5022TA

BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No/ _____ Div. Specific No. 114 A 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 RELAY RACK LIFTING FIXTURE # FOR ROTATING RACK

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 RWOODS Date 3/17/00

Engineering Note Reviewed by FANG Date 4/3/00

Lifting Device Data:

Capacity 1000 #

Fixture Weight 50 #

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

Duty Cycle _____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency EVERY

Rated Load Test by FNAL (if applicable) Date 6/13/12 Load 820 #

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

Satisfactory Load Test Witnessed by: John Voirin

Signature (of Load Test Witness) John Voirin

Pictures attached

Notes or Special Information:

5022.1TA

BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page for MD-ENG-073

Lifting Device Numbers:

FNAL Site No/ _____ Div. Specific No. ~~152~~ 114 A 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 ~~Coil Insert Lifting Fixture for SM3 Disassembly & VM Assembly~~ RACK LIFTING FIXTURE RELAY

Device was (check all applicable)
- [ ] Purchased from a Commercial Lifting Device Manufacturer. Mfg Name _____
- [ ] Designed and Built at Fermilab
- [X] Designed by Fermilab and Built by a Vendor. Assy drawing number Eng. Drawings: MC-~~407384~~ _____
- [ ] Provided by a User or other Laboratory
- [ ] Other: Describe _____

Engineering Note Prepared by ~~Edward Chi~~ Date ~~January 28, 2005~~

Engineering Note Reviewed by _____ Date _____

Lifting Device Data:

Capacity ~~9,500 lbs.~~ 1200#

Fixture Weight ~~400 lbs~~ ~~425~~ 450#

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

Duty Cycle _____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency EVERY

Rated Load Test by FNAL (if applicable) Date 04/21/2010 Load 1250#

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

Satisfactory Load Test Witnessed by: Tim Griffin

Signature (of Load Test Witness) 5108

Notes or Special Information:

See page 8 for rated load test procedures;
page 9 for rated load test setup layout;
page 10 for rated load test site pictures if have any.

BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No.:_____ if applicable Div. Specific No.: _____ if applicable Asset No. 114 if applicable

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

Device Name or Description: ELECTRONICS RACK SPREADER BAR

Device was: (check all applicable)
- ˇ Purchased from a Commercial Lifting Device Manufacturer
  mfg. name: _____
- X Designed and Built at Fermilab
- ˇ Designed by Fermilab and Built by a Vendor
  Assy drawing number: _____
- ˇ Provided by a User or Other Laboratory
- ˇ Other. Describe: _____

Engineering Note Prepared by: R. L. Woods Date: 3/17/00

Engineering Note Reviewed by: Ingrid Fang Date: 4/3/00

Lifting Device Data:

Capacity: 1000 #

Fixture Weight: 50 #

Service: X normal ˇ heavy ˇ severe (refer to B30.20 for definitions)

Duty Cycle: _____ 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency: _____

Rated Load Test by FNAL (if applicable): Date: 4/5/00 Load: 1300# + 150 #

ˇ Check if Load Test was by Vendor and attach the certificate.

Satisfactory Load Test Witnessed by: INGRID FANG

Signature (of Load Test Witness): Ingrid Fang

Notes or Special Information:

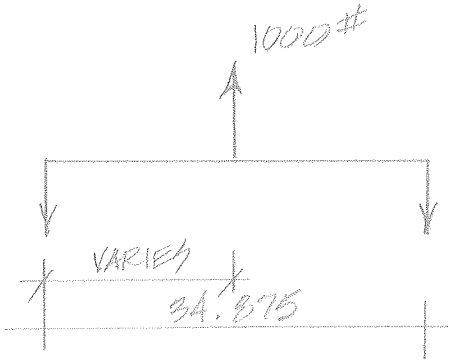
VERY WELL DONE.

Ingrid

CDF ELECTRONICS RACK
SPREADER BAR

R. J. Woods
MAR. 17, 2000

WEIGHT OF ELECTRONICS RACK W/ ELECTRONICS = 1000#



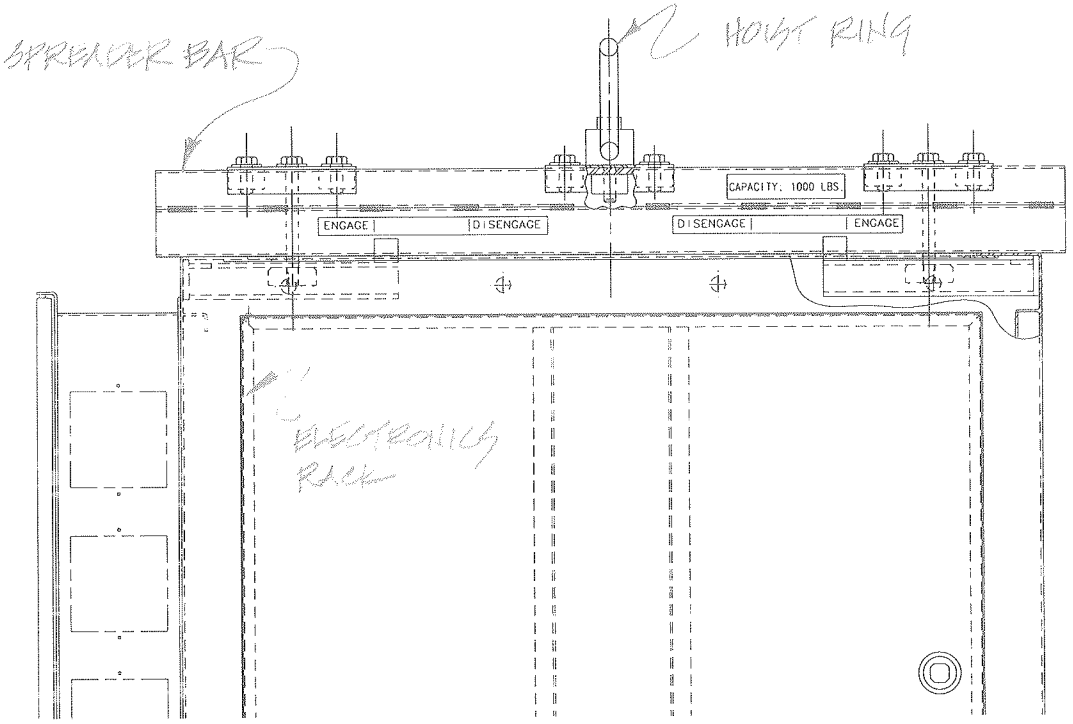


FIGURE 1

WELD BETWEEN UNISTRUT & TUBE:
SHEAR:

FROM "MECHANICAL ENGINEERING DESIGN" BY SHIGLEY:

P. 52 MAX. SHEAR STRESS DUE TO BENDING FOR W SHAPES = $\tau_{max} = \frac{V}{A_{WEB}}$

$A_{WEB} = 2(3/16)(2) + 1.625(0.105)(2)$
$= 1.09\ in^2$

$\tau_{MAX} = 800/1.09 = 733\ \#/in^2$

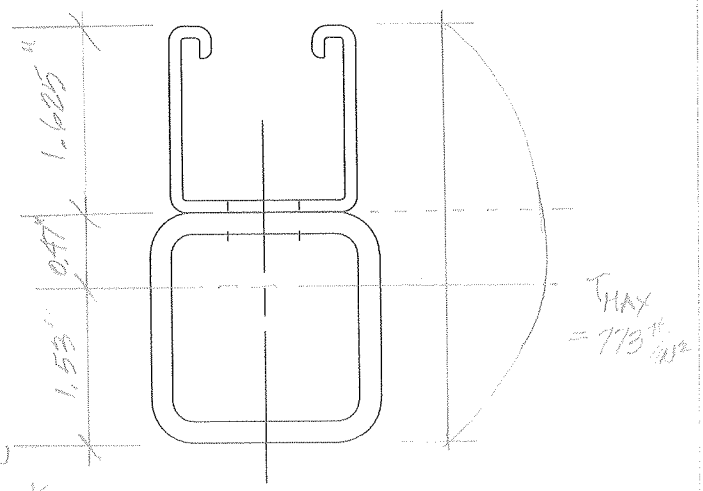
τ_{MAX} IS @ NEUTRAL AXIS

$V = 3/3\,(773)(1.625)$
$= 838\ \#/in$

FOR WELD ON EA. SIDE:
$838/2 = 419\ \#/in$

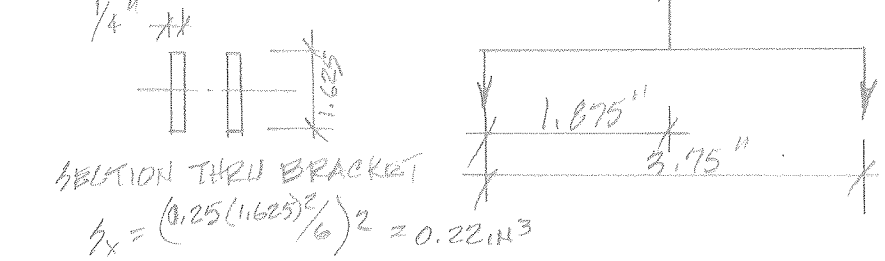
FOR 1/8" WELD:
$F_3 = 0.3(70)(.707)(1/8)$
$= 1.86\ K/in$

FOR 1" @ 4":
$1/3(1.86) = 0.62\ K/in$
$> 419\ \#/in$ OK



BOLTS:
ALL BOLTS = 1/2"-13 GRADE 5
$F_T = 44.0$ KSI (AISC A-K4 P. 5-107)
$P_T = \pi(0.5)^2/4\,(44)$
$= 8.63K = 8,630\# > 1000\#$ OK

UNISTRUT BRACKET:

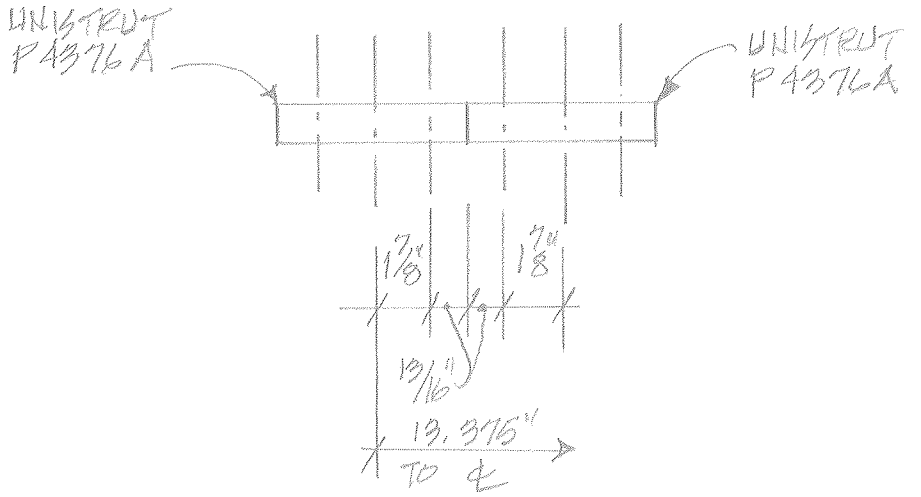


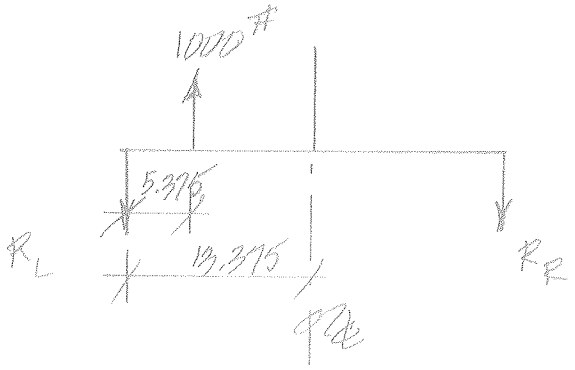
$M = PL/4 = \frac{1000(3.75)}{4}$
$= 938\ \#\text{-in}$

$S_x = \left(0.25(1.625)^2/6\right)2 = 0.22\ in^3$

$f_b = 938/0.22 = 4,263\ PSI < 33,000/3 = 11,000\ PSI$ OK

SHEAR DESIGN:
MAX. SHEAR WHEN LOAD IS CLOSEST TO SUPPORT





$R_L = (26.75 - 5.375)(1000)/26.75$

$= 799\#$ SAY $\underline{800\#}$

ALLOWABLE SHEAR STRESS:
AISC:

$F_V = .40\ F_y = 0.4(36)$ (P. 5-49)
$= 14.4$ KSI (TUBE)

$= 0.4(33)$
$= 13.2$ KSI (UNISTRUT)

HOIST & RIG MANUAL:

$F_V = F_y/3 = 36/3$
$= 12.0$ KSI (TUBE)

$= 33/3$
$= 11.0$ KSI (UNISTRUT)

TOTAL ALLOW. SHEAR FOR COMBINED SECTION =

$12.0(1.27) + 11.0(.556) = 21.4^K > 0.8^K$

OK

FLEXURE DESIGN:
MAX. MOMENT WHEN LOAD ½ @ CENTER

$$M = PL/4 = 1000(26.75)/4 = 6688\ \#\text{-IN}$$

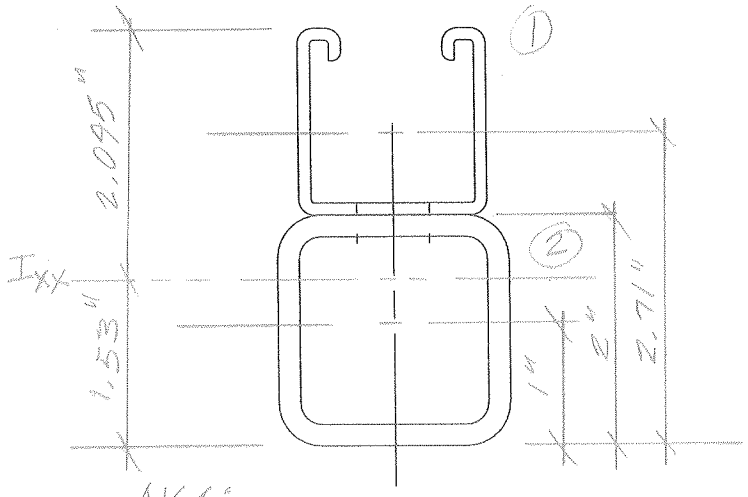
FIND I_x COMBINED SECTION:

PART	A	y	Ay	Ay^2	I_o	$Ay^2 + I_o$
1	.556	2.71	1.51	4.09	.185	4.275
2	1.27	1.0	1.27	1.27	0.668	1.938
	1.826		2.78			6.213
						−4.270
						1.943 = I_{xx}

$\bar{y} = 2.78/1.826 = 1.53''$

$A\bar{y} = 2.79$

$A\bar{y}^2 = 4.27$



$f_b = Mc/I = 6688(2.095)/1.943 = 7211$ psi

AISC:

$L_c = 1200(b/F_y) = 1200(0.75/33) = 27.0'' < 34.875$ (P. 5-49)

$\therefore F_b = 0.60F_y = 0.60(33) = 19.8$ KSI

HOIST, RIG, MAINUAL:

$F_b = F_y/3 = 33/3 = 11.0$ KSI USE ⟵
> 7.2 KSI ok

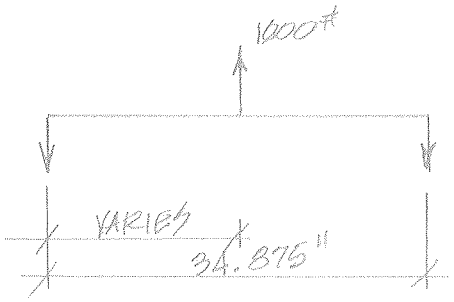
CHECK FOR COMBINED VERTICAL + 10% HORIZ. LOAD

$M_V = 6688\ \#\text{-IN}$ $M_H = PL/4 = 100(26.75)/4 = 669\ \#\text{-IN}/4$

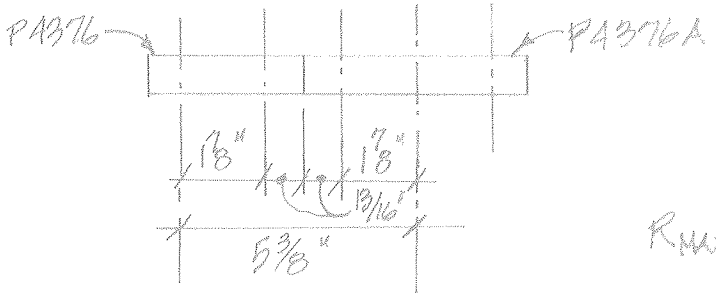
$f_{bV} = 7211$ psi $f_{bH} = 669(1.0)/(0.668+0.236) = 740$ psi

$7211/11{,}000 + 740/11{,}000 = 0.723 < 1.0$ ok

SPREADER BAR CONNECTION REVISION:
SPREADER BAR CAPACITY = 1,000 #



MAXIMUM OFF CENTER LIFT POSITION:

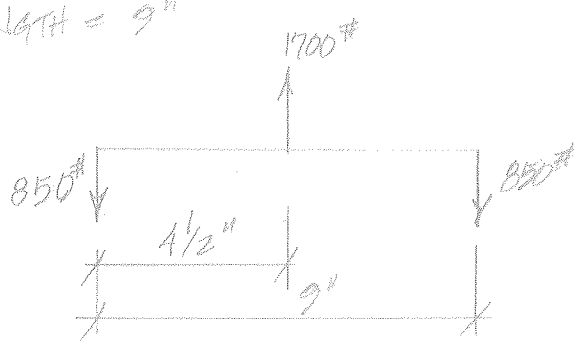


34.875 - 5.375 = 29.5"

$R_{MAX} = 29.5(1000)/34.875$
$= 846\#$

REDESIGN CLAMP FOR 850 #

TUBE LENGTH = 9"



$M = PQ/4 = 1700(9)/4$
$= 3825\#\text{-in}$

FOR TS 3 x 1.5 x 0.1875 $I_y = 0.48 in^4$ $c = 0.75$

$S_y = 0.48/0.75 = 0.64 in^3$

$f_b = 3825/0.64$
$= 5,977$ psi < $46,000/3 = 15,000$ psi ok

USE TS 3 x 1.5 x 0.1875

BOLT TORQUE REQ'D FOR 1700# CLAMPING FORCE:

USING 1/2"-13 BOLTS:

FROM "THREADED FASTENERS" BY ALEXANDER BLAKE
P. 155: $M_t = KDF_t$ WHERE:

M_t = TIGHTENING TORQUE
D = BOLT DIAMETER
F_t = TENSILE LOAD
K = FACTOR FROM TAB 18

$$M_t = 0.20(0.5)(1700)$$
$$= 170 \text{ IN-LBS}$$
$$= 14 \text{ FT. LBS}$$

TIGHTEN TO 25 FT LBS. MIN.

CHECK RACK TOP RAIL:

SPAN = 19.75"

$$M = PL/4 = 850(19.75)/4 = 3984 \#\text{-IN}$$

$$f_b = Mc/I = 3984(1.85)/0.68 = 10{,}839$$

ASSUME F_y = 30 KSI $b/t = 2.5/.105 = 24$

$65/\sqrt{30} = 12$ ∴ NON COMPACT

$L_c = 76\,b_f/\sqrt{F_y}$ or $20{,}000/(d/A_f)F_y$

$= 76(2.5)/\sqrt{30}$

$= 34.7"$ ↑ USE

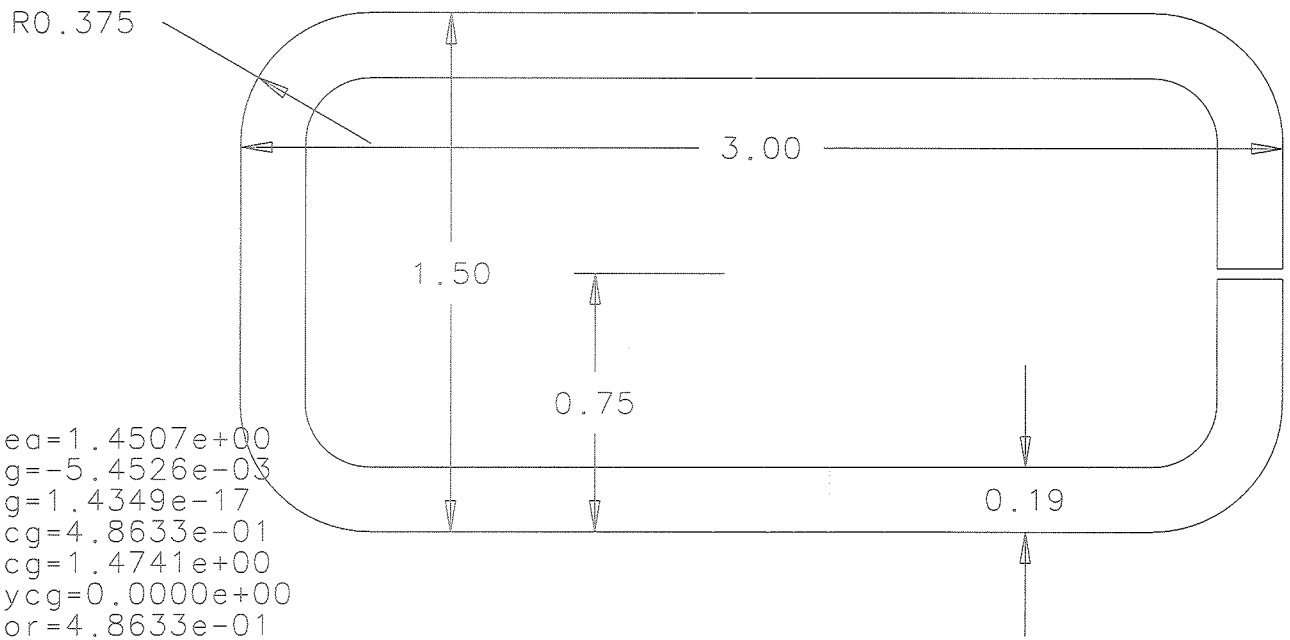
$20{,}000/\left((1.85+1.27)/((0.105)(2.5))\right)30$

$56.1"$

$F_b = 0.60F_y$
$= 0.60(30)$
$= 18.0 \text{ KSI} = 18{,}000 \text{ PSI} > 10{,}839$ ok

ALLOW. SHEAR STRESS = $0.40(30) = 12 \text{ KSI}$

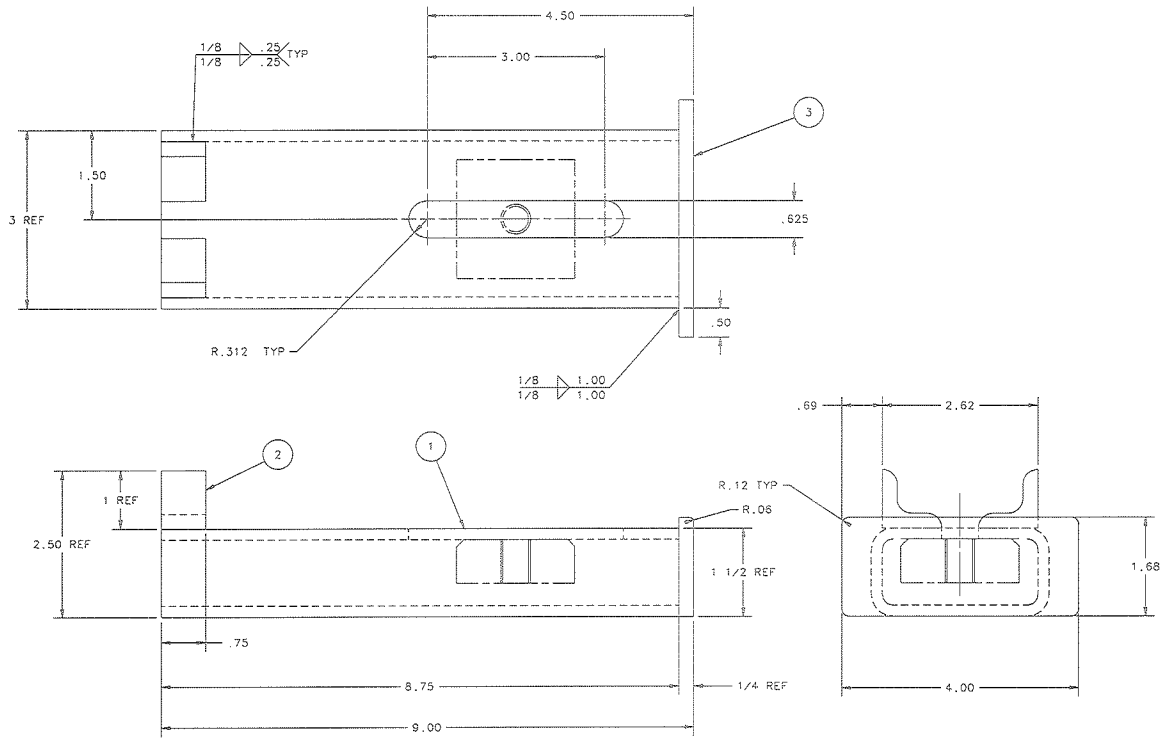
$$f_v = 850/2.5(.105)$$
$$= 3238 \text{ PSI} < 12{,}000 \text{ PSI}$$ ok



Area=1.4507e+00
Xcg=-5.4526e-03
Ycg=1.4349e-17
Ixcg=4.8633e-01
Iycg=1.4741e+00
Ixycg=0.0000e+00
Ixor=4.8633e-01
Iyor=1.4742e+00
Ixyor=2.1499e-16
Kxcg=5.7899e-01
Kycg=1.0080e+00
Kxor=5.7899e-01
Kyor=1.0080e+00
Ixprin=4.8633e-01
Iyprin=1.4741e+00
Angle=0.0000e+00
Ipolar=1.9604e+00

Plotted by jerauch on 21-Mar-00 , File: 382035-01-copy_of.pif

REV.	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE



ITEM NO.	PART NO.	DESCRIPTION OR SIZE	QTY. REQ.
3	COML	1/4 x 1.68 x 4.00 LG. FLAT HOT ROLLED, ASTM A36	1
2	COML	1 x 1 x 1/4 x .75 LG. ANGLE STEEL, ASTM A36	2
1	COML	3 x 1 1/2 x 3/16 WALL x 8.75 LG. STRUCTUAL TUBING, ATSM A500	1

PARTS LIST

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	R WOODS	3/22/00
.XX	.XXX	ANGLES	DRAWN	R HARING	3/22/00
± .03	±.015	± –	CHECKED		
			APPROVED		

1. BREAK ALL SHARP EDGES .015 MAX.
2. DO NOT SCALE DRWG.
3. DIMENSIONING IN ACCORD WITH ANSI Y14.5M-1982 STD'S.
4. ALL DIMENSIONS ARE IN INCHES.

250 MAX. ALL MACHINED SURFACES

USED ON: MD-382035

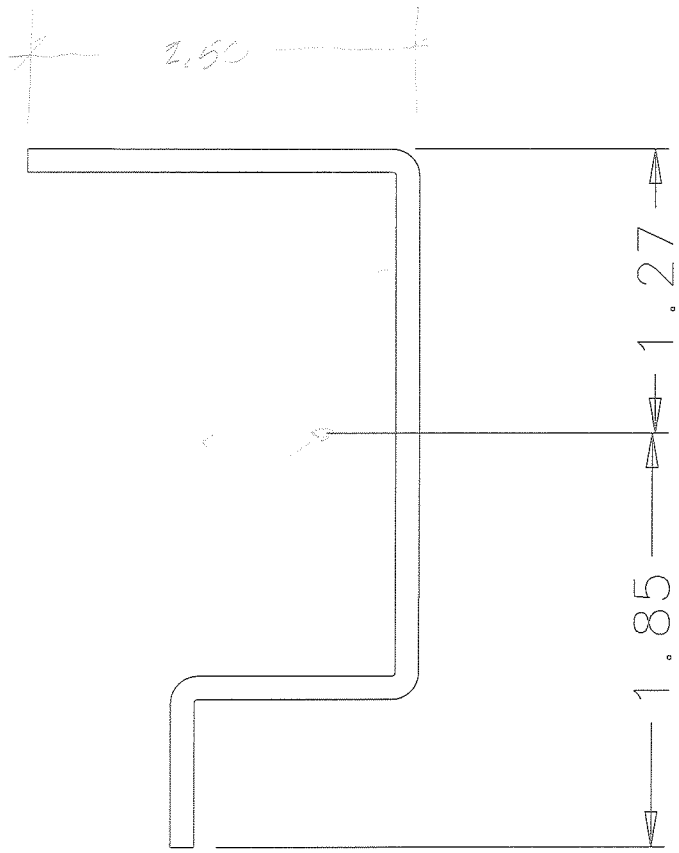
MATERIAL: SEE ABOVE

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/CDF UPGRADE
ELECTRONICS RACK SUPPORT BRACKETS
SPREADER BAR GUIDE/CLAMP

SCALE	DRAWING NUMBER	SHEET NO.	REV.
FULL	2563.100-MD-382634	1 OF 1	

Area=5.9672e-01
Xcg=2.1512e-16
Ycg=1.1163e-15
Ixcg=6.7668e-01
Iycg=1.5116e-01
Ixycg=-1.7146e-02
Ixor=6.7668e-01
Iyor=1.5116e-01
Ixyor=-1.7146e-02
Kxcg=1.0649e+00
Kycg=5.0331e-01
Kxor=1.0649e+00
Kyor=5.0331e-01
Ixprin=1.5061e-01
Iyprin=6.7724e-01
Angle=1.8667e+00
Ipolar=8.2784e-01



PROPERTIES for XHATCH ONLY

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Xcg=-1.0375e+00
Ycg=5.6785e-17
Ixcg=1.9235e-01
Iycg=8.1184e-02
Ixycg=0.0000e+00
Ixor=1.9235e-01
Iyor=7.3884e-01
Ixyor=-6.2883e-17
Kxcg=5.6109e-01
Kycg=3.6452e-01
Kxor=5.6109e-01
Kyor=1.0997e+00
Ixprin=8.1184e-02
Iyprin=1.9235e-01
Angle=0.0000e+00
Ipolar=2.7354e-01