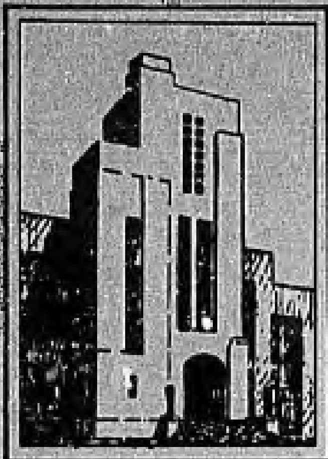

DEPARTMENT OF THE NAVY

DAVID TAYLOR MODEL BASIN

HYDROMECHANICS

o

AERODYNAMICS

o

STRUCTURAL MECHANICS

o

APPLIED MATHEMATICS

SMOOTH WATER RESISTANCE OF A NUMBER OF PLANING BOAT DESIGNS

by

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

HYDROMECHANICS LABORATORY
RESEARCH AND DEVELOPMENT REPORT

October 1959 Report 1378

PRNC-TMB-648a (Rev. 3-58)

37

SMOOTH WATER RESISTANCE OF A NUMBER OF PLANING BOAT DESIGNS

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October 1959

Report 1378
NS715-086

NOTATION

Symbols

A	Projected area bounded by chines and transom, in plan view
B	Breadth over chines at any point; also, buttock
B_A	Mean breadth over chines, A/L
B_T	Breadth over chines at transom
B_X	Maximum breadth over chines
$F_{n\nabla}$	Froude number based on volume, in any consistent units $v/\sqrt{g\nabla^{1/3}}$
g	Acceleration due to gravity
L	Overall length of the area, A, measured parallel to baseline
LCG	Longitudinal center of gravity location
P	Effective power, ft-lb/sec
R	Total resistance
S	Wetted surface, area of
SW/FW	Density ratio, salt water to fresh water
V	Speed, knots
v	Speed
w	Density of water (weight per unit volume)
WL_C	Intersection of chine with solid water, forward of 0 percent L, ft
WL_K	Wetted length of keel, forward of 0 percent L, ft
WL_{SP}	Intersection of chine with spray, forward of 0 percent L, ft
α	Angle with horizontal of tangent to mean buttock at stern, deg
β	Dead rise angle of hull bottom, deg

Δ Displacement at rest, weight of

τ Trim angle of hull with respect to attitude as drawn, deg

∇ Displacement at rest, volume of

Ⓚ Ratio of the speed of a ship to the speed of a wave having a length equal to half the length of the side of a cube having the same volume of displacement ∇ as the ship.

$$\text{Ⓚ} = \frac{V}{\sqrt{g/4\pi} \cdot \nabla^{1/6}} \text{ in any consistent units,}$$

$$= 1.056 \frac{V}{\nabla^{1/6}}, \text{ where } V \text{ is in knots and } \nabla \text{ is in } ft^3.$$

Subscripts

M Model

S Ship

0 Value at rest

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ABSTRACT

Models of a number of different planing boat designs were towed in smooth water to provide data for guidance in designing aircraft rescue boats and similar high-speed craft. Resistance, trim, rise, and wetted surface were determined for each design for either standard or comparable conditions of hull loading and center of gravity location. The test data, lines, and hull form characteristics for each design are presented in a design data sheet. The resistances of the different designs are compared, and reasons given for significant differences.

INTRODUCTION

The David Taylor Model Basin has tested models of a number of planing boat designs in a program for the Bureau of Ships designated the "Experimental Boat Hull Form Test Program." The purpose of this program was to provide data on the relative smooth water performance of a number of planing boat designs, for guidance in designing aircraft rescue boats and similar high-speed craft. Some of the designs in this program were prepared by the Bureau of Ships, and the remainder by various private designers. Individual reports on the smooth water performance of several of the designs, for a number of conditions of displacement and initial trim, were published in previous years. Subsequently, data were obtained for each of those designs for at least one standard condition of loading and center of gravity location, in order to facilitate comparisons of performance. In addition, data were obtained for either standard or comparable conditions for the other designs in the program. Data for these standard or comparable conditions are presented in this report, together with lines and pertinent hull form characteristics, with all information for a single design consolidated in a design data sheet.

MODELS AND TEST RESULTS

Design data sheets for the different hull forms are presented in Figures 1 through 10. Some discussion of the relative performance of each design is given in the "Remarks" section of the design data sheet.

Models 4301 through 4306 were formed by adding various arrangements of strakes and steps to Model 4300, which is of conventional form. It can be seen from the comparisons of model resistance in the design data sheets that for most speeds and test conditions these alterations caused an increase in resistance. Model 4303-1 at test condition number 1 (see Figure 5) is the one case where a significant improvement is shown for an appreciable part of the speed range. However, the reduction in resistance at high speeds is offset to some extent by the increase in resistance at low and intermediate speeds. It is considered, therefore, that the high resistance of Model 4303-1 in the cruising speed range, together with the added weight and cost required by the steps of the design, would make it unsuitable as a military planing boat. Also, as discussed below, comparisons on the basis of resistance data which have not been corrected to full scale are slightly biased in favor of stepped designs as compared with stepless designs.

The resistance data presented for Models 4301 through 4306 are model data rather than full-scale data. The data for these designs were not corrected to full scale because it was concluded that the designs were not of practical interest for high-speed military craft. The time and expense which would have been required for the difficult task of determining bottom wetted areas for the stepped designs would not, therefore, have been justified. If the performance comparisons had been made with corrected (full-scale) data, the margin of superiority of the original form over the stepped forms would be found to have widened, because the original form has the larger wetted area, and would, therefore, have the larger frictional resistance correction.

Model 4313 also falls in the category of those forms which are not of practical value. The inventor who conceived the design corresponding to Model 4313 expected that the vertical skegs attached to the bottom would give reduced resistance. The comparison of resistance with and without the skegs, in Figure 9, shows that the actual case is very much the opposite. The model without skegs (Model 4313) because of its flat planing bottom, has very low resistance at high speeds. This can be seen by a comparison of the values of model resistance for Model 4313, with the values of model resistance for a conventional form (Model 4300) in Figure 6. Low resistance at planing speeds is to be expected for a nearly flat planing bottom. However, such a hull form would be unsatisfactory in regard to maneuverability and rough water performance, and, therefore, Model 4313 is without interest in a consideration of practical boat forms.

The remaining models are those which are of some practical interest. They are Models 4300, 4309, 4310, and 4315. These models are listed in Table 1 with values of some pertinent hull form characteristics. Also included in the table are the models reported on in References 1 and 2*. All models listed are represented in the comparison plot of Figure 11. In this figure, values of resistance coefficient (R/Δ) are plotted against length-beam ratio (L/B_A) for several values of speed coefficient ($F_{n\nabla}$). The lines in each of the graphs of Figure 11 are taken from Reference 1. They are drawn so as to indicate the trend of change in resistance with change in

*References are listed on page 7.

Table 1

Hull Form Characteristics

A Model No.	B β at 50% L deg	C β at 0% L deg	D Twist = B - C deg	E Avg β = $\frac{B + C}{2}$ deg	F B_T/B_X
3592-1	21.5	7	14.5	14.25	0.82
3626	17.3	7.5	9.8	12.4	0.635
3720	21	2	19	11.5	0.71
3722	18	7	11	12.5	0.65
4300	15.5	4.5	11	10	0.886
4309	—	—	—	—	0.915
4310	12.75	12.5	0.25	12.6	0.89
4315	17.5	5.5	12	11.5	0.92
4667	13	12.5	0.5	12.75	0.644

length-beam ratio. The lines were drawn so as to be either through or equidistant from the data points for Models 3626 and 3722 (which are similar except for the difference in length-beam ratio), and with slope corresponding to the average for lines connecting the data points of several pairs of models which were similar except for differences in length-beam ratio. The resistance qualities of the models considered here were evaluated by considering the relative distances of their respective data points from the lines of Figure 11. In this way the effect of difference in length-beam ratio is eliminated from the consideration, and the effect of other differences in hull form can be more readily seen. The comments on resistance, in the design data sheets for the five practical hull forms considered here, were arrived at from examination of Figure 11. The reasons given for the different resistance qualities were arrived at with the assistance of Table 1.

Model 4667, which is reported on in Reference 2, was developed from a study of the design data sheets presented here and in Reference 1, as well as other data sheets available at the Model Basin. It was concluded from a study of the design data sheets, and taking into consideration the features desirable for good steering qualities and good rough water performance, that a high performance stepless planing hull of large size should have the following features:

(a) Transom width equal to about 65 percent of maximum chine width.

(b) Little or no bottom twist over the after half of the hull length.

(c) Relatively high deadrise at the transom - at least 10 degrees.

(d) Straight sections aft and convex section forward.

It can be seen from Figure 11, that the efficient performance anticipated for Model 4667 has been realized.

REFERENCES

1. Clement, E. P. and Kimon, P. M., "Comparative Resistance Data for Four Planing Boat Designs," David Taylor Model Basin Report 1113 (Jan 1957).

2. Clement, E. P., "Development and Model Tests of An Efficient Planing Hull Design," David Taylor Model Basin Report 1314 (Apr 1959).

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN
APRIL 1953

IV

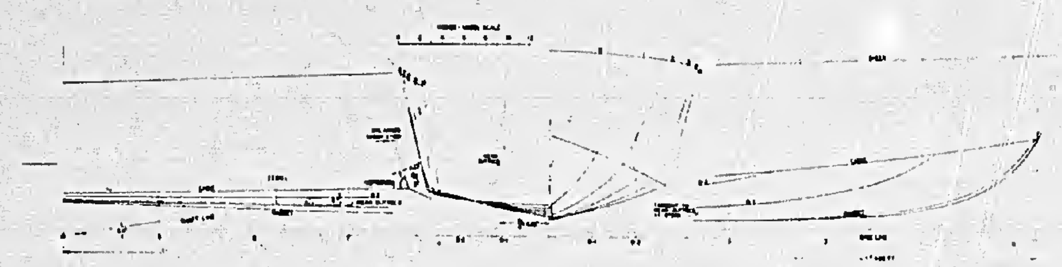
DTMB MODEL 4300 1/6 SCALE AIRCRAFT RESCUE BOAT

Remarks:

The wide transom tends to give this design high resistance at low speeds. The low average deadrise of planing bottom gives quite low resistance at high speeds. The form consists of developable surfaces, which is an important advantage for construction. The bow lines require an effective spray strip.

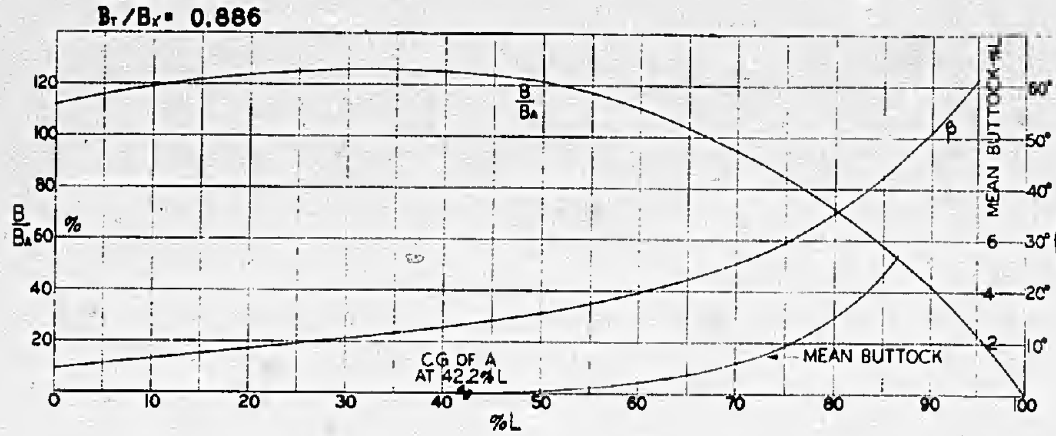
I LINES

A = 10.81 sq. ft.
L = 7.408 ft.
B_A = 1.46 ft.



II FORM CHARACTERISTICS

L/B_A = 5.08
L/B_X = 4.01
B_T/B_X = 0.886



III TEST CONDITIONS

APPENDAGES: SPRAY STRIPS

TEST NO.	Δ_M POUNDS	LCG % L	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	CG AFT CG of A	τ_o	α_o	DRAFT COEFF. FWD	DRAFT COEFF. AFT	MAXIMUM STABLE [(K)]
1	112.6	38.8	7.29	5.51	3.4 %L	ZERO	−0.7°	1.166	0.642	—
2	"	34.8	"	"	7.4	1°XSTERN	+0.3	0.768	0.940	—
3	"	31.1	"	"	11.1	2°XSTERN	+1.3	0.289	1.157	14.4
4	157.6	39.3	5.82	4.66	2.9	ZERO	−0.7	1.043	0.689	—
5	"	36.0	"	"	6.2	1°XSTERN	+0.3	0.757	0.872	—
6	"	33.1	"	"	9.1	2°XSTERN	+1.3	0.507	1.055	14.5
7	202.6	39.8	4.93	4.11	2.4	ZERO	−0.7	0.957	0.693	—
8	"	37.1	"	"	5.1	1°XSTERN	+0.3	0.757	0.844	—
9	"	34.6	"	"	7.6	2°XSTERN	+1.3	0.543	0.980	13.9
10	"	32.3	"	"	9.9	3°XSTERN	+2.3	0.301	1.103	12.1

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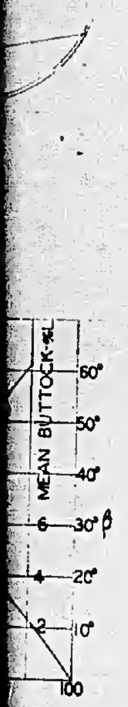

MAXIMUM STABLE Ⓚ
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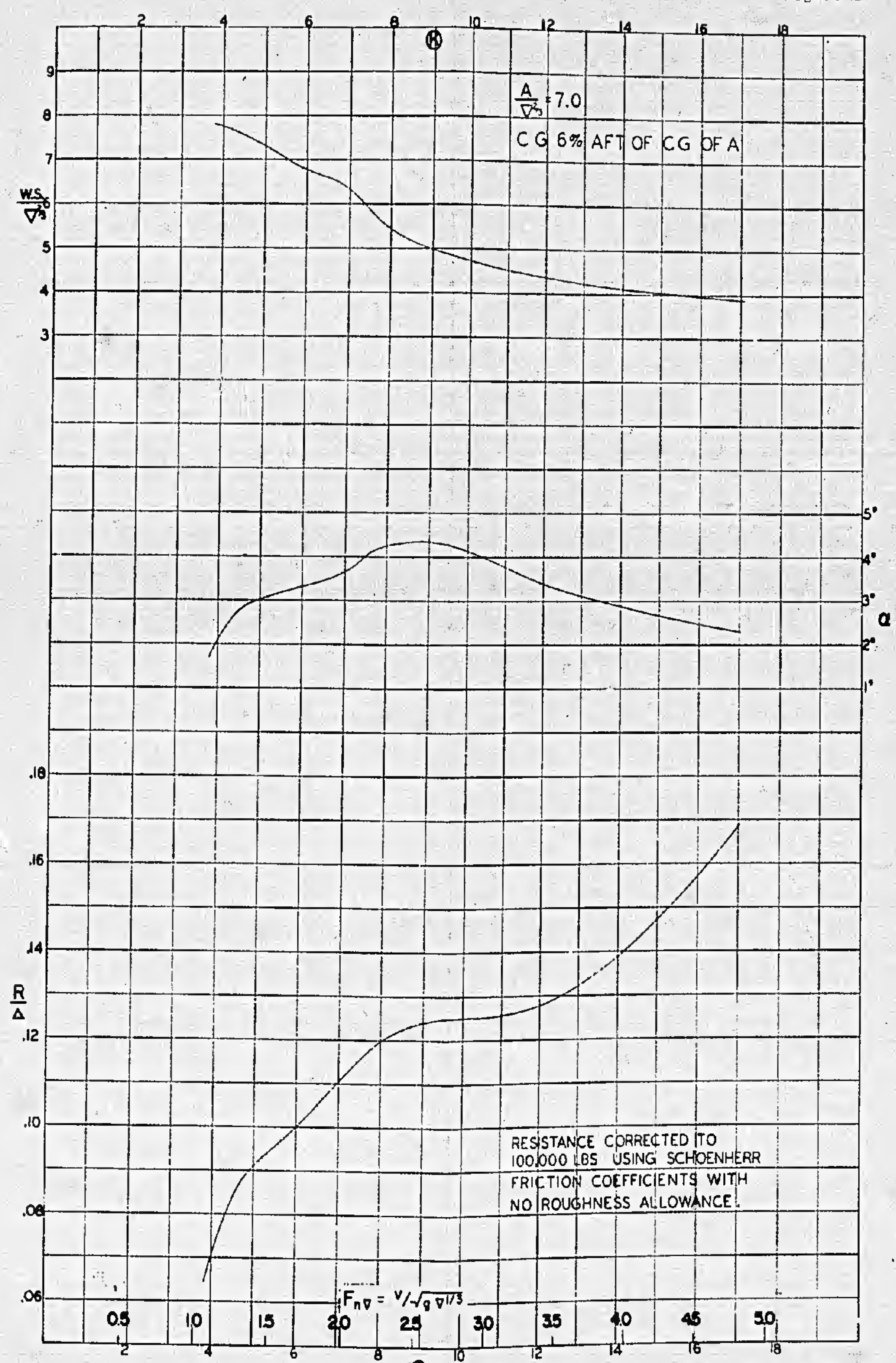
—
—
14.5
—
—
13.9
12.1

IV PERFORMANCE CHARACTERISTICS

Figure 1



PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

JAN. 1955

DTMB MODEL 4301 — 1/6 SCALE, AVR DESIGN — EXPERIMENTAL BOAT HULL FORM TEST PROGRAM

REMARKS:

POOR RESISTANCE CHARACTERISTICS — RESISTANCE INCREASED FOR PRACTICALLY ALL TEST CONDITIONS BY THE ADDITION OF LAP STRAKES TO THE HULL BOTTOM OF MODEL 4300.

I TEST CONDITIONS

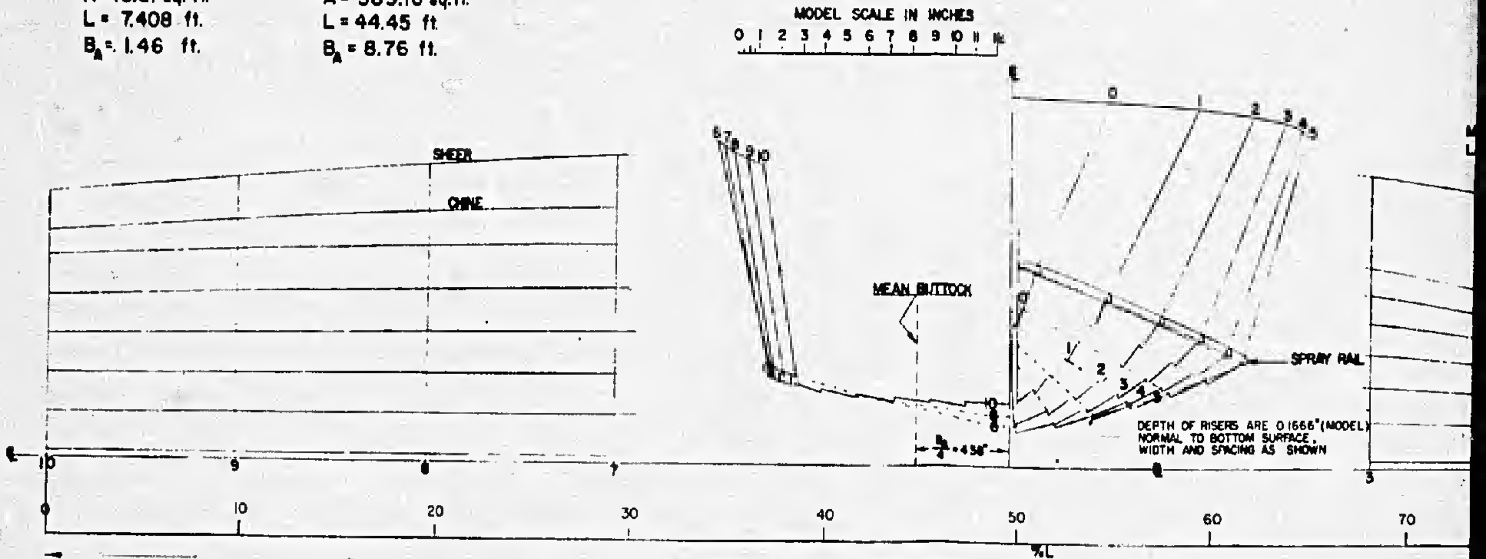
TEST NO.	Δ_M POUNDS	Δ_S POUNDS	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE (K)	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG %L
1	112.6	25,000	7.29	5.51	—	0°	-0.7°	1.166	0.642	3.4%L	38.8
2	112.6	25,000	7.29	5.51	16.27	2° STERN	+1.3°	0.289	1.157	11.1%L	31.1
3	202.6	45,000	4.93	4.11	—	0°	-0.7°	0.957	0.693	2.4%L	39.8
4	202.6	45,000	4.93	4.11	—	2° STERN	+1.3°	0.543	0.980	7.6%L	34.6

II FORM CHARACTERISTICS

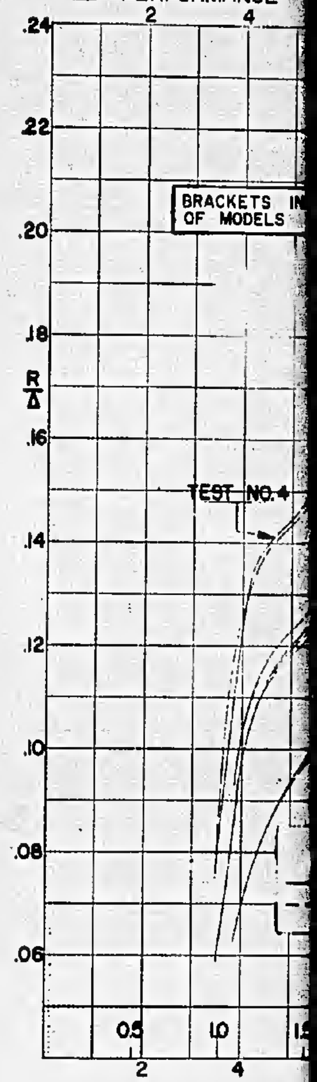
SAME AS DTMB MODEL 4300 (SHEET NO. 1)

III LINES

MODEL	FULL SIZE
A = 10.81 sq. ft.	A = 389.16 sq. ft.
L = 7.408 ft.	L = 44.45 ft.
B_A = 1.46 ft.	B_A = 8.76 ft.



IV PERFORMANCE



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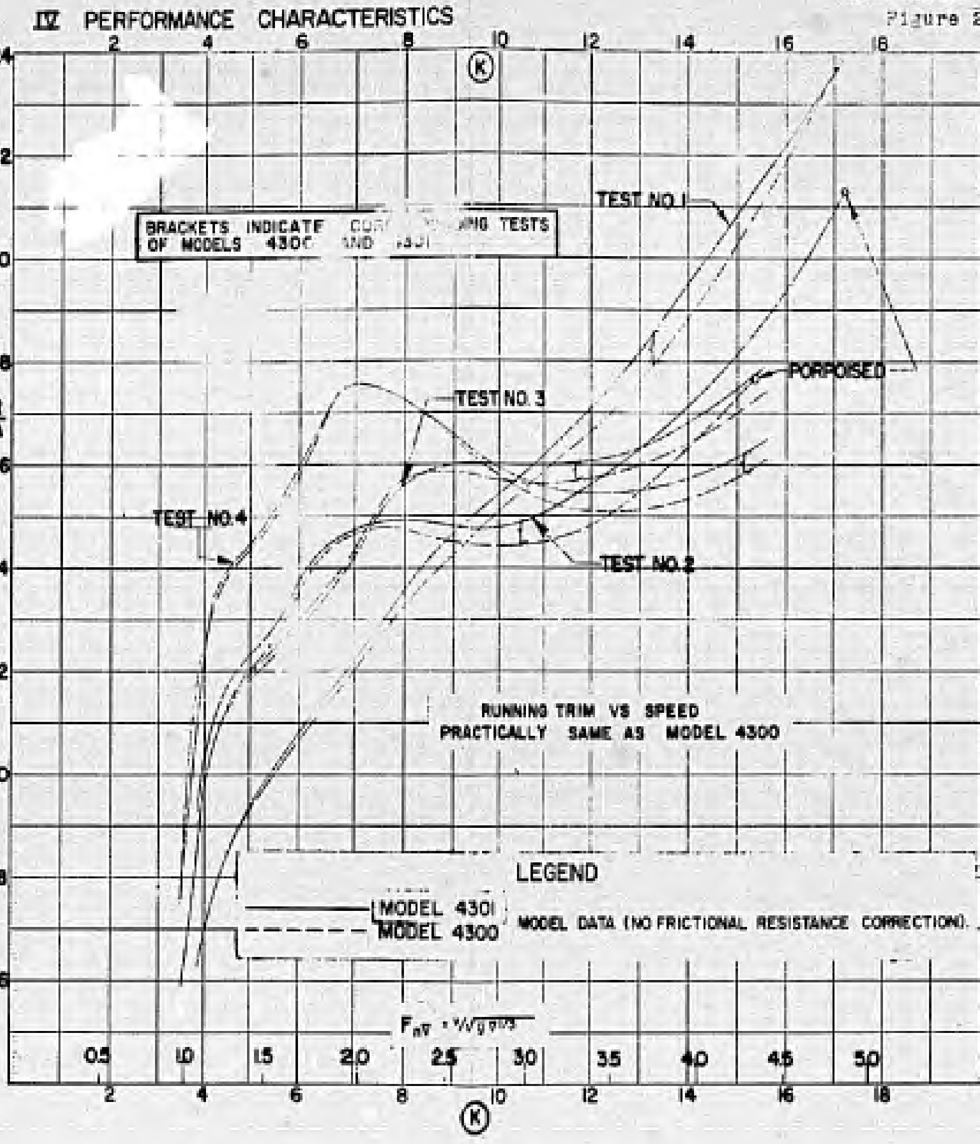
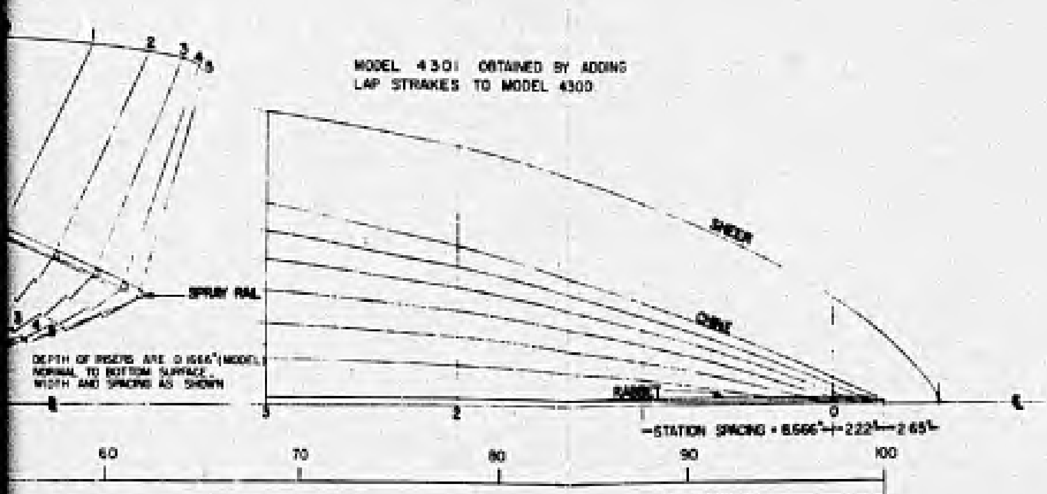
IV PERFORMANCE CHARACTERISTICS





PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

JAN. 1955

DTMB MODEL 4302 — 1/6 SCALE — AVR DESIGN — EXPERIMENTAL BOAT HULL FORM TEST PROGRAM

REMARKS:

POOR RESISTANCE CHARACTERISTICS — RESISTANCE INCREASED FOR PRACTICALLY ALL TEST CONDITIONS BY THE ADDITION OF LAP STRAKES TO THE FOREBODY OF MODEL 4300.

I TEST CONDITIONS

TEST NO.	Δ_M POUNDS	Δ_S POUNDS	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE (K)	τ_o	α_o	DRAFT COEFF. FWD	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG %L
1	112.6	25,000	7.29	5.51	—	0°	−0.7°	1.166	0.642	3.4%L	38.8
2	112.6	25,000	7.29	5.51	14.36	2° x STERN	+1.3°	0.289	1.157	11.1%L	31.1
3	202.6	45,000	4.93	4.11	—	0°	−0.7°	0.957	0.693	2.4%L	39.8
4	202.6	45,000	4.93	4.11	—	2° x STERN	+1.3	0.543	0.980	7.6%L	34.6

II FORM CHARACTERISTICS

SAME AS DTMB MODEL 4300

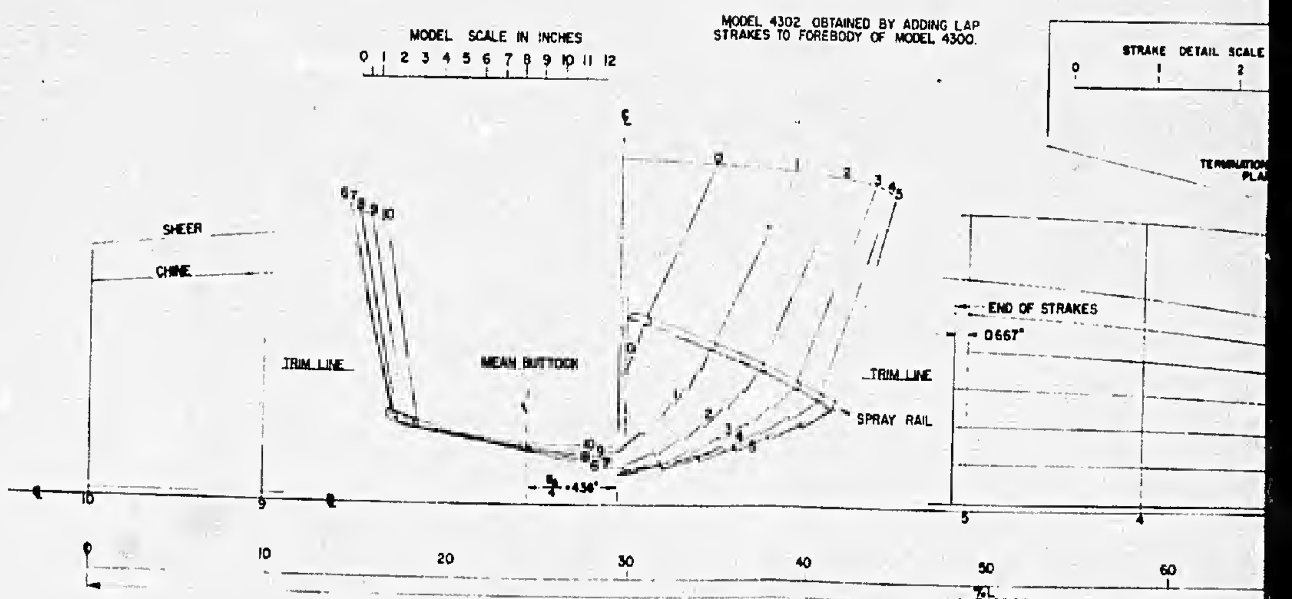
III LINES

MODEL

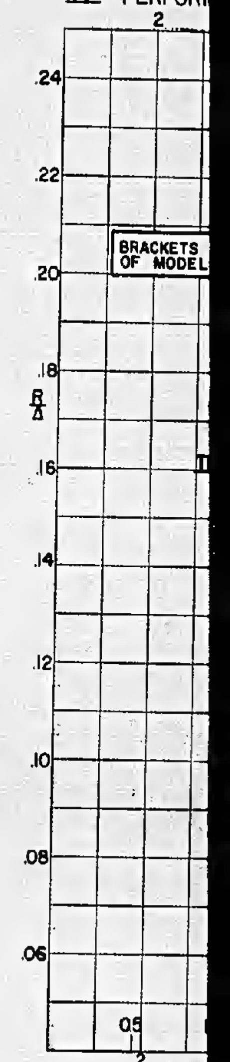
A = 10.81 sq. ft.
L = 7.408 ft.
B_A = 1.46 ft.

FULL SIZE

A = 389.16 sq. ft.
L = 44.45 ft.
B_A = 8.76 ft.



IV PERFORM



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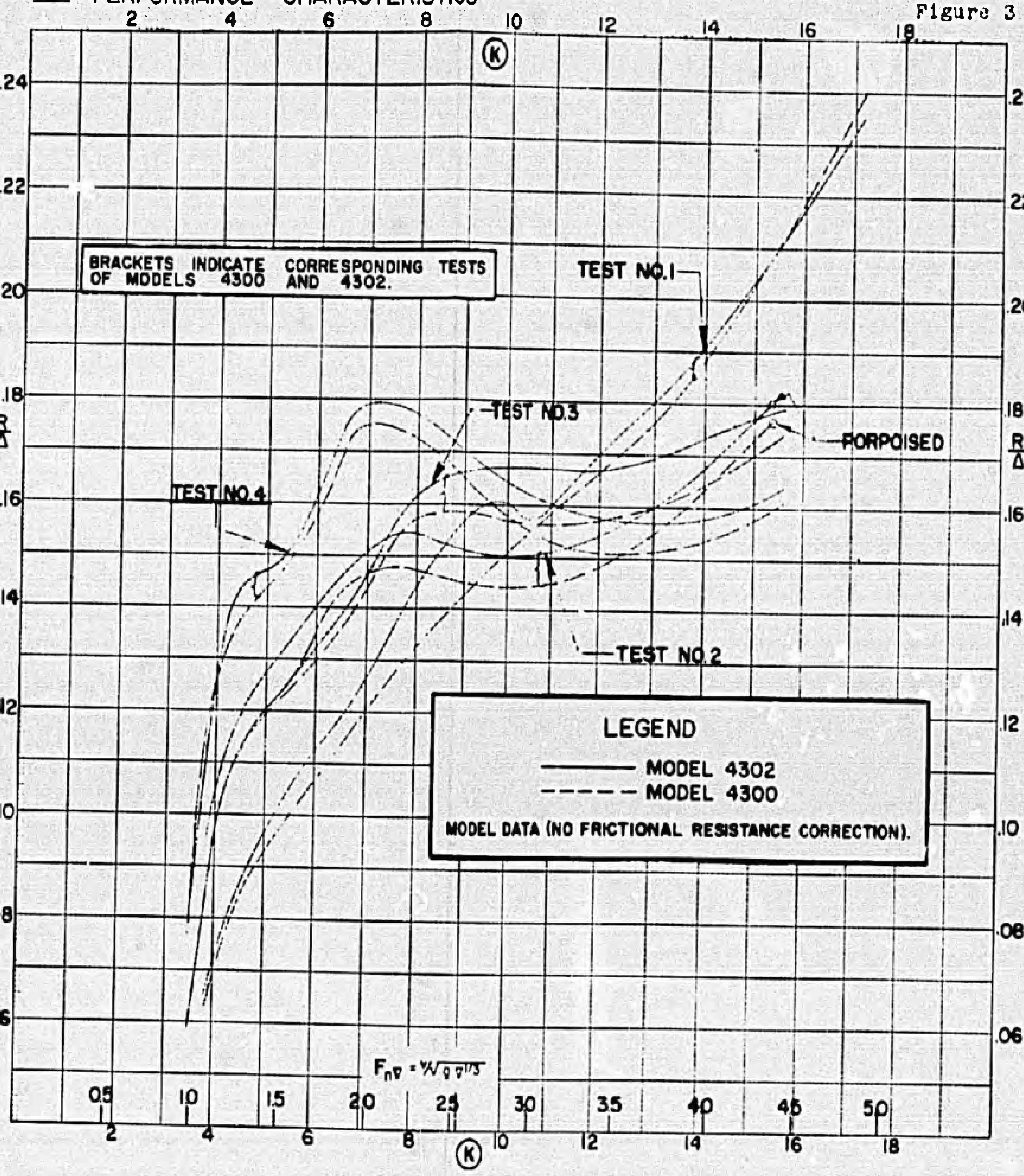
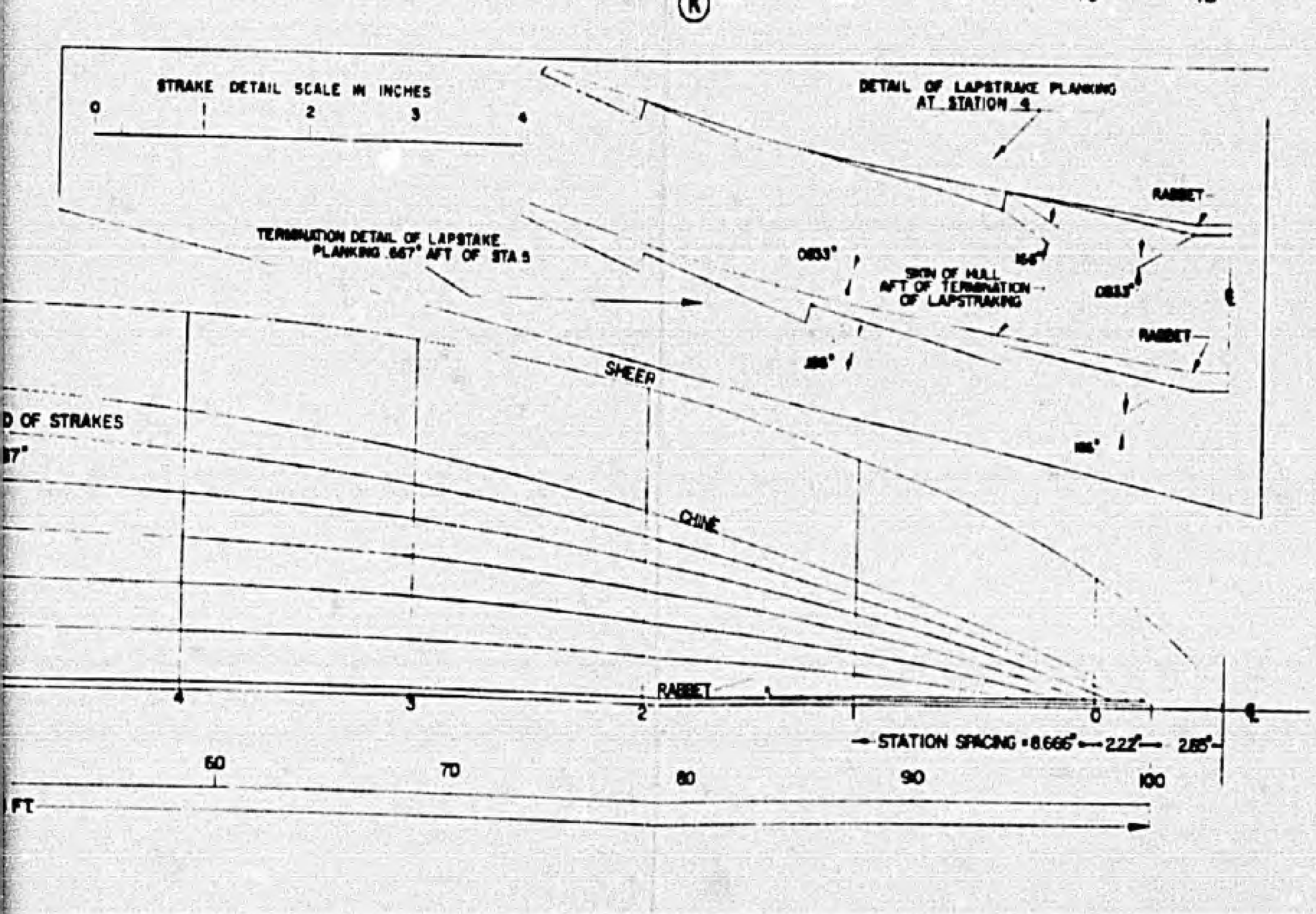
IV PERFORMANCE CHARACTERISTICS

DTMB MODEL 4302
Figure 3





B

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN
MARCH 1955

DTMB MODEL 4303 | 1/6 SCALE AVR DESIGN | EXPERIMENTAL BOAT HULL FORM TEST PROGRAM

REMARKS:

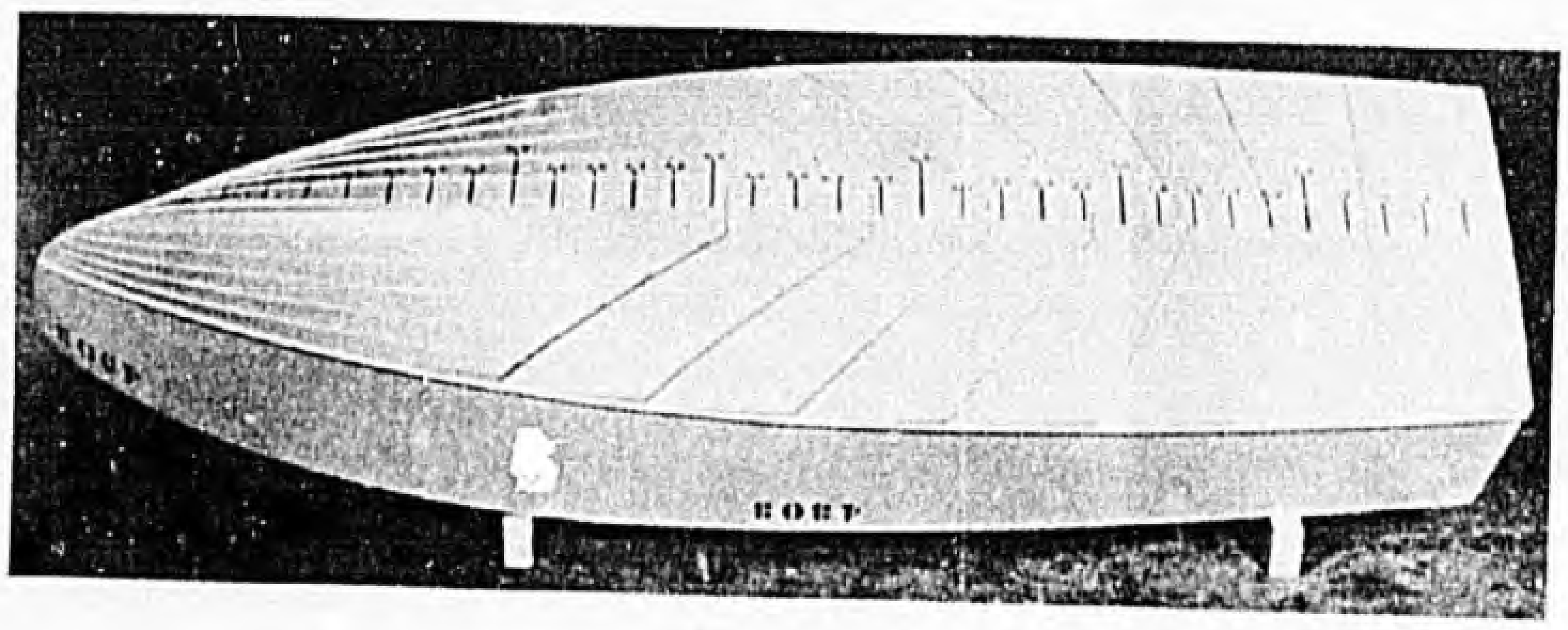
POOR RESISTANCE CHARACTERISTICS —— PRONOUNCED HUMP IN RESISTANCE CURVE CAUSED BY THE ADDITION OF LAP STRAKES TO THE FOREBODY AND MULTIPLE STEPS TO THE AFTERBODY OF MODEL 4300

I TEST CONDITIONS

TEST NO.	Δ_M POUNDS	Δ_S POUNDS	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE Ⓚ	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG %L
1	112.6	25,000	7.29	5.51	—	0°	-0.7°	1.166	0.642	3.4%L	38.8
2	112.6	25,000	7.29	5.51	—	2°x STERN	+1.3°	0.289	1.157	11.1%L	31.1
3	202.6	45,000	4.93	4.11	—	0°	-0.7°	0.957	0.693	2.4%L	39.8
4	202.6	45,000	4.93	4.11	—	2°x STERN	+1.3°	0.543	0.980	7.6%L	34.6

II FORM CHARACTERISTICS

SAME AS DTMB MODEL 4300

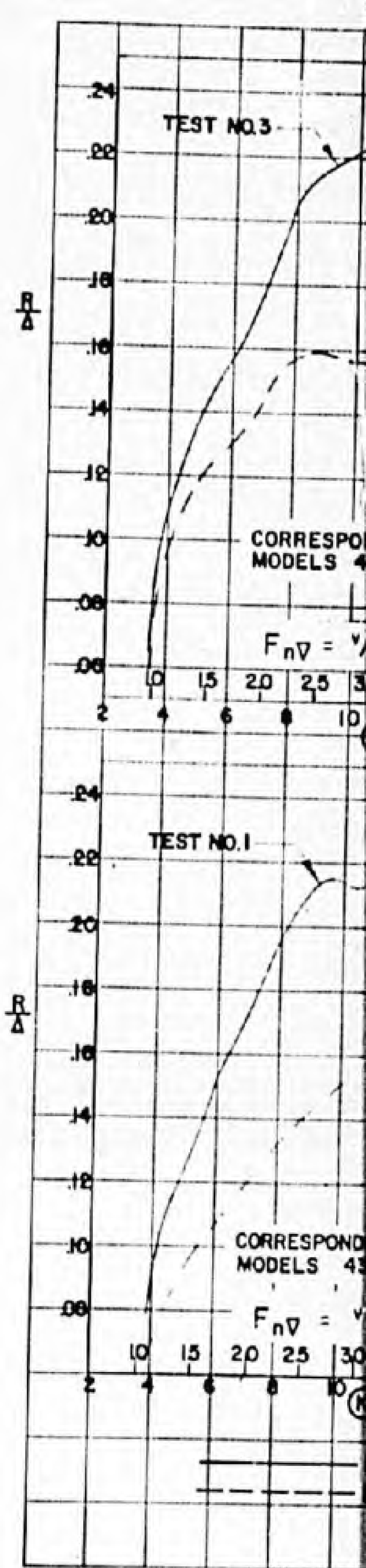


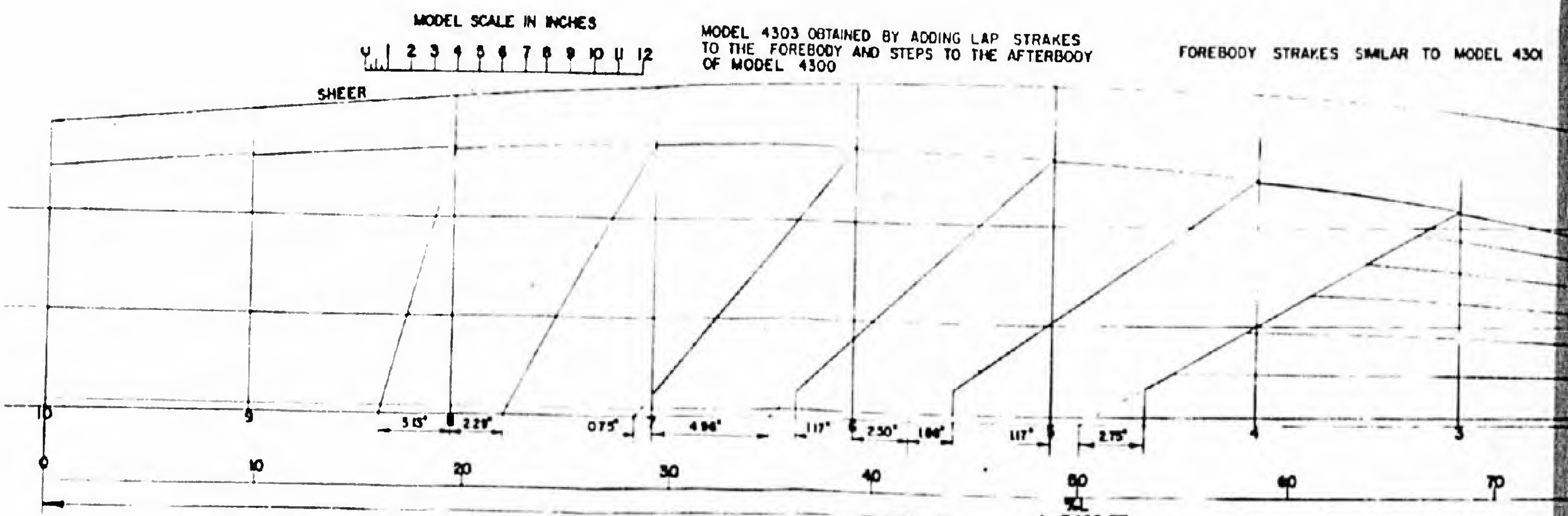
PHOTOGRAPH OF MODEL

III LINES

MODEL	FULL SIZE
A = 10.81 sq. ft.	A = 389.16 sq. ft.
L = 7.408 ft.	L = 44.45 ft.
B_A = 1.46 ft.	B_A = 8.76 ft.

IV PERFORMA





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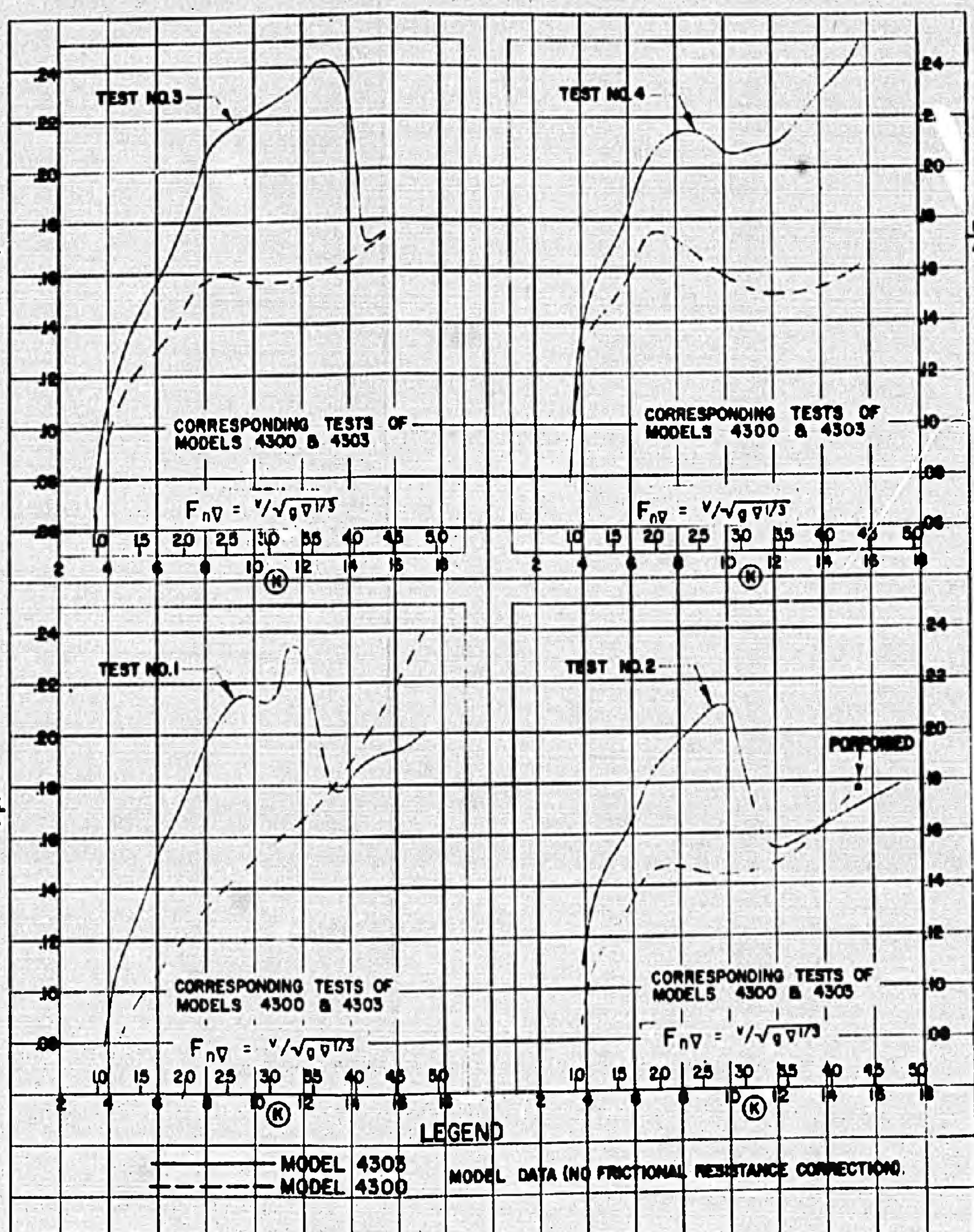
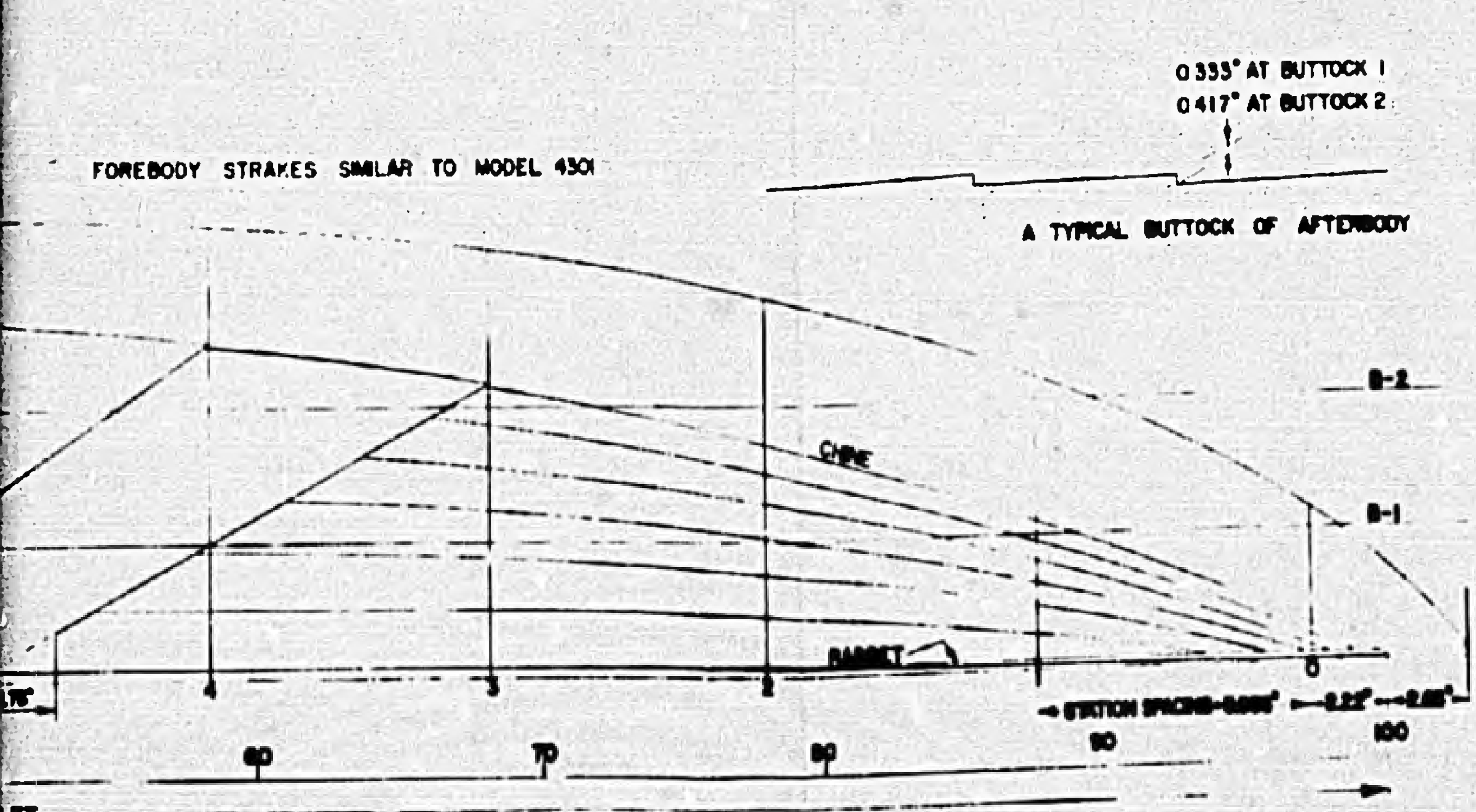
IV PERFORMANCE CHARACTERISTICS

DTMB MODEL 4303
Figure 4





PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

MARCH 1955

DTMB MODEL 4303-1 — 1/6 SCALE — AVR DESIGN — EXPERIMENTAL BOAT HULL FORM TEST PROGRAM

REMARKS:

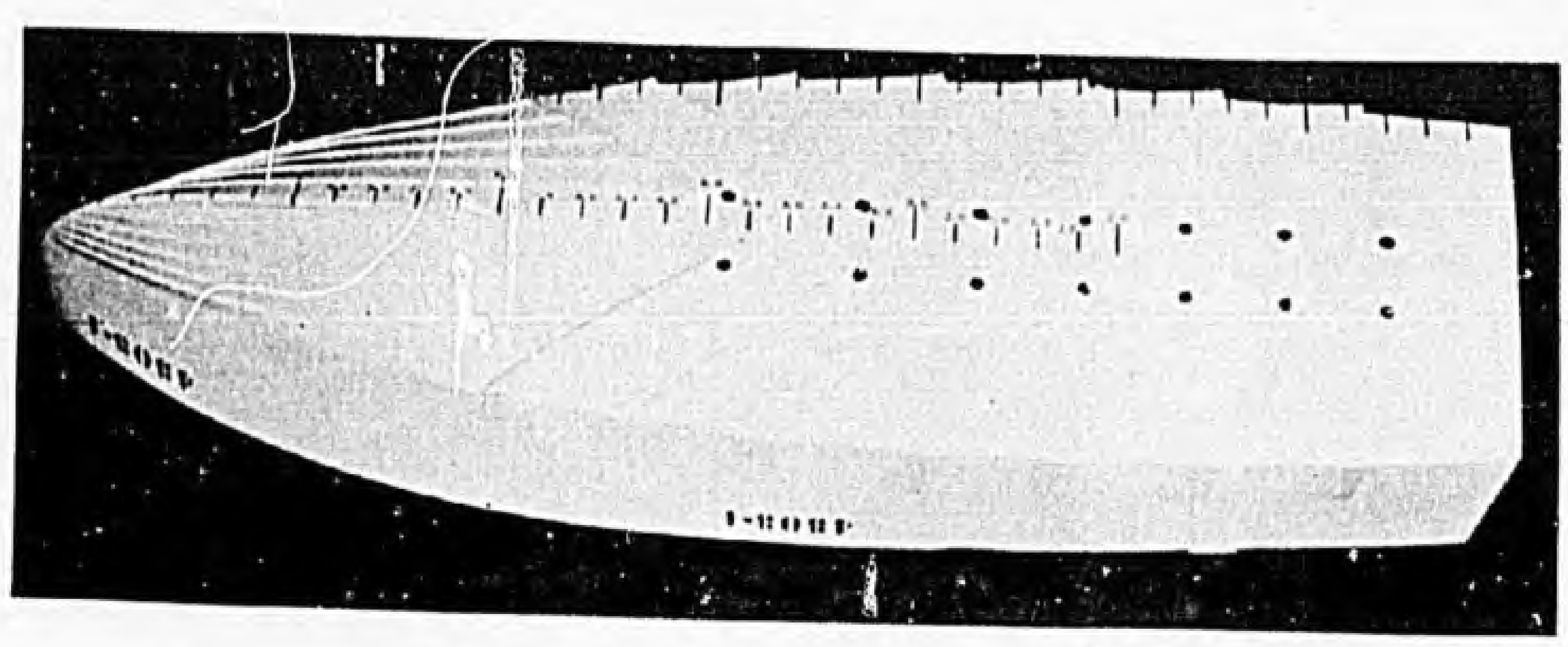
SIDE WEDGES AND VENT PIPES ADDED TO MODEL 4303 TO ELIMINATE SUCTION BEHIND STEPS. SIDE WEDGES EVIDENTLY EFFECTIVE AS RESISTANCE WAS REDUCED FOR ALL TEST CONDITIONS. VENT PIPES EVIDENTLY SUPERFLUOUS AS RESISTANCE WAS PRACTICALLY THE SAME WITH VENT PIPES EITHER OPEN OR CLOSED. RESISTANCE OF MODEL 4303-1 STILL HIGHER THAN THAT OF BASIC FORM (MODEL 4300) EXCEPT AT HIGH SPEEDS.

I TEST CONDITIONS

TEST NO.	Δ_M lbs.	Δ_S lbs.	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE $F_{n\nabla}$	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG % L
1	112.6	25,000	7.29	5.51	—	0°	−0.7°	1.166	0.642	3.4%L	38.8
2	112.6	25,000	7.29	5.51	—	2° STERN	+1.3°	0.289	1.157	11.1%L	31.1

II FORM CHARACTERISTICS

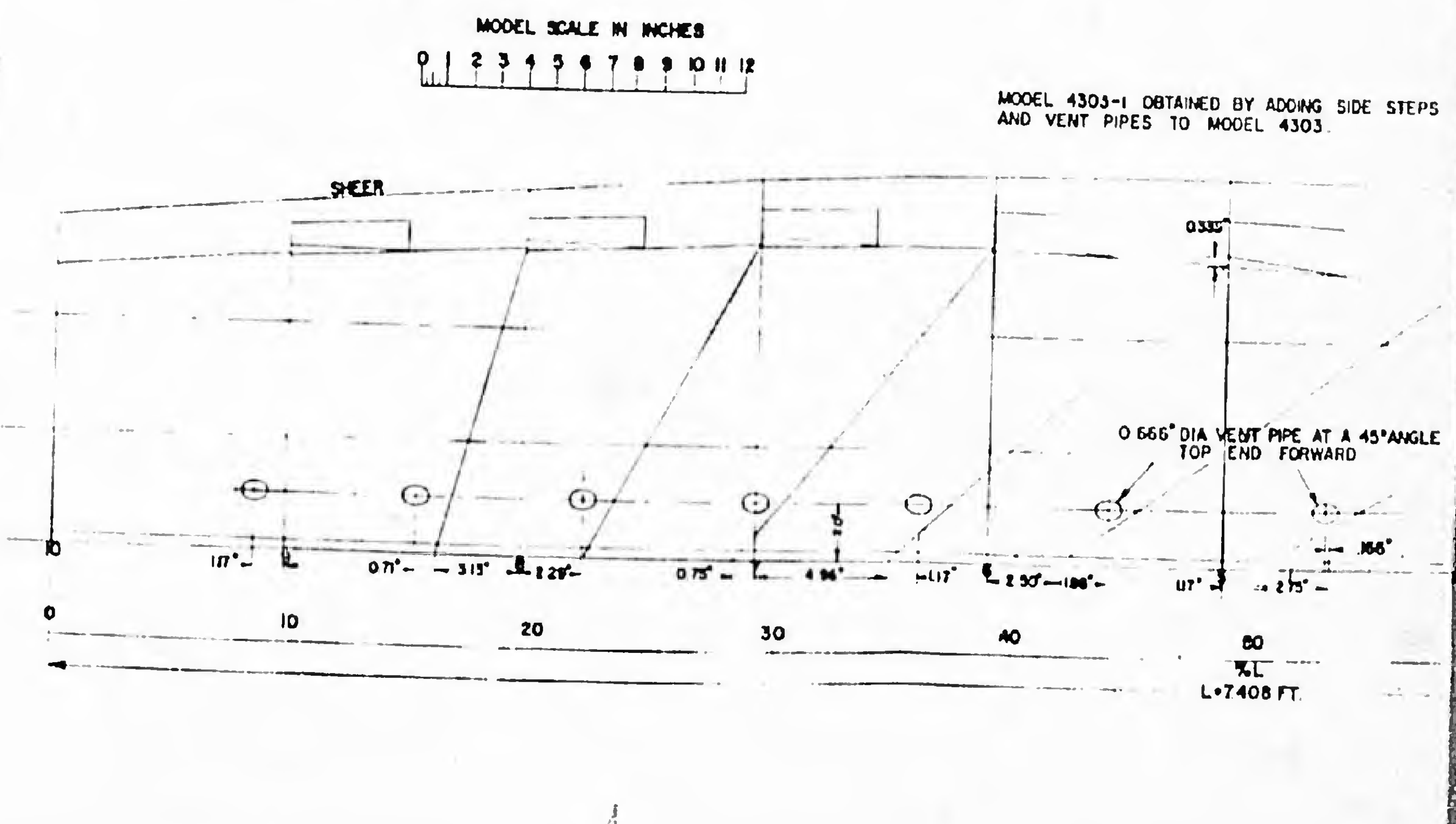
SAME AS DTMB MODEL 4300



PHOTOGRAPH OF MODEL

III LINES

MODEL	FULL SIZE
A = 10.81 sq. ft.	A = 389.16 sq. ft.
L = 7.408 ft.	L = 44.45 ft.
B_A = 1.46 ft.	B_A = 8.76 ft.



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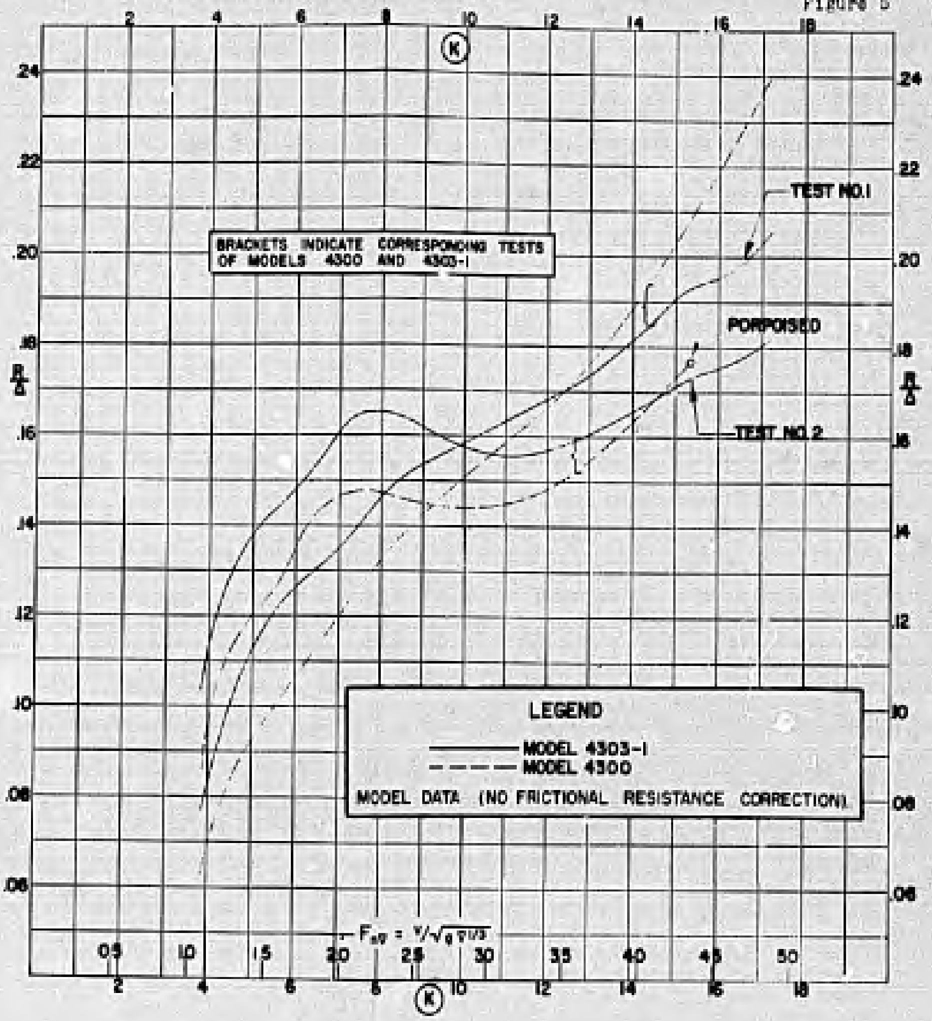
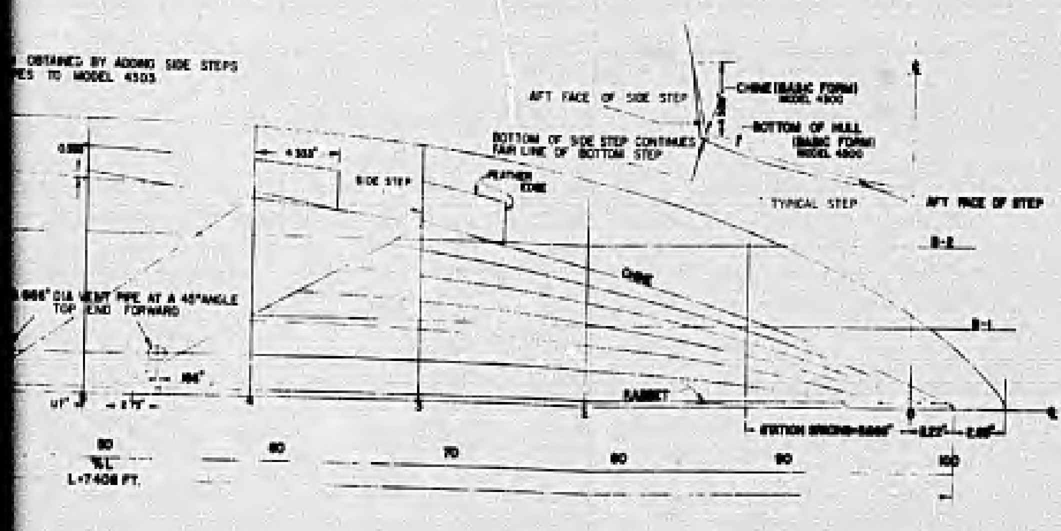
MODEL 4300)

IV PERFORMANCE CHARACTERISTICS

DTMB MODEL 4303-1
Figure 5





B

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

APRIL 1955

DTMB MODELS 4304, 4305, & 4306 — 1/6 SCALE AVR DESIGNS — EXPERIMENTAL BOAT HULL FORM TEST PROGRAM

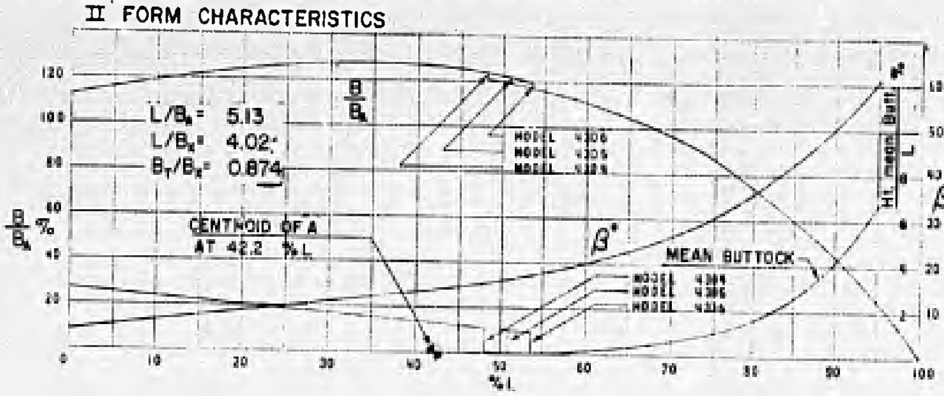
REMARKS:

MODEL 4300 CHANGED TO A STEPPED HULL. THREE STEP LOCATIONS TESTED. RESISTANCE GREATER IN EACH CASE, THAN FOR MODEL 4300.

I TEST CONDITIONS

MODEL NO.	Δ_M lbs.	Δ_S lbs.	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE $F_{n\nabla}$	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG %L
4304	119.5	26,545	7.00	5.96	—	1.10° STERN	+3.97°	-0.479	2.399	6.0%L	36.2
4305	119.5	26,545	7.00	5.96	—	1.05° STERN	+3.92°	-0.430	2.413	6.0%L	36.2
4306	119.5	26,545	7.00	5.96	—	0.99° STERN	+3.86°	-0.372	2.427	6.0%L	36.2

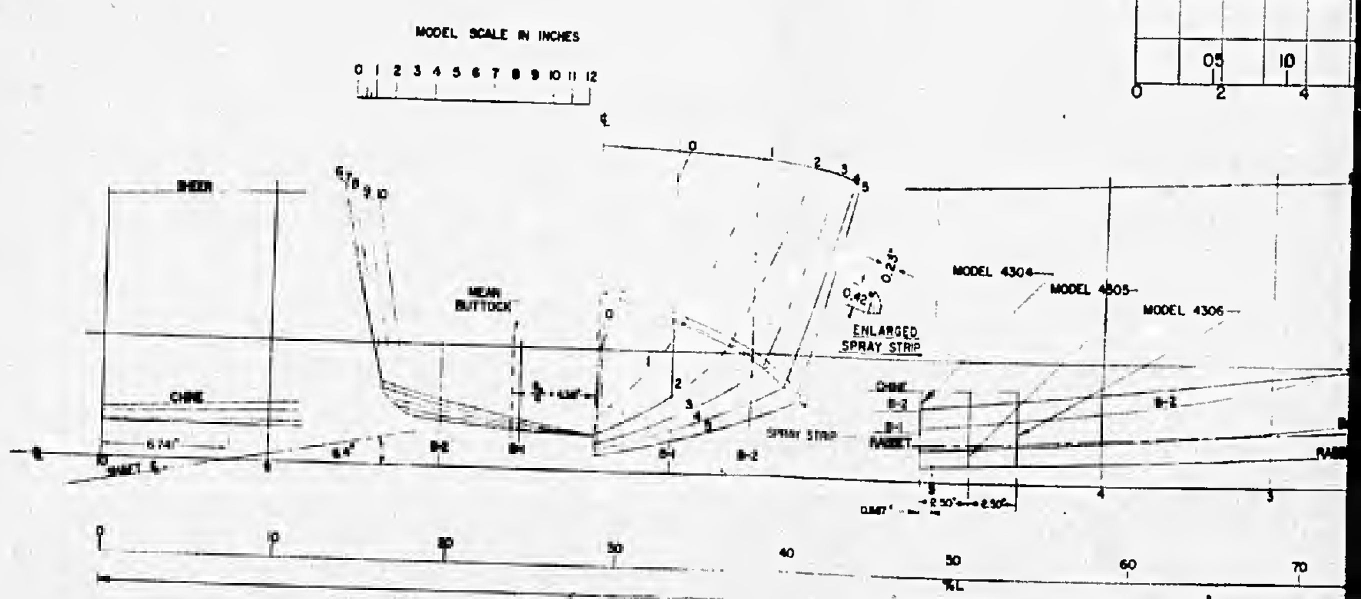
II FORM CHARACTERISTICS



III LINES

MODEL	FULL SIZE
A = 10.70 sq.ft	A = 385.20 sq.ft.
L = 7.408 ft.	L = 44.45 ft.
B_x = 1.445 ft.	B_x = 8.67 ft.

MODEL SCALE IN INCHES



A

IV PERFORMAN

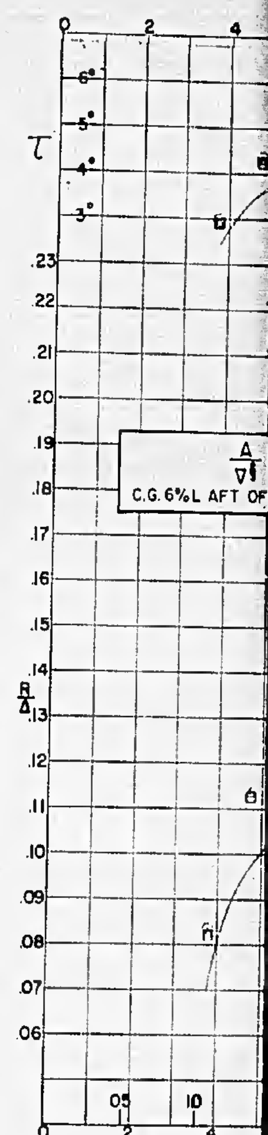
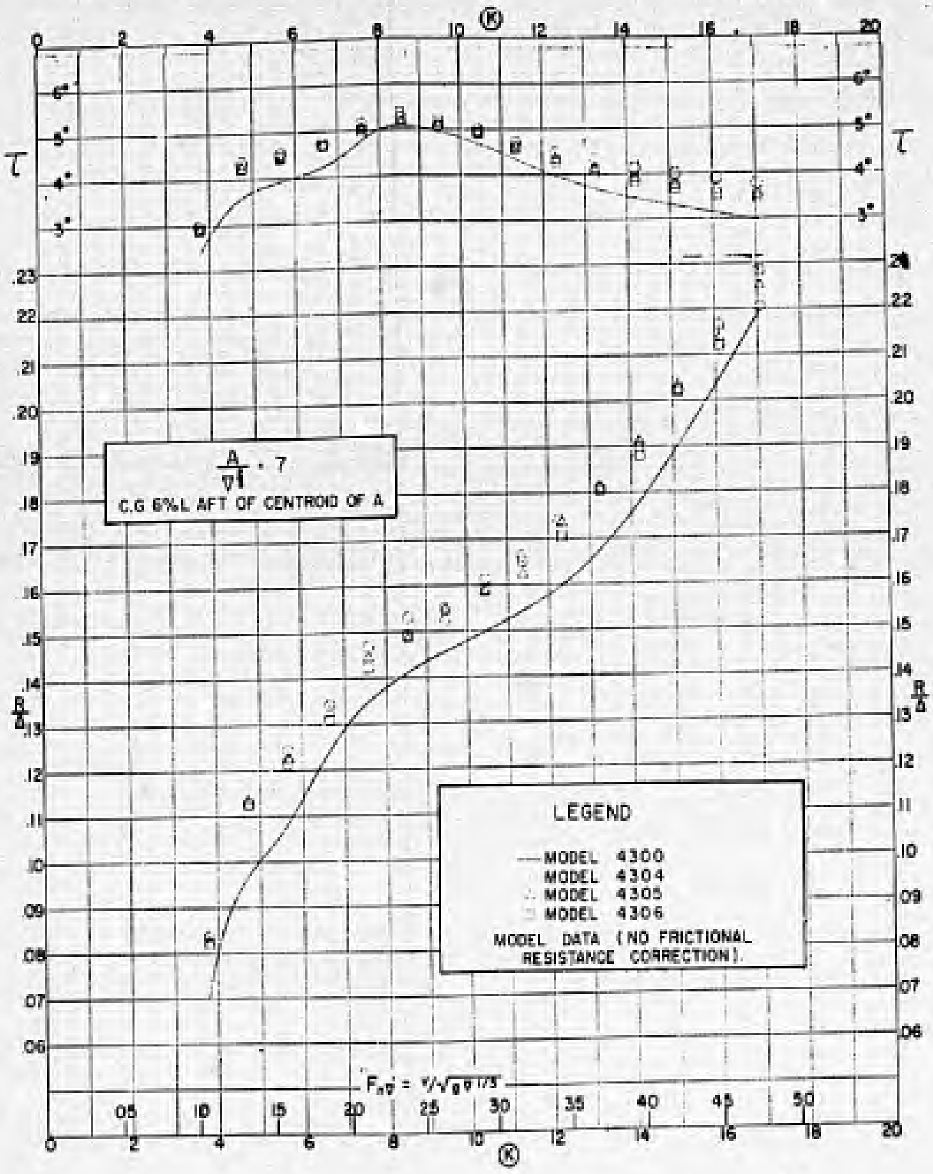
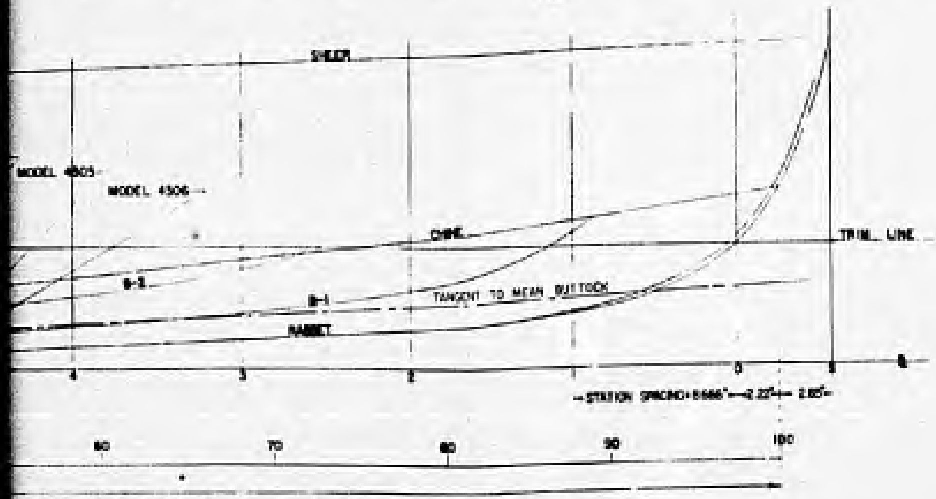


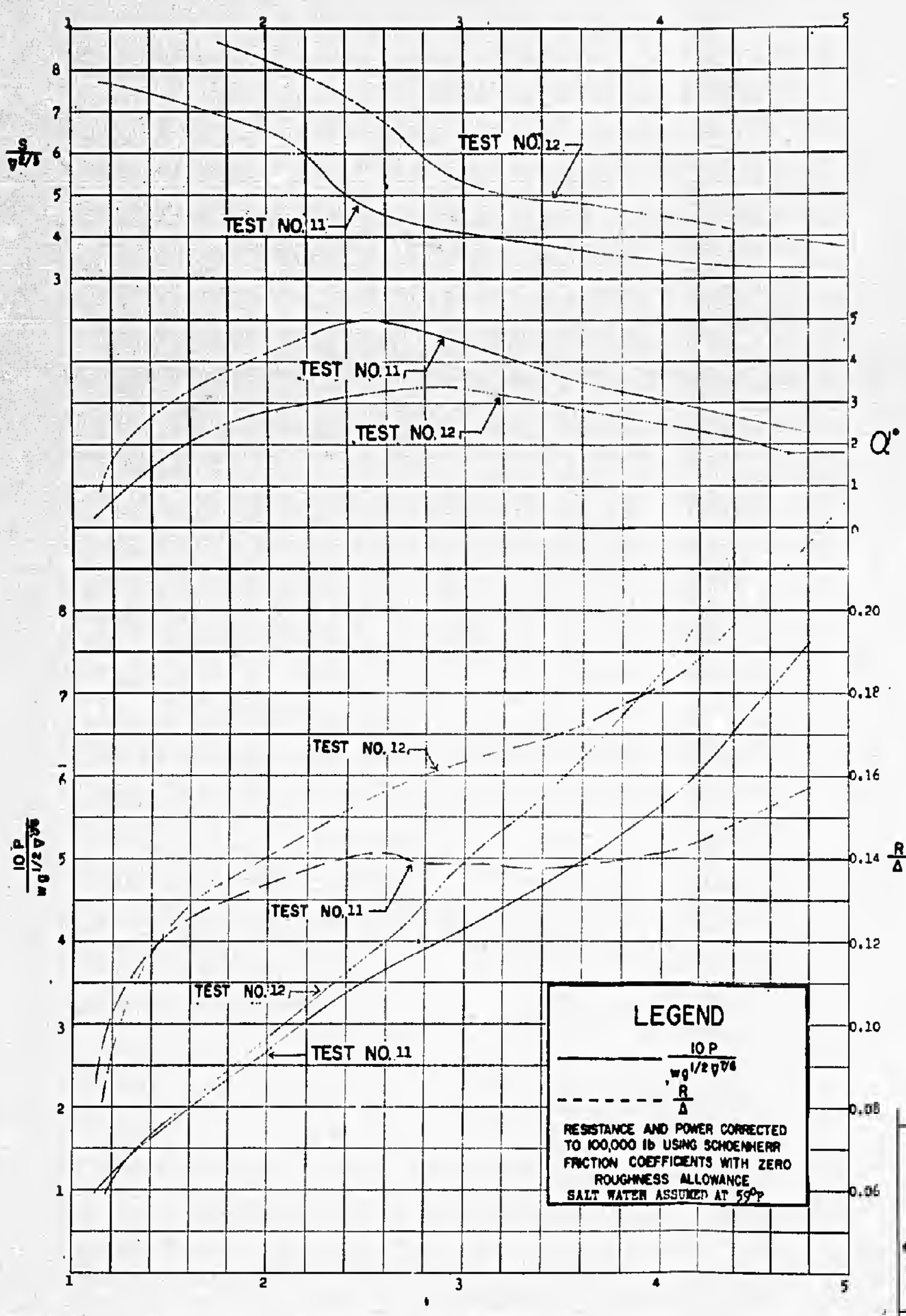
Figure 6


$\frac{A}{\nabla^{2/3}} = 7$
C.G 6%L AFT OF CENTROID OF A
LEGEND
MODEL 4300
MODEL 4304
MODEL 4305
MODEL 4306
MODEL DATA (NO FRICTIONAL RESISTANCE CORRECTION).
τ
$\frac{R}{\Delta}$
Ⓚ


SHEER
MODEL 4305
MODEL 4306
CHINE
TRIM LINE
TANGENT TO MEAN BUTTOCK
RABBET

13

IV PERFORMANCE CHARACTERISTICS



REMARKS:

Sections are W-shaped. Resistance
equals 1.5 and 2.0, very high at $F_{n\nabla}$ eq
slightly below average at $F_{n\nabla}$ equals 4.
equals 4.5. Full-scale trials have sho
in accelerating to planing speed (becau
ance at intermediate speeds), that it
the rudder, and that it pounds severely
makes the boat dry but it also tends to
in damage to tunnel and propellers.

MODEL DATA

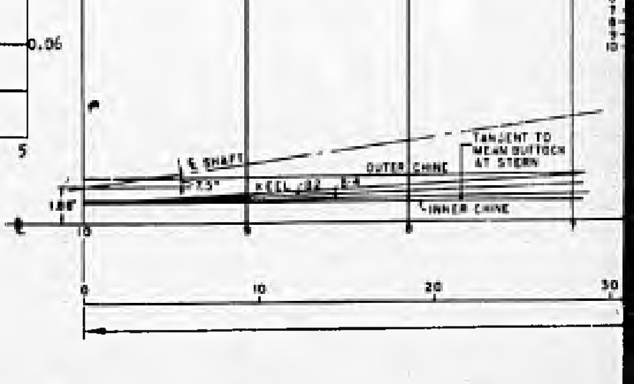
BASIN HIGH SPEED BASIN
BASIN SIZE 2968'x 21'x(10' ...
DATE OF TEST 18 NOVEMBER 19..
WATER TEMP. 65°F
APPENDAGES NONE
TURBULENCE STIM. NONE
MODEL MATERIAL WOOD
MODEL FINISH PAINT

TEST NO. 11

V_M	R_M	WL_K	WL_C	WL_{SF}
4.82	24.23		7.65	7.90
6.02	33.31		7.30	7.70
7.21	36.65		6.95	7.30
8.44	38.78		6.40	6.65
9.62	40.57		5.70	6.00
10.86	41.51		5.00	5.30
12.04	41.30		4.65	4.96
13.22	41.93		4.40	4.70
14.46	42.28		4.20	4.60
15.68	43.02		4.00	4.45
16.90	44.54		3.90	4.30
18.10	46.25		3.80	4.20
19.20	48.45		3.65	4.15
20.60	51.36		3.58	4.05

TE...

V_M	R_M
4.52	13.0
5.65	19.
6.78	21.
7.90	23.
9.03	25.
10.18	26.
11.29	28.
12.42	28.
13.58	30.
14.74	31.
15.90	33.
16.98	35.
18.12	38.
19.24	41.



A

shaped. Resistance is above average at $F_{n\nabla}$
very high at $F_{n\nabla}$ equals 2.5, 3.0 and 3.5,
e at $F_{n\nabla}$ equals 4.0, and quite low at $F_{n\nabla}$
ale trials have shown that this design is slow
laning speed (because of the very high resist-
e speeds), that it is sluggish in answering
it pounds severely in rough water. The tunnel
at it also tends to collect debris, resulting
and propellers.

Figure 7

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

JULY 1955

EXPERIMENTAL BOAT HULL FORM TEST PROGRAM — 1/6 SCALE AVR DESIGN — DTMB MODEL 4309

MODEL DATA

HIGH SPEED BASIN
SIZE 2968'x 21'x(10' and 16')
OF TEST 18 NOVEMBER 1954
TEMP. 65°F
DAGES NONE
LENCE STIM. NONE
MATERIAL WOOD
FINISH PAINT

WL
7.90
7.70
7.30
6.65
6.00
5.30
4.96
4.70
4.60
4.45
4.30
4.20
4.15
4.05

TEST NO. 12

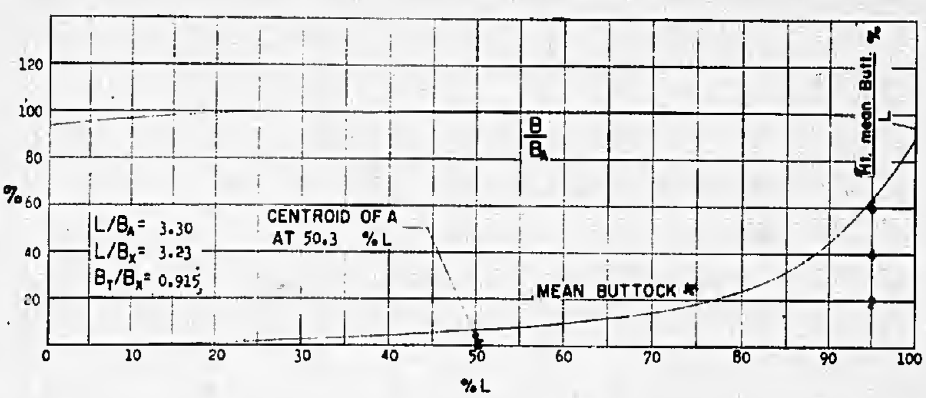
V_M	R_M	WL_K	WL_C	WL
4.52	13.04		2.50	7.65
5.65	19.42		7.20	7.40
6.78	21.81		6.80	7.15
7.90	23.66		6.35	6.60
9.03	25.45		5.80	6.18
10.18	26.92		5.15	5.60
11.29	28.04		4.60	5.00
12.42	28.88		4.25	4.60
13.58	30.13		4.15	4.50
14.74	31.77		3.95	4.30
15.90	33.60		3.80	4.20
16.98	35.76		3.60	4.10
18.12	38.27		3.40	3.80
19.24	41.03		3.20	3.80

I TEST CONDITIONS

DENSITY RATIO, SW/FW = 1.0284

TEST NO	Δ_M lb	Δ_S lb	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE $F_{n\nabla}$	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG % L
11	263.7	58,576	7.00	4.81	------	1.62° x BOW	-1.22°	1.027	1.154	6.0% L	44.3
12	180.9	40,184	9.00	5.45	------	1.70° x BOW	-1.30°	0.999	1.119	6.0% L	44.3
13	263.7	58,576	7.00	4.81	4.2	1.10° x BOW	-0.70°	0.909	1.330	8.0% L	42.3

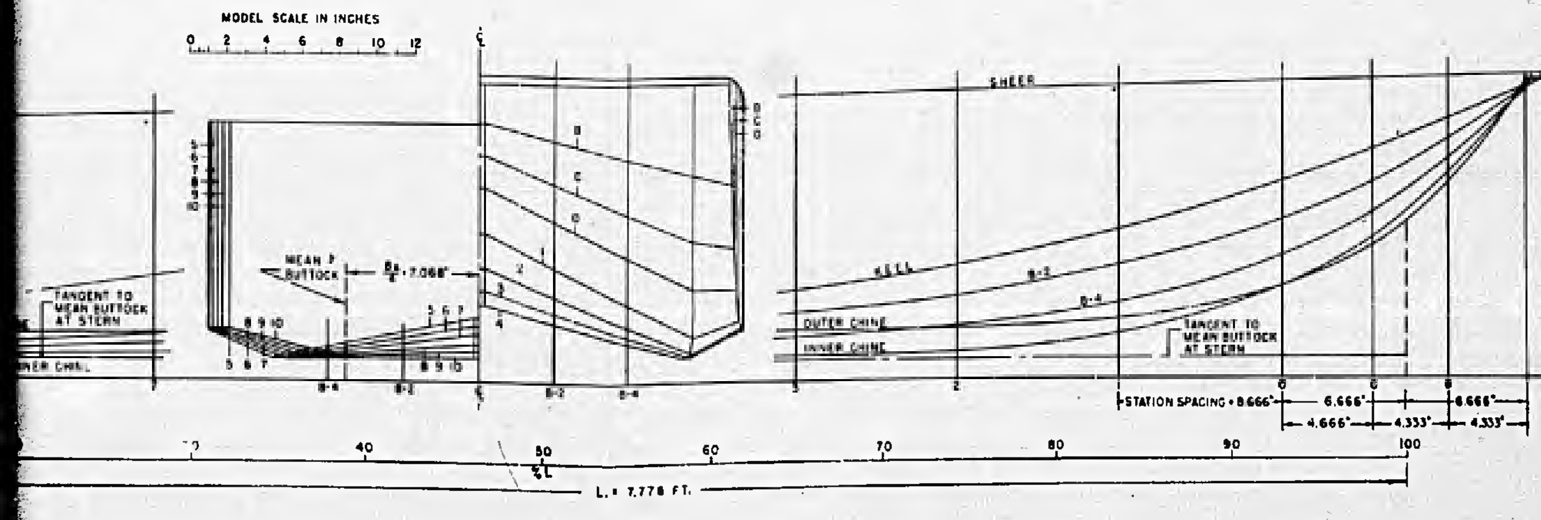
II FORM CHARACTERISTICS



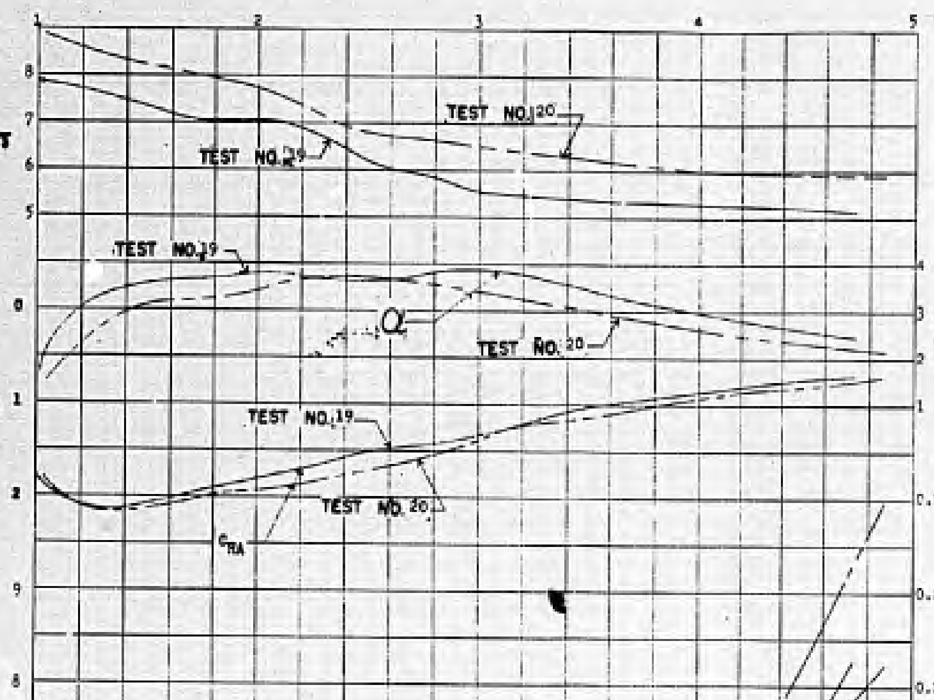
III LINES

MODEL	FULL SIZE
A = 18.320 sq.ft.	A = 659.52 sq.ft
L = 7.778 ft.	L = 46.68 ft.
B_A = 2.356 ft.	B_A = 14.14 ft.

* NOTE: THE MEAN BUTTOCK AS SHOWN IS BASED ON THE ACTUAL BODY PLAN INSTEAD OF A SIMPLIFIED BODY PLAN



IV PERFORMANCE CHARACTERISTICS



REMARKS:

Resistance throughout the speed
the average hull. This is attributed
in the planing bottom. The large dead
maneuvering characteristics. Effecti
quired with these bow lines.

MODEL DATA

BASIN HIGH SPEED BASIN
BASIN SIZE 2968'x21'x(10'and 16'
DATE OF TEST 5 APRIL 1955
WATER TEMP. 65°F
APPENDAGES SPRAY STRIPS
TURBULENCE STIM. NONE
MODEL MATERIAL WOOD
MODEL FINISH PAINT

TEST NO.19					TE	
V_M	R_M	WL_K	WL_C	WL_{SP}	V_M	R_M
3.85	9.00	7.15	6.30	6.80	3.86	7.05
4.84	13.80	7.10	5.65	6.50	4.83	10.50
5.77	15.57	7.05	5.20	6.15	5.78	12.12
6.76	16.48	7.00	4.90	5.90	6.76	13.38
7.70	17.56	6.90	4.90	5.55	7.70	14.64
8.63	18.16	6.85	4.70	5.30	8.70	15.67
9.60	18.82	6.70	4.20	4.80	9.64	16.72
10.61	20.22	6.60	3.72	4.20	10.63	18.07
11.60	21.80	6.45	3.30	3.90	11.61	19.22
12.53	22.51	6.40	3.10	3.70	12.56	20.48
13.50	24.01	6.45	2.90	3.60	13.52	22.18
14.51	25.43	6.55	2.80	3.40	14.53	24.00
15.49	27.33	6.60	2.65	3.30	15.47	26.13
16.44	29.32	6.65	2.55	3.30	16.40	28.27
17.36	31.51	6.70	2.40	3.10	17.28	30.62
18.32	34.14	6.70	2.40	3.10	18.24	33.26

MODEL SCALE IN INCHES

A

Figure 8

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN NAVY DEPARTMENT

AUGUST 1955

EXPERIMENTAL BOAT HULL
FORM TEST PROGRAM

1/6 SCALE
AVR DESIGN

DTMB MODEL 4310

hroughout the speed range is less than for
This is attributed to the absence of twist
tom. The large deadrise aft will give good
teristics. Effective spray strips are re-
bow lines.

I TEST CONDITIONS

DENSITY RATIO, SW/FW = 1.0284

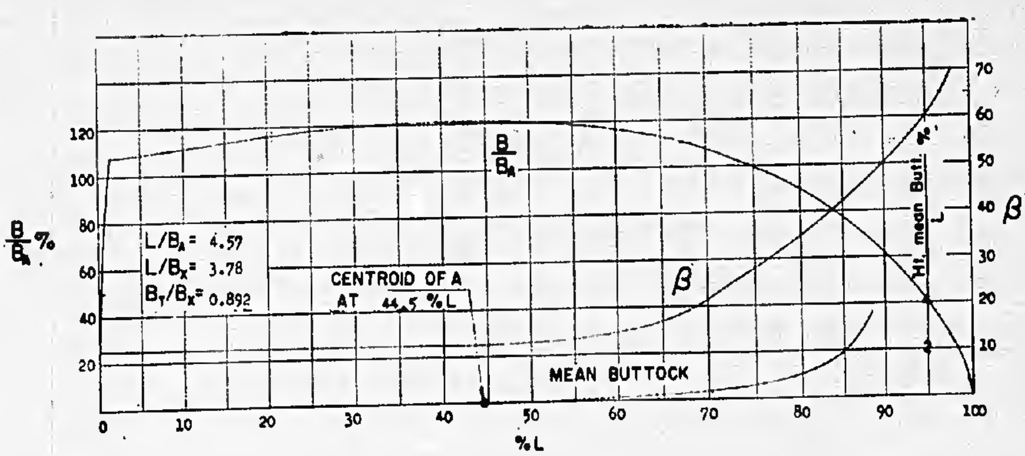
TEST NO.	Δ_M lb	Δ_S lb	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE $F_{n\nabla}$	τ_o	α_o	DRAFT COEFF. C_{HF}	DRAFT COEFF. C_{HA}	CG AFT OF CENTROID OF A	LCG %L
19	145.2	32,254	7.00	5.65	-----	0.75° x STERN	+0.75°	0.827	1.316	6.0%L	38.5
20	119.0	26,434	8.00	6.05	-----	0.60° x STERN	+0.60°	0.815	1.321	6.0%L	38.5

ODEL DATA

IGH SPEED BASIN
ZE 2968'x21'x(10' and 16')
F TEST 5 APRIL 1955
TEMP. 65°F
AGES SPRAY STRIPS
ENCE STIM. NONE
MATERIAL WOOD
FINISH PAINT

WL	TEST NO.20 V_M	R_M	WL_K	WL_C	WL_{SP}
6.80	3.86	7.05	7.25	6.10	6.80
6.50	4.83	10.50	7.10	5.45	6.40
6.15	5.78	12.12	7.05	5.00	6.10
5.90	6.76	13.38	7.00	4.75	5.70
5.55	7.70	14.64	6.90	4.30	5.30
5.30	8.70	15.67	6.75	4.00	4.60
4.80	9.64	16.72	6.65	3.70	4.20
4.20	10.63	18.07	6.60	3.50	3.95
3.90	11.61	19.22	6.60	3.25	3.80
3.70	12.56	20.48	6.65	3.00	3.65
3.60	13.52	22.18	6.65	2.80	3.50
3.40	14.53	24.00	6.70	2.60	3.25
3.30	15.47	26.13	6.70	2.40	3.20
3.30	16.40	28.27	6.75	2.35	3.00
3.10	17.28	30.62	6.80	2.25	2.90
3.10	18.24	33.26	6.80	2.10	2.80

II FORM CHARACTERISTICS



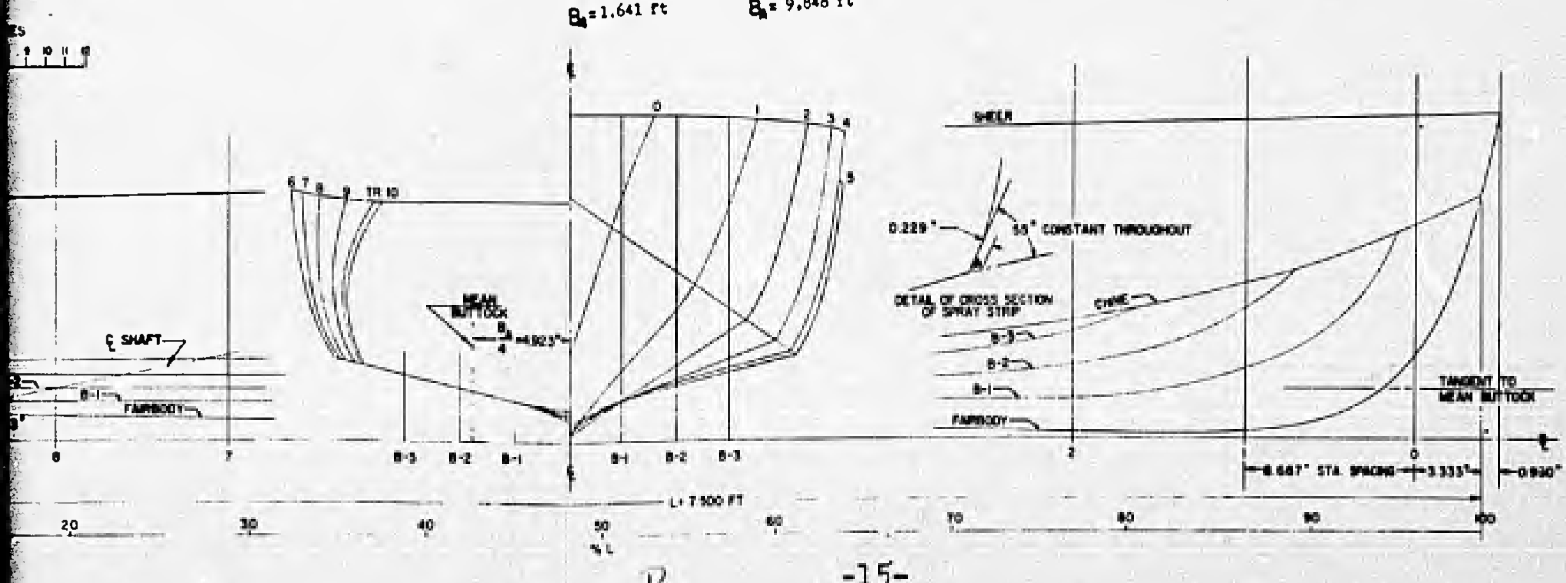
III LINES

MODEL

A = 12.311 sq ft
L = 7.500 ft
B_A = 1.641 ft

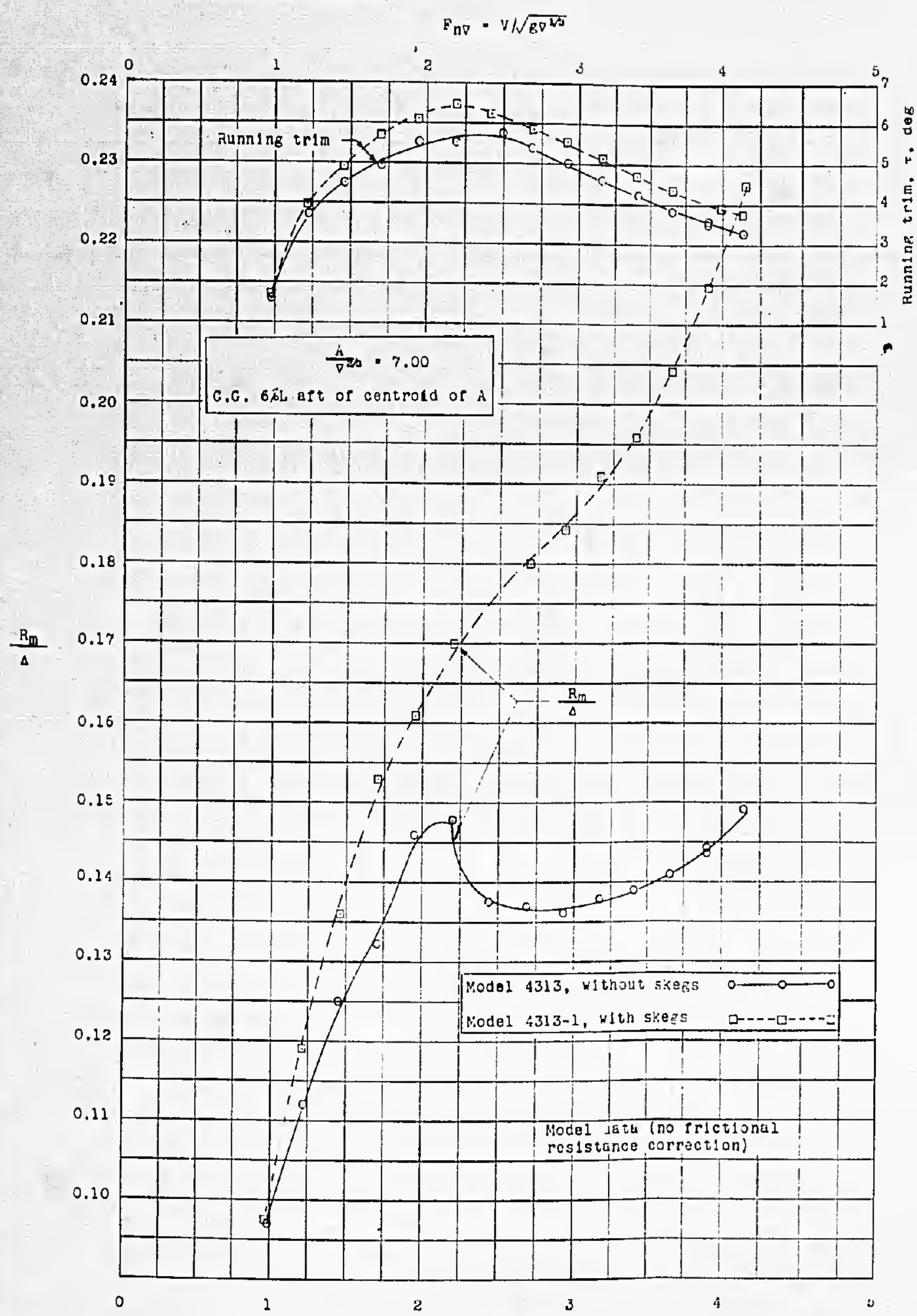
FULL SIZE

A = 443.2 sq ft
L = 45.00 ft
B_A = 9.848 ft

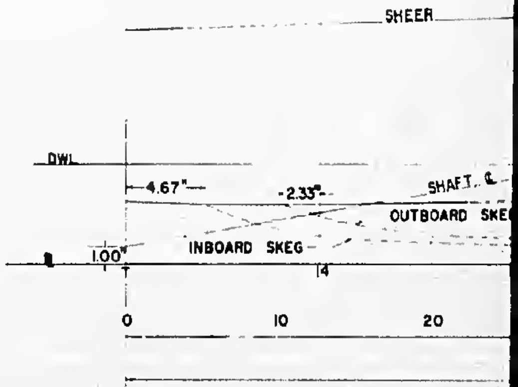


B

IV Performance characteristics



Basin: High speed basin
Basin size: 2968' x 21' x (
Date of test: 10 January 19
Water temp: 72° F
Turbulence stim.: None
Model material: Wood
Finish: Paint



speed basin
2968' x 21' x (10'and16')
t: 10 January 1965
72° F
stim.: None
ial: Wood
nt

Figure 9

Planing Boat Design Data Sheet
David W. Taylor Model Basin

April 1959

EXPERIMENTAL BOAT HULL FORM TEST PROGRAM | 1/6. SCALE AVR DESIGN | DTMB MODEL 4313

Remarks:

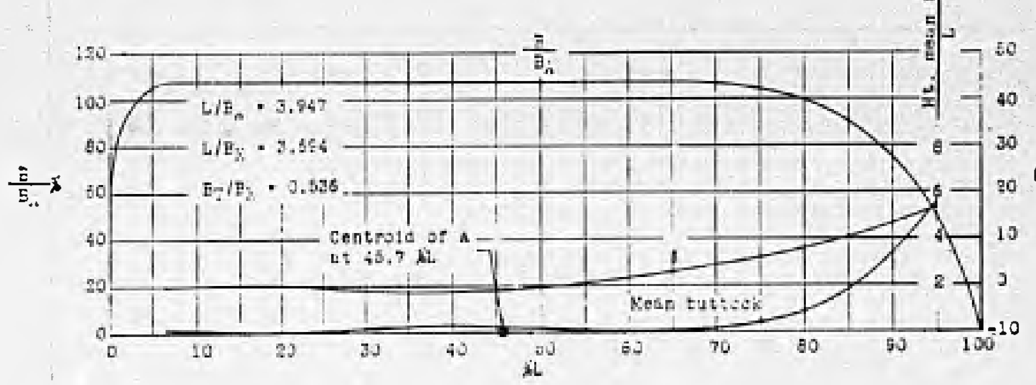
Not a practical boat hull form. The skegs under the bottom cause a great increase in resistance. Resistance without the skegs is low at high speeds because the planing bottom is nearly a flat surface.

I Test condition

Density, Ratio Sw/Fw 1.0284

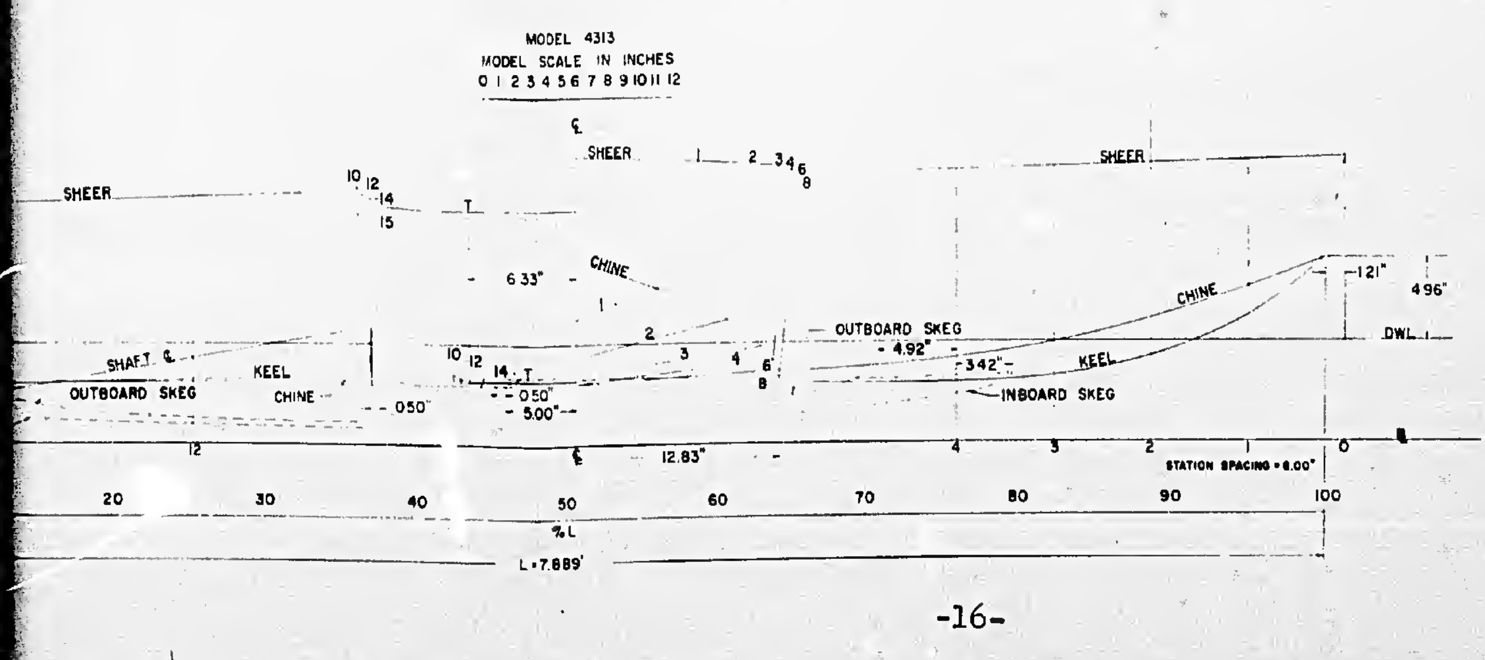
Model	Test No.	Δ_m lb	Δ_s lbs.	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	$\tau°$	C.G. aft of centroid of A	LCG %L
4313	1	211.4	45,959	7	5.26	0.42°	6.0%L	39.7
4313-1	"	"	"	"	"	0.40°	"	"

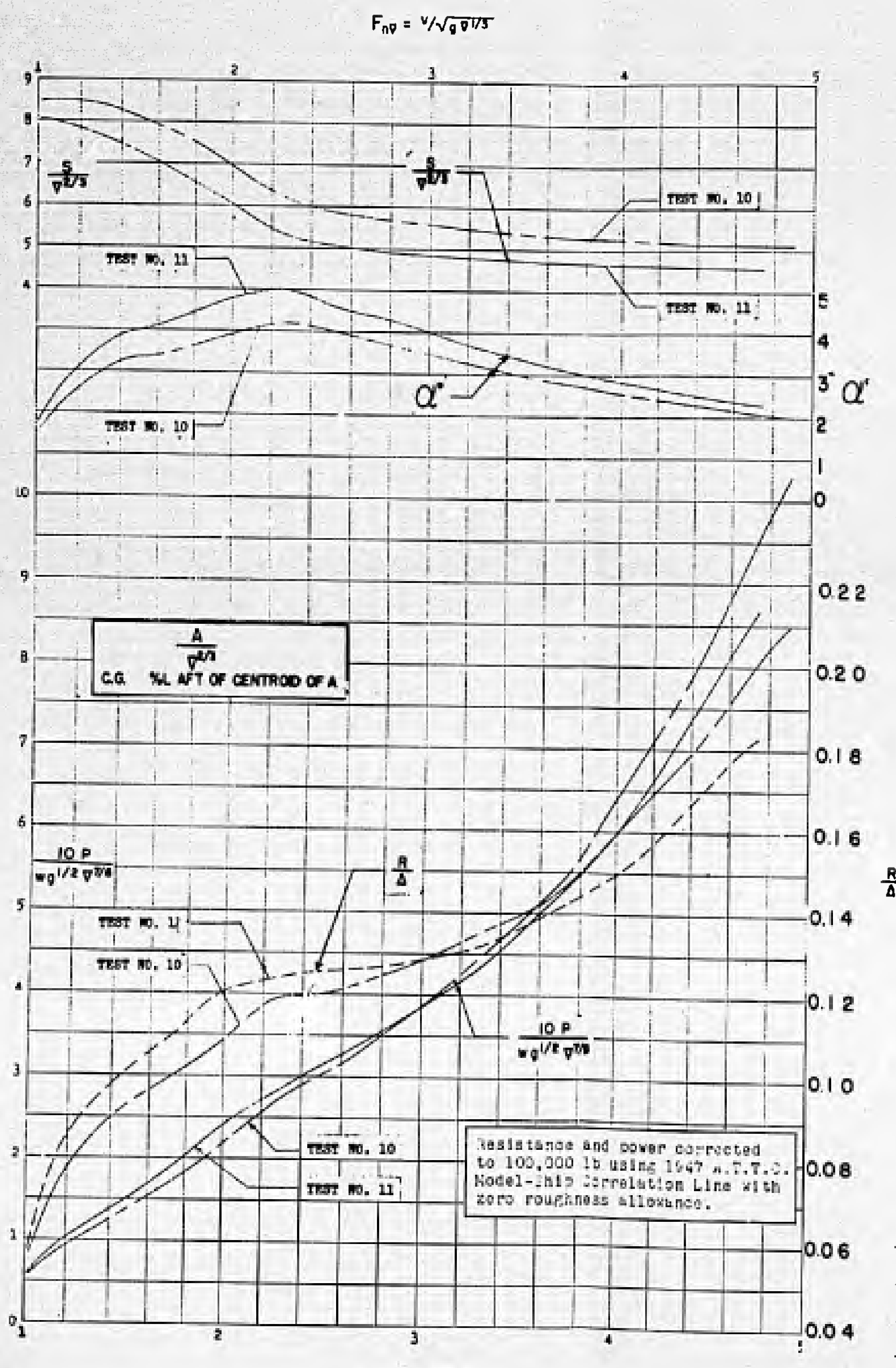
II Form characteristics



III Lines

Model	Full size
A = 15.810 sq ft	A = 569.16 sq ft
L = 7.899 ft	L = 47.39 ft
B_A = 2.000 ft	B_A = 12.00 ft





M

BASIN
BASIN S
DATE O
WATER
APPENDA
TURBUL
MODEL
MODEL

TEST NO. 10

V_M	R_M	WL_K	WL_C
3.83	7.51	7.08	5.00
4.80	11.02	6.88	5.10
5.77	12.70	6.65	4.55
6.72	13.99	6.35	4.19
7.70	15.39	5.95	3.80
8.62	16.62	5.60	3.45
9.66	17.23	5.25	3.20
10.64	18.23	5.40	2.97
11.61	19.30	5.40	2.80
12.57	20.54	5.42	2.60
13.55	21.85	5.42	2.50
14.50	23.70	5.50	2.35
15.49	25.86	5.55	2.20
16.44	27.97	5.60	2.13
17.35	30.38	5.65	2.00
18.33	33.02	5.75	1.90

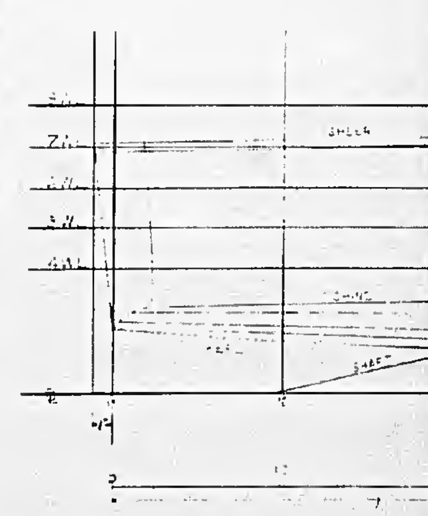


Figure 10

PLANING BOAT DESIGN DATA SHEET
DAVID W. TAYLOR MODEL BASIN

April 1959

EXPERIMENTAL BOAT HULL
FORM TEST PROGRAM

1/6 SCALE
AVR DESIGN

DTMB MODEL 4315

MODEL DATA

BASIN HIGH SPEED BASIN
BASIN SIZE 2968'x21'x(10'and 16')
DATE OF TEST 25 Feb. 1955
WATER TEMP. 64.2° F
APPENDAGES SPRAY STRIPS AND KEEL
TURBULENCE STIM. NONE
MODEL MATERIAL WOOD
MODEL FINISH PAINT

REMARKS:

The combination of a wide transom, relatively large twist, and bell-shaped sections, gives resistance above the average throughout most of the speed range. Concavity of sections at the chines tends to give a dry boat, but will produce high impact accelerations in rough water.

I TEST CONDITIONS

Density Ratio, SW/FW 1.0284

TEST NO.	Δ_M lb	Δ_S lb	$\frac{A}{\nabla^{2/3}}$	$\frac{L}{\nabla^{1/3}}$	MAXIMUM STABLE $F_{n\nabla}$	τ_o	α_o	DRAFT COEFF. FWD.	DRAFT COEFF. AFT.	CG AFT OF CENTROID OF A	LCG % L
10	118.8	26,390	8.00	5.89	-------	0.67° x Stern	0.17°	1.168	1.303	6.0% L	38.7
11	145.2	32,254	7.00	5.50	-------	0.80° x Stern	0.30°	1.082	1.283	6.0% L	38.7

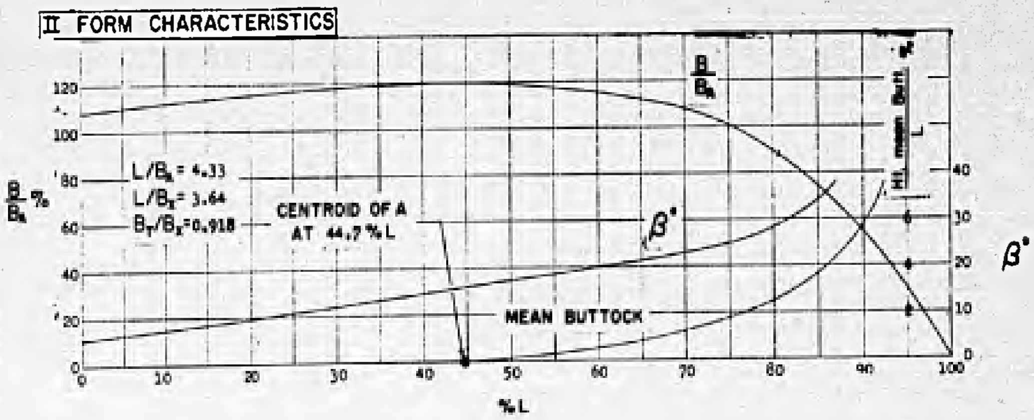
NO. 10

WL_K	WL_C	WL_{SP}
.08	5.00	6.00
.88	5.10	5.40
.65	4.55	5.30
.35	4.19	5.20
.95	3.80	4.95
.60	3.45	4.65
.25	3.20	4.42
.40	2.97	4.25
.40	2.80	4.18
.42	2.60	4.05
.42	2.50	4.00
.50	2.35	3.95
.55	2.20	3.90
.60	2.13	3.90
.65	2.00	3.85
.75	1.90	3.85

TEST NO. 11

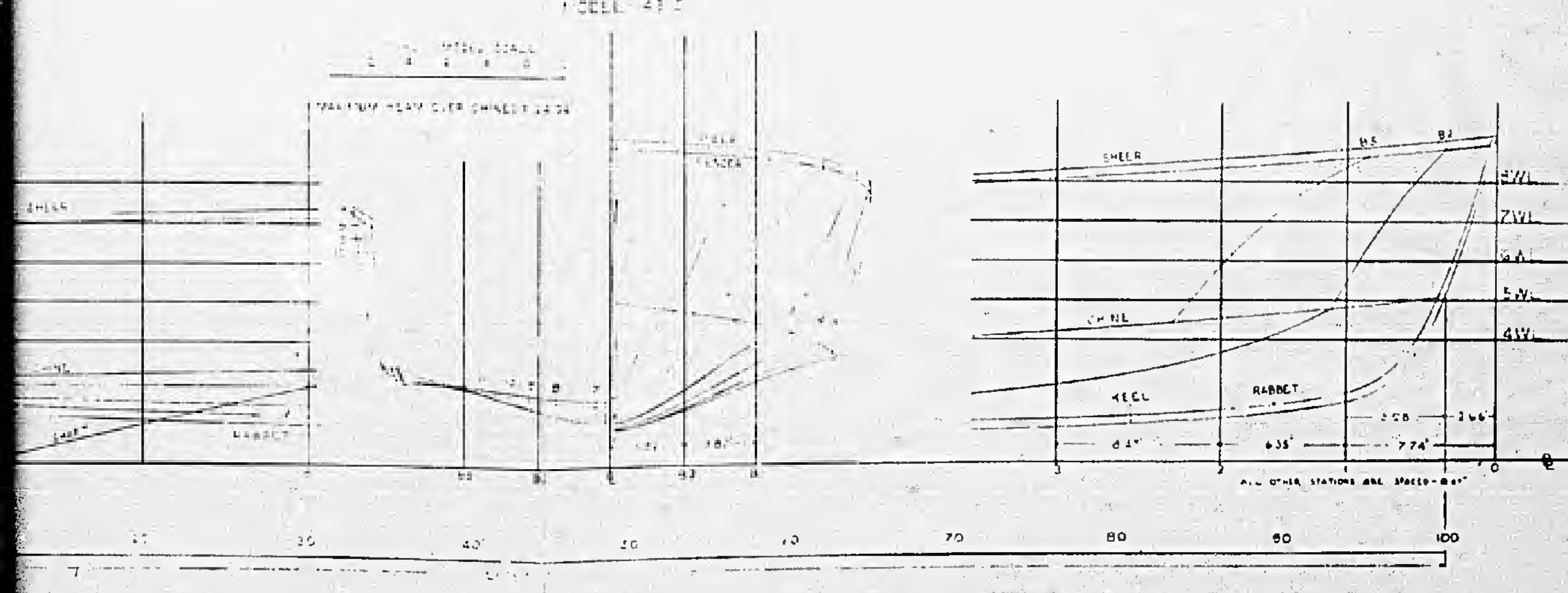
V_M	R_M	WL_K	WL_C	WL_{SP}
3.89	9.19	7.11	5.95	6.65
4.86	14.32	6.89	5.20	5.70
5.83	16.40	6.62	4.78	5.50
6.78	17.97	6.28	4.38	5.35
7.76	19.70	5.80	3.95	5.05
8.69	20.40	5.65	3.60	4.78
9.64	21.04	5.35	3.38	4.55
10.64	21.61	5.20	3.15	4.38
11.60	22.42	5.25	2.98	4.20
12.53	23.26	5.29	2.79	4.15
13.55	24.59	5.35	2.70	4.05
14.49	26.15	5.40	2.58	4.00
15.50	27.79	5.45	2.40	3.94
16.40	29.70	5.50	2.35	3.90
17.38	32.19	5.65	2.20	3.90
18.36	34.63	5.60	2.15	

II FORM CHARACTERISTICS



MODEL
A = 12.308 sq ft
L = 7.299 ft
B_x = 1.686 ft

FULL SIZE
A = 443.09 sq ft
L = 43.79 ft
B_x = 10.12 ft



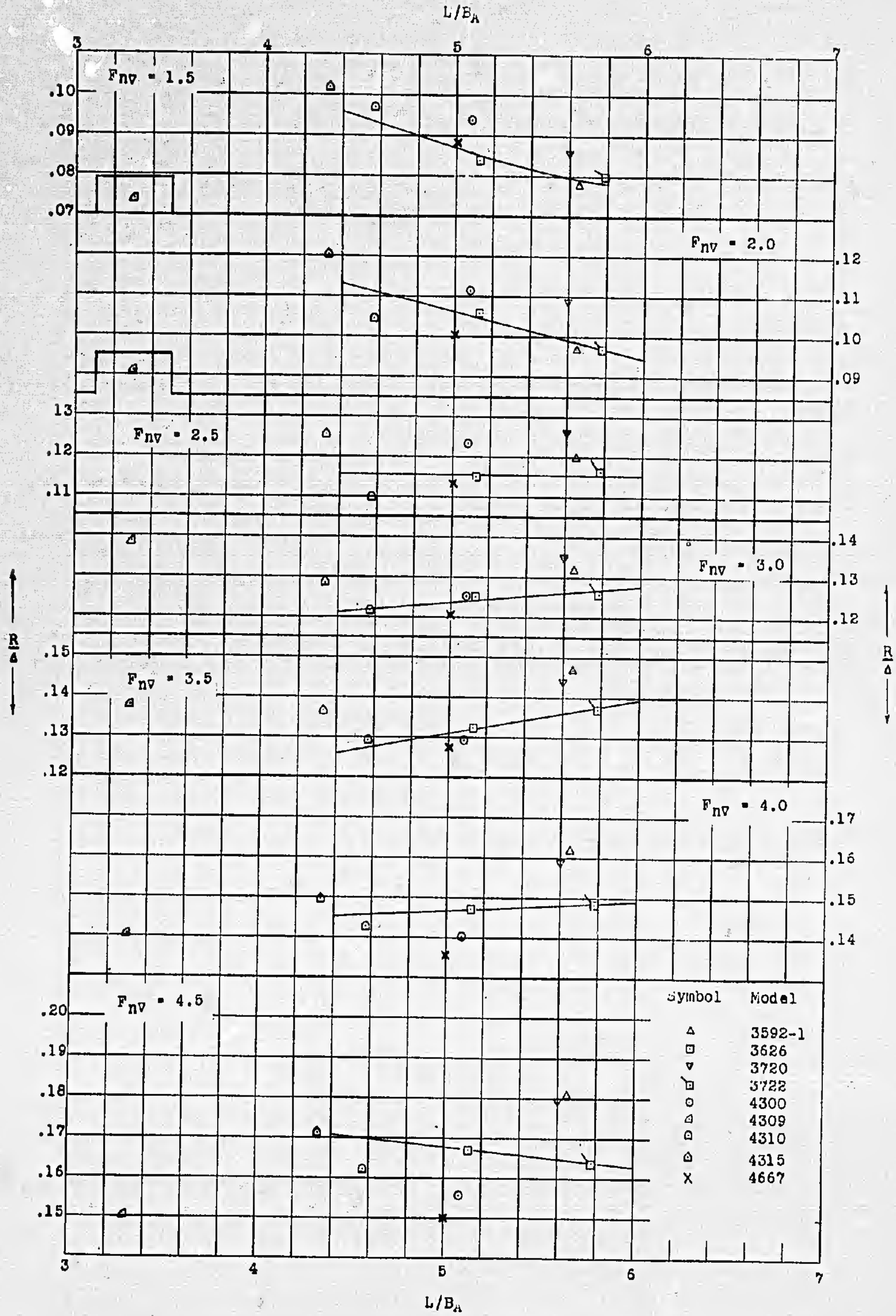


Figure 11 - Comparison of resistance versus length-beam ratio at several values of speed coefficient.