

QCX  
Avro  
CF105  
P-AD-88

(12)

FILE IN VAULT

C-105 P/Aero Data/88  
~~CONFIDENTIAL~~  
COMPARISON OF O.3 LANGLEY WIND TUNNEL  
RESULTS WITH C.A.L. RESULTS AND  
ANALYZED ESTIMATES  
Copy 6 VAE

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Report no.: QCX AVRO-CF105- P-AD-88

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by (Name): Michel W. Drapeau

(Dept.): A/DND Coordinator, Access to Information

Date: Dec. 7, 1992

R. Drapeau  
Signature



45005



A. V. ROE CANADA LIMITED  
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105

REPORT NO. P/Aero Data/88

FILE NO.

NO. OF SHEETS:

TITLE

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COMPARISON OF .03 LANGLEY WIND TUNNEL RESULTS

WITH C.A.L. RESULTS AND ESTIMATES

Classification cancelled / changed to: UNCLASSIFIED

By authority of: DRDA 7/DARET 5-8/DAS Eng 6-4-5

Date: 5 Nov 1992

Signature: Baubeey

Unit / Rank / Appointment: DS1S 3, Secretary CRAD HQ DRP

PREPARED BY: E. R. Fish

DATE: Jan. 1957

CHECKED BY: [Signature]

DATE

SUPERVISED BY

**ORIGINAL SIGNED BY  
S. KWIATKOWSKI**

DATE

APPROVED BY

DATE

ISSUE NO.	REVISION NO.	REVISED BY	APPROVED BY	DATE	REMARKS

12422365

AIRCRAFT:

C-105

PREPARED BY

DATE

R. Rangl

May 1956

CHECKED BY

DATE

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COMPARISON OF 0.3 LANGLEY WIND TUNNEL RESULTS

WITH C.A.L. RESULTS AND ESTIMATES

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X Not Included

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MALTON, ONTARIO

TECHNICAL DEPARTMENT

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REPORT No. P/AERO DATA/33

SHEET No.

PREPARED BY

DATE

E.R. Fish

January 1957.

CHECKED BY

DATE

INTRODUCTION

In this report, a comparison of the rigid longitudinal and lateral stability derivatives obtained from Langley Wind Tunnel Tests has been made with Cornell Series III wind tunnel tests and extrapolations.

The Cornell tests were conducted between 0.5 and 1.23 Mach Numbers and theoretical estimates were made for values between 1.23 and 2.0 Mach Numbers.

The Langley tests were run at 1.4, 1.6, 1.8 and 2.0 Mach Numbers to confirm the theoretical estimates.

The comparison was made using the basic wing configuration including drooped leading edge, notch and extension.

The centre of gravity was taken as  $.28\bar{c}$  on M.A.C.

The details of the tests were as follows:-

WIND TUNNEL	DATE	MODEL SCALE	MACH NO.	REYNOLDS NO.
C.A.L. 4' x 4' Transonic	Series III May 1955	.04	0.5 to 1.23	$1.64 \times 10^6$ to $2.45 \times 10^6$
Langley 4' x 4' Supersonic	April 1956	.03	1.41	$1.74 \times 10^6$
Langley 4' x 4' Unitary	July 1956	.03	1.6 1.8 2.0	$2.68 \times 10^6$ $2.50 \times 10^6$ $2.31 \times 10^6$

FROM P/WT/80  
SHEET 1-1

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C<sub>L</sub> vs MACH NO.

C<sub>L</sub> vs MACH NO.

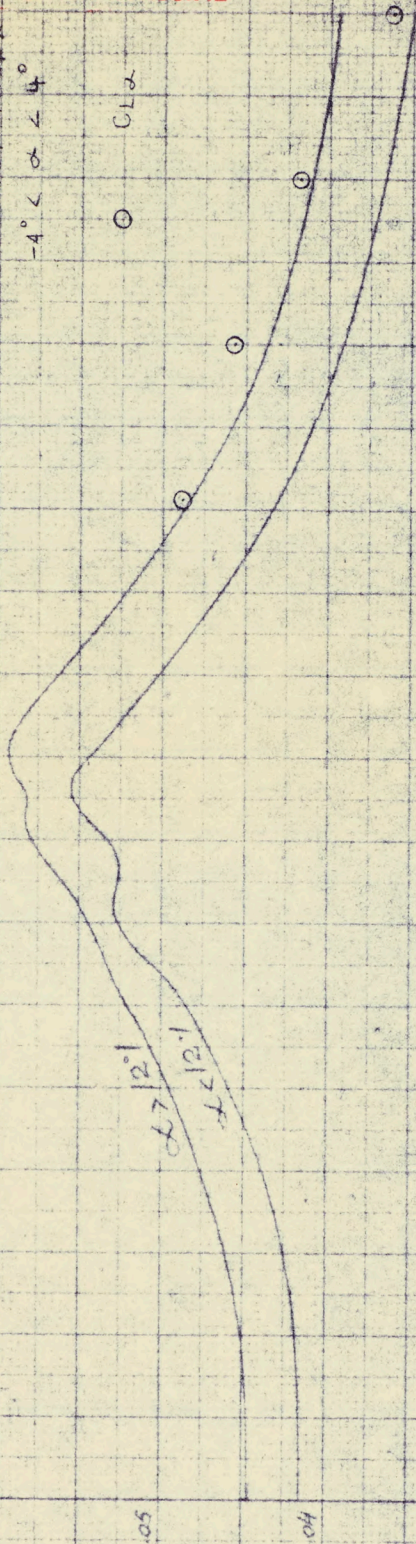
CENA # B<sub>2</sub>V, M<sub>1</sub>, E<sub>10</sub>, M<sub>5</sub> D<sub>8</sub> & D

.03 LANGLEY MODEL

-4° < α < 4°

○ C<sub>L2</sub>

MACH NO.



C<sub>L</sub>  
MACH NO.

0.06

0.05

0.04

0.03

0.02

FROM P/WT/80  
SHEET 1-2

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.03 LANGLEY MODEL

C/105

$\alpha_0$  vs MACH NO

CONF: B<sub>1</sub> V. M. E. vs D<sub>0.4</sub> W

$\alpha_0$   
DEGREES

30

20

10

4

6

8

10

12

14

16

18

MACH NO.

$\alpha_0$

$\alpha_0$

$\alpha_0$

$\alpha_0$



May 1956

R. S. R

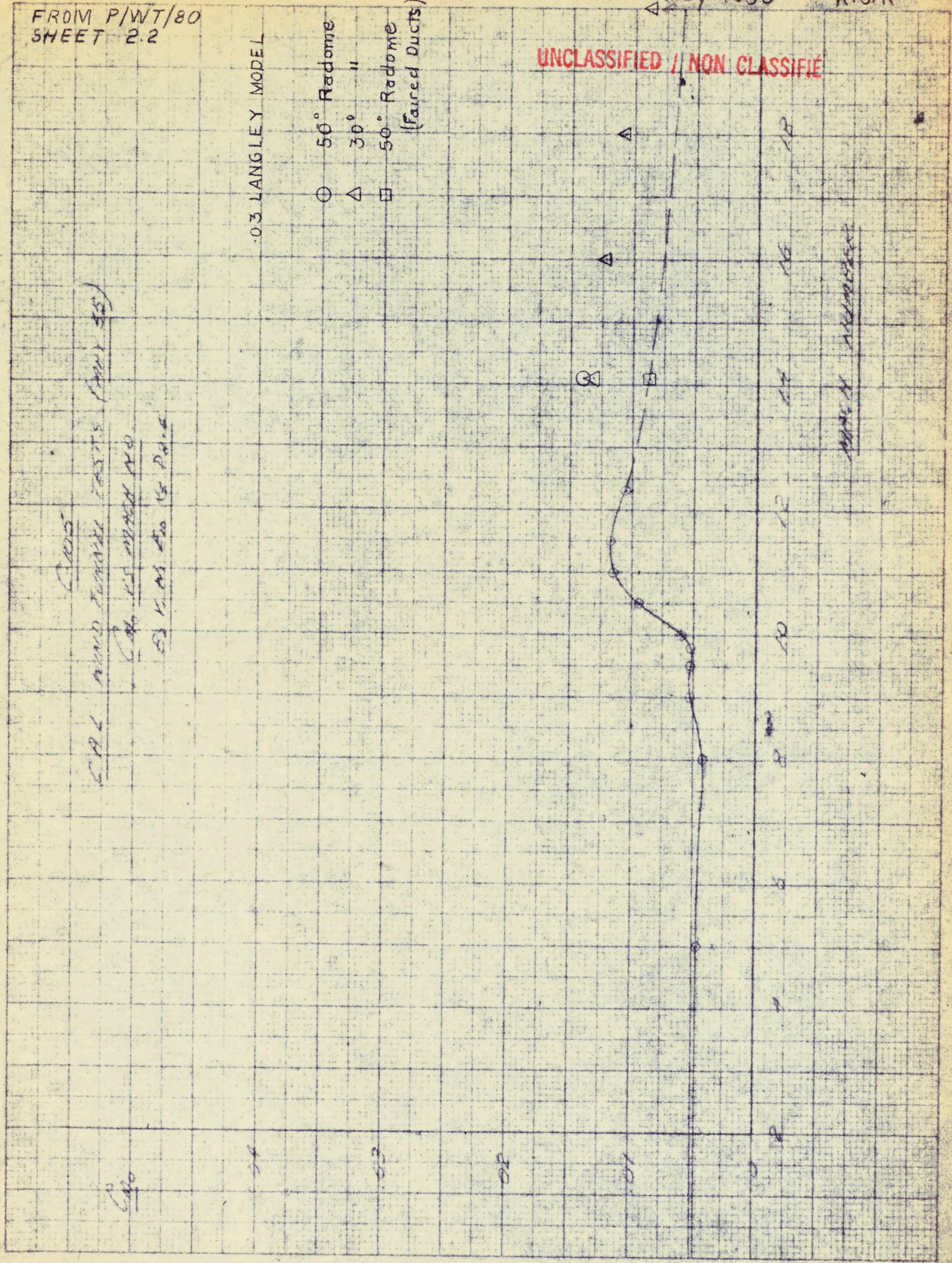
FROM P/WT/80  
SHEET 2.2

0.3 LANGLEY MODEL

- 50° Radome
- △ " "
- 50° Radome (Faired Ducts)

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CALC AND TUNNEL TESTS (MAY 55)  
 CAP. W. BRAN. NO.  
 BY K. M. Ho. 15 P. 1.4



10 X 10 TO THE 1/4 INCH 359-12

Cp

0.4

0.3

0.2

0.1

0

2

4

6

8

10

12

14

16

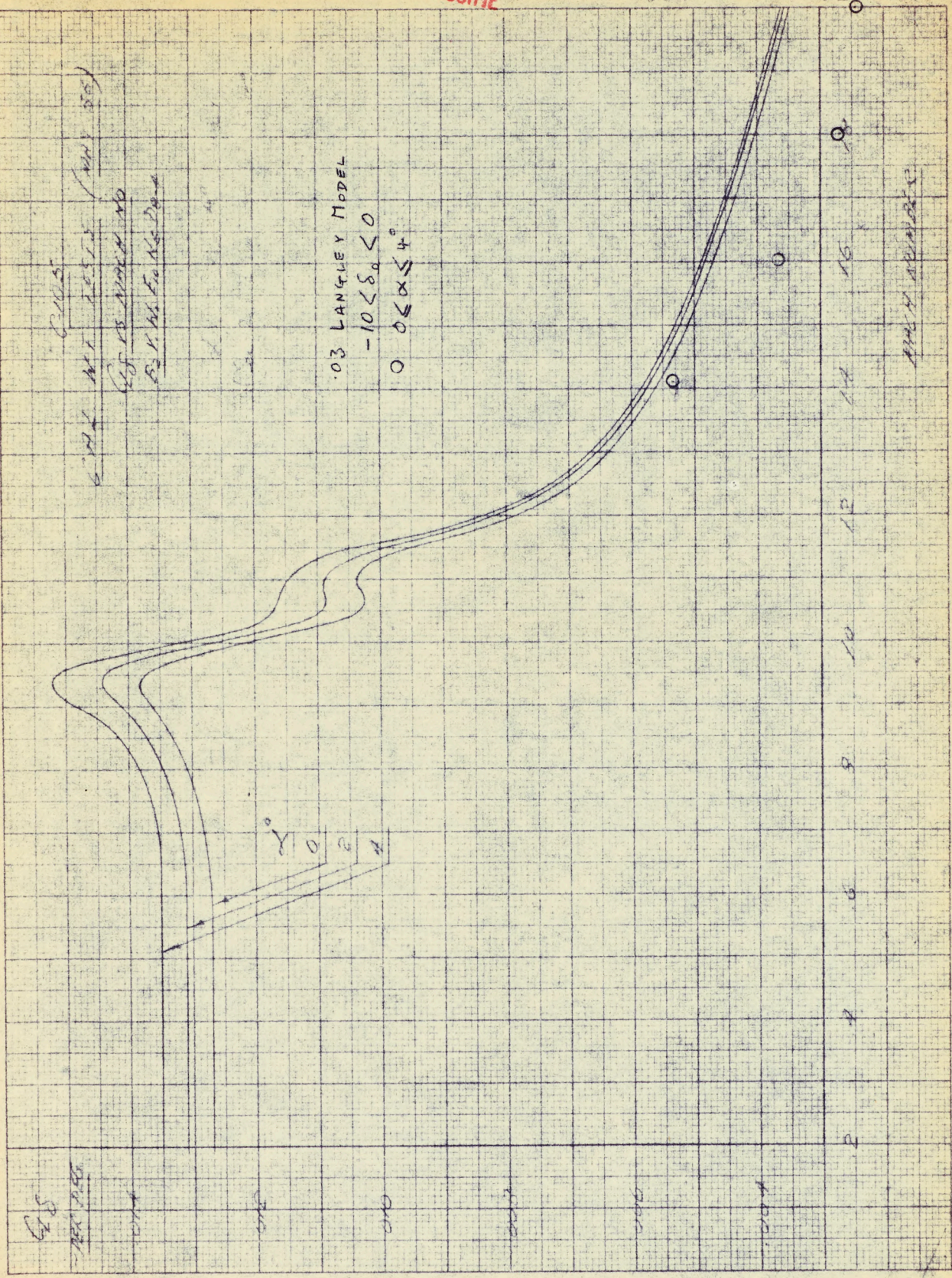
18

MAY 1956

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3.1.1 P/AERO DATA/88  
JULY 55

K&E 10X10 TO THE 1/2 INCH  
KLUFFEL & ESSER CO. MADE IN U.S.A.

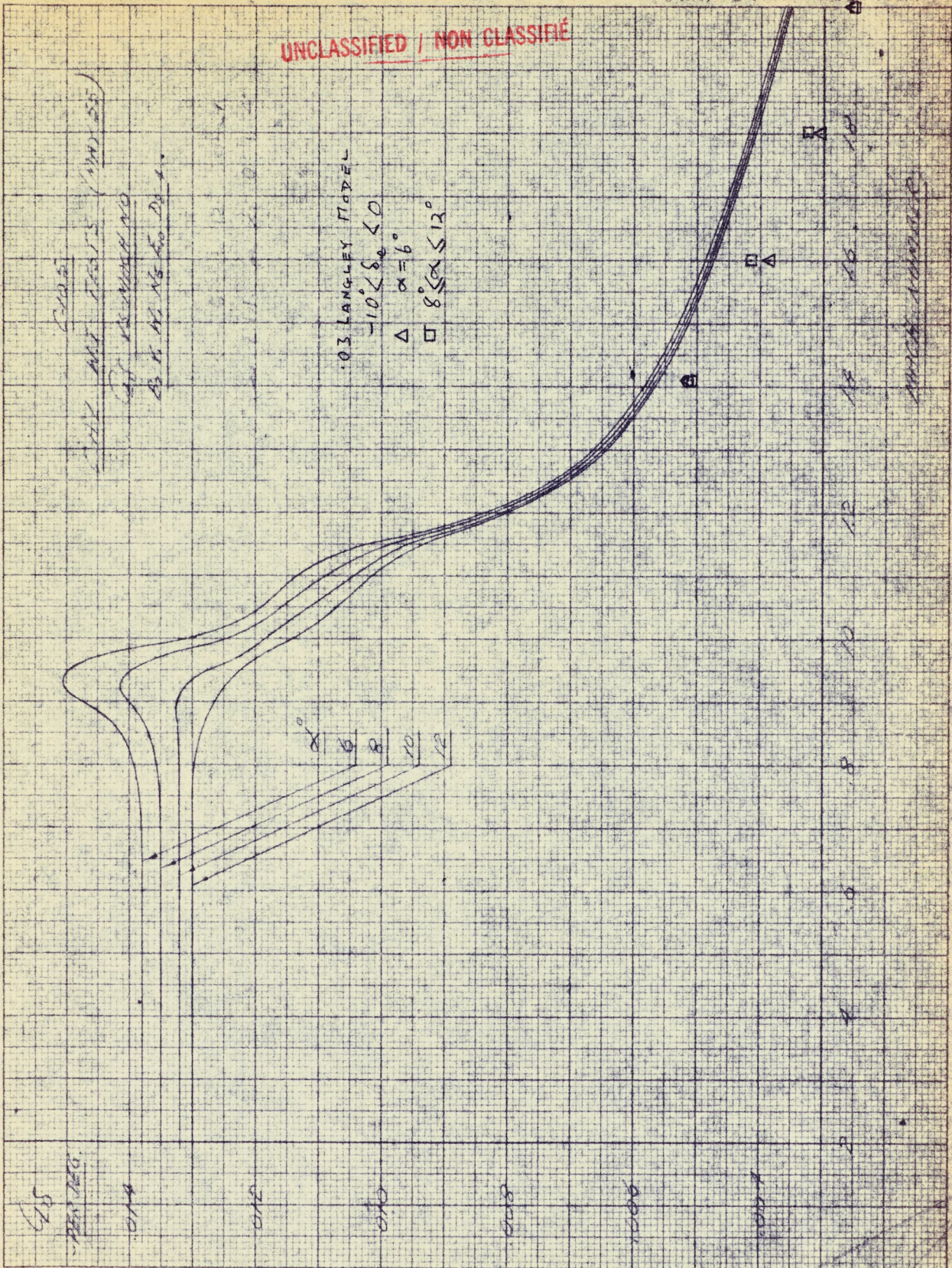


0.5  
 0.4  
 0.3  
 0.2  
 0.1  
 0.0

P/WT/80

3-12 P/WT DATA/88  
JULY 55

UNCLASSIFIED / NON CLASSIFIED



CURVE  
 1-17  
 1-18  
 1-19  
 1-20  
 1-21  
 1-22  
 1-23  
 1-24  
 1-25

$\alpha$   
 6  
 8  
 10  
 12

1-25  
 1-24  
 1-23  
 1-22  
 1-21  
 1-20  
 1-19  
 1-18  
 1-17

P/WT/80

K&E 10 X 10 TO THE 1/4 INCH 359-12  
 NEUFEL & ESSER CO. KALING, PA.

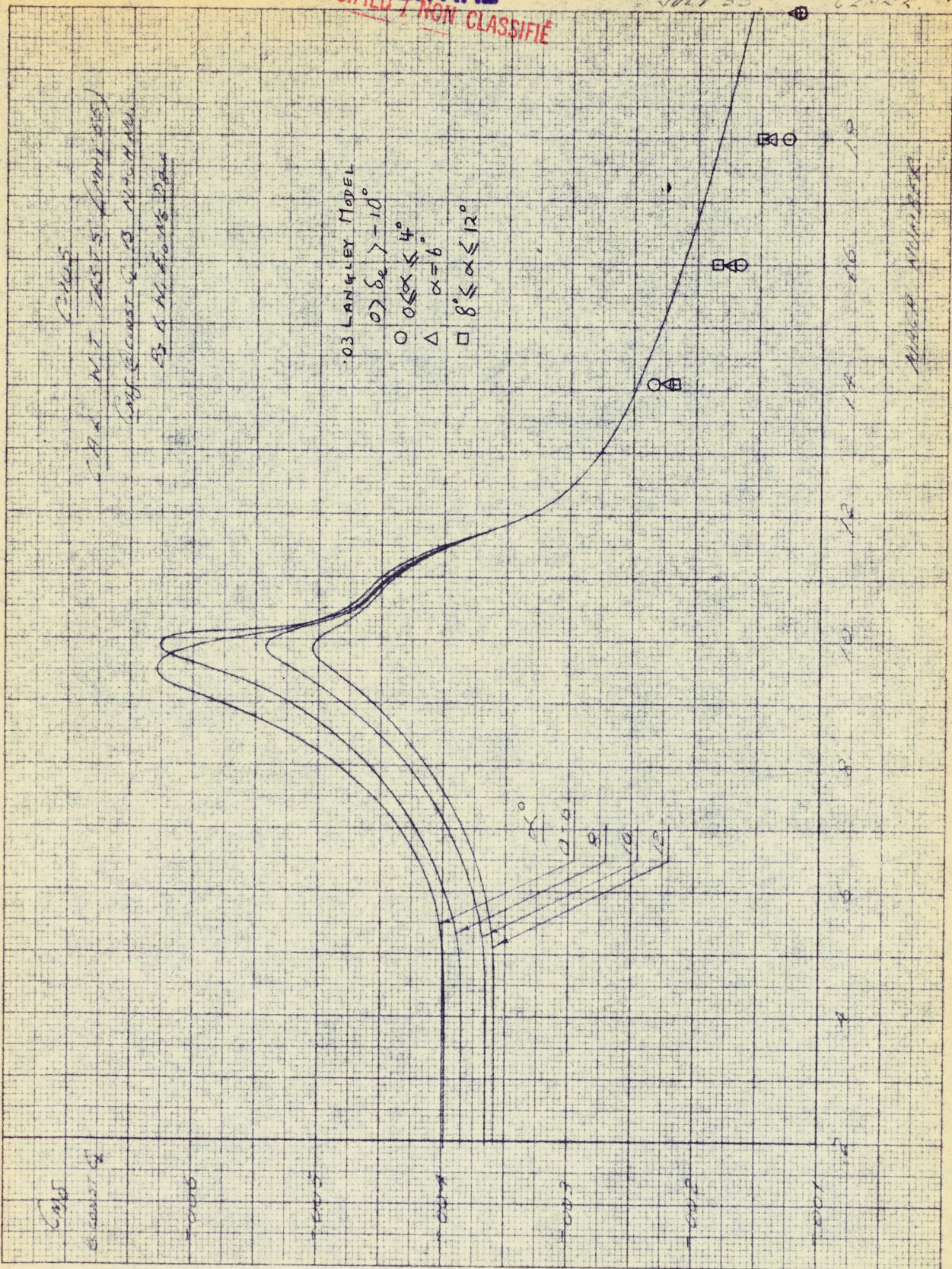
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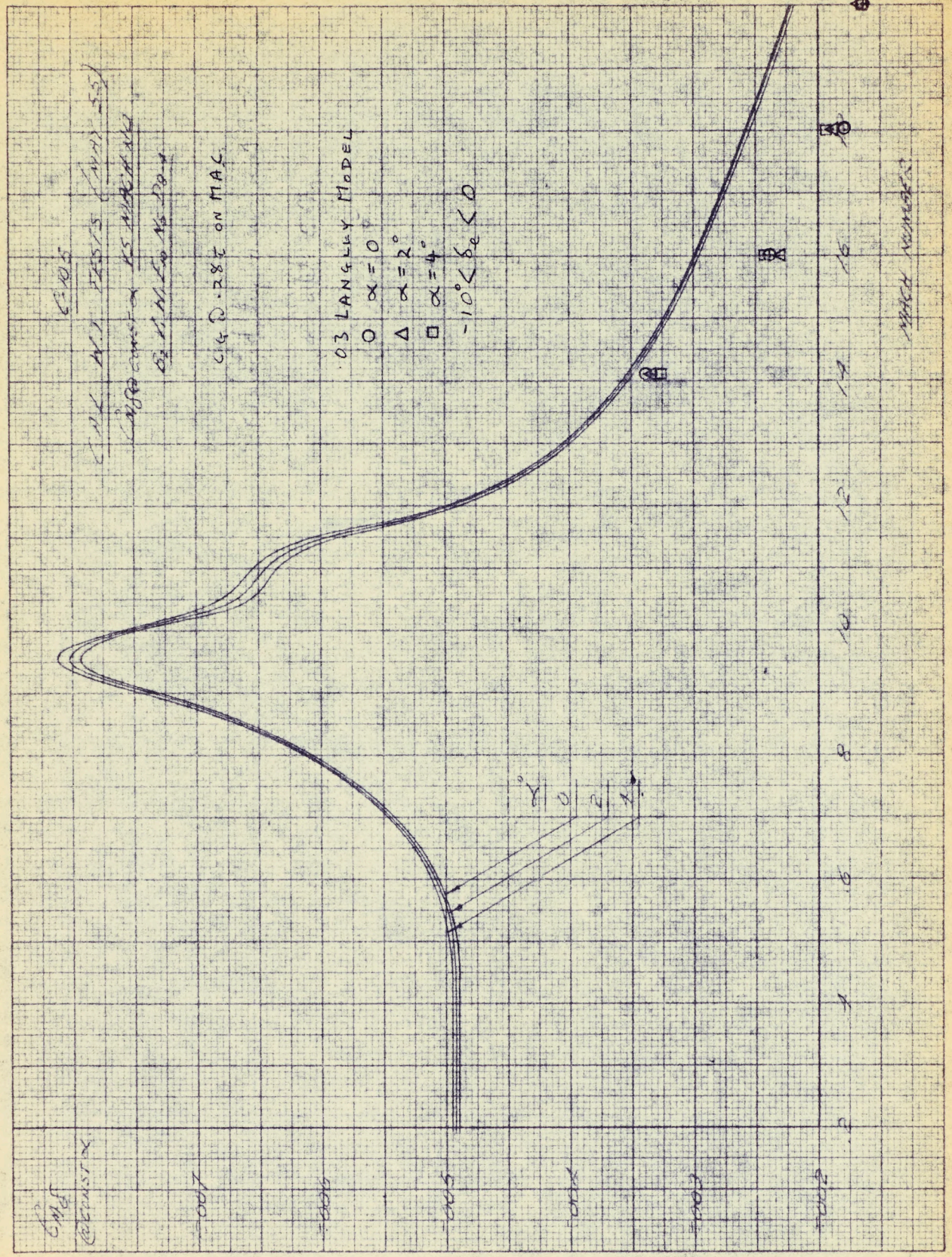
3.2

P/AERO DATA/88

JULY 55

2026





$C_{L,0.5}$   
 CNL N1 1515/5 (JUNY 55)  
 CAPA constant AS AIRCRAFT  
 O. H. H. Co No 20-1

C14 D. 287 on MAC.

0.3 LANGLEY MODEL

- $\alpha = 0$
- △  $\alpha = 2^\circ$
- $\alpha = 4^\circ$
- $10^\circ < \delta_e < 0$

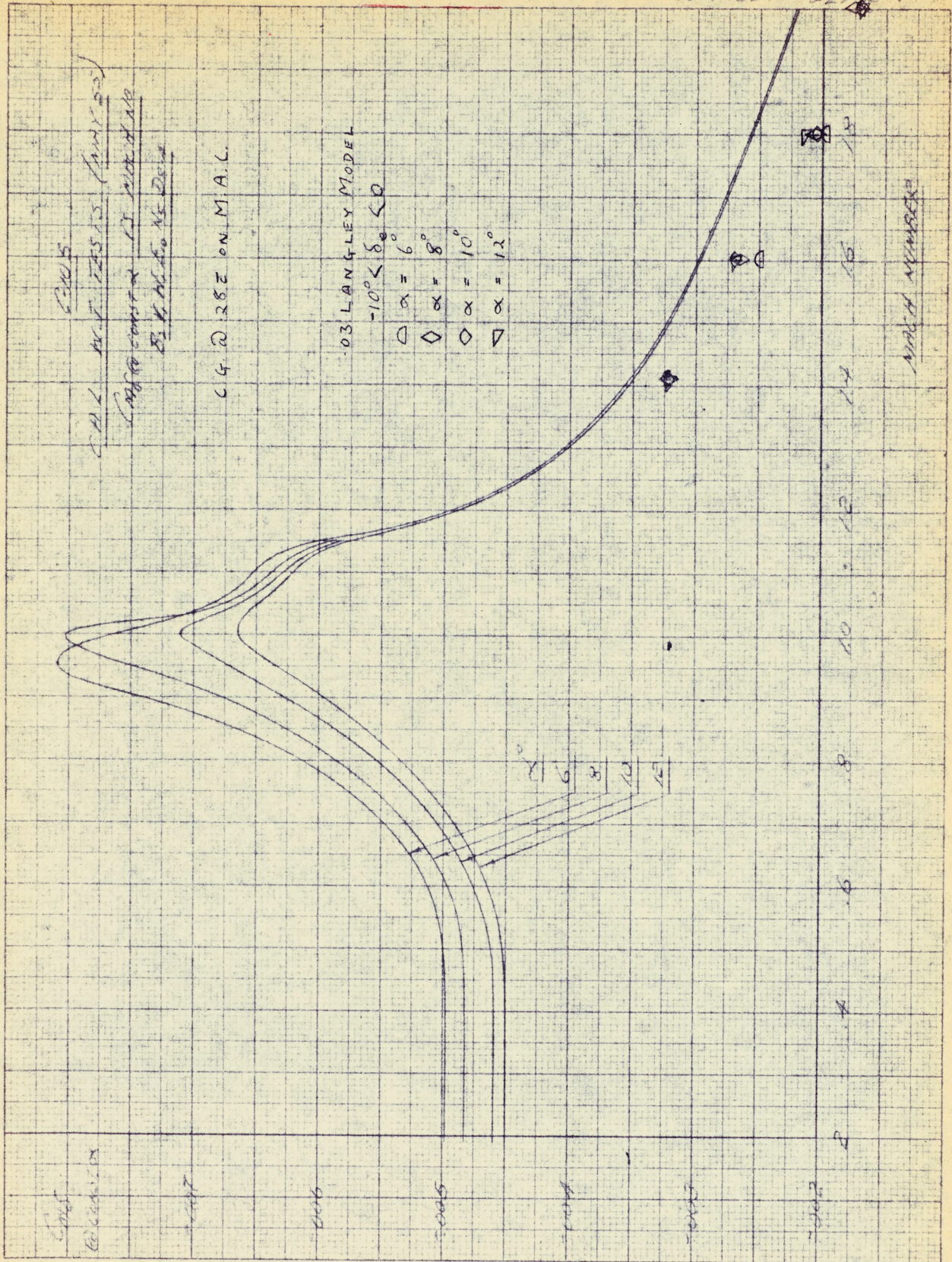
MARCH 1955

K&E 10 X 10 TO THE 1/2 INCH 359-12  
 KEUFFEL & ESSER CO. MADE IN U.S.A.

C14  
 0.3 LANGLEY MODEL

P/WT/80

JULY 55



CALC AT 22515 (MAY 52)  
 CALC CONSTANT IS 2100000  
 B. H. H. 10 15 20

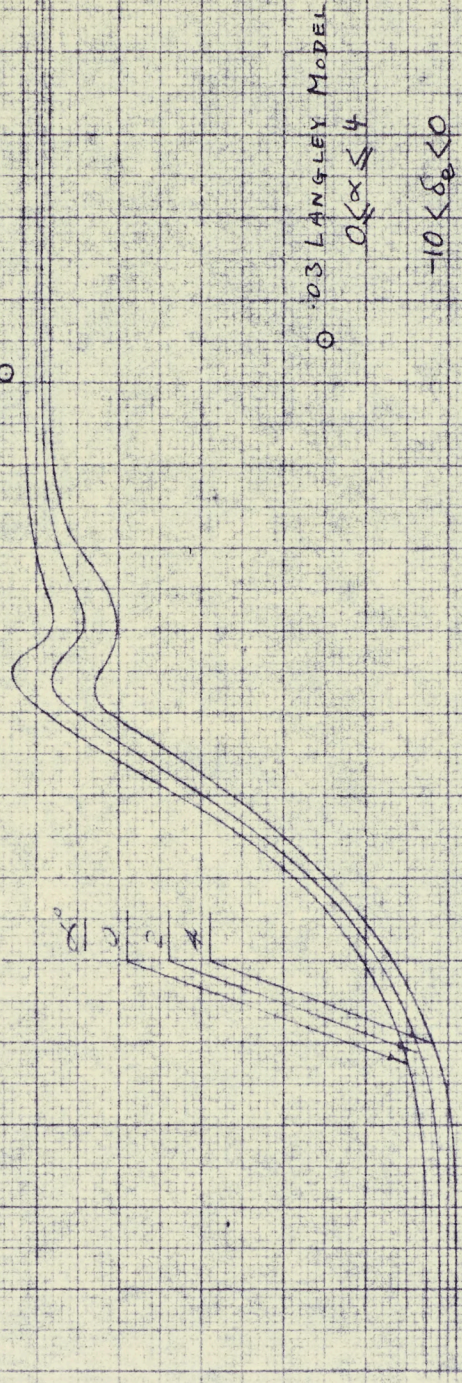
64 20 282 ON M.I.A.C.

03 LANGLEY MODEL  
 $-10^\circ < \delta_0 < 50$   
 $\alpha = 6^\circ$   
 $\alpha = 8^\circ$   
 $\alpha = 10^\circ$   
 $\alpha = 12^\circ$

MARCH NUMBERS

P/WT/80

WING  
CALC N F TESTS (MAY 55)  
EXP VS WING AREA  
SB W.W. F. 16 24 2



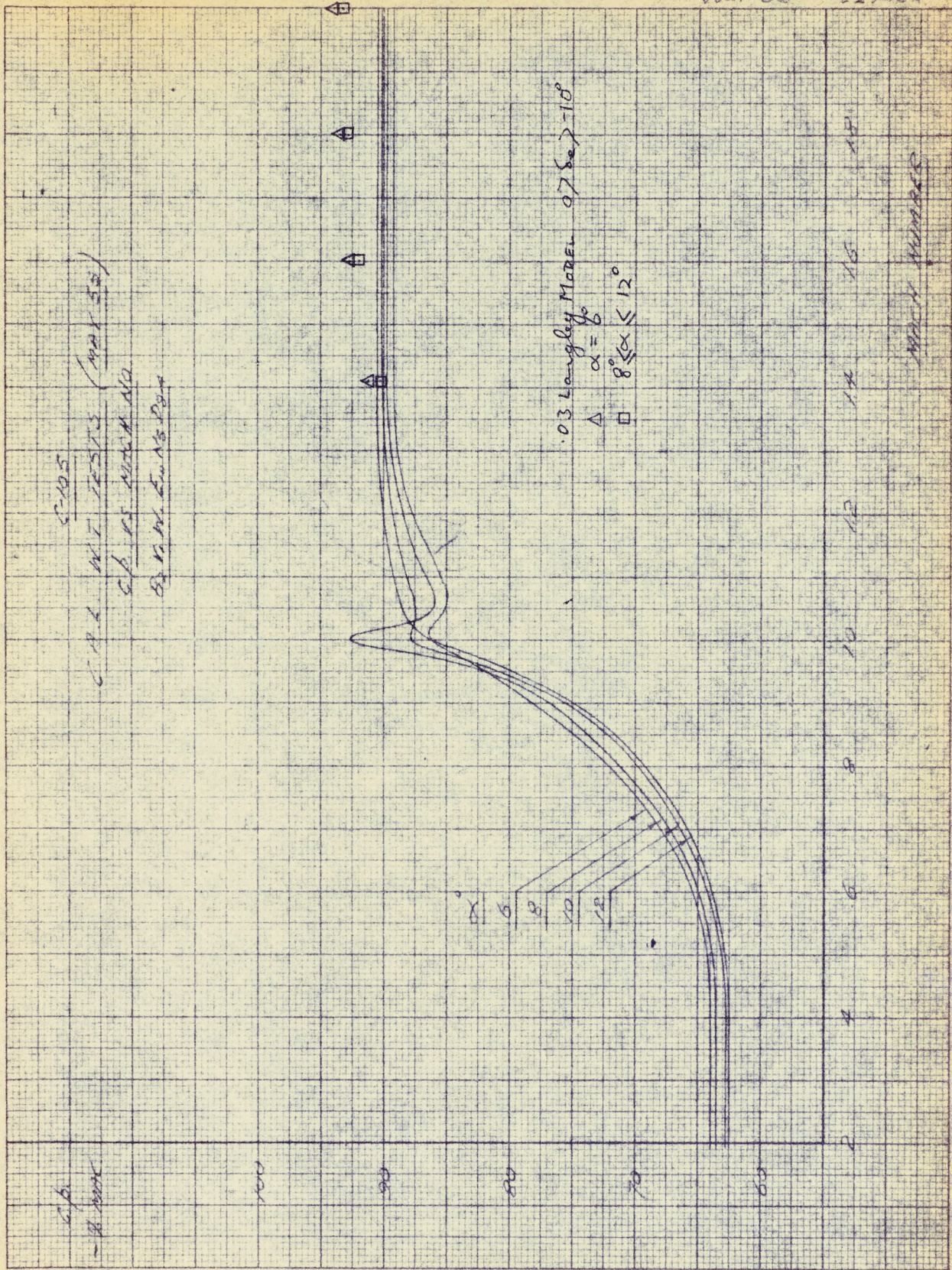
MACH NUMBER

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UNCLASSIFIED

3.4.2

T/ACRO DATA/88

JULY 55 CLARK



FROM P/AERO DATA/80  
 SHEET 3.1-1

(COPIED FROM P/W/80 4.1.2)

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R.S.R.

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$C_{np}$  TAIL-ON VS MACH NUMBER

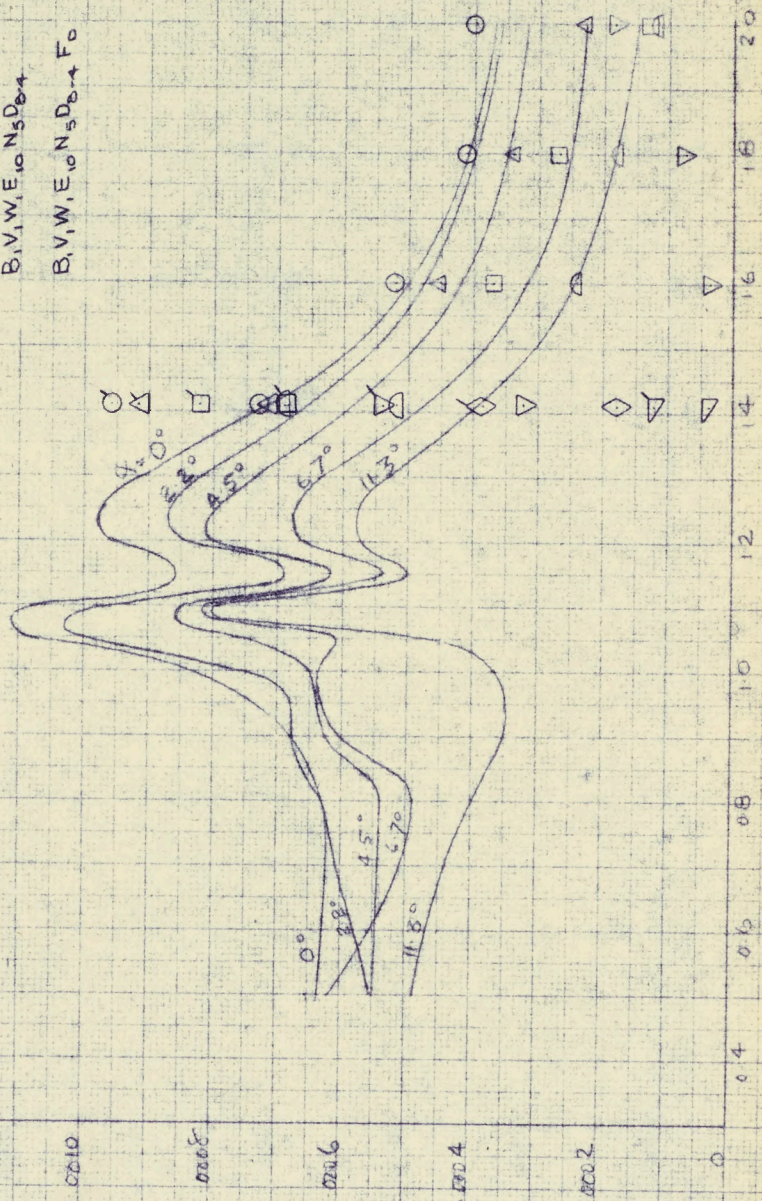
$\alpha < 3^\circ$  RIGID CG AT 0.28Z

CONFIG.

$\alpha$	0	2	4	6	8	10	14
	○	△	□	◇	▽	◇	▽
	○	△	□	◇	▽	◇	▽
	○	△	□	◇	▽	◇	▽

B, V, W, E,  $N_5 D_5$   
 B, V, W, E,  $N_5 D_5$  + F<sub>0</sub>

$C_{np}$  TAIL-ON  
 per degree



MACH NUMBER

3.1.2 FROM P/AD/60

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MAY 56 R.S.R.

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O3 LANGLEY MODEL 4

C-105

$C_{np}$  vs MACH NUMBER

TAIL-OFF

$|a| < 4^\circ$

$C_{np}$  TAIL-OFF  
 per degree

-0.016  
 -0.014  
 -0.012  
 -0.010  
 -0.008  
 -0.006

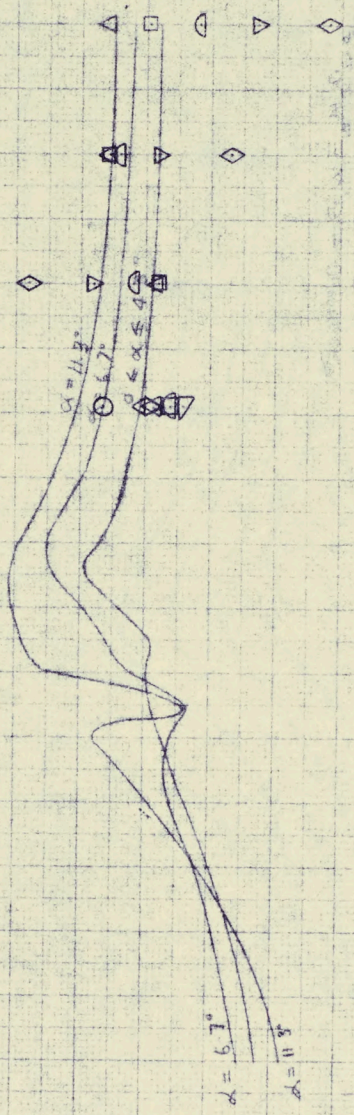
$\alpha = 6.7^\circ$   
 $\alpha = 11.3^\circ$

$\alpha = 11.3^\circ$   
 $\alpha = 6.7^\circ$   
 $\alpha = 4^\circ$

$\alpha^\circ$   
 0 2 4 6 8 10 14

MACH NUMBER

0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0



3.1.3 FROM P/AD/60

(COPIED FROM Y/NT/20 412)

May 56 RSR

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C-105

$C_{np}$  TAIL-OFF VS MACH NUMBER

$\beta > 4^\circ$

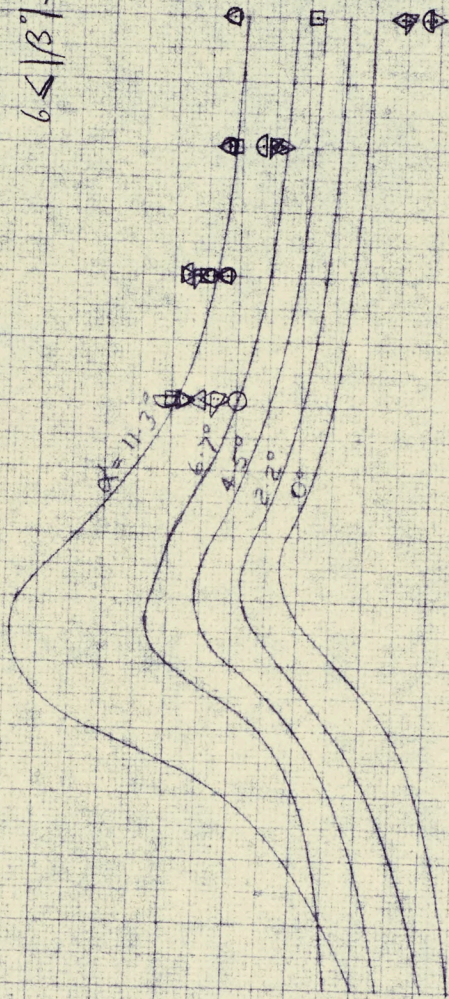
03 LANGLEY FIELD

$6 \leq |\beta| \leq 10$

$\alpha^\circ$	Symbol
0	○
2	△
4	□
6	◇
8	▽
10	◇
14	▽

$C_{np}$  TAIL-OFF  
per degree

-0.0020  
-0.0018  
-0.0016  
-0.0014  
-0.0012  
-0.0010



MACH NUMBER

0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

FROM P/AERO DATA/60  
SHEET 3.2.1 (COPIED FROM P/WT/D 4.2.2)

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3 LANGLEY MODEL

$|\alpha| < 4^\circ$

$\alpha$	0	2	4	6	8	10	4
	○	△	□	◇	▽	◇	△

C-105

$C_{Dp}$  TAIL-ON VS MACH NUMBER

$C_{Dp}$  TAIL-ON

PER DEGREE

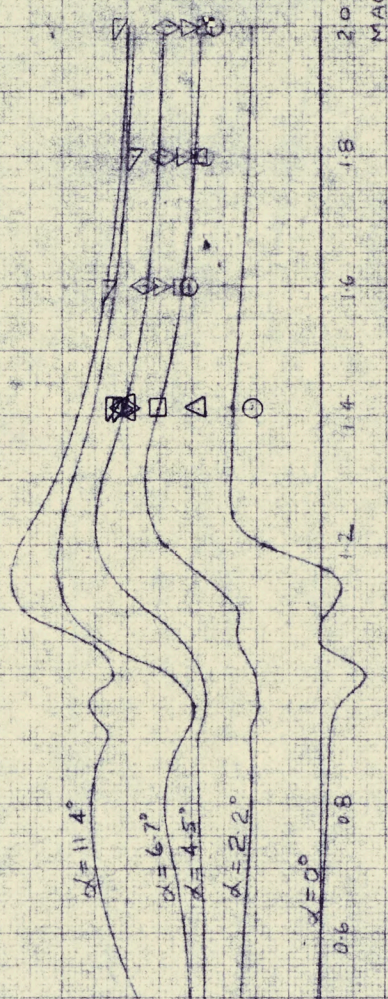
-0.03

-0.02

-0.01

0

+0.01



MACH NUMBER

AIRCRAFT  
A U W.

COMPONENT

SHEET No. 4.2.2

REPORT No P/AD/88

DATE May 1956

R.S.R.

FROM P/AD/60  
SHEET 3.2.2

03 LANGLEY MODEL

$|R| < 4^\circ$

$\alpha^\circ$	0	2	4	6	8	10	12	14
	○	△	□	○	▽	◇	◇	▽

$C_{1/2}$  TAIL-OFF VS MACH NUMBER

C-105

$C_{1/2}$  TAIL-OFF

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$C_{1/2}$   
TAIL-OFF

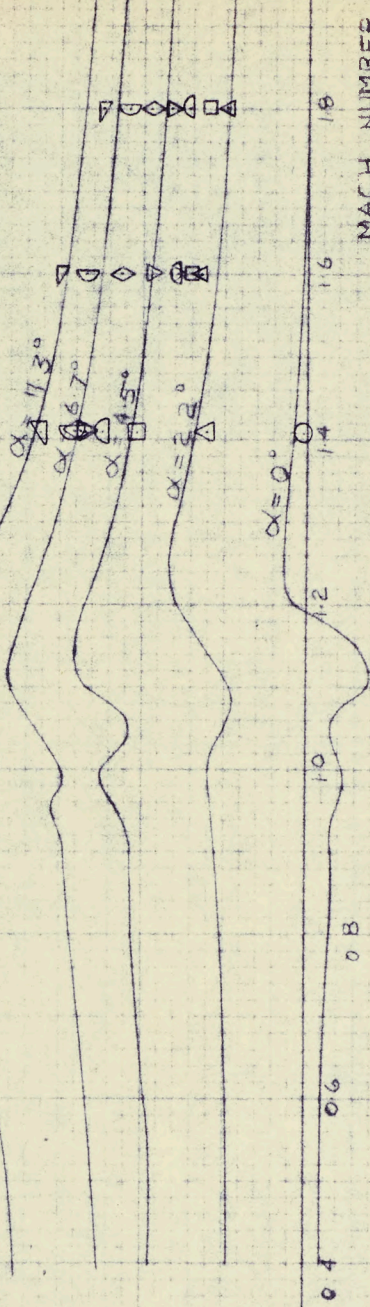
- .003

- .002

- .001

0

.001



MACH NUMBER

FROM P/AERO DATA/60  
SHEET 3.3.1

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Estimated  $C_{y\beta}$  vs Mach No

Rigid A/c. Windy Method Extended & Damped  
Based on C.A.C. Wind Tunnel Tests, May 1955

$C_{y\beta}$  TAIL ON  
per deg

010

500

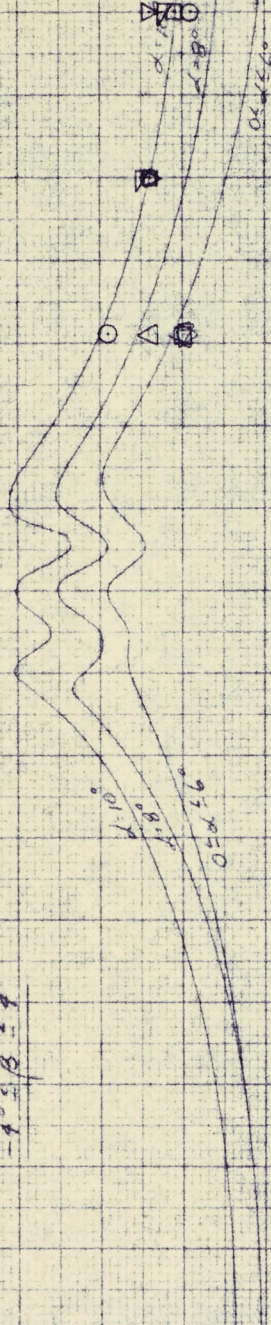
900

1000

1100

$-1^{\circ} \leq \beta \leq 9^{\circ}$

$\alpha = 10^{\circ}$   
 $\alpha = 8^{\circ}$   
 $\alpha = 6^{\circ}$   
 $\alpha = 4^{\circ}$



0.03 LANGLEY MODEL

$\alpha^{\circ}$

0 2 4 6 8 10 14

○ □ △ ◇ ▽

14

12

10

8

6

4

2

20

Mach No

FROM P/AJ/60  
SHEET 3.3.2

DATE May 1956

PREP BY R.S.R

LANGLEY MODEL

α° 0 2 4 6 8 10 14

C<sub>yβ</sub> TAIL-OFF VS MACH NUMBER

|β| < 4°

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MACH NUMBER

C<sub>yβ</sub>

TAIL OFF

-0.004

-0.003

-0.002

-0.001

0.2

0.4

0.6

0.8

1.0

1.2

1.4

1.6

1.8

2.0

α = 11.3°

α = 6.7°

α = 4.5°

0 ≤ α ≤ 2.2°

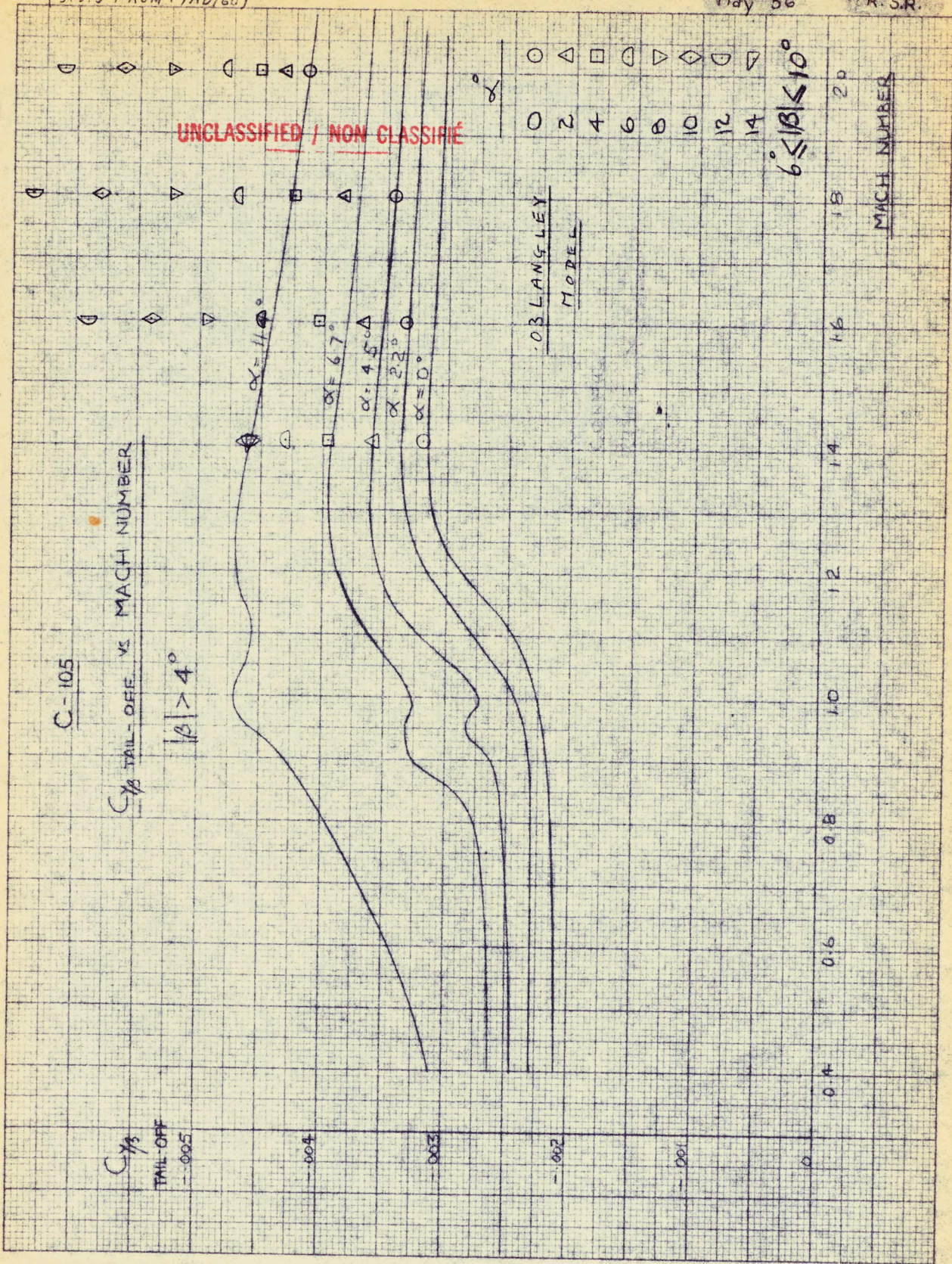
(3.3.3 FROM P/AD/60)

4-3-31

P/AD/88

May 56

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C-105 CAL W/T TESTS MAY 55

$C_{Df}$  VS MACH NUMBER

CONFIGURATION: B<sub>2</sub>W, E<sub>1</sub>N<sub>5</sub>D<sub>3</sub>-4

CG at 0.28Z

$\beta = 0^\circ$   $-10^\circ \leq \delta r \leq +10^\circ$

-03 LANGLEY MODEL

$0^\circ \leq \delta r \leq 10^\circ$

- 0°
- △ 2°
- 4°
- ◐ 6°
- ◇ 10°
- ▽ 14°

$C_{Df}$  per degree

-0010

-0008

-0006

-0004

-0002

0

0.2

0.4

0.6

0.8

1.0

1.2

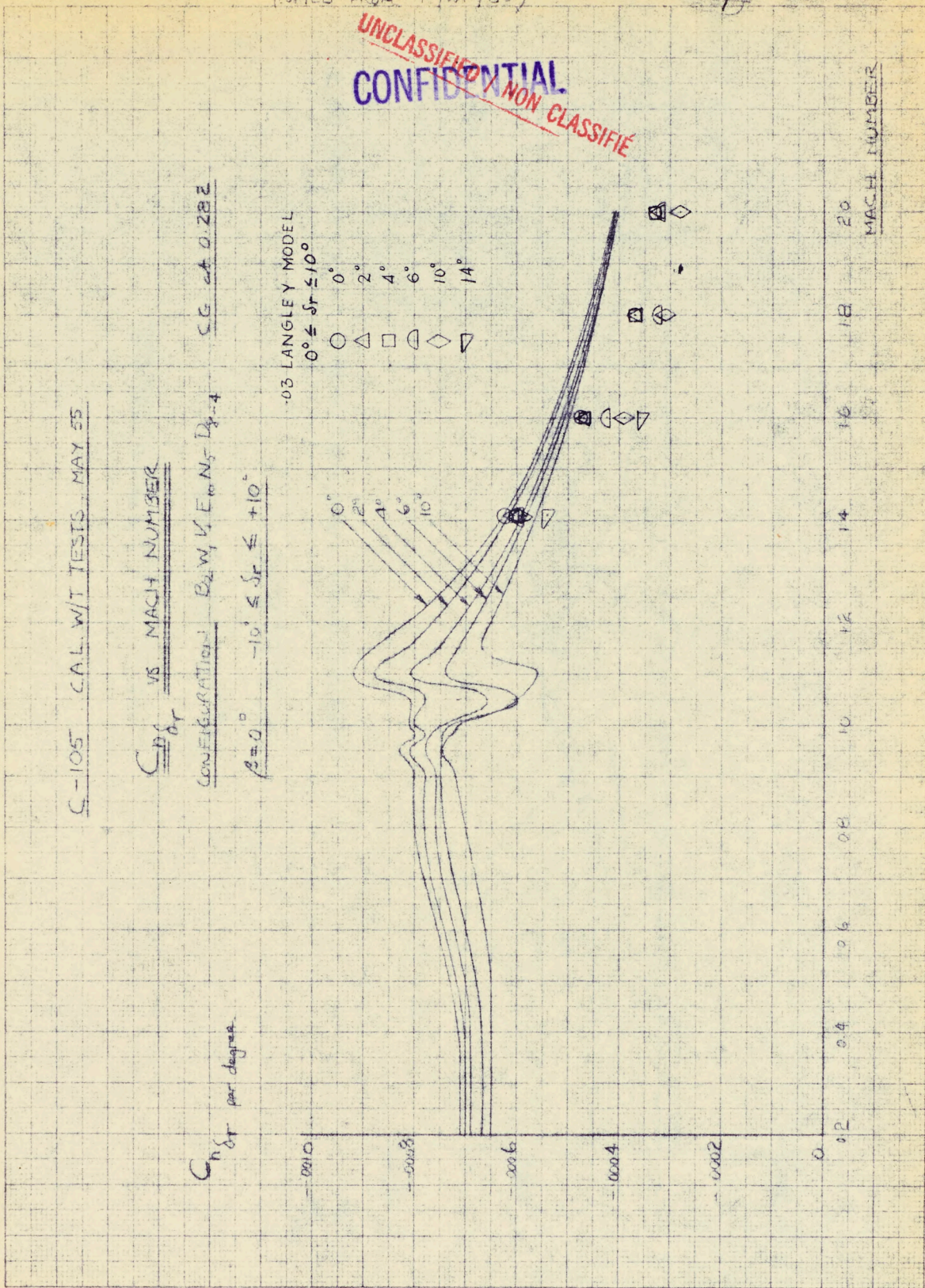
1.4

1.6

1.8

2.0

MACH NUMBER



FROM P/AD/60  
SHEET 2.2

DATE May 1956

PREP BY R. S. R.

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C-105 C.A.L. W/T TESTS, MAY 1955.

$C_{L\delta_r}$  vs MACH NUMBER

$-10^\circ \leq \delta_r \leq 10^\circ$

CONFIGURATION  $B_2 V W_1 E_{10} N_5 D_{r-4}$  ; C.G. at  $31\bar{E} \cdot 28\bar{Z}$

$\alpha = 0^\circ$   
 $2^\circ$   
 $4^\circ$   
 $6^\circ$   
 $10^\circ$

0°  
2°  
4°  
6°  
10°  
14°

0.03 LANGLEY  
MODEL

$0^\circ < \delta_r < 20^\circ$

MACH NUMBER

$C_{L\delta_r}$   
per deg

0.004

0.002

0

-0.002

2

4

6

8

10

12

14

16

18

20

FROM P/AD/60  
Sht 2-3

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08 LANGLEY MODEL

$0^\circ \leq \alpha \leq 10^\circ$

0°

2°

4°

6°

10°

14°

○

△

□

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

◇

Mach No.  
18  
20

16

14

12

10

8

6

4

2

C-105

$C_{x_{pr}}$  vs Mach No.

Repeat 1/2

Based on W-1 Tests May 1955

$C_{x_{pr}}$   
per deg

003

004

005

0

41 FROM P/AD/60

03 LANGLEY MODEL  
B<sub>1</sub> V<sub>1</sub> W<sub>1</sub> E<sub>10</sub> N<sub>5</sub> D<sub>8-4</sub>

○	0°
□	4.2°
▽	8.4°
◐	12.7°

1/31/54

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C105

Q1W 15 MACH NR

1/31/54

B<sub>1</sub> V<sub>1</sub> W<sub>1</sub> E<sub>10</sub> N<sub>5</sub> D<sub>8-4</sub>

10 X 10 TO THE 1/4 INCH 309 12  
MULTIPLE COPY

Q1W  
PER DEG

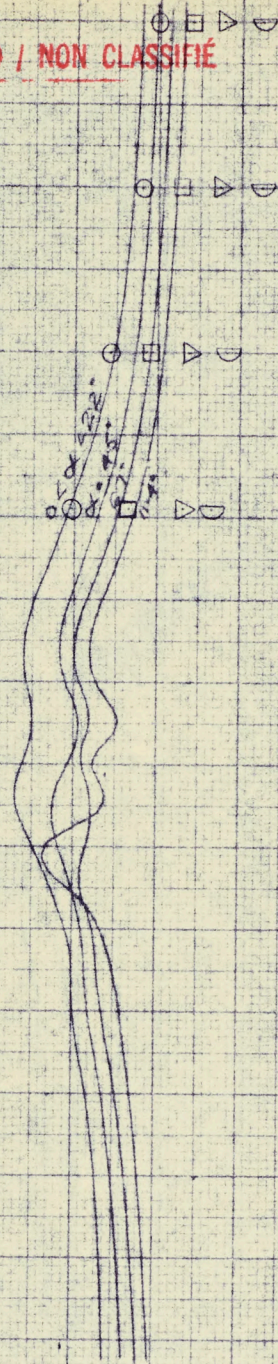
06

04

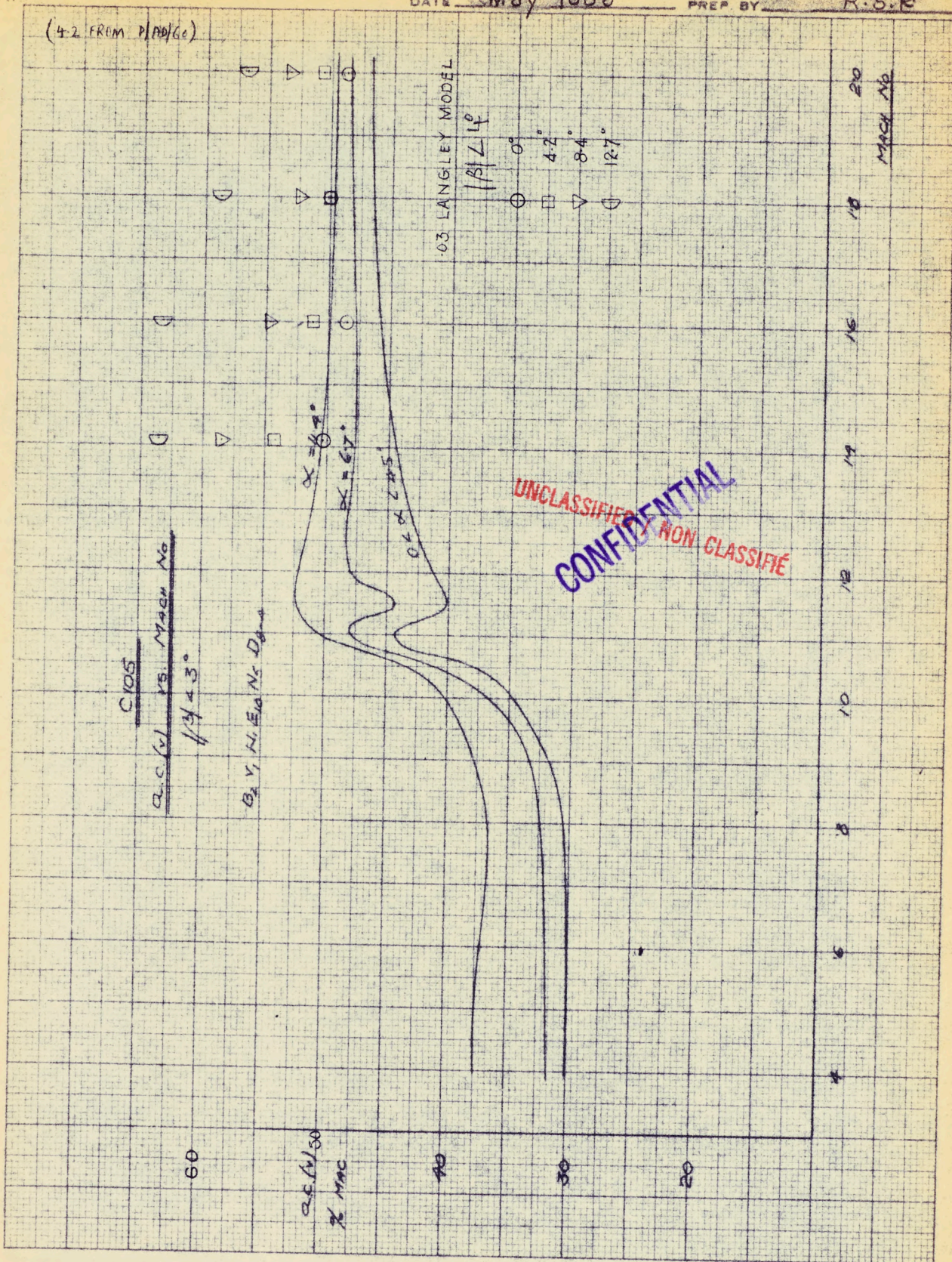
02

10	12	14	16	18	20
8					
6					
4					
2					
0					

March No



(4.2 FROM P/AD/66)



C105  
CL vs. Mach No.

$\alpha = 3^\circ$

$B_2 Y, N, E, U, N, D, D, \dots$

CL (N) 50  
% MAC

40

30

20

20  
MACH No

18

16

14

12

10

8

6

4

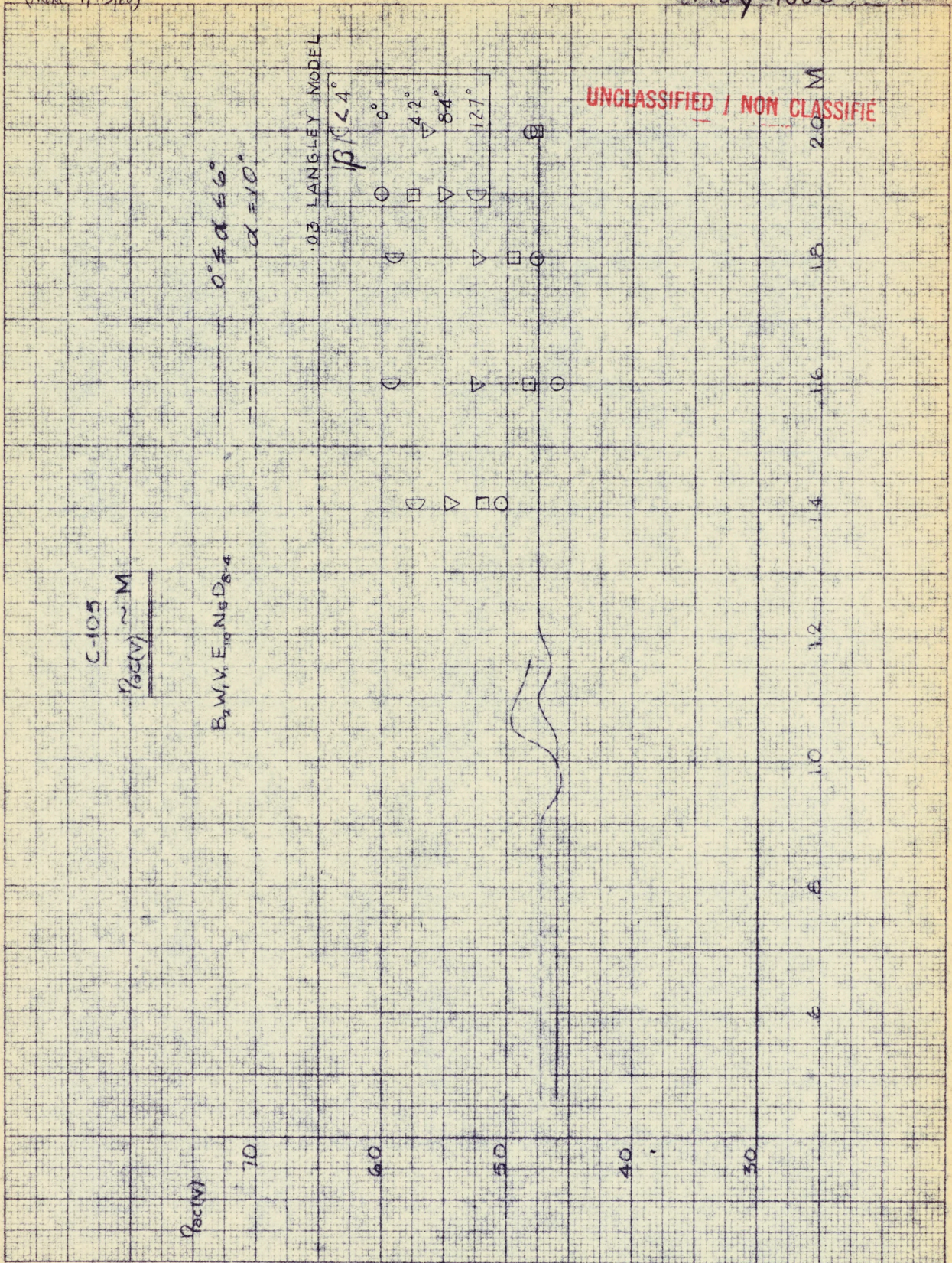
(FROM P/AD/60)

6.3

P/AD/88

May 1956

R.S.R



C-105  
 $\rho_{act}(v) \sim M$

$0^\circ \leq \alpha \leq 6^\circ$   
 $\alpha = 10^\circ$

$B_2, W, V, E_{10}, N_8 D_{8-4}$



May 1956 R.S.R.

FROM P/WT/80

UNCLASSIFIED / NON CLASSIFIED

.03 LANGLEY MODEL  
( $0^\circ \leq \delta_r \leq 10^\circ$   $M = 1.4$ )

- $0^\circ$  ○
- $2^\circ$  △
- $4^\circ$  □
- $6^\circ$  ▽
- $10^\circ$  ◇
- $14^\circ$  ▽

$\left\{ \begin{array}{l} 0^\circ \leq \delta_r \leq 5^\circ \text{ UNTAGGED} \\ 5^\circ < \delta_r \leq 20^\circ \text{ TAGGED} \end{array} \right\}$

C-105

$\beta_{2(V)}$  M

$B_{2(V)} / M^2 D_{2(V)}$

$\alpha = 0.2^\circ$   
 $4^\circ$   
 $6^\circ$   
 $10^\circ$

$\beta_{2(V)}$  / DEG

.015

.010

.005

.4

.6

.8

1.00

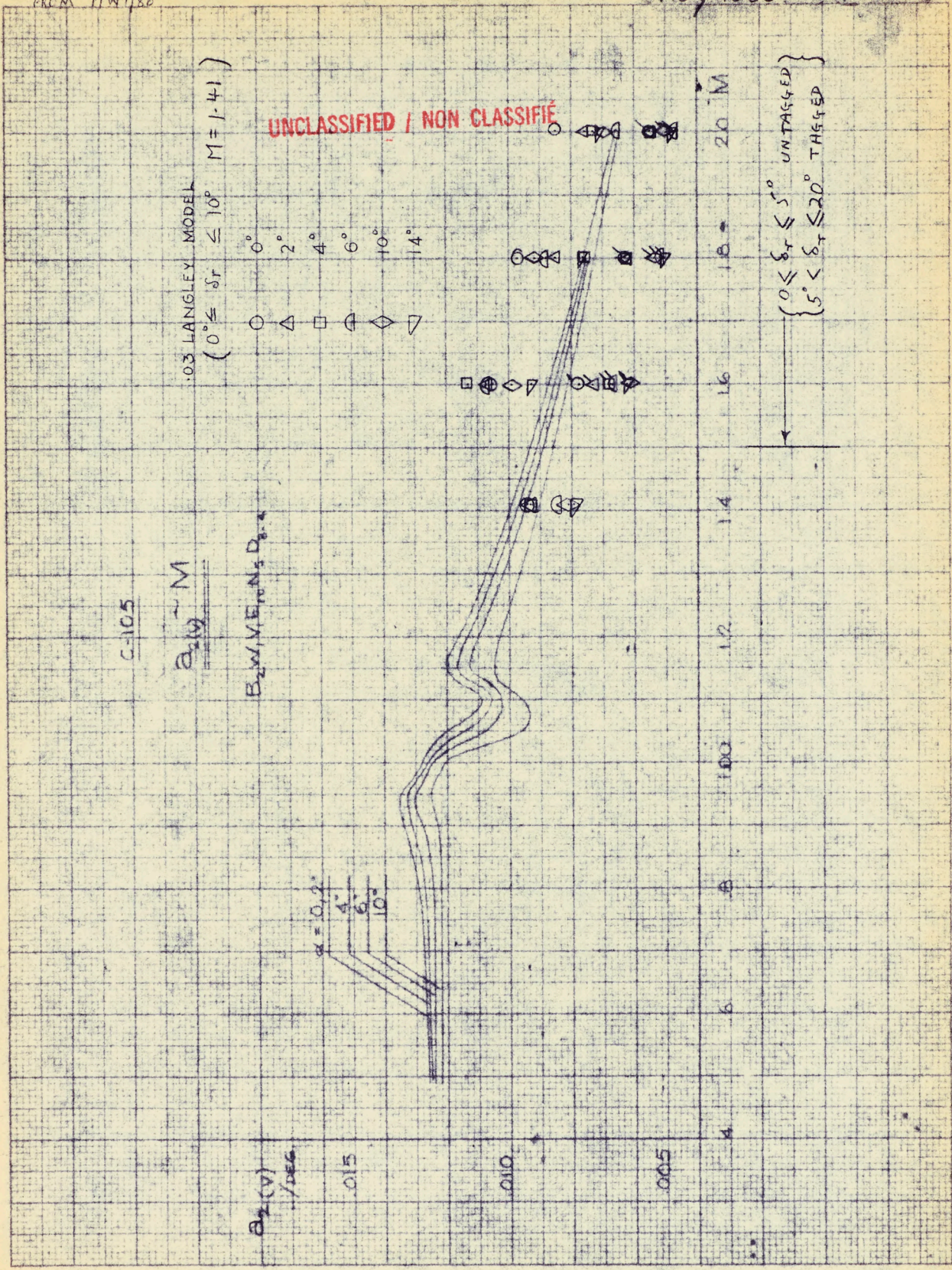
1.2

1.4

1.6

1.8

2.0 M





1/2" 10 X 10 TO THE INCH 359-12

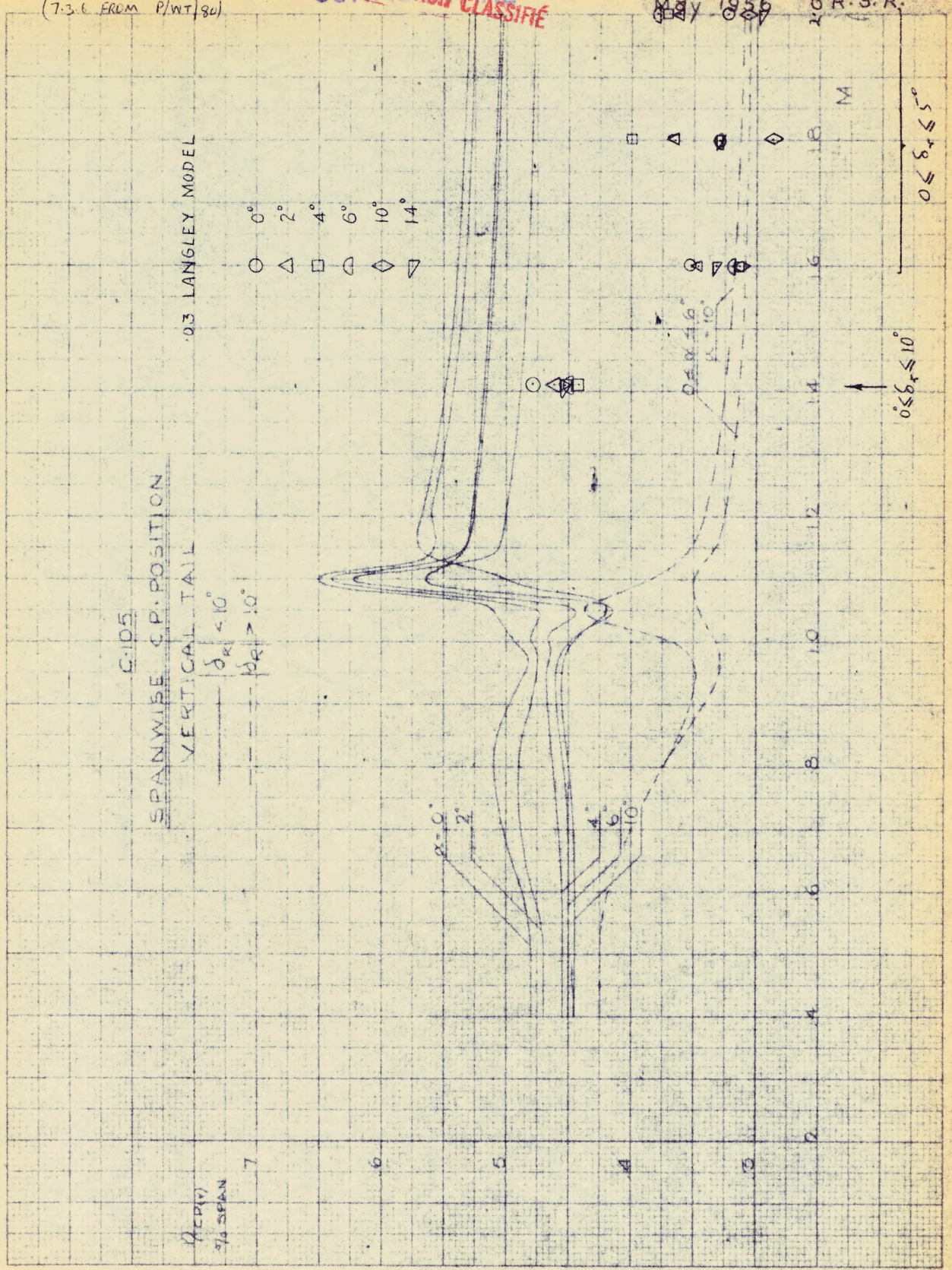
(7.3.6 FROM P/WT/80)

UNCLASSIFIED  
CONFIDENTIAL / NON CLASSIFÉ

7-3 P/AERO DATA/88

MAY 1956

20 R.S.R.



(copied from Pictlog 8.43)

OB LANGLEY MODEL

$\alpha$   
 $\oplus - 0^\circ$   
 $\triangle - 2^\circ$   
 $\square - 4^\circ$

$0 \leq \delta_n \leq 5^\circ$   
 $\diamond \left\{ \begin{array}{l} 0^\circ < \alpha < 8^\circ \\ -5^\circ < \delta_n < 20^\circ \end{array} \right.$

UNCLASSIFIED / NON CLASSIFIÉ

C105  
 U.S. MACH. No.  
 C.A.L. WIND TUNNEL TESTS

$|\delta_n| \leq 5^\circ$

$C_{mp}$

-0.0026

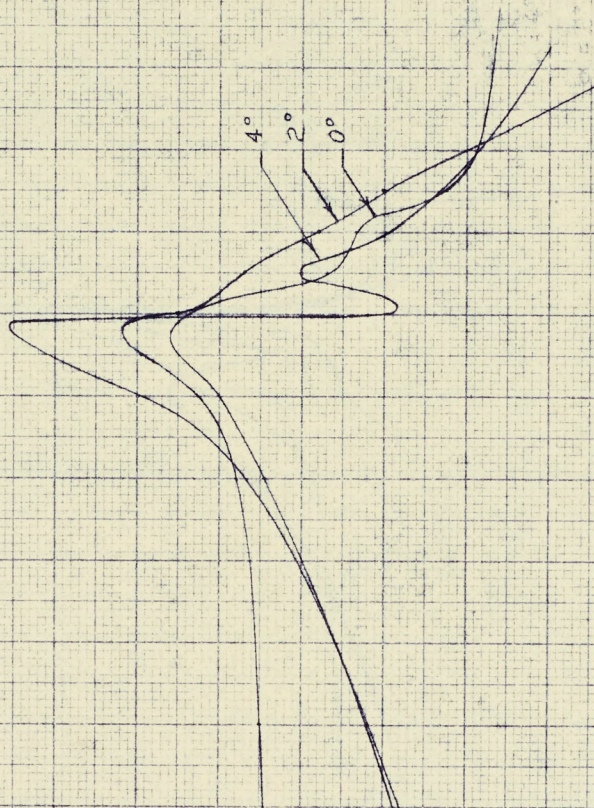
-0.0022

-0.0018

-0.0014

-0.0010

-0.0006



2.8

1.8

1.6

1.4

1.2

1.0

.8

.6

.4

.2

MACH No.

(c)  $\frac{dC_m}{d\alpha} \frac{1}{M^2} \approx 8.4 \cdot 10^{-4}$

C105  
Cm/δaR vs. MACH No.  
C.A.L. WIND TUNNEL TESTS

$|\delta a| \leq 5^\circ$

OB LANGLEY MODEL

$\infty$

- ▽ - 6°
- ▽ - 8°
- ◇ - 10°
- ◇ - 12°
- △ - 14°

$\alpha \leq \delta a \leq 5^\circ$

○  $\alpha \begin{cases} 0^\circ < \alpha < 8^\circ \\ -5^\circ < \alpha < 20^\circ \end{cases}$

UNCLASSIFIED / NON CLASSIFIED

MACH No.

Cm/δaR

-0.0026

-0.0022

-0.0018

-0.0014

-0.0010

-0.0006

.2

.4

.6

.8

1.0

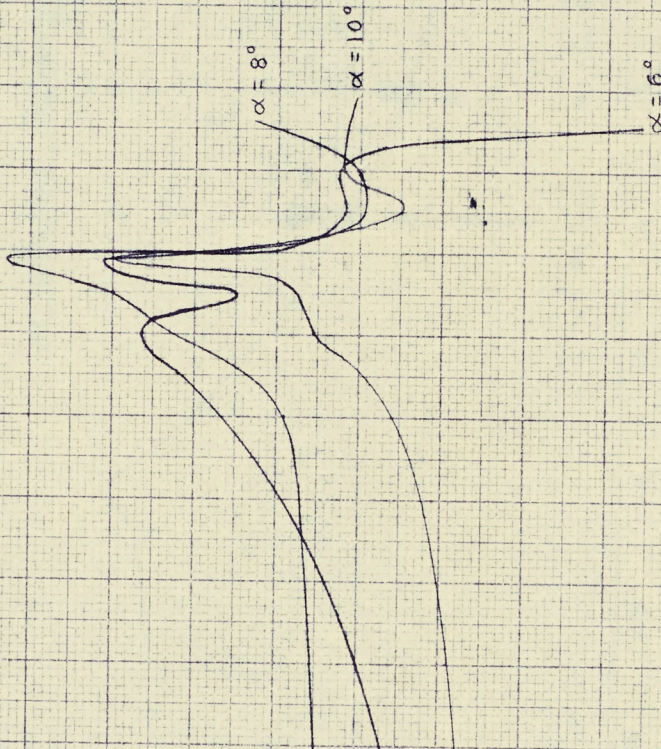
1.2

1.4

1.6

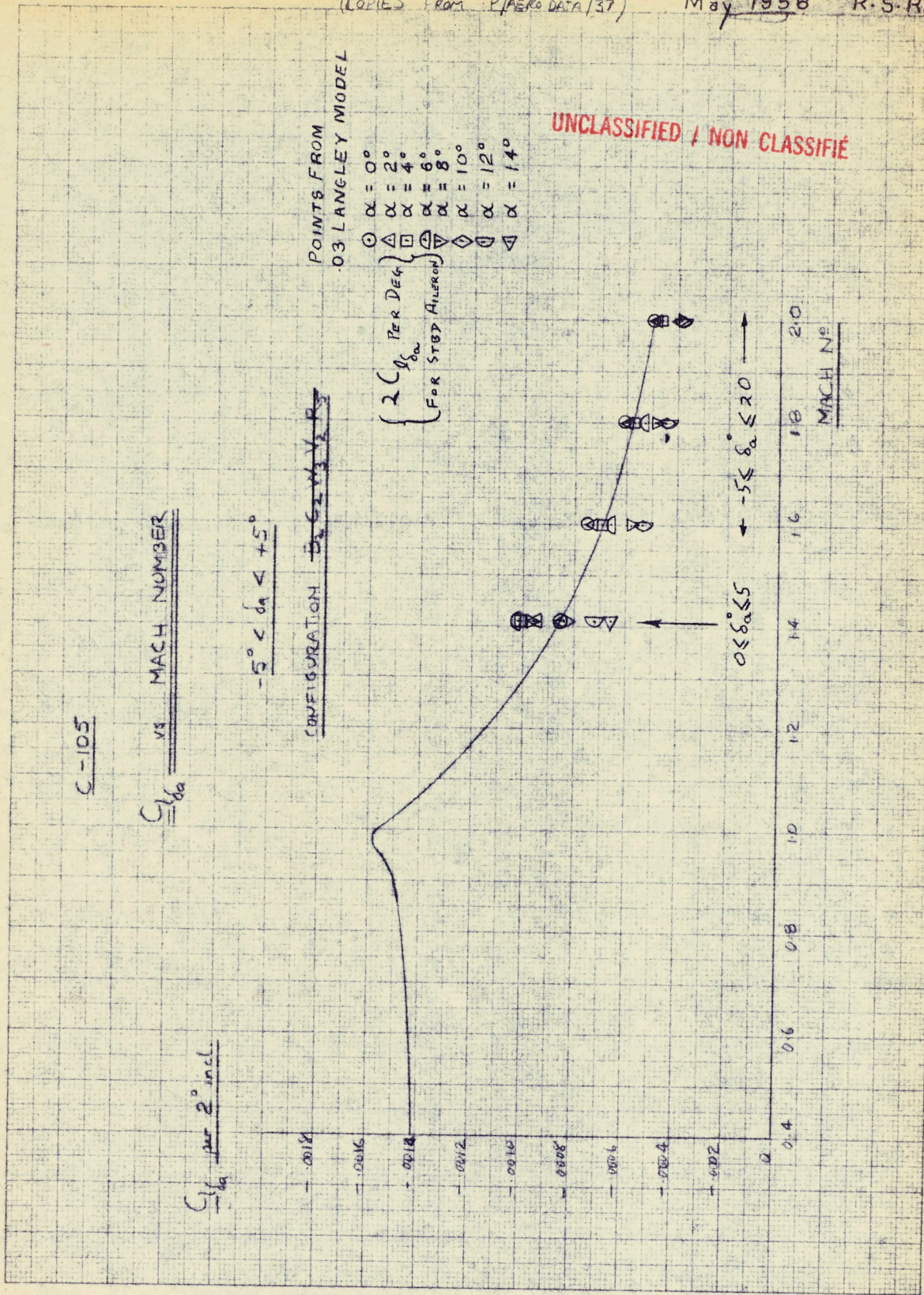
1.8

2.0



(COPIED FROM P/AERO DATA/37)

May 1958 R.S.R.



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9088

May 156

(FROM P/WT/50)

C-105  
C.R.L. WT TESTS JUNE '55

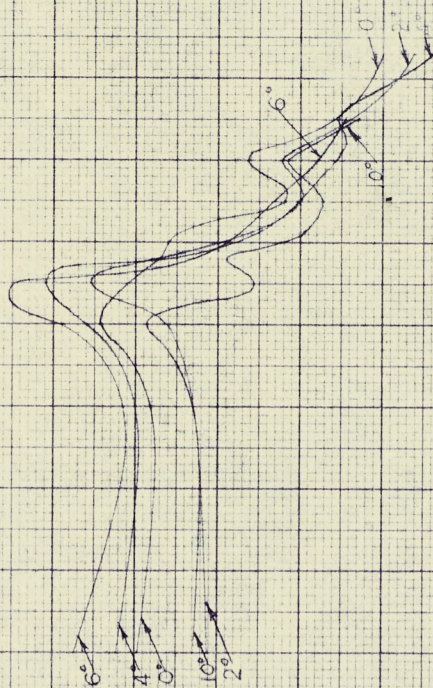
CL/SBR vs MACH NO.

0° ≤ SBR ≤ 10°

$\left\{ \begin{array}{l} 0^\circ < \alpha < 8^\circ \\ -5^\circ < \delta_n < 20^\circ \end{array} \right.$

POINTS FROM  
O.S. LANGLEY  
MODEL

0° 2° 4° 6° 8° 10° 12° 14°  
r ± 3α ± 5°



0.2

CL/SBR  
004  
PER DEG

003

002

001

0

.4

.6

.8

1.0

1.2

1.4

1.6

1.8

2.0

MACH NO.

UNCLASSIFIED / NON CLASSIFIE  
CONFIDENTIAL

9.1 P/AERO DATA/88  
May 1956 R.S.R.

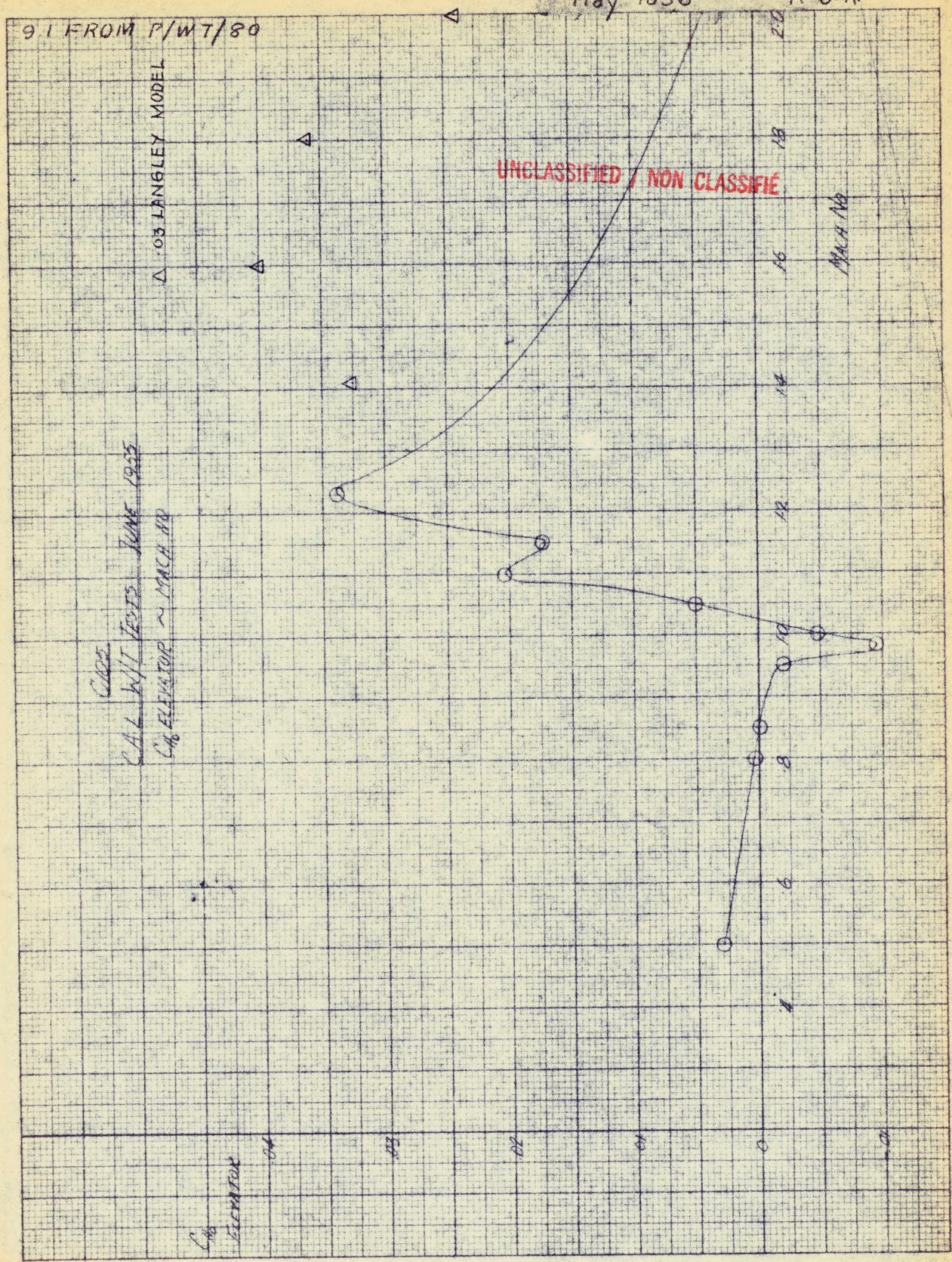
9.1 FROM P/WT/80

UNCLASSIFIED / NON CLASSIFIÉ

CAL W/T TESTS JUNE 1955  
C<sub>DB</sub> ELEVATOR ~ MARCH 40

△ 03 LANGLEY MODEL

DATA NO



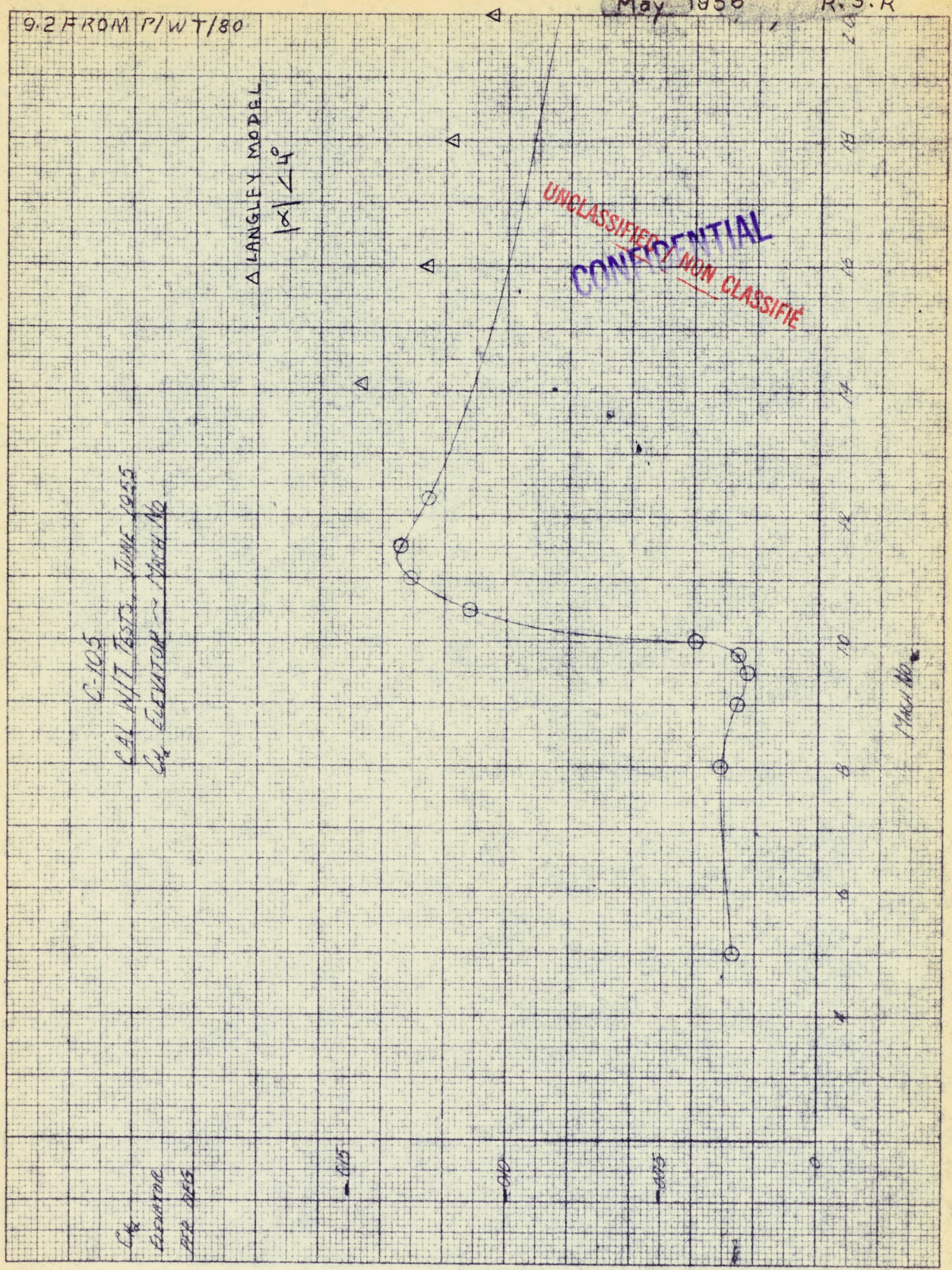
9.2 FROM P/WT/80

9.2 P/AERO DATA/88  
May 1956 R.S.R

C-105  
CAL W/T TESTS, JUNE 1945  
CAL ELEVATOR - MARCH 40

LANGLEY MODEL  
 $\alpha = 4^\circ$

UNCLASSIFIED  
~~CONFIDENTIAL~~  
NON CLASSIFIED



C<sub>D</sub>  
ELEVATOR  
PER 2615

115

115

115

Mach No.

9.3

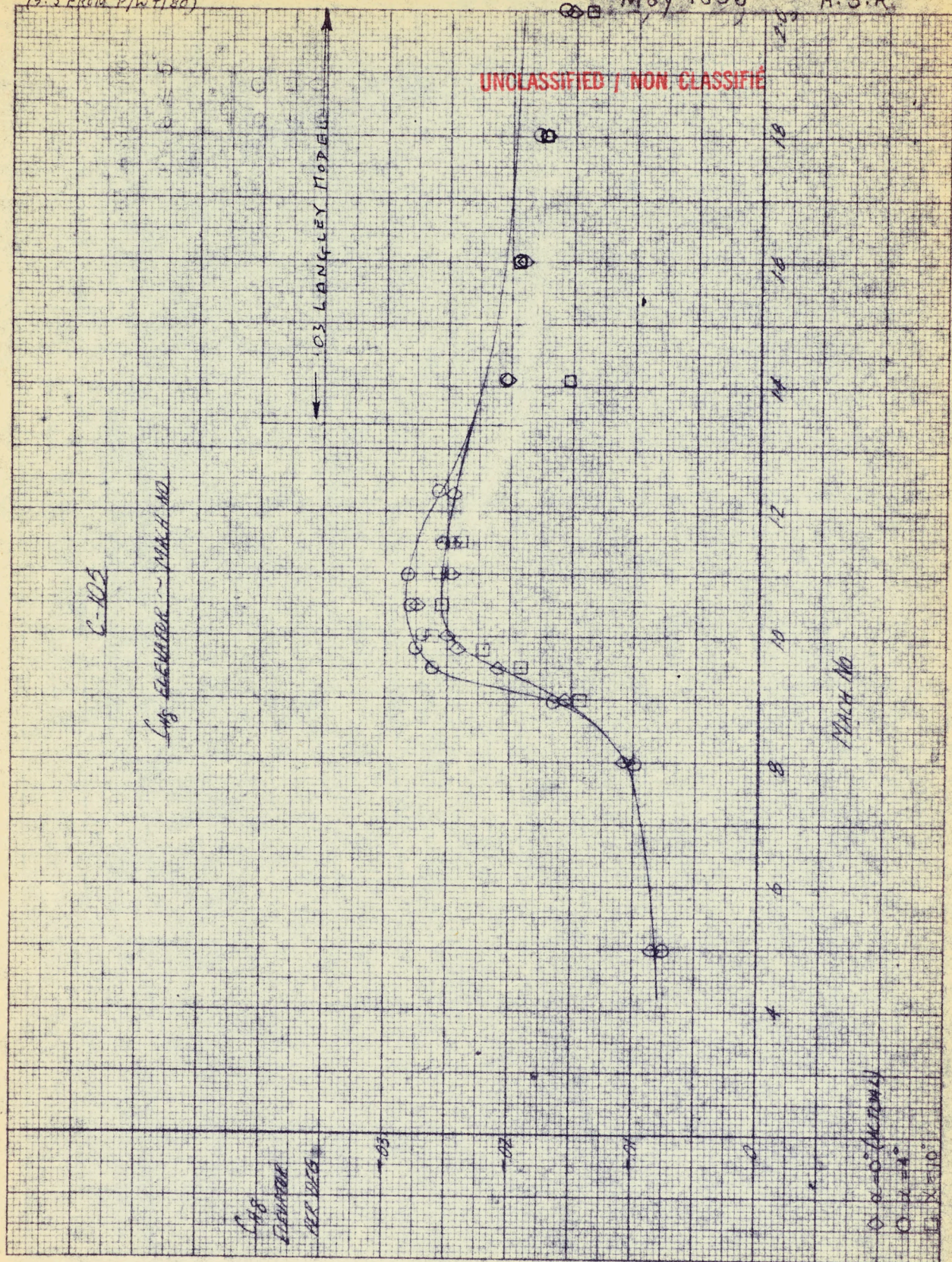
P/AERO DATA/88

(9.3 FROM P/W/T/80)

May 1956

R.S.R.

UNCLASSIFIED / NON CLASSIFIED



359-12

10X10 TO THE 1/4 INCH  
KUPPEL & ESSEN, CO.  
MAY 1956 U.S.A.

K&E

C-103  
ELEVATOR  
AIR DATA

○  $\alpha = 0^\circ$  (MACH 10)  
⊗  $\alpha = 8^\circ$   
⊠  $\alpha = 10^\circ$

AIRCRAFT  
A U W.

(L9 FROM P/AD/60)

COMPONENT

SHEET NO. 10.1

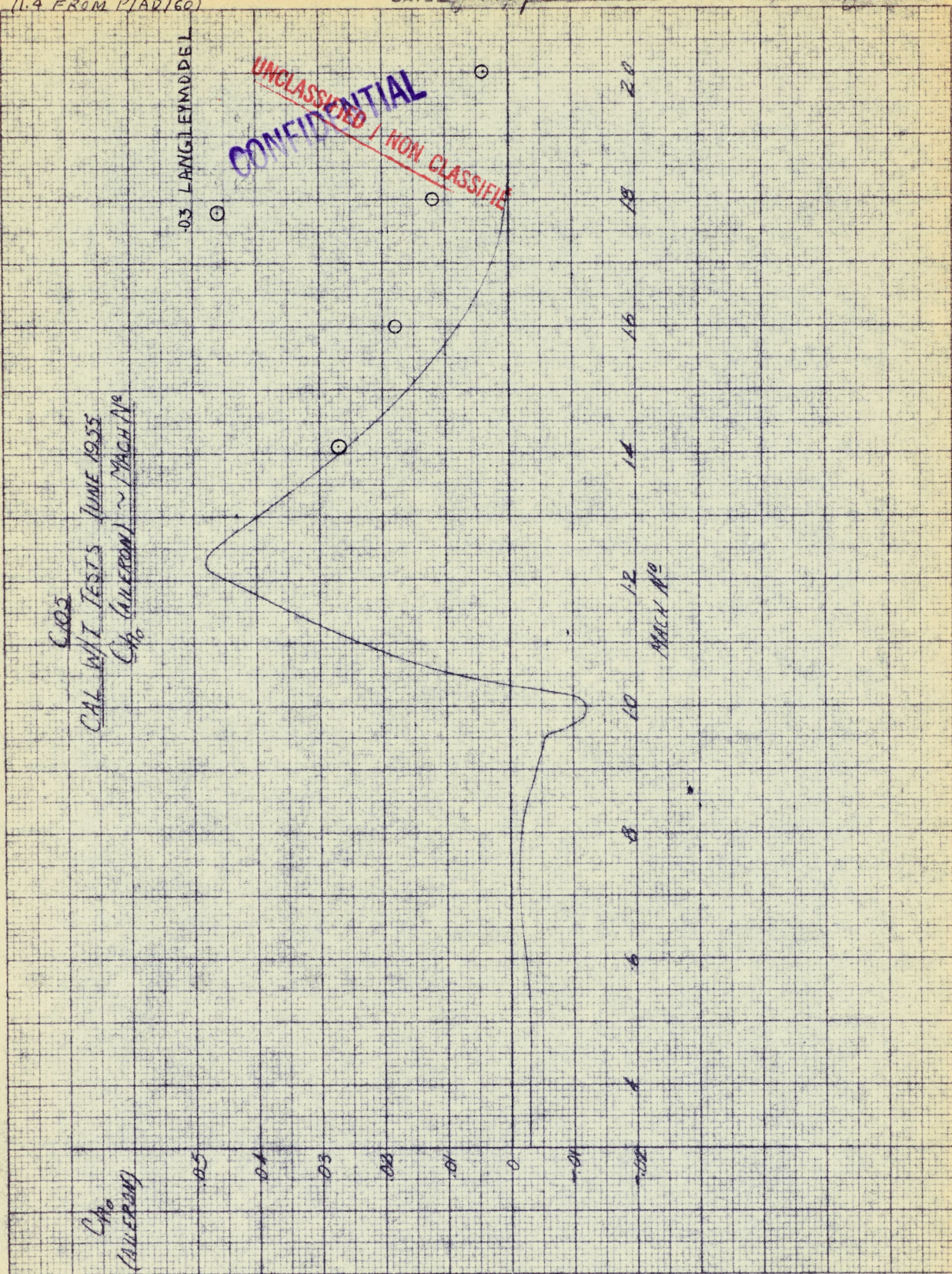
REPORT NO.

P/AERODATA/88

DATE May 1956

PREP BY

R.S.R.



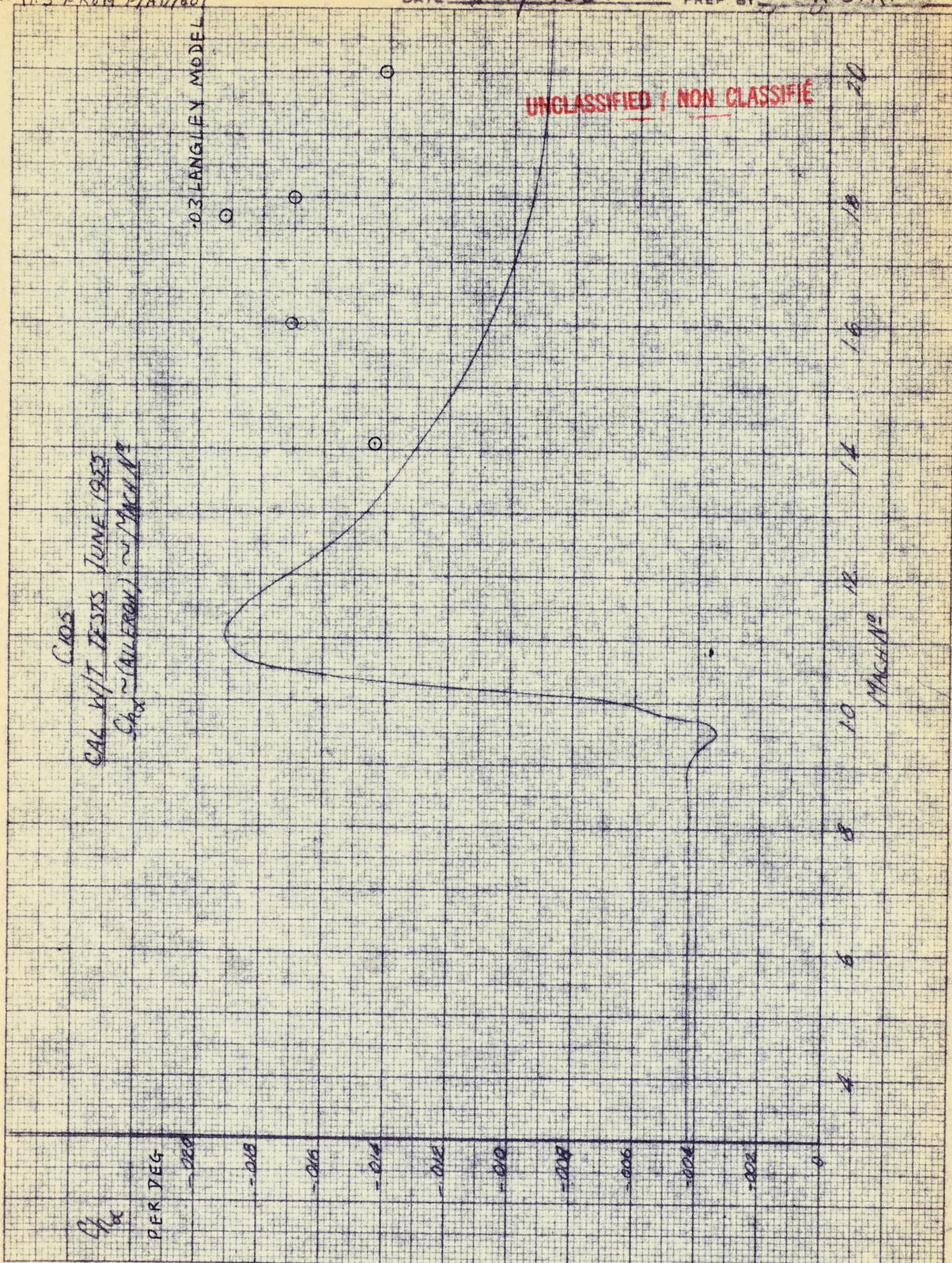
KY 10 X 10 TO THE 1/8 INCH 359-12  
ADUPT. E. L. BESSER CO. MADE IN U.S.A.

C103  
CAL W/T TESTS JUNE 1955  
 $C_{p0}$  (ALLERSON) ~ MACH No

$C_{p0}$   
(ALLERSON)

MACH No

2/AD/60

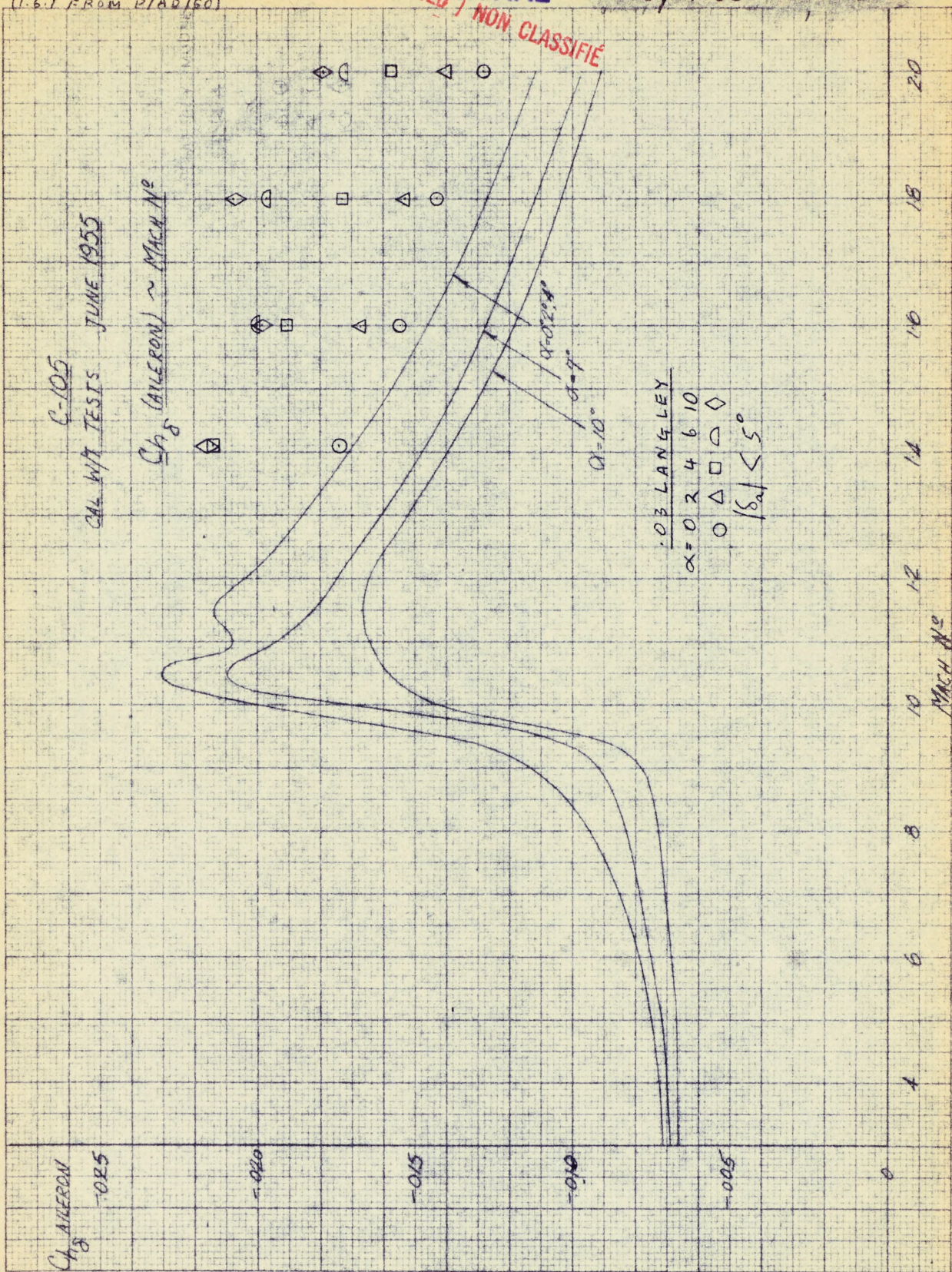


W & Y 10 X 10 TO THE 1/4 INCH KEUFFEL & ESSER CO. MODEL U.S.A. 359-12

P/AD/60.

UNCLASSIFIED / NON CLASSIFIED

(1.6.1 FROM P1AD/60)



C-105  
 CAL W/T TESTS  
 JUNE 1955

$C_{x, \text{AILERON}} \sim MACH No.$

.03 LANGLEY  
 $\alpha = 0 \quad 2 \quad 4 \quad 6 \quad 10$   
 $\delta_a \quad \square \quad \triangle \quad \circ \quad \diamond$   
 $\delta_a < 5^\circ$

$C_{x, \text{AILERON}}$

-0.25

-0.20

-0.15

-0.10

-0.05

0

20

18

16

14

12

10

8

6

4

MACH No.

P1AD/60

2.5.2 FROM P/AD/60

UNCLASSIFIED / NON CLASSIFIED

C-105  
RUDDER HINGE MOMENT  
 $C_{h_0} \sim \text{MACH}^2$   
100/175

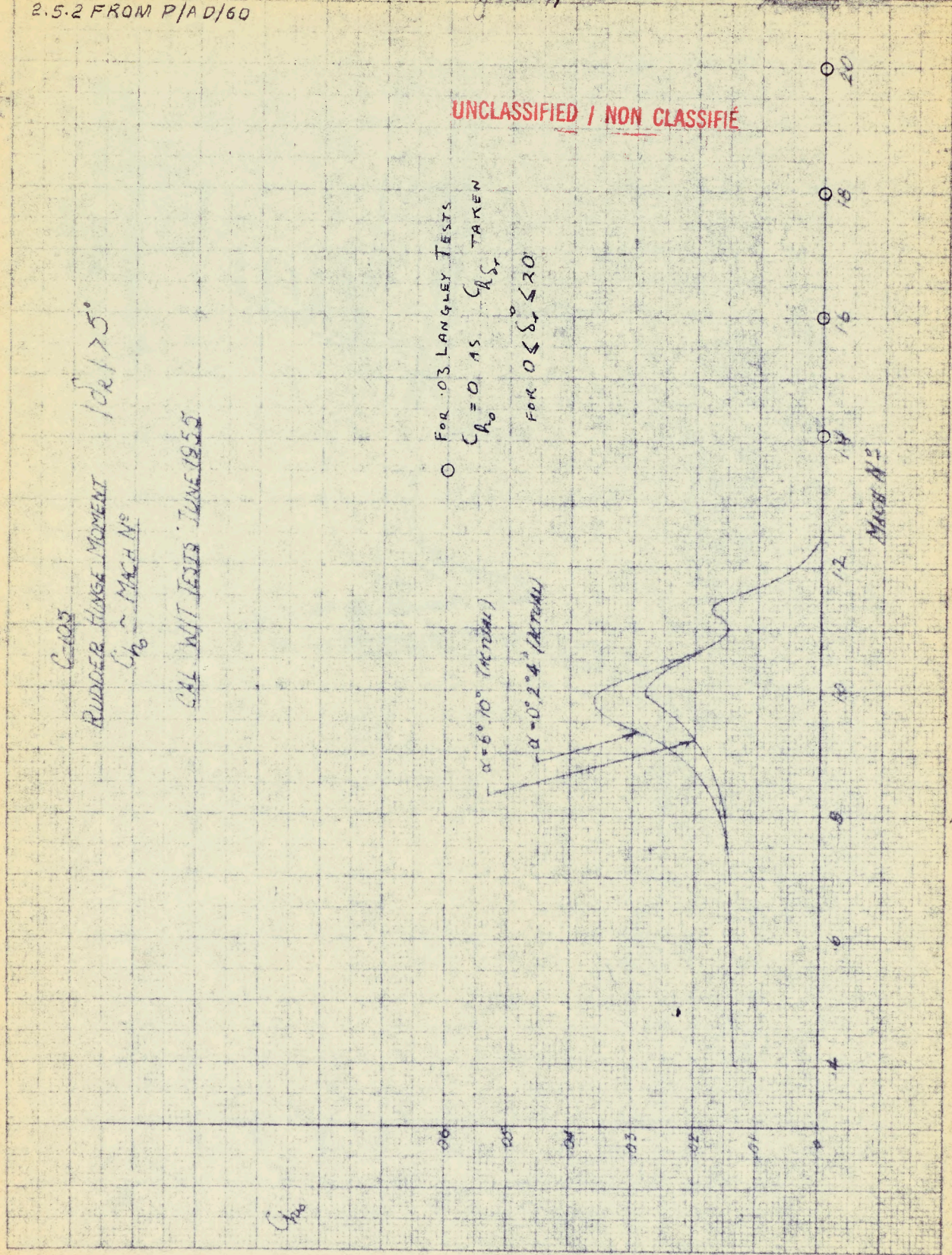
CAL WIT TESTS JUNE 1955

○ FOR .03 LANGLEY TESTS  
 $C_{h_0} = 0.15 C_{h_{sr}}$  TAKEN  
FOR  $0 \leq \delta_r \leq 20^\circ$

$\alpha = 6^\circ 10'$  (ACTUAL)  
 $\alpha = 0^\circ 2' 4''$  (ACTUAL)

$C_{h_0}$

MACH N<sup>2</sup>

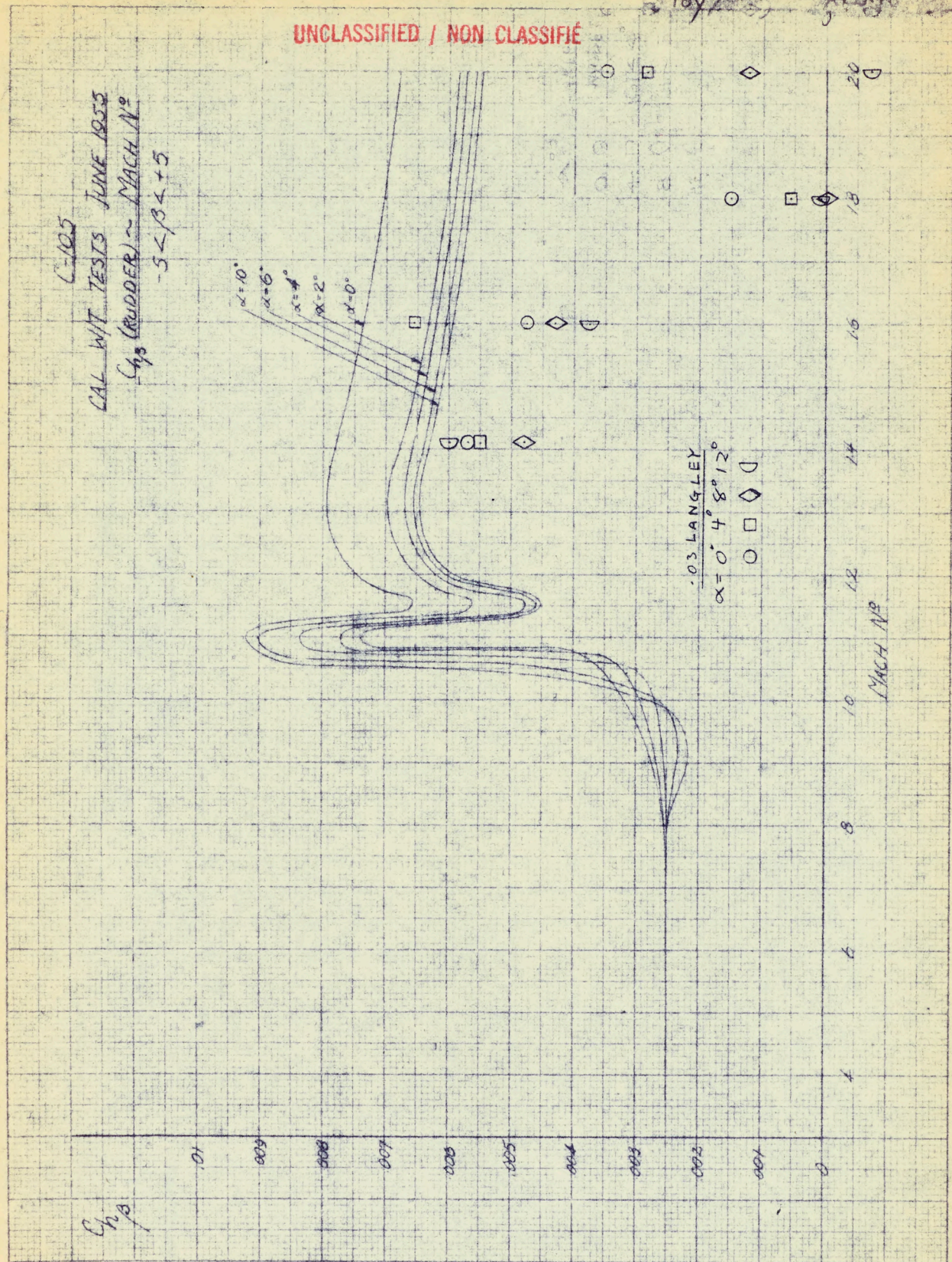


17/10/56

11-2 P/HERODATA/88  
 May/55, R.S.R.

UNCLASSIFIED / NON CLASSIFIED

C-105  
 CAL WIT TESTS JUNE 1953  
 $C_{D0}$  (RUDDER) ~ MACH N<sup>2</sup>  
 $-3 < \beta < +5$



ME 10 X 10 TO THE 1/4 INCH 359-12  
 PENTON & ESSER CO. MADE IN U.S.A.

p/20/50

C105  
CAL W/T TESTS JUNE 1953  
CAL ~ MACH No. FOR  $0^\circ < \alpha < 10^\circ$  (ACTUAL)

LANGLEY MODEL

$\alpha$  0 4 10  
O  
△  
□  
 $0 < \alpha < 30^\circ$

UNCLASSIFIED / NON CLASSIFIED

CHINA  
PER DEGREE

-04  
-03  
-02  
-01  
0

54.25  
 $0 < \alpha < 6^\circ$

20  
18  
16  
14  
12  
10  
8  
6  
4

MACH No.

K&E 10 X 10 TO THE 4 INCH  
KUPFEL & ESSER CO 359 12  
MADE IN U.S.A.

UNCLASSIFIED / NON CLASSIFIÉ

OHIO TANG  
1015, 3359  
MADE IN U.S.A.