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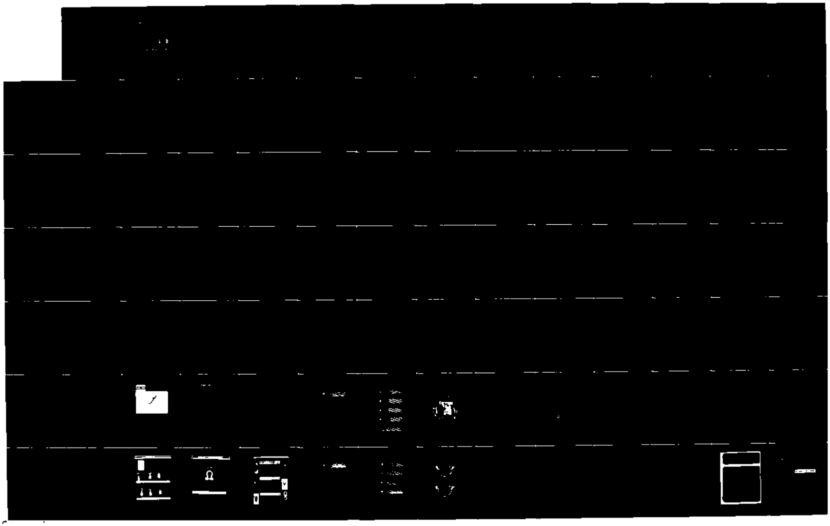

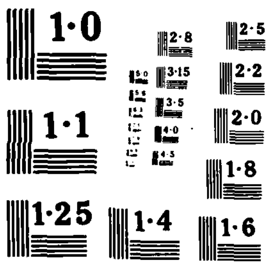
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AFDB-7 LOS ALAMOS
Mooring Overhaul

Holy Loch, Scotland

COMPLETION REPORT

Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

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A major overhaul of the mooring system of the U.S Navy Special Dry Dock LOS ALAMOS (AFDB-7) located at Holy Loch, Scotland was performed during the period 14 May through 17 July 1983. The purpose of the overhaul was to correct deficiencies noted during detailed inspection conducted in June 1982. (Con't)

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The new location of the dry dock center is 681011.459M north, 217103.358M west (OSGB) on a bearing of 308 32'38" which is 18 feet to the southeast of its pre-overhaul position. Pretensioning of the mooring legs was performed to yield bow and stern catenary angles of 50 and side catenaries of 70 for calculated nominal horizontally tensions of 20,000 and 5,000 pounds, respectively.

AFDB-7 LOS ALAMOS

MOORING OVERHAUL

HOLY LOCH, SCOTLAND

COMPLETION REPORT

FPO-1-83 (59)

Submitted to:

Ocean Engineering
Chesapeake Division
Naval Facilities Engineering Command
Washington Navy Yard
Washington, DC 20374

Prepared by:

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26 March 1984

ABSTRACT

A major overhaul of the mooring system of the U.S. Navy Special Dry Dock LOS ALAMOS (AFDB-7) located at Holy Loch, Scotland ~~was performed during the period 14 May through~~ 17 July 1983. The purpose of the overhaul was to correct deficiencies noted during detailed inspection conducted in June 1982. Twenty-two mooring legs including 13,193 feet of 3" stud link chain and 22 each 30,000 pound Navy stockless anchors were recovered and refurbished. Less than 3% of the recovered chain did not meet the minimum acceptance criteria of 2-1/8" wire diameter and was scrapped. 11,693 feet of chain was reused to assemble 20 mooring legs which were reinstalled in a slightly modified configuration.

The new location of the dry dock center is 681011.459M north, 217103.358M west (OSGB) on a bearing of 308°32'38" which is 18 feet to the southeast of its pre-overhaul position. Pretensioning of the mooring legs was performed to yield bow and stern catenary angles of 50° and side catenaries of 70° for calculated nominal horizontal tensions of 20,000 and 5,000 pounds, respectively.

ACKNOWLEDGEMENTS

The AFDB-7 mooring overhaul project was a joint effort of several U.S. Navy commands. Each organization contributed to the success of the project which was completed on schedule despite inclement weather and operational delays to accommodate fleet requirements.

The Atlantic Division (LANTDIV), Naval Facilities Engineering Command developed the AFDB-7 mooring overhaul plan and specifications. LANTDIV also arranged for minor overhaul of the 100 ton YD crane in preparation for project use and for personnel from PWC, Norfolk, for repairs to the YD during the field operations.

Underwater Construction Team One (UCT-1) was tasked with field execution of the mooring overhaul and had a major role in project planning and mobilization. In particular, BUCS P. Pronia, Chief Petty Officer In Charge, and BU1 R. Deems, Assistant Petty Officer In Charge, of UCT-1 Detachment Hotel Lima should be recognized for their excellent efforts in project planning and day-to-day management of field operations, which were conducted safely and efficiently.

The Naval Support Activity, Holy Loch, provided on-site logistics support and liaison with the Commander, Submarine Squadron Fourteen and the United Kingdom Ministry of Defence. The efforts of LT Sam Jones and LTJG Mike Price are particularly appreciated.

The Commander, Submarine Squadron Fourteen, provided considerable support, making available to the project a 100 ton YD crane, yard tugs, other small craft and crews. Personnel from the Boat Operations Division, USS LOS ALAMOS, USS PIQUA, USS NATICK, USS HUNLEY and the YD barge all worked long, hard hours and helped make the project a success. In addition, the patience and flexibility of the Squadron in integrating project activities into their operating schedules are sincerely appreciated.

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1.0 INTRODUCTION

1.1 General

The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGOM) was requested by the Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM) to provide project engineering and on-site supervision for the overhaul of the mooring system of the Special Floating Dry Dock AFDB-7, the USS LOS ALAMOS, located at Holy Loch, Scotland. This was a result of a June 1982 inspection conducted by personnel from Underwater Construction Team One (UCT-1) and the Ocean Engineering and Construction Project Office of CHESNAVFACENGCOM. Results of the inspection indicated that a majority of the ground legs in the mooring needed overhaul and that a number of legs needed to be repositioned in order to improve the catenary of the mooring chains. The Commander, Naval Construction Battalions, U.S. Atlantic Fleet (COMCBLANT), was tasked to provide fleet personnel from UCT-1 to perform the overhaul operation. In all, during 14 May through 17 July 1983, 22 mooring legs were raised, refurbished and reinstalled according to LANTNAVFACENGCOM specifications.

1.2 Background

Holy Loch is located on the west coast of Scotland about 35 miles west-northwest of Glasgow. Access to Holy Loch from the Atlantic Ocean is via the Irish Sea and the Firth of Clyde (see Figure 1-1a). The AFDB-7 Holy Loch mooring, located in about 70 feet of water, 3/4 of a mile from shore (see Figure 1-1b), is a special floating dry dock mooring consisting of four floating dock sections. This dock is routinely used by Fleet Ballistic Missle (FBM) submarines (COMSUBRON 14). Because of the strategic importance of this facility and the possibility of severe winter weather, the material condition of the mooring is of continuing concern.

The dry dock is 513 feet long and 241 feet wide, and is composed of four sections connected side-by-side. Prior to the 1983 overhaul, the dry dock was moored by 22 3" chain ground legs and 30,000 pound anchors. Figure 1-2 shows the placement of the dock sections and ground anchor legs before the overhaul operations.

1.3 Mooring History

The deployment of the LOS ALAMOS at Holy Loch and the initial installation of the mooring system was completed on 5 August 1971.

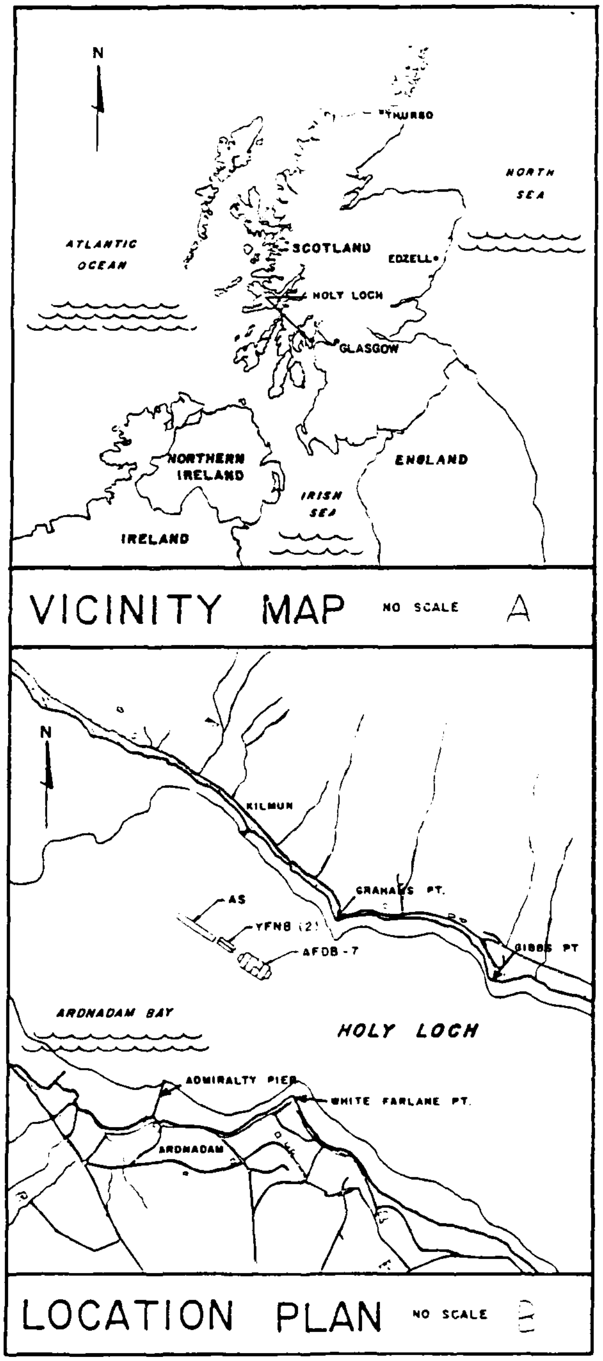
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Figure 1-1

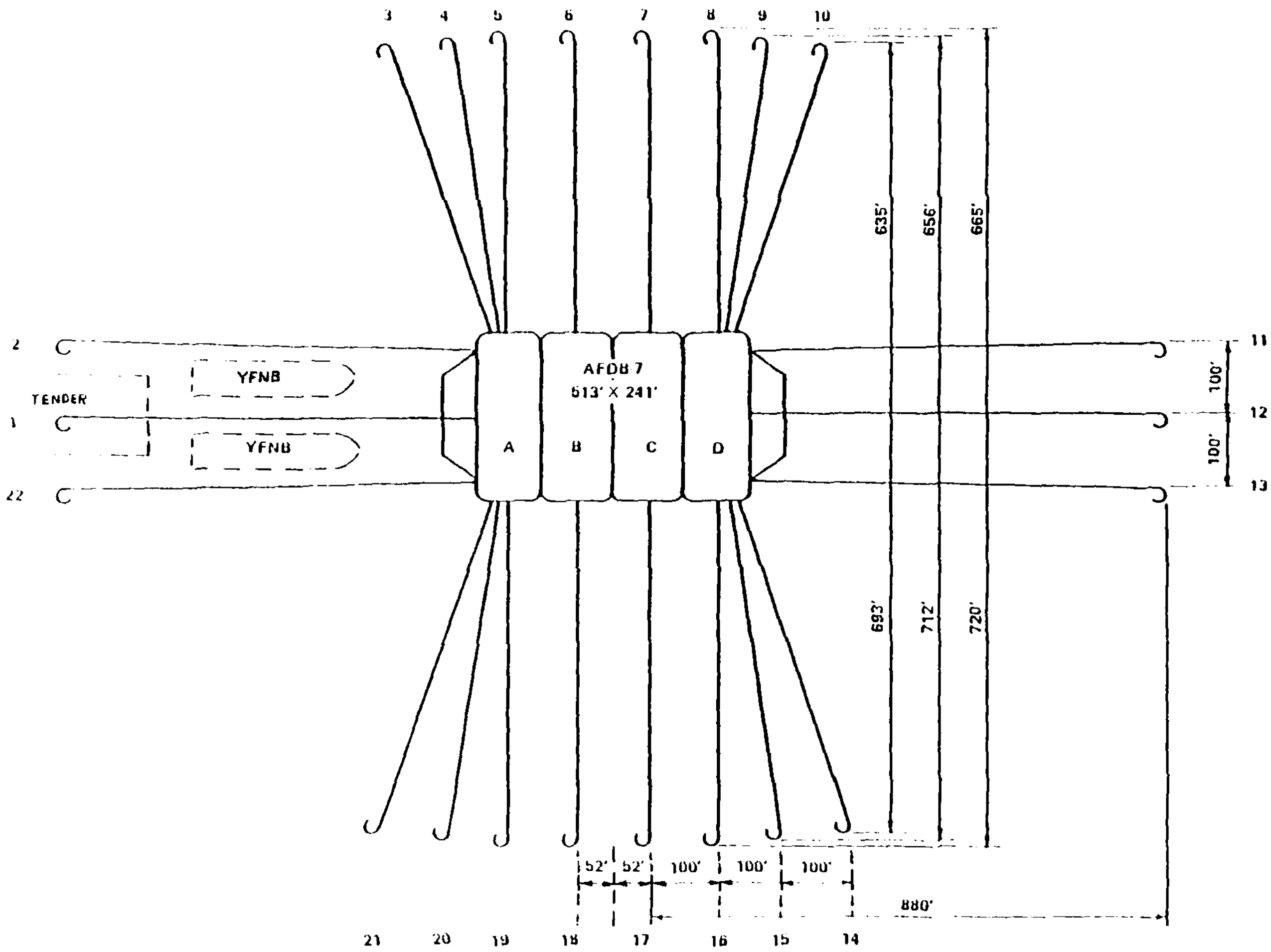


Figure 1-2: FLOATING DOCK MOORING

Since that time the following major maintenance activities have been performed on the mooring system:

June 1973. Ground legs 3, 10, 14, 21 were lifted by a crane and inspected down to the mud line. These legs were found to be in very good condition with a maximum wear of 1/16th of an inch.

July 1974. Ground legs 18 and 19 were lifted, inspected, and determined to be in good condition.

November 1975. Ground legs 5 and 6 were raised, inspected to the mud line, and found to be in good condition with a maximum wear of 1/8th of an inch.

November 1976. Ground legs 16 and 17 were lifted, inspected, and found to be in good condition.

May 1978. Five shots of ground leg 7 were raised, inspected, and found to be in good condition with a minimum wire diameter measurement of 2-11/16 inches (89.6% of the original 3" diameter). Ground leg 8 was also inspected and it was found that one chain link (link number 23) was worn to the minimum limit, 2-3/8 inches (79.2% of the original diameter). Both ground legs were relaid. It was intended to insert a new shot of 3" chain (in leg 8)) during a subsequent overhaul period. (There is no evidence that this was ever accomplished).

August 1980. Ground leg 12 was raised, measured, and relaid. No comments as to its condition.

April 1982. A limited inspection of ground legs was conducted. The anchor chain scope was estimated for all legs. Visual inspection of the legs showed good condition, however, some ground legs had little or no catenary and the major portion of each leg was apparently buried in the mud.

During 17-25 June 1982, UCT-1 diver personnel and personnel from the Ocean Engineering and Construction Project Office of CHESNAVFACENGCOM conducted an inspection of the AFDB-7. Initially requested by CINCUSNAVEUR, the inspection was to check the condition, length, and catenary of each of the 22 legs. The most important determinate used in the evaluation was the percentage of original wire diameter remaining; chain links and other components which measured greater than 90% (+90%) of original wire diameter were considered satisfactory; measurements between 80% and 90% (+80%) of original diameter were cause for the mooring classification to be downgraded; any measurement of less than 80% (-80%) would cause the mooring to be considered unsatisfactory for fleet use. Ground legs and risers were observed only to the point at which they entered the mud. No attempt was made to locate and inspect anchors or other mooring materials which were not readily visible. Table 1-1 contains a summary of the AFDB-7 June 1982 inspection results. A full report is provided in Reference 2. The major results are as follows:

- No broken links or hardware were found: 27% (6 of 22) legs were +90% of original 3" chain wire diameter over the entire inspected length (to mudline); 68% (15 of 22) were +80% in the splash zone, from chock to waterline. All but one of the +80% or lower measurements occurred in the splash zone. Leg #18 had no on-deck stopper (pelican hook).

- No anchors or sinkers were located; all legs were buried in bottom mud a relatively short distance from the floating dock.

- Three legs were noted to have slack chain resting on the bottom; 36% (8 of 22) of the legs had surface chain angles of greater than 85 degrees from the horizontal; 41% (9 of 22) had angles of 75-85 degrees; 32% (7 of 22) of the lateral distances were less than 18 feet; average lateral distance was 45 feet.

- Voltmeter readings were typical of unprotected steel in seawater, indicating that no cathodic protection is being provided via impressed current from vessels in the vicinity.

- Analysis of transit readings indicated that wind-induced movement of the AFDB-7 was not extreme. For steady winds of 30 KTS with gusts up to 40 KTS, the dock experienced a net lateral displacement of approximately 32 feet from its position in light wind (~10 KTS) in approximately the same direction; maximum displacement was 37 feet at the bow during a yaw of about 2 degrees to port; maximum yaw was about 3 degrees to starboard.

- Because of inherent inaccuracies in the observation system, no firm conclusions were drawn regarding the relative bearing of the ground legs.

Table 1-1: AFDB-7 June 82 Mooring Inspection Report, NAVACTDET Holy Loch, UK

LEG #	CONDITION I	CONDITION II	CONDITION III	WATER DEPTH (Note 1) D_B Obs.	D_B MLWS	D_C Obs.	D_C MLWS	INCLINOMETER ANGLE (Note 2)	RELATIVE BEARING (Note 3)	LATERAL DISTANCE (Note 4)
1	+90%	+80%	+90%	95	84.6	95	84.6	80°	000°	Not observed
2	+90%	+80%	+90%	104	94.8	96	96.8	59° / 62°	010°	(90)
3	+90%	+80%	+90%	108	99.3	107	98.3	78° / 71°	061°	(60)
4	+90%	+80%	+90%	108	100.6	105	97.6	87° / 77°	050°	45
5	+90%	+80%	+90%	109	102.1	109	102.1	89° / 86°	100°	(3)
6	+90%	+80%	+90%	111	104.4	109	102.4	82° / 65°	070°	54
7	+90%	+80%	+90%	95	89.3	95	89.3	77° / 55°	070°	(60)
8	+90%	+90%	+90%	88	83	92	87	66° / 33°	080°	120
9	+90%	+90%	+90%	88	84.4	86	82.4	85°	090° / 120°	52
10	+90%	+80%	+90%	88	84.6	85	81.6	78°	120° / 160°	54
11	+90%	+80%	+90%	81	78.9	85	82.9	59° / 43° /61°	180°	88
12	+90%	+90%	+90%	90	77.5	90	77.5	75°	180°	60
13	+90%	+80%	+90%	90	80.3	90	80.3	79°	175° / 170°	39
14	+90%	+80%	+90%	89	80	93	80	74°	220° / 235°	54
15	+90%	+90%	+90%	87	79.2	89	79.2	91°	230°	03
16	+90%	+80%	+90%	87	74.7	89	74.7	84°	195° / 225°	33
17	+90%	+80%	+90%	85	75.6	88	78.6	83°	185° / 220°	39
18	+90%	+90%	+90%	84	77.4	84	77.4	87°	205° / 220°	18
19	+90%	+90%	+80%	88	76.5	88	78.5	88°	285°	00
20	+90%	+80%	+90%	88	78.3	88	82.3	92°	285° / 305°	12
21	+90%	+90%	+90%	88	79.3	88	79.3	85°	290° / 300°	03
22	+90%	-80%	+90%	85	79.6	85	79.6	65°	000° / 353°	57

Note 1: D_B = Depth at dock edge; D_C = Depth where chain enters mud; Obs. = actual measurement; MLWS = Depth at Mean Low Water Springs

Note 2: Second and third angles measured during different weather conditions; see text.

Note 3: First observation taken along chain as it enters water; second observation, if re[illegible]ed, was from deck edge to pop float above point where chain enters mud.

Note 4: Unable to measure Leg #1 due to proximity of other vessels, values in parentheses are from inspection performed in April 1982 by divers from USS HUNLEY.

As a result of this inspection, it was recommended that the chain in the splash zone of leg 22 which measured less than 80% of the original wire diameter be replaced as soon as possible. In addition, it was recommended that an engineering analysis of the AFDB-7 mooring design be conducted in order to define the optimum catenary of each leg. Using the results of such an analysis, a number of legs should be repositioned to tighten the catenary prior to the 82-83 winter season.

1.4 Overhaul Operation Specifications

LANTNAVFACENGCOM developed the specifications for the overhaul based upon the results obtained during the June 1982 inspection. The specifications were provided to CHESNAVFACENGCOM on LANTNAVFACENGCOM drawing number 4091244 (2 sheets) and are summarized in Table 1-2.

During operations on-site, the specifications were modified to accommodate emerging conditions. The changes included:

- Surface preparation of the anchors prior to welding was changed to grinding; sandblasting was not required.
- The pretensioning criteria (see Figure 4-17 of Appendix A) was changed to a target catenary angle of 50° for the bow and stern legs and 70° for the side legs instead of a horizontal force.
- The desired final dry dock location was changed to a position 20 feet to the southeast of the pre-overhaul position; this amounted to a 20 foot shift directly astern.

TABLE 1-2 AFDB-7 Mooring Overhaul Specifications

1. All anchor flukes shall be fixed in place by welding to form an angle of 45° with the anchor shank.

2. All anchor surfaces to be welded shall be sandblasted to bare metal prior to welding.

3. Chain or fitting links measuring less than 2-1/8" in diameter in single link measurements should be replaced.

4. The end of each mooring leg exhibiting the greater amount of deterioration (by 1/8") shall be re-used at the anchor end of the leg.

5. All anchors shall be preset with a horizontal force of at least 30,000 lb. (13,600 KG).

6. Any anchor not achieving the preset load within 20 ft. inboard of its final design position shall be raised, re-positioned and reset.

7. The horizontal component of final mooring leg pretensions shall be as indicated in Figure 4-17 of Appendix A. Each on-deck branch of yoked legs 6 and 7 and 17 and 18 shall be pre-tensioned to one-half the tabulated values.

8. Final anchor locations (in ft.) referenced to AFDB-7 Centerlines:

Anchor	X*	Y*
1,12	± 751	0
2,11,13,20	± 751	± 90
3,10,14,22,21	± 345	± 638
4,9,15,20	± 157	± 665
5,8,16,19	± 62	± 660
6 & 7,17, & 18	0	± 665

9. No two adjacent mooring legs nor more than two mooring legs per dry dock side shall be removed simultaneously for re-conditioning.

10. Mooring leg removal and final pre-tensioning shall be sequenced as symmetrically as is logistically possible.

11. Final pre-tensioning shall be performed after all legs are reset and in winds not exceeding 10 knots.

* X is fore and aft direction; Y is athwartships.

2.0 RESULTS

2.1 As-Built Configuration

Figure 2-1 depicts the as-built mooring plan of the AFDB-7. The center of the dry dock is located at 681011.459 M north coordinate, 217103.358 M east coordinate at an azimuth of 308° 32'38". The dock is 18 feet astern (towards the southeast) of its pre-overhaul position. The onshore survey points from which the dry dock location was determined are also shown in Figure 2-1. The coordinates are given in meters with respect to the Ordnance Survey, Great Britain (OSGB) national grid system.

There are 20 mooring legs, 3 off both the bow and stern and 7 off both the port and starboard side. The numbering sequence is 1 through 22 as shown in Figure 2-1. The two legs (6/7 and 17/18) securing the center sections of the dry dock (one each on the port and starboard side) are bridled and replace the pre-overhaul 4 leg configuration. The old numbering sequence has been retained for consistency.

Table 2-1 details the as-built data for each leg including location, depth, length, catenary, and hardware configuration. Anchor locations are given in meters wih respect to the OSGB. Depths are given in feet for each anchor location and beneath the respective chock at the dry dock deck edge. Depth data are referenced to MLWS datum. The length of each leg is given in feet and is based upon the nominal length of 1 foot per link of 3" stud link chain. The catenary angle is given in degrees. It is a measurement of the angle formed by the water plane and the mooring leg riser. The catenary angle data are corrected to a MHWS condition, with 5' freeboard on the dry dock. Thus, these are the minimum angles that would be expected during normal operations.

2.2 Installed Equipment

2.2.1 Anchors

A 30,000 Standard Navy stockless anchor (see Figure 2-2) is used on each of the 20 mooring legs of the AFDB-7 LOS ALAMOS. The anchors used were recovered from the previous 22-leg moor and modified to include stabilizers and a restricted fluke angle of 45 degrees. The stabilizers were prefabricated according to NAVFAC (BUDOCKS) drawing 620656 and welded to the crown during refurbishment. The 45 degree fluke angle was secured by welding a 24" x 4" x 1" plate between the shank and crown.

Each anchor was equipped with a 5-1/4" anchor shackle.

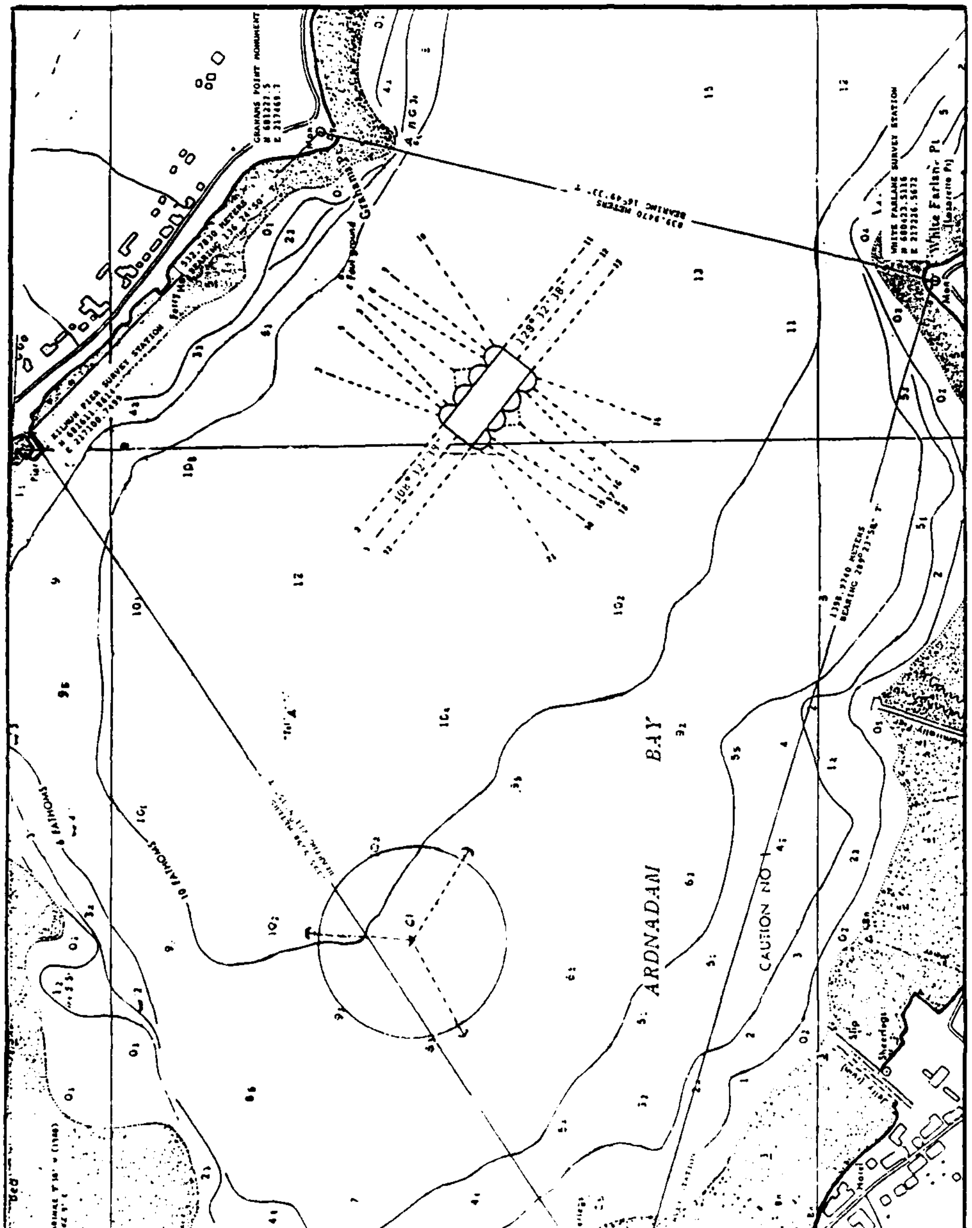


Figure 2-1: As Built Mooring Plan

Table 2-1

(AFDB-8)

USS LOS ALAMOS MOORING LEG OVERHAUL 1983

AS BUILT DATA

Leg	1	2	3	4	5	6	7	
LOCATION DATA:								
N.Coord. (M)	681156.013	681173.588	681222.828	681195.048	681176.609	681165.735		68
E.Coord. (M)	216915.185	216937.290	217138.028	217186.877	217208.269	217224.703		21
Depth at Anchor (ft)	84	--	72	70	69	76		
Depth at Chock (ft)	85	101	101	102	104	104	90	
Length Overall (ft)	581	582	576	566	583	2 bridle legs @91'each + 516		
Catenary Angle (deg)	55	49	70	71	69			
HARDWARE CONFIGURATION:	Padeye #7 Baldt AJL 49 Camp CJL 91 Camp CJL 91 Camp CJL 91 Camp CJL 91 Camp CJL 91 Baldt CJL 70 Camp CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 4"ChnSftyShkl #7 Baldt AJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 Baldt CJL 29 NACO CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 4"ChnSftyShkl #7 Baldt AJL 73 Camp CJL 91 Camp CJL 91 Camp CJL 90 Camp CJL 91 Camp CJL 91 Kenter CJL 4 Camp CJL 37 #7 Baldt AJL[4] Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 64 NACO CJL 91 Camp CJL 91 Camp CJL 91 Camp CJL 91 Camp CJL 91 NACO CJL 40 NACO CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 81 NACO CJL 89 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 42 #7 Baldt AJL[4] Swivel #7 Baldt AJL[4] 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 4"Chn Sfty shkl #7 Baldt AJL 91 Baldt CJL[4]	Padeye 3F Bend Shkl #7 Baldt AJL 91 Baldt CJL[4]	Pa 3F #7 Ca Ca Ca Ca Ba Ca Ba Sw 3- 3- 5¼ An
						Pear shaped link Baldt CJL 90 NACO CJL 90 NACO CJL 91 Camp CJL 60 Camp CJL 90 NACO CJL 88 #7 Baldt AJL[4] Swivel 3-1/8" NACO AJL 3-5/8" NACO AJL 5¼" Anchor Shkl Anchor		

Table 2-1

(AFDB-8)

USS LOS ALAMOS MOORING LEG OVERHAUL 1983

AS BUILT DATA

	6	7	8	9	10	11
.609	681165.735		681152.535	681136.422	681096.050	680889.376
.269	217224.703		217239.334	217262.528	217301.621	217304.035
9	76		76	78	76	84
4	104	90	82	83	79	79
3	2 bridle legs @91'each + 516		547	565	555	578
9			74	70	70	47
e nd Shkl ldt AJL 31 CJL 39 CJL 91 CJL 91 CJL 91 CJL 42 ldt AJL [4] 1 ldt AJL [4] "NACO AJL chor Shkl r	Padeye 4"Chn Sfty shkl #7 Baldt AJL 91 Baldt CJL [4] Pear shaped link Baldt CJL 90 NACO CJL 90 NACO CJL 91 Camp CJL 60 Camp CJL 90 NACO CJL 88 #7 Baldt AJL [4] Swivel 3-1/8" NACO AJL 3-5/8" NACO AJL 5¼" Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 91 Baldt CJL [4]	Padeye 3F Bend Shkl [1] #7 Baldt AJL 49 Camp CJL 90 Camp CJL 90 Camp CJL 90 Camp CJL 90 Baldt CJL [2] 40 Camp CJL 91 Baldt CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl [1] #7 Baldt AJL 57 Camp CJL 91 Camp CJL 76 Camp CJL 90 Camp CJL 91 Camp CJL 91 Baldt CJL 62 Baldt CJL Swivel 3-1/8"NACO AJL #7 Baldt AJL #7 Baldt AJL 5¼"Anchor Shkl Anchor	Padeye Bend Shkl [3] #7 Baldt AJL 53 NACO CJL 91 Camp CJL 91 NACO CJL 40 Camp CJL 91 NACO CJL 91 Baldt CJL 91 Camp CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye Bend Shkl [3] #7 Baldt AJL 33 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 83 Baldt CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor

Superscripts
1. Bolted
2. Welded stud link
3. Large bending shackle, designated NTG, CH3F1
4. New

Abbreviations
- AJL Anchor joining link
- CJL Chain joining link
- Chn Chain
- Shkl Shackle
- Sfty Safety

Notes
Excepts as noted, all chain is standard Navy 3" cast steel, A links, nominally 1 ft/link. All hardware is nominally 3" except as noted. All anchors are standard Navy 30,000 pound stockless with stabilizers.

Table 2-1 (Cont'd)

(AFDB-8)

USS LOS ALAMOS MOORING LEG OVERHAUL

AS BUILT DATA

Leg	12	13	14	15	16	17	18	
LOCATION DATA:								
Anchor Coord N (M)	680863.585	680846.010	680796.770	680824.550	680842.990	680853.863		680
Anchor Coord E (M)	217292.533	217270.429	2171069.690	217020.840	216999.450	216983.015		216
Depth at Anchor (ft)	80	80	82	66	72			
Depth at Chock (ft)	82	81	79	81	81	81	79	
Length Overall (ft)	564	577	568	584	596	2 bridle legs @91'each + 518		
Catenary Angle (deg)	55	47	68	72	68			
HARDWARE CONFIGURATION:	Padeye #7 Baldt AJL 29 NACO CJL 90 NACO CJL 91 NACO CJL 90 NACO CJL 91 NACO CJL 91 Baldt CJL 75 #7 Baldt AJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl[1] #7 Baldt AJL 84 NACO CJL 91 NACO CJL 91 Kenter CJL 65 Kenter CJL 59 Kenter CJL 31 NACO CJL 90 Baldt CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 18 Camp CJL 91 Camp CJL 91 Camp CJL 91 Camp CJL 90 Camp CJL 91 Camp CJL 71 Baldt CJL 17 #7 Baldt AJL[4] Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 40 NACO CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 91 Baldt CJL 91 NACO CJL 64 Baldt CJL 17 NACO CJL Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl #7 Baldt AJL 68 NACO CJL 91 Camp CJL 91 NACO CJL 91 NACO CJL 91 NACO CJL 55 Baldt CJL 13 Baldt CJL[4] 88 Baldt CJL[4] Swivel 3-1/8"NACO AJL 3-5/8"NACO AJL 5¼"Anchor Shkl Anchor	Padeye 3F Bend Shkl[1] #7 Baldt AJL 91 Baldt CJL[4]	Padeye 3F Bend Shkl #7 Baldt AJL 91 Baldt CJL[4]	Pad 4"C #7 Car Cam Cam Cam Cam NAC #7 Swi 3-1 3-5 5¼' Anc
						Pear shaped ring Baldt CJL[4] 40 Baldt CJL 91 NACO CJL 91 NACO CJL 91 Camp CJL 91 NACO CJL 91 NACO CJL 15 NACO CJL Swivel -1/8"NACO -5/8"NACO "Anchor Shkl Anchor		

Table 2-1 (Cont'd)

(AFDB-8)

USS LOS ALAMOS MOORING LEG OVERHAUL 1983

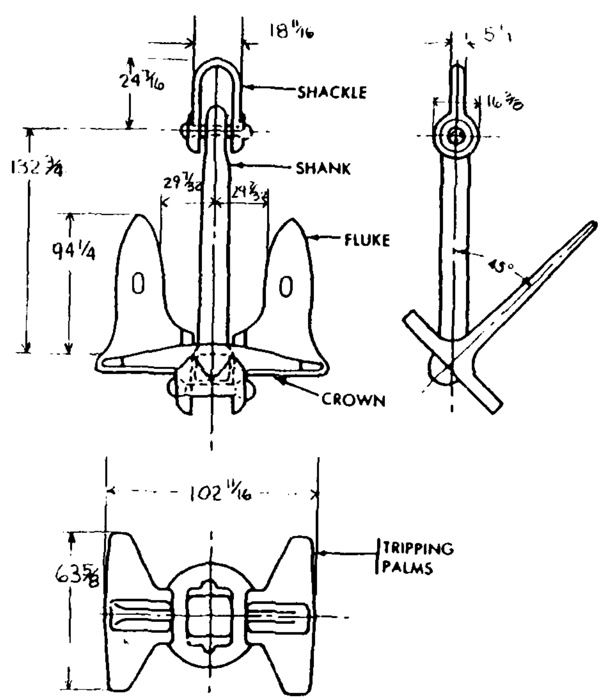
AS BUILT DATA

	17	18	19	20	21	22
	680853.863		680867.064	680883.176	680923.547	681130.222
	216983.015		216968.384	216945.190	216906.098	216903.683
			67	68	78	74
	81	79	82	81	81	78
	2 bridle legs @91'each + 518		582	567	575	558
			70	71	67	49
	Padeye	Padeye	Padeye	Padeye	Padeye	Padeye
hkl	3F Bend Shkl[1]	3F Bend Shkl	4"ChnSftyShkl	3F Bend Shkl	4"ChnSftyShkl	3F Bend Shkl[1]
AJL	#7 Baldt AJL	#7 Baldt AJL	#7 Baldt AJL	#7 Baldt AJL	#7 Baldt AJL	#7 Baldt AJL
	91	91	31	9	67	65
	Baldt CJL[4]	Baldt CJL[4]	Camp CJL	NACO CJL	NACO CJL	Camp CJL
	Pear shaped ring		90	40	91	91
	Baldt CJL[4]		Camp CJL	Baldt CJL	NACO CJL	Camp CJL
	40		91	91	91	91
	Baldt CJL		Camp CJL	Baldt CJL	NACO CJL	Camp CJL
	91		90	90	91	90
	NACO CJL		Camp CJL	Baldt CJL	NACO CJL	Camp CJL
	91		91	88	91	90
	NACO CJL		Camp CJL	Baldt CJL	NACO CJL	Camp CJL
	91		91	91	91	90
	Camp CJL		NACO CJL	Baldt CJL	NACO CJL	Camp CJL
4	91		91	44	46	34
	NACO CJL		#7 Baldt AJL[4]	Kenter CJL	Baldt CJL	Baldt CJL
4	91		Swivel	15	Swivel	Swivel
	NACO CJL		3-1/8"NACO AJL	NACO CJL	3-1/8"NACO AJL	3-1/8"NACO AJL
	15		3-5/8"NACO AJL	90	3-5/8"NACO AJL	3-5/8"NACO AJL
AJ	NACO CJL		5¼"Anchor Shkl	NACO CJL	5¼"Anchor Shkl	5¼"Anchor Shkl
AJ	Swivel		Anchor	Swivel	Anchor	Anchor
Shkl	3-1/8"NACO			3-1/8"NACO		
	3-5/8"NACO			3-5/8"NACO		
	5¼"Anchor Shkl			5¼"Anchor Shkl		
	Anchor			Anchor		

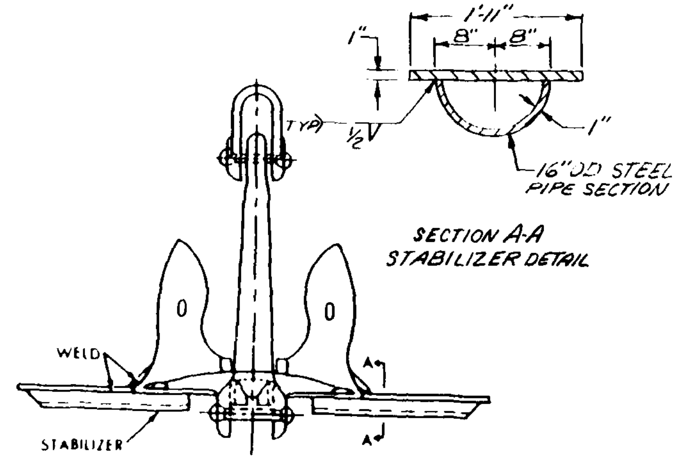
Superscripts
1. Bolted
2. Welded stud link
3. Large bending shackle, designated NTG, CH3F1
4. New

Abbreviations
AJL -Anchor joining link
CJL -Chain joining link
Chn -Chain
Shkl-Shackle
Sfty-Safety

Notes
Except as noted, all chain is standard Navy 3" cast steel, A links, nominally 1 ft/link. All hardware is nominally 3" except as noted. All anchors are standard Navy 30,000 pound stockless.



(a) NAVY STANDARD STOCKLESS ANCHOR



(b) NAVY STOCKLESS ANCHOR WITH STABILIZERS

AS INSTALLED, HOLY LOCH, SCOTLAND

QUOTED PROOF TEST OF 252,900 POUNDS

Figure 2-2: 30,000 Pound Navy Stockless Anchor with Dimensions

The two recovered anchors which were not reinstalled are presently in storage at the NATO Mooring and Salvage Depot at Fairlie, Scotland.

2.2.2 Chain

Each of the 20 mooring legs is comprised of 3" diameter cast steel standard A-link chain, with minor exceptions. The chain was obtained entirely from the recovered 22 legs. In all cases the reinstalled chain measured greater than 85% of its specified dimensions, which are given in Figure 2-3.

One mooring leg (#8) was reinstalled with a 40 link section of welded steel stud link chain (see Figure 2-4).

Recovered chain that was neither reinstalled nor identified as scrap was put in storage at the NATO facility in Fairlie, Scotland.

2.2.3 Joining Links

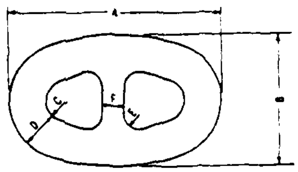
A variety of chain (CJL) and anchor (AJL) joining links are utilized in the 20 mooring legs, most reused from the 22 legs recovered. Of the more than 220 joining links installed, only 11 were new, including 7 3" Baldt chain joining links and 4 #7 Baldt anchor joining links. In general terms, each mooring leg includes the following joining links: #7 Baldt AJL connecting the leg to the padeye/shackle on the dry dock, CJLs of a variety of manufacturers connecting each shot of chain, a CJL or AJL connecting the last length of chain to the swivel, and a pair of NACO AJLs connecting the swivel and the anchor shackle. Some variation of this configuration exists on a few legs.

Specifications for the various joining links are provided below:

Baldt (Baldt Inc., Chester, Pa.): Both new and used Baldt connecting links are used, including #7 AJL and 3" CJL. Specifications are provided in Figure 2-5.

Camp (E.V. Camp Steel Works, Atlanta, Ga.): 50 Camp 3" CJL are used in the system. Figure 2-6 provides specifications.

NACO (National Casting Company, Sharon, Pa.): NACO 3" CJLs and 3-1/8 and 3-5/8 AJLs are used on most of the 20 mooring legs. The NACO design, shown in Figure 2-7, includes the use of 4 steel rivets. For those NACO links which had to be detached during refurbishment, new mild steel rivets were used for reattachment. NACO links are no longer manufactured.



All dimensions are in inches:

A = 18
B = 10-13/16
C = 1-13/16
D = 3
E = 1-1/2
F = 2-1/16

Length of six A-links = 78

Figure 2-3: A-Link Chain Dimensions

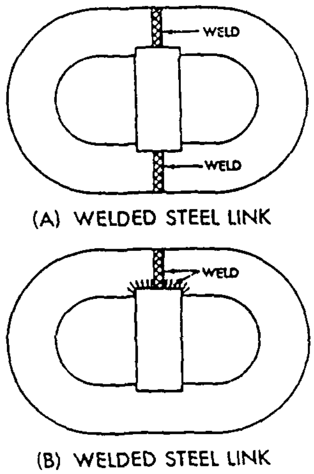
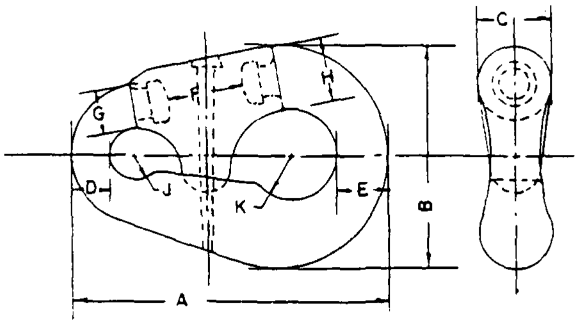


Figure 2-4: Welded Steel Links, Typical

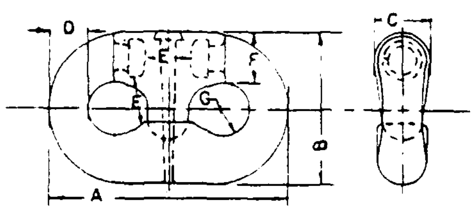


All dimensions are in inches:

A = 22-1/8	F = 5-7/8
B = 14-13/16	G = 3-3/8 x 3-1/8
C = 4-5/8	H = 4-3/8
D = 3-1/8	J = 1-29/32
E = 3-3/4	K = 3

Proof test in pounds = 748,000
Break test in pounds = 1,128,000
Weight in pounds = 208

Anchor, Baldt Number 7



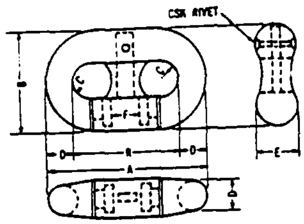
All dimensions are in inches:

A = 18	E = 3-3/8
B - 11-7/8	F = 4-3/32
C = 4-3/32	G = 1-29/32
D = 3-3/16	

Proof test in pounds = 762,000
Break test in pounds = 1,150,000
Weight in pounds = 125

Chain, 3 Inch

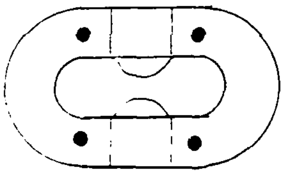
Figure 2-5: Joining Links



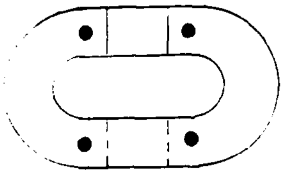
All dimensions are in inches:

A = 18
B = 11-5/8
C = 1-31/32
D = 3
E = 4-1/2
F = 3-7/16
R = 12

Figure 2-6: Camp Chain Joining Link, 3 Inches



Chain Joining Link



Anchor Joining Link

Figure 2-7: NACCO 4-Rivet Joining Links; Dimensions Not Known

Kenter (various foreign manufacturers): 5 Kenter detachable CJLs are used. Specifications are given in Figure 2-8. Kenter links are a generic design manufactured by various European and Japanese manufacturers.

2.2.4 Swivels

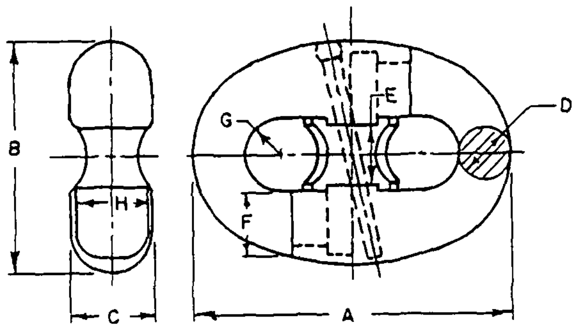
Each mooring leg included a 3" swivel close to the anchor to alleviate torsion in the mooring chain. Nominal specifications are given in Figure 2-9.

2.2.5 Shackles

Two types of shackles are used to connect the top of the mooring legs to the padeye on deck of the dry dock, depending upon the given leg: 3F bending shackle and 4" chain safety shackles. Specifications for each are given in Figures 2-10 and 2-11, respectively.

2.2.6 Pear Shaped End Link

Two 3" pear shaped end links are used to join the bridle legs with the riser leg on anchor legs 6/7 and 17/18. Specifications are given in Figure 2-12.

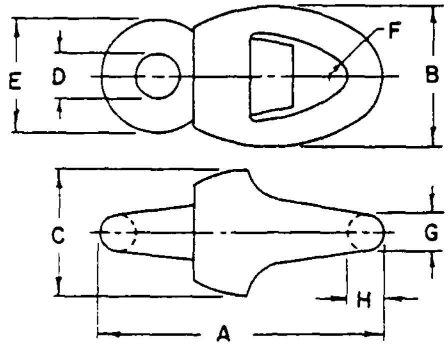


All dimensions are in inches:

A = 18	E = 3-3/8
B = 12-5/8	F = 3-7/8
C = 4-9/16	G = 2
D = 3	H = 4

Weight in pounds = 148.8

Figure 2-8: Kenter Chain Joining Link, 3 Inch

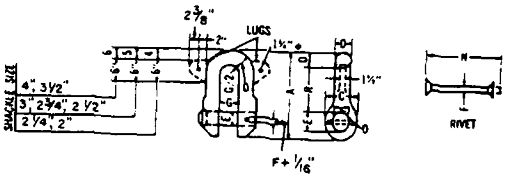


All dimensions are in inches:

A = 27-1/2	E = 10-13/16
B = 14-1/16	F = 2-1/8
C = 10	G = 3-3/4
D = 3-15/16	H = 3-3/4

Weight in pounds = 656

Figure 2-9: Swivel, Typical Dimensions

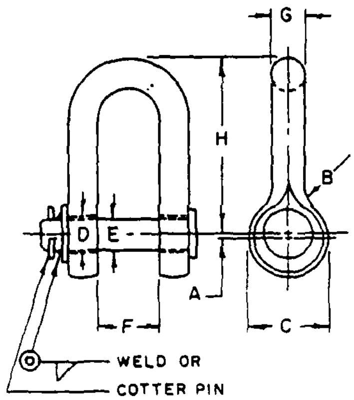


All dimensions are in inches:

A = 25-13/16	F = 1-1/4
C = 9-9/16	N = 11-9/16
D = 4-3/16	G = 6
E = 5-3/8	R = 14-1/8

Proof test in pounds = 495,000
Break Test in pounds = 693,000

Figure 2-10: 3F Bending Shackle

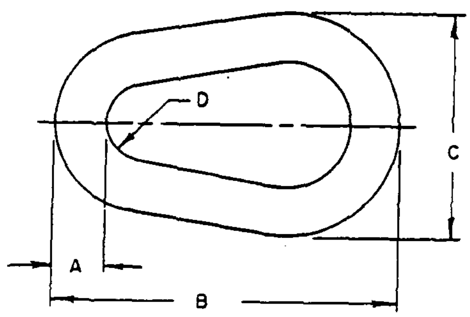


All dimensions are in inches:

A = 7/16	E = 4
B = 4	F - 5-3/4
C = 9-1/2	G = 4
D = 4-1/4	H = 23

Weight in pounds $\doteq$ 339

Figure 2-11: 4" Chain Shackle



All dimensions are in inches:

A = 3-1/8
B = 25-17/32
C = 13-9/32
D = 2-11/32

Figure 2-12: Pear Shaped End Link

3.0 OVERHAUL OPERATIONS

This section will reference the Execution Plan given as Appendix A and detail only those aspects of the operation where there were significant deviations.

3.1 Survey and Positioning

Section 3.0 of the Project Execution Plan (Appendix A) contains the methods used in establishing survey stations, locating the dry dock, and computing the dry dock's bearing and new anchor coordinates. Below is a brief description of the deviations from the original surveying plan.

- The OSGB Benchmarks Grahams Point, White Farlane Monument, and BF-41A were verified with respect to each other ($\pm$ 0.5 meters) using the Strone Church Spire benchmark.

- The original survey plan called for setting survey stations off the two known benchmarks and not closing the three point traverse. Instead, a complete four point traverse survey was conducted which closed to within 2 seconds of accuracy. Corrections were made to the traverse, and the survey stations were tied into the OSGB system using the known benchmarks and the computer programs. This gave a more accurate location of the dry dock and more accurate OSGB coordinates for the survey stations.

- Anchor locations were calculated to include the specification change requiring the dry dock to be moved aft (to the southeast) 20 feet.

- During anchor installation, the survey stations used for installation were chosen based on the angle of intersection of the lines of sight, baseline distance between stations and visibility.

- During installation, marker buoys were used to give an approximate location of the correct anchor placement so that the crane barge could be moved into place; however, transits were used for actual anchor placement by sighting on the lowering wire.

- The tide board was installed on the pier but was not used during installation or post-tensioning. Tide tables were used during post-tensioning to help calculate the proper catenary angles.

- After the installation was complete, the survey stations were made permanent and witness marks were noted in case the stations were required for future surveys

3.2 Deck Plan

Figure 3-1 gives a schematic deck layout of the YD prepared for recovery of the anchor legs over the starboard bow using the AMCON 150 as the primary hoist. On-site measurements allowed the AMCON winch to be placed partially beneath the swing of the crane counterweight, allowing for adequate deck length forward of the winch for a direct pull. This minimized the fairleading required for mooring leg recovery and redeployment. Section 2.2 of the Execution Plan (Appendix A) describes the YD deck plan and equipment used for operations. The deck plan used differs in that recovery was over the port bow and in some equipment placement.

3.3 Overhaul Procedures

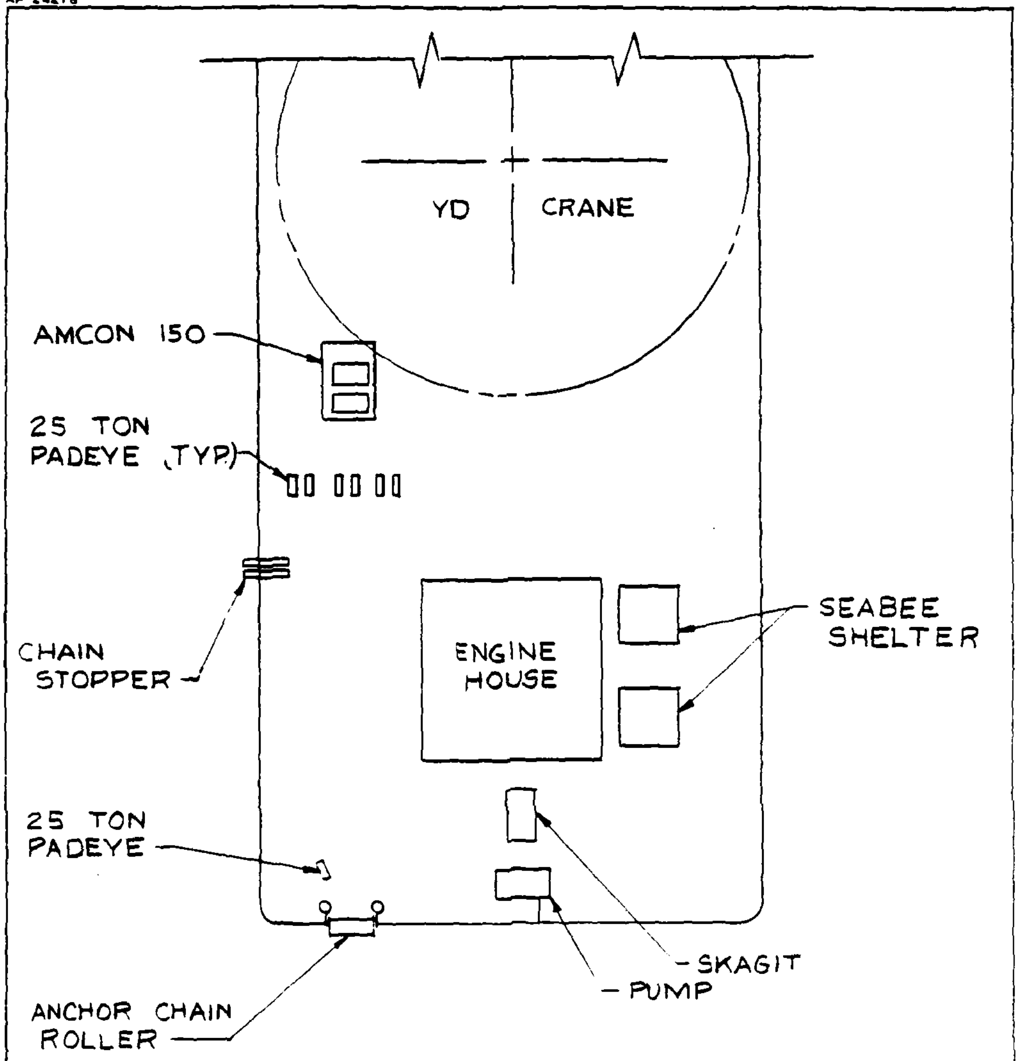
3.3.1 Recovery

The mooring legs were released from the dry dock by using the YD light crane hook to take the load of the chain outboard of the chock. To accomplish this, the YD was positioned bow to the ADFB-7 at the leg to be released. Once slack, the bitter end was detached by burning through a chain link. This release method is detailed in the Execution Plan (Appendix A), Section 4.1.1.

The mooring legs were then recovered by inhauling the chain over the bow of the YD using the AMCON 150 winch as the principal hoist. During inhaul, the chain was waterblasted to remove mud and debris. As recovery progressed, the YD was backed down over the chain length. Recovery of the chain continued until it was vertical to the anchor. The load was then transferred from the AMCON winch to the YD crane for recovery of the anchor. The pick up of the anchor was accomplished in two bights; the chain stopper mounted starboard side amidships was used to temporarily take the load while the first bight of chain was faked on deck and the wire strap relocated on the slack chain adjacent to the stopper in preparation for the pick up of the final bight and the anchor.

Maneuvering of the YD during recovery (and other) operations was accomplished using a YTB secured to the hip and two LCM-6s acting as push boats. This differed from the two YTB method originally planned (see Figure 4-2, Appendix A) but worked satisfactorily.

AF 24216



REV	DESCRIPTION	BY	DATE

Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316

Figure 3-1
Final Deck Plan

Drawn: G. F. ANDERSON	Date: 30 NOV. '93
Checked:	Scale: NONE
Approved:	Drawing Number / Rev
Sheet ____ of ____	

3.3.2 Refurbishment

The recovered mooring legs were thoroughly inspected for wear and uniform corrosion with components exhibiting greater than 30% wastage replaced. Less than 3% of the chain did not meet the acceptable criteria. With the exception of several Camp joining links, most of the detachable links were reusable. The NACCO links required new rivets, which were fabricated locally.

All changes to the mooring legs were logged and are included in Section 2.1.

The anchors were waterblasted upon recovery and areas where the stabilizers were to be welded were ground to prepare the surface. The weld was started with a root pass using a E6010 rod, and the fillet was done with 8018 rod. To obtain the specified 45 degree angle, a 24"x 4"x 1" steel plate was fitted between the shank and the crown of each anchor and welded into place. Installation of the stabilizers was greatly facilitated by a portable A-frame which was constructed to help in the fitting and welding process. After the initial learning curve, 6 to 7 hours were required for the welding process.

3.3.3 Reinstallation

The major deviation from the original reinstallation plan was the use of the primary AMCON 150 on the YD to inhaul the bitter end of the chains through the chocks to the connecting padeyes on the AFDB-7, instead of using the second AMCON mounted on the dry dock. This approach greatly improved the efficiency of the reinstallation operation by eliminating considerable mobilization and rigging time.

Bridled legs 6/7 and 17/18 required special attention because of the bridle attachment to dry dock cans B and C. For reinstallation, the YD set the anchors, deployed the chain leg and bridle up to can B, terminated the B bridle, and maneuvered to can C for termination of the C bridle to finish the yoke.

3.3.4 Pretensioning

Pretensioning was performed according to a catenary angle criteria instead of horizontal tension. As such, the specification given in Figure 4-17 and the tension measuring rig shown in Figure 4-18 of Appendix A were not implemented. Instead, catenary angles (the angle formed by the chain riser and the water plane) were measured using an inclinometer. Target angles of 70° for the sides and 50° for the bow and stern of the dry dock were established, representing nominal calculated tensions of 5000 and 20,000 pounds, respectively.

Pretensioning of the chain legs was accomplished using the traveling cranes available on the dry dock, as opposed to use of the second AMCON 150.

4.0 OVERHAUL ANALYSIS AND LESSONS LEARNED

4.1 Planning

The technical, budgetary, and scheduling goals of the Holy Loch mooring overhaul project were accomplished satisfactorily. Detailed planning and the coordination of numerous involved organizations were significant positive factors. Table 4-1 demonstrates the planned versus actual time requirements for the various project activities; the planned number of days exceeded the actual days required by 4. The detailed daily activity, however, varied considerably from the actual, as shown in Table 4-2. These variances resulted from the requirement for the continuous availability of the dry dock and its related facilities including the yard tugs to support the FBM fleet. Mooring overhaul activities had to occur on a non-interference basis with fleet requirements; FBM movements, emergency dry dockings, and requirements of the USS HUNLEY took precedence. Overhaul activities were thus planned around the immediate mission requirements of the facility, requiring flexibility and resilience of the overhaul project team.

An execution plan was developed for the project although it was not widely disseminated prior to the field operations. The plan presented the culmination of several months of study and discussion during which time various platforms, equipment, and procedures were analyzed; deviations from the plan (described in Section 3.0) resulted from evaluation, insight and experience gained once on-site.

Detailed development of the plan aided significantly in successful logistics planning. The material requirements for the project were planned sufficiently in advance to allow time for government procurement of most items. The significant purchases included stabilizers, chain parts and rigging gear. Some contractor support was required for equipment rental and hardware fabrication. Shipment of material fron CONUS to Holy Loch was accomplished via U.S. Government mechanisms, most notably from Charleston, S.C. to Holy Loch via scheduled U.S. Navy transport.

4.2 Procedures

Although the field procedures were developed well in advance of on-site operations, there was considerable refinement during the mobilization, training, and early recovery period as the engineering and construction team became familiar with the available equipment and the scope of the job. The key elements of the optimum procedures are analyzed in the subsections below.

Table 4-1

SUMMARY OF ACTIVITIES

Activity	Planned	Actual
Travel	3	3
Mobilization	14	8
Handling Chains & Anchors	20	21
Pretensioning	5	2
Site Days	9	12
Slip Days	2	0
Weather	0	7
Liberty/Holiday	4	4
Demobilization	6	2
	63	59

Table 4-2: Daily Operations, Planned vs. Actual

Date	Planned Activity	Actual Activity
4 May		UCT-1 detachment travel to Holy Loch
15 May		UCT-1 arrive at Holy Loch
16 May	Project team travel to Holy Loch	CHESDIV Reps travel to Holy Loch
17 May	Project team arrive at Holy Loch	CHESDIV Reps arrive at Holy Loch
18 May	Coordination meetings Start survey and mobilization	Coordination and scheduling meeting Inspection of YD
19 May	Survey and mobilization	Coordination meeting Partial equipment delivery
20 May	Survey and mobilization	Mobilization; mount winches and prepare YD
21 May	Survey and mobilization	Continue mobilization, preparation of YD; start survey Scheduled undocking
22 May	Liberty	Liberty; offloading of equipment and material on YD and dry dock
23 May	Survey and mobilization	Mobilization and preparation of YD Continuation of survey
24 May	Survey and mobilization	Mobilization and preparation of YD Continuation of survey Travel to Fairlie for roller, chain stopper and hardware shipment
25 May	Survey and mobilization	Roller and stopper welded in place Mobilization complete
26 May	Recover leg 6 or 7	Recovered leg 6; start anchor weld; realigned shaft of chain roller damaged in YD move 1/2 day activity due to PM docking priority

Table 4-2 (Cont'd) - Page 2

Date	Planned Activity	Actual Activity
27 May	Recover leg 17 or 18	Recovered leg 18; welded #6 anchor stabilizers Loaded 300' of 7/8" wire onto AMCON to allow lower inhaul speeds Skagit winch broke down
28 May	Practice installation	Rigged for practice run; completed #16 anchor weld; started freeing up pelican hook on other legs Shortened anchor sling by ≈ 10 feet
29 May	Liberty	Liberty Rechecked surveying calculations
30 May	Practice installation	Recovered leg 16; completed #18 anchor weld Modified anchor tripout sling YD used in PM for squadron operations
31 May	Final preparations for start of work 2 June 1983	Unscheduled docking preempted field work Discussed scheduling and priorities with CDR Kraft and CAPT Smith Travel to Glasgow and Fairlie for welding supplies
1 June	Tender shift to A-2; no work	No work due to tender shift
2 June	Recover/refurbish/install leg 16	No work due to unscheduled sub docking
3 June	Recover/refurbish/install leg 14	Completed #16 anchor weld Attempted to install leg 16, but aborted due to high winds and second sub now docked on port side of AFDB Met with Commodore on chain/sub interferences affecting side legs
4 June	Recover/refurbish/install leg 8	Again attempted to install leg 16, but aborted due to unscheduled docking in late afternoon of second sub Worked on catenary calculations for redesign of side legs

Table 4-2 (Cont'd) - Page 3

Date	Planned Activity	Actual Activity
5 June	Recover/refurbish/install leg 10	No work; tugs not available because crews worked all night undocking submarine.
6 June	Recover/refurbish/install leg 9	Installed leg 16; sheared bow roller shaft while deploying #16 chain Met with Commodore for discussion of redesign
7 June	Recover/refurbish/install leg 15	Recovered leg 17 taking all day due to special chain/anchor handling for new bridle; could only use crane due to broken shaft; during recovery, discovered that leg 16 was laid across 17
8 June	Move YFNBs - no work	YFNBs moved Inspected and flaked out #17 chain on YD deck Removed and rewound wire from both winch drums Unable to lay chain due to moving of both YFNBs
9 June	Recover/refurbish/install leg 2	Set buoy for 17/18, did not try to lay leg due to high winds (20-30 KTS); cut new shaft for bow roller and cut out old shaft; welded on #17 anchor; started welding on bow padeye for pretensioning
10 June	Recover/refurbish/install leg 22	Installed bridled leg 17/18; recovered leg 1; during #1 recovery, parted 7/8" strap with chain 60 feet in air; no injuries
11 June	Recover/refurbish/install leg 1	Rigged anchor and chain on YD for leg 1, but unable to install due to high winds (35 KTS); welded #1 anchor
12 June	Scheduled slip day	#1 anchor laid Attempted to install leg 1, but aborted due to high winds (18-22 KTS) causing YD control problems; retrieved anchor and reflaked chain; installed new bow roller shaft and repaired mounting

'able 4-2 (Cont'd) - Page 4

Date	Planned Activity	Actual Activity
13 June	Move YFNB back to mooring - no work	Installed leg 1; recovered leg 2; no problems YFNB move delayed
14 June	Recover/refurbish/install leg 11	No work due to high winds (force 7-8)
15 June	Recover/refurbish/install leg 13	Installed leg 2; recovered leg 22; no problems
16 June	Recover/refurbish/install leg 12	Installed leg 22; renewed wire on top drum of winch due to bad spots in wire; removed wire from bottom drum and rewound to tighten lay; bottom drum wire needs to be replaced.
17 June	Recover/refurbish/install leg 20	No work due to YFNB move
18 June	Recover/refurbish/install leg 4	Leg 17/18 yoke completed, leg 14 recovered and installed, leg 15 recovered; no problems
19 June	Liberty	Reweld of wedge plate for #15 anchor; installed leg 15; recovered leg 21 - had phone cable running over top of chain Divers hooked onto chain on outward side of cable, disconnected chain and put bitter end back into the water - recovery completed - phone service checked out O.K.
20 June	Recovery/refurbish/install leg 3	Installed leg 21, no further work due to sub undocking
21 June	Recover/refurbish/install leg 21	Recovered leg 7; YD barge required to assist with TAK offload Operations aborted due to high winds
22 June	Scheduled slip day	Installed leg 6/7; recovered leg 4; no problems
23 June	No work; move tender back to A-1	Installed leg 4; recovered and installed leg 3; no problems

Table 4-2 (Cont'd) - Page 5

Date	Planned Activity	Actual Activity
24 June	No work; remove equipment from dock for 27 June scheduled docking	Recovered leg 5; started installation maneuvers but aborted due to squadron movements Rewound wire on both AMCON drums
25-26 June	No work; remove equipment from dock for 27 June scheduled docking	No work due to blocking of berth by subs
27 June	Scheduled docking (later cancelled)	No work due to blocking of berth by subs
28 June	Replace equipment on dock	No work due to high winds
29 June	Recover/refurbish/install leg 19	Installed leg 5; recovered leg 12; no problems
30 June	Recover/refurbish/install leg 5	Installed leg 12; recovered leg 13; roller shaft broke while installing leg 12 - unrepairable
1 July	Recover/refurbish/install leg 6/7	Installed leg 13; recovered leg 11; no problems
2 July	Recover/refurbish/install leg 17/18	Installed leg 11; recovered leg 20 - leg 19 anchor and old phone cables also raised as chain and cable had crossed over leg 20. Cables replaced
3 July	Liberty	No work due to high winds (> 35 KTS)
4 July	Holiday	Holiday
5 July	Pretensioning	Installed leg 20; recovered and installed leg 19; no problems
6 July	Pretensioning	Recovered and installed legs 10 & 9; leg 9 had to be freed from phone cable
7 July	Pretensioning	Recovered and installed leg 8; leg had to be freed from phone cable Cleaned up YD

Table 4-2 (Cont'd) - Page 6

Date	Planned Activity	Actual Activity
8 July	Pretensioning	Started pretensioning; start packout
9 July	Pretensioning	Completed pretensioning; packout and demobe
10 July	Liberty	Liberty
11 July	Demobe and packout	Demobe and packout; cleaned up; debrief to COMSUBRON 14; set up for shipping
12 July	Demobe and packout	Liberty
13 July	Demobe and packout	UCT returned to CONUS
14-16 July	Demobe and packout	
17 July	Travel	

4.2.1 Survey and Positioning

Except for the field changes noted in Section 3.1, the survey and positioning techniques were conventional and satisfactory. The specified equipment and manpower levels met the requirements of the task precisely.

4.2.2 Recovery

Mooring leg recovery was greatly facilitated by the use of the double drum Amcon 150 and the chain roller combination because it allowed implementation of the relatively efficient hand over hand in-haul technique. Recovery of a 500 to 700 foot leg typically required 1-1/2 to 2 hours. During the first period when the chain roller shaft was damaged, a recovery was made using the YD crane picking the chain in bights and stopping off after each bight; these evolutions required 6 to 7 hours.

The Amcon 150 did not have sufficient line pull to break out or lift the anchors requiring transfer of the recovery operation to the YD crane. This did not prove to be an inefficiency in the recovery operation since the crane had to make the final pick of the anchor from the water to the deck under any recovery scenario. Use of the chain stopper helped to speed up the recovery of the final two bights of chain and the anchor, as well as improve the safety of the stopping-off task.

It was learned during the recovery operation that the extra time spent diligently waterblasting the chain and anchor as they were brought aboard and carefully organizing and faking the chain as it was placed on deck greatly improved the efficiency of subsequent inspection, overhaul, end for ending and reinstallation operations. Mud caked chain is difficult and time consuming to inspect. Chain haphazardly piled on deck had to be refaked requiring extra crane and rigging time which could have been avoided if it was laid down with care the first time.

4.2.3 Refurbishment

13,193 feet of chain were recovered during the overhaul operation, of which 292 (2.2%) feet were scrapped because of wastage in excess of the specified acceptance criteria. The few deteriorated lengths appeared to be a result of galvanic and/or crevice corrosion caused by the chain being piled up at the mudline. Most of the chain showed minimal loss (less than 3%) of diameter due to corrosion, particularly that which was buried in the mud. A slight but detectable increase in wastage (up to 5% diameter loss) was typical in the riser due both to uniform corrosion and abrasion between links.

The hardware recovered required minimal refurbishment. All of the detachable chain links were reusable except for 7 Camp CJLs which were quite loose when recovered and, hence, replaced. The

NACCO CJLs's that were disassembled were fitted with new mild steel rivets during refurbishment.

Four of the anchors recovered exhibited a higher degree of rust and encrustation than the other 18, apparently because they were not properly buried and pretensioned during the previous deployment. These anchors did not require, however, any unusual additional refurbishment.

The welding procedures used to attach the stabilizers to the anchors (previously described in Section 3.3.2) were developed on-site. Although the first 2 or 3 installations required approximately 12 hours each, the handling, fitting and welding techniques were sufficiently refined to reduce the operation to 6-7 hours.

4.2.4 Reinstallation

Reinstallation of the anchors using the tripping slings and deployment of the chain legs over the chain roller using the AMCON worked well. The importance of good coordination of barge movements and chain payout is underscored by the damage to the chain roller shaft which occurred late in the project. Apparently, the speed of the barge exceeded the payout rate of the winch, increasing the tension in the chain and ultimately causing the shaft to fail.

Use of the AMCON 150 on the YD for final leg termination also improved the operation's efficiency, because it eliminated the mobilization and rigging that would have been required had the second AMCON been used on the dry dock.

4.2.5 Pretensioning

Use of the AFDB-7 traveling cranes greatly simplified the pretensioning operation, reducing the time required from the planned five days to two days. Preparations were minimized since the complex fairleading requirements originally contemplated were, for the most part, eliminated and the AMCON winch did not have to be installed or relocated. The traveling capability of the cranes precluded the requirement for special snatch blocks and padeyes. In addition, the use of catenary angles to indirectly measure leg tension precluded the requirement for direct (dynamometer) measurement, eliminating a considerable rigging evolution at each termination.

Although use of the AFDB-7 cranes could not be counted on because of potential facility priorities, their ultimate availability and provision had a significant positive impact on the project's outcome.

4.3 Equipment

4.3.1 YD Crane Barge

The Navy YD crane barge performed satisfactorily for the overhaul operations. Although originally a concern, there were no operational problems or maintenance deficiencies which seriously impacted the project. The capacity and reach of the crane exceeded all project requirements. Deck space was minimally sufficient. The central location of the engine house dissected potential large open deck areas which would have improved the chain handling space. Use of the starboard side for recovery and deployment activities was a "lesser of two evils" choice, made because it had the fewest obstructions. Numerous hatches, scuttles and vent pipes which were located there had to be protected with well-secured wooden beams.

The frequent demand for the services of the YD by higher priority activities at Holy Loch degraded the efficiency of the overhaul operation somewhat. The flexibility of the project team and the constant availability of refurbishment tasks minimized wasted time.

4.3.2 AMCON Winches

The AMCON 150 used as the primary recovery hoist performed satisfactorily, although it had minimal hauling capacity in excess of the expected requirement. There were several circumstances when additional capacity would have aided operational response to higher-than-expected loads. The amount of wire spooled on the drums was reduced to increase the capacity of the winch for the normal operations when only 100 feet were required of the drum.

Originally planned for the reinstallation and pretensioning operations on the AFDB-7, the second AMCON 150 was not used because of the availability of the dry dock cranes. It served as a backup to the primary recovery hoist.

4.3.3 Chain Roller

The chain roller performed satisfactorily until it was damaged irreparably late in the project. Subsequent to that event, chain was recovered and deployed over the roller frame which acted as a bolster. Use of the roller (or bolster) for recovery and deployment operations proved to be substantially quicker than using the YD crane and handling the chain in bights.

The chain roller had the following deficiencies:

- It did not have sufficient reserve capacity to handle the unexpected load events.

- The flanges were not sufficiently high to keep the chain from jumping the drum at extreme fleeting angles. Doubling the flange to 12" would have been prudent. Two 12" diameter guideposts were installed aft of the roller which significantly improved the roller's safety.

- Welding the drum to the shaft and the excess shaft length over the drum width were design deficiencies. Added strength could have been obtained by improving these design elements.

4.3.4 Chain Stopper

The chain stopper worked well, speeding up the securing of the vertical chain bights and improving the safety of the operation, as hoped. No significant deficiencies were noted.

4.3.5 Water Blast Pump

The Jaeger-Sykes pump provided exellent volume and pressure for waterblasting operations. It was, however difficult to prime, requiring excessive manpower input during start-up.

4.3.6 Skagit Winch

The Skagit winch had a minor role in deck operations, limited to miscellaneous chain hauling on deck. The winch performed marginally, being difficult to start and keep running and requiring constant maintenance. A small air operated tugger would have been more suitable for the role played by the Skagit for the project.

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2. Holy Loch Fleet Moorings Inspection Report, CHESNAVFACENGCOM, FPO-1-82(22), 15 Oct 1982, 15 pp. plus appendices.

3. Design Manual, Harber and Coastal Facilities, NAVDOCKS DM-26, Feb 1962, 400 pp.

4. U.S. Navy Mooring Guide, V.1, NAVDOCKS TP-PW-2, 1 March 1954, 98pp. plus appendices.

APPENDIX A

PROJECT EXECUTION PLAN

PROJECT EXECUTION PLAN

AFDB-7 LOS ALAMOS
MOORING OVERHAUL

Holy Loch, Scotland

May 1983

Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

AFDB-7 LOS ALAMOS MOORING OVERHAUL

Holy Loch, Scotland

Execution Plan

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18 May 1983

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1.0 INTRODUCTION

1.1 Background

The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) has been requested by the Atlantic Division of the Naval Facilities Engineering Command (LANTNAVFAC-ENGCOM) to provide project engineering and on-site supervision for the overhaul of the mooring system of the Special Floating Dry Dock AFDB-7 located at Holy Loch, Scotland. The Commander, Naval Construction Battalions, U.S. Atlantic Fleet (COMCBLANT) has been tasked to provide fleet personnel from Seabee Underwater Construction Team One (UCT-1) to perform the overhaul operations.

LANTNAVFACENGCOM developed the specifications for the overhaul based upon the results of a detailed diver and engineering survey conducted in June 1982 by CHESNAVFACENGCOM and UCT-1 and reported in reference 1, as well as input from the user organization, COMSUBRON 14. The specifications are given in LANTNAVFACENGCOM drawing number 4091244. Using the specifications and other available information and applying generally accepted ocean engineering principles, a Project Execution Plan has been developed and is presented herein.

1.2 General Description

Holy Loch is located on the west coast of Scotland about 35 miles west-northwest of Glasgow. Access to Holy Loch from the Atlantic Ocean is via the Irish Sea and the Firth of Clyde (Figure 1A).

The AFDB-7 (USS LOS ALAMOS) is located in the center of Holy Loch in approximately 70 feet of water, 3/4 mile from shore (see Figure 1B). It consists of four dock cells which are

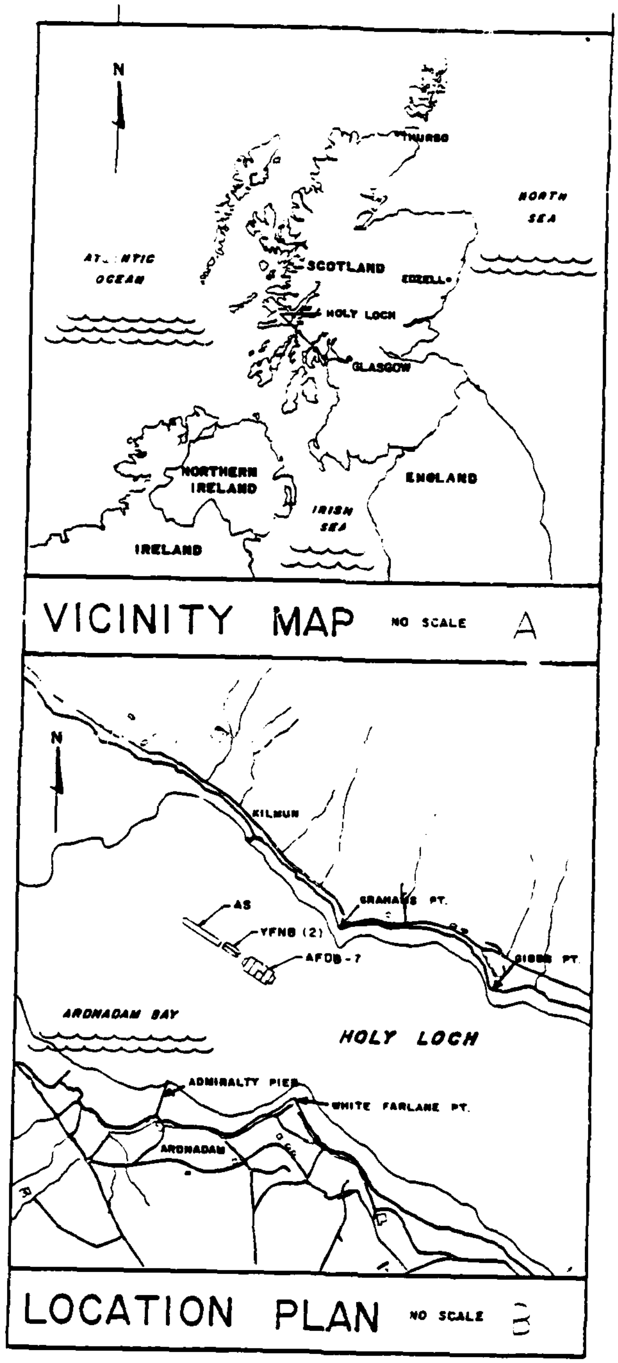

N
THURSO
NORTH
SEA
OCEAN
SCOTLAND
EDZELL
HOLY LOCH
GLASGOW
NORTHERN
IRELAND
IRISH
SEA
ENGLAND
IRELAND
VICINITY MAP
NO SCALE
A
N
KILMUN
AS
YFNB (2)
AFDB-7
ARDNADAM BAY
HOLY LOCH
ADMIRALTY PIER
WHITE FARLANE PT.
ARDNADAM
LOCATION PLAN
NO SCALE

Figure 1-1

connected together and moored in place by 22 ground legs and anchors. The dock is 513 feet long and 241 feet wide. Each leg of three-inch diameter studlink chain runs from a padeye on deck to a 30,000 pound anchor (stockless without stabilizer). AFDB-7 was originally installed in 1961 at a position to the southeast of its present location; movement of the dock to the current location was completed on 5 August 1971.

The dry dock is routinely used by fleet ballistic missile (FBM) submarines. Because of the strategic importance of this facility and the possibility of severe winter weather, the material condition of the mooring is a continuing concern. Between 1973 and 1981, 19 of the 22 ground legs were inspected by the British Ministry of Defense (M.O.D.). During this period, only one of the ground legs was determined to contain a chain link which was worn to less than 80% of the original wire diameter; the length which contained this link was replaced in 1981. In April 1982, divers from the USS HUNLEY (AS-31) visually inspected 21 of the 22 ground legs. All chain was reported to be in good condition, although some legs were observed to have little or no catenary. The June 1982 inspection confirmed the April 1982 results.

A schematic diagram of the AFDB-7 mooring is shown in Figure 1-2.

1.3 Objective

The scope of the project includes the following major objectives:

- Raise the AFDB-7 mooring legs.
- Recondition the anchors including the addition of stabilizers and fixing the fluke angle at 45°.

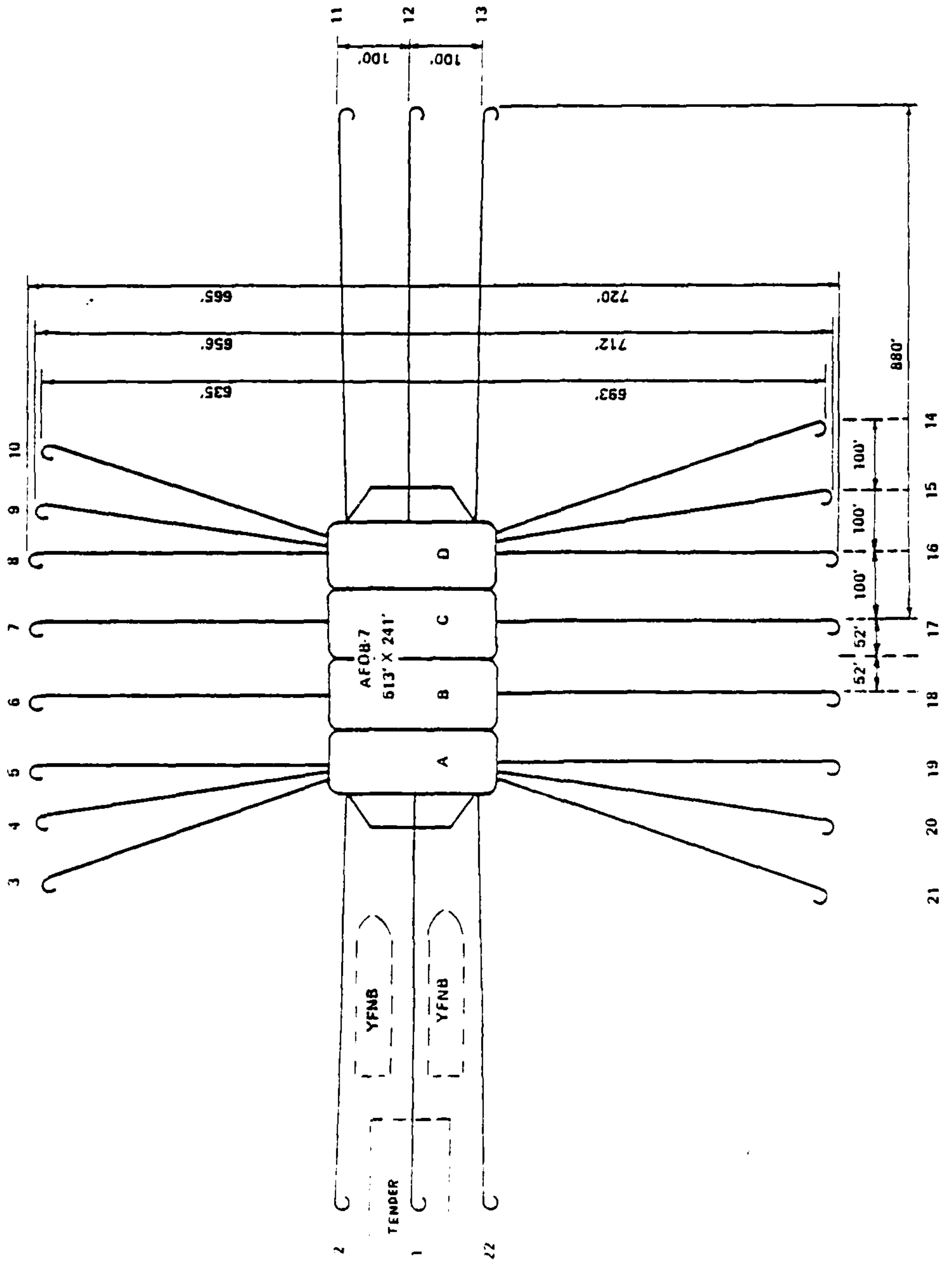


Figure 1-2: FLOATING DOCK MOORING

- Inspect the chain and refurbish as necessary. Modify the leg lengths according to the new specifications.
- Reinstall the anchors at new precision surveyed locations.
- Pretension the mooring legs according to specification.

Twenty mooring legs will be reinstalled. Legs 6/7 and 17/18 will be replaced by one leg for each pair, yoked to dry-dock sections B and C.

Accomplishment of these objectives will help reduce the excursion of the dry dock during high wind and current events and maintain the dock's position relative to the YFNB's when it is submerged.

1.4 Organization

Numerous fleet, technical and support commands will take part in the project. To ensure effective control of the various commands so that the mission will be accomplished in an efficient and safe manner, a special organization has been established. This organization is shown in Figure 1-3.

The project is under the general direction of the CHESNAVFACENGCOM technical representative, Mr. David Raecke. UCT-1 activities will be supervised by CPOIC BUCS Phillip Pronia.

1.5 Schedule

The project schedule is given in Figure 1-4. Project personnel will arrive on site the week of 16 May 1983. Material and equipment is due to arrive by 20 May 1983. Mobilization and training will require 7 to 10 days. Mooring overhaul

PROJECT ORGANIZATION

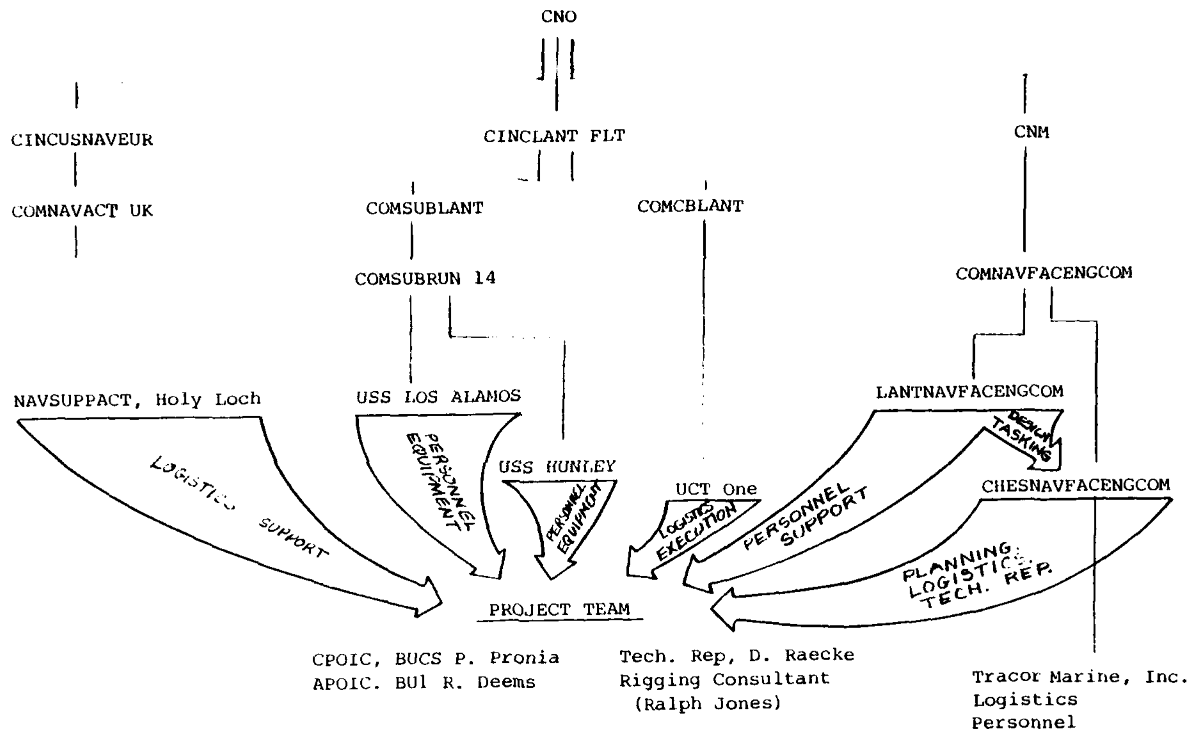


Figure 1-3

operations will require approximately one month beginning 1 June 1983. Pretensioning is scheduled for the week of 4 July 1983. Demobilization will follow beginning 10 July 1983.

The proposed schedule is largely contingent upon the availability of the work platform (YD) and tug support, and ready access to the AFDB-7. Five weather days are allotted, although they are not included in the schedule given in Figure 1-4.

1.6 Logistics

Logistics will be coordinated by CHESNAVFACENGCOM and UCT-1. Shipment of material and equipment from CONUS to Holy Loch will be made from the Naval Supply Center, Charleston, South Carolina, via T-AK. T-AK transits require 7 to 10 days; the vessels will offload at the site in Holy Loch. Equipment required on an emergent basis and weighing less than 6000 pounds can be air shipped by MAC from Charleston to Prestwick. NAVSUPPACT will provide immediate ground transfer from Prestwick to Fairlie and shipment via local freighter (Puffer) from Fairlie to Holy Loch.

Logistics support for small procurement, fabrication, and expediting will be provided both on-site and in CONUS by a support contractor to CHESNAVFACENGCOM.

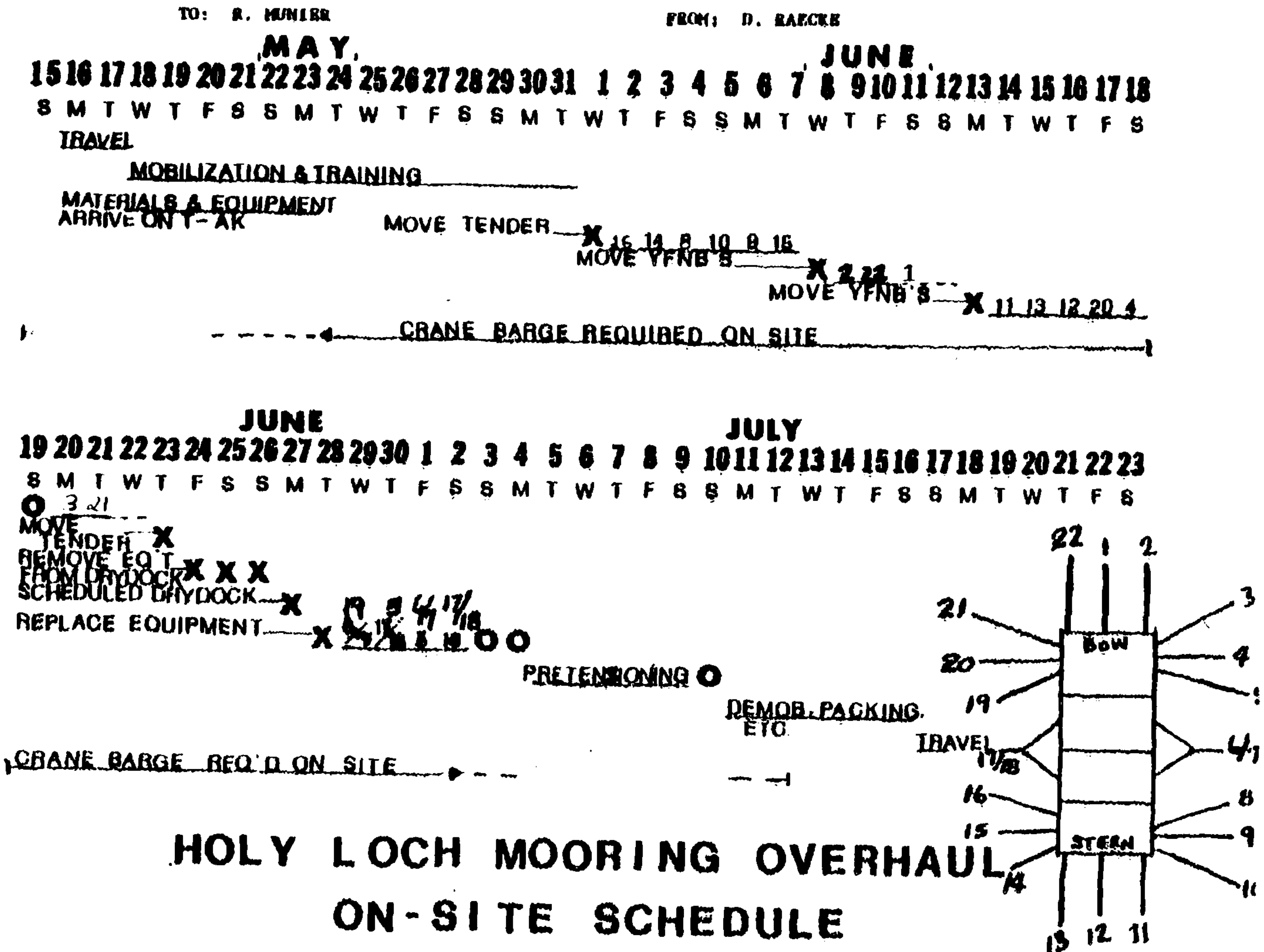


Figure 1-4: Schedule

2.0 MOBILIZATION

Project mobilization includes preliminary activities at numerous sites in CONUS, shipment of material/equipment and personnel travel to Holy Loch, setup at Holy Loch, and crew training. Mobilization tasks, by organization, are delineated as follows:

Organization	Principal Tasks
CHESNAVFACENGCOM, FPO-1C	Project management and engineering. Coordination of OCEI support, procurement.
UCT-1	Project planning, equipment preparation and shipment, crew training, platform mobilization.
Tracor Marine	Procurement, design engineering, hardware fabrication, planning, on-site consultation.
NAVSUPPACT, Holy Loch	Logistics support on-site.
USS LOS ALAMOS	Personnel, equipment as available.
USS HUNLEY	Personnel, equipment as available.
Naval Supply Center (Charleston)	Shipping

Mobilization at CONUS is scheduled for 15 April through 16 May 1983, with the primary shipment of equipment from CONUS to Holy Loch leaving Charleston, South Carolina, by T-AK during the week of 2 May 1983 and due to arrive in Holy Loch by 21 May. A secondary air shipment of equipment is scheduled from Charleston, leaving the week of 23 May 1983. Personnel travel is scheduled for the week of 16 May 1983.

2.1 Equipment

2.1.1 YD Crane Barge

The primary work platform is a 100 ton 140 x 70 foot Navy YD crane barge. The aft third of the platform supports the full rotatable crane house and crane boom. Forward approximately mid-deck is a 25 x 25 foot engine house which rises five feet above deck level. The crane boom rest sits just forward of the engine house.

The crane boom is 124 feet long and is equipped with a light hook at the end and a large main hook 20 feet inboard. Both hooks are duplex. The crane has been down rated to the following capacities:

Main hook: 150 kip at both 104 and 80 foot radii
Light hook: 16 kip at 124 foot radius.

2.1.2 YTB

Two Navy harbor tugs (YTB) will be used to dynamically position the YD during operations. YTBs (generically) are 109 LOA x 30 x 13.8 feet, displace 350 tons, and are powered by twin diesels at 2000 HP.

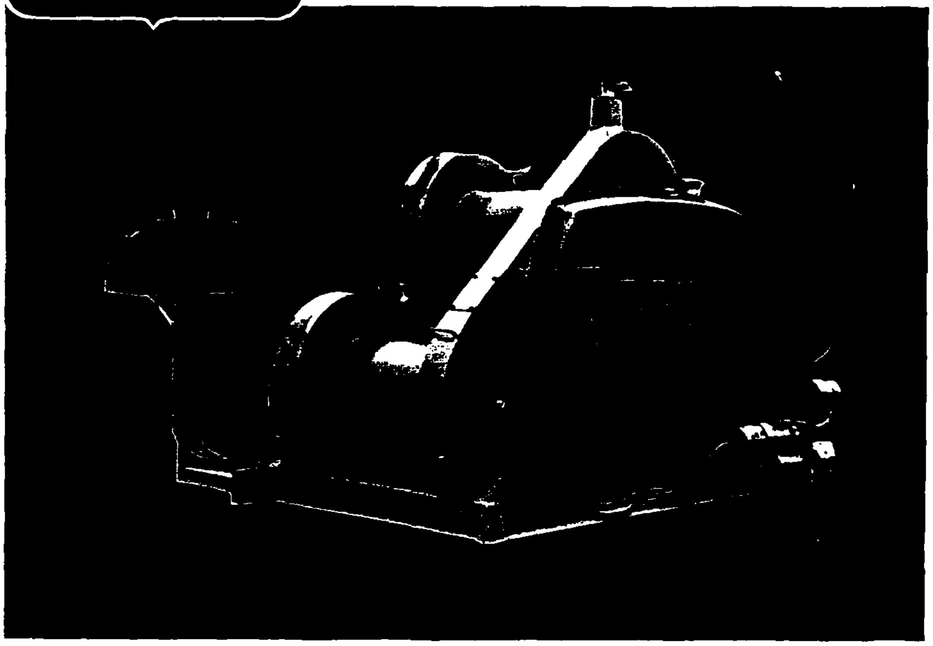
2.1.3 Double Drum Winch

Two AMCON 150 double drum winches will be on site. Specifications are given in Figure 2-1. Tentatively, one is to be placed on the AFDB-7 for releasing the chain legs and pre-tensioning operations, and the other will be located on the YD

AMCON®

A CONMACO, INC. EXCLUSIVE

150 AIR-CONTROLLED HOIST



The **AMCON**® Model 150 is a heavy-duty air-controlled hoist arranged for heavy lift, anchoring and derrick applications. The machine is available in single, double, triple and four-drum waterfall configurations. Attached boom swingers are offered as optional equipment.

The standard **AMCON**® Model 150 is powered by a Detroit Diesel Model 4-53N diesel engine driving through an Allison single-stage torque converter. An engine-driven air compressor, air tank and diesel fuel tank are furnished as standard equipment. Optional diesel engines, transmissions and electric drives are available upon request.

Figure 2-1

AMCON 150

AIR-CONTROLLED HOIST

DRUM DIMENSIONS
Flange diameter .... 30" (762 MM)
Drum diameter .... 14" (356 MM)
Drum length .... 28" (711 MM)

SPOOLING CAPACITIES
3578' (1091 M) .... 5/8" wire rope
2639' (804 M) .... 3/4" wire rope
1894' (577 M) .... 7/8" wire rope
1316' (401 M) .... 1" wire rope

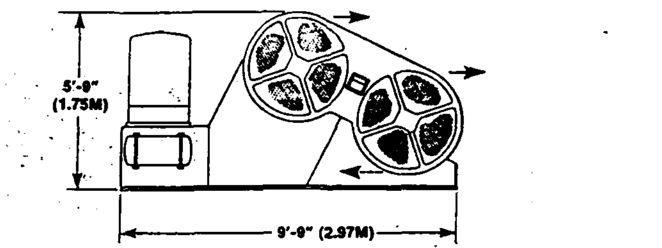
DRUM BRAKES (Single std.)
(Air-applied w/spring-set override/ parking brake feature)
Diameter .... 28" (711 MM)
Width .... 4" (102 MM)
Static holding power first layer,
Service .... 28,000# (12.7 MT)
Static holding power first layer,
Service + parking .... 50,000# (22.6 MT)

DRUM CLUTCHES (Single std.)
Diameter .... 20.25" (514 MM)
Width .... 3" (76 MM)

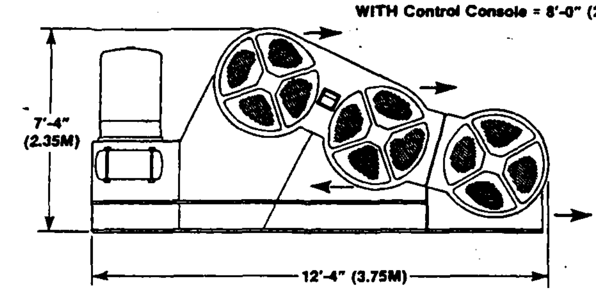
MAXIMUM SIZE WIRE ROPE FOR ANCHORING SERVICE ..... 1" wire rope

APPROXIMATE WEIGHTS
(With standard power)
Single drum .... 6,200# (2.8 MT)
Double drum .... 9,055# (4.1 MT)
Three drum .... 12,466# (5.6 MT)

CONTROL CONSOLE
Side mounted stand-up type .... Standard
Swing around — seated .... Optional
Forward facing w/cab .... Optional



OVERALL MACHINE WIDTH
WITH Control Console = 8'-0" (2.43M)



3-DRUM OVERALL MACHINE WIDTH
WITH Control Console = 8'-6" (2.59M)
W/O Control Console = 7'-0" (2.13M)

PERFORMANCE DATA

Typical single-drum line pull in pounds (metric tons) and line speed in feet per minute (meters per minute) with a Detroit Diesel Model 4-53N diesel engine driving through an Allison single-stage converter and using 1" wire rope.

	FULL DRUM	AVERAGE DRUM	FIRST LAYER
	LINE PULL / LINE SPEED	LINE PULL / LINE SPEED	LINE PULL / LINE SPEED
HIGH 70%	5,887# @ 418 FPM (2.7 MT @ 127 MPM)	7,719# @ 318 FPM (3.5 MT @ 97 MPM)	11,209# @ 219 FPM (5.1 MT @ 67 MPM)
MAX. EFF.	8,263# @ 289 FPM (3.7 MT @ 88 MPM)	10,935# @ 220 FPM (5.0 MT @ 67 MPM)	16,733# @ 152 FPM (7.6 MT @ 46 MPM)
LOW 70%	11,906# @ 170 FPM (5.4 MT @ 52 MPM)	15,612# @ 130 FPM (7.1 MT @ 40 MPM)	22,669# @ 89 FPM (10.3 MT @ 27 MPM)
STALL	18,743# (8.5 MT)	24,578# (11.2 MT)	35,688# (16.2 MT)

For special applications, consult your nearest CONMACO office.

DEPENDABLE CONSTRUCTION EQUIPMENT SINCE 1907

CONMACO, INC.

GENERAL OFFICE
920 KANSAS AVENUE
P.O. BOX 5097
KANSAS CITY, KANSAS 66119
TOLL FREE 800-255-4601
IN KANSAS CALL 913-371-3930
TWX — 910-743-6816

Figure 2-1 (Cont'd)

SALES OFFICES WORLDWIDE

as the primary chain recovery hoist. Both winches are equipped with 600 feet of 7/8" 6 x 37 IWRC on the lower drum and 1000 feet of 1" 6 x 37 IWRC on the upper drum. The specifications of the wire are given in 2-2.

2.1.4 Skagit Winch

A Skagit Model GU-8-YD, self-contained, gasoline powered, single drum winch (see Figure 2-3) will be on site for miscellaneous rigging tasks aboard the dry dock, or optionally, aboard the YD. The winch is equipped with 600 feet of 5/8" wire rope.

2.1.5 Jet Pump

A Jaeger-Sykes Model GPH (see Figure 2-4) self-priming, centrifugal dewatering pump, powered by a GM 3-53 diesel engine, will be positioned aboard the YD. It is equipped with two 10 foot sections of 6" suction hose. The discharge will be reduced to 1½" and equipped with 500 feet of fire hose for use in water blast/ cleaning operations of the mooring chain and anchors as they are recovered.

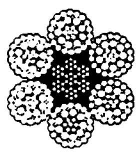
2.1.6 Chain Roller

A 30 kip steel roller will be mounted on the bow of the YD for use in recovering the anchor chain. The drum is 24" diameter, 43" long, and has a wall thickness of 1.218". The drum will rotate on a 3-7/16" steel shaft supported by sphere aligned pillow block split bearings mounted on I-beam side frames. Recovery using the YD crane may allow use of a less sophisticated bolster like that shown in Figure 2-5.

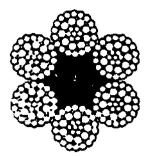
2.1.7 Chain Stopper

A 25 ton modified devil's claw chain stopper will be mounted on the YD, portside to provide a means of quick action

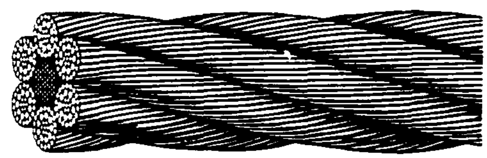
6 x 37 Classification



IWRC



Fiber Core



6 x 43 Filler Wire

General Description

Strands: 6

Wires per Strand: 27 to 49

Core: IWRC, Fiber

Grade: MONITOR AA, MONITOR, Corrosion-Resisting

Lay: Right, Left; Regular, Lang

Finish: Bright, Galvanized

Typical Applications

USS TIGER BRAND 6 x 37 Classification Wire Ropes find broad use on traveling cranes, mining and earthmoving equipment, and various heavy-duty hoisting and industrial equipment applications.

Characteristics

USS TIGER BRAND 6 x 37 Classification Wire Ropes have a third layer of wires which makes them more flexible, although less abrasion-resistant, than ropes of the 6 x 19 classification. Each strand contains numerous, comparatively small-diameter wires. As the number of wires in each strand is increased, flexibility is increased. Conversely, as wires per strand decrease, flexibility is decreased.

The 6 x 43 FW and 6 x 46 FW, with 18 outer wires in each strand, are the most flexible constructions in this classification. Ropes of both the 6 x 41 FW and 6 x 49 FW Seale constructions have 16 outside wires per strand, and are slightly less flexible.

The 6 x 36 FW construction with 14 outer wires in each strand, and the 6 x 31 Warrington-Seale with 12 outer wires in each strand are correspondingly less flexible, but offer greater resistance to wear.

6 x 37 Classification Hoisting Rope

Rope Diameter Inches	Breaking Strength in Tons of 2,000 Lb			Approximate Weight Per Foot in Lb	
	MONITOR AA Steel IWRC	MONITOR Steel IWRC	MONITOR Steel Fiber Core	MONITOR and MONITOR AA IWRC	MONITOR Steel Fiber Core
1/4	3.2	2.78	2.59	0.116	0.105
5/16	4.98	4.33	4.03	0.18	0.164
3/8	7.14	6.2	5.77	0.26	0.236
7/16	9.67	8.41	7.82	0.35	0.32
1/2	12.6	11.0	10.2	0.46	0.42
9/16	15.9	13.9	12.9	0.59	0.53
5/8	19.6	17.0	15.8	0.72	0.66
3/4	27.9	24.3	22.6	1.04	0.95
7/8	37.8	32.9	30.6	1.42	1.29
1	49.1	42.8	39.8	1.85	1.68
1 1/8	61.9	53.9	50.1	2.34	2.13
1 1/4	76.1	66.1	61.5	2.89	2.63
1 3/8	91.7	79.7	74.1	3.5	3.18
1 1/2	108.0	94.5	87.9	4.16	3.78
1 5/8	127.0	111.0	103.0	4.88	4.44
1 3/4	146.0	128.0	119.0	5.67	5.15
1 7/8	168.0	146.0	136.0	6.5	5.91
2	190.0	165.0	154.0	7.39	6.72
2 1/8	214.0	186.0	173.0	8.35	7.59
2 1/4	239.0	207.0	193.0	9.36	8.57
2 3/8	264.0	230.0	214.0	10.4	9.48
2 1/2	292.0	254.0	236.0	11.6	10.5
2 5/8	321.0	279.0	260.0	12.8	11.6
2 3/4	350.0	305.0	284.0	14.0	12.7
2 7/8	382.0	333.0	310.0	15.3	13.9
3	414.0	360.0	335.0	16.6	15.1
3 1/8	448.0	389.0	362.0	18.0	16.4
3 1/4	483.0	419.0	390.0	19.5	17.7
3 3/8	518.0	451.0	420.0	21.0	19.1
3 1/2	555.0	483.0	449.0	22.7	20.6

Galvanizing: For 6 x 37 classification galvanized wire ropes, deduct 10 percent from the listed breaking strength of bright (uncoated) wire rope.

Figure 2-2

USS Tiger Brand Wire Rope

6 x 37 Classification

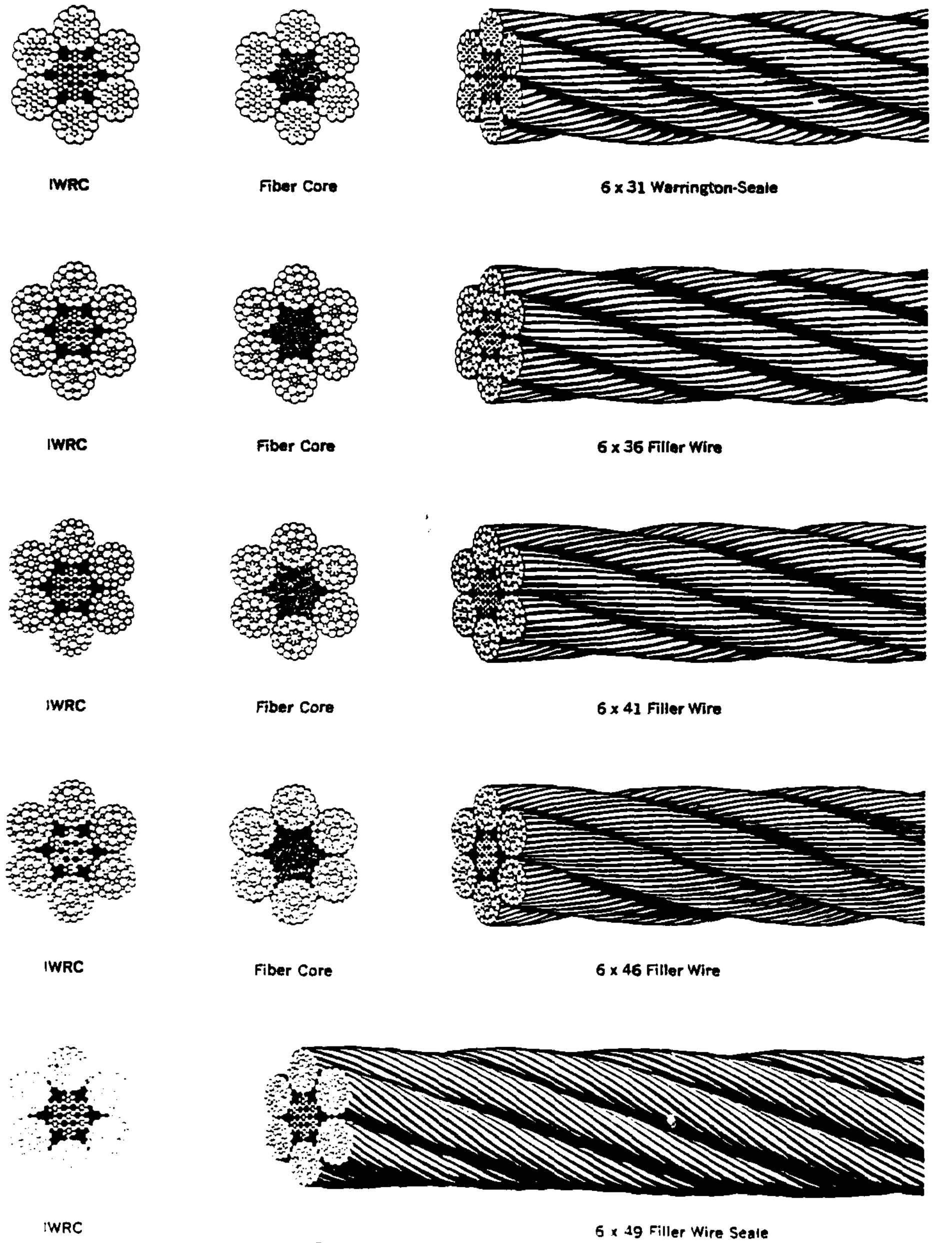
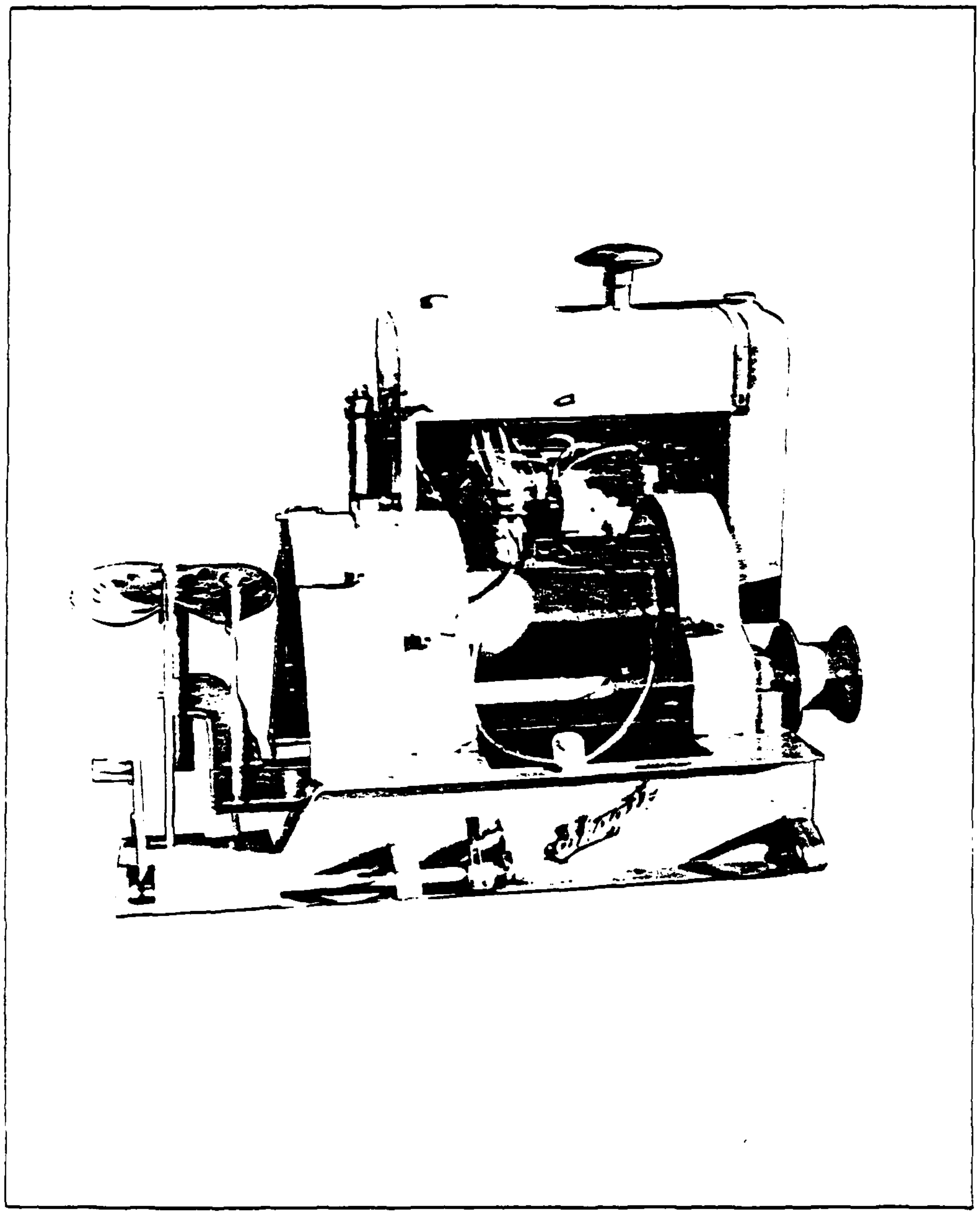


Figure 2-2 (Cont'd)



Winch, Single Drum (18K)

Figure 2-8

Item

WINCH, SINGLE DRUM (18 K)

Manufacturer

Skagit Corp., Sedro-Wooley, WA 98284

Model

GU-8-YD

General Description

The single-drum winch is a self-contained two-speed unit powered by a Waukesha, Model 190 GLU, 57 hp gasoline engine at 2,000 rpm. The unit can be used for a variety of winching, hoisting, and mooring operations.

Performance

The cable winch is capable of performing in two-speed ranges in accordance with the following data:

	Drum	Speed	Pull
High Range:	Full	370 fpm	4,580 lb.
	Average	275 fpm	8,170 lb.
	Bare	189 fpm	18,400 lb.
Low Range:	Full	181 fpm	9,380 lb.
	Average	134 fpm	12,600 lb.
	Bare	92 fpm	18,400 lb.

Physical Description

Winch Unit

Height	52-1/2 in.
Length	67-5/8 in.
Width	81-5/8 in.
Weight	N/A

Cable Drum

Flange	18-1/2 in.
Core (dia.)	9 in.
Length	18 in.

Cable Drum Capacity

Cable	Drum Capacity
3/8 in.	2,180 ft
1/2 in.	1,230 ft.
5/8 in.	790 ft.

Auxiliary Power or Support Equipment Requirements

Sufficient hoisting facilities are required for loading and off-loading the winch unit.

Operator/Crew Requirements

One experienced person is required for operating the winch unit. Additional personnel are required based upon application of unit.

Training Requirements

Two days' training in the field or at the manufacturer's facility is required to familiarize operator(s) with the operation and preventive maintenance of the equipment.

Field Maintenance Requirements

Field maintenance will be performed per OCEI instructions and manufacturer's manual. Operating logs and equipment history cards must be maintained.

Spare Parts

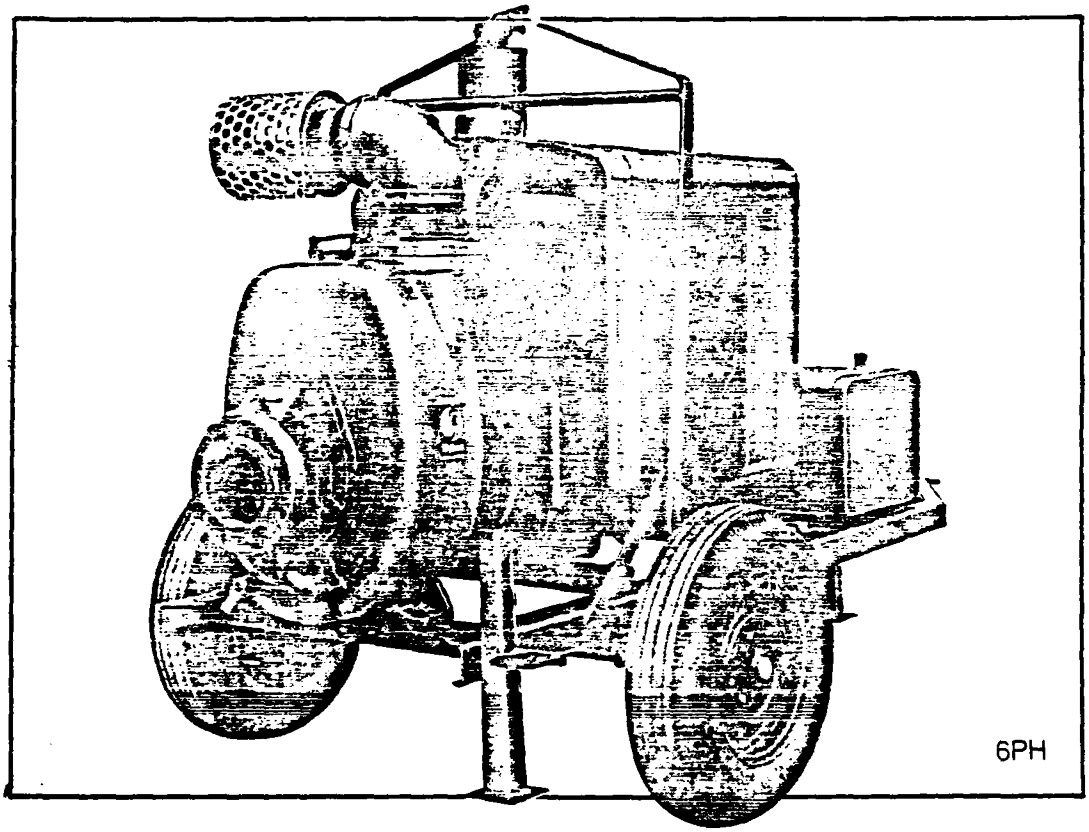
Spare parts are not available.

Mobilization Time: Two days

Figure 2-3 (Cont'd)

Jaeger
Sykes, Inc.

pump data sheet



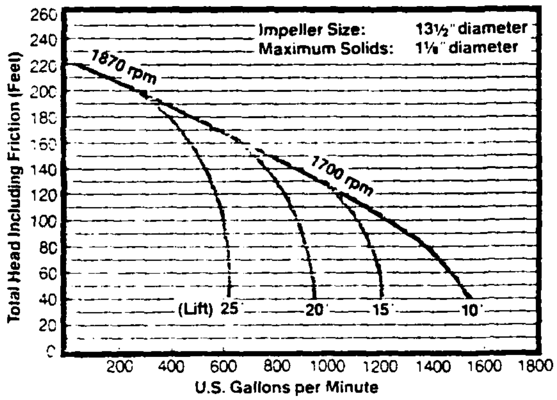
6PH

This dual duty pump will jet well points and dewater them. Model 6PH is widely used to pump large volumes at high heads 1000 GPM @ 130' total head. The shaft seal is positively lubricated and easily accessible for inspection. The liner plate is rotatable and replaceable for maximum efficiency and wear.

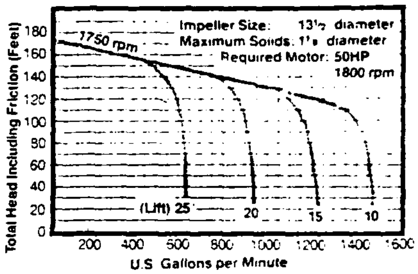
Self-priming centrifugal dewatering pump

Figure 2-4

Self-priming centrifugal dewatering pump



6PHD



6PHEL

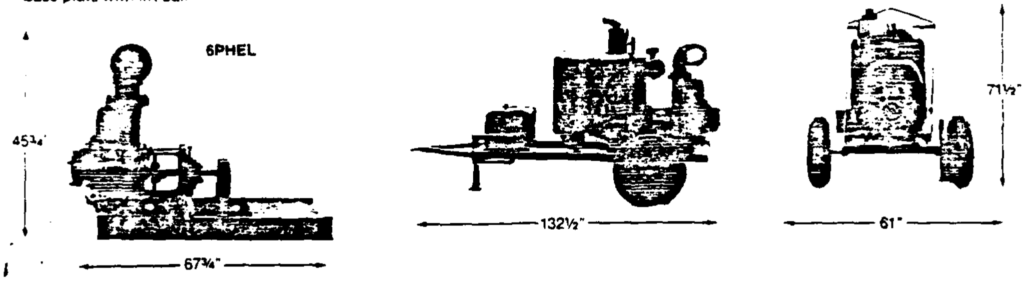
Specifications: 6PH-6PHEL
Suction Discharge: 6" x 6"
Volute: self-cleaning, close grain cast iron
Impeller: close grain cast iron, open type
Wear Plate: rotatable and replaceable, steel
Shaft Seal: mechanical, "Lubri-Seal"

Standard Equipment:
Engine Driven: 6PH
Chassis with two 7 75 x 15 pneumatic tires
Strainer
Safety switches
12 volt starting system complete with battery
Electric Motor Driven: 6PHEL
Base plate with lift bail

Primer Movers:
Gasoline Engine
Chrysler HB225
Displacement 225 cu in
Diesel Engine
GMC 3-53
Displacement 159 cu in
Optional Primer Movers
Electric Motor Required: 50 HP @ 1800 RPM

Dimensions and Weights:

	6PH	6PHEL
Length:	132½"	67¾"
Width:	61"	24½"
Height:	71½"	45¾"
Weight:	2100 lbs. (Approx.)	1070 lbs (Approx.)



Note: We reserve the right to change specifications appearing in this bulletin without incurring any obligation for equipment previously or subsequently sold

Jaeger Sykes, Inc.
223 Curtis St.
Delaware, Ohio 43015
614-369-9656 Telex 241-151

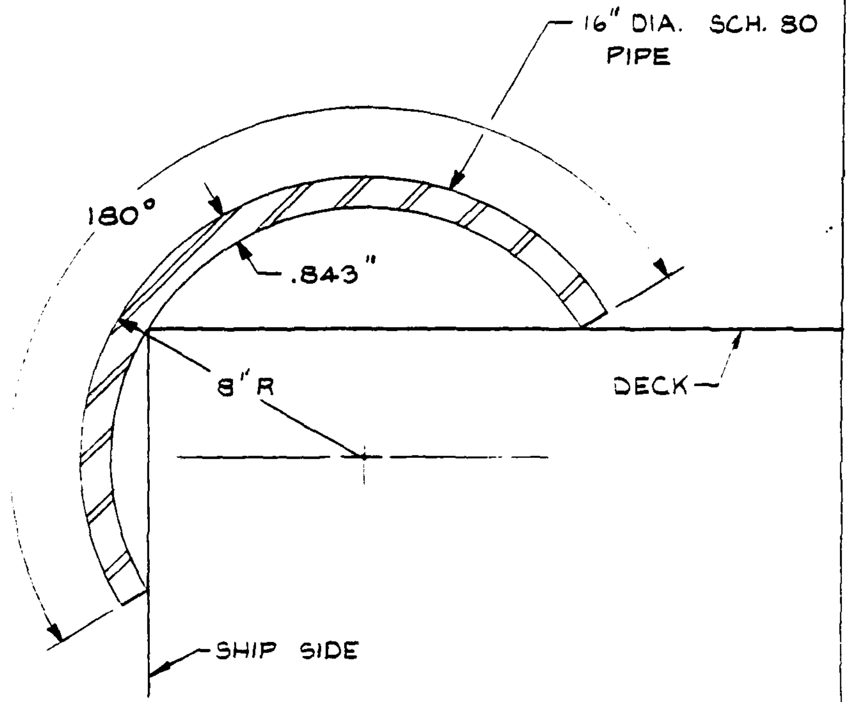
Jaeger Sykes, Inc. a wholly-owned subsidiary company of the Henry Sykes group of companies, offers a combined experience of over 167 years in the engineering design and manufacture of self-priming centrifugal pumps. This assures you the highest quality pump for your application. Jaeger Sykes pumps are used worldwide to create the *right conditions for* all types of work from drying of construction sites to *the handling of industrial effluents*, sewage and slurries. When your needs require self-priming pump capabilities, Jaeger Sykes will provide the highest availability and selection for your particular application.

Your Jaeger Sykes Distributor:

Figure 2-4 (Cont'd)

11-79

AF 24216



BOLSTER

REV	DESCRIPTION	BY	DATE

Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316

Figure 2-5

Drawn: G. F. ANDERSON	Date: 17 MAY '83
Checked:	Scale: 1/4
Approved:	Drawing Number / Rev.
Sheet ___ of ___	

stoppering of the chain when lifted in vertical (plumb) bights, using the crane. A sketch is shown in Figure 2-6. Wire rope slings, alternatives to the chain stopper, are shown in Figure 2-6A.

2.1.8 Padeyes

Twenty 25 ton padeyes are available for installation at strategic locations on the YD and/or AFDB-7, for use in securing wire rope stoppers.

2.1.9 Miscellaneous Equipment

Miscellaneous rigging gear and other project equipment are listed in Table 2-1. Available specifications are given in Figure 2-7.

2.1.10 Chain Spares

A supply of chain hardware has been procured to serve as an inventory for renewal requirements of degraded existing components. The inventory is listed in Table 2-2. Chain specifications are provided in Figure 2-8.

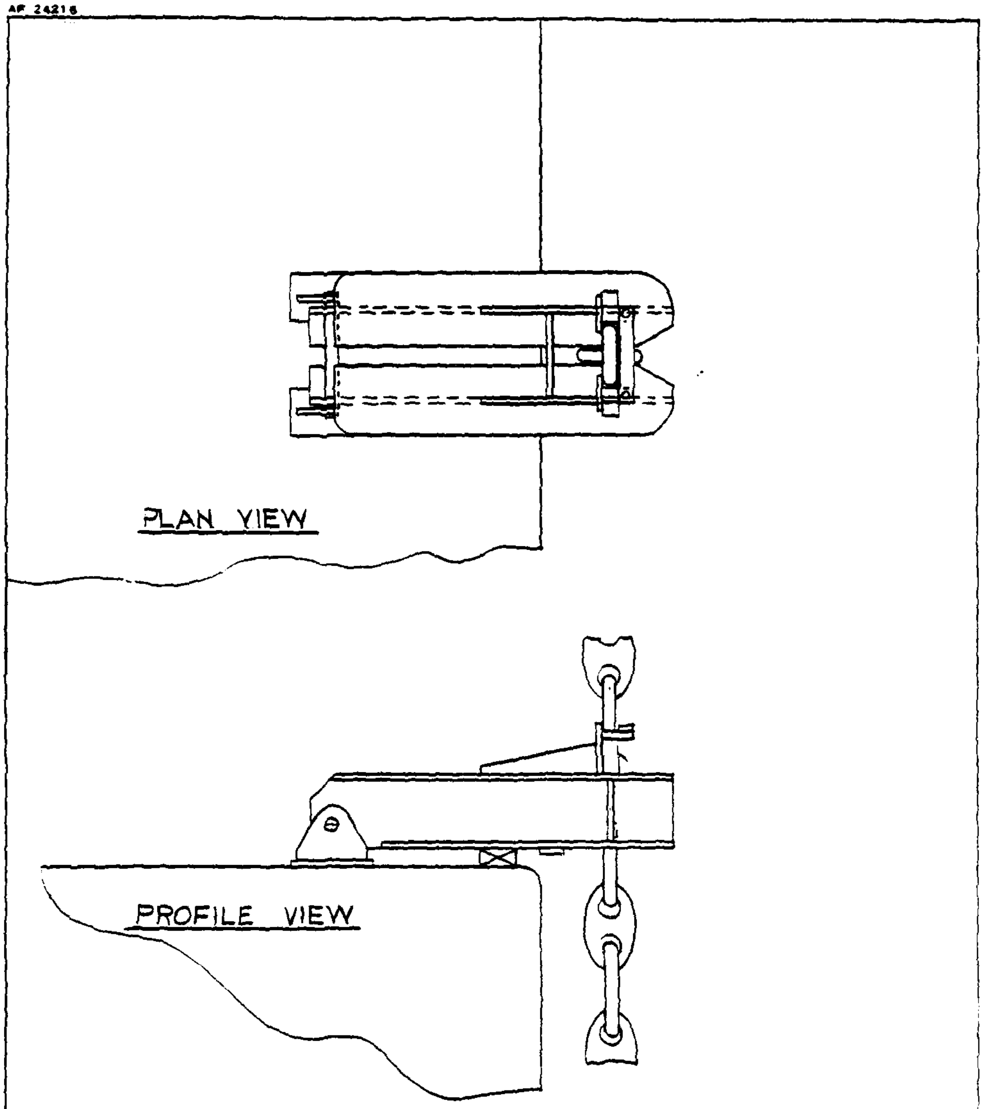
2.1.11 Stabilizers

Stabilizers have been fabricated for attachment to each anchor as per Figure 2-9. Each consists of half round 16" O.D. steel pipe welded to 74" long x 23" wide x 1" thick steel plate; two are provided for each anchor.

2.2 Equipment Setup On Site

Figure 2-10 gives a schematic deck layout of the YD prepared for recovery of the anchor legs over the port bow, using an AMCON 150 as the primary hoist, which is the primary recovery method. Table 2-3 details the preparations required on the YD. The AMCON may also be set facing forward on either the port or starboard side if there is sufficient clearance for the winch beneath the swing of the crane counter weight (see Figure 2-10a). Similarly, the deck layouts for the secondary and tertiary options of recovery over the port bow of the YD using the crane, and recovery over the portside using the crane as principal hoist

AF 24216



REV	DESCRIPTION	BY	DATE

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PT. EVERGLADES, FLORIDA
33316

Figure 2-6 - Chain Stopper

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Approved: RSCM	Drawing Number / Rev
Sheet ___ of ___	

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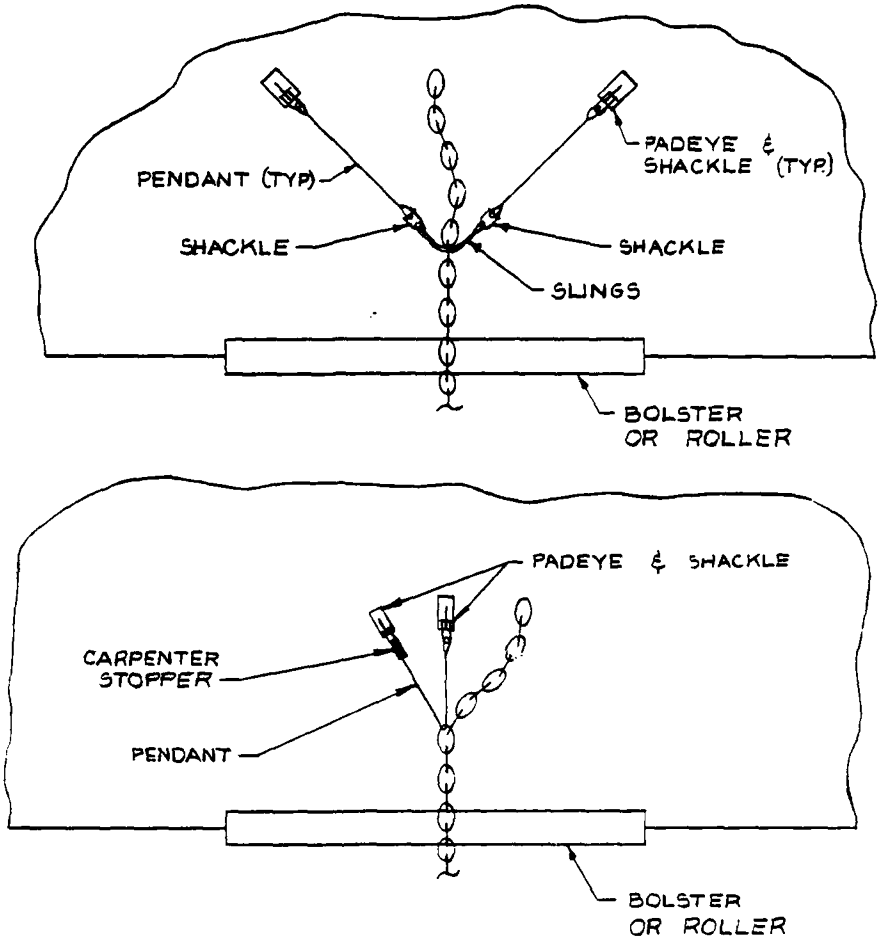

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33316

Figure 6A - Wire rope chain stopper alternatives

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Sheet ____ of ____	

Table 2-1

MISCELLANEOUS RIGGING GEAR AND PROJECT EQUIPMENT

Item	Quantity	SWL
Hardware		
8" McKissick snatch block	4	12 ton
8" McKissick snatch block	4	25 ton
1½" Bolt type shackle	35	30 ton
1½" Regular swivel	2	22.5 ton
1¼" Pelican hooks	?	?
Slings		
7/8" 6x37 IWRC, 20' long, 36" eyes	15	7 ton
5/8" 6x37 IWRC, 20' long, 36" eyes	15	4 ton
½" 6x37 IWRC, 20' long, 36" eyes	15	2.4 ton
1¼" 6x37 IWRC, 20' long, 36" eyes	4	15 ton
1-1/8" 6x19 IWRC	2	
Other		
Dillon Dynamometer	2	15,20 ton
36" diameter steel spheres	8	
EA equipment (K&E Auto ranger, EAM)		
SeaBee Bos'n Locker	1	
Motorola hand held radios	5	
Hard hat radios	4	
Bullhorn	1	
¼" welding rod	1500#	
3/8" welding rod	100#	
1/8" welding rod	50#	
Cutting kit	1	
Welding kit	1	
Electric arc welding kit	1	
Zodiac Inflatable, w/40 HP outboards	2	
Steel pigs (anchor clump)	?	
Red Lead	10 gallons	
Miscellaneous hand tools		
Air tugger winches	2	2-ton

SNATCH BLOCKS

416
ALL ALLOY
OPEN

ALL ALLOY

- Entire block made from heat treated alloy steel. Use of heat treated alloy gives block only 60% of the weight of blocks of comparable capacities.
- Hook and shackle assemblies quickly interchangeable.
- Available with bronze bushing or roller bearing in the 416, 417, 402 models; 434, 435, 401 models available in bronze bushed only.
- Easy opening feature of "Champion" blocks retained.
- Available with hook latch.

416
ALL ALLOY
WITH HOOK

417
ALL ALLOY
WITH SHACKLE

402
ALL ALLOY
TOGGLE BLOCK
(TAIL BOARD)

6	1½	¾	26	27	15	12
8	1½	¾	33	34	21	12
10	1½	¾	41	42	29	12

*Ultimate Load is 4 times the Safe Working Load.

434
ALL ALLOY
WITH HOOK

435
ALL ALLOY
WITH SHACKLE

401
ALL ALLOY
TOGGLE BLOCK
(TAIL BOARD)

BRONZE BUSHED ONLY

8	3½	1 or 1⅛	90	102	50	25
10	3½	1 or 1⅛	107	118	65	25
12	4½	1 or 1⅛	165	181½	95	30
14	4½	1 or 1⅛	180	19[illegible]	110	30

*Ultimate Load is 4 times the Safe Working Load.

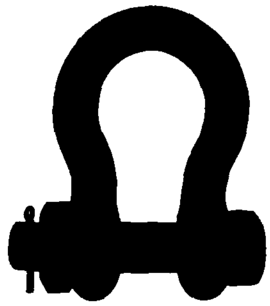
NOTE: In ordering, please specify: Size, block number, hook or shackle, bronze bushed or roller bearing, and wire rope size. Unless otherwise specified, blocks will be furnished for largest wire rope size shown.

Figure 2-7A

FORGED ALLOY SHACKLES

BOLT TYPE ANCHOR SHACKLES

Load Rated



G-2140 S-2140

- Safe Working Load is permanently shown on every shackle.
- Alloy bows, Alloy bolts.
- Quenched and Tempered.
- Individually proof tested.

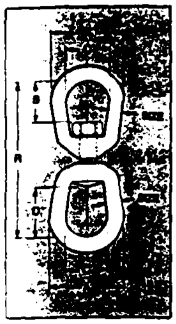
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	1½	5¾	2⅜	1⅝	3⅝	¼	⅛	20.80
40	1¾	7	2⅞	2	4 5/16	¾	⅛	33.91
50	2	7¾	3¼	2¼	5	¾	⅛	51.75
80	2½	10½	4⅛	2¾	6	¾	¼	101.59
110	3	13	5	3¼	6½	¼	¼	178.
140	3½	14⅝	5¼	3¾	8	¼	¼	265.
175	4	14½	5½	4¼	9	¼	¼	338.

*Proof Load is 2.2 times the Safe Working Load.
Minimum Ultimate Strength is 6 times the Safe Working Load

Figure 2-7B

FORGED SWIVELS

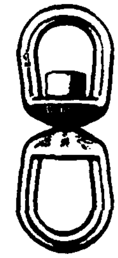
REGULAR



Size Inches	Safe Working Load*	DIMENSIONS IN INCHES					Weight Pounds
¼	850	1¼	11/16	¾	1 1/16	2 15/16	.21
5/16	1250	1⅝	13/16	1	1¼	3 9/16	.39
⅜	2250	2	15/16	1¼	1½	4 5/16	.69
½	3600	2½	1 5/16	1½	2	5 7/16	1.43
⅝	5200	3	1 9/16	1¾	2⅜	6 9/16	2.37
¾	7200	3½	1¾	2	2⅝	7 3/16	3.94
⅞	10000	4	2 1/16	2¼	3 1/16	8⅜	6.18
1	12500	4½	2 5/16	2½	3½	9⅝	8.95
1⅛	15200	5	2⅜	2¾	3¾	10⅜	12.46
1¼	18000	5⅝	2 11/16	3⅛	2 11/16	11⅛	16.76
1½	45200	7	4 3/16	4	4 3/16	17⅛	49.06

*Ultimate Load is five times the Safe Working Load

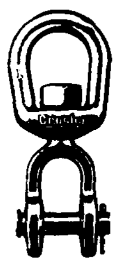
Hot Dip Galvanized



G-402
REGULAR
QUENCHED
& TEMPERED

JAW END

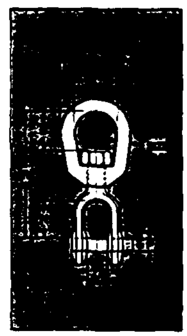
Hot Dip Galvanized



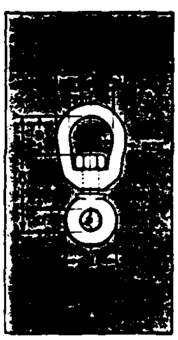
G-403
JAW END
QUENCHED
& TEMPERED

[illegible]	[illegible] Working [illegible]	DIMENSIONS IN INCHES							Weight Pounds Each
¼	850	1¼	11/16	¾	15/32	⅞	¼	2⅝	.25
5/16	1250	1⅝	13/16	1	½	⅞	5/16	2 15/16	.37
⅜	2250	2	15/16	1¼	⅝	1 1/16	⅜	3⅝	.70
½	3600	2½	1 5/16	1½	¾	1 5/16	½	4½	1.43
⅝	5200	3	1 9/16	1¾	15/16	1½	⅝	5 5/16	2.48
¾	7200	3½	1¾	2	1⅛	1¾	¾	6 1/16	4.14
⅞	10000	4	2 1/16	2¼	1 3/16	2 1/16	⅞	7	4.87
1	12500	4½	2 5/16	2½	1¾	2 13/16	1⅛	8 9/16	10.73
1⅛	15200	5	2⅜	2¾	1¾	2 13/16	1⅛	8 15/16	12.48
1¼	18000	5⅝	2 11/16	3⅛	2 1/16	2 13/16	1⅜	9 7/16	16.28
1½	45200	7	4 3/16	4	2⅞	4 7/16	2¼	14¾	49.00

*Ultimate Load is five times the Safe Working Load



CHAIN



[illegible]	[illegible]	DIMENSIONS IN INCHES						[illegible]
¼	850	1¼	11/16	¾	7/16	15/16	2¼	.20
5/16	125C	1⅝	13/16	1	½	1⅛	2 23/32	.36
⅜	2250	2	15/16	1¼	¾	1½	3 7/16	.61
½	3600	2½	1 5/16	1½	⅞	1⅞	4¼	1.12
⅝	5200	3	1 9/16	1¾	1 1/16	2 3/16	5⅛	2.47
¾	7200	3½	1¾	2	1¼	2⅝	5 25/32	3.09

Self Colored or
Hot Dip Galvanized

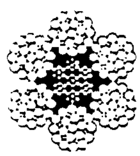
*Ultimate Load is five times the Safe Working Load

G-401 S-401
CHAIN
QUENCHED
& TEMPERED

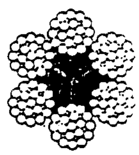
Figure 2-7C

Crosby

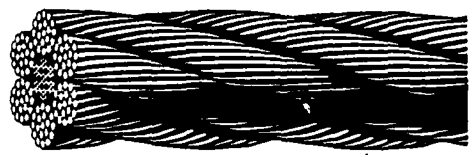
6 x 19 Classification



IWRC



Fiber Core



6 x 25 Filler Wire

General Description

Strands: 6

Wires per Strand: 15 to 26

Core: IWRC, Fiber

Grade: MONITOR AA, MONITOR, Plow, Corrosion-Resisting

Lay: Right, Left; Regular, Lang

Finish: Bright, Galvanized

Typical Applications

Specified for a greater variety of haulage and hoisting services than all other constructions combined: on cranes, derricks, dredges, power shovels, scrapers and piledrivers; for draglines, tramways, cableways; in mines and quarries, marine equipment and installations, and in practically all industries.

Characteristics

USS TIGER BRAND 6 x 19 Classification Wire Ropes provide an excellent balance between fatigue and wear resistance. They will give long service with sheaves and drums of moderate size.

The 6 x 25 Filler Wire (FW) rope is the most flexible rope in the 6 x 19 classification. It is the most widely used of all wire ropes.

The 6 x 19 Warrington rope is made in the smaller sizes of uncoated ropes, and is standard for 6 x 19 classification galvanized ropes.

The 6 x 21 FW, and 6 x 19 Seale ropes are slightly less flexible, but their larger outer wires provide greater resistance to abrasion.

6 x 19 Classification Hoisting Rope

Rope Diameter Inches	Breaking Strength in Tons of 2,000 Lb				Approximate Weight Per Foot in Lb	
	MONITOR AA Steel IWRC	MONITOR Steel IWRC	MONITOR Steel Fiber Core	Plow Steel Fiber Core	IWRC	Fiber Core
1/4		2.94	2.74	2.39	0.116	0.105
5/16		4.58	4.26	3.71	0.18	0.164
3/8		6.56	6.1	5.31	0.26	0.236
7/16		8.89	8.27	7.19	0.35	0.32
1/2	13.3	11.5	10.7	9.35	0.46	0.42
9/16	16.8	14.5	13.5	11.8	0.59	0.53
5/8	20.6	17.9	16.7	14.5	0.72	0.66
3/4	29.4	25.6	23.8	20.7	1.04	0.95
7/8	39.8	34.6	32.2	28.0	1.42	1.29
1	51.7	44.9	41.8	36.4	1.85	1.68
1 1/8	65.0	56.5	52.6	45.7	2.34	2.13
1 1/4	79.9	69.4	64.6	56.2	2.89	2.63
1 3/8	96.0	85.5	77.7	67.5	3.5	3.18
1 1/2	114.0	98.9	92.0	80.0	4.16	3.78
1 5/8	132.0	115.0	107.0	93.4	4.88	4.44
1 3/4	153.0	133.0	124.0	108.0	5.67	5.15
1 7/8	174.0	152.0	141.0	123.0	6.5	5.91
2	198.0	172.0	160.0	139.0	7.39	6.72
2 1/8	221.0	192.0	179.0	156.0	8.35	7.59
2 1/4	247.0	215.0	200.0	174.0	9.36	8.51
2 3/8	274.0	239.0			10.4	
2 1/2	302.0	262.0	244.0	212.0	11.6	10.5
2 5/8	331.0	288.0			12.8	
2 3/4	361.0	314.0	292.0	254.0	14.0	12.7

Galvanizing: For 6 x 19 classification galvanized wire rope, deduct 10 percent from the listed strength of bright (uncoated) wire rope.

Figure 2-7D

Tiger Brand Wire Rope

6 x 19 Classification

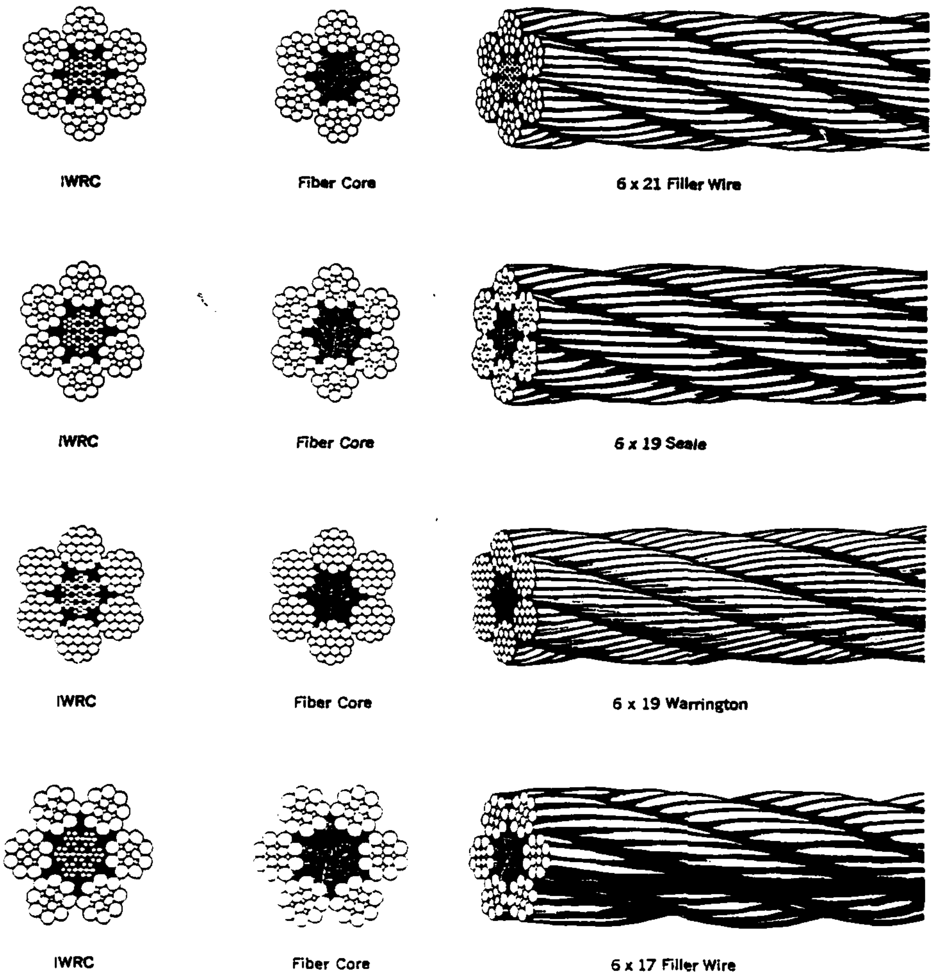
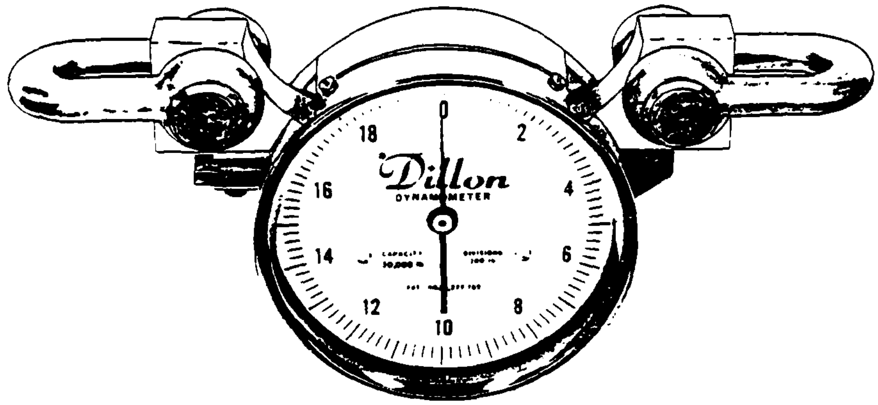
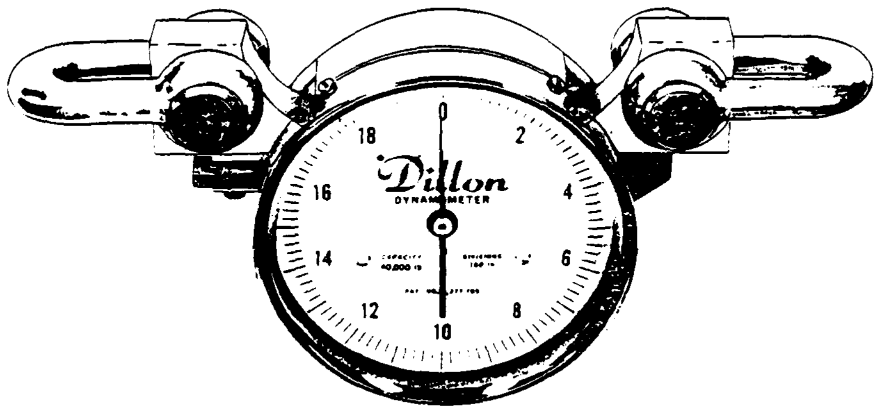


Figure 2-7D (Cont'd)



CAPACITY 30,000 LB



CAPACITY 40,000 LB

Dynamometer, In-Line

Figure 2-7B

Item

DYNAMOMETER, IN-LINE

Manufacturer

W.C. Dillon Co., Van Nuys, CA 91407

Model

N/A

General Description

The dynamometer is a self-contained in-line load measurement device utilizing the deflection of a specially-designed alloy steel beam. The dynamometer can be operated in any position without affecting accuracy. The 6-inch diameter unit is permanently sealed against dust and dirt.

Performance

The in-line dial indicator is capable of providing a reading of 0 to maximum capacity with an accuracy of ±1/2 %. The unit can be used for a variety of in-line applications for determining weight or tension.

Physical Description

Length	≈ 16 in.
Width	≈ 3 in.
Weight	≈ 20 lb.

Auxiliary Power or Support Equipment Requirements

The dynamometer requires no additional power or support equipment.

Operator/Crew Requirements

N/A

Training Requirements

The technical support literature for this item should be studied prior to using.

Field Maintenance Requirements

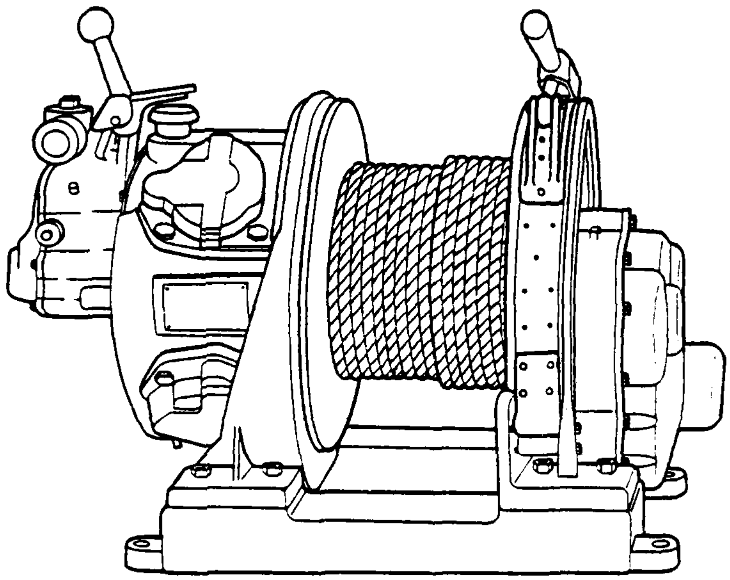
Field maintenance will be performed per OCEI instructions and manufacturer's manual. Operating logs and equipment history cards must be maintained.

Spare Parts

Repair parts are not available.

Mobilization Time: Two days

Figure 2-7E (Cont'd)



Winch, Air Powered (4K)

Figure 2-7F

Item

WINCH, AIR POWERED (4K)

Manufacturer

Ingersoll Rand, Virginia Beach, VA 23455

Models

K4U and HU 40

General Description

The air winch consists of a radial, piston-type air operated reversible motor and cable drum assembly designed to operate at 90 psi. The winch is controlled by a self closing throttle and band type brake. Power and speed are dependent upon the amount of air pressure applied. The winch is portable and lends itself to a variety of hoisting, pulling/tugging operations.

Performance

The winch is capable of controlled line tension as follows:

Winch	K4U	HU 40
Line pull	4000 lb.	4000 lb.
Line speed	125 fpm.	70 fpm.
Rope size	7/16 in.	3/8 in.

Physical Description

Winch	K4U	HU 40
Weight	850 lb.	525 lb.
Length	39 in.	32-5/8 in.
Width	20-1/4 in.	18-1/4 in.
Height	28-1/2 in.	23-1/2 in.

Wire Rope Drum	K4U	HU 40
Width	10 in.	7-1/8 in.
Flange Dia.	19 in.	16 in.
Core Dia.	8 in.	7 in.

Capacity, Wire Rope (Full Drum):

Wire Rope Dia.	K4U	HU 40
1/2 in.	687 ft.	391 ft.
5/8-in.	441 ft.	240 ft.

Auxiliary Power or Support Equipment Requirements

An air compressor capable of supplying 90 psi at a minimum of 300 cfm for Model K4U and 179 cfm for Model HU 40 is required to operate the winch drum. A lifting device of sufficient capacity is required for on-off loading.

Operator/Crew Requirements

A minimum of two persons is required to load the cable reel, thread the cable, and monitor the operation of the winch drum. One trained operator familiar with the operation of air-operated winch drums is required.

Training Requirements

One day's training in the field or at the manufacturer's facility is required to familiarize operator(s) with the operation and preventive maintenance of the equipment.

Field Maintenance Requirements

Field maintenance will be performed per OCEI instructions and manufacturer's manual. Operating logs and equipment history cards must be maintained.

Spare Parts

Spare parts are not available.

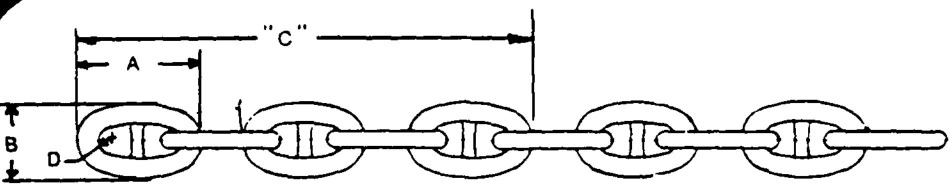
Mobilization Time: Two days

Figure 2-7F (Cont'd)

Table 2-2

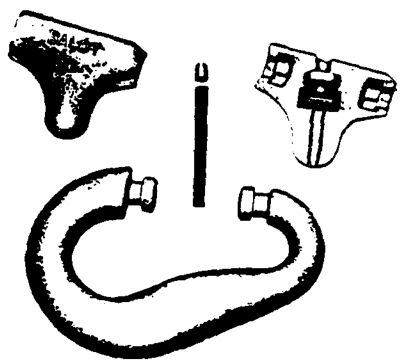
CHAIN SPARES

Item	Size	Qty	SWL
Chain Shackle	4"	3	150 ton
Chain joining link	3"	12	
Anchor joining link	3"	15	
Pear shaped link	3"	2	
Tapered pin (CJL)	3"	15	
Plug (CJL)	3"	100	
Tapered pin (AJL)	3"	10	
Plug (AJL)	3"	100	
Tapered pin (AJL)	3-5/8"	5	
Plug (AJL)	3-5/8"	25	



CHAIN SIZE		DIMENSIONS					TEST REQUIREMENTS						No. of Links per 15-Fathom Shot
							Grade 1		Grade 2		Grade 3		
Inches	Millimeters	Link Length A	Link Width B	Length over 5-Links C	Grip Radius D	Weight per 15 Fmshot (Approx.)	Proof Load	Break Load	Proof Load	Break Load	Proof Load	Break Load	
3/4	19	4 1/2	2 5/8	16 1/2	1/2	480	23800	34000	34000	47600	47600	68000	357
13/16	20	4 7/8	2 7/8	17 7/8	17/32	570	27800	39800	39800	55700	55700	79500	329
7/8	22	5 1/4	3 1/8	19 1/4	37/64	660	32200	46000	46000	64400	64400	91800	305
15/16	24	5 5/8	3 3/8	20 5/8	5/8	760	36800	52600	52600	73700	73700	105000	285
1	25	6	3 9/16	22	21/32	860	41800	59700	59700	83600	83600	119500	267
1 1/16	27	6 3/8	3 3/4	23 3/8	11/16	970	47000	67200	67200	94100	94100	135000	251
1 1/8	29	6 3/4	4	24 3/4	23/32	1080	52600	75000	75000	105000	105000	150000	237
1 3/16	30	7 1/8	4 1/4	26 1/8	25/32	1220	58400	83400	83400	116500	116500	167000	225
1 1/4	32	7 1/2	4 1/2	27 1/2	27/32	1350	64500	92200	92200	129000	129000	184000	213
1 5/16	33	7 7/8	4 3/4	28 7/8	7/8	1490	70900	101500	101500	142000	142000	203000	203
1 3/8	34	8 1/4	4 15/16	30 1/4	7/8	1630	77500	111000	111000	155000	155000	222000	195
1 7/16	36	8 5/8	5 3/16	31 5/8	15/16	1780	84500	120500	120500	169000	169000	241000	187
1 1/2	38	9	5 3/8	33	61/64	1940	91700	131000	131000	183500	183500	262000	179
1 9/16	40	9 3/8	5 5/8	34 3/8	1 1/32	2090	99200	142000	142000	198500	198500	284000	171
1 5/8	42	9 3/4	5 7/8	35 3/4	1 1/16	2240	108000	153000	153000	214000	214000	306000	165
1 11/16	43	10 1/8	6 1/16	37 1/8	1 3/32	2410	115000	166500	166500	229000	229000	327000	159
1 3/4	44	10 1/2	6 5/16	38 1/2	1 1/8	2590	123500	176000	176000	247000	247000	352000	153
1 13/16	46	10 7/8	6 1/2	39 7/8	1 5/32	2790	132000	188500	188500	264000	264000	377000	147
1 7/8	48	11 1/4	6 3/4	41 1/4	1 1/4	2980	140500	201000	201000	281000	281000	402000	143
1 15/16	50	11 5/8	7	42 5/8	1 9/32	3180	149500	214000	214000	299000	299000	427000	139
2	51	12	7 3/16	44	1 5/16	3360	159000	227000	227000	318000	318000	454000	133
2 1/16	52	12 3/8	7 7/16	45 3/8	1 3/8	3570	168500	241000	241000	337000	337000	482000	129
2 1/8	54	12 3/4	7 5/8	46 3/4	1 25/64	3790	178500	255000	255000	357000	357000	510000	125
2 3/16	56	13 1/8	7 7/8	48 1/8	1 13/32	4020	188500	269000	269000	377000	377000	538000	123
2 1/4	58	13 1/2	8 1/8	49 1/2	1 1/2	4250	198500	284000	284000	396000	396000	570000	119
2 5/16	59	13 7/8	8 5/16	50 7/8	1 17/32	4490	209000	299000	299000	418000	418000	598000	117
2 3/8	60	14 1/4	8 9/16	52 1/4	1 9/16	4730	212000	314000	314000	440000	440000	628000	113
2 7/16	62	14 5/8	8 3/4	53 5/8	1 5/8	4960	231000	330000	330000	462000	462000	660000	111
2 1/2	64	15	9	55	1 5/8	5270	242000	346000	346000	484000	484000	692000	107
2 9/16	66	15 3/8	9 1/4	56 3/8	1 11/16	5540	254000	363000	363000	507000	507000	726000	105
2 5/8	67	15 3/4	9 7/16	57 3/4	1 11/16	5820	265000	379000	379000	530000	530000	758000	103
2 11/16	68	16 1/8	9 11/16	59 1/8	1 3/4	6110	277000	396000	396000	554000	554000	792000	99
2 3/4	70	16 1/2	9 7/8	60 1/2	1 13/16	6410	289000	413000	413000	578000	578000	826000	97
2 13/16	71	16 7/8	10 1/8	61 7/8	1 27/32	6710	301000	431000	431000	603000	603000	861000	95
2 7/8	73	17 1/4	10 3/8	63 1/4	1 7/8	7020	314000	449000	449000	628000	628000	897000	93
2 15/16	75	17 5/8	10 9/16	64 5/8	1 7/8	7330	327000	467000	467000	654000	654000	934000	91
3	76	18	10 13/16	66	2	7650	340000	485000	485000	679000	679000	970000	89
3 1/16	78	18 3/8	11	67 3/8	2	7980	353000	504000	504000	705000	705000	1008000	87
3 1/8	79	18 3/4	11 1/4	68 3/4	2 1/32	8320	366000	523000	523000	732000	732000	1046000	85
3 3/16	81	19 1/8	11 1/2	70 1/8	2 1/16	8660	380000	542000	542000	759000	759000	1084000	85
3 1/4	83	19 1/2	11 11/16	71 1/2	2 1/8	9010	393000	562000	562000	787000	787000	1124000	83
3 5/16	84	19 7/8	11 15/16	72 7/8	2 1/8	9360	407000	582000	582000	814000	814000	1163000	81
3 3/8	86	20 1/4	12 1/8	74 1/4	2 3/16	9730	421000	602000	602000	843000	843000	1204000	79
3 7/16	87	20 5/8	12 3/8	75 5/8	2 3/16	10100	435000	622000	622000	871000	871000	1244000	77
3 1/2	90	21	12 5/8	77	2 1/4	10500	450000	643000	643000	900000	900000	1285000	75
3 5/8	92	21 3/4	12 13/16	79 3/4	2 5/16	11300	479000	685000	685000	958000	958000	1369000	73
3 3/4	95	22 1/2	13 1/2	82 1/2	2 13/32	12000	509000	728000	728000	1019000	1019000	1455000	71
3 7/8	98	23 1/4	14	85 1/4	2 15/32	12900	540000	772000	772000	1080000	1080000	1543000	69
4	102	24	14 3/8	88	2 5/8	13700	571000	816000	816000	1143000	1143000	1632000	67
4 1/8	105	24 3/4	14 7/8	90 3/4	2 11/16	14600	603000	862000	862000	1207000	1207000	1724000	65
4 1/4	108	25 1/2	15 5/16	93 1/2	2 3/4	15400	636000	908000	908000	1272000	1272000	1817000	63
4 3/8	111	26 1/4	15 3/4	96 1/4	2 7/8	16200	669000	956000	956000	1338000	1338000	1911000	61
4 1/2	114	27	16 3/16	99	2 15/16	17100	703000	1004000	1004000	1405000	1405000	2008000	59

Figure 2-8

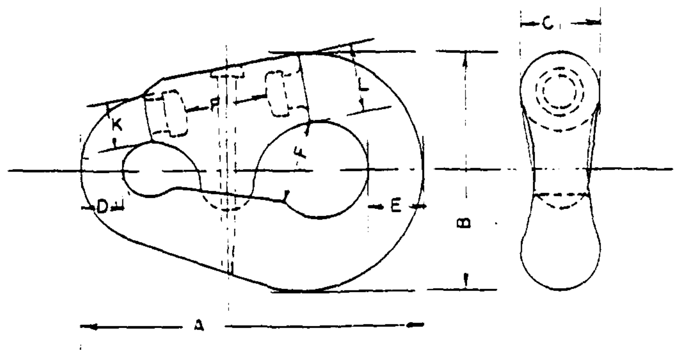


The Baldt Detachable Chain Connecting Link eliminated connecting shackles. However, the connection between the chain and the large anchor shackle still had to be made by the use of a large, weak, end or "bending" shackle, which very easily caught on the lip of the hawse pipe, spread and caused loss of a valuable anchor.

Baldt developed the Detachable (Pear Shaped) Anchor Connecting Link. It embodies all of the advantages and strength of the standard chain connecting link and is designed to fit the common link of the chain and to connect directly to the large shackle that is a part of the anchor.

The Baldt Detachable Anchor Connecting Link, as pictured above, consists of a "C" link with two mating caps. A stainless steel tapered pin and a lead plug are provided to positively lock the caps to the "C" link. It is possible to disassemble the link by removing the tapered pin by use of a drift and sledge.

Baldt Detachable Anchor Connecting Li



NO.	SIZE CHAIN	A	B	C	D	E	F	K	L	PROOF TEST IN POUNDS	BREAK TEST IN POUNDS
1	1/2 — 11/16	5 1/2	3 13/16	1 1/8	5/8	15/16	1 17/32	5/8	1	41,300	61,800
2	3/4 — 13/16	7 5/8	5 3/16	1 9/16	15/16	1 1/4	2 3/32	15/16	1 3/8	74,000	113,500
3	1 — 1 3/8	9 5/8	6 7/16	1 13/16	1 3/16	1 1/2	2 9/16	1 1/4	1 13/16	118,000	179,500
4	1 1/4 — 1 9/16	11 3/4	8 1/8	2 3/16	1 5/16	1 7/8	3 1/8	1 17/32 x 1 3/4	2 1/4	200,500	302,500
5	1 5/8 — 2	15	9 7/8	3	2	2 1/2	3 15/16	2 1/16 x 2 1/2	3	322,000	488,000
6	2 1/16 — 2 3/8	17 7/8	12 5/16	3 5/8	2 3/8	3	4 3/4	2 5/16 x 2 7/8	3 1/2	447,000	675,000
7	2 7/16 — 3	22	14 13/16	4 5/8	3	3 3/4	5 7/8	3 1/8	4 3/8	693,000	1,045,000
8	3 1/16 — 3 5/8	25 3/8	16	5 1/2	3 5/8	4 7/8	6	4 3/8 x 4 13/16	5 1/8 x 5 1/8	1,021,000	1,566,000
9	3 11/16 — 3 3/4	27 1/4	17 1/8	5 3/4	3 7/8	5 1/8	6 1/4	4 7/8 x 5 3/8	5 9/16	1,120,000	1,750,000

Figure 2-8 (Cont'd)

AD-A167 192 AFDB-7 LOS ALAMOS MOORING OVERHAUL HOLY LOCH SCOTLAND 2/2
(U) TRACOR MARINE PORT EVERGLADES FL OCEAN TECHNOLOGY
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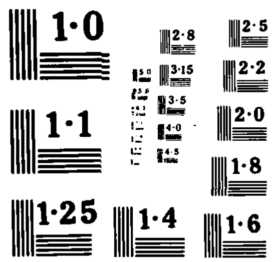
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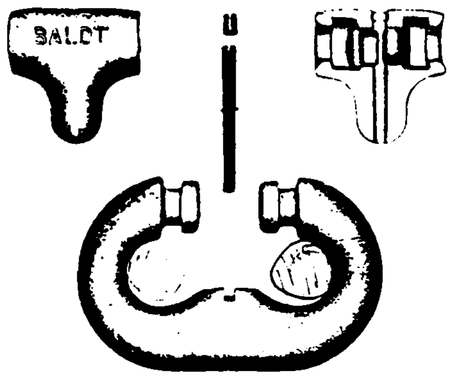
1·4
1·6

ldt Detachable Chain Connecting Link

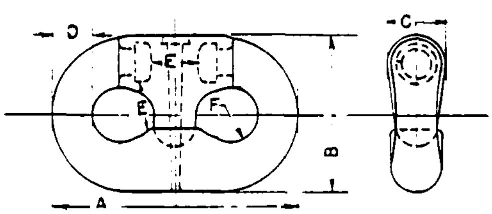
With the invention of high strength DI-LOK chain, it was evident that a chain connection had to be devised that would eliminate antiquated shackles and end links, and one that would be strong enough to take full advantage of DI-LOK's greater strength.

The answer was the forged alloy steel DETACHABLE CHAIN CONNECTING LINK developed at the Boston Navy Yard. It is so designed that its strength is equal to that of DI-LOK chain. It dispenses with shackles and end links and rides smoothly over the wildcat and through the hawse pipe. It is used not only as a connection between the 90 foot "shots" of chain but is also used as a repair or replacement link.

The alloy steel used to manufacture the Baldt Detachable Chain Connecting Link is heat-treated to a tensile strength of approximately 150,000 lbs. p.s.i. It is the standard connecting link of the U. S. Navy and is given the highest recommendation by all commercial testing societies.



The Baldt Detachable Chain Connecting Link, as pictured above, consists of a "C" link with two mating caps. A stainless steel tapered pin and a lead plug are provided to positively lock the caps to the "C" link. It is possible to disassemble the link by removing the tapered pin by use of a drift and sledge.



SIZE CHAIN	A	B	C	D	E	F	PROOF TEST IN POUNDS	BREAK TEST IN POUNDS
1/2 — 5/8	3 3/4	2 15/32	13/16	5/8	3/4	25/64	32,300	52,200
11/16 — 3/4	4 1/2	2 15/16	1 1/32	3/4	7/8	1/2	48,000	75,000
13/16 — 7/8	5 1/4	3 27/64	1 3/16	7/8	1 1/8	19/32	64,000	98,000
15/16 — 1	6	3 59/64	1 11/32	1	1 5/32	21/32	84,000	129,000
1 1/16 — 1 1/8	6 3/4	4 27/64	1 5/16	1 1/8	1 1/4	3/4	106,000	161,000
1 3/16 — 1 1/4	7 1/2	4 29/32	1 11/16	1 1/4	1 7/16	27/32	130,000	198,000
1 5/16 — 1 3/8	8 1/4	5 3/8	1 27/32	1 3/8	1 19/32	29/32	157,000	235,000
1 7/16 — 1 1/2	9	5 7/8	2	1 1/2	1 3/4	1	185,000	280,000
1 9/16 — 1 5/8	9 3/4	6 3/8	2 1/4	1 5/8	1 31/32	1 1/16	216,000	325,000
1 11/16 — 1 3/4	10 1/2	6 51/64	2 5/16	1 3/4	2 1/32	1 5/32	249,000	380,000
1 13/16 — 1 7/8	11 1/4	7 11/32	2 9/16	1 7/8	2 5/32	1 15/64	285,000	432,000
1 15/16 — 2	12	7 27/32	2 11/16	2	2 5/16	1 5/16	322,000	488,000
2 1/16	12 3/8	8 5/64	2 7/8	2 1/16	2 7/16	1 11/32	342,000	518,000
2 1/8	12 3/4	8 5/16	2 15/16	2 1/8	2 15/32	1 13/32	362,000	548,000
2 3/16	13 1/8	8 17/32	2 31/32	2 3/16	2 17/32	1 7/16	382,500	579,100
2 1/4	13 1/2	8 25/32	3 1/8	2 1/4	2 5/8	1 1/2	403,000	610,000
2 5/16	13 7/8	9 1/32	3 5/32	2 5/16	2 11/16	1 17/32	425,000	642,500
2 3/8	14 1/4	9 9/32	3 5/16	2 3/8	2 3/4	1 35/64	447,000	675,000
2 7/16 — 2 1/2	15	9 3/4	3 3/8	2 1/2	2 7/8	1 21/32	492,000	744,000
2 9/16 — 2 5/8	15 3/4	10 5/32	3 1/2	2 5/8	3 3/32	1 11/16	540,000	813,000
2 11/16 — 2 3/4	16 1/2	10 9/16	3 21/32	2 3/4	3 11/32	1 23/32	590,000	885,000
2 13/16 — 2 7/8	17 1/4	11 7/32	3 13/16	2 7/8	3 5/8	1 3/4	640,000	965,000
3	18	11 29/32	4	3	3 13/32	1 13/16	693,000	1,045,000
3 1/8	18 3/4	12 13/32	4 5/16	3 1/8	3 9/16	1 29/32	748,000	1,128,000
3 1/4	19 1/2	12 29/32	4 3/8	3 1/4	3 3/4	2 1/32	804,100	1,210,000
3 3/8	20 1/4	13 17/32	4 1/2	3 3/8	4	2 1/16	862,200	1,296,000
3 1/2	21	14 5/32	4 5/8	3 1/2	4 1/4	2 1/8	922,000	1,383,100
3 3/4	22 1/2	14 7/8	4 7/8	3 3/4	4 1/2	2 1/4	1,120,000	1,750,000

Figure 2-8 (Cont'd)

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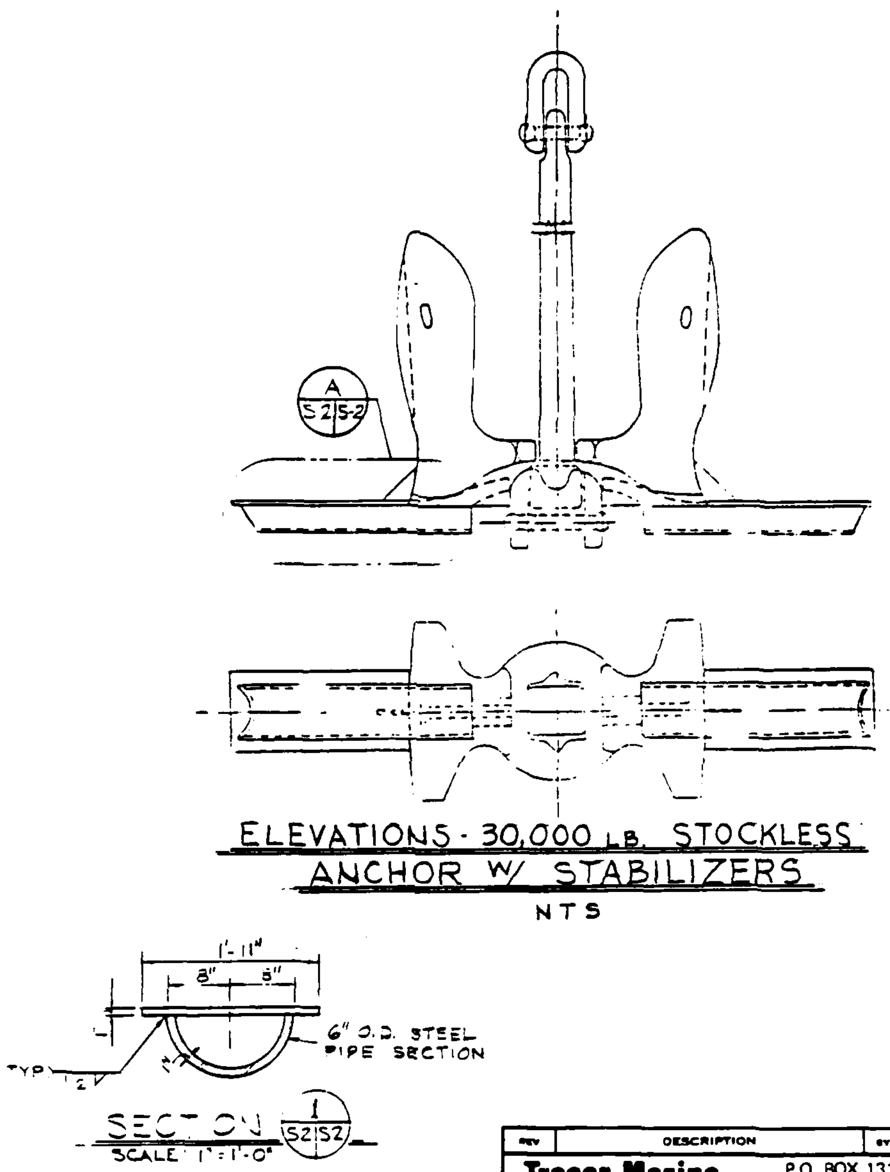

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Figure 2-9 - Stabilizer Specification

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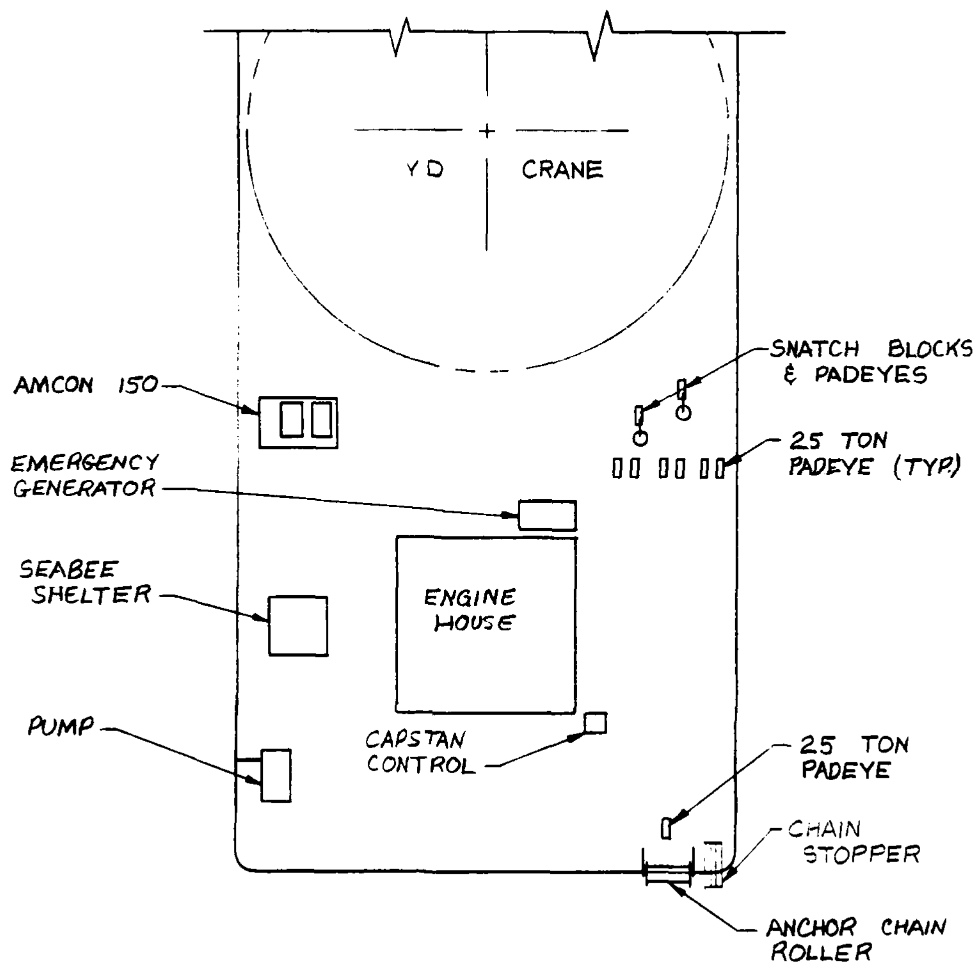

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Figure 2-10 - YD deck layout, recovery over the bow using the AMCON

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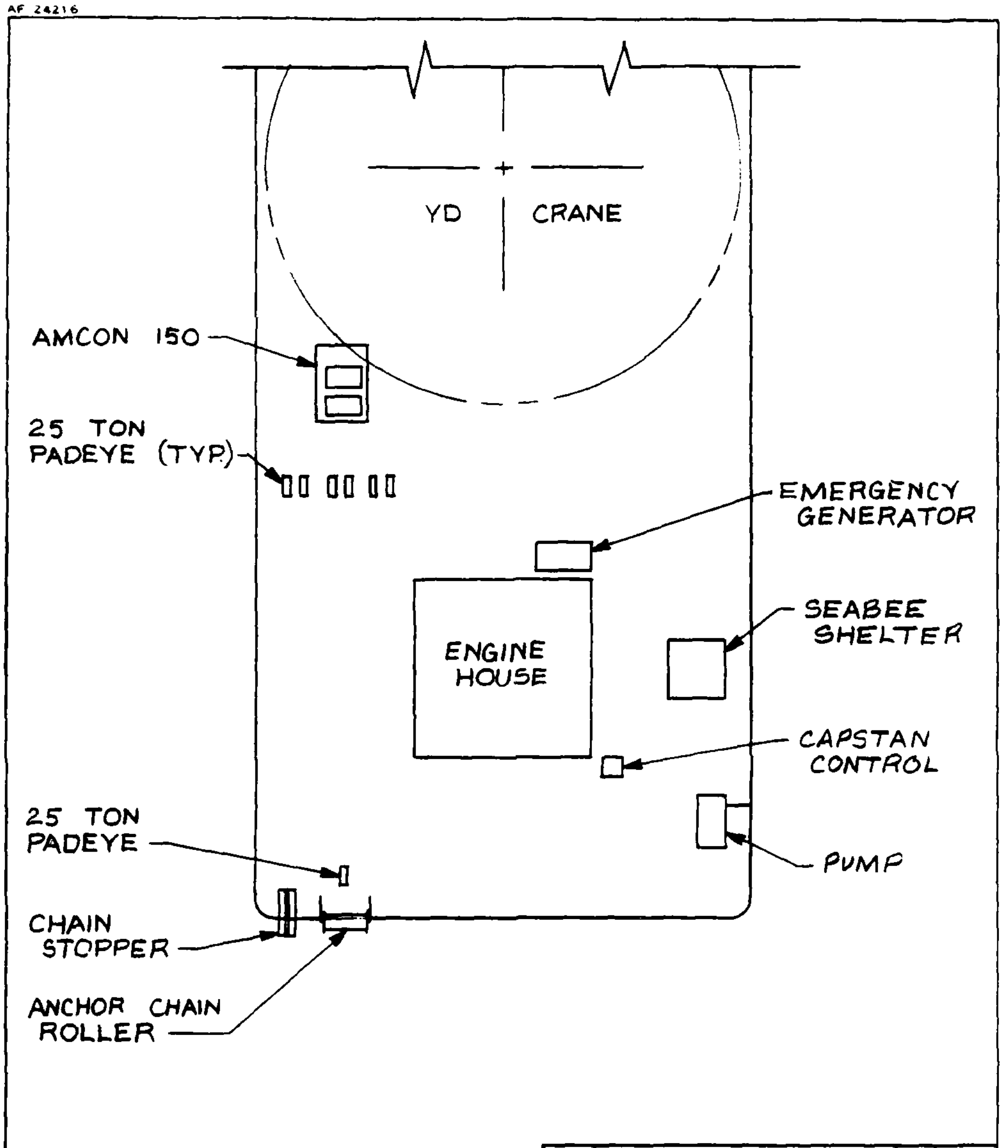

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Figure 2-10a - YD deck layout, recovery over the bow using the AMCON

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Table 2-3

PREPARATIONS ON YD

Over the Port Bow Recovery Using the AMCON

Item	Qty	Fabrication	Installation	Location	Notes
Roller	1	yes	welding	Deck edge, port-side bow	Overhangs bow 6 to 10", 15-ton capacity
Chain Stopper	1	yes	weld	Deck edge, port-side	20-ton capacity
Pump	1	no	weld/secure	Starboard side forward	Includes 20' suction, 1½" hose and nozzle
Padeyes	2	complete	weld	Portside, athwart AMCON	25-ton
Padeyes	6	complete	weld	Portside, amidships	25-ton
Padeyes	1	complete	weld		
Padeyes	As req'd	complete		Aft of roller	General fairleading
Toe Rail	N/A	no	burn	Along deck edge	Remove as req'd
Wire Rope	7/8"-2xTBD	no	N/A	Portside Padeyes	To stop off chain
Slings	1¼"-2xTBD 7/8"-1xTBD	no	N/A	Main hook	Lift bights of chain
Welder	1	N/A	secure	TBD	
Snatch Blocks	2	no	secure	Portside Padeyes	25-ton, to fair-lead AMCON wire
AMCON	1	no	weld base, bolt on winch	starboard side, amidships facing to port	Has 1", 7/8" wire

are depicted in Figures 2-11 and 2-12 and preparations for each delineated in Tables 2-4 and 2-5. A full discussion of the rationale, procedures and merits of the three options is provided in Section 4.0.

The equipment setup on the AFDB-7 is shown in Figure 2-13 and required preparations given in Table 2-6. The winch locations presume adequate open deck space on the forward cans (both port and starboard). If there are significant obstructions, alternate locations will be chosen, pending site evaluation. The strategy is to minimize the fairleading required for mooring leg release and pretensioning operations.

2.3 Testing and Training

Following installation, all equipment will be load tested and observed for operational suitability and safety. Training will also be conducted on equipment operation and rigging techniques. Table 2-7 summarizes the planned tests and training.

Practice recovery of a mooring leg is planned to serve as training and to provide an operational opportunity to conduct some of the tests described in Table 2-7, particularly those requiring a heavy load. The exercise will include the following:

- Detachment of a mooring leg from the AFDB-7.
- Recovery of a sufficient number of bights aboard the YD to ascertain the appropriate techniques and problems.
- Reinstallation of the chain and reconnection to the AFDB-7.

A decision to recover the anchor during the training exercise (thus making it the first actual recovery) may be made if the chain

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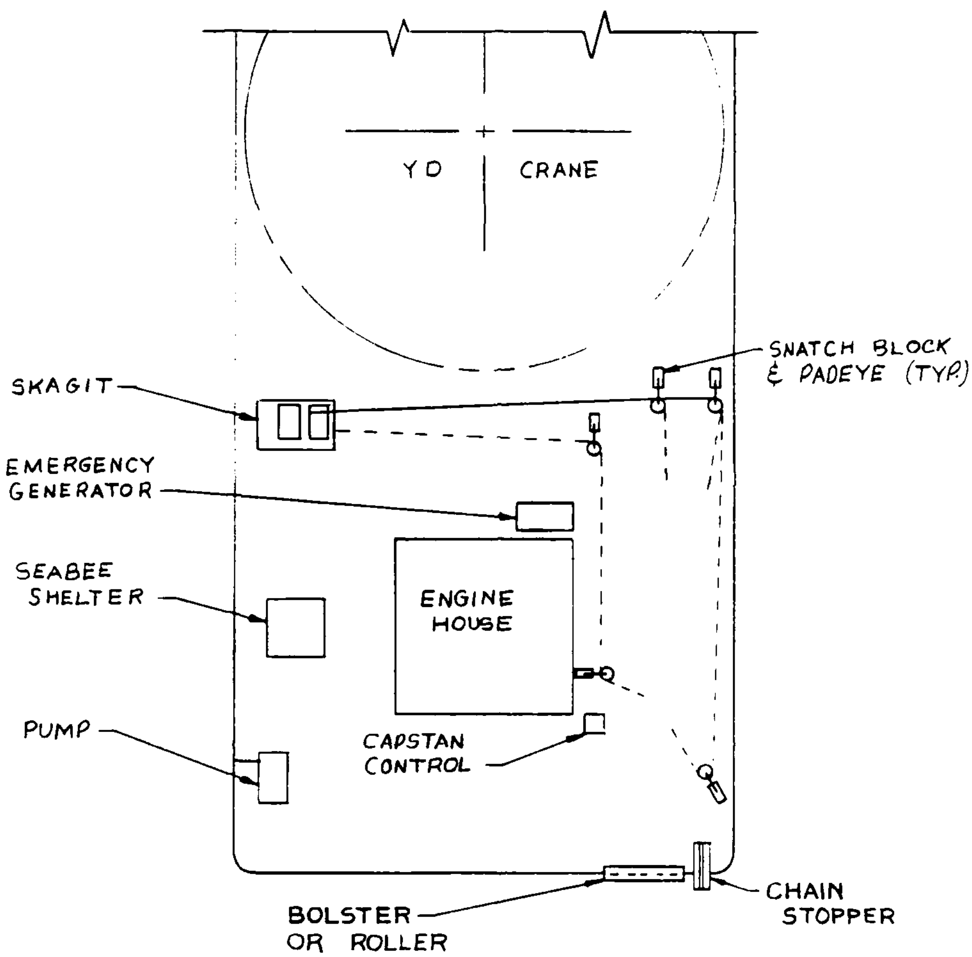

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Figure 2-11 - YD deck layout, recovery over the bow using the crane.

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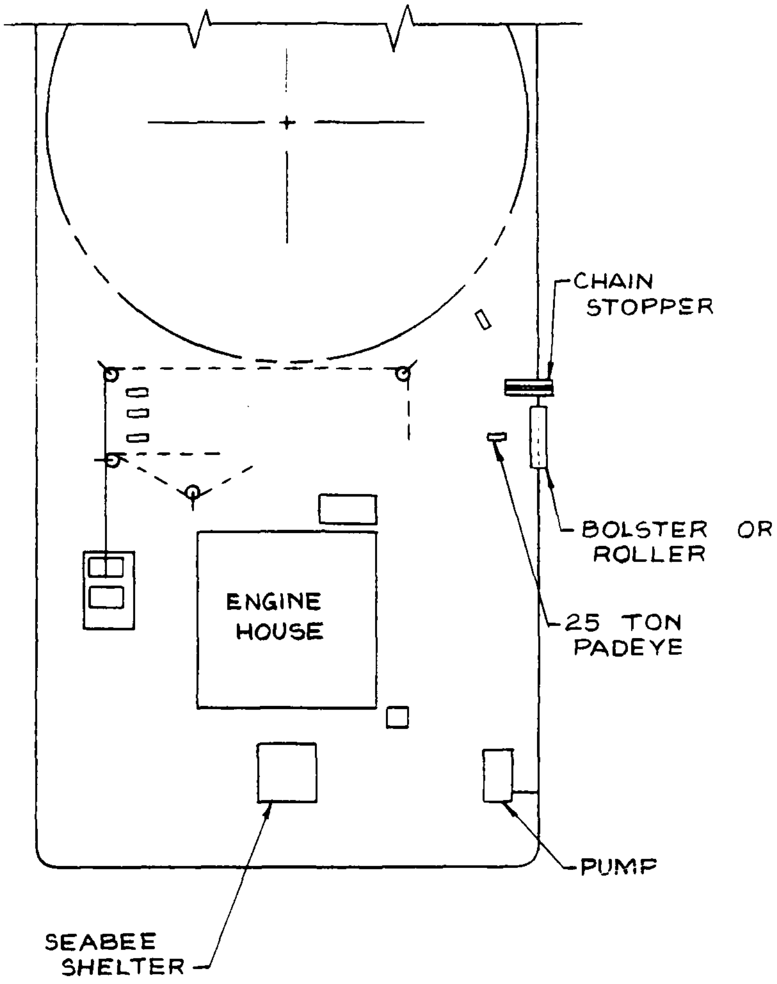

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Figure 2-1? - YD deck layout, recovery over the portside using the crane.

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Table 2-4

PREPARATIONS ON YD

Over the Port Bow Recovery Using the YD Crane

Item	Qty	Fabrication	Installation	Location	Notes
Roller	1	yes	weld	Deck edge, Portside bow	Overhangs bow 6 to 10" 15-6on capacity
Chain Stopper	1	yes	weld	Deck edge, Portside	20-ton capacity
Skagit	1	no	yes	Starboard side amidships, facing to port	Has 5/8" wire
Pump	1	no	secure	Starboard side, forward	Includes 20' suction, 1½" hose and nozzle
Padeyes	4	complete	weld	Port	25-ton, to service Skagit
Padeyes	6	complete	weld	Portside, amidships	25-ton
Padeyes	As req'd	complete	weld		
Padeyes	1	complete	weld	Aft of roller	
Toe Rail	N/A	no	burn off	Along deck edge	Remove as req'd
Wire Rope Slings	7/8"-2xTBD 1¼"-2xTBD	no	N/A	Portside Padeyes	To stop off chain
	7/8"-1xTBD	no	N/A	Main hook	Lift bights of chain
Welder	1	N/A	secure	TBD	
Snatch Blocks	4	no	secure	Portside Padeyes	

Table 2-5

PREPARATIONS ON YD

Over the Side Recovery Using the YD Crane

Item	Qty	Fabrication	Installation	Location	Notes
Bolster	1	yes	yes	Deck edge, portside	Half round 16" sch 80 pipe
Chain Stopper	1	yes	yes	Deck edge, portside	20-ton capacity
Skagit	1	no	yes	Starboard side, facing aft	Has 5/8" wire
Pump	1	no	yes	Starboard side, forward	Includes 20' suction, 1½" hose and nozzle
Padeyes	4	complete	yes	Starboard side	25-ton
Padeyes	2	complete	yes	Portside, inboard of bolster	25-ton
Toe Rail	N/A	no	no	Along deck edge	Remove as req'd
Wire Rope Slings	7/8"-2xTBD 1¼"-2xTBD	no	N/A	Portside Padeyes	To stop off chain
	7/8"-1xTBD	no	N/A	Main hook	Lift bights of chain
Welder	1	N/A	yes	TBD	

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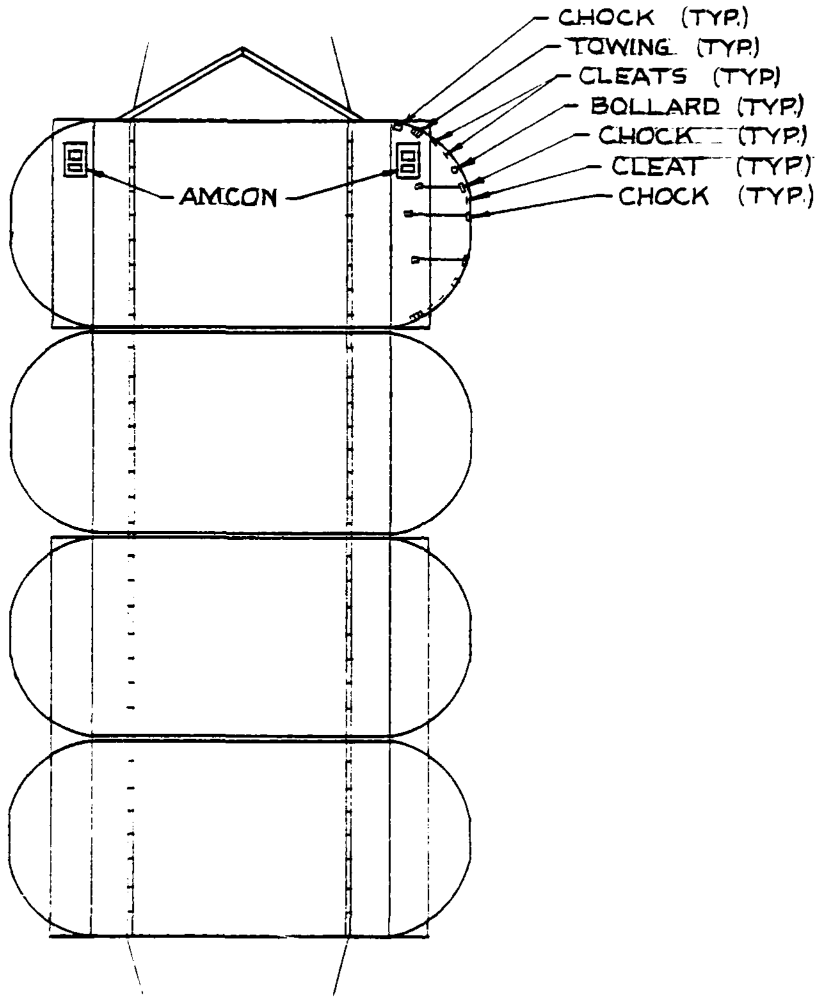

AFDB-7 PLAN VIEW

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Figure 2-13

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Table 2-6

PREPARATIONS OF AFDB-7

Item	Qty	Installation	Location	Notes
AMCON 150	2*	yes	Portside forward, facing aft starboard side forward, facing aft	
Sandblaster	1	in-place	TBD Section D Starboard	To prepare anchors
CB Lockers	2	yes	TBD	
Obstructions	TBD	remove as required	TBD	Save for reuse as applicable
Generator	1	yes		
Padeyes	TBD	yes	TBD	
Blocks				To fairlead AMCON wire
Welder			Mobile	
Cutting Torch			Mobile	
Turnbuckles	22	in-place	@ leg connections	Make operational
Air Tuggers	2			For hauling out AMCON wire and other light rigging duty

* Depending upon recovery method chosen

Table 2-7

EQUIPMENT TESTS AND TRAINING

Equipment	Test	Load Rating (kip)	Test Load (kip)	Observation	Training
AMCON 150	Line pull	See spec.	20		Operation
Skagit	Line pull	See spec.	8		Operation
Pump					Operation
Chain Roller	Load	30	35	Smooth operation	
Padeye	Load	50	40		
Chain Stopper	Load	40	40	Performance	Operation
Wire Strap Stopper					Installation

recovery portion goes smoothly and conditions/timing are satisfactory. The procedures will be in accordance with the plan described in Section 4.0.

3.0 SURVEY PLAN

The methods for establishing surveying stations, locating the dry dock and computing its bearing and new anchor coordinates are presented in this section. A tide gauge will be erected on Admiralty Pier to record tidal readings during the anchor installation operation to insure the proper tensioning of the anchor chain in a range tidal periods.

The major goals of the survey operation include:

a. Find known Ordnance Survey, Great Britain (OSGB) Benchmarks: Grahams Point, Strone Church Spire, Strone Jetty Pier and BF 41-A.

b. Establish surveying stations near White Farlane Point and at pier at Brox Wood.

c. Locate position and bearing of dry dock with respect to the OSGB national grid system.

d. Compute new anchor coordinates with respect to the OSGB national grid system.

e. Compute forward theodolite angles from established surveying stations to anchor replacement positions.

f. Use marker buoys to mark drop points for anchors.

g. Install tide gauge on Admiralty Pier.

The exact location and bearing of the floating dry dock relative to established shore coordinates is not known. Thus, the new anchor locations (given relative to the center of the dry dock) require location of the center of the dry dock relative to the shore coordinates. The survey execution plan which follows has been developed based on known benchmarks, built-in surveying programs for the TI-59 handheld calculator, hand written programs for the TI-59 and surveying measurements to be taken in the field at Holy Loch. All new coordinates will be correlated to the OSGB national grid system.

3.1 Locate Known Benchmarks and Establish Surveying Stations

In order to locate the dry dock, onshore controls adjacent to the LOS ALAMOS must be established. Figure 3-1 is a map of the survey area. Since benchmarks BF 41-A and Grahams Pont are known, a station near White Farlane Point can be established. An electronic distance measuring (EDM) reflector will be set on the BF 41-A and Grahams Point benchmarks and an EDM Auto Ranger instrument with a theodolite set near White Farlane Point to measure the distance from each benchmark to the established station at White Farlane and the included angle between benchmarks at White Farlane, as depicted in Figure 3-2. The known coordinates of the two benchmarks and the information field obtained will be input into TI-59 program SY-17 to calculate the coordinates of the new station at White Farlane.

A station will be established near the pier at Brox Wood which will have line-of-sight to the station previously established at White Farlane and the station at Grahams Point. The pier station coordinates will be determined by measuring 1) the distance between White Farlane Station and the pier station, 2) the distance between Grahams Point and the pier station, and 3) the included angle at the pier (see Figure 3-3).

GENERAL SURVEY AREA

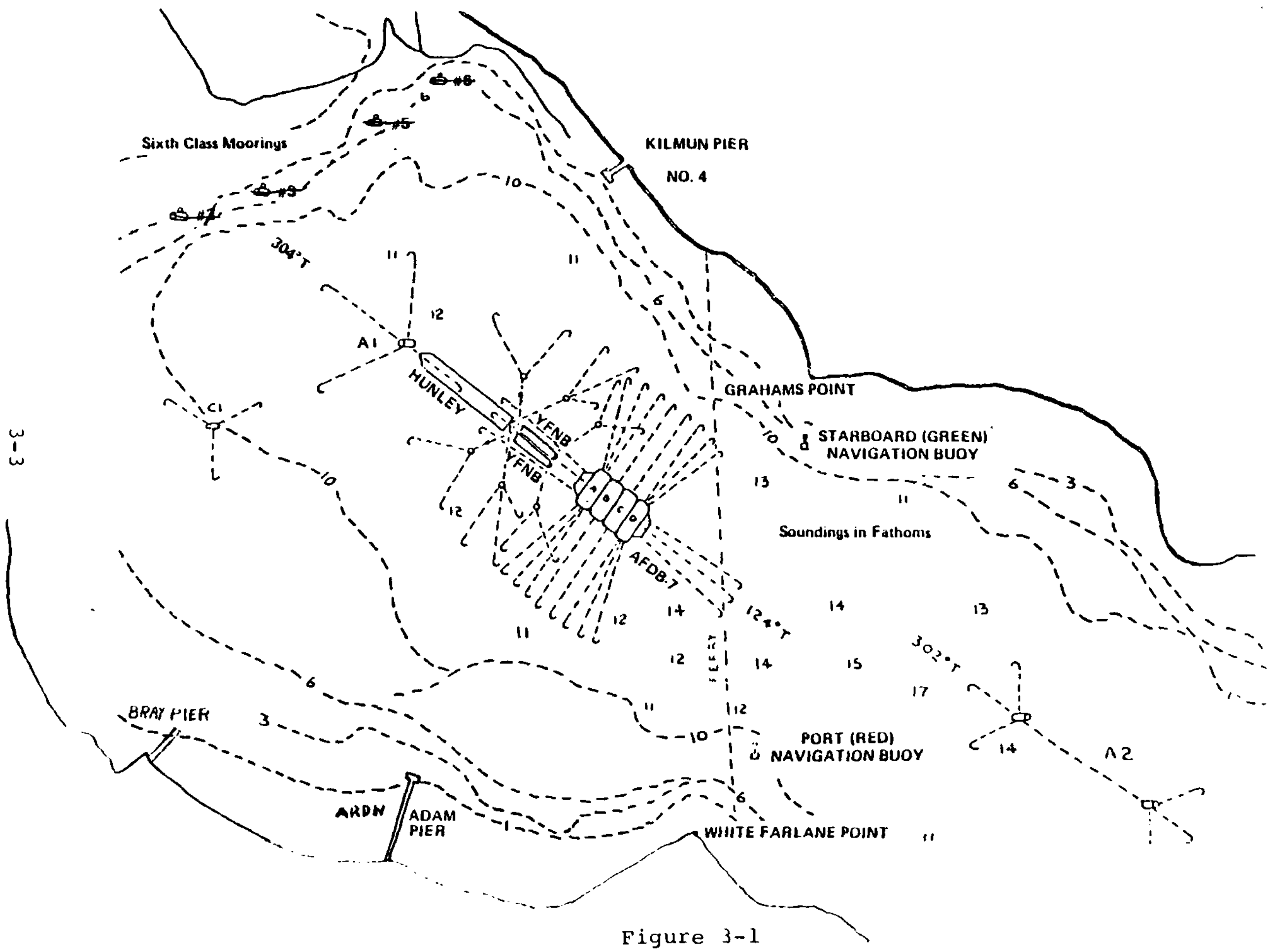

Figure 3-1

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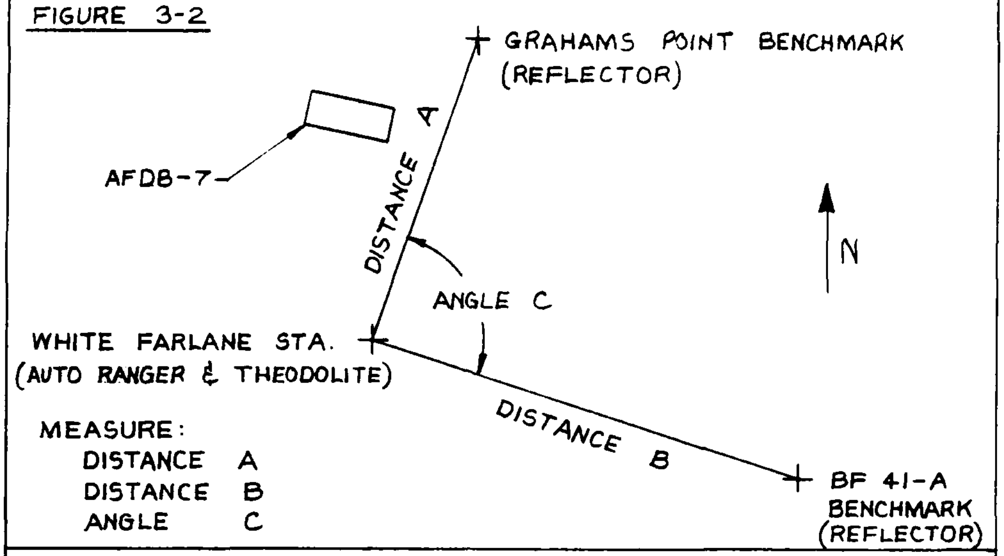
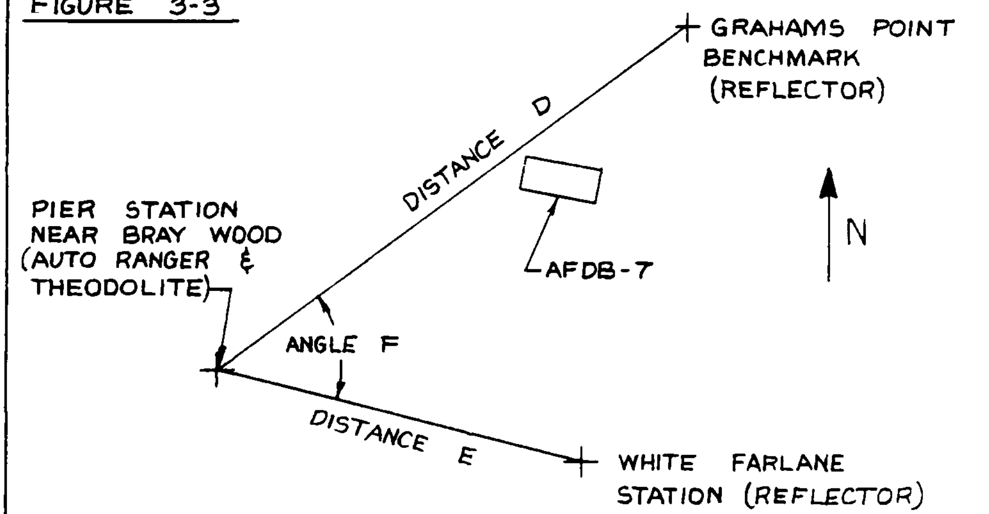
FIGURE 3-2



MEASURE:
DISTANCE A
DISTANCE B
ANGLE C

FIGURE 3-3



MEASURE:
DISTANCE D
DISTANCE E
ANGLE F

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SURVEY PLANS

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3.2 Locate Position and Bearing of LOS ALAMOS

The position and bearing of the LOS ALAMOS will be determined as described below. Set theodolites at the White Farlane and Brox Wood Pier stations and backsight the other respective station (White Farlane backsights Brox Wood Pier station and Brox Wood Pier backsights White Farlane station). Turn angles to the southwest corner of the dry dock, as shown in Figure 3-4, and record. Using the known distance between White Farlane and Brox Wood stations and angles G and H, the coordinates of the southwest corner of the dry dock will be computed.

The same measurements and calculations will be repeated to determine the coordinates of the southeast corner of the dry dock, as shown in Figure 3-5.

Using the coordinates of the southwest corner and the southeast corner of the dry dock, the bearing (see Figure 3-6) of the dry dock can be determined using TI-59 program SY-03. In order to compute the coordinates of the center of the dry dock, the dimensions D, E, L, and M shown in Figure 3-7 must be obtained, either by on-site measurement or from mechanical drawings. By inputting these dimensions into TI-59 program SY-17, the coordinates of the center of the dry dock can be determined.

3.3 Compute New Anchor Coordinates

OSGB coordinates for the new anchor positions will be calculated, using the TI-59 coordinate translation program by reference to the dry dock center position determined above. Table 3-1 gives the specified x, y translation distances in feet where x = o, y = o at the center point.

3.4 Compute Forward Theodolite Angles for Anchor Placement

Using the anchor coordinates determined in 3.3, angles from the pier, White Farlane and Grahams Point stations will be

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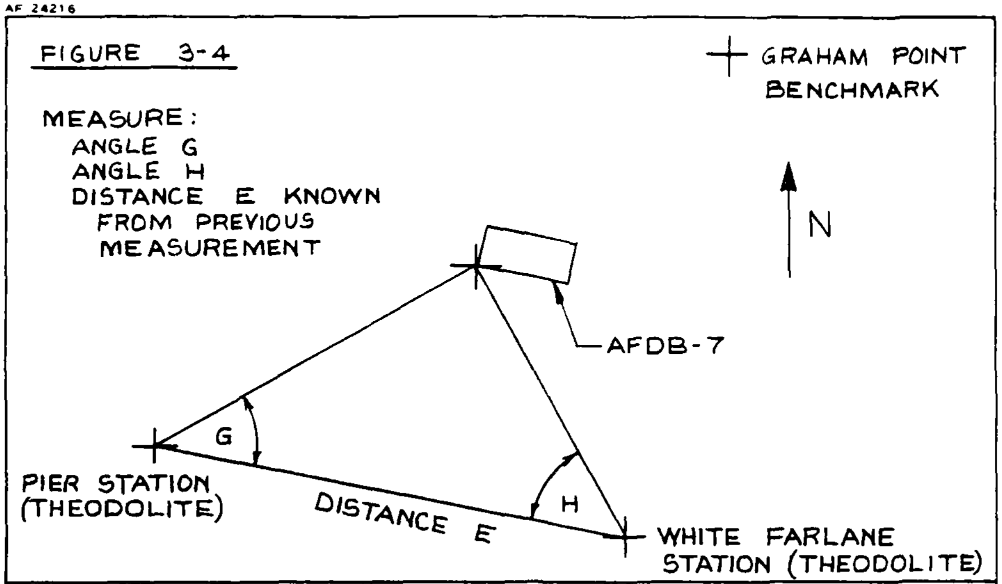

FIGURE 3-4
GRAHAM POINT BENCHMARK
MEASURE:
ANGLE G
ANGLE H
DISTANCE E KNOWN FROM PREVIOUS MEASUREMENT
N
AFDB-7
G
H
PIER STATION (THEODOLITE)
DISTANCE E
WHITE FARLANE STATION (THEODOLITE)

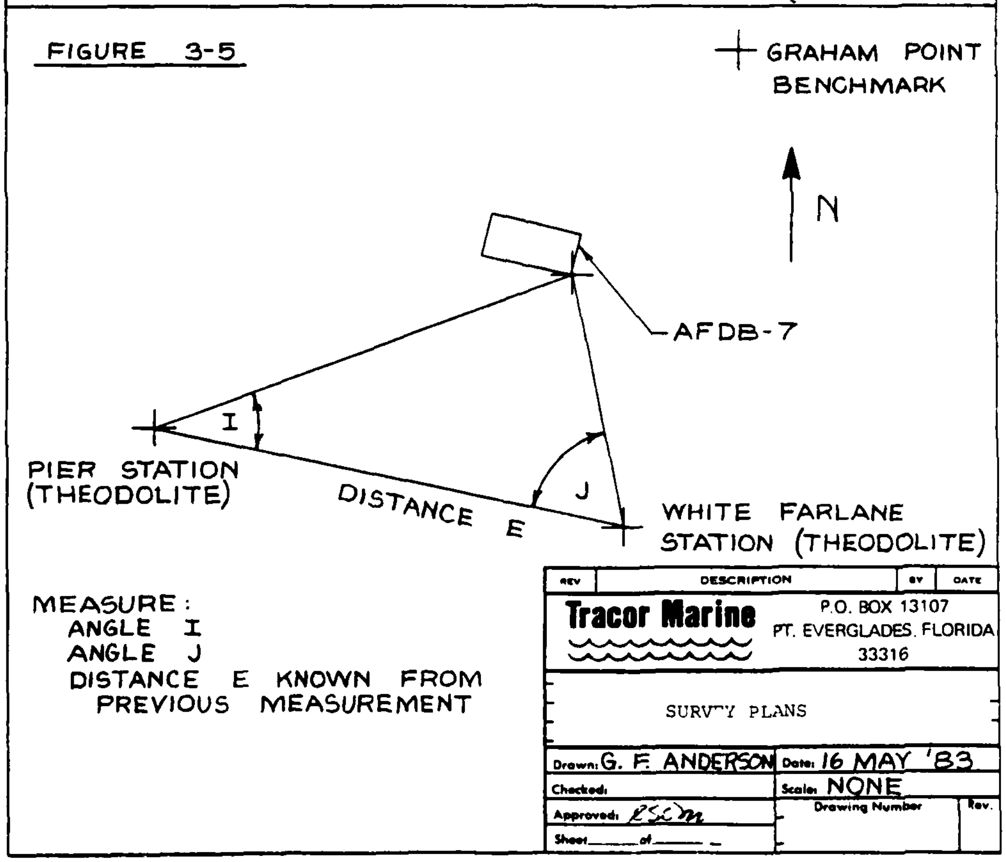

FIGURE 3-5
GRAHAM POINT BENCHMARK
N
AFDB-7
I
J
PIER STATION (THEODOLITE)
DISTANCE E
WHITE FARLANE STATION (THEODOLITE)
MEASURE:
ANGLE I
ANGLE J
DISTANCE E KNOWN FROM PREVIOUS MEASUREMENT
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FIGURE 3-6

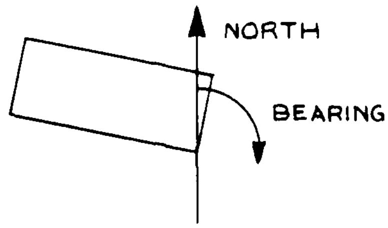


FIGURE 3-7

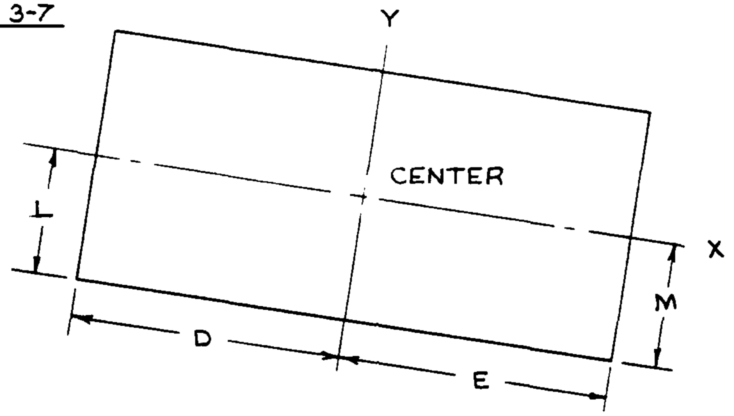
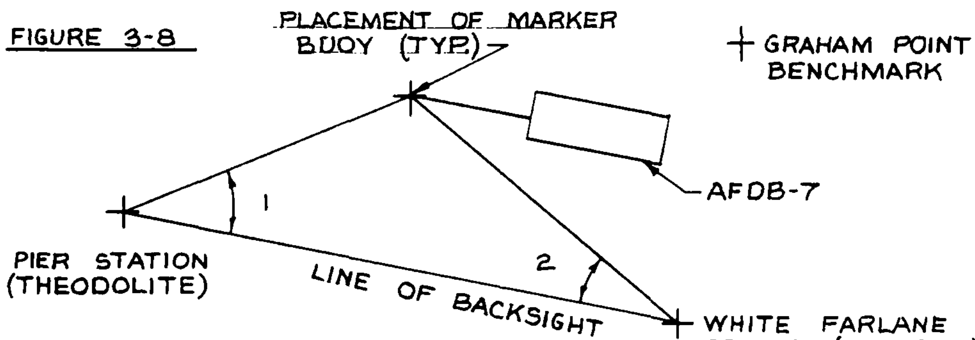


FIGURE 3-8



ANGLES 1 & 2 COMPUTED FROM PROGRAM.

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Table 3-1

FINAL ANCHOR LOCATIONS
REFERENCED TO AFDB-7 CENTERLINES

Anchor	x	y
1, 12	± 751	0
2, 11, 13, 22	± 751	± 90
3, 10, 14, 21	± 345	± 638
4, 9, 15, 20	± 157	± 665
5, 8, 16, 19	± 62	± 660
6/7, 17/18	0	± 665

computed, using the hand written theodolite angle program. Specific anchor locations can subsequently be determined in the field by turning the predetermined angles from theodolites located at two of the three stations. The point of intersection determines the desired location and will be delineated by a marked buoy. Radio communications between the theodolite operations and the marker deployment vessel are required in order to direct the vessel to the appropriate locations. See Figure 3-8.

3.5 Install Tide Gauge on Admiralty Pier

Using a theodolite stationed on the floating dry dock, Admiralty Pier will be backsighted to place a tide gauge at a known elevation and at a known tide. The tide gauge will enable determination of tidal conditions at any given time. Tide measurements are particularly important to properly tension the anchor chains.

4.0 OPERATIONS

The procedures for the overhaul of the USS LOS ALAMOS (AFDB-7) moorings at Holy Loch, Scotland, are given in the following sections. Methods of recovery are presented in Section 4.1. The preferred method is recovery over the port bow, using the AMCON; the other methods are presented as options. The plans for mooring leg inspection and refurbishment are given in 4.2. Section 4.3 describes reinstallation and 4.4 pretensioning operations. The procedures described in Section 4.3 are contingent upon (to a degree) the recovery method used. For the sake of brevity, however, the techniques are given in generic terms applicable to all three options.

4.1 Recovery

The methods for recovery of the existing mooring legs are presented herein, including:

1) Recovery over the bow of the YD, using an AMCON 150 double drum winch as the principal hoist.

2) Recovery over the bow of the YD, using the crane. as the principal hoist.

3) Recovery over the side of the YD, using the crane as the principal hoist.

Each method has certain advantages and disadvantages when compared with the other methods. Major considerations include:

- Stationkeeping ability of the YTBs working on alternate sides (recovery ops over the bow) of the YD versus working on the stern and starboard side (recovery ops over the portside).

- Reduced capacity of the crane working over the bow as compared to working over the side.

- Deck space limitations working alongships versus working athwartships.

- Use of the AMCON to haul chain in a hand over hand fashion versus recovery, using the crane which requires stopping the chain off between bights. Use of an AMCON on the YD precludes its use on the AFDB-7 during the recovery operations (it could be available for pretensioning) and requires fabrication of a sturdy roller to fairlead the 3" chain as it is brought over the bow of the 3" chain.

Certain aspects of the recovery operation will be identical regardless of the method used.

Final decision regarding the method to be used will be made following subsequent discussion, study, and perhaps further on-site evaluation. Sufficient equipment and flexibility are available (with minor exceptions) to allow choice of any of the methods on site.

4.1.1 Mooring Leg Release from the AFDB-7 (typical)

Each existing mooring leg is comprised of 3" stud link chain. The lengths of the legs vary from 740 feet to 480 feet. One shot weighs approximately four tons. Each leg is terminated at a padeye by an anchor joining link and a safety shackle. In addition, the chain is secondarily secured by a pelican hook some eight feet outboard of the primary padeye. The pelican hook is attached to a turnbuckle which, in turn, is secured to a second padeye. Nominally, the load is shared between the two termination points. The chains pass through closed chocks at deck edge and, subsequently, hang nearly vertical into the water. See Figure 4-1.*

In order to detach the bitter end of the chain from the primary termination, slack must be provided at the padeye. This can be accomplished in advance (i.e., during the preparations) if the turnbuckle on the secondary termination is operational and has sufficient scope to transfer the load to the secondary termination. If this is determined to be infeasible, slack can be provided by rigging the AMCON to inhaul the chain and/or by taking the load of the chain outboard of the chock with the YD crane. The latter method, however, requires that the YD be prepositioned, delaying release of the bitter end of the chain until the beginning of the recovery operation. The first two methods can be accomplished in advance. In addition, they can be combined (inhaul the chain using the AMCON and resecure to the secondary termination) to provide another approach which can be accomplished in advance.

Once slack, the bitter end of the chain can be detached, either by the AJL or the safety shackle. As a last resort, a slack link can be burned off using the cutting torch.

4.1.2 Recovery Over the Bow, Using an AMCON 150

In this method, one of the two available AMCON 150 double drum winches is used to recover the mooring leg over the bow of the YD, employing the hand-over-hand capability inherent in a double drum winch. The method has the advantage of not requiring stopping off the chain after each pick and keeps the sides of the YD free for YTB maneuvering. It does, however, require the use of a roller; the roller being fabricated will have a 30 kip capacity. In

*The forward legs are secured to padeyes beneath timber decking and will require the installation of secondary padeyes to facilitate detachment.

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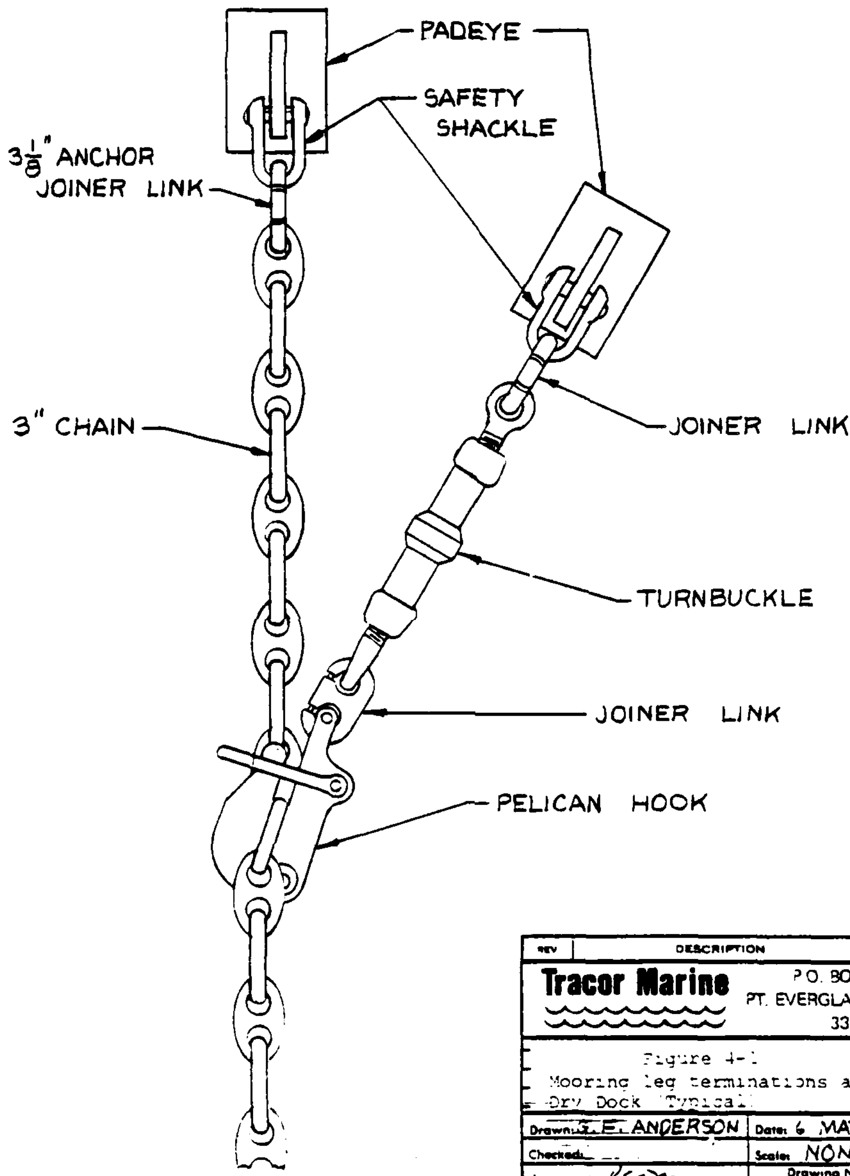

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Figure 4-1
Mooring leg terminations at the Dry Dock (Typical)

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addition, the winch does not have the capability to pick the anchor, requiring use of the crane to pick the final two bights in the manner described in subsequent sections. The deck plan has been given previously in Figure 2-10 and alternatively 2-10a.

The YD will be positioned bow to the dry dock at the termination of the mooring leg to be recovered. Figure 4-2 depicts the barge positioned for recovery of leg 16. One YTB will make up to the stern rigged Mississippi; the other to the starboard quarter.

The procedures for releasing a mooring leg from the dry dock, using the winch recovery method, are similar to the general methods described in Section 4.1.1. The principal variation is that the winch will not be able to provide slack at the primary termination because the direction of pull is at deck level. As such, the crane will take charge of the load while the primary/secondary terminations are released and the load subsequently transferred to the 1" AMCON wire, or by load transfer from the winch (AMCON or Skagit) on the dry dock to the AMCON on YD. Figures 4-3, 4-3A and 4-4A depict this scenario.

With the load transferred to the 1" AMCON wire, the chain will be inhauled over the roller. The YD should be positioned clear of the dry dock to provide adequate working room and to minimize any catenary in the chain. The recovery should be accomplished with the chain hanging vertically to the maximum extent possible, thus requiring good coordination between the tug operators and operations on the YD. The crane hook will be released from the chain when it becomes accessible on the bow. The chain will be hoisted until the attachment point is just forward of the snatch block (see Figure 4-4). Inhaul will stop and the upper

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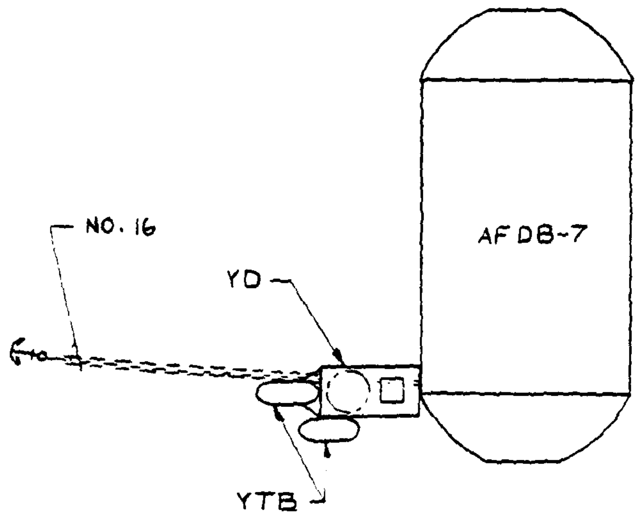

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Figure 4-2 - YD positioned at dry dock for mooring leg recovery over the bow.

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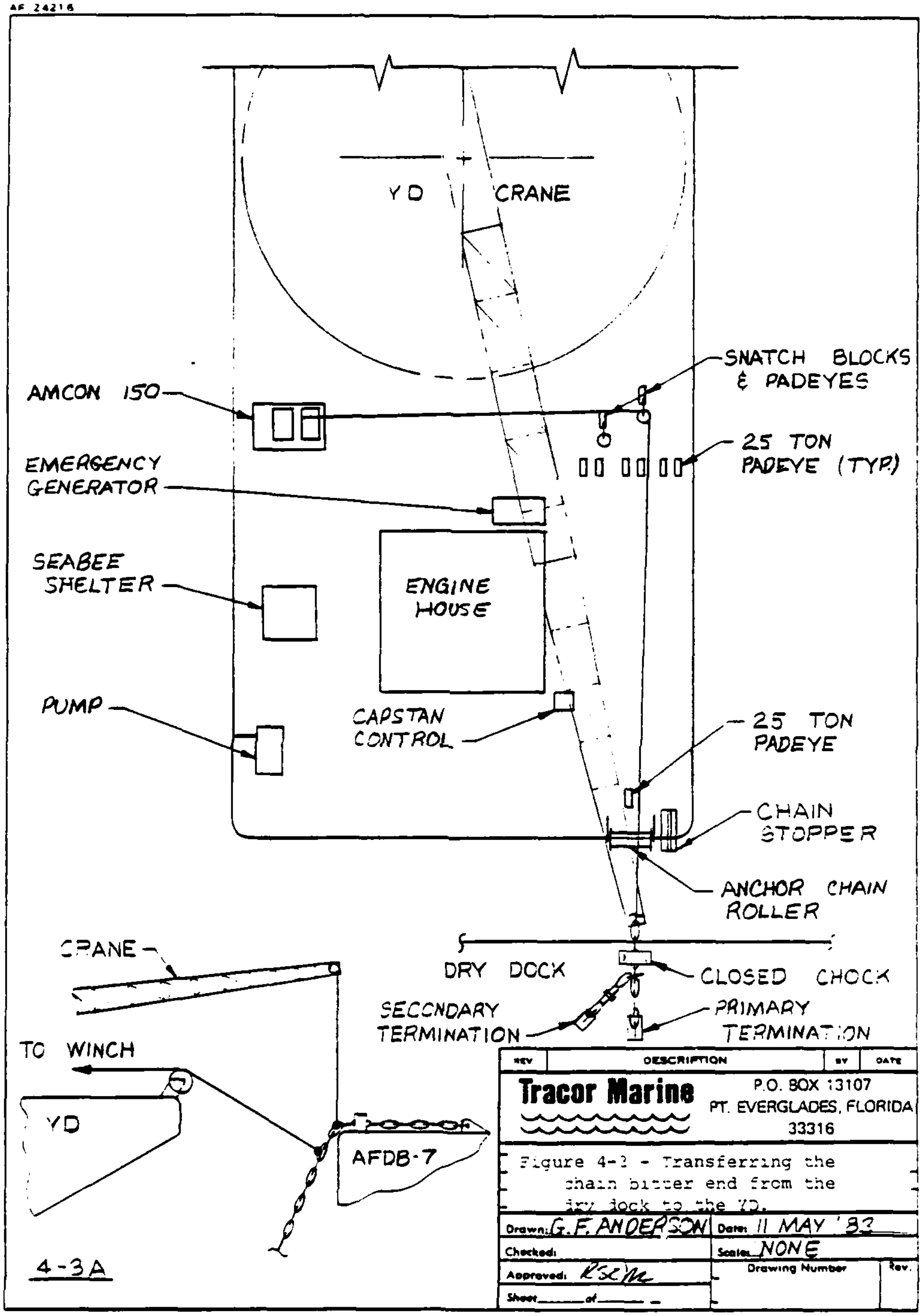

Figure 4-3 - Transferring the chain bitter end from the dry dock to the YD.

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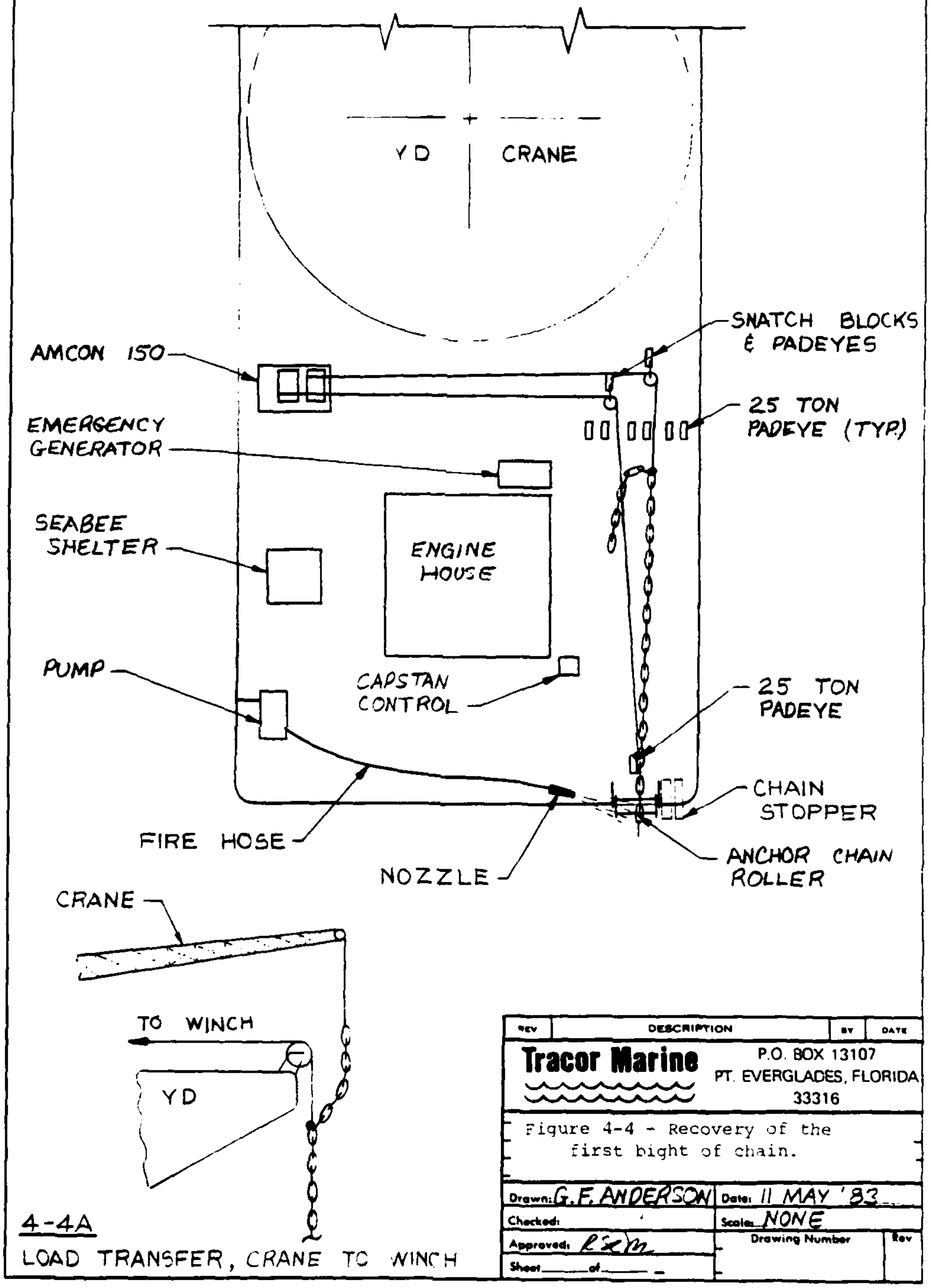

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Figure 4-4 - Recovery of the first bight of chain.

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drum dogged. The 7/8" wire (previously hauled out to the bow) will then be secured to a four part 7/8" wire strap passed through a chain link at the bow. The 7/8" wire will take charge of the load, hauling in the chain up to the second snatch block (Figure 4-5). This procedure will be repeated until the chain remaining in the water equals the water depth plus the freeboard plus a nominal 20 feet (see Figure 4-6); for safety, no attempt should be made to lift the anchor off the bottom.

The crane will subsequently be used to recover the remaining bight(s). Transfer the load from the AMCON to the main hook on the YD crane and release the AMCON wire. Take up on the crane to the maximum height and maneuver the chain into the faired opening of the chain stopper and seat in the link rest. Close the gate and transfer the load to the stopper (see Figure 4-6A). Maneuver the bight and place it on deck. Resecure the main hook to a link just inboard of the stopper, take the load on the crane, release the chain from the stopper and maneuver the chain out of the slot. Haul in the remaining chain and place the anchor on deck.

Throughout the recovery operation, the chain will be water blasted with the jet pump in order to clean the chain and anchor of mud and encrusted material.

4.1.3 Recovery Over the Bow, Using the YD Crane as Primary Hoist

The objectives of this method are to pick the chain in bights over the bow and to fake the chain on deck fore and aft along the portside. It has the advantage of keeping the sides of the YD available for tug operations. However, working over the bow reduces the YD crane's lift capacity and height for a plumb pick

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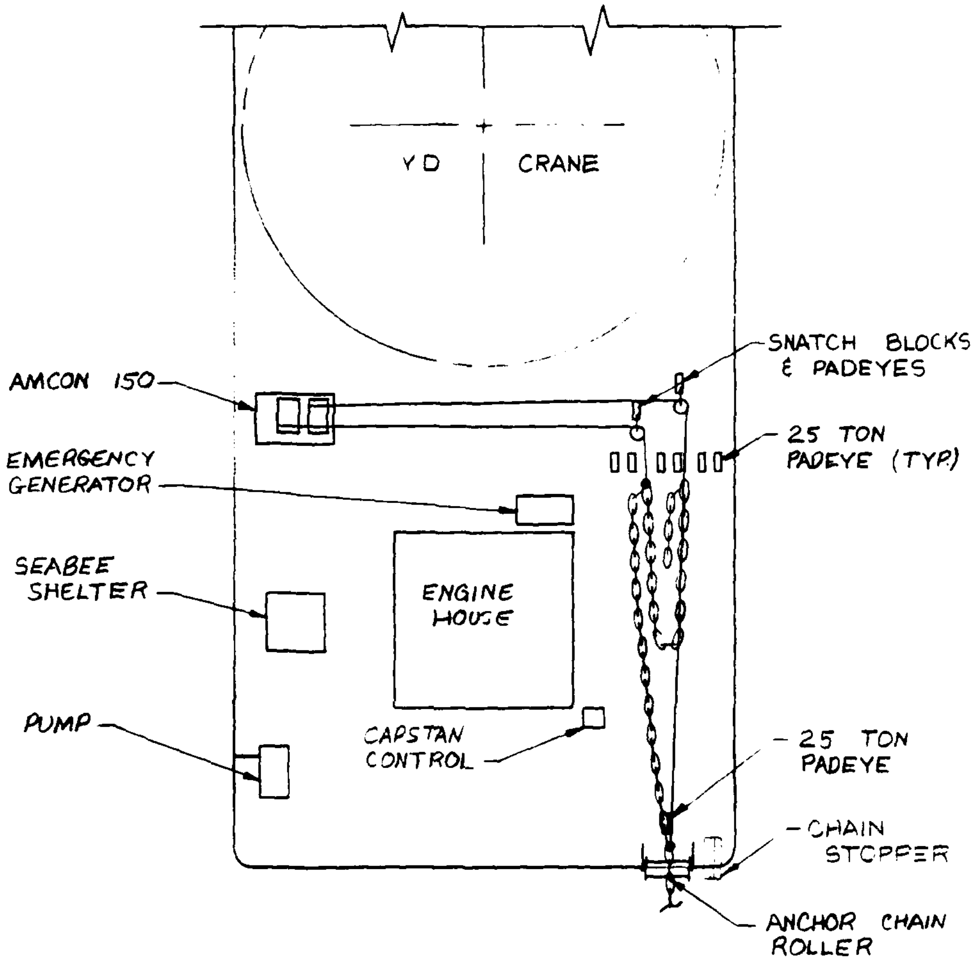

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Figure 4-5 - Hand over hand recovery using the AMCON.

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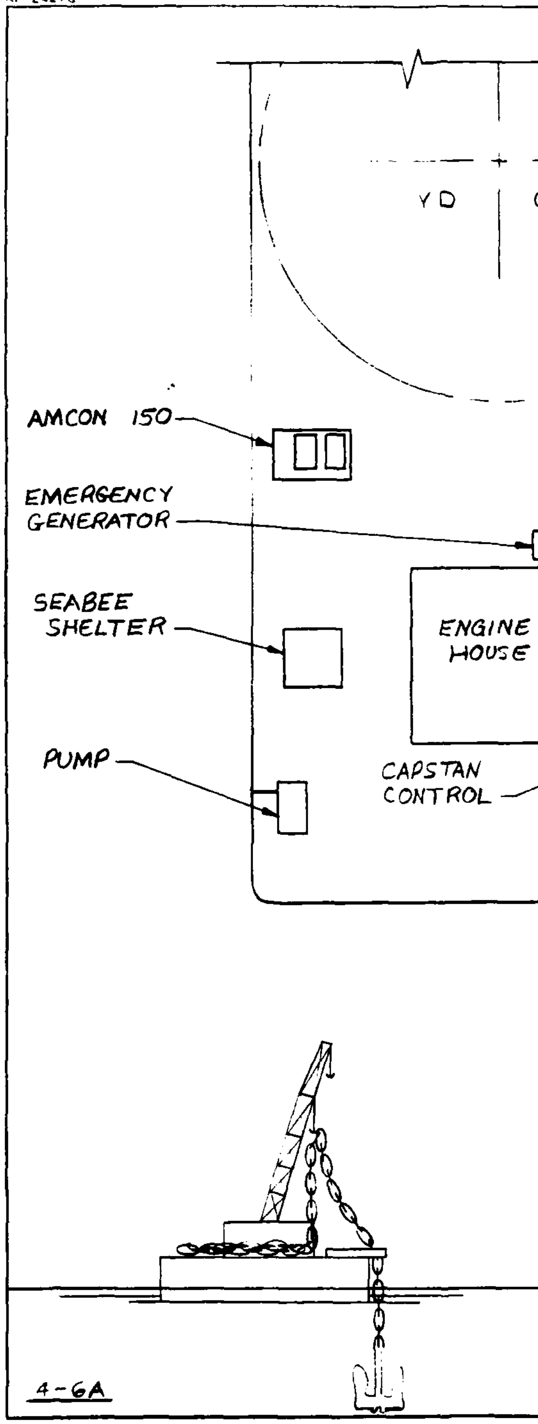

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Figure 4-6 - Recovery of the Anchor

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because of the additional required reach. The general deck layout has been given in Figure 2-11. The YD will be positioned at the AFDB-7 in the same manner as shown in Figure 4-2.

Sketches of the recovery of the mooring legs over the bow, using the YD crane are shown in Figures 4-7 and 4-8. A four-part 7/8" wire strap will be passed through the chain link just outboard of the chock and secured to the main hook. Care must be taken to load the hook evenly. The main hook takes charge of the load and the chain is released from the termination(s) on the dry dock (see Section 4.1.1).

With the YD positioned clear of the dry dock (movement of the YD should be coordinated with the recovery operation so that the chain is maintained plumb to the maximum extent possible), take in on the main hook to recover the maximum bight of chain. As the chain is raised, water blast encrusted links. Maneuver the chain with the crane into the faired opening of the chain stopper and seat in the link rest. Close the gate and transfer the load to the stopper. Maneuver the bight and place it on deck. Utilize the Skagit and the crane to keep the bight forward in the work area with the bitter end near the starboard side.

Prepare for the next bight by rerigging the 7/8" wire rope strap through a chain link just inboard of the chain stopper. Secure the strap to the main hook and take the load. Release the gate on the chain stopper, maneuver the chain out of the slot, and begin hoisting the next bight. Note that as subsequent bights are raised, the previous bight is likewise lifted off the deck. Note that the length of the bights on deck are one-half the length of the boom height at the main hook, with the exception of the last bight which equals the boom height.

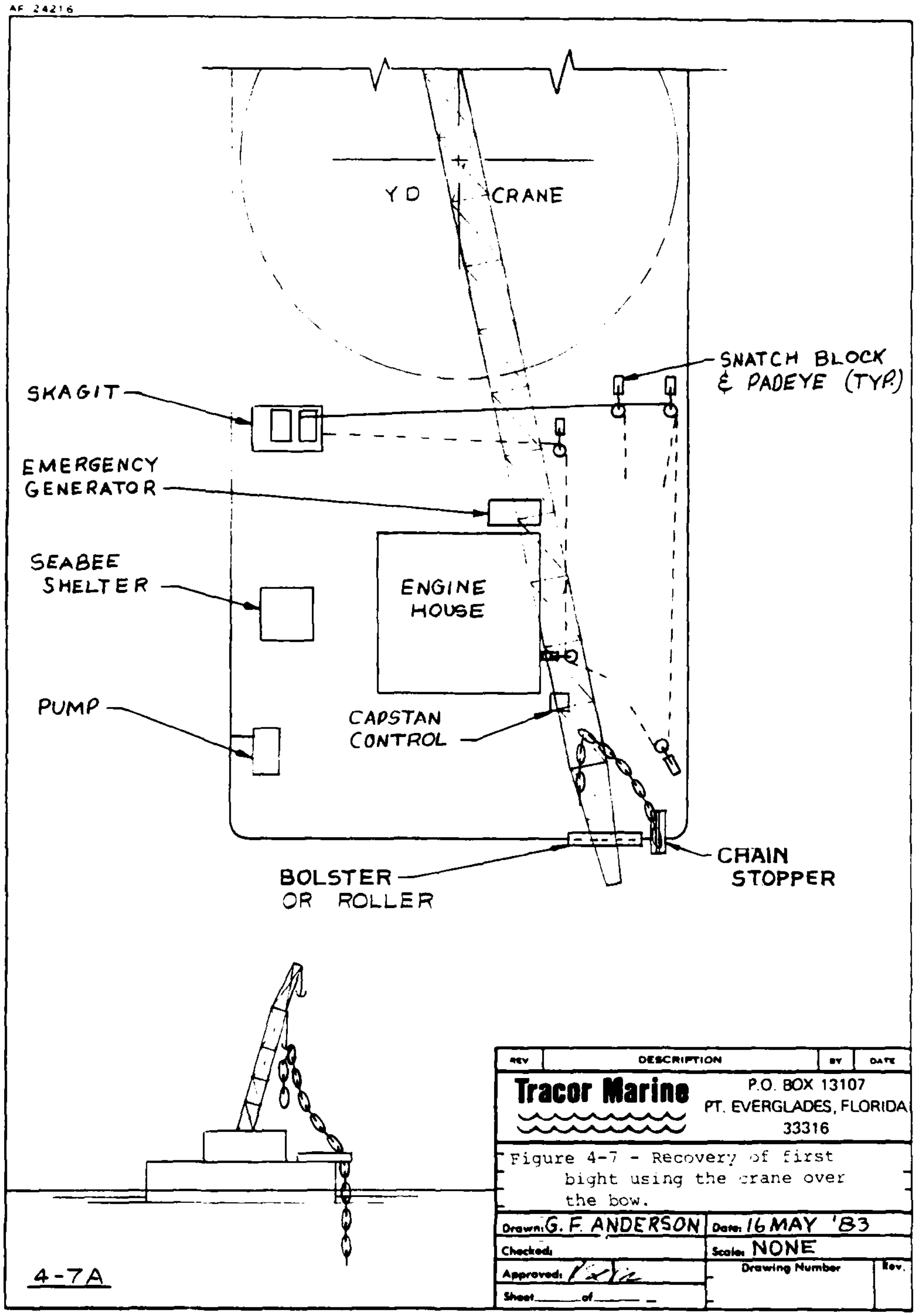

Figure 4-7 - Recovery of first bight using the crane over the bow.

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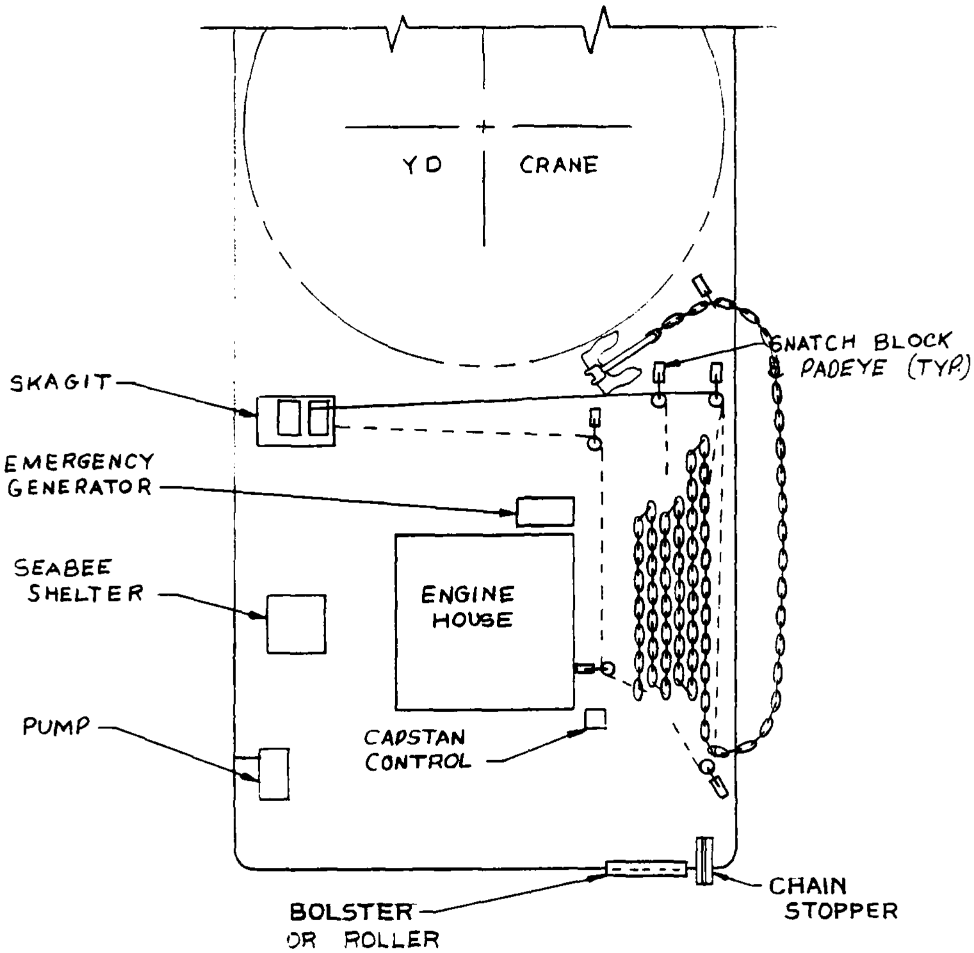

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Figure 4-8 - Final configuration following recovery of mooring leg over the bow using the crane

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Recovery of the anchor is the final step in the recovery operation and requires no special consideration. Position/placement on deck will be determined based upon available deck space, access to power tools, etc. The anchor will be detached from the chain at the 3-5/8" AJL and transferred to the dry dock for refurbishment.

4.1.4 Recovery Over the Side, Using the YD Crane as Primary Hoist

The objectives of this method are to pick the anchor chain in bights alongside the YD and to fake the chain out on deck athwartships between the crane and the engine house. This method has the advantage of utilizing the capabilities of the YD crane to the fullest, since it can be operated boomed up, thus providing maximum lifting capacity and height. It has the disadvantage of requiring that the YTBs maneuver the YD from the stern and starboard side rather than the sides.

A general deck layout is shown in Figure 2-12. The portside is nominally chosen as the recovery side; choice of the actual side to be used can wait pending a site evaluation.

With the bitter end detached or if the bitter end is to be released, using the crane (see Section 4.1.1.), the YD will be positioned with the portside work area adjacent to the leg to be recovered. Figure 4-9 shows the YD positioned for recovery of leg 16. A four-part 7/8" wire strap will be passed through the chain link just outboard of the chock and secured to the main hook. Care must be taken to load the hook evenly. The main hook takes charge of the load and the chain is released from the termination(s) on the dry dock.

With the YD positioned clear of the dry dock (movement of the YD should be coordinated with the recovery operation so that the chain is maintained plumb to the maximum extent possible), AR 24216

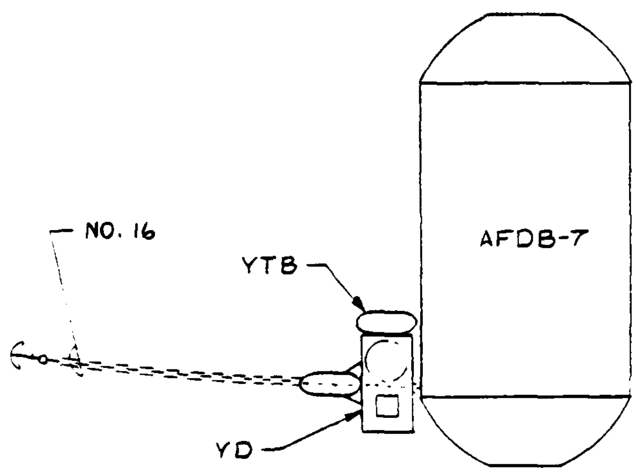

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Figure 4-[illegible] - Positioning YD at dry dock for recovery of mooring leg over portside

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take in on the main hook to recover the maximum bight of chain. As the chain is raised, water blast encrusted links. Maneuver the chain with the crane into the faired opening of the chain stopper and seat in the link rest. Close the gate and transfer the load to the stopper. Maneuver the bight and place it on deck. Utilize the Skagit and the crane to keep the bight forward in the work area with the bitter end near the portside. See Figure 4-10.

Prepare for the next bight by rerigging the 7/8" wire rope strap through a chain link just inboard of the chain stopper. Secure the strap to the main hook and take the load. Release the gate on the chain stopper, maneuver the chain out of the slot, and begin hoisting the next bight. Note that as subsequent bights are raised, the previous bight is likewsie lifted off the deck. Note that the length of the bights on deck are one-half the length of the boom height at the main hook, with the exception of the last bight which equals the boom height. See Figure 4-11.

Recovery of the anchor is the final step in the recovery operation and requires no special consideration. Position/placement on deck will be determined based upon available deck space, access to power tools, etc. The anchor will be detached from the chain at the 3-5/8" AJL and transferred to the dry dock for refurbishment.

4.2 Mooring Leg Refurbishment

Recovered mooring legs will be subject to the following refurbishment criteria. See Figure 4-12 for reference.

- All components will be thoroughly inspected for wear and uniform corrosion. Calipers will be used to measure wastage. Components exhibiting greater than 30% wastage (measured in diameter) will be replaced.

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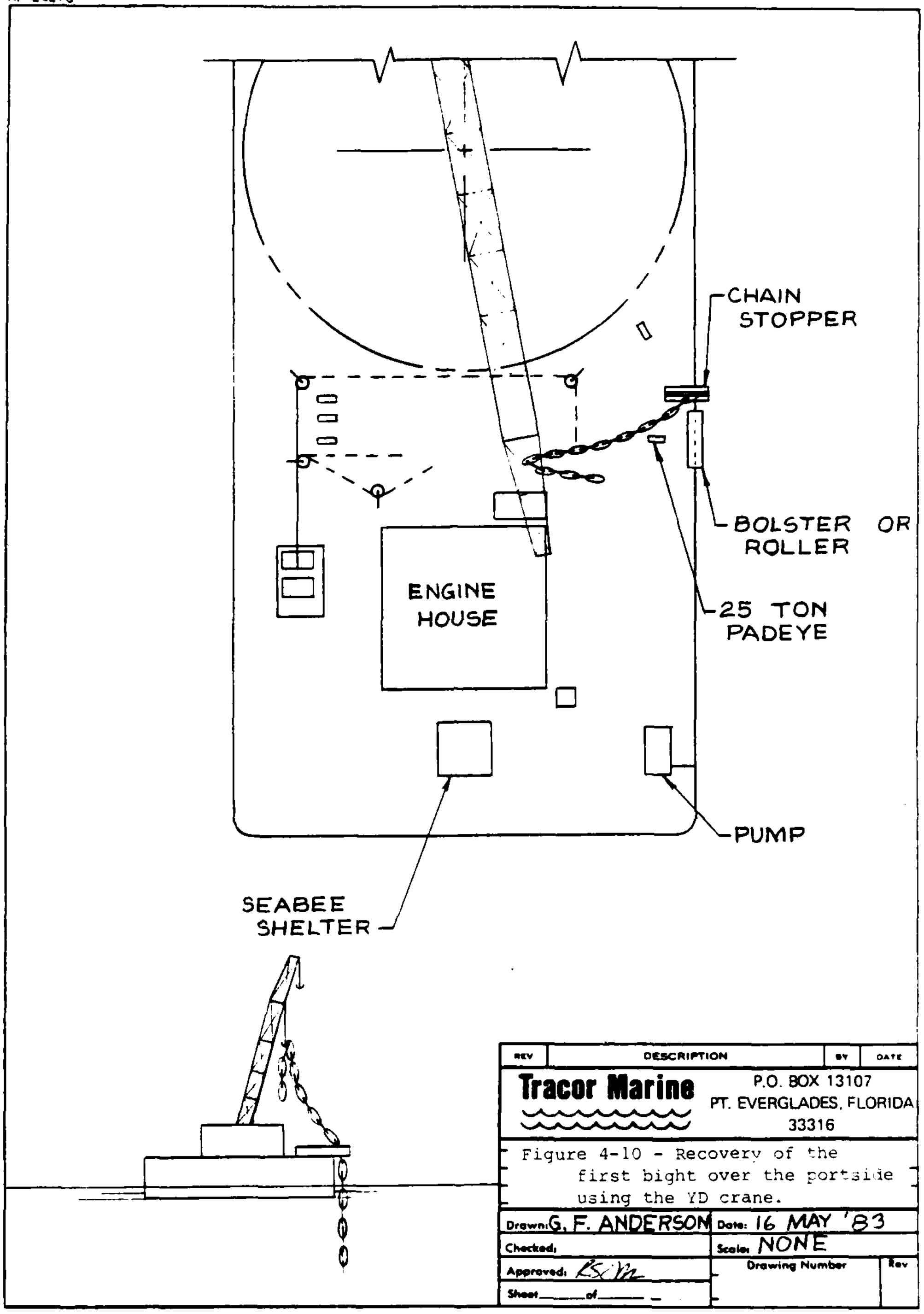

Figure 4-10 - Recovery of the first bight over the portside using the YD crane.

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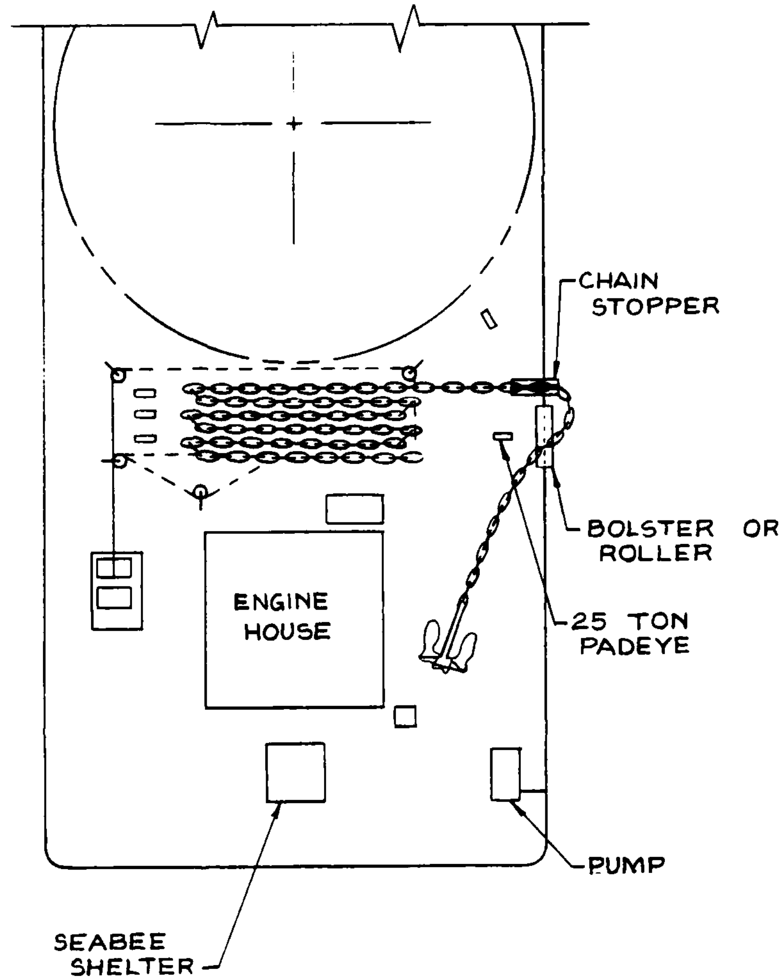

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Figure 4-11 - Final configuration, recovery over the portside using the crane.

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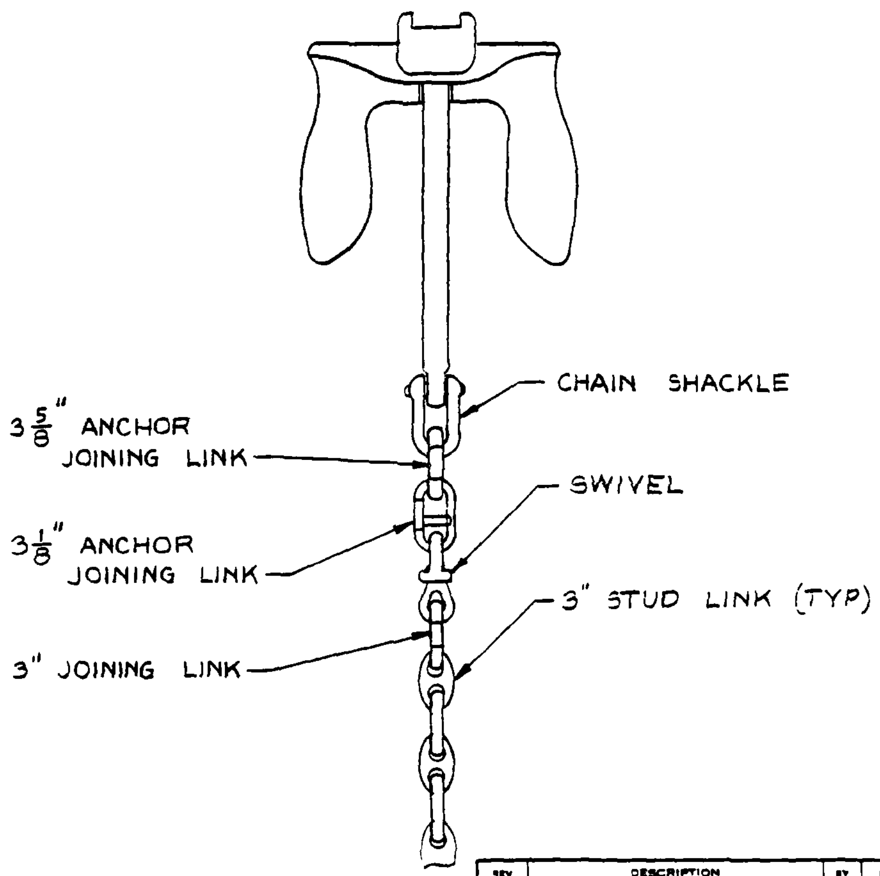

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Figure 4-[illegible] - 30,000 pound anchor and related jewelry

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- All changes to mooring legs will be logged. All as-built data will be recorded, including jewelry size and specifications, and length.

- The anchors will be sandblasted to remove encrustation and scale. Prefabricated stabilizers will be welded in place as shown in Figure 4-13, and the flukes will be welded open at a 45° angle to the shank. The welds will be red leaded.

- The mooring chain will be end for ended, as required.

4.3 Reinstallation

Each mooring leg will be reinstalled immediately after recovery and refurbishment (that is, only one leg will be put through the overhaul cycle at a time). Installation will essentially be the reverse of the recovery operation, with the exceptions noted below. The legs will be deployed from the YD anchor first, followed by the chain. The bitter end of the chain will be passed to the dry dock through the closed chock and secured to the terminations at a nominal tension of 10 kip until pretensioning.

In generic terms (not specific to the deck layout/ recovery option chosen) reinstallation will be according to the following specific steps:

1. The length of chain comprising the leg will be increased to insure that there will be sufficient scope to make the terminations at the dry dock at a nominal tension equal to the weight of a length of chain equal to the depth. Determination of the optimal amount of chain to be added will be trial and error.

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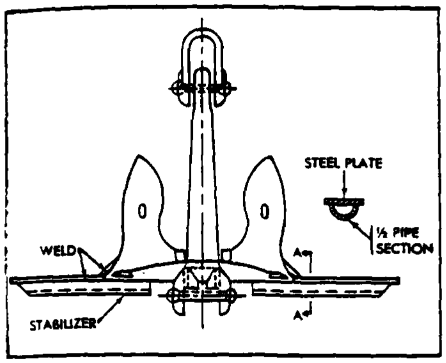

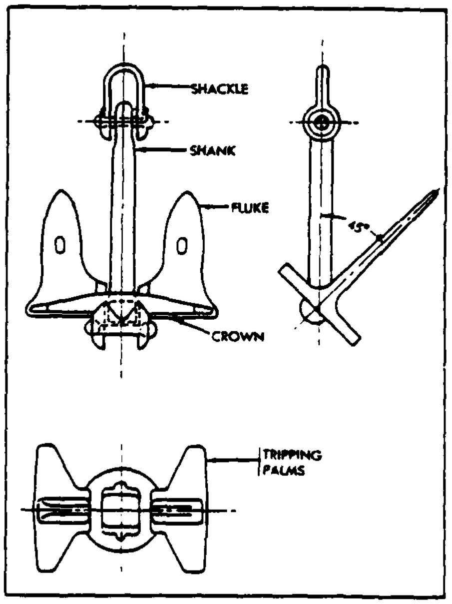

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Figure 4-13 - Anchor Refurbishment

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2. The YD will be positioned with the deployment side facing the AFDB-7 outboard of the pre-marked anchor location.

3. The anchor will be deployed with the main hook of the YD crane, using a tripping sling rigged as shown in Figure 4-14. The anchor will also be equipped with a small marker float.

4. The anchor will be placed on the bottom approximately 25 feet outboard (on the side opposite the AFDB-7) of the survey marker.

5. The tugs will move the YD towards the AFDB-7 along the planned bearing of the anchor leg. Initially, only a minimal amount of chain in excess of the depth will be deployed in order to set the anchor. The separation of the anchor marker and the survey marker will be observed with the goal of having the two markers occupy adjacent locations when the anchor sets (tension is nominally equal to 30,000 pounds). If the anchor drags a distance considerably inboard of the survey location (greater than 20 feet), a decision will have to be made whether or not to recover and redeploy it or accept the position as satisfactory.

6. With the anchor set, the chain will be deployed in bights. Each bight will be secured to padeyes on deck by wire straps and pelican hooks as a safety measure. As each bight is to be deployed, the pelican hook will be tripped. Close coordination

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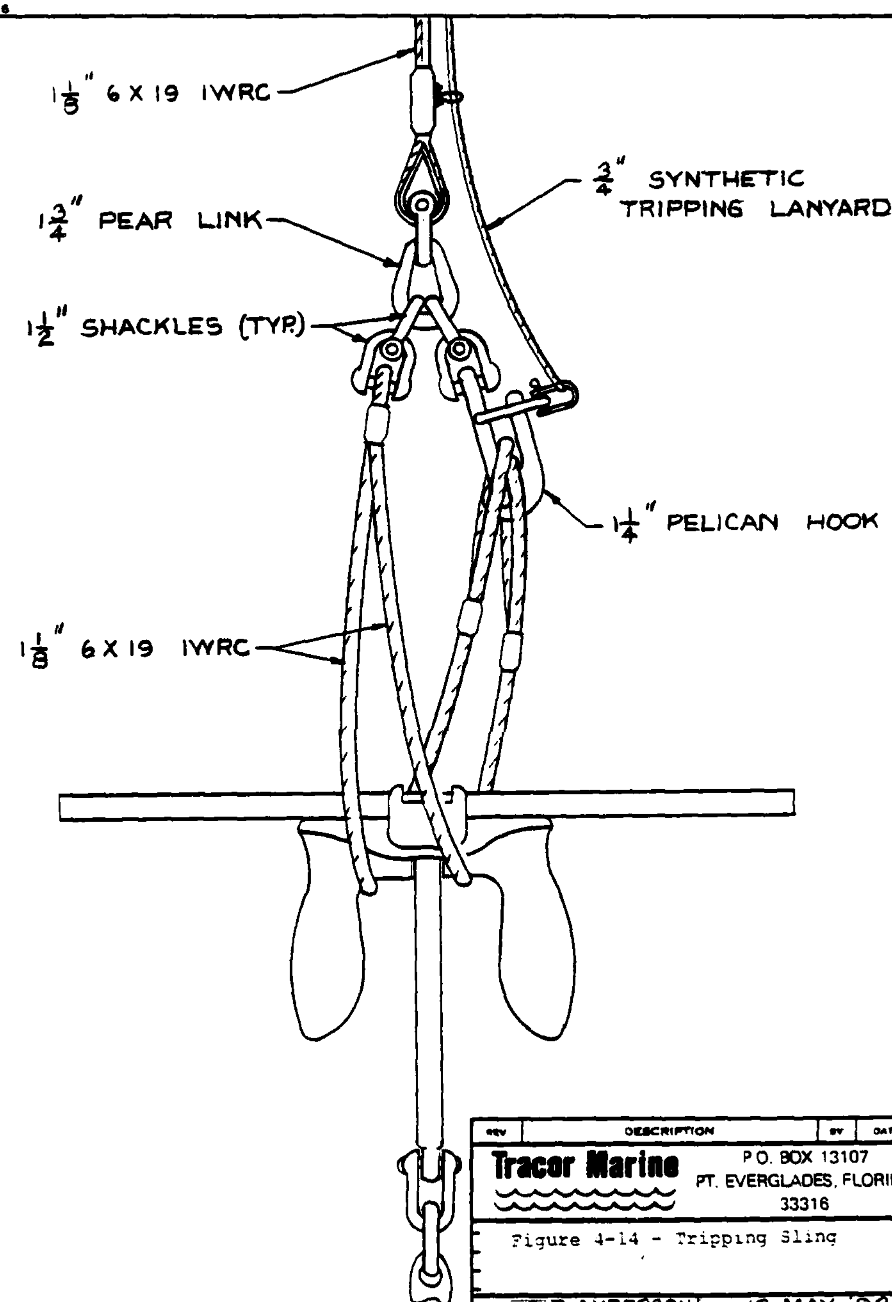

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Figure 4-14 - Tripping Sling

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between the deployment rate and the movement of the YD towards the AFDB-7 is critical. The chain must be deployed with minimal catenary in order to maintain acceptably low loads on the handling system. As such, the primary goal of the tug operations should be to keep the YD on the proper bearing. Movement toward the AFDB-7 should be deliberate and in concert with the deployment rate. A catenary which develops will tend to pull the YD back towards the anchor location.

7. When the YD reaches the AFDB-7 (see Figures 4-2 or 4-9 , depending upon the method used) the bitter end of the chain will be passed through the closed chock. The bitter end of the chain will be secured to the wire fairlead through the closed chock from the winch on the dry dock. The chain will be picked by the YD crane at a point 30 feet outboard of the bitter end and lowered as the bitter end is hauled through the chock and snubbed to the padeyes.

8. The chain will be secured by the pelican hook (secondary termination), the winch wire detached from the bitter end and reattached to the chain just inboard of the pelican hook, using a wire strap. Bights of chain will be thus inhauled until there is a nominal 10 kip tension (to be determined by observation of the angle of the chain as it enters the water). The chain will then be secured at both terminations until pretensioning.

The key elements of the scenario described above are shown in Figure 4-15.

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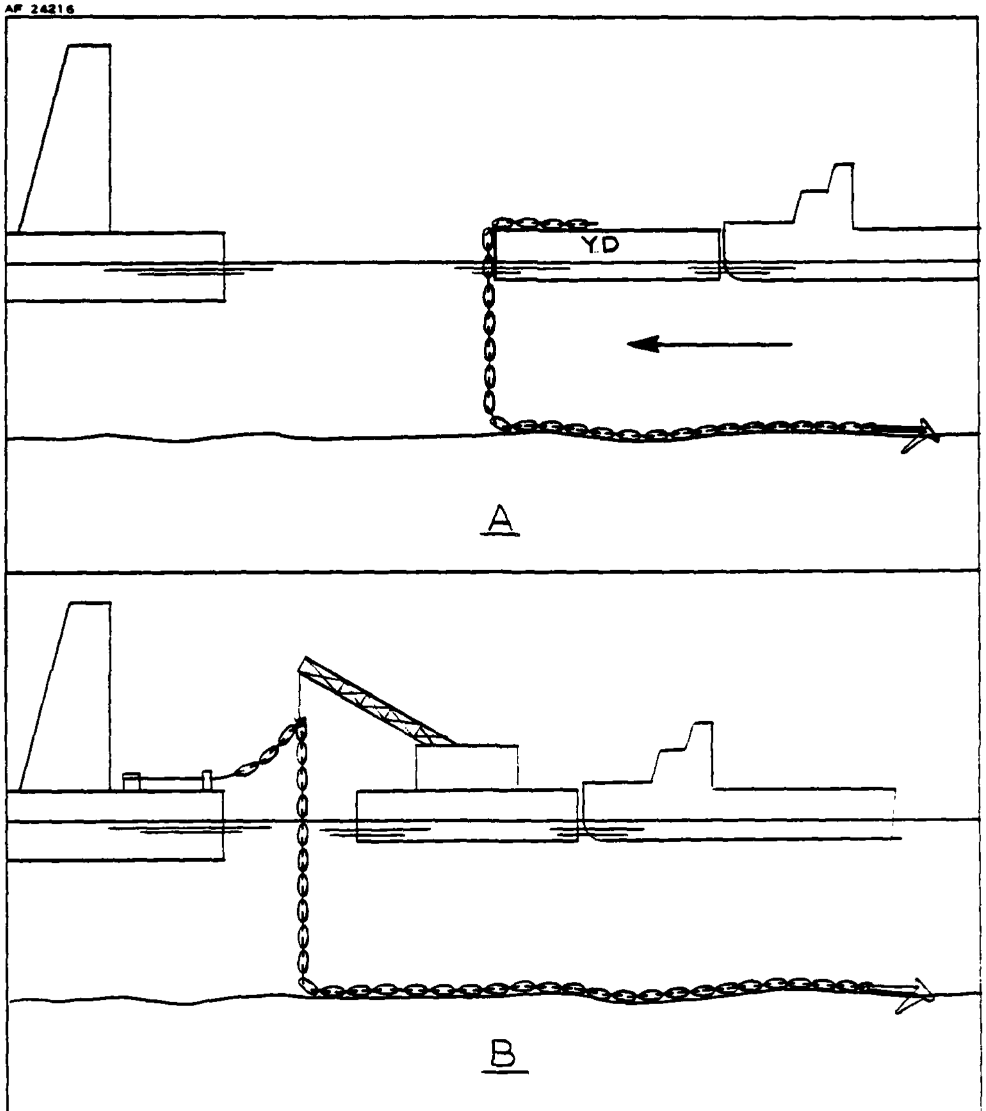

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Figure 4-15 - Reinstallation Sequence

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Installation of legs 6/7 and 17/18 requires special attention because of the bridle attachment to cans B and C. The technique is similar to that described above, utilizing the double drum feature of the winch on the AFDB-7. One wire will be fairlead through the chock on can B and the other on can C, secured to the appropriate arm of the bridle, and inhauled while the crane maintains the load near the bridle connection to the main leg. Figure 4-16 depicts the procedure. The lengths of the bridle legs and preliminary tensioning at the terminations require the same consideration of allowable tensions as described above for the generic case.

Reinstallation procedures unique to the deck layout/ recovery scenario chosen are given in the sections which follow.

4.3.1 Reinstallation Over the Bow, Using the AMCON

Reinstallation over the bow, using the AMCON, is the reverse of the recovery operation described in 4.1.2. The elements unique to this method include:

- The AMCON can only handle the deployment of the chain. Installation of the anchor and passage of the bitter end to the dry dock requires use of the crane.

- The safety padeyes (approximately six) will be located in a row athwartships on the portside facing forward. Care must be taken to leave sufficient space to fairlead the AMCON hauling wires.

4.3.2 Reinstallation Over the Bow, Using the YD Crane

This method is the reverse of that described in Section 4.1.3. The safety padeyes will be located in the same position as described in Section 4.3.1.

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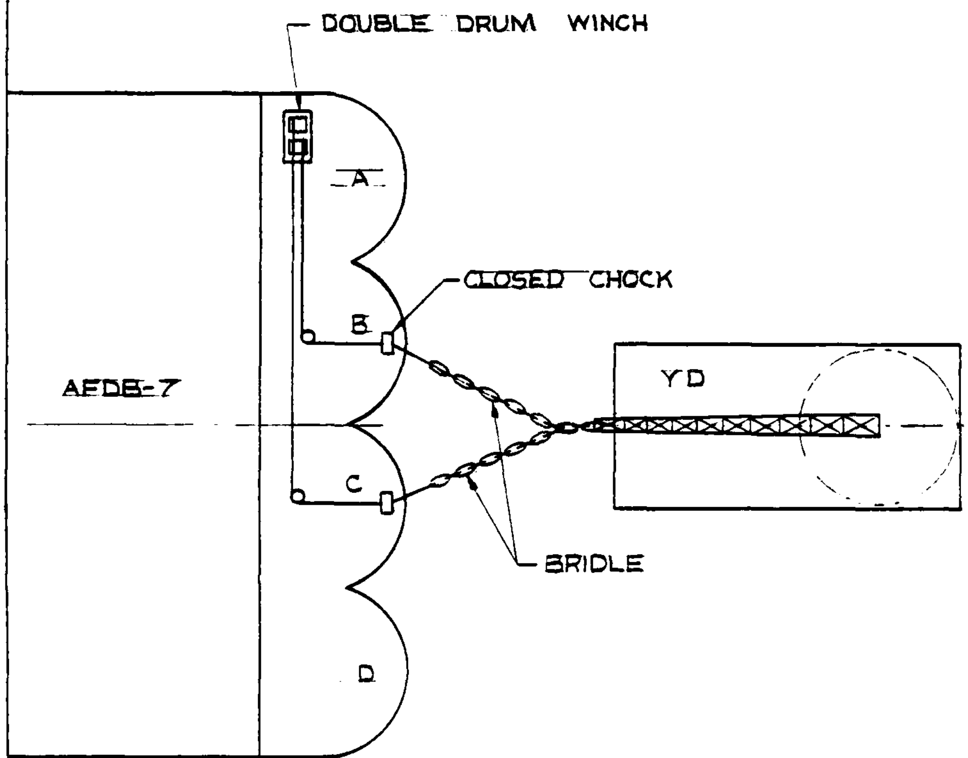

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Figure 4-16 . Bridle Reinstallation

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4.3.3 Reinstallation Over the Portside, Using the YD Crane

This method is the reverse of that described in Section 4.1.4. The safety padeyes will be mounted in a row fore and aft along the starboard side, facing to port.

4.4 Pretensioning

The reinstalled mooring legs will be pretensioned according to the specification given in Figure 4-17. The pretension force is dependent upon the draft of the dry dock and the tide at the time of pretension. The tide will be determined from the tide gauge at Admiralty Pier via the dry dock mounted theodolite. The draft can be measured directly.

Figure 4-18 depicts the pretensioning rig, which includes a dynamometer for measurement of the tension. The rig will require modification for use on the bow legs which attach to the dry dock beneath the timber decking. The addition of a second padeye and the use of a chain fall are anticipated at those locations.

The bow and stern legs will be pretensioned first, followed by the side legs, working from the corners towards the middle. The operation will alternate bow leg to stern leg and, likewise, portside leg to starboard side leg in order to maintain proper alignment of the dock. Although the nominal length of each leg is 585 feet, the pretension force is the controlling factor. Excess chain at each leg after pretensioning will be detached and removed from the dry dock.

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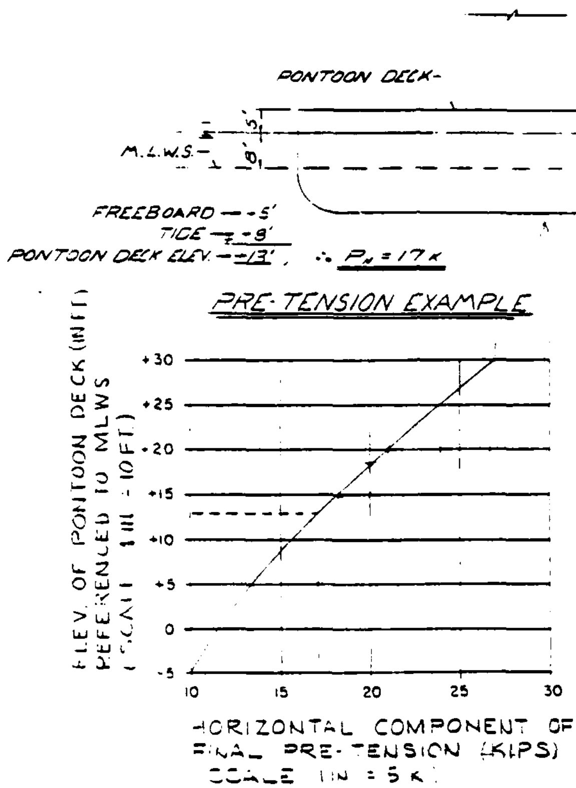

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Figure 4-17 - Pretensioning Specification

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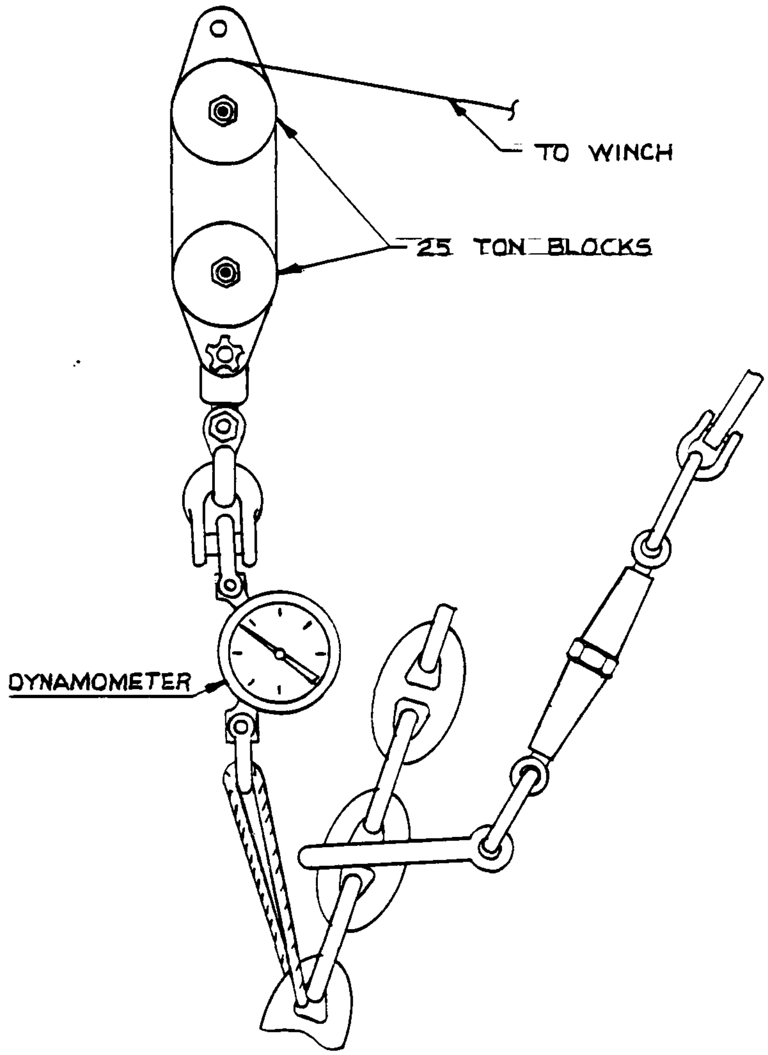

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Figure 4-18 - Pretensioning rig at the chain terminations

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5.0 DEMOBILIZATION

Following completion of the pretensioning operation and acceptance by the customer, equipment and personnel will be demobilized. Demobilization will include:

- Removal of project equipment from both the YD and AFDB-7 and preparation for shipment.
- Returning the YD and AFDB-7 to their as-found condition, including grinding down welds, red leading, and painting.
- Coordinating the logistics of shipment of equipment back to CONUS and, subsequently, the points of origin.
- Assembly of all project logs and data for subsequent inclusion in the completion report.
- Personnel travel back to CONUS.
- Expeditious return of rental equipment to the vendors to minimize lease costs.
- Determination and final disposition of acquired project equipment.

Seven days of demobilization activities are allocated on site at Holy Loch. Subsequent demobilization activities will be as required.

A completion report will be prepared that will provide as-built data, project logs and lessons learned.

6.0 REFERENCES

1. The Holy Loch Fleet Moorings Overhaul Report, FPO-82(22) Ocean Engineering and Construction Project Office, CHESNAVFACENGCOM, 15 October 1982.

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