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DEPARTMENT OF THE NAVY
DAVID TAYLOR MODEL BASIN

HYDROMECHANICS

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MODIFICATIONS TO STABILIZE THE "O" TYPE, SIZE 5, MINESWEEPING DEPRESSOR

by

Peter K. Spangler

[redacted]

REVISED EDITION

HYDROMECHANICS LABORATORY

RESEARCH AND DEVELOPMENT REPORT

DECEMBER 1960 REPORT 1475

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ABSTRACT

Tests were conducted in the Towing Basin at the David Taylor Model Basin to determine a suitable method of stabilizing the "O" Type, Size 5, Kite-Otter when used as a depressor. Corrective modifications were made and their effectiveness in subsequent towing tests was verified. The modified depressor towed in a satisfactory manner over a 0-to 10-knot speed range with slightly less cable tension than the standard depressor.

INTRODUCTION

The Bureau of Ships requested[1] the David Taylor Model Basin to determine the cause of instability and erratic operation of the "O" Type, Size 5, Kite-Otter when used as a depressor. This equipment has been reported by the Mine Forces to operate in an erratic and unstable manner during moored minesweeping operations. The purpose of this project was to determine the modifications required to stabilize the depressor.

Various hydrodynamic tests were conducted on the depressor and the preliminary results were reported to the Bureau in Reference 2. This report presents the final results of the hydrodynamic tests and describes the corrective actions which were taken to stabilize the depressor. A graph to show the amount of corrective ballast weight required as a function of operating speed is given and curves showing the effect of this weight on the towline tension and angle are included.

BASIN TESTS AND RESULTS

The initial tests were conducted with the standard depressor shown in Figure 1. The tow bridle was adjusted with the turnbuckle so that the vanes of the depressor were horizontal when suspended from the towing ring. The depressor was streamed on 16 feet of 5/16-inch cable from a towpoint 3 feet above the water surface. When towed in the speed range from 0 to 9 knots the depressor kited to port or to starboard depending on the towing speed. The greatest amount of kiting occurred at the higher speeds and the depressor broached the surface at a speed of 9 knots.

Additional tests were then conducted to investigate the effect of various adjustments of the tow bridle on the towing characteristics of the depressor. It was found that 1-inch difference in length between the two forward legs of the bridle caused the depressor to kite to the side with the shorter leg

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[1] References are listed on page 10

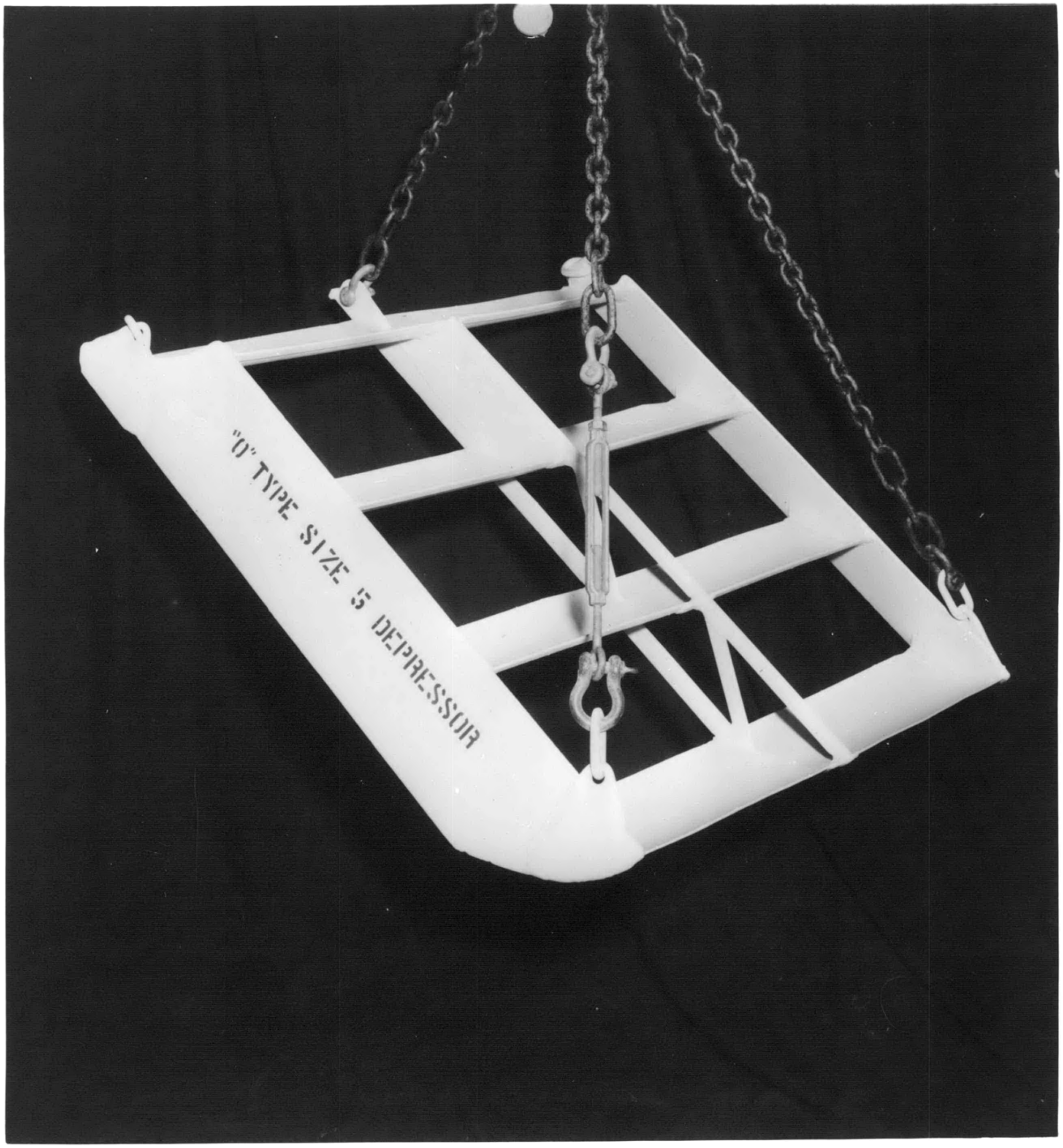

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Figure 1 - The Standard, "O" Type, Size 5 Depressor

and broach the surface at approximately 4 knots. At higher speeds, the towing characteristics were found to be extremely sensitive to small changes in the bridle adjustment. Consequently, a set consisting of three pairs of lead ballast weights was made to fit the inside of the forward vane to increase the metacentric stability of the depressor. The weights could be attached to the depressor either independently or in combinations. Figures 2, 3, and 4 show the depressor with 1, 2, and 3 pairs of weights installed, respectively. Each pair weighed approximately 12.3 pounds in air and was attached with two bolts that passed through the vane from the outside. A locking nut was added to the turnbuckle to reduce the possibility of disturbing the static horizontal trim when towing and handling.

With one pair of ballast weights installed and the tow bridle adjusted correctly, the depressor towed properly and was stable at speeds up to 6 knots, but would kite at higher speeds. With two pairs of ballast weights installed, a speed of 9 knots was successfully reached; and with three pairs installed, the depressor towed properly to 10 knots. Figure 5 summarizes these test results graphically and indicates the amount of recommended ballast which should be installed on the depressor as a function of the operating speed. The curve of recommended ballast was drawn to allow a leeway of approximately one knot from the minimum allowable ballast determined from the basin tests. It is felt that this recommended ballast will insure satisfactory operation of the equipment under any operating conditions which would normally be encountered at sea. The amount of ballast selected should be divided in half and each half installed in the outer ends of the forward vane of the depressor. With the proper amount of ballast installed, the tow bridle should be adjusted so that the leading edges of the vanes are horizontal within ±0.5 degree when the depressor is suspended from the towing ring. After the bridle is adjusted, it should be locked in place to prevent a change in the adjustment when towing and handling.

Further tests were then made to determine the sensitivity of the fully ballasted depressor to changes in adjustment of the tow bridle. With one of the forward legs of the bridle shortened by one inch, the depressor kited badly above 5 knots but remained submerged throughout the speed range. In comparison with the standard depressor, the fully ballasted depressor kited only 2 feet to the side at a speed of 4 knots, while the unballasted version would broach the surface.

The addition of ballast to the depressor had a small effect on the towline tension and negligible effect on the towline angle at the water surface. The towline tension at the water surface as a function of speed for the modified and unmodified depressor is shown in Figure 6 and the towline angle is shown in Figure 7. It can be seen from Figure 6 that the largest reduction in towline tension occurs with all the ballast installed and amounts to approximately 7 percent at a speed of 10 knots.

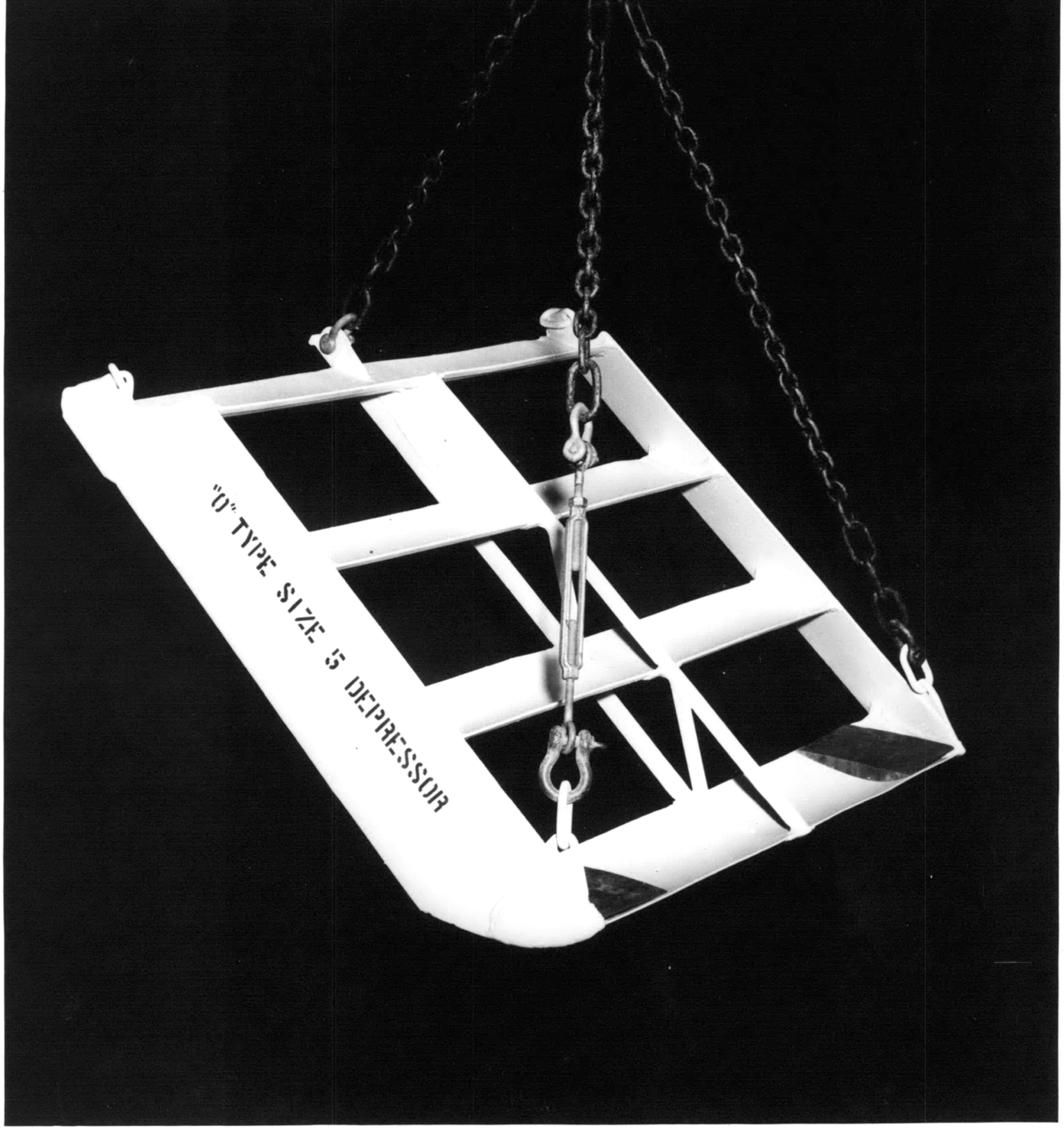

Figure 2 - The Depressor with 11.6 Pounds of Ballast in the Forward Yane

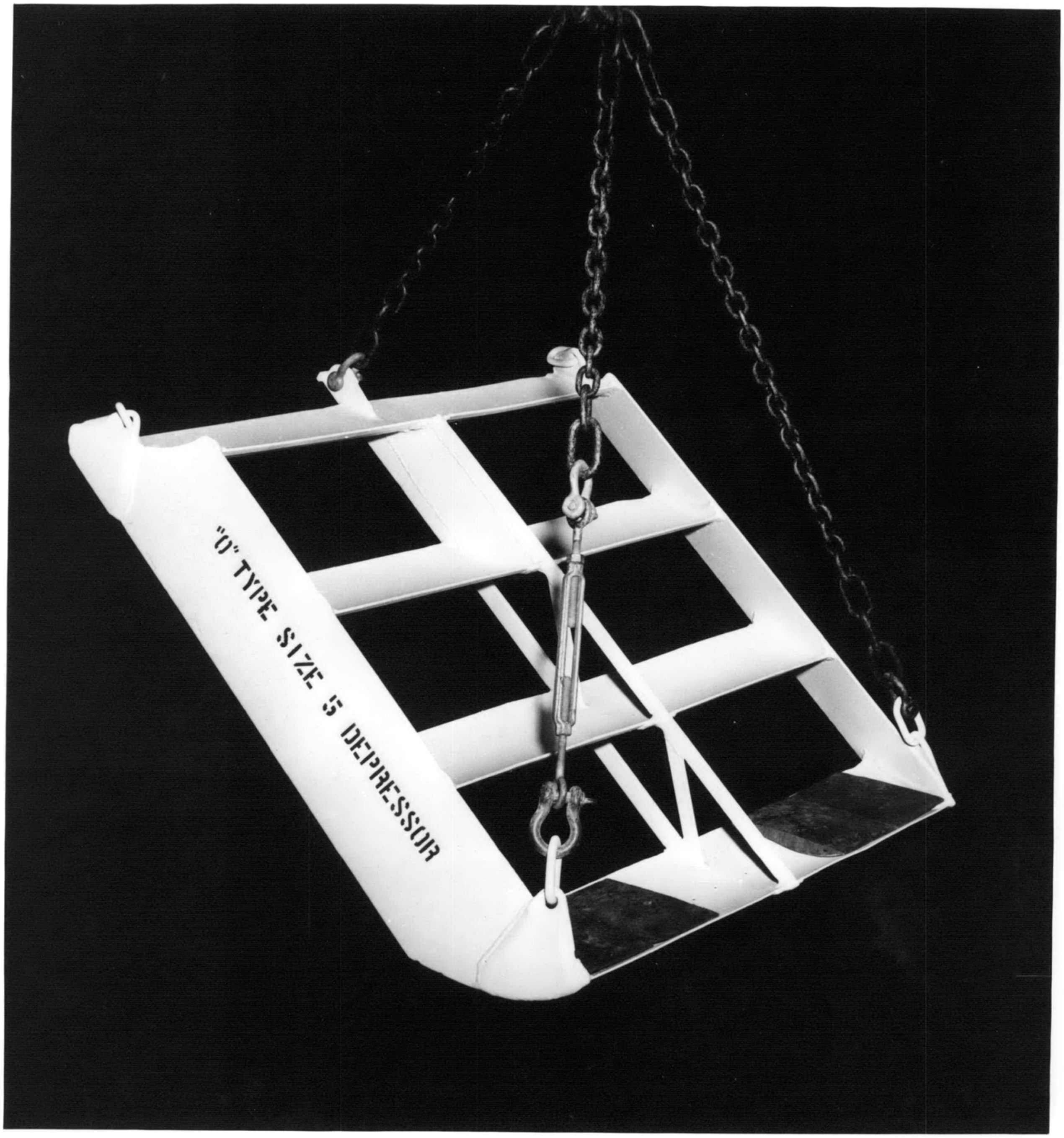

Figure 3 - The Depressor with 24.8 Pounds of Ballast in the Forward Vane

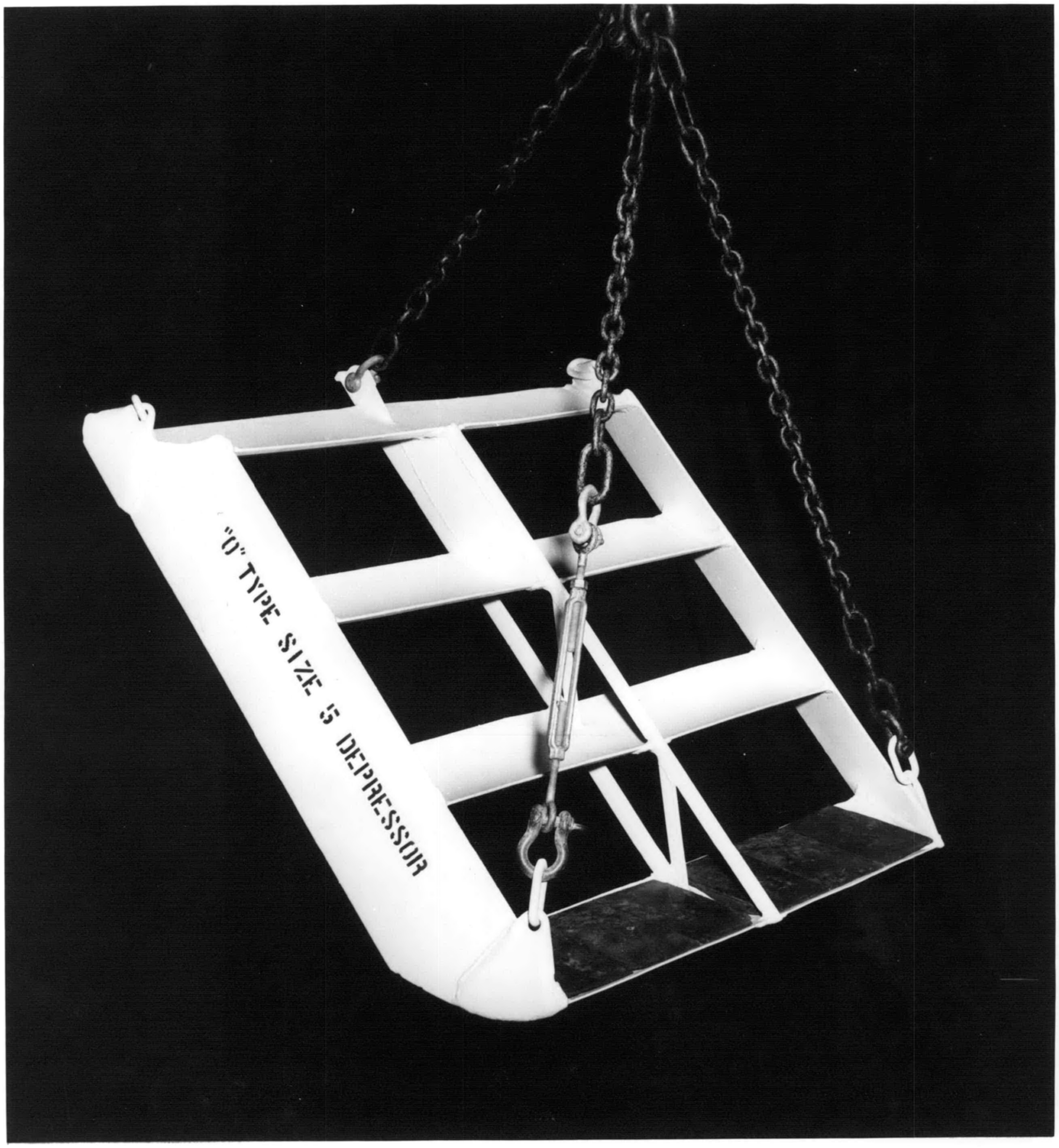

Figure 4 - The Depressor with 36.9 Pounds of Ballast in the Forward Vane

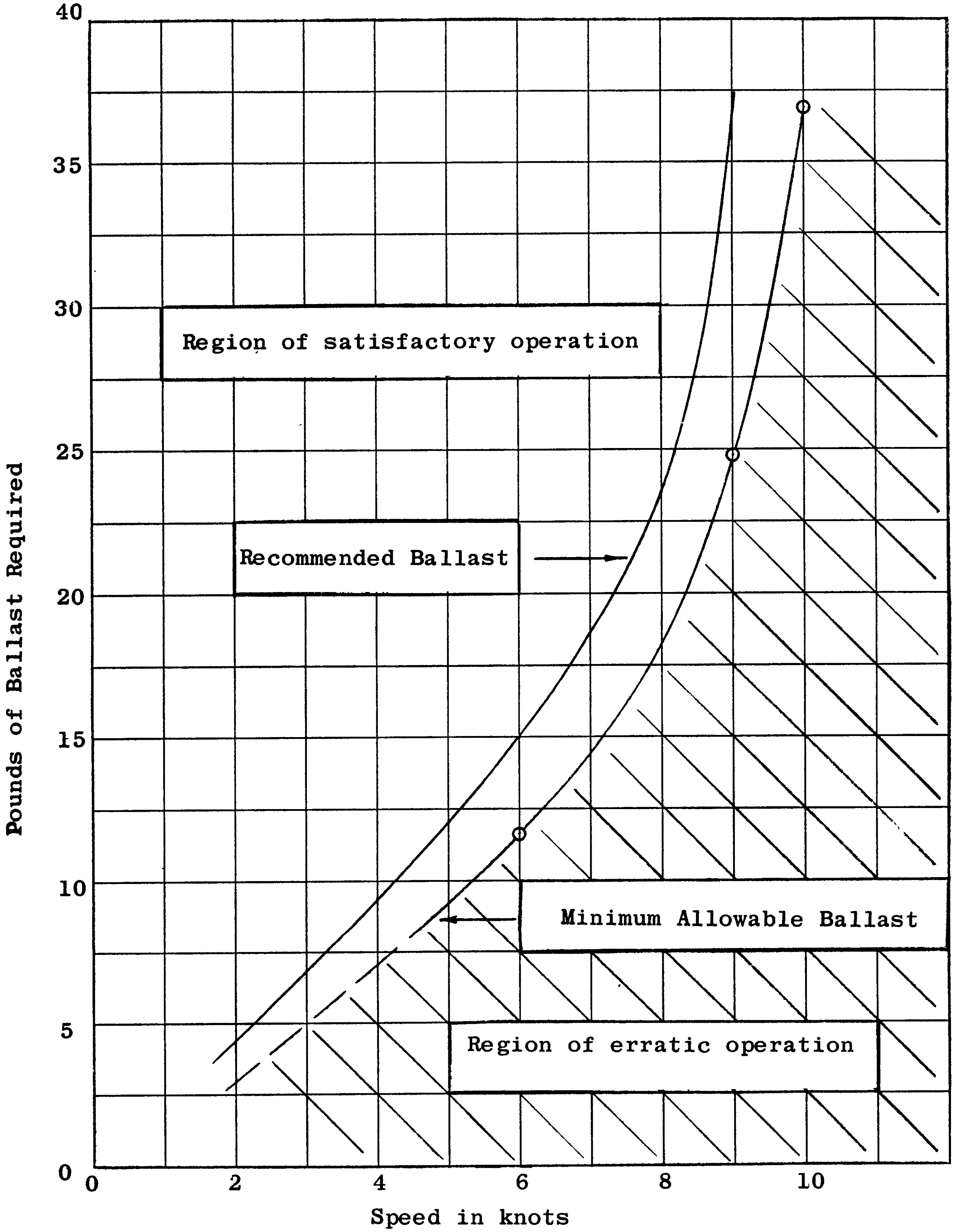

Figure 5 - Pounds of Ballast Recommended at Various Operating Speeds

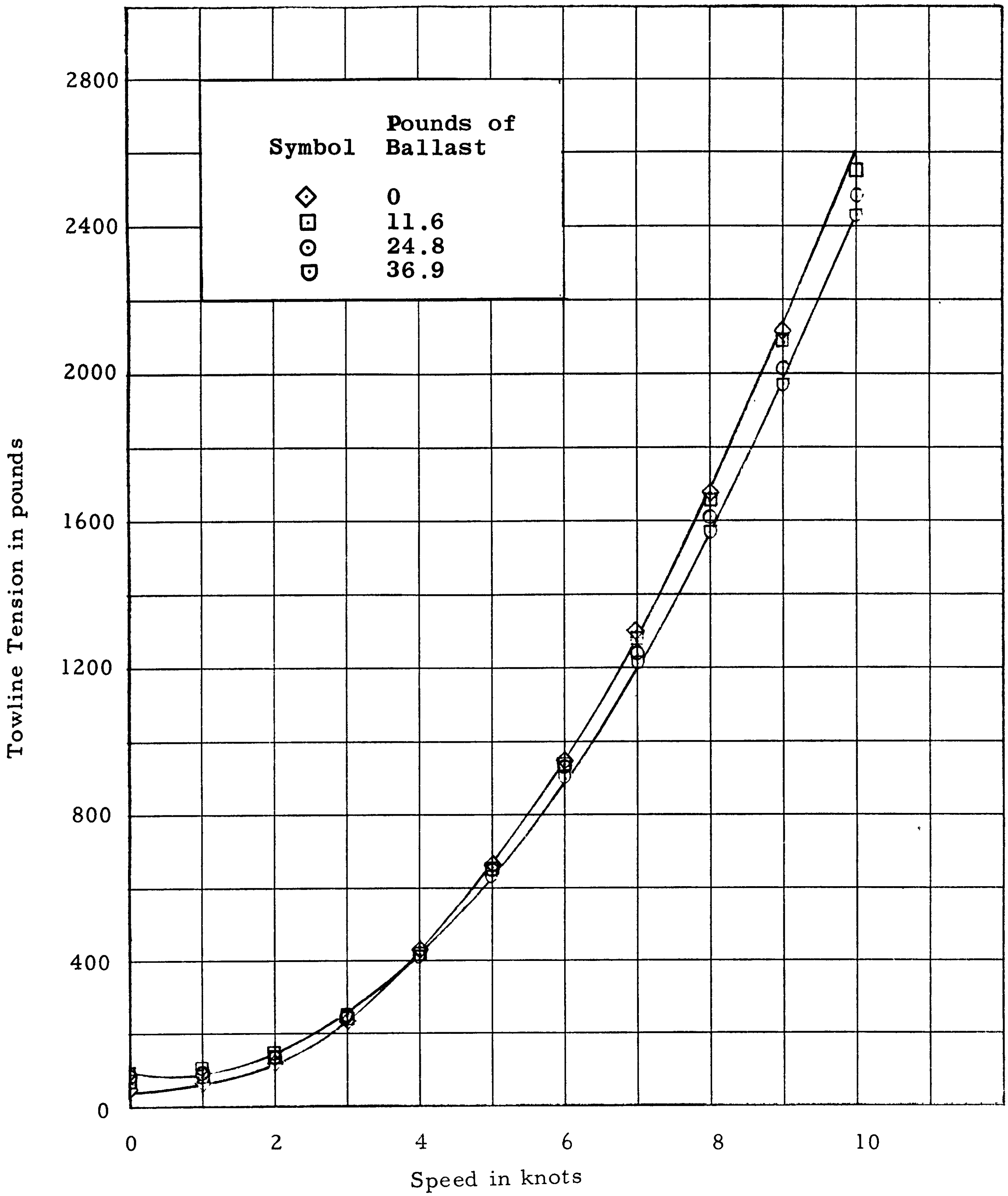

Figure 6 - Towline Tension as a Function of Speed

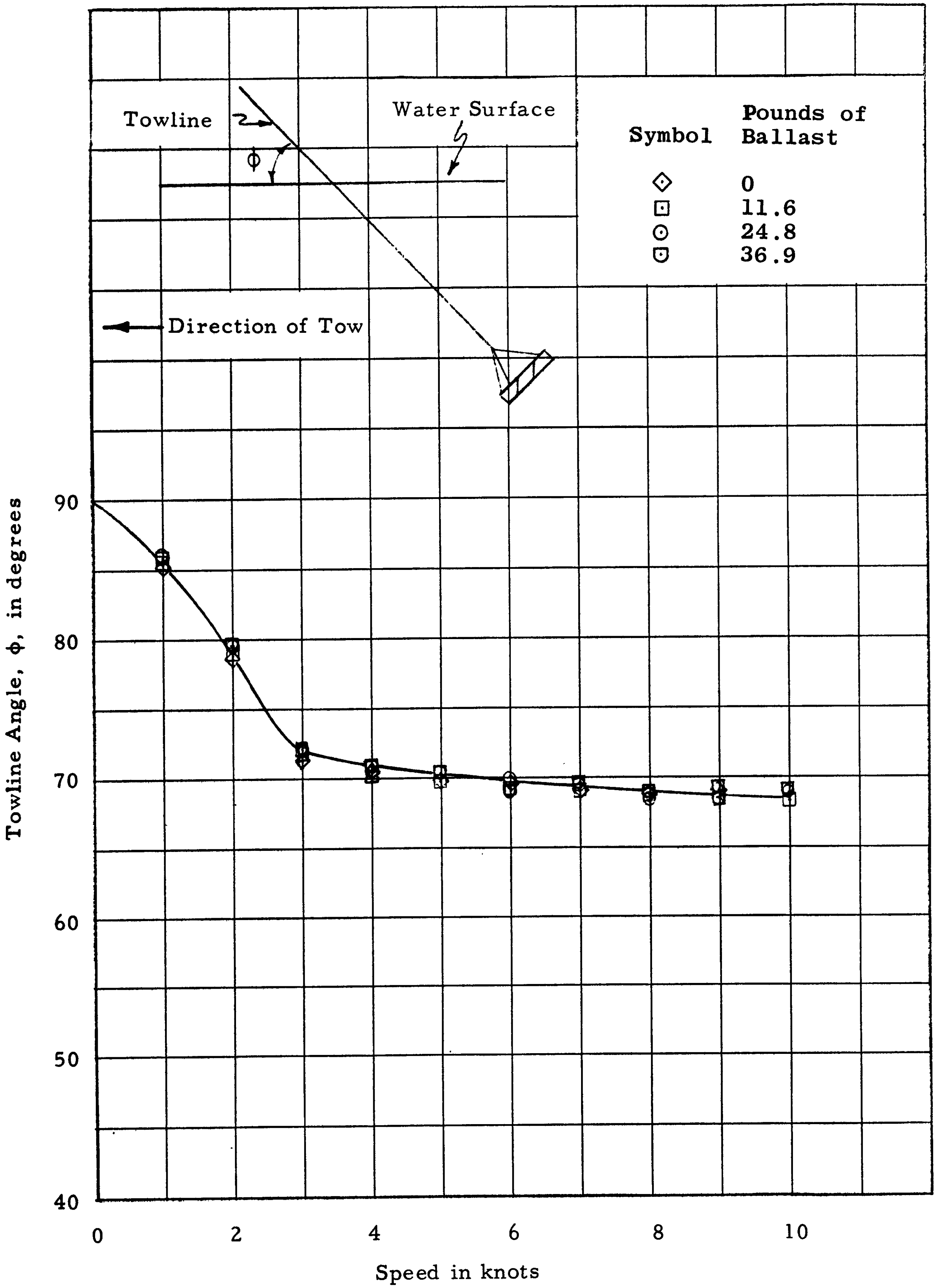

Figure 7 - Towline Angle, φ, as a Function of Speed

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the standard depressor is over-sensitive to the tow bridle adjustment. With the addition of suitable ballast weights to increase the metacentric stability, the sensitivity of the bridle adjustment can be brought within workable limits and the depressor will tow in a satisfactory manner at speeds up to 10 knots. The weight of the ballasted depressor assembly in the configuration suitable for a 6-knot operating speed is 82 pounds, an increase of 15 pounds over the present weight. However, since the "O" Type, Size 5 Float assembly weighs 96.5 pounds and is handled by the same methods as the depressor, the increase in the weight of the depressor should present no new handling problems. It is therefore recommended that the modifications and procedures described in this report be incorporated in the equipment presently in use by the Mine Forces.

REFERENCES

1. Bureau of Ships letter F01102 over 9810/1 over Serial 631E-35 of 12 February 1960 to David Taylor Model Basin.

2. David Taylor Model Basin letter 9810.1 over (548:PKS:jw) of 6 June 1960 to Bureau of Ships.

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