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CHARACTERISTICS OF AN NACA 66,S-209 SECTION HYDROFOIL AT SEVERAL DEPTHS

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CONFIDENTIAL BULLETIN

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INTRODUCTION

In order to fulfill a need for information for use in preliminary design of systems of hydrofoils, the NACA has conducted several investigations of the force characteristics of single hydrofoils. The first investigation of this type (reference 1) was made in order to determine the characteristics of hydrofoils of several sections. A second investigation of the effect of dihedral and depth of submersion was reported in reference 2. None of the sections used in the afore-mentioned tests were especially designed for use as hydrofoils. The present report supplements the reference reports and gives the results of tests of a hydrofoil with a section that was specifically designed to meet some of the requirements of high-speed underwater operation. This section, shown in figure 1, has a sharp leading edge and a substantially flat chordwise pressure distribution at a lift coefficient of 0.2. It has been designated the NACA 66,S-209 section.

RESULTS AND DISCUSSION

Figure 1 shows the 5-inch chord by 30-inch span hydrofoil with its supporting struts. Ordinates for the NACA 66,S-209 section hydrofoil are given in table I. Figures 2 to 6 show the results of the tests made with the hydrofoil at various depths and angles of attack. These results are presented as lift and drag coefficients of the standard NACA form plotted as a function of speed, with angle of attack as a parameter. Small arrows on these curves indicate the lowest speed at which cavitation was observed on the upper surface of the hydrofoil at each angle of attack. A summary of the characteristics of the hydrofoil at a depth of 25 inches (5 chords) is given in figure 7.

The drag forces measured during the tests included the windage of the support gear, the drag of the portion of the support struts in the water, the drag due to interference between the struts and the hydrofoil, and the drag of the hydrofoil itself. This measured gross drag was corrected by subtracting the measured tare drag including the drag of the struts and the windage of the gear. The net drag coefficients presented therefore include some interference drag and may be expected to represent drag encountered under conditions with similar intersections of the strut and the hydrofoil.

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REFERENCES

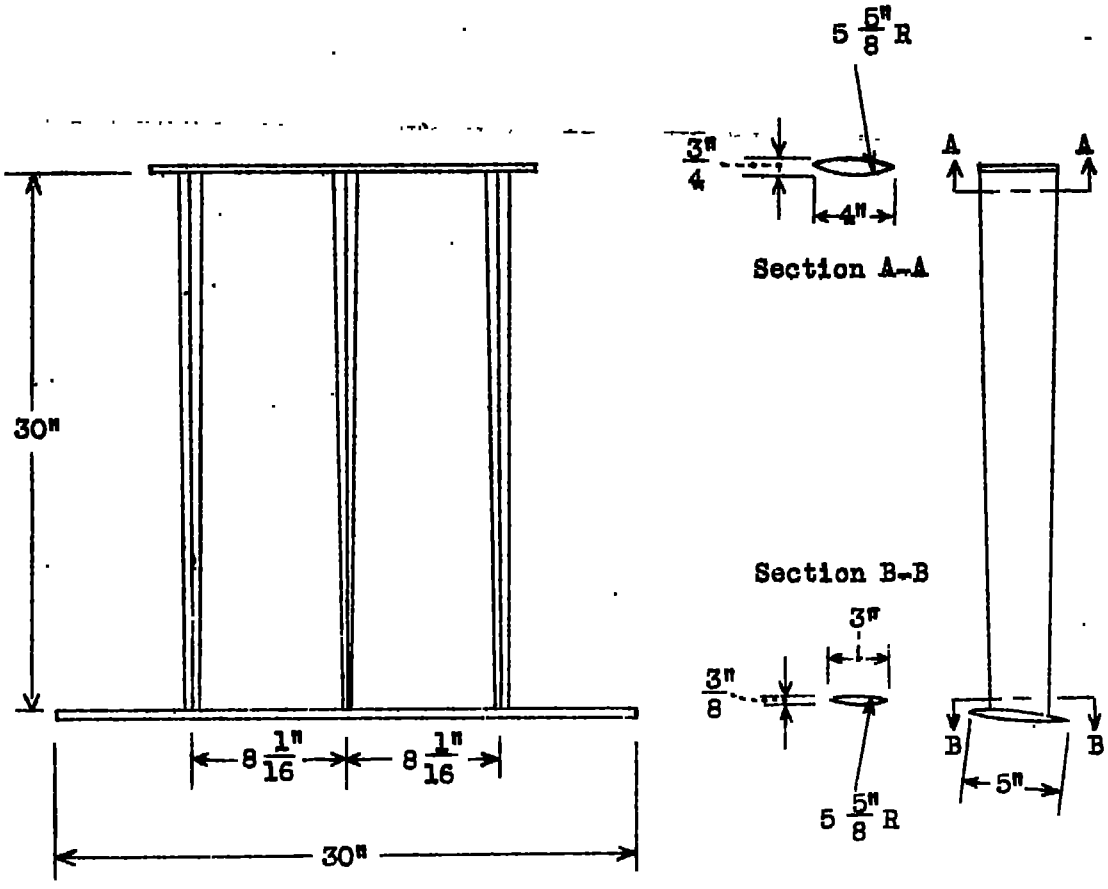
1. Ward, Kenneth E., and Land, Norman S.: Preliminary Tests in the NACA Tank to Investigate the Fundamental Characteristics of Hydrofoils. NACA ACR, Sept. 1940.

2. Benson, James M., and Land, Norman S.: An Investigation of Hydrofoils in the NACA Tank. I - Effect of Dihedral and Depth of Submersion. NACA ACR, Sept. 1942.

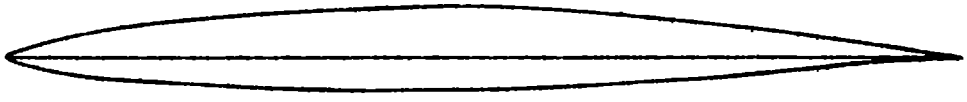
TABLE I

ORDINATES FOR NACA 66,S-209 SECTION HYDROFOIL
[Stations and ordinates in percent of chord]

Upper surface		Lower surface	
Station	Ordinate	Station	Ordinate
0	0	0	0
.476	.333	.524	-.333
.721	.445	.779	-.305
1.212	.655	1.288	-.441
2.444	1.138	2.556	-.766
4.925	1.922	5.075	-1.290
7.417	2.500	7.583	-1.652
9.914	2.970	10.086	-1.936
14.916	3.711	15.084	-2.365
19.923	4.284	20.077	-2.692
24.933	4.728	25.067	-2.938
29.945	5.079	30.055	-3.135
34.958	5.331	35.042	-3.271
39.971	5.498	40.029	-3.356
44.986	5.590	45.014	-3.400
50.000	5.576	50.000	-3.370
55.014	5.466	54.986	-3.276
60.027	5.239	59.973	-3.097
65.038	4.898	64.962	-2.838
70.046	4.414	69.954	-2.470
75.051	3.806	74.949	-2.016
80.051	3.092	79.949	-1.500
85.045	2.295	84.955	-.949
90.033	1.495	89.967	-.425
95.016	.664	94.984	-.032
100.000	0	100.000	0



Hydrofoil and support struts



Full-size section of test hydrofoil

Figure 1.- Sketch of hydrofoil and its support struts.

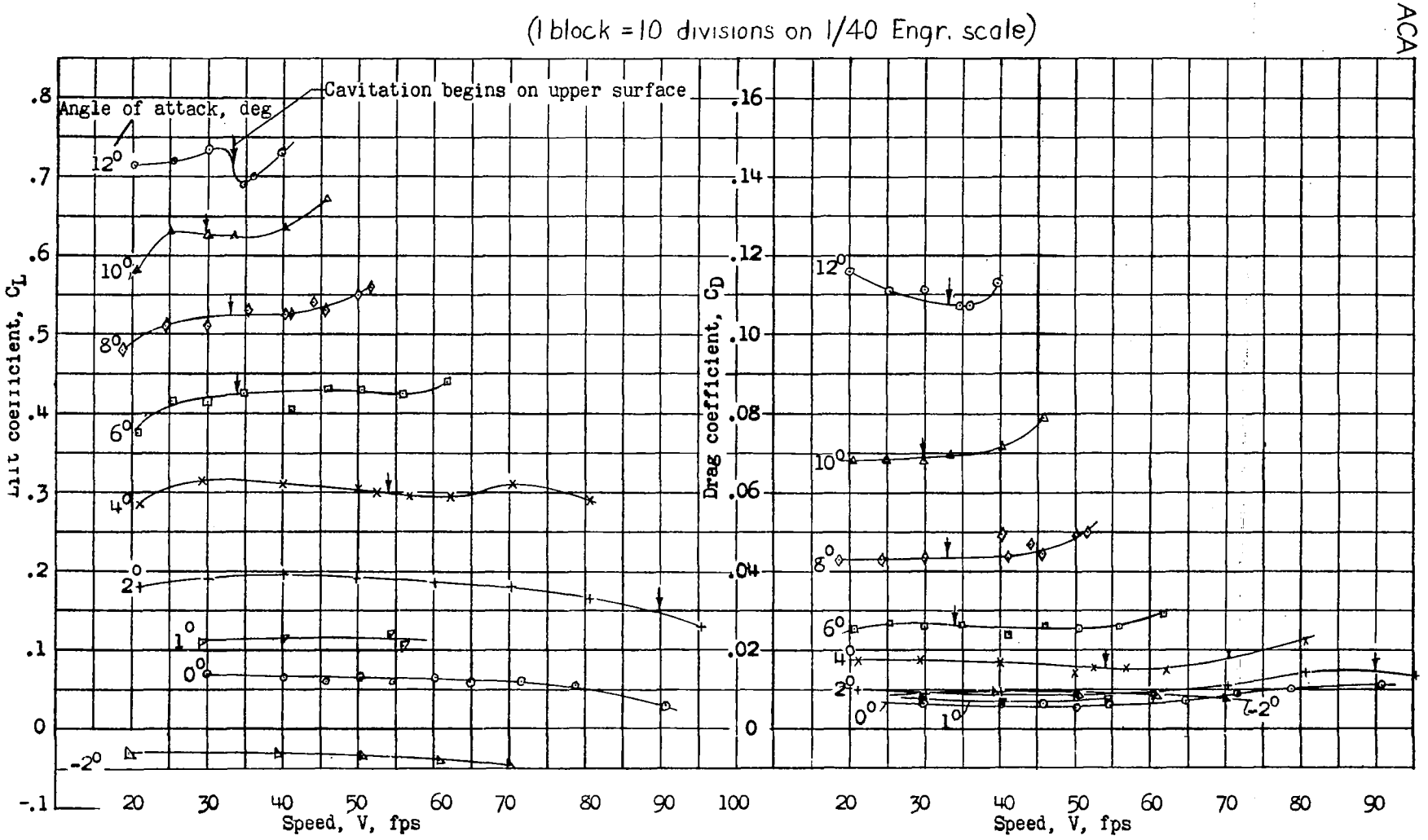


Figure 2.- NACA 66, S-209 section hydrofoil. Depth = 1/2 chord.

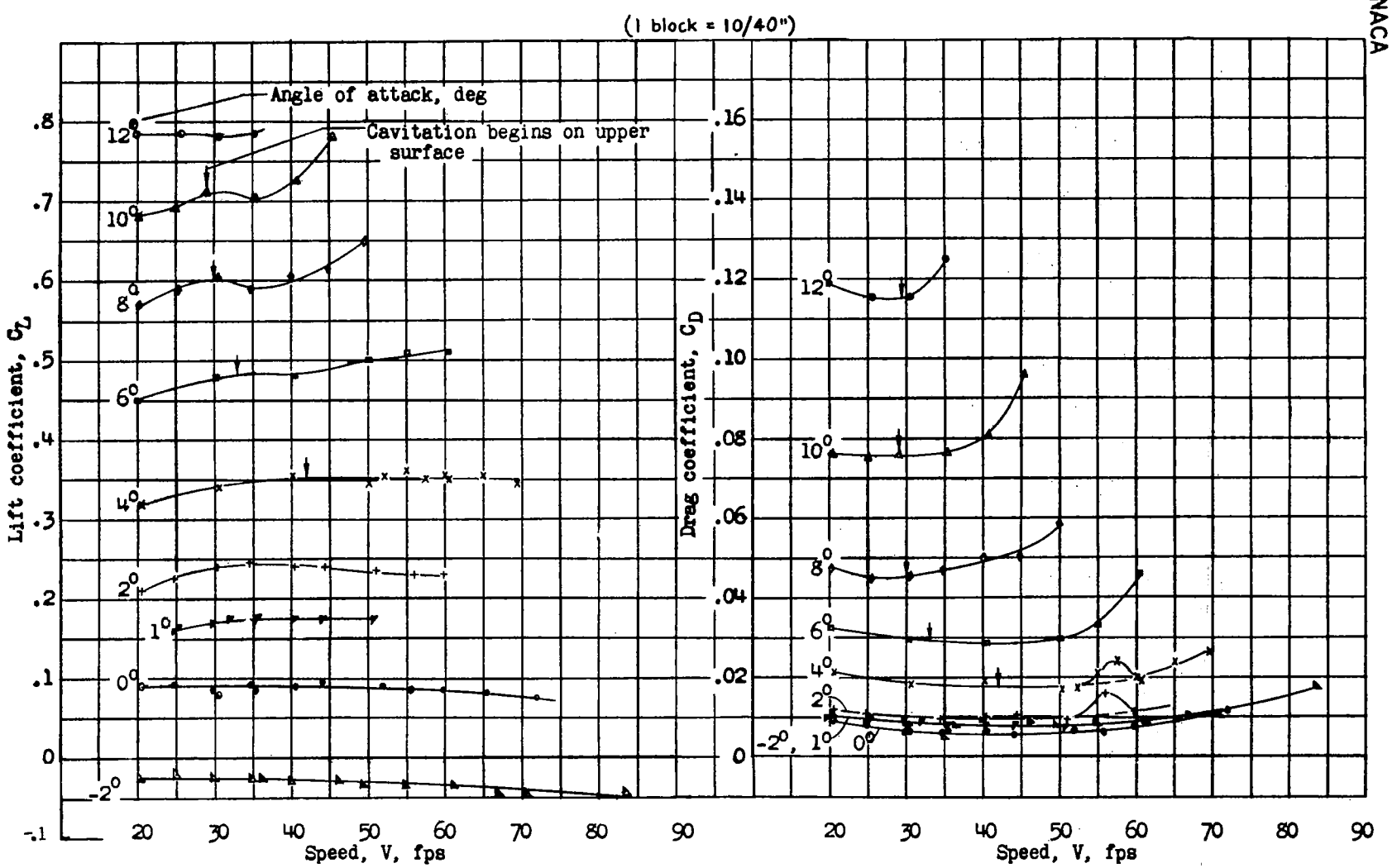


Figure 3.- NACA 66, S-209 section hydrofoil. Depth = 1 chord.

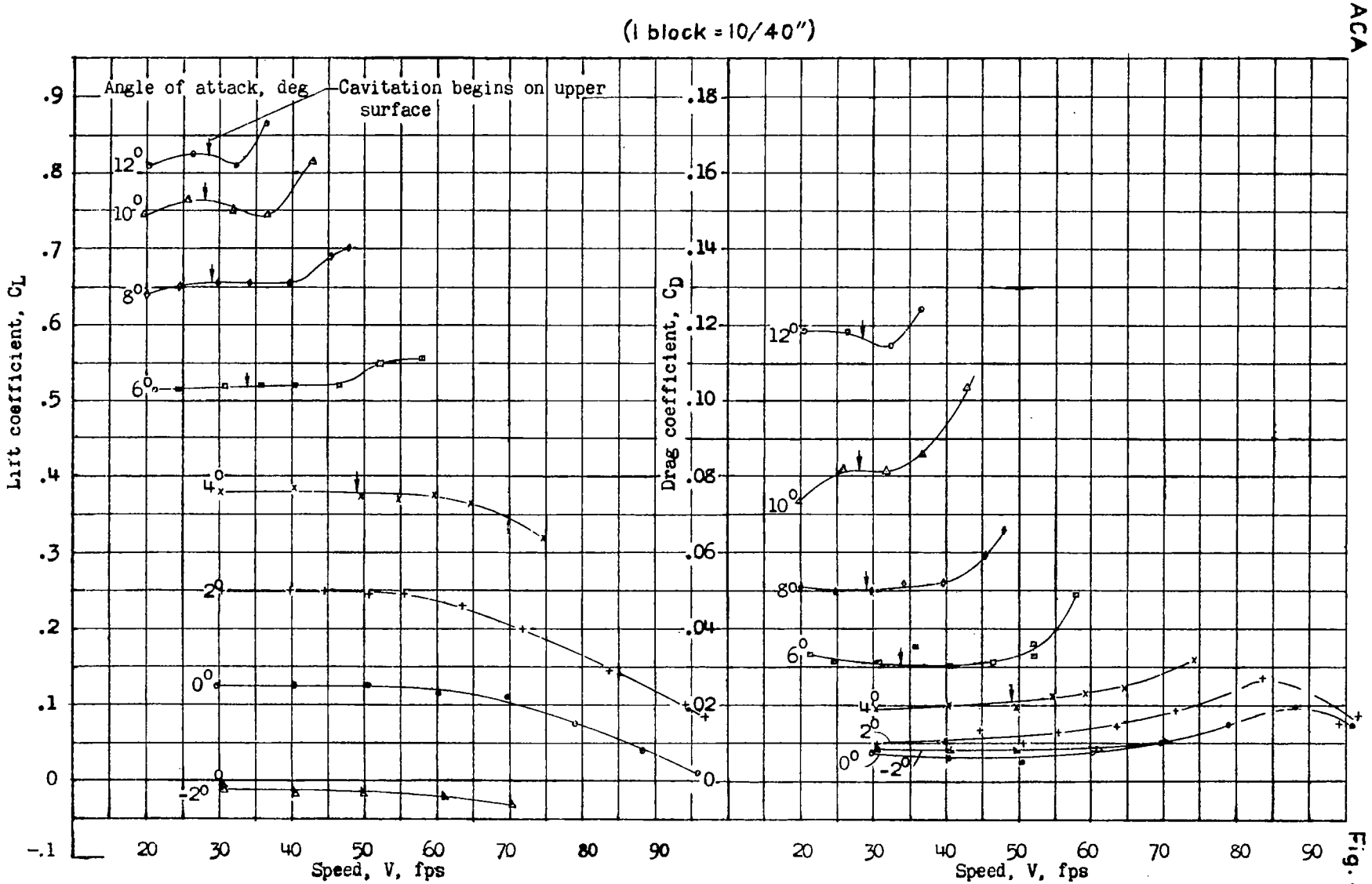


Figure 4.- NACA 66, S-209 section hydrofoil. Depth = 2 chords.

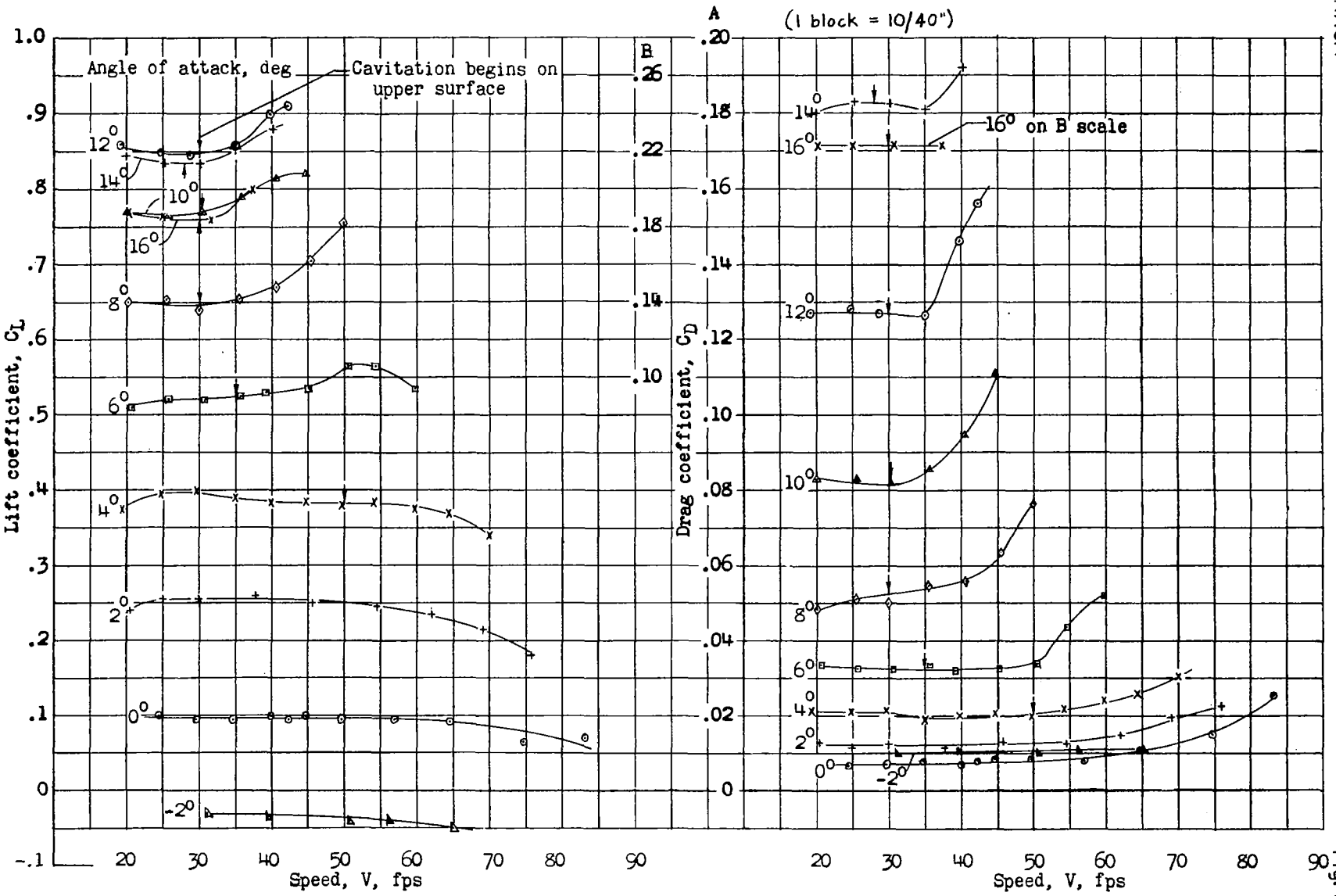


Figure 5.- NACA 66, S-209 section hydrofoil. Depth = 3 chords.

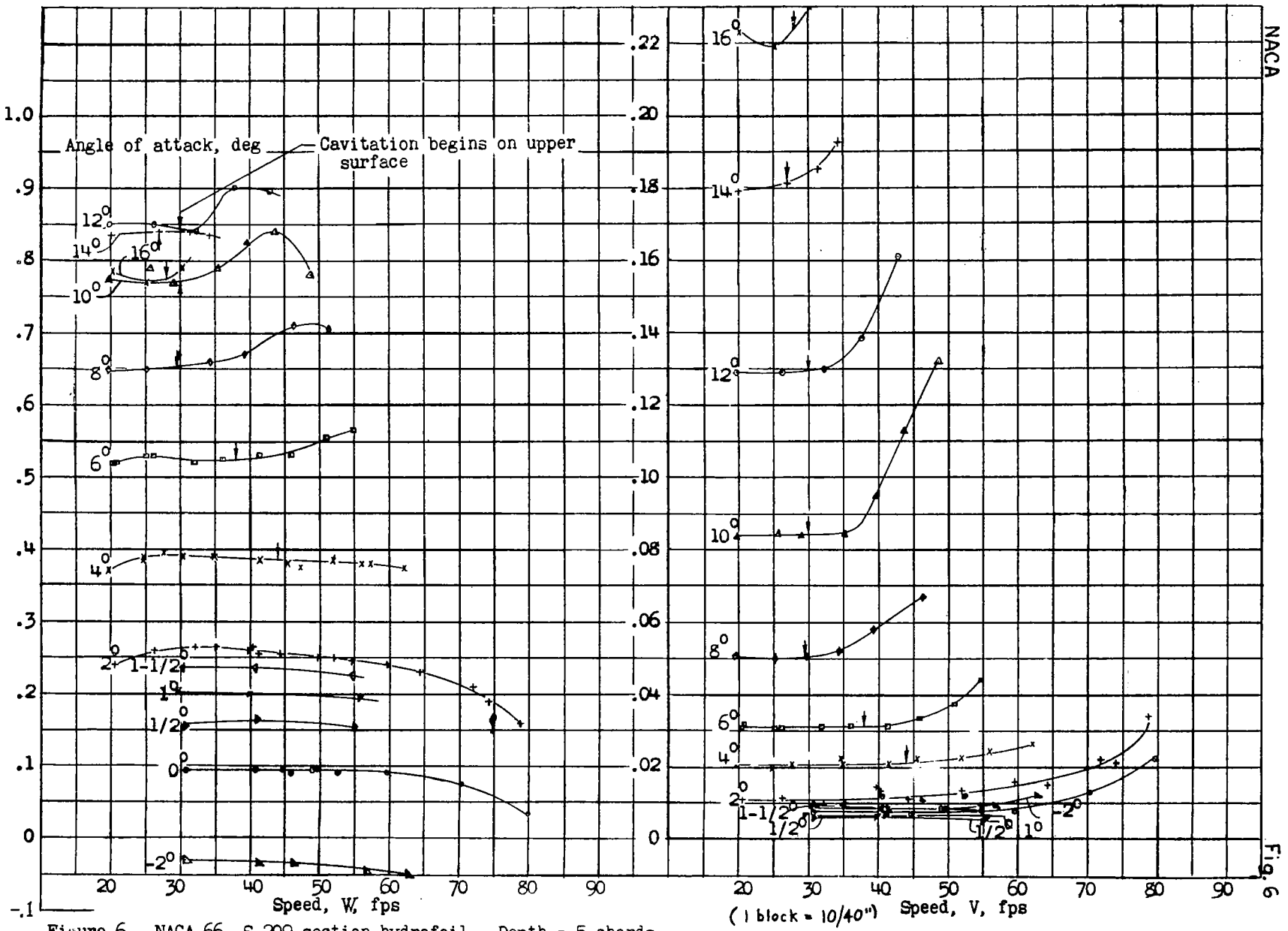


Figure 6.- NACA 66, S-209 section hydrofoil. Depth = 5 chords.

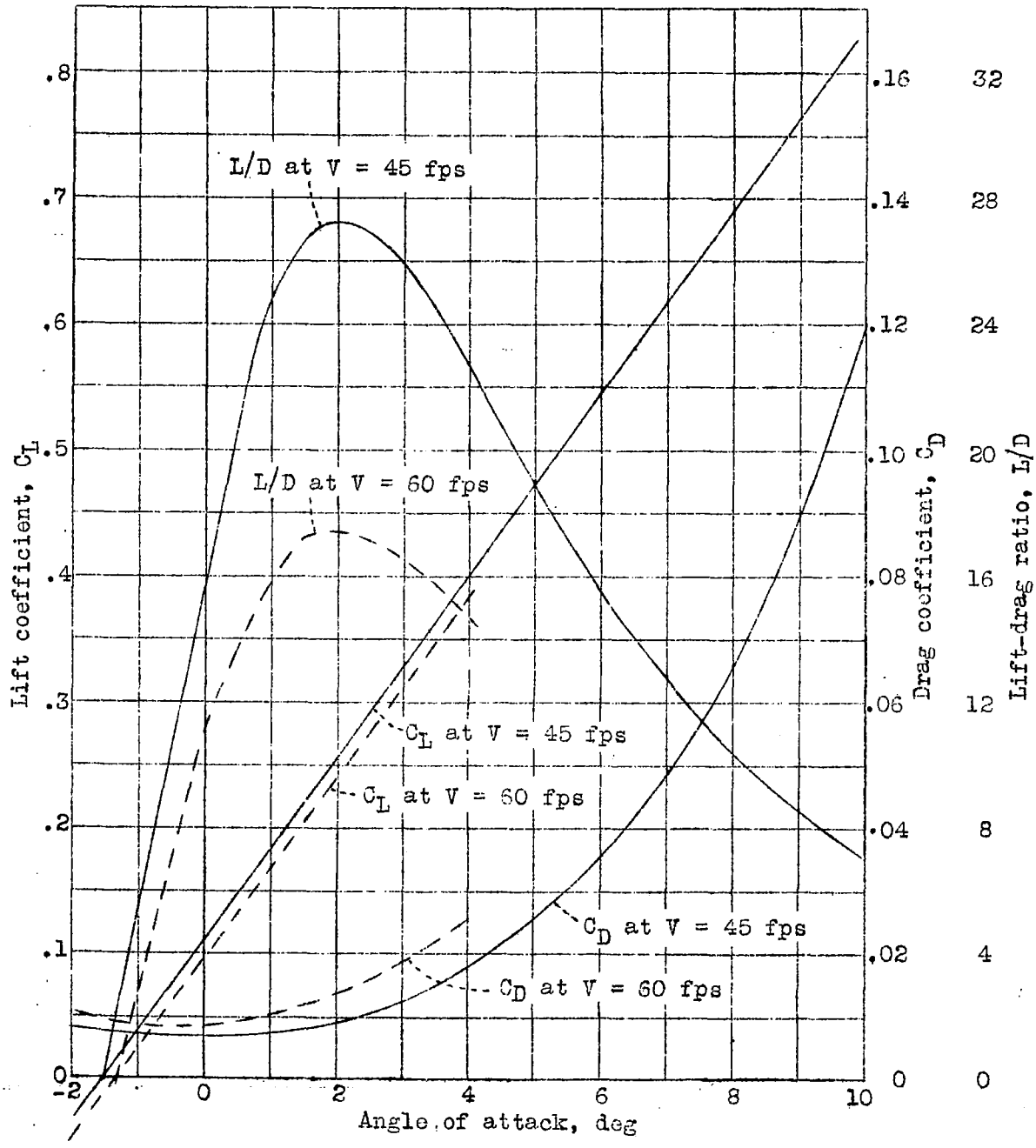


Figure 7.- Summary of characteristics of NACA 66,S-209 section hydrofoil at a depth of 25 inches (5 chords).

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