DEPARTMENT OF THE NAVY

THE EFFECT OF STERN AND APPENDAGE MODIFICATIONS ON THE POWERING CHARACTERISTICS OF A 154-FOOT PGM FROM TESTS OF MODELS 4950 AND 4950-1 (U)

HYDROMECHANICS

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by

David R. Hoekzema

HYDROMECHANICS LABORATORY
RESEARCH AND DEVELOPMENT REPORT

June 1965 16 Report C-1652-2

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ABSTRACT

Resistance and propulsion tests were conducted to evaluate the performance of a prototype of PGM 84 with two sets of stern lines and two sets of appendages. Comparisons show that the resistance of the modified hull was greater than that of the original hull with a transom wedge. Performance with Taylor Model Basin designed appendages was somewhat better than with Bureau of Ships designed appendages.

ADMINISTRATIVE INFORMATION

This test program was authorized by Bureau of Ships letter F013 0204, Serial 442-220, of 15 November 1963 and was funded under Project S-F013 0204, Task 1712.

INTRODUCTION

The Bureau of Ships requested that the David Taylor Model Basin evaluate the Gibbs & Cox modifications[1] of the stern lines of a Patrol Gunboat, Motor (PGM 84) and the Bureau of Ships designed contraguide appendages.[2] Accordingly, an evaluation was made of the bare-hull resistance of both the Model Basin and the Gibbs & Cox designs and the results compared. The resistance and propulsion characteristics of the PGM hull equipped with Model Basin appendages (represented by Model 4950) were evaluated and compared with those of the Gibbs & Cox hull with Bureau of Ships appendages (Model 4950-1). Data from these comparison tests are reported herein.

Design data sheets, propeller open-water curves, and similar information were published in an earlier report which compared the Model Basin hull with two other designs.[3] In the present evaluations, the hull and propeller constants are essentially the same as those given in Reference 3.

All calculations were performed in accordance with standard Model Basin practices and are for the ship operating in smooth, deep, salt water having a temperature of 59 degrees Fahrenheit,[4] using a correlation allowance of 0.0004.

TEST PROCEDURE

Model 4950 was stripped of all appendages except its docking skeg and resistance tests were conducted both with and without a 3-inch deep (ship scale) transom wedge. Upon the completion of these tests, the model was modified to conform to Gibbs & Cox stern lines and redesignated Model 4950-1. The model was then tested for resistance and the results were compared with those of Model 4950.

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[1] References are listed on page 14.

Model 4950-1 was then fitted with contraguide appendages designed by Bureau of Ships and resistance and propulsion tests were carried out; see Figures 1 and 2. The results of these tests were compared with results of previous tests of the Model Basin hull (Model 4950) equipped with Model Basin designed contraguide appendages.

TEST RESULTS

Both the installation of wedges and the Gibbs & Cox stern modifications resulted in improvements in bare-hull resistance over the original design with straight buttock lines. In each case, the improvement in resistance was greatest between 15 and 30 knots and decreased rapidly at higher speeds. For the Gibbs & Cox design, the improvement remained about 1 to 1.5 percent of the total resistance less than that for the Model Basin design with wedges and showed no improvement at about the design speed of 40 knots; see Figures 3 and 4.

When the resistance of the model with Model Basin appendages and wedges (Model 4950) is compared with that of the model with Bureau of Ships appendages and Gibbs & Cox stern lines (Model 4950-1), the Gibbs & Cox stern line model is found to be higher by 6 to 8 percent of the total resistance over most of the speed range; see Figures 5 and 6. Comparison of results of propulsion tests of these same configurations shows that the SHP of the Bureau of Ships and Gibbs & Cox design is higher by 13 to 15 percent of the total SHP over most of the speed range; see Figures 7, 8, and 9. Bare-hull and appendaged running trims of the models are given in Figures 10 and 11, respectively.

CONCLUSIONS AND RECOMMENDATIONS

The PGM hull with Model Basin wedges has slightly less resistance than the Gibbs & Cox modified hull. The Model Basin appendage design is significantly better than the Bureau of Ships design in resistance, that is, to the extent of several percent of the total resistance of the ship. The Model Basin design also shows superior propulsion characteristics, with the propulsion coefficient averaging about 3 percent higher than that of the Bureau of Ships design.

It is recommended that an appendage arrangement similar to that with the Model Basin appendages, but with the addition of a diagonal brace to the bottom of the strut, be designed and tested. This arrangement would alleviate the problem of unwieldy strut dimensions of the contraguide appendages necessitated by strength considerations.

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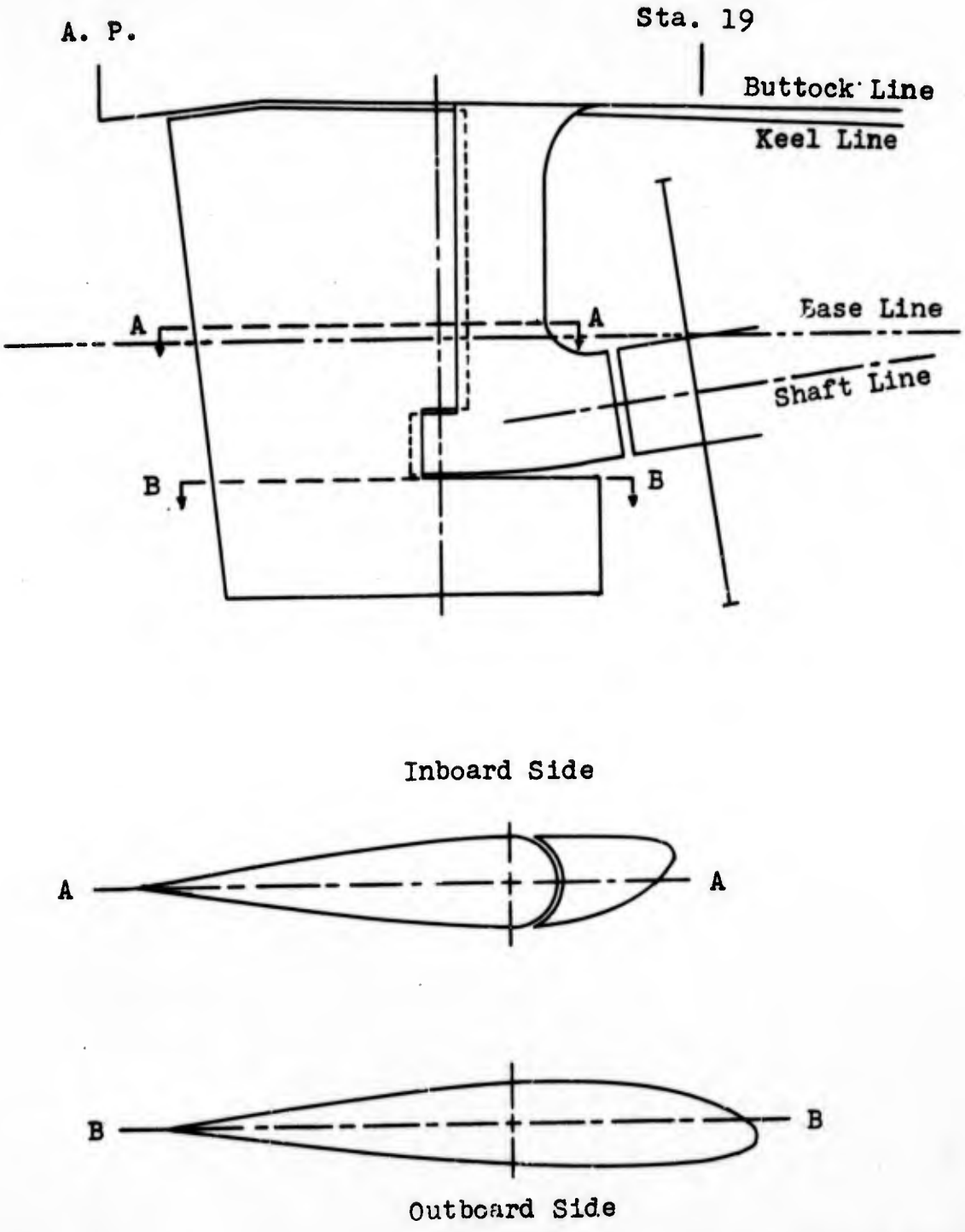

Figure 1 - Taylor Model Basin Designed Appendages Fitted to Model 4950

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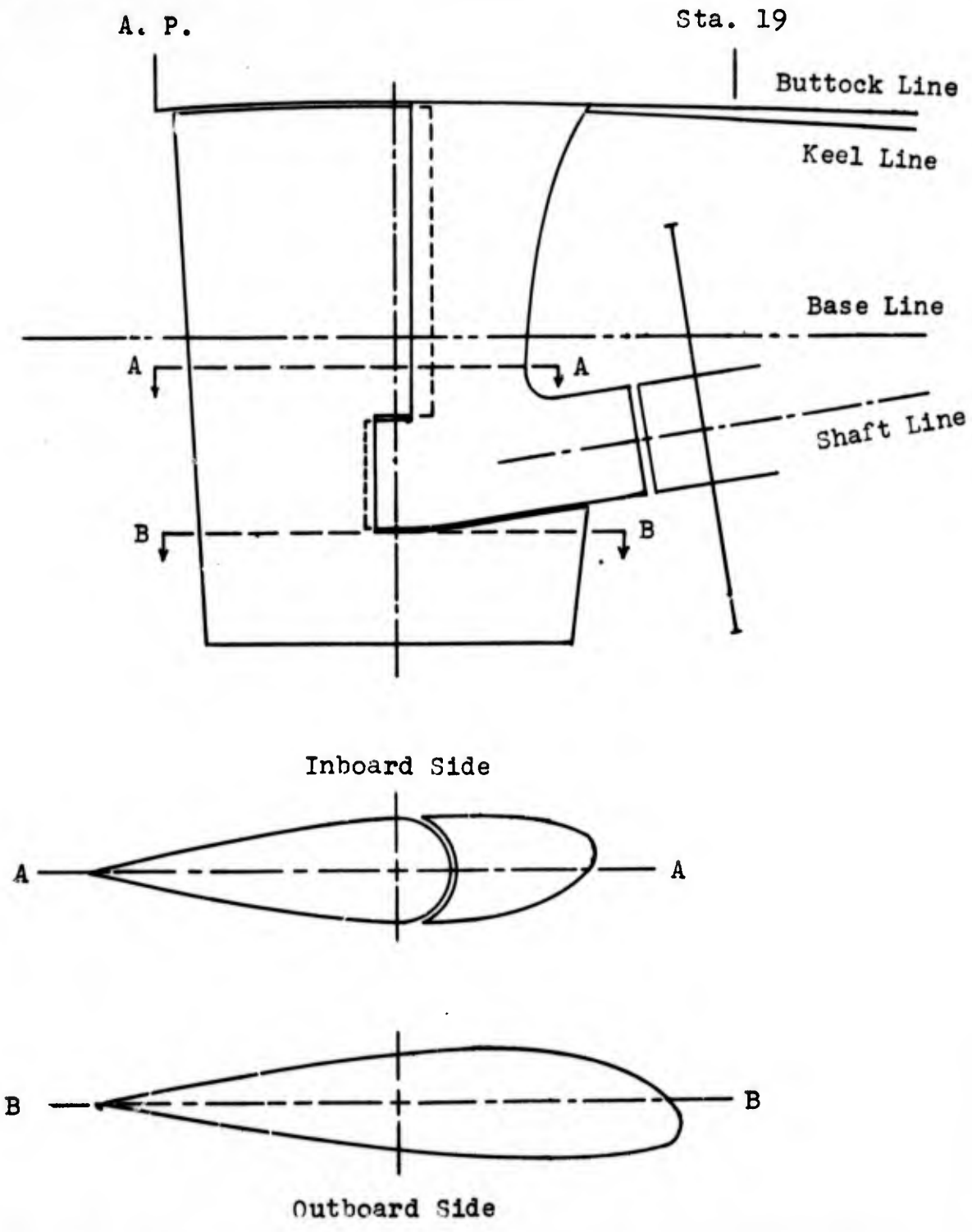

Figure 2 - Bureau of Ships Designed Appendages Fitted to Model 4950-1

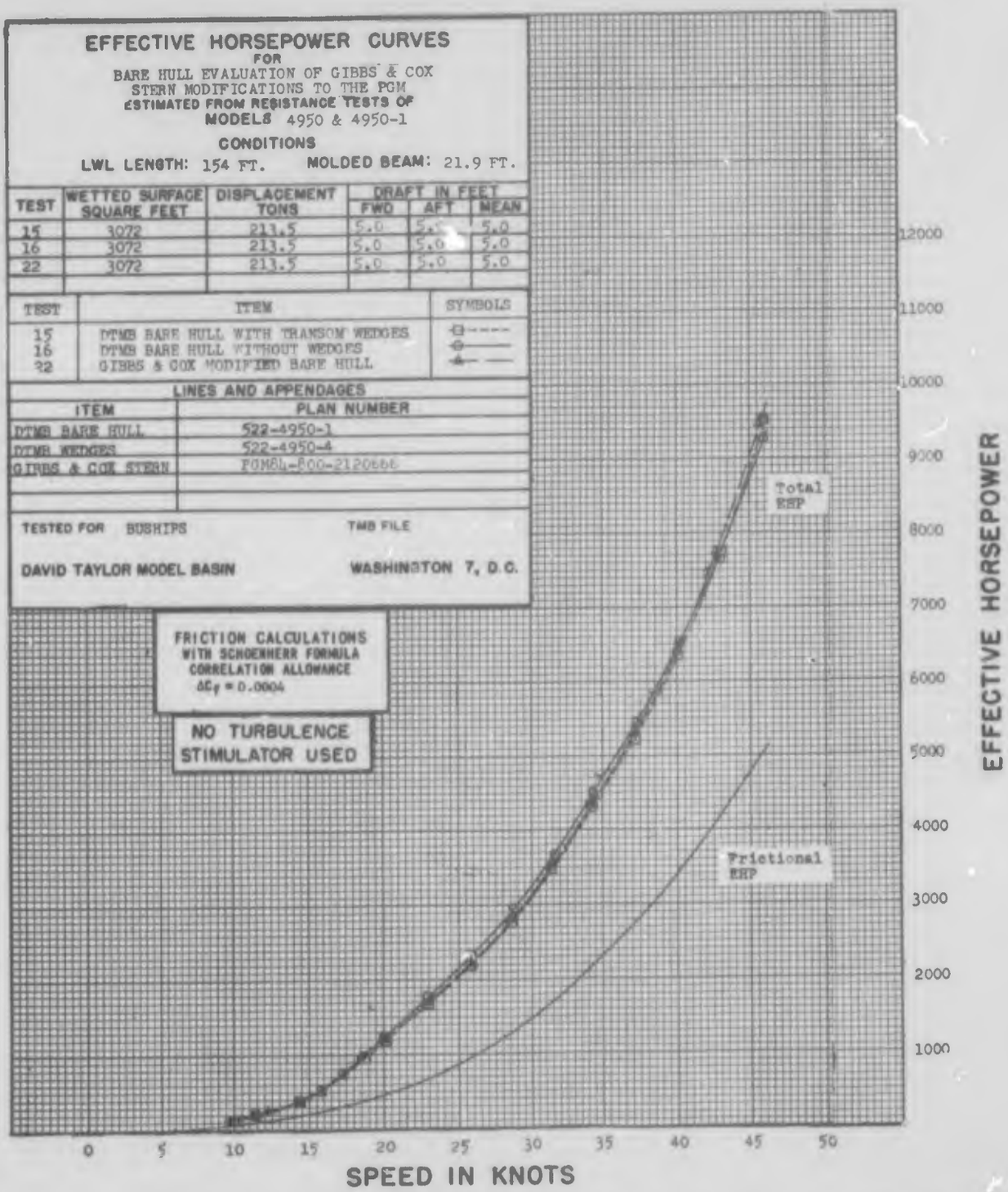

Figure 3 - Effective Horsepower Predictions from Tests of Models 4950 and 4950-1

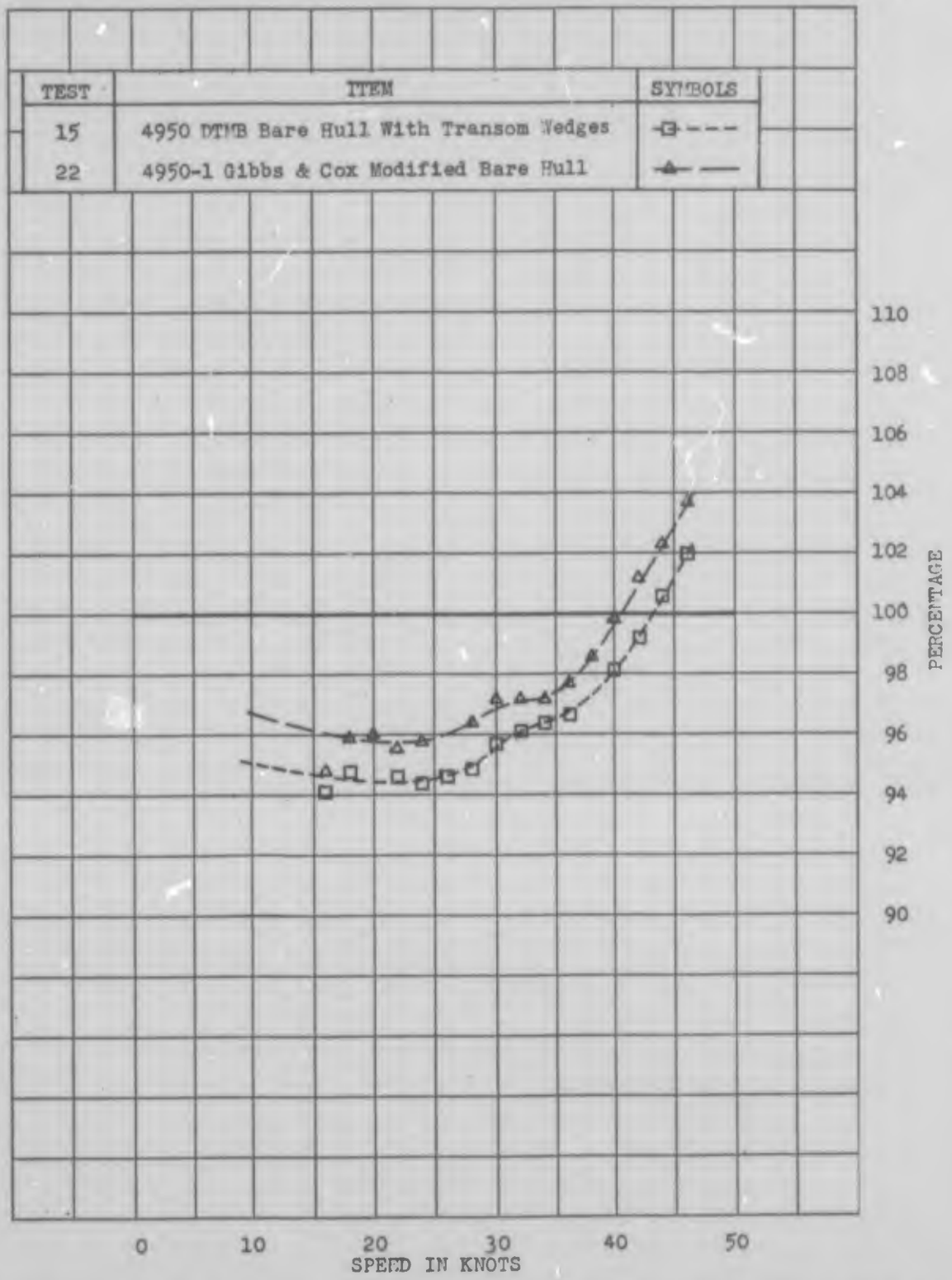

Figure 4 - EHP for Gibbs & Cox Modified Bare Hull and Model Basin Bare Hull with Wedges as a Percentage of EHP for Model Basin Bare Hull

[redacted]

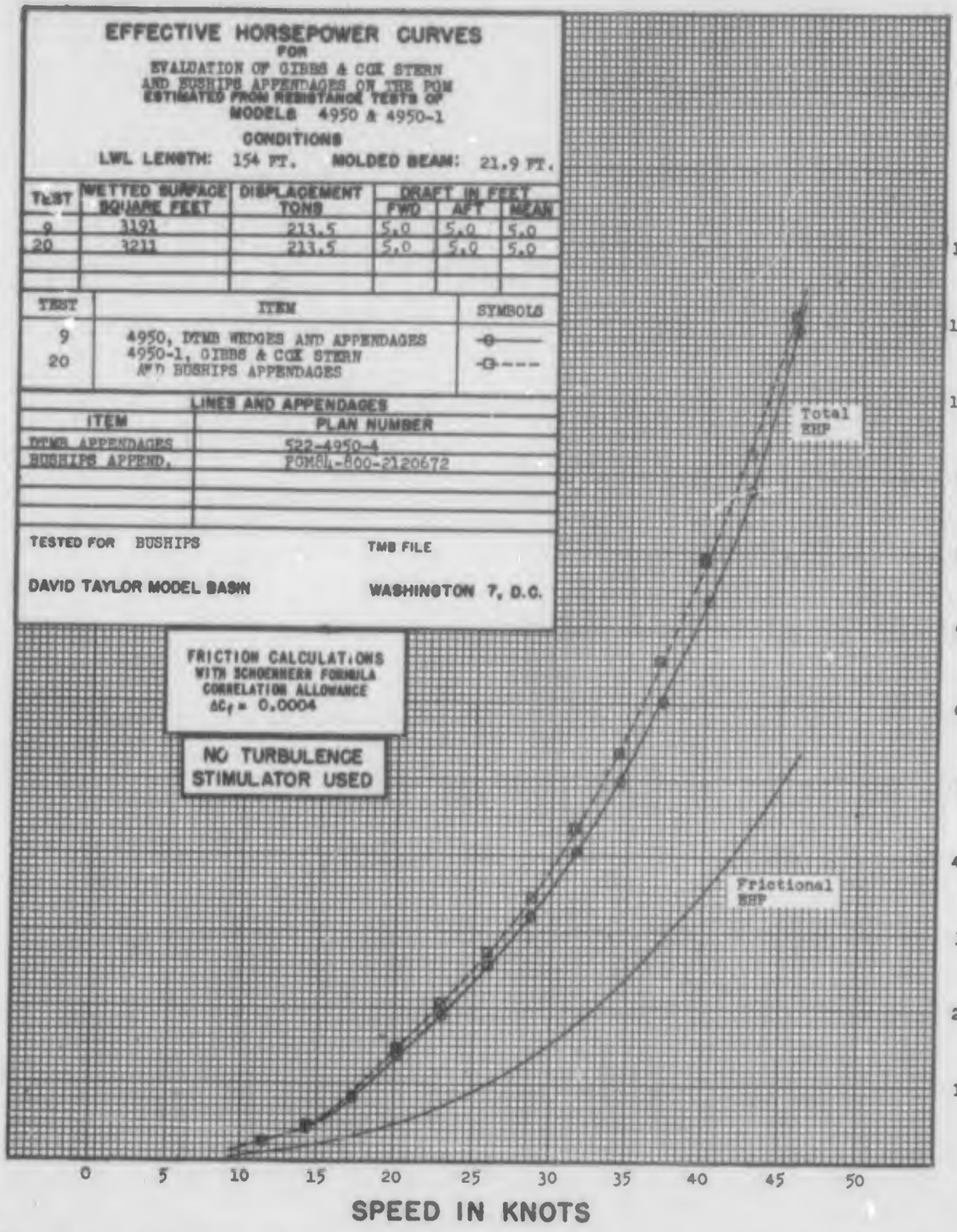

Figure 5 - Effective Horsepower Predictions from Tests of Models 4950 and 4950-1

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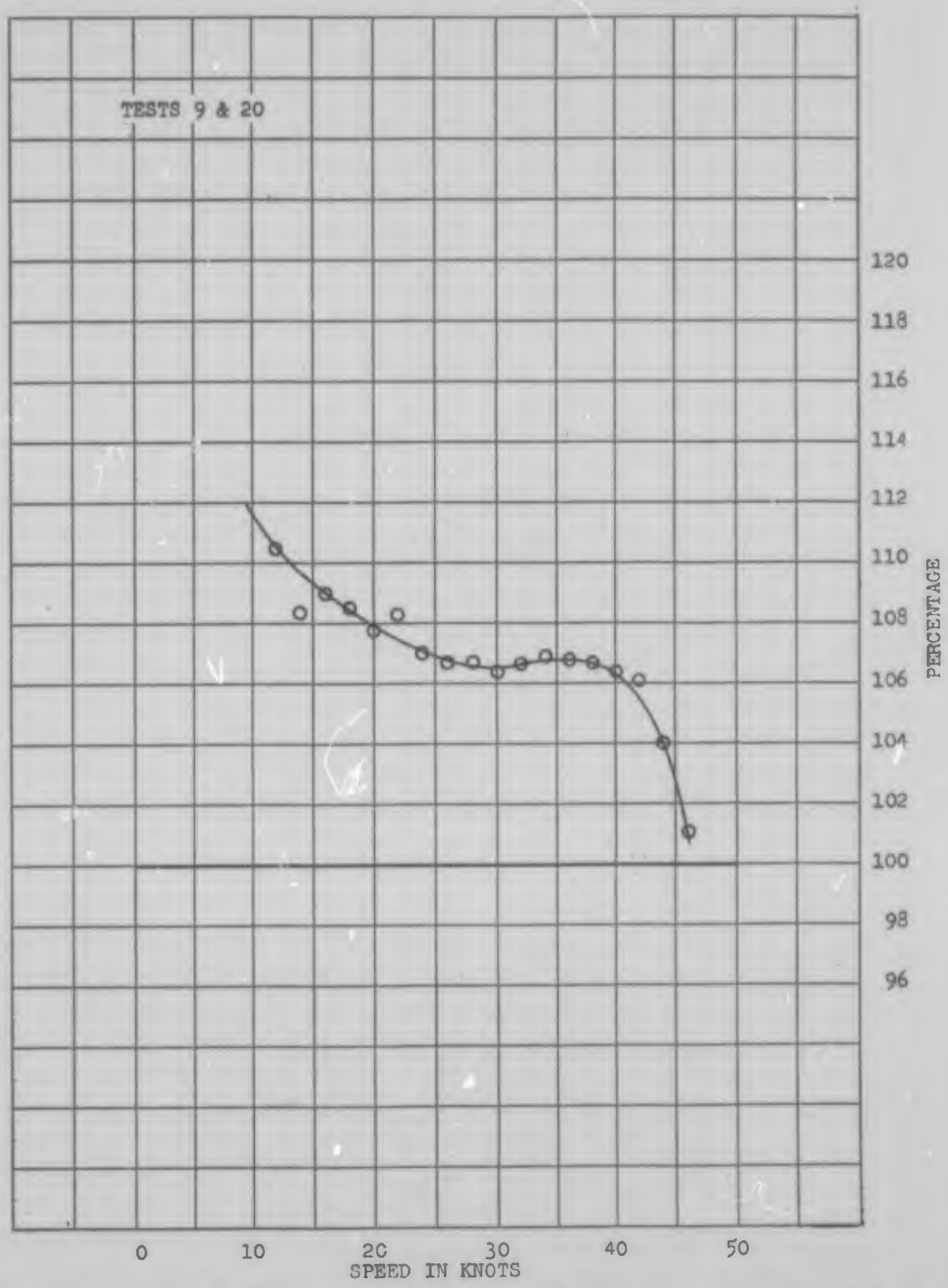

Figure 6 - EHP for the Gibbs & Cox Stern and Bureau of Ships Appendages As a Percentage of That for the Model Basin Design of the PGM

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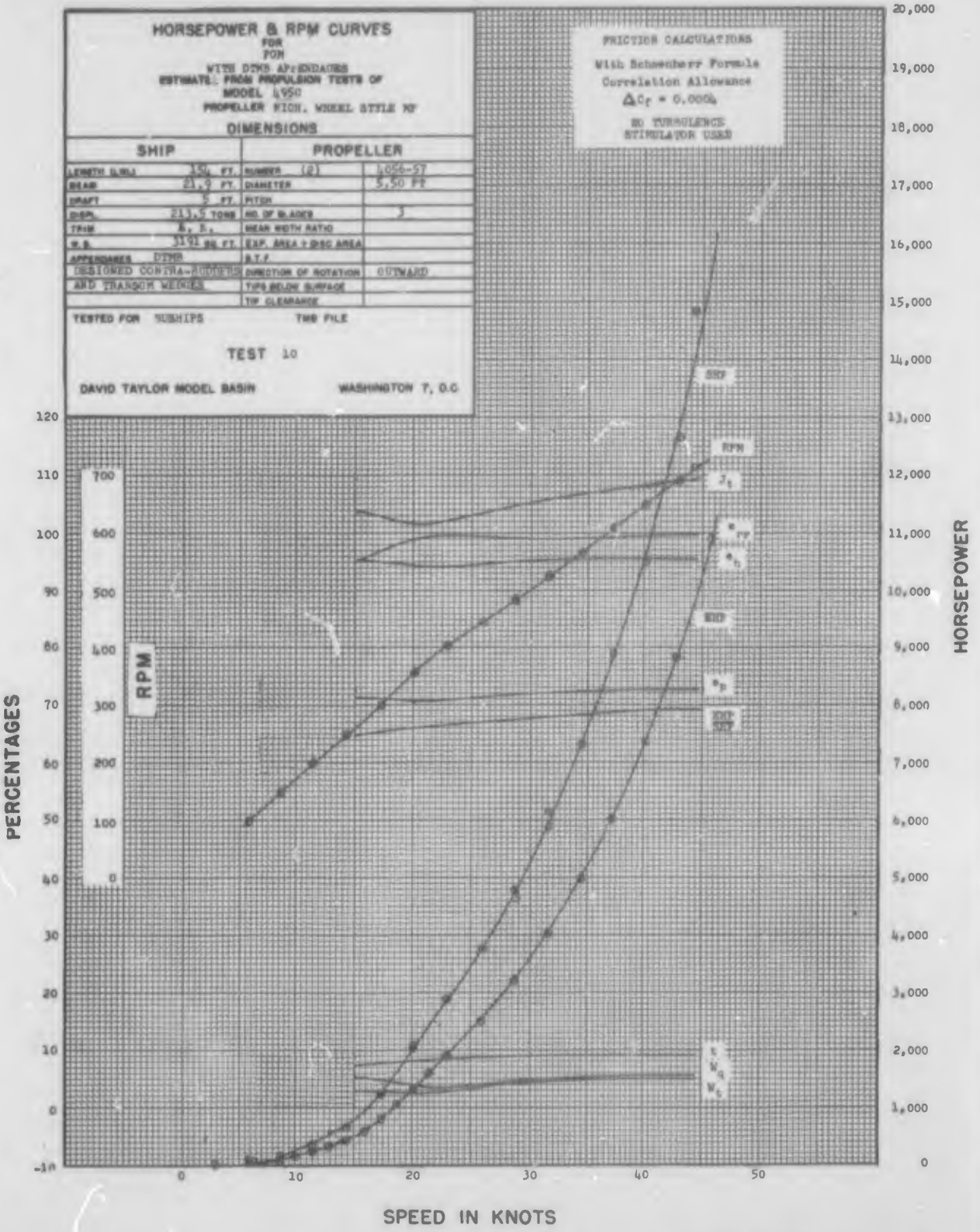

Figure 7 - Propulsive Predictions from Tests of Model 4950

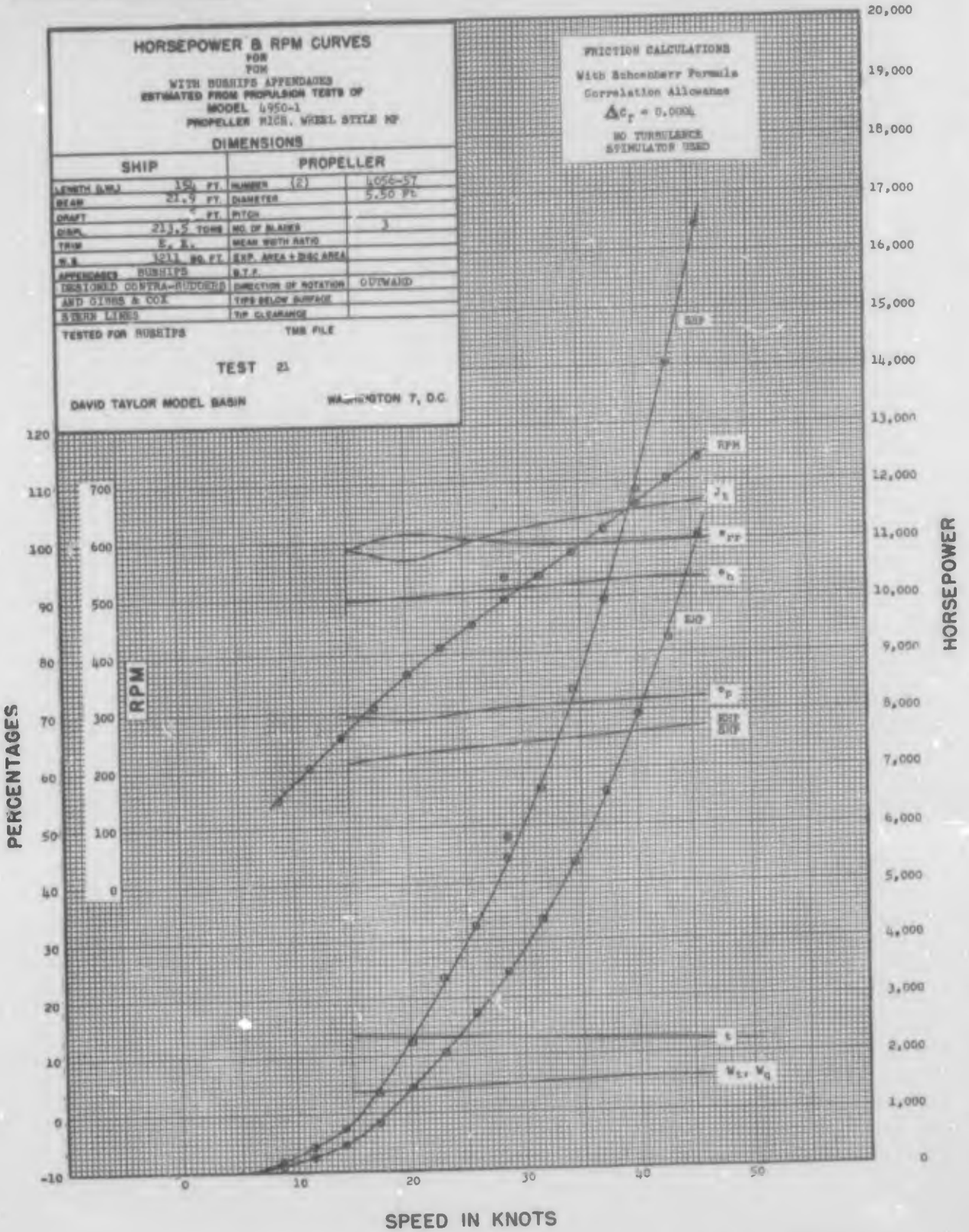

Figure 8 - Propulsive Predictions from Tests of Model 4950-1

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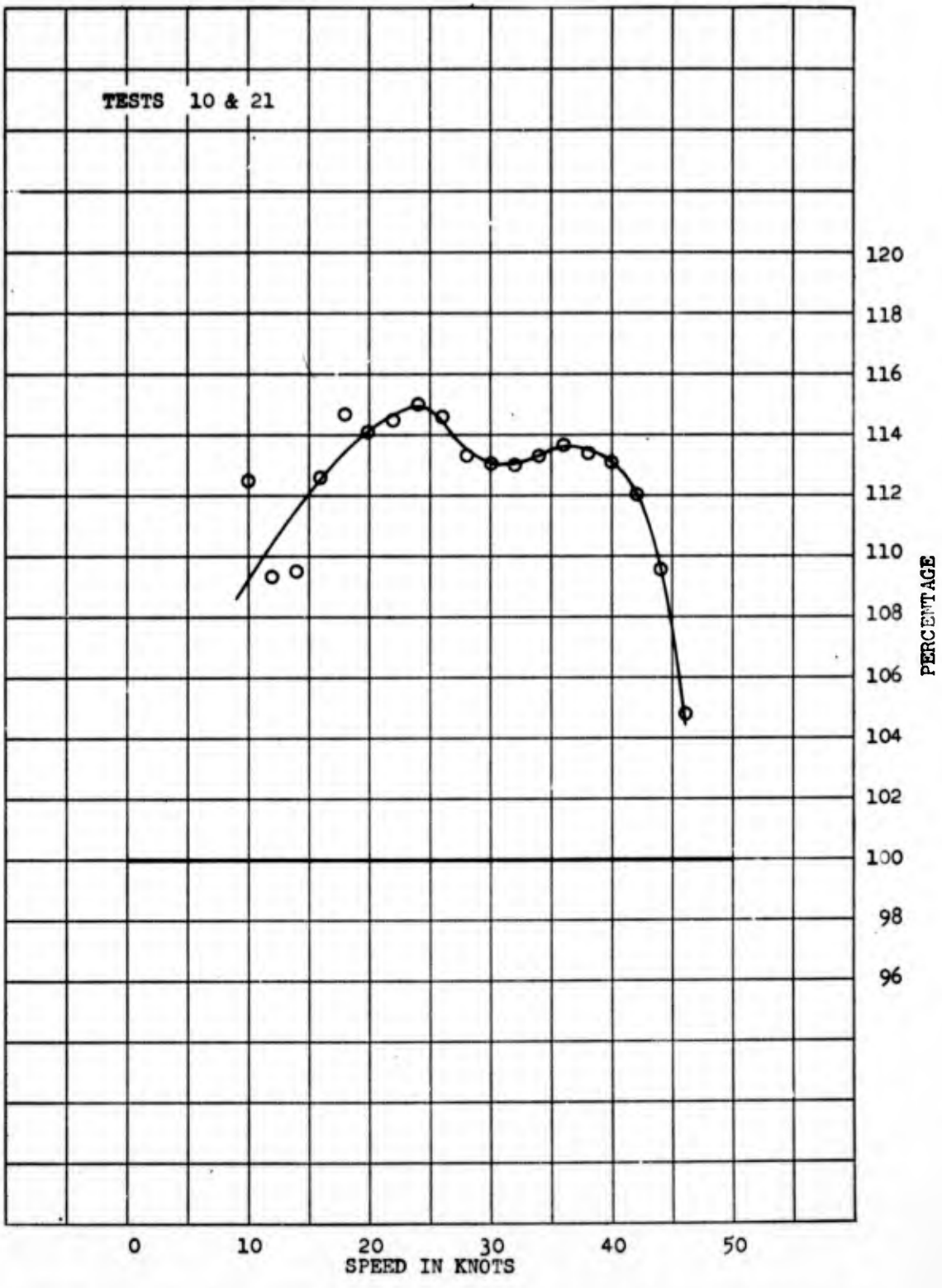

Figure 9 - SHP for Gibbs & Cox Stern and Bureau of Ships Appendages As a Percentage of SHP for Model Basin Design

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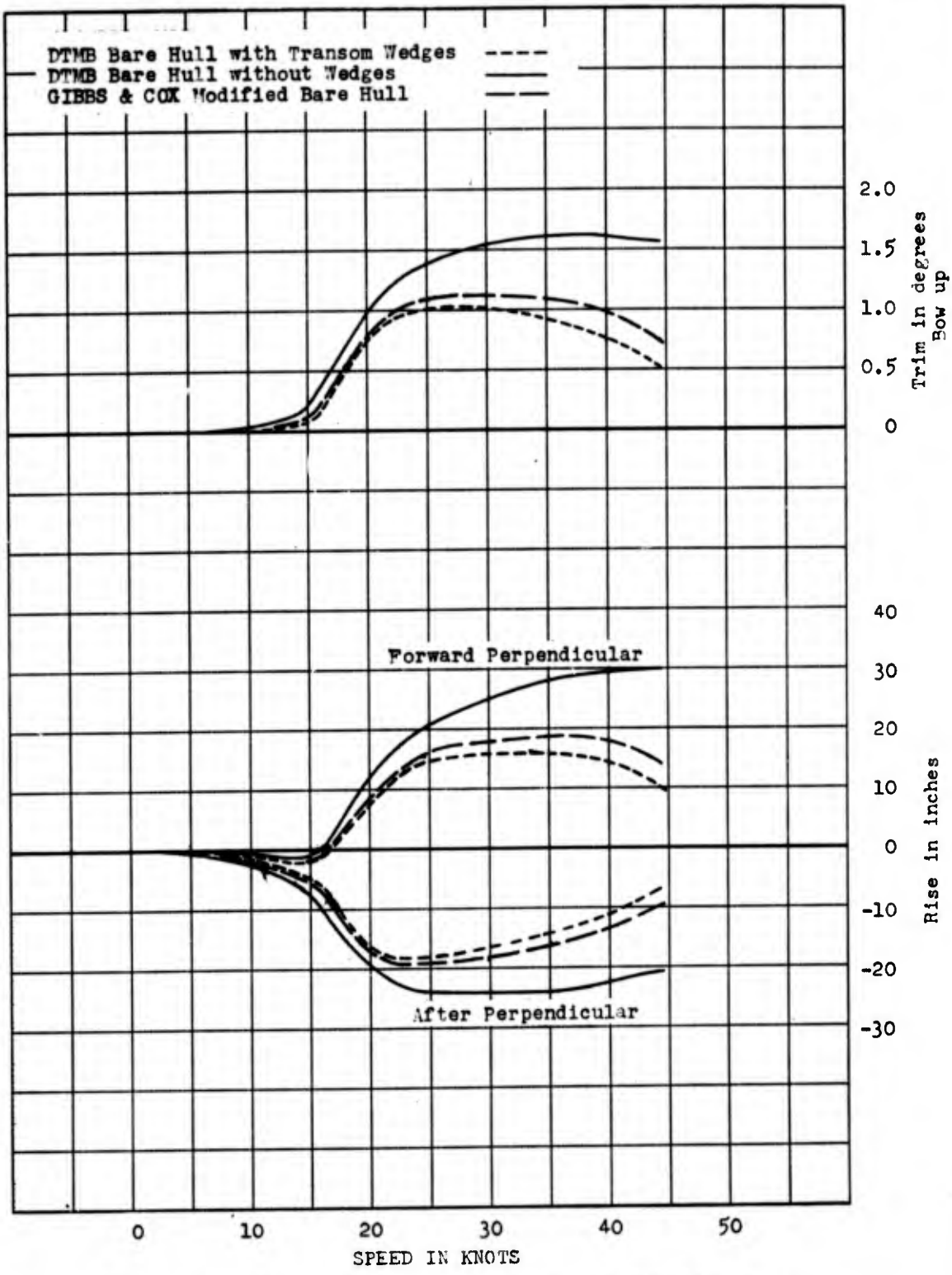

Figure 10 - Rise and Trim Comparisons of PGM Bare Hull with Gibbs & Cox and Model Basin Sterns

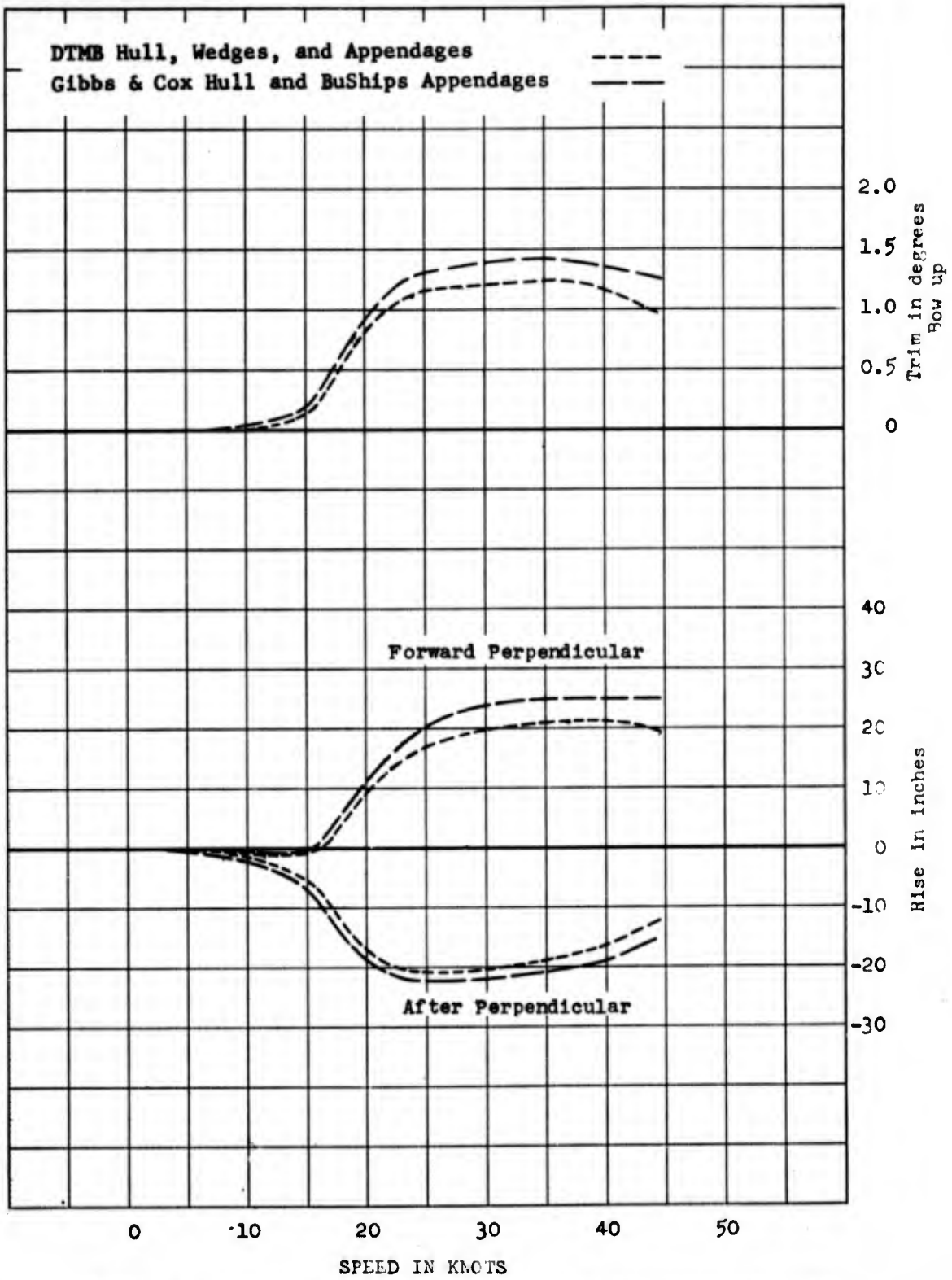

Figure 11 - Rise and Trim Comparisons of Fully Appended PGM with Gibbs & Cox and Model Basin Sterns and Appendages

REFERENCES

1. David Taylor Model Basin Drawing No. 522-4950-05, Model 4950-1, Gibbs & Cox Stern Line Modifications of PGM 84.

2. David Taylor Model Basin Drawing No. 522-4950-06, Model 4950-1 Bureau of Ships Contraguide Appendages for PGM 84.

3. Hoekzema, D., "Powering Characteristics for a 154-Foot High-Speed PGM from Tests of Models 4932, 4942, and 4950 (U)," David Taylor Model Basin Report C-1652 (Apr 1964) [redacted].

4. 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).

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2. Gunboats--Propulsion--Model tests
3. Gunboats--Resistance--Model tests
4. Transom wedges--Applications--Model tests
5. Ship models--Model TMB 4950 and 4950-1
6. PGM 84 (U.S. gunboat)
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