5022TA

BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No/ _____ Div. Specific No. 183 Asset No. _____

If applicable If applicable If applicable

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

Device Name or Description: NOvA Module Lifting Fixture used in Ash River

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

Engineering Note Prepared by: Victor Guarino Date: November 30, 2011

Engineering Note Reviewed by: Dave Pushka Date: December 1, 2011

Lifting Device Data:

Capacity: 3500 lbs

Fixture Weight: 2800 lbs

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

Duty Cycle: __50% over 16 hours daily_____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency: daily

Rated Load Test by FNAL (if applicable) Date: 11-15-2011 Load: 4000

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

Satisfactory Load Test Witnessed by: Dennis McMillian (of National Elevator Inspection Services, Inc.)

Signature (of Load Test Witness): Refer to PDF of 3rd partyCertification form

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[X] Provided by a User or other Laboratory Designed by ANL
[ ] Other: Describe _____

Engineering Note Prepared by Victor Guarino Date November 30, 2011

Engineering Note Reviewed by Dave Pushka Date December 1, 2011

Lifting Device Data:

Capacity 3200 lbs

Fixture Weight 2800 lbs

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

Duty Cycle __50% over 16 hours daily_____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency daily

Rated Load Test by FNAL (if applicable) Date 11-15-2011 Load 4000

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

Satisfactory Load Test Witnessed by: Dennis McMillian (of National Elevator Inspection Services, Inc.)

Signature (of Load Test Witness) Refer to PDF of 3rd party Certification form

Notes or Special Information: Refer to attached write-up and calculations.

NEIS
NATIONAL ELEVATOR INSPECTION SERVICES

Company ARGONNE NATIONAL LABS
Office ARGONNE ILLINOIS 60439
BLDG# 366
TYPE: LOAD TEST + INSPECTION
Inspector DENNIS McMILLAN #346
Date NOVEMBER 15TH 2011

Routine Inspection Report for CRANES AND HOISTS.

Inspecters Signature: Dennis McMillan

Assured ARGONNE NATIONAL LABORATORY
Address 9700 SOUTH CASS AVENUE ARGONNE ILLINOIS 60439
Location Inspected ARGONNE SITE.
Maintenance contract with SELF Type Contract N/A
Authority ANSI Cert. Exp. Date ONE TIME Inspections Due ANNUAL Diaried YES
Any new elevators or major alterations ☐ Yes ☒ No

BUILDING# 366

RISE	N/A					
NUMBER	004 LIFT					
LOCATION	HIGH BAY					
FREIGHT	CENTRAL SHOPS					
SERIAL#	004					
OTHER CAP.	1000 LBS WHITE 4000 LBS BLUE					

TYPE UNIT: UNDER HOOK VACUUM LIFT

Name and Title of person contacted KEN WOODS
Inspection accepted by. Ken Woods
Full load test date 11-15-11 No load test date N/A

PERFORMED INSPECTION AND WITNESSED LOAD TEST OF NEW VACUUM UNDER HOOK LIFTING FIXTURE. BLUE CUPS WERE TESTED WITH 4000 LBS STEEL PLATES. WHITE CUPS WERE TESTED WITH 1000 LBS EXTRUSION. VACUUM LIFT RAISED, HELD FOR SUFFICIENT TIME AND SAFELY LOWERED BOTH TEST LOADS.
BOTH TEST LOADS WERE HELD FOR 5 MINUTES WITH POWER REMOVED. NO VISUAL SIGNS OF DISTORTION OR DAMAGE AFTER TEST. NO VACUUM LEAKS.

ABOVE VACUUM LIFT OK FOR USE AS DESIGNED.

NOTE: FOR FURTHER INFORMATION. REFER TO ATTACHED TEST REPORT.

LIFTING BARS AND SPREADERS LOAD TEST AND INSPECTION

INSPECTOR DENNIS MCMILLAN INSPECTION DATE NOVEMBER 15TH 2011

NOTES:
1. Proof-test to ~~125%~~ of rated capacity for critical lift service. The test load shall be accurate to within -5%, +0% of stipulated values. SAFTEY FACTOR IN UNIT.
2. Qualified inspector shall witness all steps below.

INSPECTION

Lifting bars and spreaders shall be checked for signs of incipient failure in bending and shall be replaced if permanently bent more than 1/2 in. in 10 ft or twisted more than 5 degrees out of the original plan. Hook attachment welds shall be examined for cracks and signs of failure in tension.

Qualified inspector shall perform test by visual examination, liquid-penetrant examination, or magnetic-particle examination.

Acceptance: No cracks, linear indication, laps, or seams.

STATIC TEST: Hold weight for ~~10~~ 5 min and visually inspect for deformation.

Type ANVER VACUUM UNIT 30" S 01100011518 VACUUM LIFTING FIXTURE Size LENGTH 51' BEAM 14" x 14"

Rated Capacity (SWL) 1000 EXTRUSIONS 4000 PLATES lb Actual Load Test 1000 LBS WHITE CUPS 4000 LBS BLUE CUPS lb

Serial Number 004

Qualified Inspector Verify (Load Test) Dennis McMillan

Remarks VACUUM LIFT TO BE USED ONLY AS DESIGNED. NO VISUAL SIGNS OF DAMAGE OR DISTORTION AFTER TEST. HAVE PREOPERATION INSPECTION PRIOR TO USE.

Far Detector Vacuum Lifting Fixture

Victor Guarino
Argonne National Laboratory
April 29, 2011

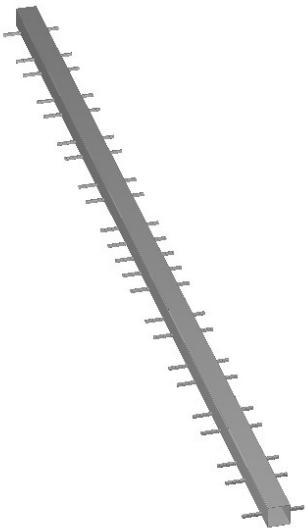
The construction of the NOvA Far Detector blocks requires the use of a vacuum lifting fixture for moving modules and moving steel compression plates. The fixture has two sets of suction cups. The first are white silicone cups that are custom made cups for lifting modules. The second set of cups are blue Anver PS65R-NBR200 cups that are used for moving the steel compression plates.

The calculation of the suction cups was done per ASME BTH-1-2008 and the calculations are shown in the appendix

The steel beam was constructed according to ASME BTH-1-2008. Drawings of the beam can be found in Appendix. A simple beam element model of the lifting fixture beam and arms was created with the nominal load case of 3200 lbs. The FEA programs is a civil engineering package called RAM and pictures of the model are shown below. The 2" square tube arms are modeled in the offset position as shown in these figures. The maximum loads/stresses were extracted from this model and used in the calculations shown in the appendix. Civil engineering programs like RAM model members which are broken into individual elements and the output is for members. In this model the 14" square tube is modeled as a single member and the loads/stresses can be extracted at any point along its length. (Internal to the program of course the member is divided into elements) Output is typically provided as max/min values for the entire member or a distances from the end (i.e. 50% is a point halfway along the length from the first node) The main beam is member 26. The 2" arms are members 41-63 on one side and 64-86 on the other side.

All calculations are shown in the appendix.

The welds of the arms to the beam were also examined using the forces on the welds that were extracted from the FEA model. These calculations are shown in Appendix.



FEA Model

Appendix

Detailed Calculations

1.0 Calculation of the strength of the 14" Square Section

1.1 Define Geometry and Material Properties

Design Category B Lifting Device so Nd=3

$Nd := 3$

$d := 14in$ Depth of beam

$tw := .375in$ Thickness of wall

$b := d - 4 \cdot tw$ Inside dimention of the beam assuming a radius of tw per Fig C3-1

$b = 12.5\,in$

$\frac{b}{tw} = 33.333$

$Ix := 577in^4$

$Ag := 18.7in^2$

$r := 5.55in$

$J := 900in^4$

$Z := 95.4in^3$

$S := 82.5in^3$

Material is ASTM A500 Grade B

$Fy := 46ksi$

$Fu := 58ksi$

$E := 29000ksi$

$$1.12 \cdot \sqrt{\frac{E}{Fy}} = 28.121$$

$$1.40 \cdot \sqrt{\frac{E}{Fy}} = 35.152$$ Section is non-compact

$$Mp := \min(Fy \cdot Z, 1.5 \cdot Fy \cdot S)$$

$$Mp = 365.7\ ft \cdot kip$$

1.2 Evaluation of Flexure

$$Lr := \frac{2 \cdot r \cdot E \cdot \sqrt{J \cdot Ag}}{Fy \cdot S}$$

$$Lr = 917.0\ ft$$

The lifting beam is 50.8ft long. The beam is loaded symmetrically about its centerline so Lb is half of this distance

$$Lb := \frac{50.8 ft}{2}$$ $$Lb = 25.4\ ft$$ Less than Lr

The maximum bending moment in the 14" tube was extracted from the FEA model to find the maximum bending stress in the section.

$$Mmax := 32.88 kip \cdot ft$$

$$Fmax := \frac{Mmax}{S}$$ $$Fmax = 4782.55\ psi$$

$$\frac{Fy}{Nd} = 15333.3\ psi$$ Allowable stress

Maximum stress is below allowable stress

1.3 Evaluation of Compress

Since the beam is supported by slings the section of the beam between the support points are

under compression. The maximum compression load from the model is 0.86kips

$Ft := \frac{1.75kip}{Ag}$ $Ft = 93.6\,psi$

$L := 72in$ distance between the pick points and length under compression

$K := 1$

$\frac{K \cdot L}{r} = 13$

$Cc := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{Fy}}$ $Cc = 111.554$

$$Fa := \frac{\left[1 - \frac{\left(\frac{K \cdot L}{r}\right)^2}{2 \cdot Cc^2}\right] \cdot Fy}{Nd \cdot \left[1 + \frac{9 \cdot \left(\frac{K \cdot L}{r}\right)}{40 \cdot Cc} - \frac{3 \cdot \left(\frac{K \cdot L}{r}\right)^3}{40 \cdot Cc^3}\right]}$$

$Fa = 14843.0\,psi$ Allowable stress in compression -- greater than actual

Analysis Results

Maximum forces at members

Condition : st2=Steel Plates 3200 lbs

	Axial [Kip]	Shear V2 [Kip]	Shear V3 [Kip]	Torsion [Kip*ft]	M22 [Kip*ft]	M33 [Kip*ft]
MEMBER 26						
Max	0.00	3.00	0.00	0.00	0.00	0.00
Min	-1.75	-3.00	0.00	0.00	0.00	-32.88

Member stresses

Location of the fibers with maximum bending stresses

CONDITION : st2=Steel Plates 3200 lbs

Station	Axial [Kip/in2]	Shear V2 [Kip/in2]	Shear V3 [Kip/in2]	Bending 2-Pos [Kip/in2]	2-Neg [Kip/in2]	3-Pos [Kip/in2]	3-Neg [Kip/in2]
MEMBER 26							
0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20%	0.00	0.17	0.00	0.97	-0.97	0.00	0.00
40%	0.00	0.35	0.00	3.95	-3.95	0.00	0.00
60%	0.00	0.35	0.00	3.95	-3.95	0.00	0.00
80%	0.00	0.17	0.00	0.97	-0.97	0.00	0.00
100%	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.0 Calculation of the strength of the 2" Square Section

2.1 Define Geometry and Material Properties

Design Category B Lifting Device so Nd=3

$Nd := 3$

$d := 2in$ Depth of beam

$tw := .25in$ Thickness of wall

$b := d - 4 \cdot tw$ $b = 1\,in$

$\frac{b}{tw} = 4$

$Ix := .747in^4$

$Ag := 1.51in^2$

$r := .704in$

$J := 131in^4$

$Z := .964in^3$

$S := .747in^3$

Material is ASTM A500 Grade B

$Fy := 46ksi$

$Fu := 58ksi$

$E := 29000ksi$

$1.12 \cdot \sqrt{\frac{E}{Fy}} = 28.121$

$1.40 \cdot \sqrt{\frac{E}{Fy}} = 35.152$ Section is compact

$Mp := \min(Fy \cdot Z, 1.5 \cdot Fy \cdot S)$

$Mp = 3.695\ ft \cdot kip$

2.2 Evaluation of Flexure

$Lp := \frac{.13 \cdot r \cdot E}{Mp} \cdot \sqrt{J \cdot Ag}$

$Lp = 70.149\ ft$

$Lb := 16in$ Length of section -- less than Lp

The maximum bending moment in the 2 tube was extracted from the FEA model to find the maximum bending stress in the section.

$Mmax := .08kip \cdot ft$

$Fmax := \frac{Mmax}{S}$ $Fmax = 1285.14\ psi$

$\frac{1.10Fy}{Nd} = 16866.7\ psi$ Allowable stress

Maximum stress is below allowable stress

Analysis Results

Maximum forces at members

Condition : st2=Steel Plates 3200 lbs

	AxialShear V2Shear V3Torsion			M22	M33
	[Kip]	[Kip]	[Kip]	[Kip*ft]	[Kip*ft]	[Kip*ft]
MEMBER 85						
Max	0.00	-0.07	0.00	0.00	0.00	0.00
Min	0.00	-0.08	0.00	0.00	0.00	-0.08
MEMBER 41						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 42						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 43						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 44						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 45						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 46						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 47						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 48						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 49						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 50						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 51						
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER 52						

Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	53					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	54					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	55					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	56					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	57					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	58					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	59					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	60					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	61					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	62					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	63					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	64					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	65					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	66					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	67					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	68					
Max	0.00	0.08	0.00	0.00	0.00	0.00
Min	0.00	0.07	0.00	0.00	0.00	-0.08
MEMBER	69					

Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 70
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 71
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 72
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 73
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 74
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 75
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 76
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 77
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 78
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 79
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 80
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 81
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 82
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 83
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 84
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08
MEMBER 86
Max 0.00 0.08 0.00 0.00 0.00 0.00
Min 0.00 0.07 0.00 0.00 0.00 -0.08

3.0 calculation of weld between arms and main beam

Max Shear and bending moments at weld extracted from FEA

$Mu := 0.08kip \cdot ft$

$Mu = 960 \cdot lbf \cdot in$

$Vu := 80lbf$

Material ASTM A500 Grade 5 and weld material FE70

$Fy := 46ksi$

$FEXX := 70ksi$

$tw := 0.25in$ fillet weld size around 2" tube

$$Iweld := \left[\frac{.707 \cdot 0.25in \, (1.5in)^3}{12} + .707 \cdot 0.25in \cdot 1.5in \cdot (1in)^2 \right] \cdot 2$$

$Iweld = 0.63 \cdot in^4$ moment of inertia of weld ignoring weld on tube radius

$$\sigma s := \frac{Vu}{2 \cdot (1.5in \cdot .707 \cdot 0.25in)}$$

$\sigma s = 150.872 \cdot psi$ weld stress due to shear ignoring the weld in the radius and assuming the shear is only resisted by the two vertical welds

$$\sigma b := \frac{Mu \cdot 1in}{Iweld}$$

$\sigma b = 1524.6 \cdot psi$

$$\sigma weld := \sqrt{\sigma s^2 + \sigma b^2}$$

$\sigma weld = 1532.1 \cdot psi$

$0.6 \cdot FEXX = 42000 \cdot psi$

$SF := \frac{0.6FEXX}{\sigma weld}$ $SF = 27.414$ greater than 3

4.0 Analysis of weld between beam and swivel eye lug

$Fv := \frac{7kip}{2}$ $Fv = 3500 \cdot lbf$ vertical load per lifting eye

Lifting with the slings at a 60 degree angle so additional load in shear

$Fh := \frac{Fv}{\tan(60deg)}$ $Fh = 2020.7 \cdot lbf$ horizontal shear load

$tw := 0.375in$ fillet weld around disk

$Lweld := \pi \cdot 6in$ $Lweld = 18.85 \cdot in$ Length of weld

$$\sigma v := \frac{Fv}{0.707 \cdot tw \cdot Lweld}$$

$\sigma v = 700.352 \cdot psi$

$$\sigma h := \frac{Fh}{0.707 \cdot tw \cdot Lweld}$$

$\sigma h = 404.348 \cdot psi$

$$\sigma weld := \sqrt{\sigma v^2 + \sigma h^2}$$

$\sigma weld = 808.697 \cdot psi$

$SF := \frac{0.6FEXX}{\sigma weld}$ $SF = 51.935$ Safety factor greater than 3.

5.0 Calculations of Suction Cup Capacity

5.1 Define Inputs

Module

$Wm := 1200lbf$ Weight of Module

Suction Cups

$Dcup := 5.5in$ Vacuum diameter of Cup

$Ncups := 48$

$Acup := \frac{\pi \cdot Dcup^2}{4}$ $Acup = 23.758 \cdot in^2$

$Wcup := \frac{Wm}{Ncups}$ $Wcup = 25 \cdot lbf$

5.2 Analysis of Suction Cups

$Pvacuum := 14psi$

$Fcups := Pvacuum \cdot Acup$

$Fcups = 332.616 \cdot lbf$

The calculation of the suction cups was done per ASME B30.20-2.2.2d. The ASME specification def
Ultimate Pad Capacity (UPC) as:

UPC = A(Hg/2)

Where A = the effective area of the suction cup in square inches and Hg is the system vacuum expre
inches of mercury.

The effective vacuum is expected to be 26” Hg. As per the ASME specification, the rated load shoul
greater than 50% of the UPC when the load is normal to the suction cup surface.

$HG := 26in$ Vacuum in suction cups in inches of mercury

$UPC := Acup \cdot \left(\frac{HG}{2} \right) \frac{lbf}{in^3}$ $UPC = 308.858 \cdot lbf$

$Fallowed := 50\% \cdot UPC$

$Fallowed = 154.429 \cdot lbf$

The actual load per cup is: $Wcup = 25 \cdot lbf$

Additional safety factor above what is required by ASME B30 is:

$SF := \frac{Fallowed}{Wcup}$ $SF = 6.177$

Total lifting capacity:

$Flift := Ncups \cdot Fallowed$

$Flift = 7.413 \times 10^{3} \cdot lbf$

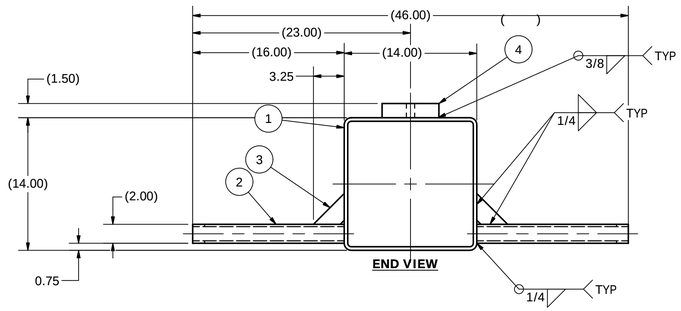
ines the

ssed in

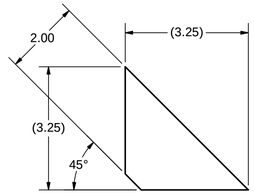
d not be

DWG NO

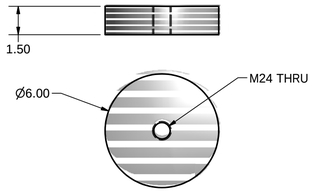
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	SQ TUBE 14 x 14 x 3/8 WALL x 610.50 LG	ASTM A500-GR. B
2	44	SQ TUBE 2 x 2 x 1/4 WALL x 16.00 LG	ASTM A500-GR. B
3	44	PL 2 x 1/4 THK	AISC A 36
4	2	LIFTING HOIST DISK	AISC A 36



END VIEW

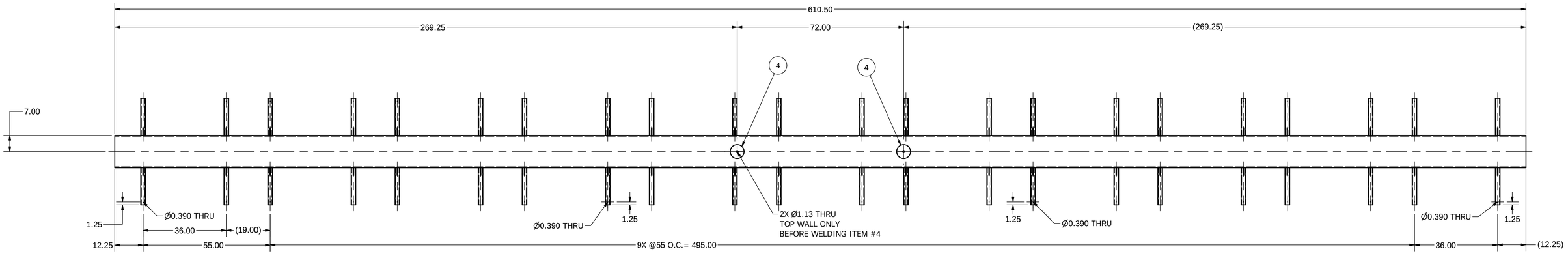


ITEM 3 DETAIL

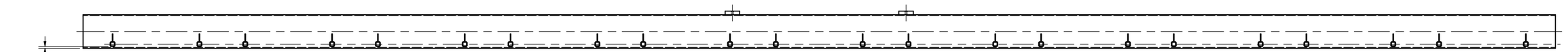


ITEM 4 DETAIL

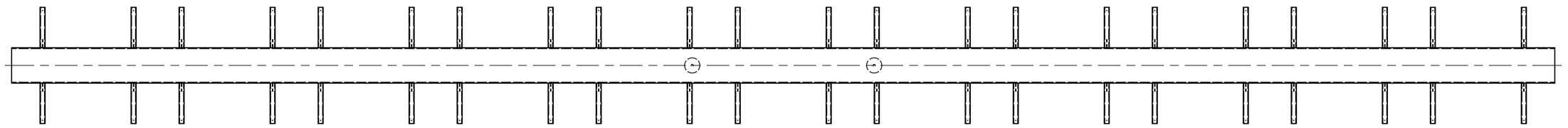
NOTE:
1. ALL STEEL SHALL BE A 36 WITH CERTIFICATION.
2. ALL WELDS AS PER AWS D.1.1.



TOP VIEW



SIDE VIEW



BOTTOM VIEW

SYM	CHANGE	BY	CHKD	DATE	APVD	DATE

UNLESS OTHERWISE NOTED
ALL DIMENSIONS ARE INCHES
DECIMAL TOLERANCE
.X ± .1
.XX ± .02
.XXX ± .005
ANGULAR TOL ± 1/2°
FRACTIONAL TOL ± 1/64
REMOVE ALL BURRS AND SHARP EDGES
SURFACES TO BE IN ACCORDANCE WITH LATEST ANSI B46.1
DIMENSIONS & TOLERANCES IN ACCORDANCE WITH LATEST ASME Y14.5M

CADD NUMBER G16363

DRAWN BY	DATE	GP LEADER	DATE
acorcuera	5/21/2010		
CHECKED J. MORGAN		PROJECT MGR	
RESPONSIBLE ENGINEER J. MORGAN		APVD/RELEASED	

MATERIAL
SEE PARTS LIST

1	G16362	1
ITEM NO	NEXT ASSEMBLY	REQD

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NE DIVISION

DOCUMENT TITLE
NOVA
GLUE MACHINE
ASSEMBLY WELDMENT

PROJECT NO:

PROJECT TITLE:

SCALE	SHEET	DRAWING NUMBER	REV
----	1 OF 1	NOVA-01-01	00

INV2010