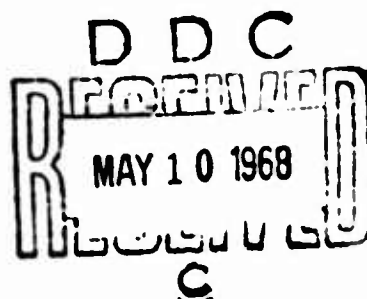


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VOUGHT AERONAUTICS DIVISION
LTV AEROSPACE CORPORATION

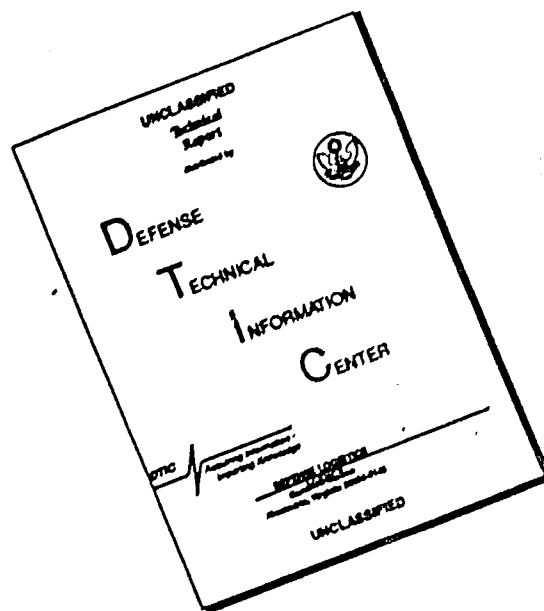
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Report No. 2-55400/8R-6140

April 1968

research on
VTOL WATER HOVER EFFECTS,
including
THE EFFECTS OF WIND AND WAVES

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TABLE OF CONTENTS

	<u>Page</u>
List of Illustrations	v
List of Tables	ix
1.0 Introduction	1-1
2.0 Test Facilities	2-1
2.1 Aero-Hydro Test Facility	2-1
2.1.1 Tank	2-1
2.1.2 Wave Generator	2-1
2.1.3 Wind Generator	2-2
2.2 Model and Model Support System	2-2
2.3 Test Instrumentation	2-4
2.3.1 Model Instrumentation	2-4
2.3.1.1 Internal Balance	2-4
2.3.1.2 Propeller Thrust Measurement	2-4
2.3.1.3 Moisture Samples	2-5
2.3.1.4 Data Recording System	2-5
2.3.2 Test Facility Instrumentation	2-5
2.3.2.1 Photographic Data	2-5
2.3.2.2 Electrical Depth Gages	2-6
2.3.2.3 Wind Generator	2-6
2.3.2.4 Ambient Data	2-7
2.3.3 Data Recording	2-7
2.3.4 Data Reduction	2-7
2.3.4.1 Six-Component Force and Moment Data ...	2-7
2.3.4.2 Thrust Data	2-8
2.3.4.3 Data Reduction Factor	2-8
2.3.4.4 Data Corrections	2-8
2.3.4.5 Tabulated Data	2-8
3.0 Force and Moment Data Results	3-1
3.1 Normal Force Data	3-2
3.2 Drag Data	3-3
3.3 Pitching Moment Data	3-3
3.4 Lateral-Directional Data	3-4

TABLE OF CONTENTS (continued)

	<u>Page</u>
3.5 Vertical Floats	3-4
3.6 Dynamic Characteristics	3-5
4.0 Downwash Environment	4-1
4.1 Introduction	4-1
4.2 Data Recording Techniques	4-1
4.2.1 Moisture	4-1
4.2.1.1 Water Flow Rate	4-1
4.2.1.2 Droplet Size	4-2
4.2.2 Water Depression	4-3
4.2.3 Qualitative Observations	4-4
4.3 Test Results	4-4
4.3.1 Flow Field Description	4-5
4.3.2 Repeatability and Sidewall Effects	4-8
4.3.3 Effects of Important Parameters	4-9
4.3.3.1 Time	4-9
4.3.3.2 Model Height	4-10
4.3.3.3 Disc Loading	4-11
4.3.3.4 Wing Angle	4-11
4.3.3.5 Wind	4-12
4.3.3.6 Waves	4-13
4.3.3.7 Roll Angle	4-14
4.3.3.8 Vertical Floats	4-15
4.3.4 Droplet Size Investigation	4-15
4.3.5 Effects of a Non-Newtonian Fluid	4-16
4.4 Data Scaling	4-17
4.5 Significance of Results	4-19
4.5.1 Spray Circulation	4-19
4.5.2 Depression Shape	4-19
4.5.3 Droplet Size	4-21
4.5.4 General Spray Patterns	4-21
5.0 Conclusions	5-1

TABLE OF CONTENTS (concluded)

	<u>Page</u>
6.0 Recommendations	6-1
7.0 References	7-1

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
2-1	LTV Aero-Hydro Test Facility	2-84
2-2	LTV Aero-Hydro Test Facility	2-85
2-3	Water Tank and Wave Generator	2-86
2-4	Wave Generator Calibration	2-87
2-5	LTV Aero-Hydro Test Facility Wind Generator	2-88
2-6	LTV Aero-Hydro Test Facility Wind Generator Plenum	2-89
2-7	LTV Aero-Hydro Test Facility Wind Generator Diffuser Exit	2-90
2-8	LTV Aero-Hydro Test Facility, Wind, Waves, and Spray	2-91
2-9	Wind Generator Calibration	2-92
3-1	Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics	3-7
3-2	Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics	3-8
3-3	Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics	3-9
3-4	Effects of Model Height Ratio and Disc Loading on Lateral-Directional Characteristics	3-10
3-5	Time History of Model Normal Force and Propeller Thrust with Surface Winds On and Off	3-11
3-6	Time History of Waves Generated by Propellers with Wave-Maker Off	3-12
4-1	Moisture Meter Installation	4-27
4-2	Isokinetic Probe Installation	4-28
4-3	Positions of Moisture Meters and the Isokinetic Probe	4-29
4-4	Droplet Snatcher	4-30
4-5	Depth Gage Installation and Vertical Float Configuration	4-31
4-6	Depth Gage Pattern	4-32
4-7	Depression Beneath Model	4-33
4-8	Neoprene Coated Propeller Prior to Installation	4-34
4-9	Uncoated Propeller after 21 Hours of Testing	4-35

LIST OF ILLUSTRATIONS (continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
4-10	Coated Propeller after 21 Hours of Testing	4-36
4-11	Effect of Sidewall Deflection	4-37
4-12	Water Entering Propellers - Repeatability	4-38
4-13	Water Entering Propellers - Effects of Side Wall	4-39
4-14	Water Displacement Along Propeller Centerline - Repeatability and Effects of Side Wall	4-40
4-15	Water Displacement Fore and Aft Repeatability and Effects of Side Wall	4-41
4-16	Effects of Time	4-42
4-17	Water Entering Propellers - Effects of Model Height	4-43
4-18	Water Entering Propellers - Effects of Model Height	4-44
4-19	Water Entering Propellers - Effects of Model Height	4-45
4-20	Water Entering Propellers - Effects of Model Height	4-46
4-21	Water Displacement Along Propeller Centerline - Effects of Model Height	4-47
4-22	Water Displacement Fore and Aft - Effects of Model Height	4-48
4-23	Water Displacement Along Propeller Centerline - Effects of Model Height	4-49
4-24	Water Displacement Fore and Aft - Effects of Model Height	4-50
4-25	Water Displacement Along Propeller Centerline - Effects of Model Height	4-51
4-26	Water Displacement Fore and Aft - Effects of Model Height	4-52
4-27	Water Displacement Along Propeller Centerline - Effects of Model Height	4-53
4-28	Water Displacement Fore and Aft - Effects of Model Height	4-54
4-29	Model at 6.45 PSF Disc Loading	4-55
4-30	Model at 10.82 PSF Disc Loading	4-56
4-31	Model at 15.25 PSF Disc Loading	4-57
4-32	Water Entering Propellers - Effects of Disc Loading	4-58
4-33	Water Entering Propellers - Effects of Disc Loading	4-59

LIST OF ILLUSTRATIONS (continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
4-34	Water Displacement Along Propeller Centerline— Effects of Disc Loading	4-60
4-35	Water Displacement Fore and Aft — Effects of Disc Loading	4-61
4-36	Water Entering Propellers — Effects of Wing Angle	4-62
4-37	Water Displacement Along Propeller Centerline — Effects of Wing Angle	4-63
4-38	Water Displacement Fore and Aft — Effects of Wing Angle	4-64
4-39	Water Entering Propellers — Effects of Surface Winds	4-65
4-40	Water Displacement Along Propeller Centerline — Effects of Wind	4-66
4-41	Water Displacement Fore and Aft — Effects of Wind	4-67
4-42	Water Entering Propellers — Effects of Wave Height	4-68
4-43	Water Entering Propellers — Effects of Wave Height	4-69
4-44	Water Entering Propellers — Effects of Wave Length	4-70
4-45	Water Displacement Along Propeller Centerline — Effects of Waves	4-71
4-46	Water Displacement Along Propeller Centerline — Effects of Waves	4-72
4-47	Water Displacement Along Propeller Centerline — Effects of Waves	4-73
4-48	Water Displacement Along Propeller Centerline — Effects of Waves	4-74
4-49	Water Displacement Fore and Aft — Effects of Waves	4-75
4-50	Water Displacement Fore and Aft — Effects of Waves	4-76
4-51	Effects of Waves	4-77
4-52	Effects of Waves	4-78
4-53	Effects of Waves	4-79
4-54	Effects of Waves	4-80
4-55	Water Entering Propellers — Effects of Roll Angle	4-81
4-56	Water Entering Propellers — Effects of Roll Angle	4-82
4-57	Water Displacement Along Propeller Centerline — Effects of Roll Angle	4-83

LIST OF ILLUSTRATIONS (continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
4-58	Water Displacement Fore and Aft - Effects of Roll Angle	4-84
4-59	Water Displacement Along Propeller Centerline - Effects of Roll Angle	4-85
4-60	Water Displacement Fore and Aft - Effects of Roll Angle	4-86
4-61	Water Displacement Topographical Plot - Effects of Roll Angle	4-87
4-62	Water Entering Propellers - Effects of Vertical Floats	4-88
4-63	Water Entering Propellers - Effects of Vertical Floats	4-89
4-64	Water Displacement Along Propeller Centerline - Effects of Vertical Floats	4-90
4-65	Water Displacement Fore and Aft - Effects of Vertical Floats	4-91
4-66	Maximum Droplet Size	4-92
4-67	Water Droplet Size	4-93
4-68	Water Droplet Size	4-94
4-69	Water Droplet Size	4-95
4-70	Water Droplet Size	4-96
4-71	Water Droplet Size	4-97
4-72	Typical Microphotograph of Glass Slide from Droplet Snatcher	4-98
4-73	Typical Photograph of Depth Gage Number 28 through 40-inch Lens	4-99
4-74	Water Droplet Size	4-100
4-75	Water Displacement Along Propeller Centerline - Effects of Polyethylene Oxide	4-101
4-76	Water Displacement Fore and Aft - Effects of Polyethylene Oxide	4-102
4-77	Effect of Froude Number on Average Moisture Circulation	4-103
4-78	Effect of Reynolds Number on Average Moisture Circulation	4-104

LIST OF ILLUSTRATIONS (concluded)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
4-79	Effect of Weber Number on Average Moisture Circulation	4-105
4-80	Effect of Disc Loading on Depression Depth	4-106
4-81	Effect of Disc Loading on Depression Width/Depth	4-107
4-82	Variation of Maximum Dynamic Pressure of Ground Flow with Height for Propellers	4-108
4-83	Effect of Maximum Ground Dynamic Pressure on Depression Depth	4-109
4-84	Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression	4-110
4-85	Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression	4-111
4-86	Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression	4-112

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
2-1	Water Hover Test Run Index	2-11
2-2	VAD Low Speed Wind Tunnel Test No. 266 - Balance Axes Data	2-18
4-1	Moisture Meter Data	4-22
4-2	Model to Full-Scale Conversions	4-25
4-3	Sea Conditions, U. S. Hydrographic Office Scale	4-26

1.0 INTRODUCTION

The growth and economic advancements made by the nations of the earth have closely paralleled the advances made in transportation and communications systems available to and used by these nations. An advance can be made in the transportation system by improving the flexibility of the system as well as the speed of the system. Just as the automotive vehicles added a large degree of flexibility to the rail system, V/STOL aircraft offers a comparable degree of flexibility to the air transportation systems of the post-1970 time period. By contrast, the ship offers a maximum of flexibility to water transportation systems; but it suffers from a slow speed potential. Some speed advances are being made for the speed potential of ships through the use of hydrofoils, but the potentials offered by these vehicles appear to be less than 100 miles per hour.

The use of seaplanes was examined extensively through the mid-1950's as one potential method of providing a combination flexibility and speed for water transportation systems. The seaplanes did offer the speed, but the seaplane was found to be relatively inflexible with regard to its ability to operate from water surfaces. The seaplane demanded relatively calm water surfaces for takeoff and landing, and such surfaces were not readily found in open ocean areas. Only under emergency conditions were landing attempts made with operational seaplanes under sea conditions more severe than a sea state two.

Recent interest in the ocean and potential advantages it offers to man if he becomes its master has caused a renewed interest in advances that might be made for water transportation systems. Just as the V/STOL

airplane has given a large degree of improvement in the flexibility for the land-based airplane, it may well be capable of providing a comparable degree of increased flexibility to a water transportation system that uses airplanes as the prime carrier. V/STOL aircraft, with slow takeoff and landing speeds, may well be able to permit the operation of air vehicles from open ocean surfaces in all but the most severe weather conditions.

The uses of water-based aircraft which could operate from open ocean surfaces under most weather conditions are many fold. Such vehicles would satisfy the need for many military operations as well as the needs of the civilian community. Some of the military needs that could be satisfied by such a vehicle include the rescue of crews of military aircraft that have gone down at sea, the conduct of anti-submarine warfare operations, and the retrieval of space exploration capsules and/or personnel. The definition of civilian applications are not as readily specified because the lack of a present capability has prevented the establishment of requirements. It is expected that recent interest in oceanographic basic research programs will shortly cause requirements to evolve that can be met by aircraft capable of operating from open ocean surfaces. In addition, VTOL aircraft (helicopters) are being used to transport personnel and equipment to and from offshore oil rigs in coastal areas, and the projected lower operating costs of V/STOL aircraft could make such operations more profitable.

The previous conjectures assume that providing a V/STOL capability to an airplane will permit it to operate from open ocean surfaces under rather severe sea state conditions. Although such an assumption is known to be under investigation, it has not as yet been proven valid.

The ability of V/STOL aircraft to operate from land surfaces has been proven by such test-bed and prototype aircraft as the LTV XC-142A, the Bell X-22A, the Ryan XV-5A, the Canadair CL-84 and the Hawker-Siddeley XV-6A. Some very limited tests have been made with some of the aircraft hovering over water surfaces, but there have been no tests which would confirm or reject the possibility that vehicles of this type could operate from open ocean surfaces.

In order to provide a data base suitable for assessing the feasibility of V/STOL aircraft for operating from open ocean surfaces, a limited amount of testing of scale models has been performed (References 1-1, 1-2 and 1-3). Reference 1-1 reports on limited measurements that were made of the spray characteristics around a V/STOL aircraft during hover over a calm and a rough water surface. Reference 1-2 reports on additional qualitative and limited quantitative measurements that were made on a model simulating a V/STOL aircraft hovering over a calm water surface. Under the direction of Reference 1-3, additional quantitative measurements were made using the same model that was used for the tests reported in Reference 1-2. For the tests performed in response to Reference 1-3, measurements were made of the spray characteristics and the forces and moments felt by the model during hover. Again, a calm water surface was used.

As a result of the previous test programs, it was considered desirable to examine the spray characteristics and the forces and moments acting on the model which simulates the airplane hovering over a water surface with water and surface wind conditions varying from calm up to those representative of at least a sea state four condition. Such tests have been conducted in response to Reference 1-4 and the results of these tests are reported herein.

More specifically, the tests reported in this report include the measurement of the water spray passing through potential engine inlet areas behind the propeller at various blade radius stations away from the propeller rotational axis, qualitative evaluations of water spray patterns, and measurement of the forces and moments acting on the model all during simulated hover over a calm water surface with no surface winds, a calm water surface with simulated 40-knot surface winds, a rough water surface (waves with simulated heights of 4.5 and 9 feet) with no surface winds, and a rough water surface with the simulated 40-knot surface wind.

2.0 TEST FACILITIES

2.1 AERO-HYDRO TEST FACILITY

An Aero-Hydro Test Facility was constructed at the LTV Hover Site located adjacent to the LTV Low Speed Wind Tunnel. The facility consists of an open tank, a wave generator, and a wind generator. The existing model support, hydraulic power system for the model, and model instrumentation system were incorporated into the facility with minor modifications but without being relocated. Photographs of the facility are presented in Figures 2-1 and 2-2.

2.1.1 Tank

The tank is a welded structure, 20 feet wide, 75 feet long, and 8 feet high, constructed of 1/4-inch steel plate with external framing. A framework filled with rock and rubberized horsehair and covered with wire mesh is located at the downstream end of the tank to provide damping and to prevent the formation of reflected waves. A sketch of the tank and wave generator is shown in Figure 2-3.

2.1.2 Wave Generator

The wave generator is of the paddle type (i.e., a panel hinged at the bottom of the tank) and located at the upstream end of the tank. It is constructed of aluminum and extends the width of the tank. Rubber strips along the sides and across the bottom seal the edges of the paddle against the sides and bottom of the tank. A 60-gpm sump type water pump is used to pump any water leaking past the seals back into the main part of the tank forward of the paddle. An air spring consisting of an air cylinder and accumulator is used to counterbalance the paddle against the static force of the water against the paddle.

An electro-hydraulic servo-controlled system, programmed to generate a sinusoidal motion, is used to drive the paddle. With the system, it is possible to obtain any combination of amplitude and frequency up to 12 degrees of paddle motion at angular acceleration rates of 0.9 radians per second per second or less. Figure 2-4 is a plot of wave height and length versus paddle amplitude and frequency as calibrated with 7.5 feet of water in the tank.

For the subject test program, 6-inch and 12-inch wave heights were used. For reference to full-scale tests of the XC-142A airplane, these wave heights would represent wave heights of 4.5 and 9.0 feet, respectively.

2.1.3 Wind Generator

The wind generator consists of two Size 9, Class 1 Buffalo-Forge squirrel-cage blowers, each driven at 587 rpm by 50-horsepower electric motors. The blowers are ducted into a common plenum/diffuser having an exit opening 11 feet high by 14 feet wide. The blower exhausts its air due north. The entire assembly is mounted over the water tank on a frame which can be moved along the tank to position the exit face of the diffuser between 10 and 20 feet from the model support. Wind velocities ranging from 10 to 15 knots are obtained over an area 10 feet high by 10 feet wide at 20 feet from the diffuser exit. Photographs of the assembly are presented in Figures 2-5 through 2-8. A plot of air velocities obtained during calibration of the blowers is shown in Figure 2-9.

2.2 MODEL AND MODEL SUPPORT SYSTEM

The test vehicle used for this program was an 0.11-scale hydraulic powered low speed wind tunnel model of the XC-142A V/STOL aircraft. The

model has a wing span of approximately 7-1/2 feet and a body length of 5-1/2 feet.

The external fuselage skins were constructed from fiberglass and attached to a steel fuselage beam which housed a steel balance adapter to accept an internal six-component strain gage balance. The aft end of the strain gage balance was attached to a steel support which extended throughout the upper-aft fuselage skin. The steel support was constructed such that various pitch, yaw, and roll angles could be obtained. The support was suspended from a manually operated hoist to obtain various heights above the water tank.

The control surfaces of this model consist of a vertical tail constructed from steel and fiberglass, a horizontal tail fabricated from aluminum, and a steel wing. The trailing edge of the wing was provided with double-slotted flaps and ailerons. Four fiberglass nacelles were located on the leading edge of the wing which housed four 28-horsepower hydraulic motors. A scaled fiberglass propeller was attached to each of the four motor shafts capable of being rotated at velocities up to 11,000 RPM. The wing was attached to the fuselage beam such that wing incidence angles between 0 and 100 degrees could be obtained.

Additional accessories were fabricated for the model to measure moisture during the water hover test. Two solenoid-operated moisture meters of steel and aluminum construction were mounted on the underside of each wing behind the props during hover operations. An isokinetic probe, with cover attached to moisture meter cover, was fabricated from bent steel tubing containing a moisture filter housing of steel with an aluminum tube leading to a vacuum pump. A hand-operated drop snatcher was made from aluminum, steel, wood, and a glass slide for catching moisture samples. This unit is composed

of a shoulder stock and handgrip and is about 7 feet long. The moisture meters can be seen in Figure 4-1, the isokinetic probe in Figure 4-2, and the droplet snatcher in Figure 4-4.

2.3 TEST INSTRUMENTATION

2.3.1 Model Instrumentation

2.3.1.1 Internal Balance

The 0.11-scale XC-142 model loads were measured by the LTV VTB-2 internal strain gage balance.

The VTB-2 is a six-component strain gage balance configured with a circular hollow along its longitudinal centerline. This hollow serves as a passage for supply and return hydraulic lines which power the four propellers. Corrections to the data were made for fluid tare effects, thermal expansion, and material modulus changes with temperature.

The model attitude (and configuration) remained fixed during a given run; therefore, no correction was necessary for model weight versus model attitude.

A complete bench balance calibration was performed prior to this test. The calibration was accomplished with deadweight loadings using Bureau of Standards class 3 certified weights. Balance output versus load was recorded to an accuracy of one microvolt. The overall balance accuracy (including nonlinearity, hysteresis, and scatter) was approximately 0.20% of full scale.

2.3.1.2 Propeller Thrust Measurement

Each of the four propellers was powered by a Vickers hydraulic motor capable of approximately 28 shaft horsepower per motor. The motor rpm could be varied from 0-11,000 and controlled within ± 2 rpm under ideal conditions and ± 6 rpm under test conditions. A five-component strain gage

thrust cowl was used to measure propeller thrust. The full-scale design thrust of each unit was 50 pounds.

The thrust units were deadweight calibrated with Bureau of Standards class 3 weights. The deadweight calibration outputs were recorded to an accuracy of one microvolt. The overall thrust accuracies (including non-linearity, hysteresis, and scatter) were approximately 0.1% full scale.

2.3.1.3 Moisture Samples

Moisture samples were obtained with two remotely controlled, solenoid-operated meters mounted on each wing between the inboard and outboard propellers and at engine inlet elevation. Each moisture meter contained four traps. A protective cover was rigged and electrically driven to close the traps. The traps remained uncovered for a specific period of time after test conditions were stabilized. The water collected in each trap was weighed with a microbalance to an accuracy of ± 1.0 milligram.

2.3.1.4 Data Recording System

The digital recording system was common for strain gage balance and component outputs, thrust outputs, and hydraulic supply pressure and return temperature. The digitizer control unit was connected to an electronic scanner, which in turn transmitted the raw data to an IBM card punch and typewriter. This system records data to an accuracy of approximately .1% of full scale. The propeller rpm was recorded by the use of magnetic pickups, and this pulse signal was displayed on an EPUT meter (frequency counter). A servo control was used to maintain plus or minus 6 rpm. The set point rpm was introduced as fixed data to the card punch and typewriter.

2.3.2 Test Facility Instrumentation

2.3.2.1 Photographic Data

Wave property instrumentation consisted primarily of photographic data.

Visual depth gages were used to measure wave height, period, and model downwash-induced local disturbances which defined the water contour beneath the model. Undisturbed wave shape and properties were monitored upstream of the model. Electrical output depth gages were also used during the test.

Movie cameras were placed around the model to record the visual depth ~~and~~ data and spray patterns. One camera was mounted above the model to record ~~the~~ general spray patterns. Two additional cameras were positioned at an elevation which caused the camera to use a downward angle of approximately 15° with respect to the water surface and located approximately 80° and 30° to the left of the model heading.

During selected runs, two high speed movie cameras were used to record droplet trajectories, while a high speed still camera was used to photograph droplets in the spray area passing through the propellers.

For runs where the model was at a rolled attitude, two additional cameras were positioned approximately 30° and 90° to the right of the model heading.

2.3.2.2 Electrical Depth Gages

The electrical depth gages acted as potentiometers indexing water level as a function of resistance change. These gages had instantaneous response and a resolution of wave height to within 0.1 inch. The output of these gages was recorded with a light beam oscillograph.

2.3.2.3 Wind Generator

The wind generator was calibrated with an anemometer, which was positioned 20 feet from the wind generator at the model location. The average velocity at this location was 13 knots over an area 8 feet wide by 7 feet high.

2.3.2.4 Ambient Data

An anemometer, thermometer, and barometer were located at the hover facility to measure ambient conditions. These data are presented in the Run Index, Table 2-1.

2.3.3 Data Recording

The recorded data during this test was obtained in the following manner:

- a. A wind-off-zero was recorded with the digital data system.
- b. Hydraulic pressure was set at the desired level.
- c. The wind generator was started.
- d. Waves were set to the desired pattern.
- e. Propeller rpm was adjusted until the desired thrust level was obtained.
- f. When all of the above conditions were obtained and stabilized, the following data were recorded:
 1. Digital data
 2. Moisture samples
 3. Photographic data
 4. Wave pattern data
 5. Ambient conditions
- g. The point was terminated, and a final wind-off-zero was recorded with the digital data system.

2.3.4 Data Reduction

2.3.4.1 Six-Component Force and Moment Data

Data from the VTB-2 six-component internal balance were displayed on the digital data system and recorded with an IBM typewriter and card-punch

machine. Using the appropriate constants, the data were reduced to balance axes data in units of pounds and inch-pounds, converted to coefficient data and transferred to the model center of gravity.

2.3.4.2 Thrust Data

The thrust data were displayed on the digital data system and recorded with an IBM typewriter and card-punch machine. Using the appropriate constant, the data were reduced to pounds of thrust.

2.3.4.3 Data Reduction Factor

$S = 931.0896$ sq in. (model wing area)

$\bar{c} = 10.6548$ in. (mean geometric chord)

$b = 89.10$ in. (model wing span)

$A_p = 2.283$ sq in. (propeller disc area)

C.G. Location: F.S. 29.132

W.L. 13.200 20% MGC

B.L. 0.000

Data Reduction Axes: Wind Axes

2.3.4.4 Data Corrections

All force and moment coefficients were corrected for balance interaction, pressure effects of the hydraulic lines, and for temperature effects. Thrust data were corrected for pressure and temperature effects.

2.3.4.5 Tabulated Data

All tabulated balance and thrust data are presented in Table 2-2. The nomenclature and symbols used in the Run Index and Tabulated Data are as follows:

<u>Aerodynamic</u> <u>Symbol</u>	<u>Definition</u>
AF	Axial force, lb
ALPHA	Model angle of attack, deg
AVET	Average thrust, lb
C_D	Drag coefficient
C_L	Lift coefficient
C_M	Pitching moment coefficient
CRM	Rolling moment coefficient
CTS_{1-4}	Thrust coefficient (subscript denotes position)
CTST	Average thrust coefficient
C_Y	Side force coefficient
CYM	Yawing moment coefficient
D_P	Propeller diameter, inches
H/DP	Ratio of model height to propeller diameter. H is the average distance between the water surface and the two outboard propeller planes at shaft centerline
IW	Wing incidence angle, deg
J_{1-4}	Propeller advance ratio (subscript denotes position)
NF	Normal force, lb
PM	Pitching moment, in-lb
PSI	Model angle of yaw, deg
Pt	Data point number
QS	Slipstream dynamic pressure

Aerodynamic
Symbol

Definition

RM	Rolling moment, in-lb
RPM ₁₋₄	Propeller speed, revolutions per minute (subscript denotes position)
SF	Side force, lb
T ₁₋₄	Thrust, lb (subscript denotes position)
T/A	Ratio of thrust to propeller disc area
YM	Yawing moment, in-lb

TABLE NO.
WATER HOVER
RUN II

RUN		H/D _p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	φ	W	D _p	FLOATS	MOISTURE SAMPLE	TANK SIDE- WALL H
NO.	PT.			(IN.)	(FT.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN.)	(ON/OFF)	(SEC)	(IN)
1	1	3.7	6.45	0	0	OFF	0	0	90	20.46	OFF	0	0
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
2	1	2.5	6.45	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
3	1	2.6	6.45	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
4	1	2.4	6.45	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
5	1	3.7	6.45	↓	↓	↓	↓	↓	↓	↓	↓	0	6.0
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	16.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
6	1	↓	6.45	↓	↓	ON	.59	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
7	1	↓	6.45	6.0	5.0	OFF	0	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
8	1	↓	6.45	↓	7.5	↓	↓	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
9	1	↓	6.45	↓	5.0	ON	.59	↓	↓	↓	↓	0	↓
	2	↓	10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3	↓	15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓

A

TABLE NO. 2-1
WATER HOVER TEST
RUN INDEX

TANK SIDE- WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR / VEL)	REMARKS	DATE
0	78	29.93	0		12/19
	72				
	70				
	68				
6.0	74		S/ 10-20		12/20
	54	29.95	NW/5		12/21
	42	30.55	N/4-10		12/22

B

RUN		H/D _p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	φ	ψ	D _p	FLOATS MOISTURE SAMPLE	TANK SIDE- WALL HT	
NO.	PT.			(IN.)	(F.T.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN)	(IN/OFF)	(SEC)	(IN)
10	1	3.7	6.45	12.0	15	OFF	0	0	90	20.46	OFF	0	6.0
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
11	1		6.45	6.0	7.5	ON	.59	0	↓	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
12	1		6.45	0	0	ON	.59	↓	85	↓	↓	0	7.0
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
13	1		6.45	↓	↓	↓	↓	↓	80	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
14	1		6.45	↓	↓	↓	↓	↓	75	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
15	1		6.45	↓	↓	↓	↓	↓	70	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	0	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
16	-		15.25	↓	↓	↓	↓	↓	70/0	↓	↓	0	↓
17	1		6.45	12.0	15	OFF	0	↓	90	↓	↓	0	↓
18	1	2.5	6.45	0	0	OFF	0	↓	90	20.46	OFF	0	7.0
	2		10.33	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
19	1		6.45	↓	↓	ON	.59	↓	↓	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
20	1	2.0	6.45	0	0	OFF	0	↓	↓	↓	↓	0	↓
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	30	↓

A

WATER HOVER TEST

RUN INDEX

URE LE	TANK SIDE- WALL HT	AMBIENT TEMP	BARO PRESS	AMBIENT WIND	REMARKS	DATE
	(IN)	(°F)	(IN. Hg)	(DIR. & VEL)		1967
	6.0	44	30.55	NW/6-10		12/22
				N/4-10		
	7.0	39	30.14	CALM		12/28
		39				
		39	30.10			
		42				
		44			No Balance Data Taken- Photos Only	
		42				12/29
	7.0	44	30.22	CALM		
					R.H. moisture tray failed to close completely	
		46	30.17	E/4		
				CALM		
					R.H. moisture tray inoperative this pnt	

TABLE NO.
WATER HOVE
RUN IN

RUN		H/D _p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	φ	i _w	D _p	FLOATS	MOISTURE SAMPLE	TAM SIDE WALL
NO.	PT.			(IN.)	(FT.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN.)	(ON/OFF)	(SEC)	(IN.)
21	1	2.0	6.45	0	0	ON	.59	0	90	20.46	OFF	30	7.0
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
22	1		6.45	6.0	7.5	OFF	0					0	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	30	
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	↓	
23	1		6.45			ON	.59					0	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	0	
	3			↓	↓	↓	↓	↓	↓	↓	↓	15	
	4		15.25	↓	↓	↓	↓	↓	↓	↓	↓	15	
24	1	3.7	6.45	0.0	0.0	OFF	0					0	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	
25	1		6.45	8.0	10	ON	.59					0	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	
26	1	1.6	6.45	0.0	0.0	OFF	0					60	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	30	
27	1		6.45	↓	↓	ON	.59					60	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	30	
28	1		6.45	6.0	7.5	OFF	0					60	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	60	
29	1		6.45	↓	↓	ON	.59					60	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	30	
30	1	1.4	6.45	0.0	0.0	OFF	0					60	
	2		10.32	↓	↓	↓	0					30	
31	1	1.4	6.45	6.0	7.5	ON	.59					30	
	2		10.32	↓	↓	↓	↓	↓	↓	↓	↓	30	

A

TABLE NO. 2-1
 WATER HOVER TEST
 RUN INDEX

URE LE C)	TANK SIDE- WALL HT. (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN HG)	AMBIENT WINDS (DIR / VEL)	REMARKS	DATE
	7.0	50	30.05	S/5.0		1968
						1/2
			30.00	S /8-12		
				S/ 6-8		
		52		SE/4		
				CALM		
		46	30.10	N/5		1/15
		48	30.08	NE/6		
		47	30.09	NE/7		
		46		NE/6-8		
		36	30.25	CALM		1/16
		40				
		43				
		51	30.18			
		51				
		54	30.16			
		49	30.12	S/10		1/17

B

RUN		H/D _p	T/A	WAVE	WAVE	BLOWER	LOAD		MONTORP		TANK		WALL
NO.	PT.			HEIGHT	LENGTH	(ON/OFF)	(PSF)	(DEG)	(IN)	(ON/OFF)	(SEC)	(IN)	
32	1	1.4	6.45	0	0	ON	.59	0	90	20.46	OFF	60	7.0
	2		10.32	↓	↓	↓	↓					30	
33	1		6.45	6.0	7.5	OFF	0					60	
	2		10.32	↓	↓	↓	↓					30	
34	1	2.5	6.45	↓	↓	↓	↓					60	
	2		10.32	↓	↓	↓	↓					60	
	3		10.32	↓	↓	↓	↓					60	
	4		15.25	↓	↓	↓	↓					60	
35	1		6.45	↓	↓	ON	.59					60	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	
36	1		6.45	0	0	OFF	0					60	
37	1		↓	↓	↓	ON	.59					60	
38	1	3.7	6.45	6.0	7.5	OFF	0				ON	60	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	
39	1		6.45	↓	↓	ON	.59					0	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	
40	1		6.45	0	0	OFF	0					0	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	
41	1		6.45	0	0	ON	.59					0	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	
42	1	2.5	6.45	↓	↓	OFF	0					0	
	2		10.32	↓	↓	↓	↓					60	
	3		15.25	↓	↓	↓	↓					60	

A

WATER HOVER TEST

RUN INDEX

URF PLE	TANK SIDE WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN HG)	AMBIENT WINDS (DIR / VE)	REMARKS	DATE
						1968
	7.0	55	30.14	CALM		1/16
		↓	↓	↓		↓
		49	30.12	S/12		1/17
		50	↓	S/10		↓
		54	30.10	S/8		↓
		62	30.06	S/10-18		↓
		50	29.95	S/1		1/24
		45	29.75	S/4		↓
		62	30.06	S/16		1/17
		45	29.75	S/4		1/25
		47	↓	S/2		↓
		60	30.04	S/12	Repeat of Run 18 Pnt 1	1/17
		61	30.04	S/10		↓
		52	30.02	SW/2		1/22
		↓	30.02	↓		↓
		↓	↓	SW/6		↓
		54	30.01	↓		↓
		↓	↓	↓		↓
		56	29.96	N/2		↓
		↓	↓	↓		↓
		57	↓	↓		↓
		59	29.95	NW/3		↓
		↓	↓	↓		↓
		56	↓	NW/2		↓
	2-14	↓	↓	↓		↓

B

* H/D_p Measured From Avg. Distance Between CL of O.B. Props

RUN		H/D_p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	ϕ	α	D_p	FLOATS	MOISTURE SAMPLE	TAN SIDE WALL
NO.	PT.			(IN.)	(FT.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN.)	(ON/OFF)	(ABC)	(IN.)
43	1	2.5	6.45	0	0	ON	.59	0	90	20.46	ON	0	7
	2		10.32									60	
	3		15.25									60	
44	1		6.45	12	15						OFF	60	
	2		10.32									60	
	3		15.25									60	
45	1		6.45			OFF	0					0	
	2		10.32									60	
	3		15.25									60	
46	1		10.32	0	0							60	
47	1											60	
48	1											60	
49	1	2.0	6.45	12	15							60	
	2		10.32									60	
50	1		6.45			ON	.59					60	
	2		10.32									60	
51	1	3.7	6.45	6	7.5			-10				0	
	2		10.82									60	
	3		15.25									60	
52	1		6.45			OFF	0					0	
	2		10.82									60	
	3		15.25									60	
53	1		6.45								ON	0	
	2		10.82									60	
	3		15.25									60	
54	1		6.45	0	0							0	
	2		10.82									60	
	3		15.25									60	

TABLE NO. 2-1
WATER HOVER TEST
RUN INDEX

UPPER TANK TYPE	TANK SIZE	AMPERE TEMP	WIND DIRECTION	WIND SPEED	REMARKS	DATE
C)						1968
7	40	30.08	CALM			1/24
	44	30.04	S/2			
	45	30.03				
	60	29.76				1/25
	64	29.75	S/3			
	70	29.72				
	72	29.73				
	72	29.68	S/8		Coated Blades for No. 3 here on	
	70	29.90	S-SE/10		No Moisture Data; R.H. Wing	1/31
			S-SE/18			
			S/15			
	66		W/16		Manually Operated Moist. Meter on R.H. Wing	2/1
		29.88	N-NW/20-22		Until Noted Otherwise	
	50	30.34	0			2/2
			W-NW/4			
			N-NW/2			
	51		0			
			N/5			

B

TABLE NO
WATER HOV
RUN INDI

RUN		H/D _p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	φ	ψ	D _p	FLOATS	MOISTURE SAMPLE	TANK SIDE- WALL
NO.	PT.			(IN.)	(FT.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN.)	(ON/OFF)		(IN.)
55	1	3.7	6.45	6	7.5	OFF	0	-10	90	20.46	OFF	0	7
	2		10.82									60	
	3		15.25									60	
56	1		6.45	0	0							0	
	2		10.82									60	
	3		15.25									0	
57	1		6.45			ON	.59					0	
	2		10.82									60	
	3		15.25									0	
58	1	2.5	6.45			OFF	0					0	
	2		10.82									60	
	3		15.25									60	
59	1		6.45	6	7.5	OFF	0					0	
	2		10.82									60	
	3		15.25									60	
60	1		6.45	12	15.0							0	
	2		10.82									60	
	3		15.25									60	
61	1		6.45	0	0	ON	.59					0	
	2		10.82									60	
	3		15.25									60	
62	1		6.45	6	7.5							0	
	2		10.82									60	
	3		15.25									60	
63	1		6.45	12	15.0							0	
	2		10.82									60	
	3		15.25									60	

A

TABLE NO. 2-1
 ER HOVER TEST
 RUN INDEX

TANK SIDE- WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR / VEL)	REMARKS	DATE
7	56	30.29	8-SW/6		1968
	60		W/5		2/2
	↓	↓	↓		
	62	30.28	W/4		
	↓	↓	0		
	↓	↓	SW/4		
	↓	↓	0		
	↓	↓	NE/5		
	↓	↓	E-NE/3		
	↓	↓	0		
	↓	↓	0		
	↓	↓	0		
	46	30.20	NW/5		2/5
	46	↓	NW/5		
	50	↓	N-NW/8		
	56	↓	NW/8		
	↓	↓	N/10		
	58	↓	↓		
	59	↓	↓		
	56	30.18	VAR/2		
	↓	↓	↓		
	58	30.16	VAR/2-5		
	↓	↓	NE/10		
	↓	↓	NW/8		
	↓	↓	VAR/2		
	45	30.31	NW/4		
	↓	↓	↓		
					2/6

B

TABLE 1
WATER H
RUN

RUN		H/D _p	T/A	WAVE HEIGHT	WAVE LENGTH	BLOWER	q	φ	ψ _w	D _p	FLOATS	MOISTURE SAMPLE	TANK SIDE- WALL H
NO.	PT.			(IN.)	(FT.)	(ON/OFF)	(PSF)	(DEG)	(DEG)	(IN.)	(ON/OFF)	(SEC)	(IN.)
64	1	2.5	6.45	0	0	OFF	0	-5	90	20.46	OFF	60	7.0
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
65	1		6.45	6.00	7.5							0	↓
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
66	1		6.45	12.00	15.0							0	↓
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
67	1		6.45	0	0	ON	.59					0	↓
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
68	1		6.45	6.0	7.5							0	↓
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
69	1		6.45	12.0	15.0							0	↓
	2		10.82	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
	3		15.25	↓	↓	↓	↓	↓	↓	↓	↓	60	↓
70	1		15.25	0	0	OFF	0	↓	↓	↓	↓	120	↓
NO BALANCE DATA HERE ON													
71	1		—	0	0	OFF	0	-5	90	20.46	OFF	0	7.0
	2		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	3		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	4		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	5		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	6		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	7		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

TABLE NO. 2-1
WATER HOVER TEST
RUN INDEX

TANK SIDE- WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR, VFL)	REMARKS	DATE
7.0	36	30.30	VAR/2		1968
↓	40	↓	NE/4		2/8
↓	43	↓	0		
↓	49	↓	0		
↓	52	↓	0		
↓	52	↓	NE/5		
↓	50	30.25	VAR/2		
↓	↓	↓	0		
↓	↓	↓	0		
↓	50	↓	NW/7		
↓	↓	↓	VAR/3-4		
↓	↓	↓	NE/4		
↓	50	30.23	0		
↓	↓	↓	N/4		
↓	↓	↓	0		
↓	54	30.21	0		
↓	↓	↓	↓		
No Perceptible Sign of Moisture This Run				Using 150-Kinetic moisture sampler	2/9
7.0	58	30.08	VAR/2-4	THRUST/cts	APPROX E-PUT
↓	↓	↓	↓	90	No. 3 N.P.
↓	↓	↓	↓	185	1220
↓	↓	↓	↓	280	1770
↓	↓	↓	↓	375	2180
↓	↓	↓	↓	470	2420
↓	↓	↓	↓	565	2720
↓	↓	↓	↓	660	2930
↓	↓	↓	↓		3220

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G C.C.									
PRESS TARE 1									
STATIC TARE 0									
TUNNEL TEMP 78.30									
PHI = 0.0									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM
1	C.C.	0.0	90.00	54.057	1.931	34.798	-0.292	-2.623	47.982
2	C.C.	0.0	90.00	53.545	2.673	36.483	0.166	-0.627	36.922
3	C.C.	0.0	90.00	52.529	4.906	72.828	-0.910	-17.117	-4.476
4	C.C.	0.0	90.00	136.875	5.725	129.182	-7.622	-30.217	-4.476
TUNNEL TEMP 78.30									
PHI = 0.0									
PT	ALPHA	PSI	IM	TI	MPH	J1	T2	APM2	J2
1	C.C.	0.0	90.00	14.61	4152.0	0.0	14.71	4204.0	0.0
2	C.C.	0.0	90.00	14.24	4152.0	0.0	14.92	4204.0	0.0
3	C.C.	0.0	90.00	24.49	5472.0	0.0	24.70	5442.0	0.0
4	C.C.	0.0	90.00	34.69	6500.0	0.0	34.79	6444.0	0.0
TUNNEL TEMP 78.30									
PHI = 0.0									
PT	ALPHA	PSI	IM	AVE	CTST	CTSI	CTS2	CTS3	CTS4
1	C.C.	0.0	90.00	14.607	1.0000	1.3003	1.0073	1.9829	1.0094
2	C.C.	0.0	90.00	14.593	1.0000	0.9761	1.0227	1.0198	0.9815
3	C.C.	0.0	90.00	24.689	1.0000	0.9920	1.0004	1.0315	0.9761
4	C.C.	0.0	90.00	34.736	1.0000	0.9987	1.0015	0.9996	1.0042
TUNNEL TEMP 78.30									
PHI = 0.0									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CRM	CYM
1	C.C.	0.0	90.00	1.3008	0.0467	0.0693	-0.0071	-0.0005	0.0130
2	C.C.	0.0	90.00	1.2956	0.0447	0.0695	0.0040	-0.0025	0.0100
3	C.C.	0.0	90.00	1.3234	0.0702	0.0833	-0.0130	-0.0024	-0.0065
4	C.C.	0.0	90.00	1.3914	0.0582	0.1112	-0.0775	-0.0015	-0.0005
TUNNEL TEMP 78.30									
PHI = 0.0									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CRM	CYM
1	C.C.	0.0	90.00	1.3008	0.0467	0.0693	-0.0071	-0.0005	0.0130
2	C.C.	0.0	90.00	1.2956	0.0447	0.0695	0.0040	-0.0025	0.0100
3	C.C.	0.0	90.00	1.3234	0.0702	0.0833	-0.0130	-0.0024	-0.0065
4	C.C.	0.0	90.00	1.3914	0.0582	0.1112	-0.0775	-0.0015	-0.0005

TABLE NO. 2-2
VAD LGM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

03/04/68															
TUNNEL 0			C.O			ALPHA TABLE 11									
PRESS TARE			1			TEMP TARE 1									
STATIC TARE			0			RUN NO. 2									
TUNNEL TEMP			72.00			PHI = 0.0									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM	T3	RPM3	J3	T4	RPM4	J4
1	G.C	0.0	90.00	57.759	1.278	46.287	0.095	-18.282	23.923	14.67	4596.0	0.0	14.96	4228.0	0.0
2	G.C	0.0	90.00	95.843	3.708	76.980	0.507	-17.508	-14.562	24.73	5958.0	0.0	24.84	5440.0	0.0
3	G.C	0.0	90.00	135.081	0.895	77.611	-0.259	-28.409	42.962	34.90	7010.0	0.0	35.15	6378.0	0.0
PT	ALPHA	PSI	IM	T1	RP1	J1	T2	RP2	J2	CT51	CT52	CT53	CT54	Q5	
1	G.C	0.0	90.00	14.61	4178.0	0.0	14.87	4202.0	0.0	0.9937	1.0072	0.9937	1.0094	6.47	
2	G.C	0.0	90.00	24.65	5414.0	0.0	24.65	5470.0	0.0	0.9971	0.9971	1.0036	1.0049	10.83	
3	G.C	0.0	90.00	34.74	6368.0	0.0	34.68	6392.0	0.0	0.9947	0.9947	1.0069	1.0080	15.27	
PT	ALPHA	PSI	IM	AVE T	CT51	CT52	CT53	CT54	Q5						
1	G.C	0.0	90.00	14.765	1.0000	0.9896	0.9973	0.9973	0.9973						
2	G.C	0.0	90.00	24.717	1.0000	0.9973	0.9973	0.9973	0.9973						
3	G.C	0.0	90.00	34.867	1.0000	0.9964	0.9964	0.9964	0.9964						
WIND AXES DATA															
SLIPSTREAM C															
PT	ALPHA	PSI	IM	CL	CC	CM	CV	CW	CX	CY	CZ	Q5	CY	CZ	Q5
1	G.C	0.0	90.00	1.3813	0.0306	0.0976	0.0023	-0.0050	0.0064	0.0050	0.0064	6.47	0.0064	0.0064	6.47
2	G.C	0.0	90.00	1.3692	0.0530	0.0923	0.0073	-0.0030	-0.0023	-0.0030	-0.0023	10.83	-0.0023	-0.0023	10.83
3	G.C	0.0	90.00	1.3680	0.0091	0.0719	-0.0026	-0.0032	0.0049	-0.0032	0.0049	15.27	0.0049	0.0049	15.27

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 200
BALANCE AXES DATA

TUNNEL Q C.O		03/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 70.00		RUN NO. 3									
		PHI = C.O									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	AM	YM		
1	C.O	C.C	90.00	59.061	2.398	41.033	-0.139	-27.896	-36.945		
2	C.O	C.C	90.00	102.414	2.963	55.340	-1.442	-59.080	-60.753		
3	C.O	C.C	90.00	145.048	4.068	83.096	0.062	-30.634	-57.349		
PT	ALPHA	PSI	IM	Y1	RP1	J1	T2	RP2	J2	Y3	RP3
1	C.O	C.C	90.00	14.77	4100.0	C.O	14.06	4204.0	C.O	14.07	4554.0
2	C.O	C.C	90.00	24.39	5300.0	C.O	24.06	5400.0	C.O	25.36	5890.0
3	C.O	C.C	90.00	34.74	6300.0	C.O	35.05	6474.0	C.O	34.74	6960.0
PT	ALPHA	PSI	IM	AVE I	CT1	CT2	CT3	CT4	QS		
1	C.O	C.C	90.00	14.752	1.0000	1.0012	0.9939	0.9946	1.0113	6.46	
2	C.O	C.C	90.00	24.035	1.0000	0.9620	1.0009	1.0212	0.9959	10.08	
3	C.O	C.C	90.00	34.014	1.0000	0.9979	1.0768	0.9979	0.9974	15.25	
WIND AXES DATA											
SLIPSTREAM U											
PT	ALPHA	PSI	IM	CL	CC	CM	CV	CA	CY	CU	CS
1	C.O	C.C	90.00	1.4281	0.0574	0.0017	-0.0033	-0.0074	-0.0099	6.46	
2	C.O	C.C	90.00	1.4561	0.0421	0.0052	-0.0205	-0.0076	-0.0096	10.08	
3	C.O	C.C	90.00	1.4793	0.0494	0.0089	0.0006	-0.0035	-0.0065	15.25	

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0		03/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 68.00		RUN NO. 4									
PT ALPHA PSI IW		PMI = 0.0									
1 0.0 0.0 90.00		NF 59.445 1.763 31.929 0.043 -15.252 27.135									
2 0.0 0.0 90.00		AF 1.916 50.786 -1.634 -22.941 19.007									
3 0.0 0.0 90.00		J1 4.411 88.139 -2.521 -47.345 29.583									
PT ALPHA PSI IW		T1 RPM1 J1 T2 RPM2 J2 T3 RPM3 J3									
1 0.0 0.0 90.00		14.51 4154.0 0.0 14.77 4168.0 0.0 14.78 4590.0 0.0									
2 0.0 0.0 90.00		24.76 5372.0 0.0 24.70 5436.0 0.0 24.94 5904.0 0.0									
3 0.0 0.0 90.00		34.43 6358.0 0.0 34.47 6374.0 0.0 34.74 6966.0 0.0									
PT ALPHA PSI IW		AVE T CTS1 CTS2 CTS3 CTS4 QS									
1 0.0 0.0 90.00		14.712 1.0000 0.9860 1.0037 1.0044 1.0058 6.44									
2 0.0 0.0 90.00		24.756 1.0000 1.0000 0.9977 1.0075 0.9948 10.84									
3 0.0 0.0 90.00		34.676 1.0000 0.9930 0.9943 1.0021 1.0107 15.19									
PT ALPHA PSI IW		T4 RPM4 J4									
1 0.0 0.0 90.00		14.80 4184.0 0.0									
2 0.0 0.0 90.00		24.63 5360.0 0.0									
3 0.0 0.0 90.00		35.04 6358.0 0.0									

WIND AXES DATA

SLIPSTREAM Q

PT ALPHA PSI IW		CL CD CM CY CVM QS					
1 0.0 0.0 90.00		1.4268 0.0423 0.0632 0.0010 -0.0041 3.0073 6.44					
2 0.0 0.0 90.00		1.4420 0.0273 0.0623 -0.0233 -0.0031 3.0024 10.84					
3 0.0 0.0 90.00		1.5045 0.0449 0.0750 -0.0257 -0.0048 0.0034 15.19					

TABLE NO. 2-2
VAD LGM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

63/54/68

TUNNEL Q 0.0

PRESS TAPE 1

ALPHA TABLE 11

STATIC TAPE 0

TEMP TAPE 1

TUNNEL TEMP 74.00 PM1 = 3.0 HUM NO. 5

PT	ALPHA	PSI	IM	IN	MF	AF	PM	SF	AM	VM	T1	T2	RPM1	J1	T3	RPM2	J2	T4	RPM3	J3	T5	RPM4	J4
1	0.0	0.0	90.00	90.00	55.042	-0.004	21.072	1.093	48.366	19.695													
2	0.0	0.0	90.00	90.00	55.202	-0.007	50.382	1.550	27.231	74.312													
3	0.0	0.0	90.00	90.00	136.125	3.023	111.010	0.353	-16.003	99.112													
PT	ALPHA	PSI	IM	IN	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4							
1	0.0	0.0	90.00	90.00	15.03	4292.0	0.0	14.66	4242.0	0.0	14.78	4798.0	0.0	14.01	4222.0	0.0							
2	0.0	0.0	90.00	90.00	24.60	5470.0	0.0	24.54	5490.0	0.0	24.63	6138.0	0.0	24.42	5484.0	0.0							
3	0.0	0.0	90.00	90.00	34.48	6560.0	0.0	35.00	6520.0	0.0	34.74	7512.0	0.0	34.78	6490.0	0.0							

PT	ALPHA	PSI	IM	IN	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	90.00	14.619	1.0000	1.0283	1.5029	1.0118	0.9580	6.40
2	0.0	0.0	90.00	90.00	24.540	1.0000	1.0021	1.9998	1.0133	0.9947	10.75
3	0.0	0.0	90.00	90.00	34.749	1.0000	0.9923	1.0072	0.9998	1.0100	15.22

28

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IM	IN	CL	CD	CM	CY	CRM	CVM	CS
1	0.0	0.0	90.00	90.00	1.3488	-0.0117	0.0511	0.0264	0.0125	0.0053	6.40
2	0.0	0.0	90.00	90.00	1.3695	-0.0001	0.0783	0.0223	0.0130	0.0120	14.75
3	0.0	0.0	90.00	90.00	1.3833	0.0305	0.0996	0.0036	-0.0019	0.0113	15.22

TABIZ NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q C.55

03/04/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 74.66

RUN NO. 6

PHI = 0.0

PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	VM	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	42.290	21.223	226.354	-1.055	-9.914	19.135	14.72	4718.0	0.1691	14.00	4278.0	0.1805
2	0.0	0.0	90.00	100.809	31.481	345.241	-0.752	6.777	14.020	24.79	6178.0	0.1292	24.89	5498.0	0.1452
3	0.0	0.0	90.00	141.826	35.113	425.832	-0.276	-53.651	46.062	34.79	7430.0	0.1074	35.25	6530.0	0.1210

WIND AXES DATA

PT	ALPHA	PSI	IN	CL	CD	CM	CV	CRM	CVM	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	16.3281	5.5633	4.4201	-0.2767	-0.0223	0.0563	0.9161	0.9286	0.9161	0.9207	7.04
2	0.0	0.0	90.00	26.4254	8.2522	6.7898	-0.1972	0.0248	0.0412	0.9486	0.9509	0.9462	0.9502	11.47
3	0.0	0.0	90.00	37.1770	9.2041	8.5759	-0.0724	-0.1561	0.1335	0.9627	0.9562	0.9622	0.9748	15.84

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IN	CL	CD	CM	CV	CRM	CVM	CTS	QS
1	0.0	0.0	90.00	1.3685	0.4663	0.3705	-0.0232	-0.0019	0.0047	0.0050	7.04
2	0.0	0.0	90.00	1.3589	0.4244	0.3492	-0.0101	0.0013	0.0021	0.0021	11.47
3	0.0	0.0	90.00	1.3849	0.3429	0.3195	-0.0027	-0.0058	0.0050	0.0050	15.84

TABLE NO. 2-2
 VAD LGM SPEED WIND TUNNEL TEST NO. 266
 BALANCE PRESS DATA

03/24/68														
ALPHA TABLE 11														
TEMP TABLE 1														
WIND NO. 7														
PT	ALPHA	PSI	IN	MF	AF	PM	SF	AM	VM					
1	C.C	0.0	50.00	57.699	-2.399	7.902	-1.620	-35.824	-3.595					
2	C.C	0.0	90.00	94.426	-6.970	-19.041	-2.020	-43.508	-35.946					
3	C.C	0.0	50.00	141.188	-7.043	20.244	-3.027	-144.532	-40.624					
PT	ALPHA	PSI	IN	IL	RP1	J1	T2	RP2	J2	T3	RP3	J3	T4	RP4
1	C.C	0.0	90.00	14.61	4110.0	0.0	14.98	4154.0	0.0	14.88	4626.0	0.0	14.80	4106.0
2	C.C	0.0	90.00	24.23	5328.0	0.0	24.59	5294.0	0.0	24.21	5050.0	0.0	24.42	5224.0
3	C.C	0.0	90.00	35.22	6330.0	0.0	34.42	6328.0	0.0	35.32	7536.0	0.0	35.04	6242.0
PT	ALPHA	PSI	IN	AVE	T	CTST	CTSL	CTC	CTS3	CTS4	QS			
1	C.C	0.0	90.00	14.817	1.0000	0.9861	1.0138	1.0044	0.9987	6.49				
2	C.C	0.0	90.00	24.362	1.0000	0.9946	1.0095	0.9937	1.0022	17.67				
3	C.C	0.0	90.00	34.998	1.0000	1.0062	0.9835	1.0091	1.0012	15.33				
WIND AXES DATA														
SLIPSTREAM Q														
PT	ALPHA	PSI	IN	CL	CL	CL	CM	CY	CRM	CYM	QS			
1	C.C	0.0	90.00	1.3751	-0.0572	0.0295	-0.0386	-0.0386	-0.0386	-0.0010	6.49			
2	C.C	0.0	50.00	1.3686	-0.1010	-0.0061	-0.0409	-0.0409	-0.0409	-0.0058	10.67			
3	C.C	0.0	50.00	1.4245	-0.0711	0.0330	-0.0366	-0.0366	-0.0155	-0.0046	15.33			

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

JUNIAL C

B 47.12

Press here

ALPHA TABLE 11

STATIC TARE C

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TUNNEL TEMP 42.5°C

144

5 UN NU. 5

PT	ALPHA	PSI	IN	NF	AF	PM	SF	MA	VM	J3	T4	RMK	J4
1	C.C	C.C	50.00	62.152	23.477	211.485	-0.522	-37.113	41.445	0.1472	15.76	4100.0	3.1844
2	C.C	C.C	50.00	102.000	23.187	339.946	-1.554	-36.742	-13.531	0.1425	25.26	5336.0	0.1631
3	C.C	C.C	50.00	145.254	37.295	456.554	-2.123	-54.783	26.297	0.1139	34.25	6246.0	0.1232

DIAL AXES DATA

PT	ALPHA	PSI	1a	CL	CU	CM	CV	LFM	CYM
1	C.C	C.C	90.CC	16.3026	6.1357	3.9354	-0.1302	-0.1050	0.1219
2	C.C	C.C	90.CC	26.0109	7.3686	6.2958	-0.4372	-0.139	-0.0398
3	C.C	C.C	90.CC	38.0752	9.7702	9.2529	-0.5591	-0.1674	0.0774

PT	ALPHA	PSI	1b	AVE 1	C1S1	C1S2	C1S3	C1S4	CS
1	C.C	C.C	90.CC	16.695	0.9161	0.9202	0.925	0.9327	7.03
2	C.C	C.C	90.CC	24.010	0.9465	0.9404	0.9382	0.9415	11.46
3	C.C	C.C	90.CC	34.721	0.9627	0.9602	0.9543	0.9606	15.00

WIND AXES DATA

PT	ALPHA	PSI	IB	CL	TL	CM	CV	CMZ	CMV
1	0.0	0.0	90.00	1.3086	0.051	0.014	0.0119	0.009	0.012
2	0.0	0.0	50.00	1.3408	0.0515	0.014	0.0119	0.009	0.012
3	0.0	0.0	50.00	1.4224	0.051	0.0159	0.012	0.009	0.012

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 206
BALANCE AXES DATA

03/04/68													
ALPHA TABLE 11													
TEMP TAKE 1													
ALUM NO. 10													
PHI = C.C													
TUNNEL TEMP 44.00													
PT	ALPHA	PSI	IN	MF	AF	PM	SF	AM	YM	J2	J3	APM4	J4
1	C.C	0.0	90.00	58.492	-2.422	17.862	-0.051	6.497	-27.337	0.0	14.88	4184.0	0.0
2	C.C	0.0	90.00	57.439	-2.344	36.891	-2.380	-9.020	-51.049	0.0	24.58	5326.0	0.0
3	C.C	0.0	90.00	139.113	-9.547	-18.610	-5.372	-191.732	-29.278	0.0	34.16	6682.0	0.0
PT	ALPHA	PSI	IN	TI	APM1	J1	APM2	J2	APM3	J3	APM4	J4	
1	C.C	0.0	90.00	14.77	4120.0	0.0	14.92	4116.0	0.0	0.0	14.69	4728.0	0.0
2	C.C	0.0	90.00	25.07	5276.0	0.0	25.22	5296.0	0.0	0.0	24.47	5142.0	0.0
3	C.C	0.0	90.00	34.37	6246.0	0.0	34.21	6170.0	0.0	0.0	35.67	6216.7	0.0
WIND AXES DATA													
SLIPSTREAM Q													
PT	ALPHA	PSI	IN	CL	CD	CM	CV	CM	CVM	GS			
1	C.C	0.0	90.00	1.3940	-0.0577	0.0519	-0.0012	0.0718	-0.0073	6.49			
2	C.C	0.0	90.00	1.3854	-0.0333	0.0561	-0.0338	-0.0026	-0.0081	10.88			
3	C.C	0.0	90.00	1.4195	-0.0974	0.0023	-0.0548	-0.0026	-0.0034	15.16			

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 206
BALANCE AXES DATA

03/24/68											
ALPHA TABLE 1											
TEMP TARE 1											
RUN NO. 11											
PMI = 0.00											
PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM		
1	C.C	C-0	50.00	04.370	19.774	23.452	0.022	-25.994	20.365		
2	C.C	0.0	50.00	105.717	31.803	374.406	0.011	-49.647	40.412		
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	J2	T3	RPM3	J3
1	C.C	C-0	90.00	14.01	4100.0	0.1066	14.07	0.1915	14.78	4176.0	0.1832
2	C.C	0.0	50.00	24.05	5360.0	0.1427	25.01	0.1454	24.79	4076.0	0.1477
T4 RPM4 J4											
14.75 4128.0 0.1853											
24.89 5370.0 0.1475											
WIND AXES DATA											
PT	ALPHA	PSI	IM	CL	CO	CM	CV	CM	CYM		
1	C.C	C-0	90.00	16.0733	5.1033	4.5954	0.0057	-0.0766	0.0599		
2	C.C	0.0	50.00	27.7119	9.3303	7.4910	0.0027	-0.1427	0.1109		
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTST	CTSI	CTSI	QS	QS
1	C.C	0.0	90.00	14.751	0.9163	0.9076	0.9238	0.9179	0.9159	7.05	7.05
2	C.C	0.0	90.00	24.035	0.9406	0.9415	0.9554	0.9466	0.9517	11.47	11.47
WIND AXES DATA											
SLIPSTREAM C											
PT	ALPHA	PSI	IM	LL	CU	CM	CV	CM	CYM	QS	QS
1	C.C	0.0	50.00	1.4119	0.4337	0.3049	0.0005	-0.0064	0.0150	7.05	7.05
2	C.C	0.0	90.00	1.4258	0.4290	0.3054	0.0001	-0.0073	0.0061	11.47	11.47

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL U C.55

03/04/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 85.00

PHI - 0.0

RUN NO. 12

PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	VM	J2	T3	RPMS	J3	T4	RPMS	J4
1	0.0	0.0	85.00	59.101	18.133	165.468	-108.506	-396.064	-169.027	0.1988	14.72	4112.0	0.1948	14.85	4116.0	0.1946
2	0.0	0.0	85.00	101.228	22.509	274.672	-0.158	3.415	41.723	0.1511	24.58	5336.0	0.1501	24.63	5306.0	0.1510
3	0.0	0.0	85.00	139.959	23.455	304.278	0.285	-63.709	91.871	0.1256	34.90	6670.0	0.1201	35.15	6270.0	0.1277

WIND AXES DATA

PT	ALPHA	PSI	IN	CL	CC	CM	CV	CRM	CVM	CT53	CT54	QS
1	0.0	0.0	85.00	15.4922	4.7332	3.0894	-28.4428	-0.4629	-0.4973	0.9169	0.9248	7.03
2	0.0	0.0	85.00	26.5351	5.9003	5.5393	-0.0414	0.0111	0.1227	0.9458	0.9478	11.38
3	0.0	0.0	85.00	30.6876	6.1403	6.2164	0.0748	-0.1893	0.2703	0.9619	0.9687	15.89

WIND AXES DATA

SLIPSTREAM 0

PT	ALPHA	PSI	IN	CL	CO	CM	CV	CRM	CVM	QS
1	0.0	0.0	85.00	1.2995	0.3987	0.2591	-2.3858	-0.0388	-0.0417	7.03
2	0.0	0.0	85.00	1.3756	0.3059	0.2872	-0.0021	0.0076	0.0064	11.38
3	0.0	0.0	85.00	1.3622	0.2243	0.2308	0.0026	-0.0070	0.0100	15.89

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 200
BALANCE AXES DATA

TUNNEL Q 0.59

03/04/68

PRESS TAKE 1

ALPHA TABLE 11

STATIC TAKE C

TEMP TAKE :

TUNNEL TEMP 80.00

PHI = 0.0

RUN NO. 13

PT	ALPHA	PSI	IN	MP	AF	PM	SP	PM	YM	J2	J3	T4	MPH4	J4
1	C.C	0.0	80.00	63.962	12.557	154.689	-0.549	-8.430	17.679	0.1682	14.72	4122.0	14.75	6.1938
2	C.C	0.0	80.00	106.291	15.273	238.761	-0.89	-27.656	32.501	0.1500	24.79	5393.0	24.84	0.1492
3	C.C	0.0	80.00	143.809	12.157	200.621	0.276	-55.383	37.422	0.1248	34.43	6638.0	34.83	0.1267

PT	ALPHA	PSI	IN	TI	MPH1	J1	T2	MPH2	J2	T3	MPH3	J3	T4	MPH4	J4
1	C.C	0.0	80.00	14.56	4112.0	0.1939	14.61	4022.0	0.1682	14.72	4122.0	14.75	4116.0	6.1938	
2	C.C	0.0	80.00	24.76	5376.0	0.1483	24.70	5314.0	0.1500	24.79	5393.0	24.84	5362.0	0.1492	
3	C.C	0.0	80.00	34.43	6336.0	0.1258	34.58	6388.0	0.1248	34.43	6638.0	34.83	6294.0	0.1267	

WIND AXES DATA

PT	ALPHA	PSI	IN	CL	CU	CM	LY	CRM	CYM	CTX3	CTX4	US
1	C.C	0.0	80.00	16.7665	3.2916	3.1752	-0.1440	-0.0212	0.0519	0.9169	0.9212	7.01
2	C.C	0.0	80.00	27.8621	4.0036	5.0459	-0.0233	-0.0602	0.0986	0.9450	0.9511	11.44
3	C.C	0.0	80.00	37.6970	3.1867	5.7490	0.0723	-0.1647	0.1101	0.9457	0.9698	15.73
PT	ALPHA	PSI	IN	AVE T	CTST	CTSI	CTX2	CTX3	CTX4			
1	C.C	0.0	80.00	14.659	0.9158	0.9056	0.9127	0.9169	0.9212			
2	C.C	0.0	80.00	24.770	0.9484	0.9479	0.9457	0.9450	0.9511			
3	C.C	0.0	80.00	34.565	0.9623	0.9586	0.9629	0.9586	0.9698			

WIND AXES DATA

SLIPSTREAM

PT	ALPHA	PSI	IN	CL	CU	CM	CY	CNM	CYM	US
1	C.C	0.0	80.00	1.4110	0.2770	0.2672	-0.0121	-0.0018	0.0044	7.1
2	C.C	0.0	80.00	1.4371	0.2065	0.2603	-0.0112	-0.0031	0.0051	11.44
3	C.C	0.0	80.00	1.4140	0.1195	0.2156	0.0027	-0.0062	0.0041	15.73

TABLE NO. 2-2

VAG LOW SPEED WIND TUNNEL TEST NO. 200
BALANCE AXES DATA

C3/C4/68

ALPHA TABLE 11

TEMP TARE 1

HUN NO. 14

PHI = 0.0

PT ALPHA PSI IM NF RPM1 J1 T2 J2 RPM2 SF RM YM

1 0.0 0.0 75.00 64.969 8.500 130.453 -0.745 -18.523 26.970

2 0.0 0.0 75.00 107.051 6.333 189.321 -0.275 -22.960 54.472

3 0.0 0.0 75.00 145.092 1.428 200.199 -0.293 -64.299 40.468

PT ALPHA PSI IM T1 RPM1 J1 T2 J2 RPM2 T3 RPM3 J3 T4 RPM4 J4

1 0.0 0.0 75.00 14.61 4114.0 0.1930 14.66 4368.0 0.1952 14.67 4172.0 0.1903 14.69 4160.0 0.1909

2 0.0 0.0 75.00 24.76 5380.0 0.1476 24.65 5322.0 0.1492 24.68 5404.0 0.1469 24.73 5368.0 0.1479

3 0.0 0.0 75.00 34.53 6350.0 0.1251 34.63 6336.0 0.1253 34.79 6604.0 0.1202 35.04 6308.0 0.1259

WIND AXES DATA

PT ALPHA PSI IM CL CO CM CY CRX CYM

1 0.0 0.0 75.00 17.0305 2.2280 2.9462 -0.1953 -0.0497 0.0793

2 0.0 0.0 75.00 28.2713 1.6600 4.3150 -0.0722 -0.0650 0.1603

3 0.0 0.0 75.00 38.0332 0.3743 4.8481 -0.0769 -0.1873 0.1191

PT ALPHA PSI IM AVE 1 CTST CTS1 CTS2 CTS3 CTS4 QS

1 0.0 0.0 75.00 14.659 0.9158 0.9129 0.9160 0.9166 0.9179 7.01

2 0.0 0.0 75.00 24.704 0.9483 0.9503 0.9461 0.9474 0.9494 11.41

3 0.0 0.0 75.00 34.762 0.9627 0.9563 0.9590 0.9636 0.9718 15.82

WIND AXES DATA

SLIPSTREAM Q

PT ALPHA PSI IM CL CO CM CY CRX CYM QS

1 0.0 0.0 75.00 1.4333 0.1875 0.2479 -0.0164 -0.0042 0.0067 7.01

2 0.0 0.0 75.00 1.4615 7.0458 0.2231 -0.0037 -0.0036 0.0083 11.41

3 0.0 0.0 75.00 1.4188 0.0140 0.1809 -0.0029 -0.0070 0.0144 15.82

TUNNEL Q 0.59

PRESS TARE 1

STATIC TARE C

TUNNEL TEMP 75.00

TUNNEL Q 0.59

PRESS TARE 1

STATIC TARE C

TUNNEL TEMP 75.00

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 246
BALANCE AXES DATA

TUNNEL C C-55

03/4/68

PRESS TARE 1

ALPHA TARE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 70.00

RUN NO. 15

PMI = 0.00

PT	ALPHA	PSI	IM	MF	AF	PM	SF	RM	YM	J2	J3	J4	PPMS
1	C.C	0.0	70.00	60.955	5.115	121.450	-1.0096	-26.021	22.038	0.1517	15.67	424.00	0.1864
2	C.C	0.0	70.00	100.130	-2.526	143.538	-0.0126	-29.739	28.002	0.1461	24.73	543.90	0.1453
3	C.C	0.0	70.00	140.213	-8.369	160.176	0.0915	-65.167	66.475	0.1252	34.85	6556.0	0.1274
PT	ALPHA	PSI	IM	TI	RPMI	J1	T2	RPM2	J2	J3	PPMS	J4	PPMS
1	C.C	0.0	70.00	14.72	4180.0	0.1851	14.92	4122.0	0.1517	15.67	424.00	0.1864	4180.0
2	C.C	0.0	70.00	24.76	5400.0	0.1464	24.86	5338.0	0.1461	24.73	543.90	0.1453	5380.0
3	C.C	0.0	70.00	34.79	6356.0	0.1244	34.58	6314.0	0.1252	34.85	6556.0	0.1274	6300.0

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CU	CM	CY	CP	CYM	CTS3	CTS4	US
1	C.C	0.0	70.00	17.5511	1.3409	2.7111	-0.0252	-0.0759	0.0648	0.9092	0.9272	7.07
2	C.C	0.0	70.00	28.3444	-0.6621	3.6661	-0.0332	-0.0860	0.0881	0.9456	0.9517	11.46
3	C.C	0.0	70.00	38.0513	-2.1939	4.3936	0.0245	-0.2094	0.1956	0.9624	0.9634	15.81
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTSE	CTSS	CTSA	US		
1	C.C	0.0	70.00	14.791	0.9165	0.9119	0.9248	0.9092	0.9272	7.07		
2	C.C	0.0	70.00	24.806	0.9465	0.9465	0.9513	0.9456	0.9517	11.46		
3	C.C	0.0	70.00	34.742	0.9627	0.9640	0.9580	0.9624	0.9634	15.81		

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IM	CL	CD	CP	CY	CM	CYM	US
1	C.C	0.0	70.00	1.4650	0.1119	0.2263	-0.0021	-0.0063	0.0154	7.07
2	C.C	0.0	70.00	1.4598	-0.0341	0.1809	-0.0017	-0.0045	0.0045	11.46
3	C.C	0.0	70.00	1.4495	-0.0819	0.1641	0.0009	-0.0076	0.0073	15.81

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AREA DATA

TUNNEL G C.U		C3/24/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 44.00		RUN NO. 18									
		PMI = 0.0									
PT	ALPHA	PSI	IN	IF	AF	PM	SP	RM	YM		
1	C.C	C.C	50.00	55.108	-1.477	1.479	-0.170	-5.132	18.664		
2	C.C	U.C	90.00	53.522	-2.808	8.463	-0.194	12.412	39.146		
3	C.C	C.C	90.00	138.579	-0.599	83.139	-0.783	-160.607	-9.776		
PT	ALPHA	PSI	IN	TI	APM1	J1	T2	MPM2	J2	T3	MPM3
1	C.C	C.C	50.00	14.61	4050.0	0.0	14.50	4000.0	0.0	14.72	4196.0
2	C.C	0.0	90.00	24.49	5342.0	0.0	24.75	5322.0	0.0	24.58	5438.0
3	C.C	C.C	90.00	34.01	6294.0	0.0	33.53	6294.0	C.C	35.06	6870.0
										14.85	4056.0
										24.68	5224.0
										35.15	6230.0
											J4
											C.C
											C.C
											C.C
PT	ALPHA	PSI	IN	AVE T	CTST	CTSL	CTS2	CTS3	CTS4	QS	
1	C.C	C.C	90.00	14.673	1.0000	0.9958	0.9885	1.0035	1.0121	6.43	
2	C.C	0.0	90.00	24.425	1.0000	0.9946	1.0051	0.9980	1.0023	10.79	
3	C.C	C.C	90.00	34.434	1.0000	0.9876	0.9737	1.0181	1.0207	15.08	
WIND AREA DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IN	CL	CD	CM	CV	CRM	CVM	QS	
1	C.C	0.0	90.00	1.3281	-0.0356	0.0107	-0.0041	-0.0013	0.0050	6.43	
2	C.C	C.C	90.00	1.3410	-0.0403	0.0197	-0.0028	0.0021	0.0063	10.79	
3	C.C	C.C	90.00	1.4211	-0.0061	0.0013	-0.0080	-0.0063	-0.0011	15.08	

TABLE NO. 2-2
VAL LCM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL C 0.59

03/14/69

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 46.00

PHI = 0.0

RUN NO. 19

PT	ALPHA	PSI	IM	IF	PF	PM	SF	RM	YM	J1	J2	J3	J4
1	0.0	0.0	50.00	62.931	19.670	207.869	-1.051	-29.400	12.035	0.1518	0.1518	0.1863	0.1851
2	0.0	0.0	50.00	101.020	24.817	306.640	-1.544	-77.513	13.712	0.1422	0.1422	0.1777	0.1721
3	0.0	0.0	50.00	145.718	22.917	340.079	-1.387	-95.951	103.141	0.1186	0.1186	0.1100	0.1225

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CD	CM	CY	CRM	CYM	CTST	CTST	CTST	CTST
1	0.0	0.0	50.00	16.4963	5.1562	4.0494	-0.2755	-0.0757	0.0356	0.9162	0.9162	0.9142	0.9142
2	0.0	0.0	50.00	26.4805	6.5053	6.2500	-0.1427	-0.2245	0.0403	0.9483	0.9483	0.9601	0.9601
3	0.0	0.0	50.00	34.1973	6.0067	7.1264	0.1015	-0.2845	0.3034	0.9631	0.9631	0.9802	0.9802

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CG	CM	CY	CRM	CYM	CTST	CTST	CTST	CTST
1	0.0	0.0	50.00	1.3826	0.4322	0.3394	-0.1231	-0.0867	0.0030	0.9162	0.9162	0.9142	0.9142
2	0.0	0.0	50.00	1.3699	0.3365	0.3233	-0.0074	-0.0116	0.0021	0.9483	0.9483	0.9601	0.9601
3	0.0	0.0	50.00	1.4096	0.2217	0.2630	0.0037	-0.0105	0.0112	0.9631	0.9631	0.9802	0.9802

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 206
BALANCE AXES DATA

03/04/66											
ALPHA TABLE 11											
TEMP TARE 1											
RUN NO. 20											
PMI = 0.0											
PT	ALPHA	PSI	IM	MP	AF	PH	SF	RM	YM		
1	0.0	0.0	90.00	90.026	-0.722	25.310	-1.120	-20.511	9.163		
2	0.0	0.0	90.00	97.524	-2.003	35.607	-0.754	-24.974	33.492		
3	0.0	0.0	90.00	144.570	-1.352	50.080	-2.983	-125.222	-39.643		
PT	ALPHA	PSI	IM	T1	APM1	J1	HPM2	J2	T3	RPM3	J3
1	0.0	0.0	90.00	14.91	4124.0	0.0	14.96	4148.0	14.93	4230.0	0.0
2	0.0	0.0	90.00	24.70	5334.0	0.0	24.28	5362.0	24.94	5494.0	0.0
3	0.0	0.0	90.00	34.93	6350.0	0.0	35.05	6358.0	34.43	6866.0	0.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	0.0	0.0	90.00	14.686	1.0000	0.9878	0.9912	1.0169	1.0041	6.43	0.0
2	0.0	0.0	90.00	24.770	1.0000	0.9973	0.9801	1.0070	1.0156	10.85	0.0
3	0.0	0.0	90.00	34.696	1.0000	0.9953	1.0102	0.9922	1.0023	15.20	0.0
WIND AXES DATA											
SLIPSTREAM G											
PT	ALPHA	PSI	IM	CL	CU	CM	LY	CRM	CYM	QS	QS
1	0.0	0.0	90.00	1.3952	-0.0174	0.0607	-0.0269	-0.0249	0.0025	6.43	0.0
2	0.0	0.0	90.00	1.3902	-0.0286	0.0535	-0.0108	-0.0037	0.0054	10.85	0.0
3	0.0	0.0	90.00	1.4713	-0.0138	0.0507	-0.0304	-0.0136	-0.0045	15.20	0.0

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 106
WIND AXES DATA

TUNNEL 4 C-55

03/24/68

WIND TABLE 1

ALPHA TABLE 11

STATIC TABLE 1

TEMP TABLE 1

TUNNEL TEMP SC-00

WIND NO. 21

FMI = 0.0

PT	ALPHA	PSI	IN	AF	PM	SF	W	Y	J1	J2	J3	J4
1	C-0	C-0	50.00	17.337	103.664	-0.253	-20.7H1	-0.767	0.1511	14.62	4146.0	0.1861
2	C-0	C-0	50.00	56.774	10.611	1.253	-1.177	-14.250	0.1393	24.73	5524.0	0.1441
3	C-0	C-0	50.00	150.221	10.664	203.475	-0.110	-71.410	0.1100	34.53	7149.0	0.1234

WIND AXES DATA

PT	ALPHA	PSI	IN	CL	CM	CY	CT	CT	CT	CT	CT	CT
1	C-0	C-0	50.00	10.0642	3.0081	-0.1764	-0.1592	-0.1592	-0.1592	-0.1592	-0.1592	-0.1592
2	C-0	C-0	50.00	25.8516	4.0344	0.3203	-0.1116	-0.1116	-0.1116	-0.1116	-0.1116	-0.1116
3	C-0	C-0	50.00	35.3782	6.0722	-0.0304	-0.2043	-0.2043	-0.2043	-0.2043	-0.2043	-0.2043

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IN	CL	CM	CY	CT	CT	CT	CT	CT	CT
1	C-0	C-0	50.00	1.3489	0.3815	-0.0065	-0.0051	-0.0051	-0.0051	-0.0051	-0.0051	-0.0051
2	C-0	C-0	50.00	1.3375	0.2248	0.0177	-0.0016	-0.0016	-0.0016	-0.0016	-0.0016	-0.0016
3	C-0	C-0	50.00	1.4734	0.1034	-0.0022	-0.0070	-0.0070	-0.0070	-0.0070	-0.0070	-0.0070

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G 0.0		C3/24/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 50.00		RUN NO. 22									
		PHI = 0.0									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	HM	YM		
1	C.C	C.C	50.00	55.711	-0.320	24.091	-1.336	-20.600	-35.580		
2	C.C	C.C	50.00	58.360	2.204	70.939	-2.374	-98.896	-40.604		
3	C.C	C.C	50.00	142.406	-1.055	59.824	0.468	-69.752	23.797		
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	C.C	C.C	50.00	14.45	4136.0	0.0	14.66	4214.0	0.0	14.62	4210.0
2	C.C	C.C	50.00	23.91	5388.0	0.0	24.33	5424.0	0.0	25.31	5554.0
3	C.C	C.C	50.00	34.79	6348.0	0.0	34.42	6408.0	0.0	33.38	6948.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	C.C	50.00	14.567	1.0000	0.9922	1.0065	1.0036	0.9977	6.38	0.0
2	C.C	C.C	50.00	24.731	1.0000	0.9670	0.9830	1.0234	1.0250	10.83	0.0
3	C.C	C.C	50.00	34.237	1.0000	1.0163	1.0054	0.9749	1.0034	15.00	0.0
PT	ALPHA	PSI	IM	CL	CD	CM	CY	CMH	CVM	QS	QS
1	C.C	C.C	50.00	1.3504	-0.0078	0.0564	-0.0324	-0.0048	-0.0090	6.38	0.0
2	C.C	C.C	50.00	1.4644	0.0315	0.0886	-0.0339	-0.0150	-0.0065	10.83	0.0
3	C.C	C.C	50.00	1.4687	-0.0109	0.0602	0.0048	-0.0081	0.0028	15.00	0.0

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL C 2-59									
PRESS TARE 1									
STATIC TARE 0									
TUNNEL TEMP 52.00 °									
PMI = 0.0									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	WM	YM
1	C.C	C.C	50.00	63.114	16.268	207.222	-0.471	-23.986	-5.085
2	C.C	C.C	90.00	105.333	19.870	302.399	0.575	-45.418	-43.687
3	C.C	C.C	50.00	107.452	20.875	314.122	0.373	-70.746	-4.234
4	C.C	C.C	90.00	142.727	16.205	315.695	-0.589	-52.125	50.100
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	RPM2	J2
1	C.C	C.C	50.00	14.56	4198.0	0.1654	14.87	4290.0	0.1403
2	C.C	C.C	90.00	24.60	5440.0	0.1433	24.86	5530.0	0.1407
3	C.C	C.C	50.00	24.49	5440.0	0.143	24.59	5472.0	0.1422
4	C.C	C.C	50.00	33.95	64.6.0	0.1215	35.00	6422.0	0.1175
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	16.5442	4.7867	4.1054	-0.1234	-0.0675	-0.0150
2	C.C	C.C	50.00	27.6110	5.2067	6.3642	0.1537	-0.1373	-0.1265
3	C.C	C.C	50.00	28.1666	5.4719	6.5983	0.1977	-0.2105	-0.0125
4	C.C	C.C	90.00	37.4136	4.2478	6.4897	-0.1545	-0.1495	0.1474
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4
1	C.C	C.C	50.00	14.672	0.9159	0.9088	0.9283	0.9126	0.9139
2	C.C	C.C	50.00	24.862	0.9486	0.9385	0.9484	0.9517	0.9558
3	C.C	C.C	90.00	24.559	0.9440	0.9454	0.9493	0.9537	0.9466
4	C.C	C.C	90.00	36.426	0.9576	1.0686	1.1015	0.9541	1.1161
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
SLIPSTREAM C									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00	1.3912	0.4927	0.3456	-0.0114	-0.0057	-0.0013
2	C.C	C.C	50.00	1.4191	0.2677	0.3271	0.0177	-0.0071	-0.0066
3	C.C	C.C	90.00	1.4666	0.2645	0.3431	0.0151	-0.0116	-0.0006
4	C.C	C.C	90.00	1.5062	0.1821	0.2921	-0.0066	-0.0063	0.0062
WIND AXES DATA									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CMH	CVH
1	C.C	C.C	50.00						

VAD LGW SPEED WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

03/04/68

TUNNEL Q C-0		ALPHA TABLE 11									
PRESS TARE 1		TEMP TARE 1									
STATIC TARE 0		PUN NO. 24									
TUNNEL TEMP 46.00		PHI = 0.0									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	RM	YM	T4	RPM4
1	0.0	0.0	90.00	57.559	-2.462	0.326	0.439	-6.306	25.879	14.11	4138.0
2	0.0	0.0	90.00	97.849	1.616	61.260	1.642	-7.203	63.598	24.95	5300.0
3	0.0	0.0	90.00	142.386	-6.307	-0.190	-1.398	-115.243	-60.473	34.72	6262.0
PT	ALPHA	PSI	IM	TI	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	0.0	0.0	90.00	14.40	3704.0	0.0	14.45	4160.0	0.0	15.20	4160.0
2	0.0	0.0	90.00	24.70	5320.0	0.0	24.75	5360.0	0.0	25.52	5412.0
3	0.0	0.0	90.00	35.16	6340.0	0.0	35.10	6300.0	0.0	42.34	6786.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	0.0	0.0	90.00	14.540	1.0000	0.9905	0.9939	1.0451	0.9705	6.37	0.0
2	0.0	0.0	90.00	24.980	1.0000	0.9889	0.9909	1.0216	0.9986	10.94	0.0
3	0.0	0.0	90.00	36.832	1.0000	0.9547	0.9531	1.1495	0.9427	16.13	0.0
TUNNEL TEMP 46.00		WIND AXES DATA									
PRESS TARE 1		SLIPSTREAM G									
STATIC TARE 0		PHI = 0.0									
TUNNEL TEMP 46.00		PHI = 0.0									
PT	ALPHA	PSI	IM	CL	CD	CM	CV	CRM	CYM	QS	Q5
1	0.0	0.0	90.00	1.3979	-0.0583	0.0265	0.0106	-0.0020	0.0071	6.37	0.0
2	0.0	0.0	90.00	1.3832	0.0228	0.0766	0.0232	-0.0017	0.0101	10.94	0.0
3	0.0	0.0	90.00	1.3651	-0.0605	0.0123	-0.0134	-0.0121	-0.0065	16.13	0.0

TABLE NO. 2-2
VAL LGM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59

PRESS TAKE 1

STATIC TAKE 1

TUNNEL TEMP 48.00

PHI = 0.0

03/04/68

ALPHA TABLE 11

TEMP TAKE 1

RUN NO. 25

PT	ALPHA	PSI	IM	NF	AF	PP	SF	HM	YM	J1	J2	J3	J4	RPM1	RPM2	RPM3	RPM4
1	C.C	C.C	50.00	62.558	22.000	230.325	-1.249	-24.103	37.804								
2	C.C	C.C	50.00	106.508	50.800	354.536	-1.150	-71.638	15.496								
PT	ALPHA	PSI	IM	TL	HPM1	J1	J2	RPM2	RPM3	J3	J4	RPM4					
1	C.C	C.C	50.00	14.56	4190.0	0.1647	14.61	4180.0	15.14	4162.0	0.1060	14.75	4224.0				
2	C.C	C.C	50.00	24.49	5410.0	0.1431	24.75	5392.0	25.78	5414.0	0.1430	24.89	5472.0				

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CC	CM	CY	CRM	CYM	CTS1	CTS2	CTS3	CTS4	Q5
1	C.C	C.C	90.00	16.5034	5.7609	4.6233	-0.3274	-0.0628	0.1112					
2	C.C	C.C	90.00	27.5150	8.0735	7.2554	-0.3014	-0.2033	0.0574					
PT	ALPHA	PSI	IM	AVE Y	CTST	CTS1	CTS2	CTS3	CTS4	Q5				
1	C.C	C.C	90.00	14.764	0.9164	0.9037	0.9068	0.9399	0.9152	7.06				
2	C.C	C.C	90.00	24.975	0.9488	0.9304	0.9402	0.9793	0.9455	11.53				

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IM	CL	CC	CM	CY	CRM	CYM	Q5
1	C.C	C.C	90.00	1.3799	0.4822	0.3866	-0.0274	-0.0055	0.0093	7.06
2	C.C	C.C	90.00	1.4286	0.4131	0.3610	-0.0154	-0.0114	0.0029	11.53

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 260
BALANCE AXES DATA

TUNNEL Q C-U		03/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 47.00		RUN NO. 26									
		PHI = 0.0									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM		
1	G.0	G.0	90.00	59.298	-5.235	-32.269	1.171	33.917	19.685		
2	C.0	G.0	90.00	101.314	-5.149	-40.501	5.828	24.604	64.052		
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	G.0	G.0	90.00	14.61	4126.0	0.0	14.66	4168.0	0.0	15.67	4162.0
2	C.0	G.0	90.00	24.76	5326.0	0.0	24.86	5370.0	0.0	23.68	5414.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS	J4
1	G.0	G.0	90.00	14.521	1.0000	0.9792	0.9826	1.0503	0.9882	6.54	0.0
2	C.0	G.0	90.00	24.521	1.0000	1.0096	1.0137	0.9659	1.0108	10.74	0.0
WIND AXES DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IM	CL	CO	CM	CV	CRM	CYM	QS	
1	G.0	G.0	90.00	1.4033	-0.1239	-0.0461	0.0277	0.0382	0.0052	6.54	
2	C.0	G.0	90.00	1.4590	-0.0741	-0.0394	0.0839	0.0719	0.0104	10.74	

TABLE NO. 2-2
VAD LCM SPEED WIND TUNNEL TEST NO. 260
BALANCE AXES DATA

TUNNEL G 0.59											
PRESS TARE 1											
STATIC TARE 0											
TUNNEL TEMP 46.00											
PHI = 1.02											
PT	ALPHA	PSI	IM	NF	AF	PM	SF	HM	YM		
1	0.0	0.0	90.00	65.765	16.947	170.570	1.484	-51.500	2.586		
2	0.0	0.0	90.00	105.517	0.215	104.777	-0.563	-40.628	-27.629		
PT	ALPHA	PSI	IM	IL	RPM1	J1	T2	PPM2	J2	T3	RPM3
1	0.0	0.0	90.00	14.72	4122.0	0.1874	14.71	4150.0	0.1861	15.14	4162.0
2	0.0	0.0	90.00	24.60	5576.0	0.1365	24.54	5402.0	0.1430	24.68	5414.0
WIND AXES DATA											
PT	ALPHA	PSI	IM	CL	CC	CM	CY	CRM	CYM		
1	0.0	0.0	90.00	17.2391	4.4424	3.2791	0.3089	-0.1611	0.0076		
2	0.0	0.0	90.00	27.6593	2.1535	4.1013	-0.1477	-0.1159	-0.0819		
PT	ALPHA	PSI	IM	AVE 1	CTS1	CTS1	CTS2	CTS3	CTS4	QS	
1	0.0	0.0	90.00	14.830	0.9167	0.9097	0.9096	0.5321	0.9115	7.09	
2	0.0	0.0	90.00	24.704	0.9483	0.9442	0.9420	0.5474	0.9506	11.41	
WIND AXES DATA											
SLIPSTREAM C											
PT	ALPHA	PSI	IM	CL	CL	CM	CY	CRM	CYM	US	
1	0.0	0.0	90.00	1.4395	6.3699	0.2731	0.0324	-0.0134	0.0006	7.09	
2	0.0	0.0	90.00	1.4302	0.1114	0.2121	-0.0076	-0.0060	-0.0042	11.41	

J4
RPM4
4102.0
25.00
5500.0
2.1304

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0		03/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 36.00		RUN NO. 28									
PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	YM		
1	0.0	0.0	90.00	40.202	-1.081	11.169	-1.498	-20.226	20.628		
2	0.0	0.0	90.00	104.442	-1.163	49.425	0.459	-10.089	34.490		
PT	ALPHA	PSI	IN	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	0.0	0.0	90.00	14.56	4098.0	0.0	14.71	4130.0	0.0	14.78	4112.0
2	0.0	0.0	90.00	24.81	5278.0	0.0	24.75	5320.0	0.0	24.89	5250.0
PT	ALPHA	PSI	IN	AVE T	CTST	CTSI	CTS2	CTSS	CTSA	QS	
1	0.0	0.0	90.00	14.659	1.0000	0.9932	1.0037	1.0080	0.9951	6.42	
2	0.0	0.0	90.00	24.849	1.0000	0.9984	0.9961	1.0017	1.0039	10.88	
PT	ALPHA	PSI	IN	T4	RPM4	J4					
1	0.0	0.0	90.00	14.59	4116.0	0.0					
2	0.0	0.0	90.00	24.95	5256.0	0.0					

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IN	CL	CD	CM	CY	CRX	CYM	QS
1	0.0	0.0	90.00	1.4501	-0.0260	0.0306	-0.0361	-0.0046	0.0056	6.42
2	0.0	0.0	90.00	1.4642	-0.0165	0.0653	0.0065	-0.0018	0.0055	10.88

TABLE NO. 2-2
VAU LCM SPEED RING TUNALL TEST NO. 266
BALANCE AXES DATA

TUNNEL 2 0.55

B914.1E.

FWESS TAME 1

ALPHA TABLE 11

STATIC TIME 0

TEMP TAKE 1

50.04 4431 770001

PL 40. 29

三

PI	ALPHA	PSI	IB	NF	AF	PM	SF	KM	YM	J3	T4	RPM4	J4
1	L.C	0.C	9C.CC	65.255	16.316	177.681	-0.22H	-35.472	5.193	C.1897	14.85	4187.0	C.1832
2	C.C	0.C	50.00	106.379	11.267	251.285	-0.44Y	18.183	-37.221	-1405	25.00	5164.0	C.1477

PLINE AXES DATA

PT	ALPHA	PSI	IN	LL	CO	CM	CY	CRM	CYM
1	C.O	0.0	90.00	17.2456	4.2742	3.4808	-0.0597	-0.1029	0.0150
2	O.C	0.0	50.00	27.0055	3.5534	5.5724	-0.1176	0.0564	-0.1055

MINC AXES DATA

SLIPSTREAM C

Pt	Alpha	PSI	IN	CL	CU	CM	CY	CRM	CVM	US
1	L.C	3.0	50.00	1.4310	0.3571	0.2915	-0.0050	-0.0086	0.0113	7.06
2	C.C	2.0	90.00	1.4335	0.1519	0.2805	-0.0060	-0.0029	-0.0056	11.47

TABLE NO. 2-2
 VAG LOW SPEED WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

TUNNEL Q C.O		03/C4/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 51.CC		RUN NO. 3F									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	KM	YM		
1	C.O	0.0	90.CC	59.589	-0.819	10.725	0.310	-10.928	22.597		
2	C.C	0.0	90.CC	104.176	0.118	49.234	-1.360	-35.367	-2.013		
PT	ALPHA	PSI	IM	Y1	RPM1	J1	T2	KPM2	J2	T3	RPM3
1	C.C	0.0	90.CC	14.91	4132.0	0.0	14.35	4192.0	0.0	14.57	4170.0
2	C.C	0.0	90.CC	24.59	5344.0	0.0	24.70	5198.0	0.0	24.84	5348.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS	
1	0.0	0.0	90.CC	14.541	1.0000	0.9976	0.9860	1.0010	1.0140	6.37	
2	C.O	0.0	90.CC	24.704	1.0000	0.9936	0.9998	1.0054	1.0012	10.82	
WIND AXES DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IM	CL	CC	CM	CY	CRM	CYM	QS	
1	0.0	0.0	90.CC	1.447C	-0.0199	0.0286	0.0075	-0.0032	0.0061	6.37	
2	0.0	0.0	90.CC	1.4891	0.0017	0.0657	-0.0196	-0.0052	-0.0003	10.82	

T4 RPM4
 14.75 4190.0
 24.73 5322.0

TABIZ NO. 2-2

VAD LGM SPEED WIND TUNNEL TEST NO. 206
BALANCE AXES DATA

TUNNEL 2 2.55

03/14/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 54.00

RUN NO. 31

FMI = 0.00

PT	ALPHA	PSI	IB	NF	AF	PM	SF	MM	YM	J3	T3	RPM3	T4	RPM4	JA
1	0.0	0.0	50.00	64.350	10.770	138.949	-1.723	-38.841	-4.877	0.1851	14.93	420.00	14.16	4156.0	0.1071
2	0.0	0.0	50.00	107.953	3.421	186.764	-0.639	-48.390	6.492	0.1389	24.68	5498.0	24.95	5416.0	0.1436

PT	ALPHA	PSI	IB	T1	RP1	J1	T2	MP2	J2	T3	RPM3	T4	RPM4	JA
1	0.0	0.0	90.00	14.00	4150.0	0.1074	14.92	4182.0	0.1859	14.93	420.00	14.16	4156.0	0.1071
2	0.0	0.0	90.00	24.60	5408.0	0.1438	25.07	5600.0	0.1389	24.68	5498.0	24.95	5416.0	0.1436

WIND AXES DATA

PT	ALPHA	PSI	IB	CL	CL	CM	CV	CRM	CVM
1	0.0	0.0	16.8698	2.0232	2.8355	-0.1896	-0.1056	-0.0143	-0.0143
2	0.0	0.0	28.2980	0.9125	4.4064	-0.1675	-0.1362	0.0191	0.0191
PT	ALPHA	PSI	IB	AVE 1	CT1	CT2	CT3	CT4	OS
1	0.0	0.0	90.00	14.606	0.9156	0.9027	0.9355	0.8878	6.99
2	0.0	0.0	90.00	24.822	0.9485	0.9400	0.9578	0.9532	11.46

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IB	CL	CL	CM	CV	CRM	CVM	OS
1	0.0	0.0	90.00	1.4245	0.2384	0.2394	-0.0160	-0.0093	-0.0012	6.99
2	0.0	0.0	90.00	1.4566	0.0470	0.2268	-0.0006	-0.0071	0.0010	11.46

TUNNEL NO. 0-59
 PRESS TARE 1
 STATIC TARE 0
 TUNNEL TEMP 55.00
 PH1 = 0.0
 ALPHA TABLE 11
 TEMP TARE 1
 RUN NO. 32

PT	ALPMA	PSI	IN	MP	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	64.893	12.998	145.541	-0.671	-30.277	11.131
2	0.0	0.0	90.00	109.632	4.043	194.404	-1.927	-59.001	5.010

PT	ALPMA	PSI	IN	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.00	4220.0	0.1045	14.98	4194.0	0.1874	34.00	4120.0	0.1000	14.59	4200.0	0.1000
2	0.0	0.0	90.00	29.02	5444.0	0.1420	24.59	5570.0	0.1398	24.50	5474.0	0.1422	24.03	5540.0	0.1400

WIND AXES DATA

PT	ALPMA	PSI	IN	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.8104	3.4073	2.8771	-0.1759	-0.1083	0.0327
2	0.0	0.0	90.00	20.7379	1.2170	4.5334	-0.4002	-0.1637	0.0148

PT	ALPMA	PSI	IN	AVE T	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.777	0.9165	0.9094	0.9229	0.9046	7.06
2	0.0	0.0	90.00	24.704	0.9403	0.9604	0.9441	0.9434	11.41

WIND AXES DATA

PT	ALPMA	PSI	IN	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4211	0.2047	0.2404	-0.0147	-0.0090	0.0027	7.06
2	0.0	0.0	90.00	1.4060	0.0629	0.2344	-0.0207	-0.0085	0.0008	11.41

TABLE NO. 2-2
VAL LCM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL NO. 6.0		03/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 0		TEMP TARE 1									
TUNNEL TEMP 45.00		RUN NO. 33									
PT	ALPHA	PSI	IN	AF	PM	SF	PM	YM			
1	0.0	0.0	50.00	0.496	37.326	-0.176	-39.743	-16.137			
2	0.0	0.0	50.00	-0.224	49.656	-2.544	-49.073	-7.174			
PT	ALPHA	PSI	IN	RPM1	J1	T4	PPM2	J2	T3	RPM3	J3
1	0.0	0.0	90.00	14.45	4134.0	0.0	14.92	4206.0	0.0	14.88	4142.0
2	0.0	0.0	50.00	24.49	5302.0	0.0	24.65	5424.0	0.0	24.89	5349.0
PT	ALPHA	PSI	IN	AVE 1	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	0.0	0.0	50.00	14.778	1.0000	0.9781	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.0	0.0	90.00	24.730	1.0000	0.9904	0.9906	1.0000	1.0000	1.0000	1.0000
WIND AXES DATA											
SLIPSTREAM 0											
PT	ALPHA	PSI	IN	CL	CU	CM	CY	CMH	CVM	CS	CS
1	0.0	0.0	50.00	1.4590	0.0119	0.0113	-0.0042	-0.0114	-0.0043	0.47	0.47
2	0.0	0.0	90.00	1.4035	-0.0032	0.0073	-0.00363	-0.0070	-0.0011	10.83	10.83

TABLE NO. 2-2
 VAO LOW SPEED WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

U3/C4/68

TUNNEL G 0.0

ALPHA TABLE 11

PRESS TARE 1

TEMP TARE 1

STATIC TARE 0

SUM NO. 34

PNE = 0.0

TUNNEL TEMP 54.00

PT	ALPHA	PSI	IM	MF	AF	PM	SF	RM	YM	T3	RPM3	J3	T4	RPM4	J4
1	C.C	C.C	90.00	57.695	-0.364	33.795	-2.268	-28.224	-16.008	14.78	4190.0	0.0	14.69	4180.0	0.0
2	C.C	C.C	90.00	95.202	5.433	95.505	-0.184	12.077	-11.087	23.74	5398.0	0.0	24.58	5400.0	0.0
3	C.C	C.C	90.00	95.506	4.788	81.103	-4.629	-107.972	5.831	24.73	5480.0	0.0	24.95	5350.0	0.0
4	C.C	C.C	90.00	130.535	0.272	57.377	-0.949	-34.303	-40.270	34.69	6296.0	0.0	34.93	6320.0	0.0

PT	ALPHA	PSI	IM	AVE T	CTST	CTSL	CTSL	CTSL	CTSL	CTSL	CTSL	CTSL	CTSL	CTSL	CTSL
1	C.C	C.C	90.00	14.791	1.0000	0.9984	1.0090	1.0090	1.0090	1.0090	1.0090	1.0090	1.0090	1.0090	1.0090
2	C.C	C.C	90.00	24.526	1.0000	1.0053	1.0244	1.0244	1.0244	1.0244	1.0244	1.0244	1.0244	1.0244	1.0244
3	C.C	C.C	90.00	24.744	1.0000	0.9920	1.0003	1.0003	1.0003	1.0003	1.0003	1.0003	1.0003	1.0003	1.0003
4	C.C	C.C	90.00	34.723	1.0000	0.9975	0.9973	0.9973	0.9973	0.9973	0.9973	0.9973	0.9973	0.9973	0.9973

218

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IM	CL	CC	CM	CV	CRM	CVM	QS
1	C.C	C.C	90.00	1.3774	-0.0007	0.0775	-0.0541	-0.0052	-0.0096	6.48
2	C.C	C.C	90.00	1.3710	0.0782	0.1129	-0.0026	0.0020	-0.0018	10.74
3	C.C	C.C	90.00	1.3637	0.0683	0.0945	-0.0061	-0.0157	0.0009	10.84
4	C.C	C.C	90.00	1.3275	0.0028	0.0542	-0.0097	-0.0037	-0.0046	15.21

TABUL NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 200
BALANCE AXES DATA

TUNNEL Q 0.55

03/ 4/68

PHYS TAKE 1

ALPHA TABLE 11

STATIC TAKE 0

TEMP TAKE 1

TUNNEL TEMP 22.00

PHI = 0.00

HUA NO. 35

PT	ALPHA	PSI	IM	NF	AF	FM	SF	KM	YM	J1	J2	J3	J4
1	C.C	C.C	9C.CC	66.491	21.065	224.853	- .424	-32.097	18.64	1.1914	14.93	4122.0	1.1837
2	C.C	C.C	9C.CC	103.355	24.111	346.76C	- .183	-37.874	5.574	1.1439	24.99	5454.0	1.1447
3	C.C	C.C	90.CC	141.368	22.613	416.189	0.883	-41.657	3.279	1.1193	34.72	6568.0	1.1199
PI	ALPHA	PSI	IM	TI	MPMI	J1	T2	MPM2	T3	MPM3	T4	PPM4	J4
1	C.C	C.C	9C.CC	14.77	4266.0	1.1849	14.82	4164.0	1.1685	14.93	4122.0	4274.0	1.1837
2	C.C	C.C	9C.CC	24.65	5598.0	1.1402	25.01	5534.0	1.1416	24.99	5454.0	5426.0	1.1447
3	C.C	C.C	9C.CC	34.58	6800.0	1.1215	34.89	6452.0	1.1217	34.22	6582.0	6568.0	1.1199

SAFETY NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q C.O

PRESS TARE 1

STATIC TARE 0

TUNNEL TEMP 40.00

PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	YM
1	C.O	0.0	90.00	58.774	1.485	63.140	0.322	-8.471	-33.970

PHI = 0.0

PT	ALPHA	PSI	IN	TL	KPM1	J1	T2	APM2	J2	T3	APM3	J3	T4	APM4	J4
1	C.O	0.0	90.00	14.56	4176.0	0.0	14.56	4260.0	0.0	14.46	4190.0	0.0	14.64	4164.0	0.0

PT	ALPHA	PSI	IN	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.554	1.0000	1.0003	1.0001	0.9937	1.0058	6.37

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IN	CL	CD	CM	CY	CRM	CVM	QS
1	C.O	0.0	90.00	1.4259	0.0360	0.1363	0.0078	-0.0025	-0.0092	6.37

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL NO. 0-55

03/04/68

PRESS TAKE 1 ALPHA TABLE 11

STATIC TAKE 0 TEMP TAKE 1

TUNNEL TEMP 61.00 HUM NO. 37

PT	ALPHA	PSI	IM	IN	AF	PM	SF	RM	YM
1	C.C.	0.0	90.00	64.001	21.002	223.985	0.258	-29.636	-0.806

PT	ALPHA	PSI	IM	IN	MPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C.	0.0	90.00	14.001	4230.0	0.1054	14.002	4180.0	0.1077	14.003	4148.0	0.1091	14.005	4268.0	0.1030

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CU	CM	CY	CHM	CYM
1	C.C.	0.0	90.00	16.7970	5.5052	4.3730	0.0675	-0.0089	-0.0124

PT	ALPHA	PSI	IM	AVE T	CTST	CTSL	CTS2	CTS3	CTS4	QS
1	C.C.	0.0	90.00	14.778	0.9165	0.9062	0.9190	0.9197	0.9210	7.06

WIND AXES DATA

SLIPSTREAM U

PT	ALPHA	PSI	IM	CL	CU	CM	CY	CFM	CYM	QS
1	C.C.	0.0	90.00	1.4033	0.4599	0.3654	0.0056	-0.0074	-0.0002	7.06

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G 0.0		03/04/68									
PRESS TAKE 1		ALPHA TABLE 11									
STATIC TAKE 0		TEMP TAKE 1									
TUNNEL TEMP 52.00		RUN NO. 30									
PT	ALPHA	PSI	IM	MF	AF	PA	SF	RM	YM		
1	C.C	0.0	90.00	52.369	-2.268	-23.433	-2.297	-83.078	-1.609		
2	C.C	0.0	90.00	90.513	-2.770	11.066	-3.415	-117.332	-10.102		
3	C.C	0.0	90.00	126.556	-1.979	20.616	-5.578	-153.649	-5.409		
PT	ALPHA	PSI	IM	T1	RP1	J1	T2	RP2	J2	T3	RP3
1	C.C	0.0	90.00	14.72	4300.0	0.0	14.61	4200.0	0.0	14.62	4120.0
2	C.C	0.0	90.00	24.40	5428.0	0.0	24.54	5418.0	0.0	24.68	5260.0
3	C.C	0.0	90.00	34.85	6404.0	0.0	34.84	6398.0	0.0	34.93	6224.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS	J4
1	C.C	0.0	90.00	14.673	1.0000	1.0030	0.9957	0.9964	1.0049	6.43	14.75
2	C.C	0.0	90.00	24.704	1.0000	0.9957	0.9934	0.9990	1.0119	10.82	25.00
3	C.C	0.0	90.00	34.749	1.0000	1.0028	1.0026	0.9938	1.0008	15.22	34.78
WIND AXES DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IM	CL	CO	CM	CY	CR	CY	QS	
1	C.C	0.0	90.00	1.2603	-0.0546	-0.0417	-0.0553	-0.0211	-0.0004	6.43	
2	C.C	0.0	90.00	1.2937	-0.0396	0.0230	-0.0468	-0.0176	-0.0029	10.82	
3	C.C	0.0	90.00	1.2860	-0.0201	0.0236	-0.0567	-0.0161	-0.0006	15.22	

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL C C-55

03/14/58

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 54.00

FLW NO. 30

PHI = 0.0

PT	ALPHA	PSI	IM	MF	AF	PM	SF	RM	YM	J1	J2	J3	J4
1	C.C	C.C	50.00	57.249	14.098	152.277	-1.757	7.178	0.407	0.1863	0.1863	0.1894	0.1876
2	C.C	C.C	90.00	126.648	31.126	419.055	-0.461	-53.902	-12.152	0.1445	0.1445	0.1468	0.1425
3	C.C	C.C	90.00	144.923	31.363	386.040	0.213	-56.445	134.345	0.1203	0.1203	0.1221	0.1216

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CD	CM	CY	CRM	CYM	CTS1	CTS2	CTS3	CTS4	QS
1	C.C	C.C	90.00	15.0009	3.9052	2.9400	-0.4606	0.0325	0.0012	0.9152	0.9125	0.9037	0.9181	6.96
2	C.C	C.C	50.00	33.1986	8.1592	8.6260	-0.1210	-0.1556	-0.0358	0.9485	0.9483	0.9376	0.9577	11.46
3	C.C	C.C	90.00	37.9888	8.2212	7.7549	0.0558	-0.1674	0.3952	0.9625	0.9634	0.9590	0.9672	15.72

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IM	CL	CG	CM	CY	CRM	CYM	CTS1	CTS2	CTS3	CTS4	QS
1	C.C	C.C	90.00	1.2725	0.3311	0.2493	-0.0351	0.0028	0.0071	0.9152	0.9125	0.9037	0.9181	6.96
2	C.C	C.C	90.00	1.7097	0.4202	0.4442	-0.0062	-0.0080	-0.0018	0.9485	0.9483	0.9376	0.9577	11.46
3	C.C	C.C	50.00	1.4255	0.3085	0.2527	0.0021	-0.0063	0.0148	0.9625	0.9634	0.9590	0.9672	15.72

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G C-0
PRESS TAKE 1
ALPHA TABLE 11

STATIC TAKE 0
TEMP TAKE 1

TUNNEL TEMP 56.0C
PHI = 0.0
RUN NO. 40

PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YP	J1	J2	J3	J4
1	C-0	0.0	90.00	55.415	-1.074	-4.277	-1.439	-0.083	-24.191	0.0	0.0	0.0	0.0
2	C-0	0.0	90.00	92.211	-1.423	10.298	-2.393	-0.064	-12.161	0.0	0.0	0.0	0.0
3	C-0	0.0	90.00	128.998	-7.878	-23.502	-3.521	-144.126	-80.561	0.0	0.0	0.0	0.0

PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	Q5
1	C-0	0.0	90.00	14.836	1.0000	0.9923	1.0028	1.0035	1.0014	6.50
2	C-0	0.0	90.00	24.888	1.0000	1.0010	0.9903	0.9980	1.0108	10.90
3	C-0	0.0	90.00	34.670	1.0000	1.0021	0.9928	0.9990	1.0061	15.18

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IM	CL	CD	CM	CY	CA	CVM	Q5
1	C-0	0.0	90.00	1.3194	-0.0446	-0.0003	-0.0343	-0.0160	-0.0005	6.50
2	C-0	0.0	90.00	1.3083	-0.0202	0.0179	-0.0340	-0.0139	-0.0019	10.90
3	C-0	0.0	90.00	1.3138	-0.0002	-0.0059	-0.0359	-0.0156	-0.0092	15.18

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 26F
BALANCE AREA DATA

TUNNEL NO. C.C.		- 3/24/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE C		TEMP TARE 1									
TUNNEL TEMP 50.CC		RPM NO. 42									
PT	ALPHA	PSI	IN	AF	PM	SF	KM	VM			
1	C.C.	50.CC	57.116	-4.077	-37.104	-4.237	-60.768	-6.360			
2	C.C.	90.CC	96.333	-4.414	-33.029	-5.967	-106.768	-37.079			
3	C.C.	90.CC	131.614	2.377	56.075	-1.952	-147.745	62.165			
PT	ALPHA	PSI	IN	TI	RPM1	J1	T2	KPM2	J2	13	RPM3
1	C.C.	50.CC	50.00	14.77	4174.0	0.0	14.82	4228.0	0.0	14.72	4244.0
2	C.C.	90.CC	90.00	24.76	5428.0	0.0	25.01	5456.0	0.0	24.99	5358.0
3	C.C.	90.CC	90.00	34.58	6458.0	0.0	34.60	6428.0	0.0	34.69	6266.0
PT	ALPHA	PSI	IN	AVE T	CTST	CTSI	CTSE	CTSE	CTSE	CTSE	US
1	C.C.	50.CC	50.00	14.831	1.0000	0.9959	0.9992	0.9992	1.0121	6.50	
2	C.C.	90.CC	90.00	24.993	1.0000	0.9905	1.0000	1.0000	1.0000	10.95	
3	C.C.	50.CC	50.00	34.643	1.0000	0.9983	1.0000	1.0000	1.0000	15.17	
WIND AREA DATA											
SLIPSTREAM C											
PT	ALPHA	PSI	IN	CL	CL	CM	CY	CM	CYP	US	
1	C.C.	50.CC	1.3600	-0.1161	-0.0589	-0.1009	-0.0019	-0.148	-0.0017	6.50	
2	C.C.	90.CC	1.3610	-0.0624	-0.0320	-0.0042	-0.0042	-0.148	-0.0059	10.95	
3	C.C.	90.CC	1.3360	0.0242	0.0494	-0.0195	-0.0195	-0.148	-0.0071	15.17	

TABLE NO. 2-2
VAC LCM SPLIT WIND TUNNEL TEST NO. 206
BALANCE AXES DATA

TUNNEL NO. 0.59

3/ 4/68

ALPHA TABLE 1:

TEMP TAKE 1

MUN NO. 43

PHI = 0.0

PT	ALPHA	PSI	IM	IF	AF	PM	SF	WM	YM	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C	0.0	90.00	61.169	20.912	167.880	-1.864	15.455	28.288	0.1937	14.88	4012.0	0.1914	14.64	4112.0	0.1888
2	C.C	0.0	90.00	122.242	26.073	342.302	0.136	-48.188	3.954	0.141	24.73	5434.0	0.1413	24.73	5364.0	0.1431
3	C.C	0.0	90.00	143.110	29.669	411.137	0.797	-65.147	-20.645	0.1195	34.85	6330.0	0.1213	34.83	6212.0	0.1217

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CO	CM	CY	CRM	CYM	CT52	CT53	CT54	US
1	C.C	0.0	90.00	16.3343	5.4816	2.9984	-7.4887	0.0575	0.0832	0.9112	0.9282	0.9131	7.07
2	C.C	0.0	90.00	26.8009	6.8346	7.0102	0.0356	-0.1426	0.0116	0.9440	0.9494	0.9494	11.41
3	C.C	0.0	90.00	37.5138	7.7771	8.5091	0.2089	-0.2086	-0.0607	0.9654	0.9612	0.9607	15.88

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IM	CL	CO	CM	CY	CRM	CYM	US
1	C.C	0.0	90.00	1.3472	0.4605	0.2519	-0.0411	0.0046	0.0071	7.02
2	C.C	0.0	90.00	1.3858	0.3534	0.3625	0.0016	-0.0074	0.0006	11.41
3	C.C	0.0	90.00	1.3939	0.2894	0.3162	0.0078	-0.0078	-0.0023	15.88

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL C 0.59		3/4/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 2		TEMP TARE :									
TUNNEL TEMP 44.00		RUN NO. 44									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	HP	YM		
1	C.C	0.0	50.00	01.939	19.674	189.768	-1.148	-40.074	2.509		
2	C.C	0.0	90.00	101.983	23.898	306.629	-0.362	-26.741	-15.141		
3	C.C	0.0	90.00	134.034	37.214	326.937	1.126	-58.018	-50.142		
PT	ALPHA	PSI	IM	TI	MPM1	J1	T2	RPM2	J2	T3	RPM3
1	C.C	0.0	90.00	14.56	4140.0	0.1864	14.61	4042.0	0.1904	14.67	4034.0
2	C.C	0.0	90.00	24.97	5380.0	0.1434	24.59	5442.0	0.1416	24.47	5364.0
3	C.C	0.0	90.00	34.53	6360.0	0.1213	34.79	6494.0	0.1188	34.85	6418.0
PT	ALPHA	PSI	IM	CL	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	16.2362	5.1571	5.6044	-0.3009	-0.11.5	0.9166	0.9245	7.01
2	C.C	0.0	90.00	26.0281	6.2643	6.2503	-0.0957	-0.0753	0.9403	0.9484	11.40
3	C.C	0.0	90.00	35.3444	9.7550	6.0292	0.2951	-0.1780	0.9429	0.9726	15.85
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	14.660	0.9158	0.9096	0.9127	0.9166	0.9245	0.9245	7.01
2	C.C	0.0	90.00	24.678	0.9482	0.9593	0.9450	0.9403	0.9484	0.9484	11.40
3	C.C	0.0	90.00	34.841	0.9623	0.9542	0.9613	0.9429	0.9726	0.9726	15.85
TUNNEL C 0.59		3/4/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 2		TEMP TARE :									
TUNNEL TEMP 44.00		RUN NO. 44									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	HP	YM		
1	C.C	0.0	50.00	01.939	19.674	189.768	-1.148	-40.074	2.509		
2	C.C	0.0	90.00	101.983	23.898	306.629	-0.362	-26.741	-15.141		
3	C.C	0.0	90.00	134.034	37.214	326.937	1.126	-58.018	-50.142		
PT	ALPHA	PSI	IM	TI	MPM1	J1	T2	RPM2	J2	T3	RPM3
1	C.C	0.0	90.00	14.56	4140.0	0.1864	14.61	4042.0	0.1904	14.67	4034.0
2	C.C	0.0	90.00	24.97	5380.0	0.1434	24.59	5442.0	0.1416	24.47	5364.0
3	C.C	0.0	90.00	34.53	6360.0	0.1213	34.79	6494.0	0.1188	34.85	6418.0
PT	ALPHA	PSI	IM	CL	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	16.2362	5.1571	5.6044	-0.3009	-0.11.5	0.9166	0.9245	7.01
2	C.C	0.0	90.00	26.0281	6.2643	6.2503	-0.0957	-0.0753	0.9403	0.9484	11.40
3	C.C	0.0	90.00	35.3444	9.7550	6.0292	0.2951	-0.1780	0.9429	0.9726	15.85
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	14.660	0.9158	0.9096	0.9127	0.9166	0.9245	0.9245	7.01
2	C.C	0.0	90.00	24.678	0.9482	0.9593	0.9450	0.9403	0.9484	0.9484	11.40
3	C.C	0.0	90.00	34.841	0.9623	0.9542	0.9613	0.9429	0.9726	0.9726	15.85
TUNNEL C 0.59		3/4/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE 2		TEMP TARE :									
TUNNEL TEMP 44.00		RUN NO. 44									
PT	ALPHA	PSI	IM	MF	AF	PM	SF	HP	YM		
1	C.C	0.0	50.00	01.939	19.674	189.768	-1.148	-40.074	2.509		
2	C.C	0.0	90.00	101.983	23.898	306.629	-0.362	-26.741	-15.141		
3	C.C	0.0	90.00	134.034	37.214	326.937	1.126	-58.018	-50.142		
PT	ALPHA	PSI	IM	TI	MPM1	J1	T2	RPM2	J2	T3	RPM3
1	C.C	0.0	90.00	14.56	4140.0	0.1864	14.61	4042.0	0.1904	14.67	4034.0
2	C.C	0.0	90.00	24.97	5380.0	0.1434	24.59	5442.0	0.1416	24.47	5364.0
3	C.C	0.0	90.00	34.53	6360.0	0.1213	34.79	6494.0	0.1188	34.85	6418.0
PT	ALPHA	PSI	IM	CL	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	16.2362	5.1571	5.6044	-0.3009	-0.11.5	0.9166	0.9245	7.01
2	C.C	0.0	90.00	26.0281	6.2643	6.2503	-0.0957	-0.0753	0.9403	0.9484	11.40
3	C.C	0.0	90.00	35.3444	9.7550	6.0292	0.2951	-0.1780	0.9429	0.9726	15.85
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C	0.0	90.00	14.660	0.9158	0.9096	0.9127	0.9166	0.9245	0.9245	7.01
2	C.C	0.0	90.00	24.678	0.9482	0.9593	0.9450	0.9403	0.9484	0.9484	11.40
3	C.C	0.0	90.00	34.841	0.9623	0.9542	0.9613	0.9429	0.9726	0.9726	15.85

TABLE NO. 2-2
 VAW LOW SPEED WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

TUNNEL 6		3/ 4/68													
PRESS TAPE 1		ALPHA TABLE 11													
STATIC TAPE 6		TEMP TAPE 1													
TUNNEL TEMP 62.00		RUN NO. 45													
		FMI = (..)													
PT	ALPHA	PSI	IM	FM	PM	SF	RM	VM	T1	T2	T3	RPM3	T4	RPM4	J4
1	C.C	0.0	90.00	57.001	13.000	-0.390	-16.103	45.717	14.61	14.77	14.67	4260.0	14.69	4240.0	0.0
2	C.C	0.0	90.00	56.937	47.809	0.441	-16.567	55.524	24.76	24.86	24.52	5490.0	24.73	5520.0	0.0
3	C.C	0.0	90.00	136.034	89.173	-0.121	-44.109	59.171	34.74	34.58	34.85	6460.0	35.00	6480.0	0.0
WIND AXES DATA															
SLIPSTREAM Q															
PT	ALPHA	PSI	IM	CL	CC	CM	CV	CRM	CYM	OS					
1	C.C	0.0	90.00	1.3706	-0.0213	0.0339	-0.0094	-0.0041	0.0123	0.43					
2	C.C	0.0	90.00	1.3848	-0.0052	0.0053	0.0003	-0.0020	0.0009	1.03					
3	C.C	0.0	90.00	1.3799	0.0140	0.0010	-0.0012	-0.0050	0.0067	15.25					

WIND AXES DATA

SLIPSTREAM 6

VAC LCM SPEED ~~WIND~~ TUNNEL TEST NO. 260
BALANCE AXES DATA

TUNNEL Q	C.C	03/ 4/60									
PRESS TARE	1	ALPHA TABLE 11									
STATIC TARE	0	TEMP TARE 1									
TUNNEL TEMP	64.00	PUN NO. 46									
PT ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM			
1	C.C	90.00	94.400	-0.448	37.513	-0.246	5.104	49.018			
PT ALPHA	PSI	IM	T1	RP1	J1	T2	KPM2	J2	T3	KPM3	J3
1	C.C	90.00	24.76	5410.0	0.0	25.27	5474.0	0.0	25.15	5464.0	0.0
PT ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTSD	CTSS	CTSS	CTSS	QS
1	C.C	90.00	25.019	1.0000	0.9095	1.0019	1.0053	1.0034	1.0034	1.0034	17.96
WIND AXES DATA											
SLIPSTREAM U											
PT ALPHA	PSI	IM	CL	CO	CM	CV	CM	CVM	US		
1	C.C	90.00	1.3333	-0.0063	0.0510	-0.0035	0.0009	0.0071	1.096		

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 200
BALANCE AXES DATA

TUNNEL G C.O		2/24/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TARE G		TEMP TARE 1									
TUNNEL TEMP 76.C0		ALUM NO. 47									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	VM		
1	G.C	0.0	90.00	99.129	-0.746	46.104	-0.955	-9.972	10.249		
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	G.C	0.0	90.00	24.86	5476.0	0.0	24.65	5530.0	0.0	24.63	5460.0
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	Q3	J4
1	G.C	0.0	90.00	24.664	1.0020	1.0080	0.9993	0.9985	-0.9962	13.80	24.52
WIND AXES DATA											
SLIPSTREAM G											
PT	ALPHA	PSI	IM	CL	CO	CM	CY	CR	CVM	Q3	
1	G.C	0.0	90.00	1.3619	-0.0107	0.0642	-0.0137	-0.0012	0.0016	10.80	

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE ARCS DATA

TUNNEL Q C.C		3/04/68									
PRESS TARE 1		ALPHA TABLE 11									
STATIC TAKE U		TEMP TARE 1									
TUNNEL TEMP 72.00		RUN NO. 48									
PT 1	ALPHA C.C	PSI U.C	IN 50.00	AF 95.781	AF 0.529	PM 53.594	SF 0.059	PM -33.900	VM 26.426		
PT 1	ALPHA C.C	PSI U.C	IN 90.00	TI 24.55	APM1 5420.0	J1 0.0	T2 24.86	RPM2 5502.0	J2 0.0	T3 RPM3 5520.0	J3 0.0
PT 1	ALPHA C.C	PSI U.C	IN 90.00	AVE T 24.730	CTST 1.0000	CTSI 0.9925	CTS2 1.0051	CTS3 0.9980	CTS4 1.0044	T4 RPM4 5482.0	J4 0.0
WIND AXES DATA											
SLIPSTREAM Q											
PT 1	ALPHA C.C	PSI U.C	IN 90.00	CL 1.3676	CL 0.0076	CM 0.0702	CY 0.0006	CAW -0.0055	CVM 0.0042	CS 10.87	QS

TABLE NO. 2-2

VAD LUN SPEED BINU TUNNEL TEST NO. 200
BALANCE AXES DATA

TUNNEL G 100

03/04/68

PRESS TAKE 1

ALPHA TABLE 11

STATIC TAKE 0

TEMP TAKE 1

TUNNEL TEMP 72.00

LUN NO. 49

FMI = 1.0

PT	ALPHA	PSI	IM	MF	AF	PM	SF	RM	YM	T3	RPM3	J3	T4	RPM4	J4
1	C.C	0.0	50.00	55.507	2.489	56.044	1.469	-30.045	-30.407	14.99	4302.0	0.0	15.01	4302.0	0.0
2	C.C	0.0	51.00	90.977	5.147	103.000	1.646	-32.091	-28.342	24.68	5524.0	0.0	24.79	5512.0	0.0
PT	ALPHA	PSI	IM	T1	RPPI	J1	T2	AVM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C	0.0	90.00	14.01	4200.0	0.0	14.52	4300.0	0.0	14.99	4302.0	0.0	15.01	4302.0	0.0
2	C.C	0.0	90.00	24.49	5500.0	0.0	24.75	5570.0	0.0	24.68	5524.0	0.0	24.79	5512.0	0.0

PT	ALPHA	PSI	IM	AVE T	CTST	CTSL	CTSE	CTSS	CTSA	OS
1	C.C	0.0	90.00	14.003	1.000	0.9010	1.0020	1.0070	1.0085	6.52
2	C.C	0.0	90.00	24.070	1.000	0.9025	1.0030	1.0041	1.0044	10.01

BINU AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IM	CL	CU	CM	LV	CM	CVH	JS
1	C.C	0.0	50.00	1.4137	0.0509	0.1140	0.0111	-0.0100	-0.0057	6.52
2	C.C	0.0	50.00	1.4102	0.0730	0.1262	0.0235	-0.0050	-0.0046	10.01

TABLE NO. 2-2
 VAO LOW SPEED WIND TUNNEL TEST NO. 206
 BALANCE AXES DATA

TUNNEL G C-59

02/14/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 72.00

FUN NO. 5

PT	ALPHA	PSI	IM	AF	PM	SF	MM	VM	J1	J2	J3	J4
1	C-0	C-0	50.00	10.50	219.500	-0.131	-44.002	-1.387	0.1075	14.48	4340.0	0.1037
2	C-0	C-0	50.00	100.219	240.139	1.190	-30.007	-35.747	0.1414	24.09	5620.0	0.1417
PT	ALPHA	PSI	IM	AF	PM	SF	MM	VM	J1	J2	J3	J4
1	C-0	C-0	50.00	10.50	219.500	-0.131	-44.002	-1.387	0.1075	14.48	4340.0	0.1037
2	C-0	C-0	50.00	100.219	240.139	1.190	-30.007	-35.747	0.1414	24.09	5620.0	0.1417

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CU	CP	CV	CAP	CVM	Q5
1	C-0	C-0	50.00	16.0000	4.0507	4.4001	-0.344	-0.1307	-0.0041	6.95
2	C-0	C-0	50.00	20.2705	4.4241	5.1421	0.2890	-0.1210	-0.1052	11.43
PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTST	CTSI	CTST	CTSI
1	C-0	C-0	50.00	14.520	0.9151	0.9171	0.9130	0.9176	0.9122	0.9151
2	C-0	C-0	50.00	24.744	0.9404	0.9549	0.9420	0.9419	0.9541	0.9543

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IM	CL	CU	CM	CV	CM	CVM	US
1	C-0	C-0	50.00	1.3635	0.4116	0.9734	-0.0029	-0.0110	-0.0003	6.95
2	C-0	C-0	50.00	1.3504	0.2204	0.2055	0.0148	-0.0003	-0.0004	11.43

TABLE NO. 2-2
 VAO LCM SPEED WIND TUNNEL TEST NO. 200
 BALANCE AXIS DATA

TUNNEL NO. 005

03/ 4/68

PRESS TAKE 1

ALPHA TABLE 11

STATIC TAKE 0

TEMP TAKE 1

TUNNEL TEMP 70.00

PMI = -10.00

POW (0.0) 51

PT	ALPHA	PSI	Im	NP	AP	PM	SP	RM	YM	J1	J2	J3	J4	KPM4	J4
1	0.0	0.0	90.00	61.082	22.983	153.746	-11.417	-21.310	3.004	0.1544	0.1544	0.1544	0.1544	0.1544	0.1544
2	0.0	0.0	50.00	121.493	31.521	175.292	-14.114	-49.237	15.196	0.1435	0.1435	0.1435	0.1435	0.1435	0.1435
3	0.0	0.0	50.00	140.419	35.231	419.426	-21.632	-41.639	-77.610	0.1207	0.1207	0.1207	0.1207	0.1207	0.1207

DIAL AXIS DATA

PT	ALPHA	PSI	Im	CL	CU	CM	CV	CPM	CYM	CT51	CT52	CT53	CT54	CS
1	0.0	0.0	90.00	16.8037	6.0272	4.3054	-0.755	-0.004	0.1392	0.9102	0.9108	0.9255	0.943	0.94
2	0.0	0.0	50.00	27.1339	8.2526	7.0116	-0.214	-0.016	0.009	0.9461	0.9541	0.9472	0.9402	0.94
3	0.0	0.0	50.00	37.3101	9.2341	9.420	0.3242	-0.0290	0.007	0.9825	0.9819	0.9551	0.9677	0.9677

DIAL AXIS DATA

SLIPSTREAM 6

PT	ALPHA	PSI	Im	CL	CU	CM	CV	CPM	CYM	CT51	CT52	CT53	CT54	CS
1	0.0	0.0	90.00	16.8037	6.0272	4.3054	-0.755	-0.004	0.1392	0.9102	0.9108	0.9255	0.943	0.94
2	0.0	0.0	50.00	27.1339	8.2526	7.0116	-0.214	-0.016	0.009	0.9461	0.9541	0.9472	0.9402	0.94
3	0.0	0.0	50.00	37.3101	9.2341	9.420	0.3242	-0.0290	0.007	0.9825	0.9819	0.9551	0.9677	0.9677

VAD LCM SPEED BOND TUNNEL TEST NO. 206
BALANCE AXES DATA

TUNNEL G 0.0

13/ 4/60

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TAME 1

TUNNEL TEMP 00.00

RUN NO. 52

PHI = -10.00

PT	ALPHA	PSI	IM	MF	AF	PH	SF	NH	YM	J1	J2	J3	J4
1	C.C	0.0	90.00	55.917	-6.553	-54.747	-13.364	-76.109	5.896	0.0	0.0	0.0	0.0
2	C.C	0.0	90.00	94.257	-13.435	-81.206	-22.690	-146.183	24.212	0.0	0.0	0.0	0.0
3	C.C	0.0	90.00	132.935	-12.300	-67.460	-15.172	-65.251	-43.833	0.0	0.0	0.0	0.0
PT	ALPHA	PSI	IM	T1	APM1	J1	T2	RPM2	J2	T3	RPM3	J3	J4
1	C.C	0.0	90.00	14.93	4220.0	0.0	14.82	4342.0	0.0	14.72	4232.0	0.0	0.0
2	C.C	0.0	90.00	24.49	5320.0	0.0	24.70	5514.0	0.0	24.84	5502.0	0.0	0.0
3	C.C	0.0	90.00	34.90	6352.0	0.0	34.58	6434.0	0.0	34.58	6374.0	0.0	0.0
PT	ALPHA	PSI	IM	Ave I	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI
1	C.C	0.0	90.00	14.791	1.0000	1.0092	1.0019	0.9955	0.9933	0.9933	0.9933	0.9933	0.9933
2	C.C	0.0	90.00	24.757	1.0000	0.9893	0.9976	1.0033	1.0097	1.0097	1.0097	1.0097	1.0097
3	C.C	0.0	90.00	34.696	1.0000	1.0055	1.0050	0.9968	1.0000	1.0000	1.0000	1.0000	1.0000

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IM	CL	CU	CM	CV	CKM	CYM	CS
1	C.C	0.0	1.3700	-0.1574	-0.0926	-0.0826	-0.0826	-0.0826	-0.0826	6.48
2	C.C	0.0	1.3002	-0.1516	-0.0731	-0.0731	-0.0731	-0.0731	-0.0731	10.84
3	C.C	0.0	1.3592	-0.1253	-0.0303	-0.0303	-0.0303	-0.0303	-0.0303	15.20

TABLE NO. 8-B

VAO LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL 0 C-U

03/04/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 90.00

PMI - -10.00

RUN NO. 53

PT	ALPHA	PSI	IM	MF	AF	PM	SF	MP	VM								
1	0.0	0.0	90.00	52.124	-4.423	-37.772	-12.830	-139.44C	-22.099								
2	0.0	0.0	90.00	88.206	-1.989	4.767	-17.628	-142.44C	-27.373								
3	0.0	0.0	90.00	126.202	-3.314	1.424	-25.108	-213.976	-57.382								
PT	ALPHA	PSI	IM	TL	MPMI	J1	T2	MPM2	J2	T3	MPM3	J3	T4	MPM4	J4		
1	0.0	0.0	90.00	14.98	4090.0	0.0	15.03	4342.0	0.0	14.72	4166.0	0.0	14.64	4130.0	0.0		
2	0.0	0.0	90.00	24.35	5230.0	0.0	24.65	5232.0	0.0	24.63	5270.0	0.0	24.89	5282.0	0.0		
3	0.0	0.0	90.00	35.00	6204.0	0.0	34.95	6270.0	0.0	34.90	6226.0	0.0	34.72	6306.0	0.0		

PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.843	1.0000	1.0092	1.0125	0.9920	0.9863	6.50
2	0.0	0.0	90.00	24.678	1.0000	0.9946	0.9987	0.9980	1.0087	10.81
3	0.0	0.0	90.00	34.893	1.0000	1.0032	1.0015	1.0002	0.9951	15.28

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IM	CL	CD	CM	CV	CRM	CRM	US
1	0.0	0.0	90.00	1.2761	-0.1052	-0.2528	-0.0854	-0.0271	-0.0076	6.5-
2	0.0	0.0	90.00	1.2879	-0.0285	0.0186	-0.0292	-0.0222	-0.0042	10.81
3	0.0	0.0	90.00	1.3029	-0.0335	0.0177	-0.0346	-0.0234	-0.0064	15.28

TABLE NO. 2-2

WAL LCM SPEED-ALINE TUNNEL TEST AC. 1966
CALCULATED DATA

TUNNEL NO. 1		/ - / 66									
PRESS TIME 1		ALPHA TABLE 11									
STATIC TABLE		TEMP TABLE 1									
TUNNEL TEMP 5100		RPM NO. 54									
		PMI = -10.36									
PT	ALPHA	PSI	IM	NF	AF	PM	SF	AP	YM		
1	C-0	0-0	50-0	56.757	-0.034	0.198	-7.480	-17.6307	-2.307		
2	C-0	0-0	50-0	49.937	-1.216	22.663	-15.95	-37.015	61.416		
3	C-0	0-0	50-0	26.015	6.103	104.039	-21.750	-70.610	93.617		
PT	ALPHA	PSI	IM	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	C-0	0-0	50-0	14.07	414.0	0.0	15.03	414.0	0.0	14.99	4104.0
2	C-0	0-0	50-0	24.91	530.0	0.0	24.44	5342.0	0.0	24.50	5200.0
3	C-0	0-0	50-0	34.37	6118.0	0.0	34.58	6366.0	0.0	34.43	6264.0
										T4	RPM4
										15.12	4294.0
										24.70	5364.0
										34.81	6356.0
PT	ALPHA	PSI	IM	AVE 1	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C-0	0-0	50-0	15.001	1.0000	0.9915	1.0010	0.9990	1.0070	0.99	0.99
2	C-0	0-0	50-0	24.070	1.0000	1.0095	0.9902	0.9959	1.0044	1.00	1.00
3	C-0	0-0	50-0	34.552	1.0000	0.9909	1.0000	0.9964	1.0080	1.00	1.00
		WIND AREA (AFT)									
		SLIPSTREAM C									
PT	ALPHA	PSI	IM	CL	CU	CP	CV	CRM	CVM	CS	
1	C-0	0-0	50-0	1.3063	-0.0705	0.0170	0.0564	-0.0295	-0.0006	0.97	
2	C-0	0-0	50-0	1.3070	-0.0174	0.0190	-0.0015	-0.0059	-0.0103	10.01	
3	C-0	0-0	50-0	1.3150	0.0413	0.0740	0.0054	-0.0082	0.0127	15.13	

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

03/04/68											
ALPHA TABLE 11											
TEMP TARE 1											
RUN NO. 55											
PHI = -10.00											
PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	YM	T3	RPM3
1	0.0	0.0	90.00	56.515	1.682	59.775	-2.309	-48.531	17.102	14.67	4122.0
2	0.0	0.0	90.00	93.653	5.051	100.406	-19.750	-57.949	-5.907	24.52	5320.0
3	0.0	0.0	90.00	133.963	4.906	131.049	-24.122	-57.393	61.152	35.06	6354.0
PT	ALPHA	PSI	IN	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	0.0	0.0	90.00	14.72	4194.0	0.0	15.03	4280.0	0.0	14.67	4122.0
2	0.0	0.0	90.00	24.76	5388.0	0.0	24.75	5422.0	0.0	24.52	5320.0
3	0.0	0.0	90.00	34.53	6280.0	0.0	34.42	6362.0	0.0	35.06	6354.0
PT	ALPHA	PSI	IN	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	0.0	0.0	90.00	14.778	1.0000	0.9959	1.0170	0.9929	0.9942	0.9942	0.9942
2	0.0	0.0	90.00	24.691	1.0000	1.0026	1.0024	0.9932	1.0017	1.0017	1.0017
3	0.0	0.0	90.00	34.749	1.0000	0.9938	0.9906	1.0088	1.0069	1.0069	1.0069
WIND AXES DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IN	CL	CO	CM	CY	CRM	CYM	CS	CS
1	0.0	0.0	90.00	1.3395	0.0402	0.1171	0.1800	-0.0175	0.0073	6.47	6.47
2	0.0	0.0	90.00	1.3680	0.0722	0.1192	-0.0458	-0.0082	0.0019	10.81	10.81
3	0.0	0.0	90.00	1.3832	0.0499	0.1027	-0.0052	-0.0064	0.0095	15.22	15.22

TABLE NO. 2-2
 VAL LCM SPLEL WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

TUNNEL NO. C.C.		3/14/68									
PRESS TAKE 1		ALPHA TABLE 11									
STATIC TAKE 0		TEMP TAPE 1									
TUNNEL TEMP 02.0J		HUN NO. 56									
		PHI = -1J.0C									
PT	ALPHA	PSI	IN	MF	AF	PM	SF	EM	YM		
1	C.C	0.0	90.00	57.954	-5.797	2.451	-10.443	-34.854	-12.309		
2	C.C	0.0	90.00	95.577	7.413	49.738	-15.938	-25.344	10.745		
3	C.C	0.0	90.00	132.100	7.479	59.320	-25.129	-112.015	5.500		
PT	ALPHA	PSI	IN	TI	RPM1	J1	T2	RPM2	J2	T3	RPM3
1	C.C	0.0	90.00	14.77	4148.0	0.0	14.77	4204.0	0.0	14.83	4170.0
2	C.C	0.0	90.00	24.60	5324.0	0.0	24.60	5416.0	0.0	24.79	5364.0
3	C.C	0.0	90.00	34.75	6390.0	0.0	34.63	6455.0	0.0	34.90	6206.0
PT	ALPHA	PSI	IN	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS	
1	C.C	0.0	90.00	14.791	1.0000	0.9986	0.9984	1.0026	1.0005	6.48	
2	C.C	0.0	90.00	24.770	1.0000	0.9931	1.0014	1.0006	1.0049	1.05	
3	C.C	0.0	90.00	34.723	1.0000	1.0021	0.9973	0.9965	1.0046	15.21	
WIND AXES DATA											
SLIPSTREAM Q											
PT	ALPHA	PSI	IN	CL	CC	CM	CV	CRM	CYM	QS	
1	C.C	0.0	90.00	1.4058	-0.0007	0.0289	-0.0055	-0.0002	-0.0032	6.48	
2	C.C	0.0	90.00	1.3013	0.0059	0.0000	0.0127	-0.0044	0.0043	1.05	
3	C.C	0.0	90.00	1.3750	0.0061	0.1331	-0.0585	-0.0113	0.0030	15.21	

T4 RPM4 4220.0
 24.89 5420.0
 34.00 6300.0

TABUL NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL NO. C.C.

13/24/62

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 0

TEMP TARE 1

TUNNEL TEMP 62.00

PHI = -17.00

RUN NO. 50

PT	ALPHA	PSI	IN	MF	AF	PM	SF	MM	YM	T1	RPMT	J1	T2	RPMT	J2	T3	RPMT	J3	T4	RPMT
1	C.C.	0.0	90.00	57.134	-0.914	25.444	-1.447	-0.725	26.362	14.82	4110.0	0.0	15.00	4260.0	0.0	14.99	4210.0	0.0	14.48	4220.0
2	C.C.	0.0	90.00	95.096	-2.947	5.040	-7.603	-30.428	-2.844	24.49	5320.0	0.0	24.44	5452.0	0.0	24.99	5410.0	0.0	24.84	5440.0
3	C.C.	0.0	90.00	133.144	0.506	81.135	-20.852	-10.179	39.527	34.85	6274.0	0.0	34.74	6436.0	0.0	34.85	6400.0	0.0	34.99	6340.0

PT	ALPHA	PSI	IN	AVE T	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST	CTST
1	C.C.	0.0	90.00	14.843	1.0000	0.9966	1.0161	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907	0.9907
2	C.C.	0.0	90.00	24.605	1.0000	0.9930	1.0071	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091	1.0091
3	C.C.	0.0	90.00	34.854	1.0000	0.9998	0.9966	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998

WIND AXES DATA

SLIPSTREAM 6

PT	ALPHA	PSI	IN	CL	CO	CM	CY	CM	CM	CM	CM	CM	CM	CM	CM	CM	CM	CM	CM	CM
1	C.C.	0.0	90.00	1.3447	-0.0217	0.2502	0.2015	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092	-0.0092
2	C.C.	0.0	90.00	1.3597	-0.0422	0.7160	0.1290	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081	-0.0081
3	C.C.	0.0	90.00	1.3651	0.0051	0.0684	0.0260	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018	-0.0018

TABLE NO. 2-2
 VAW LCM SPEED WIND TUNNEL TEST NO. 266
 BALANCE AXES DATA

TUNNEL NO. 000		3/14/63									
PRESS TAKE 1		ALPHA TABLE 21									
STATIC TAKE 2		TEMP TAKE 1									
TUNNEL TEMP 50.00		FUN NO. 02									
		PM1 = -10.00									
PT	ALPHA	PSI	IN	MF	AF	PM	SF	HM	VM		
1	0.0	0.0	50.00	57.372	-3.002	-1.013	-12.080	-07.136	0.501		
2	0.0	0.0	50.00	58.147	-6.743	-10.246	-14.529	7.471	20.722		
3	0.0	0.0	50.00	132.562	-7.776	-10.576	-26.065	-79.495	-94.136		
PT	ALPHA	PSI	IN	TI	RPM1	J1	T2	KPM2	J2	T3	RPM3
1	0.0	0.0	50.00	14.91	4140.0	0.0	14.07	4240.0	0.0	14.07	4170.0
2	0.0	0.0	50.00	25.07	5300.0	0.0	24.75	5520.0	0.0	24.94	5300.0
3	0.0	0.0	50.00	34.79	6316.0	0.0	34.95	6450.0	0.0	34.99	6306.0
PT	ALPHA	PSI	IN	AVE T	CTST	CTSI	CTS2	CTS3	CTS4		
1	0.0	0.0	50.00	14.620	1.0000	0.9923	1.0172	1.0036	0.9869	0.40	0.0
2	0.0	0.0	50.00	24.991	1.0000	1.0052	0.9924	1.0001	1.0023	10.92	0.0
3	0.0	0.0	50.00	34.920	1.0000	0.9964	1.0007	0.9994	1.0034	15.29	0.0
WIND AXES DATA											
SLIPSTREAM C											
PT	ALPHA	PSI	IN	CL	CC	CM	CY	CRM	CYM	CS	OS
1	0.0	0.0	50.00	1.4170	-0.0910	0.0141	-0.0612	-0.0167	0.0017	0.40	0.0
2	0.0	0.0	50.00	1.4042	-0.0955	0.0015	0.0305	0.0002	0.0030	10.92	0.0
3	0.0	0.0	50.00	1.3659	-0.0786	0.0070	-0.0270	-0.0084	-0.0064	15.29	0.0

TABLE NO. 2-9
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

03/24/68																
ALPHA TABLE 11																
TEMP TARE 1																
MUN NO. 61																
PHI = -10.0C																
PT	ALPHA	PSI	IN	MF	AF	PM	SF	RM	YM	J2	T3	RPM3	J3	T4	RPM4	J4
1	C-C	0.0	50.00	63.558	23.316	251.955	-9.648	-30.935	-27.000	0.1081	14.67	4156.0	0.1079	16.60	4290.0	0.1021
2	C-C	0.0	90.00	106.279	30.065	296.746	-16.689	-21.491	-158.964	0.1396	24.63	5692.0	0.1372	24.89	5456.0	0.1432
3	C-C	0.0	50.00	136.546	31.240	363.018	-24.060	-39.400	-225.003	0.1193	34.32	6672.0	0.1171	35.09	6484.0	0.1205
WIND AXES DATA																
PT	ALPHA	PSI	IN	CL	CG	CM	CY	CRX	CYM	CTS2	CTS4	GS				
1	C-C	0.0	90.00	16.8467	6.1125	4.9578	0.4001	-0.1009	0.0504	0.9107	0.9119	7.06				
2	C-C	0.0	50.00	26.6466	7.8811	6.2412	0.2528	-0.0695	-0.3091	0.9444	0.9546	11.42				
3	C-C	0.0	90.00	36.3445	8.1889	8.0653	-0.0004	-0.1159	-0.4666	0.9522	0.9736	15.79				
WIND AXES DATA																
SLIPSTREAM Q																
PT	ALPHA	PSI	IN	CL	CG	CM	CY	CRX	CYM	OS						
1	C-C	0.0	90.00	1.4085	0.5111	0.4145	0.0335	-0.0084	0.0042	7.06						
2	C-C	0.0	50.00	1.3765	0.4071	0.3224	0.0131	-0.0036	-0.0160	11.42						
3	C-C	0.0	90.00	1.3583	0.3060	0.3614	-0.0000	-0.0043	-0.0174	15.79						

TUNNEL NO. 6-55
 PRESS TIME 1
 STATIC TARE 2
 TUNNEL TEMP 58.00
 PSI = -11.00
 BALANCE AALS DATA

TUNNEL 6 6-55

PRESS TIME 1

STATIC TARE 2

TUNNEL TEMP 58.00

PSI = -11.00

12/24/68

ALPHA TABLE 11

TEMP TARE 1

RUN NO. 42

PT	ALPHA	PSI	IM	TL	APPI	J1	T2	KPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C	C.C	90.00	63.020	22.583	240.852	-9.927	-23.456	-23.456	-23.018					
2	C.C	C.C	90.00	55.358	28.346	313.748	-14.520	6.366	6.366	-51.334					
3	C.C	C.C	90.00	135.961	26.781	329.199	-24.276	-21.445	-21.445	-134.069					
PT	ALPHA	PSI	IM	TL	APPI	J1	T2	KPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C	C.C	90.00	14.51	4178.0	0.1868	14.87	4194.0	-0.1861	14.93	4356.0	0.1792	14.85	4304.0	0.1814
2	C.C	C.C	90.00	24.00	5380.0	0.1449	24.70	5440.0	0.1435	24.89	5506.0	0.1402	24.52	5494.0	0.1421
3	C.C	C.C	90.00	34.69	6370.0	0.1225	34.64	6560.0	0.1190	34.90	6720.0	0.1162	34.72	6510.0	0.1199

BIRD AXES DATA

PT	ALPHA	PSI	IM	CL	CL	CM	CY	CRX	CYM	
1	C.C	C.C	90.00	16.5285	5.9198	4.7125	0.3403	-0.0774	0.0563	
2	C.C	C.C	90.00	26.3102	7.4354	6.2867	0.7707	-0.0063	0.0114	
3	C.C	C.C	90.00	36.2031	7.0201	7.0980	-0.1029	-0.0610	-0.2204	
PT	ALPHA	PSI	IM	AVE I						OS
1	C.C	C.C	90.00	14.791	0.9165	0.8909	0.9215	0.9254	0.9203	7.07
2	C.C	C.C	90.00	24.677	0.9482	0.9452	0.9491	0.9564	0.9423	11.40
3	C.C	C.C	90.00	34.788	0.9627	0.9600	0.9642	0.9658	0.9609	15.83

BIRD AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IM	CL	CC	CM	CV	CRM	CYP	US
1	C.C	C.C	90.00	1.0131	0.4541	0.4934	0.1284	-0.0005	0.0047	7.07
2	C.C	C.C	90.00	1.0019	0.3846	0.3254	0.0399	-0.0001	0.0006	11.40
3	C.C	C.C	90.00	1.0446	0.2617	0.2646	-0.0031	-0.0023	-0.0082	15.83

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL NO. C-55

23/74/68

PRESS TARE 1

ALPHA TABLE 11

STATIC TARE 1

TEMP TARE 1

TUNNEL TEMP 45.00

PHI = -10.00

FUN NO. 43

PT	ALPHA	PSI	IM	NF	AF	PM	SF	RM	YM	T1	KPM1	J1	T2	KPM2	J2	T3	KPM3	J3	T4	KPM4	J4
1	C.C	0.0	50.00	63.756	22.167	204.079	-10.729	-27.489	-7.263	14.72	4186.0	-1.1832	14.72	4342.0	-1.1771	14.90	4308.0	-1.1789	14.90	4308.0	-1.1789
2	C.C	0.0	90.00	98.507	28.025	294.357	-16.776	-33.711	-108.799	24.60	5296.0	0.1452	24.60	5440.0	0.1406	24.75	5430.0	0.1416	24.75	5430.0	0.1416
3	C.C	0.0	90.00	136.365	27.859	399.857	-28.147	-14.177	-200.605	34.75	6320.0	0.1217	35.26	6514.0	0.1179	34.56	6424.0	0.1197	34.56	6424.0	0.1197

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CL	CM	CV	CM	CV	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI
1	C.C	0.0	50.00	16.9461	5.8106	4.7450	0.1354	-0.1842	0.1036	0.9166	0.9112	0.9208	0.9228	0.9228	0.9228	0.9228	0.9228	0.9228	0.9228	0.9228	0.9228
2	C.C	0.0	90.00	26.0641	7.3462	6.0796	0.1266	-0.1023	-0.1650	0.9463	0.9442	0.9541	0.9541	0.9541	0.9541	0.9541	0.9541	0.9541	0.9541	0.9541	0.9541
3	C.C	0.0	90.00	36.4836	7.3028	8.0685	-1.0638	-0.1154	-0.3975	0.9629	0.9594	0.9723	0.9723	0.9723	0.9723	0.9723	0.9723	0.9723	0.9723	0.9723	0.9723

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CL	CM	CV	CM	CV	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI
1	C.C	0.0	90.00	1.4134	0.4846	0.3958	0.0113	-0.0077	0.0086	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515
2	C.C	0.0	90.00	1.3477	0.3759	0.3144	0.0066	-0.0052	-0.0065	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515
3	C.C	0.0	90.00	1.3552	0.2715	0.2547	-0.0035	-0.0015	-0.0146	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515	0.9515

SADZ NO. 2-2

VAC LUM SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL NO. 0.0

12/ 4/02

WIND TANK 1

ALPHA TABLE 11

STATIC TANK 1

TEMP TANK 1

TUNNEL TEMP 30.00

PMI = -4.00

LUM NO. 1

PT	ALPHA	PSI	IM	AF	AP	PM	SF	RM	YM	T3	KPM3	J3	T4	KPM4	J4
1	C.C	0.0	90.00	58.330	-0.750	41.723	1.661	7.663	-3.362	14.62	4130	0.0	14.62	4130	0.0
2	C.C	0.0	90.00	58.156	-4.614	23.533	-2.630	38.413	36.100	24.64	5360	0.0	24.64	5360	0.0
3	C.C	0.0	90.00	135.839	-1.862	71.656	0.407	-3.275	39.709	34.69	6260	0.0	34.69	6260	0.0

PT	ALPHA	PSI	IM	AVE 1	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI	CTSI
1	C.C	0.0	90.00	14.77	4324.0	0.0	14.92	4236.0	0.0	14.92	4236.0	0.0	14.92	4236.0	0.0
2	C.C	0.0	90.00	24.60	5630.0	0.0	24.91	5486.0	0.0	24.91	5486.0	0.0	24.91	5486.0	0.0
3	C.C	0.0	90.00	34.09	6196.0	0.0	34.47	6436.0	0.0	34.47	6436.0	0.0	34.47	6436.0	0.0

WIND AXES DATA

SLIPSTREAM 0

PT	ALPHA	PSI	IM	LL	CL	CO	CM	CV	CRM	CYM	CS
1	C.C	0.0	90.00	1.3513	-0.0179	0.0371	0.0458	0.0458	0.0458	0.0458	0.0458
2	C.C	0.0	90.00	1.4023	-0.0069	0.0458	0.0458	0.0458	0.0458	0.0458	0.0458
3	C.C	0.0	90.00	1.3825	-0.0152	0.0458	0.0458	0.0458	0.0458	0.0458	0.0458

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

03/ 4/68

TUNNEL G ---

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE :

TUNNEL TEMP 49.00 HUM NO. 65

PMI - -5.00

PT	ALPHA	PSI	IM	NP	AF	PM	SF	RM	VM	J3	PPM3	J4
1	C.C	C.C	90.00	59.231	0.755	58.083	1.994	6.423	7.410	14.84	4190.0	14.78
2	C.C	C.C	90.00	56.982	-3.750	12.221	1.291	23.760	20.131	24.58	5312.0	24.63
3	C.C	C.C	90.00	135.594	-7.990	2.630	1.772	14.078	42.507	34.04	6203.0	34.78
PT	ALPHA	PSI	IM	T1	MPM1	J1	PPM2	J3	PPM3	J4	PPM4	J4
1	C.C	C.C	90.00	14.82	4076.0	0.0	4222.0	0.0	14.84	4190.0	14.78	4222.0
2	C.C	C.C	90.00	24.81	5260.0	0.0	5456.0	0.0	24.58	5312.0	24.63	5364.0
3	C.C	C.C	90.00	34.04	6200.0	0.0	6430.0	0.0	34.04	6203.0	34.78	6307.0

PT	ALPHA	PSI	IM	AVE I	CTST	CTSI	CTSD	CTSE	CTSF	CTSG
1	C.C	C.C	90.00	14.830	1.0000	0.9954	1.0028	0.9947	0.9947	0.9947
2	C.C	C.C	90.00	24.664	1.0001	1.0050	0.9952	0.9985	0.9985	0.9985
3	C.C	C.C	90.00	34.630	1.0000	1.0002	0.9954	1.0047	1.0047	1.0047

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IM	CL	CU	CM	CV	CS	CS
1	C.C	C.C	90.00	1.4103	0.0100	0.1261	0.0237	0.0111	0.021
2	C.C	C.C	90.00	1.3013	-0.0537	0.0275	0.0185	0.0134	0.032
3	C.C	C.C	90.00	1.3820	-0.0815	0.0192	0.0101	0.0113	0.0150

TABLE NO. 2-2

VAJ LCM SPEED WIND TUNNEL TEST NO. 264
BALANCE AXIS DATA

TUNNEL NO. 1

3/ 4/68

PRESS TAKE 1

ALPHA TAKE 11

STATIC TAKE J

TEMP TAKE 1

TUNNEL TEMP 50.00

ALM NO. 46

PHI = -5.01

PT	ALPHA	PSI	IN	MF	AF	PH	SF	RM	YM
1	C.C	0.0	90.00	58.794	-6.197	-27.912	0.541	13.510	0.714
2	C.C	0.0	90.00	96.735	-6.702	-18.229	1.578	8.712	32.929
3	C.C	0.0	90.00	134.528	-7.466	4.610	-0.766	-170.807	-4.752
4	C.C	0.0	90.00	-0.867	7.318	-6.803	-0.727	-1.161	-1.378

PT	ALPHA	PSI	IN	TI	RP1	J1	T2	RP2	J2	T3	RP3	J3	T4	RP4	J4
1	C.C	0.0	90.00	14.66	408.0	0.0	14.82	428.0	0.0	14.93	4134.7	0.0	14.60	5880.0	0.0
2	C.C	0.0	90.00	24.70	5254.0	0.0	24.80	5450.0	0.0	24.84	5324.0	0.0	24.89	5364.0	0.0
3	C.C	0.0	90.00	34.93	6220.0	0.0	34.89	6424.0	0.0	34.89	6280.0	0.0	34.67	6394.0	0.0
4	C.C	0.0	90.00	-0.32	2.0	0.0	-0.42	2.0	0.0	-0.31	2.0	0.0	-0.54	2.0	0.0

PT ALPHA PSI IN

AVE T

CTST

CTSI

CTS2

CTS3

CTS4

OS

OS

OS

OS

WIND AXIS DATA

SLIPSTREAM G

PT	ALPHA	PSI	IN	LL	CL	CM	CV	CW	CS
1	C.C	0.0	90.00	1.4049	-0.1481	-0.0320	0.0129	0.0033	0.0072
2	C.C	0.0	90.00	1.3768	-0.2954	-0.0067	0.0225	0.0037	0.0043
3	C.C	0.0	90.00	1.3676	-0.0759	0.0201	-0.0088	-0.0098	-0.0045
4	C.C	0.0	90.00	0.7504	-0.2757	0.1222	0.6294	-0.0140	0.0127

PT	ALPHA	PSI	IN	LL	CL	CM	CV	CW	CS
1	C.C	0.0	90.00	1.4049	-0.1481	-0.0320	0.0129	0.0033	0.0072
2	C.C	0.0	90.00	1.3768	-0.2954	-0.0067	0.0225	0.0037	0.0043
3	C.C	0.0	90.00	1.3676	-0.0759	0.0201	-0.0088	-0.0098	-0.0045
4	C.C	0.0	90.00	0.7504	-0.2757	0.1222	0.6294	-0.0140	0.0127

PT	ALPHA	PSI	IN	LL	CL	CM	CV	CW	CS
1	C.C	0.0	90.00	1.4049	-0.1481	-0.0320	0.0129	0.0033	0.0072
2	C.C	0.0	90.00	1.3768	-0.2954	-0.0067	0.0225	0.0037	0.0043
3	C.C	0.0	90.00	1.3676	-0.0759	0.0201	-0.0088	-0.0098	-0.0045
4	C.C	0.0	90.00	0.7504	-0.2757	0.1222	0.6294	-0.0140	0.0127

PT	ALPHA	PSI	IN	LL	CL	CM	CV	CW	CS
1	C.C	0.0	90.00	1.4049	-0.1481	-0.0320	0.0129	0.0033	0.0072
2	C.C	0.0	90.00	1.3768	-0.2954	-0.0067	0.0225	0.0037	0.0043
3	C.C	0.0	90.00	1.3676	-0.0759	0.0201	-0.0088	-0.0098	-0.0045
4	C.C	0.0	90.00	0.7504	-0.2757	0.1222	0.6294	-0.0140	0.0127

TABLE NO. 2-2
VAL LUM SPEED PIND TUNNEL TEST NO. 216
BALANCE WRES DATA

TUNNEL 2 1.55

3915.120

WESS LAKE 1

ALPHA TABLE 11

STATIC ANALYSIS

TEMP TARE 1

TUNNEL TEMP 50.00

Pril - 5-5-51

434 NO. 17

[illegible]

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CU	CM	CY	CAM	CYM
1	C-0	0-0	90-00	16.7070	6.0959	4.6176	-0.1284	-0.1574	0.1111
2	0-C	C-0	50-00	26.5845	7.4280	6.5510	-0.3012	-0.1171	-0.1507
3	C-C	0-C	90-00	36.2408	6.4043	6.6196	0.0429	-0.1577	-0.3428

PT	ALPHA	PSI	IM	AVE T	CTST	CTSI	CTS2	CTS3	CTS4	QS
1	C-0	0-0	90-00	14.817	0.9167	0.9072	0.9168	0.9207	0.9270	7.08
2	0-C	C-0	50-00	26.835	0.9406	0.9435	0.9433	0.9566	0.9577	11.47
3	C-0	0-C	90-00	34.722	0.9627	0.9647	0.9601	0.9693	0.9656	15.80

MAIN AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IM	UL	CO	CP	CV	CPM	CYM	US
1	C.C	0.0	90.00	1.1523	0.5303	0.1646	-0.0107	-0.0056	0.0093	7.78
2	C.C	0.0	50.00	1.1670	0.1622	1.1376	-0.0196	-0.0060	-0.0170	11.47
3	C.C	0.0	50.00	1.1558	0.2392	1.2472	0.0016	-0.0022	-0.0120	15.80

TABLE NO. 2-2
VAL LUM SPEED WIND TUNNEL TEST AG. 602
BALANCE AXES DATA

TUNNEL A		0.55		0.7		0.9		1.1		1.3		1.5		1.7		1.9		2.1		2.3		2.5		2.7		2.9		3.1		3.3		3.5		3.7		3.9		4.1		4.3		4.5		4.7		4.9		5.1		5.3		5.5		5.7		5.9		6.1		6.3		6.5		6.7		6.9		7.1		7.3		7.5		7.7		7.9		8.1		8.3		8.5		8.7		8.9		9.1		9.3		9.5		9.7		9.9		10.1		10.3		10.5		10.7		10.9		11.1		11.3		11.5		11.7		11.9		12.1		12.3		12.5		12.7		12.9		13.1		13.3		13.5		13.7		13.9		14.1		14.3		14.5		14.7		14.9		15.1		15.3		15.5		15.7		15.9		16.1		16.3		16.5		16.7		16.9		17.1		17.3		17.5		17.7		17.9		18.1		18.3		18.5		18.7		18.9		19.1		19.3		19.5		19.7		19.9		20.1		20.3		20.5		20.7		20.9		21.1		21.3		21.5		21.7		21.9		22.1		22.3		22.5		22.7		22.9		23.1		23.3		23.5		23.7		23.9		24.1		24.3		24.5		24.7		24.9		25.1		25.3		25.5		25.7		25.9		26.1		26.3		26.5		26.7		26.9		27.1		27.3		27.5		27.7		27.9		28.1		28.3		28.5		28.7		28.9		29.1		29.3		29.5		29.7		29.9		30.1		30.3		30.5		30.7		30.9		31.1		31.3		31.5		31.7		31.9		32.1		32.3		32.5		32.7		32.9		33.1		33.3		33.5		33.7		33.9		34.1		34.3		34.5		34.7		34.9		35.1		35.3		35.5		35.7		35.9		36.1		36.3		36.5		36.7		36.9		37.1		37.3		37.5		37.7		37.9		38.1		38.3		38.5		38.7		38.9		39.1		39.3		39.5		39.7		39.9		40.1		40.3		40.5		40.7		40.9		41.1		41.3		41.5		41.7		41.9		42.1		42.3		42.5		42.7		42.9		43.1		43.3		43.5		43.7		43.9		44.1		44.3		44.5		44.7		44.9		45.1		45.3		45.5		45.7		45.9		46.1		46.3		46.5		46.7		46.9		47.1		47.3		47.5		47.7		47.9		48.1		48.3		48.5		48.7		48.9		49.1		49.3		49.5		49.7		49.9		50.1		50.3		50.5		50.7		50.9		51.1		51.3		51.5		51.7		51.9		52.1		52.3		52.5		52.7		52.9		53.1		53.3		53.5		53.7		53.9		54.1		54.3		54.5		54.7		54.9		55.1		55.3		55.5		55.7		55.9		56.1		56.3		56.5		56.7		56.9		57.1		57.3		57.5		57.7		57.9		58.1		58.3		58.5		58.7		58.9		59.1		59.3		59.5		59.7		59.9		60.1		60.3		60.5		60.7		60.9		61.1		61.3		61.5		61.7		61.9		62.1		62.3		62.5		62.7		62.9		63.1		63.3		63.5		63.7		63.9		64.1		64.3		64.5		64.7		64.9		65.1		65.3		65.5		65.7		65.9		66.1		66.3		66.5		66.7		66.9		67.1		67.3		67.5		67.7		67.9		68.1		68.3		68.5		68.7		68.9		69.1		69.3		69.5		69.7		69.9		70.1		70.3		70.5		70.7		70.9		71.1		71.3		71.5		71.7		71.9		72.1		72.3		72.5		72.7		72.9		73.1		73.3		73.5		73.7		73.9		74.1		74.3		74.5		74.7		74.9		75.1		75.3		75.5		75.7		75.9		76.1		76.3		76.5		76.7		76.9		77.1		77.3		77.5		77.7		77.9		78.1		78.3		78.5		78.7		78.9		79.1		79.3		79.5		79.7		79.9		80.1		80.3		80.5		80.7		80.9		81.1		81.3		81.5		81.7		81.9		82.1		82.3		82.5		82.7		82.9		83.1		83.3		83.5		83.7		83.9		84.1		84.3		84.5		84.7		84.9		85.1		85.3		85.5		85.7		85.9		86.1		86.3		86.5		86.7		86.9		87.1		87.3		87.5		87.7		87.9		88.1		88.3		88.5		88.7		88.9		89.1		89.3		89.5		89.7		89.9		90.1		90.3		90.5		90.7		90.9		91.1		91.3		91.5		91.7		91.9		92.1		92.3		92.5		92.7		92.9		93.1		93.3		93.5		93.7		93.9		94.1		94.3		94.5		94.7		94.9		95.1		95.3		95.5		95.7		95.9		96.1		96.3		96.5		96.7		96.9		97.1		97.3		97.5		97.7		97.9		98.1		98.3		98.5		98.7		98.9		99.1		99.3		99.5		99.7		99.9		100.1		100.3		100.5		100.7		100.9		101.1		101.3		101.5		101.7		101.9		102.1		102.3		102.5		102.7		102.9		103.1		103.3		103.5		103.7		103.9		104.1		104.3		104.5		104.7		104.9		105.1		105.3		105.5		105.7		105.9		106.1		106.3		106.5		106.7		106.9		107.1		107.3		107.5		107.7		107.9		108.1		108.3		108.5		108.7		108.9		109.1		109.3		109.5		109.7		109.9		110.1		110.3		110.5		110.7		110.9		111.1		111.3		111.5		111.7		111.9		112.1		112.3		112.5		112.7		112.9		113.1		113.3		113.5		113.7		113.9		114.1		114.3		114.5		114.7		114.9		115.1		115.3		115.5		115.7		115.9		116.1		116.3		116.5		116.7		116.9		117.1		117.3		117.5		117.7		117.9		118.1		118.3		118.5		118.7		118.9		119.1		119.3		119.5		119.7		119.9		120.1		120.3		120.5		120.7		120.9		121.1		121.3		121.5		121.7		121.9		122.1		122.3		122.5		122.7		122.9		123.1		123.3		123.5		123.7		123.9		124.1		124.3		124.5		124.7		124.9		125.1		125.3		125.5		125.7		125.9		126.1		126.3		126.5		126.7		126.9		127.1		127.3		127.5		127.7		127.9		128.1		128.3		128.5		128.7		128.9		129.1		129.3		129.5		129.7		129.9		130.1		130.3		130.5		130.7		130.9		131.1		131.3		131.5		131.7		131.9		132.1		132.3		132.5		132.7		132.9		133.1		133.3		133.5		133.7		133.9		134.1		134.3		134.5		134.7		134.9		135.1		135.3		135.5		135.7		135.9		136.1		136.3		136.5		136.7		136.9		137.1		137.3		137.5		137.7		137.9		138.1		138.3		138.5		138.7		138.9		139.1		139.3		139.5		139.7		139.9		140.1		140.3		140.5		140.7		140.9		141.1		141.3		141.5		141.7		141.9		142.1		142.3		142.5		142.7		142.9		143.1		143.3		143.5		143.7		143.9		144.1		144.3		144.5		144.7		144.9		145.1		145.3		145.5		145.7		145.9		146.1		146.3		146.5		146.7		146.9		147.1		147.3		147.5		147.7		147.9		148.1		148.3		148.5		148.7		148.9		149.1		149.3		149.5		149.7		149.9		150.1		150.3		150.5		150.7		150.9		151.1		151.3		151.5		151.7		151.9		152.1		152.3		152.5		152.7		152.9		153.1		153.3		153.5		153.7		153.9		154.1		154.3		154.5		154.7		154.9		155.1		155.3		155.5		155.7		155.9		156.1		156.3		156.5		156.7		156.9		157.1		157.3		157.5		157.7		157.9		158.1		158.3		158.5		158.7		158.9		159.1		159.3		159.5		159.7		159.9		160.1		160.3		160.5		160.7		160.9		161.1		161.3		161.5		161.7		161.9		162.1		162.3		162.5		162.7		162.9		163.1		163.3		163.5		163.7		163.9		164.1		164.3		164.5		164.7		164.9		165.1		165.3		165.5		165.7		165.9		166.1		166.3		166.5		166.7		166.9		167.1		167.3		167.5		167.7		167.9		168.1		168.3		168.5		168.7		168.9		169.1		169.3		169.5		169.7		169.9		170.1		170.3		170.5		170.7		170.9		171.1		171.3		171.5		171.7		171.9		172.1		172.3		172.5		172.7		172.9		173.1		173.3		173.5		173.7		173.9		174.1		174.3		174.5		174.7		174.9		175.1		175.3		175.5		175.7		175.9		176.1		176.3		176.5		176.7		176.9		177.1		177.3		177.5		177.7		177.9		178.1		178.3		178.5		178.7		178.9		179.1		179.3		179.5		179.7		179.9		180.1		180.3		180.5		180.7		180.9		181.1		181.3		181.5		181.7		181.9		182.1		182.3		182.5		182.7		182.9		183.1		183.3		183.5		183.7		183.9		184.1		184.3		184.5		184.7		184.9		185.1		185.3		185.5		185.7		185.9		186.1		186.3		186.5		186.7		186.9		187.1		187.3		187.5		187.7		187.9		188.1		188.3		188.5		188.7		188.9		189.1		189.3		189.5		189.7		189.9		190.1		190.3		190.5		190.7		190.9		191.1		191.3		191.5		191.7		191.9		192.1		192.3		192.5		192.7		192.9		193.1		193.3		193.5		193.7		193.9		194.1		194.3		194.5		194.7		194.9		195.1		195.3		195.5		195.7		195.9		196.1		196.3		196.5		196.7		196.9		197.1		197.3		197.5		197.7		197.9		198.1		198.3		198.5		198.7		198.9	
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TABLE NO. 2-2
VAL LCM SPEED WIND TUNNEL TEST NO. 260
BALANCE AXES DATA

TUNNEL NO C-55																			
PRESS TARE 1																			
STATIC TARE 0																			
TUNNEL TEMP 54.00																			
PMT = -5.01																			
PT	ALPHA	PSI	IM	MF	AF	PM	SF	MM	VM	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.C	0.0	90.00	63.657	22.970	242.264	-0.419	-21.726	17.232	0.1836	14.78	4118.0	0.1887	14.54	3262.0	0.1823			
2	C.C	0.0	90.00	100.324	27.691	320.950	0.243	-20.514	-54.987	0.1473	24.54	5474.0	0.1410	25.07	5519.0	0.1409			
3	C.C	0.0	90.00	134.200	22.351	327.012	-1.030	-35.144	-96.617	0.1162	34.50	6500.0	0.1198	34.67	6472.0	0.1200			
PT	ALPHA	PSI	IM	T1	RPPI	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4				
1	C.C	0.0	90.00	14.45	4112.0	0.1839	14.98	4232.0	0.1836	14.78	4118.0	0.1887	14.54	3262.0	0.1823				
2	C.C	0.0	90.00	24.61	5352.0	0.1452	24.44	5518.0	0.1473	24.54	5474.0	0.1410	25.07	5519.0	0.1409				
3	C.C	0.0	90.00	34.64	6346.0	0.1224	35.05	6572.0	0.1162	34.50	6500.0	0.1198	34.67	6472.0	0.1200				

WIND AXES DATA

PT	ALPHA	PSI	IM	CL	CU	CM	CV	CHM	CVM
1	C.C	0.0	90.00	16.0866	5.9162	4.7386	-0.1058	-0.0610	0.0557
2	C.C	0.0	90.00	29.3500	7.2507	6.3483	0.0636	-0.0754	-0.0114
3	C.C	0.0	90.00	36.2267	5.8589	6.0355	-0.0270	-0.0954	-0.02437
PT	ALPHA	PSI	IM	AVE T	CTST	CTST	CTST	CTSA	US
1	C.C	0.0	90.00	14.751	0.9165	0.8956	0.9280	0.9164	0.928
2	C.C	0.0	90.00	24.704	0.9463	0.9521	0.9386	0.9433	0.9506
3	C.C	0.0	90.00	34.614	0.9627	0.9579	0.9693	0.9651	0.9686

WIND AXES DATA

SLIPSTREAM 0									
PT	ALPHA	PSI	IM	CL	CU	CM	CV	CHM	CVM
1	C.C	0.0	90.00	1.3525	0.4933	0.3955	-0.0052	-0.0251	0.0042
2	C.C	0.0	90.00	1.3025	0.3753	0.3306	0.0023	-0.0041	-0.0074
3	C.C	0.0	90.00	1.3455	0.2183	0.2540	-0.0101	-0.0030	0.0110
PT	ALPHA	PSI	IM	CL	CU	CM	CV	CHM	CVM
1	C.C	0.0	90.00	1.3525	0.4933	0.3955	-0.0052	-0.0251	0.0042
2	C.C	0.0	90.00	1.3025	0.3753	0.3306	0.0023	-0.0041	-0.0074
3	C.C	0.0	90.00	1.3455	0.2183	0.2540	-0.0101	-0.0030	0.0110

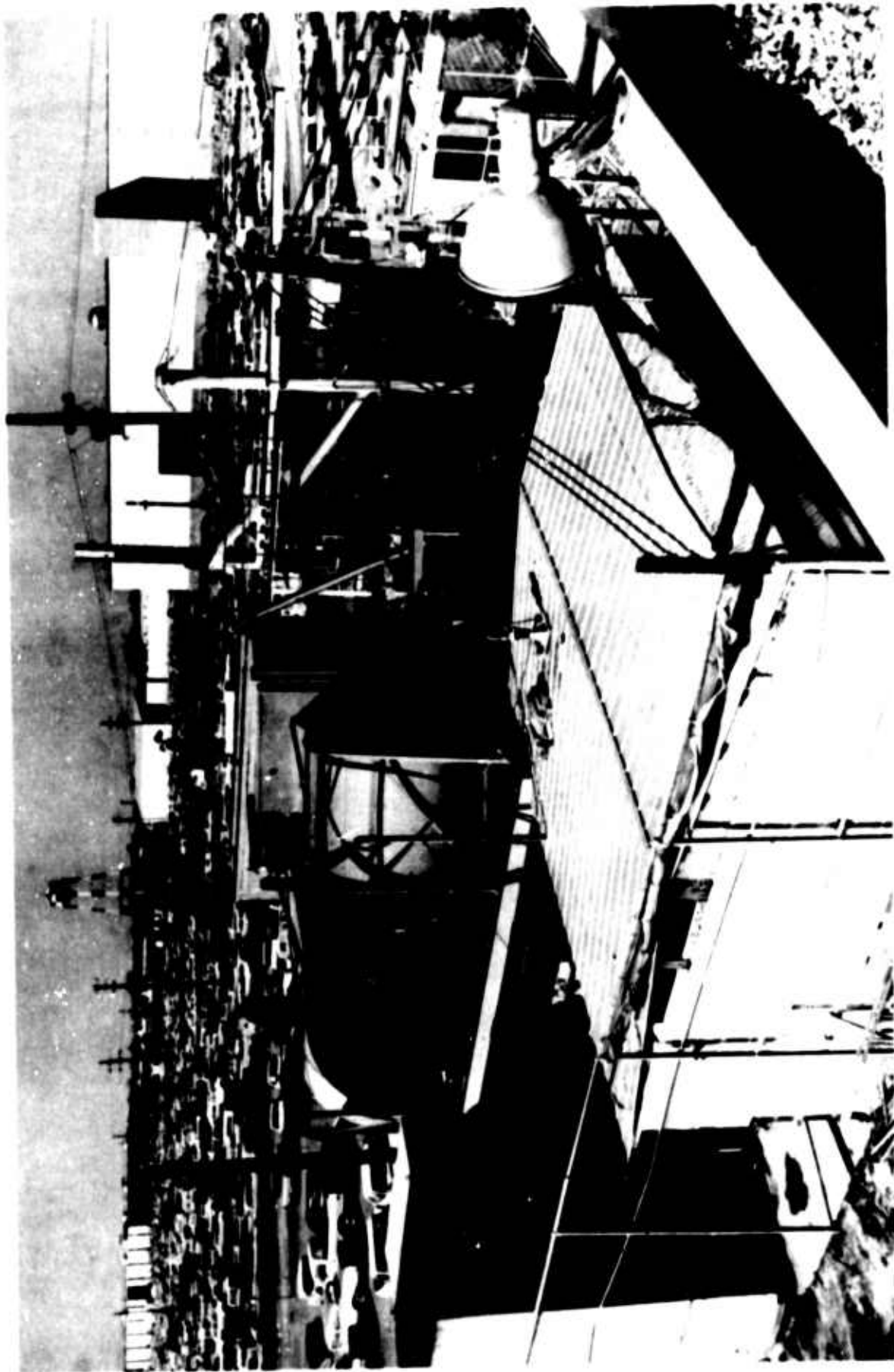


Figure 2-1 LTV Aero-Hydro Test Facility



Figure 2-2 LTV Aero-Hydro Test Facility

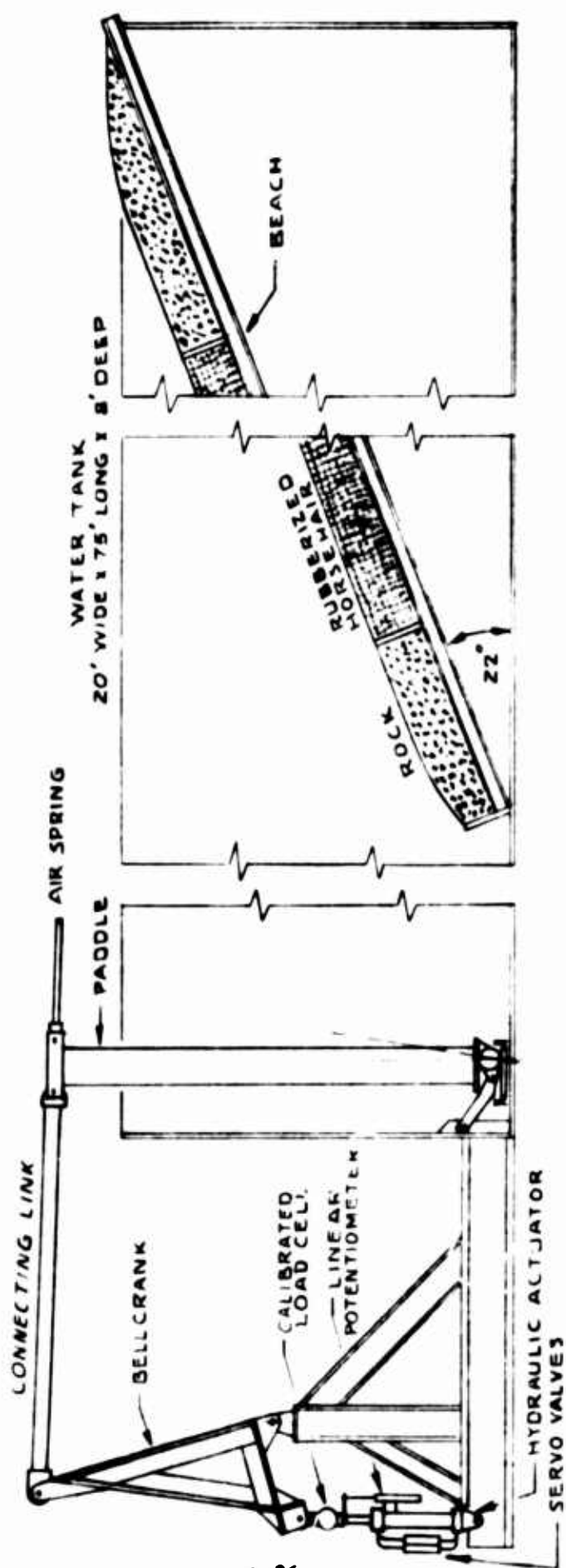
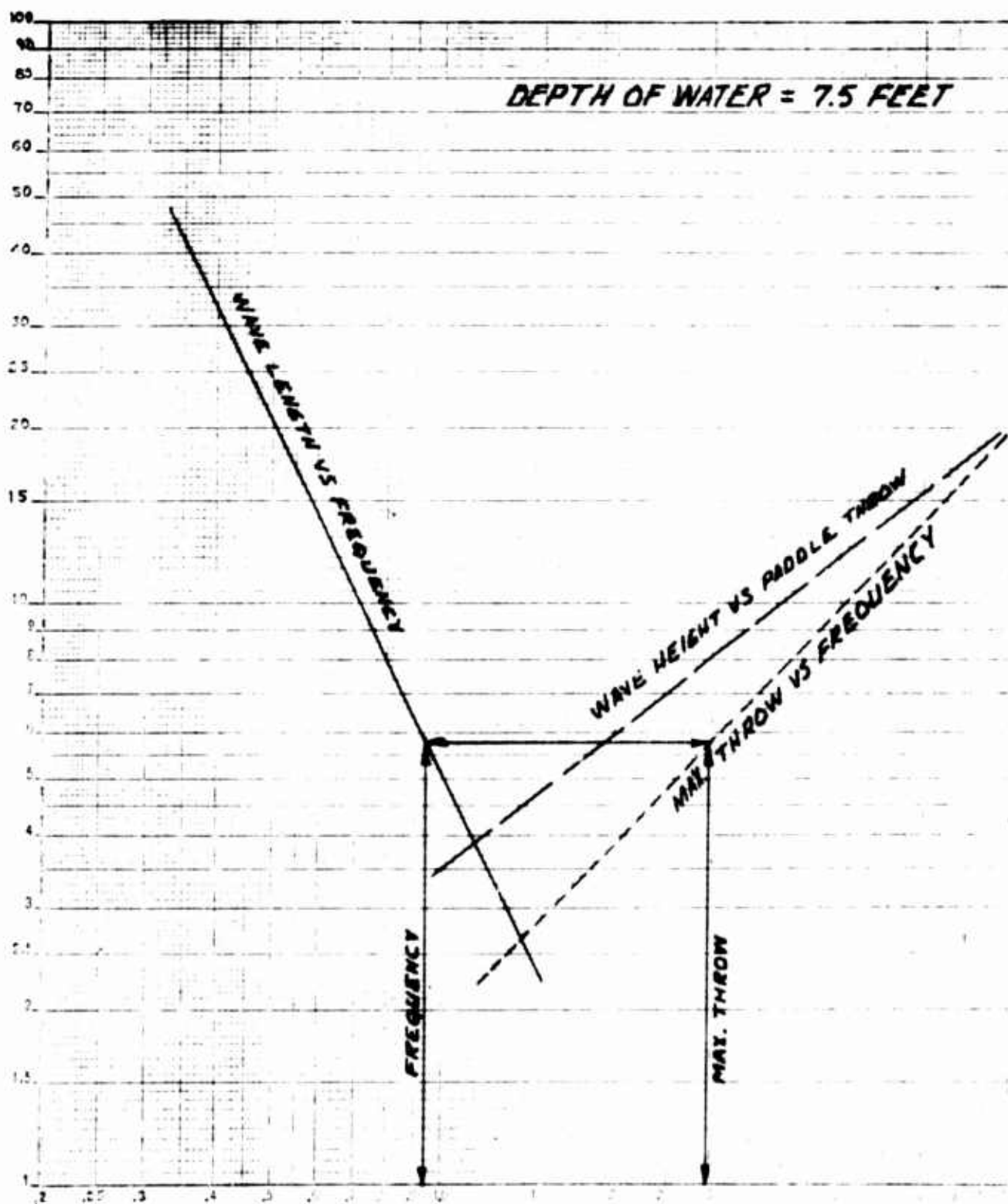


Figure 2-3 Water Tank and Wave Generator

WAVE HEIGHT IN INCHES AND LENGTH IN FEET



TOTAL PADDLE THROW (DEGREES) & FREQUENCY (CPS)

Figure 2-4 Wave Generator Calibration



Figure 2-5 LTV Aero-Hydro Test Facility Wind Generator

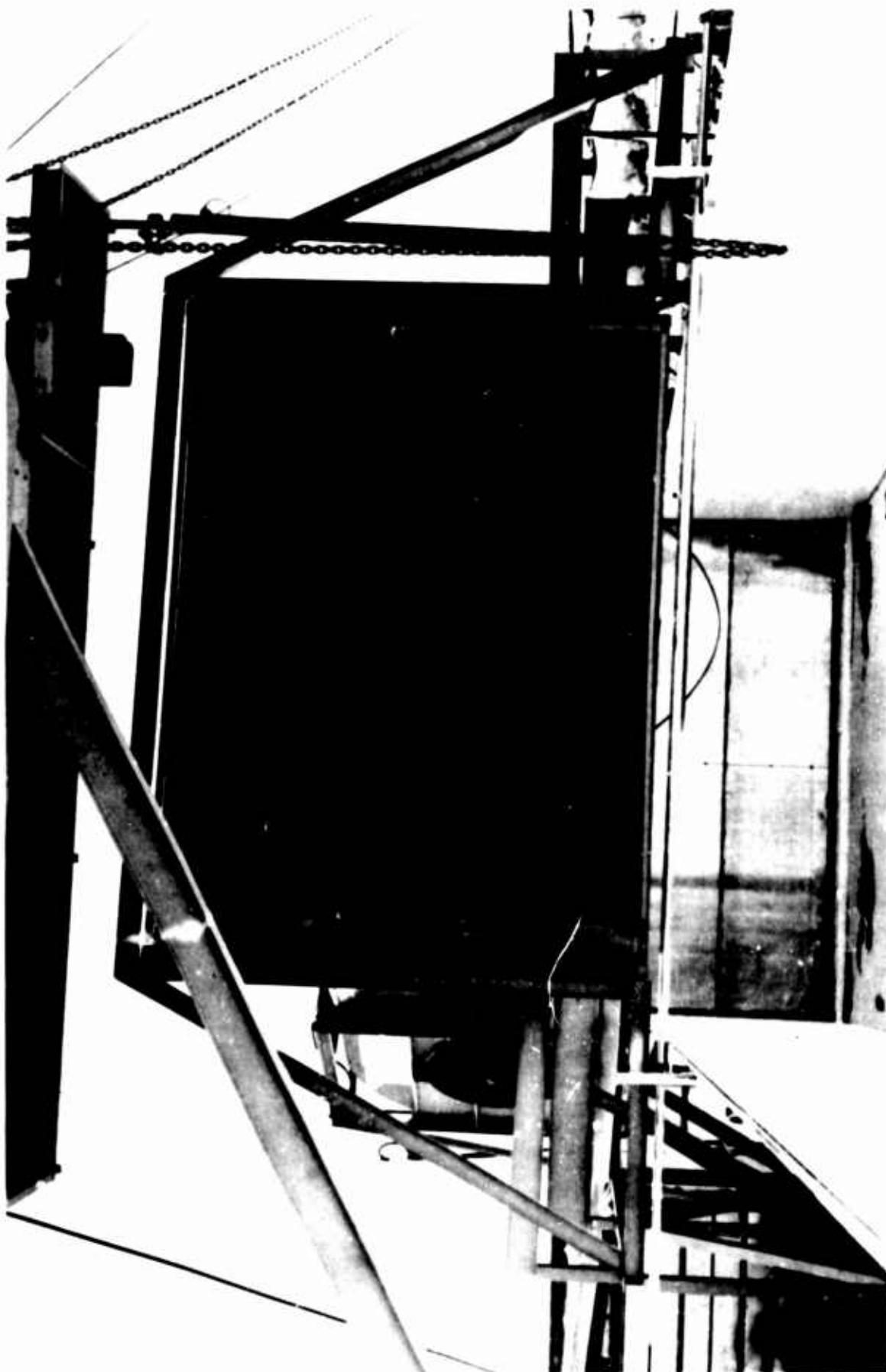


Figure 2-6 LTV Aero-Hydro Test Facility Wind Generator Plenum

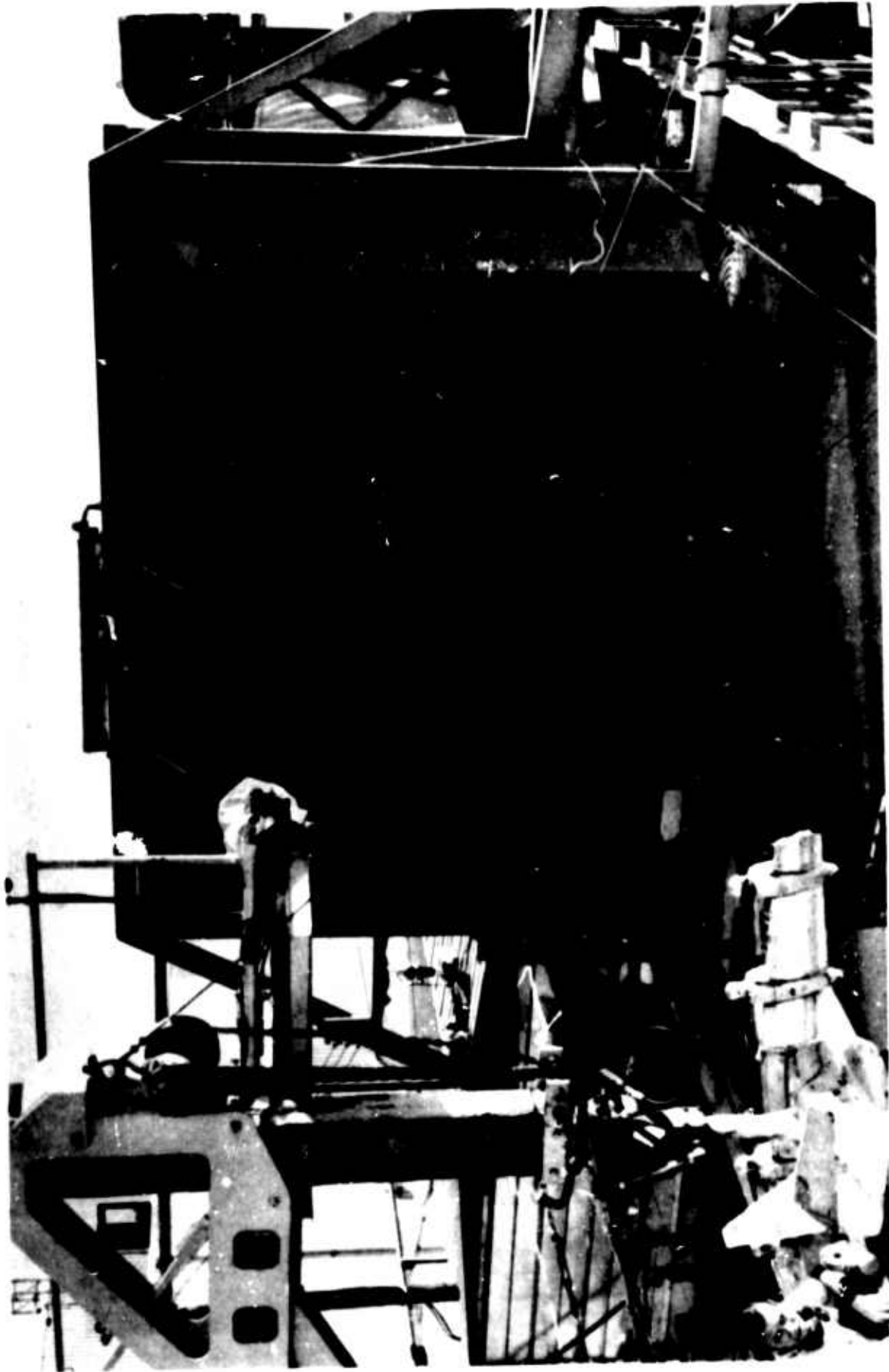


Figure 2-7 LTV Aero-Hydro Test Facility Wind Generator Diffuser Exit

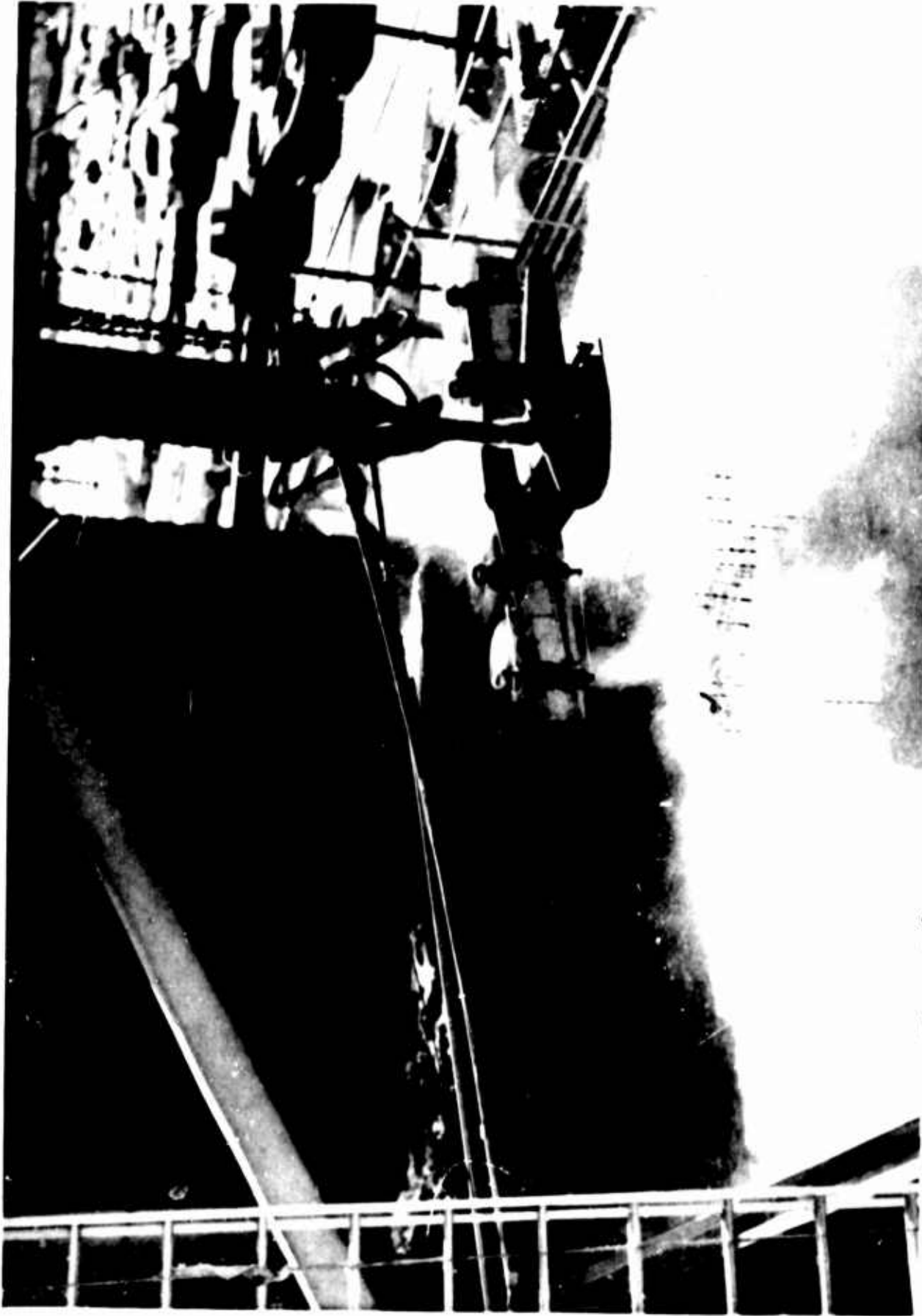


Figure 2-8 LTV Aero-Hydro Test Facility, Wind, Waves, and Spray

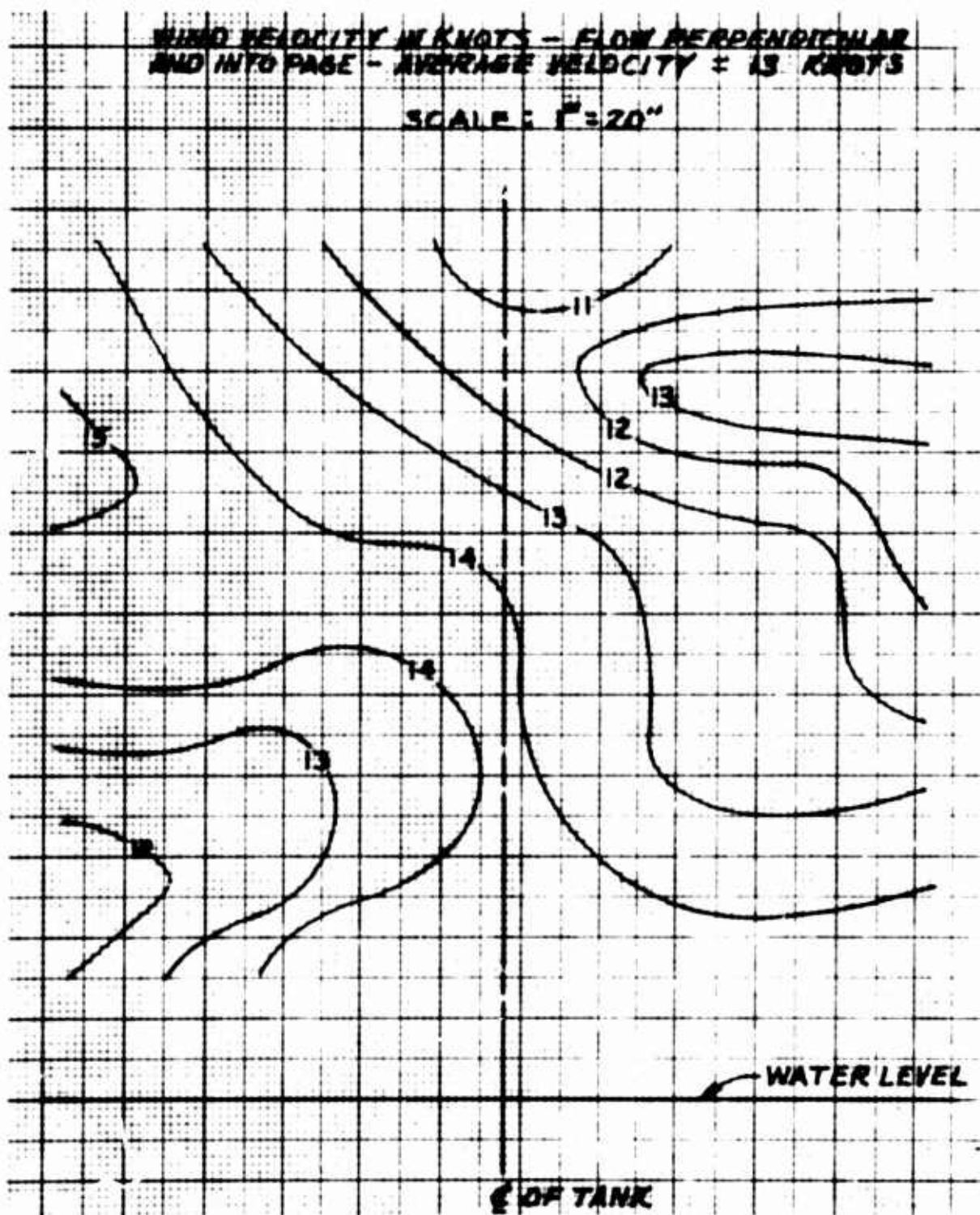


Figure 2-9 Wind Generator Calibration

3.0 FORCE AND MOMENT DATA RESULTS

The model forces and moments were measured by an internal six-component balance, and the thrust of each propeller was measured by a separate thrust cowl. The complete tabulated data are presented in Section 2.3.

The objectives of this phase of the test program were to:

- a. Obtain model force and moment data while hovering at different heights over a water surface with and without waves and a steady surface wind.
- b. Determine the effects of height, water surface, and surface wind on a rolled model.

Model force and moment data presented in this report have been nondimensionalized by the wing area and the slipstream dynamic pressure. The slipstream dynamic pressure is defined as the freestream dynamic pressure plus the average of the four propeller disc loadings. These data are presented as a function of model height to propeller diameter ratio for various propeller disc loadings and model roll angles with and without waves and surface winds. The model height was measured from the water surface to the propeller plane of the outboard propellers; for the rolled model, the model height is the average height to the outboard propellers measured at the propeller shafts.

The propeller disc loadings used in this test were approximately 6.5, 10.8, and 15.2 pounds per square foot. The basis for these loadings is discussed in Section 4.0.

The propeller thrust was measured with a five-component thrust cowl behind each propeller, but only the thrust component was recorded. These

thrust cowls have an accuracy of approximately ± 0.25 -pound thrust when the temperature tares are neglected, as was done in this test due to the wide range of ambient conditions. Thrust can be measured within ± 0.1 pound under controlled conditions. Propeller rpm was measured to ± 2 ; but under slightly gusty ambient wind conditions, the servo control system could only hold the rpm within ± 6 . These thrust and rpm variations represent good control of the model propeller, considering the wide range of uncontrolled ambient conditions; and only a small amount of scatter was seen in the thrust readings during the test. Model propeller controllability problems are not applicable to the full-scale airplane.

3.1 NORMAL FORCE DATA

Figures 3-1, 3-2, and 3-3 show the change in the model normal force or lift coefficient with model height ratio as a function of propeller disc loading. These data were first examined to determine the effects of various wave heights. Within the scatter of the data, the normal force coefficient was independent of wave height and surface wind. The data for 0-, 6-, and 12-inch waves were averaged together and are presented in Figures 3-1 through 3-4. The data of Figures 3-1 and 3-2 indicate that there is a small increase of the normal force coefficient as the disc loading increases and the normal force coefficient decreases with increasing model height above the water.

The variation of normal force coefficient with model height ratio for the model rolled 10 degrees is presented in Figure 3-3. At the model height ratios of 2.5 and 3.7, there is no significant change from the previous data of Figures 3-1 and 3-2. A model height ratio (2.5) was tested with the model rolled 5 degrees; and the results showed no significant differences from the data of Figure 3-3 and, therefore, have not been presented.

3.2

DRAG DATA

The change in drag coefficient with model height ratio is presented in Figures 3-1, 3-2, and 3-3. Figure 3-1 shows that, with no surface wind, there is a small effect on drag with the drag coefficient decreasing with increasing height ratios. No distinct effects of disk loading are apparent, possibly due to the scatter of the data. With the blower on, creating a steady surface wind, the data show a large increase in drag coefficient with increasing height ratio (Figure 3-2). These data also show that drag coefficient decreases with increasing disc loading. Part of the drag with surface winds shown in Figure 3-2 is the result of the propeller normal force. As the disc loading is increased, the surface wind becomes a smaller component relative to the velocity normal to the propeller disc, and the propeller normal force decreases. With the model rolled 10 degrees, the drag coefficient data of Figure 3-3 shows no significant changes from the data of Figures 3-1 and 3-2. No differences were seen at the model height ratio (2.5) with the model rolled 5 degrees, and the data are not presented.

3.3

PITCHING MOMENT DATA

The pitching moment coefficient data variations with model height ratio are presented in Figures 3-1, 3-2, and 3-3. The data of Figure 3-1 show that with no surface winds there is a small positive pitching moment acting about the center of gravity at the 20 percent MGC position that appears to be independent of model height ratio and disc loading within the scatter of the data available. With a surface wind, there is a large increase in positive pitching moment shown in Figures 3-2 and 3-3 that increases with

increasing model height ratio and decreases with increasing disc loading. This pitching moment is primarily the propeller hub pitching moment resulting from the surface wind. As was the case with the drag coefficient, as the disc loading is increased, the surface wind is a smaller component relative to the velocity normal to the propeller disc; therefore, the propeller hub pitching moment is decreased with increasing disc loading.

3.4 LATERAL-DIRECTIONAL DATA

Figure 3-4 presents the yawing moment, rolling moment, and side force coefficients with the surface wind on and off at average model height ratios of 2.5 and 3.7 for three disc loadings with XC-142A model rolled 10 degrees. The surface waves of 6 and 12 inches had no apparent effect on the data, and these points have been averaged together with the smooth surface data. Within the scatter of the data, no consistent variations with surface winds, disc loading, or model height ratio are apparent. The mean value for the yawing moment and side force coefficients appears to be zero, while the rolling moment coefficient (C_{l15}) has a mean value of $-.0075$ for the left wing down 10 degrees.

3.5 VERTICAL FLOATS

The XC-142A model was tested with vertical floats replacing the landing gear wheel pods as shown in Figure 4-5 at model height ratios of 2.5 and 3.7 with and without 6-inch waves and surface winds. Within the scatter of the data, no significant differences from landing gear pods on data were seen; therefore, the float data are omitted from this report.

The dynamic characteristics of the No. 1 propeller thrust and the two normal force elements of the model internal balance (R_1 and R_2) were recorded on a 6-inch light beam oscillograph. These signals were picked off before they were filtered by the low speed wind tunnel data system.

Only the natural frequencies of the thrust cowl and the model were observed from these data. The frequency of the thrust element signal of the thrust cowl was observed to be from 220 to 280 cycles per second for all rpm's, model heights, and water conditions and is the approximate natural frequency of the thrust cowl (250 cycles per second). Superimposed on this thrust frequency of 250 cycles per second was an approximate eight-cycle-per-second frequency, which was also observed in the normal force gage output of the main balance. The natural frequency of the model on its hover mounting is approximately eight cycles per second in the vertical plane. These frequencies are all well within the capability of the light beam oscillograph which can record frequencies from zero to in excess of 900 cycles per second.

The amplitude of the 8 cps thrust oscillation was very large and was affected by the surface winds. Figure 3-5 presents a typical oscillograph trace for the condition of surface winds on and off. For all three disc loadings, the amplitude of the thrust oscillation varied plus and minus 10 to 15 pounds with no surface winds and plus and minus 20 to 25 pounds with the surface winds ($q = 0.59$). Although the surface winds approximately

doubled the amplitude of the propeller thrust oscillation, the frequencies were so high that the model data was not affected. These frequencies and amplitudes only affect the mechanical life of the thrust cowls. The various sea states simulated by the wave-maker had no apparent effect on the propeller thrust amplitude or frequency.

Six electric depth gages were positioned in the water under the model as shown in Figure 4-6 to record the amplitude and frequency of the water surface disturbances on a 6-inch light beam oscillograph. These data indicate that with the wave maker on and off the propellers generate waves with a frequency of approximately three cycles per second that move out from the model with an amplitude that is dependent on model height and disk loading. These data are presented in detail in Section 4. A typical time history of waves generated by the propellers with the wave maker off is presented in Figure 3-6. Data obtained with the wave maker on showed the three cycles per second frequency superimposed on the wave pattern.

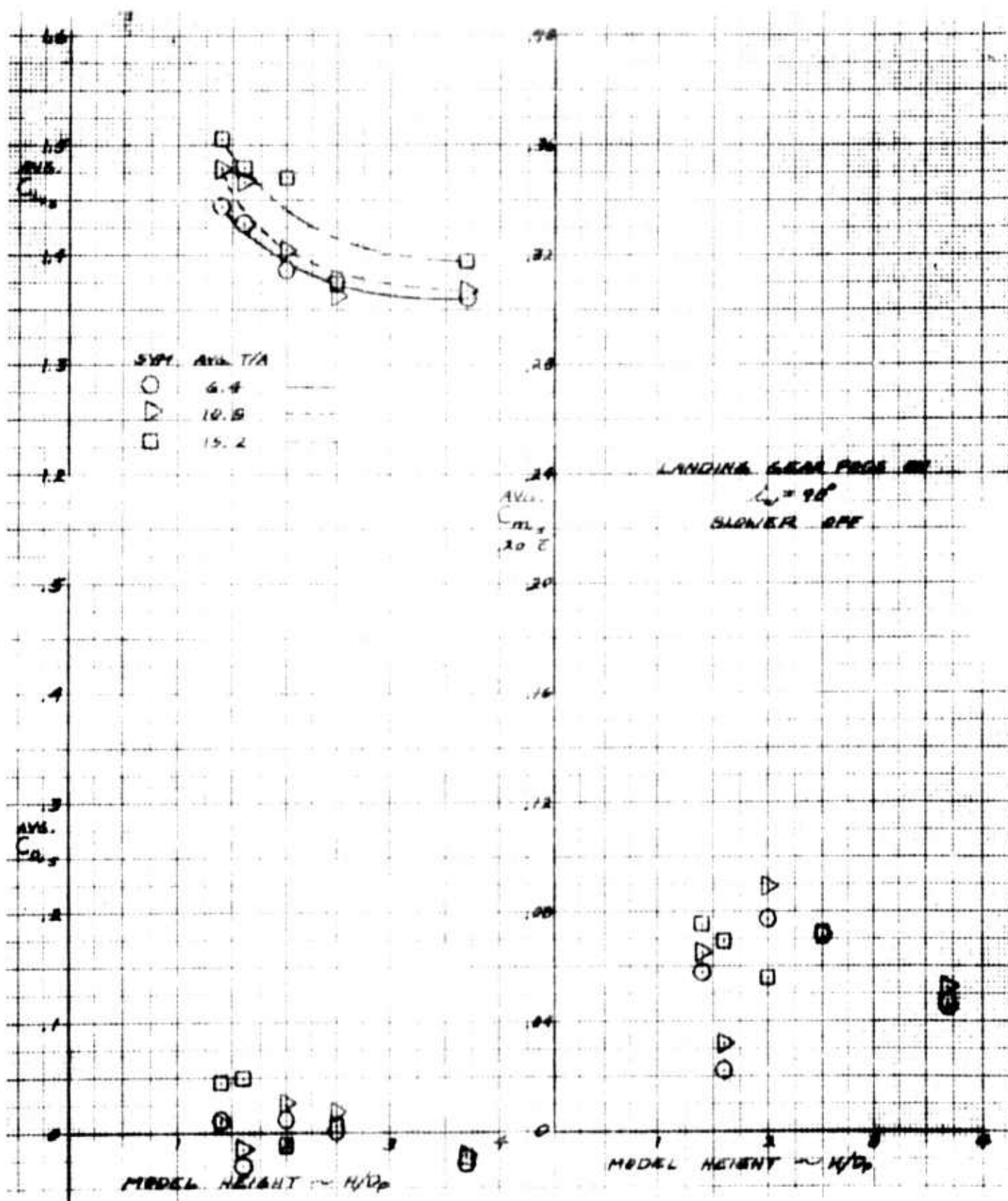


Figure 3-1 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

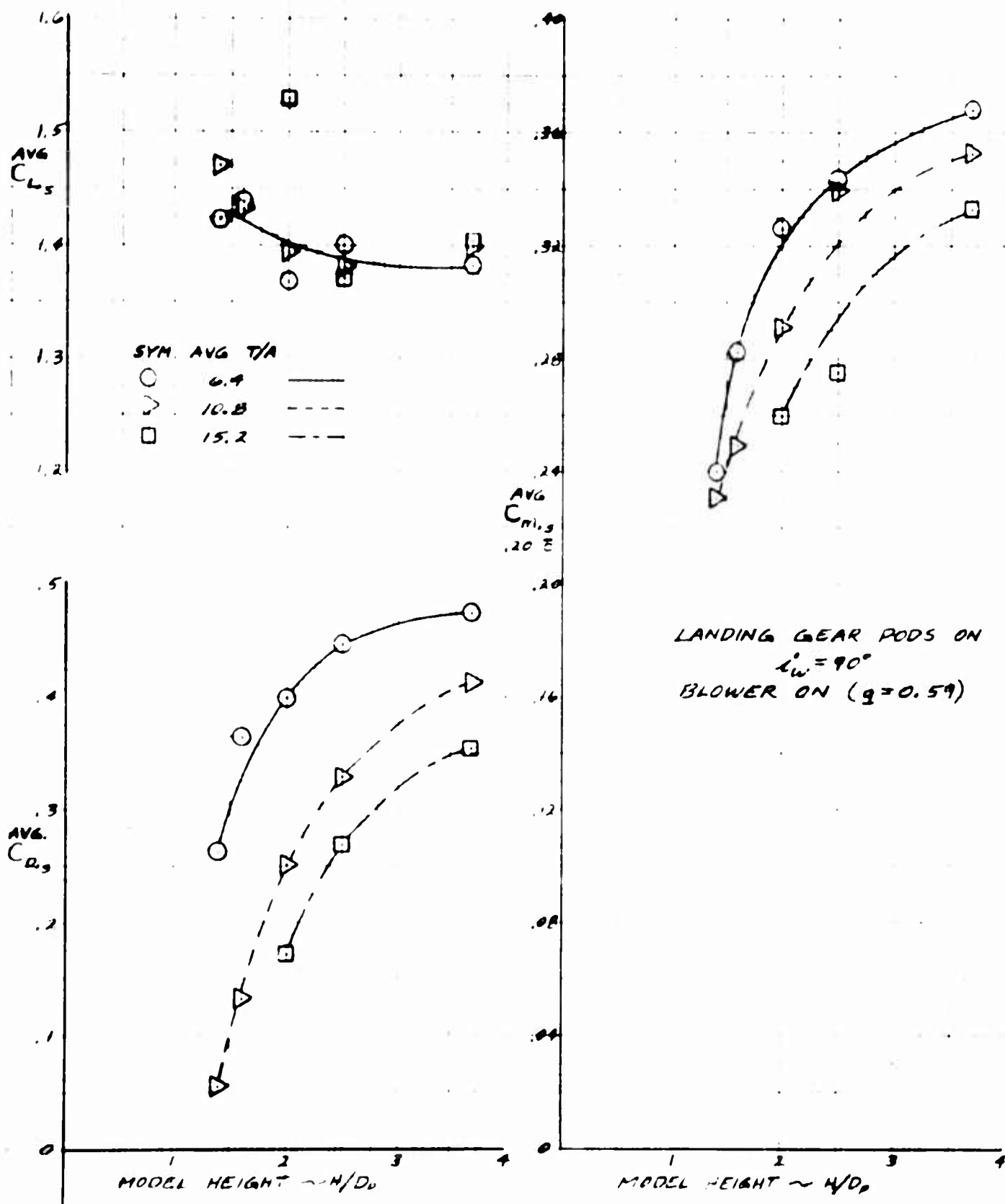


Figure 3-2 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

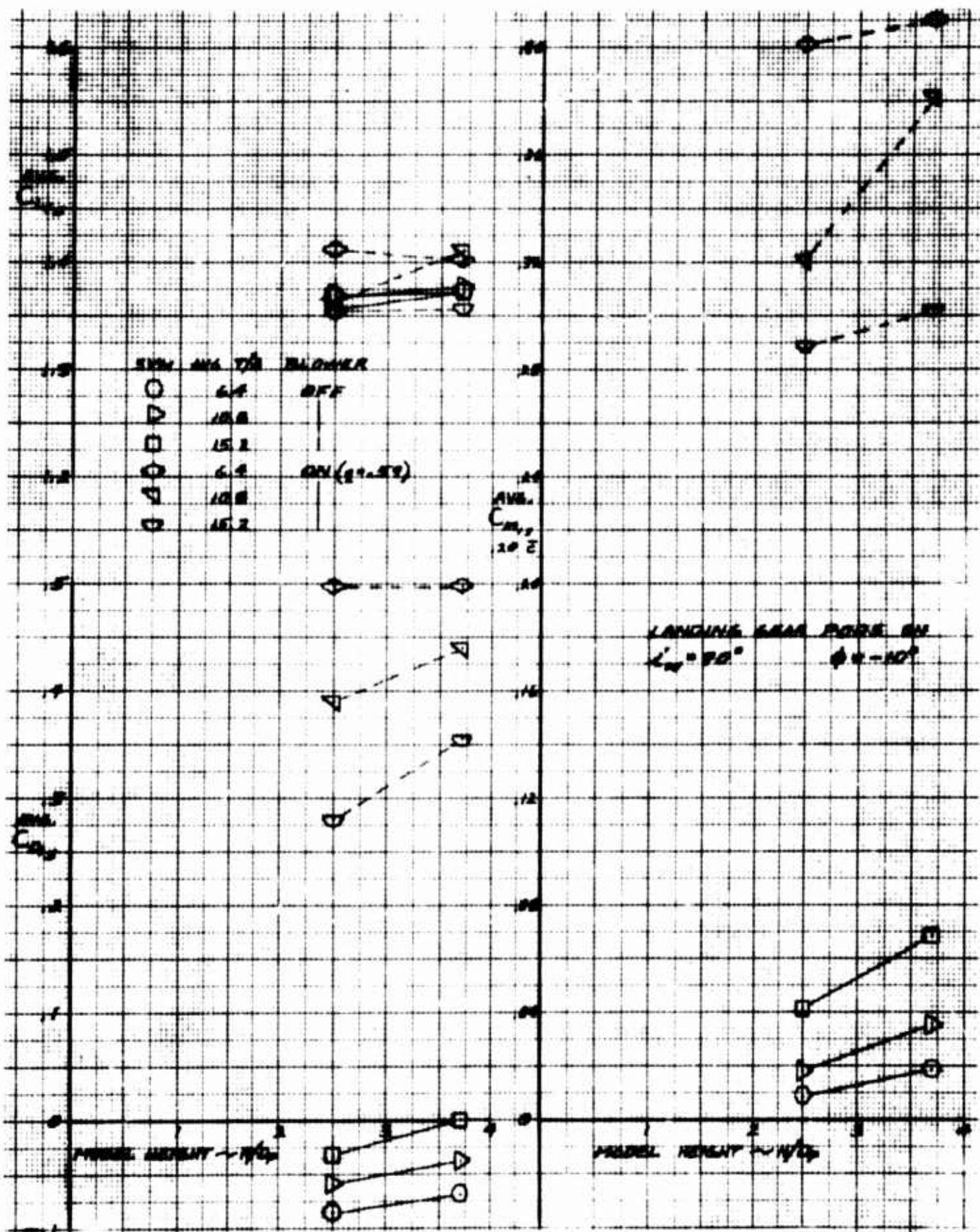


Figure 3-3 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

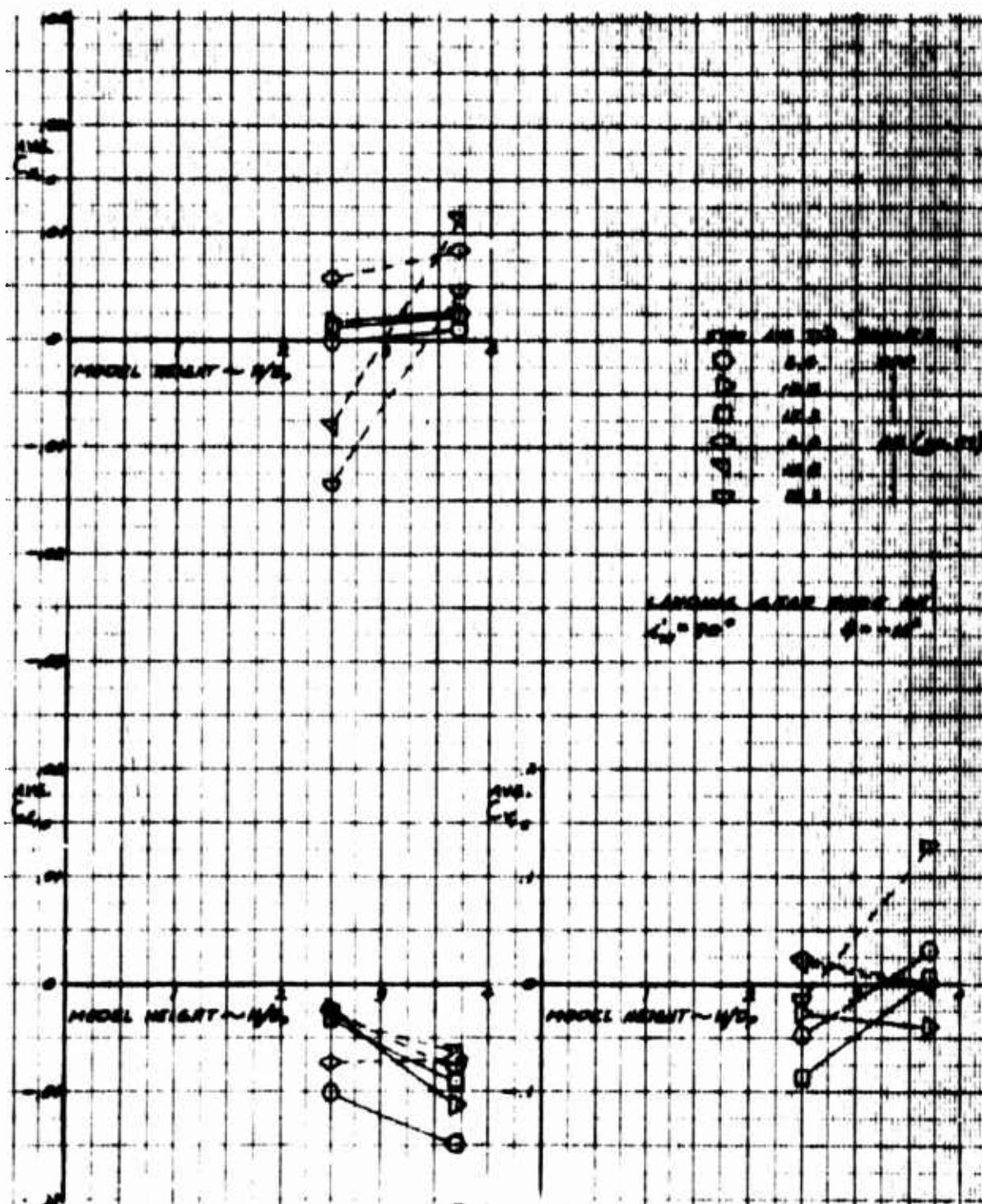


Figure 3-4 Effects of Model Height Ratio and Disc Loading on Lateral-Directional Characteristics

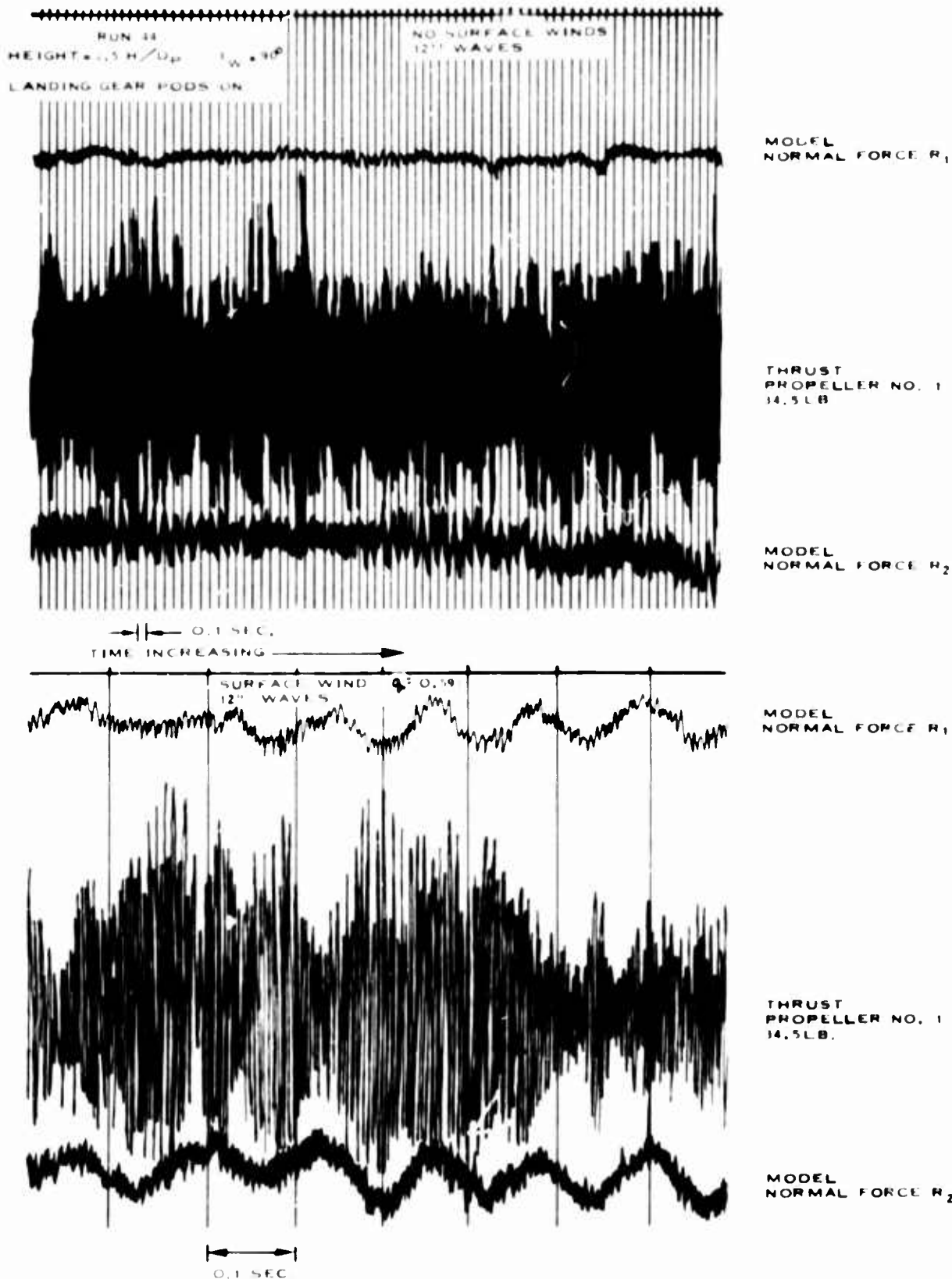


Figure 3-5 Time History of Model Normal Force and Propeller
 Thrust with Surface Winds On and Off

ELECTRIC DEPTH GAGE, POSITION NUMBER 3
NO SURFACE WIND NO WAVES

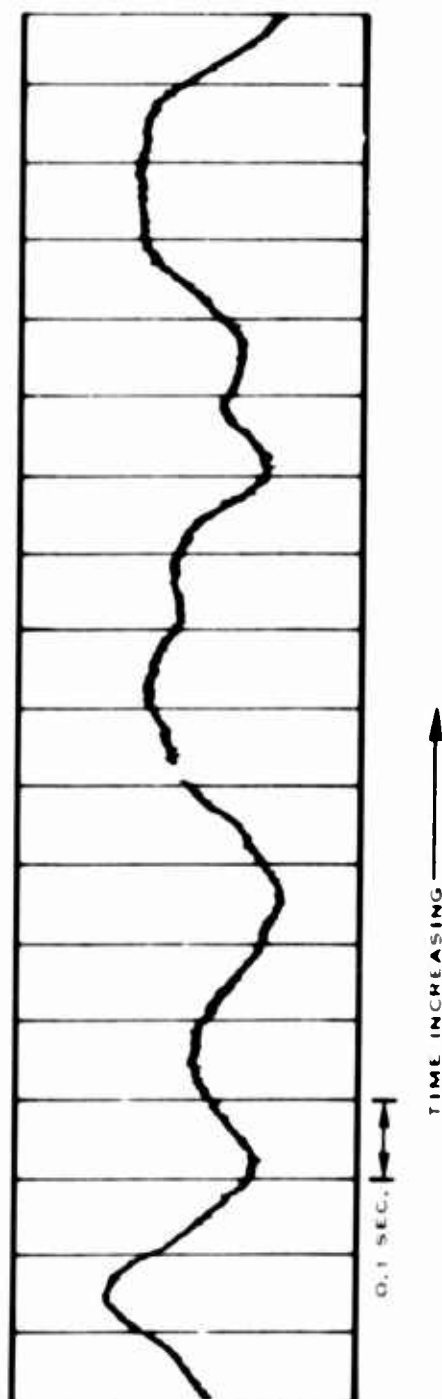


Figure 3-6 Time History of Waves Generated by Propellers
with Wave-Maker Off

4.0 DOWNWASH ENVIRONMENT

4.1 INTRODUCTION

One of the objectives of this test program was the definition of environmental conditions generated by a four-engined tilt-wing vehicle using a powered .11-scale model of the XC-142 hovering over water. Primary emphasis was placed on determining the following:

- a. Amount of spray passing through the propellers.
- b. Shape of the depression formed by the slipstream in the water beneath the model.
- c. Size of the spray droplets.
- d. General spray patterns.

For each of the above, the effects of model height, roll angle, wing angle, disc loading, wave height, wave length, ambient winds, and vertical floats were determined. The results of this test have been compared with those of other tests, some of which were with full-scale vehicles.

4.2 DATA RECORDING TECHNIQUES

4.2.1 Moisture

4.2.1.1 Water Flow Rate

Experience with seaplanes and helicopters operating near the water surface indicates that water ingestion (particularly salt water) is sufficient to be detrimental to gas turbine engine operation and life. Engine flameout occurs over fresh water with concentrations of 5%-10% by weight of water-in-air; however, salt water can cause unacceptable corrosion with concentration of one part per million (ppm) of salt-in-air (Reference 4-1). Water measurement accuracy requirements were set by the salt water criteria; individual measurements were accurate to $\pm .00002 \text{ lb/min-in.}^2$ (.2 ppm salt-in-air).

Two methods were attempted to record the quantity of water passing through the model propellers. The primary method was the moisture meter shown in Figure 4-1. For the previous test, conducted under contract No. N00014-66-C0095 (Reference 4-2), a single moisture meter was mounted on the left wing; for this test a moisture meter was mounted on each wing to record the unsymmetrical spray pattern created by the model in roll. The meters opened for a specified time exposing sponge-filled trays. Analytical balances, providing measurement accuracies to $\pm .002$ grams, were used to determine the amount of water collected. As a check for the moisture meters, the isokinetic probe shown in Figure 4-2 was used to sample the moisture behind the propellers. The velocity into the probe was maintained equal to the surrounding slipstream velocity by a vacuum pump. Thus an undisturbed stream of air entered the probe and was filtered for analysis. The filter portion of the isokinetic probe weighed over a pound, and, as a consequence, was too heavy to weigh on available scales having sufficient accuracy. As a result, no useful data was acquired from the isokinetic probe. The locations of the moisture meter trays and the isokinetic probe are shown in Figure 4-3.

4.2.1.2 Droplet Size

The size of the droplets in a flow field determines the ability of the spray to follow air currents; light spray and aerosols follow the airstream, while larger droplets tend to precipitate. Previous investigations with various size models with scaled disc loadings (References 4-3 and 4-4) indicated that a finer mist was generated by the larger models. Droplet sizes were recorded to determine if the droplets created by the present test were too large to follow the airstream and to provide a base for comparison with full-scale tests.

Two types of instrumentation were used to determine droplet sizes for this test. Pictures of droplets down to 40 microns in diameter were taken from 13 feet away using the 40-inch lens mounted on a camera. Another method using a device known as a droplet snatcher (Figure 4-4) was also employed to measure droplet size. Glass slides coated with light (SG = .972) over heavy (SG = 1.11) silicone fluids were inserted in the droplet snatcher, exposed to the spray for 1 to 2 seconds, and photographed under a microscope. The droplets were suspended at the interface between the two fluids. The smallest droplets that could be detected were 9 microns in diameter, while the largest that could be captured without shattering were 1,250 microns.

4.2.2 Water Depression

The slope of the depression formed by the slipstream in the water beneath the model influences the amount of spray circulation. The vertical component of the spray leaving the water is determined by the slope of the water near the depression lip. The amount of spray generated is determined by the size of the wavelets formed in the depression.

Two methods of recording depression characteristics were employed: (a) motion pictures of the visual depth gages shown in Figure 4-5; and (b) oscillograph traces from electrical depth gages. An instantaneous depression contour was obtained from a given movie frame; time variations at a given point were obtained from the electrical depth gages. Visual depth gage readings were checked for accuracy by comparisons between various readings for still water and comparisons of these readings with actual measurements of the gages. These comparisons indicated that the average reading was within .3 inch of the actual depth. The accuracy of the electrical depth gages was within .1 inch, except where limited by the small scale require record

16-inch waves on 6-inch oscillograph paper. The depth gage pattern presented in Figure 4-6 shows the following types of depth gages:

- a. Visual depth gages from the previous test (Reference 4-2).
- b. Redesigned visual depth gages constructed for this test.
- c. Electrical depth gages.

4.2.3 Qualitative Observations

Observations of flow patterns and related data were made visually during the test and recorded with standard and high speed movie cameras. A Photosonics movie camera at 500 frames per second and a Milliken movie camera at 100 and 400 frames per second provided high speed motion picture coverage.

4.3 TEST RESULTS

The following range of parameters were investigated in the test:

Disc Loading = 6.45, 10.8, and 15.45 PSF

Model Height = 1.4, 1.6, 2.0, 2.5, and 3.7 propeller diameters

Wing Incidence Angle = 70, 75, 80, 85, and 90 degrees

Model Roll Angle = 0, 5, and 10 degrees

Vertical Floats: on and off

Wave Height = 0, 6, and 12 inches

Wave Length-to-Height Ratio = 10 and 15

Wind: off and on (13 knot headwind)

An additional test parameter was ambient winds. The wind generator was directly in front and due south of the model as shown in Figure 4-7; consequently, wind-on runs were usually conducted when the wind exceeded 8 knots only if the wind was from the south, since a south wind was found to have a minimum effect on wind generator flow characteristics. Testing was generally terminated when the wind exceeded 8 knots from any other direction.

A standard format has been adapted for each of the four types of data presented in the following sections:

- a. The moisture meter data, tabulated in terms of lb/min-in.^2 , is presented in Table 4-1. This information is presented graphically in terms of spray circulation profiles along the wing and comparisons between averages of all the moisture trays for a given condition.
- b. Contours beneath the wings, fore and aft beneath each nacelle, and topographical maps of the water depression have been prepared from visual depth gage data.
- c. Depth variation with time at a given point is recorded by the electrical depth gages.
- d. Droplet photographs were used to prepare droplet size distribution curves.

4.3.1 Flow Field Description

Wind and waves complicate the already complex flow field generated by a tilt-wing aircraft with four propellers hovering over water. There are interactions between neighboring propeller slipstreams, and between individual propeller slipstreams and the wind, the waves, and the fuselage. These interactions over deep water generate a flow field that never reaches a steady state.

The basic flow pattern without waves beneath the model is shown in Figure 4-7. The two propeller slipstreams on each wing coalesce to form a single depression beneath each wing. The two coalesced jets of air met beneath the fuselage to produce a "fountain effect," which was responsible for the majority of spray generated at any test condition. This reinforced flow

area carried the spray forward and aft beneath the fuselage and up onto the bottom of fuselage. Movies from the previous test (Reference 4-2) indicate that, when fuselage blockage is not available, the spray is carried into the area of the propellers. There is virtually no additional spray formed between adjacent propellers due to their overlap.

In still water, wavelets are formed at the bottom of each depression and increase in amplitude as they progress up the sides of the depression. For mild spray conditions, spray is formed along the rim of the depression as each wavelet reaches the rim (Figure 4-7). Spray is formed on the crest of each wavelet at severe spray conditions. The depression shape and location varies continuously in a random manner.

The wave-slipstream interactions with 6-inch wave patterns as a function of slowly increasing model disc loading at a given model height lead to the following four observations:

- a. Below 6.4 psf, the wave velocity decreases at the center of the wave forcing the wave crestline into an arc.
- b. Increasing the disc loading forces the wave crest into a chevron with the peak upstream of the model. This creates essentially two wave patterns that meet and form 10- to 12-inch unstable mounds of water immediately forward of the fuselage. The tops of these mounds are carried away, creating dense spray. Only near the tank sidewalls did the wave pattern pass the model. There is a 2- to 4-inch high wave pattern aft of the model.
- c. Still further increases in disc loading transformed the area forward of the model into a confused sea with waves 12 to 14

inches high. The slipstream completely destroys the wave pattern, leaving only ripples downstream of the model.

- d. Because of the cross waves set up by the model, an acceptable wave train could not be established in less than 5 minutes after termination.

The 12-inch waves contained more energy; consequently, they were not destroyed by the slipstream. A depression was formed, and, at high disc loadings, spray was driven up the advancing side of the wave; and the wave crest was transformed into spray.

Actuation of the wind generator forced the forward-driven spray to form a vertical wall, and then rolled it back toward the model. Since the model support system was stiffened prior to this test, the model did not sway as it did in the previous test with the wind off. However, the wind generator and model dynamics were sufficient to cause sway in the stiffened support system with the wind on.

The intermediate disc loading of 10.82 psf was equal to the highest disc loading on the previous test. The highest disc loading (15.45 psf) run in this test was responsible for considerable propeller damage. The right inboard propeller (No. 3) was subject to most of the damage, with the right outboard propeller (No. 4) a close second. After 49 runs, two propellers had eroded severely in the No. 3 position. Because of this problem, the high disc loading testing at low heights was minimized because of possible propeller damage. In addition, one propeller was coated with a VAD-developed neoprene coating and installed in the No. 3 position. A photograph of this propeller is shown in Figure 4-8 prior to installation. A short time later, a new uncoated propeller was installed in the No. 4 position and at the end of the test, approximately 21 hours of running time for each propeller, the new

propeller was severely damaged (Figure 4-9) while the coated propeller was only slightly pitted (Figure 4-10). This coating is thus considered very effective in protecting surfaces from water erosion under conditions similar to those experienced by a propeller blade.

4.3.2 Repeatability and Sidewall Effects

The tank was full of water during the first four runs of this test. For the remaining runs, the water level was maintained 7 inches below the tank low point (the tank low point was 2 inches below the sides of the test section) to provide sufficient room to generate 12-inch waves. These four initial runs provide a comparison with the previous test (Reference 4-2) and show sidewall effects when compared with later runs. The tank sidewalls were close enough to the model to provide some flow blockage (Figure 4-11) that slightly increased the depression depth and the amount of spray circulation. However, since 20 minutes are required to change the water level 1 inch, it was not considered worthwhile to change water level between runs to minimize this interference effect.

The ability to repeat a given result is very important for this type of test. Figure 4-12 shows data from four separate runs from this test and one from the previous test. Movies of the earlier test indicate that the fountain effect was allowed to periodically escape fuselage blockage at this height by the swaying motion of the model. This probably accounts for the larger spray circulation for the previous test. From Figure 4-12, it appears that the moisture meter data for this test can be repeated within .0005 lb/min per sq inch.

Moisture meter data and propeller erosion indicated that the right wing of the model experienced more spray recirculation than the left.

This may have been caused by a camera platform (Figure 2-2) some distance above the left wing.

The importance of tank sidewall blockage at high disc loadings is shown in Figure 4-13, where approximately seven times as much water was trapped at the lower water level as with the tank full. While Figure 4-13 shows a small increase in spray circulation at the intermediate disc loading, the influence of the sidewalls became more pronounced as the model was lowered. At the lowest model height tested ($H/D = 1.4$), the intermediate disc loading also shows a sevenfold increase in spray circulation with sidewalls (Table 4-1).

The shape of the water depressions for this test is compared with similar data from the previous test in Figures 4-14 and 4-15. Reasonable agreement was shown with the tank full. Complete agreement could not be expected, since depth is a function of time (Figure 4-16), and there is no way to synchronize the two tests. The effects of sidewalls on depression shape are presented in Figures 4-14 and 4-15. The sidewall blockage apparently gives deeper depressions beneath the propellers. The data presented in the following sections include the effects of the 7-inch sidewalls.

4.3.3 Effects of Important Parameters

4.3.3.1 Time

When an air mass, accelerated by a propeller, strikes the water surface, an inherently unstable condition is the result. Electrical depth gages were used to measure the time variations of the water surface beneath the model. A number of typical electric depth gage traces are presented in Figure 4-16. The axis of abscissa was arbitrarily placed in the center of the trace to provide a direct comparison between disc loadings and reflects depth

variations about a given point and not the absolute displacement. The smallest wavelets at each disc loading were recorded on gages 18 and 22 located near the center of the depression and directly beneath the propellers (Figure 4-6). The growth of the wavelets as they move up the sides of the depression can be determined by a comparison of gages 22, 35, and 32. The basic frequency of the wavelets is approximately three cycles per second. Some subsequent sections present water contours beneath the model at a given instant. It should be emphasized that these are subject to considerable variations with time.

4.3.3.2 Model Height

Model height was measured from the water surface to the average of the outboard propeller centerlines and expressed as height divided by propeller diameter (H/D). Table 4-2 presents the full-scale heights, disc loadings, wave heights, and wind speeds for the model conditions tested. These data can be compared with sea state definitions presented in Table 4-3 to obtain equivalent full-scale sea states.

Since air velocities near the water surface increase as the model is lowered (Reference 4-5), additional spray was formed and circulated. Figures 4-17 and 4-18 present the increased circulation with model height reduction for the intermediate and high disc loadings respectively. The effects of waves, wind, and height are presented in Figure 4-19 for the intermediate disc loading. The increase of spray circulation as height decreases is a minimum without wind or waves. It increases with the addition of 6-inch waves and no surface wind. It increases far more with the addition of the 13 knot surface wind and no waves. The spray circulation is most pronounced with both wind and waves. As shown by comparison of Figure 4-20 to Figure 4-19,

increasing the disc loading increased the amount of water flowing through the propellers at any given height.

Reducing model height increased depression depth, as seen in Figures 4-21 through 4-28, due to an increase in static pressure beneath the propellers (Reference 4-5). Figures 4-21 and 4-22 present complete sets of contours beneath the left wing at a given instant for a certain height. The following sets are taken at four frame intervals (1/6 second) to account for time variations. In the following sections only one set of typical data will be presented.

4.3.3.3 Disc Loading

Increasing disc loading increases the amount of spray for given test condition as shown in Figures 4-29, 4-30, and 4-31. Figure 4-32 presents the increased spray circulation caused by increased disc loading as measured by the individual trays. The interactions of wind, waves, and disc loading in relation to spray circulation are examined in Figure 4-33. It was found that the amount of water trapped increases much more rapidly with increasing disc loading when wind and/or waves are present. The destruction of 6-inch waves by the high disc loading in the presence of wind generated the most spray circulation.

Figures 4-34 and 4-35 present the change in depression shape and depth as the disc loading is increased. Only with the model in the highest position was it practical to read the visual depth gages for the 15.45 psf disc loading.

4.3.3.4 Wing Angle

A series of runs was conducted with the wind on and various wing positions at a model height (H/D) of 3.7. Previous tests (Reference 4-6)

indicated that a tilt wing, four-propeller STOL has much more water circulation than VTOL when they are waterborne. The STOL slipstream carried spray forward of the craft, and the propellers drew the spray back toward the craft. This series of runs was conducted to determine if this same principle would apply to a VTOL vehicle hovering in a headwind. At this height the headwind tends to blow the spray back beneath the model before it reaches the area of the propellers. Decreasing the wing angle below 80° helped the wind to blow the spray aft, giving a marked reduction in the amount of spray trapped (Figure 4-36). Contributing to this reduction of spray circulation was the movement of the depression to the rear as wing angle was reduced (Figures 4-37 and 4-38).

4.3.3.5 Wind

The dramatic increase in spray circulation, attributable to wind, has been discussed in the previous sections with relation to model height and disc loading. The wind does not generate spray; however, it will roll slipstream-generated spray back over the model. This effect is demonstrated in Figure 4-39 where more water is trapped at the lower model heights where more spray is generated. The effect of wind on spray circulation may have been influenced by the swaying of the model and sting during wind-on runs, although the magnitude of this effect could not be assessed.

The influence of wind on depression, presented in Figures 4-40 and 4-41, indicates that the primary effect of wind was to move the depression aft. As would be expected, the lower disc loading depressions were moved the farthest aft.

4.3.3.6 Waves

Wave heights of 6 and 12 inches were tested which, along with the still water data, present a three-point comparison. Scaled wave heights and lengths shown in Table 4-2 were determined by assuming that they were proportional to the propeller diameter. The effect of wave height on the amount of spray trapped is shown in Figure 4-42. Both wave heights increased spray circulation. The small waves probably increased the spray circulation by their instability, and the large ones probably because their tops pass closer to the model. The average of the moisture trapped at all stations shows interesting trends at various wave heights (Figure 4-43). With the wind off, the spray circulation was greatest with the 12-inch wave height; with the wind on, the unstable 6-inch waves caused the most spray circulation. Wave length-to-height ratios of 10 and 15 were tested; the shorter waves were less stable, causing an increased spray circulation as shown in Figure 4.44. The shorter wave length decreased the wave-maker reliability; therefore, the majority of the testing was conducted at the longer wave length.

Providing valid data when waves are present is a major problem in using visual depth gages. The source of the problem is the difficulty of stopping two moving waves in precisely the same phase for comparison. The available data was examined until frames with the waves in the same phase were found, and only then could such a comparison be made. A wave height comparison is presented in Figures 4-45 to 4-47. The instability of the 6-inch waves is highlighted by Figure 4-45, since the waves are in phase per Figures 4-46 and 4-47. Wind and model height effects are presented in the next three curves (Figures 4-48 to 4-50). The lower the model height, the greater the disruptive effects of the downwash on wave pattern.

Since visual depth gage data is not entirely satisfactory when waves were present, additional data from the electrical depth gages is presented in Figures 4-51 to 4-54. Information from rolled configurations is presented, since the electrical gages were not completely operational until late in the test program. Data for 6-inch waves are presented in Figures 4-51 and 4-52. Gage 28 is 40 inches forward of the model and, although it reflects some influence of the slipstream disturbance, the trace basically represents an undisturbed wave. The wave properties directly beneath the left inboard and outboard propellers are presented by gages 18 and 22 respectively; these traces show that the wave pattern has been depressed in this area. A comparison of gage 44, which is forward of the depression, and gage 35, which is aft of the depression, shows increased wave destruction as disc loading is increased. Twelve-inch wave properties for a typical run are presented in Figures 4-53 and 4-54. Gages 18 and 22 show the basic depressed wave shape in the stagnation region directly beneath the propellers. In the flow turning region, approximately one propeller diameter from the stagnation point, the flow velocity increases as the static pressure decreases. The increasing wave disturbance, as the velocity increases, is shown by a comparison of gage 32 with gages 35 and 44.

4.3.3.7 Roll Angle

The model was rolled with the left wing down to determine the effects of this configuration on spray circulation. Previous tests (Reference 4-2) indicated that severe spray circulation could be generated with a 10° roll and a model height (H/D) of one. During this earlier test, roll and model sway allowed the fountain effect to periodically escape fuselage blockage and enter the region of the right-hand propellers. However, it was shown that spray circulation dropped off rapidly as the model was raised.

This test covered the higher model positions ($2 \leq H/D \leq 3.7$) and showed that rolling the model at these conditions dropped spray circulation (Figures 4-55 and 4-56). The model did not generate a strong fountain effect at the heights tested; consequently, rolling the model had the same effect as decreasing wing incidence angle; i.e., the spray was blown away from the model by the slipstream. Even at the highest disc loading, the slipstream struck the right tank sidewall with insufficient force to carry the spray back into the propeller region.

The depression beneath the left wing becomes deeper as roll angle is increased since the effective height of this wing is reduced (Figures 4-57 and 4-58). Rolling the model raises the right wing; therefore, the depression for the left wing is deeper than for the right as shown in Figures 4-59 and 4-60. A topographic map of the water contours beneath the model at each roll condition is presented in Figure 4-61.

4.3.3.8 Vertical Floats

Vertical floats (Figure 4.5) combined with a VTOL capability present great promise for a practical seaplane having an open ocean operational capability. The vertical floats provide a more stable platform at sea than does a flying boat configuration. The vertical floats were mounted on the model approximately where the heavy spray formations originate from the fore and aft ends of the depression. Thus, the floats served as spray deflectors, reducing spray circulation for the majority of the cases shown in Figures 4-62 and 4-63. The floats also block the slipstream and force the water depression to become deeper, according to Figures 4-64 and 4-65.

4.3.4 Droplet Size Investigation

The size of droplets entrained in an airstream determines the droplet trajectory. Previous investigators (References 4-3 and 4-4) have indicated that the droplets created by small-scale devices are actually larger

than their full-scale counterparts when a scaled disc loading is used. Reference 4-7 used a shock tube with a velocity peak to determine the maximum droplet size that can exist in a flow field with a given velocity. The largest droplets photographed during this test compare favorably (Figure 4-66) with results from Reference 4-7 when the maximum velocity across the water is used. The same trend is evident from Figures 4-67 and 4-68, since more of the droplets are in the larger size ranges for the lower disc loading. The introduction of wind apparently changes this trend (Figures 4-69 and 4-70). The preceding samples were obtained about 10 feet aft, 8 feet to the left of model

centerline, and approximately 1 foot above the water surface. The sample shown in Figure 4-71 was taken aft of the model beside the tank approximately 4 feet below water level and 12 feet to the left of the model. A typical micro photograph of a droplet snatcher slide is shown in Figure 4-72.

Photographs through a 40-inch lens system were taken of the area near depth gage No. 28. The depth of field was very shallow; thus droplets that are in focus are in the same plane as the depth gage, which provides a method of scaling. A typical photograph is presented in Figure 4-73. Only a small amount of data was successfully recorded with this method; consequently, the data from all three disc loadings were combined and are presented in Figure 4-74. These data also indicate that most of the droplets are below 100 microns in diameter. However, since the 6.45 disc loading was included and the droplets were not subject to shattering, more droplets in the larger size bands were detected.

4.3.5 Effects of a Non-Newtonian Fluid

Approximately two pounds of polyethylene oxide (poly-ox) were sprinkled on the water beneath the model. This compound has a molecular weight of approximately six million and forms a heavy gelatinlike coating on

water. This coating slowly dissolved as the poly-ox increased the surface tension of the water, causing noticeably larger droplets to be formed at the same test condition. These larger droplets had a tendency to precipitate, giving an overall reduction in spray.

After the poly-ox was spread, it was discovered that a foreign object had been dropped on the left side. Retrieving this object disturbed the poly-ox coating, causing the coating to sink a few inches below the surface of the water. This, perhaps, explains the deep depression with poly-ox shown in Figures 4-75 and 4-76.

Application of the poly-ox was rendered difficult by a slight breeze wafting the light powder away. Larger grain size would ease application but would probably increase the time required for the pad to dissolve. A more buoyant form would also be advantageous. A number of similar compounds are available, and tests of each might lead to the discovery of a spray inhibitor in a most useful form.

4.4 DATA SCALING

Considerations of dynamic similarity between fluid motions on the model scale and full scale are extremely important in acquiring representative and meaningful results in any experiment. For the present problem, the forces which appear to predominate are inertial, gravitational, viscous, and surface tension (Reference 4-2). Dividing the last three by the inertial force yields the Froude, Reynolds, and Weber numbers, respectively. These three ratios cannot be satisfied simultaneously; consequently, complete dynamic similarity is not possible. The ratio having the strongest influence must be satisfied, realizing that other effects may be distorted.

If viscous and surface tension effects are ignored, the resulting flow, including the cavity shape and air velocity field, depends only upon the Froude number which is defined by:

$$Fr = q_n/gD$$

Where:

q_n = Disc loading of the propulsive unit

g = Gravitational constant

D = Diameter of propulsive unit

The spray cloud height was used in Reference 4-4 as a criterion to make the following modification to the Froude number:

$$F_{CW} = \frac{q_n - q_0}{gD}$$

Where q_0 is the dynamic pressure across the water required to initiate spray (approximately 2 psf). The full-scale disc loadings presented in Table 4-2 were derived from this relationship. Comparisons of motion pictures of the model and the XC-142A actual airplane under similar conditions indicate that the wave patterns and heavy spray characteristics are better represented by a model disc loading approximately 50% higher than that derived from the relationship used in Reference 4-4. This agrees with the conclusions reached in Reference 4-8.

The effect of viscosity, or Reynolds number, would be expected to affect two areas: mixing at the jet boundary and shear at the air/water interface. The effects of mixing at the jet boundary are currently undefined, although they are believed to be small.

Not only viscosity but also surface tension, or Weber number, plays a significant role in spray formation at the air/water interface. This

portion of the flow was studied using comparisons of full-scale and model motion pictures. The pictures indicated that more light spray was present for the XC-142A airplane than for the model tests. This is directly attributable to the inability to scale Weber number.

Increasing Froude, Reynolds, and Weber numbers increased the spray recirculation for a given test condition as shown in Figures 4-77 to 4-89. Since each of these parameters is directly proportional to disc loading, the result was to be expected.

4.5 SIGNIFICANCE OF RESULTS

The results of this test have been compared with other tests to improve the applicability of the data. Comparisons for each type of downwash environment measurement are presented in the following sections.

4.5.1 Spray Circulation

The majority of the spray circulation measurements recorded in the literature have been concerned with salt ingestion by gas turbine helicopter engines. The salt ingestion rate for helicopters hovering in zero wind conditions generally falls below 1 ppm salt-in-air (Reference 4-1). Limited data for the F6M and XF2Y while waterborne indicates that aircraft ingested 2,000 to 4,000 ppm salt-in-air in some conditions. The amount of water trapped in the moisture meters was scaled to a full-scale XC-142A by assuming that the same quantity of water would pass through a given flow area in a unit time. The results, presented in Table 4-1, indicate that salt ingestion for the XC-142A will be slightly greater than for a helicopter at the same conditions.

4.5.2 Depression Shape

Another report in the area of depression depth and shape is Reference 4-9, which presents a wealth of test data for isolated uniform jets

of various sizes over water. Various depression parameters were carefully measured and correlations were prepared. Although the present test used overlapping propellers which created a vortex-filled slipstream with a fountain effect beneath the fuselage, the data from this test correlates well with the data from Reference 4-9, as shown in Figures 4-80 and 4-81.

The discrepancies in depression depth shown in Figure 4-80 are apparently the result of model height effects as shown by the points at low heights ($H/D < 12$) presented by Reference 4-9. Figure 4-81 shows that the depression diameter (measured fore and aft for this test) agrees very well with Reference 4-9.

An alternate method of predicting depression depth was also considered. The maximum dynamic pressure moving across the ground as a function of propeller height was obtained from Reference 4-3 and presented in Figure 4-82. These data were used to determine the maximum dynamic pressure over the water for this test. This term gave an excellent correlation with depression depth for the present test at various conditions as shown in Figure 4-83.

To predict the depth and diameter of the depression beneath the full-scale XC-142, two methods have been employed. A typical movie frame from the model data was increased ninefold to represent a full-scale depression. Predictions of the depression depth and diameter of the depression were prepared for the same conditions using Figures 4-81 and 4-83. The predicted contours for the full-scale XC-142 and the predicted depth and diameter of the depression are compared in Figures 4-84 to 4-86. The results show good agreement when the time variation of the contour is considered; apparently either method can be used to predict full-scale depression characteristics.

4.5.3 Droplet Size

From Figures 4-67 through 4-71 it can be seen that the majority of the droplets recorded during this test fell between 0 and 100 microns. This agrees very well with similar data for a helicopter (Reference 4-10), which hovered at a disc loading of approximately 6.2 psf. The maximum droplet size recorded beneath the helicopter compares well with this test and Reference 4-7 as shown in Figure 4-66. Additional testing would be required to determine if the droplets in spray from a full-scale airplane are appreciably smaller than the model droplets.

4.5.4 General Spray Patterns

From motion pictures and visual observations it was found that the most notable spray pattern characteristic of the full-scale XC-142A hovering over water was the spray donut formed in the flow field by the rollup of the airflow. The outside of this pattern is nearly vertical and the inside is sloping, which give the spray the appearance of a football stadium. Although the tank was too small to reproduce this pattern, a similar pattern was formed in front of the model when the wind generator was operating.

Examination of motion pictures of the model test and full-scale test of the XC-142A and the XV-5A hovering over water revealed that spray is generated as the wavelets in the depression reach the lip of the depression and break. The frequency of this spray generation is apparently related to the size of the depression made by the aircraft slipstream since the frequency for the XC-142 model was about 4 per second, the XV-5A was about 1.8 per second, and the full-scale XC-142A was about 1.1 per second. These frequencies were obtained with each vehicle at about the same height-to-diameter ratio.

*Wave Length-To-Height Ratio of These Waves
is 10:1. Wave Length-To-Height Ratio of All
Other Waves is 15:1.

Tank Side Wall Height Inches	Roll Angle	Wing Angle	FLOATS	H/D	WIND	Wave Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Flo		
									Left Hand Meters		
									1	2	3
0	0	90	OFF	3.7	OFF	0	10.82	-/0	-	.00002624	0
7				3.7			15.25	-/0	.00002624	.00003936	.00001312
7				2.5			10.82	-/0	.0000591	.00001968	.0000459
7				2.5			15.25	-/0	.00001312	.0001246	.0000786
7				1.6			10.82	-/0	.000321	.000459	.000236
7				1.6			15.25	-/0	.000505	.001265	-
7				1.4			6.45	-/0	-	.000328	0
7				1.4			10.82	-/0	.0000787	.000164	.0000985
7				1.4			15.25	-/0	-	.00151	-
7				3.7	ON		15.25	-/0	0	0	.000214
7							15.25	-/0	.000623	.000492	.000603
7							15.25	-/0	.000643	.000616	.000905
7							15.25	-/0	.00059	.000721	.000918
6		70			OFF	0	10.82	N/5	.0001115	.000164	.0001246
6		75				0	10.82	S/10-20	.00001312	.0000984	.0001836
6		80				0	15.25	S/10-20	.000736	.000413	.00082
6		85				0	15.25	N/5	.00177	.00179	.00095
6		90				6*	10.82	NW/5	0	0	0
6						6*	15.25	NW/5	.0000524	.000348	.000295
6						6	15.25	N/4-10	-	.000695	-
6						12	10.82	NW/6-10	0	0	.00001965
6						12	15.25	NW/6-10	.0001835	.000105	.000216
6					ON	0	10.82	S/10-20	.00001312	.00000656	.00000656
6						0	15.25	S/10-20	.000774	.000478	.000492
6						6*	10.82	N/4-10	.000439	.000557	.000511
6						6	10.82	N/4-10	0	0	-
6						6*	15.25	N/4-10	.001462	.000531	.001036
7						8	10.82	NE/6	.0059	.000144	.00008528
7				2.5	OFF	0	6.45	S/12	0	.0000328	0
7						0	10.82	-/0	0	0	0
7						0	10.82	S/3	0	.0001181	.0001508
7						0	10.82	S/3	0	.00001968	.000151
7						0	10.82	S/3	.0000656	.0000394	.0000918
7						0	15.25	-/0	.000459	.001212	.001112
7						6	6.45	S/8	-	-	-
7						6	10.82	S/10-18	.001148	.00105	.000853
7						6	15.25	S/10-18	.0001574	.0002886	.000633
7						12	10.82	S/2	.0003477	.0009643	.0010889
7						12	15.25	S/2	.0004395	.0004395	.0006035
7					ON	0	6.45	S/10	0	-	0
7						0	10.82	E/4	.00426	.000328	.000295
7						0	15.25	E/4	.001135	.00528	.00523

A

ATURE METER DATA

Low Rate ~ LB/IN ² - MIN						Average Model Water Flow Rate ~ lb/ In ² - Min	Average Full Scale Water Flow Rate ~ lb/ - Min	Average Full Scale Dry Salt-In Air Content ~ PPM	Run Number	Point
Right Hand Meters										
	4	1	2	3	4					
12	.00001312	.00001312	.00002624	.0000328	.00002624	.0000197	.003845	.08192	1	2
9	.00004592	.0000328	.00002624	.00003936	.00005248	.000034	.00663	.14144	1	3
5	.00002624	.00002624	.0000853	.00003936	.000059	.000045	.00878	.18656	2	2
	.000236	.0000656	.000419	.0004	.0001968	.0001916	.0374	.7968	2	3
	.000354	.000059	.000249	.000177	.000315	.000027125	.00529	.1129	3	2
	.001153	.00059	.00193	.0014	.00644	.000018261	.00356	.07584	3	3
	.0000131	0	0	0	0	.0000656	.00128	.02736	4	1
5	.000269	-	.0000131	0	0	.000089	.0177	.3776	4	2
	.00253	.0000262	.000151	.0008	.000675	.001351	.264	5.632	4	3
	0	.000164	0	.000164	.0000656	.000076	.0148	.31552	15	3
	.000492	.000689	.000249	.000538	.000656	.00005428	.0106	.17856	14	3
	.000787	.000853	-	.000414	.00111	.00007611	.01483	.31552	13	3
	.00118	.00105	.000426	.000689	.000669	.00007804	.01521	.3248	12	3
5	.000328	.000275	.000538	.000288	.00055	.00030238	.059	1.2576	24	2
5	.00000656	0	0	0	0	.0000376	.00734	.15616	5	2
	.000295	.000518	.000643	.0012136	.001758	.0007375	.1439	3.0528	5	3
	.00210	.001377	.00272	.002145	.003096	.00001994	.003894	.08288	24	3
	0	0	0	0	0	0	0	0	7	2
	.000242	.0001248	.000774	-	.000426	.0003231	.063	1.344	7	3
	-	-	.0001968	.000328	.000446	.0004164	.0813	1.728	8	3
5	.0000393	0	0	0	.0000656	0	0	0	10	2
	.000557	.00017	.000164	.0000656	.0001965	.0002072	.04045	.8628	10	3
6	.00001312	0	0	.00001312	.00001968	.00000901	.001759	.03744	6	3
	.000524	.003011	.00023	.000328	.000512	.0007935	.15485	3.492	6	2
	.000629	.000059	.00019	.000242	-	.000375	.0731	1.5552	9	2
	0	-	0	0	0	0	0	0	11	2
	.00176	.000905	.000721	.000754	.000557	.0009657	.1881	4.01084	9	3
8	.000262	.0002296	.000164	.000374	.0001968	.00025571	.0498	1.0622	25	2
	-	-	0	-	-	.0000082	.0016	.034128	36	1
	0	.0001115	0	.0000328	0	.00007215	.01405	.29989	18	2
	.00021	.0000722	.0002428	.000341	.00059	.0002464	.0481	1.026	46	2
	.000728	.000433	.000886	0	.0004265	.0004407	.086	1.8344	47	2
	.000164	.0000394	.000151	.000151	.000223	.0001157	.02255	.4809	48	2
	.0017	.00177	.00326	.00116	.000446	.001389	.271	5.78	18	3
	-	-	-	0	-	0	0	0	34	1
	.00105	.000754	.000787	.000328	.000964	.00086675	.169	3.605	34	2
	.0007216	.000354	-	.001207	.001102	.0037474	.73067	15.592	34	3
	.0012136	.0024731	.0036146	.0029979	.004428	.002141	.417295	8.9053	45	2
	.0005116	.0002755	.0012792	.0009708	.0002427	.000598	.11661	2.4871	45	3
	.0000328	.0000328	0	.0000328	0	.0000141	.0027495	.05868	37	1
	.000721	.000446	.0000656	.0000984	.000459	.0008341	.1616495	3.438	19	2
	.00567	.0057	.00344	.00381	.00425	.0043156	.0424	2.9874	19	3

B

4.5.3 Droplet Size

From Figures 4-67 through 4-71 it can be seen that the majority of the droplets recorded during this test fell between 0 and 100 microns. This agrees very well with similar data for a helicopter (Reference 4-10), which hovered at a disc loading of approximately 6.2 psf. The maximum droplet size recorded beneath the helicopter compares well with this test and Reference 4-7 as shown in Figure 4-66. Additional testing would be required to determine if the droplets in spray from a full-scale airplane are appreciably smaller than the model droplets.

4.5.4 General Spray Patterns

7 From motion pictures and visual observations it was found that the most notable spray pattern characteristic of the full-scale XC-142A hovering over water was the spray donut formed in the flow field by the rolling of the airflow. The outside of this pattern is nearly vertical and the inside is sloping, which give the spray the appearance of a football stadium. Although the tank was too small to reproduce this pattern, a similar pattern was formed in front of the model when the wind generator was operating.

Examination of motion pictures of the model test and full-scale test of the XC-142A and the XV-5A hovering over water revealed that spray is generated as the wavelets in the depression reach the lip of the depression and break. The frequency of this spray generation is apparently related to the size of the depression made by the aircraft slipstream since the frequency for the XC-142 model was about 4 per second, the XV-5A was about 1.8 per second, and the full-scale XC-142A was about 1.1 per second. These frequencies were obtained with each vehicle at about the same height-to-diameter ratio.

TABLE 4-1 MOISTURE METER

Tank Side Ball Height Inches	Roll Angle	Wing Angle	FLOATS	H/ D	WIND	Wave Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Flow Rate ~			
									Left Hand Meters			
									1	2	3	4
7	0	90	OFF	2.5	ON	6	6.45	S/16	.0000984	-	.0000328	0
7						6	10.82	S/16	.001575	.001056	.000734	.00201
7						6	15.25	S/16	.00894	.010489	.00998	.00970
7						12	6.45	S/2	.0024731	-	-	.00000
7						12	10.82	S/2	.0015088	.0012464	.0007544	.00205
7						12	15.25	S/2	.0035096	.0104763	.0131266	.00801
7				2.0	OFF	0	10.82	-/0	.0001968	.0000984	.0001968	.00006
7						0	15.25	-/0	.0013776	.00282	.00249	.00492
7						6	10.82	S/8-12	.0003936	.0000656	.0002624	.00013
7						6	15.25	S/6-8	.01647	.01685	.01870	.01935
7						12	6.45	S/8	.00000656	.00001968	.0000328	.00007
7						12	10.82	S/8	.0004854	.001167	-	.00116
7					ON	0	10.82	S/5	.00236	.0019024	.00164	.00242
7						0	15.25	S/5	.019	.01508	.0123	.0117
7						6	10.82	SE/4	.00879	.01705	.00787	.011
7						6	15.25	-/0	-	.0132	.02047	.01863
7						12	6.45	S/8	.0000262	.0000459	.0000525	.00000
7						12	10.32	S/8	.010398	.009774	.00656	.01381
7				1.6	OFF	0	6.45	NE/7	-	-	-	-
7						0	10.82	NE/7	.0000656	-	-	-
7						6	6.45	-/0	.000243	.000413	.00061	.00074
7						6	10.82	-/0	.0028	.00085	.00514	.00829
7					ON	0	6.45	NE/6-8	0	.0000459	.0000656	.00001
7						0	10.82	NE/6-8	.00665	.007111	.006008	.00452
7						6	6.45	-/0	.0000459	.00005298	.0002165	.00015
7						6	10.82	-/0	-	.0148	.01338	.01725
7				1.4	OFF	0	6.45	-/0	-	.00001968	.00001968	.00001
7						0	10.82	-/0	-	.0001968	.000262	.00002
7						6	6.45	S/12	.000492	.000164	.000328	.00032
7						6	10.82	S/10	.00118	.004592	.00236	.00104
7					ON	0	6.45	-/0	.00807	.00758	.00538	.00587
7						0	10.82	-/0	.02538	.022	.01364	.02132
7						6	6.45	-/0	.00368	-	-	.00006
7						6	10.82	S/10	.00017056	.000105	-	.00006
7			OFF	3.7	OFF	0	10.82	N/2	.0000656	.0000984	.00001968	-
7						0	15.25	N/2	.0002952	.0003936	.000328	.00036
7						6	6.45	SW/2	.0000328	.0000656	.0000328	.00006
7						6	10.82	SW/2	.0000328	.0000328	.0000656	0
7						6	15.25	SW/6	.0000328	.0000984	.0000328	.00013
7					ON	0	10.82	NW/3	.0000328	0	0	.00003
7						0	15.25	NW/3	.0011808	.0005248	.0004592	.00072
7						6	10.32	SW/6	.000131	.00131	.000656	.00065
7						6	15.25	SW/6	.001738	.0010168	-	.00124
7				2.5	OFF	0	10.82	NW/2	.0001312	.000328	.000328	.00042
7						0	15.25	NW/2	.000328	.000623	.000754	.00095

WETNESS METER DATA (CONT)

Flow Rate ~ LB/IN ² - MTN						Average Model Water Flow Rate ~ lb/ In ² min	Average Full Scale Water Flow Rate lb/ -Min	Average Full Scale Dry Salt-In Air Content PPM	Run Number	Point
Right Hand Meters										
3	4	1	2	3	4					
00328	0	.0000328	.0000656	-	.0000328	.0000437	.008547	.1835	35	1
0734	.002015	.00666	.003482	.0036	.00755	.003335	.65033	13.8715	35	2
998	.009702	.010332	.0090396	.010732	.010312	.0199	3.8805	82.7711	35	3
-	.00000656	.00001968	.0000328	.0000656	-	.000507	.098865	2.11	44	1
07544	.0020992	.0030832	.001148	.0006888	.0030837	.001701	.3317	7.07	44	2
31266	.0080163	.0101024	.0032013	.0097613	.0110405	.008654	1.68753	35.9	44	3
01968	.0000656	.00082	.0001968	.0001968	.0000459	.0001968	.038376	.819	20	2
249	.00492	-	-	-	-	.0029	.5655	12.08	20	3
02624	.000131	.0003936	.00131	.001115	.00109	.00059515	.116025	2.479	22	2
870	.01935	.00249	.004067	.004067	.000118	.01081667	2.0099	42.7	22	3
00328	.00007216	.00004592	.00001968	.0001049	.0001443	.0000558	.010881	.232	49	1
-	.001167	.001469	.0031291	.00244	.0020795	.001705	.3325	7.09	49	2
164	.002427	.00787	.001246	.01213	.00262	.0040244	.78476	16.81	21	2
23	.0117	.01541	.009708	.009774	.00332	.0120365	2.3471175	50.	21	3
787	.011	.0042	.00223	.001837	.010758	.0079669	1.62033	34.4	23	2
047	.01863	.0198	.0097	.01571	.01338	.0158457	3.08977	65.9	23	3
00525	.00000656	.0000918	.0000328	0	-	.0000426	.008307	.178	50	1
656	.01381531	.009807	.006724	.010004	.0069216	.009426	1.83807	39.18	50	2
-	-	-	.000164	-	-	.000164	.03198	.682	26	1
-	-	.0001968	.0000262	.0000656	.000262	.0001232	.024034	.512	26	2
061	.000741	.000131	.0004526	.0000328	.0000656	.0003361	.0653395	1.39	28	1
514	.008298	.0021189	.000774	.0013317	.0009184	.0027751	.5401445	11.53	28	2
00656	.00001968	.00001968	.0002296	0	0	.00004756	.0092732	.1975	27	1
6008	.004526	.005471	.00316	.00236	.004526	.0049765	.9694175	20.62	27	2
02165	.000151	.007183	.0000918	.000984	.00421	.0016168	.315315	6.725	29	1
338	.017253	.00935	.02326	.00909	.01456	.0145271	2.83335	61.5	29	2
001968	.00001968	.000177	-	.000131	.00018368	.00009178	.017897	.3819	30	1
0262	.0000262	.00017	.00017	.001876	.001574	.0006107	.119087	2.54	30	2
0328	.000328	.000131	.0000328	.0000656	.0000131	.0001943	.03789	.807	33	1
236	.001049	.00059	.000692	.0001968	.0009184	.00147235	.28712	6.125	33	2
538	.00587	.00558	.00672	.0098	.00543	.0068	.1.326	28.25	32	1
364	.02132	.02289	.008	.00682	.01108	.0163925	3.198635	66.1	32	2
-	.0000656	.000656	.000262	.0001312	.0000656	.00081006	.0157962	.3362	31	1
-	.0000656	.0001312	.0000787	.000105	.00003936	.00009934	.019371	.4125	31	2
001968	-	.0001312	.0001312	.0000984	.0000656	.0002137	.031672	.675	40	2
0328	.0003608	.000656	.0008856	.0008528	.0014104	.0006478	.126331	2.69	40	3
00328	.0000656	0	0	0	.0000328	.0000287	.005597	.1172	38	1
00656	0	-	.0000328	.0000656	0	.0000287	.005597	.1172	38	2
00328	.000131	.000164	.000262	.000229	.0001968	.0001433	.027944	.596	38	3
0	.0000328	.0000656	-	.001148	.0000984	.0001722	.03358	.716	41	2
04592	.0007216	.0019024	.0005248	.0003936	.0006888	.0007995	.1559	3.325	41	3
0656	.000656	.000361	.00001312	.0001312	.0000656	.0002098	.040911	.872	39	2
-	.0012464	-	.0005248	.007872	.0013776	.0011513	.2244	4.79	39	3
0328	.0004265	.0001312	.0002295	.0005576	.0008925	.0003803	.0741585	1.58	42	2
0754	.0009512	.0003608	.0012792	.00164	.000246	.0011274	.225243	4.81	42	3

B

TABLE 4-1 MOISTURE ME

Tank Side Wall Height Inches	Roll Angle	Wing Angle	FLOATS	H/D	WIND	Weight Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Flow		
									Left Hand Meters		
									1	2	3
7	0	90	ON	2.5	ON	0	10.82	-/0	.0014104	.000984	.000656
7	↓	↓	↓	↓	↓	0	15.25	-/0	.0030176	.0017712	.0019024
7	-5	↓	OFF	↓	OFF	0	6.45	VAR/2	.00002624	.00001968	.00001968
7	↓	↓	↓	↓	↓	0	10.82	NE/4	.00001968	.00001312	.00000656
7	↓	↓	↓	↓	↓	0	15.25	-/0	.00005248	.00007216	.0000656
7	↓	↓	↓	↓	↓	6	10.82	-/0	.00009184	.00007216	.00005904
7	↓	↓	↓	↓	↓	6	15.25	NE/5	.00046576	.00008528	.00007872
7	↓	↓	↓	↓	↓	12	10.82	-/0	.00017712	.0002493	.00024272
7	↓	↓	↓	↓	↓	12	15.25	-/0	.00005904	.00012464	.0001312
7	↓	↓	↓	↓	ON	0	10.82	VAR./3-4	.0013185	.00064944	.00078064
7	↓	↓	↓	↓	↓	0	15.25	NE/4	.0048806	.00033653	.0036605
7	↓	↓	↓	↓	↓	6	10.82	N/4	.00067568	.0014694	.00056416
7	↓	↓	↓	↓	↓	6	15.25	-/0	.0073013	.0066518	.005143
7	↓	↓	↓	↓	↓	12	10.82	-/0	.0010496	.000328	.0004592
7	↓	↓	↓	↓	↓	12	15.25	-/0	.0062387	.0049594	.0056744
7	-10	↓	↓	3.7	OFF	0	10.82	-/0	.00000656	.00001968	.00132512
7	↓	↓	↓	↓	↓	6	10.82	N-NW/20-22	.00002624	0	0
7	↓	↓	↓	↓	↓	6	10.82	W/5	0	.00001312	.00000656
7	↓	↓	↓	↓	↓	6	15.25	W/5	.00000656	.00001312	.00001312
7	↓	↓	↓	↓	ON	0	10.82	NE/5	.00001312	.00000656	.00000656
7	↓	↓	↓	↓	↓	6	10.82	S-SE/16	.00001312	.00001968	.00011152
7	↓	↓	↓	↓	↓	6	15.25	S/15	.00064288	.00007872	.0011283
7	↓	↓	↓	2.5	OFF	0	10.82	-/0	.00001312	.00001312	0
7	↓	↓	↓	↓	↓	0	15.25	-/0	.00005904	.00005904	.00001968
7	↓	↓	↓	↓	↓	6	10.82	NW/5	.00017056	.0001968	.00015068
7	↓	↓	↓	↓	↓	6	15.25	N-NW/8	.0004789	.0007478	.00066912
7	↓	↓	↓	↓	↓	12	10.82	N/10	.00002624	.00001312	.00003936
7	↓	↓	↓	↓	↓	12	15.25	N/10	.0010561	.00150224	.00090528
7	↓	↓	↓	↓	ON	0	10.82	VAR/2	.00000656	.00046576	.00033456
7	↓	↓	↓	↓	↓	0	15.25	VAR/2	.00414592	.00202048	.00280768
7	↓	↓	↓	↓	↓	6	10.82	NE/10	.00070192	.0023813	.0004002
7	↓	↓	↓	↓	↓	6	15.25	NW/8	.0046904	.00264368	.003608
7	↓	↓	↓	↓	↓	12	10.82	NW/4	.00184992	.0004654	.00074128
7	↓	↓	↓	↓	↓	12	15.25	NW/4	.00977584	.00608768	.00702576
7	↓	↓	ON	3.7	OFF	0	10.82	N/5	.00001968	.00001968	.00001968
7	↓	↓	↓	↓	↓	0	15.25	N/5	.0000328	.00005904	.00002624
7	↓	↓	↓	↓	↓	6	10.82	W-NW/4	.00001312	.00060052	.00001312
7	↓	↓	↓	↓	↓	6	15.25	N-NW/2	.00034768	.00012464	.0

STURE METER DATA (CONT)

Flow Rate ~ $\frac{LB}{IN^2}$ - MIN						Average Model Water Flow Rate ~ lb/ In ² min	Average Full Scale Water Flow Rate lb/ -Min	Average Full Scale Dry Salt-In Air Content PPM	Run Number	Point
Right Hand Meters										
	4	1	2	3	4					
328	0	.0000328	.0000656	-	.0000328	.0000437	.008547	.1835	35	1
34	.002015	.00666	.003482	.0036	.00755	.003335	.65033	13.8715	35	2
8	.009702	.010332	.0090396	.010732	.010312	.0199	3.8805	82.7711	35	3
	.00000656	.00001968	.0000328	.0000656	-	.000507	.098865	2.11	44	1
544	.0020992	.0030832	.001148	.0006888	.0030837	.001701	.3317	7.07	44	2
266	.0080163	.0101024	.0032013	.0097613	.0110405	.008654	1.68753	35.9	44	3
968	.0000656	.00082	.0001968	.0001968	.0000459	.0001968	.038376	.819	20	2
9	.00492	-	-	-	-	.0029	.5655	12.08	20	3
624	.000131	.0003936	.00131	.001115	.00109	.00059515	.116025	2.479	22	2
0	.01935	.00249	.004067	.004067	.000118	.01081667	2.0099	42.7	22	3
328	.00007216	.00004592	.00001968	.0001049	.0001443	.0000558	.010881	.232	49	1
	.001167	.001469	.0031291	.00244	.0020795	.001705	.3325	7.09	49	2
4	.002427	.00787	.001246	.01213	.00262	.0040244	.78476	16.81	21	2
	.0117	.01541	.009708	.009774	.00332	.0120365	2.3471175	50.	21	3
7	.011	.0042	.00223	.001837	.010758	.0079669	1.62033	34.4	23	2
7	.01863	.0198	.0097	.01574	.01338	.0158457	3.08977	65.9	23	3
525	.00000656	.0000918	.0000328	0	-	.0000426	.008307	.178	50	1
6	.01381531	.009807	.006724	.010004	.0069216	.009426	1.83807	39.18	50	2
	-	-	.000164	-	-	.000164	.03198	.602	26	1
	-	.0001968	.0000262	.0000656	.000262	.0001232	.024034	.512	26	2
1	.000741	.000131	.0004526	.0000328	.0000656	.0003361	.0653395	1.39	28	1
4	.008298	.0021189	.000774	.0013317	.0009184	.0027751	.5401445	11.53	28	2
556	.00001968	.00001968	.0002296	0	0	.00004756	.0092732	.1975	27	1
08	.004526	.005471	.00316	.00236	.004526	.0049765	.9694175	20.62	27	2
165	.000151	.007183	.0000918	.000984	.00421	.0016168	.315315	6.725	29	1
8	.017253	.00935	.02326	.00909	.01456	.0145275	2.83335	61.5	29	2
1968	.00001968	.000177	-	.000131	.00018368	.00009178	.017897	.3819	30	1
52	.0000262	.00017	.00017	.001876	.001574	.0006107	.119087	2.54	30	2
28	.000328	.000131	.0000328	.0000656	.0000131	.0001943	.03789	.807	33	1
6	.001049	.00059	.000692	.0001968	.0009184	.00147235	.28712	6.125	33	2
8	.00587	.00558	.00672	.0098	.00543	.0068	.1.326	28.25	32	1
4	.02132	.02289	.008	.00682	.01108	.0163925	3.198635	66.1	32	2
	.0000656	.000656	.000262	.0001312	.0000656	.00081008	.0157962	.3362	31	1
	.0000656	.0001312	.0000787	.000105	.00003936	.00009934	.019371	.4125	31	2
1968	-	.0001312	.0001312	.0000984	.0000656	.0002137	.031672	.675	40	2
28	.0003608	.000656	.0008856	.0008528	.0014104	.0006478	.126331	2.69	40	3
328	.0000656	0	0	0	.0000328	.0000287	.005597	.1172	38	1
556	0	-	.0000328	.0000656	0	.0000287	.005597	.1172	38	2
328	.000131	.000164	.000262	.000229	.0001968	.0001433	.027944	.596	38	3
	.0000328	.0000656	-	.001148	.0000984	.0001722	.03358	.716	41	2
592	.0007216	.0019024	.0005248	.0003936	.0006888	.0007995	.1559	3.325	41	3
56	.000656	.000361	.00001312	.0001312	.0000656	.0002098	.040911	.872	39	2
	.0012464	-	.0005248	.007872	.0013776	.0011513	.2244	4.79	39	3
28	.0004265	.0001312	.0002295	.0005576	.0008525	.0003803	.0741585	1.58	42	2
54	.0009512	.0003608	.0012792	.00164	.000246	.0011274	.225243	4.81	42	3

B

TABLE 4-2 MODEL TO FULL-SCALE CONVERSIONS

Disc Loading			
Full-Scale Disc Loading	Model Disc Loading	Full-Scale Gross Weight	Full-Scale Wind ₁ Speed ¹
42.5 lb/ft ²	6.45 lb/ft ²	32,000 lb	34 knots
82.4 lb/ft ²	10.82 lb/ft ²	62,000 lb	36.8 knots
125.3 lb/ft ²	15.25 lb/ft ²	94,000 lb	38 knots

Scale Conversions for a Full-Scale Aircraft with 15.6-Foot Diameter Propeller				
Vehicle Height ²			Wave Height	
H/D	Model Height	Full-Scale Height	Model	Full Scale
1.4	2.39 ft	21.9 ft	6 inch	4.5 ft
2.0	3.41 ft	31.25 ft	12 inch	9 ft
2.5	4.26 ft	39.05 ft		
3.7	6.31 ft	57.81 ft		

$$1 \quad q_{WIND \text{ FULL SCALE}} = q_{WIND \text{ MODEL}} \left(\frac{\text{Full-Scale Disc Loading}}{\text{Model Disc Loading}} \right)$$

2 Measured from water surface to plane of outboard propellers

Table 4-3 Sea Conditions, U. S. Hydrographic Office Scale

* Wind Velocity is not included in the official definition of sea states
 ** Description of sea noise has been omitted

Sea State No.	Approx. Height of Sea Ft	Wind Velocity* Range Kts	Seaman's Description **
0	0	0	Calm - Sea like mirror
1	Less than 1	0 - 3	Smooth - Small wavelets or ripples with the appearance of scales but without crests
2	1 - 3	3 - 6	Slight - The waves or small rollers are short and more pronounced, when capping the foam is not white but more of a glossy appearance
3	3 - 5	6 - 10	Moderate - The waves or large rollers become longer and begin to show whitecaps occasionally
4	5 - 8	10 - 26	Rough - Medium waves that take a more pronounced long form with extensive whitecapping and white foam crests
5	8 - 12	26 - 40	Very rough - The medium waves become larger and begin to heap up, the whitecapping is continuous, and the seas break occasionally; the foam from the capping and breaking waves begins to be blown along in the direction of the wind.
6	12 - 20	40 - 50	High - Heavy, whitecapped waves that show a visible increase in height and are breaking extensively. The foam is blown in dense streaks along in the direction of the wind.

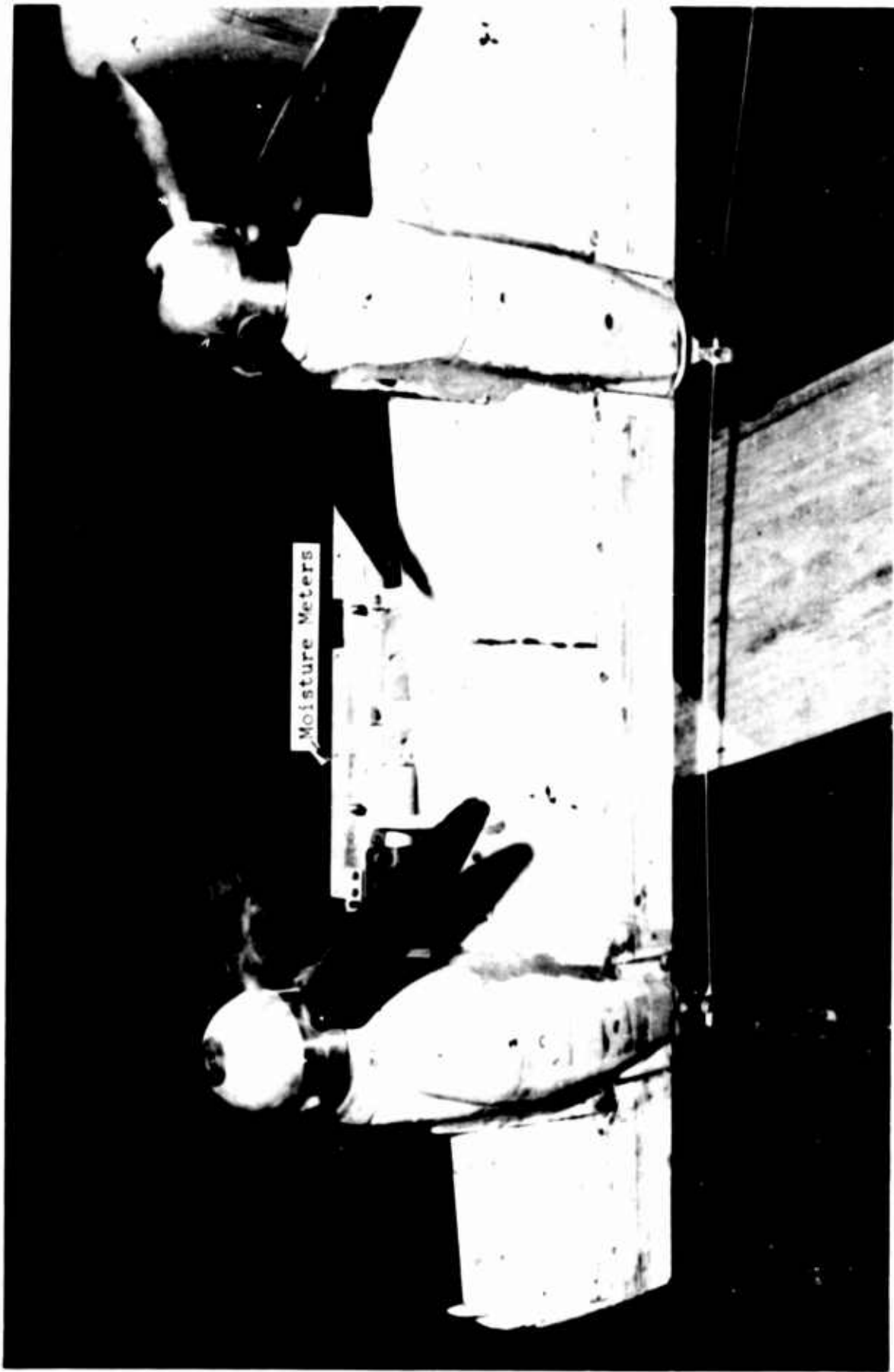


Figure 4-1 Moisture Meter Installation



Figure 4-2 Isokinetic Probe Installation

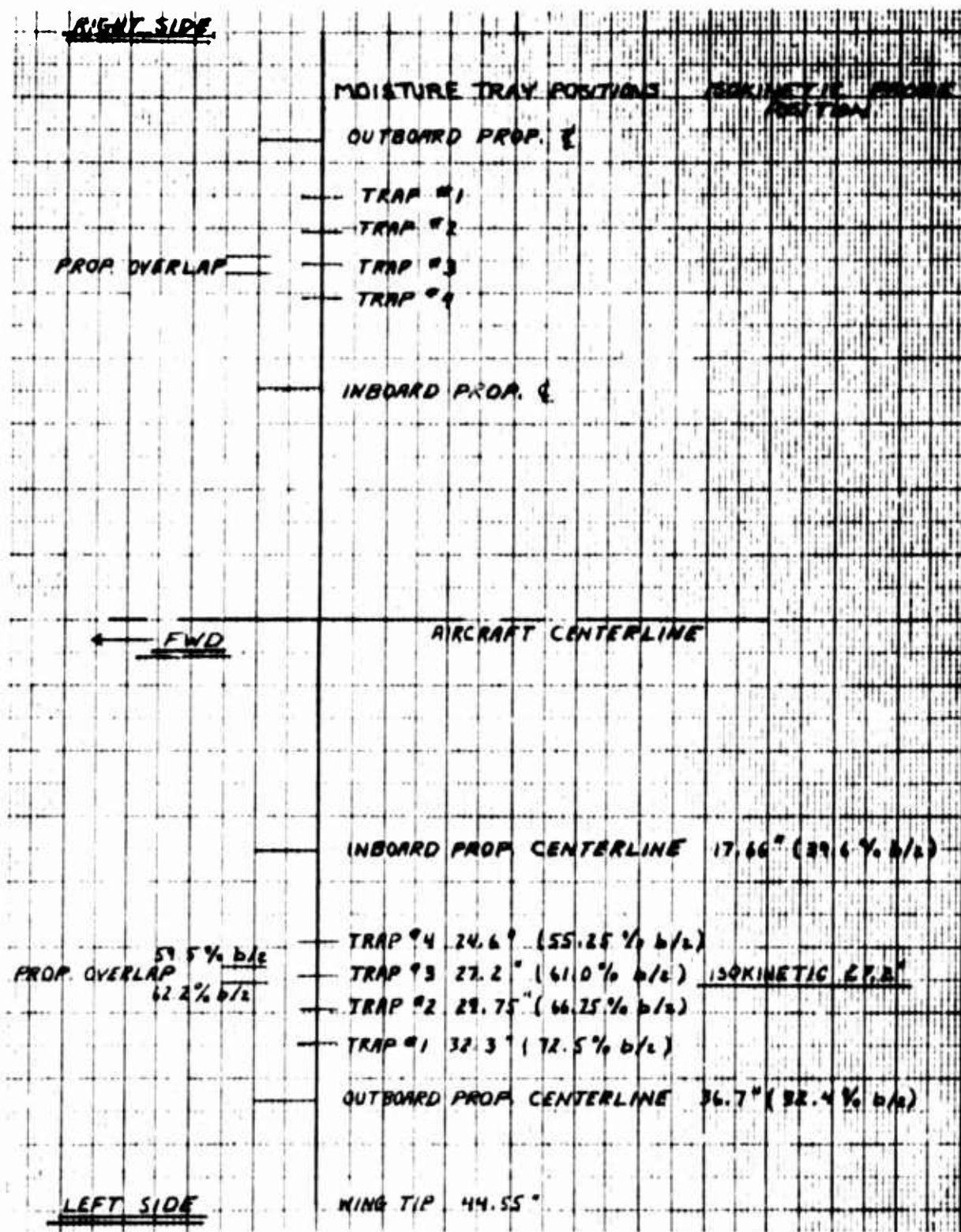


Figure 4-3 Positions of Moisture Meters and the Isokinetic Probe

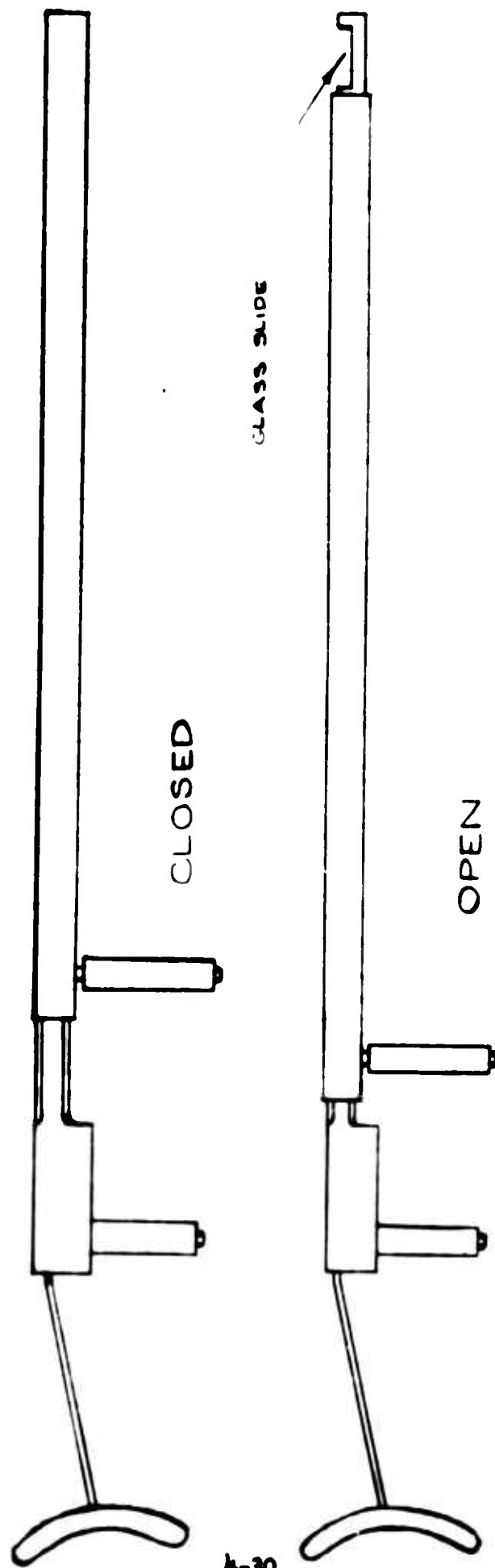


Figure 4-4 Droplet Snatcher

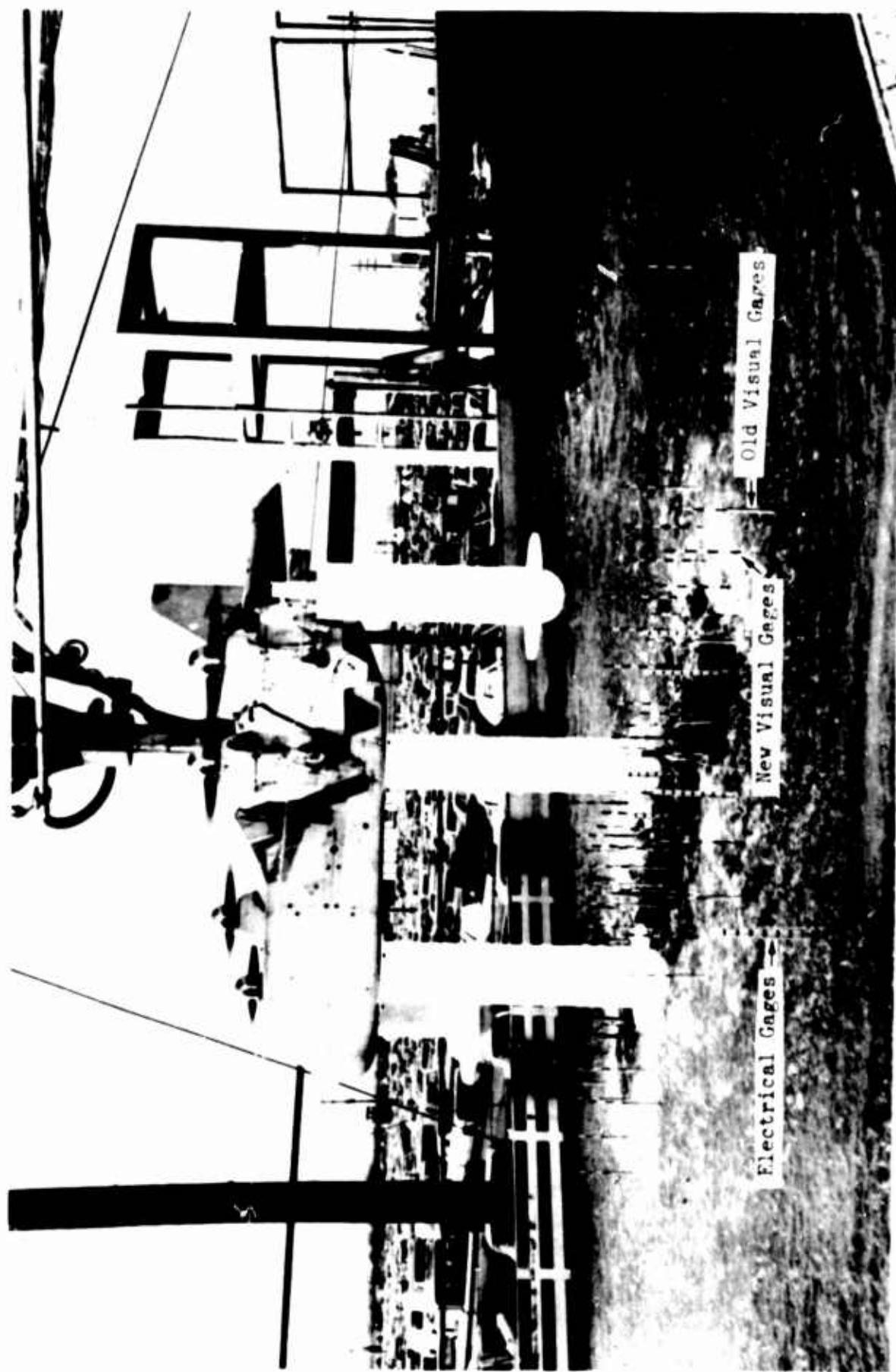


Figure 4-5 Depth Gage Installation and Vertical Float Configuration

- OLD DEPTH GAGES - 43
- NEW DEPTH GAGES - 21
- ELECTRICAL GAGES - 6

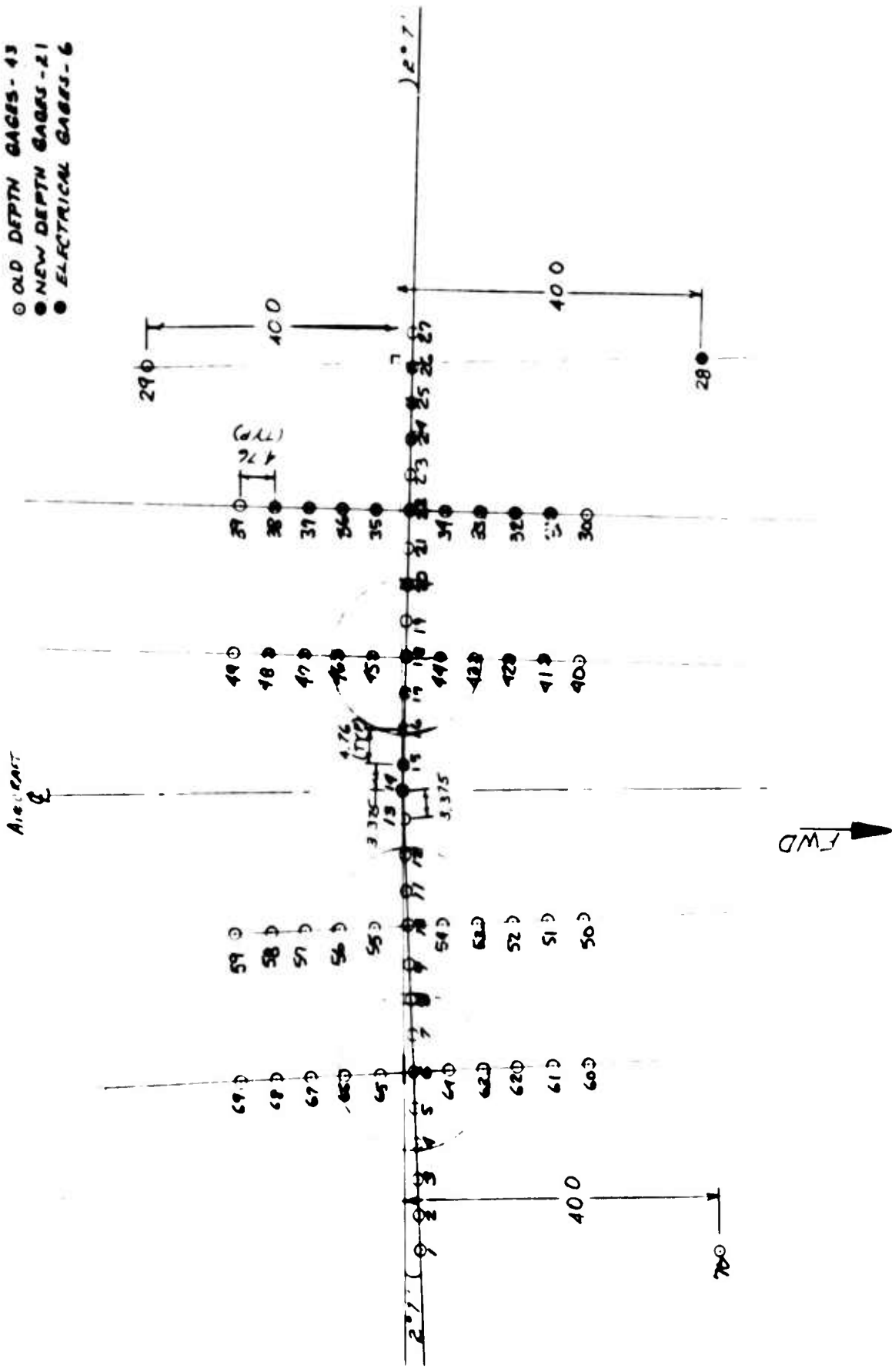


Figure 4-6 Depth Gage Pattern



Figure 4-7 Depression Beneath Model

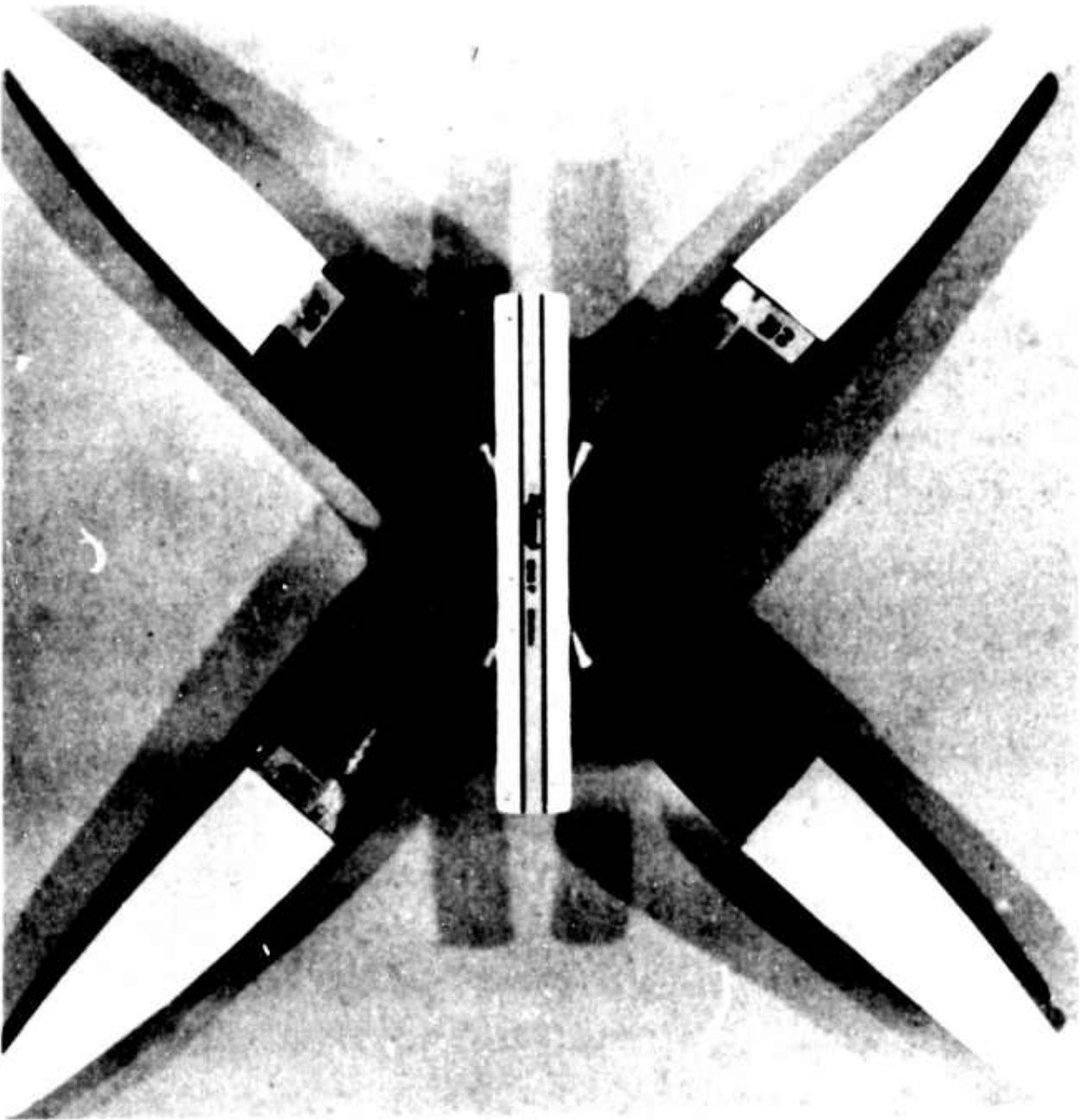


Figure 4-8 Neoprene Coated Propeller Prior to Installation

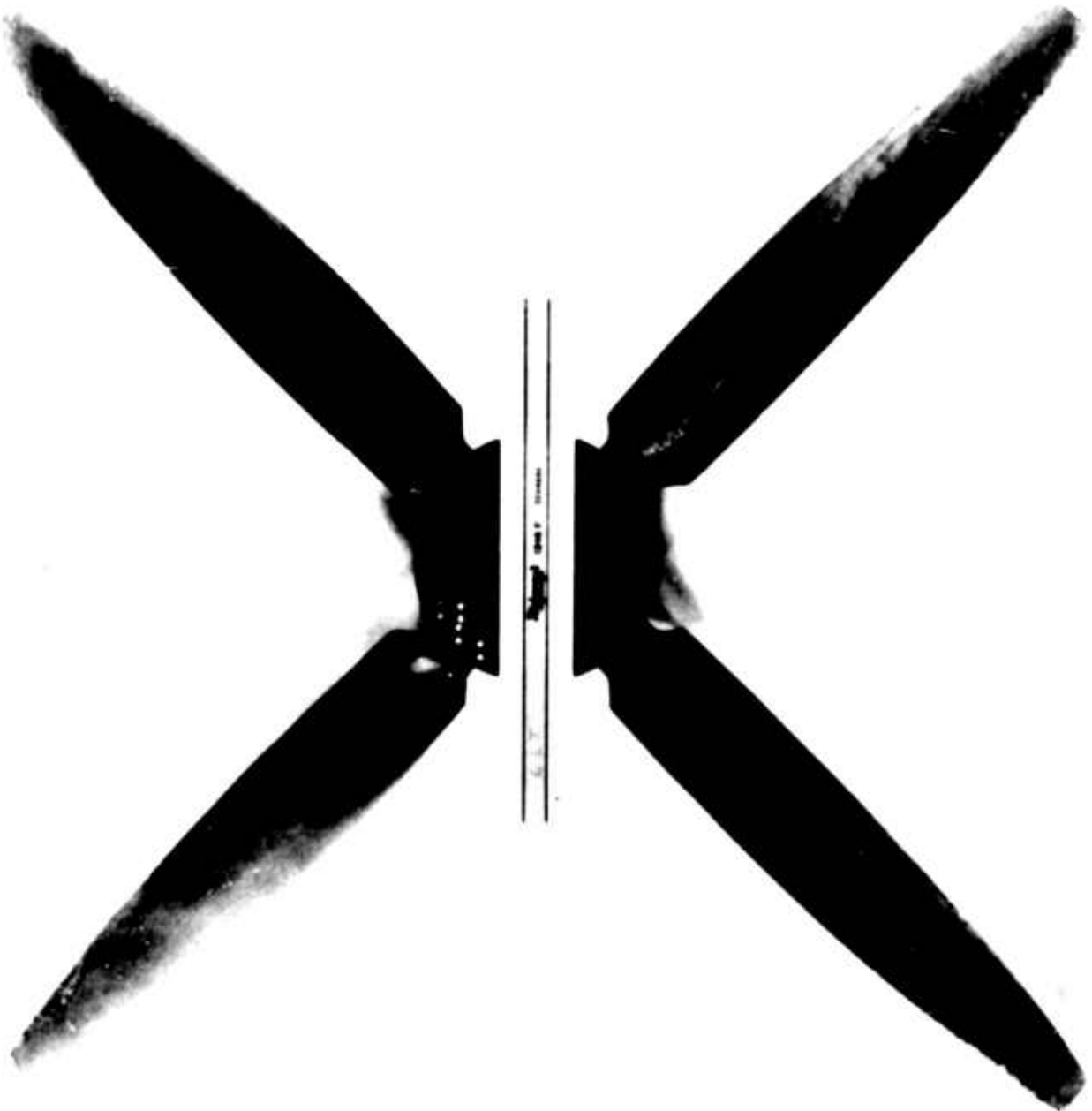


Figure 4-9 Uncoated Propeller after 21 Hours of Testing

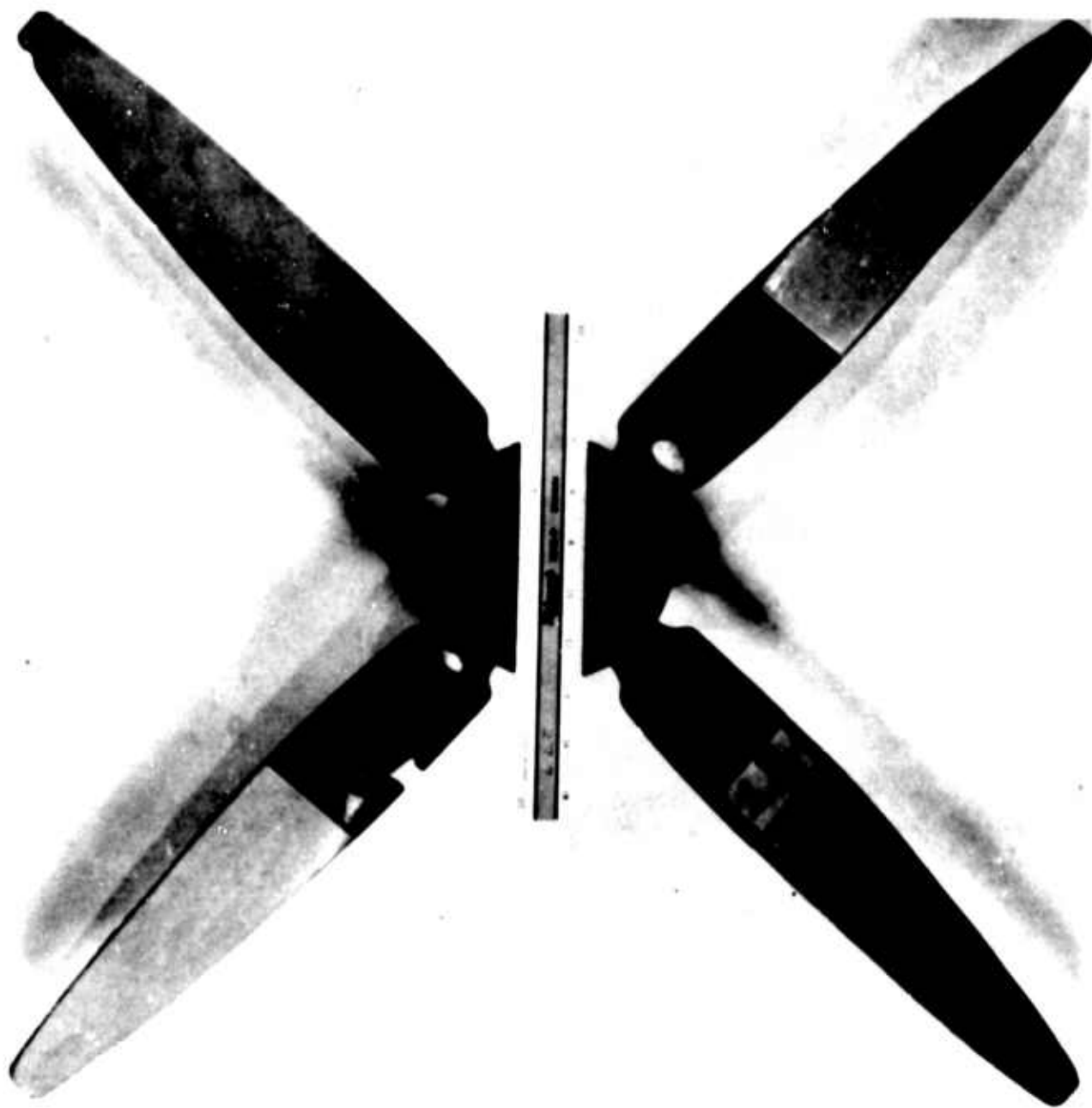


Figure 4-10 Coated Propeller after 21 Hours of Testing

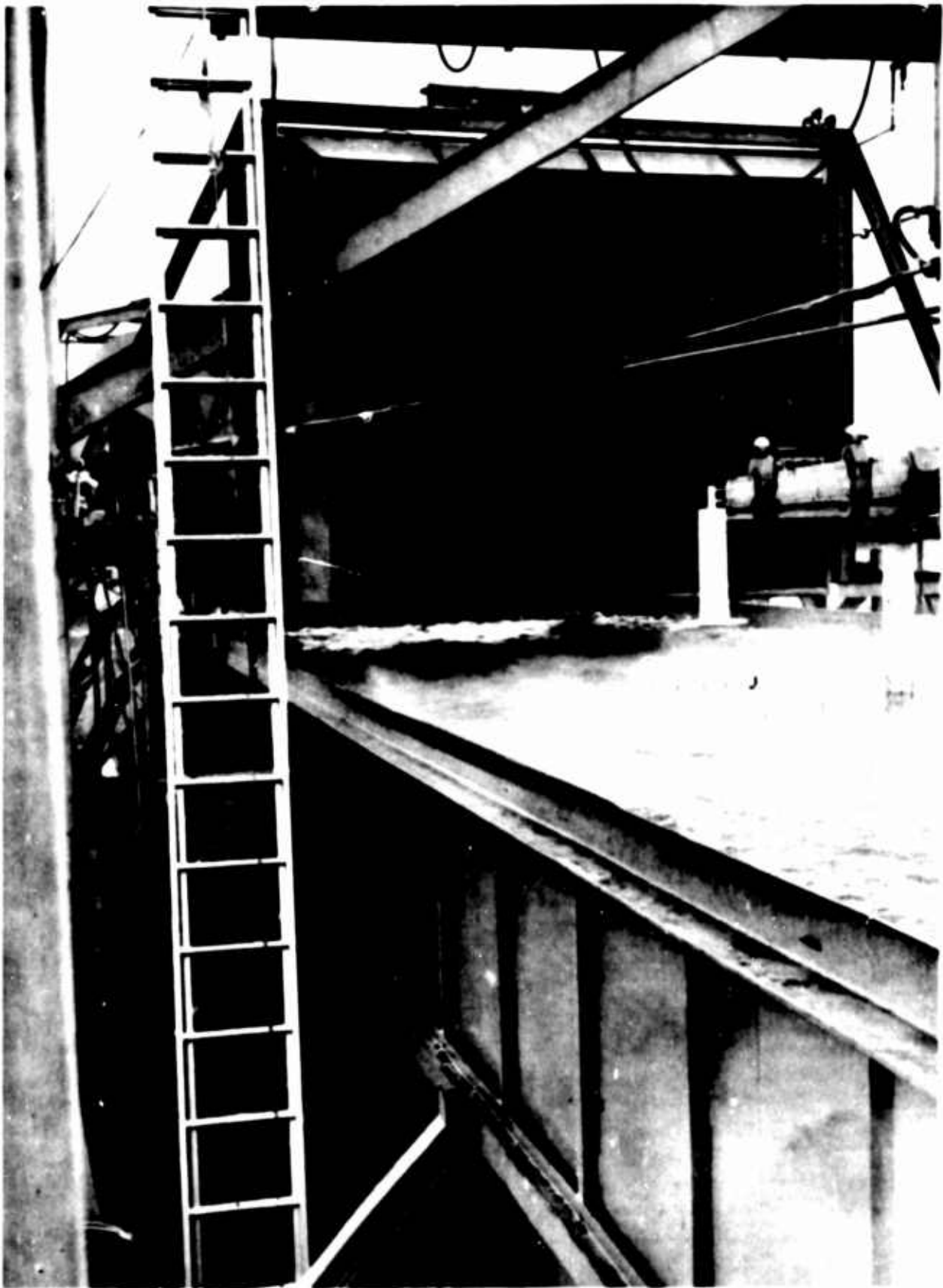


Figure 4-11 Effect of Sidewall Deflection

KC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS : OFF
 WIND AND WAVES : OFF
 MODEL HEIGHT (H_p) = 2.5
 DISC LOADING = 10.82

○ RUN #18
 ◇ RUN #46
 △ RUN #47
 ▽ RUN #48
 □ DATA FROM PREVIOUS TEST

WATER ENTERING PROPELLERS - LB/MIN-W

PROP OVERLAP

PROP OVERLAP

LEFT OUTBOARD PROPELLER

RIGHT OUTBOARD PROPELLER

TRAP #1 #2 #3 #4
 50 60 70 80
 PERCENT SEMISPAN

TRAP #1 #2 #3 #4
 50 60 70 80
 PERCENT SEMISPAN

Figure 4-12 Water Entering Propellers-Repeatibility

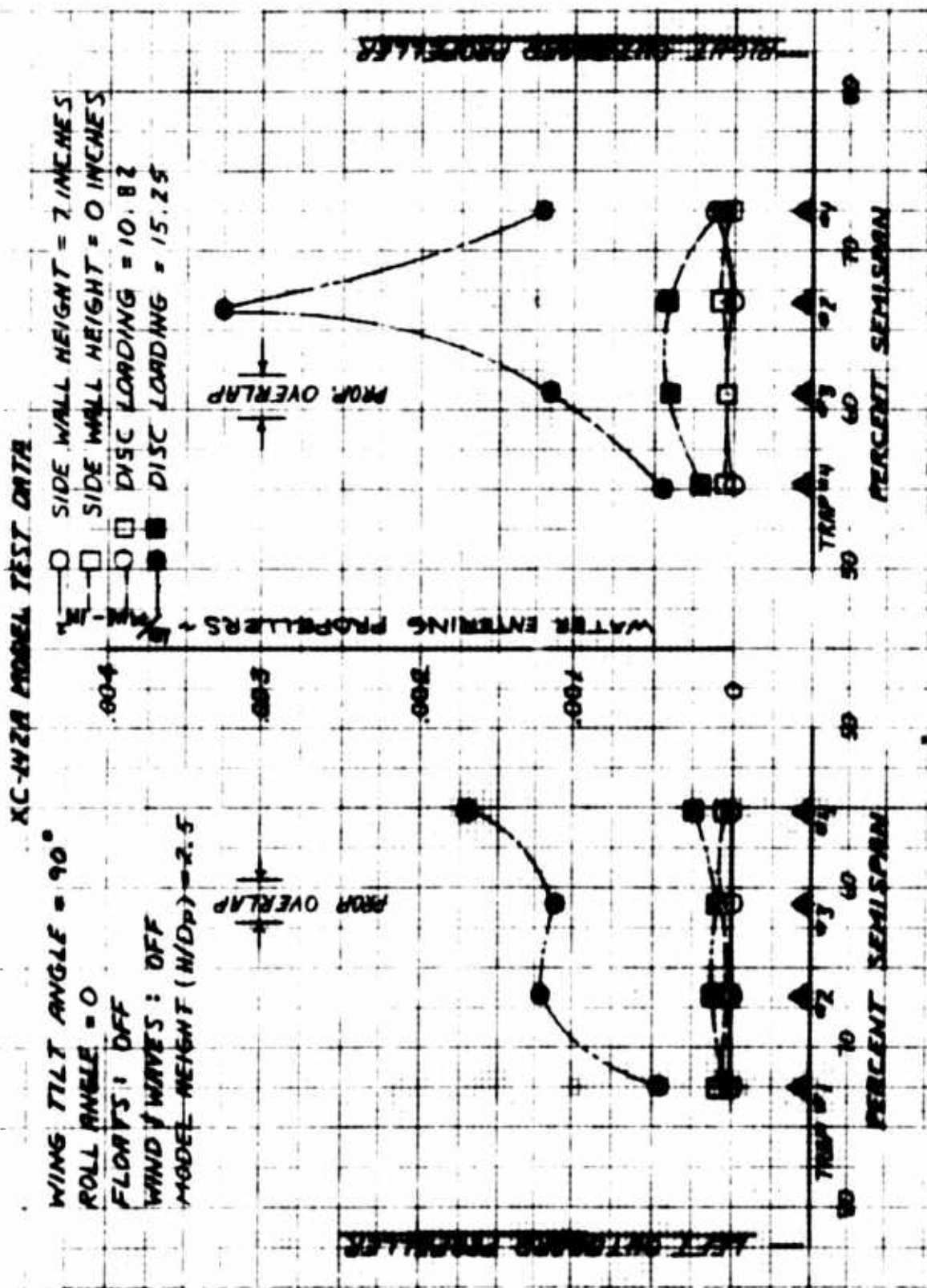


Figure 4-13 Water Entering Propellers-Effects of Side Wall

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0
 FLOATS: OFF
 WIND & WAVES: OFF
 MODEL HEIGHT (H/D) = 1.6
 DISC LOADING = 6.45

- SIDE WALL = 7.0 INCHES
FRAME 5
- SIDE WALL = 7.0 INCHES
FRAME 23
- NO SIDE WALL
FRAME 15
- NO SIDE WALL
FRAME 33

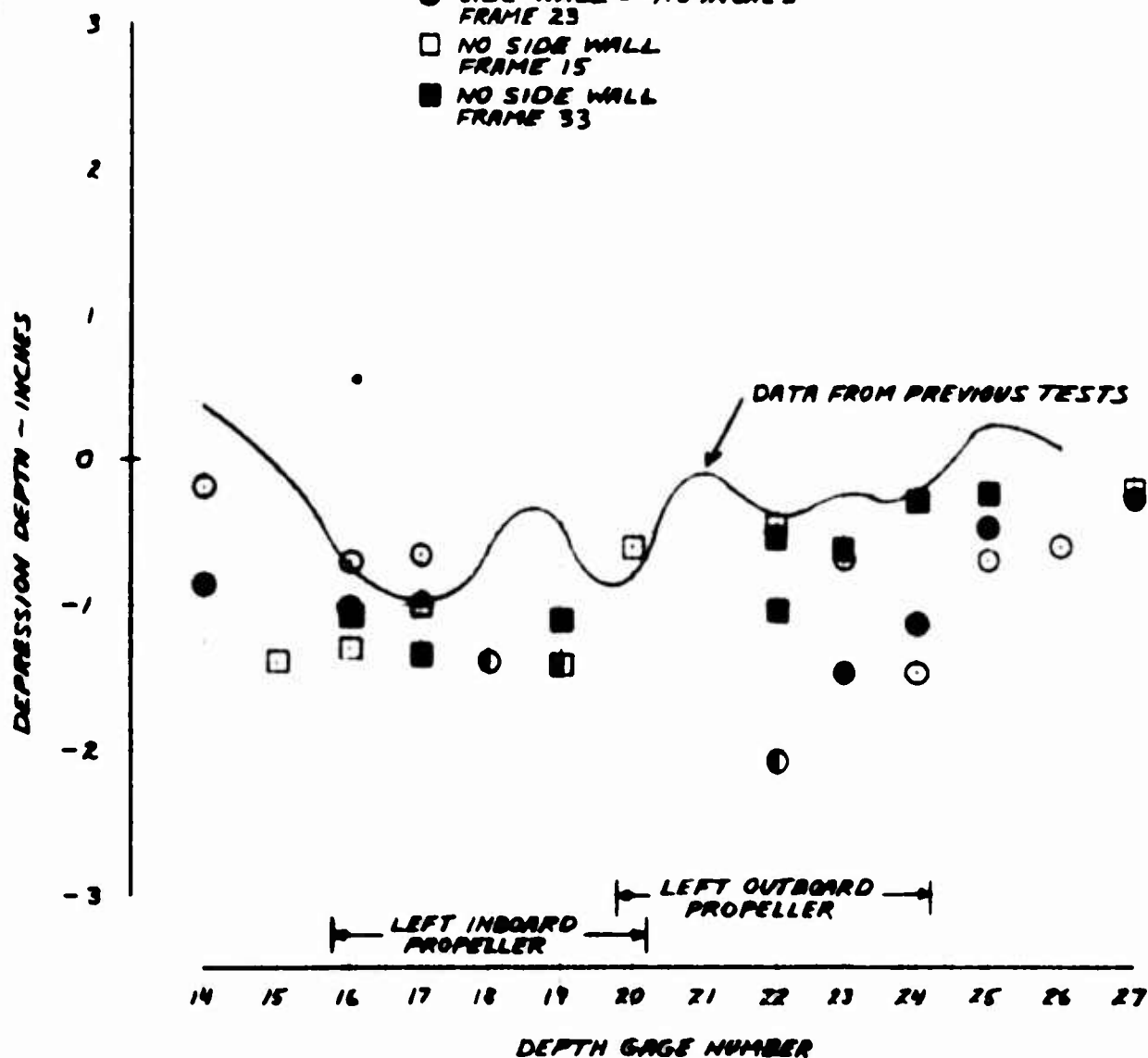


**Figure 4-14 Water Displacement Along Propeller Centerline
 Repeatability and Effects of Side Wall**

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0
 FLOATS : OFF
 WIND & WAVES : OFF
 MODEL HEIGHT (H/D) = 1.6
 DISC LOADING = 6.45

- SIDE WALL = 7.0 INCHES FRAME 5
- SIDE WALL = 7.0 INCHES FRAME 23
- NO SIDE WALL FRAME 15
- NO SIDE WALL FRAME 33

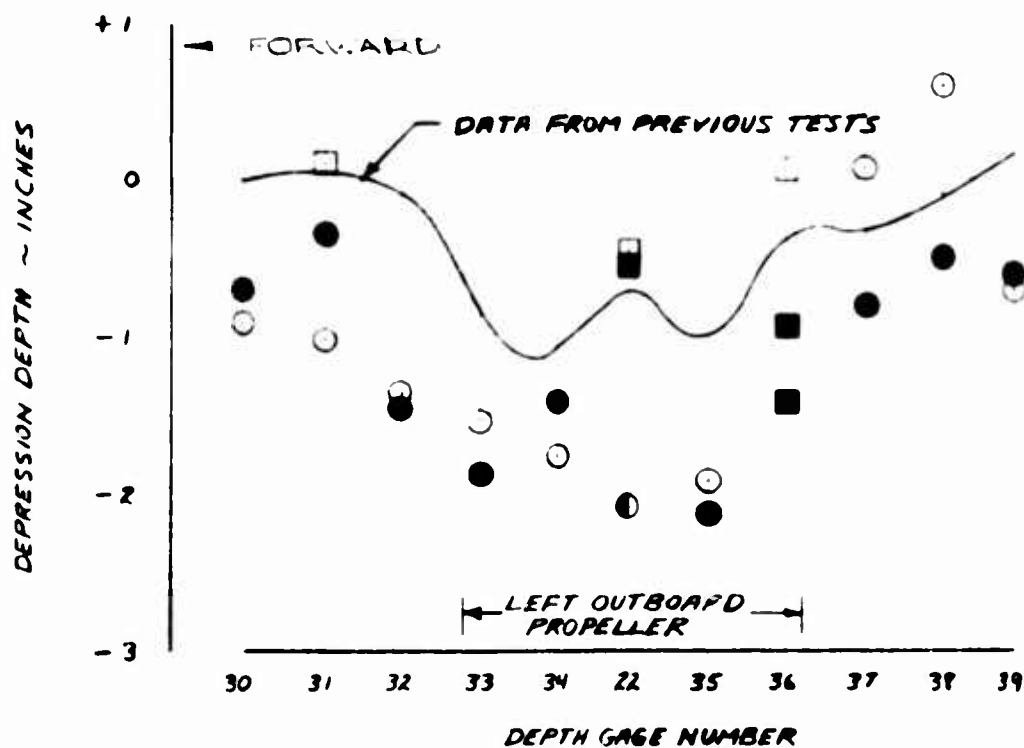
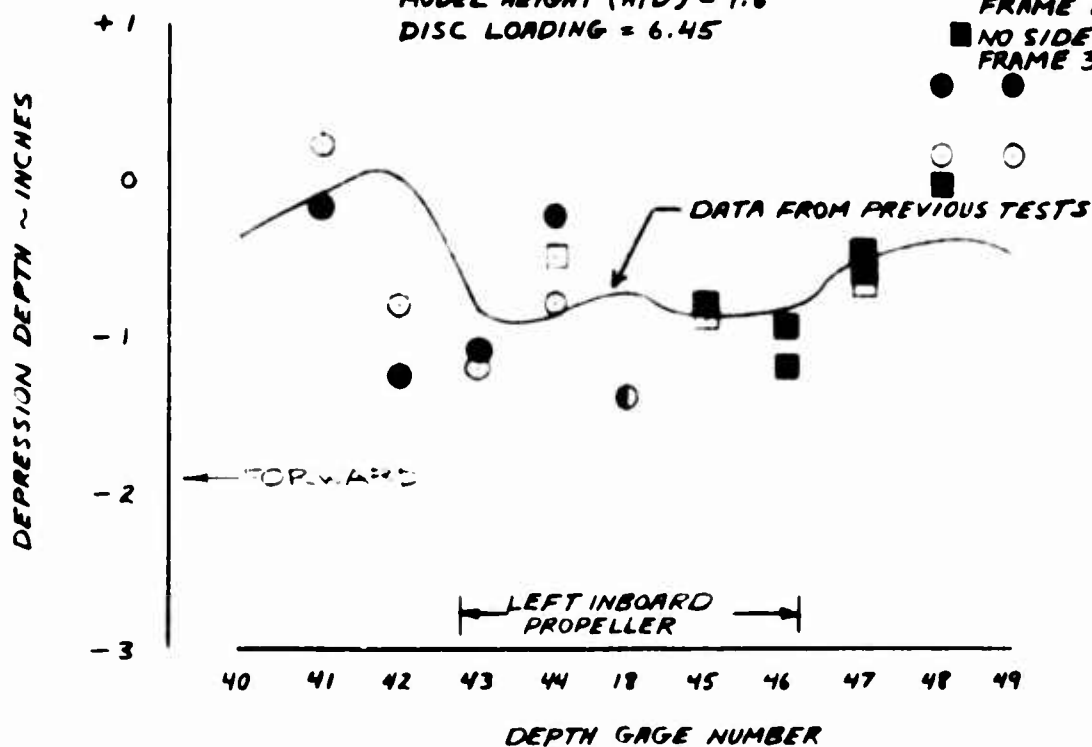


Figure 4-15 Water Displacement Fore and Aft
 Repeatability and Effects of Side Wall

42A MODEL TEST DATA

WING TILT ANGLE 40°	POINT 1 DISC LOADING $\cdot 6.45$
ROLL ANGLE $\cdot 0^\circ$	POINT 2 DISC LOADING $\cdot 10.82$
FLOATS ON	POINT 3 DISC LOADING $\cdot 15.25$
13 KNOT HEAD WIND	
WAVES OFF	
MODEL HEIGHT = 2.5	

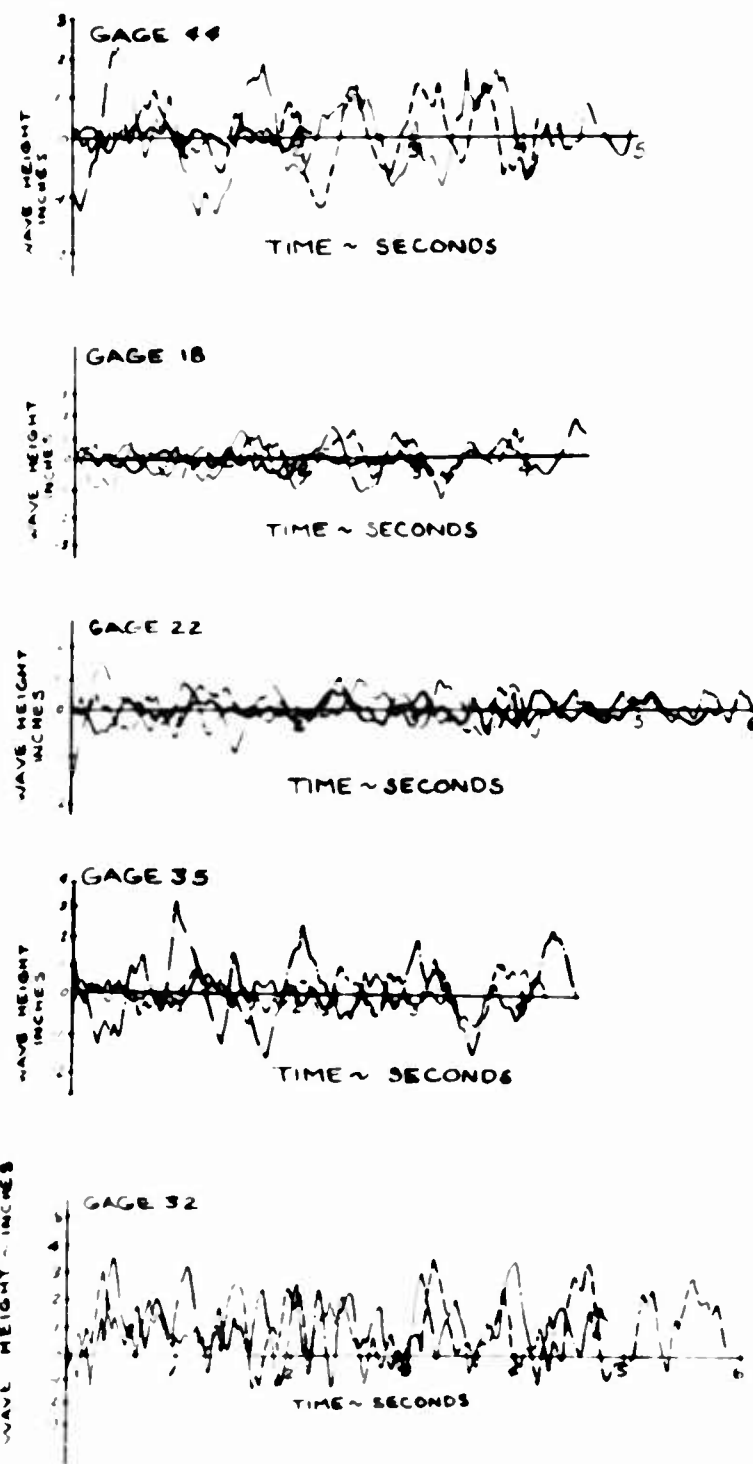


Figure 4-16 Effects of Time

WAVE TILT ANGLE = 70°
ROLL ANGLE = 0°
FLOATS OFF
WIND AND WAVES OFF
DISC LOADING = 10.82

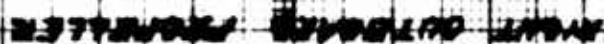


Figure 4-17 Water Entering Propellers - Effects of Model Height

KC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS : OFF
 WIND AND WAVES : OFF
 DISC LOADING : 15.25

□ $M/b_p = 2.0$
 ○ $M/b_p = 2.5$
 △ $M/b_p = 3.7$

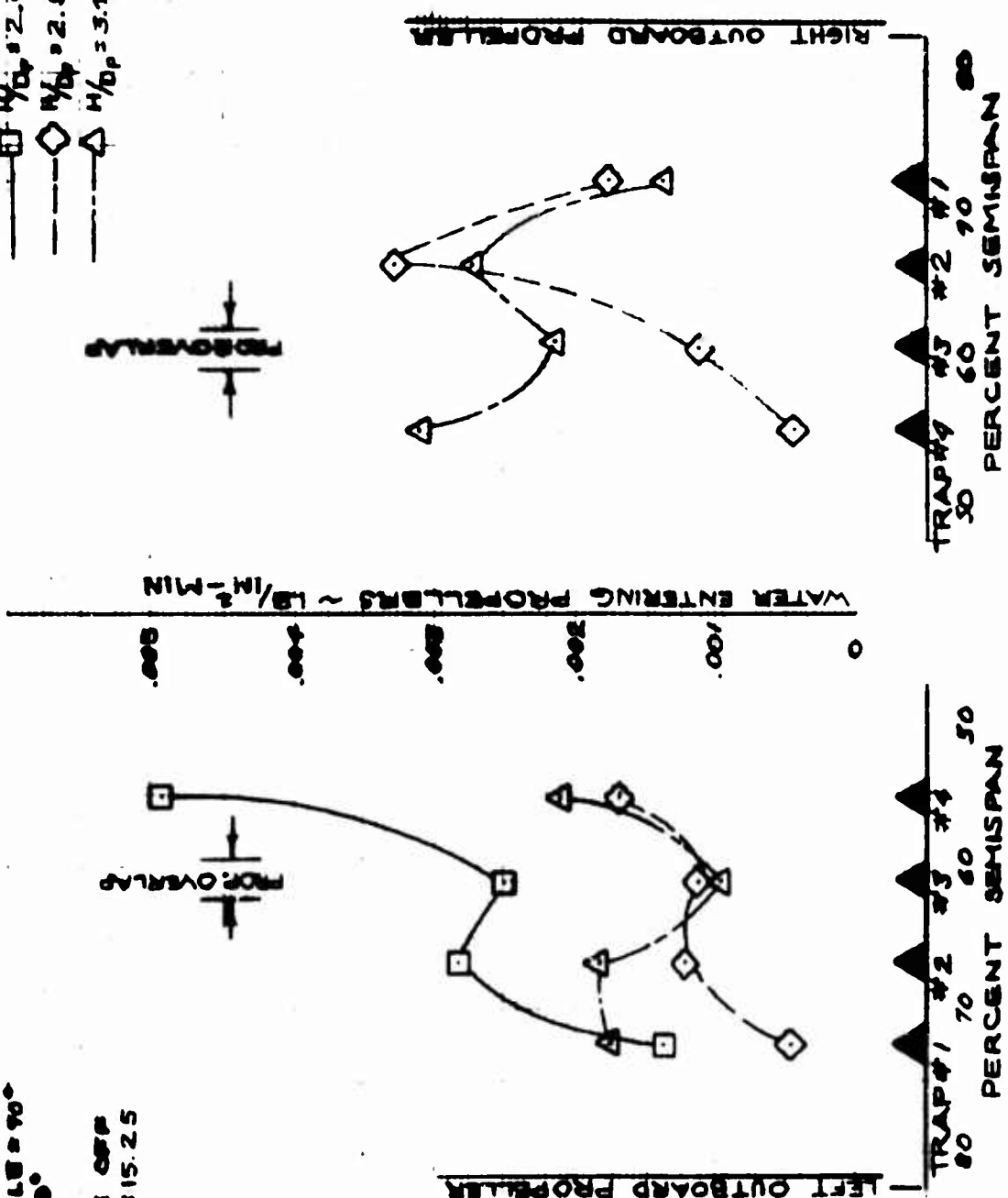


Figure 4-18 Water Entering Propellers -
 Effects of Model Height

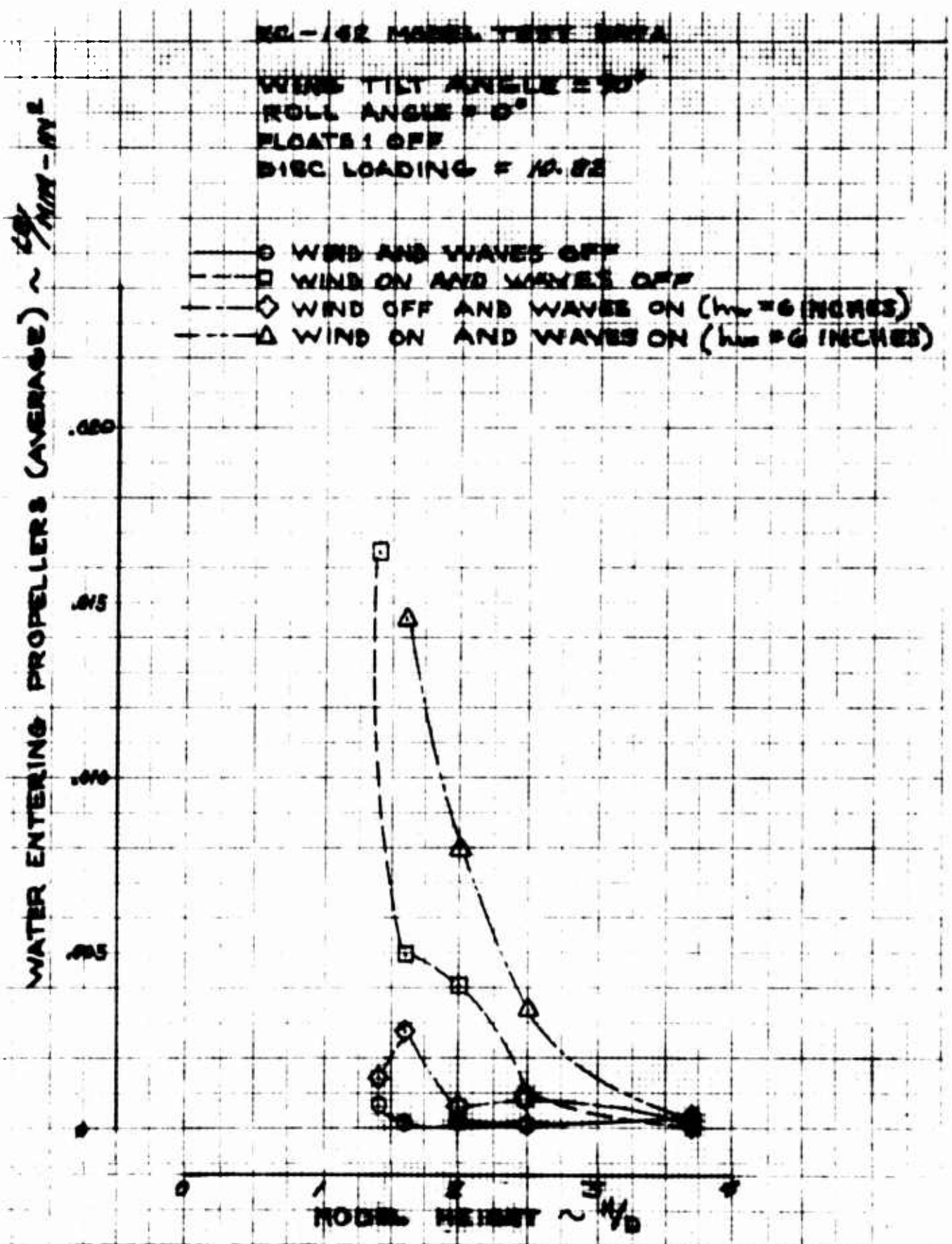


Figure 4-19 Water Entering Propellers -
 Effects of Model Height

XC-42 MODEL TEST DATA

WING TILT ANGLE = 90°

ROLL ANGLE = 0°

FLOATS : OFF

DISC LOADING = 15.25

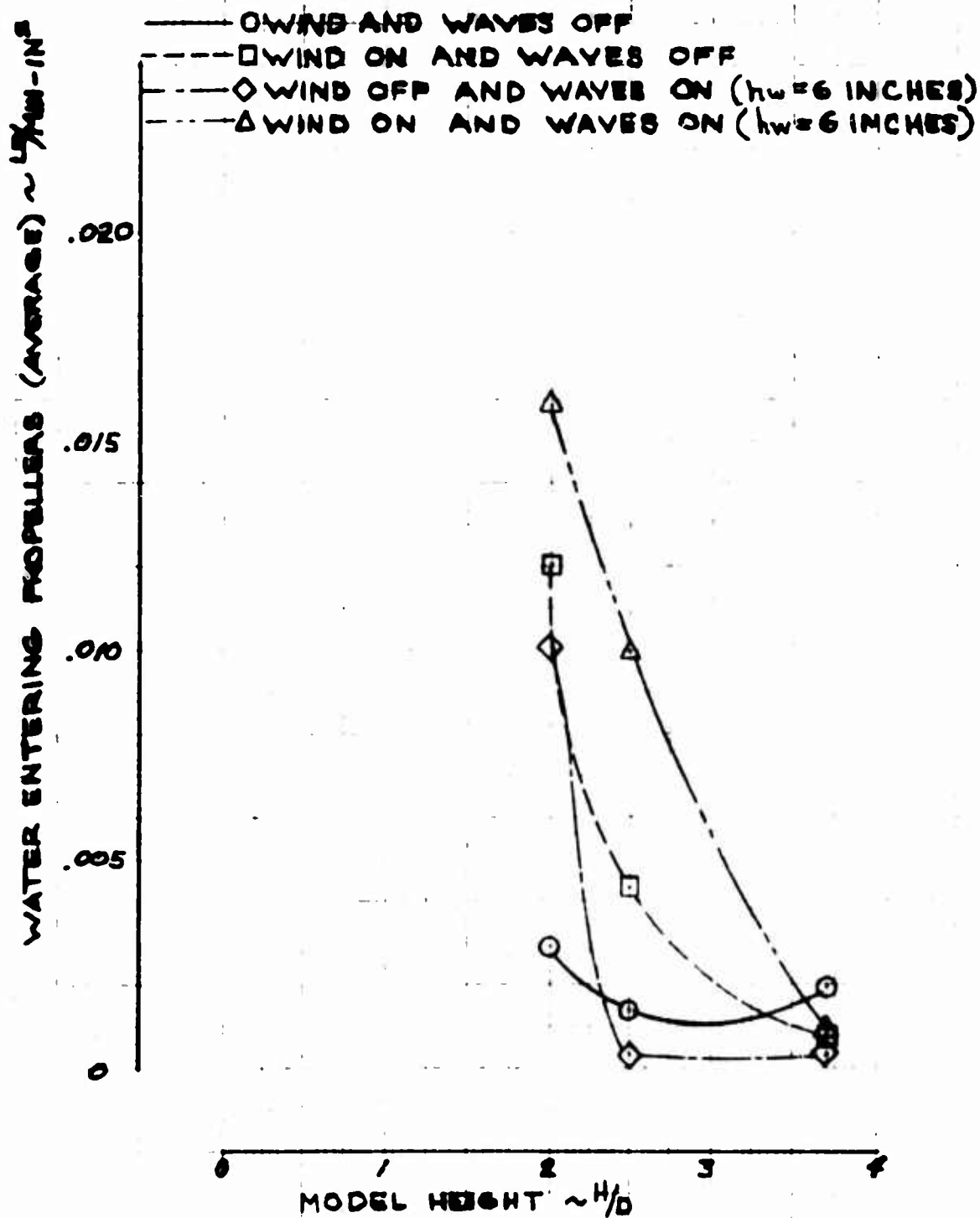


Figure 4-20 Water Entering Propellers --
Effects of Model Height

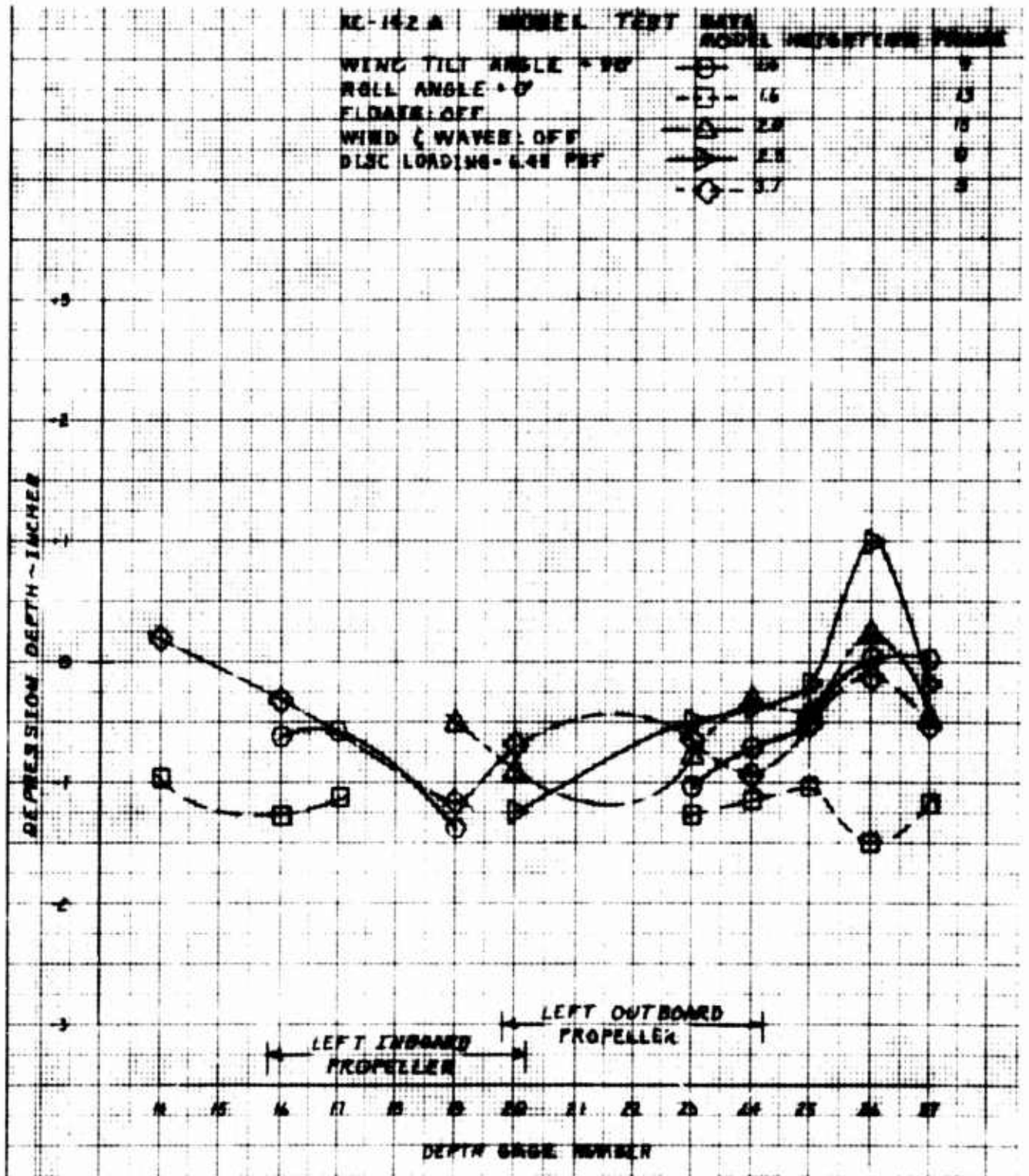


Figure 4-21 Water Displacement Along Propeller Centerline—
Effects of Model Height

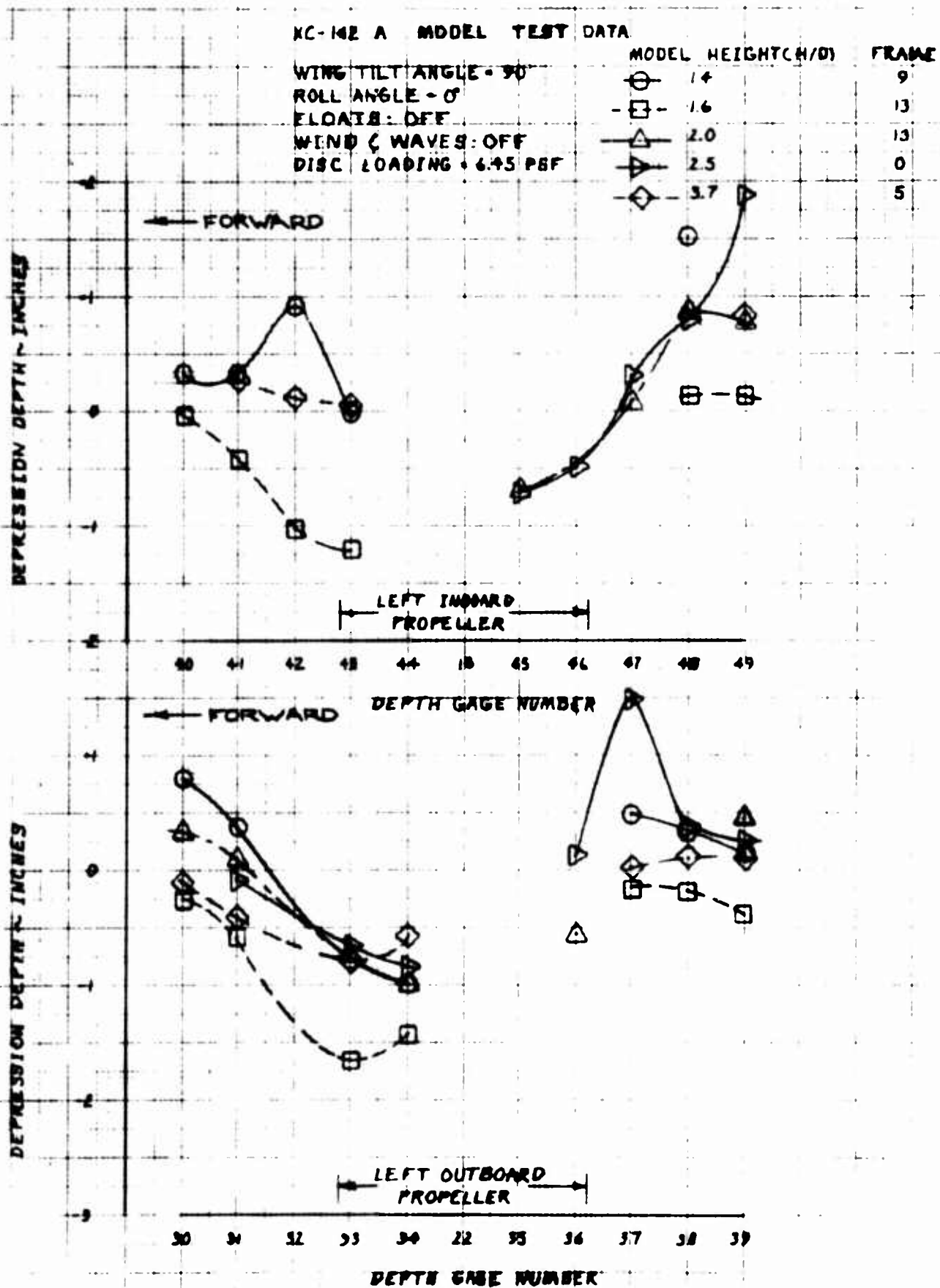


Figure 4-22 Water Displacement Fore and Aft—
Effects of Model Height

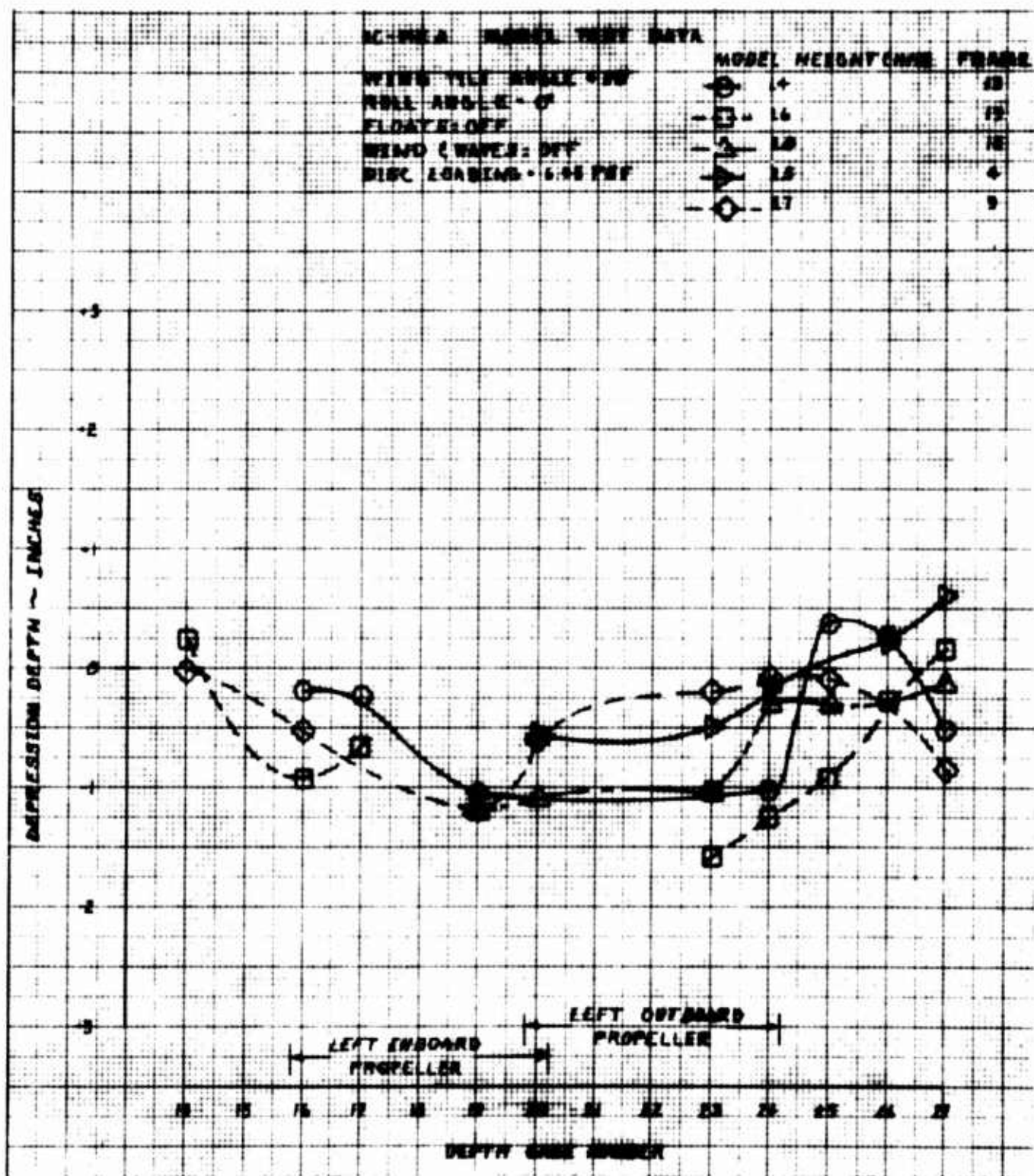


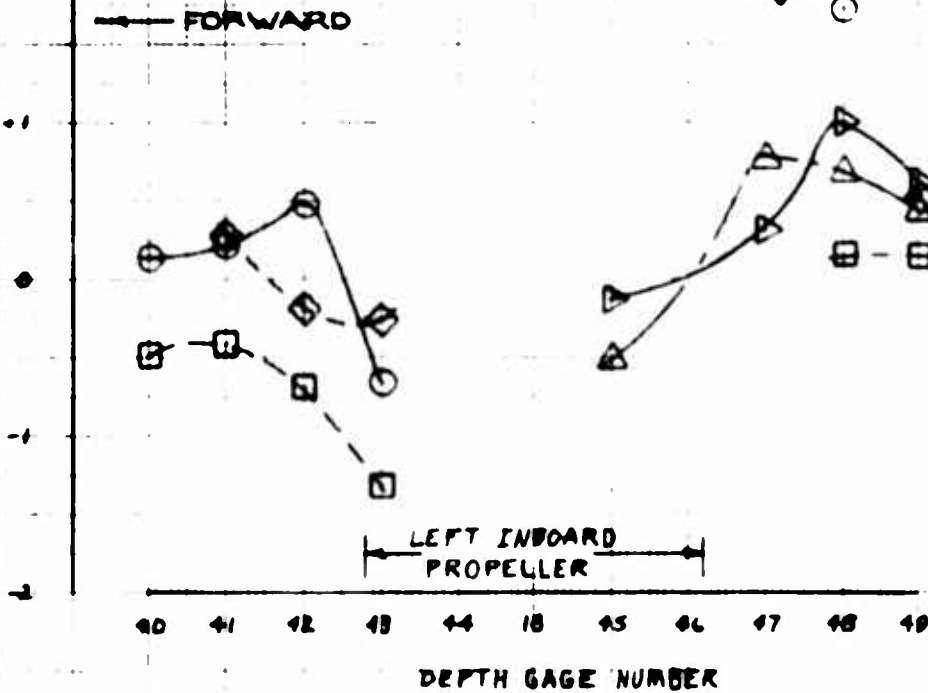
Figure 4-23 Water Displacement Along Propeller Centerline -
Effects of Model Height

NC-142 A MODEL TEST DATA

WING TILT ANGLE: 90°
 ROLL ANGLE: 0°
 FLOATS: OFF
 WIND & WAVES: OFF
 DISC LOADING: 6.45 PSF

MODEL HEIGHT (H/D)	FRAME
4	15
16	19
2.0	18
2.5	4
3.7	9

DEPRESSION DEPTH - INCHES



DEPRESSION DEPTH - INCHES

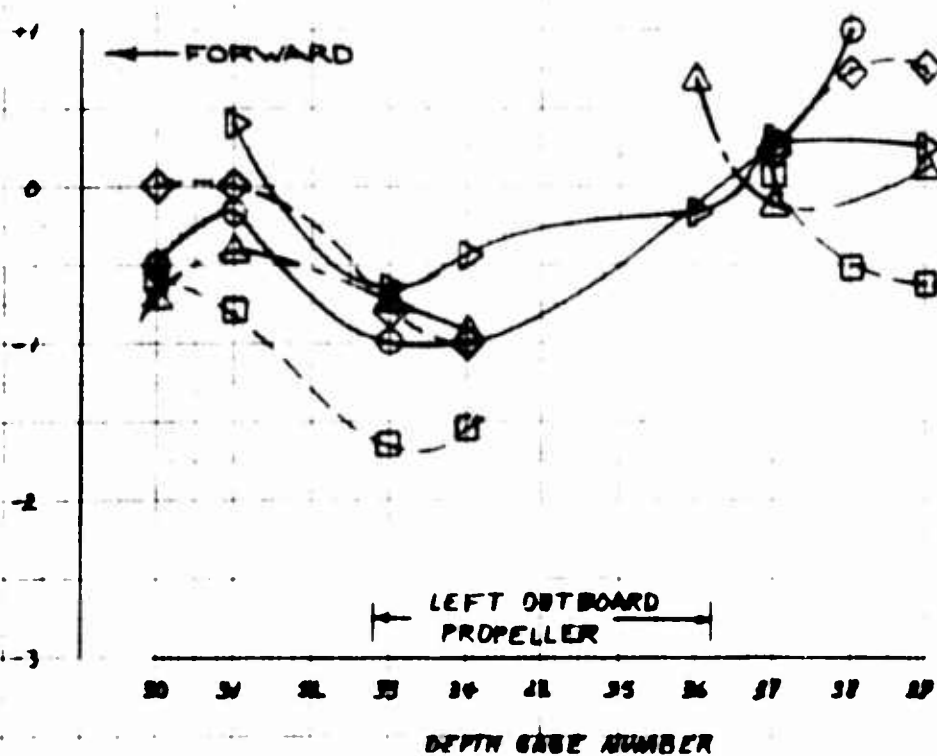


Figure 4-24 Water Displacement Fore and Aft - Effects of Model Height

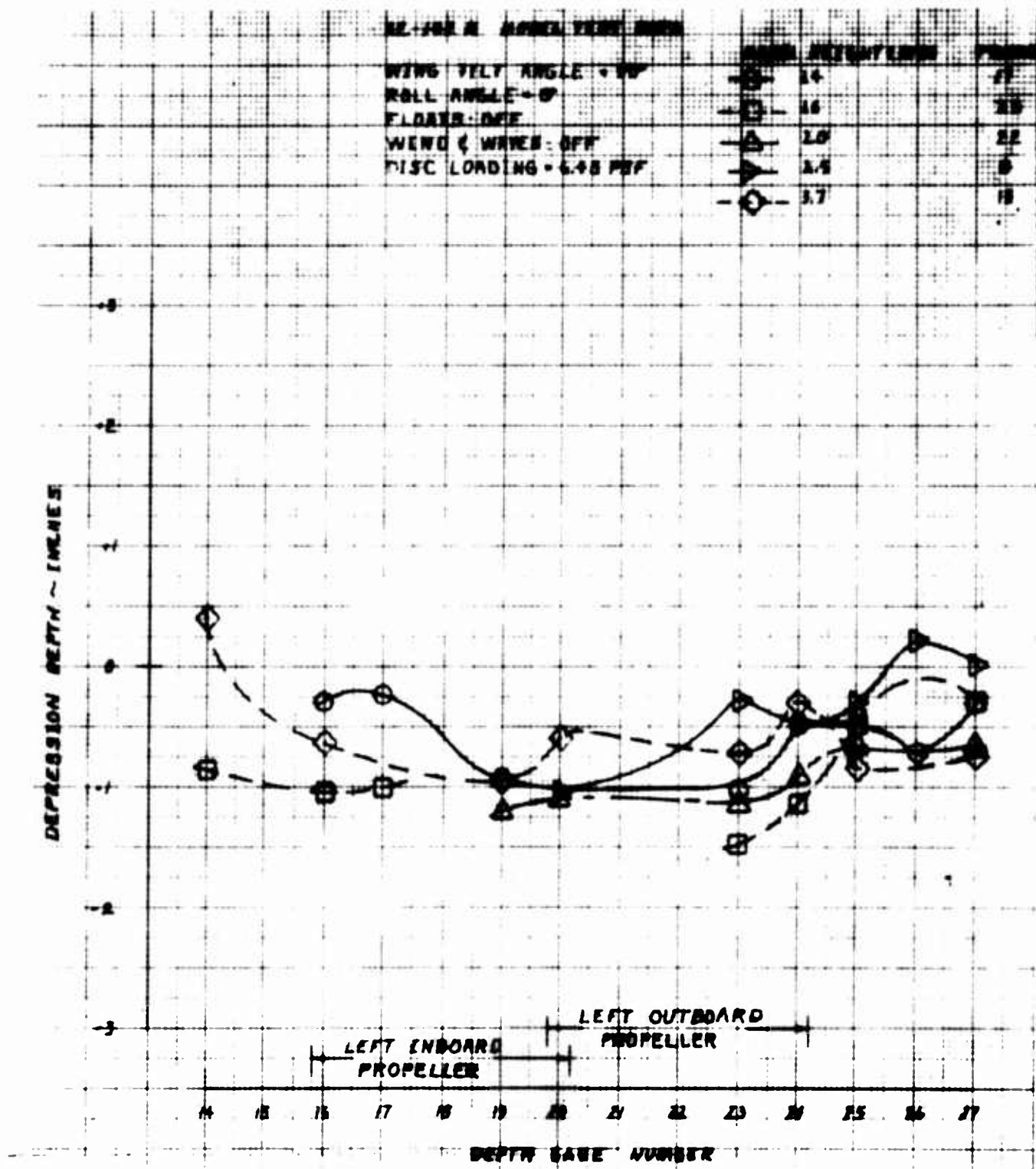


Figure 4-25 Water Displacement Along Propeller Centerline -
 Effects of Model Height

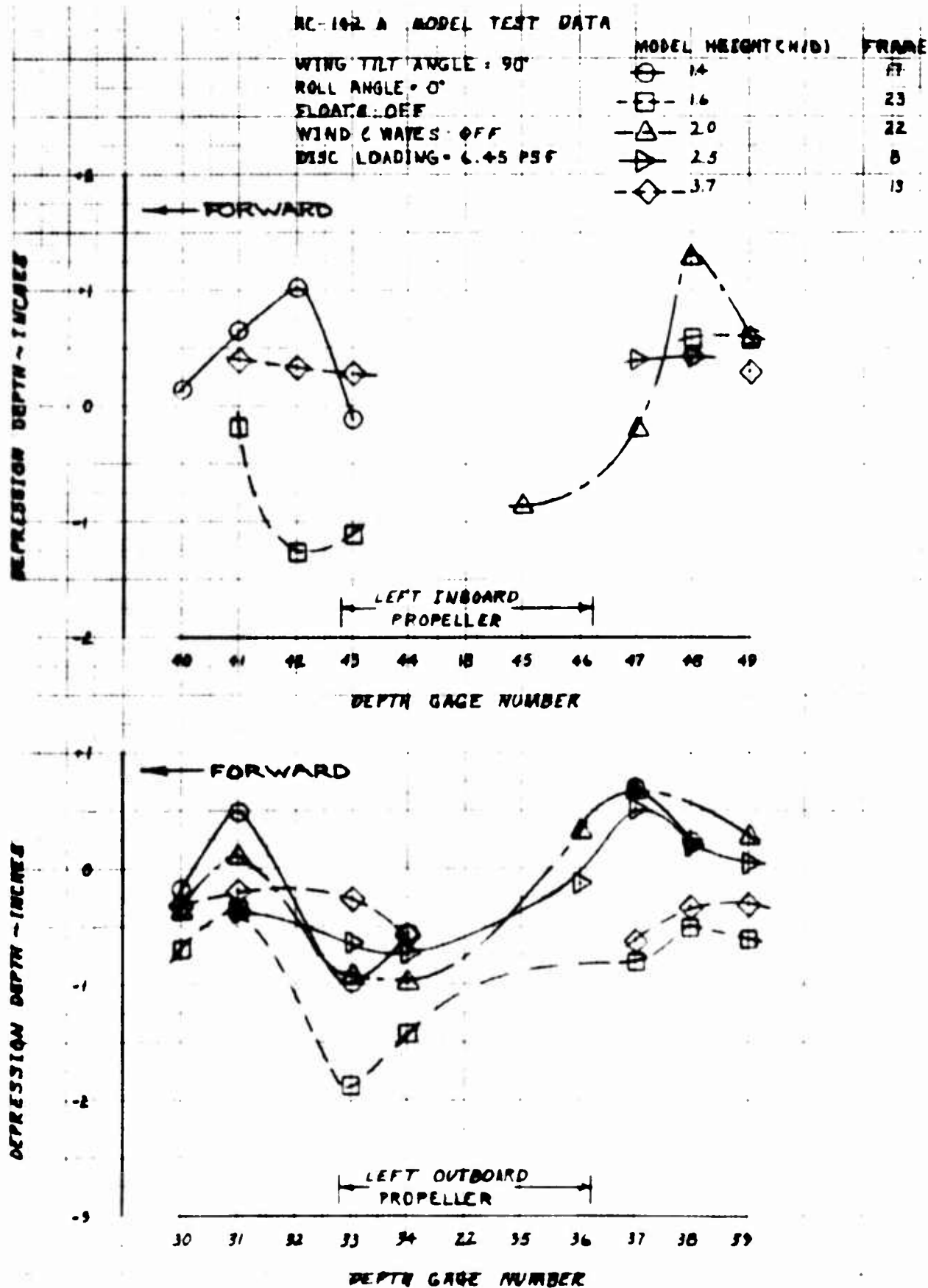


Figure 4-26 Water Displacement Fore and Aft - Effects of Model Height

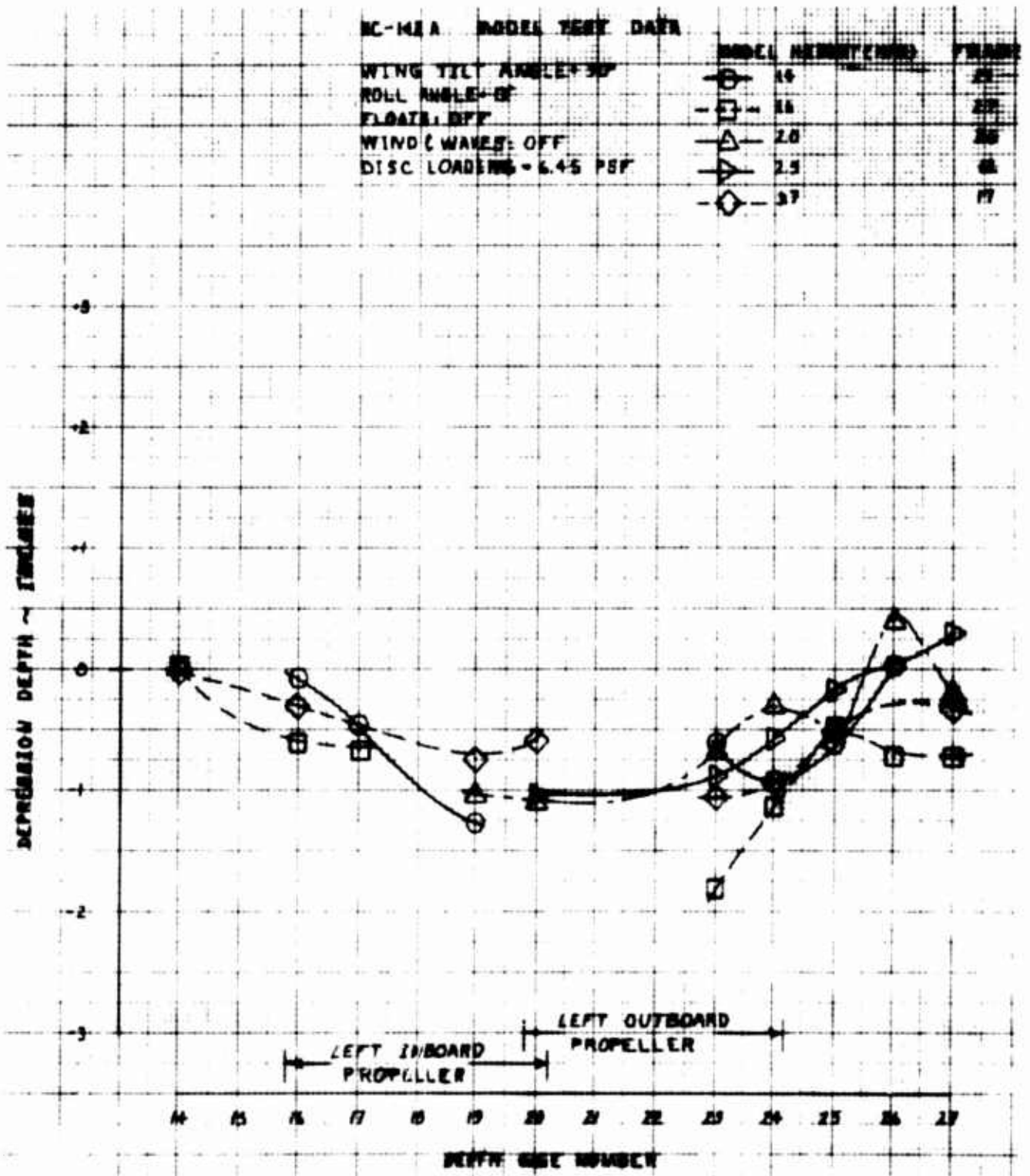


Figure 4-27 Water Displacement Along Propeller Centerline -
 Effects of Model Height

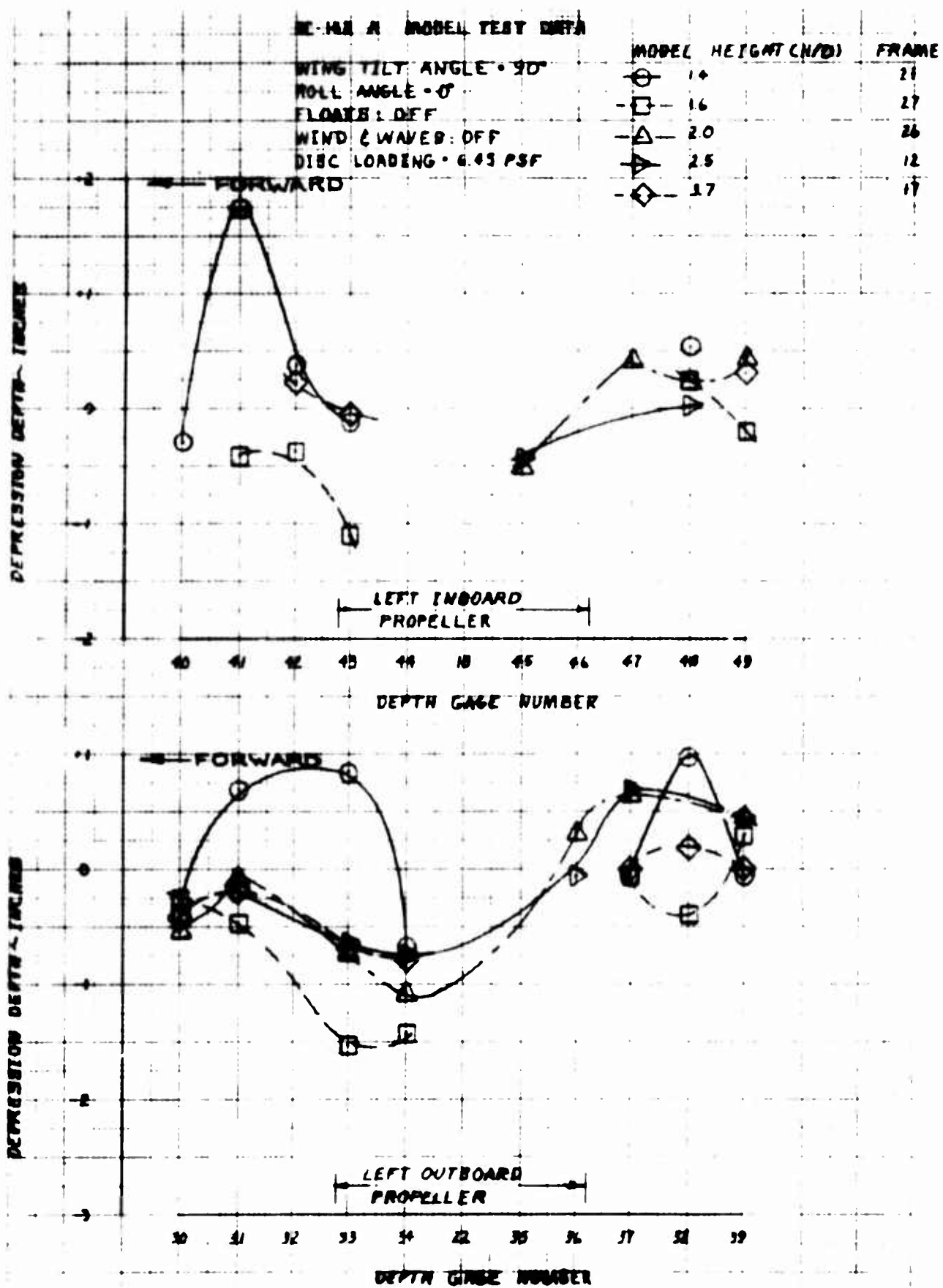


Figure 4-26 Water Displacement Fore and Aft -
 Effects of Model Height

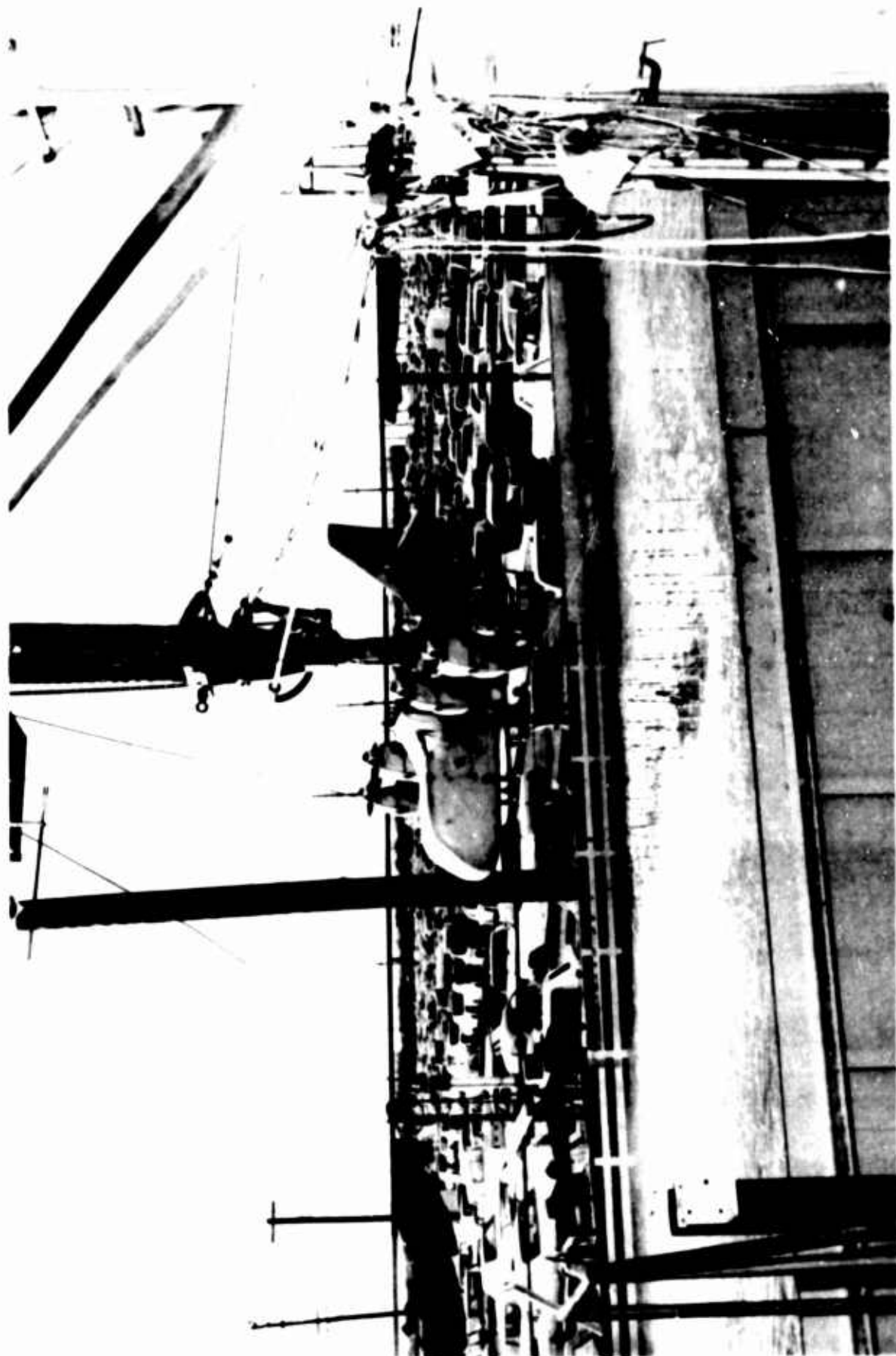


Figure 4-29 Model at 6.45 PSF Disc Loading

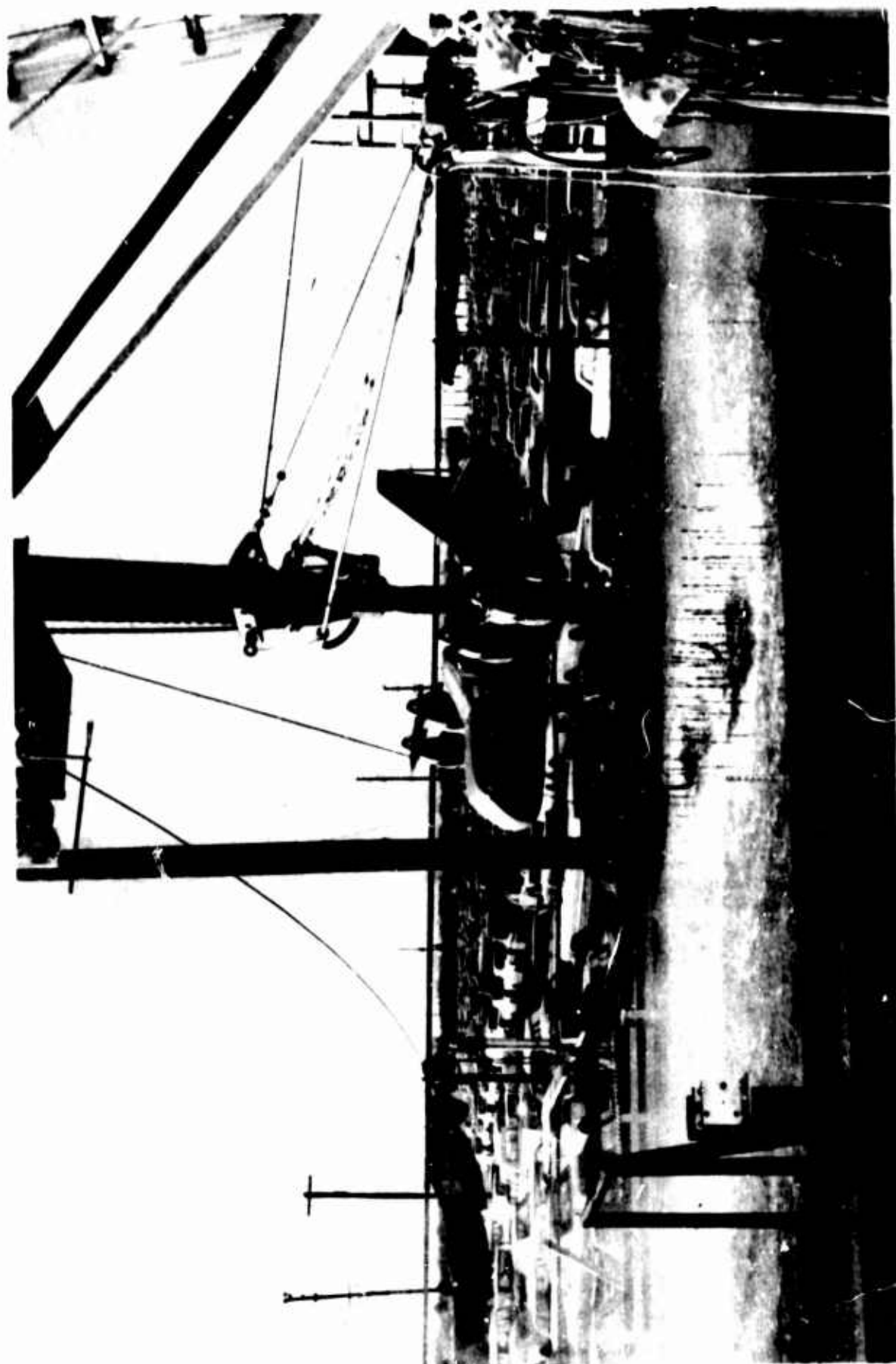


Figure 4-30 Model at 10.82 PSF Disc Loading

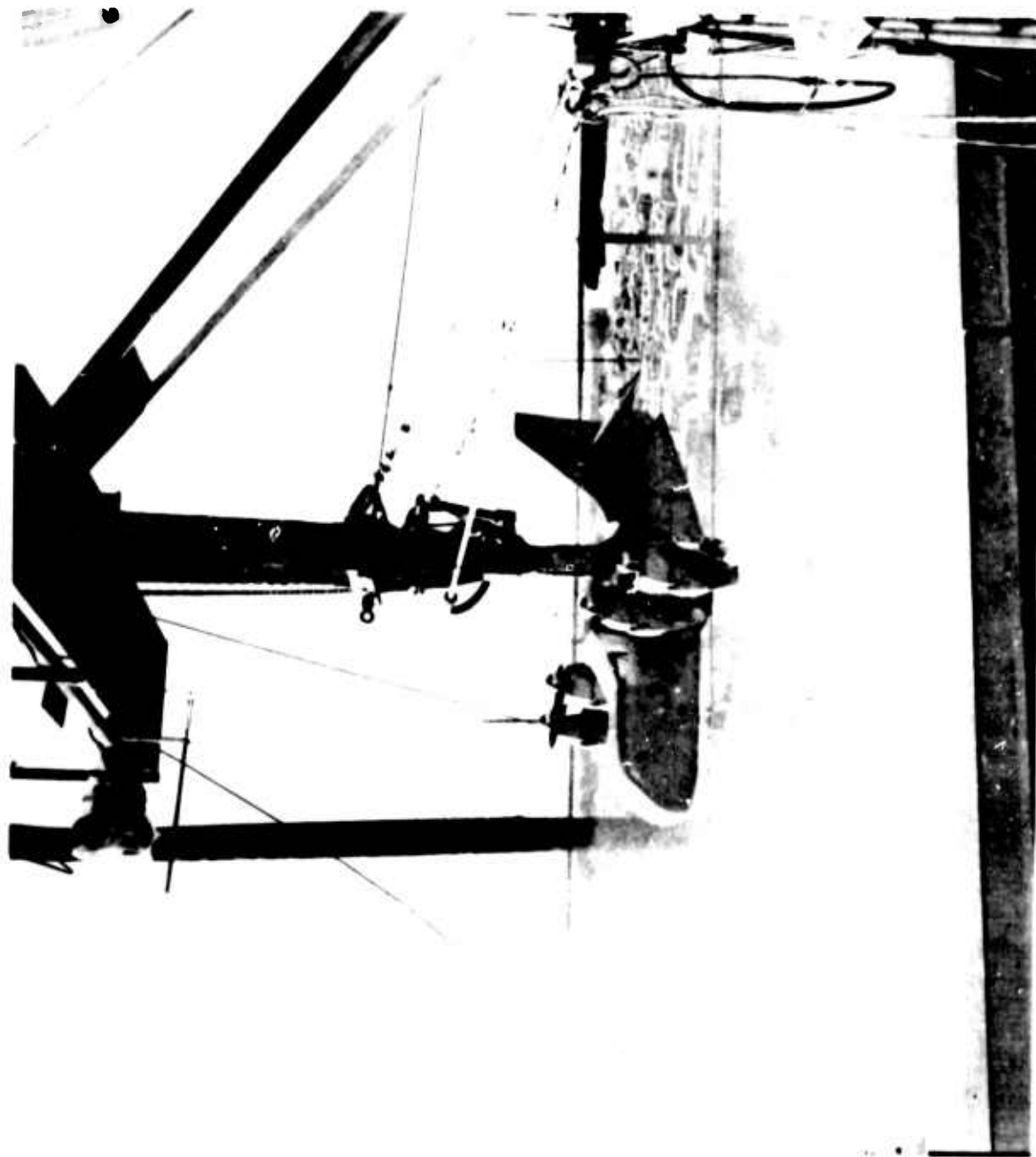


Figure 4-31 Model at 15.25 PSF Disc Loading

XC-142 MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS: OFF
 WIND AND WAVES: OFF
 MODEL HEIGHT (H/D_p) = 2.5

— O DISC LOADING = 6.125
 — □ DISC LOADING = 10.182
 — ◇ DISC LOADING = 15.25

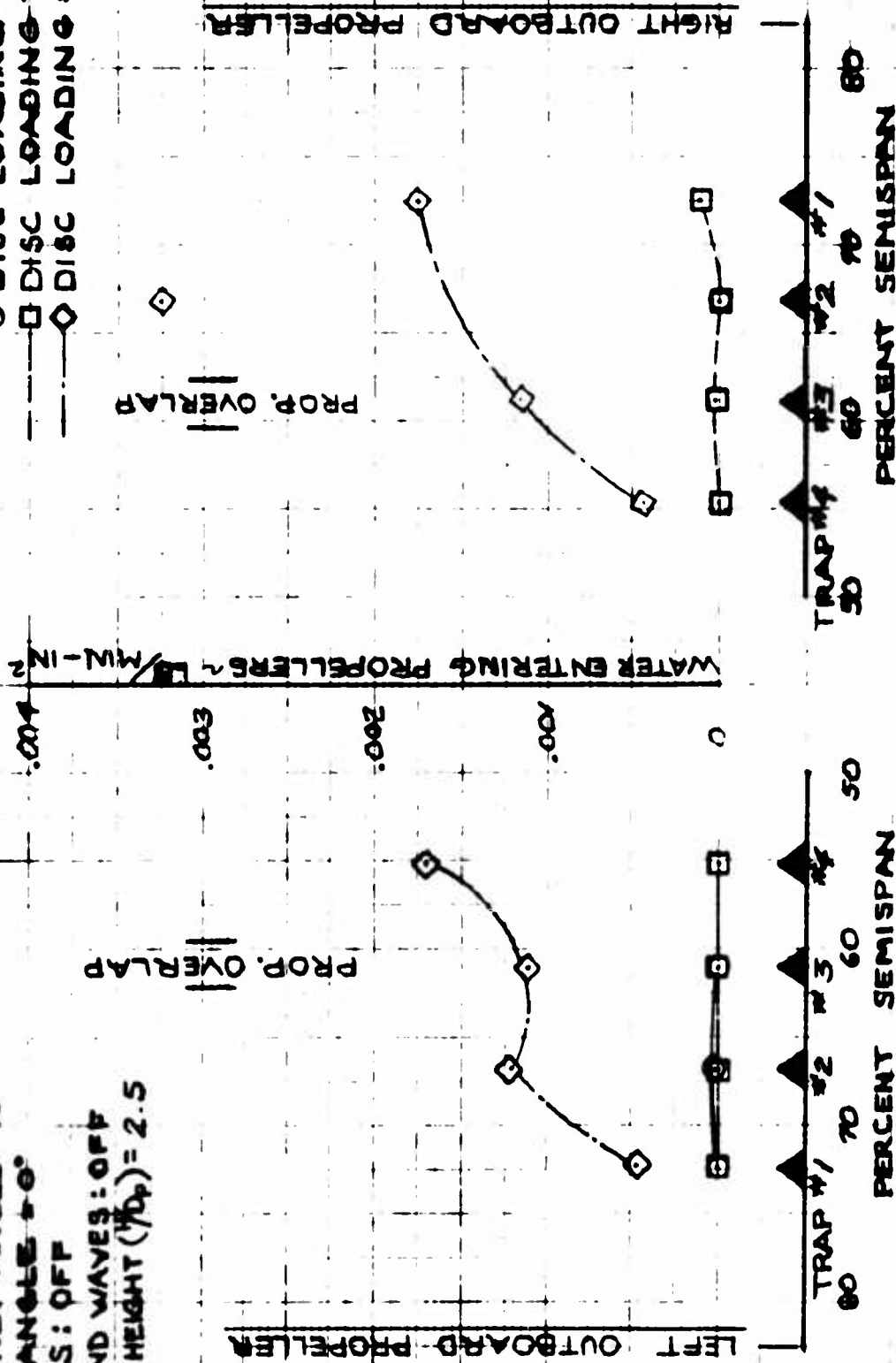


Figure 4-32 Water Entering Propellers - Effects of Disc Loading

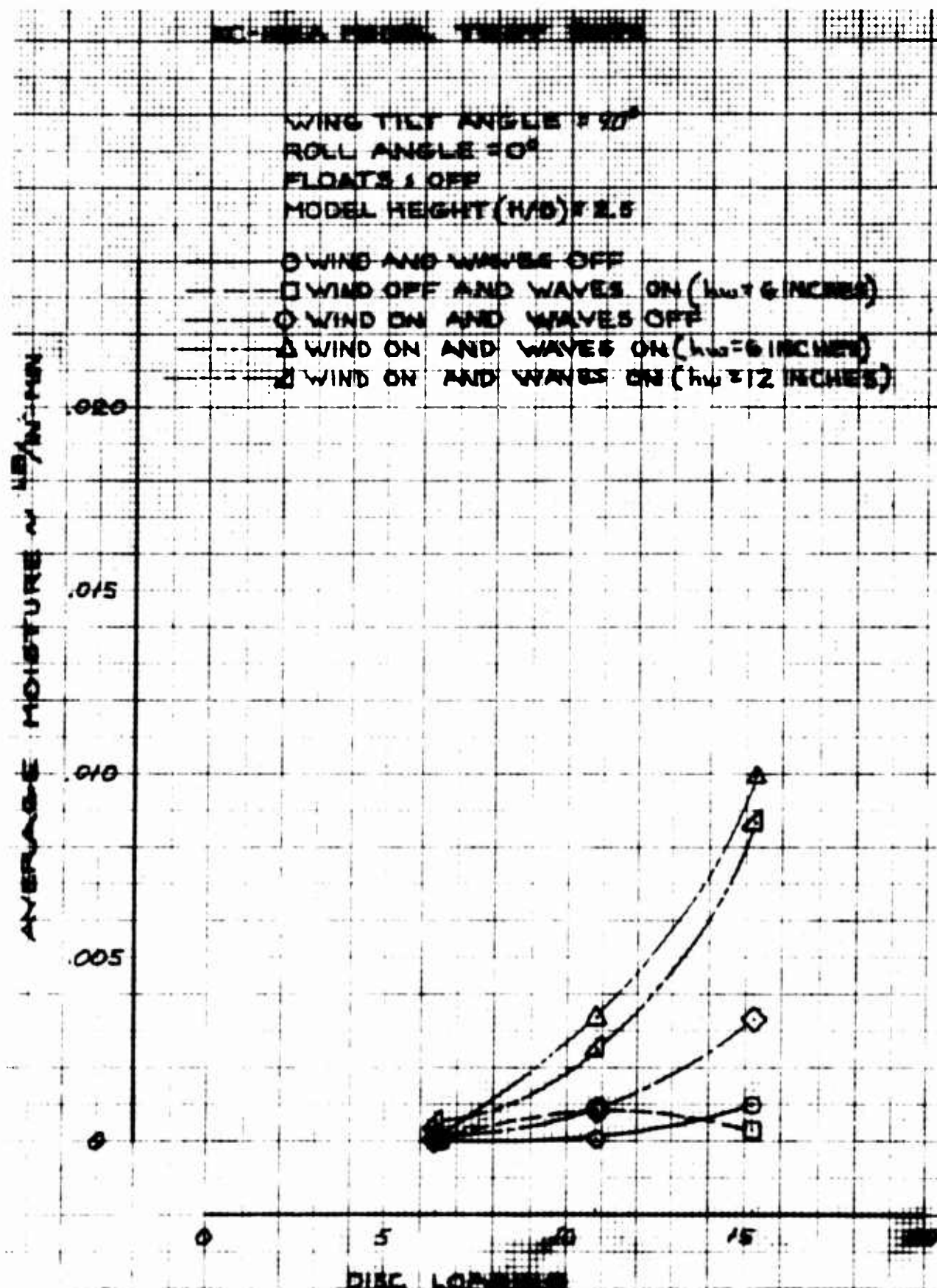


Figure 4-33 Water Entering Propellers - Effects of Disc Loading

XC-142A MODEL TEST DATA

WING TILT ANGLE - 90°

ROLL ANGLE - 0°

FLOATS: DEF

WIND (WAVES): OFF

MODEL HEIGHT (H/D) - 3.7

DISC LOADING

FRAME

⊙ - 6.45 PSF	5
□ - 10.82 PSF	9
△ - 15.25 PSF	17

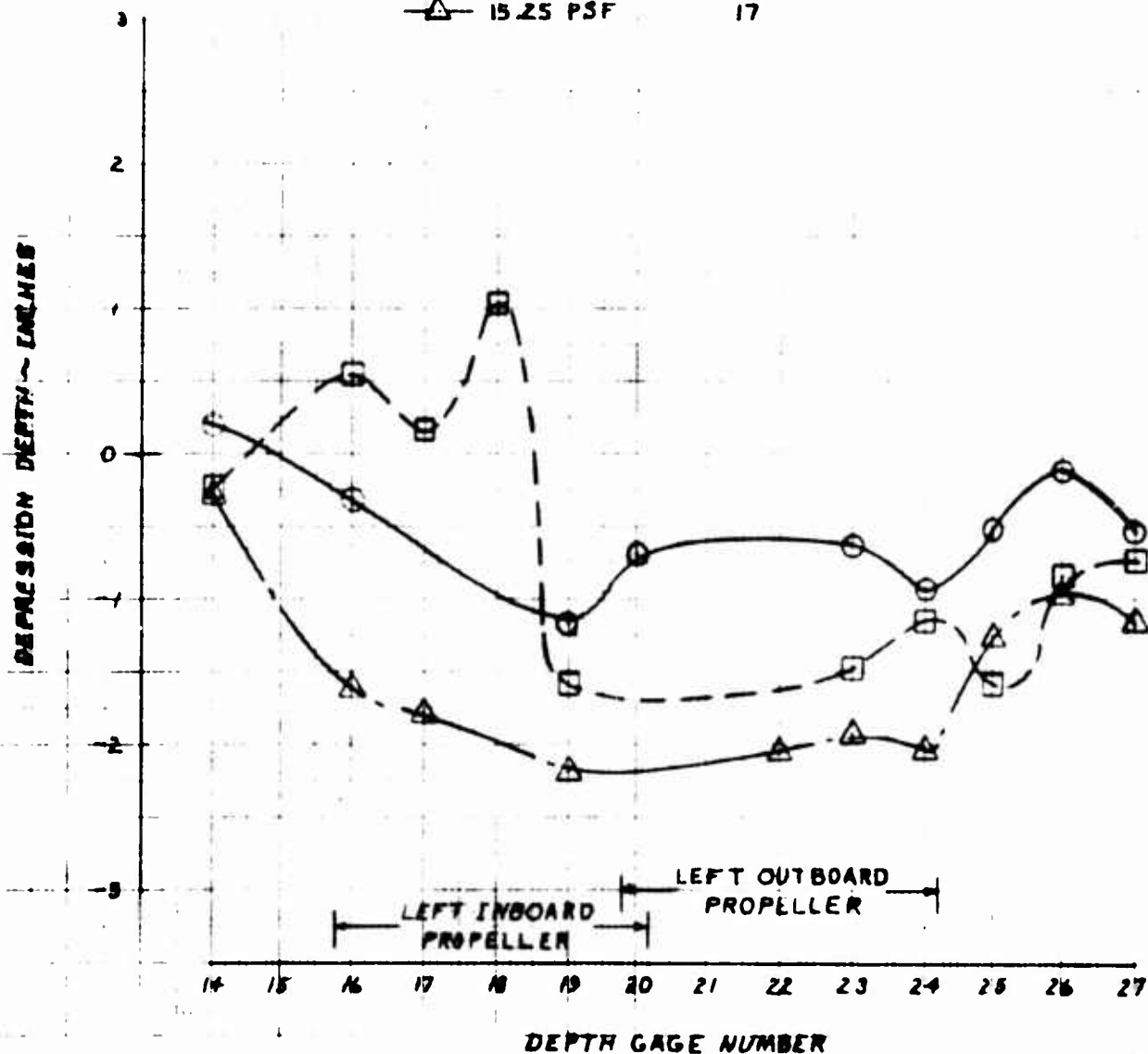


Figure 4-34 Water Displacement Along Propeller Centerline - Effects of Disc Loading

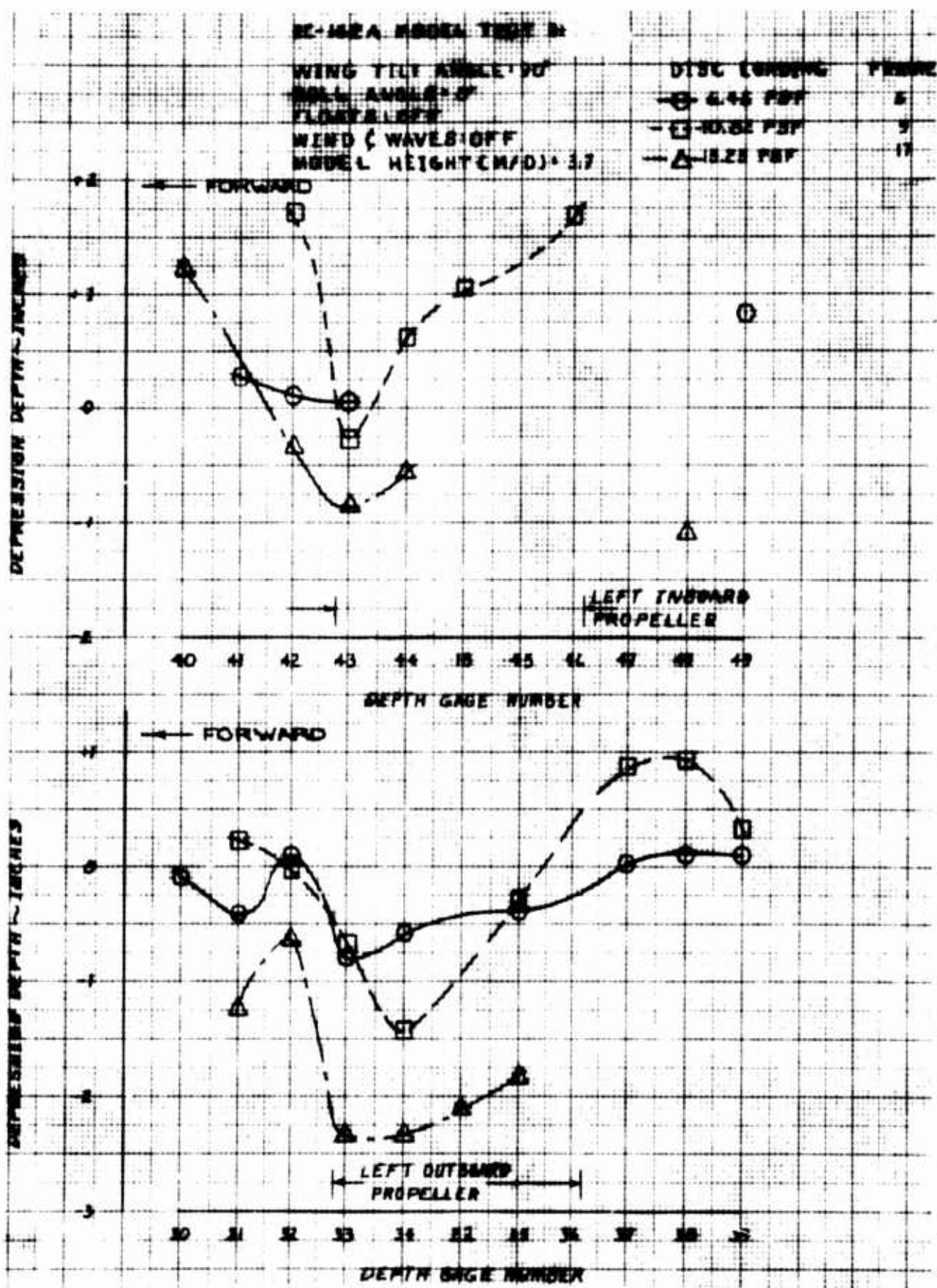


Figure 4-35 Water Displacement Fore and Aft -
 Effects of Disc Loading

XC-142A MODEL HOVER TEST

ROLL ANGLE = 0°
FLOATS : OFF
13 KNOT HEADWIND
WAVES : OFF
MODEL HEIGHT (H/D) = 3.7
DISC LOADING = 15.25

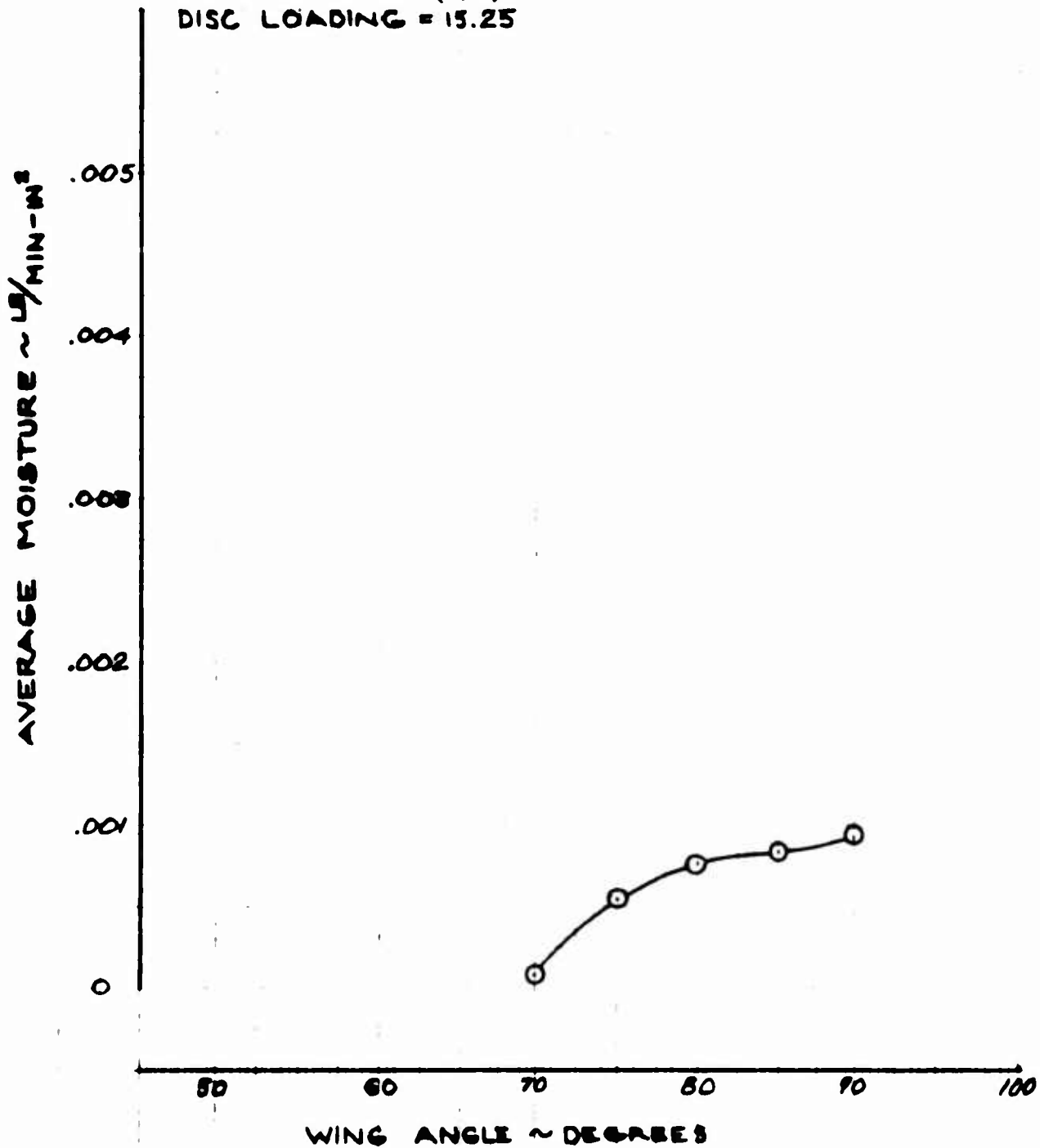


Figure 4-36 Water Entering Propellers - Effects of Wing Angle

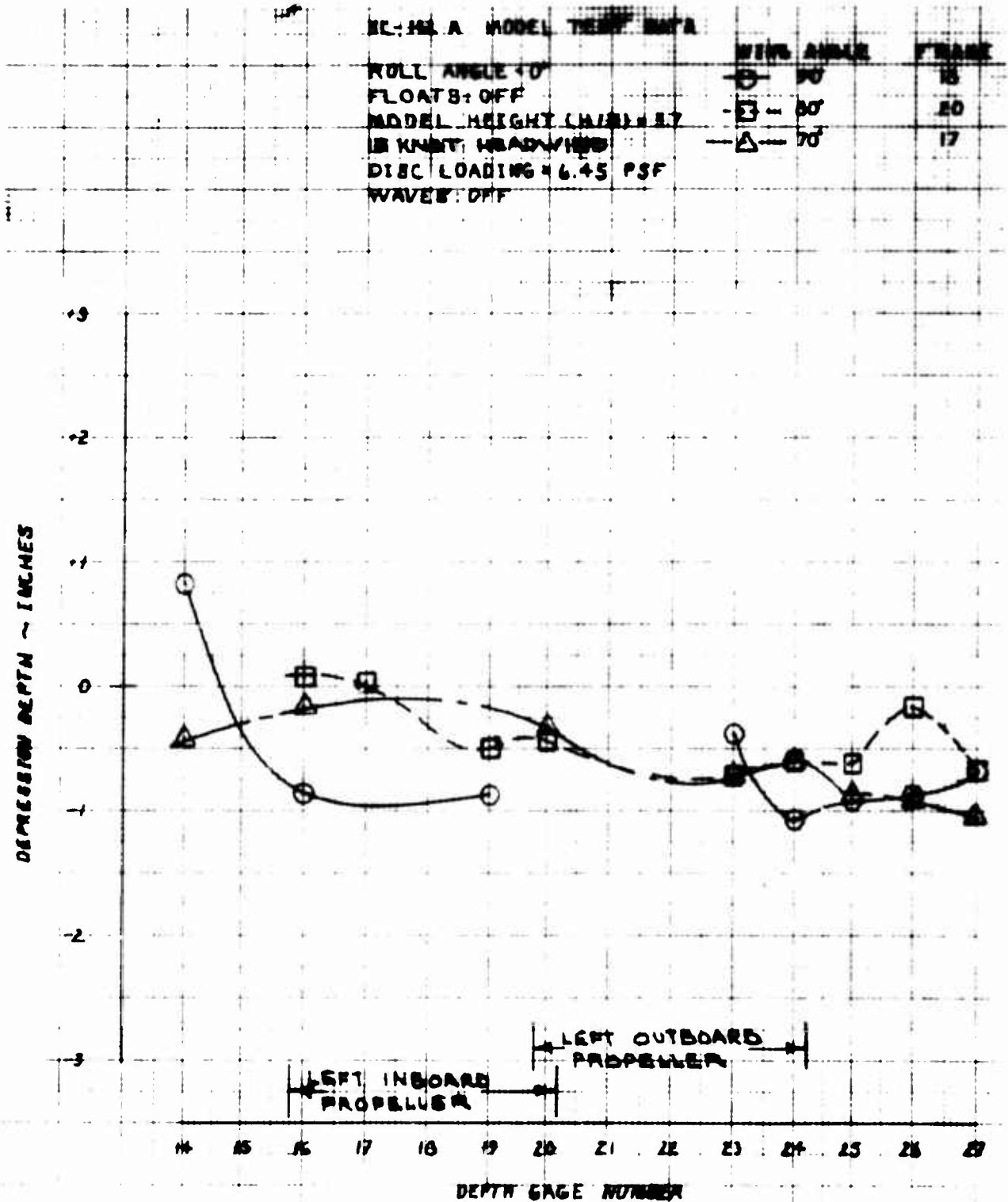


Figure 4-37 Water Displacement Along Propeller Centerline - Effects of Wing Angle

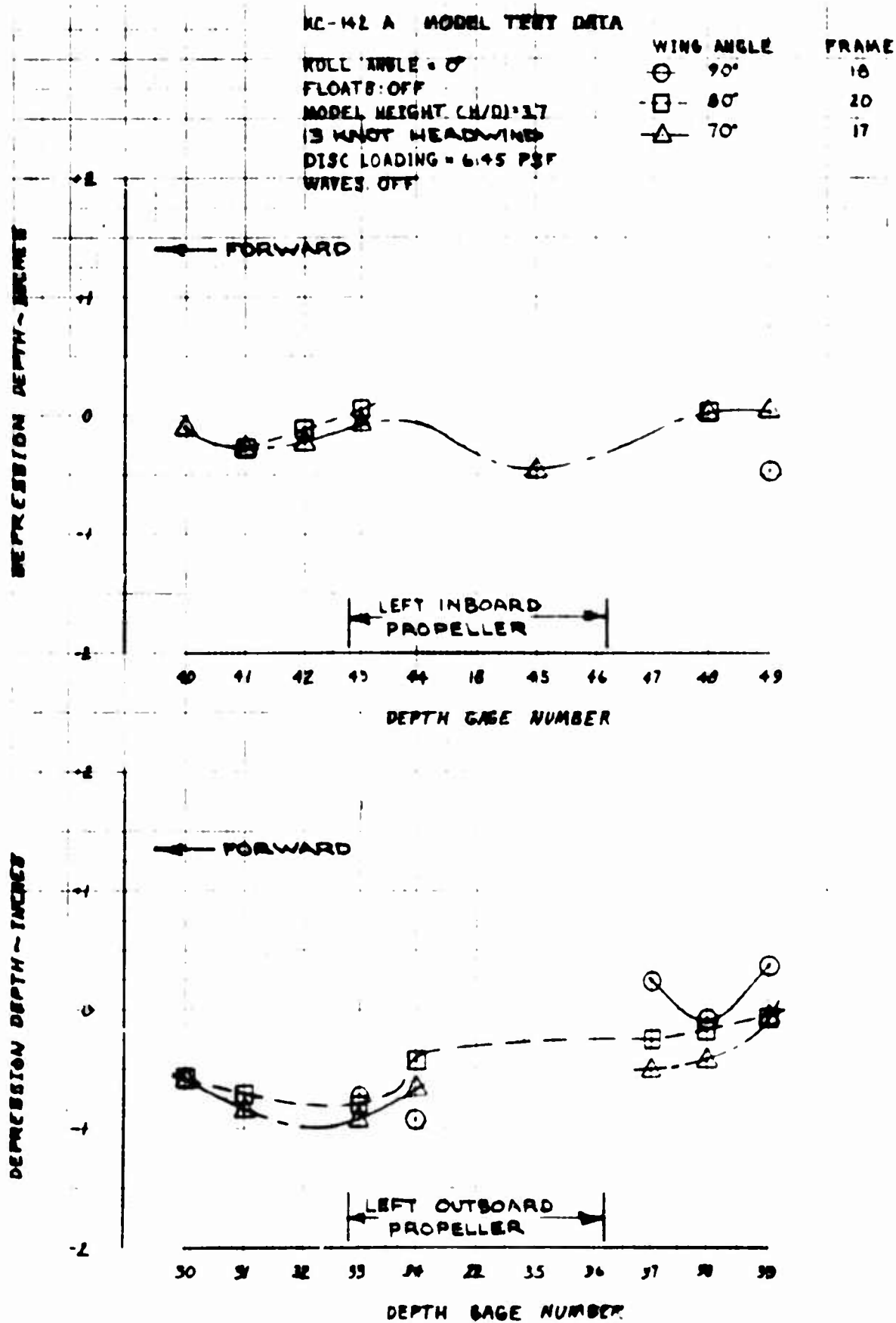


Figure 4-38 Water Displacement Fore and Aft -
 Effects of Wing Angle

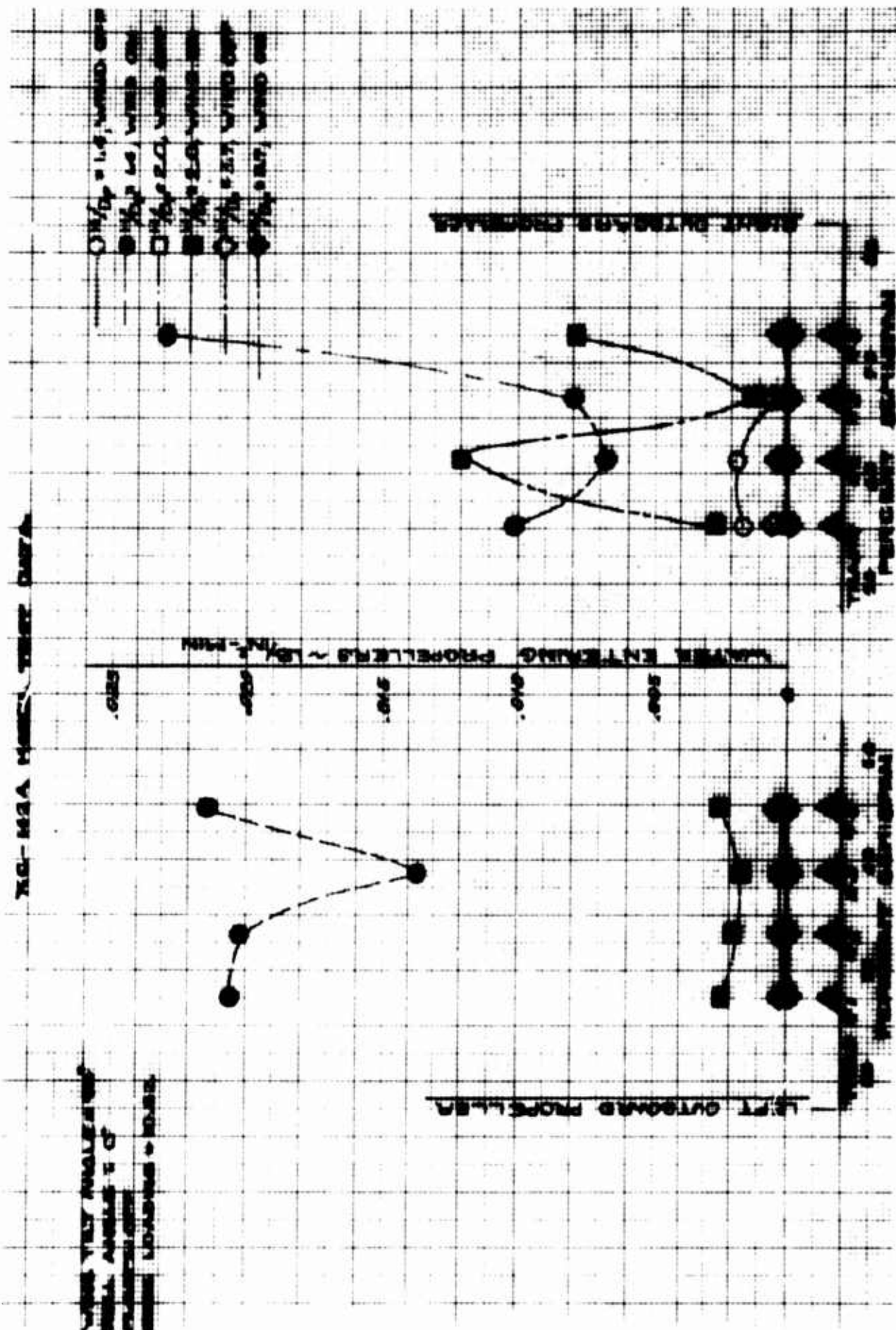


Figure 4-39 Water Entering Propellers - Effects of Surface Winds

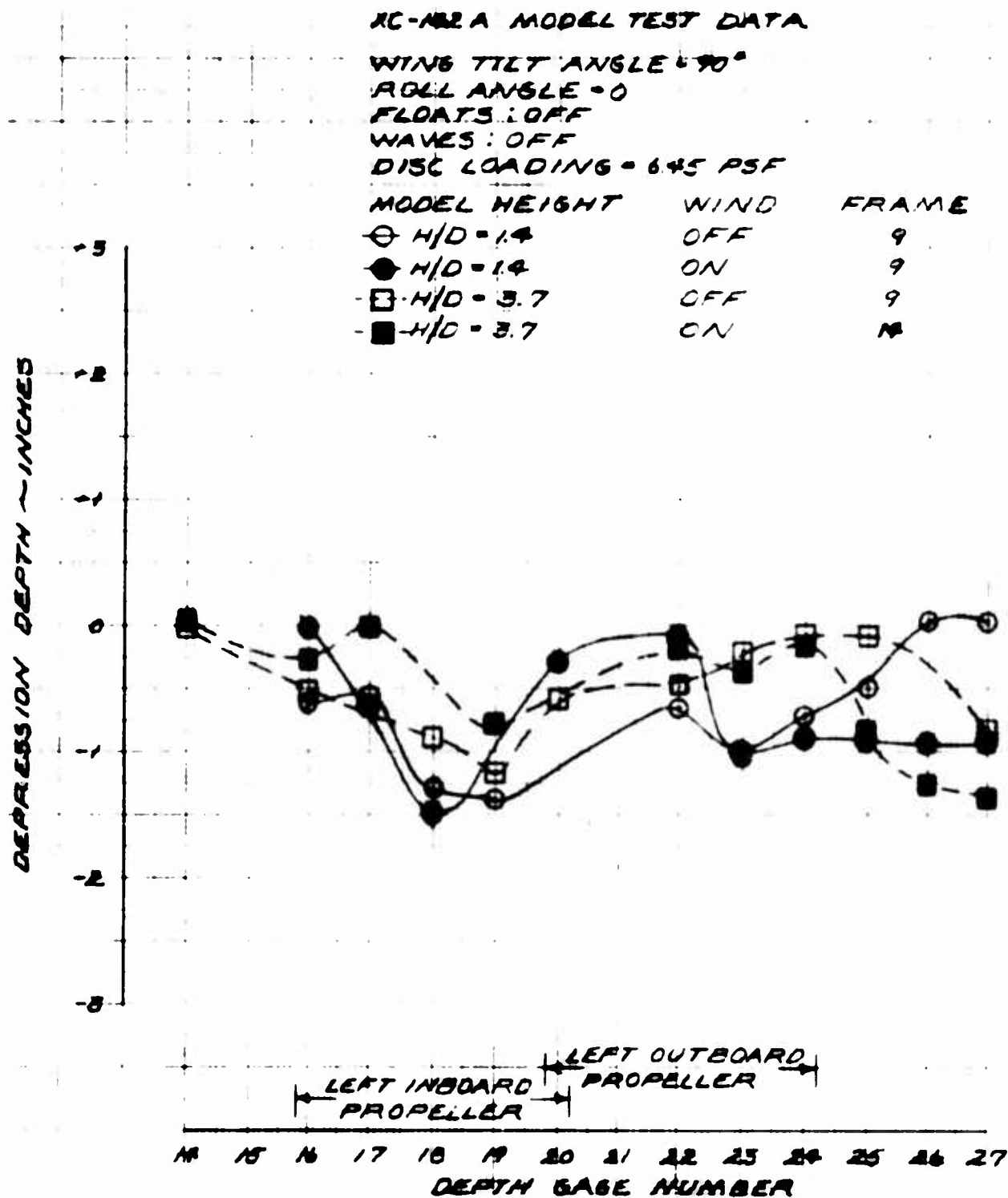
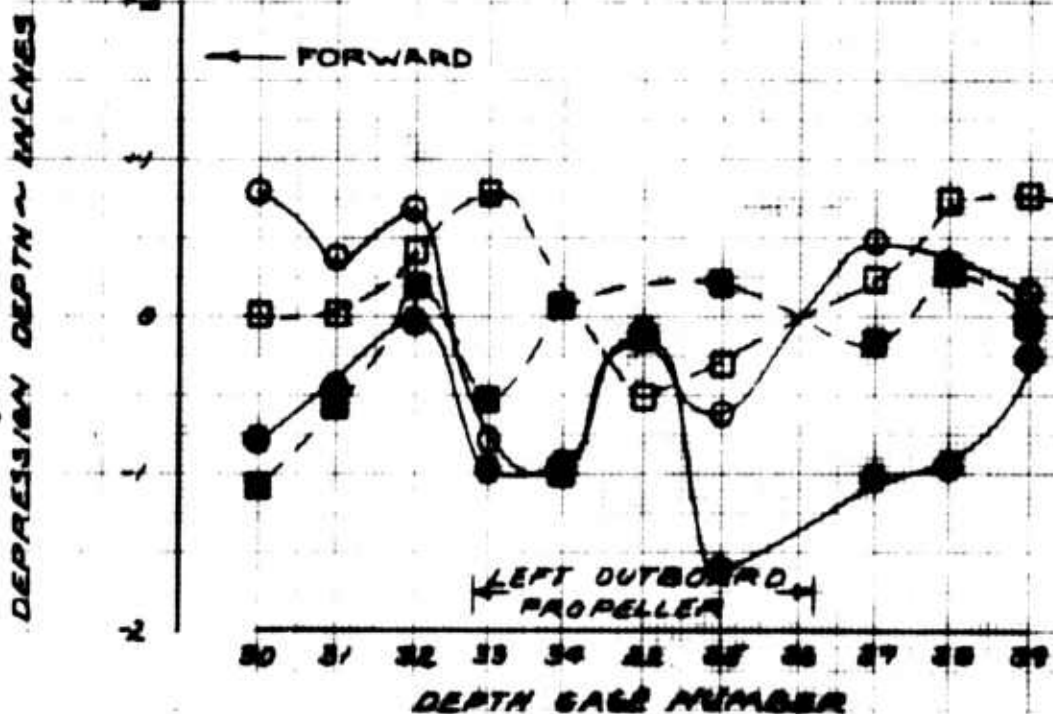


Figure 4-40 Water: Displacement Along Propeller Centerline -
Effects of Wind

WAVE TEST MODE = 90°
 WAVE MODE = 0
 FLIGHT 2 ON
 WAVE 1 OFF
 DISC LOADING = 6.45 PSF

④ $H_0: \sigma^2 = 1.0$
 ⑤ $H_0: \sigma^2 = 1.0$
 ⑥ $H_0: \sigma^2 = 1.0$
 ⑦ $H_0: \sigma^2 = 1.0$

OFF
ON
OFF
ON



4-67

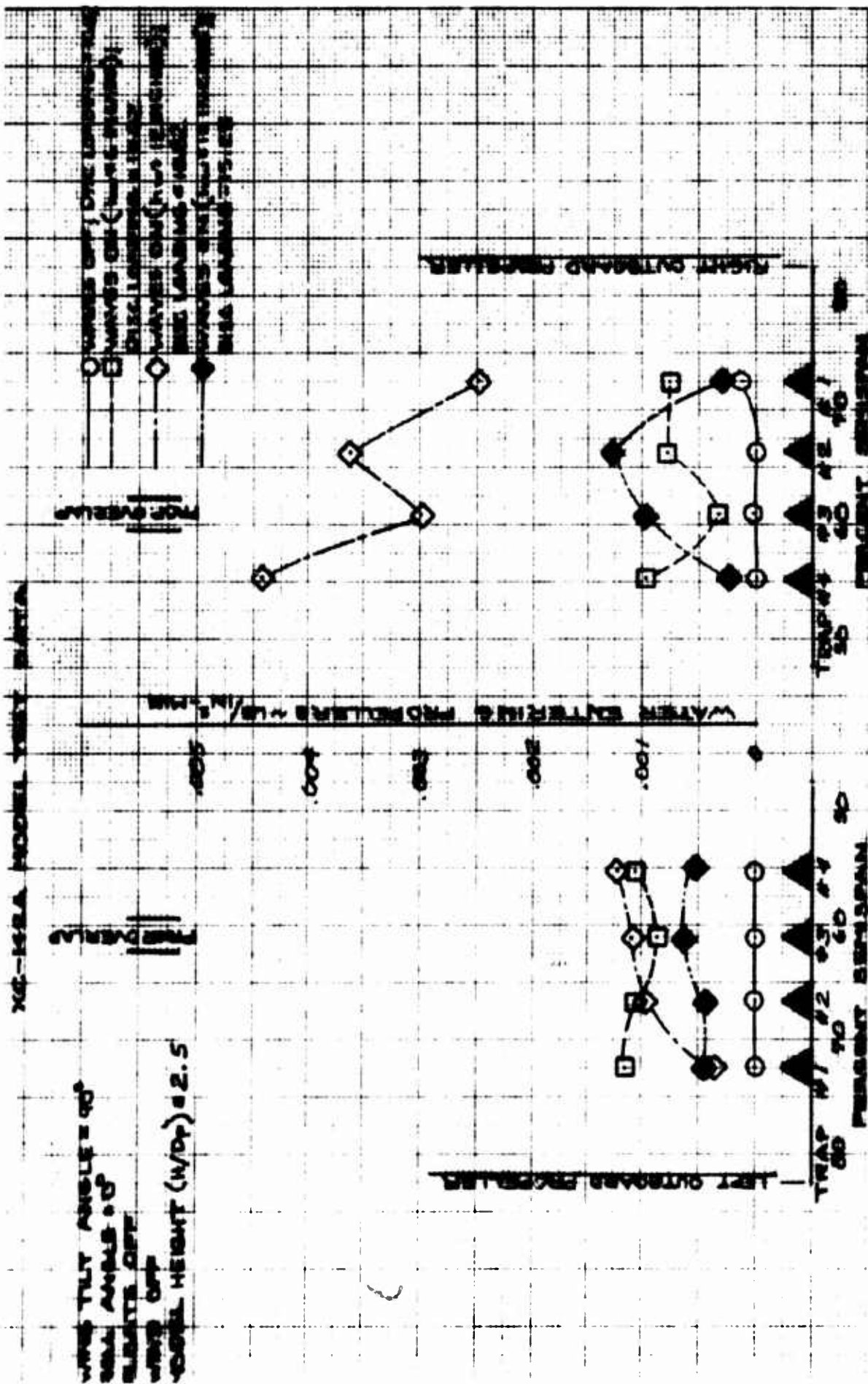


Figure 4-42 Water Entering Propellers - Effects of Wave Height

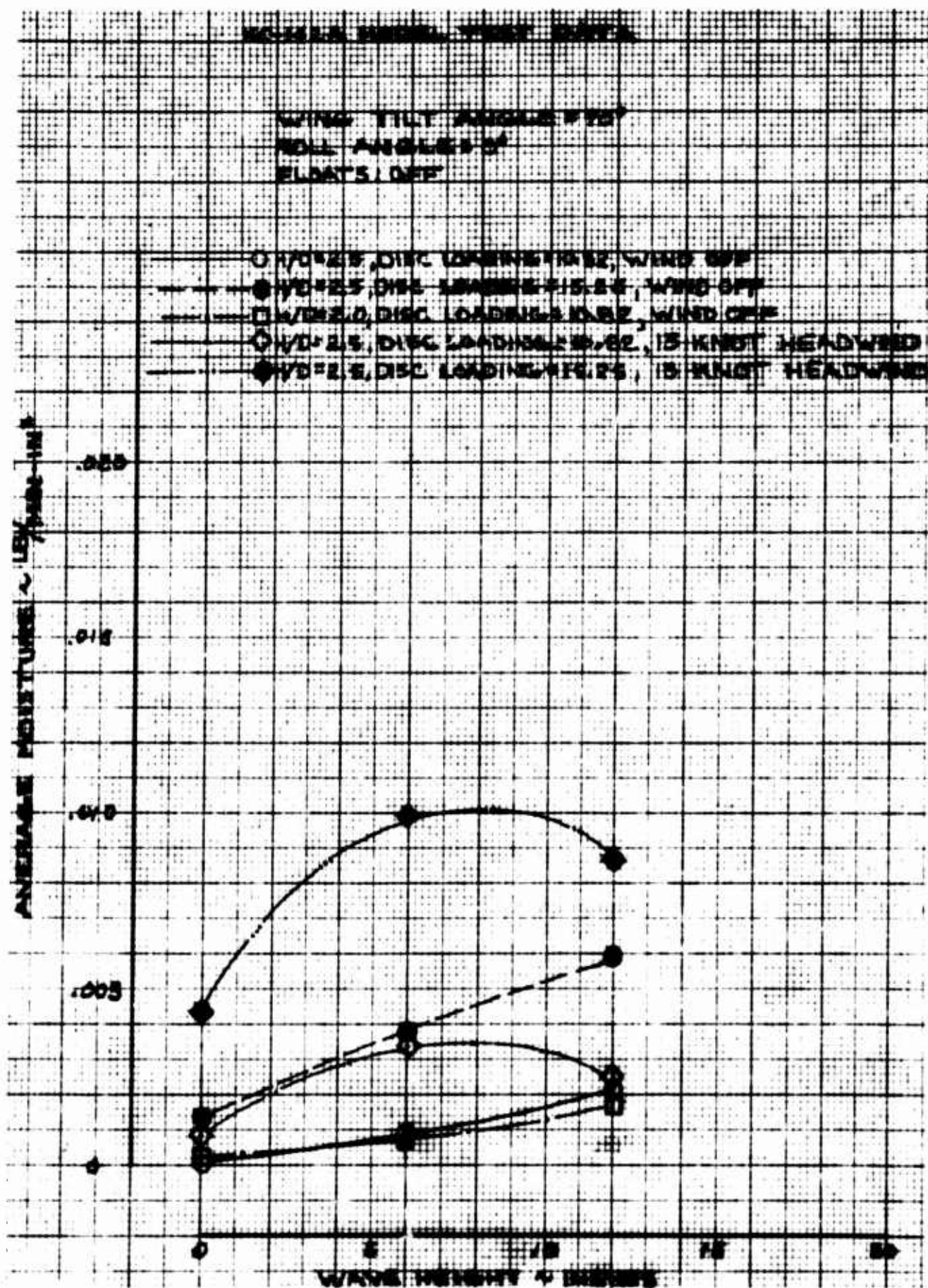


Figure 4-43 Water Entering Propellers - Effects of Wave Height

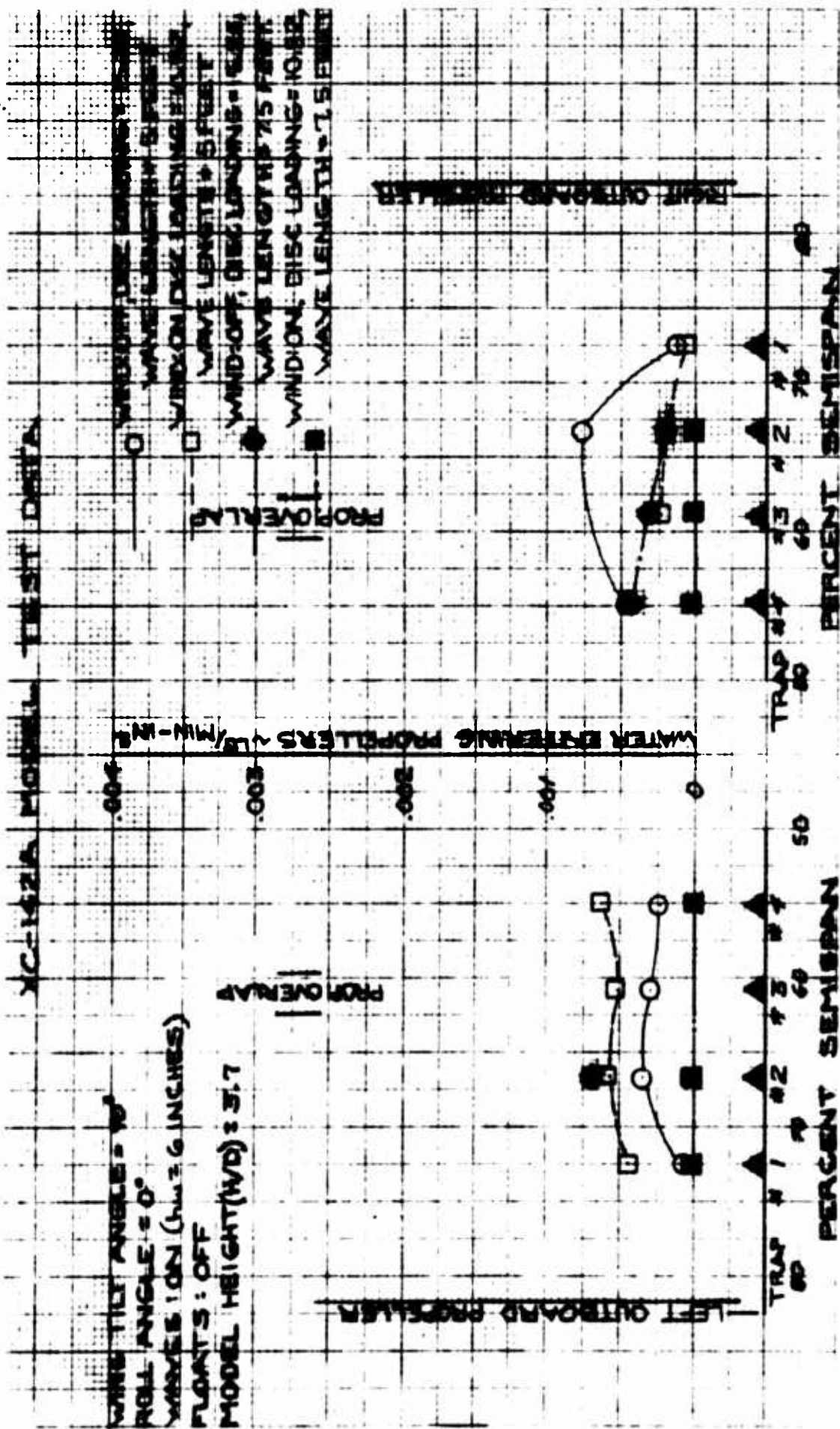


Figure 4-44 Water Entering Propellers - Effects of Wave Length

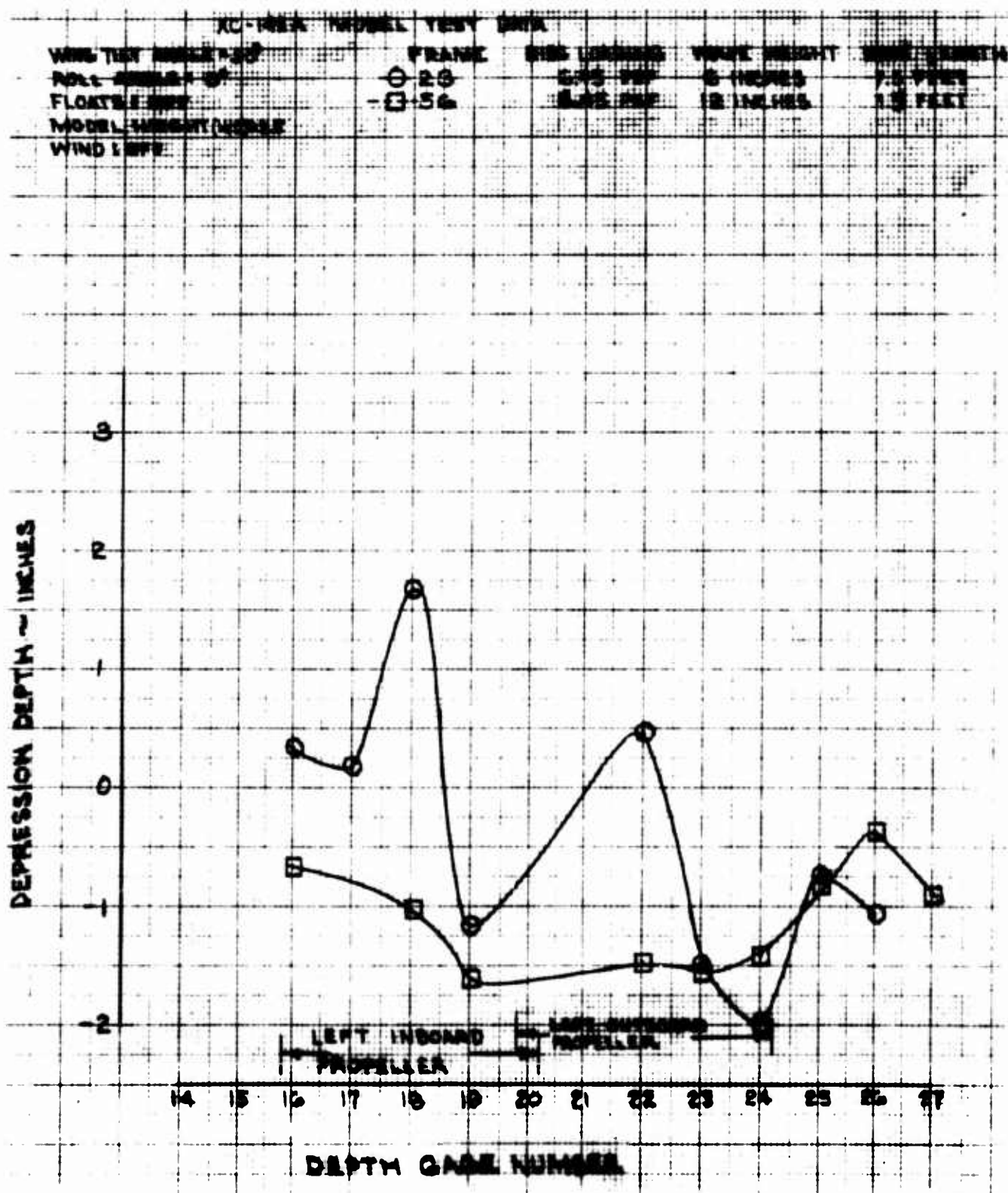


Figure 4-45 Water Displacement Along Propeller Centerline..
Effects of Waves

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS: OFF
 MODEL HEIGHT (H/M) = 2.5
 WIND: OFF

FRAME	DIRE. LAMINAR	WAVE HEIGHT	WAVE LENGTH
○ 29	0.45 PSF	6 INCHES	7.5 FEET
□ 50	0.45 PSF	12 INCHES	15 FEET

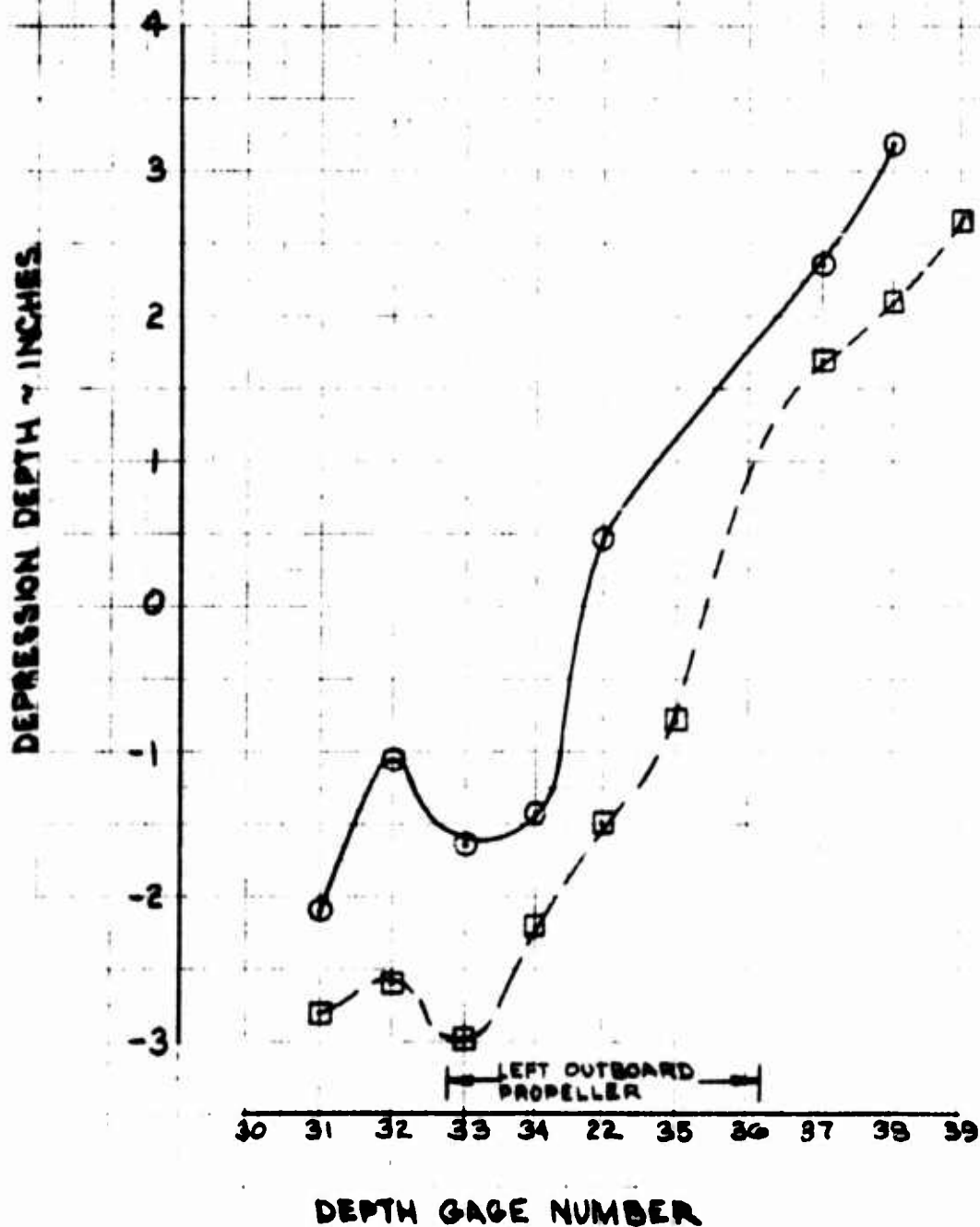


Figure 4-46 Water Displacement Along Propeller Centerline - Effects of Waves

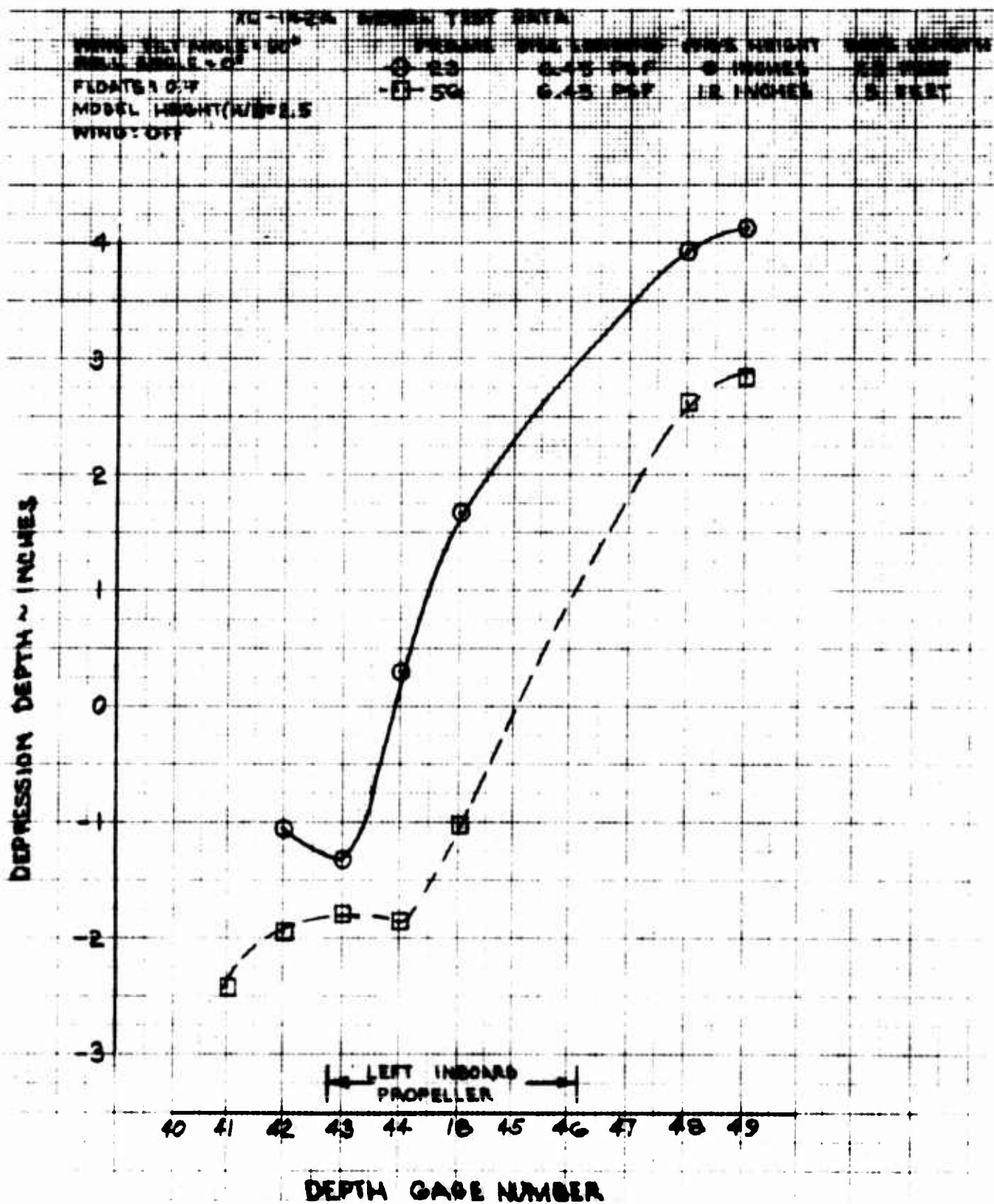


Figure 4-47 Water Displacement Along Propeller Centerline -
Effects of Waves

EC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS 1, 2, 3
 DISC. LOADS = 6.45
 WAVE LENGTH = 7.5 FT
 WAVE HEIGHT = 6 INCHES

MODEL HEIGHT	WIND	FRAME
1.4	OFF	43
1.8	ON	17
3.7	ON	57

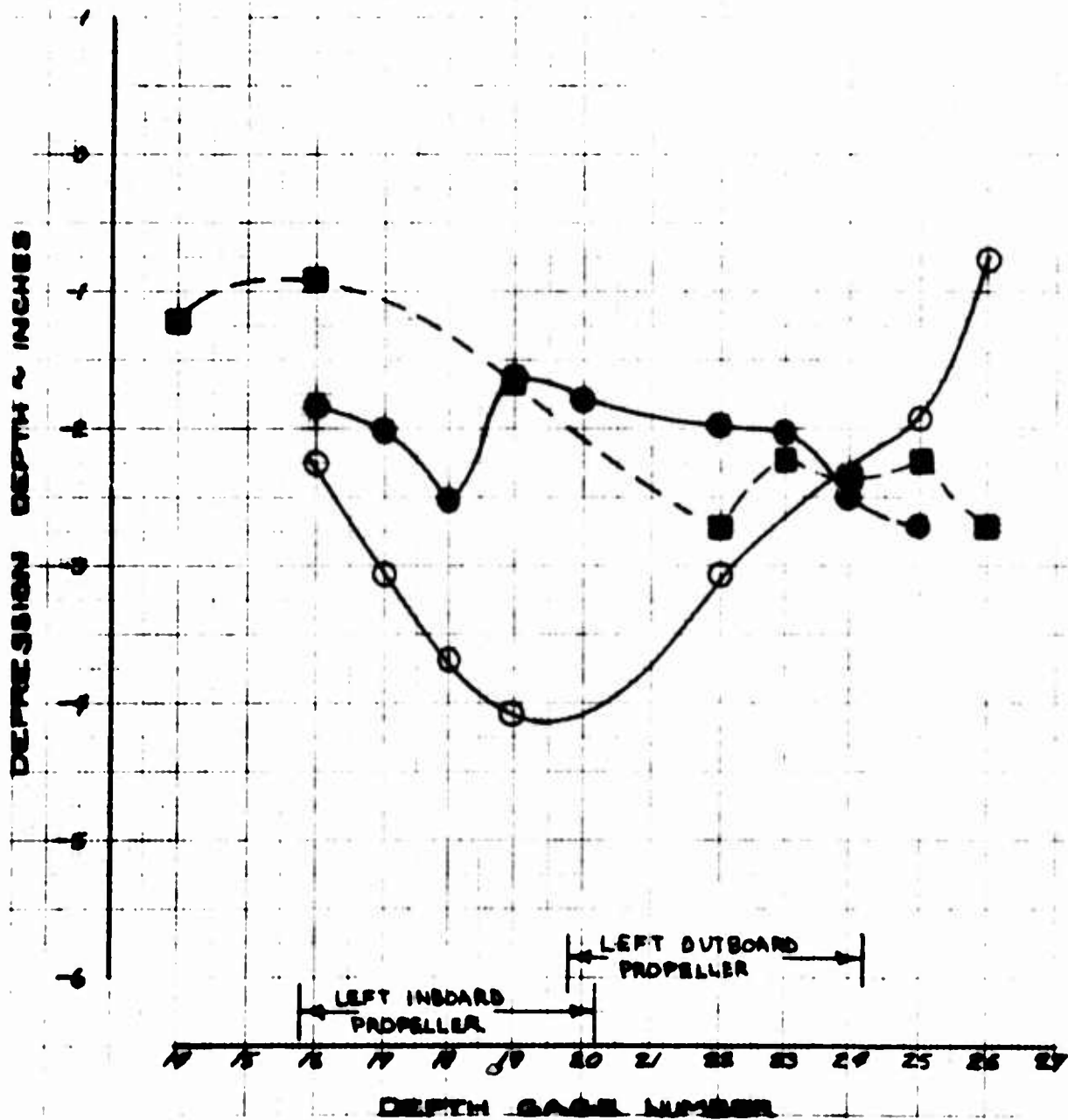


Figure 4-48 Water Displacement Along Propeller Centerline - Effects of Waves

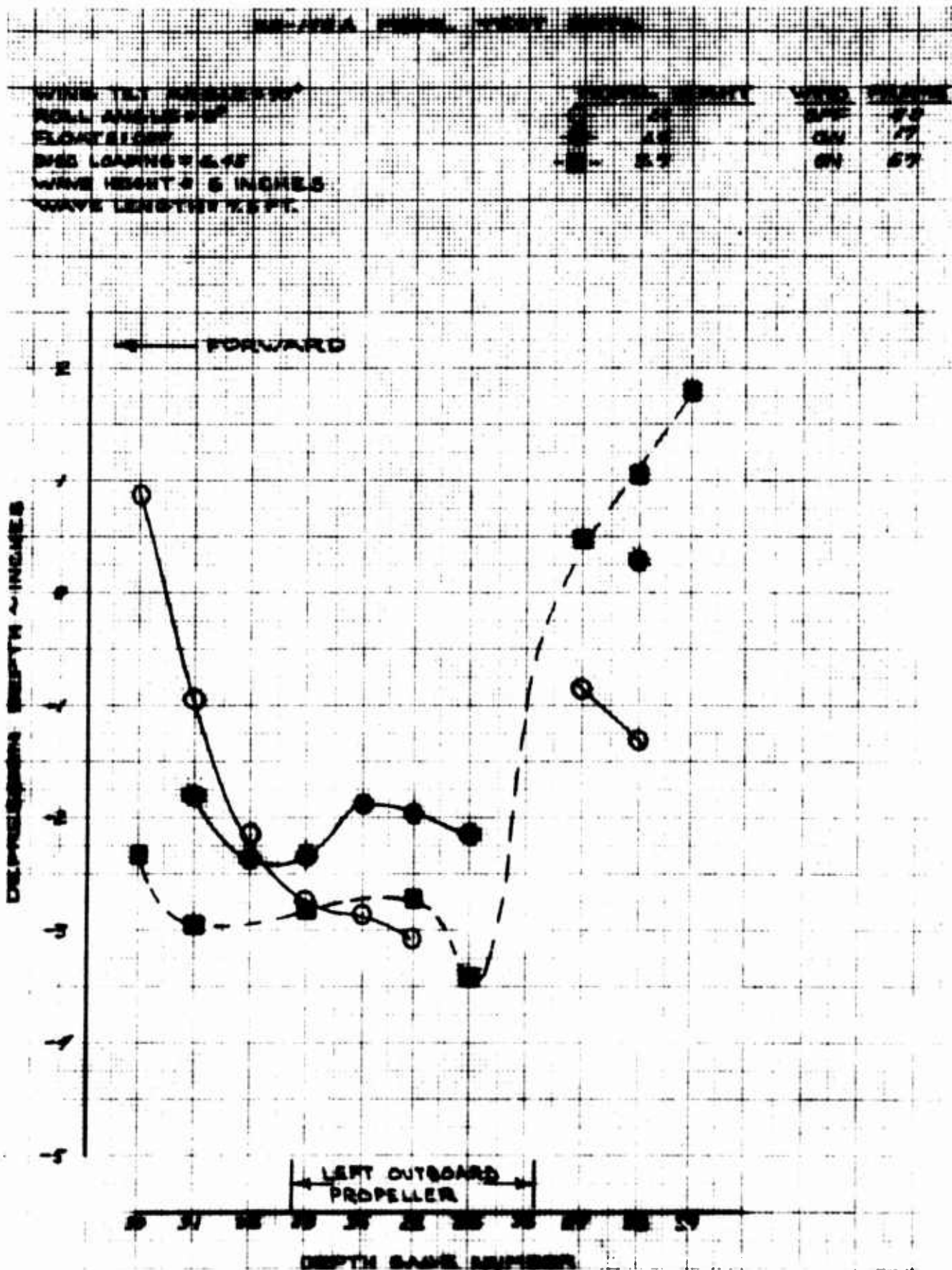


Figure 4-49 Water Displacement Fore and Aft -
Effects of Waves

SEA MODEL TEST DATA

HEEL YET ANGLE = 70°
 ROLL ANGLE = 0°
 FLOATE / SET
 DISC LOADING = 6.45
 WAVE HEIGHT = 6 INCHES
 WAVE LENGTH = 18 FT.

	MODEL HEIGHT	WIND	FRAME
○	1.0	OFF	43
●	1.0	ON	17
■	3.7	ON	57

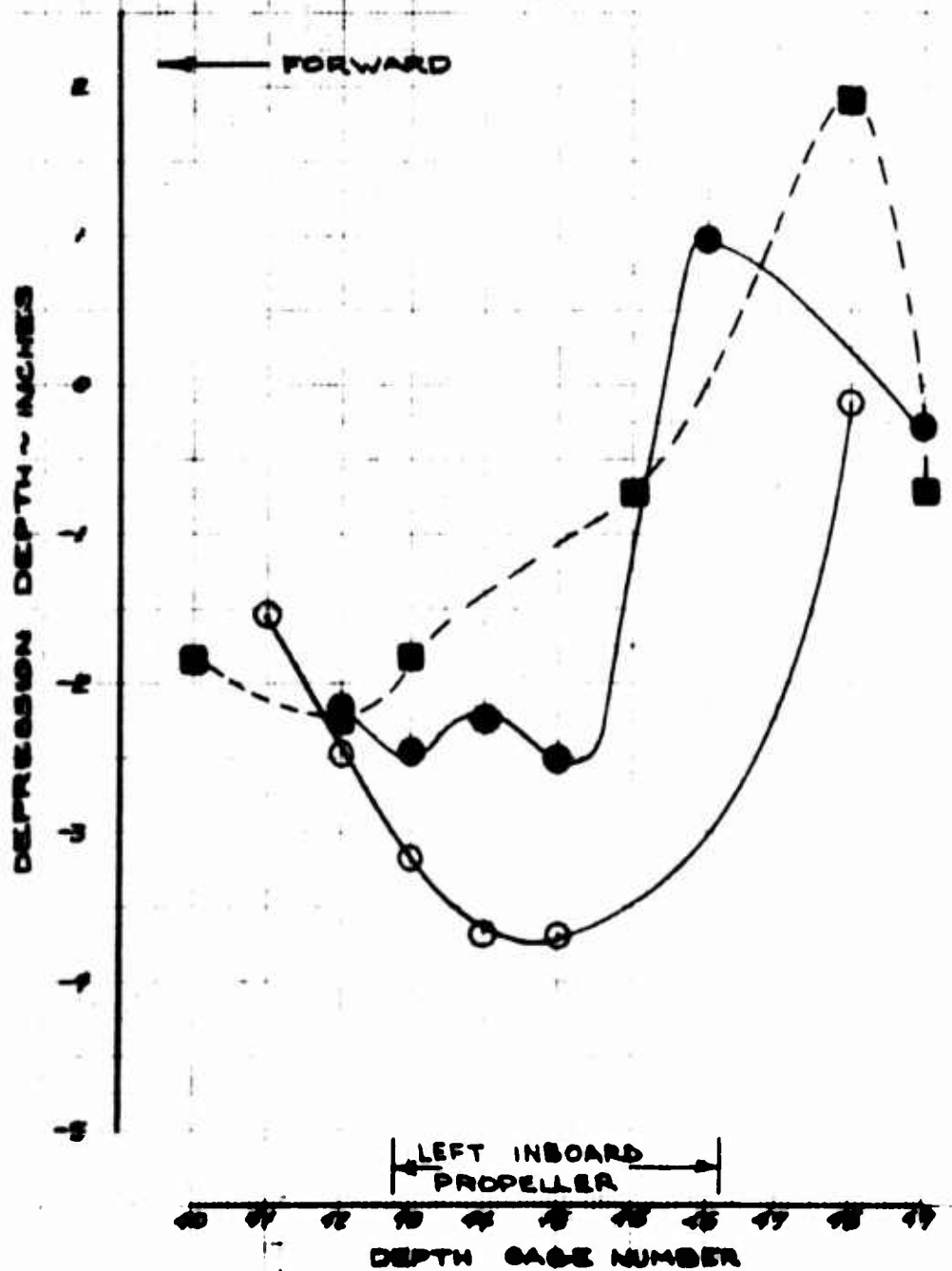


Figure 4-50 Water Displacement Fore and Aft — Effects of Waves

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = -10°
 FLOATS: OFF
 WIND: OFF
 WAVES: ON ($h_w = 6$ INCHES)
 MODEL HEIGHT = 3.7

—— POINT 1 DISC LOADING = 6.45
 - - - POINT 2 DISC LOADING = 10.82
 - · - POINT 3 DISC LOADING = 15.25

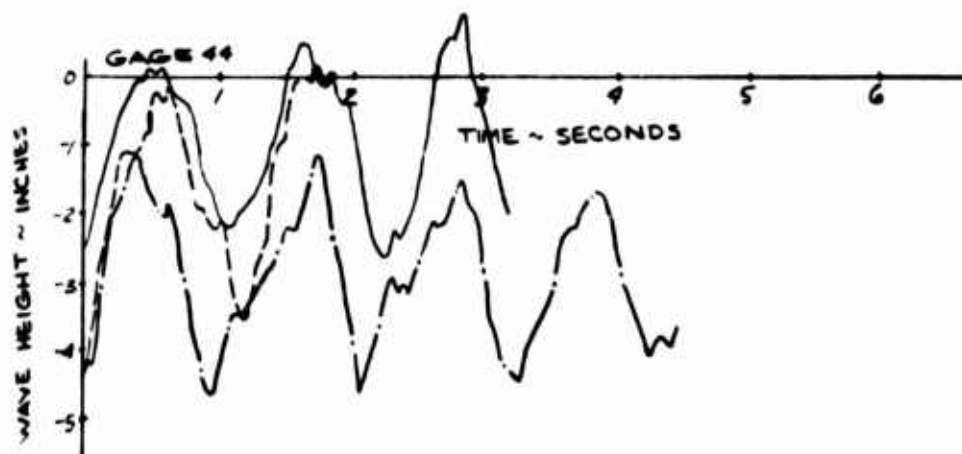
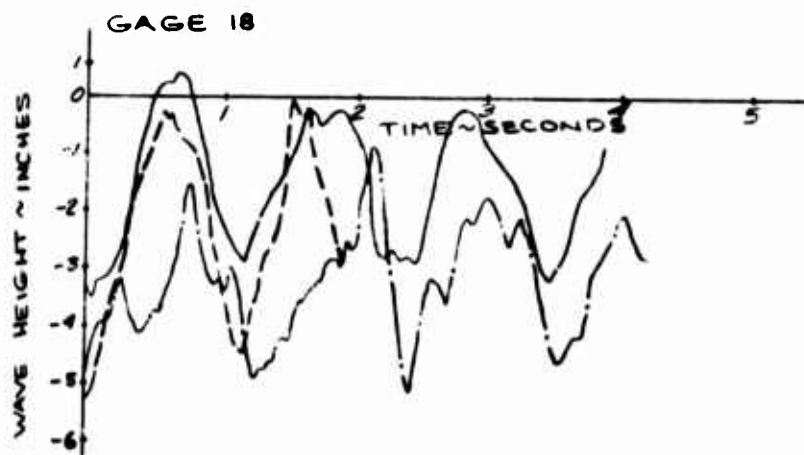


Figure 4-51 Effects of Waves

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°

ROLL ANGLE = -10°

FLOATS: OFF

WIND: OFF

WAVES: ON ($h_w = 6$ INCHES)

MODEL HEIGHT = 3.7

—— POINT 1, DISC LOADING = 6.45

- - - POINT 2, DISC LOADING = 10.82

— · — · — POINT 3, DISC LOADING = 15.25

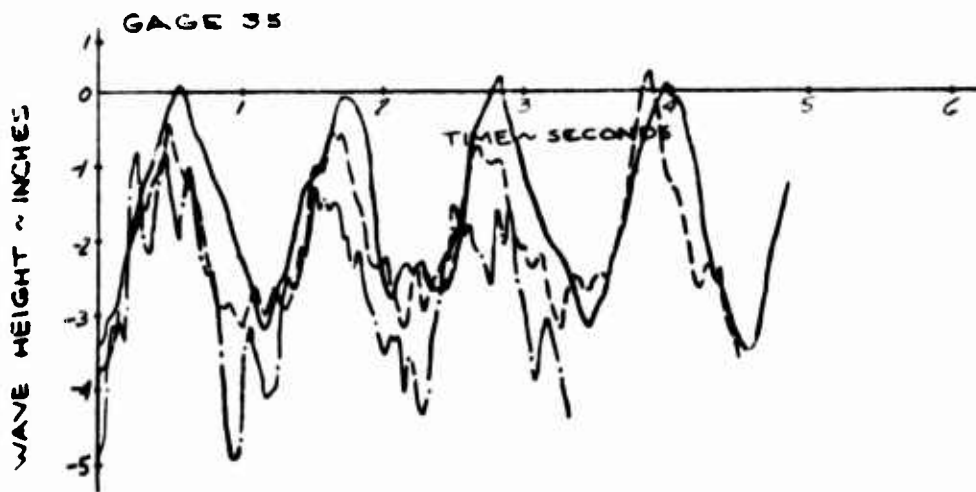
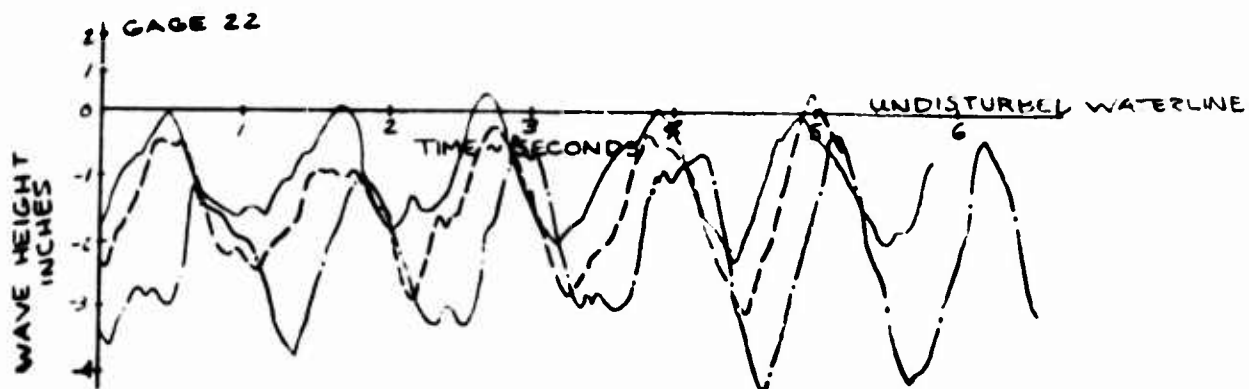


Figure 4-52 Effects of Waves

XC-142A. MODEL TEST DATA

WING TILT ANGLE = 90°

ROLL ANGLE = 0°

FLOATS: OFF

13 KNOT HEADWIND

WAVES: ON, ($h_w = 12$ INCHES)

MODEL HEIGHT = 2.5

— POINT 1 DISC LOADING = 6.45
 --- POINT 2 DISC LOADING = 10.82
 - - - POINT 3 DISC LOADING = 15.25

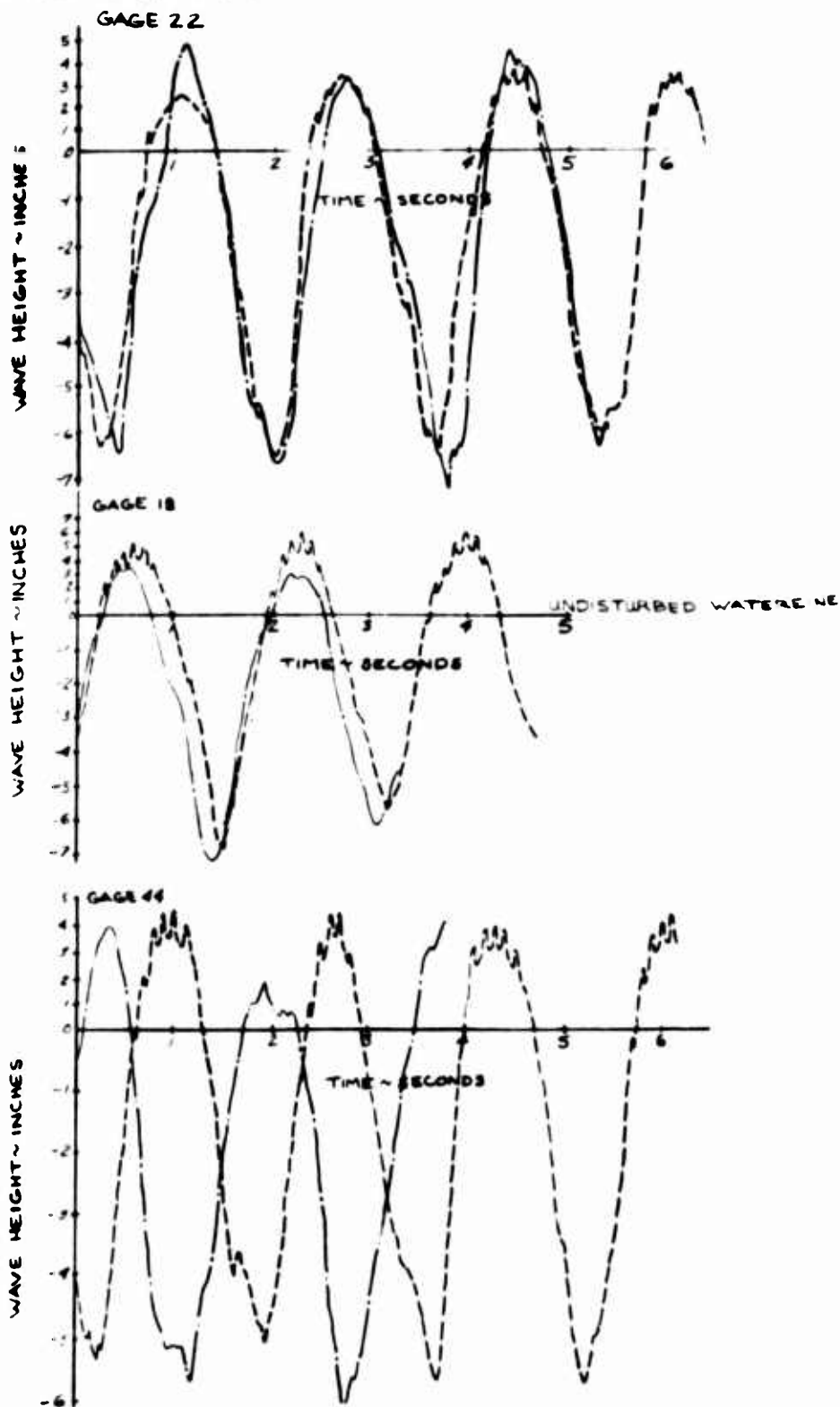


Figure 4-53 Effects of Waves

XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°

ROLL ANGLE = 0°

FLOATS: OFF

13 KNOT HEADWIND

WAVES: ON (hw = 12 INCHES)

MODEL HEIGHT = 2.5

—— POINT 1, DISC LOADING = 6.45

- - - POINT 2, DISC LOADING = 10.82

- · - POINT 3, DISC LOADING = 15.25

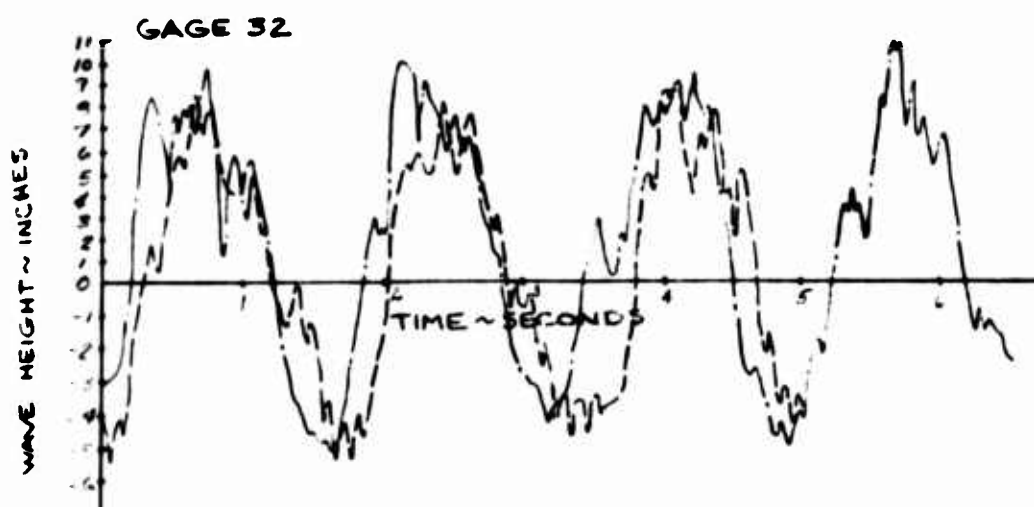
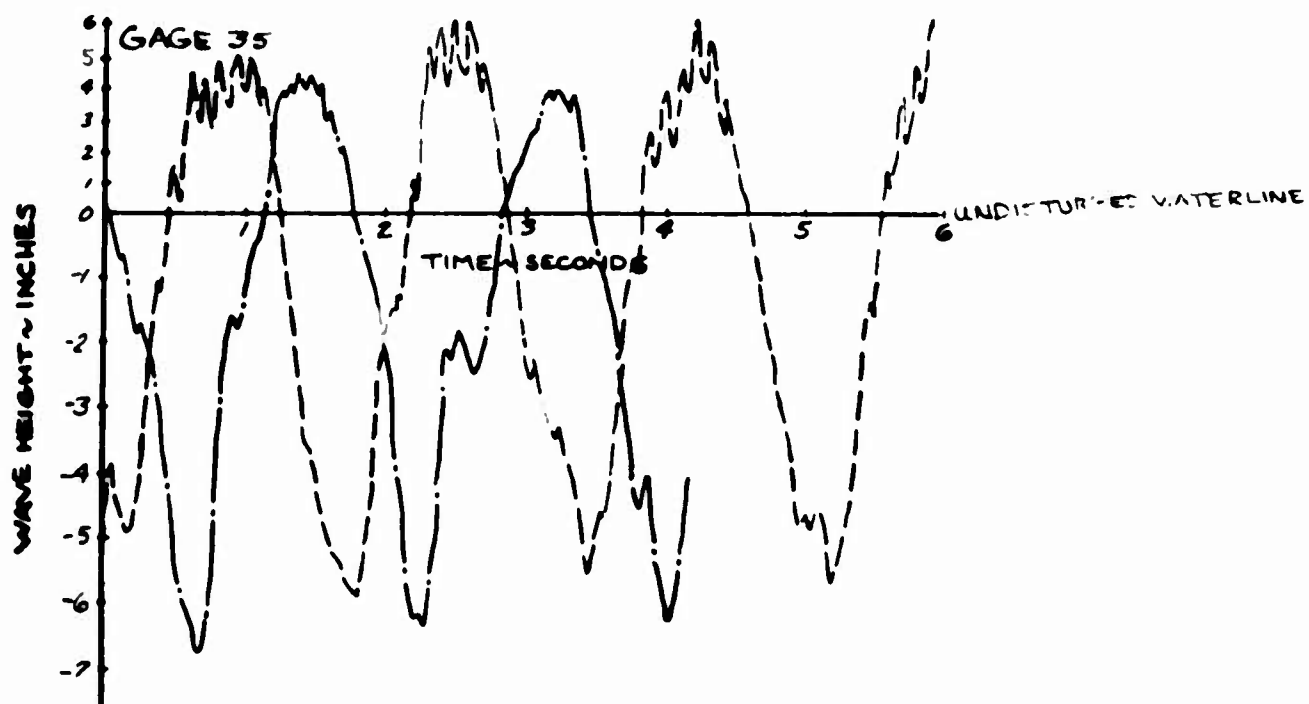


Figure 4-54 Effects of Waves

XC-142A MODEL TEST DATA

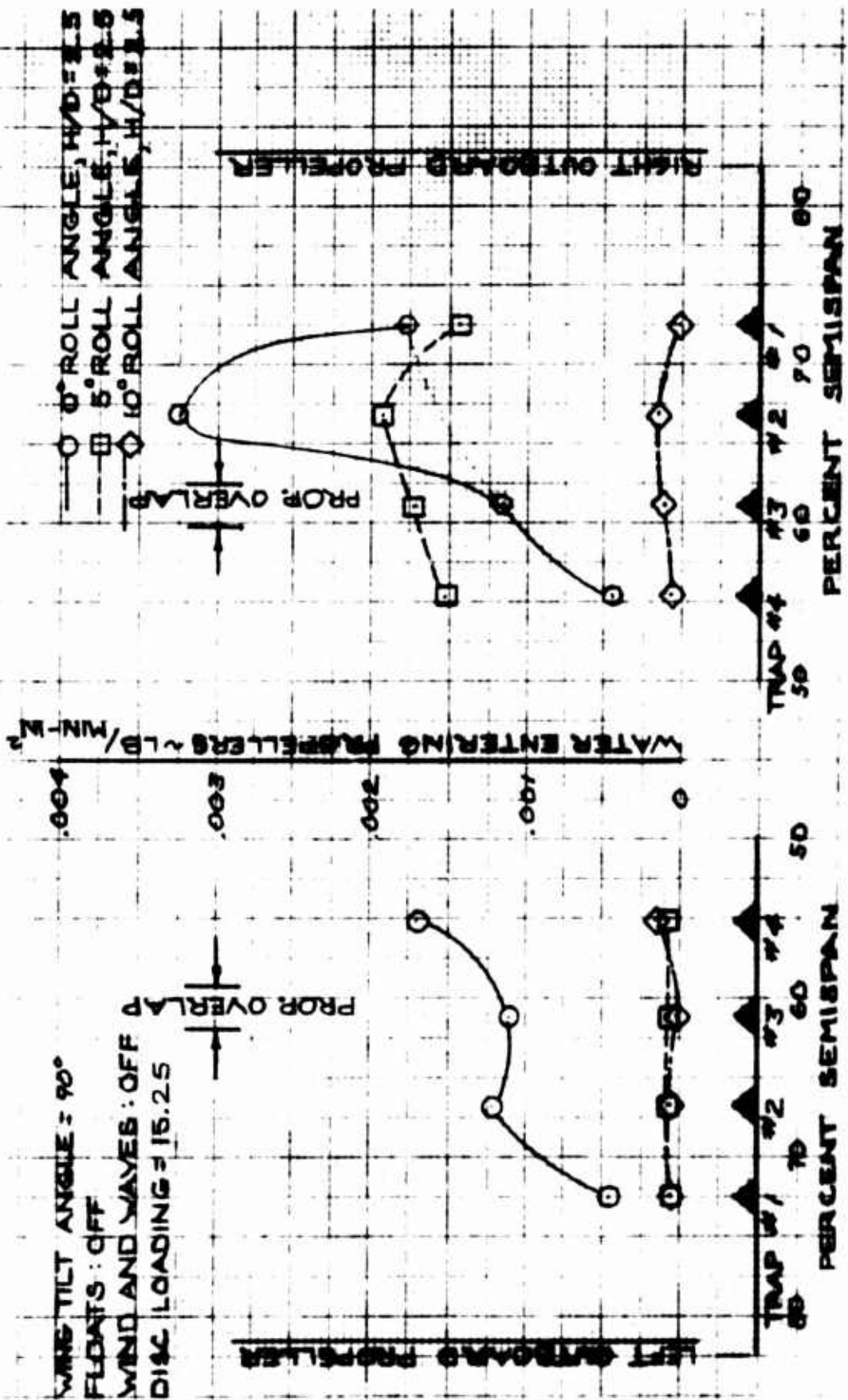


Figure 4-55 Water Entering Propellers - Effects of Roll Angle

HC-119A MODEL TEST DATA

WING TILT ANGLE = 40°

FLOATS OFF

MODEL HEIGHT (H/D) = 2.5

- WIND AND WAVES OFF, DISC LOADING = 10.82
- WIND OFF, WAVES ON ($h_w = 6$ INCHES), DISC LOADING = 10.82
- ◇ WIND ON, WAVES OFF, DISC LOADING = 10.82
- △ WIND ON, WAVES ON ($h_w = 6$ INCHES), DISC LOADING = 10.82
- ▲ WIND ON, WAVES ON ($h_w = 6$ INCHES), DISC LOADING = 15.25

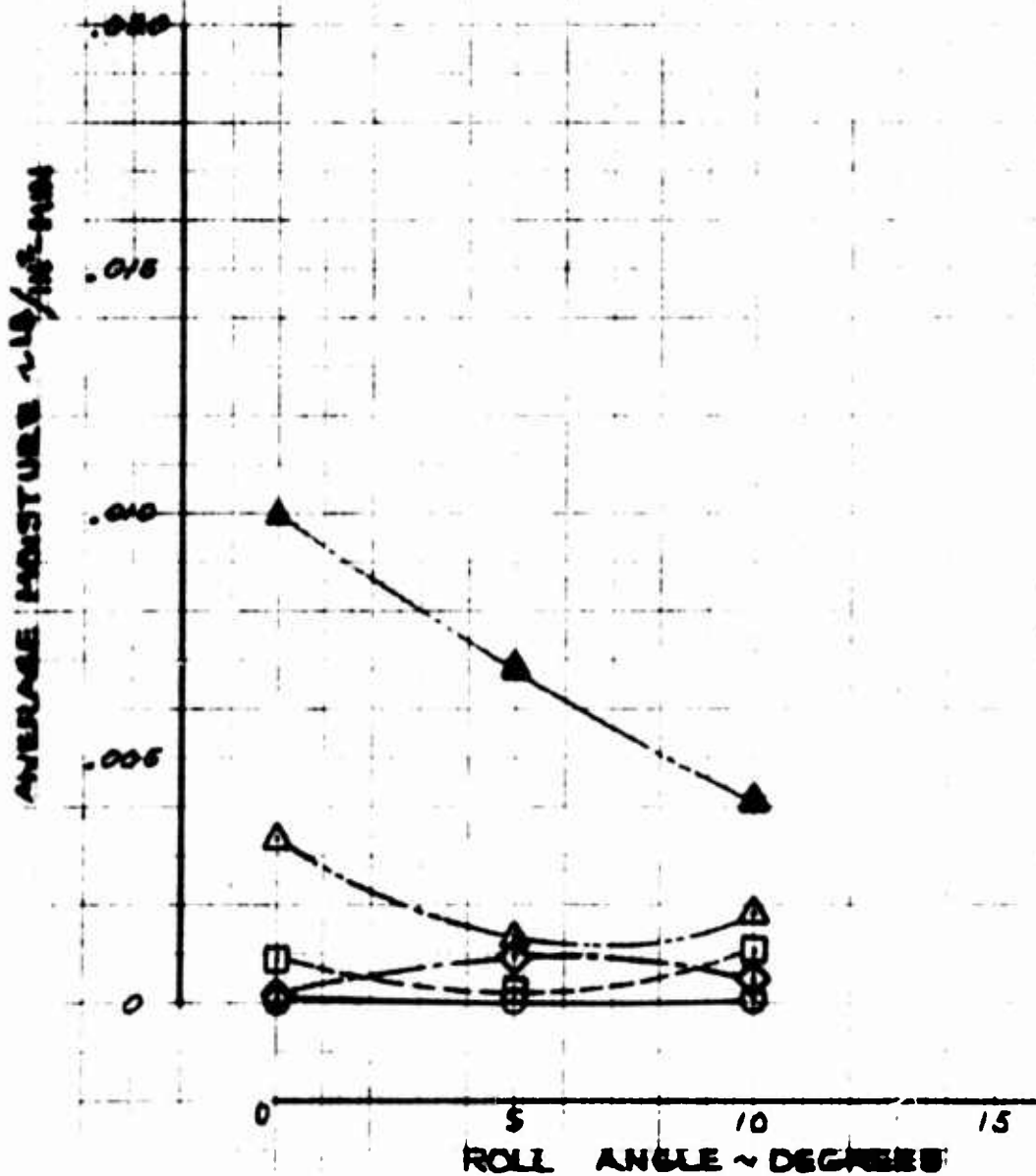


Figure 4-56 Water Entering Propellers - Effects of Roll Angle

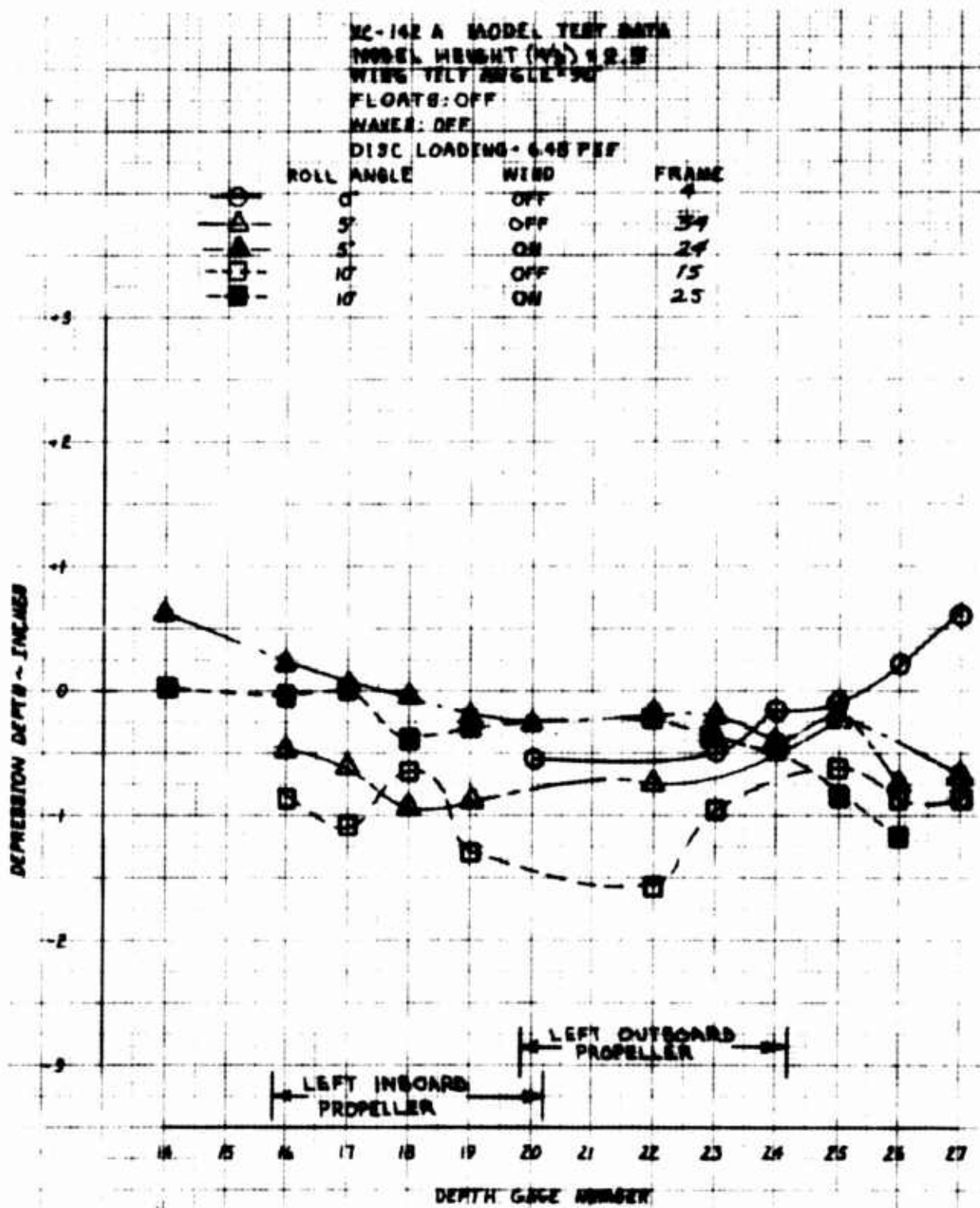


Figure 4-57 Water Displacement Along Propeller Centerline -
 Effects of Roll Angle

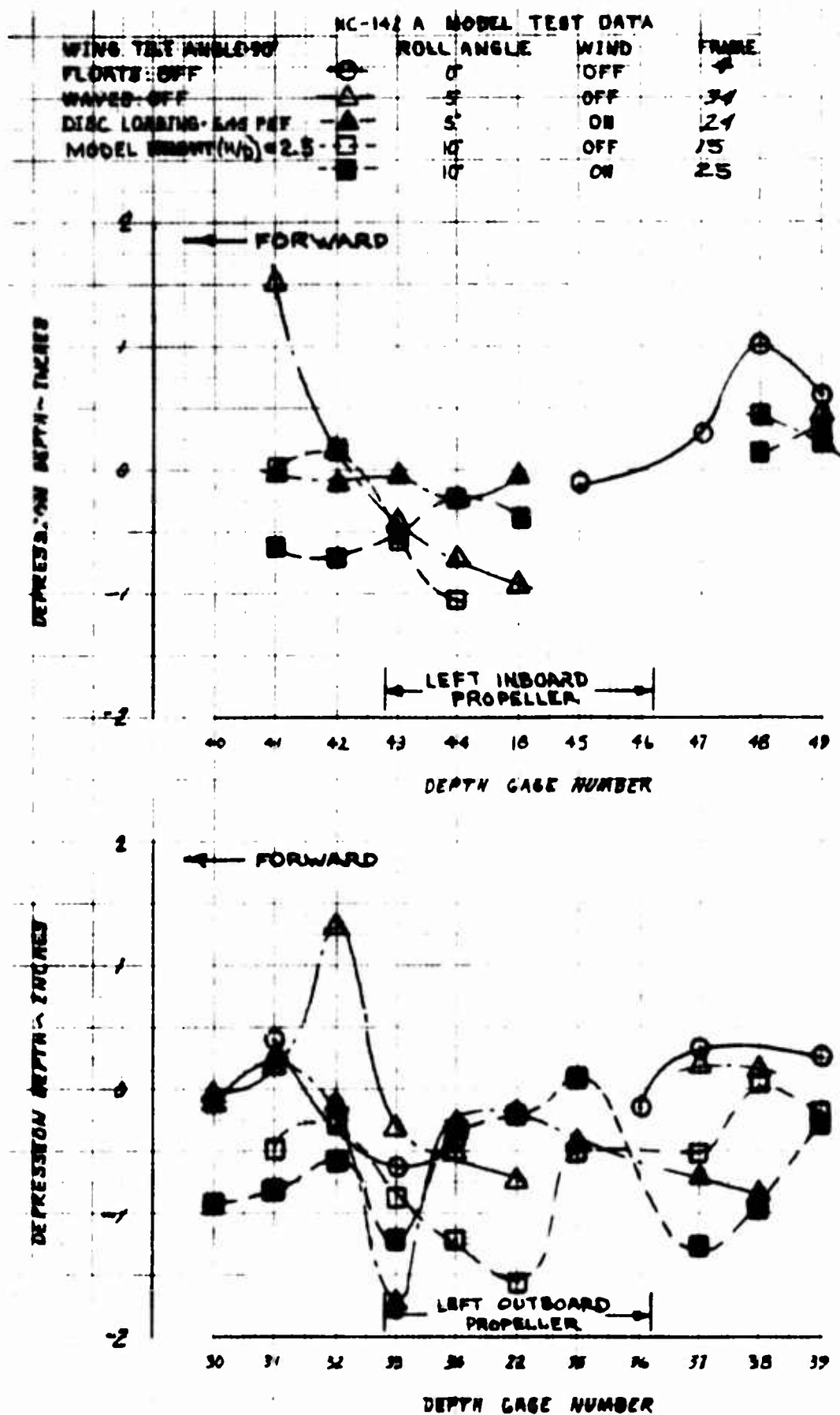


Figure 4-58 Water Displacement Fore and Aft -
Effects of Roll Angle
4-84

RC-119A MODEL TEST DATA

WING TILT ANGLE = 90°
 FLOATS : OFF
 WIND & WAVES : OFF
 MODEL HEIGHT (H/D) = 2.5

DISC LOADING

⊕ 6.45
 ● 6.45
 □ 6.45
 ⊗ 6.45

ROLL ANGLE

5°
 5°
 10°
 10°

FRAME

65 LEFT SIDE
 49 RIGHT SIDE
 49 LEFT SIDE
 80 RIGHT SIDE

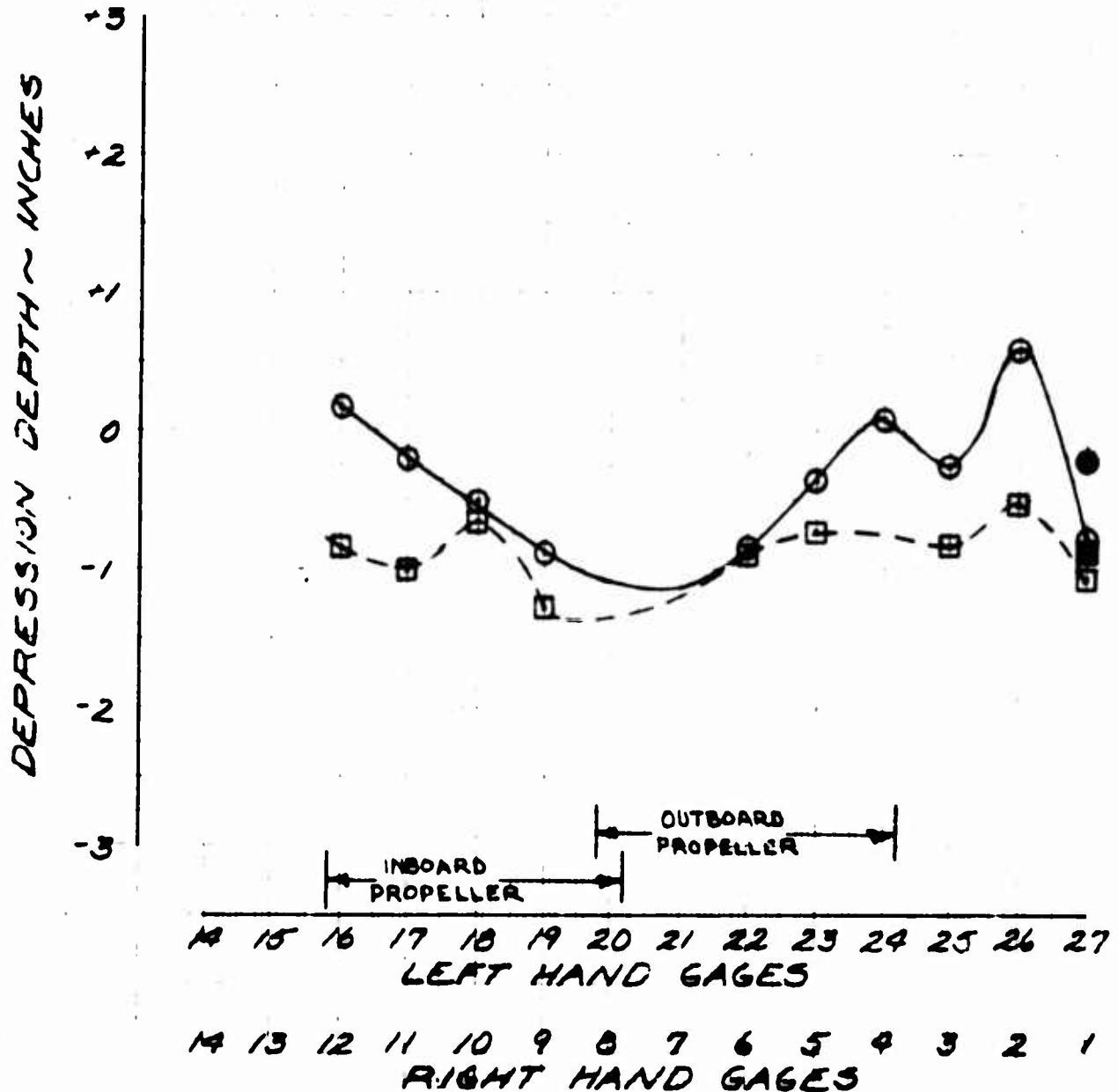


Figure 4-59 Water Displacement Along Propeller Centerline - Effects of Roll Angle

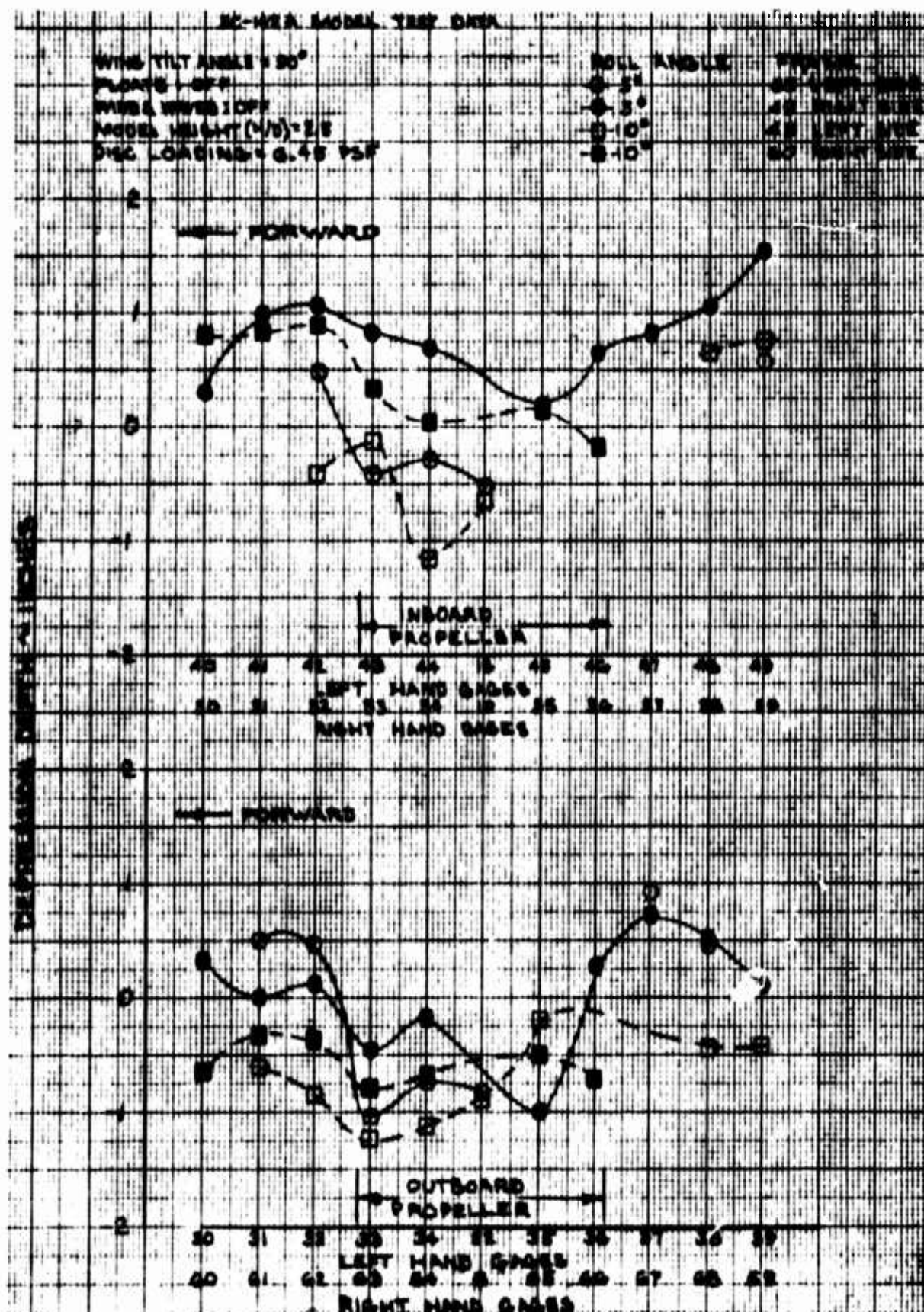


Figure 4-60 Water Displacement Fore and Aft ...
Effects of Roll Angle

XC-142 MODEL TEST DATA
 WING TILT ANGLE = 90° MODEL HEIGHT (H/D) = 2.5
 FLOATS : OFF DISC LOADING = 6.45
 WIND & WAVES : OFF

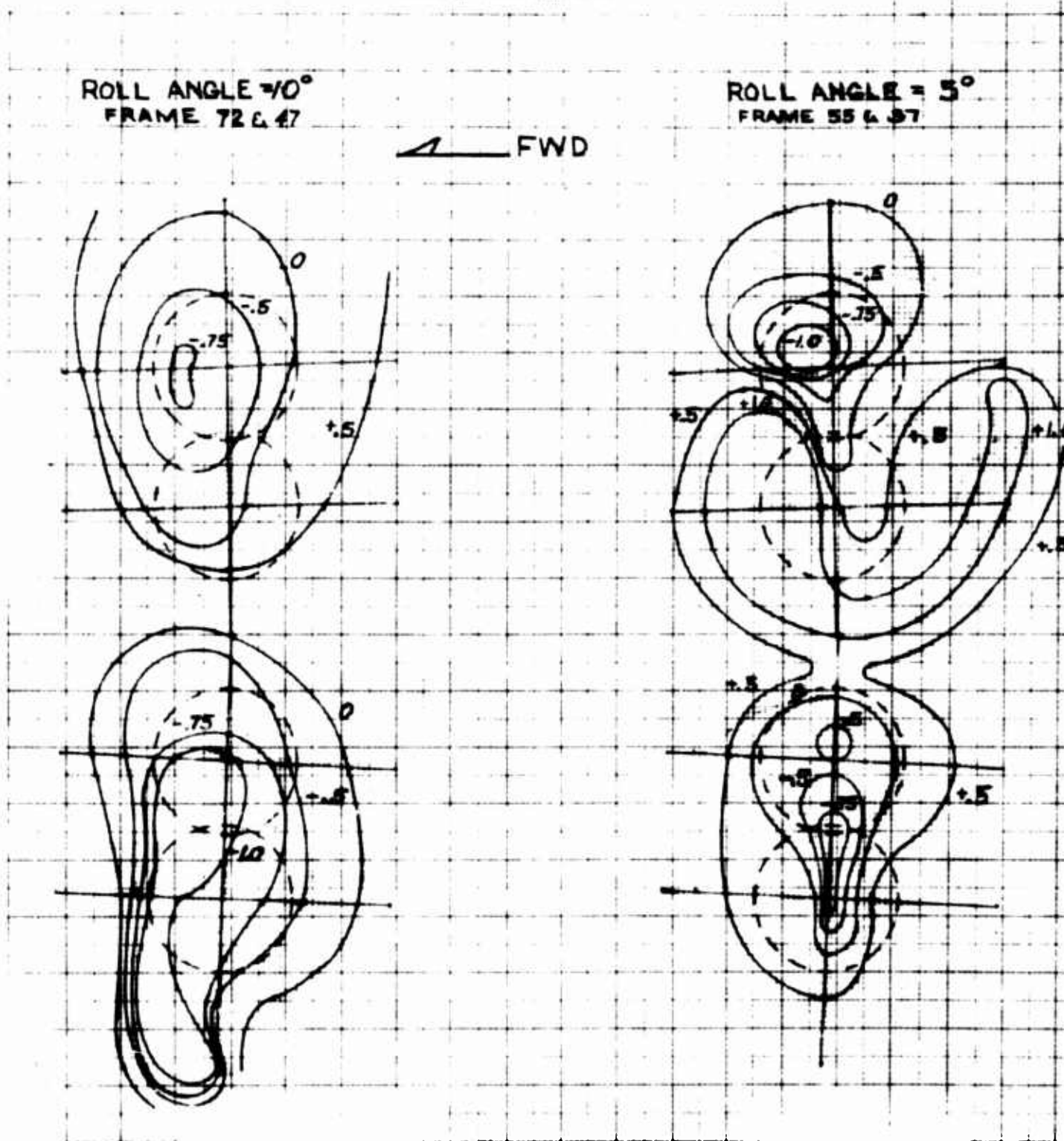


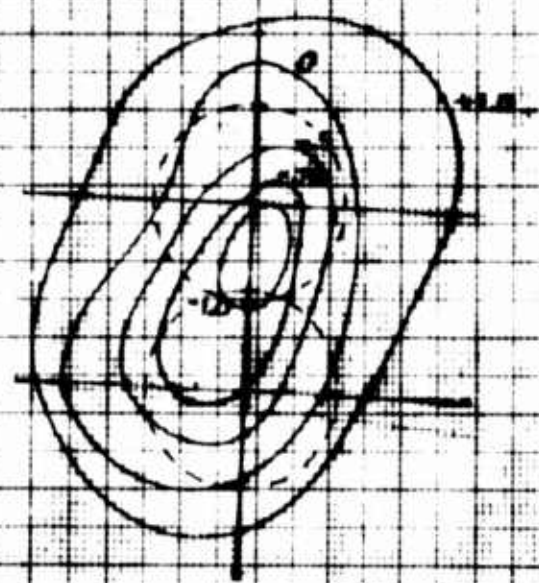
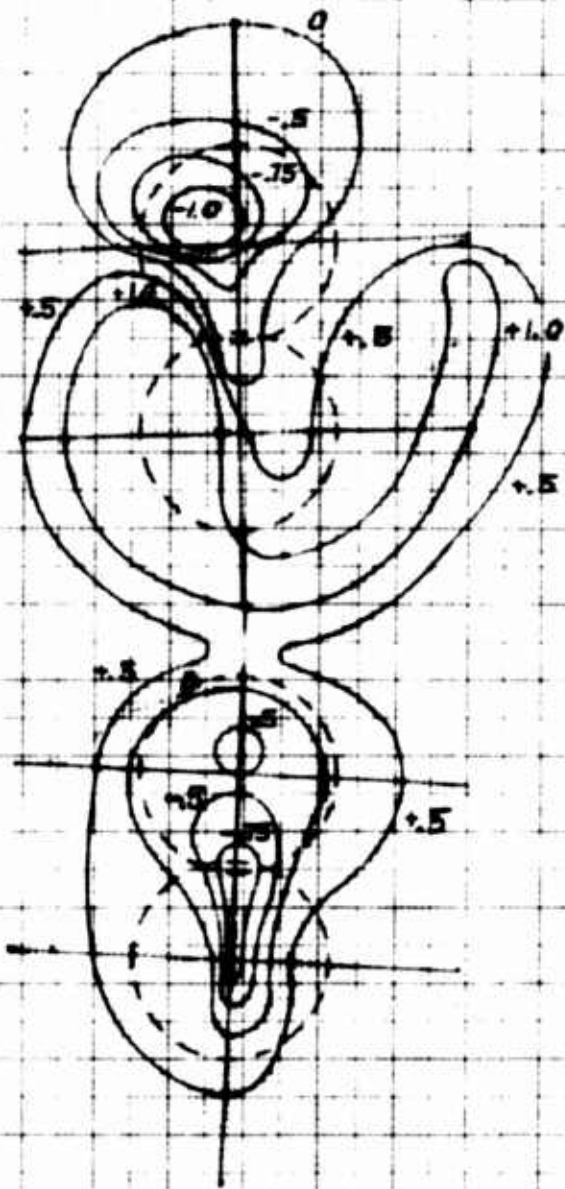
Figure 4-61 Water Displacement Topographical Plot —
 Effects of Roll Angle

A

C-142 MODEL TEST DATA
 $\phi = 90^\circ$ MODEL HEIGHT (W_D) = 2.5
 DISC LOADING = 6.45

ROLL ANGLE = 5°
 FRAME 55 & 57

ROLL ANGLE = 0°
 FRAME 0



Placement Topographical Plot --
 Effects of Roll Angle

B

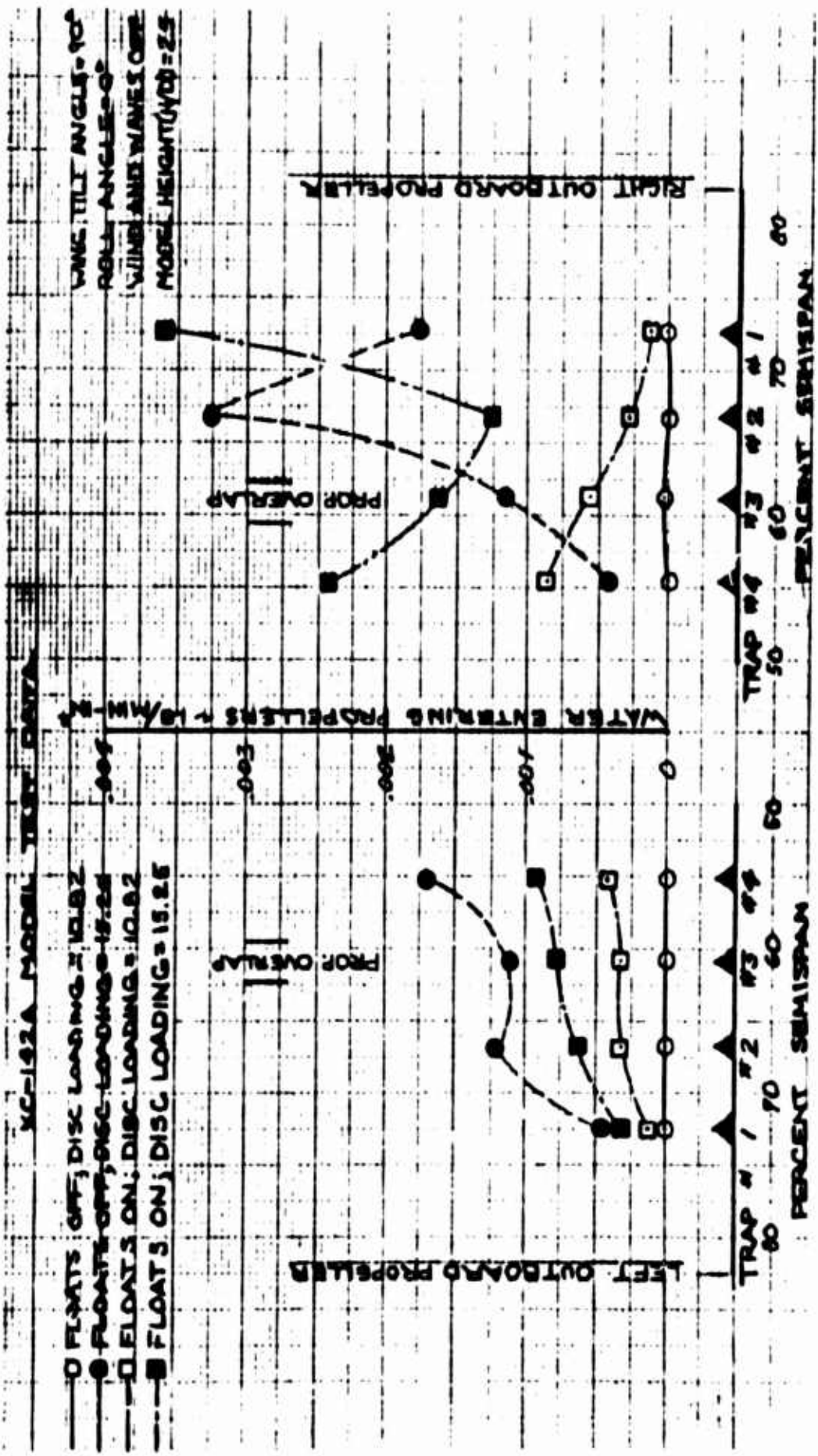


Figure 4-62 Water Entering Propellers - Effects of Vertical Floats

XC-142 MODEL TEST DATA
 WING TILT ANGLE = 90° MODEL WEIGHT (Wp) = 2.5
 FLOATS: OFF DISC LOADING = 6.45
 WIND & WAVES: OFF

ROLL ANGLE = 10°
 FRAME 72 & 47

ROLL ANGLE = 5°
 FRAME 55 & 37

▲ FWD

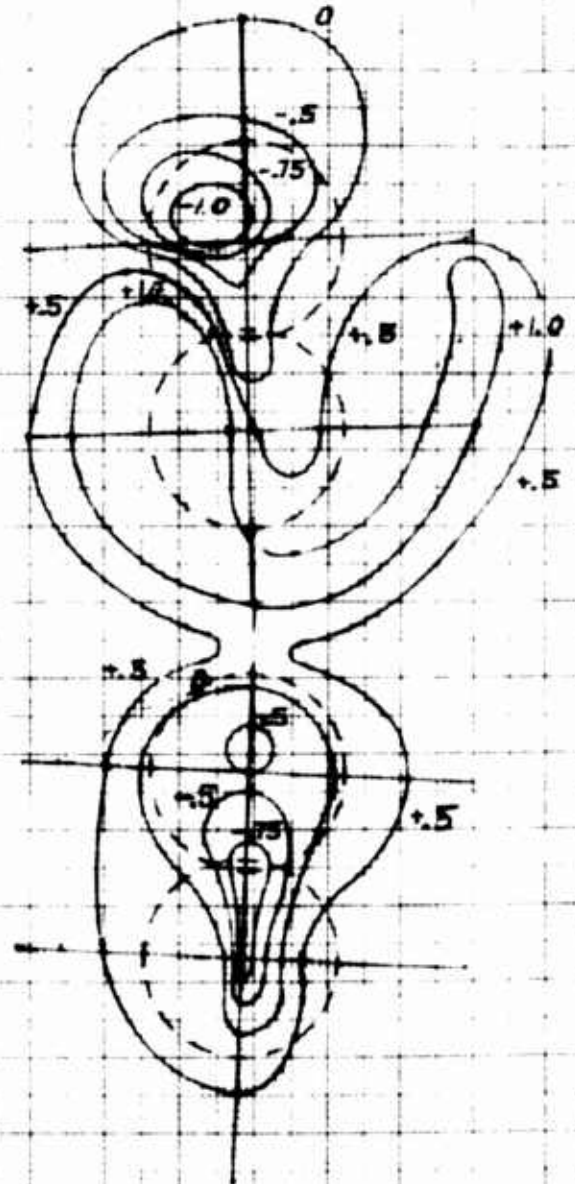
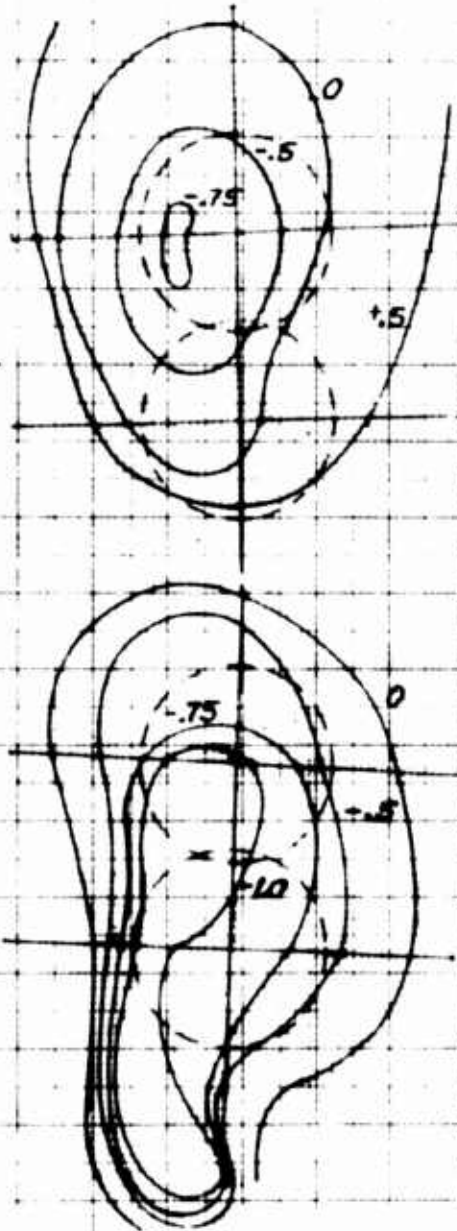
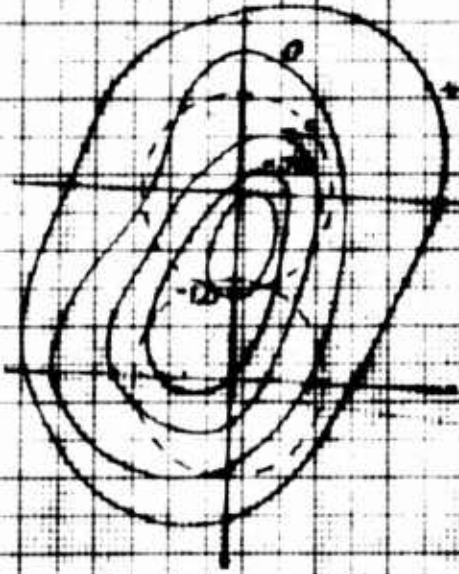
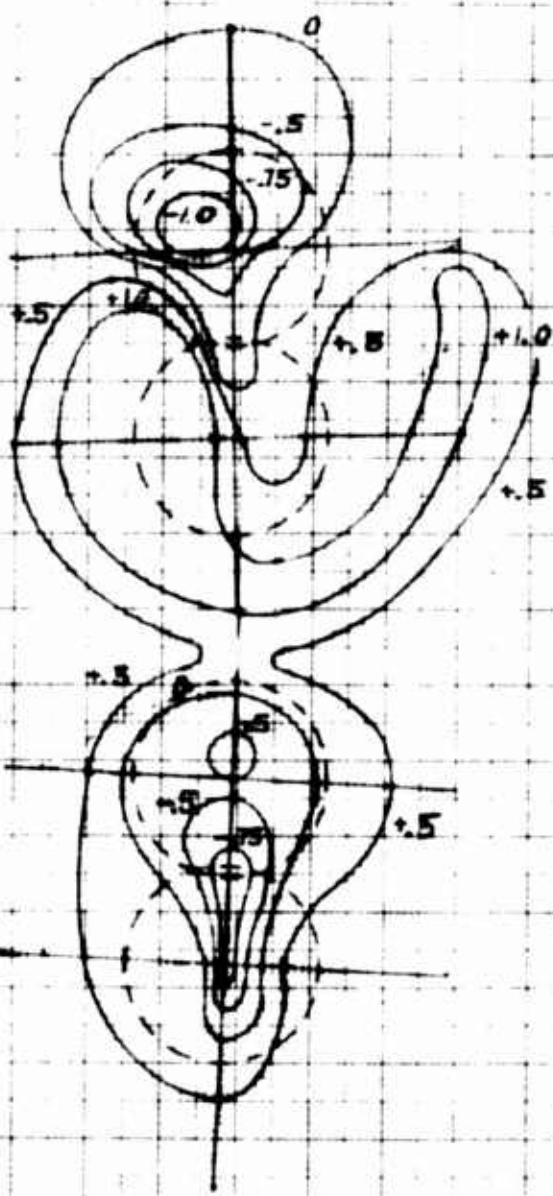


Figure 4-61 Water Displacement Topographical Plot --
 Effects of Roll Angle

2 MODEL TEST DATA
MODEL HEIGHT (Wp) = 2.5
DISC LOADING = 6.45

ROLL ANGLE = 5°
FRAME 55 & 57

ROLL ANGLE = 0°
FRAME 0



Print Topographical Plot --
of Roll Angle

B

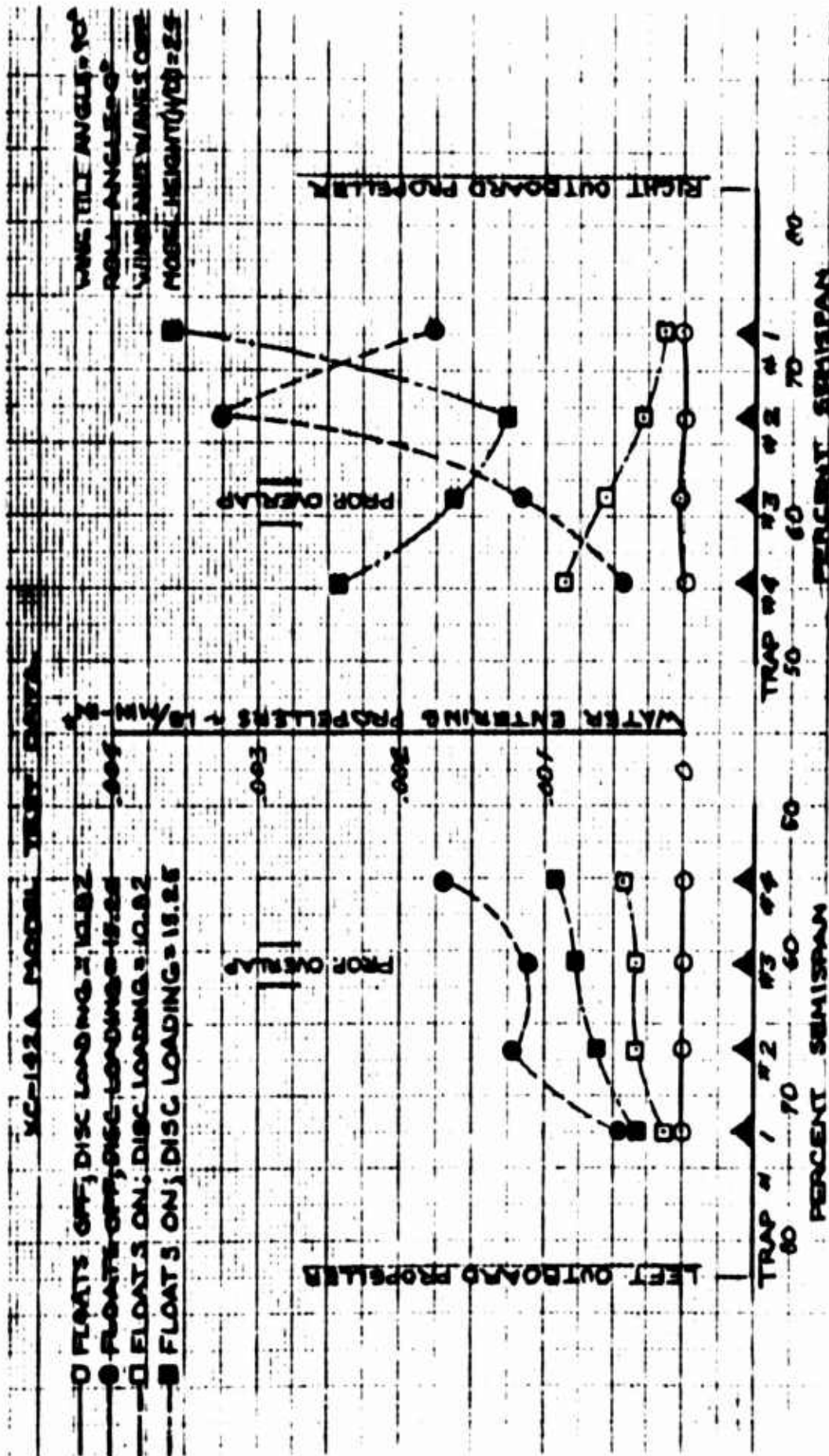


Figure 4-62 Water Entering Propellers - Effects of Vertical Floats

XC-142A MODEL TEST DATA

WAVE TILT ANGLE: 40°
 WIND AND WAVES: OFF
 MODEL HEIGHT (H/D): 3.7
 DISC LOADING = 10.82

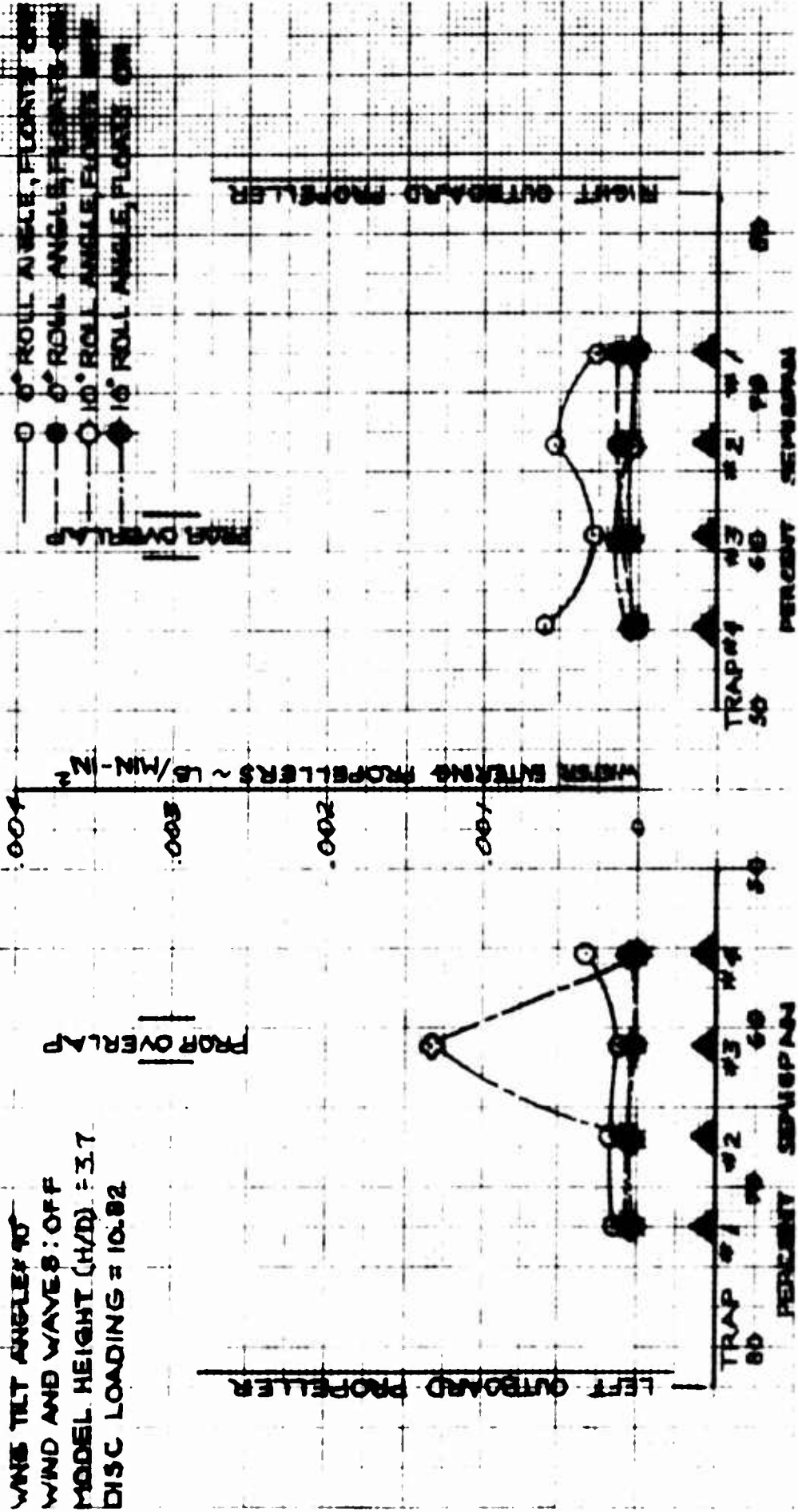


Figure 4-63 Water Entering Propellers - Effects of Vertical Floats

HC-142A. MODEL TEST DATA

WING TILT ANGLE = 0°
 WAVES: OFF
 DISC LOADING = 6.45 PSF

	FRAME	MODEL HEIGHT (H/D)	ROLL ANGLE	FLOATS	WIND
○	9	3.7	0°	OFF	OFF
△	32	3.7	0°	ON	OFF
▲	50	3.7	0°	ON	ON
□	42	2.5	0°	ON	OFF
●	35	3.7	10°	ON	OFF

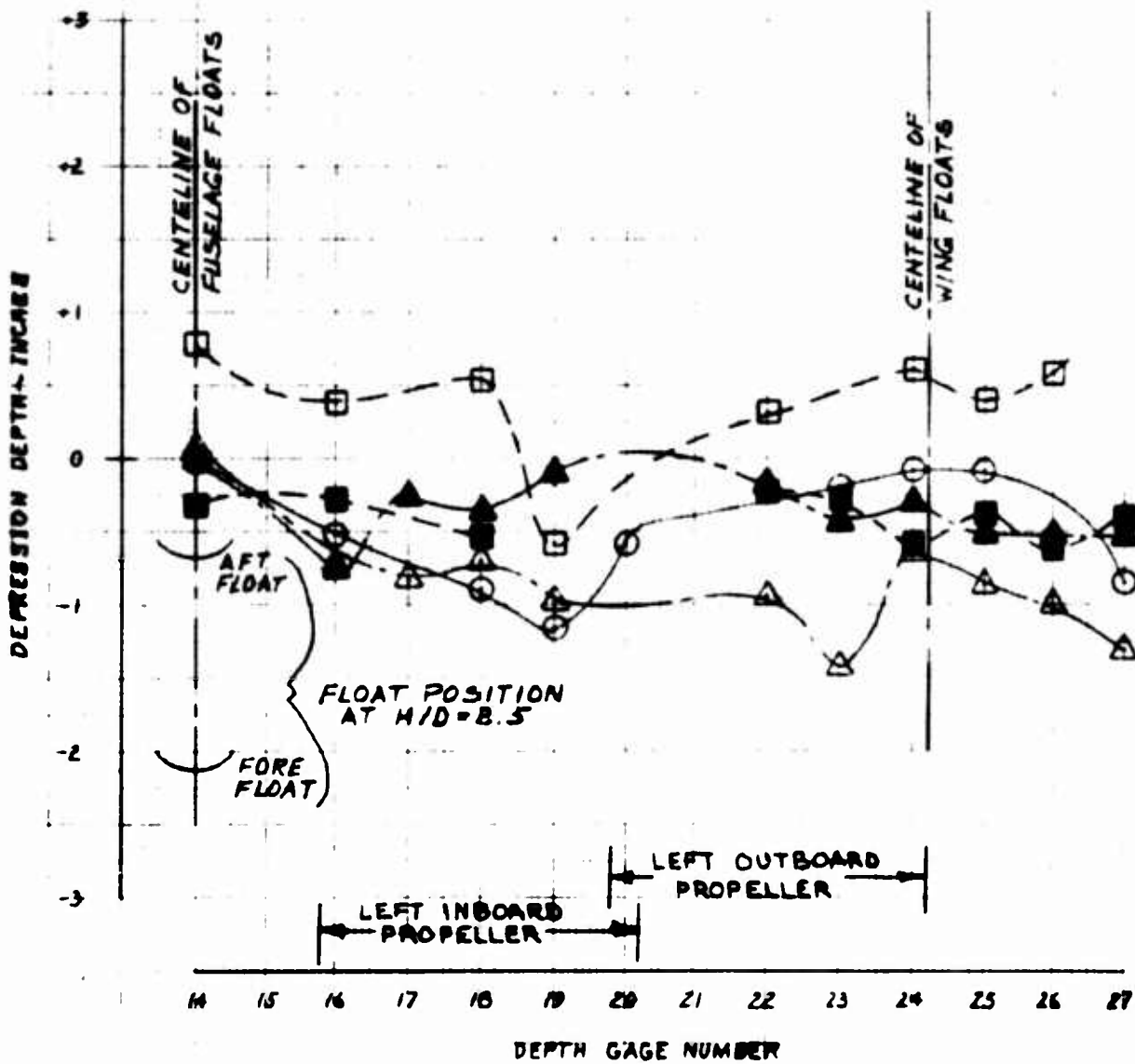


Figure 4-64 Water Displacement Along Propeller Centerline - Effects of Vertical Floats

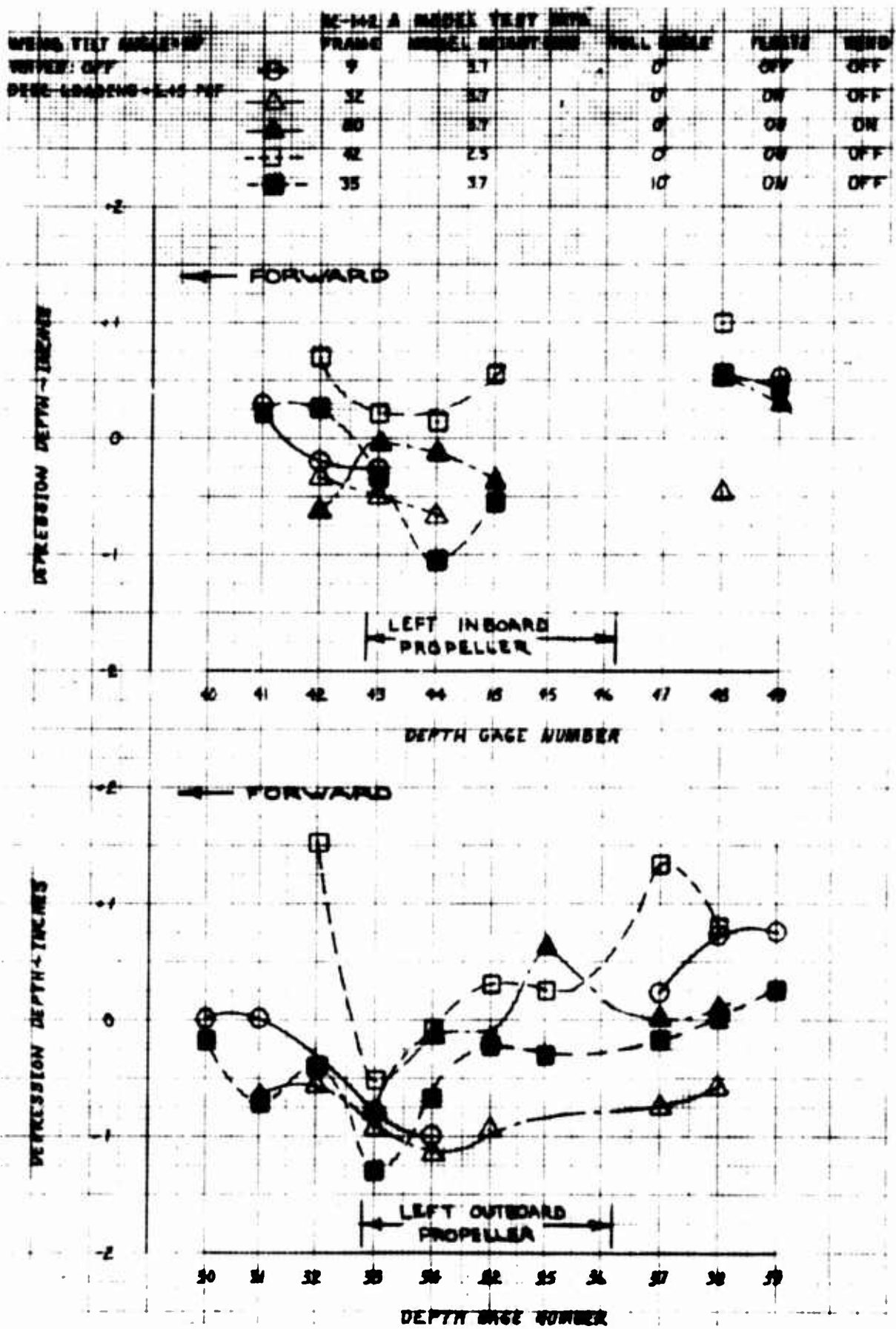
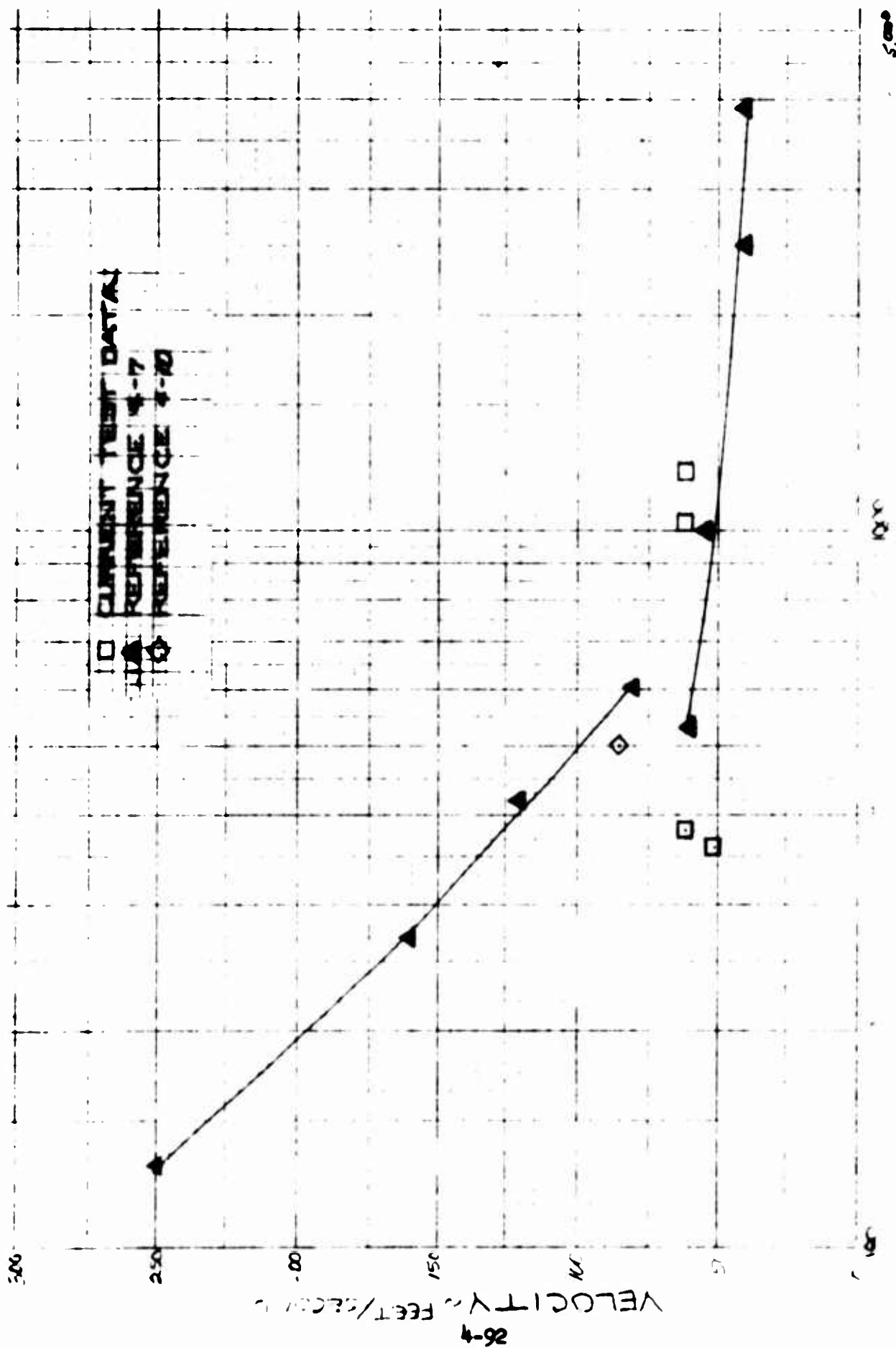


Figure 4-65 Water Displacement Fore and Aft -
Effects of Vertical Floats



MAXIMUM DROPLET DIAMETER ~ MICRONS

Figure 4-66 Maximum Droplet Size

**RC-MFA MODEL TEST DATA
DROPLET SNATCHER**

MODEL HEIGHT(H/D) = 3.7
DISC LOADING = 10.82
WAVE HEIGHT = 6 INCHES
WAVE LENGTH = 7.5 FEET

WIND : OFF
FLUTTS : OFF
ROLL ANGLE = -10°
WING TILT ANGLE = 90°

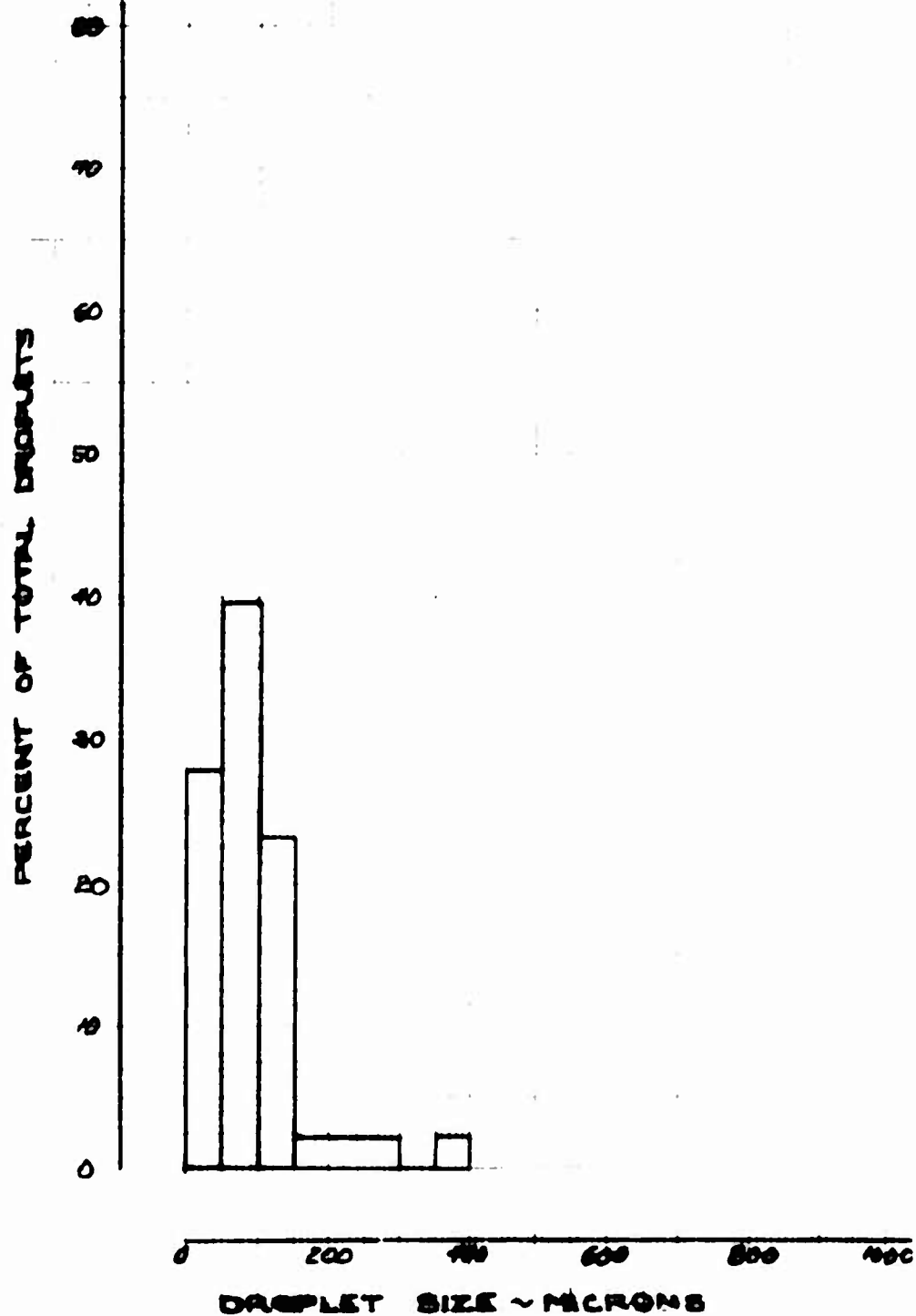


Figure 4-67 Water Droplet Size

XC-H2A MODEL TEST DATA
DROPLET SNATCHER

MODEL HEIGHT (H/D) = 3.7
DISC LOADING = 15.25
WAVE HEIGHT = 6 INCHES
WAVE LENGTH = 7.5 FEET
WIND OFF
FLOATS OFF
ROLL ANGLE = -10°
WING TILT ANGLE = 90°

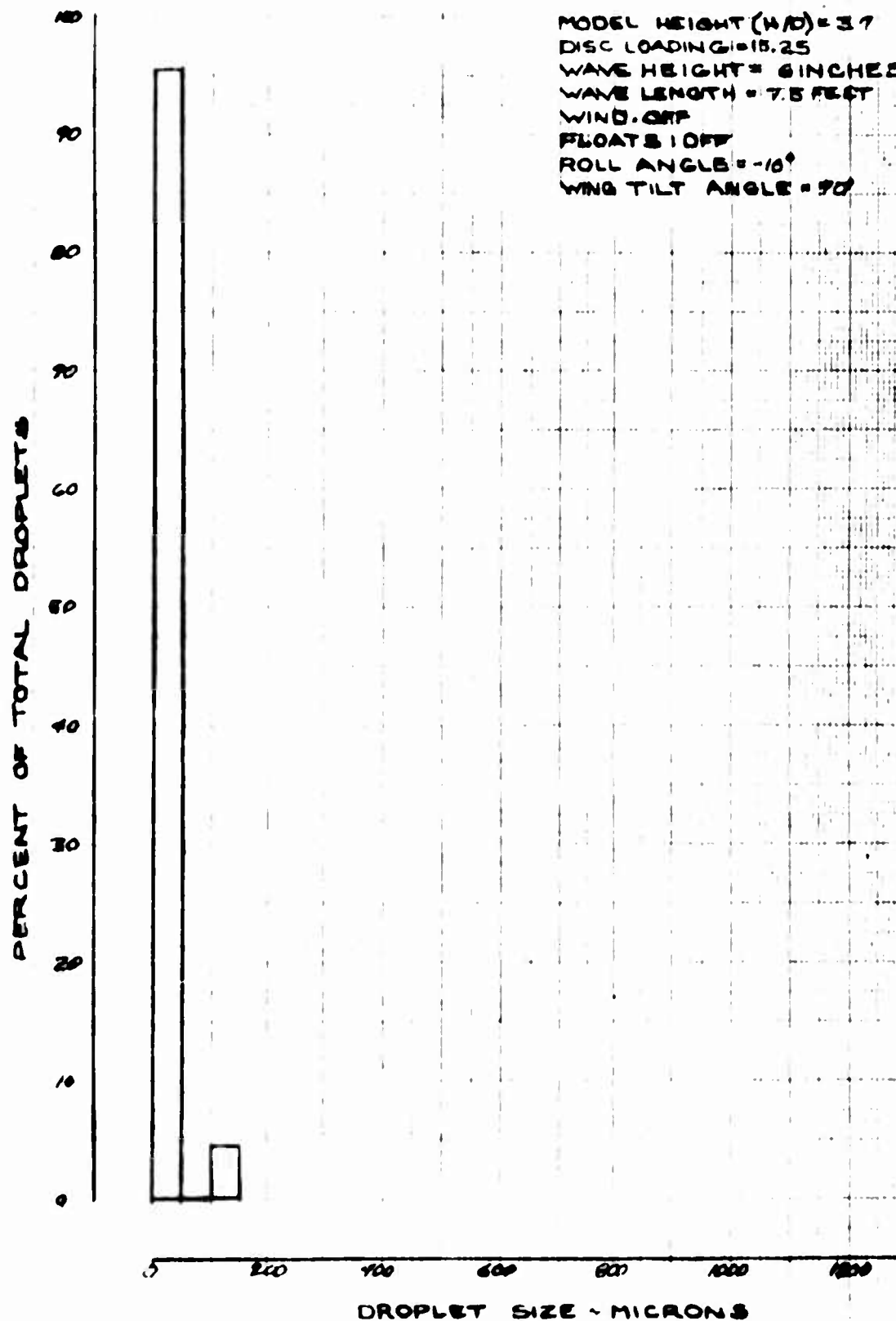


Figure 4-68 Water Droplet Size

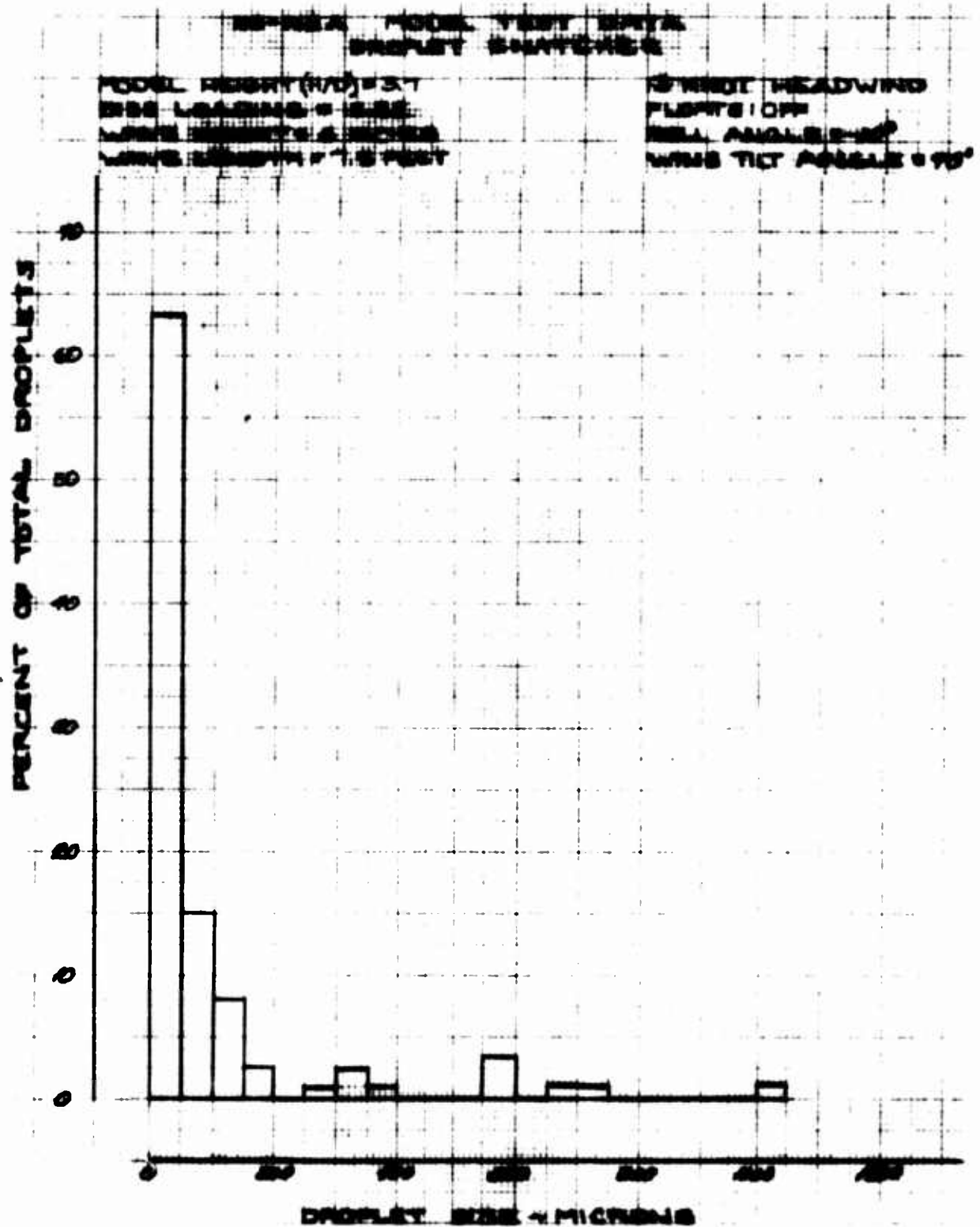


Figure 4-69 Water Droplet Size

KE-112A MODEL TEST DATA
DROPLET SNATCHER

MODEL HEIGHT = 2.7
WING LEADING = 15.25
WING SPAN = 25 INCHES
WING LENGTH = 16 FEET

15 KNOT HEADWIND
FLOATS OFF
ROLL ANGLE = -12°
WING TILT ANGLE = 9°

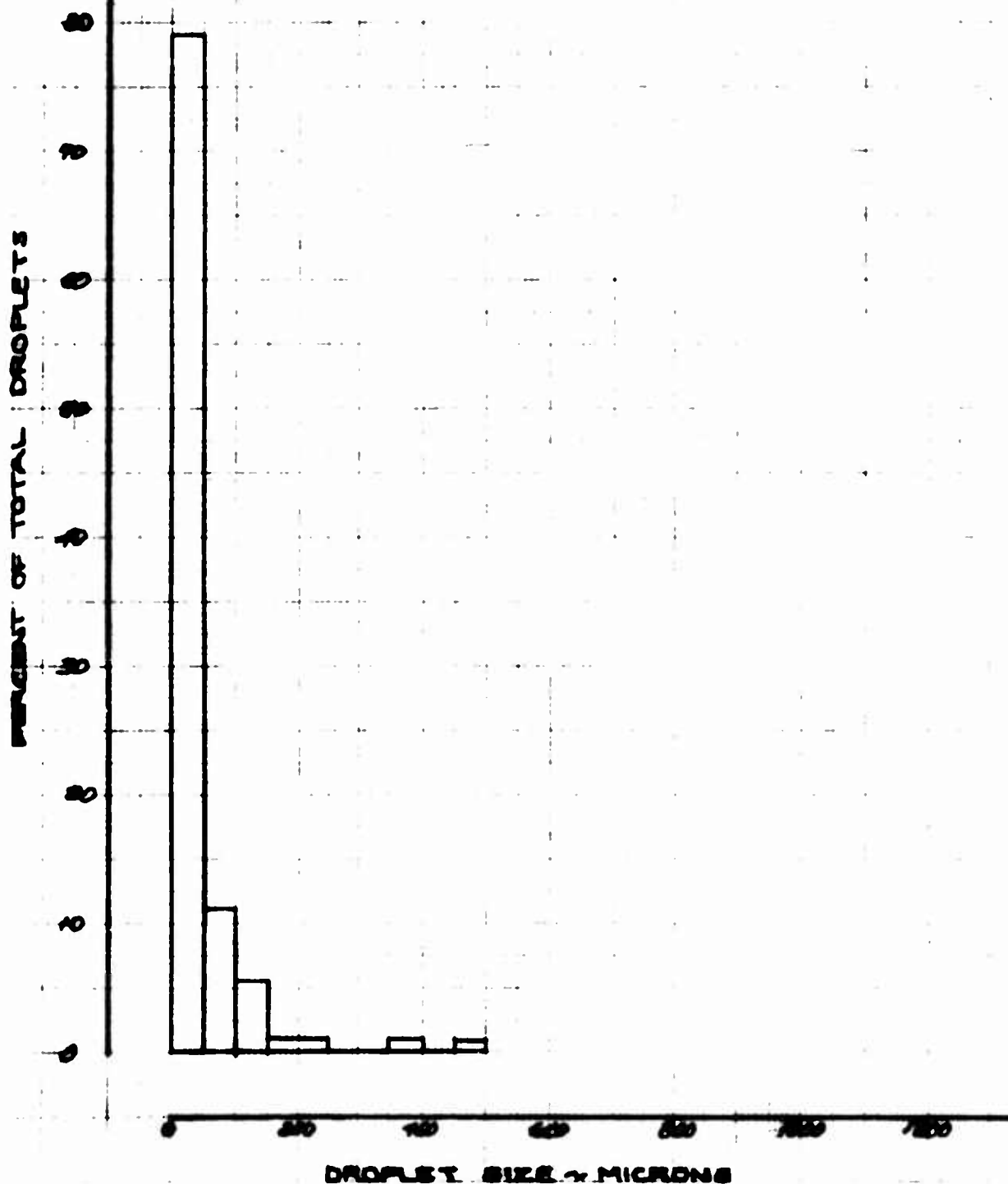


Figure 4-70 Water Droplet Size

XC-142A MODEL TEST DATA
DROPLET ENATCHER

MODEL HEIGHT(H/D)=3.7
DISC LOADING = 15.25
WAVE HEIGHT = 6 INCHES
WAVE LENGTH = 7.6 FEET

13 KNOT HEADWIND
FLOATS: ON
ROLL ANGLE = 0°
WING TILT ANGLE = 75°

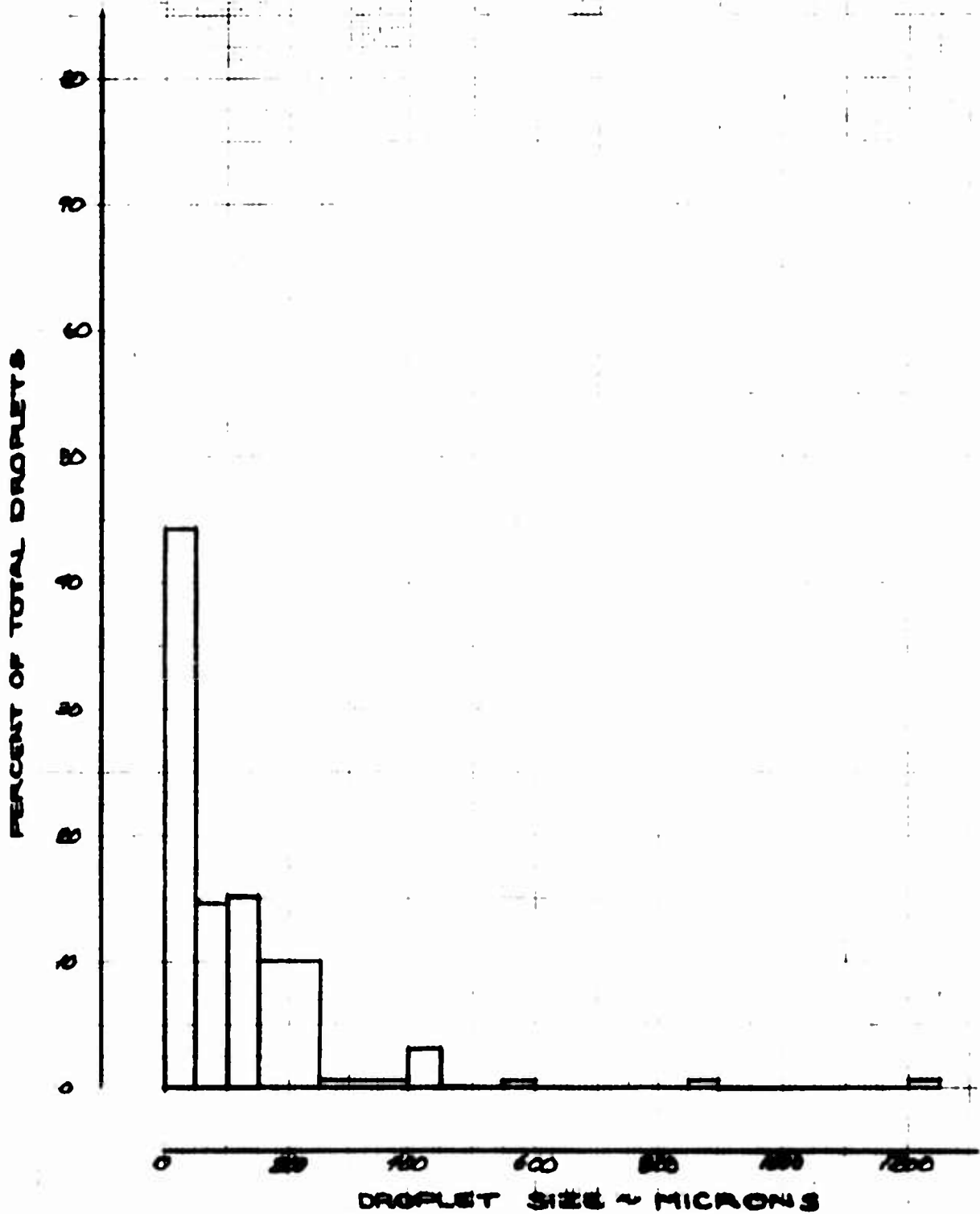


Figure 4-71 Water Droplet Size

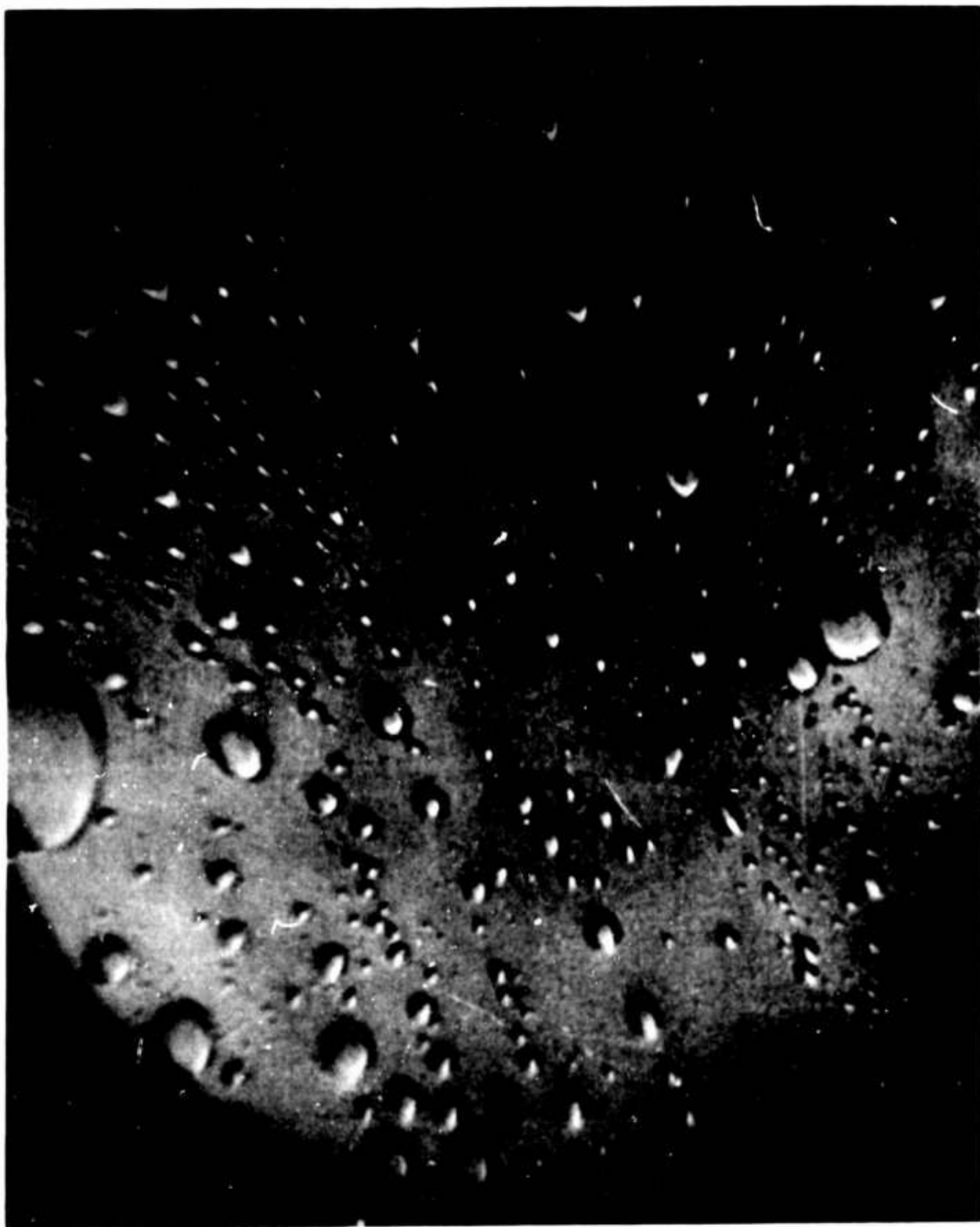


Figure 4-72 Typical Microphotograph of Glass Slide from Droplet Snatcher

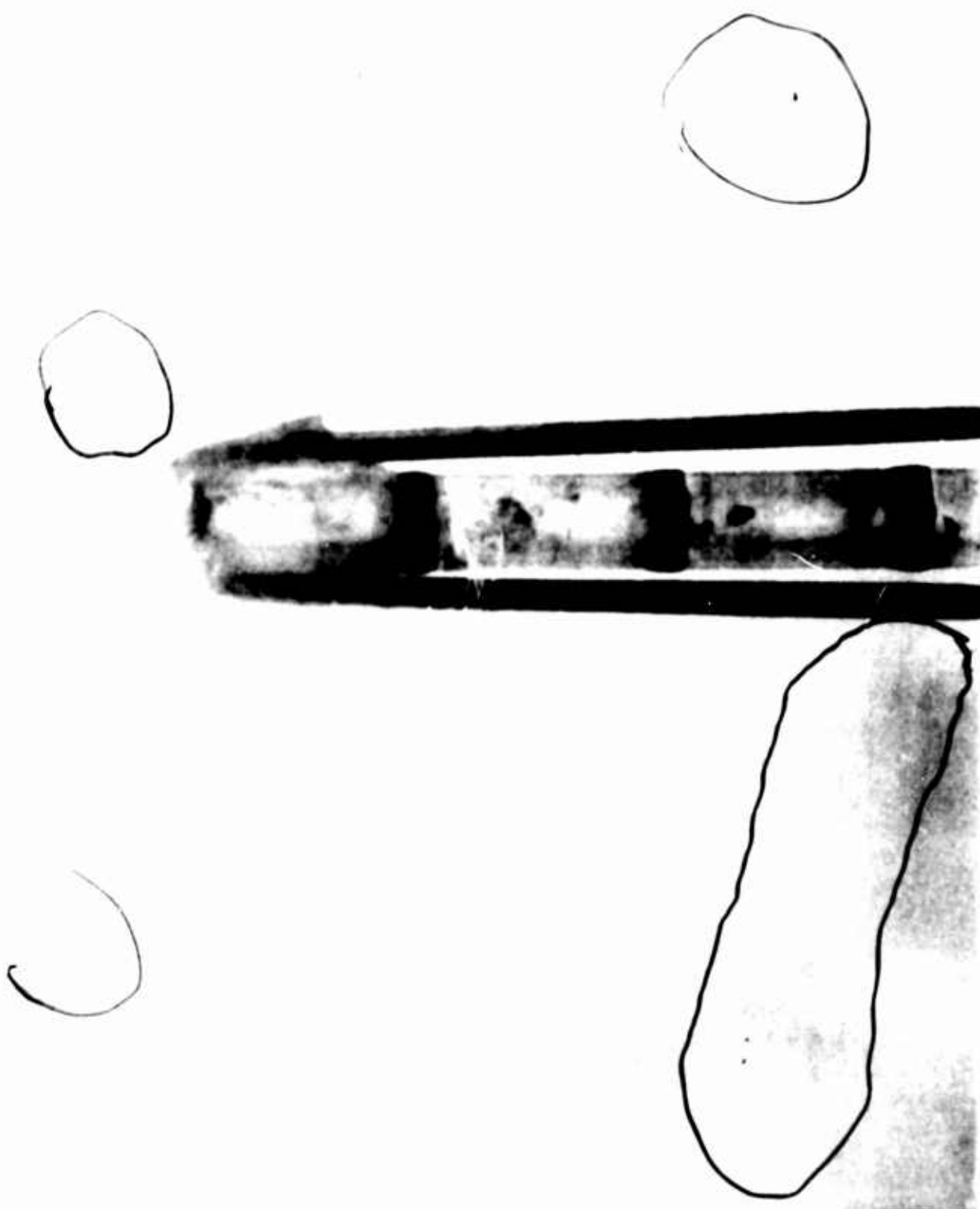


Figure 4-73 Typical Photograph of Depth Gage Number 28 through 40-inch Lens

NO TEST DATA

NO TEST DATA

MODEL HEIGHT (H/D) = 2.5

DISC LEADING / ALL

WAVE HEIGHT = 0

WAVE LENGTH = 0

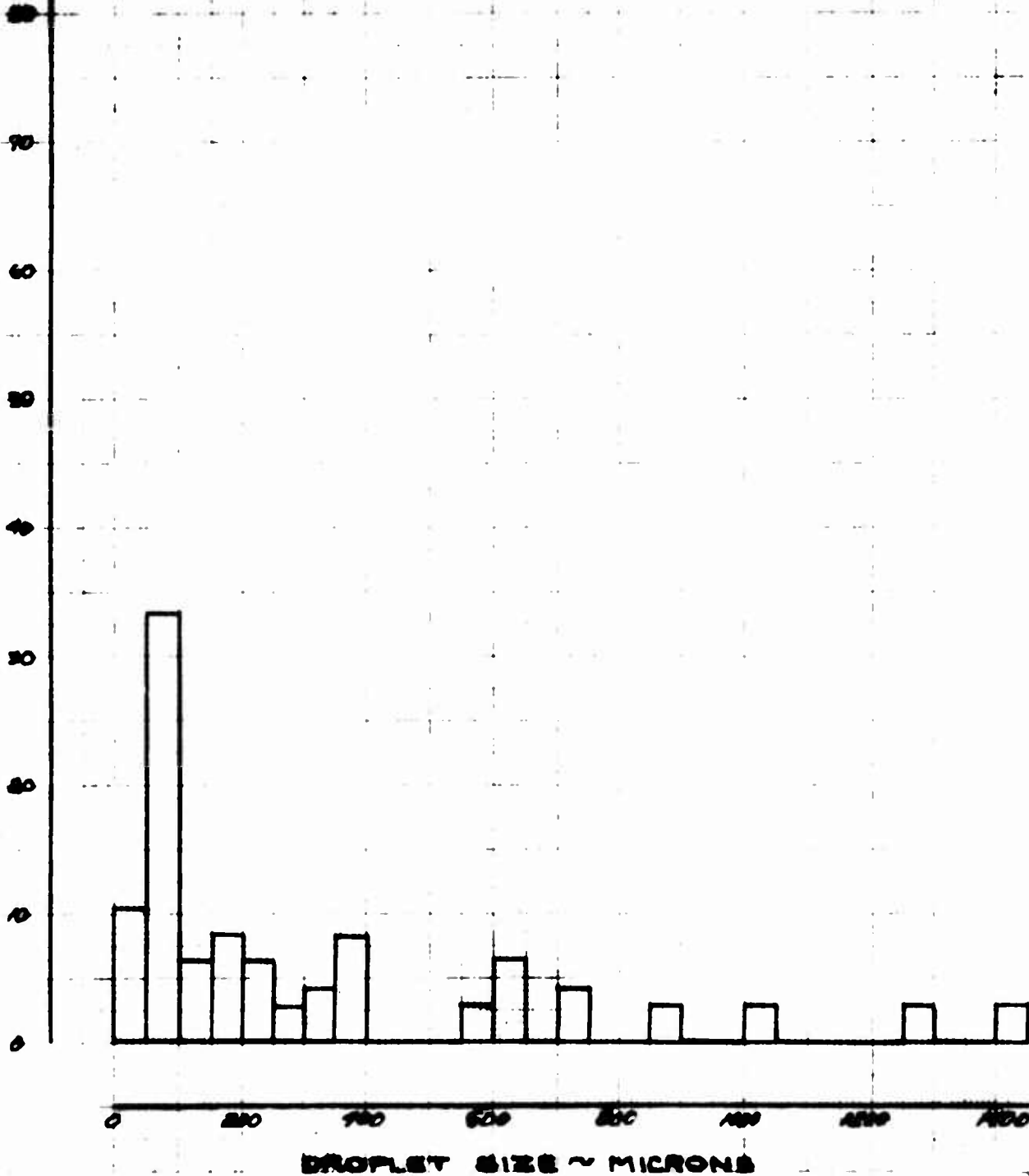
WIND OFF

FLATS OFF

ROLL ANGLE = 5°

WIND TILT ANGLE = 90°

PERCENT OF TOTAL DROPLETS



DROPLET SIZE ~ MICRONS

Figure 4-74 Water Droplet Size

XC-142A. MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS : OFF
 WIND & WAVES : OFF
 MODEL HEIGHT (H₀) = 2.5
 DISC LOADING = 6.45 PSF

FRAME

13 ⊕ WITH POLYETHYLENE OXIDE
 15 ● WITHOUT POLYETHYLENE OXIDE

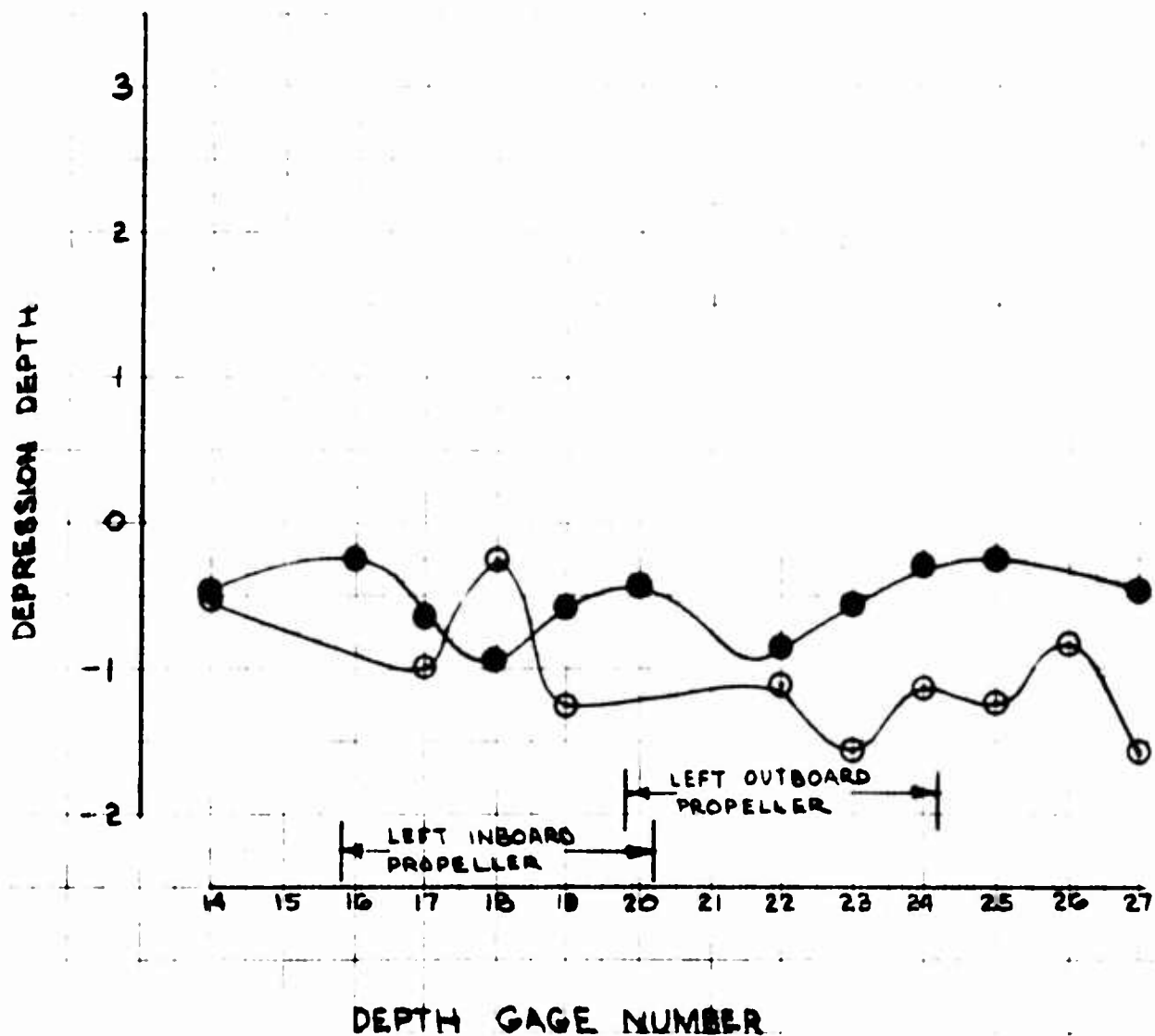


Figure 4-75 Water Displacement Along Propeller Centerline -
 Effects of Polyethylene Oxide

VT-162A MODEL TEST DATA

WIND TILT ANGLE = 30°
 ROLL ANGLE = 0°
 WIND WAVES: OFF
 FLOATS: OFF
 MODEL HEIGHT (H₀) = 2.5
 DISC LOADING = 6.45 PSF

FRAME

15 ○ WITH POLYETHYLENE OXIDE
 45 ● WITHOUT POLYETHYLENE OXIDE

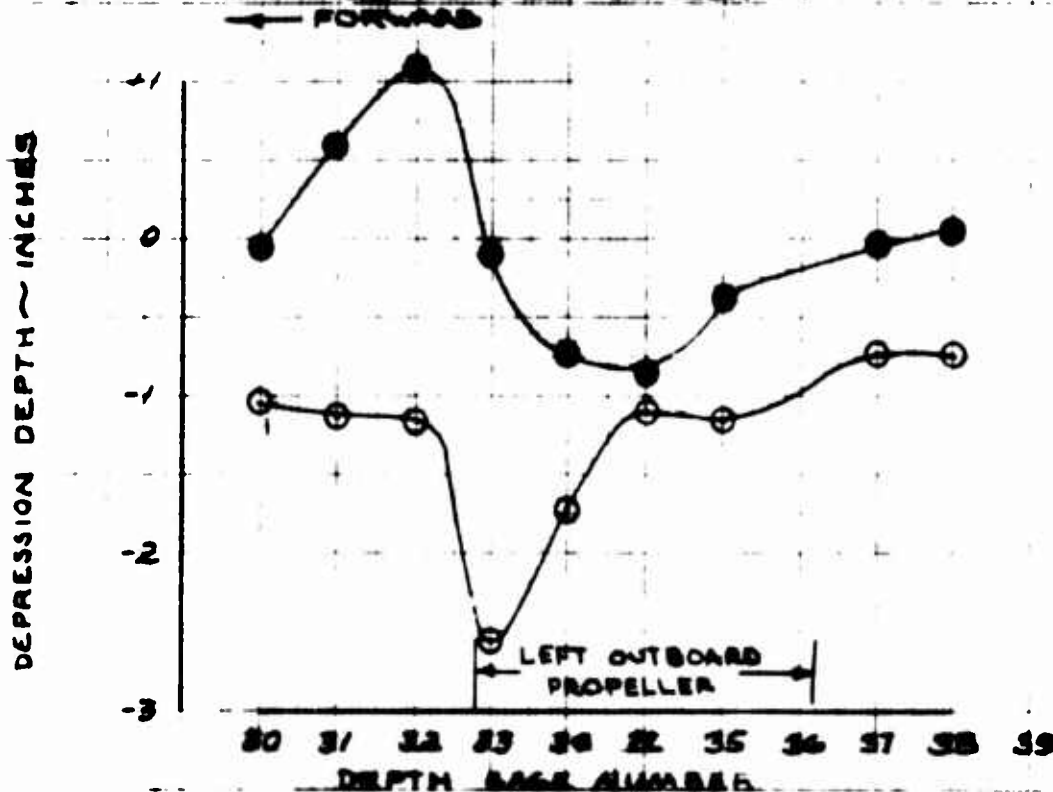
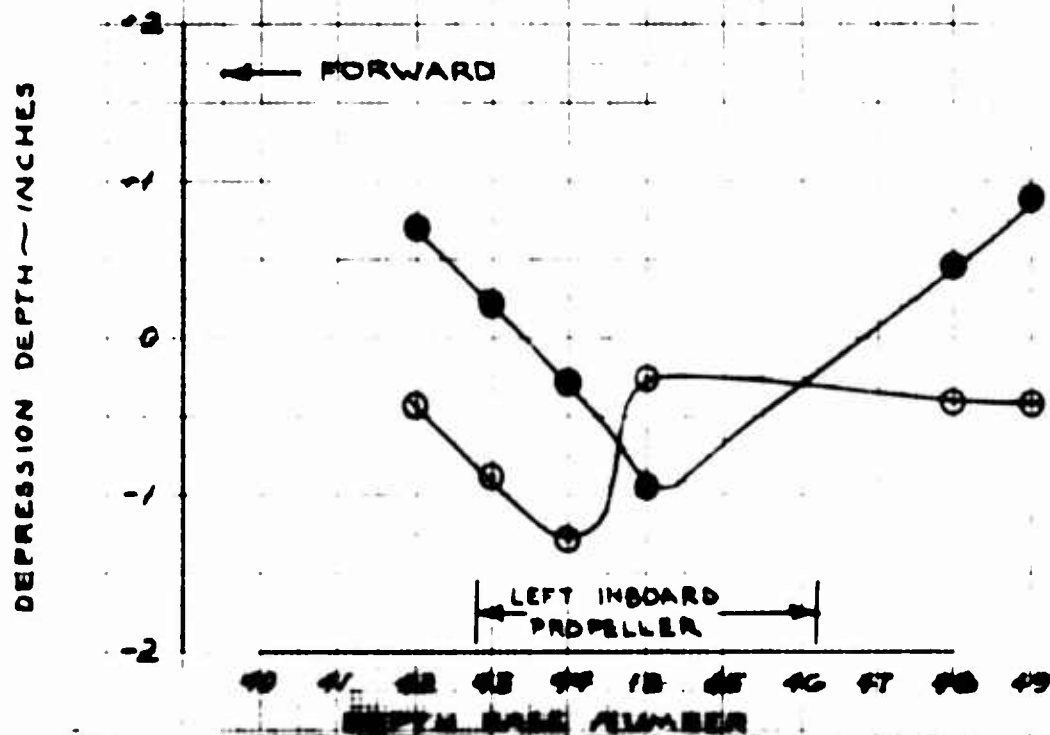


Figure 4-76 Water Displacement Fore and Aft - Effects of Polyethylene Oxide

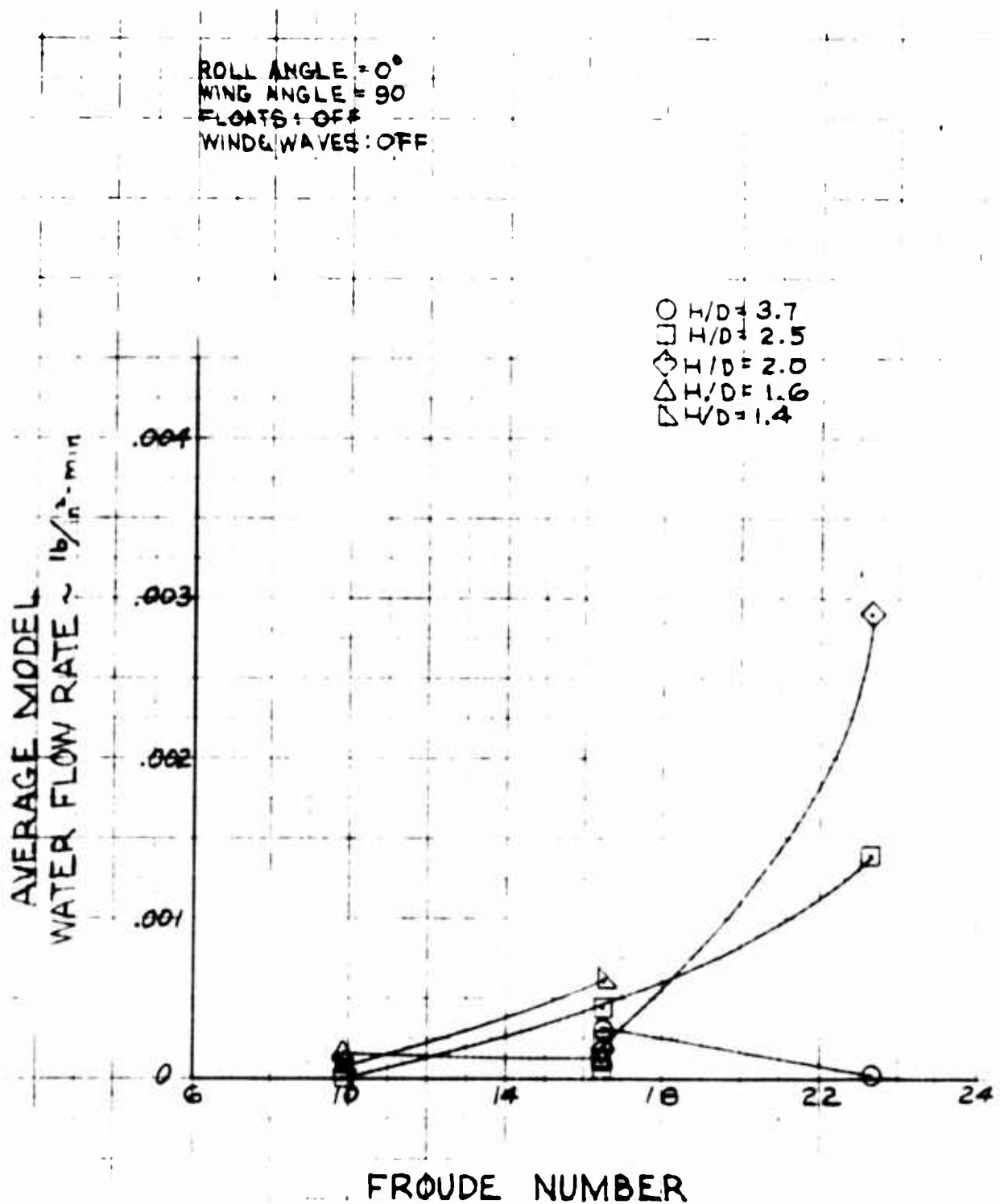


Figure 4-77 Effect of Froude Number on Average Moisture Circulation

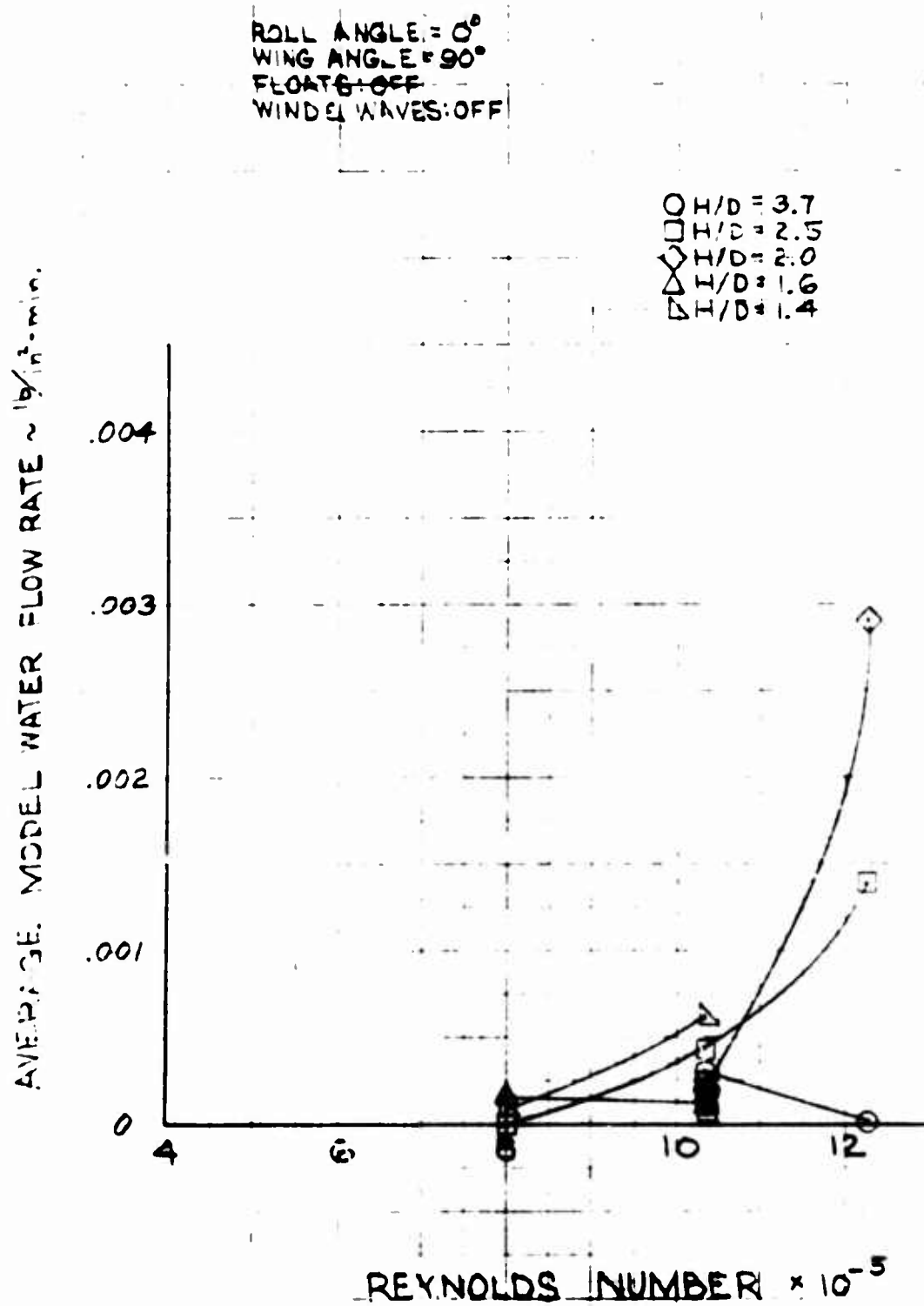


Figure 4-78 Effect of Reynolds Number on Average Moisture Circulation

ROLL ANGLE: 0°
 WING TILT ANGLE: 90°
 FLOATS: OFF
 WIND & WAVES: OFF

○ $H/D = 3.7$
 □ $H/D = 2.5$
 ◇ $H/D = 2.0$
 △ $H/D = 1.6$
 ▢ $H/D = 1.4$

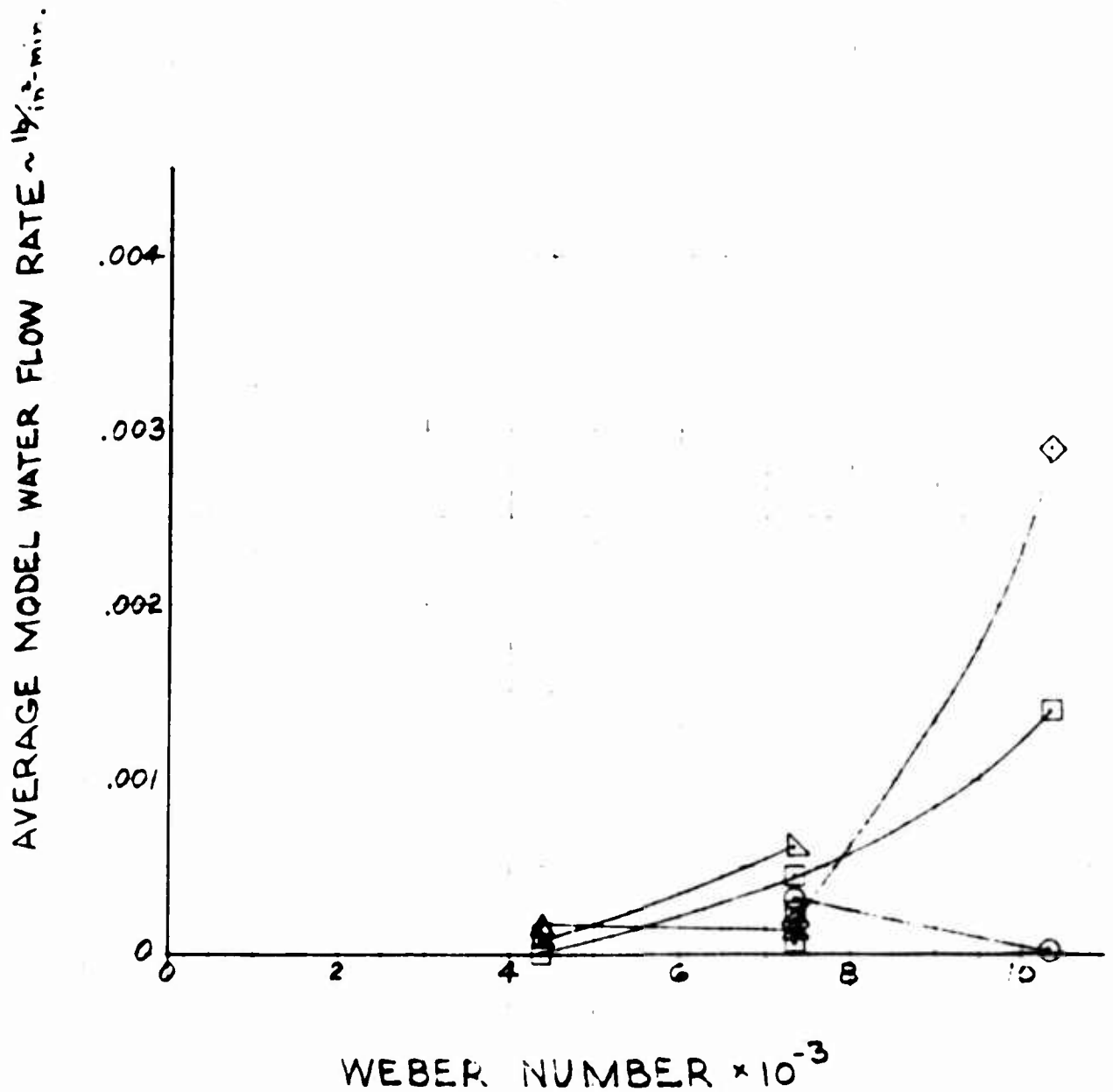


Figure 4-79 Effect of Weber Number on Average Moisture Circulation

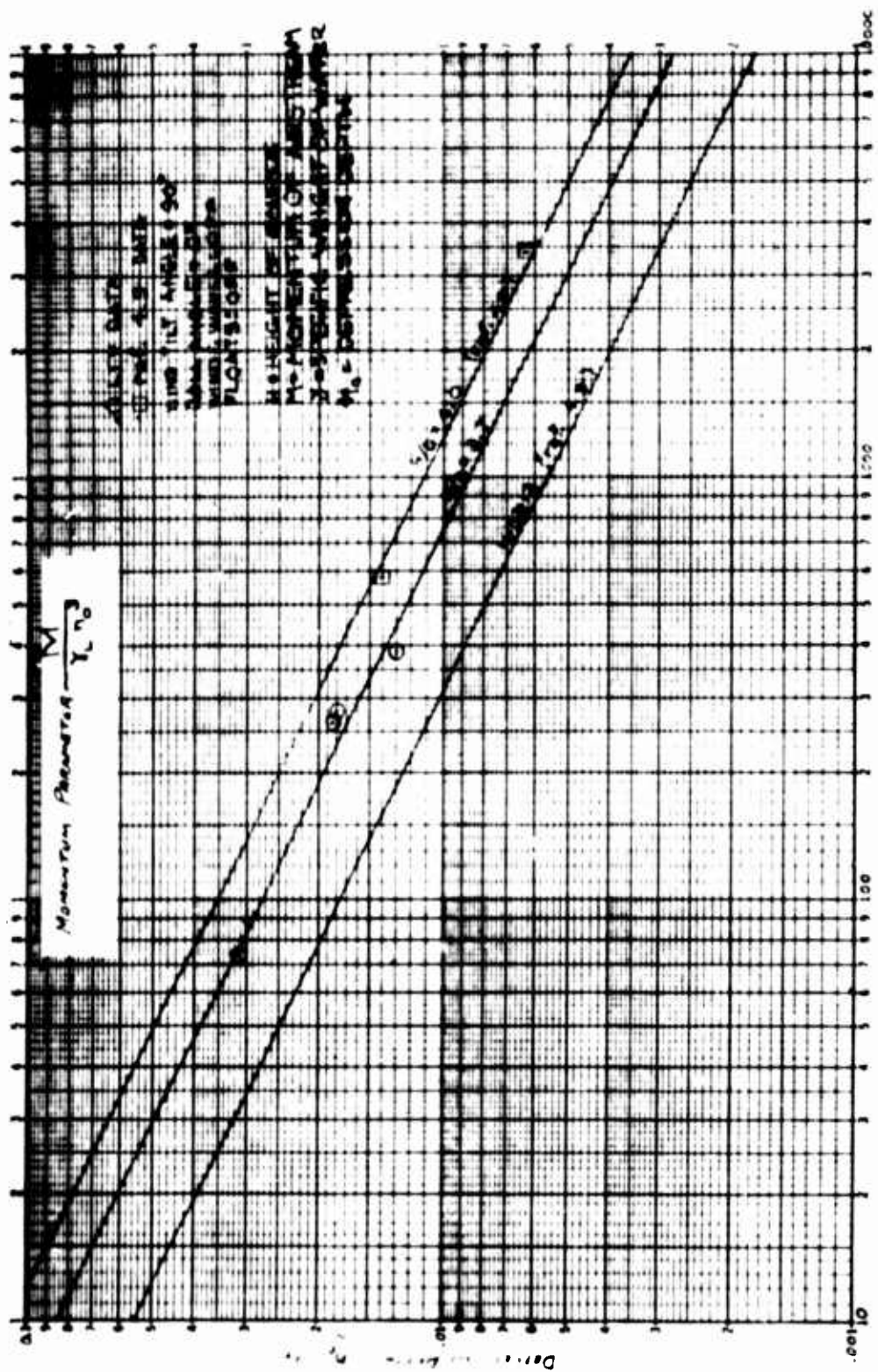
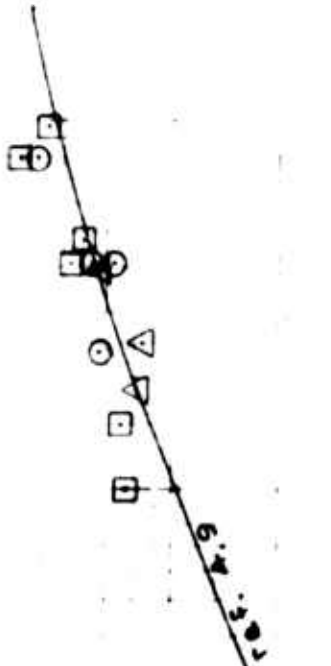


Figure 4-80 Effect of Disc Loading on Depression Depth

$$C \text{ Momentum Parameter } \frac{M_j}{\gamma_L n_o^3}$$

DEPRESSION, DIAMETER $\sim \frac{d_c}{\eta_o}$

LOT-4



DISC
LOADING W/D
△ 10.82 PSF 3.7
□ 6.43 PSF 3.7
○ 6.45 PSF 1.4
WING TILT ANGLE = 90°
ROLL ANGLE = 0°
WIND WAVES: OFF
FLOATS: OFF

M = MOMENTUM OF AIR STREAM
γ = SPECIFIC WEIGHT OF WATER
η_o = DEPRESSION DEPTH
d_c = DEPRESSION DIAMETER

Figure 4-81 Effect of Disc Loading on Depression Width/Depth

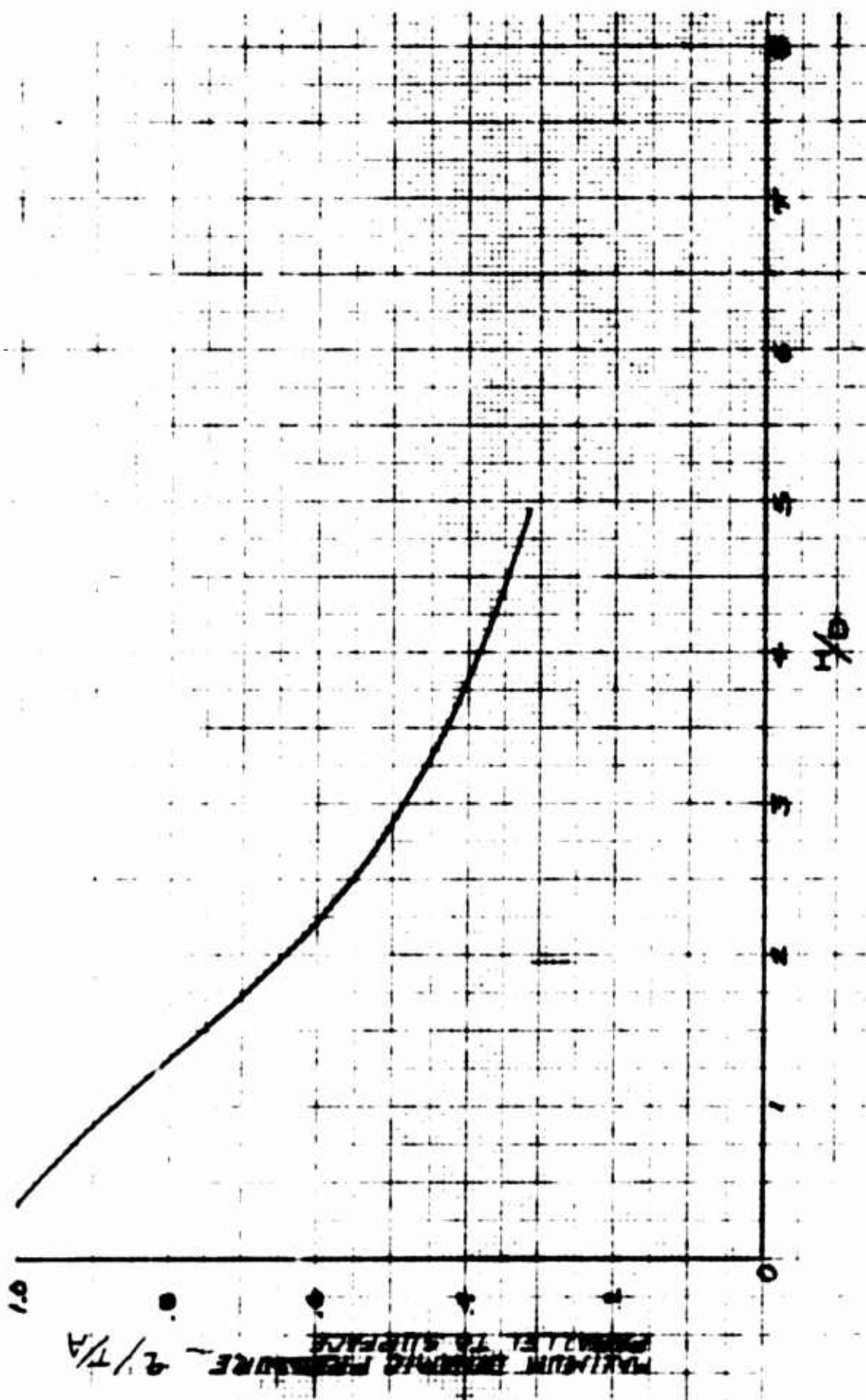


Figure 4-82 Variation of Maximum Dynamic Pressure of Ground Flow with Height for Propellers

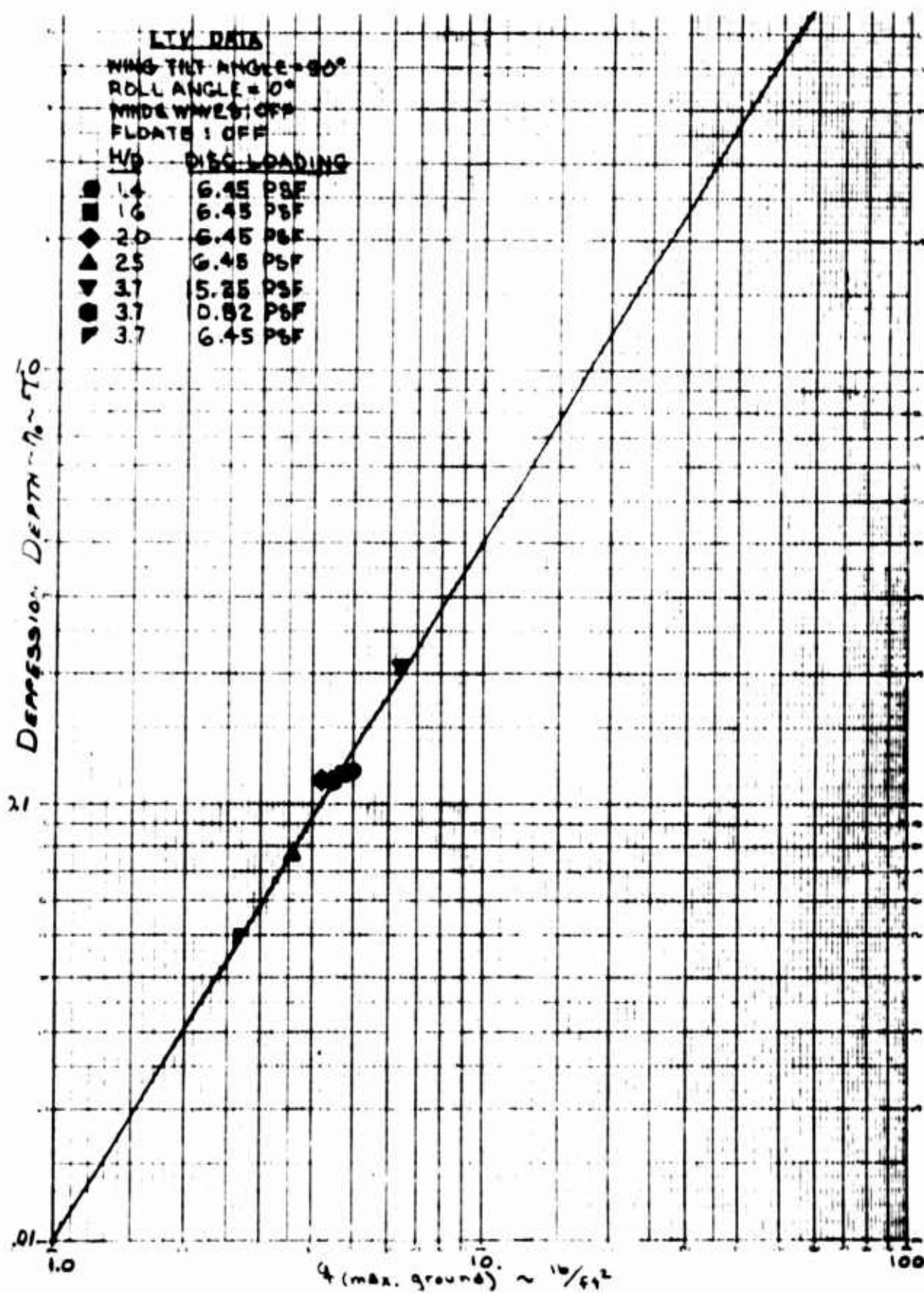


Figure 4-83 Effect of Maximum Ground Dynamic Pressure on Depression Depth

BASED ON XC-142A MODEL TEST DATA

WING TILT ANGLE = 70°
 ROLL ANGLE = 0°
 FLOATS: OFF
 WIND AND WAVES: OFF
 MODEL HEIGHT (H/D) = 3.7
 DISC LOADING = 6.45

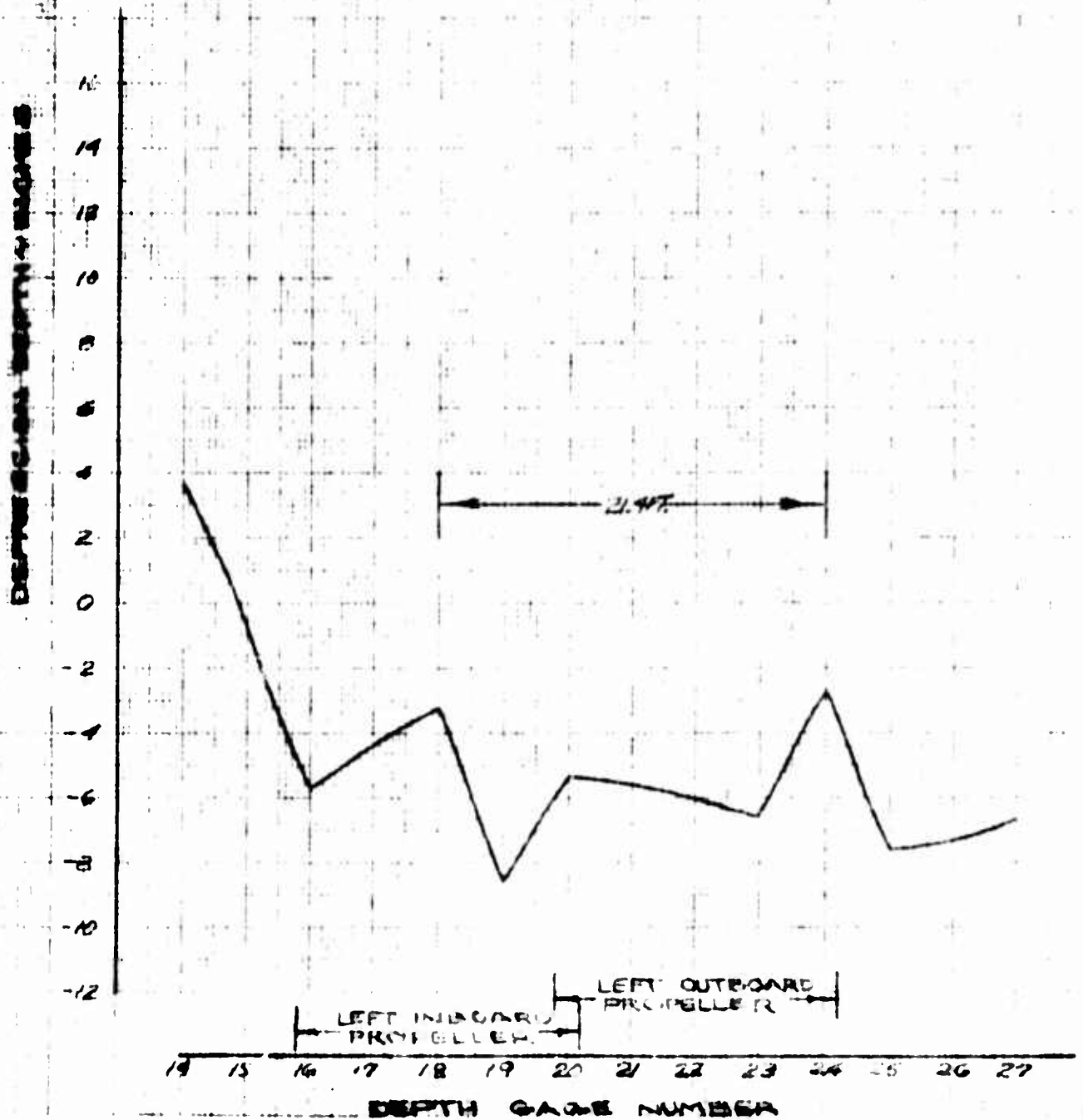


Figure 4-8a Water Displacement Along Propeller Centerline -
 Predicted Full-Scale XC-142A Depression

BASED ON XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE = 0°
 FLOATS: OFF
 WIND AND WAVES: OFF
 MODEL HEIGHT (WD) = 3.7
 DISC LOADING = 6.45

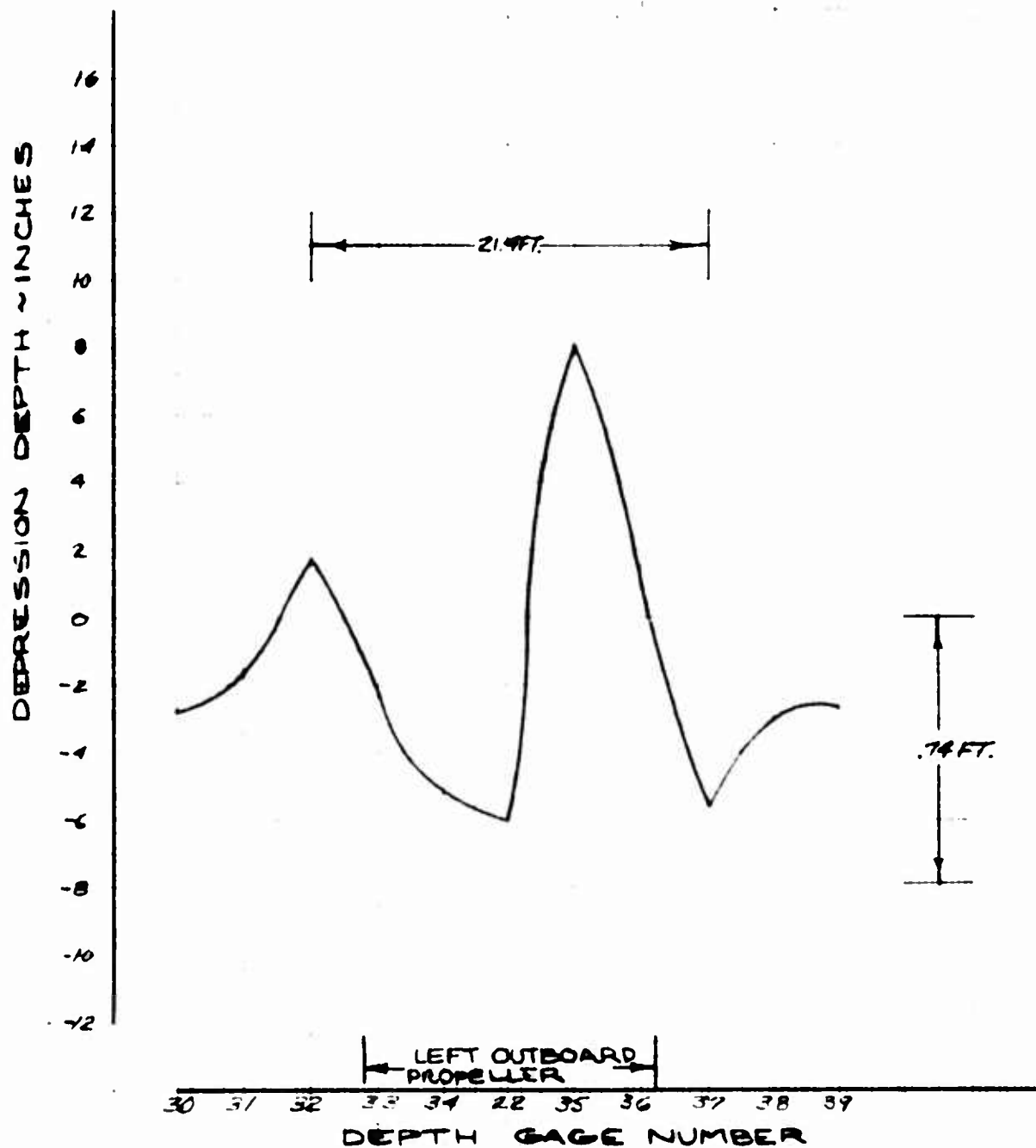


Figure 4-85 Water Displacement Along Propeller Centerline -
 Predicted Full-Scale XC-142A Depression

BASED ON XC-142A MODEL TEST DATA

WING TILT ANGLE = 90°
 ROLL ANGLE 50°
 FLOATS OFF
 WIND AND WAVES OFF
 MODEL HEIGHT (HVD) = 3.7
 DISC LOADING = 8.75

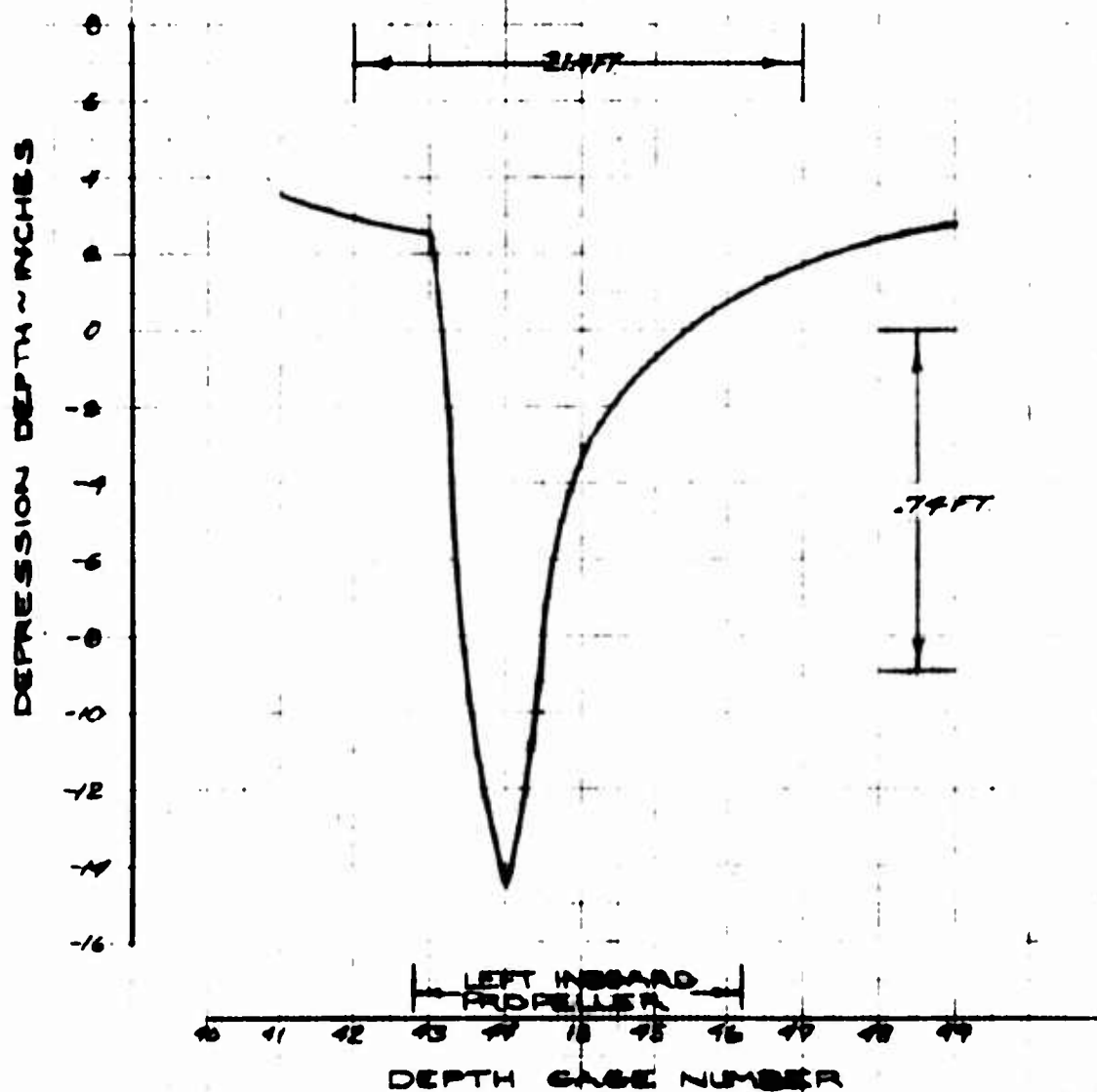


Figure 4-86 Water Displacement Along Propeller Centerline -
 Predicted Full-Scale XC-142A Depression

5.0 CONCLUSIONS

A series of tests have been performed with a model having a tiltwing configuration and four propellers simulating a hover over a calm water surface with and without a surface wind, and over a water surface having two wave heights both with and without a surface wind. These tests examined the forces and moments acting on the model and the environmental conditions generated by this model. As a result of these tests, the following conclusions are drawn:

- a. The forces and moments acting on the model were not affected by the waves on the water surface below the model.
- b. The addition of vertical floats to the model had a negligible effect on the forces and moments felt by the model in the hover mode.
- c. Rolling the model as much as 10 degrees had a negligible effect on the normal, drag and side forces and the pitching and directional moments.
- d. The addition of a surface wind had a negligible effect on the normal force, but the effects of the surface wind on the pitching moment were large. The pitching moment coefficient, based on the slipstream dynamic pressure, increases by a value of approximately 0.4 for the full-scale disc loading of 42.5 pounds per square foot; at a higher disc loading (125 pounds per square foot), the moment coefficient increase due to the surface wind was only 0.25.
- e. Wind had the largest effect on spray circulation, forcing the spray on the windward side up and back over the model.
- f. Small waves can be destroyed by the slipstream and, in this case, more spray is generated than with larger waves which are not destroyed.

g. The increases in spray circulation caused by wind and waves independently are approximately additive when encountered simultaneously.

h. The correlation parameters presented in Reference 4-9 can be used to predict depression characteristics although better depth predictions can be made using Figure 4-84.

i. The method outlined in Reference 4-7 is adequate for predicting maximum droplet size.

j. The addition of vertical floats reduces the amount of spray circulation by spray deflection.

k. The addition of polyethylene oxide to the water beneath the model showed some promise as a spray inhibitor by increasing the spray droplet size, and such an additive may prove useful for full-scale aircraft.

l. Based on model data, it is estimated that a full-scale tiltwing airplane with engines that require approximately 25 pounds of air per second and having a 50 psf disc loading would probably not ingest more than 2 ppm salt-in-air hovering near the water under zero sea state conditions, and not more than 100 ppm in a sea state 4.

m. The majority of the spray droplets in the model flow field were less than 100 microns in diameter.

n. Electrical depth gages can be used to determine the frequency of water motion in still water and to determine the wave/slipstream interactions.

o. These tests have shown the developed test facility to be excellent for evaluating the characteristics of spray around a V/STOL aircraft hovering above a water surface. Good correlation has been found between the spray patterns formed beneath a full-scale airplane and tests at this facility of a model under comparable test conditions.

p. During these tests it has been found that a coating of neoprene that is approximately 0.01 inches thick applied to the blades of the fiberglass propellers virtually eliminated the spray-caused erosion of these blades.

q. There are certain disc loadings above which it will be impractical to operate V/STOL aircraft near a water surface. This maximum tolerable disc loading will reduce as the size of the waves and/or the magnitude of the surface wind increases.

6.0 RECOMMENDATIONS

As a result of these tests, the following recommendations are made:

a. A series of tests should be performed using models of other types of V/STOL aircraft in this test facility in order to properly evaluate their compatibility with an open ocean type of environment.

b. Areas such as the visibility available to the pilot of a V/STOL aircraft hovering over a water surface should be quantitatively measured.

c. Additional tests of compounds similar to polyethylene oxide should be performed in an attempt to find an effective and practical spray suppressant.

7.0 REFERENCES

- 1-1 "An Investigation of the Over Water Aspects of VTOL Airplanes at High Disc Loading," Final Report No. 012-26, Curtiss Wright Corp., December 1963.
- 1-2 "Feasibility Study, XC-142A Modified for Open Ocean Operation," Report No. 2-55400/4R-963, Vought Aeronautics Division, 9 February 1965.
- 1-3 "Research on VTOL Water Hover Effects," Report No. 2-55400/6R-6090, Vought Aeronautics Division, 30 September 1966.
- 1-4 Office of Naval Research Contract No. N00014-67-C-0488, dated 5 May 1967.
- 4-1 "Engine/Airframe Interface Study for Open-Ocean ASW Air/Sea Craft," Report No. 2-55400/7R-2419, Vought Aeronautics Division, 30 June 1967.
- 4-2 "Research on VTOL Water Hover Effects," Report No. 2-55400/6R-6090, Vought Aeronautics Division, 30 September 1966.
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- 4-4 "An Investigation of the Over Water Aspects of VTOL Airplanes at High Disc Loading," Final Report No. 012-26, Curtiss Wright Corp., December 1963.
- 4-5 "Downwash Impingement Design Criteria for VTOL Aircraft," TRECOM Technical Report 64-48, U. S. Army Transportation Research Command, August 1961.
- 4-6 "Feasibility Study, XC-142A Modified for Open Ocean Operation," Report No. 2-55400/4R-963, Vought Aeronautics Division, 9 February 1965.
- 4-7 "Shock Tube Investigation of the Breakup of Drops by Air Blast," The Physics of Fluids, Vol. 6, August 1963.
- 4-8 "Experimental Study of Pilot Visibility From a VTOL Air/Sea Craft Near the Ocean Surface," TAR-TR 6704, Therm Advanced Research, Inc., July 1967.
- 4-9 "Hydromechanics of a High Velocity Gas Jet Penetrating a Liquid Surface," Bureau of Ships Index No. SF013-02-07, Task 1714, March 1962.
- 4-10 "Salt Water Ingestion by Gas Turbine Engines," Conference on Environmental Effects on Aircraft Propulsion, June 1961.

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14. ABSTRACT

Very little is known about the problems associated with a VTOL aircraft hovering over a water surface. Some of the more important of these unknown effects appear to be the effects of surface winds and waves on the stability and control characteristics of the hovering airplane, the effects of the airplane's downwash on the water surface, and the effects of surface winds and waves on the spray generated by the airplane's downwash. In order to examine these seemingly more important effects, a special model testing facility has been built. This facility permits a model simulating a hovering airplane to be tested as the facility generates waves of variable heights and lengths on the water surface below the model test station. The facility can also generate a surface wind. During this test a model of a tiltwing VTOL airplane with four propellers was tested as it simulated hover at varying heights and disk loadings above the variable water surface conditions. The effects of water waves on the forces and moments felt by the hovering model were found to be negligible, and the effects of the surface wind on the forces and moments were found to be as would be predicted with a negligible effect of waves even with the surface wind. By contrast, it was found that the waves and the surface wind both had significant effects on the effects of the airplane's downwash on the water surface and the spray generated around the model. Comparison of some of the spray patterns found in this test program with results of full scale airplane tests indicate that these results of the model tests correlate well with the limited data available from the actual airplane tests.

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KEY WORDS

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Hover
VTOL
Tiltwing
Surface winds
Surface waves
Forces
Moments
Downwash
Spray
Recirculation
Edge effects
Disk Loading
Height above water

LINK A

ROLE

WT

LINK B

ROLE

WT

LINK C

ROLE

WT

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