYDROGEN MITIGATION PROJECT

F | 241-SY | 4750 | H-2-821386 | 0

SCALE 1/8 | XXXXX | SHEET 1 OF 1

TRACEABILITY LIST | REFERENCES | NEXT USED ON H-2-821392

CADFILE B821386A | REVISIONS | CADCODE DOS:6.0:ACD2:12.0:SS