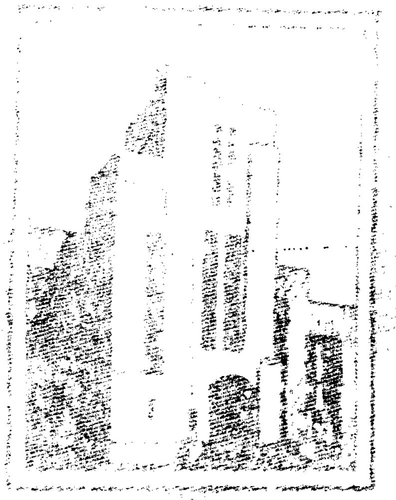

NAVY DEPARTMENT

DAVID TAYLOR MODEL BASIN

HYDROMECHANICS

MODEL TEST RESULTS AND PREDICTED EHP FOR AN 86-FOOT PERSONNEL BOAT, FROM TESTS OF MODEL 4675

by

Eugene P. Clement and Charles W. Tate, Sr.

AERODYNAMICS

STRUCTURAL MECHANICS

HYDROMECHANICS LABORATORY

RESEARCH AND DEVELOPMENT REPORT

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December 1958

Report 1288
NS715-086

NOTATION

A	Area of a vertical transverse underwater section
A_W	Area of waterplane at the load waterline
A_X	Area of maximum vertical transverse underwater section
$\mathbb{B}$	Baseline
B_X	Breadth at the maximum-area section, measured at the LWL
C_B	Block coefficient (volume of the underwater body, ∇, divided by the volume of a rectangular parallelepiped, LWL $\cdot B_X \cdot H_X$)
CG	Center of gravity
℄	Centerline
C_P	Prismatic coefficient (volume of the underwater body, ∇, divided by the volume of the prism, LWL $\cdot A_X$)
C_W	Waterplane coefficient (ratio of area, A_W, to area of rectangle, LWL $\cdot B_X$)
C_X	Maximum section coefficient (area, A_X, divided by the area of rectangle, $B_X \cdot H_X$)
ehp	Effective horsepower
$F_{n\nabla}$	Froude number based on volume, in any consistent units, $v/\sqrt{g\nabla^{1/3}}$
g	Acceleration due to gravity
H	Draft of underwater hull, measured from $\mathbb{B}$ to LWL
H_X	Draft at the section of maximum area
LCG	Longitudinal center of gravity location
LOA	Length overall
LWL	Load waterline or length on load waterline
P	Effective power, ft-lb/sec
R	Total resistance, lb
V	Speed, knots
v	Speed
w	Density of water, weight per unit volume
Δ	Displacement at rest, weight of
∇	Displacement at rest, volume of
λ	Linear ratio, ship to model
τ	Trim angle of hull with respect to the at-rest position

ABSTRACT

Smooth-water model tests were made of an 86-ft personnel boat designed for "all-weather" operation. The model was tested for ehp at full-scale displacements of 130,000 lb, 140,000 lb, and 150,000 lb. In addition, at one speed and displacement, the lines of flow were determined by the acid-trace method, in order to find the appropriate location for the bilge keels.

INTRODUCTION

The Bureau of Ships, by Reference 1,* requested ehp tests of a new design for an 86-ft, "all-weather," personnel boat.

MODEL AND TEST PROGRAM

A 1/16-scale model, 4675, was built to the lines of Reference 2. The lines are shown in Figure 1. The tests were made in the high-speed basin, using Carriage 3. The model was towed in the shaft centerline, which is shown in Figure 1. Tests were made at full-scale displacements of 130,000 lb, 140,000 lb, and 150,000 lb. Initial trim was zero deg in each case. The speed range tested was up to 18 knots, full scale. Resistance, trim angle, and bow rise were measured.

Because of the relatively small size of the model (5 ft in length), it was considered that artificial stimulation of turbulence might be required. Accordingly, the model was towed both with and without a trip wire. The trip wire was 0.042 in. in diameter and was attached to the model surface 3 in. aft of the bow. The 3-in. dimension was measured along the surface of the model, parallel to the waterline planes. However, it was found that at low speeds the trip wire did not consistently have the expected effect of producing higher and more consistent values of resistance. Furthermore, at the high speeds, the trip wire caused the water to separate from the side of the model for a short distance aft of the wire. For these speeds, the model had consistently lower resistance with the trip wire than without--presumably because of the reduced wetted area. For the above reasons, only the data obtained without a trip wire are presented in this report.

TEST RESULTS

The model data obtained are presented in Figure 2. The air drag of the towing gear has been subtracted from the measured resistance data. Values of full-scale ehp are presented in Figure 3. The ehp was calculated by the method described in Reference 3, using the 1947 ATTC friction coefficients with zero roughness allowance. Values of wetted surface and wetted length for the different displacements tested, are tabulated.

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*References are listed on page 2.

Full-Scale Displacement lb	Model Displacement lb	Model LWL Length ft	Model Wetted Surface ft^2
130,000	30.86	5.02	5.138
140,000	33.24	5.03	5.330
150,000	35.61	5.03	5.505

An acid-trace test was also run to determine the appropriate location for the bilge keels. This test was run, in accordance with Reference 1, at a full-scale displacement of 140,000 lb, and at a speed corresponding to 160 ehp, full scale (12.1 knots, full scale). Figure 4 shows the appropriate location for the bilge keels, as indicated by the acid-trace test.

REFERENCES

1. Bureau of Ships ltr S82/27(452) Ser 452-30 of 31 May 1957 to David Taylor Model Basin.

2. Bureau of Ships Sketch No. 027170, 86-Foot, All-Weather Boat, Lines and Offsets.

3. Gertler, M., "The Prediction of Effective Horsepower of Ships by Methods in Use at the David Taylor Model Basin," David Taylor Model Basin Report 576 (Dec 1947).

FIGU

DESIGN DA

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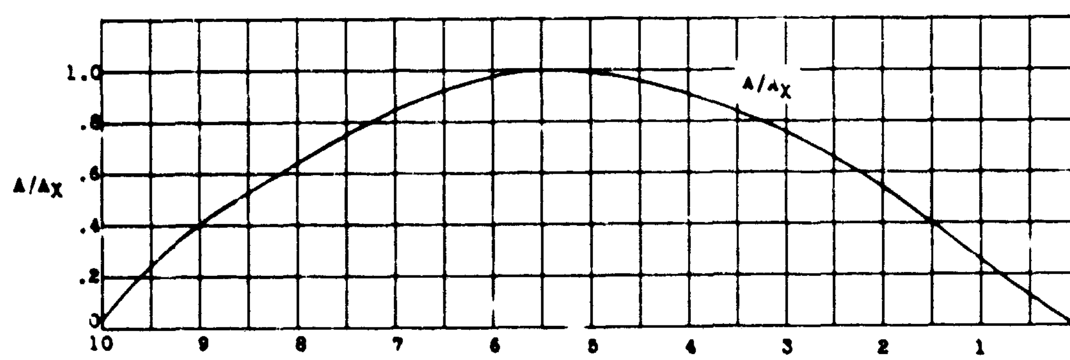
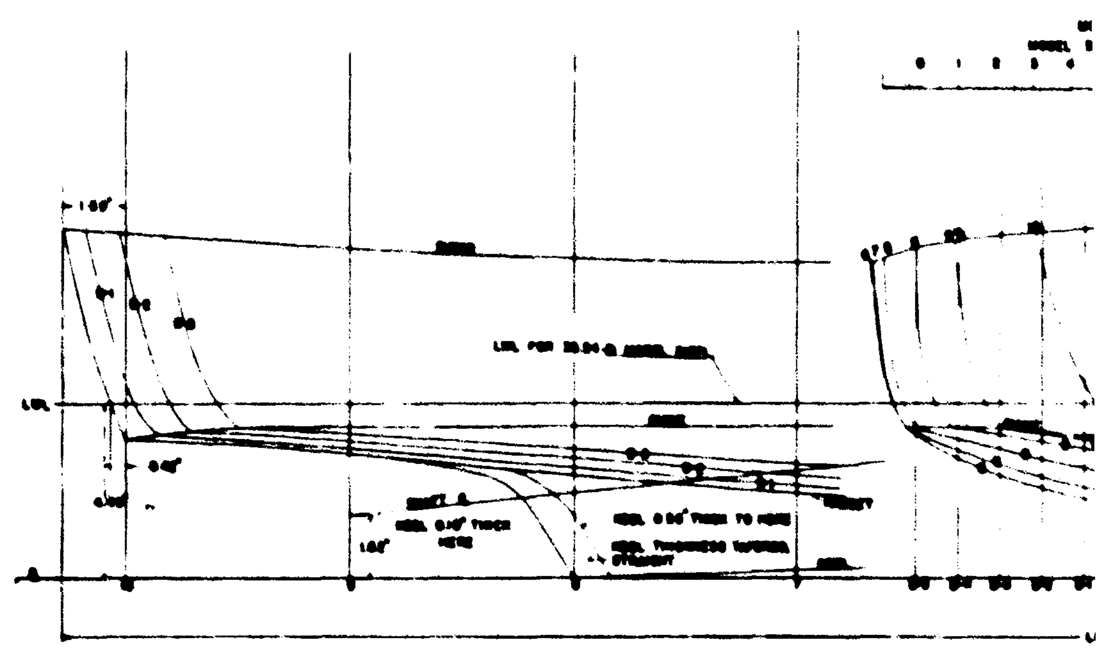
NOVEMB

SHIP AND MODEL DATA FOR BUSHIPS 86-FT PERSONNEL BOAT MODEL 4675			
APPENDAGES: KEEL			
DIMENSIONS			
IN FEET	SHIP	MODEL	LWL COEFFICIENTS
LENGTH (LWL)	80.50	5.031	C_B 0.380*
LENGTH (LOA)	85.92	5.370	C_P 0.645*
BREADTH (B_X)	19.25	1.203	C_X 0.589
DRAFT (H_X)	3.600	0.225	C_W 0.546
DISPL. in lb	140,000	33.24	$L_{WL}/\nabla^{1/3}$ = 6.20
			$A_W/\nabla^{2/3}$ = 5.94
LWL AREA	1,001 FT²	3.910 FT²	
LCG/LWL = 0.482 FROM STERN		λ = 16	
W.L. ENTRANCE HALF ANGLE = 18.7°		INITIAL TRIM, τ° = 0°	
AGENCY: BUSHIPS, LINES PLAN: 027170			

* volume of kee
included in cal





IGURE 1

DATA SHEET

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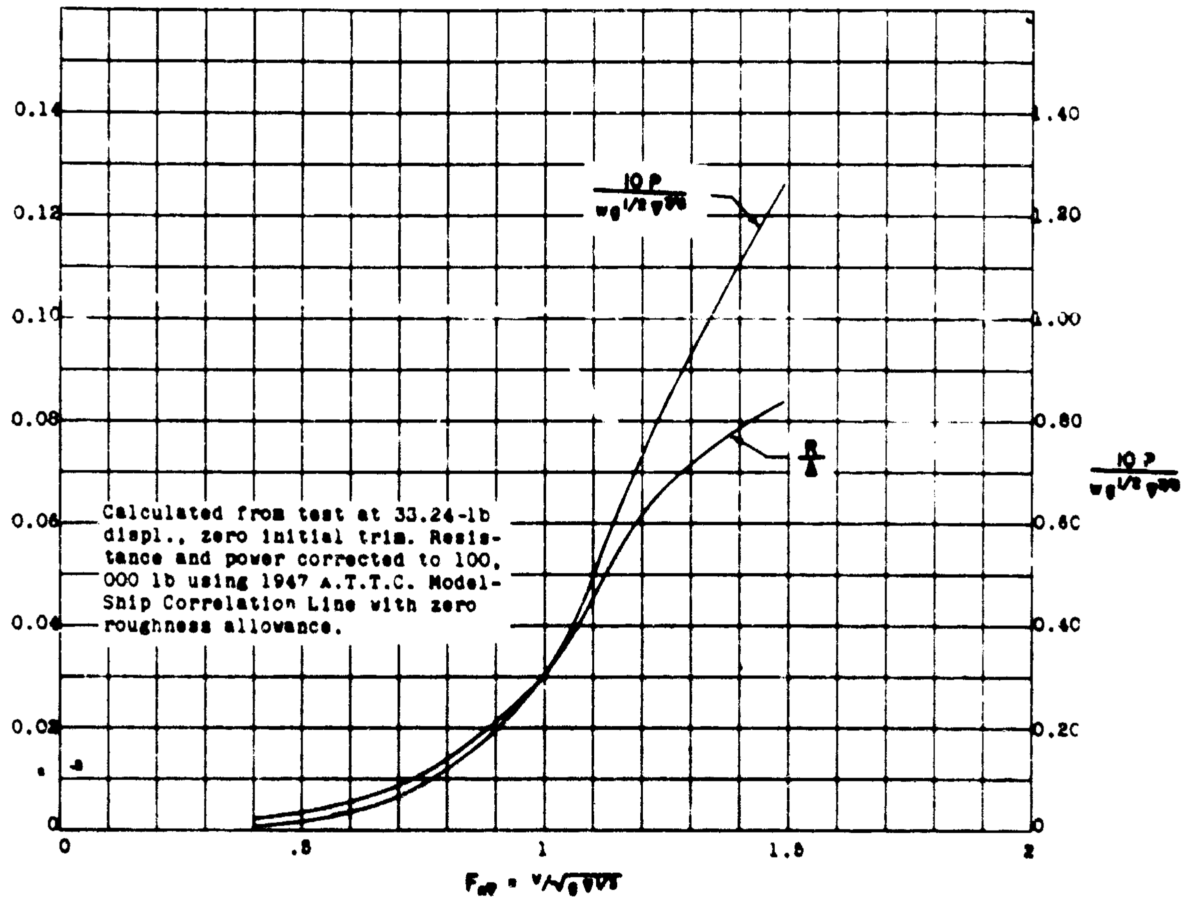

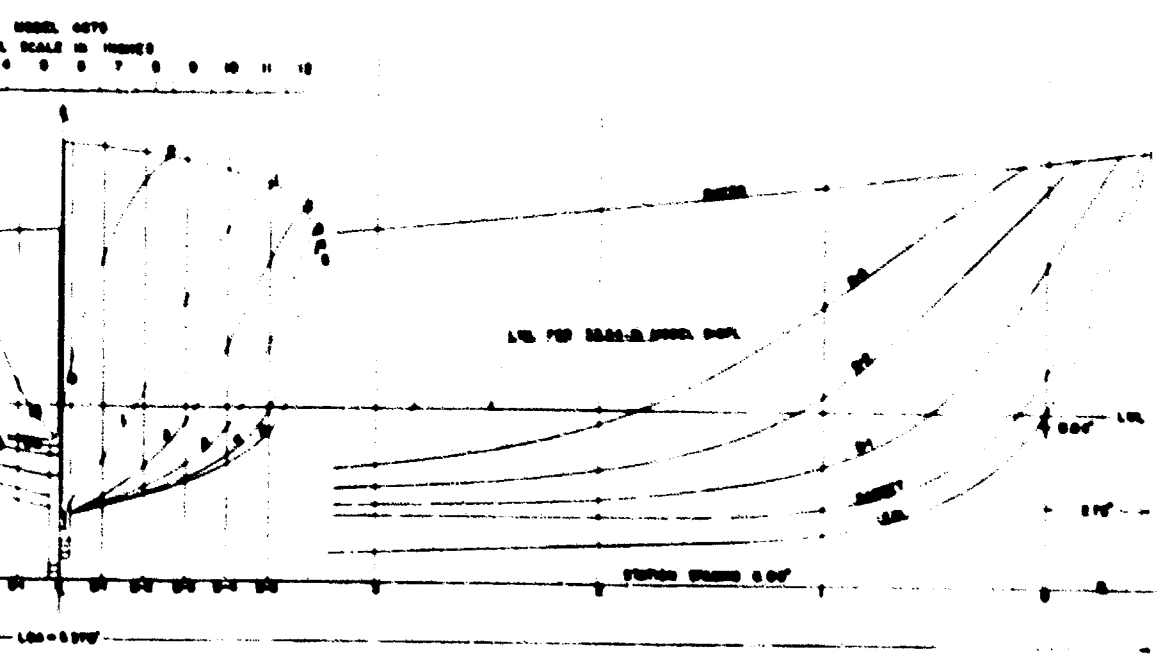

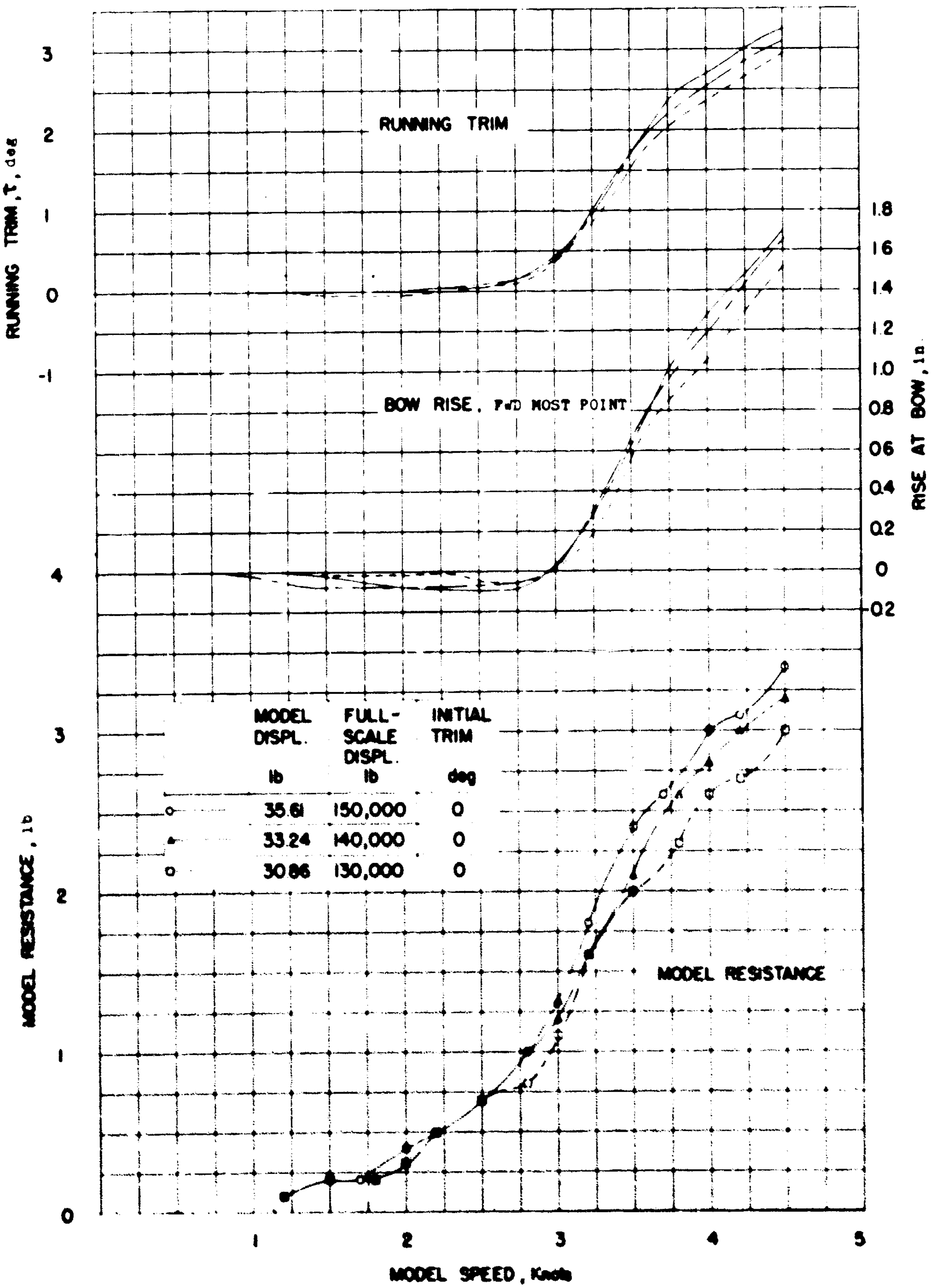

Figure 2 - Model resistance, bow rise, and running trim, three displacements.

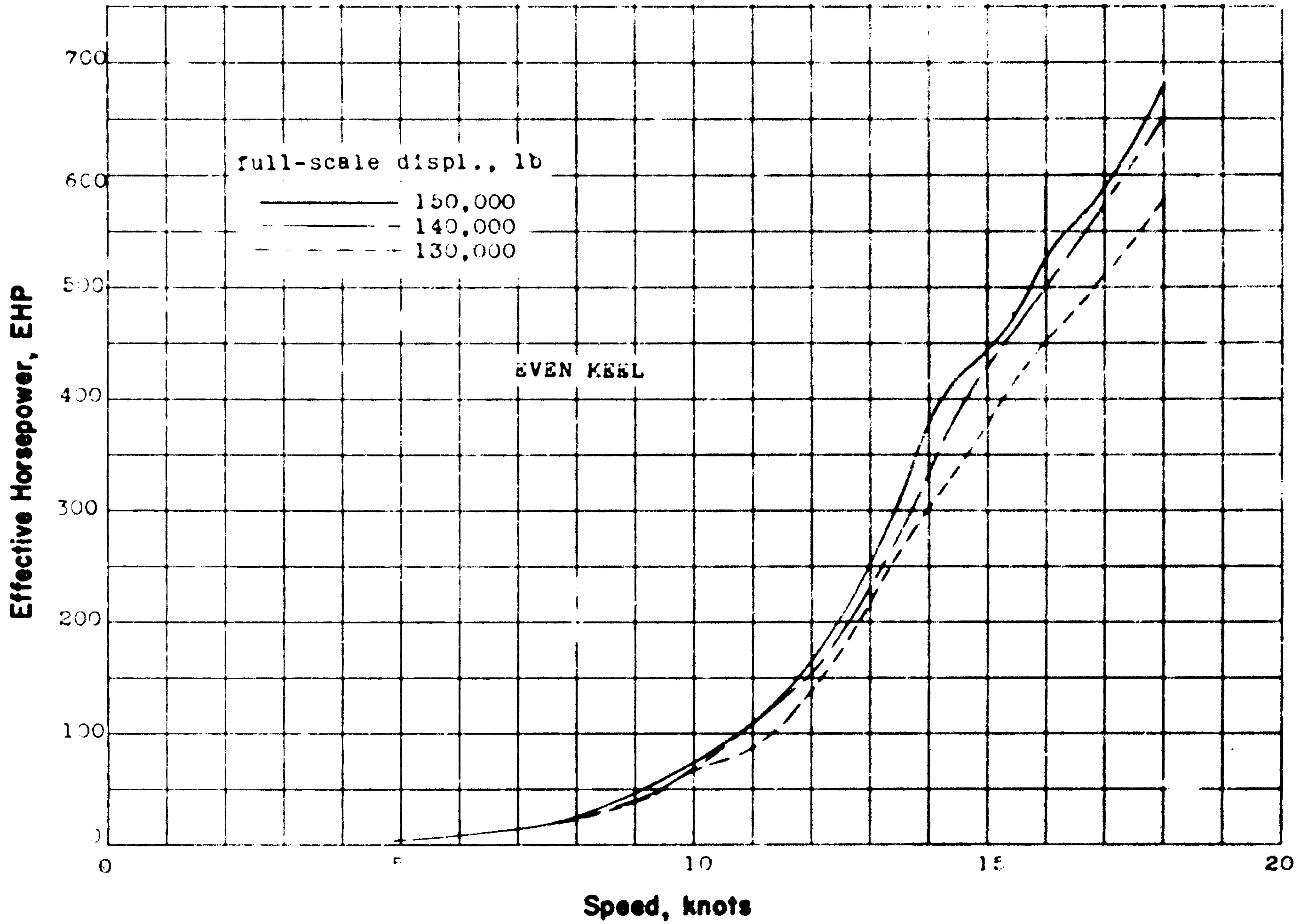

Figure 3 - Full-scale EHP; three displacements.

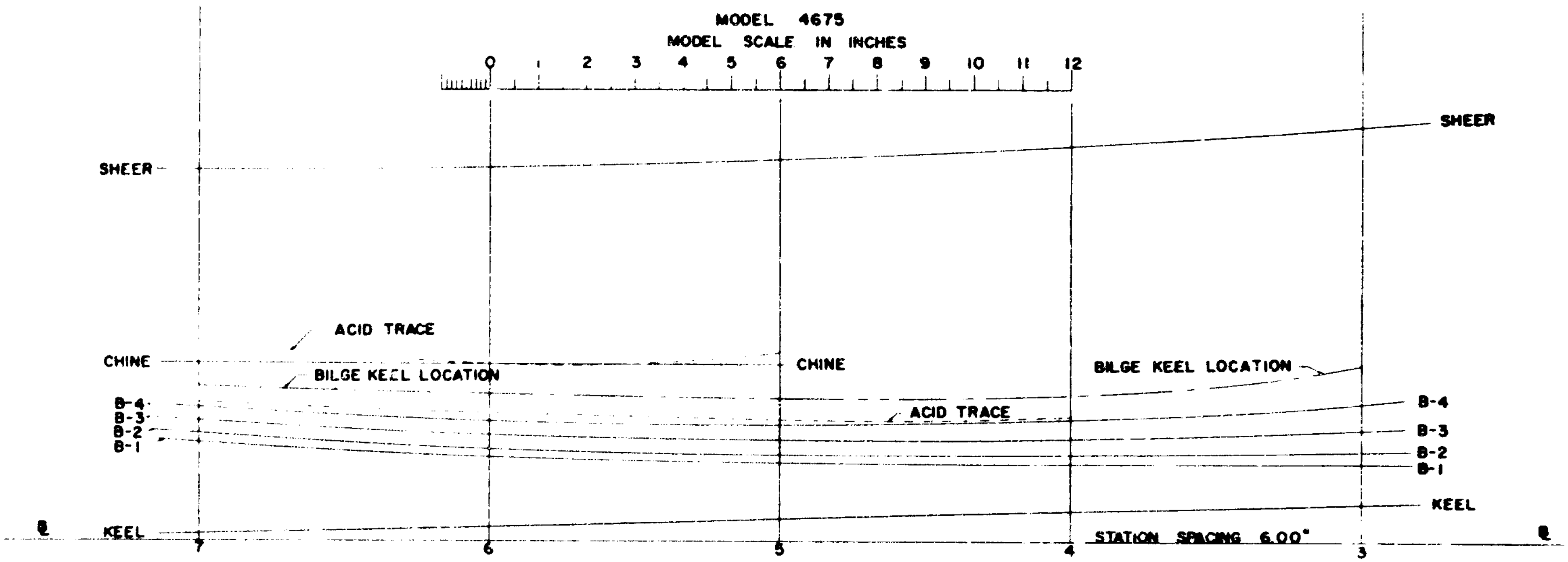

Figure 4 – Bilge keel location as indicated by acid trace test

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1. Personnel boats – Propulsion – Model tests
2. Personnel boats – Resistance – Model tests
3. Ship models – Model TMB 4675
I. Clement, Eugene P.
II. Tate, Charles W.
III. NS 715-086

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