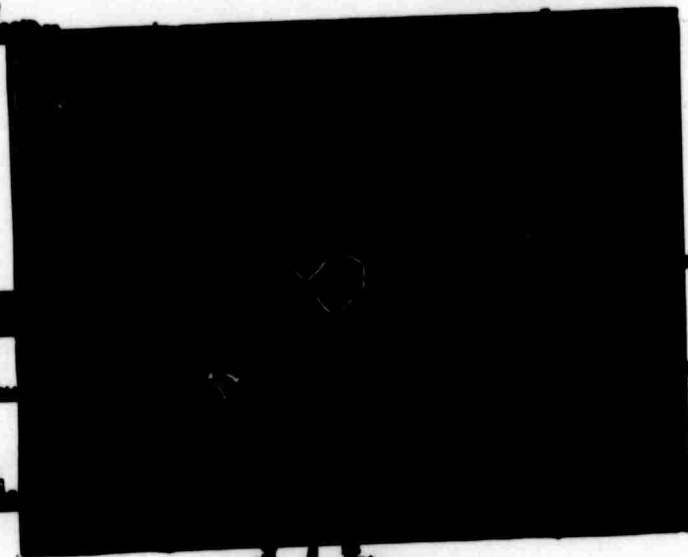


ADA 027183

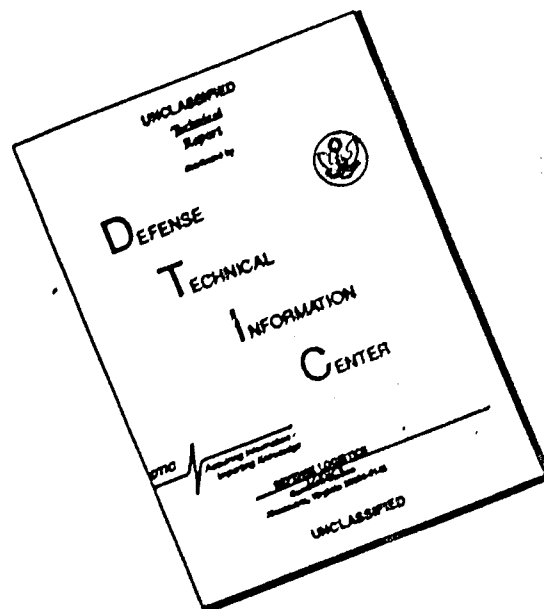


DECLASSIFIED
JUL 16 1976

STATEMENT A
APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

43

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

NAVAL SHIP ENGINEERING CENTER

HULL MECHANICAL & WEAPONS SYSTEMS

ASB - 21/22
FOUR POINT MOOR
ANCHOR WINDLASS
DESIGN REVIEW

1974

latest year

6162-74-4

NAV SHIP Sys Cam

12/138 p.

BY

R.D. JAMIESON, SEC 6162E
J.C. SANDISON, SEC 6162E
M. [REDACTED], SEC 6164B

M. /Bartaszyk

IN RESPONSE TO:

ACTION MESSAGE 301432Z

ETA 36018 of 28 APR 74 (NAVSEC CONTROL 4119005)

ETA 36025 of 8 AUG 74 (NAVSEC CONTROL 4224001)

BY

PMS 383

DDC
RECEIVED
JUL 16 1976
A

Signature

Arthur Smith
Head, Shipboard Ocean Engineering, Section 6162E

Signature

K. S. Pettit
Head, Unrep and Ship Control, Section 6164B

INDEX

Cover sheet	1
Index	11
List of figures	111
I Task	
ETA 36018	1
ETA 36025	2
Naval message 301432Z of Aug 74	3
II Introduction	
1) Anchor windlass design	6
2) Anchor windlass - Ortolan	6
3) Anchor windlass - Pigeon	7
III Calculations of existing system requirements	
1) Sea state conditions	9
2) Holding power	9
3) Plot of anchor chain catenaries	13
4) Sea state motions and added mass	14
5) Sea state recovery requirements	17
IV Present capabilities of the 4 point moor recovery system	
1) Determine bolster efficiency	18
2) Forward bolster efficiency test	19
3) Wildcat efficiency test	26
4) Aft bolster efficiency test	32
5) Bolster efficiencies	35
V Conclusions	
A) Anchor chain jumping on the wildcat	36
B) Electric motor overload and stall	36
C) Hydraulic components	37
D) Travel of the locking head dogs in the slots	37
E) Wildcat shaft bushing damaged	38
F) Anchor windlass system	38
VI Recommendations	
A) Anchor chain jumping on wildcat	39
B) Electric motor overload and stall	39
C) Hydraulic components	39
D) Travel of locking dogs in their slots	40
E) Emergency system for mooring leg recovery	41
Appendix	
A - Computer printout of chain catenaries	A1
B - Dynamometer / stripchart readouts of the bolster efficiency tests	B1
C - Anchor windlass test data and calculations	C1

LIST OF FIGURES

Figure	Title	Page
1	Sea state chart	9
2	Relative wind bearing	10
3	Wind force	10
4	Relative current bearing	11
5	Current force	11
6	Sea state wind loads	12
7	Sea state wind and current loads	12
8	Plot of anchor chain catenaries	13
9	Sea state recovery requirements	17
10	Fwd. bolster efficiency test	19
11	Photo - test weight	21
12	Photo - load cell	21
13	Photo - load cell	22
14	Photo - load cell	22
15	Photo - starboard fwd. bolster	23
16	Photo - starboard fwd. bolster	23
17	Photo - starboard fwd. bolster	24
18	Photo - starboard fwd. bolster rigged	24
19	Photo - inhaul loadcell installed	25
20	Photo - cross deck rigging	25
21	Wildcat efficiency test	26
22	Photo - wildcat efficiency test	28
23	Photo - wildcat efficiency test	28
24	Bolster efficiency test rigging	30
25	Wildcat drag test	31
26	Aft bolster efficiency test	32
27	Photo - port aft bolster	33
28	Photo - stb. aft bolster	34
29	Bolster efficiencies of fore and aft bolsters	35
29a	Existing windlass lift capacities	35a
30	Improved windlass performance at 4000 psi setting ..	40
31	Recovery of aft mooring legs using two wildcats	41
32	Recovery of fwd. mooring legs using two wildcats ...	41
33	Lift capacity of aft bolster in crossrig mode	42

ENGINEERING TASK AUTHORIZATION

4113005

FROM: PMS383D	NAME: (Originator) CDR R. Christensen	(Extension) 692-3517	CHARGE JOB ORDER NO. 837E200	ORIGINATOR'S SERIAL NO. 36018
TO: SEC 6162	NAME: (Optional) Robert Jamieson	PRIORITY: * R ☐ U ☒ E ☐		REQUESTED COMPLETION DATE 3 MAY 1974
VIA: SEC 6106A22	TITLE: ASR 21/22 Mooring System Deficiencies			SWAPS DESIGNATOR

ENCL: (1) ORTOLAN Casrpt msg 220400Z Apr 74
(2) Two photos of ASR-22 Focsle Area

TASK DESCRIPTION:

The USS ORTOLAN has experienced (1) a problem on the forward two mooring buoys with a slippage of the chain around the wildcat when walking out the anchor and (2) with marginal wildcat capacity (hydraulic power unit) to lift 1000' moor when ship experiencing surging seas. Request NAVSEC investigate and provide recommended corrective action.

List of applicable drawings ^{AND PHOTO'S} to be provided by separate correspondence.

RESPONSE REQUESTED: ☐ OFFICIAL LETTER	☒ NAVSEC TECH. MEMO	☐ OTHER	REPORTS REQUIRED ☒ TRAVEL	☐ OTHER	☐ CONSIDER USE OF CASREPT/MDCS DATA IN PERFORMING TASK, IF APPROPRIATE
ORIGINATOR'S MANDAY EST. 20	TRAVEL AUTHORIZED ☒ YES ☐ NO	ORIGINATOR'S AUTHORIZATION SIGNATURE <i>Robert Christensen</i>		DATE 4/24/74	
(Blocks below for NAVSEC use)					
TECHNICAL CODE 6169B	DATE REC'D 5/19/74	DATE COMPL'D 11/22/74	RESPONSE SERIAL SEC 6163-378	TECHNICAL CODE SIGNATURE <i>M. Bortoluzzi</i>	
ACTION ADDRESSEE SIGNATURE		DATE	SINGLE POINT OF CONTACT SIGNATURE		DATE

PRIORITY CRITERIA

R = (ROUTINE) Give originator revised date in ETA Status Report if completion date cannot be met.

U = (URGENT) Complete before any of originator's routine tasks. If completion date cannot be met, inform originator.

E = (EMERGENCY) Completion date must be met. Contact originator upon receipt if there is any problem.

ENGINEERING TASK AUTHORIZATION

4224001

FROM: MS383D	NAME: (Originator) CDR R. CHRISTENSEN	(Extension) 23517	CHARGE JOB ORDER NO. 337E200	ORIGINATOR'S SERIAL NO. 36025
TO: SEC 6164	NAME: (Optional) M. BARTOSZYK	PRIORITY: R ☐ U ☒ E ☐		REQUESTED COMPLETION DATE 9/13/74
VIA: SEC 6106A22	TITLE: ASR 21/22 MOORING SYSTEM DEFICIENCIES			SWAPS DESIGNATOR
REF (a) NAVSEA ETA# 36018 DATED 4/24/74 ASR 21/22 MOORING SYSTEM DEFICIENCIES				

TASK DESCRIPTION:

1. IN CONJUNCTION WITH AND AS A CONTINUATION OF REFERENCE (a), NAVSEC IS REQUESTED TO CONTINUE THE INVESTIGATION OF THE PROBLEMS ASSOCIATED WITH THE ASR 21/22 MOORING AND ANCHOR HANDLING SYSTEM. THE INVESTIGATION SHALL INCLUDE THE USE OF SKAGIT STEEL AND IRON WORKS PERSONNEL, THE MANUFACTURERS OF THE INSTALLED ANCHOR WINDLASS MECHANERY.

RESPONSE REQUESTED: ☐ OFFICIAL LETTER ☒ NAVSEC TECH. MEMO ☐ OTHER	REPORTS REQUIRED: ☒ TRAVEL ☐ OTHER
ORIGINATOR'S MANDAY EST. 20MD.	TRAVEL AUTHORIZED: ☒ YES ☐ NO
ORIGINATOR'S AUTHORIZATION SIGNATURE: <i>R. Christensen</i> DATE: 8/8/74	
(Blocks below for NAVSEC use)	
TECHNICAL CODE 6164B	DATE REC'D 8/12/74
DATE COMPL'D 11/22/74	RESPONSE SERIAL SEC 6163-37E
TECHNICAL CODE SIGNATURE: <i>M. Bartoszyk</i>	
ACTION ADDRESSEE SIGNATURE	DATE
SINGLE POINT OF CONTACT SIGNATURE	
DATE	

PRIORITY CRITERIA

R = (ROUTINE) Give originator revised date in ETA Status Report if completion date cannot be met.

U = (URGENT) Complete before any of originator's routine tasks. If completion date cannot be met, inform originator.

E = (EMERGENCY) Completion date must be met. Contact originator upon receipt if there is any problem.

*** R E C A L L E D ***

*****U N C L A S E F T O*****

PRIORITY
P 301432Z AUG 74
FM COMNAVSEASYS COM WASHINGTON DC

RECEIVED 1300

TO NAVSEC HYATTSVILLE MD
USS PIGEON

NAVSHIPYD PHILADELPHIA PA

INFO COMSUBLANT NORFOLK VA
COMSUBPAC PEARL HARBOR HI
NAVSHIPYD LONG BEACH CA

CONSUBRON SIX
CONSUBDEVRONE SAN DIEGO CA
SKAGIT CORPORATION
SEDR0-WOODLEY, WASHINGTON 98104

UNCLAS E F T O //N09260//

NAVSEC PASS TO CODES 6162E AND 6164B
ASR 21/22 FOUR POINT MDRING SYSTEM
A. NAVSEA 261917Z AUG 74.
B. ASR 21/22 SHIP SPEC PARA 9260-1-B.
C. ORTOLAN 011415Z AUG 74.

1. A MEETING OF PMS383, NAVSEC AND SKAGIT CORP. (WINDLASS MFG) REPS WAS CONDUCTED 27 AUG 74 AS INDICATED IN REF (A). THE BASIC PROBLEM ADDRESSED WAS THE NEED TO INSURE THE ABILITY OF THE WINDLASS SYSTEM TO PERFORM AS INTENDED DURING EXTENDED RETRIEVAL OPERATIONS OF A DEEP MDR. A REVIEW OF THE SYSTEM AND THE PROBLEMS ENCOUNTERED TO DATE INDICATES THAT THEY CAN BE OVERCOME BY UPGRADING PERFORMANCE OF EXISTING SYSTEM.

2. A REVIEW OF THE DESIGN CALCULATIONS AND PREVIOUS TEST RESULTS INDICATES THAT SYSTEM HAS THE BASIC ABILITY TO LIFT THE 5000 LB LWT MDRING ANCHOR AND 200 FATHOMS OF CHAIN (TOTAL WEIGHT 35,630

SEASYS PMS383(1)...ORG
RELEASER PMS383(1) SEA 944(1) 09035(1) 383A4S(1) 383D(1)
383M(1) 383(1)

U 000

SEC 164E(1)...ACT
SECCOMM(1) 6162(1) 6141B(1) 6131(1) 6231(1) 6140E(1)

0358 R 007

TOTAL COPIES ... 015 ...

RECALLED/

255170/242

1 OF 3 ATT 7413 242/171002

301432Z AUG 74

*****U N C L A S E F T O*****

1. AT 24 FT PER MINUTE AS REQUIRED BY REF (B). THIS IS CONSIDERED A MAJOR PROBLEM. THE PROBLEM OF OVERHEATING OF HYDRAULIC SYSTEM ENCOUNTERED DURING THE RETRIEVAL OPERATION IS ATTRIBUTED TO PREMATURE LIFTING OF THE HYDRAULIC RELIEF VALVE (INTERNAL RELIEF RESULTS IN RAPID INCREASE IN OIL TEMP.), AND INSUFFICIENT COOLING OF HYDRAULIC OIL SYSTEM. ADDITIONALLY, THE DUTY CYCLE OF THE ELECTRIC DRIVE MOTOR IS CONSIDERED MARGINAL. THE PROBLEM IS COMPOUNDED BY POSSIBLE OVERLOADING OF SYSTEM UNDER SUSTAINED ADVERSE SEA WIND/CURRENT CONDITIONS AND/OR A CATENARY WHICH RESULTS IN THE WINDLASS BEING REQUIRED TO LIFT IN EXCESS OF ITS RATED LOAD OVER AN EXTENDED PERIOD OF TIME. DURING TESTS CONDUCTED ON DRYDOCK ON 28 JULY UNDER SEA STATE ONE CONDITIONS, PROBLEMS WITH OVERHEATING OR INSUFFICIENT WINDLASS TORQUE WERE NOT ENCOUNTERED. REF (C) REFERS. UPCOMING TESTS ON PIGEON WILL PROVIDE ADDITIONAL DATA.

2. REVIEW OF INSTALLED SYSTEM COMPONENTS INDICATES THAT CERTAIN STEPS CAN BE TAKEN TO UPGRADE THE SYSTEM'S OVERALL PERFORMANCE. TO THIS END, THE FOLLOWING AGREED UPON ACTION IS REQUIRED:

(A) FOR NAVSEC:

1. ESTABLISH STATIC AND DYNAMIC MOORING LOADS UNDER VARYING CONDITIONS OF DEPTH, WIND, AND CURRENT AT SEA STATES THREE AND BELOW. DEVELOP CURVES OF CHAIN CATENARY AND ASSOCIATED WEIGHT OF FREE HANGING CHAIN.
2. INVESTIGATE AND RECOMMEND SPECIFIC MODS REQUIRED TO UPGRADE SYSTEM PERFORMANCE. AS A MINIMUM, SYSTEM OPERATING PRESSURE NEEDS TO BE INCREASED, MEANS OF EXTENDING DUTY CYCLE OF MOTOR SHOULD BE CONSIDERED, AND A HYDRAULIC COOLER SHOULD BE INSTALLED.
3. ESTABLISH INCREASED SYSTEM CAPABILITY TO BE ACHIEVED UPON INSTALLATION OF RECOMMENDED MODS.
4. UPDATE TECH MANUALS AND PMS TO REFLECT MODS INCORPORATED INTO SYSTEM PLUS ADDITIONAL OPERATING PARAMETERS DEEMED NECESSARY.
5. EXECUTE CONTRACT WITH SKANSKY CORP. ON EMERGENCY BASIS TO OBTAIN REQUIRED TECHNICAL ASSISTANCE IN SUPPORT OF ABOVE TASKS.
6. ASSIST PMSY IN ESTABLISHING HAWSEPIPE/BOLSTER EFFICIENCY. OBSERVE AND EVALUATE TEST RESULTS.
7. ESTABLISH OPERATING PROCEDURES/LIMITATIONS DETERMINED TO BE REQUIRED WHEN CONDUCTING DEEP MOORING.
8. OBSERVE AT SEA TESTS OF WINDLASS ON USS PIGEON AND EVALUATE RESULTS. REF (A) REFERS.

(B) FOR PMSY:

1. DETERMINE HAWSEPIPE/BOLSTER EFFICIENCY.
2. OBSERVE AT SEA TESTS OF WINDLASS ON USS PIGEON AND EVALUATE RESULTS. ASSIST NAVSEC IN ANALYSIS.
3. INCORPORATE REQUIRED FIXES ON DRYDOCK AND TEST SYSTEM DURING RAV SEA TRIAL IN 1000 FT OF WATER USING FULL SCOPE OF CHAIN.

(C) FOR NAVSEC/PNSY:

1. PROVIDE LOGON AND LOGOFF (CODE 216) WITH NECESSARY DOCUMENTATION TO PERMIT INCORPORATION OF REQUIRED MODS ON PIGEON. THOSE ACTIONS LISTED ABOVE WHICH ARE REQUIRED TO SUPPORT ACCOMPLISHMENT OF ACTUAL CHANGES TO EQUIPMENT ON ORTOLAN ARE TO BE COMPLETED ASAP AND NLT 1 OCT 1974.

4. FOR USS PIGEON, REQUEST SHIP ADVISE CDR CHRISTENSEN, NAVSEA PMS303, TEL. AUTOVON 222-3513, MR. R. JAMIESON, NAVSEC CODE 61623, TEL. AUTOVON 296-1156, AND MR. ED DRAGON, PNSY CODE 216, TEL. AUTOVON 443-3809 WHEN PIGEON WILL CONDUCT AT SEA TESTS OF ANCHOR WINDLASS.

II INTRODUCTION:

↳ This Center

By NAVSEA ETA's 36018 of 24 April 1974, 36025 of 8 August 1974 and action message 301432Z, NAVSEC was requested to investigate and recommend alterations to correct the difficulties being experienced by the ASR's 21 and 22, USS PIGEON and ORTOLAN during deep sea mooring operations. The difficulties being experienced by the ships were found to fall in the following categories: (1)

- a. Anchor chains jumps off wildcat during payout operation; (2)
- b. Electric motors overload and stall during anchor retrieving operations in 1000 foot of water; (3)
- c. Hydraulic components (pumps and motors) and fluid overheat; (4)
- d. Wildcat locking head dogs travel in their slots causing "hammering" on the anchor windlasses; and (5)
- e. Wildcat shafts bushings (bearings) damaged during operations.

The first step of the investigation by NAVSEC was to define the baseline for the anchor windlass system and its problems. The problems were as follows:

1. Anchor Windlass Design

The anchor windlasses aboard USS PIGEON (ASR 21) and USS ORTOLAN (ASR 22) were designed by Skagit Corporation in accordance with the ASR 21/22 ships specification. Section 9260 of that document requires standard and deep sea anchoring systems. In the deep sea mooring application the anchor windlass must be capable of lowering and recovering 5,000 pound LWT anchor plus 200 fathoms of 1-1/2" diameter anchor chain at a speed of not less than 4 fathoms per minute. The windlass should be designed in accordance with Military Specification, MIL-w-19623, used in the purchasing of conventional electric-hydraulic windlasses. The specification was deficient by only specifying the duty of electric motor as: full load one hour; 1/4 load continuous; and also by not requiring a deep sea mooring testing. Therefore, it is believed that the manufacturer, Skagit, complied with the ships specifications in all areas.

2. Anchor Windlass - ORTOLAN

The anchor chain jumps off the forward port and starboard wildcats during payout operations. These abnormalities normally begin at the sixth to eighth shot of chain on the deck. According to ORTOLAN these abnormalities occur only when the forward (port or starboard) 5,000 pound anchors are used. It was concluded by

NAVSEC and NAVSHIPYD PHILA that the jumping of the anchor chain is due to insufficient wrap (approximately 115°) of the anchor chain on the wildcats. In normal anchor handling arrangements the anchor chain wrap of the wildcat is 180°. At the request of NAVSEA, NAVSHIPYD PHILA designed and NAVSHIPYD NORVA fabricated and installed aboard ORTOLAN a chain guide which increased the anchor chain wrap on the wildcat from 115° to 125°. Ship check shows however, that the chain guide as fabricated does not conform with the drawing requirements. As a further improvement on NAVSEC recommendation, ORTOLAN eliminated the anchor chain twist between the wildcat and the bitter end shackle in the chain locker and reoriented the detachable links into a horizontal position (links flat side is parallel to the deck when passing through the wildcat). With the above corrections, ORTOLAN subjected her forward windlasses to tests on 30 July 1974. Test results show that the starboard windlass could not be operated due to hammering of the traveling locking head dogs in their engagement slots. ORTOLAN's previous experience indicated that the wildcat shaft bushings were damaged. Therefore, the stb. windlass was disassembled and forwarded to NAVSHIPYD NORVA for inspection of the wildcat shaft bushings. The results of this inspection did not reveal any deficiency in the bushings. The port windlass performed satisfactorily with the exception of chain jumping the wildcat (22 times during 30 shots of anchor chain payout). The power plant of the port windlass operated satisfactorily at this time. There was no overheating of any components or overloading of the electric motor. The highest temperature recorded was 154°F on the hydraulic pump case, whereas temperature of hydraulic fluid was 115°F. The Navy's maximum permissible hydraulic fluid temperature is 180°F. The highest load recorded on the electric motor was 65 amps while rated full load operating amperage is 78.5 amps. The average speed of anchor chain recovery was about 5 fathom per minute. It should be noted that the above operation was not conducted at required sea state 3 but at calm sea (sea state 1). Based on the above data, it was concluded that further improvement of the chain guide will eliminate chain jumping off from wildcats.

3. Anchor Windlass - PIGEON

On 8 October 1974, PIGEON subjected her forward port windlass with the improved chain guide (anchor chain wrap on the wildcat about 140°) to a deep sea mooring test. The test was conducted in 1,000 feet depth of water and at sea state 1-1/2 - 2. The tests show that chain started to jump when the 13th shot reached the deck. A check of the anchor chain revealed that the width of all common links of the 13th shot measured 5-5/8" whereas NAVSEA Dwg. 805-2137659 specifies 5-3/8" ± 1/8". Thus, oversized chain caused the chain to jump in this situation. Performance of the windlass power plants was satisfactory. The highest oil temperature

recorded was 164°F and the highest amperage recorded for the electric motor was 68 amps. During this test, the chain guide and wildcat whelps were greased with graphite grease to improve the chain mating with the wildcat. The second test conducted by PIGEON on 17 October 1974 in 180 fathoms of water and sea state 1 (calm sea) revealed an oversized detachable link which precluded proper mating of the chain on the wildcat. The maximum hydraulic fluid temperature incurred was 159°F and the electric motor was momentarily overloaded by drawing 80 and 83 amps.

III. Calculations of Existing System Requirements

1) Sea State Conditions

SEA STATE	SEA - GENERAL (DESCRIPTION)	WIND (DESCRIPTION)	WIND VELOCITY (FPS)	WIND VELOCITY (KNOTS)	WAVE HEIGHT (FT) (SIGNIFICANT)
0	SEA LIKE A MIRROR	CALM	0	0	0
1	SMALL WAVELETS, STILL SHORT BUT MORE PRONOUNCED: CRESTS HAVE A GLASSY APPEARANCE, BUT DO NOT BREAK. LARGE WAVELETS, CRESTS BEGIN TO BREAK, FOAM OF GLASSY APPEARANCE.	GENTLE BREEZE	14.3	8.5	1.0
2	SMALL WAVES, BECOMING LARGER: FAIRLY FREQUENT WHITE HORSES.	MODERATE BREEZE	22.8	13.5	2.9
3			27.0	16.0	4.6
4	MODERATE WAVES, TAKING A MORE PRONOUNCED LONG FORM: MANY MORE WHITE HORSES ARE FORMED.	FRESH BREEZE	32.1	19.0	6.9

figure 1

2) Holding Power

The next step was to determine the holding power required for each sea state with wind and current both coming from 15° off the bow.

The wind force was taken from Hydrospace Research Corporation Report No. 141 "ASR Catamaran Mooring." By using Figure 3-1 a wind from 15° off the bow will have a resultant bearing which is then transferred to figure 2-2.

from figure 2 $\theta = 15^\circ$ $\alpha = 46^\circ$
 from figure 3 $\alpha = 46^\circ$

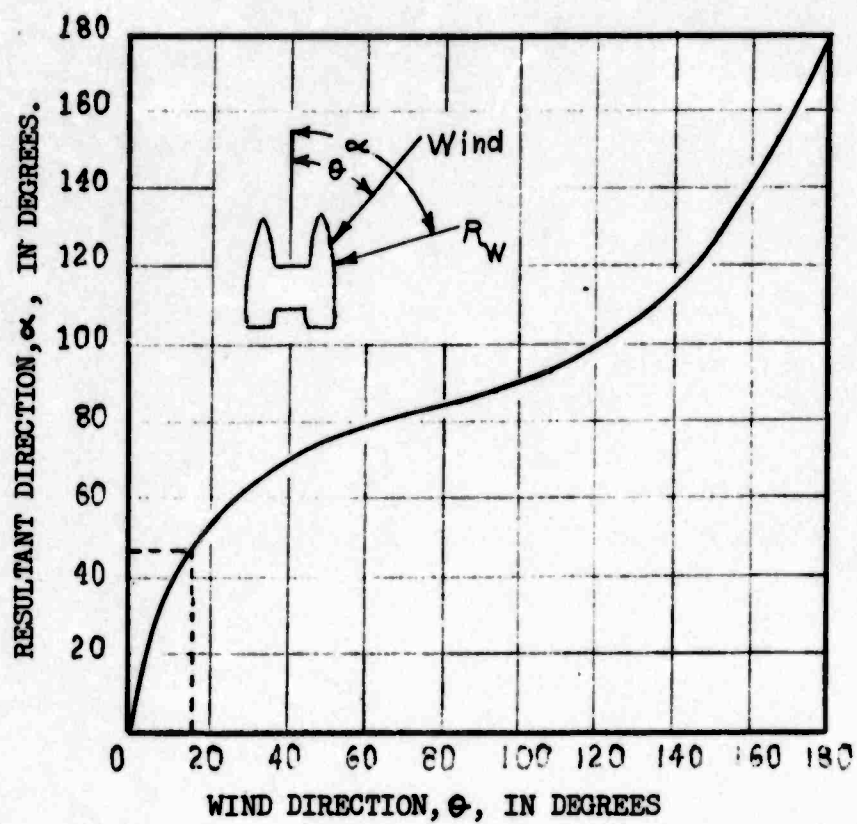
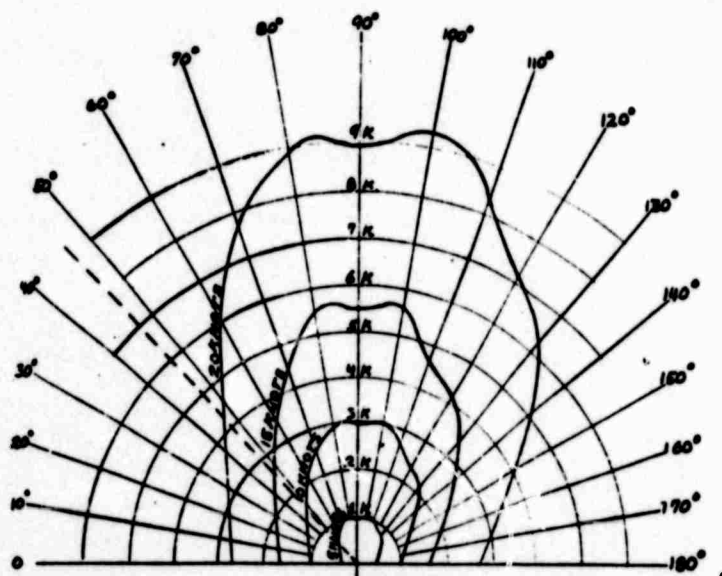


figure 2



WIND FORCE IN THOUSANDS OF POUNDS.
RESULTANT WIND FORCE AS A FUNCTION OF
ANGLE, L , FOR VARIOUS WIND VELOCITIES.

figure 3

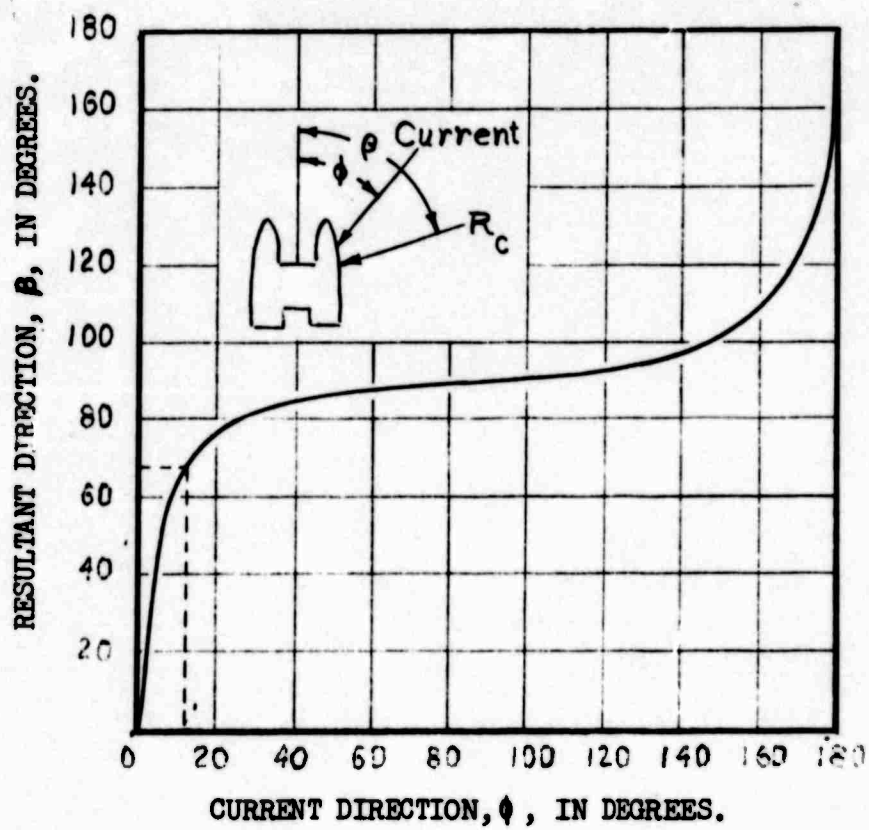


figure 4

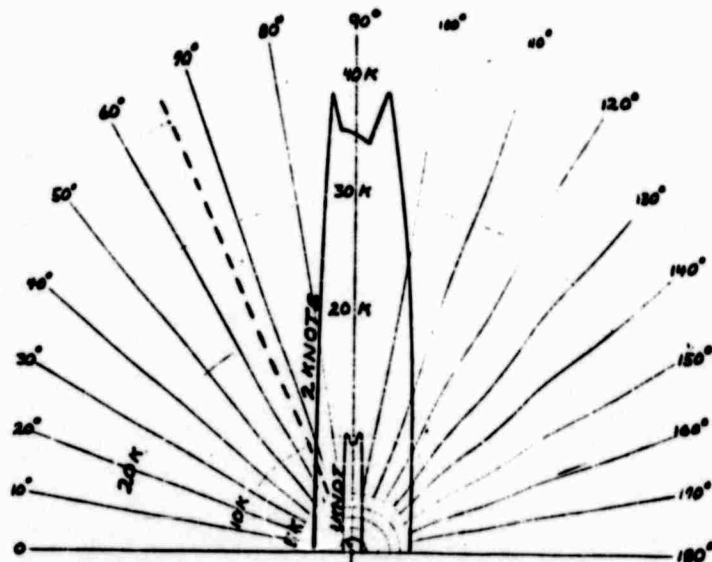


figure 5

Sea State	Wind (Knots)	Force F_w (lbs.)
1	8.5	1,500
2	13.5	2,300
3	16.0	2,750
4	19.0	3,500

figure 6

The current force was also taken from Hydrospace Research Corporation Report No. 141. By using figure 4 a current from 15° off the bow will have a resultant bearing of 66° which is then transferred to figure 2-4.

from figure 4	$\Theta = 15^\circ$	$\beta = 66^\circ$
from figure 5	$\beta = 66^\circ$ (1 knot)	$F = 2,000$ lbs.
from figure 5	$\beta = 66^\circ$ (2 knots)	$F = 8,500$ lbs.

A combining of the wind and current data generates the following resultant forces.

Sea State	Holding Power Required (lbs.)		
	Wind	Wind + 1 knot current	Wind + 2 knots Cur.
1	1500	3500	10,000
2	2500	4500	10,800
3	2750	4750	11,250
4	3500	5500	12,000

figure 7

These values represent the loads the ASH 21/22 could see while in a four point moor recovery mode for sea states 1 through 4, with currents ranging from 0-2 knots.

3. PLOT OF ANCHOR CHAIN CATENARIES

The figure below represents the computer printouts contained in Appendix A of this report. The weight of the anchor chain catenary generated by the various holding powers imposed on the ship will then be used to determine the lifting loads necessary for the recovery of the chain in various sea states.

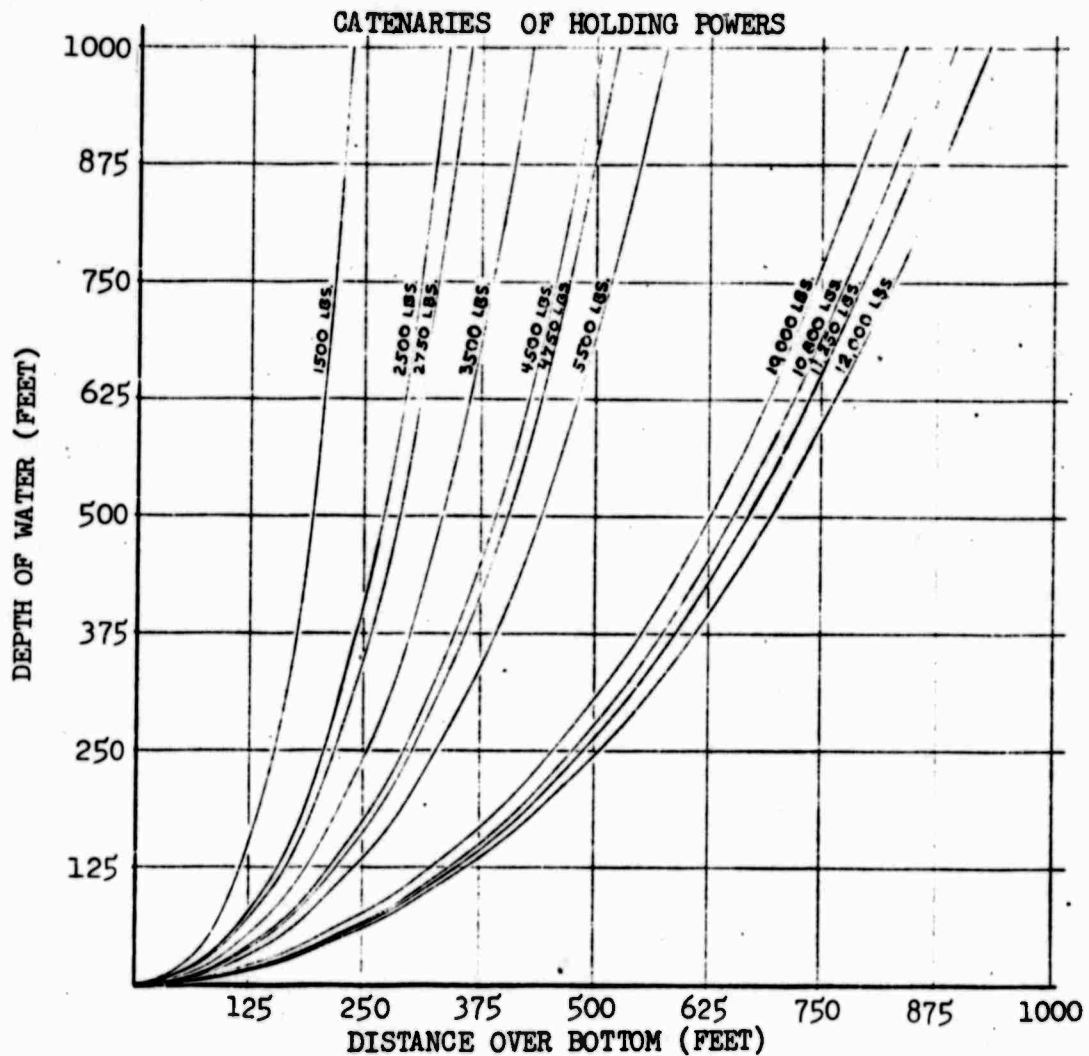


figure 8

4. Sea State Motions and Added Mass

When sea states are imposed during the recovery operation the lifting loads will naturally increase due to the increased motions of the ship and the increased wind. The motion analysis will be done at station "0" for roll pitch and heave.

Sea State 0 - No motions assumed.

Sea State 3 - 4 ft. waves 0 knots current

Motions	1.8 fps
Acceleration	2.0 ft/sec ²
Heave	1.3 fps @ midships
Pitch	.5 fps @ Sta. "0"

These motions were taken from a NAVSEC computer program of ship motions that has proven quite accurate in predicting motions in pitch and heave. A reasonable assumption for roll would be a value equal to 1.44 of pitch.

Distance of bolster off $\bar{c}$	40 ft.
Distance of Sta "0" from $\bar{m}$	115 ft.

The roll would therefor be:

$$(1) \quad (.5) (1.44) \left(\frac{40}{115} \right) = .25 \text{ fps}$$

Motions for a sea state 3 would then be:

$$1.3 + .5 + .25 = 2.05 \text{ fps}$$

$$\begin{aligned} \text{Acceleration } \frac{1.8}{2.05} &= \frac{2}{x} \\ 1.8 x &= (2.05) (2) \\ x &= 2.277 \end{aligned}$$

$$(2) \quad a = 2.277 \text{ ft/sec}^2$$

Sea State 4 7 ft waves 0 knots current

Motions	4.0 fps
Acceleration	3.9 ft/sec ²
Heave	1.9 fps @ midships
Pitch	2.1 fps @ Sta "0"

Assuming roll to be 1.44 of pitch

Distance of Bolster off $\bar{c}$	40 ft.
Distance of bolster from $\bar{m}$	115 ft.

The roll would therefor be:

$$(3) \quad (2.1) (1.44) \left(\frac{40}{115}\right) = 1.052 \text{ fps}$$

Motions for a sea state 4 would then be:

$$1.9 + 2.1 + 1.05 = 5.05 \text{ fps}$$

$$\text{Acceleration} \quad \frac{4}{5.05} = \frac{3.9}{x}$$

$$4x = (3.9) (5.05)$$

$$x = 4.9237 \text{ ft/Sec}^2$$

$$(4) \quad \underline{a = 4.9237 \text{ ft/Sec}^2}$$

Added Mass of the Chain

Discussions with the Hydrodynamics people in NAVSEC indicated that added mass values of 160 lbs. and 1000 lbs. could be expected for sea states 3 and 4 consecutively.

Lift Load Requirements

The specifications for the ASR 21/22 Class required that the windlass machinery be capable of lifting 200 fathoms of 1½" high strength die lock chain plus a 5000 lb. anchor.

$$(5) \quad \begin{array}{rcl} (1 \text{ shot of } 1\frac{1}{2}'' \text{ chain} & = & 2,260 \text{ lbs.}) \\ 200 \text{ fathoms} & = & 30,133 \text{ lbs.} \\ 1 \text{ anchor} & = & 5,000 \text{ lbs.} \\ & \underline{\hspace{1.5cm}} & 35,133 \text{ lbs.} \end{array}$$

$$(6) \quad (35,133) \times (.872) = 30,636 \text{ lbs.}$$

The windlass was therefore required to lift an equivalent load of 30,636 lbs. (outside of the bolster).

A vertical lift in 1,000 ft. of water would see the following load:

$$(7) \quad (1000) \left(\frac{2260}{90}\right) (.872) = \underline{21,896 \text{ lbs.}}$$

A vertical lift in 1,000 ft. of water with motions from a sea state 3 imposed on the ship would yield the following lift loads:

$$(8) \quad L = (21,896) + \left(\frac{21,896}{32.2}\right) (2.278) + (160) = \underline{23,611 \text{ lbs.}}$$

If lifting were done in a sea state 3 with the ship being set down by wind the scope of the chain would be increased to 1,119 ft. The new lift load would be:

$$S = (1,119) \left(\frac{2260}{90} \right) (.872) = 24,503 \text{ lbs.}$$

$$(9) \quad L = (24,600) + \left(\frac{24,503}{32.2} \right) (2.278) + (160) = \underline{26,493 \text{ lbs.}}$$

If the lift were done in a sea state 3 with the ship being set down by wind and a 2 knot current the scope of the chain would increase to 1,425 ft. The new lift load would be:

$$S = (1425) \left(\frac{2260}{90} \right) (.872) = 31,203 \text{ lbs.}$$

$$(10) \quad L = (33,080) + \left(\frac{31,203}{32.2} \right) (2.278) + (160) = \underline{35,447 \text{ lbs.}}$$

Repeating the process for sea state 4 conditions - for a vertical lift the recovery loads are:

$$(11) \quad L = (21,896) + \left(\frac{21,896}{32.2} \right) (4.9237) + (1000) = \underline{26,244 \text{ lbs.}}$$

For a sea state 4 recovery with wind setting the ship down the scope increases to 1,149 ft. The resulting lift load is:

$$S = (1,149) \left(\frac{2260}{90} \right) (.872) = 25,159 \text{ lbs.}$$

$$(12) \quad L = (25,340) + \left(\frac{25,159}{31.2} \right) (4.9237) + (1,000) = \underline{30,187 \text{ lbs.}}$$

For a sea state 4 recovery with wind and a 2 knot current setting the ship down the chain scope increases to 1,449 ft. The resulting lift load is:

$$S = (1440) \left(\frac{2260}{90} \right) (.872) = 31,428 \text{ lbs.}$$

$$(13) \quad L = (33,810) + \left(\frac{31,728}{32.2} \right) (4.4237) + (1000) = \underline{39,661 \text{ lbs.}}$$

If the chain were lifted in a calm sea with two knots of current the scope would be 1,331 ft. and the recovery loads would be:

$$(14) \quad L = (1331.) \left(\frac{2260}{90} \right) (.872) = \underline{29,144 \text{ lbs.}}$$

These values, plotted in figure 9, represent the loads that will be seen during various chain recovery conditions. They all assume that the ship is dead in the water and no effort is being made to lessen the load on the anchor chain. By the same token the load can be reduced by steaming up on the anchor chain and thus shortening the chain catenary.

5. SEA STATE RECOVERY REQUIREMENTS

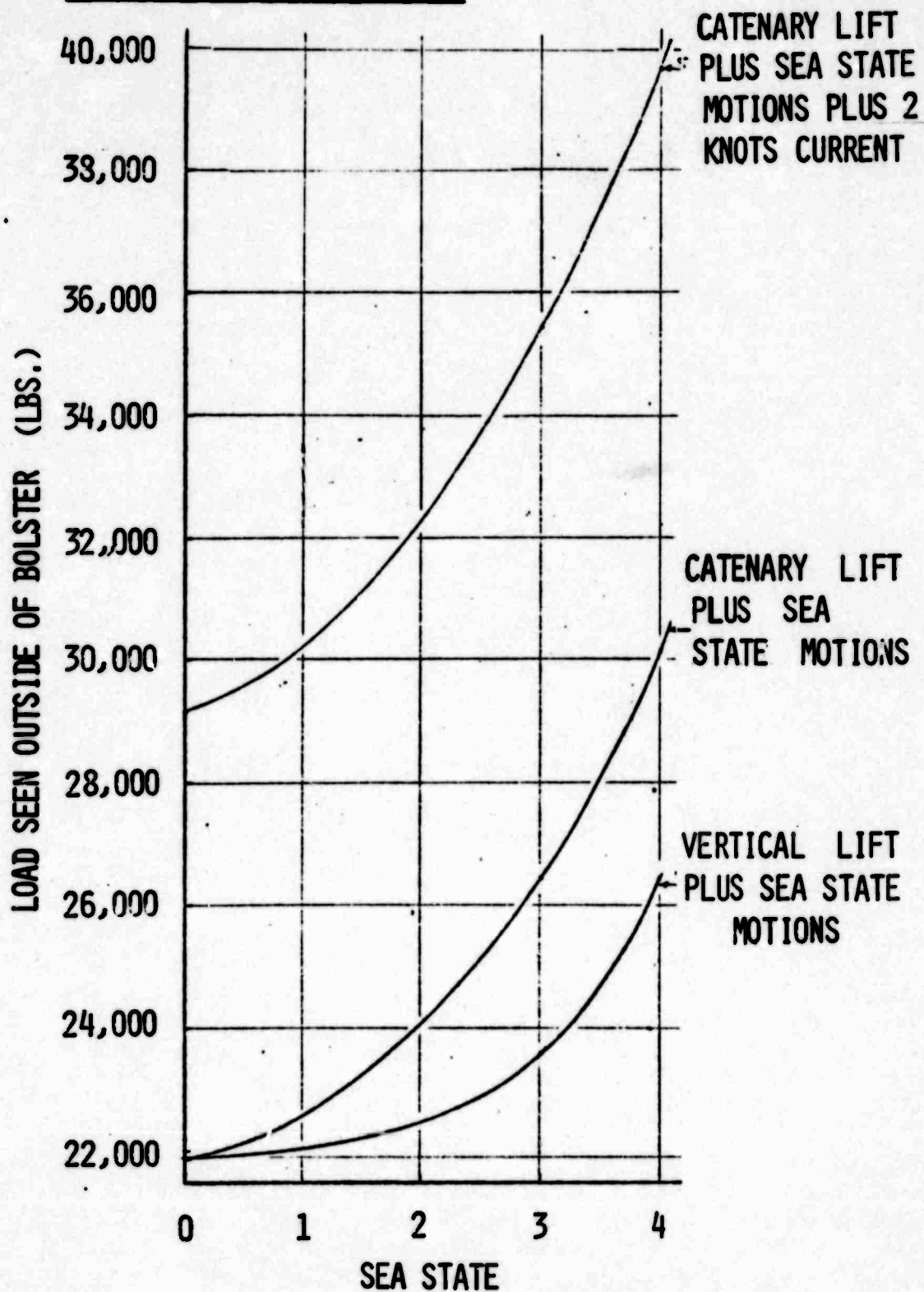


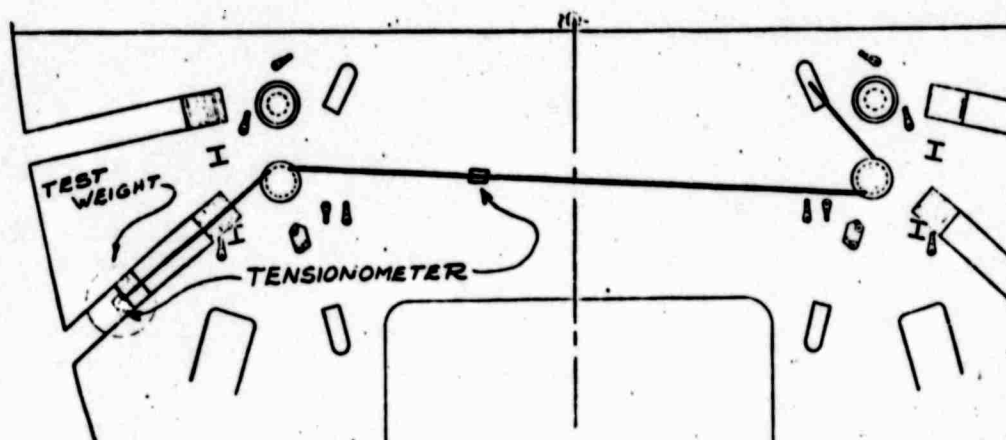
figure 9

IV PRESENT CAPABILITIES OF THE 4 POINT MOOR RECOVERY SYSTEM

1. Determine bolster efficiencies

The bolster efficiencies were done on the ASR 22 while she was in drydock at the Philadelphia Naval Shipyard. The tests themselves were done by placing weights on the drydock floor and lifting them with the anchor chain the same way it is done in operation. To determine the efficiency of the bolster itself load cells were placed in the chain before and after the bolster to obtain the differential load in the chain as it passed over the bolster. This test is described in the following section.

2. Forward bolster efficiency test.



RIGGING ARRANGEMENT FOR FORWARD STARBOARD
BOLSTER EFFICIENCY TEST
figure 10

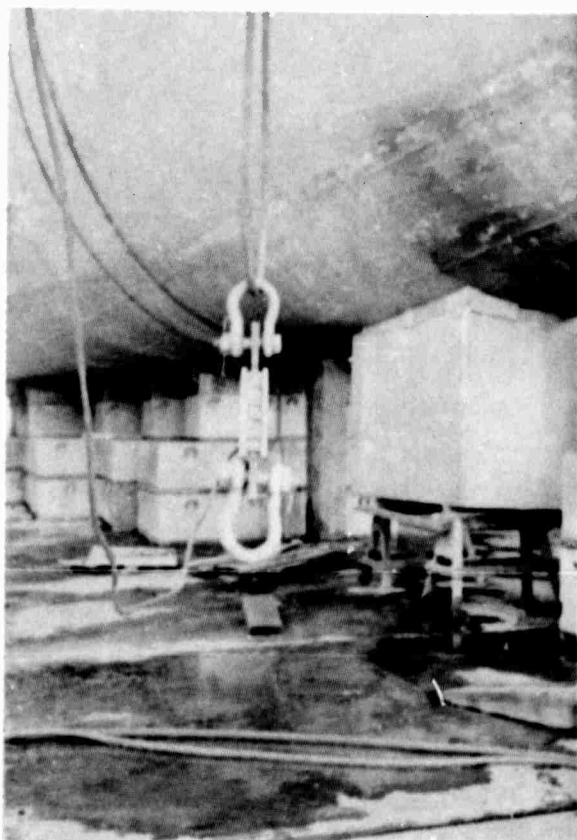
TEST SEQUENCE

TEST	DESCRIPTION	REMARKS	TIME
1.	Calibration		13:29
2.	Heave in		13:55
3.	Up	Up Speed Setting 1	13:55
4.	Down	Down Speed Setting 2	
5.	Up	Up 3	
6.	Down	Down 2	
7.	Up	STALL	
8.	Up	STALL	
9.	Down		
10.	Up	STALL	
11.	Down		
12.	Up	STALL	
13.	Down		
14.	Up	STALL	
15.	Up	Up 4	

16.	Down	Down 4	
17.	Up	STALL	
18.	Down	JOG	
19.	Up	JOG	
20.	Down		
21.	Up		
22.	Down		
23.	Up	JOG	
24.	Down	Down & Up	
25.	Down	JOG	
26.	Up	STALL	
27.	Down		
28.	Up	STALL	
29.	Hold		14:18
30.	Down	JOG	
31.	Up	Up 4	
32.	Down		
33.	Up	Up 4 STALL	
34.	Down		
35.	Up	Up 4 STALL	
36.	Down		
37.	Up	STALL - HOLD	
38.	Down		
39.	Up	STALL	
40.	Down		
41.	Up	STALL	
42.	Down		
43.	Up	STALL	
44.	Down	7 Seconds	
45.	Up	Up 1 STALL	
46.	Down	Down 2 5 Seconds	
47.	Up	Up 4 STALL	
48.	Down	Wet Bolster Up 1	
49.	Up	Up 4 STALL	
50.	Down	Down-Up 4 STALL	
51.	Down	JOG	
52.	Up	STALL	
53.	Up	Up 4 STALL	
54.	Up	STALL	
55.	Up	STALL	
56.	Down	Weight reduced to 23,000#	14:47
57.		Changing Weights	
58.	Up	Dry Bolster Up 2	
59.	Up		
60.	Down	Down 4	
61.	Up	Up 4	
62.	Down	Down 4	
63.	Up	Wet Bolster Up 4	
64.	Down	Down 4	
65.	Up	Up 4	
66.	Down	Down 4	

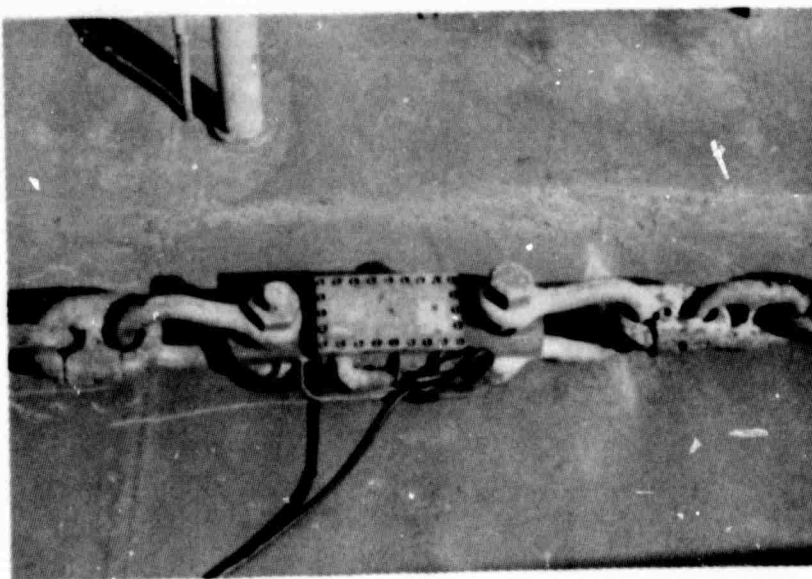
TEST WEIGHT SHOWN AT BOTTOM
OF DRYDOCK READY FOR HOOK
UP TO LIFTING CHAIN.

figure 11



TEST WEIGHT LOAD CELL
SHOWN IN POSITION READY
TO HOOK UP TO TEST WEIGHT
BY PLATE SHACKLE SHOWN IN
PHOTO ABOVE. WIRE STRAPS
WERE USED TO TAKE UP FAIR-
LEAD DIFFERENCES BETWEEN
FORE AND AFT BOLSTERS.

figure 12



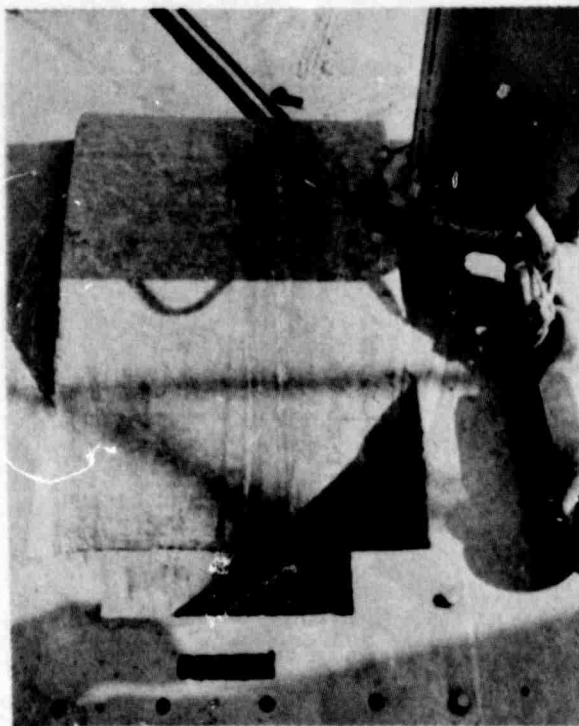
TOPSIDE IN-HAUL LOAD CELL RATED AT 100,000 LBS.

figure 13



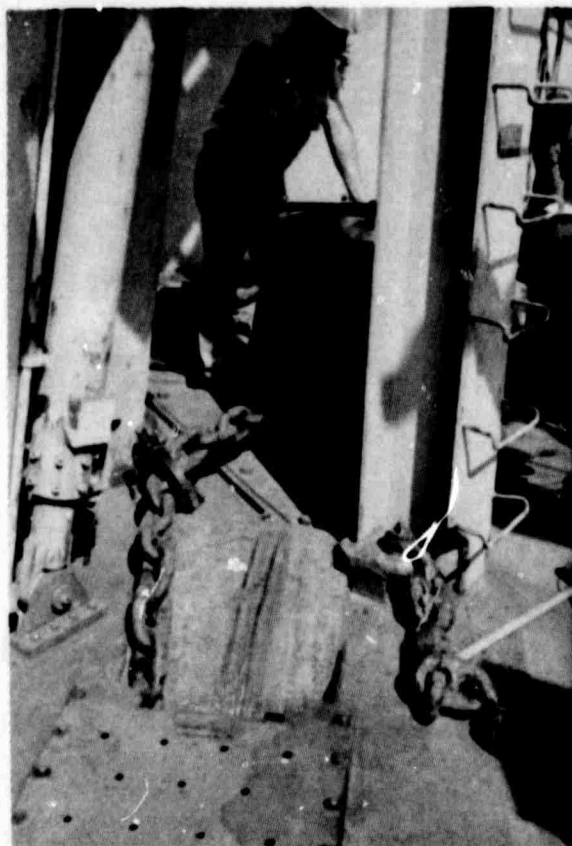
OUTBOARD TEST WEIGHT LOAD
CELL. RATED AT 100,000 LBS.

figure 14



CONDITION OF THE
STARBOARD FWD
BOLSTER BEFORE THE
TEST RUNS WERE
STARTED.

figure 15

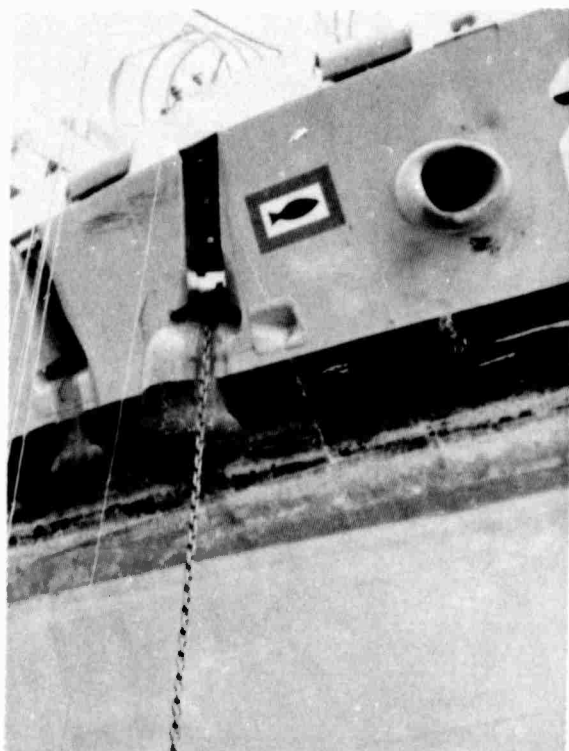
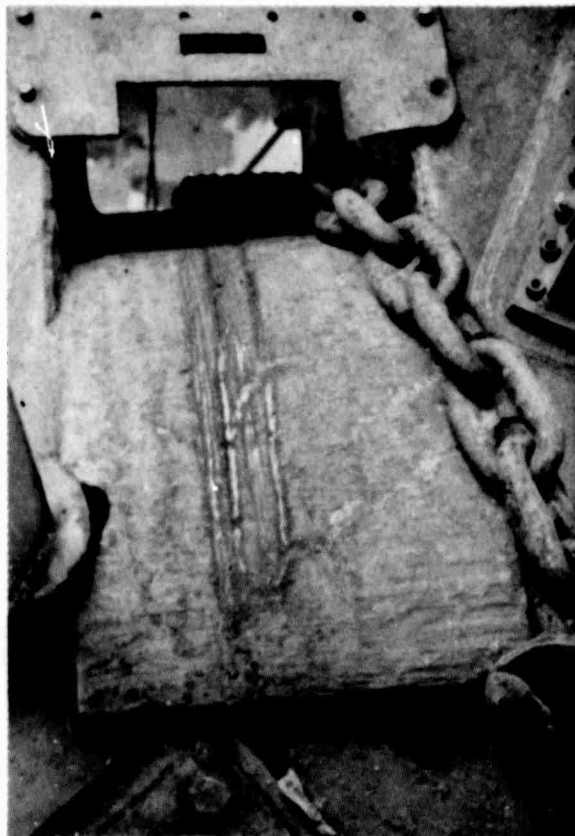


CONDITION OF THE
STARBOARD FWD BOLSTER
AFTER THE TEST RUNS
WERE COMPLETED.

figure 16

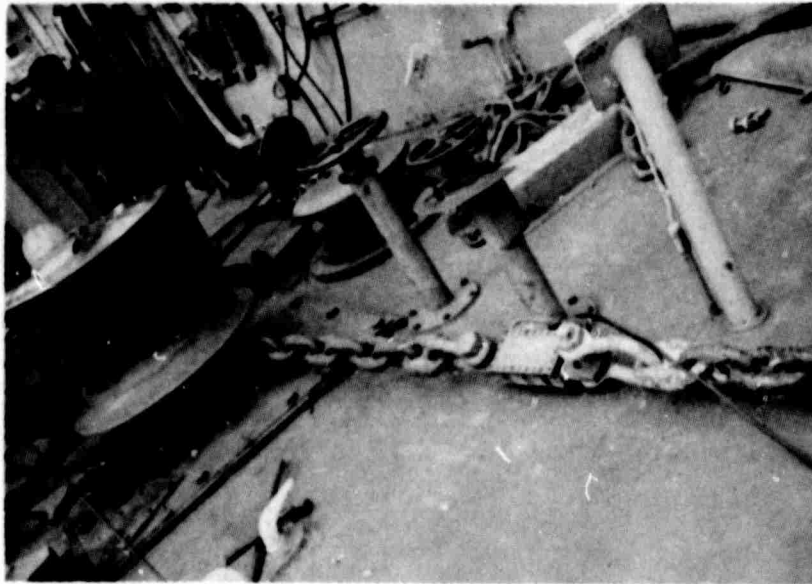
STARBOARD FWD BOLSTER,
AFTER TEST RUNS WERE
COMPLETED.

figure 17



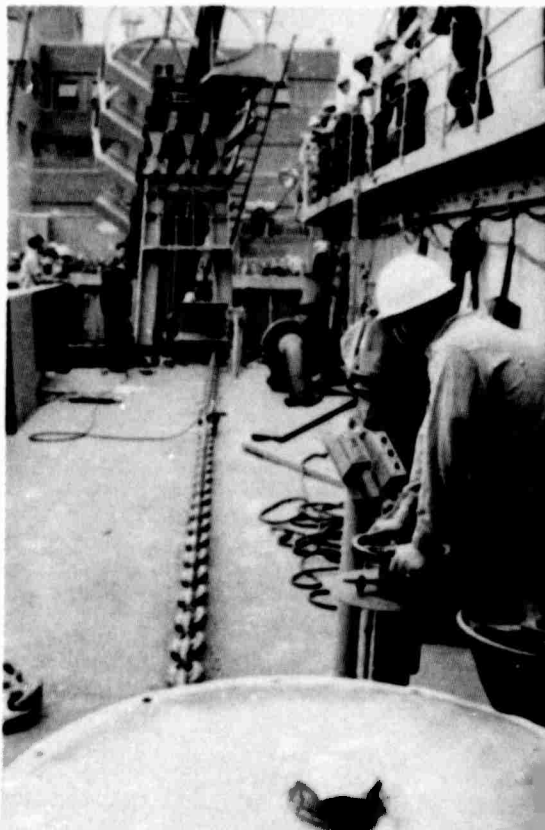
STARBOARD FWD BOLSTER IN
THE RIGGED CONDITION PRIOR
TO TEST RUNS.

figure 18



THE INHAUL LOAD CELL WAS INSTALLED AS SHOWN. THE EXTRA LOAD FROM THE WILDCAT (BEING USED AS AN IDLER) WAS SUBTRACTED FROM THE FINAL READINGS.

figure 19



THE HAULING FORCE FOR THE LIFT TEST WAS PROVIDED BY THE ACROSS DECK WINDLASS. THE LENGTH OF THE RUN WAS TIMED THUS GIVING SPEED VALUES.

figure 20

3. Wildcat efficiency test.

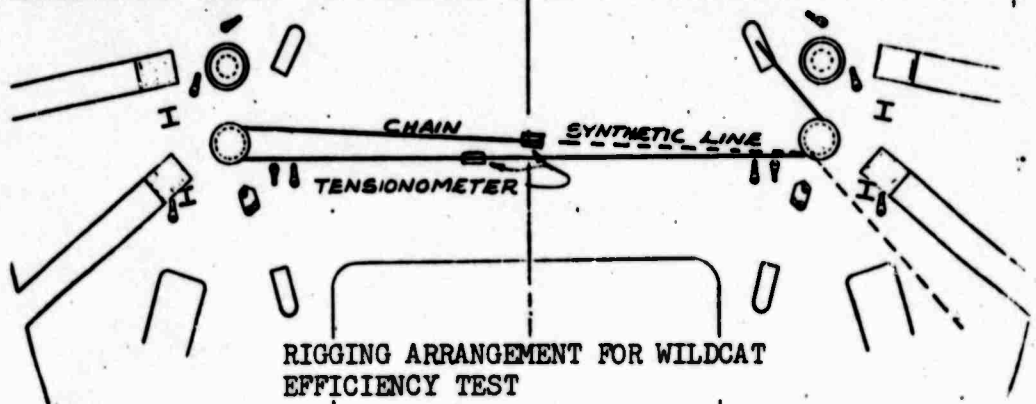


figure 21

TEST	DESCRIPTION	REMARKS	TIME
85.	Start	Wildcat Idler Efficiency Test	
86.	Flat		
87.	Flat		
88.	Flat		
89.	Flat		
90.	Flat		
91.	Flat	STOP	
92.	Flat	2nd Test	
93.	Flat		
94.	Flat		
95.	Flat		
96.	Flat		
97.	Flat		
98.	Flat		
99.	Peak		
100.	Peak		
101.	Flat		
102.	Flat		
103.	Flat		
104.	Flat		
105.	Flat		
106.	Flat		
107.	Flat		
108.	Flat		
109.	Stop		
110.	Start	Wildcat Idler Efficiency	
111.	Peak		
112.	Peak/Flat		
113.	Flat		
114.	Peak/Flat		
115.	Series Peaks/Flats		
116.	Flat		
117.	Flat		
118.	End		

119.	Start	STALL Tests
120.	Up (1)	
121.	Up (2)	
122.	Up (3)	
123.	End/Start	2nd Test
124.	Up (1)	
125.	Up (2)	
126.	Up (3)	
127.	Up (4)	
128.	End/Start	3rd Test
129.	Up (1)	
130.	Up (2)	
131.	Up (3)	
132.	Up (4)	
133.	End/Start	4th STALL Test
134.	Up (1)	
135.	Up (2)	
136.	Up (3)	
137.	Up (4)	End STALL Test

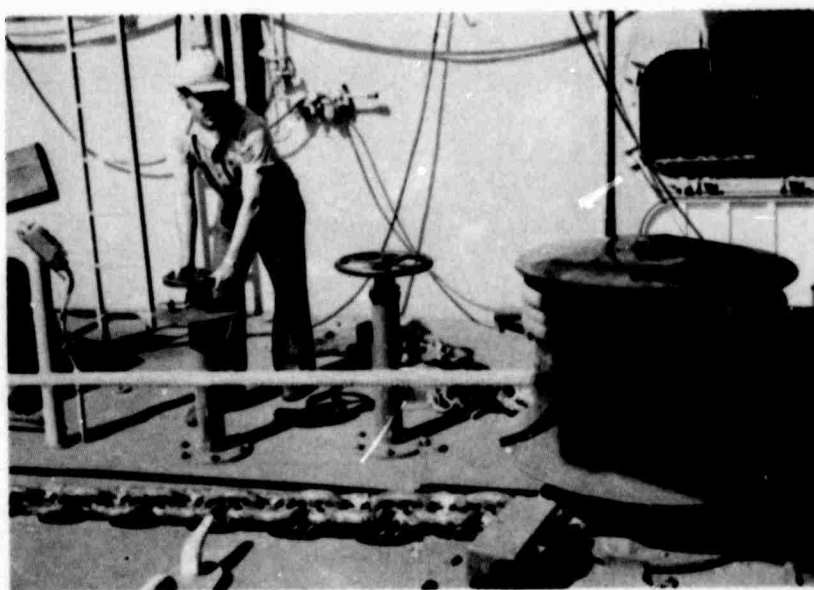


WILDCAT EFFICIENCY TEST.
LOAD CELLS WERE INSTALLED
ON BOTH SIDES OF WILDCAT.
ONE IN THE CHAIN RUN AND
THE OTHER AT THE CONNECTION
OF THE SYNTHETIC LINE.

figure 22

A RUNNING LOAD FOR THE TEST WAS ACCOMPLISHED BY HAULING IN ON THE CHAIN AND THE SYNTHETIC LINE AT THE SAME TIME. THE SYNTHETIC LINE WAS SLIPPED OVER THE CAPSTAN CREATING A BACK TENSION.

figure 23



CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date _____
 Subject WILDCAT EFFICIENCY Chkd. _____ date _____
TESTS 85-108 Sheet No. _____ of _____

(CHAIN PULL) IN LINE TENSIONOMETER		(SYN PULL) TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
20.0	.	14.7	.
20.3	.	15.0	.
18.4	.	13.4	.
21.9	.	16.0	.
18.6	.	14.1	.
17.7	.	13.2	.
21.5	.	17.0	.
31.3	.	24.5	.
22.3	.	17.5	.
21.3	.	17.0	.
16.9	.	14.2	.
22.1	.	18.0	.
20.9	.	17.3	.
20.8	.	17.0	.
20.6	.	16.7	.
22.1	.	17.7	.
20.3	.	16.3	.

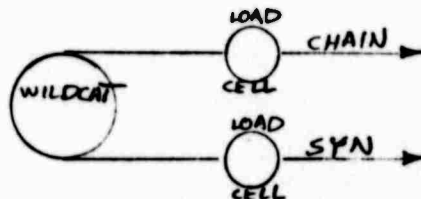
Total 357.0 297.6

Ave. 21.0000 16.4470

DIFFERENCE 4.5530

WILDCAT DRAG 4.553*

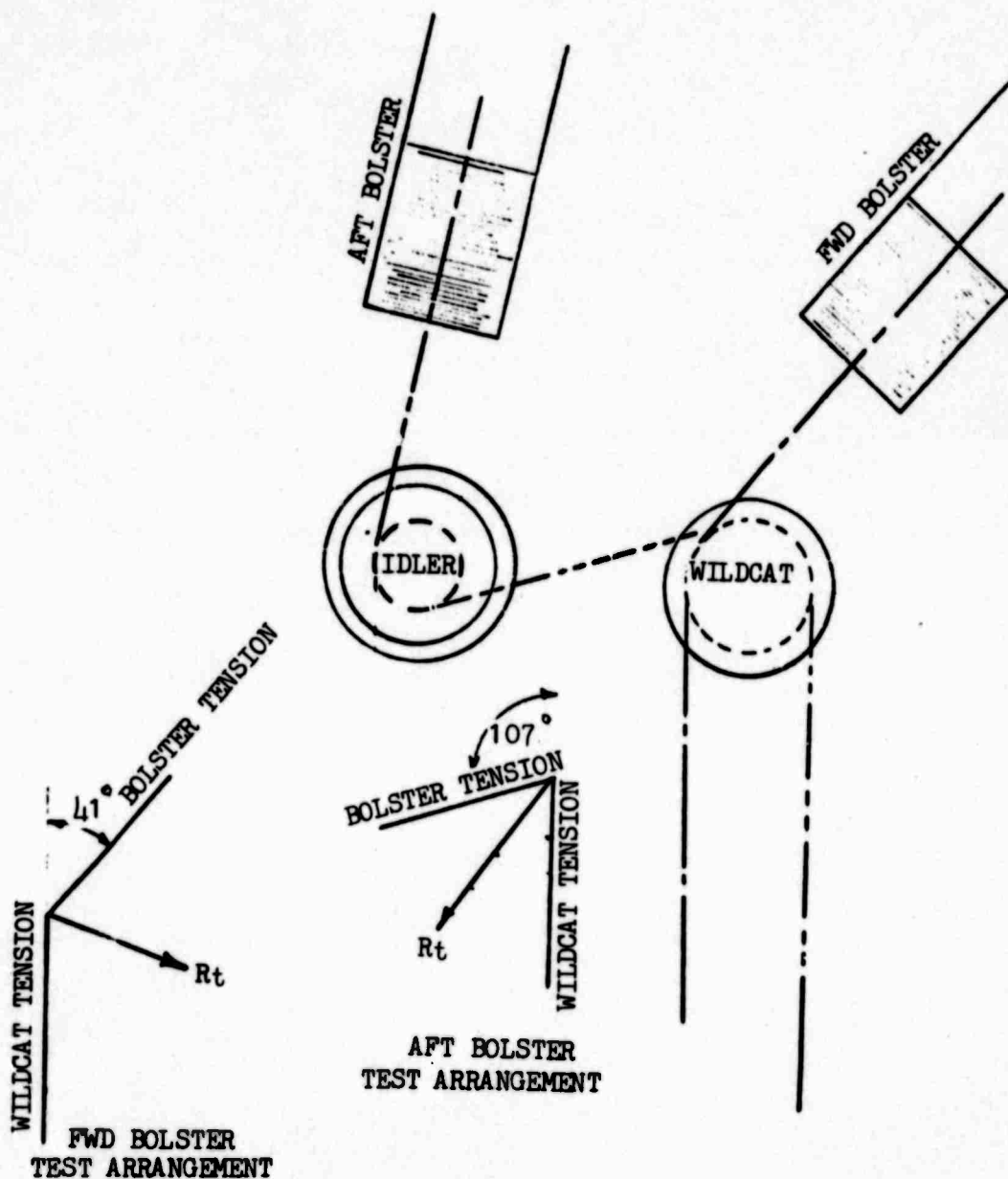
RESULTANT LOAD 37.447*



WILDCAT FRICTION $\mu = \frac{.1216}{87.84\%}$
 WILDCAT EFFICIENCY $= \frac{.1216}{87.84\%}$

CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date _____
 Subject WILDCAT EFFICIENCY Chkd. _____ date _____
 Sheet No. _____ of _____



RIGGING ARRANGEMENT FOR BOLSTER EFFICIENCY TEST USING A WILDCAT
AS AN IDLER.

figure 24

CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date _____
Subject WILDCAT DRAG Chkd. _____ date _____
Sheet No. _____ of _____

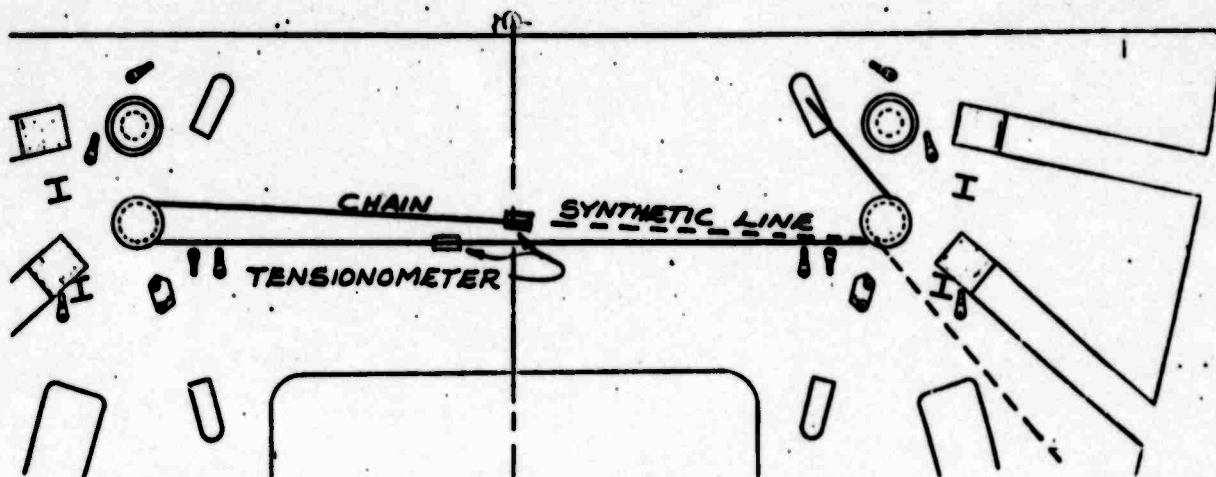


figure 25

FOR A WRAP OF 180° THE CAPSTAN SHOWED A MEAN DRAG LOAD OF 4,553 LBS. FOR A CHAIN PULL OF 21,000 LBS.

∞ ASSUME A $\mu = \frac{4,553}{21,000} = .2168$

USING A SIMPLIFIED APPROXIMATION OF THE DRAG FOR VARIOUS WRAPS OF THE CAPSTAN WE HAVE:

FOR INHAUL: $DRAG_1 = (MEAN\ CHAIN\ LOAD)(\mu)\left(\frac{WRAP}{180^\circ}\right)$

$$DRAG_1 = (MCL)(.2168)\left(\frac{41}{180}\right)$$

$$DRAG_1 = .0494(MCL)$$

$$DRAG_2 = (MCL)(.2168)\left(\frac{107}{180}\right)$$

$$DRAG_2 = .1298(MCL)$$

FOR LOWERING: $DRAG_1 = (MEAN\ BACKHAUL\ LOAD)(\mu)\left(\frac{WRAP}{180^\circ}\right)$

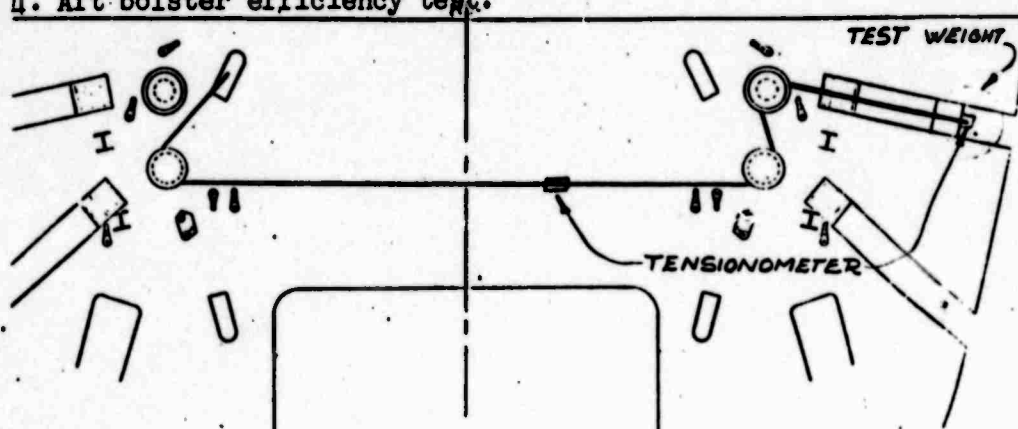
$$DRAG_1 = (MBL)(.2168)\left(\frac{41}{180}\right)$$

$$DRAG_1 = .0636(MBL)$$

$$DRAG_2 = (MBL)(.2168)\left(\frac{107}{180}\right)$$

$$DRAG_2 = .16573(MBL)$$

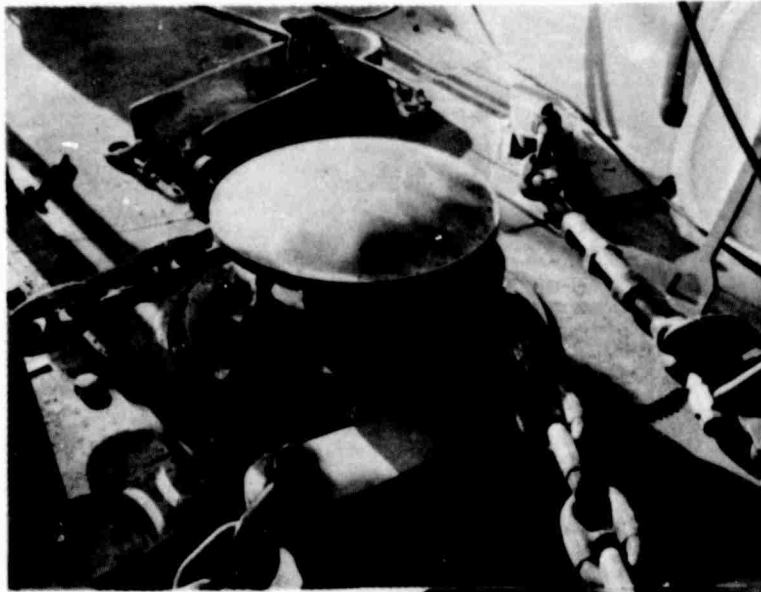
4. Aft bolster efficiency test.



RIGGING ARRANGEMENT FOR AFT PORT
BOLSTER EFFICIENCY TEST

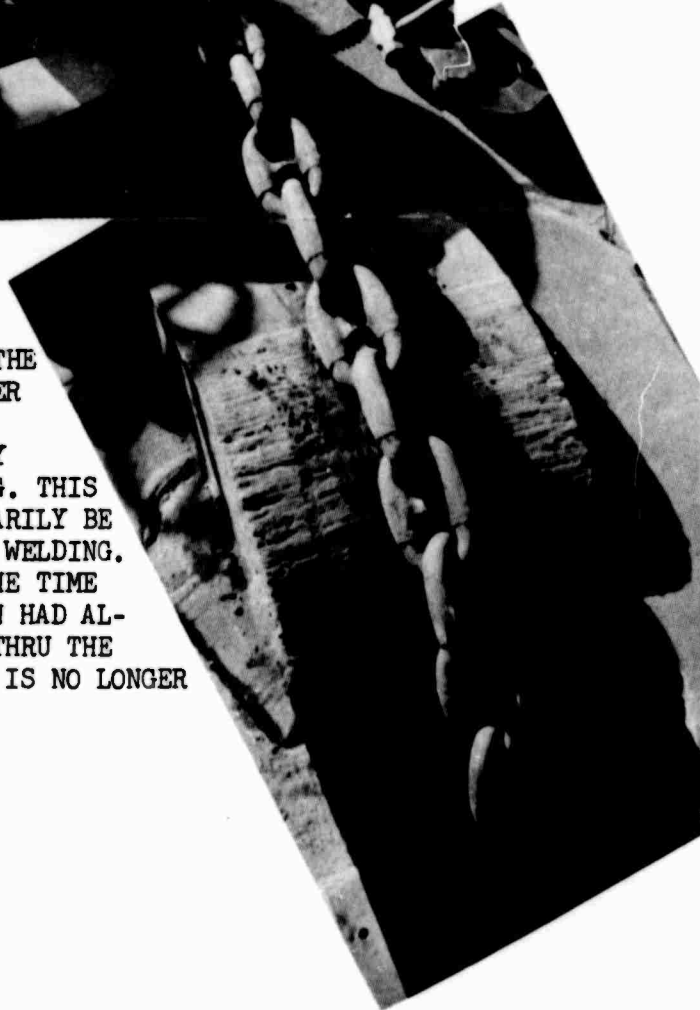
figure 26

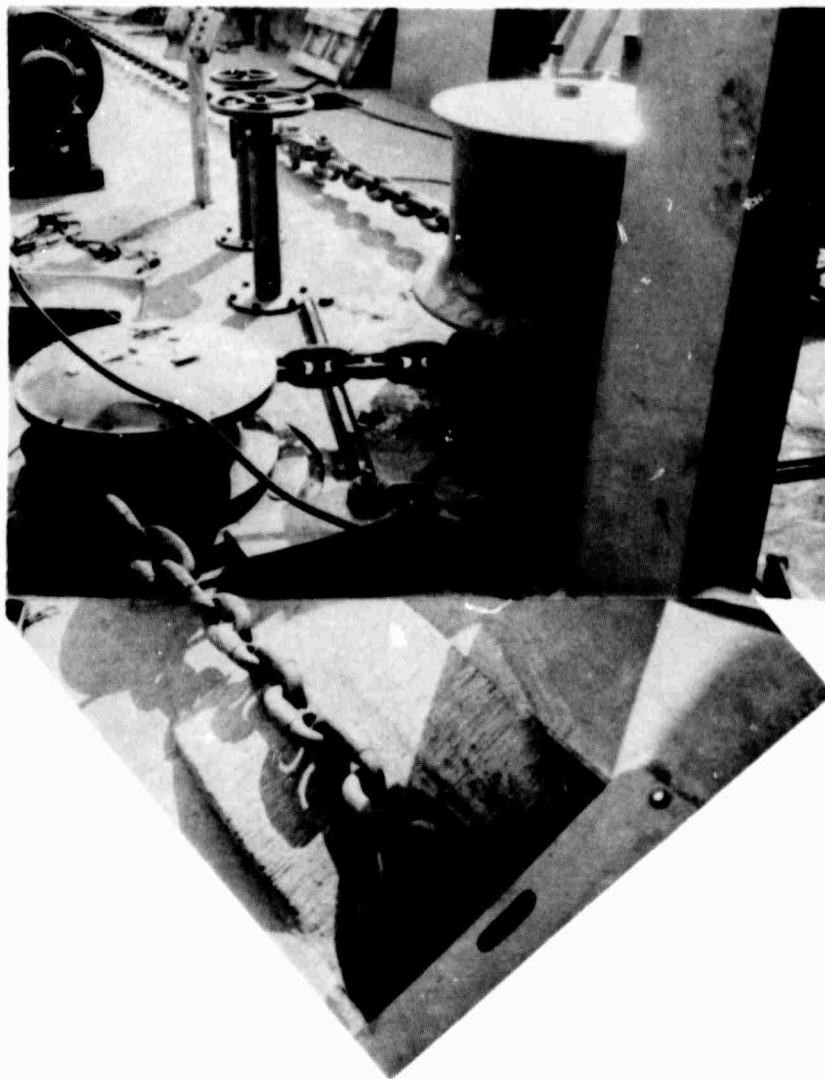
TEST	DESCRIPTION	REMARKS	TIME
138.	Start of Port After Bolster		16:37
139.	Up (1)		
140.	Heave Up		
141.	Heav Up Both Wildcats		
142.	Chain Slipped		
143.	Heave Up		
144.	Down		
145.	Heave Up		
146.	Down		
147.	Up (4)		
148.	Down (4)		
149.	Up (4) Wet		
150.	Down (4)		
151.	Up (4)		
152.	Down (4)		
153.	Up (2)	STALLED	
154.	Down		
155.	Up - STALL		
156.	Down		
157.	Up (4)		
158.	Down (4)		
159.	Up (4)	STALL	
160.	Down		
161.	Up (4)	STALL?	
162.	Up (4)	STALL (Damp)	
163.	Up (4)	STALL	
164.	Down/Up		
165.	Up (4)	STALL	
166.	Down		



PORT AFTER BOLSTER
SHOWING THE ANCHOR
CHAIN GOING AROUND
THE IDLER AND OVER THE
BOLSTER. THE BOLSTER
HAS BEEN CLAD WITH
HARDENED MATERIAL BY
ELECTRIC ARC WELDING. THIS
CLADING WOULD ORDINARILY BE
GROUND SMOOTH AFTER WELDING.
THIS WAS NOT. AT THE TIME
OF TESTING THE CHAIN HAD AL-
READY WORN GROOVES THRU THE
CLADING SO FRINDING IS NO LONGER
NECESSARY.

figure 27





RIGGING OF THE STARBOARD AFT BOLSTER PRIOR TO TEST RUNS. THIS SHOWS FAIRLEADING REQUIRED TO INSTALL THE LOOK LOAD CELL. THIS TEST WAS CANCELED DO TO A FROZEN IDLER. UNSUCCESSFUL ATTEMPTS WERE MADE TO BREAK IT FREE. THE TEST WAS MOVED TO THE PORT SIDE WHERE THE SAME ARRANGEMENT WAS USED.

figure 28

5. Bolster efficiencies.

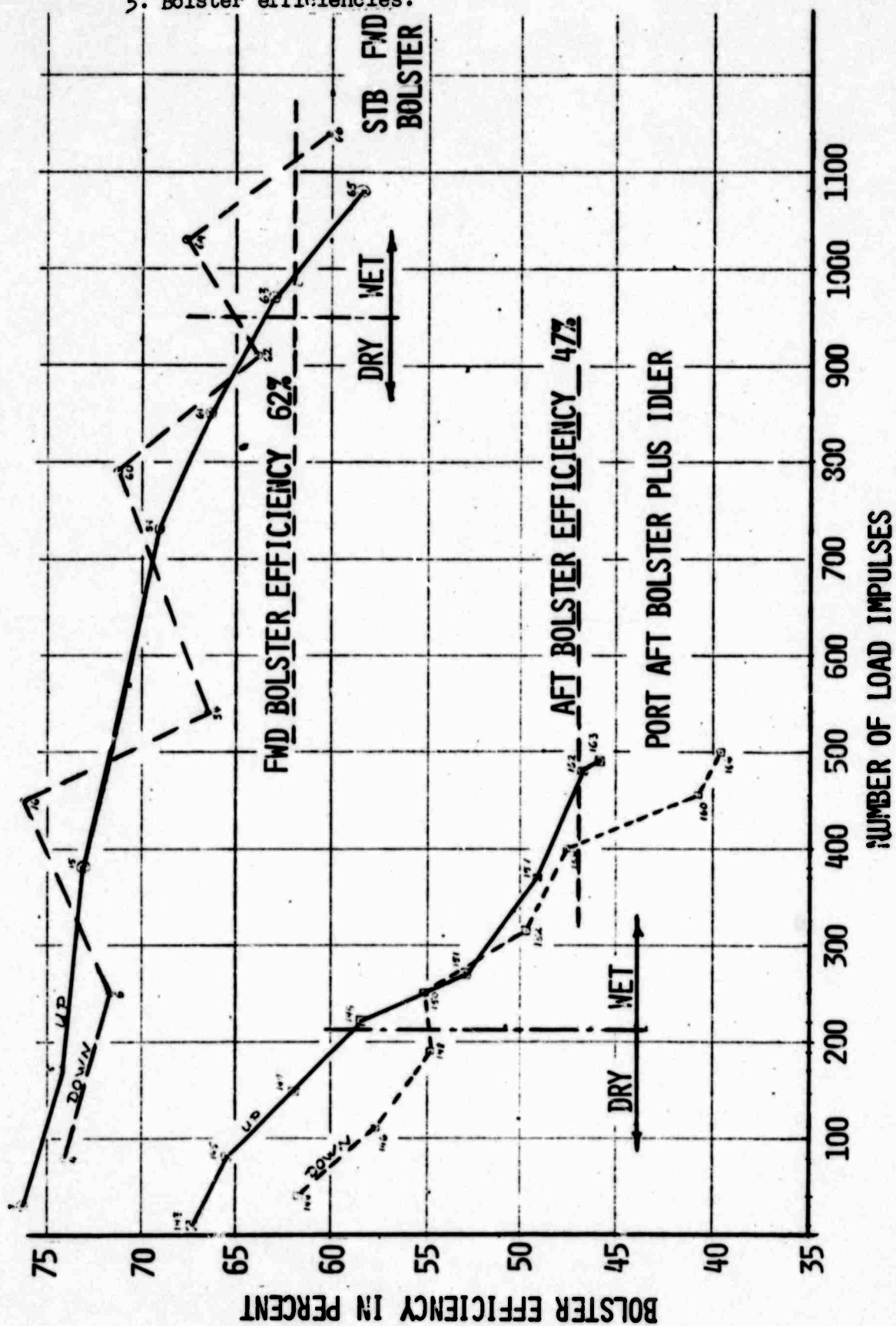


figure 29

Based on the efficiencies determined in the bolster tests the lift capacity of the windlasses aboard the ASR 22, with a pressure relief setting of 3500 psi, is as shown below:

EXISTING WINDLASS LIFT CAPACITY FOR ASR 22
(3500 PSI RELIEF VALVE)

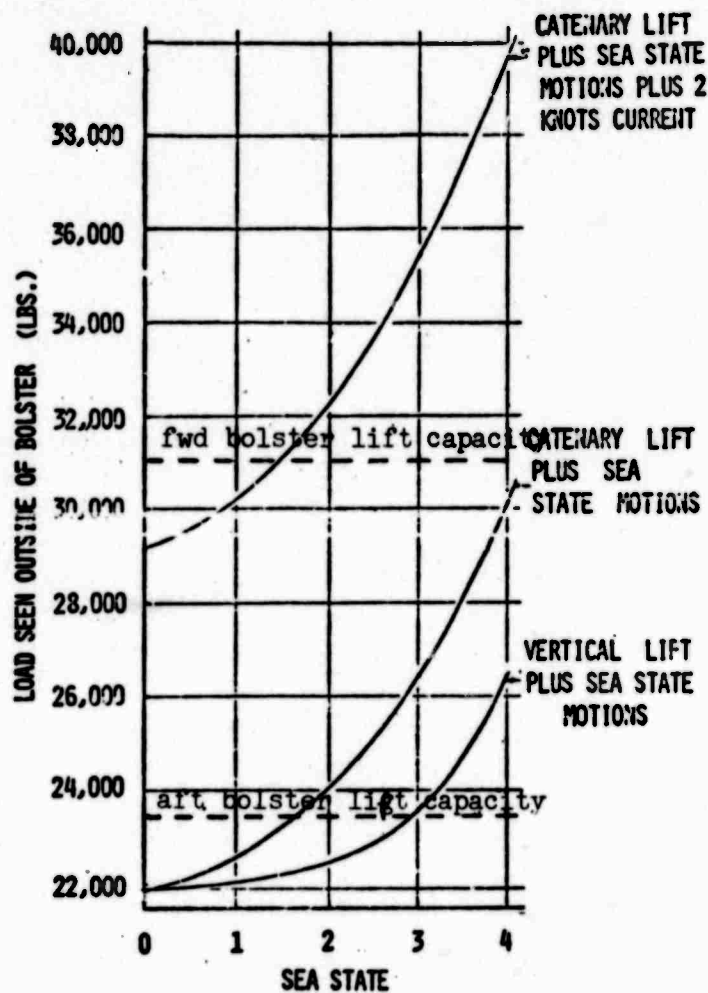


figure 29a

V CONCLUSIONS

An analysis of the above deficiencies, the anchor windlass design information, and the available test data, lead NAVSEC to the following conclusions:

A. Anchor Chain Jumping on the Wildcat

Insufficient anchor chain wrap is the primary cause for chain jumping on the wildcat. The secondary cause is twist of the chain between the wildcat and the chain locker bolster and orientation of the detachable links with the wildcat. The effect of the anchor chain twist and the detachable link orientation has been experienced on other ships, the difference being that the deficiency was less pronounced since less chain load was being applied. In addition to the above, a factor causing the chain to jump is the fact that the strain on the anchor chain between the wildcat and chain locker is substantially lower than the strain in the chain between the wildcat and anchor. High strain in a chain ordinarily causes better engagement of the chain with the wildcat as observed during anchor chain retrieval operations. The best solution to preclude the anchor chain jumping would be to redesign the anchor handling systems to provide a 180° chain wrap on the wildcat or to increase strain in the anchor chain from the chain locker to the wildcat for better chain engagement. Both these solutions are expensive alterations. NAVSEC believes that further improvement of the chain system by (1) further increase of the anchor chain wrap angle, (2) eliminating twist in the anchor chain between wildcat and the bitter end shackle in the chain locker, (3) orienting all "D" links so that their flat surfaces are in the plane parallel to the deck, (4) ensuring that the centerline of the anchor chain on the deck tray, chain guides, and the wildcat are on the same level, (5) and greasing the wildcat whelps chain guide and deck tray before each operation will rectify the problem. The difficulty of anchor chain retrieval can be resolved by increasing tolerances in the horizontal groove (parallel to deck) of the chain guide and ensuring that the centerline of the anchor chain between wildcat and hawsepipe is on the same level. If further difficulties are encountered the chain guide can be redesigned so that it can be partially or completely removed during anchor chain retrieval evolution.

B. Electric Motor Overload and Stall

The tests conducted and recorded by PIGEON and ORTOLAN do not indicate an overload or stall of the electric motors except for two surge loads recorded by PIGEON during her 17 October 1974 forward port windlass test. As stated above, tests were not conducted at sea state 3, but at sea state 1 or 2. The

surges of amperage experienced by PIGEON on 17 October 1974 were 80 amps and 83 amps. These surges indicate that electric motor was overloaded 1.5% and 5.1% respectively. Such overloads are negligible since electric motors can be overloaded momentarily as high as 200% of the rated full HP. load. It should be noted that such overloads are not critical if they are not continuous. As far as electric motor stall is concerned (reported by ORTOLAN verbally) there is no possibility of this happening unless the main pressure relief valve and the horsepower limiter are set above 4,000 psig and 3500 psig respectively. According to the technical manual for the windlass the main pressure relief valve is set at 3500 psig and the horsepower limiter at 3000 psig. These settings preclude a stall of the electric motor since any of the overloads that could occur would cause the pressure relief valve to lift thus protecting the motor from any additional overload. It is believed that the main relief valves and horsepower limiters on ORTOLAN's anchor windlass are set in accordance with the machinery's technical manual. PIGEON has not reported any electric motor problems. Investigation reveals that relief valves and horsepower limiters aboard PIGEON are set at 4,500 psig and 4,000 psig per a NAVSHIPYD HUNTERS POINT alteration. This must be corrected by adjusting the maximum settings to 4,000 psig for the relief valve and 3,500 psig for the horsepower limiter to prevent a possible electric motor stall.

C. Hydraulic Components (Pump, Motors) and Fluid Overheat

There is no test data indicating that the hydraulic components or that the fluid overheats. All records show that the temperatures and hydraulic fluids are within the operating limits. It should be pointed out that the windlasses were tested at sea state 1 and 2 and not at sea state 3 at which the windlasses must be operable. Therefore, the forward windlasses should be tested at sea state 3 and all performance data (electric motor amp, volts, temperature of hydraulic pump motor, fluid and ambient) recorded. Based on this information, the need for a cooler can be determined. Without this information the size of the cooler can be only estimated by assuming that 50% of the horsepower of the hydraulic motor is converted to heat. Therefore, for the present anchor handling system, it is estimated that a 1,000 Btu cooler could be used.

D. Travel of Wildcat Locking Head Dogs in the Slots

ORTOLAN is the only ship experiencing this abnormality. Investigation of this deficiency shows that it can be caused by dragging of either the handbrake or the hydraulic brake (brake linings are not completely released). Also, this abnormality could be caused by wildcat shaft bushing distortion, insufficient tolerance between bushings and wildcat shafts, or by too much deflection of the

wildcat shaft during operation. All these causes should be investigated to resolve the problem.

E. Wildcat Shaft Bushings Damaged

The wildcat shaft bushings were damaged only aboard ORTOLAN. It is believed that their damage was caused by hammering of the wildcat locking head dogs. Resolution of locking head dogs hammering will preclude wildcat bushing damage.

F. Anchor Windlass System

Review of the anchor windlass design calculations shows that the anchor windlass was designed to handle a load of 47,130 pounds. This load included the weight of 200 fathoms of anchor chain, anchor plus bolster friction. For calculations of bolster friction, the manufacturer assumed a bolster efficiency of 65%. No loads due to sea state or currents were included in the design of the anchor windlass. The validity of the bolster efficiency of 65%, was questioned. NAVSEC/NAVSHIPYD PHILA was tasked to determine bolster efficiencies aboard ASR 21/22 Class ships. Their findings indicate that the forward deep sea mooring bolster efficiency is 62% whereas aft bolster efficiency is 47%. Further, the maximum load outside of the bolster at sea state 3, when the chain is lifted vertically (no catenary in the chain), is about 23,6000 pounds. The load in sea state 3 with catenary lift is about 26,200 pounds, and the load in sea state 3, plus 2 knots current, with catenary is about 35,500 pounds as shown on figure (9). Assuming that the NAVSEC/NAVSHIPYD PHILA test data is correct, the present windlass should have no difficulty raising vertically the fwd and aft anchors and chains at sea state 3. See figure (9). The capability of the anchor windlass to raise the fwd and aft anchors and chains at sea state 3 with catenary is marginal, whereas the recovery of the anchor and chain at sea state 3, 2 knots current with catenary is impossible since the prime mover electric motor, must be of the 91 HP capacity. Further, investigation reveals that the present anchor windlass capability can be increased by setting the main pressure relief valve at 4,000 psig and horsepower limiter at 3,500 psig. These settings have been concurred by the windlass manufacturer. In view of the forgoing, there is no need for modification of anchor windlass if the operational procedure is imposed on the ships to retrieve their anchors and anchor chains at sea state 3 vertically or at lower sea state (1-2). If the anchor windlasses must have the capability of retrieving anchor chains at sea state 3, 3 knots current and with catenary, then the prime movers must be upgraded to 100HP (91 HP is required), main pressure relief valve set at 4,500 psig, horsepower limiter set at 4,000 psig, filtering system upgraded, and a cooler added.

VI RECOMMENDATIONS

In view of the above, it is recommended that NAVSHIPYD PHILA performs the following:

A. Anchor Chain Jumping on Wildcat

- (1) Verify each anchor chain common link and Detachable link for proper dimensions.
- (2) Ensure that there is no twist in the anchor chain between wildcat and bitter end shackle.
- (3) Ensure that all Detachable links are vertically position positioned (perpendicular to the wildcat).
- (4) Install a chain guide at a position which will provide maximum chain wrap on the wildcat.
- (5) Each ship must grease wildcat whelps, chain guide, and deck tray before each operation.
- (6) Ensure that the centerline of the anchor chain on the wildcat, the chain guide, and the deck tray is on the same level.
- (7) Increase tolerances for the horizontal groove parallel to the deck on the chain guide.
- (8) Redesign chain guide to make it partially or totally removable during anchor chain retrieval.
- (9) Test above fixes by operating anchor windlasses at 1,000 foot depth of water and at sea state 3 while powering out 30 shots of chain.

B. Electric Motor Overload and Stall

- (1) Test anchor windlass at 1,000 feet water and at sea state 3 to determine overloads by powering out 30 shots of chain and record necessary data.

C. Hydraulic Components and Fluid Overheat

- (1) The same as paragraph b(1) above.
- (2) Set main pressure relief valve at 4,000 psig and HP limiter at 3,500 psig.

Improved windlass performance at 4000 psi setting

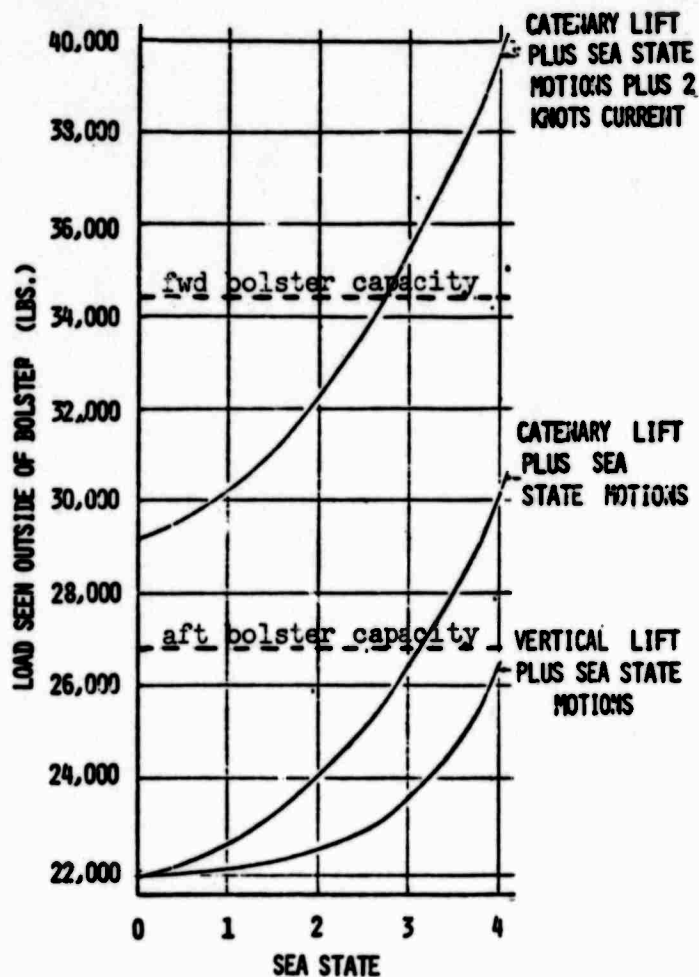


figure 30

D. Travel of Locking Head Dogs in Their Slots

- (1) Investigate performance of the hydraulic brake.
- (2) Investigate adequacy of the present tolerances used between wildcat shaft bushings and shaft.
- (3) Investigate wildcat shaft deflection under the anticipated loads.

E. EMERGENCY SYSTEM FOR MOORING LEG RECOVERY

The emergency system for mooring leg recovery is to be used when deep mooring coupled with high sea state exceeds the capability of the standard one wildcat recovery mode.

RECOVERY OF AFTER MOORING LEG USING TWO WILDCATS

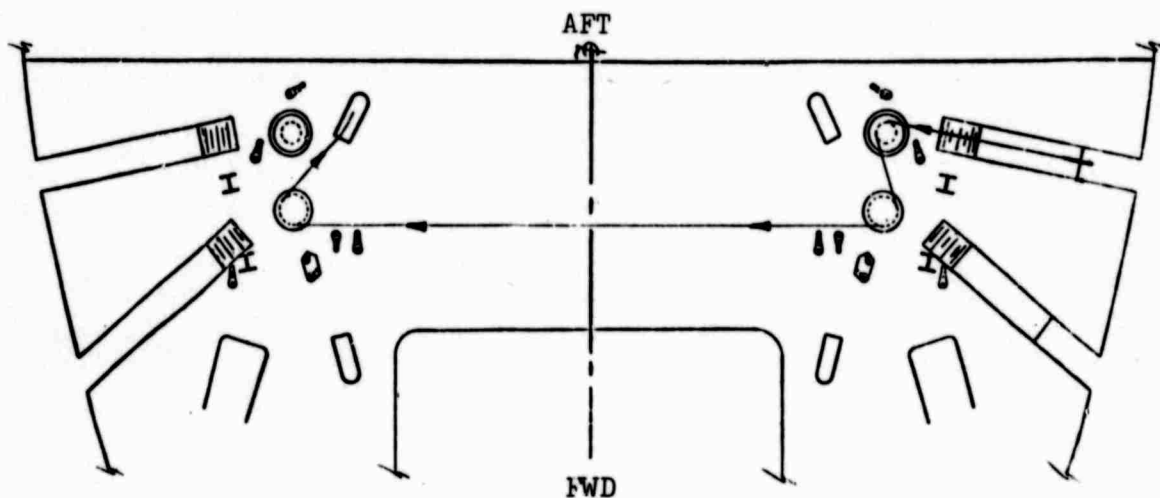


figure 31

RECOVERY OF FOWARD MOORING LEG USING TWO WILDCATS AND PORTABLE CHAIN GUIDE

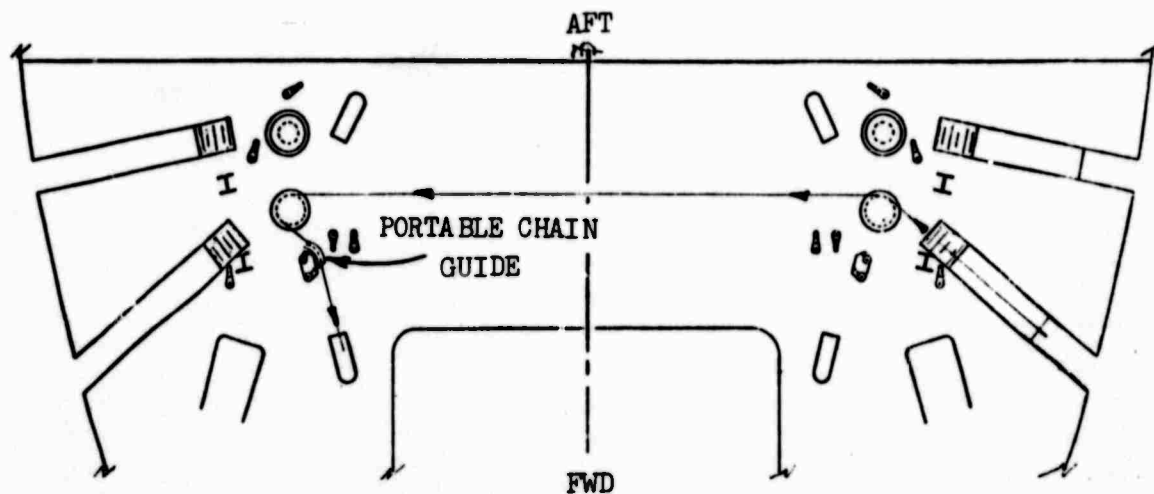
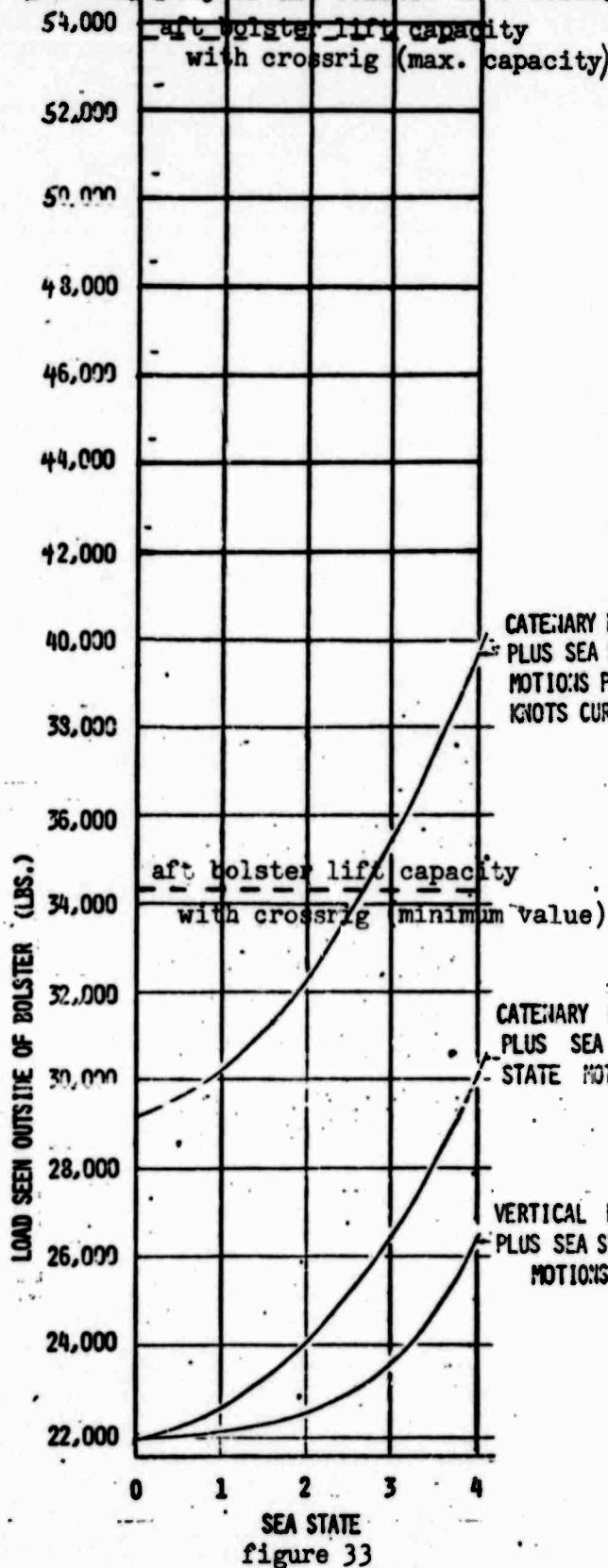


figure 32

Lift capacity of aft bolster in crossrig mode.

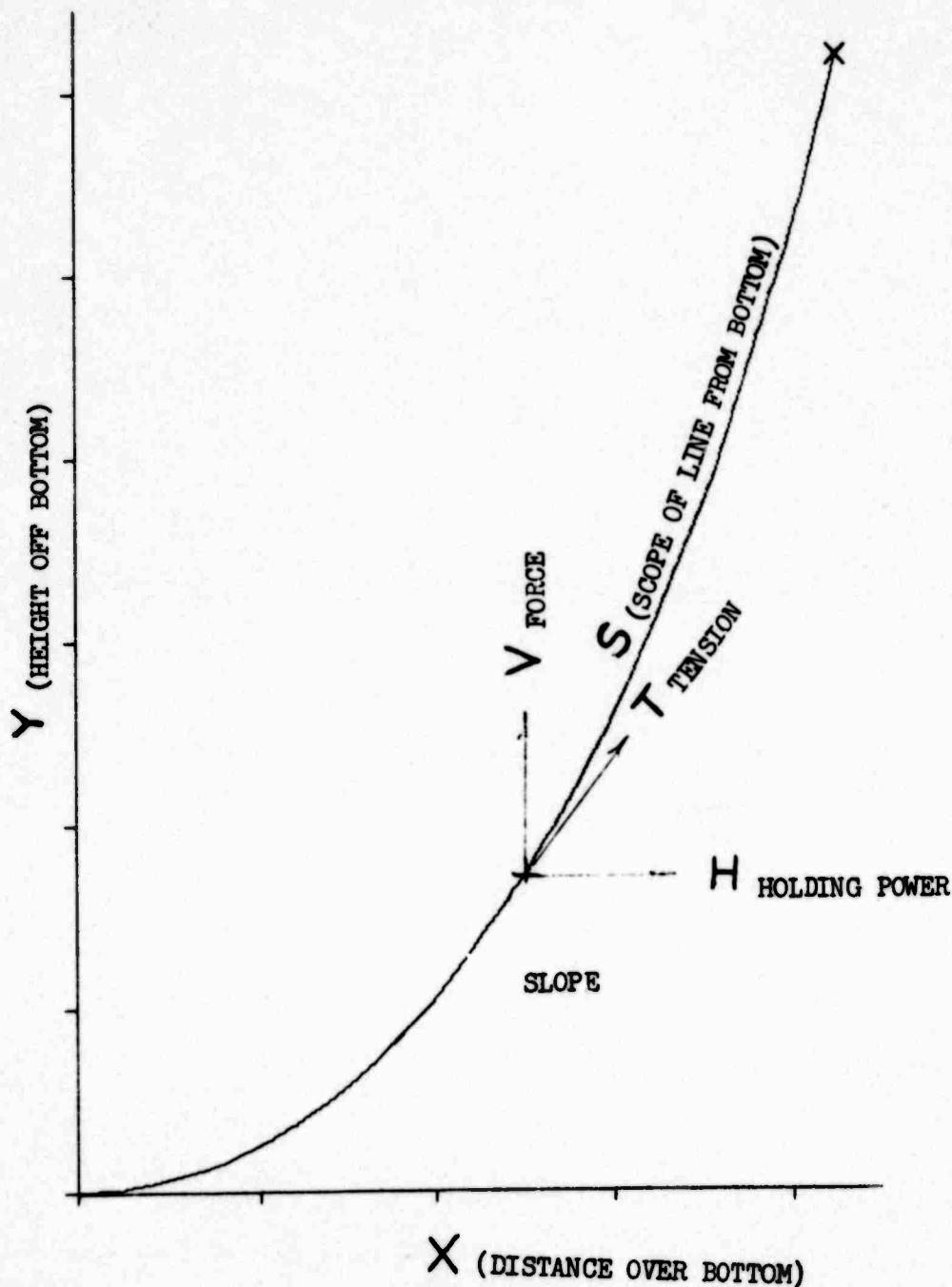


The lifting capacity over the aft bolster is shown as a range because of the number of variables that come to bear in calculating the the hauling capacity of a wildcat that does not have a wrap of 180°.

The forward bolster cross-rig chart is not shown here because it is in excess of the aft bolster and is not envisioned as being needed except for the case of a windlass failure.

APPENDIX A
COMPUTER PRINTOUT
OF
CHAIN CATENARIES

The following is a computer printout of the chain catenaries generated by an ASR 21/22 class ship when moored in 1000 feet of water. The catenaries depict mooring loads ranging from 1,500 lbs. to 12,000 lbs.. A graphic display of the printout is shown below.



CATENARY FORMAT FOR COMPUTER DISPLAY

SUPERCAT

NO OF CATS= 1

HOLDING POWER=

1500.0

WTFT	21.8457	LENGTH OF LINE	1200.0	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
0.00	0.00	0.0	0.00	1500.00	0.00	
12.06	1.06	12.1	10.01	1523.19	264.73	
23.76	4.15	24.2	19.45	1590.74	529.53	
34.85	9.03	36.4	27.91	1697.36	794.33	
45.16	15.39	48.5	35.23	1836.26	1059.17	
54.65	22.92	60.6	41.43	2000.72	1323.97	
63.35	31.36	72.7	46.65	2184.99	1598.75	
71.32	40.49	84.8	51.02	2384.46	1853.50	
78.62	50.15	97.0	54.70	2595.65	2118.35	
85.35	60.24	109.1	57.81	2815.91	2393.14	
91.50	70.64	121.2	60.47	3043.28	2667.94	
97.32	81.31	133.3	62.75	3276.23	2912.71	
102.68	92.18	145.5	64.73	3513.78	3177.52	
107.68	103.22	157.6	66.45	3754.94	3442.32	
112.37	114.47	169.7	67.97	3999.03	3707.11	
116.78	125.69	181.8	69.31	4245.71	3971.91	
120.95	137.07	193.9	70.50	4494.40	4236.73	
124.88	148.53	206.1	71.57	4744.83	4501.49	
128.62	160.07	218.2	72.53	4996.75	4766.29	
132.17	171.66	230.3	73.40	5249.93	5031.09	
135.55	183.29	242.4	74.19	5504.21	5295.87	
138.78	194.99	254.5	74.90	5759.43	5560.67	
141.87	206.70	266.7	75.56	6015.48	5825.46	
144.83	218.45	278.8	76.16	6272.26	6090.25	
147.67	230.24	290.9	76.72	6529.67	6355.05	
150.40	242.05	303.0	77.23	6787.66	6619.84	
153.03	253.88	315.1	77.71	7046.15	6884.64	
155.56	265.73	327.3	78.15	7305.03	7149.43	
158.01	277.60	339.4	78.56	7564.44	7414.22	
160.37	289.49	351.5	78.95	7824.15	7679.02	
162.65	301.40	363.6	79.31	8084.19	7943.81	
164.87	313.31	375.8	79.64	8344.53	8208.61	
167.01	325.24	387.9	79.96	8605.14	8473.41	
169.10	337.18	400.0	80.26	8866.03	8738.19	
171.12	349.13	412.1	80.54	9127.09	9002.99	
173.08	361.10	424.2	80.81	9388.38	9267.79	
174.99	373.07	436.4	81.06	9649.87	9532.57	
176.85	385.04	448.5	81.30	9911.53	9797.37	
178.66	397.03	460.6	81.52	10173.35	10062.15	
180.42	409.02	472.7	81.74	10435.32	10326.95	
182.15	421.02	484.8	81.94	10697.44	10591.75	
183.82	433.02	497.0	82.13	10959.68	10856.54	
185.46	445.03	509.1	82.32	11222.04	11121.33	
187.07	457.05	521.2	82.50	11484.51	11386.13	
188.65	469.07	533.3	82.66	11747.09	11650.92	
190.16	481.09	545.4	82.83	12009.76	11915.72	
191.66	493.12	557.6	82.98	12272.52	12180.51	
193.13	505.15	569.7	83.13	12535.37	12445.31	
194.56	517.19	581.8	83.27	12798.30	12710.11	
195.97	529.23	593.9	83.41	13061.31	12974.89	
197.35	541.27	606.1	83.54	13324.33	13239.63	
198.70	553.31	618.2	83.66	13587.53	13504.43	
200.02	565.36	630.3	83.79	13850.73	13769.27	
201.32	577.41	642.4	83.90	14114.00	14034.07	
202.60	589.47	654.5	84.01	14377.32	14298.84	

200.15	601.52	666.7	84.12	14640.71	14563.65
205.09	613.50	678.8	84.22	14904.12	14828.45
206.29	625.64	690.9	84.32	15167.59	15093.24
207.49	637.71	703.0	84.42	15431.11	15358.03
208.65	649.77	715.1	84.52	15694.67	15622.83
209.80	661.84	727.3	84.61	15958.27	15887.62
210.93	673.90	739.4	84.69	16221.91	16152.42
212.04	685.97	751.5	84.78	16485.59	16417.21
213.13	698.05	763.6	84.86	16749.30	16682.00
214.21	710.12	775.7	84.94	17013.05	16946.80
215.27	722.19	787.9	85.02	17276.83	17211.59
216.32	734.27	800.0	85.09	17540.64	17476.39
217.34	746.35	812.1	85.17	17804.48	17741.19
218.36	758.43	824.2	85.24	18068.34	18005.97
219.36	770.51	836.4	85.31	18332.23	18270.76
220.34	782.59	848.5	85.37	18596.15	18535.56
221.31	794.67	860.6	85.44	18860.10	18800.35
222.27	806.75	872.7	85.50	19124.06	19065.15
223.21	818.84	884.8	85.56	19388.05	19329.94
224.15	830.92	897.0	85.62	19652.06	19594.73
225.06	843.01	909.1	85.68	19916.09	19859.53
225.97	855.10	921.2	85.74	20180.15	20124.32
226.87	867.18	933.3	85.79	20444.22	20389.11
227.75	879.27	945.4	85.85	20708.31	20653.91
228.62	891.36	957.6	85.90	20972.41	20918.70
229.49	903.45	969.7	85.95	21236.54	21183.50
230.33	915.54	981.8	86.00	21500.68	21448.29
231.16	927.64	993.9	86.05	21764.83	21713.08
232.01	939.73	1006.1	86.10	22029.00	21977.88
232.83	951.82	1018.2	86.14	22293.19	22242.67
233.64	963.91	1030.3	86.19	22557.39	22507.46
234.44	976.01	1042.4	86.23	22821.61	22772.25
235.23	988.10	1054.5	86.27	23085.83	23037.05
236.01	1000.20	1066.7	86.32	23350.07	23301.84
236.79	1012.30	1078.8	86.36	23614.33	23566.64
237.55	1024.39	1090.9	86.40	23878.59	23831.43
238.31	1036.49	1103.0	86.44	24142.87	24096.23
239.06	1048.59	1115.1	86.48	24407.16	24361.02
239.80	1060.69	1127.3	86.51	24671.45	24625.81
240.53	1072.79	1139.4	86.55	24935.76	24890.61
241.26	1084.89	1151.5	86.59	25200.09	25155.41
241.98	1096.99	1163.6	86.62	25464.41	25420.19
242.69	1109.09	1175.7	86.66	25728.75	25684.99
243.39	1121.19	1187.9	86.69	25993.10	25949.79
244.09	1133.29	1200.0	86.73	26257.46	26214.59

SUPERCAT

NO OF CATS= 1		HOLDING POWER= 2500.0					
MTFT	21.8457	LENGTH OF LINE	1200.0	POINTS100	VERTICAL FORCE	0.0	
X	Y	S	SLOPE	TENSION	VFORCE		
0.00	0.00	0.0	0.00	2500.00	3.00		
12.10	.64	12.1	6.05	2513.99	264.79		
24.06	2.54	24.2	11.96	2555.48	529.59		
35.78	5.64	36.4	17.63	2623.17	794.39		
47.14	9.85	48.5	22.96	2715.12	1059.17		
58.08	15.06	60.6	27.91	2828.94	1323.97		
68.55	21.15	72.7	32.44	2962.12	1588.75		
78.54	28.02	84.8	36.55	3112.13	1853.56		
88.00	35.50	97.0	40.28	3276.80	2118.35		
97.04	43.66	109.1	43.63	3453.89	2383.14		
105.58	52.26	121.2	46.65	3641.64	2647.94		
113.69	61.27	133.3	49.36	3838.49	2912.73		
121.38	70.64	145.5	51.81	4043.10	3177.52		
128.69	80.31	157.6	54.01	4254.36	3442.32		
135.63	90.24	169.7	56.01	4471.32	3707.11		
142.25	100.39	181.8	57.81	4693.19	3971.91		
148.56	110.75	193.9	59.46	4919.31	4236.70		
154.58	121.27	206.1	60.95	5149.12	4501.49		
160.33	131.93	218.2	62.32	5382.15	4766.29		
165.84	142.73	230.3	63.58	5617.99	5031.08		
171.13	153.64	242.4	64.73	5856.30	5295.87		
176.20	164.65	254.5	65.79	6096.80	5560.67		
181.07	175.74	266.7	66.77	6339.24	5825.45		
185.76	186.92	278.8	67.68	6583.40	6090.25		
190.28	198.17	290.9	68.53	6829.10	6355.05		
194.64	209.48	303.0	69.31	7076.18	6619.84		
198.85	220.84	315.1	70.04	7324.43	6884.64		
202.92	232.26	327.3	70.73	7573.93	7149.43		
206.85	243.73	339.4	71.37	7824.37	7414.22		
210.67	255.23	351.5	71.97	8075.72	7679.02		
214.36	266.78	363.6	72.53	8327.91	7943.81		
217.94	278.36	375.8	73.06	8580.86	8208.60		
221.42	289.97	387.9	73.56	8834.50	8473.40		
224.81	301.61	400.0	74.03	9088.78	8738.19		
228.09	313.27	412.1	74.48	9343.65	9002.99		
231.29	324.96	424.2	74.90	9599.05	9267.78		
234.41	336.68	436.4	75.30	9854.95	9532.57		
237.45	348.41	448.5	75.69	10111.30	9797.37		
240.40	360.17	460.6	76.05	10368.03	10062.16		
243.29	371.94	472.7	76.39	10625.25	10326.95		
246.11	383.73	484.8	76.72	10882.79	10591.75		
248.86	395.53	497.0	77.03	11140.67	10856.54		
251.55	407.35	509.1	77.33	11398.85	11121.33		
254.18	419.19	521.2	77.62	11657.35	11386.13		
256.75	431.03	533.3	77.89	11916.12	11650.92		
259.27	442.89	545.4	78.15	12175.15	11915.72		
261.73	454.75	557.6	78.40	12434.42	12180.51		
264.14	466.63	569.7	78.64	12693.92	12445.30		
266.50	478.52	581.8	78.87	12953.63	12710.10		
268.82	490.42	593.9	79.09	13213.55	12974.89		
271.09	502.33	606.0	79.31	13473.65	13239.69		
273.32	514.24	618.1	79.51	13733.93	13504.49		
275.50	526.16	630.3	79.71	13994.39	13769.27		
277.65	538.09	642.4	79.90	14255.00	14034.07		

279.76	551.03	654.5	81.08	14515.76	14298.85
281.83	561.97	666.7	80.26	14776.67	14563.65
283.86	573.92	678.8	80.43	15037.71	14828.45
285.86	585.88	690.9	80.60	15298.89	15093.24
287.82	597.84	703.0	80.75	15560.18	15358.03
289.75	609.80	715.1	80.91	15821.59	15622.83
291.65	621.78	727.3	81.06	16083.11	15887.62
293.54	633.75	739.4	81.20	16344.74	16152.42
295.36	645.73	751.5	81.34	16606.47	16417.21
297.17	657.72	763.6	81.48	16868.29	16682.03
298.95	669.71	775.7	81.61	17130.20	16946.87
300.71	681.70	787.9	81.74	17392.21	17211.59
302.44	693.70	800.0	81.86	17654.29	17476.38
304.14	705.70	812.1	81.98	17916.46	17741.18
305.82	717.70	824.2	82.10	18178.73	18005.97
307.48	729.71	836.4	82.21	18441.01	18270.76
309.11	741.72	848.5	82.32	18703.39	18535.56
310.72	753.73	860.6	82.43	18965.84	18800.35
312.33	765.75	872.7	82.53	19228.36	19065.15
313.87	777.77	884.8	82.63	19490.94	19329.94
315.41	789.79	897.0	82.73	19753.57	19594.73
316.94	801.82	909.1	82.83	20016.26	19859.53
318.44	813.85	921.2	82.92	20279.01	20124.32
319.93	825.87	933.3	83.01	20541.81	20389.11
321.39	837.91	945.4	83.10	20804.66	20653.91
322.84	849.94	957.6	83.18	21067.56	20918.73
324.27	861.98	969.7	83.27	21330.51	21183.53
325.68	874.02	981.8	83.35	21593.50	21448.29
327.07	886.06	993.9	83.43	21856.53	21713.18
328.45	898.10	1006.1	83.51	22119.61	21977.88
329.81	910.14	1018.2	83.59	22382.72	22242.67
331.16	922.19	1030.3	83.66	22645.88	22507.46
332.49	934.24	1042.4	83.73	22909.07	22772.26
333.81	946.29	1054.5	83.81	23172.31	23037.05
335.11	958.34	1066.7	83.89	23435.57	23301.84
336.39	970.39	1078.8	83.94	23698.87	23566.64
337.66	982.45	1090.9	84.01	23962.20	23831.43
338.92	994.50	1103.0	84.08	24225.57	24096.23
340.17	1006.56	1115.1	84.14	24488.95	24361.02
341.40	1018.62	1127.3	84.21	24752.39	24625.81
342.61	1030.68	1139.4	84.26	25015.84	24890.61
343.82	1042.74	1151.5	84.32	25279.32	25155.41
345.01	1054.80	1163.6	84.38	25542.83	25420.19
346.19	1066.86	1175.7	84.44	25806.37	25684.93
347.36	1078.93	1187.9	84.51	26069.93	25949.78
348.52	1090.99	1200.0	84.55	26333.51	26214.58

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 2750.0

HTFT	21.0457	LENGTH OF LINE	1300.0	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
0.00	0.00	0.0	0.00	2750.00	0.37	
13.11	.68	13.1	5.96	2764.92	286.86	
26.08	2.71	26.3	11.78	2809.21	573.72	
38.78	6.02	39.4	17.38	2881.51	860.58	
51.11	10.54	52.5	22.65	2979.78	1147.44	
62.99	16.09	65.7	27.54	3101.57	1434.33	
74.38	22.62	78.8	32.04	3244.21	1721.16	
85.25	29.99	91.9	36.14	3405.09	2008.02	
95.59	38.07	105.0	39.85	3581.73	2294.88	
105.42	46.78	118.2	43.19	3771.99	2581.74	
114.75	56.02	131.3	46.21	3973.83	2868.67	
123.60	65.72	144.4	48.93	4185.62	3155.46	
132.01	75.80	157.6	51.38	4405.91	3442.32	
140.00	86.22	170.7	53.59	4633.49	3729.18	
147.61	96.92	183.8	55.60	4867.35	4016.04	
154.85	107.88	197.0	57.42	5116.61	4302.97	
161.76	119.04	210.1	59.07	5350.55	4589.76	
168.36	130.39	223.2	60.58	5598.56	4876.62	
174.67	141.91	236.4	61.96	5850.13	5163.49	
180.71	153.57	249.5	63.23	6104.81	5450.34	
186.50	165.35	262.6	64.39	6362.23	5737.20	
192.07	177.25	275.8	65.46	6622.07	6024.05	
197.41	189.24	288.9	66.45	6884.05	6310.92	
202.56	201.32	302.0	67.37	7147.95	6597.78	
207.52	213.48	315.1	68.23	7413.55	6884.64	
212.51	225.70	328.3	69.02	7680.68	7171.53	
216.93	238.00	341.4	69.76	7949.19	7458.36	
221.40	250.34	354.5	70.45	8218.93	7745.22	
225.72	262.74	367.7	71.17	8489.80	8032.08	
229.91	275.19	380.8	71.71	8761.69	8318.94	
233.96	287.68	393.9	72.28	9034.50	8605.79	
237.90	300.20	407.1	72.82	9308.16	8892.65	
241.73	312.77	420.2	73.32	9582.59	9179.51	
245.44	325.36	433.3	73.80	9857.73	9466.37	
249.05	337.98	446.5	74.25	10133.51	9753.23	
252.57	350.64	459.6	74.68	10409.90	10040.09	
255.99	363.31	472.7	75.09	10686.84	10326.95	
259.33	376.01	485.9	75.47	10964.28	10613.81	
262.58	388.74	499.0	75.84	11242.21	10900.67	
265.75	401.48	512.1	76.19	11520.56	11187.53	
268.85	414.24	525.2	76.52	11799.33	11474.39	
271.88	427.02	538.4	76.84	12078.49	11761.25	
274.83	439.81	551.5	77.14	12357.97	12048.11	
277.72	452.62	564.6	77.43	12637.80	12334.97	
280.55	465.44	577.8	77.71	12917.94	12621.83	
283.31	478.28	590.9	77.97	13198.36	12908.69	
286.02	491.13	604.0	78.23	13479.06	13195.55	
289.67	503.99	617.2	78.47	13760.01	13482.41	
291.27	516.86	630.3	78.71	14041.23	13769.27	
293.82	529.74	643.4	78.93	14322.62	14056.13	
296.31	542.64	656.6	79.15	14604.24	14342.99	
298.76	555.54	669.7	79.35	14886.07	14629.85	
301.16	568.47	682.8	79.55	15168.03	14916.71	
303.52	581.36	696.0	79.75	15450.28	15203.57	
305.84	594.29	709.1	79.93	15732.64	15490.43	

308.41	607.22	722.2	80.11	16015.16	15777.29
310.35	620.16	735.3	80.29	16297.84	16064.15
312.55	633.11	748.5	80.45	16580.65	16351.01
314.71	646.16	761.6	80.61	16863.61	16637.87
316.83	659.02	774.7	80.77	17146.69	16924.73
318.92	671.90	787.9	80.92	17429.91	17211.59
320.97	684.95	801.0	81.07	17713.22	17498.45
323.00	697.93	814.1	81.21	17996.66	17785.31
324.99	710.90	827.3	81.35	18280.20	18072.17
326.95	723.85	840.4	81.48	18563.85	18359.03
328.88	736.88	853.5	81.61	18847.59	18645.83
330.78	749.87	866.7	81.74	19131.43	18932.75
332.65	762.87	879.8	81.86	19415.35	19219.61
334.50	775.87	892.9	81.98	19699.36	19506.47
336.32	788.87	906.1	82.09	19983.45	19793.33
338.11	801.88	919.2	82.20	20267.62	20080.19
339.88	814.89	932.3	82.31	20551.86	20367.05
341.63	827.91	945.4	82.42	20836.18	20653.91
343.35	840.92	958.6	82.52	21120.56	20940.77
345.05	853.94	971.7	82.62	21405.01	21227.63
346.72	866.97	984.8	82.72	21689.53	21514.49
348.38	880.00	998.0	82.81	21974.11	21801.35
350.01	893.02	1011.1	82.90	22258.74	22088.21
351.62	906.06	1024.2	82.99	22543.43	22375.07
353.21	919.09	1037.4	83.08	22828.17	22661.93
354.79	932.13	1050.5	83.17	23112.97	22948.79
356.34	945.17	1063.6	83.25	23397.82	23235.65
357.87	958.21	1076.8	83.33	23682.71	23522.51
359.39	971.25	1089.9	83.41	23967.65	23809.37
360.89	984.30	1103.0	83.49	24252.64	24096.23
362.37	997.34	1116.2	83.57	24537.67	24383.09
363.83	1010.39	1129.3	83.64	24822.75	24669.95
365.28	1023.44	1142.4	83.71	25107.86	24956.81
366.71	1036.50	1155.5	83.78	25393.01	25243.67
368.12	1049.55	1168.7	83.85	25678.20	25530.52
369.52	1062.61	1181.8	83.92	25963.43	25817.39
370.90	1075.67	1194.9	83.99	26248.70	26104.24
372.27	1088.73	1208.1	84.05	26533.99	26391.11
373.62	1101.79	1221.2	84.11	26819.33	26677.95
374.96	1114.85	1234.3	84.18	27104.69	26964.82
376.29	1127.91	1247.5	84.24	27390.09	27251.69
377.61	1140.98	1260.6	84.30	27675.51	27538.54
378.90	1154.05	1273.7	84.36	27960.97	27825.40
380.18	1167.12	1286.9	84.41	28246.45	28112.26
381.46	1180.18	1300.0	84.47	28531.96	28399.12

SUPERCAT

NO OF CATS= 1		HOLDING POWER=		3500.0		
WTFT	21.8457	LENGTH OF LINE	1300.0	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
0.00	0.00	0.0	0.00	3500.00	0.00	
13.12	.54	13.1	4.69	3511.74	286.85	
26.15	2.14	26.3	9.31	3546.71	573.72	
39.31	4.77	39.4	13.81	3604.25	860.59	
51.63	8.39	52.5	18.15	3683.29	1147.44	
63.94	12.93	65.7	22.28	3782.49	1434.33	
75.91	18.32	78.8	26.19	3900.31	1721.16	
87.50	24.50	91.9	29.84	4035.11	2008.02	
98.69	31.37	105.0	33.25	4185.27	2294.89	
109.46	38.87	118.2	36.41	4349.19	2581.74	
119.82	46.94	131.3	39.34	4525.36	2868.61	
129.78	55.50	144.4	42.04	4712.42	3155.46	
139.33	64.50	157.6	44.52	4909.13	3442.32	
148.51	73.90	170.7	46.92	5114.37	3729.19	
157.31	83.64	183.8	48.93	5327.15	4016.04	
165.77	93.68	197.0	50.87	5546.01	4302.90	
173.89	104.03	210.1	52.67	5771.99	4589.76	
181.70	114.50	223.2	54.33	6002.62	4876.62	
189.21	125.33	236.4	55.87	6237.91	5163.49	
196.44	136.29	249.5	57.29	6477.36	5450.34	
203.40	147.42	262.6	58.61	6720.52	5737.20	
210.12	158.70	275.8	59.84	6967.01	6024.06	
216.60	170.12	288.9	60.99	7216.43	6310.92	
222.80	181.67	302.0	62.05	7468.64	6597.79	
228.91	193.32	315.1	63.05	7723.23	6884.64	
234.77	205.07	328.3	63.99	7980.00	7171.51	
240.44	216.92	341.4	64.86	8238.75	7458.35	
245.93	228.85	354.5	65.68	8499.32	7745.22	
251.25	240.85	367.7	66.45	8761.52	8032.09	
256.42	252.92	380.8	67.18	9025.22	8318.94	
261.44	265.05	393.9	67.87	9290.33	8605.79	
266.32	277.25	407.1	68.52	9556.64	8892.65	
271.06	289.49	420.2	69.13	9824.13	9179.51	
275.68	311.78	433.3	69.71	10092.68	9466.37	
280.17	314.12	446.5	70.26	10362.22	9753.23	
284.55	326.50	459.6	70.78	10632.66	10040.09	
288.82	338.92	472.7	71.28	10903.94	10326.95	
292.98	351.37	485.9	71.75	11176.00	10613.81	
297.04	363.86	499.0	72.20	11448.79	10900.67	
301.01	376.38	512.1	72.63	11722.24	11187.53	
304.89	388.92	525.2	73.04	11996.32	11474.39	
308.67	401.50	538.4	73.43	12270.99	11761.25	
312.38	414.11	551.5	73.80	12546.20	12048.11	
316.00	426.72	564.6	74.16	12821.92	12334.97	
319.55	439.36	577.8	74.50	13098.12	12621.83	
323.02	452.02	590.9	74.83	13374.76	12908.69	
326.42	464.71	604.0	75.14	13651.83	13195.55	
329.75	477.41	617.2	75.45	13929.30	13482.41	
333.02	490.13	630.3	75.74	14207.14	13769.27	
336.23	502.86	643.4	76.02	14485.33	14056.13	
339.37	515.61	656.6	76.29	14763.85	14342.99	
342.45	528.37	669.7	76.55	15042.69	14629.85	
345.48	541.15	682.8	76.80	15321.82	14916.71	
348.45	553.94	696.0	77.04	15601.24	15203.57	
351.37	566.74	709.1	77.27	15880.91	15490.43	

354.24	579.50	722.2	77.49	16160.84	15777.29
357.06	592.38	735.3	77.71	16441.01	16064.15
359.83	605.22	748.5	77.92	16721.41	16351.01
362.56	618.06	761.6	78.12	17002.02	16637.87
365.24	630.92	774.7	78.32	17282.84	16924.73
367.88	643.78	787.9	78.51	17563.65	17211.59
370.47	656.65	801.0	78.69	17845.05	17498.45
373.03	669.53	814.1	78.87	18126.42	17785.31
375.54	682.42	827.3	79.04	18407.97	18072.17
378.02	695.32	840.4	79.21	18689.67	18359.03
380.46	708.22	853.5	79.37	18971.54	18645.89
382.87	721.13	866.7	79.53	19253.54	18932.75
385.24	734.04	879.8	79.68	19535.69	19219.61
387.57	746.97	892.9	79.83	19817.98	19506.47
389.88	759.89	906.1	79.97	20100.39	19793.33
392.15	772.83	919.2	80.11	20382.93	20080.19
394.39	785.77	932.3	80.25	20665.59	20367.05
396.59	798.71	945.4	80.38	20948.36	20653.91
398.77	811.66	958.6	80.51	21231.24	20940.77
400.92	824.61	971.7	80.64	21514.23	21227.63
403.05	837.57	984.8	80.76	21797.32	21514.49
405.14	850.53	998.0	80.88	22080.51	21801.35
407.21	863.50	1011.1	81.00	22363.79	22088.21
409.25	876.47	1024.2	81.11	22647.15	22375.07
411.27	889.45	1037.4	81.22	22930.61	22661.93
413.26	902.43	1050.5	81.33	23214.15	22948.79
415.23	915.41	1063.6	81.43	23497.77	23235.65
417.17	928.40	1076.8	81.54	23781.47	23522.51
419.09	941.39	1089.9	81.64	24065.24	23809.37
420.99	954.38	1103.0	81.74	24349.09	24096.23
422.87	967.38	1116.2	81.83	24633.00	24383.09
424.72	980.38	1129.3	81.93	24916.99	24669.95
426.56	993.38	1142.4	82.02	25201.03	24956.81
428.37	1006.38	1155.5	82.11	25485.15	25243.67
430.16	1019.39	1168.7	82.19	25769.32	25530.52
431.94	1032.40	1181.8	82.28	26053.55	25817.39
433.69	1045.42	1194.9	82.36	26337.84	26104.24
435.43	1058.43	1208.1	82.45	26622.18	26391.17
437.15	1071.45	1221.2	82.53	26906.57	26677.95
438.84	1084.47	1234.3	82.60	27191.02	26964.82
440.53	1097.49	1247.5	82.69	27475.52	27251.64
442.19	1110.52	1260.6	82.76	27760.07	27538.54
443.84	1123.55	1273.7	82.83	28044.65	27825.47
445.47	1136.58	1286.9	82.90	28329.30	28112.26
447.08	1149.61	1300.0	82.97	28613.99	28399.12

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 4500.0

MTFT	21.84>7	LENGTH OF LINE	1303.1	POINTS100	VERTICAL FORCE	3.0
	X	Y	S	SLOPE	TENSION	VFORCE
	0.00	0.00	0.0	0.00	4500.00	0.00
	13.14	.42	13.1	3.65	4509.13	286.86
	26.19	1.67	26.3	7.27	4536.43	573.72
	39.16	3.73	39.4	10.83	4561.55	860.59
	51.97	6.59	52.5	14.30	4643.99	1147.44
	64.59	10.21	65.7	17.68	4723.05	1434.30
	76.98	14.55	78.8	20.93	4817.92	1721.16
	89.11	19.58	91.9	24.05	4927.69	2008.02
	100.96	25.24	105.0	27.02	5051.38	2294.89
	112.50	31.49	118.2	29.84	5188.00	2581.74
	123.74	38.29	131.3	32.52	5336.56	2868.61
	134.65	45.60	144.4	35.04	5496.08	3155.49
	145.24	53.36	157.6	37.41	5665.65	3442.32
	155.51	61.54	170.7	39.65	5844.38	3729.19
	165.46	70.16	183.8	41.75	6031.46	4016.04
	175.10	79.02	197.0	43.72	6226.15	4302.90
	184.45	88.24	210.1	45.57	6427.74	4589.76
	193.49	97.76	223.2	47.30	6635.62	4876.62
	202.26	107.54	236.4	48.93	6849.20	5163.49
	210.75	117.55	249.5	50.46	7067.97	5450.34
	218.98	127.78	262.6	51.89	7291.46	5737.20
	226.96	138.21	275.8	53.24	7519.25	6024.06
	234.70	148.82	288.9	54.51	7750.98	6310.92
	242.21	159.59	302.0	55.70	7986.28	6597.79
	249.50	170.51	315.1	56.83	8224.85	6884.64
	256.59	181.57	328.3	57.89	8466.42	7171.50
	263.47	192.75	341.4	58.90	8710.74	7458.36
	270.16	204.05	354.5	59.84	8957.59	7745.22
	276.66	215.45	367.7	60.74	9206.75	8032.09
	282.99	226.96	380.8	61.59	9458.05	8318.94
	289.16	238.55	393.9	62.39	9711.32	8605.79
	295.17	250.23	407.1	63.16	9966.41	8892.65
	301.02	261.98	420.2	63.88	10223.19	9179.51
	306.73	273.81	433.3	64.59	10481.52	9466.37
	312.30	285.70	446.5	65.23	10741.30	9753.23
	317.73	297.65	459.6	65.86	11002.43	10040.09
	323.04	309.66	472.7	66.45	11264.81	10326.95
	328.23	321.73	485.9	67.02	11528.36	10613.81
	333.29	333.84	499.0	67.57	11792.99	10900.67
	338.25	346.00	512.1	68.09	12058.84	11187.53
	343.10	358.21	525.2	68.59	12325.25	11474.39
	347.84	370.45	538.4	69.06	12592.74	11761.25
	352.48	382.73	551.5	69.52	12861.07	12048.11
	357.03	395.05	564.6	69.96	13130.19	12334.97
	361.48	407.40	577.8	70.39	13400.02	12621.83
	365.85	419.79	590.9	70.78	13670.56	12908.69
	370.13	432.20	604.0	71.17	13941.76	13195.55
	374.33	444.64	617.2	71.54	14213.57	13482.41
	378.45	457.11	630.3	71.90	14485.99	13769.27
	382.49	469.61	643.4	72.25	14758.99	14056.13
	386.45	482.12	656.6	72.58	15032.35	14342.99
	390.39	494.66	669.7	72.90	15306.29	14629.85
	394.18	507.23	682.8	73.21	15580.70	14916.71
	397.93	519.81	696.0	73.51	15855.55	15203.57
	401.63	532.41	709.1	73.80	16130.82	15490.43

405.26	545.03	722.2	74.09	16466.49	15777.23
408.83	557.66	735.3	74.35	16682.53	16064.15
412.35	570.32	748.5	74.61	16958.94	16351.71
415.80	582.98	761.6	74.87	17235.68	16637.87
419.20	595.67	774.7	75.11	17512.75	16924.73
422.55	608.36	787.9	75.35	17790.13	17211.59
425.85	621.07	801.0	75.58	18067.81	17498.45
429.09	633.80	814.1	75.81	18345.77	17785.31
432.29	646.53	827.3	76.02	18624.00	18072.17
435.44	659.28	840.4	76.23	18902.49	18359.03
438.54	672.04	853.5	76.43	19181.22	18645.89
441.60	684.81	866.7	76.63	19460.19	18932.75
444.62	697.59	879.8	76.82	19739.39	19219.61
447.59	710.38	892.9	77.01	20018.80	19506.47
450.52	723.16	906.1	77.19	20298.42	19793.33
453.41	735.99	919.2	77.37	20578.24	20080.13
456.26	748.81	932.3	77.54	20858.25	20367.05
459.08	761.63	945.4	77.71	21138.45	20653.91
461.85	774.47	958.6	77.87	21418.82	20940.77
464.60	787.31	971.7	78.03	21699.36	21227.63
467.30	800.16	984.8	78.19	21980.06	21514.49
469.97	813.02	998.0	78.34	22260.92	21801.35
472.61	825.88	1011.1	78.48	22541.94	22088.21
475.22	838.75	1024.2	78.63	22823.03	22375.07
477.79	851.63	1037.4	78.77	23104.39	22661.93
480.33	864.51	1050.5	78.91	23385.82	22948.79
482.84	877.40	1063.6	79.04	23667.39	23235.65
485.32	890.29	1076.8	79.17	23949.03	23522.51
487.78	903.19	1089.9	79.30	24230.89	23809.37
490.20	916.10	1103.0	79.42	24512.81	24096.23
492.60	929.01	1116.2	79.54	24794.86	24383.09
494.97	941.92	1129.3	79.66	25077.01	24669.95
497.31	954.85	1142.4	79.78	25359.26	24956.81
499.63	967.77	1155.5	79.89	25641.62	25243.67
501.92	980.71	1168.7	80.00	25924.08	25530.52
504.19	993.63	1181.8	80.11	26206.63	25817.38
506.43	1006.57	1194.9	80.22	26489.27	26104.24
508.65	1019.51	1208.1	80.32	26772.01	26391.11
510.84	1032.46	1221.2	80.43	27054.83	26677.95
513.02	1045.41	1234.3	80.53	27337.73	26964.92
515.17	1058.37	1247.5	80.62	27620.72	27251.69
517.30	1071.32	1260.6	80.72	27903.79	27538.54
519.40	1084.28	1273.7	80.81	28186.93	27825.41
521.49	1097.25	1286.9	80.91	28470.15	28112.25
523.55	1110.22	1300.0	81.00	28753.44	28399.12

SUPERCAT

NO OF CATS= 1		HOLDING POWER= 4750.0				
MTFT	21.8457	LENGTH OF LINE	1300.0	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
3.00	0.00	0.0	0.00	4750.00	0.00	
13.12	.40	13.1	3.46	4758.05	286.86	
26.29	1.58	26.3	6.89	4784.52	573.72	
39.18	3.54	39.4	10.27	4827.33	860.58	
52.03	6.25	52.5	13.58	4886.63	1147.44	
64.70	9.70	65.7	16.80	4961.83	1434.37	
77.16	13.83	78.8	19.92	5052.22	1721.16	
89.38	18.63	91.9	22.92	5157.03	2008.72	
101.34	24.05	105.0	25.79	5275.32	2294.88	
113.02	30.74	114.2	28.53	5406.28	2581.74	
124.41	36.57	131.3	31.13	5549.03	2868.60	
135.50	43.60	144.4	33.60	5702.58	3155.46	
146.29	51.09	157.6	35.93	5866.19	3442.32	
156.77	59.00	170.7	38.14	6038.98	3729.18	
166.94	67.30	183.8	40.21	6220.21	4016.04	
176.82	75.95	197.0	42.17	6409.17	4302.97	
186.41	84.92	210.1	44.02	6605.18	4589.76	
195.71	94.19	223.2	45.75	6807.64	4876.62	
204.74	103.73	236.4	47.39	7015.98	5163.49	
213.50	113.51	249.5	48.93	7229.71	5450.34	
222.00	123.52	262.6	50.38	7448.35	5737.27	
230.25	133.73	275.8	51.74	7671.49	6024.05	
238.26	144.14	288.9	53.03	7898.74	6310.92	
246.04	154.71	302.0	54.25	8129.77	6597.78	
253.61	165.44	315.1	55.40	8364.25	6884.64	
260.96	176.32	328.3	56.48	8601.91	7171.53	
268.11	187.34	341.4	57.51	8842.49	7458.36	
275.07	198.47	354.5	58.48	9085.75	7745.22	
281.84	209.72	367.7	59.40	9331.49	8032.78	
288.44	221.07	380.8	60.27	9579.52	8318.94	
319.03	279.16	446.5	64.03	10848.41	9753.23	
324.71	291.00	459.6	64.68	11107.02	10040.09	
330.26	302.90	472.7	65.30	11366.99	10326.95	
335.68	314.85	485.9	65.89	11628.22	10613.81	
340.99	326.87	499.0	66.45	11893.63	10900.67	
346.18	338.93	512.1	66.99	12154.15	11187.53	
351.25	351.04	525.2	67.51	12418.70	11474.39	
356.22	363.19	538.4	68.01	12684.23	11761.25	
361.09	375.39	551.5	68.48	12950.66	12048.11	
365.86	387.63	564.8	68.94	13217.94	12334.97	
370.53	399.90	577.8	69.38	13486.04	12621.83	
375.11	412.20	590.9	69.80	13754.88	12908.69	
379.60	424.54	604.0	70.20	14024.45	13195.55	
384.00	436.91	617.2	70.59	14294.68	13482.41	
388.33	449.31	630.3	70.97	14565.55	13769.27	
392.57	461.74	643.4	71.33	14837.03	14056.13	
396.73	474.19	656.6	71.68	15109.07	14342.99	
400.80	486.67	669.7	72.01	15381.65	14629.85	
404.85	499.17	682.8	72.34	15654.74	14916.71	
408.80	511.69	696.0	72.65	15928.31	15203.57	
412.68	524.24	709.1	72.95	16202.34	15490.43	
416.50	536.80	722.2	73.24	16476.81	15777.29	
420.25	549.39	735.3	73.53	16751.73	16064.15	
423.94	561.99	748.5	73.80	17026.98	16351.01	
427.58	574.60	761.6	74.07	17302.64	16637.37	

431.15	587.24	774.7	74.32	17578.65	16924.73
434.67	599.89	787.9	74.57	17855.01	17211.53
438.14	612.56	801.0	74.81	18131.69	17438.45
441.55	625.25	814.1	75.05	18408.69	17785.31
444.92	637.93	827.3	75.27	18685.98	18072.17
448.23	650.63	840.4	75.49	18963.56	18359.83
451.50	663.35	853.5	75.71	19241.41	18645.89
454.71	676.08	866.7	75.92	19519.52	18932.75
457.89	688.83	879.8	76.12	19797.87	19219.61
461.02	701.58	892.9	76.31	20076.47	19506.47
464.16	714.34	906.1	76.51	20355.33	19793.33
467.14	727.12	919.2	76.69	20634.35	20080.19
470.15	739.96	932.3	76.87	20913.61	20367.05
473.11	752.69	945.4	77.05	21193.07	20653.91
476.03	765.49	958.6	77.22	21472.73	20940.77
478.92	778.36	971.7	77.39	21752.58	21227.63
481.77	791.12	984.8	77.55	22032.60	21514.49
484.58	803.95	998.0	77.71	22312.89	21801.35
487.36	816.78	1011.1	77.86	22593.17	22088.21
490.10	829.62	1024.2	78.01	22873.70	22375.07
492.81	842.47	1037.4	78.16	23154.38	22661.93
495.49	855.33	1050.5	78.31	23435.21	22948.79
498.14	868.19	1063.6	78.45	23716.19	23235.65
500.75	881.06	1076.8	78.58	23997.31	23522.51
503.34	893.95	1089.9	78.72	24278.56	23809.37
505.89	906.81	1103.0	78.85	24559.94	24096.23
508.41	919.70	1116.2	78.98	24841.44	24383.09
510.91	932.59	1129.3	79.10	25123.07	24669.95
513.38	945.49	1142.4	79.22	25404.81	24956.81
515.82	958.39	1155.5	79.34	25686.67	25243.67
518.24	971.36	1168.7	79.46	25968.64	25530.52
520.63	984.21	1181.8	79.58	26250.71	25817.33
522.99	997.12	1194.9	79.69	26532.89	26104.24
525.33	1010.05	1208.1	79.80	26815.16	26391.11
527.64	1022.97	1221.2	79.90	27097.53	26677.95
529.93	1035.90	1234.3	80.01	27380.00	26964.82
532.20	1048.84	1247.5	80.11	27662.55	27251.69
534.44	1061.77	1260.6	80.21	27945.19	27538.54
536.66	1074.72	1273.7	80.31	28227.92	27825.41
538.86	1087.66	1286.9	80.41	28510.73	28112.25
541.04	1100.61	1300.0	80.50	28793.62	28399.12

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 5500.0

MTFT	21.8457	LENGTH OF LINE	1300.0	POINTS100	VERTICAL FORCE	J.0
	X	Y	S	SLOPE	TENSION	VFORCE
	0.00	0.00	0.0	0.00	5500.00	0.00
13.13		.34	13.1	2.99	5507.48	286.85
26.21		1.37	26.3	5.96	5529.84	573.72
39.23		3.00	39.4	8.89	5566.92	860.58
52.15		5.42	52.5	11.78	5618.42	1147.44
64.93		8.42	65.7	14.62	5683.94	1434.30
77.55		12.04	78.8	17.38	5763.02	1721.15
89.99		16.25	91.9	20.06	5855.10	2008.02
102.22		21.04	105.0	22.65	5959.57	2294.89
114.22		26.36	118.2	25.15	6075.80	2581.74
125.99		32.19	131.3	27.54	6203.13	2868.61
137.50		38.49	144.4	29.84	6340.83	3155.46
148.76		45.25	157.6	32.04	6488.42	3442.32
159.76		52.42	170.7	34.14	6645.06	3729.19
170.50		59.97	183.8	36.14	6810.18	4016.04
180.97		67.84	197.0	38.04	6983.19	4302.91
191.19		76.15	210.1	39.85	7163.51	4589.75
201.14		84.71	223.2	41.56	7350.61	4876.62
210.84		93.56	236.4	43.19	7543.97	5163.49
220.29		102.68	249.5	44.74	7743.14	5450.34
229.53		112.04	262.6	46.21	7947.67	5737.23
238.47		121.63	275.8	47.60	8157.16	6024.06
247.21		131.43	288.9	48.93	8371.24	6310.92
255.72		141.43	302.0	50.18	8589.57	6597.73
264.02		151.60	315.1	51.38	8811.82	6884.64
272.12		161.94	328.3	52.51	9037.72	7171.53
280.01		172.44	341.4	53.59	9266.93	7458.36
287.71		183.07	354.5	54.62	9499.39	7745.22
295.22		193.85	367.7	55.63	9734.69	8032.09
302.55		204.74	380.8	56.53	9972.73	8318.94
309.70		215.75	393.9	57.42	10213.21	8605.79
316.69		226.87	407.1	58.26	10456.07	8892.65
323.52		238.08	420.2	59.07	10701.17	9179.51
330.19		249.39	433.3	59.84	10948.16	9466.37
336.71		260.79	446.5	60.58	11197.12	9753.23
343.09		272.27	459.6	61.29	11447.86	10040.09
349.33		283.82	472.7	61.96	11700.25	10326.95
355.44		295.45	485.9	62.61	11954.21	10613.81
361.42		307.14	499.0	63.23	12209.61	10900.67
367.27		318.89	512.1	63.82	12466.33	11187.53
373.01		330.70	525.2	64.39	12724.45	11474.39
378.62		342.57	538.4	64.94	12983.72	11761.25
384.13		354.49	551.5	65.46	13244.13	12048.11
389.53		366.46	564.6	65.97	13505.61	12334.97
394.83		378.40	577.8	66.45	13768.13	12621.83
400.02		390.54	590.9	66.92	14031.55	12908.69
405.12		402.64	604.0	67.37	14295.89	13195.55
410.13		414.78	617.2	67.81	14561.09	13482.41
415.04		426.95	630.3	68.23	14827.10	13769.27
419.37		439.17	643.4	68.63	15093.87	14056.13
424.61		451.41	656.6	69.02	15361.36	14342.99
429.28		463.69	669.7	69.40	15629.54	14629.85
433.86		475.99	682.8	69.76	15899.37	14916.71
438.36		488.33	696.0	70.11	16167.83	15203.57
442.79		500.69	709.1	70.45	16437.87	15490.43

447.15	513.67	722.2	70.78	16709.47	15777.29
451.44	525.49	735.3	71.10	16979.60	16064.15
455.06	537.92	748.5	71.41	17251.25	16351.31
459.61	550.38	761.6	71.71	17523.38	16637.97
463.90	562.86	774.7	72.00	17795.97	16924.73
467.93	575.35	787.9	72.28	18069.00	17211.59
471.93	587.87	801.0	72.55	18342.46	17498.45
475.80	600.41	814.1	72.82	18616.32	17785.31
479.65	612.96	827.3	73.07	18890.56	18072.17
483.45	625.53	840.4	73.32	19165.18	18359.03
487.19	638.12	853.5	73.57	19440.14	18645.83
490.88	650.72	866.7	73.80	19715.45	18932.75
494.52	663.34	879.8	74.03	19991.08	19219.61
498.11	675.97	892.9	74.25	20267.03	19506.47
501.65	688.61	906.1	74.47	20543.27	19793.33
505.14	701.27	919.2	74.68	20819.80	20080.19
508.58	713.94	932.3	74.89	21096.69	20367.05
511.99	726.63	945.4	75.09	21373.67	20653.91
515.34	739.32	958.6	75.28	21651.00	20940.77
518.66	752.03	971.7	75.47	21928.57	21227.63
521.93	764.74	984.8	75.66	22206.38	21514.49
525.16	777.47	998.0	75.84	22484.41	21801.35
528.35	790.21	1011.1	76.02	22762.66	22088.21
531.51	802.90	1024.2	76.19	23041.13	22375.07
534.62	815.71	1037.4	76.36	23319.80	22661.93
537.70	828.48	1050.5	76.52	23598.66	22948.79
540.74	841.25	1063.6	76.68	23877.71	23235.65
543.75	854.03	1076.8	76.84	24156.95	23522.51
546.72	866.82	1089.9	76.99	24436.36	23809.37
549.66	879.62	1103.0	77.14	24715.95	24096.23
552.57	892.43	1116.2	77.29	24995.70	24383.09
555.44	905.24	1129.3	77.43	25275.60	24669.95
558.28	918.06	1142.4	77.57	25555.67	24956.81
561.09	930.89	1155.5	77.71	25835.88	25243.67
563.87	943.72	1168.7	77.84	26116.23	25530.52
566.63	956.56	1181.8	77.97	26396.73	25817.39
569.35	969.41	1194.9	78.10	26677.36	26104.24
572.04	982.26	1208.1	78.23	26958.12	26391.10
574.71	995.12	1221.2	78.35	27239.01	26677.95
577.34	1007.94	1234.3	78.47	27520.02	26964.82
579.95	1021.85	1247.5	78.59	27801.16	27251.64
582.54	1033.72	1260.6	78.71	28082.40	27538.54
585.10	1046.60	1273.7	78.82	28363.76	27825.40
587.63	1059.49	1286.9	78.93	28645.23	28112.25
590.14	1072.38	1300.0	79.04	28926.81	28399.12

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 10000.0

WTFT	21.0457	LENGTH OF LINE	1500.3	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
0.00	0.00	0.0	0.00	10000.00	0.00	
15.15	.25	15.2	1.90	10005.48	330.93	
30.20	1.00	30.3	3.79	10021.89	661.99	
45.30	2.25	45.5	5.67	10049.18	992.99	
60.43	3.99	60.6	7.54	10087.26	1323.97	
75.42	6.23	75.8	9.40	10136.02	1654.95	
90.32	8.94	90.9	11.23	10195.29	1985.95	
105.13	12.13	106.1	13.04	10264.90	2316.94	
119.84	15.78	121.2	14.83	10344.64	2647.94	
134.42	19.88	136.4	16.59	10434.27	2978.93	
148.88	24.42	151.5	18.31	10533.55	3309.92	
163.19	29.40	166.7	20.01	10642.19	3640.91	
177.35	34.79	181.8	21.66	10759.93	3971.91	
191.35	40.58	197.0	23.28	10886.46	4302.91	
205.18	46.76	212.1	24.86	11021.49	4633.89	
218.84	53.31	227.3	26.40	11164.68	4964.89	
232.32	60.23	242.4	27.91	11315.75	5295.87	
245.62	67.49	257.6	29.37	11474.39	5626.87	
258.73	75.08	272.7	30.79	11640.29	5957.85	
271.65	83.00	287.9	32.17	11813.11	6298.85	
284.38	91.21	303.3	33.50	11992.59	6619.84	
296.92	99.72	318.2	34.80	12178.43	6950.83	
309.26	108.51	333.3	36.06	12370.33	7281.83	
321.41	117.55	348.5	37.28	12568.02	7612.82	
333.37	126.85	363.6	38.46	12771.22	7943.81	
345.14	136.40	378.8	39.61	12979.63	8274.81	
356.72	146.17	393.9	40.71	13193.17	8605.79	
368.11	156.16	409.1	41.79	13411.42	8936.79	
379.31	166.36	424.2	42.82	13634.21	9267.78	
390.34	176.75	439.4	43.83	13861.33	9598.77	
401.18	187.34	454.5	44.80	14092.56	9929.75	
411.84	198.10	469.7	45.74	14327.70	10260.76	
422.33	209.04	484.8	46.65	14566.53	10591.75	
432.64	220.13	500.0	47.53	14808.99	10922.74	
442.79	231.39	515.1	48.38	15054.73	11253.73	
452.77	242.78	530.3	49.20	15303.73	11584.72	
462.59	254.32	545.4	50.00	15555.84	11915.72	
472.25	265.99	560.6	50.77	15810.81	12246.71	
481.76	277.79	575.8	51.51	16068.56	12577.71	
491.11	289.71	590.9	52.24	16328.94	12908.69	
500.32	301.75	606.1	52.94	16591.84	13239.63	
509.38	313.89	621.2	53.61	16857.14	13570.68	
518.30	326.14	636.4	54.27	17124.73	13901.67	
527.07	338.49	651.5	54.91	17394.50	14232.65	
535.72	350.93	666.7	55.52	17666.35	14563.65	
544.23	363.47	681.8	56.12	17940.19	14894.65	
552.61	376.09	697.0	56.70	18215.93	15225.64	
560.86	388.79	712.1	57.27	18493.49	15556.63	
569.00	401.58	727.3	57.81	18772.76	15887.62	
577.01	414.44	742.4	58.34	19053.73	16218.61	
584.90	427.37	757.6	58.86	19336.22	16549.61	
592.68	440.37	772.7	59.36	19620.26	16880.61	
600.35	453.44	787.9	59.84	19905.75	17211.59	
607.90	466.57	803.0	60.32	20192.63	17542.58	
615.35	479.77	818.2	60.77	20480.84	17873.57	

622.70	493.02	833.3	61.22	20770.32	18204.57
629.94	506.33	848.5	61.65	21061.03	18535.56
637.39	519.69	863.6	62.07	21352.91	18866.55
644.14	533.10	878.8	62.48	21645.91	19197.54
651.09	546.50	893.9	62.88	21940.00	19528.53
657.95	560.07	909.1	63.27	22235.13	19859.53
664.72	573.63	924.2	63.65	22531.25	20190.52
671.46	587.22	939.4	64.02	22828.32	20521.51
677.99	600.87	954.5	64.38	23126.32	20852.50
684.50	614.55	969.7	64.73	23425.21	21183.51
690.93	628.27	984.8	65.07	23724.95	21514.49
697.28	642.03	1000.0	65.40	24025.51	21845.49
703.54	655.82	1015.1	65.73	24326.86	22176.47
709.73	669.65	1030.3	66.04	24628.96	22507.46
715.85	683.51	1045.4	66.35	24931.81	22838.46
721.69	697.41	1060.6	66.65	25235.36	23169.45
727.86	711.33	1075.7	66.95	25539.59	23500.44
733.75	725.29	1090.9	67.24	25844.48	23831.43
739.58	739.28	1106.0	67.52	26150.00	24162.42
745.34	753.29	1121.2	67.79	26456.14	24493.42
751.04	767.33	1136.4	68.06	26762.87	24824.41
756.60	781.40	1151.5	68.32	27070.17	25155.40
762.25	795.49	1166.7	68.58	27378.02	25486.39
767.73	809.61	1181.8	68.83	27686.41	25817.38
773.18	823.75	1197.0	69.07	27995.31	26148.38
778.56	837.91	1212.1	69.31	28304.72	26479.37
783.88	852.09	1227.3	69.54	28614.60	26810.36
789.15	866.30	1242.4	69.77	28924.96	27141.35
794.36	880.53	1257.6	70.00	29235.76	27472.35
799.51	894.78	1272.7	70.22	29547.61	27803.34
804.61	909.04	1287.9	70.43	29858.69	28134.33
809.66	923.33	1303.0	70.64	30170.76	28465.32
814.66	937.63	1318.2	70.85	30483.24	28796.31
819.60	951.95	1333.3	71.05	30796.13	29127.31
824.50	966.29	1348.5	71.25	31109.34	29458.30
829.34	980.65	1363.6	71.44	31422.95	29789.29
834.14	995.02	1378.8	71.63	31736.91	30120.28
838.89	1009.41	1393.9	71.82	32051.21	30451.27
843.60	1023.81	1409.1	72.00	32365.84	30782.27
848.26	1038.23	1424.2	72.18	32680.83	31113.26
852.87	1052.66	1439.4	72.36	32996.07	31444.25
857.44	1067.10	1454.5	72.53	33311.65	31775.24
861.97	1081.56	1469.7	72.70	33627.52	32106.23
866.45	1096.04	1484.8	72.87	33943.68	32437.23
870.89	1110.52	1500.0	73.03	34260.13	32768.22

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 10000.0

MTFT	21.8457	LENGTH OF LINE	1500.0	POINTS100	VERTICAL FORCE	0.0
X	Y	S	SLOPE	TENSION	VFORCE	
0.00	0.00	0.0	0.00	10800.00	0.00	
15.15	.23	15.2	1.76	10805.07	330.99	
30.20	.93	30.3	3.51	10820.27	661.99	
45.39	2.09	45.5	5.25	10845.55	992.99	
60.45	3.70	60.6	6.99	10880.85	1323.97	
75.46	5.77	75.8	8.71	10926.06	1654.96	
90.40	8.29	90.9	10.42	10981.07	1985.95	
105.26	11.25	106.1	12.11	11045.73	2316.94	
120.03	14.64	121.2	13.78	11119.87	2647.94	
134.69	18.46	136.4	15.42	11203.30	2978.93	
149.24	22.70	151.5	17.04	11295.82	3309.92	
163.66	27.34	166.7	18.63	11397.21	3640.91	
177.95	32.37	181.8	20.19	11507.22	3971.91	
192.10	37.79	197.0	21.72	11625.62	4302.91	
206.10	43.59	212.1	23.22	11752.15	4633.89	
219.94	49.74	227.3	24.69	11886.55	4964.83	
233.63	56.24	242.4	26.12	12028.56	5295.87	
247.15	63.07	257.6	27.52	12177.92	5626.87	
260.50	70.24	272.7	28.88	12334.35	5957.86	
273.68	77.71	287.9	30.21	12497.59	6288.85	
286.69	85.48	303.0	31.51	12667.37	6619.84	
299.52	93.54	318.2	32.77	12843.45	6950.83	
312.17	101.88	333.3	33.99	13025.55	7281.83	
324.64	110.48	348.5	35.18	13213.44	7612.82	
336.94	119.33	363.6	36.34	13406.87	7943.81	
349.05	128.43	378.8	37.46	13605.60	8274.81	
360.99	137.76	393.9	38.55	13809.41	8605.79	
372.75	147.31	409.1	39.61	14018.97	8936.79	
384.34	157.07	424.2	40.63	14231.36	9267.79	
395.75	167.04	439.4	41.63	14449.10	9598.77	
406.99	177.20	454.5	42.60	14671.07	9929.76	
418.06	187.55	469.7	43.53	14897.09	10260.76	
428.96	198.07	484.8	44.44	15126.97	10591.75	
439.69	208.76	500.0	45.32	15360.54	10922.74	
450.26	219.62	515.1	46.18	15597.64	11253.73	
460.67	230.62	530.3	47.01	15838.11	11584.72	
470.93	241.78	545.4	47.81	16081.80	11915.72	
481.03	253.07	560.6	48.59	16328.56	12246.71	
490.97	264.50	575.8	49.35	16579.26	12577.71	
500.77	276.06	590.9	50.08	16830.76	12908.69	
510.42	287.74	606.1	50.79	17085.94	13239.68	
519.92	299.54	621.2	51.49	17343.63	13570.63	
529.29	311.45	636.4	52.16	17603.87	13901.67	
538.51	323.47	651.5	52.81	17866.41	14232.66	
547.61	335.59	666.7	53.44	18131.19	14563.65	
556.57	347.81	681.8	54.05	18398.11	14894.65	
565.40	360.12	697.0	54.65	18667.08	15225.64	
574.10	372.52	712.1	55.23	18938.02	15556.63	
582.68	385.01	727.3	55.79	19210.84	15887.62	
591.14	397.58	742.4	56.34	19485.47	16218.61	
599.47	410.23	757.6	56.87	19761.82	16549.61	
607.76	422.96	772.7	57.39	20039.82	16880.63	
615.81	435.76	787.9	57.89	20319.42	17211.59	
623.80	448.63	803.0	58.38	20600.54	17542.59	
631.69	461.56	818.2	58.86	20883.12	17873.57	

639.48	474.56	833.3	59.32	21167.10	18204.57
647.16	447.62	848.5	59.77	21452.43	18535.56
654.73	500.74	863.6	60.21	21739.66	18866.55
662.21	513.92	878.8	60.64	22026.93	19197.54
669.59	527.15	893.9	61.06	22316.30	19528.53
676.88	540.44	909.1	61.46	22606.21	19859.53
684.67	553.77	924.2	61.86	22897.53	20190.52
691.17	567.16	939.4	62.24	23189.92	20521.51
698.18	580.59	954.5	62.62	23483.33	20852.51
705.11	594.06	969.7	62.99	23777.73	21183.50
711.95	607.58	984.8	63.34	24073.08	21514.49
718.76	621.14	1000.0	63.69	24369.34	21845.49
725.38	634.75	1015.1	64.03	24666.49	22176.47
731.97	648.39	1030.3	64.37	24964.49	22507.46
738.49	662.07	1045.4	64.69	25263.31	22838.45
744.93	675.78	1060.6	65.01	25562.93	23169.45
751.29	689.53	1075.7	65.32	25863.31	23500.44
757.58	703.32	1090.9	65.62	26164.43	23831.43
763.80	717.13	1106.0	65.92	26466.26	24162.42
769.95	730.98	1121.2	66.21	26768.78	24493.42
776.02	744.86	1136.4	66.49	27071.96	24824.41
782.03	758.77	1151.5	66.76	27375.80	25155.40
787.98	772.70	1166.7	67.03	27680.25	25486.39
793.86	786.67	1181.8	67.30	27985.31	25817.38
799.67	800.66	1197.0	67.56	28290.95	26148.38
805.43	814.68	1212.1	67.81	28597.15	26479.37
811.12	829.72	1227.3	68.06	28903.90	26810.36
816.75	842.78	1242.4	68.30	29211.19	27141.35
822.32	856.87	1257.6	68.54	29518.97	27472.35
827.84	870.98	1272.7	68.77	29827.26	27803.34
833.30	885.12	1287.9	69.00	30136.03	28134.33
838.70	899.27	1303.0	69.22	30445.27	28465.32
844.04	913.45	1318.2	69.44	30754.96	28796.31
849.34	927.65	1333.3	69.66	31065.09	29127.31
854.58	941.86	1348.5	69.87	31375.65	29458.31
859.77	956.10	1363.6	70.07	31686.62	29789.29
864.91	970.35	1378.8	70.27	31997.99	30120.28
870.00	984.62	1393.9	70.47	32309.75	30451.27
875.04	998.91	1409.1	70.67	32621.89	30782.27
880.03	1013.22	1424.2	70.86	32934.41	31113.26
884.98	1027.54	1439.4	71.04	33247.27	31444.25
889.87	1041.87	1454.5	71.23	33560.43	31775.24
894.73	1056.23	1469.7	71.41	33874.04	32106.23
899.54	1070.60	1484.8	71.58	34187.92	32437.23
904.30	1084.98	1500.0	71.76	34502.12	32768.22

J U P E R C A T

NO OF CATS= 1 HOLDING POWER= 11250.0

WTFT	21.8457	LENGTH OF LINE	150.0	POINTS100	VERTICAL FORCE	0.0
	X	Y	S	SLOPE	TENSION	VFORCE
	0.00	0.00	0.0	0.00	11250.00	0.00
	15.15	.22	15.2	1.69	11254.87	330.99
	30.29	.89	30.3	3.37	11269.46	661.99
	45.40	2.00	45.5	5.04	11293.74	992.99
	60.47	3.55	60.6	6.71	11327.64	1323.97
	75.49	5.54	75.6	8.37	11371.09	1654.95
	90.44	7.96	90.9	10.01	11423.94	1985.95
	105.32	10.81	106.1	11.64	11486.11	2316.94
	120.12	14.07	121.2	13.24	11557.42	2647.94
	134.82	17.75	136.4	14.83	11637.72	2978.93
	149.41	21.83	151.5	16.39	11726.81	3309.92
	163.88	26.30	166.7	17.93	11824.90	3640.91
	178.24	31.15	181.8	19.45	11930.57	3971.91
	192.46	36.38	197.0	20.93	12044.81	4302.90
	206.54	41.98	212.1	22.39	12166.98	4633.89
	220.47	47.92	227.3	23.81	12296.85	4964.88
	234.26	54.21	242.4	25.21	12434.19	5295.87
	247.89	60.82	257.6	26.57	12578.72	5626.87
	261.36	67.76	272.7	27.91	12730.22	5957.86
	274.67	75.00	287.9	29.21	12888.45	6288.85
	287.81	82.54	303.0	30.47	13053.15	6619.84
	300.78	90.37	318.2	31.71	13224.09	6950.83
	313.59	98.46	333.3	32.91	13401.03	7281.83
	326.22	106.83	348.5	34.09	13583.72	7612.82
	338.68	115.44	363.6	35.23	13771.95	7943.81
	350.98	124.30	378.8	36.34	13965.49	8274.80
	363.09	133.40	393.9	37.41	14164.12	8605.79
	375.04	142.71	409.1	38.46	14367.63	8936.79
	386.82	152.24	424.2	39.48	14575.81	9267.79
	398.43	161.98	439.4	40.47	14788.47	9598.77
	409.88	171.91	454.5	41.43	15005.42	9929.75
	421.15	182.03	469.7	42.37	15226.48	10260.76
	432.26	192.32	484.8	43.27	15451.46	10591.75
	443.22	202.80	500.0	44.15	15680.20	10922.74
	454.01	213.43	515.1	45.01	15912.54	11253.73
	464.64	224.22	530.3	45.84	16148.32	11584.72
	475.12	235.17	545.4	46.65	16387.40	11915.72
	485.44	246.26	560.6	47.43	16629.62	12246.71
	495.62	257.48	575.8	48.19	16874.86	12577.70
	505.65	268.84	590.9	48.93	17122.99	12908.69
	515.53	280.32	606.1	49.64	17373.88	13239.69
	525.27	291.93	621.2	50.34	17627.42	13570.68
	534.87	303.65	636.4	51.02	17883.48	13901.67
	544.33	315.48	651.5	51.68	18141.97	14232.66
	553.66	327.42	666.7	52.31	18402.79	14563.65
	562.86	339.46	681.8	52.94	18665.82	14894.65
	571.93	351.60	697.0	53.54	18931.99	15225.64
	580.87	363.83	712.1	54.13	19199.21	15556.63
	589.68	376.10	727.3	54.70	19467.38	15887.62
	598.38	388.50	742.4	55.25	19738.44	16218.61
	606.96	401.05	757.6	55.79	20011.30	16549.61
	615.42	413.62	772.7	56.32	20285.88	16880.60
	623.76	426.27	787.9	56.83	20562.13	17211.59
	632.00	438.99	803.0	57.33	20839.98	17542.59
	640.12	451.78	818.2	57.81	21119.35	17873.57

648.14	404.63	833.3	58.28	21400.20	18044.57
656.05	477.55	848.5	58.74	21682.47	18535.56
663.06	490.54	863.6	59.19	21966.09	18866.55
671.57	503.53	878.8	59.63	22251.03	19197.54
679.18	516.68	893.9	60.05	22537.22	19528.53
686.76	529.84	909.1	60.47	22824.62	19859.53
694.12	543.04	924.2	60.87	23113.19	20190.52
701.45	556.31	939.4	61.27	23402.88	20521.51
708.69	569.62	954.5	61.65	23693.66	20852.50
715.84	582.97	969.7	62.03	23985.47	21183.50
722.90	596.38	984.8	62.39	24278.30	21514.49
729.88	609.83	1000.0	62.75	24572.09	21845.48
736.78	623.32	1015.1	63.10	24866.81	22176.47
743.59	636.85	1030.3	63.44	25162.44	22507.46
750.32	650.42	1045.4	63.78	25458.94	22838.46
756.98	664.03	1060.6	64.10	25756.28	23169.45
763.56	677.68	1075.7	64.42	26054.43	23500.44
770.07	691.37	1090.9	64.73	26353.36	23831.43
776.50	705.08	1106.0	65.03	26653.03	24162.42
782.80	718.84	1121.2	65.33	26953.48	24493.42
789.15	732.62	1136.4	65.62	27254.61	24824.41
795.37	746.44	1151.5	65.90	27556.43	25155.40
801.52	760.28	1166.7	66.18	27858.91	25486.39
807.60	774.16	1181.8	66.45	28162.03	25817.38
813.62	788.06	1197.0	66.72	28465.77	26148.38
819.58	801.99	1212.1	66.98	28770.11	26479.37
825.47	815.95	1227.3	67.24	29075.04	26810.36
831.30	829.94	1242.4	67.49	29380.53	27141.35
837.08	843.95	1257.6	67.73	29686.57	27472.35
842.79	857.98	1272.7	67.97	29993.13	27803.34
848.44	872.04	1287.9	68.21	30300.21	28134.33
854.04	886.11	1303.0	68.44	30607.79	28465.32
859.58	900.22	1318.2	68.66	30915.86	28796.31
865.07	914.34	1333.3	68.88	31224.39	29127.31
870.50	928.48	1348.5	69.10	31533.38	29458.30
875.88	942.65	1363.6	69.31	31842.81	29789.29
881.20	956.83	1378.8	69.52	32152.67	30120.28
886.48	971.04	1393.9	69.72	32462.94	30451.27
891.71	985.26	1409.1	69.92	32773.62	30782.27
896.88	999.50	1424.2	70.12	33084.73	31113.26
902.01	1013.75	1439.4	70.31	33396.16	31444.25
907.09	1028.03	1454.5	70.50	33707.99	31775.24
912.12	1042.32	1469.7	70.69	34020.18	32106.23
917.11	1056.63	1484.8	70.87	34332.73	32437.23
922.05	1070.95	1500.0	71.05	34645.62	32768.22

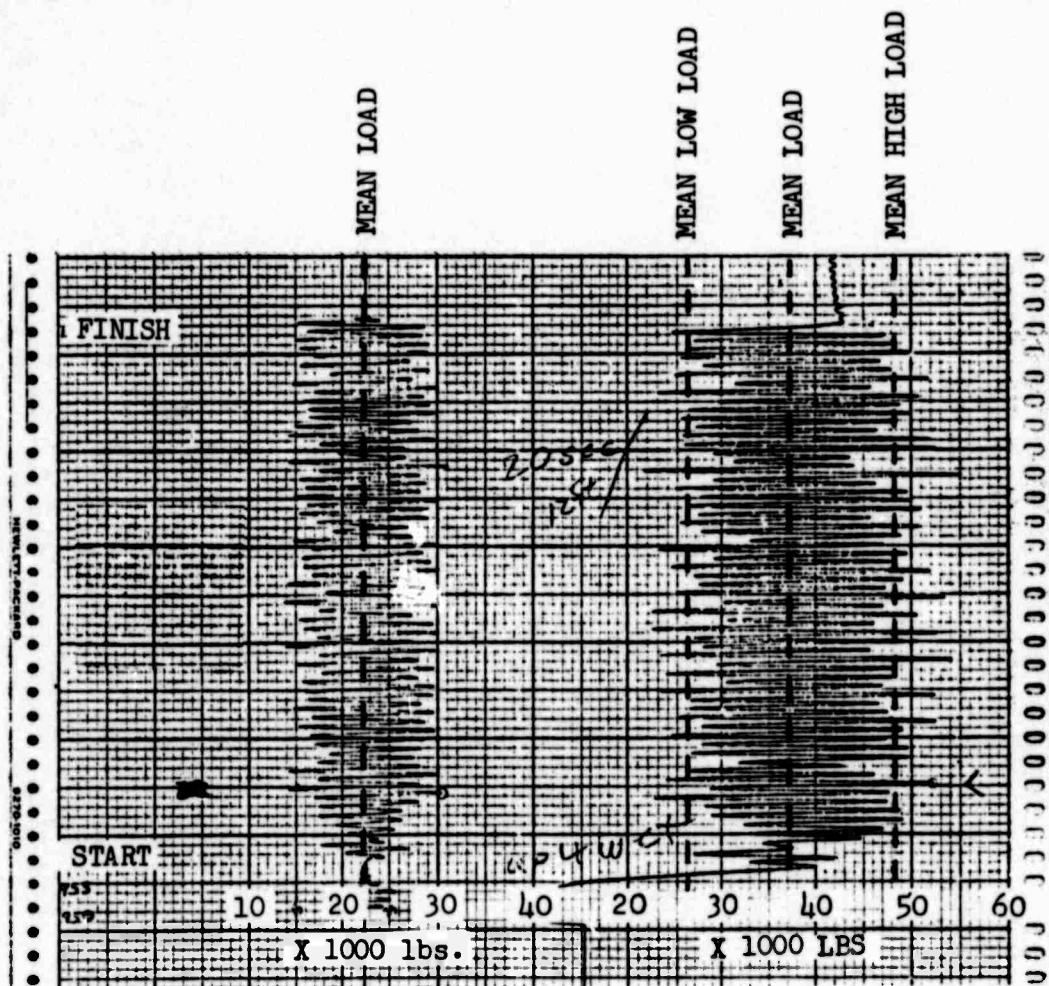
SUPERCAT

NO OF CATS= 1 HOLDING POWER= 12000.0

WTFT	21.8457	LENGTH OF LINE	1500.0	POINTS100	VERTICAL FORCE	0.0
	X	Y	S	SLOPE	TENSION	VFORCE
	0.00	0.00	0.0	0.00	12000.00	0.00
	15.15	.21	15.2	1.50	12004.56	330.99
	30.29	.84	30.3	3.16	12010.25	661.99
	45.40	1.88	45.5	4.73	12041.01	992.99
	60.48	3.33	60.6	6.30	12072.82	1323.97
	75.52	5.20	75.8	7.85	12113.58	1654.96
	90.50	7.47	90.9	9.40	12163.22	1985.95
	105.41	10.15	106.1	10.93	12221.63	2316.94
	120.25	13.21	121.2	12.44	12288.68	2647.94
	135.00	16.67	136.4	13.94	12364.22	2978.93
	149.66	20.51	151.5	15.42	12448.12	3309.92
	164.21	24.73	166.7	16.88	12540.19	3640.91
	178.65	29.31	181.8	18.31	12641.25	3971.91
	192.97	34.25	197.0	19.73	12748.13	4302.91
	207.17	39.53	212.1	21.11	12863.63	4633.89
	221.24	45.16	227.3	22.48	12986.53	4964.88
	235.17	51.11	242.4	23.81	13116.64	5295.87
	248.96	57.39	257.6	25.12	13253.74	5626.87
	262.61	63.98	272.7	26.40	13397.61	5957.84
	276.10	70.86	287.9	27.66	13548.05	6288.85
	289.45	78.04	303.0	28.88	13704.83	6619.84
	302.63	85.54	318.2	30.08	13867.74	6950.83
	315.67	93.24	333.3	31.25	14036.56	7281.83
	328.54	101.21	348.5	32.39	14211.03	7612.82
	341.25	109.45	363.6	33.50	14391.11	7943.81
	353.81	117.94	378.8	34.59	14576.43	8274.80
	366.20	126.65	393.9	35.65	14766.84	8605.79
	378.43	135.59	409.1	36.68	14962.16	8936.79
	390.50	144.75	424.2	37.68	15162.19	9267.78
	402.42	154.11	439.4	38.66	15366.73	9598.77
	414.17	163.68	454.5	39.61	15575.63	9929.75
	425.76	173.43	469.7	40.53	15788.73	10260.76
	437.20	183.37	484.8	41.43	16005.73	10591.75
	448.48	193.48	500.0	42.31	16226.71	10922.74
	459.61	203.76	515.1	43.16	16451.34	11253.73
	470.59	214.21	530.3	43.99	16679.53	11584.72
	481.41	224.81	545.4	44.80	16911.07	11915.72
	492.09	235.50	560.6	45.58	17145.91	12246.71
	502.62	246.45	575.8	46.35	17383.86	12577.71
	513.01	257.48	590.9	47.09	17624.82	12908.69
	523.25	268.64	606.1	47.81	17868.67	13239.64
	533.36	279.93	621.2	48.51	18115.29	13570.68
	543.33	291.34	636.4	49.20	18364.54	13901.67
	553.16	302.87	651.5	49.86	18616.35	14232.65
	562.86	314.51	666.7	50.51	18870.61	14563.65
	572.43	326.25	681.8	51.14	19127.22	14894.65
	581.87	338.10	697.0	51.76	19386.08	15225.64
	591.19	350.05	712.1	52.35	19647.10	15556.63
	600.38	362.09	727.3	52.94	19910.21	15887.62
	609.45	374.23	742.4	53.50	20175.32	16218.61
	618.41	386.45	757.6	54.05	20442.34	16549.61
	627.24	398.76	772.7	54.59	20711.22	16880.61
	635.96	411.15	787.9	55.12	20981.87	17211.59
	644.57	423.62	803.0	55.63	21254.23	17542.59
	653.07	436.16	818.2	56.12	21528.23	17873.57

661.47	448.78	833.3	56.61	21803.81	19204.57
669.75	461.46	848.5	57.08	22080.92	18535.55
677.93	474.21	863.6	57.54	22359.49	13866.25
686.02	487.03	870.8	57.99	22639.47	19197.54
694.60	499.91	893.9	58.43	22920.81	19528.53
701.88	512.95	909.1	58.86	23203.47	19059.53
709.67	525.84	924.2	59.28	23487.38	23190.52
717.36	538.89	939.4	59.68	23772.51	20521.51
724.97	552.00	954.5	60.08	24058.82	23052.57
732.48	565.16	969.7	60.47	24346.26	21183.57
739.90	578.37	984.8	60.85	24634.81	21514.43
747.24	591.62	1000.0	61.22	24924.33	21845.41
754.49	604.92	1015.1	61.58	25214.99	22176.47
761.66	618.27	1030.3	61.94	25506.59	22507.45
768.75	631.66	1045.4	62.28	25799.13	22838.46
775.76	645.10	1060.6	62.62	26092.59	23169.45
782.69	658.57	1075.7	62.95	26386.94	23500.44
789.54	672.08	1090.9	63.27	26682.15	23831.43
796.32	685.64	1106.0	63.59	26978.19	24162.42
803.02	699.22	1121.2	63.90	27275.03	24493.42
809.65	712.85	1136.4	64.20	27572.65	24824.41
816.21	726.51	1151.5	64.50	27871.03	25155.47
822.70	740.20	1166.7	64.79	28170.13	25486.39
829.12	753.92	1181.8	65.07	28469.94	25817.31
835.47	767.68	1197.0	65.35	28770.43	26148.35
841.76	781.46	1212.1	65.62	29071.59	26479.37
847.98	795.28	1227.3	65.89	29373.36	26810.36
854.14	809.12	1242.4	66.15	29675.80	27141.35
860.23	822.99	1257.6	66.40	29978.82	27472.35
866.27	836.89	1272.7	66.65	30282.43	27803.34
872.24	850.81	1287.9	66.90	30586.61	28134.33
878.15	864.76	1303.0	67.14	30891.33	28465.32
884.61	878.74	1318.2	67.38	31196.61	28796.31
889.81	892.73	1333.3	67.61	31502.38	29127.31
895.55	906.75	1348.5	67.84	31808.67	29458.37
901.24	920.80	1363.6	68.06	32115.44	29789.29
906.88	934.86	1378.8	68.28	32422.73	30120.29
912.46	948.95	1393.9	68.49	32730.42	30451.27
917.99	963.05	1409.1	68.70	33038.53	30782.27
923.47	977.18	1424.2	68.91	33347.19	31113.26
928.69	991.33	1439.4	69.11	33656.22	31444.25
934.27	1005.49	1454.5	69.31	33965.65	31775.24
939.60	1019.67	1469.7	69.51	34275.51	32106.23
944.88	1033.88	1484.8	69.70	34585.74	32437.23
950.11	1048.09	1500.0	69.89	34896.36	32768.22

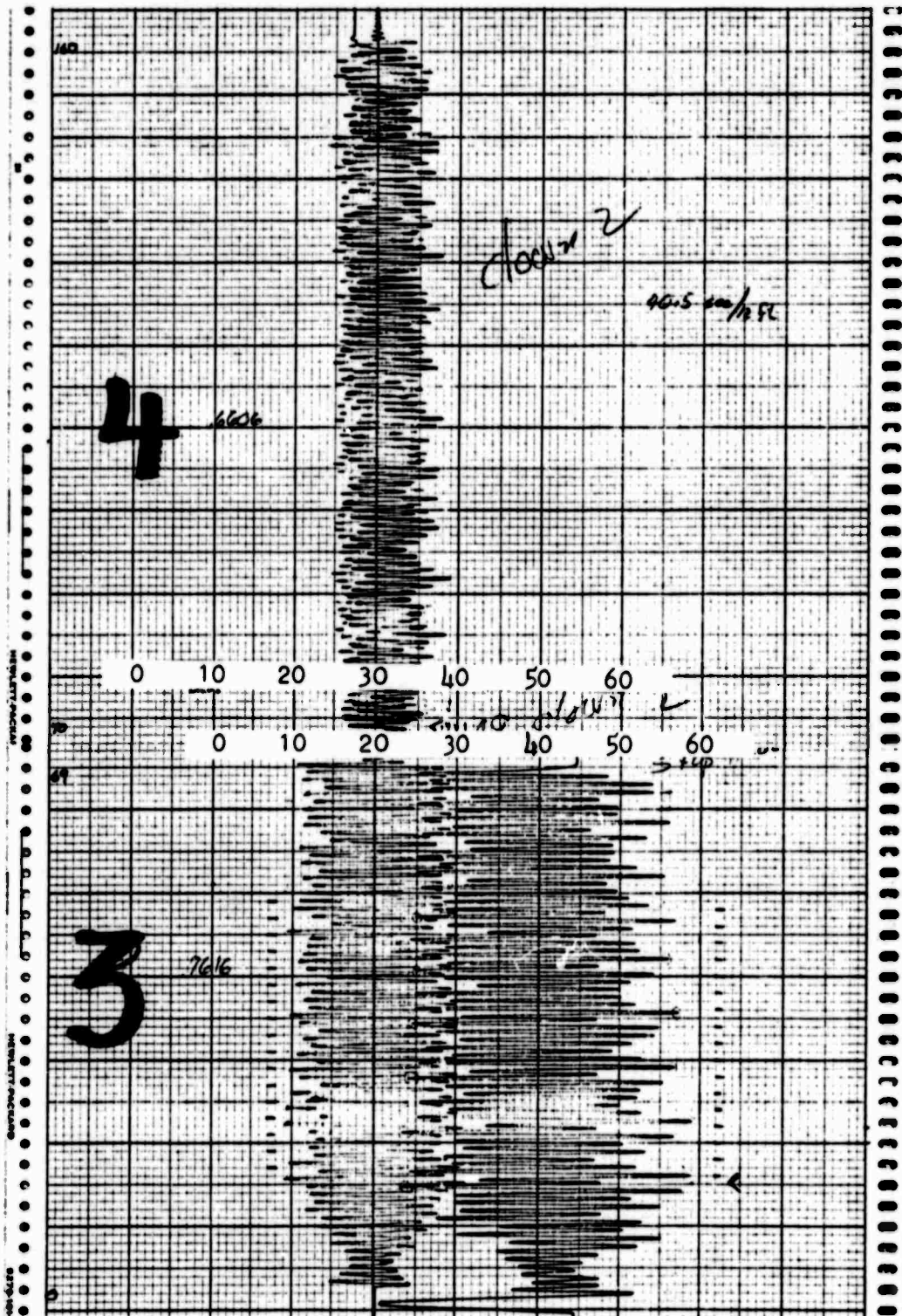
APPENDIX B
DYNAMOMETER / STRIPCHART
READOUTS OF THE
BOLSTER EFFICENCY TESTS



TEST WEIGHT
LOAD CELL READOUT

TOPSIDE WINDLASS
LOAD CELL READOUT

FORMAT STRIP CHART READOUT FOR THE
BOLSTER EFFICIENT TESTS



CALCULATION WORK SHEET

SAVEDOWN CORP. ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 3

Calc. JAMIE date _____
 Chkd. JCS date _____
 Sheet No. _____ of _____

UP ONE, DRY, FIRST RUN

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
52.8	29.2	38.5	22.1
50.	25.5	39.7	19.9
52.2	31.1	38.5	23.6
52.6	28.7	39.3	21.
55.2	24.	40.2	19.8
47.2	31.7	37.9	23.1
56.8	25.4	40.	20.6
53.7	29.6	38.4	22.4
49.1	26.3	38.8	21.4
51.5	30.5	38.	23.3
54.2	27.5	40.1	20.9
54.7	24.5	40.3	19.8
47.	30.7	38.4	22.1
57.3	24.9	39.9	21.5
52.	29.4	38.8	22.5
50.2	24.9	39.5	20.5
50.	32.6	37.7	24.5

TOTAL 886.5 476.5 664.0 386.9

Ave. 52.1471 28.0294 39.0558 21.7588

MEAN 40.0883 30.4088

WILDCAT DRAG 1.980

CORRECTED MEAN 39.8903

BOLSTER EFFICIENCY 0.76231

CALCULATION WORK SHEET

SQUADRON CORPUS ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject COLSTER EFFICIENCY TEST # 4

Calc. JAMIE date _____
 Chkd. JCS date _____
 Sheet No. _____ of _____

DOWN TWO, DRY

17.778 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
23.5	16.7	35.	26.
23.9	16.3	35.4	26.
25.5	17.8	34.7	26.4
23.5	17.2	34.5	26.7
23.3	19.4	32.5	26.9
25.	17.8	33.9	25.4
27.4	18.2	36.3	26.2
24.0	16.3	34.4	25.7
25.6	17.5	35.4	26.8
23.7	16.1	33.9	25.5
26.8	17.9	35.7	26.7
23.1	17.3	32.8	25.9
26.2	17.5	35.	25.0
28.4	18.7	36.1	26.0
25.6	16.7	35.1	25.5
24.2	16.4	35.8	25.4
25.3	17.0	35.3	26.4

TOTAL 425.0 293.8 591.8 442.5

Ave. 25.0 17.2823 34.8118 26.0294

MEAN 21.1412 30.4206

WINDCAT DRAG 1.3445

CORRECTED MEAN 22.4858

COLSTER EFFICIENCY .7391

All is Sore
 This is a
 Field Par
 belster

See
 earlier
 Down 40.5 sec / 12 ft
 28.0" / 12 ft
 37.0" / 12 ft

6

0 10 20 30 40 50 60

0 10 20 30 40 50 60

5

28 sec/mf

Timing
 Source
 up 32

CALCULATION WORK SHEET

SHUTTLEWORTH ENGINEERING SYSTEMS SECTION 6152E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST "5"

Calc. JAMIE date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

UP THREE, DRY

25.714 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
57.8	32.1	35.9	22.3
50.4	34.5	34.7	24.3
53.9	33.5	36.1	22.5
51.5	30.1	36.5	22.7
47.8	32.5	35.5	23.4
50.8	36.6	35.8	25.1
56.5	27.5	38.0	21.0
49.4	35.8	36.0	24.3
54.2	27.9	37.7	21.8
46.3	33.0	35.4	24.0
51.7	36.5	35.7	24.7
57.5	27.6	37.5	21.2
49.0	35.8	35.3	23.9
50.8	30.8	35.4	24.2
45.7	31.1	36.1	23.1
49.3	37.5	35.3	25.6
57.6	27.7	37.5	21.4

Total 883.4 550.8 614.4 395.5

Ave. 51.9647 32.4000 36.1412 23.2647

MEAN 42.1823 29.7029

WILDCAT DRAG 2.0838
0.0494

CORRECTED MEAN 40.0984

BOLSTER EFFICIENCY 0.74075

CALCULATION WORK SHEET

SOUTHERN OCEAN INTER-OCEANIC SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Cdr. JAMIE

date _____

Subject: _____

Chkd. _____

date _____

BOLSTER EFFICIENCY TEST # 6

Sheet No. _____

of _____

DOWN TWO, DRY

19.459 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
26.1	16.7	36.2	26.5
23.2	15.7	34.6	25.7
25.1	17.	34.3	24.3
27.	17.8	35.8	25.4
25.8	16.4	35.3	25.8
24.2	16.2	35.8	26.
24.1	15.8	36.5	26.5
25.6	15.5	35.3	26.0
23.4	15.9	34.5	25.9
24.9	16.8	35.3	25.0
26.3	18.5	35.1	25.6
25.3	16.1	35.3	25.3
23.7	15.5	36.5	25.8
24.	15.8	36.1	26.2
24.1	16.3	33.9	25.6
24.	16.4	36.6	26.3
23.7	16.3	35.4	24.5

TOTAL 420.5 279.7 602.5 436.4

Ave. 24.7333 16.4529 35.4412 25.6706

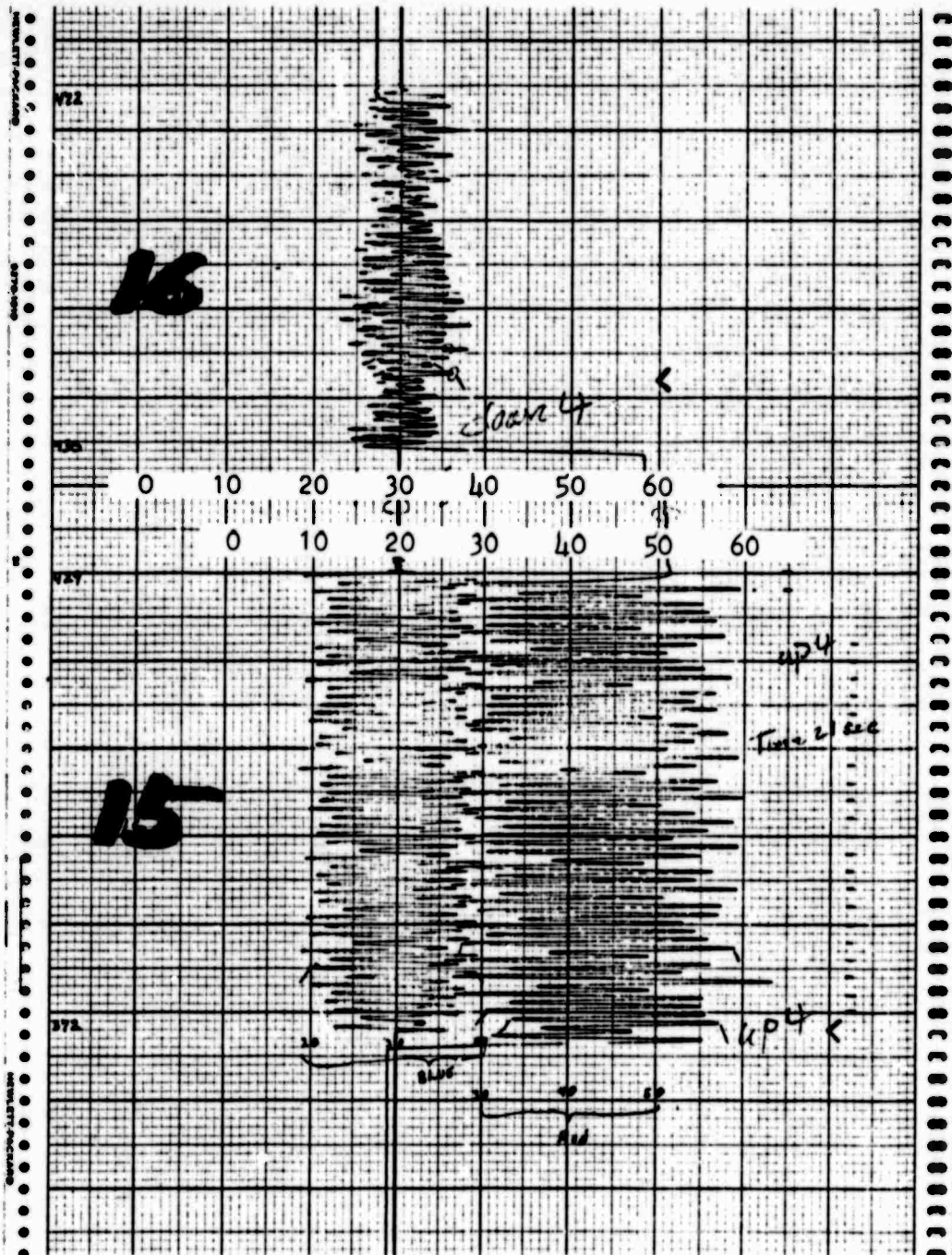
MEAN 20.5941

30.5559

WILDCAT DRAG 1.3097

CORRECTED MEAN 21.9038

BOLSTER EFFICIENCY .7168



CALCULATION WORK SHEET

STANDARD GUN ENGINEERING DIVISION'S SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 15

Calc. JAMES date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

UP FOUR, DRY

34.286 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
57.	30.5	39.4	19.7
55.5	33.3	37.4	22.3
55.1	26.8	39.6	18.9
35.3	36.5	36.0	25.
49.2	26.6	38.6	19.9
63.5	33.2	37.6	21.5
52.9	25.5	39.4	19.3
56.0	37.9	37.1	23.7
49.1	27.6	38.2	20.8
39.	30.4	38.7	20.2
55.9	27.0	37.	21.8
54.5	34.3	38.9	20.5
53.0	29.4	38.3	22.3
57.0	27.2	40.2	19.3
57.4	32.0	36.2	25.5
50.8	26.4	37.	21.7
59.2	31.5	39.1	20.5

TOTAL 940.4 516.1 648.7 362.9

Ave. 55.3176 30.3588 38.1588 21.3470

MEAN 42.8382 29.7529

WILDCAT DRAG 2.1162

CORRECTED MEAN 40.7220

BOLSTER EFFICIENCY .7306

CALCULATION WORK SHEET

SOUTHWEST COAST ENGINEERING SYSTEMS SECTION 6162B

U.S.S. ORTOLAN ASR-22
 Subject POIATED EFFICIENCY TEST # 16

Calc. JAMES date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

DOWN FOUR, DRY

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
26.2	18.5	33.7	27.2
23.7	17.6	33.1	25.8
25.7	15.5	35.8	24.1
27.9	17.7	35.	23.
24.9	17.1	34.1	25.4
25.3	15.0	35.5	26.2
28.3	17.8	35.5	22.9
25.3	16.9	35.	25.8
26.5	14.6	37.3	25.2
27.4	18.0	37.	25.3
25.6	16.7	34.7	25.6
25.9	16.0	35.4	25.7
25.6	18.7	34.6	24.7
25.3	16.7	35.1	25.8
25.0	15.6	35.	25.9
25.0	18.7	34.6	26.5
25.9	16.6	34.9	27.4

TOTAL 439.5 288.5 596.3 432.5

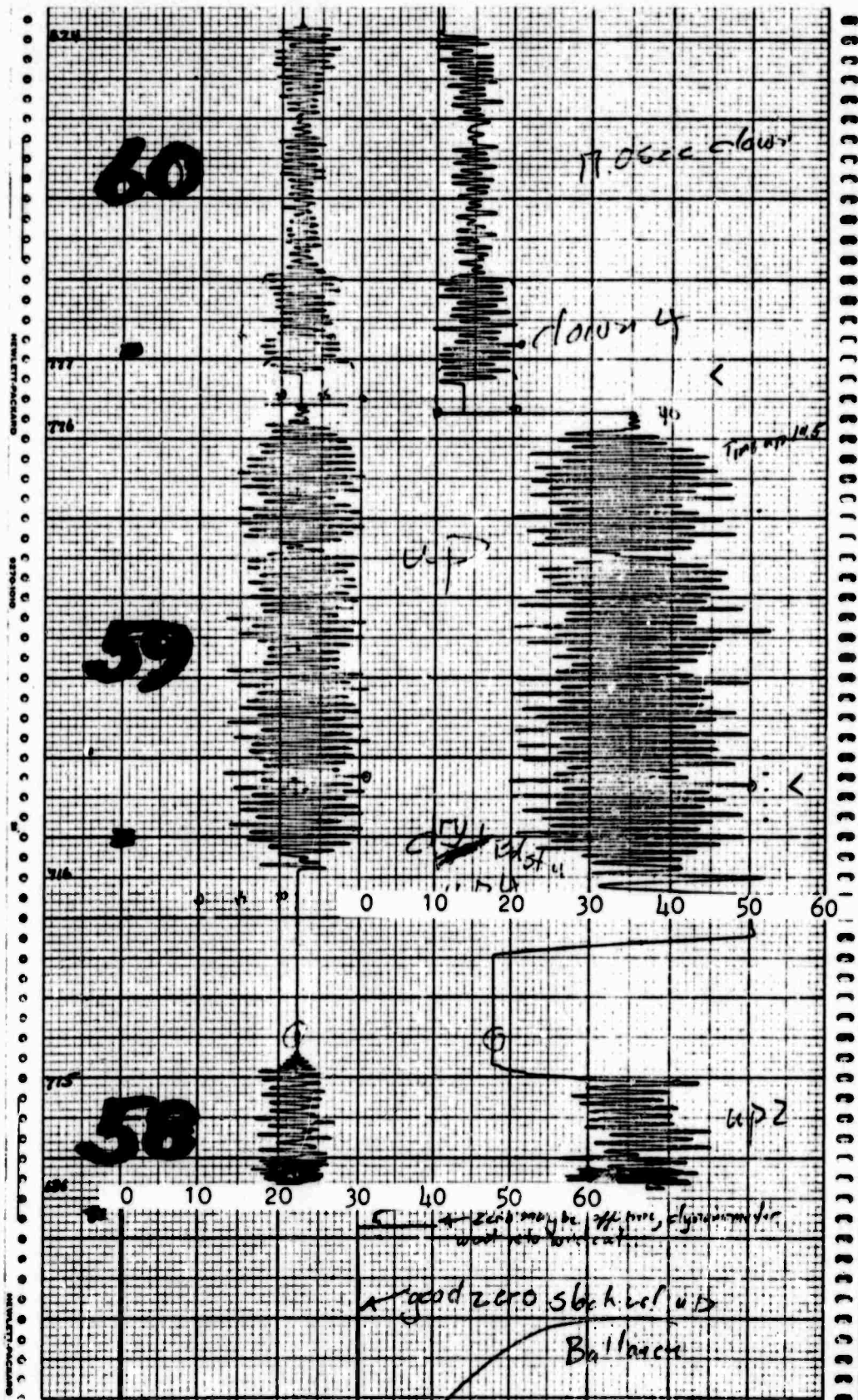
Ave. 25.8529 16.9106 35.0764 25.4411

MEAN 21.4117 30.2587

WILDCAT DRAG 1.3617

CORRECTED MEAN 22.7422

EOLSTER EFFICIENCY .7515



CALCULATION WORK SHEET

SHUTTLE COLUMBIAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject: BOLSTER EFFICIENCY TEST #59

Calc. J.M.E. date _____
 Chkd. J.M.E. date _____
 Sheet No. _____ of _____

UP FOUR, DRY

36.923 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
50.5	19.7	31.2	13.2
42.2	25.5	27.4	18.0
41.0	27.2	28.2	17.5
47.9	21.5	29.3	16.2
45.0	26.0	29.0	16.5
45.7	20.8	31.4	14.3
45.4	26.3	28.8	17.6
40.8	20.5	30.5	13.5
43.0	24.8	28.0	17.3
45.5	23.2	30.0	15.0
48.2	21.5	27.5	15.8
44.0	21.5	28.5	16.2
45.2	20.0	31.2	14.7
44.1	23.5	28.8	17.8
49.8	20.5	30.4	13.4
42.7	25.6	27.3	17.1
41.0	27.7	27.4	18.4

TOTAL 771.0 403.3 496.9 273.3

Ave. 45.3529 23.7235 29.2294 16.0764

MEAN 34.5382 22.6529

WILDCAT DRAG 1.7062

CORRECTED MEAN 32.8320

BOLSTER EFFICIENCY .6899

CALCULATION WORK SHEET

SHIPBOARD CORRECTION ENGINEERING SELF INSPECTION SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject: ROLLSTER EFFICIENCY TEST # 60

Calc. JAMIE date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

DOWN FOUR, DRY

42353 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
19.6	10.5	28.5	18.5
17.5	10.5	26.8	17.8
19.5	10.2	27.4	17.3
19.7	10.8	27.2	18.
21.2	12.3	26.2	19.4
18.	12.7	25.4	19.8
18.4	9.5	26.3	17.4
20.5	13.	25.8	19.8
16.9	11.6	25.6	19.1
19.6	11.9	26.7	19.1
17.8	12.5	25.2	19.
19.	10.1	27.2	18.3
18.6	11.	26.5	18.4
18.5	10.	26.8	18.
19.4	12.8		
.	.	.	.
.	.	.	.

TOTAL 284.2 169.4 371.6 259.9

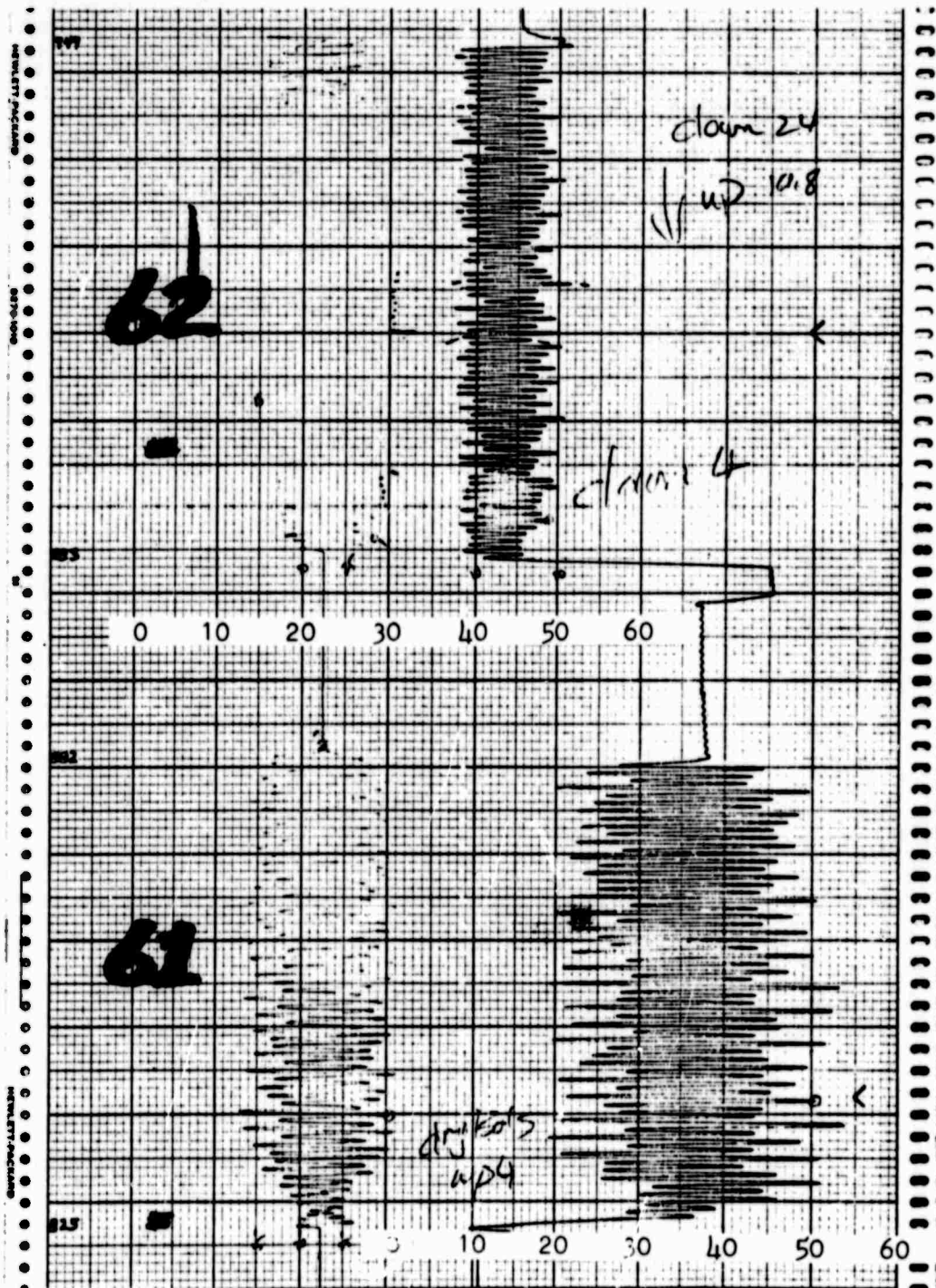
AVE. 18.9 11.29 26.5428 18.5642

MEAN 15.1183 22.5535

WINDCAT DRAG .9615
 0636

CORRECTED MEAN 16.0798

ROLLSTER EFFICIENCY .7129



CALCULATION WORK SHEET

SAFETY/COM ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORITOLAN ASR-22

Calc. JAMIE

date _____

Subject _____

Chkd. JAMIE

date _____

BOLSTER EFFICIENCY TEST # 61

Sheet No. _____

of _____

UP FOUR, DRY

36.364 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
20.4	21.4	30.4	13.0
44.4	20.4	27.0	17.4
45.2	27.3	29.7	16.3
44.6	28.5	25.7	15.3
47.0	27.0	28.1	17.0
46.0	24.5	31.0	17.7
44.4	26.7	27.8	18.5
51.6	27.0	27.2	14.7
43.5	27.5	28.1	16.9
46.3	22.0	27.6	18.6
46.0	27.2	27.0	14.5
52.4	21.0	27.1	18.7
47.5	27.3	27.0	14.8
47.3	27.8	27.2	17.4
47.0	27.0	27.0	13.5
47.0	28.0	27.0	18.0
47.4	27.0	27.0	17.0

TOTAL 798.0 415.4 491.0 273.3

Ave. 46.9412 24.4235 28.8223 16.0765

MEAN 35.6824 22.4773

WILDCAT DRAG 1.7627
0494

CORRECTED MEAN 33.9196

BOLSTER EFFICIENCY 0.6627

CALCULATION WORK SHEET

SHUTTLE COUN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject DRY EFFICIENCY TEST # 62

Calc. JAMES date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

DOWN FOUR DRY

30.0 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
16.7	8.2	27.7	15.9
20.1	8.8	29.2	17.4
17.3	7.7	28.	16.5
19.7	10.	27.	17.6
18.	7.3	29.2	16.7
18.1	10.8	28.2	18.7
17.	8.5	27.	17.5
17.5	8.	27.6	16.5
21.5	8.7	29.4	16.2
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

TOTAL 165.9 78. 253.3 153.0

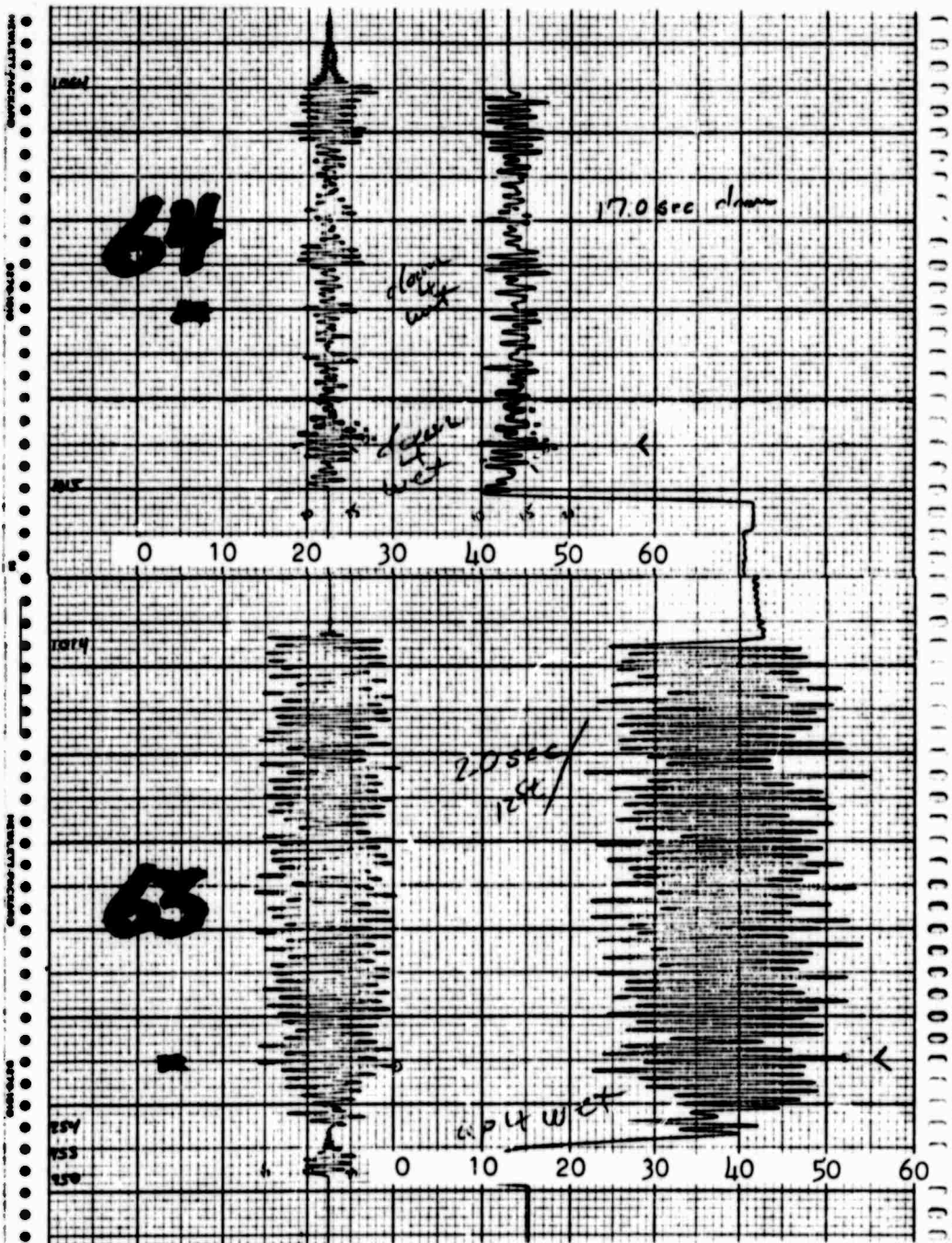
Ave. 18.4333 8.6666 28.1444 17.000

MEAN 13.5499 22.5722

WILDCAT DRAG 86177

CORRECTED MEAN 14.4116

BOLSTER EFFICIENCY .6385



SEATTLE CITY ENGINEERING DIVISION SECTION 6162E

date _____

date _____

of _____

36.0 FPM

B19

CALCULATION WORK SHEET

SHORELAND OF THE ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject _____

Chkd. JCS

date _____

WILDCAT EFFICIENCY TEST #64

Sheet No. _____

of _____

DOWN FOUR, WET

42.353 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
17.3	09.6	26.7	20.0
16.3	12.5	25.6	19.9
14.1	11.5	24.3	19.8
15.3	12.7	23.2	20.6
12.7	13.3	22.1	20.3
14.8	12.5	23.0	21.4
14.3	14.2	23.9	21.8
13.4	11.5	23.1	21.0
14.3	14.3	24.6	21.3
14.7	13.0	23.4	21.6
15.0	13.2	22.2	20.8
16.5	10.7	22.5	22.0
12.8	13.1	21.3	21.4
14.1	13.7	24.5	20.7
13.4	12.0	22.6	20.5
15.2	12.2	22.0	22.0
16.7	13.5	21.0	21.8

Total 258.7 213.0 385.8 355.9

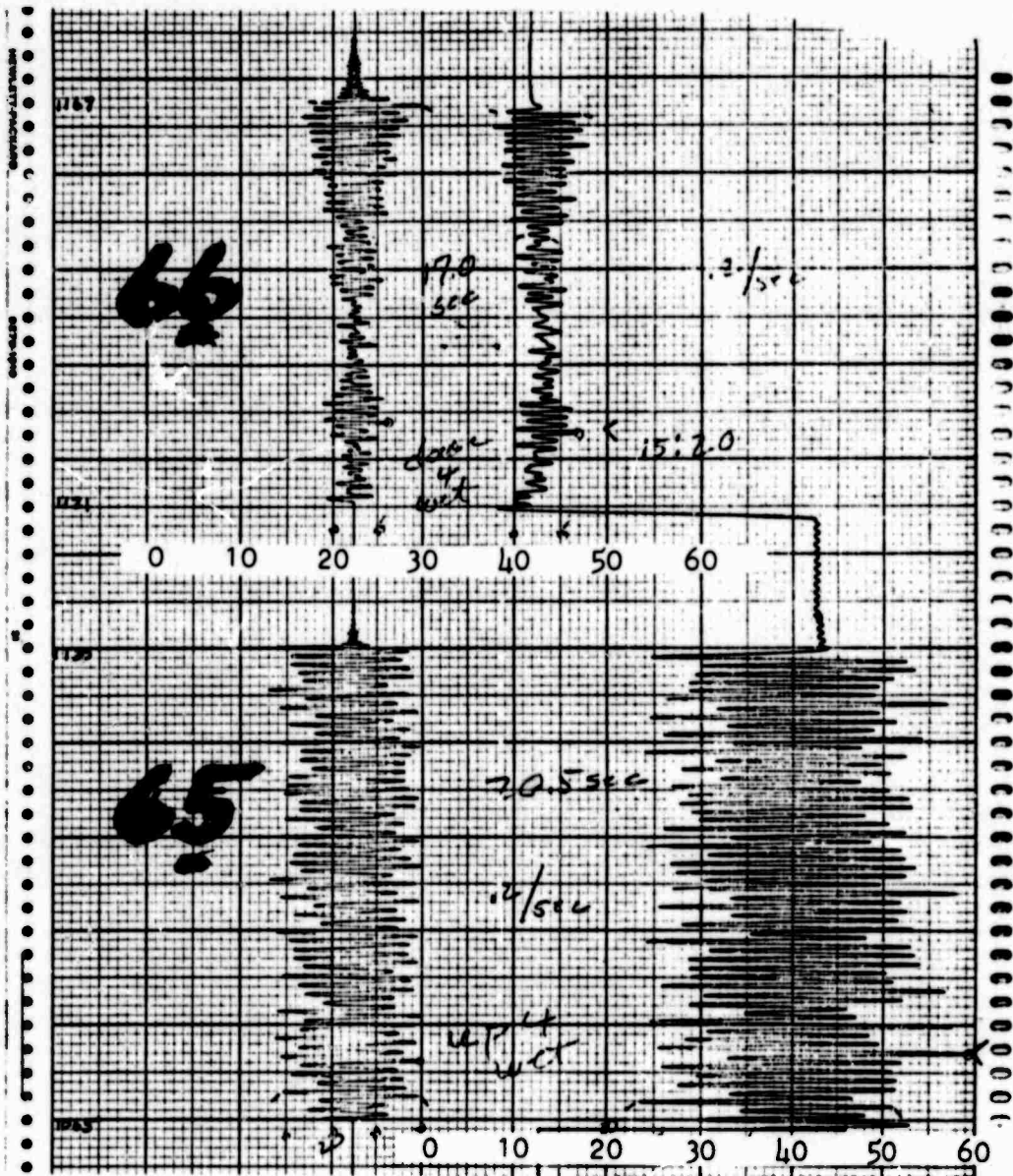
Ave. 15.2176 12.5294 22.6941 20.9353

MEAN: 13.8735 21.8146

WILDCAT DRAG 0.8023

CORRECTED MEAN 14.7558

BOLESTER EFFICIENCY 0.6764



CALCULATION WORK SHEET

NAVY ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE date _____

Subject BOOSTER EFFICIENCY TEST # 65

Chkd. JAMIE date _____

Sheet No. _____ of _____

UP FOUR, WET

35.122 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
51.1	23.5	29.8	14.6
46.7	33.	28.4	18.4
51.5	27.5	27.9	15.5
51.6	29.5	27.4	16.4
51.	25.7	29.9	14.4
52.	32.9	28.	16.4
59.7	25.3	29.4	13.7
49.5	28.2	27.5	16.4
48.5	30.5	29.3	17.
57.5	24.5	30.	14.
47.	34.8	27.1	19.
46.	28.8	27.	17.
52.1	30.2	29.3	16.3
56.7	25.8	28.9	14.5
51.1	29.	26.9	16.8
50.3	28.8	29.7	15.8
54.	28.6	28.6	15.8

Total 876.3 486.6 485.1 272.0

Ave. 51.5470 28.6235 28.5352 16.000

MEAN 40.0852 22.2676

WINDCAT DRAIS 1.9802
0.0494

CORRECTED MEAN 38.1049

BOOSTER EFFICIENCY .5843

CALCULATION WORK SHEET

NAVY AND ARMY ENGINEERING BUREAU SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject: BOULSTER EFFICIENCY TEST # 66

Calc. JAMIE date _____
 Chkd. JAMIE date _____
 Sheet No. _____ of _____

DOWN FOUR, WET

42.353 F.P.M.

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
17.2	8.7	30.	18.6
16.6	9.8	27.6	17.9
17.4	7.7	28.5	16.7
16.4	9.	27.4	17.3
18.	8.6	27.6	17.4
16.	8.9	26.7	17.5
16.5	9.8	26.4	18.4
15.5	8.5	27.2	17.7
15.7	10.2	26.	18.7
15.6	8.8	27.2	17.8
14.6	10.	25.7	19.
16.7	10.	25.4	19.4
14.9	9.9	25.8	19.1
15.9	10.7	25.8	19.3
15.2	9.5	26.1	18.9
13.8	11.3	23.3	20.2
13.9	11.4	24.	20.8

TOTAL 269.9 162.8 450.7 314.7

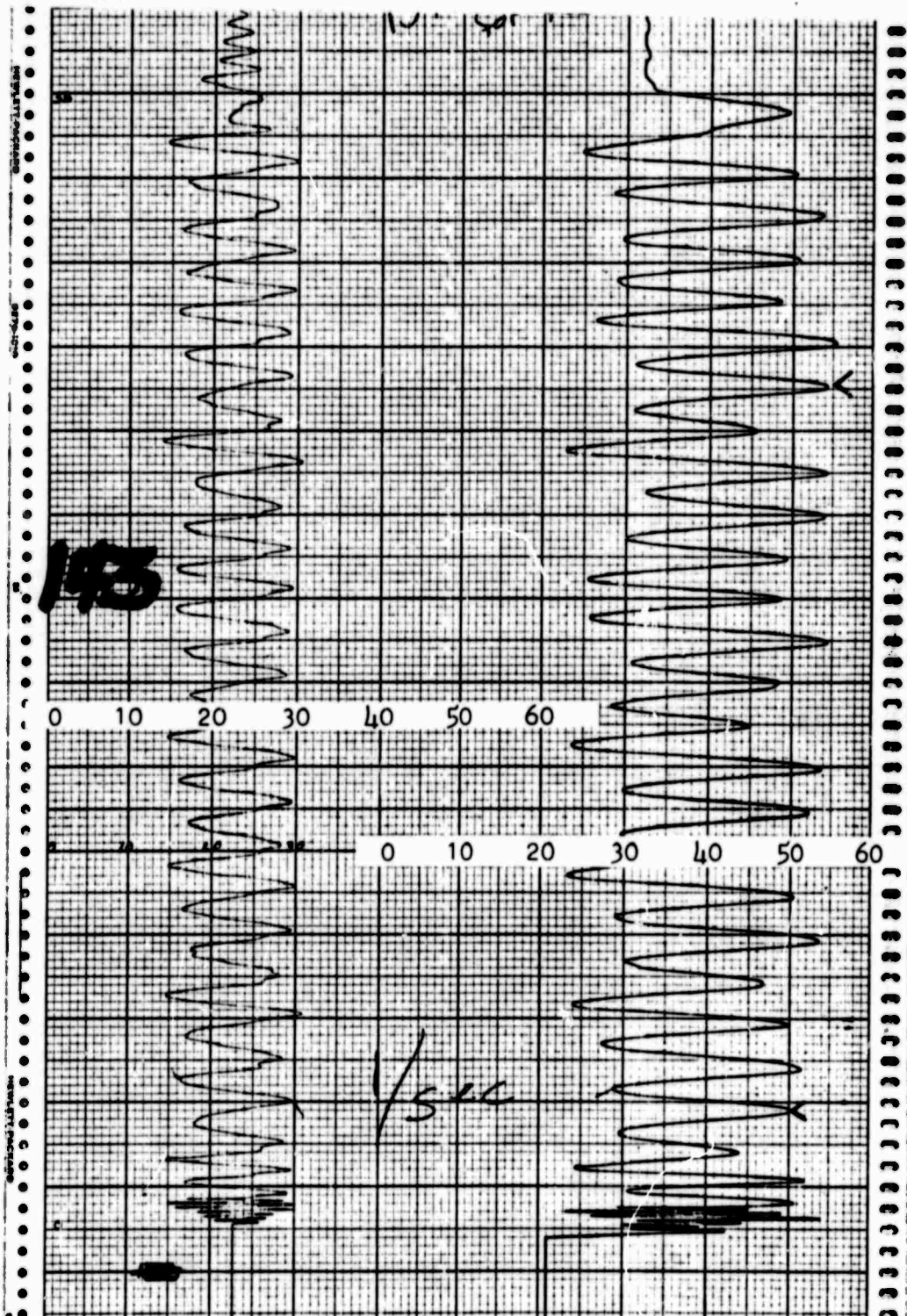
AVG. 15.8765 9.5765 26.5117 18.5117

MEAN 12.7265 22.5117

WILDCAT DRAG .8094
.0636

CORRECTED MEAN 13.5359

BOULSTER EFFICIENCY .60128



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 143
UP DRY

Calc. JAMIE date _____
 Chkd. _____ date _____
 Sheet No. _____ of _____
34.8 RPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
50.2	28.7	29.6	16.5
51.5	27.3	28.4	17.
49.8	23.9	30.8	14.7
46.7	30.2	28.1	17.5
53.6	23.9	29.5	16.5
50.4	23.3	30.	14.9
44.5	29.6	28.2	17.2
52.2	29.7	29.5	16.1
53.8	23.5	29.8	14.7
45.	28.3	29.1	17.2
43.5	30.8	28.7	16.6
54.5	25.8	29.1	15.7
48.6	25.5	29.5	15.7
50.1	30.	29.1	16.5
51.	32.3	28.	17.9
44.4	22.9	30.6	14.
45.6	30.9	28.	18.

TOTAL 852.7 471.8 406.0 270.8

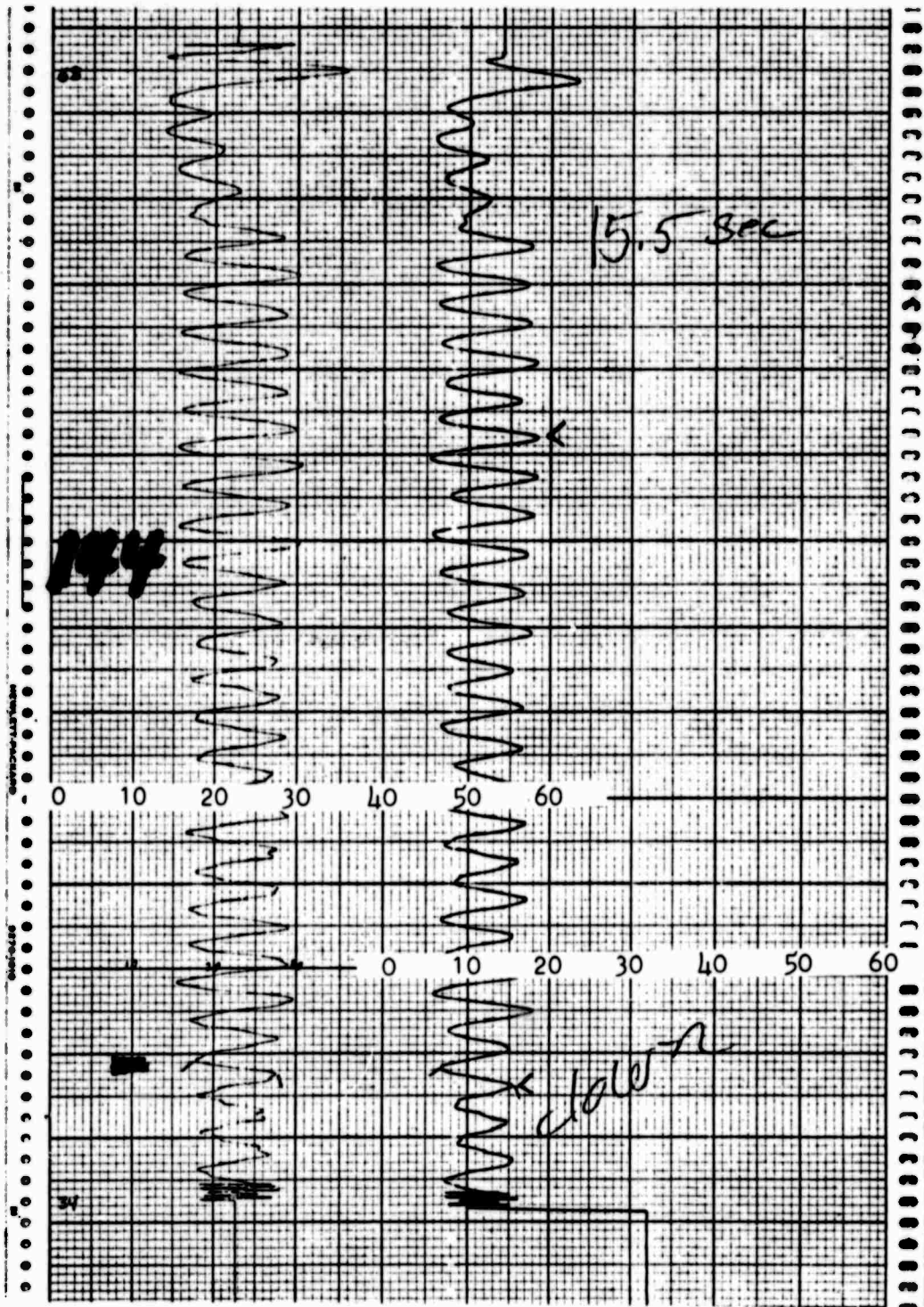
Ave. 50.1588 27.7529 29.1765 16.2823

MEAN 38.9558 22.7294

WILDCAT DRAG 5.0565
1298

CORRECTED MEAN 33.8972

BOLSTER EFFICIENCY 0.6705
 B25'



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 144
DOWN DRY

Calc. JAMIE date _____
 Chkd. SC date _____
 Sheet No. _____ of _____
34.8 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
15.4	6.8	27.5	17.8
15.1	7.7	27.8	17.1
17.9	6.9	29.7	15.5
18.2	7.	29.	16.9
15.4	6.8	29.1	16.9
17.3	8.4	27.7	17.7
16.1	7.2	27.5	16.5
17.	7.	29.	18.
16.5	8.3	27.	17.9
17.6	6.8	28.5	17.5
17.6	7.6	27.8	17.2
15.3	7.5	27.5	17.8
17.7	7.5	28.1	17.2
16.7	6.6	28.5	16.1
17.2	5.7	30.3	15.6
17.9	7.9	29.	16.
18.4	5.4	30.6	15.5

Total 281.3 121.1 484.6 287.2

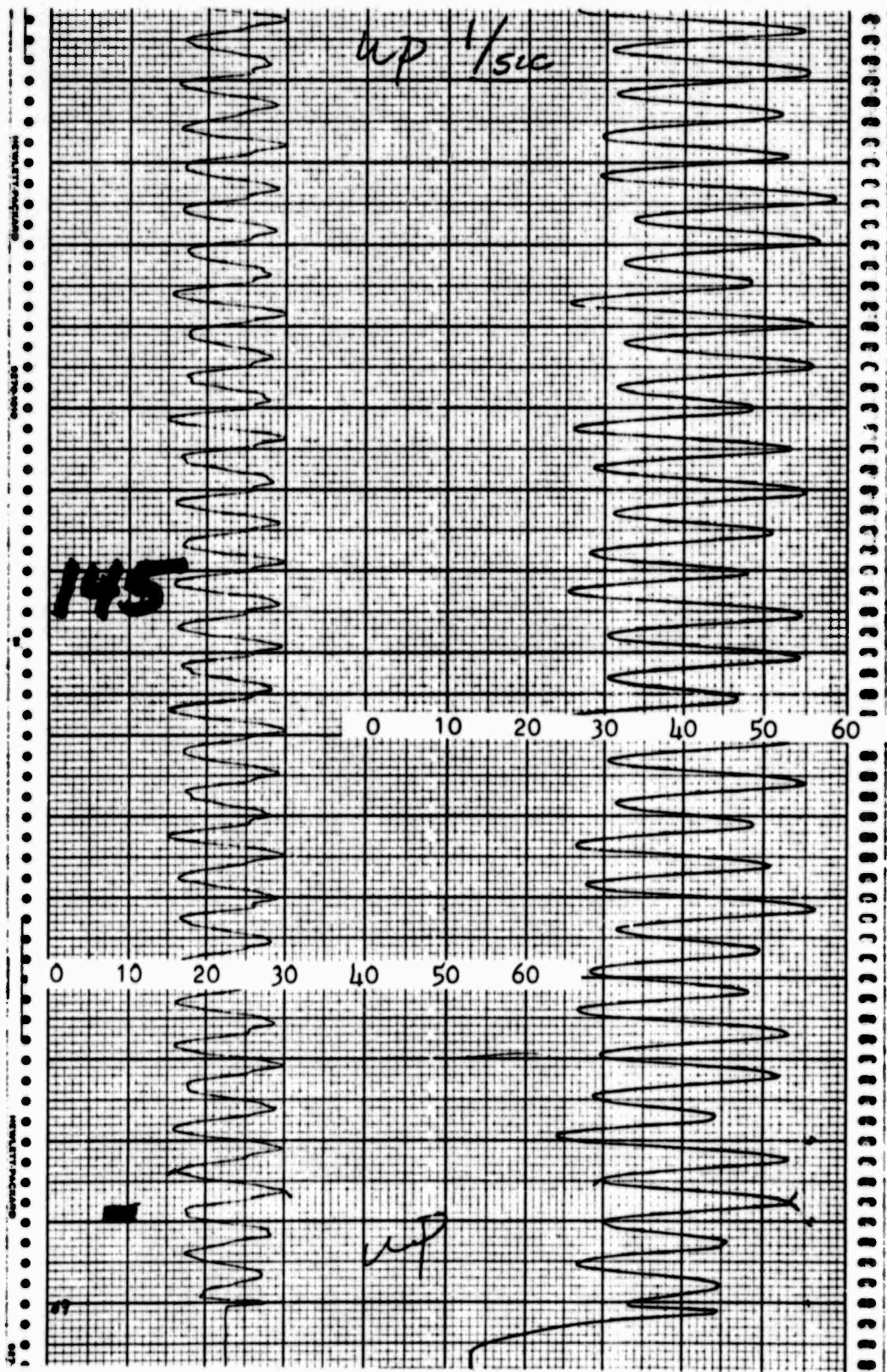
Ave. 16.9000 7.1235 28.5059 16.8941

MEAN 12.0117 22.7000

WILDCAT DRAG 1.9903
165"

CORRECTED MEAN 14.0020

BOLSTER EFFICIENCY .6168
 B2T°



CALCULATION WORK SHEET

SHIPBOARD COAL ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 145
UP DRY

Calc. JAMIE date _____
 Chkd. JS date _____
 Sheet No. _____ of _____
35.4 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
33.3	29.9	30.	16.3
53.1	23.9	29.9	15.8
44.2	28.6	28.8	17.6
51.9	29.5	29.9	15.9
33.	26.8	28.8	16.
48.2	28.3	29.5	16.1
49.7	31.6	28.2	16.5
56.2	27.8	29.	16.1
50.9	26.4	29.8	15.
48.7	31.4	28.	17.3
54.9	30.3	29.1	16.
53.	23.9	30.	15.1
46.4	30.3	28.2	16.8
54.3	30.4	29.6	16.3
54.5	25.3	29.1	15.8
48.	28.1	30.	16.9
51.	31.	29.2	15.

Total 871.6 483.5 497.1 274.8

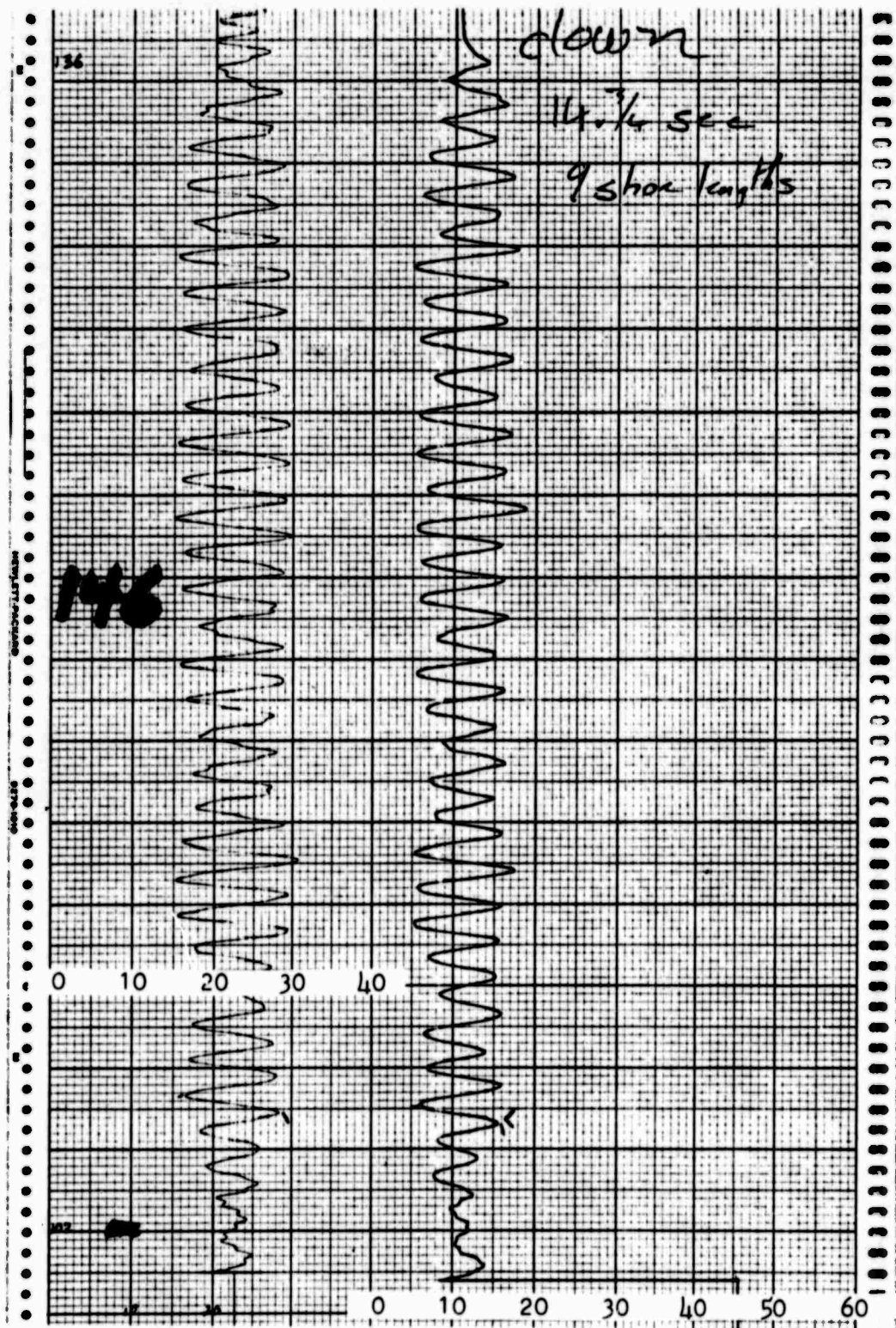
Ave. 51.2706 28.4412 29.2412 16.1647

MEAN 39.8557 22.7029

WILDCAT DRAG 5.1733
.1298

CORRECTED MEAN 34.6826

BOLSTER EFFICIENCY 0.6546
 B29



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject BOLSTER EFFICIENCY TEST # 146

Calc. JAMIE date _____
 Chkd. JCS date _____
 Sheet No. _____ of _____

DOWN DRY

36.6 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
15.5	6.3	28.4	16.5
15.9	7.	28.	17.
14.	6.5	27.5	17.4
15.9	8.5	26.4	18.6
15.3	7.	27.3	17.6
15.6	5.4	29.4	15.4
15.8	5.8	29.5	15.3
17.5	5.3	30.8	16.1
15.9	7.8	28.9	17.8
14.8	7.2	27.2	17.4
16.2	8.5	27.9	18.1
15.1	6.8	27.5	16.5
16.1	5.5	28.7	16.8
15.	8.	28.8	18.
16.5	5.9	27.7	15.9
16.1	6.1	28.8	16.3
15.7	5.6	29.8	15.

Total 266.9 113.2 482.6 285.7

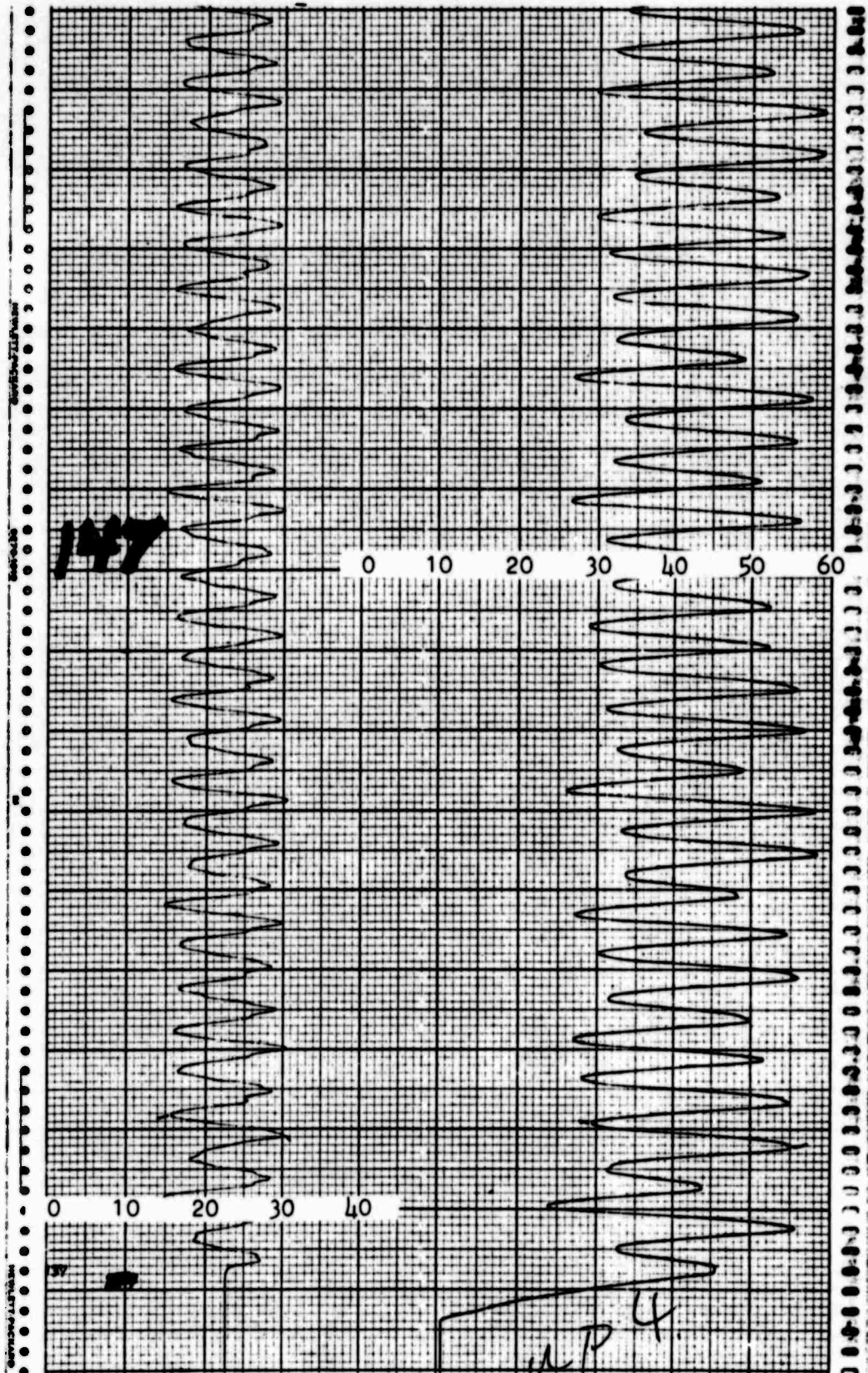
Ave. 15.7000 6.6588 28.3282 16.8059

MEAN 11.1794 22.5970

WILDCAT DRAG 1.8524

CORRECTED MEAN 13.0318

BOLSTER EFFICIENCY .5767
 B31°



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject BOLSTER EFFICIENCY TEST # 147

Chkd. JAMIE

date _____

Sheet No. _____ of _____

UP FOUR DRY

34.8 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
55.	29.5	30.2	15.7
54.9	28.	28.6	16.5
51.6	27.	30.5	16.
30.	31.5	29.1	16.6
55.9	30.1	28.5	16.7
54.6	27.2	29.9	14.9
48.4	33.6	28.3	17.8
58.3	33.1	29.4	17.2
58.	26.	30.6	15.7
49.	32.5	28.5	17.5
56.7	31.1	29.6	15.6
55.8	30.1	28.7	16.7
52.2	28.9	29.7	16.3
52.3	31.9	28.9	16.6
55.5	31.	28.2	16.8
36.1	26.5	30.1	15.
51.	31.9	28.7	16.4

Total 915.3 509.9 490.3 278.2

Ave. 53.8411 29.9941 28.8411 16.3647

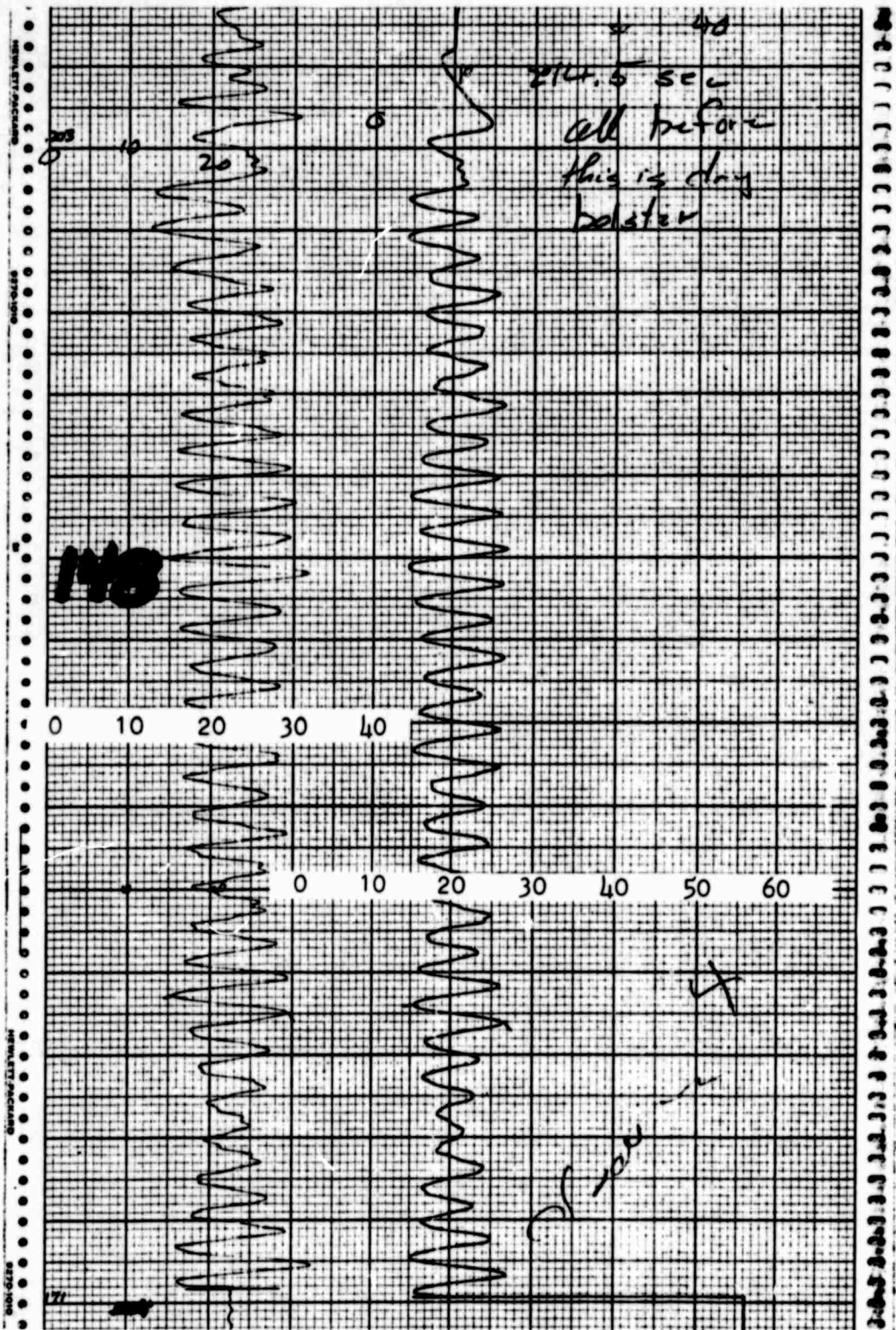
MEAN 41.9176 22.6029

WINDCAT DRAS 5.4409
.1298

CORRECTED MEAN 36.4767

BOLSTER EFFICIENCY 0.6196

B33"



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE date _____

Subject _____

Chkd. JCS date _____

BOLSTER EFFICIENCY TEST # 148

Sheet No. _____ of _____

DOWN FOUR, DRY

37.24 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
16.4	5.5	29.4	15.7
16.	6.	29.5	16.9
13.4	7.1	28.1	17.7
14.9	7.4	26.8	17.7
13.5	5.9	26.7	17.2
14.6	6.3	29.3	18.
14.1	7.4	26.9	16.7
15.8	5.2	28.2	16.3
15.9	6.1	28.3	16.9
13.6	6.5	28.5	17.5
16.4	6.2	27.7	16.3
15.	5.4	28.4	16.4
16.3	4.5	31.7	15.
16.7	5.9	29.6	16.5
16.2	4.8	30.2	15.9
15.7	6.2	29.5	15.9
14.2	6.7	28.4	16.3

Total 258.7 103.6 487.7 282.9

Ave. 15.2176 6.0941 28.6882 16.6411

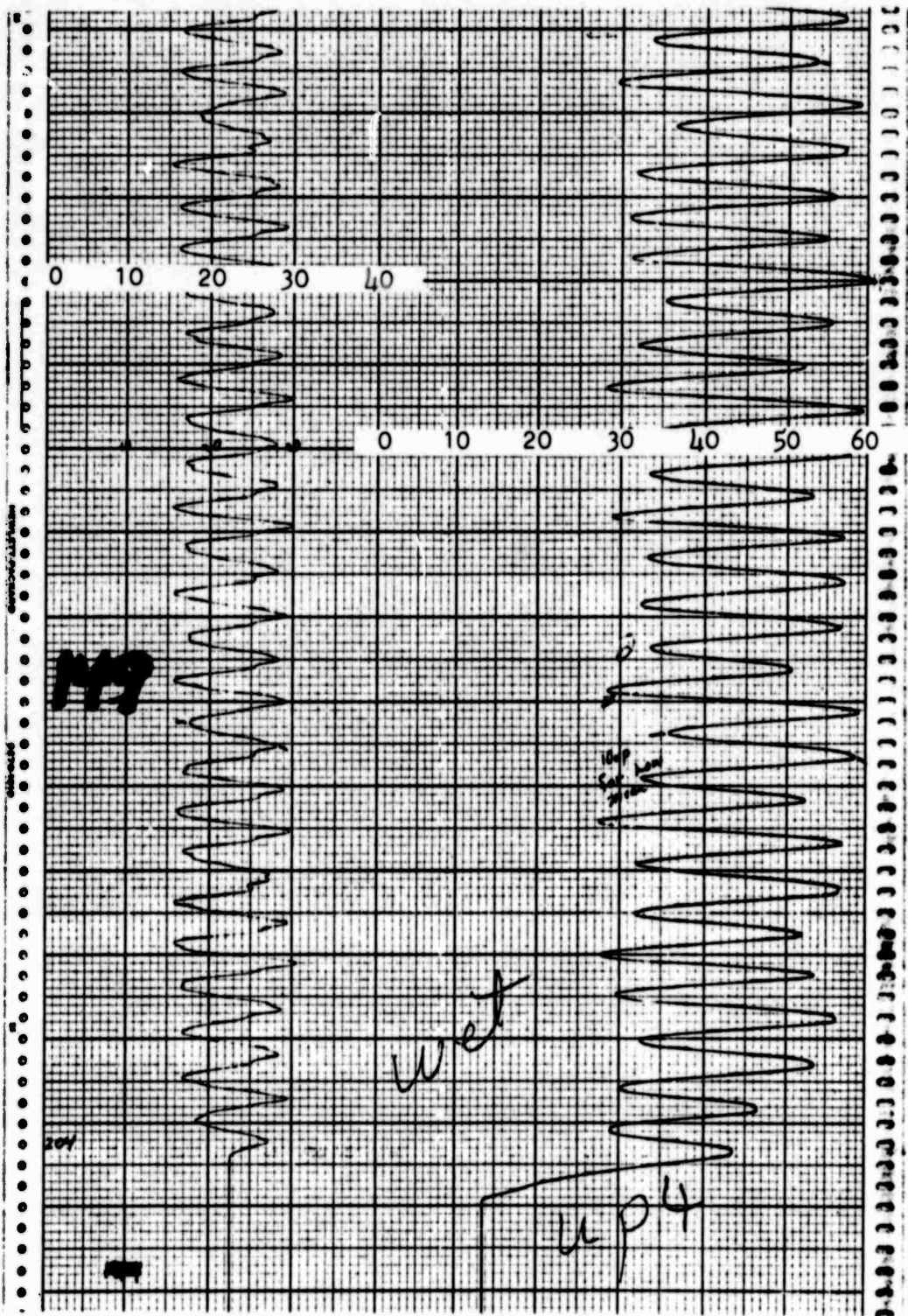
MEAN 10.6558 22.6646

WILDCAT DRAG 1.7656

CORRECTED MEAN 12.4214

BOLSTER EFFICIENCY .5481

B35'



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Subject BOLSTER EFFICIENCY TEST # 149

UP FOUR, WET

Calc. JAMIE date _____

Chkd. JCS date _____

Sheet No. _____ of _____

33.75 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
58.7	35.8	28.1	17.5
59.1	28.4	29.2	15.7
50.5	33.8	28.3	17.4
56.8	32.5	29.3	15.8
57.2	33.3	28.2	17.1
57.2	29.	30.	15.7
53.2	33.6	28.1	17.2
57.8	34.7	28.	17.1
59.6	28.3	30.	16.
52.1	32.1	28.5	17.
55.6	35.3	27.6	17.
61.5	31.3	29.	16.3
55.	31.	29.2	16.4
55.9	31.9	28.1	15.5
57.3	36.6	27.	18.5
59.1	29.5	28.8	16.4
53.6	33.7	28.3	16.8

Total 960.2 550.8 485.7 283.4

Ave. 56.4823 32.4000 28.5705 16.6705

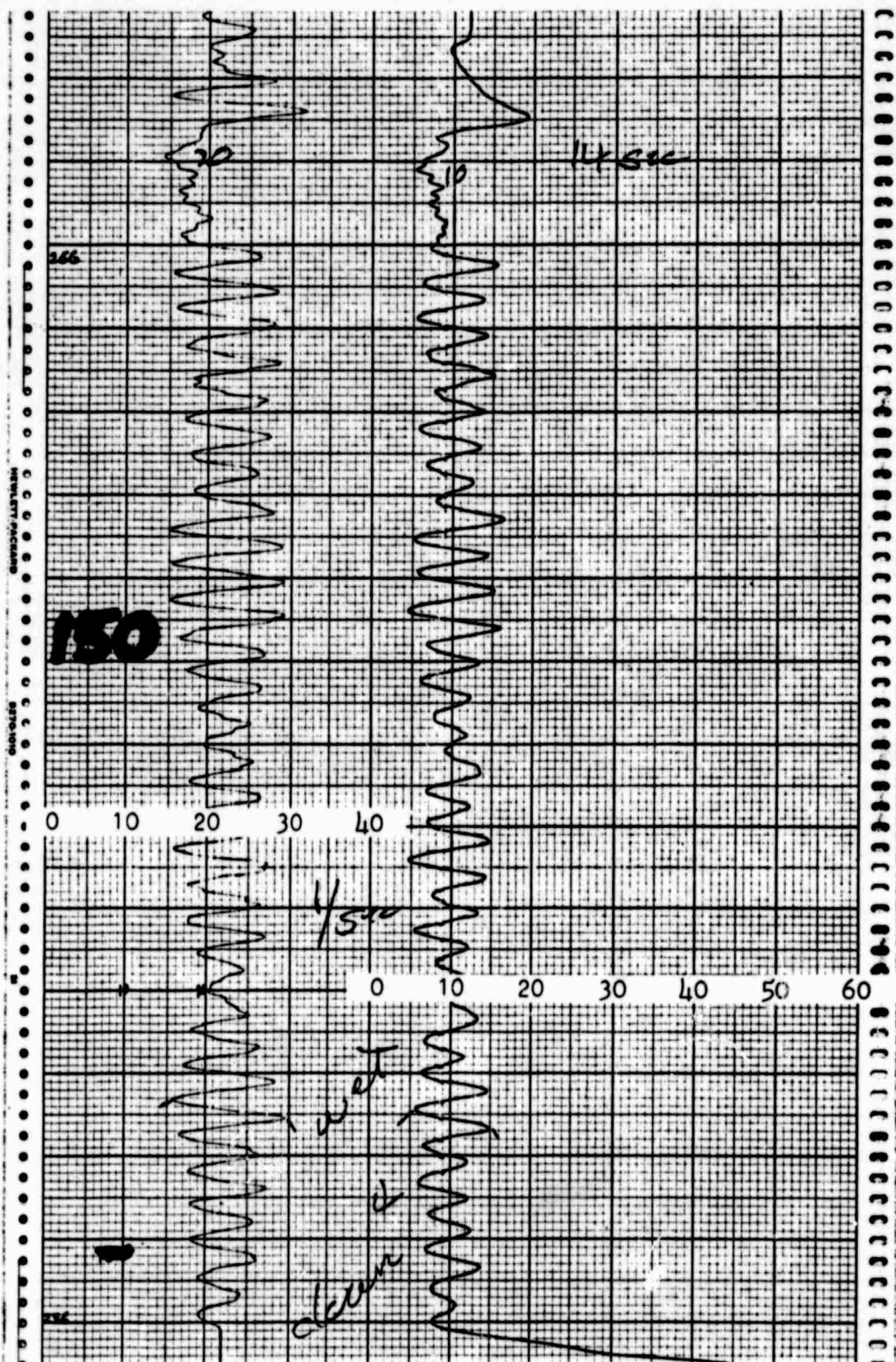
MEAN 44.4415 22.6205

WILDCAT DRAG 5.7684
1298

CORRECTED MEAN 38.673

BOLSTER EFFICIENCY 0.5849

B37"



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject BOLSTER EFFICIENCY TEST # 150

Chkd. _____

date _____

Sheet No. _____

of _____

DOWN FOUR WET

38.57 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
15.	5.6	29.5	15.9
14.6	6.4	28.1	17.0
11.7	6.6	26.3	18.1
13.4	9.4	25.1	20.3
12.	8.0	24.6	18.8
12.2	5.3	26.8	17.5
13.4	7.5	26.4	17.4
14.3	4.6	27.1	15.6
14.7	6.8	28.7	17.1
12.2	6.7	26.3	17.6
13.6	9.0	25.5	19.6
12.	7.7	25.1	18.8
12.4	6.0	26.3	17.3
13.5	7.7	26.7	16.4
16.	4.4	29.1	15.2
15.3	5.4	29.0	15.3
14.4	5.2	28.8	15.0

Total 230.9 112.3 432.6 292.9

Ave. 13.5823 6.6059 25.4471 17.2294

MEAN 10.0941 21.3382

+ WINDCAT DRAG 6726
1657

CORRECTED MEAN 1.7667

BOLSTER EFFICIENCY .5514
B39'

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. STAFFE

date _____

Subject _____

Chkd. JCS

date _____

WET EFFICIENCY TEST # 151

Sheet No. _____

of _____

UP FOUR WET

31.76 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
.	37.5	27.1	16.9
.	37.6	27.7	17.
.	34.9	28.1	15.9
.	33.3	28.4	15.4
.	36.4	26.9	15.6
.	38.6	24.	16.9
.	34.2	28.3	15.
.	36.1	28.1	16.4
.	34.4	28.	15.
.	37.7	25.9	17.
.	30.5	28.	15.2
.	35.7	27.1	16.1
.	39.	27.8	16.5
.	34.1	27.8	16.
.	32.9	28.7	15.4
.	36.2	27.	15.5
.	42.4	26.5	17.5

Total _____ 613.5 _____ 468.6 _____ 273.3

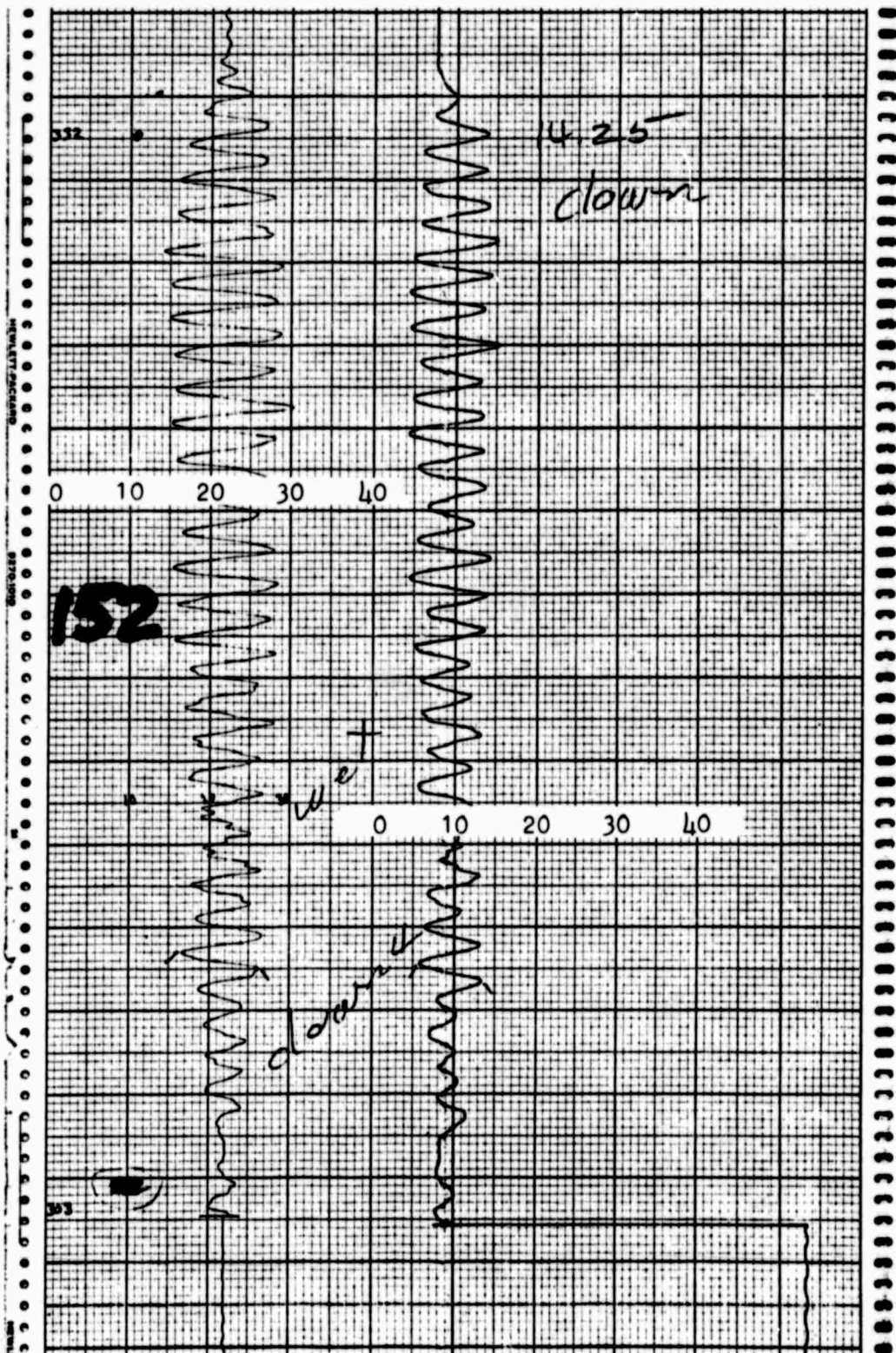
Ave. 58.65 _____ 36.0882 _____ 27.5647 _____ 16.0764

MEAN _____ 47.3691 _____ 21.8205

— WILDCAT DRAG 6.1485

CORRECTED MEAN _____ 41.2205

BOLSTER EFFICIENCY _____ .5294



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 0102E

U.S.S. ORTOLAN ASR-22

Subject

DOWN FOUR, WFT

Calc. JAMIE

date

Chkd. JCS

date

Sheet No.

of

DOWN FOUR, WFT

37.89 FPM

IN LINE TENSIONOMETER

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
13.4	5.7	26.3	16.5
13.2	6.3	26.6	18.3
10.8	6.7	25.2	17.8
13.1	8.2	26.4	19.1
11.	7.3	25.2	18.9
12.3	5.5	26.7	17.4
12.1	6.6	26.3	17.9
13.3	6.	28.	16.9
12.	5.8	26.	17.6
11.8	5.2	28.1	15.7
13.7	6.6	27.6	16.
14.	4.4	28.4	15.5
14.4	5.4	28.	16.6
12.3	6.7	26.1	18.
13.7	5.5	26.9	15.9
13.5	4.3	28.1	15.3
13.4	4.9	30.4	15.8

Total 218.0 101.1 460.3 289.2

Ave. 12.8235 5.947 27.0764 17.0117

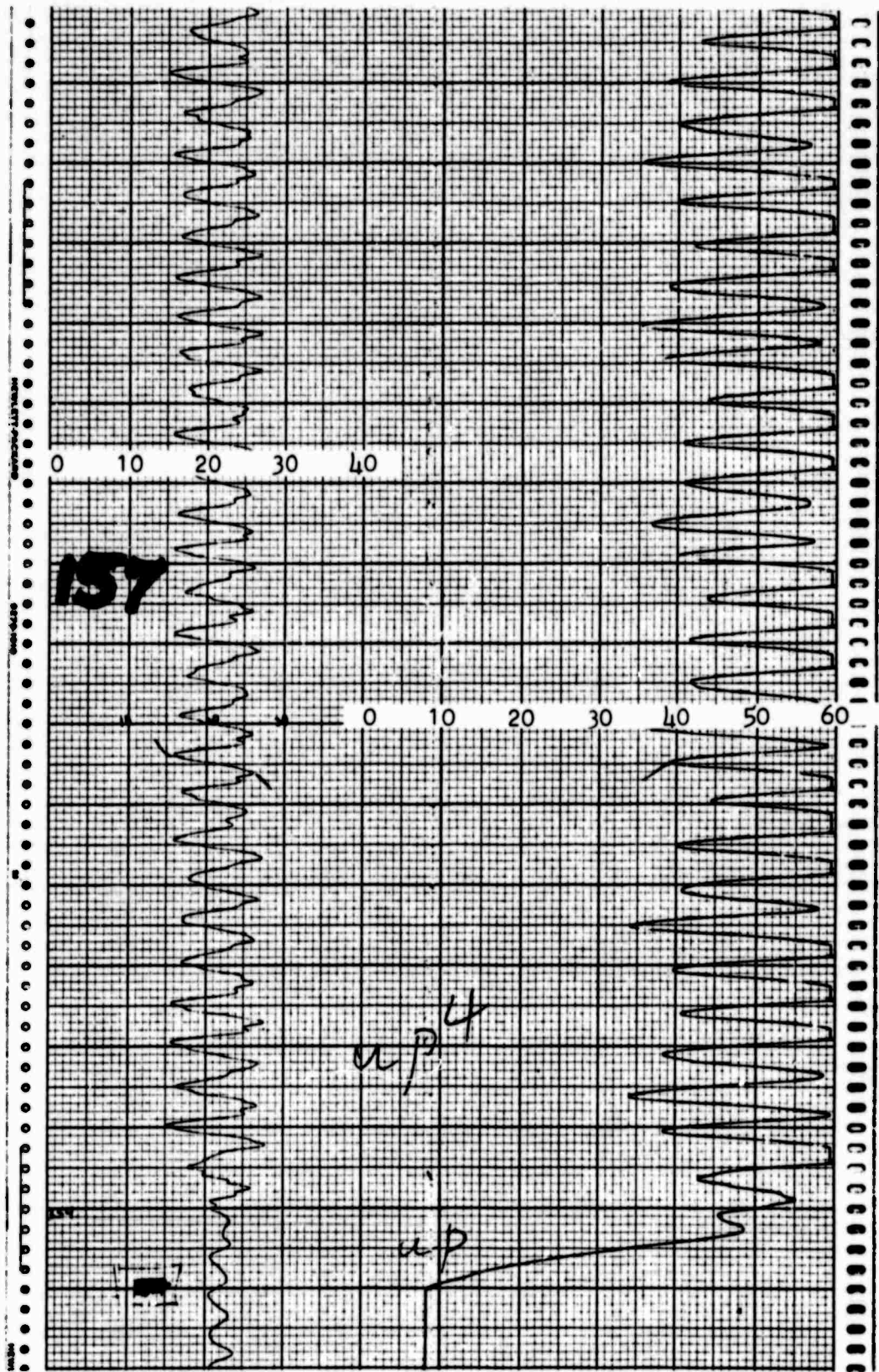
MEAN 9.3852 22.0441

WILDCAT DRAG 1.5551

CORRECTED MEAN 10.9403

BOLSTER EFFICIENCY .4962

B43"



CALCULATION WORK SHEET

SHINDO AND CO. INC. ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject REGISTERED EFFICIENCY TEST # 157

Chkd. JCS

date _____

Sheet No. _____

of _____

UP FOUR WET

27 F.P.M

IN LINE TENSIONOMETER.

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
.	39.2	26.1	16.
.	35.5	26.1	16.6
.	41.8	25.4	17.5
.	41.2	26.8	16.
.	44.	26.	17.2
.	40.	26.3	15.9
.	36.7	25.9	16.3
.	41.	25.6	16.3
.	40.7	26.6	15.8
.	44.	25.3	17.5
.	38.	27.	16.4
.	35.3	27.	16.3
.	38.9	27.	16.
.	42.2	27.	16.8
.	40.	26.6	16.9
.	35.5	26.1	15.8
.	40.	25.5	16.9

Total _____ 674.5 _____ 446.3 _____ 280.2

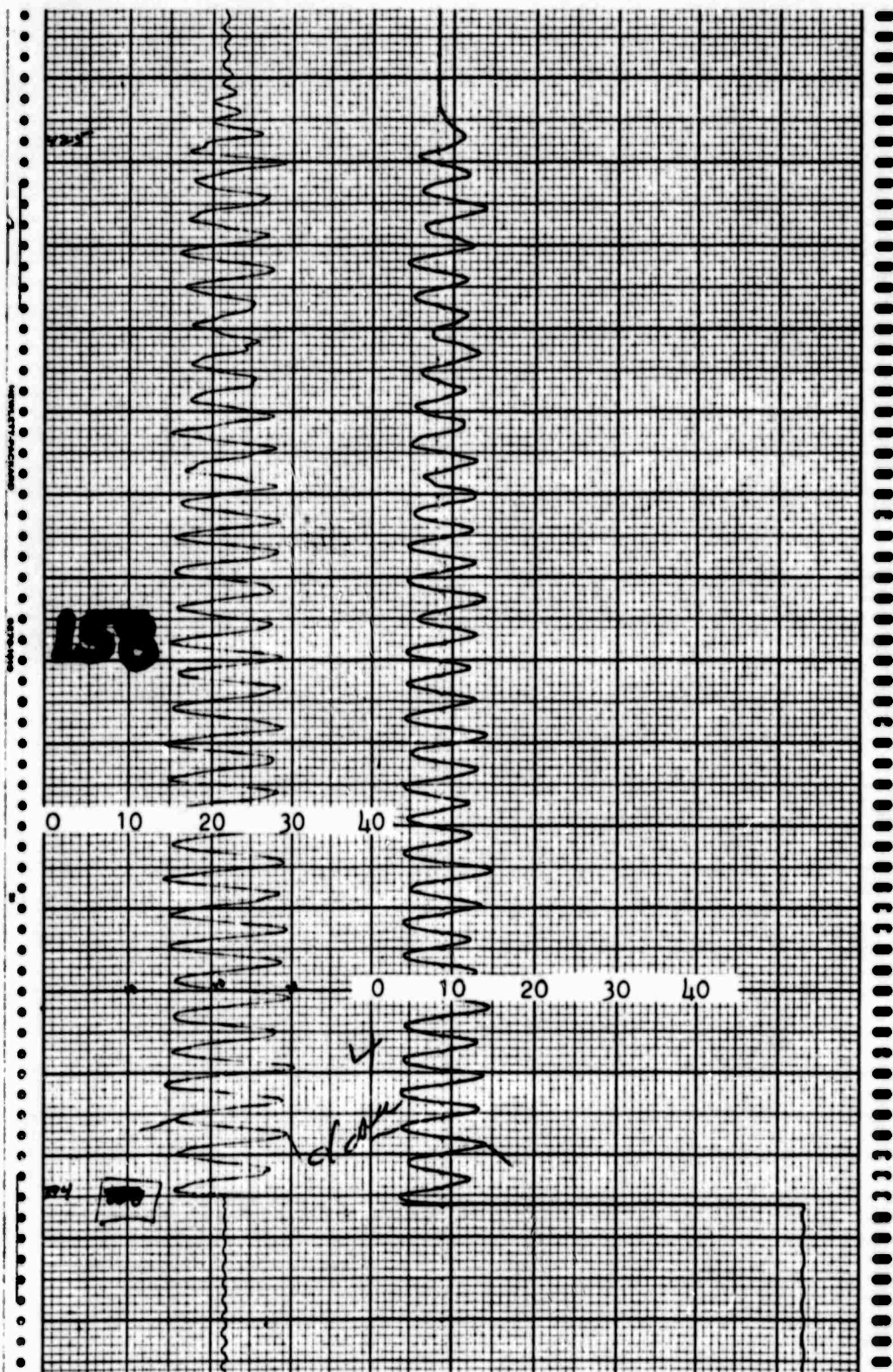
Ave. 60.3200 39.6765 26.2329 16.4823

MEAN 49.9982 21.3676

WILDCAT DRAG 6.4891
1295

CORRECTED MEAN 43.5084

BULSTER EFFICIENCY .4911



CALCULATION WORK SHEET

SAFEDARD COLLEGE ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject _____

Chkd. JCS

date _____

WILDCAT EFFICIENCY TEST # 158

Sheet No. _____

of _____

DOWN FOUR WET

IN LINE TENSIONOMETER

HIGH	LOW
14.3	4.
13.4	3.9
14.	4.3
13.2	4.4
14.6	4.5
13.1	4.3
12.3	4.2
13.7	5.
5.	4.2
12.3	4.7
12.1	4.4
13.1	5.1
14.2	4.3
12.9	4.5
12.1	4.5
13.	5.9
14.	4.6

TEST LOAD TENSIONOMETER

HIGH	LOW
29.5	15.8
29.	14.5
30.4	15.3
28.	15.5
29.8	15.6
28.7	15.
29.4	15.
28.4	14.3
29.	15.2
27.	16.
28.1	15.
27.5	14.5
28.9	15.3
28.4	16.
28.6	15.1
27.5	15.8
27.6	15.5

TOTAL 227.3 76.8 485.8 259.4

Ave. 13.3706 4.5176 28.5765 15.2588

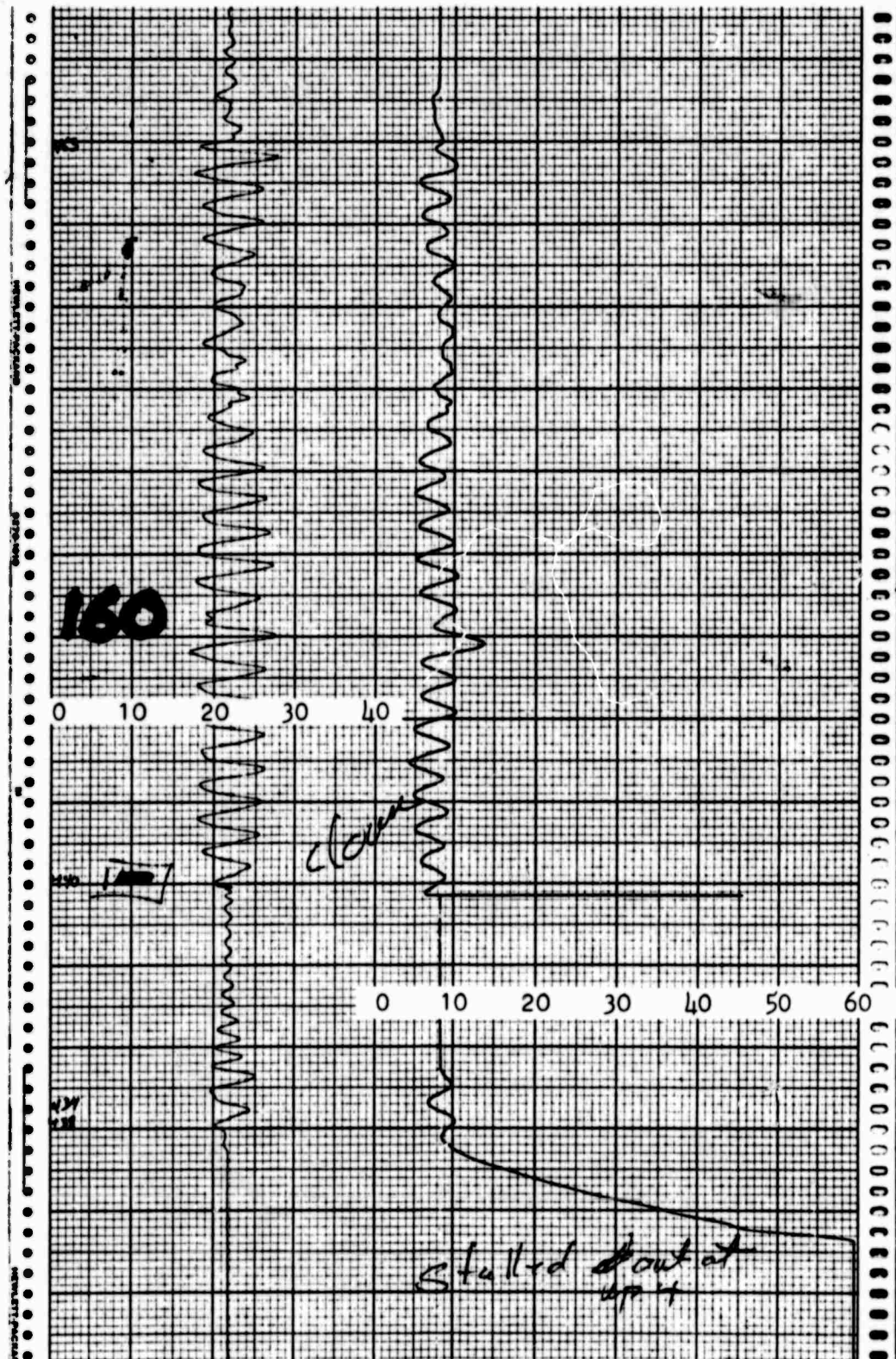
MEAN 8.9441 21.9176

WILDCAT DRAG 1.4820

CORRECTED MEAN 10.4261

BOBSTER EFFICIENCY .4756

B47.



CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject _____

Chkd. _____

date _____

BOLSTER EFFICIENCY TEST #160

Sheet No. _____

of _____

DOWN WET

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
9.	5.7	24.3	18.6
8.9	5.	25.5	18.
9.3	4.8	25.6	18.2
8.7	4.2	26.	18.4
9.5	4.9	26.	17.8
10.3	5.6	26.3	17.9
10.2	5.8	26.	17.
13.8	7.3	27.4	19.
10.4	5.7	25.5	17.8
10.5	5.1	27.1	18.
10.	5.4	26.8	18.5
9.4	4.9	26.2	18.
8.8	5.4	26.	18.5
9.5	6.4	24.6	19.2
9.7	7.2	24.1	19.6
.	.	.	.
.	.	.	.

TOTAL 148.0 83.1 387.4 274.5

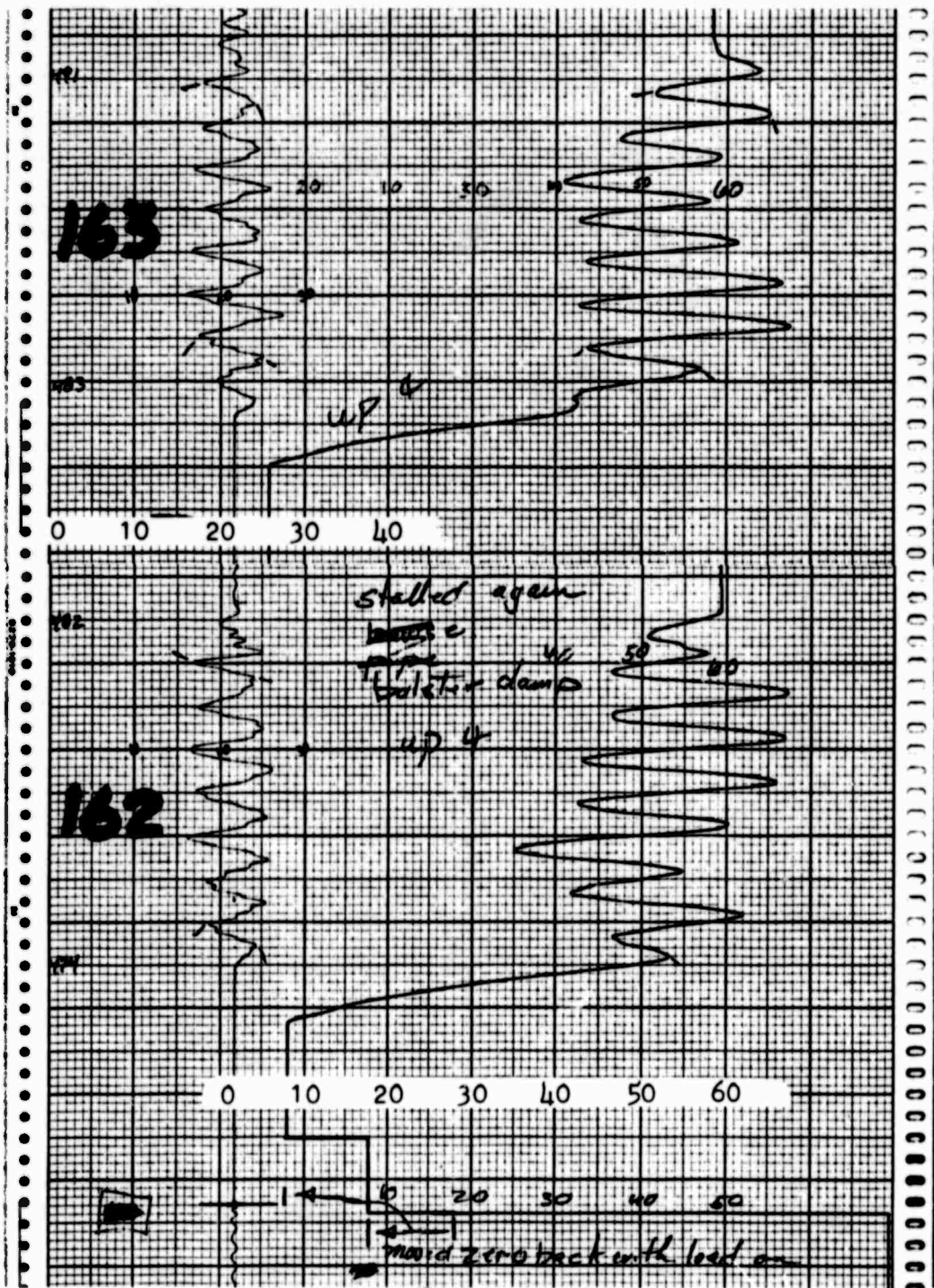
Ave. 9.8666 5.5400 25.8266 18.3000

MEAN 7.7033 22.0633

WILDCAT DRAG 12766
16573

CORRECTED MEAN 8.9779

BOLSTER EFFICIENCY 40%



CALCULATION WORK SHEET

NAVY/NAVY ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22
 Subject MOISTURE EFFICIENCY TEST # 152

Calc. SAH date _____
 Chkd. JOE date _____
 Sheet No. _____ of _____

UP FOUR DAMP - STALL

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
53.2	46.7	24.4	18.7
52.	41.8	25.6	18.4
54.8	45.	25.8	16.2
60.2	42.5	25.7	17.1
63.	43.1	26.3	16.6
57.	46.6	25.1	17.4
67.5	46.5	24.	16.9
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

TOTAL 430.7 302.2 176.9 121.3

Ave. 61.5286 43.1714 25.274 17.3285

MEAN 52.3500 21.2999

WINDCAT DRAG 6.7950
.1295

CORRECTED MEAN 45.5549

BOLSTER EFFICIENCY .4675

CALCULATION WORK SHEET

SOUTHWEST COAST GUARDIAN AND ELSTON'S SECTION 6162E

U.S.S. ORTOLAN ASR-22Calc. JAMIE

date _____

Subject _____

Chkd. JCS

date _____

BOLSTER EFFICIENCY TEST # 163

Sheet No. _____

of _____

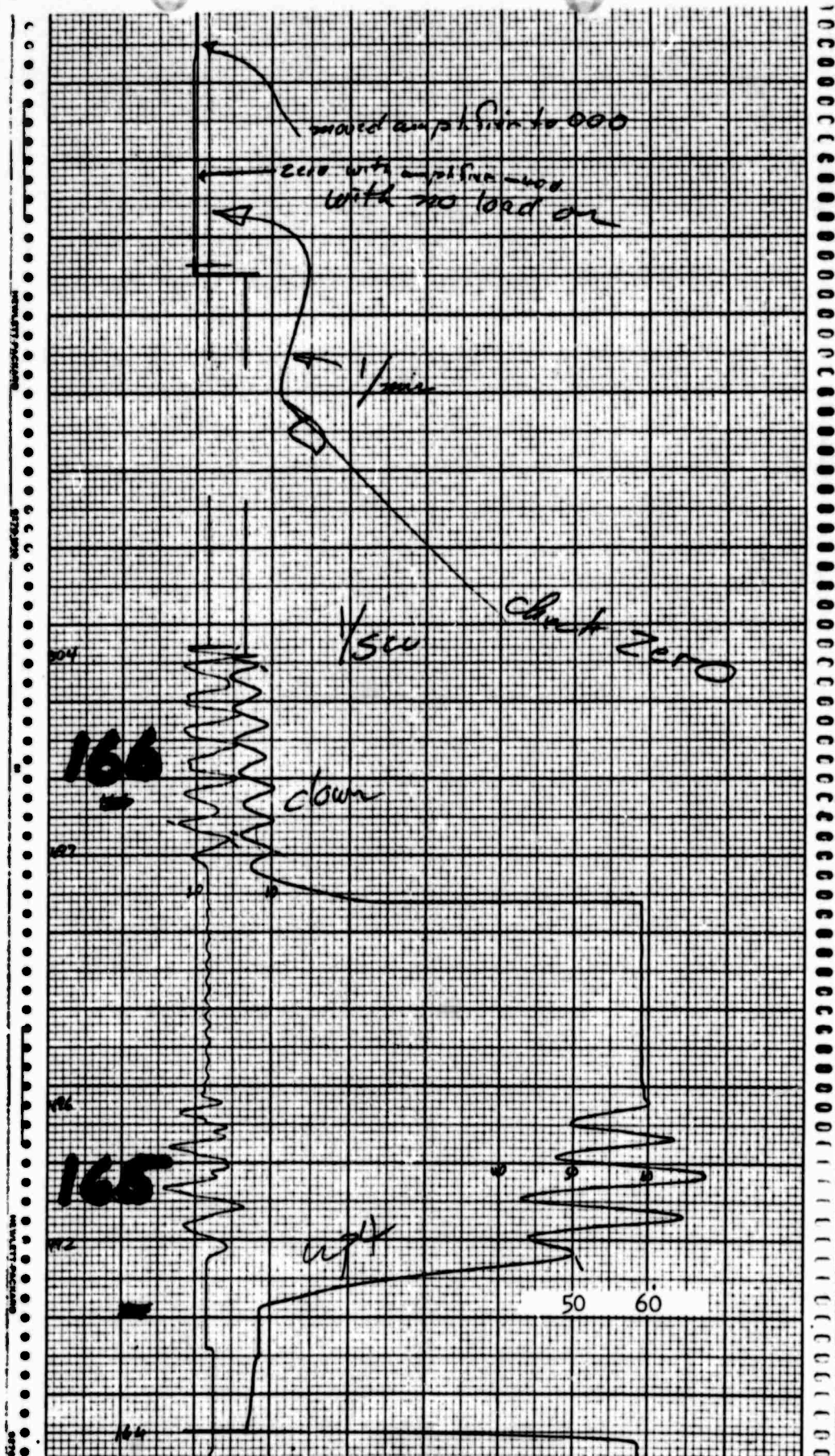
UP FOUR DAMP - STALL

IN LINE TENSIONOMETER.

TEST LOAD TENSIONOMETER

HIGH	LOW	HIGH	LOW
57.	43.7	25.1	17.5
67.7	42.7	27.5	16.1
66.8	43.5	25.1	16.8
61.4	42.7	24.7	18.
58.	40.9	26.	17.
59.3	47.4	24.6	17.9
65.2	51.4	24.	18.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

Total 435.4 312.3 177.0 121.3Ave. 62.2 44.6143 25.2857 17.3285MEAN 53.4071 21.3071WILDCAT DRAG 6.9322
1298CORRECTED MEAN 46.4748BOLSTER EFFICIENCY .4584



CALCULATION WORK SHEET

SAFETY SYSTEMS DIVISION SECTION 6162B

U.S.S. ORTOLAN ASR-22

Calc. JAMIE

date _____

Subject

Chkd. JCS

date _____

COLSTER EFFICIENCY TEST # 166

Sheet No. _____

of _____

DOWN

DAMP

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
10.1	6.	24.5	17.5
10.2	6.3	23.	18.3
10.2	5.7	25.5	18.9
9.3	5.	25.5	18.3
9.2	4.9	26.	18.5
8.6	4.5	25.4	18.3
8.1	4.9	25.4	18.9
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

TOTAL 66.0 37.3 175.3 128.8

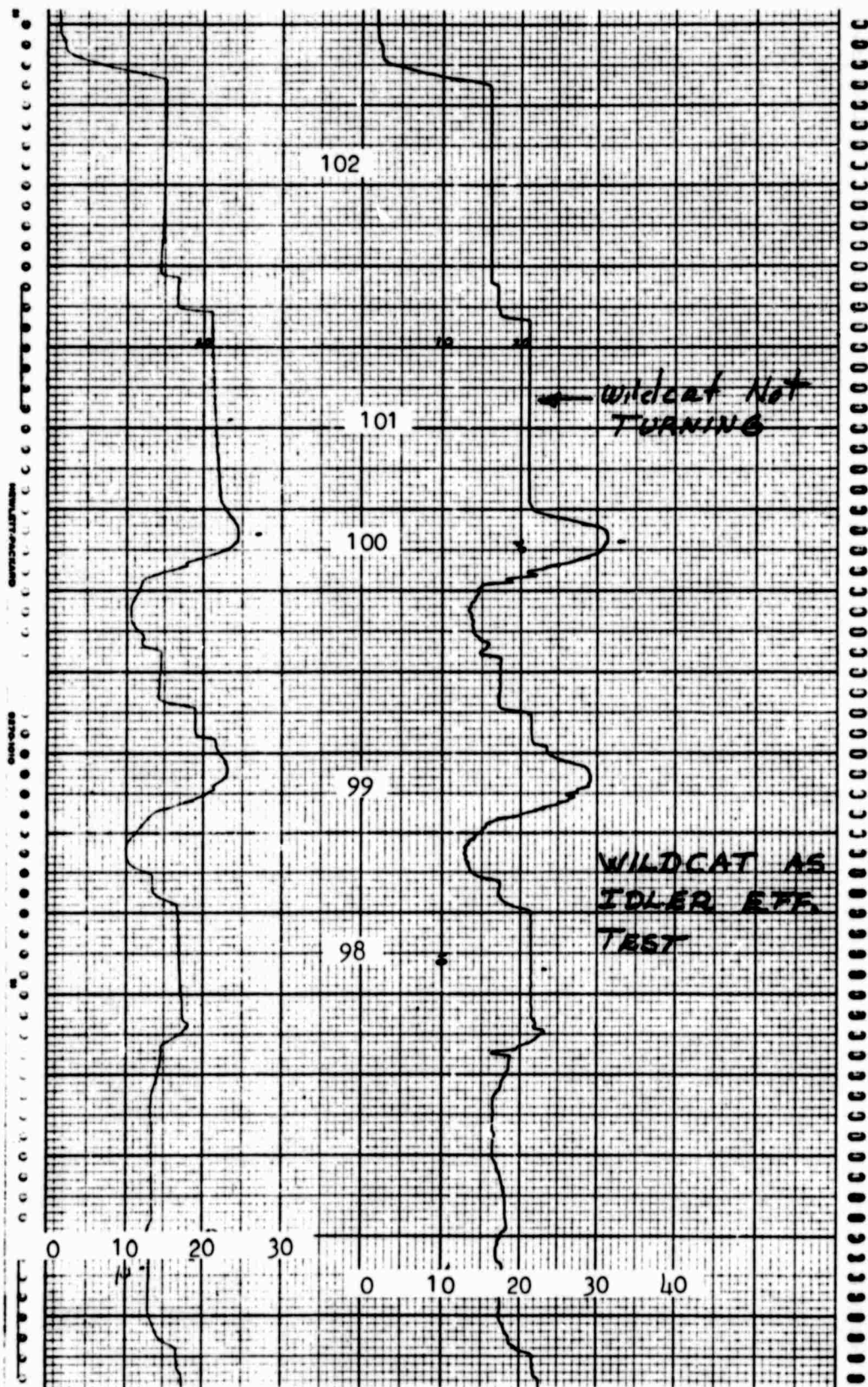
Ave. 9.4285 5.3285 25.0428 18.4000

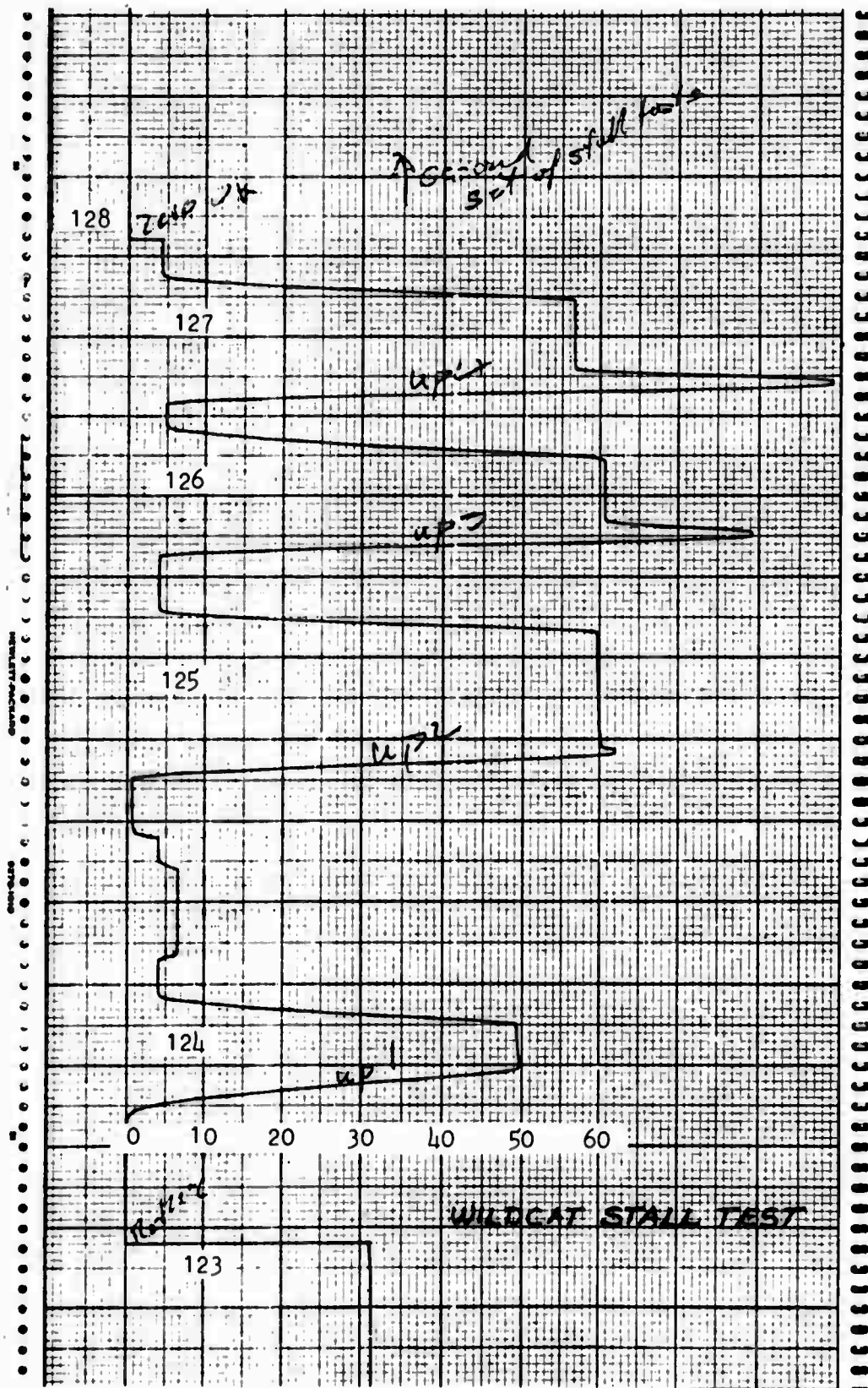
MEAN 7.3785 21.7214

WINDCAT DRAG 1.2226

CORRECTED MEAN 8.6011

COLSTER EFFICIENCY 39.59





APPENDIX C
ANCHOR WINDLASS TEST
DATA AND
CALCULATIONS

PORT ANCHOR WINDLASS
ASR 22 windlass test at PNSY
while in drydock

TIME	PUMP DISCH.	PUMP SUCTION	TEMP °C	REPLN
1330	1000	300	27	322
1338	3500	300	28	320
1341	1150	280	28	315
1355	1000	300	34	310
1358	3550	300	34	310
1400	3700	290	34	280
1406	1650	300	36	325
1408	3600	300	37	290
1409	1700	298	37	325
1415	1070	270	38	288
1418	3600	305	38	290
1419	3800	280	39	270
1420	1550	280	39	355
1421	3600	270	39	290
1438	3500	280	41	290
1439	3650	300	42	310
1445	3600	290	42	290
1447	1000	300	42	290
1450	SECURED		42	
1511				280
1513	3300	250	44	270
1515	3500	250	44	290
1516	1500	250	44	270
1518	3500	200	44	330
1520	1300	250	44	345
1521	1300	300	45	
1526	1300	300	46	305
1530	SECURED		46	

PORT FWD WINDLASS

1256	2500	295	28	300
1308	700	300	27.5	360
1315	1350	290	28	330

TIME	PUMP DISCH.	PUMP SUCTION	TEMP °C	REPLIN
1326	975	700	29.5	340
1350	1850	280	29	330
1357	3500	260	30	320
1403	1000	350	32.5	310
1407	3500	250	33	320

STALL TESTS

1435	3600	250	32	310
1447	3650	250	33.5	310
1450	3650	250	34.5	300
1503	1200	275	35	310
1510	950	300	36	300
1517	950	300	36	300
1527	950	300	37	300
1600	1000	290	38	300
1602	1100	300	39	340
1603	1300	290	39	300
1610	1200	300	39	350
1611	1500	300	39	300
1615	1000	300	41	700
1617	2000	310	41	310
1618	1000	220	42	300
1619	1200	250	42	300
1630	1200	300	40	290
1640	700	300	42	290
1645	1200	225	41	300
1655	1500	300	44	300
1660	1000	225	45	285
1705	1500	290	45	290
1715	1000	300	45	290

CALCULATION OF HORSEPOWER REQUIREMENTS

$$1. \text{ Hydraulic Motor Horsepower (HP}_H\text{)} = \frac{\text{Load on Wildcat (L}_w\text{)} \times \text{Wildcat Velocity}}{33000 \times .85 \text{ (Gearbox eff)}} = \frac{L_w \times 24}{33000 \times .85} = .00085 L_w$$

$$2. \text{ Electric Motor Horsepower (HP}_E\text{)} = \frac{\text{HP}_H}{\text{Hydraulic Transmission Eff}} = \frac{\text{HP}_H}{.75}$$

Load on Wilcat L _w	Hydraulic Mot. HP _H	Electric Mot. HP _E
45,000	38.5	51.4
50,000	42.7	57.0
60,000	51.4	68.5
70,000	60.0	80.0
80,000	68.4	91.0
90,000	77.0	102.5
100,000	85.5	114.0

CALCULATION OF WILDCAT LOADS

$$\text{Load on Wildcat (L}_w\text{)} = \frac{\text{Load outside bolster}}{\text{Bolster Eff}}$$

Load Before Bolster	Efficiency of Bolster				
	65%	60%	55%	50%	45%
25,000	38,200	41,600	45,500	50,000	55,500
30,000	46,200	50,000	54,600	60,000	67,000
35,000	53,900	58,400	63,600	70,000	78,000
40,000	61,160	66,600	72,700	80,000	89,000
45,000	69,400	75,000	82,000	90,000	100,000
50,000	77,000	83,500	91,000	100,000	111,000
55,000	84,600	91,800	100,000	110,000	122,000
60,000	92,000	100,000	109,000	120,000	133,000

PIGEON (ASR 21) TEST CONDUCTED ON 17 OCT 1974

PORT ANCHOR WINDLESS TEST

TIME (Mins)	PUMP PSIG	AMPS	MOTOR SUMP (Temp)
03	285/250	28	120
05	310/300	27	120
10	325/450	26	118
15	325/600	26	118
20	225/350	26	124
25	320/800	29	125
30	315/950	28	128
35	310/900	32	131
40	310/1050	31	131
45	270/250	26	135
50	250/2000	39 (1)	135
55	240/2100	71 (2)	136
60	230/2400	66 (3)	139
65	230/2200	76	142
70	230/2100	68	145
75	235/1800	60	150
80	230/1600	54	---
85	235/1250	46	156
90	235/950	38	157
95	245/750	30	159

NOTE: (1) Surge to 74
 (2) Surge to 80
 (3) Surge to 83

USS PIGEON (ASR-21)

7 October 1974
San Diego, Calif.

ANCHOR WINDLASS TEST

TIME	PUMP PSIG	DISCH °F	IP K	CASING OF	MOTOR AMPS	REPLEN PSIG	REMARKS	STRAIN from 0
1800	250/125	80		80	24	325	Idle	
1815	250/125	83		86	24	320	Idle	
1820	250/125	86		88	27	280	Start Out	+2
1825	175/200	87	/92	86	25	330	"	+3
1830	190/380	90	/92	86	24	355	"	+4
1835	180/750	98	/97	86	24	350	"	+4-5
1840	187/850	97	/104	88	26	340	"	+4-5
1845	100/2000	98	/107	88	24	260	Stop	+5
1850	125/190	96	/110	88	24	275	Idle	+5
1855	125/185	98	/110	89	24	275	Idle	+5
1900	125/187	98	/112	90	38	280	In Haul	+5
1905	125/187	99	/112	90	24	280	Idle	+5
1907	100/2000	101	0/113	90	65	260	Inhaul	+5
1910	100/1800	105	0/113	91	60	260	"	+5
1915	100/1700	107	4/116	94	56	255	"	+6
1920	187/1600	106	5/123	99	44	270	"	+5
1925	125/1500	106	5/124	95	30	270	"	+6
1930	125/1500	108	7/125	95	32	255	"	+7
1935	197/1300	113	9/127	96	44	250	"	+7
1940	187/1000	114	1/130	97	35	250	Motor RPM Oscil. with ca link, Idle	+7-8

7 October 1974
San Diego, Calif.

TIME	PUMP PSIG	DISCH F	SUMP TANK F	CASING MOTOR °F	AMES	REPLEN PSIG	REMARKS	STRAIN from 0
1945	125/250	111	112/134	97	24	255	Idle	+8
1950	125/175 at housing	111	113/134	97	24	280	"	+6
1954	125/1500	112	114/135	97	26	265	Housing	+8

* Immersion thermometer installed in sump tank

Pressure 700mm previous to idle
to 1000

USS PIGEON (ASR-21)

8 October 1974
San Diego, Calif.

PORT ANCHOR WINDLASS TEST

TIME	PUMP PSIG	°F	SUMP °F	MOTOR °F	REPL PSIG	MOTOR AMPS	
1045	125/150	126	120(148)	98	275	24	Lower (Power)
1050	125/375	128	122(148)	98	295	24	Lower (Power)
1055	125/375	128	123(148)	99	295	24	" "
1100	125/650	128	124(149)	94	295	25	" "
1105	125/850	132	125(150)	93	285	24	" "
1110	125/900	129	127(154)	94	282	29	" "
1115	87/150	129	127(154)	96	250	24	Idle (Anchored)
1120	87/150	125	126(154)	97	250	24	" "
1130	87/150	124	126(154)	98	250	24	" "
1135	87/2200	128	126(154)	98	235	32	Raise
1140	87/150	127	125(154)	98	245	24	Idle
1145	70/2000	125	124(154)	99	225	68	Raise
1150	70/2000	128	128(160)	100	220	65	"
1155	67/1700	128	130(162)	103	220	65	"
1200	67/1700	125	130(162)	105	225	45	"
1205	70/1500	129	131(162)	105	225	51	"
1210	70/1300	132	132(166)	106	225	42	"
1215	70/950	134	134(166)	117	230	35	"
1220	70/700	130	134(167)	116	240	24	"
1225	70/170	130	134(167)	116	250	24	Idle

4103

8 October 1974
San Diego, Calif.

USS PIGEON (ASR-21)

PORT ANCHOR WINDLASS TEST

TIME	PUMP PSIG	°F	SUMP °F	MOTOR °F	REPL PSIG	MOTOR AMPS	
1230	125/125	130	133(164)	115	250	24	Idle
1235	125/125	130	133(164)	115	250	24	"
1240							
1245							
1250							
1255							

USS PIGEON ASR-21

8 October 1974
San Diego, Calif.

TIME	PUMP PSIG	o F	SUMP TANK o F	MOTOR o F	REPLEN. PRESS PSIG	MOTOR AMPS
0710	0	92	88	86	0	Free Fall
0840	125/250	85	85	83	305	Idle 24
0850	80/1000	82	89(98)	88	275	Raise 38
0855	80/1000	95	92(102)	87	270	" 38
0900	80/1000	98	95(105)	88	270	" 38
0905	100/950	99	97(109)	90	265	" 38
0910	100/950	103	100(111)	91	260	" 38
0915	100/950	104	102(116)	92	260	" 37
0920	100/900	105	104(120)	93	255	" 36
0925	100/900	106	105(124)	94	255	" 36
0930	100/900	110	107(126)	95	255	" 35
0935	100/900	110	110(128)	95	250	" 35
0940	100/850	110	112(130)	96	250	" 35
0945	100/850	112	113(134)	97	250	" 35
0950	100/850	113	114(137)	97	245	" 35
0955	100/900	115	116(145)	97	245	" 36
1000	100/700	117	117(142)	98	245	" 36
1005	100/1050	118	119(145)	98	240	" 38
1010	100/800	118	119(148)	99	240	" 32
1015	100/250	119	120(148)	99	250	Idle 24
1020	100/250	118	120(148)	99	255	" 24
1025	100/257	117	120(148)	98	255	Idle 24
1030	100/600	116	120(148)	98	260	Raise 32
1035	125/187	117	121(148)	98	260	Idle 24