

LIFTING DEVICE

DEVICE NAME: KTEV TRD LIFTING FIXTURE

ENGINEERING NOTE NUMBER: 74

DRAWING NUMBER: 3832.113-MD-268238

APPLICABLE STANDARD: ASME B30.20 - 1993

AISC 9th EDITION ASD

RATED LOAD: 3200 #

TEST LOAD: 4000 # ('D' BLOCK)

TEST LOAD PERCENT: 125%

LAST LOAD TEST DATE: 28 APRIL '95

COLOR: YELLOW

STRESS CALCULATIONS:

Done by: DAVE PUSHKA

Date: 15 MARCH 1995

Reviewed by: Z. TANG

Date: _____

REMARKS:

IDENTIFICATION:

Engineering Note Number & Rated Load Must be Clearly Marked On a Conspicuous Surface.



3
2
1

LOAD TEST OF KTEV TRD LIFTING FIXTURE

ID # 74

28 APRIL '95

**MECHANICAL SUPPORT DEPARTMENT
ENGINEERING NOTE**

NUMBER: MSD EN-1.1.3.A - KTeV
(WBS number items 1.1.3, 1.5.1, 1.6.1 and 1.6.4)

DATE: 22 August, 1994, Revised 15 March 1995

TITLE: Design Note for the Lifting Fixture used to install the KTeV
Drift Chambers, TRD's, and Trigger Hodoscopes

AUTHOR(s): Dave Pushka

REVIEWER: Zhijing Tang, August, 1994

KEY WORDS: Drift Chambers, TRD's, and Trigger Hodoscopes

ABSTRACT/SUMMARY:

This design note contains the calculations required to size member used for the lifting fixture. Allowable stresses are based on those calculated from AISC 9th edition and from ASME B30.20 'Under-the-Hook Lifting Fixtures'. The most conservative of the two values calculated from each Code was used.

The frames for SA4 and CIA are supported by a structural steel bent which also supports the TRDs, DC-4, and the Trigger Hodoscopes. This lifting fixture is designed for installing the detectors into the bent.

The subject of this design note is limited to the lifting fixture. Details of the detectors are the subject of other design notes.

This Design note applies to lifting fixtures 73 and 74 which have identical load ratings but slightly different hook openings for lifting different detectors. Fixture 73 is for Drift Chamber 4 and the Trigger Hodoscopes while Fixture 74 is for the TRDs.

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MECHANICAL SUPPORT DEPARTMENT
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SUBJECT

TRD/DC-4/TRIGGER HODOSCOPE LIFTING FIXTURE

NAME

DAVE PUSKA

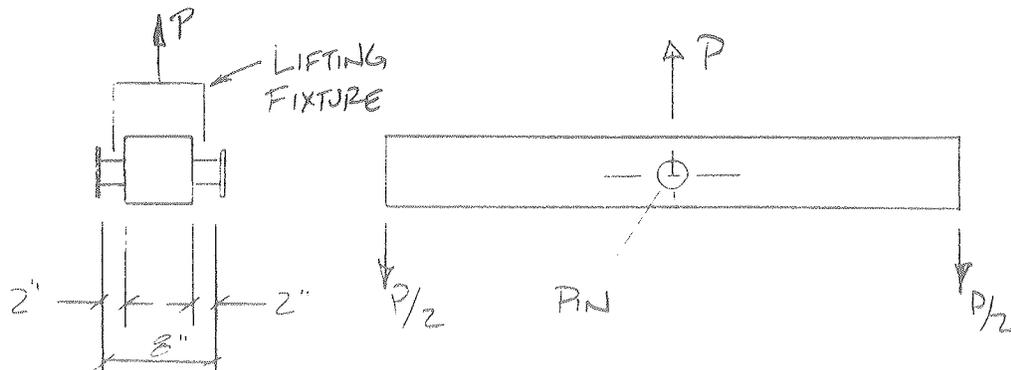
DATE

8/11/94

REVISION DATE

DESIGN A COMMON 'BELOW-THE-HOOK' LIFTING FIXTURE FOR INSTALLING/REMOVING THE KTeV TRD'S, DC-4, & TRIGGER HODOSCOPES.

SINCE THE TRD'S ARE THE HEAVIEST OF THE THREE TYPE OF DETECTORS - BASE DESIGN ON THEM.



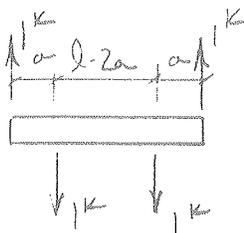
TYPICAL SUPPORT/
WHEEL ASSY
F.B.D DURING
INSTALLATION

DESIGN USING CARBON STEEL w/ $\sigma_y = 30 \text{ ksi}$ $\therefore F_v = 0.40\sigma_y = 12 \text{ ksi}$

$$P_{\text{MAX}} = 2 \text{ KIPS}$$

$$F_t = 0.60\sigma_y = 18 \text{ ksi}$$

FOR PIN, $F_v = 12 \text{ ksi}$, $F_t = 18 \text{ ksi}$



$$M = P a = (1 \text{ KIP})(2 \text{ INCHES}) = 2 \text{ KIP-IN.}$$

FOR THE SUPPORT/WHEEL ASSY

BUT USE $F_v = F_t = \frac{1}{3}\sigma_y$

FOR LIFTING

FIXTURE PER ASME

B20.30

$$\text{TRY } 1" \text{ } \phi \text{ BAR, } I = \frac{\pi}{64} y = \frac{1}{2} \quad \sigma = \frac{M y}{I} = \frac{(2 \text{ KIP-IN})(\frac{1}{2} \text{ IN})}{\frac{\pi}{64}} = 20.3 \text{ ksi} \therefore \text{NG}$$

$$\text{TRY } \frac{3}{8}" \text{ } \phi \text{ BAR, } I = \frac{\pi}{64} d^4 \quad y = \frac{1}{16} \quad \sigma = \frac{(2)(\frac{1}{16})}{\frac{\pi}{64} (1.375^4)} = 7.8 \text{ ksi} < 10 \text{ ksi} \therefore \text{OK}$$

$$\text{CHECK SHEAR } V = 1 \text{ K} \quad \tau = \frac{V}{A} = \frac{1 \text{ K}}{\frac{\pi}{4} (1.375^2)} = 673 \text{ PSI} \ll F_v \therefore \text{OK}$$

\therefore THE MINIMUM PIN DIA. IS $\frac{3}{8}" \phi$ - LARGER IS OK.



SUBJECT

TRD/DC-4/TRIG. HODO LIFTING FIXTURE.

NAME

DAVE PUSKAS

DATE

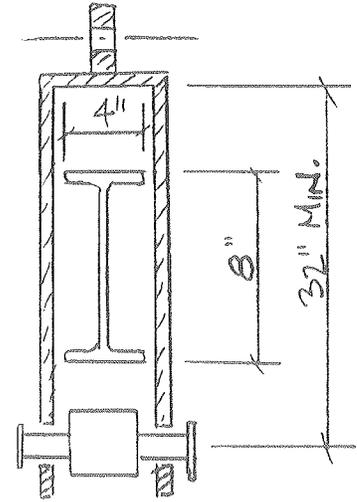
8/10/94

REVISION DATE

LIFTING FIXTURE -

FIXTURE MUST STRADDLE A W8x10

LET'S DESIGN THE FIXTURE FOR A CAPACITY OF 3200#. SINCE 3200# IS GREATER THAN THE 2000# TRD IT WILL BE MORE THAN SUFFICIENT AND THE TEST WE WILL BE A SINGLE 'D' BLOCK:

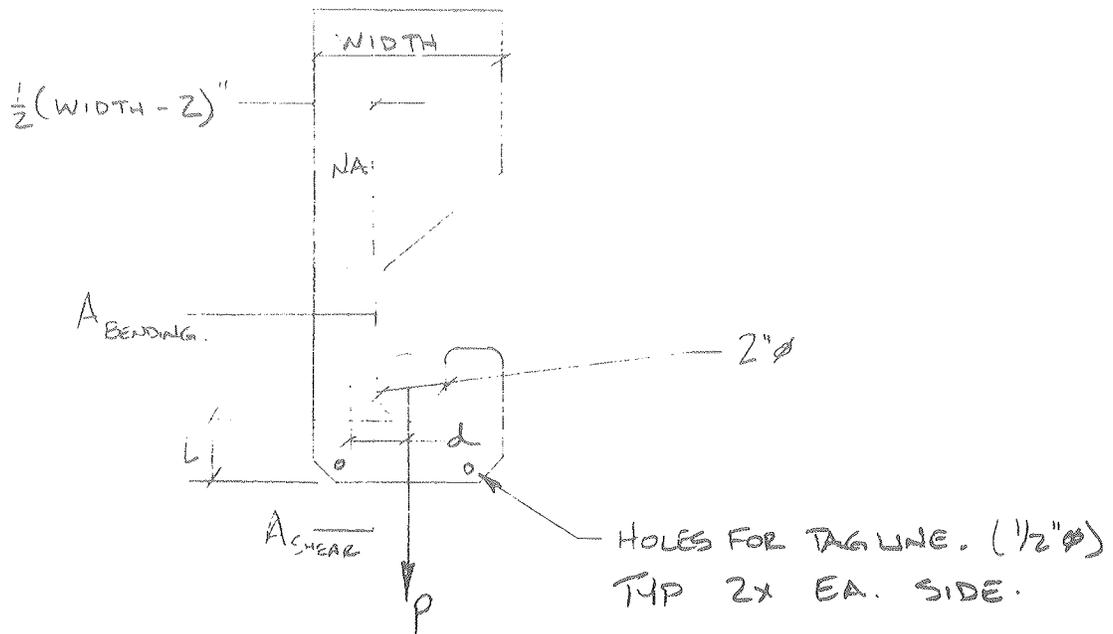


$$(3200\#)(25\%) = 4000\# = 2 \text{ TONS} = \text{WT OF A 'D' BLOCK.}$$

$$F_t = 10 \text{ KSI}, P = 4000\# = 4 \text{ KIPS}, F = \frac{P}{A} \rightarrow A = \frac{P}{F}$$

$$\text{MINIMUM AREA } A_{\text{MIN}} = \frac{P}{F_t} = \frac{4 \text{ KIPS}}{10 \text{ KSI}} = 0.4 \text{ IN}^2 \text{ ON TENSILE MEMBERS.}$$

$$\text{SINCE } F_v = F_t \quad A_{\text{SHEAR}} = A_{\text{TENSION}} = 0.4 \text{ IN}^2 \text{ AS A MINIMUM.}$$





SUBJECT

TRD/DC-4 / TRG. HOOPS. LIFTING FIXTURE

NAME

D. PISHKA

DATE

8/16/94

REVISION DATE

Hook Design -

FOR 6" WIDTH, 2" ϕ HOOK NOTCH, 1/2" THK PLATE

$$d = \frac{6}{2} - \frac{1}{2} \left(\frac{1}{2} (6-2) \right) = 3 - 1 = 2"$$

$$M = Pd = \frac{1}{2} (4 \text{ KIPS}) (2") = 4 \text{ KIP-IN}$$

$$\sigma_B = \frac{MY}{I} = \frac{(4 \text{ KIP})(1 \text{ IN})}{\frac{1}{12} (1/2)(2^3)} = \frac{(12)(4)}{(1/2)(8)} = \frac{48}{4} = 12 \text{ KSI} > 10 \text{ KSI} \therefore \text{NG}$$

TRY 8" WIDTH, 2" ϕ HOOK NOTCH, 1/2" THK PL

$$M = Pd = \frac{1}{2} (4 \text{ KIPS}) \left(\frac{8}{2} - \frac{1}{2} \left(\frac{1}{2} (8-2) \right) \right) = (2 \text{ KIPS}) (4 - 1/2) = (2)(2.5) = 5 \text{ KIP-IN}$$

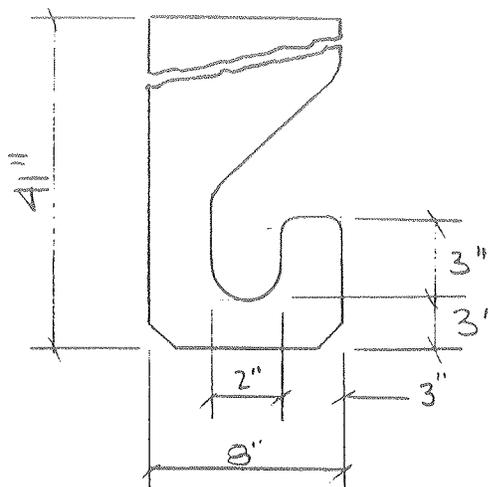
$$\sigma_B = \frac{MY}{I} = \frac{(5 \text{ KIP})(1.5)}{\frac{1}{12} (1/2)(3^3)} = \frac{12(7.5 \text{ KIP})}{(1/2) 27 \text{ IN}^4} = 6.6 \text{ KSI}$$

$$\sigma_{\text{TENSION}} = \frac{\frac{1}{2} P}{A} = \frac{\frac{1}{2} 4 \text{ KIPS}}{(3) 1/2} = 1.3 \text{ KSI}$$

$$\sigma_{\text{TOTAL}} = \sigma_B + \sigma_T = 6.6 + 1.3 = 8.0 \text{ KSI} < 10 \text{ KSI} \therefore \text{OK}$$

$$\tau = \frac{P}{A_s} = \frac{\frac{1}{2} 4 \text{ KIPS}}{(L)(t)} \quad t = 1/2" \therefore L_{\text{MIN}} = \frac{\frac{1}{2} 4 \text{ KIPS}}{(1/2")(10 \text{ KSI})} = .4"$$

$$\text{USE A 2" DIMENSION FOR L} \therefore \tau = \frac{\frac{1}{2} 4 \text{ KIPS}}{(2")(1/2")} = 2 \text{ KSI} < 10 \text{ KSI} \therefore \text{OK}$$





SUBJECT

TRD/DC-4/TEG. HODO LIFTING FIXTURE

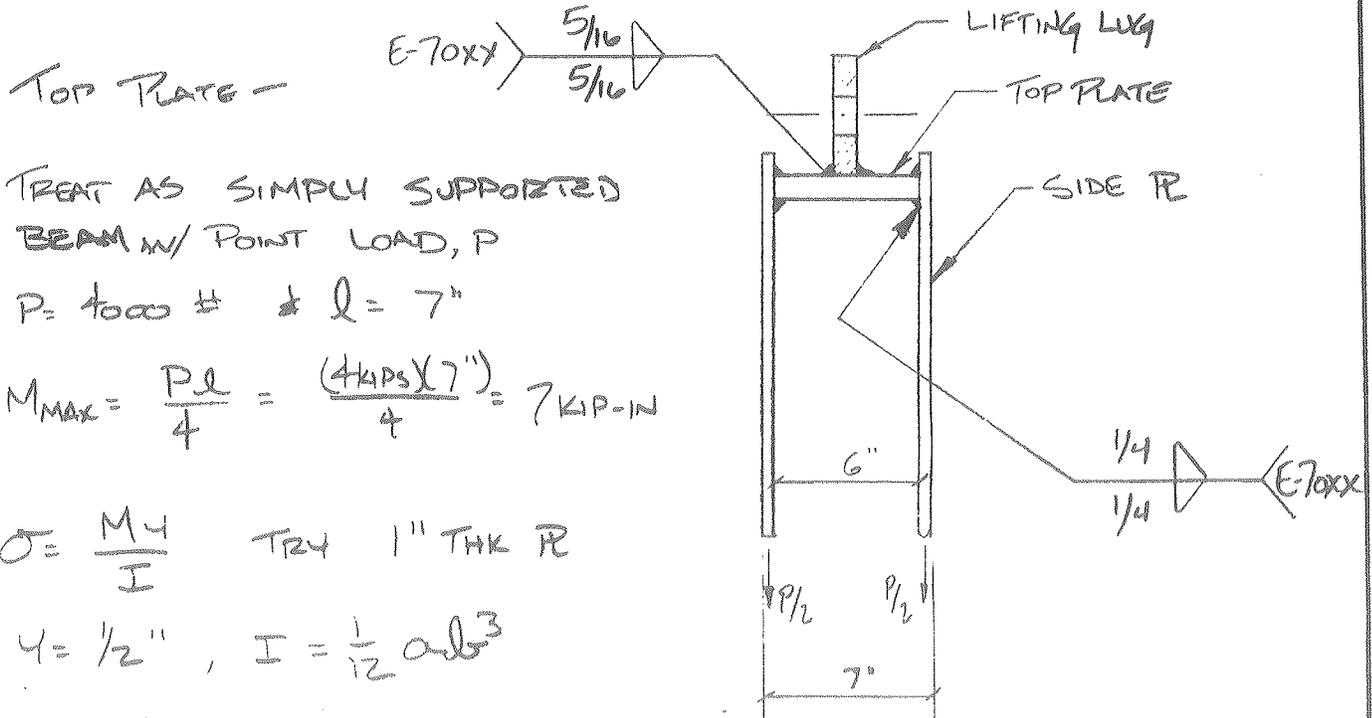
NAME

D. PISHKA

DATE

8/16/94

REVISION DATE



SIZE WELDS FROM SIDE TO TOP PLATES -

$$P_w = \frac{P}{2} = 2 \text{ KIPS} \quad L = (2 \text{ SIDES})(8" \text{ PER SIDE}) = 16"$$

$P_{allow} = 0.928 \text{ DL}$ (SEE AISC VOL II pg 2-30) FOR E-70XX

$$D = \frac{P_w}{0.928 L} = \frac{2 \text{ KIPS}}{(0.928 \frac{\text{KIP}}{\text{IN}} / \frac{1}{16}" \text{ FILLET})(16 \text{ IN})} = 0.13$$

\therefore LESS THAN $1/16$ OF A FILLET WELD IS REQ'D - USE $1/4"$ FILLETS.



SUBJECT

TRD/DC-4/TRIG HODO LIFTING FIXTURE

NAME

D. PUSHTKA

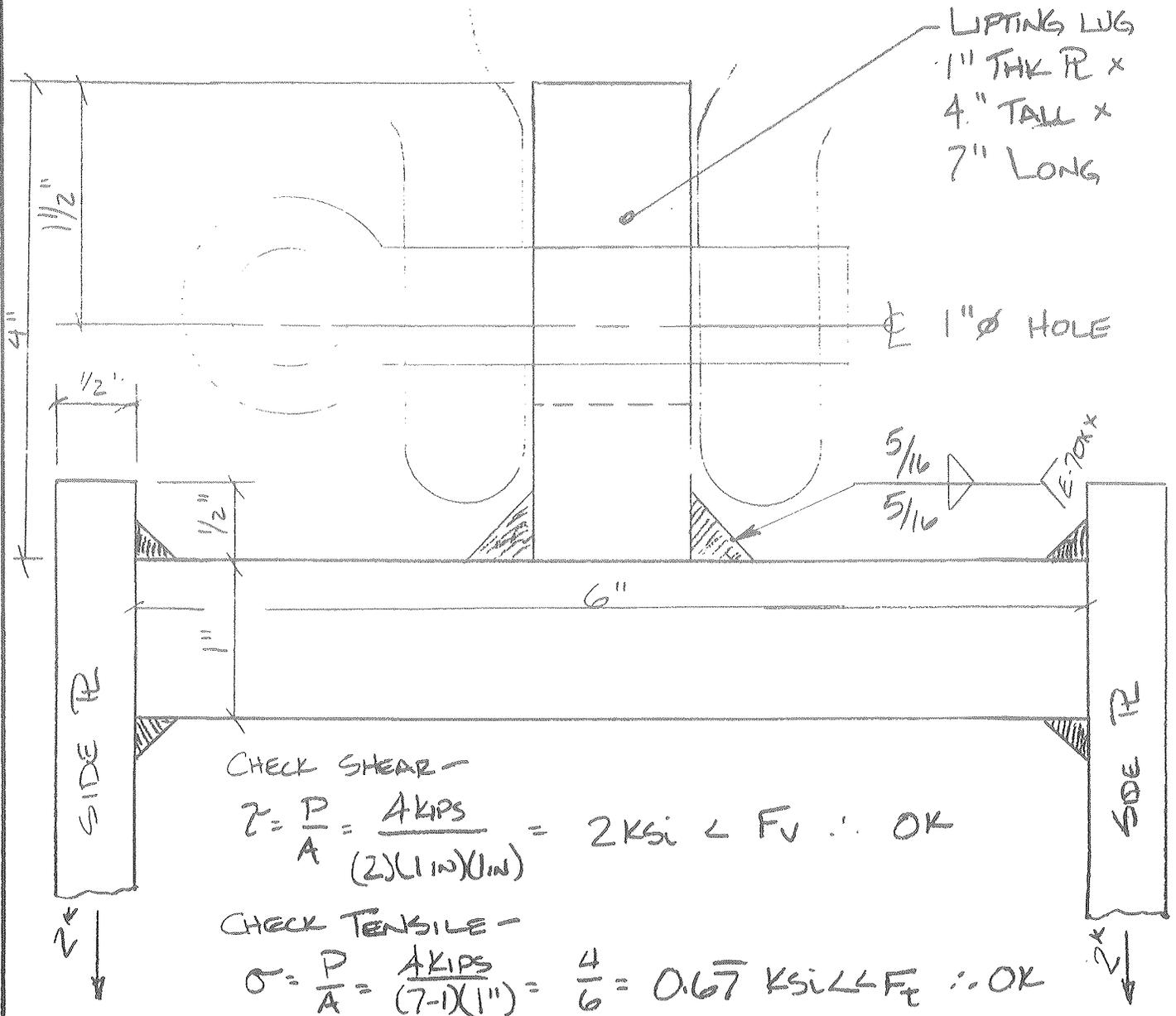
DATE

8/16/94

REVISION DATE

LIFTING LUG -

SINCE THE DESIGN LOAD IS 4000#, THE MIN. SIZE ANCHOR SHACKLE IS $5/8"$ (6500# CAP.). PIN DIA = $3/4"$ & WIDTH = $1/16"$. SINCE IT IS DESIRABLE TO KEEP LOAD SQUARE ON SHACKLE - USE A 1" WIDE LUG.





SUBJECT

TRD/DC-4/TRG. HOOD LIFTING FIXTURE.

NAME

D. PUSKA

DATE

8/22/94

REVISION DATE

LIFTING LOG WELD SIZING. -

$$P_w = 4 \text{ KIPS}$$

$$L = (2) \text{ SIDES} \times (7" / \text{SIDE}) = 14"$$

$$P = 0.928 \text{ KIPS} / 1/16 \text{ FILLET} / \text{LENGTH} \quad \left. \vphantom{P} \right\} \text{ SEE AISL VOL II} \\ \text{Pg 2-30}$$

$$D = \frac{P_w}{0.928 L} = \frac{4 \text{ KIPS}}{(0.928)(14)} = 0.3 < 1.0$$

∴ A FILLET OF LESS THAN 1/16" IS REQ'D.

USE 5/16" FILLET WELDS (E-70XX)



SUBJECT

TRIGGER HODOSCOPE / TRD LIFTING FIXTURE.

NAME

DAVE PUSKA

DATE

15 MAR '95

REVISION DATE

NEED TO OPEN THE HOOK UP FROM 2" ϕ TO 2 1/2" ϕ
TO ACCOMMODATE THE 2" ϕ PIPE USED ON THE TRD
SUPPORTS (ALL DIM. IDENTICAL BUT R THKS \rightarrow 3/4").

From Pg 3, $M = 5 \text{ KIP-IN}$

$$\sigma_B = \frac{M y}{I} = \frac{(5 \text{ KIP-IN})(1.375)}{\frac{1}{12} (3/4)(2.5^3)} = 7.04 \text{ KSI}$$

$$\sigma_{\text{TENSION}} = \frac{\frac{1}{2} P}{A} = \frac{\frac{1}{2} (4^k)}{(2.75)^{3/4}} = 0.97 \text{ KSI}$$

$$\sigma_{\text{TOTAL}} = \sigma_B + \sigma_T = 7.04 + 0.97 = 8.0 \text{ KSI} < 10.0 \therefore \text{OK}$$

$$\tau = \frac{P}{A_{\text{SHEAR}}} = \frac{\frac{1}{2} (4 \text{ KIPS})}{L t} = \frac{\frac{1}{2} (4^k)}{(2")(3/4")} = 1.3 \text{ KSI} < 10 \text{ KSI} \therefore \text{OK}$$

SUMMARY - THE USE OF $\frac{3}{4}$ " THK PL IS OKAY TO COMPENSATE
FOR THE INCREASED OPENING.



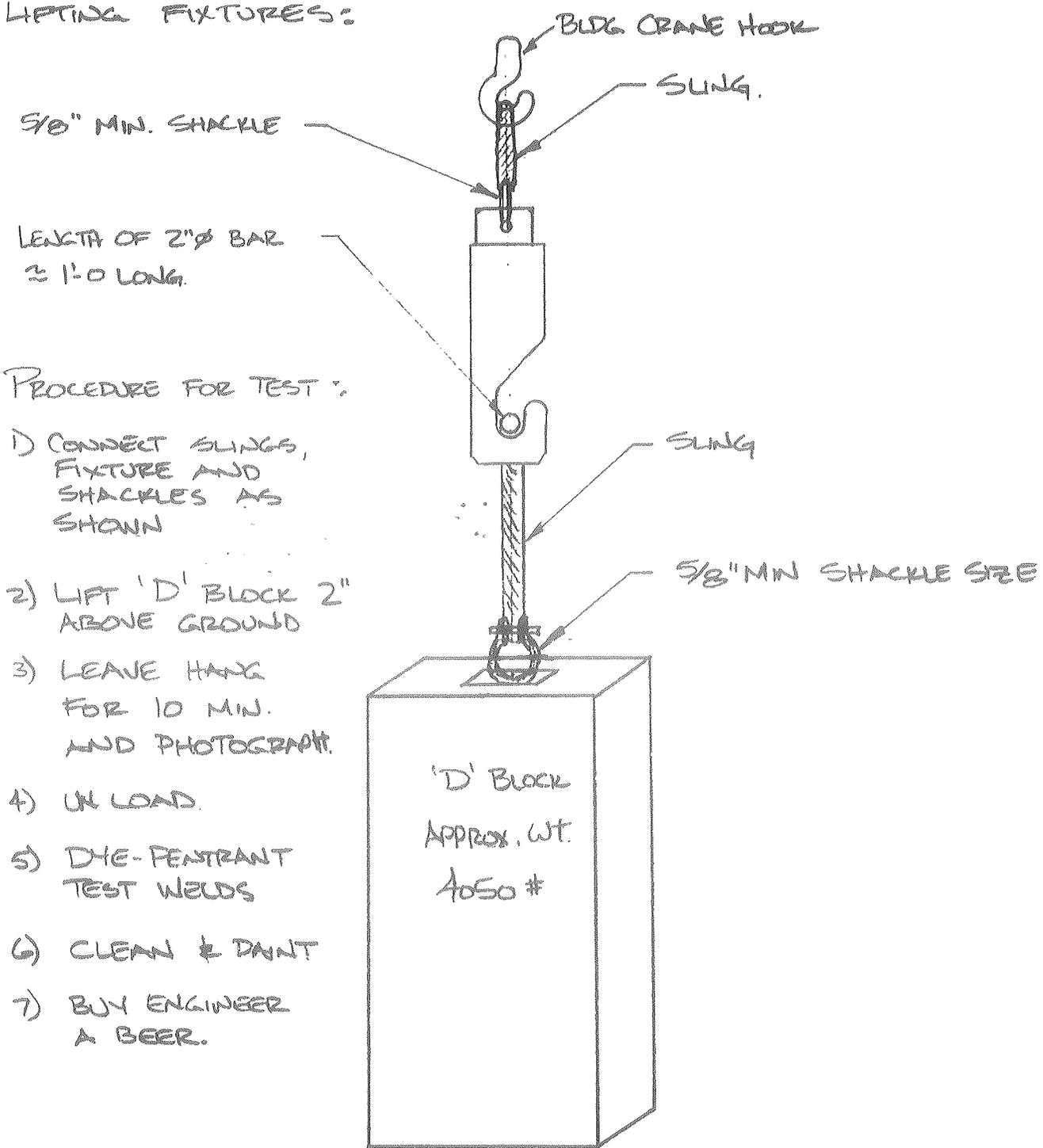
SUBJECT TRIGGER HODOSCOPE LIFTING FIXTURE

NAME DAWE PUSHEA

DATE 15 MARCH '95

REVISION DATE

PROOF TEST SET-UP FOR TRD AND TRIGGER HODOSCOPE LIFTING FIXTURES:



PROCEDURE FOR TEST:

- 1) CONNECT SLINGS, FIXTURE AND SHACKLES AS SHOWN
- 2) LIFT 'D' BLOCK 2" ABOVE GROUND
- 3) LEAVE HANG FOR 10 MIN. AND PHOTOGRAPH.
- 4) UN LOAD.
- 5) DYE-FENRANT TEST WELDS
- 6) CLEAN & PAINT
- 7) BUY ENGINEER A BEER.