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RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Department of the Navy

TAKE-OFF STABILITY CHARACTERISTICS OF A $\frac{1}{13}$ -SCALE MODEL
OF THE CONSOLIDATED VULTEE SKATE 7 SEAPLANE

TRD NO. NACA DE 338

By

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and Donald D. Arabian

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SUMMARY

The take-off stability characteristics of a Consolidated Vultee Aircraft Corporation Skate 7 seaplane were determined in the Langley tank no. 2. Trim limits of stability, trim tracks, and elevator limits of stability are presented.

INTRODUCTION

The Consolidated Vultee Aircraft Corporation has proposed a jet-propelled type of seaplane (called the "Skate") in which the hull bottom is merged into the wing, resulting in an over-all depth of airplane much less than used in conventional flying boats. Models of several different configurations of the Skate type seaplane have been tested by Consolidated Vultee using their open-water hydrodynamic test facilities.

At the request of the Bureau of Aeronautics, Department of the Navy, a general evaluation of the hydrodynamic characteristics of the Skate 7 is being conducted in Langley tank no. 2.

In order to expedite the availability of the data, the results obtained from the investigation of take-off stability are presented in the present report without analysis before completion of the rest of the tests.

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MODEL AND APPARATUS

The $\frac{1}{13}$ -scale powered model used in these tests was designed and constructed by the Consolidated Vultee Aircraft Corporation. Photographs of the model, designated Langley tank model 261, are shown in figure 1. A photograph of the model on the towing apparatus is shown in figure 2. The general arrangement and hull lines are shown in figures 3 and 4. Pertinent dimensions are given in table I. The design of the hull is discussed in references 1 and 2.

Jet thrust was simulated by supplying air from a reservoir on the towing carriage to ejectors mounted one in each throat of the twin jets. The hose carrying the air supply to the model jets were of gum rubber and were wound with fine wire. An investigation of the decrement in trim amplitude during oscillation of the model in the air with the hose under the required pressure indicated that the restraint from the hose would be small enough to be neglected in the tests.

The model was provided with contacts in the step point and at the sternpost to indicate the instant of leaving or contacting the water. A recording oscillograph was used to obtain a time history of the model motions.

From preliminary test runs made with the model free to trim in the air just above the water's surface, it was found necessary to set the stabilizer at 14° in order to obtain reasonable aerodynamic trim with the air-flow conditions existing under the towing carriage.

PROCEDURE

The model weight was such that when the towing fittings were added it was impracticable to meet the design gross weight and the present tests were made with a model gross weight of 16.5 pounds, equivalent to about 10-percent overload.

The trim limits of stability were investigated during constant-speed runs by slowly increasing or decreasing the trim of the model with the elevators until the porpoising limit was crossed. Only the limits obtainable with the range of elevator deflection and center-of-gravity position available on the model were determined. The variation of trim with speed for three locations of the center of gravity (10, 20, and 30 percent M.A.C.) was determined during accelerated runs to take-off with full power, fixed elevators, and flaps deflected 20° . The

maximum constant rate of acceleration available from the towing carriage (approx. 5.5 ft/sec^2) was used on the assumption that the thrust available would result in a rate of acceleration during take-off at least equal to this value. The range of elevator deflection, within the limits obtainable on the model, over which stable take-offs could be made without encountering porpoising of 2° amplitude was determined during these and other similar accelerated test runs.

RESULTS

The results of the take-off stability tests are presented converted to full-scale values. Trim limits are given in figure 5. Between 60 and 80 knots no lower-limit porpoising could be obtained within the range of elevator and center-of-gravity position available on the model. Below 75 knots where no upper-limit decreasing trim is shown, upper-limit porpoising could not be stopped by movement of the elevators once it had been started.

The variation of trim with speed during accelerated take-off runs is plotted in figure 6. The range of elevator deflection available for take-off with less than 2° of oscillation in trim for the range of center-of-gravity position between 10 and 30 percent mean aerodynamic chord is given in figure 7. Porpoising in excess of 2° amplitude of trim occurred only at the forward position of the center of gravity at low elevator deflections. It should be noted that the data were obtained from accelerated test runs made at 5.5 feet per second per

second whereas most of the previous NACA tank investigations have been made with a value of 1 foot per second per second.

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REFERENCES

1. Caldwell, R. W.: Data and Specifications for a $\frac{1}{13}$ -Scale Powered Tank Model of Skate 7. Rep. No. ZH-063, Consolidated Vultee Aircraft Corp., Jan. 20, 1949.
2. Caldwell, R. W.: Hydrodynamic Design of the Consolidated Vultee Seaplane Night Fighter. Rep. No. ZH-061, Consolidated Vultee Aircraft Corp., Dec. 1948.

TABLE I

SKATE 7 - LANGLEY TANK MODEL 261

General Data

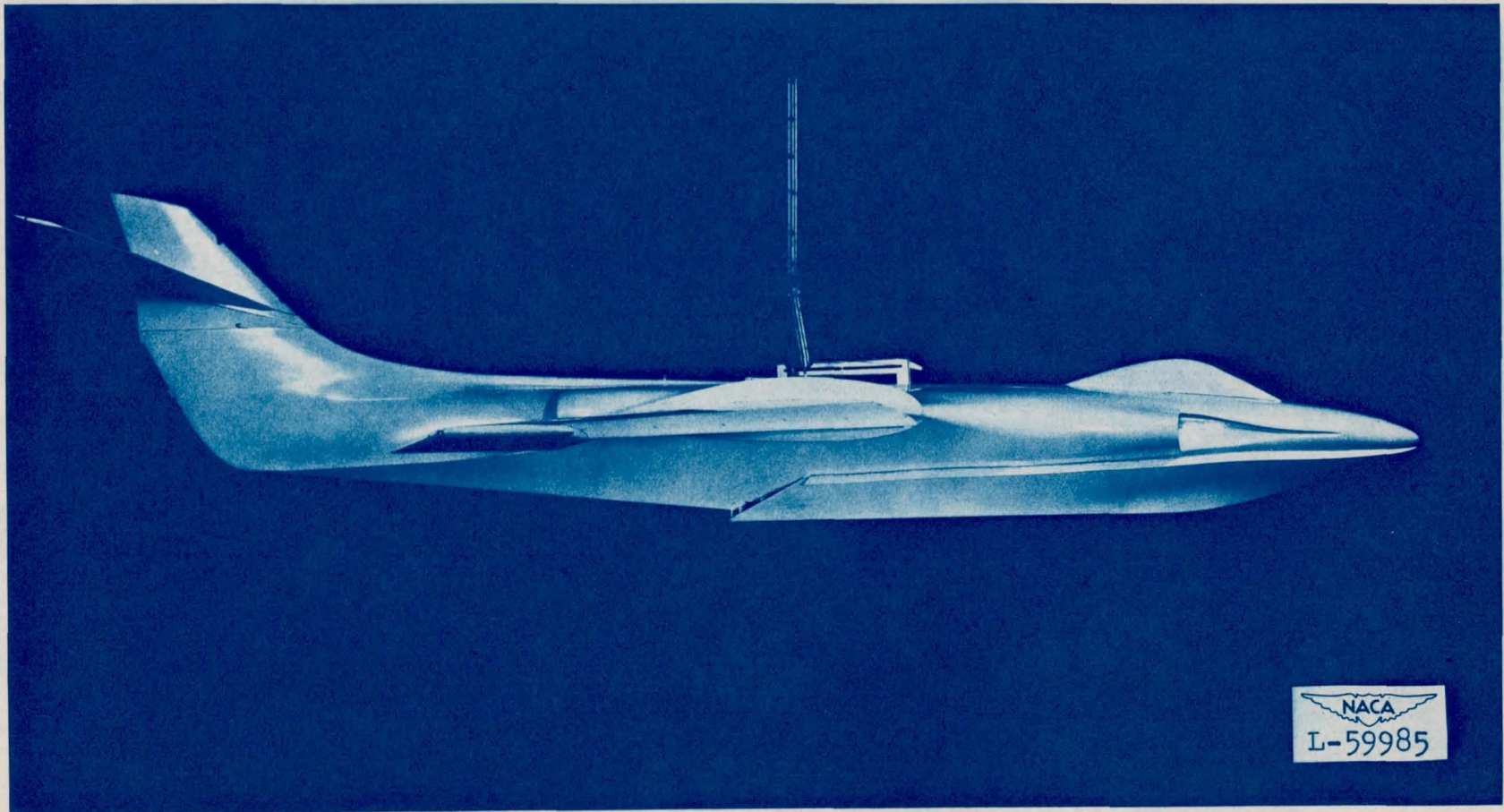
	Full size	Model
Hull:		
Gross load, lb	33,000	14.88 ^a
Length of forebody to step point, in.	495	38.06
Length of afterbody, in.	345	26.55
Length over all, in.	984	75.7
Beam between spray strips, in.	109	8.39
Depth of step, in.	8.4	0.646
Deadrise angle at step, deg	30	30
Sternpost angle, deg	6.74	6.74
Afterbody keel angle, deg	5.5	5.5
Height of center of gravity above base line, in.	58	4.46
Height of center line of jet inlet above base line, in.	78.12	6.01
Wing:		
Area, sq ft	960	5.69
Span, in.	744	57.2
Root chord, in.	266	20.4
Tip chord, in.	106	8.15
Mean aerodynamic chord, \bar{c} , in.	197.8	15.2
Leading edge of mean aerodynamic chord aft of bow, in.	387.5	29.8
Aspect ratio	4.0	4.0
Sweep of 25-percent chord line, deg	35	35
Horizontal tail:		
Total area projected, sq ft	144	0.85
Span, in.	288	22.15
Dihedral, deg	10	10
Vertical tail:		
Total area, sq ft	117	0.69
Static thrust, lb	15,000	6.84

^aSpecific weight of Langley tank no. 2 water in these tests was 63.2 lb/cu ft.



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(a) Profile view.

Figure 1.- Langley tank model 261.

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(b) Bottom view.

Figure 1.- Concluded.

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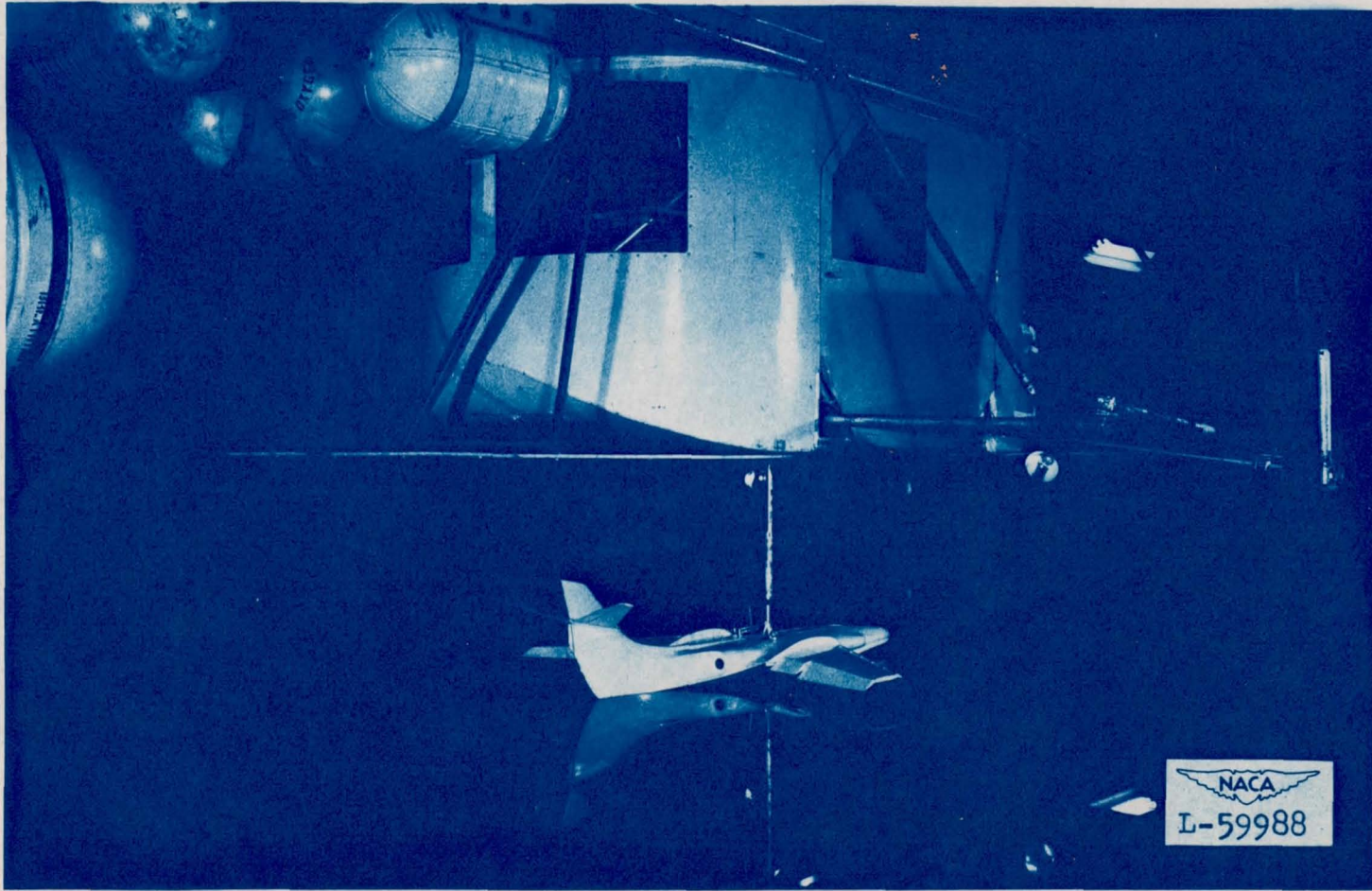


Figure 2.- Model 261 on towing apparatus.
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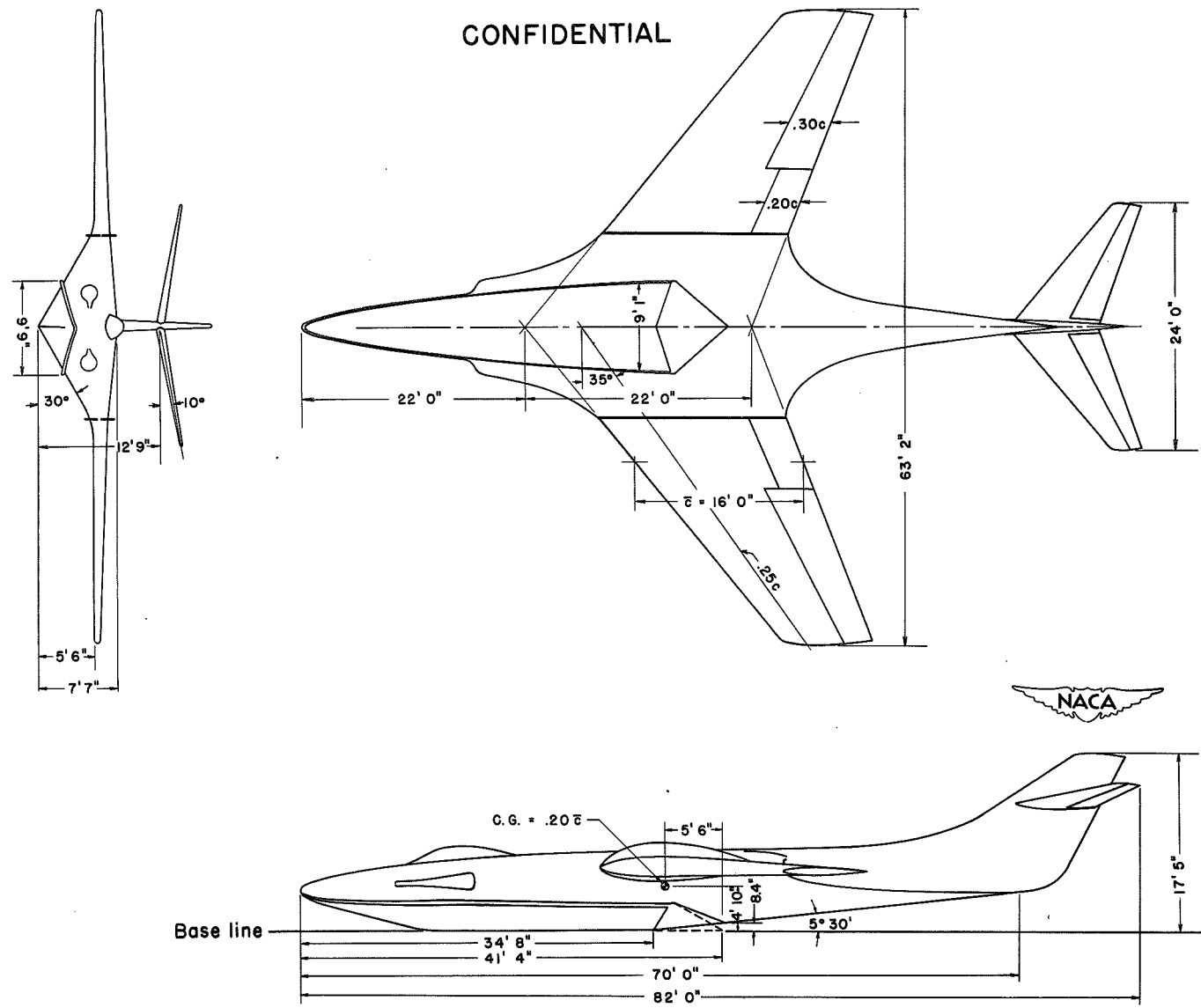
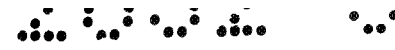
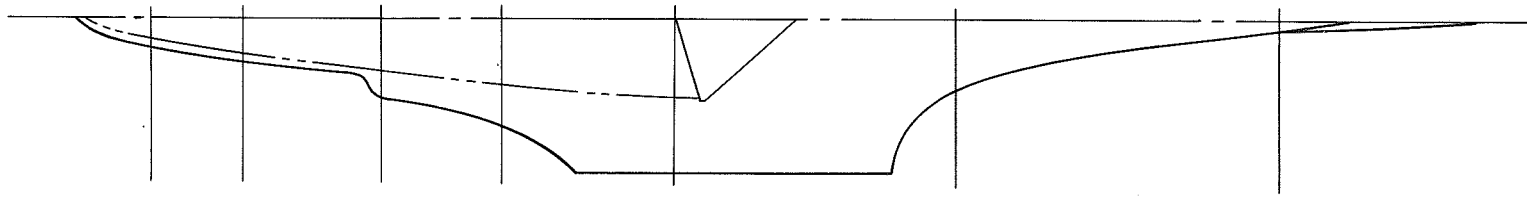


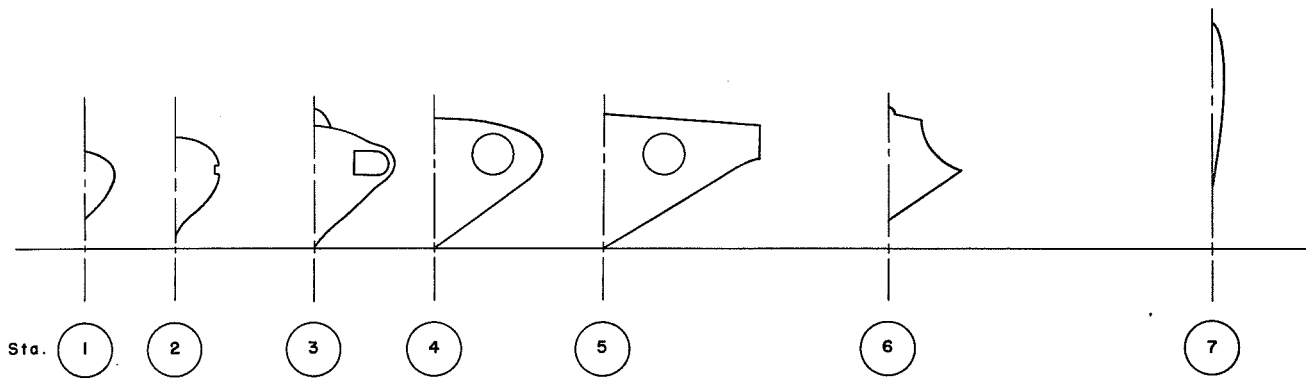
Figure 3.- General arrangement of Skate 7.
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Bottom view.



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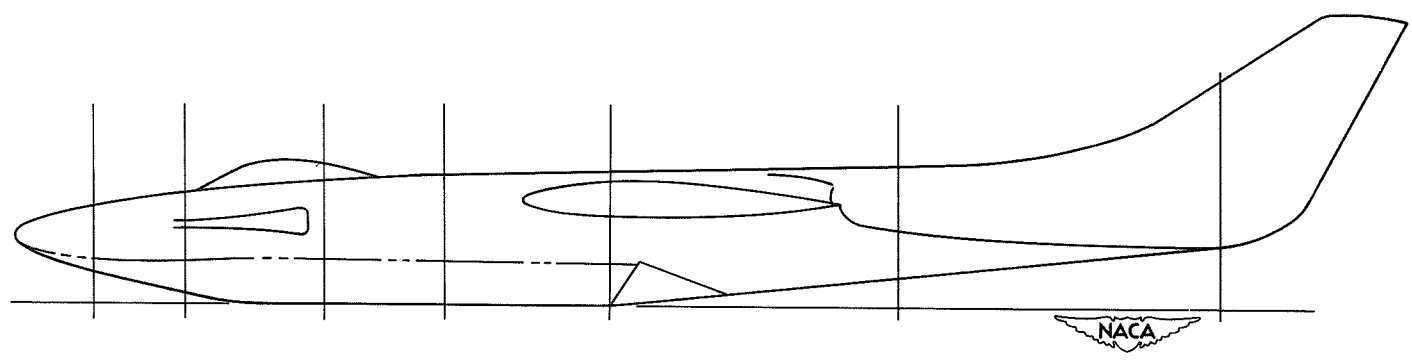


Figure 4.- Hull lines of Skate 7.

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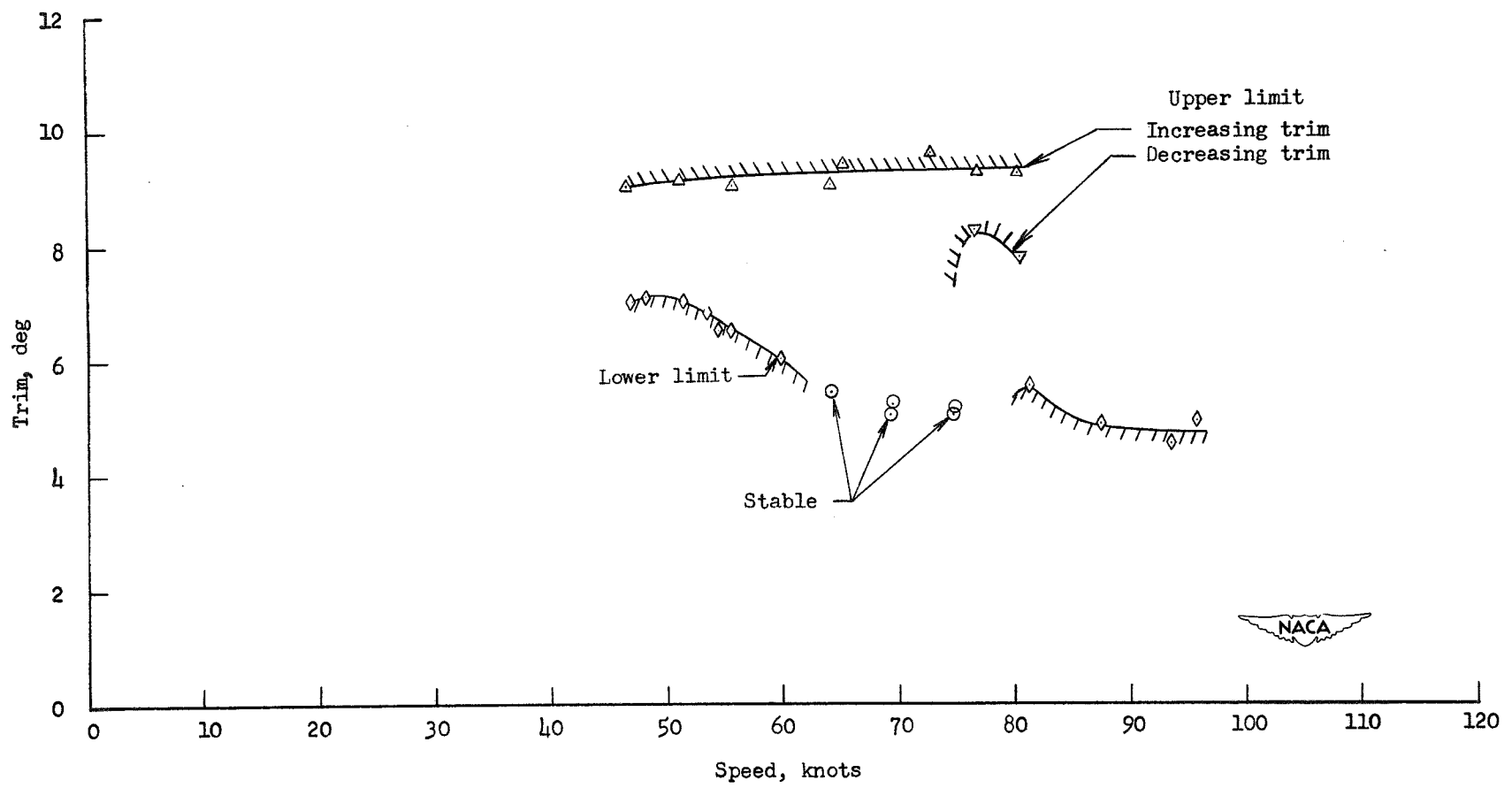
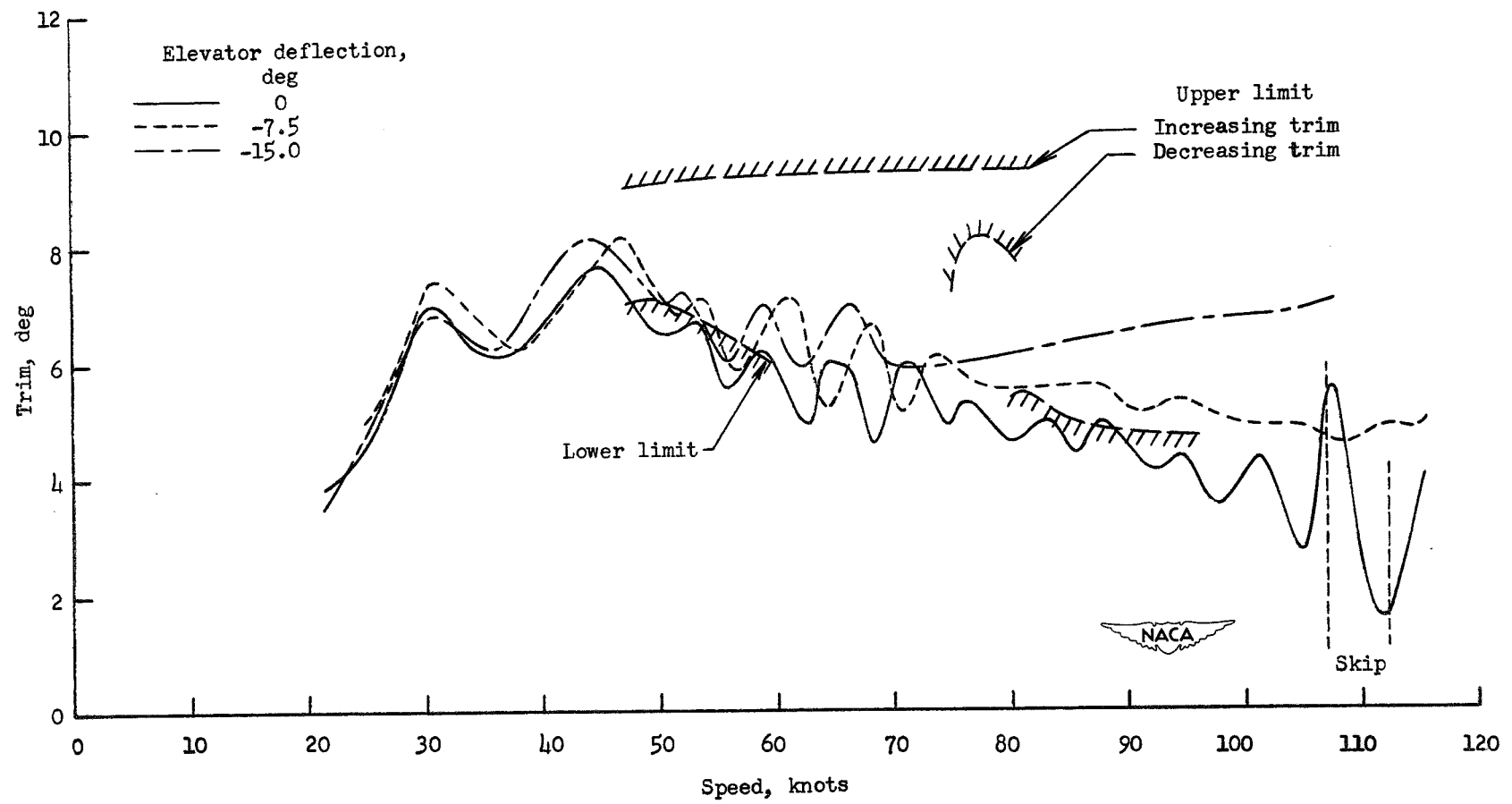


Figure 5.- Trim limits of stability.
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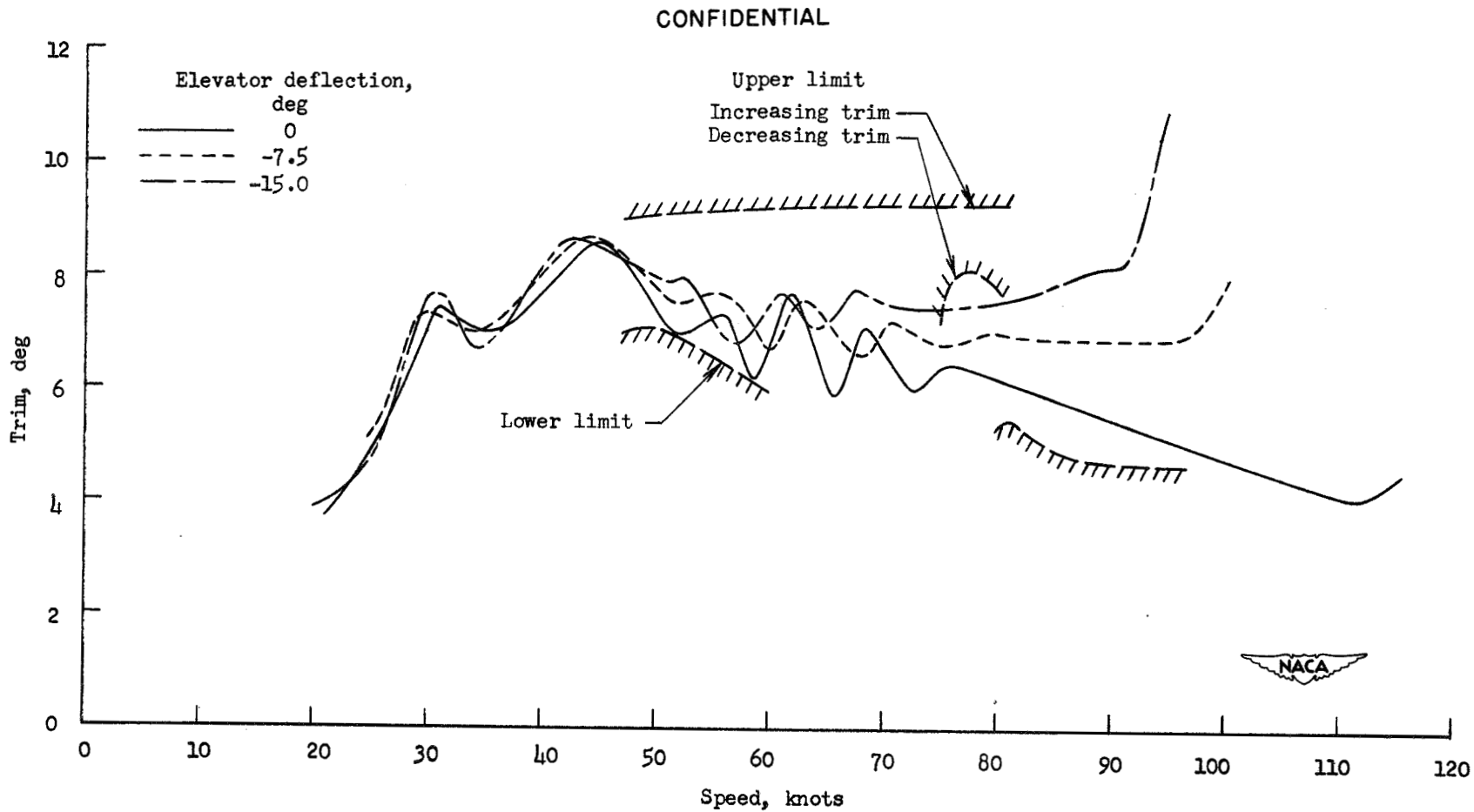
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(a) Center-of-gravity, 10 percent mean aerodynamic chord.

Figure 6.- Trim tracks.

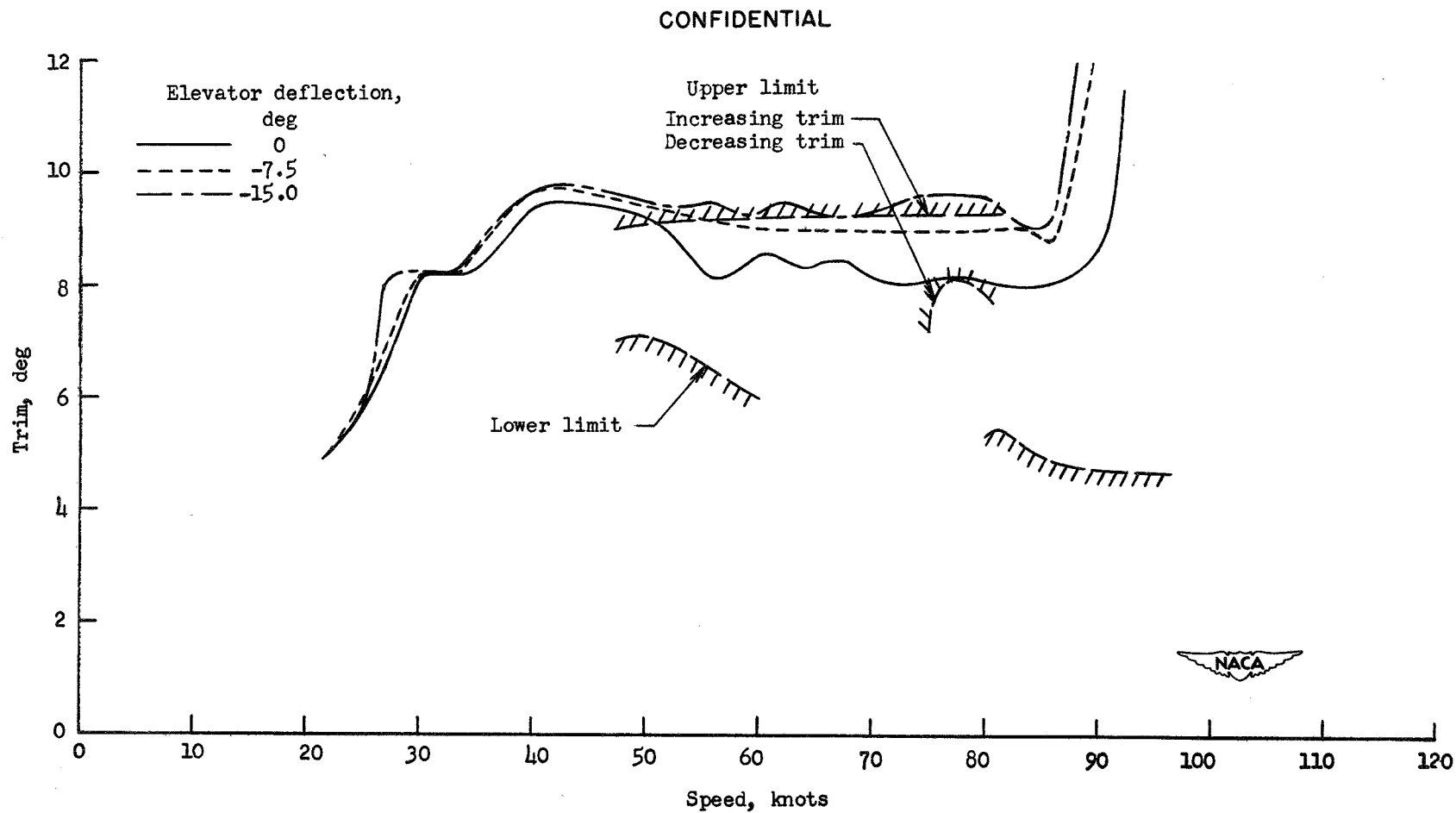
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(b) Center-of-gravity, 20 percent mean aerodynamic chord.

Figure 6.- Continued.

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(c) Center-of-gravity, 30 percent mean aerodynamic chord.

Figure 6.- Concluded.

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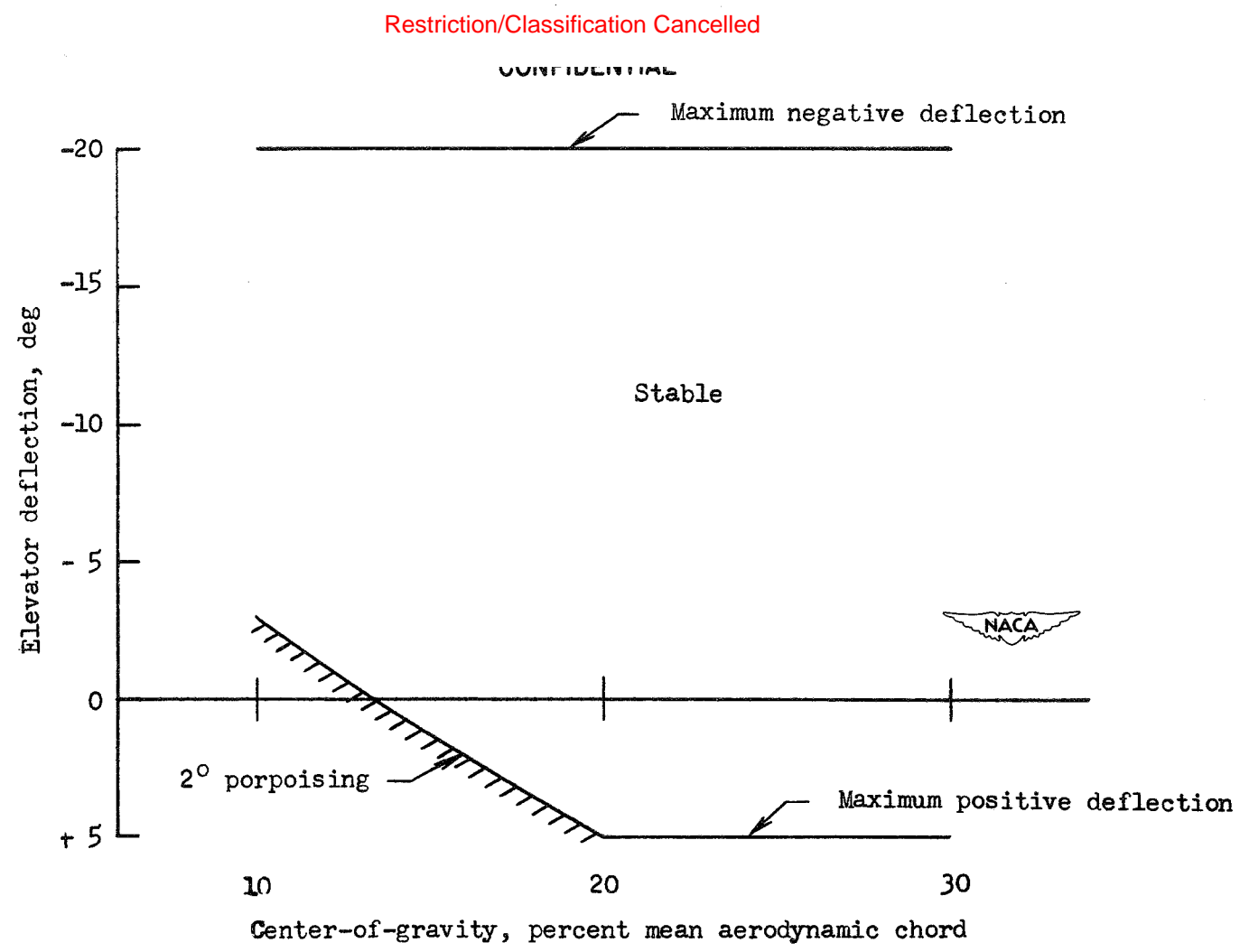


Figure 7.- Elevator limits for various center-of-gravity locations.

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