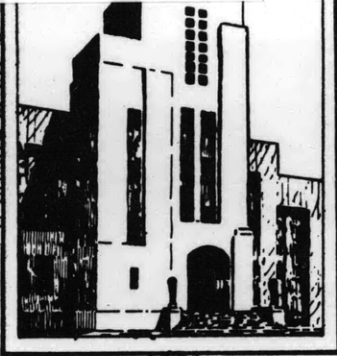


V393
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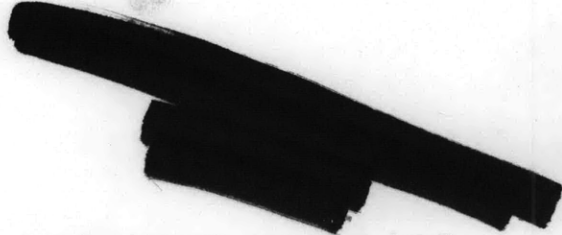
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#1

Report 1775

DEPARTMENT OF THE NAVY
DAVID TAYLOR MODEL BASIN



HYDROMECHANICS

PERFORMANCE CHARACTERISTICS OF MODEL 4958
REPRESENTING A PLANING TYPE 63-FOOT
AIRCRAFT RESCUE BOAT

AERODYNAMICS

by



Kenneth H. Harbaugh

STRUCTURAL
MECHANICS

HYDROMECHANICS LABORATORY
RESEARCH AND DEVELOPMENT REPORT

APPLIED
MATHEMATICS

September 1963

Report 1775

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NOTATION

A_P	Projected planing bottom area, excluding area of external spray strips
\underline{B}	Baseline
B_P	Beam or breadth over chines, excluding external spray strips
B_{PA}	Mean breadth over chines, A_P/L_P
B_{PX}	Maximum breadth over chines, excluding external spray strips
CG	Center of gravity
\underline{C}	Centerline
ehp	Effective horsepower
F_{∇}	Froude number based on volume in any consistent units, $v/\sqrt{g \nabla^{1/3}}$
g	Acceleration due to gravity
LCG	Longitudinal center of gravity location
L_P	Projected chine length
R	Total resistance, lb
S	Area of wetted surface (This is the actual wetted surface underway including the area of the sides which is wetted at low speeds and the wetted bottom area of external spray strips; however, the area wetted by spray is excluded.)
V	Speed, knots
v	Speed, feet per second
w	Density of water, weight per unit volume
Δ	Displacement at rest, weight of
∇	Displacement at rest, volume of
τ	Trim angle of hull with respect to attitude as drawn, deg

ABSTRACT

Tests using TMB Model 4958 were made in Langley Tank No. 1 to determine the performance characteristics of a V-bottom 63-foot Aircraft Rescue Boat. Model speed, resistance, trim, and wetted length were measured throughout the speed range for a number of hull loadings, initial trim conditions, and with all appendages. Tests with and without appendages were conducted for the TMB standard condition for planing boats and test data for that condition are presented in nondimensional form. Change in trim and ehp are presented in terms of full-scale speed in knots.

INTRODUCTION

The Bureau of Ships¹ requested that the David Taylor Model Basin conduct model tests of a 63-foot Aircraft Rescue Boat. Feasibility studies and conversions of these boats have been hampered by a lack of speed-power data and effect of change in displacement. Thus, in accordance with Reference 1, the High Speed Phenomena Division of the David Taylor Model Basin at Langley Field, Virginia, determined the resistance and running trim of a model in smooth water. The work was accomplished under Task 2062.

DESCRIPTION OF MODEL

A 1/7-scale model, designated TMB Model 4958, was constructed in accordance with the lines and offsets of Reference 2. Lines and form characteristics are presented in Figure 1. Three views of Model 4958 are shown in Figure 2.

¹ References are listed on page 3.

TEST PROCEDURE

The tests were made in Langley Towing Tank No. 1. Model 4958 was towed in the thrust line with the model free to trim. Table 1 presents a schedule of the model tests. Tests 1 and 2, TMB standard condition and standard condition with appendages, were conducted at full-scale speeds ranging from 0 to 56 knots; Tests 3 through 8, at full-scale speeds ranging from 0 to 40 knots. Resistance, trim, CG rise, and wetted lengths were measured throughout the speed range, and photographs were taken at 5-knot intervals.

TEST RESULTS

Results of model tests are presented in Figures 1, 3, and 4. The air drag of the towing gear has been subtracted from all resistance data. The full-scale resistance and ehp were calculated by the method described in Reference 3, using the 1947 ATTC friction coefficients with zero roughness allowance. Test data and results for the TMB standard condition for planing boats are presented in Figure 1. Included in Figure 1c is a dashed curve giving the resistance-weight ratio for the fully appendaged model operating at the standard condition. The effect of change in initial trim at the design load had only a small effect on trim (Figure 3a) or ehp (Figure 4a) except at high speeds where an increase in initial trim decreased the ehp. Change in displacement had only a small effect on trim (Figure 3b), and increased the ehp (Figure 4b) by about 70 hp for an increase in displacement of 5000 lb at speeds above 12 knots.

Spray characteristics under given test conditions and at various speeds are presented in Figures 5 through 11.

REFERENCES

1. Bureau of Ships letter S-F014-0202, Serial 449-110 of 27 November 1962 to David Taylor Model Basin.
2. Bureau of Ships Plans, Lines and Offsets S8203(5)-63-H-1428743 Rev. A., Rudder Detail 63-MK4-445-1760754 Rev. A., Shaft-Log, Strut, and Fair-water S8203(5)-63-H-1428780 Rev. A.
3. Gertler, M., "The Prediction of the Effective Horsepower of Ships by Methods in Use at the David Taylor Model Basin," David Taylor Model Basin Report 576 (Dec 1947).

TABLE 1
Test Schedule

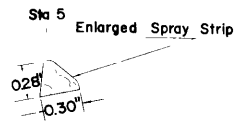
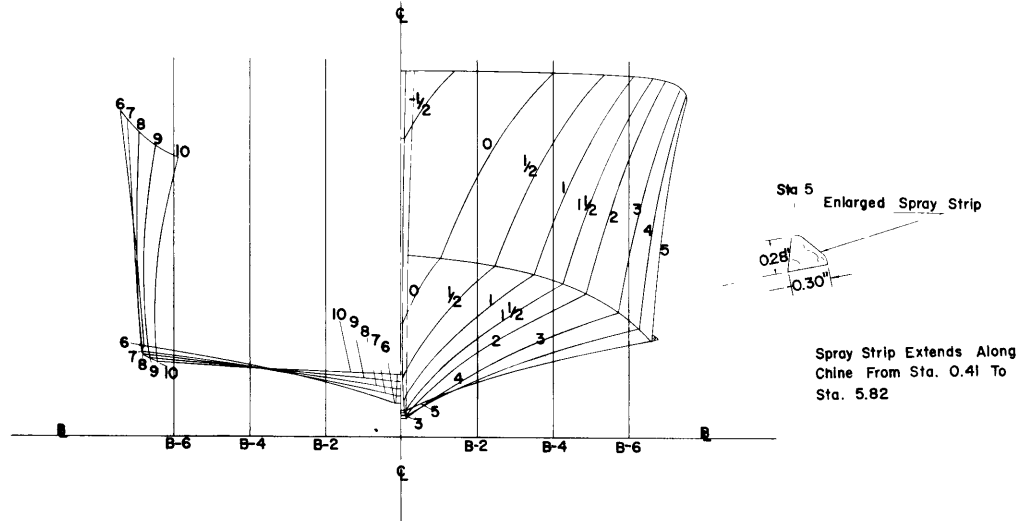
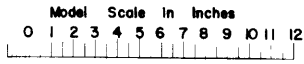
Test No.	Model Displacement lb	Ship Displacement lb	$\frac{A_P}{\nabla^{2/3}}$	Initial Trim	LCG % L_p aft of Centroid of A_P	Configuration
1*	179.0	100,000	7.0	0.38° by stern	6.0	No appendages
2*	179.0	100,000	7.0	0.38° by stern	6.0	All appendages
3	158.5	55,000	7.56	EK	5.2	All appendages
4	172.9	60,000	7.137	EK	5.1	All appendages
5	172.9	60,000	7.137	0.5° by stern	6.93	All appendages
6	172.9	60,000	7.137	0.5° by bow	2.66	All appendages
7	187.3	65,000	6.767	EK	4.73	All appendages
8	201.7	70,000	6.441	EK	4.27	All appendages

* The total resistance has been corrected to a 100,000-lb displacement (TMB standard condition), which corresponds to a linear ratio of 8.202.

David Taylor Model Basin Small Craft Data Sheet

Hard chine boat, $L_p/B_{px}=4.43$

TMB Model No. 4958



Spray Strip Extends Along Chine From Sta. 0.41 To Sta. 5.82

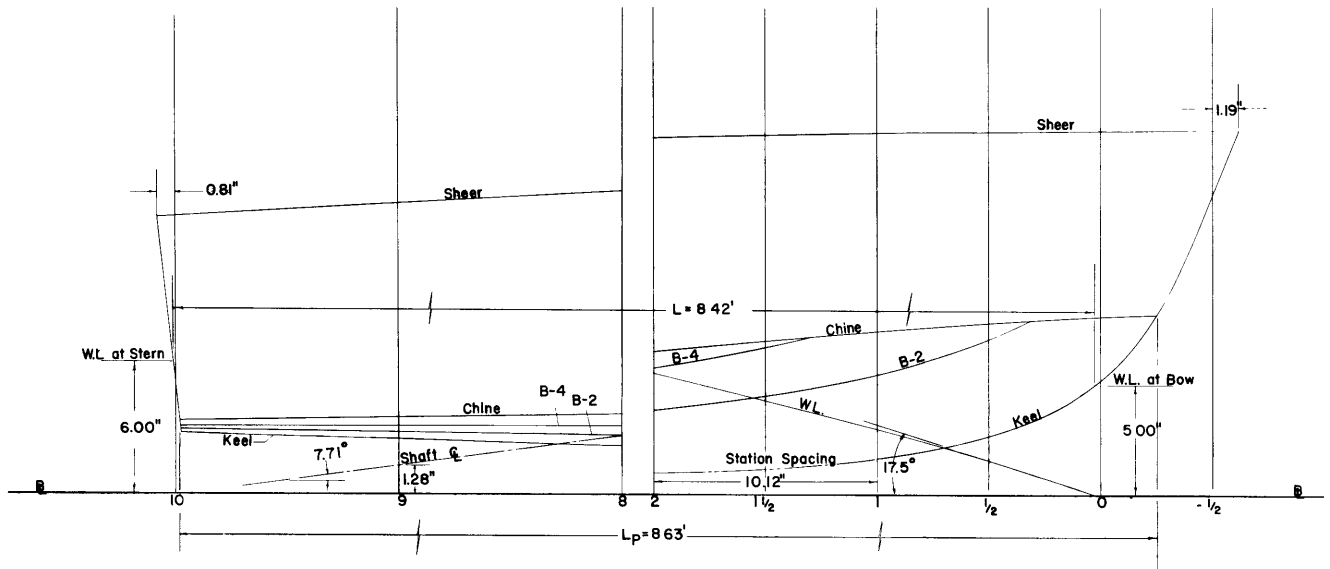


Figure 1a

PERFORMANCE CHARACTERISTICS

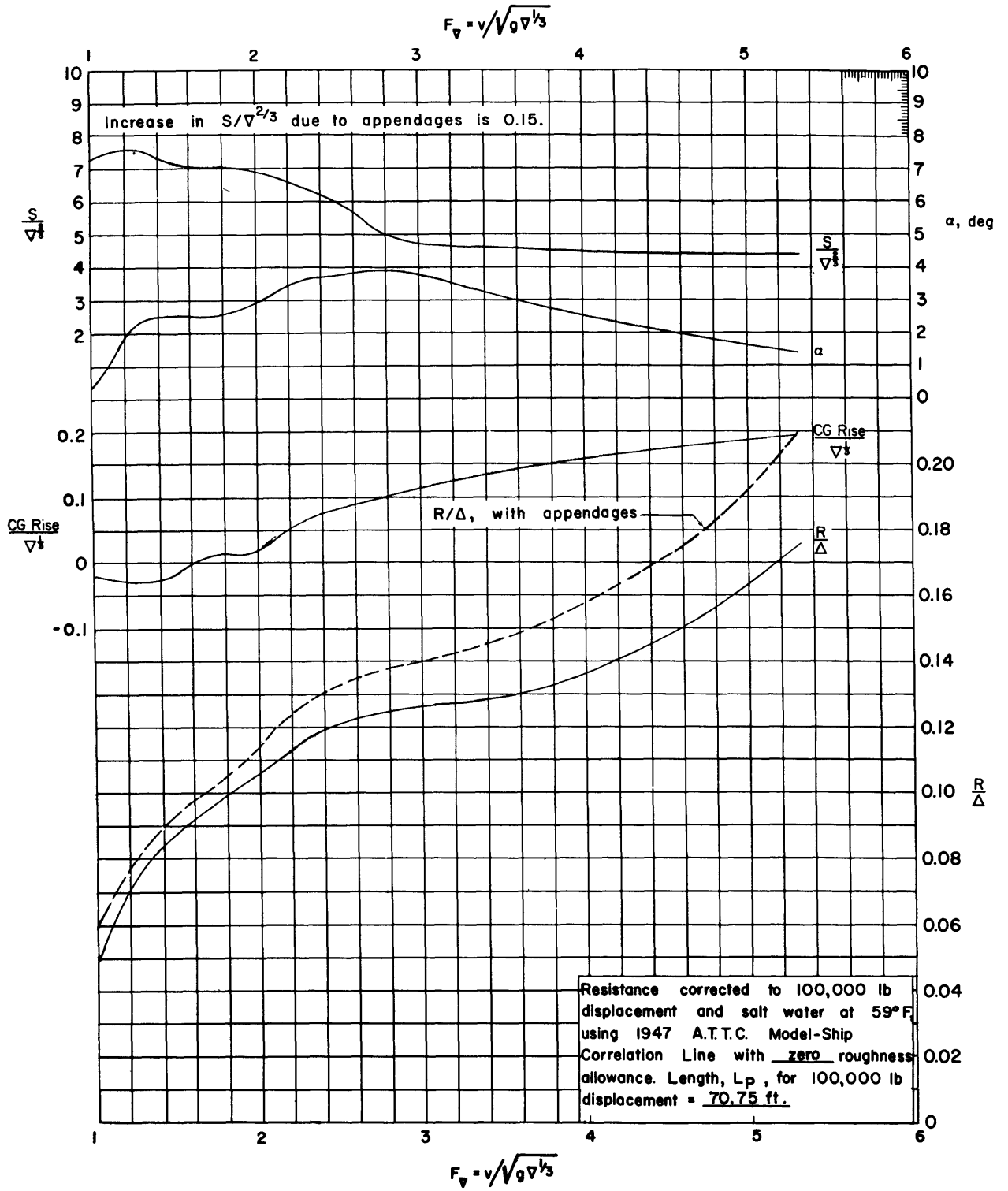
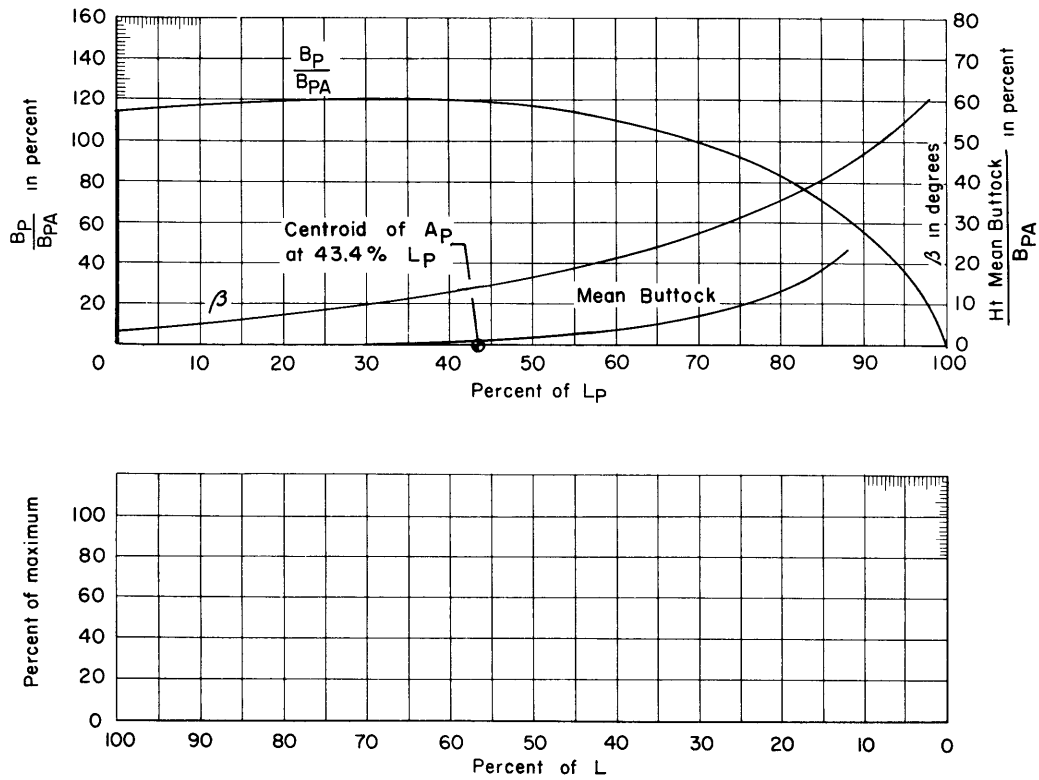


Figure 1c

FORM CHARACTERISTICS



Notation

As far as possible the notation used is consistent with the Society's "Explanatory Notes for Resistance and Propulsion Data Sheets" (Technical and Research Bulletin No. 1-13). Exceptions and additions are listed below. The subscript P designates the planing bottom which is the portion of the bottom bounded by the chines and transom.

- A_p Projected planing bottom area, excluding area of external spray strips
 - B_p Beam or breadth over chines, excluding external spray strips
 - B_{pA} Mean breadth over chines, A_p/L_p
 - B_{pX} Maximum breadth over chines, excluding external spray strips
 - L_p Projected chine length
 - S Area of wetted surface (This is the actual wetted surface underway including the area of the sides which is wetted at low speeds and the wetted bottom area of external spray strips; however, the area wetted by spray is excluded).
 - α Angle of attack of stern portion of planing bottom in degrees
 - β Dead rise angle of planing bottom in degrees. This angle is obtained by approximating each body plan section by a straight line.
 - Δ Displacement at rest, weight of
 - τ Trim angle of hull with respect to attitude as drawn in degrees
 - ∇ Displacement at rest, volume of
- Subscript O indicates value when hull is at rest in water.

Figure 1d

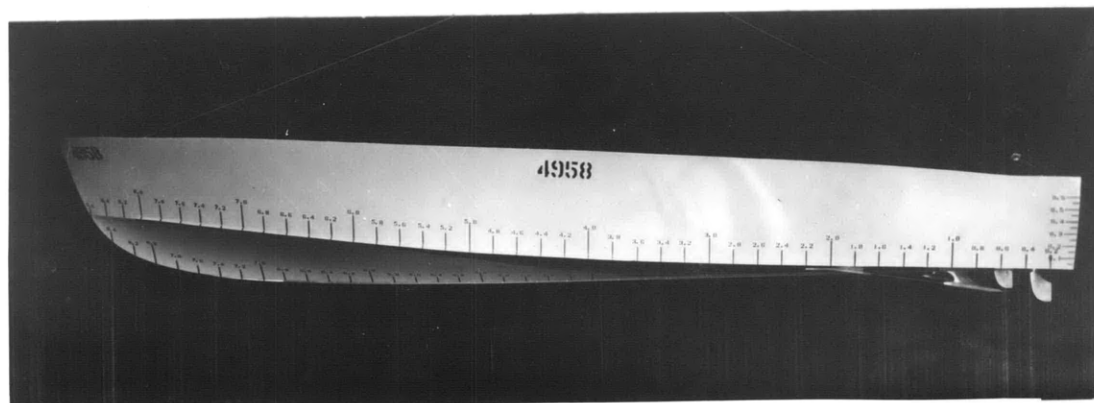


Figure 2a - Side View

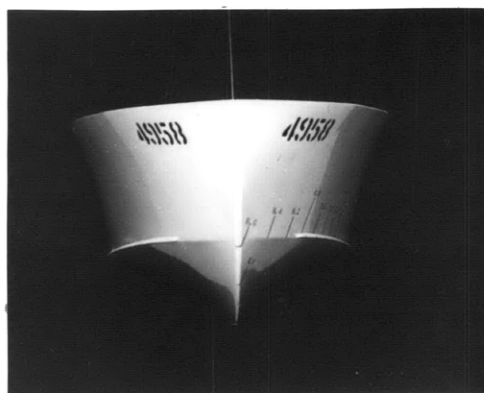


Figure 2b - Bow View

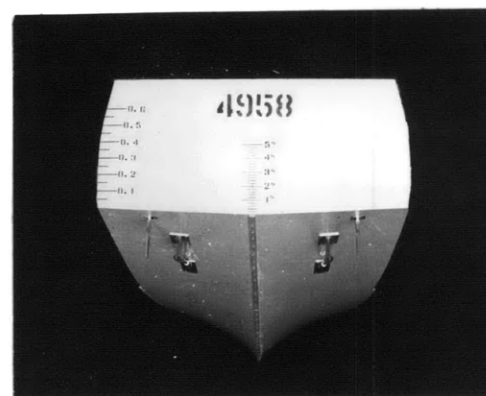


Figure 2c - Stern View

Figure 2 - Photographs of Model 4958

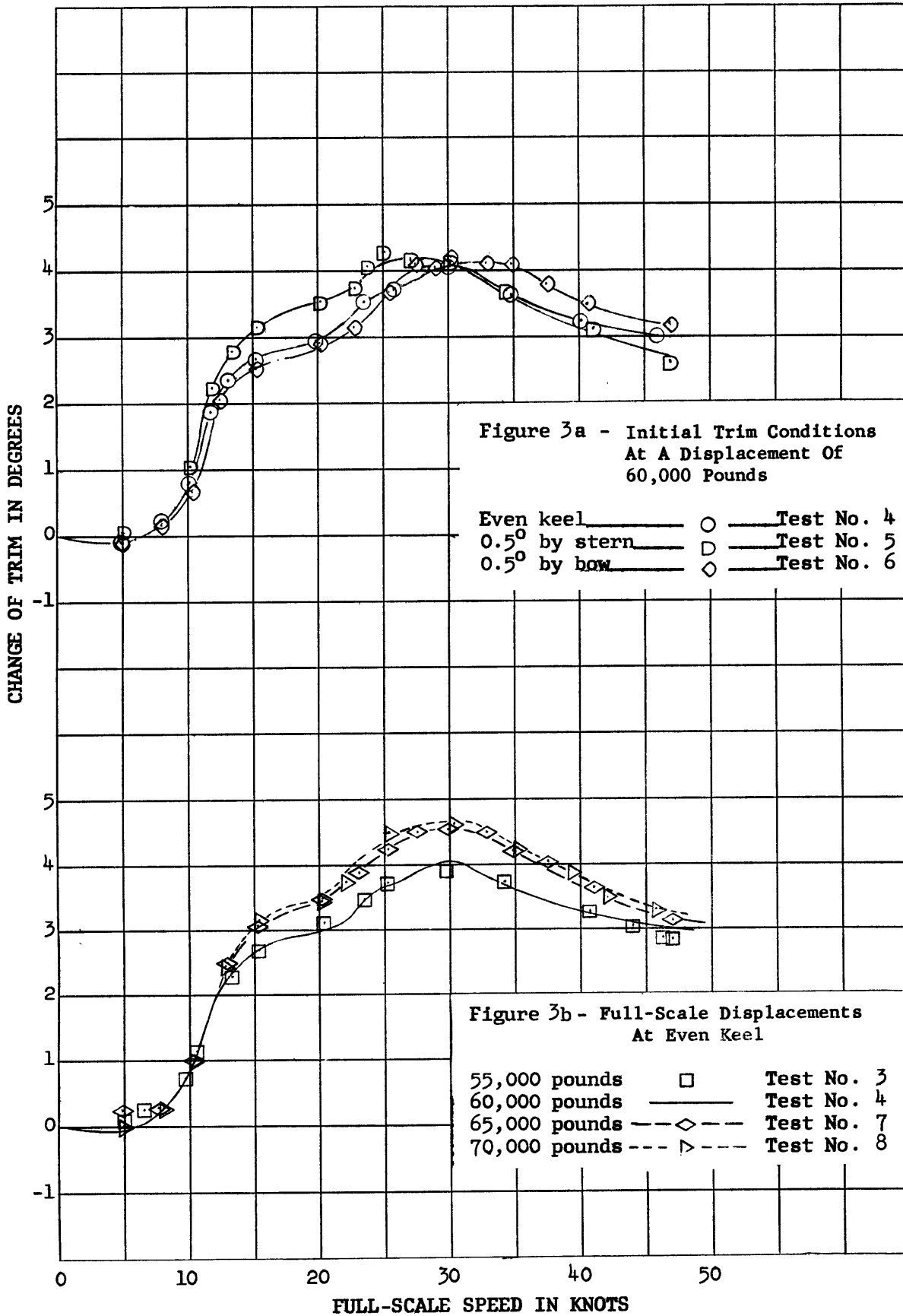


Figure 3 - Variation of Trim with Speed

TOTAL EFFECTIVE HORSEPOWER - EHP

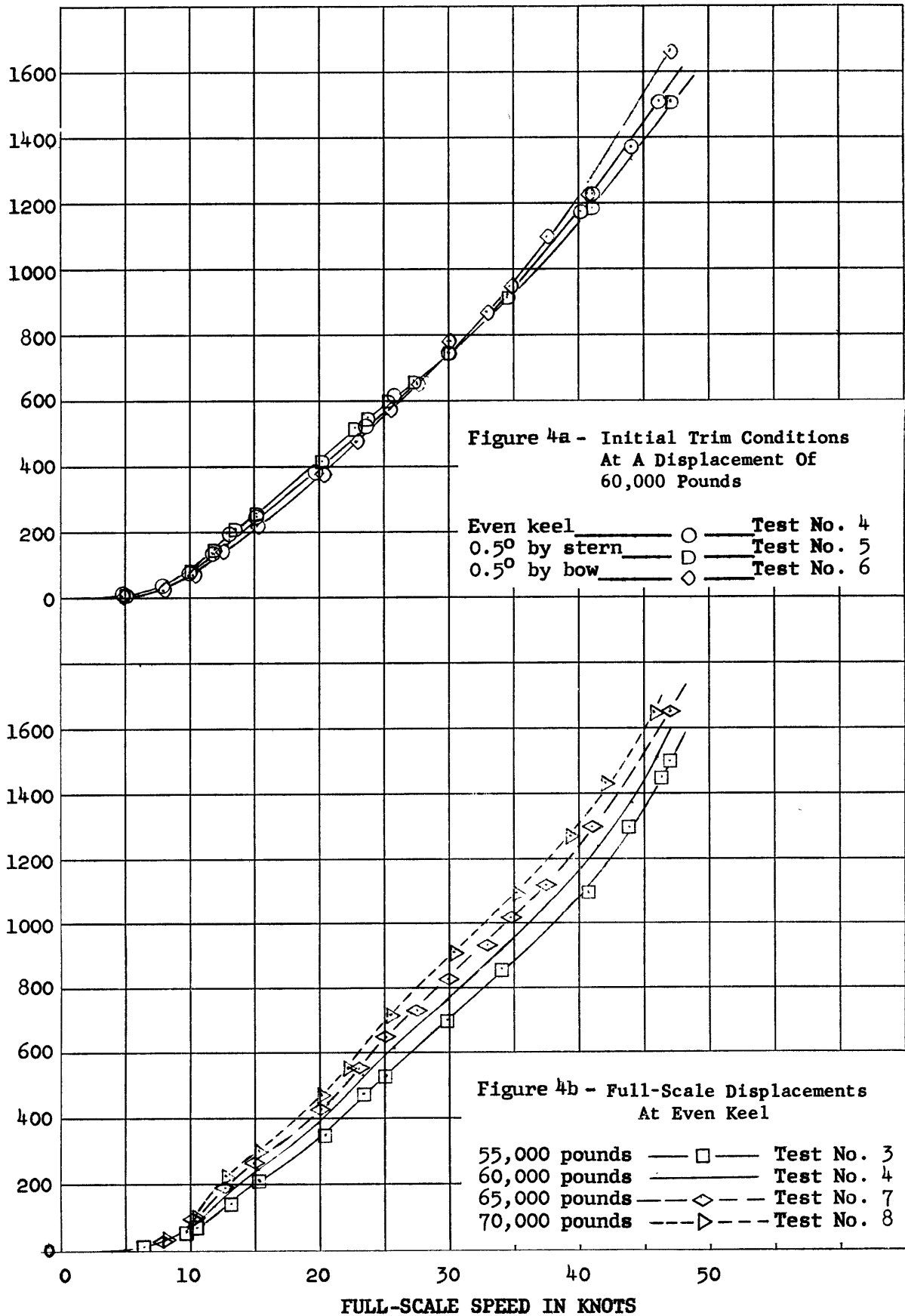
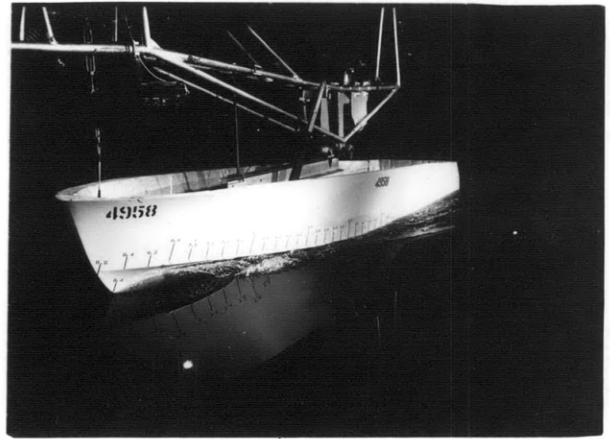


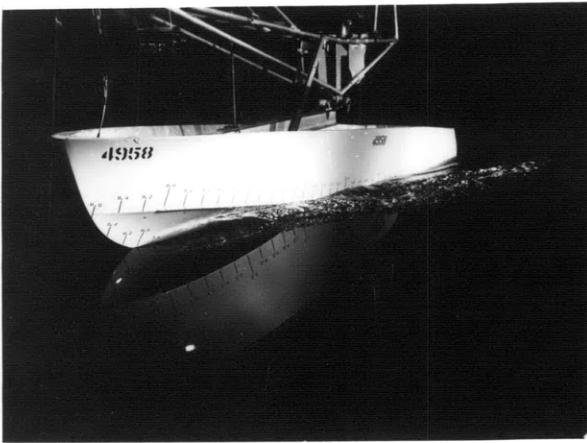
Figure 4 - Variation of Total Effective Horsepower with Speed



$F_{\nabla} 0$



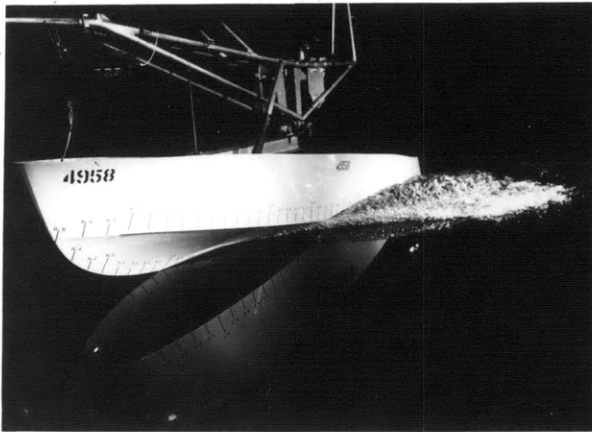
$F_{\nabla} 0.98$



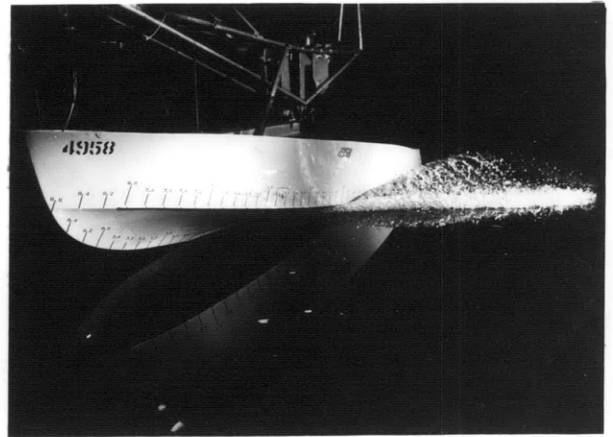
$F_{\nabla} 1.40$



$F_{\nabla} 1.85$

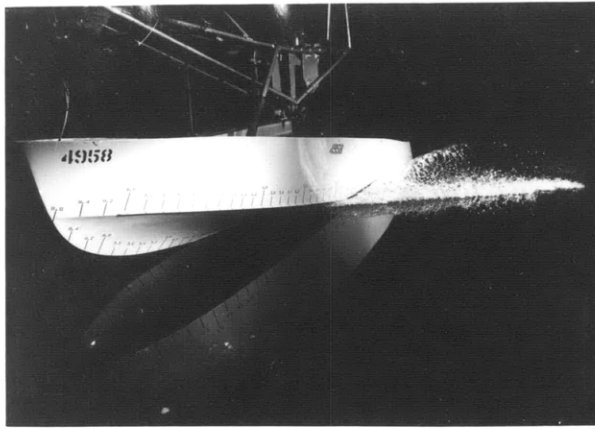


$F_{\nabla} 2.35$

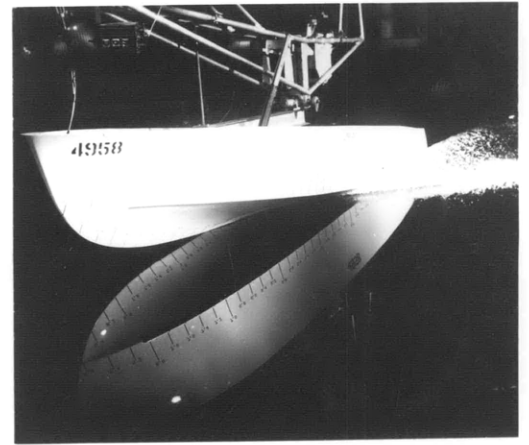


$F_{\nabla} 2.87$

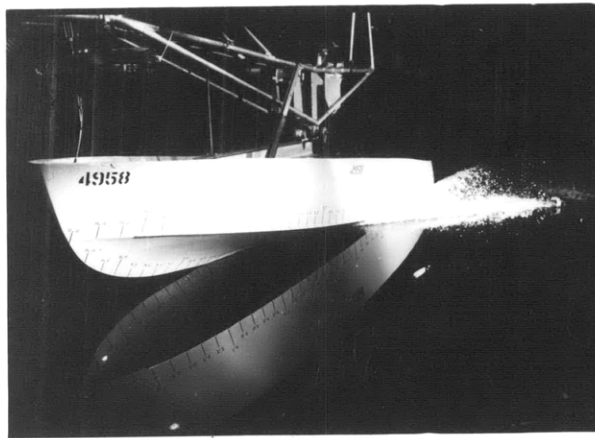
Figure 5 - Spray Characteristics of Model 4958 with no Appendages at Various Froude Numbers for the DTMB Standard Condition for Planing Boats



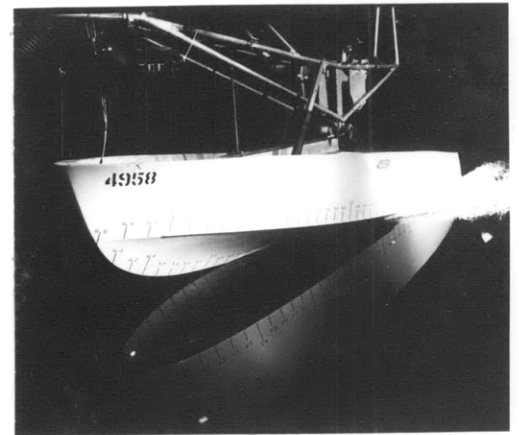
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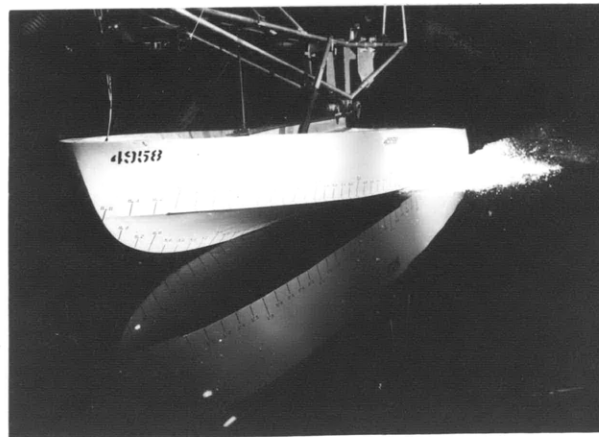
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F_{∇} 4.28

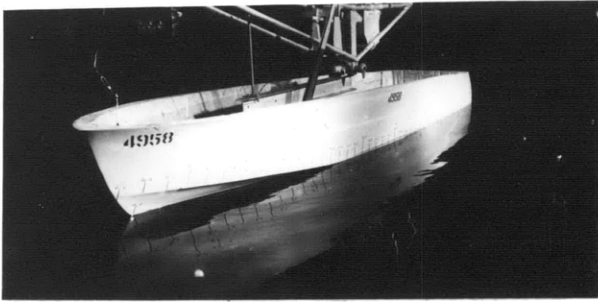


F_{∇} 4.92

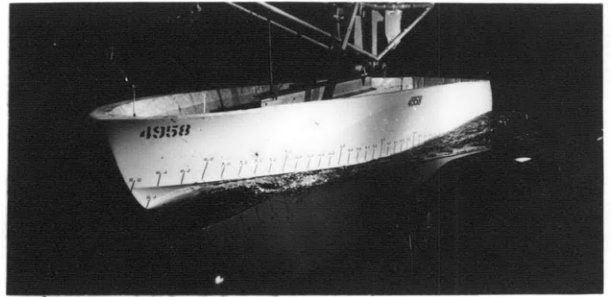


F_{∇} 5.27

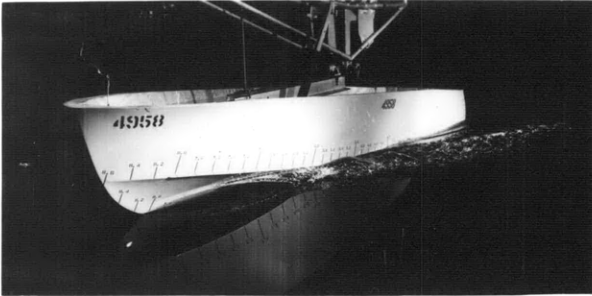
Figure 5 (Concluded)



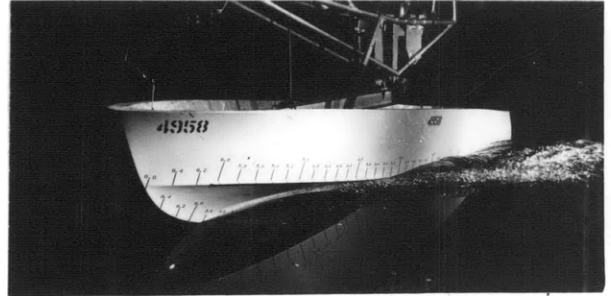
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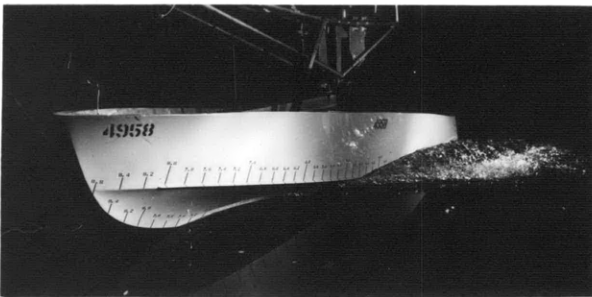
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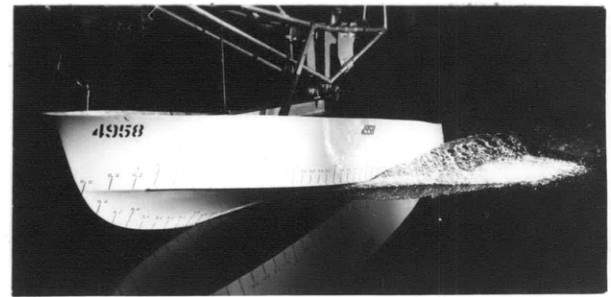
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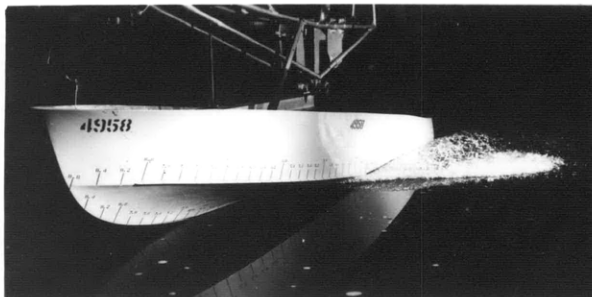
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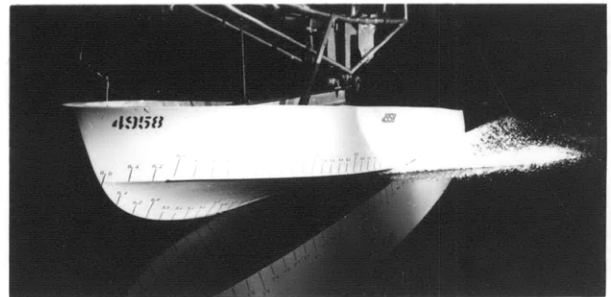
25.1 Knots



29.9 Knots

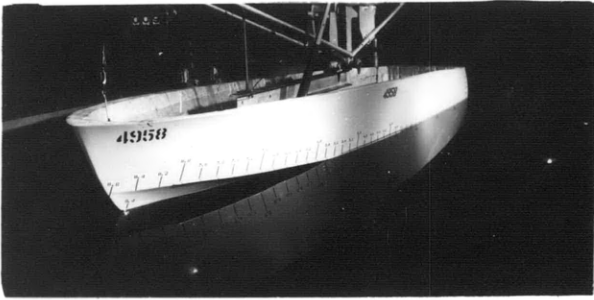


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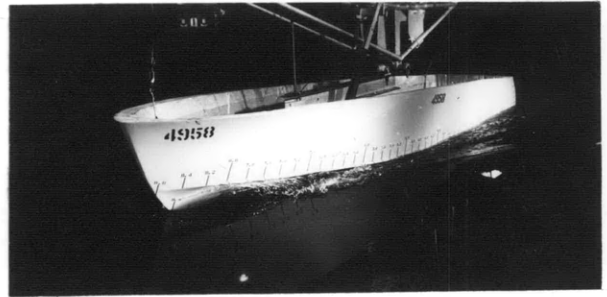


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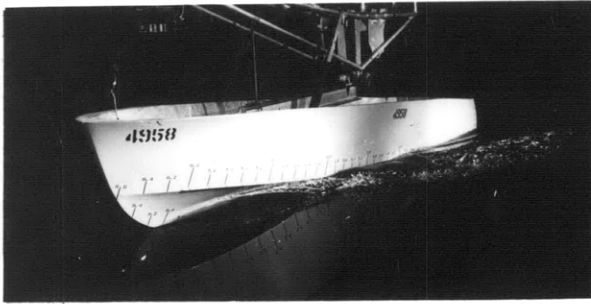
Figure 6 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 55,000 Pounds Initially at Even Keel



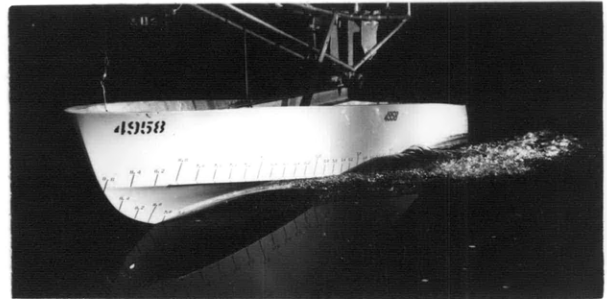
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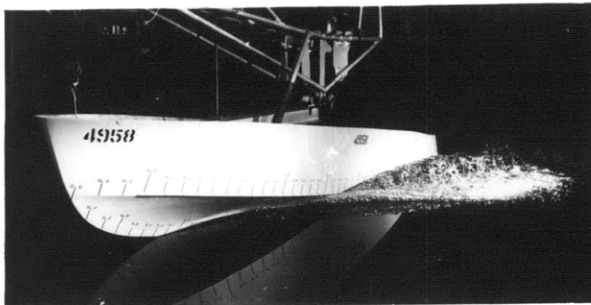
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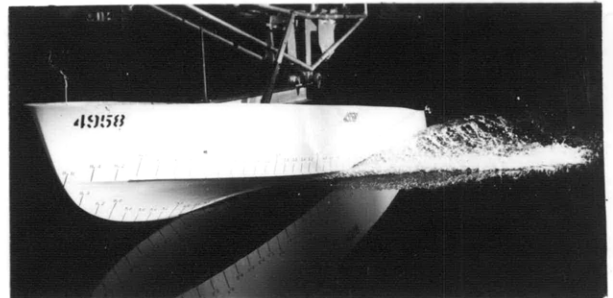
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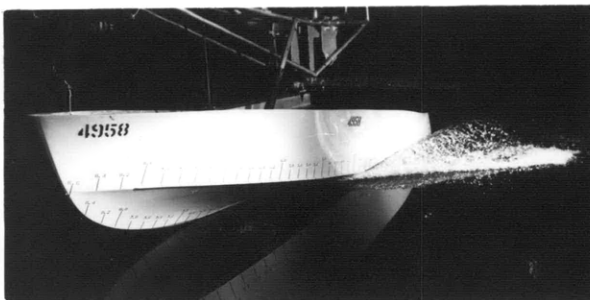
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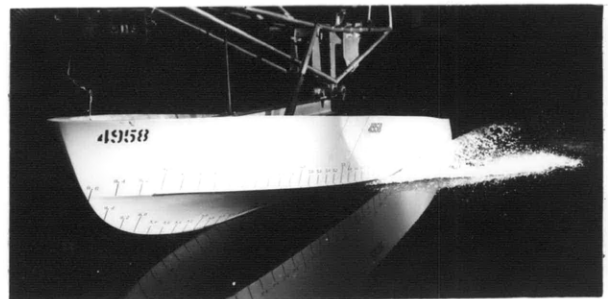
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29.9 Knots



34.8 Knots

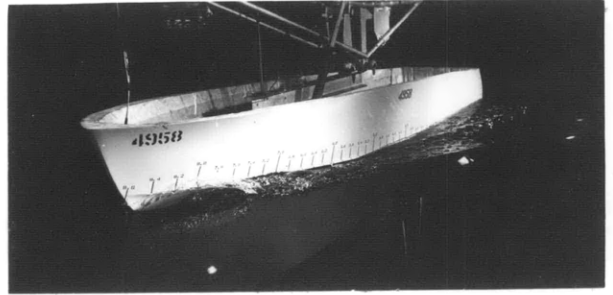


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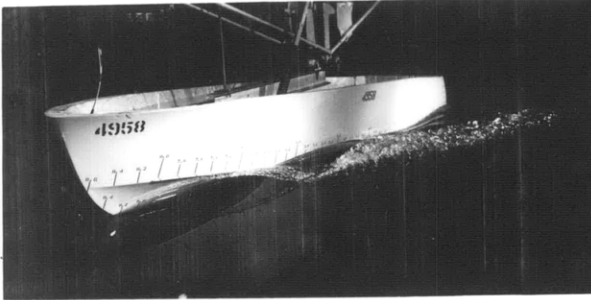
Figure 7 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 60,000 Pounds Initially at Even Keel



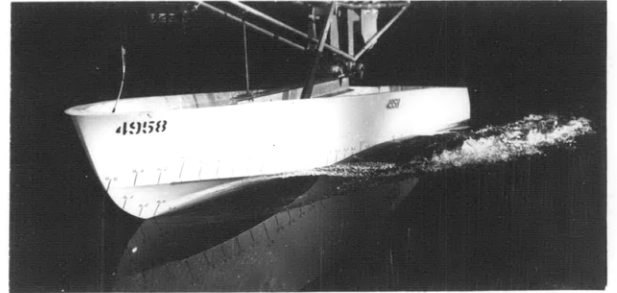
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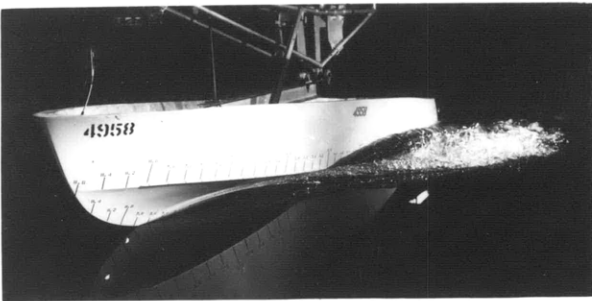
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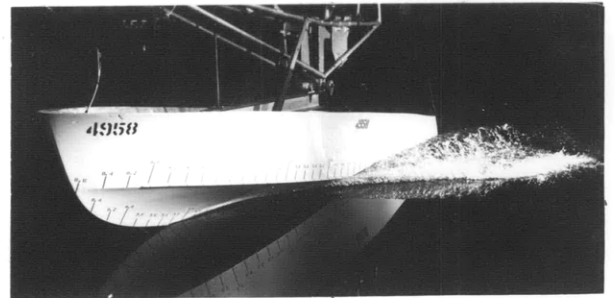
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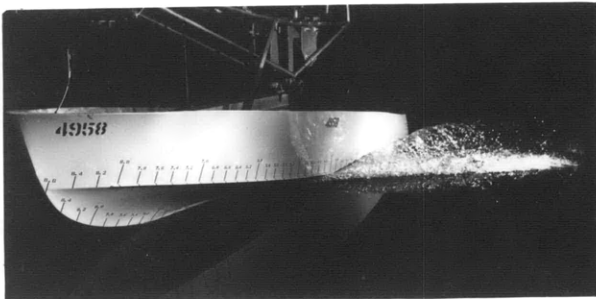
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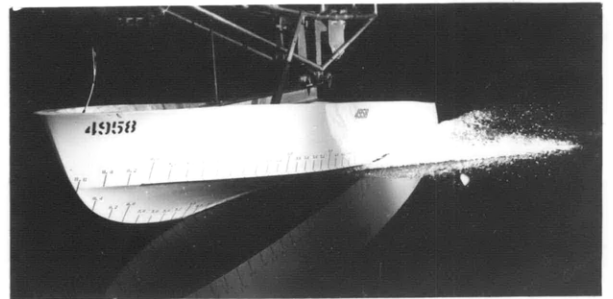
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30.1 Knots



34.8 Knots

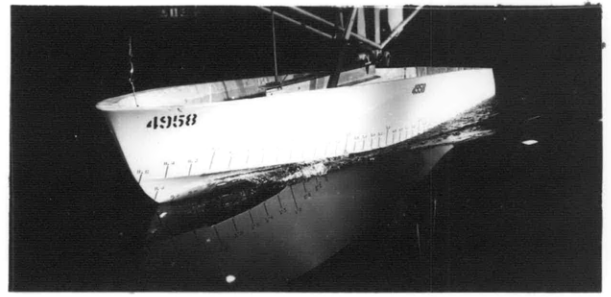


40.1 Knots

Figure 8 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 60,000 Pounds Initially at 1/2 Degree by the Bow



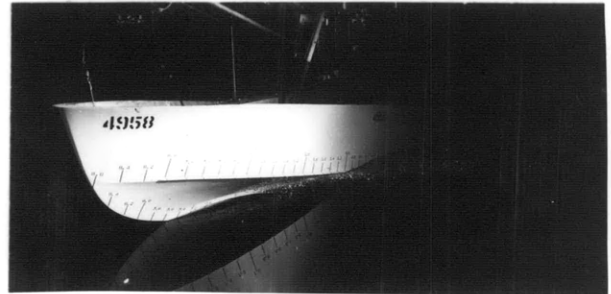
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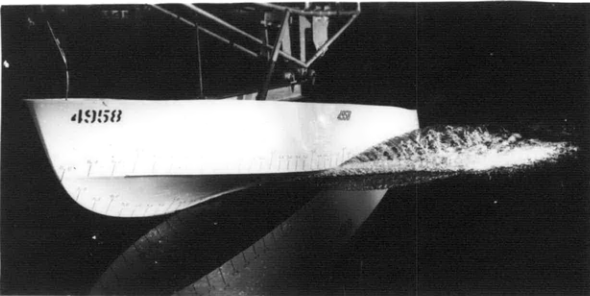
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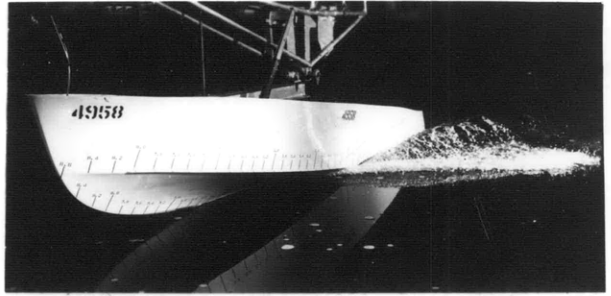
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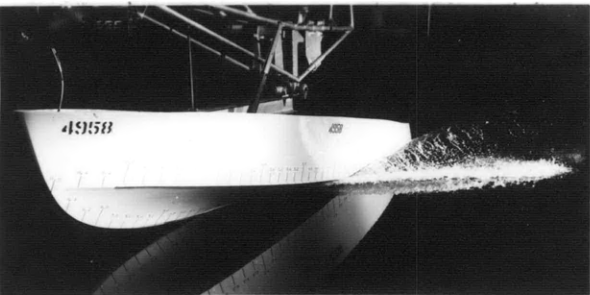
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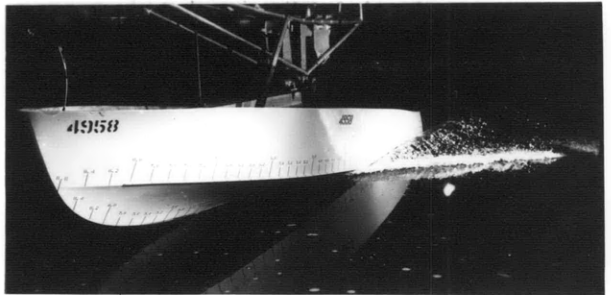
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30.1 Knots

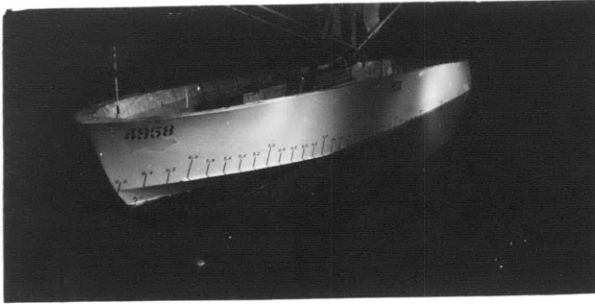


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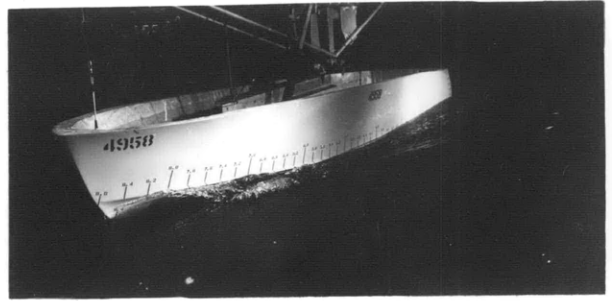


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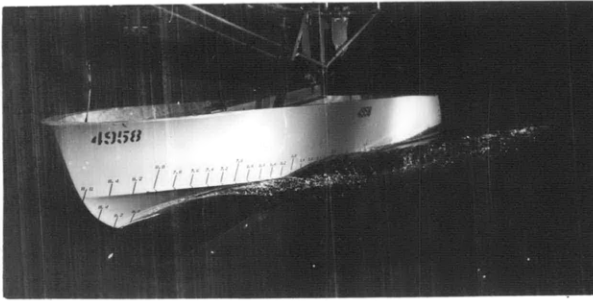
Figure 9 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 60,000 Pounds Initially at 1/2 Degree by the Stern



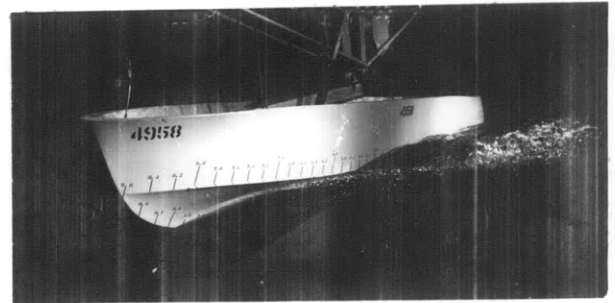
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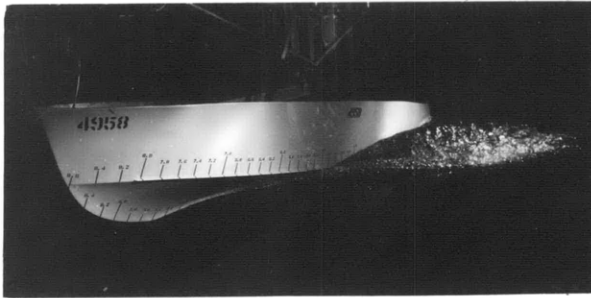
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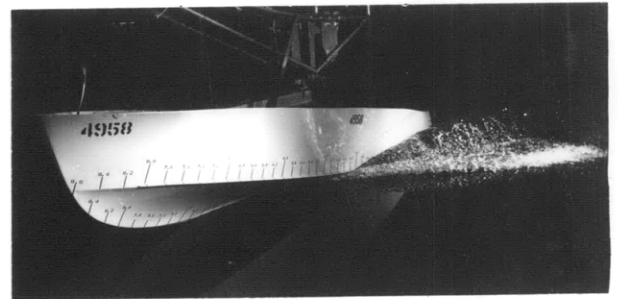
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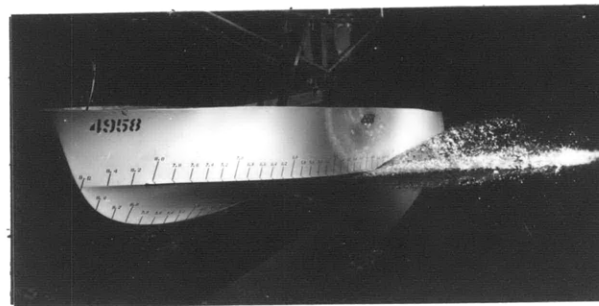
20.3 Knots



25.2 Knots



29.9 Knots



34.8 Knots

Figure 10 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 65,000 Pounds Initially at Even Keel



0 Knots



10.3 Knots



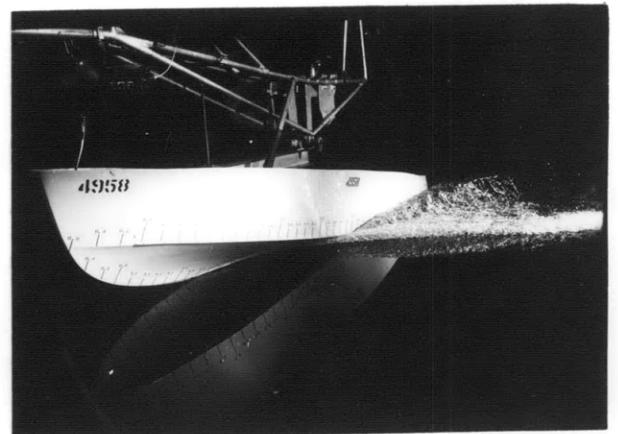
15.4 Knots



20.2 Knots



25.4 Knots



30.3 Knots

Figure 11 - Spray Characteristics of Model 4958 at Various Full-Scale Speeds for a Displacement of 70,000 Pounds Initially at Even Keel

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PERFORMANCE CHARACTERISTICS OF MODEL 4958 REPRESENTING A PLANING TYPE 68-FOOT AIRCRAFT RESCUE BOAT, by Kenneth H. Harbaugh. Sep 1963. iv, 17p. illus., UNCLASSIFIED

Tests using TMB Model 4958 were made in Langley Tank No. 1 to determine the performance characteristics of a V-bottom 68-foot Aircraft Rescue Boat. Model speed, resistance, trim, and wetted length were measured throughout the speed range for a number of hull loadings, initial trim conditions, and with all appendages. Tests with and without appendages were conducted for the DTMB standard condition for planing boats and test data for that condition are presented in nondimensional form. Change in trim and ehp are presented in terms of full-scale speed in knots.

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