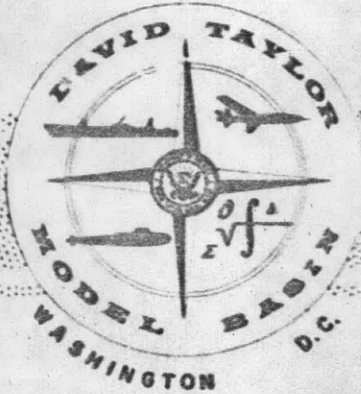




Report 1749

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DEPARTMENT OF THE NAVY

HYDROMECHANICS

PERFORMANCE OF MODIFIED AO 22-CLASS TANKER
PREDICTED FROM TESTS WITH MODEL 4895

by

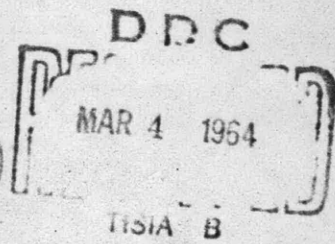
A. Q. Aquino

AERODYNAMICS

STRUCTURAL
MECHANICS

APPLIED
MATHEMATICS

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HYDROMECHANICS LABORATORY
RESEARCH AND DEVELOPMENT REPORT

September 1963

Report 1749



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PERFORMANCE OF MODIFIED AO 22-CLASS TANKER
PREDICTED FROM TESTS WITH MODEL 4895

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A. Q. Aquino

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S-F013 02 04

ABSTRACT

Model 4895 was constructed by the David Taylor Model Basin to represent a jumboized design of the AO 22-Class Tanker. Resistance and propulsion tests were conducted to determine the ability of the enlarged ship to maintain an acceptable speed with existing shaft horsepower of 13,500. Model tests indicate that at the design condition, the prototype of Model 4895 will attain a speed of 17.6 knots while absorbing 13,500 shp at 101 rpm.

INTRODUCTION

At the request of the Bureau of Ships,¹ the David Taylor Model Basin built a model to represent a jumboized design of the AO 22-Class Tanker and conducted model tests to determine the powering characteristics of that tanker. The test program consisted of (a) resistance tests to determine the fully appended effective horsepower at displacements of 19,090 and 33,100 tons and (b) propulsion tests to determine the powering characteristics at a displacement of 33,100 tons. The purpose of the project is to determine if the enlarged ship can maintain an acceptable speed with the existing shaft horsepower of 13,500.

TMB Model 4895 was constructed in accordance with Plan A024/S0500/916239, with the afterbody and appendages modified according to Plan A022/802/1895719 (Station 17 aft). The model was built to a scale ratio of 26.25. Figure 1 gives the dimensions and general characteristics of the model and Figures 2 and 3 are fitting-room photographs of the model. Stock, four-bladed propellers were selected and designated as Propellers 2502 and 2503. Figure 4a is a drawing of Propeller 2502. A correlation allowance (ΔC_f) of 0.0004 was used in the frictional calculation for the powering prediction, and stud-stimulators, as described by Hughes and Allan,² were used on the hull to induce turbulence.

The principal hull modification to jumboize the tanker was to lengthen the middle body by 91 ft, or 17.3 percent of the original length.

¹References are listed on page 3.

This change increased displacement by 42.5 percent, as compared to the trial displacement of the original AO 22. Figure 5 shows the enlarged rudder designed for the new class. As a further modification, the bossings were eliminated and replaced with V-strut shaft supports. This alteration is shown in Figures 2 and 3b. Finally, the centerline of the propellers was moved to a point 18.17 ft forward of the AP.

The resistance and propulsion characteristics of the enlarged ship are presented.

DISCUSSION AND CONCLUSIONS

The design condition for this ship is specified as a displacement of 33,100 tons at a draft of 34.25 ft, even keel. Additional ship and model data are given in Figure 1.

RESISTANCE

Effective horsepower predictions estimated from model tests are presented in Figure 6 for the design displacement and for a displacement of 19,090 tons. These data for the design condition are compared with Taylor's Standard Series as a ratio curve in Figure 7. The curves indicate that at the design speed ($W/L = 0.700$), the ratio of the predicted ehp to the Taylor ehp is 1.035.

PROPULSION

Powering predictions based upon results of tests conducted on Model 4895 are shown as curves of horsepower, rpm, and associated coefficients in Figure 8. Open-water characteristics of Propellers 2502 and 2503 are shown in Figure 4b.

Model test data indicate that at the design condition, the prototype of Model 4895 will attain a speed of about 17.6 knots, while absorbing 13,500 shp at 101 rpm. The propulsive coefficient for this condition is 0.692.

REFERENCES

1. Bureau of Ships ltr FO13 02 04, Ser 442-108 of 27 Jun 1961 to the David Taylor Model Basin.
2. Hughes, G. and Allan, J. F., "Turbulence Stimulation on Ship Models," Transactions, Society of Naval Architects and Marine Engineers, Vol. 59 (1951).

APPENDAGES : NONE

DIMENSIONS			L W L. COEFFICIENTS			
	SHIP	MODEL	C_B	C_{WF}	C_{WA}	C_{WP}
LENGTH (LWL) FT.	636.0	24.228	0.708	0.774	0.842	
LENGTH (LBP) FT.	616.0	23.466	0.717		0.339	
BEAM (B_x) FT.	75.0	2.857	0.987		L_E/L	0.218
DRAFT (H) FT.	34.25	1.305	0.808		L_X/L	0.443
DISPL. IN TONS (. W.)	33100 SW	1.778 FW	0.745		L_R/L	0.480
WETTED SURF. SQ. FT.	68450	99.34	0.690		L/B	8.480
DESIGN V IN KTS.	17.65	3.44	0.630		B_x/H	2.190
LCB _{LWL} • 0.487	AFT OF F.P.		0.651		$\Delta/(.OIL)^3$	128.6
LCB _{LBP} • 0.503	AFT OF F.P.		0.876		$S/\sqrt{\Delta L}$	14.95
W.L. ENTRANCE HALF ANGLE • 9.2 DEG.			0.809		f	0.08
λ • 26.25	$v/\sqrt{L_{LWL}} \cdot 0.700$		0.950		t	2.23
Ⓢ • 1.813	Ⓟ • 0.614		L B P COEFFICIENTS			
LINES: BUSHIPS PLANS:			C_B	0.731	L/B	8.21
A024/S0500/916239			C_p	0.741	$\Delta/(.OIL)^3$	141.6
A022/802/1895719						

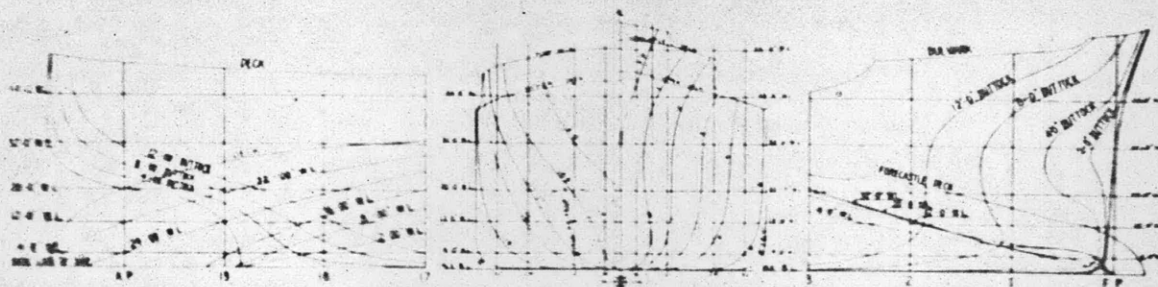
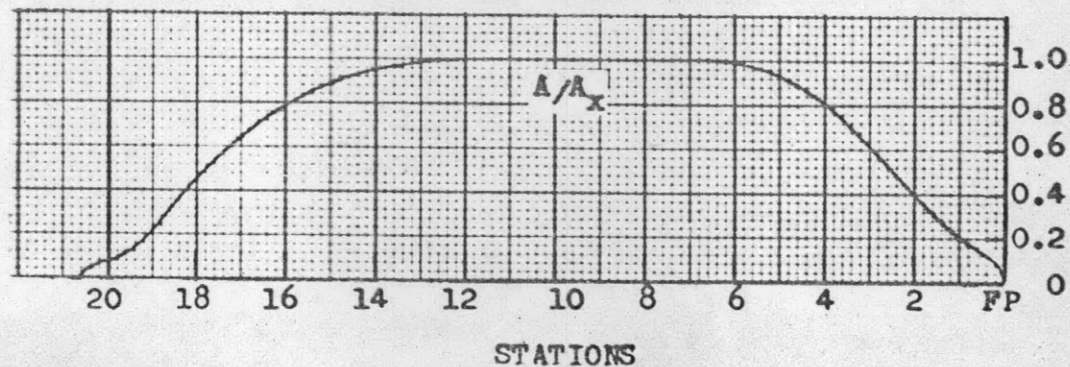


Figure 1 - Ship and Model Data for Modification of
AO 22-Class Tankers, Model 4895

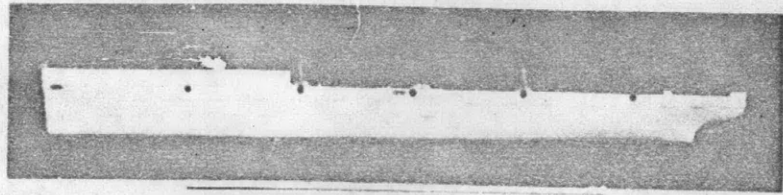


Figure 2a

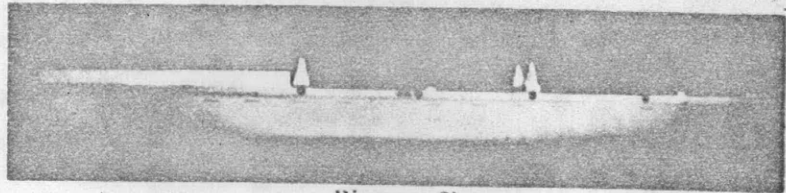


Figure 2b

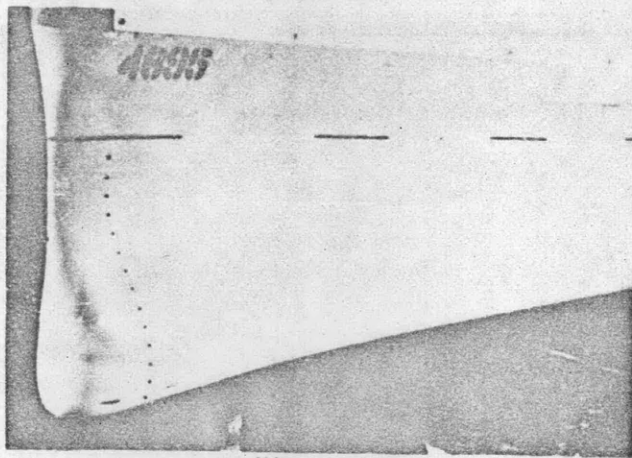


Figure 2c

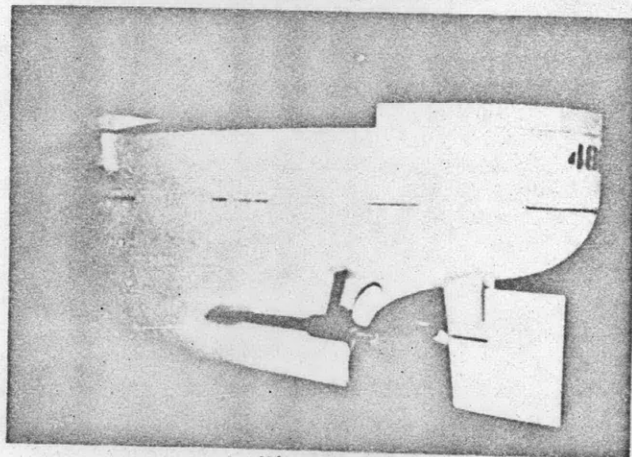


Figure 2d

Figure 2 - Fitting-Room Photographs, Model 4895

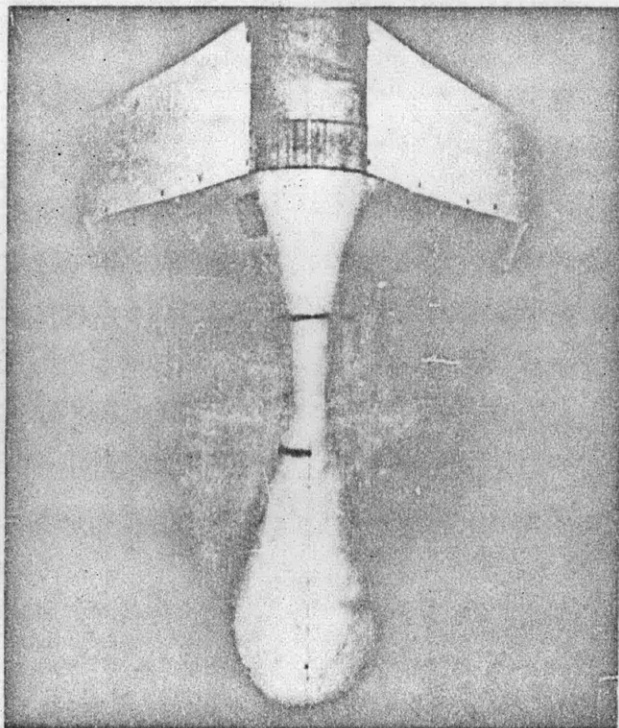


Figure 3a

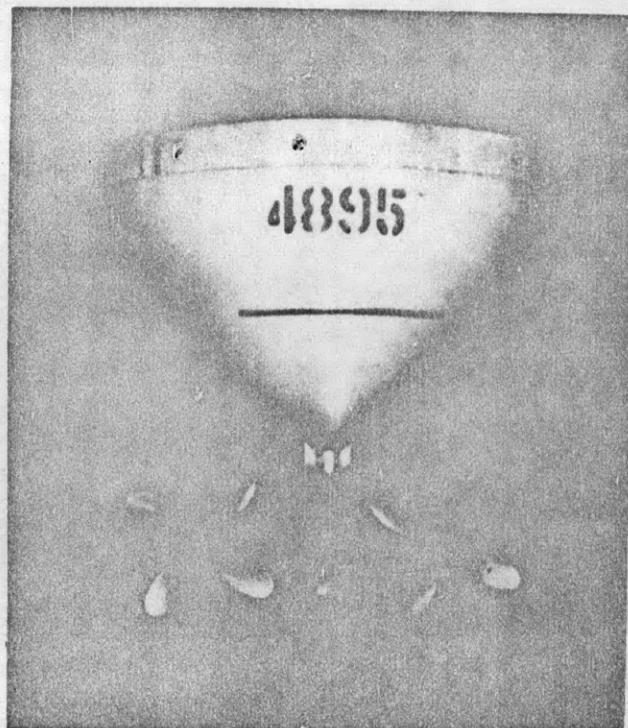


Figure 3b

Figure 3 - Fitting-Room Photographs, Model 4895

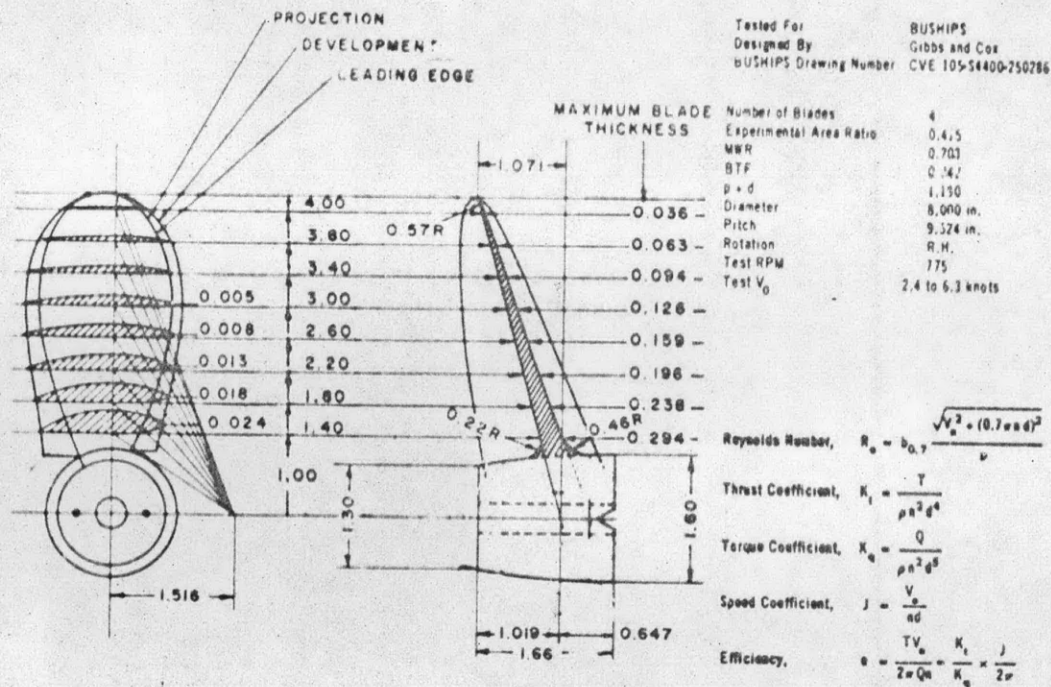


Figure 4a - Propeller 2502

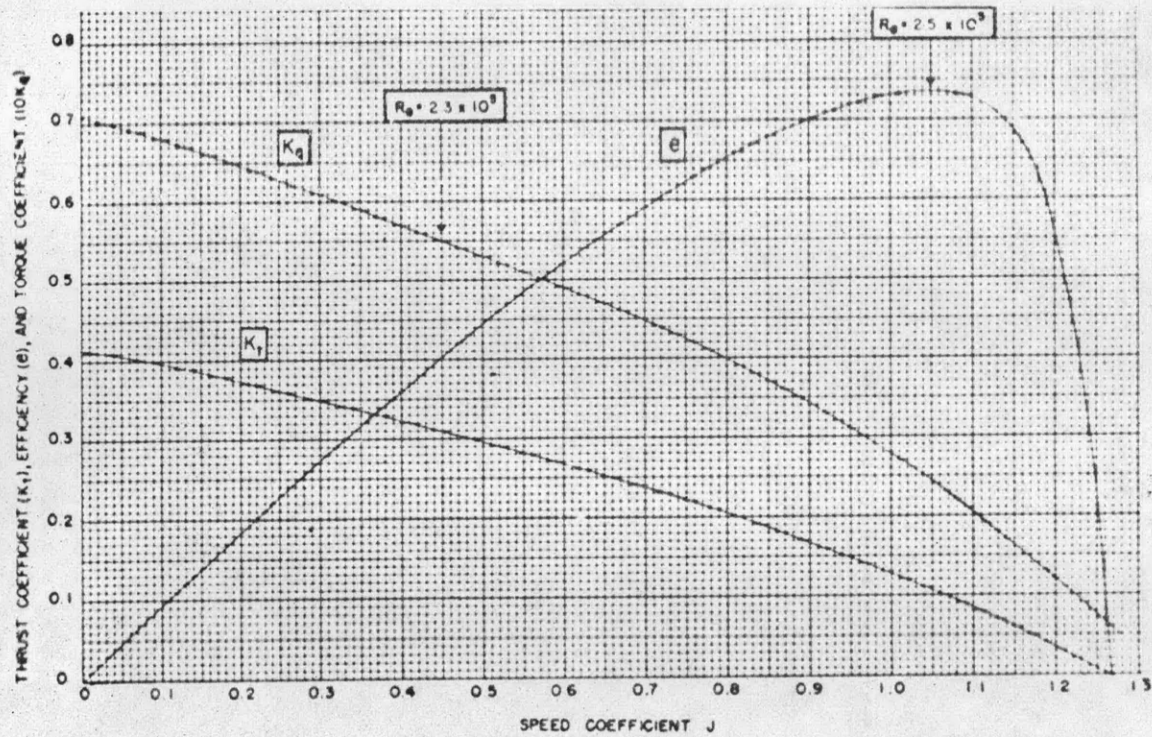


Figure 4b - Characteristic Curves of Propeller 2502

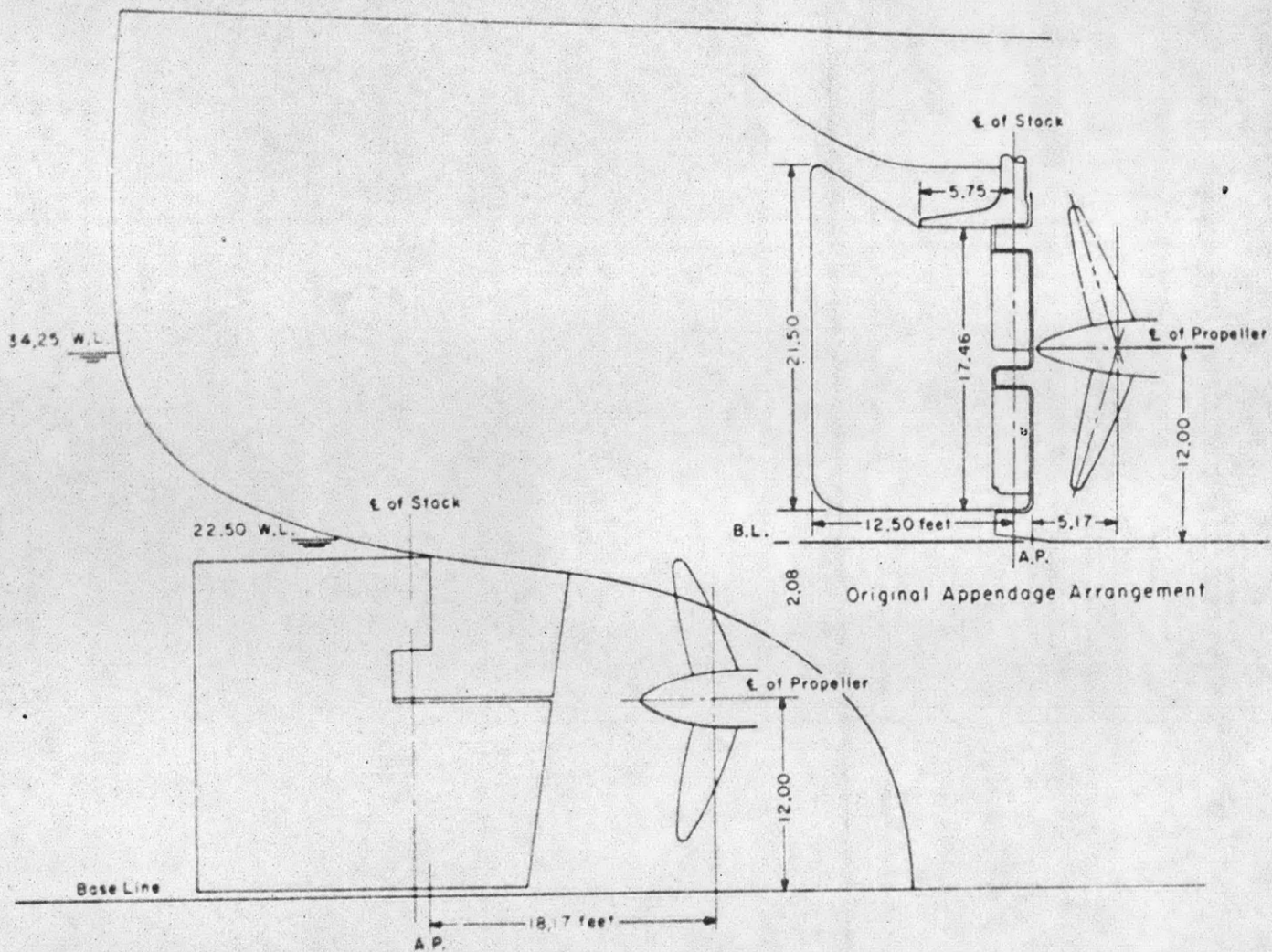


Figure 5 - Enlarged Rudder

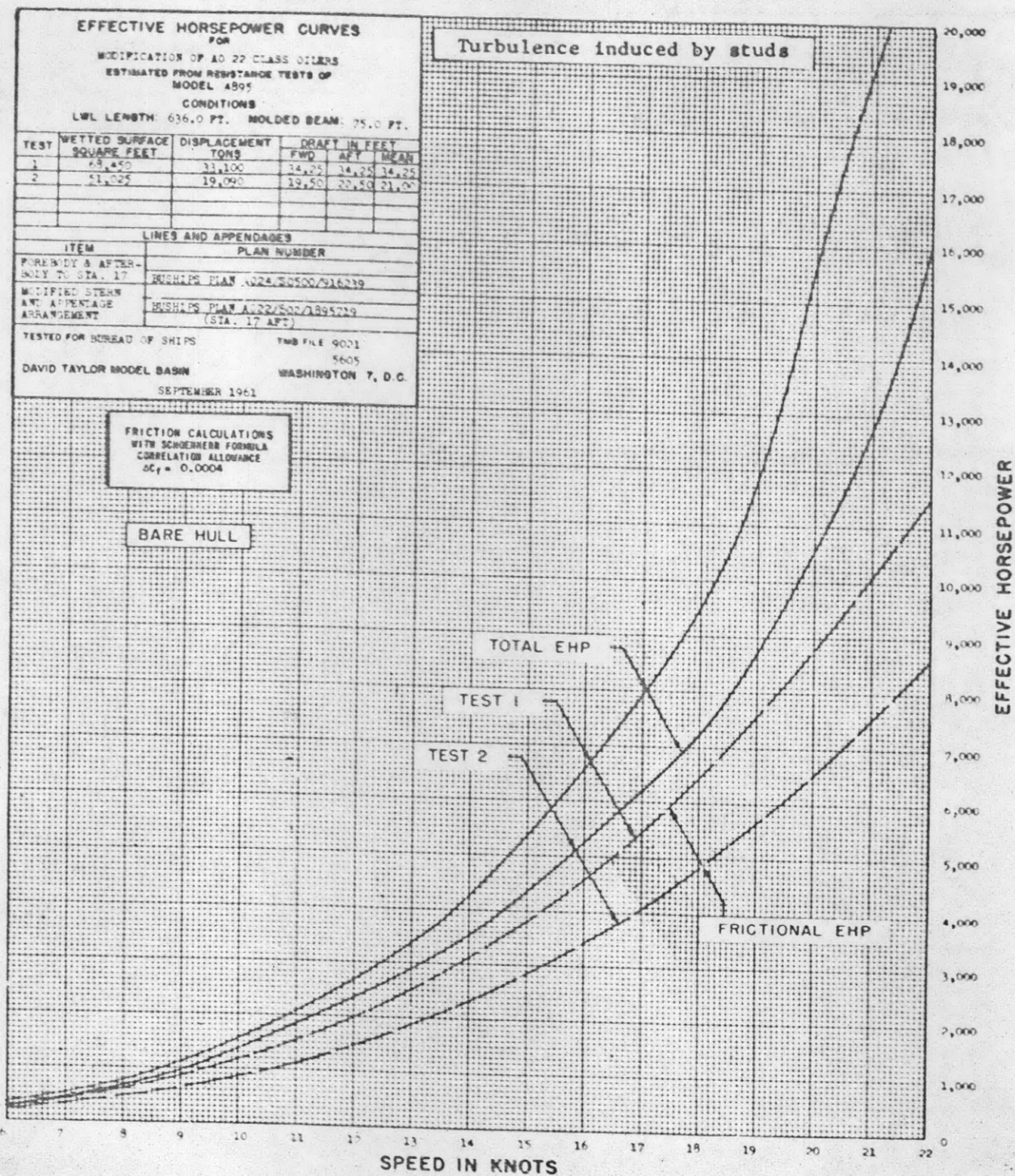


Figure 6

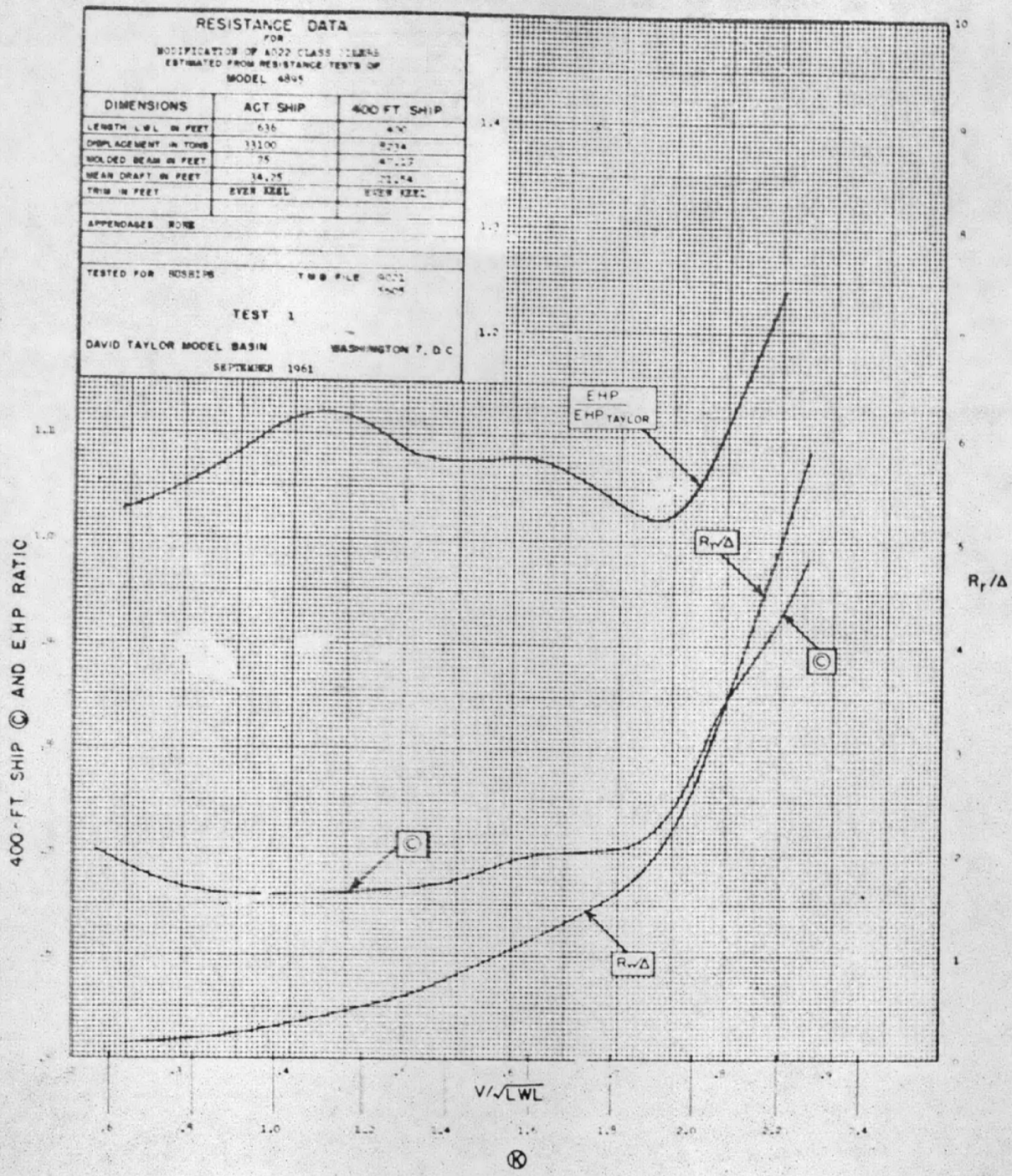


Figure 7

HORSEPOWER & RPM CURVES
FOR
MODIFICATION OF 4000 CLASS CIGERS
ESTIMATED FROM PROPULSION TESTS OF
MODEL 4165
PROPELLER 1502-2501

SHIP		PROPELLER	
LENGTH OVER	430 FT	NUMBER	2501 - 2501
BEAM	75 FT	DIAMETER	32.50 FT
DRAUGHT	14.00 FT	PITCH	50.51 FT
DISH	11.100 TONS	NO. OF BLADES	4
TRIP	EVERY 2200	MEAN WPT/RATIO	0.201
R.S.	22.457 SQ. FT	PROJ. AREA - DISC AREA	0.278
APPROXIMATE R.P.M.		B.T.F.	0.047
WINDS 13.000 SHAPTS		DIRECTION OF ROTATION	FORWARD
ANG. VE. 3.0000		TIPS BELOW SURFACE	
		T/C CLEARANCE	

TESTED FOR ROSS SHIPS TMB FILE 9021
5604

TESTS 3 AND 4

DAVID TAYLOR MODEL BASIN WASHINGTON, D. C.
SEPTEMBER 1961

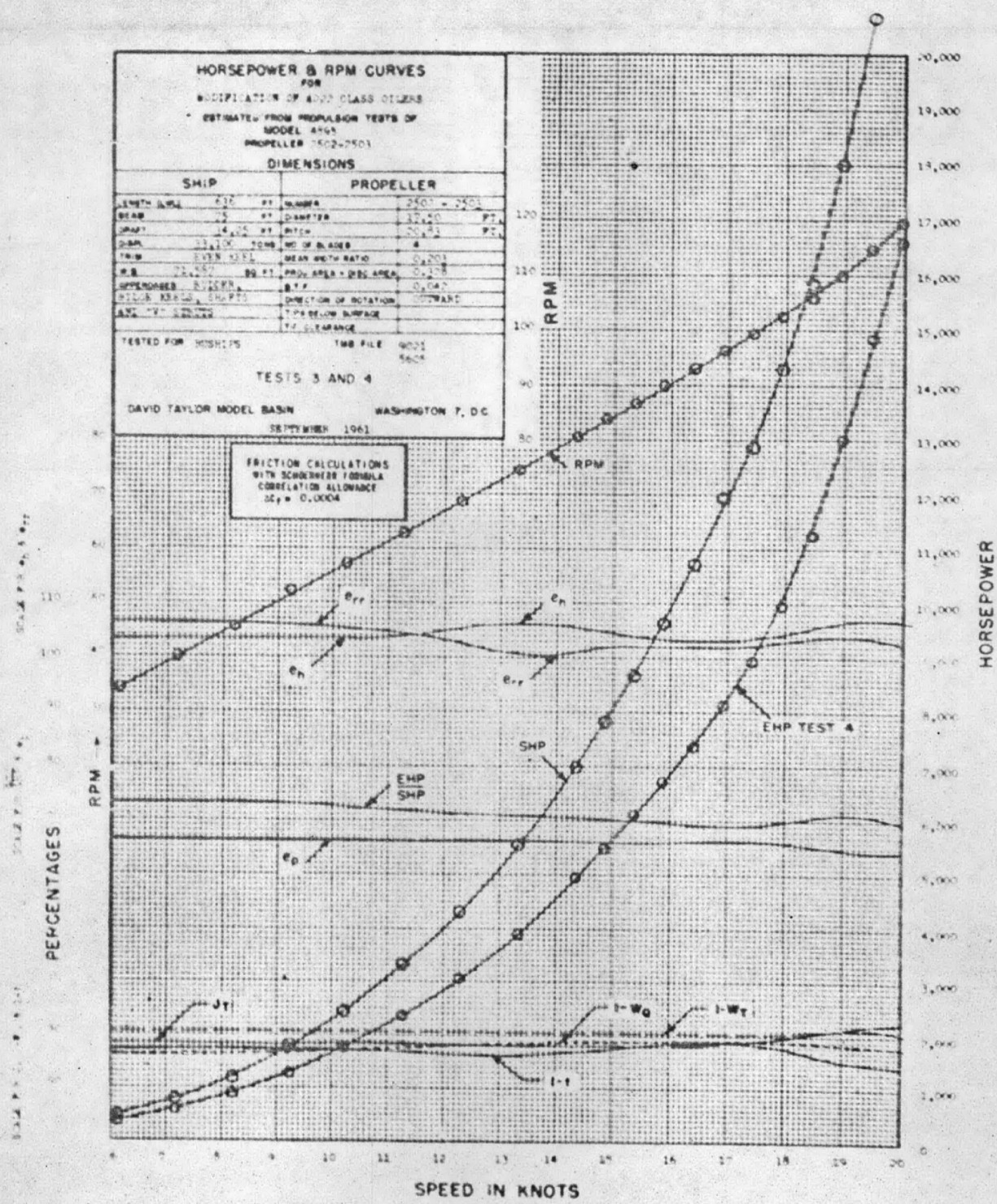


Figure 5

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