COMPUTER AND WIND TUNNEL DEVELOPMENT OF FLAPS AND CONTROL SURFACES FOR ADVANCED TECHNOLOGY GENERAL AVIATION AIRFOILS

NSG 1165

SEMI-ANNUAL PROGRESS REPORT

June 1, 1975 - Nov. 30, 1975

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NASA Technical Officer

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(NASA-CR-146015) COMPUTER AND WIND TUNNEL DEVELOPMENT OF FLAPS AND CONTROL SURFACES FOR ADVANCED TECHNOLOGY GENERAL AVIATION AIRFOILS Semiannual Progress Report, 1 Jun. - 30 Nov. 1975 (Wichita State Univ.) 36 p 00/98 N76-70828 Unclas 05631

Progress Report - NSG 1165

The following work has been accomplished during the present reporting period:

1. GA(W)-2 Airfoil with 40% Fowler flap: Design, fabrication and testing of this model has been carried out. Preliminary results of these tests are shown in Appendix A. Flap nested data compare very well with NASA Langley tests of the same section. Flaps down data show that a C_{lmax} of 3.8 can be attained with 40° flap applied to this section. Tuft photos show that attached flow is achieved over the flap at stalling angles of attack and beyond.

2. Tests of GA(W)-1 airfoil with 20% chord aileron: Design, fabrication and testing has been carried out. Preliminary results of these tests are shown in Appendix B. Aileron slot gaps of 0, 0.5%, 1.0% and 2.0% of wing chord were evaluated. Pressure distributions were obtained, and aileron pressures have been integrated to obtain hinge-moment data.

3. Tests of advanced configurations: Because of the excellent performance shown by the 13% GA(W)-2 section both unflapped and flapped, this model has been selected for further evaluation. A 25% chord slotted flap is being designed for computer evaluation and wind tunnel testing. In addition, a 20% chord aileron is currently being fabricated for testing on the GA(W)-2 section. A slot-lip spoiler will also be designed for testing on this section

4. Wind tunnel testing completed to date: 80 hours.

5. The principal investigator and co-investigator participated in the following technical briefings during this reporting period:

a. Airfoil Optimization Workshop directed by Mr. Ray Hicks of NASA Ames Research Center. Held at WSU, Nov. 1975.

b. Airfoil Workshop Session of AIAA Technology-fest directed by Mr. P. K. Pierpont of NASA Langley Research Center. Held in Wichita at Century II Convention Hall, Nov. 1975.

6. Work is progressing on schedule and no major problems have been encountered.

APPENDIX A - PRELIMINARY RESULTS OF GA(W)-2 TESTS @ WSU

23 OCT 75

W H Wentz Jr.
Wichita State Univ.

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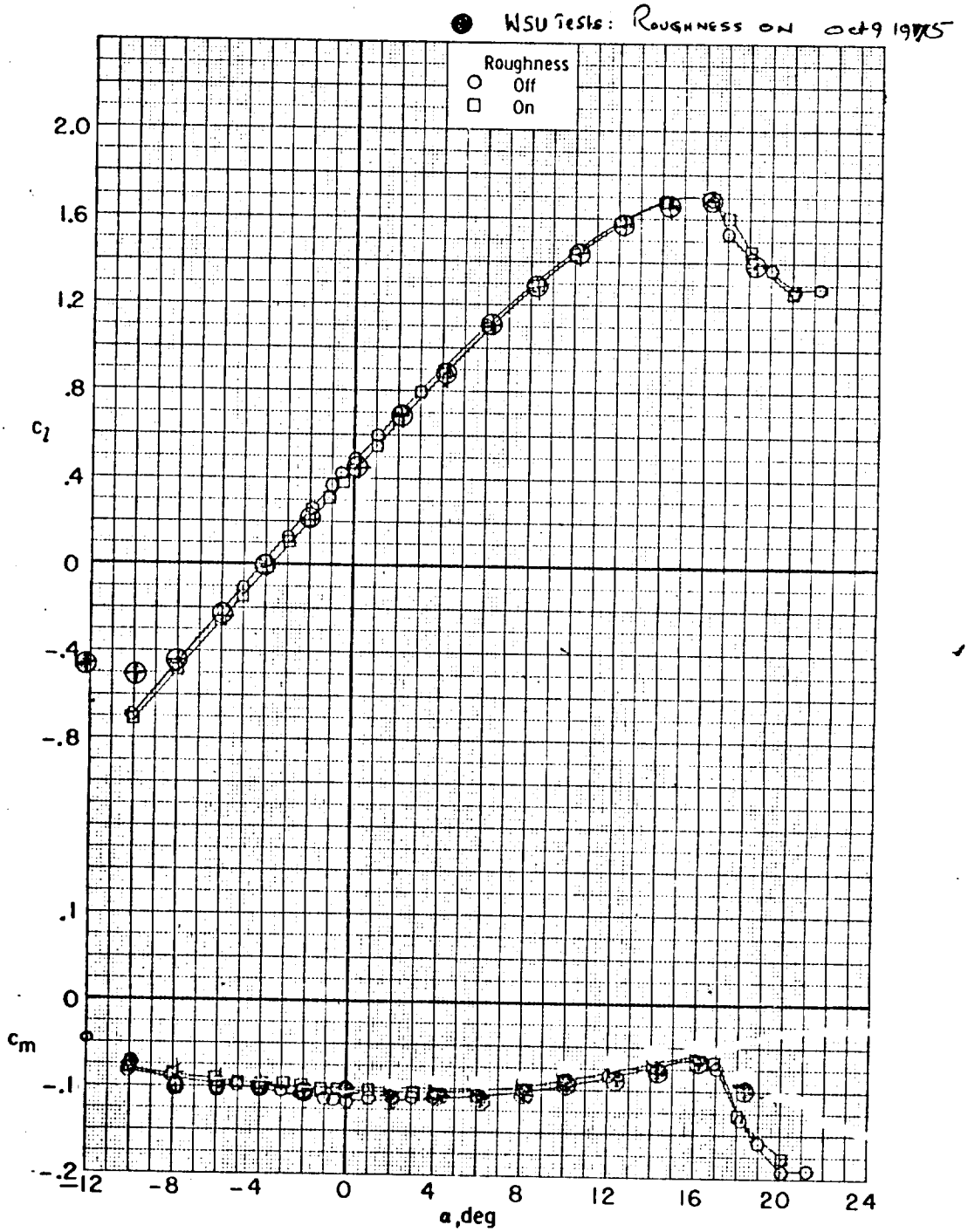
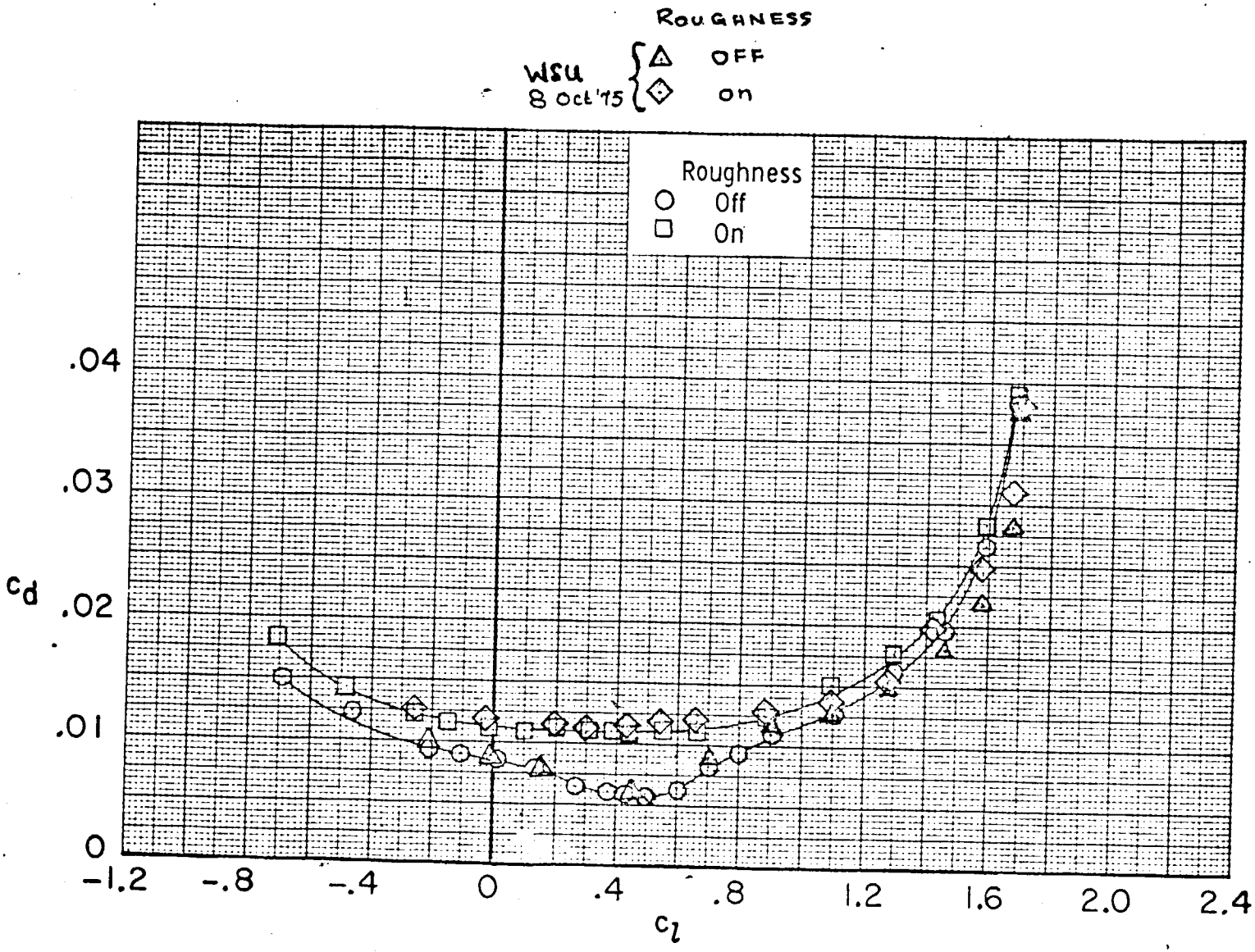
Date for general release Oct 1977



(a) $R = 2.1 \times 10^6$.

Effect of Reynolds number on airfoil section characteristics. M = 0.15.
(FROM TMX- 72697, p.23)

Figure A1- Comparison of WSU test results with NASA LRC tests - GA(W)-2 Airfoil.



(a) R = 2.1 x 10^6. Concluded.

Figure A1- Concluded.

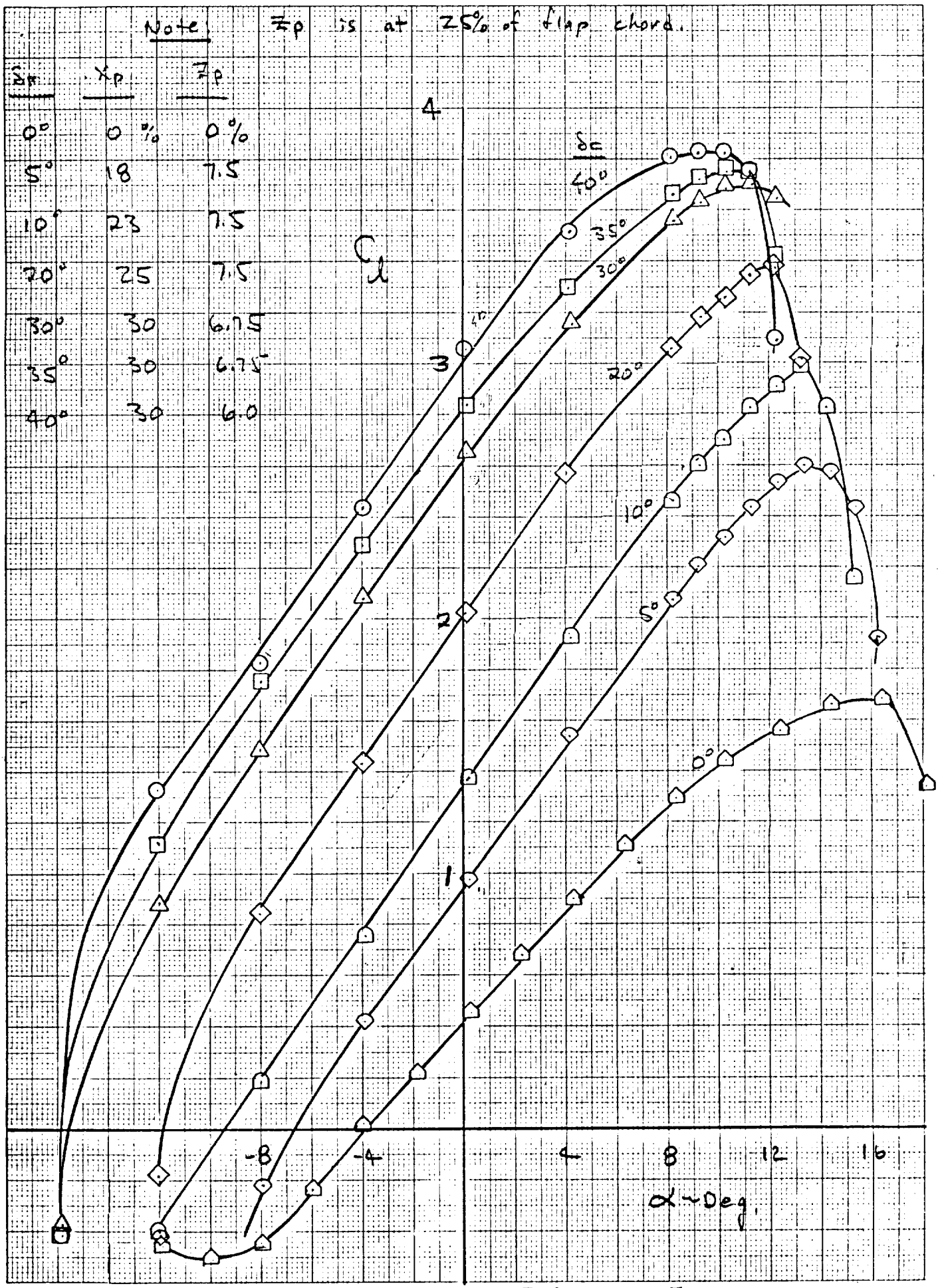


Figure A2 - GA(W)-2 with 30% Fowler Flap.

46 1513
K+E 10 X 10 TO THE CENTIMETER 16 X 25 CM. KEUFFEL & ESSER CO. MADE IN U.S.A.

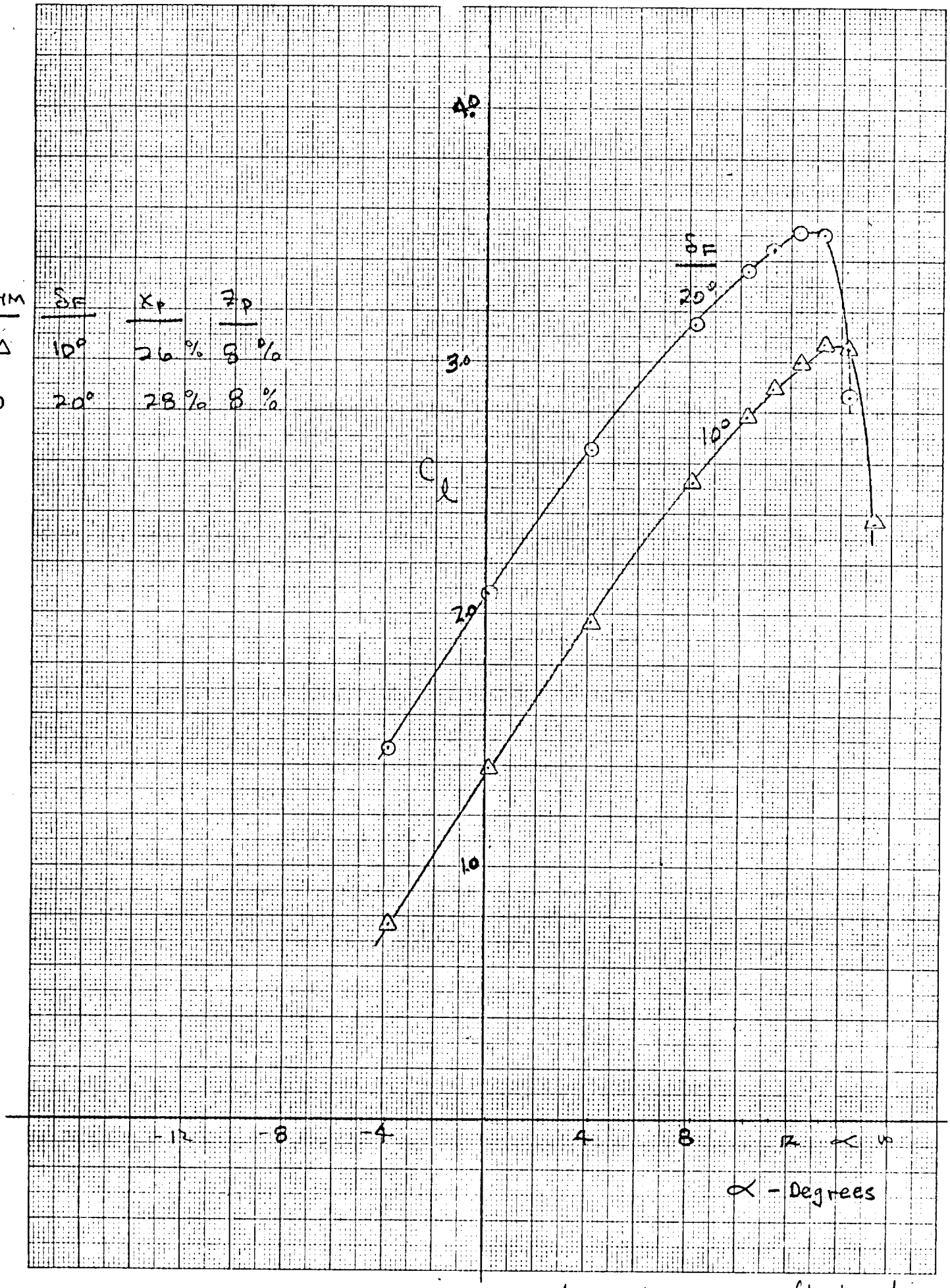


Figure A3- Effect of providing Large aft travel [illegible] small flap deflections — GA(W)-2, 30° FLAP.

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

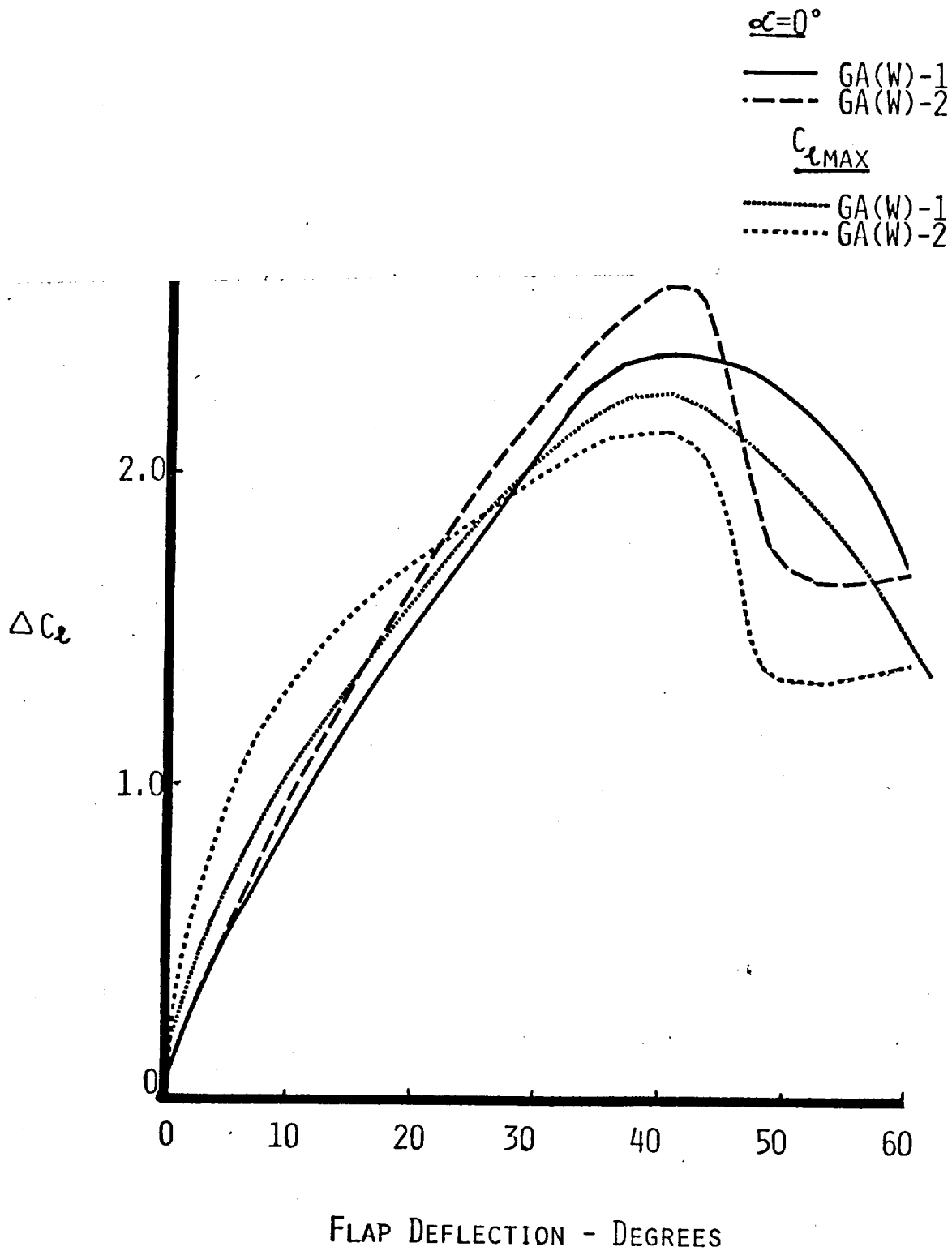
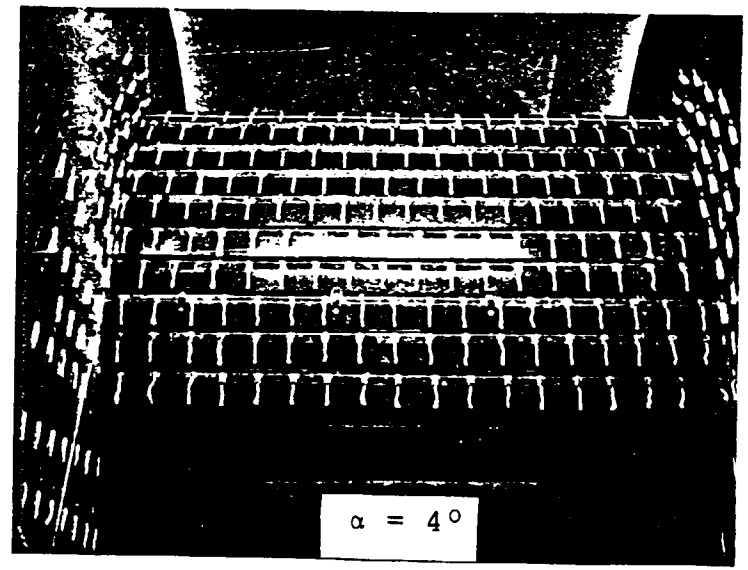
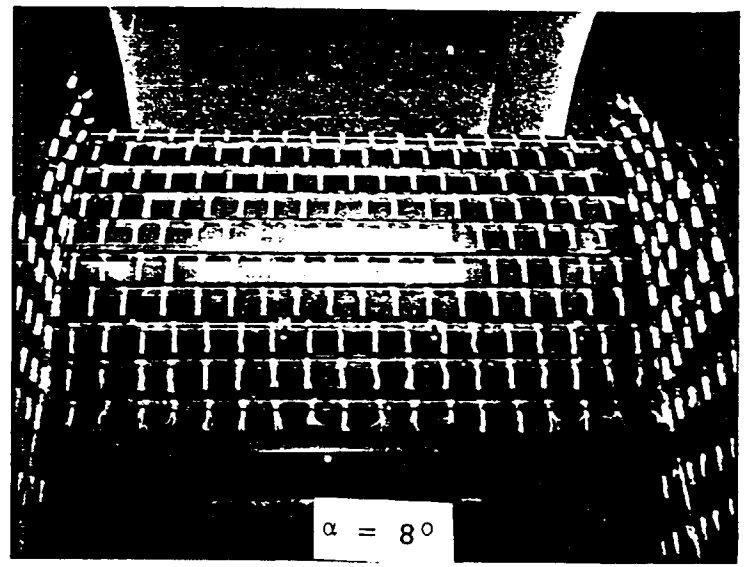
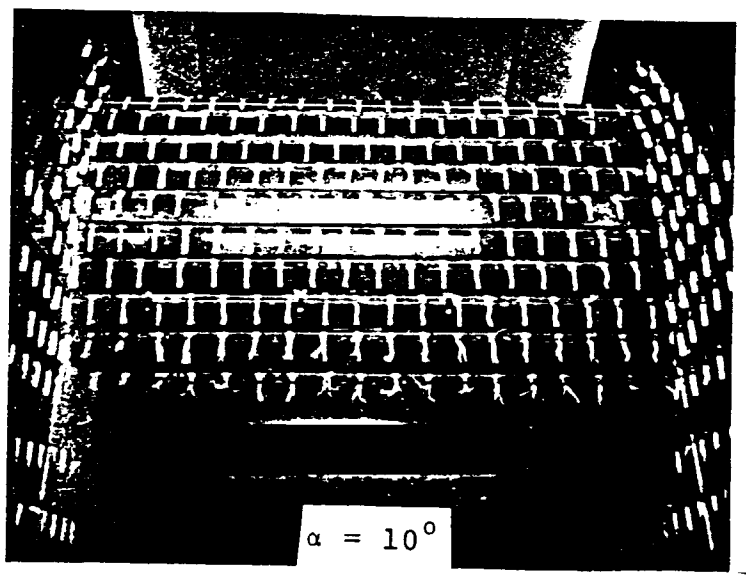


Figure A4- FOWLER FLAP EFFECTIVENESS - GA(W)-1 AND GA(W)-2 AIRFOILS







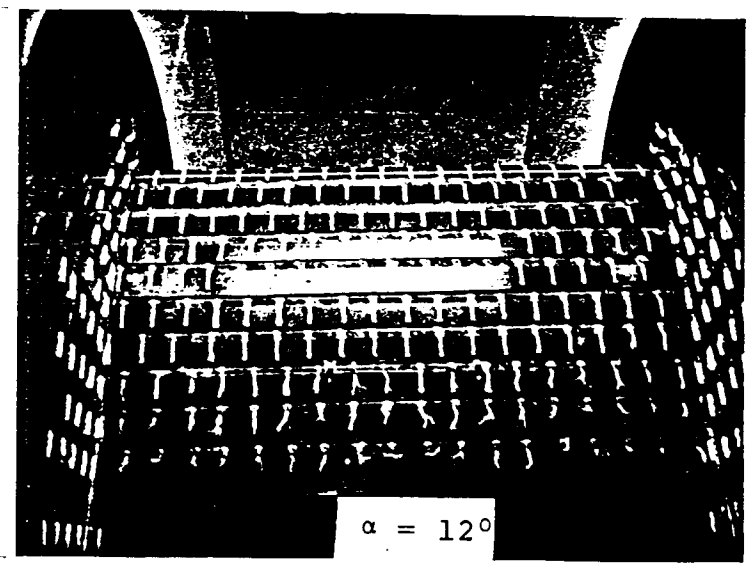


Figure A5 -Tuft Studies, Flap Nested, α = 4° to 12°. GA(W)-2

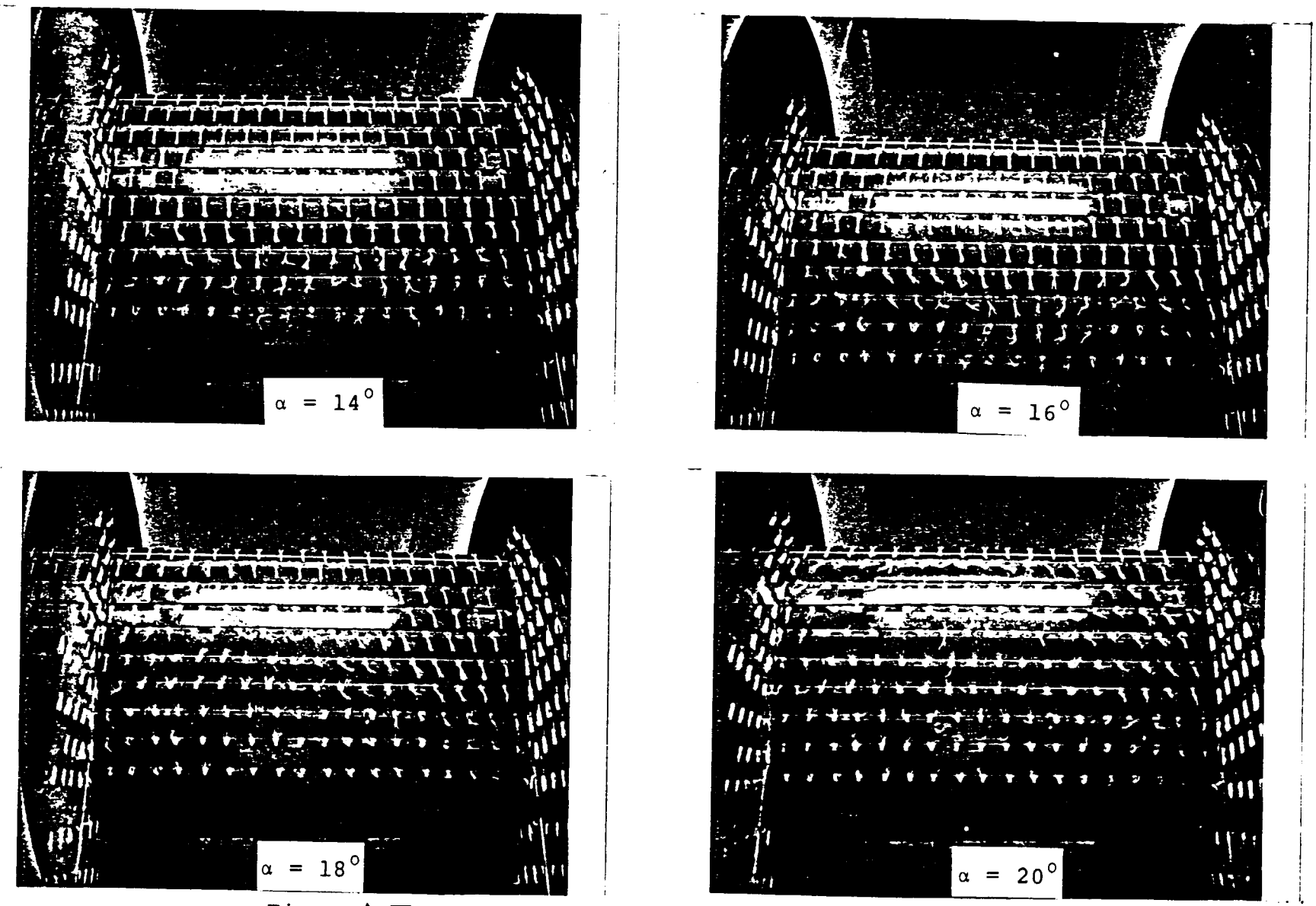


Figure A 5 Concluded, α = 14° to 20°.

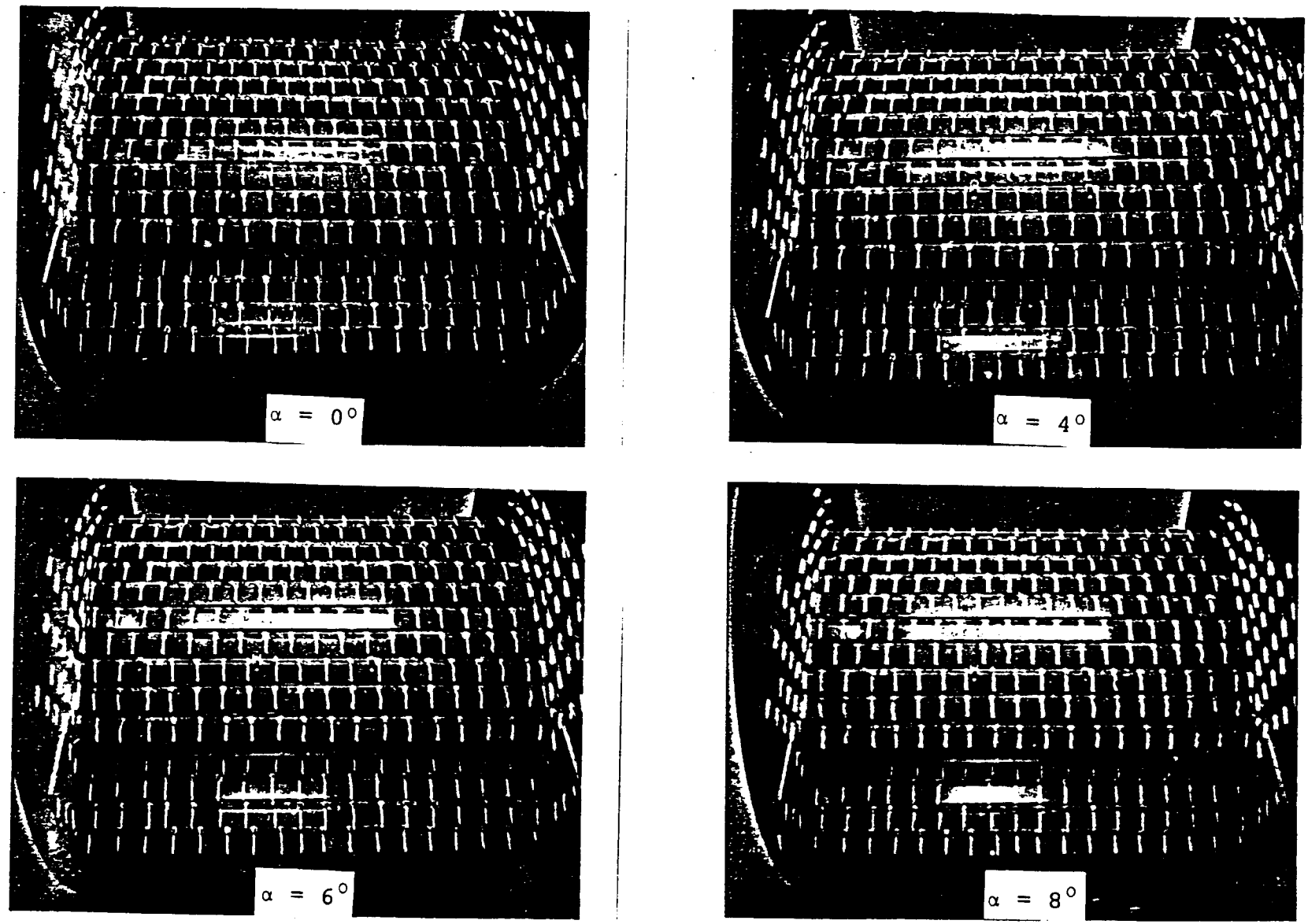


Figure A6- Tuft Studies, 10° Flap, α = 0° to 8°

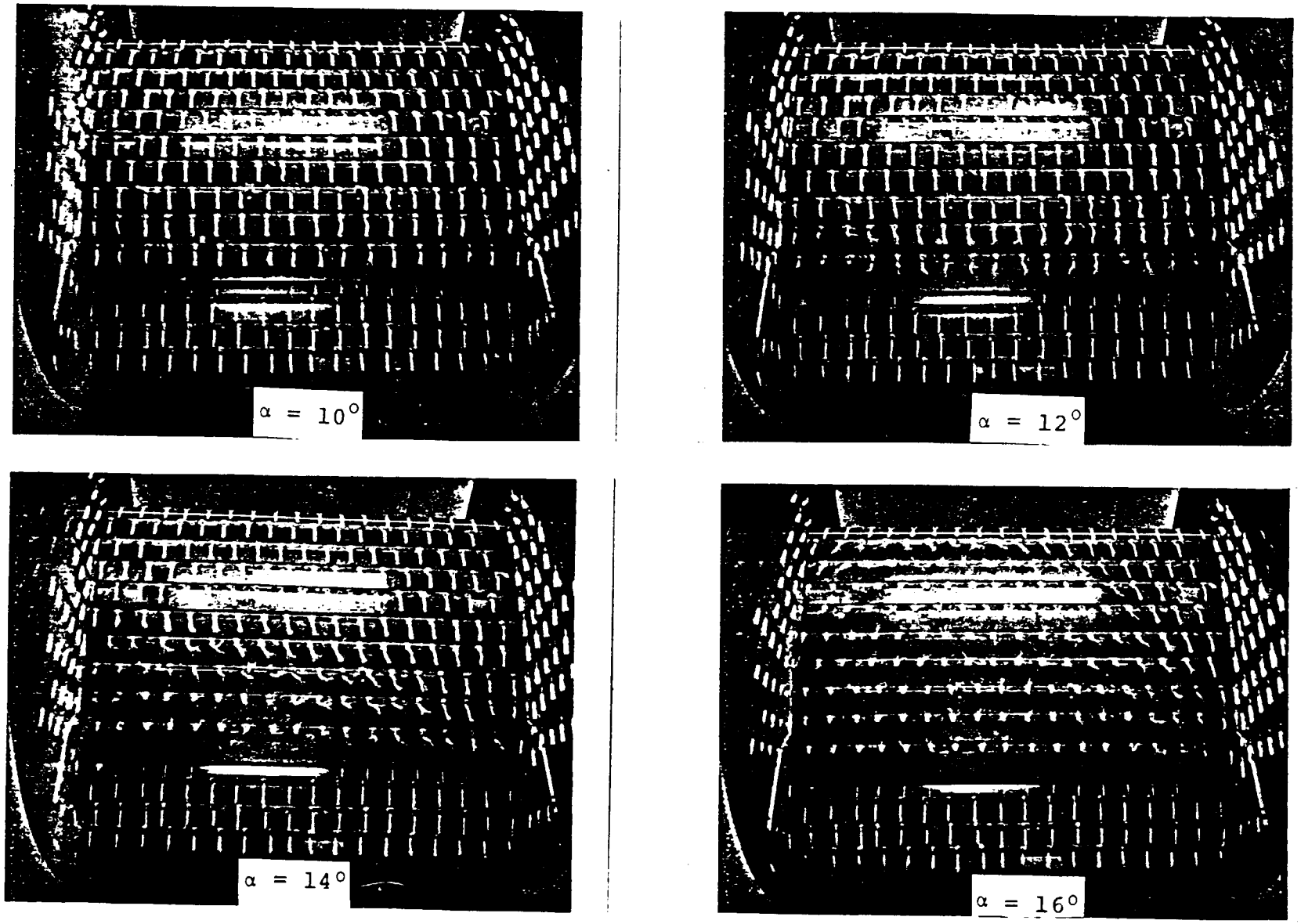


Figure 6 - Concluded, $\alpha = 10^\circ$ to 16°.

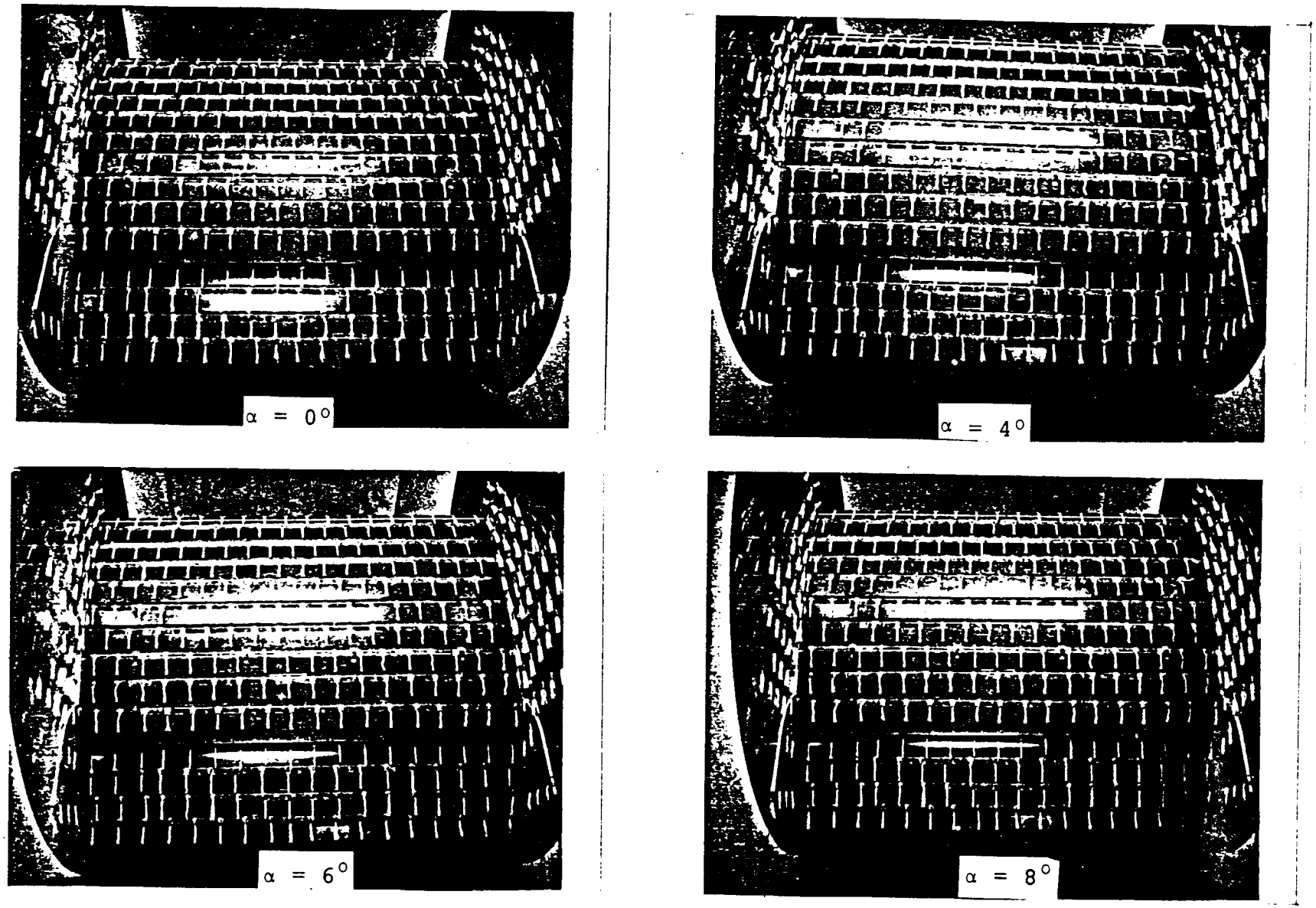


Figure A7 - Tuft Studies, 20° Flap, α = 0° to 8°.

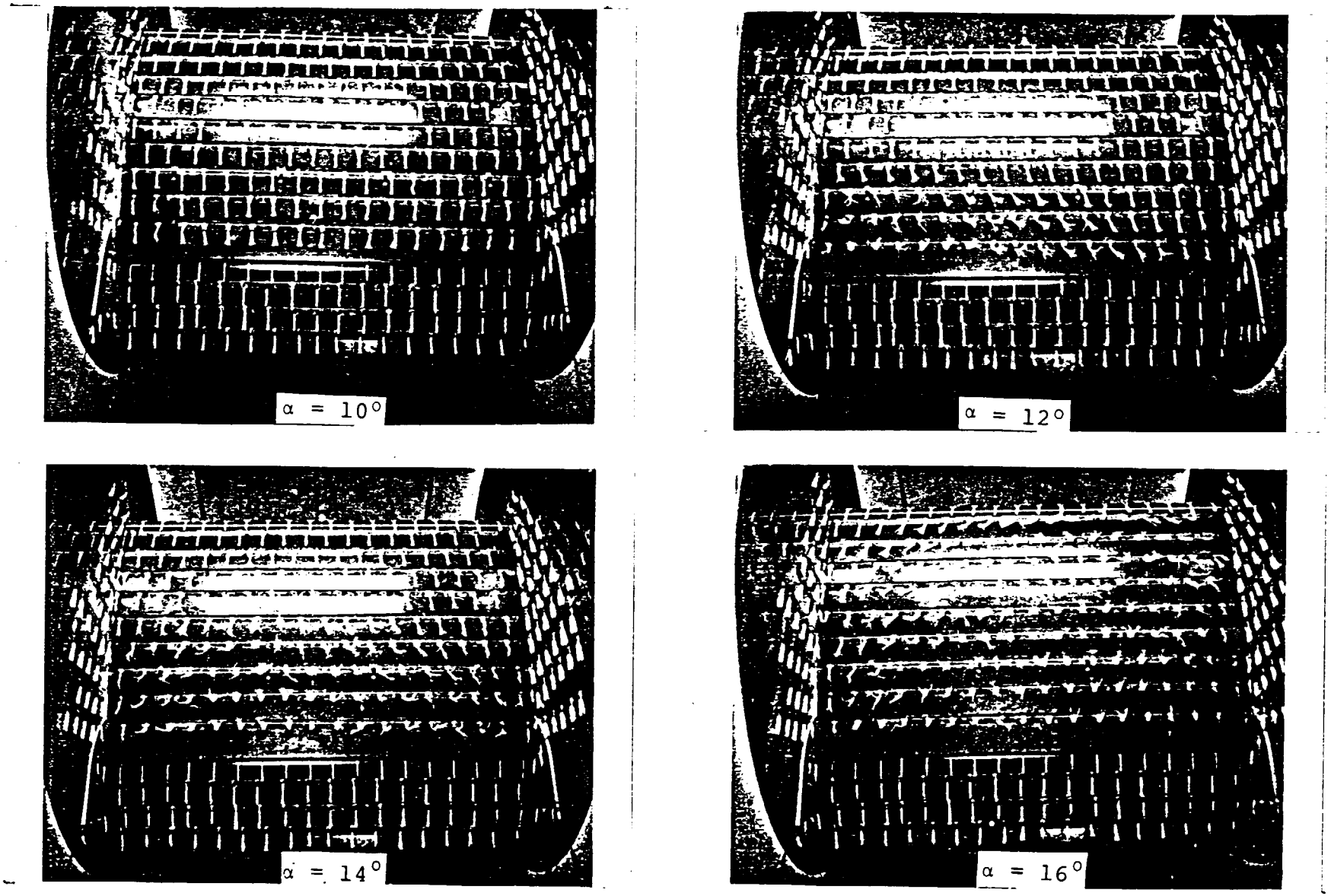


Figure A7 - Concluded, α = 10° to 16°.

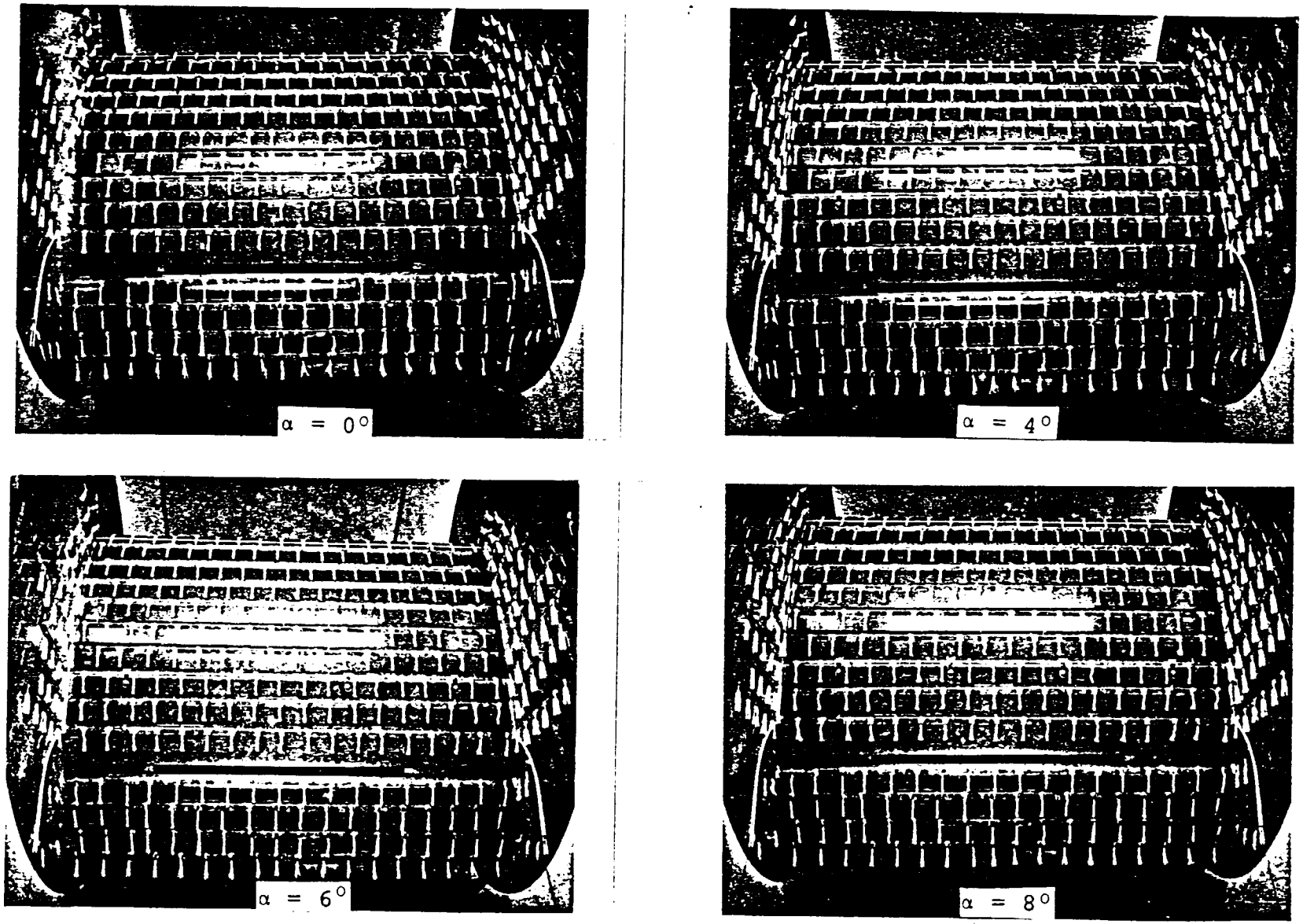
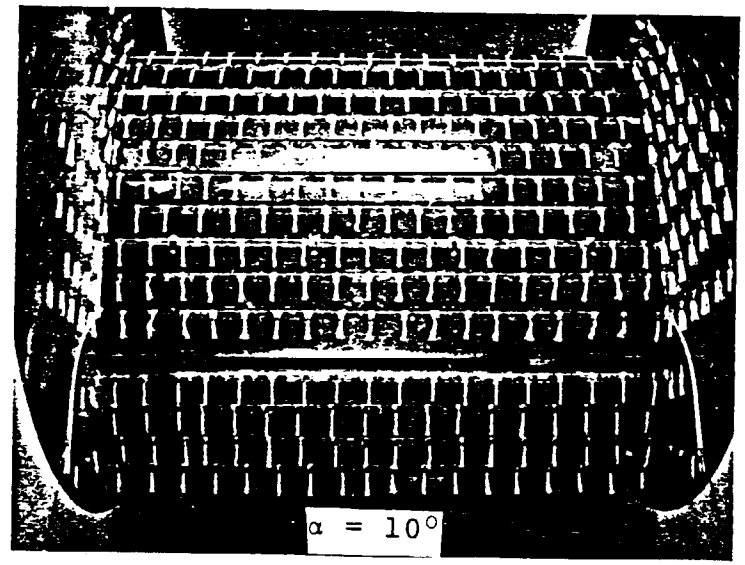
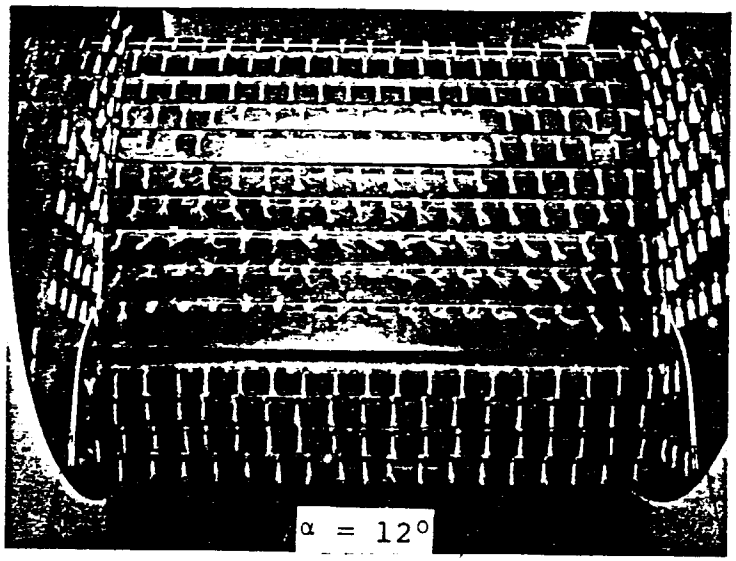
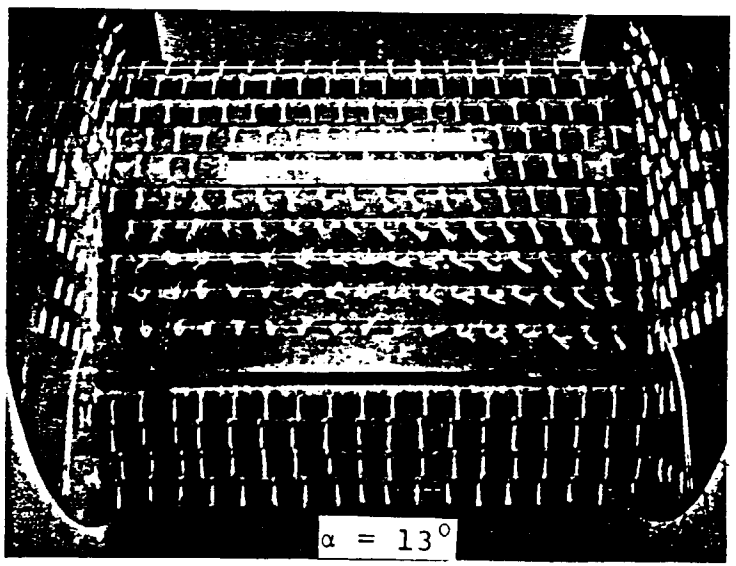


Figure 18 — Tuft Studies, 30° Flap, α = 0° to 8°.







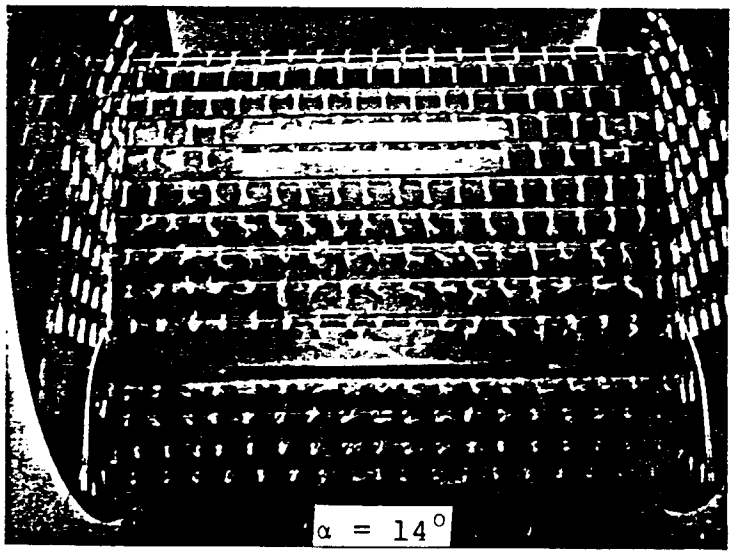


Figure A3 – Concluded, $\alpha = 10^\circ$ to 14°.

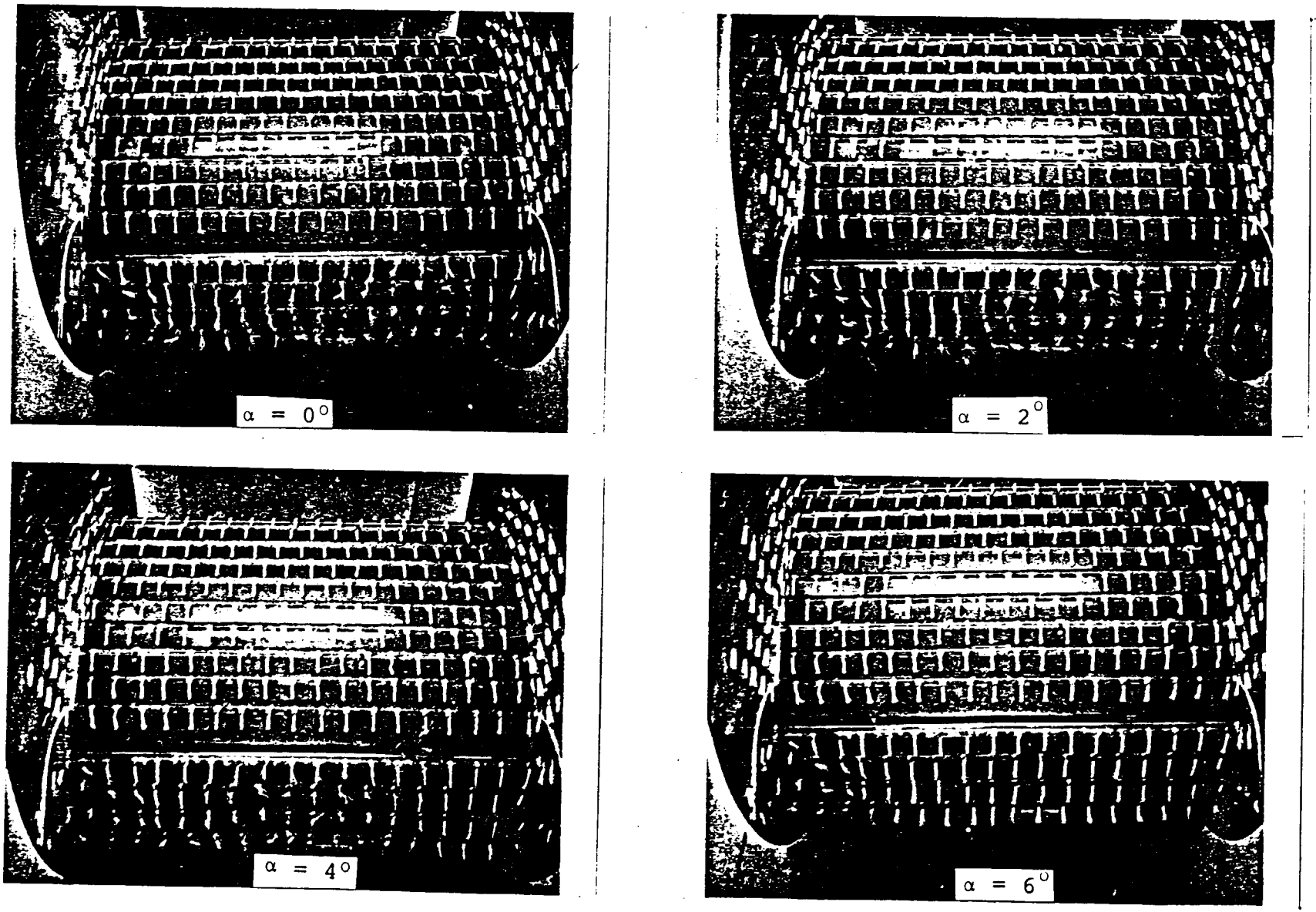


Figure A9 - Tuft Studies, 40° Flap, α = 0° to 6°.

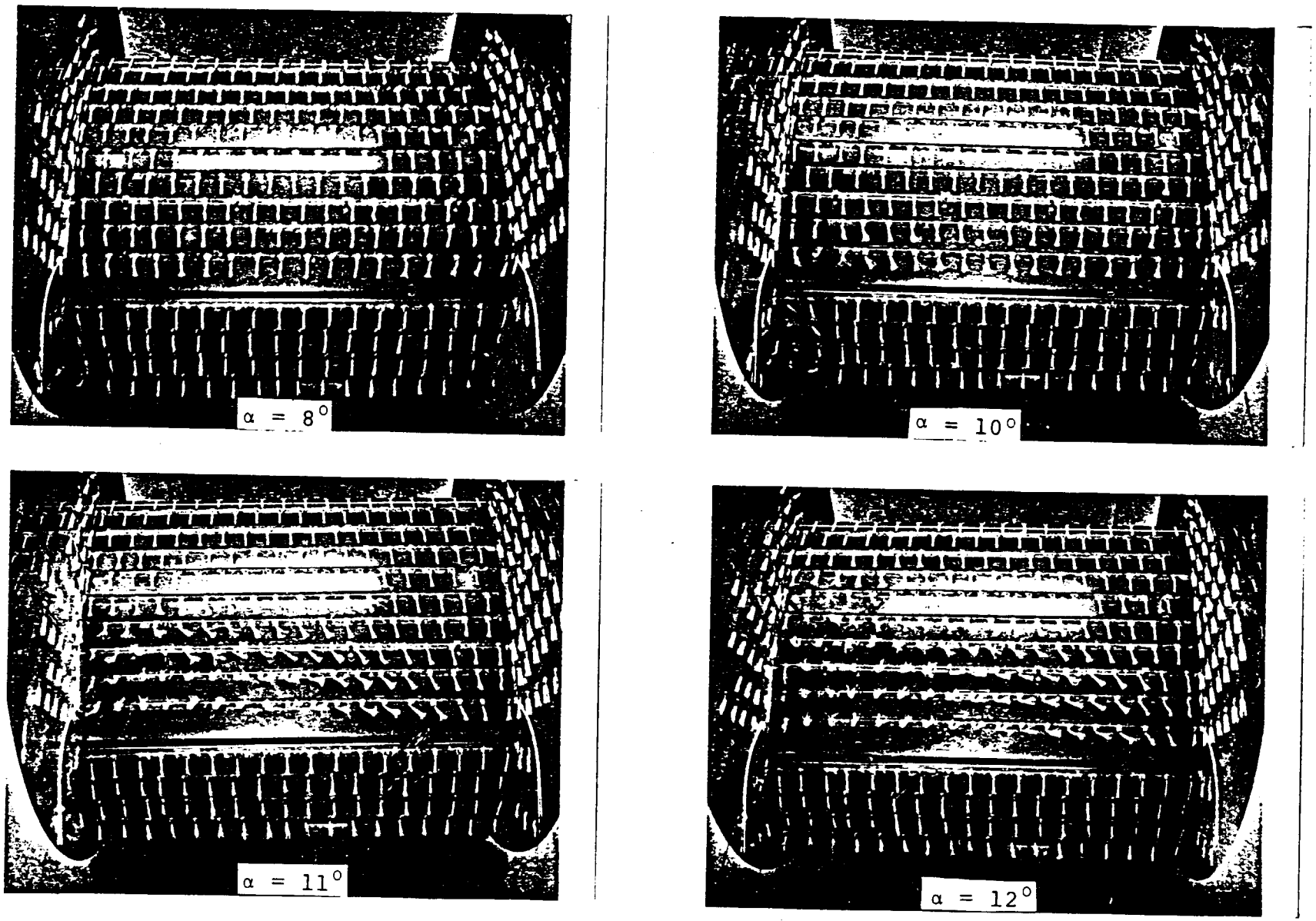


Figure A9 - Concluded, α = 8° to 12°.

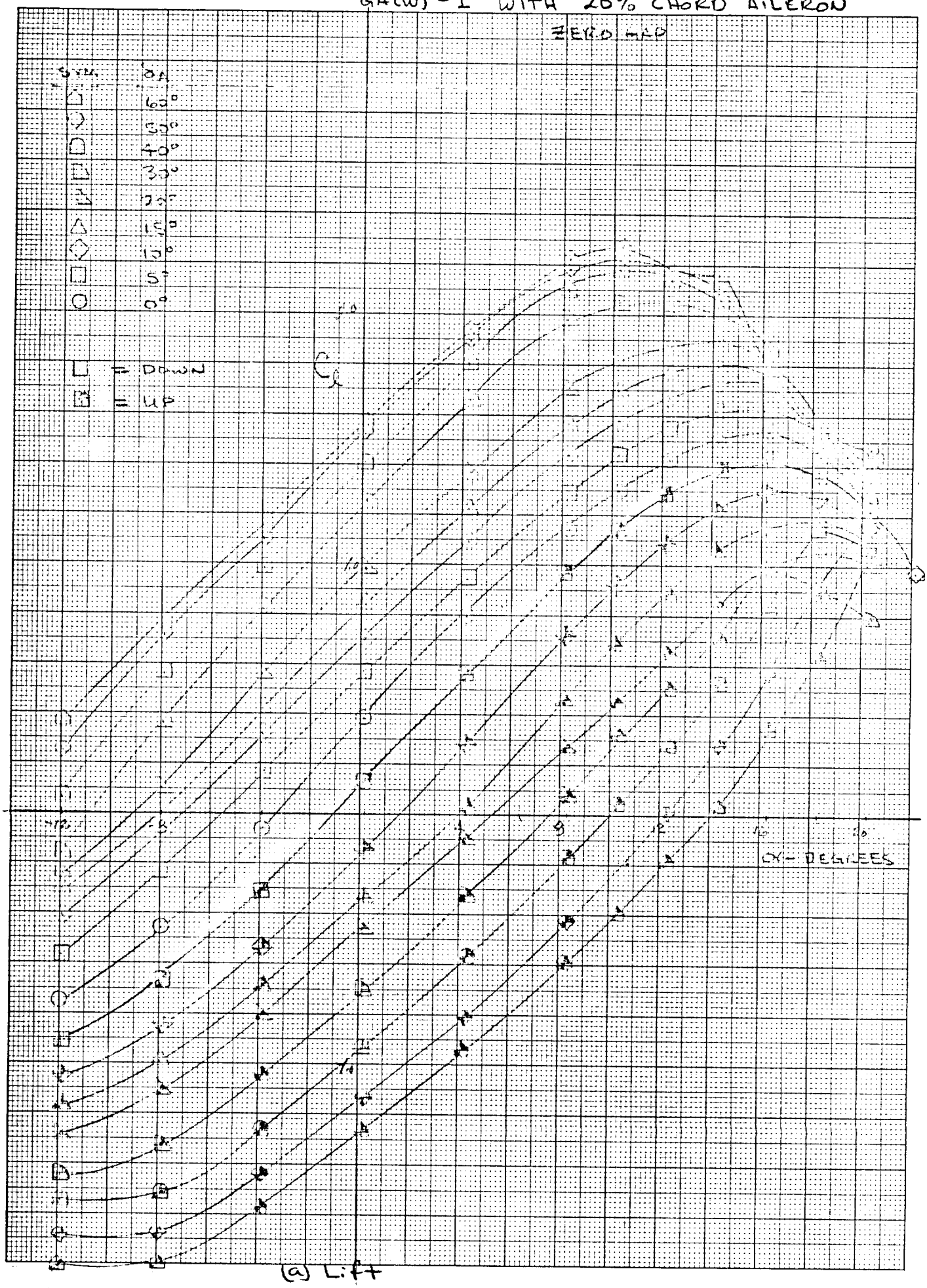
APPENDIX B - PRELIMINARY RESULTS OF GA(W)-1 20%c AILERON TESTS AT WSU

Sept. 1975 Tests

W H Wentz Jr.
Wichita State Univ.

GA(W)-1 WITH 20% CHORD AILERON

ZERO HAD



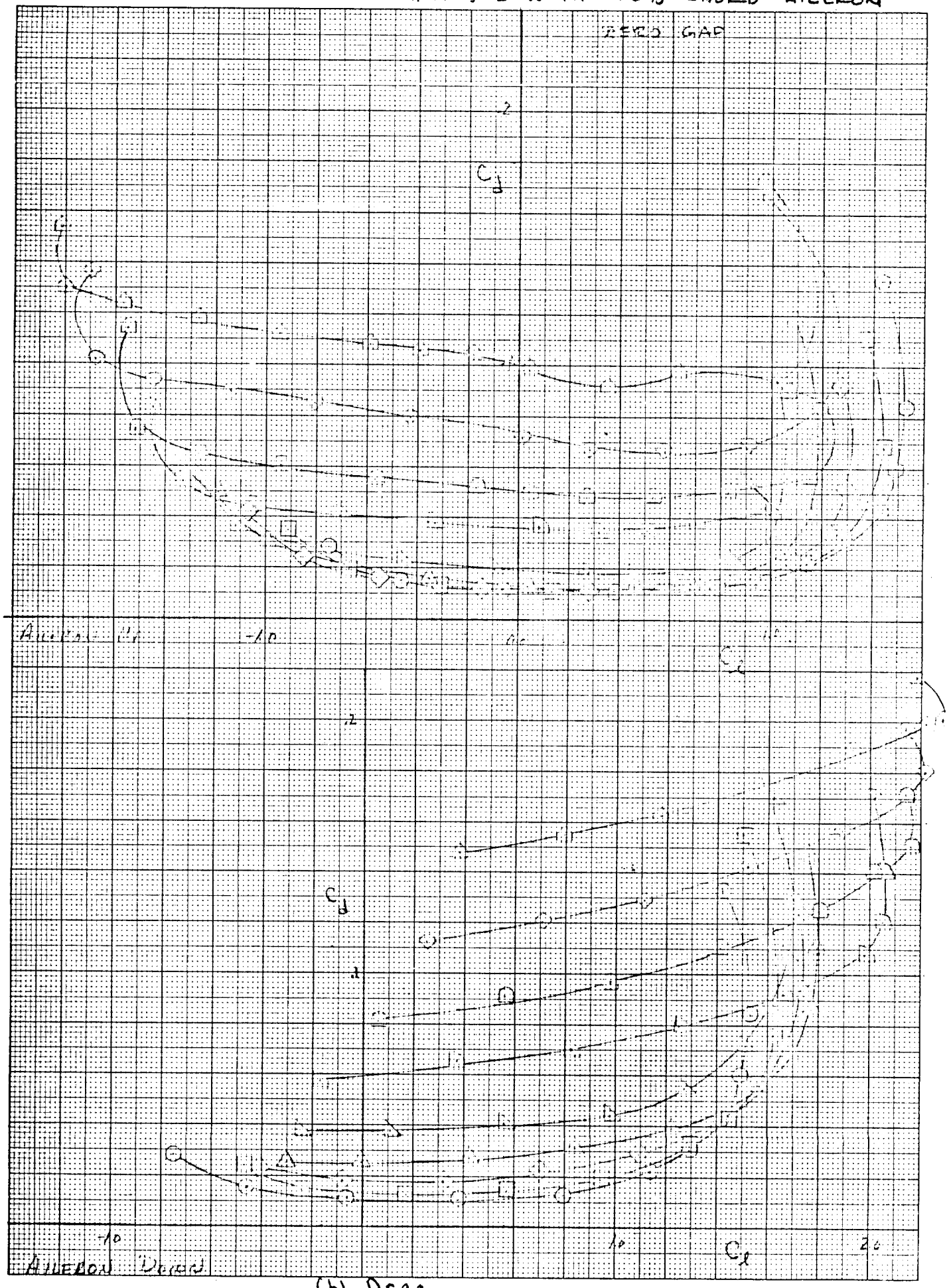
(a) Lift

Figure B1- Aileron Force Characteristics

Revised 8-6-75

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

GA(W)-1 WITH 20% CHORD AILERON



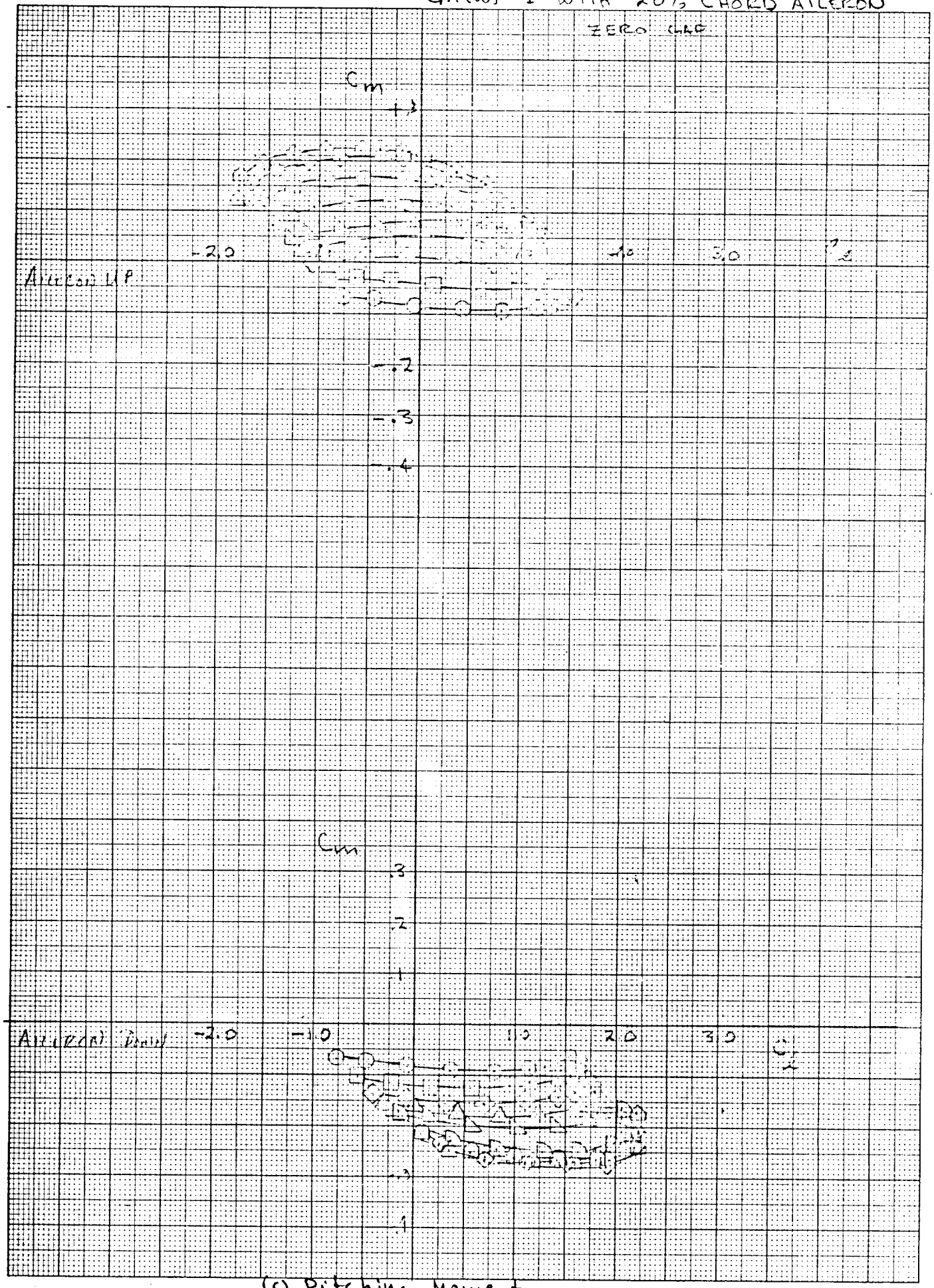
(b) Drag

Figure B1 - Continued.

RINCKER 8-8-75

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

GA(W)-1 WITH 20% CHORD AILERON



(c) Pitching Moment

Figure B1 - Concluded.

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

PUNCHED 8-11-75

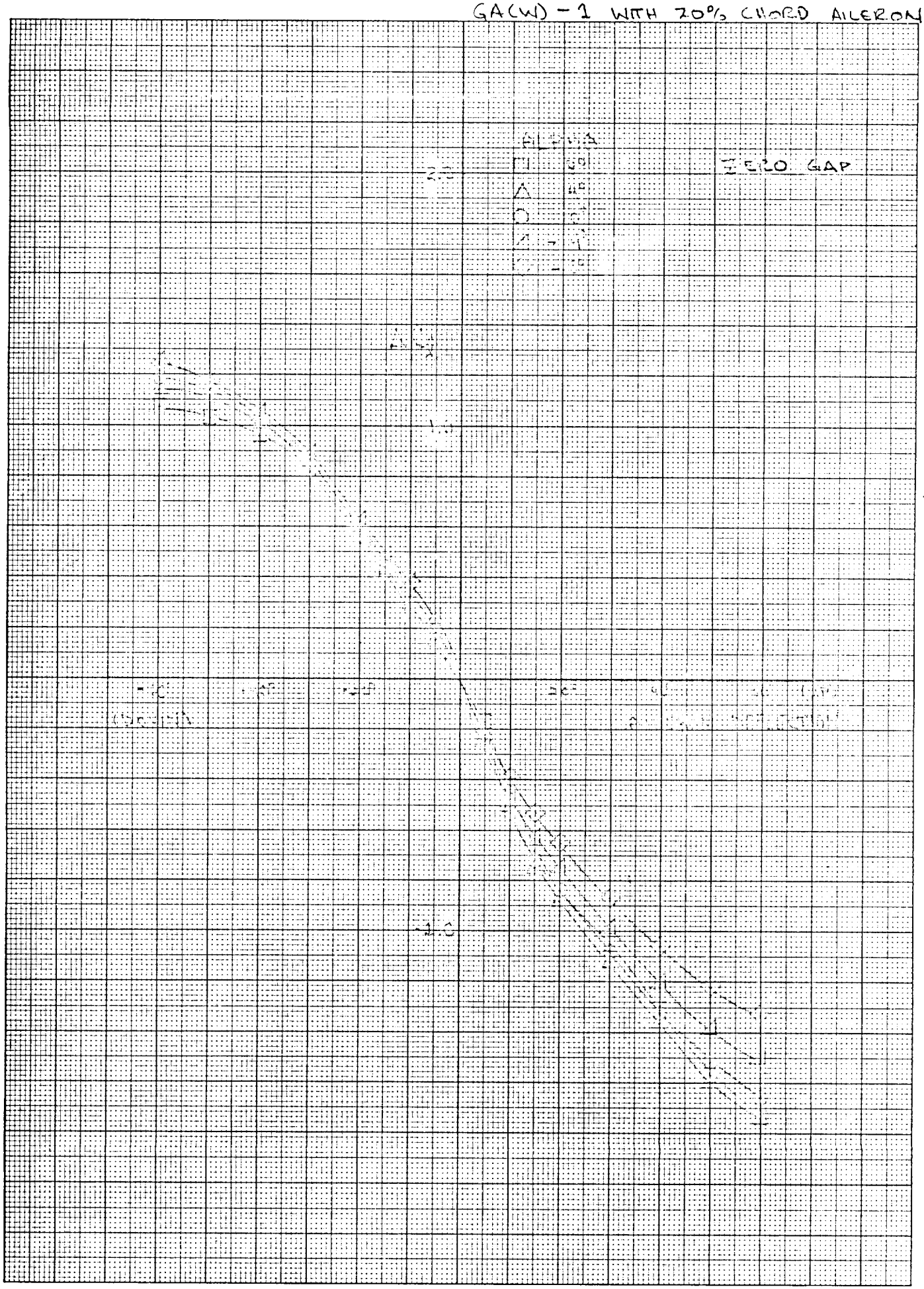


Figure B2 - Aileron Effectiveness

Kurt Fiscko 9/3/75

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

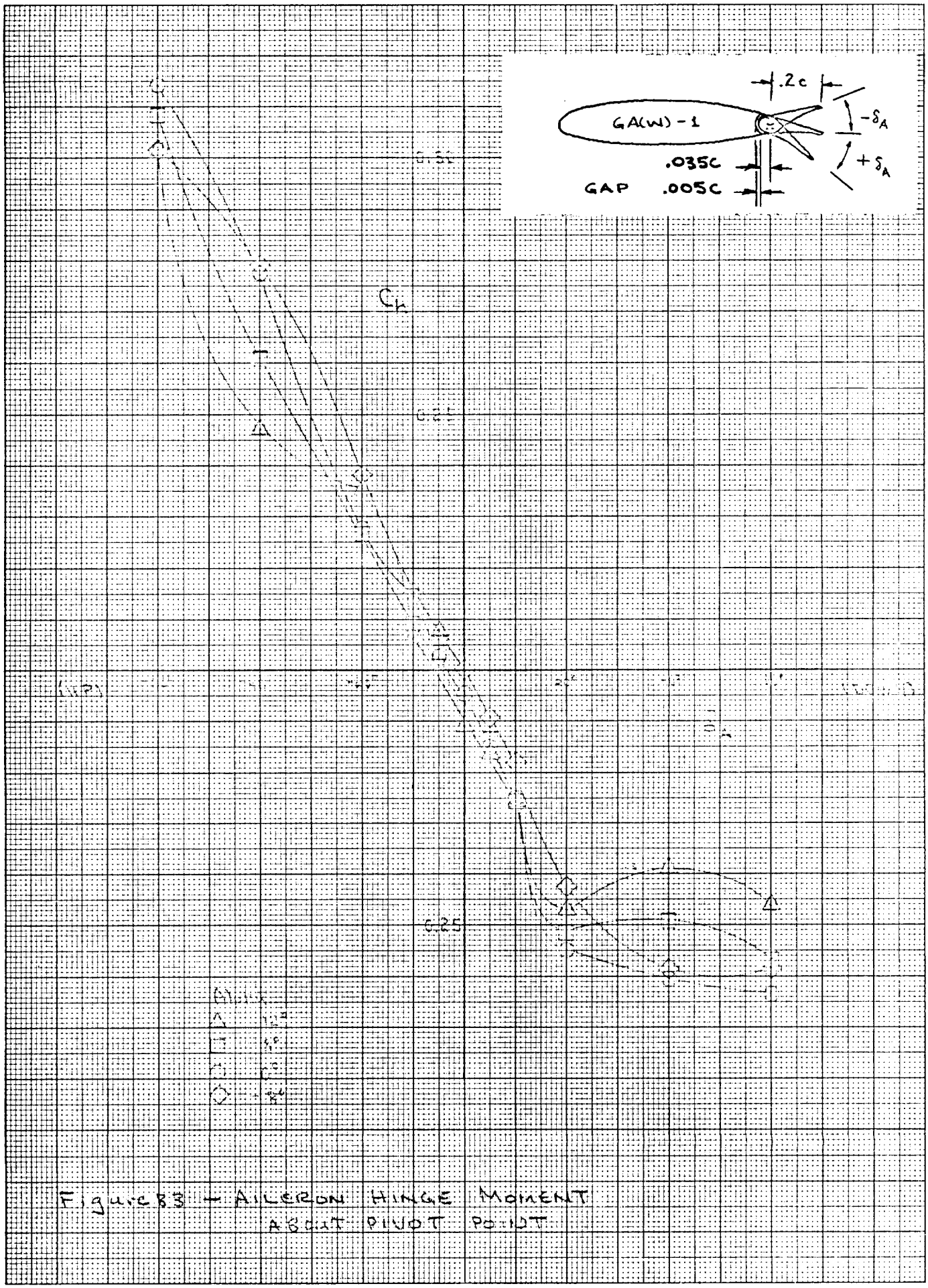


Figure 83 - AILERON HINGE MOMENT ABOUT PIVOT POINT

Kurt Fisko 10-30-75

46 1513
K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

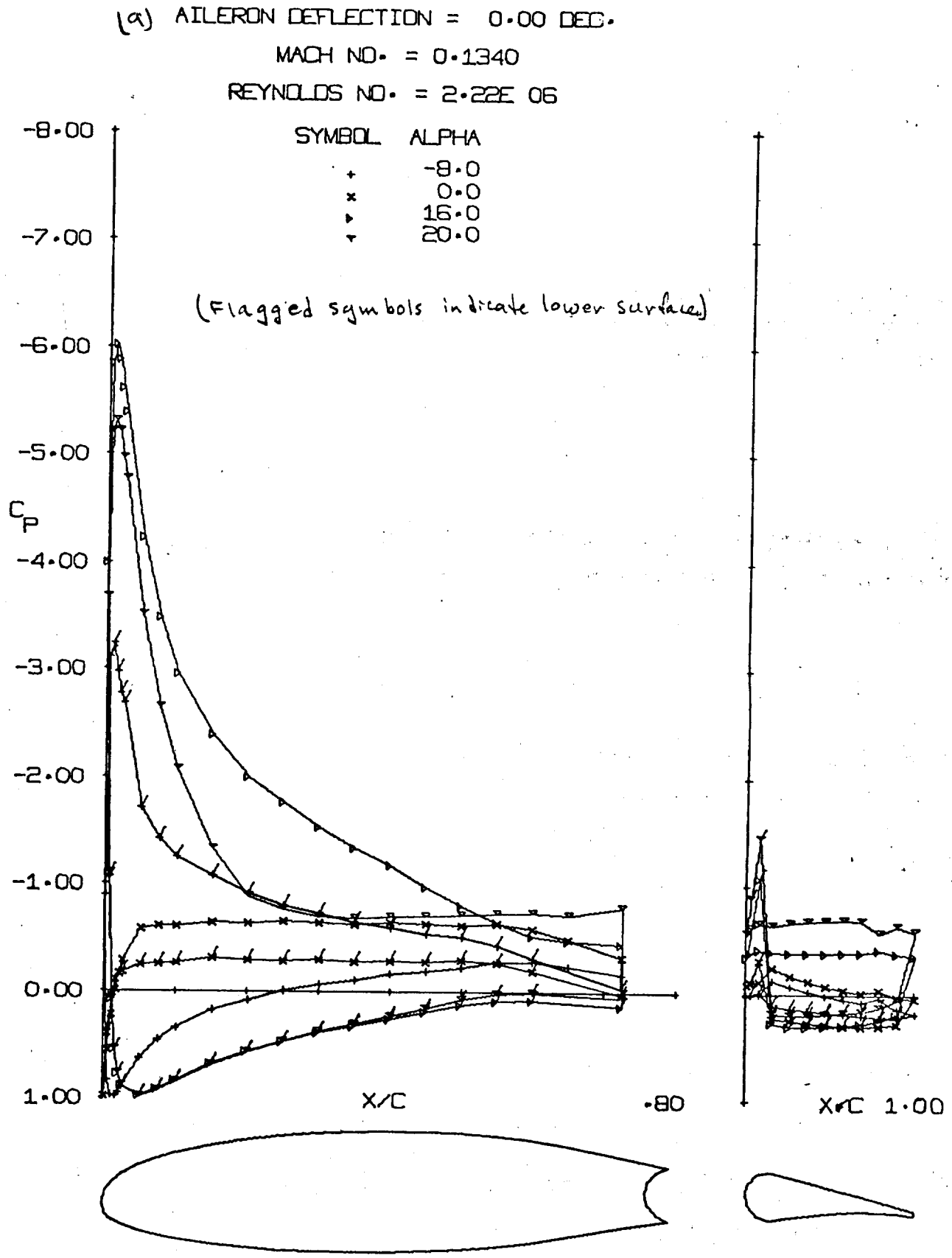
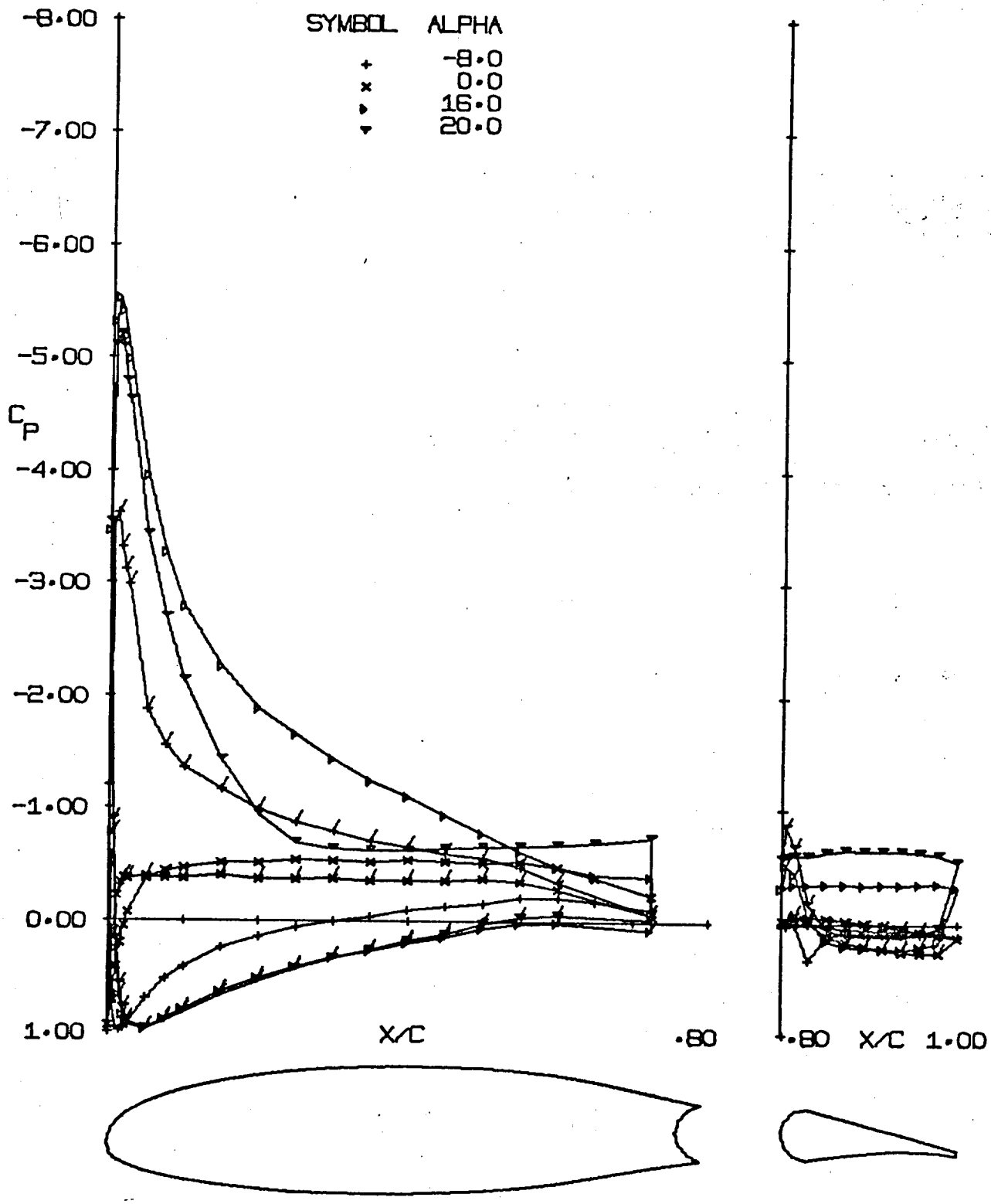


Figure B4- Airfoil and Aileron Pressure Distributions. 0.5% Gap.

(b) AILERON DEFLECTION = -5.00 DEG.

MACH NO. = 0.1340

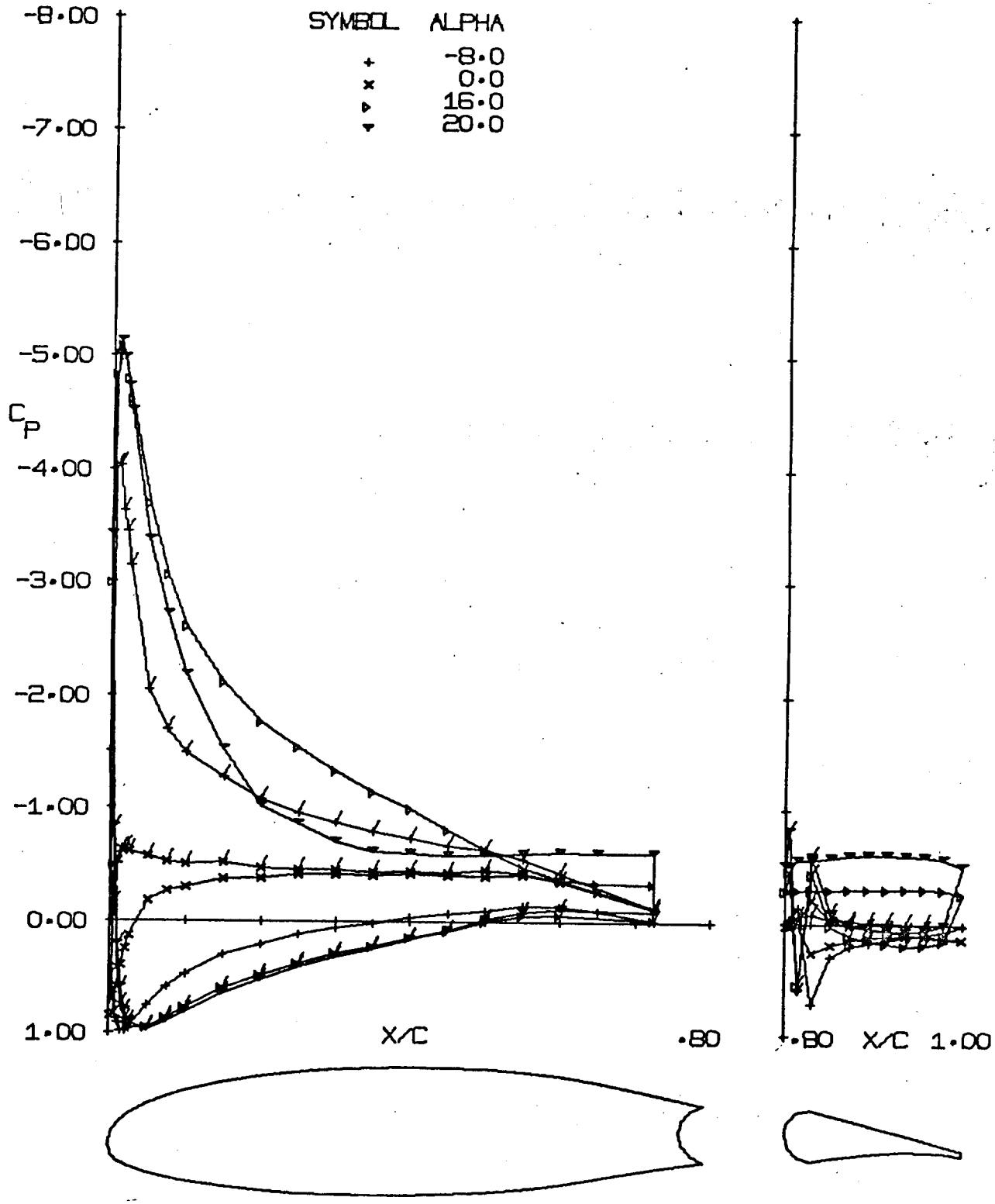
REYNOLDS NO. = 2.22E 06



(c) AILERON DEFLECTION =-10.00 DEG.

MACH NO. = 0.1340

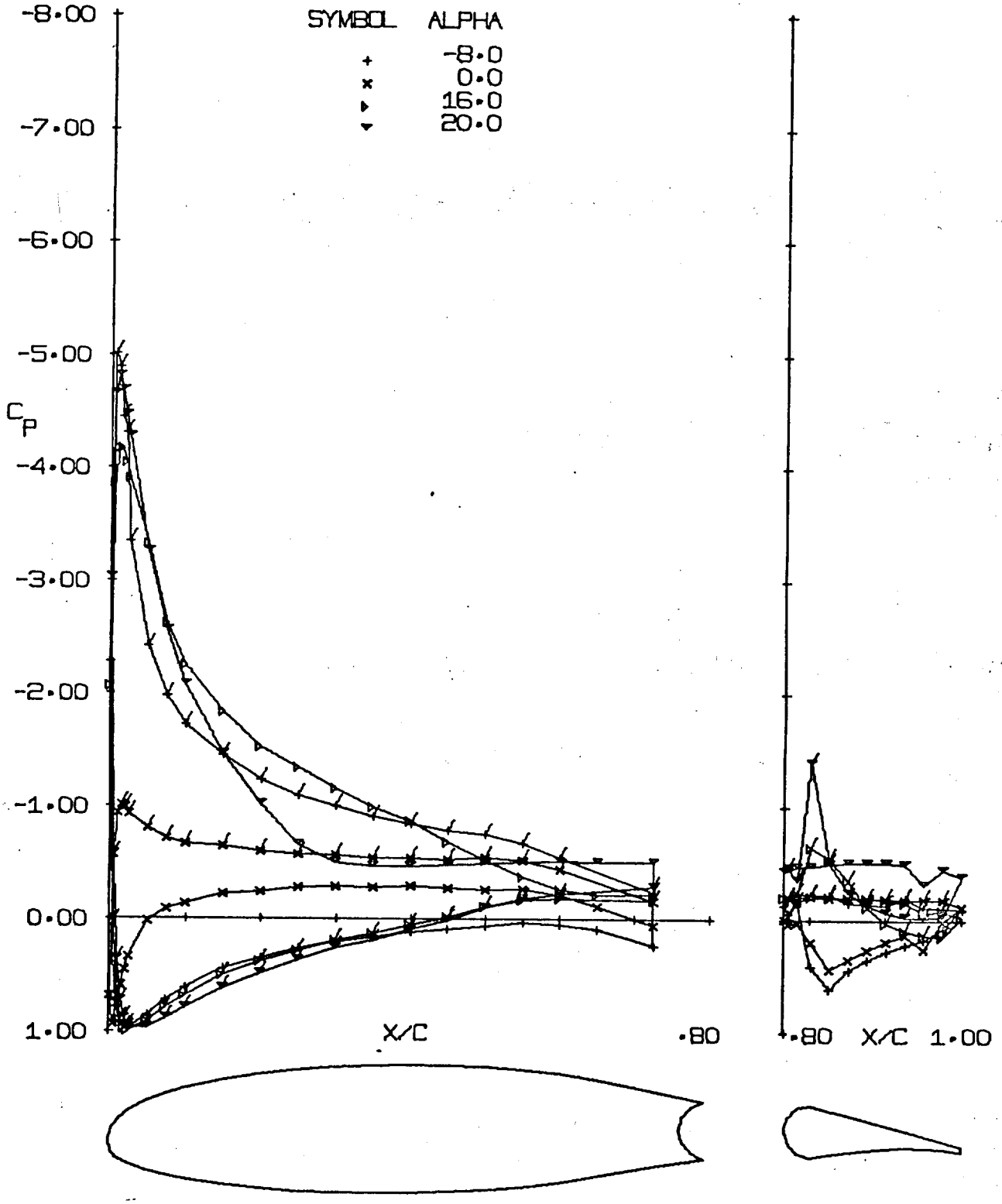
REYNOLDS NO. = 2.22E 06



(d) AILERON DEFLECTION =-20.00 DEG.

MACH NO. = 0.1340

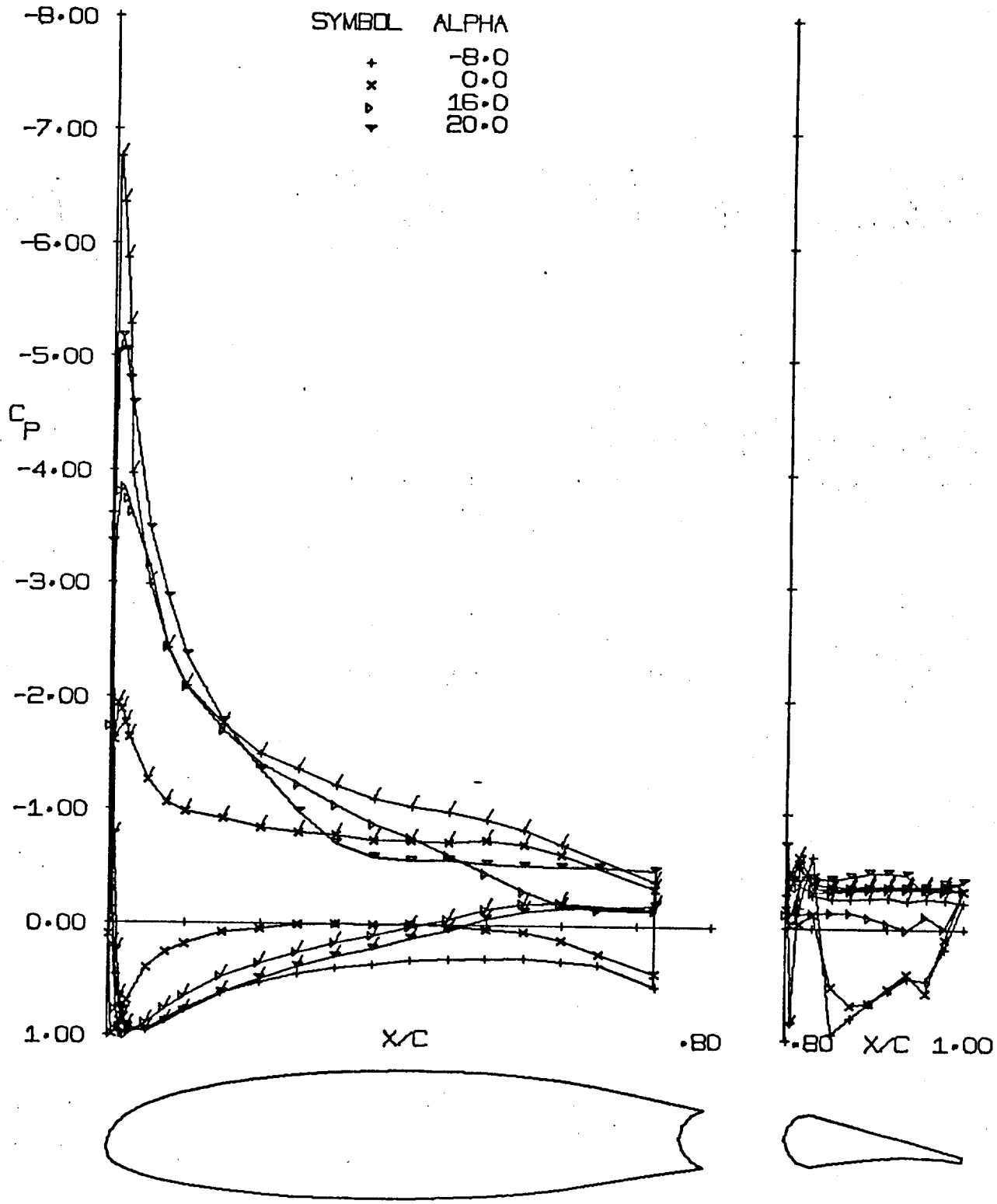
REYNOLDS NO. = 2.22E 06



(e) AILERON DEFLECTION =-40.00 DEG.

MACH NO. = 0.1340

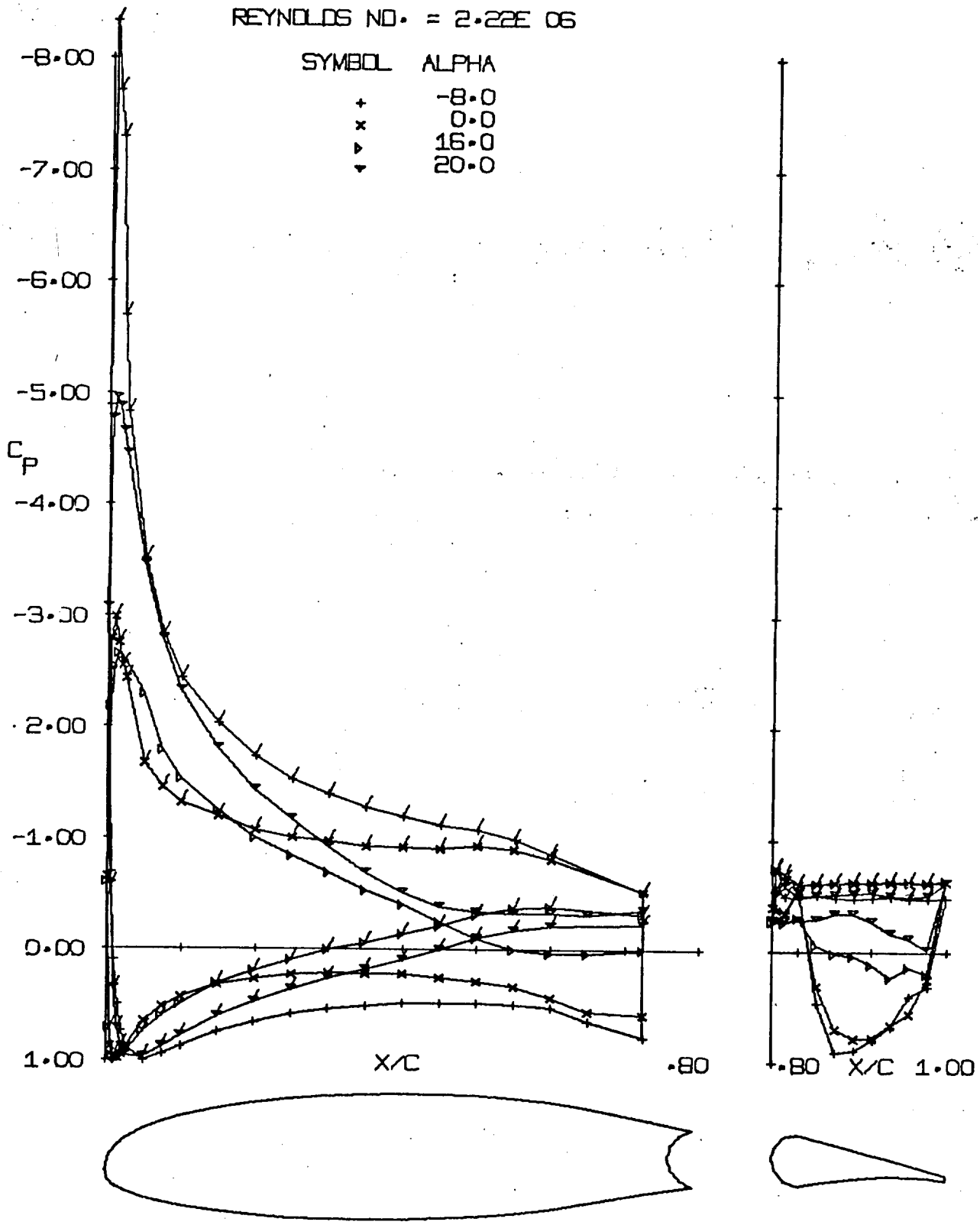
REYNOLDS NO. = 2.22E 06



(f) AILERON DEFLECTION =-60.00 DEG.

MACH NO. = 0.1340

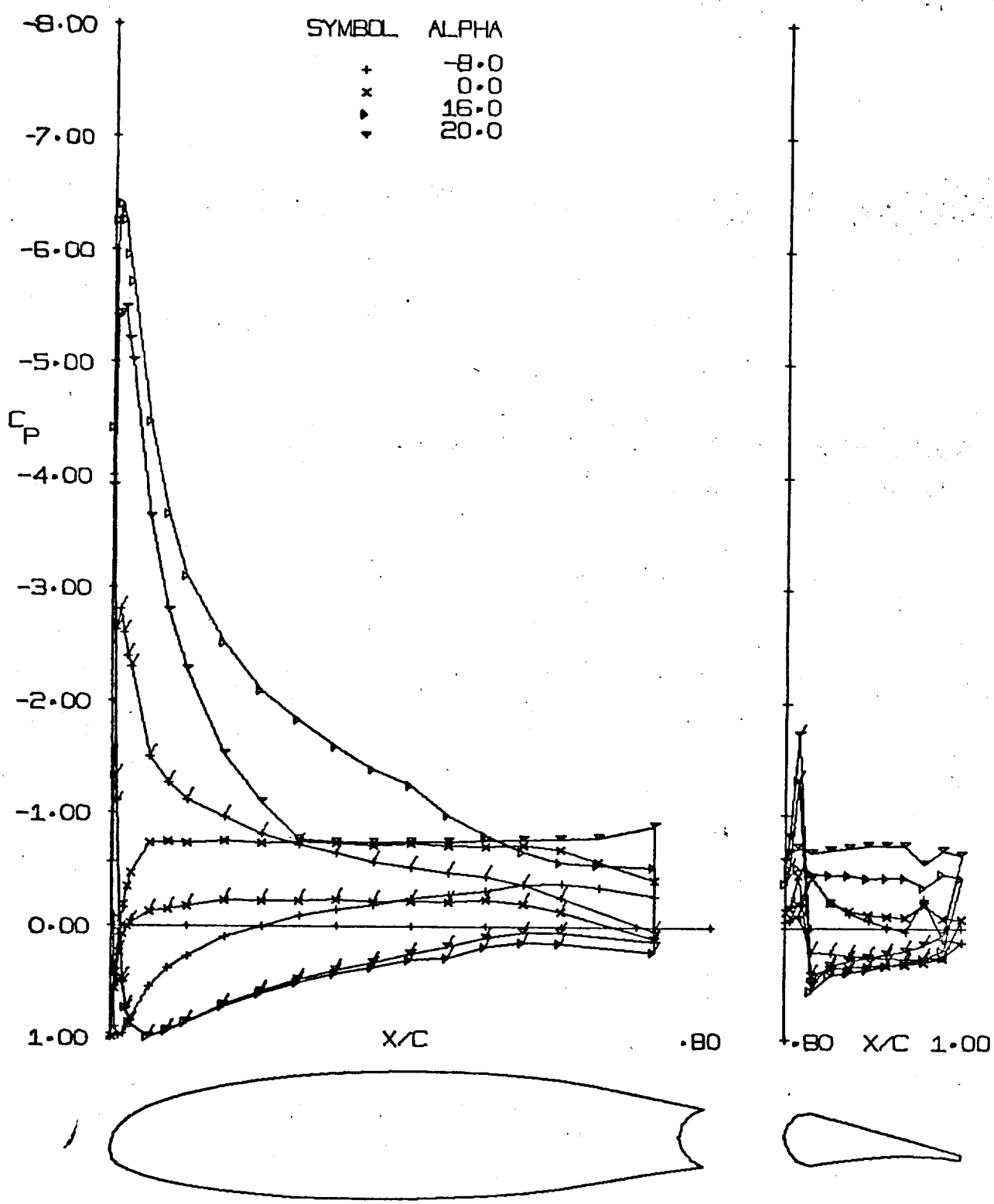
REYNOLDS NO. = 2.22E 06



(g) AILERON DEFLECTION = 5.00 DEG.

MACH NO. = 0.1340

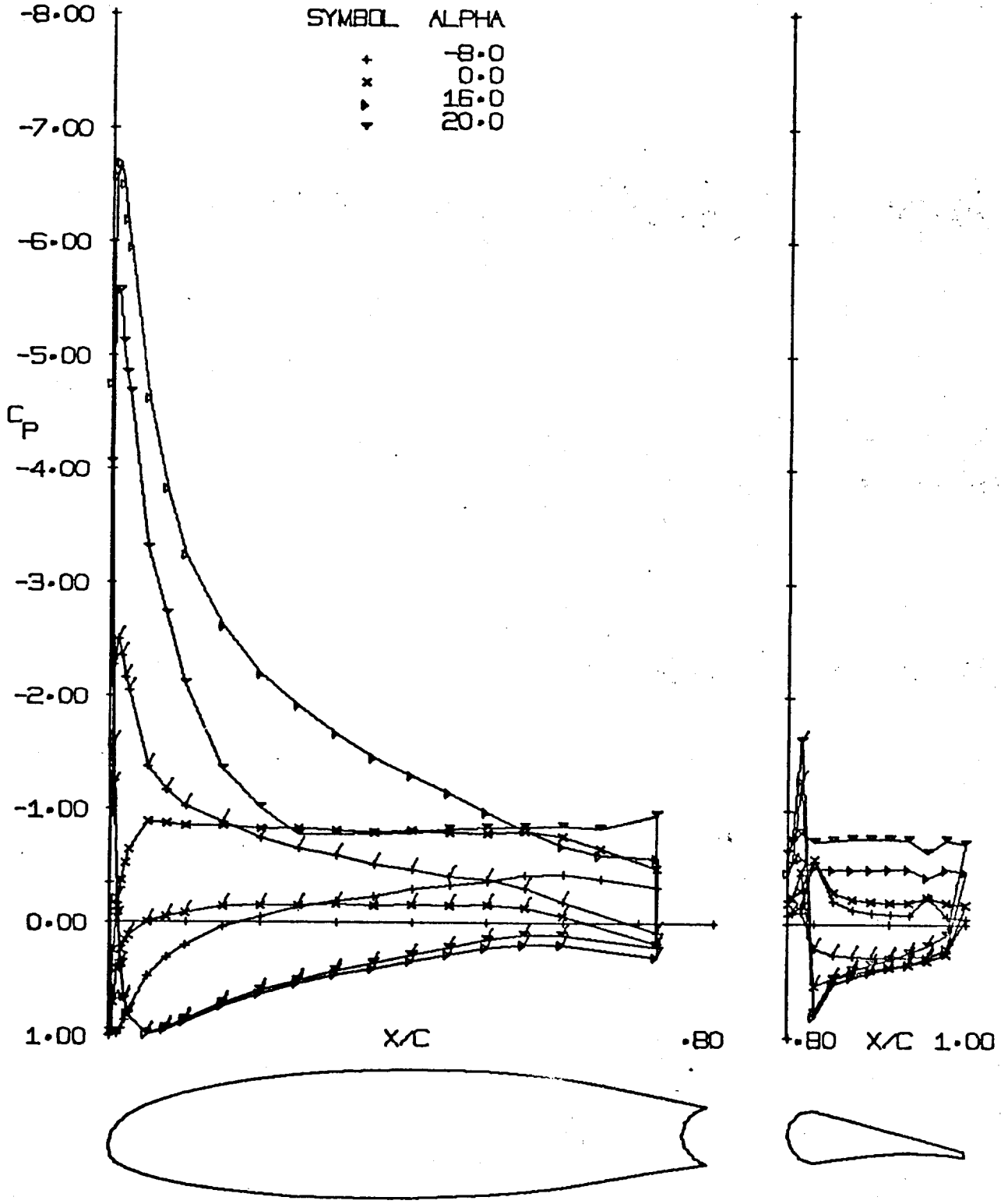
REYNOLDS NO. = 2.22E 06



(h) AILERON DEFLECTION = 10.00 DEG.

MACH NO. = 0.1340

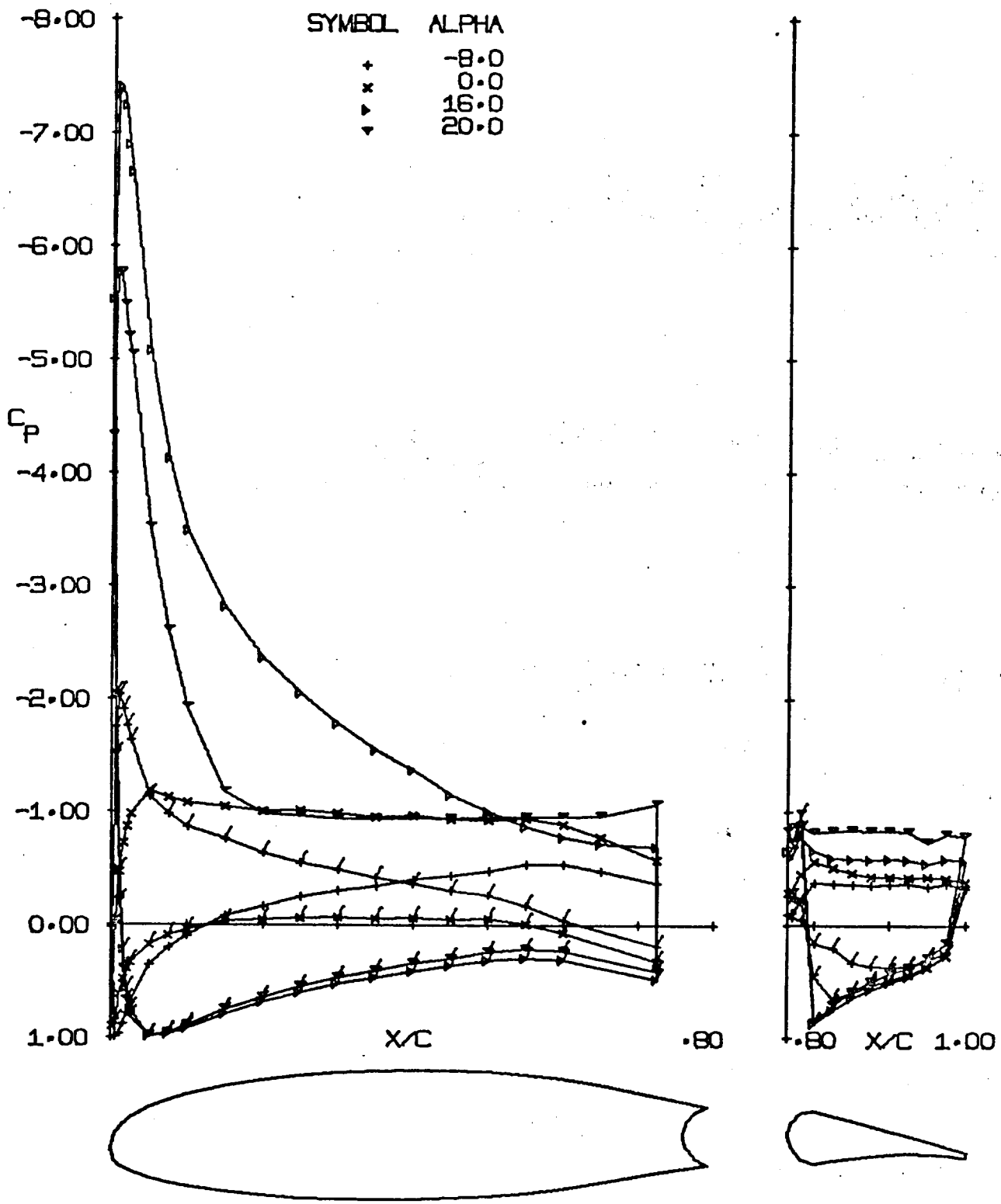
REYNOLDS NO. = 2.22E 06



(i) AILERON DEFLECTION = 20.00 DEG.

MACH NO. = 0.1340

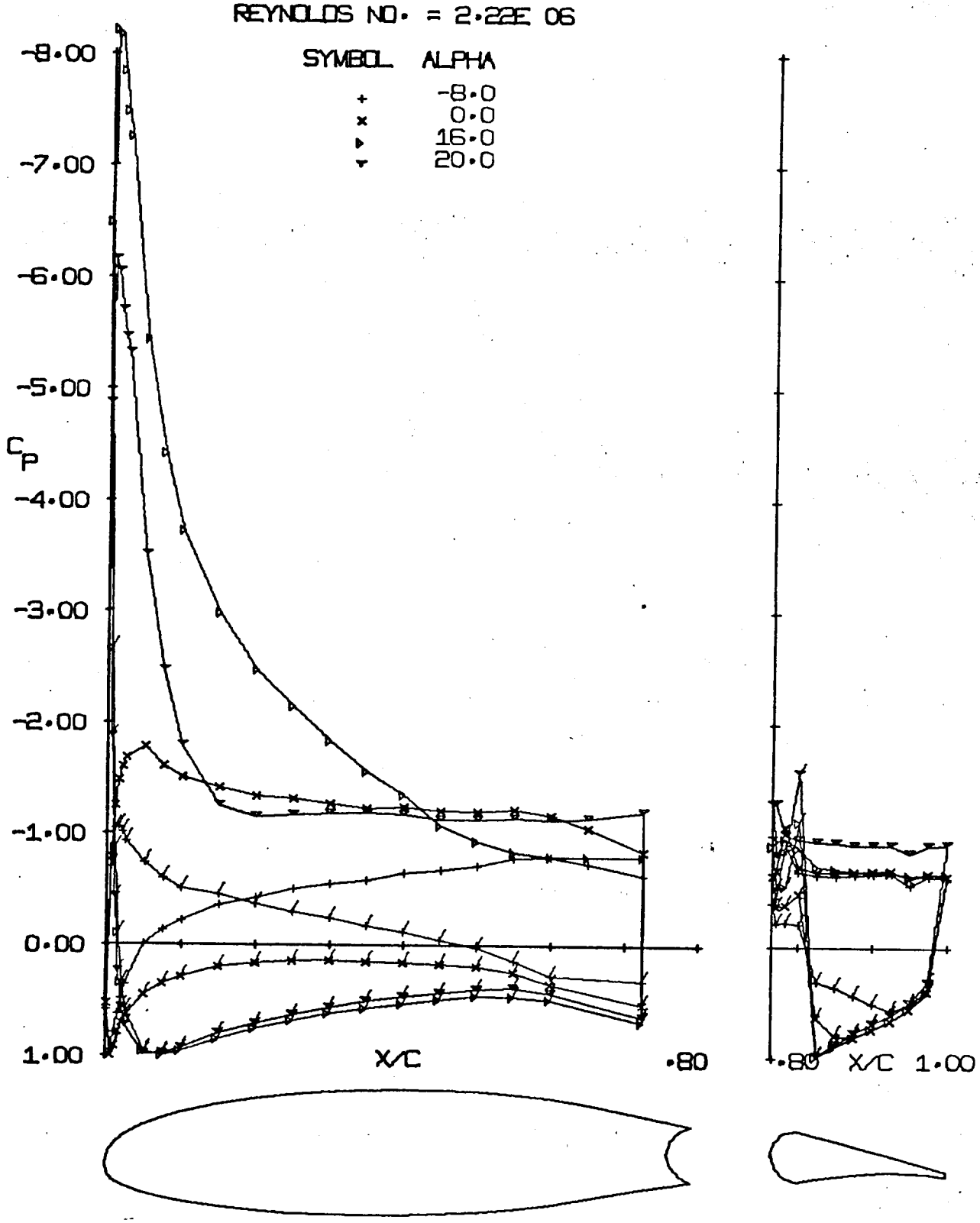
REYNOLDS NO. = 2.22E 06



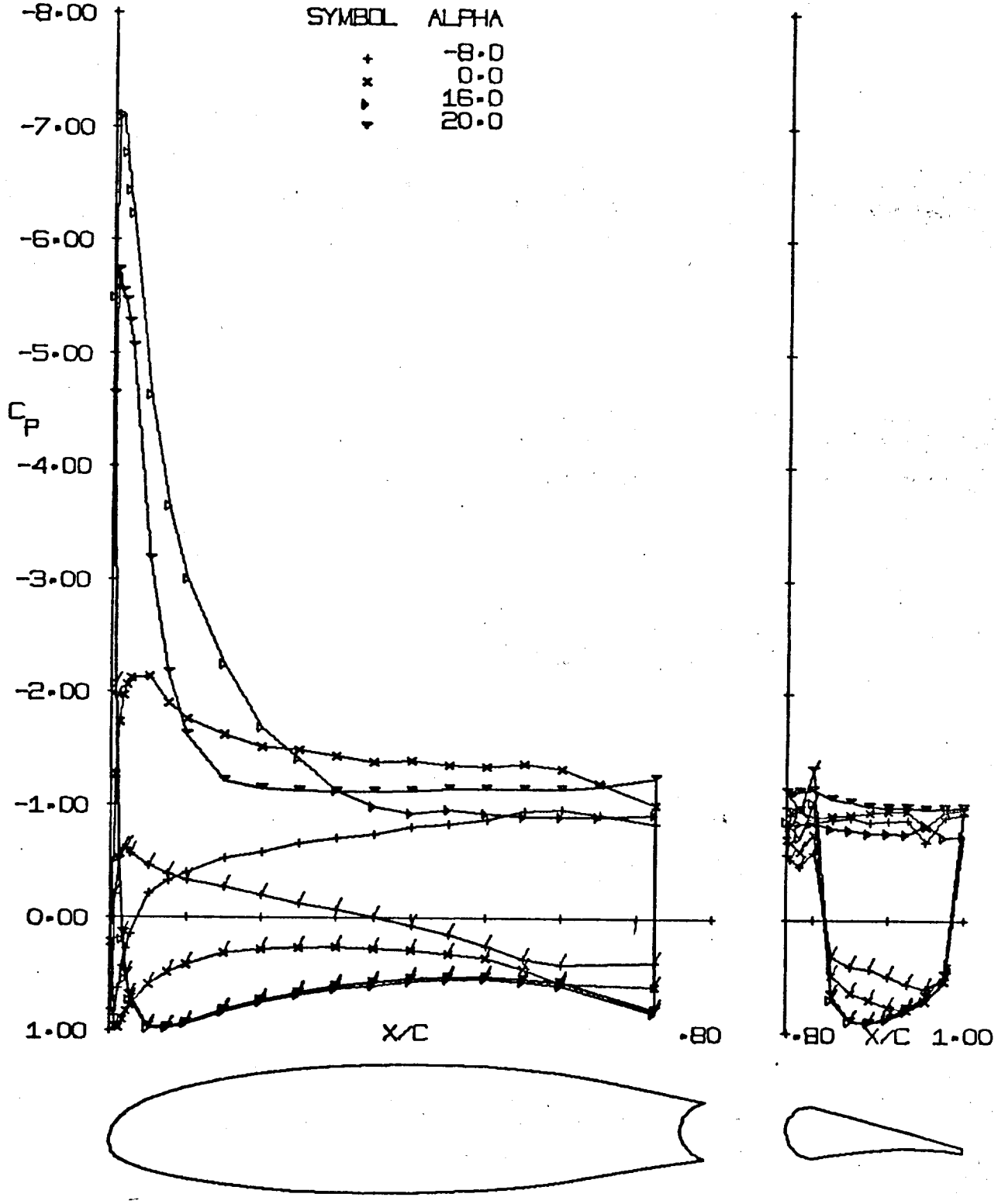
(j) AILERON DEFLECTION = 40.00 DEG.

MACH NO. = 0.1340

REYNOLDS NO. = 2.22E 06



(k) AILERON DEFLECTION = 60.00 DEG.

MACH NO. = 0.1340

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