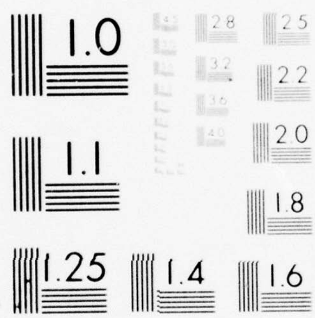
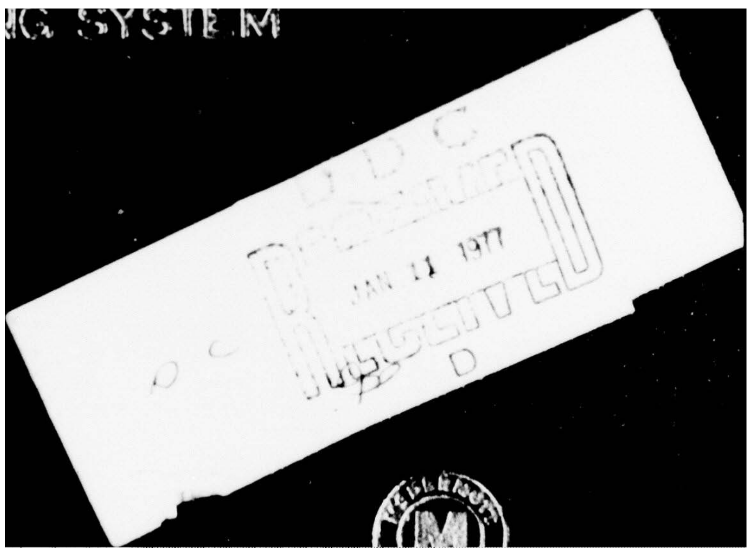
AD-A034 243 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 2. --ETC(U)
1966 DA-44-009-AMC-841(T)
UNCLASSIFIED NL

1 OF 2
AD
A034243



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


NG SYSTEM
D D C
JAN 11 1977
D

White Section
Buff Section

/AVAILABILITY CODES

AVAIL. and/or SPECIAL

A

ENGINEERING

DESIGN CALCULATIONS

MONO-MOORING SYSTEM.

VOLUME 2.

APPENDIX A.
TO
FINAL REPORT, on Phase 1.

Contract No. DA-44-009-AMC-841(T)

U. S. ARMY
ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES
FORT BELVOIR, VIRGINIA

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NEW ORLEANS, LOUISIANA

106 p.

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ENGINEERING

DESIGN CALCULATIONS

MONO-MOORING SYSTEM

VOLUME 2

APPENDIX A
to
FINAL REPORT

Contract No. DA-44-009-AMC-841(T)

U. S. ARMY MATERIEL COMMAND

ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES

FORT BELVOIR, VIRGINIA

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J. RAY McDERMOTT & CO., INC.
Saratoga Building
New Orleans, Louisiana

1966

' RAY McDERMOTT & CO., INC.

ENGINEERING DEPARTMENT - COMPUTATION SHEET   SHEET No. 1

COMPANY: USA / ERDL

SUBJECT: Mono-Mooring System

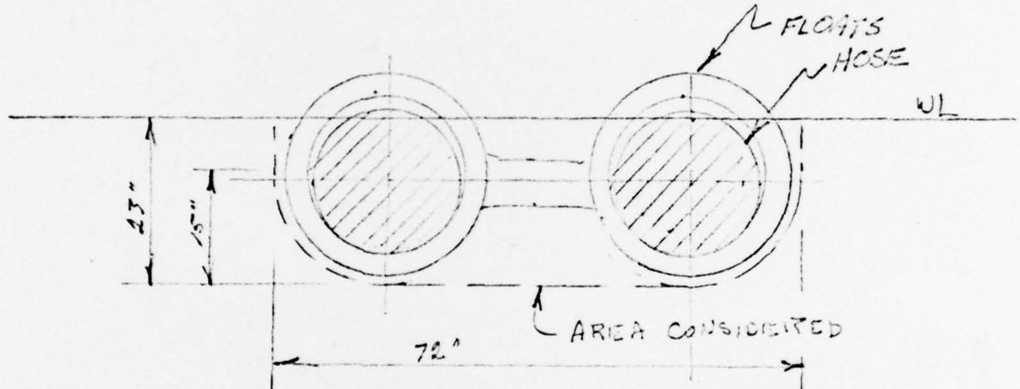
DRAWING No. ____ COMPUTER: 9.R.C. CHKD. BY ____ DATE: 4-22 1965

DRAG FORCE OF HOSE   FILE 6-8.1

$V = 4$ KT

$v = 1.69 \times 4 = 6.75$ ft/sec

v^2



CROSS SECTION OF HOSE

WETTED SURFACE /IN = 8 + 8 + π 15 + 42 =

16 + 47 + 42 = 105"

" " /FT ≅ = 9 □'

LENGTH = 700'

WETTED AREA = 9 × 700 = 6,300 □'

IN FREE TEATHERED CONDITION

$R_e = \frac{vL}{\nu} = \frac{6.75 \times 700}{1.211 \times 10^{-5}} = 3900 \times 10^{5} = 3.9 \times 10^{8}$

$C_f = 1.724 \times 10^{-3}$

$R = \frac{\rho}{2} C_f S v^2 = 1 \times 1.724 \times 10^{-3} \times 6.3 \times 10^{3} \times 45.6 = 495$ #

J. RAY McDERMOTT & CO., INC.

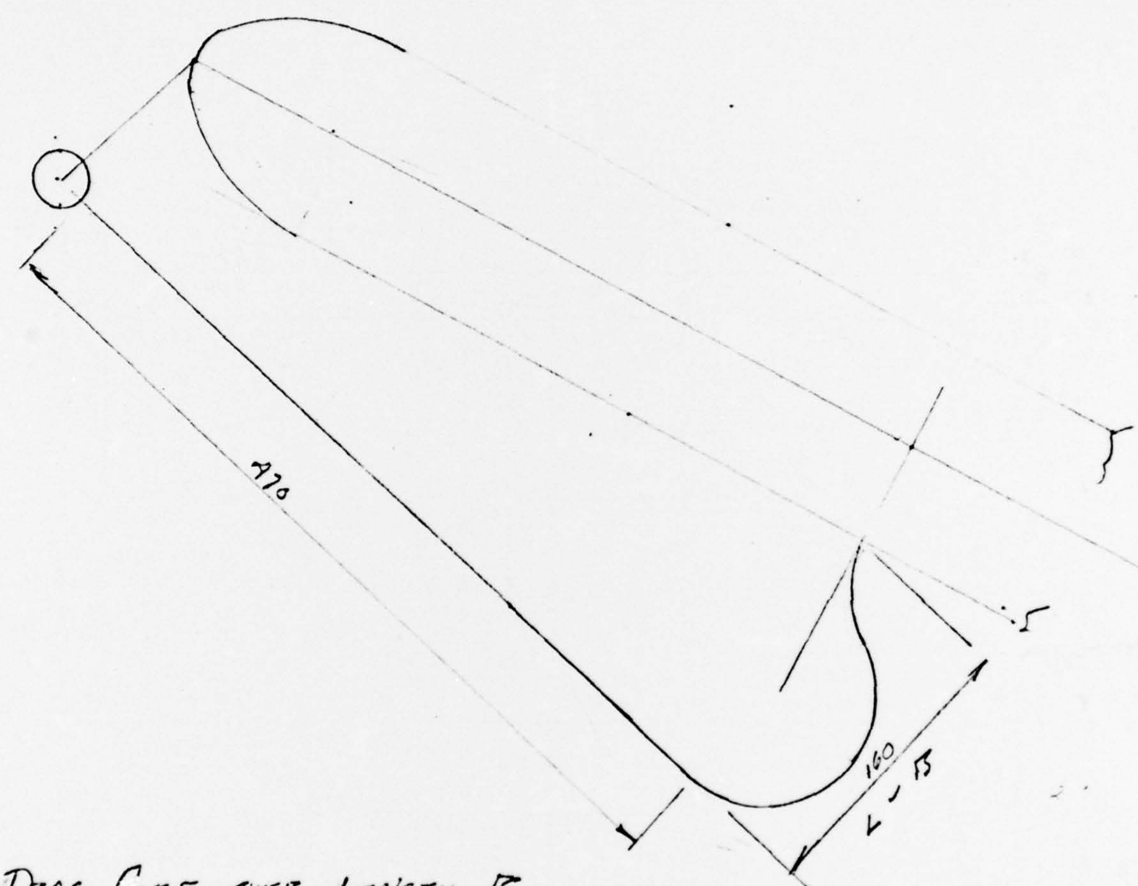
ENGINEERING DEPARTMENT - COMPUTATION SHEET

SHEET NO.

COMPANY

SUBJECT

DRAWING NO. COMPUTER CHKD. BY DATE 19



DRAG COEF OVER LENGTH B

USE $C_D = 1.2$

$$\text{TOTAL DRAG} = \frac{\rho}{2} V^2 \left(C_f S_1 + C_D \frac{A}{2} \right)$$

$$= 1 \times 45.6 \left(1.724 \times 10^{-5} \times 9 \times 470 + 1.2 \times \frac{2 \times 160}{2} \right)$$ ½ LOAD

$$= 45.6 (7.14 + 192$$

$$= 9130^{\#}$$

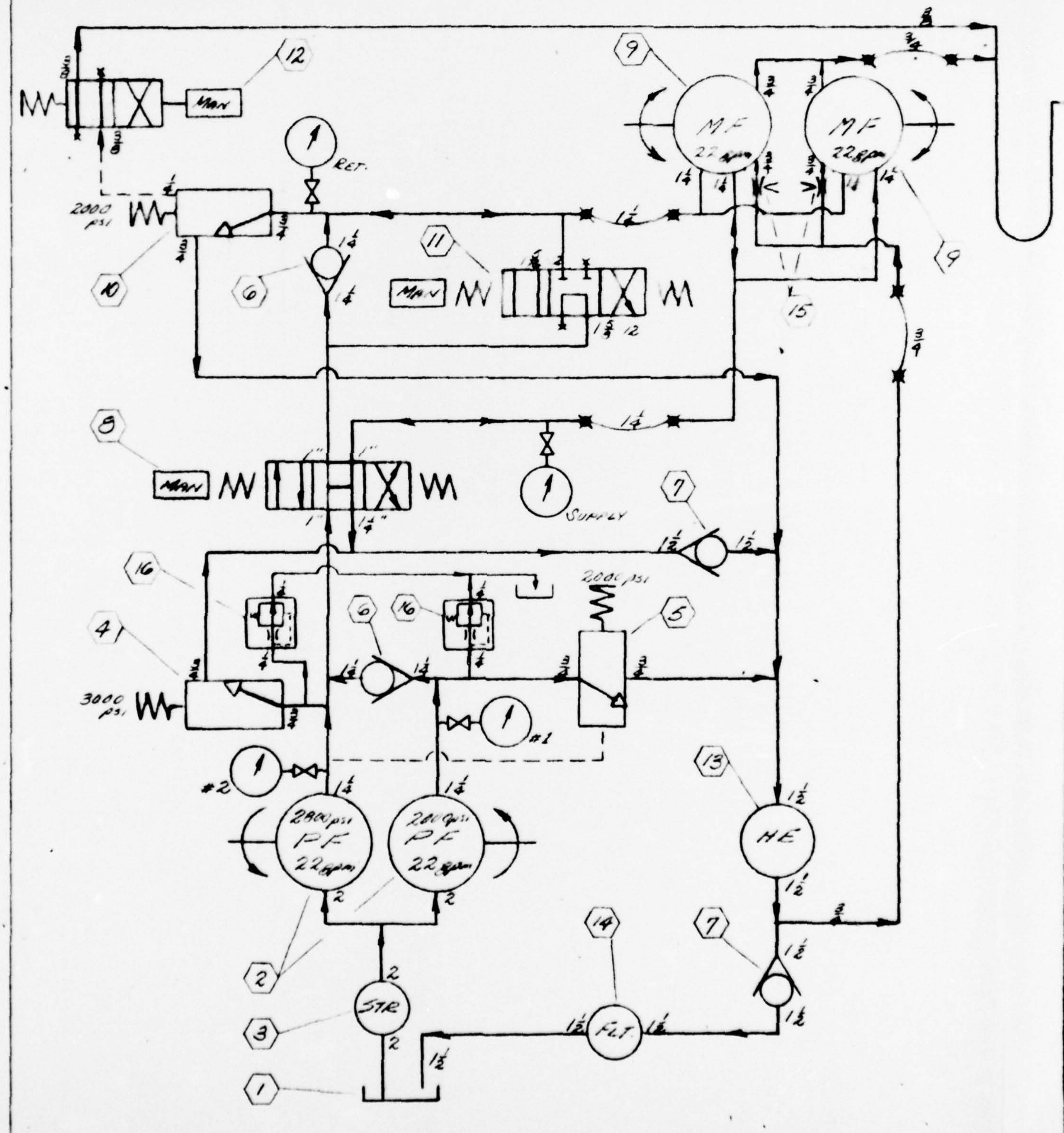
SAY 10 Kips

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5036

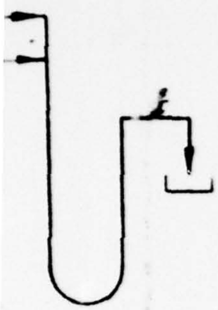
J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL	SHEET NO: 1 of 1
SUBJECT: CHAIN HANDLING BOOM - HYDRAULIC CIRCUIT	

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		11/24/65



INSTALLATION EQUIPMENT



		VICKERS No
(1)	RESERVOIR 88 GAL. NOM. CAP.	
(2)	PUMP - VANE TYPE - FIXED VOLUME	35V25A-1C10-132
(3)	STRAINER	50S-149-M-3-P4
(4)	RELIEF VALVE	CG-06-F-10
(5)	UNLOADING VALVE	RG-06-F4-10
(6)	CHECK	C2-825
(7)	CHECK	C2-830-S19
(8)	DIRECTIONAL VALVE	CM3N01-KBL-20
(9)	MOTOR (ROTO VERSAL 22000 SERIES BY GEARMATIC)	
(10)	RELIEF VALVE	CG-06-F-10
(11)	DIRECTIONAL VALVE	CM2N02-KDL-20
(12)	DIRECTIONAL VALVE	DG17S4-012A-41
(13)	OIL COOLER	OCA-30-10
(14)	FILTER	OFM-202
(15)	NEEDLE VALVE	
(16)	AIR BLEED VALVE	ABT-02-10

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY - ERDL			SHEET NO. 1 of
SUBJECT MONO MOORING SYSTEM - ELECTRICAL SYSTEM CO[illegible]			
[redacted] NUMBER J.O. 56017	COMPUTER WAP	CHECKED BY	DATE ~~ON 8-20-65~~ REV 10-31-65

POWER LOAD ON ENG GENER

TOP SIDE: RECEPTACLE 250 WATTS
DK LIGHT
(C.H. VPH4209) 200 "
450 "

ENG COMPT. VENTILATOR 417 WATTS
(2-FANS 190 W ea.)
(1-SOC 37 W)
LIGHTING
(2 R&S 6250MC 75 W ea) 150 "
567 "

STORES COMPT. - VENTILATOR 37 WATTS
(1-SOC 37 W)
LIGHTING
(2 - R&S 6250MC 50 W ea) 100 "
137 "

1154 WATT

REQD MIN. GEN CAP. 24V D.C. SYSTEM

$I = \frac{P}{E} = \frac{1154}{24} = 48$

RESERVE CAP

48.1 × 1.15 = 5

ENG. EQUIPPED W/ 24V, 60 AMP

1

LOAD

65

65

ENERATOR

TTS

ATTS

"

"

WATTS

"

"

WATTS TOTAL

TEM

48.1 AMPS

15

55.3 AMP CAP MIN.

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL
SHEET NO.: 1 of
SUBJECT: MONO MOORING SYSTEM - ELECTRICAL SYSTEM
NUMBER: J.O. 56017
COMPUTER: WAF
CHECKED BY:
DATE: 6-10-65

POWER LOAD ON ENG. GENERATOR

TOP SIDE:	FLOODLIGHT	250	WATTS
	DECK LIGHTING (6-75W)	450	"
		700	"
ENG. COMPT:	VENT FAN	100	WATTS
	LIGHTING (3-75W)	225	"
		325	
STORAGE COMPT:	VENT FAN	100	WATTS
	LIGHTING (2-75W)	150	
		250	
	TOTAL	1275	WATT

REQD GEN CAP.: 24 VOLT SYSTEM - D.C.

$I = \frac{P}{E} = \frac{1275}{24} = 53.1$ AMPS LOAD

RESERVE CAPACITY 15%

$53.1 \times 1.15 = 61$ AMP GEN REQD

ENG EQUIPPED W/ 60 AMP 24 VOLT [illegible]

see revised sheet
8/20/65

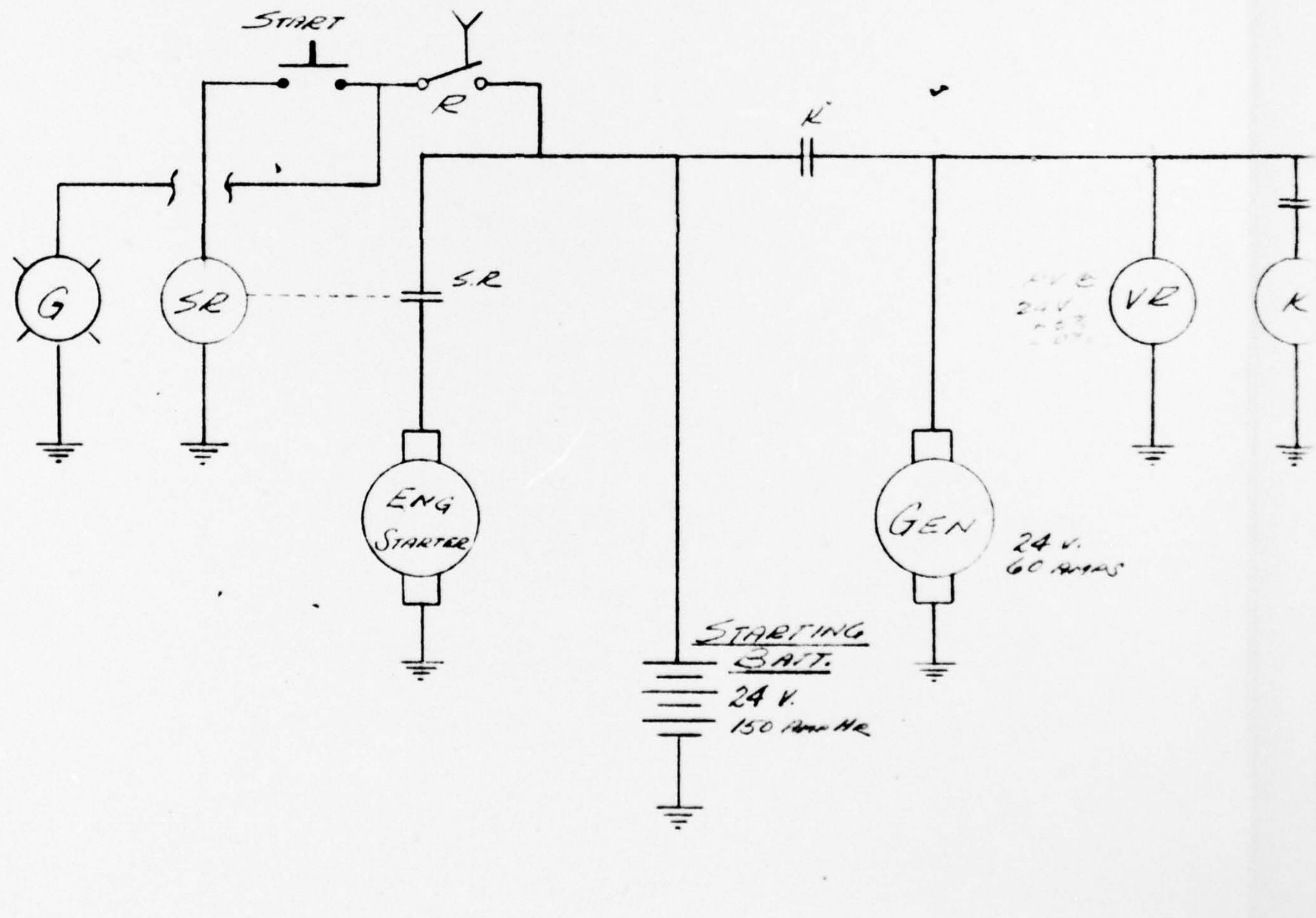
e

s LCN

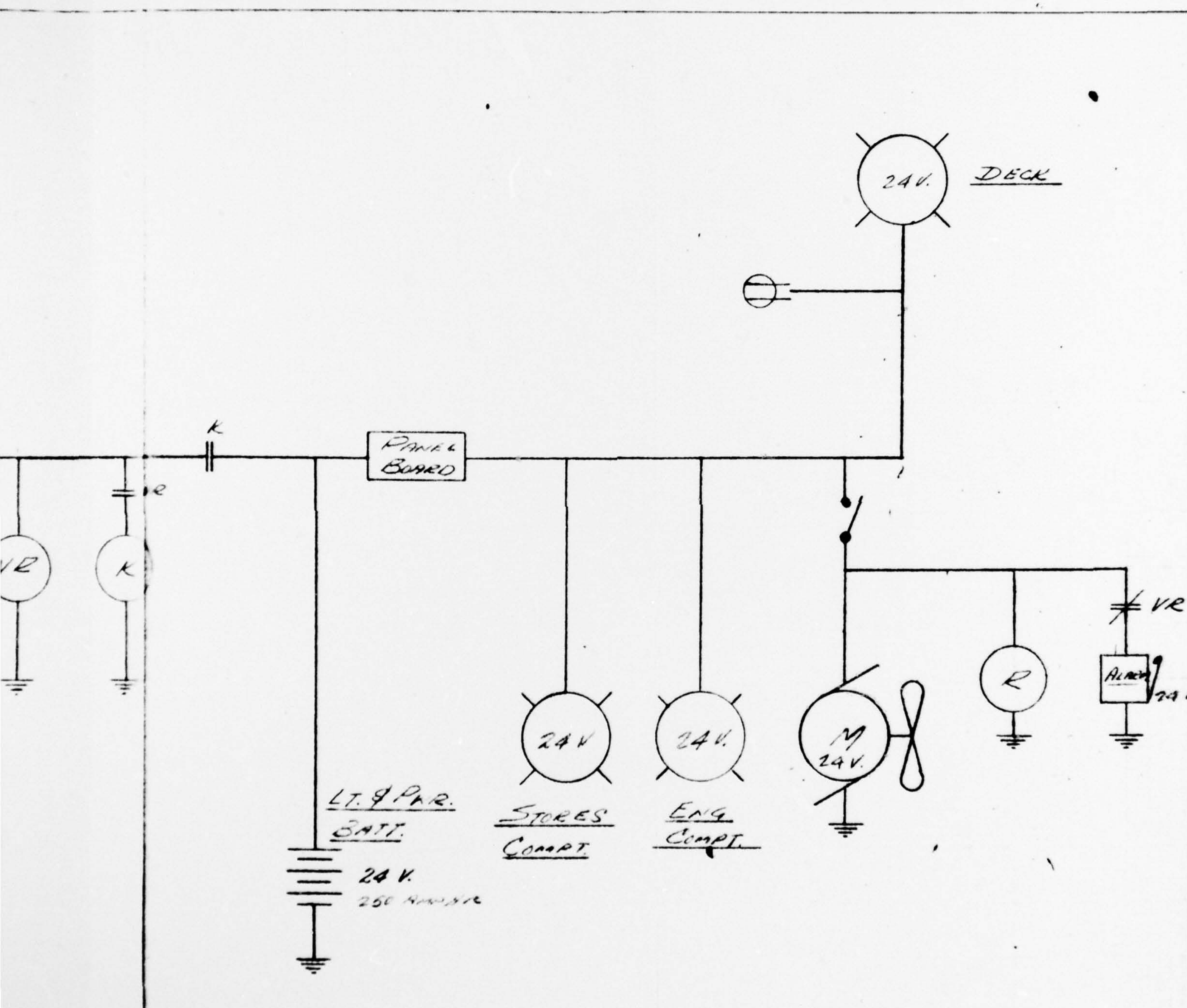
ALTERNATOR

2

COMPANY			SHEET NO
U.S. Army - ERDL			2 of
SUBJECT			
Mono Mooring System - Electrical Syst…			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



c System


24V.
DECK
K
PANEL BOARD
R
VR
K
LT. & PWR. BATT.
24 V.
24 V
STORES COMPT.
24 V.
ENG COMPT.
M 24 V.
R
VR
ALARM
24 V.

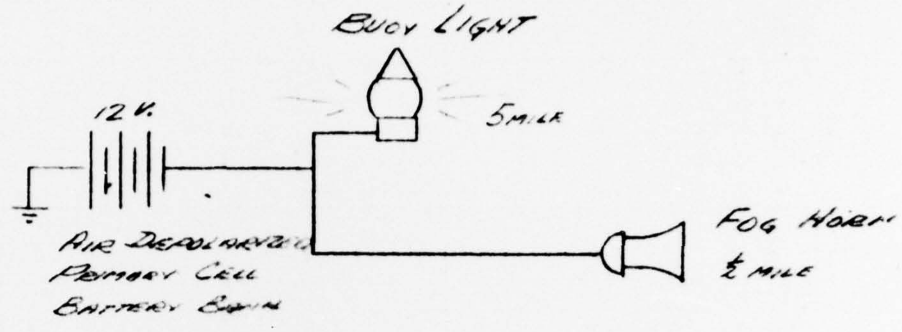
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

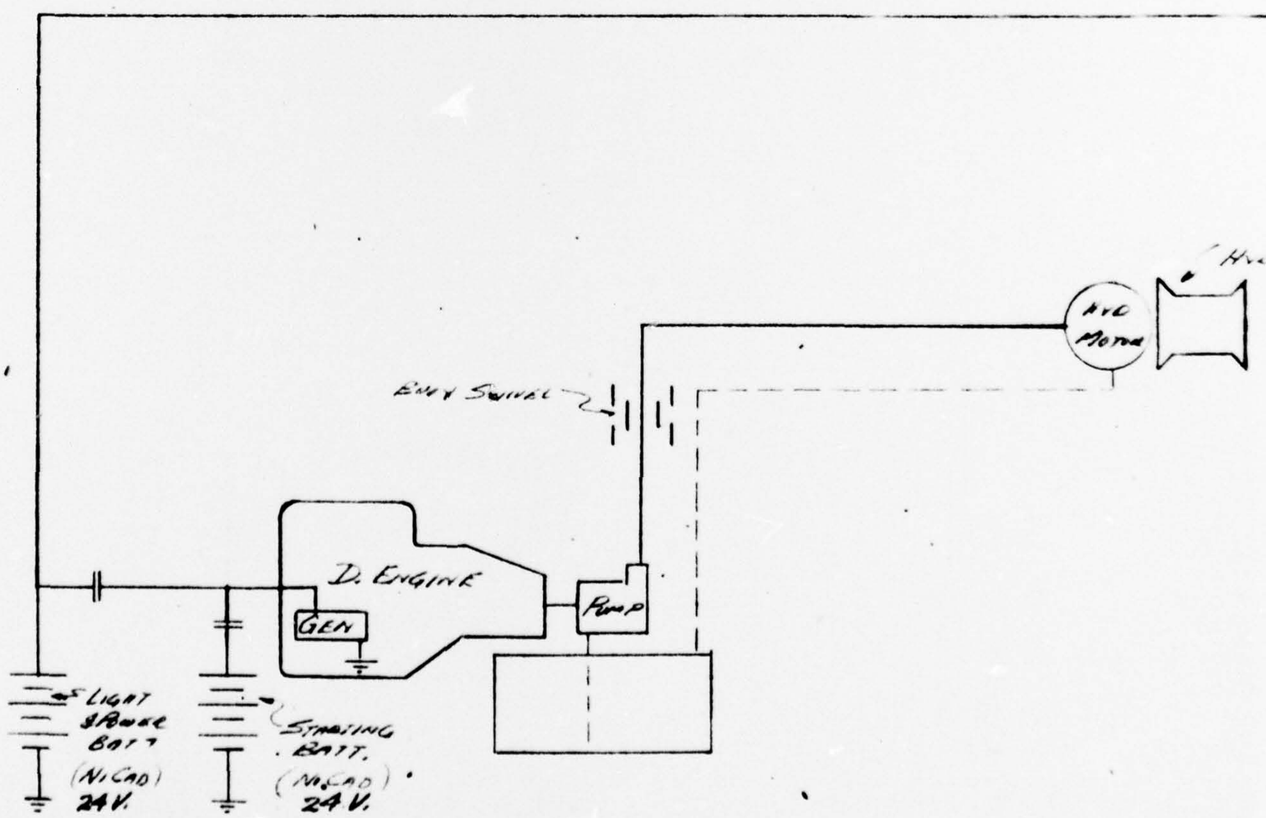
COMPANY: U.S. ARMY - ERDL
SHEET NO.: 10 of 1[illegible]

SUBJECT: Mono Mooring System - Equipment

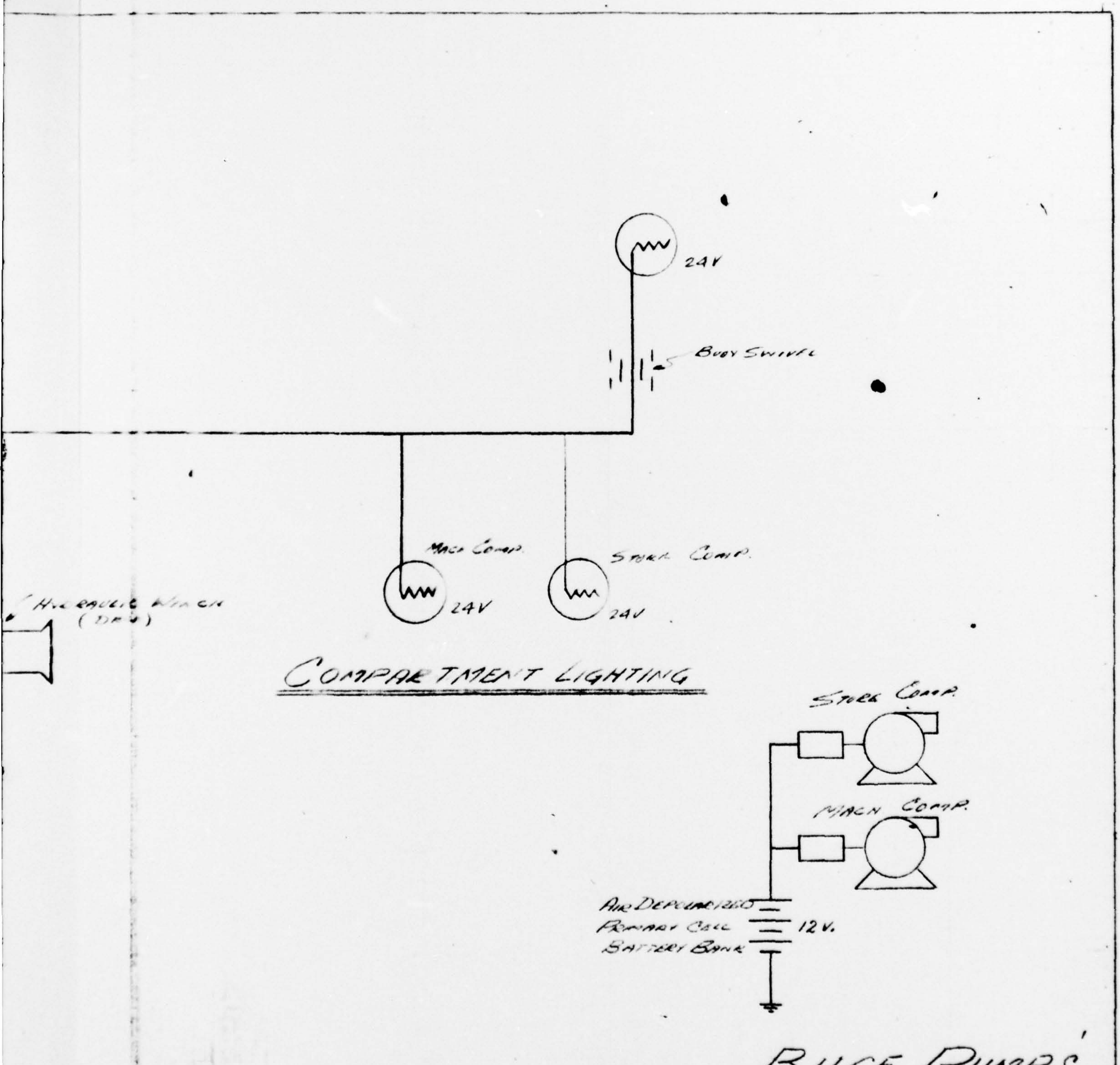
NUMBER: J.O. 56017
COMPUTER: WAP
CHECKED BY:
DATE: 6-17-65



NAVIGATIONAL AIDS



HYD. PUMPING UNIT


24V
BUOY SWIVEL
HYDRAULIC WINCH
MACH COMP.
24V
STORE COMP.
24V
COMPARTMENT LIGHTING
STORE COMP.
MACH COMP.
AIR DEPOLARIZED
PRIMARY CELL
BATTERY BANK
12 V.
BILGE PUMPS

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

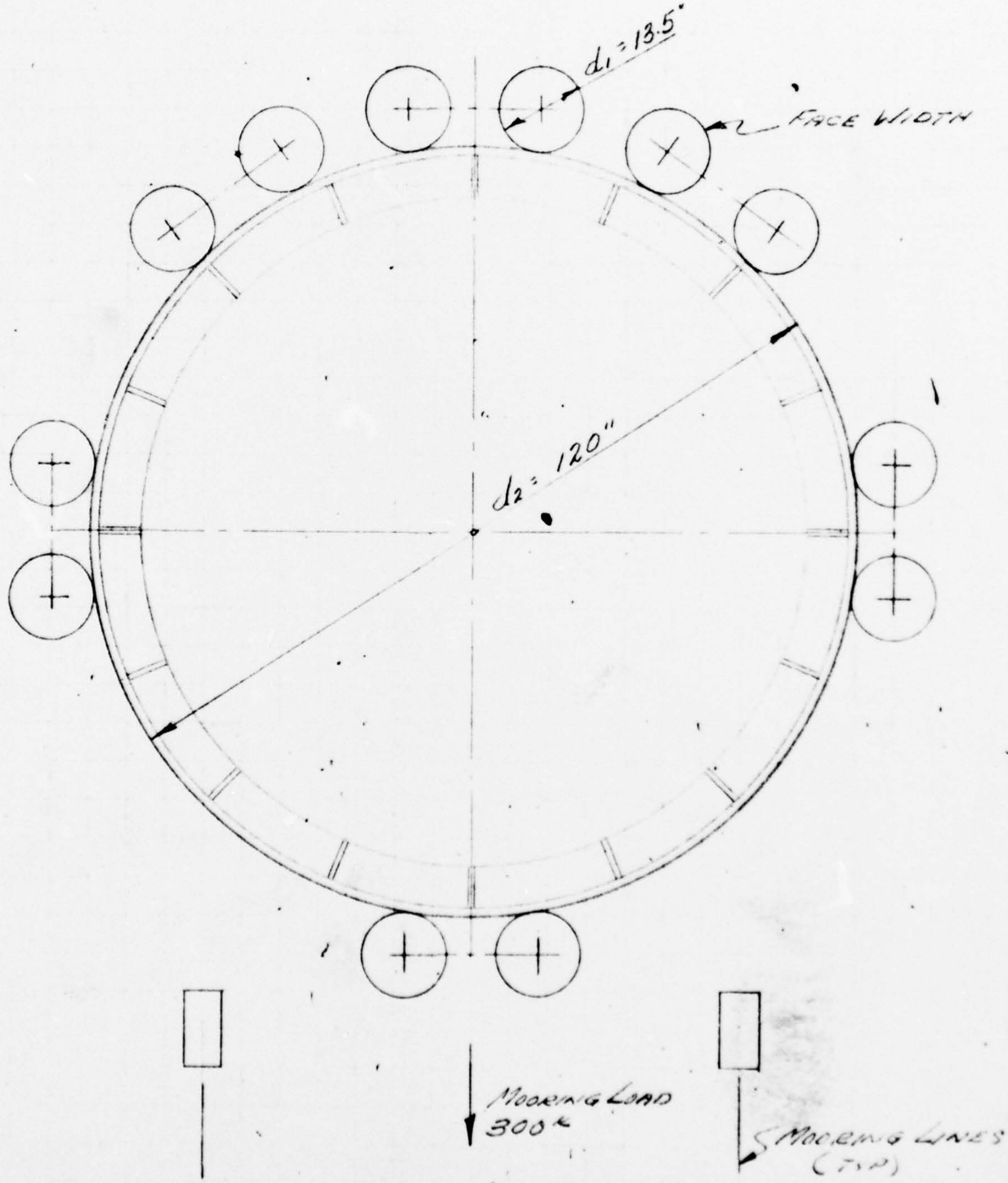
J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	1 of 6

SUBJECT: MONO MOORING SYSTEM - INNER RACE BOGIE

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JO 56017	WAD		4/13/65

INNER RACE FOR HORIZONTAL LOA[D]



BOGIE CALCULATIONS

LOAD

PRESSURES & AREAS OF CONTACT / BOGIE

MOORING LOAD = 300^K MAX
ACTIVE BOGIES = 6
LOAD/BOGIE = $\frac{300}{6}$ = 50^K +

formulas: —

LOAD CAPACITY PER LIN. INCH OF WHEEL FACE (AISC) PP 5-19

$$F_p = \left(\frac{F_y - 13{,}000}{20{,}000}\right) 660\, d = LBS$$

AREAS OF CONTACT & PRESSURES (KENT 8-36)

$$S_c = .591 \sqrt{F_p E \left(\frac{d_1 + d_2}{d_1 \times d_2}\right)}$$

$$b = 2.15 \sqrt{\frac{F_p}{E} \left(\frac{d_1 \times d_2}{d_1 + d_2}\right)}$$

$$y = \frac{2(1-V^2)}{E} \frac{F_p}{\pi} \left(\frac{2}{3} + \log_e \frac{2d_1}{b} + \log_e \frac{2d_2}{b}\right)$$

F_y = YIELD STRENGTH OF STEEL = 42,000 PSI
F_p = WHEEL CAPACITY PER LIN. IN. = LBS
S_c = MAX PRESSURE AT ℄ CONTACT = PSI
E = MODULUS OF ELASTICITY = 30,000,000
b = CONTACT WIDTH = INCHES
y = COMBINED DEFORMATION OF BOTH BODIES = IN.
V = POISSION'S RATIO = .3

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14-03

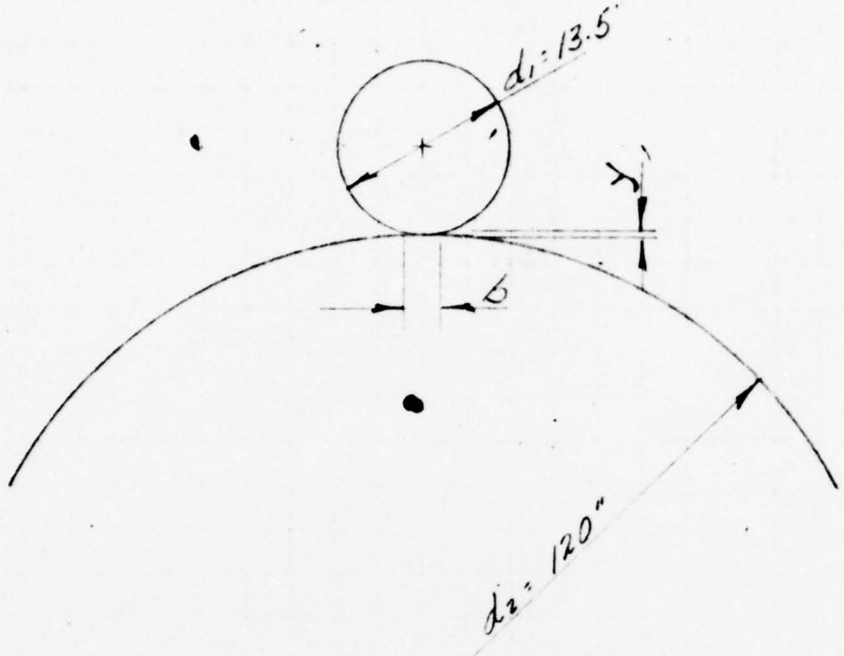
J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL

SHEET NO: 2 of 6

SUBJECT: MONO MOORING SYSTEM - INNER RACE BOGIE

NUMBER: J.O. 56017 | COMPUTER: WAP | CHECKED BY: | DATE: 4/13/65



ALLOWABLE LOAD / INCH OF FACE WIDTH OF WHEEL

$$F_p = \left(\frac{F_y - 13000}{20,000}\right) 660 d_1$$

$$F_p = \left(\frac{42 - 13}{20}\right) 660 \times 13.5 = 12,900 \text{ LBS/LIN. IN.}$$

FACE WIDTH OF WHEEL

$$W = \frac{LOAD}{F_p}$$

$$W = \frac{50^k}{12.9} = 3.87'' \text{ USE } \underline{4}'' \text{ MIN.}$$

BASIC CALCULATIONS

ACTUAL F_p = $\frac{LOAD}{W}$

$$F_p = \frac{50^k}{4} = 12.5^k$$

MAX UNIT STRESS AT CONTACT POINT

$$S_c = .591 \sqrt{F_p E \left(\frac{d_1 + d_2}{d_1 \times d_2}\right)}$$

$$S_c = .591 \sqrt{12{,}500 \times 30 \times 10^6 \left(\frac{13.5 + 120}{13.5 \times 120}\right)}$$

$$S_c = .591 \sqrt{375 \times 10^9 \, (.0825)} = 103{,}500 \text{ psi}$$

CONTACT WIDTH

$$b = 2.15 \sqrt{\frac{F_p}{E} \left(\frac{d_1 \times d_2}{d_1 + d_2}\right)}$$

$$b = 2.15 \sqrt{\frac{12{,}500}{30 \times 10^6} \left(\frac{13.5 \times 120}{13.5 + 120}\right)}$$

$$b = 2.15 \sqrt{.000416 \, (12.1)} = 0.153''$$

TOTAL DEFORMATION OF BOTH BODIES

$$y = \frac{2(1 - \nu^2)}{E} \frac{F_p}{\pi} \left(\frac{2}{3} + \log_e \frac{2d_1}{b} + \log_e \frac{2d_2}{b}\right)$$

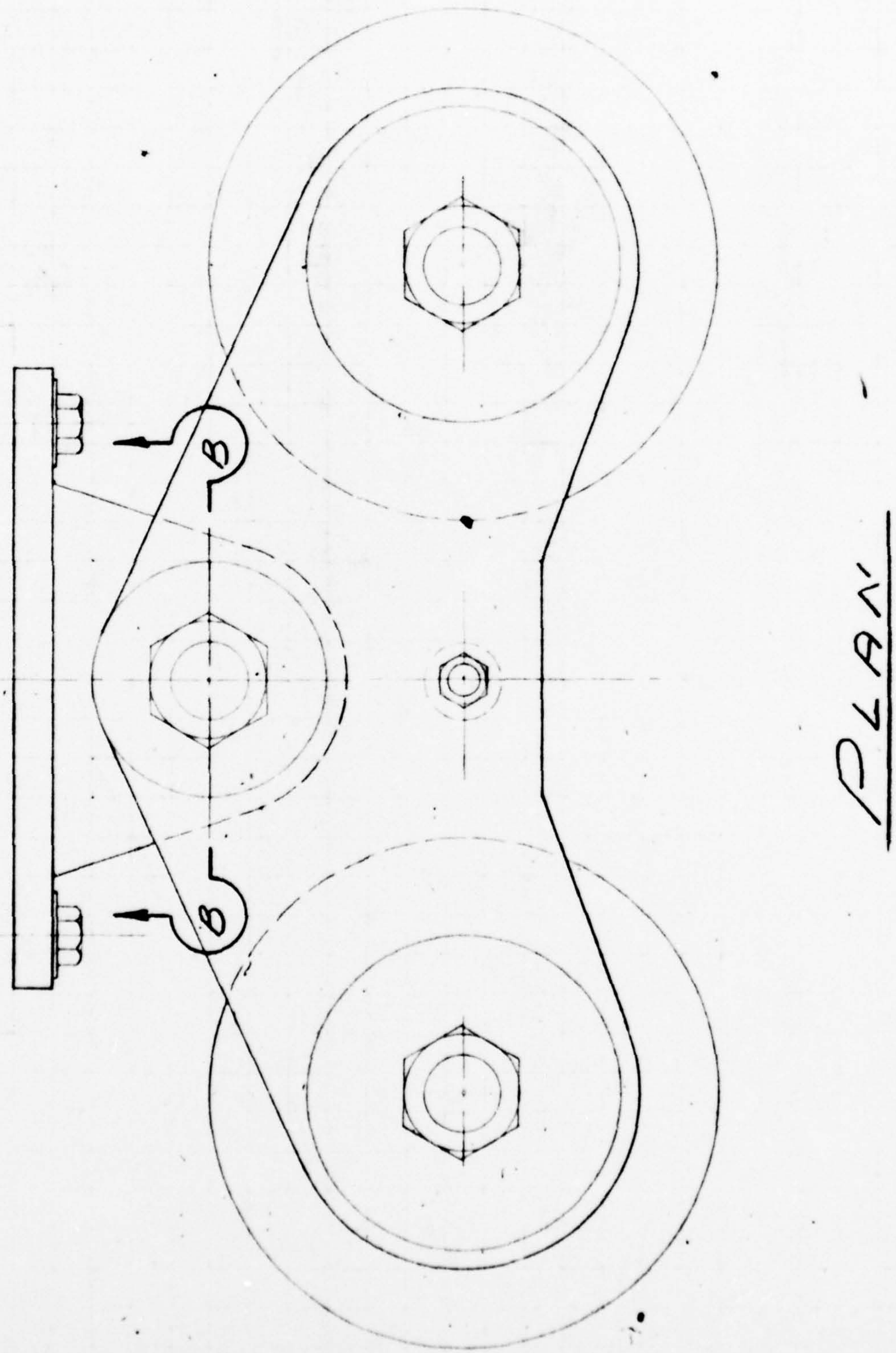
$$y = \frac{2(1 - .3^2)}{30 \times 10^6} \times \frac{12500}{3.14} \left(\frac{2}{3} + \log_e \frac{2 \times 13.5}{.153} + \log_e \frac{2 \times 120}{.153}\right)$$

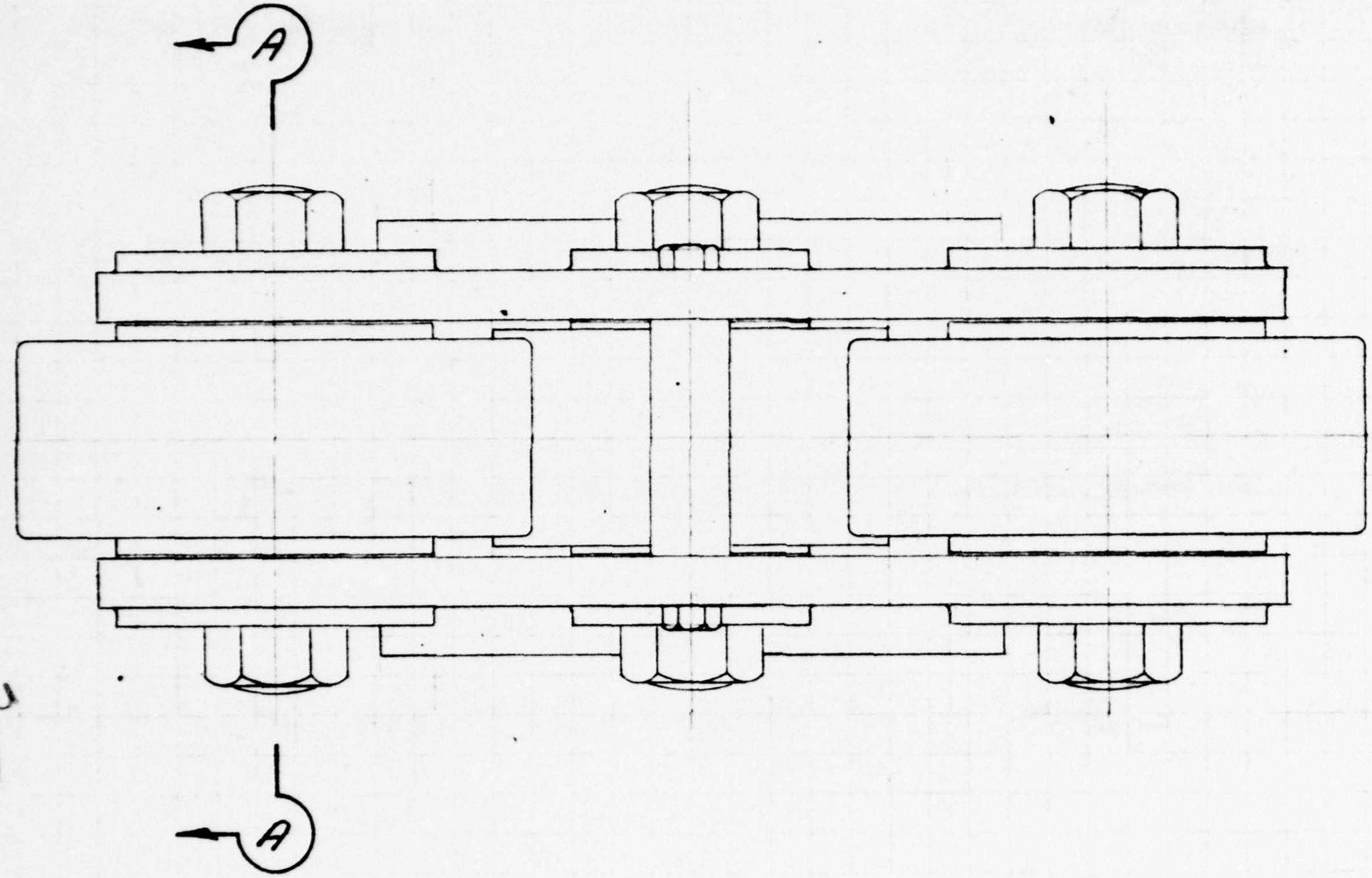
$$y = .00000006 \times 4160 \, (13.7) = 0.0034''$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY · ERDL	SHEET NO: 3 of 6
SUBJECT: MONO MOORING SYSTEM - INNER RACE BOGIE	
NUMBER: J.O. 56017	COMPUTER: WAP · CHECKED BY: · DATE: 4/13/65



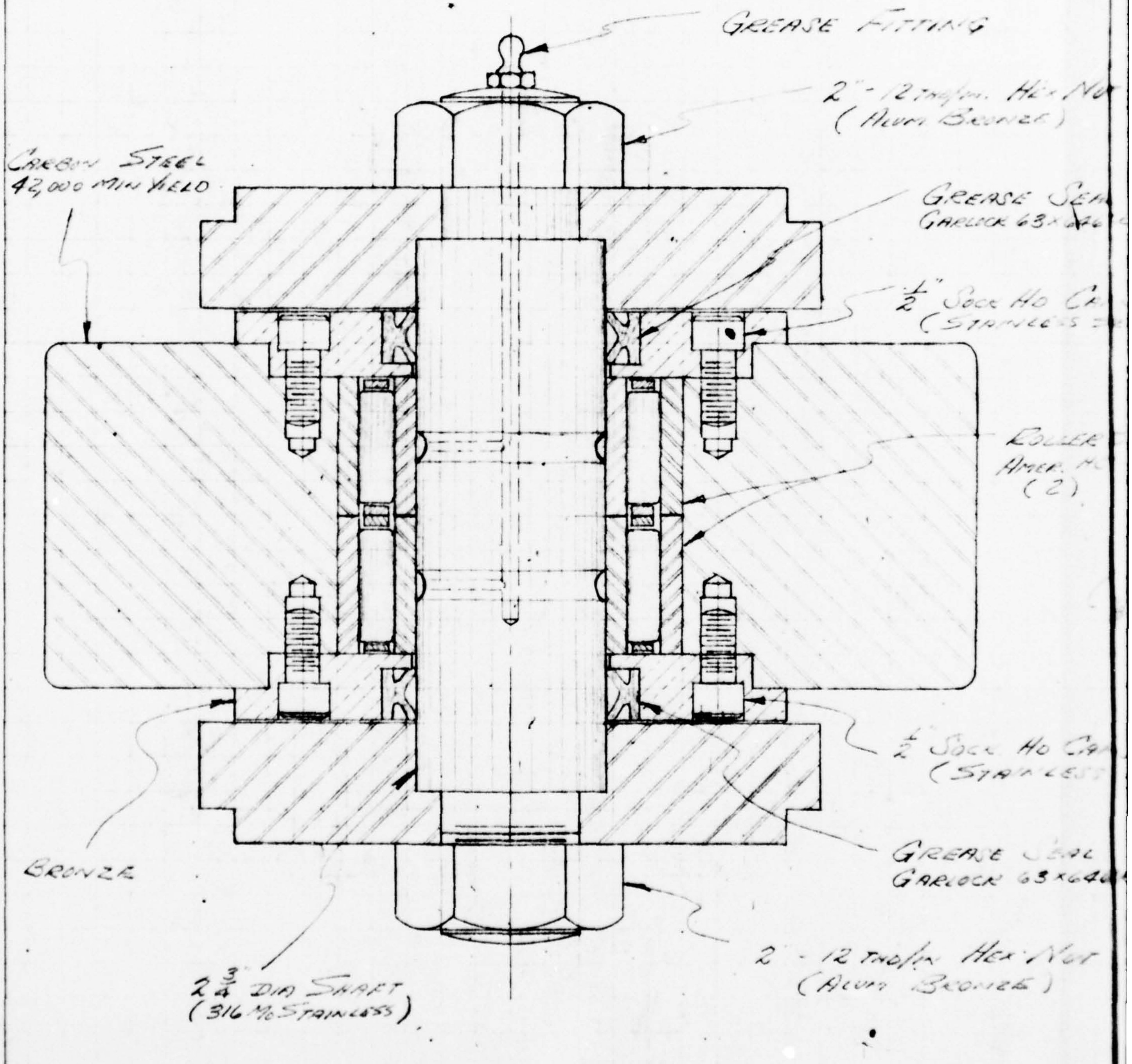


ELEVATION

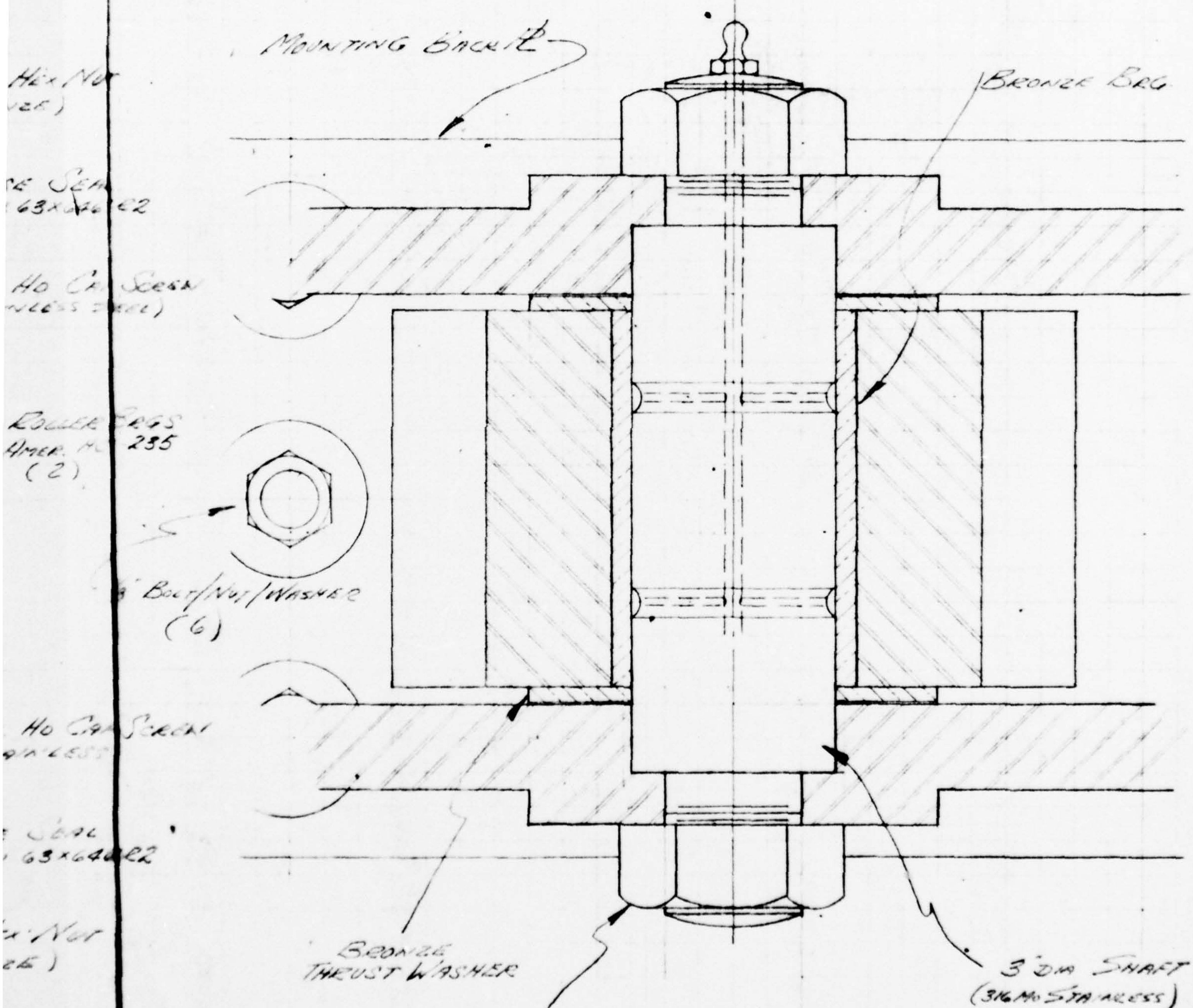
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - E.R.D.L.
SHEET NO: 4 of 6
SUBJECT: MONO MOORING SYSTEM - INNER RACE BOG...
[redacted] NUMBER: J.O 56017
COMPUTER: WAD
CHECKED BY:
DATE: 4/12/65



SECTION "A-A"


MOUNTING BRACKET
BRONZE BRG
BRONZE THRUST WASHER
2" - 12 THD/IN HEX NUT (ALUM BRONZE)
3" DIA SHAFT (316 Mo STAINLESS)
BOLT/NUT/WASHER (6)

SECTION "B-B"

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 1A003

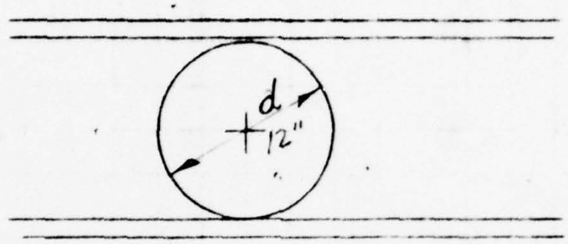
J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	5 of 6

SUBJECT: MONO MOORING SYSTEM - OUTER RACE BOGIE C...

NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAD		4/14/65

OUTER RACE FOR VERTICAL LOA...



PRESSURES & AREAS OF CONTACT / BOGIE

MOORING LOAD = 195^k
ACTIVE BOGIES = 6
LOAD / BOGIE = $\frac{195}{6} = 32.5^k$
FACE WIDTH = 4"

formulas:-

LOAD CAPACITY PER LIN. INCH of WHEEL FACE

$$F_p = \left(\frac{F_y - 13{,}000}{29{,}000}\right) 660\,d = \left(\frac{42 - 13}{20}\right) 660 \times 12 = 11{,}500$$

AREAS of CONTACT & PRESSURES

$$S_c = .591 \sqrt{\frac{F_p E}{d}}$$

$$b = 2.15 \sqrt{\frac{F_p d}{E}}$$

BOGIE CALCULATIONS

LOAD

ACTUAL $F_p = \frac{LOAD}{W}$

$F_p = \frac{32.5}{4} = \underline{8.125^K}$

MAX UNIT STRESS AT CONTACT POINT

$S_c = .591 \sqrt{\frac{F_p E}{d}}$

$S_c = .591 \sqrt{\frac{8.125 \times 30 \times 10^6}{12}}$

$S_c = .591 \sqrt{20,300,000,000} = \underline{84,000 \text{ psi}}$

CONTACT WIDTH

$b = 2.15 \sqrt{\frac{F_p d}{E}}$

$b = 2.15 \sqrt{\frac{8125 \times 12}{30 \times 10^6}}$

$b = 2.15 \sqrt{.00325} = \underline{0.122''}$

COMPRESSION OF WHEEL BETWEEN TWO PLATES

$\Delta D = 4 F_p \left(\frac{1 - \nu^2}{\pi E}\right)\left(\frac{1}{3} + \log_e \frac{2d}{b}\right)$

$\Delta D = 4 \times 8125 \left(\frac{1 - .3^2}{3.14 \times 30 \times 10^6}\right)\left(\frac{1}{3} + \log_e \frac{2 \times 12}{.122}\right)$

$\Delta D = 32.5 \, (.0000000965)(5.47)$

$\Delta D = \underline{0.0000016''}$

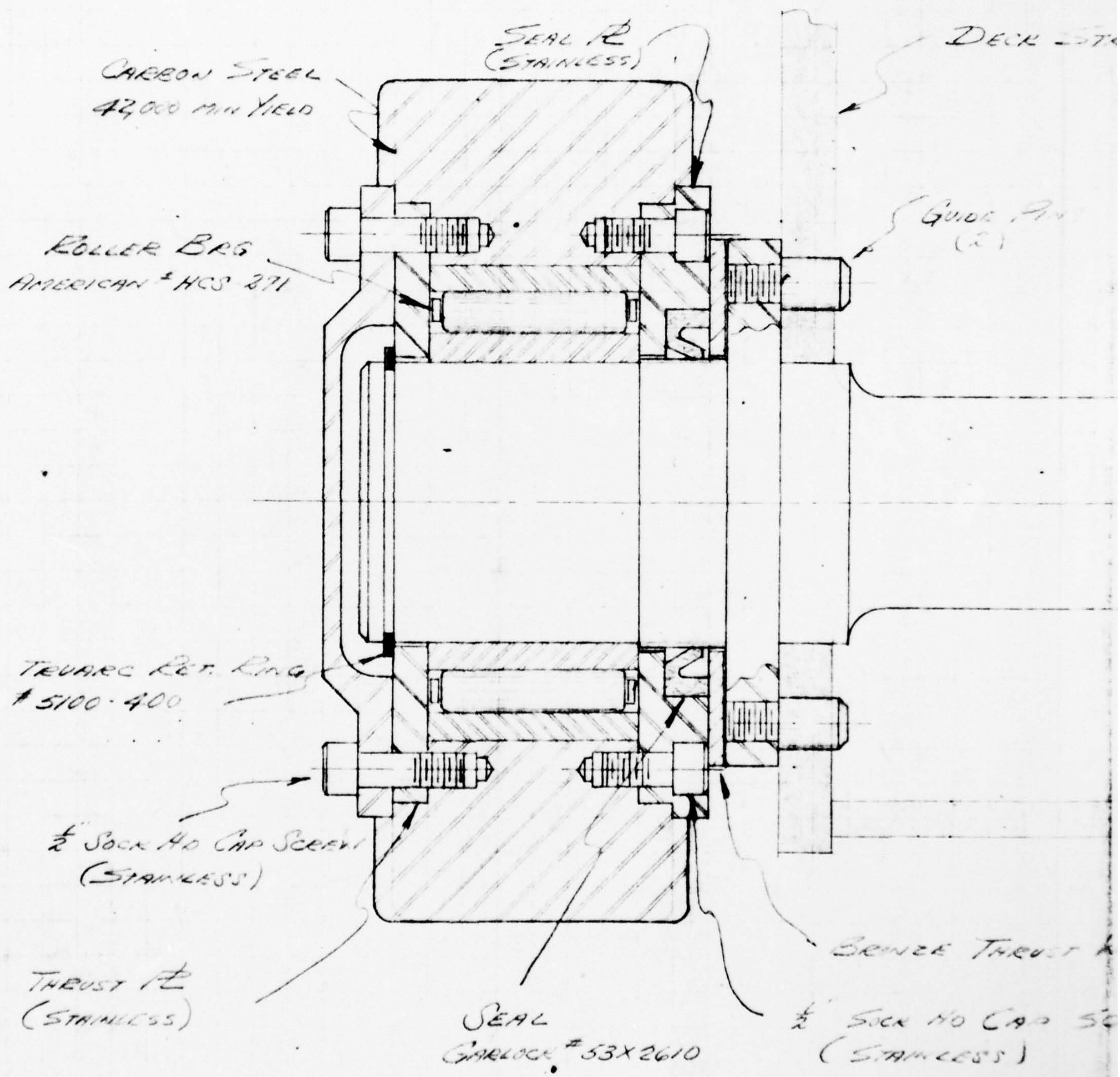
E

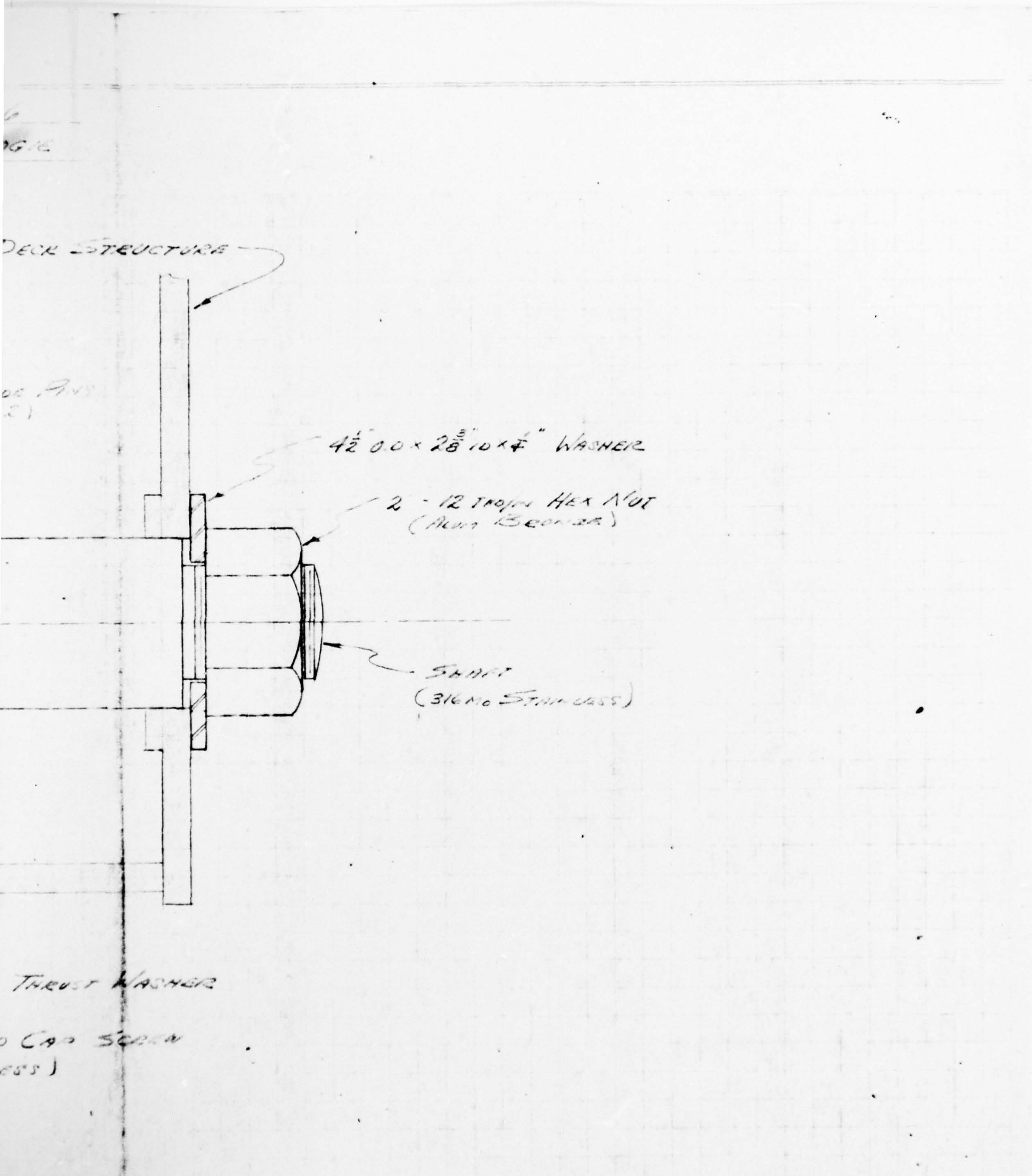
= 11,500

ENGINEERING DEPARTMENT COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S. ARMY - ERDL			6 of 6
SUBJECT			
MONO MOORING SYSTEM - OUTER RACE BOGIE			
~~DRAWING~~ NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAD		4/13/65



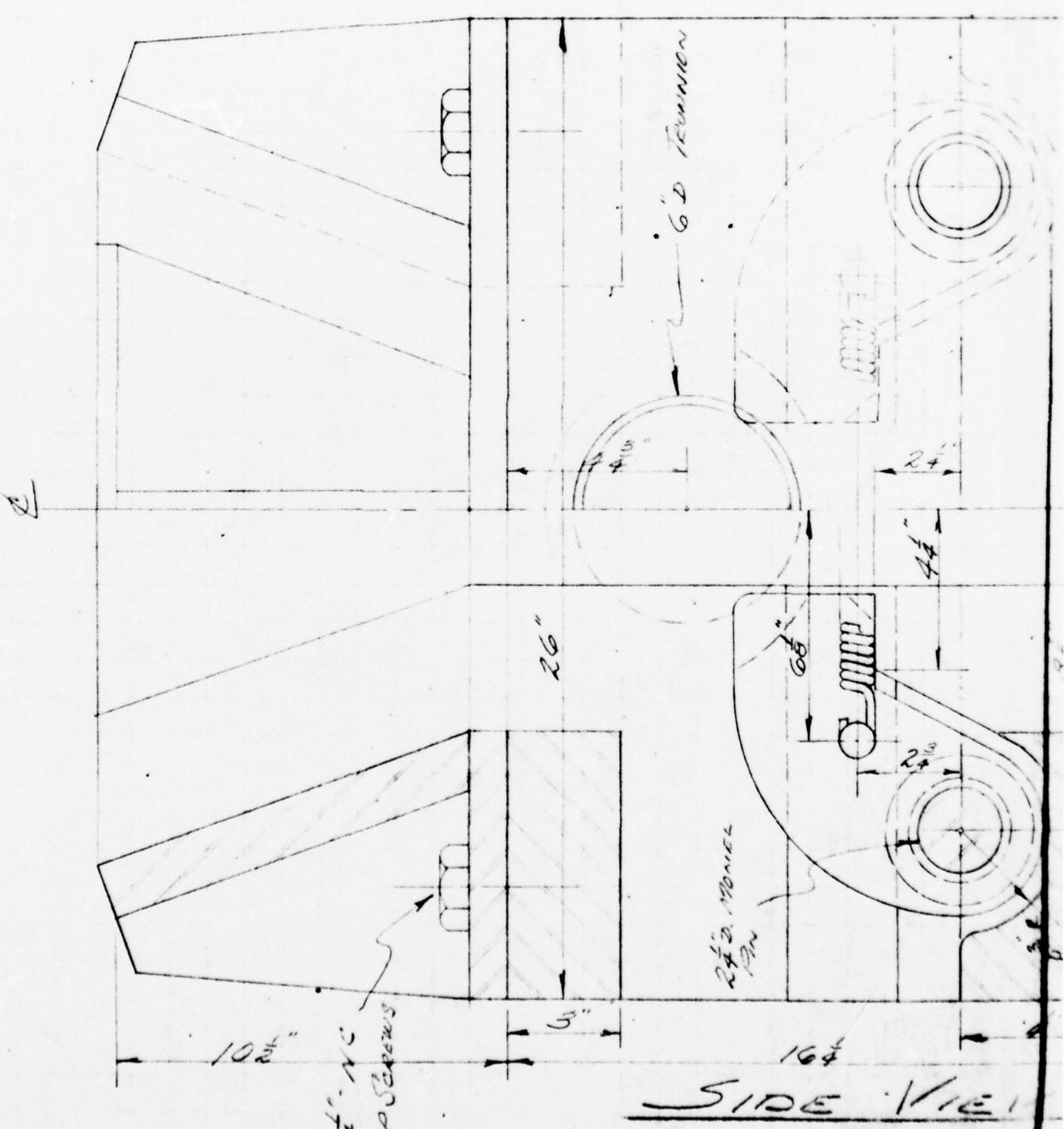

DECK STRUCTURE
4½" O.D. × 2⅜" I.D. × ¼" WASHER
2 - 12 THD/IN HEX NUT
(ALUM BRONZE)
SHAFT
(316 Mo STAINLESS)
THRUST WASHER

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

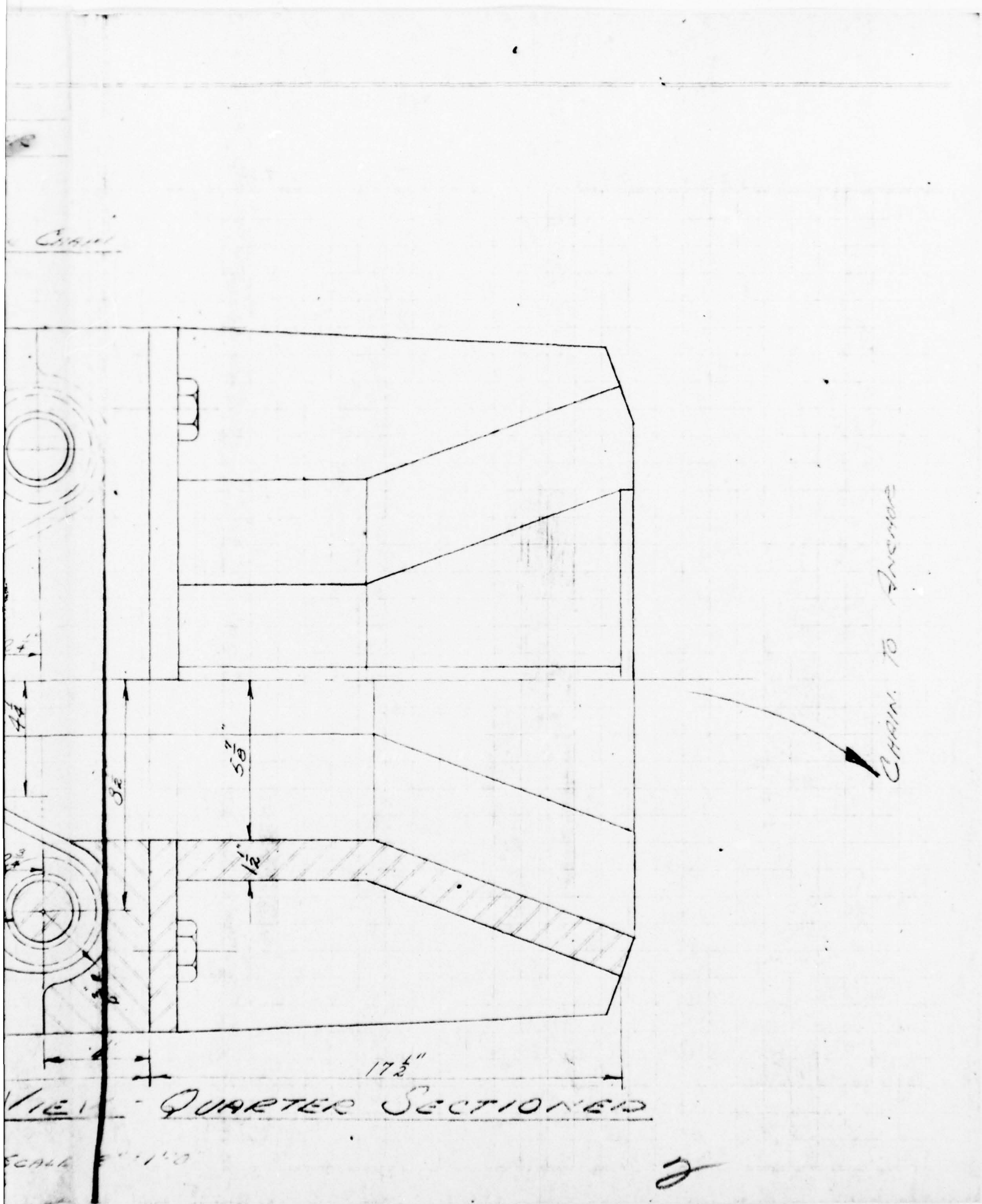
COMPANY: U S ARMY - ERDL			SHEET NO: 1 of 4
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER			
DRAWING NUMBER: J.O. 56017	COMPUTER: WH	CHECKED BY:	DATE: 5-11-65

DESIGNED for STD. 3" WELDED STUD LINK CHAIN



SIDE VIEW

SCALE

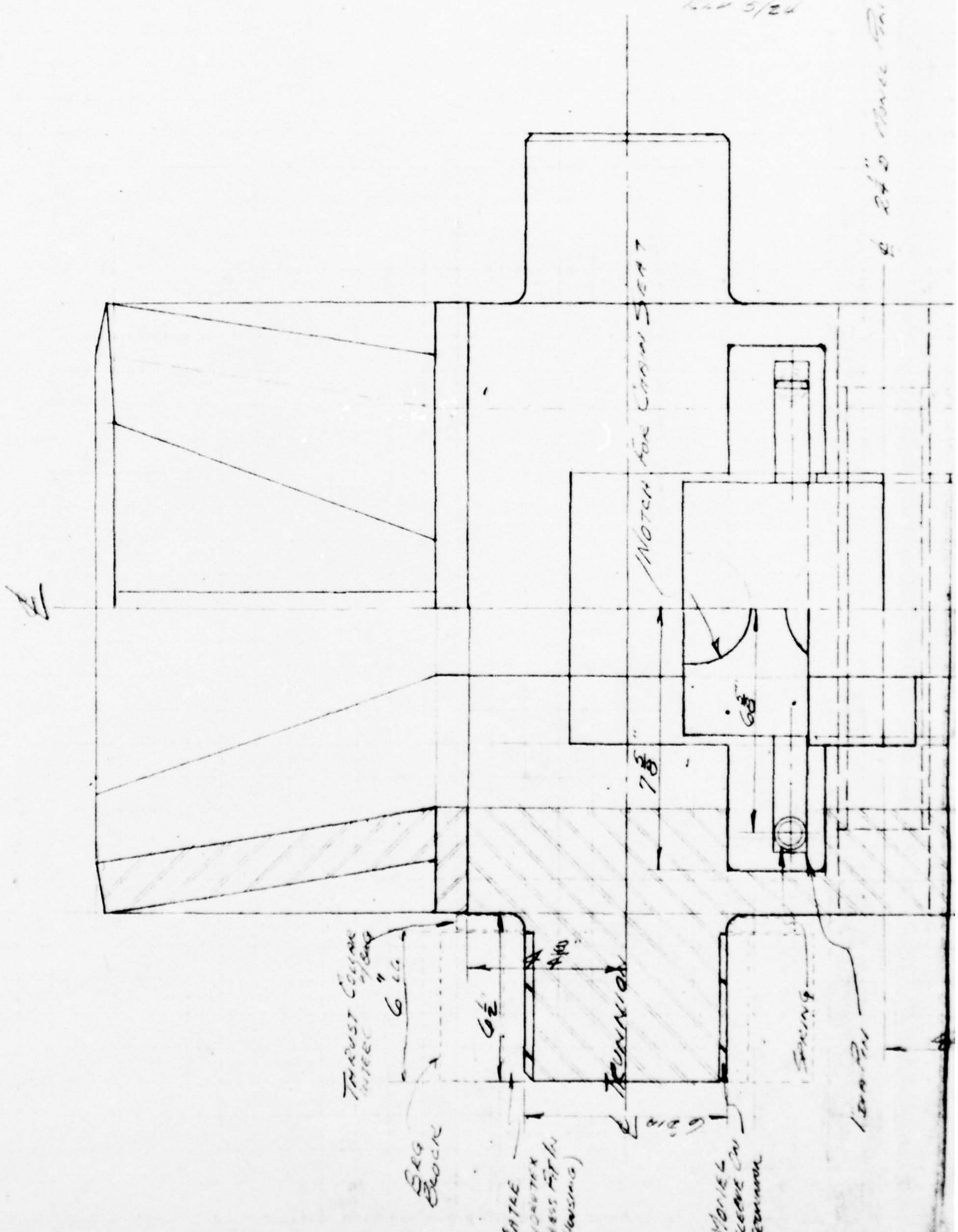


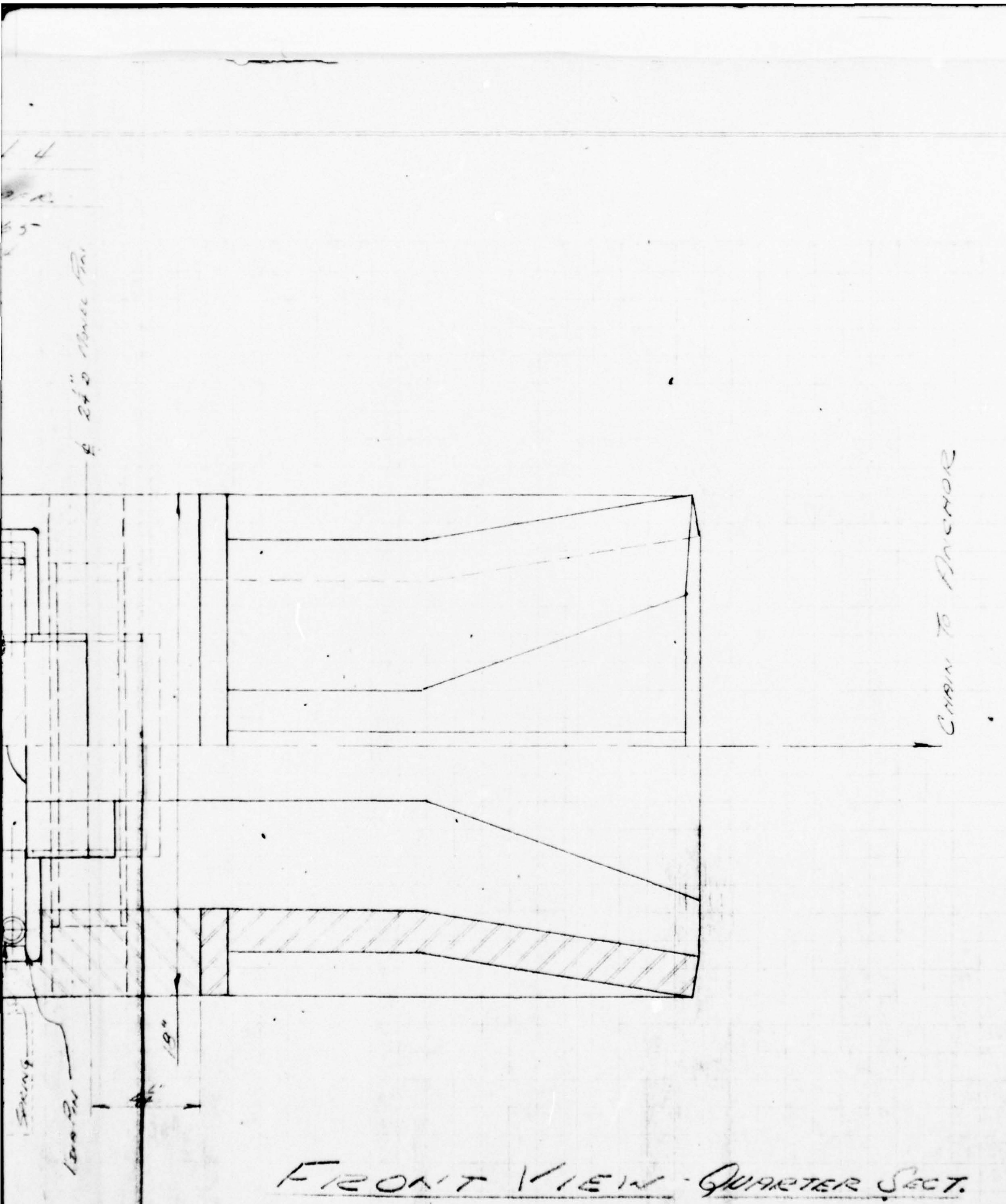
CHAIN TO ...
17½"
5⅞"
1½"
...VIEW - QUARTER SECTIONED
SCALE

ENGINEERING DEPARTMENT COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL	SHEET NO: 2 of 4
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER	
NUMBER: J0. 56017	COMPUTER: [initials]
CHECKED BY:	DATE: 5-11-65 Rev 5/24





FRONT VIEW - QUARTER SECT.

SCALE 3" = 1'-0"

2

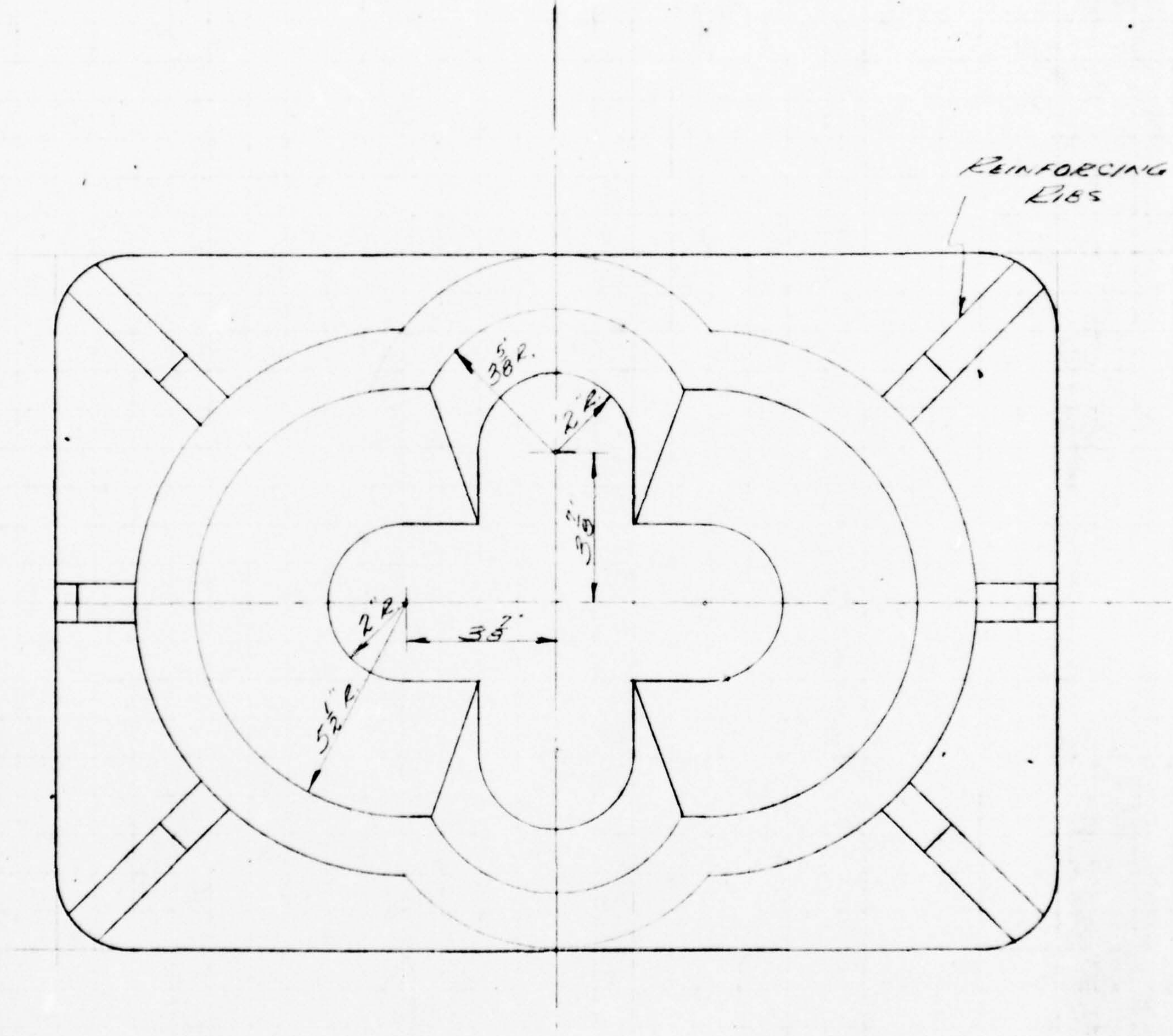
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

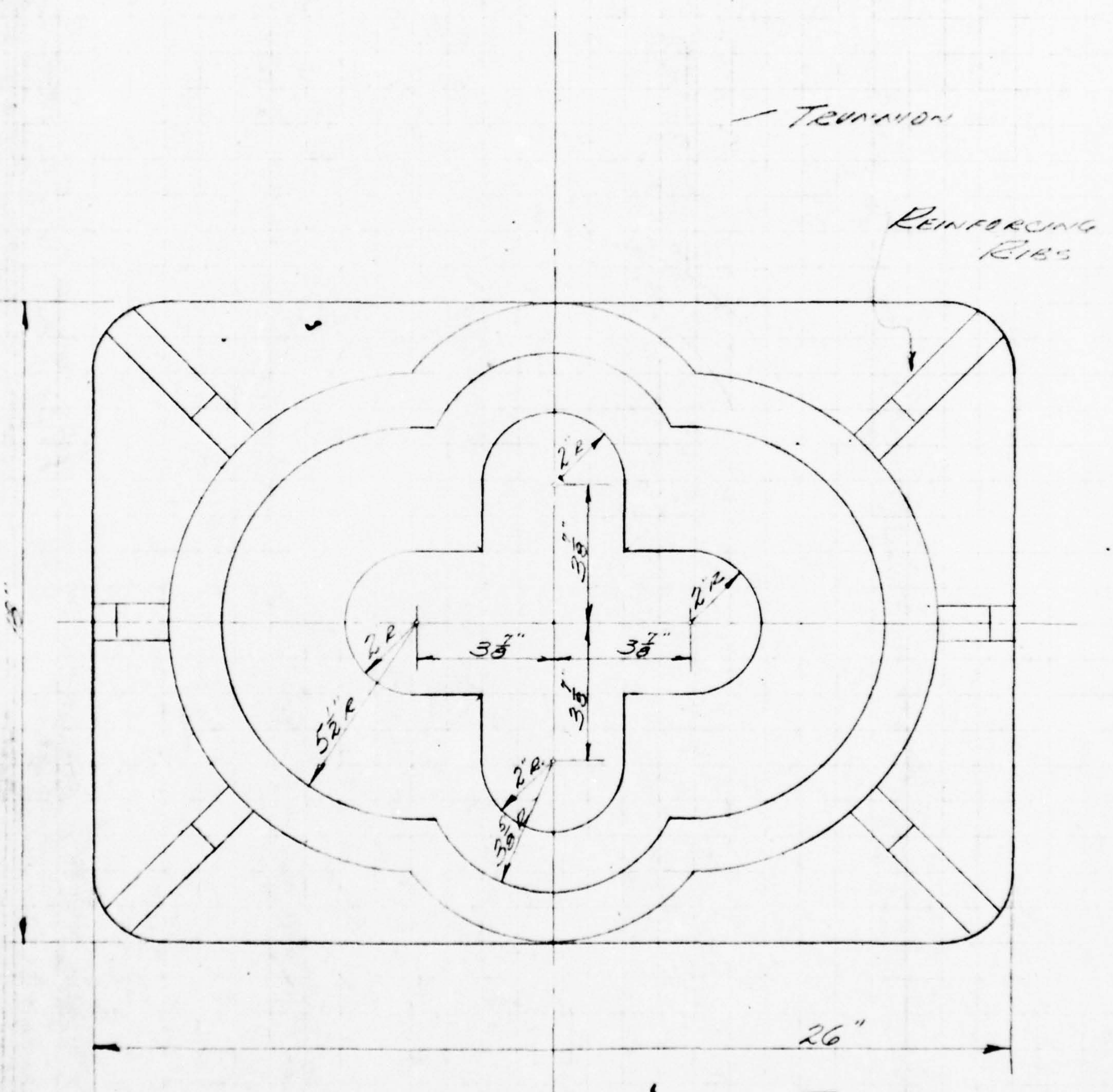
COMPANY	SHEET NO
U.S. ARMY - ERDL	3 of 4

SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER

NUMBER	COMPUTER	CHECKED BY	DATE
JO 50617	[illegible]		5-11-65



TOP VIEW



BOTTOM VIEW

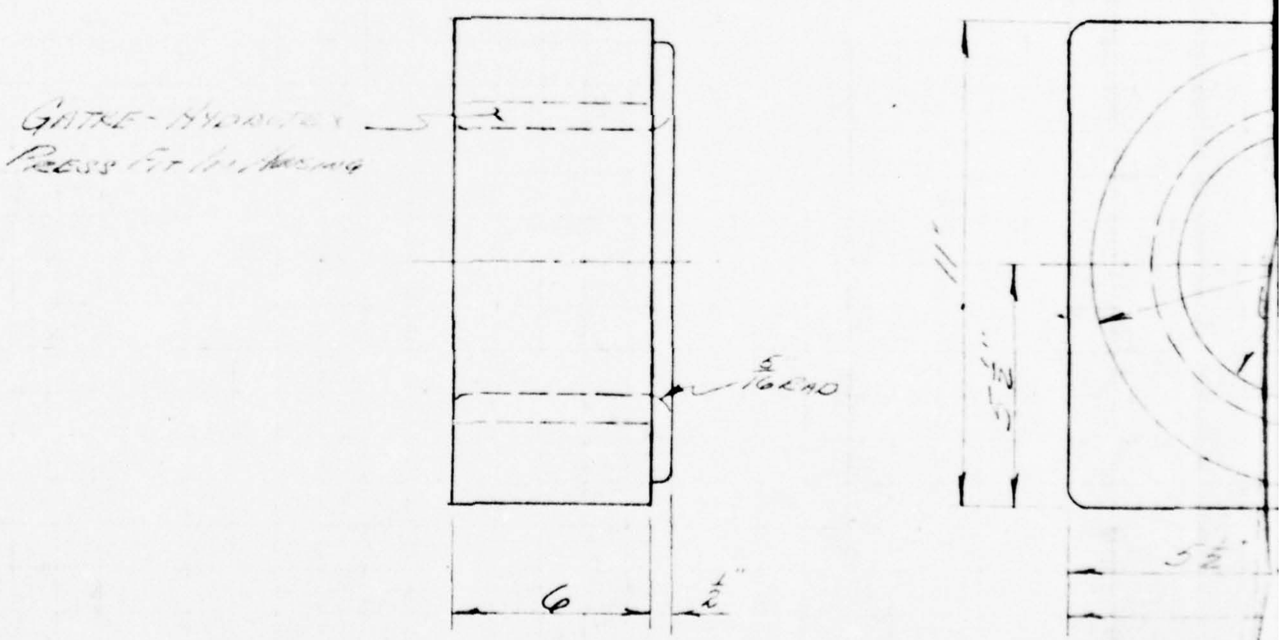
ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	4 of 4
SUBJECT	
MENO MOORING SYSTEM - CHAIN STOPPER BAG	

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
V.C. 56017			5 24 65

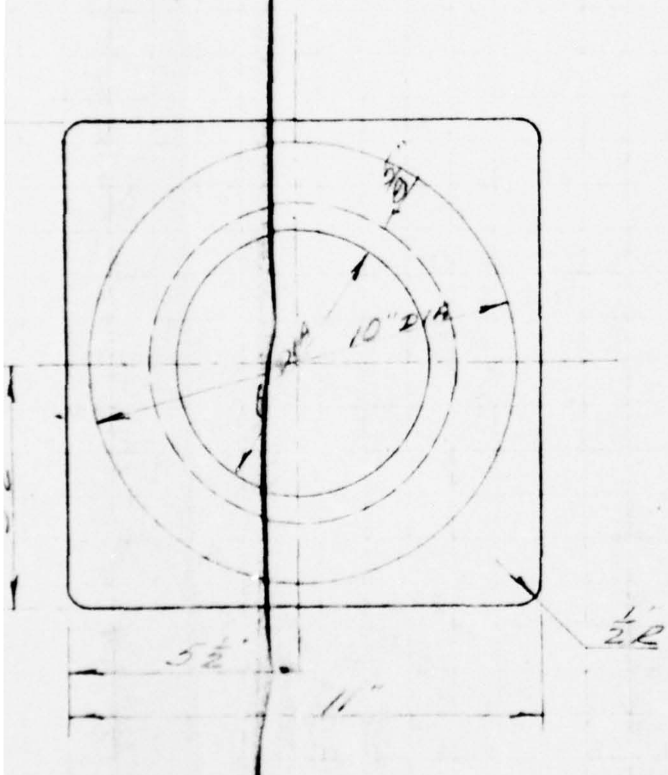
TRUNNION B



BEARING BLOC

...4
...G
...4-65

...ON BEARING



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2

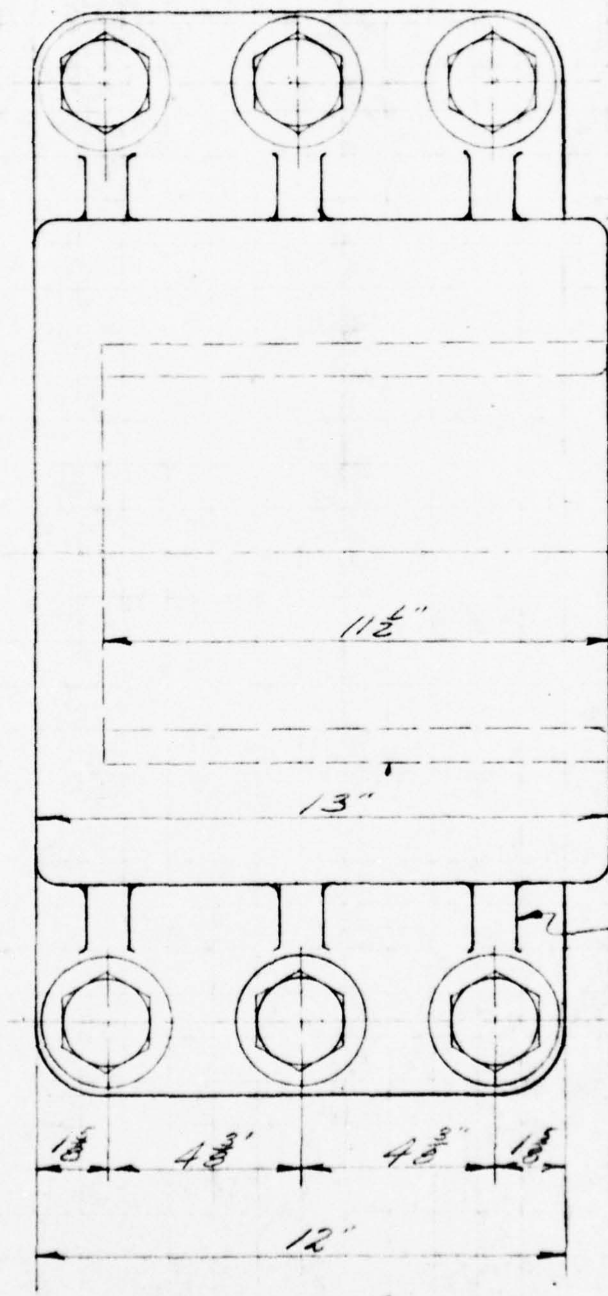
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S Army - ERDL	9 of 4
SUBJECT	
Mono Mooring System - Chain Stopper	

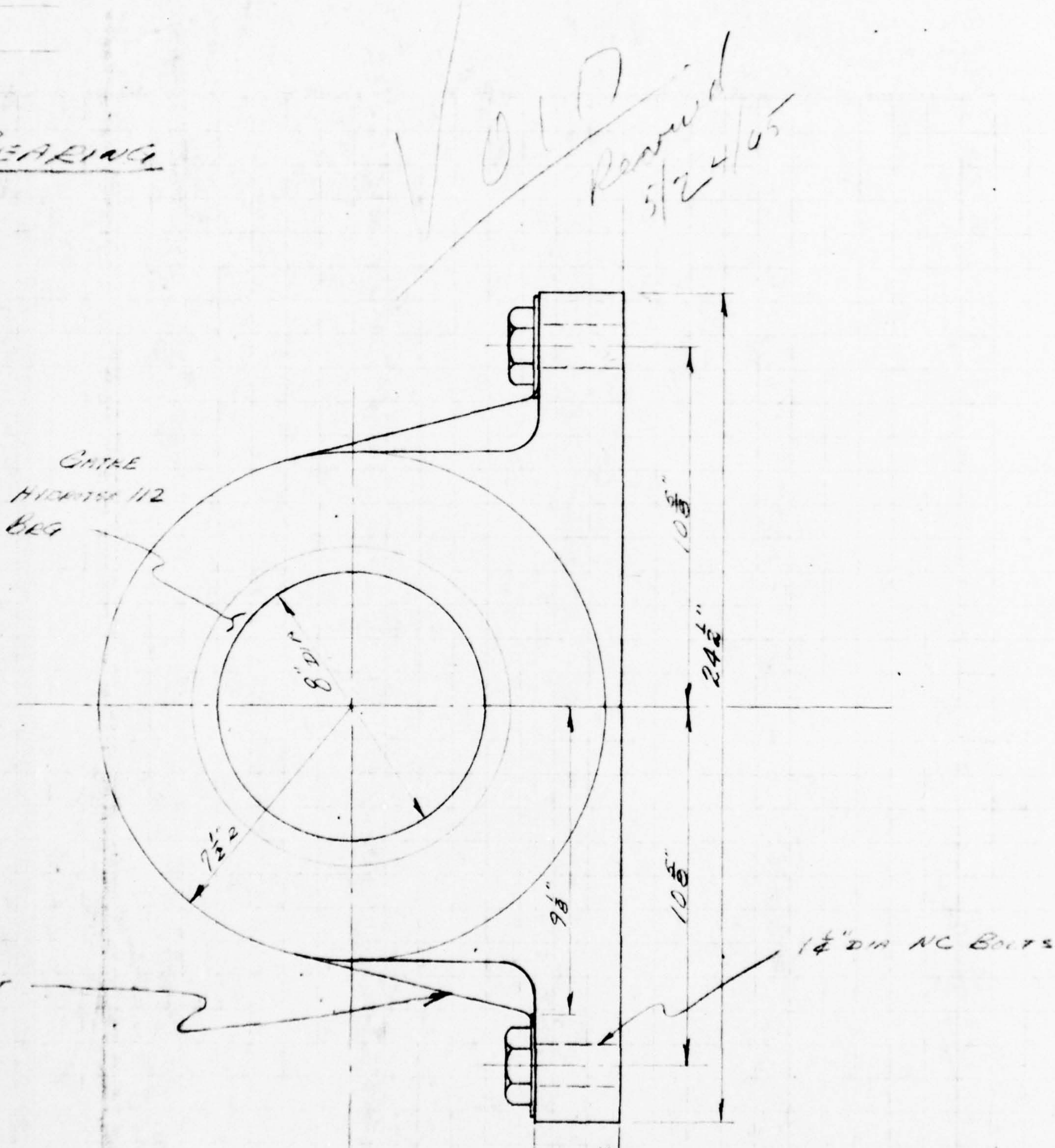
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE

Trunnion Bearin



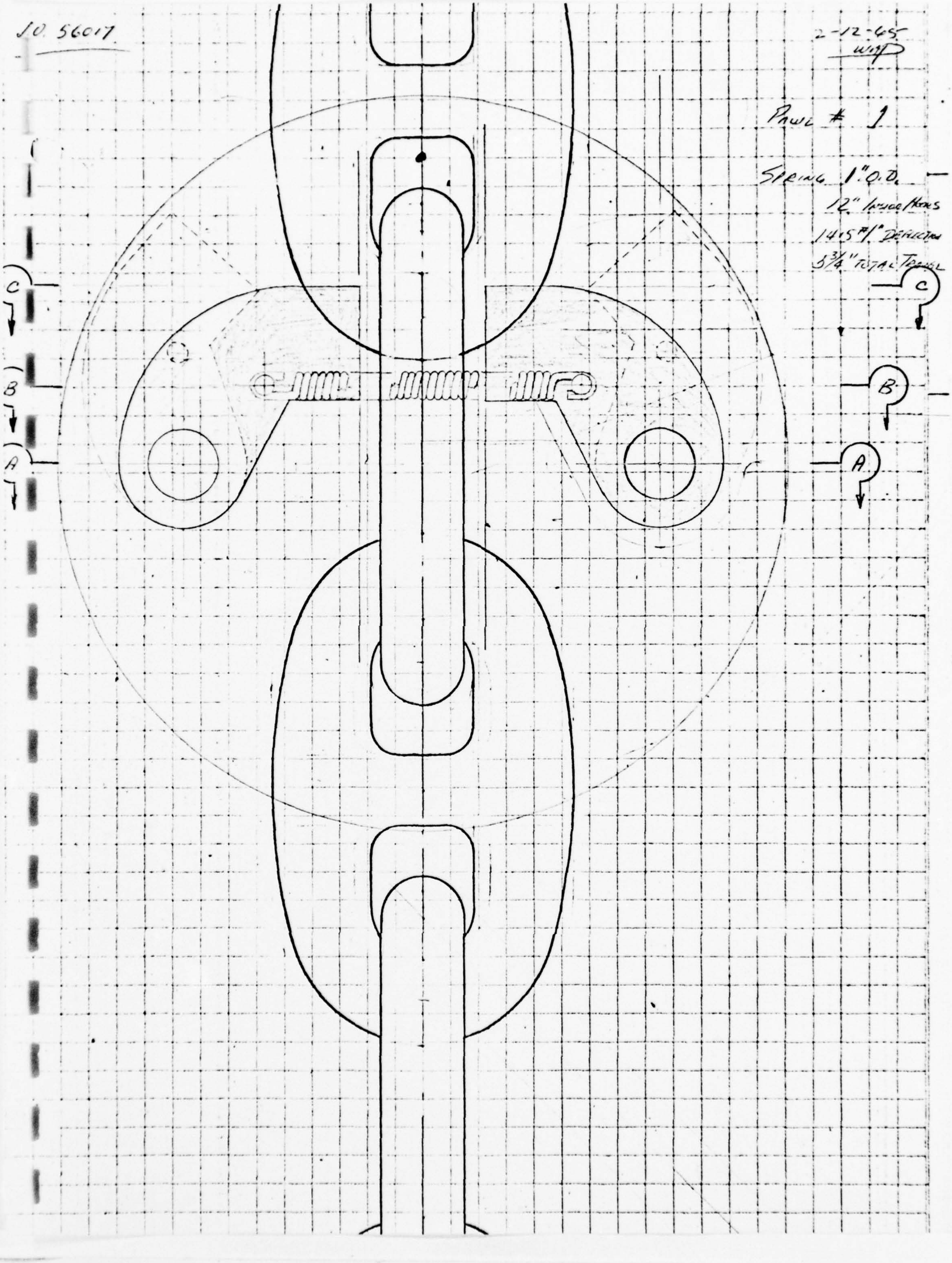
Top View

BEARING



SIDE VIEW

2


J.O. 56017
2-12-65
PAWL # 1
SPRING 1" O.D.
12" INSIDE HOOKS
14.5#/" DEFLECTION
3 3/4" TOTAL TRAVEL
C
C
B
B
A
A

COMPUTATION SHEET
ENGINEERING DEPARTMENT
CD 5011

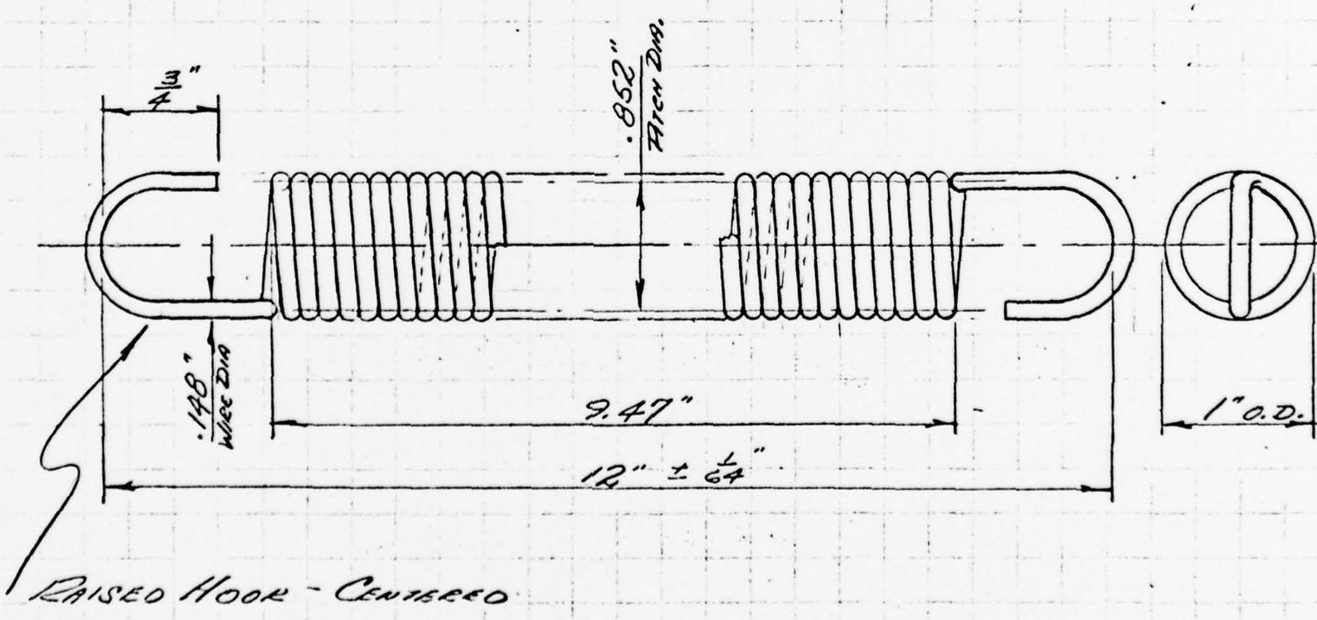
J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY - ERDL	FIELD	SHEET NO. 1 of 1
SUBJECT MONO MOORING SYSTEM - CHAIN STOPPER	WELL NO.	DATE 2/12/65
WING NO. V.O 56017 SPRING CALCULATION	COMPUTER WAP	

MATERIAL:- SAE 30316 STAINLESS OR AS140 MONEL

WORKING SPECIFICATIONS:-

OUTSIDE DIA	1"
PITCH DIA	.852"
WIRE DIA	.148"
INITIAL TENSION	10 LBS
NO COILS	64
COIL LENGTH	9.47"
LENGTH INSIDE HOOKS	12"
APPROX SPRING RATE	14.5 LBS/" DEFLECTION
TOTAL DEFLECTION	6" MAX



NOTE: TOTAL LOAD @ 6" DEFLECTION 95# ± 5%

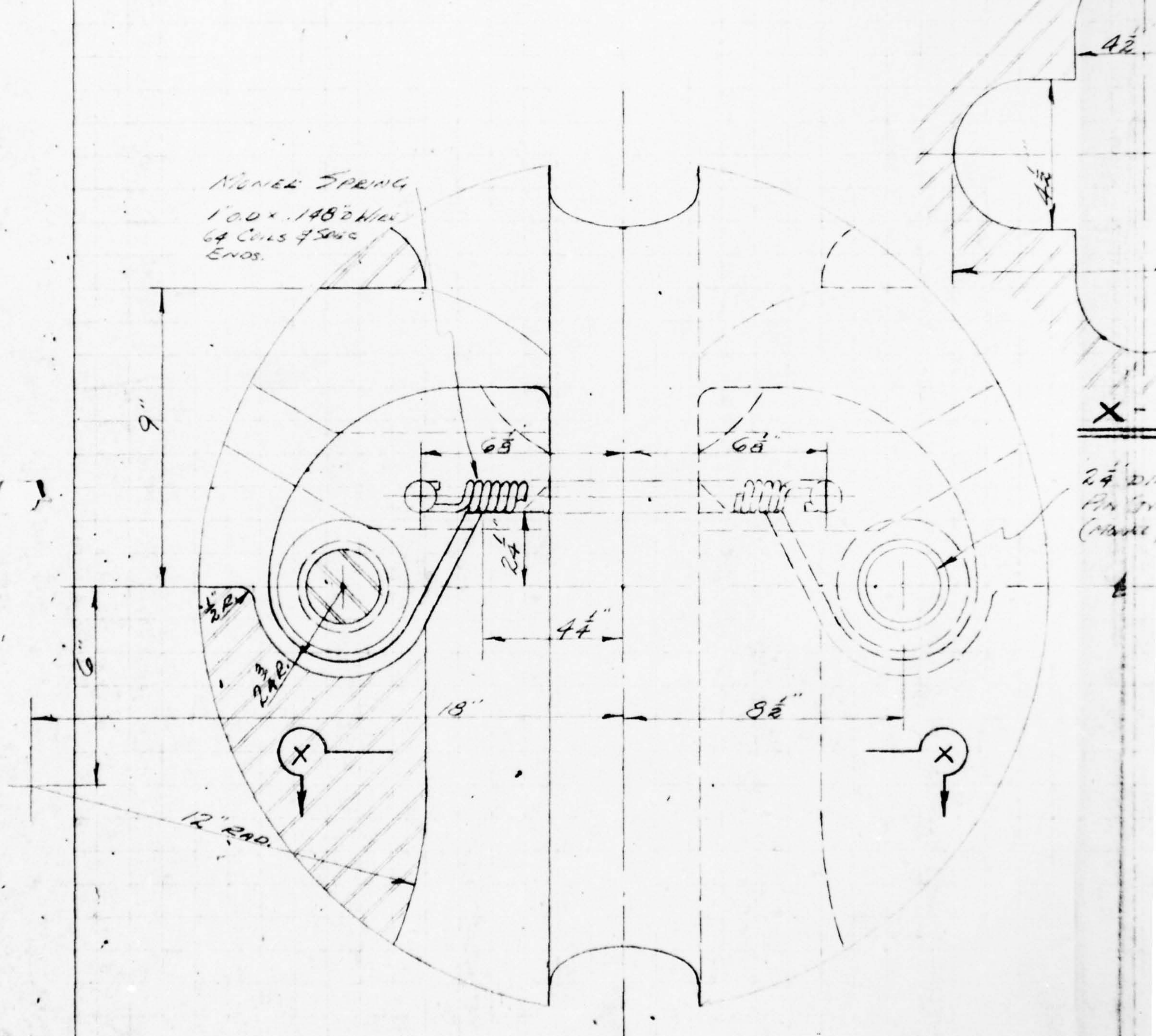
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	

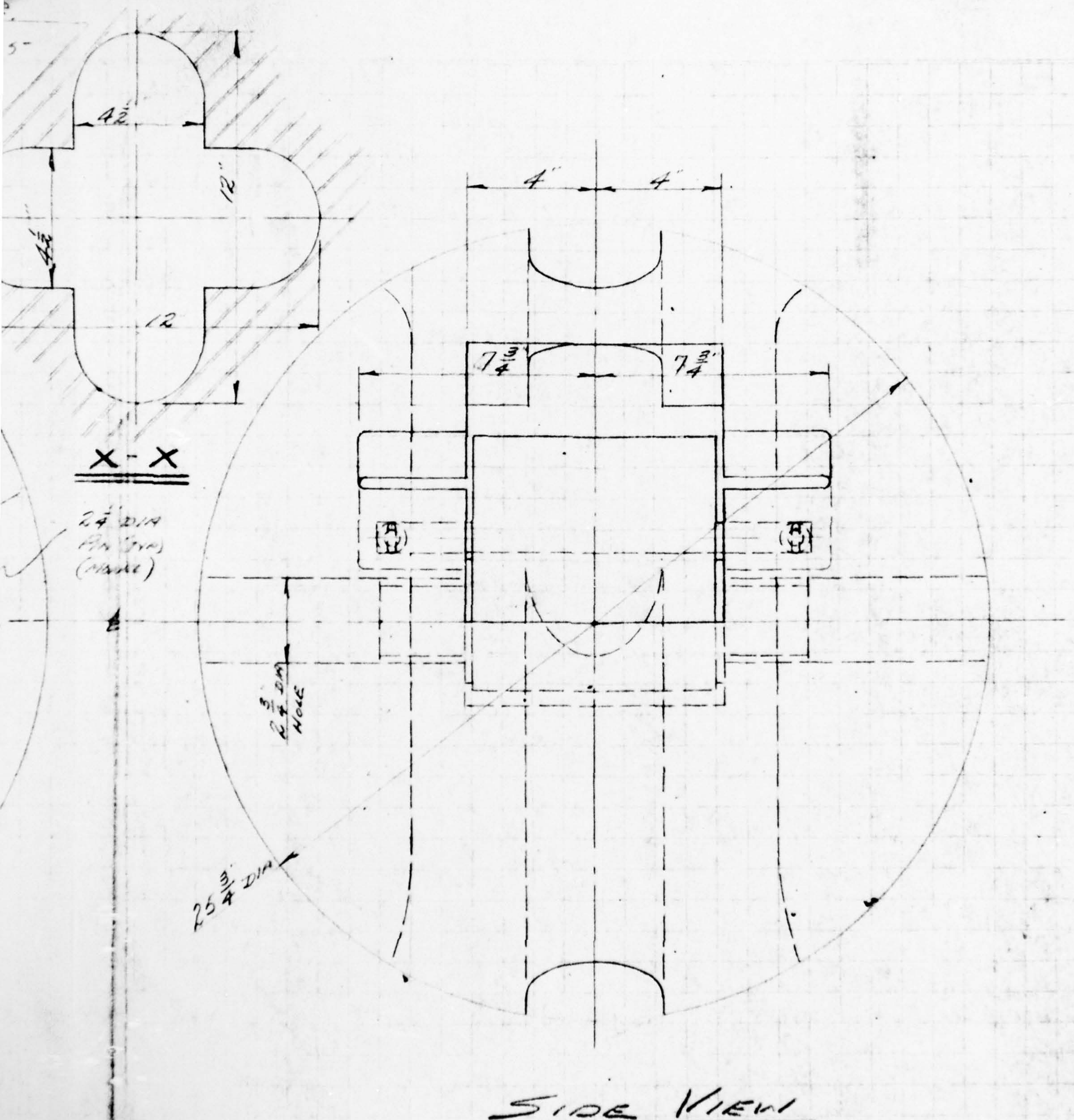
SUBJECT
MENO MOORING SYSTEM - CHAIN STOPPER

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		4-30-65



FRONT

PARTIAL SECTIONAL VIEW

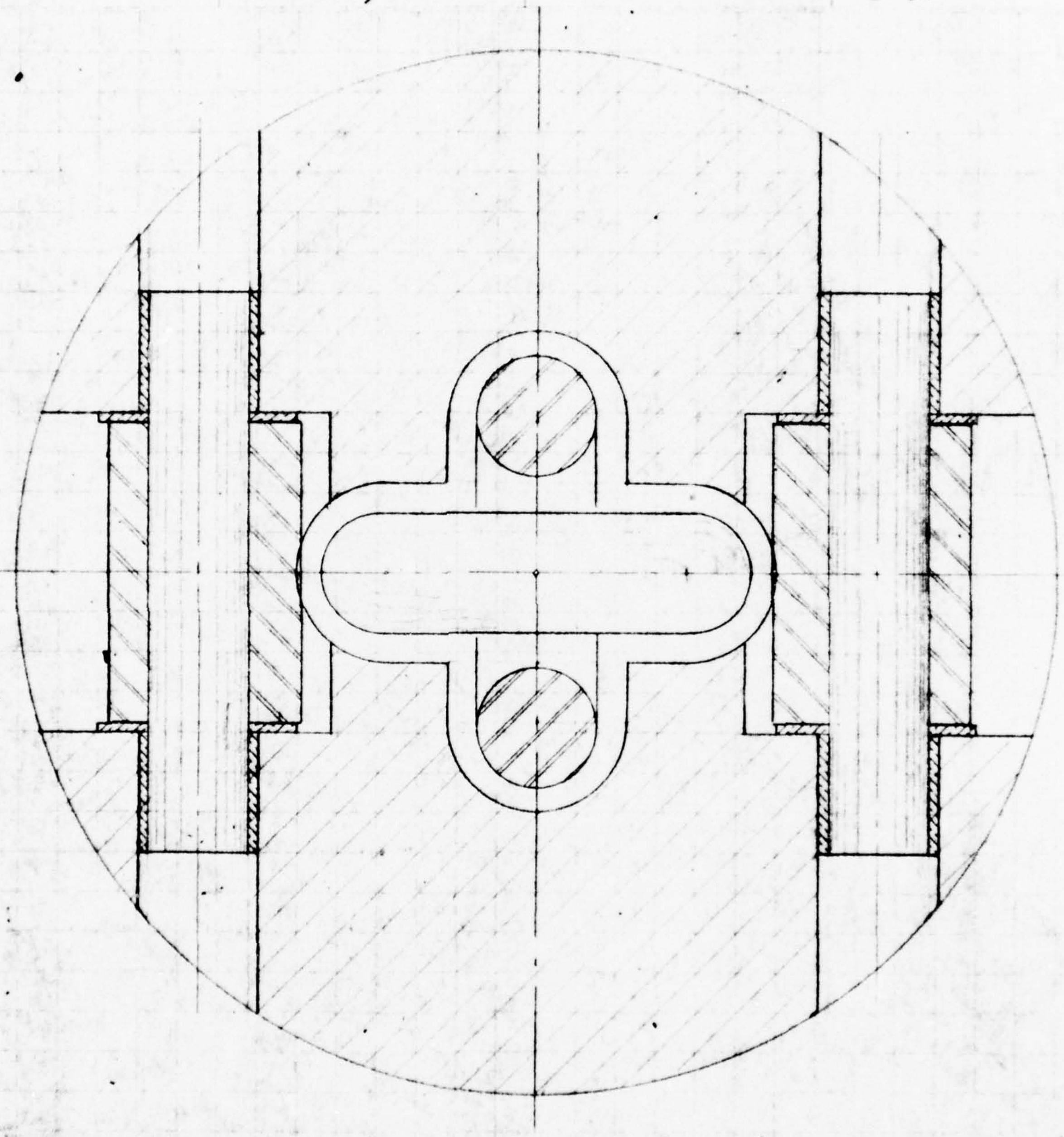

4½"
12"
4½"
12
X - X
2¼ DIA
PIN (TYP)
(MALE)
4"
4"
7¾"
7¾"
2¾ DIA HOLE
25¾ DIA
SIDE VIEW

2

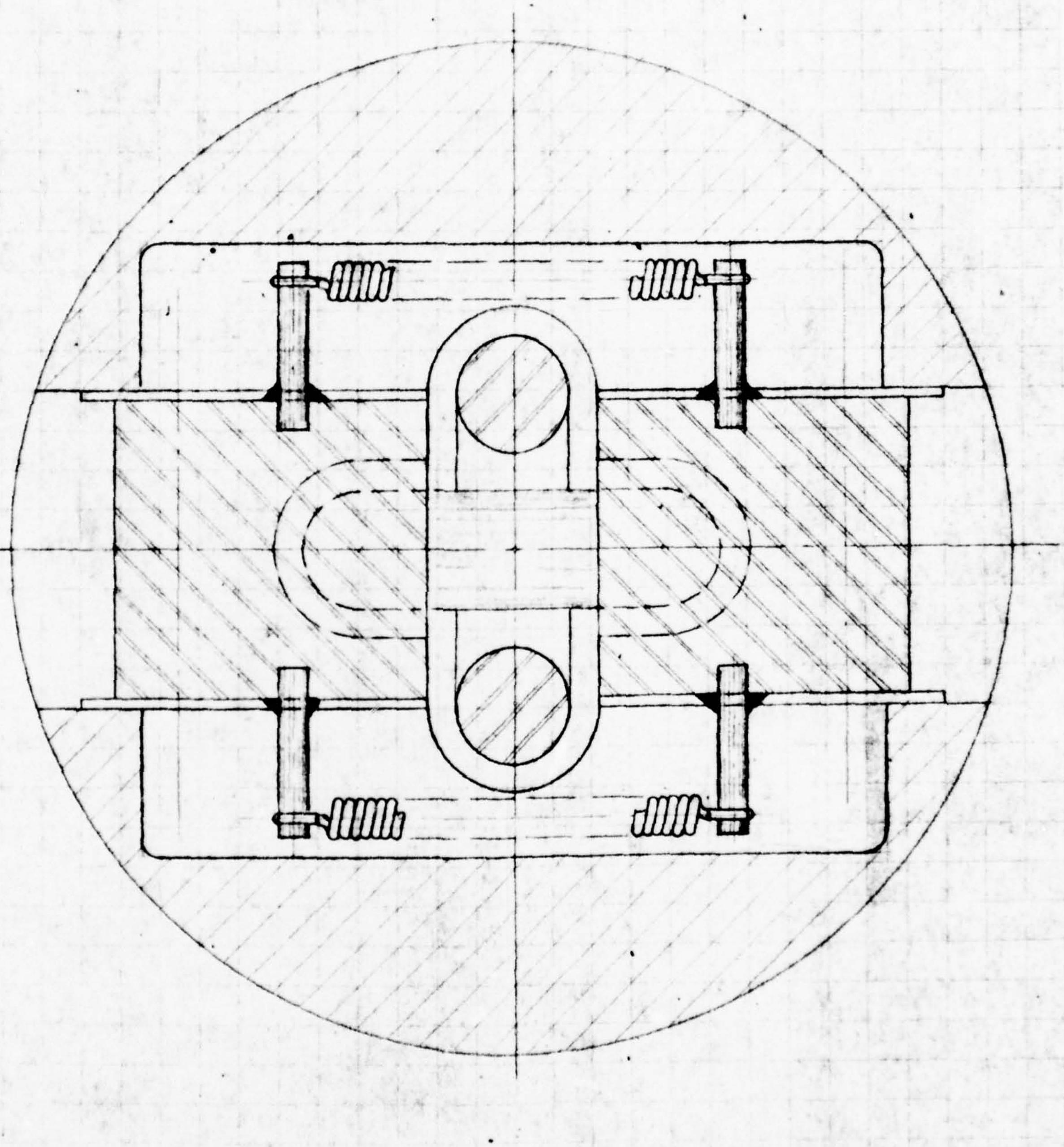
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY - E.R.D.L
SHEET NO:
SUBJECT: MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPPER
DRAWING NUMBER:
COMPUTER: WAP
CHECKED BY:
DATE: 2-12-65



SECTION "A-A"

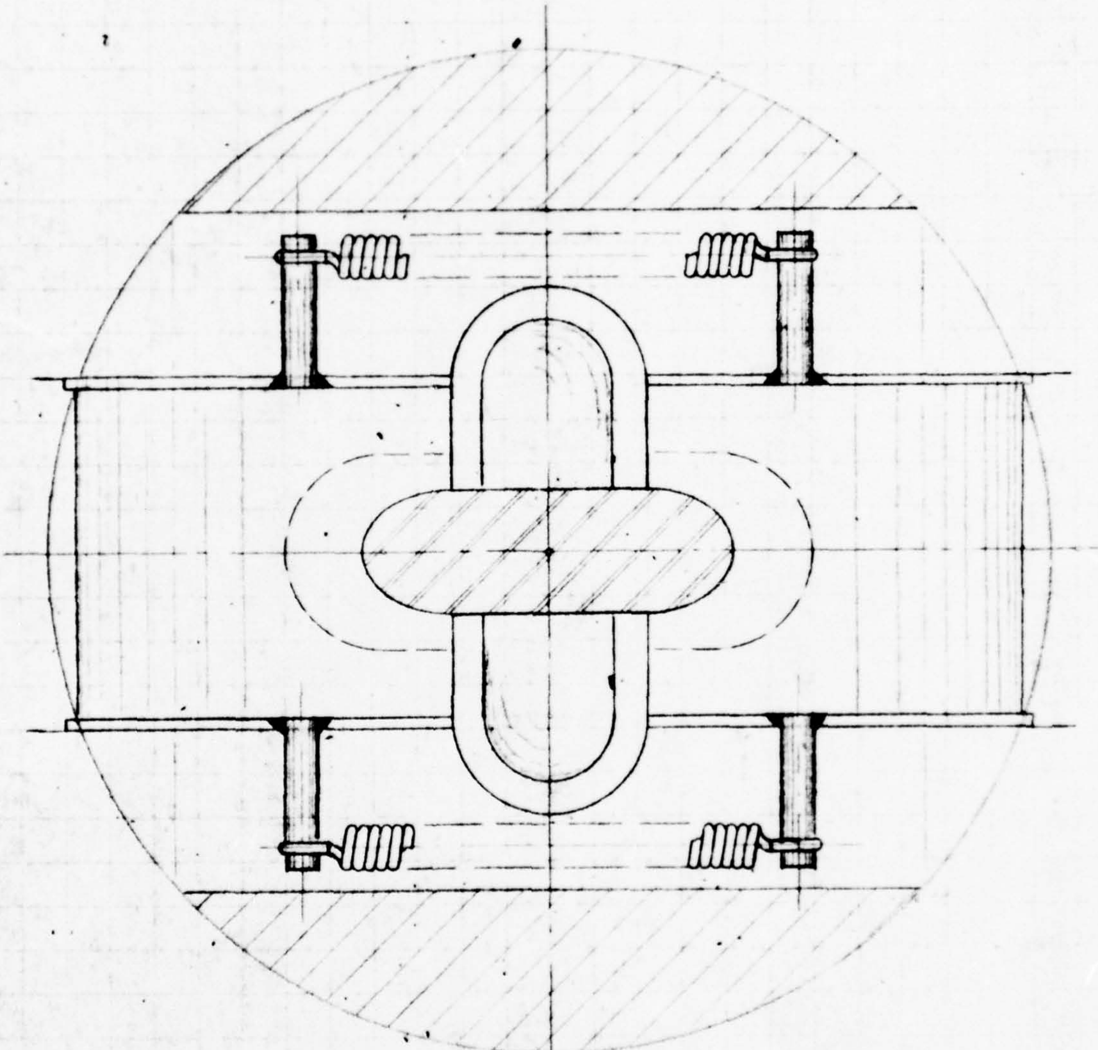


SECTION "B-B"

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD J 4003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY ERDL
SHEET NO:
SUBJECT: MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPP
DRAWING NUMBER:
COMPUTER: WHD
CHECKED BY:
DATE: 2-15-65

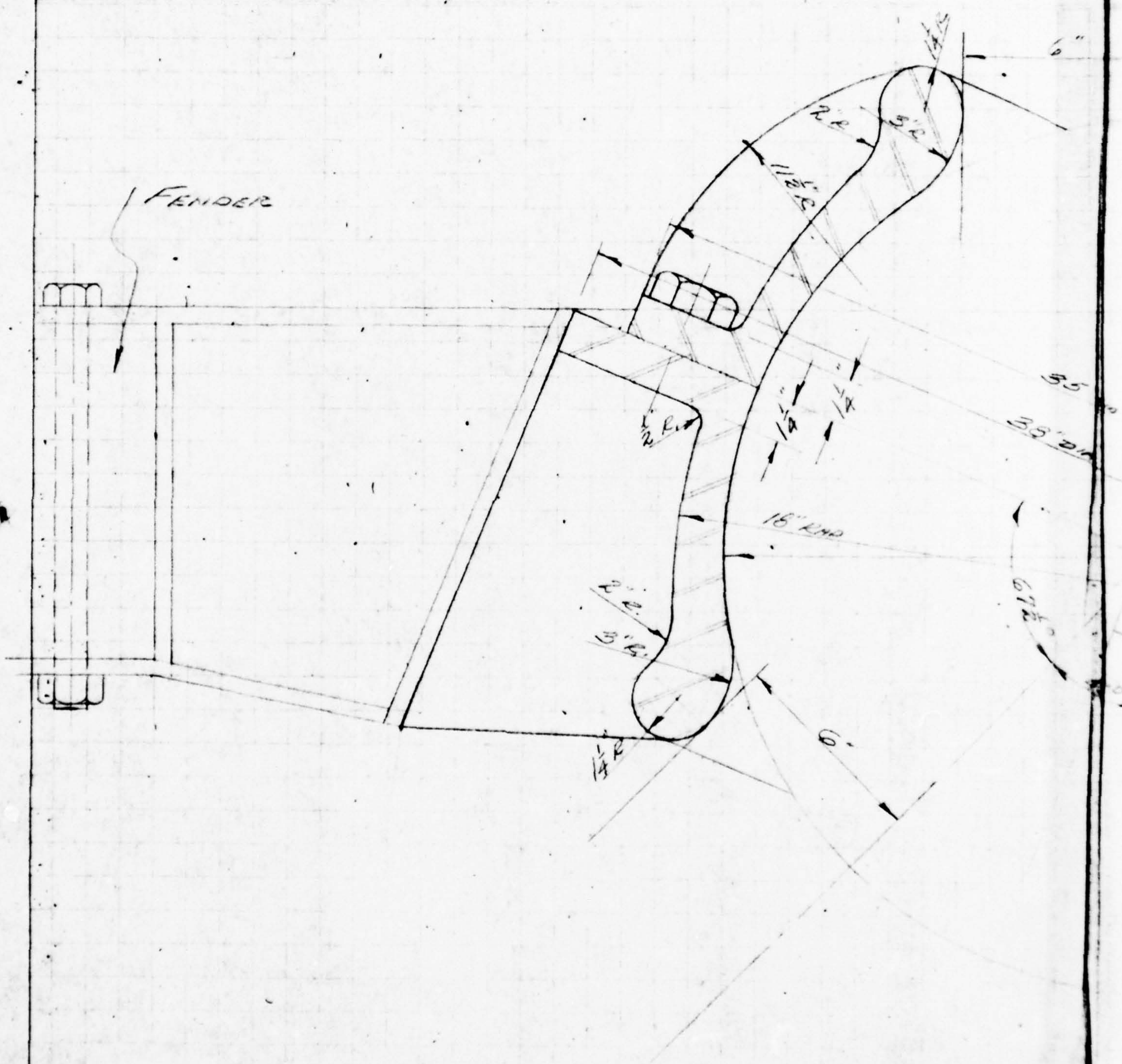


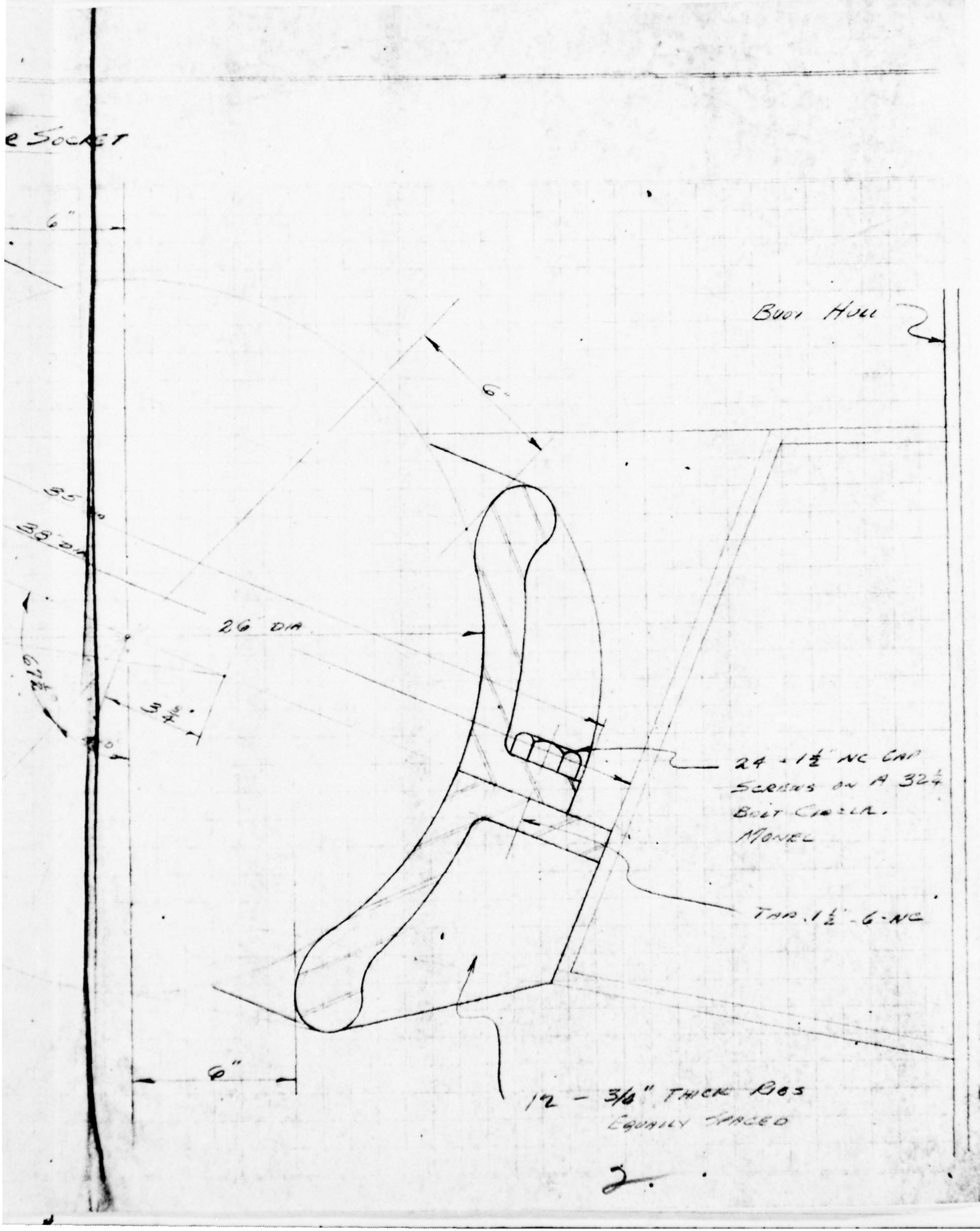
Storag

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

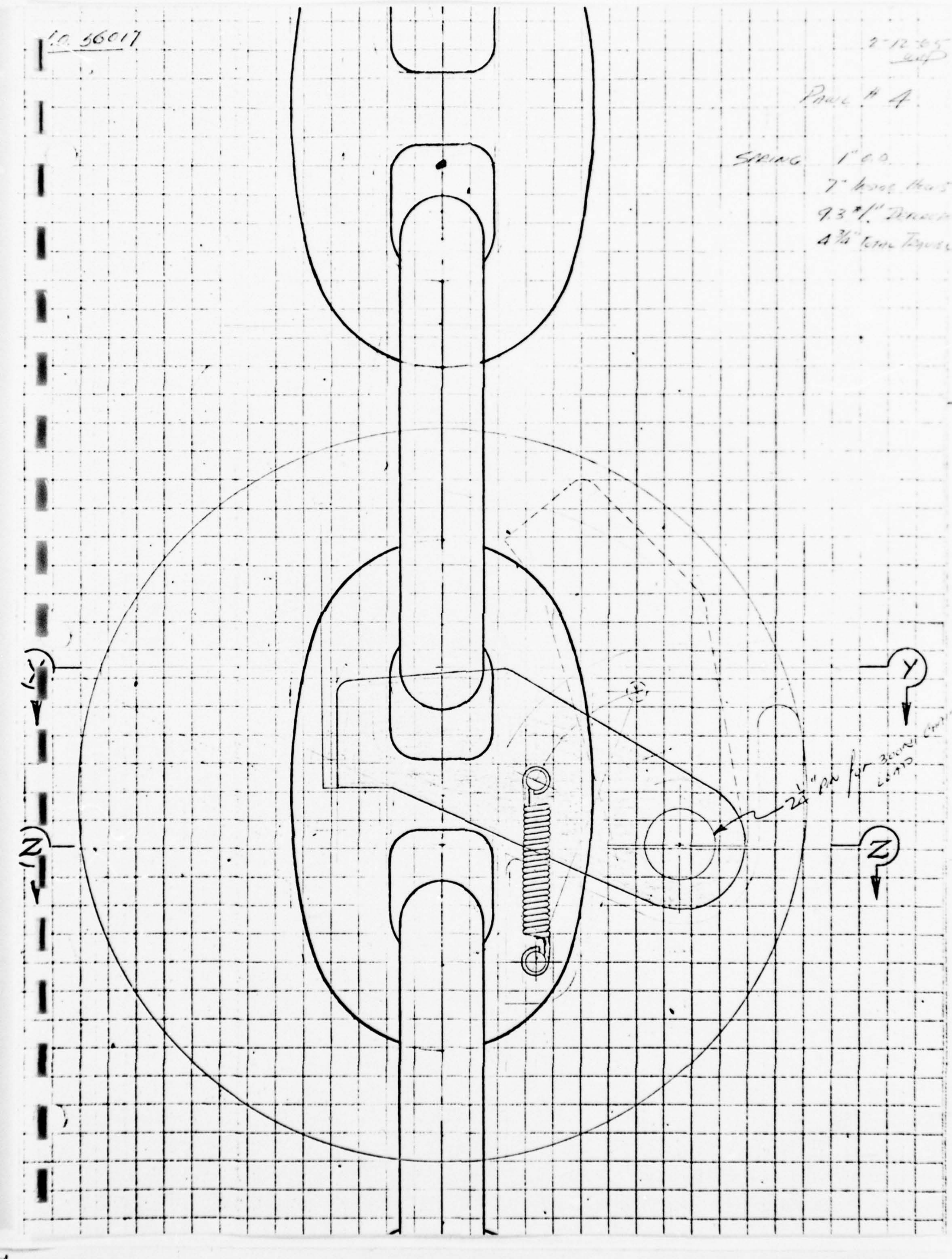
COMPANY: U.S. ARMY ERDL
SHEET NO
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER SOCK
DRAWING NUMBER | COMPUTER | CHECKED BY | DATE





e Socket
6"
35"
38" DIA
26 DIA
67½°
3¾"
6"
Buoy Hull
24 - 1½" NC Cap Screws on A 32¼ Bolt Circle. Monel
Tap 1½" - 6 - NC
6"
12 - 3/16" Thick Ribs Equally Spaced

2


Pawl # 4
SPRING 1" O.D.
Y
Z

2-11-65
[initials]

PITCH DIA = .880 = D

WIRE DIA = .120 = d , d^3 = .0017 , d^4 = .0002

INITIAL TENSION = 5 # = P_i

NO COILS 37 = N

COIL LENGTH = 4.58"

LENGTH INSIDE HOOKS 7"

OUTSIDE DIA = 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P_i D}{d^3}$

$$S = \frac{2.55 \times 5 \times .880}{.0017}$$

$$S = 6{,}600 \text{ psi}$$

SPRING RATE: $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .0002}{8 \times .69 \times 37}$$

$$P = 9.3 \text{ \#/'' DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi [illegible])

$$P_{MAX} = \frac{S_T \pi d^3}{16 \; R \frac{1}{14}}$$

$$P_{MAX} = \frac{75{,}000 \times 3.14 \times .0017}{16 \times .44 \times 1.15}$$

P_{MAX} = 49.4 # (MAX ALLOWABLE SAFE LOAD)

INITIAL TENSION = 5 # = P_1

NO COILS 37 = N

COIL LENGTH = 4.58"

LENGTH INSIDE HOOKS 7"

OUTSIDE DIA = 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P_1 D}{d^3}$

$$S = \frac{2.55 \times 5 \times .880}{.0017}$$

$$S = 6{,}600 \text{ psi}$$

SPRING RATE: $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .0002}{8 \times .69 \times 37}$$

$$P = 9.3 \ \#/'' \text{ DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi HINRL)

$$P_{MAX} = \frac{S_T \pi d^3}{16 R \frac{r_1}{r_4}}$$

$$P_{MAX} = \frac{75{,}000 \times 3.14 \times .0017}{16 \times .44 \times 1.15}$$

$$P_{MAX} = 49.4 \ \#$$ (MAX ALLOWABLE SAFE LOAD)

BENDING STRESS = $S_B = \frac{32 PR}{\pi d^3} \times \frac{r_1}{r_3}$

$$S_B = \frac{32 \times 49.4 \times .44}{3.14 \times .0017} \times 1.15$$

$$S_B = 149{,}000 \text{ psi}$$

DEFLECTION = $F = \frac{P_{MAX} - P_1}{P}$

$$F = \frac{49.4 - 5}{9.3} = 4.77''$$ (MAX SAFE DEFLECTION

Extension Springs

An extension spring is a close-coiled helical spring that offers resistance to a pulling force. They are made from round and square wire; coils are usually close-wound and in contact with each other. They are different from compression springs from a loading standpoint, inasmuch as the coils may be wound so tightly together that an effort is required to pull them apart. This load built up by coiling is called initial tension and is a controllable factor to a certain extent.

To provide a satisfactory extension spring, or to intelligently quote on your inquiries, the following information should be given:

Specifications and Design of Extension Springs

Material

The material, if steel, may be specified as "Spring Steel Wire" if the choice of the grade of wire is to be left to the manufacturer.

If, however, a particular type or grade of material has been found to be satisfactory or necessary, full information should be given to assure satisfactory springs.

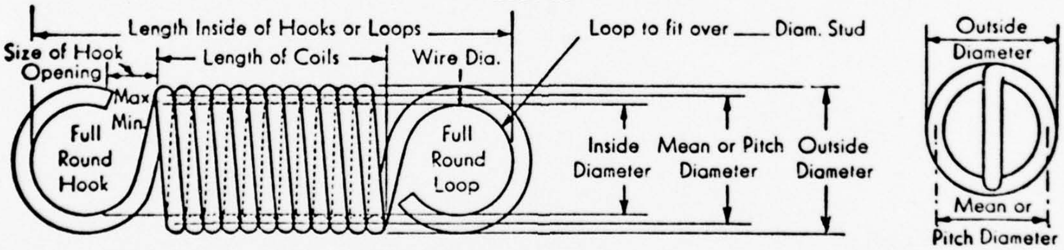
Wire Diameter

The wire diameter should be specified in decimals to avoid any confusion due to the various gauge tables. If no loads are specified on the blueprint, the wire will be maintained within the commercial tolerance for its size. If loads are specified, the wire diameter is then of secondary importance and may be changed in order to meet the load requirements.

Spring Diameter

While extension springs do not require a stud or hole to guide their action, few have unlimited operating space, and necessary clearances between component parts must be maintained. If spring operates in a hole

FIG. 11



To provide a satisfactory extension spring, or to quote intelligently on inquiries, the following information should be given:

Material ~~4340 [illegible]~~ SAE 30316 STAINLESS

Working Specifications *(Fill in required data only)*

Max. outside diameter 1"

Min. inside diameter ______

Initial tension 5#

To support 50 *lbs. ±* ____ *lbs. at* 4 3/4 *inches*

To support ____ *lbs. ±* ____ *lbs. at* ____ *inches*

Rate per inch 9.3#

Max. extended length without set 4 3/4"

Direction of coil RH OR LH

Position of loops CENTERED

Type of ends FULL ROUND LOOP

Suggested Specifications

If no loads are given maintain as required specifications

Wire diameter .120

Outside diameter 1"

Total number of coils 37

Free length inside loops 7"

Special Information

______

______

1

2-11-65

PITCH DIA .865 = D

WIRE DIA .135 = d, $d^3 = .0024$, $d^4 = .00033$

INITIAL TENSION 5# = P_1

NO COILS 41 = N

COIL LENGTH 5.67"

LENGTH INSIDE HOOKS 8"

OUTSIDE DIA 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P D}{d^3}$

$$S = \frac{2.55 \times 5 \times .865}{.0024}$$

$$S = 4{,}600 \text{ psi}$$

SPRING RATE = $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .00033}{8 \times .65 \times 41}$$

$$P = 14.75 \text{ \#/" DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi MONEL)

$$P_{max} = \frac{S_T \pi d^3}{16 R \frac{r_1}{r_4}}$$

$$P_{max} = \frac{75{,}000 \times 3.14 \times .0024}{16 \times .432 \times 1.15}$$

P_{max} = 71# (MAX ALLOWABLE SAFE LOAD)

BENDING STRESS = $S_B = \frac{32 PR}{\pi d^3} \times \frac{r_1}{r_3}$

$$S_B = \frac{32 \times 71 \times .432}{3.14 \times .0024} \times 1.15$$

$$S_B = 149{,}000 \text{ psi}$$

DEFLECTION = $F = \frac{P_{max} - P_1}{P}$

INITIAL TENSION 5 # = P_i

NO COILS 41 = N

COIL LENGTH 5.67"

LENGTH INSIDE HOOKS 8"

OUTSIDE DIA 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P D}{d^3}$

$$S = \frac{2.55 \times 5 \times .865}{.0024}$$

$$S = 4,600 \text{ psi}$$

SPRING RATE = $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .00033}{8 \times .65 \times 41}$$

$$P = 14.75 \text{ \#/" DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi MONEL)

$$P_{max} = \frac{S_T \pi d^3}{16 R \frac{r_1}{r_4}}$$

$$P_{max} \frac{75,000 \times 3.14 \times .0024}{16 \times .432 \times 1.15}$$

$$P_{max} = 71 \text{ \#}$$ (MAX ALLOWABLE SAFE LOAD)

BENDING STRESS = $S_B = \frac{32 PR}{\pi d^3} \times \frac{r_1}{r_3}$

$$S_B = \frac{32 \times 71 \times .432}{3.14 \times .0024} \times 1.15$$

$$S_B = 149,000 \text{ psi}$$

DEFLECTION = $F = \frac{P_{max} - P_i}{P}$

$$F = \frac{71 - 5}{14.75} = 4.48"$$ (MAX SAFE DEFLECTION)

Extension Springs

An extension spring is a close-coiled helical spring that offers resistance to a pulling force. They are made from round and square wire; coils are usually close-wound and in contact with each other. They are different from compression springs from a loading standpoint, inasmuch as the coils may be wound so tightly together that an effort is required to pull them apart. This load built up by coiling is called initial tension and is a controllable factor to a certain extent.

To provide a satisfactory extension spring, or to intelligently quote on your inquiries, the following information should be given:

Specifications and Design of Extension Springs

Material

The material, if steel, may be specified as "Spring Steel Wire" if the choice of the grade of wire is to be left to the manufacturer.

If, however, a particular type or grade of material has been found to be satisfactory or necessary, full information should be given to assure satisfactory springs.

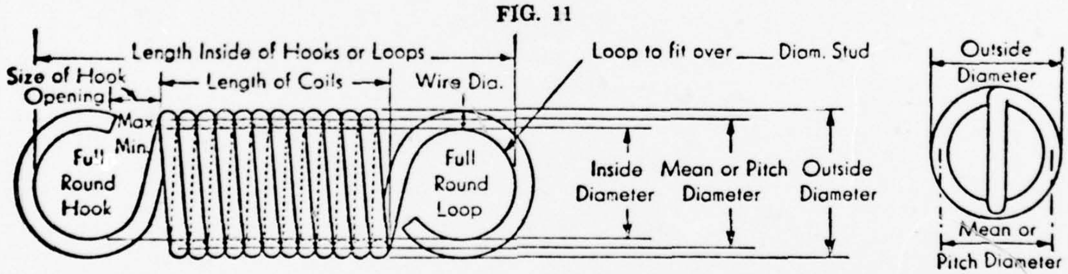
Wire Diameter

The wire diameter should be specified in decimals to avoid any confusion due to the various gauge tables. If no loads are specified on the blueprint, the wire will be maintained within the commercial tolerance for its size. If loads are specified, the wire diameter is then of secondary importance and may be changed in order to meet the load requirements.

Spring Diameter

While extension springs do not require a stud or hole to guide their action, few have unlimited operating space, and necessary clearances between component parts must be maintained. If spring operates in a hole

FIG. 11



To provide a satisfactory extension spring, or to quote intelligently on inquiries, the following information should be given:

Material ~~[illegible]~~ SAE 30316 STAINLESS

Working Specifications *(Fill in required data only)*

Max. outside diameter 1"

Min. inside diameter ______

Initial tension 5#

To support 70 ***lbs. ±*** ______ ***lbs. at*** 4 1/2 ***inches***

To support ______ ***lbs. ±*** ______ ***lbs. at*** ______ ***inches***

Rate per inch 14.75 #

Max. extended length without set 4 1/2"

Direction of coil RH or LH

Position of loops CENTERED

Type of ends FULL ROUND LOOP

Suggested Specifications

If no loads are given maintain as required specifications

Wire diameter .135

Outside diameter 1"

Total number of coils 41

Free length inside loops 8"

Special Information

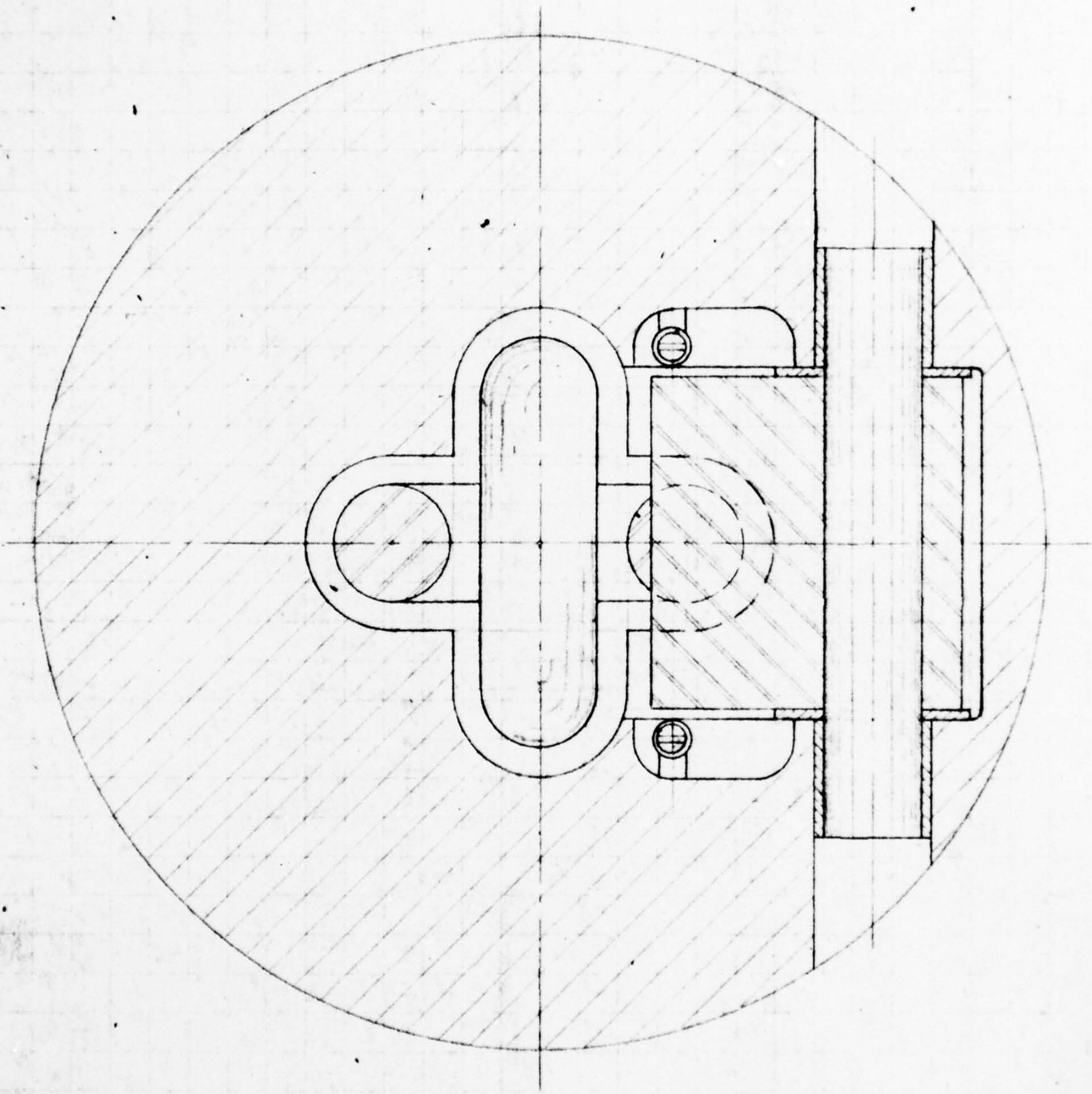
______

______

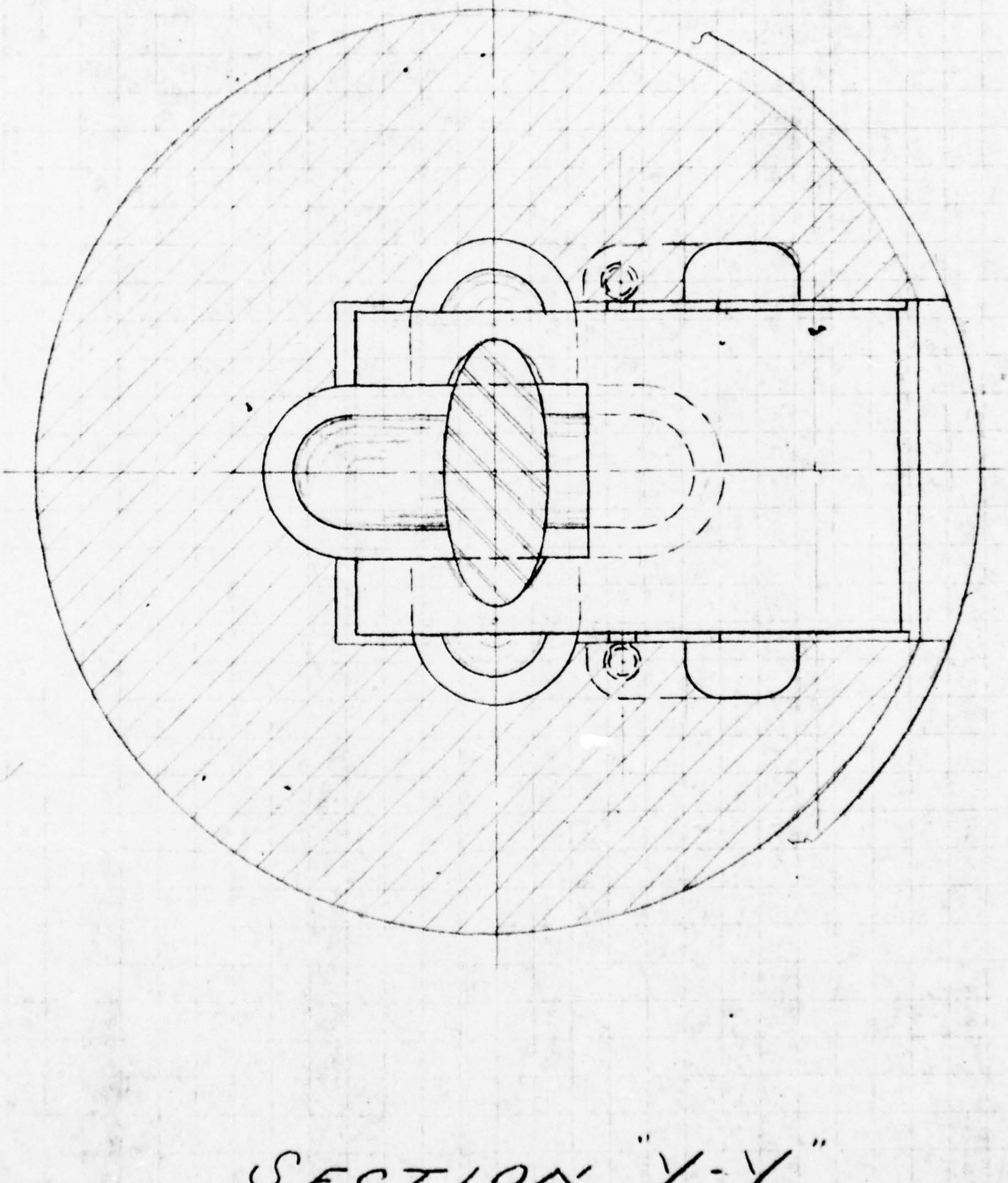
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY - E.R.D.L.
SHEET NO
SUBJECT MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPPER
DRAWING NUMBER
COMPUTER WKP
CHECKED BY
DATE 2-15-65



SECTION Z-Z



SECTION "Y-Y"

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

Job 56017

COMPANY	SHEET NO 1 of
SUBJECT Mono Mooring System	

DRAWING NUMBER	COMPUTER WAP	CHECKED BY	DATE 12-18-64

Mooring Windlass Calculations

Design Load:-

Chain Tensioning Load 28.3 K/chain
Hawse Pipe Friction = 40% : 11.3 K
Net Effective Chain Load 39.6 K

Chain Take Up Speed 10 ft/min.

Efficiencies:- (Assumed)

Wildcat & Bearings	.95
Power Gearing	.64
Hydraulic Unit & Piping	.70
Overall	.425

Chain H.P.:-

$$\frac{39.6 \times 10}{33} = 12 \text{ HP}$$

H.P. to Power Gearing Input Shaft:-

$$\frac{12}{.95 \times .64} + 5 \text{ (HP to turn idle wildcat - no load)} =$$

$$19.8 + 5 = 24.8 \text{ HP}$$

H.P. Reqd to Tension One Chain to Net Eff. Load

(Hydraulic Motor)

$$\frac{24.8}{.70} = 35.4 \text{ HP}$$

Gear Ratio:-

10:1 @ Wildcat Secondary
30:1 @ Power Sprocket Primary

$$\frac{10 \times 30}{1 \times 1} = 300:1$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

J. RAY McDERMOTT & CO., INC.

Job 56017

COMPANY	SHEET NO
	2 of

SUBJECT: Mono Mooring System

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-18-64

Effective P.D. of Wildcat:-

Based on 2⅞" Chain Size
Length 1 Link = 17¼"
Thickness of Link = 2⅞"

P.D. for Std 5 Whelp Wildcat

Length 10 Links = $10\left(17\tfrac{1}{4} - (2 \times 2\tfrac{7}{8})\right) = 115''$

$\frac{115}{3.1416} = 36.8''$ P.D. $\qquad \frac{115}{12} = 9.6'$

P.D. for 4 Whelp Wildcat

Length 8 Links = $8\left(17\tfrac{1}{4} - (2 \times 2\tfrac{7}{8})\right) = 92''$

$\frac{92}{3.1416} = 29.3''$ PD $\qquad \frac{92}{12} = 8.66'$

Wildcat R.P.M.:- (for 10 Ft/min Chain Speed)

for 5 Whelp Wildcat

$\frac{10}{9.6} = 1.04$ RPM

for 4 Whelp Wildcat

$\frac{10}{8.66} = 1.15$ RPM

Main Shaft Torque:—

for 5 Whelp Wildcat

$\frac{39.6^{k} \times 36.8}{2 \times .95} = 767{,}000$ #"

for 4 Whelp Wildcat

$\frac{39.6 \times 29.3}{2 \times .95} = 610{,}000$ #"

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

J. RAY McDERMOTT & CO., INC.

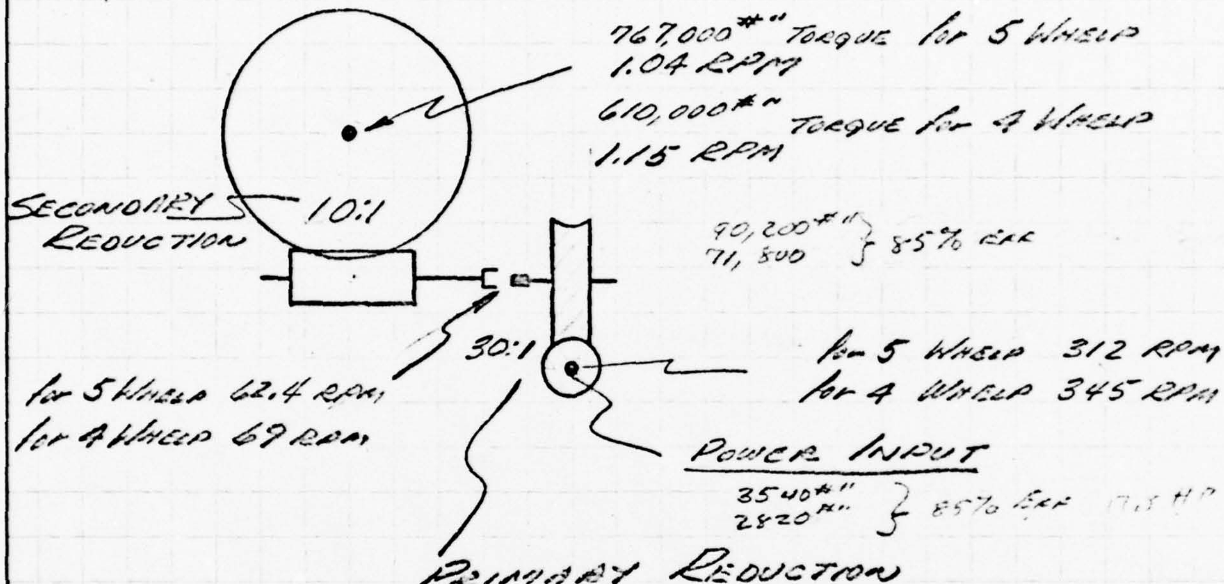
JOB 56017

COMPANY	SHEET NO
	3 of

SUBJECT: MONO MOORING SYSTEM

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-18-64

GEARING:-

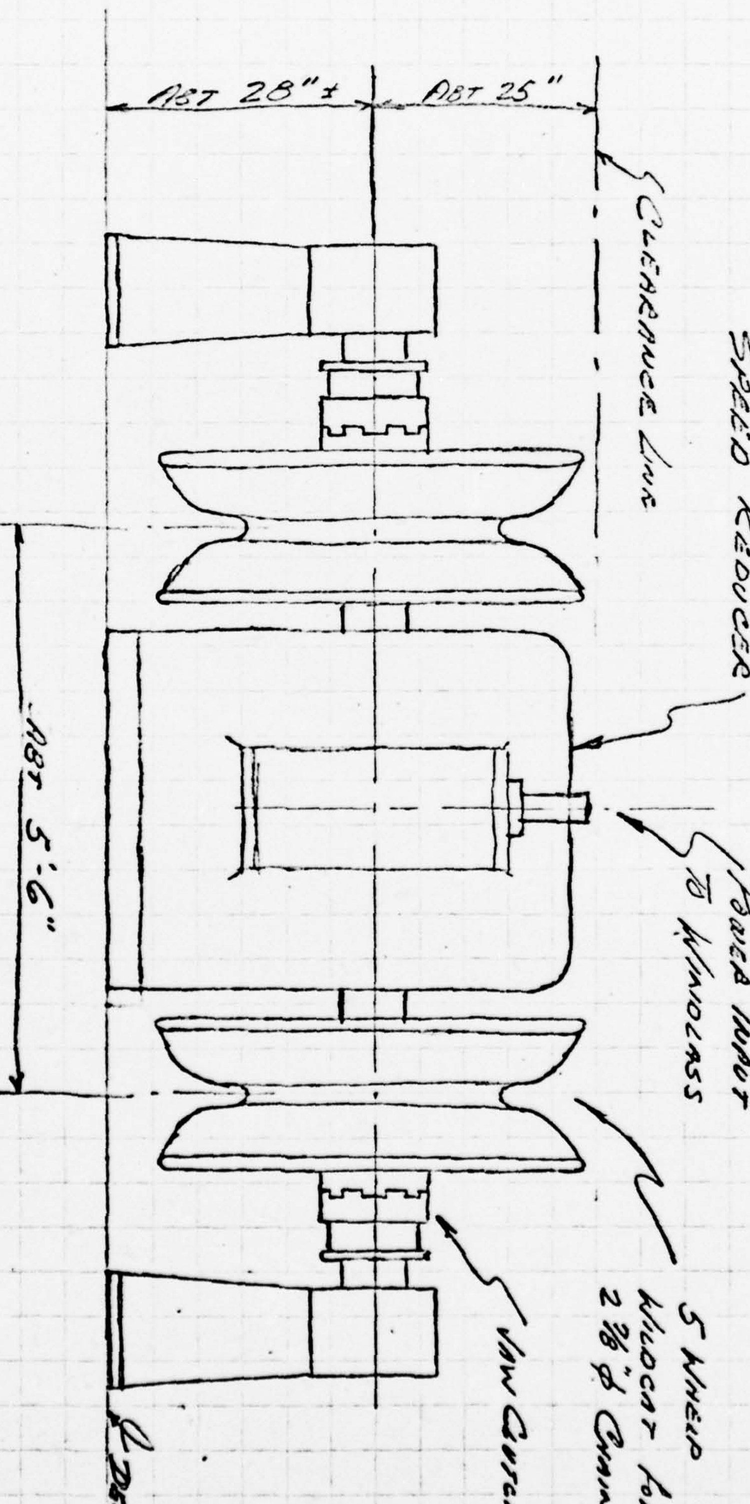


ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

J. RAY McDERMOTT & CO., INC.

JOB 56017

COMPANY			SHEET NO.
SUBJECT: MONO MOORING SYSTEM			
DRAWING NUMBER	COMPUTER: WAP	CHECKED BY	DATE: 12-21-64



ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

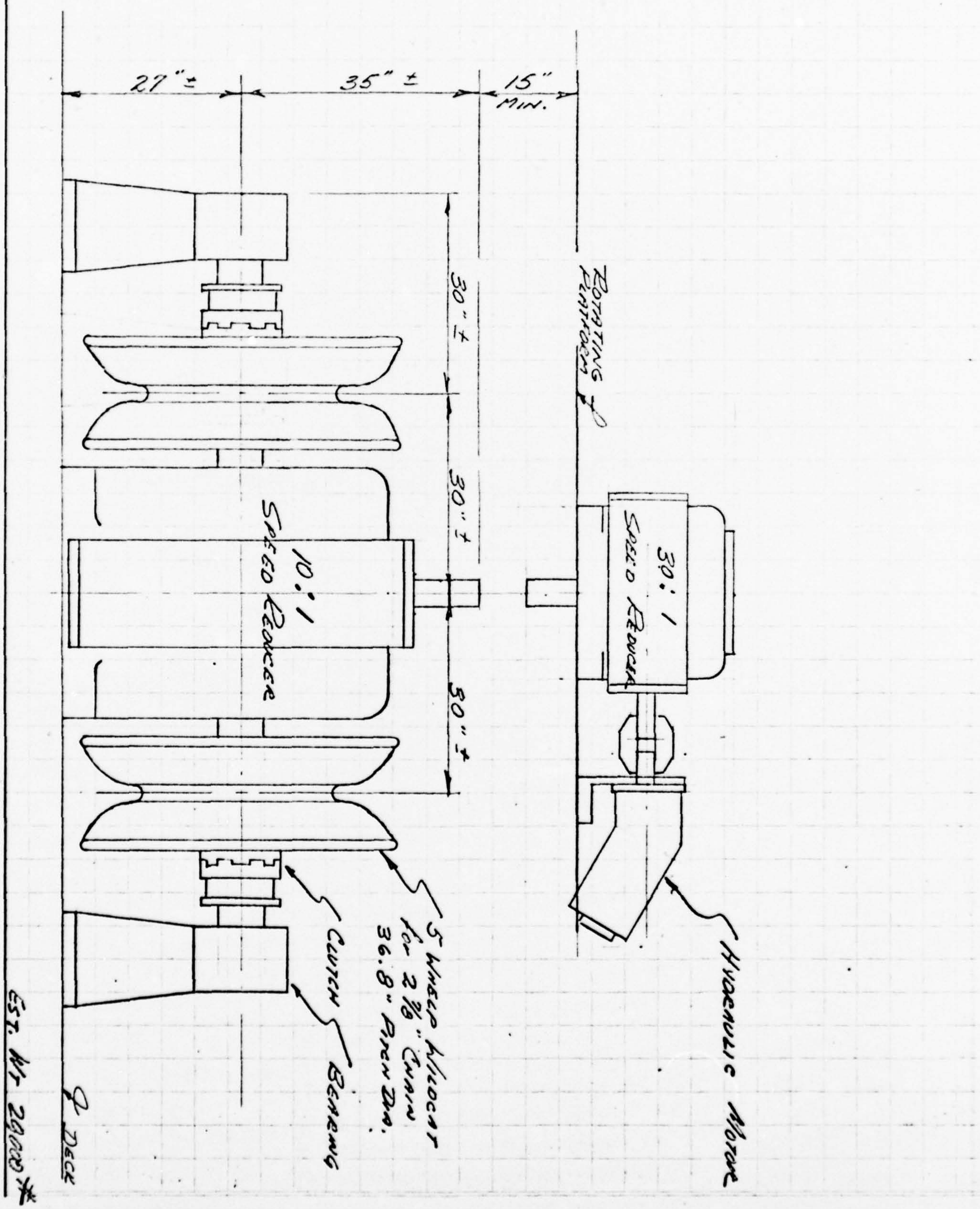
J. RAY McDERMOTT & CO., INC.

Job 56017

COMPANY	SHEET NO

SUBJECT: Mono Mooring System

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-22-67

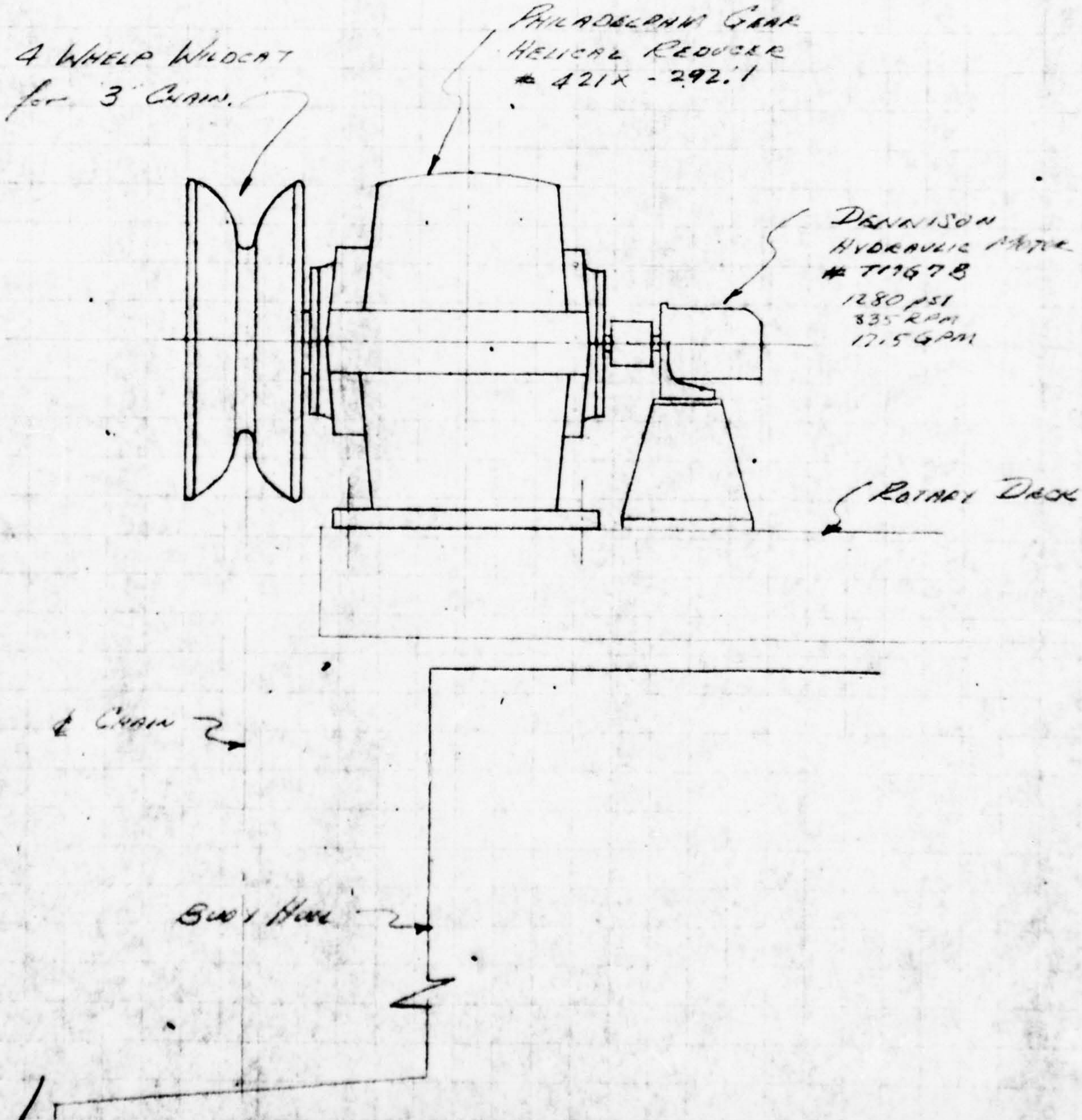


ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

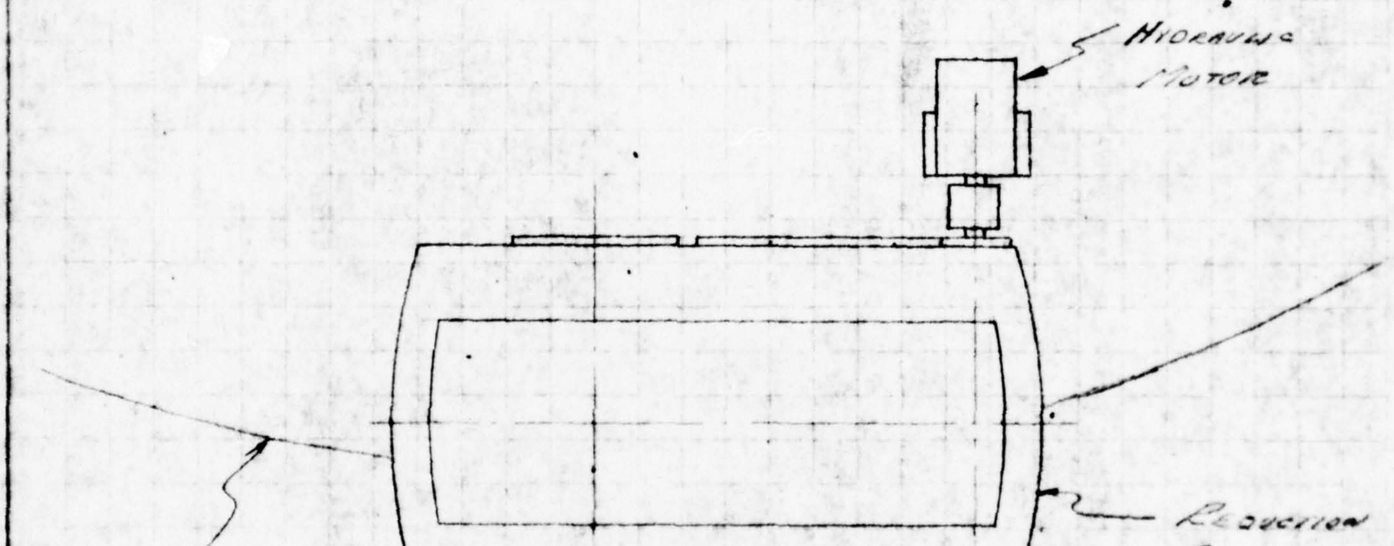
J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - E.R.D.L.			SHEET NO.
SUBJECT: MONO MOORING SYSTEM			
DRAWING NUMBER	COMPUTER: WAJ	CHECKED BY	DATE: 2-16-65

SECTION



PLAN



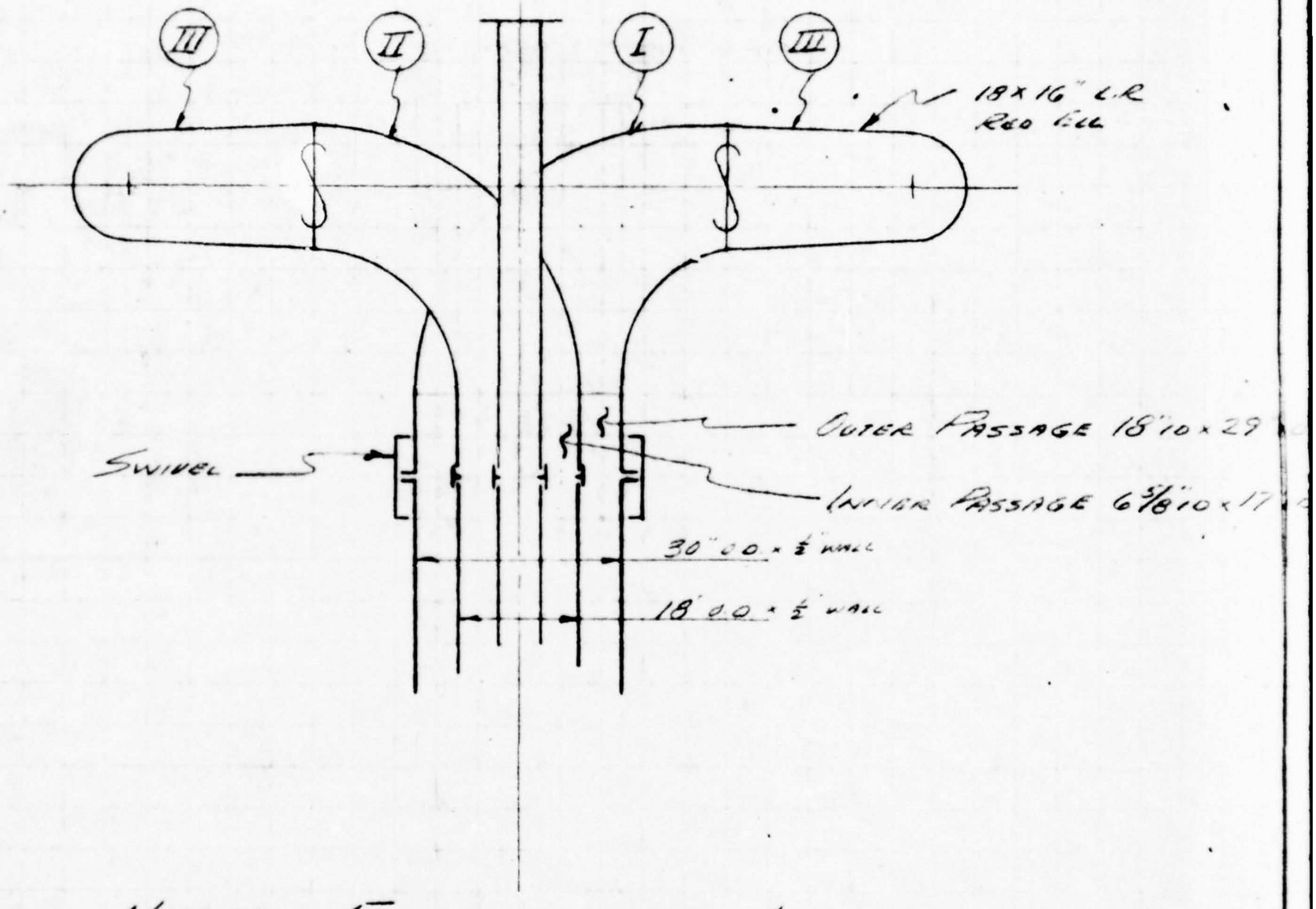
HYDRAULIC
MOTOR
REDUCTION
GEAR
BUOY HULL
WILDCAT
OUTER BUOY FENDER

12,000 #

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY - ERDL	SHEET NO: 1 of
SUBJECT: MONO MOORING SYSTEM - SWIVEL LOADS	
NUMBER: 56017	COMPUTER: WAP
CHECKED BY:	DATE: 2-19-65



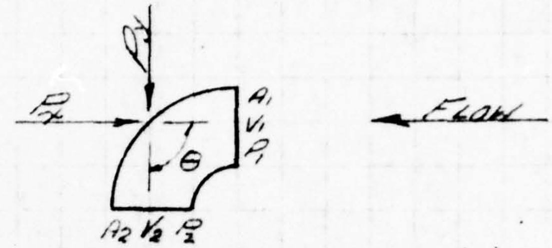
NOTES: FLOW THRU INNER & OUTER PASSAGES TO BE 10,500 GPM EACH. TOTAL 21,000 GPM (39000 BPH)

FLOW MAY BE THRU EITHER PASSAGE OR BOTH SIMULTANEOUS.

SERVICE PRESSURE RATING 150 psi @ AMBIENT TEMPERATURES

FORMULAS:

"BERNOULLI THEOREM"

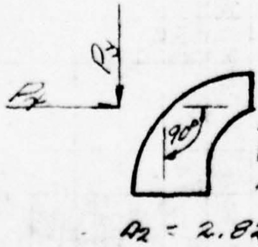


$$P_x = -\rho Q (V_2 \cos\theta - V_1) + P_1 A_1 - P_2 A_2 \cos\theta$$

$$P_y = \rho Q V_2 \sin\theta + P_2 A_2 \sin\theta$$

Q = FLOW cfs
ρ = DENSITY IN SLUGS PER CU FT : 1.935 for WATER
A_1 = AREA SQ FT
A_2 = " "
V_1 = VELOCITY fps
V_2 = " "
P_1 = PRESSURE LBS/SQ FT
P_2 = " "

(I).



$Q = 23.4$

A_1 = 1.58
V_1 = 14.8
P_1 = 21,600

A_2 = 2.82
V_2 = 8.3
P_2 = 21,600

(Cont'd)

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY - ERDL

SHEET NO: 2 of

SUBJECT: MONO MOORING SYSTEM - SWIVEL LOADS

NUMBER: J.O. 56017 | COMPUTER: WAP | CHECKED BY: | DATE: 2-22-65

(I) cont'd

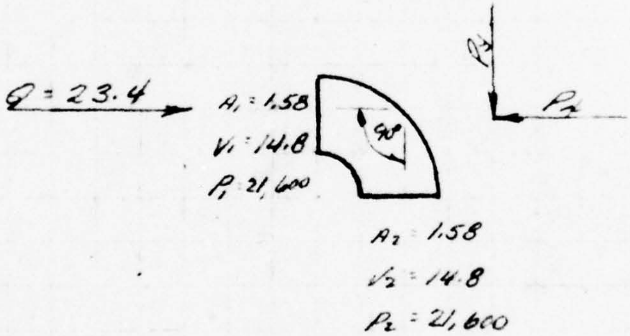
$P_x = -1.935 \times 23.4^{2} (8.3 \cos 90 - 14.8) + 21{,}600 \times 1.58 - 21{,}600$

$P_x = 670 + 34{,}100 - 0 = \underline{34{,}770 \text{ LBS}}$

$P_y = 1.935 \times 23.4 \times 8.3 \sin 90 + 21{,}600 \times 2.82 \sin 90$

$P_y = 375 + 60{,}850 = \underline{61{,}225 \text{ LBS}}$

(II)



$P_x = -1.935 \times 23.4 (14.8 \cos 90 - 14.8) + 21{,}600 \times 1.58\ 21$

$P_x = 670 + 34{,}100 - 0 = \underline{34{,}770 \text{ LBS}}$

$P_y = 1.935 \times 23.4 \times 14.8 \sin 90 + 21{,}600 \times 1.58 \sin 90$

$P_y = 670 + 34{,}100 = \underline{34{,}770 \text{ LBS}}$

s

1.58 - 21,600 x 2.82 cos 90

sin 90

x 1.58 21,600 x 1.58 cos 90

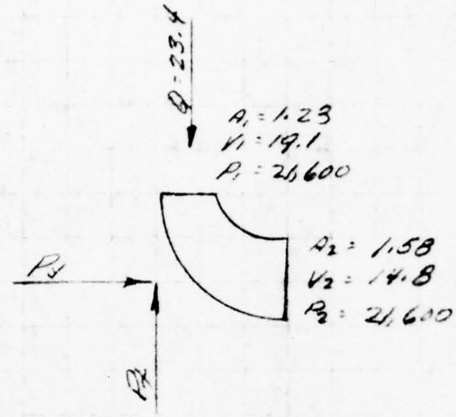
s

58 sin 90

s

2

(III)



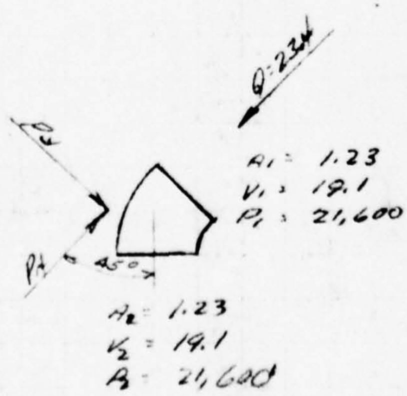
$P_x = -1.935 \times 23.4\ (14.8 \cos 90 - 19.1) + 21{,}600 \times 1.2$

$P_x = \quad 865 + 26{,}600 - 0 \quad = \quad \underline{27{,}465}$ LB

$P_y = 1.935 \times 23.4 \times 14.8 \sin 90 + 21{,}600 \times 1.58$

$P_y = \quad 670 + 34{,}100 \quad = \quad \underline{34{,}770}$ LBS

(IV)



$P_x = -1.935 \times 23.4\ (19.1 \cos 45 - 19.1) + 21{,}600 \times 1.$

$P_x = \quad 254 + 26{,}600 - 18{,}800 \quad = \quad \underline{8{,}05}$

⊥

905

45

600 x 1.23   21,600 x 1.58 cos 90

465 LBS

x 1.58 sin 90°

LBS

,600 x 1.23 - 21,600 x 1.23 cos 45

8,054 LBS

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

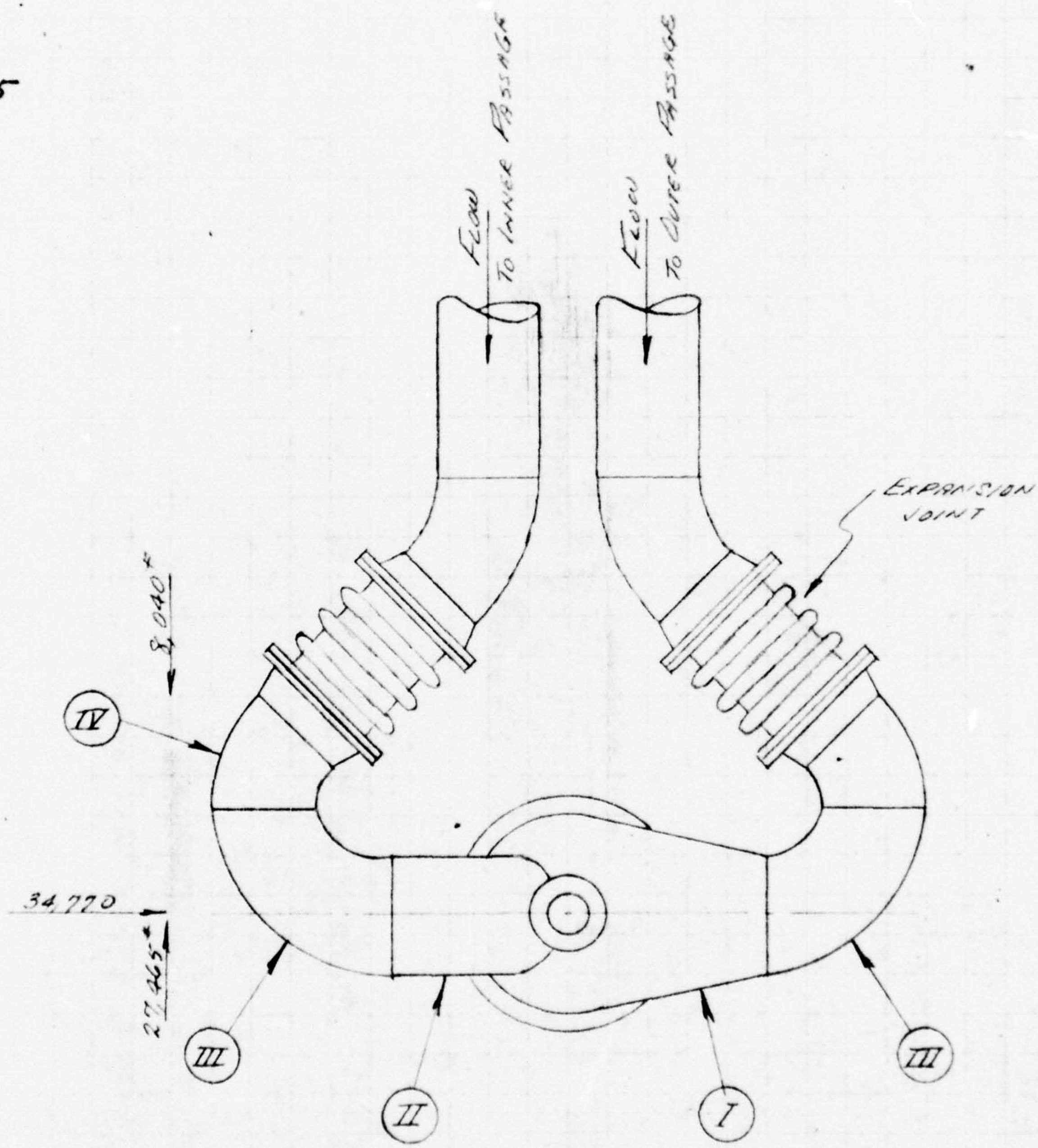
COMPANY	SHEET NO.
U.S. ARMY - E.R.D.L.	4 of

SUBJECT			
MONO MOORING SYSTEM - SWIVEL LOADS			
NUMBER	COMPUTER	CHECKED BY	DATE
V.O. 56017	WAD		2-22-65

(IV) cont'd

$P_y = 1.935 \times 23.4 \times 19.1 \sin 45 + 21{,}600 \times 1.$

$P_y = 612 + 18{,}800 = \underline{19{,}412 \text{ LBS}}$

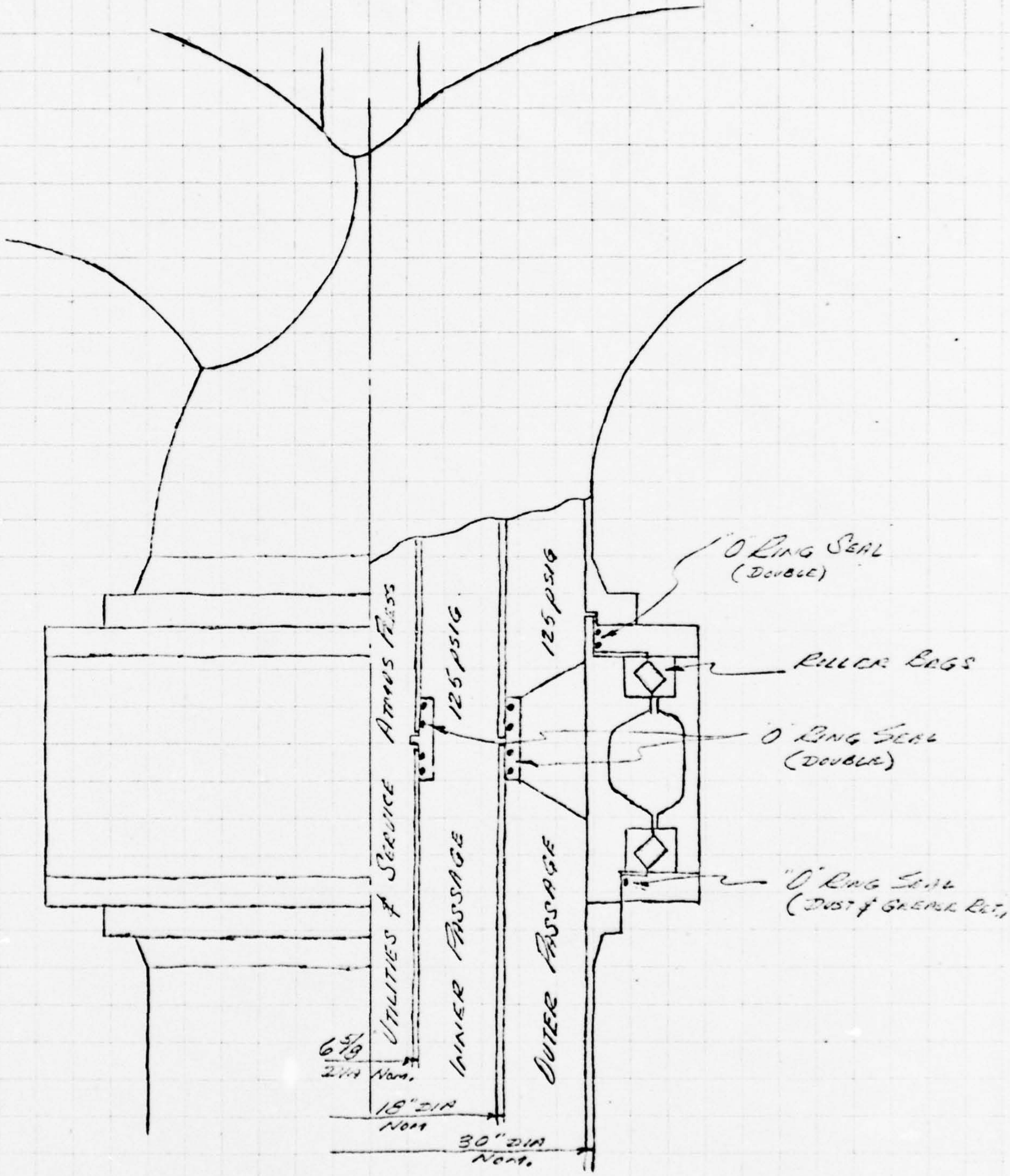


FLOW
TO INNER PASSAGE
FLOW
TO OUTER PASSAGE
EXPANSION JOINT
8.040±
34.770
27.465±
IV
III
II
I
III

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO JOB 56017
SUBJECT: MONO MOORING SYSTEM			
DRAWING NUMBER	COMPUTER: WAD	CHECKED BY	DATE: 2-1-65

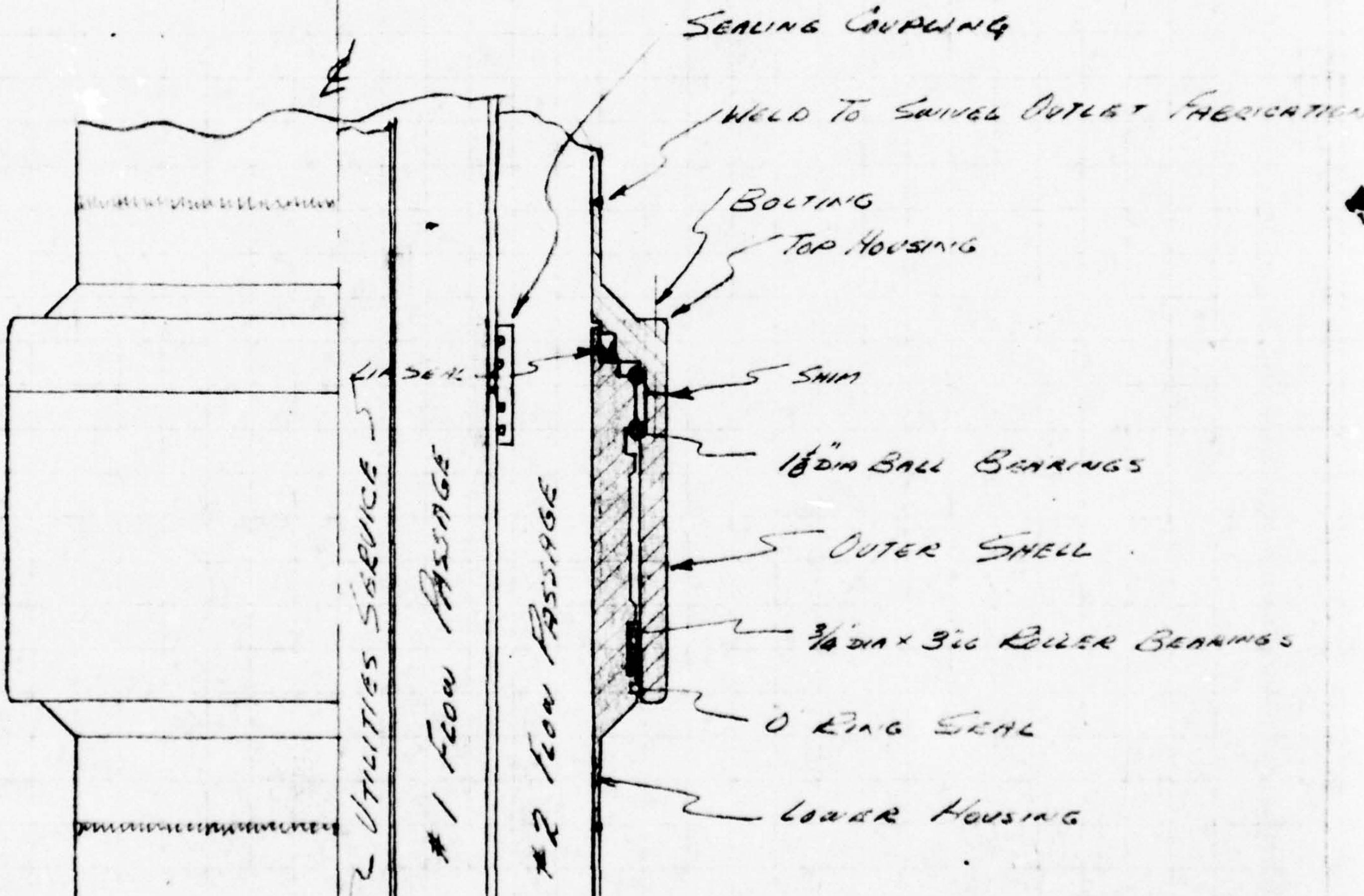


FLUID IN FLOW PASSAGES :-
AVIATION GASOLINE
JET FUEL, DIESEL OIL

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO 1 of 1
SUBJECT Mono Mooring System - Swivel	
DRAWING NUMBER	COMPUTER WAP
CHECKED BY	DATE 12-23-64



FABRICATION

BEARINGS

VERTICAL LIFTING FORCE = F (A - a)

F = 100 psi

A = $29^2 \times .785$ = 660.5 sq in

a = $6\frac{5}{8}^2 \times .785$ = 34.5 sq in

F = 100 (660.5 - 34.5) = **62,600#**

NEGLECTING WT OF SWIVEL OUTLET COMPONENTS

LOAD RATING FOR BALL BEARINGS: $P = .44Kd^2n$

P = PERMISSIBLE LOAD

K = CONSTANT 5-10 RPM = 20

d = DIA BALL = $1\frac{1}{8}$ = 9/8 = .9

n = NUMBER BALLS = $\frac{34 \times \pi}{1.125}$ = 95

$P = .44 \times 20 \times .9^2 \times 95$ = **68,400#**

LOAD RATING FOR ROLLER BEARING: $P = \frac{Klnd^2}{ND + 2000d}$

P: PERMISSIBLE LOAD

K: CONSTANT = 1,200,000

d = DIA ROLLER = .750"

n = NUMBER ROLLERS = 141

D = INNER RACE DIA = 33.5"

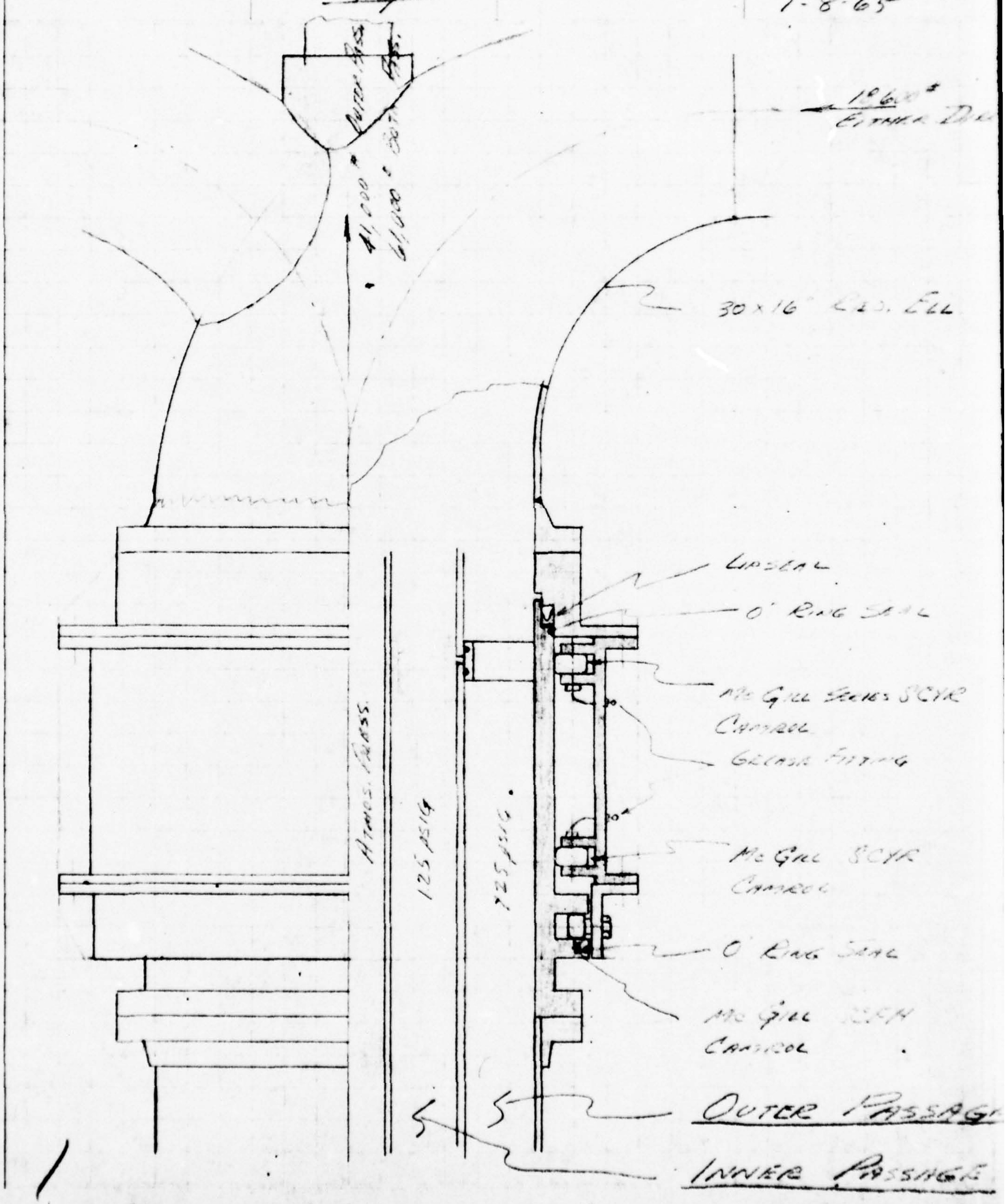
l = LENGTH OF ROLLER = 3"

$P = \frac{1,200,000 \times 3 \times 141 \times .75^2}{1 \times D + 2000 \times .75}$ = **186,000#**

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 2 of
SUBJECT Mono Mooring System - Preliminary Swivel			
DRAWING NUMBER	COMPUTER WAF	CHECKED BY	DATE 1-8-65



...URE DESIGN for 100 psi

...DIAGRAM

...ELL

...CYR

...SAGE

...AGE

OPERATING CONDITIONS

for 100 psi Service

1. FLOW IN OUTER PASSAGE ONLY

VERTICAL THRUST = 41,000#
OVERHANG LOAD = 18,600# @ 45"

2. FLOW IN BOTH PASSAGES

VERTICAL THRUST = 61,000#
OVERHANG LOAD = 22,000# @ 45"

3. FLOW IN INNER PASSAGE

LOADS EQUAL OR LESS THAN
CONDITION 1.

NOTE - ROTATION TO BE
ALMOST STATIC CONDITION

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY E.R.D.L.

SHEET NO: 3 of

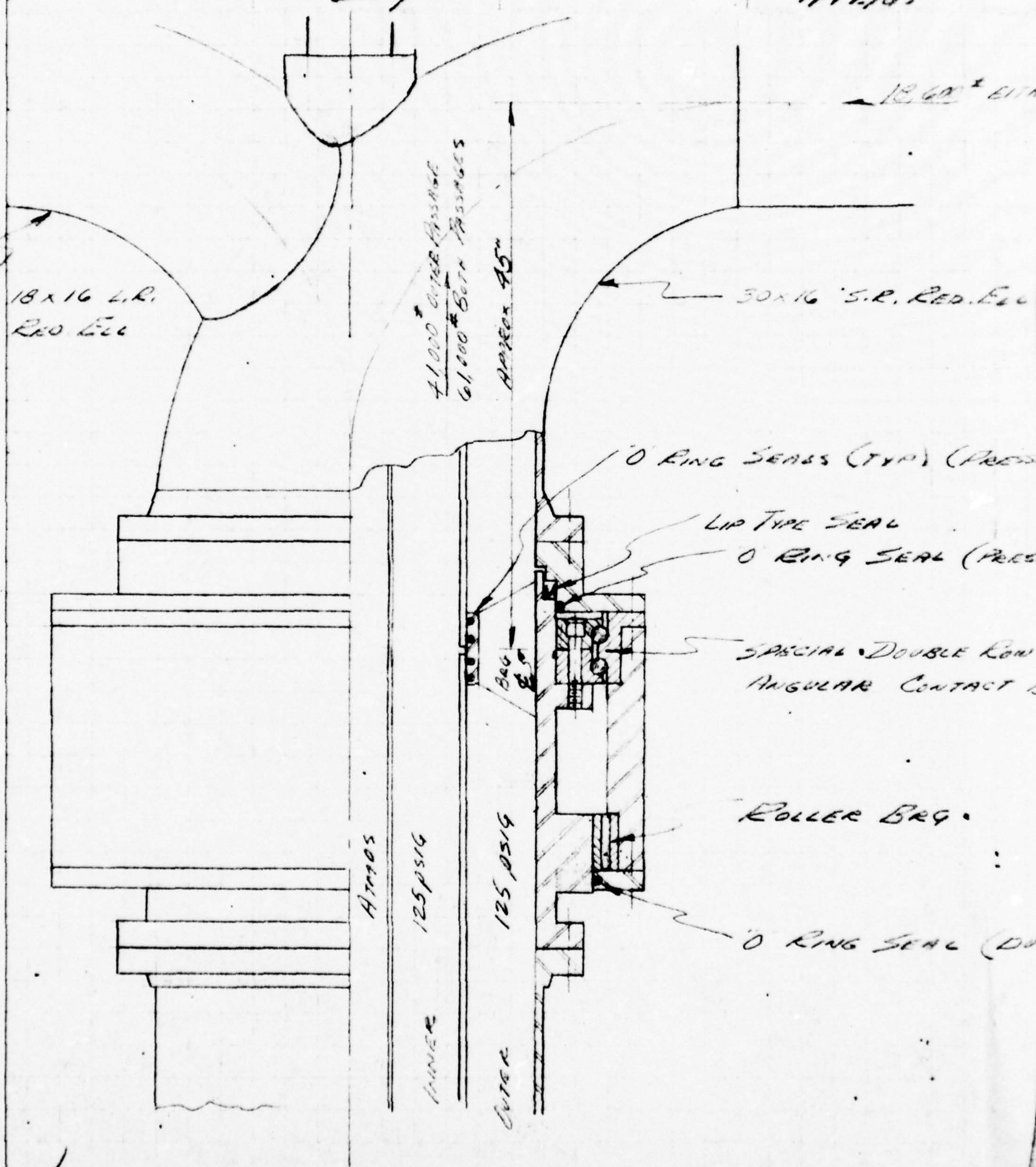
SUBJECT: MONO MOORING SYSTEM PRELIMINARY SWIV

DRAWING NUMBER:

COMPUTER: WRF

CHECKED BY:

DATE: 1/11/65



...f

... SWIVEL DESIGN for 100psi

...00 ± EITH DIRECTION

...RED. ELL

(PRESSURE)

...L (PRESSURE)

...GLE ROW
...NTACT BALL BRG.

...G.

:

...L (DUST & WATER)

OPERATING CONDITIONS
for 100 psi SERVICE

1. FLOW IN OUTER PASSAGE ONLY

VERTICAL THRUST 41,000#
OVER HUNG LOAD 18,600# @ 45"

2 FLOW IN BOTH PASSAGES

VERTICAL THRUST 61,000#
OVER HUNG LOAD : 22,000# @ 45"

3 FLOW IN INNER PASSAGE ONLY

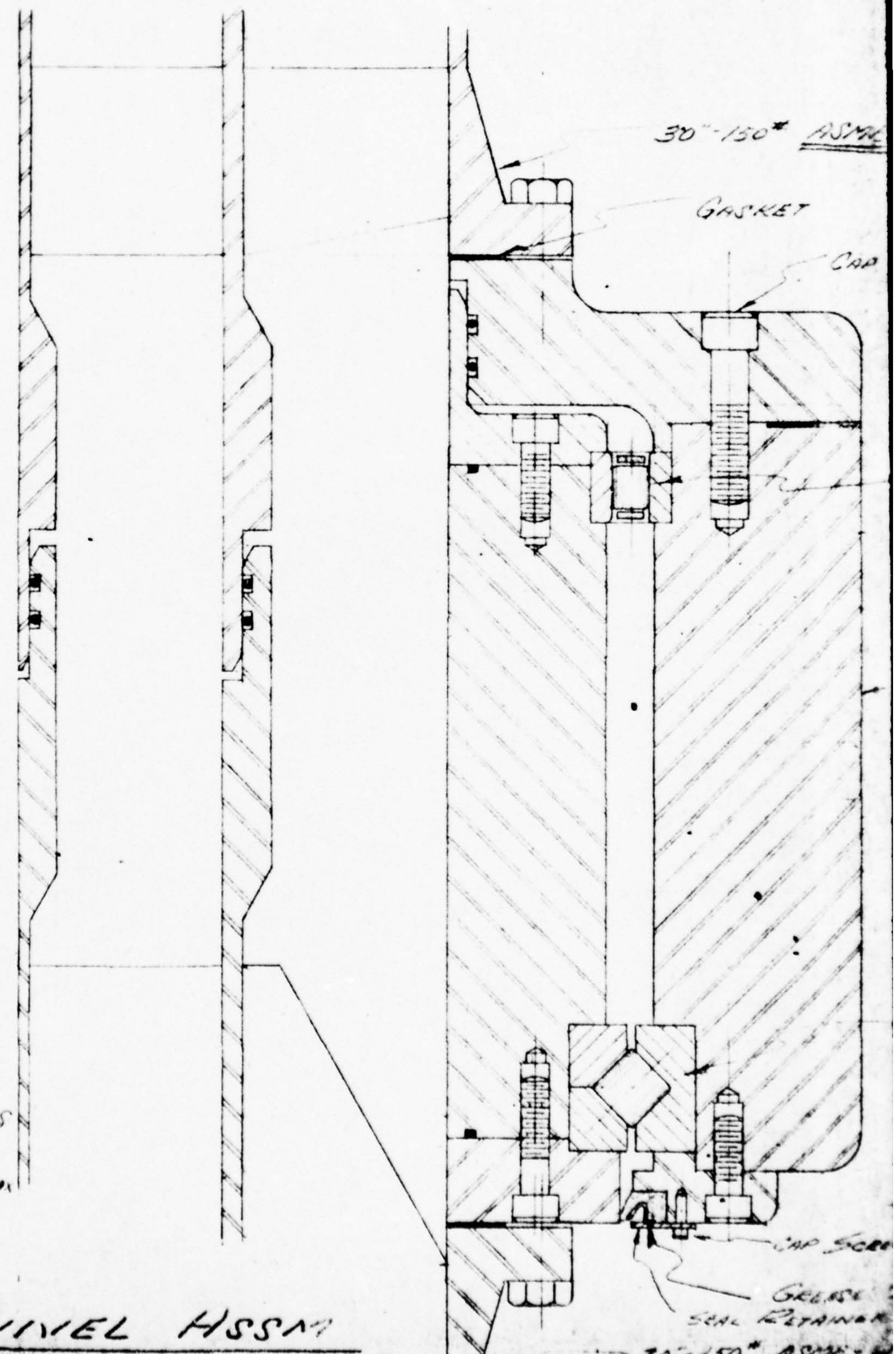
USE FIGURES FOR CONDITION 1.

NOTE: ROTATION TO BE
ALMOST STATIC CONDITION

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - EROL	SHEET NO
SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN for 150	
NUMBER: J.O. 56017 / COMPUTER: WAP / CHECKED BY:	DATE: 3-31-65



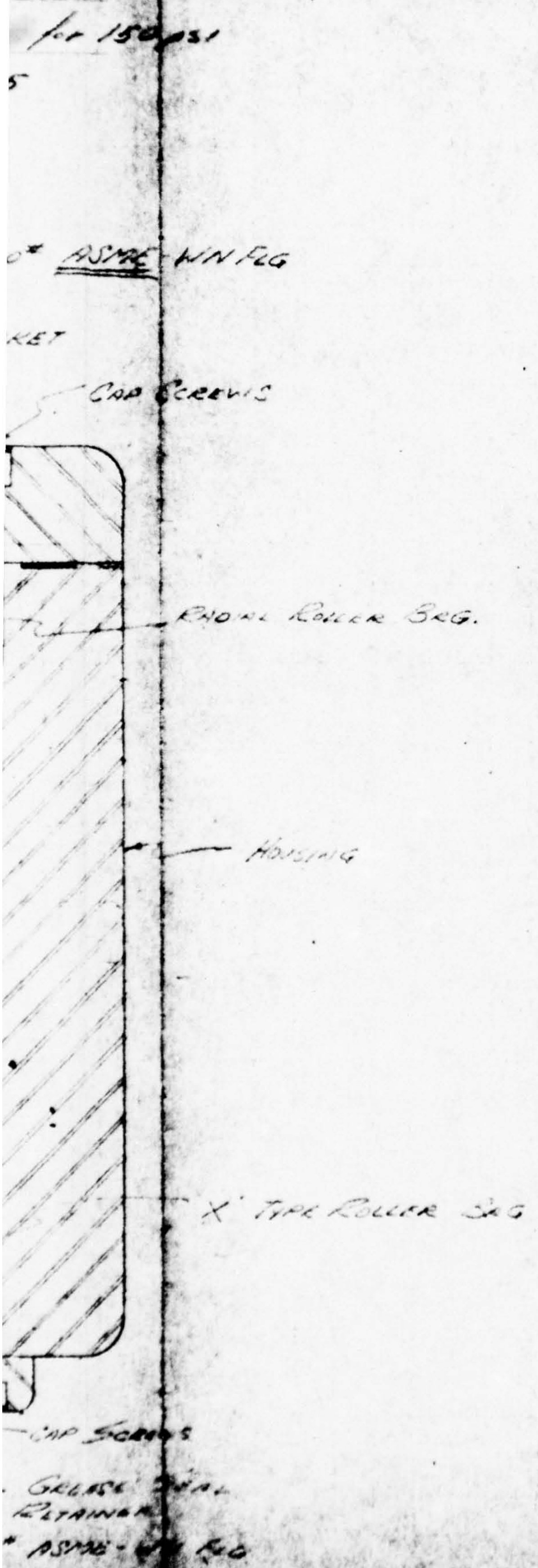
NOTE: —

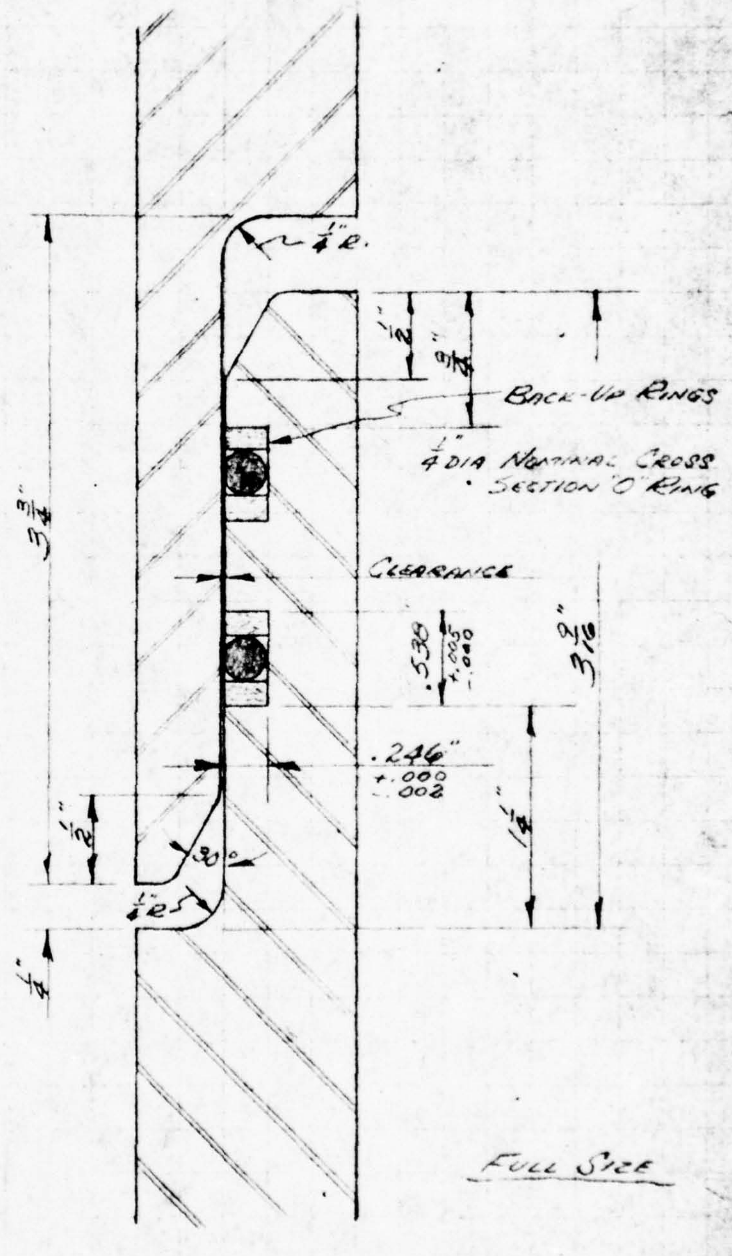
1. ALL SURFACES WHICH O RINGS FORM DYNAMIC SEAL TO BE 16 RMS
2. STATIC O RING SEAL TO BE 32 RMS
3. TIR TO BE .004" MAX

SWIVEL HSSM

¼ SIZE

1





TYPICAL SEAL ASSM.

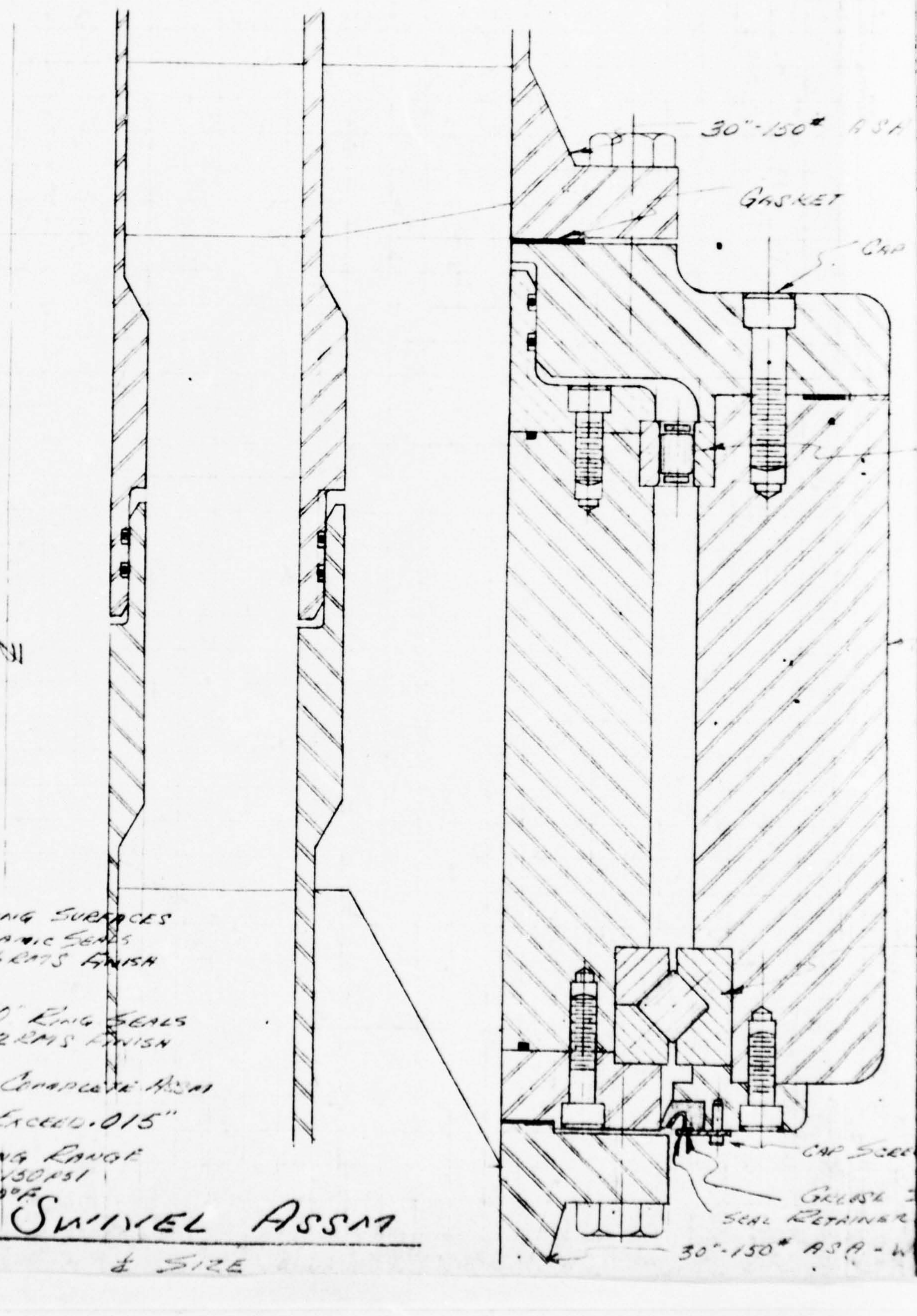
ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S ARMY · EROL	

SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN FOR 15[illegible]

NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		4-23-65

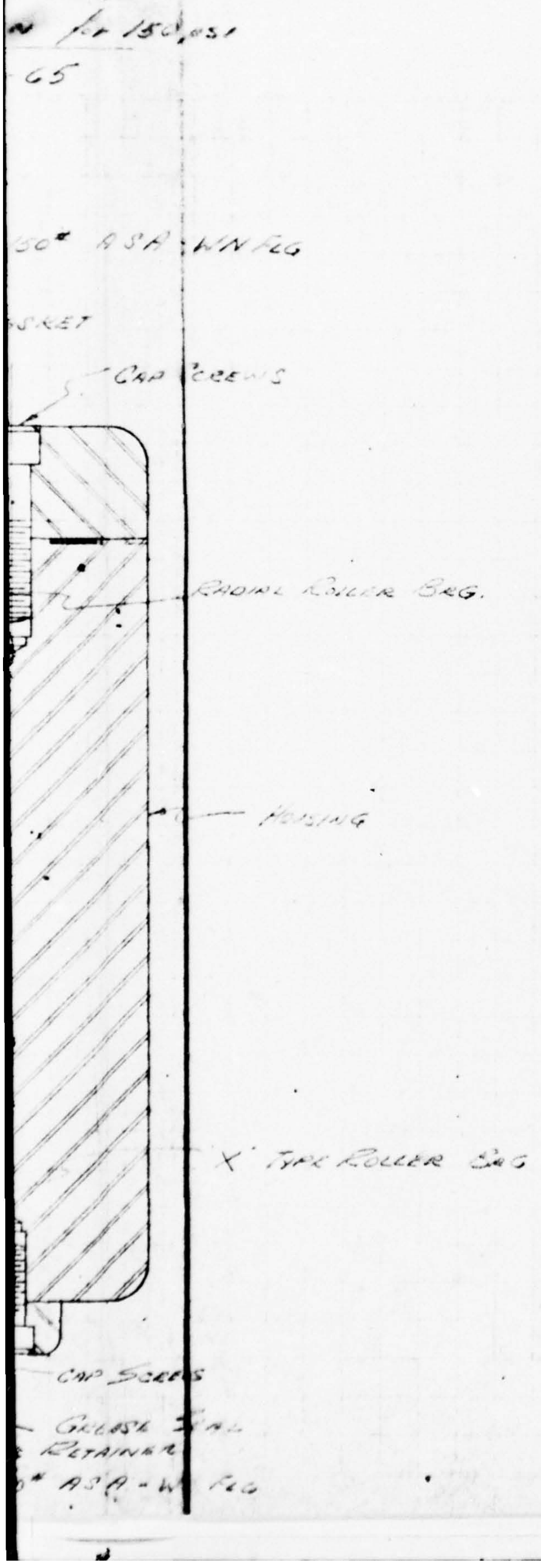


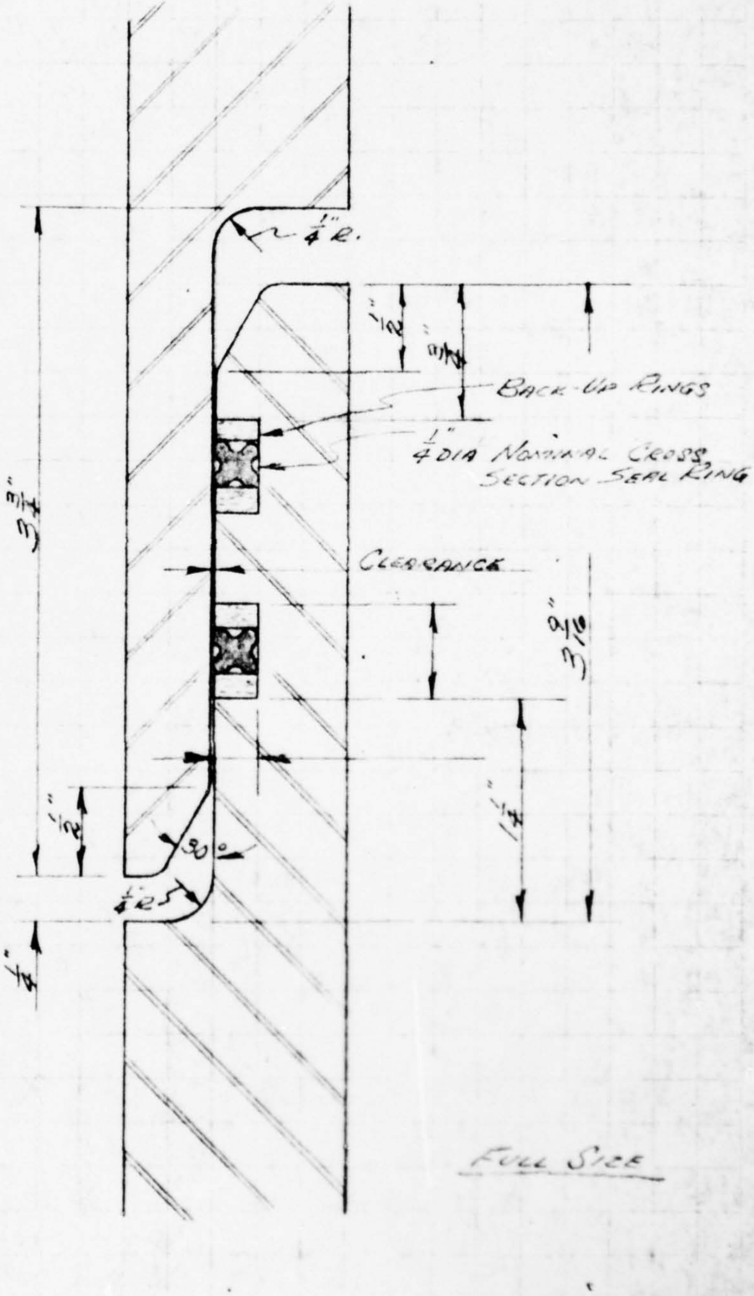
NOTES -

1. ALL SEALING SURFACES WITH DYNAMIC SEALS TO BE 16 RMS FINISH
2. STATIC "O" RING SEALS TO BE 32 RMS FINISH
3. T.I.R. OF COMPLETE ASSM NOT TO EXCEED .015"
4. OPERATING RANGE 30 to 150 PSI 20 to 120°F

SWIVEL ASSM

½ SIZE



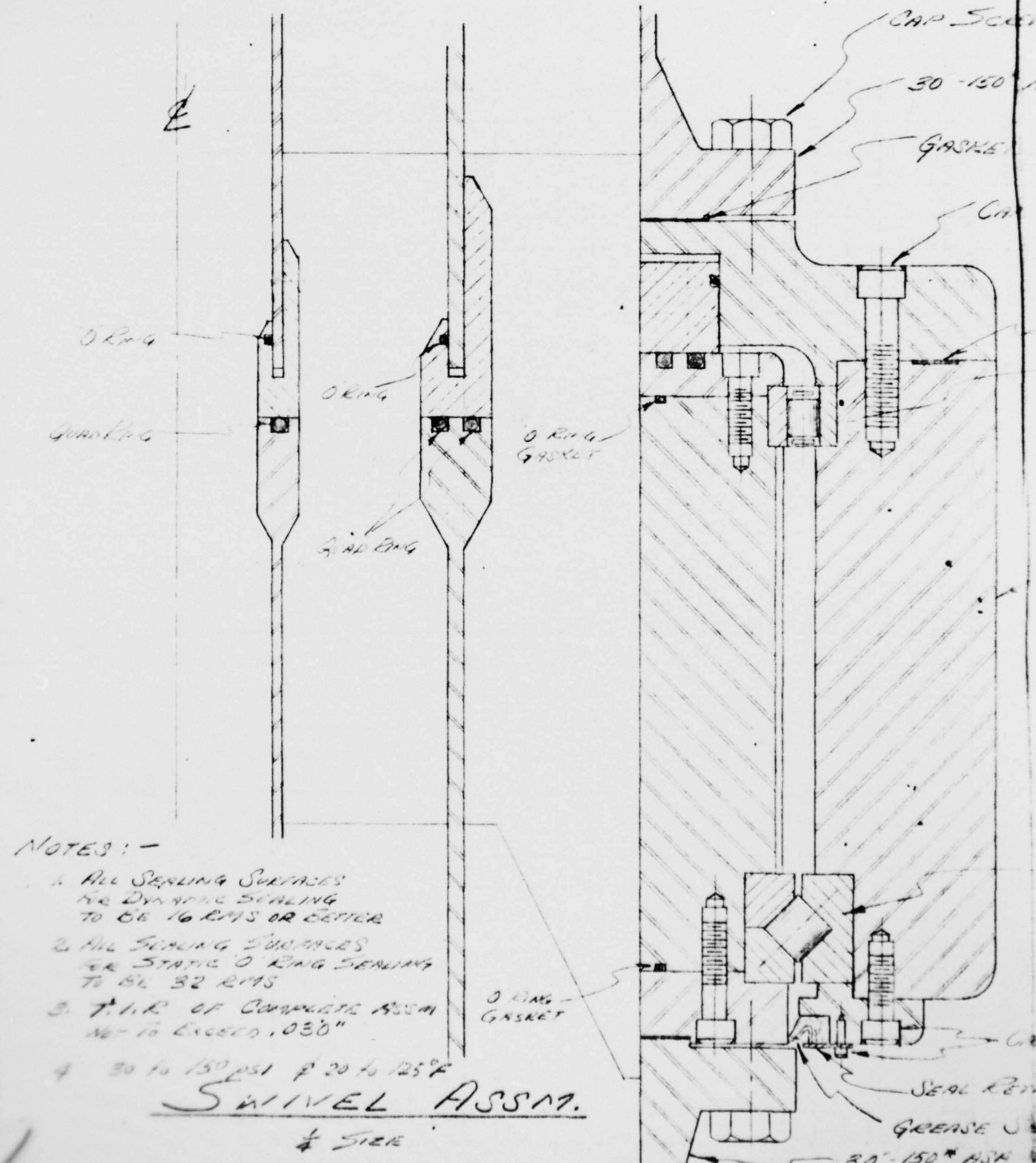


TYPICAL SEAL ASSM.

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S ARMY - ERDL			
SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		4/23/65

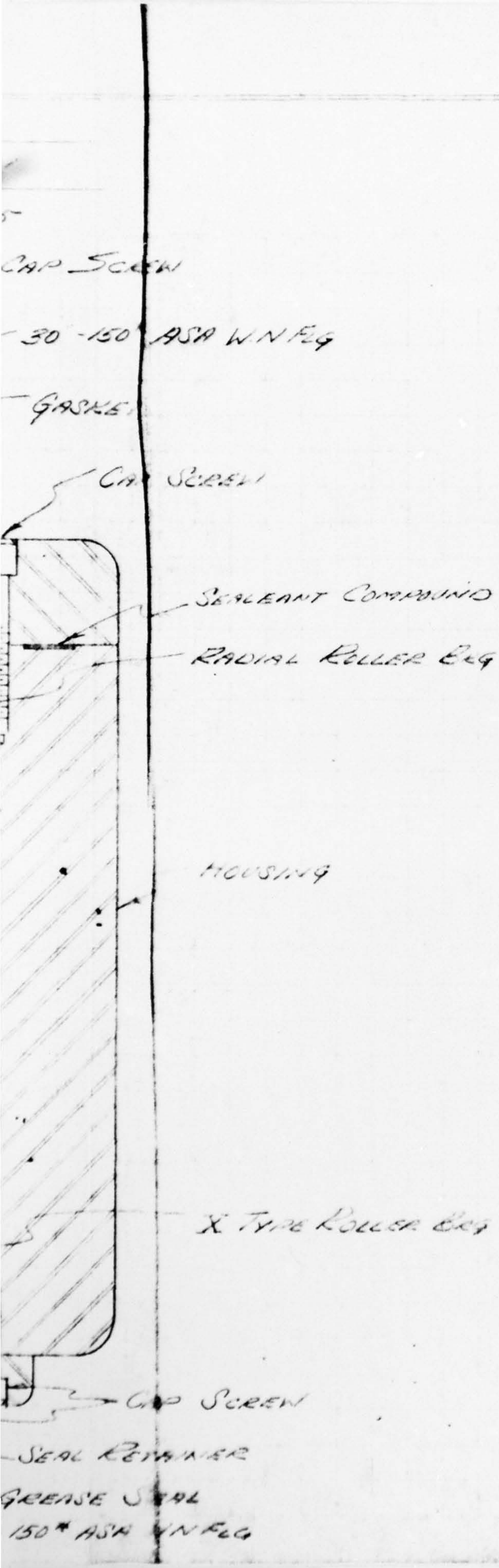


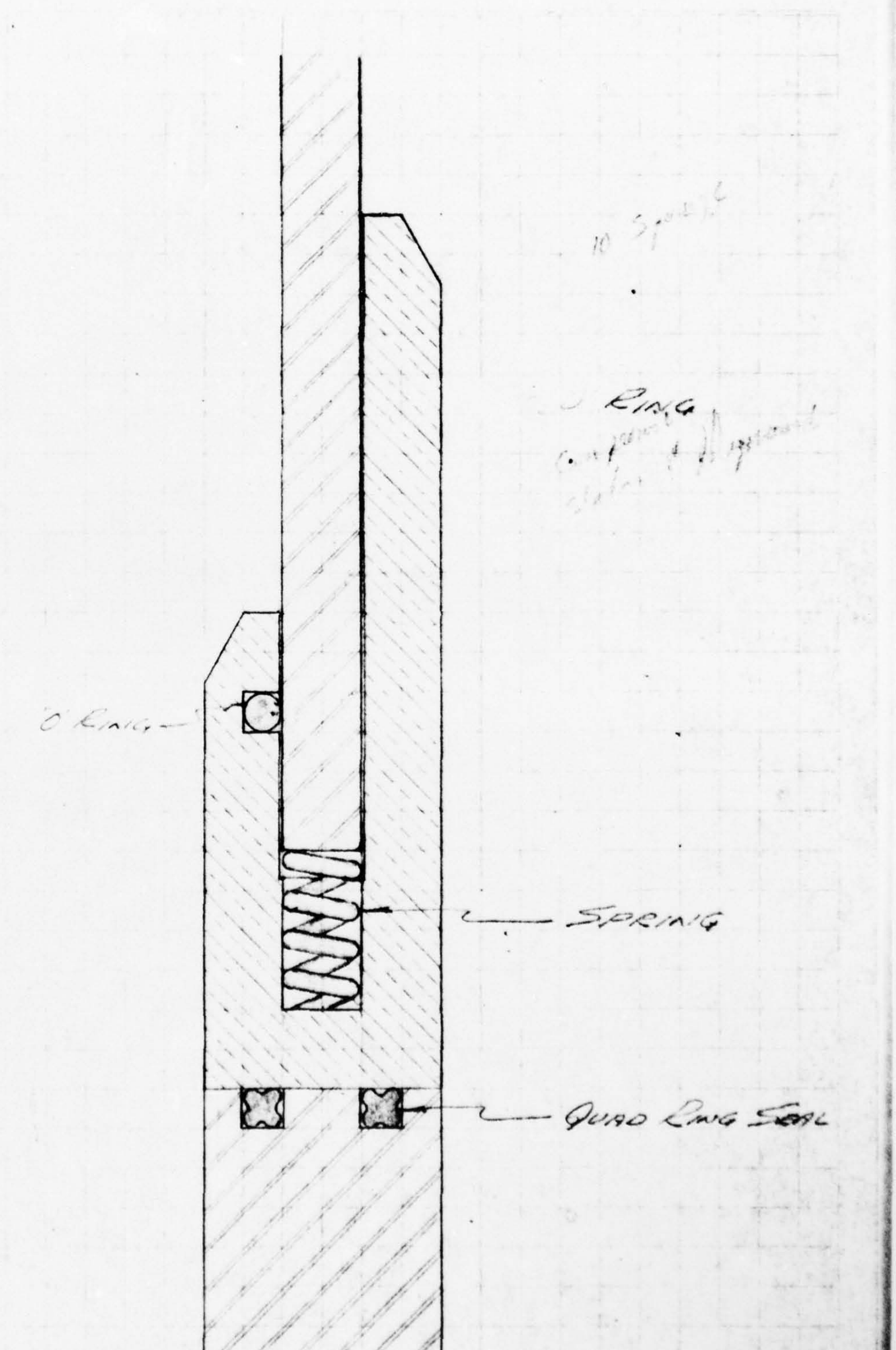
NOTES: -

1. ALL SEALING SURFACES FOR DYNAMIC SEALING TO BE 16 RMS OR BETTER
2. ALL SEALING SURFACES FOR STATIC O RING SEALING TO BE 32 RMS
3. T.I.R OF COMPLETE ASSM NOT TO EXCEED .030"
4. 30 to 150 PSI @ 20 to 125°F

SWIVEL ASSM.

1/4 SIZE





TYPICAL SEAL ASSM.

FULL SIZE

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

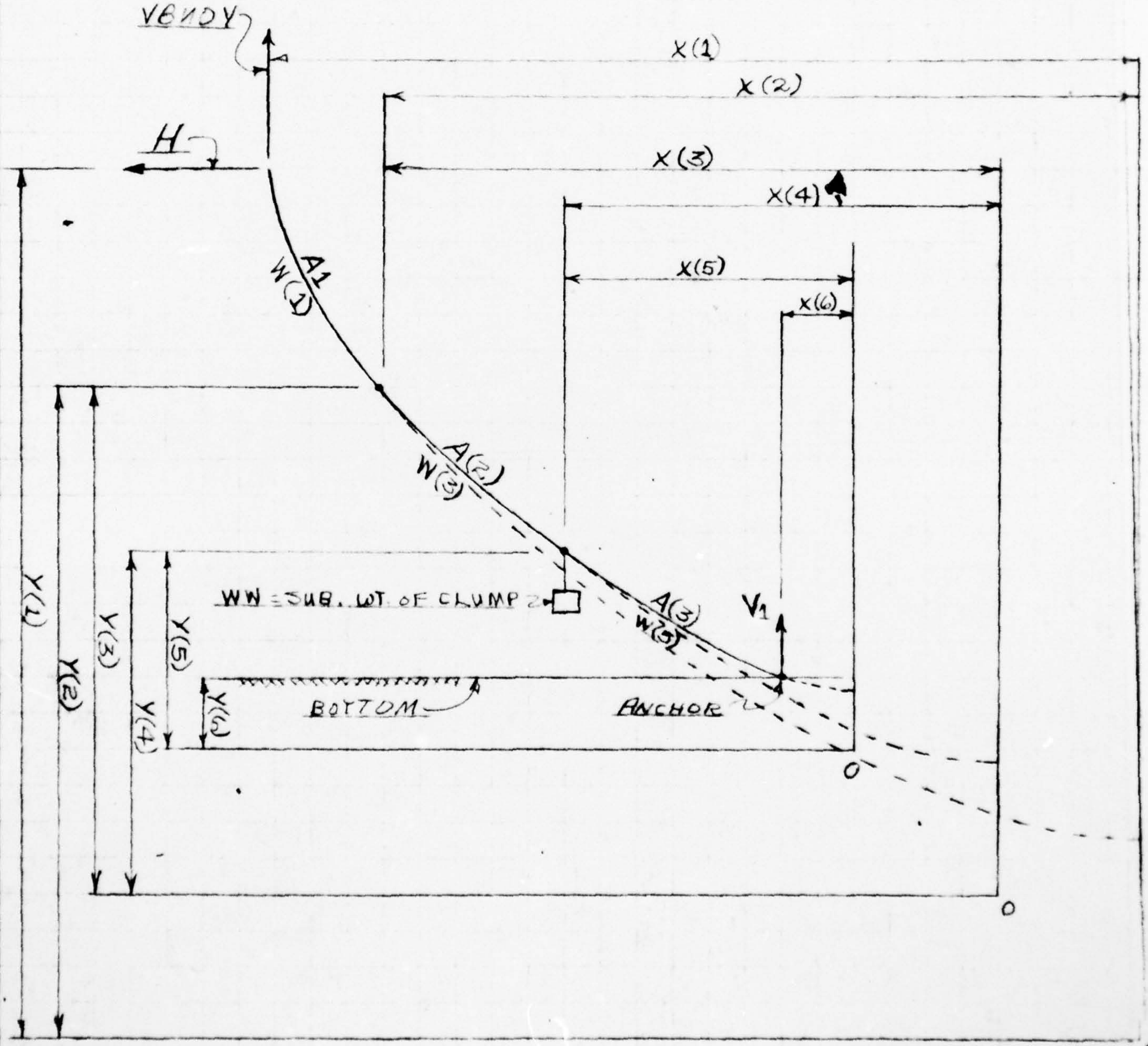
J. RAY MCDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY/EROL	1

SUBJECT: MONO-MOORING SYSTEM - SAMPE CALCULATIONS

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB 56017	ANDREWS		11-4-65

EXPLANATION OF VARIABL



NOTE: IF SENSE SWITCH 2 IS "OFF", NONE OF THE "T", "X" OR "Y" VALUES WILL BE PRINTED OUT.

ANCHOR LEG CALCULATIONS

VARIABLES FOR COMPUTER PROGRAM

ADDITIONAL INPUT

VPCC = WATER DEPTH (VERTICAL PROJECTION FROM H TO BOTTOM)
DELTA = INCREMENT TO VARY H BY
TOL = ALLOWABLE TOLERANCE FOR VPCC
M = CONTROL VARIABLE 1 OR 2 TO BE USED TO DESIGNATE CONDITION AT ANCHOR.
1 - SIGNIFIES NO VERTICAL REACTION AT ANCHOR
2 - SIGNIFIES VERTICAL REACTION AT ANCHOR TO BE CONSIDERED.

OUTPUT

T(1) = TENSION @ BUOY (TOP OF A1)
T(2) = TENSION @ BOTTOM OF A1
T(3) = TENSION @ TOP OF A2
T(4) = TENSION @ BOTTOM OF A2
T(5) = TENSION @ TOP OF A3
T(6) = TENSION @ BOTTOM OF A3 (AT ANCHOR)

X(1), X(2), X(3), X(4), X(5), & X(6) = HORIZONTAL PROJECTIONS FROM ORIGIN TO CORRESPONDING "T" POINTS.

Y(1), Y(2), Y(3), Y(4), Y(5) & Y(6) = VERTICAL PROJECTIONS FROM ORIGIN TO CORRESPONDING "T" POINTS.

H = HORIZONTAL COMPONENT THROUGHOUT CATENARY
VBUOY = VERTICAL COMPONENT OF CATENARY @ BUOY
CHP = HORIZONTAL PROJECTION OF CATENARY FROM ANCHOR TO BUOY
DX = CHANGE IN HORIZONTAL PROJECTION (CHP).
V1 = VERTICAL COMPONENT OF CATENARY @ ANCHOR.

THREE ELEMENT CATENARY SH. 2

```
      DIMENSION C(6),S(6),T(6),U(6),W(6),X(6),Y(6)
    1 PRINT 5100
      PRINT 5000
      IF (SENSE SWITCH 2)  112,114
  114 PRINT 5001
  112 K=0
      CHPL=0.0
      A1L=0.0
      A2L=0.0
      B2L=0.0
      V1 =0.0
      N=1
      DO 2 I=1,6
      X(I)= 0.0
      Y(I)= 0.0
    2 S(I)= 0.0
      READ 3, H,DELTA,VPCC,WW,W(1),TOL
      READ44, W(3),W(5),A1,A2,A3,M
    3 FORMAT (F8.2,F8.2,F8.2,F8.2,F8.2,F8.2)
   44 FORMAT (5F8.2,I4)
      CON = DELTA
      W(2)= W(1)
      W(4)= W(3)
      W(6)= W(5)
    9 S(6)= V1/ W(6)
      S(5)= S(6)+ A1L
      S(4)= S(5)+ B2L
      S(3)= S(4)+ A2L
      S(2)= (S(3)*W(3))/ W(2)
      S(1)= S(2) + A1
   10 DO 4 I=1,6
      C(I)= H/ W(I)
    4 Y(I)= SQRT(S(I)**2 + C(I)**2)
      CVP = (Y(1)+Y(3)+Y(5)) - (Y(2)+Y(4)+Y(6))
        TEST= CVP-VPCC
      IF(CVP-VPCC)11,12,13
   11 IF(TEST+TOL)111,12,12
  111 H= H- CON
      CON= CON/ 10.0
      GO TO 10
   13 IF (TEST-TOL)12,12,113
  113 H= H+ CON
      GO TO 10
   12 CON= DELTA
      DO 5 I=1,6
      U(I)= Y(I)/ C(I)
      IF(U(I)-1.0)17,18,18
   17 U(I)= 1.0
   18 X(I)= LOG(U(I)+(SQRT(U(I)**2-1.0))) * C(I)
    5 T(I)= Y(I) * W(I)
      VBUOY=SQRT(T(1)**2-H**2)
```

```
      SUM= A2+A3-A1L-A2L
      CHP = (X(1)+X(3)+X(5)) - (X(2)+X(4)+X(6)) + SUM
      DX=CHP-CHPL
      IF(SENSE SWITCH 2)51,50
   51 PRINT 5200
      PRINT 5021
      DO 6 I=1,6
    6 PRINT 5022,T(I),X(I),Y(I)
      PRINT 5200
      PRINT 5001
   50 PRINT 5002,H,VBUOY,CHP,DX,V1
      CHPL=CHP
      GO TO (60,200,80,90),N
   60 IF(K-10)61,69,69
   61 A2L= A2L + (A2/ 10.0)
      K=K+1
      GO TO 9
   69 K=0
  200 IF(WW)201,201,70
  201 B2L=0.
      N=3
      GO TO 9
   70 IF(K-10)71,79,79
   71 B2L= B2L + (WW/ (W(4)*10.0))
      K=K+1
      N=2
      GO TO 9
   79 K=0
   80 IF(K-10)81,89,89
   81 A1L=A1L+(A3/10.0)
      K=K+1
      N=3
      GO TO 9
   89 K=0
  300 IF(M-1)99,99,90
   90 IF(K-10)91,99,99
   91 V1= V1 + (H/ 100.0)
      K=K+1
      N=4
      GO TO 9
   99 GO TO 1
 5000 FORMAT (23HXTHREE ELEMENT CATENARY)
 5001 FORMAT(10X,1HH,5X,5HVBUOY,9X,3HCHP,10X,2HDX,6X,2HV1)
 5002 FORMAT (1X,2F10.2,2F12.4,F8.2)
 5021 FORMAT (18X,1HT,17X,1HX,17X,1HY)
 5022 FORMAT (1X,3E18.8)
 5100 FORMAT (1H1)
 5200 FORMAT (1H )
      END
```

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY/ERDL | SHEET NO. 4

SUBJECT MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

DRAWING NUMBER JOB 55017 | COMPUTER ANDREWS | CHECKED BY | DATE 10-27-65

SAMPLE FOR 100 FOOT WATER DEPTH

DETERMINE INPUT FOR NORMAL W.D. = 100'

MSL = 100' WT. OF BUOY = 145 Tons

VERTICAL REACTION FROM PRELOAD ≈ 126^K

WEIGHT OF FOAM = 29^K

DETERMINE APPROXIMATE DRAFT UNDER PRELOAD

TOTAL VERTICAL ≈ 290 + 126 + 29 = 445^K
BUOYANCY FROM SKIRT AND RUBBER BUMPERS ≈ 41^K

REVISED TOTAL WT. = 445 - 41 = 404^K

BUOYANCY/FT. FOR BUOY = 41.6^K

APPROXIMATE DRAFT UNDER PRELOAD = $\frac{404}{41.6}$ = 9.7'

VERTICAL PROJECTION OF CATENARY
VPCC = 100 - (9.7 - 7) = 97.3'

ADDITIONAL COMPUTER INPUT FOR 3"φ CHAIN

H = 0. DELTA = 3. VPCC = 96.3 WW = 0. W(1) = .0784 TOL = .1

W(3) = .0784 W(5) = .0784 A1 = 100. A2 = 500. A3 = 500. M = 1

SUBMERGED WT OF CHAIN IN SEAWATER = DRY WT/FT x 0.8693
SUBMERGED WT OF CHAIN IN FRESHWATER = DRY WT/FT x 0.8725

ANCHOR LEG CALCULATIONS

[illegible]TER DEPTH (MSL)

DETERMINE INPUT FOR 100' W.D. (MAX. CONDITIONS)

MAX. W.D. = 100 + 10 + 20(.67) = 123.4' BUOY WT. = 145T

VERTICAL UNDER MOORING LOAD ≈ 200^k

WT. OF FOAM = 29^k

DETERMINE APPROX. MAX. DRAFT UNDER MOORING LOAD

TOTAL VERTICAL = 290 + 200 + 29 − 41 = 478^k

DRAFT = $\frac{478}{41.6}$ = 11.5'

VERTICAL PROJECTION OF CATENARY

VPCC = 123.4 − (11.5 − 7) = 118.9'

COMPUTER INPUT

N = 0. DELTA = 3.0 VPCC = 118.9 WW = 0 W(1) = .0784 TOL = .1

W(3) = .0784 W(4) = .0784 A1 = 120. A2 = 500. A3 = 500. M = 1

[illegible]L = .1

1

INPUT CIFICATIONS
MCD 12504

J. RAY McDERMOTT & CO., INC.
COMPUTER PROGRAM DOCUMENTATION

DATE	PROGRAM NO.	USER GROUP NUMBER	SHEET	OF
10-27-65	CHTNRY		5	

TITLE
SAMPLE DATA FOR THREE ELEMENT CATENARY

1–8	9–16	17–24	25–32	33–40	41–48
0.	3.	97.3	0.	.07764	.1
.07764	.0784	100.	500.	500.	1

1–8	9–16	17–24	25–32	33–40	41–48
0.	3.	118.9	0.	.07769	.1
.07769	.07764	120.	500.	500.	1

SUBMITTED BY: ANDREWS
PUNCHED BY: ANDREWS
VERIFIED BY:

100' NORMAL W.D.

SHEET 6

THREE ELEMENT CATENARY

H	VBUOY	CHP	DX	V1
.30	7.83	1015.1405	1015.1405	0.00
5.37	11.75	1054.5119	39.3714	0.00
12.51	15.67	1067.5091	12.9972	0.00
21.66	19.59	1074.4792	6.9701	0.00
32.82	23.51	1078.9070	4.4278	0.00
46.05	27.43	1082.0339	3.1269	0.00
61.35	31.35	1084.3590	2.3251	0.00
78.57	35.27	1086.1056	1.7466	0.00
98.07	39.19	1087.5609	1.4553	0.00
119.37	43.11	1088.6907	1.1298	0.00
142.77	47.03	1089.6422	.9515	0.00
142.77	47.03	1089.6422	0.0000	0.00
168.27	50.95	1090.4524	.8102	0.00
195.57	54.87	1091.1234	.6710	0.00
224.97	58.79	1091.7122	.5888	0.00
256.47	62.71	1092.2326	.5204	0.00
290.07	66.63	1092.6936	.4610	0.00
326.07	70.55	1093.1176	.4240	0.00
363.27	74.47	1093.4648	.3472	0.00
402.87	78.39	1093.7916	.3268	0.00
444.87	82.31	1094.0942	.3026	0.00
488.37	86.23	1094.3576	.2634	0.00

100' W.D. (MAX. CONDITIONS)

SHEET 7

THREE ELEMENT CATENARY

H	VBUOY	CHP	DX	V1
.09	9.40	1006.1331	1006.1331	0.00
4.86	13.32	1057.4700	51.3369	0.00
11.28	17.24	1074.2048	16.7348	0.00
19.38	21.16	1083.6304	9.4256	0.00
29.07	25.08	1089.6343	6.0039	0.00
40.47	29.00	1093.9728	4.3385	0.00
53.46	32.92	1097.1604	3.1876	0.00
68.16	36.84	1099.6792	2.5188	0.00
84.42	40.76	1101.6546	1.9754	0.00
102.42	44.68	1103.3077	1.6531	0.00
121.98	48.60	1104.6633	1.3556	0.00
121.98	48.60	1104.6633	0.0000	0.00
143.28	52.52	1105.8320	1.1687	0.00
166.38	56.44	1106.8564	1.0244	0.00
190.68	60.36	1107.6835	.8271	0.00
217.08	64.28	1108.4626	.7791	0.00
244.68	68.20	1109.1080	.6454	0.00
274.38	72.12	1109.7183	.6103	0.00
305.28	76.04	1110.2364	.5181	0.00
338.28	79.96	1110.7290	.4926	0.00
372.48	83.88	1111.1529	.4239	0.00
408.78	87.80	1111.5593	.4064	0.00

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

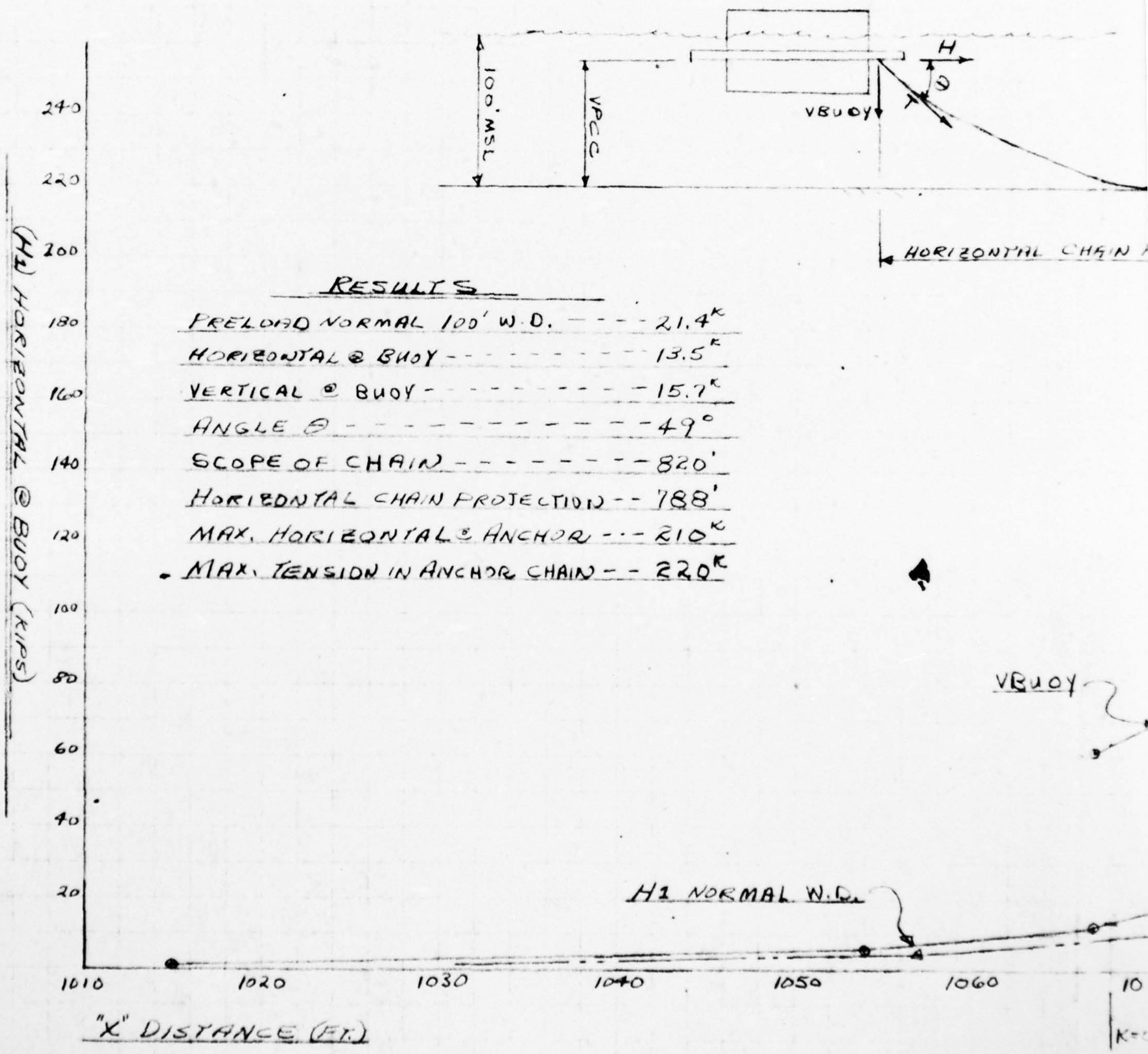
J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY / ERDL

SHEET NO: 8

SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

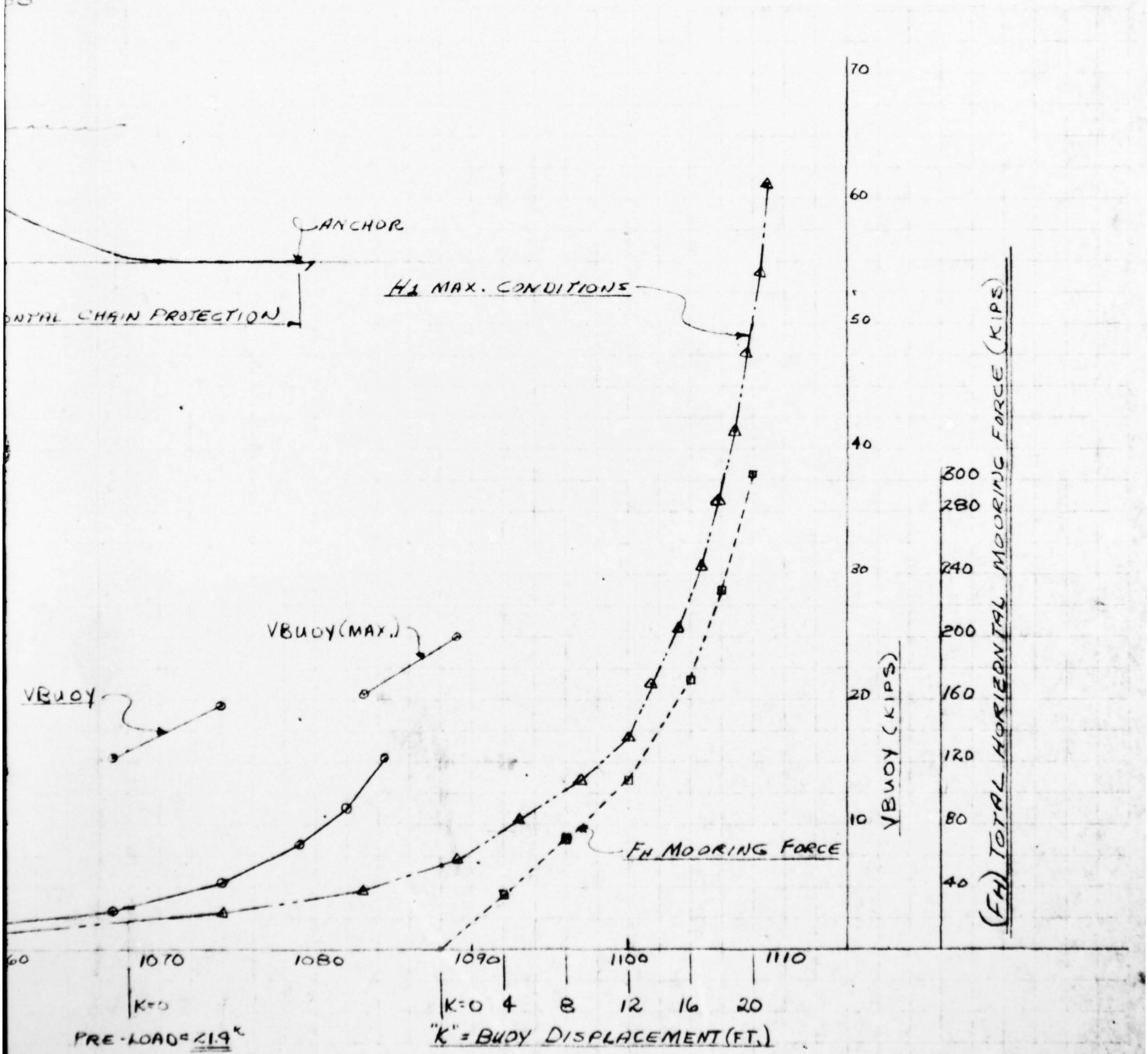
DRAWING NUMBER: JOB 56017 | COMPUTER: ANDREWS | CHECKED BY: | DATE: 10-28-65



RESULTS

- PRELOAD NORMAL 100' W.D. ---- 21.4 K
- HORIZONTAL @ BUOY ---------- 13.5 K
- VERTICAL @ BUOY ---------- 15.7 K
- ANGLE θ ------------ 49°
- SCOPE OF CHAIN -------- 820'
- HORIZONTAL CHAIN PROJECTION -- 788'
- MAX. HORIZONTAL @ ANCHOR --- 210 K
- MAX. TENSION IN ANCHOR CHAIN -- 220 K

TIONS   CURVES DEVELOPED FROM COMPUTER RESULTS



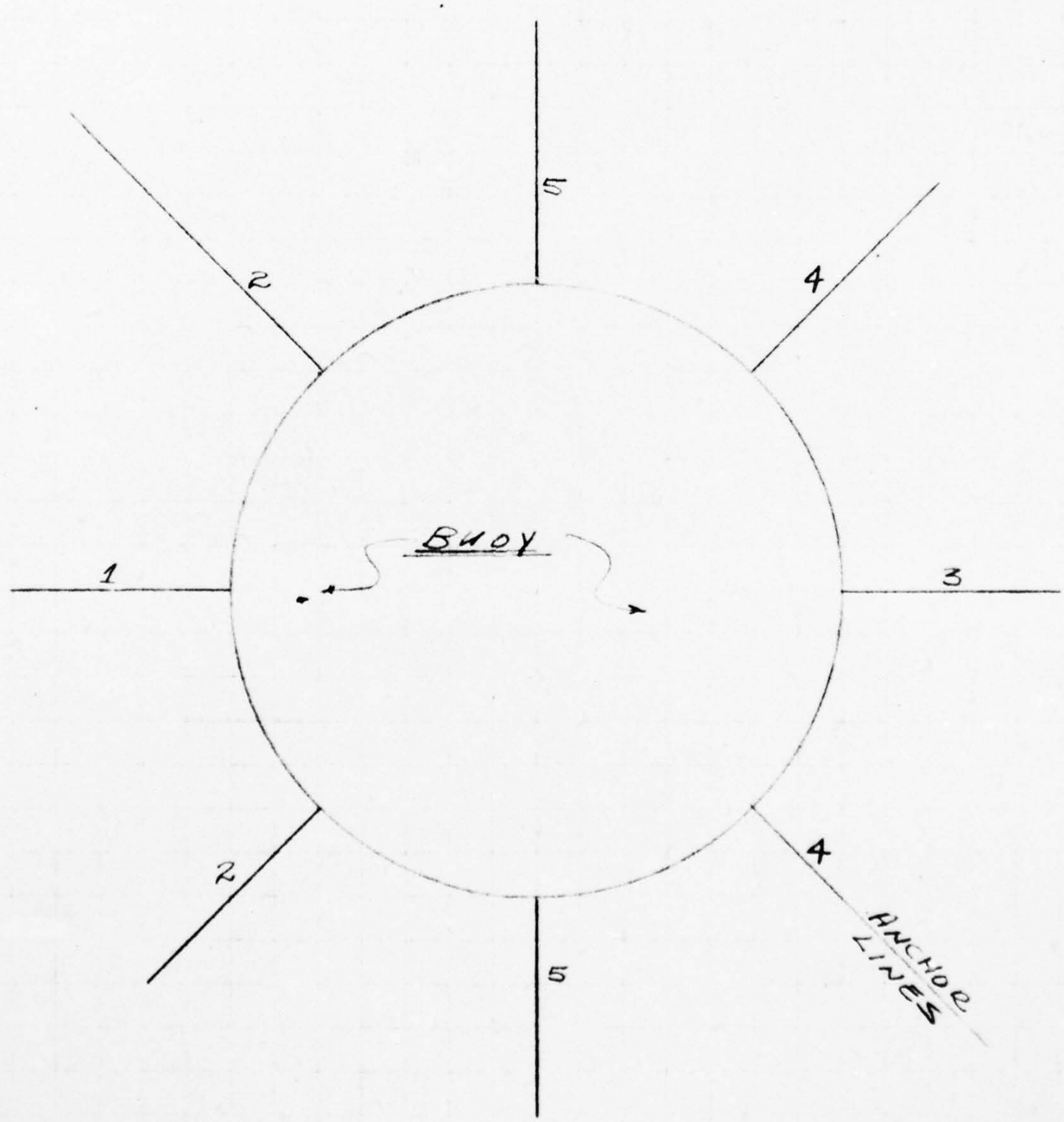
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY / ERDL
SHEET NO: 9

SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

DRAWING NUMBER: JOB 56017
COMPUTER: ANDREWS
CHECKED BY:
DATE: 10-27-65



NOTE: HEEL IS CALCULATED BY S[...]
MOMENTS ABOUT "K".

AD-A034 243 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 2. --ETC(U)
1966 DA-44-009-AMC-841(T)
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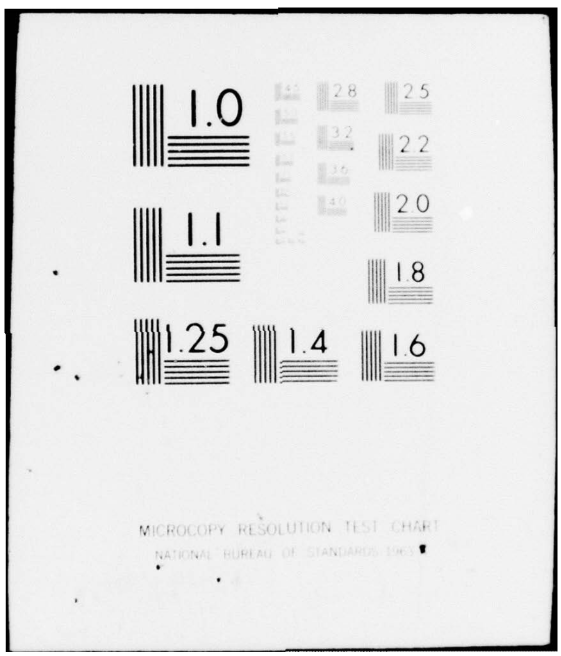
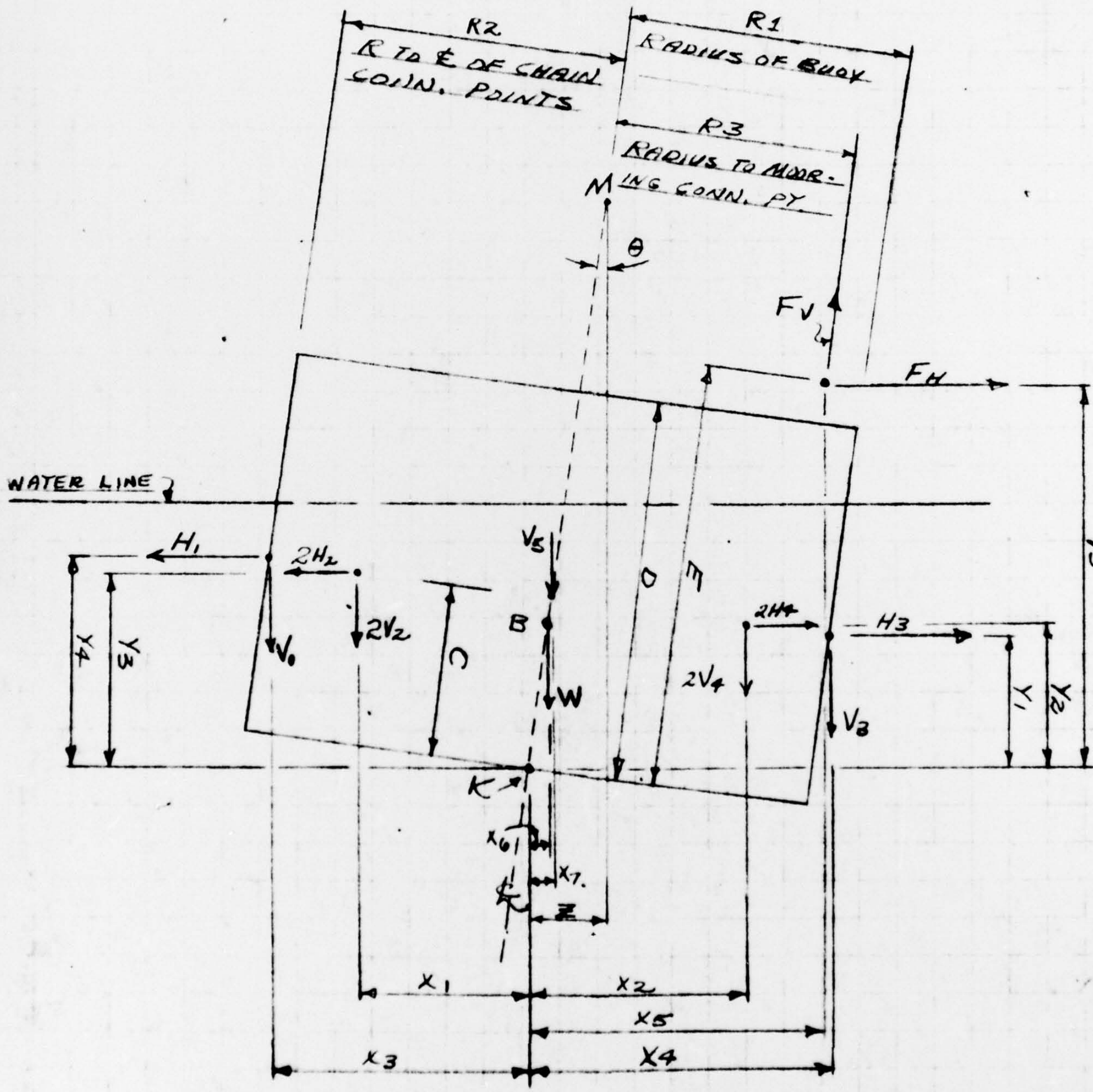

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

HEEL ANGLE OF BUOY



FREE BODY DIAGRAM OF BUOY

BY SWAMING

2.

J. RAY MC DERMOTT CO., INC. ENGINEERS AND GENERAL CONTRACTORS NEW ORLEANS, LA.

BUOY HEEL ANGLE SHEET 10

```
 10 READ 1,R1,R2,R3,W,C,D,E,BK
    IF(R1)20,30,20
 20 READ 1,FH,H1,H2,H3,H4
    READ 1,FV,V1,V2,V3,V4,V5,WL
  1 FORMAT (F10.4,F10.4,F10.4,F10.4,F10.4,F10.4,F10.4,F10.4)
    B=V1+2.*V2+2.*V4+V3+2.*V5+W-FV
    TOP1 = (FH*E+H3*C+2.*H4*C+V3*R2+1.414*V4*R2)
    TOP2 = (-FV*R3-H1*C-2.*H2*C-V1*R2-1.414*V2*R2)
    BOT1 = (FH*R3+H3*R2+1.414*H4*R2-V3*C-2.*V4*C-2.*V5*C-W*BK+FV*E)
    BOT2 = (H1*R2+1.414*H2*R2-V1*C-2.*V2*C+WL*.7854*R1**4+B*BK)
100 TANA =(TOP1+TOP2)/(BOT1+BOT2)
200 DEG = 180.*ATANF(TANA)/3.14
    PRINT 4,B,DEG
  4 FORMAT (10X,3HB =,F10.4,10X,5HDEG =,F10.6)
    GO TO 10
 30 PAUSE
    END
```

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY/EROL	11

SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB 56017	ANDREWS		10-28-65

DEFINITION OF VARIABLES

R1 = RADIUS OF BUOY
R2 = RADIUS TO ℄ OF PENDANT CONN. PT.
R3 = RADIUS TO MOORING LINE CONN. PT.
W = WEIGHT OF BUOY
C = DISTANCE FROM PT. "K" TO PENDANT CONN. PT.
D = DEPTH OF BUOY
E = DISTANCE FROM PT. "K" TO MOORING LINE CONN. PT.
BK = DISTANCE FROM PT. "K" TO POINT OF BUOYANCY
FH = HORIZONTAL COMPONENT FROM MOORING LINE
H1 = HORIZONTAL @ BUOY FROM CORRESPONDING PENDANT.
H2 = HORIZONTAL @ BUOY FROM #2 PENDANTS
H3 = HORIZONTAL COMPONENT @ BUOY FROM #3 PENDANTS
H4 = HORIZONTAL COMPONENT @ BUOY FROM #4 PENDANT
FV = VERTICAL COMPONENT FROM MOORING LINE
V1 = VERTICAL COMPONENT @ BUOY FROM PENDANT #1
V2 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #2
V3 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #3
V4 = VERTICAL COMPONENT @ BUOY FROM PENDANT #4
V5 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #5
WL = WEIGHT OF LIQUID FLOATING BUOY

HEEL ANGLE OF BUOY

INPUT FOR 100' W.D. (MAX. CONDITIONS)

R1 = 15.
R2 = 17.
R3 = 11.5
W = 290.
C = 7.
D = 15.
E = 17.5
BK = 5.5
FH = 300.
H1 = 210.
H2 = 58.
H3 = 10.
H4 = 8.
FV = 0. (CASE I) 50. (CASE II) 100. (CASE III) 150. (CASE IV)
V1 = 68.
V2 = 42.
V3 = 15.5
V4 = 17.3
V5 = 24.
WL = 64.

NOTE: HEEL ANGLE IS FIGURED FOR FOUR CASES OF FV.

INPUT S[illegible]TIFICATIONS
MCD 12504

J. RAY McDER[illegible]TT & CO., INC.
COMPUTER PROGRAM DOCUMENTATION

DATE: 10-28-65 | PROGRAM NO: | USER GROUP NUMBER: | SHEET/PAGE: 12 | OF:

TITLE: SAMPLE DATA FOR BUOY HEEL ANGLE

	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
	15.	171.	11.5	2901.	71.	15.	17.5	5.5
	300.	210.	58.	10.	8.			
I	2.	68.	42.	16.5	17.3	24.	.064	
II	50.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	
III	100.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	
IV	150.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	

SUBMITTED BY: ANDREWS | PUNCHED BY: ANDREWS | VERIFIED BY:

BUOYANT FORCE	HEEL ANGLE °	
B = 540.1000	DEG = 8.646987	CASE I
B = 490.1000	DEG = 5.389638	CASE II
B = 440.1000	DEG = 2.423317	CASE III
B = 390.1000	DEG = -.275415	CASE IV

COMPANY: U. S. ARMY/ERDL | SHEET NO: 14

SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

NUMBER: JOB 56017 | COMPUTER: ANDREWS | CHECKED BY: | DATE: 10-28-65

CHECK DRAFT OF BUOY UNDER PRELOAD

WT. OF BUOY + EQPT. = 290^K

WT. OF FOAM WITH NO COMPTS. BALLASTED = 29^K

VERTICAL FROM PRELOAD = 15.7(8) = 126^K

BUOYANCY FROM SKIRT AND RUBBER BUMPER = 41^K

TOTAL VERTICAL = 290 + 29 + 126 − 41 = 404^K

BUOYANCY/1 = 41.6^K

DRAFT = $\frac{404}{41.6}$ = 9.71 FT. O.K.

CHECK DRAFT OF BUOY UNDER MAX. CONDITIONS & 300^K MOORING LOAD.

CASE I FV = 0

TOTAL VERTICAL = 540.1 − 41 = 499.1

DRAFT = $\frac{499.1}{41.6}$ = 12.0 FT. O.K.

CASE IV FV = 150

TOTAL VERTICAL = 390.1 − 41 = 349.1

DRAFT = $\frac{349.1}{41.6}$ = 8.5 FT. O.K.

DRAFT & FREEBOARD CALCULATIONS

CHECK POSITIVE FREEBOARD UNDER PRELOAD AND ALL COMPARTMENTS FLOODED

TOTAL VERTICAL = 290 + 126 + 29 = 445^K

TOTAL BUOYANCY

LOWER HALF OF BUOY = 41.6 (7) = 291
UPPER HALF OF BUOY = 20.8 (8) = 166
SKIRT AND RUBBER BUMPERS = 41

TOTAL = 498^K

498 > 445 ∴ BUOY WILL HAVE POSITIVE FBD.

NOTE: FOR MAXIMUM WATER DEPTH OF 150' IT WAS NECESSARY TO CONSIDER REDUCTION IN THE VERTICAL COMPONENT OF THE CHAIN AT THE BUOY DUE TO THE INCREASED DRAFT. IT SHOULD ALSO BE NOTED THAT THE ROTATING DECK, MACHINERY, AND PARTS OF THE BUOY HULL MAY BE CONVERTED TO SUBMERSED WEIGHT IN LIEU OF AIR WEIGHT WHICH WILL FURTHER REDUCE THE BUOYANT FORCE REQUIRED TO MAINTAIN POSITIVE FREEBOARD.

ENGINEERING DEPARTMENT
COMPUTATION SHEET

J. RAY McDERMOTT & CO., INC.

McD 14003

COMPANY: U.S. ARMY/ERDL

SHEET NO. 15

SUBJECT: MONO-MOORING SYSTEM - DESIGN FACTORS

DRAWING NUMBER: JOB 56017 | COMPUTER: ANDREWS | CHECKED BY: | DATE: 10-27-65

BUOY

LOADS

BUOY HULL WAS DESIGNED FOR HYDROSTATIC WATER PRESSURE WITH TOP OF ROTATING DECK UNDER A 4' HEAD. WHICH RESULTS IN THE FOLLOWING LOADS:

BUOY BOTTOM - - 9.1 Psi BUOY TOP - - 2.67 Psi MACHINERY DECK - - 6.45 Psi

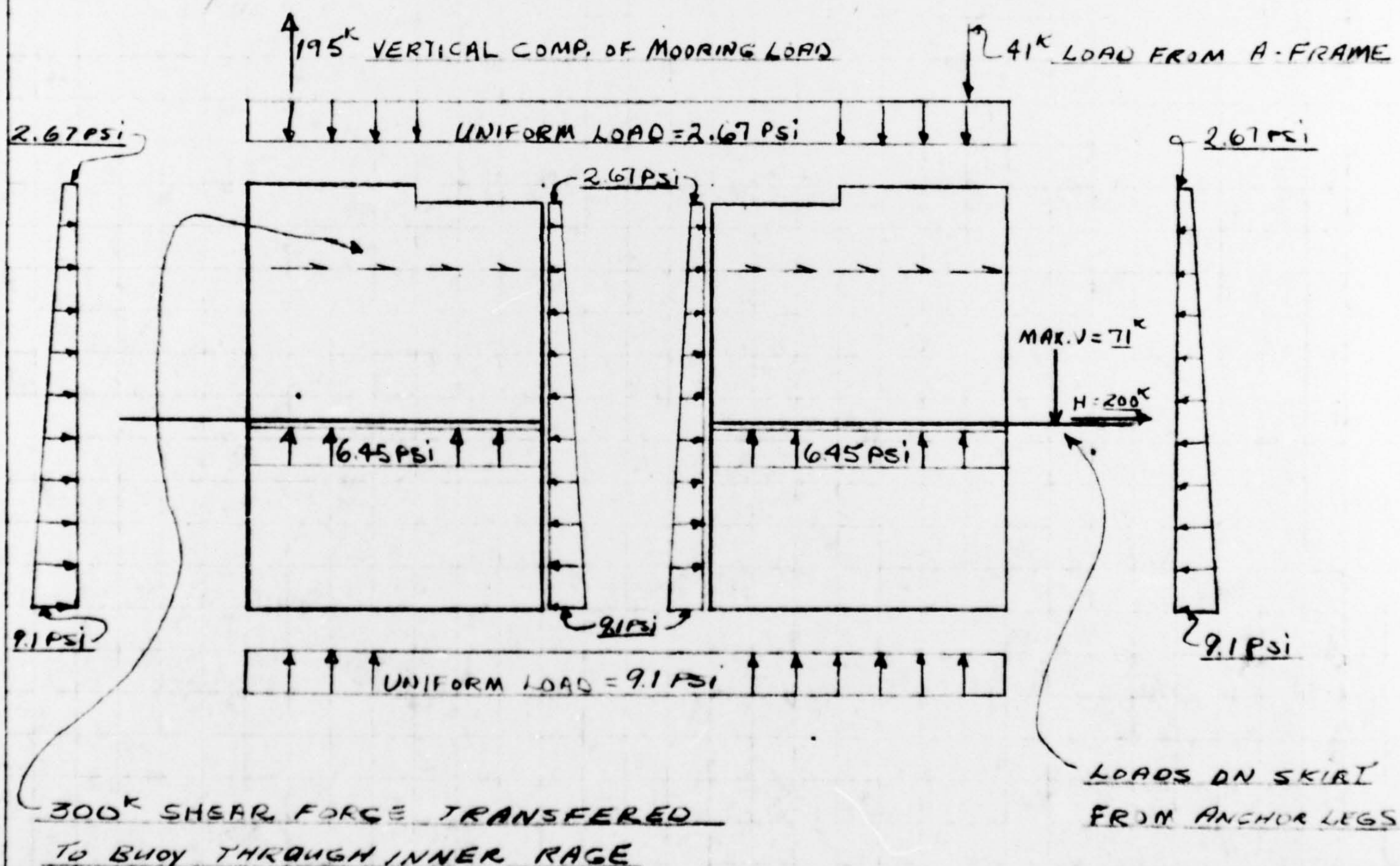


DIAGRAM OF LOADS APPLIED TO BUOY

--6.45 psi

A-FRAME

67 psi

1 psi

N SKIRT

ICHOR LEGS

BUOY WAS DESIGNED FOR LOADS AS NOTED, USING THE FOLLOWING MATERIAL WITH ALLOWABLE STRESSES AS NOTED.

ASTM A7 STEEL

- TENSION -------- 20,000 psi
- BENDING --------- 20,000 psi
- COMPRESSION ----- AS CALCULATED
- SHEAR ---------- 13,000 psi
- BEARING -------- 30,000 psi OR AS CALCULATED.

ASTM A36 STEEL

- TENSION -------- 22,000 psi
- BENDING -------- 22,000 psi
- COMPRESSION ----- AS CALCULATED
- SHEAR -------- 14,500 psi
- BEARING -------- 33,000 psi OR AS CALCULATED

ASTM A242 & ASTM A441

- TENSION -------- 25,000 psi
- BENDING -------- 25,000 psi
- COMPRESSION ---- AS CALCULATED
- SHEAR -------- 17,000 psi
- BEARING -------- 38,000 psi OR AS CALCULATED

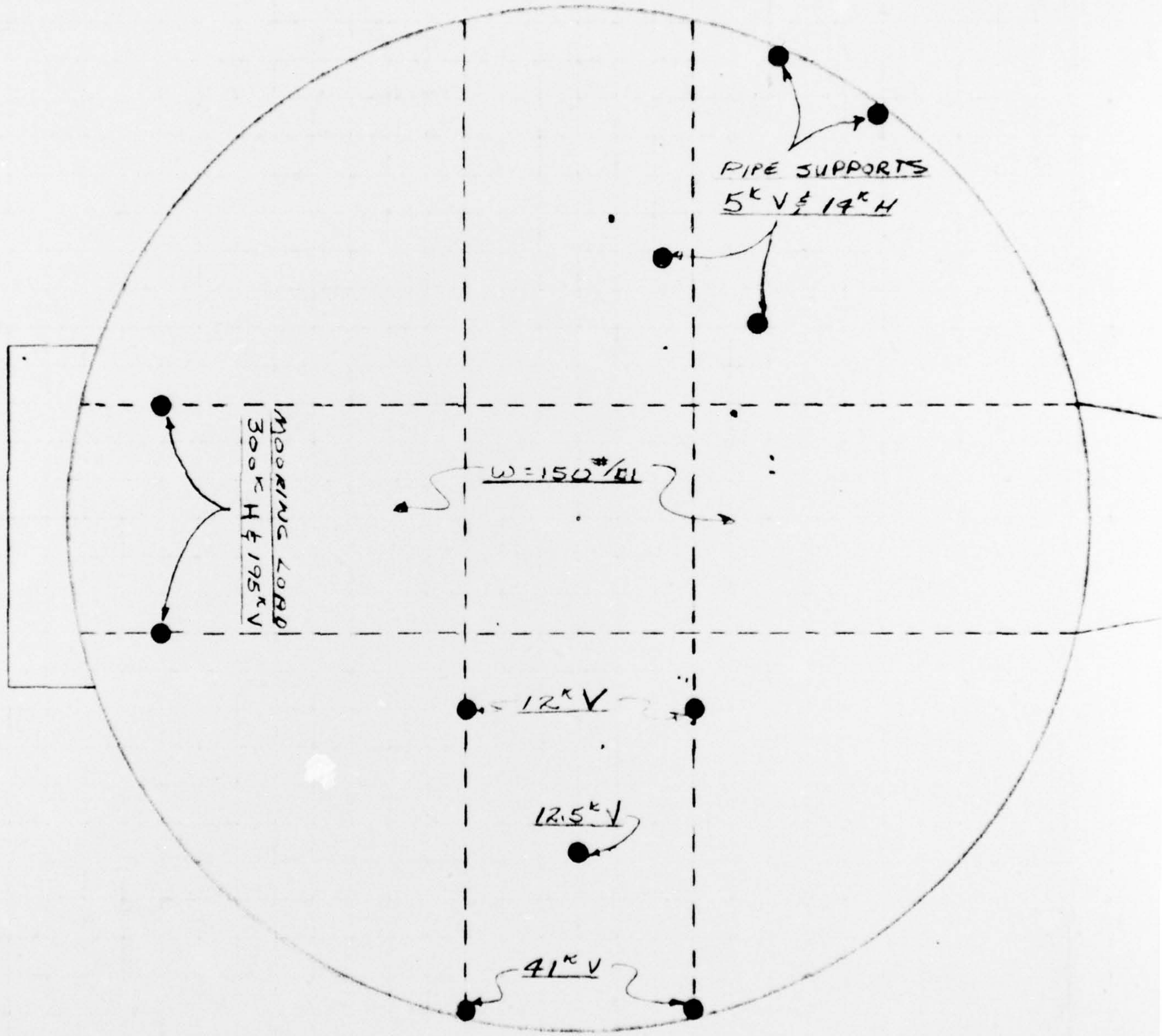
ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

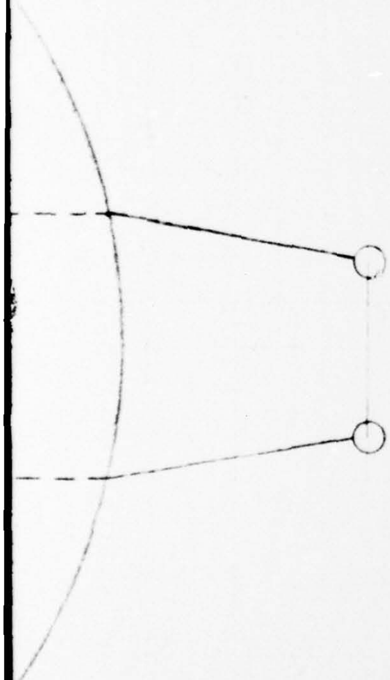
COMPANY	SHEET NO
U. S. ARMY / ERDL	16

SUBJECT: MONO - MOORING SYSTEM - DESIGN FACTORS

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB 56017	ANDREWS		10-29-65



PLAN VIEW OF ROTATING DECK



ROTATING DECK

DESIGN LOADS

TOTAL HORIZONTAL MOORING LOAD - - - - 300^K →
MAXIMUM VERTICAL COMPONENT - - - - - - - 195^K ↑
(DECK DESIGNED FOR 60% UNBALANCED MOORING LOAD)

VERTICAL REACTION FORWARD LEG A-FRAME - - 41^K ↓/LEG
VERTICAL REACTION BACK LEG OF A-FRAME - - 12^K ↑/LEG
VERTICAL REACTION FROM WINCH - - - - - - - 12.5^K ↑

VERTICAL REACTION FROM PIPES - - - - - 5.0^K ↓/SUPPORT
MAXIMUM HORIZONTAL FROM PIPES - - - - - - 14^K/SUPPORT

DECK WAS DESIGNED FOR A UNIFORM LOAD OF 150 PSF PLUS THE CONCENTRATED LOAD AS NOTED ABOVE.

ALLOWABLE STRESSES

ALLOWABLE STRESSES USED WERE THOSE NOTED ON PG. 15 OF THE SAMPLE CALCULATIONS.

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY / ERDL	SHEET NO: 17
SUBJECT: MONO-MOORING SYSTEM - DESIGN FACTORS	
DRAWING NUMBER: JOB. 56017	COMPUTER: ANDREWS	CHECKED BY:	DATE: 10-27-65

MOORING LINES

LOADS

MAXIMUM HORIZONTAL MOORING LOAD --- 300^k

USE 65% UNBALANCED = 300(.65) = 195^k

MAX. HORIZONTAL COMPONENT/MOORING LINE = 195^k

RESULTANT @ 30° = $\frac{195}{.866}$ = 225^k/LINE

SAFETY FACTORS

ITEMS	SAFETY FACTORS
PAD-EYES ---------	USE ALLOWABLE STRESSES AS NOTED PG. 15
CHAIN ENDS & FITTINGS --	2.0 FOR PROOF LOAD OF CHAIN
WIRE ROPE & FITTINGS ---	2.0 FOR ULTIMATE STRENGTH OF W.R.
NYLON ROPE & FITTINGS ---	1.6 FOR ULTIMATE STRENGTH OF ROPE

ANCHOR SYSTEM

MAX. ANCHOR LOAD ≈ 225^K

MAX. TENSION IN ANCHOR LEG ≈ 230^K

SAFETY FACTORS

ANCHORS - - - - - - - - - - - - - - - 1.0 FOR 50' DRAG
ANCHOR CHAIN - - - - - - - - - - - - 3.0 FOR PROOF LOAD OF CHAIN

.15'

.R.
ROPE