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Title/Desc:

FLEXIBLE RECEIVER ADAPTER & SECONDARY BAGGER
SUPPORT FRAME ANALYSIS FOR 241AP102 MIXER PUMP
REMOVAL

Station 35 **22**
Sept. 29, 1995

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT

609749

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8. Originator Remarks: Approval for Release of Document				9. Equip./Component No.: N/A	
				10. System/Bldg./Facility: 241AP102	
11. Receiver Remarks:				12. Major Assm. Dwg. No.: N/A	
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1	WHC-SD-WM-DA-206		0	Flexible Receiver Adapter and Secondary Bagger Support Frame Analysis for 241AP102 Mixer Pump Removal	SQ	1	1	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
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Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.
1	1	Cog. Eng. C.F. Hoffman	<i>C.F. Hoffman</i>	9/29/95	S4-43	M. D. Axup	<i>Mark Axup</i>	9/29/95	S2-03	1	1
1	1	Cog. Mgr. T.W. Bohan	<i>T.W. Bohan</i>	9/29/95	S5-06	R.M. Boger	<i>R.M. Boger</i>	9/29/95	H5-57	1	1
1	1	QA W.I. Adams	<i>W.I. Adams</i>	9-28-95	S1-57	T.K. Peterson	<i>Theresa Peterson</i>	9/28/95	S2-03	1	1
1	1	Safety S.U. Zaman	<i>S.U. Zaman</i>	9/29/95	R3-09						
		Env.									
1	1	T.C. Mackey	<i>T.C. Mackey</i>	9/29/95	S2-03						

18. M. D. Axup <i>Mark Axup</i> Signature of EDT Originator		19. C.F. Hoffman <i>C.F. Hoffman</i> Authorized Representative Date for Receiving Organization		20. T.W. Bohan <i>T.W. Bohan</i> Cognizant Manager Date		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-DA-206, Rev. 0

Document Title: Flexible Receiver Adapter and Secondary Bagger
Support Frame Analysis for 241API02 Mixer Pump
Removal

Release Date: 9/29/95

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

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

C. WILLINGHAM

9/29/95

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SUPPORTING DOCUMENT

1. Total Pages **31**

2. Title

Flexible Receiver Adapter and Secondary Bagger
Support Frame Analysis for 241AP102 Mixer Pump
Removal

3. Number

WHC-SD-WM-DA-206

4. Rev No.

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5. Key Words

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Flexible Receiver Adapter, Secondary Bag,
Secondary Bagger Frame, Pump Removal

6. Author

Name: M. D. Axup

Signature

Organization/Charge Code 5A620/D46EA

7. Abstract

As part of the Grout Process startup, the 241AP102 Mixer Pump, failed in 1993, is scheduled to be removed. A structural analysis was performed on two components to be used in the bagging process for the failed pump. The loading criteria was based on a worst case accident of the entire pump weight (including a 50% impact load) being applied over a small localized area. The results show that the design of each structure is adequate to protect against failure, i.e., YIELD.

MDA
9/29/95

8. RELEASE STAMP

OFFICIAL RELEASE
BY WHC

DATE Sept. 29, 1995

Station 35

FLEXIBLE RECEIVER ADAPTER AND SECONDARY BAGGER SUPPORT FRAME ANALYSIS
FOR 241AP102 MIXER PUMP REMOVAL

September 1995

PREPARED BY: Mark D. Axup
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9/27/95
Date

James V. Egger
J. V. Egger, Structural Engineer
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9/27/95
Date

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T. K. Peterson, Engineer
Analytical Services

9/28/95
Date

APPROVED BY: R. M. Boger
R. M. Boger, Manager
Analytical Services

9/29/95
Date

ICF Kaiser Hanford Company
Hanford Operations and Engineering Contractor
for the
U. S. Department of Energy
Richland, Washington

TYPICAL CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed: WHC-SD-WM-DA-206

Author M. D. Axup / J. V. Egger

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

Theresa Peterson
Reviewer

9/28/95
Date

TYPICAL CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed: WHC-SD-WM-DA-206

Author J. V. Egger

Yes No N/A

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☒	☐	☐	Results and conclusions address all points required in the problem statement.

MANDATORY

Software QA Log Number N/A

Mark D. Auer
Reviewer

9/28/95
Date

TYPICAL CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed: WHC-SD-WM-DA-206, APPENDIX C

Author T. K. Peterson

Yes No N/A

☒	☐	☐	Problem completely defined.
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MANDATORY

Software QA Log Number N/A

James A. Tuck
Reviewer

28 Sept. '95
Date

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FLEXIBLE RECEIVER ADAPTER AND SECONDARY BAGGER SUPPORT FRAME ANALYSIS FOR 241AP102 MIXER PUMP REMOVAL

1.0 INTRODUCTION

The 241AP102 Mixer Pump (APMP) is a 150-horsepower submersible slurry pump (CVI #21924). The pump is approximately 50 ft long below the flange, and fits in a 42-in. riser. It is a 10-in. GN-Hazleton Type "SSB" Pump, serial number N-20556. The pump weighs approximately 12,700 lbs. The pump was installed in 241AP102 to mix the tank contents to a homogeneous mixture. From the tank, the waste was to be pumped to the wet grout facility where it would be mixed into grout. Then the grout would be pumped to the grout vaults where it will be stored as low level radioactive waste. In 1993, the mixer pump failed in the tank. The pump is scheduled to be removed and replaced as part of the Grout Process startup.

2.0 DISCUSSION

The flexible receiver adapter, secondary bagger and secondary bagger support frame are approval designator Safety and Quality. The design is in accordance with Manual of Steel Construction, (AISC 1989) and with SDC 4.1. All welds and weld inspection are in accordance with AWS D1.1-1994.

The flexible receiver adapter, secondary bagger and secondary bagger support frame are designed to accommodate the mixer pump. The following are the pump's governing dimensions and weights:

Length mounting flange to bottom	49 ft-11 7/16-in.
Height above mounting flange	1 ft-1/2-in.
Max. diam. below flange	3 ft-4 1/2-in.
Diam. of flange	4 ft-5-in.
Pump C.G. from top of flange	30.7 ft
Weight of pump	12,688 lbs

2.1 FLEXIBLE RECEIVER ADAPTER

The flexible receiver adapter is the load distribution frame for the blast shield and flexible receiver bag. It also serves the purpose of supporting the flexible receiver equipment in place over the 241AP102 central pump pit 42" riser. The adapter also houses the water jet cutter and its backup as well as two cameras for viewing the cutter in operation.

The flexible receiver adapter was designed to provide a smooth transition between the 42" riser and the blast shield. The transition prevents the pump from becoming caught during removal. The adapter is also designed to take loads due to the pump being accidentally lowered onto the

blast shield during a rewashing effort. The allowable design values have been increased by 1.6 to determine the factor of safety against failure due to the accidental weight of the pump being applied to the adapter. The adapter was designed with jack screws to allow for greater flexibility while mounting it in the central pump pit.

The flexible receiver system is to be assembled in accordance with H-14-100176 and WHC-SD-WM-OMM-023. The camera and cutter is to be installed in accordance with the instructions of H-14-100190 and WHC-SD-WM-OMM-021.

2.2 LEAK CONTAINMENT BAG SUPPORT FRAME

The leak containment bag was designed to provide a secondary bag for leak containment during 42" riser equipment removal for projects W-151 and W-320. The secondary bag was designed to attach to the bottom of removed equipment to ensure no tank waste fluid from the removed equipment would leak onto the ground. However, the leak containment equipment was designed to double bag only a short section of the removed equipment. For the purposes of AP102 mixer pump removal, it was decided a longer bag was needed to ensure the main flexible receiver bag would not drip fluid on the ground. Therefore the decision was made to suspend the secondary bagger over the central pump pit to provide the necessary length for the longer equipment. To this end the secondary bagger support frame was designed to be mounted on top of the 241AP102 central pump pit.

The secondary bagger support frame shall be assembled and installed per H-14-100490, H-14-100176, and WHC-SD-WM-OMM-023

3.0 RESULTS / CONCLUSIONS

The flexible receiver adapter and leak containment bag support frame have been designed based on a worst case accident of the entire pump weight being applied (including a 50% impact) over a small localized area. As a result, both structures were analyzed based on the design provision of the AISC manual and qualified using material yield stresses in lieu of allowable stress. The results show that the design of each structure is adequate to protect against failure, i.e., YIELD.

9/28/95

5.0 REFERENCES

- AISC, 1989, *Manual of Steel Construction, Allowable Stress Design*, 9th Ed., American Institute of Steel Construction, Chicago, Illinois.
- AWS D1.1, 1994, *Structural Welding Code - Steel*, 13th Ed., American Welding Society, Miami, Florida.
- DOE-RL, 1993, *Standard Architectural-Civil Design Criteria, Design Loads for Facilities*, DOE-RL-SDC 4.1, Rev. 12, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- ASME B31.3, 1993, *Chemical Plant and Petroleum Refinery Piping*, American Society of Mechanical Engineers, New York, New York.

Young, Warren C., 1989, *Roark's Formulas for Stress & Strain*, Sixth Edition, McGraw-Hill, New York, New York.

Drawings

- WHC, 1994, H-2-79362, TWRS Flexible Receiver 42" Leak Containment Bag/Stand Assembly, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100149, Flexible Receiver Camera Housing, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100150, Flexible Receiver Cutter Housing, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100151, Flexible Receiver Adapter Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100153, Flexible Receiver Adapter Restraint, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100175, Flexible Receiver Drawing Tree, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100176, Flexible Receiver Installation, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100190, Flexible Receiver Adapter Assembly, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100490, Flexible Receiver Bagger Stand Installation, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995, H-14-100491, Flexible Receiver Secondary Containment Bag, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Certified Vendor Information

CVI #21924, 10-in. GN Hazleton Type "SSB" Pump

APPENDIX A

FLEXIBLE RECEIVER ADAPTER CALCULATIONS

ANALYTICAL CALCULATIONS

Page 1 of 11

Subject FLEXIBLE RECEIVER ADAPTER
Originator J.V. EGGEN Date 9/22/95
Checker Mark D. Amp Date 9/27/95

OBJECTIVE.

ANALYZE FLEXIBLE RECEIVER ADAPTER
FOR WEIGHT OF PUMP (13000#) DURING
LOWERING AND CRANE CAPACITY (24000#)
DURING RAISING (24000 - 13000 = 11000#)
FLEXIBLE RECEIVER ADAPTER SHOWN ON H-19-100190

CRITERIA

1. CHECK FLEXIBLE RECEIVER FOR LOADS
INCREASED 50% FOR IMPACT.
2. USE AISC TO CHECK ALLOWABLE
STRESS. (SAFETY FACTOR $\frac{5}{3}$)
3. LOAD CONDITION RESULTS FROM AN ACCIDENT
DURING THE REMOVAL OF THE PUMP.
4. DETERMINE SAFETY FACTOR AGAINST
FAILURE

RESULTS

LEVELING SCREW HAS SMALLEST SAFETY
FACTOR AGAINST FAILURE - 1.639

ANALYTICAL CALCULATIONS

Page 2 of 11

Subject FLEXIBLE RECEIVER ADAPTER
Originator J. Y. EGGER Date 9/22/95
Checker Mark D. Long Date 9/23/95

DRAWINGS

H-14-100190 REV 0 SH 1-4
H-14-100153 REV 0 SH 1

REFERENCES

1. MANUAL OF STEEL CONSTRUCTION
ALLOWABLE STRESS DESIGN 9th EDITION (AISC)
2. ROARK'S FORMULAS FOR STRESS &
STRAIN 4th EDITION
3. CCMAIL MESSAGE T.K. PETERSON TO
M.D. AXUP 8/30/95 9:29 AM

ANALYTICAL CALCULATIONS

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Subject FLEXIBLE RECEIVER ADAPTER

Originator J. V. EGGER

Date 9/22/95

Checker Mal D. Amp

Date 9/27/95

CHECK STIFFENERS FOR VERTICAL PUMP LOAD.

$$r = \sqrt{\frac{I}{A}} = \sqrt{\frac{bd^3}{12}} = \frac{d}{\sqrt{12}}$$

$$r = \frac{1.5}{\sqrt{12}} = 0.1443 \text{ in}$$

$$\frac{L}{r} = \frac{20}{0.1443} = 139 > 126.1$$

$$F_a = 7.73 \text{ ksi/in}^2 \text{ (AISC pg 5-42, 5-122)}$$

$$P = 13^k (1.5) = 19.5^k$$

$$A_{REQ'D} = \frac{19.5}{7.73} = 2.523 \text{ in}^2$$

$$\text{WIDTH REQ'D} = \frac{2.523 \text{ in}^2}{0.5 \text{ in}} = 5.0453 \text{ in.}$$

MINIMUM WIDTH $6\frac{1}{4}"$ OK

CHECK HOUSING FOR PUMP LOAD.

$$\frac{D}{t} = \frac{56.25}{0.25} = 225 \text{ (AISC pg 5-36)}$$

$$\frac{3300}{\sqrt{F_y}} = \frac{3300}{\sqrt{36}} = 550 > 225 \text{ NO LOCAL BUCKLING}$$

$$F_a = 0.66 F_y = 23.76 \text{ ksi/in}^2$$

$$A_{REQ'D} = \frac{19.5^k}{23.76} = 0.8207 \text{ in}^2$$

$$\text{WIDTH REQ'D} = \frac{0.8207 \text{ in}^2}{0.25 \text{ in}} = 3.2828 \text{ in}$$

ANALYTICAL CALCULATIONS

Page 4 of 11

Subject FLEXIBLE RECEIVER ADAPTER

Originator J.V. EGGER

Date 9/22/95

Checker Mah. D. Arif

Date 9/27/95

CHECK $\frac{3}{8}$ " STIFFNESS

$$r = \frac{0.375}{\sqrt{12}} = 0.1083 \text{ in}$$

$$\frac{L}{r} = \frac{21.0431}{0.1083} = 194.3038$$

$$KL/r > C_c$$

$$L = \sqrt{(15.25)^2 + (4.5)^2}$$

$$L = 21.0431$$

$$F_a = 3.96 \text{ K/in}^2$$

(AISC pg 5-122)

$$A_{REQ'D} = \frac{19.5}{3.96} = 4.9242 \text{ in}^2$$

$$\text{WIDTH REQ'D} = \frac{4.9242}{0.375} = 13.1313 \text{ in.} < 14.5" \text{ OK.}$$

ANALYTICAL CALCULATIONS

Page 5 of 11

Subject FLEXIBLE RECEIVER ADAPTER
Originator J. V. EGGER Date 9/22/95
Checker Mark D. Anup Date 9/27/95

CHECK COLLAR PART 19 (ROMER pg 453)

$$P = \frac{E\delta}{(1-\nu^2)Ma^2} \left[(h-\delta) \left(h - \frac{\delta}{2} \right) t + t^3 \right]$$

$$\sigma_A = \frac{-E\delta}{(1-\nu^2)Ma^2} \left[C_1 \left(h - \frac{\delta}{2} \right) + C_2 t \right]$$

$$\sigma_b = \frac{-E\delta}{(1-\nu^2)Ma^2} \left[C_1 \left(h - \frac{\delta}{2} \right) - C_2 t \right]$$

$$\frac{q}{b} = \frac{68.75}{56.25} = 1.2222$$

$$M = 0.32665 \quad C_1 = 1.02555 \quad C_2 = 1.05999$$

$$h = 3.375'' \quad t = 0.25'' \quad \nu = 0.30$$

$$P = 19,500 \#$$

$$19500 = \frac{29,000,000 \delta}{(1-0.3^2)(0.32665) \left(\frac{68.75}{2} \right)^2}$$

$$\left[(3.375 - \delta) \left(3.375 - \frac{\delta}{2} \right) (0.25) + 0.25^3 \right]$$

BY TRIAL & ERROR

$$\delta = 0.0857''$$

$$\sigma_A = \frac{-29,000,000 (0.0857)}{(1-0.3^2)(0.32665) \left(\frac{68.75}{2} \right)^2}$$

$$\left[1.02555 \left(3.375 - \frac{0.0857}{2} \right) + 1.05999 (0.25) \right]$$

$$\sigma_A = -26054 \# / \text{in}^2$$

$$\sigma_b = -22304 \# / \text{in}^2$$

ANALYTICAL CALCULATIONS

Page 6 of 11

Subject FLEXIBLE RECEIVER ADAPTER

Originator J.V. EGGER

Date 9/22/95

Checker Mark D. Amp

Date 9/27/95

CHECK CLX8.2 FOR VERTICAL PUMP LOAD

$$M = \frac{Pl}{4} = \frac{19.5 (24.4375)}{4} = 119.1328 \text{ #-IN}$$

$$f_b = \frac{M}{s} = \frac{119.1328}{4.38} = 27.1993 \text{ K/IN}^2$$

$$F_b = \frac{12 \times 10^3}{2 (d/A_f)} = \frac{12000}{(24.4375)(9.10)} = 53.9614 \text{ K/IN}^2$$

$$F_b \leq 0.6 F_y = 0.6 (36) = 21.6 \text{ K/IN}^2 \text{ N.G.}$$

CHECK BEARING

$$\frac{R}{L_w (N + 5K)} = \frac{19.5}{(0.200) [\frac{1}{2} + 5 (\frac{13}{16})]} = 21.3699 \text{ K/IN}^2$$

$$0.66 F_y = 0.66 (36) = 23.76 \text{ K/IN}^2 > 21.3699 \text{ K/IN}^2 \text{ OK.}$$

SAFETY FACTOR

$$SF = \frac{1.6 (21.6)}{27.1993} = 1.27 \text{ OK.}$$

ANALYTICAL CALCULATIONS

Page 7 of 11Subject FLEXIBLE RECEIVER ADAPTEROriginator J. V. EGGERDate 9/22/95Checker Wahid D. ArifDate 9/27/95

CHECK TS 4x4 x 1/2 FOR PUMP LIFT

$$M = 16.2778(12.0625) = 196.3513 \text{ k-in}$$

$$f_b = \frac{M}{S} = \frac{196.3513}{6.13} = 32.0312 \text{ k/in}^2$$

$$L_c = \frac{1200 b}{F_y} = \frac{1200(4)}{39} = 123" > 73" \text{ OK}$$

$$F_b = 0.66 F_y = 0.66(39) = 25.74 \text{ k/in}^2$$

$$F_b > F_b$$

14.5 k

$$f_v = \frac{16.2778}{2(1/2)(4)} = 4.0695 \text{ k/in}^2$$

$$F_v = 0.40 F_y = 0.4(39) = 15.6 \text{ k/in}^2 > 4.0695 \text{ k/in}^2 \text{ OK.}$$

SAFETY FACTOR

FAILURE STRESS

$$F = 1.6(25.74) = 41.18 \text{ k/in}^2 \text{ USE } 39 \text{ k/in}^2$$

$$SF = \frac{39}{32.0312} = 1.2176 \text{ OK}$$

ANALYTICAL CALCULATIONS

Page 6 of 11Subject FLEXIBLE RECEIVER ADAPTEROriginator J.V. EGGER Date 9/22/95Checker Mark D. Arp Date 9/27/95

CHECK LEVELING SCREW

$$K = 0.847 \text{ in} \quad A = \frac{\pi (0.847)^2}{4} = 0.5635 \text{ in}^2$$

$$r = \frac{d}{4} = \frac{0.847}{4} = 0.2118 \text{ in}$$

$$\frac{Kd}{r} = \frac{0.8(12)}{0.2118} = 45.3258$$

$$\frac{\frac{Kd}{r}}{C_c} = \frac{45.3258}{126.1} = 0.3594$$

$$C_a = 0.521 \quad (\text{AISC pg. 5-119})$$

$$F_a = 0.521(36) = 18.756 \text{ k/in}^2$$

$$f_a = \frac{16.2778}{0.5635} = 28.887 \text{ k/in}^2$$

SAFETY FACTOR

$$SF = \frac{18.756(1.6)}{28.887} = 1.039$$

CHECK BEARING ON CONCRETE

$$A = \frac{\pi (4)^2}{4} = 12.5664 \text{ in}^2$$

$$f_p = \frac{16.2778}{12.5664} = 1.2953 \text{ k/in}^2$$

$$F_p = 0.7 f'_c = 0.7(3) = 2.1 \text{ k/in}^2 \quad \text{OK}$$

(AISC 5-79
§ 3-107)

ANALYTICAL CALCULATIONS

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Subject FLEXIBLE RECEIVER ADAPTER

Originator J.V. EGGER

Date 9/22/95

Checker Mark D. Arup

Date 9/27/95

MAXIMUM UPLIFT ON SUPPORT IS

THRU DESTACO MODEL 374 CLAMPS.

4000# / CLAMP

$$4(4000) = 16,000\#$$

CRANE CAPACITY - 24,000#

PUMP WEIGHT - 13,000#

NET UPLIFT 11,000#

CHECK END RESTRAINT ANCHOR BOLTS.

MINIMUM BOLT SPACING

$$P_y = 16,000\# / 4 = 4000\#$$

SHEAR ON BOLT

$$\frac{P_y}{4} = 1000\#$$

$$M_z = P_x (21.75)$$

ANALYTICAL CALCULATIONS

Page 10 of 11Subject FLEXIBLE RECEIVER ADAPTEROriginator J. V. EGGERDate 9/22/95Checker Mark D. ArupDate 9/27/95

$$I_z = 4(5^2 + 5.5^2) = 221 \text{ in}^2$$

$$C = \sqrt{5.5^2 + 5^2} = 7.4330$$

$$\frac{M_z C}{I_z} = \frac{P_x(21.75)(7.4330)}{221} = 0.7315 P_x$$

TENSION ON BOLT

$$M_x = P_y(8) = 4,000(8) = 32,000 \text{ #-in}$$

$$I_x = 4(5.5)^2 = 121 \text{ in}^2$$

$$\frac{32,000(5.5)}{121} = 1455 \text{ #}$$

$$M_y = P_x(8)$$

$$I_y = 4(5)^2 = 100 \text{ in}^2$$

$$\frac{P_x(8)(5)}{100} = 0.4 P_x$$

ALLOWABLE LOADS ON $\frac{3}{4}$ " EXPANSION ANCHOR

$$T = 3870 \text{ #}$$

$$V = 3710 \text{ #}$$

$$\frac{1455 + 0.4 P_x}{3870} + \frac{1000 + 0.7315 P_x}{3710} \leq 1.0$$

$$(3870)(3710) > 3710(1455) + 3870(1000) + [0.4(3710) + 0.7315(3870)] P_x$$

$$14357700 > 9268050 + 4315 P_x$$

$$1180 \text{ #} > P_x \quad \text{MAXIMUM LATERAL LOAD}$$

$$2(1180) = 2360 \text{ #}$$

ANALYTICAL CALCULATIONS

Page 11 of 11Subject FLEXIBLE RECEIVER ADAPTEROriginator J. V. EGGERDate 9/22/95Checker Mark D. AepDate 9/27/95CHECK TORSION ON (12) $\frac{3}{4}$ " X 15" PLATE.

$$T = 12 (1180) = 14160 \text{ #-IN}$$

$$f_v = \frac{T}{\frac{1}{3} b t^2} = \frac{14160}{\frac{1}{3} (15) (0.75)^2} = 5035 \text{ #/IN}^2$$

$$F_v = 0.4 (36) = 14.4 \text{ #/IN}^2 > 5.035 \text{ #/IN}^2 \text{ OK.}$$

CHECK BENDING (14) $\frac{1}{2}$ " PLATE ON (11) $\frac{3}{4}$ " PLATE

$$f_b = \frac{4600}{1.5 (\frac{3}{4})} = 3556 \text{ #/IN}^2 \text{ OK.}$$

APPENDIX B

SECONDARY BAGGER SUPPORT FRAME CALCULATIONS

ANALYTICAL CALCULATIONS

Page 1 of 4

Subject FLEXIBLE RECEIVER BAGGER STAND
Originator J.V. EGGER Date 9/25/95
Checker Mahesh Arup Date 9/27/95

OBJECTIVE

ANALYZE FLEXIBLE RECEIVER BAGGER
STAND FOR WEIGHT OF PUMP (13000#)
DURING LOWERING.

CRITERIA

1. CHECK FLEXIBLE RECEIVER BAGGER
MAXIMUM ALLOWABLE LOAD ON
42" LEAK CONTAINMENT BAG/STAND.
2. USE AISC TO CHECK ALLOWABLE
STRESS (FACTOR OF SAFETY $5/3$)
3. LOAD CONDITION RESULTS FROM AN
ACCIDENT DURING THE LOWERING
OF THE PUMP INTO THE SECONDARY
BAG.
4. DETERMINE SAFETY FACTOR AGAINST
FAILURE.

RESULTS

W6X15 SAFETY FACTOR AGAINST
FAILURE LOAD ON BAGGER STAND
IS 1.272.

ANALYTICAL CALCULATIONS

Page 2 of 4

Subject FLEXIBLE RECEIVER BATTERY STAND
Originator J. V. LEGER Date 9/25/95
Checker Mark D. Aug Date 9/27/95

DRAWINGS

H-14-100490 REV 0 SH 1-2

H-2-79362 REV 1 SH 1-7

REFERENCES

1. MANUAL OF STEEL CONSTRUCTION
ALLOWABLE STRESS DESIGN 9TH ED. (AISC)
2. ASME B 31.3 - 1993 EDITION
TABLE A-1 & TABLE C-6
3. CC MAIL MESSAGE T.K. PETERSON TO
M.D. AXUP 8/30/95 9:29 AM

ANALYTICAL CALCULATIONS

Page 3 of 4
Subject FLEXIBLE RECEIVER BAGGER STAND
Originator J.V. EGGER Date 9/22/95
Checker Mark D. Arp Date 9/27/95

DESIGN FLEXIBLE RECEIVER BAGGER STAND
SUPPORT FOR MAXIMUM AXIAL LOAD FOR
TURS FLEXIBLE RECEIVER 42" LEAK CONTAINMENT
BAG/STAND ASSY LEG. - L2X2X1/4 ASTM 276
304L SST.

$$F_y = 25 \text{ K/IN}^2 \quad (\text{ASME TABLE A-1})$$

(SEE NOTE 37)

$$E = 28,300 \text{ K/IN}^2 \quad (\text{ASME TABLE C-6})$$

$$\frac{KL}{r} = \frac{2.0(16)}{0.391} = 81.8414$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = \sqrt{\frac{2\pi^2 (28300)}{25}} = 149.4817$$

(AISC pg 5-42)

$$\frac{\frac{KL}{r}}{C_c} = \frac{81.8414}{149.4817} = 0.5475 \quad (\text{AISC pg 5-119})$$

$$F_a = C_a F_y = 0.459 (25) = 11.475 \text{ K/IN}^2$$

$$P_a = F_a A = 11.475 (0.938) = 10.7636 \text{ K}$$

ANALYTICAL CALCULATIONS

Page 4 of 4Subject FLEXIBLE RECEIVER BAGGER STANDOriginator J. Y. EGGER Date 9/22/95Checker Mark D. Acuff Date 9/27/95

$$M = 8.1861 (31.25) = 255.8163 \text{ K-in}$$

$$f_b = \frac{255.8163}{9.72} = 26.3185 \text{ K/in}^2$$

$$L_u = 12 \text{ FT} \quad (\text{AISC pg 2-73})$$

$$F_b = 0.6 F_y = 0.6 (36) = 21.6 \text{ K/in}^2$$

(AISC pg 2-36)

SAFETY FACTOR

$$SF = \frac{21.6 (1.6)}{26.3185} = 1.3131$$

REV. 0

Author: Theresa K Peterson at ~KEH7
Date: 8/30/95 9:29 AM
Priority: Normal
TO: Mark D Axup at ~KEH16
CC: Thomas C Mackey at ~WHC396
Subject: AP crane radius

----- Message Contents -----

Mark,

With the crane located 75 feet from the pump pit (as shown on the sketch), the crane has a capacity of 24,000 lbs with the 180 foot boom on the L-518 crane. The pump weighs approximately 13,000 lbs.

Theresa

SAFETY CLASS 3

APPENDIX C

SECONDARY BAGGER LENGTH CALCULATIONS

ANALYTICAL CALCULATIONS

Page 1 of 3

Subject Secondary Containment Bag Length
Originator Theresa Peterson Date 8/24/95
Checker Warren Tuck Date 29 Aug. '95

Purpose: Calculate length of secondary containment bag required to cover bottom of 24/AP102 mixer pump to above the flexible receiver horsetail.

Given: Pump length covered is bottom of pump to top of pump cap.

Pump drawing: Hazelton E20556

Pump cap drawing: WHC H-14-100177

Pump length = 49' - 6 ³/₁₆" pump below flange
3 ¹/₂" top flange
6" miscellaneous bottom parts
9 ³/₄" pump cap

51' - 1 ¹/₁₆"

≈ 51'

Flexible receiver bag length is long enough to be looped up to the side from the pump bottom to prevent the unsealed bag end from leaking pump wash water.

Flexible Receiver bag drawing: WHC H-14-100179

Flexible Receiver bag length = 58' - 6"

Assuming: Folding the bag over the bottom of the pump will reduce the effective length of the bag by 1/2 foot.

Therefore: The maximum length of the bag being horsetailed up the side of the pump is 7 feet.

ANALYTICAL CALCULATIONS

Page 2 of 3

Subject Secondary Containment Bag Length
Originator Thomas Peterson Date 8/25/95
Checker James A. Tuck Date 29 Aug. 95

Because the secondary containment bag has a flat bottom of a larger diameter than the pump bottom, only the height of the pump needing to be double bagged is considered.

To ensure the horsetail of the flexible receiver bag is inside the secondary containment bag add $\frac{1}{2}$ foot onto the maximum required length of 7 feet.

Therefore: The secondary containment bag needs to be a minimum of $7\frac{1}{2}$ feet long.

ANALYTICAL CALCULATIONS

Page 3 of 3

Subject Secondary Containment Bagger Support Height
Originator Theresa Peterson Date 8/25/95
Checker Samuel Tuck Date 29 Aug 95

Purpose: Determine required height above 24/AP102 central pump pit the secondary containment bagger must be supported.

Given: The bagger will be located over the pump pit away from the 42" riser to allow the mixer pump to be removed with out interferences.

Bagger height: 2'-8" (Ref. H-2-79362)

Central Pump Pit depth: 6'-4 3/4" (Ref. H-2-90447)
measured from pit floor to top of pit wall

Central Pump Pit floor obstructions height: 1'-2" (Ref. H-2-90563)

measured from floor to top of 4" riser

1'-3" (Ref. H-2-90563)

measured from floor to top of 12" riser long down

Therefore: Should clear bottom of pit floor by minimum of 2 feet to avoid riser obstructions.

Height usable from bagger and pit = +2'-8"

+ 6'-4 3/4"

- 2'

≈ 7'

The support for the bagger spanning the pit must have a minimum height of 6 inches for use with a 7 1/2 foot long secondary containment bag.