Report No. CG-D-27-97

49-FT Boat Utility Stern Loading (BUSL) (49403 Underway Testing)

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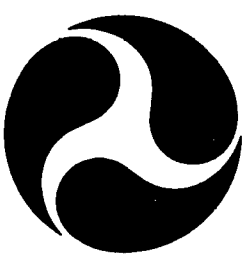

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16. Abstract

Sea trials were conducted on the first production 49-FT BUSL (49403) in August and September of 1997. The trials consisted of speed/power, tactical measurements, spiral maneuver, zig zag maneuvers, bollard pull, noise and vibration survey, endurance test, emergency stop, scale weighing, and an initial corrosion survey. The BUSL met all of its on-board noise requirements. The steering trials demonstrated that the 49403 had very good directional stability and good rudder responsiveness. It was determined that little additional speed was gained for the fuel expended when running at engine rpms above 2300 rpm. Derating the engine from 2500 to 2300 rpm will save fuel costs while retaining a top speed of 10 knots. The 49403 achieved a bollard pull of 11,000 lbs. and 8,300 lbs. when pulling from the aft and the bow, respectively.

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METRIC CONVERSION FACTORS

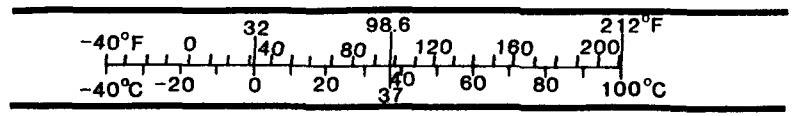
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	* 2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	*kilometers*	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	*square kilometers*	km^2
	acres	0.4	hectares	ha
		MASS (WEIGHT)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	*liters*	*l*
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (EXACT)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly).

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	*meters*	3.3	*feet*	*ft*
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	*square miles*	mi^2
ha	*hectares (10,000 m^2)*	2.5	acres	
		MASS (WEIGHT)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	*cubic meters*	1.3	cubic yards	yd^3
		TEMPERATURE (EXACT)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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ACKNOWLEDGMENTS

Appreciation is expressed to CWO Hummer from G-AWL for providing on-site advice and guidance to the team conducting the underway trials

EXECUTIVE SUMMARY

The Coast Guard Yard has been awarded the construction of ten 49-foot Boat Utility Stern Loading (BUSL) boats by Commandant, US Coast Guard (G-AWL). The BUSL is a stern loading buoy tender that is replacing the aging 46-foot BUSLs. The Coast Guard Yard conducted underway trials in August and September 1997 on its first production 49403 BUSL to demonstrate that it met the requirements of the BUSL production specification. The R&D Center provided ship Test & Evaluation (T&E) support in a number of areas. The trials consisted of the following: speed/power, tactical measurements, spiral maneuver, zig zag maneuver, bollard pull, noise and vibration measurements, endurance test, emergency stop, scale weighing, and an initial corrosion survey.

The BUSL met all of its on-board noise requirements. Its far field noise Sound Pressure Level (SPL) was measured as 72 dBA +/- 1 dBA. The far field distance was estimated visually. Stiffeners were added to the 49403 hull plating above the propellers during the sea trials to reduce observed vibration levels. Subsequent vibration measurements indicate that the blade frequency is the dominant excitation source for most of the engine speeds tested.

The 49403 achieved 10 knots at both full load at 2200 rpm and full load plus 16,000 lbs of deck cargo at 2300 rpm. The 49403 is powered by two Cummins engines de-rated to 305 BHP at 2500 rpm. Little additional speed was achieved for the additional fuel expended when running at rpms above 2300. It is recommended, based on the assumption that a maximum speed of 10 knots is required for the BUSL under full load conditions with deck cargo, that the engines be governed to 2300 rpm. This will reduce fuel burn rate by over 30% compared to when running the engines at 2500 rpm. A 300 nm endurance can be achieved at 2300 rpm but not at 2500 rpm. In this engine configuration, it is recommended that operational guidelines limit extreme towing evolutions, e.g., pulling a vessel from aground, to 2200 rpm which was the maximum rpm achievable during the bollard pull.

The BUSL achieved a bollard pull of 11,000 lbs and 8,300 lbs when pulling from aft and from the bow, respectively. The steering trials demonstrate that the BUSL has very good directional stability and good rudder responsiveness. The BUSL passed the crash-stop-reversal test which presents the greatest abuse to the engine. It experienced no engine stalls and took only two and on-half boat lengths in 12 seconds to come to Dead-in-the-Water (DIW). Load cells were used to determine the light ship weight of 30.8 LT with an LCG at 18 feet forward of the Aft Perpendicular (AP). The corrosion survey demonstrated that sufficient sacrificial anodic protection was provided to the boat and its through-fittings although, it was observed that the BUSL's ground was connected to the shore-tie.

It is recommended, after the production run and/or after any significant design changes are made, some standardization trials be performed to verify performance for the operators. Speed/power, limited maneuvering, and noise and vibration checks should be performed after engine modifications, i.e., de-rating and after outfitting of the vessel is completed.

The Coast Guard Yard delivered the 49403 on 30 September, 1997.

1 Introduction

1.1 49-FT BUSL Overview

The stern loading buoy boat project at the Coast Guard (CG) Yard was established to provide up to forty new buoy tending boats as replacements for the Coast Guard's fleet of 45 foot Buoy Boats (BU) and 46 foot Stern Loading Buoy Boats (BUSL) which are reaching the end of their service lives. This effort (at the CG) is a follow-on to a commercial contract which delivered two pre-production boats. The pre-production boats demonstrated the suitability and effectiveness of the basic design of the BUSL for meeting the sponsor's operational requirements. The BUSL performance characteristics are illustrated in Figure 1.

The boats under construction at the CG Yard are essentially the same operationally to the pre-production boats but modified in many areas to improve boat performance and customer acceptance based on pre-production Operational Testing & Evaluation (OT&E) results.

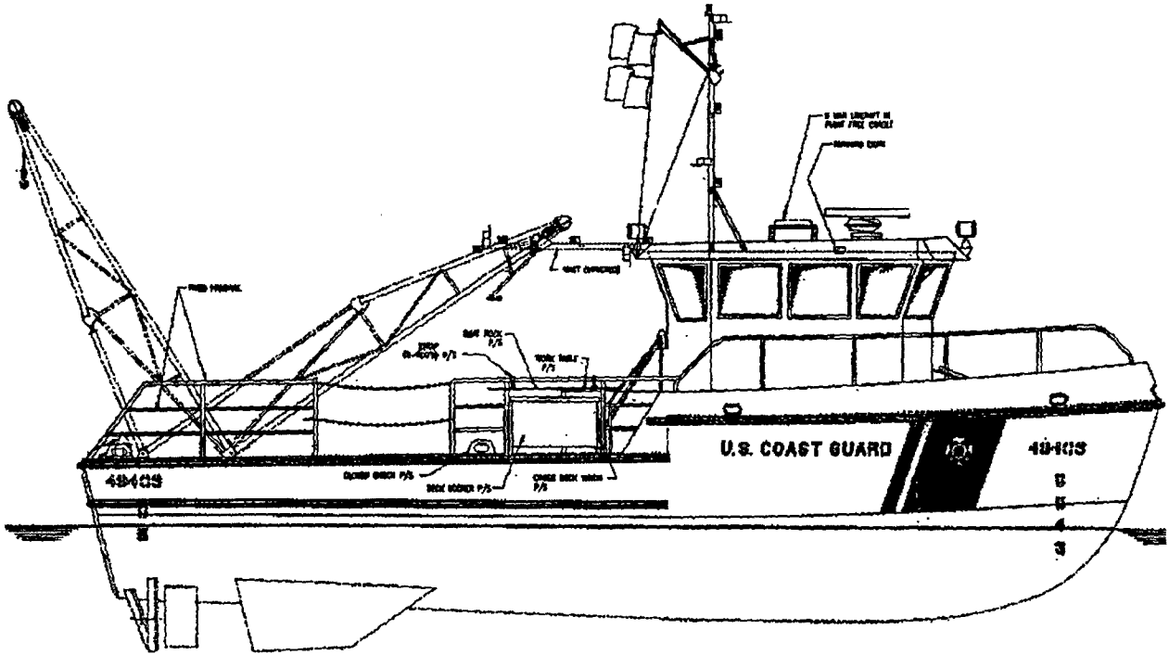
1.2 49403 Testing Requirements

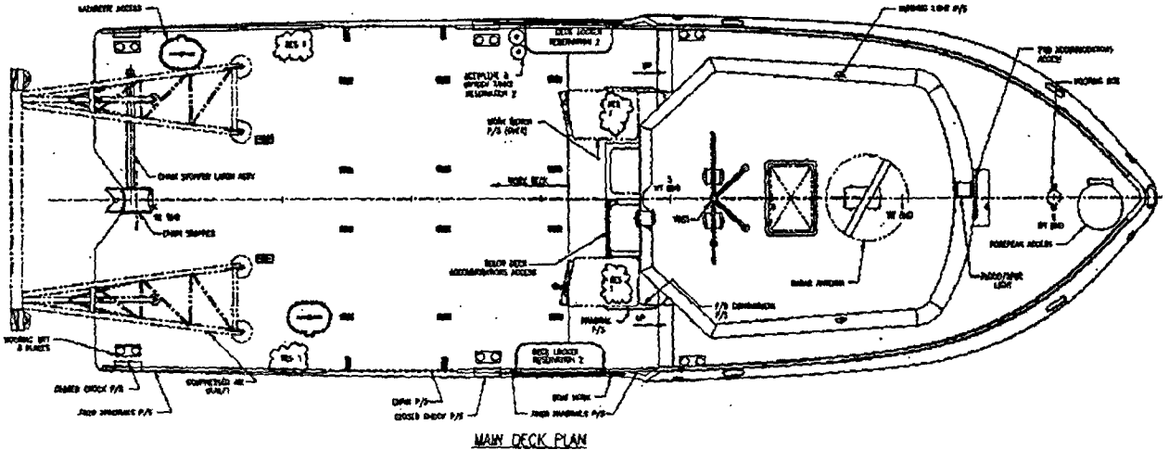
The CG Yard was required to conduct Builder's Trials and Preliminary Acceptance trials to ensure that the boat met the requirements of the BUSL Production Specification. The underway trials and the 49403 results are the subject of this report. The following underway trials were conducted.

Underway Trials

Type	Status
Endurance Trial	Completed
Speed/Power Trial	Completed
Steering Trial	Completed
Emergency Stop	Completed
Bollard Pull	Completed
Noise Survey	Partially Complete*
Dieudonne Spiral	Completed
Buoy Handling	Completed
CO_2 Test	Completed

* noise data were not collected at idle with buoy hydraulics in operation





BUSL Physical Characteristics
Length, molded 49 ft 2.5 in
Beam molded (max) 16 ft 10 in
Depth at midship 6.9 ft
Range at 10 kts (full load) 300NM
Endurance 4 days
Hoist Capacity SWL 4500 lbs
Towing Capacity (min bollard pull) 6000 lbs
Deck load 16k lbs
Propellers, fixed pitch
Accommodations: 4 crew and 3 spare
Weight (light ship) 31.65 long tons
VCG above baseline (max) 6.2 ft
Forward most LCG (max) 20 ft
Aft most LCG (min) 19 ft
Draft, appendage (max) 5.6 ft and freeboard
at transom (max) 3.25 ft

Figure 1 - BUSL Physical Characteristics

The CO_2 and Buoy Handling test results were provided by the CG Yard as separate reports. The noise surveys were planned for underway at full speed and with the main engine at idle with the trolling gear engaged and the buoy hydraulic equipment at maximum load. The buoy hydraulics were not operating on 9 September. Therefore, these data were not collected.

Additional testing support provided by the R&D Center included.

Scale Weighing	Completed
Corrosion Survey	Completed

Under Sections 092 and 094 of the 49-foot BUSL Production Specification, there were a number of tests and trials that the CG Yard was tasked to perform. Additionally, there were some tests and equipment installations that the CG Yard has not historically done without outside assistance. A request for R&D Center support from the CG Yard dated 25 June 1997 asked that the R&D Center provide T&E support in a number of the underway tests of the 49403 BUSL.

1.3 49403 Trial Conditions

Caution was observed to minimize shallow water effects on several of the underway trials. The Society of Naval Architecture and Marine Engineering (SNAME) criterion of,

$$H > 0.4V^2$$

where H is defined as the water depth (m)
where V is defined as speed (m/s).

A minimum depth of 40 feet was required for the speed/power trials, turning maneuvers, spiral maneuver, and zig zag maneuvers.

A depth of five times the draft of the 49-foot BUSL was required to minimize shallow water and circulation effects for the bollard pull off the CG Yard pier bollard.

Several days of underway trials were conducted. Speed/power trials were conducted on 28 August and 9 September 1997. There were 10 persons (1900 lbs) aboard on 28 August and 12 persons (2271 lbs) aboard on 9 September. The weight conditions of the BUSL on 28 August and 9 September are estimated based on scale test weighing of the BUSL on 10 September. The trial weights are summarized as follows:

28 August	Full Load (no cargo)	79,683 lbs [+/- 800 lbs]
9 September	Full Load + 16K lbs cargo	96,150 lbs [+/- 800 lbs]

The CG Yard weight manager calculated the displacement based on freeboard measurements he made prior to getting underway. The trial displacements which include all of the personnel aboard are summarized below:

28 August	Full Load (no cargo)	82,182 lbs [+/- 0.5 in or +/- 1000 lbs]
9 September	Full Load + 16K lbs Cargo	95,612 lbs [+/- 0.5 in or +/- 1000 lbs]

Seas were observed to be less than or equal to one foot for all the underway trials.

1.4 Overview of Test Equipment

All of the sensor test data were recorded on a Digital Audio Tape (DAT) Instrumentation recorder during the underway tests. Some information was manually recorded by CG Yard personnel and R&DC Test Team.

A Humphrey motions package was installed near the BUSL's center of gravity in the Engine Room. A rudder angle indicator was used to measure all of the rudder motion information. Turning circles and position data were collected using an Ashtech DGPS receiver and Tacman41 (Tactical Maneuvering) software program on a Gateway 2000 portable computer. The Tacman41 program recorded the ship position during maneuvering and determined the ship speed, advance, transfer, acceleration, deceleration and other characteristics. Sound level measurements were collected using a portable Bruel & Kjaer precision sound level meter.

The following equipment was installed during the underway trials of the 49403 at the CG Yard in Baltimore, MD.

o BRUEL & KJAER Model BZ100 Precision Sound Level Meter

o WIRELESS DATA CORP, (Formerly ACUREX) Model 1642 Horsepower Meter W/ shaft mounted collars and strain gauges

o HUMPHREY Model H-1 Motion Package, 6 Degrees of Freedom (DOF)

o MAGNETEK Model PSA-40A 5K(A179) Linear Motion Transducer

o ASHTECH Model XII Global Positioning System (GPS) Receiver & STARLINK Beacon Receiver

o TEAC Model RD-200T 16 channel Digital PCM Data Recorder

o Hedland Flow Meters 0.1-1 GPM (Model No. 601-001) and 0.05-0.5 GPM (Model No. 201-000) provided by CG Yard

o TACMAN41 GPS Data Acquisition Software

o Boat Weighing System
30 k lb BLH Type T3P2-B

50 k lb Sensotec Model 41/573
Strain Gage Conditioner / Indicator Daytronic Model 3278
MICROMEASUREMENTS Type 2310 Signal Conditioning Amplifier

The following additional equipment was used during data reduction.

o TEAC Model RD-101TD Digital PCM Data Recorder

o FLUKE Model 97 Scopemeter

o TEAC Quick VU II Software

o TRIMETRIX Axum Technical Graphics and Data Analysis Software

2 Trial Agenda

2.1 Boat Weighing

On 10 September, the 49403 was weighed using the CG Yard crane No. 1 rated at 38 tons. Two load cells were used, a 50k lb and 30k lb load cell. These load cells are accurate to 0.5% of their full scale reading. Therefore, an accuracy of +/- 800 lbs can be expected for the load cell arrangement used. Figure 2 illustrates the weight test arrangement for the 49403. The boat was lifted three times with the load cells aft and then three times with the load cells moved forward. In both the forward and aft lifts the trim of the boat was approximately 1.3 degrees bow down. The geometry of the straps was measured with an electronic inclinometer held to the straps. There was an approximate one degree angle to the straps in the fore-to-aft orientation. The fore-to-aft geometry and trim were not used in determining the scale weight. The athwartship geometry presented the most significant angles.

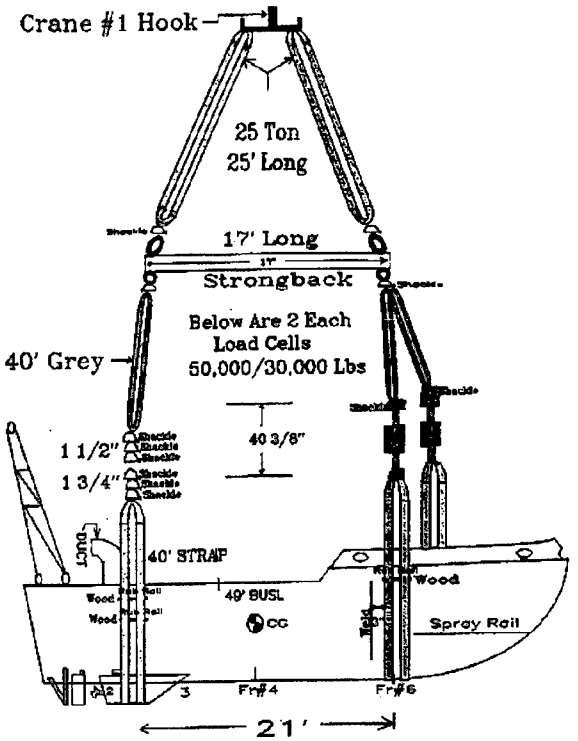


Figure 2 - BUSL Scale Weighing Test

Table 1 presents a summary of the weight test.

Table 1 - Weight Test Summary

Aft Lift				
	Port Aft (lbs)	Stbd Aft (lbs)	Port Aft (deg)	Stbd Aft (deg)
	18600	17700	9.1	9.7
	18580	17740	8.5	8.4
	18590	17815	-	-
Average	18590	17752	8.8	9.1
Scale Weight	**18371**	**17528**		
Forward Lift				
	Port Fwd (lbs)	Stbd Fwd (lbs)	Port Fwd (deg)	Stbd Fwd (deg)
	17700	17515	7.9	9.4
	17450	17780	7.9	8.9
	17300	17900	-	-
Average	17483	17732	7.9	9.2
Scale Weight	**17317**	**17504**		
Total Scale Weight		**70720**		

The light ship condition is defined as the boat completely ready for service in every respect less crew and variable loads. The light ship weight was calculated based on the following subtractions

- 530 lbs [lifting straps]
- 290 lbs [R& D Center test gear]
- 428 lbs [2-persons on board during weighing]
- 280 lbs [residual fuel remaining in tanks, approx. 40 gallons]

69,192 lbs [+/- 800 lbs]

The displacement calculated by the CG Yard BUSL Weight Manager based on recorded freeboards was 71,746 lbs [+/- 0.5 in. or +/- 1000 lbs]. This is after the same subtractions were applied as above. The light ship weight determined by the load cells is less than the light ship performance requirements of 31.65 LT (71,213 lbs). It should be noted that the BUSL was not completely outfitted. The following items were not onboard:

o cable for A frame winches	35 lbs
o cable for cross deck winches	21 lbs
o stores	96 lbs
o personnel effects	200 lbs

The Longitudinal Center of Gravity (LCG) was determined based on the hoisting strap locations relative to Frame No. 4 and by summing the moments about the aft perpendicular. The LCG was determined to be 18.03 feet forward of the aft perpendicular.

The measured LCG is further aft than the 19 ft < LCG < 20 ft performance range described.

2.2 Speed/Power Trial

Speed/power trials were conducted on two different occasions. On the first occasion the 49-foot BUSL was in a full load condition without cargo. The second set of speed/power data include the full load condition with an additional 16,000 lbs loaded to the buoy deck. These data are presented in Appendix A. It should be noted that the strain gauge/ horsepower meter installation was functioning on the port shaft for the full load test and on the starboard shaft during the full load plus cargo test. The 49-foot BUSL speeds were obtained from DGPS reciprocal run averages recorded with the TACMAN41 system for one minute time periods. Figure 3 presents speed/power data for both the full load and full load plus 16k lb cargo displacements.

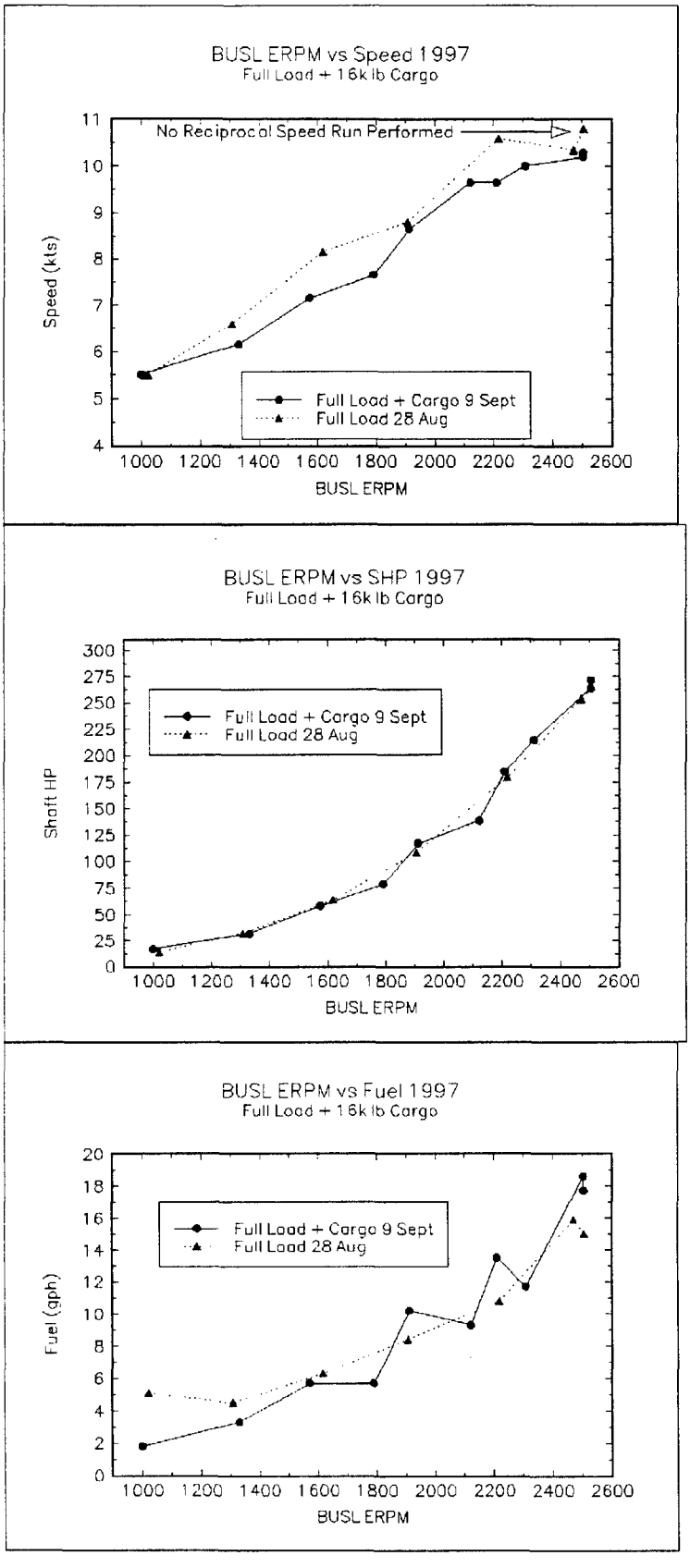


Figure 3 - Speed/Power Result

There appears to be little difference in shaft horsepower performance between the full load and full load plus cargo condition. Speed performance is generally better in the full load condition, but there is no significant gain in top speed in the lighter condition. Trim was determined from the motions package for the full load plus 16K lb cargo conditon. Trim increased from 0 to 2 degrees (bow up) as speed increased to full throttle.

Fuel consumption was measured using in-line Hedland fuel flow meters, one attached to the inlet and one attached to the exit side of the engine fuel system. These meters are analog devices with limited accuracy. The net fuel was determined by subtracting the inlet rate from the exit rate with an accuracy of +/- 4.5 GPH. In both speed runs, the fuel meters on the port engine did not seem to operate properly and were not used in the results.

2.3 Endurance Trial

At full load plus cargo the BUSL achieves 10 kts at 2300 ERPM with a fuel rate of approximately 12 gph. Using a conservative estimate of fuel/oil consumption by the ship service diesel generator of 1.95 gph at 20 kW the endurance can be estimated as

$$\frac{782 \text{ gal}}{[(12 \text{ gal/hr} \times 2 \text{ engines}) + 1.95 \text{ gph}]} \times 10 \text{ kts} = 301 \text{ nm}$$

At full load the BUSL achieves 10 kts at 2200 ERPM with a fuel rate of approximately 11 gph. This translates to an endurance of

$$\frac{782 \text{ gal}}{[(11 \text{ gal/hr} \times 2 \text{ engines}) + 1.95 \text{ gph}]} \times 10 \text{ kts} = 326 \text{ nm}$$

At 2500 ERPM (full load plus cargo) the BUSL fuel consumption is approximately 19 gph which only translates to an endurance of 196 nm. The endurance trial data, engine parameters, were collected by CG Yard personnel and are presented in Appendix B for information.

2.4 Steering Trials

The steering trials consists of a number of tests to measure different aspects of the maneuverability of the BUSL. These data are presented in Appendix C.

2.4.1 Zig Zag Test

The zig zag maneuver is a definitive ship trial for measuring the rudder's ability to control the boat in calm water. A string potentiometer was attached to the rudder and was used to synchronize the execution of rudder maneuvers with the boat's heading. Heading was recorded using the yaw gyro of the motions package installed near the BUSL center of gravity. The BUSL's track was recorded using the DGPS Tacman41 system. Figure 4 illustrates the BUSL results for a 35 and 20 degree zig zag at full speed.

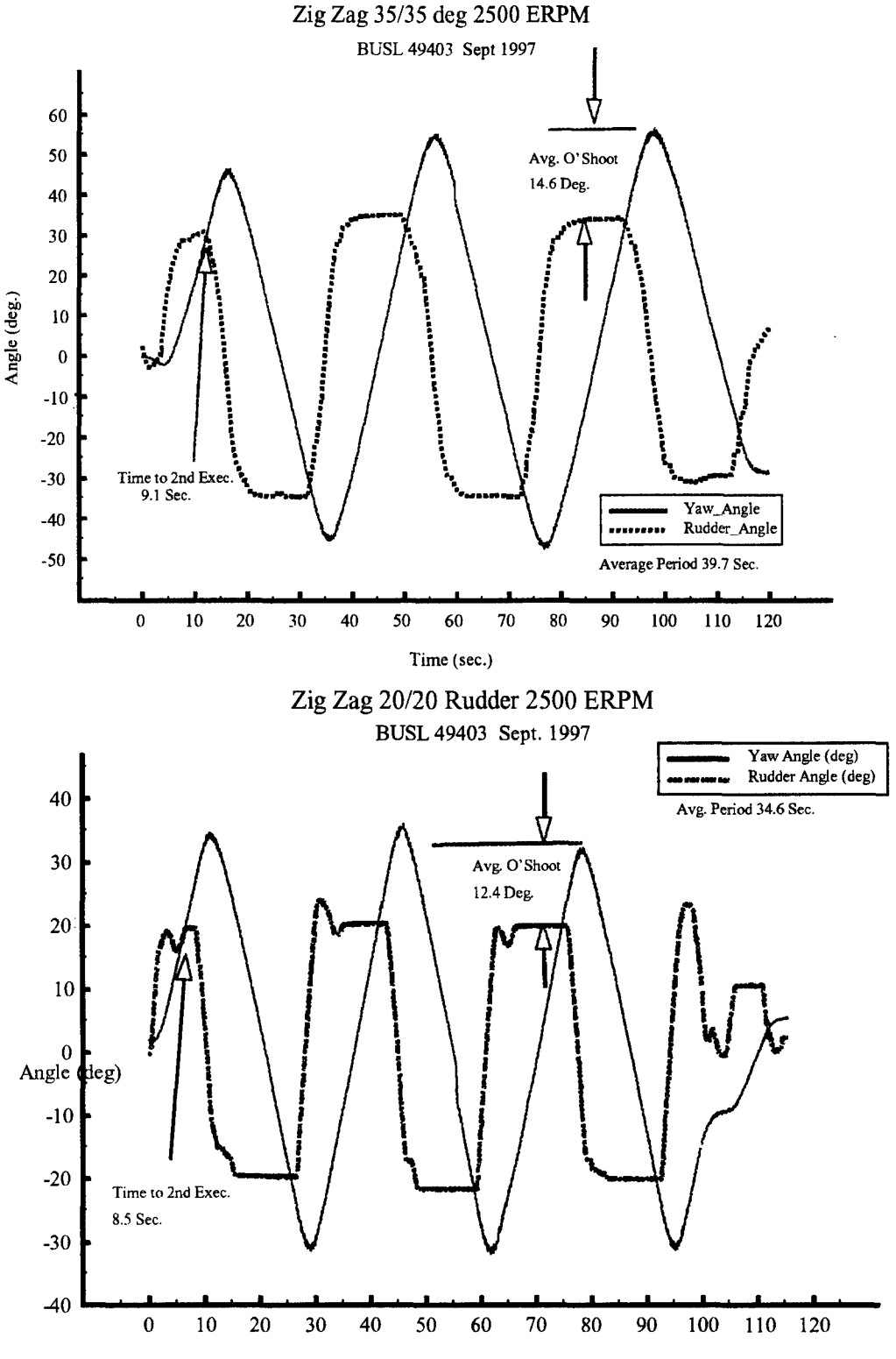


Figure 4 - Zig Zag Maneuvers

Table 2 presents a summary of the zig zag results averaged over reciprocal runs.

Table 2 - BUSL 49403 Zig Zag Results

	Time to Reach 2nd Execute (sec)	Average Overshoot Yaw Angle (deg)	Average Period (sec)	Overshoot Width of Path (ft)
20/20 zig zag @ 2500 ERPM	8	12	34	98
35/35 zig zag @ 2500 ERPM	8	15	40	148

The time to reach second execute is a measure of the ability of the BUSL to rapidly change course. This is only slightly more than the time it takes a Coast Guard 41-foot Utility Boat (approximately six seconds) to reach its second execute. The average overshoot angle and overshoot width of path are indicative of the amount of anticipation the coxswain will need to operate in restricted waters.

2.4.2 Dieudonne Spiral Maneuver

The Dieudonne spiral test measures the directional stability, turn rate, and course-keeping ability of a boat in calm water. This is an important test that should be performed on the first of any new class of vessels. This test was conducted beyond the Annapolis Bay Bridge in water depths greater than 40 feet. The rudder angle was measured using a string potentiometer and the yaw rate was recorded using the motions package yaw rate gyro. The yaw rate information was averaged over a one-minute period of steady turning for incremental rudder commands. Figure 5 demonstrates the results of this test maneuver.

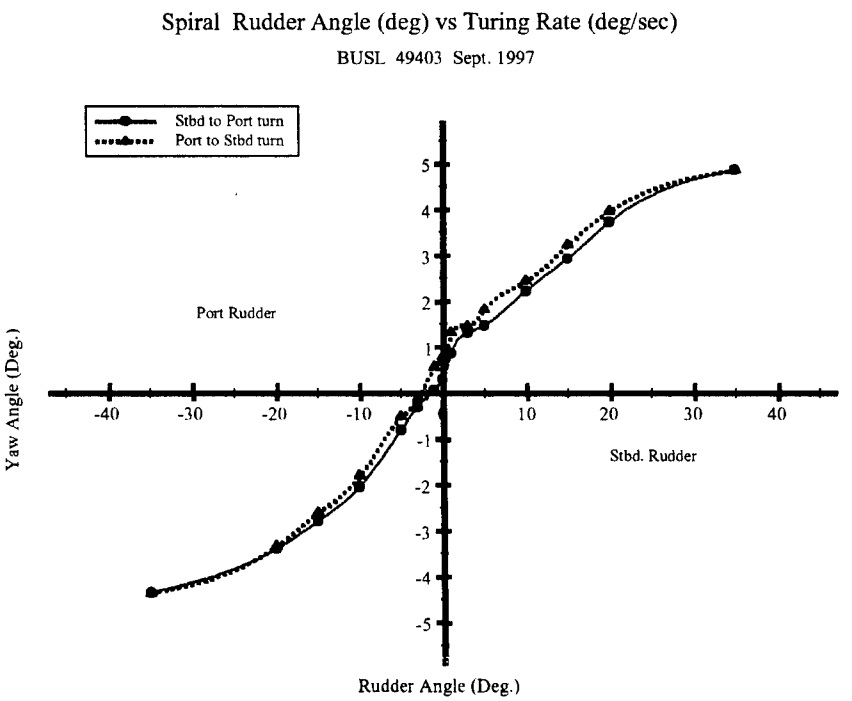


Figure 5 - Spiral Maneuver

There is little hysteresis in the plot which indicates that the BUSL 49403 has good directional stability and will be easy to keep on course. The little hysteresis apparent in the plot is in the noise of the instrumentation. The 49-foot BUSL may be paying the price for the good directional stability with its maneuverability as demonstrated by the large overshoot width of path and yaw angles in the zig zag results.

2.4.3 Turning Performance

Almost all ship maneuvers involve some degree of turning. Therefore, quantifying a vessel's turning maneuverability is important. The turning path of a vessel is characterized by four numerical measures: 1) advance, 2) transfer, 3) tactical diameter, and 4) steady turning diameter. Figure 6 illustrates these measures.

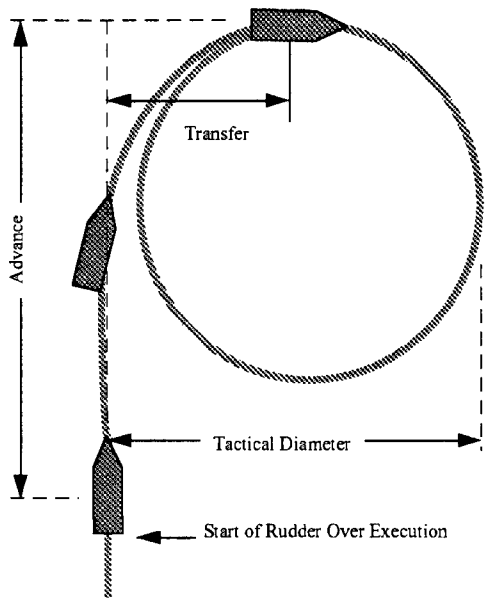


Figure 6 - Tactical Turning Maneuver

The advance is the distance from the point of execution when the rudder is quickly placed over to the desired setting to the point when the boat has turned 90 degrees. The transfer is the distance from the original approach course to the boat's center when it has turned 90 degrees. The tactical diameter is the distance from the original approach course to the point where the boat has turned 180 degrees. The steady turning diameter is different from the tactical diameter. The tactical diameter includes the initial transient part of the maneuver whereas the steady turning diameter reflects the footprint of the steady-state part of the maneuver only.

The trials were conducted in a calm area of water in the Patapsco River with approximately 40 feet of water depth near the CG Yard. Each run was started with the boat on a straight approach with a fixed throttle, i.e., engine RPM held constant. At the turning point, the rudder was rapidly moved to a specified angle and held there until the boat changed a course of 720 degrees. The track of the boat was measured by the

Tacman41 software. Corrections were also made for set and drift using the Tacman41 software. Six degrees of freedom of motion measured by the Humphreys motions package were recorded to a digital tape recorder. Figure 7 illustrates an example of BUSL 49403 tactical data captured by the Tacman41 software.

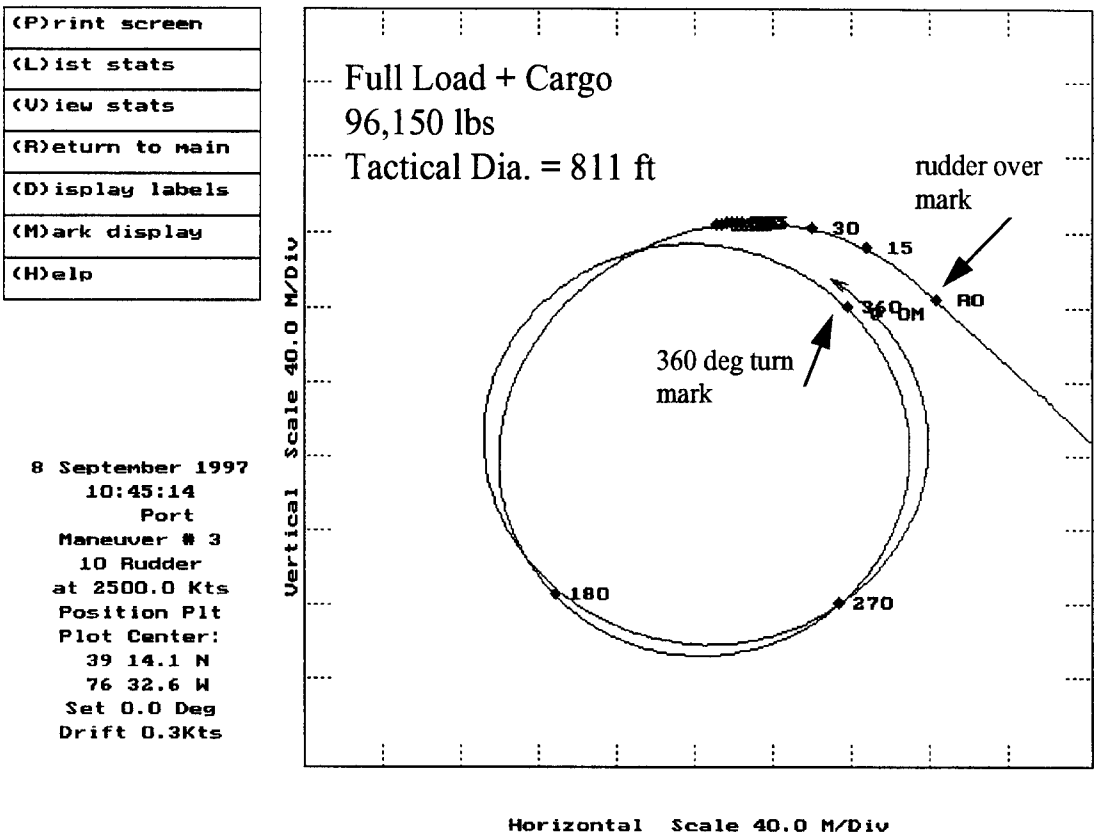


Figure 7 - Example of Test Run (10 deg rudder at 2500 ERPM)

Table 3 presents a summary of the tactical measurements collected during the underway trials of the 49403. It can be observed from Table 3 that there is no consistent bias to port or starboard. This means that there is no misalignment of the rudders or asymmetry in the controls fixed appendages. The tactical diameters are only slightly larger than the steady turn diameters. This indicates that there is little initial sliding of the boat in the transient part of the turn even at full rudder. An average speed loss in the turn across all the maneuvers is about 15%. Previous BUSL tactical data could not be identified for comparison to data collected on the 49403 BUSL. Therefore, a comparison was made to a 10 knot steady turn radius of a 41-FT UTB and the 10 knot turning radius of the 49 foot BUSL normalized to a 41 foot length. The results were comparable which is indicative of good turning performance of the BUSL 49403.

Table 3 - 49403 Turning Performance Summary

Initial Speed (kts)	Rudder (°/dir)	Eng. RPM	Time to Turn 180 deg (sec)	Time to Turn 360 deg (sec)	Steady Turning Dia. (ft)	Tactical Diameter (ft)	Advance @ 90 deg (ft)	Transfer @ 90 deg (ft)	Turning Spd_{avg} at180° (kts)
6.7	10° Port	1250	127	246	793	813	440	403	5.5
5.5	10° Stbd	1250	121	235	721	749	321	359	5.5
6.3	20° Port	1250	68	127	334	307*	176	160	5.5
6.2	20° Stbd	1250	68	139	400	391*	222	194	5.5
5.6	35° Port	1250	55	107	236	237	122	44	4.0
6.1	35° Stbd	1250	55	100	234	236	162	119	4.5
10.4	10° Port	2500	72	138	708	811	340	155	9.2
10.1	10° Stbd	2500	64	126	636	642	360	322	10.0
10.4	20° Port	2500	38	73	341	359	216	186	9.0
10.4	20° Stbd	2500	41	76	367	373	251	193	9.5
10.1	35° Port	2500	32	59	230	236	187	120	7.5
10.2	35° Stbd	2500	29	57	236	239	180	120	8.0

* difficulty in correcting for set & drift resulted in tactical diameter slightly smaller than steady diameter

2.5 Emergency Stop Trial

An acceleration and crash stop test was conducted on 9 September in the Patapsco River near the CG Yard after the speed power trials. Time was only allowed for one direction runs. Standard testing procedures require reciprocal runs to be made to cancel current effects. Nevertheless, the results for one direction are as follows:

Crash Stop [12 sec to DIW - stops in 2.5 boat lengths]

Acceleration [17 sec to full speed - achieves full speed in 4.3 boat lengths]

The time for the throttle to move from full ahead to full astern was two seconds. The engines did not stall during the crash stop and moved no more than 0.2 inches in both directions in their mounts.

Appendix D presents the acceleration and crash stop time histories and data collected by CG Yard personnel.

2.6 Bollard Pull

A bollard pull was attempted on 28 August but was aborted because the bridle was attached to the aft cleats and came to a point at the pier-side bollard. This did not allow for a pivot point on the BUSL to control the pull against side current. The drifting of the BUSL around the end of the pier on 28 August resulted in a crushed connector on a load cell. A new bridle was constructed that attached to deck shackles and came to a 'V' at the stern. A 50K lb load cell was attached to the bridle end point on the BUSL. The bollard pull was performed on 9 September. The stern pull results are presented in Table 4.

Table 4 - Stern Bollard Pull

ERPM	Pull (lbs)	Torque	Shaft HP
1326	3790	580	64
1631	5740	880	112
1943	8120	1250	188
2189	10330	1960	265
2294	11085	1990	367

The BUSL 49403 could not achieve 2500 ERPM on 28 August. An engine rpm of 2300 at about 11K lbs was as high as it could go. It maintained this for three minutes before the turbocharger hose broke free. An additional 4:46 minutes was attempted before the water temperature became too high. A bow bollard pull was also performed. The BUSL 49403 achieved 8320 lbs in this configuration. The bow pull results are presented in Table 5.

Table 5 - Bow Bollard Pull

ERPM	Pull (lbs)
1300	2400
1600	3850
1900	5700
2200	7500
2400	8320

The CG Yard retested the bollard pull on 22 September. The BUSL easily maintained 2200 ERPM for the ten minute period required without any problems. The pulling strength of the 49403 exceeds the minimum required bollard pull of 6000 lbs. Appendix E presents the bollard pull data results.

2.7 Noise Survey

Noise measurements were made in several locations while the BUSL was underway at maximum speed. The 'A' weighted results are demonstrated in Table 6.

Table 6 - 'A' Weight Noise Results

Location Description	Average 'A' Weighted SPLs
Berthing Area Center of Compartment	68.6 dBA
Berthing Area Average of Head of Each Berth	73.9 dBA
Pilot House (one foot above chart table)	68.0 dBA
Galley and Mess (center of passageway)	75.1 dBA
Workshop	73.1 dBA
Work Deck (eight feet from stern)	83.3 dBA
Engine Room (between engines)	109.8 dBA

Both the 'A' weighted and 1/3 octave band measurement criteria were met in all of the designated spaces.

A far field noise survey was conducted on 9 September. A 41-FT UTB from Station Baltimore was used as the standoff vessel for conducting the measurements. The 41-FT UTB secured its engines for a background measurement using the B&K 2231 Precision Sound Level meter. A background sound pressure level of 65.5 dBA was recorded. The BUSL then proceeded at 2500 ERPM past the bow of the 41-FT UTB four times. The first time was very close, approximated at 50 feet or less while the other passes were about 100 ft +/- 10 ft. A measured 100 ft marker was not employed. The consensus of the BUSL test personnel was that the first data point should be discarded because the run was much less than 100 feet away from the 41-FT UTB. The variations noted in the SPL readings were +/- 1 dBA. The correction for a recorded noise source that is 7.3 dBA above the background noise is 0.8 dBA. The results are as follows

	SPL	Direction of Approach
	~~78.8 dBA~~	~~Port~~ (Discarded)
	71.0 dBA	Port
	77.9 dBA	Port
	69.5 dBA	Stbd
Avg.	**72.8 dBA**	

Corr. **72.0 dBA [+/- 1 dBA @ 100 ft +/- 10 ft]**

Although this did not meet the 70 dBA far field noise requirement, it should be noted that measurements on the pre-production 49-foot BUSLs resulted in a far field noise level of 76 dBA.

During the 28 August speed/power trials significant vibrations were observed around 2300 ERPM and greater. The vibration was so severe that the feedback transmitter on the steering in the Lazarrette vibrated off. The port lube oil reduction gear seal also began to

leak around this time. The vibration source was isolated to local hull plating directly above the propellers. The CG Yard added several stiffeners which appeared to reduce the vibrations to an acceptable level. An accelerometer was installed on a stiffener adjacent to the hull plating during the 9 September sea trial. Vibration data were collected during these speed/power measurements to serve as a baseline for any future comparisons. The blade rate frequency is the dominant excitation source for most of the engine speeds tested. The vibration levels rapidly increased at 2100 ERPM. At this speed the amplitude of vibration is the most significant. At 2100 ERPM (actual was 2123 ERPM) the blade rate frequency was estimated as follows:

$$\frac{2123\ (\text{ERPM})}{2.54\ (\text{red. gear ratio}) \times 60\ (\text{sec/min})} \times 4\ (\text{blades}) = 56\ \text{Hz}$$

The acceleration levels at the 2100 ERPM blade rate frequency are in a range where human response increases rapidly in severity based on SNAME guidelines for ship vibration. However, this may not be a reason for concern if these levels are localized to the lazarrette and not transmitted to a habitable space. It is difficult to determine based on these limited measurements whether of not the acceleration amplitude at 2100 ERPM is a resonant condition with the hull or non-resonant condition associated with cavitation. Noise and vibration data are presented in Appendix F.

2.8 Corrosion Survey

A corrosion test meter with a silver/silver chloride half cell (Yacht Corrosion Consultants, Inc. Model No. 296584) was used to test for sufficiency of sacrificial anodic protection in the 49403. The hull and steel through hull fitting readings were approximately 800 mV. Steel freely erodes at 425 mV and is protected at 675 mV. When the shore-tie was connected the reading went down to 700 mV. This means that the BUSL 49403's ground was connected to the shore power and there was no galvanic isolator or isolation transformer in the system. The BUSL 49403 is loosing zinc to the dock or other boats. A ZINC SAVER installed between the A.C. green wire system and D.C. bonding is recommended.

The stainless steel shafts and rudder posts were apparently bonded to the hull and protected. Bronze freely erodes at 120 mV and is protected at 380 mV. Therefore, the bronze fittings by the grid coolers are isolated from the hull and are protected when the shore tie is disconnected. The pictures of the zincs on the grid cooler recesses in Appendix E demonstrate significant erosion after only two weeks in the water. The tubes are copper/nickel and a reading was not obtained for the tubing. The results of the corrosion survey are presented in Appendix E.

3 Test Summary/Recommendations

Table 7 provides a quick-look summary of the testing conducted on the BUSL 49403. The CG Yard conducted many other dock-side tests not addressed in this report. This report addresses the majority of underway test requirements required by the 49-foot BUSL Production Specification and Test Memos No. 094-02 and 094-03. Because this was the

first production boat built by the CG Yard, it is expected that some changes would will occur to improve its performance. It is recommended, after the production run, some standardization trials be performed to verify that changes have not affected performance in any way. Speed/power, limited maneuvering, and noise and vibration checks should be performed after engine modifications, i.e., de-rating, and after outfitting of the vessel is completed.

Table 7 - Summary of Results

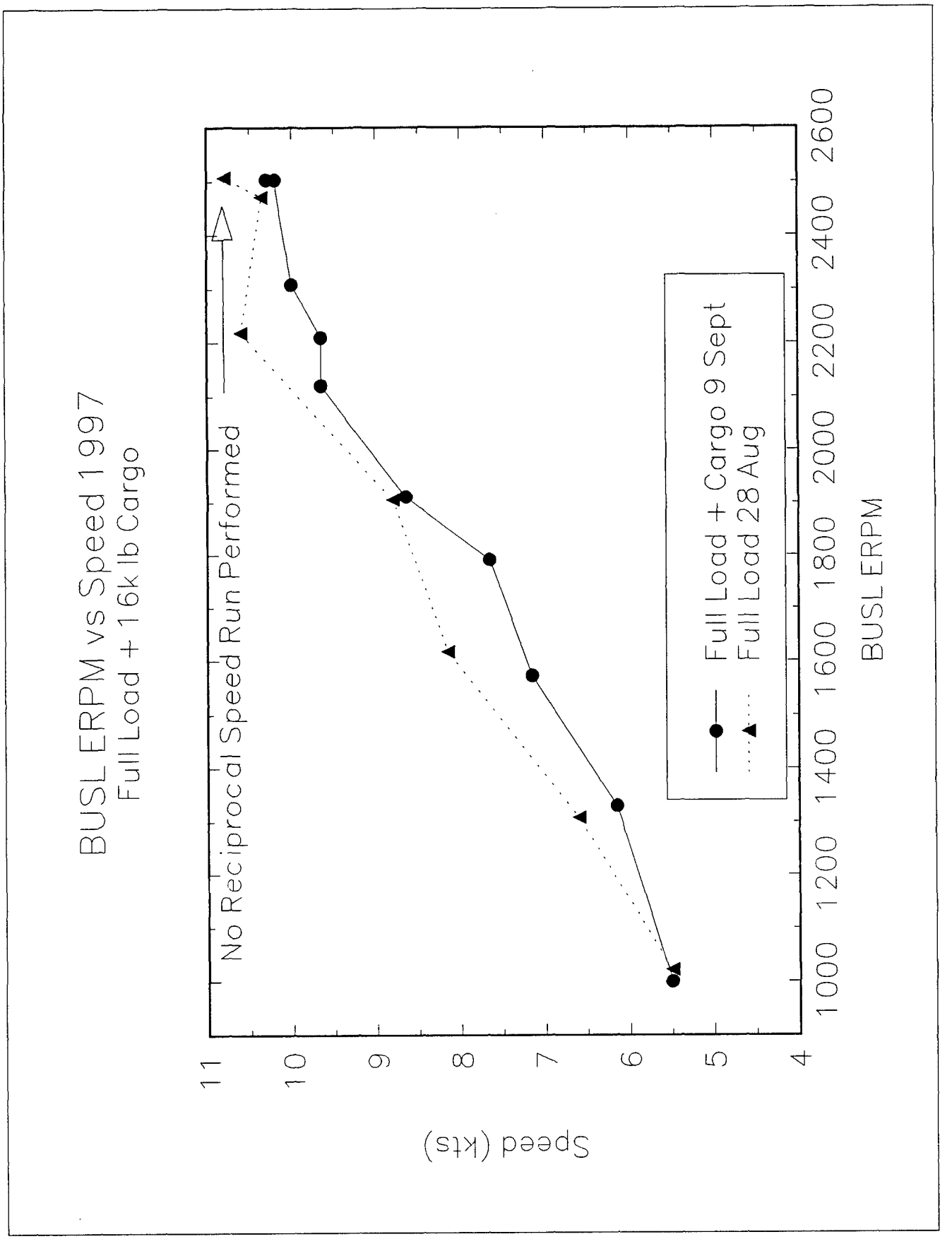
Noise	meets all on-board noise requirements at full speed does not meet far-field noise of 70 dBA [72 dBA +/-1 dBA]
Speed/Power	achieves 10 kt design speed full load (@ 2200 ERPM) and full load + 16,000 lb cargo (@ 2300 ERPM)
Bollard Pull	bollard pull maintained for 10 minutes at 2200 ERPM; far exceeds 6000 lbs of min. bollard pull
Turning Performance	large vertical inboard rudders provide good turning performance
Acceleration	good acceleration performance (17 sec to full speed in 4.3 boat lengths)
Crash/Stop	excellent crash stop performance; no engine stalling (12 sec to DIW in 2.5 boat lengths)
Corrosion	loosing zinc to dock; otherwise adequate zinc protection
Weight	less than 31.65 LT for light ship; LCG 18 ft fwd AP (30.75 LT but not completely outfitted)
Zig zag	good rudder responsiveness
Spiral	excellent directional stability
Vibration	vibration levels should be monitored in follow-on BUSLs
Endurance	(301 nm+ @10 kts @ full load + 16,000 lbs cargo)

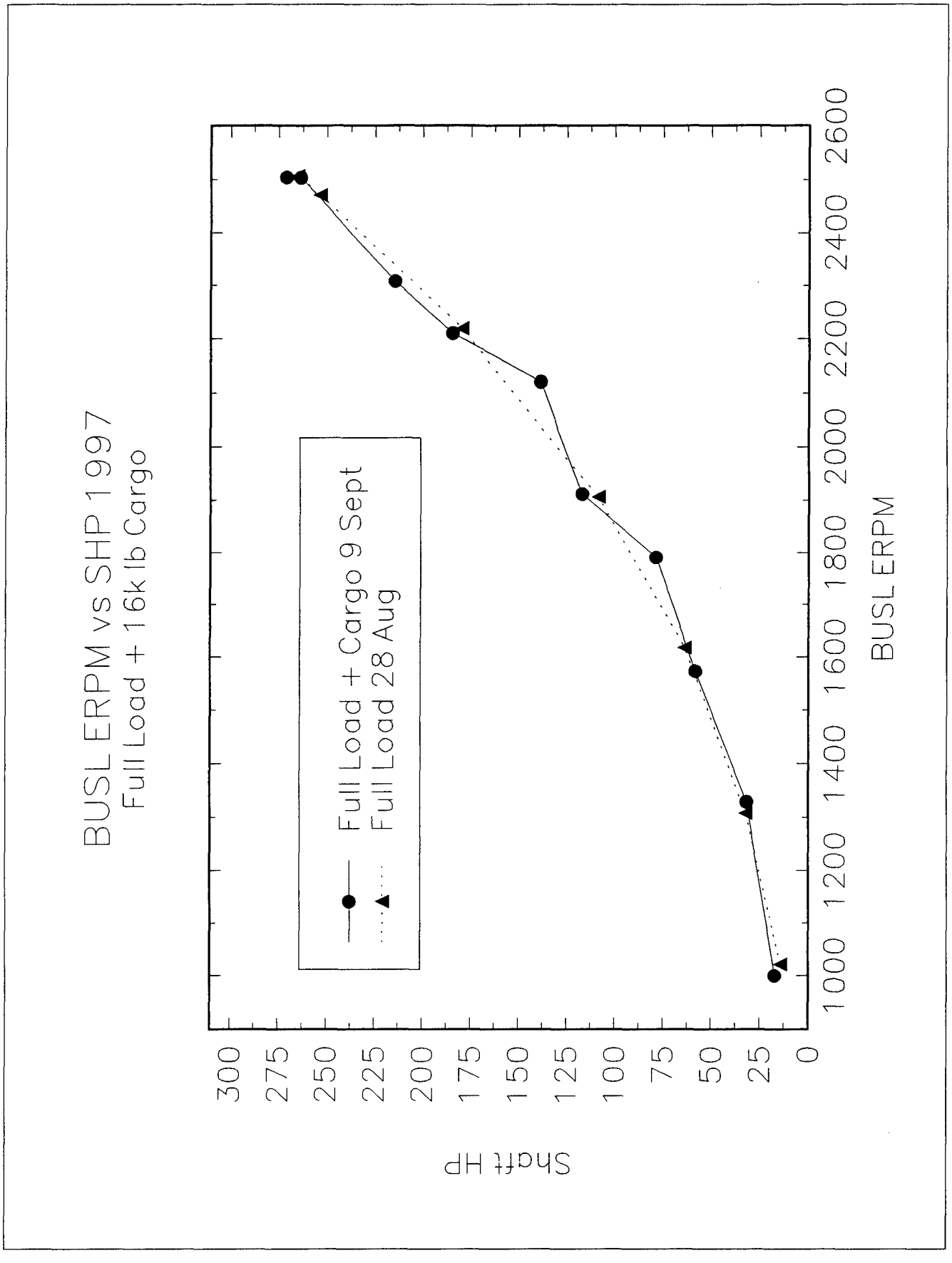
Appendix A
Speed/Power Trials Data

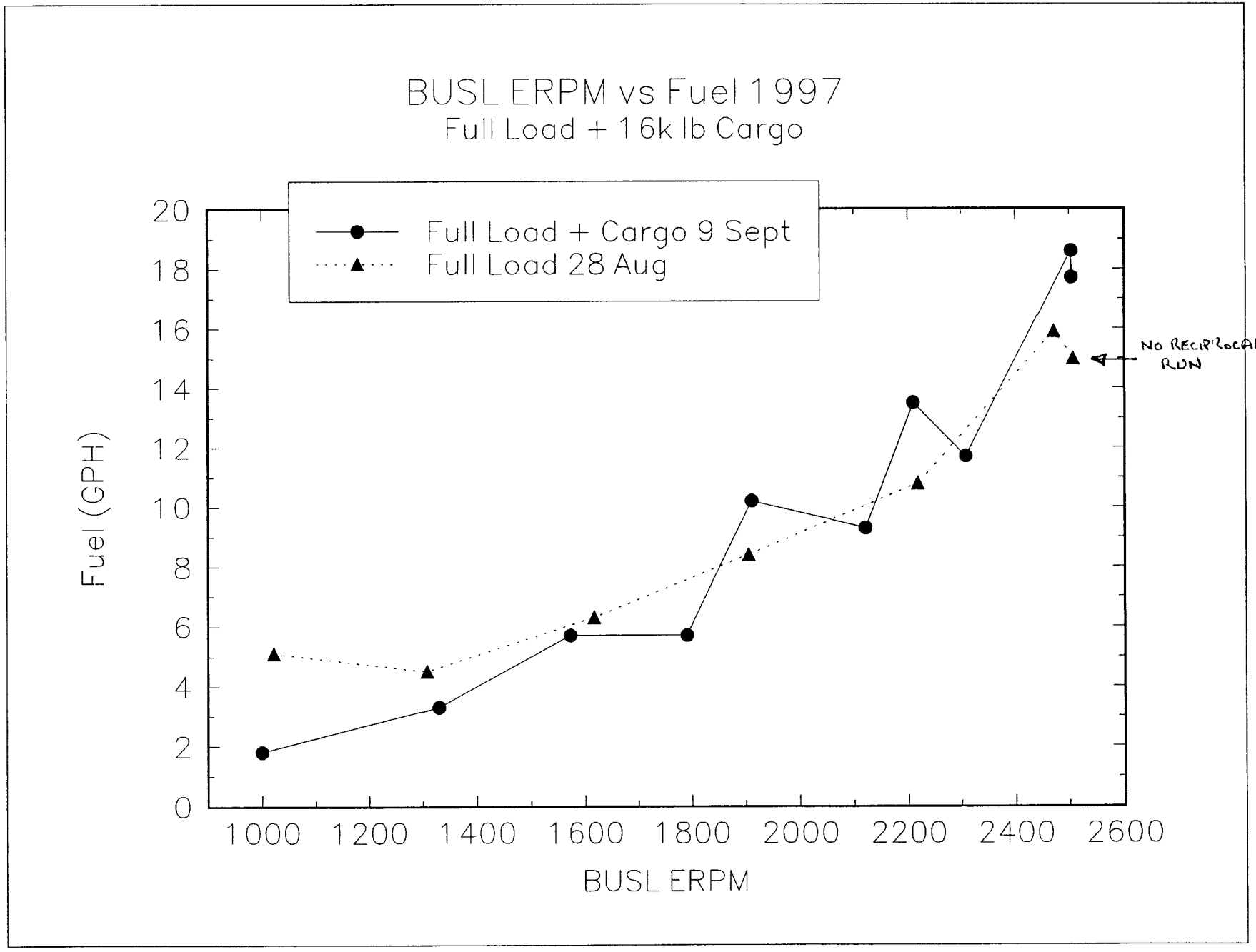
BUSL Speed Power Trials 1997

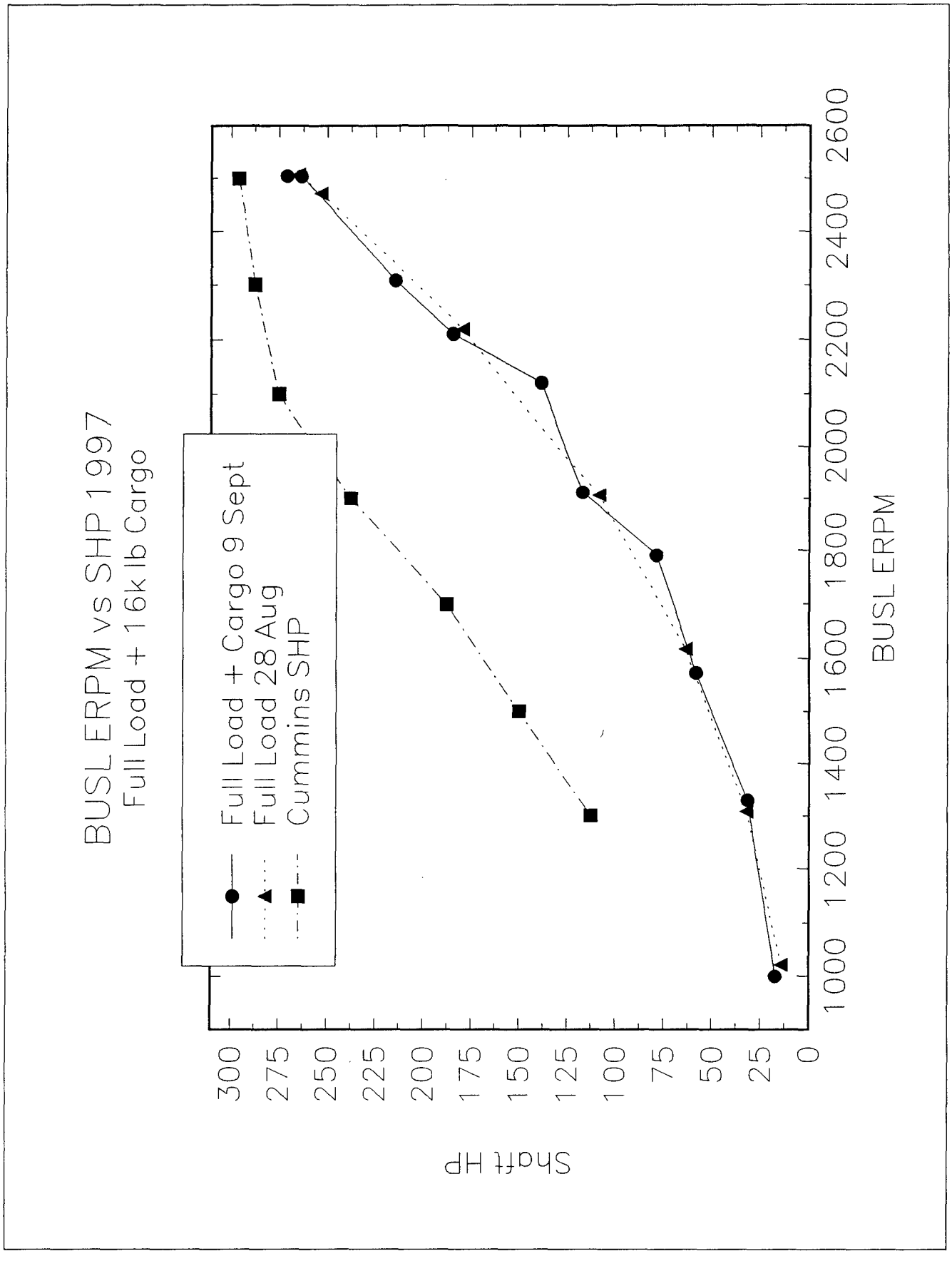
9 Sept. 1997 BUSL Test in Patapsco River																	
(full load displ. + 16k lb cargo; based on red gear ratio of 2.54 to 1; gear efficiency of 97%; port shaft not instrumented; seas < 1 foot)																	
Run No.	Start Time	End Time	Stbd SRPM	Stbd ERPM	Stbd TQ	Stbd SHP	Stbd BHP	Direction	Trim (deg)	Port Fuel			Stbd Fuel			DGPS spd.	
										in (gpm)	out (gpm)	net (gph)	in (gpm)	out (gpm)	net (gph)	(kts)	
2	-	-	393	998.2	240	18	18.54	A	TBD	0.47	0.44	1.8	0.39	0.36	1.8	5.5	
3	-	-	394	1000.8	230	16	16.5	B	TBD	0.47	0.44	1.8	0.39	0.35	2.4	5.5	
4	-	-	524	1331.0	340	32	33.0	A	TBD	0.47	0.45	1.2	0.48	0.46	1.2	5.8	
5	-	-	523	1328.4	320	31	31.9	B	TBD	0.53	0.44	5.4	0.48	0.44	2.4	6.5	
6	-	-	616	1564.6	480	56	57.7	A	TBD	0.54	0.46	4.8	0.47	0.47	0	6.5	
7	-	-	622	1579.9	500	60	61.8	B	TBD	0.55	0.44	6.6	0.47	0.44	1.8	7.8	
8	-	-	752	1910.1	800	116	119.5	A	TBD	0.42	0.2	13.2	0.47	0.42	3	8.5	
9	-	-	753	1912.6	810	118	121.5	B	TBD	0.4	0.28	7.2	0.47	0.39	4.8	8.8	
10	-	-	870	2209.8	1100	181	186.4	A	TBD	0.57	0.34	13.8	0.52	0.43	5.4	9.5	
11	-	-	870	2209.8	1140	188	193.6	B	TBD	0.59	0.37	13.2	0.53	0.41	7.2	9.8	
12	-	-	986	2504.4	1410	262	269.9	A	TBD	0.58	0.28	18	0.56	0.37	11.4	10	
13	-	-	985	2501.9	1430	265	273.0	B	TBD	0.59	0.27	19.2	0.57	0.39	10.8	10.4	
14	-	-	985	2501.9	-	-	-	B	TBD	0.55	0.28	16.2	0.57	0.39	10.8	10.1	
15	-	-	985	2501.9	1320	271	279.1	A	TBD	0.58	0.26	19.2	0.57	0.37	12	10.5	
16	-	-	705	1790.7	650	84	86.5	B	TBD	0.53	0.44	5.4	0.47	0.45	1.2	7.8	
17	-	-	705	1790.7	550	73	75.2	A	TBD	0.53	0.43	6	0.46	0.44	1.2	7.5	
18	-	-	834	2118.4	950	146	150.4	B	TBD	0.58	0.43	9	0.52	0.42	6	9.5	
19	-	-	836	2123.4	850	131	134.9	A	TBD	0.59	0.43	9.6	0.51	0.43	4.8	9.8	
20	-	-	904	2296.2	1050	222	228.7	B	TBD	0.62	0.43	11.4	0.54	0.41	7.8	10	
21	-	-	913	2319.0	970	207	213.2	A	TBD	0.62	0.42	12	0.52	0.41	6.6	10	

28 August 1997 BUSL Test in Patapsco River																
(full load displ.; based on red gear ratio of 2.54 to 1; gear efficiency of 97%; stbd shaft not instrumented; seas < 1 foot)																
Run No.	Start Time	End Time	Port SRPM	Port ERPM	Port TQ	Port SHP	Port BHP	Direction	Trim (deg)	Port Fuel			Stbd Fuel			DGPS spd.
										in (gpm)	out (gpm)	net (gph)	in (gpm)	out (gpm)	net (gph)	
7	1230	1233	401	1019	180	14	14.4	A	TBD	0.46	0.38	4.8	0.21	0.19	1.2	5.5
8	1238	1240	403	1024	180	14	14.4	B	TBD	0.47	0.38	5.4	0.21	0.19	1.2	5.5
9	1245	1251	515	1308	320	32	33.0	A	TBD	0.54	0.46	4.8	0	0	0	6.6
10	1257	1259	515	1308	320	32	33.0	B	TBD	0.54	0.47	4.2	0	0	0	6.6
11	107	110	636	1615	520	64	65.9	A	TBD	0.57	0.47	6.0	0.3	0.28	1.2	7.5
12	116	119	637	1618	520	63	64.9	B	TBD	0.57	0.46	6.6	0.3	0.27	1.8	8.8
13	127	129	749	1902	760	109	112.3	A	TBD	0.60	0.45	9.0	0.21	0.16	3.0	8.2
14	134	136	752	1910	750	108	111.2	B	TBD	0.59	0.46	7.8	0.21	0.15	3.6	9.4
15	146	148	873	2217	1080	179	184.4	A	TBD	0.63	0.44	11.4	0.21	0.09	7.2	10.8
16	151	153	874	2220	1080	180	185.4	B	TBD	0.61	0.44	10.2	0.21	0.08	7.8	10.4
17	159	202	973	2471	1350	253	260.6	A	TBD	0.63	0.36	16.2	0.32	0.12	12.0	10.2
18	308	310	973	2471	1390	254	261.6	B	TBD	0.64	0.38	15.6	0.49	0.32	10.2	10.5
	Max Speed Run - Reciprocal Course not Run															
19	0	0	987	2507	1400	265	273.0	A	TBD	0.64	0.39	15.0	0.34	0.12	13.2	10.8


BUSL ERPM vs Speed 1997
Full Load + 16k lb Cargo
No Reciprocal Speed Run Performed
Full Load + Cargo 9 Sept
Full Load 28 Aug
Speed (kts)
BUSL ERPM
11
10
9
8
7
6
5
4
1000
1200
1400
1600
1800
2000
2200
2400
2600


BUSL ERPM vs SHP 1997
Full Load + 16k lb Cargo
Full Load + Cargo 9 Sept
Full Load 28 Aug
Shaft HP
BUSL ERPM
0
25
50
75
100
125
150
175
200
225
250
275
300
1000
1200
1400
1600
1800
2000
2200
2400
2600


BUSL ERPM vs Fuel 1997
Full Load + 16k lb Cargo
Full Load + Cargo 9 Sept
Full Load 28 Aug
NO RECIPROCAL RUN
Fuel (GPH)
0
2
4
6
8
10
12
14
16
18
20
1000
1200
1400
1600
1800
2000
2200
2400
2600
BUSL ERPM


BUSL ERPM vs SHP 1997
Full Load + 16k lb Cargo
Full Load + Cargo 9 Sept
Full Load 28 Aug
Cummins SHP
Shaft HP
BUSL ERPM
0
25
50
75
100
125
150
175
200
225
250
275
300
1000
1200
1400
1600
1800
2000
2200
2400
2600

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 8 OF 22
REV DATE 08/18/97

DATA SHEET FULL LOAD + 16K LB CARGO SEPT. 9

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	SPEED/POWER TRIAL		
	@ 1000 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	5.5 KTS
(a) (3)	Fuel Flow Rate (STBD)	GPH	1.8 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	0.9 DEG
	STBD SHP		17 SHP
	@ 1300 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	6.2 KTS
(a) (3)	Fuel Flow Rate	GPH	3.3 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	0.9 DEG
	STBD SHP		32 SHP
	@ 1600 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	7.2 KTS
(a) (3)	Fuel Flow Rate	GPH	5.7 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	0.98 DEG
	STBD SHP		58 SHP
	@ 1900 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	8.7 KTS
(a) (3)	Fuel Flow Rate	GPH	10.0 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	1.0 DEG
	STBD SHP		117 SHP
	@ 2200 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	9.7 KTS
(a) (3)	Fuel Flow Rate	GPH	14.0 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	1.3 DEG
	STBD SHP		185 SHP

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 9 OF 22
REV DATE 08/18/97

DATA SHEET FULL LOAD + 16K lb CARGO SEPT. 9

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	SPEED/POWER TRIAL (cont'd)		
	@ 2500 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	N/A
	Opposite Direction Time	Elapsed Time	N/A
	Average Time/Speed	Time/Knots	10.2 KTS
(a) (3)	Fuel Flow Rate	GPH	19.0 GPH
(a) (4)	Running Trim	Deg +aft/-fwd	2.1 DEG
	STBD SHP		264 SHP
	ENDURANCE TRIAL		
	@ 15 MINUTES		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	
	Engine Oil Temperature	180-250 deg F	
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	
	Engine Exhaust Gas Temperature	650-850 deg F	
	Reduction Gear Oil Temperature	150-210 deg F	
	@ 30 MINUTES		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	
	Engine Oil Temperature	180-250 deg F	
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	
	Engine Exhaust Gas Temperature	650-850 deg F	
	Reduction Gear Oil Temperature	150-210 deg F	
	@ 45 MINUTES		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	
	Engine Oil Temperature	180-250 deg F	
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	
	Engine Exhaust Gas Temperature	650-850 deg F	
	Reduction Gear Oil Temperature	150-210 deg F	

Appendix B
Endurance Trial Data

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS	
	ENDURANCE TRIAL (cont'd)		ENGINE	
	@ 60 MINUTES 1700		PORT	STBD
(b) (2)	Engine Speed	2450-2550 RPM	2507	2502
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60	60
	Engine Oil Temperature	180-250 deg F	160	140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170	160
	Engine Exhaust Gas Temperature	650-850 deg F	557	490
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE	
	FWD PILOTHOUSE CONSOLE READINGS		ENGINE	
	@ 60 MINUTES ONLY 1700		PORT	STBD
(b) (2)	Engine Speed	2450-2550 RPM	2500	2500
	Engine Oil Pressure	30-70 psig	30	60
	Engine Oil Temperature	180-250 deg F	160	150
	Engine Jacket Water Temperature	155-185 deg F	190	210
	Engine Exhaust Gas Temperature	650-850 deg F	400	400
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE	
	@ 75 MINUTES 1715		ENGINE	
			PORT	STBD
(b) (2)	Engine Speed	2450-2550 RPM	2509	2503
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60	60
	Engine Oil Temperature	180-250 deg F	160	140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170	170
	Engine Exhaust Gas Temperature	650-850 deg F	575	560
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE	
	@ 90 MINUTES 1730		ENGINE	
			PORT	STBD
(b) (2)	Engine Speed	2450-2550 RPM	2507	2502
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60	60
	Engine Oil Temperature	180-250 deg F	160	140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170	170
	Engine Exhaust Gas Temperature	650-850 deg F	580	554
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE	

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	SPEED/POWER TRIAL (cont'd)		
	@ 2500 Engine RPM		
(a) (2)	Starting Direction Time	Elapsed Time	
	Opposite Direction Time	Elapsed Time	
	Average Time/Speed	Time/Knots	
(a) (3)	Fuel Flow Rate	GPH	
(a) (4)	Running Trim	Deg +aft/-fwd	
	ENDURANCE TRIAL Start 1600		
	@ 15 MINUTES 1615		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	2512 / 2509
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60 / 60
	Engine Oil Temperature	180-250 deg F	150 / 140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170 / 170
	Engine Exhaust Gas Temperature	650-850 deg F	570 / 520
No Gauge →	Reduction Gear Oil Temperature	150-210 deg F	N/A / N/A
	@ 30 MINUTES 1630		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	2508 / 2505
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60 / 60
	Engine Oil Temperature	180-250 deg F	160 / 140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170 / 170
	Engine Exhaust Gas Temperature	650-850 deg F	560 / 550
	Reduction Gear Oil Temperature	150-210 deg F	No Gauge
	@ 45 MINUTES 1645		ENGINE PORT / STBD
(b) (2)	Engine Speed	2450-2550 RPM	2508 / 2502
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60 / 60
	Engine Oil Temperature	180-250 deg F	160 / 140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170 / 170
	Engine Exhaust Gas Temperature	650-850 deg F	578 / 541
	Reduction Gear Oil Temperature	150-210 deg F	No Gauge

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	ENDURANCE TRIAL (cont'd)		ENGINE PORT / STBD
	@ 105 MINUTES 1745		
(b) (2)	Engine Speed	2450-2550 RPM	2505 / 2506
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60 / 65
	Engine Oil Temperature	180-250 deg F	160 / 140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170 / 170
	Engine Exhaust Gas Temperature	650-850 deg F	560 / 530
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE
			ENGINE PORT / STBD
	@ 120 MINUTES 1800		
(b) (2)	Engine Speed	2450-2550 RPM	2508 / 2502
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	60 / 60
	Engine Oil Temperature	180-250 deg F	160 / 140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	170 / 170
	Engine Exhaust Gas Temperature	650-850 deg F	590 / 534
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE
	AFT PILOTHOUSE CONSOLE READINGS		ENGINE PORT / STBD
	@ 120 MINUTES ONLY 1800		
(b) (2)	Engine Speed	2450-2550 RPM	2500 / 2500
	Engine Oil Pressure	30-70 psig	45 / 60
	Engine Oil Temperature	180-250 deg F	140 / 150
	Engine Jacket Water Temperature	155-185 deg F	200 / 220
	Engine Exhaust Gas Temperature	650-850 deg F	400 / 400
	Reduction Gear Oil Temperature	150-210 deg F	NO GAUGE
	MN ENG/RED GEAR PIPING SYSTEMS LEAK/DEFECT INSPECTION	Leaks/Defects	ENGINE PORT / STBD
(b) (3)	Mn Eng Sea Water Piping	None	NONE / NONE
	Mn Eng Jacket Water Piping	None	NONE / NONE
	Mn Eng Lube Oil Piping	None	NONE / NONE
	Red Gear Lube Oil Piping	None	NONE / NONE

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	LOAD TEST		
	@ 30 MINUTES		
(c) (1)	Generator Power Output	20 KW	
	Generator Voltage	116-126 VAC	120
	Generator Frequency	57-62 Hz	60
	Generator Amps	N/A	—
	Engine Jacket Water Temp	170-210 deg F	175
	Engine Lube Oil Pressure	35-60 psig	75
	@ 60 MINUTES		
(c) (1)	Generator Power Output	20 KW	
	Generator Voltage	116-126 VAC	120
	Generator Frequency	57-62 Hz	60
	Generator Amps	N/A	—
	Engine Jacket Water Temp	170-210 deg F	175
	Engine Lube Oil Pressure	35-60 psig	75
	@ 90 MINUTES		
(c) (1)	Generator Power Output	20 KW	
	Generator Voltage	116-126 VAC	120
	Generator Frequency	57-62 Hz	60
	Generator Amps	N/A	—
	Engine Jacket Water Temp	170-210 deg F	175
	Engine Lube Oil Pressure	35-60 psig	75
	@ 120 MINUTES		
(c) (1)	Generator Power Output	20 KW	
	Generator Voltage	116-126 VAC	120
	Generator Frequency	57-62 Hz	60
	Generator Amps	N/A	—
	Engine Jacket Water Temp	170-210 deg F	175
	Engine Lube Oil Pressure	35-60 psig	75

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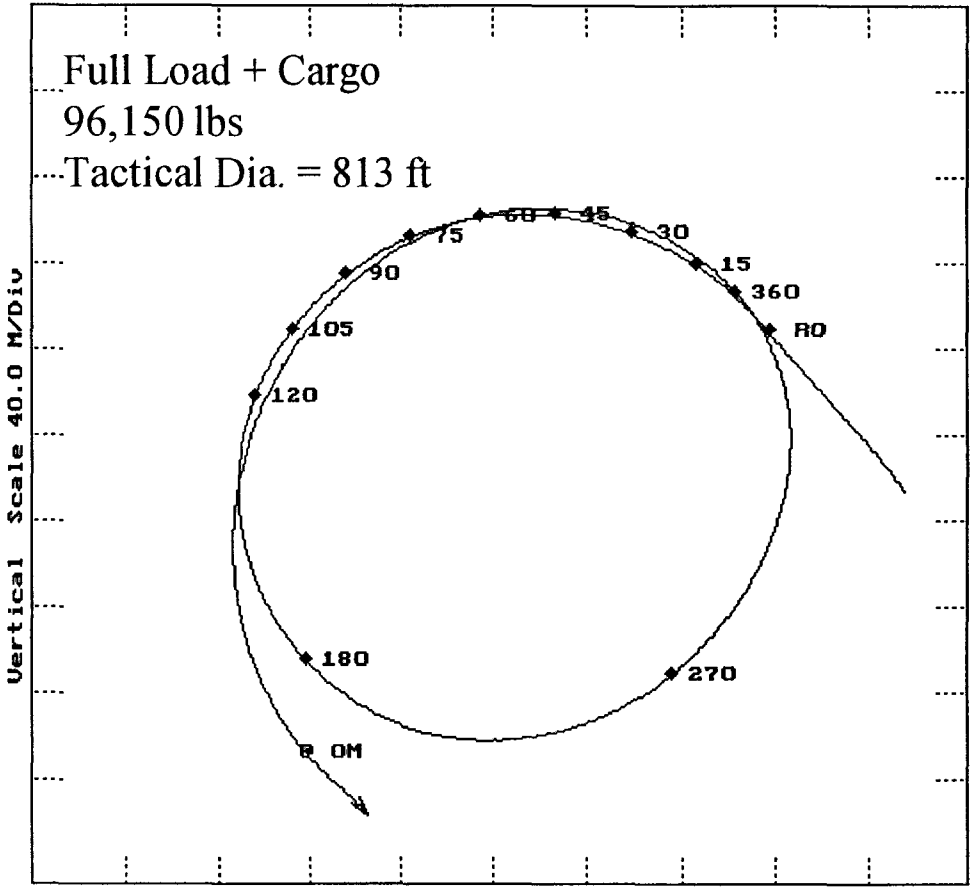
Appendix C
Steering Trials Data

BUSL 49403 8 Sept 1997
(1250 ERPM 10 deg Port Turn)

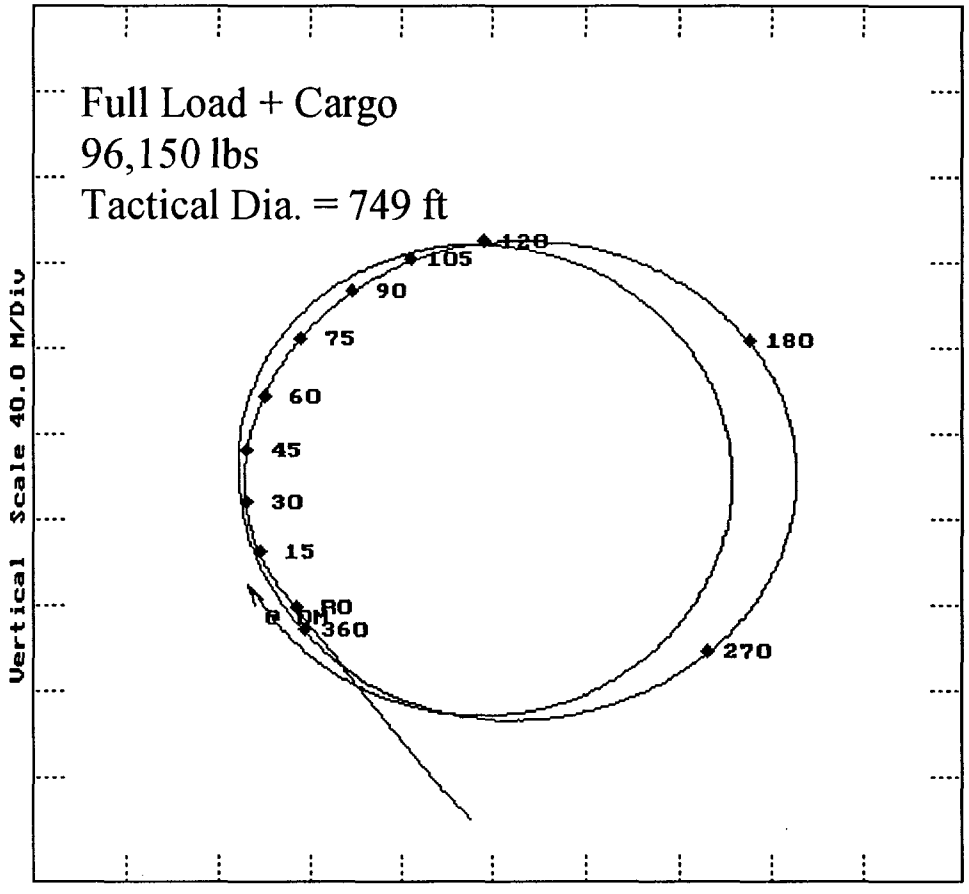
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
14:50:02
Port
Maneuver # 10
10 Rudder
at 1200.0 Kts
Position Plt
Plot Center:
39 14.3 N
76 33.1 W
Set 200.0 Deg
Drift 0.1Kts

BUSL 49403 8 Sept 1997
(1250 ERPM 10 deg Stbd Turn)

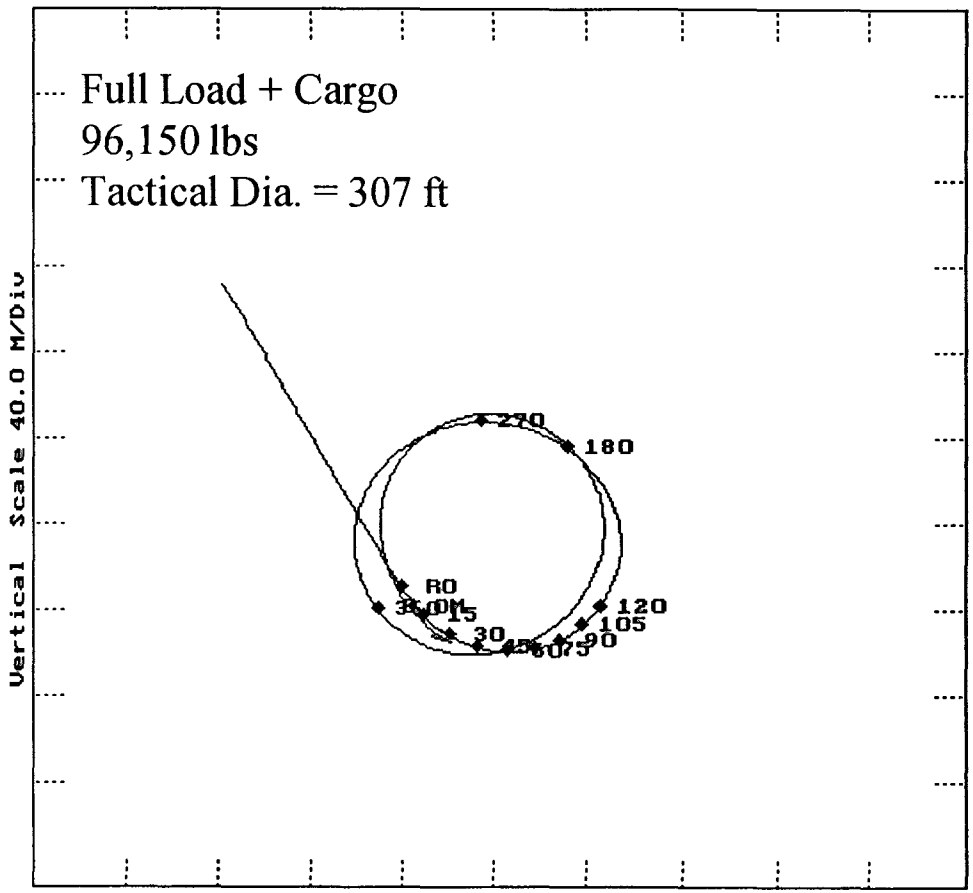
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
15:00:55
Starboard
Maneuver # 11
10 Rudder
at 1250.0 Kts
Position Plt
Plot Center:
39 14.5 N
76 33.2 W
Set 315.0 Deg
Drift 0.1Kts

BUSL 49403 8 Sept 1997
(1250 ERPM 20 deg Port Turn)

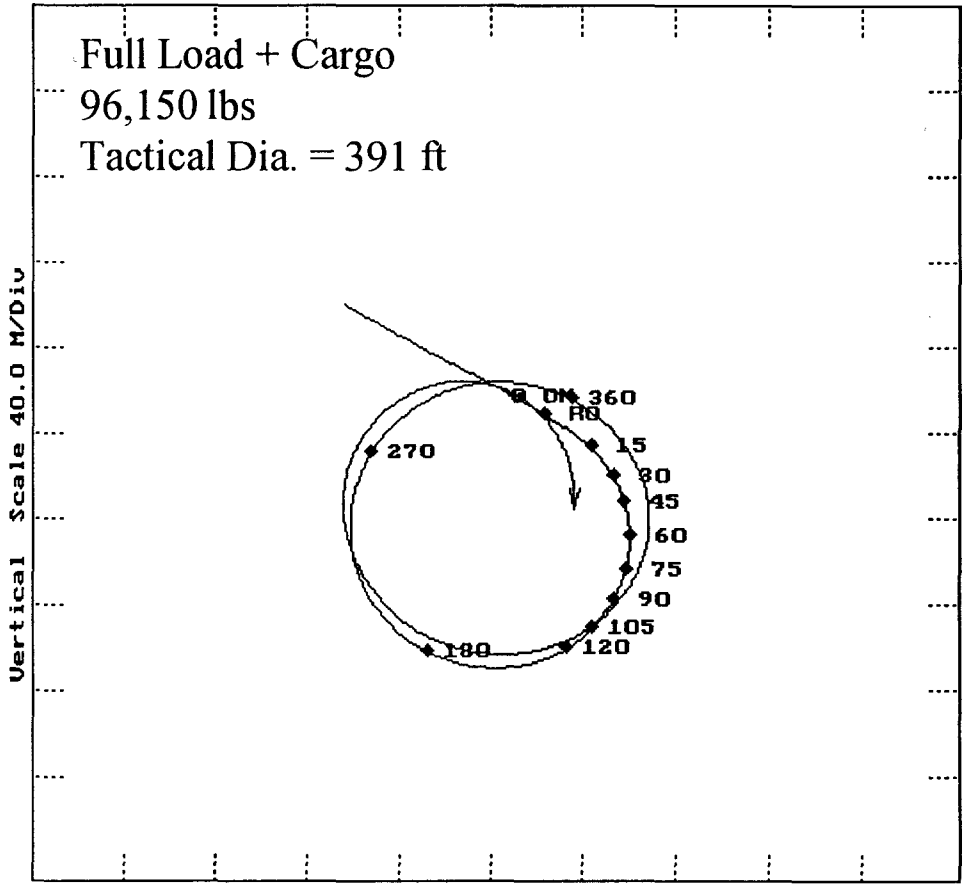
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
15:11:33
Port
Maneuver # 12
20 Rudder
at 1250.0 Kts
Position Plt
Plot Center:
39 14.5 N
76 33.2 W
Set 270.0 Deg
Drift 0.1Kts

BUSL 49403 8 Sept 1997
(1250 ERPM 20 deg Stbd Turn)

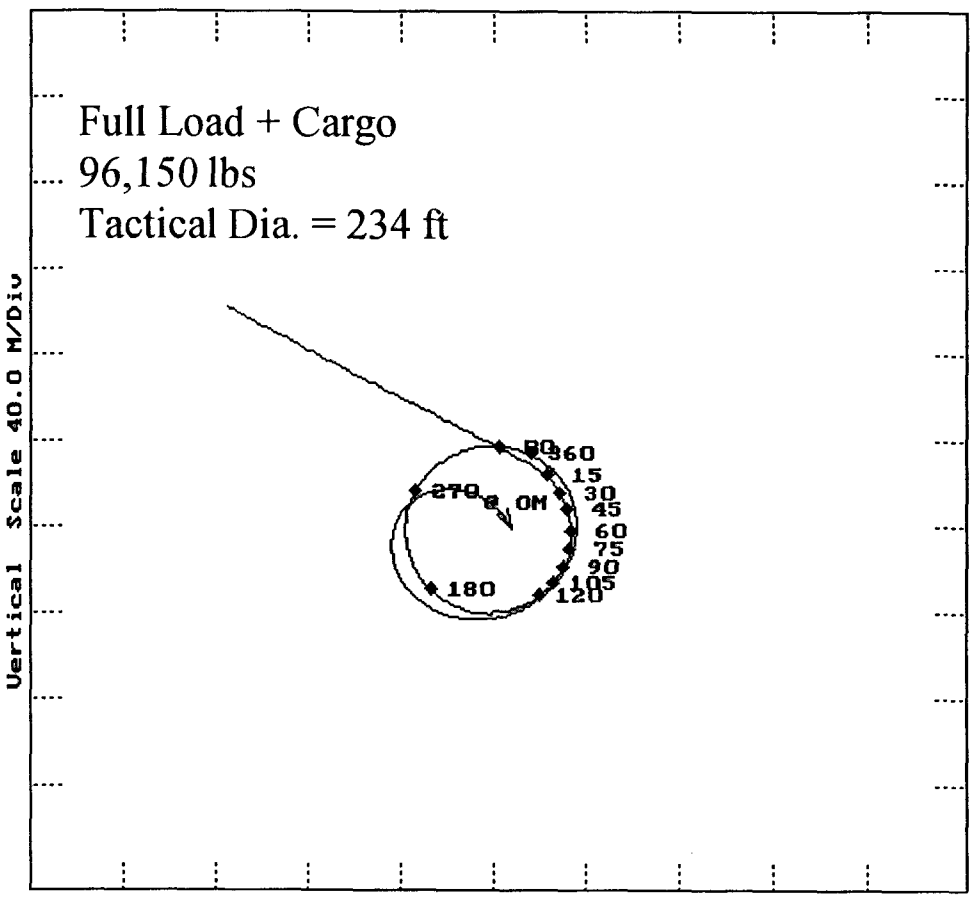
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
15:17:56
Starboard
Maneuver # 13
20 Rudder
at 1250.0 Kts
Position Plt
Plot Center:
39 14.4 N
76 33.0 W
Set 0.0 Deg
Drift 0.1Kts

BUSL 49403 8 Sept 1997
(1250 ERPM 35 deg Stbd Turn)

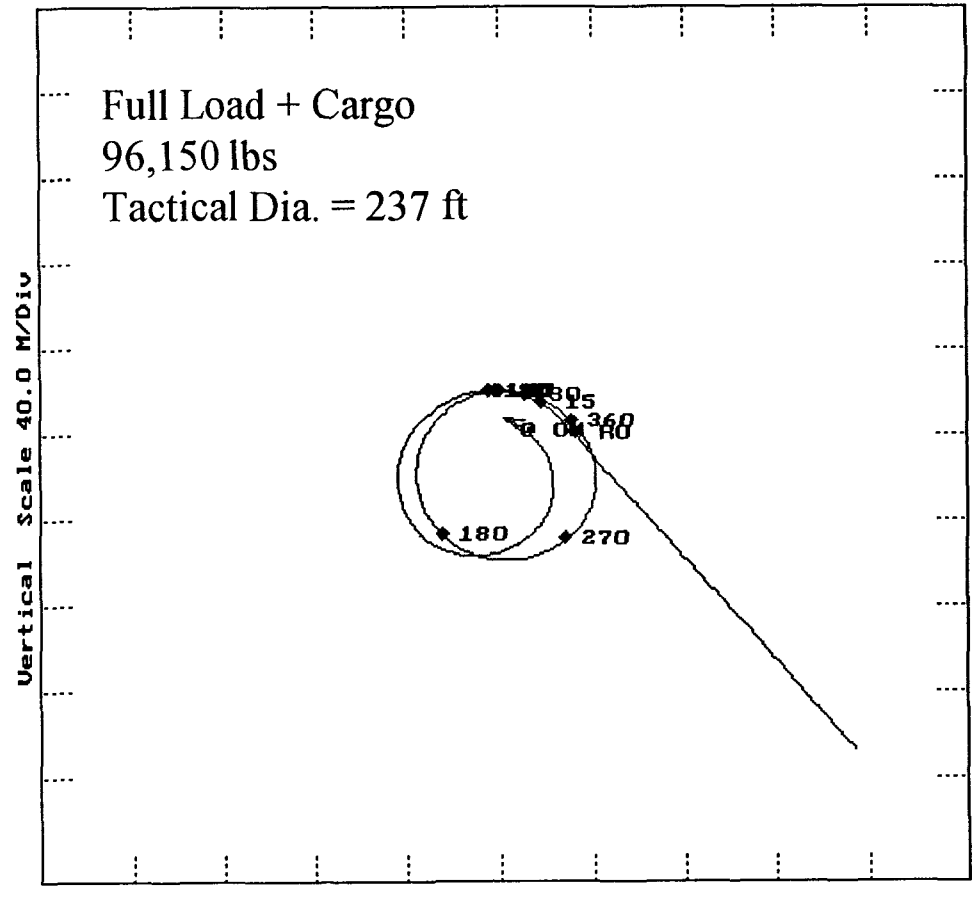
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
10:32:14
Starboard
Maneuver # 1
35 Rudder
at 1250.0 Kts
Position Plt
Plot Center:
39 14.0 N
76 32.5 W
Set 15.0 Deg
Drift 0.2Kts

BUSL 49403 8 Sept 1997
(1250 ERPM 35 deg Port Turn)

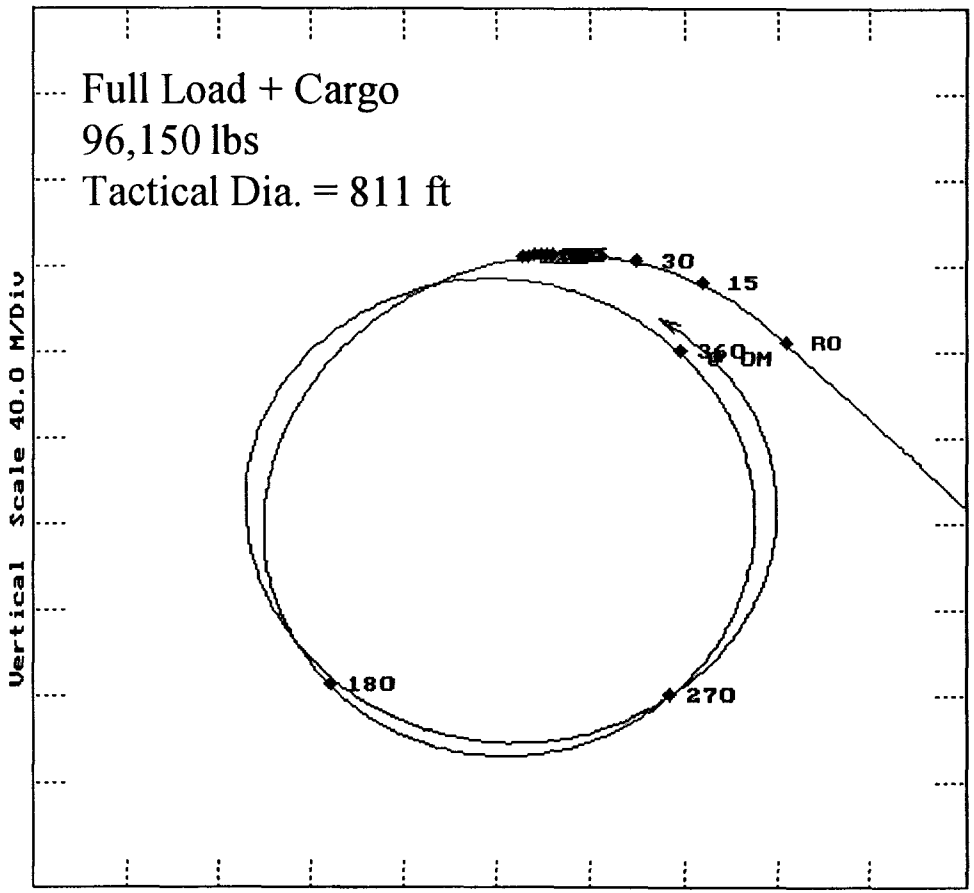
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
10:39:31
Port
Maneuver # 2
35 Rudder
at 1250.0 Kts
Position Plt
Plot Center:
39 14.0 N
76 32.4 W
Set 270.0 Deg
Drift 0.1Kts

BUSL 49403 8 Sept 1997
(2500 ERPM 10 deg Port Turn)

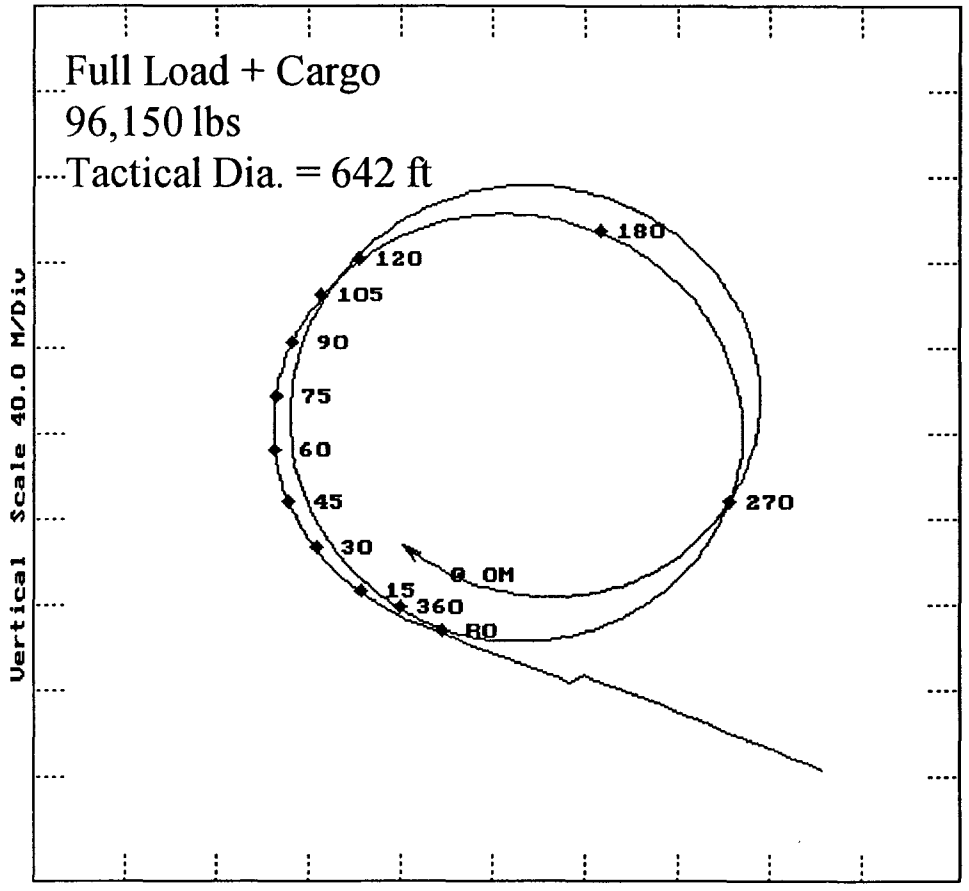
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
10:45:14
Port
Maneuver # 3
10 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.1 N
76 32.6 W
Set 0.0 Deg
Drift 0.3Kts

BUSL 49403 8 Sept 1997
(2500 ERPM 10 deg Stbd Turn)

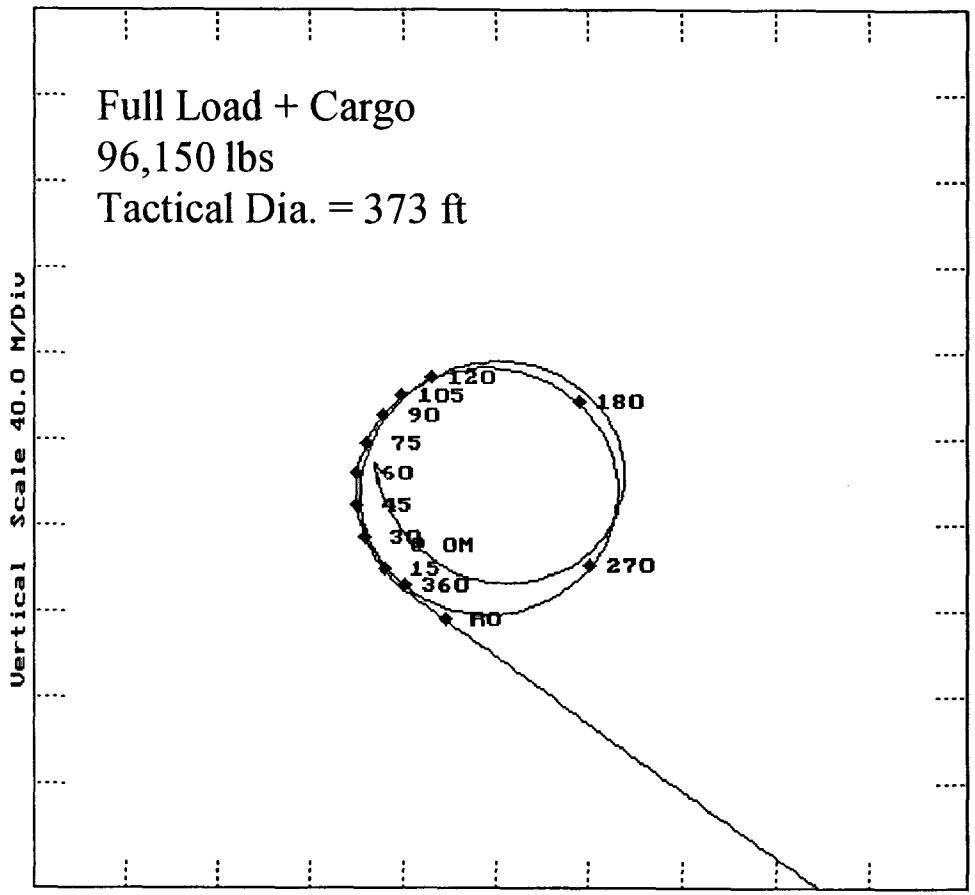
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
10:51:24
Starboard
Maneuver # 4
10 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.3 N
76 32.9 W
Set 240.0 Deg
Drift 0.2Kts

BUSL 49403 8 Sept 1997
(2500 ERPM 20 deg Stbd Turn)

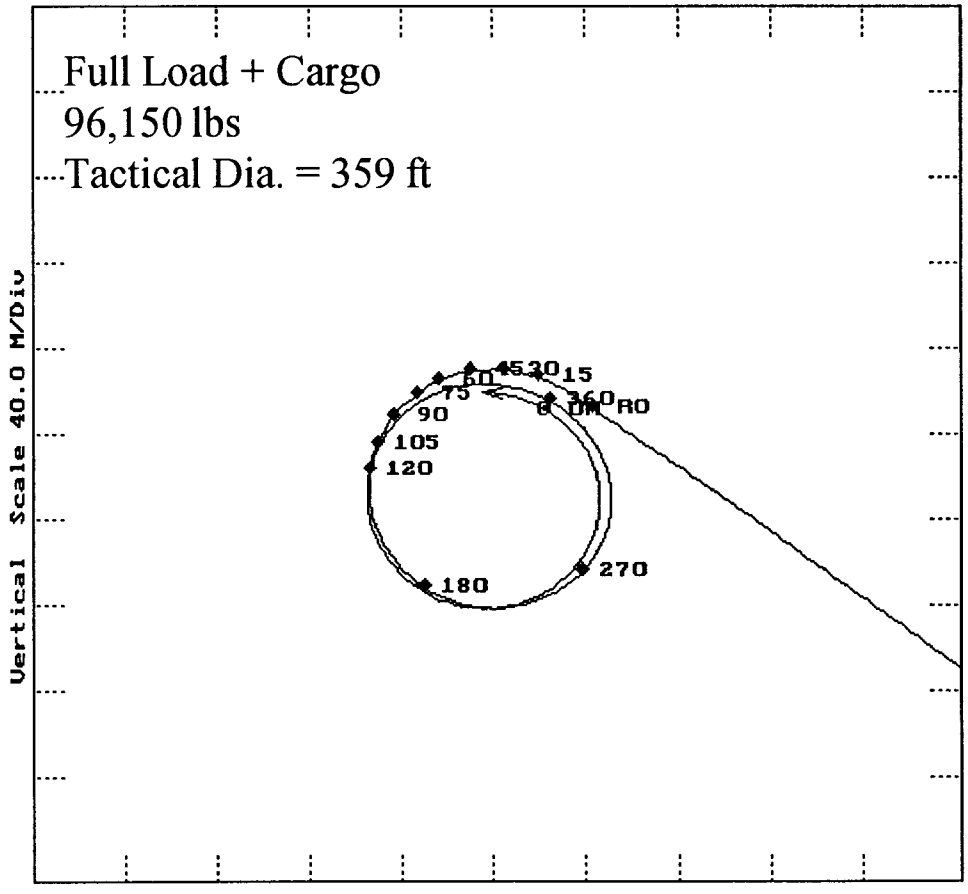
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
10:56:38
Starboard
Maneuver # 5
20 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.4 N
76 33.2 W
Set 200.0 Deg
Drift 0.2Kts

BUSL 49403 8 Sept 1997
(2500 ERPM 20 deg Port Turn)

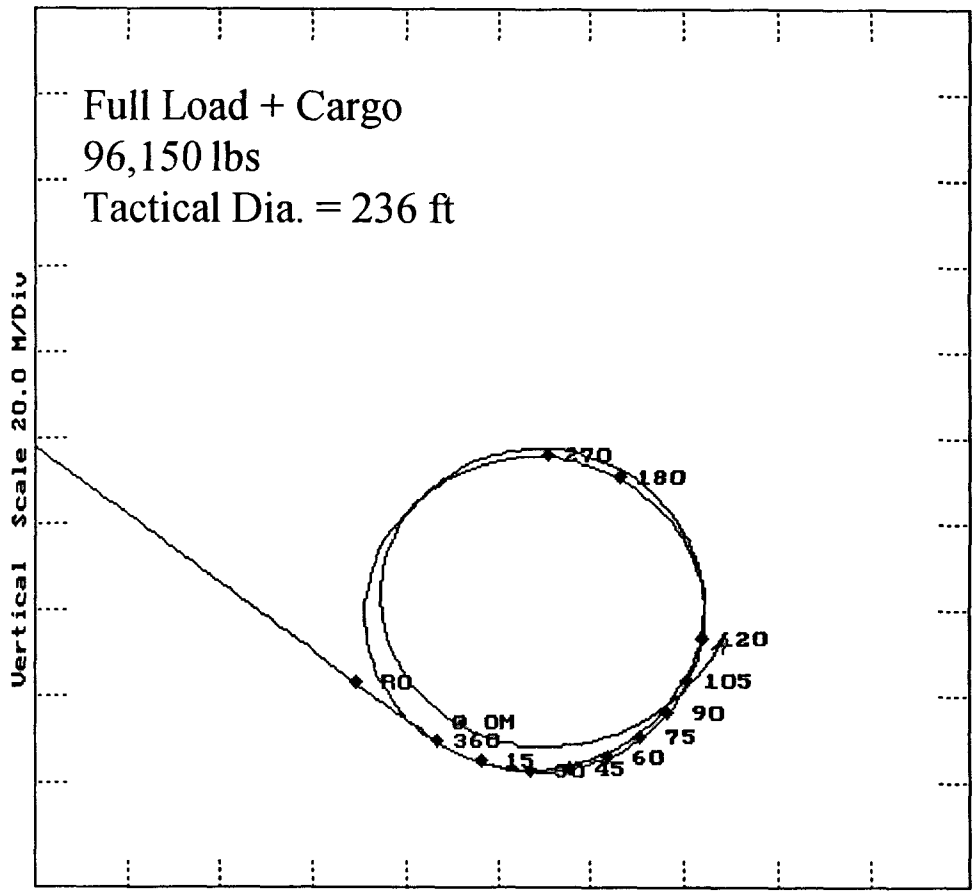
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
11:01:05
Port
Maneuver # 6
20 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.7 N
76 33.3 W
Set 0.0 Deg
Drift 0.3Kts

BUSL 49403 8 Sept 1997
(2500 ERPM 35 deg Port Turn)

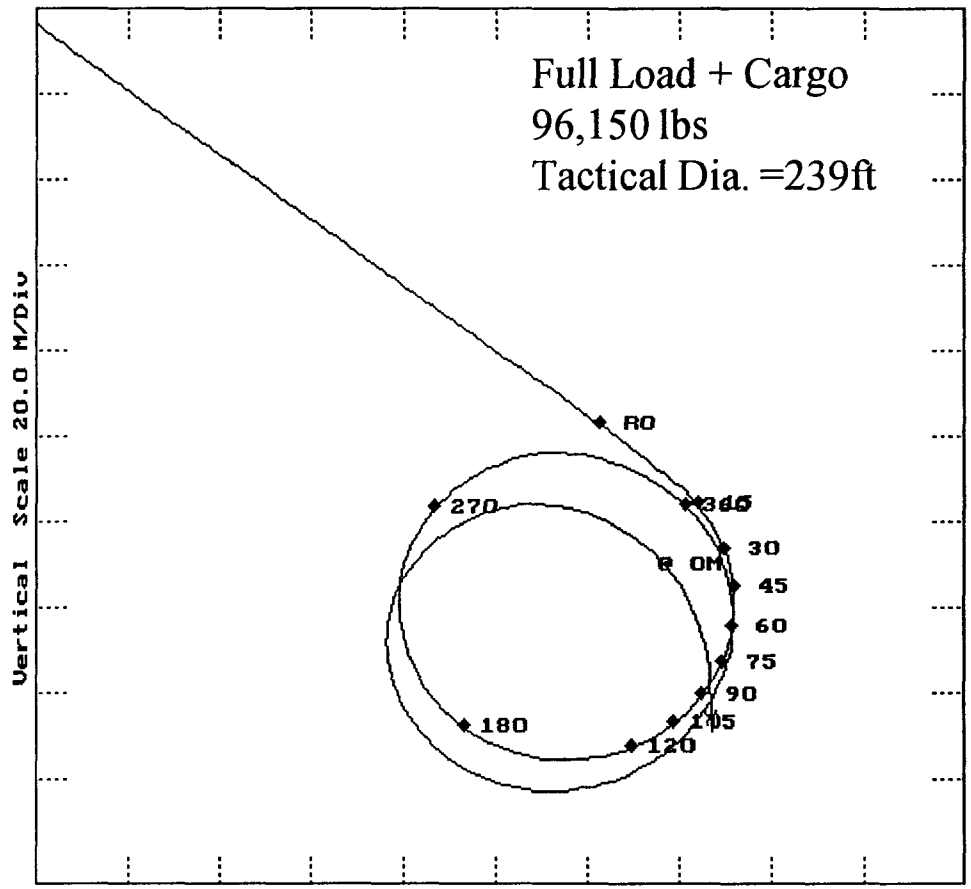
(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp



8 September 1997
11:04:56
Port
Maneuver # 7
35 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.7 N
76 33.5 W
Set 200.0 Deg
Drift 0.3Kts

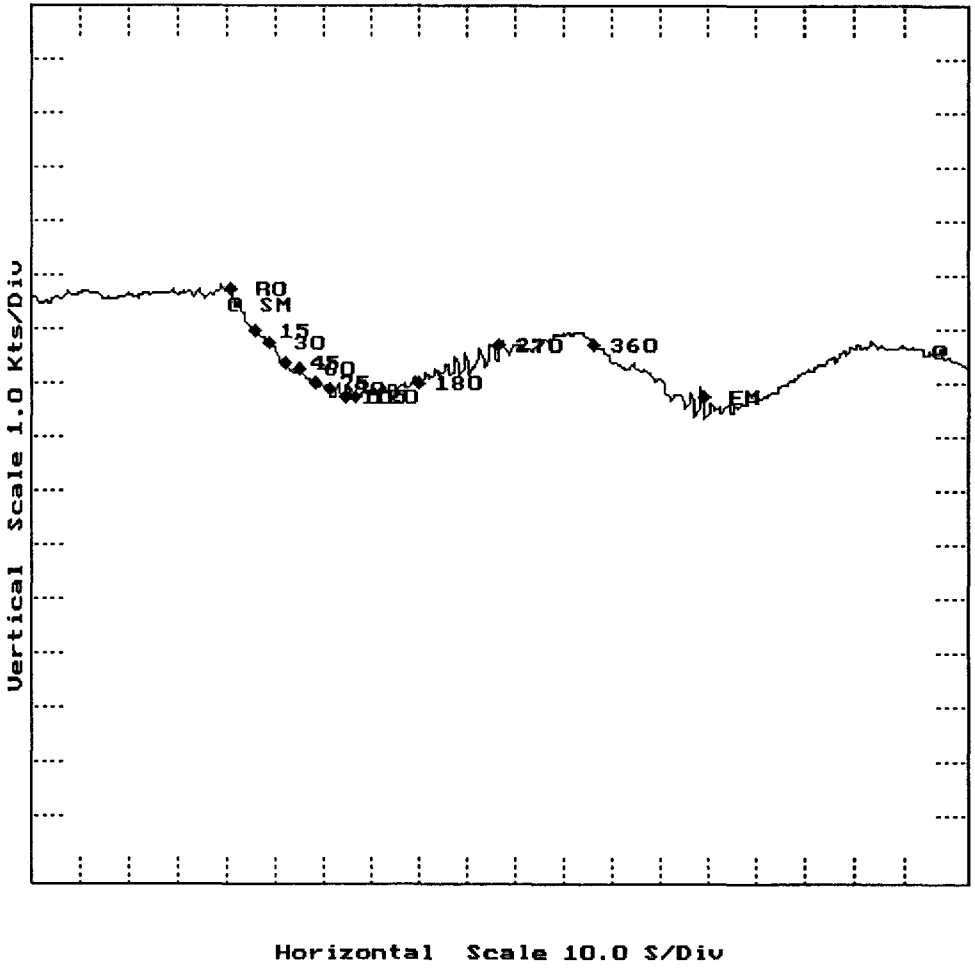
BUSL 49403 8 Sept 1997
(2500 ERPM 35 deg Stbd Turn)

(P)rint screen
(L)ist stats
(V)iew stats
(R)eturn to main
(D)isplay labels
(M)ark display
(H)elp

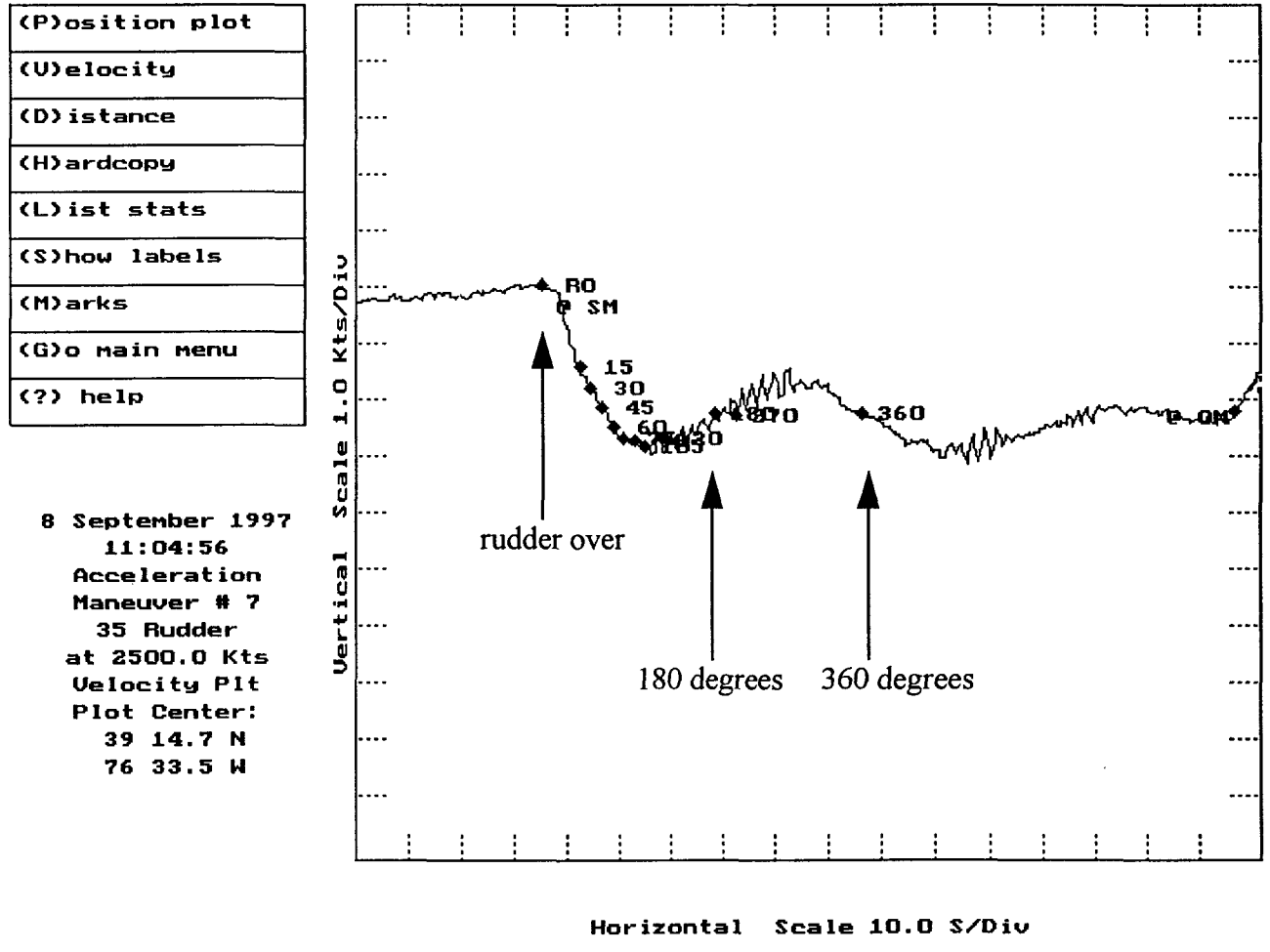


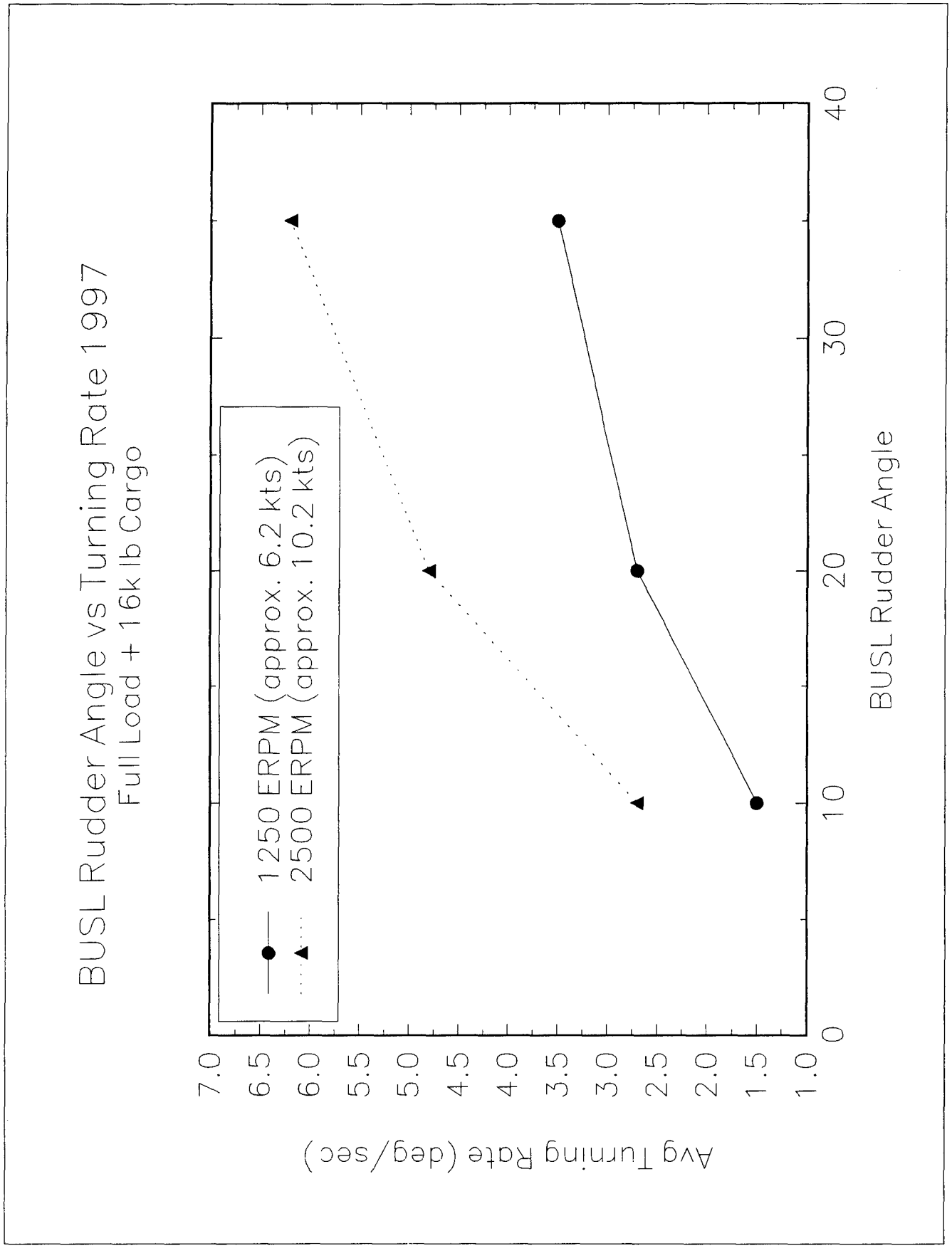
8 September 1997
11:08:50
Starboard
Maneuver # 8
35 Rudder
at 2500.0 Kts
Position Plt
Plot Center:
39 14.6 N
76 33.2 W
Set 0.0 Deg
Drift 0.1Kts

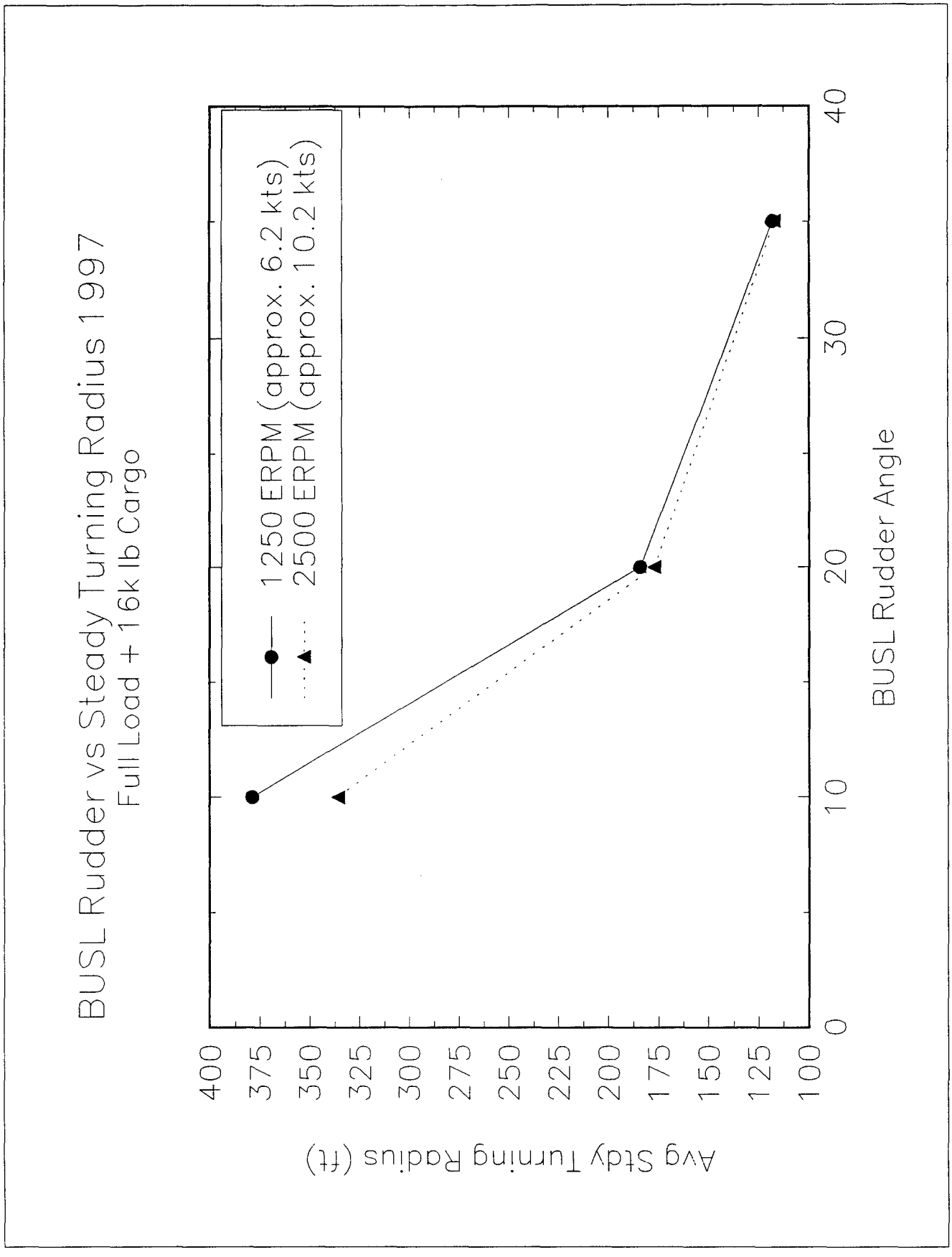
BUSL 49403 8 Sept 1997
(Example of Speed Profile for a 2500 ERPM 20 deg Port Turn)

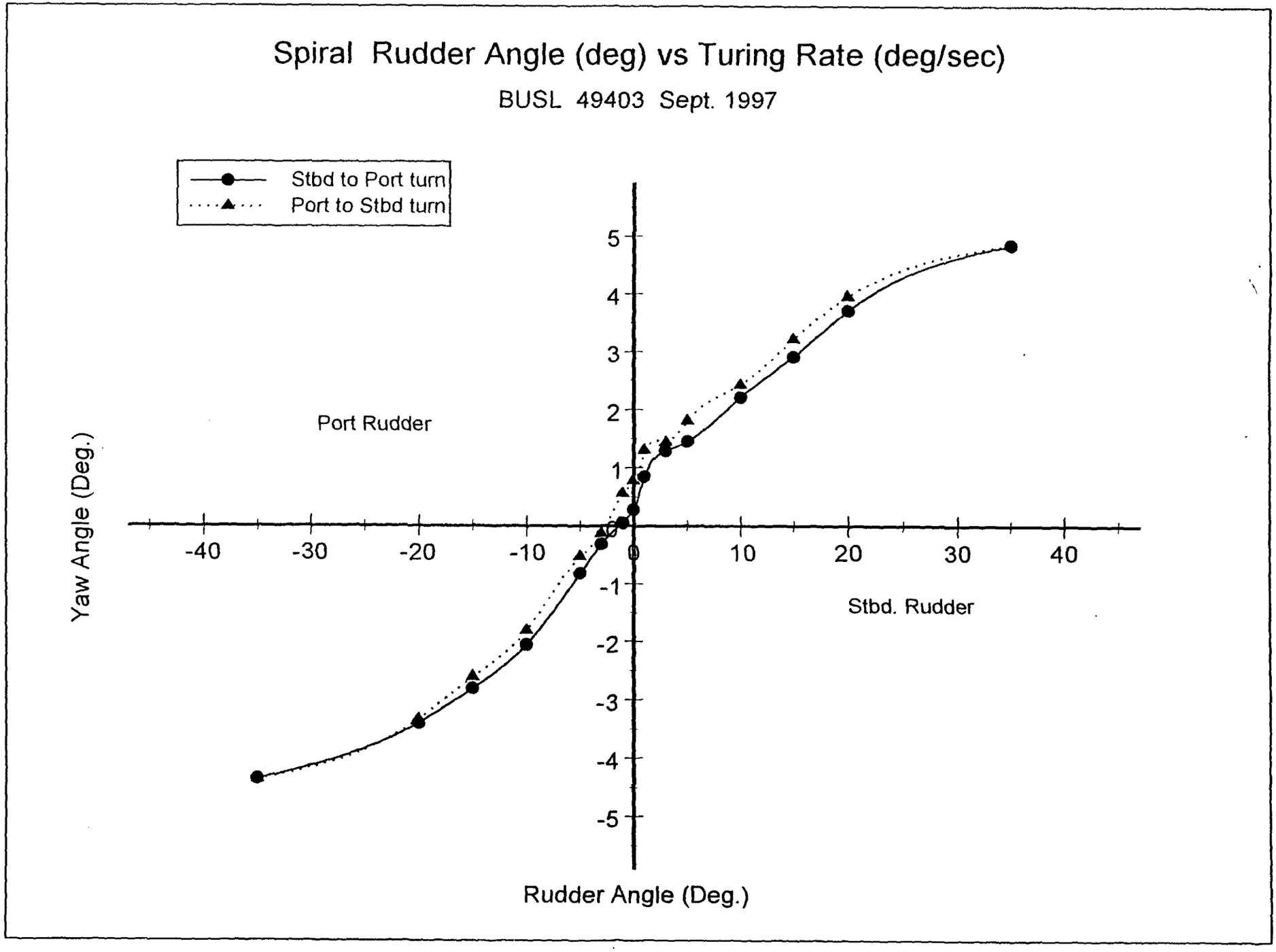


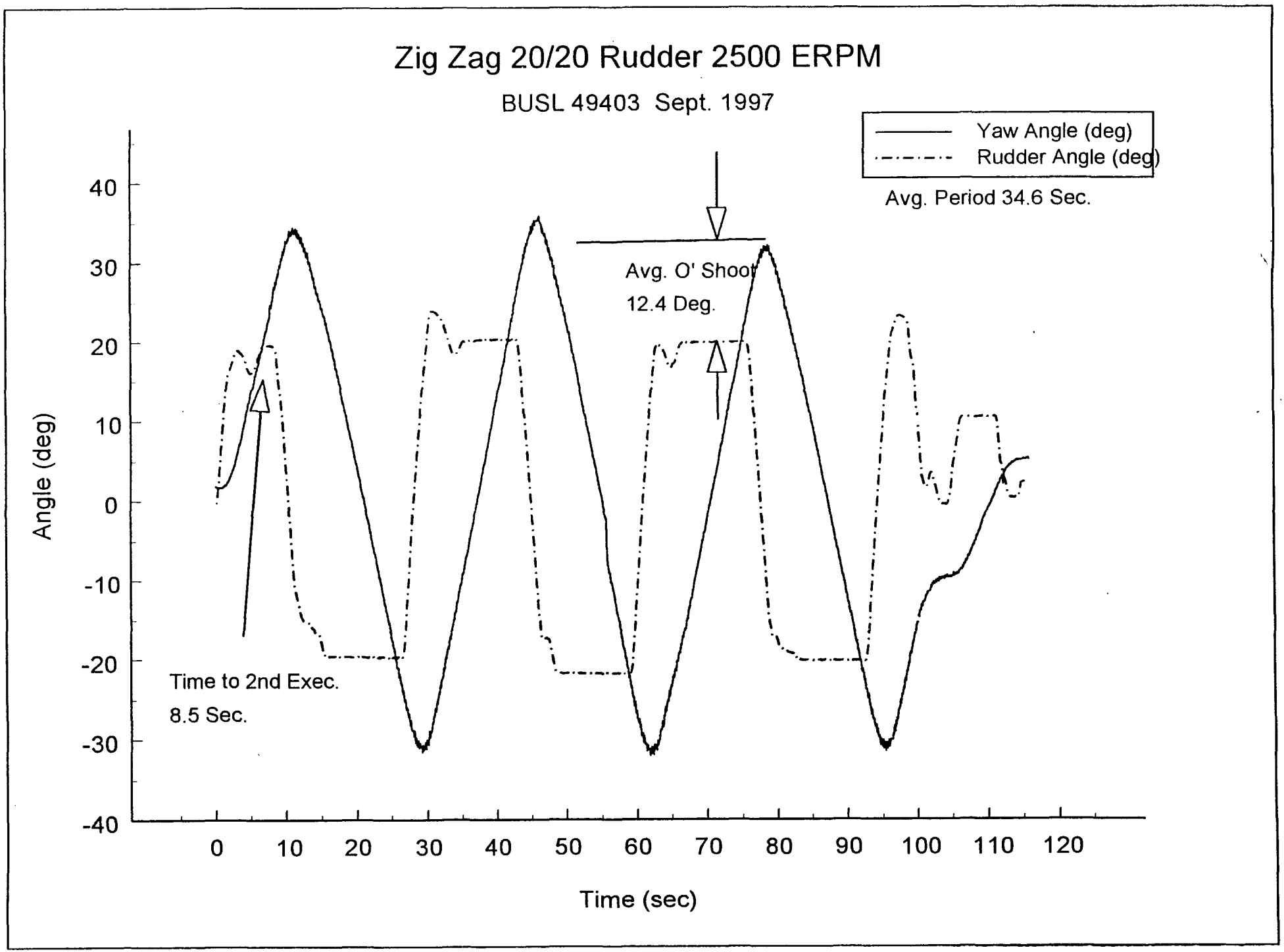
BUSL 8 Sept 1997
(Example of Speed Profile in a 2500 ERPM 35 deg Port Turn)




BUSL Rudder Angle vs Turning Rate 1997
Full Load + 16k lb Cargo
1250 ERPM (approx. 6.2 kts)
2500 ERPM (approx. 10.2 kts)
Avg Turning Rate (deg/sec)
BUSL Rudder Angle
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
10
20
30
40

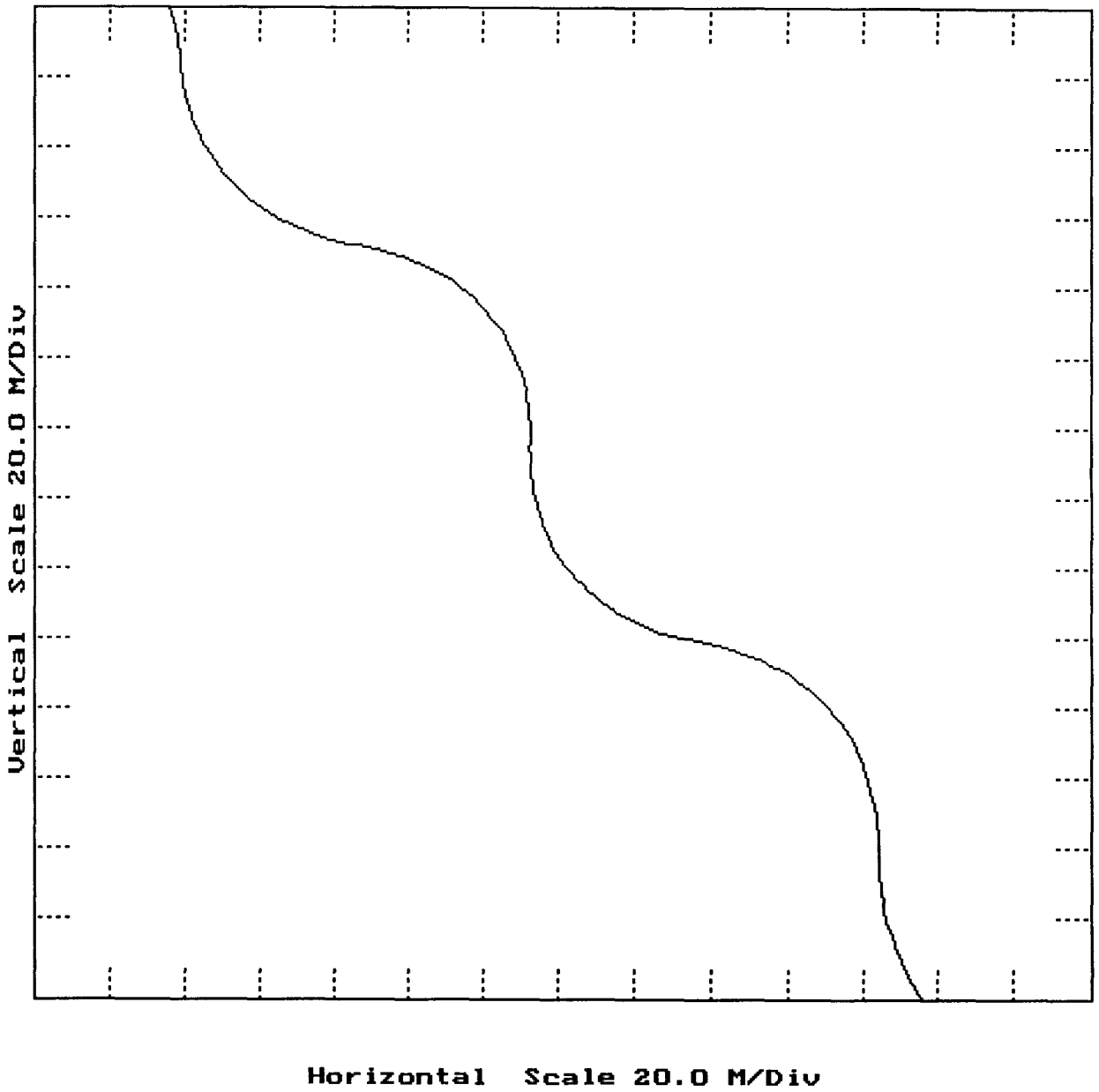

BUSL Rudder vs Steady Turning Radius 1997
Full Load + 16k lb Cargo
1250 ERPM (approx. 6.2 kts)
2500 ERPM (approx. 10.2 kts)
Avg Stdy Turning Radius (ft)
400
375
350
325
300
275
250
225
200
175
150
125
100
0
10
20
30
40
BUSL Rudder Angle

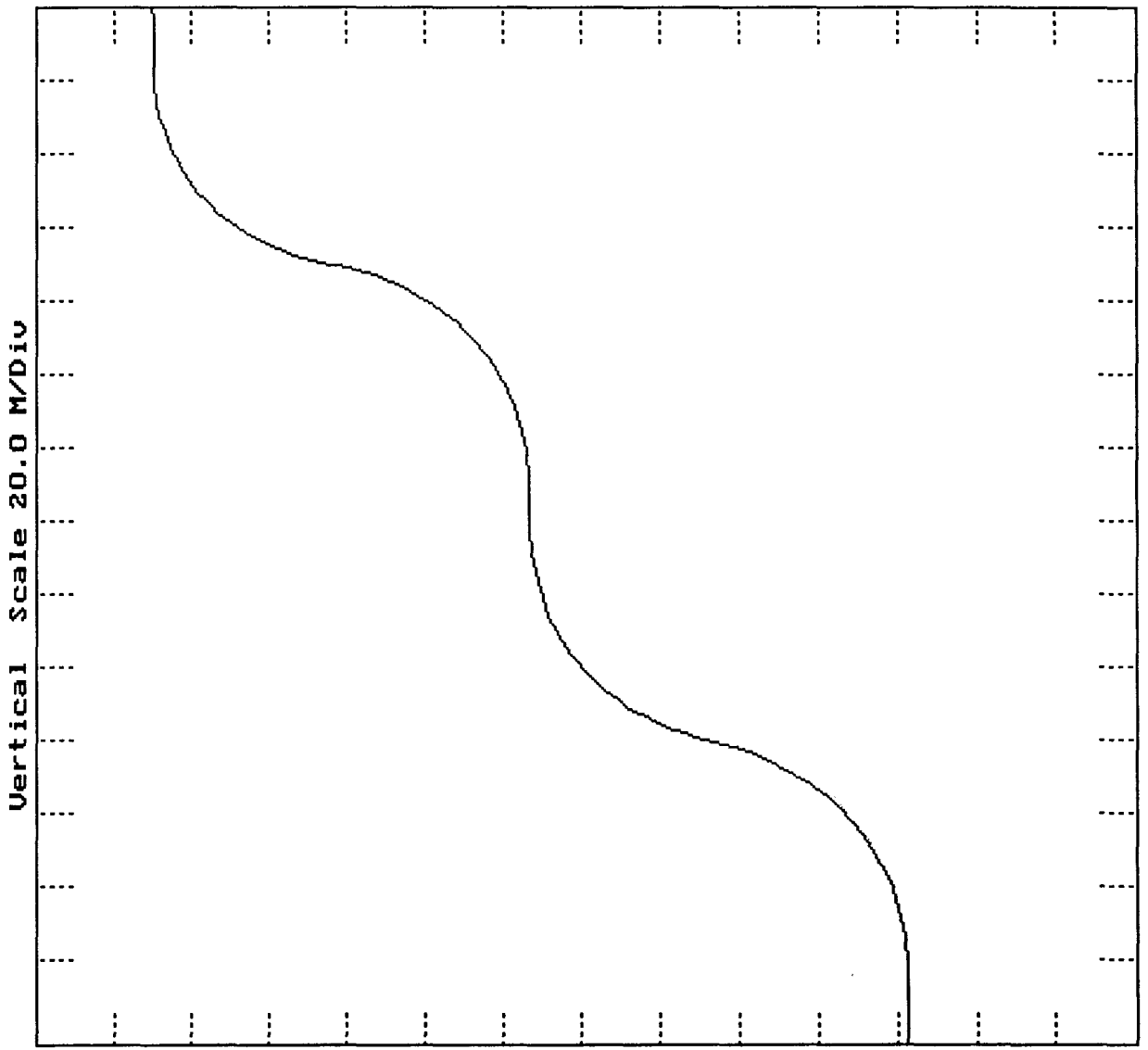

Spiral Rudder Angle (deg) vs Turing Rate (deg/sec)
BUSL 49403 Sept. 1997
Stbd to Port turn
Port to Stbd turn
Port Rudder
Stbd. Rudder
Yaw Angle (Deg.)
Rudder Angle (Deg.)
5
4
3
2
1
-1
-2
-3
-4
-5
-40
-30
-20
-10
0
10
20
30
40


Zig Zag 20/20 Rudder 2500 ERPM
BUSL 49403 Sept. 1997
Yaw Angle (deg)
Rudder Angle (deg)
Avg. Period 34.6 Sec.
Avg. O' Shoot
12.4 Deg.
Time to 2nd Exec.
8.5 Sec.
Angle (deg)
Time (sec)
40
30
20
10
0
-10
-20
-30
-40
0
10
20
30
40
50
60
70
80
90
100
110
120

8 September 1997
13:54:09
Acceleration
Maneuver # 1
0 Rudder
at 10.0 Kts
Position Plt
Plot Center:
39 14.4 N
76 33.1 W

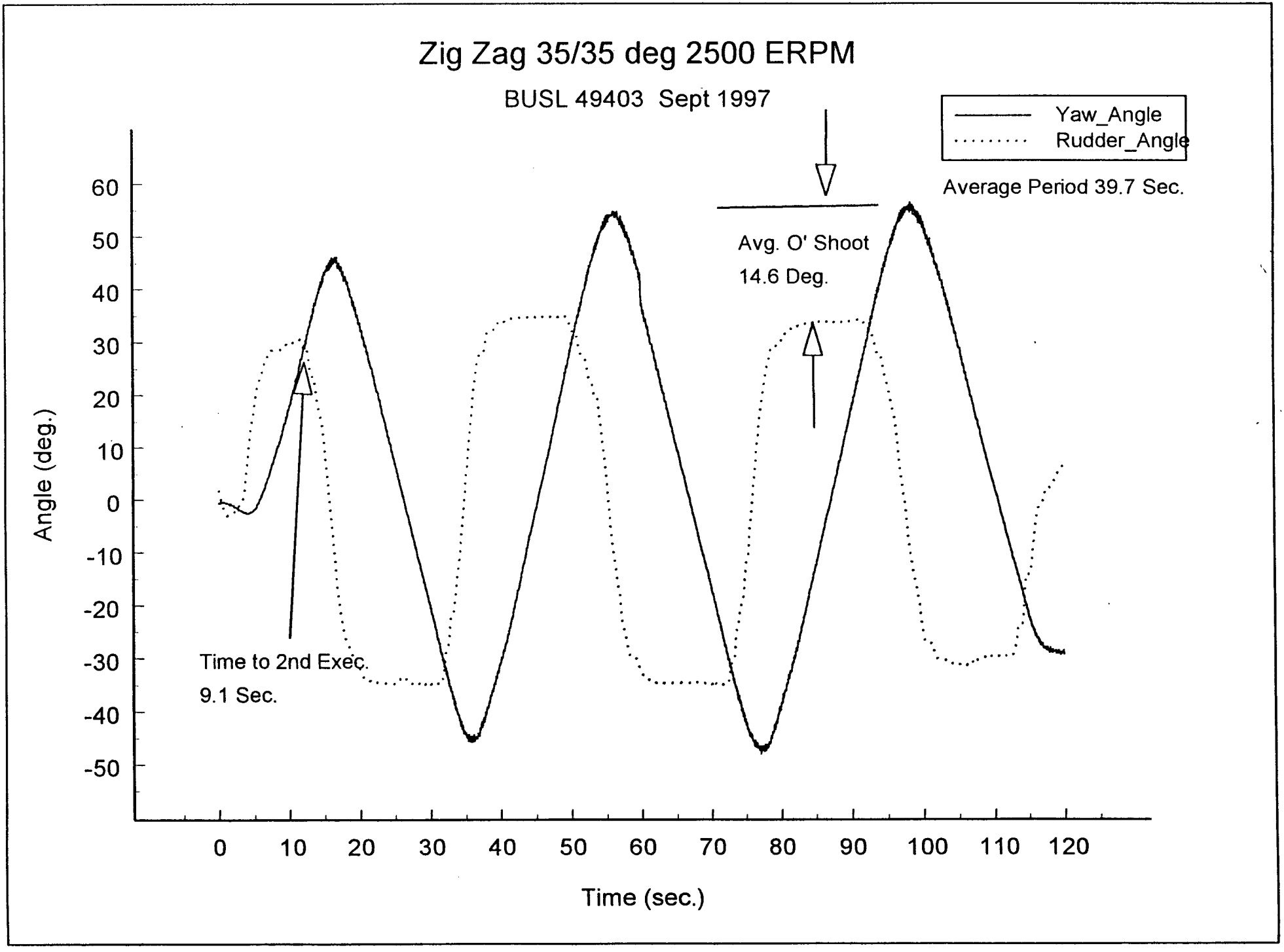
20°/20° RUDDER
20°/20° YAW
DIR. A

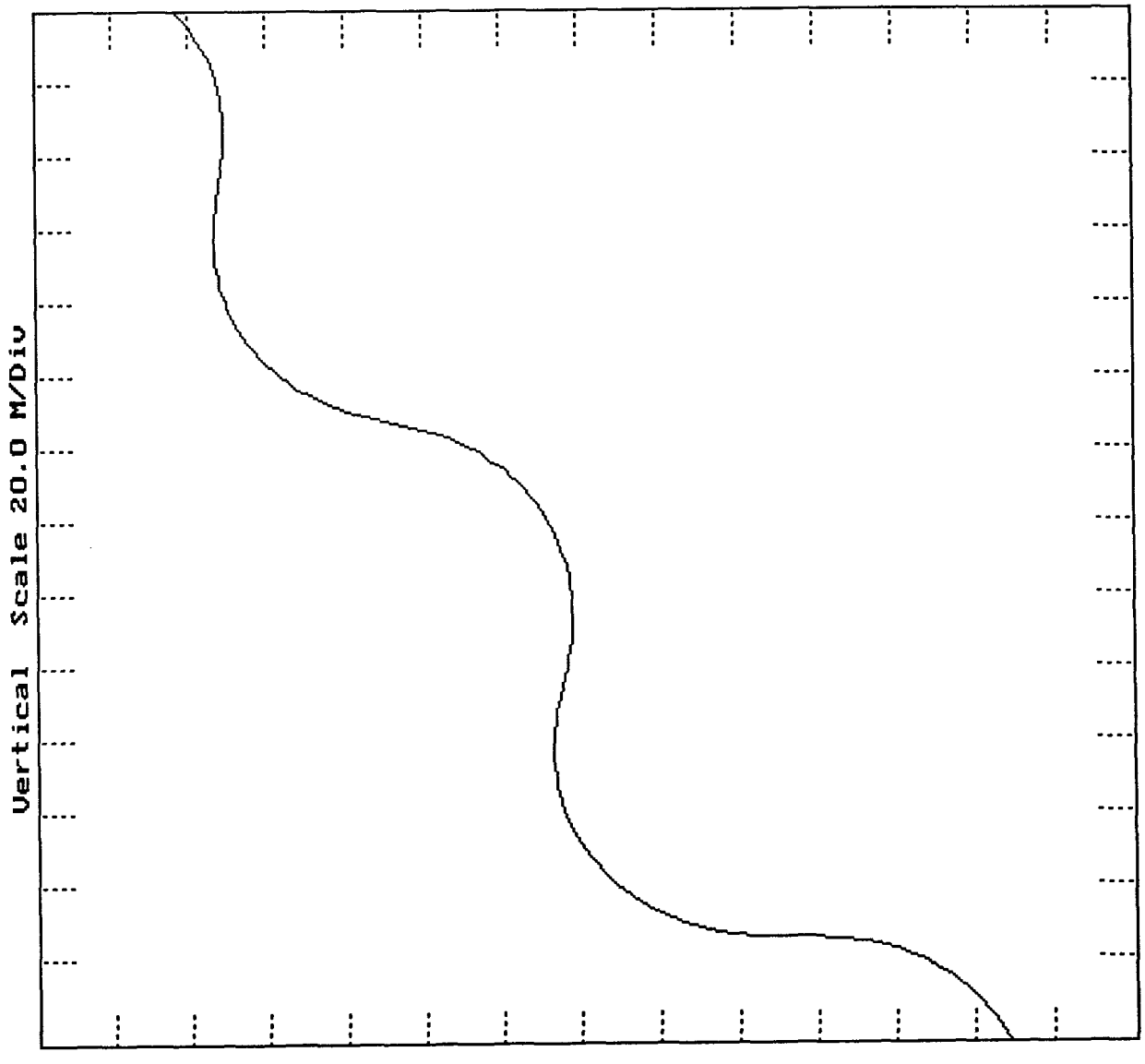




8 September 1997
13:59:41
Starboard
Maneuver # 2
0 Rudder
at 10.0 Kts
Position Plt
Plot Center:
39 14.7 N
76 33.4 W

20°/20° RUDDER
20°/20° YAW
DIR. B

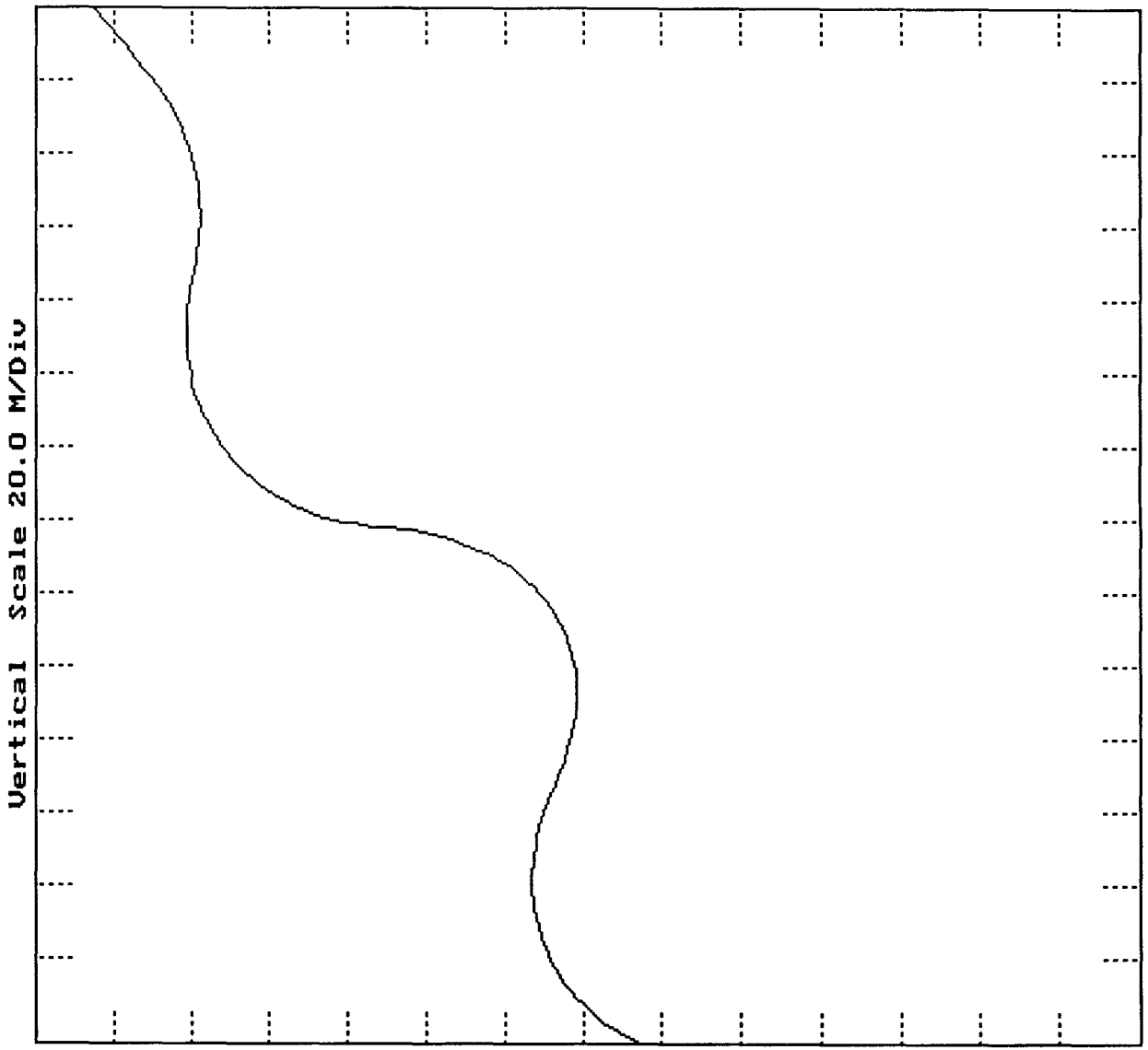

Zig Zag 35/35 deg 2500 ERPM
BUSL 49403 Sept 1997
Yaw_Angle
Rudder_Angle
Average Period 39.7 Sec.
Avg. O' Shoot
14.6 Deg.
Time to 2nd Exec.
9.1 Sec.
Angle (deg.)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
10
20
30
40
50
60
70
80
90
100
110
120
Time (sec.)



8 September 1997
14:25:56
Acceleration
Maneuver # 7
0 Rudder
at 10.0 Kts
Position Plt
Plot Center:
39 14.4 N
76 33.2 W

35°/35° RUDDER
20°/20° YAW
DIR. A

8 September 1997
14:34:39
Acceleration
Maneuver # 9
0 Rudder
at 10.0 Kts
Position Plt
Plot Center:
39 14.4 N
76 33.2 W



35°/35° RUDDER
20°/20° YAW
DDR B

- **Turning rate vs Rudder Angle**

  Average Turning Rates in Degrees per Second for BUSL 49403.
  Data Taken From Spiral Curve Data, September 1997

Rudder Angle Degrees	Turn Rate Deg./Sec.
35	4.61
20	3.61
15	2.89
10	2.13
5	1.15
3	0.80
1	0.69

- **Average Rudder Time from 35 Degrees Port to 35 Degrees Starboard**

  Average Rudder Time in seconds, as taken from the 35 deg. Zig Zag maneuver in manual mode 10.4 Sec.

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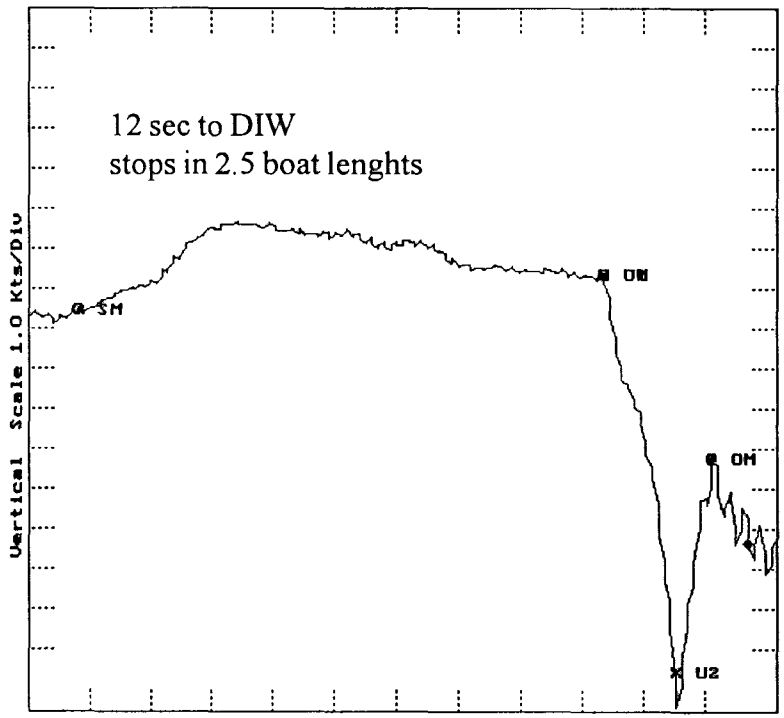
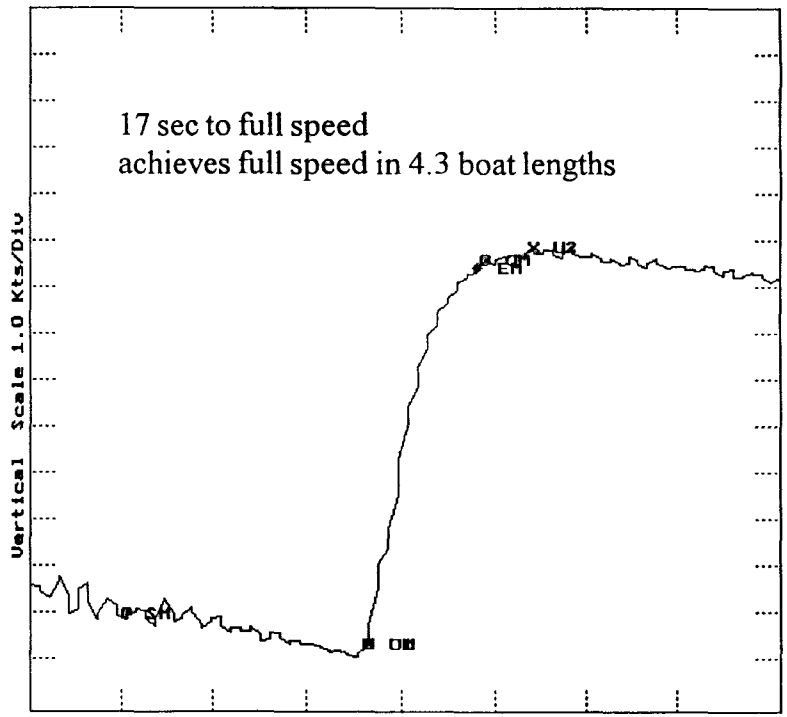
Appendix D
Acceleration/Crash Stop Trials Data

BUSL 9 Sept 1997
(Acceleration and Crash Stop - One Direction Only)





DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	STEERING TRIAL		
(d) (3)	Contractor to provide report of rudder angle rate and times. Attach to memo as Attachment D.		
(d) (4)	Manual Steering Mode	Satisfactory	SAT DPS.
(d) (5)	Aft Helm Mode	Satisfactory	SAT DPS
	EMERGENCY STOP TRIAL		
(e) (1)	Time for Throttle Movement from Full Ahead to Full Astern	≤ 4 seconds	2 sec
(e) (2)	Movement of Engines Resulting from Emergency Stop "FOR INFORMATIONAL PURPOSES"	N/A N/A	Port From Full Ahead to Full Astern Stbd •200 Both P+S DDS 9.4.97
(e) (3)	Verify the Following:		
	Engine Mount Adequacy	Satisfactory	OK
	Propulsion Control Response	Satisfactory	OK
	Stalling of Engines	No	NO
	Lube Oil System Leaks	None	NONE
	Fuel Oil System Leaks	None	NONE
	Exhaust System Leaks	None	NONE
	Foundation Structural Defects	None	NONE

[BLANK]

Appendix E
Bollard Pull Data

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. ____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. ____
PAGE 14 OF 22
REV DATE 08/18/97

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS
	BOLLARD PULL		
(f) (2)	Engine Speed	≤ 2500 RPM	
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	
	Engine Oil Temperature	180-250 deg F	
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	
(f) (4)	Engine Speed	≤ 2500 RPM	
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	
	Engine Oil Temperature	180-250 deg F	
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	
	STEP (f)(7) FOR HULL 49403 ONLY		
(f) (7)	Load Cell Reading @ 1300 RPM	≤ 12,000 lbs	3790 lbs
	Load Cell Reading @ 1600 RPM	≤ 12,000 lbs	5740 lbs
	Load Cell Reading @ 1900 RPM	≤ 12,000 lbs	8120 lbs
	Load Cell Reading @ 2200 RPM	≤ 12,000 lbs	10330 lbs
	Load Cell ~~Reading @ 2500 RPM~~	~~≤ 12,000 lbs~~	N/A
	MAX ERPM OBTAINED 2300		11086 lbs
	If Load Cell Reading Reaches 12,000 lbs Before 2500 RPM Record Engine RPM	≤ 2500 RPM	
	LOAD CELL DID NOT REACH 12K lbs		

TEST MEMORANDUM

U.S. COAST GUARD YARD

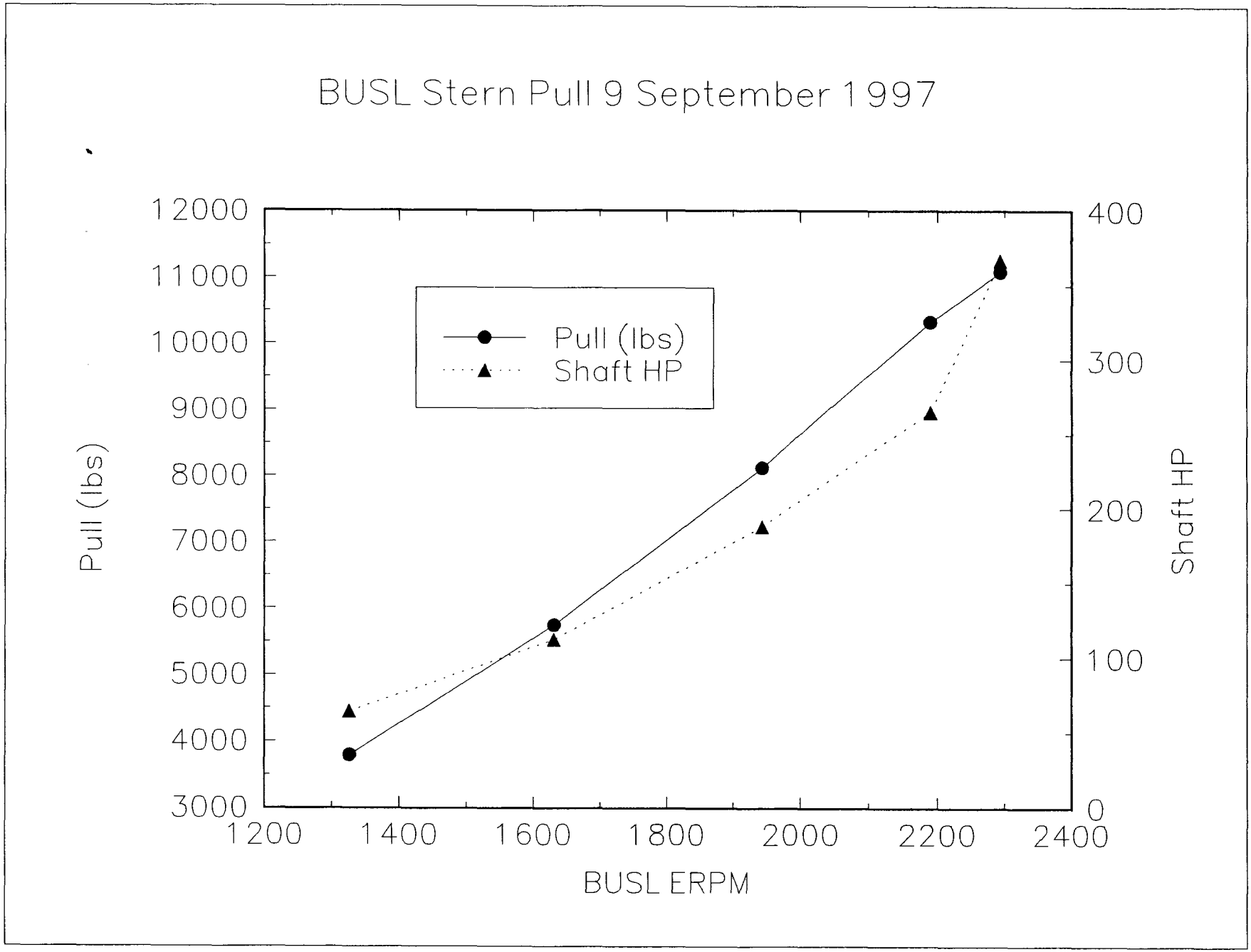
HULL NO. ______
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. ______

REV DATE 08/18/97

DATA SHEET

STEP	DATA OR FUNCTION	EXPECTED RESULTS	ACTUAL RESULTS PORT	ACTUAL RESULTS STBD
	BOLLARD PULL			
(f) (2)	Engine Speed	≤ 2500 RPM	2242	2314
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	70	65
	Engine Oil Temperature	180-250 deg F	130	120
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	175 (*)	170 (*)
(f) (4)	Engine Speed	≤ 2500 RPM	2328	2379
	Engine Oil Pressure(SF15 GAUGE)	30-70 psig	70	70
	Engine Oil Temperature	180-250 deg F	135	140
	Engine JW Temp (SR200 GAUGE)	155-185 deg F	152	165
	STEP (f)(7) FOR HULL 49403 ONLY			
(f) (7)	~~Load Cell Reading @ 1300 RPM~~	~~≤ 12,000 lbs~~		
	~~Load Cell Reading @ 1600 RPM~~	~~≤ 12,000 lbs~~		
	~~Load Cell Reading @ 1900 RPM~~	~~≤ 12,000 lbs~~		
	~~Load Cell Reading @ 2200 RPM~~	~~≤ 12,000 lbs~~		
	~~Load Cell Reading @ 2500 RPM~~	~~≤ 12,000 lbs~~		
	~~If Load Cell Reading Reaches 12,000 lbs Before 2500 RPM Record Engine RPM~~	~~≤ 2500 RPM~~		

(*) [illegible]


BUSL Stern Pull 9 September 1997
Pull (lbs)
Shaft HP
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
400
300
200
100
0
1200
1400
1600
1800
2000
2200
2400
BUSL ERPM

DEPT. OF TRANSPORTATION
U.S. COAST GUARD
CGYARD-229 (Rev. 12/96)

INTRA-YARD CORRESPONDENCE

Sheet 1 of 1

Office Code X-23
File Code
Date 9-23-97

Form may be prepared with ball point pen or pencil - Typing is not required

FROM:
DON SHIELDS X-23

SUBJECT:
RETEST OF BOLLARD PULL ON 49403

TO:
- ☐ Commanding Officer, YARD
- ☐ Industrial Manager
- ☐ Financial Manager
- ☐ Support Manager
- ☐ Quality Manager
- ☐ Chief, _____ Dept.
- ☐ Chief, _____ Div.
- ☐ Shop Head _____
- ☒ (Specify) T.K. TURNER

VIA:
- ☐ Industrial Manager
- ☐ Financial Manager
- ☐ Support Manager
- ☐ Quality Manager
- ☐ Chief, _____ Dept.
- ☐ Chief, _____ Div.
- ☒ Shop Head J. RICE
- ☐ (Specify) _____

ACTION/RESPONSE

ON 9-22-97 WE RETESTED THE BOLLARD PULL ON 49403 WITH THE FOLLOWING RESULTS;

	PORT	STBD
ENGINE SPEED	2215	2210
ENGINE OIL PSI (SF15)	55	55
" " (SF10)	55	55
ENGINE L/O TEMP.	130	130
ENGINE J/W TEMP. (SR200)	200	208
" " (SR205)	185	195
TRANS. GEAR OIL PSI	340	325

TESTING HELD FOR TEN MINUTES.

ALL READINGS TAKEN AT LOCAL GAUGE BOARDS AS THE P/H GAUGE BOARDS DO NOT READ PROPERLY.

OFFICE OR DIVISION	10 345				
INITIALS OF RESPONSIBLE OFFICERS					
DATE	9/23/97				

ACTION & DISTRIBUTION

Originator - Forward original to addressee for action (through the chain of command) if applicable. Retain copy for file.

Addressee - Write response on 229 and return to originator. Retain copy for file.

[BLANK]

Appendix F
Noise Data

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 15 OF 22
REV DATE 08/18/97

DATA SHEET	BUSL 49403 8 SEPTEMBER 1997									
	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA

1	PILOTHOUSE APPROXIMATE CENTER OF COMPARTMENT									
MAX ALLOWABLE	90	84	79	76	N/A	N/A	N/A	N/A	N/A	76
FULL POWER RESULTS	80.7	81.4	72.4	67.9	L	L	L	L	L	67.9 (70.4 / 65.6)
	80.3	83.0	74.0	64.5	L	L	L	L	L	67.5 (68.3 / 65.5)
MAX ALLOWABLE	90	84	79	76	N/A	N/A	N/A	N/A	N/A	70
BUOY OPS RESULTS										

BUOY HYDRAULICS NOT YET INSTALLED

LOCATION

FULL POWER MEASUREMENT #1- ONE FOOT ABOVE CHART TABLE CENTER

FULL POWER MEASUREMENT #2- ONE FOOT ABOVE CHART TABLE CENTER

BUOY OPS MEASUREMENT #1- _____

BUOY OPS MEASUREMENT #2- _____

"L" - UNDER RANGE OF SOUND LEVEL METER

WINDOWS WERE CLOSED & AC ON

FULL LOAD + CARGO 2500 RPM

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 16 OF 22
REV DATE 08/18/97

DATA SHEET	BUSL 49403 @ SEPTEMBER 1997									
	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA

2	BERTHING AREA APPROXIMATE CENTER OF COMPARTMENT									
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
FULL POWER RESULTS	75.3	84.9	73.2	75.4	62.2	62.4	L	L	L	68.4
	76.3	87.4	75.4	74.8	62.3	64.4	L	L	L	68.7
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
BUOY OPS RESULTS										

69.0 / 66.3
74.2 / 66.6

BUOY HYDRAULICS NOT YET INSTALLED

LOCATION

FULL POWER MEASUREMENT #1- CENTER OF COMPARTMENT

FULL POWER MEASUREMENT #2- CENTER OF COMPARTMENT

BUOY OPS MEASUREMENT #1- _____

BUOY OPS MEASUREMENT #2- _____

"L" - UNDER RANGE OF SOUND LEVEL METER
DOOR CLOSED & AC ON
FULL LOAD + CARGO 2500 RPM

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 17 OF 22
REV DATE 08/18/97

DATA SHEET BOSL 49403 & SEPTEMBER 1997

	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA
3	BERTHING AREA HEAD OF EACH BERTH									
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
FULL POWER RESULTS 1 (PORT TOP)	81.8	96.8	84.6	68.6	L	L	L	L	L	72.9 (74.3 / 70.0)
2 (PORT BOTTOM)	81.8	96.5	89.7	74.1	62.8	L	L	L	L	74.5 (75.4 / 72.4)
3 (STBD TOP)	85.2	98.9	84.2	68.9	L	L	L	L	L	74.9 (77.9 / 70.2)
4 (STBD BOTTOM)	75.7	91.0	86.9	73.3	64.9	63.1	L	L	L	73.3 (75.5 / 71.1)
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
BUOY OPS RESULTS 1										
2	BUOY HYDRAULICS NOT YET INSTALLED									
3										
4										

"L" - UNDER RANGE OF SOUND LEVEL METER AC ON

FULL LOAD + CARGO 2500 RPM LOCATION

FULL POWER MEASUREMENT #1- ONE FOOT ABOVE HEAD PLACEMENT

FULL POWER MEASUREMENT #2- ON BERTH

BUOY OPS MEASUREMENT #1- _____

BUOY OPS MEASUREMENT #2- _____

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 18 OF 22
REV DATE 08/18/97

DATA SHEET	BOSL 49403 8 SEPTEMBER 1997									
	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA

4	GALLEY AND MESS AREA										
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84	
FULL POWER RESULTS	78.5	91.4	76.4	75.6	71.3	71.6	67.5	L	L	75.7	76.9 / 74.2
	80.1	88.0	75.7	75.8	70.3	69.3	64.7	L	L	74.5	74.9 / 72.6
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84	
~~BUOY OPS~~ RESULTS		BOOM HYDRAULICS NOT YET INSTALLED									

"L" - UNDER RANGE OF SOUND LEVEL METER
DOORS CLOSED + AC ON

LOCATION

FULL POWER MEASUREMENT #1- GALLEY/MESS PASSAGE WAY - FRAME NO. 6

FULL POWER MEASUREMENT #2- 3-FT ABOVE DECK

~~BUOY OPS~~ MEASUREMENT #1- _____

~~BUOY OPS~~ MEASUREMENT #2- _____

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____
PAGE 19 OF 22
REV DATE 08/18/97

DATA SHEET	BUSL 49403 8 SEPTEMBER 1997									
	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA
5	WORKSHOP									
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
FULL POWER RESULTS	87.2	86.9	80.2	73.2	69.5	68.4	64.3	L	L	72.7 (72.9 / 71.3)
	88.5	88.0	79.7	74.5	68.8	68.9	65.7	L	L	73.4 (73.8 / 72.4)
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	82
~~BUOY OPS~~ RESULTS		BUOY HYDRAULICS NOT YET INSTALLED								

"L" - UNDER RANGE OF SOUND LEVEL METER

DOORS CLOSED + AC ON

LOCATION

FULL POWER MEASUREMENT #1- 4-FT ABOVE DECK / 3-FT FROM PORT

FULL POWER MEASUREMENT #2- HULL / 3-FT AFT OF HEAD BKHD

~~BUOY OPS~~ MEASUREMENT #1- _____

~~BUOY OPS MEASUREMENT #2~~- _____

TEST MEMORANDUM

U.S. COAST GUARD YARD

HULL NO. _____
TEST MEMO NO. 094-02
LEAD SHOP X-23
J.O. NO. _____

REV DATE 08/18/97

DATA SHEET	BOSL 49403 8 SEPTEMBER 1997									
	OCTAVE BAND CENTER FREQ.(Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA
6	WORK DECK									
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	84
FULL POWER RESULTS	80.1	94.8	94.5	84.3	81.1	76.2	73.9	69.1	65.3	83.0
	78.1	94.6	94.2	83.1	79.5	76.5	73.6	69.1	66.0	83.6
MAX ALLOWABLE	105	100	95	90	N/A	N/A	N/A	N/A	N/A	82
~~BUOY OPS~~ RESULTS		BUOY HYDRAULICS NOT YET INSTALLED								

83.3
81.9
83.8
81.8

DOORS CLOSED / HATCHES CLOSED

LOCATION

FULL POWER MEASUREMENT #1- 3-FT ABOVE DECK / CENTERLINE / 8-FT

FULL POWER MEASUREMENT #2- FROM STERN

~~BUOY OPS~~ MEASUREMENT #1- _____

BUOY OPS MEASUREMENT ~~#2~~- _____

7	FAR FIELD NOISE									
MAX ALLOWABLE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	70
FULL POWER RESULTS										72

* N/A = NOT APPLICABLE

SEE REPORT DISCUSSION

The following SPLs were collected in the BUSL engine room. These data were not required as part of Test Memo No. 094-02.

BUSL 49403 8 September 1997

Engine Room

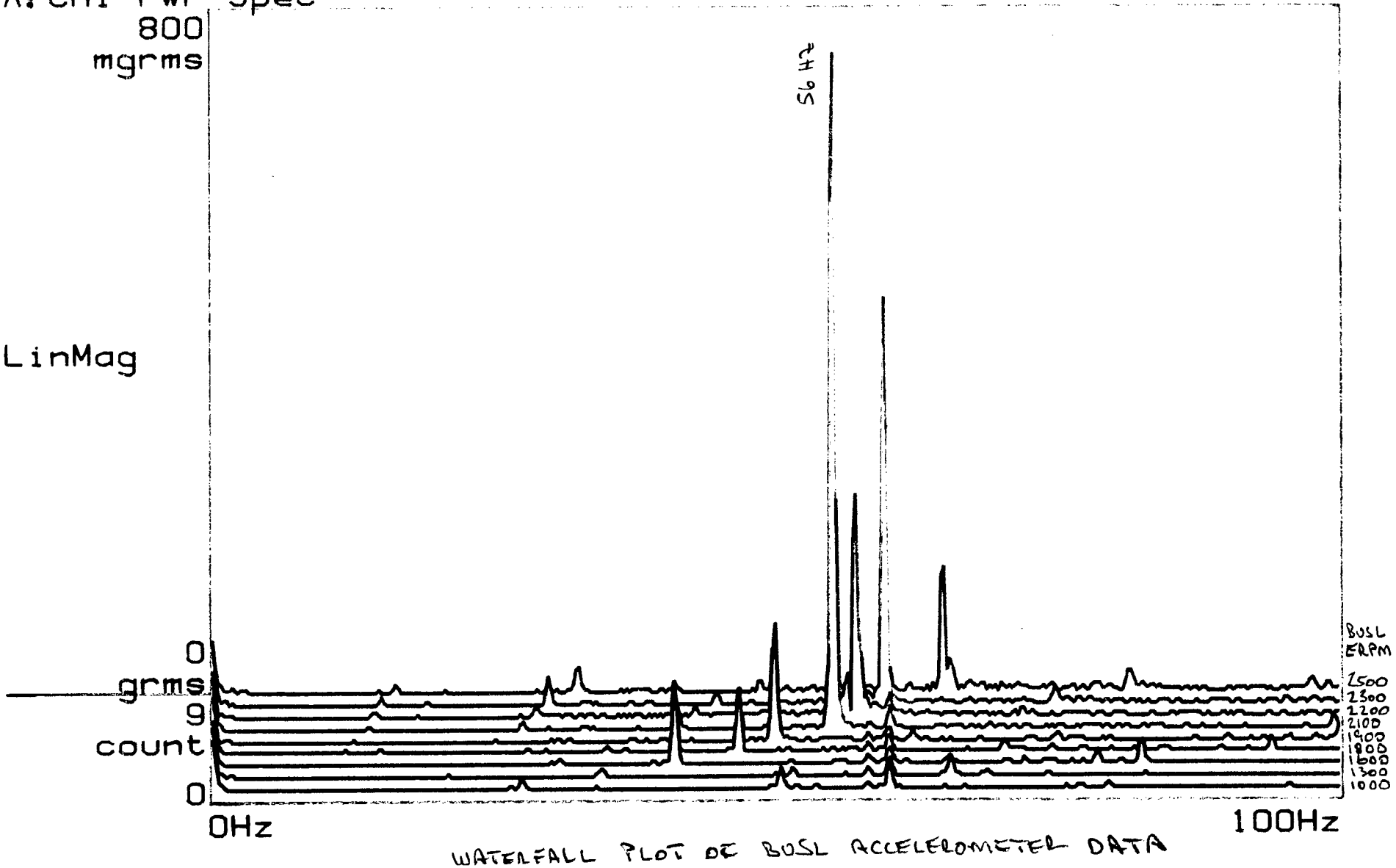
Full Pwr. Results	31.5	63	125	250	500	1000	2000	4000	8000	dBA
	91.3	109.4	105.5	104.6	102.1	104.9	103.2	98.5	99.5	$108.9\ ^{109.4}_{108.4}$
	91.3	111.7	107.3	105.3	103.1	105.5	104.2	99.2	99.8	$110.7\ ^{111.1}_{110.6}$

Centerline of boat 4-ft Aft of engine room door

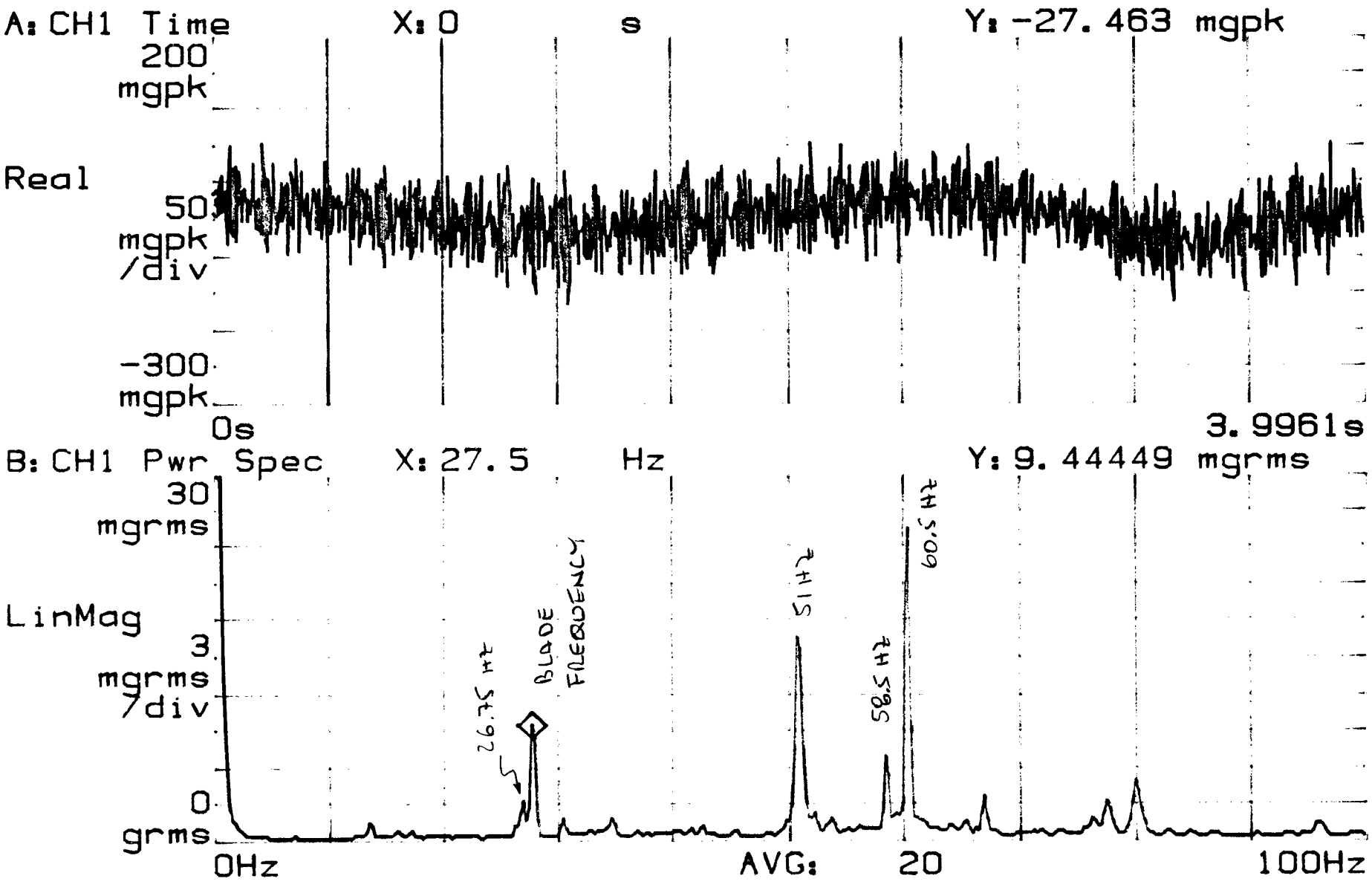
Disp Frmat Z Range A: 9 count
Height A: 86 %

Base Supr A: 0 %
Hidn Rmvl A: On

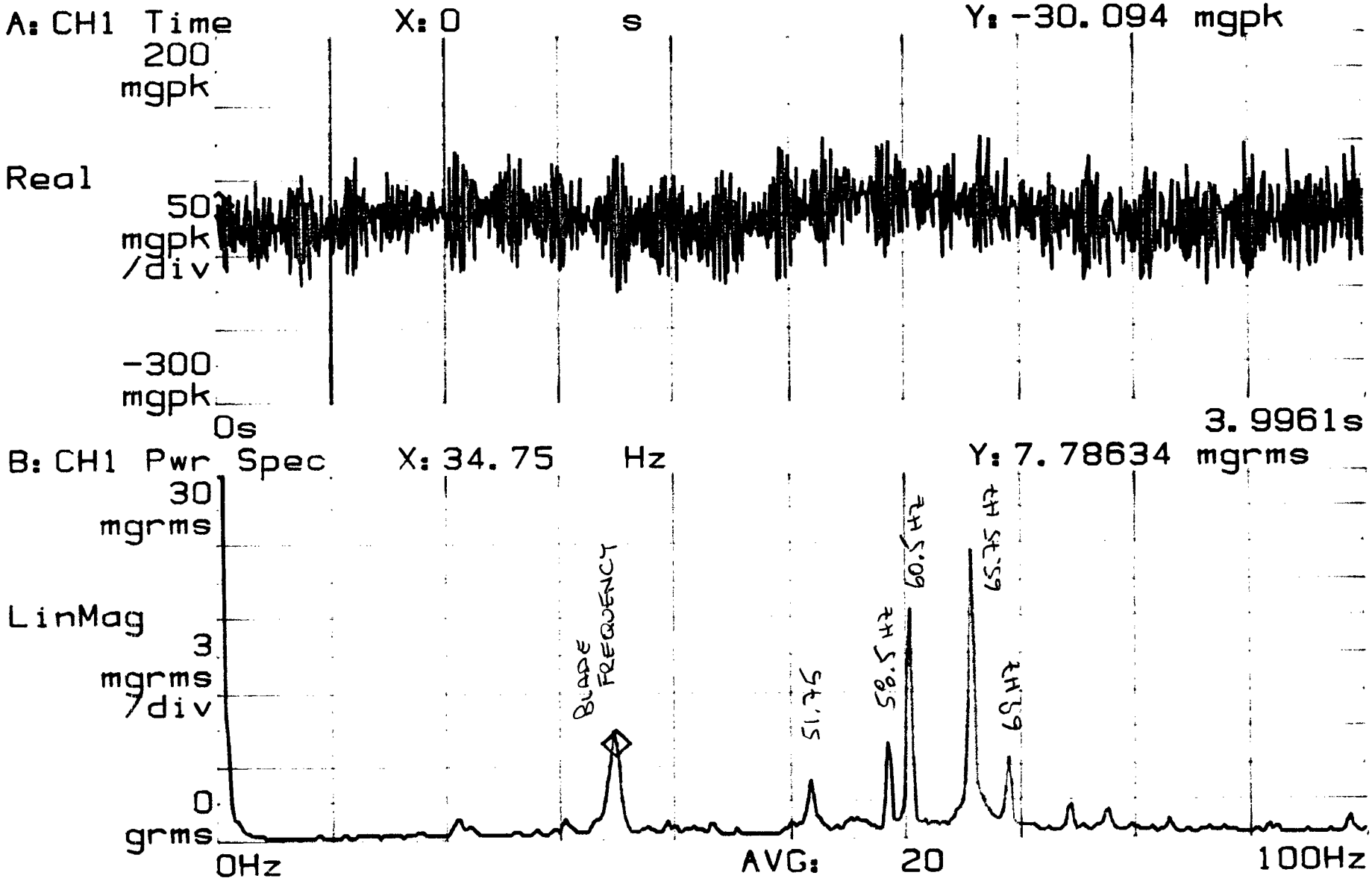
Date: 12 15 Time: 13:47:00



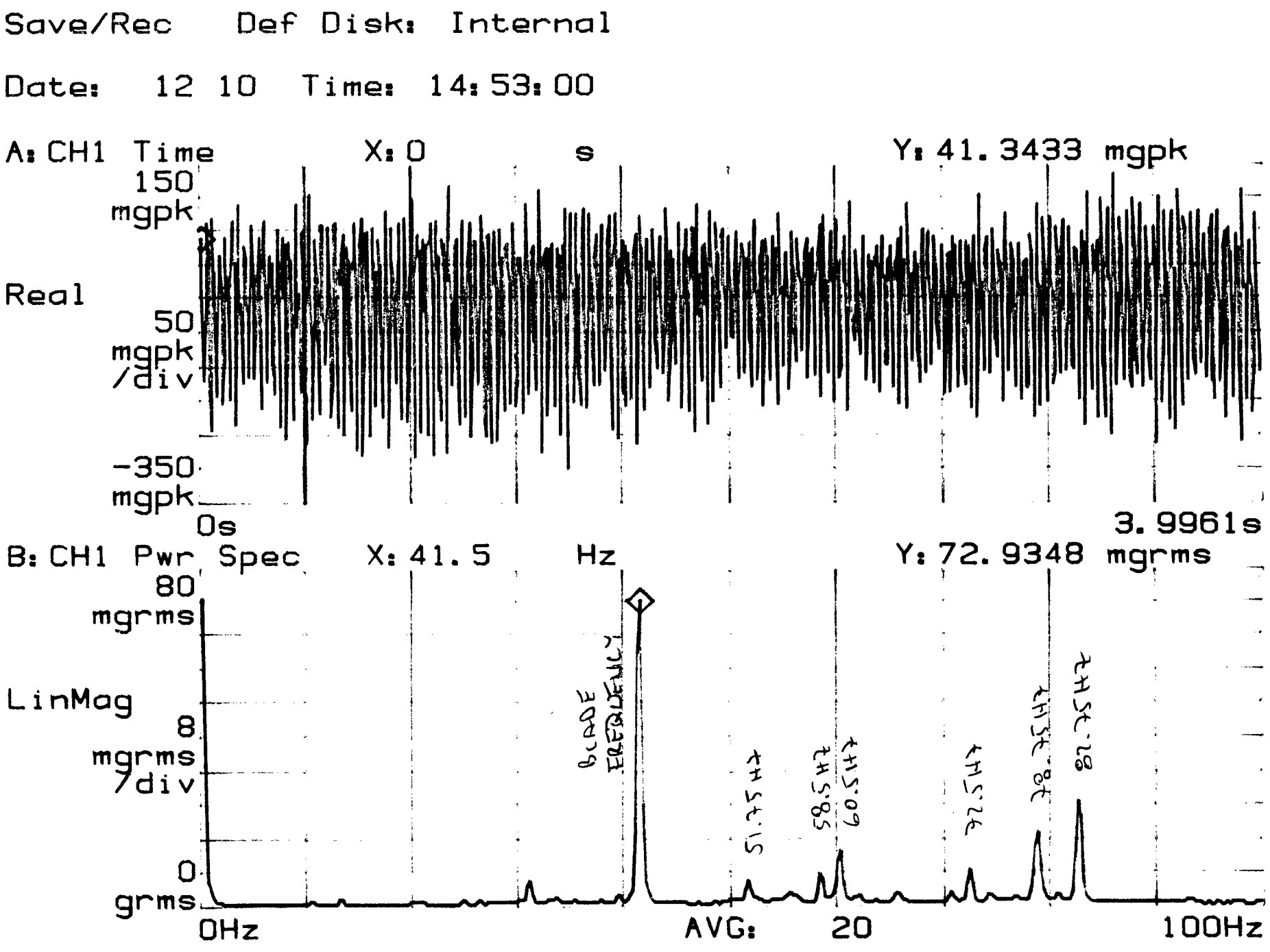
WATERFALL PLOT OF BOSL ACCELEROMETER DATA



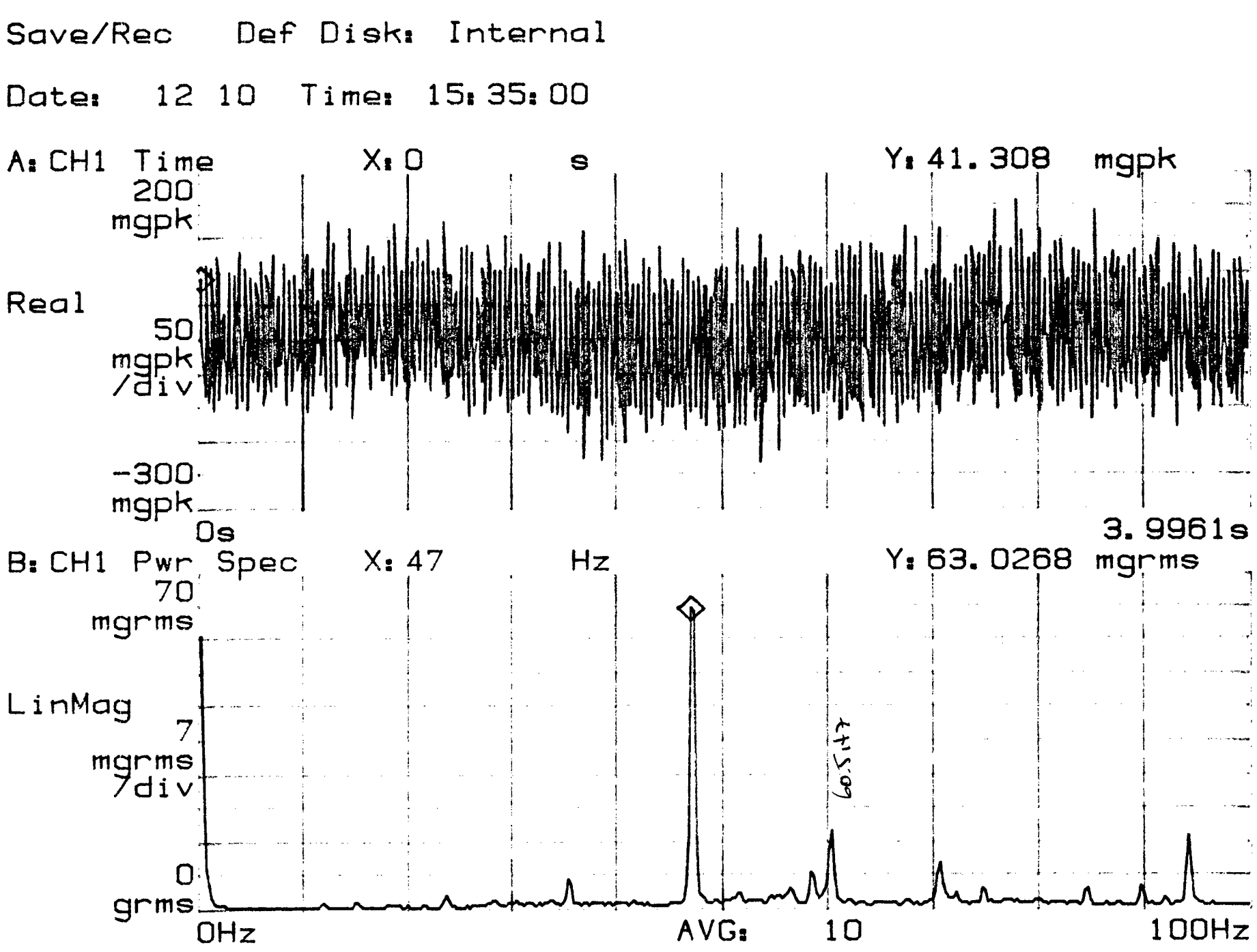
ACCELEROMETER MEASUREMENT AT 1000 ERPM



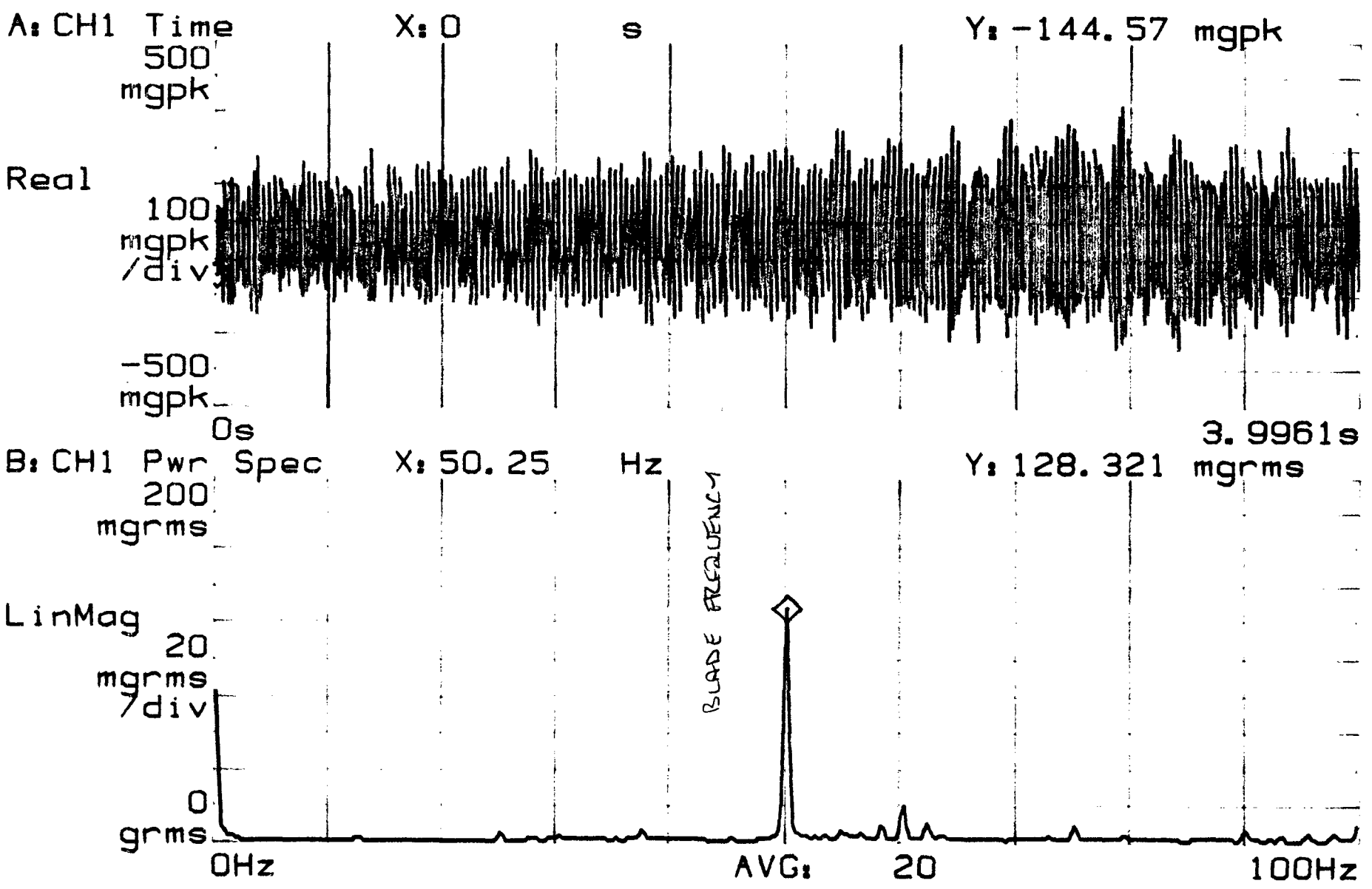
ACCELEROMETER MEASUREMENT AT 1300 ERPM



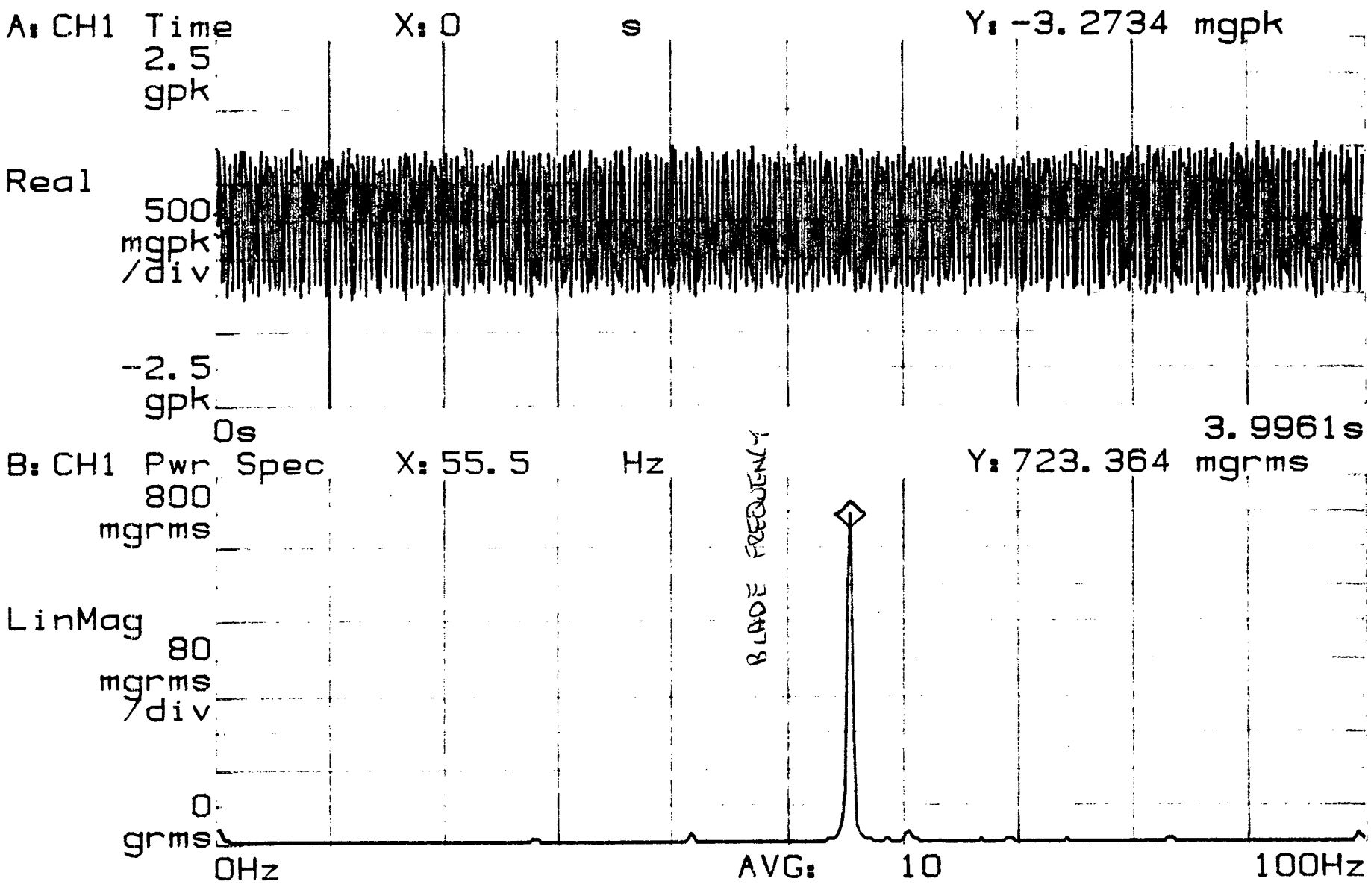
ACCELEROMETER MEASUREMENT AT 1600 ERPM



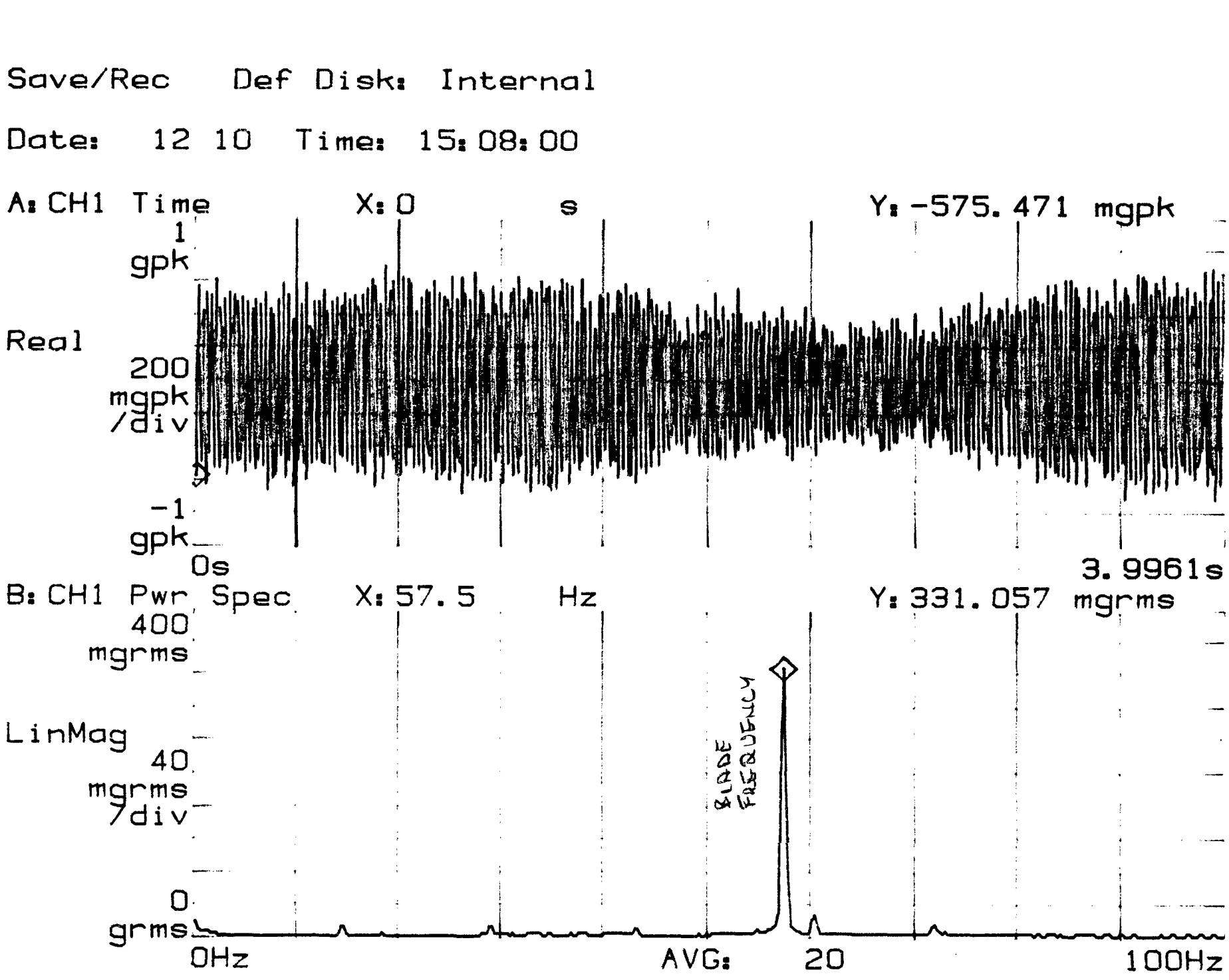
ACCELEROMETER MEASUREMENT AT 1800 ERPM



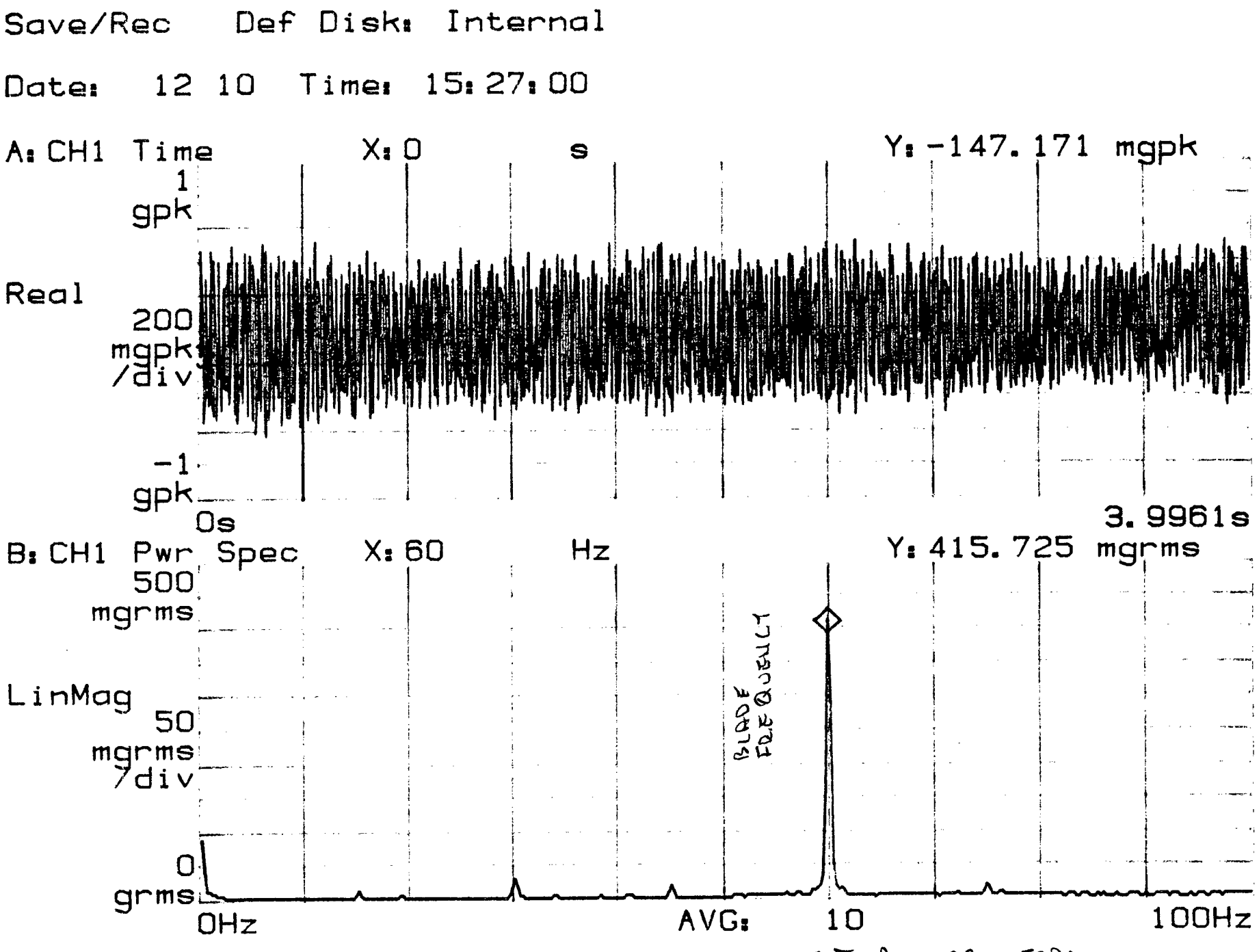
ACCELEROMETER MEASUREMENT AT 1900 ERPM



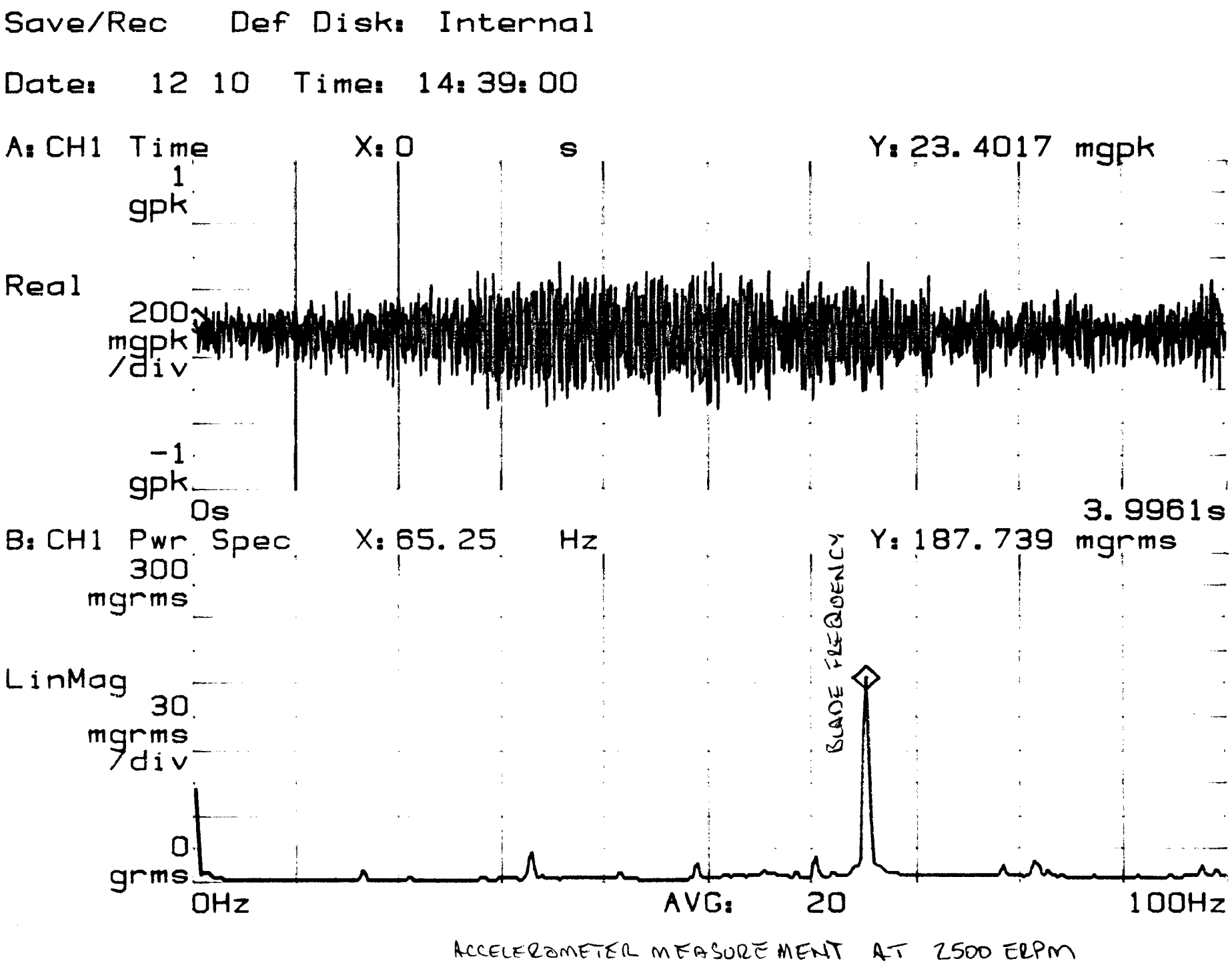
ACCELEROMETER MEASUREMENT AT 2100 ERPM



ACCELEROMETER MEASUREMENT AT 2200 RPM



ACCELEROMETER MEASUREMENT AT 2300 ERPM


Save/Rec Def Disk: Internal
Date: 12 10 Time: 14:39:00
A: CH1 Time X: 0 s Y: 23.4017 mgpk
1 gpk
Real
200 mgpk /div
-1 gpk
0s
3.9961s
B: CH1 Pwr Spec X: 65.25 Hz Y: 187.739 mgrms
300 mgrms
LinMag
30 mgrms /div
0 grms
BLADE FREQUENCY
0Hz
AVG: 20
100Hz
ACCELEROMETER MEASUREMENT AT 2500 RPM

Appendix G
Corrosion Survey

CORROSION SURVEY REPORT

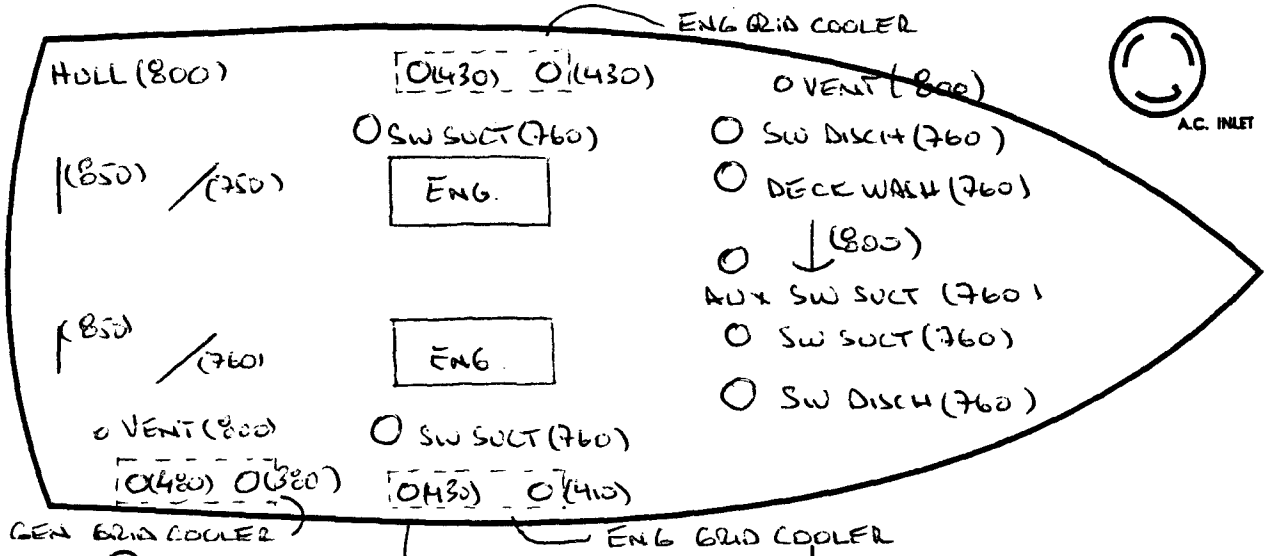
Name of Boat BOSI **Registration #** 49403

Hull Material STEEL

Reason for Survey INITIAL DETERMINATION OF SUFFICIENCY OF SACRIFICIAL ANODIC PROTECTION ON 1ST PRODUCTION BOSL

Owner C G YARD **Phone**

Address **City/State**



○ = Through hull fitting
/ = shaft
▨ = shaft log
| = rudder shaft
▯▯ = rudder shaft log
⌐ = shaft brush
↓ = transducer
▭ = sacrificial anode
☺ = A.C. inlet
▭ = engine
⊤ = strainer

BRONZE FITTINGS TUBING IS COPPER/NICKLE

RESULTS 800 mV to HULL W/O SHORE TIE BUT 700 mV to HULL W/ SHORE TIE CONNECTED

A.C. Stray current Present

D.C. Stray current Present

RECOMMENDATIONS INSTALL ZINC SAVER

Signed
Surveyor

CORROSION SURVEY REPORT

Name of Boat BUSI Registration # 49403

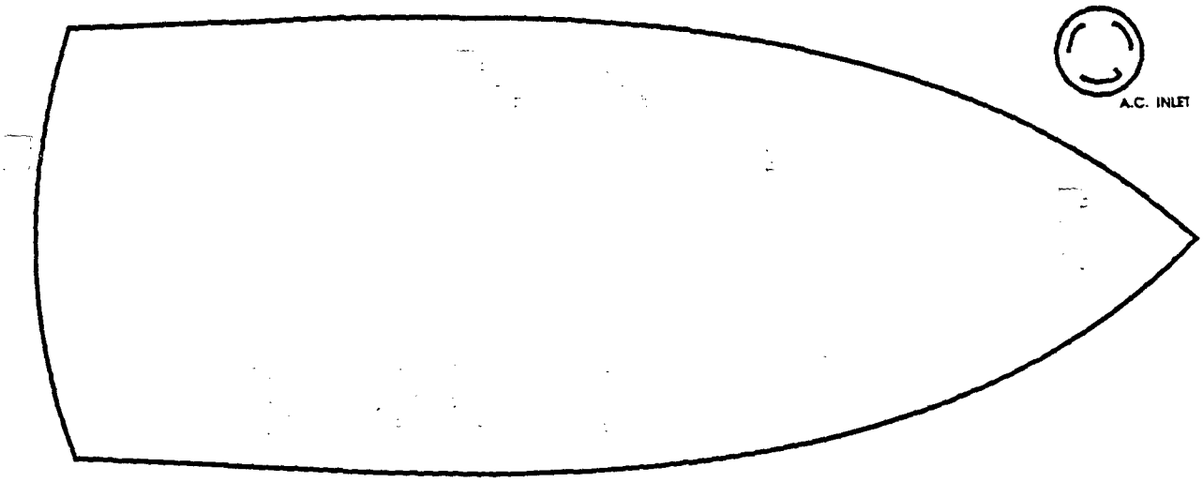
Hull Material STEEL

Reason for Survey _____

_____

Owner _____ Phone _____

Address _____ City/State _____



○ = Through hull fitting

/ = shaft

⊠ = shaft log

| = rudder shaft

⊟ = rudder shaft log

= shaft brush

= transducer

= sacrificial anode

= A.C. inlet

▭ = engine

= strainer

RESULTS _____

_____

A.C. Stray current Present _____

D.C. Stray current Present _____

RECOMMENDATIONS _____

_____

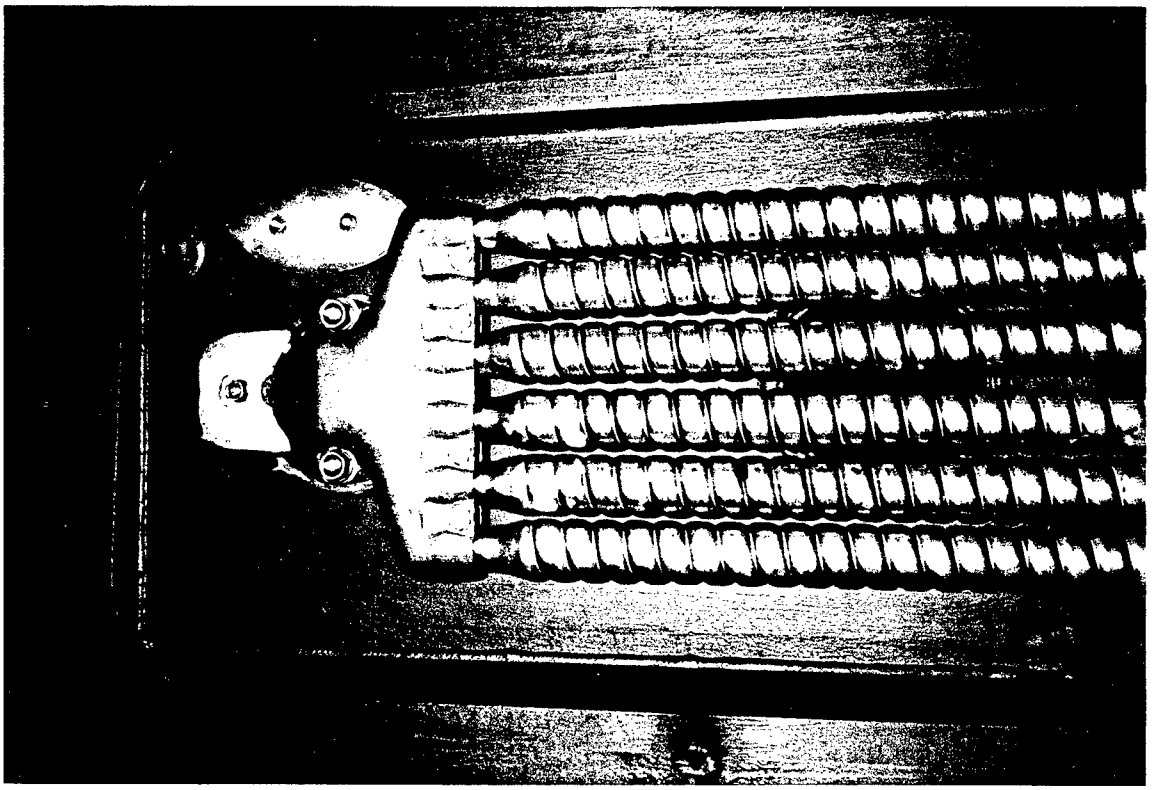
_____

_____

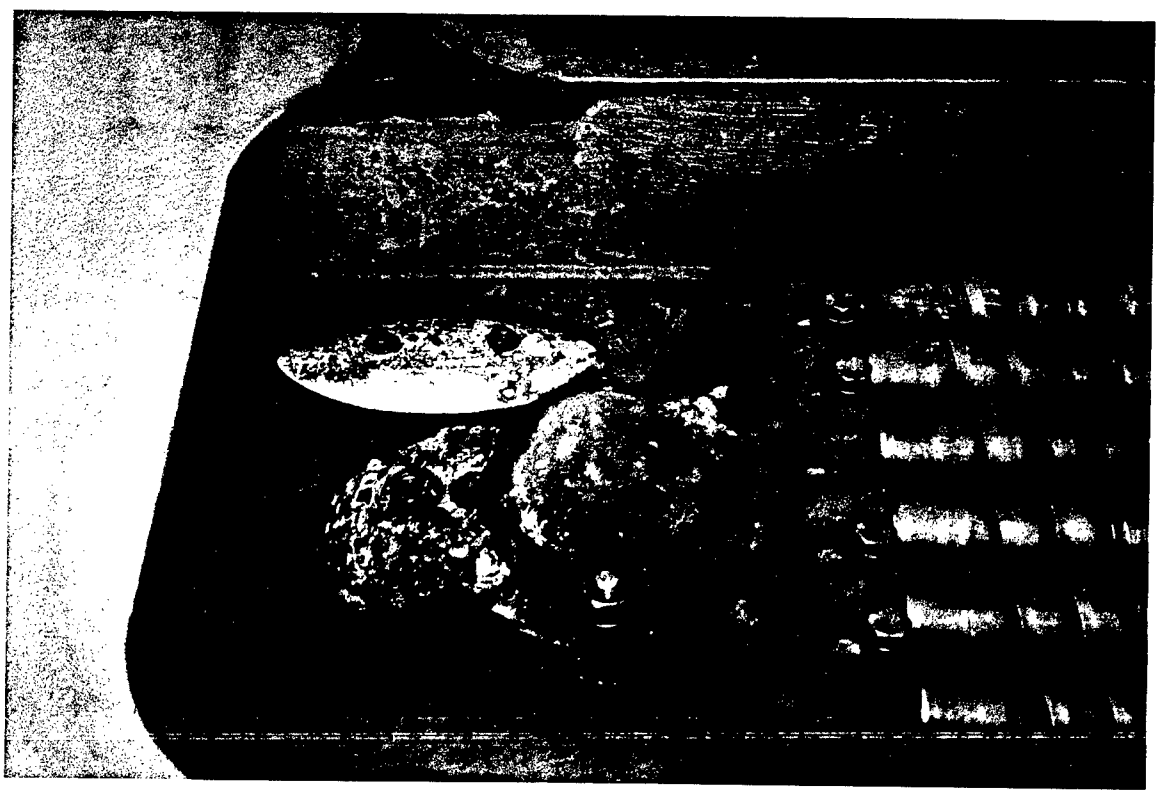
Signed _____

Surveyor

49403 GRID COOLER EROSION



[BEFORE]



[AFTER] - Approximately 2-weeks in water