BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No/	Div. Specific No.	178 Modified for MicroBooNE Vessel Lift	Asset No.
If applicable		If applicable	If applicable

ASME B30.20 Group: (check one)
- [x] Group I — Structural and Mechanical Lifting Devices
- [ ] Group II — Vacuum Lifting Devices
- [ ] Group III — Magnets, Close Proximity Operated
- [ ] Group IV — Magnets, Remote Operated

Device Name or Description _____

Device was (check all applicable)
- [ ] Purchased from a Commercial Lifting Device Manufacturer. Mfg Name _____
- [x] Designed and Built at Fermilab
- [ ] Designed by Fermilab and Built by a Vendor. Assy drawing number _____
- [ ] Provided by a User or other Laboratory
- [ ] Other: Describe _____

Engineering Note Prepared by R. J. Woods Date 1/7/2013

Engineering Note Reviewed by Anglee Date 1-10-2013

Lifting Device Data:

Capacity 40,000#

Fixture Weight 6,000# As modified

Service: [x] normal [ ] heavy [ ] severe (refer to B30.20 for definitions)

Duty Cycle __N.A.____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency Before each use

Rated Load Test by FNAL (if applicable) Date _____ Load Previously tested for 80,000#

[ ] Check if Load Test was by Vendor and attach the certificate

Satisfactory Load Test Witnessed by: _____

Signature (of Load Test Witness) _____

Notes or Special Information:

This fixture was originally designed and used for a 80,000 pound lifted load. The W24X62 Cross Beam assembly was relocated to the center of the Transverse Beams.

Particle Physics Division

Mechanical Department Engineering Note

Number: MD-ENG-455 Date: 7 January, 2013

Project: MicroBooNE

Project Internal Reference:

Title: Modification of Lifting Fixture #178 for MicroBooNE Vessel

Author(s): R. J. Woods

Reviewer(s):

Key Words:

Abstract/Summary:

Lifting fixture 178 was previously designed and tested for lifting NOvA FHEP Table sections at CDF. The original design load was 80,000 pounds. In order to lift a vessel for MicroBooNE, this fixture was slightly modified by moving the W24X62 cross beam assembly to the center of the W27X84 Longitudinal beams and adding two HSS 3X3 square tubes, one at each end, spanning between these W27X84 beams. These tubes were necessary since the spacing of the lifting lugs on the fixture is 116.5 inches while the spacing of the lugs on the vessel is 143.6 inches. This would produce a small horizontal load that would induce torsion in the W27X84 beams. The tubes take the load in tension, eliminating this twisting force. The new design load is 40,000 pounds, one half of the original design load. For this reason, all the calculations for the original fixture in Engineering Note MD-ENG-283 are still valid. Only the differences caused by the modifications are covered here.

Applicable Codes:

ASME B30.20
AISC Manual of Steel Construction, Ninth Edition

CHECK MOMENT IN W27X84 BEAMS DUE TO RELOCATION OF W24X62 BEAM ASSEMBLY:

USE LOAD CASE 7, AISC P. 2-28

TOTAL LOAD OF VESSEL = 40,000#

LOAD ON EACH BEAM = 40,000/2 = 20,000#

$M = PL/4 = 20{,}000(174.25)/4$

$= 871{,}250$ #-IN

$f_b = M/S = 871{,}250/213$

$= 4090$ psi

FROM ENG. NOTE MB-ENG-283

ALLOWABLE BENDING STRESS = 11,880 psi > 4090 OK

LIFTING FIXTURE 178 CAN BE USED TO LIFT MICROBOONE VESSEL

WIDTH OF LIFTING FIXTURE LUGS = 116.5"
WIDTH OF VESSEL LUGS = 71.804 x 2 = 143.6"

143.6 − 116.5 = 27.1" (SEE FIG. 1 FOR DIMS.)

27.1/2 = 13.6" PER SIDE
USING 6'-0 SLINGS
LIFT ANGLE = SIN 13.6/72
= 10.9°

SLING LOAD = 10,000#/COS A
= 10,000/COS 10.9 = 10,184#

HORIZ. LOAD = 10,000 x TAN 10.9 = 1926#

CHECK TENSION ON 3x3x1/4 TUBE A_{TUBE} =

1926#/2.59 in² = 744 PSI
FOR LIFTING FIXTURE F_t = 1/3 (46 000 psi)
= 15,330 psi > 744 psi
OK

USING 4 BOLTS:
LOAD/BOLT = 744/4
= 186#/BOLT

F_t = 44.0 KSI FOR GRADE 5 BOLTS

ASSUME 3/4"ϕ BOLTS
F_t = 44/3 (.4418) = 6.5 K/BOLT
6,500# > 186# OK

WELD BETWEEN PLATE & TUBE
FOR 3/16" FILLET
F_t = (70 (.707) (3/16))/3 = 3.09 K/IN
OR F_t = 0.3 (70) (.707) (3/16) = 2.78 K/IN (AISC TAB J2.5 p 5-70)
USE 2.78 K/IN
2" PER FACE OF GOOD WELD
TOTAL WELD = 2 (4) (2.78) = 22.2 K
22,200# > 1926# OK

USE HSS 3x3x1/4 W/ 1/2" PLATE EA END CONNECT TO BRACE FRAME W/ 4 - 3/4"ϕ GRADE 5 BOLTS EA. END.

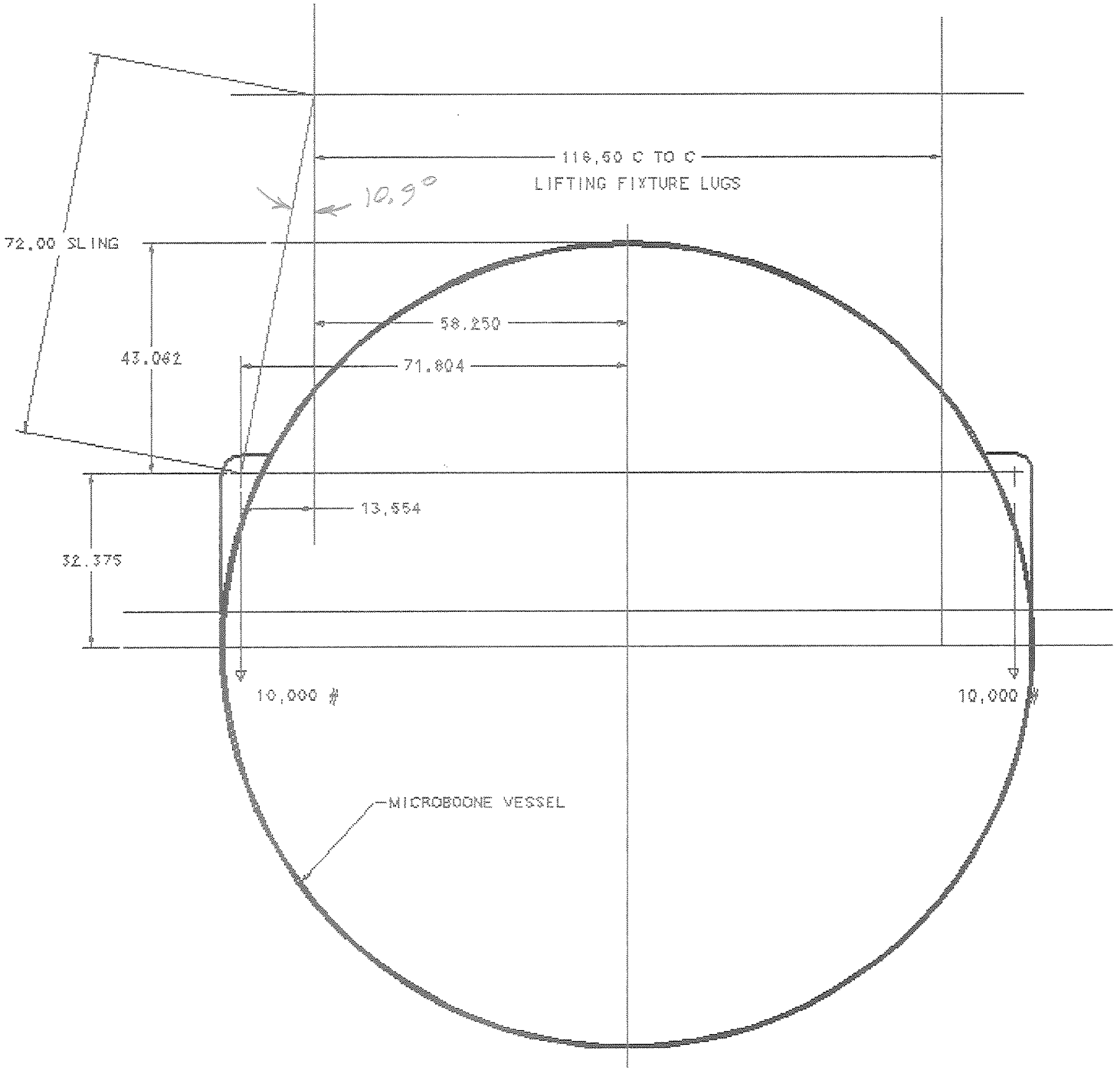
116.50 C TO C
LIFTING FIXTURE LUGS
10.9°
72.00 SLING
43.062
58.250
71.804
13.554
32.375
10,000 #
10,000 #
MICROBOONE VESSEL

FIGURE 1