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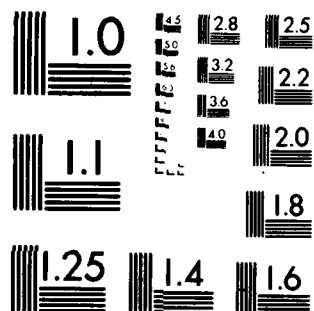
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INTRODUCTION

The Navy's Civil Engineering Laboratory (CEL) has been conducting tests of conventional drag embedment anchors in a range of seafloor soil types typical of Navy fleet mooring sites. These tests are being performed to improve the Navy's capability to select and size anchors for moorings, to improve installation procedures and to enable development of an empirical scheme to predict anchor behavior.

Tests have been performed in sand at San Diego, Calif., and in mud at Indian Island, Wash. Results of these tests are described in Reference 1.

This report documents results of instrumented anchor tests conducted in Apra Harbor, Guam during March 1980. These data are provided for immediate use by the Navy for selecting and sizing anchors for Guam and similar sites. Detailed analysis of these and previous data for San Diego and Indian Island is ongoing and will be completed during early FY81. Both commercially available and Navy drag embedment anchors were tested. Only Navy anchor test data are presented; the commercial anchor data will be the subject of a later report.

The test program is being sponsored by the Naval Facilities Engineering Command and the Naval Sea Systems Command, Supervisor of Salvage.

SITE EVALUATION

Site evaluation relied upon data gathered previously by boring and subbottom profiling and later through coring and in-situ vane shear testing. Borings taken in inner Apra Harbor during 1964 (Ref 2) show surface silty clay with coral fragments, of 0 to 40 ft thickness overlying stiff clay with coral fragments, sand, coral rubble, or medium to compact coralline limestone. During 1977, CEL performed a subbottom profile survey using a 5-kHz profiler (Ref 3). A more detailed survey was subsequently performed (Ref 4) using a deeper penetrating 3.5-kHz sound source; survey tracks are shown on Figure 1. Both subbottom surveys indicated a nearly flat seafloor underlain by a channelled topography. The area shown on Figure 1 in the southwest portion of the harbor was selected as the test site. All tracklines surrounding the selected area (Figure 2) indicated channels with at least 33 ft of sediment to the coral or dense sand subsurface. Figure 3 provides more exact information on barge and anchor test locations within the selected test area.

In-situ vane shear testing from a vessel-mounted vane shear platform and engineering analysis of cores taken with a 10-ft piston corer were planned; however, seafloor conditions were such that cores were not recovered. Details of the equipment, procedures, and soil analysis are included as Appendix A. As of this report, soil samples taken off each anchor had not been received from Guam; their analysis will be included in a subsequent report.

The seafloor conditions in inner Apra Harbor were different than had been expected based upon subbottom profile record interpretations and upon probings and borings previously taken in support of dredging operations. Deep channels of soft clay sediment were not located during the site evaluation with the vane shear device and piston corer. Rather, the deep channels south of buoy 28 consisted of corally sand overlain by soft clay of a few inches to 5 to 6 ft. For these conditions, a cone penetration device for the corally sand in conjunction with the vane shear device for the surficial clay would have provided more acceptable site data. It is not clear at this time why the site conditions encountered were different than those expected based upon previous data; however, this does highlight the difficulties associated with the performance of site investigations and the interpretation of the data.

TEST PROGRAM

Test Anchors

The anchors tested at Guam are listed below:

<u>Anchor</u>	<u>Nominal Weight</u> <u>lb (kg)</u>
STOCKLESS	5,000, 20,000
STATO	1,000, 3,000, 6,000
BRUCE (twin shank)	(500)
BRUCE	(1,000)
STEVDIG	(1,000)
STEVUD	(500) (1,000)
STEVFIX (sand)	(640)
HOOK	(560)

Dimensions of all tested anchors are provided in Appendix B. A summary of the anchor tests and anchor test configurations is given in Table 1.

The STOCKLESS anchor was tested with stabilizers and with free and fixed (fully opened) anchor flukes. The 20,000-lb STOCKLESS anchor is shown in both tested configurations in Figure 4.

Three sizes of STATO anchor were tested; each anchor was initially modified by extending the stabilizers according to the tentative recommendations provided by Figure 5. The 1,000-lb STATO with 14-in. T-plate extensions is shown in Figure 6.

Two types of BRUCE anchor were tested, the standard cast fixed fluke BRUCE anchor and the new adjustable fluke-welded BRUCE anchor. Figure 7 shows the cast BRUCE anchor with instrumentation package atop the shank forward of a multiholed padeye. The welded pad eye was attached specifically for the Guam test series to evaluate the effect of cable attachment point on anchor behavior. By moving the attachment point forward, nearer the fluke, the angle between cable attachment point and the center of pressure on the fluke is increased, thus, effectively increasing fluke angle. A new 500-kg adjustable fluke BRUCE anchor was provided for testing. It was similar to the 340-kg welded BRUCE anchor tested at Indian Island (Ref 1) except the fluke can be

adjusted for soft and stiff seafloors. Figure 8 shows the adjustable BRUCE in end and side views. Fluke angle is adjusted at the juncture of the shank and anchor fluke.

Other high efficiency anchors tested included the HOOK, STEVFIX, STEVMUD, and STEVDIG anchors. The HOOK anchor, Figure 9, is a movable fluke anchor designed for use with permanent mooring installations because it must be lowered in a flukedown orientation. The HOOK anchor was originally provided to CEL for testing with auxiliary flukes on the shank just forward of the shackle. They were removed during previous tests at San Diego because they impeded rather than enhanced penetration. Two sizes of STEVMUD anchor (Figure 10) were tested. This is a single-purpose anchor designed with a 50-deg fluke angle for mud seafloors. The STEVFIX anchor was designed for stiff as well as soft seafloors. Its fluke is adjustable to 32 deg for stiff and 50 deg for soft seafloors. In addition, fluke extensions are available for soft seafloors as shown in Appendix A. Figure 11 shows the STEVFIX anchor in plan view and also provides a side view to show a plate that has been added to the anchor crown to fill in the space between anchor fluke and tripping palm. This was done by CEL in an attempt to promote more rapid anchor keying in soft seafloors. The STEVDIG anchor, designed for stiff seafloors, was also tested at its primary 32-deg fluke angle.

Test Procedures and Equipment

The test setup employed at Guam and used previously at San Diego and Indian Island (Ref 1) is illustrated by Figure 12. A YC barge is used as the pulling and data recovery platform, and a YFNB barge, with pusher boat support, is used for test anchor installation and recovery.

Anchor loading was accomplished by a 100-ton hydraulic cable puller that pulls the YC barge toward the restraint mooring. The test mooring line consisted of about 340 ft of 2-in. wire and a length of chain sized for the anchor to ensure horizontal loading at the seafloor at estimated peak load. The anchor was loaded at about 2 ft per minute and pulled roughly 50 ft or until the anchor became unstable. The crane barge, also shown in Figure 12, was attached to the test barge by a 1-in. wire to aid in barge positioning during installation and recovery. Installation of the STATO anchor from the YFNB barge is shown in Figure 13.

Each anchor tested was instrumented to determine anchor depth, anchor shank pitch, anchor roll, and anchor load (see Figure 9). The load cell is the slender object attached between the end of the shank and the mooring chain. The instrument package is located on the shank and contains a pressure transducer to measure anchor depth, inclinometers to measure shank pitch and anchor roll, all signal conditioning equipment, and the load cell amplifiers. A hose attached to the pressure transducer was buoyed off to ensure that its bitter end remained in the water column to prevent false depth readings. The anchor measurement system was connected to the instrument shack onboard the YC barge via a 1,000-ft-long, six-conductor electrical cable. Mooring line load and mooring line angle at the barge and barge displacement relative to a fixed spar buoy were also recorded. These data are needed to calculate true anchor drag distance as well as the contribution of the bottom resting chain to mooring capacity.

A more detailed description of the test procedures and equipment is provided in the report describing anchor tests performed at San Diego and Indian Island (Ref 1).

RESULTS AND DISCUSSION

Test Procedures

The anchor test procedure employed at Guam, San Diego and Indian Island was similar and reasonably effective. Problems did occur, however, with maintaining the integrity of the pressure transducer hose and the electrical wires to the anchor-mounted instrument pack and to the load cell. Even though armoured cables were purchased for Guam to resolve problems encountered at Indian Island, the cable and cable connectors were often damaged. A more secure method of restraining the cables and transducer hose and sturdier cables would have improved the data recovery rate. This particular problem is significant in soft seafloors where anchor penetration and resulting cable drag is high and in seafloors like Apra Harbor where coral fragments or rubble are present.

Anchor Tests

Twenty-three tests of Navy and commercial anchors were completed at Guam. Results of Navy anchor (STOCKLESS and STATO) tests are described in this section. Further, data plots, data tabulations and descriptions of the data outputs for the twelve Navy anchor tests are presented in Appendix C. Commercial anchor test results will be discussed in a subsequent report.

Fewer tests were conducted at Guam than planned. High winds were a continual problem and caused considerable difficulty in maneuvering the anchor-handling barge. Also, sharp coral fragments frequently severed the electrical cable at the inception of a test. The anchor then had to be recovered for electrical cable repair.

Due to a time constraint on the test effort, certain lower priority tests and some duplicative tests were eliminated from the schedule. Time-consuming tandem anchor tests were not performed. However, techniques for installing anchors with welded-open anchor flukes (a requirement for the inboard anchor in a tandem arrangement, see Reference 1) were evaluated, and the approach shown in Figure 4a proved to be the simplest. After the chain is released and stretched out, the anchor is lowered in its flukedown orientation to the seafloor.

STOCKLESS Anchor. Both 5,000- and 20,000-lb stabilized STOCKLESS anchors were tested. Table 2 provides peak performance data for each of the tests. Results of the two tests of the 5,000-lb STOCKLESS anchor were quite different. This is probably due to the presence of a few feet of soft clay over the corally sand for Test 1 and corally sand at the immediate surface for Test 2.

In Test 1, the efficiency of the stabilized STOCKLESS anchor with 48-deg fluke angle, based on the true anchor weight of 5950 lb, was 3.5; based on nominal weight of 5000 lb, it was 4.2. Total mooring load was 36,400 lb which shows that about 2,300 lb of chain was holding 15,000 lb. This large chain effect occurs once the chain is pulled into

the seafloor, and was also seen in the tests at San Diego and Indian Island (Ref 1). A large part of the chain effect should be considered as part of true anchoring capacity. This effect is being evaluated in more detail as part of the ongoing effort to develop a scheme to predict anchor holding capacity as a function of the seafloor's engineering properties. Results of Test 2 for the 5,000-lb STOCKLESS anchor were significant because anchor efficiency was 9.9 with a fluke angle of 48 degrees, which is often not suitable for competent seafloors. At peak load there is very little chain on or in the seafloor; thus, the 67,600-lb peak line load is essentially the true anchor holding capacity.

The 20,000-lb STOCKLESS anchor with a 48-deg fluke angle exhibited an anchor efficiency of about 5 for both fixed and movable fluke conditions. Without the instrument package on the anchor, it was difficult to tell the distance the movable fluke version took to key into the seafloor, but an estimate is about 5 to 10 ft. The seafloor conditions for all four 20,000-lb anchor tests were similar with one exception; the thickness of the soft clay over the corally sand decreased in a southerly direction. It varied from 5 to 6 ft for Test 20 (20,000-pound STOCKLESS with fixed flukes) to 0 ft for Test 23. One test of the STOCKLESS anchor (Test 21) occurred too near the edge of the test sediment channel because it appeared the anchor hooked a coral outcrop. However, the anchor broke free and soon embedded into the corally sand.

Near the northern part of inner Apra Harbor, the surface sediment is predominantly soft clay varying in thickness from 0 to 40 ft. Typical STOCKLESS anchor performance would probably more nearly approximate Test 1 behavior. To ensure that this behavior is at least equalled, the anchor flukes should be welded fully open, otherwise they may not open in the soft sediment and would result in an anchor efficiency closer to 2 than 4 (Ref 1). The massive STOCKLESS fixed-fluke anchor did not seem to be affected by the surficial clay and the movable fluke STOCKLESS anchor had no difficulty in penetrating the corally sand. The STOCKLESS anchor with welded-open flukes (48-deg fluke angle) should satisfy the majority of inner Apra Harbor needs.

STATO Anchor. The 1,000-lb STATO was only tested once because its stabilizer broke off during its first test and there was not sufficient time to fabricate another one. The peak mooring line load was 20,000 lb, of which about 15,000 to 17,000 lb would be the true anchoring load once the chain effect was eliminated. The most notable feature of this test was that the STATO with mud palm extensions was pulled almost 40 ft before significant load buildup. The seafloor surface at this test location was soft clay.

The 3,000-lb STATO was first tested with a 50-deg mud fluke angle; this was ineffective for it yielded an anchor efficiency of only 4. The fluke angle was changed to 32 deg, and the anchor was retested. The peak mooring load increased from 25,000 to 61,000 lb. At 61,000 lb, the anchor began to roll, and the test was stopped to avoid electrical cable damage. The final test of the 3,000-lb STATO was with a 1-1/2-in. wire, 100 ft long, between the anchor and mooring chain. Total mooring load increased slightly to 63,700 lb. Basically, the anchor with wire or chain at its shank behaved similarly in the Apra Harbor corally sand seafloor.

The 6,000-lb STATO was tested twice with the anchor flukes set at 34 deg and with extended stabilizers for the first and with normal stabilizers for the second test. The first test was stopped at an anchor load of 40,000 lb when the anchor started to rotate. When the anchor was recovered, one stabilizer extension was missing. This probably contributed to the initiation of anchor rotation. This anchor was pulled for almost 35 ft before digging into the seafloor, then it dug in quite rapidly. Peak mooring line load for the second test of the 6,000-lb STATO was 106,900 lb. At about 80,000 lb, the anchor started to rotate while building up load. It appeared to stabilize at about 37 deg rotation; however, the test was stopped to avoid cable damage.

The unusually long drag distances for the STATO anchor, both 1,000-lb and 6,000-lb size (refer to Appendix C, Tests 3 and 18), are attributed to the very soft surficial clay overlying the competent corally sand subsurface at the site of these tests. It appears from the data for Test 18 (6,000-lb STATO) that the anchor penetrated (or sunk into) the soft clay and was dragged over the harder substrata for a considerable distance until it dug in. The heavy, inefficient STOCKLESS anchor with fixed fluke did not have difficulty embedding in this same seafloor.

An inadvertent test of the 9,000-lb STATO back leg anchor occurred when it was dragged for over 150 ft without setting at about 30,000-lb total load. The 5,000-lb STOCKLESS anchor that was being tested (Test 1) remained fixed while the 9,000-lb STATO was dragged. When the STATO was recovered, it was found that the anchor crown wire was loosely hung under one anchor fluke. That wire was sufficient to prevent the fluke from embedding. This problem plus the unpredictable behavior of the STATO anchor in inner Harbor at Guam makes it necessary to verify anchor capacity by proofsetting (testing to design load) prior to use. This recommendation applies to all the high efficiency anchors tested at Guam. High efficiency anchors are much more sensitive to seafloor conditions than less efficient but more predictable anchors such as the STOCKLESS anchors.

SUMMARY

The series of tests at Guam with Navy STOCKLESS and STATO anchors and with various commercially available high-efficiency drag anchors concludes the field experimental phase of a project directed at improving the Navy's capability to select and size anchors for Fleet moorings. Results of these and previous tests, and tentative recommendations concerning necessary anchor modifications to improve anchor performance, are being provided for immediate use by the Navy for selection and sizing of anchors for the specific test sites (Guam, San Diego, Indian Island) in addition to sites with similar seafloor conditions. These data provide the basis for the eventual development of a scheme to predict anchor behavior as a function of soil engineering properties. This project will be completed during 1981.

CONCLUSIONS AND RECOMMENDATIONS

The recent anchor tests at Guam and the previous tests at San Diego in sand and at Indian Island in mud highlight the significant dependence of high-efficiency anchor performance on seafloor soil characteristics. There are several recommendations, in decreasing order of effectiveness, that can be used for determining anchor capacity and suitability. Anchor proof setting is the safest method of ensuring the ability of an anchor system to satisfy design loads. Use of historical test data, such as that described in this report, provides suitable design information for that test site. Reliance on tests of smaller-size anchors in conjunction with information on the sediment characteristics is also a reasonably acceptable method of anchor design. Determination of anchor performance from knowledge of the engineering soil characteristics (soil strength, soil type, soil profile) is undergoing development and ultimately will provide a reasonable basis for design. The least reliable method of selection and of determining suitability is on the basis of available design charts without in-place verification that the anchor is properly set. If this method is employed, and it is often the only available option, then a factor of safety of two should be applied to the mooring design load for anchor selection based upon existing design charts or advertising literature.

Some specific conclusions and recommendations regarding Navy Stockless anchor and STATO anchor performance in inner Apra Harbor, Guam, are provided.

1. About 5 to 6 ft of soft surficial clay did not prevent the 20,000-lb STOCKLESS anchor with fixed fully opened flukes from penetrating the harder corally sand subsurface, thus illustrating the less sensitive nature of higher mass, low-efficiency anchors to site conditions.
2. The movable fluke STOCKLESS anchor (48-deg fully opened fluke angle) had no difficulty in penetrating the uncovered corally sand. The density of the corally sand in inner Apra Harbor is not sufficient to require a reduced fluke angle of 35 deg commonly recommended for sand to enable penetration.
3. A STOCKLESS anchoring efficiency of four based on nominal anchor weight is recommended for inner Apra Harbor. The STOCKLESS anchor should be stabilized, have a normal fluke angle of 48 deg, and in areas where surface clay cover is greater than 5 to 7 ft, the flukes should be fixed fully open to ensure proper keying without proof setting. Available data suggest that keying problems with the STOCKLESS could occur north of buoy 28. Soft sediment cover seems to increase to the north in the inner harbor.
4. The performance of the STATO anchor in inner Apra Harbor was erratic, apparently due to the surficial soft clay. The presence of soft clay over a stiffer substrata appears sufficient to retard anchor penetration into the substrata. This problem makes it necessary to proof-set the STATO or other high-efficiency anchors in inner Apra Harbor or in similar areas with soft sediment overlying a stiffer substrata.

5. High-efficiency anchors are more sensitive to seafloor conditions than less efficient, but more predictable STOCKLESS anchors. The seafloor conditions in inner Apra Harbor are more suited to the less sensitive STOCKLESS anchor; thus, the STOCKLESS anchor is recommended for inner harbor Fleet mooring use.

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1. Civil Engineering Laboratory. Technical Note N-1581: Conventional anchor test results at San Diego and Indian Island, by R. J. Taylor. Port Hueneme, Calif., Jul 1980.
2. Navy Public Works Center, Guam. Navy Bureau of Yards and Docks Drawing 1014202.
3. Civil Engineering Laboratory. Technical Memorandum M-42-77-3: Apra Harbor mooring inspection, by R. J. Taylor. Port Hueneme, Calif., Feb 1977.
4. Chesapeake Division of NAVFAC. Ocean Engineering and Construction Project Office. Report FPO-1-79 (11), by A. R. Del Collo. Washington, D.C., Oct 1979.

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REFERENCES

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4. Chesapeake Division of NAVFAC. Ocean Engineering and Construction Project Office. Report FPO-1-79 (11), by A. R. Del Collo. Washington, D.C., Oct 1979.

Table 1. Data Summary for APRA Harbor, Guam Anchor Tests

Test No.	Anchor	Date Calendar (Julian)	Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Water Depth (ft)	Anchor Alterations	Test Mooring Lines Makeup (from anchor to barge)*	General Seafloor Characteristics
1	STOCKLESS	3/19/80 (079)	5,000	5,950	48	F	40	1. w/stabilizers 2. flukes fixed fully open	186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	mud over corally sand
2	STOCKLESS	3/19/80 (079)	5,000	5,950	48	F	40	1. w/stabilizers 2. flukes fixed fully open	186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	corally sand
3	STATO	3/19/80 (079)	1,000	1,070	50	M	36	1. w/40-in. stabilizers (14-in. extensions) 2. w/mud palms	186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	mud over corally sand
4	HOOK	3/21/80 (081)	(560)	1,230 (560)	50	F	37.5	1. w/o shank auxiliary flukes	97 ft of 1- $\frac{1}{4}$ -in. chain; 186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	mud over corally sand
5	STEVFIX	3/21/80 (081)	(640)	1,408 (640)	50	M	40	1. w/plates added to fill-in tripping palms	97 ft of 1- $\frac{1}{4}$ -in. chain; 186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	less than 5 ft mud over corally sand
6	STEVFIX	3/21/80 (081)	(640)	1,408 (640)	50	F	41.6	1. w/plates added to fill-in tripping palms 2. anchor flukes fixed fully open	97 ft of 1- $\frac{1}{4}$ -in. chain; 186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	less than 5 ft mud over corally sand
7	STEVNUD	3/21/80 (081)	(500)	1,100 (500)	50	M	34		97 ft of 1- $\frac{1}{4}$ -in. chain; 186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	less than 5 ft mud over corally sand
8	STEVNUD	3/22/80 (082)	(500)	1,100 (500)	50	M	35		97 ft of 1- $\frac{1}{4}$ -in. chain; 54 ft of 2-in. chain; 186 ft of 2- $\frac{1}{4}$ -in. chain; 340 ft of 2-in. wire	less than 5 ft mud over corally sand

(continued)

Table 1. Continued

Test No.	Anchor	Date Calendar (Julian)	Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Water Depth (ft)	Anchor Alterations	Test Mooring Lines Makeup (from anchor to barge)*	General Seafloor Characteristics
9	BRUCE	3/24/80 (082)	(1,000)	2,200 (500)	-	F	40	1. chain attached atop shank 21 in. forward of standard end of shank attachment point	97 ft of 1-1/4-in. chain; 54 ft of 2-in. chain; 186 ft of 2-1/4-in. chain 340 ft of 2-in. wire	less than 5 ft mud over corally sand
10	BRUCE	3/24/80 (084)	(1,000)	2,200 (500)	-	F	40	1. chain attached atop shank 46 in. forward of standard end of shank attachment point	97 ft of 1-1/4-in. chain; 54 ft of 2-in. chain; 186 ft of 2-1/4-in. chain 340 ft of 2-in. wire	less than 5 ft mud over corally sand
11	STEPMUD	3/24/80 (084)	(1,000)	2,200 (500)	50	M	35		97 ft of 1-1/4-in. chain; 54 ft of 2-in. chain; 186 ft of 2-1/4-in. chain; 340 ft of 2-in. wire	less than 5 ft mud over corally sand
12	TWIN-SHANK BRUCE	3/25/80 (085)	(500)	1,100 (500)	-	F	35	1. fluke angle adjusted for mud	97 ft of 1-1/4-in. chain; 54 ft of 2-in. chain; 186 ft of 2-1/4-in. chain; 340 ft of 2-in. wire	corally sand with clay
13	TWIN-SHANK BRUCE	3/25/80 (085)	(500)	1,100 (500)	-	F	36.4	1. fluke angle adjusted for sand	97 ft of 1-1/4-in. chain; 54 ft of 2-in. chain; 186 ft of 2-1/4-in. chain; 340 ft of 2-in. chain	corally sand with clay
14	STATO	3/25/80 (085)	3,000	3,500	50	M	36	1. w/52-in. stabilizers (18-in. extensions) 2. w/mud palms	54 ft of 2-in. chain; 82 ft of 2-1/4-in. chain; 186 ft of 2-1/4-in. chain; 340 ft of 2-in. wire	corally sand with clay
15	STATO	3/26/80 (085)	3,000	3,500	32	M	35.5	1. w/52-in. stabilizers 2. w/mud palms 3. w/32° fluke angle (34° is standard)	54 ft of 2-in. chain; 82 ft of 2-1/4-in. chain; 186 ft of 2-1/4-in. chain; 340 ft of 2-in. wire	corally sand with clay

(continued)

Table 1. Continued

Test No.	Anchor	Date Calendar (Julian)	Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Water Depth (ft)	Anchor Alterations	Test Mooring Lines Makeup (from anchor to barge) ^a	General Seafloor Characteristics
16	STATO	3/26/80 (086)	3,000	3,500	32	M	36	1. w/52-in. stabilizers 2. w/mud palms 3. w/32° fluke angle 4. w/1-1/2-in. wire at shank	100 ft of 1-1/2-in. wire; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. wire	corally sand with clay
17	STEVDIG	3/26/80 (086)	(1,000)	2,550 (1,160)	32	M	42.5		54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. wire	corally sand
18	STATO	3/27/80 (087)	6,000	6,600	34	M	36	1. w/67-in. stabilizers (23-in. extensions) 2. w/mud palms	54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. wire	5-7 ft mud over corally sand
19	STATO	3/27/80 (087)	6,000	6,600	34	M	36	1. w/standard 44-in. stabilizers 2. w/mud palms	54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. chain	1-2 ft mud over corally sand
20	STOCKLESS	3/28/80 (088)	20,000	22,000	48	F	35	1. w/stabilizers 2. flukes fixed fully open	54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. chain	5-7 ft mud over corally sand
21	STOCKLESS	3/28/80 (088)	20,000	22,000	48	F	35	1. w/stabilizers 2. flukes fixed fully open	54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. wire	mud over corally sand
22	STOCKLESS	3/28/80 (088)	20,000	2,200	48	M	36.5	1. w/stabilizers	54 ft of 2-in. chain; 82 ft of 2-1/2-in. chain; 186 ft of 2-1/2-in. chain; 340 ft of 2-in. wire	1-2 ft mud over corally sand

(continued)

Table 1. Continued

Test No.	Anchor	Date Calendar (Julian)	Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Water Depth (ft)	Anchor Alterations	Test Mooring Lines Makeup (from anchor to barge) ^a	General Seafloor Characteristics
23	STOCKLESS	3/28/80 (088)	20,000	22,200	48	M	36.5	1. w/stabilizers	54 ft of 2-in. chain; 82 ft of 2- $\frac{1}{2}$ -in. chain; 186 ft of 2- $\frac{1}{2}$ -in. chain; 340 ft of 2-in. wire	corally sand

^aTest pulling barge height above water was 9 ft 4 in.

Table 2. Peak Anchor Performance Data for Inner Apra Harbor, Guam

Test No.	Anchor	True Anchor Weight (lb)	Drag Dist. at Peak Load (ft)	Peak Load at Anchor (lb)	Peak Mooring Load (lb)	Mooring Line Weight on Bottom (lb)	Mooring Line Length on Bottom (lb)	Peak Anchor Efficiency	Remarks
1	5K STOCKLESS o Stabilizers o Fixed flukes o 48° fluke angle	5,950	15	21,000	36,400	2,282	56	3.5	Anchor recovered with only soft mud on anchor flukes.
2	5K STOCKLESS o Stabilizers o Fixed flukes o 48° fluke angle	5,950	33	59,000	67,600	303	7	9.9	Anchor recovered with corrally sand on anchor flukes.
3	1K STATO o 40-in. stabilizers o 50° fluke angle	1,070	51	no reading	20,400	5,113	126	N/A	Anchor stabilizer broke off. Bolt for anchor stabilizer attachment sheared.
14	3K STATO o 52-in. stabilizers o 50° fluke angle	3,500	44	14,000	25,300	10,059	240	4	Anchor recovered with corrally sand. Anchor became unstable at about 40 ft of drag.
15	3K STATO o 52-in. stabilizers o 32° fluke angle	3,500	42	no reading	61,000	5,422	128	N/A	Anchor began to rotate and lose capacity after reaching peak capacity.
16	3K STATO o 52-in. stabilizers o 32° fluke angle	3,500	26	44,000	63,700			12.6	100-ft length of wire between anchor and chain had no effect on total mooring capacity.
18	6K STATO o 67-in. stabilizers o 34° fluke angle	6,600	42	45,000	54,400	6,545	154	-	Anchor began to rotate rapidly at 40 ft of drag; thus, test was ended to avoid instrument damage.

(continued)

Table 2. Continued

Test No.	Anchor	True Anchor Weight (lb)	Drag Dist. at Peak Load (ft)	Peak Load at Anchor (lb)	Peak Mooring Load (lb)	Mooring Line Weight on Bottom (lb)	Mooring Line Length on Bottom (lb)	Peak Anchor Efficiency	Remarks
19	6K STATO o 67-in. stabilizers o 34° fluke angle	6,600	38	no reading	106,900	1,574	49	N/A	Anchor rotated to about 40° and stabilized. One anchor stabilizer extension broke off during test.
20	20K STOCKLESS o Stabilizers o Fixed flukes o 48° fluke angle	22,000	22	no reading	120,500	0	0	5.5	About 20 ft of drag required to reach peak load.
21	20K STOCKLESS o Stabilizers o Fixed flukes o 48° fluke angle	22,000	43	no reading	101,600	0	0	4.6	Anchor first approached 100 kips at 18 ft of drag. Appeared that anchor hooked coral at edge of channel.
22	20K STOCKLESS o Stabilizers o Movable flukes o 48° fluke angle	22,000	32	no reading	117,600	0	0	5.3	Anchor first approached 100 kips at 17 ft of drag. About 5-10 ft (est) required to open flukes.
23	20K STOCKLESS o Stabilizers o Movable flukes o 48° fluke angle	22,000	25	no reading	121,500	0	0	5.5	

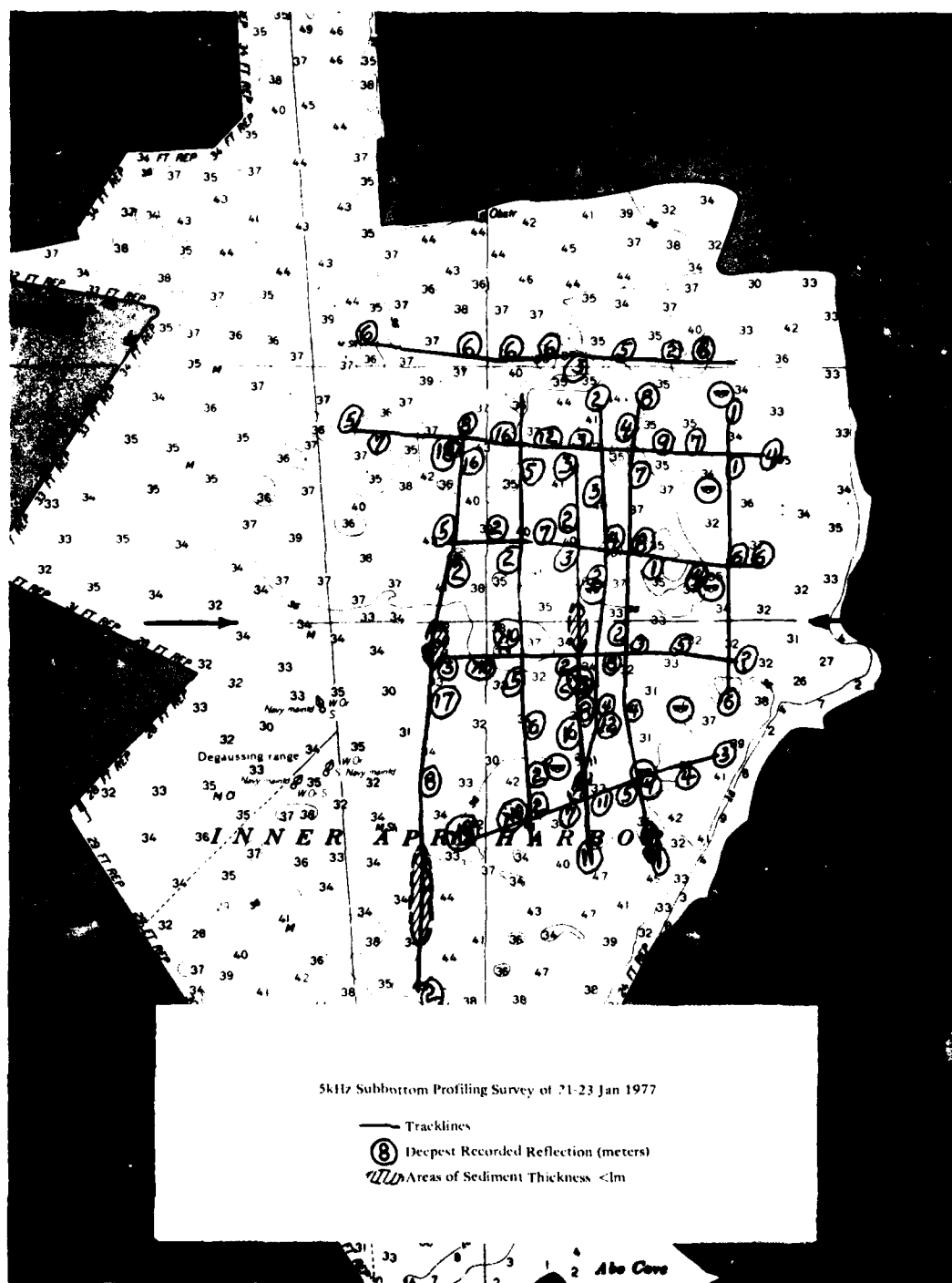


Figure 1. Results of subbottom profile survey using 5kHz sound source. (after Ref. 3.)

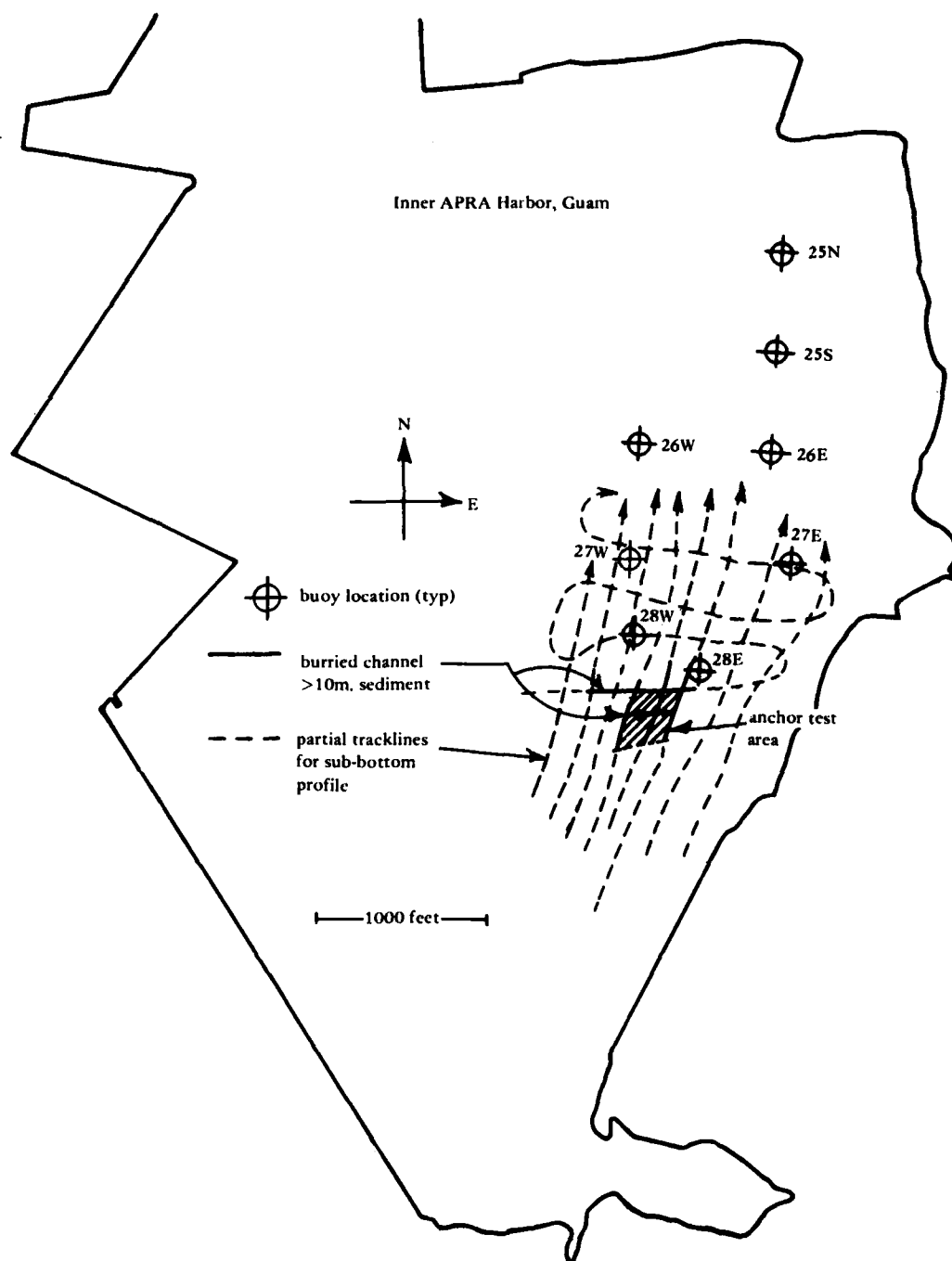


Figure 2. Results of subbottom profile survey using 3.5kHz sound source.
(after Ref. 4.)

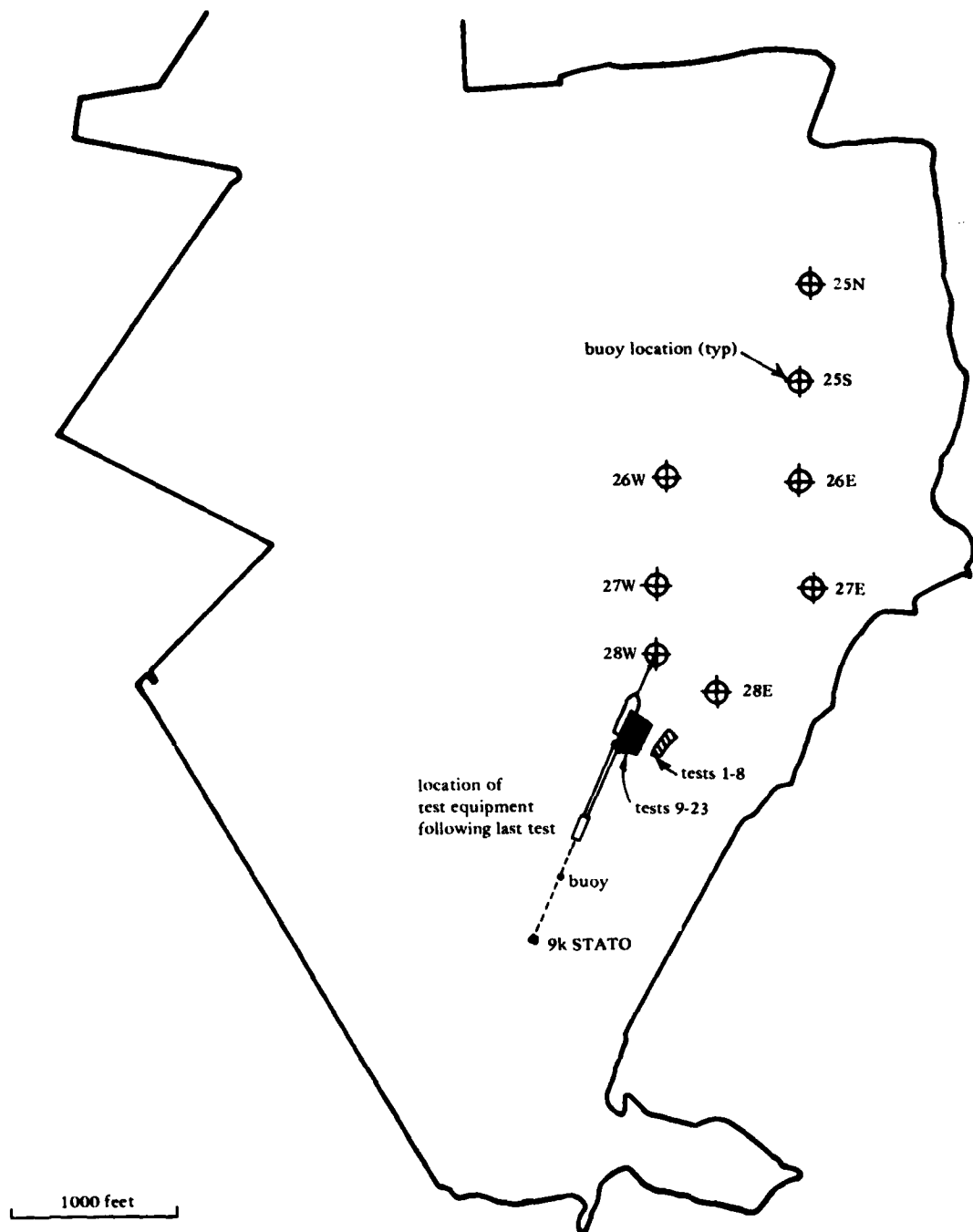
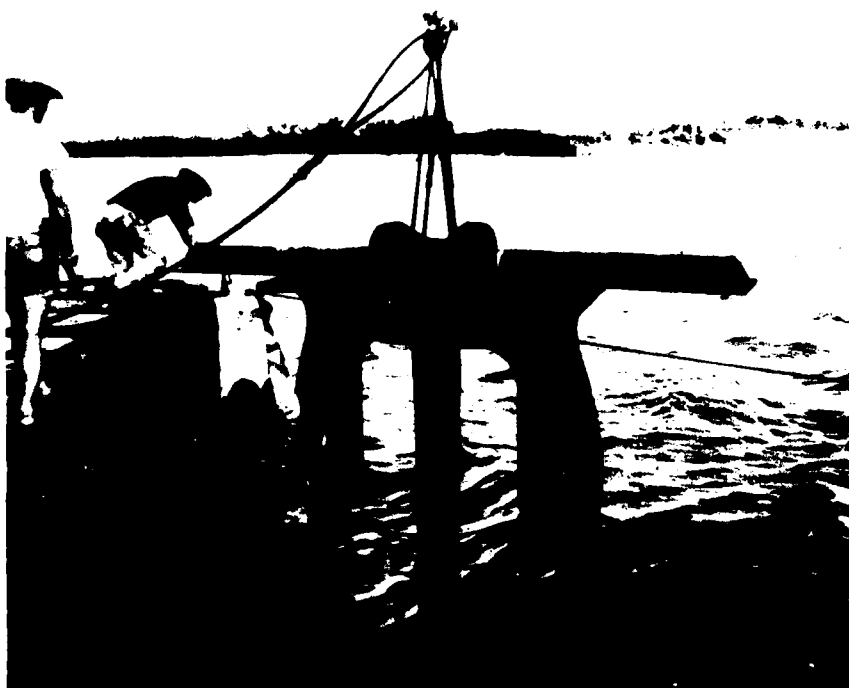


Figure 3. Location of anchor tests and mooring buoys as surveyed during the anchor tests. Apra Harbor outline from PWC Drawing 15345.



a. With stabilizers and fixed flukes.



b. With stabilizers and movable flukes.

Figure 4. Navy STOCKLESS anchors.

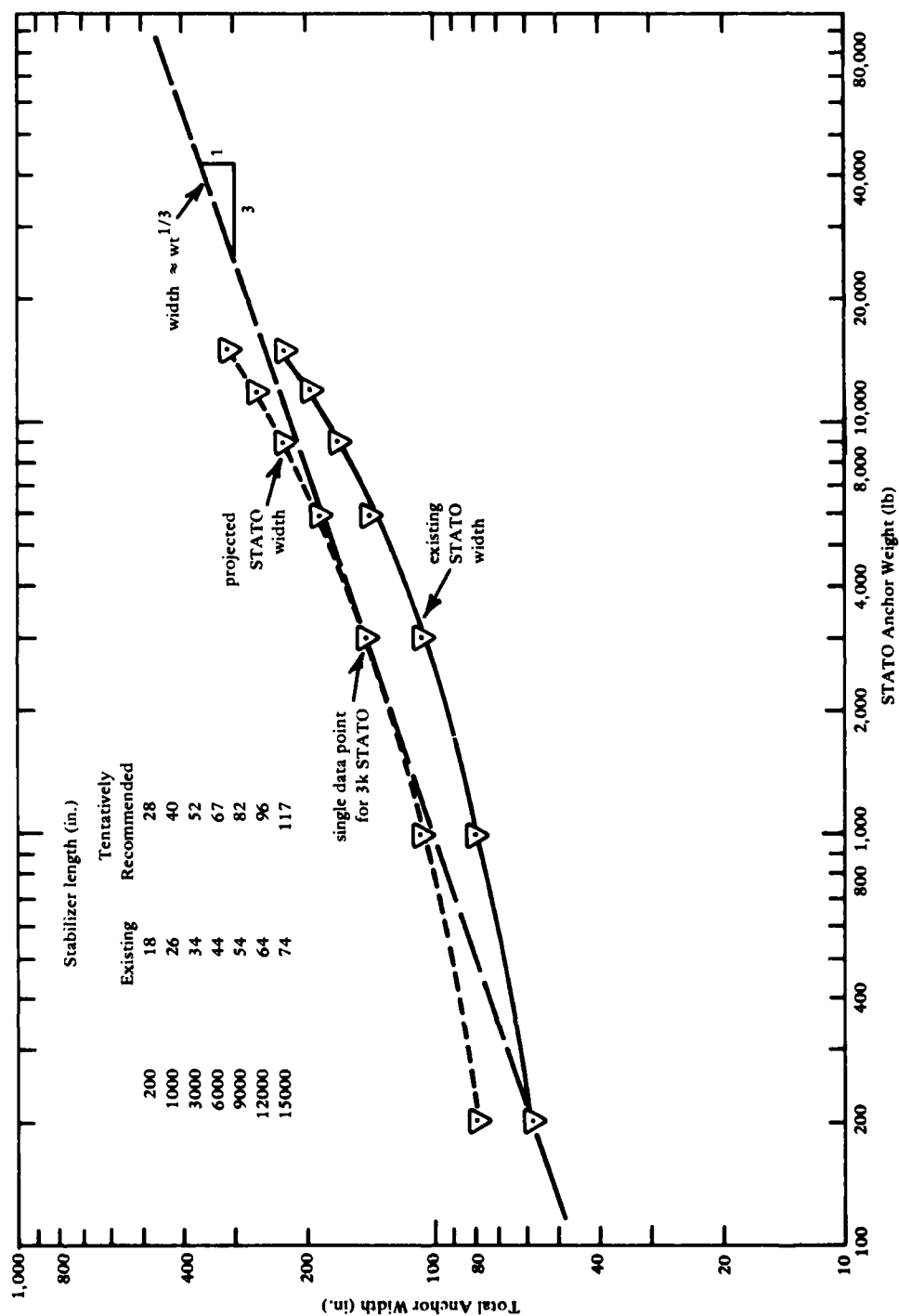


Figure 5. Recommendations for STATO anchor stabilizer length. (from Ref. 1.)



Figure 6. 1000-lb STATO anchor with extended stabilizers.



Figure 7. 1000-Kg BRUCE anchor with multi-holed padeye atop shank.



a. Side view.



b. End view.

Figure 8. 500-Kg twin-shank BRUCE anchor.



Figure 9. 560-Kg HOOK anchor.

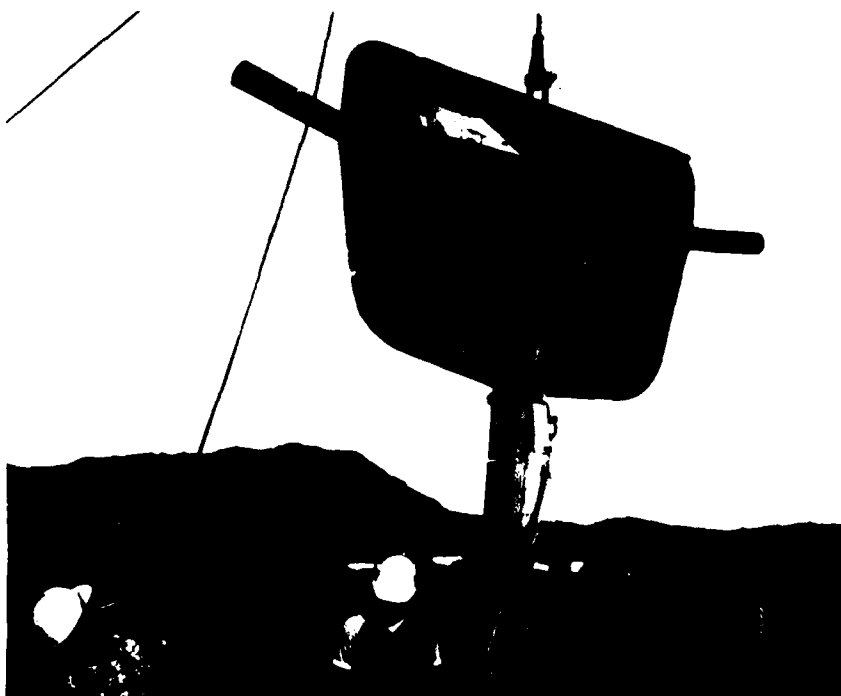


Figure 10. 1000-Kg STEVMUD anchor.

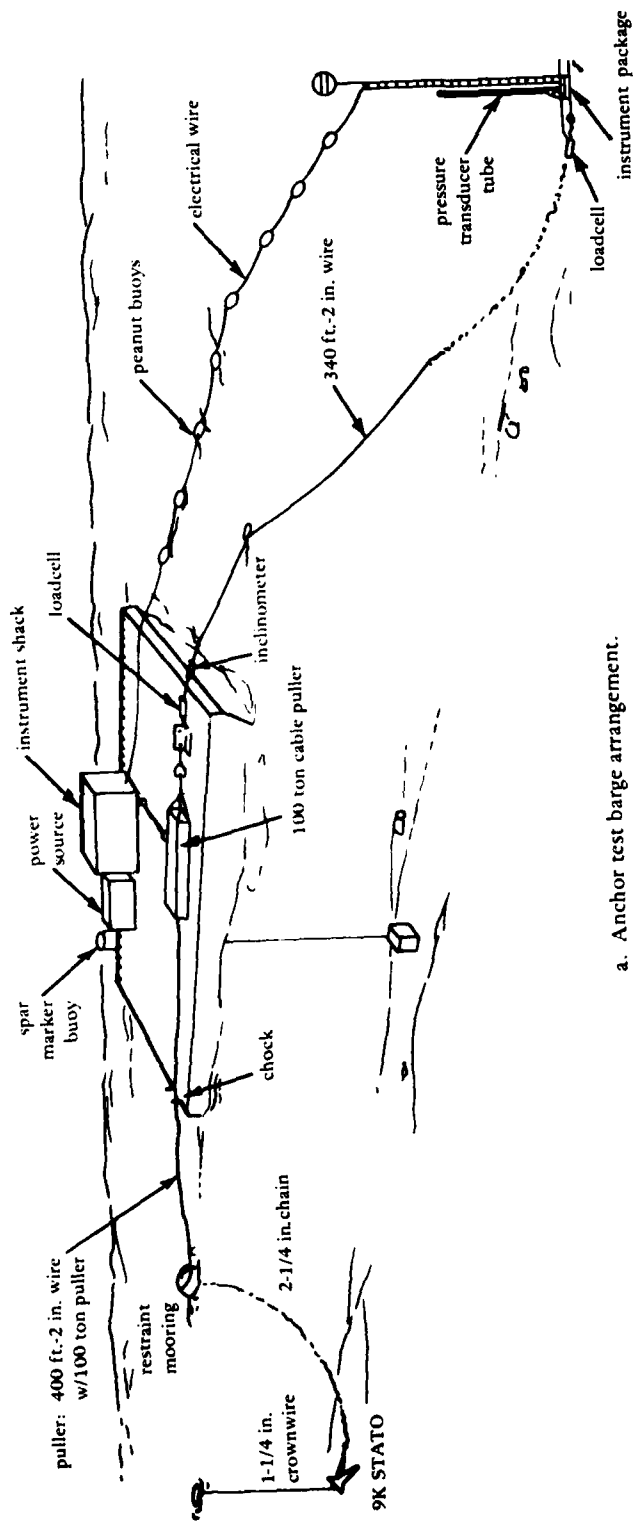


a. Anchor.

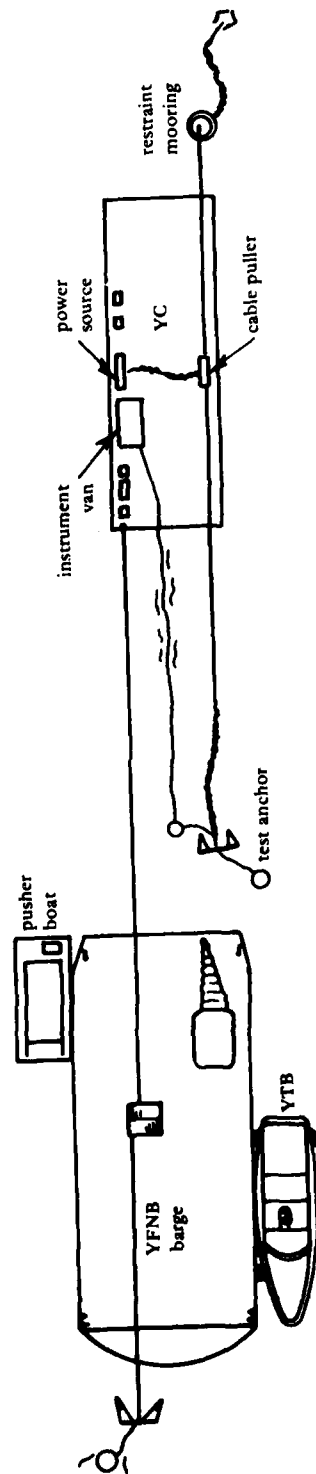


b. Anchor with extended tripping palms.

Figure 11. 640-kg STEVFIX anchor.



a. Anchor test barge arrangement.



b. Overall test arrangement.

Figure 12. Conventional anchor test arrangement.

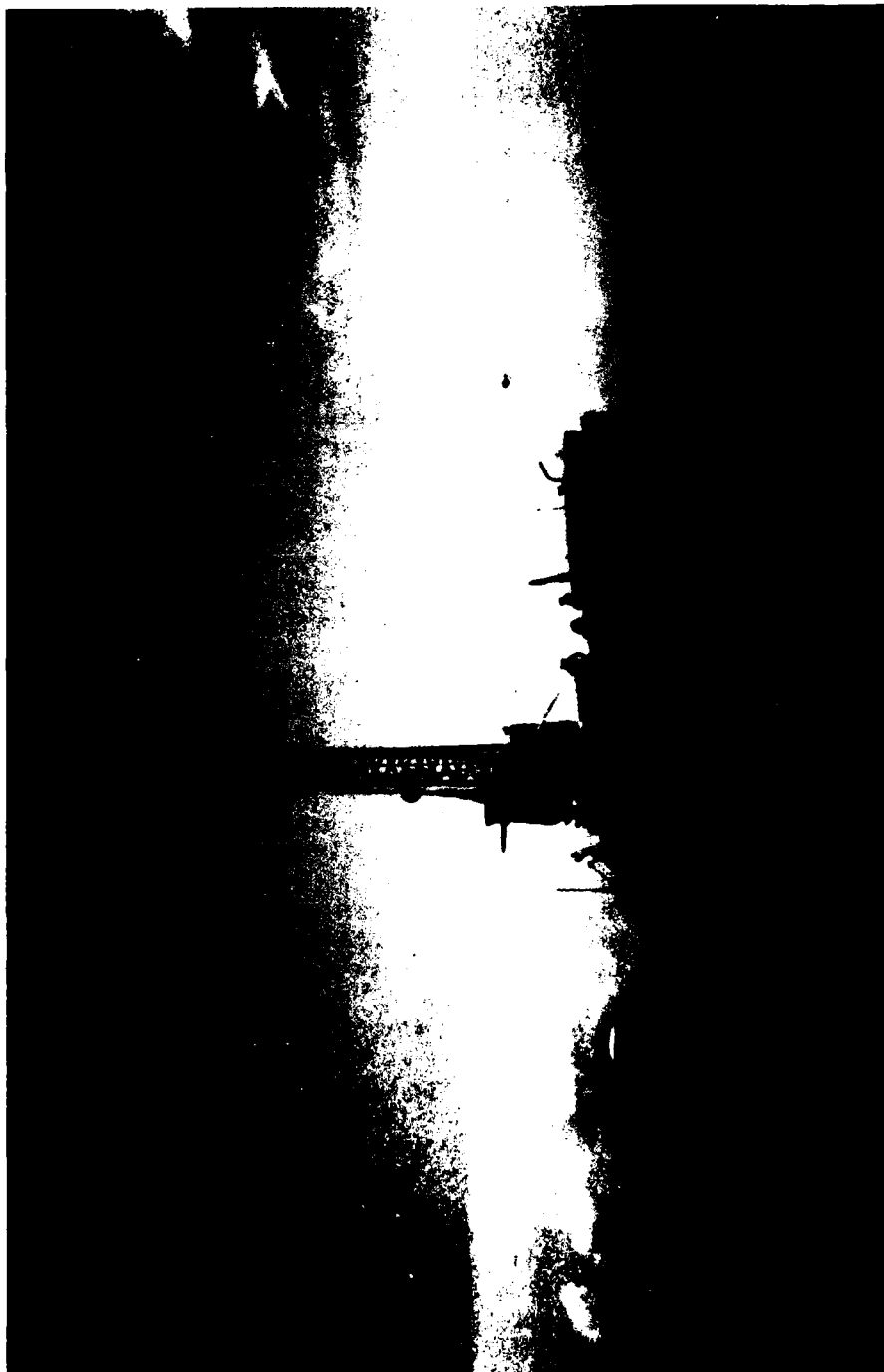


Figure 13. Anchor-handling barge during STATO anchor installation.

APPENDIX A

Apra Harbor Site Conditions

SITE EVALUATION

Site evaluation relied upon existing boring and probe data, on sub-bottom profiling gathered previously, and later through coring and in-situ vane shear testing performed during the anchor test period. Borings taken in inner Apra Harbor during 1964 (Ref 2) showed surficial silty clay with coral fragments of 0-to-40 ft thickness overlying stiff clay with coral fragments, sandy coral rubble, or medium to compact coralline limestone. During 1977, CEL performed a subbottom profile survey using a 5 kHz profiler (Ref 3). A more detailed survey was subsequently performed (Ref 4) using a deeper penetrating 3.5 kHz sound source. Both subbottom surveys indicated a nearly flat seafloor underlain by a channeled topography. Most areas of apparent deep sediment were primarily small pockets or narrow channels not sufficient in size to run a significant number of anchor tests. South of buoys 28E and 28W, however, the 3.5 kHz data showed an extensive area where at least 33 ft of sediment overlaid the coral or dense sand subsurface. A large area was also indicated by the 5 kHz profiles. This area was selected as the test site to eliminate or limit time-consuming resetting of the back leg mooring.

During the site investigation it became apparent that the mooring buoys were not in the locations shown on the profiler maps or in the locations shown on the most up-to-date Public Works Center charts. The mooring buoys were known to have been displaced as a result of a recent typhoon. The locations shown in Figure A-1 are believed to be more accurate, although not exact, than those currently available on other charts. (The location of buoy 28E and the alignment of buoys 26W, 27W, and 28W are distinctly different than shown on other charts.

Data on the sediment conditions were to be gathered by taking and examining conventional piston (or gravity) cores, by recovering sediment from locations of high interest adjacent to anchor flukes and chain - through a number of experimental methods (described in the text), and by using unique in-situ field vane shear equipment. Shear strength variation with depth was considered the primary parameter of interest. Water content variation, soil density and the existence of layers or location of significant changes in soil conditions, as well as general soil classification, were also considered important.

It became apparent shortly after the testing began that the soft sediments were not as deep as had been indicated in previous surveys. Figure A-1 shows those areas in which all tests were conducted. There appeared no reason to believe other areas shown by the profiler data would be more suitable. Time and support craft limitations did not

allow for more than one or two complete realignments of the test setup. Therefore, it was decided to complete the test effort at the initial sites indicated on Figure A-1.

Significant changes were made in the planned type and amount of site investigations as a result of the unexpected site conditions. Much of the intended sampling could not be accomplished. Individual tests are discussed briefly below, with data presented in the accompanying figures and tables. It is noted that as of this writing, the soil samples taken at Guam have not yet been examined. A full analysis of the samples and the implications of the results of the analysis on anchor performance will be the subject of a future report.

VANE SHEAR TESTS

The in-situ vane shear testing equipment is shown in Figure A-2 during use. The equipment is a Jonell & Nilsson device of Swedish manufacture designed to take vane shear, cores, and penetrometer data on land. The device was borrowed from the United States Geological Survey (Menlo Park, CA). It is not known to have been used previously for testing "through" a water column. A collar guide was constructed to prevent instability in the unsupported length of rod. The support frame was welded onto the side of a pusher boat, and the tests were run while in a three-point mooring. It is apparent from these tests that in-situ tests can be conducted without significant loss of data quality in shallow water despite strong wind and harbor chop. Three tests were run at the locations shown in Figure A-1. The data are plotted in Figure A-3. In each case, the vane was advanced in the soil until it would not penetrate further without significant tendency to bend. The reduction in shear strength below 5 ft in VS-3 is believed to be a true reflection of material change of state (based on a similar reduction in resistance to penetration between 5 and 8 ft).

Hand-held vane shear tests were made on five samples brought back by tube samplers (Figure A-4) and at 10 to 15 locations within the mass of sediment brought back on the 9,000-lb STATO back anchor (Figure A-5). Data from these tests will be presented when examination of the samples and equipment can be made.

GRAVITY CORING

The piston corer shown in Figure A-6 was used as a gravity corer in Apra Harbor. Two cores were attempted before coring was abandoned due to poor results. The first core attempted resulted in loss of the barrel and lower assembly. The core tip apparently struck a hard surface, shearing all connecting barrel screws. The second attempt was successful at the location shown on Figure A-1. While penetration was 9.2 ft, recovery was only 25 percent. The material in the barrel (Figure A-7) was highly disturbed, and a large coral chunk blocked the lower end of the core. These results were not considered valuable enough to warrant further coring of this type.

TUBE SAMPLING

"Tube sampling" is used here to describe a number of sampling attempts using 1.3-in. diameter stainless steel samplers. These samplers were equipped with a flexible membrane which would allow sediment to flow through the tube during sampler penetration of the seafloor, then would collapse to close off the tube and prevent sediment from flowing out when the sampler was retrieved. The tubes were attached to a steel rod (as shown in Figure A-4), to chain links along the anchor chain, and to parts of one anchor. The tube samplers worked when used with a rod, but invariably broke off the chain and anchor (despite two steel clamp bands).

The samples taken with the rod-attached tube (shown in Figure A-1 as RS-1 and RS-2) were used to obtain soil water contents at the identified shallow sediment locations. These revealed the very high water contents shown in the top 18 inches of sediment on Figure A-8.

OTHER TESTING

Water content determinations were made on samples taken from several anchors. These data show water contents of between 45 and 60 percent, but are not identifiable as to sediment depth of origin. The data likely lie within the rectangle shown on Figure A-8. All water content data are shown in Table A-1.

Samples were taken for visual and laboratory classification from each of the anchor types following recovery. These samples, as previously mentioned, have not yet been analyzed. However, Atterberg Limits were run on two small samples. These were taken from beneath the fluke of the STEVDIG anchor (Test 17) and from behind the shank of the Twin-Shank BRUCE anchor (Test 12). The depth of origin of the sediment is unknown. The computed Atterberg Limits are shown below. In the absence of any grain size data, these tests and visual classifications indicate an inorganic silt-sized structure of moderate-to-high plasticity.

	<u>Liquid Limit</u>	<u>Plastic Limit</u>	<u>Plasticity Index</u>
STEVDIG	91.3	44.0	47.3
BRUCE	58.7	28.7	30.0

Figures A-5 and A-9 offer some feel for the material type present in the area of anchor testing. The material at the deepest depths to which the tested anchors penetrated was revealed by trapped material behind the stabilizers or other anchor parts. Figure A-6 shows a matrix of clay-like material (probably with a high percentage of silt-sized grains) with broken coral tubes and other coral chunks being washed off the anchor. This was characteristic of many of the tests. In Figure A-7, the large mass of soil was 28 in. thick and practically devoid of coral pieces, although there were many small shells. Although this came from the 9,000-lb STATO back anchor, south of the test area, it is

probably similar to the material in the test areas which lie above the coral-laden sediment. This conclusion tends to be confirmed by the tube samples taken at several locations.

Table A-1. Water Content Determinations

Sample Location	Depth	Percent Water Content	Material Description
1. RS-1 ^a	6 in.	190	Soft grey clay-like material
2. RS-1 ^a	10 in.	182	Soft grey clay-like material
3. RS-1 ^a	14 in.	183	Soft grey clay-like material
4. RS-1 ^a	18 in.	188	Soft grey clay-like material
5. RS-2 ^a	5 in.	172	Soft grey clay-like material
6. 6K STATO (Test 18)	unknown	148	Soft grey clay-like material
7. 6K STATO (Test 18)	unknown	133	Soft grey clay-like material from area with coral tubes and pieces
8. 6K STATO (Test 19)	unknown	55.8	
9. Gravity Core	"X" (7-9 ft) ^c	58.2	Clay-like material adjacent to coral piece plugging corer nose
10. Gravity Core	>14 in. above "X"	98.7	Stiffest clay-like material (with shells) found
11. 9K STATO ^b	"Y" (5-10 ft) ^c (7 in. above fluke)	52.9	Light grey cohesive clay-like sediment with many small shells
12. 9K STATO ^b	"Y" (5-10 ft) ^c (7 in. above fluke)	48.0	Light grey cohesive clay-like sediment with many small shells
13. 9K STATO ^b	3 in. above "Y"	45.2	Light grey cohesive clay-like sediment with many small shells
14. 9K STATO ^b	12 in. above "Y"	60.2	Light grey cohesive clay-like sediment with many small shells

(continued)

Table A-1. Continued

Sample Location	Depth	Percent Water Content	Material Description
15. 9K STATO ^b	12 in. above "Y"	60.2	Light grey cohesive clay-like sediment with small shells

^a"RS" designates a "rod sample" described in the appendix.

^bThe 9,000-lb STATO was used as the "back" anchor against which all other anchors were pulled.

^cDepth of sample unknown - estimate made on the basis of probable anchor penetration and location of sample on the anchor.

^dWater content equals the ratio of weight of water to weight of solids.

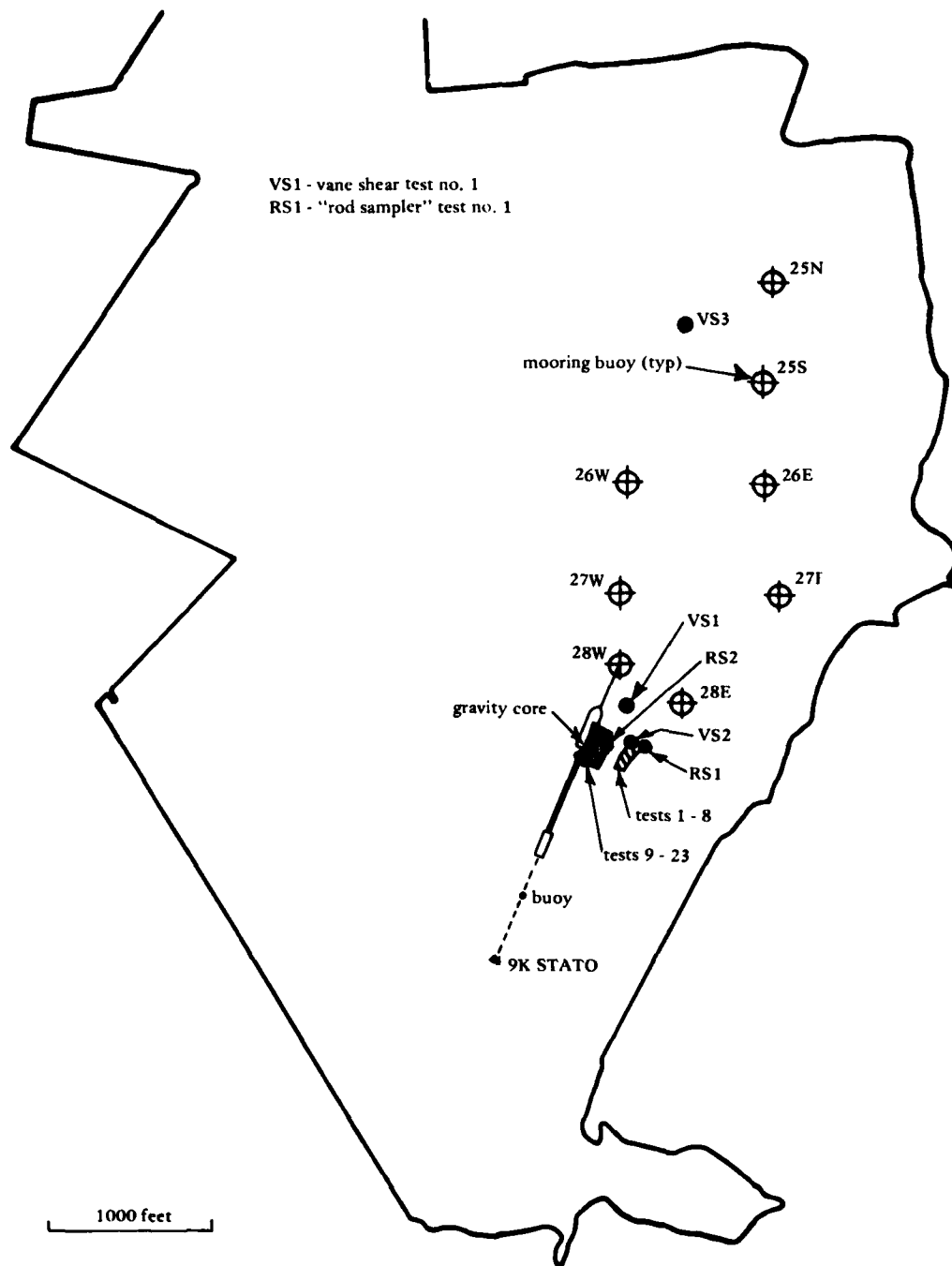


Figure A-1. Location of anchor tests, equipment and soils tests. Mooring buoys shown were surveyed during tests. Apra Harbor outline from PWC Drawing 15545.



Figure A-2. In-situ vane shear test being run in 30 ft. of water off the side of pusher boat.

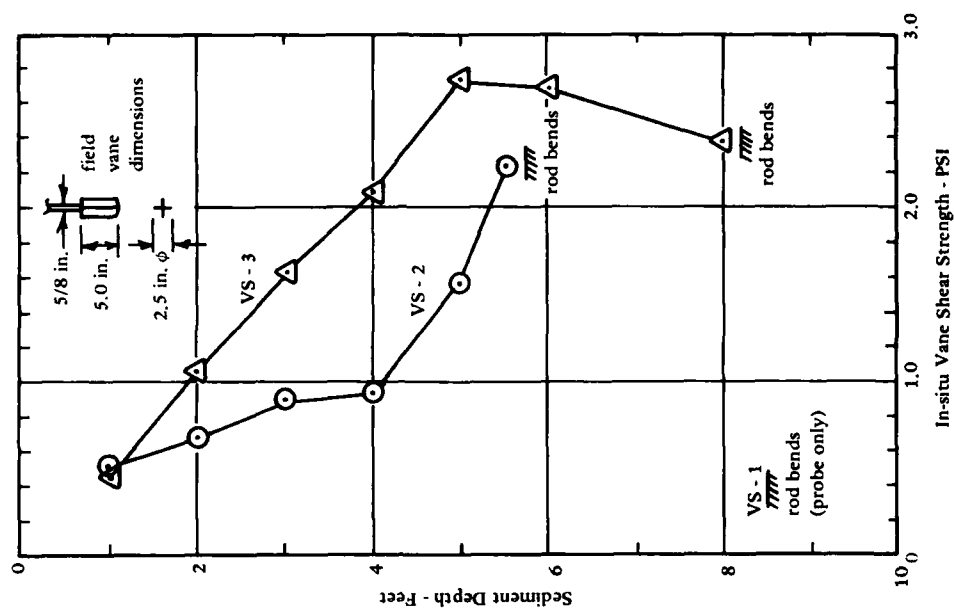


Figure A-3. In-situ vane shear strength at two inner harbor locations.



Figure A-4. "Pole sample" following an attempt to sample the top layer of sediment.



Figure A-5. Large mass of cohesive clay-like sediment with many small shells being recovered on 9K STATO anchor used for the back anchor.

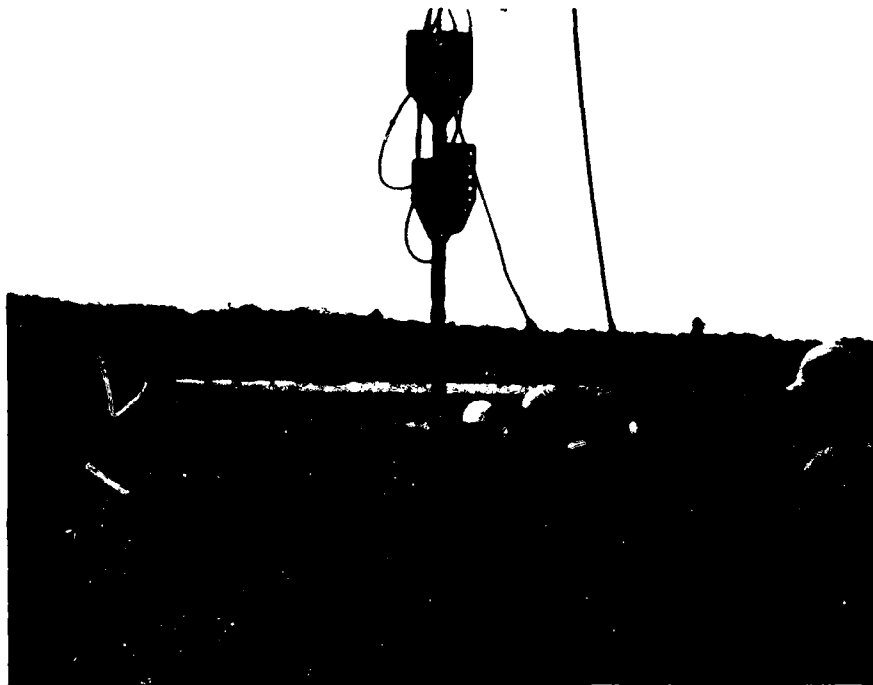


Figure A-6. Gravity corer being readied for drop.



Figure A-7. Lower portion of 28-in. of material recovered on second gravity core attempt.

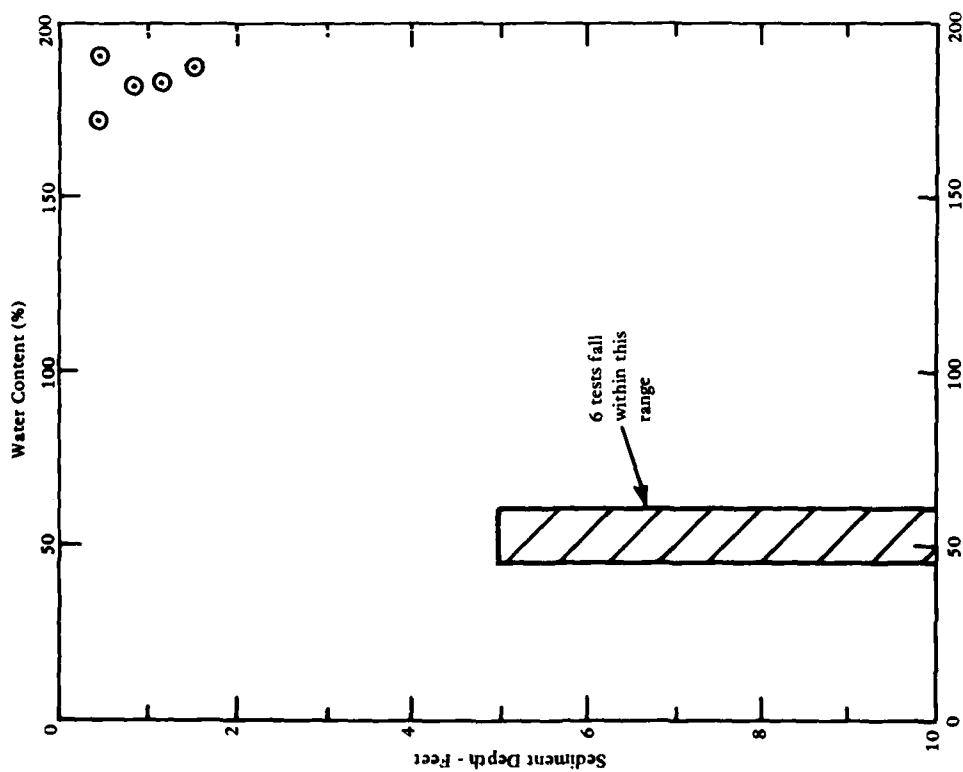


Figure A-8. Summary of water content determinations for harbor area.

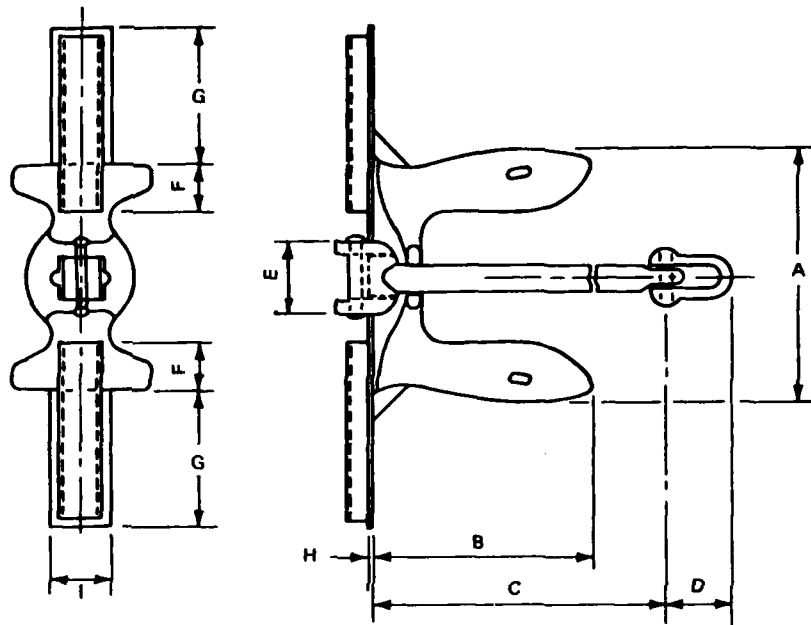


Figure A-9. Coral tube and piece-laden cohesive silty clay-like material being cleaned from the 20K STOCKLESS anchor (Test 20).

Appendix B

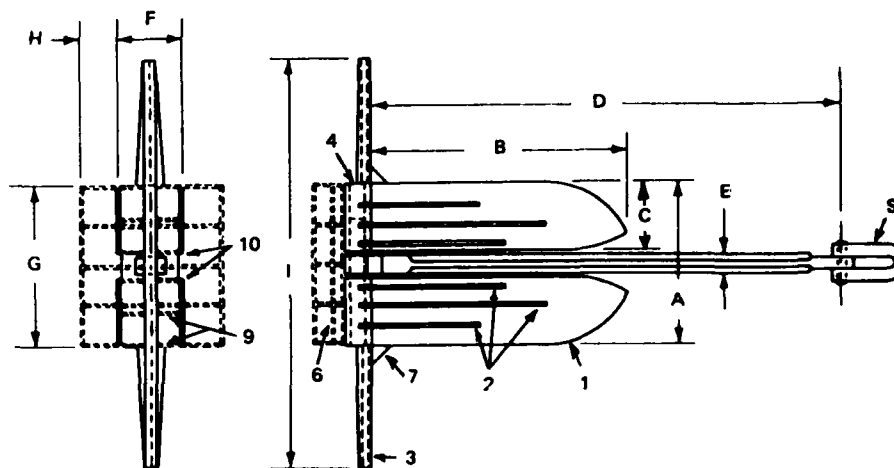
DIMENSIONS OF ALL TESTED ANCHORS

Dimensions for all tested anchors are included in this Appendix. Schematics for each anchor as well as the actual anchor dimensions are given in Figures B-1 through B-8.



Nominal Weight (lb)	Anchor Dimensions (in.)								
	A	B	C	D	E	F	G	H	I
500	29-3/4	26-7/8	37-1/4	7-5/8	8-1/2	—	—	—	—
1,500	43	38-3/4	53-5/8	11	12-1/8	—	—	—	—
3,000	54-1/8	48-3/4	67-1/2	13-7/8	15-3/8	11	30	1/2	13
5,000	64-1/8	57-3/4	80-1/8	16-1/2	18-1/4	13	36	1/2	16
6,000	67-7/8	62-9/16	85-1/16	17-3/8	19-1/8	14	36	1/2	16
7,000	71-7/16	65-7/8	89-9/16	18-5/16	20-1/8	15	36	1/2	16
9,000	78-1/16	70-3/8	97-1/2	20	22-1/8	16	36	3/4	16
10,000	80-1/2	74-3/16	100-7/8	20-5/8	22-11/16	17	36	3/4	19
13,000	87-7/8	79-1/8	109-3/4	22-1/2	24-7/8	18	40	3/4	19
14,500	90-7/8	83-3/4	114	23-1/4	25-5/8	19	40	3/4	21
18,000	98-3/8	90-3/8	122-3/4	25-1/4	27-3/4	20	45	1	21
20,000	101-7/8	91-3/4	127-1/4	26-1/8	28-7/8	21	45	1	21
25,000	109-3/4	98-7/8	137-1/16	28-1/8	31-1/8	22	48	1	22
30,000	116-5/8	107-1/4	145-5/8	29-13/16	33-3/16	24	50	1	23
40,000	127-3/4	117-13/16	160-1/16	32-11/16	36	27	36	1-1/4	26

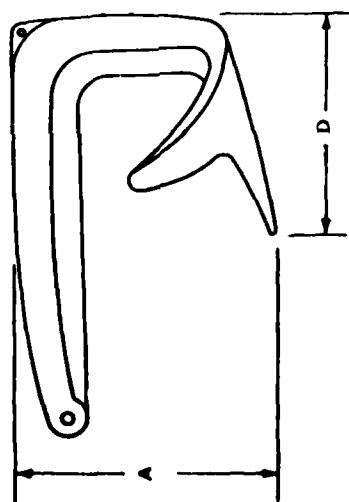
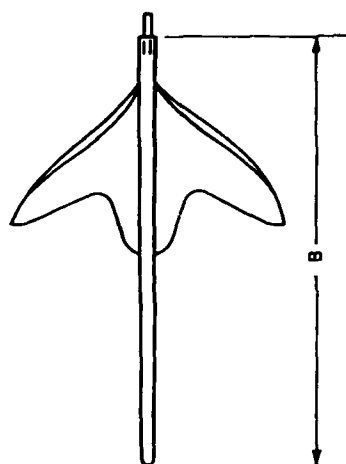
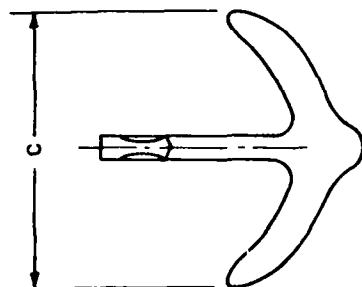
Figure B-1. Dimensions of standard STOCKLESS anchor.



Nominal Weight (lb)	Dimensions of Anchors (in.)								
	A	B	C	D	E	F	G	H	I
200	23	25	10	42	2	9-1/2	23	6	59
1,000	28	43	75	80	-	-	28	-	80
3,000	41-1/2	69	18	129	4	19	41-1/2	13	109-1/2
6,000	55	82	24	144	5	21	55	15	143
9,000	62	96	27	160	6	27	62	16	170
12,000	69	108	30	186	7	30	69	18	197
15,000	76	121	33	205	8	32-3/8	76	20	224

Nominal Weight (lb)	Thickness of Plates (in.)									
	1	2	3	4	5	6	7	8	9	10
200	1/4	1/2	1/4	1/4	1/4	1/4	1/4	1/4 x 4	1/4	1/2
3,000	1-1/4	1	1/2	5/8	5/8	5/8	5/8	1/2 x 6	5/8	5/8
6,000	1-1/2	1	1/2	3/4	3/4	3/4	3/4	5/8 x 7	3/4	3/4
9,000	1-3/4	1-1/8	5/8	7/8	7/8	7/8	7/8	3/4 x 7	7/8	7/8
12,000	2	1-1/4	5/8	1	1	1	1	3/4 x 7	1	1
15,000	2-1/4	1-1/2	5/8	1-1/8	1-1/8	1-1/8	1-1/8	3/4 x 7-1/2	1-1/8	1-1/8

Figure B-2. Dimensions of Navy STATO anchor.



Nominal Weight		Dimensions (mm)		
kg	lb	A	B	C
500*	1100	1069/1499**	2083	1702
600	1320	1160	2050	1311
1000	2200	1375	2430	1554
				D
				1219
				1025
				1215

Note: *500-kg BRUCE is welded, not cast, and has a twin plate shank separated by spacers (see Figure B-4)

**Sand/mud settings.

Figure B-3. Dimensions of BRUCE anchor.

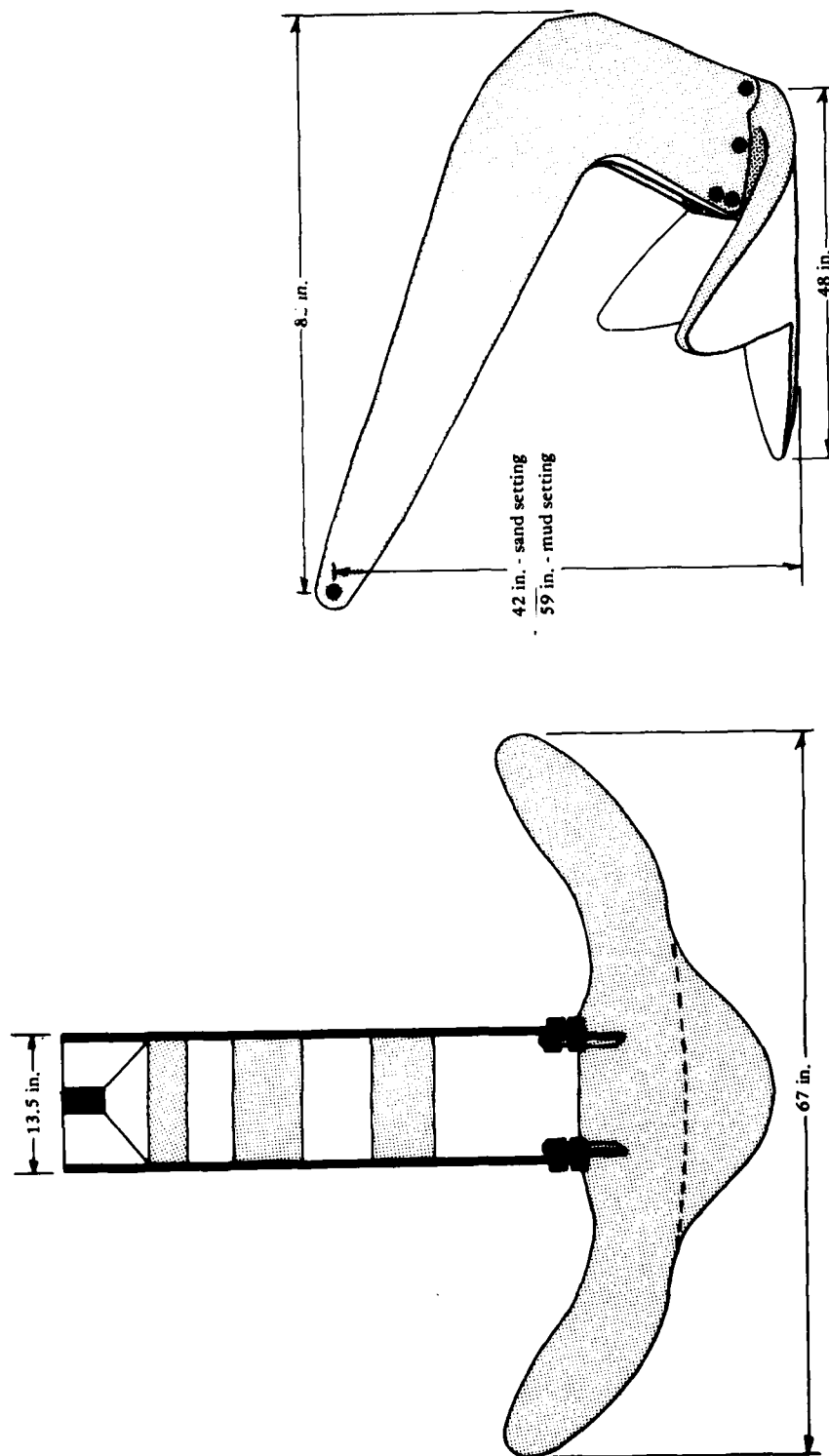


Figure B-4. Dimensions of Twin-Shank Bruce Anchor.

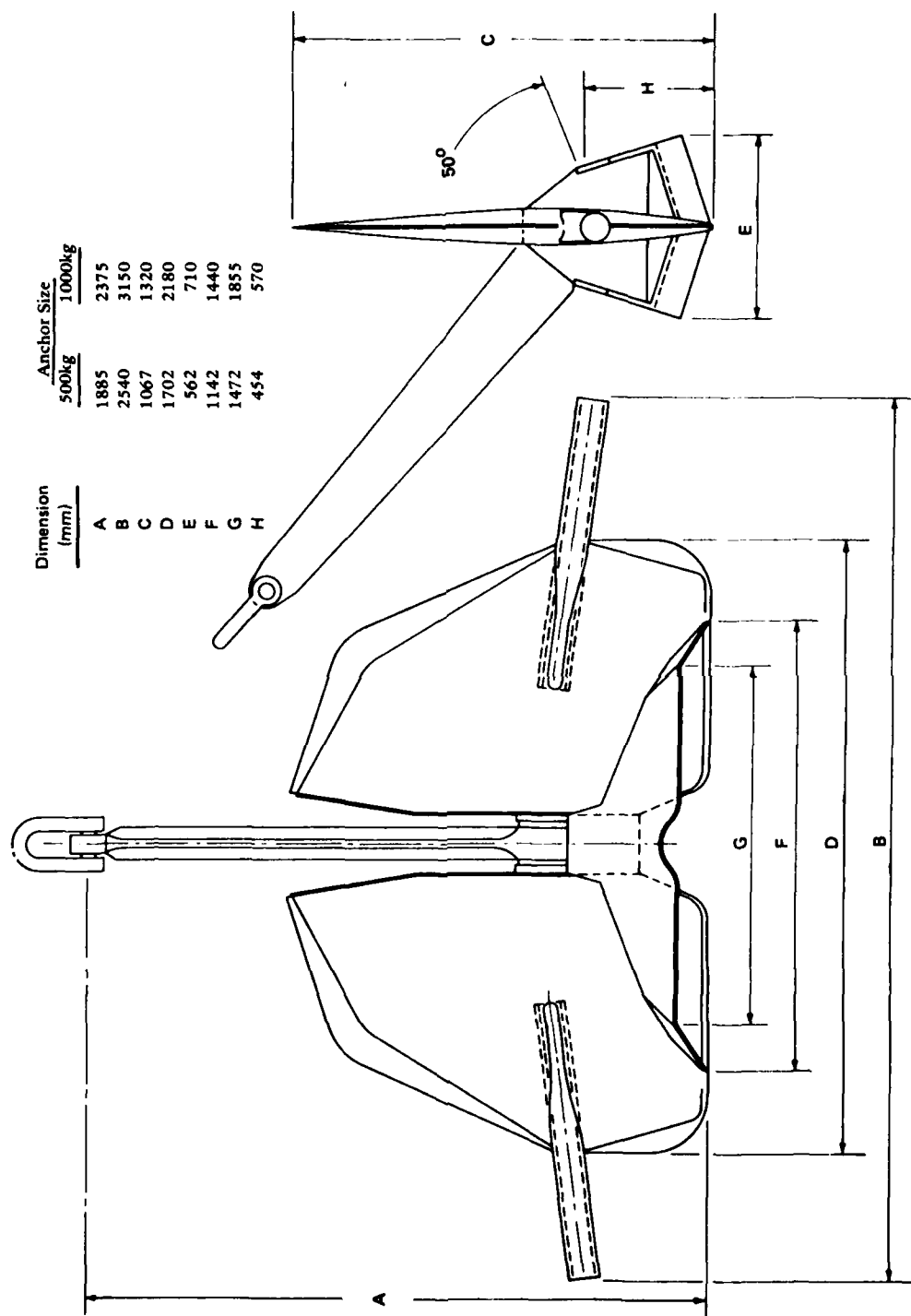


Figure B-5. Dimensions of STEVMUD® anchor.

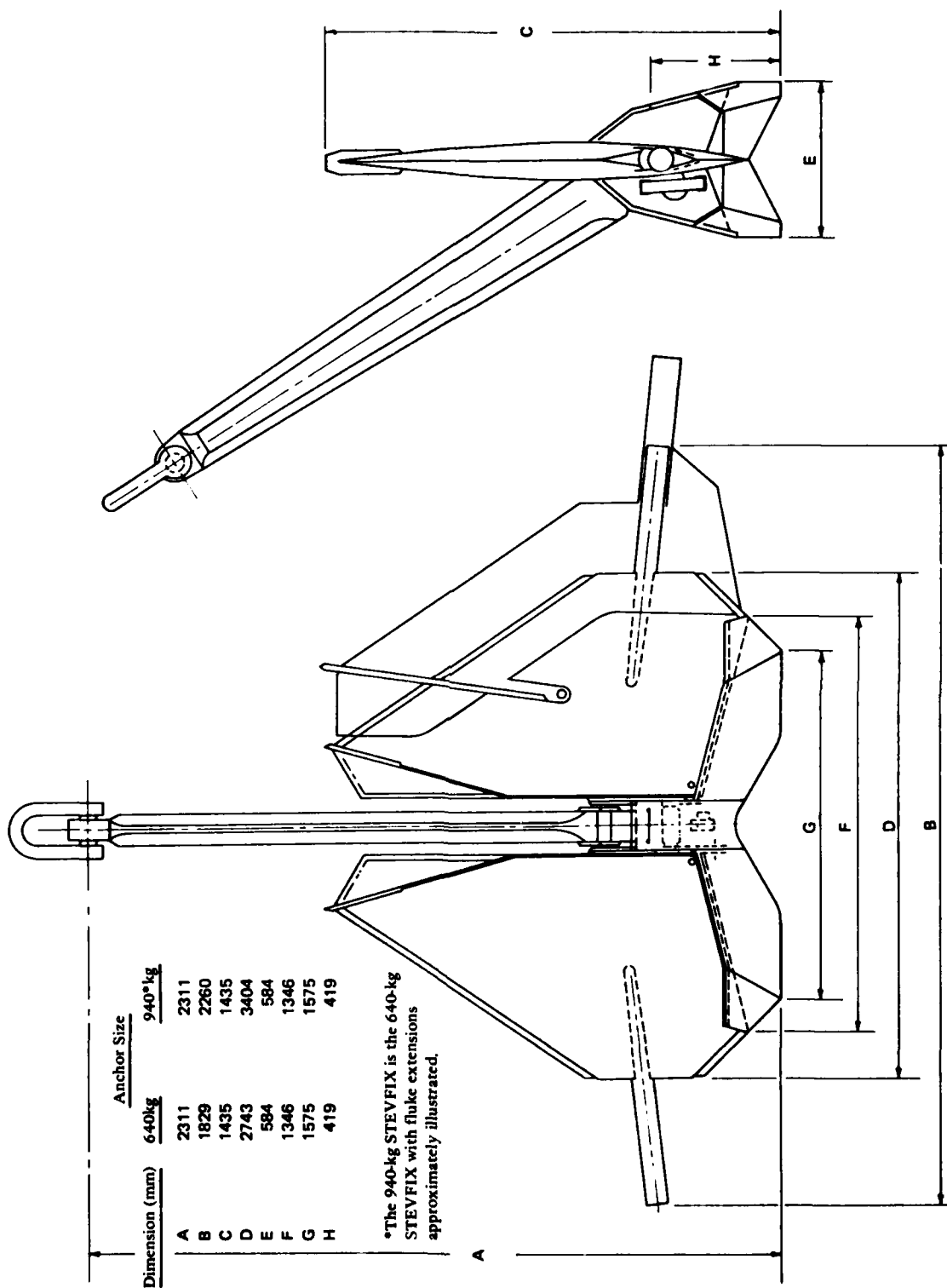


Figure B-6. Dimensions of STEVFIX® anchor.

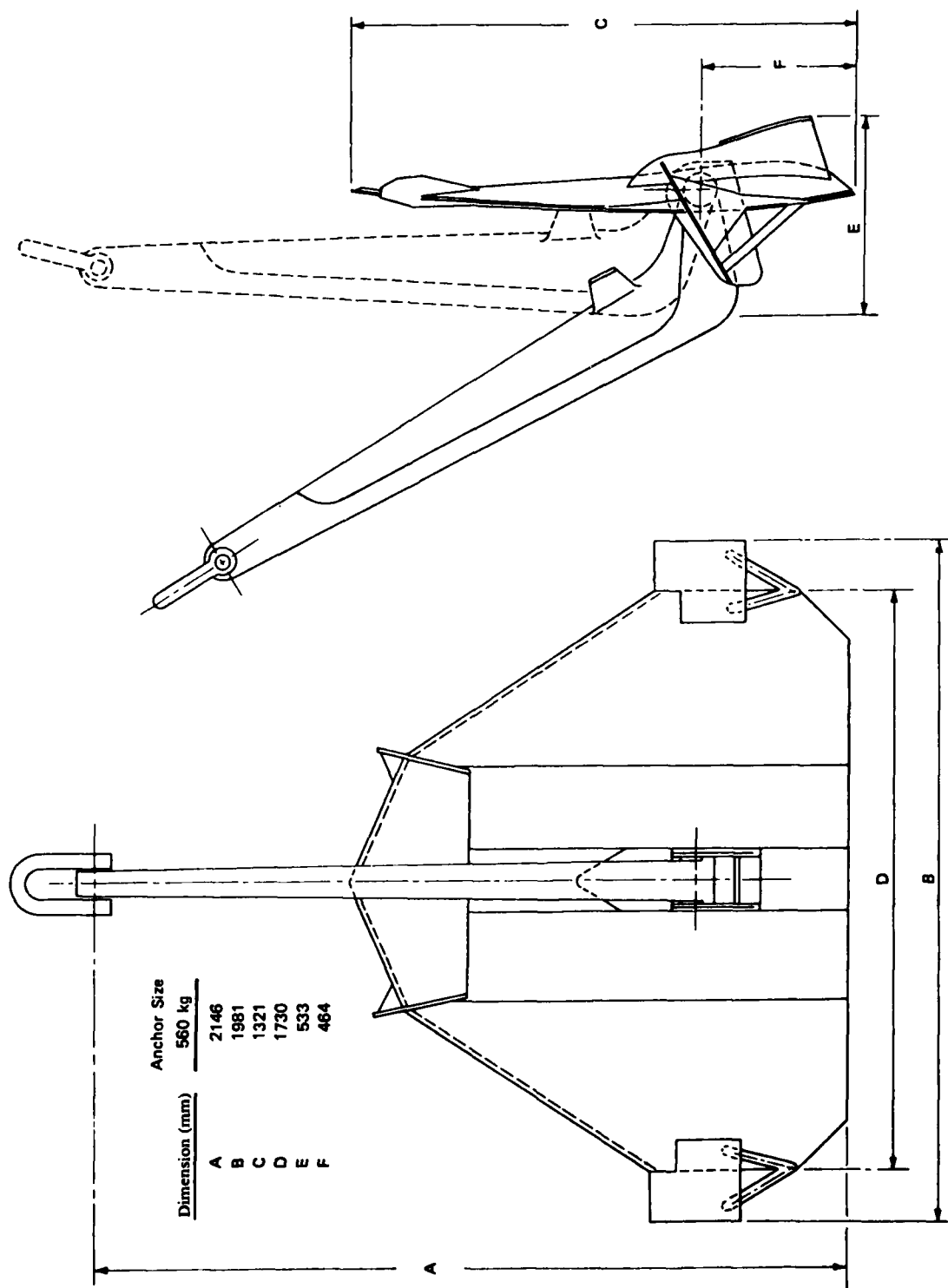


Figure B-7. Dimensions of HOOK® anchor.

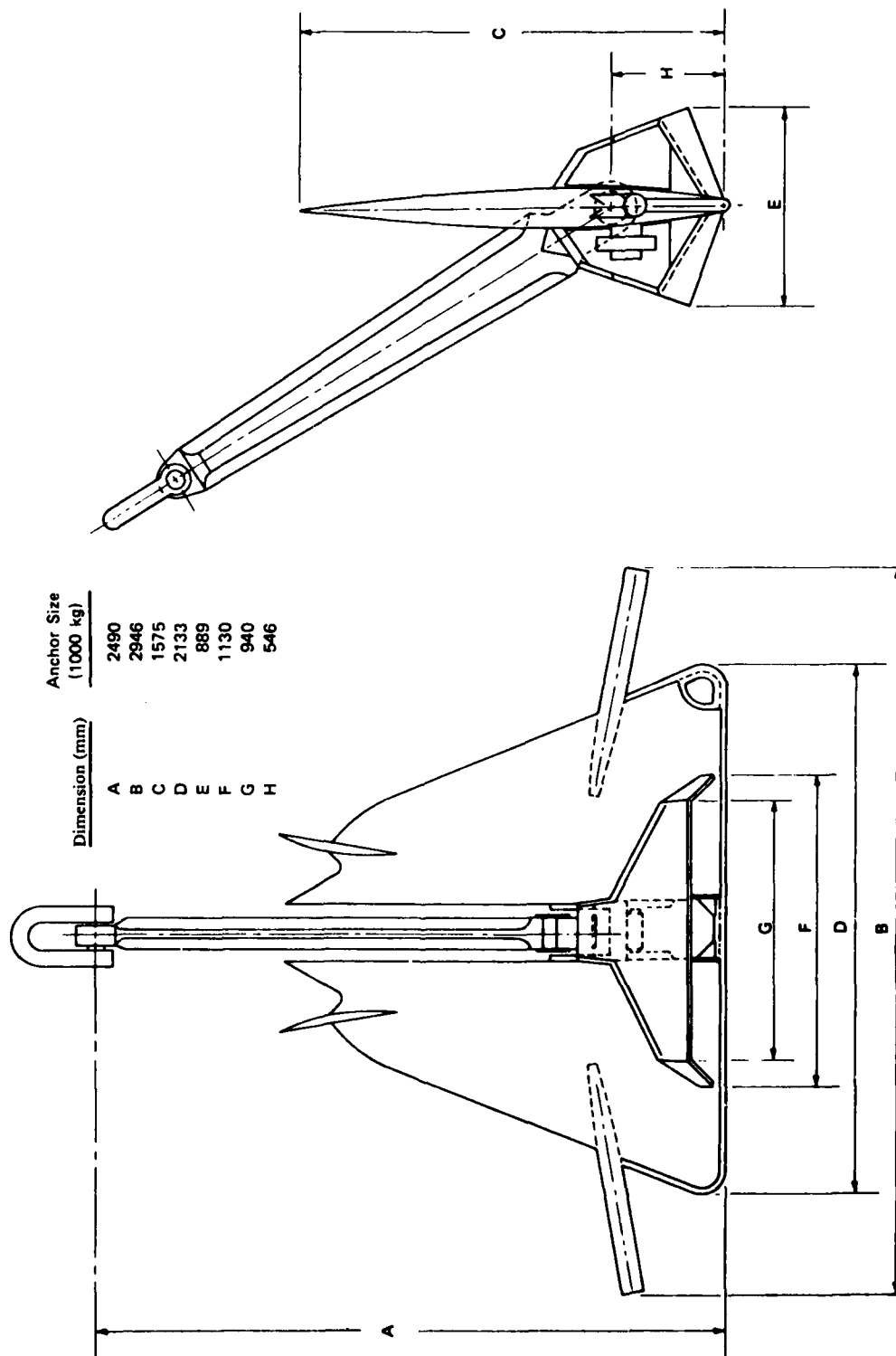


Figure B-8. Dimensions of STEVDIG® anchor.

Appendix C

STOCKLESS AND STATO ANCHOR TEST DATA

All test results at Guam for the STOCKLESS and STATO anchors are included in this Appendix. Data are presented as plots and digitized listings of anchor performance. Anchor and deck tension, anchor crown penetration, chain weight on bottom, anchor shank pitch and anchor roll are plotted as functions of true anchor drag distance. Presented opposite each data plot is a digitized listing of all plotted data plus additional descriptive data that may be useful during data analysis.

When data were not recovered due to instrumentation difficulties, straight lines with zero ordinates were plotted. There were several instances where sharp coral pieces cut the electrical cable part way through a test, thereby eliminating all underwater anchor data.

The lower block of all data plots provides anchor tension, deck tension, and chain weight on bottom. The difference between both tension measurements is attributed solely to chain drag both on and in the seafloor.

The center block of the data plots provides anchor/shank roll. Shank pitch is plotted as a positive angle when shank tip is below shank crown. Both shank pitch and anchor/shank roll are limited to about ± 45 degrees due to inclinometer limits. Anchor crown penetration is plotted in the top block versus anchor drag distance. During portions of some tests the wire between test barge and YFNB barge (refer to Figure 12) became taut due to high winds, causing a temporary reduction in test mooring line tension with no apparent reduction in anchor tension. This reduction is associated with a reduction in mooring line angle and an increase in chain weight on bottom.

Of the tabulated data presented opposite the data plots, item 13, fluke tip depth, should be used with caution. In sand, fluke opening is obvious; there is a sudden increase in shank angle associated with a gradual increase in anchor tension; however, fluke opening in mud is not obvious, but it can be assumed if anchor penetration continues.

STOCKLESS ANCHOR TEST

TEST DATE 79
 TEST NO. 1
 TEST RUN C
 TEST AREA INNH APRR HAKBOK, GUAM.
 START-END TIMES 1343 - 1418
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 5000 LBS STABILIZED, 48 DEG FIXED FLUKES
 ANCHOR WEIGHT 5950.00 LB.
 FLUKE ANGLE-TYPE 45.00 DEG. - 1 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 186 FT. 2.25 IN. CHAIN, 340 FT. 2 IN. 14KC ROPE.

1. CRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH
 2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH
 3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT
 4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET
0.0	6.3	4.5	40.0	.5	-32.3	20.3	5.9	185.8	7518.3	41.3	37.9	42.6
1.0	6.4	5.0	40.5	.5	-32.3	20.3	6.4	181.7	7350.1	41.8	38.4	43.1
4.1	4.4	4.5	40.5	.5	-32.3	24.5	4.0	243.0	7491.2	41.8	38.4	43.1
5.1	5.3	4.5	40.5	.5	-32.3	22.0	5.0	213.6	7702.4	41.8	38.4	43.1
6.2	6.3	4.5	40.0	.5	-32.3	20.0	5.9	188.9	7544.2	41.3	37.9	42.6
8.6	7.7	4.5	39.5	-1.7	-30.3	17.8	9.3	166.6	6741.8	40.7	37.5	42.2
9.2	10.7	7.0	41.5	-1.5	-20.3	16.3	9.8	169.3	6849.1	42.3	40.1	44.6
12.1	13.6	9.0	41.5	1.8	-15.5	15.8	13.1	148.6	6011.4	42.1	40.4	44.7
12.9	30.1	20.0	39.5	18.0	15.5	12.3	29.4	81.9	3311.9	38.9	40.5	43.0
14.9	36.4	21.0		-3.8	20.5	11.8	35.7	56.4	2282.5			
15.2	29.2	19.5	38.5	-17.8	19.5	10.8	28.6	105.4	4266.1	37.7	39.8	42.0
19.2	15.6	15.5	41.0	-15.0	19.3	14.5	15.1	143.6	5811.2	40.2	42.3	44.5

DISTANCE BARGE TRAVELLED 21.0
 DISTANCE ANCHOR TRAVELLED 19.2

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

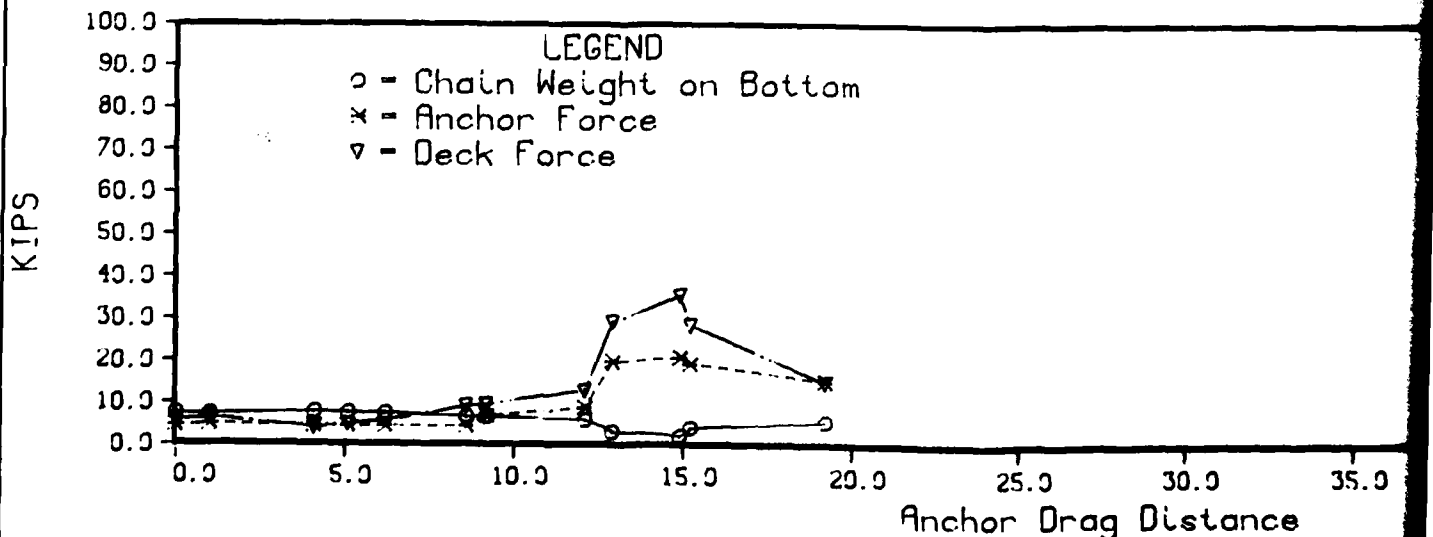
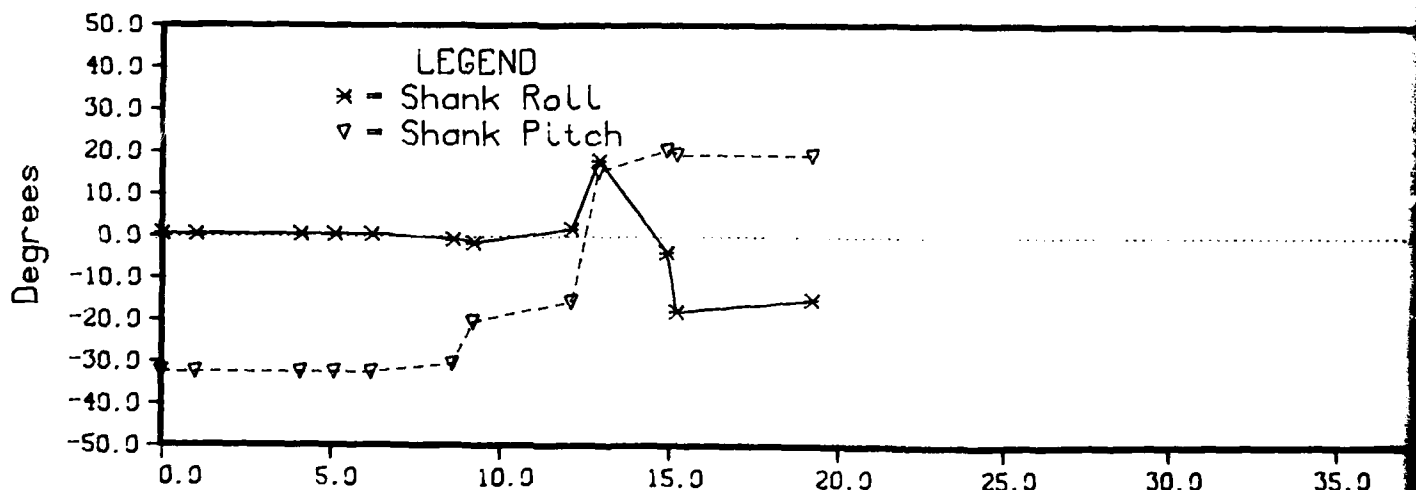
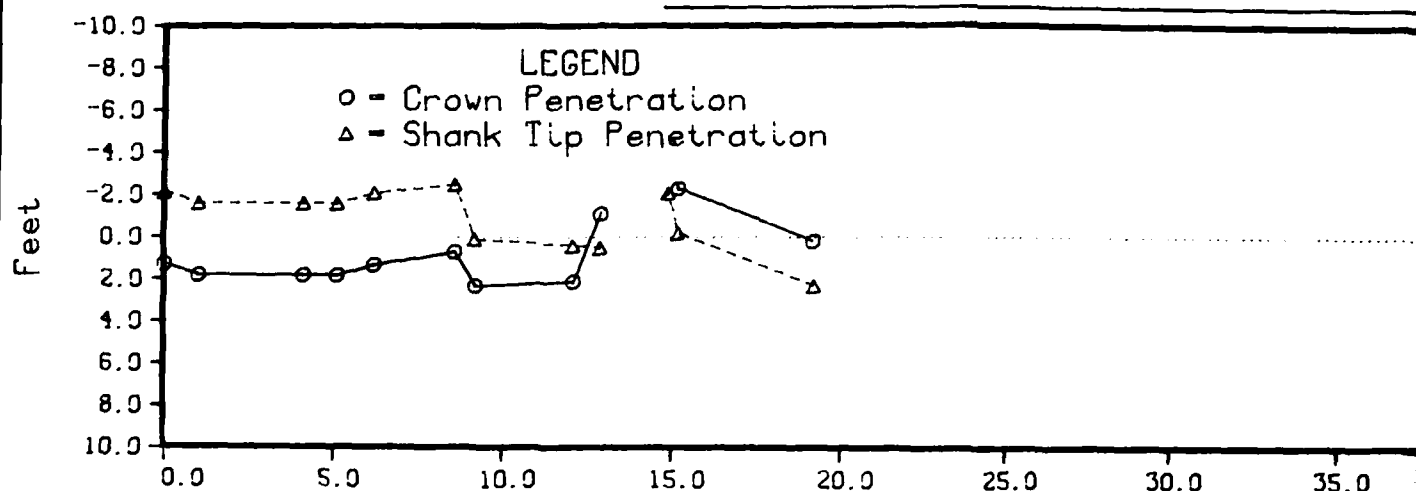
Day # - 79

INNER APRA HARBOR, GUAM.

Test No. - 1

stockless 5000 lbs stabilized, 48 deg

Test Series No. - 0



14 15
FEET LBS
0.0 13468.3
0.0 13300.1
0.0 13841.2
0.0 13652.4
0.0 13494.2
0.0 12691.8
0.0 12799.1
0.0 11961.4
0.0 9261.9
0.0 8232.5
0.0 10216.1
0.0 11761.2

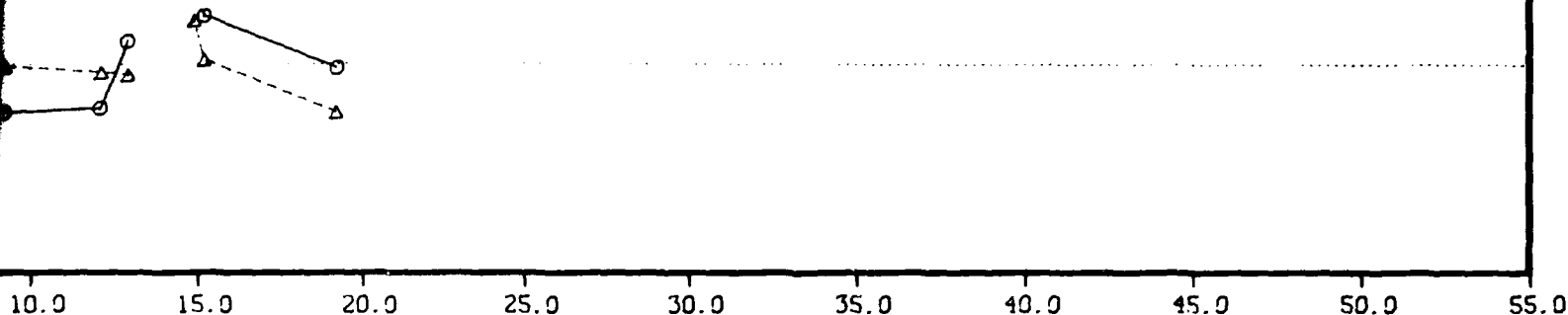
✓

R APRA HARBOR, GUAM.

stockless 5000 lbs stabilized, 48 deg fixed flukes

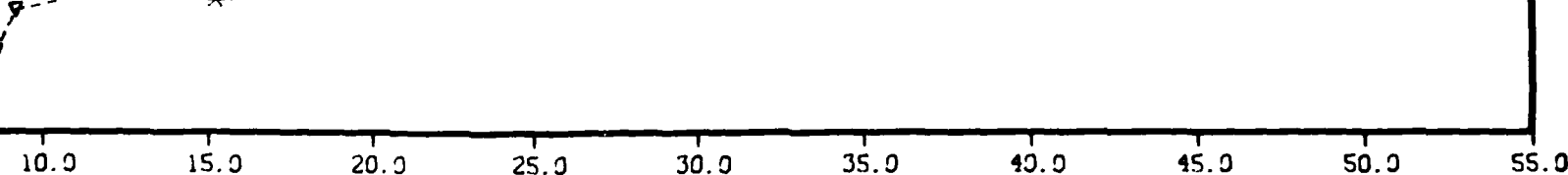
LEGEND

in Penetration
k Tip Penetration



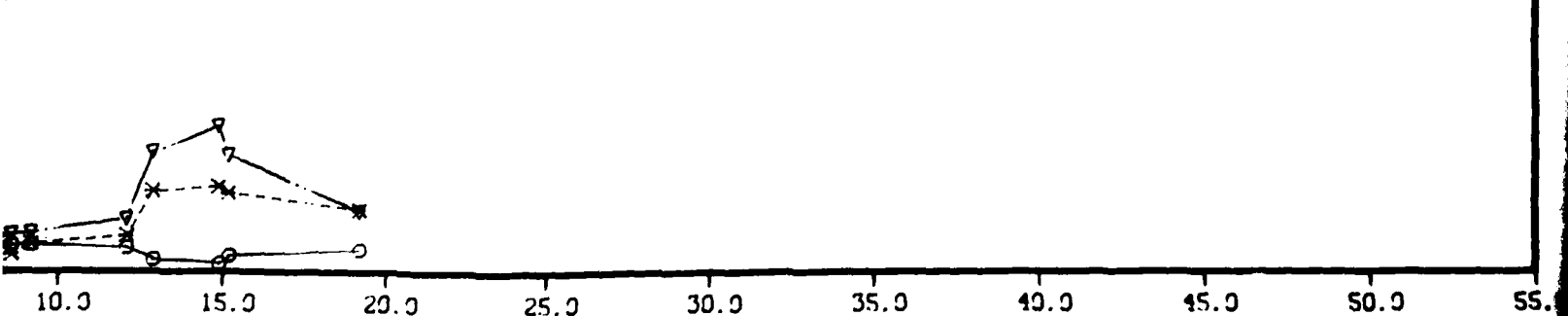
LEGEND

ink Roll
ink Pitch



LEGEND

ain Weight on Bottom
chor Force
ck Force



Anchor Drag Distance

STOCKLESS ANCHOR TEST

TEST DATE 79
 TEST NO. 2
 TEST RUN 0
 TEST AREA INNER APRA HARBOR, GUAM.
 START-END TIMES 1444 - 1502
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 5000 LBS STABILIZED, 48 DEG FIXED FLUKES
 ANCHOR WEIGHT 5950.00 LB.
 FLUKE ANGLE-TYPE, 48.00 DEG. - 1 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 186 FT. 2.25 IN. CHAIN, 340 FT. 2 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET
0.0	10.2	7.5	*****	8.0	-7.8	15.0	9.9	174.6	7063.6	*****	*****	*****	40.0
2.0	13.6	10.0	*****	7.0	-4.8	14.3	13.2	157.1	6355.4	*****	*****	*****	40.0
3.3	18.5	11.0	*****	3.5	4.5	12.5	18.0	141.1	5707.9	*****	*****	*****	40.0
5.2	25.3	21.0	*****	5.5	18.0	11.5	24.8	115.3	4666.7	*****	*****	*****	40.0
6.9	33.0	26.0	*****	14.5	19.5	10.5	32.5	91.0	3682.7	*****	*****	*****	40.0
8.9	29.6	22.0	*****	10.5	11.5	10.8	29.1	103.2	4175.5	*****	*****	*****	40.0
11.1	47.6	36.0	*****	12.3	13.3	10.0	46.9	35.5	1434.8	*****	*****	*****	40.0
12.6	36.9	25.5	*****	12.5	8.3	10.0	36.4	61.3	3291.4	*****	*****	*****	40.0
14.9	42.6	35.0	*****	7.5	5.0	10.0	42.1	56.3	2278.7	*****	*****	*****	40.0
16.8	53.0	40.0	*****	5.0	5.8	9.5	52.2	23.8	962.1	*****	*****	*****	40.0
18.9	57.3	45.5	*****	5.3	9.5	9.5	56.6	5.9	240.2	*****	*****	*****	40.0
20.8	40.3	28.5	*****	7.3	13.0	10.0	39.7	66.7	2700.6	*****	*****	*****	40.0
22.3	31.6	22.5	*****	6.3	0.0	10.0	31.1	104.3	4219.6	*****	*****	*****	40.0
24.9	24.8	20.0	*****	7.8	-4.5	11.3	24.3	120.4	4869.7	*****	*****	*****	40.0
26.6	36.0	33.5	*****	7.0	-7.5	10.0	35.4	85.5	3460.1	*****	*****	*****	40.0
28.5	34.4	35.5	*****	5.3	-4.8	9.8	38.8	75.1	3038.6	*****	*****	*****	40.0
30.8	47.6	41.0	*****	4.8	-3.8	9.8	46.9	40.5	1639.5	*****	*****	*****	40.0
32.5	51.5	44.5	*****	2.3	-1.0	9.3	50.8	35.2	1424.5	*****	*****	*****	40.0
33.7	67.6	59.0	*****	-2.5	4.5	8.0	66.9	7.5	303.6	*****	*****	*****	40.0
35.7	68.0	56.0	*****	.8	8.0	8.0	67.4	5.8	236.0	*****	*****	*****	40.0

DISTANCE BARGE TRAVELLED 38.0
 DISTANCE ANCHOR TRAVELLED 35.7

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

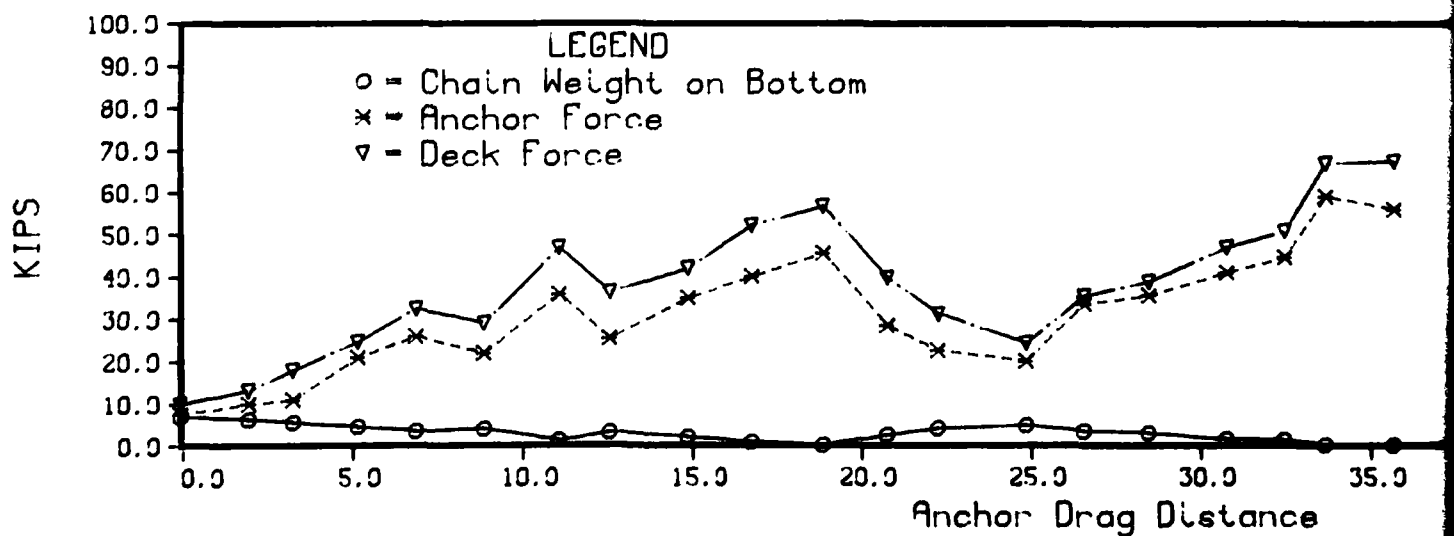
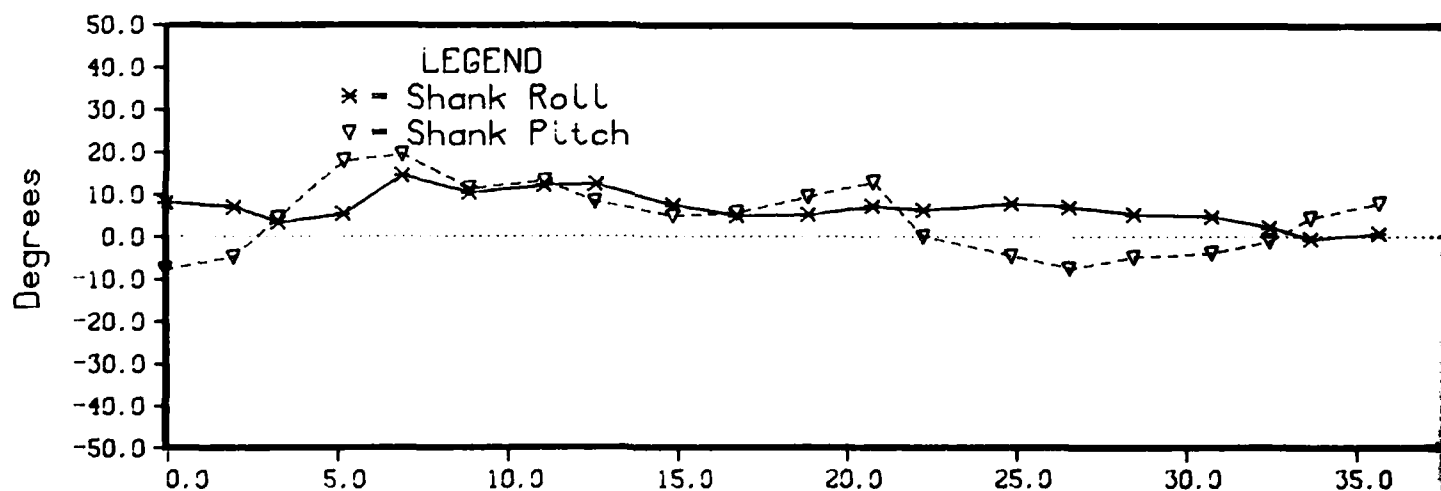
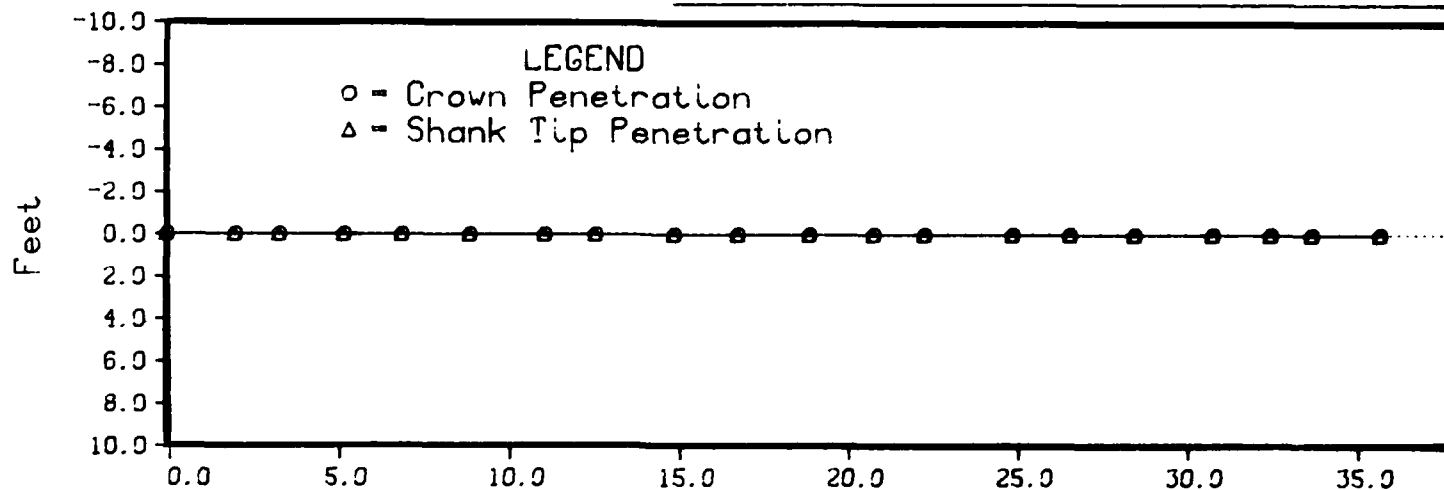
Day # - 79

INNER APRA HARBOR, GUAM.

Test No. - 2

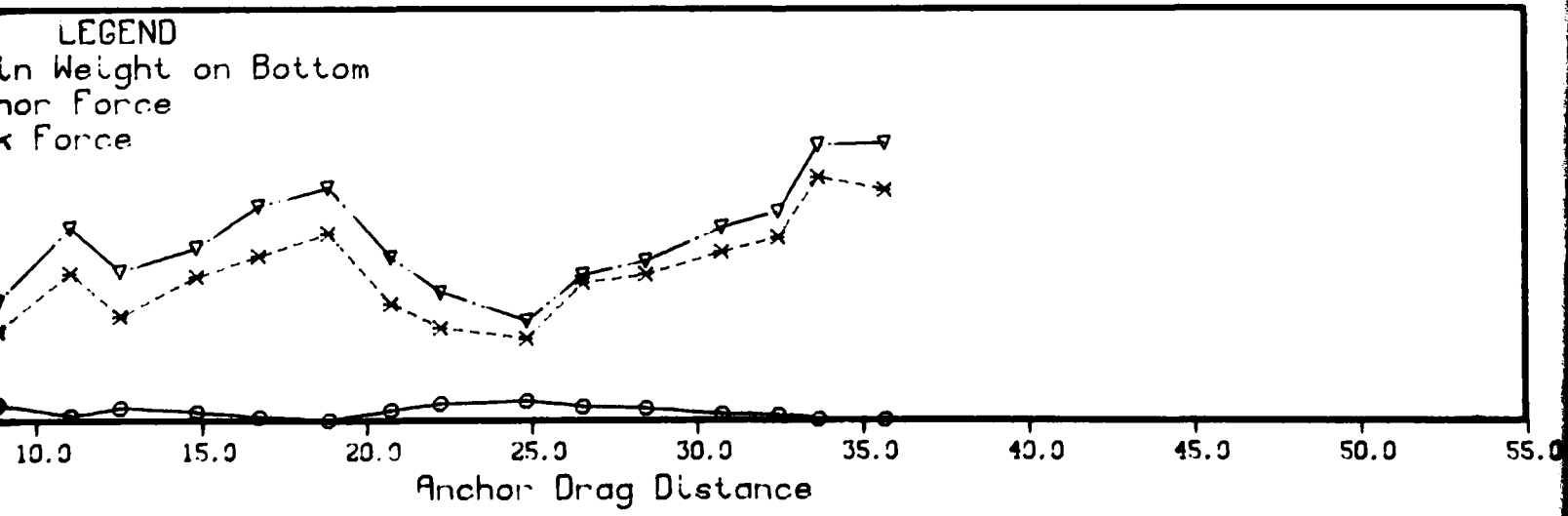
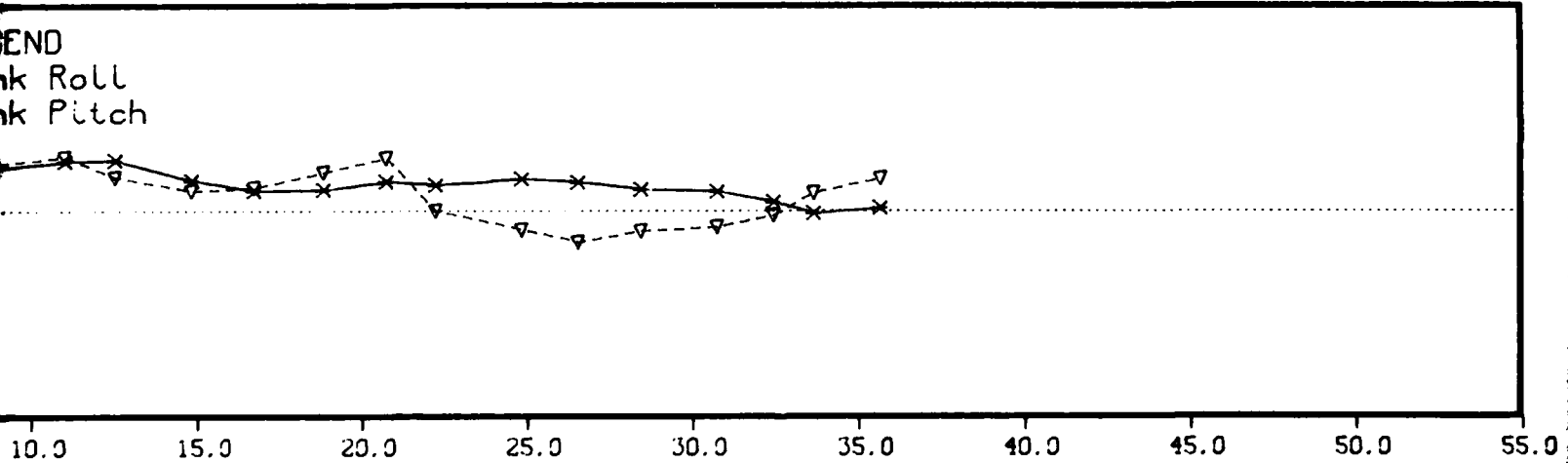
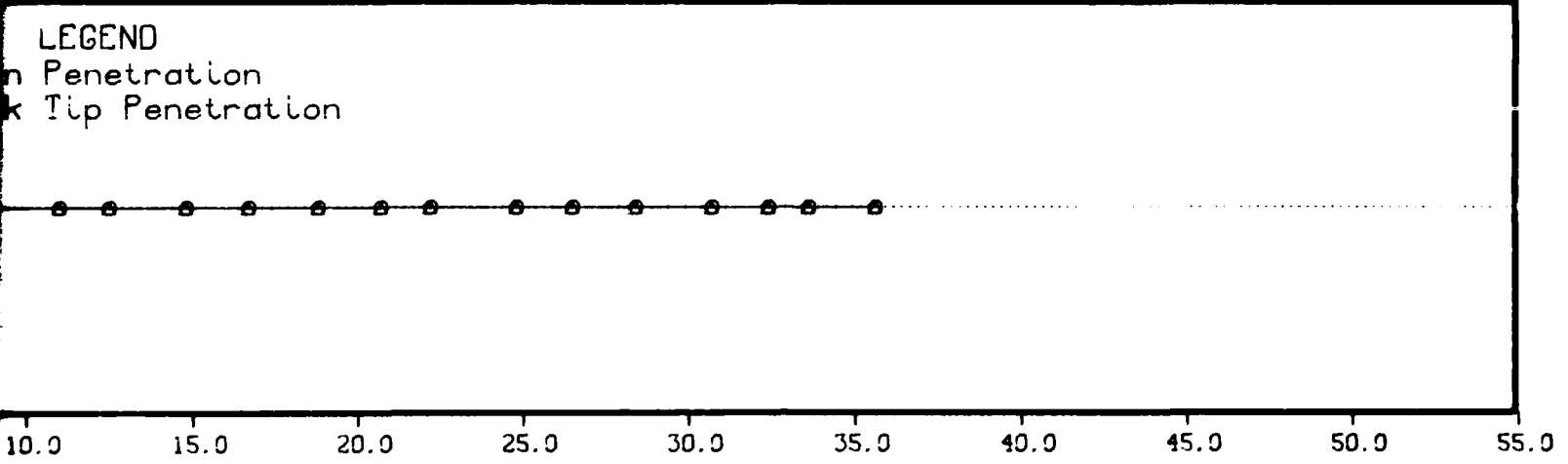
stockless 5000 lbs stabilized, 48 deg

Test Series No. - 0



R APRA HARBOR, GUAM.

stockless 5000 lbs stabilized, 48 deg fixed flukes



STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE,
MOORING LINE DESCRIPTION

79
3
0
INNER APRA HARBOR, GUAM.
1735 - 1755

STATO 1000 LBS, 40 IN STABILIZERS, 50 DEG MOVABLE FLUKE
1070.00 LB.
50.00 DEG. - 0 0=MOV 1=FIX
186 FT. 2.25 IN. CHAIN, 340 FT. 2 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	5.8	3.0	*****	-11.8	-4.5	20.0	5.5	214.8	7710.4	*****	*****	*****	36
2.0	8.3	4.0	*****	-5.0	-8.5	19.3	7.8	172.5	6981.2	*****	*****	*****	36
3.6	9.7	2.5	*****	-4.8	-9.5	18.0	9.2	165.6	6701.4	*****	*****	*****	36
4.7	9.7	5.0	*****	-5	-9.5	17.3	9.3	168.6	6822.7	*****	*****	*****	36
6.3	8.7	4.5	*****	14.5	-7.5	17.5	8.3	174.9	7074.5	*****	*****	*****	36
8.6	8.7	4.0	*****	12.3	-5	17.8	8.3	174.0	7038.1	*****	*****	*****	36
10.3	8.7	4.5	*****	12.5	7.5	17.5	8.3	174.9	7074.5	*****	*****	*****	36
12.1	8.7	2.5	*****	12.0	8.5	17.3	8.4	175.8	7110.9	*****	*****	*****	36
14.1	4.9	2.5	*****	12.5	8.5	21.0	4.5	254.3	7963.4	*****	*****	*****	36
16.1	4.9	3.0	*****	12.5	8.5	21.0	4.5	254.3	7963.4	*****	*****	*****	36
18.6	6.3	4.5	*****	8.3	20.8	19.8	5.9	192.9	7570.1	*****	*****	*****	36
20.3	8.7	5.0	*****	10.3	22.5	17.5	8.3	174.9	7074.5	*****	*****	*****	36
21.4	9.7	5.0	*****	10.0	21.8	16.0	9.3	173.6	7025.9	*****	*****	*****	36
23.9	9.7	4.5	*****	10.0	21.3	16.5	9.3	171.6	6944.4	*****	*****	*****	36
25.3	9.2	5.0	*****	10.0	21.3	16.3	8.9	176.0	7121.1	*****	*****	*****	36
28.1	10.7		*****	10.0	20.8	16.3	10.3	165.9	6713.2	*****	*****	*****	36
29.6	10.2		*****	9.5	14.5	16.0	9.8	170.3	6891.9	*****	*****	*****	36
31.2	11.7		*****	7.8	20.0	15.0	11.3	165.3	6686.2	*****	*****	*****	36
33.5	11.2		*****	7.3	20.0	15.5	10.8	166.0	6717.9	*****	*****	*****	36
36.1	12.6		*****	-5	10.5	15.5	12.2	156.4	6328.3	*****	*****	*****	36
37.0	11.2		*****	0.0	-1.0	15.0	10.8	168.4	6812.0	*****	*****	*****	36
39.3	10.2		*****	.5	-2.8	15.8	9.8	171.4	6934.8	*****	*****	*****	36
42.1	10.7		*****	.8	-2.8	16.3	10.3	165.9	6713.2	*****	*****	*****	36
42.9	9.7		*****	1.0	-2.5	15.5	9.4	175.7	7107.5	*****	*****	*****	36
45.8	15.1		*****	3.3	-2	14.5	14.6	146.6	5932.9	*****	*****	*****	36
46.9	10.2		*****	3.3	0.0	15.3	9.8	173.5	7020.6	*****	*****	*****	36
49.3	20.4		*****	5.0	2.5	13.0	19.9	126.4	5113.4	*****	*****	*****	36
51.3	20.4		*****	6.5	3.2	13.0	19.9	126.4	5113.4	*****	*****	*****	36

DISTANCE BARGE TRAVELLED 54.0
DISTANCE ANCHOR TRAVELLED 51.3

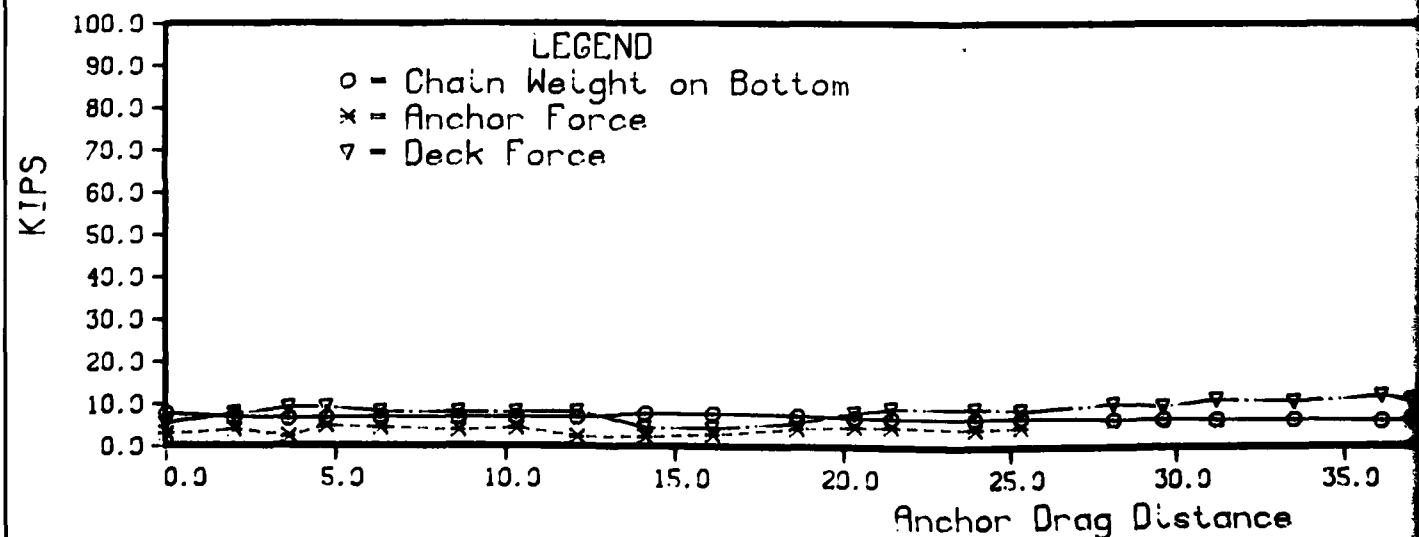
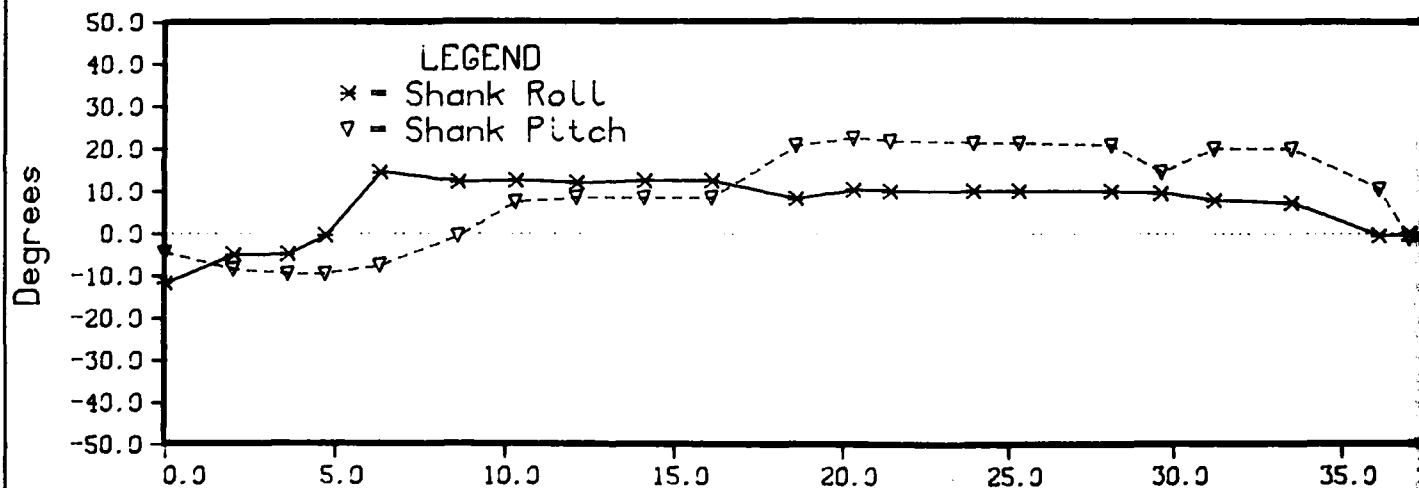
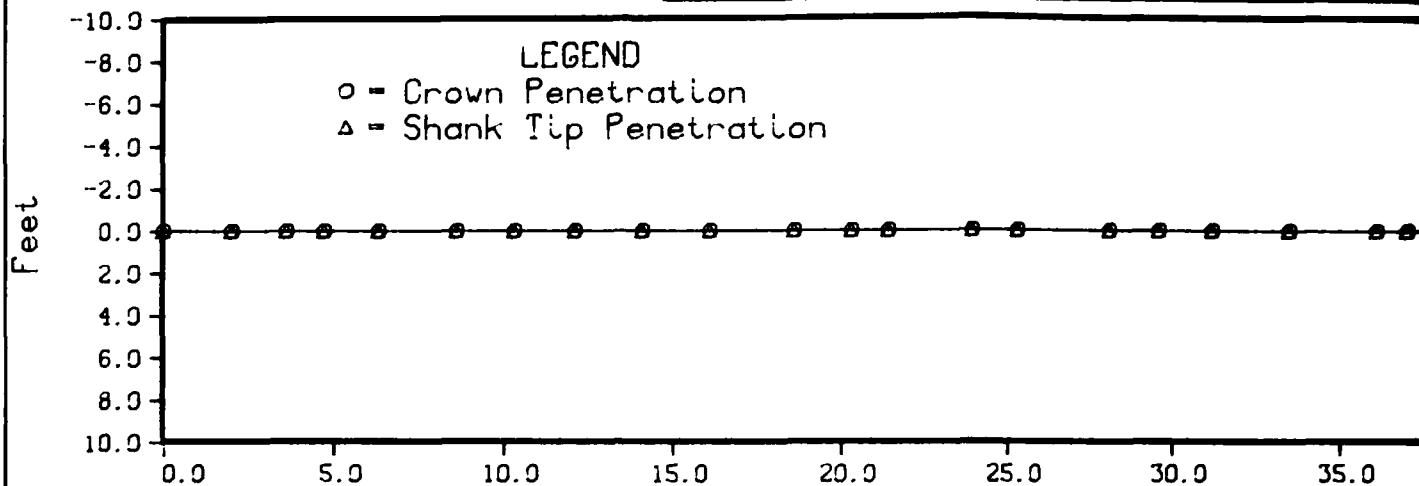
NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

Day # - 79 INNER APRA HARBOR, GUAM.

Test No. - 3

state 1000 lbs, 40 in stabilizers,

Test Series No. - 0

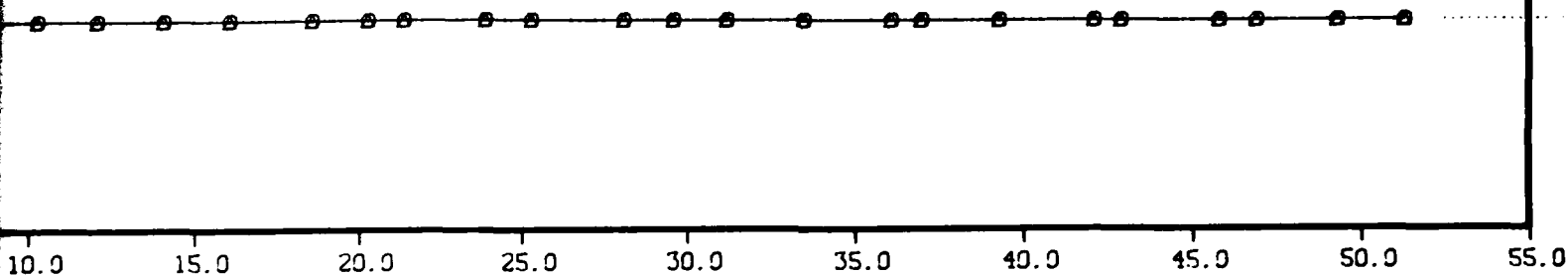


R APRA HARBOR, GUAM.

stato 1000 lbs, 40 in stabilizers, 50 deg movable flukes

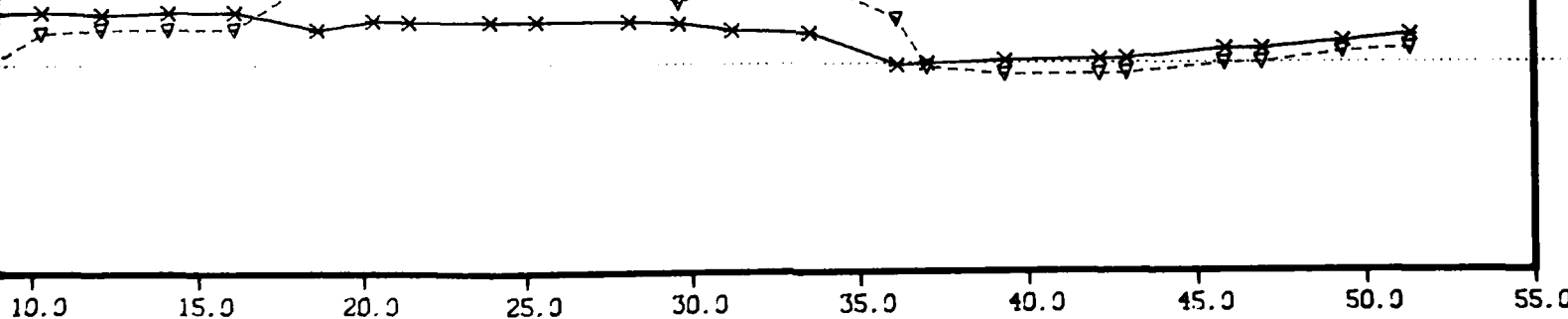
LEGEND

n Penetration
k Tip Penetration



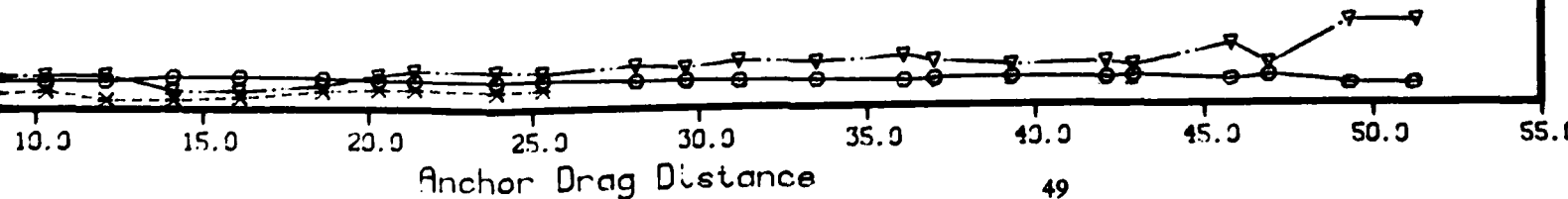
SEND

nk Roll
nk Pitch



LEGEND

in Weight on Bottom
hor Force
k Force



Anchor Drag Distance

STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE,
MOORING LINE DESCRIPTION

85
14
0
INNER APRA HARBOR, GUAM.
1703 - 1718

STATO 3000 LBS, STABILIZED, 50 DEG MOVABLE FLUKES
3500.00 LB.
50.00 DEG. - 0 0=MOV 1=FIX
54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

1. DRAG DISTANCE	5. ROTATION ANGLE	9. CHAIN LENGTH ON BOTTOM	13. ANCHOR FLUKE TIP DEPTH
2. DECK TENSION	6. SHANK ANGLE	10. CHAIN WEIGHT ON BOTTOM	14. WATER DEPTH
3. ANCHOR TENSION	7. WIRE ROPE ANGLE	11. ANCHOR CROWN DEPTH	15. TOTAL BOTTOM WEIGHT
4. PACKAGE DEPTH	8. DECK HORIZ. FORCE	12. ANCHOR SHANK TIP DEPTH	

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	10.7	4.5	*****	-7.0	29.5	17.0	10.2	298.6	12403.1	*****	*****	*****	36.0
2.0	15.6	5.0	*****	-7.0	29.5	15.8	15.0	271.5	11307.7	*****	*****	*****	36.0
3.1	14.6	4.5	*****	-7.0	29.0	15.3	14.1	281.1	11694.2	*****	*****	*****	36.0
5.4	14.6	5.0	*****	-7.0	29.3	15.5	14.0	279.6	11632.8	*****	*****	*****	36.0
9.5	15.1	5.0	*****	-7.0	29.5	17.0	14.4	267.0	11124.3	*****	*****	*****	36.0
9.7	15.6	5.0	*****	-7.3	28.8	15.5	15.0	273.1	11373.1	*****	*****	*****	36.0
11.2	16.0	5.0	*****	-7.5	28.0	15.0	15.5	273.3	11378.2	*****	*****	*****	36.0
13.3	16.5	5.5	*****	-7.3	29.0	15.0	16.0	270.2	11252.5	*****	*****	*****	36.0
14.9	18.5	5.5	*****	-7.3	29.0	14.3	17.9	263.5	10983.2	*****	*****	*****	36.0
15.9	14.6	5.0	*****	-7.5	28.5	14.3	14.1	267.2	11940.2	*****	*****	*****	36.0
18.3	18.5	5.0	*****	-7.3	28.5	13.8	17.9	267.4	11139.6	*****	*****	*****	36.0
20.1	17.5	5.0	*****	-7.3	28.5	13.8	17.0	273.1	11370.6	*****	*****	*****	36.0
22.5	18.0	6.0	*****	-7.0	28.8	14.0	17.4	268.4	11178.9	*****	*****	*****	36.0
24.2	18.0	6.0	*****	-7.5	28.8	13.8	17.5	270.2	11255.1	*****	*****	*****	36.0
26.6	18.5	6.0	*****	-7.0	29.3	14.0	17.9	265.4	11061.4	*****	*****	*****	36.0
28.2	19.4	6.0	*****	-7.3	29.5	13.5	18.9	263.7	10991.0	*****	*****	*****	36.0
30.5	19.4	7.0	*****	-6.3	30.3	13.8	18.9	261.7	10908.6	*****	*****	*****	36.0
31.7	19.4	6.5	*****	-6.3	30.5	13.0	18.9	267.8	11156.1	*****	*****	*****	36.0
33.8	20.4	6.5	*****	-4.5	32.3	13.0	19.9	262.4	10937.5	*****	*****	*****	36.0
35.4	19.4	6.5	*****	-5.0	34.8	12.8	19.0	269.8	11238.8	*****	*****	*****	36.0
37.3	19.0	5.5	*****	-7.3	37.8	12.8	18.5	272.5	11346.1	*****	*****	*****	36.0
39.6	20.4	9.0	*****	-11.5	40.5	12.8	19.9	264.5	11024.3	*****	*****	*****	36.0
41.9	22.8	10.0	*****	-12.5	41.5	12.8	22.3	251.3	10488.0	*****	*****	*****	36.0
44.0	25.3	14.0	*****	-17.5	42.8	12.5	24.7	240.7	10059.4	*****	*****	*****	36.0
45.5	21.9	11.0	*****	-27.8	45.3	12.5	21.4	258.9	10795.7	*****	*****	*****	36.0
47.1	19.0	7.5	*****	-32.5	48.8	12.5	18.5	274.5	11426.8	*****	*****	*****	36.0
49.7	19.4	8.5	*****	-32.5	49.3	13.0	18.9	267.8	11156.1	*****	*****	*****	36.0

DISTANCE BARGE TRAVELLED 52.0
DISTANCE ANCHOR TRAVELLED 49.7

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

Day # - 85

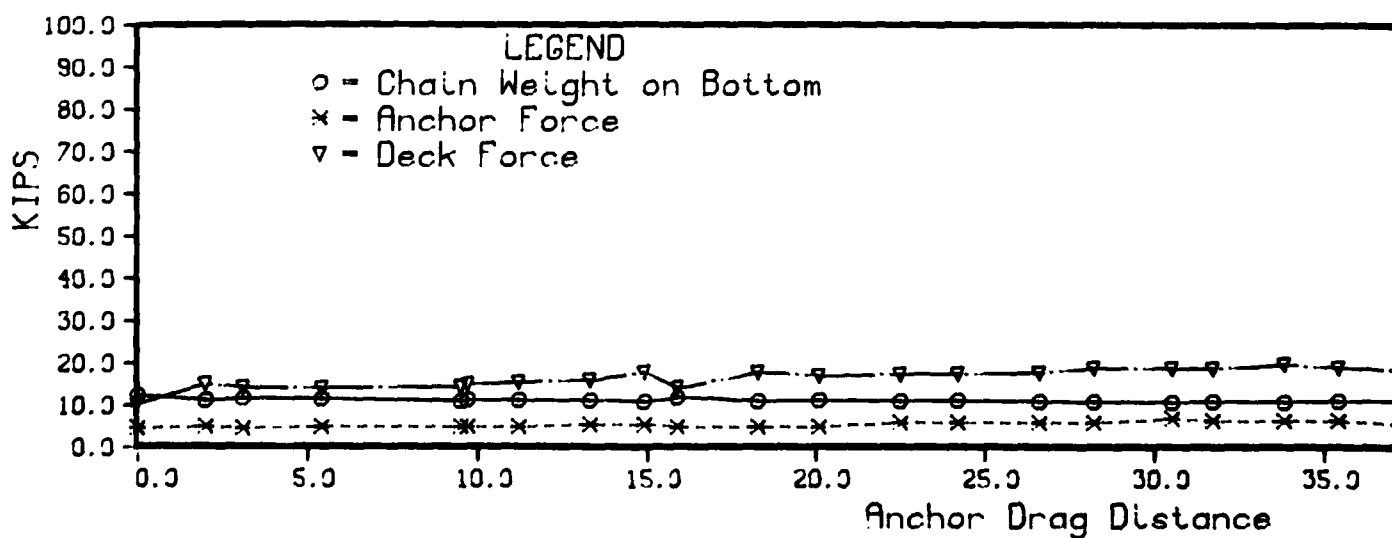
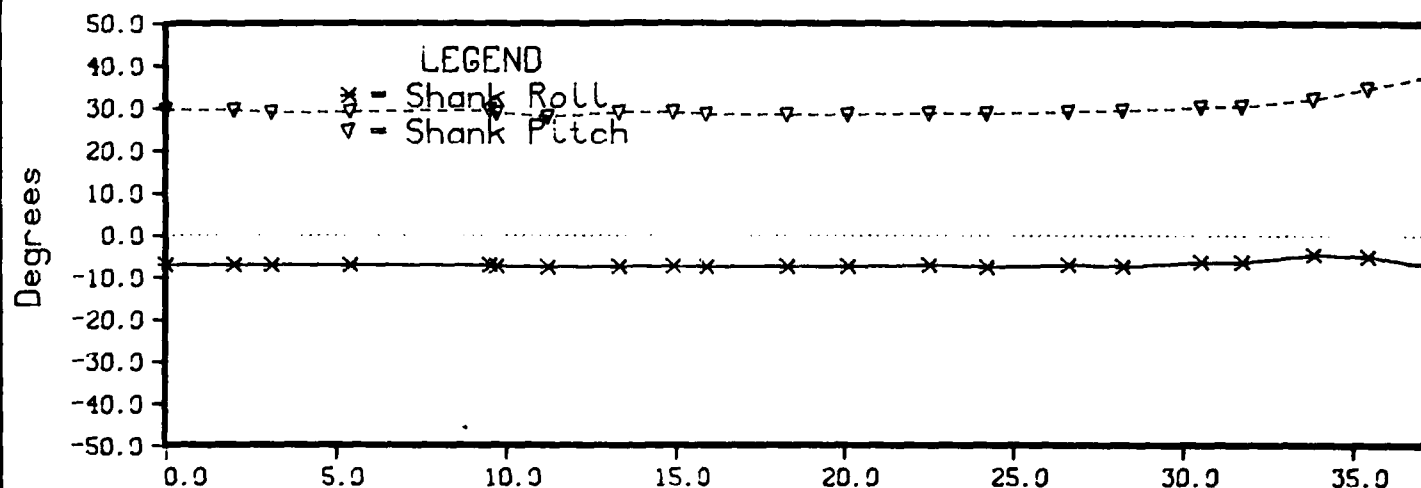
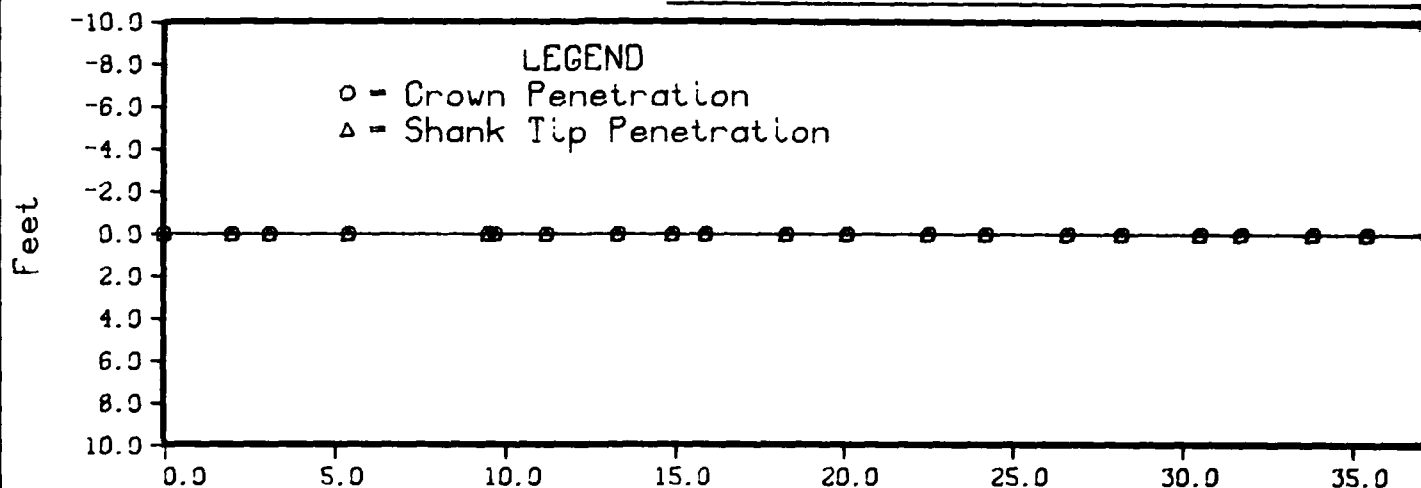
INNER APRA HARBOR, GUAM.

Test No. - 14

stato 3000 lbs,

50 de

Test Series No. - 0



2

APRA HARBOR, GUAM.

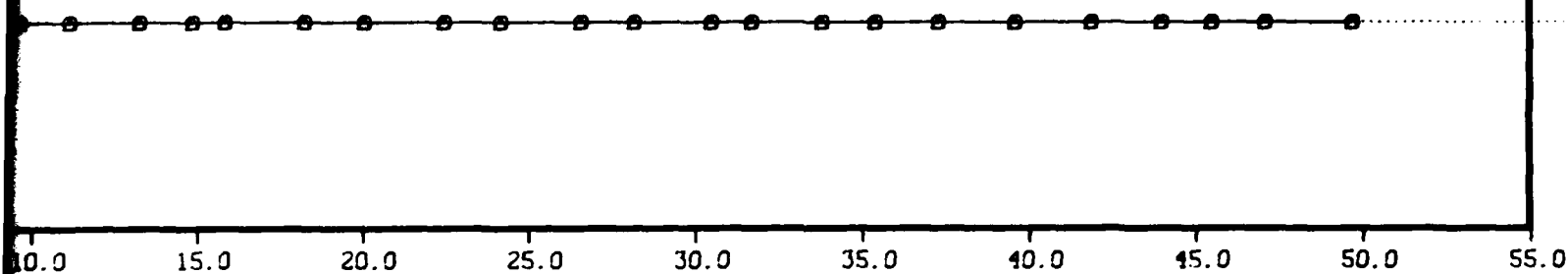
stato 3000 lbs,

50 deg movable flukes

LEGEND

Penetration

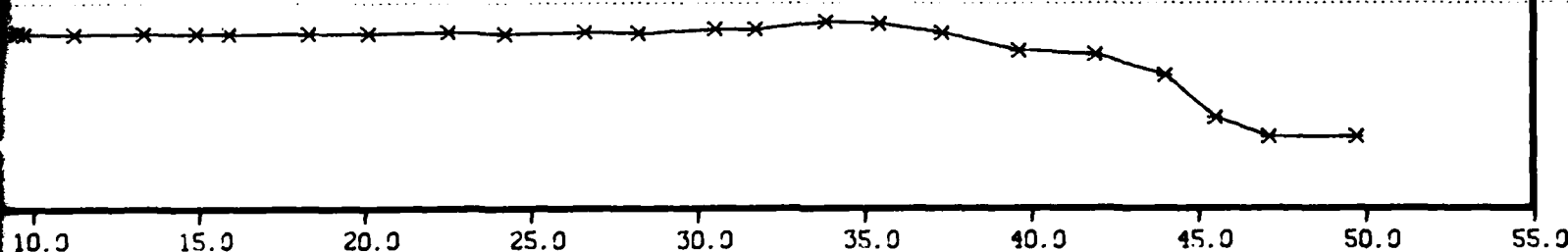
Tip Penetration



END

Roll

Pitch

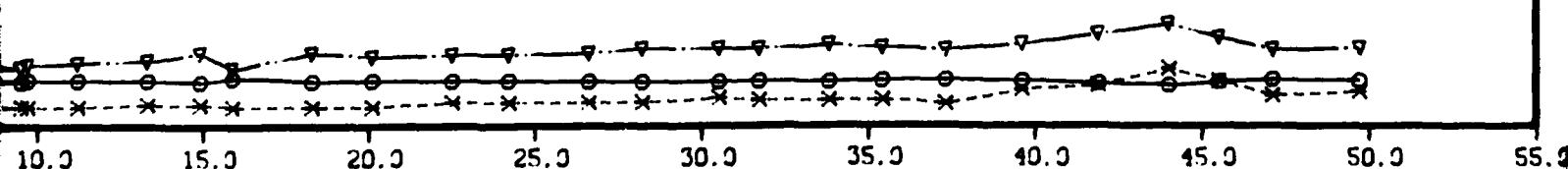


LEGEND

Ln Weight on Bottom

hor Force

k Force



Anchor Drag Distance

STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE,
MOORING LINE DESCRIPTION

85
15
0
INNER APRA HARBOR, GUAM.
1020 - 1040

STATO 3000 LBS, STABILIZED, 32 DEG MOVABLE FLUKES
3500.00 LB.
32.00 DEG. - 0 0=MOV 1=FIX
54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET
0.0	14.1	*****	*****	7.3	23.8	14.5	13.6	288.7	12000.3	*****	*****	*****	35
4.0	14.1	*****	*****	7.3	23.5	14.5	13.6	288.7	12000.3	*****	*****	*****	35
5.5	19.0	*****	*****	7.5	22.5	13.0	18.5	270.5	11265.5	*****	*****	*****	35
7.5	19.0	*****	*****	7.5	22.0	13.0	18.5	270.5	11265.5	*****	*****	*****	35
9.5	21.9	*****	*****	7.0	22.0	12.5	21.4	258.9	10795.7	*****	*****	*****	35
11.2	24.3	*****	*****	6.0	21.8	12.0	23.8	251.0	10477.0	*****	*****	*****	35
13.7	28.7	*****	*****	7.8	25.3	12.0	28.0	228.5	9567.6	*****	*****	*****	35
15.3	34.0	*****	*****	8.8	25.0	11.3	33.4	211.8	8892.3	*****	*****	*****	35
17.0	34.0	*****	*****	7.8	25.0	11.0	33.4	215.4	9037.9	*****	*****	*****	35
18.7	36.4	*****	*****	5.0	24.5	10.5	35.8	211.7	8886.8	*****	*****	*****	35
20.8	38.9	*****	*****	2.8	24.5	10.5	38.2	200.8	8444.0	*****	*****	*****	35
22.3	38.9	*****	*****	3.8	23.3	10.0	38.3	209.0	8777.8	*****	*****	*****	35
24.1	36.0	*****	*****	5.0	23.0	10.0	35.4	221.5	9284.2	*****	*****	*****	35
26.2	37.4	*****	*****	5.0	22.8	10.0	36.9	215.3	9031.0	*****	*****	*****	35
28.8	38.4	*****	*****	5.0	23.0	10.5	37.7	202.9	8532.5	*****	*****	*****	35
30.3	39.4	*****	*****	5.3	23.0	10.0	38.8	206.9	8693.4	*****	*****	*****	35
32.2	41.3	*****	*****	3.3	22.3	9.8	40.7	203.0	8533.5	*****	*****	*****	35
34.5	43.7	*****	*****	2.5	22.5	10.0	43.1	188.1	7933.9	*****	*****	*****	35
36.3	51.0	*****	*****	.5	22.5	9.5	50.3	167.7	7107.0	*****	*****	*****	35
38.9	53.9	*****	*****	0.0	22.3	10.0	53.1	144.3	6161.8	*****	*****	*****	35
40.2	55.4	*****	*****	-.7	22.0	9.3	54.7	155.8	6623.6	*****	*****	*****	35
42.6	61.2	*****	*****	-4.5	22.8	9.5	60.4	128.0	5422.6	*****	*****	*****	35
44.0	58.3	*****	*****	-9.0	25.0	9.0	57.6	150.4	6406.1	*****	*****	*****	35
46.5	48.6	*****	*****	-17.3	28.8	9.8	47.9	172.5	7299.0	*****	*****	*****	35
48.0	34.0	*****	*****	-30.0	32.5	10.0	33.5	229.9	9621.7	*****	*****	*****	35

DISTANCE BARGE TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 48.0

END-OF-FILE ENCOUNTERED, FILENAME - INPUT
ERROR NUMBER 65 DETECTED BY INPC- AT ADDRESS 000135
CALLED FROM ANCHOR AT LINE 33

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

Day # - 85

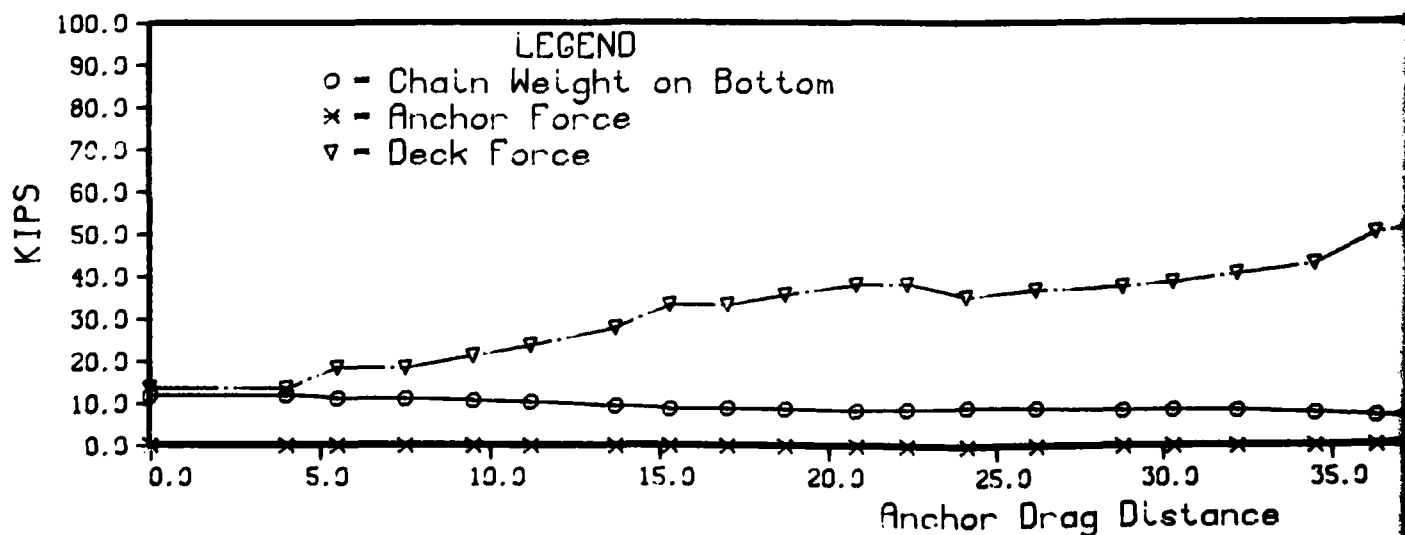
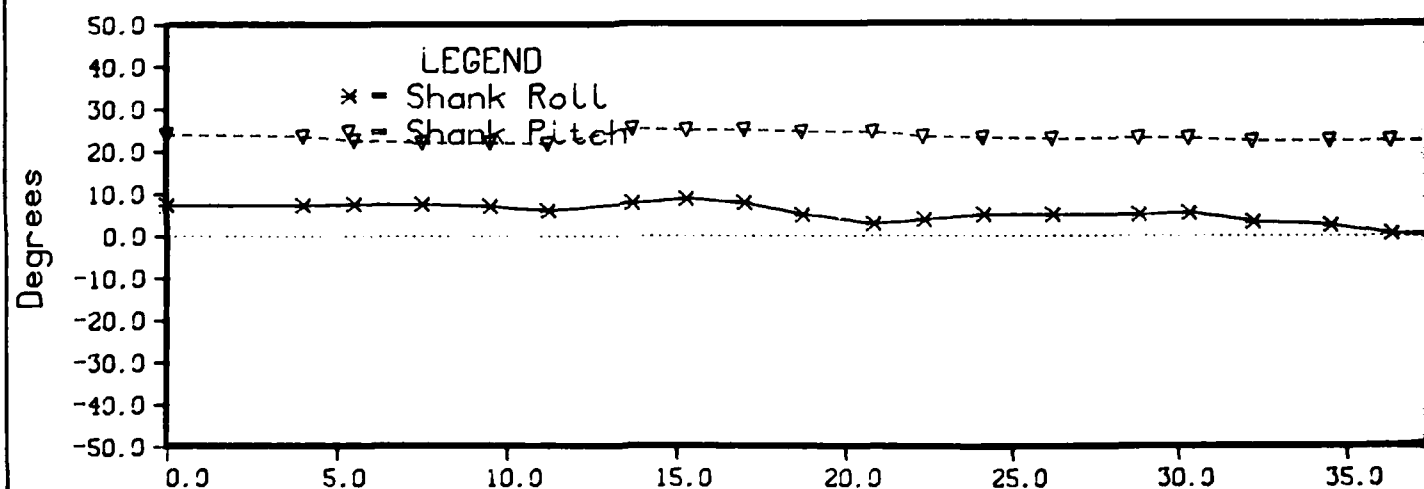
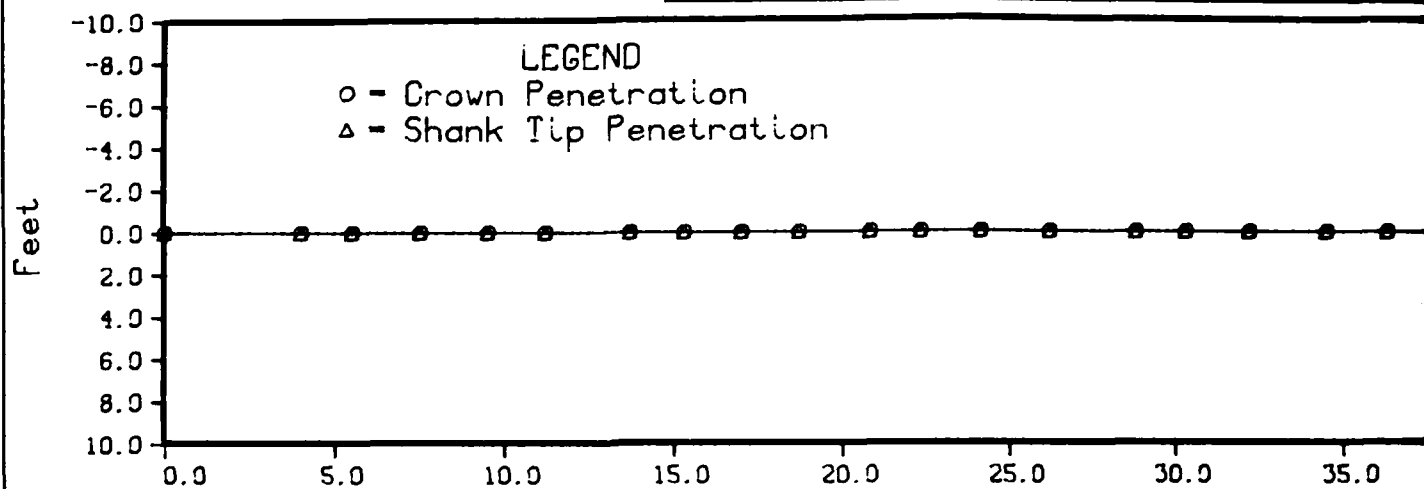
INNER APRA HARBOR, GUAM.

Test No. - 15

stato 3000 lbs,

32 deg

Test Series No. - 0



14
FEET

15
LBS

15500.3

15500.3

14765.5

14765.5

14295.7

13977.0

13067.6

12392.3

12537.9

12386.8

11944.0

12277.8

12784.2

12531.0

12032.5

12193.4

12033.5

11433.9

10607.0

9661.8

10123.6

8922.6

9906.1

10799.0

13121.7

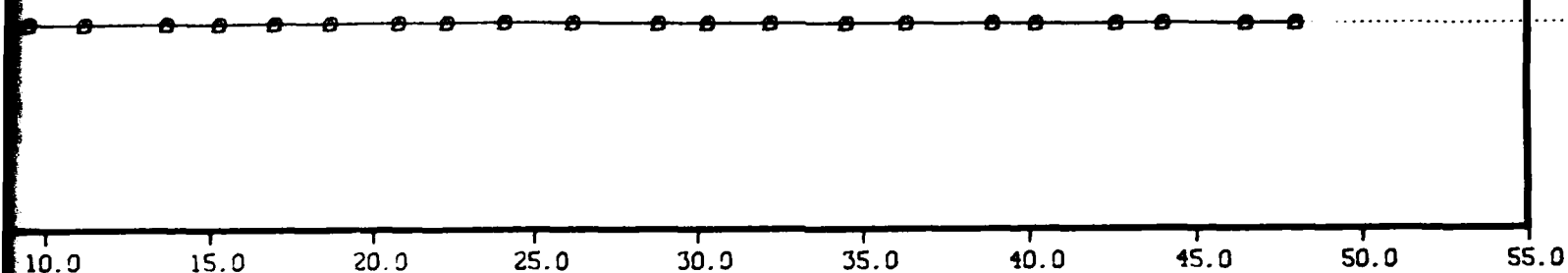
R APRA HARBOR, GUAM.

stato 3000 lbs,

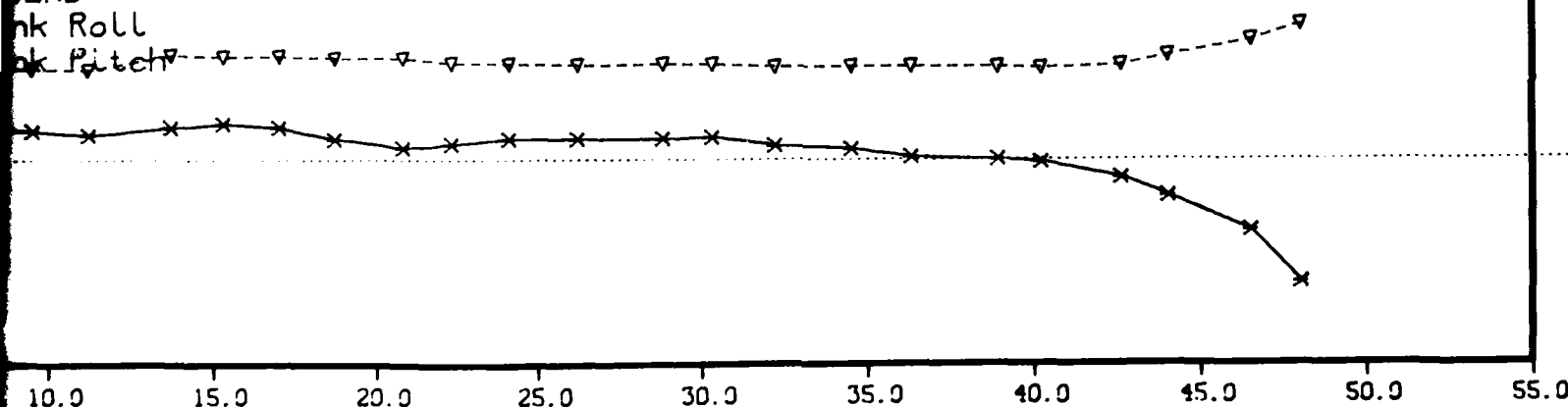
32 deg movable flukes

LEGEND

n Penetration
k Tip Penetration

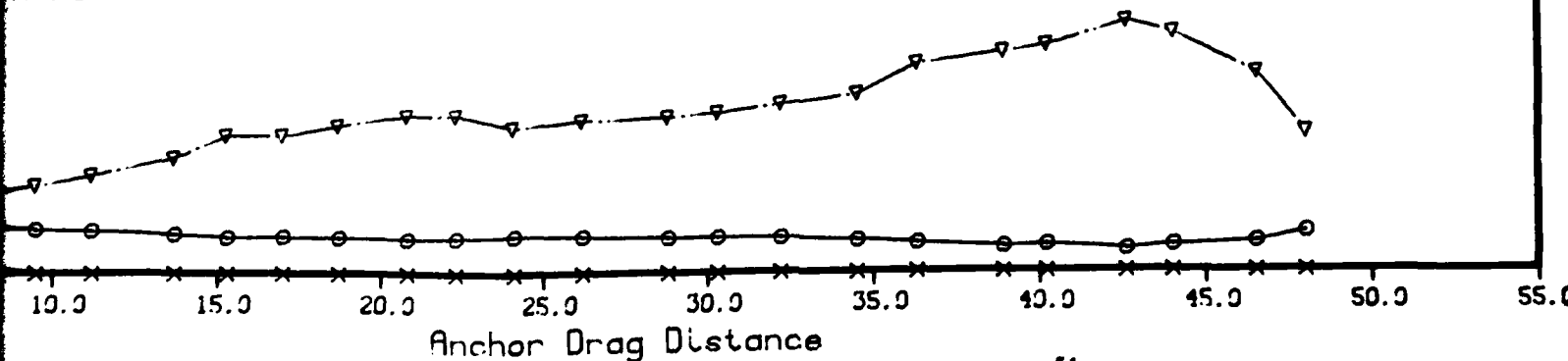


END



LEGEND

in Weight on Bottom
hor Force
k Force



STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE
MOORING LINE DESCRIPTION

86
16
0
INNER APRA HARBOR, GUAM.
1336 - 1350

STATO 3000 LBS., STABILIZED, 32 DEG MOVABLE FLUKES
3500.00 LB.
32.00 DEG. - 0 0=MOV 1=FIX
100 FT 1.5 IN WIRE, 54 FT 2.0 CHAIN, 82 FT 2.5 IN CHAIN,
196 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	17.5	6.5	37.0	-15.5	28.5	13.3	17.0	376.8	11869.1	33.0	38.0	37.8	36.0
2.0	17.5	5.5	35.5	-15.0	27.0	12.5	17.1	382.3	12092.3	31.7	36.4	36.4	36.0
4.3	19.4	6.5	35.5	-15.0	27.0	12.5	19.0	371.9	11671.6	31.7	36.4	36.4	36.0
6.6	25.3	11.0	35.5	-12.0	27.8	12.0	24.7	346.0	10624.9	31.5	36.4	36.4	36.0
8.8	30.1	14.5	36.5	-7.7	27.0	11.8	29.5	324.2	9743.1	32.6	37.4	37.4	36.0
9.8	34.5	17.5	36.0	-3.0	22.5	10.5	33.9	320.5	9591.1	32.7	36.8	37.3	36.0
11.8	43.7	25.5	35.5	-2.2	20.3	10.0	43.1	288.1	8284.0	32.5	36.2	37.0	36.0
13.9	45.7	25.0	35.0	-3.2	21.3	10.0	45.0	279.8	7946.4	31.8	35.8	36.4	36.0
15.9	47.6	28.5	35.0	-5.2	20.5	10.0	46.9	271.5	7608.8	31.9	35.7	36.5	36.0
17.7	49.1	29.5	35.0	-5.0	20.5	9.8	48.4	270.4	7566.7	31.9	35.7	36.5	36.0
19.6	52.5	32.0	35.0	-5.2	20.5	9.5	51.8	261.8	7216.4	31.9	35.7	36.5	36.0
21.3	58.3	40.5	35.0	-3.0	20.0	9.0	57.6	250.4	6756.1	32.0	35.7	36.5	36.0
23.4	62.7	42.5	35.0	-2.5	20.0	9.0	61.9	234.0	6071.9	32.0	35.7	36.5	36.0
26.0	63.7	44.0	36.5	-1.5	19.8	9.5	62.8	220.0	5371.5	33.5	37.2	38.1	36.0
27.9	61.2	42.5		1.3	15.8	9.5	60.4	228.0	5772.6				36.0
29.8	57.3	40.5	35.5	2.3	15.5	9.5	56.6	241.9	6414.3	33.2	36.1	37.4	36.0
31.0	59.3	45.5	36.0	2.0	15.5	8.8	58.6	252.9	6859.7	33.7	36.6	37.9	36.0

DISTANCE BARGE TRAVELLED 32.0
DISTANCE ANCHOR TRAVELLED 31.0

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

Day # - 86

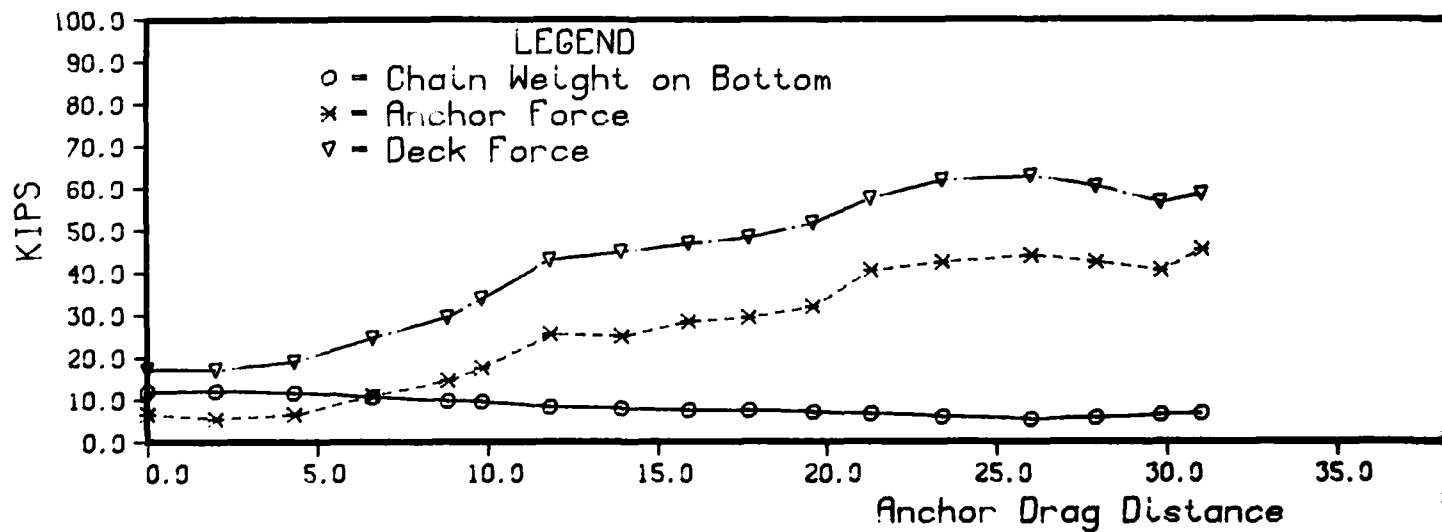
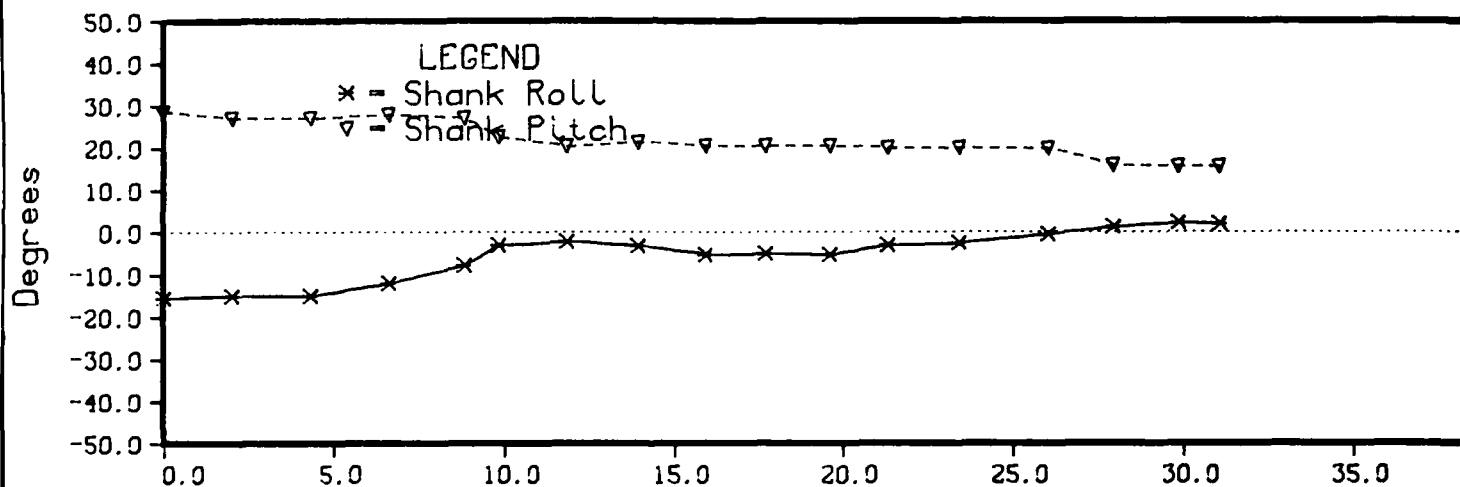
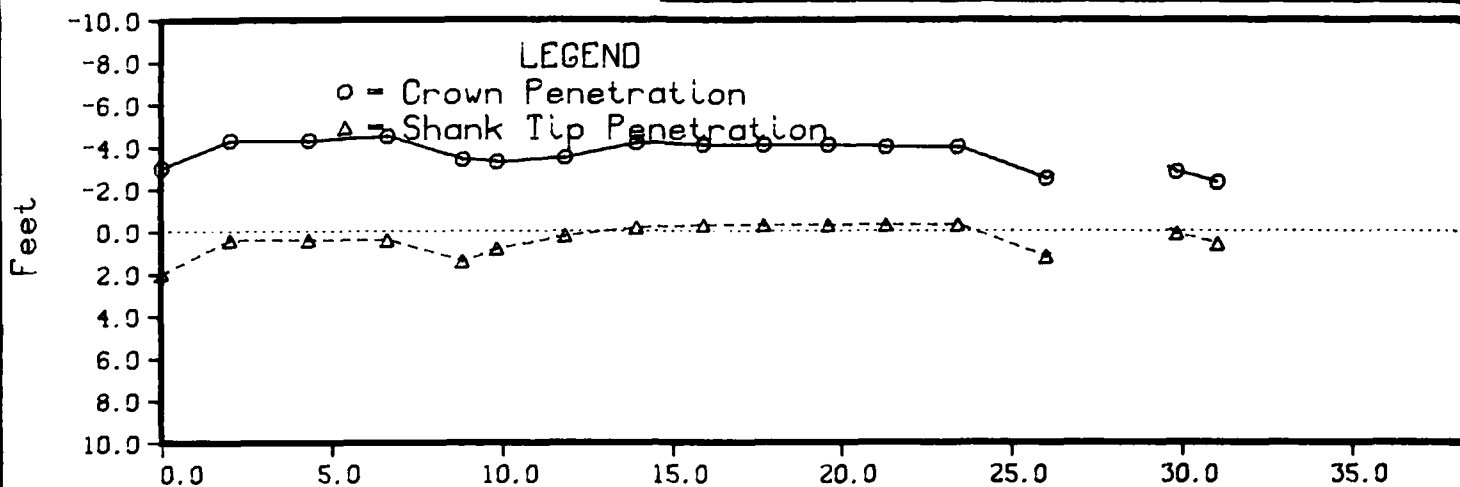
INNER APRA HARBOR, GUAM.

Test No. - 16

stato 3000 lbs,

32 deg

Test Series No. - 0



15
LBS
15369.1
15592.3
15171.6
14124.9
13243.1
13091.1
11784.0
11446.4
11108.8
11066.7
10716.4
10256.1
9571.9
8871.5
9272.6
9914.3
10359.7

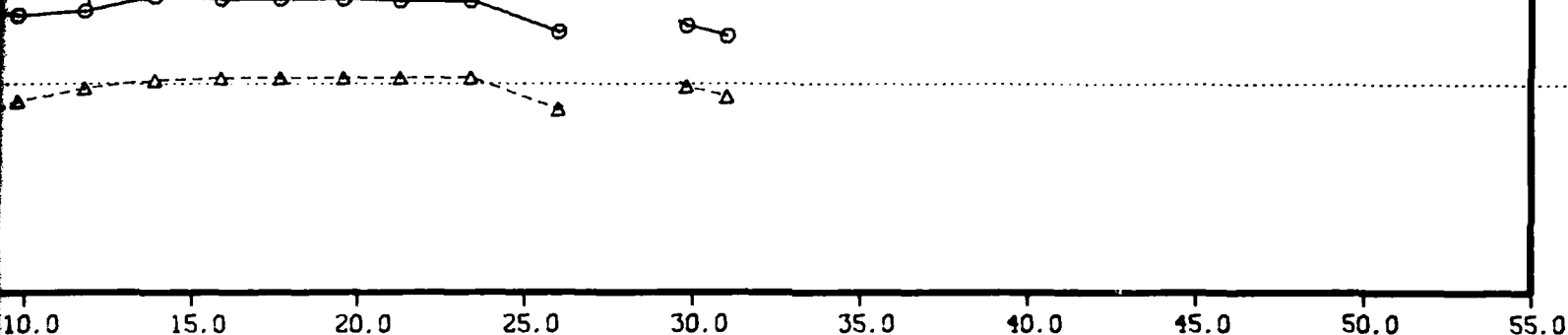
APRA HARBOR, GUAM.

stato 3000 lbs,

32 deg movable flukes

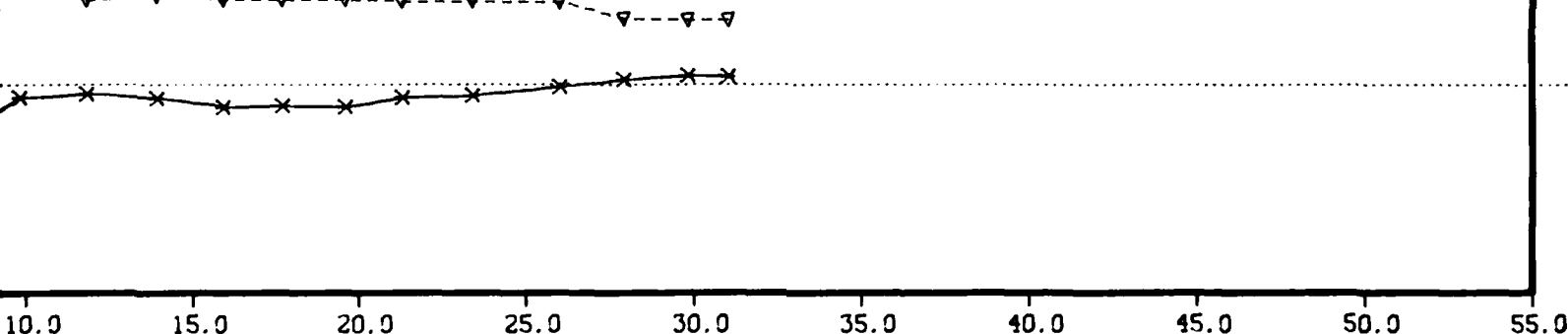
LEGEND

n Penetration
k Tip Penetration



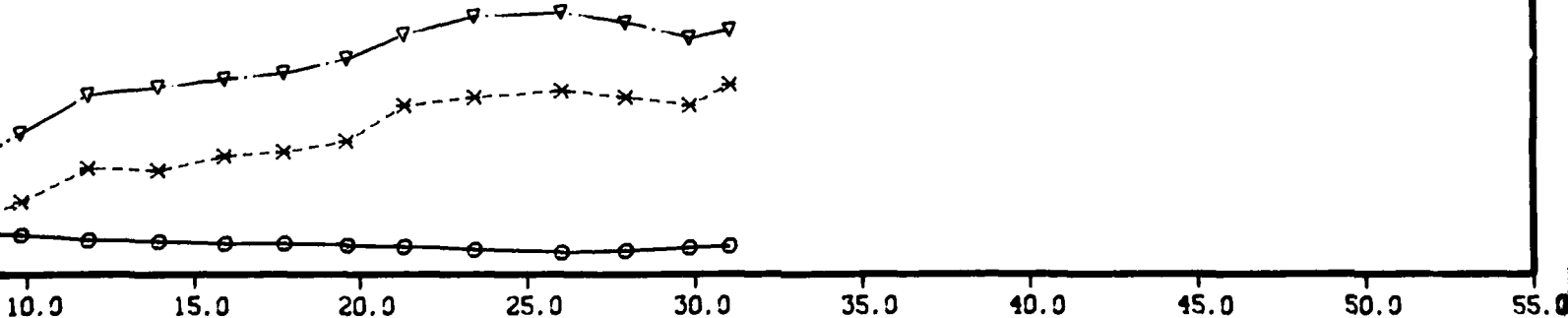
END

k Roll
k Pitch



LEGEND

in Weight on Bottom
hor Force
k Force



Anchor Drag Distance

STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE,
MOORING LINE DESCRIPTION

87
18
0
INNER APRA HARBOR, GUAM.
1107 - 1122

STATO 6000 LBS, 67 IN. EXTED STAB., 34 DEG. MOVABLE FLKS
6600.00 LB.
34.00 DEG. - 0 0=MOV 1=FIX
54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	12.1	1.0	35.5	-5.5	24.5	15.0	11.7	298.1	12384.5	34.6	39.6	40.7	36.0
2.0	19.9	5.0	36.0	-4.8	25.0	11.3	19.5	279.8	11641.8	35.1	40.2	41.2	36.0
4.0	24.3	8.5	36.0	-4.2	21.3	10.8	23.9	263.8	10996.7	35.2	39.6	41.1	36.0
6.2	21.4	9.0	36.0	-4.8	20.8	11.3	21.0	272.8	11357.4	35.2	39.5	41.1	36.0
8.7	23.8	9.5	39.0	-3.5	21.3	11.5	23.3	258.5	10781.4	38.2	42.6	44.1	36.0
10.0	19.9	9.0	39.0	-3.2	20.5	11.3	19.5	279.8	11641.8	38.2	42.5	44.1	36.0
11.6	18.5	5.5	37.0	-5.0	20.0	11.0	18.1	288.8	12005.3	36.3	40.4	42.0	36.0
15.1	19.4	5.0	39.0	-8.0	22.5	12.5	19.0	271.9	11321.6	38.2	42.8	44.1	36.0
16.6	19.4	5.0	39.0	-9.5	22.0	12.0	19.0	276.0	11487.4	38.2	42.7	44.1	36.0
18.7	19.9	5.5	39.5	-10.0	22.8	12.0	19.5	273.5	11386.3	38.7	43.3	44.6	36.0
19.5	19.4	4.0	38.5	-11.5	21.0	10.8	19.1	286.2	11903.1	37.7	42.0	43.5	36.0
21.6	20.4	4.5	37.5	-12.3	21.3	10.8	20.1	281.8	11721.8	36.7	41.0	42.5	36.0
25.0	18.5	6.0	37.5	-10.8	22.5	12.5	18.0	277.1	11532.0	36.7	41.2	42.6	36.0
27.3	20.4	9.0	38.5	-10.0	22.5	12.5	19.9	266.7	11111.2	37.7	42.3	43.6	36.0
28.6	25.3	10.0	37.5	-7.7	22.5	11.3	24.8	254.0	10598.9	36.7	41.3	42.6	36.0
30.0	24.3	10.0	37.5	-4.2	22.0	10.8	23.9	263.8	10996.7	36.7	41.2	42.6	36.0
32.5	24.3	10.0	38.0	-2.5	22.5	11.3	23.8	258.7	10788.5	37.2	41.8	43.1	36.0
33.8	24.3	11.0	39.0	-4.0	21.8	10.5	23.9	266.4	11100.9	38.2	42.7	44.1	36.0
35.8	26.7	11.0	37.5	-5.0	20.5	10.3	26.3	258.3	10772.8	36.7	41.0	42.6	36.0
38.1	28.2	15.5	38.0	-7.3	21.8	10.5	27.7	248.9	10392.4	37.2	41.7	43.1	36.0
40.0	42.8	32.5	37.5	-17.3	32.8	9.5	42.2	201.4	8470.5	36.4	42.6	42.7	36.0
42.4	54.4	45.0	39.0	-20.0	35.0	9.5	53.7	153.8	6545.5	37.8	44.4	44.1	36.0

DISTANCE BARGE TRAVELLED 42.0
DISTANCE ANCHOR TRAVELLED 42.4

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

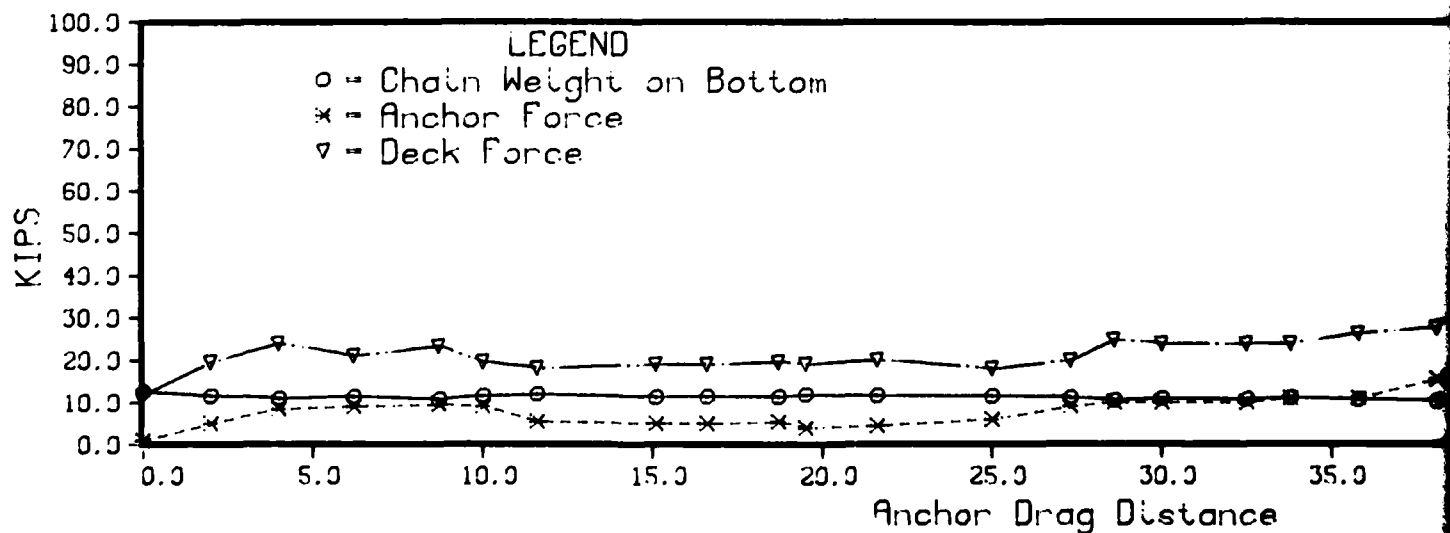
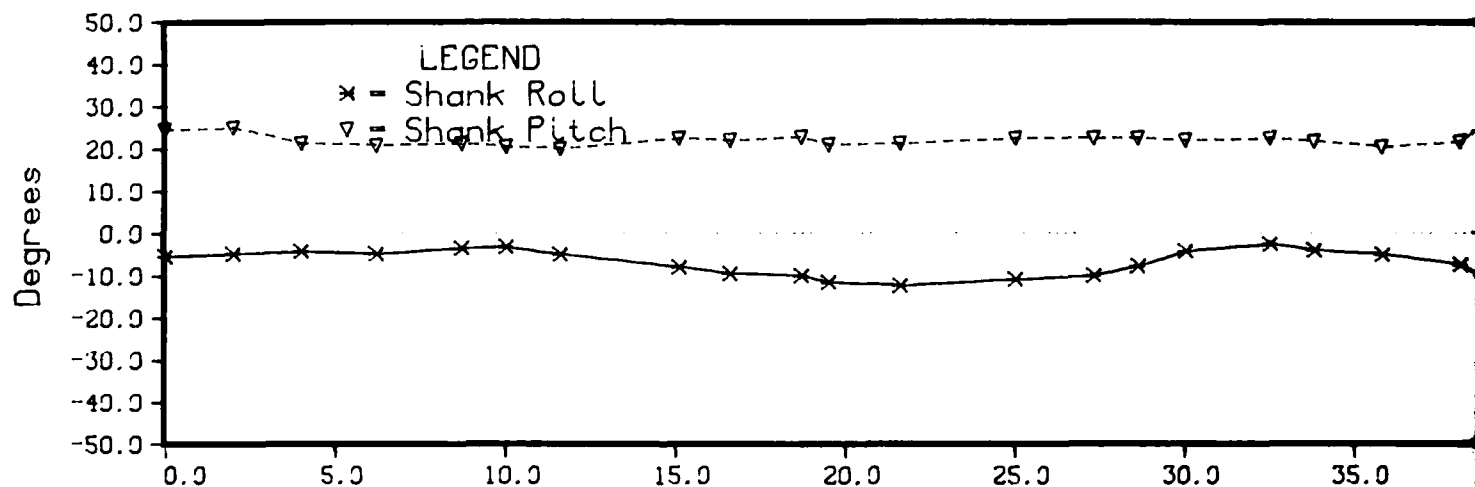
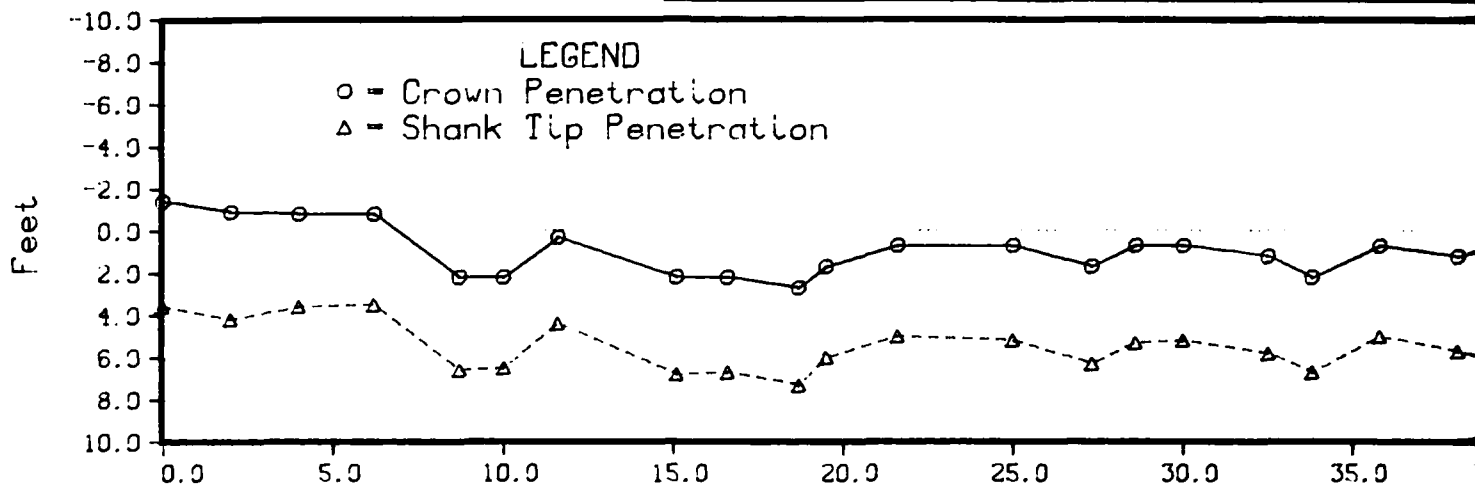
Day # - 87

INNER APRA HARBOR, GUAM.

Test No. - 18

stato 6000 lbs, 67 in. exted stab.,

Test Series No. - 0



15
LBS
18984.5
18241.8
17596.7
17957.4
17381.4
18241.8
18605.3
17921.6
18087.4
17986.3
18503.1
18321.8
18132.0
17711.2
17198.9
17596.7
17388.5
17700.9
17372.8
16992.4
15070.5
13145.5

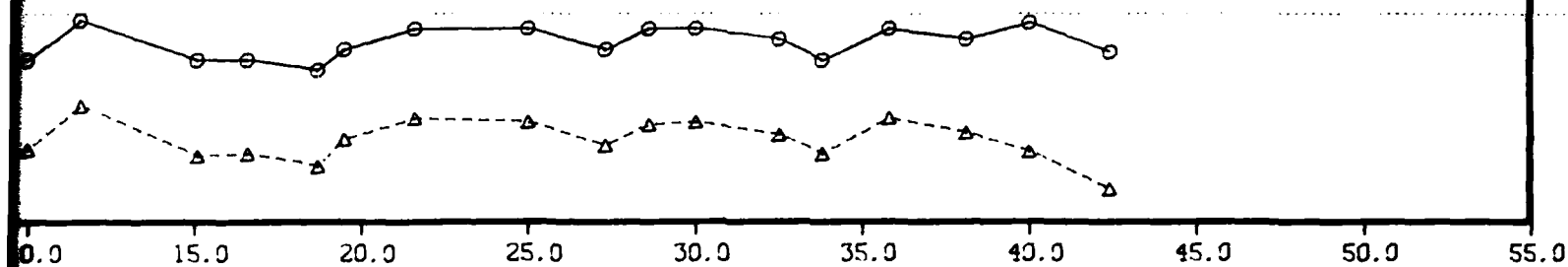
APRA HARBOR, GUAM.

stato 6000 lbs, 67 in. exted stab., 34 deg. movable flks

LEGEND

Penetration

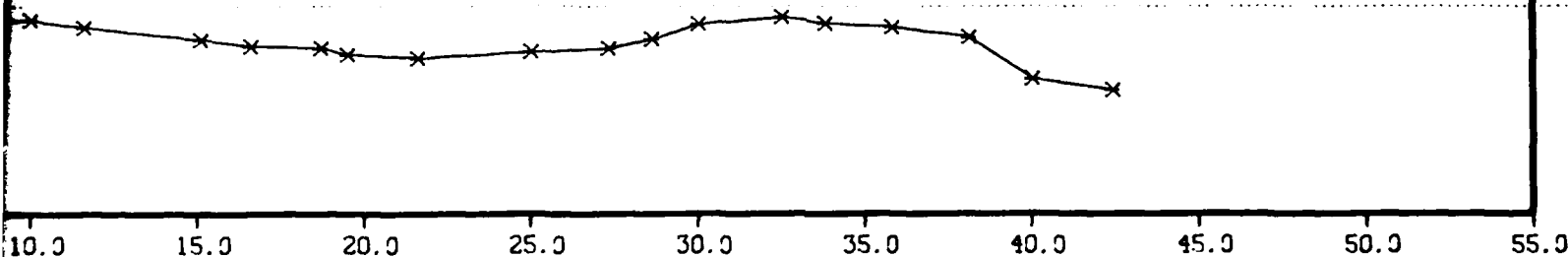
Tip Penetration



END

* Roll

* Pitch

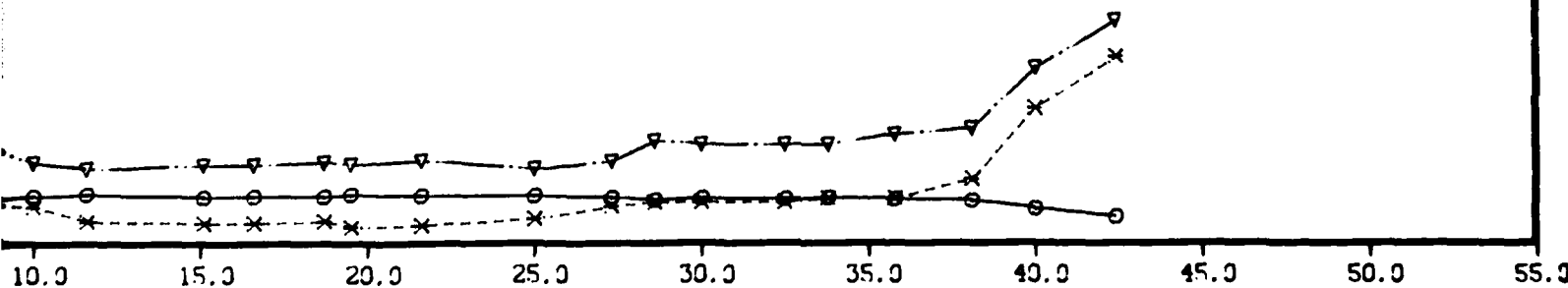


LEGEND

Weight on Bottom

Horizontal Force

* Force



Anchor Drag Distance

STATO ANCHOR TEST

TEST DATE
TEST NO.
TEST RUN
TEST AREA
START-END TIMES
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUKE ANGLE-TYPE,
MOORING LINE DESCRIPTION

87
19
0
INNER APRA HARBOR, GUAM.
1340 - 1355

STATO 6000 LBS, NORMAL STABILIZED, 34 DEG MOVABLE FLUKES
6600.00 LB.
34.00 DEG. - 0 0=MOV 1=FIX
54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET
0.0	14.6	4.5		-5.0	26.3	12.5	14.2	297.9	12373.4				36.0
2.0	19.0	6.0		-5.5	23.3	10.5	18.6	290.5	12075.1				36.0
4.5	26.7	12.0		-3.8	24.3	10.3	26.3	258.3	10772.8				36.0
6.5	36.4	23.5		-5	22.8	9.5	35.9	227.2	9513.3				36.0
8.3	51.0	38.0		1.3	20.8	8.8	50.4	184.0	7766.5				36.0
10.2	53.9	41.5		.3	20.0	8.5	53.4	178.8	7555.6				36.0
12.2	55.9	41.5		-1.0	18.8	8.5	55.3	171.7	7268.3				36.0
13.9	58.8	46.5		.3	17.0	8.0	58.2	173.6	7345.1				36.0
16.6	62.7	50.0	*****	1.3	16.0	8.8	62.0	140.2	5992.2	*****	*****	*****	36.0
19.4	70.5	55.5	*****	1.8	15.5	9.3	69.6	103.6	4201.9	*****	*****	*****	36.0
20.9	73.4	59.0	*****	-5	15.0	8.8	72.5	106.9	4365.7	*****	*****	*****	36.0
21.4	78.7	*****	*****	-1.8	10.8	7.0	78.1	138.7	5934.4	*****	*****	*****	36.0
24.6	84.1	*****	*****	-4.8		8.3	83.2	88.9	3464.9	*****	*****	*****	36.0
26.1	86.0	*****	*****	-7.3		7.8	85.2	98.2	3929.3	*****	*****	*****	36.0
27.9	86.0	*****	*****	-32.0		7.5	85.3	105.6	4301.3	*****	*****	*****	36.0
30.7	88.0	*****	*****	-26.0		8.3	87.1	77.8	2907.0	*****	*****	*****	36.0
31.5	88.4	*****	*****	-34.3		7.0	87.8	114.6	4749.9	*****	*****	*****	36.0
34.3	97.2	*****	*****	-37.5		7.8	96.3	68.1	2422.0	*****	*****	*****	36.0
36.1	98.2	*****	*****	-37.8		7.5	97.3	73.9	2715.5	*****	*****	*****	36.0
38.2	106.9	*****	*****	-37.5		7.5	106.0	49.5	1573.7	*****	*****	*****	36.0

DISTANCE BARGE TRAVELLED 38.0
DISTANCE ANCHOR TRAVELLED 38.2

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN

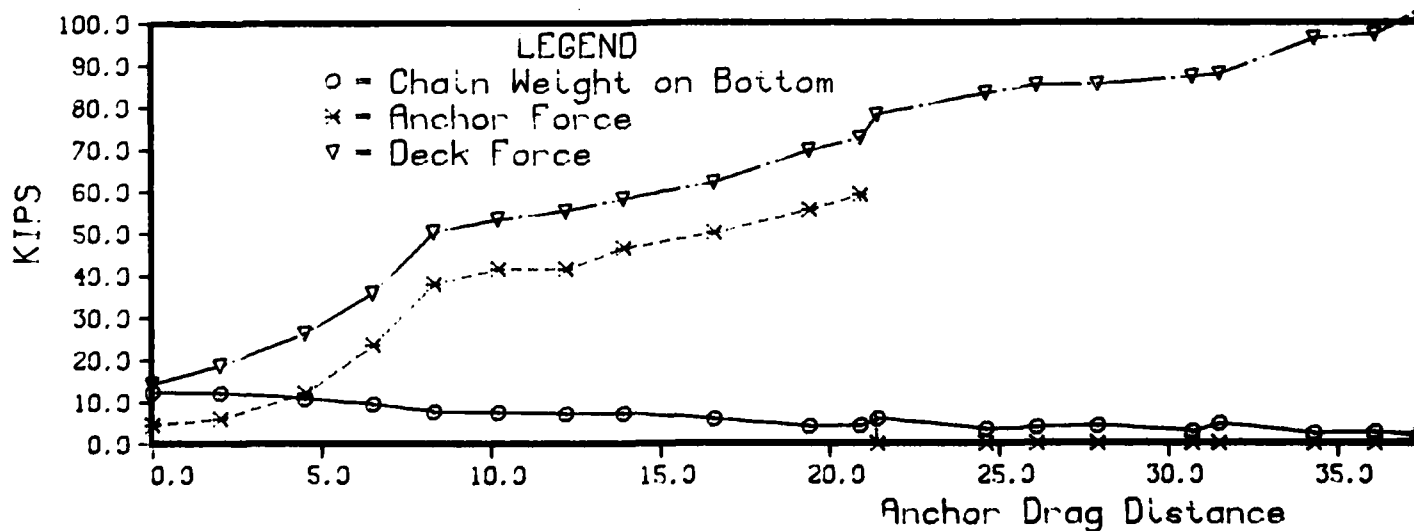
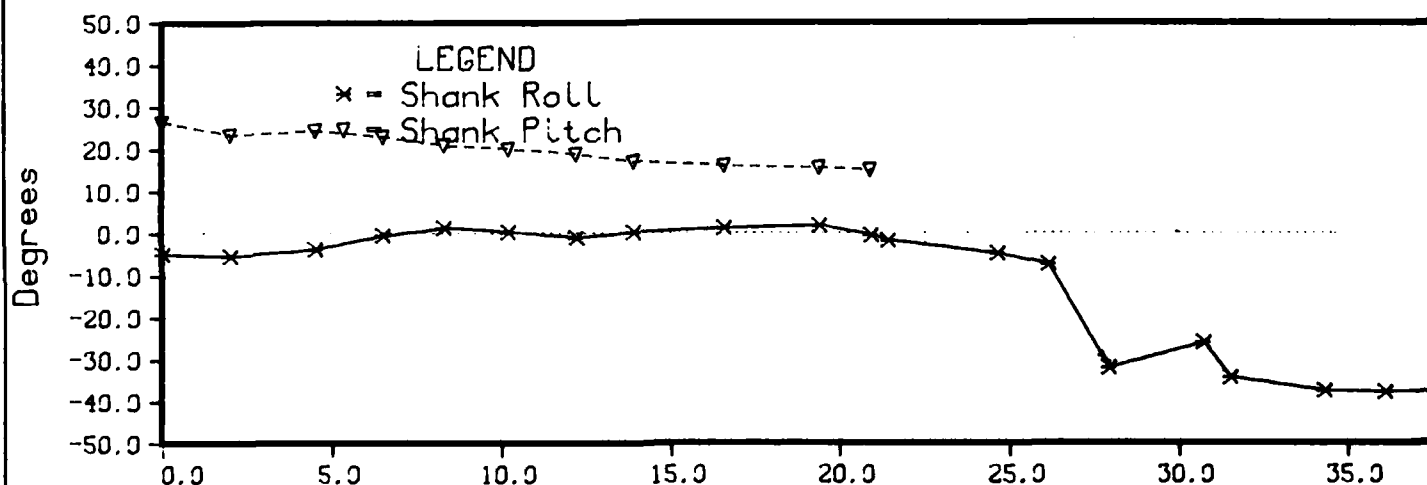
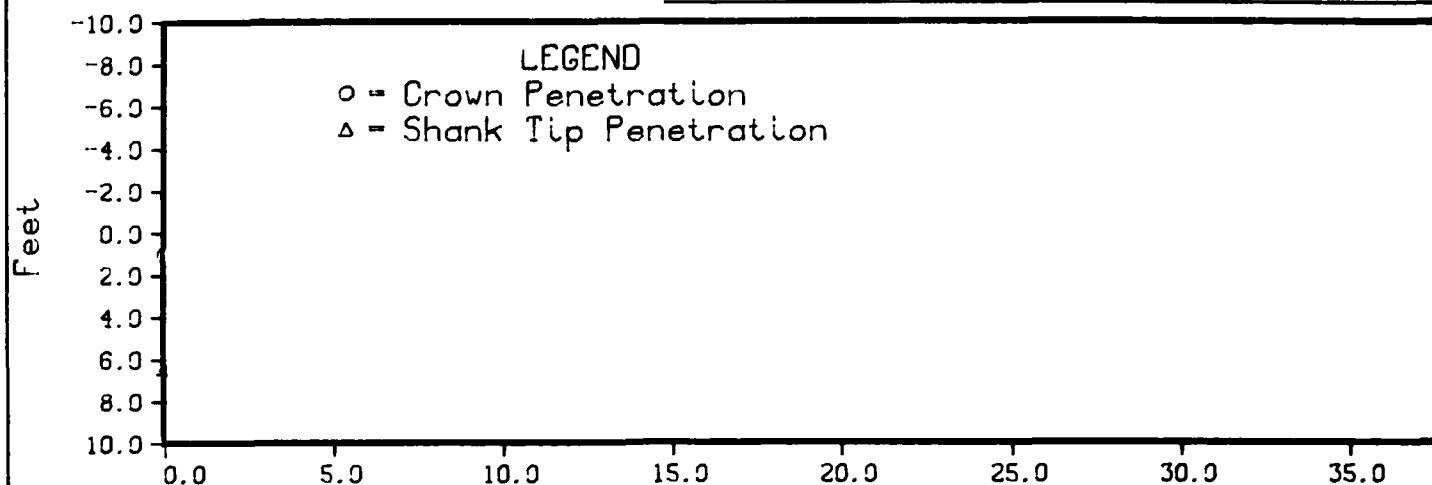
Day # - 87

INNER APRA HARBOR, GUAM.

Test No. - 19

stato 6000 lbs, normal stabilized,

Test Series No. - 0



2

APRA HARBOR, GUAM.

stato 6000 lbs, normal stabilized, 34 deg movable flukes

LEGEND

Penetration

Tip Penetration

0.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0

END

* Roll

* Pitch

10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0

LEGEND

n Weight on Bottom

or Force

Force

10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0

Anchor Drag Distance

STOCKLESS ANCHOR TEST

TEST DATE 88
 TEST NO. 20
 TEST RUN 0
 TEST AREA INNER APRA HARBOR, GUAM.
 START-END TIMES 1250 - 1307
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 20000 LBS STABILIZED, 48 DEG FIXED FLUKES
 ANCHOR WEIGHT 22000.00 LB.
 FLUKE ANGLE-TYPE, 48.00 DEG. - 1 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
 186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH
 2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH
 3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT
 4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	19.4	*****	*****	*****	*****	12.0	19.5	273.5	11386.3	*****	*****	*****	35.
2.0	27.7	*****	*****	*****	*****	11.0	27.2	245.2	10243.4	*****	*****	*****	35.
4.2	64.6	*****	*****	*****	*****	9.5	63.7	116.8	4861.1	*****	*****	*****	35.
6.1	71.4	*****	*****	*****	*****	9.3	71.0	98.9	3967.6	*****	*****	*****	35.
8.5	76.3	*****	*****	*****	*****	9.5	75.3	78.3	2936.1	*****	*****	*****	35.
9.7	78.7	*****	*****	*****	*****	8.8	77.8	90.7	3552.5	*****	*****	*****	35.
11.2	97.2	*****	*****	*****	*****	8.0	96.3	59.7	2001.9	*****	*****	*****	35.
13.4	93.3	*****	*****	*****	*****	8.3	92.3	62.5	2140.0	*****	*****	*****	35.
15.2	98.7	*****	*****	*****	*****	8.0	97.7	55.6	1799.0	*****	*****	*****	35.
17.2	98.7	*****	*****	*****	*****	8.0	97.7	55.6	1799.0	*****	*****	*****	35.
19.4	110.8	*****	*****	*****	*****	8.0	109.7	3.4	108.1	*****	*****	*****	35.
21.6	120.5	*****	*****	*****	*****	8.0	119.4	0.0	0.0	*****	*****	*****	35.

NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 21.6 FEET

DISTANCE BARGE TRAVELLED 22.0
 DISTANCE ANCHOR TRAVELLED 21.6

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

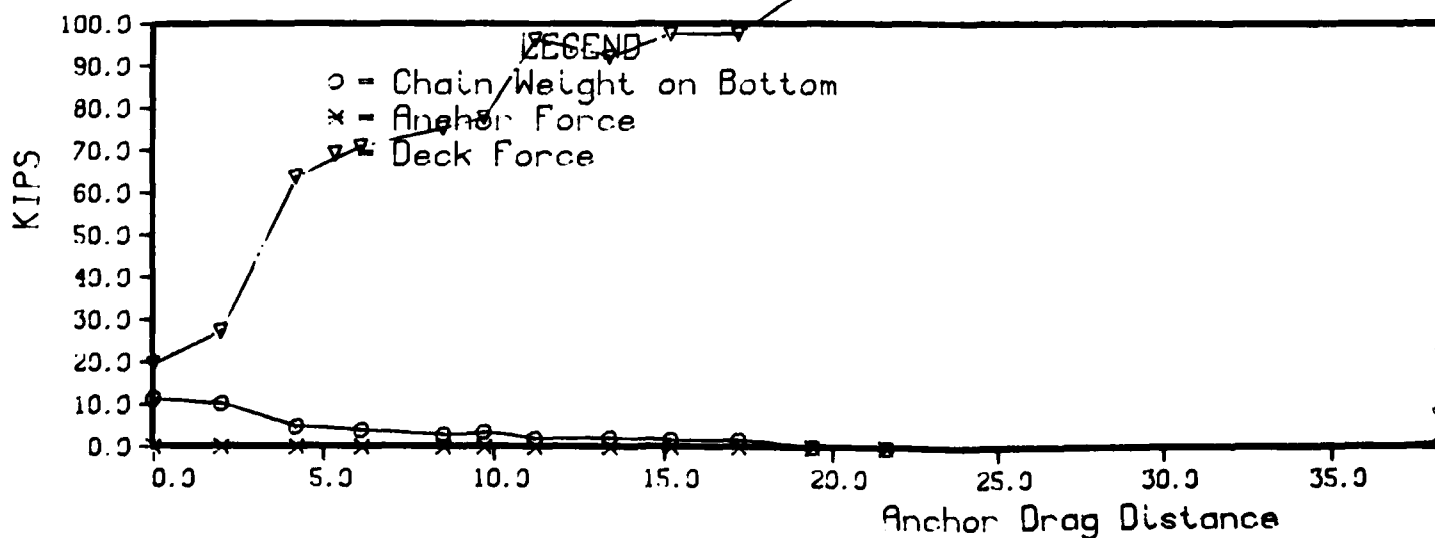
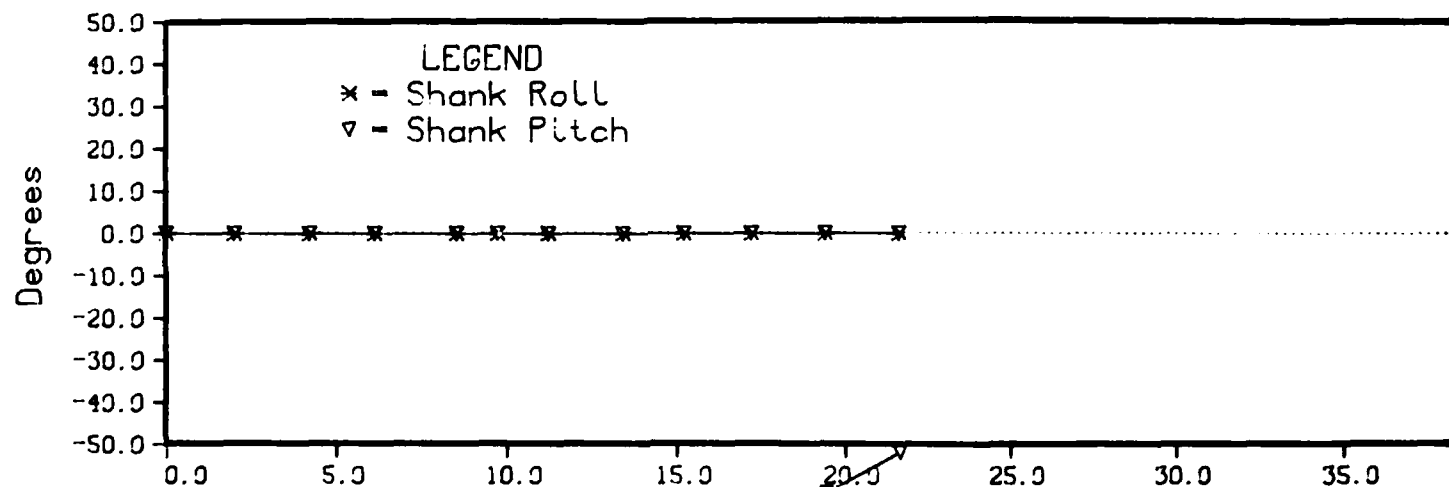
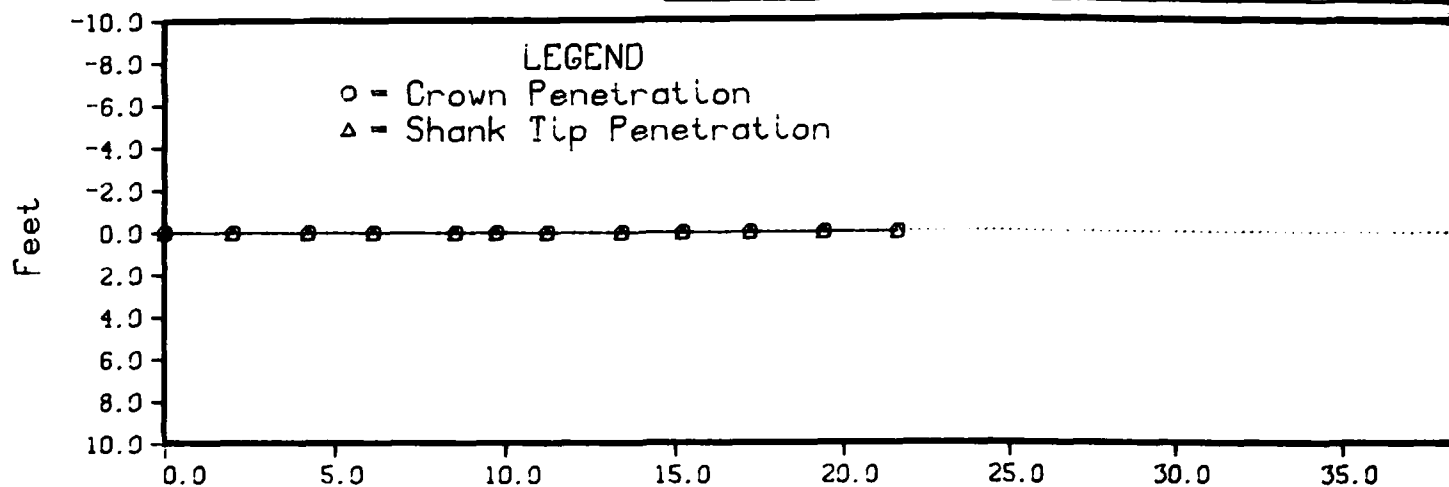
Day # - 88

INNER APRA HARBOR, GUAM.

Test No. - 20

stockless 20000 lbs stabilized, 48 deg

Test Series No. - 0

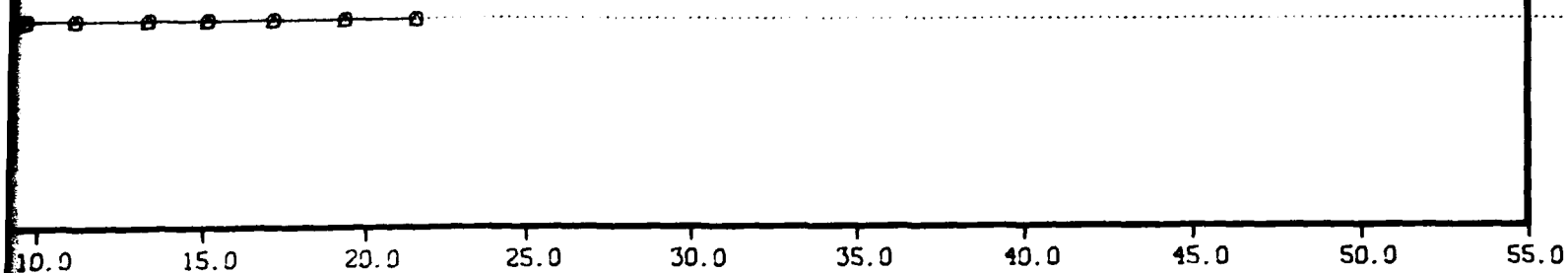


APRA HARBOR, GUAM.

stockless 20000 lbs stablized, 48 deg fixed flukes

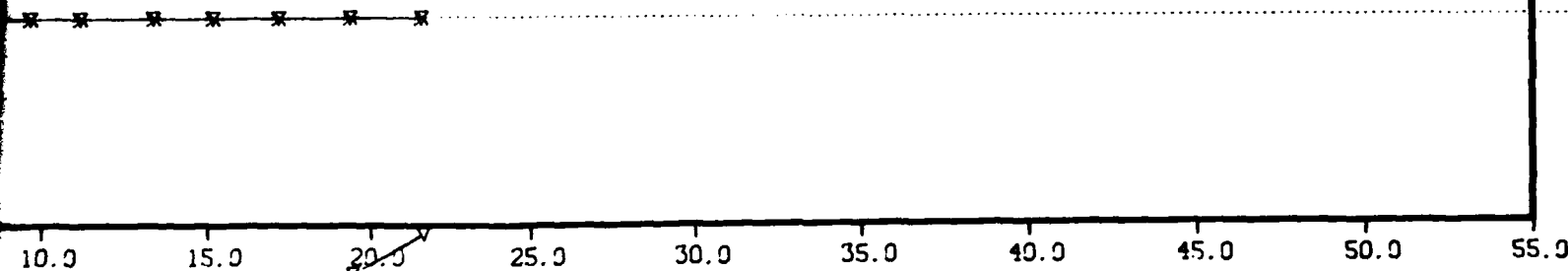
LEGEND

h Penetration
x Tip Penetration



END

nk Roll
nk Pitch



LEGEND

in Weight on Bottom
her Force
k Force



Anchor Drag Distance

STOCKLESS ANCHOR TEST

TEST DATE 88
 TEST NO. 21
 TEST RUN 0
 TEST AREA INNER APRA HARBOR, GUAM.
 START-END TIMES 1427 - 1445
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 20000 LBS STABILIZED, 48 DEG FIXED FLUKES
 ANCHOR WEIGHT 22000.00 LB.
 FLUKE ANGLE-TYPE, 48.00 DEG. - 1 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
 186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	19.0	*****	*****	*****	*****	13.3	18.4	268.5	11184.9	*****	*****	*****	35.0
2.0	24.3	*****	*****	*****	*****	13.0	23.7	240.8	10062.9	*****	*****	*****	35.0
4.0	29.2	*****	*****	*****	*****	12.5	28.5	219.9	9217.9	*****	*****	*****	35.0
6.7	36.4	*****	*****	*****	*****	12.5	35.6	180.9	7640.1	*****	*****	*****	35.0
8.1	53.5	*****	*****	*****	*****	11.3	52.4	121.5	5099.9	*****	*****	*****	35.0
8.7	57.3	*****	*****	*****	*****	10.0	56.5	130.9	5571.0	*****	*****	*****	35.0
10.9	63.2	*****	*****	*****	*****	10.0	62.2	110.7	4558.4	*****	*****	*****	35.0
12.8	68.5	*****	*****	*****	*****	9.8	67.5	98.1	3924.6	*****	*****	*****	35.0
14.9	71.9	*****	*****	*****	*****	9.8	70.9	86.6	3348.5	*****	*****	*****	35.0
16.6	82.6	*****	*****	*****	*****	9.3	81.5	64.6	2249.0	*****	*****	*****	35.0
18.6	98.2	*****	*****	*****	*****	9.0	97.0	5.4	172.1	*****	*****	*****	35.0
20.8	51.5	*****	*****	*****	*****	10.3	50.7	149.3	6362.4	*****	*****	*****	35.0
22.9	53.5	*****	*****	*****	*****	10.3	52.6	140.8	6016.5	*****	*****	*****	35.0
24.9	62.7	*****	*****	*****	*****	10.0	61.7	112.4	4642.7	*****	*****	*****	35.0
28.8	53.0	*****	*****	*****	*****	11.8	51.9	114.4	4741.7	*****	*****	*****	35.0
28.9	64.1	*****	*****	*****	*****	10.0	63.2	107.4	4389.6	*****	*****	*****	35.0
30.6	63.2	*****	*****	*****	*****	9.8	62.3	116.2	4829.9	*****	*****	*****	35.0
33.1	68.5	*****	*****	*****	*****	10.0	67.5	92.2	3630.1	*****	*****	*****	35.0
36.6	39.4	*****	*****	*****	*****	12.3	38.5	169.4	7176.8	*****	*****	*****	35.0
38.2	44.2	*****	*****	*****	*****	11.8	43.3	153.3	6523.1	*****	*****	*****	35.0
39.0	58.3	*****	*****	*****	*****	10.3	57.4	122.6	5151.8	*****	*****	*****	35.0
40.8	81.6	*****	*****	*****	*****	9.5	80.5	60.7	2053.7	*****	*****	*****	35.0
42.7	101.6	*****	*****	*****	*****	9.0	100.3	0.0	0.0	*****	*****	*****	35.0
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 42.7 FEET													
44.3	82.1	*****	*****	*****	*****	9.0	81.1	73.3	2680.9	*****	*****	*****	35.0
45.1	41.3	*****	*****	*****	*****	9.0	40.8	216.2	9067.0	*****	*****	*****	35.0

DISTANCE BARGE TRAVELLED 48.0
 DISTANCE ANCHOR TRAVELLED 45.1

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

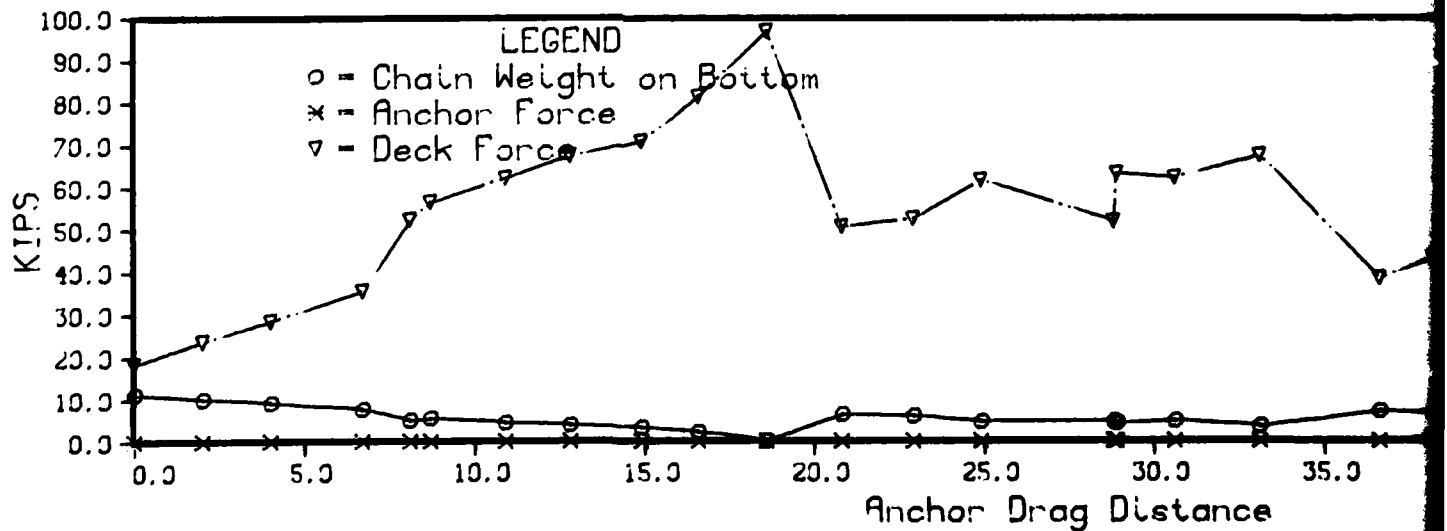
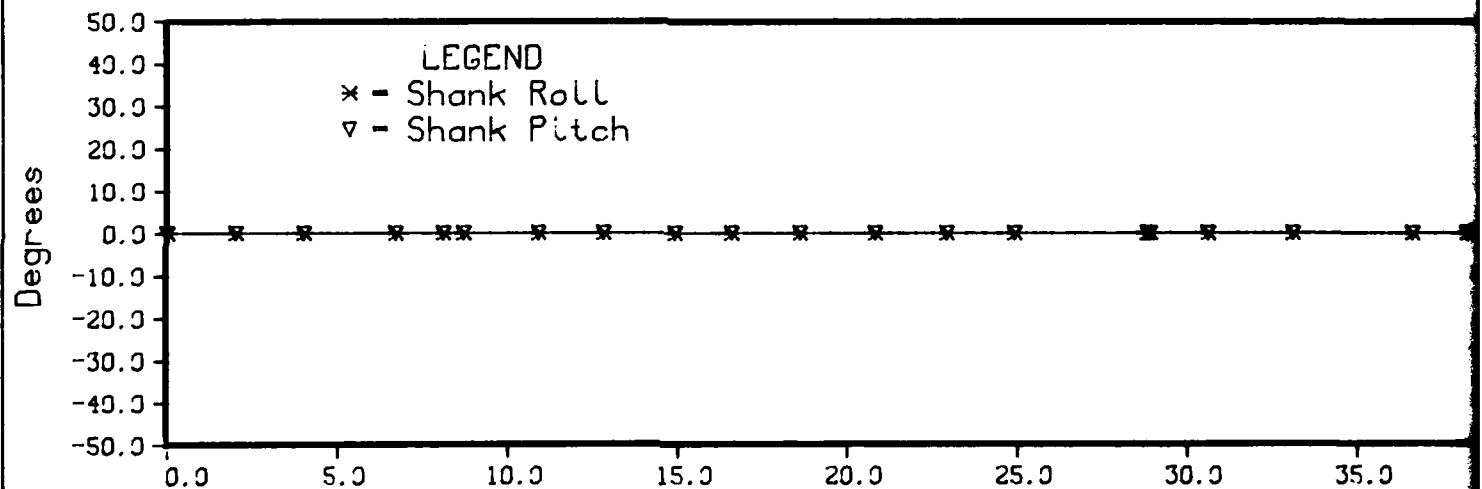
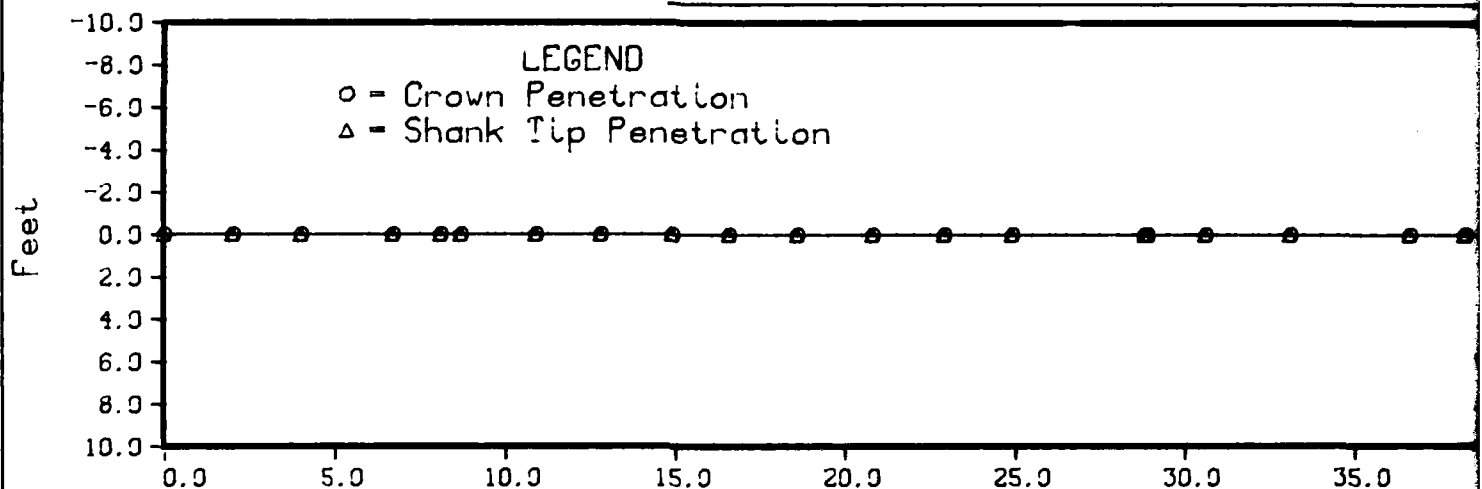
Day # - 88

INNER APRA HARBOR, GUAM.

Test No. - 21

stockless 20000 lbs stablized, 48 deg f

Test Series No. - 0



15
LBS
33184.9
32062.9
31217.9
29640.1
27099.9
27571.0
26558.4
25924.6
25348.5
24249.0
22172.1
28362.4
28016.5
26642.7
26741.7
26389.6
26829.9
25630.1
29176.8
28523.1
27151.8
24053.7
22000.0

24680.9
31067.0

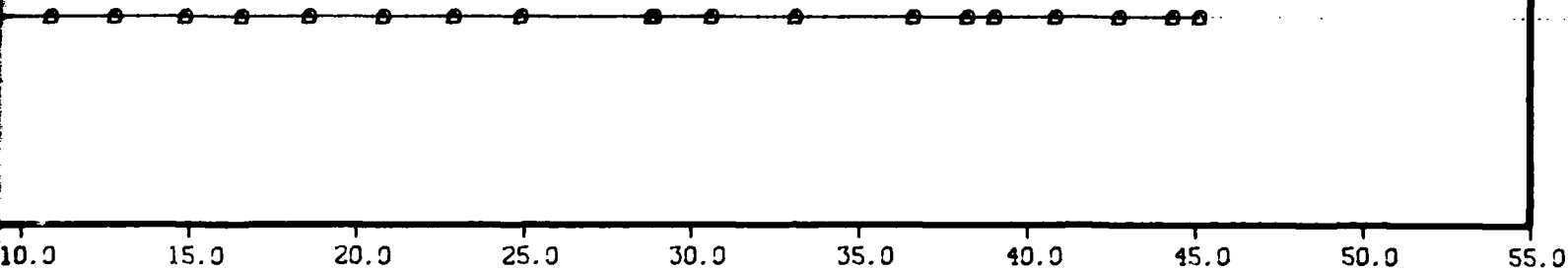
2

R APRA HARBOR, GUAM.

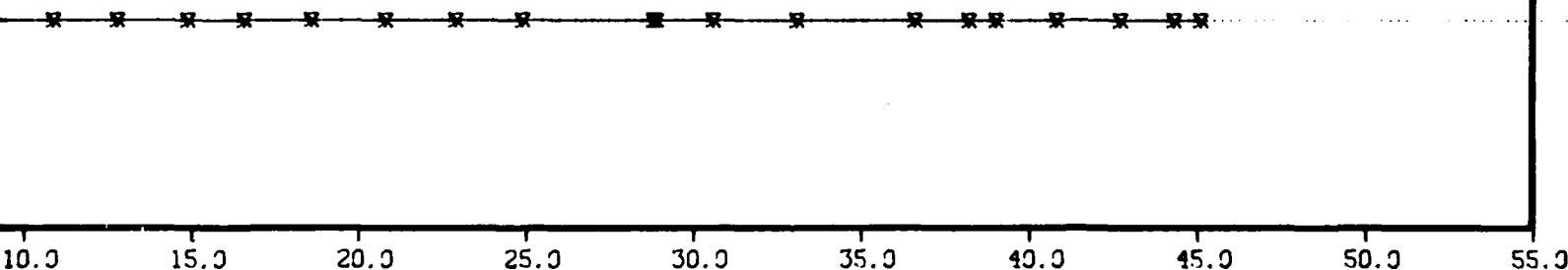
stockless 20000 lbs stabilized, 48 deg fixed flukes

LEGEND

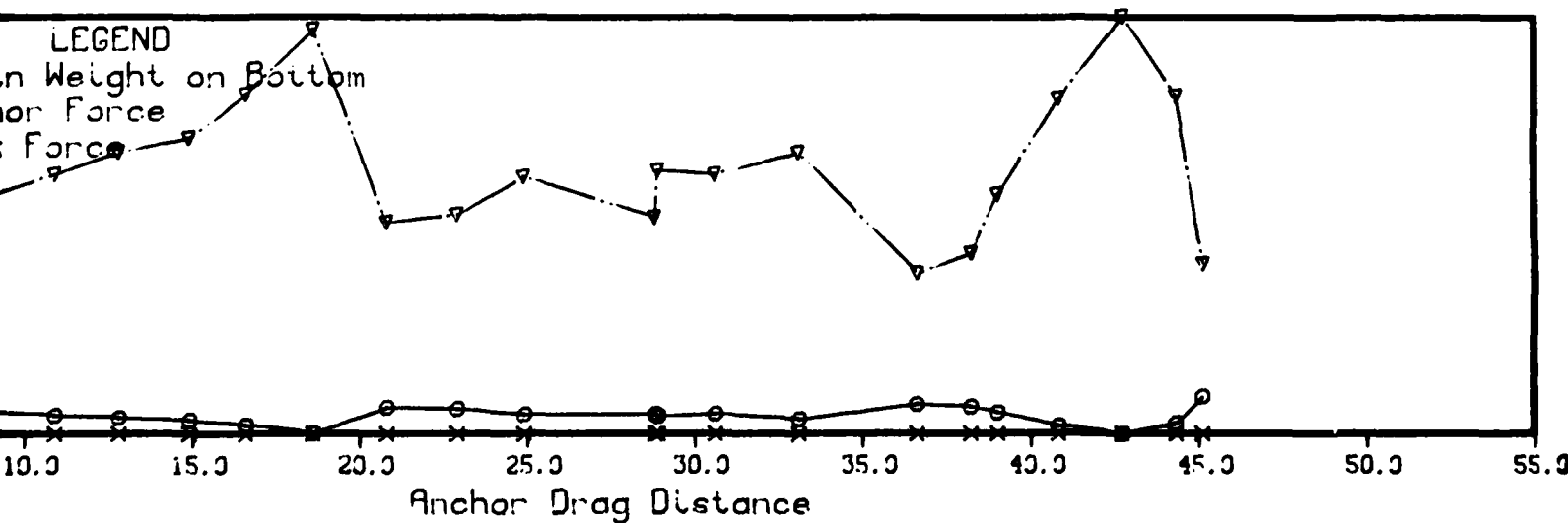
Penetration
Tip Penetration



END
Roll
Pitch



LEGEND
Weight on Bottom
Anchor Force
Force



STOCKLESS ANCHOR TEST

TEST DATE 88
 TEST NO. 22
 TEST RUN 0
 TEST AREA INNER APRA HARBOR, GUAM.
 START-END TIMES 1615 - 1630
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 20000 LBS STABILIZED, 48 DEG MOVABLE FLUKES
 ANCHOR WEIGHT 22000.00 LB.
 FLUKE ANGLE-TYPE, 48.00 DEG. - 0 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
 186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	1
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FE
0.0	23.8	*****	*****	*****	*****	12.3	23.3	251.0	10476.4	*****	*****	*****	36
2.0	47.6	*****	*****	*****	*****	10.3	46.4	166.4	7054.3	*****	*****	*****	36
4.1	65.1	*****	*****	*****	*****	9.8	64.2	109.6	4500.7	*****	*****	*****	36
6.6	83.1	*****	*****	*****	*****	9.8	81.9	45.8	1455.6	*****	*****	*****	36
8.5	94.8	*****	*****	*****	*****	9.5	93.5	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 8.5 FEET													
10.9	63.2	*****	*****	*****	*****	10.5	62.1	99.9	4015.8	*****	*****	*****	36
12.8	78.2	*****	*****	*****	*****	10.0	77.1	58.5	1942.3	*****	*****	*****	36
14.9	83.6	*****	*****	*****	*****	10.0	82.3	31.9	1014.0	*****	*****	*****	36
16.9	97.7	*****	*****	*****	*****	9.8	96.3	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 16.9 FEET													
18.1	105.9	*****	*****	*****	*****	9.0	104.6	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 18.1 FEET													
19.8	107.4	*****	*****	*****	*****	8.8	106.2	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 19.8 FEET													
22.6	84.1	*****	*****	*****	*****	9.8	82.9	40.6	1291.0	*****	*****	*****	36
24.6	84.1	*****	*****	*****	*****	9.8	82.9	40.6	1291.0	*****	*****	*****	36
27.3	85.0	*****	*****	*****	*****	10.3	83.7	12.4	395.5	*****	*****	*****	36
29.0	116.1	*****	*****	*****	*****	9.5	114.6	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 29.0 FEET													
29.2	107.9	*****	*****	*****	*****	8.3	106.8	1.5	47.9	*****	*****	*****	36
32.3	117.6	*****	*****	*****	*****	9.0	116.2	0.0	0.0	*****	*****	*****	36
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 32.3 FEET													

DISTANCE BARGE TRAVELLED 32.0
 DISTANCE ANCHOR TRAVELLED 32.3

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

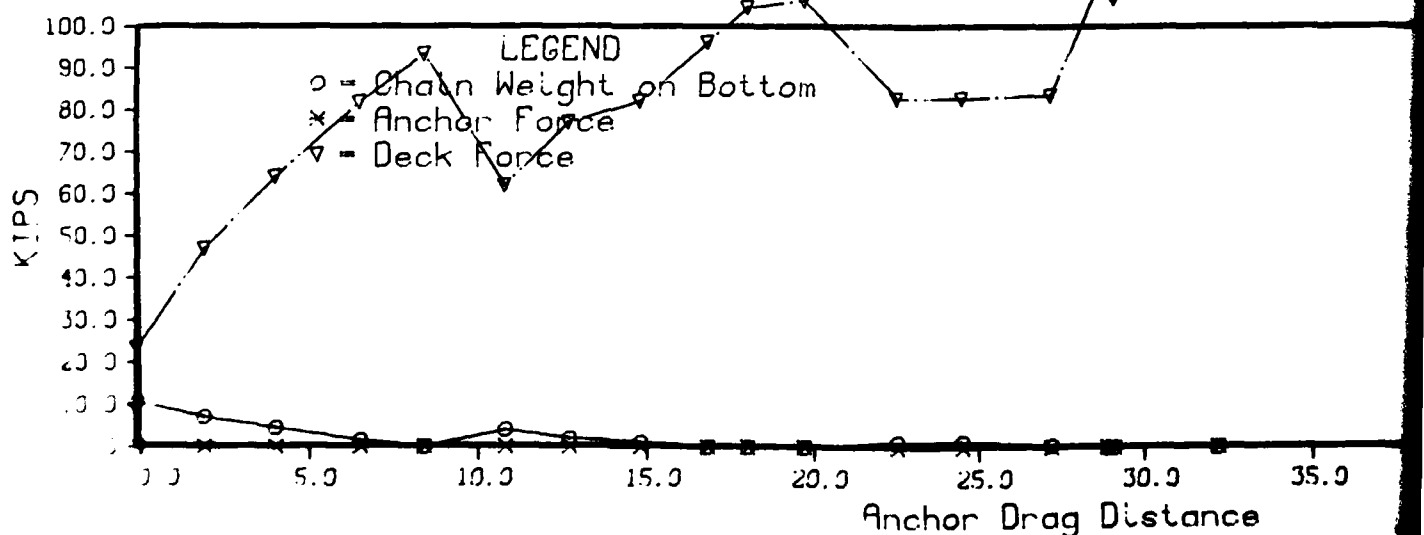
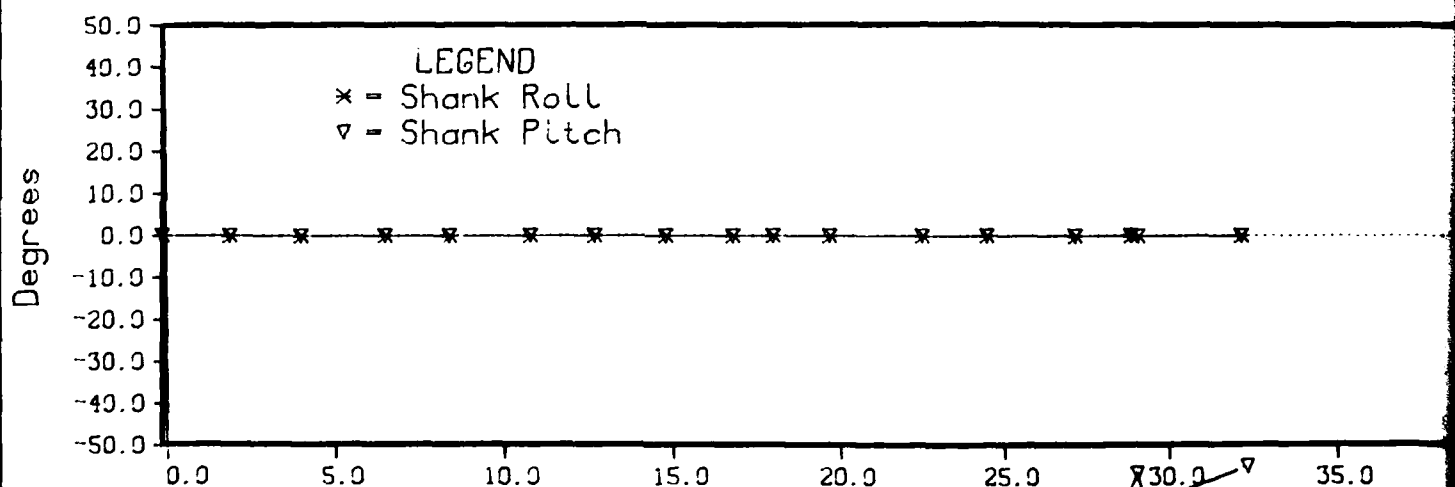
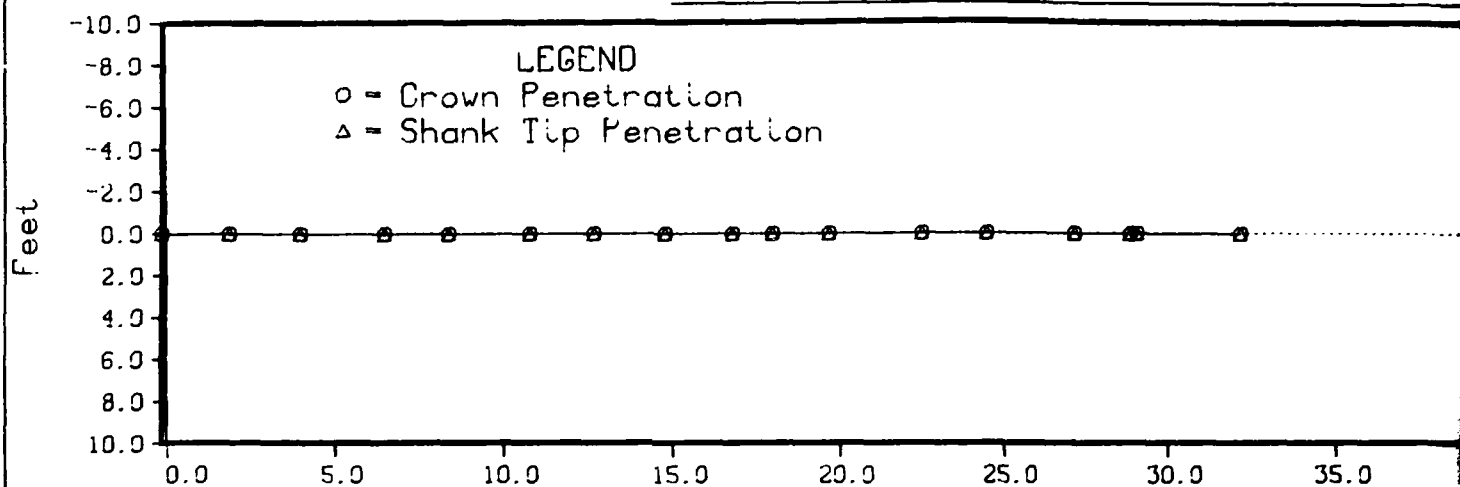
Day # - 88

INNER APRA HARBOR, GUAM.

Test No. - 22

Test Series No. - 0

stockless 20000 lbs stabilized, 48 deg m



15
LBS
32476.4
29054.3
26500.7
23455.6
22000.0

26015.8
23942.3
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22000.0

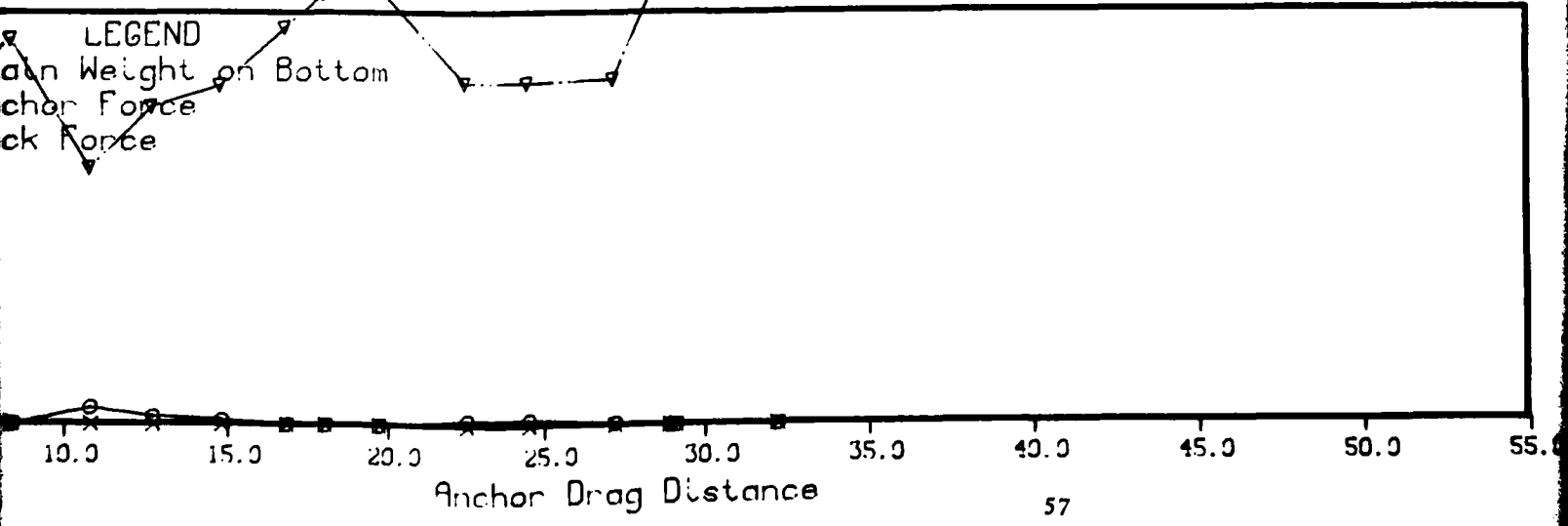
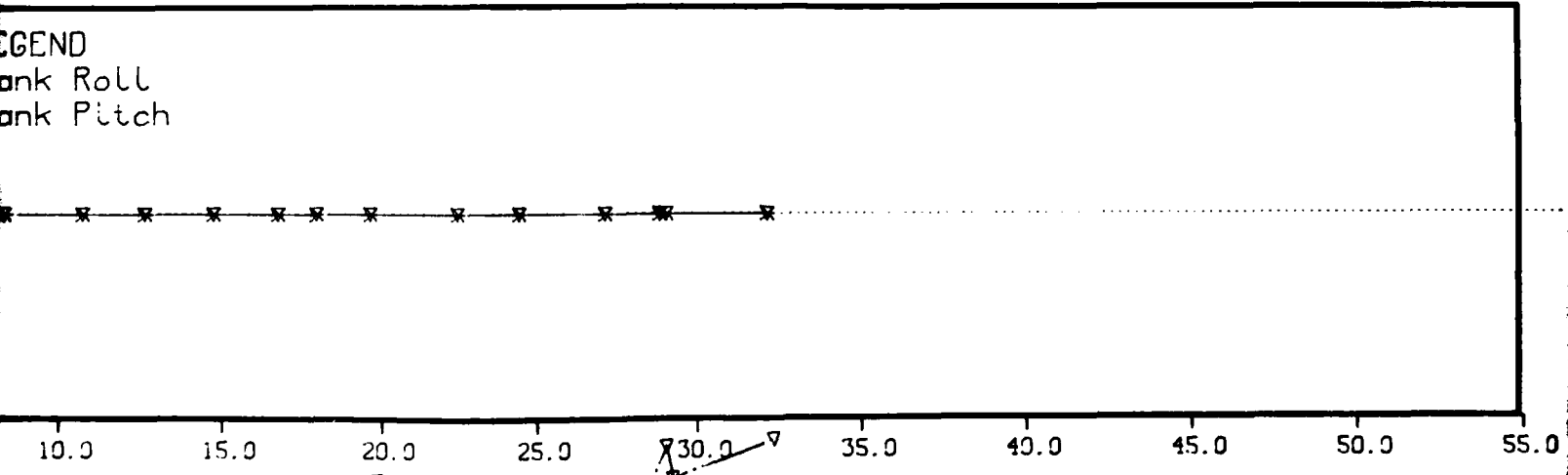
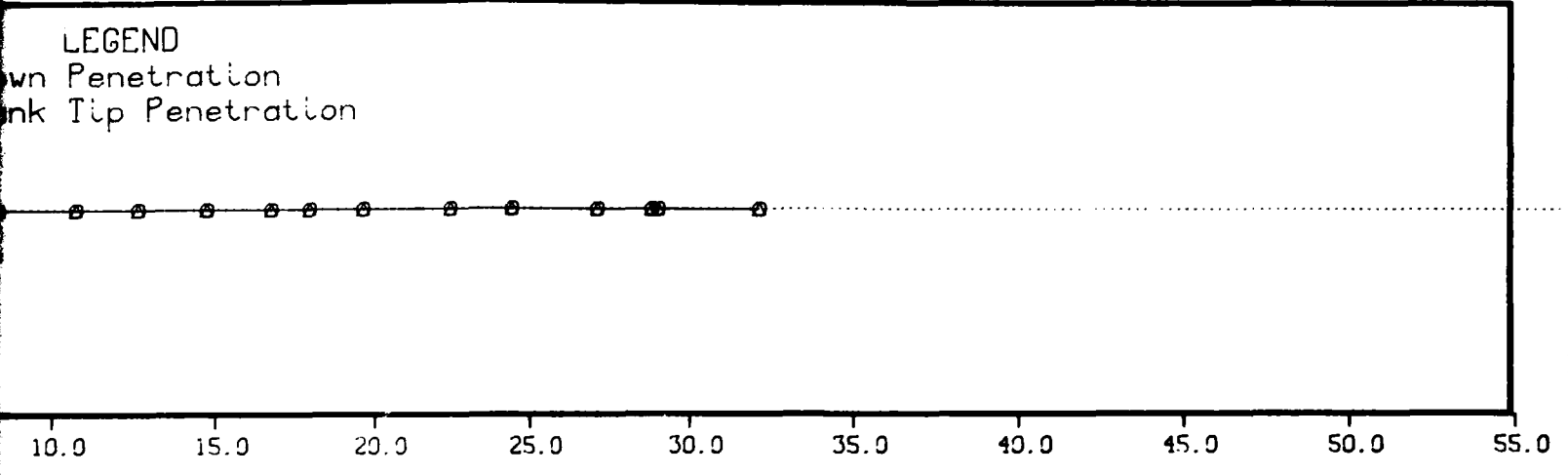
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23291.0
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22047.9
22000.0

ER APRA HARBOR, GUAM.

stockless 20000 lbs stablized, 48 deg movable flukes



STOCKLESS ANCHOR TEST

TEST DATE 88
 TEST NO. 23
 TEST RUN 0
 TEST AREA INNER APRA HARBOR, GUAM.
 START-END TIMES 1635 - 1650
 SEAFLOOR TYPE
 ANCHOR TYPE STOCKLESS 20000 LBS STABILIZED, 48 DEG MOVABLE FLUKES
 ANCHOR WEIGHT 22000.00 LB.
 FLUKE ANGLE-TYPE, 48.00 DEG. - 0 0=MOV 1=FIX
 MOORING LINE DESCRIPTION 54 FT. 2.0 IN. CHAIN, 82 FT. 2.5 IN. CHAIN,
 186 FT. 2.25 IN. CHAIN, 340 FT. 2.0 IN. IWRC ROPE.

- | | | | |
|-------------------|----------------------|----------------------------|----------------------------|
| 1. DRAG DISTANCE | 5. ROTATION ANGLE | 9. CHAIN LENGTH ON BOTTOM | 13. ANCHOR FLUKE TIP DEPTH |
| 2. DECK TENSION | 6. SHANK ANGLE | 10. CHAIN WEIGHT ON BOTTOM | 14. WATER DEPTH |
| 3. ANCHOR TENSION | 7. WIRE ROPE ANGLE | 11. ANCHOR CROWN DEPTH | 15. TOTAL BOTTOM WEIGHT |
| 4. PACKAGE DEPTH | 8. DECK HORIZ. FORCE | 12. ANCHOR SHANK TIP DEPTH | |

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET
0.0	39.4	*****	*****	*****	*****	10.8	38.7	194.4	8186.6	*****	*****	*****	36.5
2.0	45.2	*****	*****	*****	*****	10.8	44.4	167.5	7098.8	*****	*****	*****	36.5
4.0	66.6	*****	*****	*****	*****	10.0	65.6	98.9	3967.6	*****	*****	*****	36.5
5.5	71.9	*****	*****	*****	*****	9.5	70.9	92.8	3657.9	*****	*****	*****	36.5
7.7	78.7	*****	*****	*****	*****	9.5	77.6	70.3	2535.0	*****	*****	*****	36.5
9.8	84.1	*****	*****	*****	*****	9.5	82.9	52.0	1652.7	*****	*****	*****	36.5
11.7	90.9	*****	*****	*****	*****	9.3	89.7	29.0	921.0	*****	*****	*****	36.5
13.8	96.7	*****	*****	*****	*****	9.3	95.5	0.0	0.0	*****	*****	*****	36.5
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 13.8 FEET													
14.1	98.2	*****	*****	*****	*****	8.3	97.2	45.4	1442.6	*****	*****	*****	36.5
16.3	107.4	*****	*****	*****	*****	7.8	106.9	30.8	980.3	*****	*****	*****	36.5
18.3	111.8	*****	*****	*****	*****	7.8	110.8	14.3	456.0	*****	*****	*****	36.5
20.3	112.3	*****	*****	*****	*****	7.8	111.2	12.3	390.4	*****	*****	*****	36.5
22.5	116.6	*****	*****	*****	*****	8.0	115.5	0.0	0.0	*****	*****	*****	36.5
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 22.6 FEET													
24.7	121.5	*****	*****	*****	*****	8.0	120.3	0.0	0.0	*****	*****	*****	36.5
NOTE- ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 24.7 FEET													

DISTANCE BARGE TRAVELLED 26.0
 DISTANCE ANCHOR TRAVELLED 24.7

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

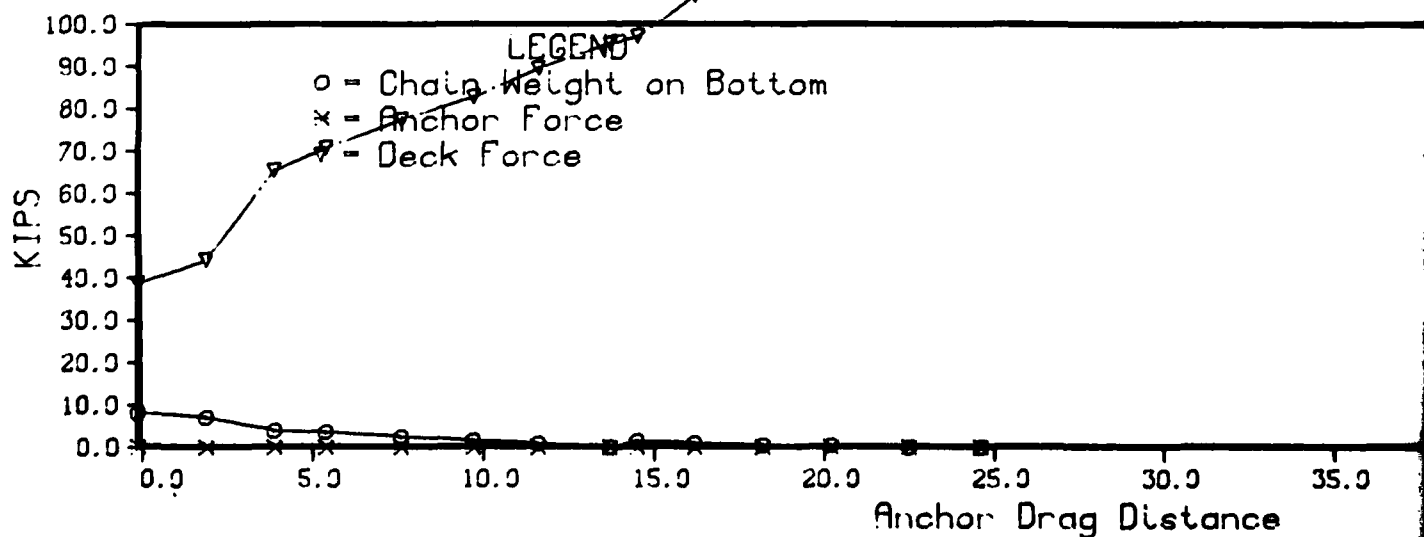
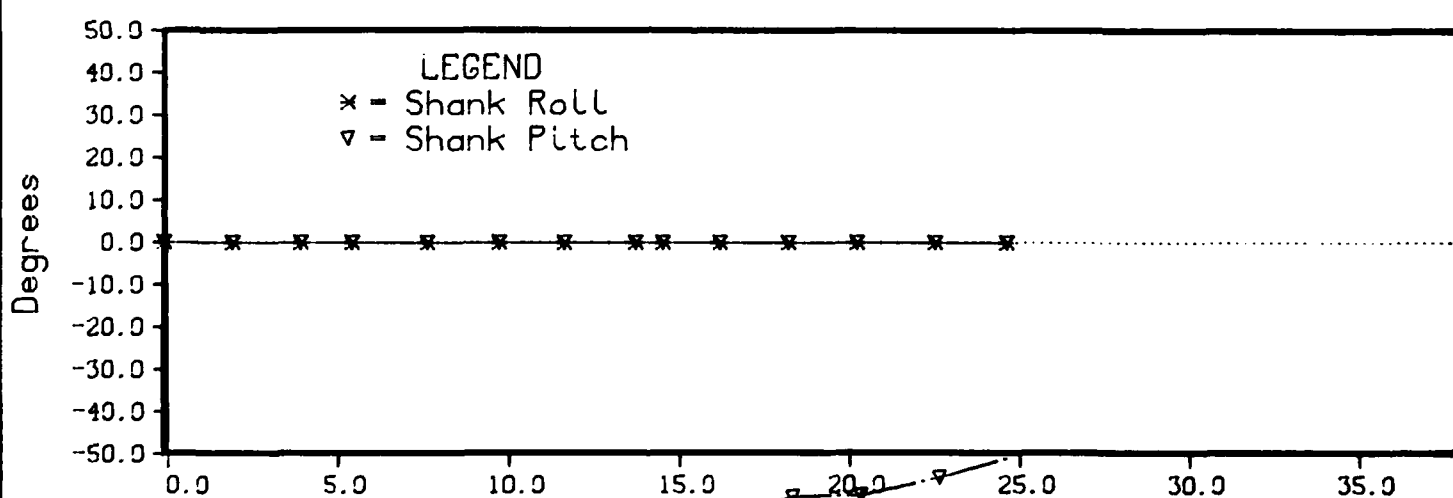
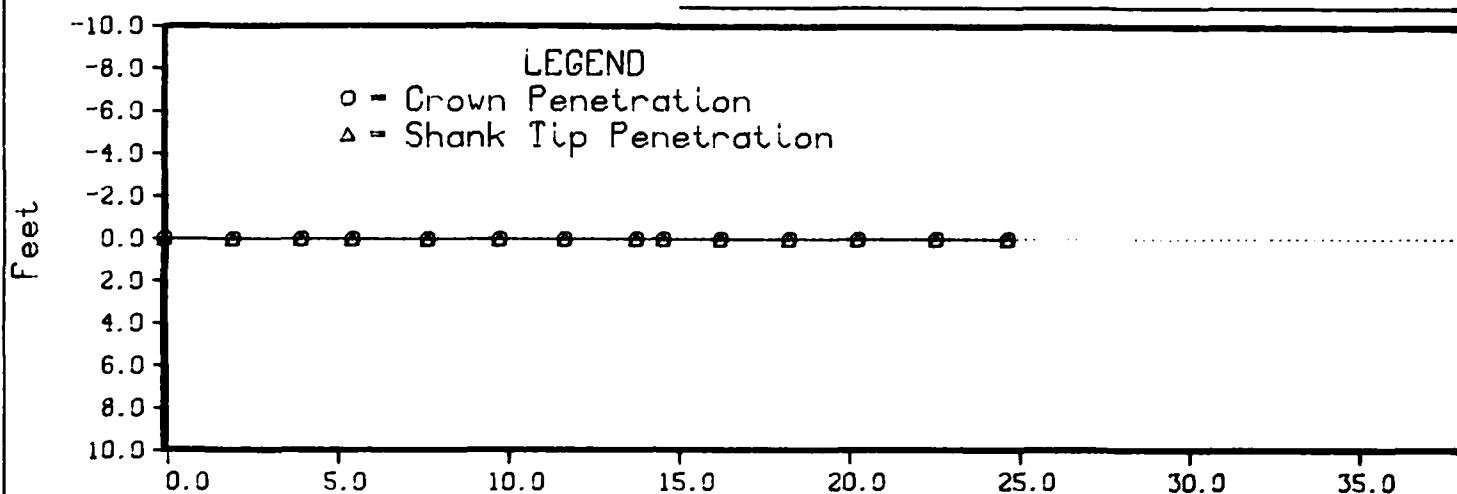
Day # - 88

INNER APRA HARBOR, GUAM.

Test No. - 23

stockless 20000 lbs stabilized, 48 deg

Test Series No. - 0



15
LBS
30186.6
29098.8
25967.6
25657.9
24535.0
23652.7
22921.0
22000.0

23442.6
22980.3
22456.0
22390.4
22000.0

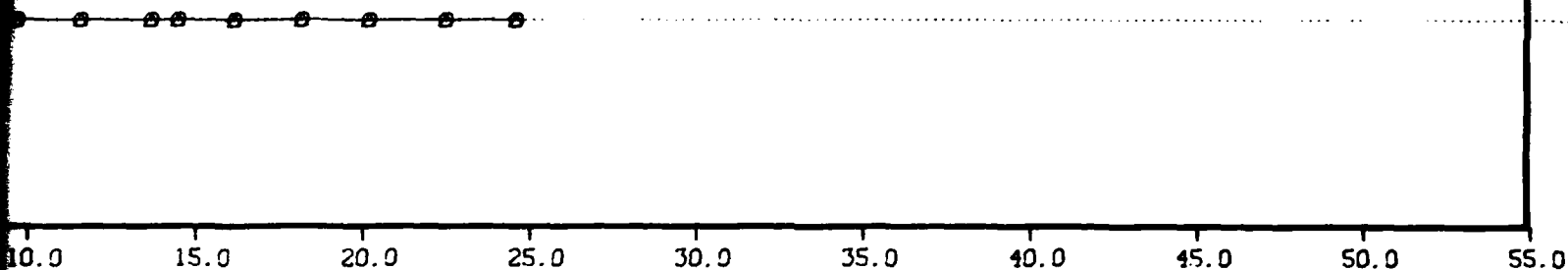
22000.0

APRA HARBOR, GUAM.

stockless 20000 lbs stablized, 48 deg movable flukes

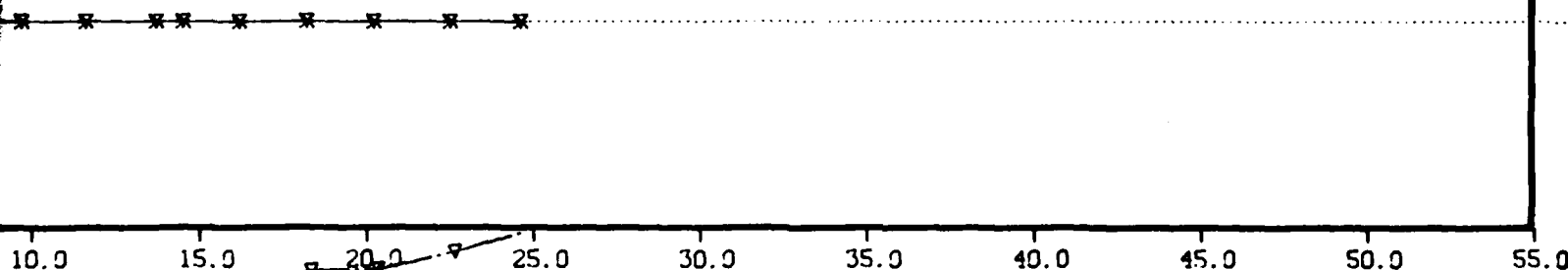
LEGEND

- Penetration
- Tip Penetration



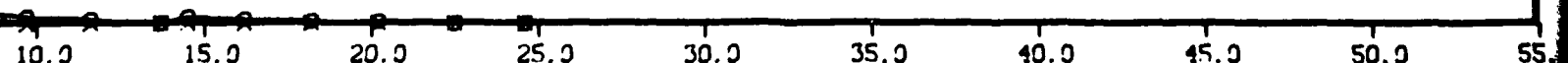
END

- Roll
- Pitch



LEGEND

- Weight on Bottom
- Horizontal Force
- Vertical Force



Anchor Drag Distance

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